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Final Report

Saltstone Curing Assessment

prepared by

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Completeness of Testing:

This report describes the results of work and testing specified by the referenced SRR approved Test Plan(s). The work and any associated testing followed established quality assurance requirements and was conducted as authorized. The descriptions provided in this test report are an accurate account of both the conduct of the work and the data collected. Results required by the Test Plan are reported. Also reported are any unusual or anomalous occurrences that are different from the starting hypotheses. The test results and this report have been reviewed and verified.

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List of Acronyms and Abbreviations

AFm	-	Group of calcium sulfoaluminate hydrate phases (from "alumina, ferric oxide, mono-sulfate")
BEI	-	Backscattered Electron Imaging
BFS	-	Blast Furnace Slag
CBO	-	Carbon Burn-Out
CSH	-	Calcium Silicate Hydrate
CUA	-	Catholic University of America
EDS	-	Energy Dispersive X-Ray Spectroscopy
ES	-	Energy*Solutions*
FA	-	Fly Ash
LLW	-	Low-Level Waste
MCU	-	Modular Caustic Side Solvent Extraction Unit
PA	-	Performance Assessment
PC	-	Portland Cement
PFA	-	Pulverized Fly Ash
RH	-	Relative Humidity
SD	-	Standard Deviation
SDU	-	Salstone Disposal Unit
SEI	-	Secondary Electron Imaging
SEM	-	Scanning Electron Microscopy
SOW	-	Statement of Work
SPF	-	Saltstone Production Facility
SRR	-	Savannah River Remediation, LLC
SRS	-	Savannah River Site
SWPF	-	Salt Waste Processing Facility
VSL	-	Vitreous State Laboratory
XAS	-	X-Ray Absorption Spectroscopy
XRD	-	X-Ray Diffraction
XRF	-	X-Ray Fluorescence

SECTION 1.0
INTRODUCTION

1.1 Background

At the Savannah River Site (SRS), low-level waste (LLW) is immobilized by mixing the waste with a dry blend of 45 wt% blast furnace slag (BFS), 45 wt% Class F fly ash (FA), and 10 wt% Portland Cement (PC) (45-45-10) [1]. The process takes place at the Saltstone Production Facility (SPF) and yields a cementitious mixture that, upon solidification, forms a monolithic material called saltstone. The quality of saltstone produced at the SPF is evaluated in terms of processing (fresh) and performance (cured) properties. While the composition of the premix, the makeup of waste, and the water to premix (w/p) ratio used to fabricate the saltstone are some of the factors governing its properties, the performance of saltstone is also affected by its curing conditions, including temperature and relative humidity (RH), and potentially the rate at which these parameters change during curing [2]. Among the cured properties of saltstone, the saturated hydraulic conductivity is of particular interest because of its role in determining long-term contaminant release rates in the disposal facility, which makes it a key property in the saltstone Performance Assessment (PA) [3]. Consequently, Savannah River Remediation, LLC (SRR) tasked Energy*Solutions* (ES) and the Vitreous State Laboratory (VSL) of the Catholic University of America (CUA) with investigating the impact of three distinct temperature profiles on the hydraulic conductivity of simulated saltstone grouts cured under saturated conditions (100% RH) for 28 and 90 days [4]. The temperature profiles were selected based on temperature readings previously recorded at different elevations in Cell A of Saltstone Disposal Unit 2 (SDU2). These readings generally suggested that higher temperatures, reached at a faster rate, are to be expected with increasing elevation within the disposal cells. It is possible that these variations in curing temperatures could produce spatial variations in the cured properties of the saltstone in the disposal cells, depending on the sensitivity of the saltstone properties to these variations in curing conditions. Consequently, the present study was designed to investigate the impact of selected curing temperature profiles on the properties of the cured saltstone.

1.2 Objectives

The objectives of the present work were to [4]:

- Determine the saturated hydraulic conductivity of saltstone samples cured for 28 and 90 days under 100% RH and a temperature profile that involves a starting temperature of 25°C, a temperature rise of 10 degrees per day to a maximal temperature of 35°C, and isothermal curing at 35°C for the remainder of the curing period (profile *Temp1*).

- Determine the saturated hydraulic conductivity of saltstone samples cured for 28 and 90 days under 100% RH and a temperature profile that involves a starting temperature of 25°C, a temperature rise of 10 degrees per day to a maximal temperature of 45°C, and isothermal curing at 45°C for the remainder of the curing period (profile *Temp2*).

- Determine the saturated hydraulic conductivity of saltstone samples cured for 28 and 90 days under 100% RH and a temperature profile that involves a starting temperature of 25°C, a temperature rise of 10 degrees per day to a maximal temperature of 55°C, and isothermal curing at 55°C for the remainder of the curing period (profile *Temp3*).

- Analyze by X-Ray Diffraction (XRD) and Scanning Electron Microscopy/ Energy Dispersive X-Ray Spectroscopy (SEM/EDS) the microstructure of the saltstone samples cured under the previously described temperature profiles (*Temp1*, *Temp2*, and *Temp3*) for 28 and 90 days.

The study was performed according to a corresponding Test Plan [4], which was responsive to the Request for Task Order Proposal #26803R and the test objectives outlined in the SRR Statement of Work (SOW) G-SOW-Z-00012, Rev. 1. This report presents the results and conclusions from the experimental work performed to address the above objectives.

SECTION 2.0
TEST MATRIX

The test matrix, shown in Table 2.1, examined the effect of the three different curing temperature profiles (*Temp1*, *Temp2*, and *Temp3*) on the saturated hydraulic conductivity of simulated saltstone grouts after 28 and 90 days of curing.

All temperature profiles involved a starting temperature that was near ambient (25°C) and which increased at a rate of 10°C per day. The profiles differed only in the final maximal temperature, which was set at 35° (*Temp1*), 45° (*Temp2*), or 55°C (*Temp3*) (Figure 2.1). After the initial temperature ramp, samples were cured isothermally for the remainder of the curing period. The profiles were provided by SRR and were intended to provide a simplified representation of actual temperature readings that were recorded at different elevations in Cell A of SDU2 from March through May of 2013 (Figure 2.2)[1].

All grouts were fabricated with the Modular Caustic Side Solvent Extraction Unit (MCU) simulant waste composition of Table 2.2 and were exposed to 100% RH for the duration of the curing. The saturated hydraulic conductivity of the grouts was assessed at two different time points: 28 and 90 days. Although many previous studies have involved saturated hydraulic conductivity measurements at 28 days of curing, a reduction in hydraulic conductivity values and an improvement in saltstone performance has previously been seen with longer periods of curing time; this reduction was attributed to continuing pozzolanic reactions that are known to take place at a lower rate and for extended periods of time [5].

Measurements of hydraulic conductivity were performed with quadruplicate samples. Five samples were cast for each time point with the fifth sample reserved for microstructure/phase analysis.

[1]The figure was presented at the Tank Waste Integration Workshop-Cementitious Waste Forms, Richland, WA, July 24-25, 2013.

SECTION 3.0
SAMPLE PREPARATION

3.1 Materials

Waste Simulant. The simulant formulation used in this work was provided by SRR and was utilized in a number of previous studies [2]. The simulant (Table 2.2) is based on an average MCU composition with low aluminate content and without the minor components present in the actual waste. A recipe for the preparation of 10 liters of MCU simulant is shown in Table 3.1.

Dry Mix. The premix blend was composed of 45 wt% Grade 100 BFS from Holcim, 45 wt% Class F FA from SEFA, and 10 wt% Type II Portland Cement from Holcim. The SEFA material is a Carbon Burn-Out (CBO) FA. All of the materials were provided by SRR.

3.2 Sample Preparation

Saltstone grouts were fabricated from 55.8 wt% premix blend and 44.2 wt% waste simulant using a w/p ratio of 0.6 according to the procedures outlined in ASTM C 192 [6]. The recipe used for the preparation of the saltstone grouts is shown in Table 3.2. Grout preparation involved the blending of dry mix materials followed by the addition of the desired amount of the simulant salt solution and vigorous mechanical mixing of the resulting mixture until a homogeneous paste was obtained. The paste was subsequently poured into thirty cylindrical molds, 2″ in diameter by 4″ high, and vibrated for ~1 min to dislodge any air bubbles.

The molds were divided into groups of ten molds and each group was placed uncapped in a plastic container that was then filled halfway with deionized water in such a manner that the tops of the molds remained above the water level; the outer plastic containers were then capped. This curing configuration was selected in order to provide a saturated environment. The containers were subsequently placed in a temperature controlled water bath to ensure: a) a starting temperature of 25ºC, b) exposure of the samples to an environment capable of mitigating any temperature rise related to the heat released during initial hydration reactions, and c) exposure of the samples to a uniform temperature profile during ramping of the temperature to the predetermined maxima. The water bath was equipped with a Eurotherm temperature regulator to which the *Temp3*[2] profile was communicated using custom software programmed in LabVIEW (National Instruments). The containers were removed from the water bath once their individual maximal temperature was reached and placed in preheated convection ovens (*Temp2*

[2] Samples were cured in the water bath only for the duration of their temperature ramp. Because the *Temp3* profile involves a temperature increase from 25º to 55ºC over a 72-hr period, it is inclusive of the temperature ramps of *Temp1* (from 25º to 35ºC over a 24-hr period) and *Temp2* (from 25º to 45ºC over a 48-hr period) profiles. Consequently, only the *Temp3* profile was communicated to the Eurotherm temperature regulator.

and *Temp3* samples) or an environmental chamber (*Temp1* samples) for the isothermal part of their curing. *Temp1* samples were isothermally cured in an environmental chamber because that system, which possesses both heating and cooling capacities, provides a somewhat better temperature control for temperatures closer to room temperature. The temperatures in the convection ovens and the environmental chamber were monitored both manually and recorded electronically; a significant fraction of the electronic monitoring data for the environmental chamber were lost due to a computer malfunction but there is no reason to believe that the temperature deviated from the set point during that time. After 28 days of curing, five samples were removed from each container: four samples were used to perform measurements of the saturated hydraulic conductivity and one sample was used for microstructure/phase analysis. Curing of the remaining five samples for each temperature profile was continued to a total duration of 90 days before they were removed for hydraulic conductivity and microstructure/phase analysis.

SECTION 4.0
TESTING

Grouts, fabricated and cured as previously described, underwent hydraulic conductivity testing at 28 and 90 days of curing. At each time point, the testing was performed in quadruplicate. In addition to hydraulic conductivity testing, grout microstructure analysis was performed at the same curing time points using specimens obtained from the interior of a fifth sample after the sample underwent compressive strength testing. Although not an objective of the study, the sample was tested for compressive strength since this provided a convenient means of sampling the interior of the sample and also provided additional information.

4.1 Saturated Hydraulic Conductivity

Saturated hydraulic conductivity provides a measure of the ease with which a fluid can move through a saturated, porous material and depends on the density and viscosity of the permeating fluid. It is commonly measured using a permeameter in accordance with ASTM D 5084-10. In the present study, saturated hydraulic conductivity measurements of grouts cured under the various temperature profiles for 28 or 90 days were performed by a qualified laboratory (AMEC, Atlanta, GA) following curing of the samples at VSL. The testing was performed on samples (~2.5 inches tall by 2 inches in diameter) that were cut from the interior of the cylindrical samples. The simulant of Table 2.2 was used as the permeating fluid.

4.2 Compressive Strength

Compressive strength is measured by applying a compressive axial load to molded cylinders until failure occurs. The compressive strength of the specimen is calculated by dividing the maximum load attained during the test by the cross-sectional area of the specimen in accordance with ASTM C 39/C 39M-11.

4.3 Microstructure/Phase Analysis

Specimens retrieved from the interior of a cured cylindrical grout sample following compressive strength testing at 28 or 90 days of curing were immediately ground and analyzed by XRD for the presence of crystalline phases. Similarly obtained specimens were prepared for SEM imaging, as described below.

Specimens for SEM observation were embedded in epoxy in 1” or 1-1/4” diameter cylindrical mold cups. After curing the mounts were removed from the cups and ground on

Omnibrade Fine Grind, Rough Polish, and Medium Polish diamond discs using water as a lubricant, followed by polishing using 1 μm, 0.25 μm, and 0.5 μm diamond suspensions. Although this produced a macroscopically flat surface on the specimens, it did not produce a truly polished surface owing to the fragility and friability of the grout matrix. An assessment of dry and other polishing methods available led to the conclusion that they probably could not produce a better surface on samples of this type, so it was decided to evaluate the samples as-prepared while expressing any necessary caveats in the resulting SEM observations. Finally, the samples were carbon coated for imaging in the SEM.

Precautions were taken during SEM sample preparation in order to minimize exposure of the grout specimens to the air in order to minimize water loss that might alter crystal morphologies. For example, specimens were impregnated in an epoxy resin immediately after retrieval and cross-sectioned and polished immediately prior to imaging.

SEM samples were imaged by Backscattered Electron Imaging (BEI) and occasionally by Secondary Electron Imaging (SEI). SEM images provided a qualitative assessment of the microstructure development, formation of hydrated products, and the degree of reacted blend components in the various grouts. EDS point analysis provided a semi-quantitative estimation of the composition of the matrix formed in the samples during hydration of its components under the specified curing conditions.

SECTION 5.0
RESULTS

5.1 Saturated Hydraulic Conductivity

Hydraulic conductivity measurements associated with samples cured under the three distinct temperature profiles for 28 days are shown in Figure 5.1, which depicts values as a function of time during the hydraulic conductivity measurement process. In Figure 5.1, open symbols refer to samples of the *Temp1* profile (maximal temperature: 35ºC), while black and red symbols refer to samples cured under profiles *Temp2* (maximal temperature: 45ºC) and *Temp3* (maximal temperature: 55ºC), respectively. The nature of the measurement is that the values fall slightly over time before stabilizing to an essentially constant value. The figure suggests that curing profile *Temp1* yields samples having slightly higher hydraulic conductivity values than those observed for samples cured under *Temp2* or *Temp3*. In contrast, *Temp2* and *Temp3* samples appear to exhibit essentially identical hydraulic conductivity values. Figure 5.1 also reveals that, although *Temp3* samples appear to reach a constant hydraulic conductivity within 24 hrs, a further decrease in hydraulic conductivity measurements is seen when the test is extended to 48 hrs. It is not clear to what extent such changes represent an intrinsic aspect of the measurement process or an actual change in the sample itself. Since testing of *Temp1* or *Temp2* samples was not extended to 48 hrs, it is not known whether similar behavior would be found for these samples.

Extending the curing of saltstone grouts from 28 to 90 days resulted in only minor changes in the hydraulic conductivity. In Figure 5.2, which depicts hydraulic conductivity measurements obtained during the hydraulic conductivity test as a function of test time, data points from different temperature profiles are more or less coincident, suggesting that after 90 days of curing the specimens exhibit similar hydraulic conductivity values regardless of the curing temperature profile employed. Comparison of the hydraulic conductivity results for grouts cured under a specific temperature profile for 28 days with those for grouts cured under the same temperature profile for 90 days (Figures 5.3 to 5.5) shows that only grouts cured under the *Temp1* profile exhibited a reduction in hydraulic conductivity with a longer curing time (Figure 5.3). No improvement in the hydraulic conductivity of grouts cured under *Temp2* or *Temp3* profile was seen with an increase in curing time.

Measured hydraulic conductivity values for individual grouts cured for 28 and 90 days are shown in Tables 5.1 and 5.2, respectively. Details of measurement for each individual sample are provided in Appendices A (28 days curing) and B (90 days curing). In determining the final reported hydraulic conductivity value of each sample, AMEC follows ASTM D5084 and considers that a steady state is reached when two or more consecutive measurements fall within ±50% of the mean when the mean is $\leq 1 \times 10^{-8}$ cm/s; then, as a final value, AMEC reports the average of the last seven measurements. Consequently, the absolute values of the reported

individual measurements in Tables 5.1 and 5.2 depend to a certain extent on the duration of the hydraulic conductivity test, with longer times often yielding lower values due to the exclusion of the initial high measurements. This is evident in the case of grouts cured for 28 days under *Temp3*, which exhibited lower hydraulic conductivity values when the test time was extended from 24 (2.43×10^{-9} cm/s) to 48 hrs (1.75×10^{-9} cm/s) (Table 5.1). While minor, this decrease was statistically significant (*Student's t-test; p=0.007)* and, as noted above, reflects the exclusion of earlier readings from the reported mean.

Tables 5.1 and 5.2 also report the mean hydraulic conductivity values of grouts cured under each temperature profile. In comparing mean hydraulic conductivity values of grouts cured under different curing regimes, the ASTM D 5084 guidelines should be taken into consideration. These guidelines are broad and suggest that, even if the final hydraulic conductivity values of two distinct samples exhibit a statistically significant difference, this difference may not be meaningful if it falls within ±50% of the final hydraulic conductivity value of either sample. According to this rationale, one would be led to conclude that the samples of the present study exhibit comparable hydraulic conductivity in the range of 1×10^{-9} cm/s after 28 days of curing, suggesting that neither the temperature profiles of Figure 2.1 nor the duration of the curing have significant effect on this aspect of saltstone performance. In view of the ASTM D5084 guidelines and the time dependence of the measurement results (see Figures 5.1 and 5.3), care should be exercised in interpreting small differences in the measured hydraulic conductivity values. Further review of this aspect of the measurements may be warranted.

5.2 Microstructure Development

5.2.1 SEM Imaging

SEM studies, presented here, were performed mainly in the BEI mode using polished specimens (Section 4.3) of grouts hydrated for 28 (Figures 5.6 to 5.11) or 90 days (Figures 5.12 to 5.15). A minimum number of 5 to 6 sites per grout specimen were observed at different magnifications. Figures 5.6 to 5.15 provide examples of the images collected. Micrographs of grouts cured under the *Temp1* profile can be found in Figures 5.6 and 5.9, while Figures 5.7 and 5.10 show images of grouts cured under the *Temp2* profile. Images of grouts cured under the *Temp3* profile are shown in Figures 5.8 and 5.11. Figures 5.7, 5.9, and 5.11 present all micrographs obtained at the 60 μm scale for the 28-day grouts cured under profiles *Temp1*, *Temp2*, and *Temp3*, respectively. Finally, Figure 5.15 compares high magnification SEI mode images of specimens cured under the three different profiles for 90 days. The SEI mode typically gives a more faithful profile of the upper surface of the sample since most secondary electrons originate within 5 nm of the surface whereas backscattered electrons may originate from 1 μm or more beneath the surface at 20 kV accelerating voltage.

In understanding the micrographs shown in the above figures, the shape and the gray level of the observed areas within the images should be taken into consideration. In evenly polished sections of hydrated cement pastes, anhydrous cement phases appear nearly white, calcium hydroxide is seen as light gray, while other hydration products are generally darker gray, and pores appear nearly black [7-9]. An increase in the dissolution or hydration of cement grains

or other pozzolanic particles is expected to result in a darker level of gray. Calcium silicate hydrate (CSH) phases that possess a Ca/Si atomic ratio that is similar to, for example, belite (C_2S or $2CaO.SiO_2$)[3] are expected to appear darker than the anhydrous clinker phase due to the presence of water and pores in CSH [7]. In general, CSH phases exhibit a wide range of brightness gradation due to their variable composition and structure. BFS particles are nearly white and can be distinguished from cement particles in composite pastes by their angular morphology and the presence of sharp edges [8]. FA particles are distinguished by the generally spherical shape, although FA particles of irregular shapes are often seen; the latter are thought to be the product of the fusion of particle fragments and an incomplete melt [10]. Although shapes and brightness gradation in BEI may by z-contrast (brightness gradation proportional to the average atomic number of elements present) provide important information regarding the degree of particle hydration and the quality of the hydrated products formed, the reliability of this information often depends on the ability of specimen preparation techniques to produce a flat, well-polished cross-section. Uneven surfaces may exhibit brightness variations that are unrelated to z-contrast and surface roughness will prevent close examination of the interfaces between the grout matrix and included particles. SEM sample preparation for the present study proved to be rather challenging due to the weakness and friability of the hydrated grout matrix, which led to crumbling of and particle pull-out from the matrix during attempted surface polishing, leaving a relatively rough surface where particle pull-out artifacts may be indistinguishable from preexisting pores in the grout specimen. As a result, uneven surfaces and particle "pull outs" are evident in the images shown in Figures 5.6 through 5.14. The variation of these surfaces from the ideal flat plate is estimated to be on the order of the largest retained particles in the surface, or roughly 10 to 30 μm. Nowhere in these micrographs can the desired flat sections through the included particles and the surrounding matrix be found. Despite these features, a number of valid observations can still be made regarding the degree of hydration and the development of the microstructure in the various grouts.

Grouts cured under the three different temperature profiles exhibited a generally similar morphology dominated by large unreacted or partially reacted FA and BFS particles surrounded by a porous CSH matrix. In the micrograph (C) of Figure 5.6, which depicts images of a grout sample cured under the *Temp1* profile for 28 days, FA particles are denoted with the letter *f*, BFS particles are denoted with the letter *s*, a possible cement particle is denoted with the letter *c*, while the letter *h* indicates CSH. The image suggests that, after 28 days of curing, numerous BFS grains have partially dissolved, forming a hydrated surface layer that appears as a gray rim (see particle *s1*; red arrow). The majority of the FA particles appear unreacted although a gray rim may be distinguished in some of them (see particle *f2*; red arrow). Other FA particles exhibit deposited hydrated products on an otherwise unreacted surface (see particle *f;* red arrow), an indication that the surface of those particles provides nucleation sites for CSH growth. Overall, Figure 5.6 reveals the lack of a smooth transition between particles and matrix in the grout. The most striking feature of all of the of the high magnification images in Figures 5.6 to 5.14 is the lack of matrix continuity between partially hydrated FA or BFS particles. In those images, the grout matrix is dominated by large voids, which sometimes bear the shape of a FA or BFS particle and are attributed to particle "pull outs", whereas other times they may simply be the result of the absence of hydrated product deposition. In Figure 5.6, yellow arrows indicate

[3] This is the second most abundant anhydrous silicate phase in cement.

examples of the voids formed by possible particle "pull outs", whereas green arrows point to the presence of pores surrounding unreacted or poorly reacted particles. The existence of CSH is evident in areas where small sized particles are prevalent (see blue arrows in areas *h*), suggesting that these particles are more prone to dissolve and provide a stronger binding matrix.

The morphology of grouts is affected minimally when a different curing temperature profile (*Temp2* or *Temp3*) is used or when the grouts are cured for 90 days. In Figure 5.8, which depicts images of a grout sample cured under the *Temp2* profile for 28 days, BFS and FA particles exhibit a degree of hydration that is similar to that observed for the grout specimen of Figure 5.6 (*Temp1*) and a similarly limited CSH formation. The most interesting feature of Figure 5.8 is the presence of crystalline phases. In that figure, red arrows indicate the existence of needle-like crystals, while green arrows indicate crystals with a twisted morphology. Although an unusually high concentration of crystalline phases is evident in the images of Figure 5.8, crystals with similar morphology were observed in all grouts, regardless of the curing temperature profile or the duration of the curing.

The degree of BFS and FA hydration and the morphology of the hydrated phases formed in a saltstone grout sample cured under the *Temp3* profile for 28 days did not differ significantly from those of grouts cured under the *Temp1* or *Temp2* profiles. The only notable difference in the image (C) of Figure 5.10 compared to the respective images in Figures 5.6 and 5.8 is an increase in the number of large voids observed in the microstructure of the *Temp3* grout. In Figure 5.10, very little CSH matrix has been formed or remains following sample preparation in comparison to the microstructures developed in the *Temp1* and *Temp2* grouts. Furthermore, an increase in the amount of hydrated products and/or the quality of the matrix is seen with an increase in the curing time of the *Temp3* grout (compare Figures 5.10 and 5.11 with 5.14). This is not the case for grouts *Temp1* and *Temp2*, whose microstructures remain morphologically the same (compare Figures 5.7 and 5.9 with Figures 5.12 and 5.13).

It is commonly understood that, in neat or composite cement pastes hydrated with water or alkaline solutions, increased particle dissolution and hydration is associated with an increase in the amount of binding matrix formed, a decrease in porosity, and an increase in the compressive strength. Furthermore, compressive strength values of composite pastes composed of materials with latent hydraulicity are usually expected to improve with increasing curing times. Because compressive strength values may serve as a general indicator of the quality of the microstructure formed, it is worth reviewing the values obtained here and elsewhere (Table 5.3). In Table 5.3, compressive strength values obtained for grouts fabricated with the MCU waste simulant of Table 2.2 and cured under ambient temperature for 28 days [13][4] have comparable compressive strengths to the grouts of the present study, which were fabricated with the same waste simulant and cured under different temperature profiles and 100% RH for the same number of days. This would suggest that elevated curing temperatures do not affect the compressive strength of saltstone grouts, a rather unexpected observation since the curing temperature is known to affect hydration not only of cement but also of slag and FA [9,14]. The

[4] These grouts were cured in a sealed-sample configuration. At the end of the 28-day curing period, they appeared wet but exhibited no bleed water. Thus, although unlike the present study, no provisions were made to maintain 100% RH, they were likely cured at or near saturation.

latter is certainly evident in the case of GL0[5] saltstone grouts, whose compressive strength declines when the curing temperature is elevated from ambient to 55 or 80ºC [12]. Since the saltstone grouts of Table 5.1 were fabricated with the same 45-45-10 dry mix, but with different waste simulants, the disparity in the effect of curing temperature on saltstone compressive strength may be the result of an effect that different waste simulant components have on the hydration of the saltstone dry mix particles.

5.2.2 EDS Analysis

To further understand the nature of the microstructure that is developed under the different temperature profiles, the specimens were subjected to compositional analysis by EDS. The analysis involved randomly selected spots, mainly on the binding matrices of the grouts but also on the surface of a limited number of unreacted or partially reacted particles. For highly accurate analysis by EDS, the sample should have a flat, well-polished surface which was not obtained on these samples, as was noted earlier. The greater scattering of the beam will increase the x-ray signal contribution to the desired spectrum from surrounding material resulting in higher than optimal standard deviations in data sets. Nevertheless, useful observations can be made from the data. The spectra obtained are presented in detail in Appendices C and D. Appendix C presents EDS analysis of the grouts cured under the three different temperature profiles for 28 days, while Appendix D presents the EDS analysis performed on the 90 day-cured samples.

Compositional data associated with the EDS point analysis of the matrices of *Temp1*, *Temp2*, and *Temp3* grouts cured for 28 or 90 days are summarized in Tables 5.4 to 5.9. The total number of points analyzed differ for different grout specimens. For grouts cured for 28 days, a total of 28-30 points were collected and a total of 18-19 points were used for studying the composition of the matrix formed in these samples. The remaining points were excluded because they reflected the composition of unreacted or partially reacted FA or BFS particles. On the other hand, a total of 12-15 points were collected for 90-day cured samples and a total of 8-10 points reflected the matrix composition. Consequently, observations related to the matrix composition of the 28-day cured samples are likely of somewhat higher confidence than observations associated with the 90-day cured samples. Nevertheless, some interesting trends are evident in the data. Tables 5.4 to 5.6 indicate that there is a trend of increasing Al_2O_3 and SiO_2 matrix content of the 28-day cured grouts with increasing maximal profile temperature, while the corresponding CaO content decreases. These trends appear to be governed by well-correlated linear relationships, as shown in Figure 5.16, and may be explained on the basis of increasing FA dissolution with increasing curing temperature [14-16]. Dissolved FA particles are expected to enrich the matrix in Al and Si and to produce CSH with reduced Ca:Si atomic ratios. This is apparent in several of the spectra shown in Appendices C and D. For example, Spectrum 4.6 of HC3-15-1S (see Appendix C) suggests that the specific FA particle examined in the spectrum contains 31.4 wt% Al_2O_3, 53.1 wt% SiO_2, and 5.1 wt% CaO, while Spectrum 4.4 of HC3-15-1S

[5] These are grouts associated with a study exploring the impact of glycolate on the fresh and cured properties of saltstone. GL0 pastes were fabricated in the absence of glycolate and served as control grouts. However, they employed a different waste simulant from that used in the present study.

indicates that dissolution of the FA particle of spectrum of 4.6 of HC3-15-1S produces a binding matrix comprising 18.7 wt% Al_2O_3, 42.7 wt% SiO_2, and 13.6 wt% CaO. In contrast, the composition of the matrix of the same site typically contains less alumina and far more CaO, as indicated by the composition of the matrix of Spectrum 4.7 of HC3-15-1S, which shows 6.4 wt% Al_2O_3, 38.6 wt% SiO_2, and 38.2 wt% CaO. It should be noted here that Figure 5.16 depicts mean wt% oxide contents and that the differences in the mean oxide matrix content between grouts cured with increasing maximal profile temperature rise to statistical significance only when *Temp1* and *Temp3* samples are compared.

Interestingly, reverse correlations were observed for 90-day cured grouts. In Tables 5.6 to 5.9 and in Figure 5.17, the Al_2O_3 content of the matrix decreases, the CaO content decreases, while the SiO_2 content remains essentially the same with increasing maximal profile temperature. The above observations suggest that, after 90 days of curing, FA dissolution has slowed down considerably, while BFS and/or cement dissolution has increased. Instances of temperature-driven inversion of hydration have been reported often for neat and blended cement pastes. For example, as early as 1962, Kantro et al. reported that the initial hydration rate of alite, the major anhydrous phase of cement, increases with temperature; however, after 10 days or 35% hydration, the rate observed at 25ºC surpasses that seen at 50ºC [17]. Other investigators have shown that, depending on the type of cement used, hydration of alite at 10ºC will exceed that at 60ºC at some point between 28 and 180 days of curing [18]. Finally, a temperature inversion in the compressive strength has been described for cement-pulverized FA (PFA) and cement-BFS composite pastes cured at 10, 30, or 60ºC [19]. In that report, the compressive strength of pastes cured at 30ºC exceeded that of pastes cured at 60ºC after ~2 weeks of curing. The temperature inversion in the rate of hydration of cement and pozzolanic materials is attributed to the formation of a diffusion barrier around the hydrating particles due to a non-uniform distribution of hydrated products at high curing temperature [20]. In contrast, low curing temperatures are associated with a slow diffusion and a uniform precipitation of CSH throughout the matrix of the paste [16,19,20].

Increased dissolution of FA particles in cement composite pastes is commonly linked to the formation of Al-substituted CSH. To understand how the composition of CSH, the major hydration product in saltstone, changes with curing under the different temperature profiles for 28 or 90 days, the atomic ratios present in the grout matrices were calculated from the wt% Oxide Composition values of the obtained spectra. Atomic ratios involving several elemental pairs are shown in Tables 5.10 to 5.15 for individual matrix points along with the mean values. In those tables, Al-substituted CSH was evident by its typically low Ca:Si ratio and its elevated Al:Si ratio. For example, the CSH matrix surrounding the dissolving FA particle of Spectrum HC3-35-1S 4.6 had Al:Si=0.5 and Ca:Si=0.3 (See Spectrum 4.4 of Table 5.10), while the CSH matrix of the same site away from any FA particles had Al:Si=0.2 and Ca:Si=1.1 (see Spectrum 4.7 of Table 5.10). Plotting of various atomic ratios versus the maximal temperature of each profile (Figures 5.18 and 5.20) revealed some interesting trends. A linear relationship between the atomic ratios of Al:Ca and Ca:Si present in the CSH matrix of the grouts and the maximal profile temperature appears to exist. The above pairs appear to exhibit opposite behaviors such that when one increases, the other decreases. In the case of the 28-day cured samples, the increase in the Al:Ca ratio and the concomitant decrease in the Ca:Si ratio with increasing curing

temperature likely reflects formation of Al-substituted CSH due to FA dissolution. At 90 days of curing, the decrease in the content of matrix Al_2O_3 with increasing temperature restores the Ca:Si ratio present in CSH to expected levels (~0.8). Interestingly, a linear relationship was identified between the atomic ratio of S:Al and the curing temperature for grouts cured for 90 days but not for 28 days (Figure 5.20). This may indicate the increased dissolution of BFS with temperature. No such correlation between the S:Al ratio and the curing temperature exists for the 28-day cured sample. In BFS, the overwhelming majority of sulfur exists as sulfide S^{-2}. Roy, who studied sulfur speciation in slag by X-Ray Absorption Spectroscopy (XAS), reported an increase in the sulfate content and a decrease in the sulfide content of slag after hydration in a $Ca(OH)_2$-saturated solution for 5 months [21]. Additional speciation studies, performed at VSL using X-Ray Fluorescence (XRF), have confirmed that >90% of the sulfur found in the currently used BFS is present as insoluble S^{-2}. It is thus possible that the presence of an alkaline environment and the application of high temperature assists in the dissolution of slag sulfide and formation of sulfate, which reacts with aluminate species present in the matrix to form an aluminosulfate mineral such as AFm (calcium sulfoaluminate hydrate) [16].

Finally, the needle-like crystals, seen clearly in the micrograph (C) of Figure 5.8, and observed in several specimens regardless of the temperature profile or curing time, were examined by SEM/EDS. However, because of the roughness of the surface and the small dimensions of the crystals, it was impossible for the electron beam to sample the crystals exclusively, which means that a spectrum obtained by placing the beam on a crystal inevitably includes significant signal contribution from the material around it. Table 5.16 gives the EDS-analyzed compositions obtained by placing the electron beam on the crystals at different points. The data suggest a calcium aluminosilicate phase. In addition to the presence of the needle-like crystals, formation of other crystals can occasionally be distinguished in the milieu of the heterogeneous grout matrix. Some of these crystals appear to be highly enriched in Na and they are likely nitratine ($NaNO_3$) or nitratine deposited on a CSH matrix. In Appendix D, imaging of Site 5 of the grout cured under the *Temp1* profile for 90 days (HC3-35-6) indicates the existence of an area within the site that was dominated by the presence of such crystals. Spectra taken from two different points within the area (HC3-35-6 Site 5 Spectrum 1 and HC3-35-6 Site 5 Spectrum 2) showed an unusually high Na_2O content, likely originating from crystallization of waste simulant salts.

5.2.3 XRD Analysis

The mineralogy of the microstructure in grouts cured as previously described was analyzed by XRD. Diffractograms of grouts cured under the three different profiles for 28 days are shown in Figures 5.21 to 5.23. The figures suggest an increase in sample crystallinity with increasing maximal temperature. However, this may be in part an artifact of the manner in which the experiment was executed, which allowed the samples to dry to different extents while the samples were awaiting analysis; drying would likely cause nitratine crystals to grow. Briefly, all three samples were retrieved from the central interior of the samples after they were fragmented during compressive strength testing; the samples were immediately ground into a fine powder and placed into the sample chamber of the XRD instrument. The samples were analyzed

sequentially. *Temp1* sample was analyzed first and its analysis took ~4.5 hrs. Because it was analyzed first, it was likely the wettest of the three samples and no major nitratine peaks were seen in its XRD pattern, especially at early test times, which correspond to low 2θ angles. In contrast, nitratine peaks are prominent in the *Temp2* and *Temp3* samples, which presumably were dryer by the time they were analyzed. A more direct comparison could be obtained by drying all the samples prior to XRD analysis or by sealing the samples to prevent drying. Additional peaks attributed to calcite, mullite, and quartz are found in all samples. The latter two phases originate from the FA. Further examination of the XRD patterns of the three samples indicated that the *Temp1* sample may contain more calcium silicate phases than the other two samples. In Figures 10 and 11, which compare the diffractograms of the *Temp3* and *Temp2* samples with that of *Temp1* sample, enhanced peaks are seen in the 2θ angle area between 32 and 35º of the *Temp1* spectrum; these peaks can be attributed to the increased presence of CSH and/or larnite (Ca_2SiO_4). Unfortunately, the major diffractogram peak of CSH at ~29º 2θ angle overlaps with the major peaks of nitratine and calcite, thus making definitive conclusions on the presence of CSH in these samples challenging.

Grouts cured for 90 days were also analyzed by XRD. A comparison of the diffractograms obtained from these samples with the corresponding XRD patterns of the samples cured for 28 days can be found in Figures 5.24, 5.26 and 5.27. The figures suggest that only *Temp1* grouts have undergone a few mineralogical changes with increasing curing time; these changes are indicated in Figure 5.24 by the red arrows. Figure 5.25, which compares the spectra of the *Temp1* grouts to the published spectrum of larnite, suggests that, while the major quartz peak at ~27º 2θ exhibits a similar relative intensity in both 28- and 90-day cured samples, the peaks assigned to larnite seem to diminish in the XRD pattern of the 90-day cured grout. Since larnite often refers to belite and belite is known to have a slower dissolution rate than alite [22], this alteration may be attributed to an increase in the consumption of cement with curing time. Larnite peaks appear to maintain their relative intensity in grouts cured under the *Temp2* or *Temp3* profiles (Figures 5.26 and 5.27). Finally, when the XRD diffractograms of grouts cured under the various temperature profiles are compared (Figure 5.28), no major differences are apparent suggesting that, at this curing time point, all grout specimens exhibit identical crystalline mineralogy dominated by the presence of nitratine.

SECTION 6.0
SUMMARY AND CONCLUSIONS

The present work investigated the extent to which the hydraulic conductivity of saltstone is affected by temperature variations that are representative of those likely experienced by the curing saltstone in the SDUs. The work also investigated effects on the microstructure and compressive strength of the saltstone samples, although the latter was not part of the original objectives. Saltstone samples were prepared using the nominal 45-45-10 (BFS-FA-PC) blend with an MCU waste simulant and were cured at each of three different temperature profiles at 100% RH for 28 days and 90 days.

In a previous study the effect of a certain temperature profile (recorded in SDU2B) on the hydraulic conductivity of MCU grouts cured for 28, 60, and 90 days was investigated [5]. The results showed an improvement in hydraulic conductivity (lower values) by about one log unit with an increase in the curing time from 28 to 60 or 90 days (Table 5.3; Grout ID: ST-HC1R). The improvement was attributed to pozzolanic reactions associated with FA dissolution; these reactions are known to start late in the curing process, reportedly after 28 days for cement-FA composite pastes [16]. An increase in the dissolution of FA is expected to pack the pores within the binding matrix of the curing paste with hydrated products and to reduce the overall grout permeability. Based on the SDU2B temperature profile, it was apparent that the highest hydraulic conductivity (in the range of ~$1x10^{-8}$ cm/s) was recorded while the curing temperature in the SDU2B profile was ramping from ~45 to 65ºC, while the decrease in the mean value of the hydraulic conductivity (from ~$1x10^{-8}$ to ~$1x10^{-9}$ cm/s) was associated with a curing temperature that decreased from ~65 to ~60ºC. In addition, when MCU grouts were cured at ambient temperature for 28 days, their hydraulic conductivity was in the range of $1x10^{-9}$ cm/s (Table 5.3; Grout ID: GF-1M). Other grouts fabricated with the same 45-45-10 dry mix as that used in the present study but a different MCU waste simulant and cured isothermally at ambient and elevated temperatures for 28 days (Table 5.3; Grouts: GL0-RT, GL0-55, and GL0-80), exhibited hydraulic conductivity values in the range of $1x10^{-9}$ cm/s. Collectively, these observations were suggestive of a temperature effect on the grout hydraulic conductivity values only when grouts were cured under non-isothermal conditions. This raised the possibility that variations in curing temperatures within the same disposal unit could lead to spatial variations in the hydraulic conductivity of the saltstone.

Figure 2.2 suggests that higher temperatures, reached at a faster rate, are to be expected with increasing elevation within the disposal vaults. These data served as the basis for the selection of the temperature profiles that were used in the present study to investigate the effect on the hydraulic conductivity and microstructure of saltstone. The results suggest that little difference in the performance of saltstone curing in SDU2A should be expected at different elevations since all samples developed a hydraulic conductivity in the range of $1x10^{-9}$ cm/s within 28 days of curing, regardless of the temperature profile used. No improvement in the

hydraulic conductivity was seen when the curing was extended to 90 days. However, it should be noted here that the temperature profiles used in the present study differ from the temperature profile used for the ST-HC1R grouts (Table 5.3; Ref. [5]) in terms of the rate of the temperature ramp. The present samples experienced a fast increase in temperature (10ºC/24 hrs) that lasted 24 to 72 hrs, depending on the profile, and isothermal curing for the remainder of the study. In contrast, ST-HC1R grouts were exposed to a temperature rise of ~20ºC/28 days. It is thus still possible that saltstone hydraulic conductivity can be affected by the temperature profile to which it is exposed during curing.

The microstructures formed in saltstone samples cured under the tested temperature profiles did not differ significantly from the microstructure previously seen with other saltstone grouts [11,12]. Certain alterations, observed in the composition of the binding matrix with an increase in the curing time, did not translate into changes in the hydraulic conductivity or compressive strength. Although not part of the initial objective of the study, compressive strength measurements were performed and showed certain unexpected trends. For example, while the compressive strength of GL0 grouts decreased as the curing temperature increased from ambient to 55ºC (Table 5.3, Ref. [12]), the compressive strength of MCU grouts remained essentially unaffected by an increase in the curing temperature from ambient (Table 5.3; Grouts GF-1M, Ref. [13]) to 35ºC (Table 5.3; Grouts ST-HC3-35, present report), or 55ºC (Table 5.3; Grouts ST-HC3-55, present report). Since grouts GL0 were fabricated with a different simulant than the one used for grouts GF-1M or ST-HC3, it is possible that certain components of the waste may mediate or mitigate some of the temperature effects on grout properties.

In cement pastes fabricated with water, an increase in compressive strength is often associated with a more dense CSH matrix and a decrease in porosity and permeability. However, in saltstone mixes, there does not appear to be a general relationship between compressive strength and hydraulic conductivity values. In Table 5.3, grouts exhibiting similar hydraulic conductivity in the range of $1x10^{-9}$ cm/s possess variant compressive strengths. The discrepancy between these results and those observed in simple cement pastes fabricated with water may be attributable to the fabrication of the saltstone pastes with waste simulant compositions of high salt content. In saltstone grouts, packing of the matrix pores is likely achieved in the absence of a cohesive, dense matrix through precipitation not only of CSH but also of inorganic salts.

Per SRR-CWDA-2013-00062, Rev. 2 [23], the nominal value of the saturated hydraulic conductivity for intact saltstone is $6.4x10^{-9}$ cm/s. The mean values of the saturated hydraulic conductivity determined in the present work for samples cured according to three different temperature profiles at both 28 days and 90 days curing were lower than this nominal value.

In view of the above observations and associated hypotheses, further investigation of the relationship between curing profiles, waste components, compressive strength, and hydraulic conductivity would be useful. In particular, some of the observed trends appear to vary considerably with the composition of the waste simulant. Consequently, studies to isolate and better understand the effects of the individual waste components, and the possible interactions between them, would be useful in assessing and potentially improving the robustness of the saltstone waste form.

SECTION 7.0
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Table 2.1. Test Matrix.

Premix Composition (BFS-FA-PC)	Fabrication Parameters		Curing Conditions			Number of Samples
	Waste Simulant	w/p	Temp Profile	RH	Time Period (days)	
45-45-10	MCU	0.6	*Temp-1*	100%	28	5
45-45-10	MCU	0.6	*Temp-1*	100%	90	5
45-45-10	MCU	0.6	*Temp-2*	100%	28	5
45-45-10	MCU	0.6	*Temp-2*	100%	90	5
45-45-10	MCU	0.6	*Temp-3*	100%	28	5
45-45-10	MCU	0.6	*Temp-3*	100%	90	5
Total Number of Samples						*30*

Table 2.2. Waste Simulant Formulation.

Ingredient	MCU Simulant	
	Molarity (Moles/Liter)	**Mass (g/ Liter H_2O)**
Sodium Hydroxide, NaOH (50% by weight)	1.594	127.50
Sodium Nitrate, $NaNO_3$	3.159	268.48
Sodium Nitrite, $NaNO_2$	0.368	25.39
Sodium Carbonate, Na_2CO_3	0.176	18.65
Sodium Sulfate, Na_2SO_4	0.059	8.37
Aluminum Nitrate, $Al(NO_3)_3.9H_2O$	0054	20.33
Sodium Phosphate, $Na_3PO_4.12H_2O$	0.012	4.67

Table 3.1. Recipe for the Preparation of 10 Liters of MCU Waste Simulant.

Order of Addition	Reagent	Target Concentration, M	Molecular Weight	Assay	Target Mass, g
1	$Al(NO_3)_3*9H_2O$	0.054	375.13	0.980	207
1	Na_2CO_3	0.176	105.99	0.998	187
1	$Na_3PO_4*12H_2O$	0.012	380.12	0.980	47
1	Na_2SO_4	0.059	142.04	0.990	85
1	$NaNO_3$	3.159	84.99	0.995	2698
1	$NaNO_2$	0.368	69.00	0.995	255
3	NaOH	1.594	40.01	0.990	644
2	H_2O		18.02		8498[$]
Total (g)					12621

[$] Actual water mass.

Table 3.2. Recipe for the Preparation of Saltstone Grouts.

Order of Addition	Component	Target Mass, g
1	Holcim BFS (Grade 100)	4051.1
1	SEFA FA	4051.1
1	Holcim PC	900.2
2	MCU Simulant	7899.4
Total		16901.8

Table 5.1. Reported Final Hydraulic Conductivity Values of Samples Cured Under the Temperature Profiles of Figure 2.1 for 28 Days.

Sample ID	Profile	Hydraulic Conductivity (cm/s)		
		Individual Measurements		
		End Test Time ≤ 24 hrs	*End Test Time= 48 hrs*	*Mean±SD*
ST-HC3-35-2	*Temp1* (35ºC)	$4.0x10^{-9}$	ND[a]	$(5.05±1.05)x10^{-9}$
ST-HC3-35-3		$4.7x10^{-9}$	ND	
ST-HC3-35-4		$6.5x10^{-9}$	ND	
ST-HC3-35-5		$5.0x10^{-9}$	ND	
ST-HC3-45-2	*Temp2* (45ºC)	$2.0x10^{-9}$	ND	$(2.13±0.42)x10^{-9}$
ST-HC3-45-3		$2.7x10^{-9}$	ND	
ST-HC3-45-4		$2.1x10^{-9}$	ND	
ST-HC3-45-5		$1.7x10^{-9}$	ND	
ST-HC3-55-2	*Temp3* (55ºC)	$2.2x10^{-9}$	$1.70x10^{-9}$	[b]$(2.43±0.29)x10^{-9}$
ST-HC3-55-3		$2.2x10^{-9}$	$1.60x10^{-9}$	
ST-HC3-55-4		$2.8x10^{-9}$	$2.00x10^{-9}$	[c]$(1.75±0.17)x10^{-9}$
ST-HC3-55-5		$2.5x10^{-9}$	$1.70x10^{-9}$	

[a]ND: not done
[b]End test time~24 hr
[c]End test time~48 hrs

Table 5.2. Reported Final Hydraulic Conductivity Values of Samples Cured Under the Temperature Profiles of Figure 2.1 for 90 Days.

Sample ID	**Profile**	**Hydraulic Conductivity (cm/s)**	
		Individual Measurements	*Mean±SD*
ST-HC3-35-7	*Temp1* (35ºC)	2.2×10^{-9}	$(2.43 \pm 0.17) \times 10^{-9}$
ST-HC3-35-8		2.5×10^{-9}	
ST-HC3-35-9		2.4×10^{-9}	
ST-HC3-35-10		2.6×10^{-9}	
ST-HC3-45-7	*Temp2* (45ºC)	1.6×10^{-9}	$(1.75 \pm 0.42) \times 10^{-9}$
ST-HC3-45-8		1.8×10^{-9}	
ST-HC3-45-9		1.3×10^{-9}	
ST-HC3-45-10		2.3×10^{-9}	
ST-HC3-55-7	*Temp3* (55ºC)	1.5×10^{-9}	$(1.33 \pm 0.13) \times 10^{-9}$
ST-HC3-55-8		1.3×10^{-9}	
ST-HC3-55-9		1.2×10^{-9}	
ST-HC3-55-10		1.3×10^{-9}	

Table 5.3. Summary of Compressive Strength and Hydraulic Conductivity Values of Saltstone Grouts Prepared Using the 45-45-10 Dry Mix and Cured Under Various Conditions. Values from Current and Previously Performed Studies.

Grout ID	Simulant			Curing			Compressive Strength, psi	Hydraulic Conductivity, cm/s	Report
	Name	[OH], M	[$NaNO_3$], M	Temperature	RH	Time, days			
GF-1	SWPF	2.86	1.97	Ambient	[e]Ambient	28	[a]1260	NA	VSL-12R2420-1 Rev 0, Ref. [11]
GL0-RT	SIM-GL0	1.72	2.04	Ambient	100%	28	[a]2075	[a]1.50×10^{-9}	VSL-13R2980-1 Rev 0, Ref. [12]
GL0-55	SIM-GL0	1.72	2.04	55ºC	100%	28	[a]1039	[a]2.35×10^{-9}	VSL-13R2980-1 Rev 0, Ref. [12]
GL0-80	SIM-GL0	1.72	2.04	80ºC	100%	28	[a]947	[a]2.05×10^{-9}	VSL-13R2980-1 Rev 0, Ref. [12]
GF-1M	MCU	1.59	3.16	Ambient	[e]Ambient	28	[b]761±35	[b]$(2.83 \pm 1.17) \times 10^{-9}$	VSL-14R2890-1 Rev 0, Ref. [13]
ST-HC1R	MCU	1.59	3.16	SDU2B	100%	28	NA	[b]$(2.93 \pm 0.38) \times 10^{-8}$	VSL-13R23010-1 Rev 0, Ref. [5]
ST-HC1R	MCU	1.59	3.16	SDU2B	100%	60	NA	[b] $(4.23 \pm 0.38) \times 10^{-9}$	VSL-13R23010-1 Rev 0, Ref. [5]
ST-HC1R	MCU	1.59	3.16	SDU2B	100%	90	NA	[b]$(4.93 \pm 0.22) \times 10^{-9}$	VSL-13R23010-1 Rev 0, Ref. [5]
ST-HC3-35	MCU	1.59	3.16	*Temp1*	100%	28	[c]755	[d]$(5.05 \pm 1.05) \times 10^{-9}$	Present Study
ST-HC3-45	MCU	1.59	3.16	*Temp2*	100%	28	[c]685	[d]$(2.13 \pm 0.42) \times 10^{-9}$	Present Study
ST-HC3-55	MCU	1.59	3.16	*Temp3*	100%	28	[c]885	[d]$(1.75 \pm 0.17) \times 10^{-9}$	Present Study
ST-HC3-35	MCU	1.59	3.16	*Temp1*	100%	90	[c]899	[d]$(2.43 \pm 0.17) \times 10^{-9}$	Present Study
ST-HC3-45	MCU	1.59	3.16	*Temp2*	100%	90	[c]769	[d]$(1.75 \pm 0.42) \times 10^{-9}$	Present Study
ST-HC3-55	MCU	1.59	3.16	*Temp3*	100%	90	[c]981	[d]$(1.33 \pm 0.13) \times 10^{-9}$	Present Study

[a]Duplicate measurements.
[b]Triplicate measurements.
[c]Single measurement.
[d]Quadruplicate measurement.
[e]Cured in a closed-cap configuration.

Table 5.4. SEM/EDS Point Analysis of the Matrix Formed in a *Temp1* Grout Sample (HC-35-1S) after 28 Days of Curing. Details Regarding the Point Location and the Individual Spectra Obtained are Provided in Appendix C.

Wt% Oxide Composition																					
Oxide	**Spectrum ID**																			**Mean**	**SD**
	4.1	***4.2***	***4.3***	***4.4***	***4.7***	***5.2***	***5.3***	***5.4***	***5.5***	***5.6***	***5.7***	***5.8***	***6.1***	***6.3***	***6.5***	***6.6***	***6.7***	***6.8***	***6.9***		
Na_2O	4.7	10.8	5.5	15.0	7.4	6.8	6.3	7.7	7.4	3.6	6.7	13.0	10.3	9.4	6.6	3.9	2.9	6.3	8.7	**7.5**	**3.1**
MgO	4.1	5.3	1.0	2.1	4.3	1.8	3.4	2.2	3.1	7.9	3.0	3.3	2.8	2.6	1.5	3.8	1.4	1.9	4.9	**3.2**	**1.7**
Al_2O_3	7.5	12.1	13.6	18.7	6.4	5.9	6.1	11.6	24.2	7.6	9.0	11.1	17.5	18.9	9.8	6.2	4.0	22.0	8.8	**11.6**	**5.9**
SiO_2	39.5	39.3	44.0	42.7	38.6	37.5	35.2	39.5	42.1	43.1	39.5	44.6	40.4	44.1	38.9	36.0	24.6	45.8	38.1	**39.7**	**4.7**
SO_3	1.8	2.1	0.0	1.1	2.8	2.1	2.6	1.6	1.5	2.3	1.4	1.1	1.4	2.4	2.5	3.7	2.1	1.2	2.6	**1.9**	**0.8**
K_2O	1.0	0.9	1.5	1.5	1.1	0.8	1.2	2.0	0.8	0.7	1.4	1.4	2.1	1.4	1.7	0.9	0.8	2.4	1.5	**1.3**	**0.5**
CaO	38.4	26.5	29.4	13.6	38.2	42.1	42.5	20.5	15.4	33.9	31.7	22.8	14.2	16.0	35.6	43.8	61.0	10.2	33.5	**30.0**	**13.2**
TiO_2	0.8	0.9	1.8	0.8	0.5	0.7	0.4	1.0	0.8	0.4	1.0	0.5	1.5	0.9	0.6	0.5	0.4	2.9	0.6	**0.9**	**0.6**
FeO	2.3	2.2	3.3	4.5	0.8	1.3	2.3	14.0	4.8	0.4	6.4	2.3	10.0	4.3	2.8	1.3	1.9	7.4	1.3	**3.9**	**3.5**

Table 5.5. SEM/EDS Point Analysis of the Matrix Formed in a *Temp2* Grout Sample (HC-45-1S) after 28 Days of Curing. Details Regarding the Point Location and the Individual Spectra Obtained are Provided in Appendix C.

Wt% Oxide Composition																				
Oxide	**Spectrum ID**																		**Mean**	**SD**
	4.1	***4.2***	***4.3***	***4.4***	***4.5***	***4.6***	***4.7***	***5.1***	***5.3***	***5.5***	***5.6***	***5.7***	***5.8***	***5.9***	***6.1***	***6.3***	***6.5***	***6.6***		
Na_2O	9.5	4.8	11.6	9.3	14.1	6.1	2.7	9.9	20.1	6.0	6.8	10.4	17.1	9.6	3.5	6.9	5.7	5.4	**8.8**	**4.6**
MgO	1.5	4.6	5.5	1.5	1.2	1.9	0.4	8.3	4.5	2.2	1.0	3.1	1.3	2.4	1.5	7.2	8.2	5.2	**3.4**	**2.6**
Al_2O_3	20.2	5.6	10.3	8.5	10.3	37.3	14.0	7.8	9.6	21.1	4.1	9.3	7.1	18.1	21.9	9.9	14.8	8.3	**13.2**	**8.1**
SiO_2	47.4	36.7	39.7	38.0	35.6	41.4	63.8	40.4	37.9	39.9	25.7	42.4	48.5	54.2	47.5	41.6	43.0	43.7	**42.6**	**8.1**
SO_3	3.6	4.1	2.9	5.1	2.1	0.8	0.2	2.2	1.8	0.9	1.3	3.8	2.4	1.2	0.5	1.9	1.7	1.7	**2.1**	**1.3**
K_2O	1.6	1.6	1.9	2.7	2.8	1.1	5.6	0.7	1.6	1.7	0.3	1.7	1.4	1.2	1.9	0.9	1.5	1.0	**1.7**	**1.1**
CaO	13.7	40.4	26.4	29.1	31.1	4.8	3.1	29.9	20.7	14.2	59.6	26.5	21.0	9.0	9.6	29.6	21.9	33.4	**23.6**	**13.8**
TiO_2	0.8	0.5	0.3	0.5	0.7	1.4	3.9	0.2	0.2	2.2	0.2	0.8	-	1.2	1.3	0.7	0.8	0.3	**0.9**	**0.9**
FeO	1.7	1.6	1.5	5.3	2.3	5.2	6.3	0.7	3.5	10.2	1.0	2.1	1.3	3.1	12.3	1.3	2.5	1.0	**3.5**	**3.3**

Table 5.6. SEM/EDS Point Analysis of the Matrix Formed in a *Temp3* Grout Sample (HC-55-1S) after 28 Days of Curing. Details Regarding the Point Location and the Individual Spectra Obtained are Provided in Appendix C.

Wt% Oxide Composition																				
Oxide	**Spectrum ID**																		**Mean**	**SD**
	4.1	***4.4***	***4.6***	***4.7***	***4.1***	***4.1***	***4.1***	***5.1***	***5.3***	***5.5***	***5.6***	***5.7***	***5.8***	***5.9***	***6.4***	***6.5***	***6.6***	***6.7***		
Na_2O	12.7	9.9	8.3	5.1	6.5	8.3	10.1	6.7	7.8	4.4	3.9	8.4	7.1	7.4	4.0	3.9	4.6	4.3	**6.8**	**2.5**
MgO	1.9	6.0	2.4	2.0	1.6	2.3	3.0	5.5	2.4	7.5	3.7	6.6	1.1	5.4	7.4	5.1	5.5	5.1	**4.1**	**2.1**
Al_2O_3	22.6	17.1	25.7	7.9	40.6	33.0	8.7	17.3	18.8	8.7	23.6	11.2	14.2	10.6	12.5	9.7	11.1	9.5	**16.8**	**9.2**
SiO_2	42.9	44.1	45.9	53.6	39.8	48.6	44.3	43.1	44.6	43.6	46.6	45.0	47.7	43.9	45.6	39.7	41.8	43.0	**44.7**	**3.2**
SO_3	1.7	1.7	1.1	1.4	0.3	1.0	2.5	1.6	1.2	2.0	0.5	1.6	0.9	1.6	1.9	1.9	1.5	1.8	**1.4**	**0.5**
K_2O	1.2	1.2	2.1	2.3	0.9	0.6	1.5	0.6	1.9	0.7	1.4	0.7	1.8	0.8	0.5	1.1	1.0	0.5	**1.2**	**0.6**
CaO	14.8	16.5	11.3	22.3	5.0	3.5	27.8	20.4	19.6	32.3	10.8	25.5	24.7	28.3	26.9	36.4	30.6	33.9	**21.7**	**9.7**
TiO_2	0.3	1.2	0.7	0.6	0.4	0.6	0.4	0.8	0.9	0.3	4.9	0.3	0.5	0.4	0.4	0.6	0.6	0.4	**0.8**	**1.0**
FeO	2.0	2.4	2.6	5.0	3.6	2.0	1.6	4.0	2.9	0.4	4.6	0.8	2.1	1.6	0.9	1.7	3.3	1.5	**2.4**	**1.3**

Table 5.7. SEM/EDS Point Analysis of the Matrix Formed in a *Temp1* Grout Sample (HC-35-6) after 90 Days of Curing. Details Regarding the Point Location and the Individual Spectra Obtained are Provided in Appendix D.

Wt% Oxide Composition										
Oxide	**Spectrum ID**									
	4.1	***4.2***	***4.4***	***4.5***	***4.6***	***4.7***	***6.1***	***6.2***	**Mean**	**SD**
Na_2O	10.4	16.6	8.5	6.4	23.2	6.4	6.0	4.3	**10.2**	**6.5**
MgO	2.3	6.8	1.9	0.7	1.3	0.2	1.3	11.3	**3.2**	**3.9**
Al_2O_3	14.2	11.6	36.6	12.6	9.8	56.4	31.9	9.1	**22.8**	**17.2**
SiO_2	38.9	36.1	38.0	46.6	36.9	32.5	43.1	43.5	**39.4**	**4.6**
SO_3	3.9	3.7	1.7	2.6	4.4	-	0.4	2.8	**2.8**	**1.4**
K_2O	3.3	2.4	1.3	2.6	3.1	0.9	1.7	0.8	**2.0**	**1.0**
CaO	18.5	19.7	4.7	18.7	19.3	2.7	2.8	28.0	**14.3**	**9.6**
TiO_2	1.6	1.6	4.5	3.9	-	-	1.5	0.3	**2.2**	**1.6**
FeO	7.0	1.6	2.8	5.9	2.1	1.0	11.4	-	**4.5**	**3.8**

Table 5.8. SEM/EDS Point Analysis of the Matrix Formed in a *Temp2* Grout Sample (HC-45-6) after 90 Days of Curing. Details Regarding the Point Location and the Individual Spectra Obtained are Provided in Appendix D.

Wt% Oxide Composition											
	Spectrum ID										
Oxide	**3.1**	**3.2**	**3.3**	**3.4**	**3.5**	**5.1**	**5.2**	**5.3**	**5.4**	**Mean**	**SD**
Na_2O	6.34	5.62	10.2	14	8.8	14.1	4.62	11.5	1.54	**8.5**	**4.3**
MgO	0.92	0.68	7.6	2.12	4.88	2.11	0.72	3.16	9.12	**3.5**	**3.1**
Al_2O_3	24.3	3.29	9.31	8.65	5.02	8.42	37.7	13.4	9.88	**13.3**	**11.0**
SiO_2	40.6	30.3	44.2	40.2	35.4	40.2	49.1	45.4	42.7	**40.9**	**5.6**
SO_3	1.1	1.3	3.1	3.5	3.2	4.3	0.6	2.4	3.1	**2.5**	**1.3**
K_2O	1.5	0.4	1.5	1.9	0.8	2.1	2.0	2.3	0.6	**1.5**	**0.7**
CaO	13.4	57.3	22.3	27.2	40.1	26.4	2.27	17.9	32.1	**26.5**	**15.9**
TiO_2	1.52	0.12	0.64	0.88	0.35	0.61	0.52	0.67	0.22	**0.6**	**0.4**
FeO	8.29	1.12	1.1	1.55	0.55	1.75	2.48	3.34	0.74	**2.3**	**2.4**

Table 5.9. SEM/EDS Point Analysis of the Matrix Formed in a *Temp3* Grout Sample (HC-55-6) after 90 Days of Curing. Details Regarding the Point Location and the Individual Spectra Obtained are Provided in Appendix D.

Wt% Oxide Composition												
Oxide	**Spectrum ID**										**Mean**	**SD**
	3.1	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**	**3.9**	**4.1**	**4.2**	**4.3**		
Na_2O	13.6	4.5	8.9	8.5	10.0	3.2	22.1	17.5	15.0	14.7	**11.8**	**5.9**
MgO	2.7	7.3	2.1	1.8	0.1	6.1	2.8	4.1	2.4	14.1	**4.3**	**4.0**
Al_2O_3	10.1	5.8	26.6	5.0	6.4	15.0	6.5	8.4	4.2	13.4	**10.1**	**6.8**
SiO_2	34.0	35.5	37.9	43.2	44.1	36.0	35.9	38.2	30.5	38.3	**37.3**	**4.0**
SO_3	3.0	3.3	2.6	4.7	4.9	2.8	4.3	7.0	3.9	5.0	**4.2**	**1.3**
K_2O	1.4	0.7	1.5	2.4	2.5	1.0	1.6	2.5	1.8	2.1	**1.8**	**0.6**
CaO	28.9	42.2	8.6	33.7	30.4	35.0	25.9	20.8	40.9	10.1	**27.6**	**11.6**
TiO_2	0.5	0.6	2.6	0.3	0.4	0.4	0.3	-	0.2	0.8	**0.7**	**0.8**
FeO	6.0	-	9.1	0.5	1.1	0.6	0.8	1.7	1.0	1.6	**2.5**	**3.0**

Table 5.10. Atomic Ratios Present at the Points of *Temp1* Grout (HC-35-1S) Matrix Analyzed by SEM/EDS and Presented in Table 5.4. Curing Time: 28 Days.

Atomic Ratios Present in HC-35-1S Grout Matrix																					
Ratio	**Spectrum ID**																			**Mean**	**SD**
	4.1	***4.2***	***4.3***	***4.4***	***4.7***	***5.2***	***5.3***	***5.4***	***5.5***	***5.6***	***5.7***	***5.8***	***6.1***	***6.3***	***6.5***	***6.6***	***6.7***	***6.8***	***6.9***		
Al:Si	0.22	0.36	0.36	0.51	0.19	0.18	0.20	0.35	0.67	0.21	0.27	0.29	0.51	0.50	0.30	0.20	0.19	0.57	0.27	0.34	0.15
Ca:Si	1.04	0.72	0.72	0.34	1.06	1.20	1.29	0.56	0.39	0.84	0.86	0.55	0.38	0.39	0.98	1.31	2.65	0.24	0.94	0.87	0.55
Al:Ca	0.21	0.50	0.51	1.51	0.18	0.15	0.16	0.62	1.72	0.25	0.31	0.53	1.35	1.29	0.30	0.16	0.07	2.38	0.29	0.66	0.66
S:Al	0.15	0.11	0.00	0.04	0.28	0.23	0.27	0.09	0.04	0.19	0.10	0.06	0.05	0.08	0.16	0.38	0.33	0.03	0.18	0.15	0.11

Table 5.11. Atomic Ratios Present at the Points of *Temp2* Grout (HC-45-1S) Matrix Analyzed by SEM/EDS and Presented in Table 5.5. Curing Time: 28 Days.

Atomic Ratios Present in HC-45-1S Grout Matrix																				
Ratio	**Spectrum ID**																		**Mean**	**SD**
	4.1	***4.2***	***4.3***	***4.4***	***4.5***	***4.6***	***4.7***	***5.1***	***5.3***	***5.5***	***5.6***	***5.7***	***5.8***	***5.9***	***6.1***	***6.3***	***6.5***	***6.6***		
Al:Si	0.50	0.18	0.31	0.26	0.34	1.06	0.26	0.23	0.30	0.62	0.19	0.26	0.17	0.39	0.54	0.28	0.41	0.22	0.36	0.22
Ca:Si	0.31	1.18	0.71	0.82	0.94	0.12	0.05	0.79	0.58	0.38	2.49	0.67	0.46	0.18	0.22	0.76	0.55	0.82	0.67	0.55
Al:Ca	1.62	0.15	0.43	0.32	0.36	8.57	4.90	0.29	0.51	1.63	0.08	0.38	0.37	2.21	2.50	0.37	0.74	0.27	1.43	2.16
S:Al	0.11	0.46	0.18	0.38	0.13	0.01	0.01	0.18	0.12	0.03	0.21	0.26	0.21	0.04	0.01	0.12	0.07	0.13	0.15	0.12

Table 5.12. Atomic Ratios Present at the Points of *Temp3* Grout (HC-55-1S) Matrix Analyzed by SEM/EDS and Presented in Table 5.6. Curing Time: 28 Days.

Ratio	Atomic Ratios Present in Grout Matrix																			
	Spectrum ID																		Mean	SD
	4.1	***4.4***	***4.6***	***4.7***	***4.1***	***4.11***	***4.12***	***5.1***	***5.3***	***5.5***	***5.6***	***5.7***	***5.8***	***5.9***	***6.4***	***6.5***	***6.6***	***6.7***		
Al:Si	0.62	0.46	0.66	0.17	1.20	0.80	0.23	0.47	0.50	0.23	0.60	0.29	0.35	0.28	0.32	0.29	0.31	0.26	0.45	0.26
Ca:Si	0.37	0.40	0.26	0.44	0.13	0.08	0.67	0.51	0.47	0.79	0.25	0.61	0.55	0.69	0.63	0.98	0.78	0.84	0.53	0.25
Al:Ca	1.68	1.14	2.49	0.39	8.89	10.27	0.34	0.93	1.05	0.30	2.41	0.48	0.63	0.41	0.51	0.29	0.40	0.31	1.83	2.91
S:Al	0.05	0.06	0.03	0.11	0.01	0.02	0.18	0.06	0.04	0.15	0.01	0.09	0.04	0.1	0.09	0.12	0.09	0.12	0.08	0.05

Table 5.13. Atomic Ratios Present at the Points of *Temp1* Grout (HC-35-6) Matrix Analyzed by SEM/EDS and Presented in Table 5.7. Curing Time: 90 Days.

Ratio	Atomic Ratios Present in Grout Matrix									
	Spectrum ID								Mean	SD
	4.1	*4.2*	*4.4*	*4.5*	*4.6*	*4.7*	*6.1*	*6.2*		
Al:Si	0.43	0.38	1.13	0.32	0.31	2.04	0.87	0.24	0.72	0.62
Ca:Si	0.51	0.59	0.13	0.43	0.56	0.09	0.07	0.69	0.38	0.25
Al:Ca	0.84	0.65	8.56	0.74	0.56	23.10	12.41	0.35	5.90	8.32
S:Al	0.17	0.20	0.03	0.13	0.29	0.00	0.01	0.19	0.13	0.11

Table 5.14. Atomic Ratios Present at the Points of *Temp2* Grout (HC-45-6) Matrix Analyzed by SEM/EDS and Presented in Table 5.8. Curing Time: 90 Days.

Atomic Ratios Present in Grout Matrix											
Ratio	**Spectrum ID**									**Mean**	**SD**
	3.1	**3.2**	**3.3**	**3.4**	**3.5**	**5.1**	**5.2**	**5.3**	**5.4**		
Al:Si	0.70	0.13	0.25	0.25	0.17	0.25	0.90	0.35	0.27	0.36	0.25
Ca:Si	0.35	2.03	0.54	0.72	1.21	0.70	0.05	0.42	0.80	0.76	0.54
Al:Ca	1.99	0.06	0.46	0.35	0.14	0.35	18.25	0.82	0.34	2.53	5.58
S:Al	0.03	0.25	0.21	0.26	0.40	0.33	0.01	0.12	0.20	0.20	0.12

Table 5.15. Atomic Ratios Present at the Points of *Temp3* Grout (HC-55-6) Matrix Analyzed by SEM/EDS and Presented in Table 5.9. Curing Time: 90 Days.

Atomic Ratios Present in Grout Matrix												
Ratio	**Spectrum ID**										**Mean**	**SD**
	3.1	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**	**3.9**	**4.1**	**4.2**	**4.3**		
Al:Si	0.35	0.19	0.82	0.14	0.17	0.49	0.21	0.26	0.16	0.41	0.32	0.21
Ca:Si	0.91	1.28	0.24	0.84	0.74	1.04	0.77	0.58	1.44	0.28	0.81	0.38
Al:Ca	0.38	0.15	3.40	0.16	0.23	0.47	0.27	0.44	0.11	1.46	0.71	1.02
S:Al	0.19	0.37	0.06	0.61	0.48	0.12	0.42	0.53	0.6	0.24	0.36	0.20

Table 5.16. SEM/EDS Point Analysis of the Needle-Like Crystals Formed in a *Temp2* Grout Sample (HC-45-1S) after 28 Days of Curing. Details Regarding the Point Location and the Individual Spectra Obtained are Provided in Appendix C.

Wt% Oxide Composition					
Oxide	**Spectrum ID**			**Mean**	**SD**
	4.1	***4.11***	***4.12***		
Na_2O	17.8	6.5	7.7	10.7	6.2
MgO	1.6	1.4	1.3	1.4	0.2
Al_2O_3	10.6	22.9	12.6	15.4	6.6
SiO_2	51.0	45.7	39.8	45.5	5.6
SO_3	1.2	1.1	2.6	1.6	0.8
K_2O	2.7	3.3	2.6	2.9	0.3
CaO	11.0	8.8	27.3	15.7	10.1
TiO_2	0.7	0.4	1.9	1.0	0.8
FeO	3.4	10.0	4.3	5.9	3.6

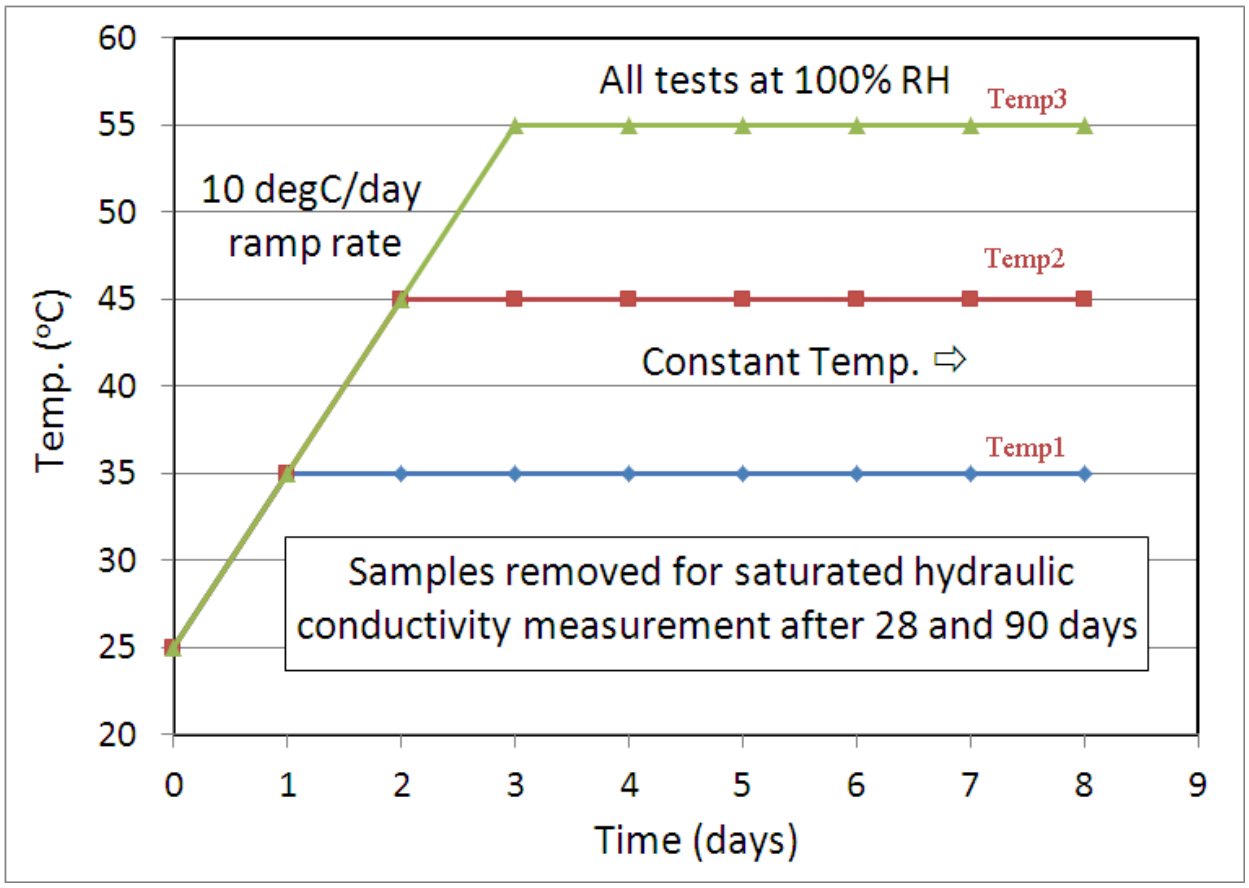


Figure 2.1. Temperature profiles provided by SRR for curing of MCU saltstone grouts.

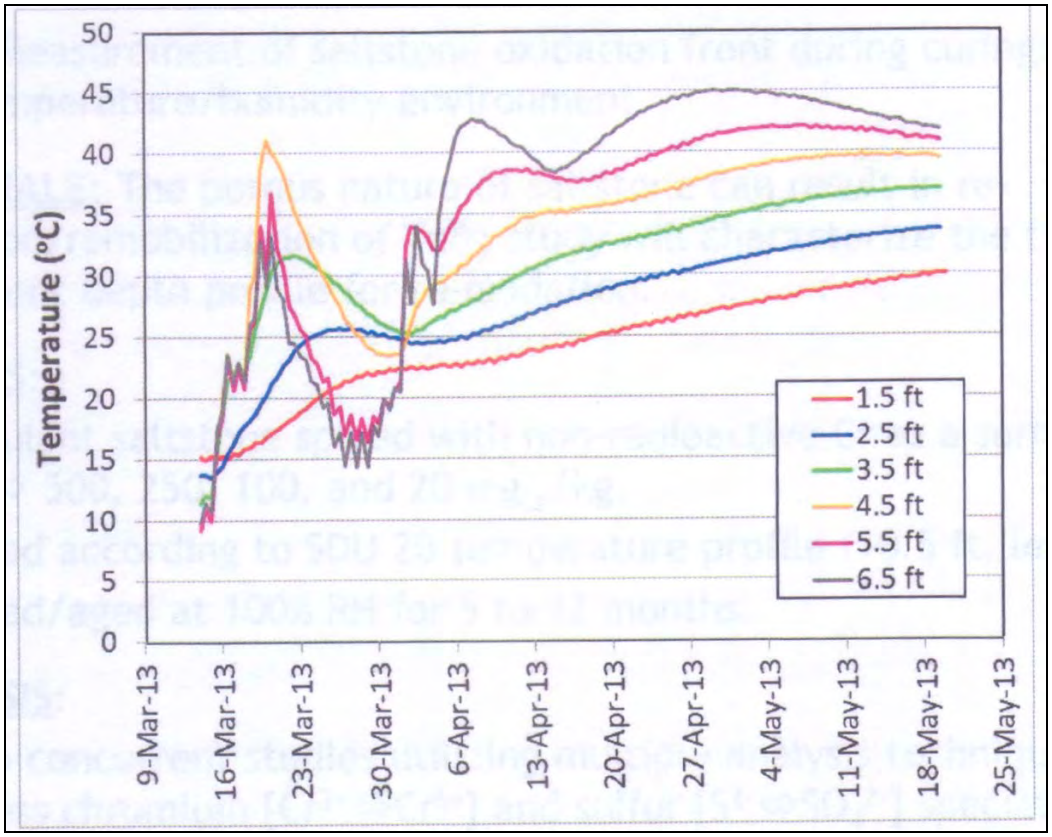


Figure 2.2. Actual temperatures recorded at different elevations in SDU2A. Plot was presented at the Tank Waste Integration Workshop-Cementitious Waste Forms, Richland, WA, July 24-25, 2013.

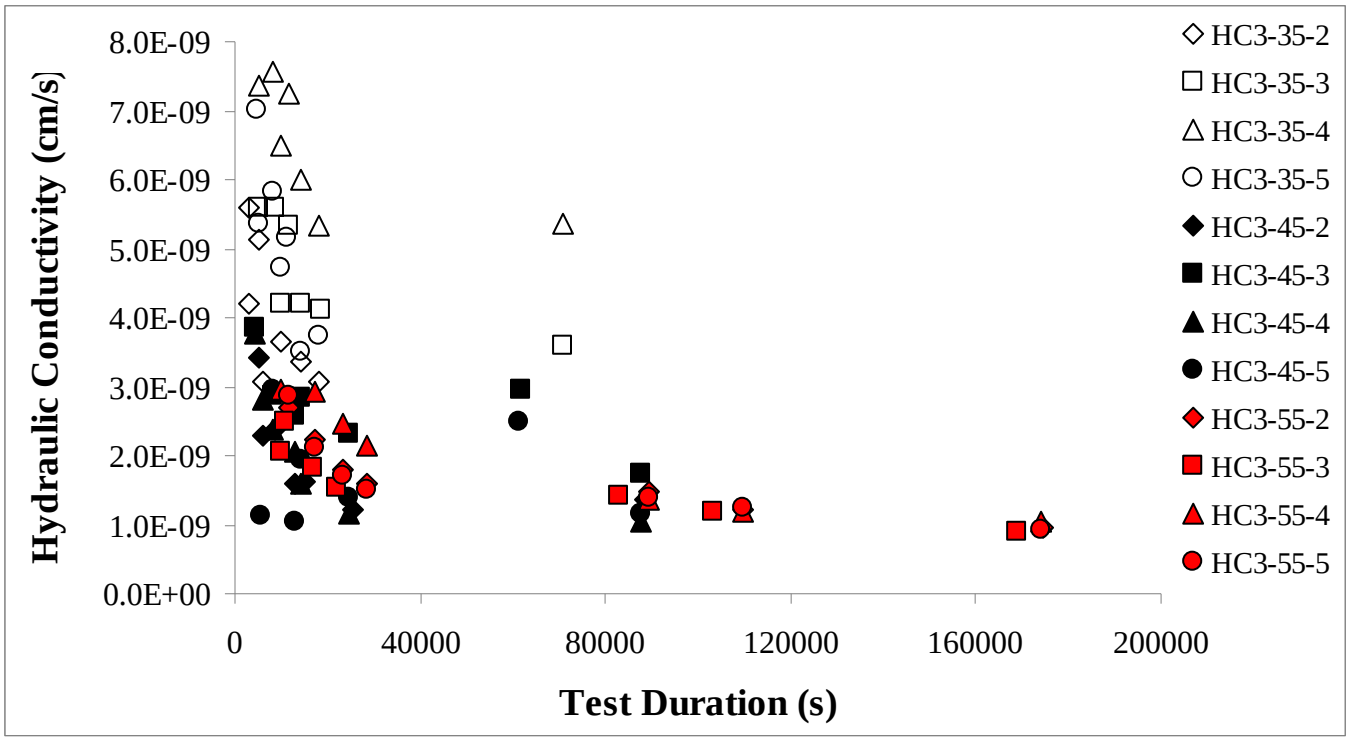


Figure 5.1. Hydraulic conductivity values of grouts cured for 28 days as a function of test time. Open symbols: *Temp1* (35°C) sample. Black symbols: *Temp2* (45°C) samples. Red symbols: *Temp3* (55°C) samples.

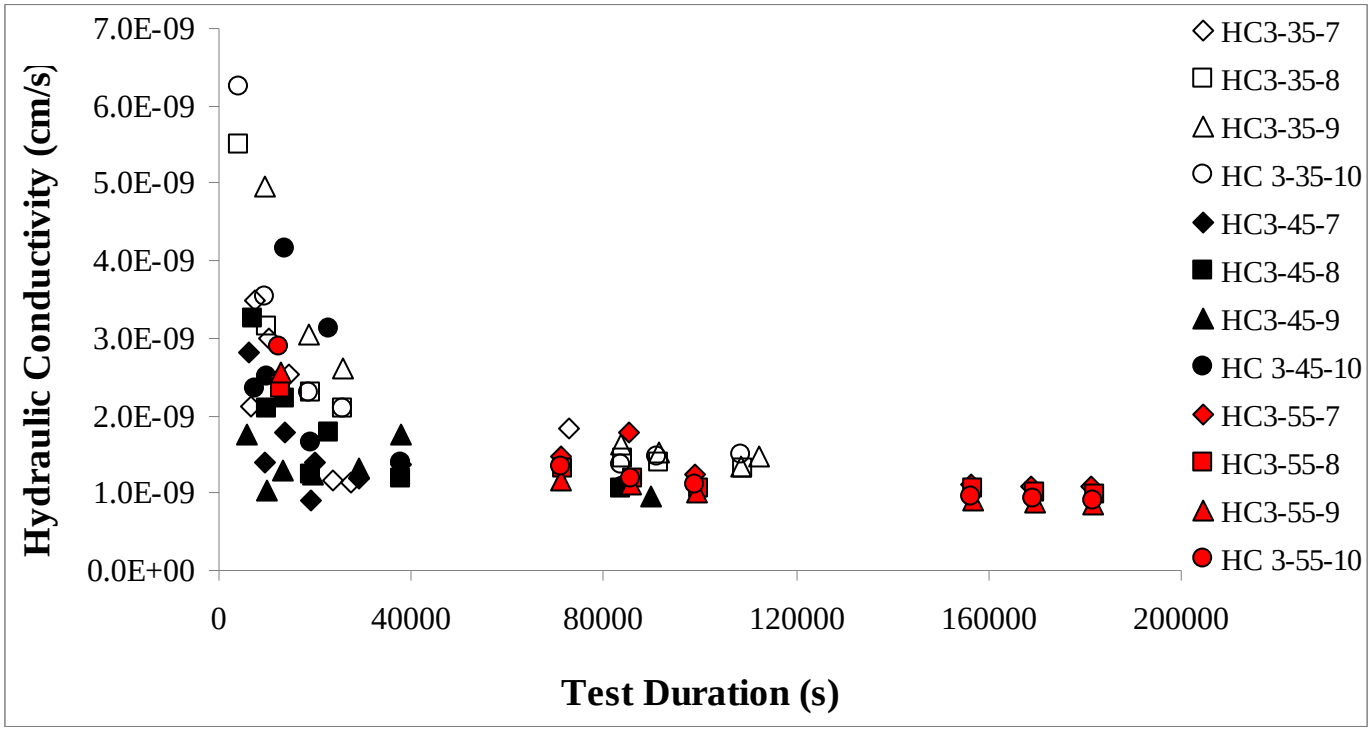


Figure 5.2. Hydraulic conductivity values of grouts cured for 90 days as a function of test time. Open symbols: *Temp1* (35ºC) sample. Black symbols: *Temp2* (45ºC) samples. Red symbols: *Temp3* (55ºC) samples.

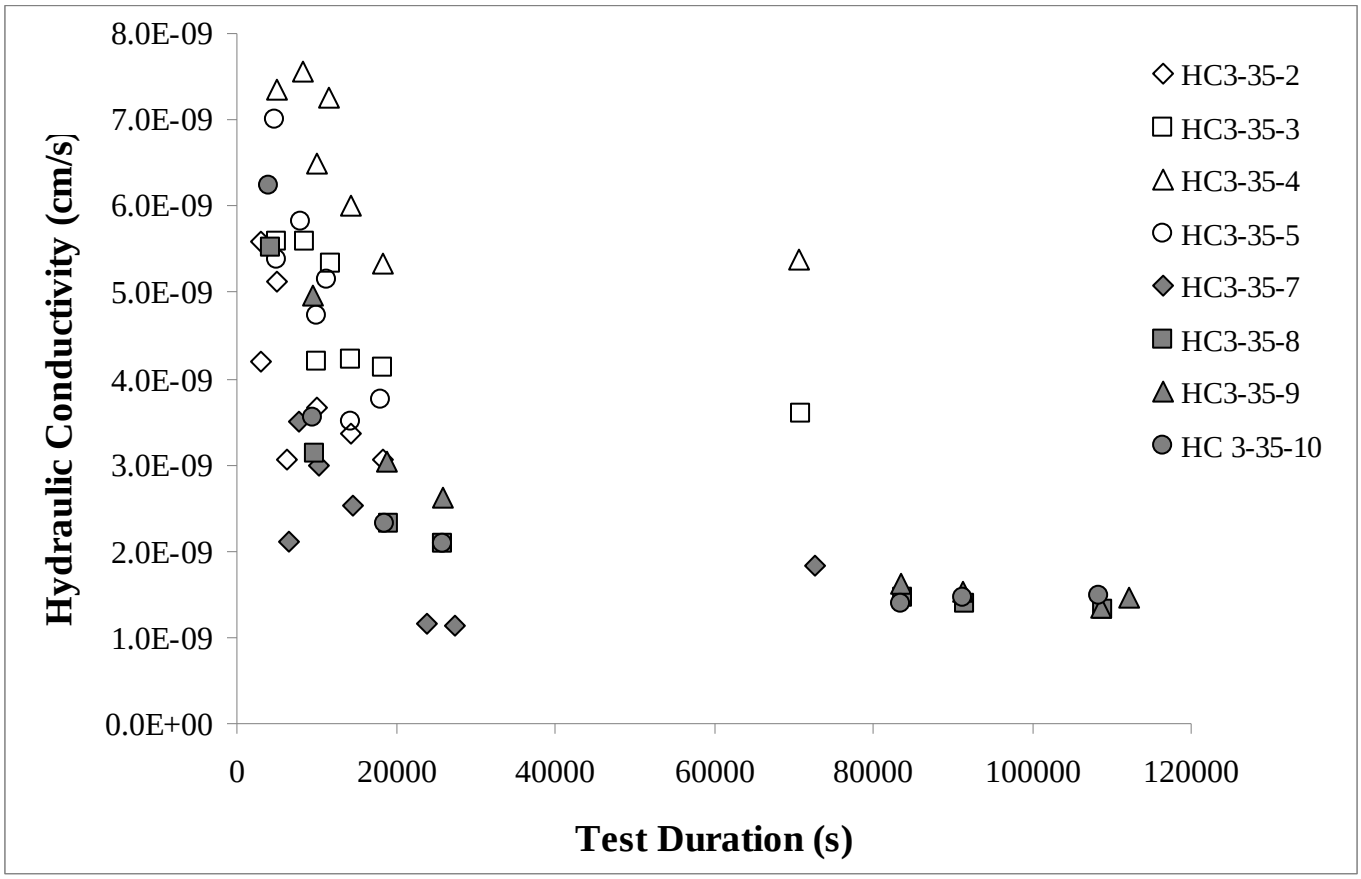


Figure 5.3. Comparison of hydraulic conductivity values of grouts cured for 28 days (open symbols) and 90 days (gray symbols) under the *Temp1* (35ºC) profile.

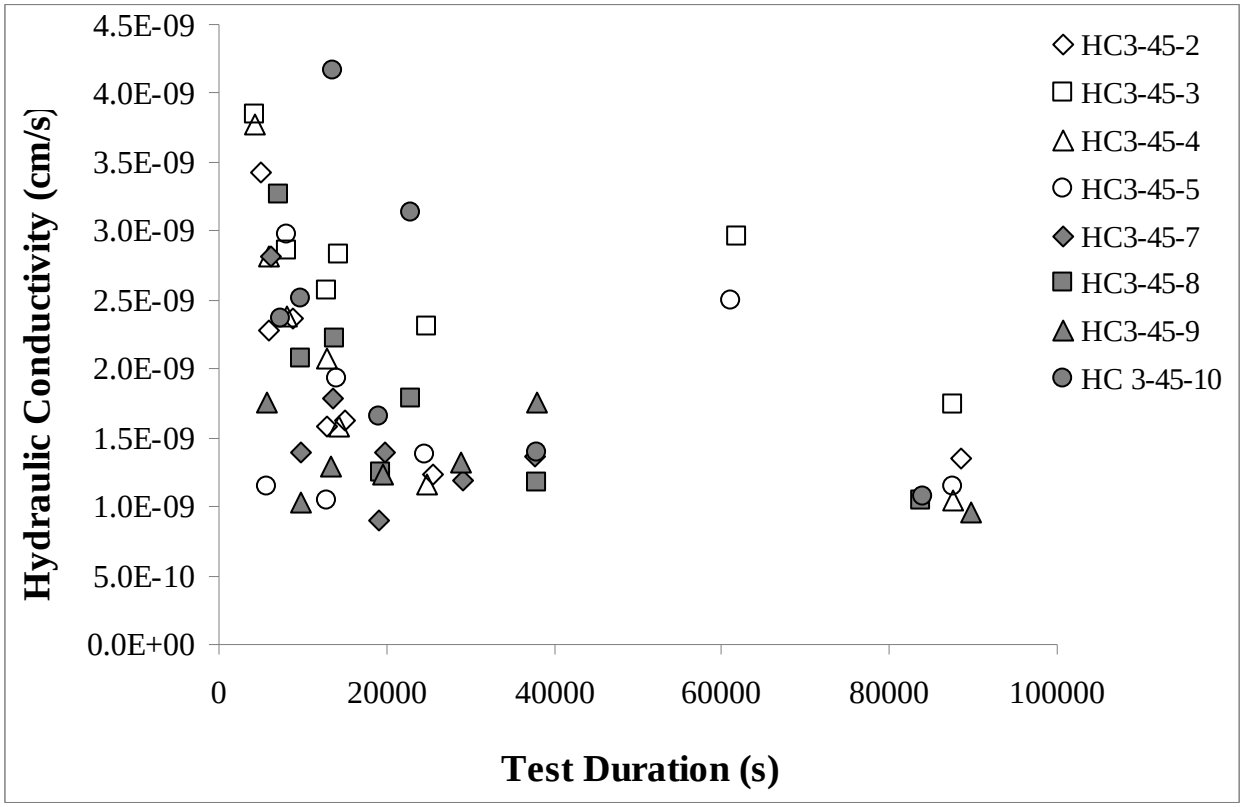


Figure 5.4. Comparison of hydraulic conductivity values of grouts cured for 28 days (open symbols) and 90 days (gray symbols) under the *Temp2* (45ºC) profile.

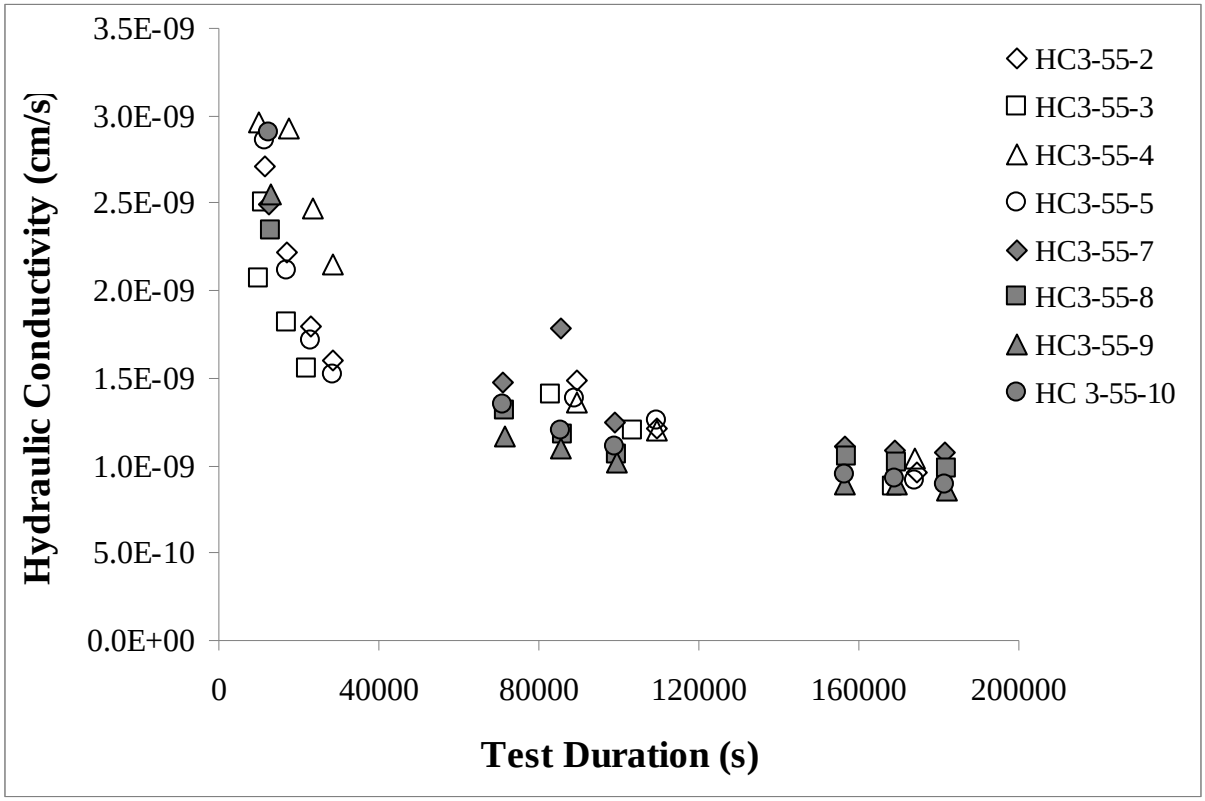


Figure 5.5. Comparison of hydraulic conductivity values of grouts cured for 28 days (open symbols) and 90 days (gray symbols) under the *Temp3* (55ºC) profile.

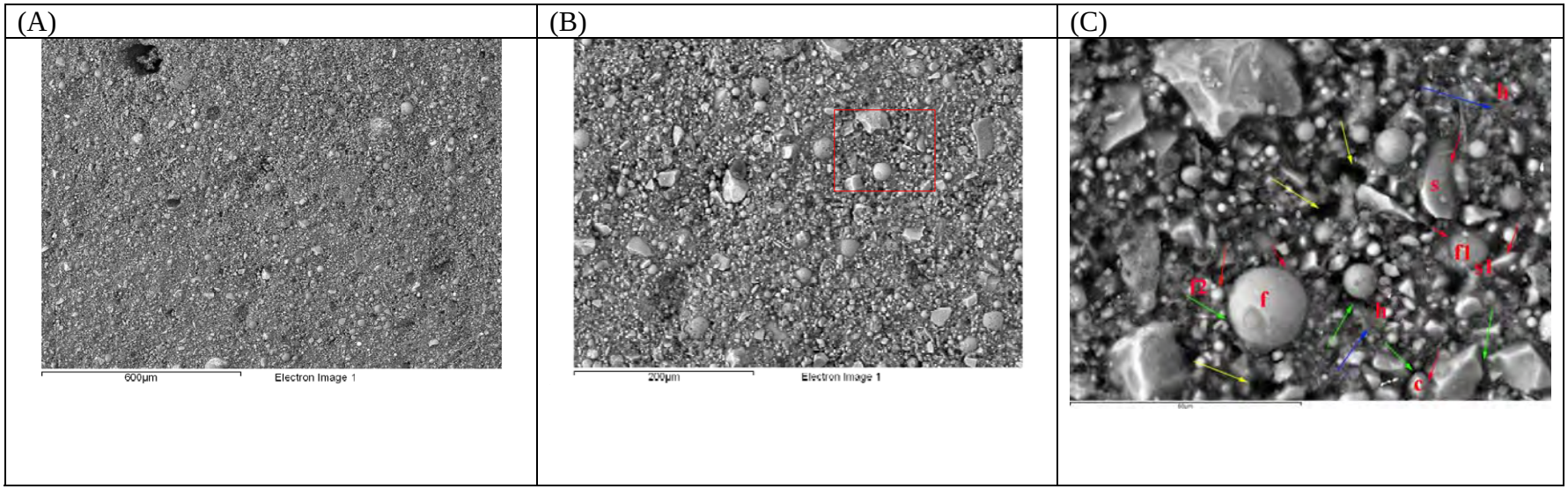


Figure 5.6. SEM images (BEI) of a specimen cured under the *Temp1* profile for 28 days (HC3-35C-1S) and viewed at three different magnifications. Scale bar = (A) 600 μm, (B) 200 μm, (C) 60 μm.
Red square in image (B) indicates the area of image (C).
f: FA, s: BFS, c: cement, h: hydrated product (CSH). Red arrows: surface layers due to particle dissolution or deposition of hydrated products. Yellow arrows: possible particle "pull outs". Green arrows: possible pores forming around unreacted particles. Blue arrows: pores within CSH matrix.

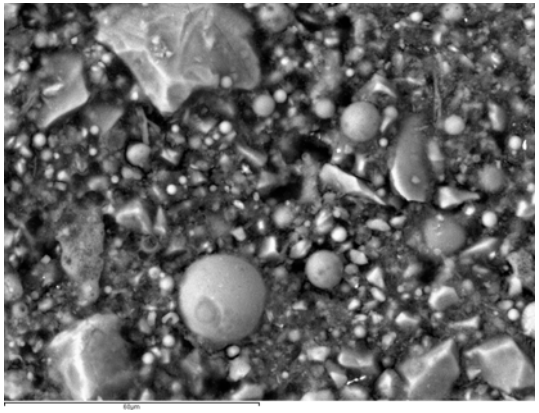
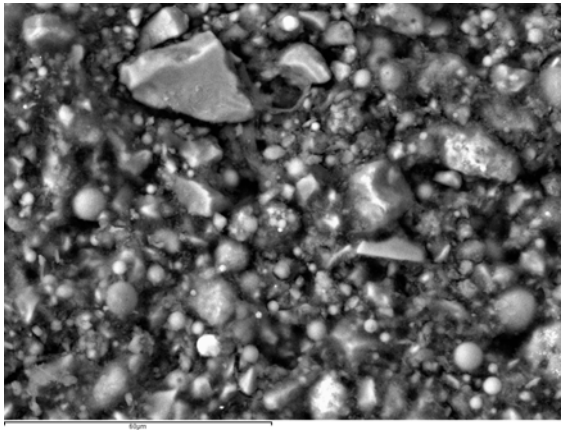
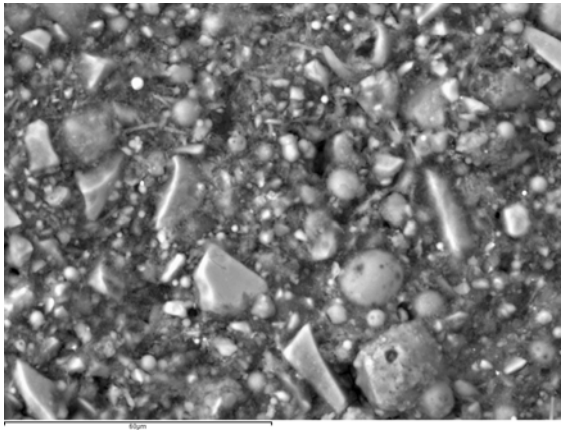
(A)	(B)	(C)
Site 4 	Site 5 	Site 6 

Figure 5.7. SEM images (BEI) of a specimen cured under the *Temp1* profile for 28 days (HC3-35-1S) at three different locations (60 μm scale bar).

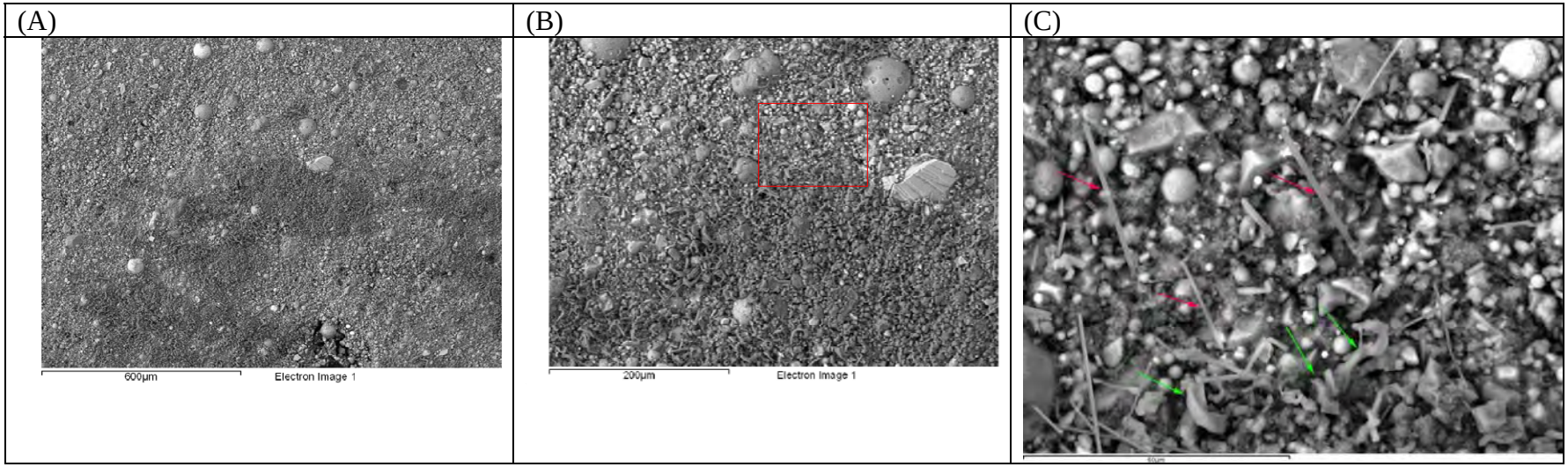


Figure 5.8. SEM images (BEI) of a specimen cured under the *Temp2* profile for 28 days (HC3-45-1S) and viewed at three different magnifications. Scale bar = (A) 600 µm, (B) 200 µm, (C) 60. Red square in image (B) indicates the area of image (C). Red Arrows: Needle-like crystals. Green Arrows: Crystals of twisted morphology.

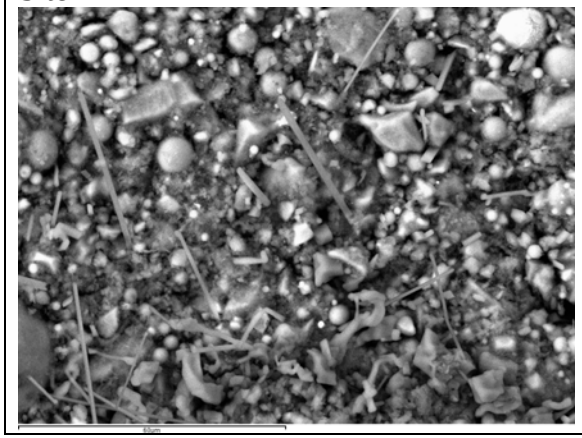
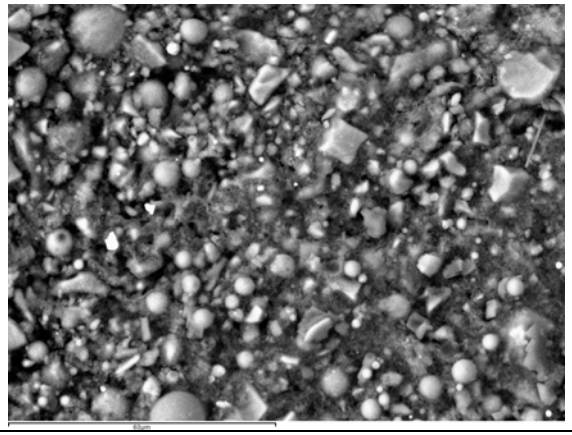
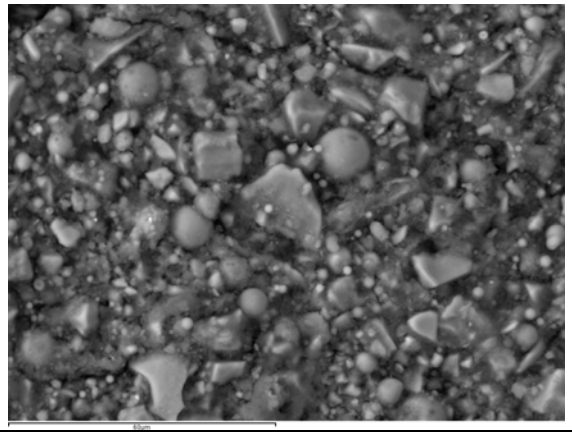
(A)	(B)	(C)
Site 4	Site 5	Site 6
		

Figure 5.9. SEM images (BEI) of a specimen cured under the *Temp2* profile for 28 days (HC3-45-1S) (60 μm scale bar).

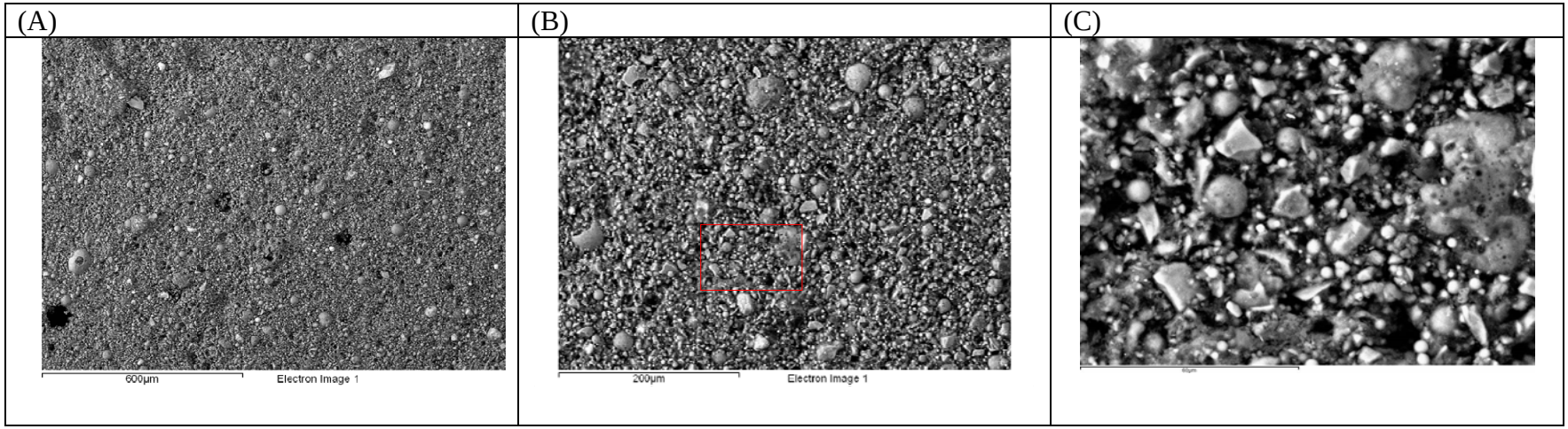


Figure 5.10. SEM images (BEI) of a specimen cured under the *Temp3* profile for 28 days (HC3-55-1S) and viewed at three different magnifications. Scale bar = (A) 600 µm, (B) 200 µm, (C) 60 µm.
Red square in image (B) indicates the area of image (C).

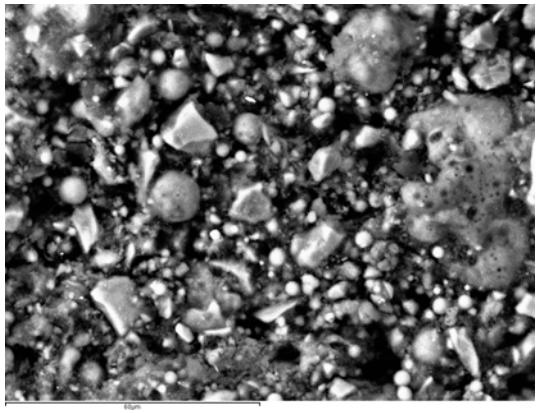
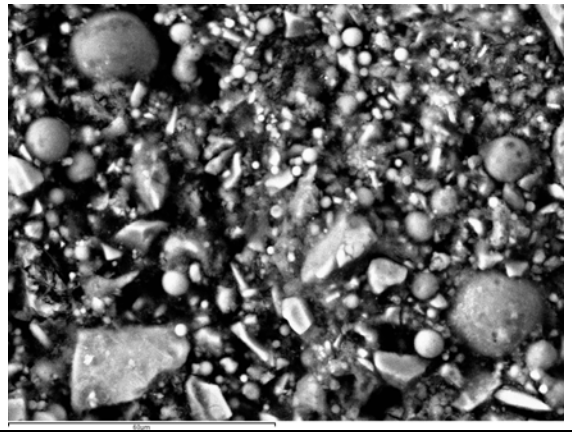
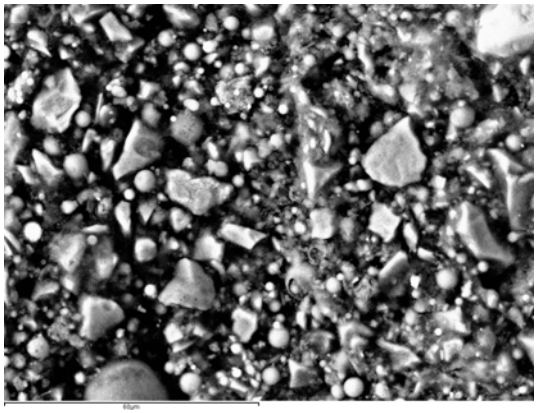
(A)	(B)	(C)
Site 4 	Site 5 	Site 6 

Figure 5.11. SEM images (BEI) of a specimen cured under the *Temp3* profile for 28 days (HC3-55-1S) (60 μm scale bar).

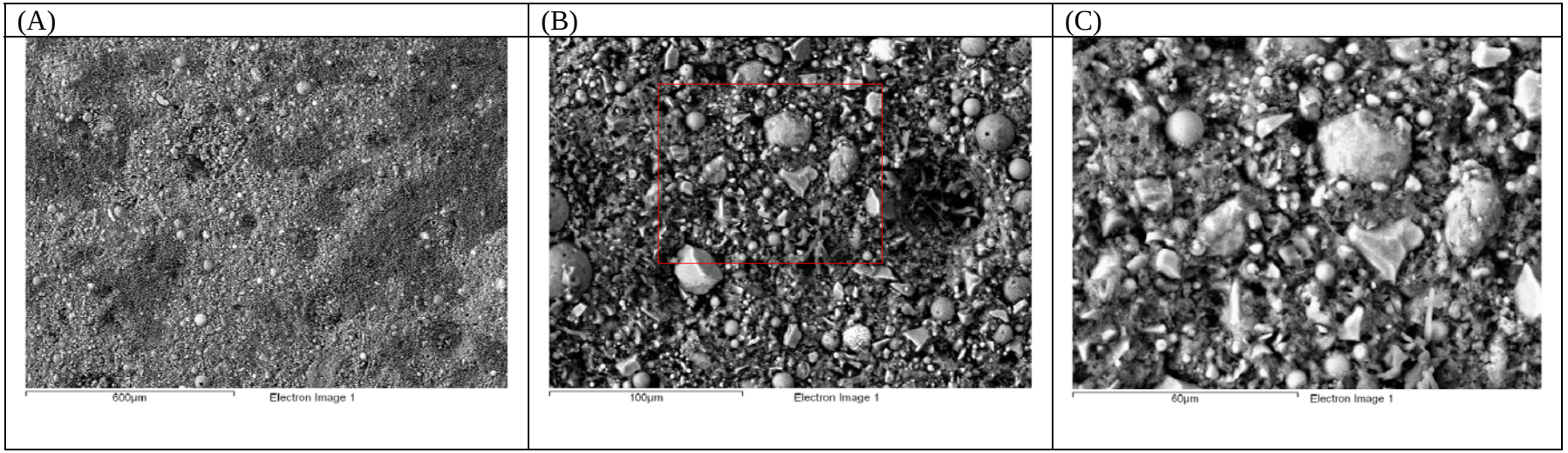


Figure 5.12. SEM images (BEI) of a specimen cured under the *Temp1* profile for 90 days (HC3-35-6) and viewed at three different magnifications. Scale bar = (A) 600 µm, (B) 100 µm, (C) 60 µm.
Red square in image (B) indicates the area of image (C).

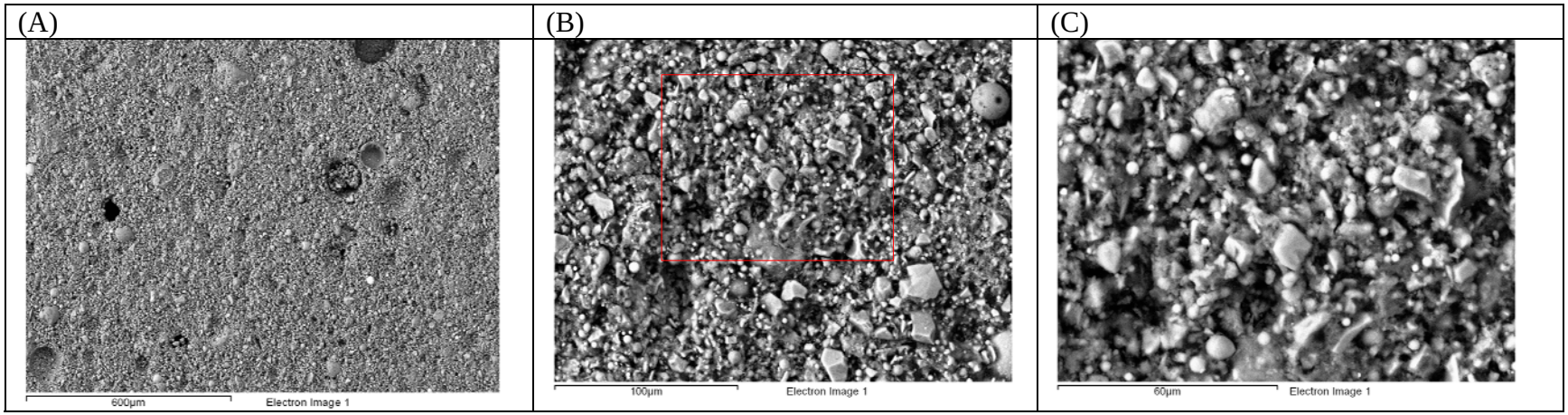


Figure 5.13. SEM images (BEI) of a specimen cured under the *Temp2* profile for 90 days (HC3-45-6) and viewed at three different magnifications. Scale bar = (A) 600 µm, (B) 100 µm, (C) 60 µm.
Red square in image (B) indicates the area of image (C).

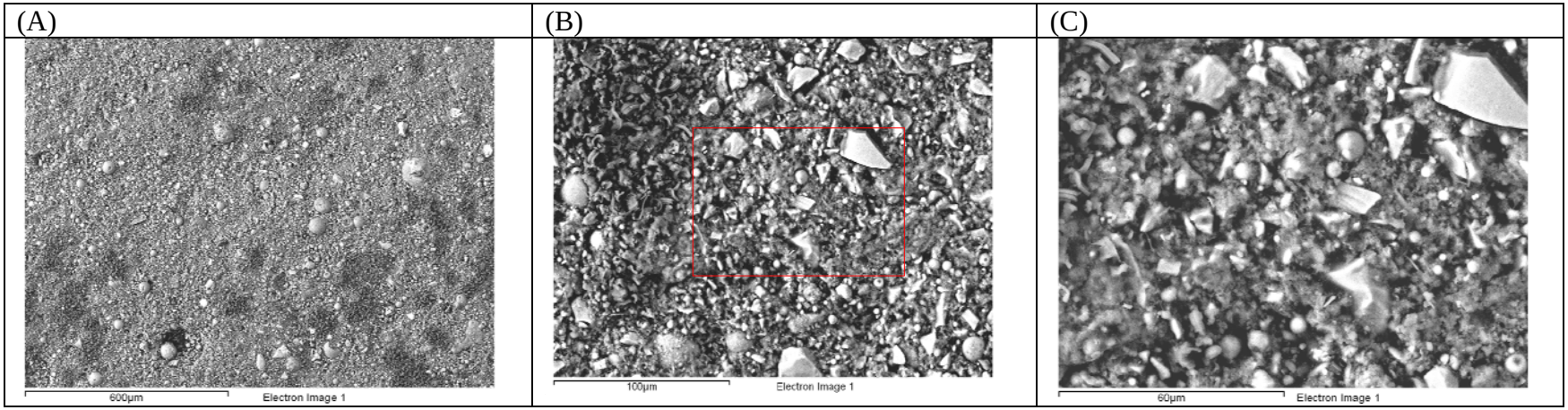


Figure 5.14. SEM images (BEI) of a specimen cured under the *Temp3* profile for 90 days (HC3-55-6) and viewed at three different magnifications. Scale bar = (A) 600 µm, (B) 100 µm, (C) 60 µm.
Red square in image (B) indicates the area of image (C).

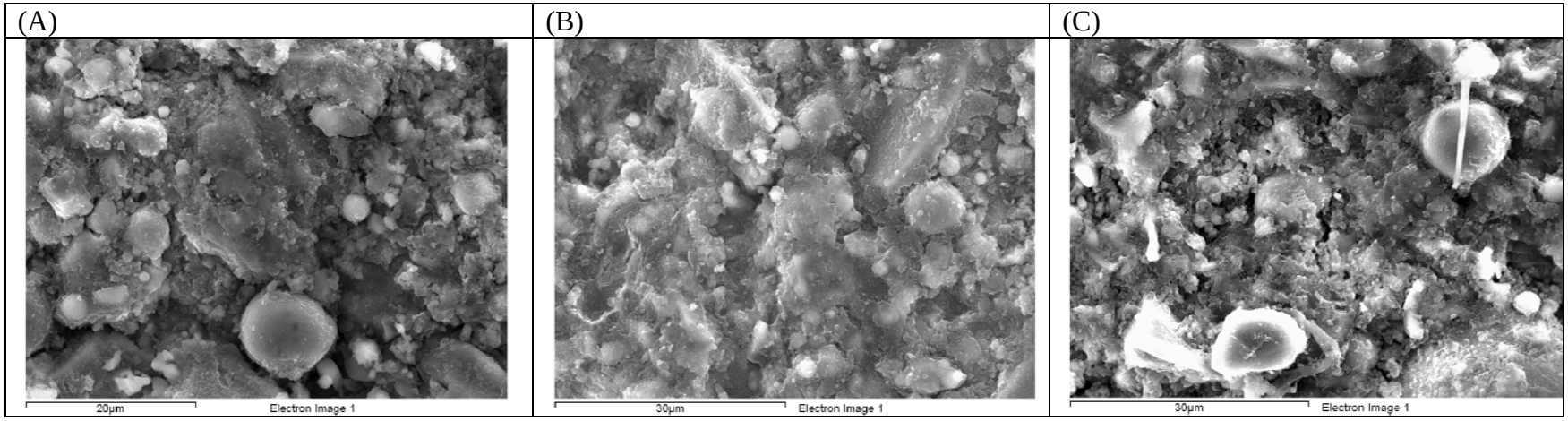


Figure 5.15. SEM images of specimens cured under the *Temp1* (A), *Temp2* (B) or *Temp3* (C) profile for 90 days and viewed in the SEI mode.

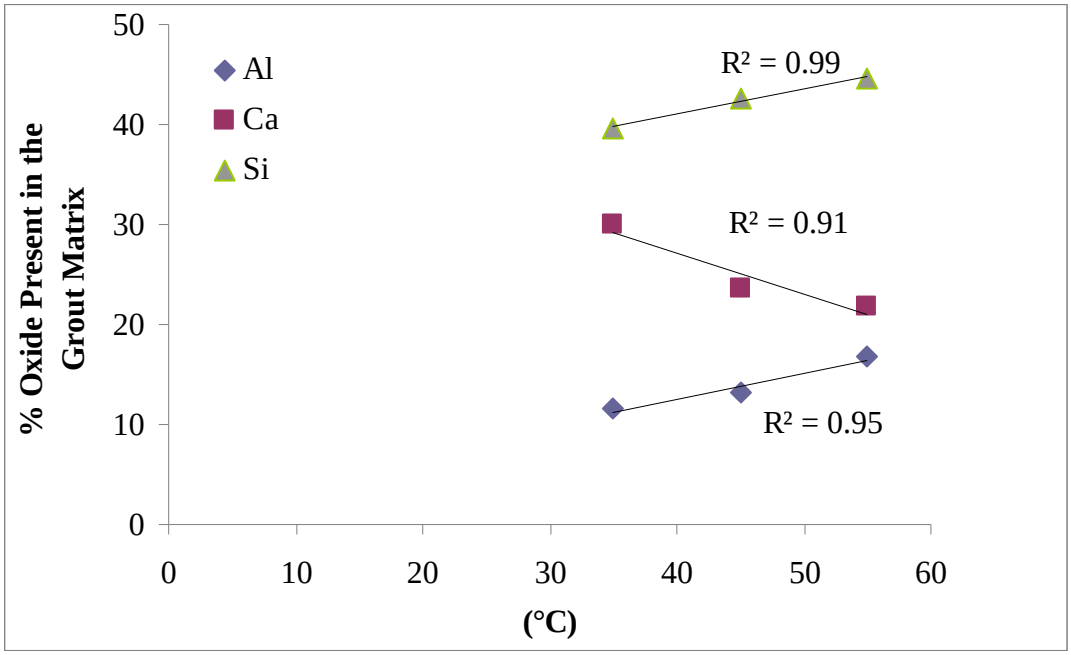


Figure 5.16. Al_2O_3, CaO, and SiO_2 composition (wt%) of the matrix found in the 28-day cured grouts as a function of the maximal profile temperature.

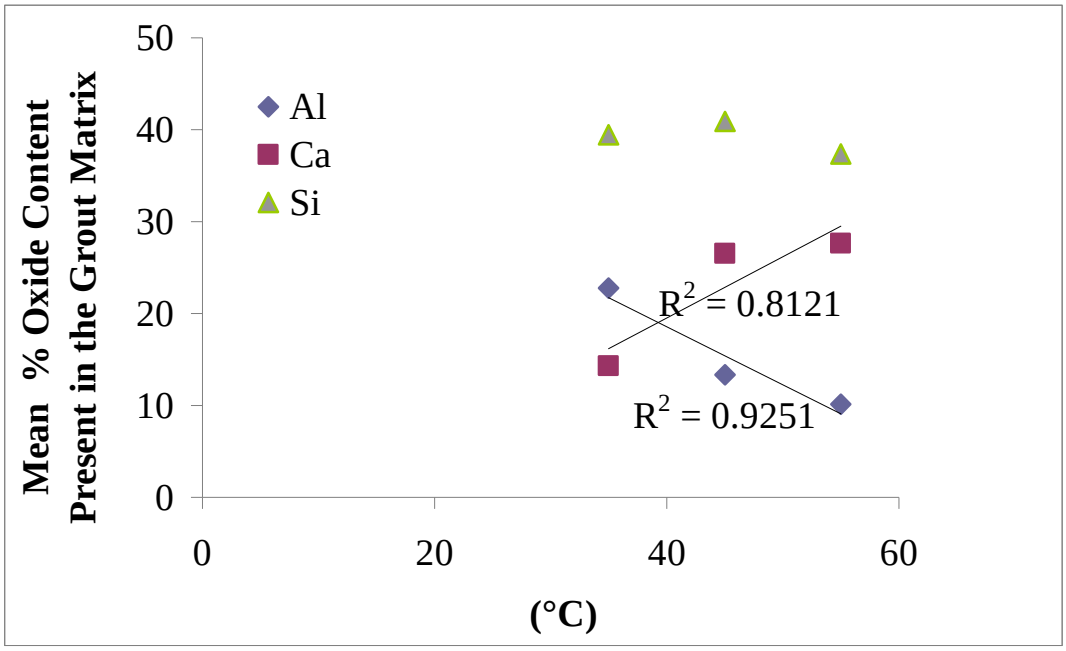


Figure 5.17. Al_2O_3, CaO, and SiO_2 composition (wt%) of the matrix found in the 90-day cured grouts as a function of the maximal profile temperature.

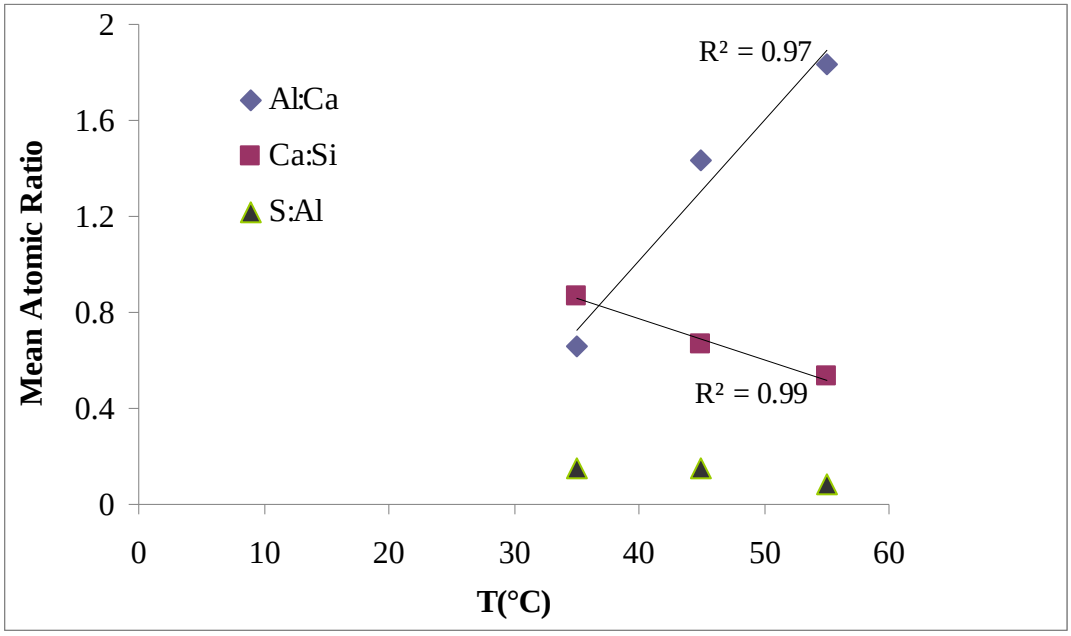


Figure 5.18. Atomic ratios found in the matrices of grouts cured under different temperature profiles for 28 days as a function of the maximal profile temperature.

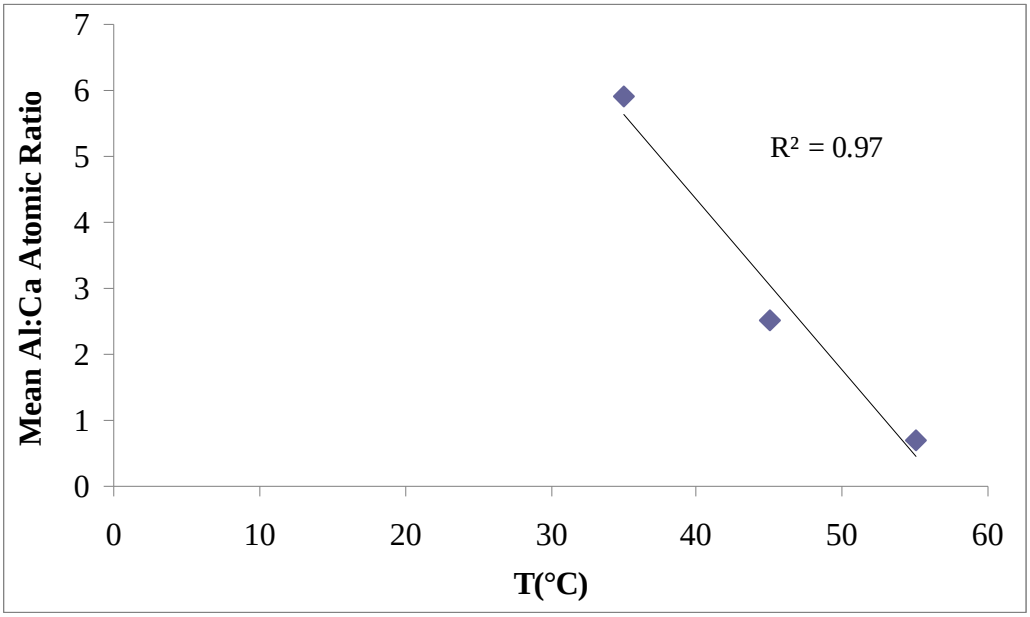


Figure 5.19. Al:Ca atomic ratios found in the matrices of grouts cured under different temperature profiles for 90 days as a function of the maximal profile temperature.

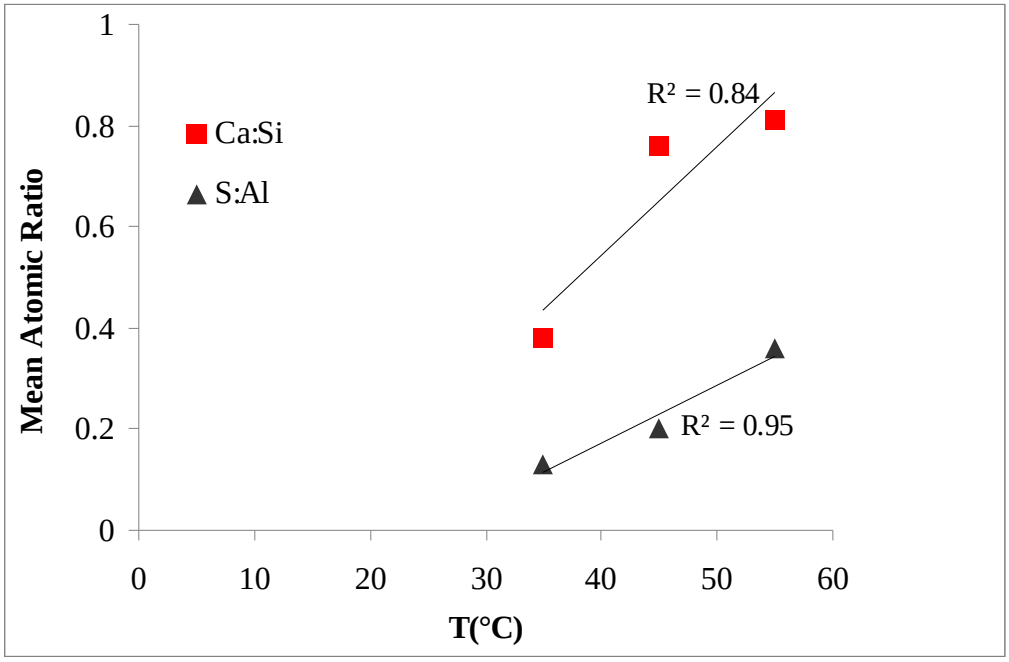


Figure 5.20. Atomic ratios found in the matrices of grouts cured under different temperature profiles for 90 days as a function of the maximal profile temperature.

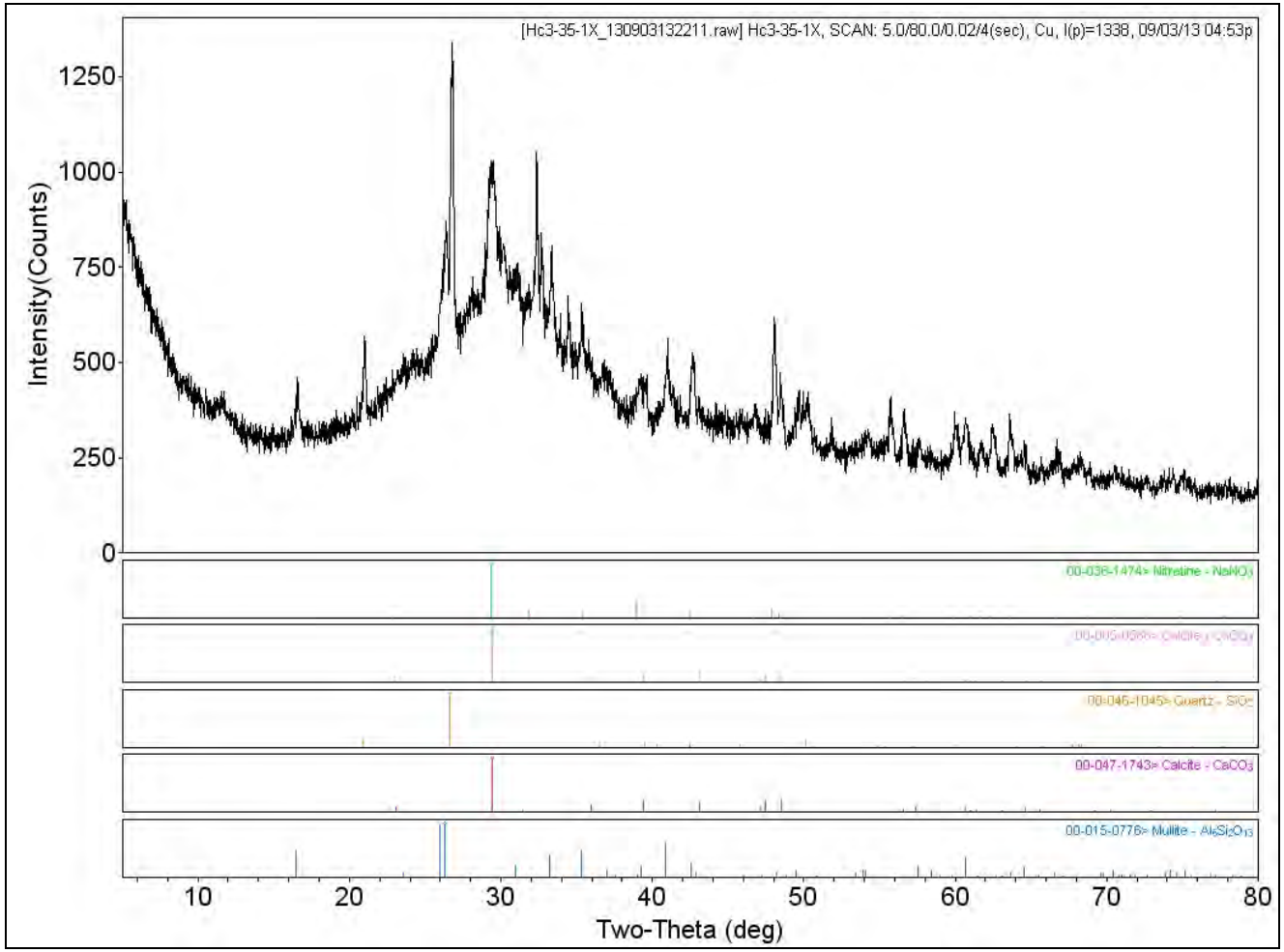


Figure 5.21. XRD diffractogram of a *Temp1* sample cured for 28 days. Possible crystalline phase are indicated.

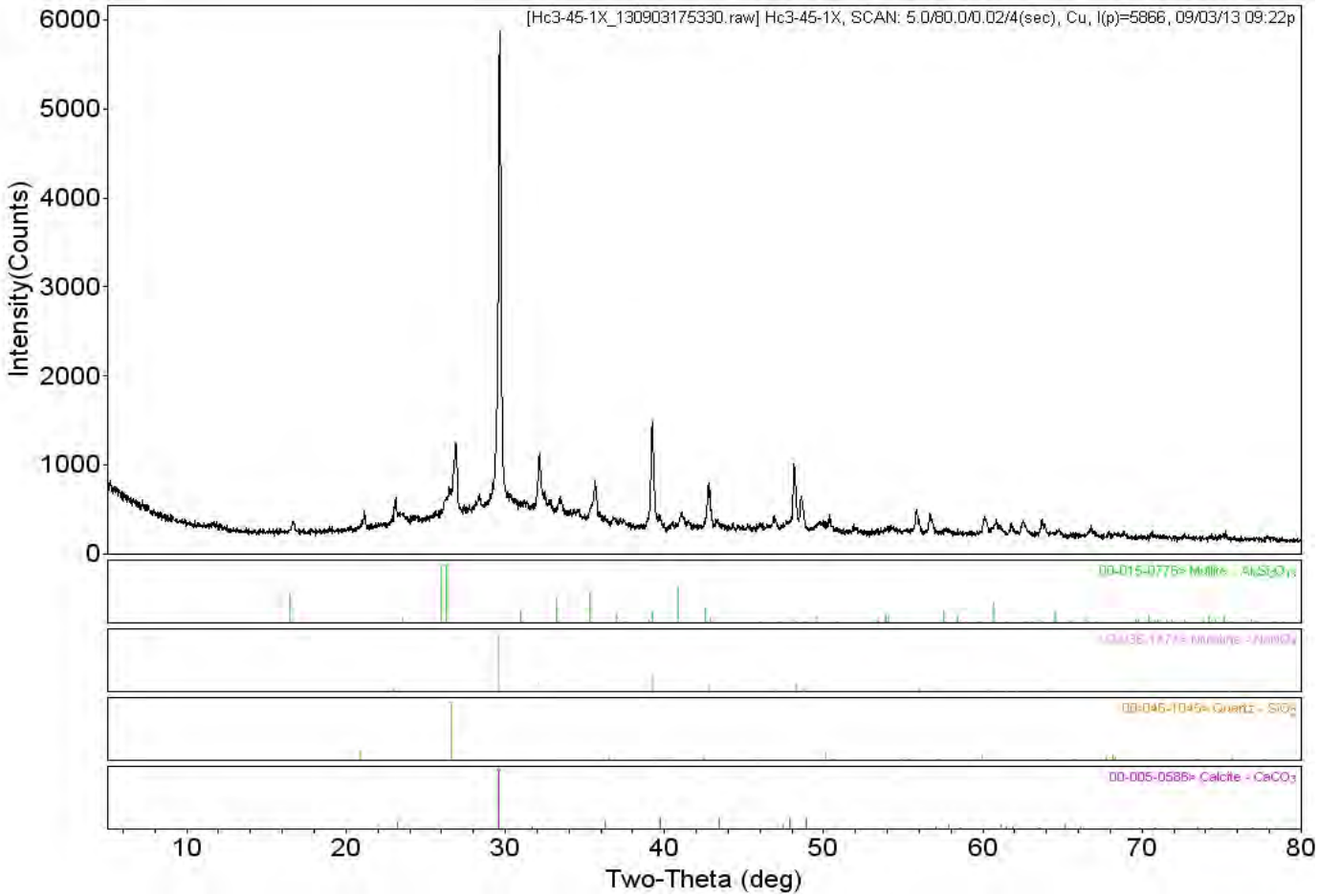


Figure 5.22. XRD diffractogram of a *Temp2* sample cured for 28 days. Possible crystalline phase are indicated.

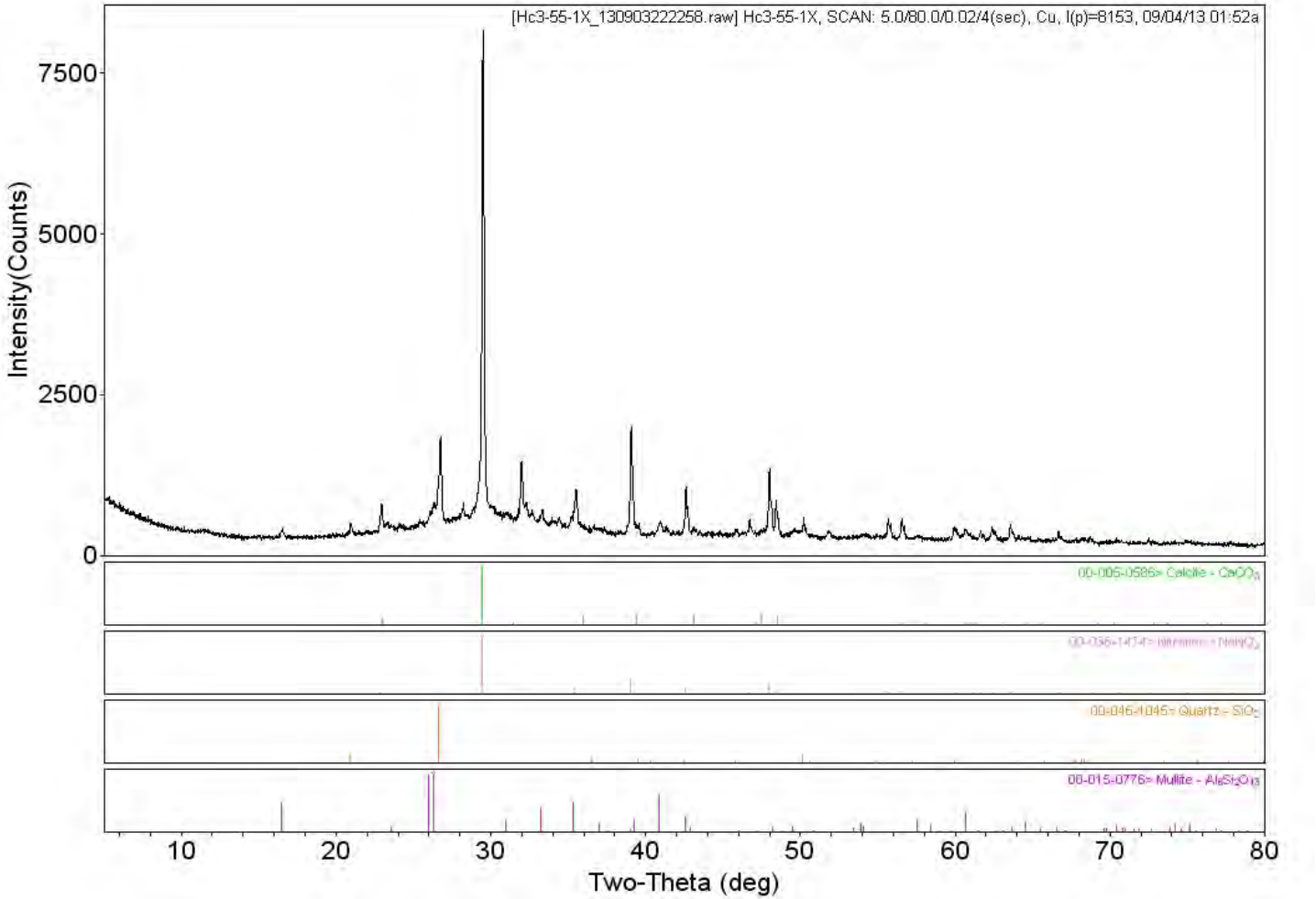


Figure 5.23. XRD diffractogram of a *Temp3* sample cured for 28 days. Possible crystalline phase are indicated.

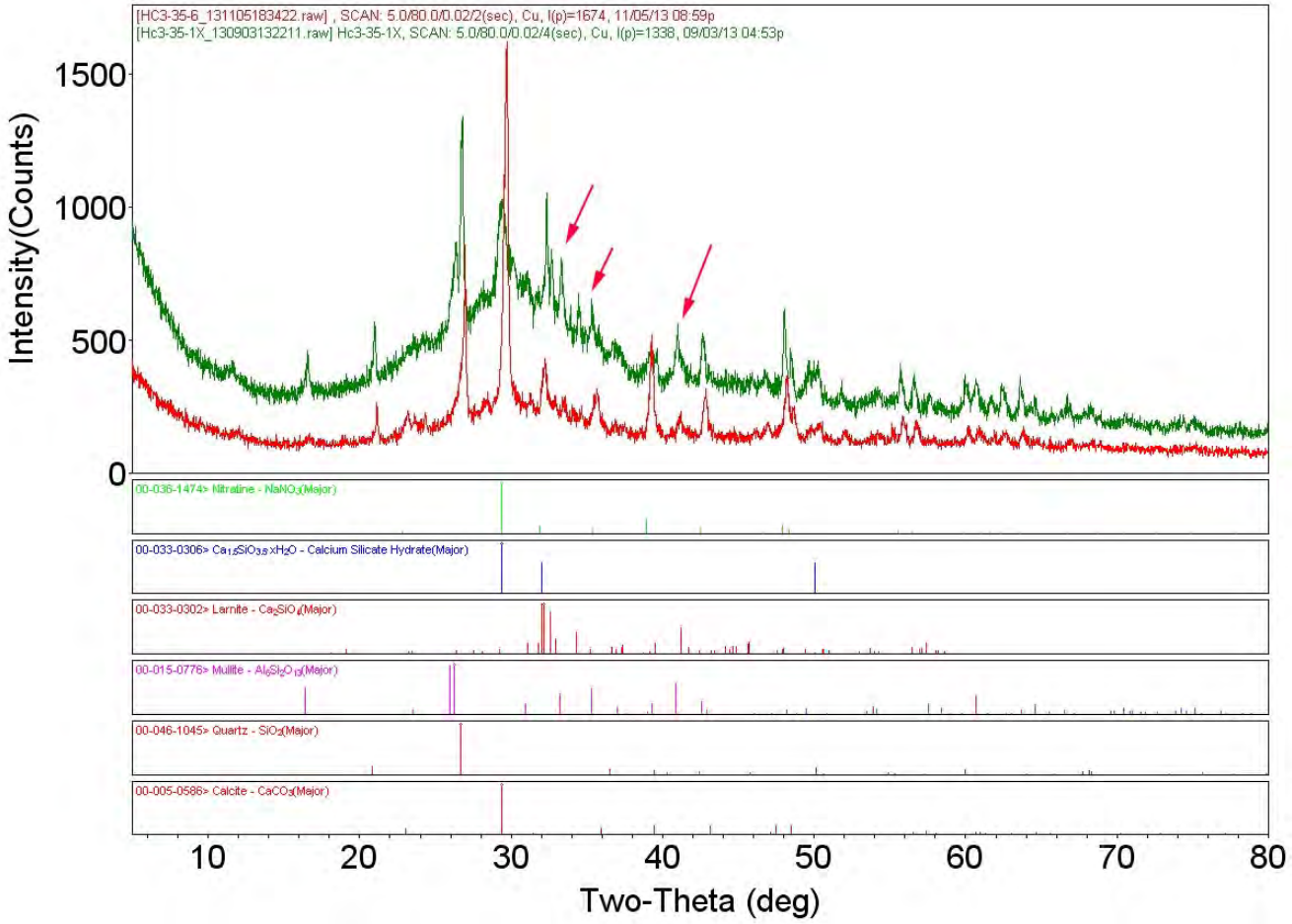


Figure 5.24. Comparison of the XRD diffractograms of grouts cured under the *Temp1* profile for 28 days (green line) or 90 days (red line). Possible crystalline phase are indicated. Arrows indicate areas of difference between the spectra.

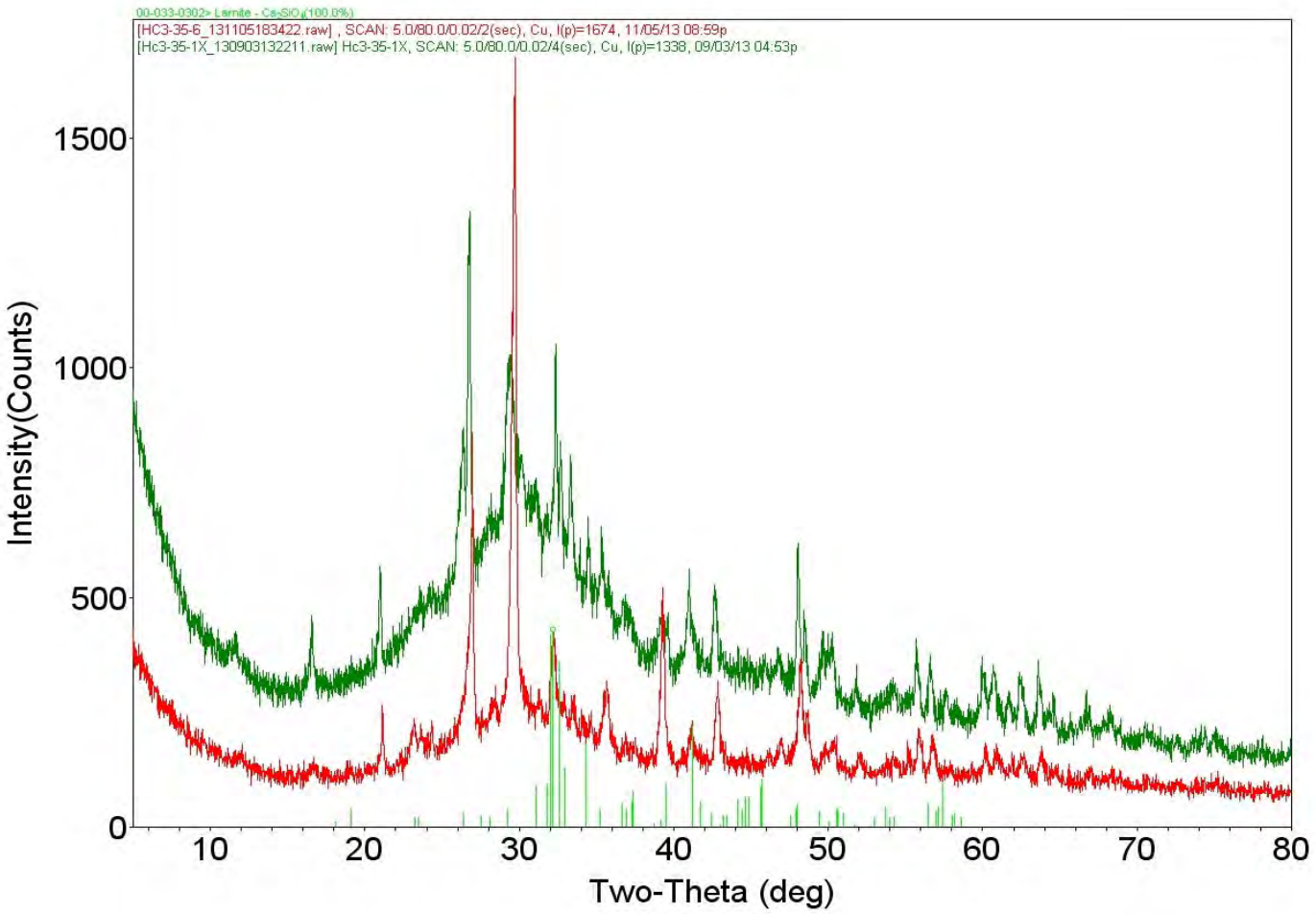


Figure 5.25. Comparison of the XRD diffractograms of grouts cured under the *Temp1* profile for 28 days (green line) or 90 days (red line). The spectrum of larnite (Ca_2SiO_4) is shown.

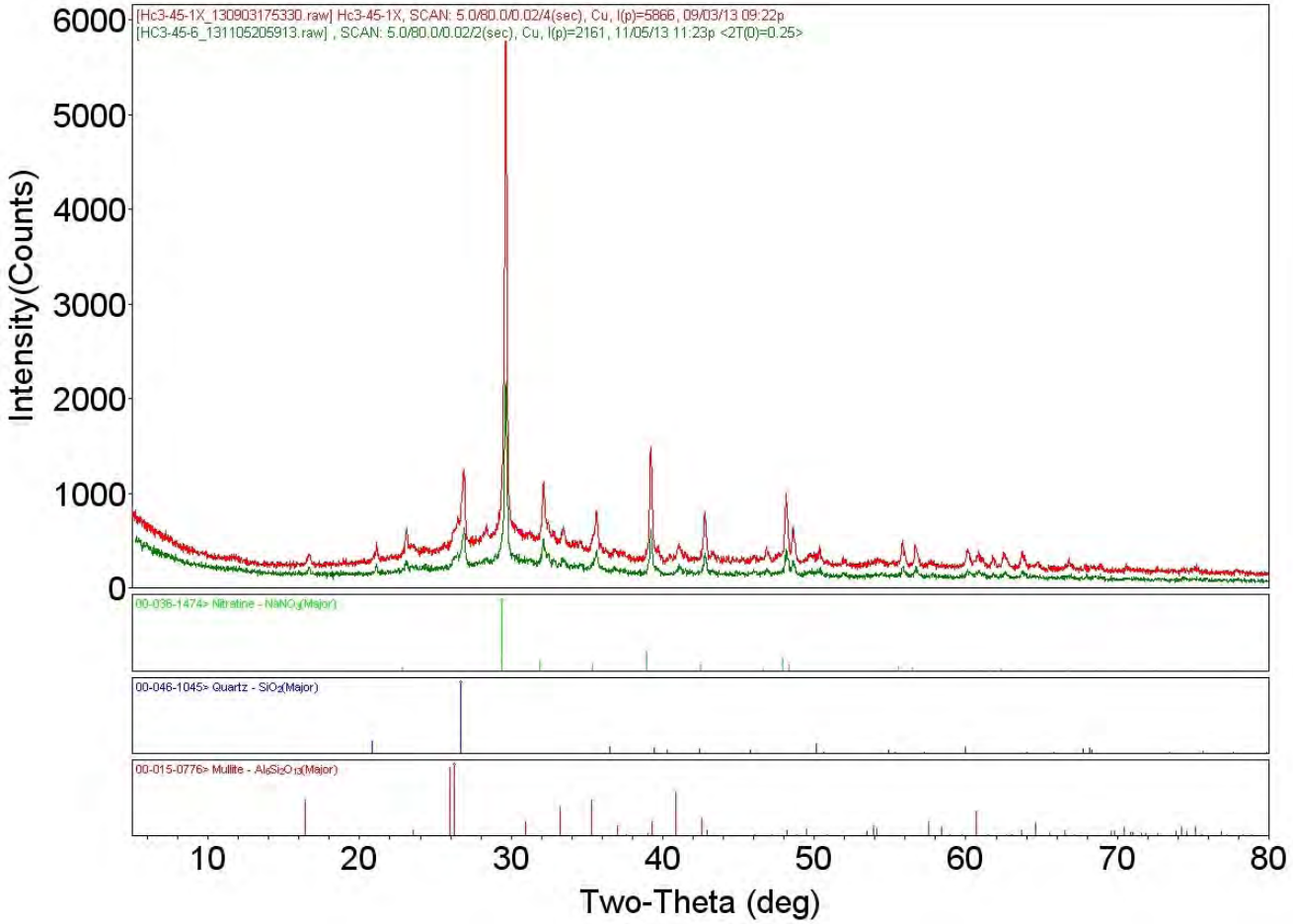


Figure 5.26. Comparison of the XRD diffractograms of grouts cured under the *Temp2* profile for 28 days (red line) or 90 days (green line). Major crystalline phases are indicated.

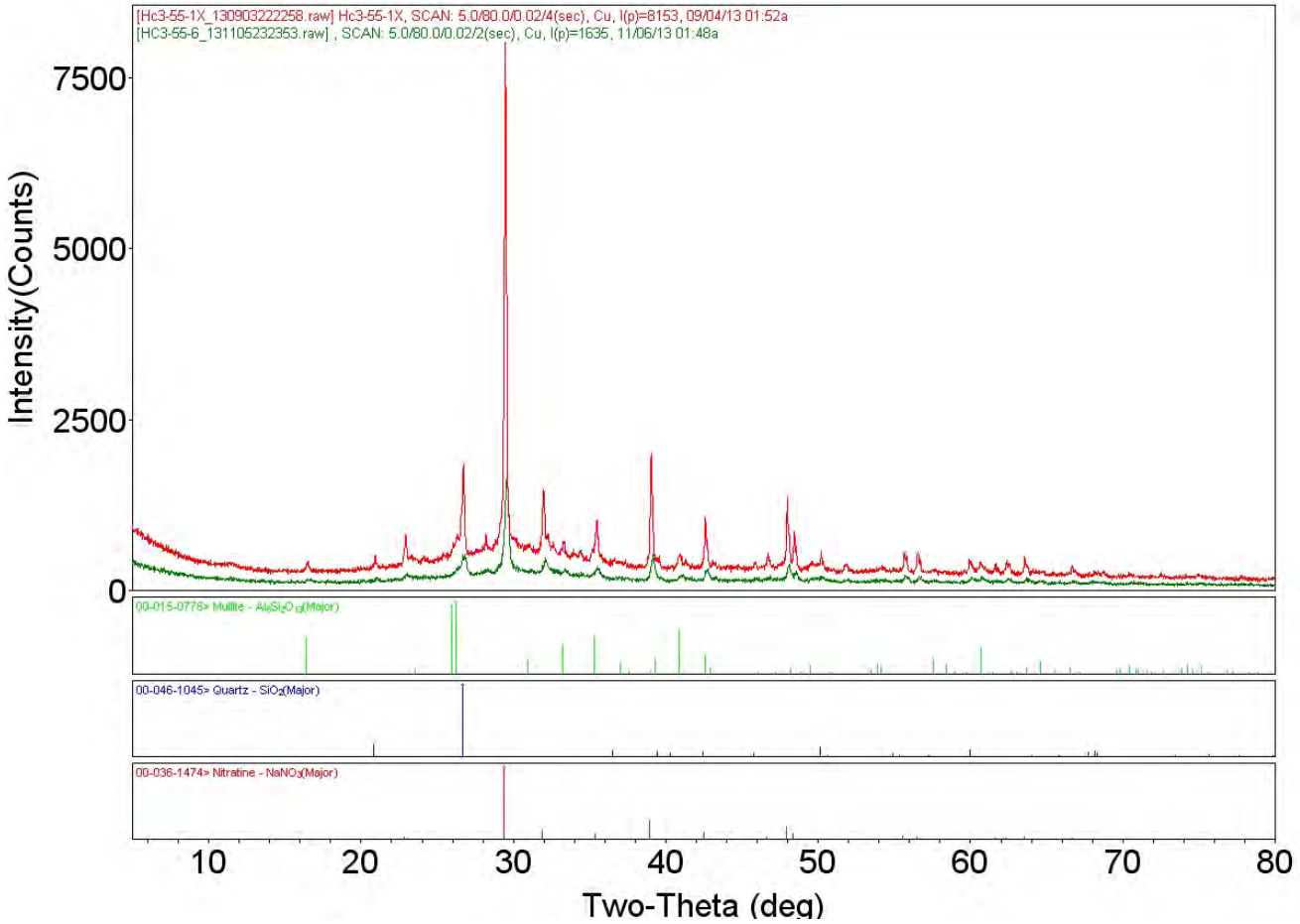


Figure 5.27. Comparison of the XRD diffractograms of grouts cured under the *Temp3* profile for 28 days (red line) or 90 days (green line). Major crystalline phases are indicated.

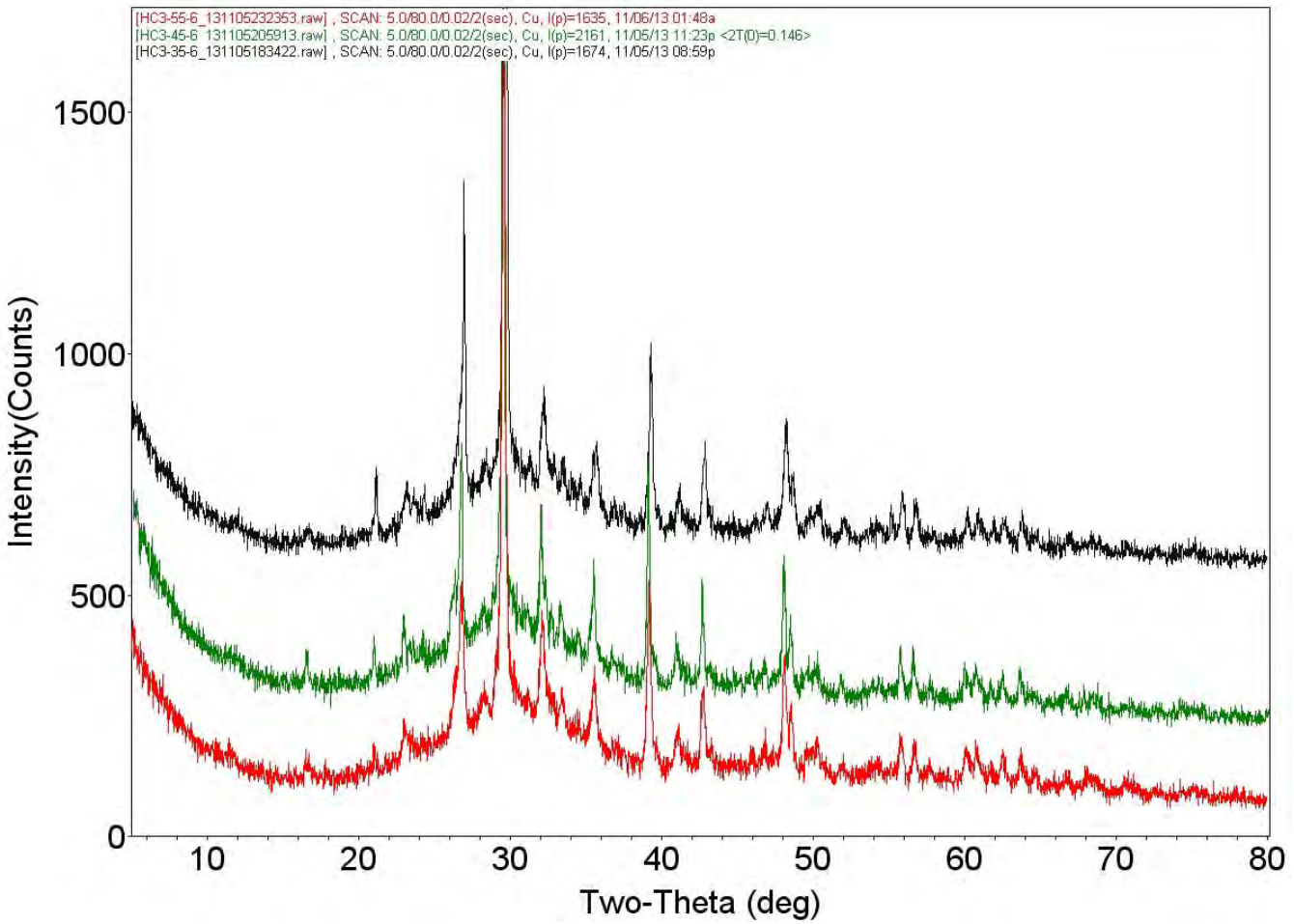


Figure 5.28. Comparison of XRD diffractograms of grouts cured for 90 days. Black line: *Temp1*. Green line: *Temp2*. Red line: *Temp3*.

APPENDIX A

HYDRAULIC CONDUCTIVITY MEASUREMENTS OF SAMPLES CURED FOR 28 DAYS

September 27, 2013

The Catholic University of America
Vitreous State Laboratory
Cardinal Station
Hannan Hall #32
Washington D.C. 20064

Attention: Mr. Weiliang Gong

Subject:: **Report of Laboratory Hydraulic Conductivity Tests/Certificate of Conformance**
VSL Req# 37596/CUA PO0000079566, 8/5/2013
AMEC Project Name: CUA Grout Sample Testing
AMEC Project Number: 6163-13-0012

Dear Mr. Gong:

AMEC Environment & Infrastructure, Inc. (AMEC) has completed the first group of 12 hydraulic conductivity tests for the above referenced project. The test results are included in Attachment 1. An equipment list used in testing is included in Attachment 2. The equipment was calibrated in accordance with the applicable requirements of AMEC's Nuclear Quality Assurance Program and was NIST traceable. The tests performed are listed below along with applicable procedure:

Hydraulic Conductivity	Modified ASTM D5084-10

We hereby certify that the services supplied under this VSL Req# 37596/CUA PO0000079566 were performed in accordance with the applicable requirements of AMEC's Nuclear Quality Assurance Program and the requirements of the subject Contract VSL Req# 37596/CUA PO0000079566.

Please contact us if you have any questions.

AMEC Environment & Infrastructure, Inc.

Technical Lead — Jianren Wang — Date: 9/27/13

Project Manager — geoffrey.hebner@amec.com — Digitally signed by geoffrey.hebner@amec.com DN: cn=geoffrey.hebner@amec.com Date: 2013.09.27 15:50:30 -04'00' — Geoffrey Hebner — Date:

Quality Assurance Representative — JDM — Digitally signed by John D Martin 2013.09.27 16:35:39 -04'00' — John D. Martin — Date:

AMEC Environment & Infrastructure
396 Plasters Avenue, NE • Atlanta, GA 30324 • Phone: 404-873-4761 • Fax: 404-817-0221
AMEC.com

Attachment 1

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*9/6/2013*
Boring No.	*ST-HC3-35-2*	Reviewed By	JEJ
Sample No.	*ST-HC3-35-2*	Review Date	*9/27/13*
Sample Depth	*N/A*	Lab No.	*12340*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.7*
Wet Unit Weight, pcf:	*108.3*
Dry Unit Weight, pcf:	*74.8*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***4.0E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-35-2	Reviewed By	JFF
Sample No.	ST-HC3-35-2	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12340
Sample Description	Grout Core		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	V-25
Location 1	2.776	Location 1	2.004	Wet Soil+Pan, grams	266.10
Location 2	2.757	Location 2	2.008	Dry Soil + Pan, grams	186.46
Location3	2.767	Location 3	2.011	Pan Weight, grams	14.43
Average	2.767	Average	2.008	Moisture Content, %	46.3
Volume, in^3	8.76	Wet Soil + Tare, grams	248.90	Dry Unit Weight, pcf	74.8
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	110.9
Soil Sample Wt., g	248.90	Dry Soil +Tare, grams	172.03	Diameter, in.	N/A
Dry UW, pcf	74.8	Moisture Content, %	44.7	Length, in.	N/A
Saturation, %	107.1			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
2940	2.10	27.00	26.50	0.50	22.6	44.5	43.6	5.94E-09	5.58E-09
3000	2.10	28.00	27.60	0.40	22.6	46.3	45.6	4.46E-09	4.19E-09
6180	2.10	28.00	27.40	0.60	22.6	46.3	45.2	3.26E-09	3.07E-09
5040	2.10	24.50	23.80	0.70	22.4	40.1	38.8	5.42E-09	5.12E-09
10140	2.10	24.50	23.50	1.00	22.4	40.1	38.2	3.88E-09	3.66E-09
14400	2.10	24.50	23.20	1.30	22.6	40.1	37.6	3.57E-09	3.36E-09
18300	2.10	24.50	23.00	1.50	22.6	40.1	37.3	3.26E-09	3.07E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **4.0E-09** **cm/sec**

a_a = 0.76712 cm^2 a_p = 0.031416 cm^2

A = 20.42 cm^2 M_1 = 0.03018

L = 7.03 cm M_2 = 1.04095

S=L/A= 0.34407 1/cm $C = M_1 S/(G_{Hg}-1)$ = 0.0008261 for 15° to 25°

Remarks:

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*9/6/2013*
Boring No.	*ST-HC3-35-3*	Reviewed By	*JES*
Sample No.	*ST-HC3-35-3*	Review Date	*9/27/13*
Sample Depth	*N/A*	Lab No.	*12341*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.7*
Wet Unit Weight, pcf:	*107.7*
Dry Unit Weight, pcf:	*74.5*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***4.7E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-35-3	Reviewed By	JCJ
Sample No.	ST-HC3-35-3	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12341
Sample Description	Grout Core		\

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	R-74
Location 1	2.952	Location 1	2.007	Wet Soil+Pan, grams	280.80
Location 2	2.893	Location 2	2.005	Dry Soil + Pan, grams	196.94
Location3	2.928	Location 3	2.003	Pan Weight, grams	16.47
Average	2.924	Average	2.005	Moisture Content, %	46.5
Volume, in^3	9.23	Wet Soil + Tare, grams	261.12	Dry Unit Weight, pcf	74.5
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	110.3
Soil Sample Wt., g	261.12	Dry Soil +Tare, grams	180.47	Diameter, in.	N/A
Dry UW, pcf	74.5	Moisture Content, %	44.7	Length, in.	N/A
Saturation, %	106.1			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
8640	2.00	27.50	26.10	1.40	22.6	43.2	40.7	5.96E-09	5.60E-09
11760	2.00	27.50	25.70	1.80	22.6	43.2	40.0	5.68E-09	5.34E-09
70920	2.00	27.50	21.00	6.50	22.4	43.2	31.7	3.81E-09	3.59E-09
5040	2.00	26.90	26.10	0.80	22.4	42.1	40.7	5.91E-09	5.58E-09
10140	2.00	26.90	25.70	1.20	22.4	42.1	40.0	4.44E-09	4.20E-09
14400	2.00	26.90	25.20	1.70	22.6	42.1	39.1	4.48E-09	4.21E-09
18360	2.00	26.90	24.80	2.10	22.6	42.1	38.4	4.38E-09	4.12E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **4.7E-09 cm/sec**

a_a = 0.76712 cm^2 a_p = 0.031416 cm^2

A = 20.37 cm^2 M_1 = 0.03018

L = 7.43 cm M_2 = 1.04095

S=L/A= 0.36465 1/cm $C = M_1S/(G_{Hg}-1)$ = 0.0008755 for 15° to 25°

Remarks:

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*9/6/2013*
Boring No.	*ST-HC3-35-4*	Reviewed By	JE2
Sample No.	*ST-HC3-35-4*	Review Date	9/27/13
Sample Depth	*N/A*	Lab No.	*12342*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.2*
Wet Unit Weight, pcf:	*107.9*
Dry Unit Weight, pcf:	*74.8*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***6.5E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-35-4	Reviewed By	JGJ
Sample No.	ST-HC3-35-4	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12342
Sample Description	Grout Core		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	R-40
Location 1	2.754	Location 1	2.003	Wet Soil+Pan, grams	262.53
Location 2	2.723	Location 2	2.001	Dry Soil + Pan, grams	184.99
Location3	2.710	Location 3	2.002	Pan Weight, grams	16.33
Average	2.729	Average	2.002	Moisture Content, %	46.0
Volume, in^3	8.59	Wet Soil + Tare, grams	243.24	Dry Unit Weight, pcf	74.8
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	110.1
Soil Sample Wt., g	243.24	Dry Soil +Tare, grams	168.66	Diameter, in.	N/A
Dry UW, pcf	74.8	Moisture Content, %	44.2	Length, in.	N/A
Saturation, %	105.9			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
8400	2.00	28.30	26.30	2.00	22.6	47.7	43.9	8.05E-09	7.56E-09
11520	2.00	28.30	25.70	2.60	22.6	47.7	42.8	7.73E-09	7.26E-09
70680	2.00	28.30	18.50	9.80	22.4	47.7	29.2	5.69E-09	5.37E-09
5040	2.00	26.50	25.40	1.10	22.4	44.4	42.4	7.78E-09	7.35E-09
10020	2.00	26.50	24.60	1.90	22.4	44.4	40.8	6.88E-09	6.50E-09
14400	2.00	26.50	24.00	2.50	22.6	44.4	39.7	6.39E-09	6.01E-09
18300	2.00	26.50	23.70	2.80	22.6	44.4	39.1	5.67E-09	5.33E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **6.5E-09** **cm/sec**

a_a =	0.76712	cm^2	a_p =	0.031416	cm^2
A =	20.31	cm^2	M_1 =	0.03018	
L =	6.93	cm	M_2 =	1.04095	
S=L/A=	0.34131	1/cm	$C = M_1S/(G_{Hg}-1)$ =	0.0008195	for 15° to 25°

Remarks:

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*9/6/2013*
Boring No.	*ST-HC3-35-5*	Reviewed By	*JGJ*
Sample No.	*ST-HC3-35-5*	Review Date	*9/27/13*
Sample Depth	*N/A*	Lab No.	*12343*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.4*
Wet Unit Weight, pcf:	*107.9*
Dry Unit Weight, pcf:	*74.7*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***5.0E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-45-2	Reviewed By	JEF
Sample No.	ST-HC3-45-2	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12344
Sample Description	Grout Core		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	R-14
Location 1	2.935	Location 1	2.010	Wet Soil+Pan, grams	281.88
Location 2	2.946	Location 2	2.009	Dry Soil + Pan, grams	198.35
Location3	2.977	Location 3	2.010	Pan Weight, grams	16.05
Average	2.953	Average	2.010	Moisture Content, %	45.8
Volume, in^3	9.37	Wet Soil + Tare, grams	263.95	Dry Unit Weight, pcf	74.1
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	107.8
Soil Sample Wt., g	263.95	Dry Soil +Tare, grams	182.30	Diameter, in.	N/A
Dry UW, pcf	74.1	Moisture Content, %	44.8	Length, in.	N/A
Saturation, %	105.4			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
5040	2.10	27.30	26.80	0.50	22.5	42.2	41.4	3.64E-09	3.43E-09
8820	2.10	27.30	26.70	0.60	22.3	42.2	41.2	2.50E-09	2.37E-09
15000	2.10	27.30	26.60	0.70	22.4	42.2	41.0	1.72E-09	1.63E-09
25440	2.10	27.30	26.40	0.90	22.6	42.2	40.7	1.31E-09	1.23E-09
88660	2.10	27.30	24.00	3.30	23.0	42.2	36.5	1.45E-09	1.35E-09
5940	2.10	27.90	27.50	0.40	22.4	43.2	42.5	2.41E-09	2.28E-09
12900	2.10	27.90	27.30	0.60	22.4	43.2	42.2	1.67E-09	1.58E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **2.0E-09 cm/sec**

a_a =	0.76712	cm^2	a_p =	0.031416	cm^2
A =	20.46	cm^2	M_1 =	0.03018	
L =	7.50	cm	M_2 =	1.04095	
S=L/A=	0.36647	1/cm	$C = M_1S/(G_{Hg}-1)$ =	0.0008799	for 15° to 25°

Remarks:

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	***CUA Grout Sample Testing***	Test Date	*9/6/2013*
Boring No.	***ST-HC3-45-3***	Reviewed By	JEZ
Sample No.	***ST-HC3-45-3***	Review Date	9/27/13
Sample Depth	*N/A*	Lab No.	*12345*
Sample Description	***Grout Core***		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.5*
Wet Unit Weight, pcf:	*108.5*
Dry Unit Weight, pcf:	*75.1*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***2.7E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-45-3	Reviewed By	JGF
Sample No.	ST-HC3-45-3	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12345
Sample Description	Grout Core		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	P-28
Location 1	2.917	Location 1	2.002	Wet Soil+Pan, grams	276.36
Location 2	2.902	Location 2	2.002	Dry Soil + Pan, grams	194.74
Location3	2.896	Location 3	1.999	Pan Weight, grams	14.68
Average	2.905	Average	2.001	Moisture Content, %	45.3
Volume, in^3	9.14	Wet Soil + Tare, grams	260.14	Dry Unit Weight, pcf	75.1
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	109.4
Soil Sample Wt., g	260.14	Dry Soil +Tare, grams	180.06	Diameter, in.	N/A
Dry UW, pcf	75.1	Moisture Content, %	44.5	Length, in.	N/A
Saturation, %	107.3			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
61920	2.00	27.60	22.70	4.90	22.4	43.6	34.9	3.13E-09	2.96E-09
4320	2.00	28.10	27.60	0.50	22.3	44.5	43.6	4.07E-09	3.85E-09
8160	2.00	28.10	27.40	0.70	22.4	44.5	43.2	3.03E-09	2.86E-09
14220	2.00	28.10	26.90	1.20	22.6	44.5	42.3	3.01E-09	2.83E-09
24720	2.00	28.10	26.40	1.70	23.0	44.5	41.4	2.48E-09	2.31E-09
87660	2.00	28.10	23.90	4.20	22.1	44.5	37.0	1.83E-09	1.74E-09
12900	2.00	28.40	27.40	1.00	22.4	45.0	43.2	2.72E-09	2.57E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **2.7E-09** **cm/sec**

a_a =	0.76712	cm^2	a_p =	0.031416	cm^2
A =	20.29	cm^2	M_1 =	0.03018	
L =	7.38	cm	M_2 =	1.04095	
S=L/A=	0.36369	1/cm	$C = M_1S/(G_{Hg}-1)$ =	0.0008732	for 15° to 25°

Remarks:

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	***CUA Grout Sample Testing***	Test Date	*9/6/2013*
Boring No.	***ST-HC3-45-4***	Reviewed By	*JCJ*
Sample No.	***ST-HC3-45-4***	Review Date	*9/27/13*
Sample Depth	*N/A*	Lab No.	*12346*
Sample Description	***Grout Core***		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.5*
Wet Unit Weight, pcf:	*107.8*
Dry Unit Weight, pcf:	*74.6*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***2.1E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-45-4	Reviewed By	JCS
Sample No.	ST-HC3-45-4	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12346
Sample Description	Grout Core		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	R-50
Location 1	2.933	Location 1	2.010	Wet Soil+Pan, grams	280.39
Location 2	2.914	Location 2	2.009	Dry Soil + Pan, grams	198.00
Location3	2.930	Location 3	2.006	Pan Weight, grams	16.58
Average	2.926	Average	2.008	Moisture Content, %	45.4
Volume, in^3	9.27	Wet Soil + Tare, grams	262.20	Dry Unit Weight, pcf	74.6
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	108.1
Soil Sample Wt., g	262.20	Dry Soil +Tare, grams	181.42	Diameter, in.	N/A
Dry UW, pcf	74.6	Moisture Content, %	44.5	Length, in.	N/A
Saturation, %	106.0			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
4260	2.00	29.00	28.50	0.50	22.3	45.7	44.8	3.99E-09	3.78E-09
8100	2.00	29.00	28.40	0.60	22.4	45.7	44.6	2.52E-09	2.38E-09
14220	2.00	29.00	28.30	0.70	22.6	45.7	44.4	1.68E-09	1.58E-09
24720	2.00	29.00	28.10	0.90	23.0	45.7	44.1	1.25E-09	1.16E-09
87600	2.00	29.00	26.30	2.70	22.1	45.7	40.9	1.10E-09	1.04E-09
5880	2.00	28.20	27.70	0.50	22.4	44.3	43.4	2.98E-09	2.81E-09
12840	2.00	28.20	27.40	0.80	22.4	44.3	42.9	2.20E-09	2.07E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **2.1E-09** **cm/sec**

a_a = 0.76712 cm^2 a_p = 0.031416 cm^2

A = 20.44 cm^2 M_1 = 0.03018

L = 7.43 cm M_2 = 1.04095

S=L/A= 0.36360 1/cm $C = M_1S/(G_{Hg}-1)$ = 0.0008730 for 15° to 25°

Remarks:

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	***CUA Grout Sample Testing***	Test Date	*9/6/2013*
Boring No.	***ST-HC3-45-5***	Reviewed By	JEJ
Sample No.	***ST-HC3-45-5***	Review Date	9/27/13
Sample Depth	*N/A*	Lab No.	*12347*
Sample Description	***Grout Core***		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*45.4*
Wet Unit Weight, pcf:	*108.4*
Dry Unit Weight, pcf:	*74.6*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.7E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-45-5	Reviewed By	JGF
Sample No.	ST-HC3-45-5	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12347
Sample Description	Grout Core		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	C-33
Location 1	2.969	Location 1	2.010	Wet Soil+Pan, grams	284.72
Location 2	2.946	Location 2	2.006	Dry Soil + Pan, grams	199.24
Location3	2.954	Location 3	2.008	Pan Weight, grams	15.95
Average	2.956	Average	2.008	Moisture Content, %	46.6
Volume, in^3	9.36	Wet Soil + Tare, grams	266.48	Dry Unit Weight, pcf	74.6
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	111.0
Soil Sample Wt., g	266.48	Dry Soil +Tare, grams	183.29	Diameter, in.	N/A
Dry UW, pcf	74.6	Moisture Content, %	45.4	Length, in.	N/A
Saturation, %	108.1			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
61200	2.20	28.90	24.60	4.30	22.4	44.7	37.2	2.65E-09	2.50E-09
8040	2.20	28.00	27.30	0.70	22.4	43.2	42.0	3.14E-09	2.97E-09
14100	2.20	28.00	27.20	0.80	22.6	43.2	41.8	2.05E-09	1.93E-09
24600	2.20	28.00	27.00	1.00	23.0	43.2	41.4	1.48E-09	1.38E-09
87600	2.20	28.00	25.20	2.80	22.1	43.2	38.3	1.21E-09	1.15E-09
5820	2.20	28.40	28.20	0.20	22.4	43.9	43.5	1.21E-09	1.14E-09
12840	2.20	28.40	28.00	0.40	22.4	43.9	43.2	1.10E-09	1.04E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.7E-09 cm/sec**

a_a = 0.76712 cm^2 a_p = 0.031416 cm^2

A = 20.43 cm^2 M_1 = 0.03018

L = 7.51 cm M_2 = 1.04095

S=L/A= 0.36754 1/cm $C = M_1S/(G_{Hg}-1)$ = 0.0008824 for 15° to 25°

Remarks:

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	***CUA Grout Sample Testing***	Test Date	*9/6/2013*
Boring No.	***ST-HC3-55-2***	Reviewed By	JGJ
Sample No.	***ST-HC3-55-2***	Review Date	9/27/13
Sample Depth	*N/A*	Lab No.	*12348*
Sample Description	***Grout Core***		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*45.2*
Wet Unit Weight, pcf:	*108.5*
Dry Unit Weight, pcf:	*74.7*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.7E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-55-2	Reviewed By	JEJ
Sample No.	ST-HC3-55-2	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12348
Sample Description	Grout Core		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	V-83
Location 1	3.014	Location 1	2.008	Wet Soil+Pan, grams	286.28
Location 2	2.962	Location 2	2.004	Dry Soil + Pan, grams	201.10
Location3	2.970	Location 3	2.004	Pan Weight, grams	16.32
Average	2.982	Average	2.005	Moisture Content, %	46.1
Volume, in^3	9.42	Wet Soil + Tare, grams	268.31	Dry Unit Weight, pcf	74.7
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	110.2
Soil Sample Wt., g	268.31	Dry Soil +Tare, grams	184.78	Diameter, in.	N/A
Dry UW, pcf	74.7	Moisture Content, %	45.2	Length, in.	N/A
Saturation, %	108.1			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
11520	2.10	27.90	27.00	0.90	22.4	42.8	41.3	2.87E-09	2.71E-09
17160	2.10	27.90	26.80	1.10	22.6	42.8	40.9	2.36E-09	2.22E-09
23160	2.10	27.90	26.70	1.20	22.6	42.8	40.7	1.91E-09	1.80E-09
28320	2.10	27.90	26.60	1.30	22.6	42.8	40.6	1.70E-09	1.60E-09
89340	2.10	27.90	24.30	3.60	22.0	42.8	36.6	1.57E-09	1.49E-09
109560	2.10	27.90	24.30	3.60	22.3	42.8	36.6	1.28E-09	1.21E-09
174360	2.10	27.90	23.50	4.40	21.8	42.8	35.2	1.00E-09	9.58E-10

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.7E-09** **cm/sec**

a_a = 0.76712 cm^2 a_p = 0.031416 cm^2

A = 20.38 cm^2 M_1 = 0.03018

L = 7.57 cm M_2 = 1.04095

S=L/A= 0.37172 1/cm $C = M_1S/(G_{Hg}-1)$ = 0.0008925 for 15° to 25°

Remarks:

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	***CUA Grout Sample Testing***	Test Date	*9/6/2013*
Boring No.	***ST-HC3-55-3***	Reviewed By	JEJ
Sample No.	***ST-HC3-55-3***	Review Date	9/27/13
Sample Depth	*N/A*	Lab No.	*12349*
Sample Description	***Grout Core***		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*45.2*
Wet Unit Weight, pcf:	*107.9*
Dry Unit Weight, pcf:	*74.3*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.6E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-55-3	Reviewed By	JEF
Sample No.	ST-HC3-55-3	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12349
Sample Description	Grout Core		\

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	C-43
Location 1	2.944	Location 1	2.001	Wet Soil+Pan, grams	279.63
Location 2	2.913	Location 2	2.003	Dry Soil + Pan, grams	196.97
Location3	2.943	Location 3	2.007	Pan Weight, grams	16.52
Average	2.933	Average	2.004	Moisture Content, %	45.8
Volume, in^3	9.25	Wet Soil + Tare, grams	261.94	Dry Unit Weight, pcf	74.3
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	108.3
Soil Sample Wt., g	261.94	Dry Soil +Tare, grams	180.46	Diameter, in.	N/A
Dry UW, pcf	74.3	Moisture Content, %	45.2	Length, in.	N/A
Saturation, %	106.8			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
9960	2.00	27.30	26.70	0.60	22.6	42.7	41.6	2.21E-09	2.07E-09
10920	2.00	27.60	26.80	0.80	22.6	43.2	41.8	2.66E-09	2.50E-09
16920	2.00	27.60	26.70	0.90	22.6	43.2	41.6	1.94E-09	1.82E-09
22080	2.00	27.60	26.60	1.00	22.6	43.2	41.4	1.65E-09	1.55E-09
83100	2.00	27.60	24.40	3.20	22.0	43.2	37.6	1.48E-09	1.41E-09
103320	2.00	27.60	24.20	3.40	22.3	43.2	37.2	1.27E-09	1.20E-09
168720	2.00	27.60	23.60	4.00	21.8	43.2	36.2	9.25E-10	8.86E-10

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.6E-09 cm/sec**

a_a = 0.76712 cm^2 a_p = 0.031416 cm^2

A = 20.34 cm^2 M_1 = 0.03018

L = 7.45 cm M_2 = 1.04095

S=L/A= 0.36626 1/cm $C = M_1S/(G_{Hg}-1)$ = 0.0008794 for 15° to 25°

Remarks:

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	***CUA Grout Sample Testing***	Test Date	*9/6/2013*
Boring No.	***ST-HC3-55-4***	Reviewed By	*QCJ*
Sample No.	***ST-HC3-55-4***	Review Date	*9/27/13*
Sample Depth	*N/A*	Lab No.	*12350*
Sample Description	***Grout Core***		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.8*
Wet Unit Weight, pcf:	*107.5*
Dry Unit Weight, pcf:	*74.2*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***2.0E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-55-4	Reviewed By	JEF
Sample No.	ST-HC3-55-4	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12350
Sample Description	Grout Core		\

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	V-77
Location 1	2.922	Location 1	2.008	Wet Soil+Pan, grams	280.47
Location 2	2.938	Location 2	2.010	Dry Soil + Pan, grams	197.85
Location3	2.949	Location 3	2.010	Pan Weight, grams	16.49
Average	2.936	Average	2.009	Moisture Content, %	45.6
Volume, in^3	9.31	Wet Soil + Tare, grams	262.66	Dry Unit Weight, pcf	74.2
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	107.4
Soil Sample Wt., g	262.66	Dry Soil +Tare, grams	181.36	Diameter, in.	N/A
Dry UW, pcf	74.2	Moisture Content, %	44.8	Length, in.	N/A
Saturation, %	105.7			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
9900	2.00	28.80	27.90	0.90	22.6	45.2	43.6	3.15E-09	2.96E-09
17280	2.00	28.20	26.70	1.50	22.6	44.2	41.5	3.11E-09	2.93E-09
23280	2.00	28.20	26.50	1.70	22.6	44.2	41.2	2.63E-09	2.47E-09
28440	2.00	28.20	26.40	1.80	22.6	44.2	41.0	2.28E-09	2.15E-09
89280	2.00	28.20	24.80	3.40	22.0	44.2	38.2	1.42E-09	1.36E-09
109680	2.00	28.20	24.50	3.70	22.3	44.2	37.7	1.27E-09	1.20E-09
174180	2.00	28.20	23.30	4.90	21.8	44.2	35.6	1.09E-09	1.04E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **2.0E-09 cm/sec**

a_a =	0.76712 cm²	a_p =	0.031416 cm²	Remarks:
A =	20.46 cm²	M_1 =	0.03018	
L =	7.46 cm	M_2 =	1.04095	
S=L/A=	0.36457 1/cm	$C = M_1S/(G_{Hg}-1)$ =	0.0008753 for 15° to 25°	

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*9/6/2013*
Boring No.	*ST-HC3-55-5*	Reviewed By	JGJ
Sample No.	*ST-HC3-55-5*	Review Date	9/27/13
Sample Depth	*N/A*	Lab No.	*12351*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.6*
Wet Unit Weight, pcf:	*108.0*
Dry Unit Weight, pcf:	*74.6*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.7E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	09/06/13
Boring No.	ST-HC3-55-5	Reviewed By	JEJ
Sample No.	ST-HC3-55-5	Review Date	9/27/13
Sample Depth	N/A	Lab No.	12351
Sample Description	Grout Core		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	C-25
Location 1	2.896	Location 1	2.007	Wet Soil+Pan, grams	274.30
Location 2	2.854	Location 2	2.006	Dry Soil + Pan, grams	193.87
Location3	2.860	Location 3	2.007	Pan Weight, grams	16.02
Average	2.870	Average	2.007	Moisture Content, %	45.2
Volume, in^3	9.08	Wet Soil + Tare, grams	257.22	Dry Unit Weight, pcf	74.6
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	107.9
Soil Sample Wt., g	257.22	Dry Soil +Tare, grams	177.85	Diameter, in.	N/A
Dry UW, pcf	74.6	Moisture Content, %	44.6	Length, in.	N/A
Saturation, %	106.4			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
11580	2.20	28.20	27.20	1.00	22.4	44.8	43.0	3.03E-09	2.86E-09
17220	2.20	28.20	27.10	1.10	22.4	44.8	42.9	2.24E-09	2.12E-09
23220	2.20	28.20	27.00	1.20	22.6	44.8	42.7	1.82E-09	1.71E-09
28330	2.20	28.20	26.90	1.30	22.6	44.8	42.5	1.62E-09	1.52E-09
89220	2.20	28.20	24.70	3.50	22.0	44.8	38.6	1.45E-09	1.38E-09
109680	2.20	28.20	24.30	3.90	22.3	44.8	37.8	1.33E-09	1.26E-09
174120	2.20	28.20	23.80	4.40	21.8	44.8	36.9	9.55E-10	9.14E-10

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.7E-09** **cm/sec**

a_a = 0.76712 cm^2 a_p = 0.031416 cm^2

A = 20.40 cm^2 M_1 = 0.03018

L = 7.29 cm M_2 = 1.04095

S=L/A= 0.35728 1/cm $C = M_1S/(G_{Hg}-1)$ = 0.0008578 for 15° to 25°

Remarks:

Attachment 2

Equipment List

VSL Req#36902/CUA PO0000078082
AMEC Project Name: CUA Grout Sample Testing
AMEC Project No.: 6163-13-0012

Equipment Name	Laboratory ID	Calibration Due Date
Oven	109	11/18/2013
Balance	416	9/11/2013
Thermometer	2278	3/27/2014
Caliper	2376	1/30/2014
Pressure Transducers	3638	6/19/14
Timer	2607	12/19/2013
Timer	2608	12/19/2013

APPENDIX B

HYDRAULIC CONDUCTIVITY MEASUREMENTS OF SAMPLES CURED FOR 90 DAYS

December 4, 2013

The Catholic University of America
Vitreous State Laboratory
Cardinal Station
Hannan Hall #32
Washington D.C. 20064

Attention: Mr. Weiliang Gong

Subject:: **Report of Laboratory Hydraulic Conductivity Tests/Certificate of Conformance**
VSL Req# 37596/CUA PO0000079566, 8/5/2013
AMEC Project Name: CUA Grout Sample Testing
AMEC Project Number: 6163-13-0012

Dear Mr. Gong:

AMEC Environment & Infrastructure, Inc. (AMEC) has completed the second group of 12 hydraulic conductivity tests for the above referenced project. The test results are included in Attachment 1. An equipment list used in testing is included in Attachment 2. The equipment was calibrated in accordance with the applicable requirements of AMEC's Nuclear Quality Assurance Program and was NIST traceable. The tests performed are listed below along with applicable procedure:

Hydraulic Conductivity	Modified ASTM D5084-10

We hereby certify that the services supplied under this VSL Req# 37596/CUA PO0000079566 were performed in accordance with the applicable requirements of AMEC's Nuclear Quality Assurance Program and the requirements of the subject Contract VSL Req# 37596/CUA PO0000079566.

Please contact us if you have any questions.

AMEC Environment & Infrastructure, Inc.

Technical Lead	Jianren Wang	12/4/13 Date:
Project Manager	Geoffrey Hebner	12/4/13 Date:
Quality Assurance Representative	JDM John D. Martin	Digitally signed by John D Martin 2013.12.06 18:12:50 -05'00' Date:

AMEC Environment & Infrastructure
396 Plasters Avenue, NE • Atlanta, GA 30324 • Phone: 404-873-4761 • Fax: 404-817-0221
AMEC.com

Attachment 1

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-35-7*	Reviewed By	JEJ
Sample No.	*ST-HC3-35-7*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12414*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.7*
Wet Unit Weight, pcf:	*108.3*
Dry Unit Weight, pcf:	*74.8*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***2.2E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	11/07/13
Boring No.	ST-HC3-35-7	Reviewed By	JGJ
Sample No.	ST-HC3-35-7	Review Date	12/4/13
Sample Depth	N/A	Lab No.	12414
Sample Description	Grout Core		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	C-28
Location 1	2.830	Location 1	2.007	Wet Soil+Pan, grams	272.89
Location 2	2.828	Location 2	2.006	Dry Soil + Pan, grams	191.28
Location3	2.826	Location 3	2.004	Pan Weight, grams	15.77
Average	2.828	Average	2.006	Moisture Content, %	46.5
Volume, in^3	8.93	Wet Soil + Tare, grams	253.98	Dry Unit Weight, pcf	74.8
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	111.5
Soil Sample Wt., g	253.98	Dry Soil +Tare, grams	175.51	Diameter, in.	N/A
Dry UW, pcf	74.8	Moisture Content, %	44.7	Length, in.	N/A
Saturation, %	107.2			Volume, in^3	N/A

Consolidation

Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
10200	1.90	28.10	27.20	0.90	20.4	45.8	44.2	3.02E-09	2.99E-09
7680	1.90	27.90	27.10	0.80	21.1	45.5	44.0	3.59E-09	3.49E-09
14580	1.90	27.90	26.80	1.10	21.3	45.5	43.5	2.61E-09	2.53E-09
72600	1.90	27.90	24.30	3.60	19.4	45.5	38.9	1.81E-09	1.84E-09
6540	1.90	27.80	27.40	0.40	19.8	45.3	44.6	2.10E-09	2.11E-09
23820	1.90	27.80	27.00	0.80	19.9	45.3	43.9	1.16E-09	1.16E-09
27360	1.90	27.80	26.90	0.90	19.9	45.3	43.7	1.14E-09	1.14E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **2.2E-09 cm/sec**

a_a =	0.76712 cm²	a_p =	0.031416 cm²	Remarks:
A =	20.38 cm²	M_1 =	0.03018	
L =	7.18 cm	M_2 =	1.04095	
S=L/A=	0.35240 1/cm	$C = M_1S/(G_{Hg}-1)$ =	0.0008461 for 15° to 25°	

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-35-8*	Reviewed By	JEF
Sample No.	*ST-HC3-35-8*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12415*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.8*
Wet Unit Weight, pcf:	*109.3*
Dry Unit Weight, pcf:	*75.5*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***2.5E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number 6163-13-0012 — Tested By JW
Project Name CUA Grout Sample Testing — Test Date 11/07/13
Boring No. ST-HC3-35-8 — Reviewed By JEJ
Sample No. ST-HC3-35-8 — Review Date 12/4/13
Sample Depth N/A — Lab No. 12415
Sample Description Grout Core

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	C-30
Location 1	2.935	Location 1	2.009	Wet Soil+Pan, grams	283.67
Location 2	2.830	Location 2	2.010	Dry Soil + Pan, grams	198.68
Location3	2.934	Location 3	2.007	Pan Weight, grams	16.54
Average	2.900	Average	2.009	Moisture Content, %	46.7
Volume, in^3	9.19	Wet Soil + Tare, grams	263.73	Dry Unit Weight, pcf	75.5
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	113.9
Soil Sample Wt., g	263.73	Dry Soil +Tare, grams	182.14	Diameter, in.	N/A
Dry UW, pcf	75.5	Moisture Content, %	44.8	Length, in.	N/A
Saturation, %	109.3			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
4320	2.00	28.60	27.90	0.70	20.4	45.4	44.2	5.56E-09	5.51E-09
9780	2.00	28.60	27.70	0.90	20.4	45.4	43.8	3.17E-09	3.14E-09
19020	2.00	28.60	27.30	1.30	21.1	45.4	43.1	2.37E-09	2.31E-09
25920	2.00	28.60	27.00	1.60	21.3	45.4	42.6	2.16E-09	2.09E-09
83820	2.00	28.60	25.30	3.30	19.4	45.4	39.5	1.43E-09	1.45E-09
91500	2.00	28.60	25.10	3.50	19.8	45.4	39.2	1.39E-09	1.40E-09
108840	2.00	28.60	24.70	3.90	19.9	45.4	38.5	1.32E-09	1.32E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **2.5E-09 cm/sec**

a_a = 0.76712 cm^2 — a_p = 0.031416 cm^2
A = 20.44 cm^2 — M_1 = 0.03018
L = 7.37 cm — M_2 = 1.04095
S=L/A= 0.36025 1/cm — $C = M_1S/(G_{Hg}-1)$ = 0.0008650 for 15° to 25°

Remarks:

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-35-9*	Reviewed By	JEF
Sample No.	*ST-HC3-35-9*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12416*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.6*
Wet Unit Weight, pcf:	*108.3*
Dry Unit Weight, pcf:	*74.9*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***2.4E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number 6163-13-0012 — Tested By JW
Project Name CUA Grout Sample Testing — Test Date 11/07/13
Boring No. ST-HC3-35-9 — Reviewed By JEB
Sample No. ST-HC3-35-9 — Review Date 12/4/13
Sample Depth N/A — Lab No. 12416
Sample Description Grout Core

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	R-67
Location 1	2.823	Location 1	2.006	Wet Soil+Pan, grams	271.28
Location 2	2.796	Location 2	2.005	Dry Soil + Pan, grams	190.25
Location3	2.807	Location 3	2.001	Pan Weight, grams	16.00
Average	2.809	Average	2.004	Moisture Content, %	46.5
Volume, in^3	8.86	Wet Soil + Tare, grams	251.96	Dry Unit Weight, pcf	74.9
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	111.8
Soil Sample Wt., g	251.96	Dry Soil +Tare, grams	174.25	Diameter, in.	N/A
Dry UW, pcf	74.9	Moisture Content, %	44.6	Length, in.	N/A
Saturation, %	107.2			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
9600	2.10	28.30	26.90	1.40	20.4	46.2	43.6	5.02E-09	4.97E-09
18840	2.10	28.30	26.60	1.70	21.1	46.2	43.0	3.12E-09	3.04E-09
25800	2.10	28.30	26.30	2.00	21.3	46.2	42.5	2.70E-09	2.62E-09
83640	2.10	28.30	24.60	3.70	19.4	46.2	39.4	1.60E-09	1.62E-09
91380	2.10	28.30	24.50	3.80	19.8	46.2	39.2	1.51E-09	1.52E-09
108660	2.10	28.30	24.30	4.00	19.9	46.2	38.8	1.34E-09	1.34E-09
112260	2.10	28.60	24.10	4.50	19.9	46.7	38.4	1.46E-09	1.46E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **2.4E-09 cm/sec**

a_a = 0.76712 cm^2 — a_p = 0.031416 cm^2
A = 20.35 cm^2 — M_1 = 0.03018
L = 7.13 cm — M_2 = 1.04095
S=L/A= 0.35058 1/cm — $C = M_1S/(G_{Hg}-1)$ = 0.0008417 for 15° to 25°

Remarks:

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-35-10*	Reviewed By	JGJ
Sample No.	*ST-HC3-35-10*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12417*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*44.7*
Wet Unit Weight, pcf:	*108.4*
Dry Unit Weight, pcf:	*74.9*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***2.6E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number 6163-13-0012 | Tested By JW
Project Name CUA Grout Sample Testing | Test Date 11/07/13
Boring No. ST-HC3-35-10 | Reviewed By JEJ
Sample No. ST-HC3-35-10 | Review Date 12/4/13
Sample Depth N/A | Lab No. 12417
Sample Description Grout Core

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	V-69
Location 1	2.768	Location 1	2.002	Wet Soil+Pan, grams	268.43
Location 2	2.786	Location 2	2.001	Dry Soil + Pan, grams	188.27
Location3	2.776	Location 3	2.001	Pan Weight, grams	16.47
Average	2.777	Average	2.001	Moisture Content, %	46.7
Volume, in^3	8.73	Wet Soil + Tare, grams	248.58	Dry Unit Weight, pcf	74.9
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	112.1
Soil Sample Wt., g	248.58	Dry Soil +Tare, grams	171.80	Diameter, in.	N/A
Dry UW, pcf	74.9	Moisture Content, %	44.7	Length, in.	N/A
Saturation, %	107.4			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
4020	2.10	28.20	27.45	0.75	20.4	46.5	45.1	6.30E-09	6.24E-09
9480	2.10	28.20	27.20	1.00	20.4	46.5	44.7	3.58E-09	3.55E-09
18720	2.10	28.20	26.90	1.30	21.1	46.5	44.1	2.37E-09	2.31E-09
25680	2.10	28.20	26.60	1.60	21.3	46.5	43.5	2.14E-09	2.08E-09
83520	2.10	28.20	25.00	3.20	19.4	46.5	40.6	1.36E-09	1.38E-09
91200	2.10	28.20	24.50	3.70	19.8	46.5	39.7	1.46E-09	1.47E-09
108540	2.10	28.20	23.80	4.40	19.9	46.5	38.4	1.48E-09	1.49E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **2.6E-09 cm/sec**

a_a = 0.76712 cm^2 | a_p = 0.031416 cm^2
A = 20.30 cm^2 | M_1 = 0.03018
L = 7.05 cm | M_2 = 1.04095
S=L/A= 0.34751 1/cm | $C = M_1S/(G_{Hg}-1)$ = 0.0008343 for 15° to 25°

Remarks:

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-45-7*	Reviewed By	JEJ
Sample No.	*ST-HC3-45-7*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12418*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*46.0*
Wet Unit Weight, pcf:	*108.1*
Dry Unit Weight, pcf:	*74.1*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.6E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number	6163-13-0012	Tested By	JW
Project Name	CUA Grout Sample Testing	Test Date	11/07/13
Boring No.	ST-HC3-45-7	Reviewed By	JGB
Sample No.	ST-HC3-45-7	Review Date	12/4/13
Sample Depth	N/A	Lab No.	12418
Sample Description	Grout Core		\

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	V-55
Location 1	2.872	Location 1	2.007	Wet Soil+Pan, grams	276.11
Location 2	2.884	Location 2	2.012	Dry Soil + Pan, grams	193.60
Location3	2.874	Location 3	2.003	Pan Weight, grams	16.6
Average	2.877	Average	2.007	Moisture Content, %	46.6
Volume, in^3	9.10	Wet Soil + Tare, grams	258.36	Dry Unit Weight, pcf	74.1
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	109.5
Soil Sample Wt., g	258.36	Dry Soil +Tare, grams	177.00	Diameter, in.	N/A
Dry UW, pcf	74.1	Moisture Content, %	46.0	Length, in.	N/A
Saturation, %	108.0			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
6120	1.90	28.20	27.70	0.50	19.9	45.2	44.3	2.81E-09	2.81E-09
13560	1.90	28.20	27.50	0.70	19.9	45.2	44.0	1.78E-09	1.79E-09
19860	1.90	28.20	27.40	0.80	19.9	45.2	43.8	1.39E-09	1.40E-09
29160	1.90	28.20	27.20	1.00	19.9	45.2	43.5	1.19E-09	1.19E-09
9720	1.90	28.30	27.90	0.40	20.1	45.4	44.7	1.41E-09	1.40E-09
19020	1.90	28.30	27.80	0.50	20.1	45.4	44.5	9.00E-10	8.98E-10
37680	1.90	28.30	26.80	1.50	20.6	45.4	42.7	1.39E-09	1.37E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.6E-09 cm/sec**

a_a =	0.76712 cm^2	a_p =	0.031416 cm^2	Remarks:
A =	20.42 cm^2	M_1 =	0.03018	
L =	7.31 cm	M_2 =	1.04095	
S=L/A=	0.35787 1/cm	$C = M_1S/(G_{Hg}-1)$ =	0.0008592 for 15° to 25°	

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HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-45-8*	Reviewed By	JET
Sample No.	*ST-HC3-45-8*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12419*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*46.1*
Wet Unit Weight, pcf:	*107.8*
Dry Unit Weight, pcf:	*73.8*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.8E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

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Project Number 6163-13-0012 — Tested By JW
Project Name CUA Grout Sample Testing — Test Date 11/07/13
Boring No. ST-HC3-45-8 — Reviewed By DGJ
Sample No. ST-HC3-45-8 — Review Date 12/4/13
Sample Depth N/A — Lab No. 12419
Sample Description Grout Core

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	V-4
Location 1	2.837	Location 1	2.004	Wet Soil+Pan, grams	269.85
Location 2	2.827	Location 2	2.012	Dry Soil + Pan, grams	188.82
Location3	2.838	Location 3	2.005	Pan Weight, grams	15.17
Average	2.834	Average	2.007	Moisture Content, %	46.7
Volume, in^3	8.97	Wet Soil + Tare, grams	253.72	Dry Unit Weight, pcf	73.8
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	108.8
Soil Sample Wt., g	253.72	Dry Soil +Tare, grams	173.65	Diameter, in.	N/A
Dry UW, pcf	73.8	Moisture Content, %	46.1	Length, in.	N/A
Saturation, %	107.5			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
7260	2.00	28.50	27.80	0.70	19.9	46.3	45.0	3.25E-09	3.26E-09
13740	2.00	28.50	27.60	0.90	19.9	46.3	44.6	2.22E-09	2.22E-09
22920	2.00	28.50	27.30	1.20	19.9	46.3	44.1	1.78E-09	1.79E-09
83700	2.00	28.50	26.00	2.50	19.8	46.3	41.7	1.05E-09	1.05E-09
9900	2.00	28.00	27.40	0.60	20.1	45.4	44.3	2.08E-09	2.08E-09
19260	2.00	28.00	27.30	0.70	20.1	45.4	44.1	1.25E-09	1.25E-09
37920	2.00	28.00	26.70	1.30	20.6	45.4	43.0	1.19E-09	1.18E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.8E-09 cm/sec**

a_a = 0.76712 cm^2 — a_p = 0.031416 cm^2
A = 20.41 cm^2 — M_1 = 0.03018
L = 7.20 cm — M_2 = 1.04095
S=L/A= 0.35268 1/cm — $C = M_1S/(G_{Hg}-1)$ = 0.0008468 for 15° to 25°

Remarks:

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-45-9*	Reviewed By	JEJ
Sample No.	*ST-HC3-45-9*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12420*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*46.3*
Wet Unit Weight, pcf:	*108.0*
Dry Unit Weight, pcf:	*73.8*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.3E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number 6163-13-0012 | Tested By JW
Project Name CUA Grout Sample Testing | Test Date 11/07/13
Boring No. ST-HC3-45-9 | Reviewed By JEB
Sample No. ST-HC3-45-9 | Review Date 12/4/13
Sample Depth N/A | Lab No. 12420
Sample Description Grout Core

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	V-61
Location 1	2.907	Location 1	2.007	Wet Soil+Pan, grams	277.75
Location 2	2.895	Location 2	2.007	Dry Soil + Pan, grams	194.23
Location3	2.897	Location 3	2.008	Pan Weight, grams	16.4
Average	2.900	Average	2.007	Moisture Content, %	47.0
Volume, in^3	9.18	Wet Soil + Tare, grams	260.10	Dry Unit Weight, pcf	73.8
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	109.6
Soil Sample Wt., g	260.10	Dry Soil +Tare, grams	177.83	Diameter, in.	N/A
Dry UW, pcf	73.8	Moisture Content, %	46.3	Length, in.	N/A
Saturation, %	107.9			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
5820	2.10	28.70	28.40	0.30	19.9	45.4	44.9	1.76E-09	1.76E-09
13260	2.10	28.70	28.20	0.50	19.9	45.4	44.5	1.29E-09	1.29E-09
19560	2.10	28.70	28.00	0.70	19.9	45.4	44.2	1.23E-09	1.23E-09
28920	2.10	28.70	27.60	1.10	19.9	45.4	43.4	1.32E-09	1.32E-09
89760	2.10	28.70	26.30	2.40	19.8	45.4	41.1	9.52E-10	9.57E-10
9900	2.10	28.60	28.30	0.30	20.1	45.2	44.7	1.04E-09	1.03E-09
37860	2.10	28.60	26.70	1.90	20.6	45.2	41.9	1.77E-09	1.75E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.3E-09 cm/sec**

a_a = 0.76712 cm^2 | a_p = 0.031416 cm^2
A = 20.42 cm^2 | M_1 = 0.03018
L = 7.37 cm | M_2 = 1.04095
S=L/A= 0.36073 1/cm | $C = M_1S/(G_{Hg}-1)$ = 0.0008661 for 15° to 25°

Remarks:

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-45-10*	Reviewed By	JEJ
Sample No.	*ST-HC3-45-10*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12421*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*45.9*
Wet Unit Weight, pcf:	*107.3*
Dry Unit Weight, pcf:	*73.5*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***2.3E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number 6163-13-0012 | Tested By JW
Project Name CUA Grout Sample Testing | Test Date 11/07/13
Boring No. ST-HC3-45-10 | Reviewed By JGF
Sample No. ST-HC3-45-10 | Review Date 12/4/13
Sample Depth N/A | Lab No. 12421
Sample Description Grout Core

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	R-53
Location 1	2.910	Location 1	2.002	Wet Soil+Pan, grams	276.26
Location 2	2.899	Location 2	2.007	Dry Soil + Pan, grams	193.28
Location3	2.907	Location 3	2.009	Pan Weight, grams	16.01
Average	2.905	Average	2.006	Moisture Content, %	46.8
Volume, in^3	9.18	Wet Soil + Tare, grams	258.65	Dry Unit Weight, pcf	73.5
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	108.4
Soil Sample Wt., g	258.65	Dry Soil +Tare, grams	177.27	Diameter, in.	N/A
Dry UW, pcf	73.5	Moisture Content, %	45.9	Length, in.	N/A
Saturation, %	106.3			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
7380	2.10	28.40	27.90	0.50	19.9	44.8	43.9	2.35E-09	2.36E-09
13680	2.10	28.40	26.80	1.60	19.9	44.8	42.0	4.16E-09	4.17E-09
22980	2.10	28.40	26.40	2.00	19.9	44.8	41.3	3.12E-09	3.13E-09
83990	2.10	28.40	25.90	2.50	19.8	44.8	40.4	1.08E-09	1.08E-09
9780	2.10	28.20	27.50	0.70	20.1	44.5	43.2	2.52E-09	2.51E-09
19200	2.10	28.20	27.30	0.90	20.1	44.5	42.9	1.65E-09	1.65E-09
37860	2.10	28.20	26.70	1.50	20.6	44.5	41.8	1.42E-09	1.40E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **2.3E-09 cm/sec**

a_a = 0.76712 cm^2 | a_p = 0.031416 cm^2
A = 20.39 cm^2 | M_1 = 0.03018
L = 7.38 cm | M_2 = 1.04095
S=L/A= 0.36192 1/cm | $C = M_1S/(G_{Hg}-1)$ = 0.0008690 for 15° to 25°

Remarks:

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-55-7*	Reviewed By	JCS
Sample No.	*ST-HC3-55-7*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12422*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*45.7*
Wet Unit Weight, pcf:	*107.8*
Dry Unit Weight, pcf:	*74.0*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.5E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number 6163-13-0012 | Tested By JW
Project Name CUA Grout Sample Testing | Test Date 11/07/13
Boring No. ST-HC3-55-7 | Reviewed By JEF
Sample No. ST-HC3-55-7 | Review Date 12/4/13
Sample Depth N/A | Lab No. 12422
Sample Description Grout Core

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	R-28
Location 1	2.955	Location 1	2.002	Wet Soil+Pan, grams	280.20
Location 2	2.953	Location 2	2.008	Dry Soil + Pan, grams	197.34
Location3	2.944	Location 3	2.007	Pan Weight, grams	16.29
Average	2.951	Average	2.006	Moisture Content, %	45.8
Volume, in^3	9.32	Wet Soil + Tare, grams	263.75	Dry Unit Weight, pcf	74.0
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	107.2
Soil Sample Wt., g	263.75	Dry Soil +Tare, grams	181.05	Diameter, in.	N/A
Dry UW, pcf	74.0	Moisture Content, %	45.7	Length, in.	N/A
Saturation, %	107.0			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
12540	1.90	28.20	27.30	0.90	21.0	44.1	42.5	2.55E-09	2.49E-09
70920	1.90	28.20	25.40	2.80	19.9	44.1	39.2	1.46E-09	1.47E-09
85380	1.90	28.20	24.20	4.00	20.1	44.1	37.1	1.78E-09	1.78E-09
98940	1.90	28.20	24.90	3.30	20.1	44.1	38.3	1.25E-09	1.25E-09
156300	1.90	28.20	23.70	4.50	20.0	44.1	36.3	1.11E-09	1.11E-09
169020	1.90	28.20	23.40	4.80	20.3	44.1	35.7	1.10E-09	1.09E-09
181380	1.90	28.20	23.10	5.10	20.8	44.1	35.2	1.10E-09	1.08E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.5E-09 cm/sec**

a_a = 0.76712 cm^2 | a_p = 0.031416 cm^2
A = 20.38 cm^2 | M_1 = 0.03018
L = 7.49 cm | M_2 = 1.04095
S=L/A= 0.36769 1/cm | $C = M_1S/(G_{Hg}-1)$ = 0.0008828 for 15° to 25°

Remarks:

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-55-8*	Reviewed By	
Sample No.	*ST-HC3-55-8*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12423*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*45.4*
Wet Unit Weight, pcf:	*106.8*
Dry Unit Weight, pcf:	*73.4*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.3E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number 6163-13-0012 — Tested By JW
Project Name CUA Grout Sample Testing — Test Date 11/07/13
Boring No. ST-HC3-55-8 — Reviewed By JCJ 12/4/13
Sample No. ST-HC3-55-8 — Review Date
Sample Depth N/A — Lab No. 12423
Sample Description Grout Core

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	R-40
Location 1	2.901	Location 1	2.009	Wet Soil+Pan, grams	272.96
Location 2	2.893	Location 2	2.007	Dry Soil + Pan, grams	192.49
Location3	2.879	Location 3	2.003	Pan Weight, grams	16.34
Average	2.891	Average	2.006	Moisture Content, %	45.7
Volume, in^3	9.14	Wet Soil + Tare, grams	256.15	Dry Unit Weight, pcf	73.4
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	105.4
Soil Sample Wt., g	256.15	Dry Soil +Tare, grams	176.15	Diameter, in.	N/A
Dry UW, pcf	73.4	Moisture Content, %	45.4	Length, in.	N/A
Saturation, %	104.8			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
13080	2.00	28.30	27.40	0.90	21.0	45.0	43.4	2.40E-09	2.34E-09
71640	2.00	28.30	25.70	2.60	19.9	45.0	40.4	1.31E-09	1.31E-09
85980	2.00	28.30	25.50	2.80	20.1	45.0	40.0	1.18E-09	1.18E-09
99600	2.00	28.30	25.40	2.90	20.1	45.0	39.9	1.06E-09	1.06E-09
156900	2.00	28.30	23.90	4.40	20.0	45.0	37.2	1.05E-09	1.05E-09
169740	2.00	28.30	23.70	4.60	20.3	45.0	36.8	1.02E-09	1.02E-09
181980	2.00	28.30	23.50	4.80	20.8	45.0	36.5	1.00E-09	9.82E-10

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.3E-09 cm/sec**

a_a = 0.76712 cm^2 — a_p = 0.031416 cm^2
A = 20.40 cm^2 — M_1 = 0.03018
L = 7.34 cm — M_2 = 1.04095
S=L/A= 0.36001 1/cm — $C = M_1S/(G_{Hg}-1)$ = 0.0008644 for 15° to 25°

Remarks:

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-55-9*	Reviewed By	JEJ
Sample No.	*ST-HC3-55-9*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12424*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*45.5*
Wet Unit Weight, pcf:	*107.7*
Dry Unit Weight, pcf:	*74.0*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.2E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number 6163-13-0012 | Tested By JW
Project Name CUA Grout Sample Testing | Test Date 11/07/13
Boring No. ST-HC3-55-9 | Reviewed By JEF
Sample No. ST-HC3-55-9 | Review Date 12/4/13
Sample Depth N/A | Lab No. 12424
Sample Description Grout Core \

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	C-44
Location 1	2.823	Location 1	2.005	Wet Soil+Pan, grams	270.94
Location 2	2.847	Location 2	2.003	Dry Soil + Pan, grams	190.98
Location3	2.859	Location 3	2.006	Pan Weight, grams	16.57
Average	2.843	Average	2.005	Moisture Content, %	45.8
Volume, in^3	8.97	Wet Soil + Tare, grams	253.74	Dry Unit Weight, pcf	74.0
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	107.6
Soil Sample Wt., g	253.74	Dry Soil +Tare, grams	174.41	Diameter, in.	N/A
Dry UW, pcf	74.0	Moisture Content, %	45.5	Length, in.	N/A
Saturation, %	106.8			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
12900	2.10	28.90	27.90	1.00	21.0	46.7	44.8	2.61E-09	2.55E-09
71280	2.10	28.90	26.50	2.40	19.9	46.7	42.3	1.17E-09	1.17E-09
85740	2.10	28.90	26.20	2.70	20.1	46.7	41.8	1.10E-09	1.10E-09
99300	2.10	28.90	26.00	2.90	20.1	46.7	41.4	1.02E-09	1.02E-09
156720	2.10	28.90	25.00	3.90	20.0	46.7	39.6	8.92E-10	8.93E-10
169440	2.10	28.90	24.70	4.20	20.3	46.7	39.0	8.95E-10	8.89E-10
181800	2.10	28.90	24.50	4.40	20.8	46.7	38.7	8.78E-10	8.61E-10

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.2E-09 cm/sec**

a_a = 0.76712 cm^2 | a_p = 0.031416 cm^2
A = 20.36 cm^2 | M_1 = 0.03018
L = 7.22 cm | M_2 = 1.04095
S=L/A= 0.35462 1/cm | $C = M_1S/(G_{Hg}-1)$ = 0.0008514 for 15° to 25°

Remarks:

amec

HYDRAULIC CONDUCTIVITY

Project No.	*6163-13-0012*	Tested By	*JW*
Project Name	*CUA Grout Sample Testing*	Test Date	*11/7/2013*
Boring No.	*ST-HC3-55-10*	Reviewed By	JEJ
Sample No.	*ST-HC3-55-10*	Review Date	12/4/13
Sample Depth	*N/A*	Lab No.	*12425*
Sample Description	*Grout Core*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*Core*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*45.5*
Wet Unit Weight, pcf:	*107.7*
Dry Unit Weight, pcf:	*74.0*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.3E-09***

Remarks: _____

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

amec

Project Number 6163-13-0012 — Tested By JW
Project Name CUA Grout Sample Testing — Test Date 11/07/13
Boring No. ST-HC3-55-10 — Reviewed By JEF
Sample No. ST-HC3-55-10 — Review Date 12/4/13
Sample Depth N/A — Lab No. 12425
Sample Description Grout Core

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	R-50
Location 1	2.866	Location 1	2.002	Wet Soil+Pan, grams	273.08
Location 2	2.871	Location 2	2.008	Dry Soil + Pan, grams	192.58
Location3	2.864	Location 3	2.007	Pan Weight, grams	16.6
Average	2.867	Average	2.006	Moisture Content, %	45.7
Volume, in^3	9.06	Wet Soil + Tare, grams	256.07	Dry Unit Weight, pcf	74.0
SG Assumed	2.40	Tare Weight, grams	0.00	Saturation, %	107.3
Soil Sample Wt., g	256.07	Dry Soil +Tare, grams	175.98	Diameter, in.	N/A
Dry UW, pcf	74.0	Moisture Content, %	45.5	Length, in.	N/A
Saturation, %	106.7			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	70
Back Pressure, psi	60
Confining Pressure, psi	10
Initial Burett Reading	0
Final Burett Reading	0
Volume Change, cc	0

Permeant used MCU3-10L3

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
12660	2.10	28.80	27.70	1.10	21.0	46.1	44.1	2.97E-09	2.90E-09
71100	2.10	28.80	26.10	2.70	19.9	46.1	41.2	1.34E-09	1.35E-09
85560	2.10	28.80	25.90	2.90	20.1	46.1	40.9	1.20E-09	1.20E-09
99120	2.10	28.80	25.70	3.10	20.1	46.1	40.5	1.11E-09	1.11E-09
156540	2.10	28.80	24.70	4.10	20.0	46.1	38.7	9.54E-10	9.55E-10
169200	2.10	28.80	24.50	4.30	20.3	46.1	38.4	9.30E-10	9.24E-10
181560	2.10	28.80	24.30	4.50	20.8	46.1	38.0	9.11E-10	8.94E-10

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	Core	N/A	N/A	Vertical

Avg. k at 20 °C **1.3E-09 cm/sec**

a_a = 0.76712 cm^2 — a_p = 0.031416 cm^2
A = 20.38 cm^2 — M_1 = 0.03018
L = 7.28 cm — M_2 = 1.04095
S=L/A= 0.35726 1/cm — $C = M_1S/(G_{Hg}-1)$ = 0.0008578 for 15° to 25°

Remarks:

Attachment 2

Equipment List

VSL Req#36902/CUA PO0000078082
AMEC Project Name: CUA Grout Sample Testing
AMEC Project No.: 6163-13-0012

Equipment Name	Laboratory ID	Calibration Due Date
Oven	109	11/18/2013
Balance	416	9/17/2014
Thermometer	2278	3/27/2014
Caliper	2376	1/30/2014
Pressure Transducers	3638	6/19/14
Timer	2607	12/19/2013
Timer	2608	12/19/2013

APPENDIX C

SEM/EDS ANALYSIS OF SAMPLES CURED FOR 28 DAYS

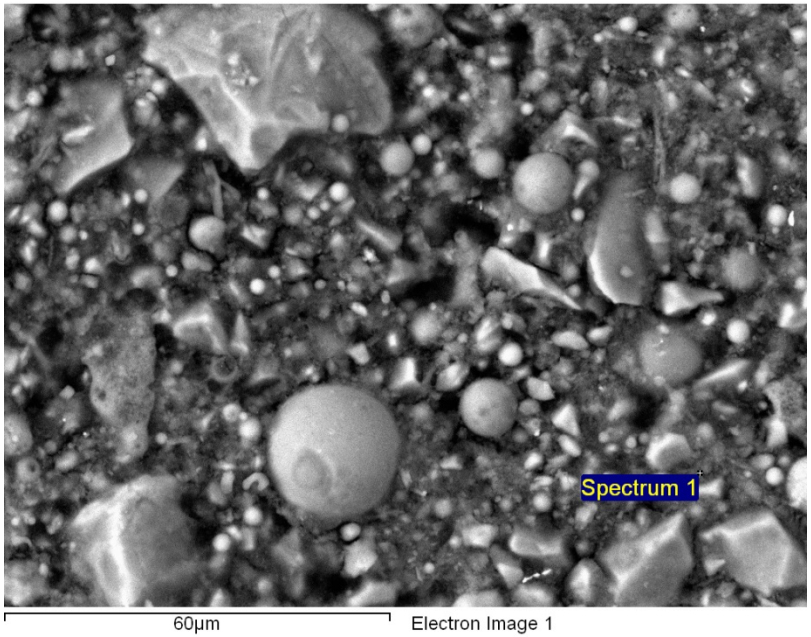
HC3-35-1S Site 4 Spectrum 1 (4.1)

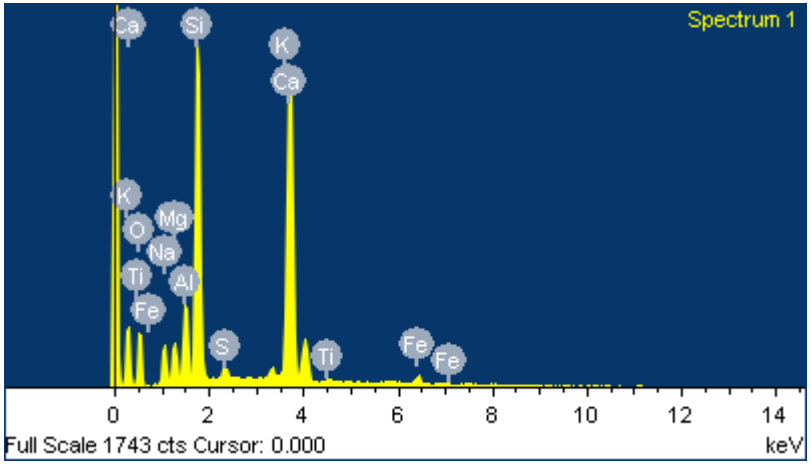
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.52	3.52	4.74	Na_2O
Mg K	2.49	2.36	4.13	MgO
Al K	3.94	3.36	7.45	Al_2O_3
Si K	18.44	15.09	39.46	SiO_2
S K	0.72	0.52	1.81	SO_3
K K	0.87	0.51	1.04	K_2O
Ca K	27.42	15.72	38.36	CaO
Ti K	0.45	0.22	0.75	TiO_2
Fe K	1.76	0.72	2.26	FeO
O	40.39	58.00		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

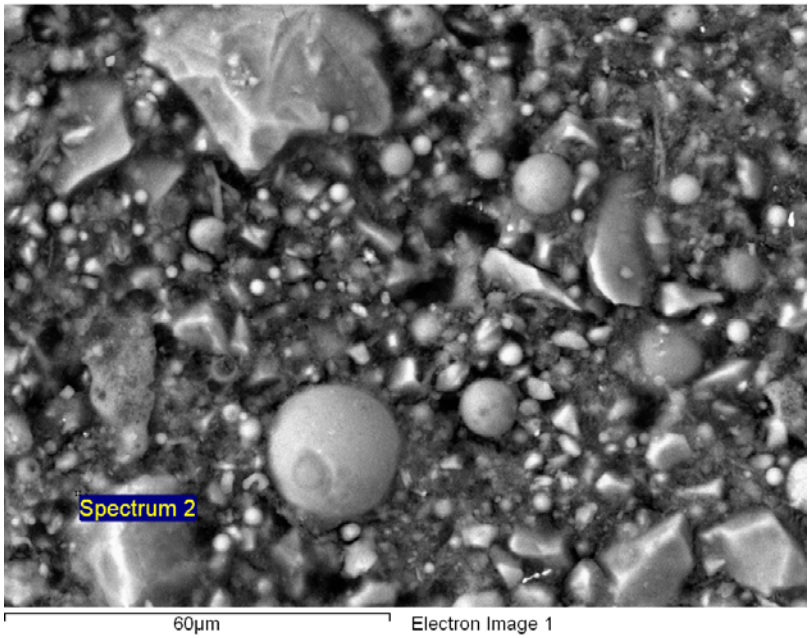
HC3-35-1S Site 4 Spectrum 2 (4.2)

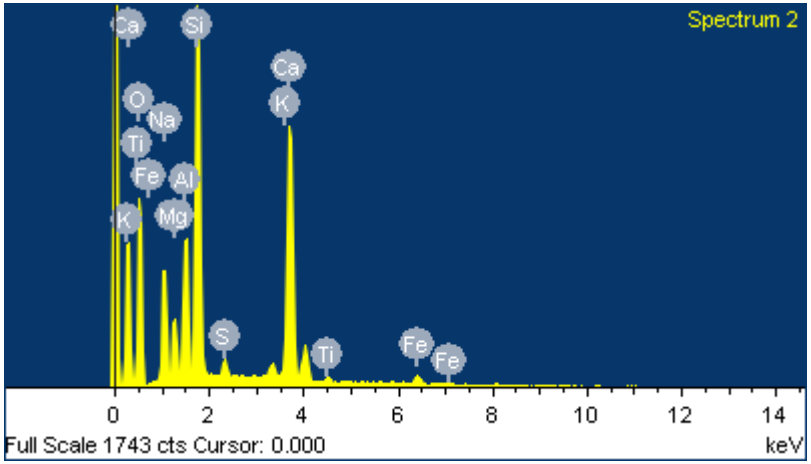
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	8.01	7.73	10.80	Na_2O
Mg K	3.20	2.91	5.30	MgO
Al K	6.39	5.25	12.07	Al_2O_3
Si K	18.35	14.49	39.27	SiO_2
S K	0.83	0.58	2.08	SO_3
K K	0.78	0.44	0.94	K_2O
Ca K	18.91	10.46	26.46	CaO
Ti K	0.51	0.24	0.86	TiO_2
Fe K	1.73	0.69	2.22	FeO
O	41.28	57.21		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

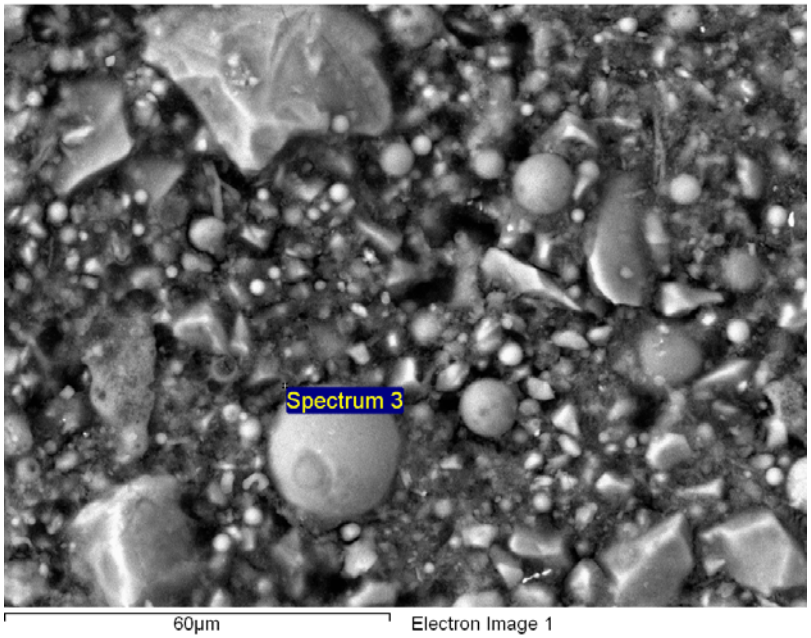
HC3-35-1S Site 4 Spectrum 3 (4.3)

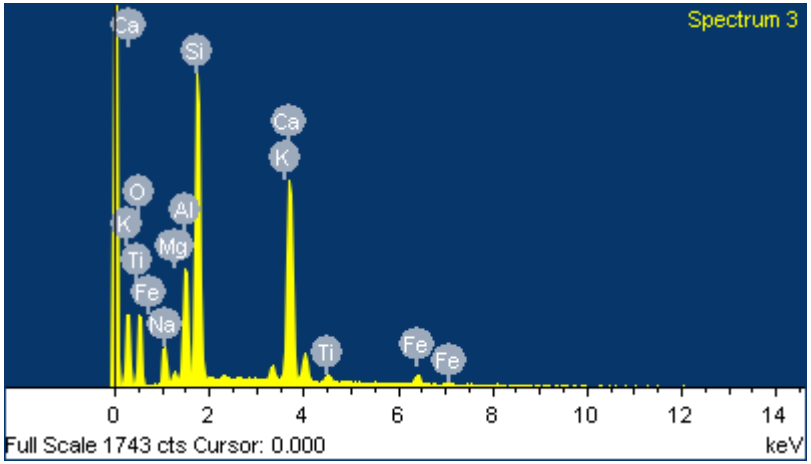
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.10	4.03	5.53	Na_2O
Mg K	0.59	0.55	0.98	MgO
Al K	7.19	6.02	13.59	Al_2O_3
Si K	20.56	16.52	43.98	SiO_2
K K	1.24	0.72	1.50	K_2O
Ca K	21.01	11.83	29.40	CaO
Ti K	1.05	0.50	1.76	TiO_2
Fe K	2.54	1.03	3.27	FeO
O	41.71	58.82		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

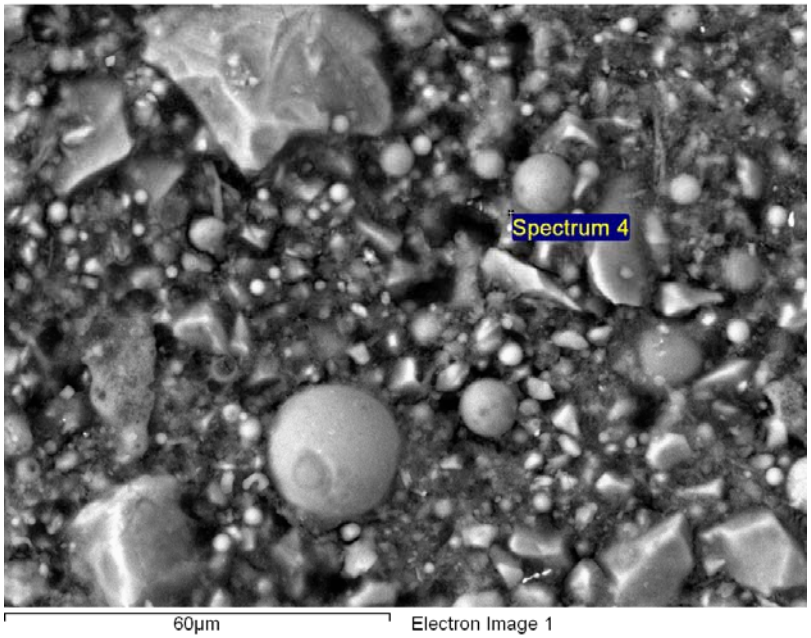
HC3-35-1S Site 4 Spectrum 4 (4.4)

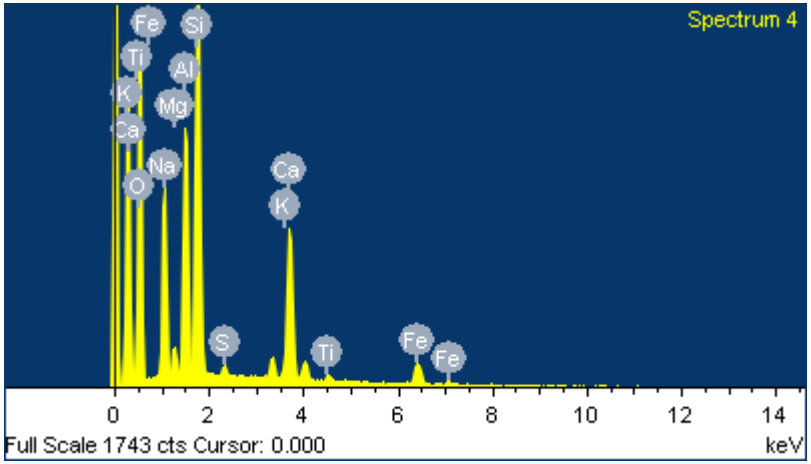
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	11.10	10.45	14.97	Na2O
Mg K	1.28	1.14	2.13	MgO
Al K	9.89	7.93	18.69	Al2O3
Si K	19.97	15.38	42.72	SiO2
S K	0.43	0.29	1.07	SO3
K K	1.24	0.69	1.50	K2O
Ca K	9.72	5.25	13.61	CaO
Ti K	0.50	0.22	0.83	TiO2
Fe K	3.50	1.36	4.50	FeO
O	42.36	57.29		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

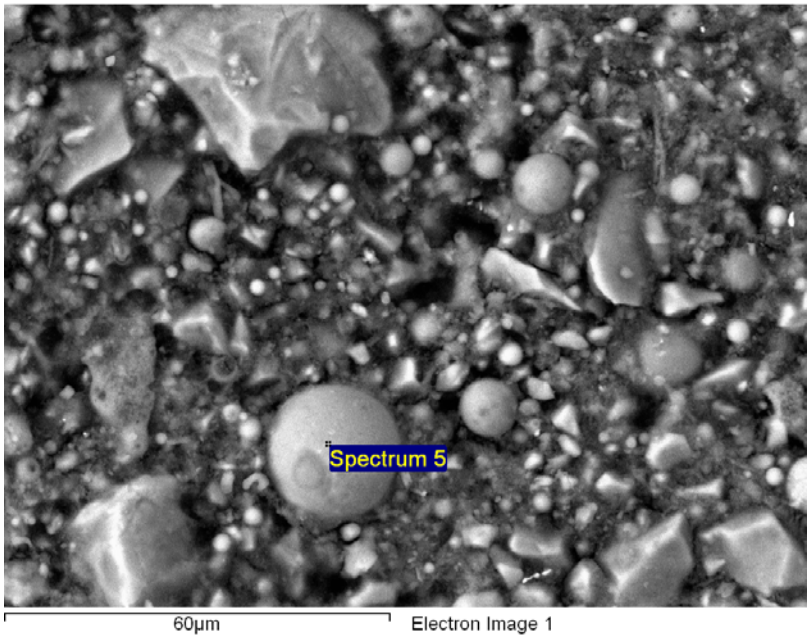
HC3-35-1S Site 4 Spectrum 5 (4.5)

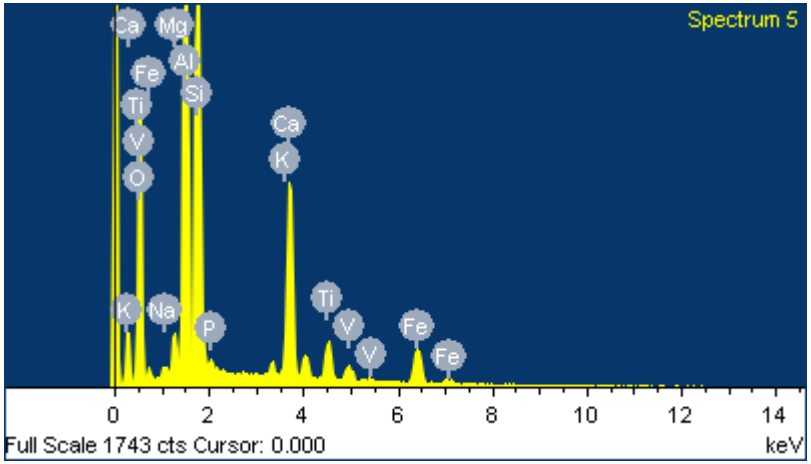
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
P GaP 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
V V 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	0.36	0.34	0.48	Na_2O
Mg K	0.99	0.88	1.64	MgO
Al K	16.08	12.96	30.37	Al_2O_3
Si K	20.17	15.62	43.15	SiO_2
P K	0.42	0.29	0.95	P_2O_5
K K	0.48	0.27	0.58	K_2O
Ca K	8.60	4.67	12.04	CaO
Ti K	2.46	1.12	4.10	TiO_2
V K	0.69	0.29	1.23	V_2O_5
Fe K	4.25	1.66	5.47	FeO
O	45.52	61.90		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *FA particle*

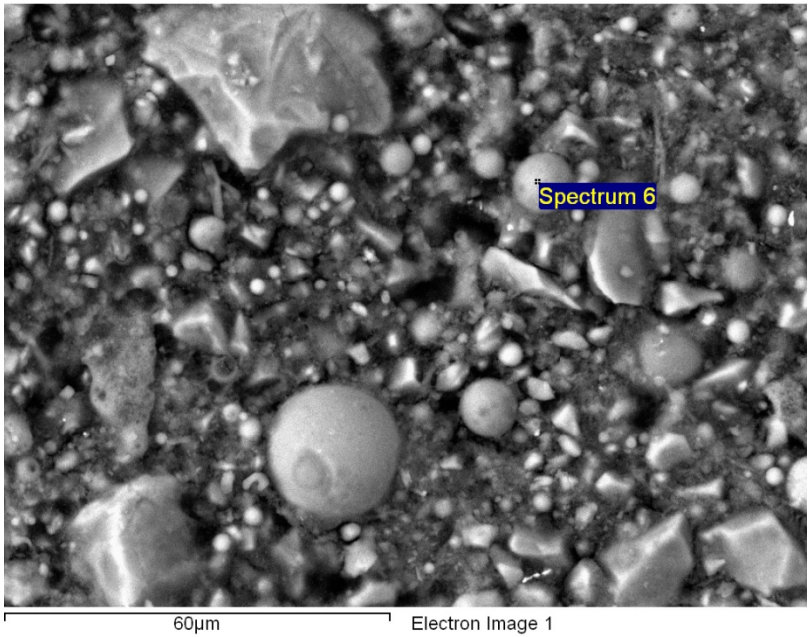
HC3-35-1S Site 4 Spectrum 6 (4.6)

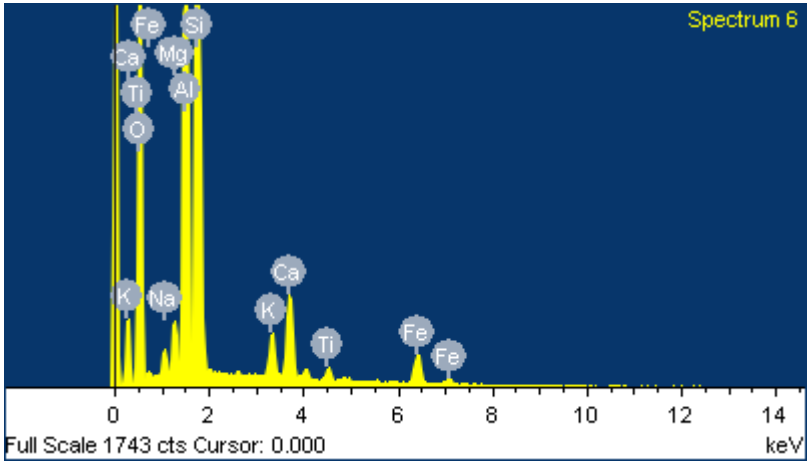
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	0.96	0.88	1.29	Na_2O
Mg K	1.21	1.05	2.01	MgO
Al K	16.64	12.98	31.43	Al_2O_3
Si K	24.80	18.58	53.05	SiO_2
K K	1.70	0.91	2.04	K_2O
Ca K	3.64	1.91	5.09	CaO
Ti K	0.65	0.29	1.09	TiO_2
Fe K	3.10	1.17	3.99	FeO
O	47.30	62.23		
Totals	100.00			





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *FA particle*

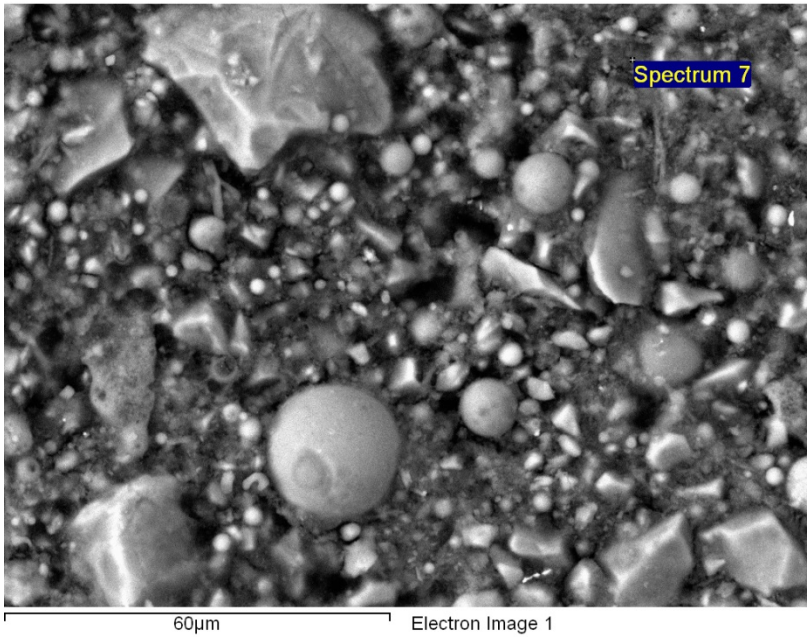
HC3-35-1S Site 4 Spectrum 7 (4.7)

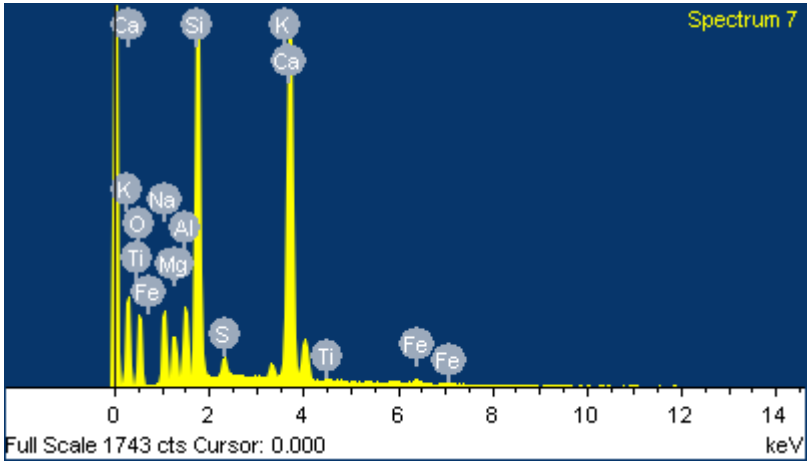
Spectrum processing :
Peak possibly omitted : 8.854 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.50	5.45	7.41	Na_2O
Mg K	2.59	2.43	4.29	MgO
Al K	3.37	2.85	6.37	Al_2O_3
Si K	18.06	14.66	38.64	SiO_2
S K	1.11	0.79	2.77	SO_3
K K	0.89	0.52	1.07	K_2O
Ca K	27.32	15.54	38.23	CaO
Ti K	0.28	0.13	0.46	TiO_2
Fe K	0.58	0.24	0.75	FeO
O	40.30	57.40		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

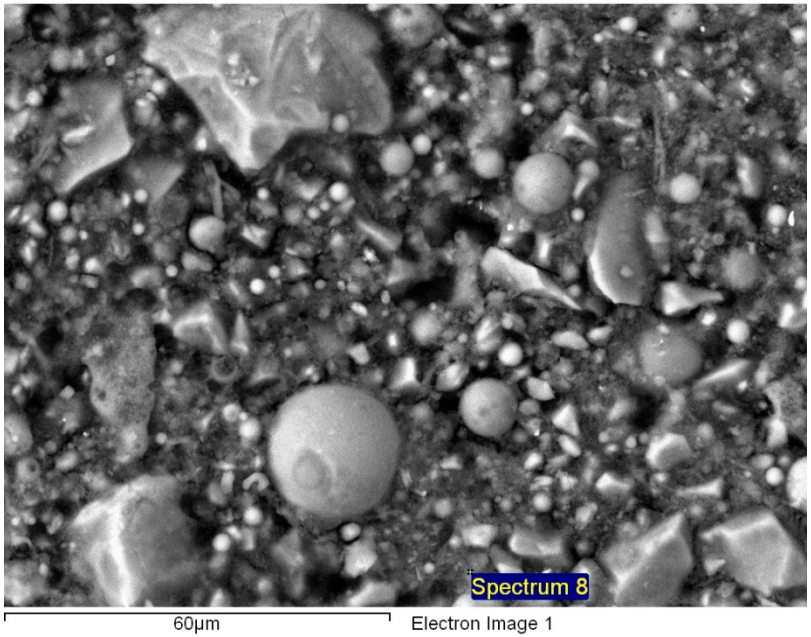
HC3-35-1S Site 4 Spectrum 8 (4.8)

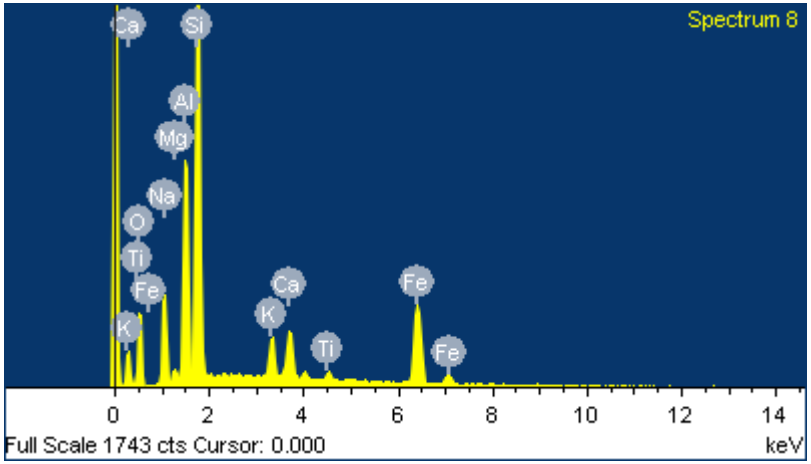
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.83	6.74	9.21	Na_2O
Mg K	0.62	0.58	1.03	MgO
Al K	9.88	8.30	18.66	Al_2O_3
Si K	20.29	16.37	43.40	SiO_2
K K	2.52	1.46	3.04	K_2O
Ca K	3.44	1.94	4.81	CaO
Ti K	0.81	0.38	1.34	TiO_2
Fe K	14.39	5.84	18.51	FeO
O	41.23	58.40		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *FA particle (based on FeO content)*

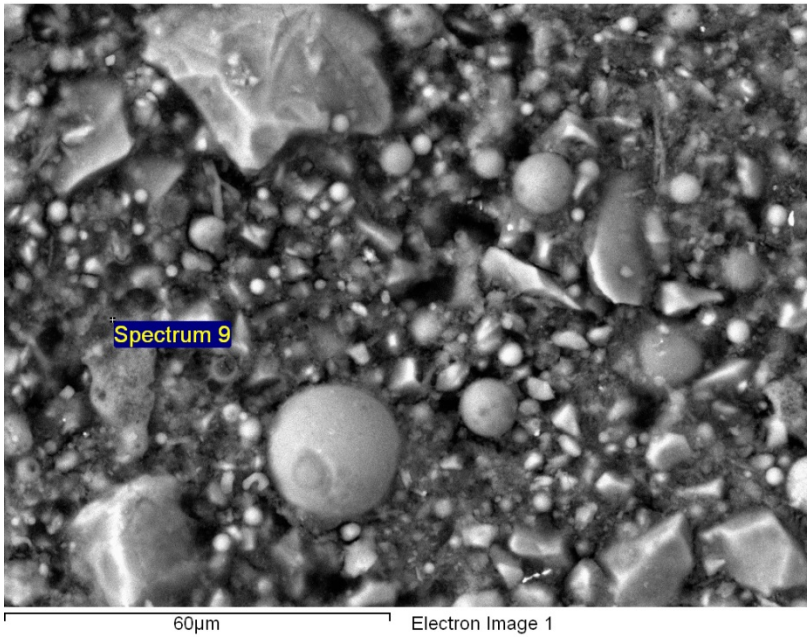
HC3-35-1S Site 4 Spectrum 9 (4.9)

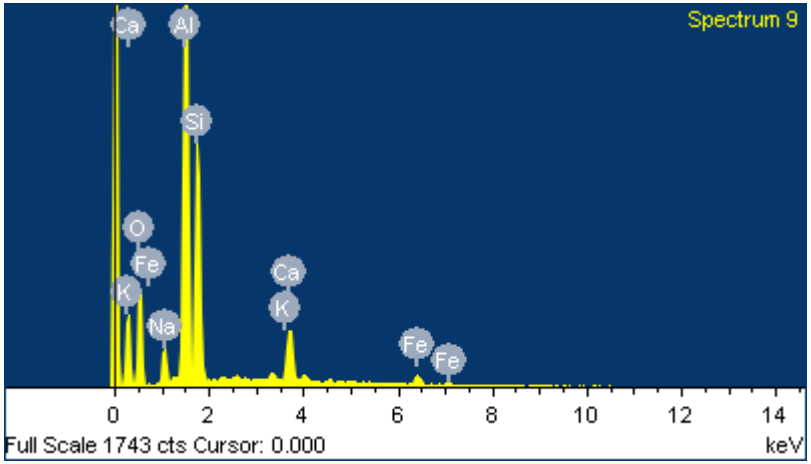
Spectrum processing :
Peak possibly omitted : 4.505 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 2

Standard :
Na Albite 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.16	2.88	4.25	Na_2O
Al K	24.20	18.85	45.73	Al_2O_3
Si K	18.14	13.57	38.81	SiO_2
K K	0.67	0.36	0.80	K_2O
Ca K	5.34	2.80	7.47	CaO
Fe K	2.28	0.86	2.93	FeO
O	46.21	60.69		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix* near an irregular-shaped FA particle

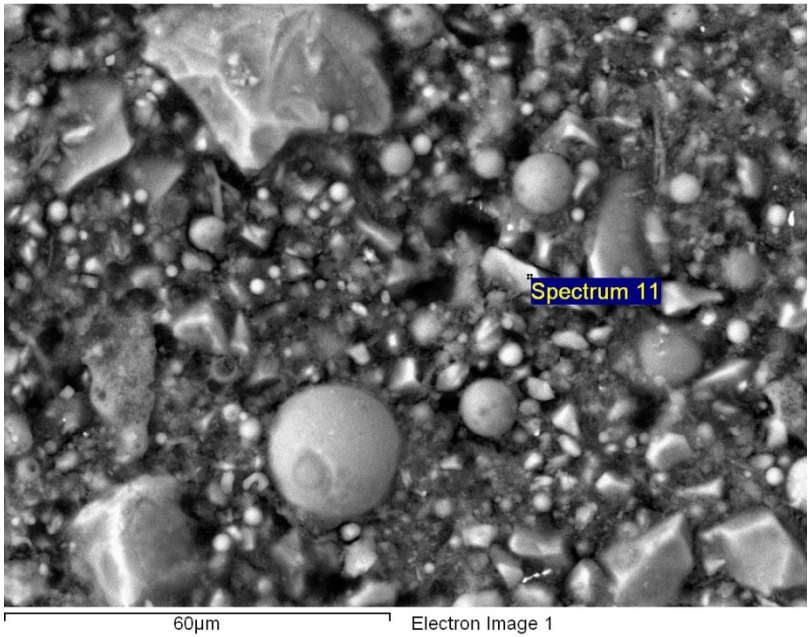
HC3-35-1S Site 4 Spectrum 10 (4.10)

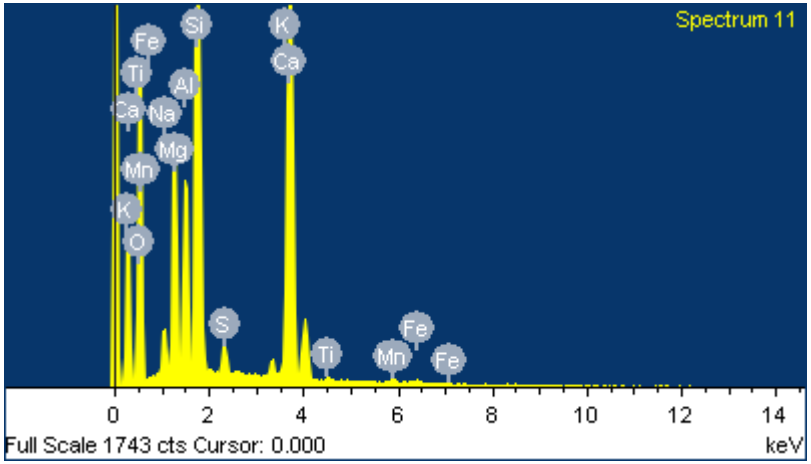
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Mn Mn 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.83	1.75	2.47	Na_2O
Mg K	6.88	6.24	11.42	MgO
Al K	4.98	4.06	9.41	Al_2O_3
Si K	20.71	16.24	44.29	SiO_2
S K	0.94	0.65	2.35	SO_3
K K	0.55	0.31	0.66	K_2O
Ca K	20.16	11.08	28.21	CaO
Ti K	0.20	0.09	0.33	TiO_2
Mn K	0.35	0.14	0.45	MnO
Fe K	0.32	0.13	0.42	FeO
O	43.08	59.31		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *BFS particle*

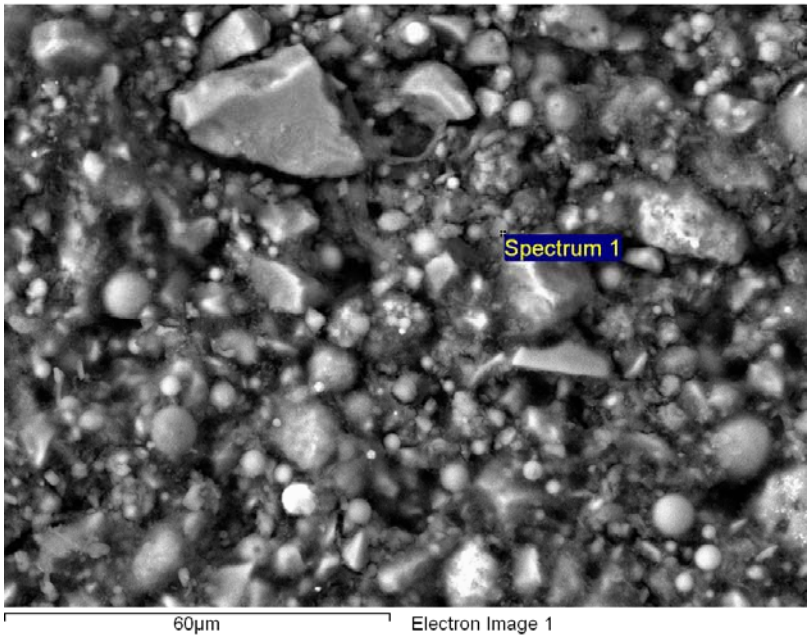
HC3-35-1S Site 5 Spectrum 1 (5.1)

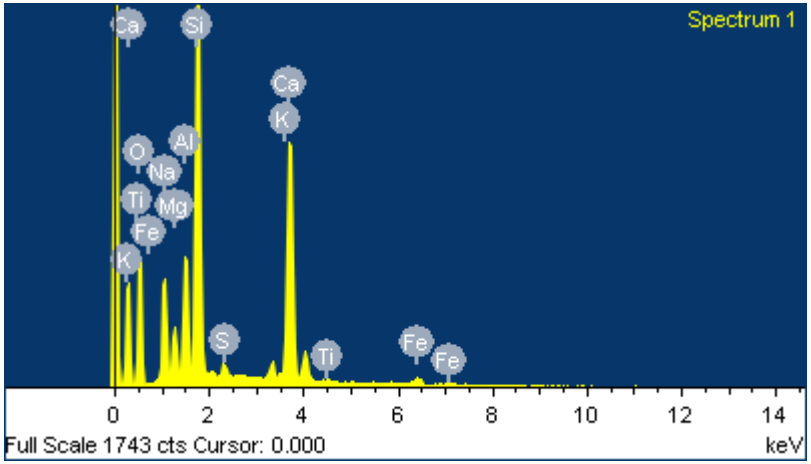
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.39	7.07	9.96	Na_2O
Mg K	2.68	2.42	4.44	MgO
Al K	5.40	4.40	10.21	Al_2O_3
Si K	21.06	16.50	45.06	SiO_2
S K	0.76	0.52	1.91	SO_3
K K	0.94	0.53	1.14	K_2O
Ca K	18.12	9.95	25.35	CaO
Ti K	0.15	0.07	0.25	TiO_2
Fe K	1.31	0.52	1.68	FeO
O	42.18	58.01		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *Particle (possibly BFS)*

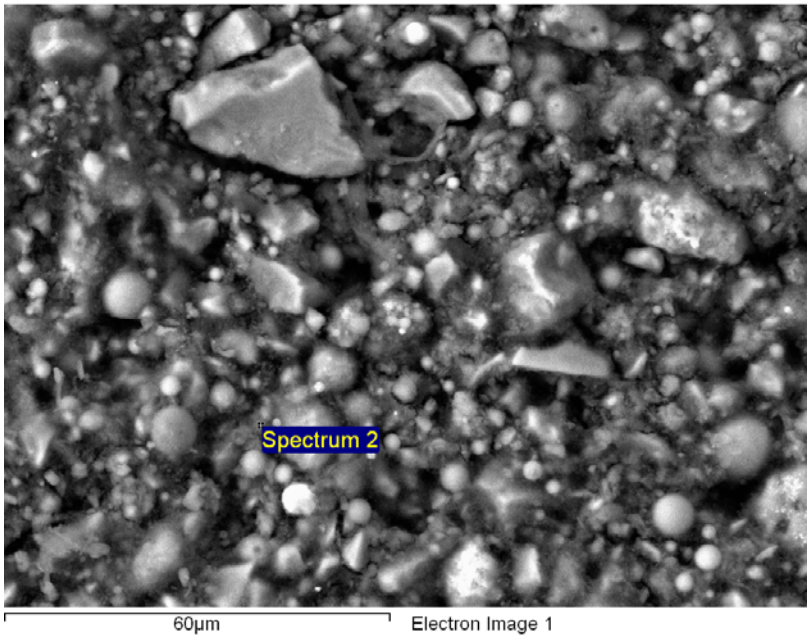
HC3-35-1S Site 5 Spectrum 2 (5.2)

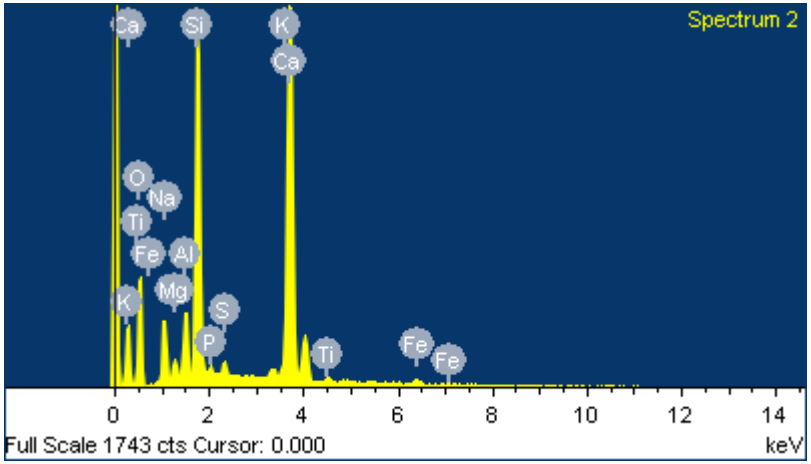
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
P GaP 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.03	5.06	6.78	Na_2O
Mg K	1.10	1.04	1.82	MgO
Al K	3.10	2.66	5.86	Al_2O_3
Si K	17.53	14.44	37.50	SiO_2
P K	0.46	0.34	1.05	P_2O_5
S K	0.83	0.60	2.07	SO_3
K K	0.64	0.38	0.77	K_2O
Ca K	30.10	17.37	42.12	CaO
Ti K	0.43	0.21	0.72	TiO_2
Fe K	1.02	0.42	1.31	FeO
O	39.76	57.48		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

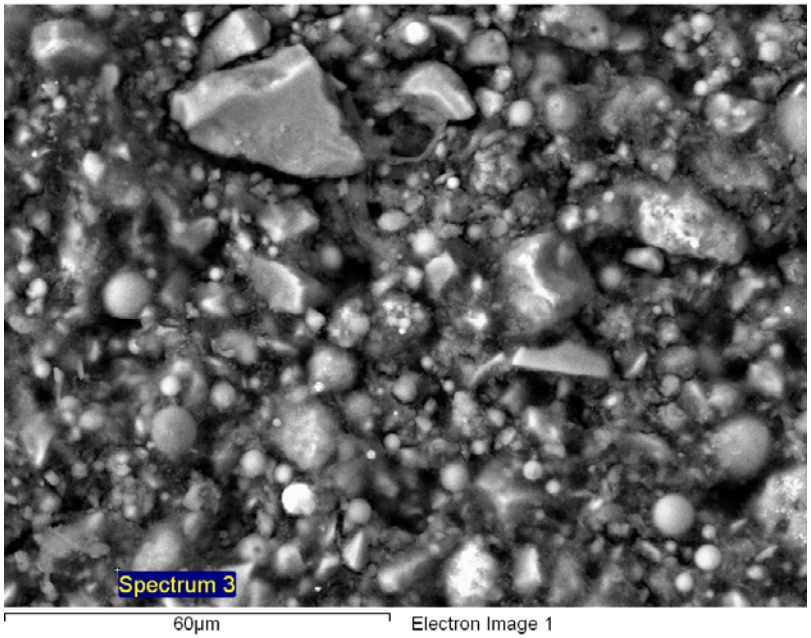
HC3-35-1S Site 5 Spectrum 3 (5.3)

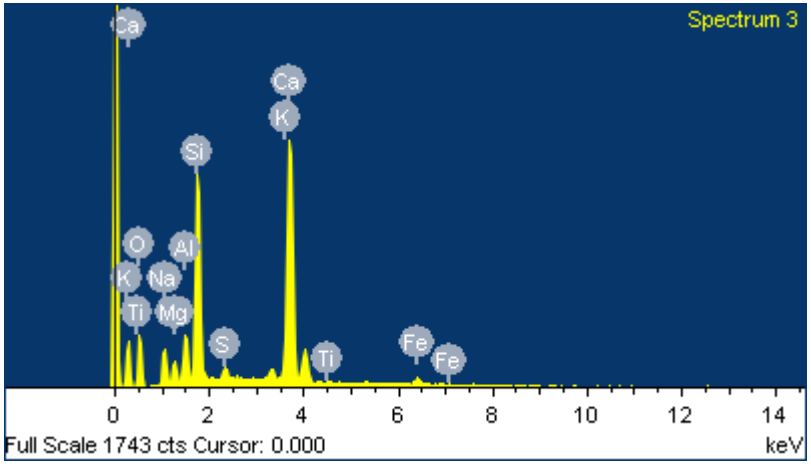
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.67	4.74	6.30	Na2O
Mg K	2.08	1.99	3.44	MgO
Al K	3.22	2.78	6.08	Al2O3
Si K	16.46	13.65	35.22	SiO2
S K	1.05	0.76	2.61	SO3
K K	1.01	0.60	1.21	K2O
Ca K	30.35	17.63	42.46	CaO
Ti K	0.21	0.10	0.36	TiO2
Fe K	1.79	0.75	2.31	FeO
O	39.16	57.00		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

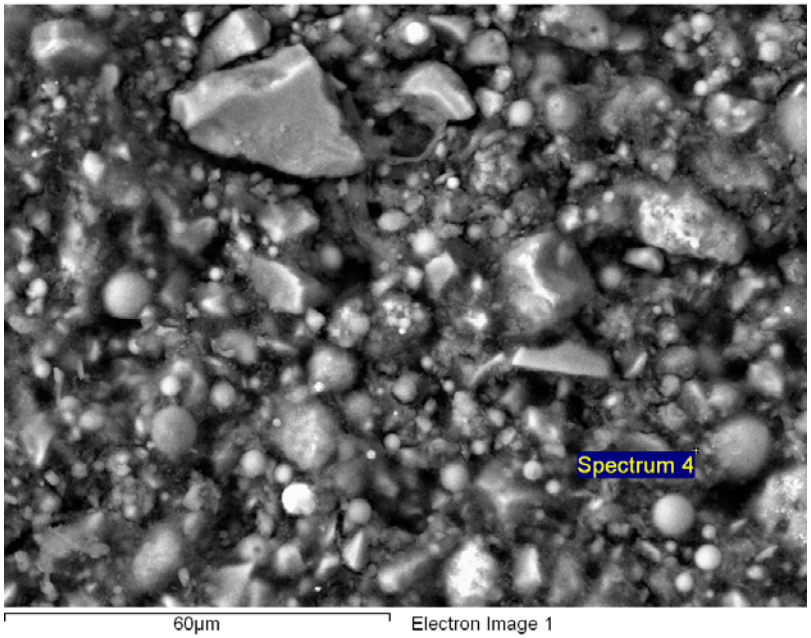
HC3-35-1S Site 5 Spectrum 4 (5.4)

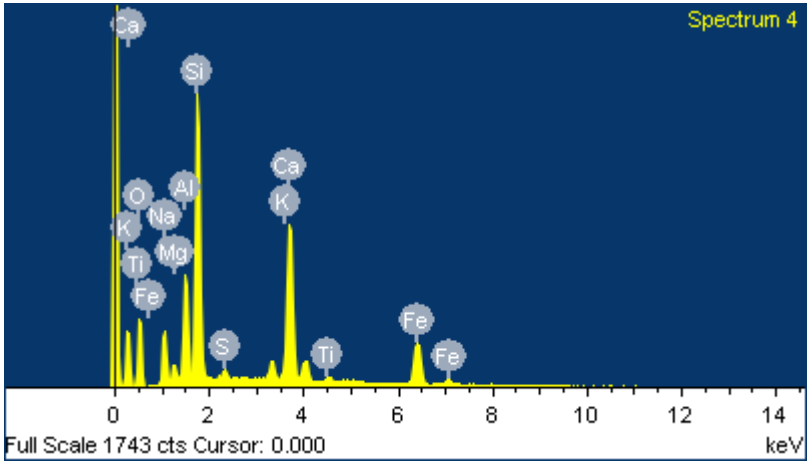
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.68	5.72	7.66	Na_2O
Mg K	1.30	1.23	2.15	MgO
Al K	6.15	5.27	11.62	Al_2O_3
Si K	18.44	15.20	39.45	SiO_2
S K	0.64	0.46	1.59	SO_3
K K	1.68	0.99	2.02	K_2O
Ca K	14.66	8.47	20.52	CaO
Ti K	0.62	0.30	1.04	TiO_2
Fe K	10.84	4.50	13.95	FeO
O	39.98	57.85		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

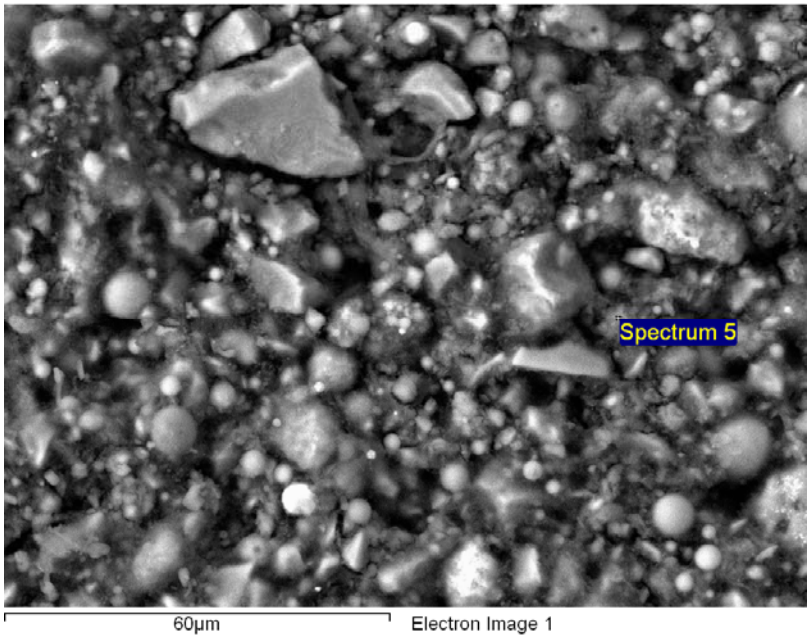
HC3-35-1S Site 5 Spectrum 5 (5.5)

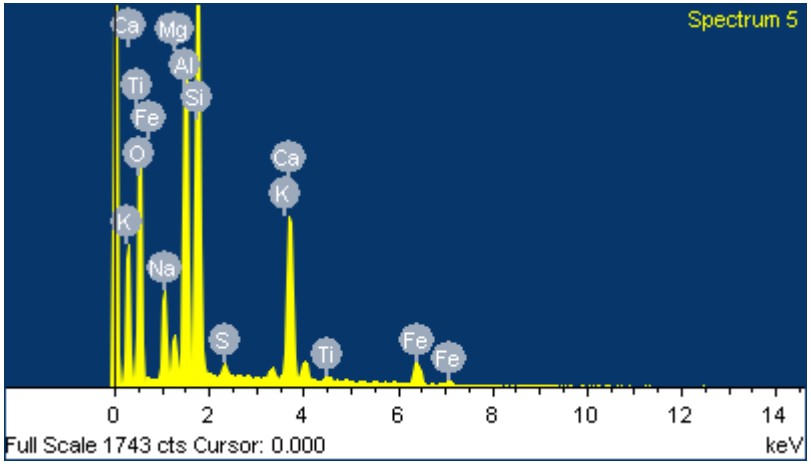
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.48	5.17	7.39	Na_2O
Mg K	1.85	1.65	3.06	MgO
Al K	12.79	10.28	24.16	Al_2O_3
Si K	19.70	15.21	42.14	SiO_2
S K	0.60	0.41	1.50	SO_3
K K	0.67	0.37	0.80	K_2O
Ca K	11.01	5.96	15.40	CaO
Ti K	0.46	0.21	0.76	TiO_2
Fe K	3.72	1.44	4.78	FeO
O	43.74	59.30		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

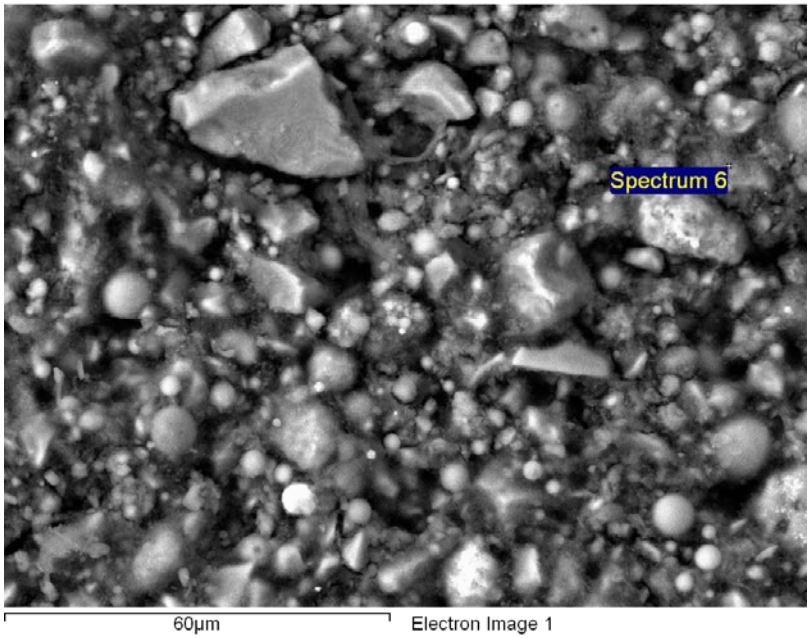
HC3-35-1S Site 5 Spectrum 6 (5.6)

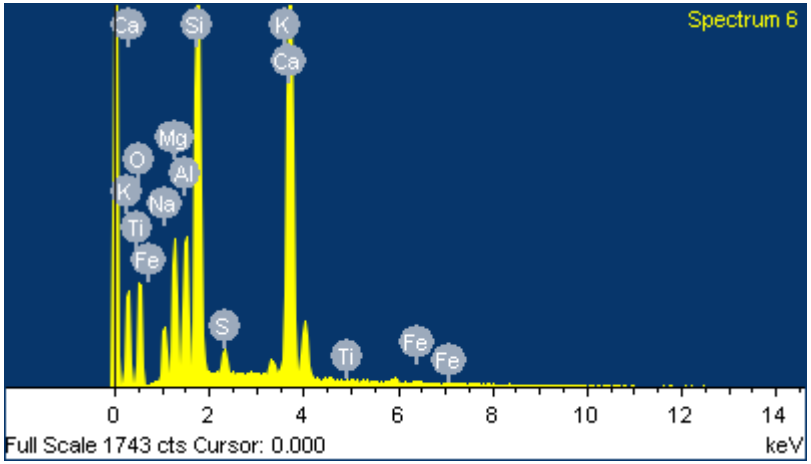
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.69	2.62	3.63	Na_2O
Mg K	4.77	4.39	7.90	MgO
Al K	4.02	3.33	7.59	Al_2O_3
Si K	20.16	16.07	43.14	SiO_2
S K	0.92	0.64	2.29	SO_3
K K	0.60	0.34	0.72	K_2O
Ca K	24.22	13.53	33.89	CaO
Ti K	0.27	0.12	0.44	TiO_2
Fe K	0.30	0.12	0.39	FeO
O	42.05	58.83		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

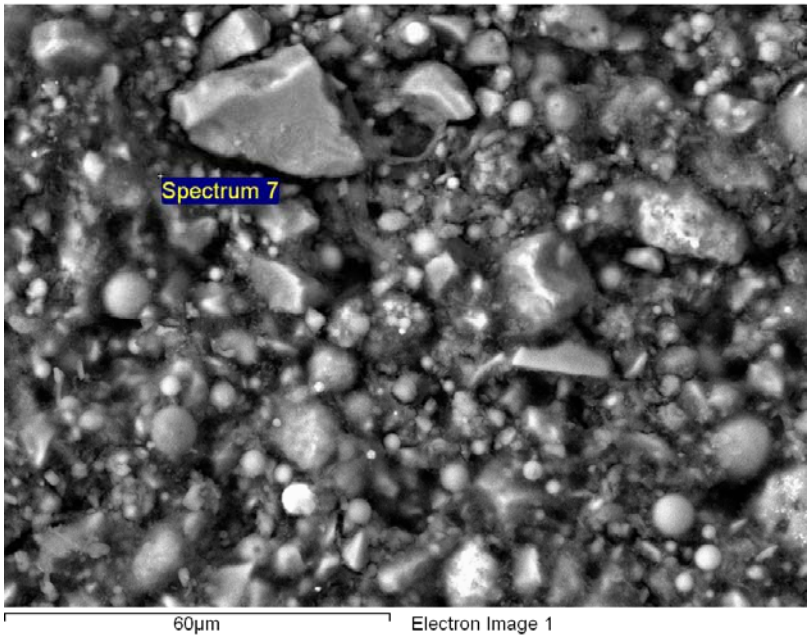
HC3-35-1S Site 5 Spectrum 7 (5.7)

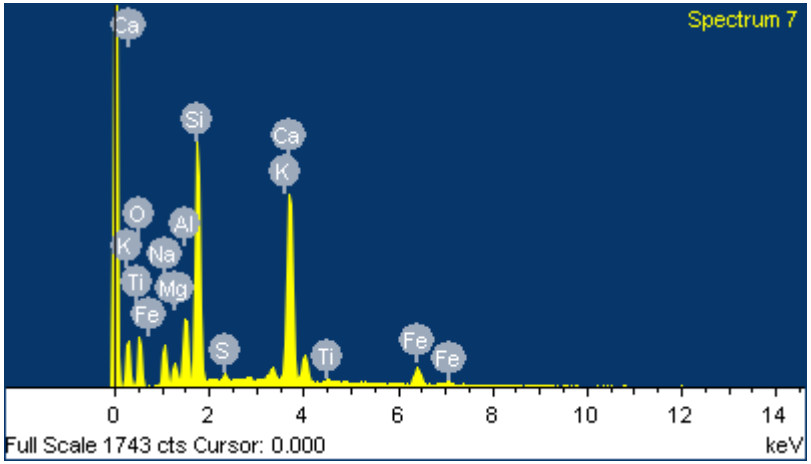
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.97	4.98	6.70	Na_2O
Mg K	1.79	1.69	2.97	MgO
Al K	4.74	4.05	8.97	Al_2O_3
Si K	18.49	15.15	39.54	SiO_2
S K	0.56	0.40	1.40	SO_3
K K	1.14	0.67	1.37	K_2O
Ca K	22.62	12.99	31.65	CaO
Ti K	0.61	0.29	1.02	TiO_2
Fe K	4.96	2.04	6.38	FeO
O	40.12	57.72		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

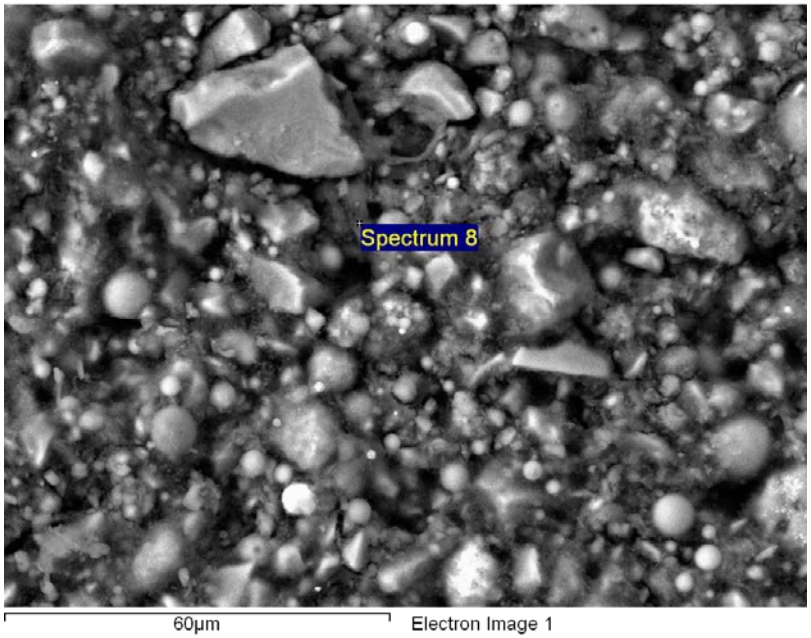
HC3-35-1S Site 5 Spectrum 8 (5.8)

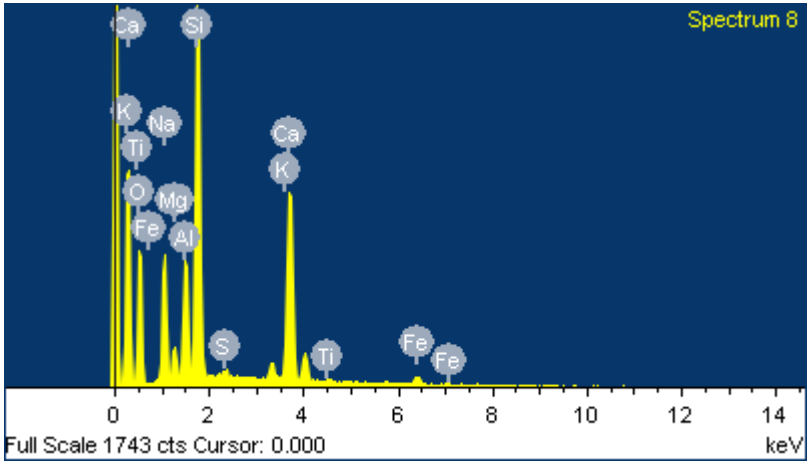
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	9.67	9.23	13.03	Na_2O
Mg K	1.97	1.78	3.26	MgO
Al K	5.86	4.77	11.07	Al_2O_3
Si K	20.83	16.28	44.56	SiO_2
S K	0.42	0.29	1.06	SO_3
K K	1.19	0.67	1.43	K_2O
Ca K	16.30	8.93	22.80	CaO
Ti K	0.31	0.14	0.52	TiO_2
Fe K	1.76	0.69	2.27	FeO
O	41.69	57.22		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

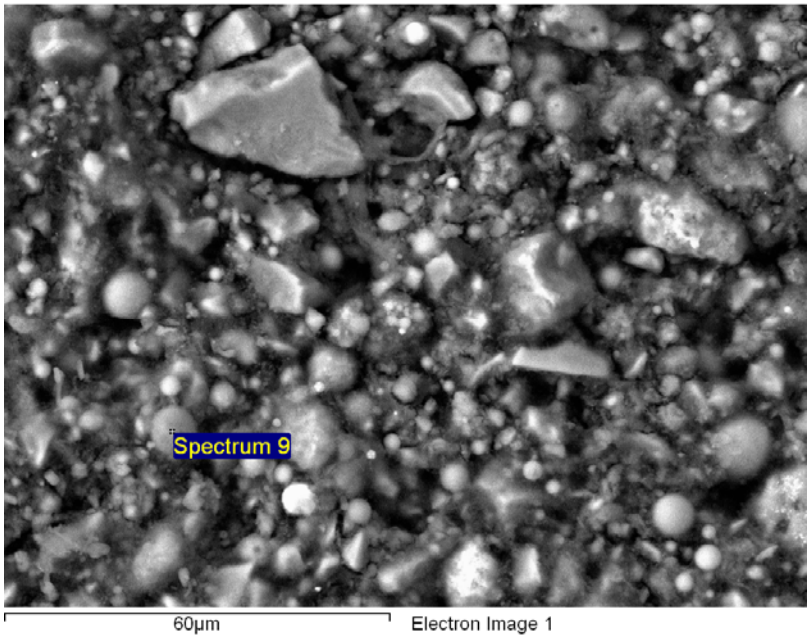
HC3-35-1S Site 5 Spectrum 9 (5.9)

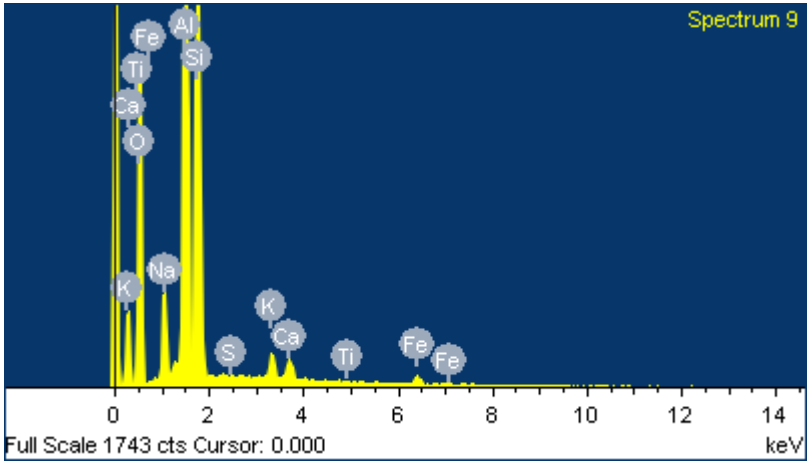
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 2

Standard :
Na Albite 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.99	3.56	5.38	Na_2O
Al K	20.60	15.66	38.92	Al_2O_3
Si K	23.94	17.49	51.22	SiO_2
S K	0.08	0.05	0.21	SO_3
K K	1.23	0.64	1.48	K_2O
Ca K	1.02	0.52	1.42	CaO
Ti K	0.05	0.02	0.08	TiO_2
Fe K	1.01	0.37	1.30	FeO
O	48.09	61.67		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *FA particle*

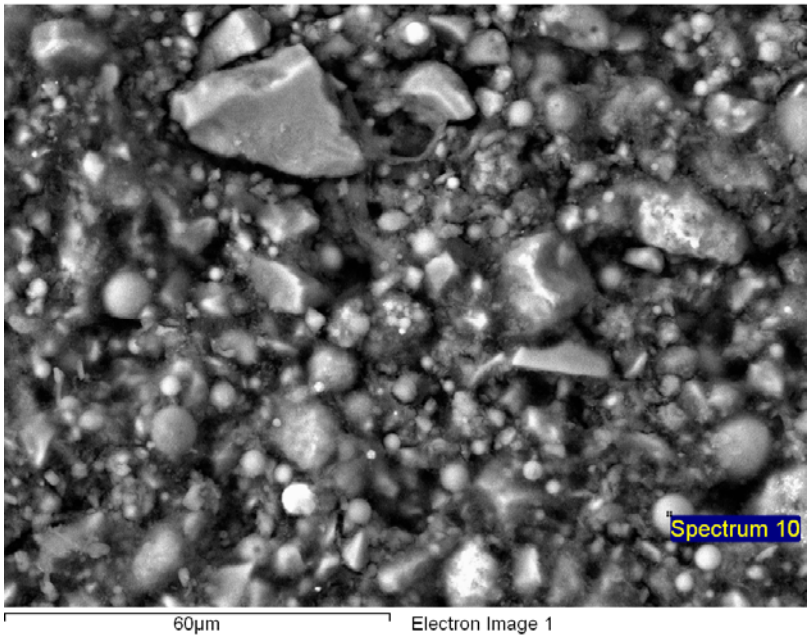
HC3-35-1S Site 5 Spectrum 10 (5.10)

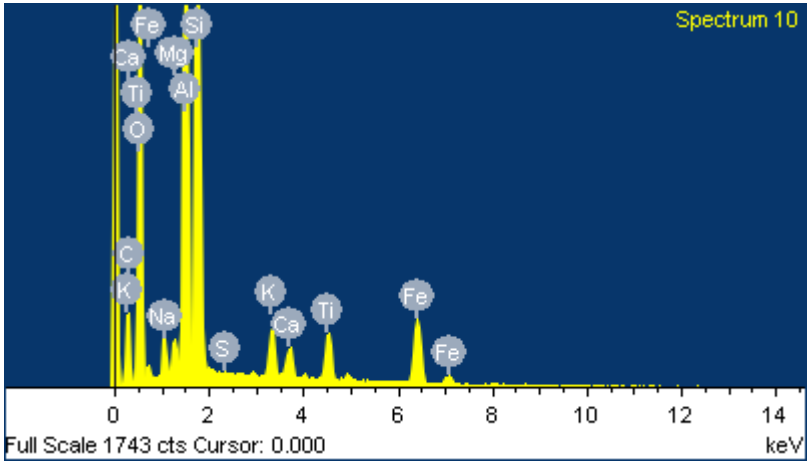
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.66	1.56	2.24	Na_2O
Mg K	0.85	0.76	1.41	MgO
Al K	15.84	12.69	29.93	Al_2O_3
Si K	22.31	17.17	47.72	SiO_2
S K	0.08	0.06	0.21	SO_3
K K	2.04	1.13	2.46	K_2O
Ca K	1.26	0.68	1.77	CaO
Ti K	2.93	1.32	4.89	TiO_2
Fe K	7.28	2.82	9.37	FeO
O	45.73	61.80		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *FA particle*

INCA

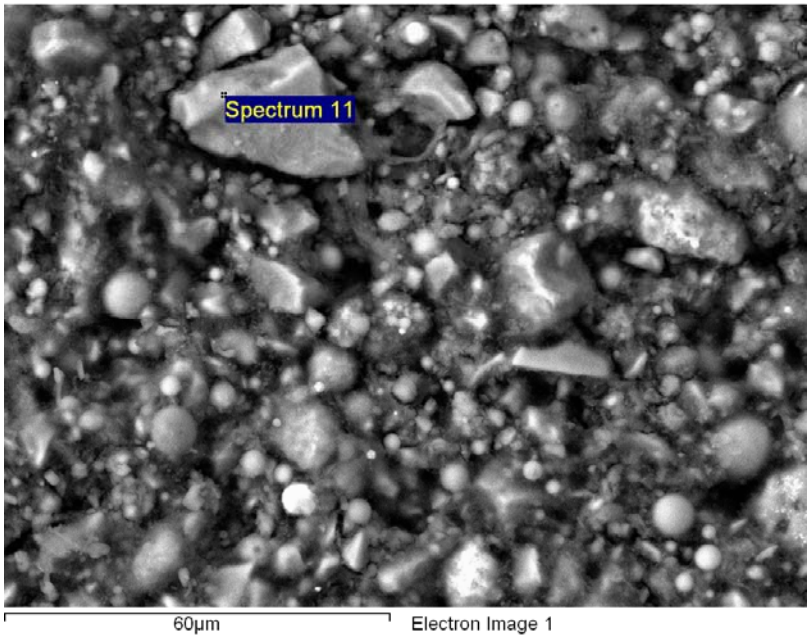
HC3-35-1S Site 5 Spectrum 11 (5.11)

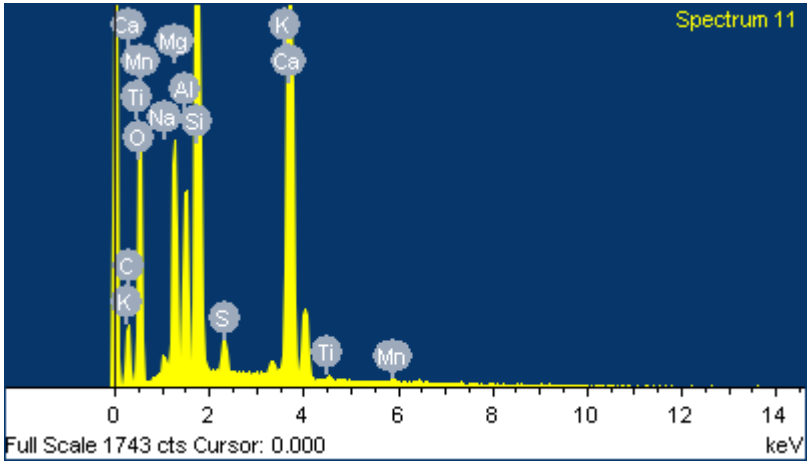
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Mn Mn 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	0.70	0.68	0.94	Na_2O
Mg K	6.59	6.03	10.93	MgO
Al K	4.42	3.65	8.36	Al_2O_3
Si K	20.19	16.00	43.19	SiO_2
S K	1.07	0.74	2.67	SO_3
K K	0.52	0.30	0.63	K_2O
Ca K	23.22	12.90	32.49	CaO
Ti K	0.26	0.12	0.44	TiO_2
Mn K	0.27	0.11	0.35	MnO
O	42.75	59.47		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *BFS particle*

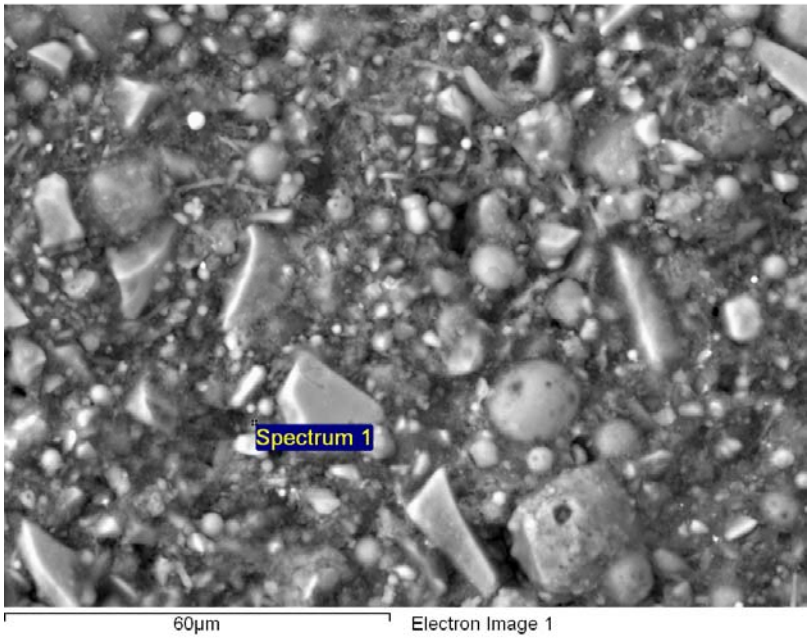
HC3-35-1S Site 6 Spectrum 1 (6.1)

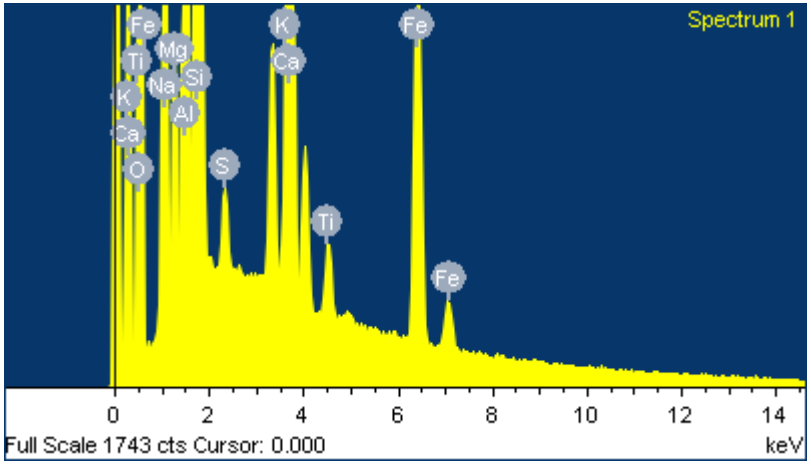
Spectrum processing :
Peak possibly omitted : 17.220 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.65	7.42	10.31	Na_2O
Mg K	1.67	1.53	2.77	MgO
Al K	9.24	7.64	17.47	Al_2O_3
Si K	18.86	14.98	40.35	SiO_2
S K	0.55	0.38	1.37	SO_3
K K	1.75	1.00	2.11	K_2O
Ca K	10.14	5.64	14.19	CaO
Ti K	0.88	0.41	1.46	TiO_2
Fe K	7.75	3.10	9.97	FeO
O	41.51	57.88		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

INCA

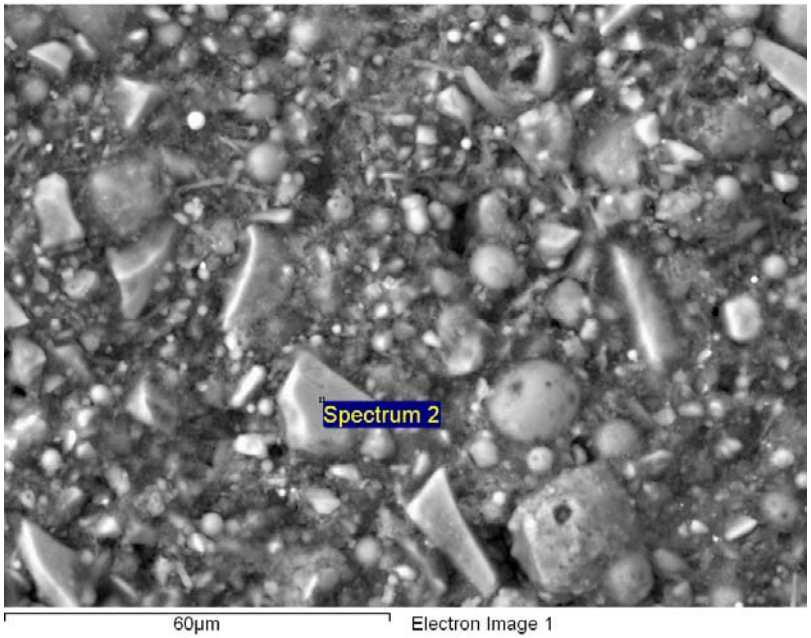
HC3-35-1S Site 6 Spectrum 2 (6.2)

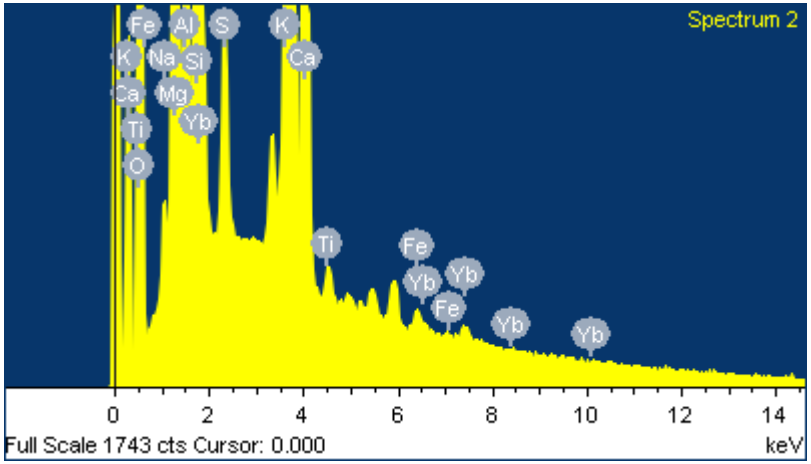
Spectrum processing :
Peak possibly omitted : 5.445 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM
Yb YbF3 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	0.41	0.40	0.55	Na_2O
Mg K	5.90	5.50	9.79	MgO
Al K	3.50	2.94	6.61	Al_2O_3
Si K	19.90	16.04	42.57	SiO_2
S K	0.87	0.61	2.17	SO_3
K K	0.38	0.22	0.46	K_2O
Ca K	26.00	14.69	36.38	CaO
Ti K	0.27	0.13	0.46	TiO_2
Fe K	0.20	0.08	0.25	FeO
Other	0.67	0.09	0.76	Other
O	41.90	59.30		
Totals	100.00			100.00





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *BFS particle*

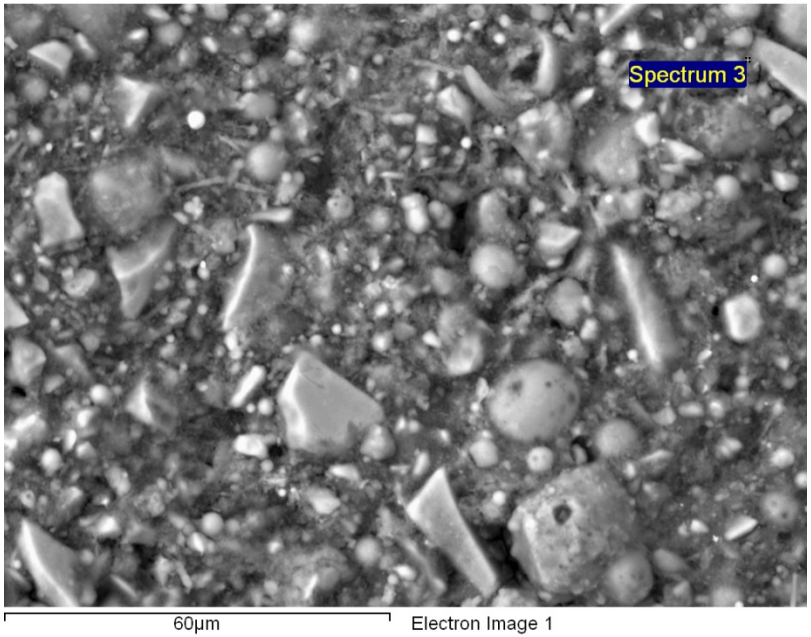
HC3-35-1S Site 6 Spectrum 3 (6.3)

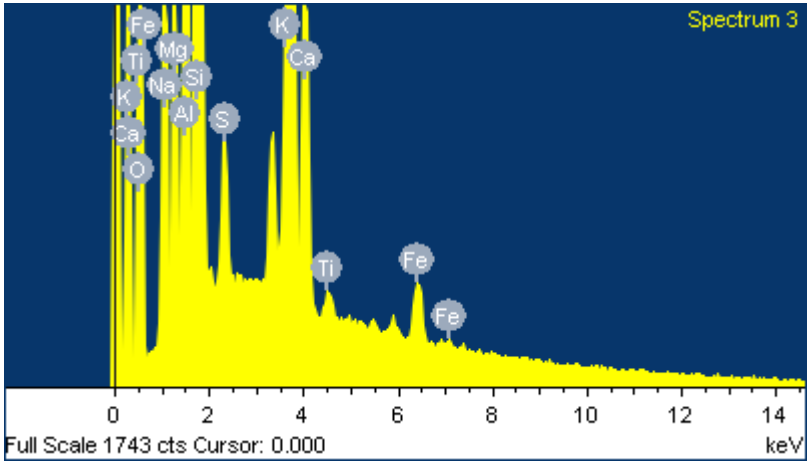
Spectrum processing :
Peak possibly omitted : 5.475 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.58	4.50	6.17	Na_2O
Mg K	2.34	2.18	3.88	MgO
Al K	4.36	3.65	8.24	Al_2O_3
Si K	19.59	15.76	41.90	SiO_2
S K	1.02	0.72	2.53	SO_3
K K	1.07	0.62	1.29	K_2O
Ca K	24.08	13.58	33.70	CaO
Ti K	0.34	0.16	0.56	TiO_2
Fe K	1.34	0.54	1.72	FeO
O	41.29	58.31		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

INCA

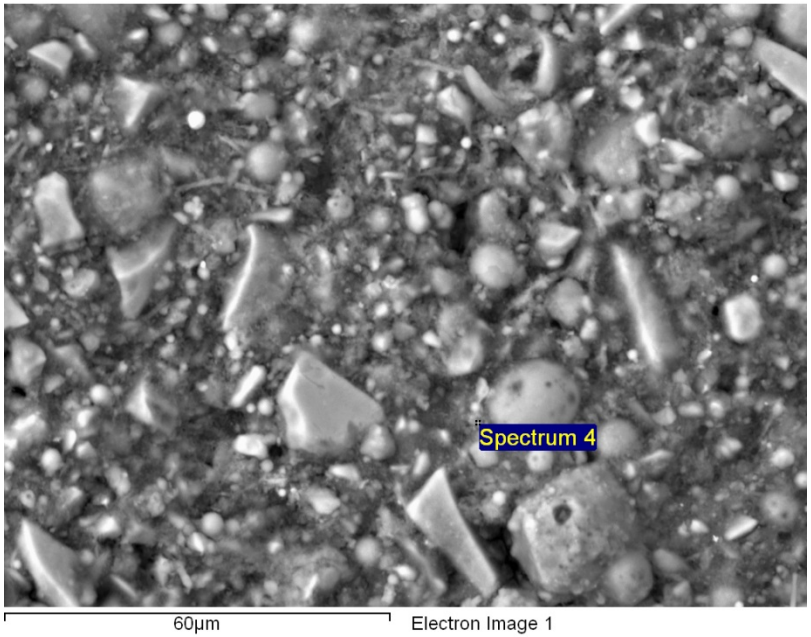
HC3-35-1S Site 6 Spectrum 4 (6.4)

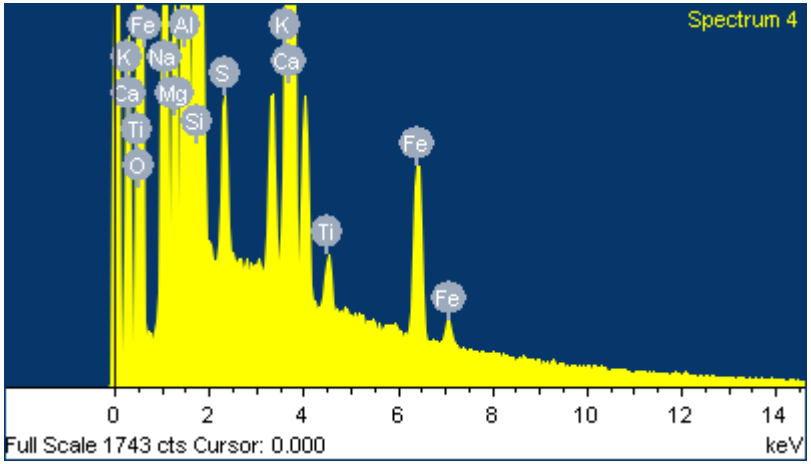
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.99	6.60	9.42	Na_2O
Mg K	1.58	1.41	2.62	MgO
Al K	9.99	8.04	18.87	Al_2O_3
Si K	20.61	15.95	44.08	SiO_2
S K	0.95	0.65	2.38	SO_3
K K	1.16	0.64	1.39	K_2O
Ca K	11.45	6.21	16.02	CaO
Ti K	0.55	0.25	0.92	TiO_2
Fe K	3.35	1.30	4.31	FeO
O	43.39	58.94		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

inca

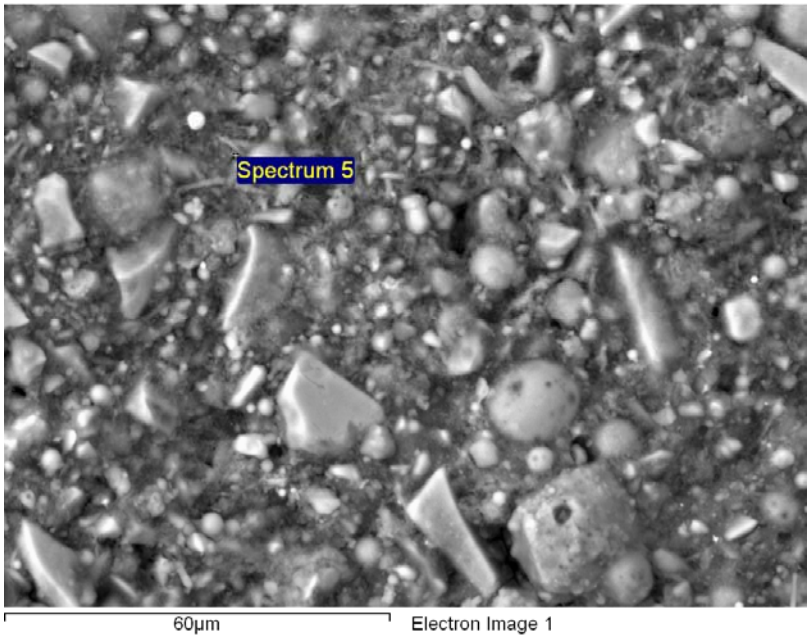
HC3-35-1S Site 6 Spectrum 5 (6.5)

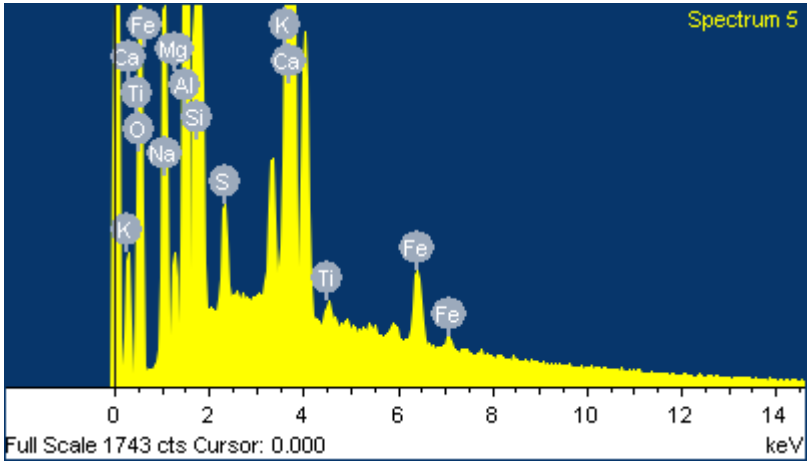
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.89	4.87	6.59	Na_2O
Mg K	0.88	0.82	1.45	MgO
Al K	5.18	4.40	9.78	Al_2O_3
Si K	18.19	14.84	38.92	SiO_2
S K	1.01	0.72	2.52	SO_3
K K	1.43	0.84	1.72	K_2O
Ca K	25.47	14.56	35.64	CaO
Ti K	0.36	0.17	0.60	TiO_2
Fe K	2.17	0.89	2.79	FeO
O	40.44	57.90		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

INCA

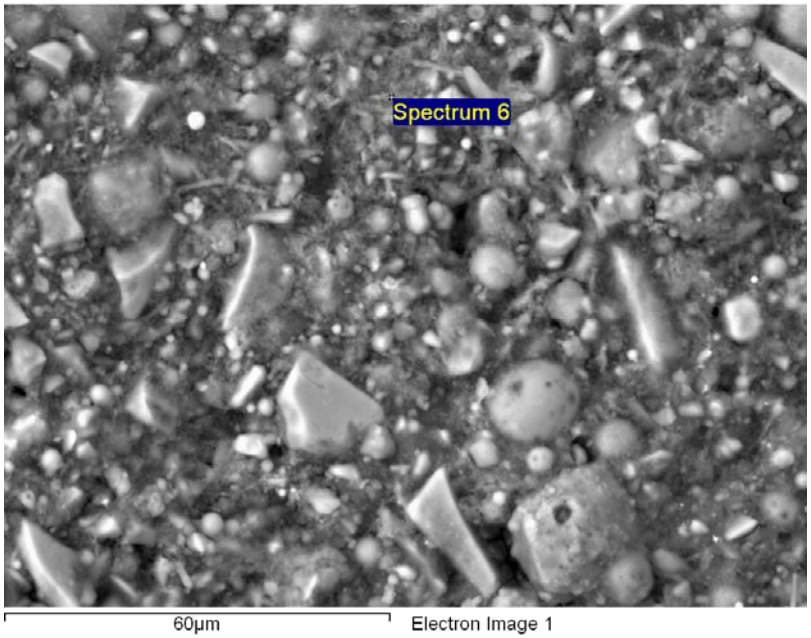
HC3-35-1S Site 6 Spectrum 6 (6.6)

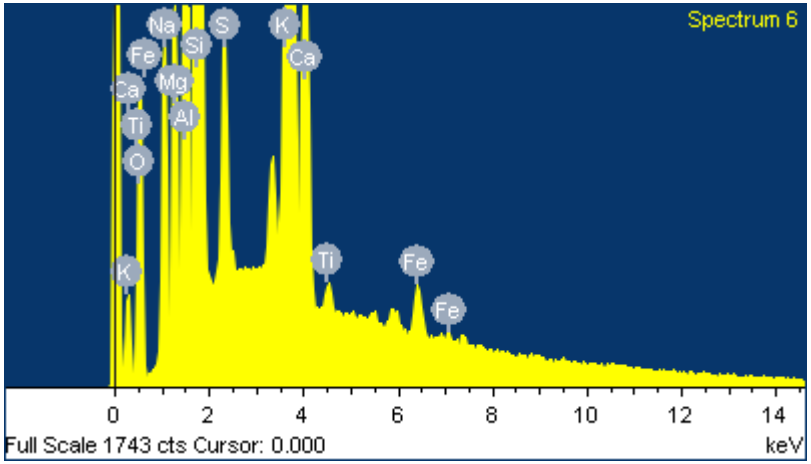
Spectrum processing :
Peak possibly omitted : 5.444 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.88	2.91	3.88	Na_2O
Mg K	2.29	2.19	3.80	MgO
Al K	3.29	2.83	6.21	Al_2O_3
Si K	16.81	13.90	35.96	SiO_2
S K	1.47	1.07	3.67	SO_3
K K	0.72	0.43	0.87	K_2O
Ca K	31.31	18.14	43.80	CaO
Ti K	0.31	0.15	0.53	TiO_2
Fe K	1.00	0.42	1.29	FeO
O	39.92	57.97		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

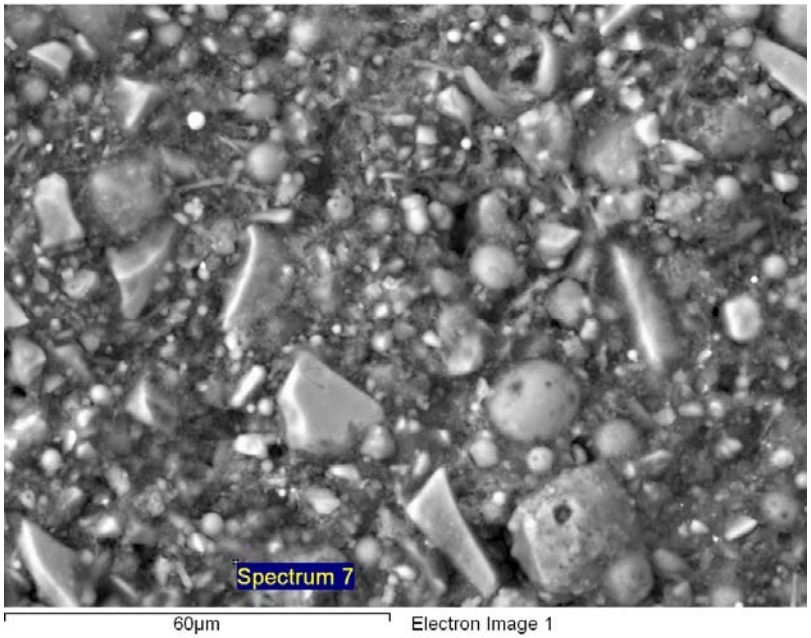
HC3-35-1S Site 6 Spectrum 7 (6.7)

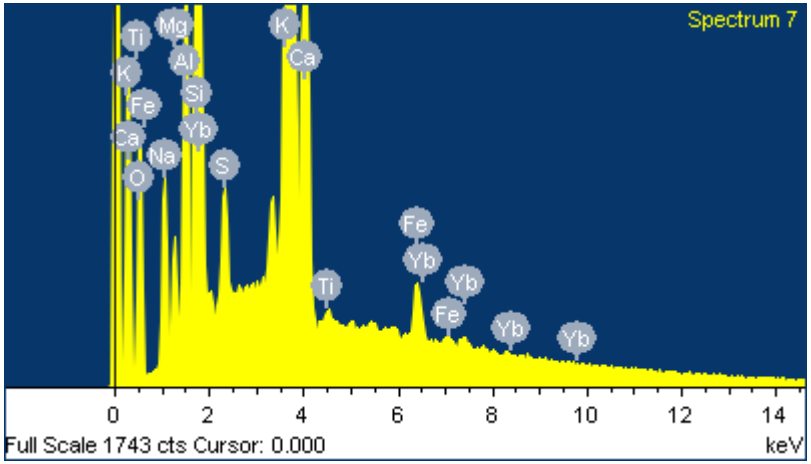
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM
Yb YbF3 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.18	2.36	2.94	Na_2O
Mg K	0.85	0.87	1.41	MgO
Al K	2.14	1.97	4.04	Al_2O_3
Si K	11.51	10.19	24.62	SiO_2
S K	0.83	0.64	2.07	SO_3
K K	0.64	0.41	0.77	K_2O
Ca K	43.59	27.05	60.99	CaO
Ti K	0.21	0.11	0.36	TiO_2
Fe K	1.48	0.66	1.90	FeO
Other	0.80	0.12	0.91	Other
O	35.78	55.62		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

inca

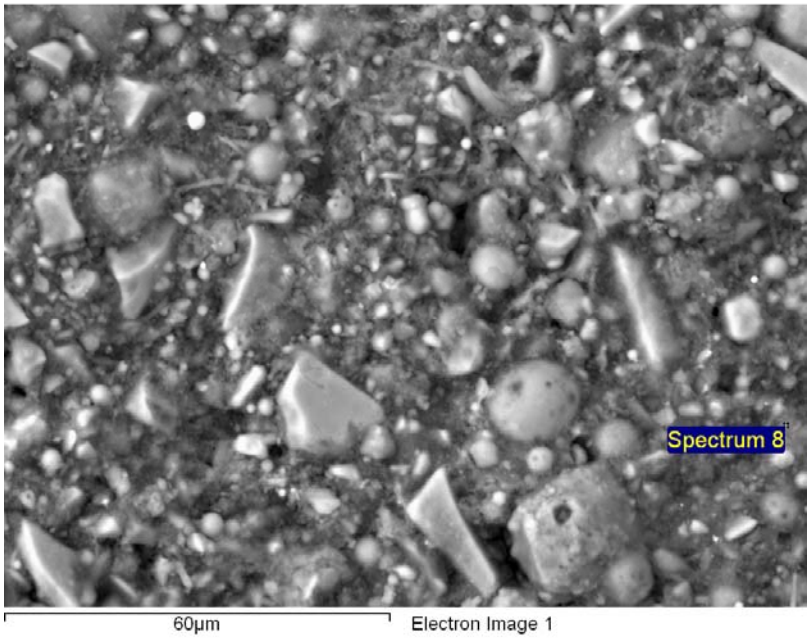
HC3-35-1S Site 6 Spectrum 7 (6.7)

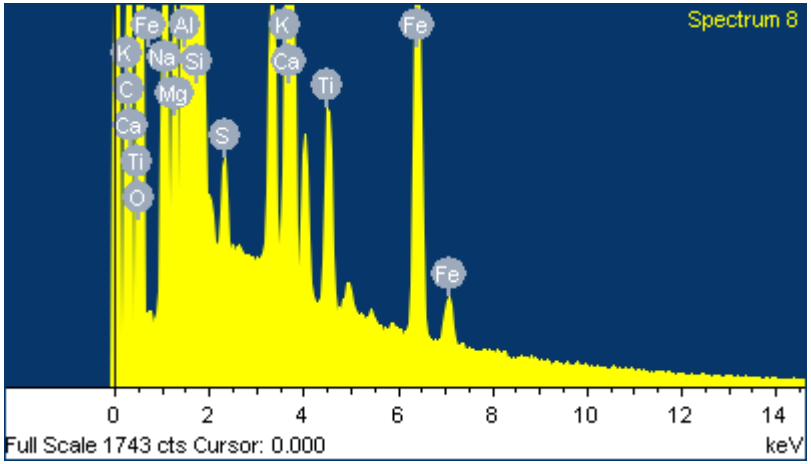
Spectrum processing :
Peaks possibly omitted : 5.428, 17.135 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.69	4.45	6.32	Na_2O
Mg K	1.12	1.01	1.86	MgO
Al K	11.66	9.44	22.03	Al_2O_3
Si K	21.41	16.66	45.79	SiO_2
S K	0.47	0.32	1.17	SO_3
K K	1.95	1.09	2.35	K_2O
Ca K	7.25	3.95	10.15	CaO
Ti K	1.74	0.79	2.90	TiO_2
Fe K	5.77	2.26	7.43	FeO
O	43.94	60.02		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

INCA

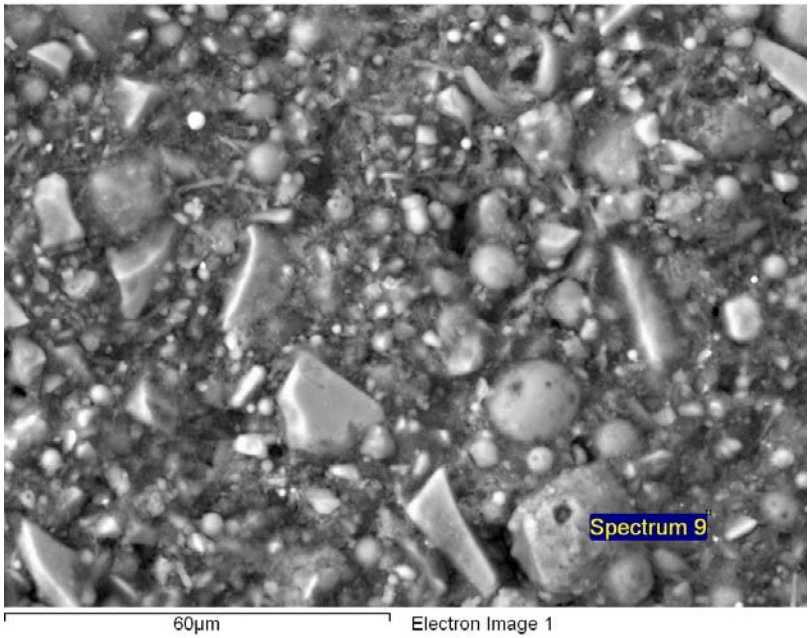
HC3-35-1S Site 6 Spectrum 9 (6.9)

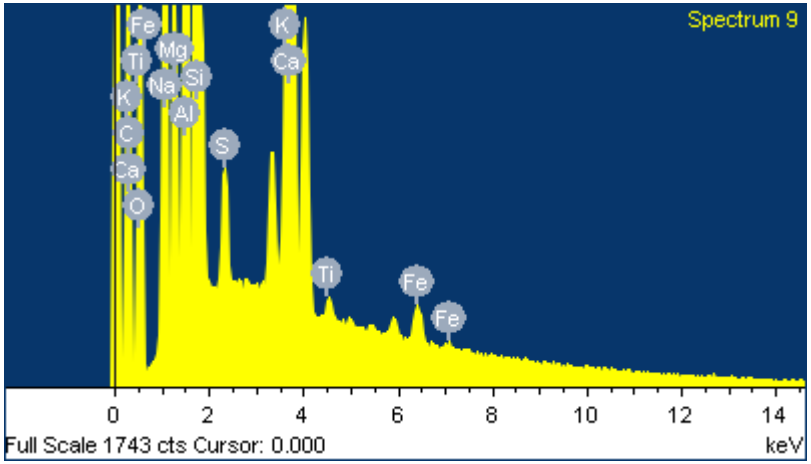
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.48	6.36	8.73	Na_2O
Mg K	2.98	2.76	4.94	MgO
Al K	4.68	3.92	8.84	Al_2O_3
Si K	17.79	14.30	38.06	SiO_2
S K	1.03	0.72	2.56	SO_3
K K	1.23	0.71	1.48	K_2O
Ca K	23.96	13.49	33.52	CaO
Ti K	0.34	0.16	0.57	TiO_2
Fe K	1.01	0.41	1.30	FeO
O	40.51	57.16		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 28 days
Type of material analyzed: *matrix*

INCA

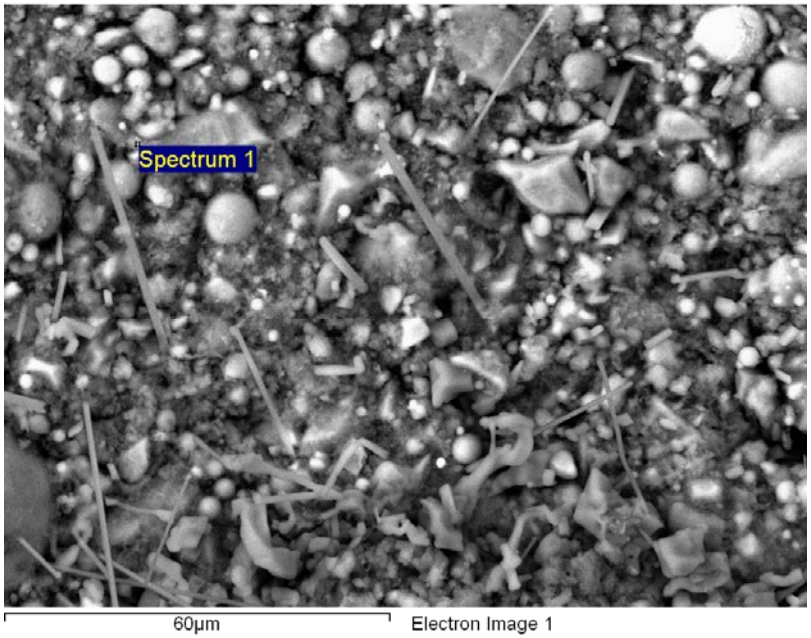
HC3-45-1S Site 4 Spectrum 1 (4.1)

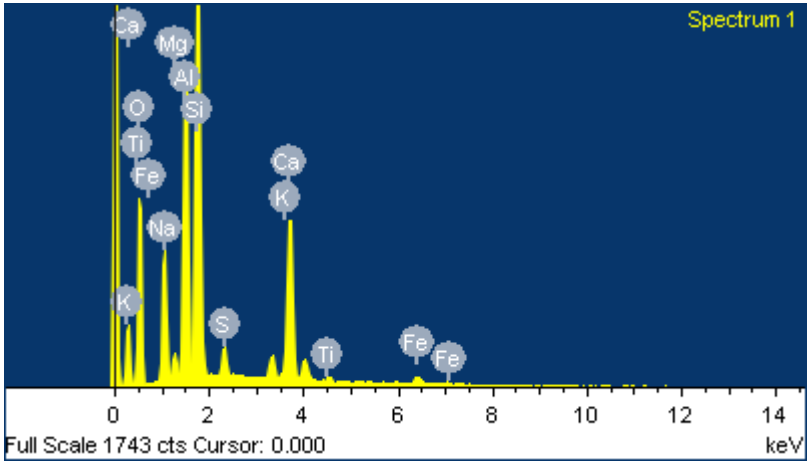
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.02	6.52	9.47	Na_2O
Mg K	0.90	0.79	1.49	MgO
Al K	10.70	8.46	20.23	Al_2O_3
Si K	22.15	16.83	47.39	SiO_2
S K	1.45	0.96	3.62	SO_3
K K	1.32	0.72	1.60	K_2O
Ca K	9.82	5.23	13.74	CaO
Ti K	0.45	0.20	0.75	TiO_2
Fe K	1.34	0.51	1.72	FeO
O	44.84	59.78		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

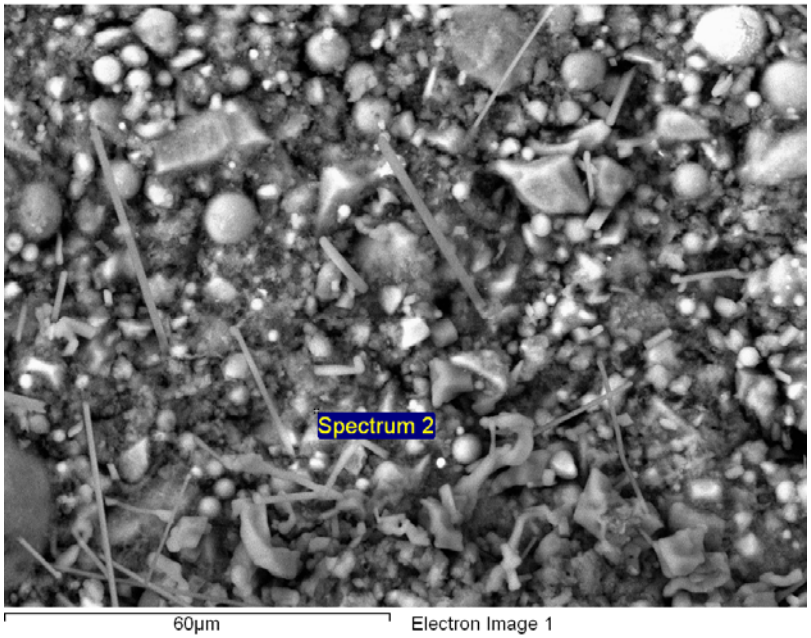
HC3-45-1S Site 4 Spectrum 2 (4.2)

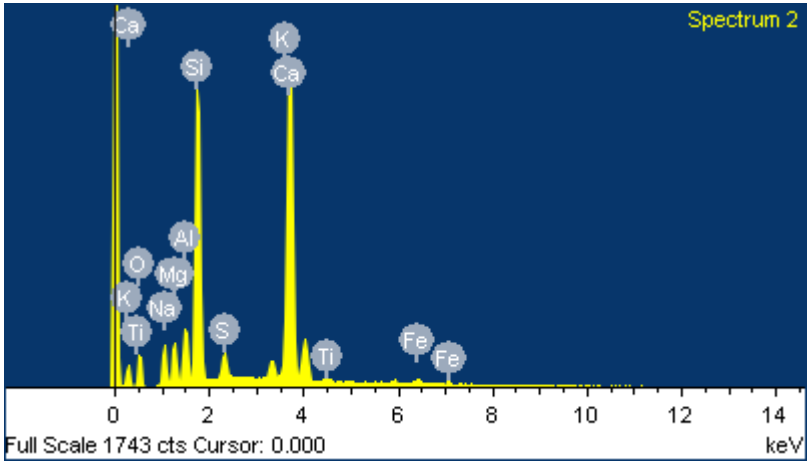
Spectrum processing :
Peak possibly omitted : 5.880 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.54	3.56	4.78	Na_2O
Mg K	2.78	2.64	4.60	MgO
Al K	2.99	2.55	5.64	Al_2O_3
Si K	17.16	14.11	36.72	SiO_2
S K	1.65	1.19	4.11	SO_3
K K	1.35	0.80	1.63	K_2O
Ca K	28.88	16.63	40.41	CaO
Ti K	0.32	0.16	0.54	TiO_2
Fe K	1.21	0.50	1.56	FeO
O	40.11	57.87		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

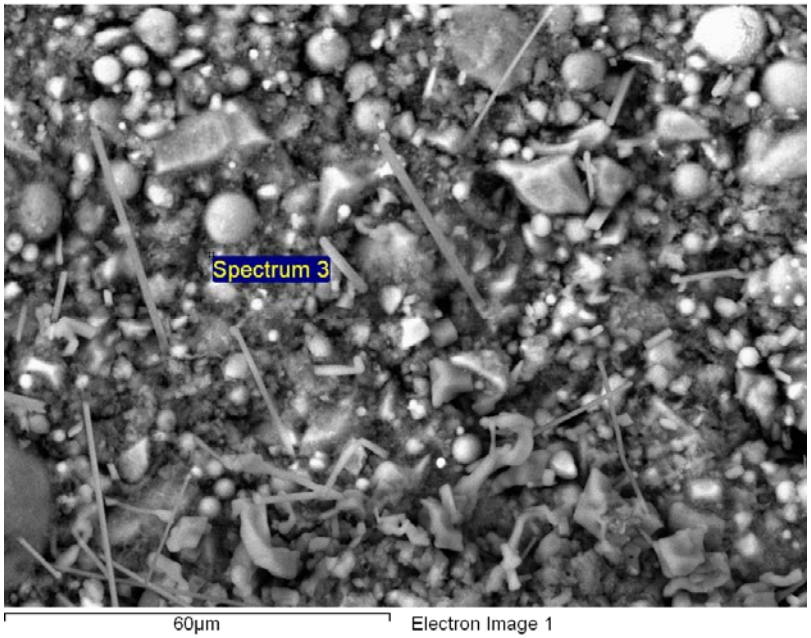
HC3-45-1S Site 4 Spectrum 3 (4.3)

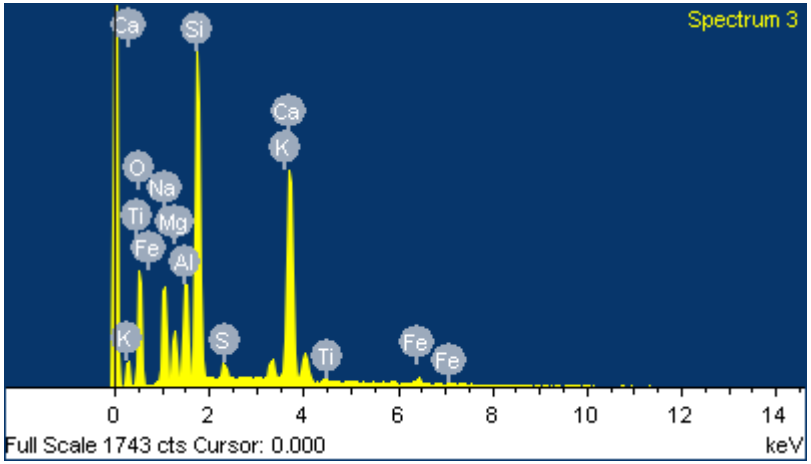
Spectrum processing :
Peak possibly omitted : 5.900 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	8.58	8.27	11.57	Na_2O
Mg K	3.30	3.01	5.47	MgO
Al K	5.47	4.49	10.34	Al_2O_3
Si K	18.54	14.62	39.67	SiO_2
S K	1.14	0.79	2.85	SO_3
K K	1.60	0.91	1.93	K_2O
Ca K	18.89	10.43	26.43	CaO
Ti K	0.16	0.07	0.26	TiO_2
Fe K	1.14	0.45	1.47	FeO
O	41.16	56.96		
Totals	100.00			





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

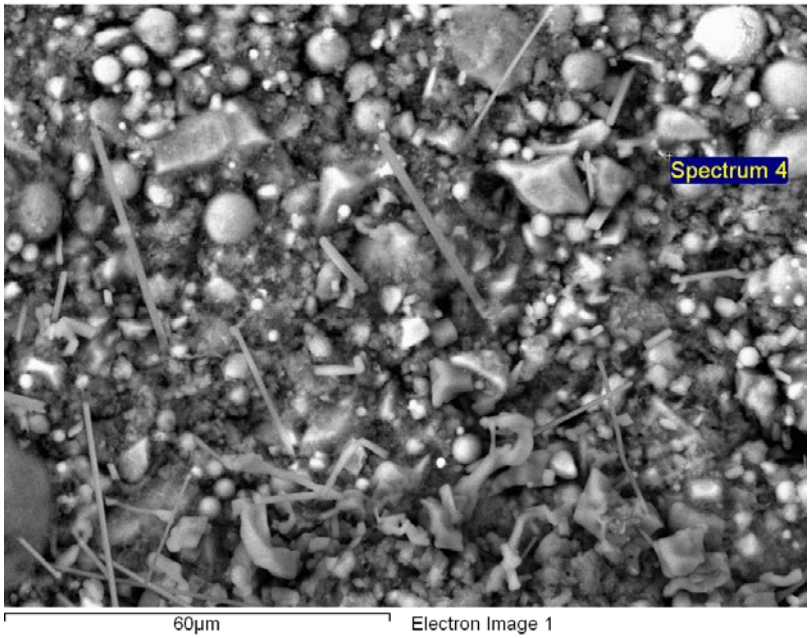
HC3-45-1S Site 4 Spectrum 4 (4.4)

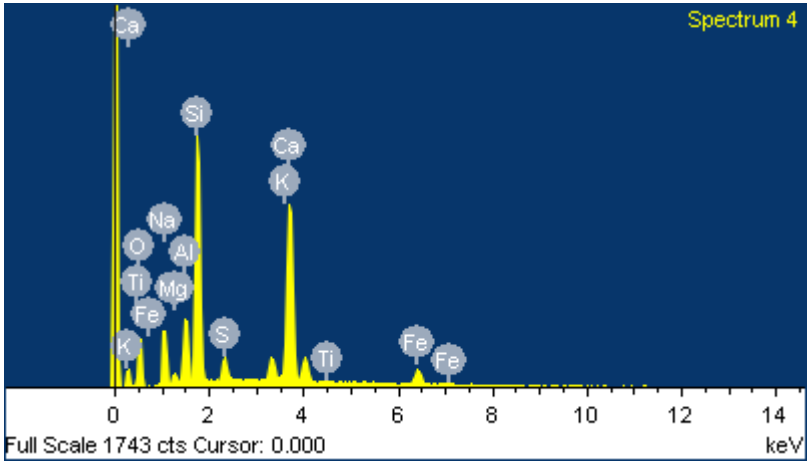
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.93	6.87	9.34	Na_2O
Mg K	0.91	0.85	1.50	MgO
Al K	4.52	3.82	8.54	Al_2O_3
Si K	17.74	14.41	37.95	SiO_2
S K	2.03	1.44	5.07	SO_3
K K	2.26	1.32	2.73	K_2O
Ca K	20.78	11.83	29.08	CaO
Ti K	0.33	0.16	0.54	TiO_2
Fe K	4.08	1.67	5.25	FeO
O	40.42	57.63		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

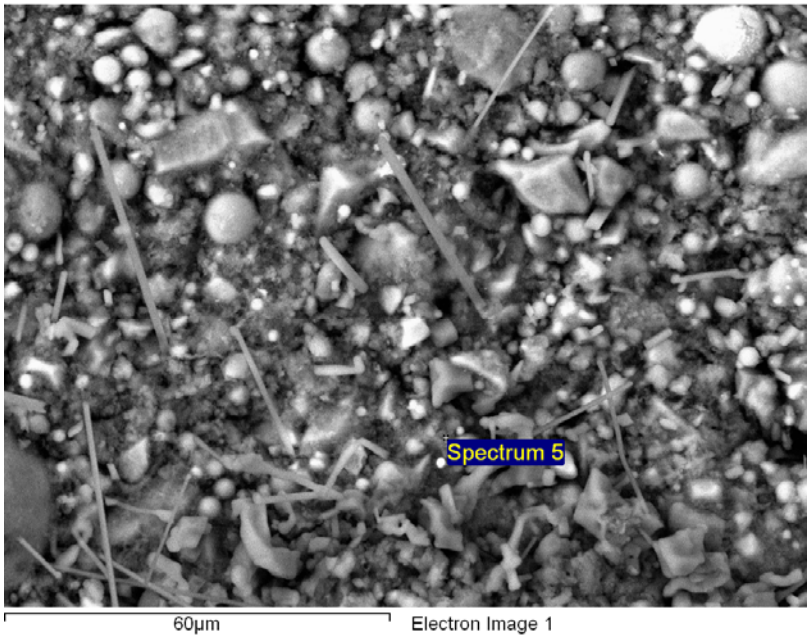
HC3-45-1S Site 4 Spectrum 5 (4.5)

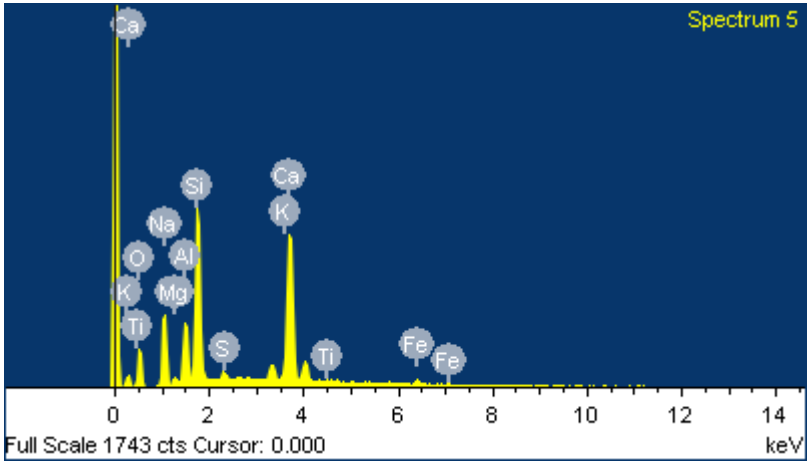
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	10.42	10.28	14.05	Na_2O
Mg K	0.70	0.66	1.17	MgO
Al K	5.46	4.59	10.31	Al_2O_3
Si K	16.62	13.42	35.56	SiO_2
S K	0.84	0.59	2.10	SO_3
K K	2.35	1.36	2.83	K_2O
Ca K	22.19	12.56	31.05	CaO
Ti K	0.40	0.19	0.67	TiO_2
Fe K	1.76	0.72	2.27	FeO
O	39.25	55.63		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

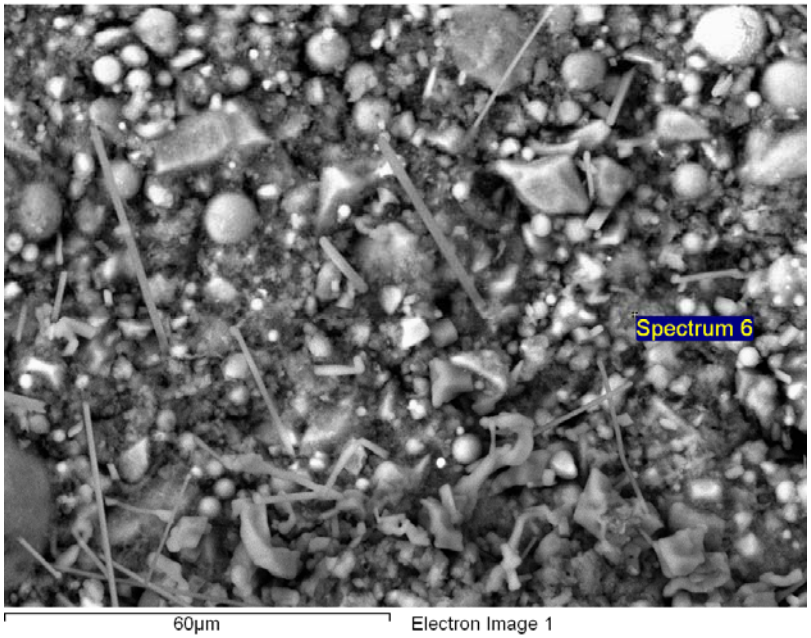
HC3-45-1S Site 4 Spectrum 6 (4.6)

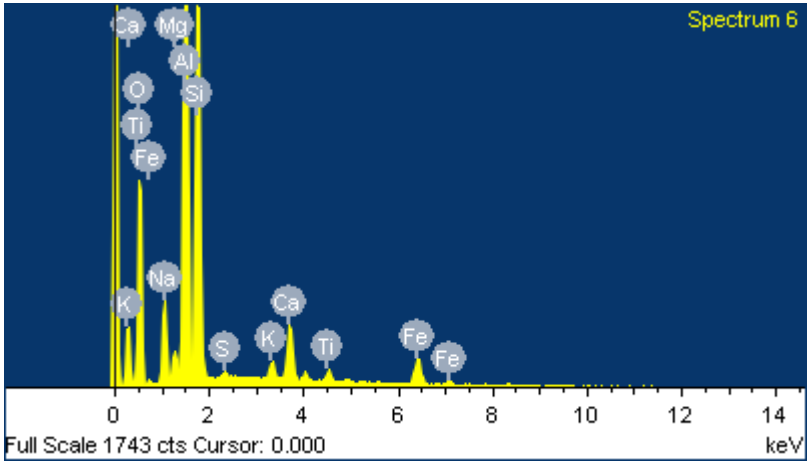
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.56	4.19	6.14	Na_2O
Mg K	1.12	0.98	1.86	MgO
Al K	19.75	15.47	37.31	Al_2O_3
Si K	19.35	14.57	41.40	SiO_2
S K	0.31	0.21	0.78	SO_3
K K	0.89	0.48	1.08	K_2O
Ca K	3.42	1.80	4.78	CaO
Ti K	0.86	0.38	1.44	TiO_2
Fe K	4.05	1.53	5.21	FeO
O	45.69	60.38		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

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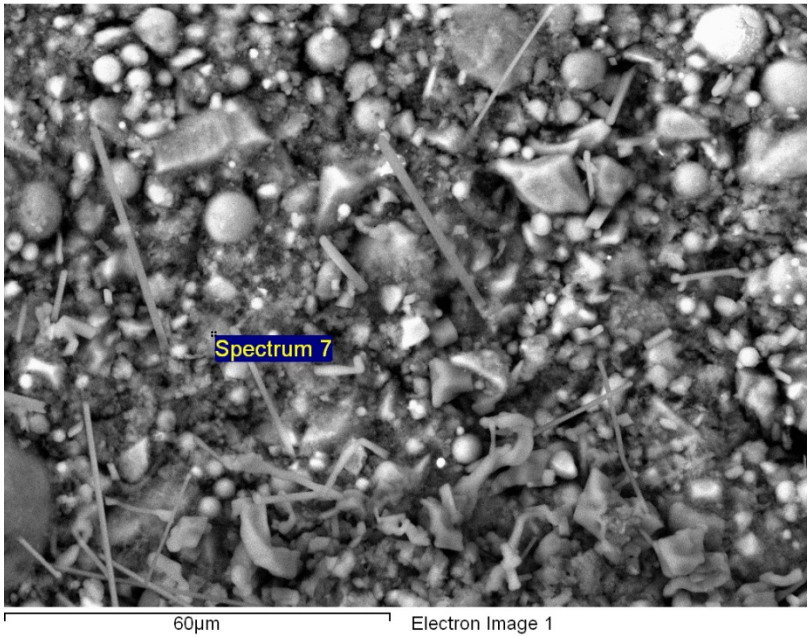
HC3-45-1S Site 4 Spectrum 7 (4.7)

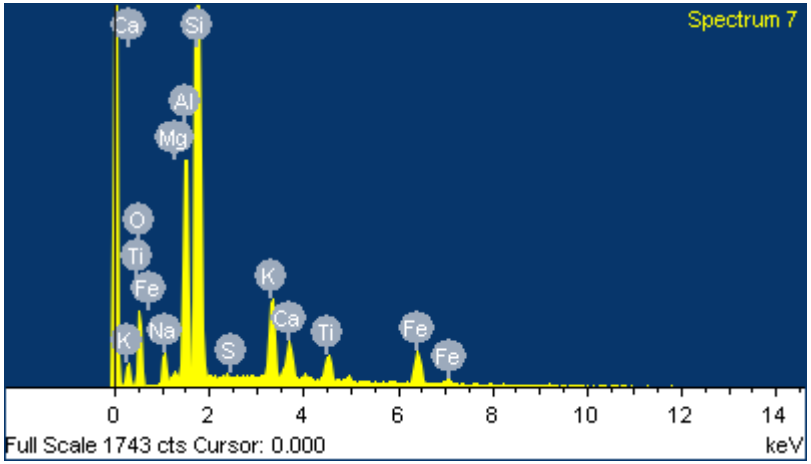
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.98	1.85	2.66	Na_2O
Mg K	0.24	0.22	0.40	MgO
Al K	7.42	5.92	14.02	Al_2O_3
Si K	29.80	22.85	63.75	SiO_2
S K	0.10	0.06	0.24	SO_3
K K	4.61	2.54	5.55	K_2O
Ca K	2.24	1.21	3.14	CaO
Ti K	2.36	1.06	3.94	TiO_2
Fe K	4.90	1.89	6.30	FeO
O	46.36	62.40		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

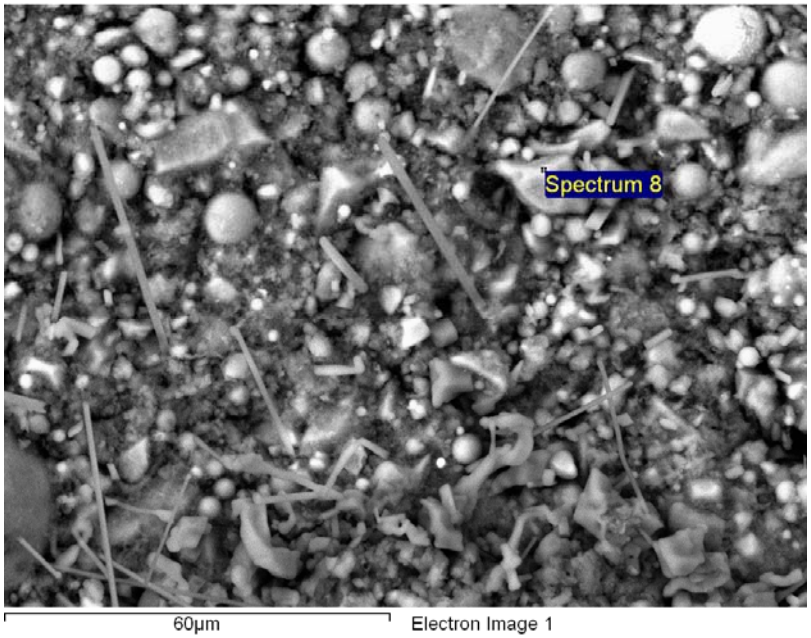
HC3-45-1S Site 4 Spectrum 8 (4.8)

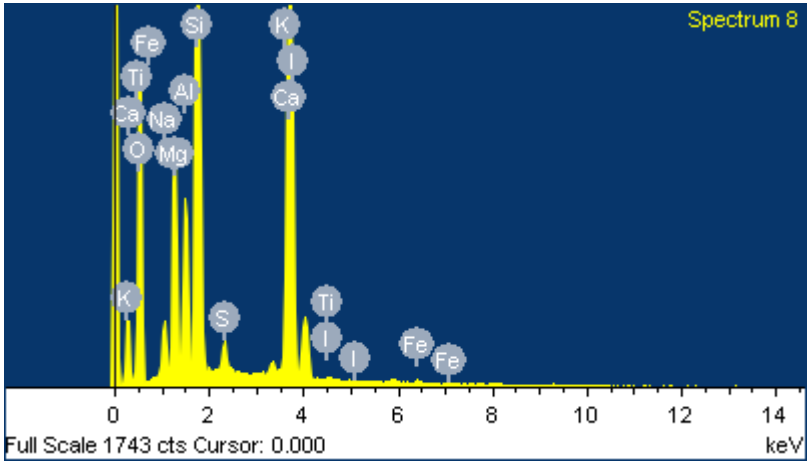
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM
I Not defined 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.07	2.00	2.78	Na_2O
Mg K	6.73	6.15	11.17	MgO
Al K	4.27	3.52	8.07	Al_2O_3
Si K	20.04	15.85	42.86	SiO_2
S K	0.96	0.66	2.39	SO_3
K K	0.51	0.29	0.61	K_2O
Ca K	22.39	12.41	31.33	CaO
Ti K	0.12	0.06	0.20	TiO_2
Fe K	0.33	0.13	0.42	FeO
I L	0.16	0.03	0.00	
O	42.42	58.91		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *BFS particle*

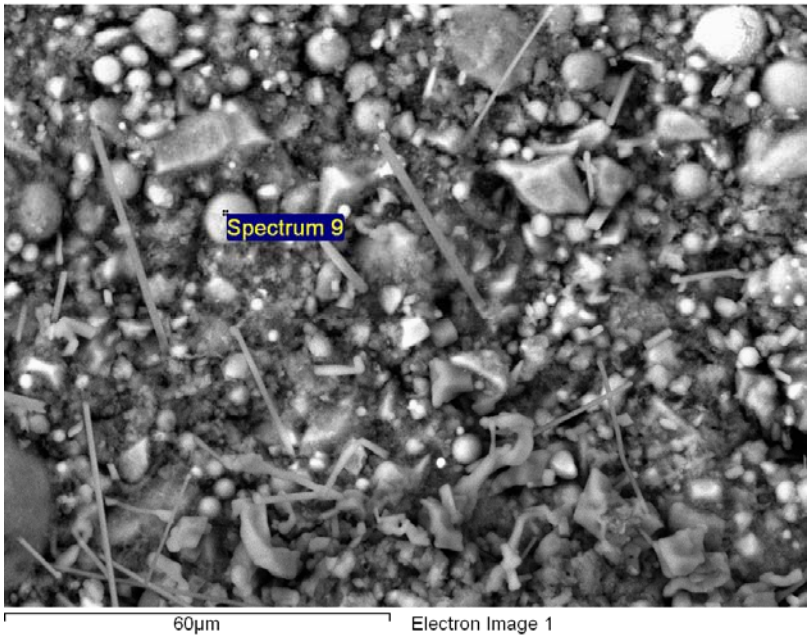
HC3-45-1S Site 4 Spectrum 9 (4.9)

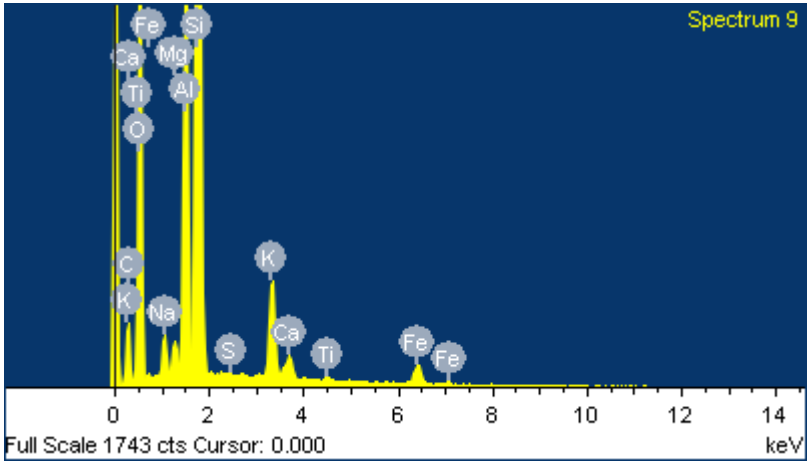
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.44	1.30	1.94	Na_2O
Mg K	0.73	0.63	1.22	MgO
Al K	9.15	7.05	17.29	Al_2O_3
Si K	32.96	24.41	70.52	SiO_2
S K	0.03	0.02	0.06	SO_3
K K	3.82	2.03	4.60	K_2O
Ca K	0.97	0.50	1.35	CaO
Ti K	0.24	0.10	0.39	TiO_2
Fe K	2.04	0.76	2.62	FeO
O	48.63	63.20		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *FA particle*

INCA

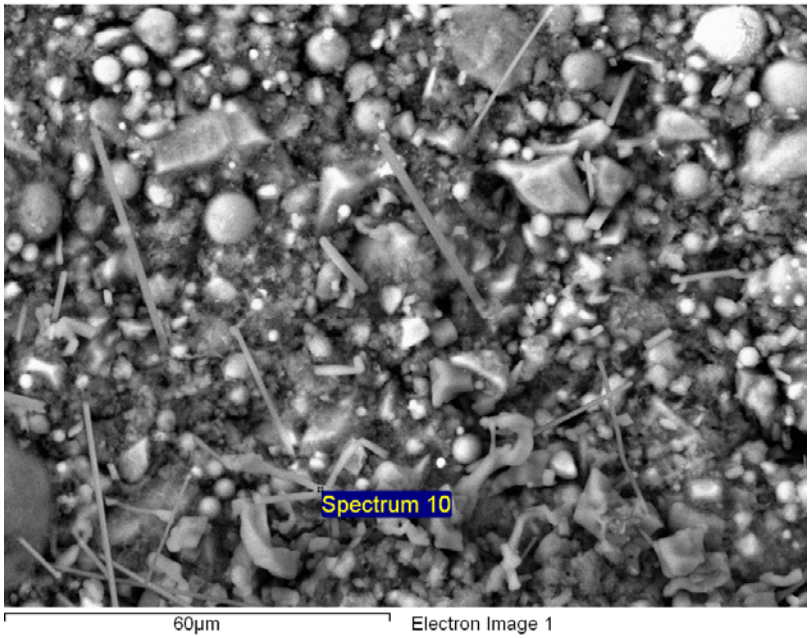
HC3-45-1S Site 4 Spectrum 10 (4.10)

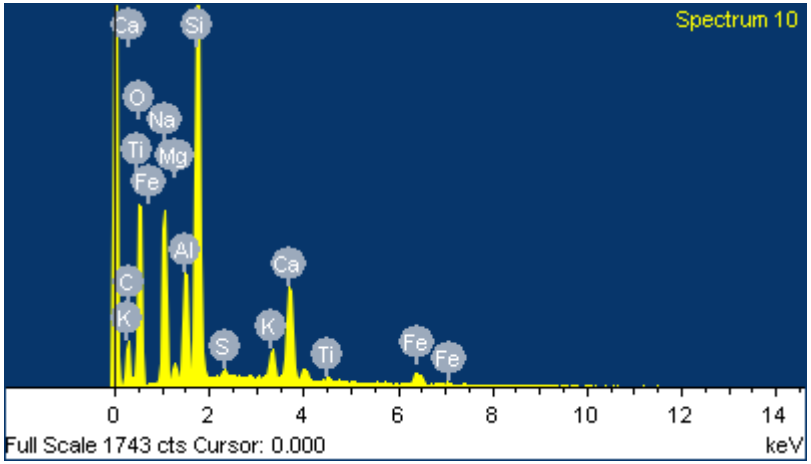
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	13.18	12.29	17.77	Na_2O
Mg K	0.95	0.84	1.57	MgO
Al K	5.60	4.45	10.59	Al_2O_3
Si K	23.86	18.20	51.04	SiO_2
S K	0.48	0.32	1.19	SO_3
K K	2.25	1.23	2.71	K_2O
Ca K	7.87	4.21	11.01	CaO
Ti K	0.45	0.20	0.74	TiO_2
Fe K	2.63	1.01	3.38	FeO
O	42.74	57.25		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *Needle-like particle*

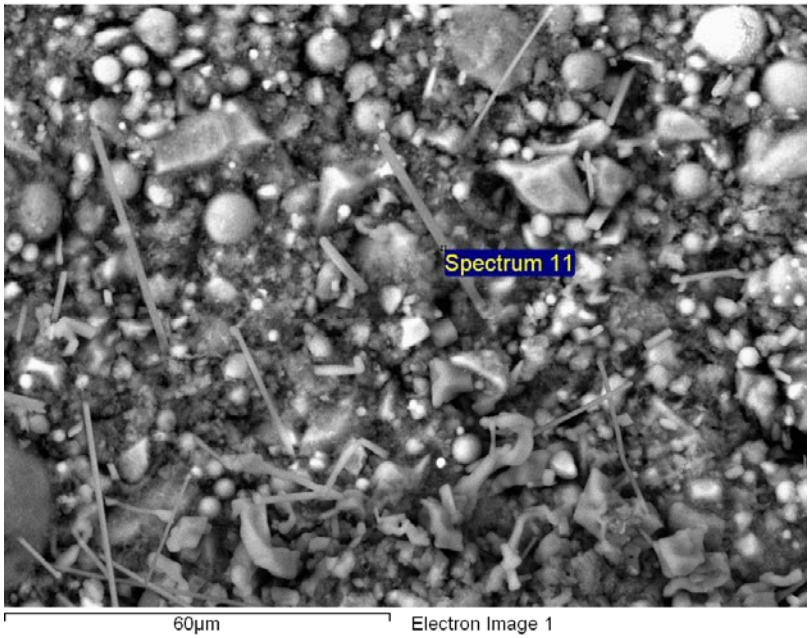
HC3-45-1S Site 4 Spectrum 11 (4.11)

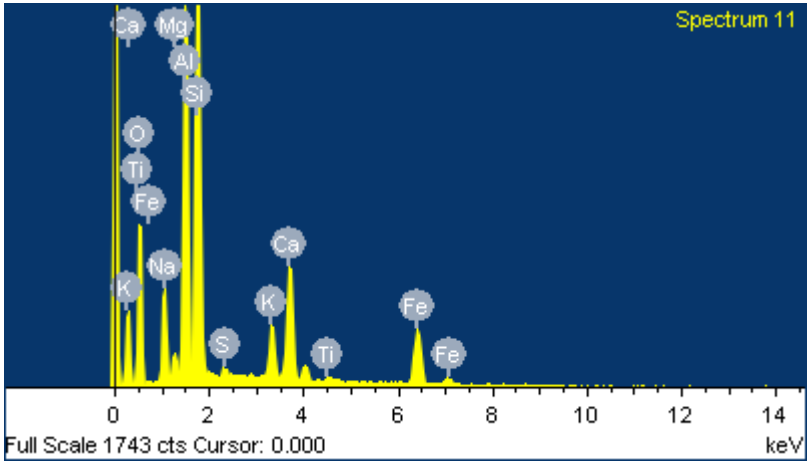
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.81	4.60	6.49	Na_2O
Mg K	0.86	0.78	1.43	MgO
Al K	12.13	9.87	22.92	Al_2O_3
Si K	21.35	16.69	45.67	SiO_2
S K	0.43	0.30	1.08	SO_3
K K	2.70	1.51	3.25	K_2O
Ca K	6.26	3.43	8.75	CaO
Ti K	0.26	0.12	0.44	TiO_2
Fe K	7.76	3.05	9.98	FeO
O	43.44	59.64		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *Needle-like particle*

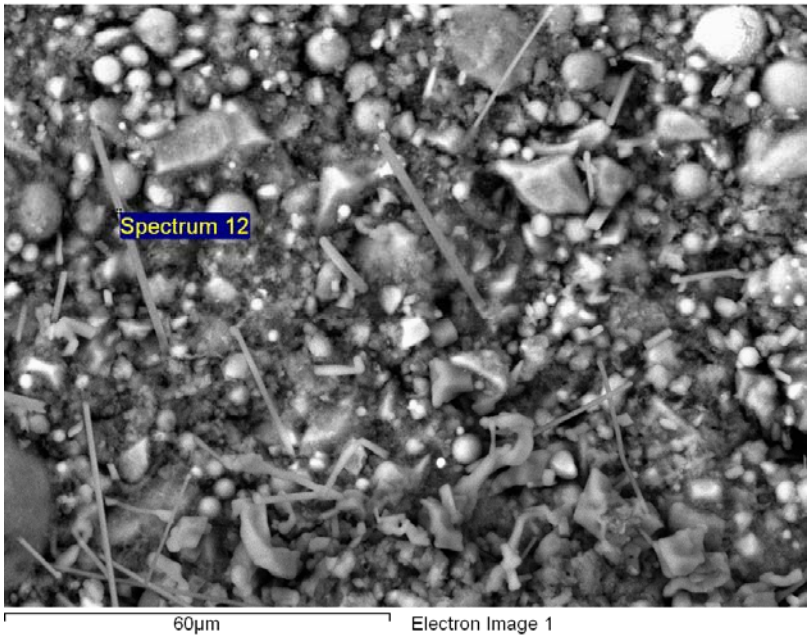
HC3-45-1S Site 4 Spectrum 12 (4.12)

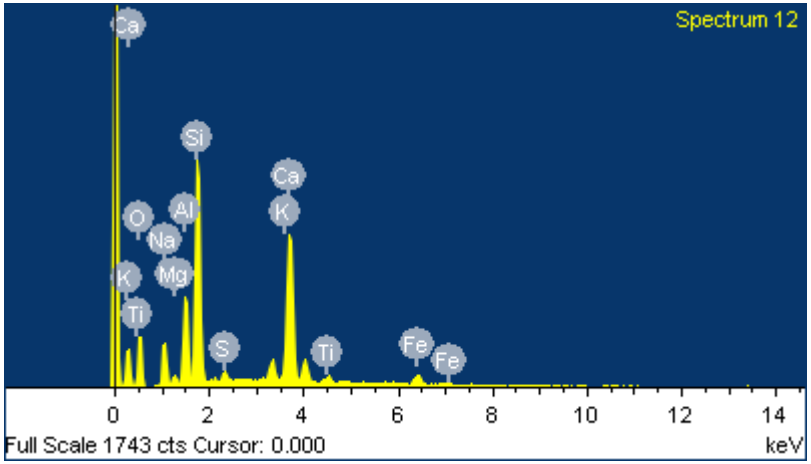
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalised)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.71	5.63	7.70	Na2O
Mg K	0.75	0.70	1.25	MgO
Al K	6.66	5.59	12.58	Al2O3
Si K	18.61	15.01	39.81	SiO2
S K	1.02	0.72	2.55	SO3
K K	2.18	1.26	2.62	K2O
Ca K	19.51	11.03	27.30	CaO
Ti K	1.14	0.54	1.89	TiO2
Fe K	3.35	1.36	4.31	FeO
O	41.08	58.17		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *Needle-like particle*

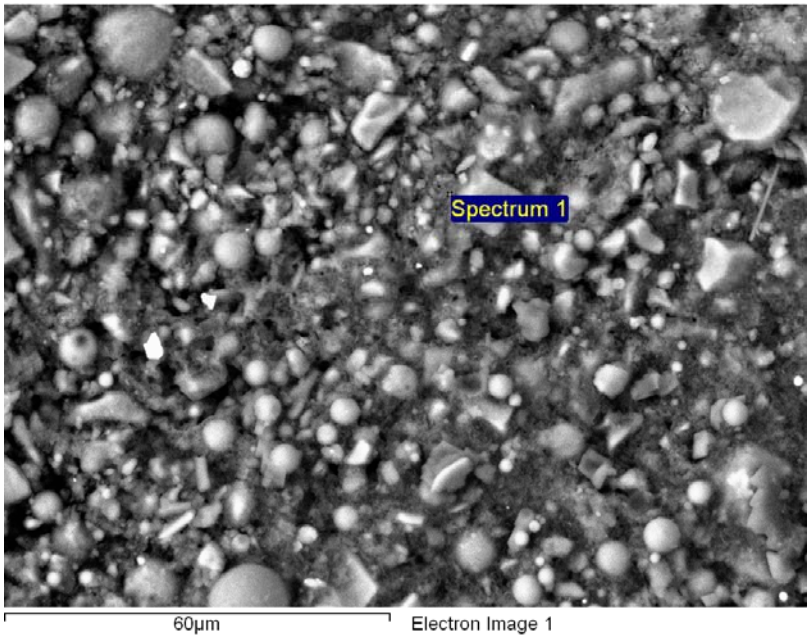
HC3-45-1S Site 5 Spectrum 1 (5.1)

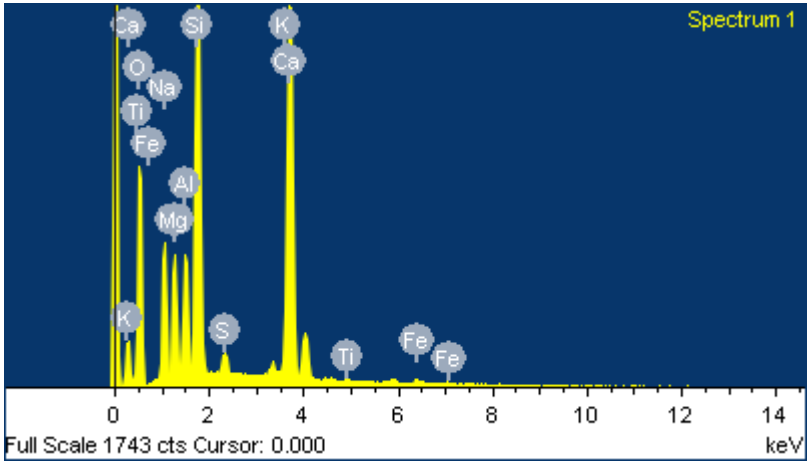
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.32	7.05	9.87	Na_2O
Mg K	5.00	4.56	8.29	MgO
Al K	4.15	3.41	7.84	Al_2O_3
Si K	18.88	14.90	40.40	SiO_2
S K	0.88	0.61	2.20	SO_3
K K	0.57	0.32	0.69	K_2O
Ca K	21.36	11.81	29.89	CaO
Ti K	0.11	0.05	0.18	TiO_2
Fe K	0.51	0.20	0.66	FeO
O	41.22	57.09		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix near the BFS particle of Spectrum 5.2*

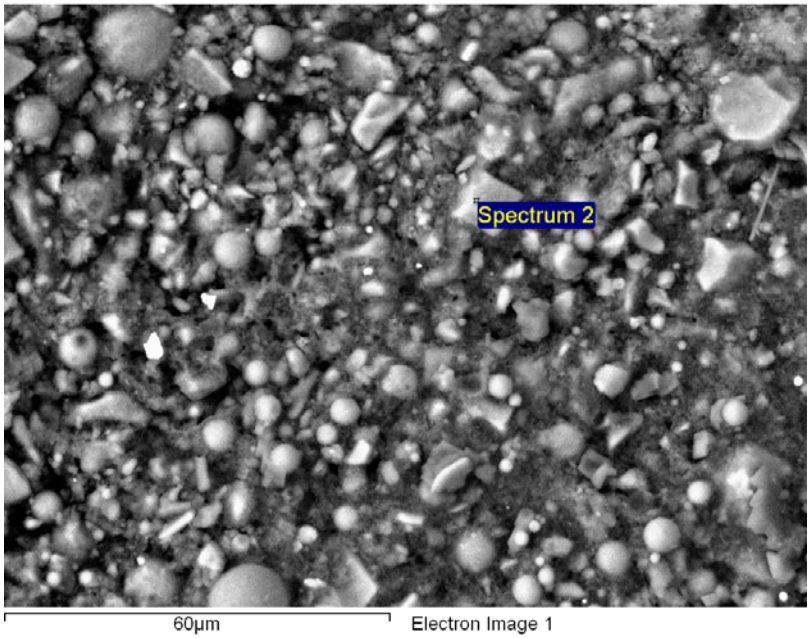
HC3-45-1S Site 5 Spectrum 2 (5.2)

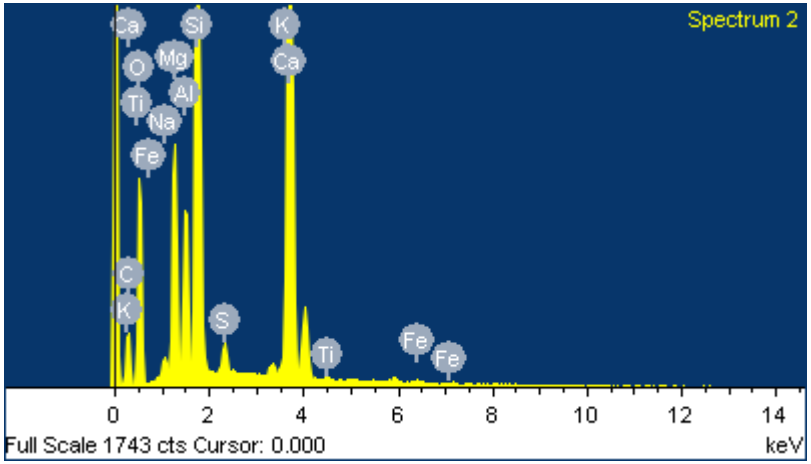
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	0.69	0.67	0.93	Na_2O
Mg K	6.67	6.11	11.05	MgO
Al K	4.03	3.33	7.61	Al_2O_3
Si K	20.56	16.30	43.99	SiO_2
S K	0.88	0.61	2.20	SO_3
K K	0.42	0.24	0.51	K_2O
Ca K	23.66	13.15	33.11	CaO
Ti K	0.23	0.11	0.38	TiO_2
Fe K	0.17	0.07	0.22	FeO
O	42.69	59.42		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *BFS particle*

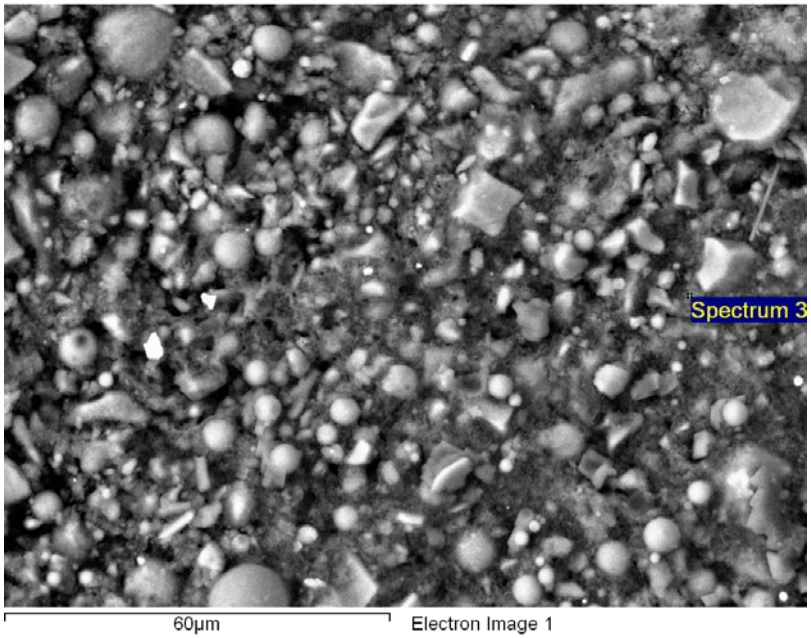
HC3-45-1S Site 5 Spectrum 3 (5.3)

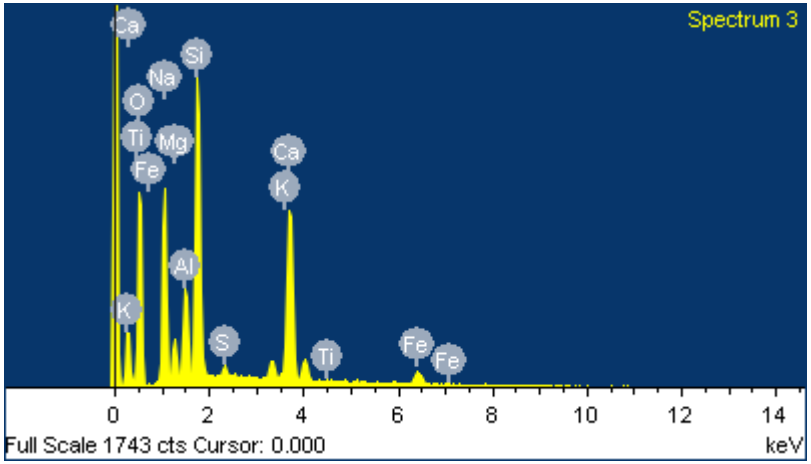
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	14.89	14.25	20.08	Na_2O
Mg K	2.74	2.48	4.54	MgO
Al K	5.09	4.15	9.62	Al_2O_3
Si K	17.72	13.88	37.91	SiO_2
S K	0.71	0.49	1.78	SO_3
K K	1.36	0.77	1.64	K_2O
Ca K	14.79	8.12	20.69	CaO
Ti K	0.14	0.07	0.24	TiO_2
Fe K	2.72	1.07	3.50	FeO
O	39.83	54.74		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix near the BFS particle of Spectrum 5.4*

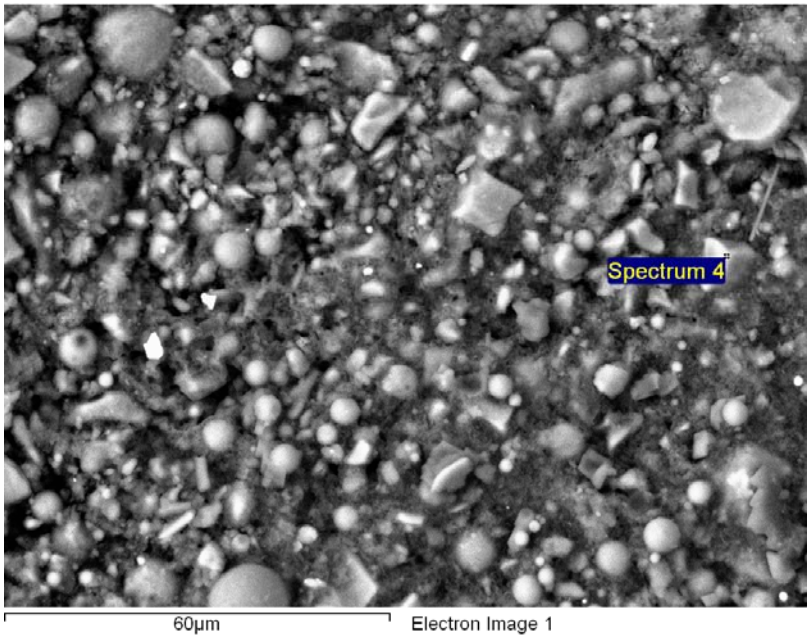
HC3-45-1S Site 5 Spectrum 4 (5.4)

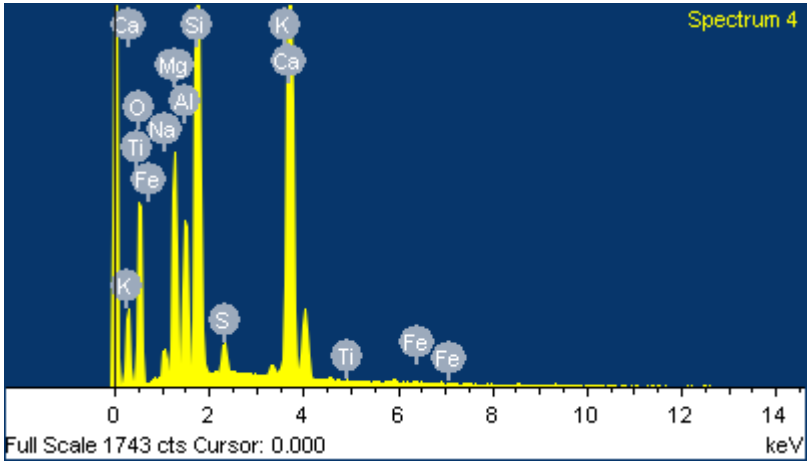
Spectrum processing :
Peak possibly omitted : 5.900 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.33	1.29	1.79	Na_2O
Mg K	6.66	6.12	11.05	MgO
Al K	4.33	3.58	8.17	Al_2O_3
Si K	19.29	15.33	41.26	SiO_2
S K	1.11	0.77	2.77	SO_3
K K	0.36	0.20	0.43	K_2O
Ca K	24.26	13.52	33.94	CaO
Ti K	0.21	0.10	0.34	TiO_2
Fe K	0.18	0.07	0.24	FeO
O	42.28	59.01		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *BFS particle*

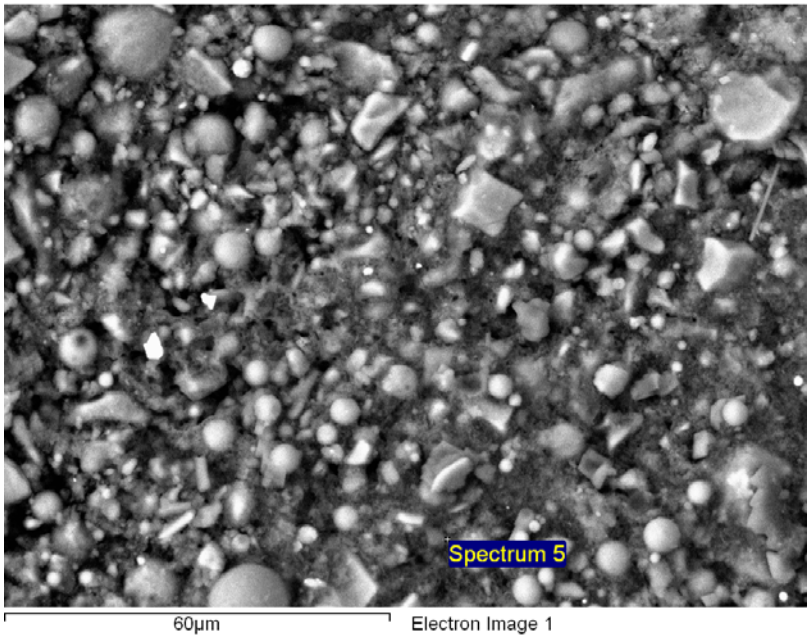
HC3-45-1S Site 5 Spectrum 5 (5.5)

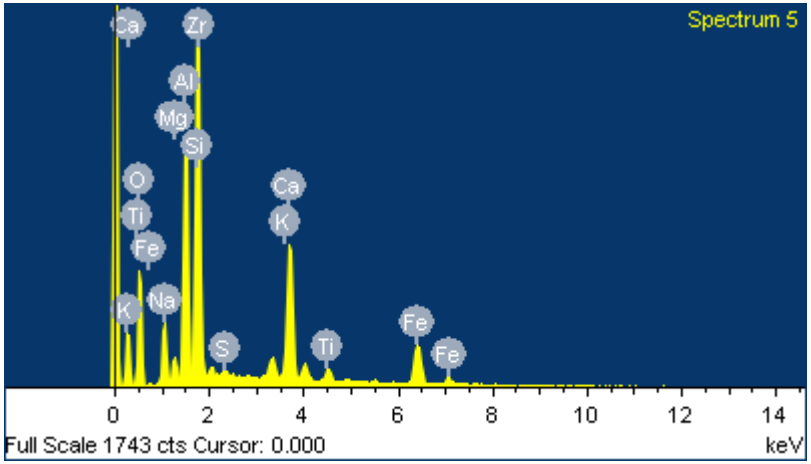
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM
Zr Zr 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.45	4.36	5.99	Na_2O
Mg K	1.33	1.23	2.20	MgO
Al K	11.16	9.32	21.08	Al_2O_3
Si K	18.66	14.98	39.92	SiO_2
S K	0.35	0.25	0.89	SO_3
K K	1.38	0.79	1.66	K_2O
Ca K	10.17	5.72	14.23	CaO
Ti K	1.29	0.61	2.16	TiO_2
Fe K	7.92	3.19	10.18	FeO
Other	1.26	0.31	1.70	Other
O	42.04	59.24		
Totals	100.00			





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

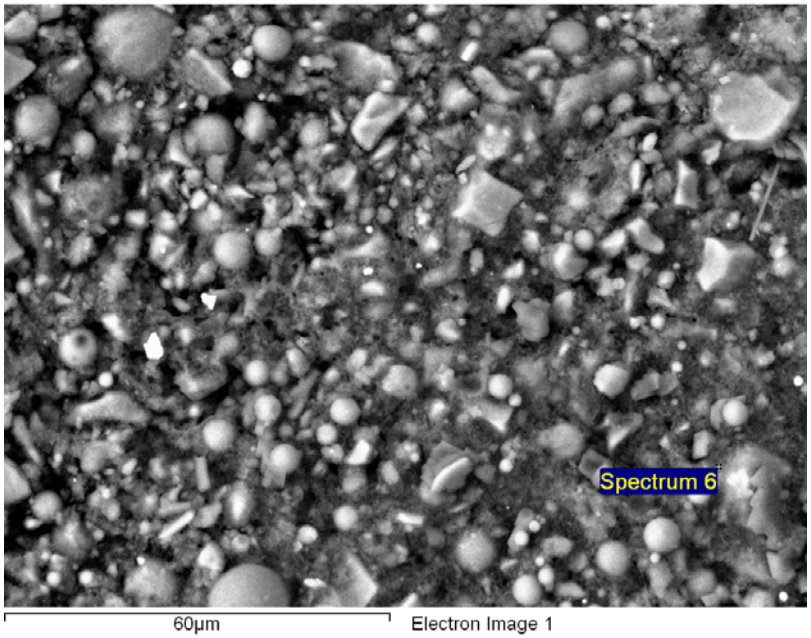
HC3-45-1S Site 5 Spectrum 6 (5.6)

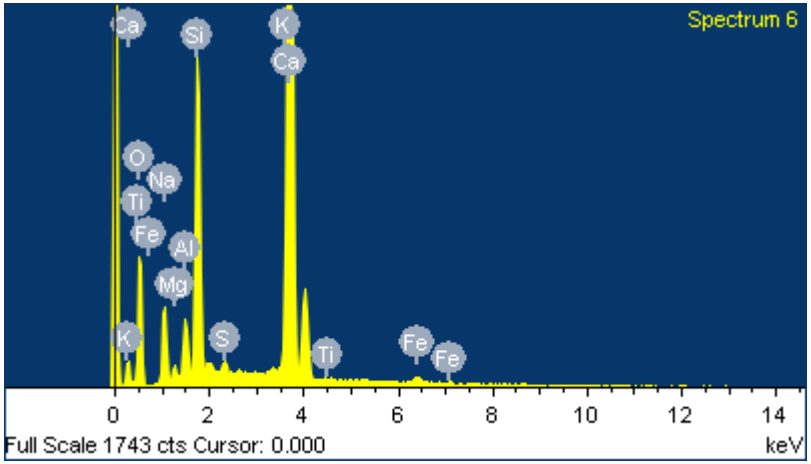
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.03	5.33	6.78	Na_2O
Mg K	0.60	0.60	0.99	MgO
Al K	2.18	1.97	4.12	Al_2O_3
Si K	12.00	10.42	25.67	SiO_2
S K	0.54	0.41	1.34	SO_3
K K	0.27	0.17	0.33	K_2O
Ca K	42.58	25.92	59.58	CaO
Ti K	0.13	0.07	0.21	TiO_2
Fe K	0.77	0.34	0.99	FeO
O	35.91	54.77		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

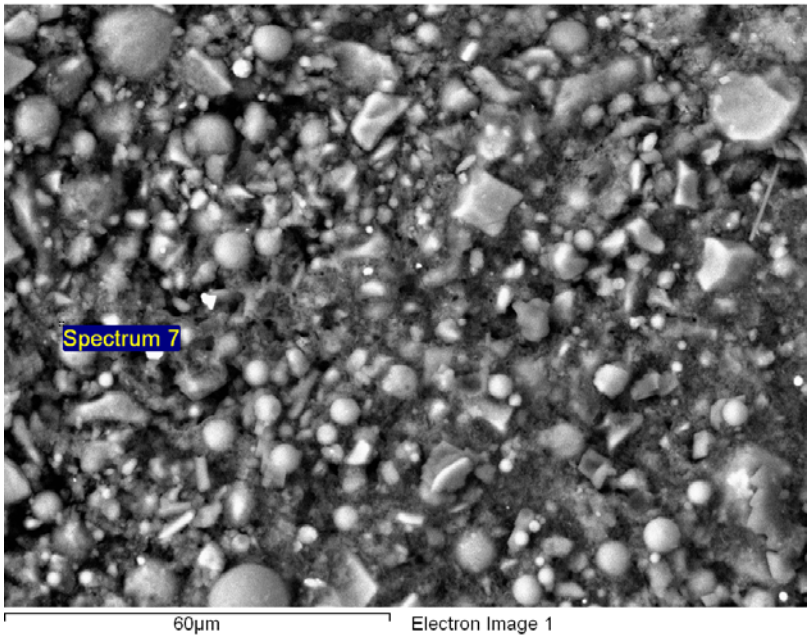
HC3-45-1S Site 5 Spectrum 7 (5.7)

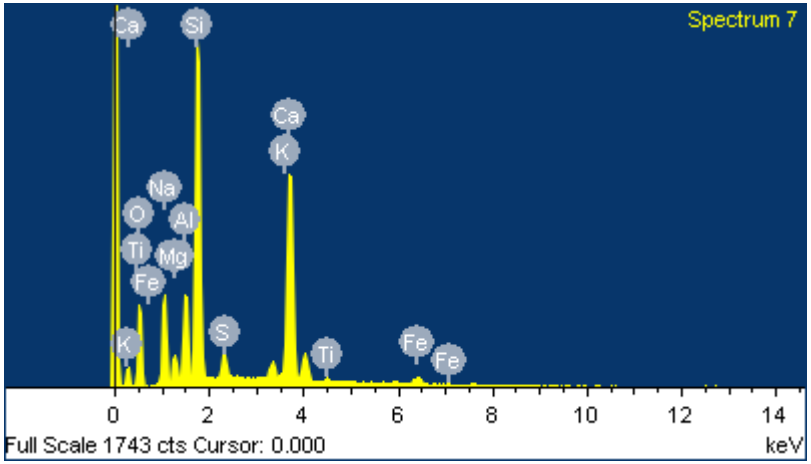
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.69	7.43	10.37	Na_2O
Mg K	1.85	1.69	3.07	MgO
Al K	4.89	4.03	9.25	Al_2O_3
Si K	19.84	15.68	42.43	SiO_2
S K	1.53	1.06	3.82	SO_3
K K	1.41	0.80	1.69	K_2O
Ca K	18.92	10.48	26.47	CaO
Ti K	0.48	0.22	0.80	TiO_2
Fe K	1.63	0.65	2.09	FeO
O	41.76	57.96		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

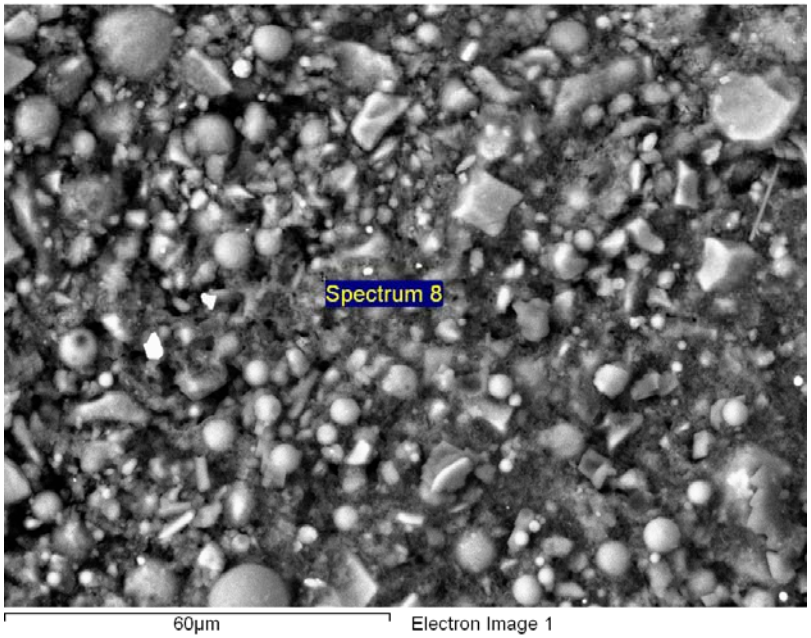
HC3-45-1S Site 5 Spectrum 8 (5.8)

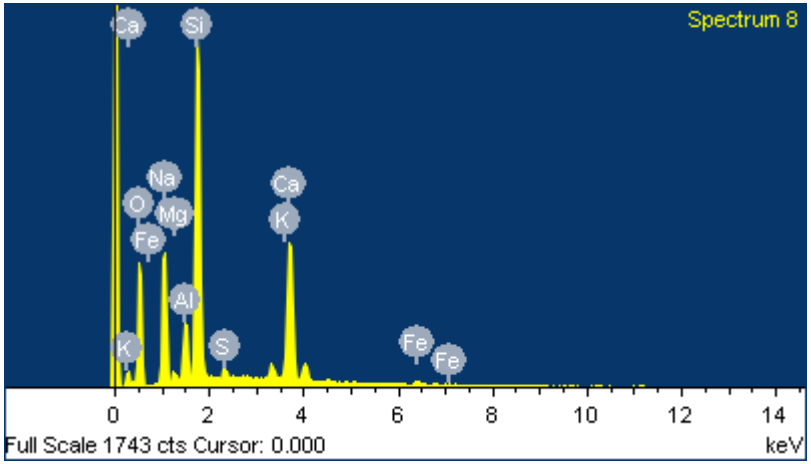
Spectrum processing :
Peak possibly omitted : 4.475 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	12.65	11.95	17.06	Na_2O
Mg K	0.78	0.70	1.29	MgO
Al K	3.74	3.01	7.07	Al_2O_3
Si K	22.69	17.53	48.53	SiO_2
S K	0.94	0.64	2.36	SO_3
K K	1.20	0.67	1.44	K_2O
Ca K	15.00	8.12	20.99	CaO
Fe K	0.97	0.38	1.25	FeO
O	42.02	57.01		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

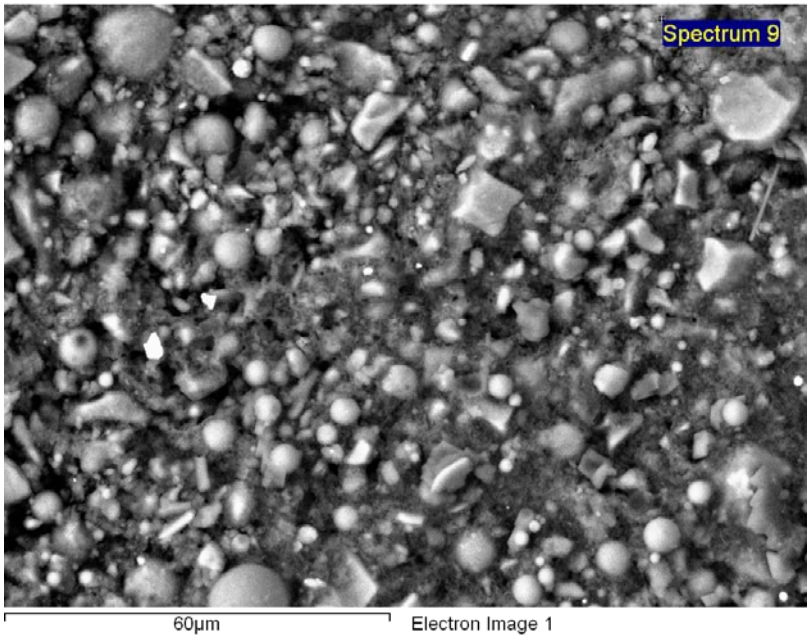
HC3-45-1S Site 5 Spectrum 9 (5.9)

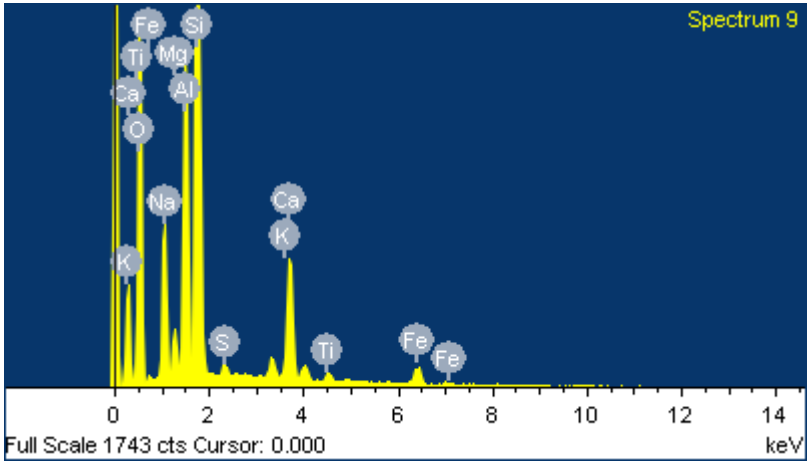
Spectrum processing :
Peak possibly omitted : 8.080 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.15	6.57	9.63	Na_2O
Mg K	1.46	1.27	2.43	MgO
Al K	9.56	7.50	18.07	Al_2O_3
Si K	25.32	19.06	54.16	SiO_2
S K	0.50	0.33	1.24	SO_3
K K	1.03	0.56	1.24	K_2O
Ca K	6.42	3.39	8.99	CaO
Ti K	0.72	0.32	1.20	TiO_2
Fe K	2.37	0.90	3.05	FeO
O	45.47	60.11		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

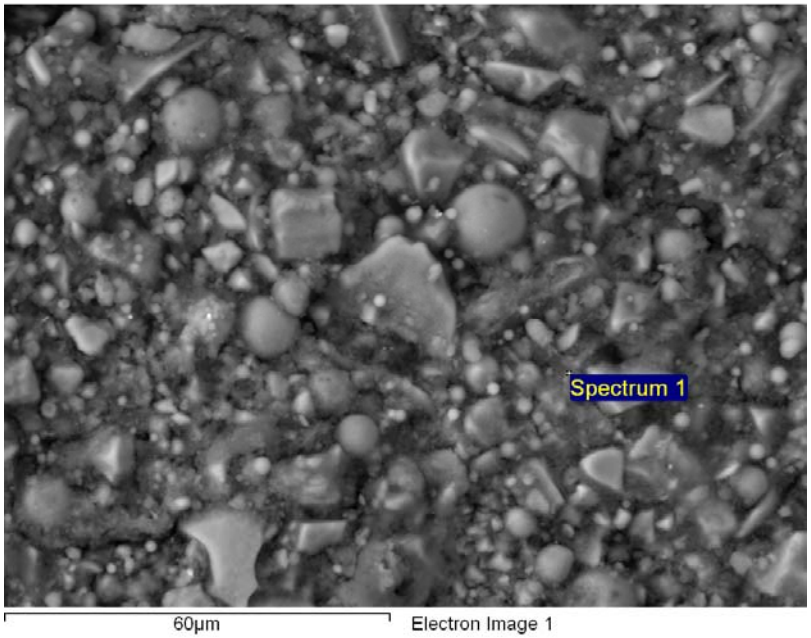
HC3-45-1S Site 6 Spectrum 1 (6.1)

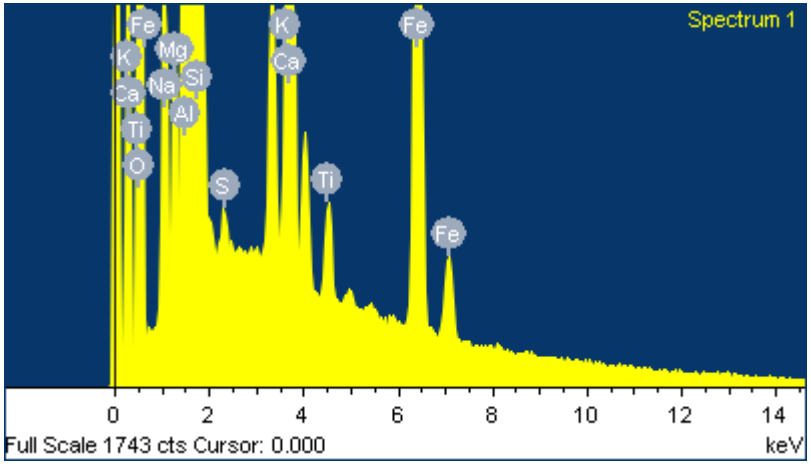
Spectrum processing :
Peak possibly omitted : 5.420 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.57	2.48	3.47	Na_2O
Mg K	0.92	0.84	1.53	MgO
Al K	11.57	9.51	21.85	Al_2O_3
Si K	22.22	17.55	47.53	SiO_2
S K	0.20	0.14	0.49	SO_3
K K	1.56	0.88	1.88	K_2O
Ca K	6.86	3.80	9.60	CaO
Ti K	0.80	0.37	1.33	TiO_2
Fe K	9.57	3.80	12.31	FeO
O	43.73	60.63		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 28 days
Type of material analyzed: *matrix*

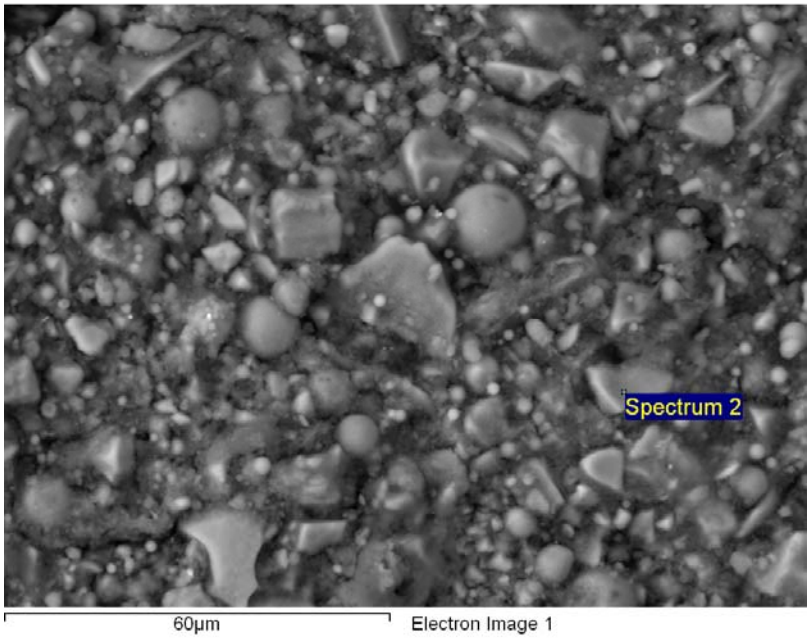
HC3-45-1S Site 6 Spectrum 2 (6.2)

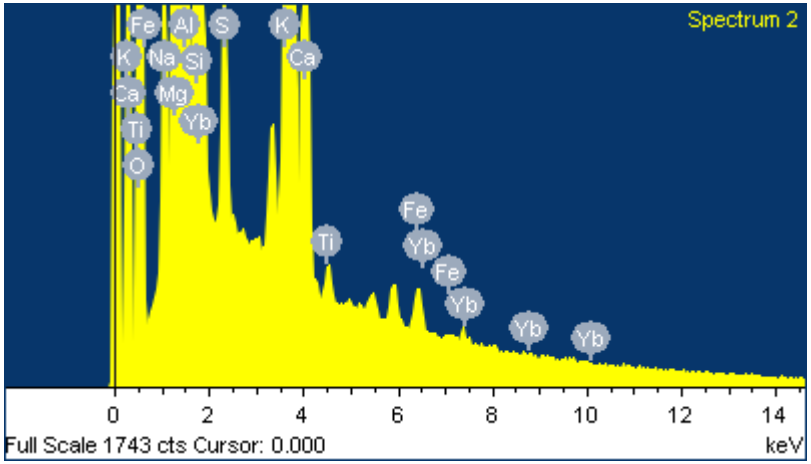
Spectrum processing :
Peaks possibly omitted : 5.438, 16.035 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM
Yb YbF3 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.58	1.52	2.13	Na_2O
Mg K	6.19	5.66	10.26	MgO
Al K	4.98	4.10	9.41	Al_2O_3
Si K	20.38	16.12	43.59	SiO_2
S K	0.90	0.63	2.26	SO_3
K K	0.48	0.27	0.57	K_2O
Ca K	21.60	11.98	30.22	CaO
Ti K	0.26	0.12	0.43	TiO_2
Fe K	0.53	0.21	0.68	FeO
Other	0.41	0.05	0.46	Other
O	42.71	59.34		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *BFS particle*

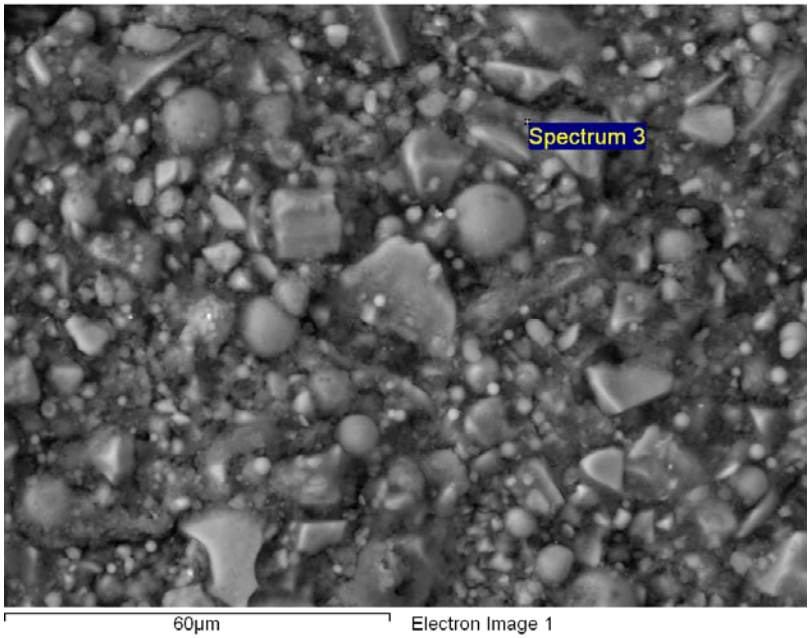
HC3-45-1S Site 6 Spectrum 3 (6.3)

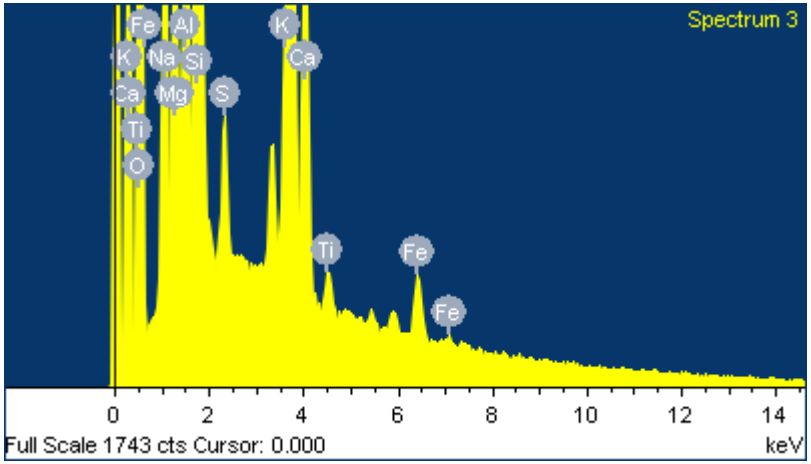
Spectrum processing :
Peak possibly omitted : 5.436 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.11	4.95	6.89	Na_2O
Mg K	4.37	4.00	7.24	MgO
Al K	5.22	4.30	9.86	Al_2O_3
Si K	19.46	15.42	41.64	SiO_2
S K	0.74	0.52	1.86	SO_3
K K	0.74	0.42	0.89	K_2O
Ca K	21.14	11.73	29.58	CaO
Ti K	0.43	0.20	0.72	TiO_2
Fe K	1.03	0.41	1.32	FeO
O	41.76	58.06		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

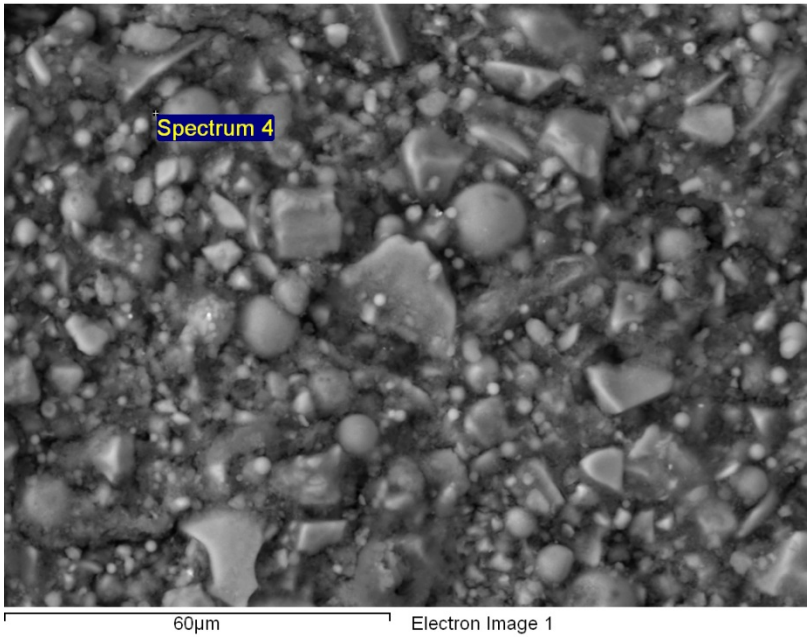
HC3-45-1S Site 6 Spectrum 4 (6.4)

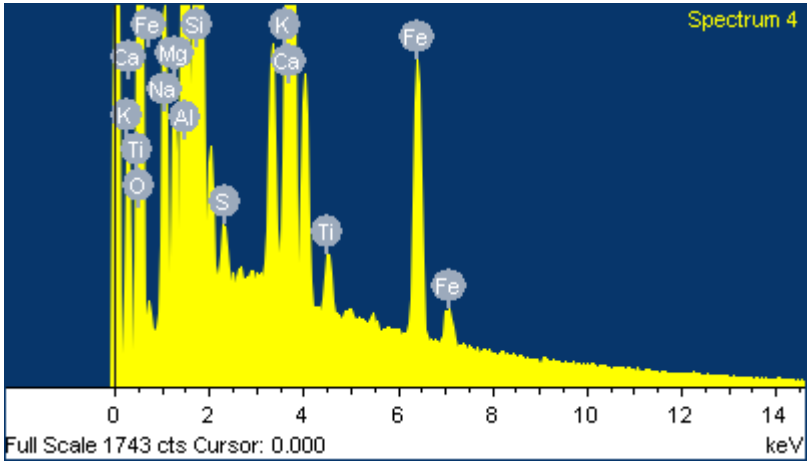
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.39	2.30	3.22	Na_2O
Mg K	0.98	0.89	1.62	MgO
Al K	11.40	9.35	21.54	Al_2O_3
Si K	21.13	16.64	45.19	SiO_2
S K	0.39	0.27	0.98	SO_3
K K	1.47	0.83	1.78	K_2O
Ca K	12.88	7.11	18.02	CaO
Ti K	0.63	0.29	1.05	TiO_2
Fe K	5.13	2.03	6.60	FeO
O	43.60	60.29		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *FA particle*

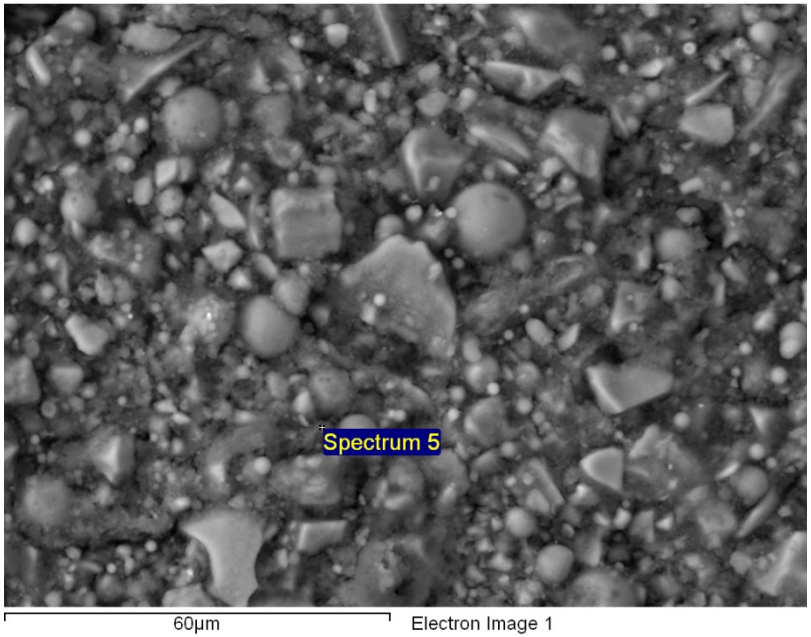
HC3-45-1S Site 6 Spectrum 5 (6.5)

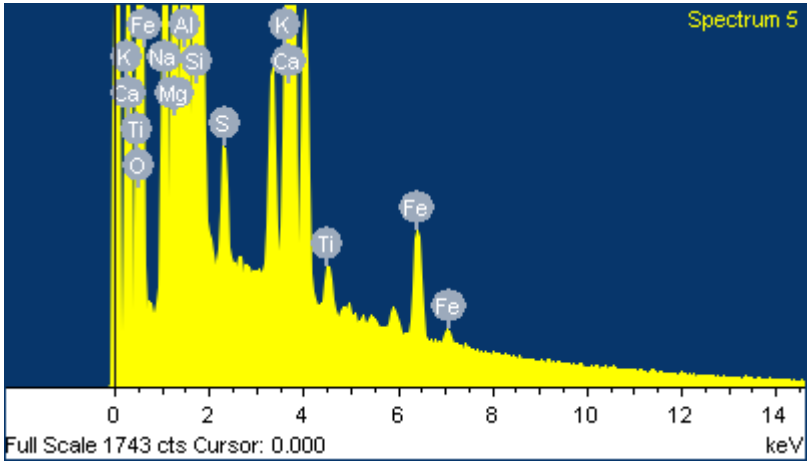
Spectrum processing :
Peak possibly omitted : 5.439 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.21	4.01	5.68	Na_2O
Mg K	4.95	4.46	8.21	MgO
Al K	7.85	6.37	14.82	Al_2O_3
Si K	20.10	15.68	43.00	SiO_2
S K	0.67	0.46	1.68	SO_3
K K	1.22	0.68	1.47	K_2O
Ca K	15.64	8.54	21.88	CaO
Ti K	0.47	0.21	0.78	TiO_2
Fe K	1.92	0.75	2.48	FeO
O	42.97	58.82		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

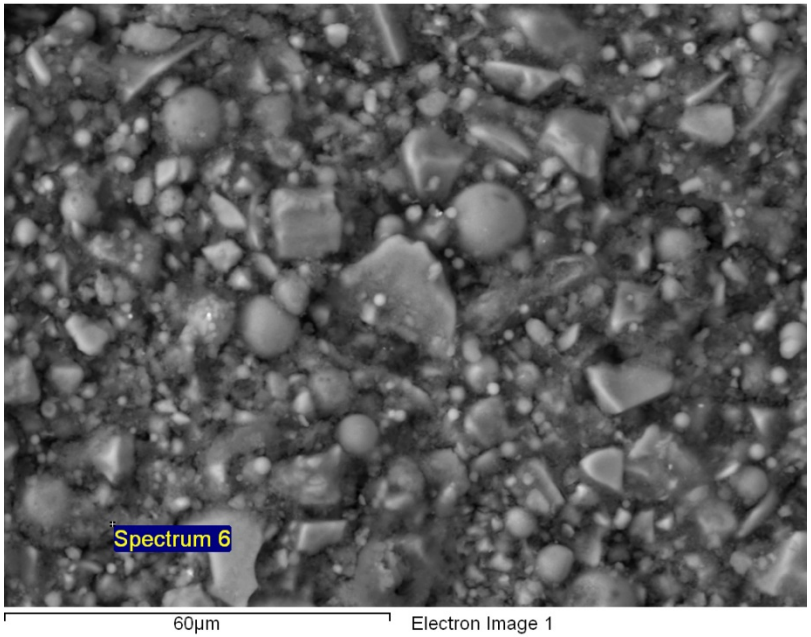
HC3-45-1S Site 6 Spectrum 6 (6.6)

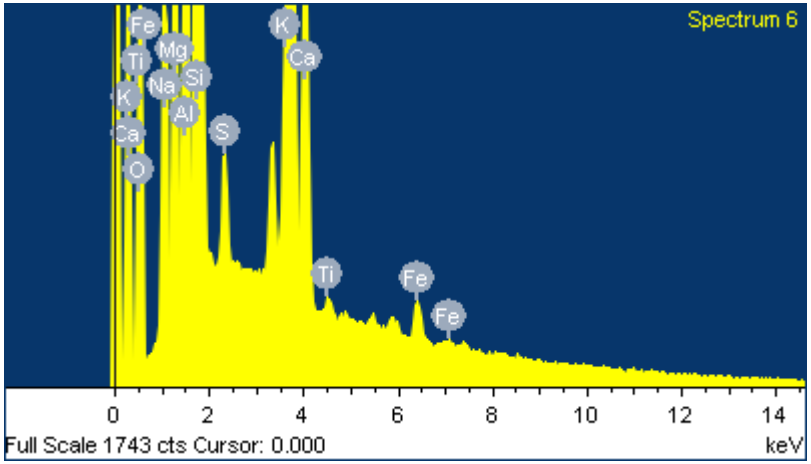
Spectrum processing :
Peak possibly omitted : 5.441 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.01	3.92	5.41	Na_2O
Mg K	3.14	2.90	5.20	MgO
Al K	4.39	3.65	8.30	Al_2O_3
Si K	20.41	16.31	43.67	SiO_2
S K	0.68	0.47	1.69	SO_3
K K	0.82	0.47	0.99	K_2O
Ca K	23.88	13.37	33.41	CaO
Ti K	0.20	0.09	0.34	TiO_2
Fe K	0.78	0.31	1.00	FeO
O	41.69	58.49		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

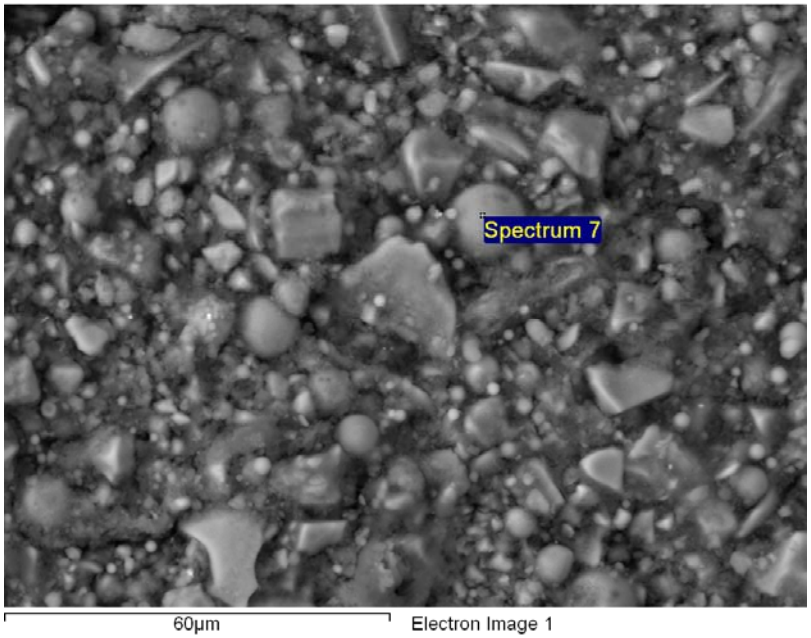
HC3-45-1S Site 6 Spectrum 7 (6.7)

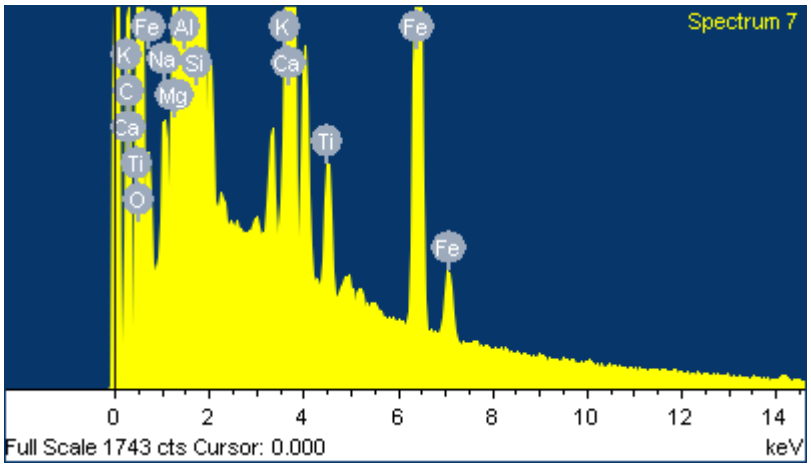
Spectrum processing :
Peaks possibly omitted : 2.275, 5.480, 14.154 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	0.52	0.49	0.71	Na_2O
Mg K	1.17	1.05	1.95	MgO
Al K	20.58	16.55	38.88	Al_2O_3
Si K	17.85	13.79	38.19	SiO_2
K K	0.41	0.23	0.50	K_2O
Ca K	7.75	4.19	10.84	CaO
Ti K	0.79	0.36	1.31	TiO_2
Fe K	5.92	2.30	7.62	FeO
O	45.00	61.03		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *FA particle*

INCA

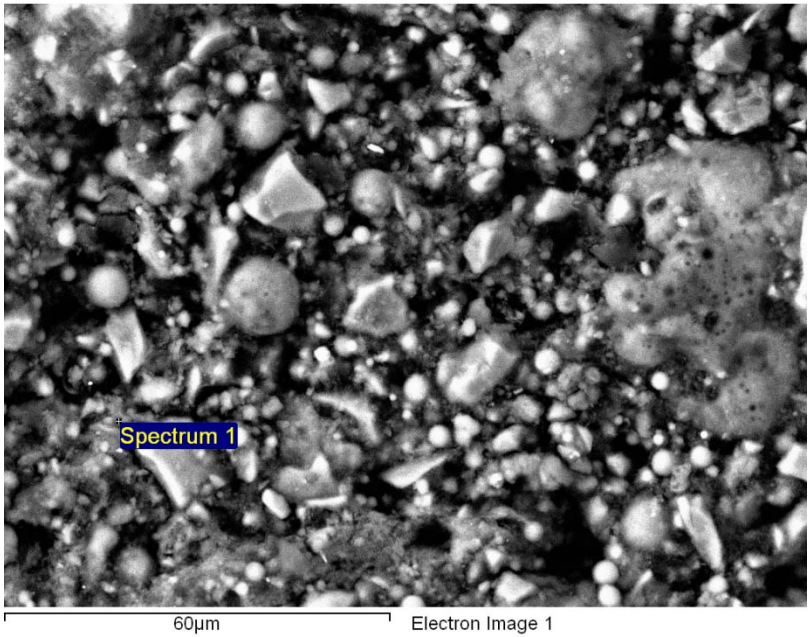
HC3-55-1S Site 4 Spectrum 1 (4.1)

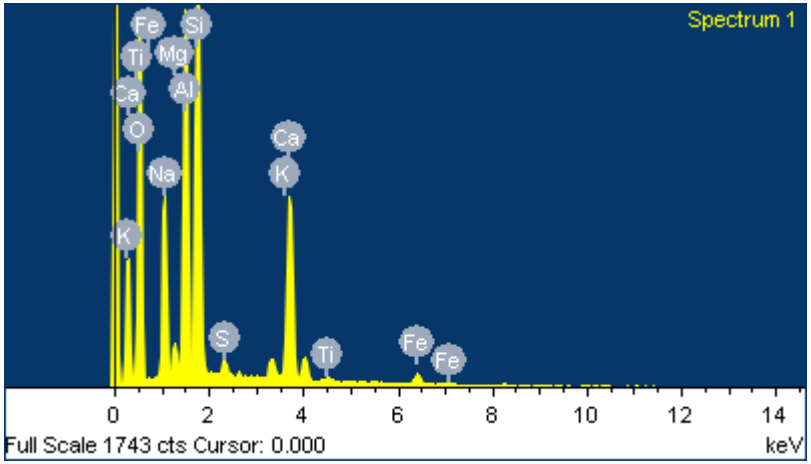
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	9.38	8.74	12.65	Na_2O
Mg K	1.15	1.01	1.90	MgO
Al K	11.96	9.48	22.59	Al_2O_3
Si K	20.04	15.27	42.87	SiO_2
S K	0.67	0.45	1.68	SO_3
K K	0.98	0.54	1.18	K_2O
Ca K	10.58	5.65	14.80	CaO
Ti K	0.18	0.08	0.30	TiO2
Fe K	1.56	0.60	2.01	FeO
O	43.49	58.18		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

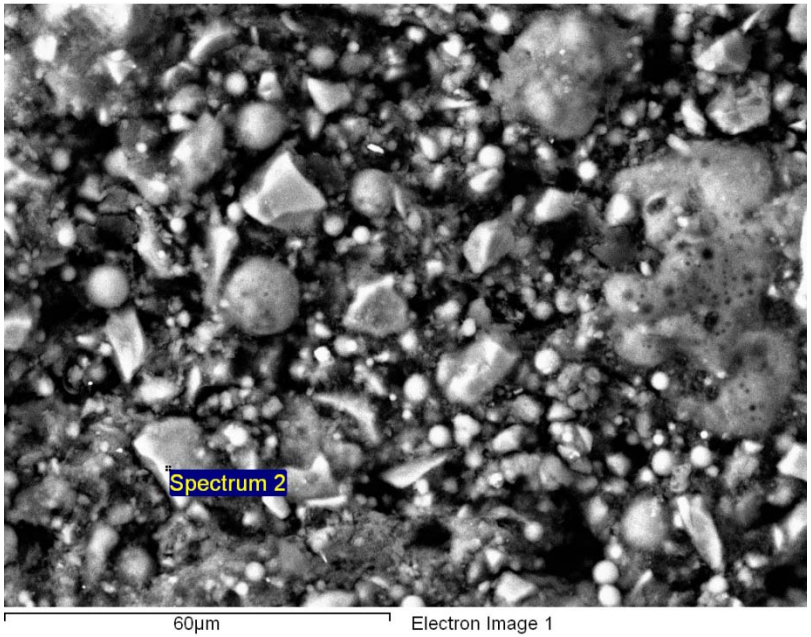
HC3-55-1S Site 4 Spectrum 2 (4.2)

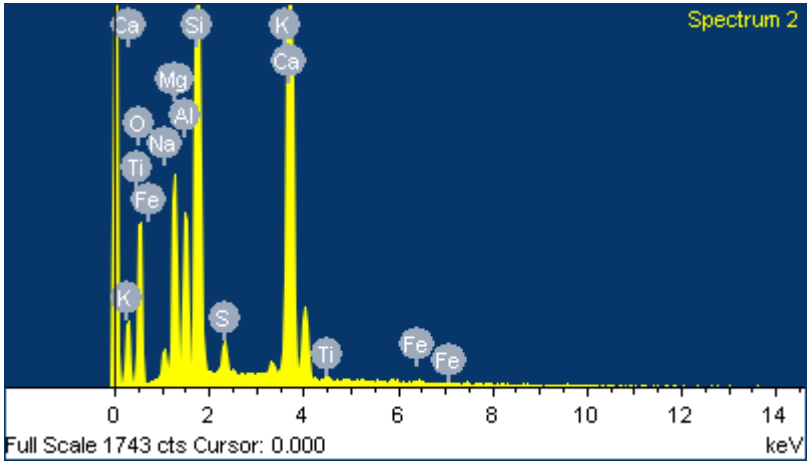
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.27	1.24	1.72	Na_2O
Mg K	5.93	5.48	9.83	MgO
Al K	4.11	3.42	7.76	Al_2O_3
Si K	19.30	15.42	41.28	SiO_2
S K	1.13	0.79	2.81	SO_3
K K	0.56	0.32	0.67	K_2O
Ca K	25.45	14.25	35.61	CaO
Ti K	0.11	0.05	0.19	TiO_2
Fe K	0.10	0.04	0.12	FeO
O	42.05	58.99		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *BFS particle*

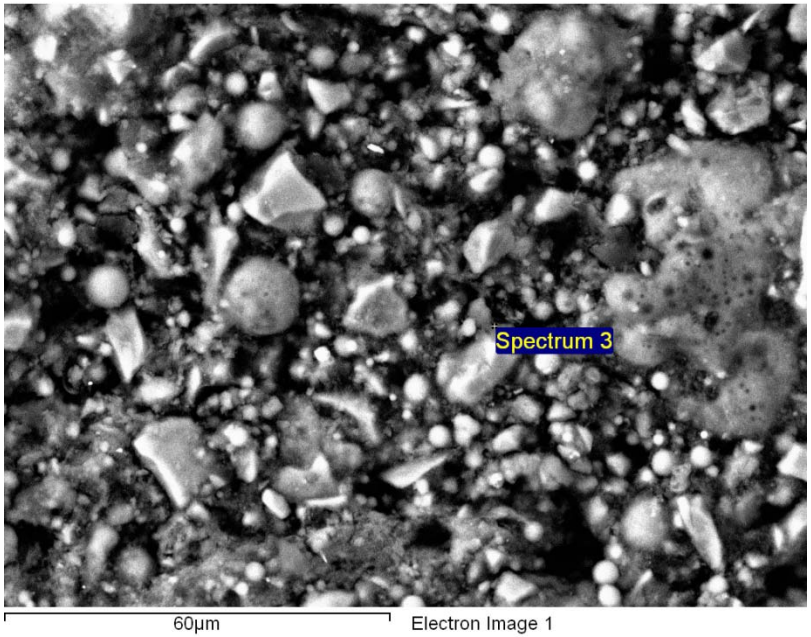
HC3-55-1S Site 4 Spectrum 3 (4.3)

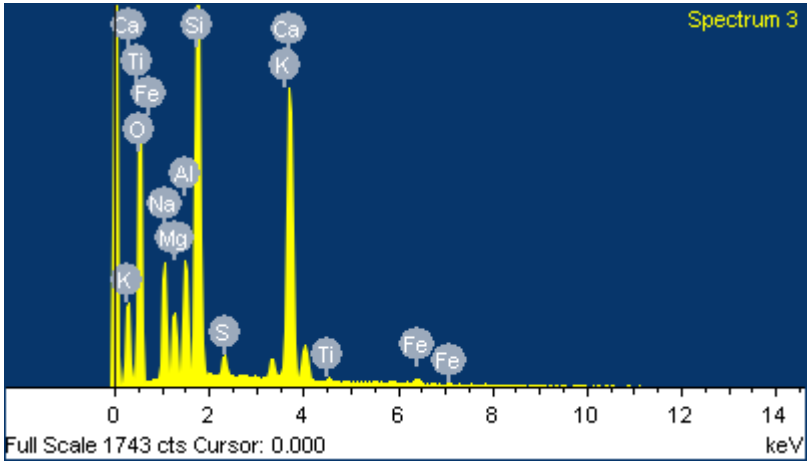
Spectrum processing :
Peak possibly omitted : 7.790 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.01	6.72	9.44	Na_2O
Mg K	3.32	3.01	5.51	MgO
Al K	4.58	3.74	8.65	Al_2O_3
Si K	20.68	16.24	44.24	SiO_2
S K	0.99	0.68	2.48	SO_3
K K	1.03	0.58	1.24	K_2O
Ca K	19.09	10.51	26.71	CaO
Ti K	0.36	0.17	0.60	TiO_2
Fe K	0.88	0.35	1.13	FeO
O	42.06	58.00		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *BFS particle*

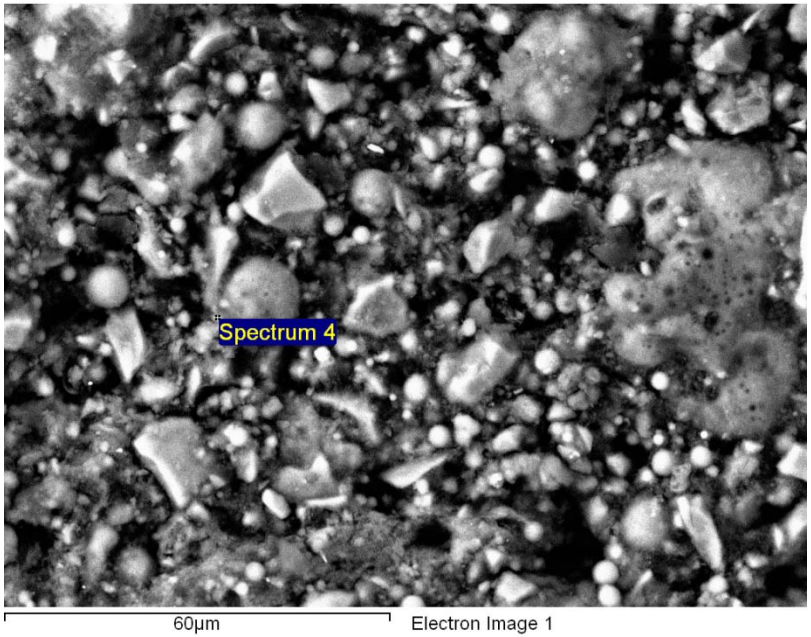
HC3-55-1S Site 4 Spectrum 4 (4.4)

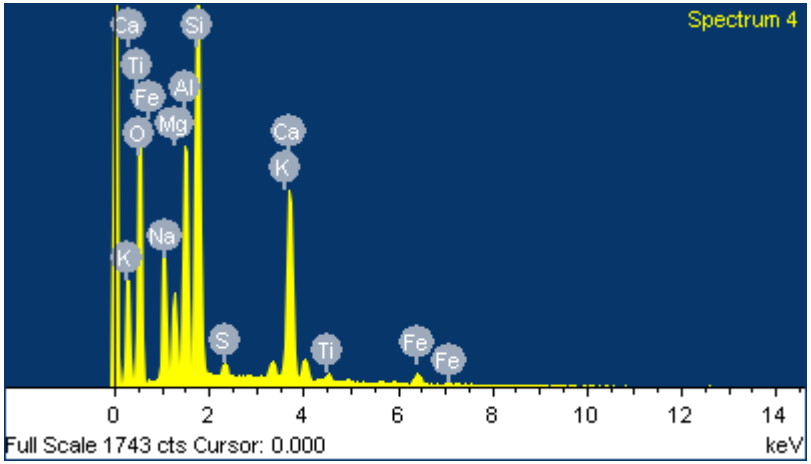
Spectrum processing :
Peak possibly omitted : 5.880 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.31	6.85	9.85	Na_2O
Mg K	3.62	3.22	6.01	MgO
Al K	9.05	7.24	17.11	Al_2O_3
Si K	20.63	15.84	44.13	SiO_2
S K	0.67	0.45	1.68	SO_3
K K	0.97	0.53	1.17	K_2O
Ca K	11.82	6.36	16.53	CaO
Ti K	0.69	0.31	1.15	TiO_2
Fe K	1.85	0.71	2.38	FeO
O	43.39	58.49		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix near the FA particle of Spectrum 4.5*

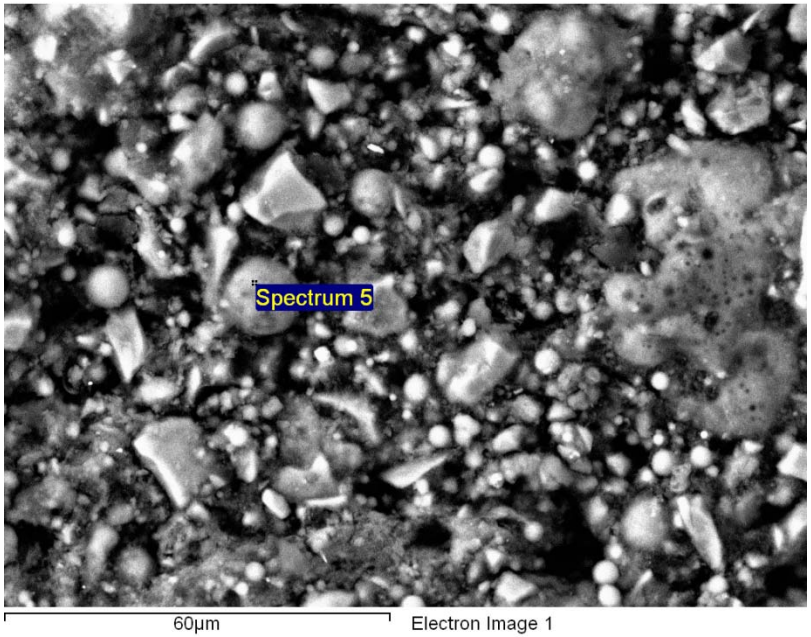
HC3-55-1S Site 4 Spectrum 5 (4.5)

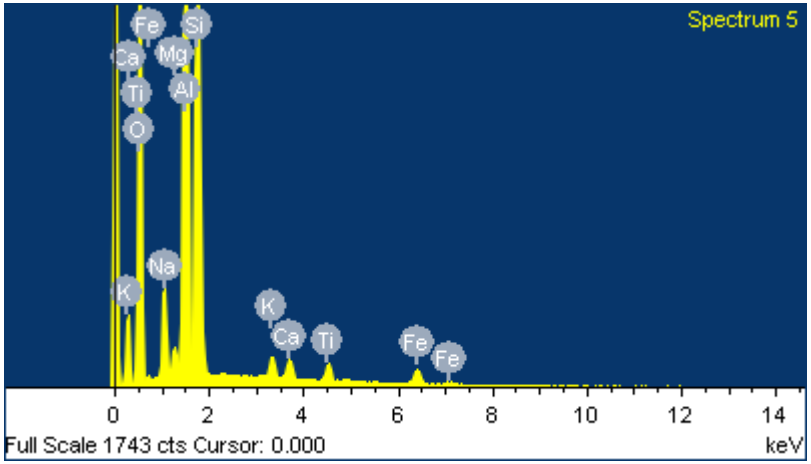
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 2

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.89	3.50	5.24	Na_2O
Mg K	0.69	0.58	1.14	MgO
Al K	19.68	15.09	37.19	Al_2O_3
Si K	23.21	17.09	49.65	SiO_2
K K	1.08	0.57	1.30	K_2O
Ca K	0.91	0.47	1.28	CaO
Ti K	1.07	0.46	1.79	TiO_2
Fe K	1.87	0.69	2.40	FeO
O	47.59	61.53		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *FA particle*

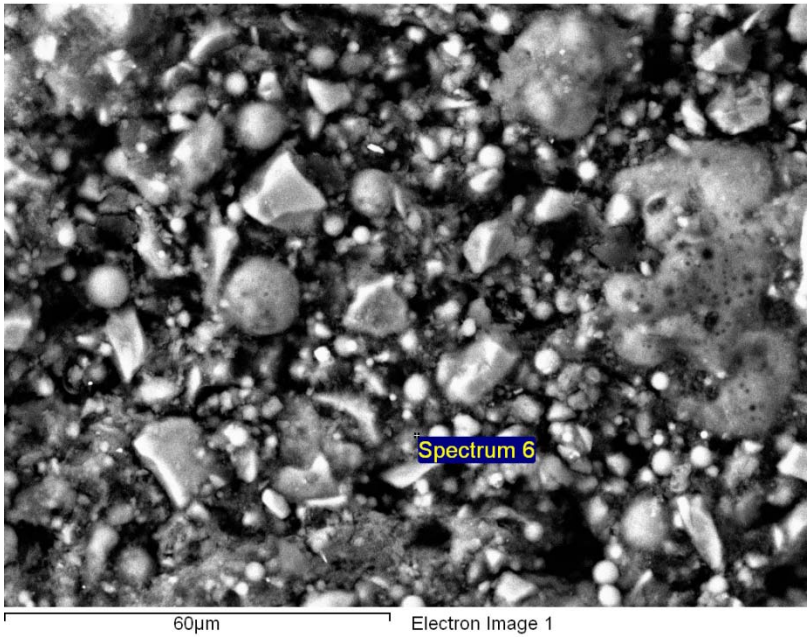
HC3-55-1S Site 4 Spectrum 6 (4.6)

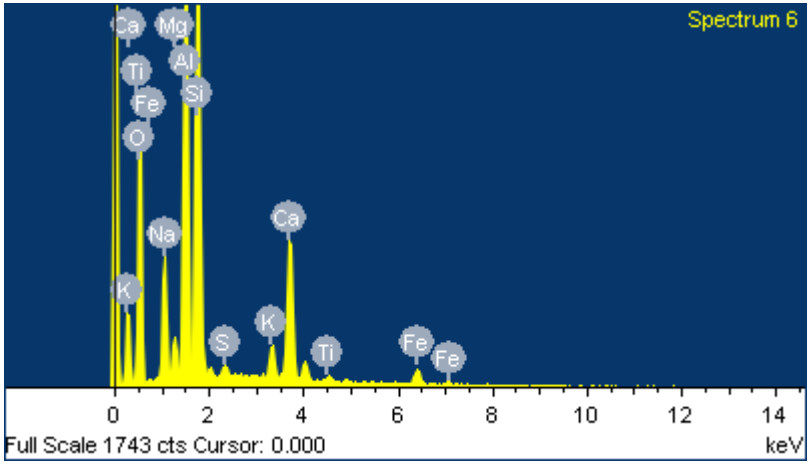
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.13	5.68	8.26	Na_2O
Mg K	1.42	1.24	2.35	MgO
Al K	13.60	10.74	25.70	Al_2O_3
Si K	21.43	16.27	45.85	SiO_2
S K	0.46	0.30	1.14	SO_3
K K	1.72	0.94	2.08	K_2O
Ca K	8.09	4.30	11.32	CaO
Ti K	0.43	0.19	0.71	TiO_2
Fe K	2.01	0.77	2.59	FeO
O	44.71	59.56		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

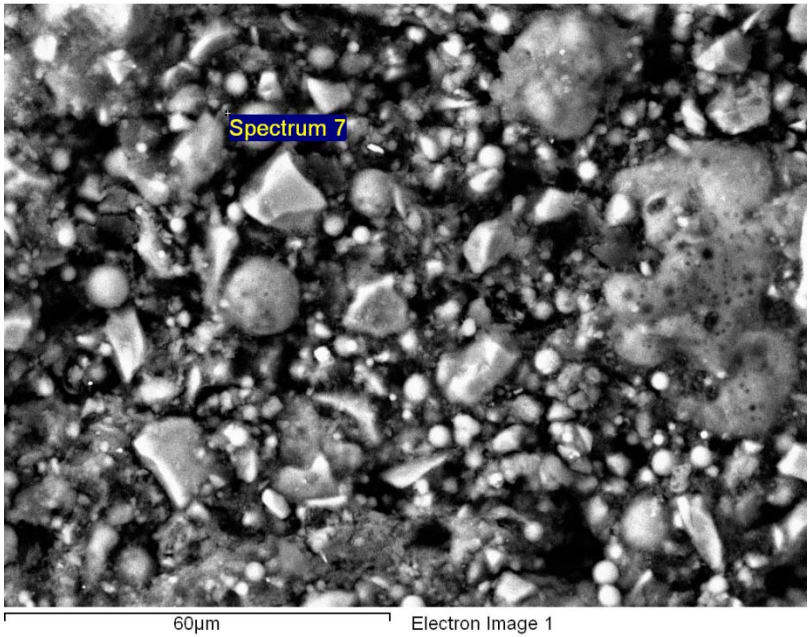
HC3-55-1S Site 4 Spectrum 7 (4.7)

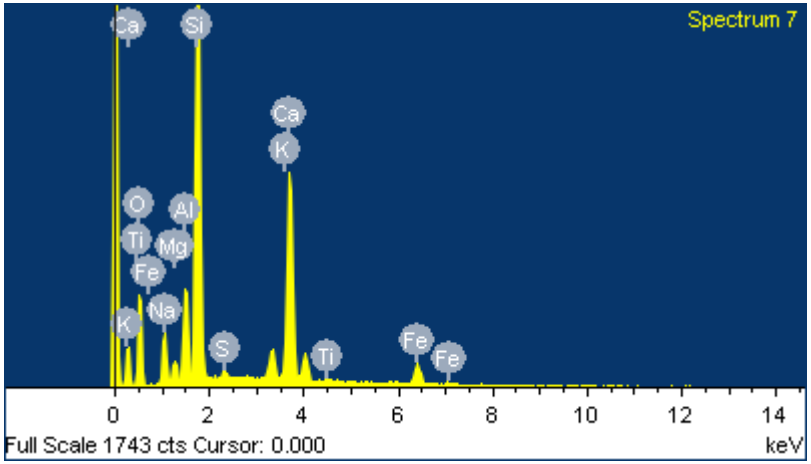
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.75	3.63	5.06	Na_2O
Mg K	1.18	1.08	1.96	MgO
Al K	4.15	3.42	7.85	Al_2O_3
Si K	25.06	19.82	53.61	SiO_2
S K	0.55	0.38	1.38	SO_3
K K	1.94	1.10	2.34	K_2O
Ca K	15.90	8.82	22.25	CaO
Ti K	0.36	0.17	0.60	TiO_2
Fe K	3.86	1.53	4.96	FeO
O	43.24	60.05		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

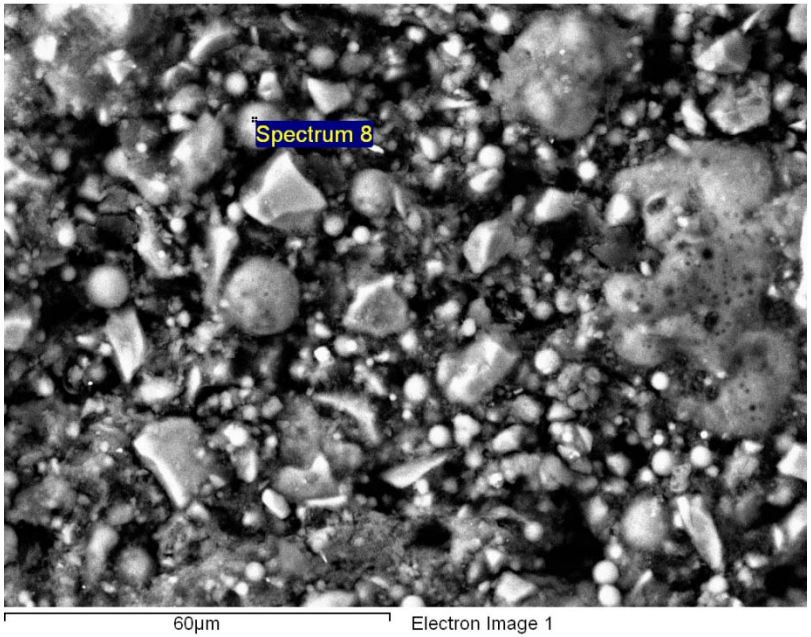
HC3-55-1S Site 4 Spectrum 8 (4.8)

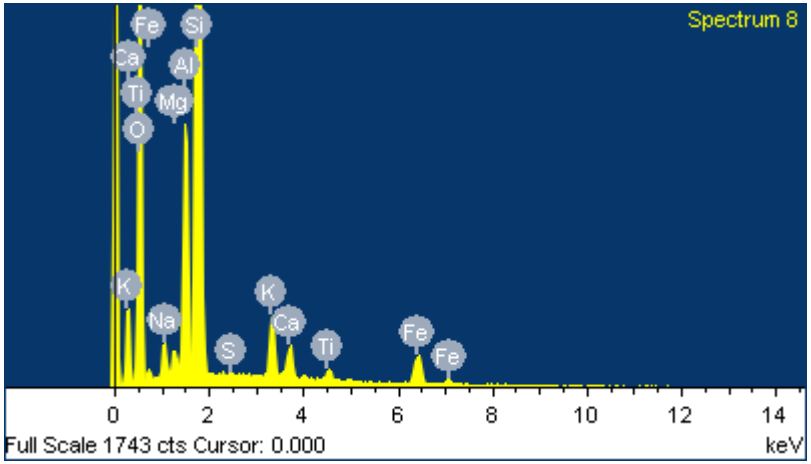
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.32	1.20	1.78	Na_2O
Mg K	0.56	0.48	0.93	MgO
Al K	5.61	4.34	10.60	Al_2O_3
Si K	35.79	26.59	76.56	SiO_2
K K	2.52	1.35	3.04	K_2O
Ca K	1.31	0.68	1.83	CaO
Ti K	0.67	0.29	1.11	TiO_2
Fe K	3.28	1.23	4.22	FeO
O	48.97	63.87		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *FA particle*

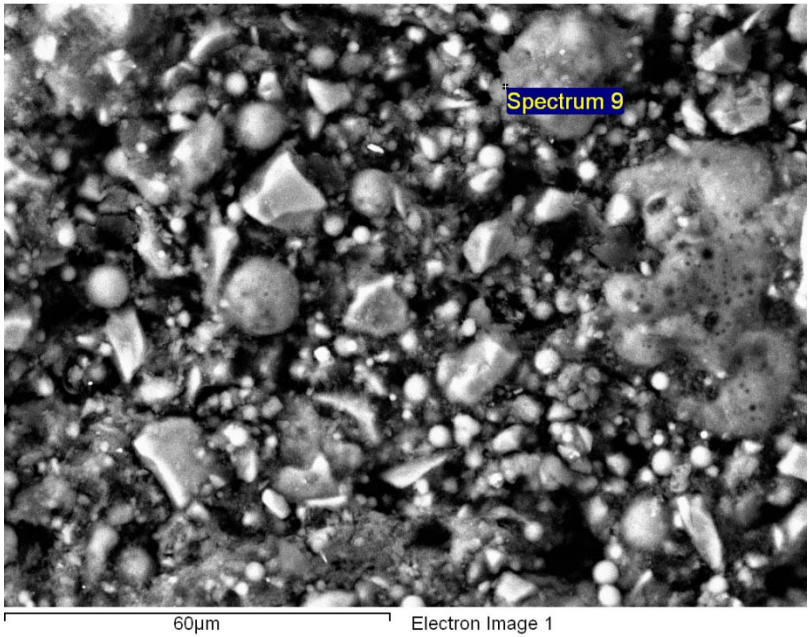
HC3-55-1S Site 4 Spectrum 9 (4.9)

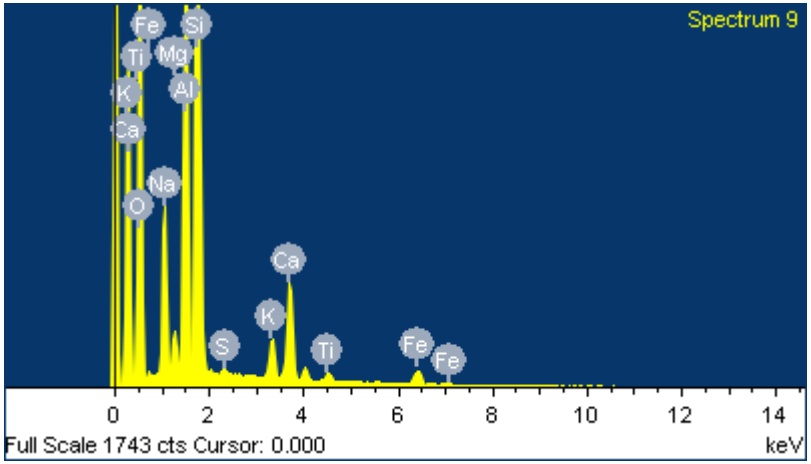
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.45	6.81	10.05	Na2O
Mg K	1.28	1.10	2.12	MgO
Al K	12.18	9.48	23.02	Al2O3
Si K	24.48	18.30	52.38	SiO2
S K	0.23	0.15	0.57	SO3
K K	1.76	0.95	2.13	K2O
Ca K	4.75	2.49	6.65	CaO
Ti K	0.48	0.21	0.80	TiO2
Fe K	1.78	0.67	2.29	FeO
O	45.59	59.84		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *irregular shaped FA particle*

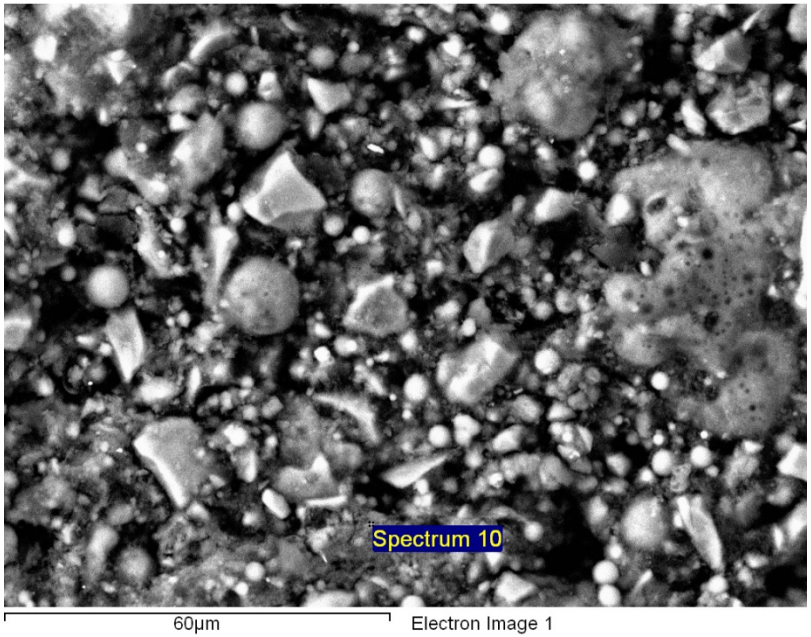
HC3-55-1S Site 4 Spectrum 10 (4.10)

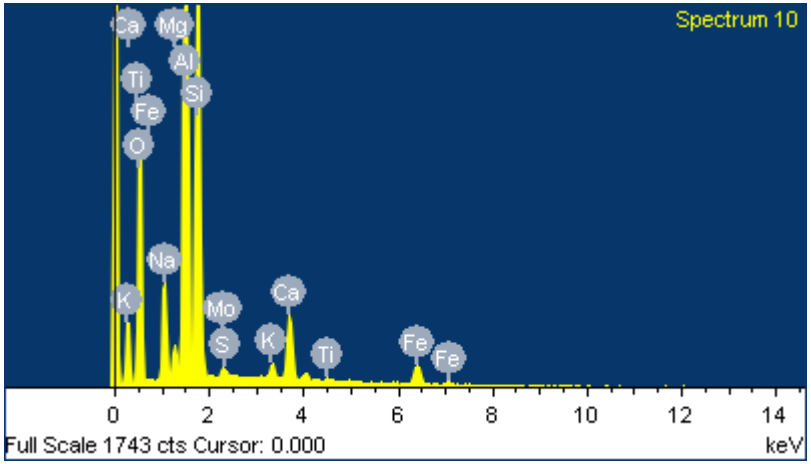
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 2

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM
Mo Mo 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.79	4.39	6.46	Na_2O
Mg K	0.95	0.82	1.57	MgO
Al K	21.48	16.78	40.58	Al_2O_3
Si K	18.60	13.96	39.79	SiO_2
S K	0.13	0.09	0.33	SO_3
K K	0.78	0.42	0.94	K_2O
Ca K	3.58	1.88	5.01	CaO
Ti K	0.24	0.10	0.40	TiO_2
Fe K	2.80	1.06	3.60	FeO
Other	0.87	0.19	1.30	Other
O	45.77	60.30		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

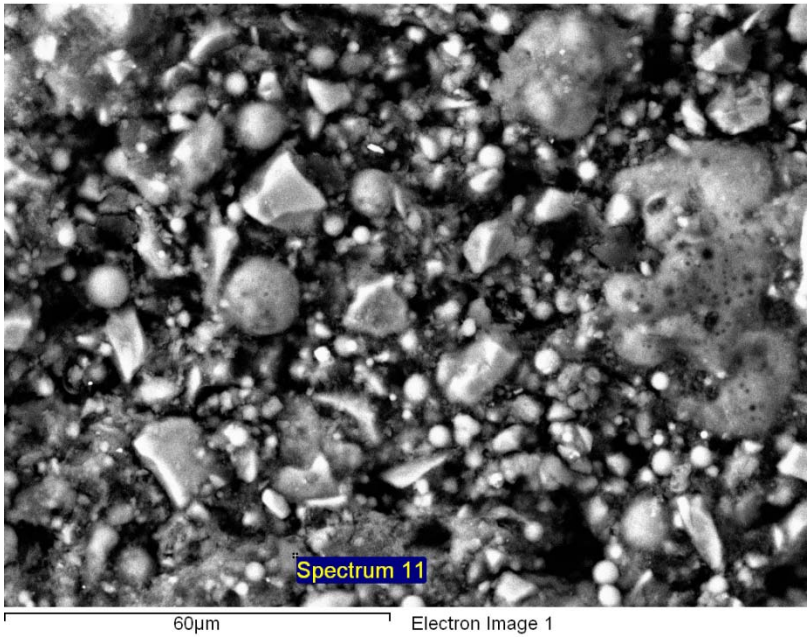
HC3-55-1S Site 4 Spectrum 11 (4.11)

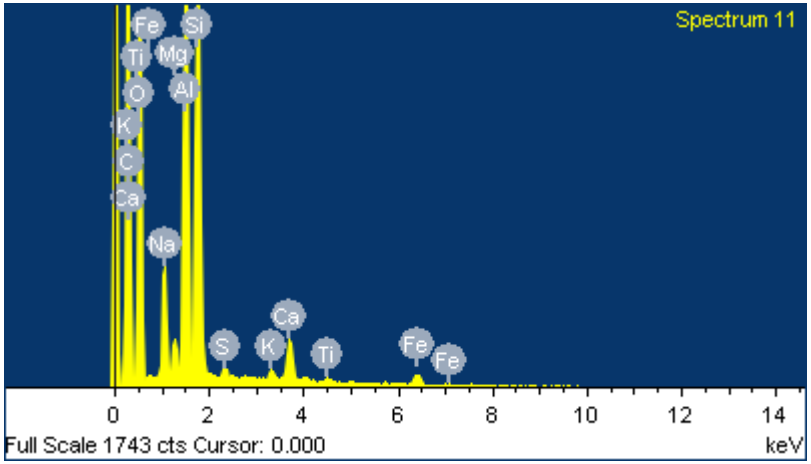
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.17	5.55	8.32	Na_2O
Mg K	1.36	1.16	2.26	MgO
Al K	17.48	13.39	33.02	Al_2O_3
Si K	22.73	16.73	48.62	SiO_2
S K	0.41	0.26	1.02	SO_3
K K	0.53	0.28	0.64	K_2O
Ca K	2.53	1.30	3.53	CaO
Ti K	0.35	0.15	0.59	TiO_2
Fe K	1.56	0.58	2.01	FeO
O	46.89	60.60		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

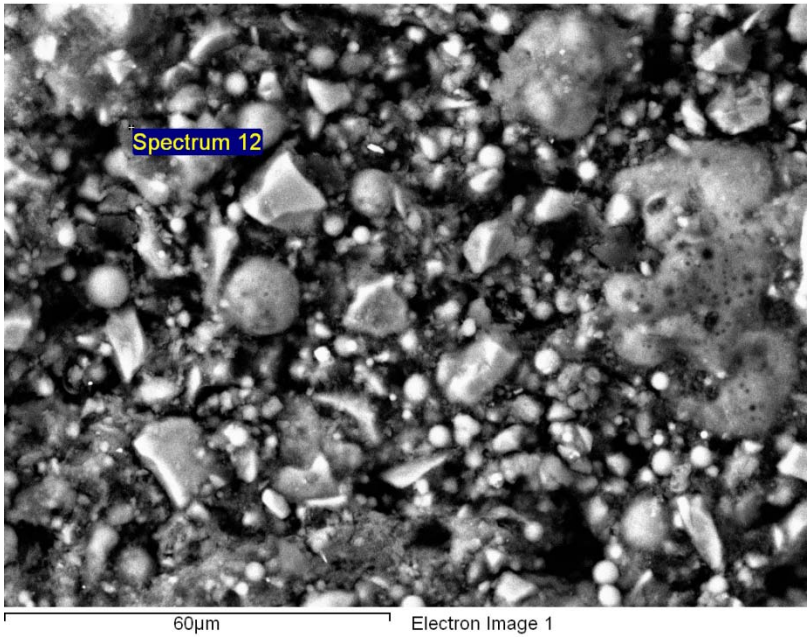
HC3-55-1S Site 4 Spectrum 12 (4.12)

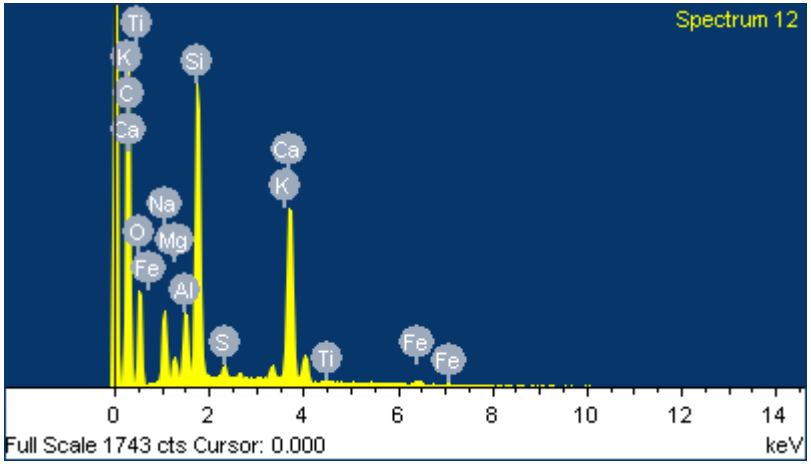
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.47	7.22	10.07	Na_2O
Mg K	1.83	1.67	3.04	MgO
Al K	4.58	3.77	8.65	Al_2O_3
Si K	20.72	16.38	44.33	SiO_2
S K	1.00	0.70	2.51	SO_3
K K	1.28	0.73	1.54	K_2O
Ca K	19.89	11.02	27.83	CaO
Ti K	0.26	0.12	0.43	TiO_2
Fe K	1.25	0.50	1.60	FeO
O	41.72	57.90		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

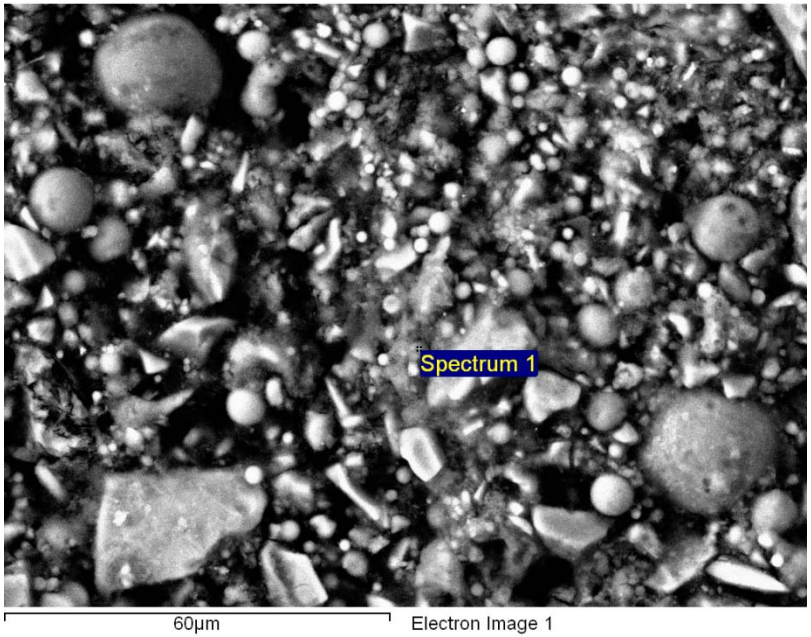
HC3-55-1S Site 5 Spectrum 1 (5.1)

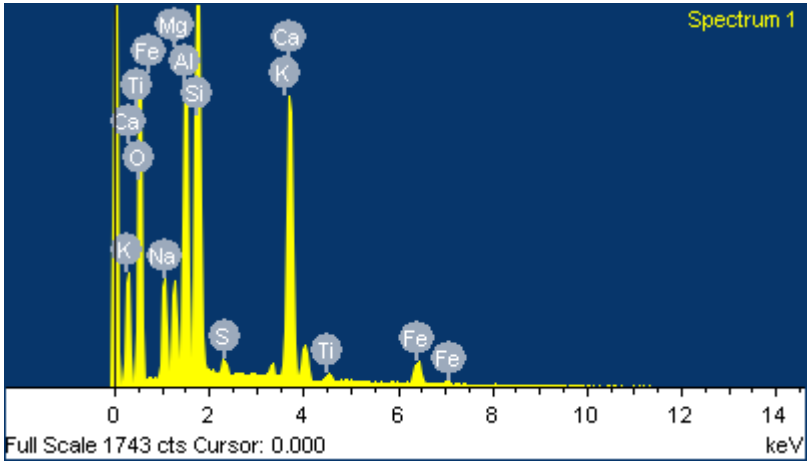
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.95	4.72	6.68	Na_2O
Mg K	3.32	2.99	5.50	MgO
Al K	9.16	7.44	17.32	Al_2O_3
Si K	20.15	15.72	43.10	SiO_2
S K	0.62	0.42	1.55	SO_3
K K	0.52	0.29	0.63	K_2O
Ca K	14.56	7.96	20.37	CaO
Ti K	0.51	0.23	0.84	TiO_2
Fe K	3.12	1.22	4.01	FeO
O	43.09	59.01		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

INCA

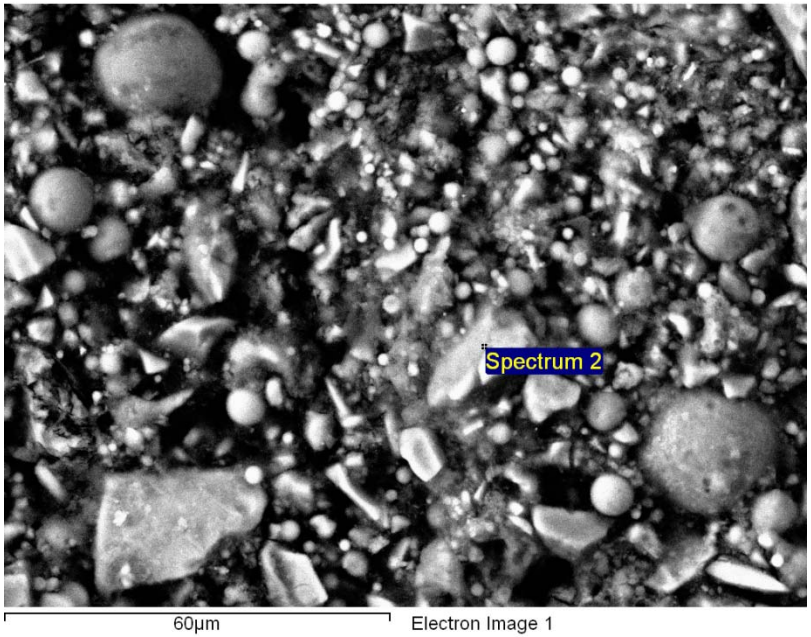
HC3-55-1S Site 5 Spectrum 2 (5.2)

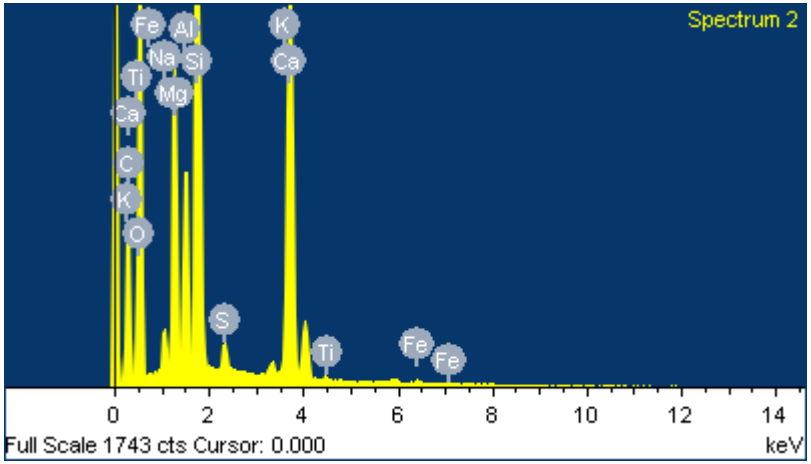
Spectrum processing :
Peak possibly omitted : 5.896 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.46	1.38	1.96	Na_2O
Mg K	8.17	7.32	13.54	MgO
Al K	4.75	3.84	8.97	Al_2O_3
Si K	21.60	16.76	46.20	SiO_2
S K	0.92	0.62	2.29	SO_3
K K	0.43	0.24	0.52	K_2O
Ca K	18.51	10.07	25.90	CaO
Ti K	0.13	0.06	0.21	TiO_2
Fe K	0.32	0.12	0.41	FeO
O	43.73	59.59		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *BFS particle*

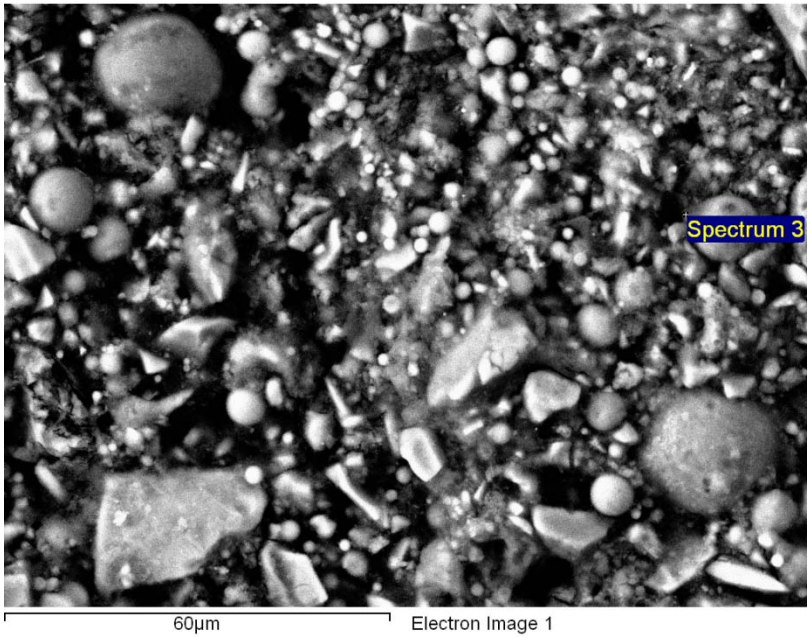
HC3-55-1S Site 5 Spectrum 3 (5.3)

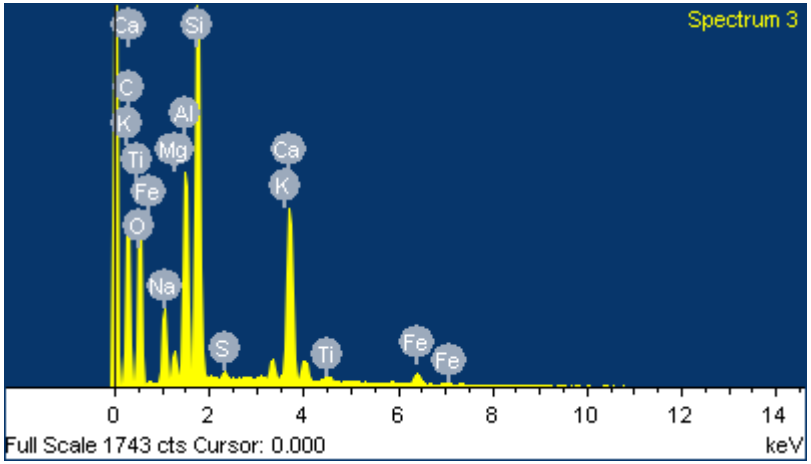
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.75	5.47	7.75	Na_2O
Mg K	1.45	1.30	2.40	MgO
Al K	9.96	8.07	18.82	Al_2O_3
Si K	20.85	16.22	44.60	SiO_2
S K	0.48	0.32	1.19	SO_3
K K	1.54	0.86	1.86	K_2O
Ca K	14.02	7.65	19.62	CaO
Ti K	0.53	0.24	0.88	TiO_2
Fe K	2.25	0.88	2.89	FeO
O	43.18	58.99		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed*: matrix near the FA particle of Spectrum 5.4*

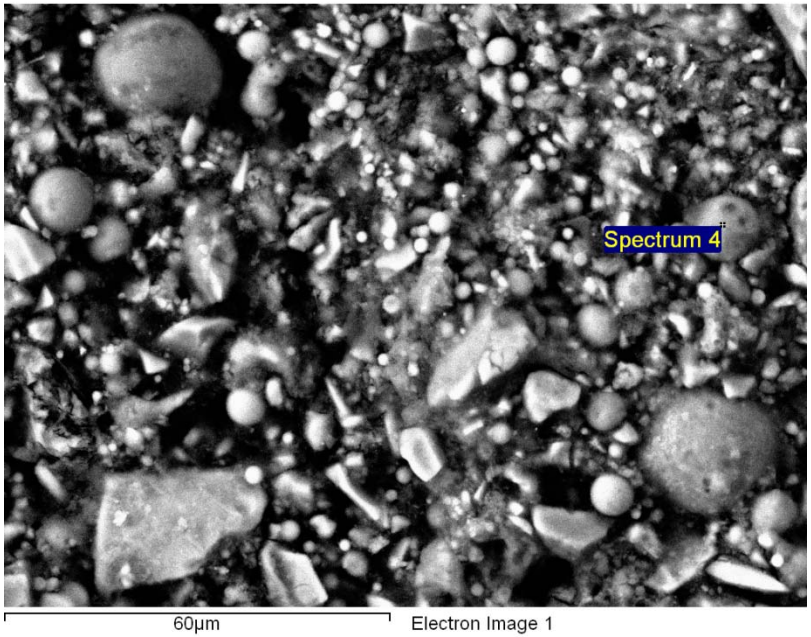
HC3-55-1S Site 5 Spectrum 4 (5.4)

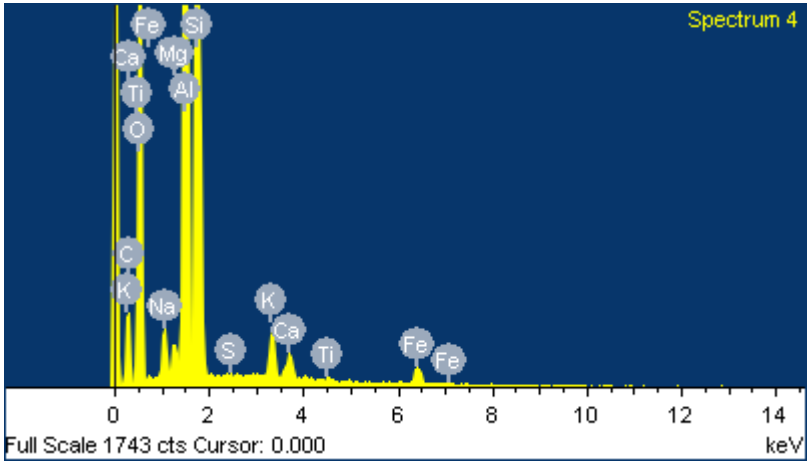
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 2

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.74	1.56	2.34	Na_2O
Mg K	0.70	0.60	1.17	MgO
Al K	18.13	13.89	34.25	Al_2O_3
Si K	25.95	19.10	55.52	SiO_2
S K	0.06	0.04	0.14	SO_3
K K	2.01	1.06	2.42	K_2O
Ca K	1.06	0.55	1.49	CaO
Ti K	0.19	0.08	0.32	TiO_2
Fe K	1.83	0.68	2.36	FeO
O	48.33	62.44		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed*: FA particle*

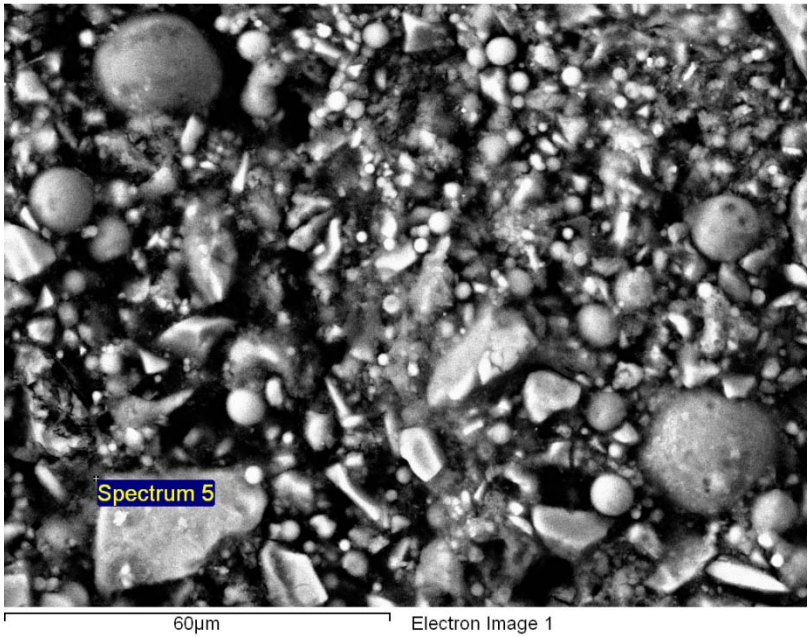
HC3-55-1S Site 5 Spectrum 5 (5.5)

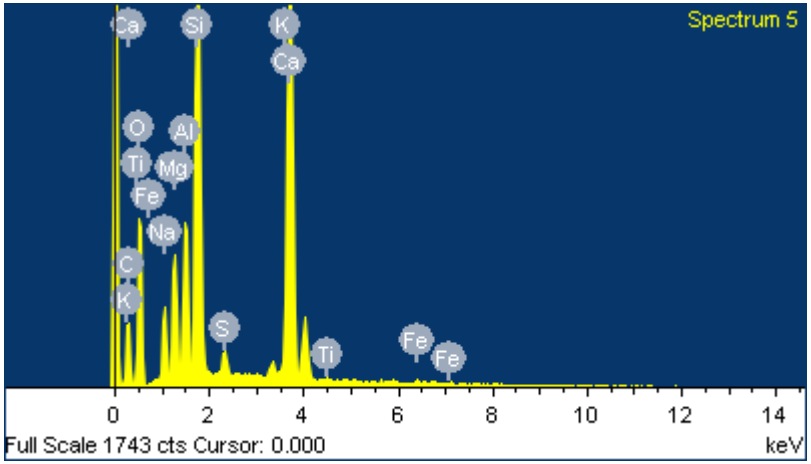
Spectrum processing :
Peak possibly omitted : 5.890 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.29	3.19	4.44	Na_2O
Mg K	4.51	4.14	7.48	MgO
Al K	4.61	3.81	8.71	Al_2O_3
Si K	20.38	16.17	43.61	SiO_2
S K	0.80	0.55	1.99	SO_3
K K	0.59	0.34	0.71	K_2O
Ca K	23.10	12.84	32.32	CaO
Ti K	0.17	0.08	0.29	TiO_2
Fe K	0.34	0.14	0.44	FeO
O	42.19	58.75		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed*: matrix near a BFS particle*

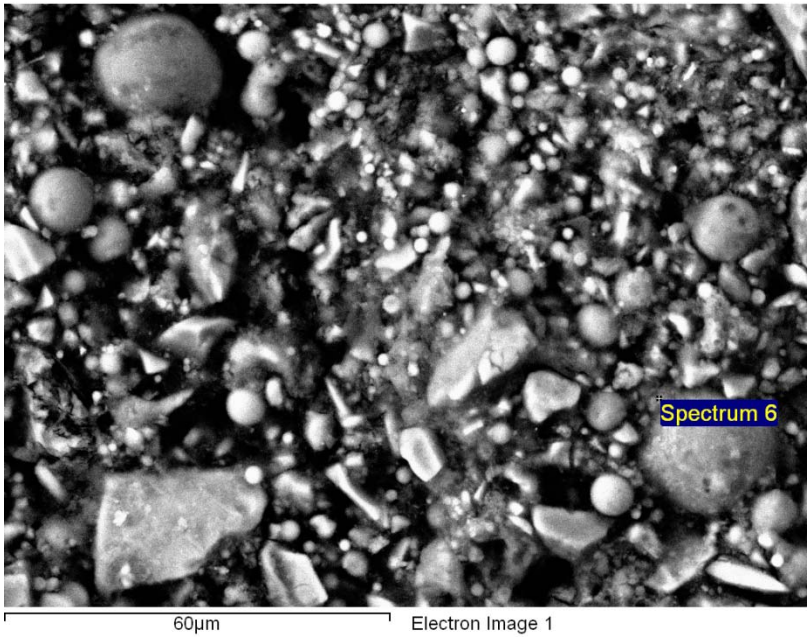
HC3-55-1S Site 5 Spectrum 6 (5.6)

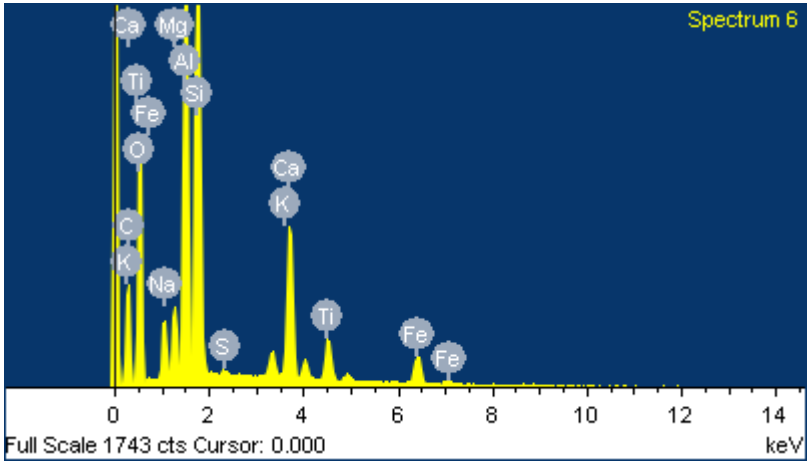
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.88	2.71	3.88	Na_2O
Mg K	2.21	1.97	3.66	MgO
Al K	12.51	10.03	23.64	Al_2O_3
Si K	21.78	16.78	46.59	SiO_2
S K	0.20	0.13	0.50	SO_3
K K	1.19	0.66	1.43	K_2O
Ca K	7.71	4.16	10.79	CaO
Ti K	2.92	1.32	4.88	TiO_2
Fe K	3.60	1.39	4.63	FeO
O	45.00	60.85		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed*: matrix near a FA particle*

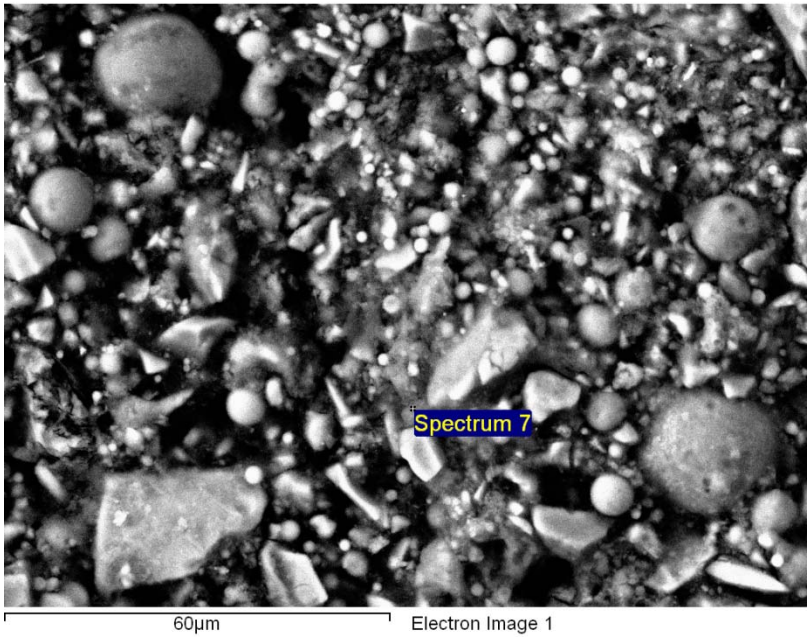
HC3-55-1S Site 5 Spectrum 7 (5.7)

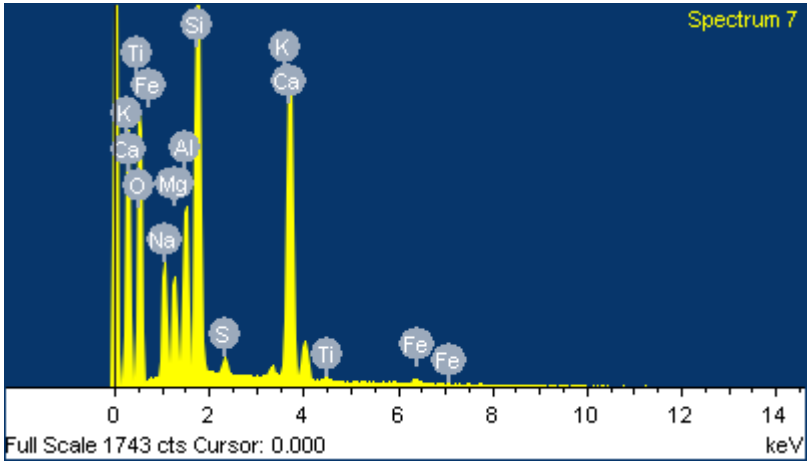
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.23	5.93	8.40	Na_2O
Mg K	3.97	3.57	6.58	MgO
Al K	5.90	4.79	11.15	Al_2O_3
Si K	21.03	16.39	45.00	SiO_2
S K	0.62	0.43	1.56	SO_3
K K	0.60	0.34	0.73	K_2O
Ca K	18.25	9.96	25.54	CaO
Ti K	0.17	0.08	0.28	TiO_2
Fe K	0.61	0.24	0.78	FeO
O	42.62	58.29		
Totals	100.00			





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed*: matrix*

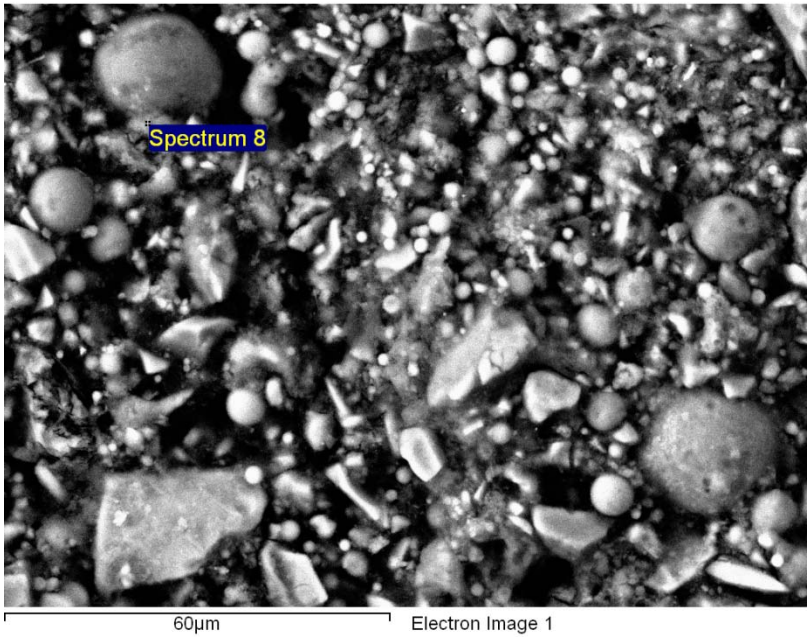
HC3-55-1S Site 5 Spectrum 8 (5.8)

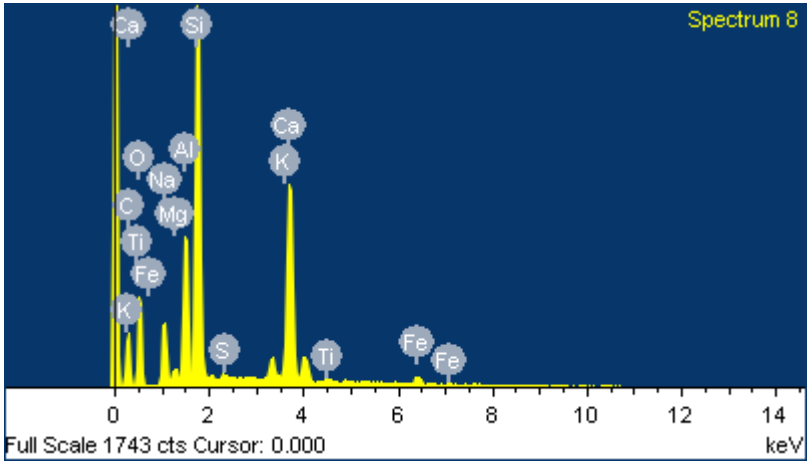
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.25	5.04	7.08	Na_2O
Mg K	0.66	0.60	1.10	MgO
Al K	7.51	6.14	14.18	Al_2O_3
Si K	22.27	17.50	47.65	SiO_2
S K	0.34	0.23	0.85	SO_3
K K	1.53	0.86	1.84	K_2O
Ca K	17.63	9.71	24.67	CaO
Ti K	0.32	0.15	0.54	TiO_2
Fe K	1.62	0.64	2.09	FeO
O	42.86	59.12		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed*: matrix*

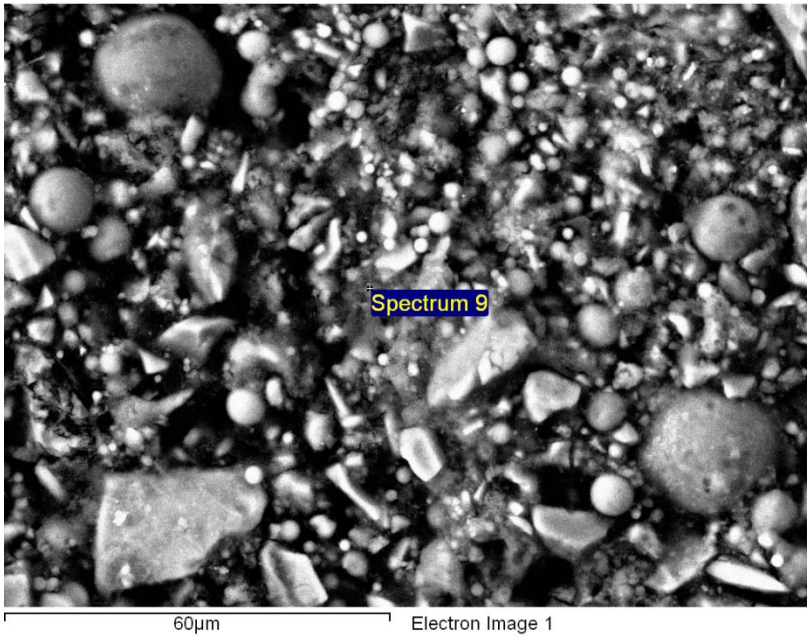
HC3-55-1S Site 5 Spectrum 9 (5.9)

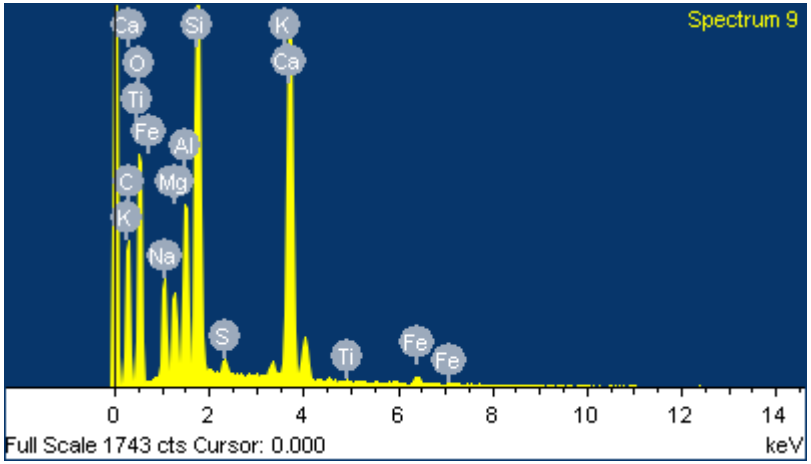
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.47	5.28	7.38	Na_2O
Mg K	3.28	2.99	5.44	MgO
Al K	5.62	4.61	10.62	Al_2O_3
Si K	20.52	16.19	43.90	SiO_2
S K	0.64	0.44	1.59	SO_3
K K	0.63	0.36	0.76	K_2O
Ca K	20.25	11.20	28.34	CaO
Ti K	0.23	0.11	0.39	TiO_2
Fe K	1.23	0.49	1.58	FeO
O	42.12	58.34		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed*: matrix*

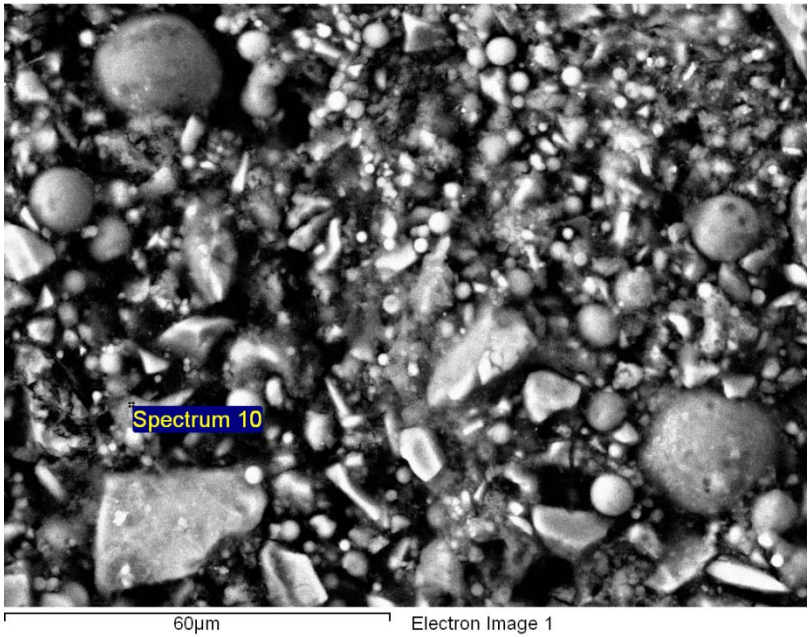
HC3-55-1S Site 5 Spectrum 10 (5.10)

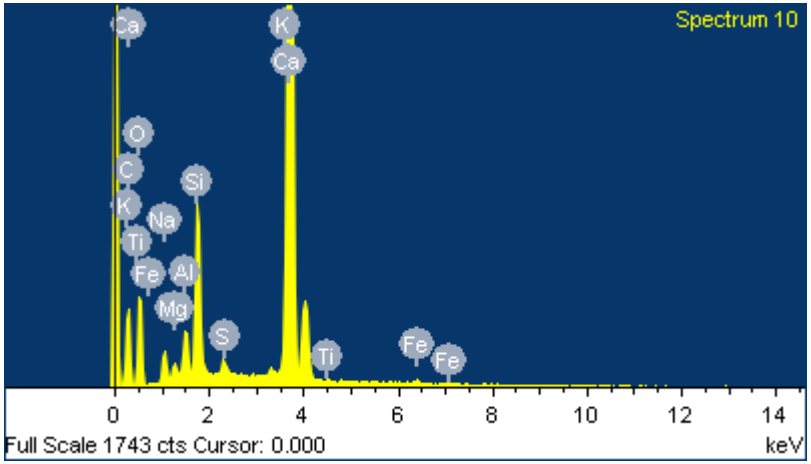
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 2

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.61	2.88	3.52	Na_2O
Mg K	0.67	0.70	1.12	MgO
Al K	1.99	1.87	3.76	Al_2O_3
Si K	8.16	7.37	17.46	SiO_2
S K	0.68	0.54	1.69	SO_3
K K	0.31	0.20	0.37	K2O
Ca K	50.68	32.07	70.91	CaO
Ti K	0.21	0.11	0.34	TiO_2
Fe K	0.64	0.29	0.83	FeO
O	34.05	53.97		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed*: matrix*

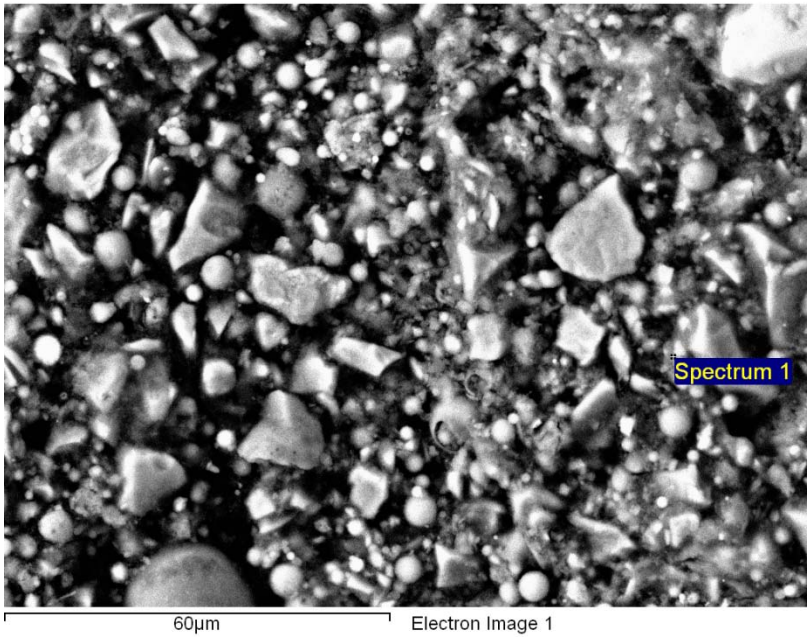
HC3-55-1S Site 6 Spectrum 1 (6.1)

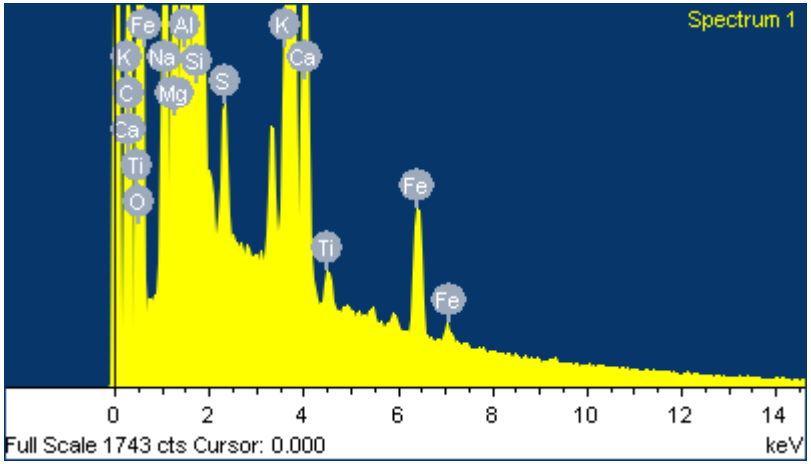
Spectrum processing :
Peak possibly omitted : 5.435 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.75	3.58	5.06	Na_2O
Mg K	3.29	2.97	5.46	MgO
Al K	7.29	5.94	13.78	Al_2O_3
Si K	21.56	16.87	46.13	SiO_2
S K	0.68	0.46	1.69	SO_3
K K	0.67	0.37	0.80	K_2O
Ca K	17.08	9.36	23.89	CaO
Ti K	0.37	0.17	0.61	TiO_2
Fe K	2.00	0.79	2.58	FeO
O	43.31	59.48		
Totals	100.00			





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

INCA

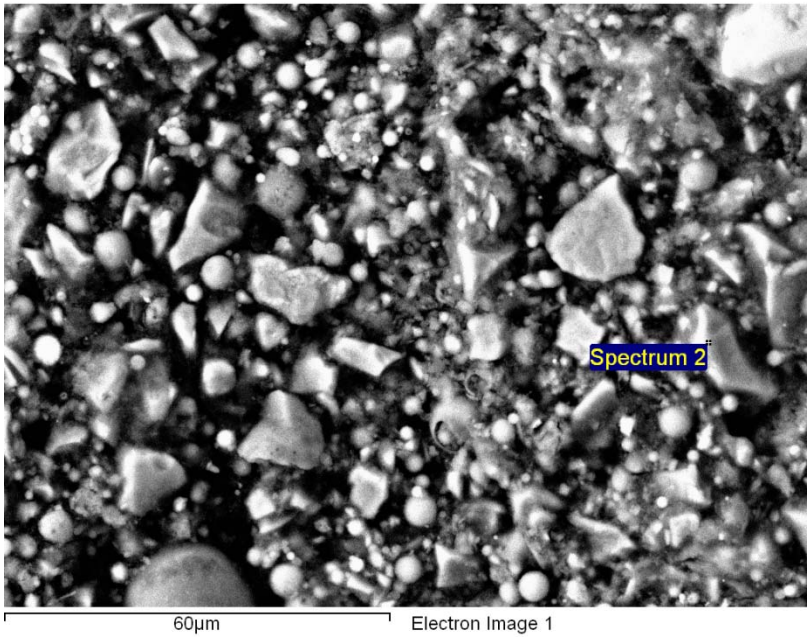
HC3-55-1S Site 6 Spectrum 2 (6.2)

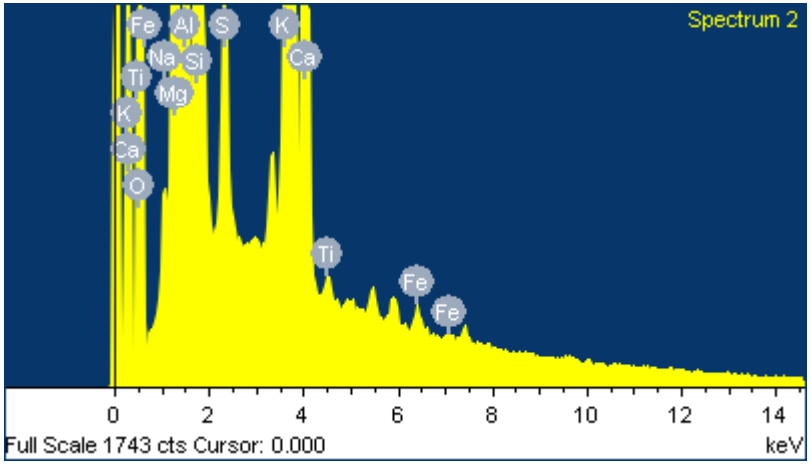
Spectrum processing :
Peak possibly omitted : 5.448 keV

Processing option : Oxygen by stoichiometry (Normalised)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	0.48	0.47	0.65	Na_2O
Mg K	5.74	5.32	9.52	MgO
Al K	4.17	3.48	7.87	Al_2O_3
Si K	19.41	15.56	41.52	SiO_2
S K	1.08	0.76	2.70	SO_3
K K	0.35	0.20	0.43	K_2O
Ca K	26.19	14.72	36.64	CaO
Ti K	0.19	0.09	0.32	TiO_2
Fe K	0.27	0.11	0.35	FeO
O	42.11	59.29		
Totals	100.00			





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

inca

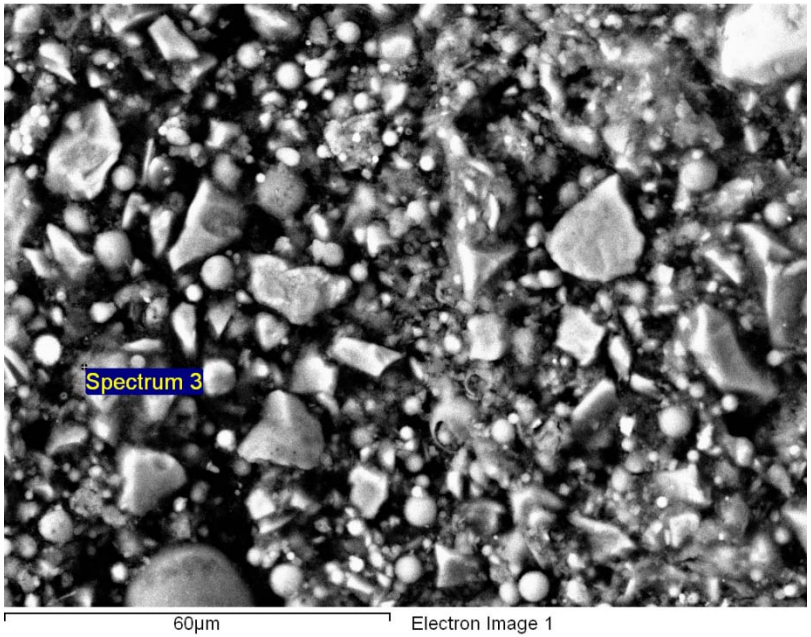
HC3-55-1S Site 6 Spectrum 3 (6.3)

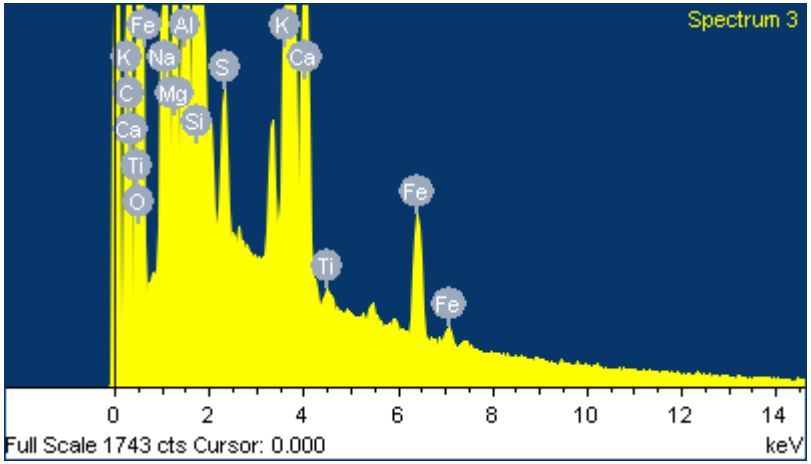
Spectrum processing :
Peak possibly omitted : 5.439 keV

Processing option : Oxygen by stoichiometry (Normalised)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.53	6.36	8.81	Na_2O
Mg K	1.79	1.65	2.97	MgO
Al K	3.67	3.04	6.93	Al_2O_3
Si K	21.38	17.03	45.74	SiO_2
S K	0.72	0.50	1.79	SO_3
K K	0.68	0.39	0.82	K_2O
Ca K	21.58	12.05	30.19	CaO
Ti K	0.18	0.08	0.29	TiO_2
Fe K	1.92	0.77	2.47	FeO
O	41.56	58.13		
Totals	100.00			





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

inca

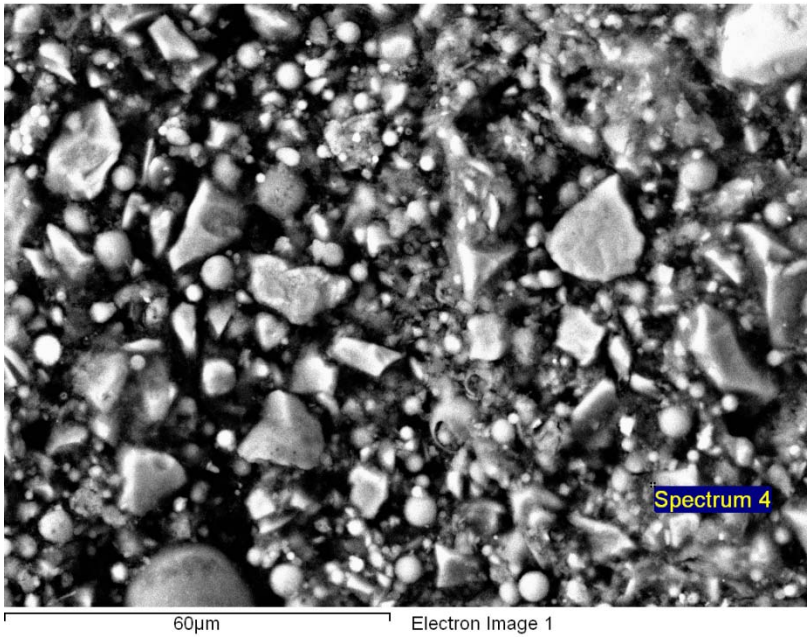
HC3-55-1S Site 6 Spectrum 4 (6.4)

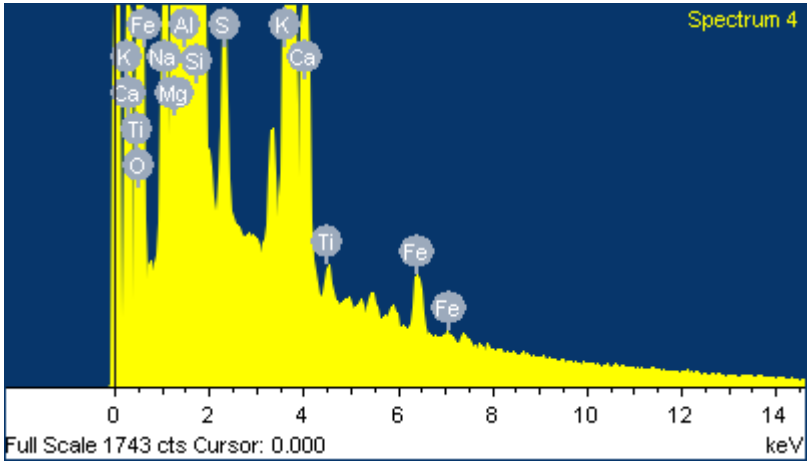
Spectrum processing :
Peak possibly omitted : 5.452 keV

Processing option : Oxygen by stoichiometry (Normalised)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.98	2.85	4.02	Na_2O
Mg K	4.45	4.01	7.37	MgO
Al K	6.61	5.38	12.49	Al_2O_3
Si K	21.29	16.64	45.55	SiO_2
S K	0.74	0.51	1.85	SO_3
K K	0.44	0.25	0.53	K_2O
Ca K	19.22	10.52	26.89	CaO
Ti K	0.26	0.12	0.43	TiO_2
Fe K	0.68	0.27	0.87	FeO
O	43.34	59.46		
Totals	100.00			





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

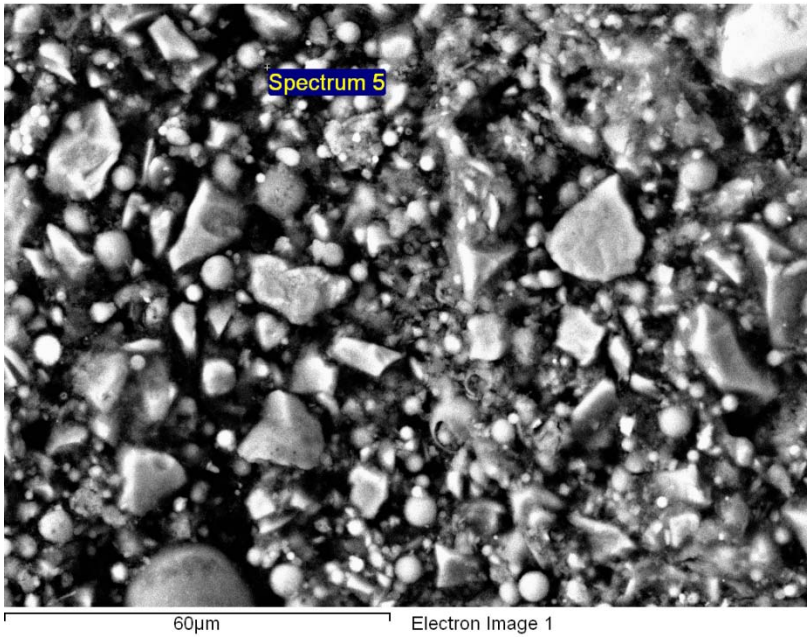
HC3-55-1S Site 6 Spectrum 5 (6.5)

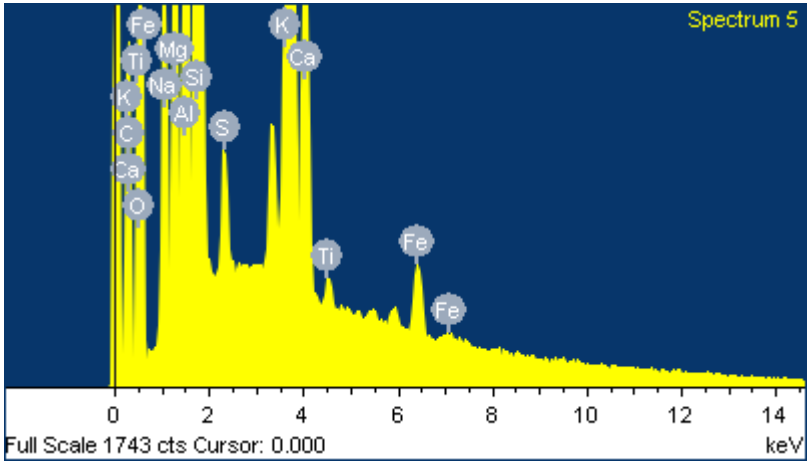
Spectrum processing :
Peak possibly omitted : 5.444 keV

Processing option : Oxygen by stoichiometry (Normalised)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.93	2.90	3.94	Na_2O
Mg K	3.06	2.87	5.08	MgO
Al K	5.15	4.35	9.74	Al_2O_3
Si K	18.57	15.05	39.73	SiO_2
S K	0.74	0.53	1.85	SO_3
K K	0.90	0.53	1.09	K_2O
Ca K	25.98	14.75	36.35	CaO
Ti K	0.33	0.16	0.55	TiO_2
Fe K	1.30	0.53	1.67	FeO
O	41.03	58.36		
Totals	100.00			





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

inca

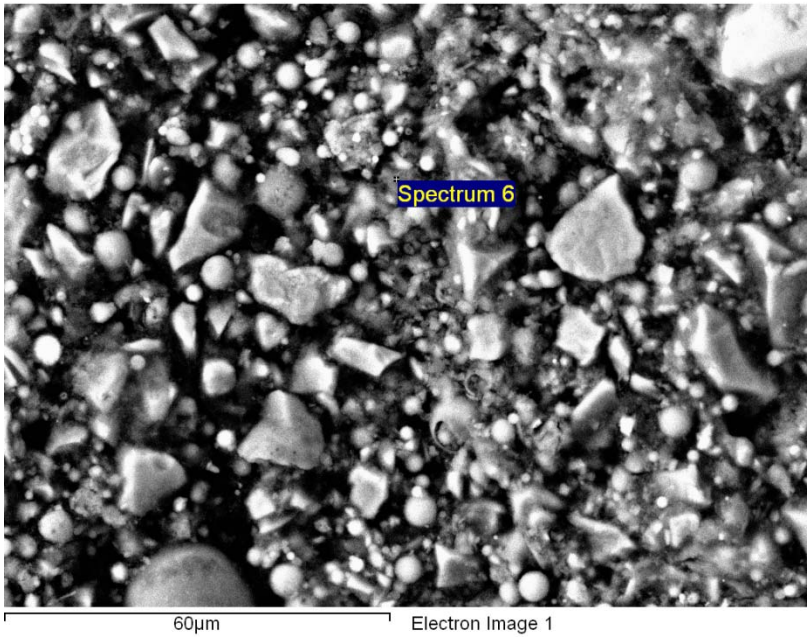
HC3-55-1S Site 6 Spectrum 6 (6.6)

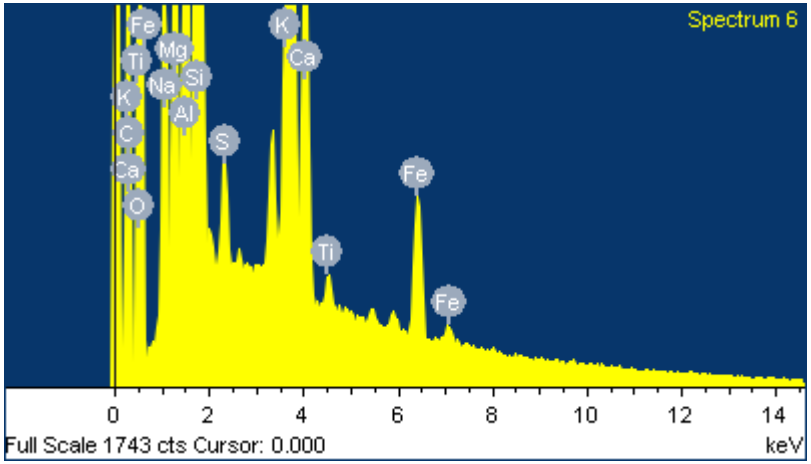
Spectrum processing :
Peak possibly omitted : 5.444 keV

Processing option : Oxygen by stoichiometry (Normalised)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.43	3.36	4.62	Na_2O
Mg K	3.30	3.06	5.48	MgO
Al K	5.87	4.90	11.08	Al_2O_3
Si K	19.55	15.67	41.81	SiO_2
S K	0.61	0.43	1.52	SO_3
K K	0.80	0.46	0.97	K_2O
Ca K	21.89	12.30	30.62	CaO
Ti K	0.37	0.17	0.62	TiO_2
Fe K	2.55	1.03	3.27	FeO
O	41.64	58.62		
Totals	100.00			





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

INCA

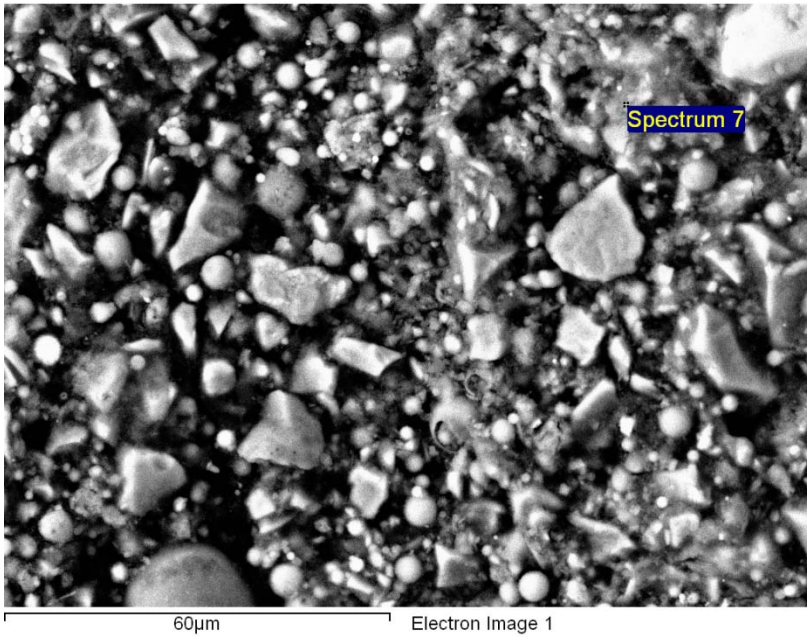
HC3-55-1S Site 6 Spectrum 7 (6.7)

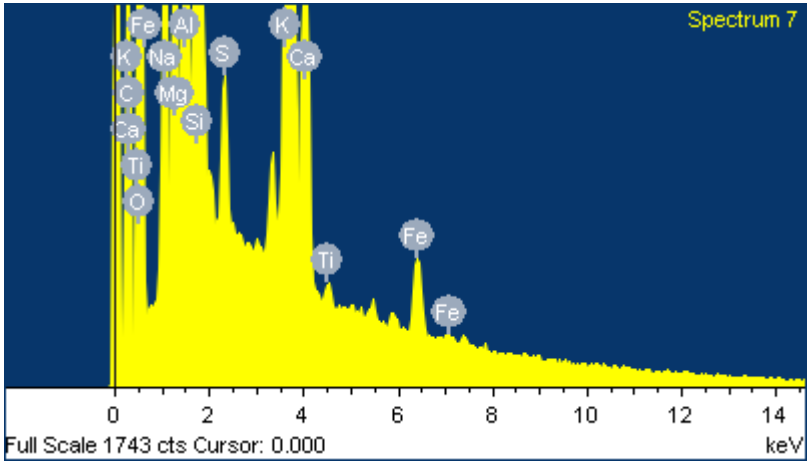
Spectrum processing :
Peak possibly omitted : 5.441 keV

Processing option : Oxygen by stoichiometry (Normalised)
Number of iterations = 4

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.15	3.08	4.25	Na_2O
Mg K	3.05	2.82	5.06	MgO
Al K	5.03	4.19	9.49	Al_2O_3
Si K	20.10	16.10	43.01	SiO_2
S K	0.74	0.52	1.84	SO_3
K K	0.44	0.25	0.53	K_2O
Ca K	24.23	13.60	33.90	CaO
Ti K	0.23	0.11	0.39	TiO_2
Fe K	1.19	0.48	1.53	FeO
O	41.84	58.84		
Totals	100.00			





Comment:
Curing conditions: *Temp3*, 28 days
Type of material analyzed: *matrix*

APPENDIX D

SEM/EDS ANALYSIS OF SAMPLES CURED FOR 90 DAYS

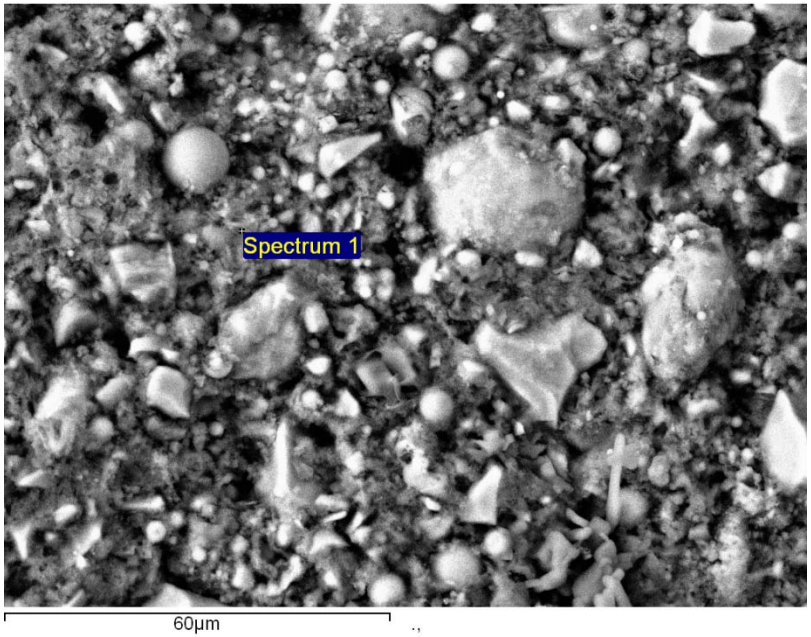
HC3-35-6 Site 4 Spectrum 1 (4.1)

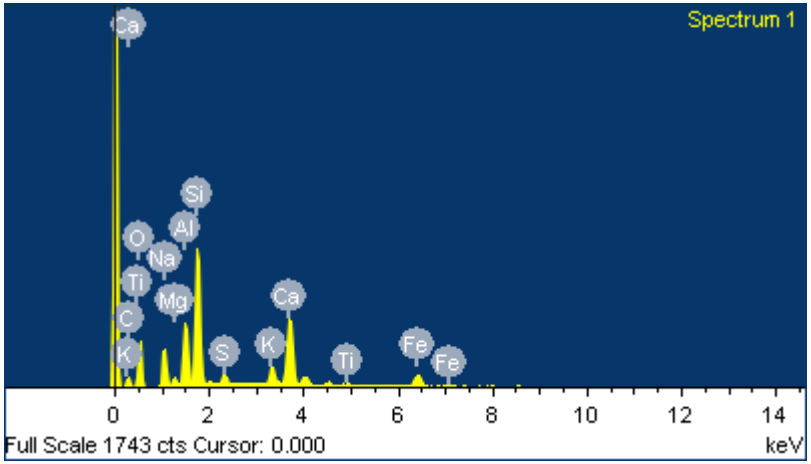
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.74	7.54	10.44	Na_2O
Mg K	1.39	1.28	2.31	MgO
Al K	7.51	6.23	14.18	Al_2O_3
Si K	18.17	14.48	38.87	SiO_2
S K	1.55	1.08	3.86	SO_3
K K	2.71	1.55	3.27	K_2O
Ca K	13.20	7.38	18.48	CaO
Ti K	0.96	0.45	1.59	TiO_2
Fe K	5.44	2.18	6.99	FeO
O	41.33	57.83		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix*

INCA

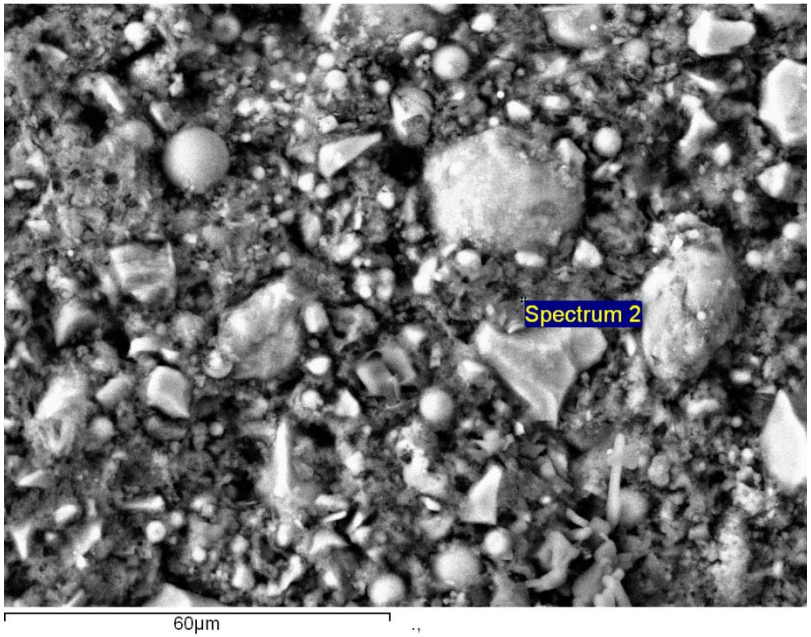
HC3-35-6 Site 4 Spectrum 2 (4.2)

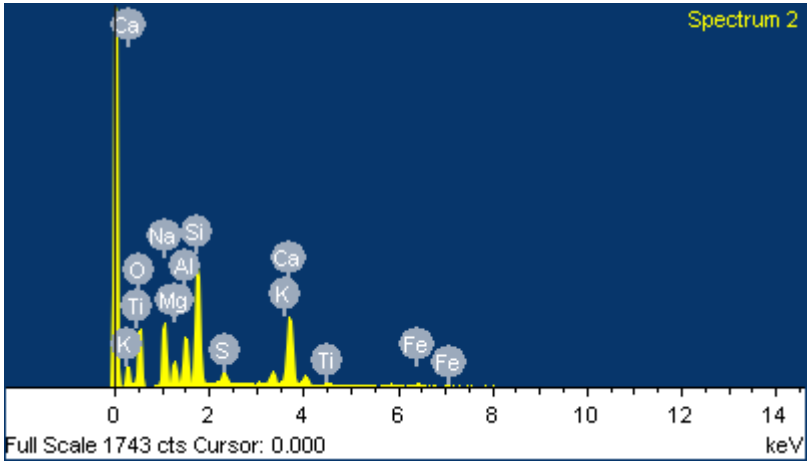
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	12.33	11.72	16.62	Na_2O
Mg K	4.12	3.71	6.84	MgO
Al K	6.14	4.97	11.60	Al_2O_3
Si K	16.86	13.11	36.06	SiO_2
S K	1.49	1.01	3.71	SO_3
K K	1.97	1.10	2.38	K_2O
Ca K	14.07	7.67	19.69	CaO
Ti K	0.93	0.43	1.56	TiO_2
Fe K	1.20	0.47	1.55	FeO
O	40.88	55.82		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix*

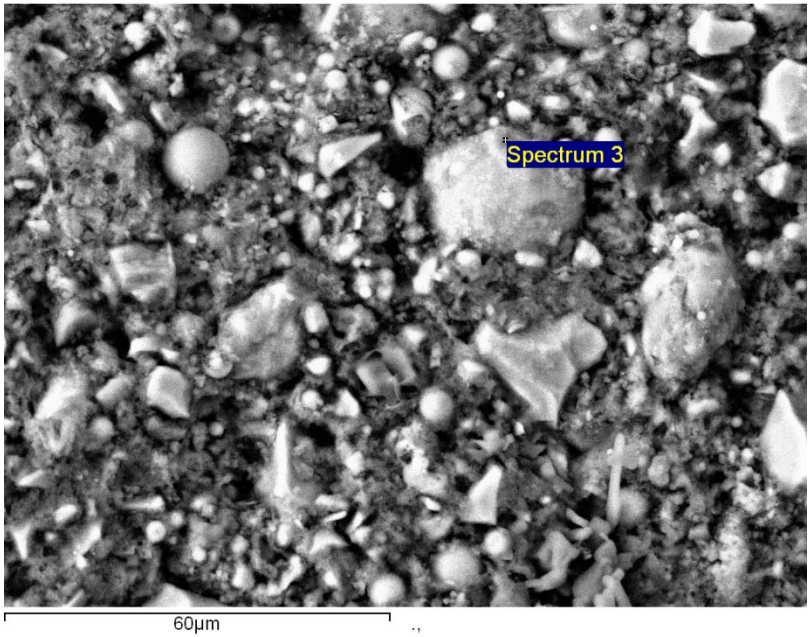
HC3-35-6 Site 4 Spectrum 3 (4.3)

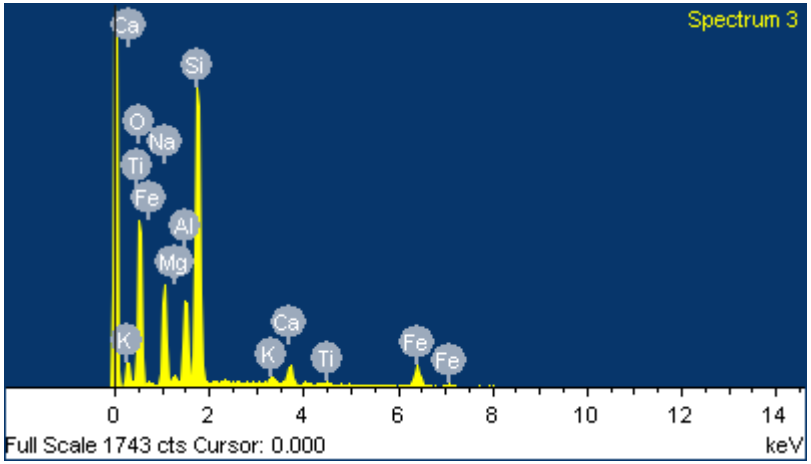
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	11.97	11.06	16.14	Na_2O
Mg K	0.67	0.59	1.11	MgO
Al K	6.54	5.15	12.37	Al_2O_3
Si K	26.86	20.31	57.46	SiO_2
K K	0.92	0.50	1.11	SO_3
Ca K	2.27	1.20	3.18	K_2O
Ti K	0.51	0.23	0.85	CaO
Fe K	6.04	2.30	7.77	TiO_2
O	44.20	58.66		FeO
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *irregular shaped FA particle*

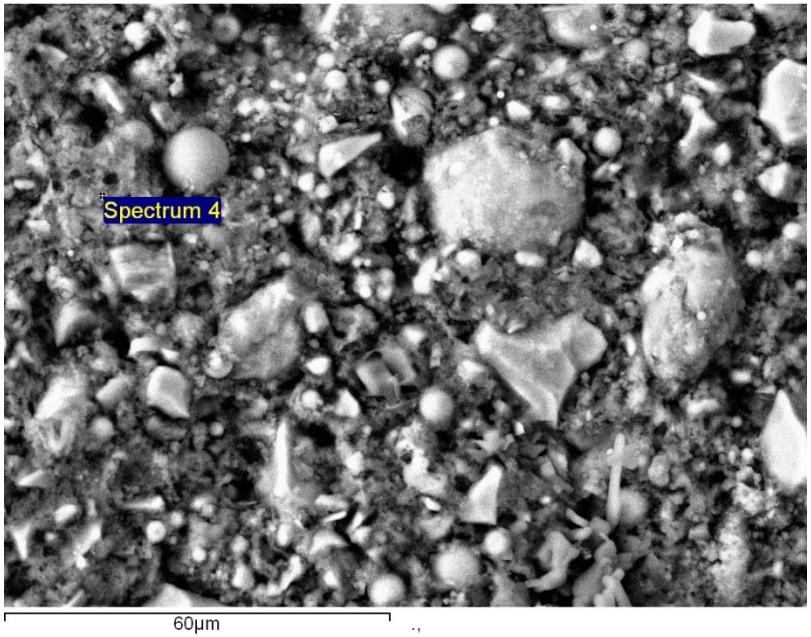
HC3-35-6 Site 4 Spectrum 4 (4.4)

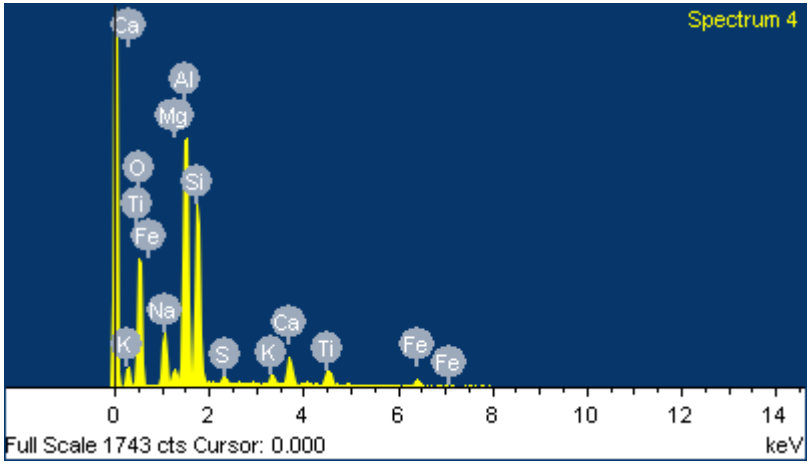
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.31	5.79	8.50	Na_2O
Mg K	1.13	0.98	1.87	MgO
Al K	19.36	15.14	36.57	Al_2O_3
Si K	17.77	13.36	38.02	SiO_2
S K	0.68	0.45	1.71	SO_3
K K	1.11	0.60	1.34	K_2O
Ca K	3.35	1.77	4.69	CaO
Ti K	2.68	1.18	4.48	TiO_2
Fe K	2.19	0.83	2.82	FeO
O	45.41	59.91		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix*

INCA

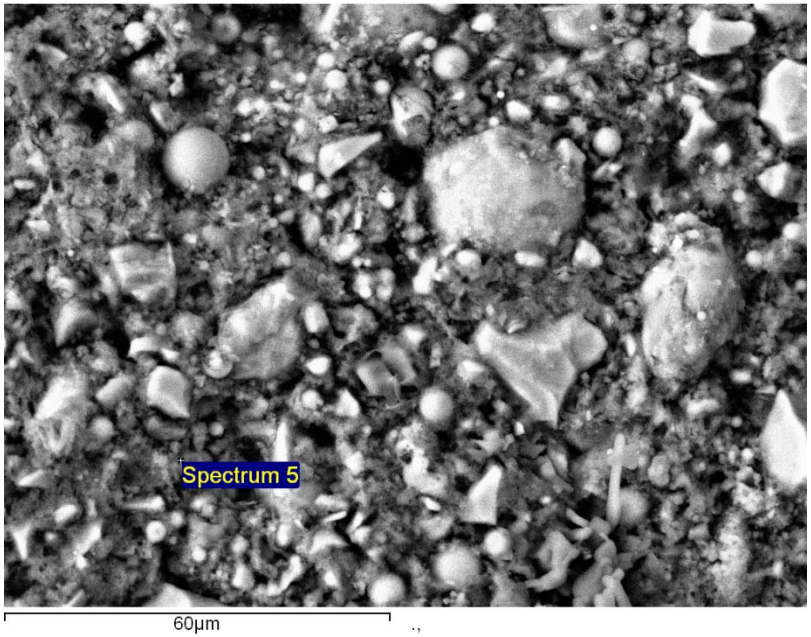
HC3-35-6 Site 4 Spectrum 5 (4.5)

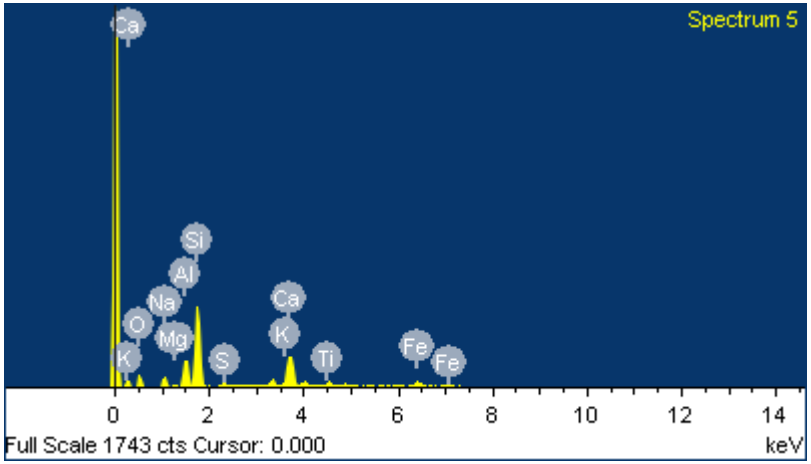
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.76	4.62	6.42	Na_2O
Mg K	0.44	0.41	0.74	MgO
Al K	6.65	5.50	12.57	Al_2O_3
Si K	21.79	17.31	46.61	SiO_2
S K	1.04	0.73	2.60	SO_3
K K	2.12	1.21	2.55	K_2O
Ca K	13.39	7.45	18.73	CaO
Ti K	2.35	1.10	3.93	TiO_2
Fe K	4.55	1.82	5.86	FeO
O	42.90	59.85		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix*

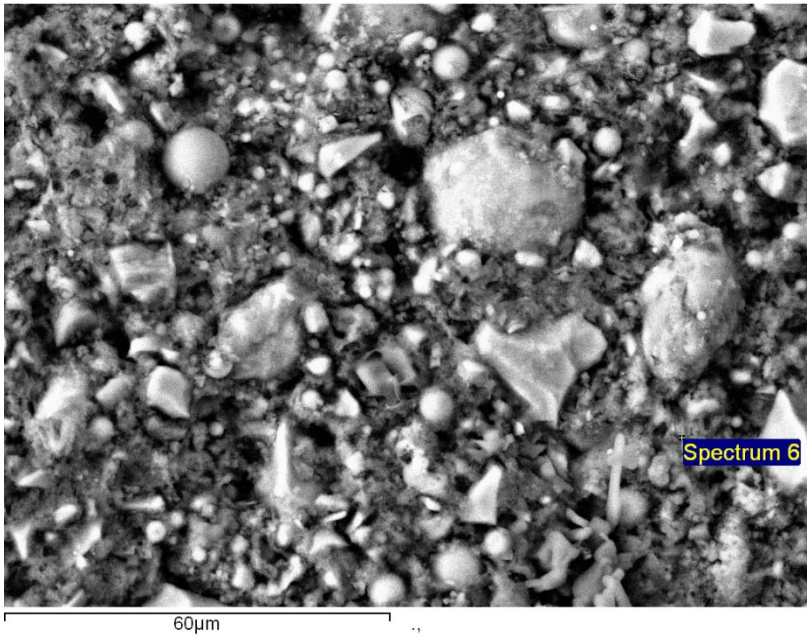
HC3-35-6 Site 4 Spectrum 6 (4.6)

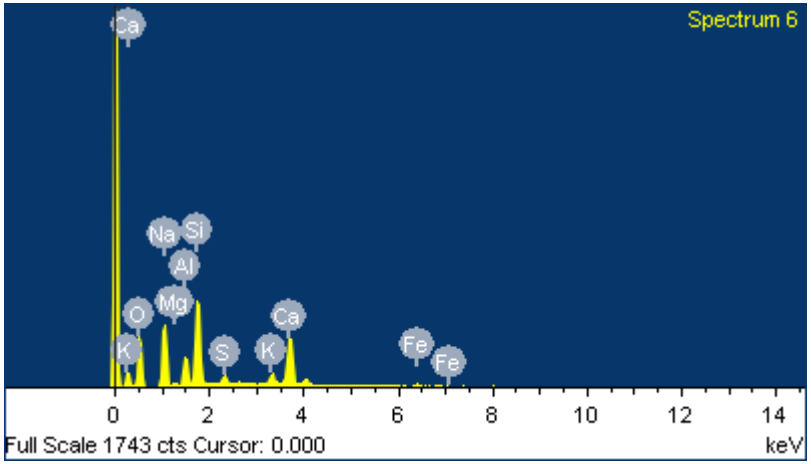
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	17.19	16.36	23.18	Na_2O
Mg K	0.78	0.70	1.29	MgO
Al K	5.17	4.19	9.77	Al_2O_3
Si K	17.23	13.42	36.86	SiO_2
S K	1.77	1.20	4.41	SO_3
K K	2.59	1.45	3.12	K_2O
Ca K	13.75	7.51	19.25	CaO
Fe K	1.65	0.65	2.13	TiO_2
O	39.86	54.51		FeO
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix*

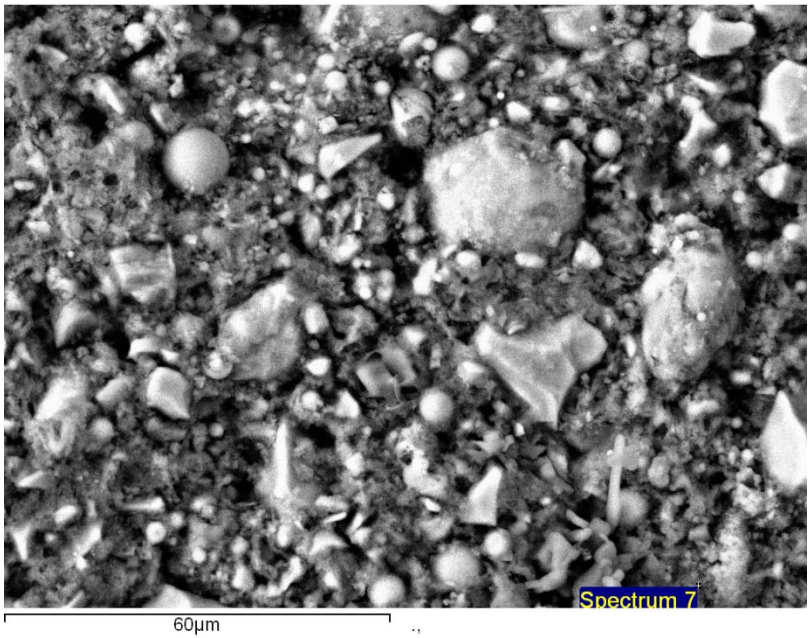
HC3-35-6 Site 4 Spectrum 7 (4.7)

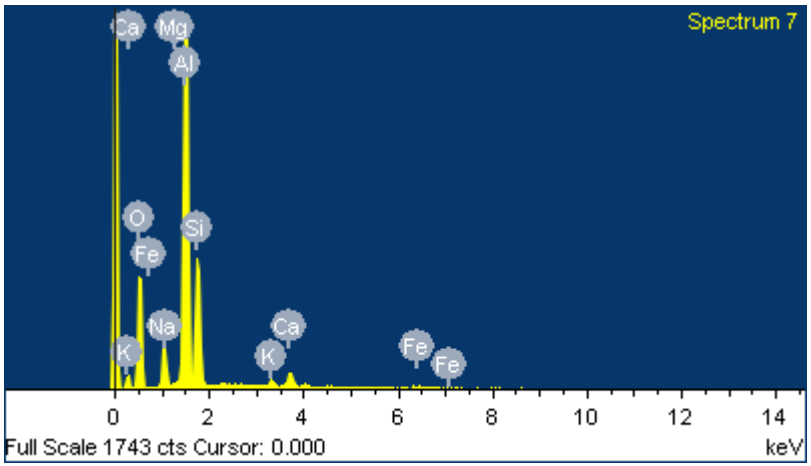
Spectrum processing :
Peak possibly omitted : 4.530 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.74	4.25	6.39	Na_2O
Mg K	0.10	0.08	0.16	MgO
Al K	29.84	22.77	56.39	Al_2O_3
Si K	15.19	11.13	32.49	SiO_2
K K	0.78	0.41	0.94	SO_3
Ca K	1.91	0.98	2.68	K_2O
Fe K	0.74	0.27	0.95	CaO
O	46.70	60.10		FeO
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix*

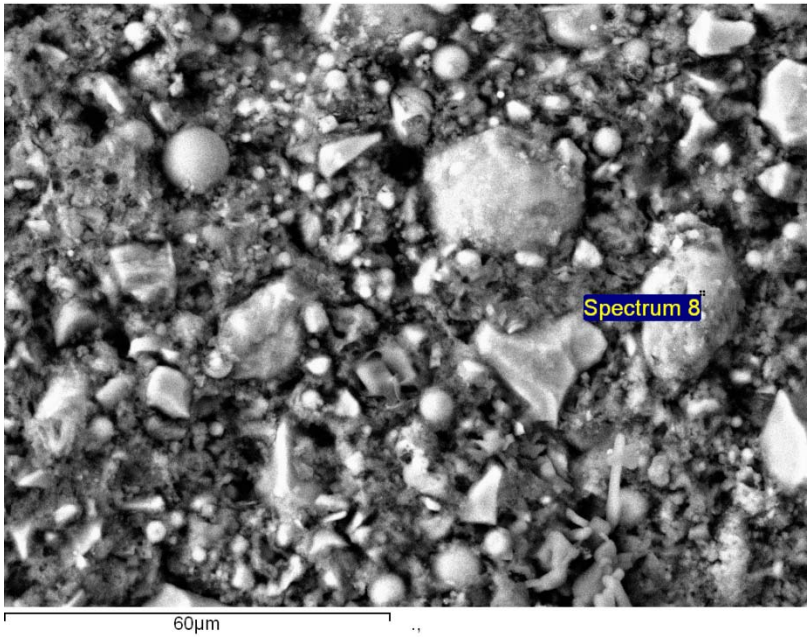
HC3-35-6 Site 4 Spectrum 8 (4.8)

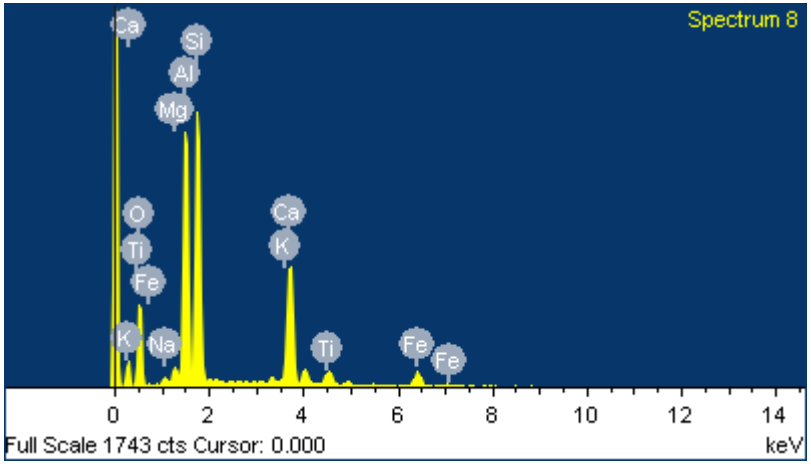
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	0.56	0.54	0.76	Na_2O
Mg K	0.81	0.74	1.35	MgO
Al K	14.98	12.19	28.31	Al_2O_3
Si K	20.11	15.72	43.02	SiO_2
K K	0.49	0.27	0.59	SO_3
Ca K	12.63	6.92	17.67	K_2O
Ti K	2.10	0.96	3.51	CaO
Fe K	3.73	1.47	4.80	FeO
O	44.58	61.19		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *irregular shaped FA particle*

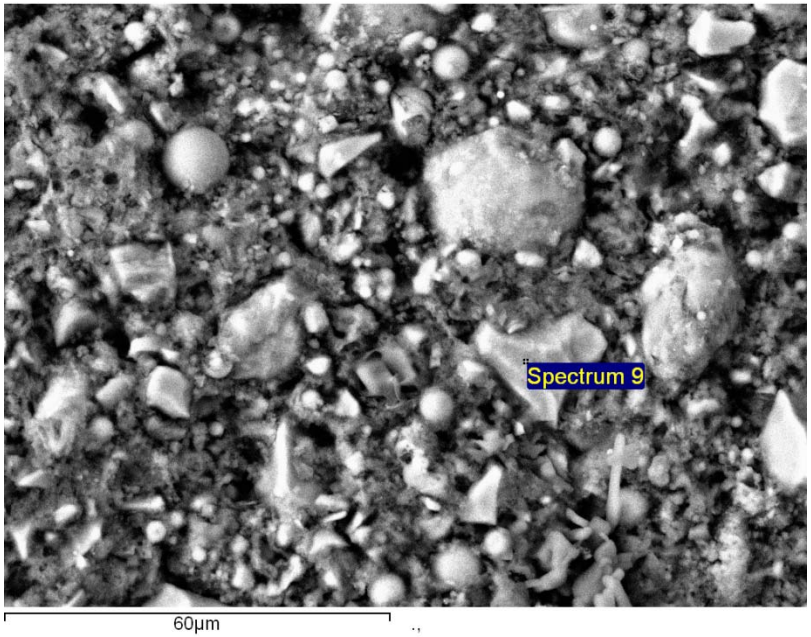
HC3-35-6 Site 4 Spectrum 9 (4.9)

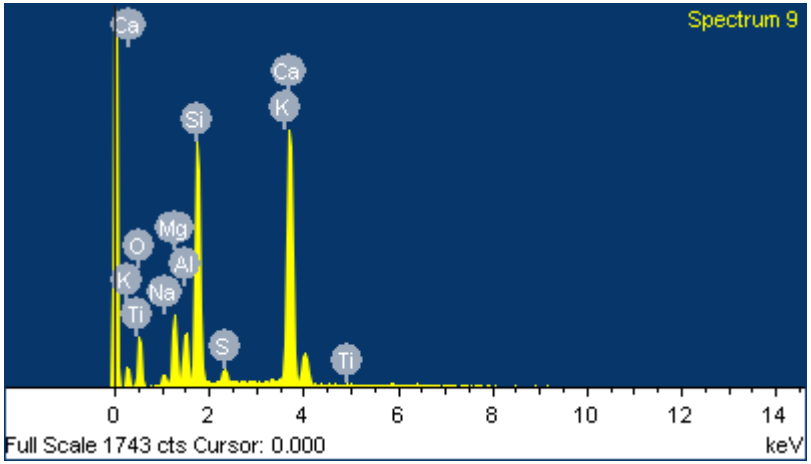
Spectrum processing :
Peak possibly omitted : 5.896 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.06	1.05	1.43	Na_2O
Mg K	5.36	5.02	8.88	MgO
Al K	3.56	3.01	6.73	Al_2O_3
Si K	17.93	14.55	38.35	SiO_2
S K	1.19	0.84	2.96	SO_3
K K	0.28	0.16	0.34	K_2O
Ca K	29.39	16.72	41.13	CaO
Ti K	0.11	0.05	0.19	TiO_2
O	41.12	58.59		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *BFS particle*

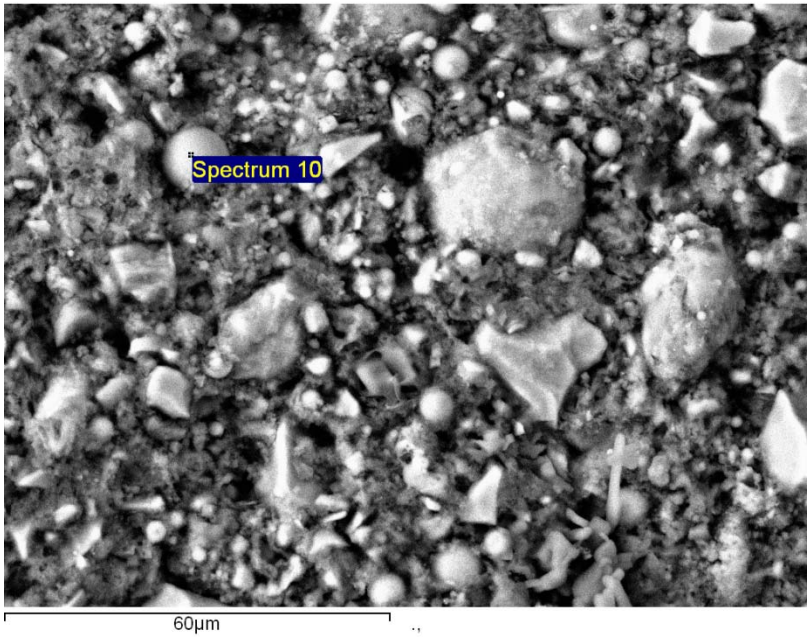
HC3-35-6 Site 4 Spectrum 10 (4.10)

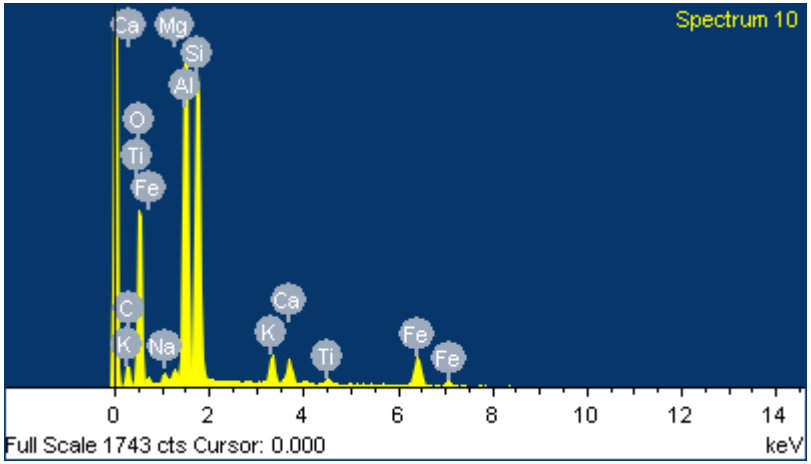
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	0.96	0.89	1.29	Na_2O
Mg K	0.61	0.54	1.01	MgO
Al K	18.57	14.77	35.09	Al_2O_3
Si K	22.03	16.83	47.13	SiO_2
K K	2.33	1.28	2.81	K_2O
Ca K	2.12	1.13	2.96	CaO
Ti K	0.57	0.26	0.95	TiO_2
Fe K	6.80	2.61	8.75	FeO
O	46.01	61.69		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *FA particle*

INCA

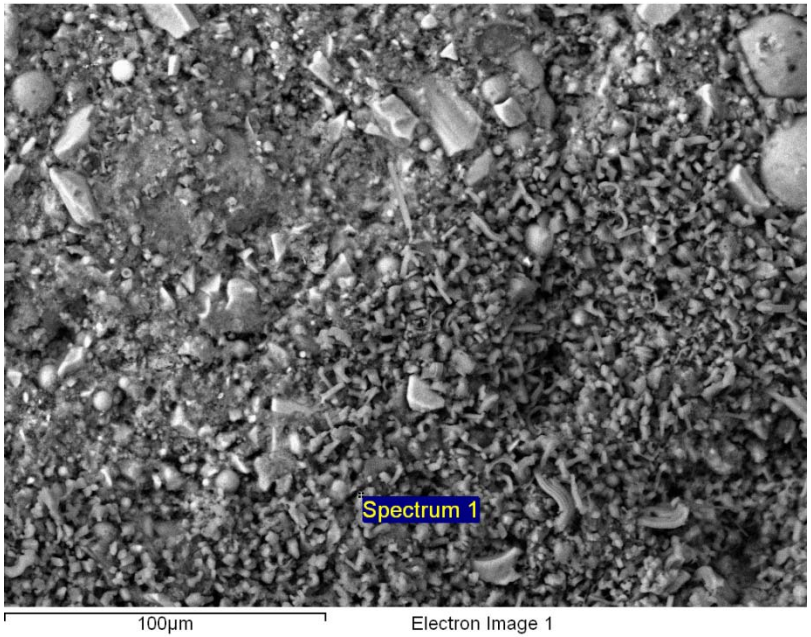
HC3-35-6 Site 5 Spectrum 1 (5.1)

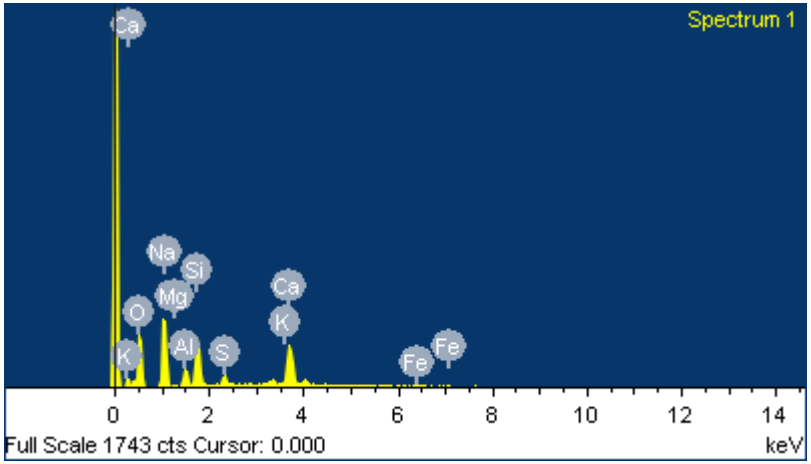
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	23.50	22.37	31.68	Na_2O
Mg K	0.28	0.26	0.47	MgO
Al K	4.32	3.51	8.17	Al_2O_3
Si K	13.11	10.21	28.04	SiO_2
S K	2.77	1.89	6.92	SO_3
K K	1.53	0.86	1.85	K_2O
Ca K	15.56	8.50	21.77	CaO
Fe K	0.87	0.34	1.12	FeO
O	38.06	52.07		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix (likely precipitated salts)*

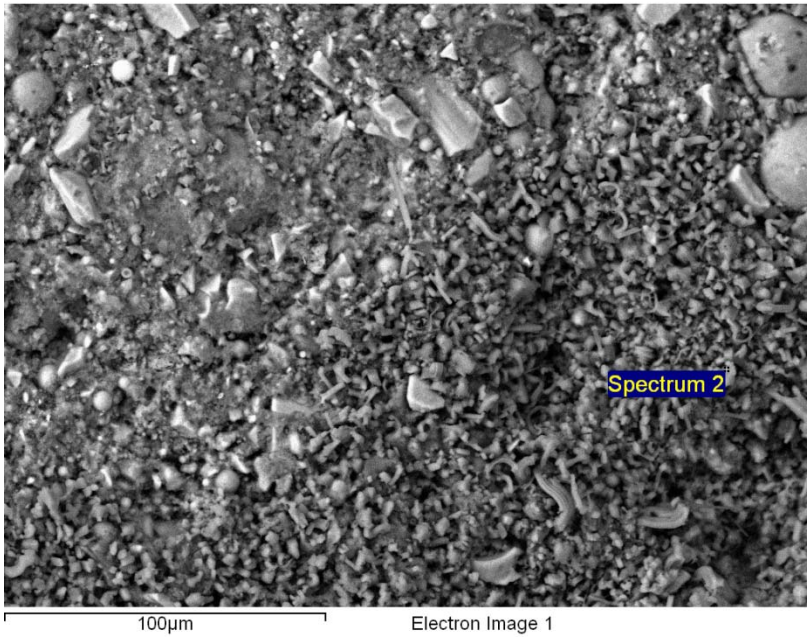
HC3-35-6 Site 5 Spectrum 2 (5.2)

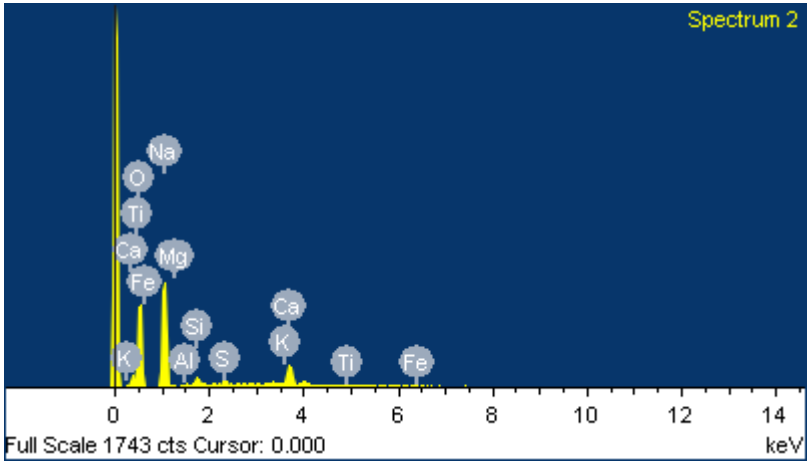
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	51.10	48.68	68.88	Na_2O
Mg K	0.42	0.38	0.69	MgO
Al K	0.03	0.02	0.06	Al_2O_3
Si K	3.11	2.42	6.64	SiO_2
S K	1.01	0.69	2.52	SO_3
K K	0.90	0.51	1.09	K_2O
Ca K	12.85	7.02	17.98	CaO
Ti K	0.08	0.03	0.13	TiO_2
Fe K	1.57	0.62	2.02	FeO
O	28.94	39.63		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix (likely precipitated salts)*

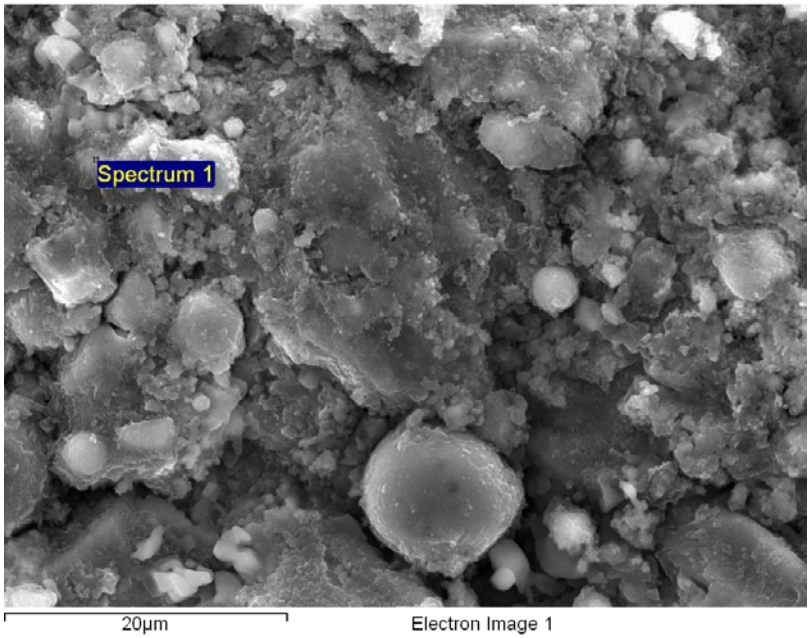
HC3-35-6 Site 6 Spectrum 1 (6.1)

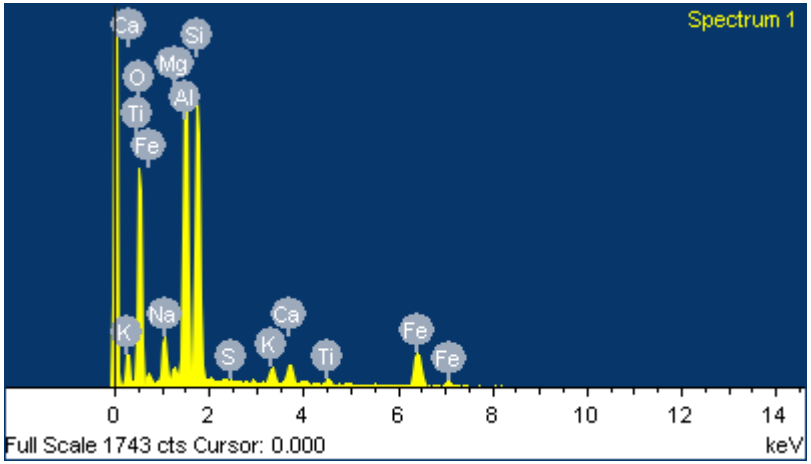
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.42	4.17	5.96	Na_2O
Mg K	0.80	0.72	1.33	MgO
Al K	16.87	13.55	31.87	Al_2O_3
Si K	20.14	15.54	43.09	SiO_2
S K	0.15	0.10	0.38	SO_3
K K	1.44	0.80	1.73	K_2O
Ca K	2.02	1.09	2.82	CaO
Ti K	0.89	0.40	1.48	TiO_2
Fe K	8.82	3.42	11.35	FeO
O	44.46	60.22		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix*

INCA

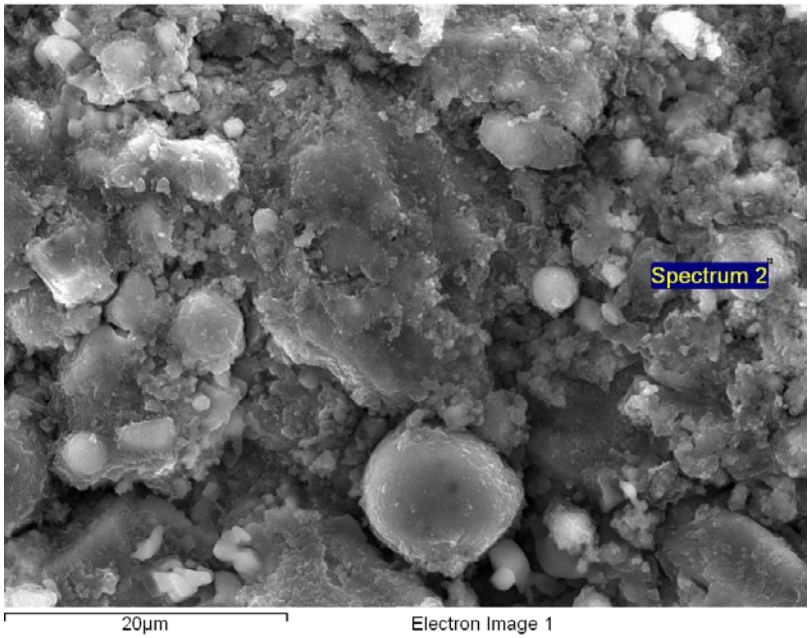
HC3-35-6 Site 6 Spectrum 2 (6.2)

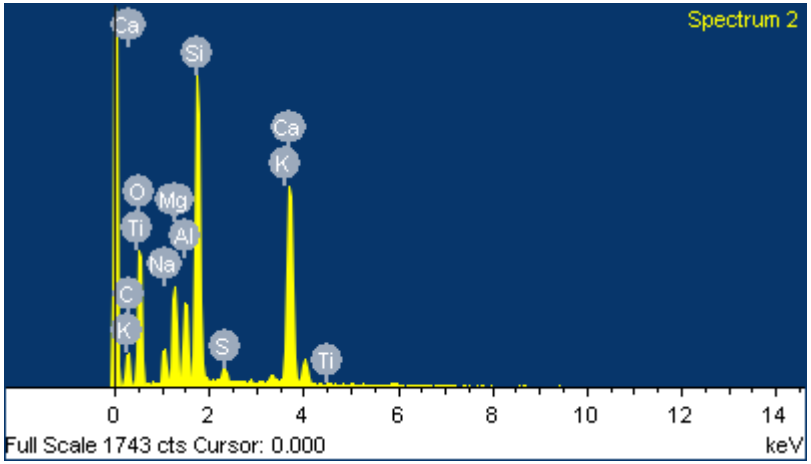
Spectrum processing :
Peak possibly omitted : 5.904 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.20	3.05	4.31	Na_2O
Mg K	6.83	6.16	11.32	MgO
Al K	4.79	3.90	9.05	Al_2O_3
Si K	20.33	15.88	43.49	SiO_2
S K	1.10	0.76	2.76	SO_3
K K	0.64	0.36	0.77	K_2O
Ca K	20.04	10.97	28.04	CaO
Ti K	0.15	0.07	0.26	TiO_2
O	42.91	58.85		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix*

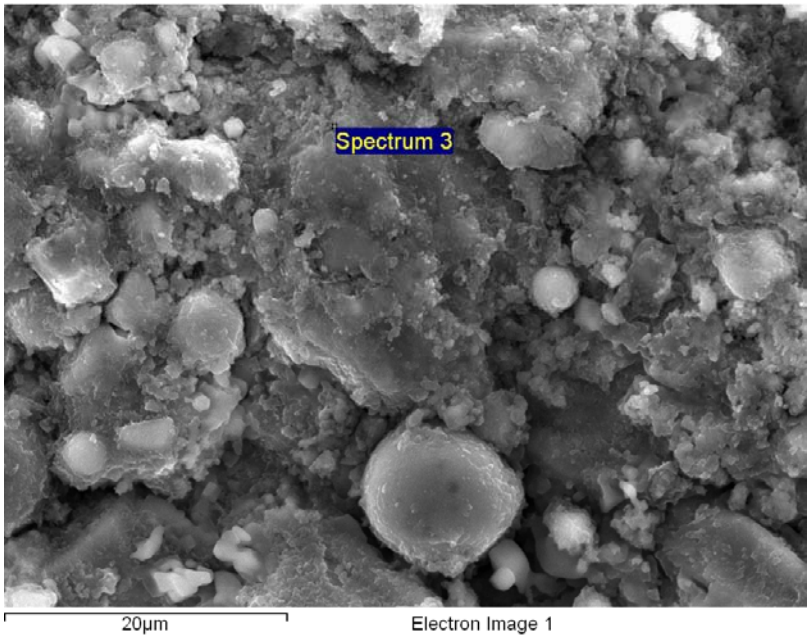
HC3-35-6 Site 6 Spectrum 3 (6.3)

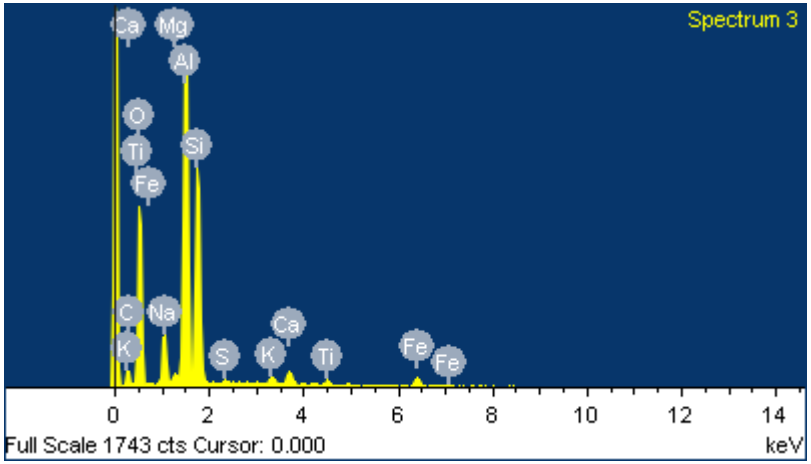
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	5.24	4.75	7.07	Na_2O
Mg K	0.54	0.47	0.90	MgO
Al K	22.52	17.37	42.55	Al_2O_3
Si K	19.15	14.19	40.97	SiO_2
S K	0.28	0.18	0.71	SO_3
K K	0.82	0.44	0.99	K_2O
Ca K	1.49	0.77	2.09	CaO
Ti K	0.90	0.39	1.50	TiO_2
Fe K	2.51	0.93	3.23	FeO
O	46.54	60.52		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp1*, 90 days
Type of material analyzed: *matrix*

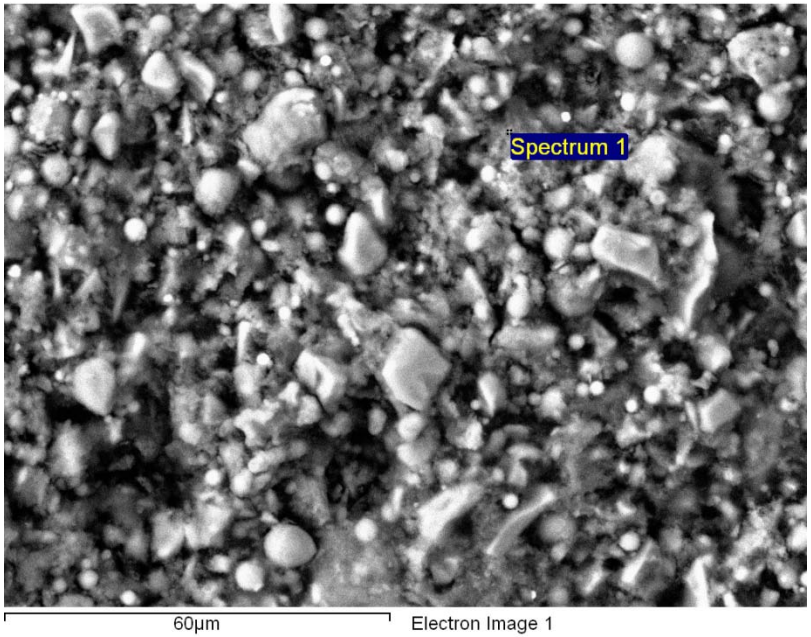
HC3-45-6 Site 3 Spectrum 1 (3.1)

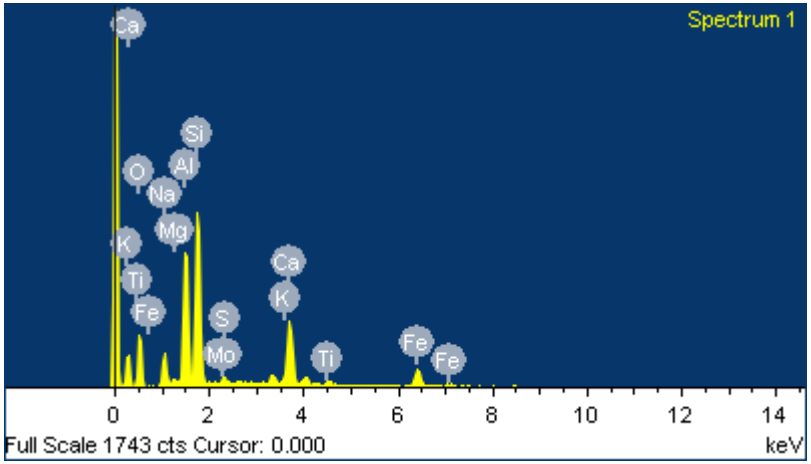
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM
Mo Mo 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.70	4.55	6.34	Na_2O
Mg K	0.55	0.50	0.92	MgO
Al K	12.86	10.61	24.31	Al_2O_3
Si K	18.97	15.02	40.58	SiO_2
S K	0.43	0.30	1.07	SO_3
K K	1.28	0.73	1.54	K_2O
Ca K	9.58	5.32	13.41	CaO
Ti K	0.91	0.42	1.52	TiO_2
Fe K	6.44	2.57	8.29	FeO
Other	1.35	0.31	2.03	Other
O	42.91	59.67		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *matrix*

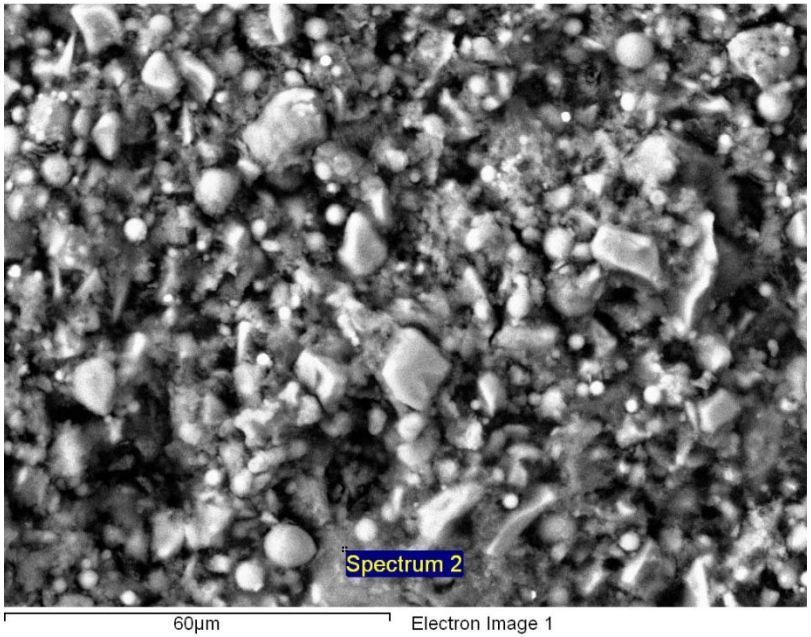
HC3-45-6 Site 3 Spectrum 2 (3.2)

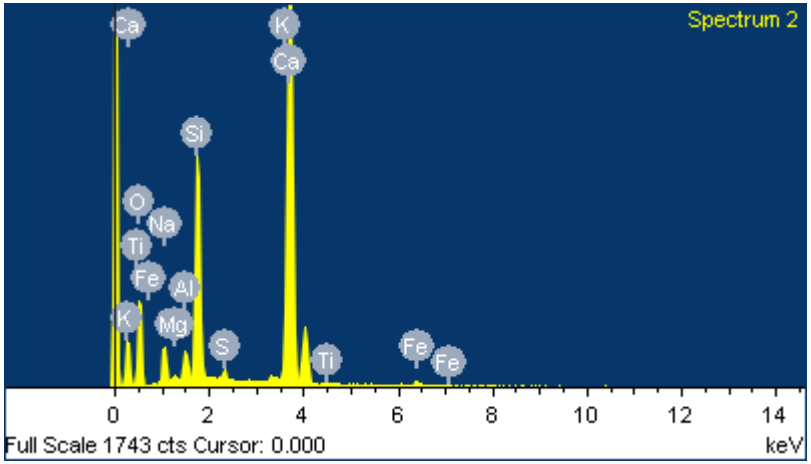
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	4.17	4.39	5.62	Na_2O
Mg K	0.41	0.41	0.68	MgO
Al K	1.74	1.56	3.29	Al_2O_3
Si K	14.14	12.19	30.25	SiO_2
S K	0.52	0.39	1.29	SO_3
K K	0.31	0.19	0.37	K_2O
Ca K	40.92	24.71	57.26	CaO
Ti K	0.07	0.03	0.12	TiO_2
Fe K	0.87	0.38	1.12	FeO
O	36.85	55.75		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *matrix*

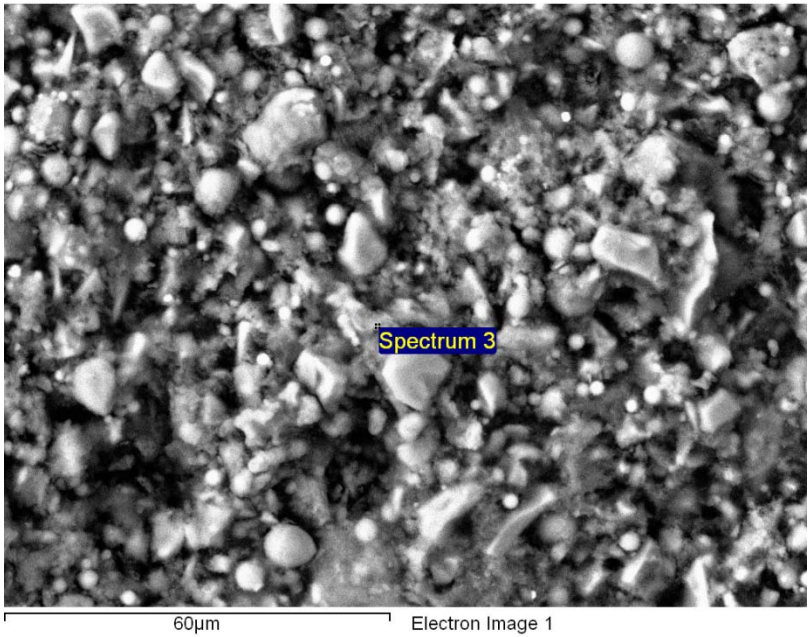
HC3-45-6 Site 3 Spectrum 3 (3.3)

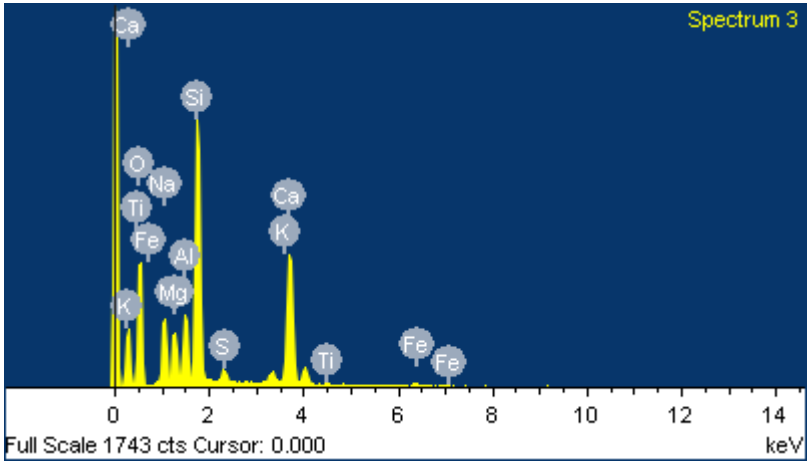
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.56	7.17	10.19	Na_2O
Mg K	4.58	4.11	7.60	MgO
Al K	4.93	3.98	9.31	Al_2O_3
Si K	20.68	16.04	44.23	SiO_2
S K	1.24	0.85	3.11	SO_3
K K	1.27	0.71	1.53	K_2O
Ca K	15.93	8.66	22.29	CaO
Ti K	0.38	0.17	0.64	TiO_2
Fe K	0.86	0.33	1.10	FeO
O	42.57	57.98		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *matrix*

INCA

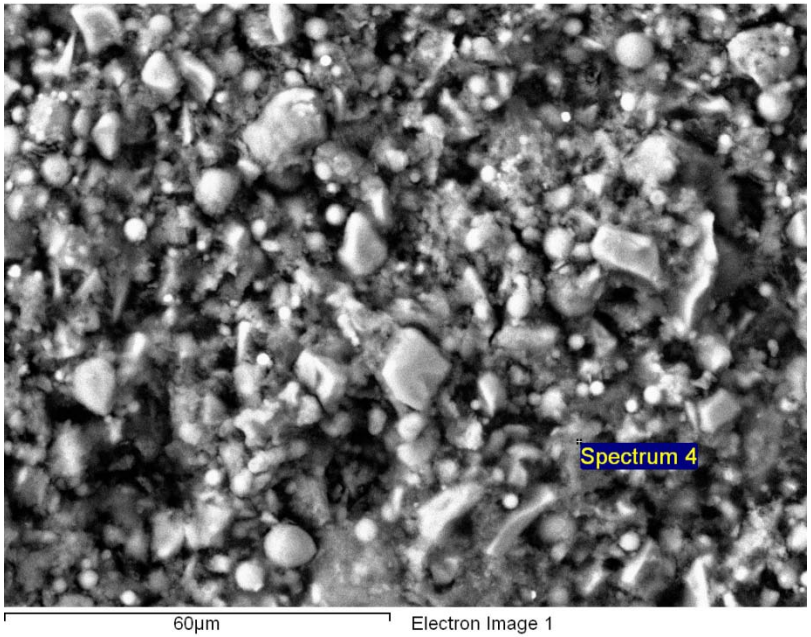
HC3-45-6 Site 3 Spectrum 4 (3.4)

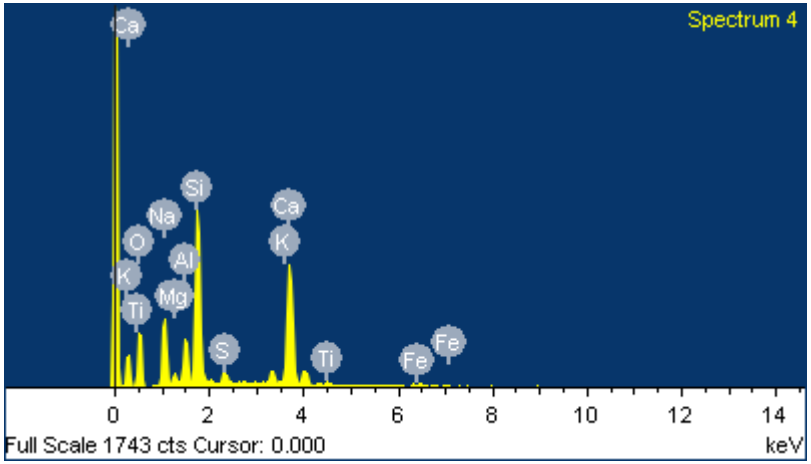
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalised)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	10.39	10.05	14.01	Na_2O
Mg K	1.28	1.17	2.12	MgO
Al K	4.58	3.77	8.65	Al_2O_3
Si K	18.80	14.89	40.22	SiO_2
S K	1.39	0.97	3.48	SO_3
K K	1.59	0.90	1.91	K_2O
Ca K	19.43	10.78	27.19	CaO
Ti K	0.53	0.24	0.88	TiO_2
Fe K	1.20	0.48	1.55	FeO
O	40.81	56.74		
Totals	100.00			





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *matrix*

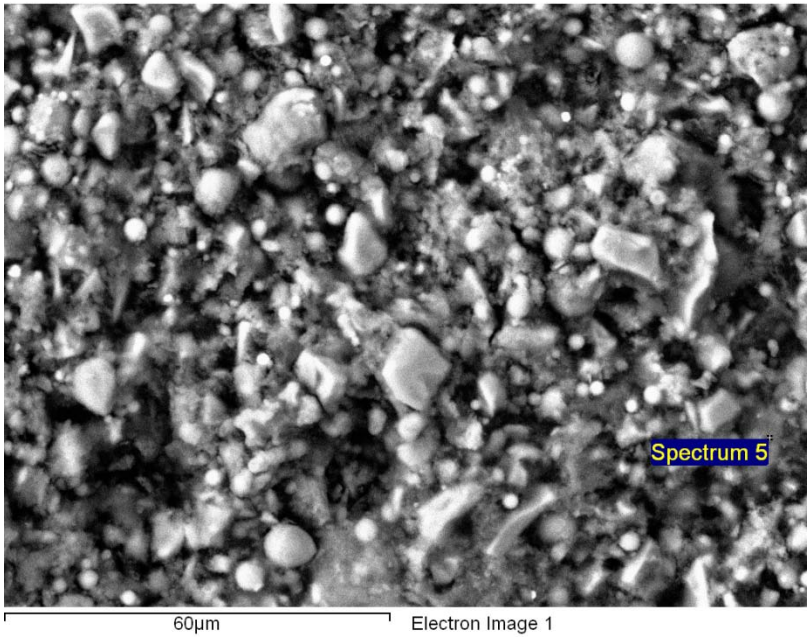
HC3-45-6 Site 3 Spectrum 5 (3.5)

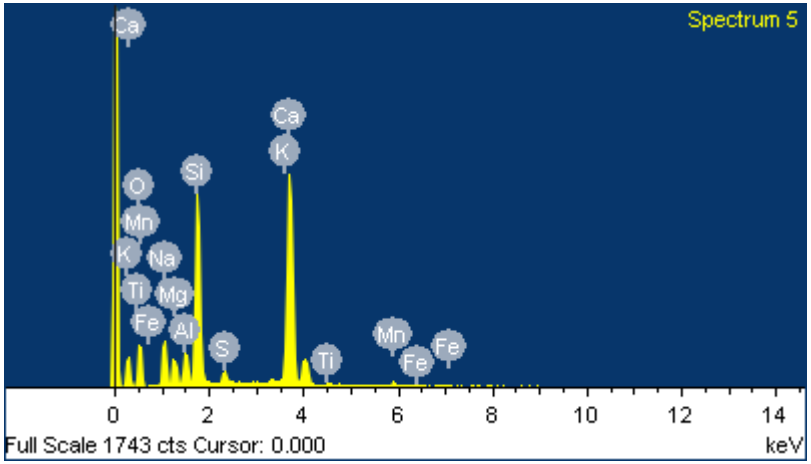
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Mn Mn 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.53	6.53	8.80	Na_2O
Mg K	2.95	2.78	4.88	MgO
Al K	2.66	2.27	5.02	Al_2O_3
Si K	16.56	13.55	35.42	SiO_2
S K	1.26	0.91	3.15	SO_3
K K	0.65	0.38	0.78	K_2O
Ca K	28.63	16.42	40.06	CaO
Ti K	0.21	0.10	0.35	TiO_2
Fe K	0.42	0.17	0.55	FeO
Other	0.77	0.32	0.99	Other
O	39.37	56.57		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *matrix*

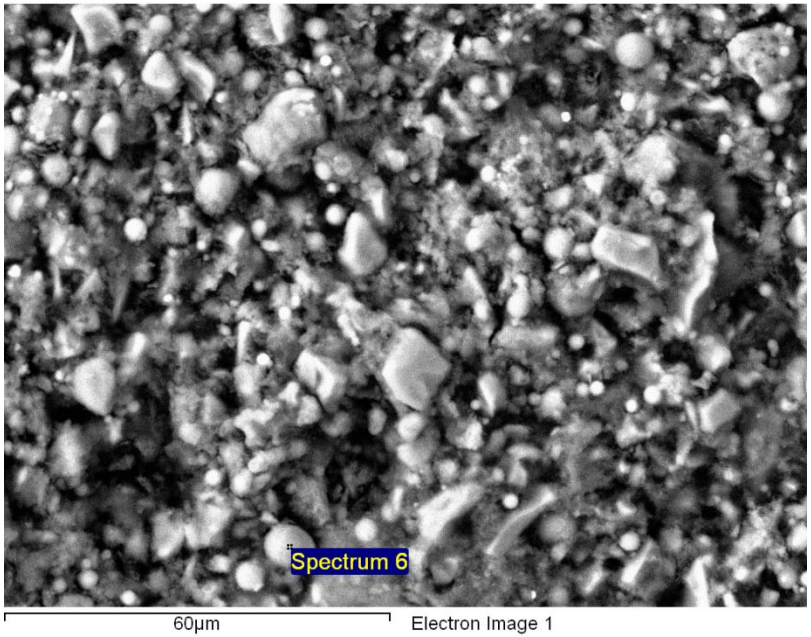
HC3-45-6 Site 3 Spectrum 6 (3.6)

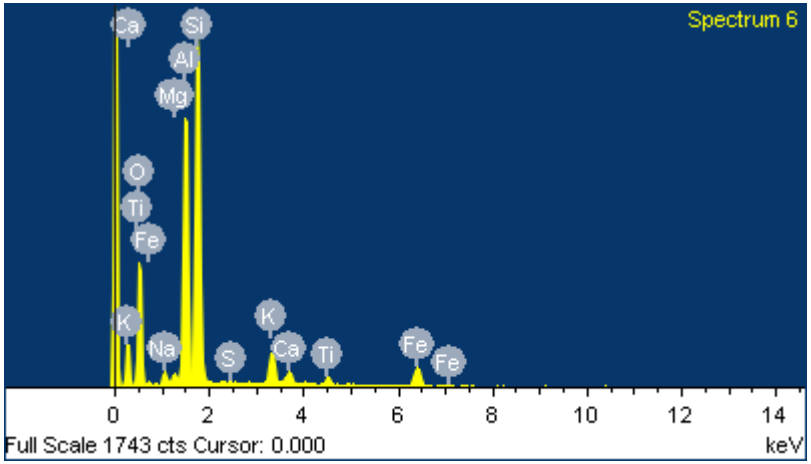
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.09	1.01	1.47	Na_2O
Mg K	0.50	0.44	0.83	MgO
Al K	15.48	12.21	29.24	Al_2O_3
Si K	25.32	19.18	54.16	SiO_2
S K	0.08	0.05	0.20	SO_3
K K	3.28	1.79	3.96	K_2O
Ca K	1.30	0.69	1.82	CaO
Ti K	0.99	0.44	1.66	TiO_2
Fe K	5.18	1.97	6.67	FeO
O	46.77	62.22		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *FA particle*

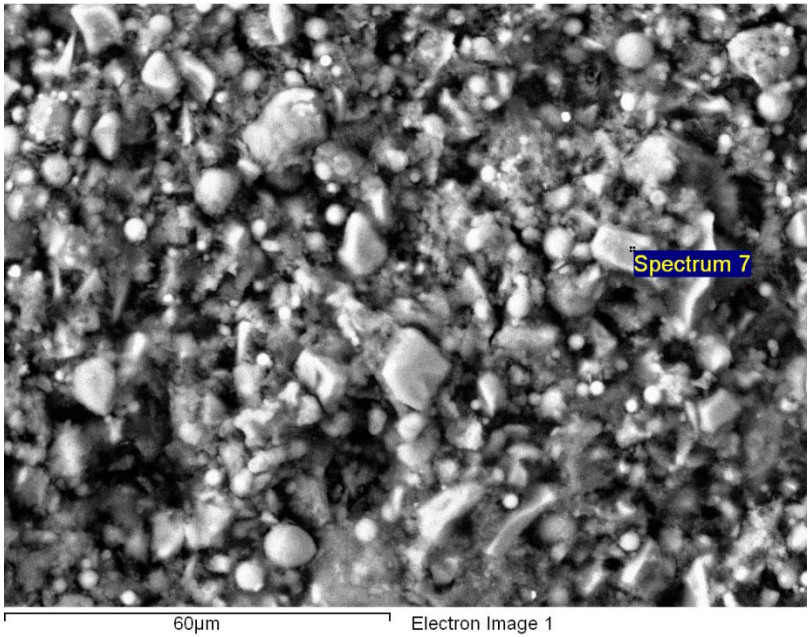
HC3-45-6 Site 3 Spectrum 7 (3.7)

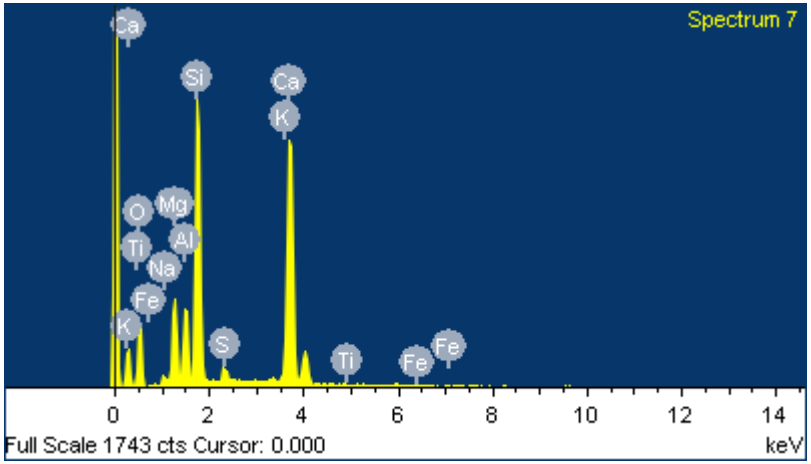
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	0.70	0.68	0.94	Na_2O
Mg K	6.02	5.58	9.98	MgO
Al K	4.49	3.75	8.49	Al_2O_3
Si K	18.80	15.07	40.21	SiO_2
S K	1.08	0.76	2.71	SO_3
K K	0.33	0.19	0.40	K_2O
Ca K	26.12	14.67	36.54	CaO
Ti K	0.30	0.14	0.50	TiO_2
Fe K	0.18	0.07	0.23	FeO
O	41.98	59.09		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *BFS particle*

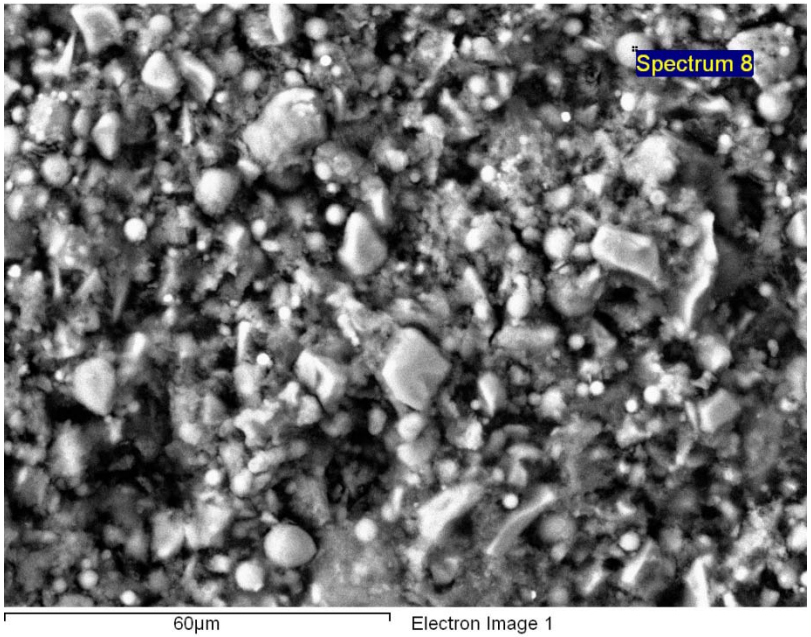
HC3-45-6 Site 3 Spectrum 8 (3.8)

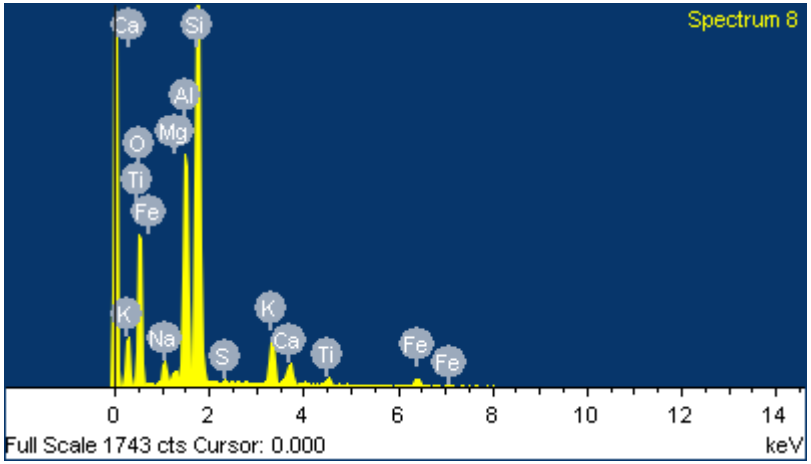
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.04	1.87	2.76	Na_2O
Mg K	0.44	0.38	0.73	MgO
Al K	12.11	9.42	22.88	Al_2O_3
Si K	28.58	21.37	61.15	SiO_2
S K	0.23	0.15	0.58	SO_3
K K	4.16	2.24	5.02	K_2O
Ca K	2.08	1.09	2.91	CaO
Ti K	0.93	0.41	1.56	TiO_2
Fe K	1.88	0.71	2.42	FeO
O	47.53	62.37		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *FA particle*

INCA

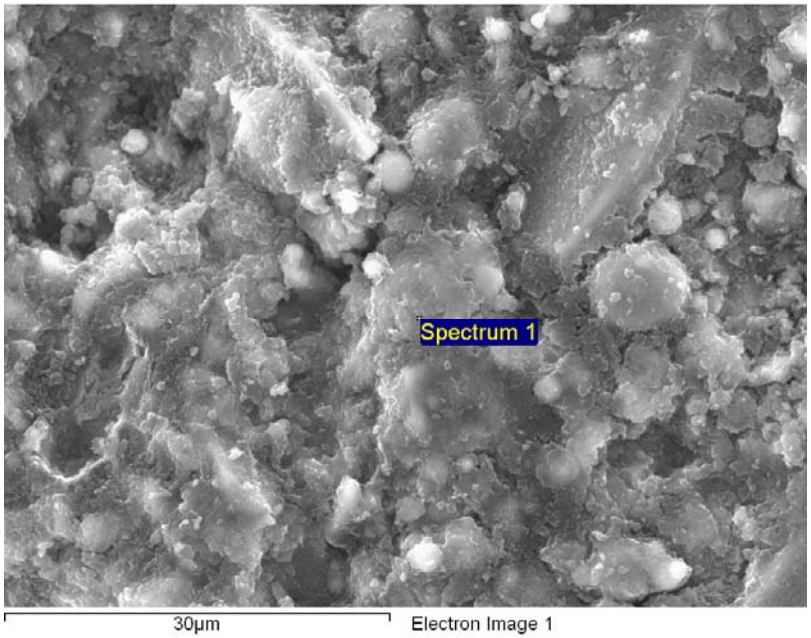
HC3-45-6 Site 5 Spectrum 1 (5.1)

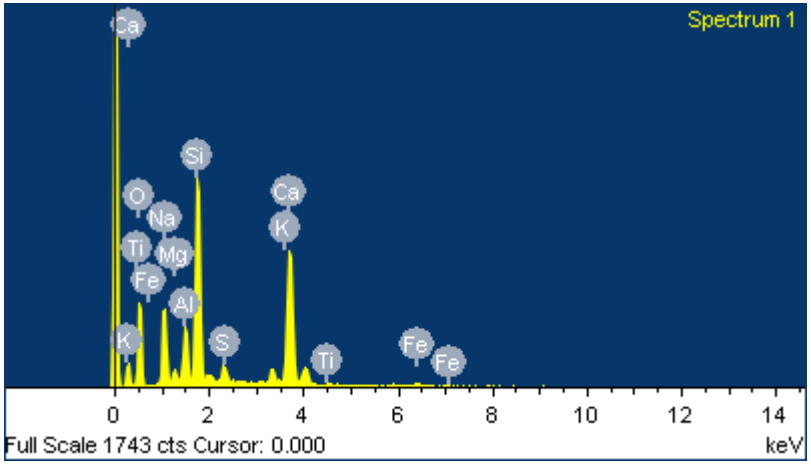
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	10.44	10.08	14.07	Na_2O
Mg K	1.27	1.16	2.11	MgO
Al K	4.45	3.67	8.42	Al_2O_3
Si K	18.81	14.87	40.23	SiO_2
S K	1.73	1.20	4.33	SO_3
K K	1.77	1.00	2.13	K_2O
Ca K	18.83	10.44	26.35	CaO
Ti K	0.37	0.17	0.61	TiO_2
Fe K	1.36	0.54	1.75	FeO
O	40.97	56.87		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *matrix*

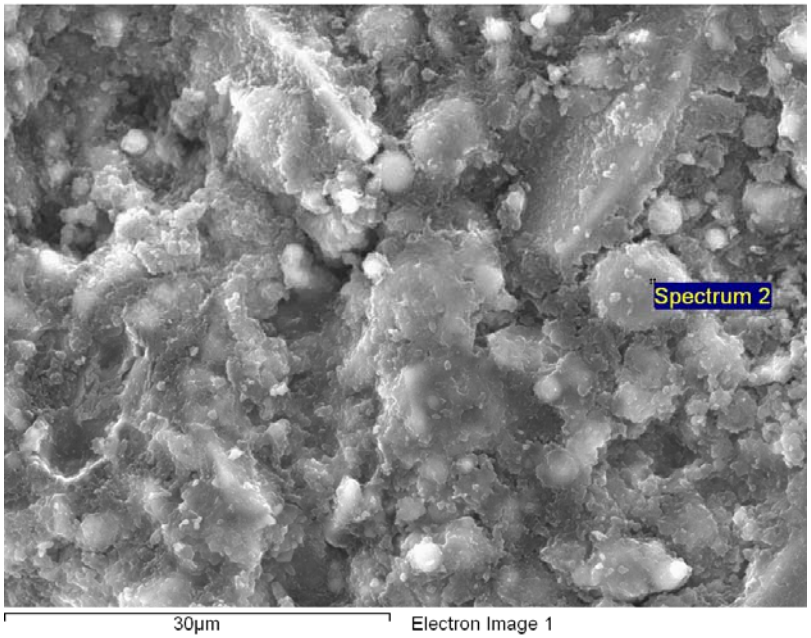
HC3-45-6 Site 5 Spectrum 2 (5.2)

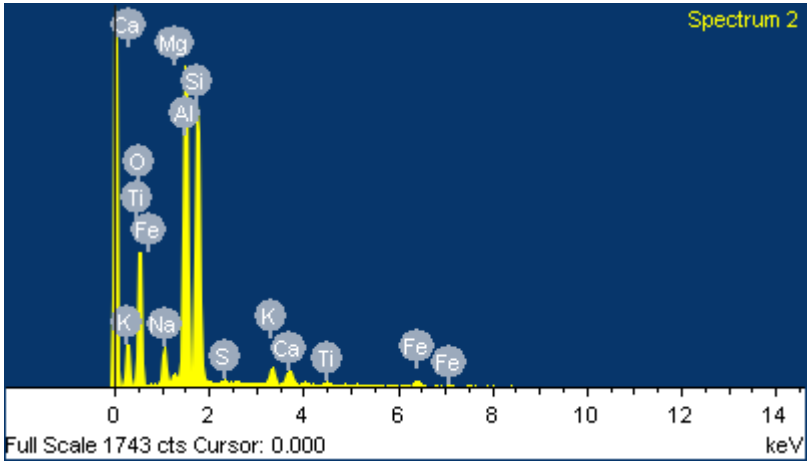
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 2

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.42	3.09	4.62	Na_2O
Mg K	0.43	0.37	0.72	MgO
Al K	19.96	15.34	37.72	Al_2O_3
Si K	22.96	16.95	49.11	SiO_2
S K	0.24	0.16	0.60	SO_3
K K	1.63	0.86	1.96	K_2O
Ca K	1.62	0.84	2.27	CaO
Ti K	0.31	0.14	0.52	TiO_2
Fe K	1.93	0.72	2.48	FeO
O	47.49	61.55		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *matrix deposited on a FA particle*

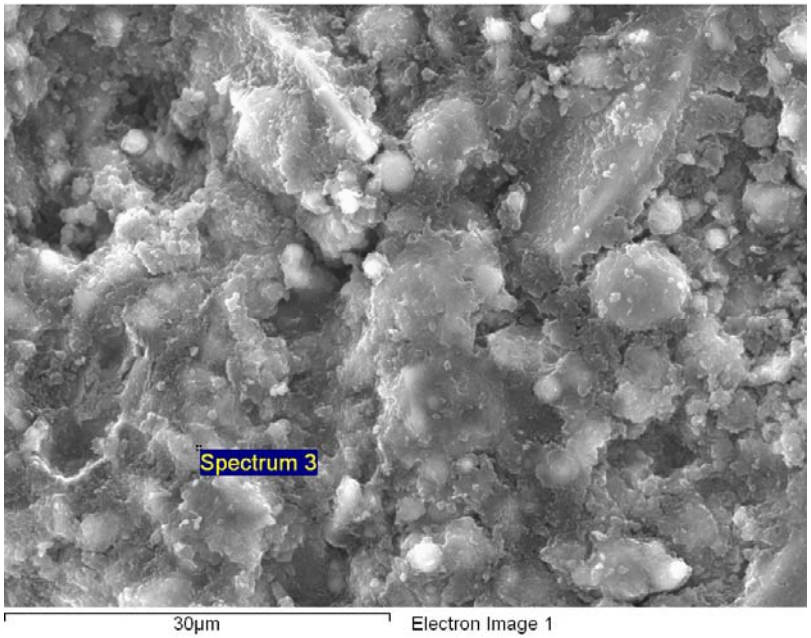
HC3-45-6 Site 5 Spectrum 3 (5.3)

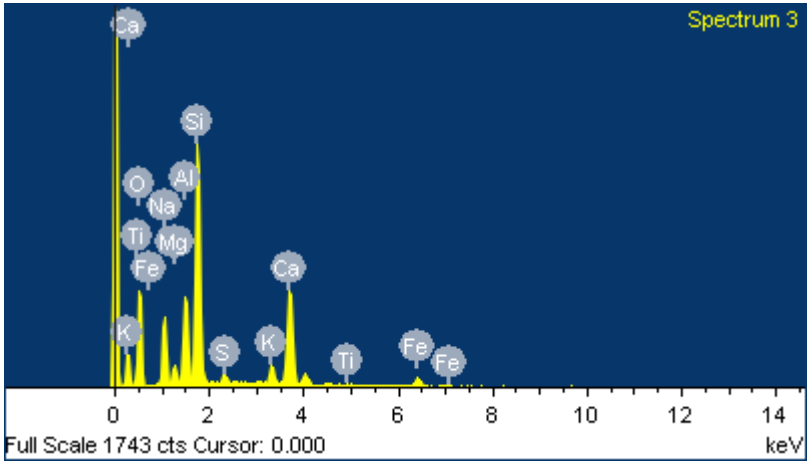
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	8.50	8.07	11.46	Na_2O
Mg K	1.90	1.71	3.16	MgO
Al K	7.08	5.72	13.37	Al_2O_3
Si K	21.23	16.49	45.42	SiO_2
S K	0.98	0.66	2.44	SO_3
K K	1.88	1.05	2.27	K_2O
Ca K	12.78	6.95	17.88	CaO
Ti K	0.40	0.18	0.67	TiO_2
Fe K	2.60	1.01	3.34	FeO
O	42.65	58.15		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *matrix*

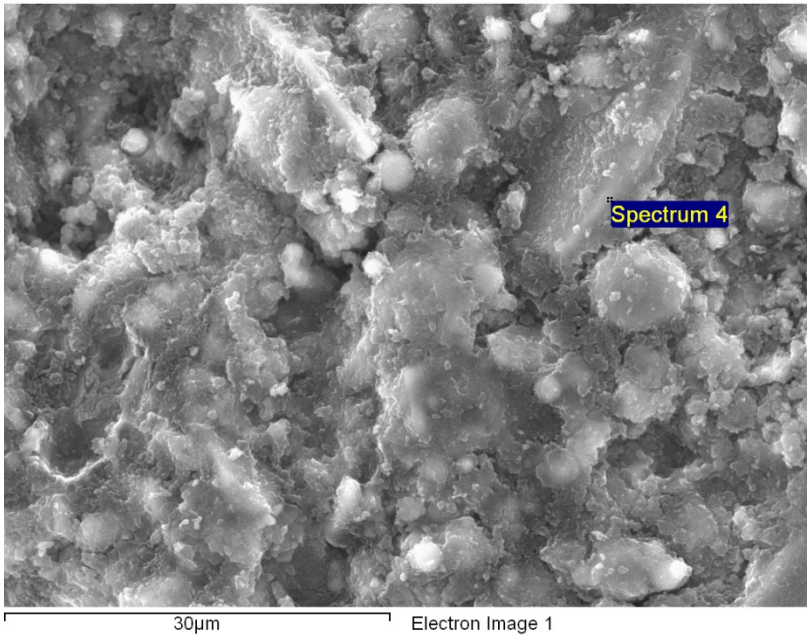
HC3-45-6 Site 5 Spectrum 4 (5.4)

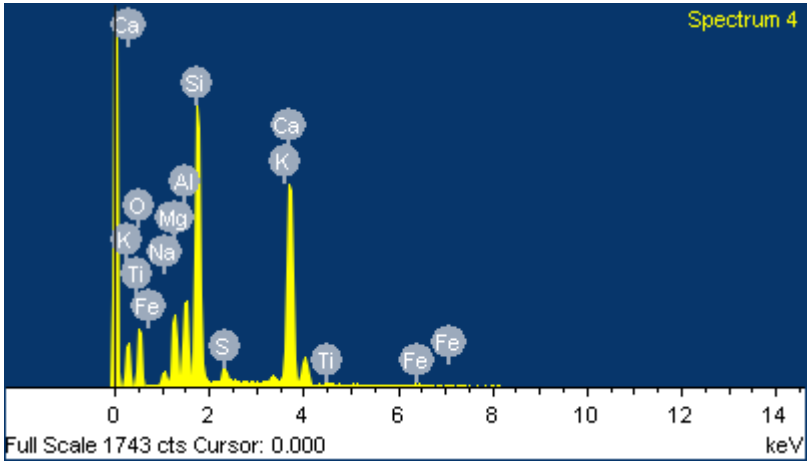
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	1.14	1.11	1.54	Na_2O
Mg K	5.50	5.04	9.12	MgO
Al K	5.23	4.31	9.88	Al_2O_3
Si K	19.95	15.82	42.69	SiO_2
S K	1.25	0.87	3.13	SO_3
K K	0.50	0.29	0.61	K_2O
Ca K	22.92	12.73	32.07	CaO
Ti K	0.13	0.06	0.22	TiO_2
Fe K	0.58	0.23	0.74	FeO
O	42.79	59.54		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp2*, 90 days
Type of material analyzed: *matrix deposited on a BFS*

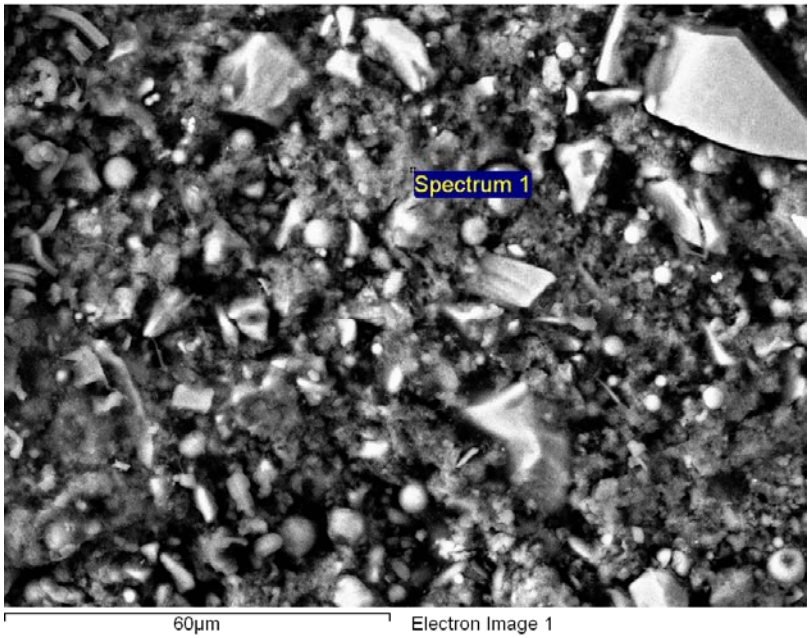
HC3-55-6 Site 3 Spectrum 1 (3.1)

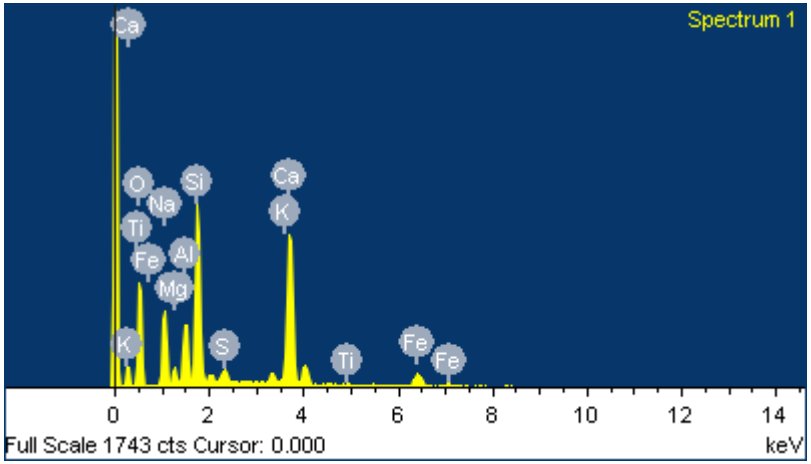
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	10.06	9.98	13.56	Na_2O
Mg K	1.60	1.50	2.65	MgO
Al K	5.34	4.51	10.09	Al_2O_3
Si K	15.89	12.89	33.99	SiO_2
S K	1.21	0.86	3.03	SO_3
K K	1.14	0.67	1.38	K_2O
Ca K	20.63	11.73	28.86	CaO
Ti K	0.28	0.14	0.48	TiO_2
Fe K	4.64	1.89	5.97	FeO
O	39.20	55.84		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *matrix*

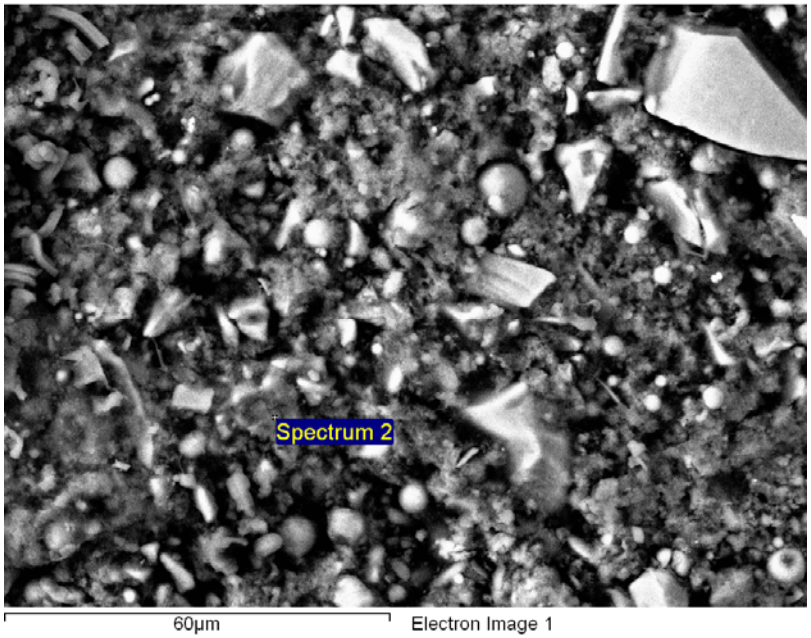
HC3-55-6 Site 3 Spectrum 2 (3.2)

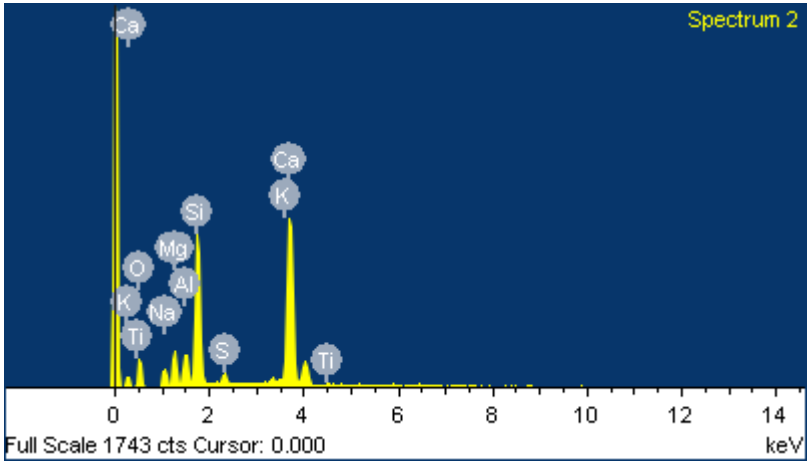
Spectrum processing :
Peaks possibly omitted : 5.890, 6.410 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	3.36	3.36	4.54	Na_2O
Mg K	4.41	4.16	7.31	MgO
Al K	3.06	2.60	5.78	Al_2O_3
Si K	16.58	13.56	35.48	SiO_2
S K	1.33	0.95	3.32	SO_3
K K	0.61	0.36	0.73	K_2O
Ca K	30.18	17.29	42.23	CaO
Ti K	0.36	0.17	0.61	TiO_2
O	40.10	57.54		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *matrix*

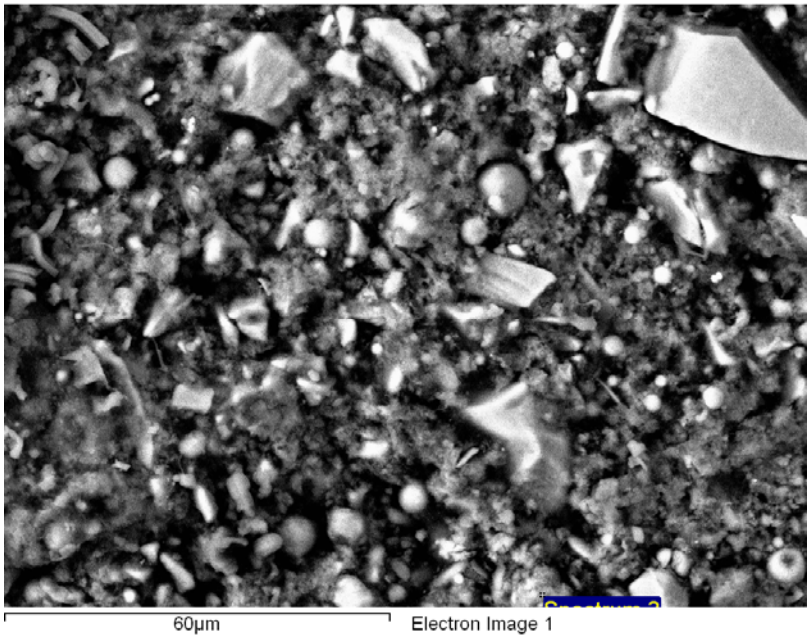
HC3-55-6 Site 3 Spectrum 3 (3.3)

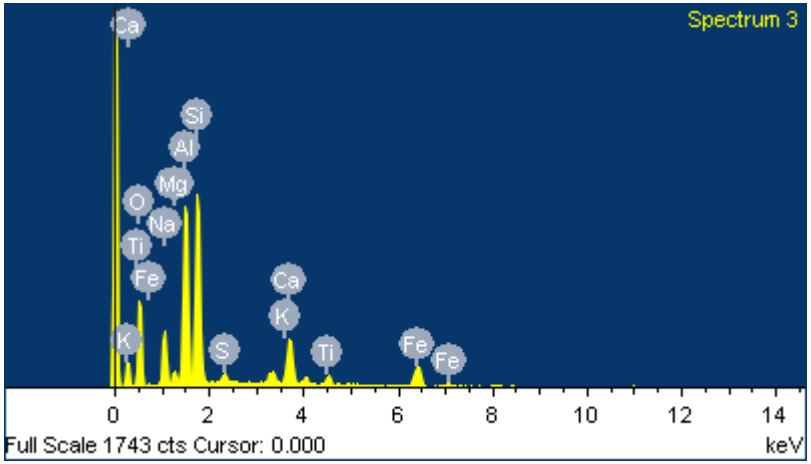
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.62	6.30	8.92	Na_2O
Mg K	1.29	1.16	2.14	MgO
Al K	14.06	11.40	26.57	Al_2O_3
Si K	17.73	13.81	37.93	SiO_2
S K	1.04	0.71	2.60	SO_3
K K	1.24	0.69	1.49	K_2O
Ca K	6.14	3.35	8.59	CaO
Ti K	1.58	0.72	2.63	TiO_2
Fe K	7.09	2.78	9.13	FeO
O	43.21	59.08		
Totals	100.00			





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *matrix*

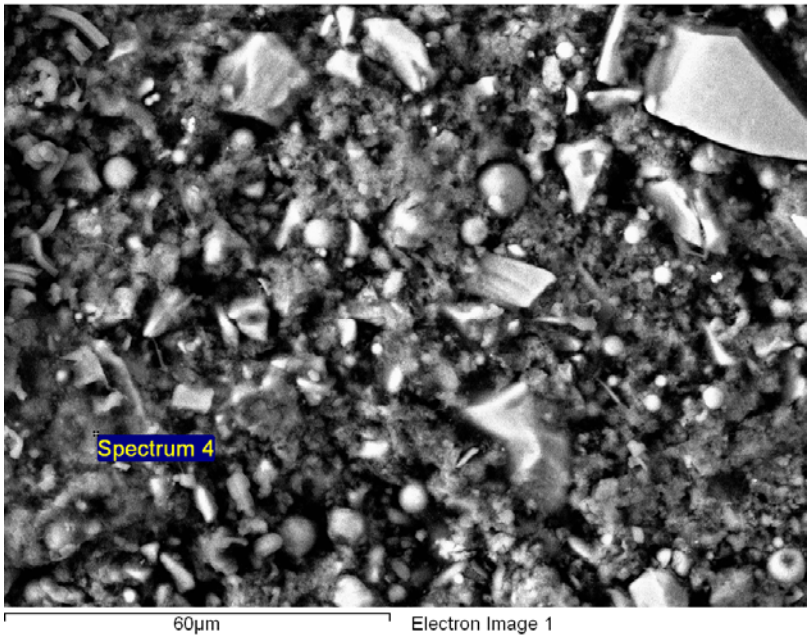
HC3-55-6 Site 3 Spectrum 4 (3.4)

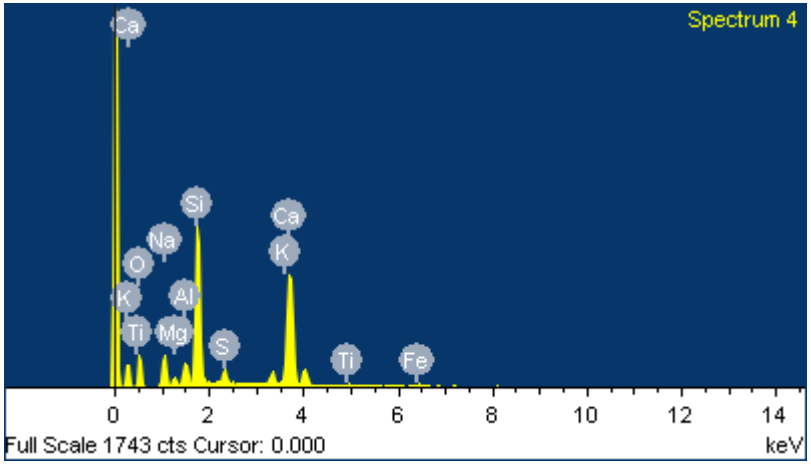
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	6.27	6.14	8.45	Na_2O
Mg K	1.07	0.99	1.77	MgO
Al K	2.64	2.20	4.98	Al_2O_3
Si K	20.18	16.20	43.18	SiO_2
S K	1.90	1.33	4.73	SO_3
K K	2.00	1.16	2.42	K_2O
Ca K	24.09	13.55	33.70	CaO
Ti K	0.16	0.08	0.27	TiO_2
Fe K	0.39	0.16	0.50	FeO
O	41.31	58.20		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *matrix*

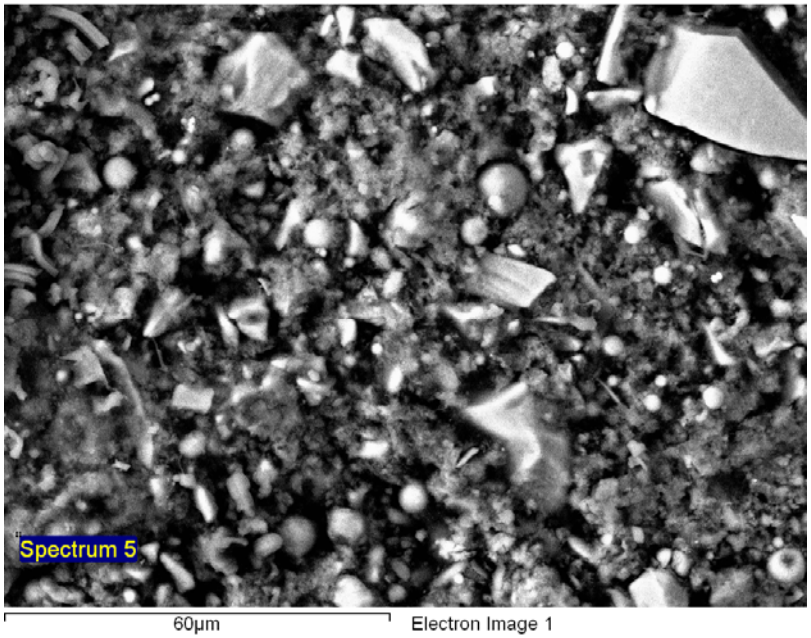
HC3-55-6 Site 3 Spectrum 5 (3.5)

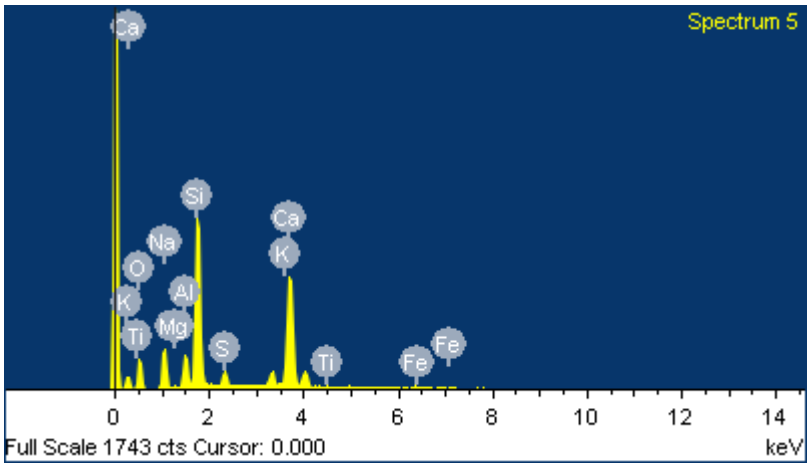
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	7.42	7.23	10.01	Na_2O
Mg K	0.07	0.06	0.11	MgO
Al K	3.41	2.83	6.44	Al_2O_3
Si K	20.62	16.45	44.10	SiO_2
S K	1.96	1.37	4.88	SO_3
K K	2.09	1.19	2.51	K_2O
Ca K	21.74	12.15	30.42	CaO
Ti K	0.26	0.12	0.43	TiO_2
Fe K	0.85	0.34	1.10	FeO
O	41.59	58.25		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *matrix*

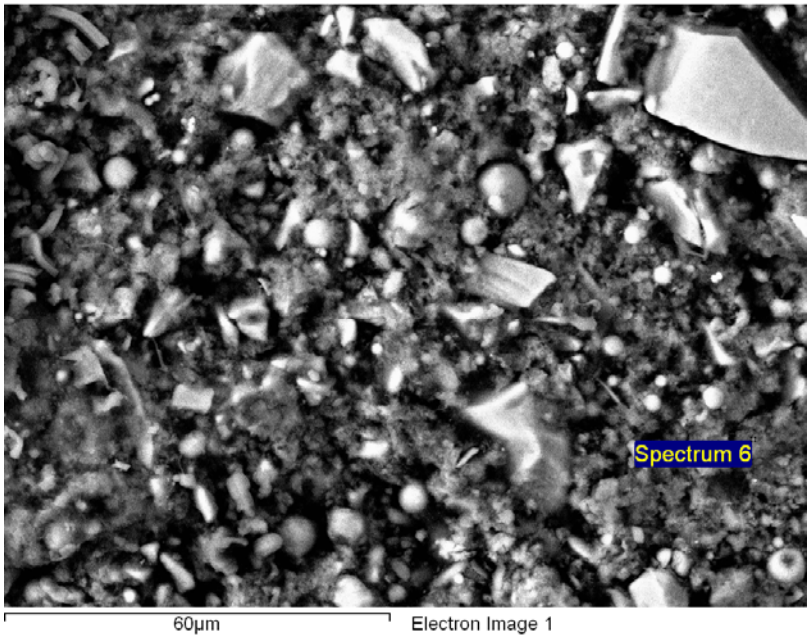
HC3-55-6 Site 3 Spectrum 6 (3.6)

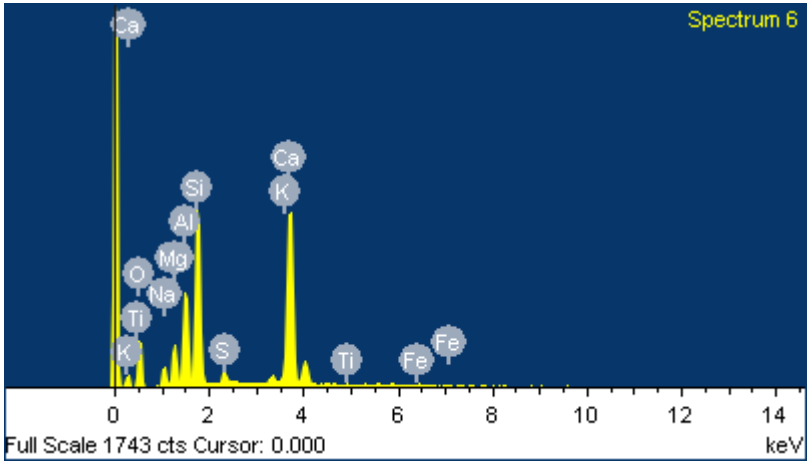
Spectrum processing :
Peak possibly omitted : 5.875 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.35	2.31	3.17	Na_2O
Mg K	3.66	3.40	6.08	MgO
Al K	7.95	6.64	15.02	Al_2O_3
Si K	16.80	13.48	35.95	SiO_2
S K	1.11	0.78	2.77	SO_3
K K	0.84	0.49	1.01	K_2O
Ca K	25.03	14.08	35.03	CaO
Ti K	0.24	0.11	0.40	TiO_2
Fe K	0.45	0.18	0.58	FeO
O	41.56	58.54		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *matrix*

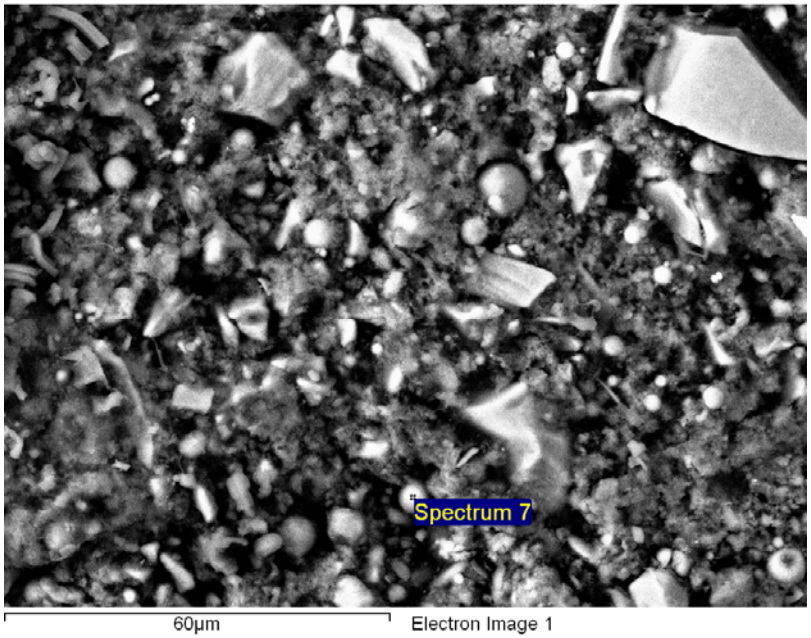
HC3-55-6 Site 3 Spectrum 7 (3.7)

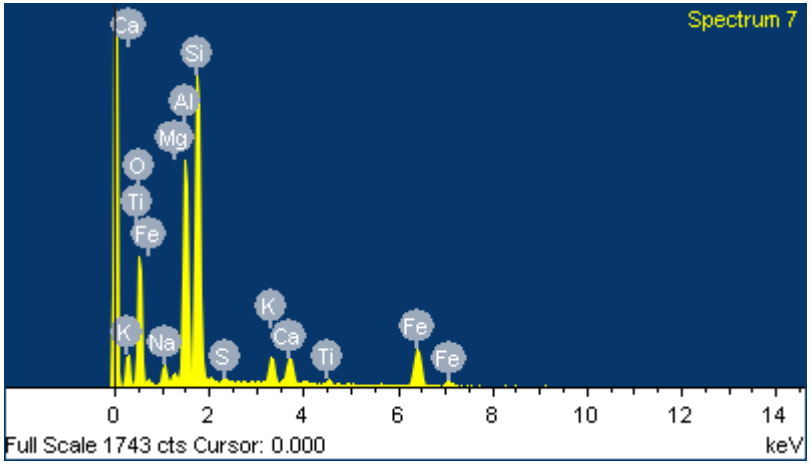
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.05	1.96	2.76	Na_2O
Mg K	0.68	0.62	1.13	MgO
Al K	13.39	10.91	25.29	Al_2O_3
Si K	22.92	17.94	49.03	SiO_2
S K	0.19	0.13	0.48	SO_3
K K	2.50	1.41	3.01	K_2O
Ca K	2.79	1.53	3.91	CaO
Ti K	0.65	0.30	1.08	TiO_2
Fe K	10.34	4.07	13.30	FeO
O	44.49	61.14		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *FA particle*

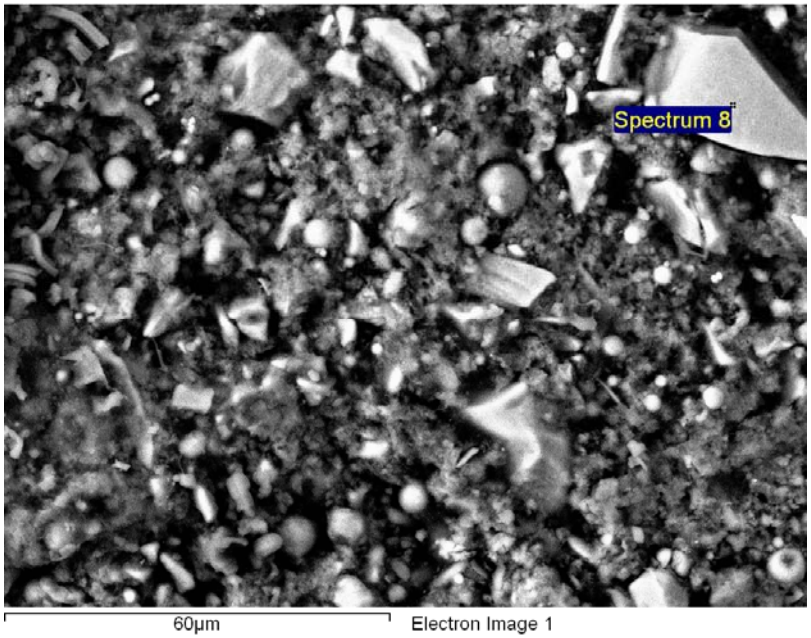
HC3-55-6 Site 3 Spectrum 8 (3.8)

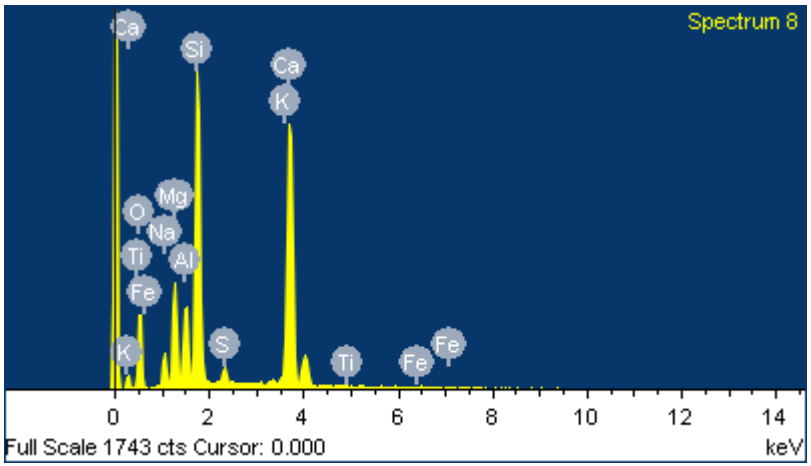
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	2.52	2.45	3.39	Na_2O
Mg K	6.50	5.98	10.78	MgO
Al K	4.25	3.53	8.04	Al_2O_3
Si K	18.56	14.79	39.70	SiO_2
S K	1.06	0.74	2.64	SO_3
K K	0.33	0.19	0.40	K_2O
Ca K	24.54	13.71	34.34	CaO
Ti K	0.19	0.09	0.32	TiO_2
Fe K	0.31	0.12	0.40	FeO
O	41.74	58.40		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *BFS particle*

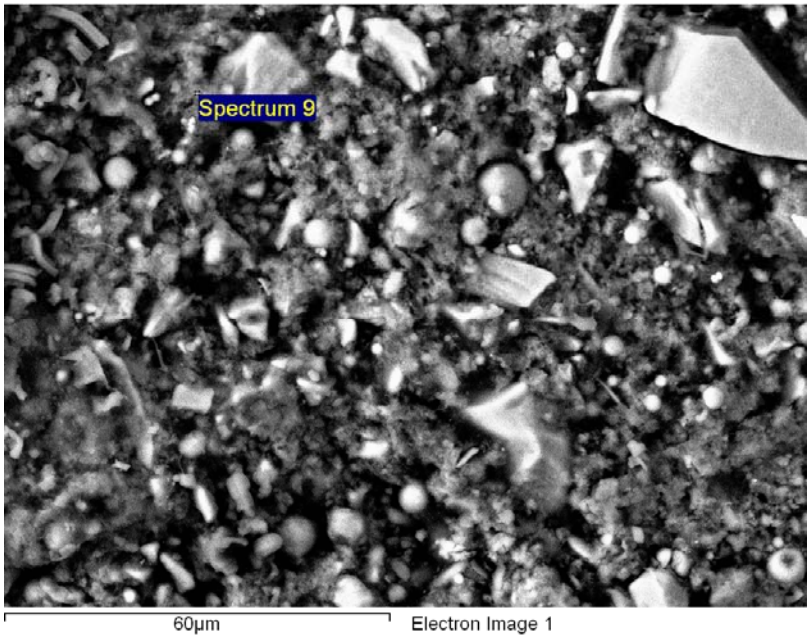
HC3-55-6 Site 3 Spectrum 9 (3.9)

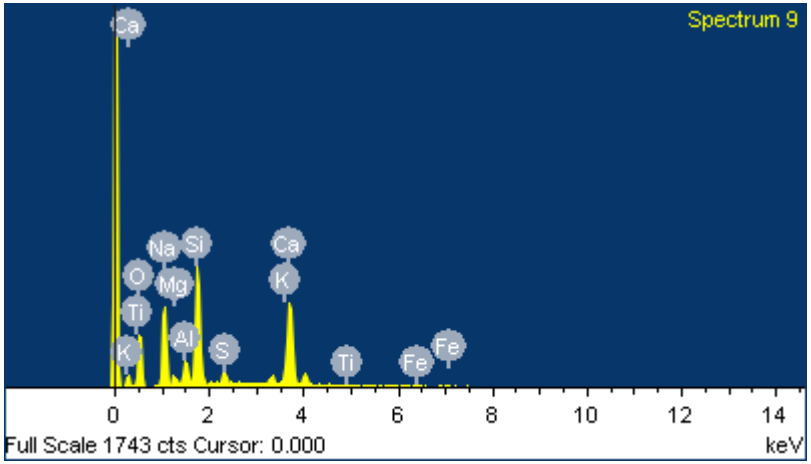
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	16.40	15.73	22.10	Na_2O
Mg K	1.67	1.52	2.78	MgO
Al K	3.41	2.79	6.45	Al_2O_3
Si K	16.76	13.16	35.86	SiO_2
S K	1.72	1.18	4.28	SO_3
K K	1.35	0.76	1.63	K_2O
Ca K	18.47	10.16	25.85	CaO
Ti K	0.17	0.08	0.29	TiO_2
Fe K	0.59	0.23	0.76	FeO
O	39.45	54.38		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *matrix*

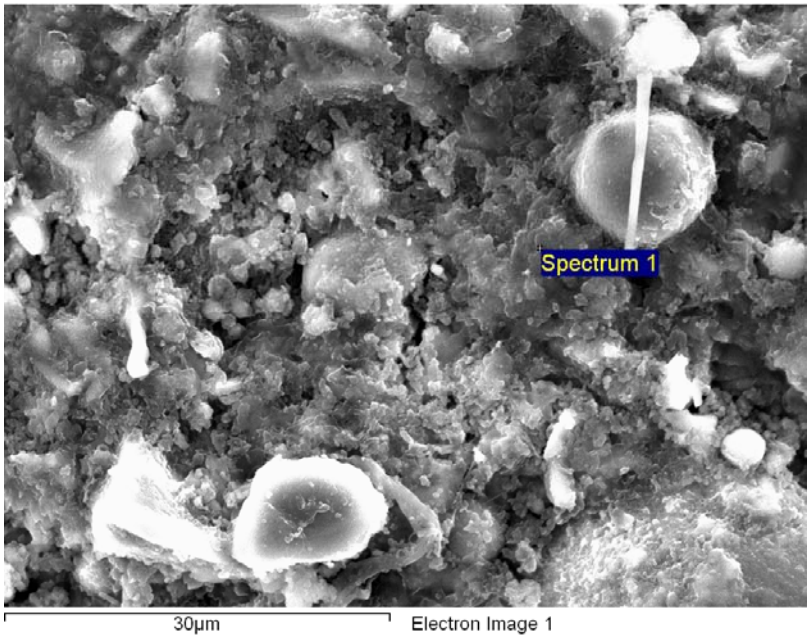
HC3-55-6 Site 4 Spectrum 1 (4.1)

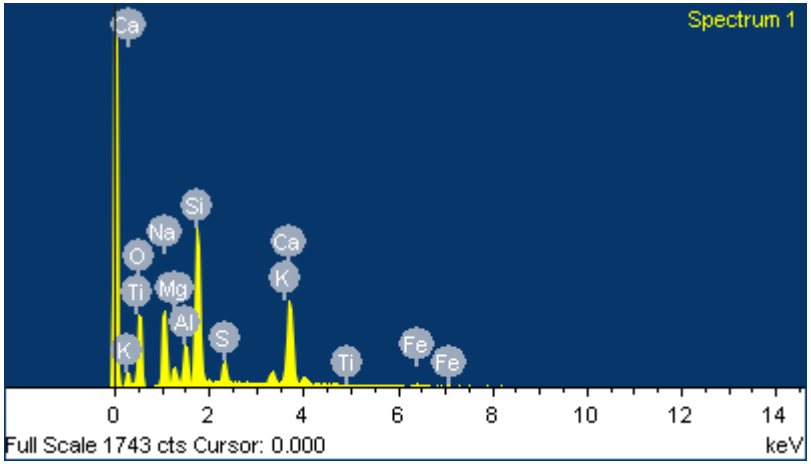
Spectrum processing :
No peaks omitted

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	13.00	12.35	17.52	Na_2O
Mg K	2.47	2.22	4.09	MgO
Al K	4.45	3.60	8.41	Al_2O_3
Si K	17.84	13.87	38.16	SiO_2
S K	2.79	1.90	6.97	SO_3
K K	2.04	1.14	2.46	K_2O
Ca K	14.85	8.09	20.78	CaO
Fe K	1.33	0.52	1.71	FeO
O	41.29	56.35		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *matrix*

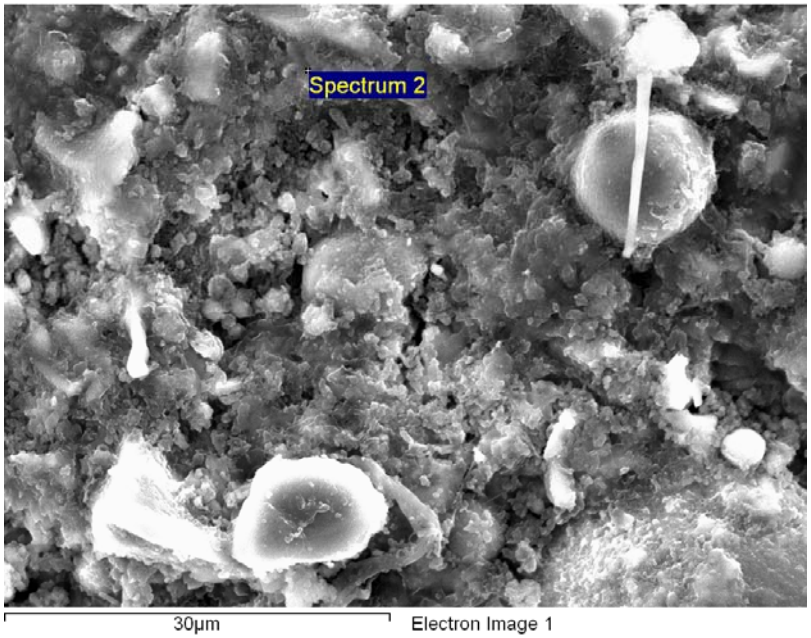
HC3-55-6 Site 4 Spectrum 2 (4.2)

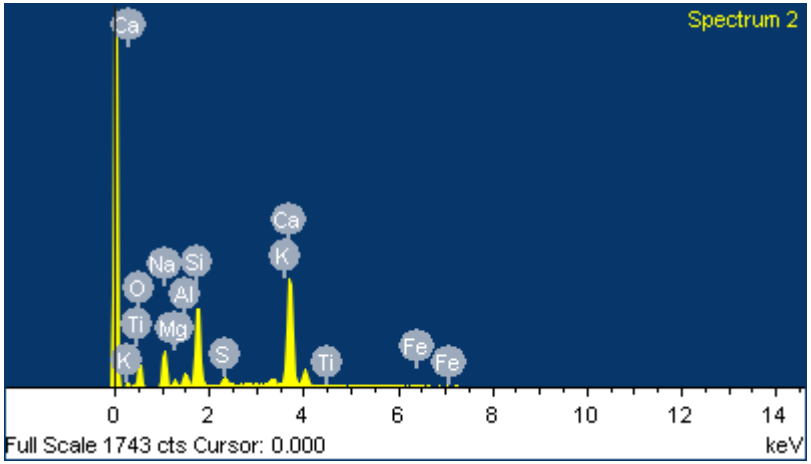
Spectrum processing :
Peak possibly omitted : 5.875 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	11.13	11.20	15.01	Na_2O
Mg K	1.46	1.39	2.42	MgO
Al K	2.21	1.89	4.18	Al_2O_3
Si K	14.27	11.75	30.52	SiO_2
S K	1.56	1.13	3.91	SO_3
K K	1.50	0.89	1.81	K_2O
Ca K	29.25	16.88	40.93	CaO
Ti K	0.13	0.06	0.21	TiO_2
Fe K	0.79	0.33	1.02	FeO
O	37.69	54.48		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *matrix*

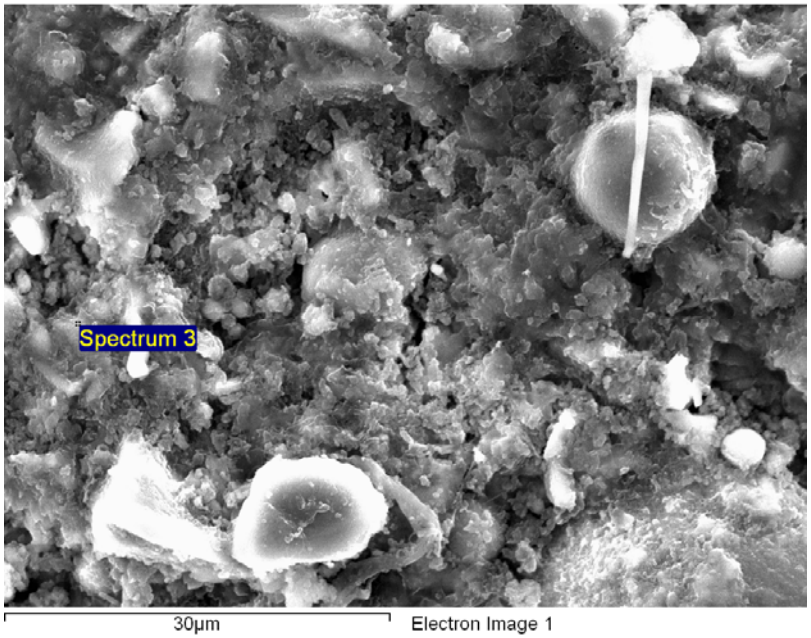
HC3-55-6 Site 4 Spectrum 3 (4.3)

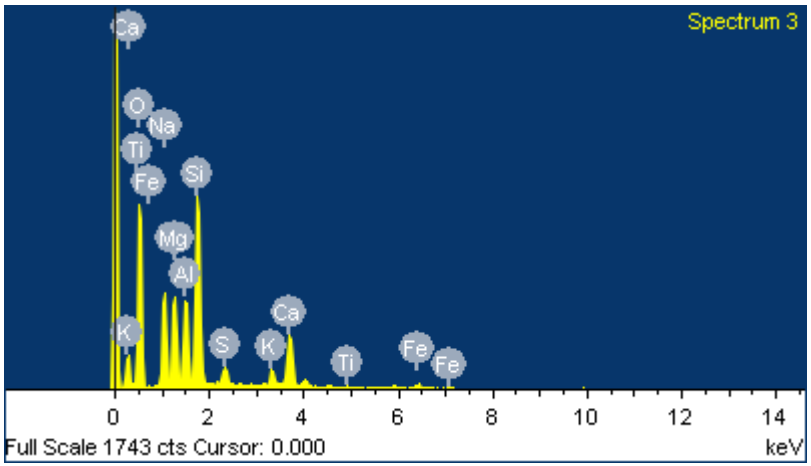
Spectrum processing :
Peak possibly omitted : 5.865 keV

Processing option : Oxygen by stoichiometry (Normalized)
Number of iterations = 3

Standard :
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Al Al2O3 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
S FeS2 1-Jun-1999 12:00 AM
K MAD-10 Feldspar 1-Jun-1999 12:00 AM
Ca Wollastonite 1-Jun-1999 12:00 AM
Ti Ti 1-Jun-1999 12:00 AM
Fe Fe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%	Compd%	Formula
Na K	10.90	10.03	14.69	Na_2O
Mg K	8.50	7.39	14.09	MgO
Al K	7.08	5.55	13.37	Al_2O_3
Si K	17.89	13.47	38.28	SiO_2
S K	2.01	1.33	5.03	SO_3
K K	1.72	0.93	2.08	K_2O
Ca K	7.18	3.79	10.05	CaO
Ti K	0.49	0.22	0.82	TiO_2
Fe K	1.24	0.47	1.59	FeO
O	42.98	56.82		
Totals	100.00		100.00	





Comment:
Curing conditions: *Temp3*, 90 days
Type of material analyzed: *matrix*