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Susan K. Whatley, Manager
Engineering Analysis and Planning
Chemical Technology Division
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, TN 37830

Dear Ms. Whatley:

SUBJECT: CONTRACT NO. NRC-50-19-03-01, FIN B-0287, "TECHNICAL ASSISTANCE IN GEOCHEMISTRY," SEPTEMBER, 1984, MONTHLY PROGRESS REPORT

I have reviewed the September monthly progress report dated October 10, 1984. Based on my review, I have the following comments:

Task 1 - BWIP Geochemical Technical Assistance

° Progress to date is satisfactory.

° I will soon be receiving an August draft of the BWIP EA. If it is significantly different than the June draft that we have, I will send a copy of it to you.

° The current schedule for receiving the EA is 12-20-84. At this time, this date appears firm.

Task 2 - NNWSI Geochemical Technical Assistance

° Progress to date is satisfactory.

Task 3 - Salt Site Geochemical Technical Assistance

° Progress to date is satisfactory.

° Attachment 1 is for your information and should be entered into the ORLOOK system.

Task 4 - Short Term Geochemical Technical Assistance

° Progress to date is satisfactory.

WM-RES
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° The workshop on geochemical modeling was a success. The comments that I have received have indicated that both the organization and technical content were exemplary. Please let me know when a draft of the proceeding will be ready.

Task 5 - Project Management

° Progress to date is satisfactory.

° I have reviewed the 189 you submitted and see no need for any changes.

° As we discussed on the telephone (26 October 1984), I will be coming to ORNL to discuss the FY 85 work plan on November 14 and 15. In my opinion, this years work needs to be structured around the following: (1) Topical Reports, (2) Site Document Reviews,(3) EA Reviews, and (4) SCP review.

The action taken by this letter is considered to be within the scope of the current contract NRC-50-19-03-01/FIN B-0287. No changes to costs or delivery of contracted products is authorized. Please notify me immediatley if you believe that this letter would result in changes to costs or delivery of contracted products.

Sincerely,

David J. Brooks
Geochemistry Section
Geotechnical Branch
Division of Waste Management, NMSS
Office of Nuclear Material Safety
and Safeguards

Enclosures:
As Stated

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WMGT Document Review

FILE NUMBER: 3012.6, 106

DOCUMENT: Olander, D.R. A Study of Thermal-Gradient-Induced Migration of Brine Inclusions in Salt: Final Report, BMI/ONWI-538, August 1984.

REVIEWER: Walton R. Kelly, WMGT WRK DATE REVIEW COMPLETED: 9-18-84

DATE APPROVED:

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

Brine inclusion migration under thermal gradients is a process which may significantly affect the performance of a high-level waste (HLW) repository in salt by allowing brine to contact and degrade the waste form. Both intracrystalline and intercrystalline migration must be considered, but neither is well understood. Not only does brine inclusion migration provide a means for water ingression (all-liquid inclusions), but also a pathway for radionuclide release and transport (gas-liquid inclusions).

BRIEF SUMMARY OF DOCUMENT:

This document is the final report of a project initiated to "elucidate the fundamental phenomena responsible for the migration of brine inclusions in salt subjected to a temperature gradient." The investigators considered the behavior of both all-liquid (move up a temperature gradient) and gas-liquid (move down a temperature gradient) inclusions in laboratory experiments and theorectical calculations. The effects of temperature, temperature gradient, and mechanical loading on inclusion shapes and migration velocities were studied. Synthetic single crystals of KCl and NaCl and natural salt from the Richton Dome were used in experimental studies and inclusions were produced in the laboratory.

Migration velocities were observed to depend on temperature, temperature gradient, inclusion shape and size, and interfacial mass transfer resistance at the brine/solid interface (i.e., at the hot face). The last process depends on the dislocation density in the crystal, which in turn depends on the axial compressive loading of the crystal. These interfacial kinetic processes may be rate-controlling. The investigator predicts both a threshold temperature gradient and minimum inclusion size below which migration will not occur.

Large "narrow" inclusions tend to break down into smaller inclusions under a temperature gradient. Migration velocity tends to be erratic due to the inclusion picking up or losing dislocations as it moves.

Gas-liquid inclusions may form when all-liquid inclusions migrate to the waste package, open up at the salt/canister interface, partially evaporate and reseal with some insoluble gas trapped inside (and some radioactive material). The velocity of gas-liquid inclusions was found to be a function of gas type (air, helium, and argon were used in experimental studies). A gas volume fraction of 0.1 was postulated to be the limit for migration behavior, below which the inclusion behaved as an all-liquid inclusion.

PROBLEMS, DEFICIENCIES, OR LIMITATIONS OF REPORT:

In the introduction (p. 1), the author states that salt deposits are the "prime candidates for a future nuclear waste repository." The author is premature in his judgment of the DOE HLW disposal program.

The report is a valuable addition to the theoretical understanding of intracrystalline brine migration. Although the study touched on inclusion migration at grain boundaries, very little work was done concerning intercrystalline brine migration, which may be significant. The author did not consider the substantial work of Edwin Roedder (USGS) on brine migration in this study.

ACTION TAKEN:

Document review forwarded to salt team members of the Materials Engineering Section of WMEG and to ORNL.

ACTION RECOMMENDED:

None