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July 27, 1987

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Mr. M. E. Blackford, MS-623ss
Project Officer
Technical Review Branch
Division of High-Level Management, NMSS
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Transmittal of Reference Trip Report

Reference: Nevada Bureau of Mines and Geology's Rock Varnish Sampling Trip, July 11-14, 1987 (NNWSI Site) by C. Rus Purcell (Three pages)

Dear Mr. Blackford:

Attached herewith, please find the reference trip report prepared by C. Rus Purcell. The report covers Purcell's field trip to the Crater Flats Area, in close coordination with Ms. C. Abrams of NRC's lead geologist for the NNWSI Site.

The primary purpose of this field trip was to observe the rock varnish sampling methods of Ron I. Dorn of Texas Tech University, consultant to the Nevada Bureau of Mines and Geology (NBMG). The result of this work when combined with our earlier work and other rock varnish data will provide a basis of a developmental history of the Quaternary geology in the Crater Flat Area.

If you have any questions, please let us know.

Sincerely yours,

Dae H. (Danny) Chung
Project Leader

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Attachment as stated.

cc: Ms. C. Abrams, NRC, WMGT

WM Record File

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WM Project 11

Docket No.

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(Return to WM, 623-SS)

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To: D. Chung

From: R. Purcell **RP**

Date: July 23, 1987

Subject: Nevada Bureau of Mines and Geology (NBMG) Rock Varnish Sampling Trip, July 11-14, 1987.

Participants: John Bell (Trip Leader, NBMG), Fred Peterson (Consultant, UNR), Ron Dorn (Consultant, TX Tech Univ.), Rus Purcell (Consultant, UNL), Alan Ramelli (Graduate Student, UNR) and Craig Polo (Graduate Student, UNR).

This trip was set up by the NBMG in conjunction with soils consultant Fred Peterson and rock varnish expert Ron Dorn. I was invited to attend as an observer because of my previous geomorphic work in the Crater Flats area. The trip was very successful in collecting various desert varnish samples for Carbon-14 and Cation-Ratio Dating, and in better tying detailed soil descriptions to morphostratigraphic units. The following generic points highlight my major observations on the trip:

- 1) Ron Dorn advocates the biogeological theory of rock varnish formation.
 - a) Rock varnish is a coating composed of mostly Mn, Fe Oxides, and clays.
 - b) Microorganisms oxidize ambient Mn which is subsequently fixed by wetting and drying of the clays within the varnish.

- 2) Comments on rock varnish field sampling.
 - a) Collect samples from the Av soil horizon for dust chemistry analysis.
 - b) Concentrate on pavette areas to collect rock varnish samples.
 - c) Avoid biocopice areas (areas of copice dunes and bio-activity).
 - d) Collect clasts with varying lithology to extract varnish from.
 - e) In areas of only small, pebble-sized clasts, need to collect many with varnish in depressions and cracks.
 - f) Areas with large boulders are preferable for varnish sampling. Thin pieces of rock surface are broken off with a rock hammer.
 - g) Lab analysis is performed on the innermost layers of varnish, therefore Ron doesn't feel that human contamination from handling the samples without gloves is important.

- h) Avoid clasts that have or may have bio-contamination (e.g. lichens, algae, or located near vegetation).
 - i) Important to be able to tell the top of the clasts. Don't want clasts that may not be representative of the surface they are associated with.
 - j) Microorganisms can't form in the underlying alkaline silts, therefore, the top of the clast is typically a dark brown varnish while the bottom is very orange (iron staining only) because the Mn dissolving organisms are absent.
 - k) All samples are wrapped in Saran (plastic) wrap and tightly taped for transportation.
 - l) Sampling time averages from 30 to 45 minutes per site.
- 3) Two types of age-dating analyses are performed on rock varnish samples: Carbon-14 on the organic carbon in the varnish and Cation-ratio of minor elements in the varnish that are not overly sensitive to factors that affect Mn deposition.
- 4) The premise of Cation-Ratio Dating is that with time, the leachable cations in varnish, such as Na, Mg, K, and Ca are gradually replaced and/or depleted relative to the less mobile cations such as Ti. The decreasing cation ratio of $Na + Mg + K + Ca : Ti$, or any component thereof (e.g. $Ca : Ti$) provides an estimate of the length of time the varnish has been exposed to cation leaching. Cation ratio in varnishes therefore should give a relative-age sequence.
- 5) If the absolute-age of different surfaces can be determined (e.g. from C-14 or K/Ar, etc.) than an empirical relationship between the age of the surface and the cation ratios (cation-leaching curve) can be established to provide estimates of the absolute age of correlative surfaces in the region.
- 6) Fred Peterson was hired by the NBMG to do detailed soils descriptions in the Crater Flats area. He spent two week in the field in May 1987, and will be going back to finish up for one week in August. His detailed soils descriptions were discussed in context with the surficial mapping units of the USGS. When combined with the work by John Bell and myself in May of 1986, we can begin to

develop a geomorphic chronology for the area, which when combined with the future rock varnish data should give an excellent developmental history of the Quaternary geology in the Crater Flats area.

- a) SPECULATIONS on the age of the geomorphic surfaces in Crater Flats area based on soil development and rock varnish appearance suggests potentially younger ages than reported by the USGS for portions of the Q₁ and Q₂ classifications.

Interdepartmental letterhead

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July 24, 1987

TO: BWIP Task Group Members
(Robert D. Bentley, Richard W. Gasler, H. Larry McKague
and D. Burt Slemmons)

FROM: Dae H. (Danny) Chung *DH Chung*

SUBJECT: BWIP Field Trip With Robert D. Bentley

Reference: Agenda for the BWIP Field Trip with Dr. Robert Bentley,
Central Washington University, Ellensburg, WA
August 3-6, 1987. (Two pages)

Attached, please find the reference agenda for the subject field trip program task. Bob Bentley has recently accepted our invitation to become a consultant staff member of the LLNL team for the BWIP Task Group. The subject field trip program is the first important interaction among our team members and the NRC project staff, with Bob Bentley's field-trip leadership.

Our objectives of the subject field trip program are to understand:

- o Evidence for Quaternary faulting and timing and style of deformation in the Yakima Fold belt
- o Evidence for the timing of initiation of deformation in the Yakima Fold belt and Holocene faulting along the Columbia River
- o Evidence for post 10 million year old faulting

(See the reference agenda for various topics related to these primary objectives.)

Larry McKague will be serving as our Task Leader and my representative. Please submit your field trip report (including comments and suggestions if any) to Larry within one week after the completion of the field trip. Please have a good field trip, and in the meantime, I wish you all have a pleasant Summer.

University of California

 Lawrence Livermore
National Laboratory