Gene Smith, Geoscience Dept, UNLV

REGIONAL IMPORTANCE OF POST-6 M.Y. OLD VOLCANISM IN THE SOUTHERN GREAT BASIN: IMPLICATIONS FOR RISK ASSESSMENT OF VOLCANISM AT THE PROPOSED NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA

1) BASIC STATEMENT REGARDING PROPOSED RESEARCH

'86 JUL -3 A3:24

To properly assess the potential of volcanic eruption near the proposed nuclear waste repository at Yucca Mountain, Nevada, it is necessary to study post-6 m.y. old volcanism in the southern Great Basin in terms of its regional tectonic and petrologic setting. Post-6 m.y. old volcanism in the vicinity of the NTS seems to be related to one of two belts.

1. The basalt volcanoes of Crater Flat (studied in detail by Crowe and others) form one of several volcanic fields that define a northeast trending belt of post-6 m.y. old volcanism that extends from Death Valley to the Reveille Range and Lunar Crater volcanic field (Crater Flat-Lunar Crater belt).

2. A northwest-trending belt of Quaternary volcanoes (basalt with local silicic centers) that may be related to the Walker Lane tectonic zone intersects the Crater Flat-Lunar Crater belt near Crater Flat. It is conjectural whether or not this belt continues farther to the southeast; it may in fact extend into the Lake Mead area to include the 6 m.y. old Fortification Hill basalts near Hoover Dam.

I propose to focus my studies in the Reveille-Pancake ranges in the northern part of the Crater Flat-Lunar Crater belt, and in the Fortification Hill basalt field in the Lake Mead area. Techniques to be used in this study include 1. geological and structural mapping, 2. geochemistry (to be done at UNLV and at the Phoenix Lab of the University of Michigan), and 3. K-Ar age dating (lab to be determined). My intent is to investigate five critical problems that have important implications for assessing the degree of risk of volcanic eruption near the Yucca Mountain site, and for determining the nature of volcanism during the waning stages of a middle-to late-Tertiary extensional orogeny. These problems are:

1. The age of volcanism in the Crater Flat-Lunar Crater belt. Was activity coeval along the entire length of the belt, or did each field erupt independently?

2. The petrogenetic history of the Crater Flat-Lunar Crater belt. Did the basalts and associated differentiates along this belt have a similar

WM Record File 102

WM Project 11
Docket No.
PDR ✓
LPDR ✓

H

87030113F

1026

Distribution:
Linehan | CAbrams
KStablein | NStill
(Return to WM, 623-SS)

To: CAbrams

petrogenetic history? The main purpose is to determine whether volcanism along the Crater Flat-Lunar Crater belt was characterized by the eruption of compositionally distinct and independently derived magmas as separate volcanic fields or by the eruption of genetically related magmas along the length of the belt.

3. The structural control of volcanism. Is volcanism associated with a major northeast trending rift system or is it localized by older structures such as caldera ring fractures?

4. What is the geometry of the system of dikes and sills that act as feeding conduits for the eruptions of basalt? The waste repository, if affected by volcanic activity, will first be engulfed by intruding magma, therefore it is important to understand the geometry of the conduits. The Fortification Hill basalt field is an ideal location to do such a study since the area was deeply eroded during the formation of Black Canyon by the Colorado River. As a result, the conduit system is clearly exposed.

5. Does volcanism along the Walker Lane belt extend to the southeast of the Crater Flat area, and if so, how does it compare in terms of age and composition to volcanic activity along the Crater Flat-Lunar Crater belt?

To investigate these problems, I propose a three year project involving myself and four graduate students. This group will study the geology and geochemistry of the Reveille-Lunar Crater field (the northern end of the Crater Flat-Lunar Crater belt) and the Fortification Hill basalt (the possible southeast extension of the Walker Lane belt in the Hoover Dam area). In the paragraphs below, I briefly outline this proposal. I also provide a preliminary budget for the project.

2. BRIEF COMMENT ON THE WORK OF CROWE

After reading the reports produced by Crowe and his co-workers it is clear that they did an excellent job of characterizing volcanic activity at Crater Flat. I only find two faults with their work: 1. To assess the hazard of volcanic activity near the waste repository, the Crater Flat area must be considered as part of a regional episode of volcanism. They did this only in a cursory manner. 2. The rare-earth element geochemistry provided by Crowe was not used to model the source rock composition for the basalts. This is

important because it constrains the composition of the mantle source region for the magmas of the Crater Flat-Lunar Crater belt, and it allows estimates of the amount of melting to produce the basaltic magmas.

The work done by Crowe will provide a good comparative data base for our studies in the Reveille-Lunar Crater area to the north and the Fortification Hill area to the southeast.

3. BASALTS OF THE REVEILLE RANGE AND THE LUNAR CRATER VOLCANIC FIELD

The geology of the Pliocene-Pleistocene basalts of the Reveille and Pancake Ranges is poorly known. The geology of this area is described on several U.S.G.S. quadrangle maps (1:62,500 scale) and was mapped and sampled in a reconnaisance fashion by Crowe (see Crowe, Vaniman and Carr, 1983). The Lunar Crater volcanic field may contain the youngest basaltic volcanoes of the Crater Flat-Lunar Crater belt and is much better known geologically. Trask (1969) reported on the numerous ultramafic nodules in the lavas near Lunar Crater, and Scott and Trask (1971) described the geology and major element geochemistry of the Lunar Crater area as part of a comparative study of lunar and terrestrial volcanic morphologies. It is interesting to note that Crowe in his numerous reports on the Crater Flat-Lunar Crater belt does not mention these publications on the Lunar Crater area.

The major objectives of the proposed work in the Reveille range-Lunar Crater area are to 1. provide a geologic map indicating structural control of volcanism, and volcanic stratigraphy. 2. characterize geochemically the basalt flows to determine chemical change with time and to model the composition of the source rock, and 3. determine the age of volcanism (K-Ar technique) so that changes in volume, volcanic eruptive style and chemistry can be placed in the proper time frame. As mentioned in the first section, this data will then be used to compare with the geological studies of Crowe, and Scott and Trask to better evaluate the hazard of volcanic activity near the Crater Flat waste storage repository.

I propose that geologic work in the Reveille and Pancake Ranges be done by

three graduate students (as part of their M.S. thesis work at UNLV) and myself. Each of the students will map an area of approximately 150 square miles and will produce at the end of their research a detailed geologic map of their respective areas, a detailed structural analysis of the area to determine the structural control for Pliocene-Quaternary volcanism, and a petrographic and geochemical study of the volcanic flows in the area to determine the change in the nature of the mineralogy and chemistry of the magma with time.

As PI, I will also contribute to the geologic mapping, supervise the students, collect samples for K-Ar geochronology, compile the geologic mapping to determine regional trends, make comparisons with other nearby areas of basaltic volcanism (such as Crater Flat) and prepare the final report.

4. FORTIFICATION HILL BASALTS

Very little is known about the Pliocene basalt of Fortification Hill. These rocks extend from Callville Mesa in Nevada to Malpais Mesa 40 km south of Hoover Dam in Arizona. A basalt flow on Fortification Hill was dated at 5.88 $\pm$ 0.18 m.y. old by Damon and others(1978). Several maps show the general distribution of the basalt (Smith, 1984; Anderson, 1981), but no detailed studies have been completed. The unit up to now was studied only because of its importance in interpreting the complex structural history of the area. It is important to determine whether this volcanic field is part of the Walker Lane belt or related to northwest trending Basin-and-Range structures in the Lake Mead-Colorado River area.

To study the Fortification Hill field, one student (M.S. candidate) will map the entire volcanic field, determine structural control and do a geochemical study. Even though the volcanic field is spread over a large area (300 square miles), basalt exposures cover less than 25 square miles. Loss of exposure is due to 920 m of erosion associated with the down cutting of the Colorado River). Deep erosion has its advantages since dike rock (possible feeder conduits) can be studied in detail. This area provides a unique opportunity to study the geometry of the conduits for the basaltic flows. Information gathered at Fortification Hill may allow the construction of models for the conduit system

beneath the Crater Flat and Lunar Crater volcanoes. As PI, I will supervise the study, and will be responsible for comparing this volcanic field with nearby Pliocene-Quaternary volcanoes.

SELECTED REFERENCES, PLIOCENE-QUATERNARY VOLCANISM IN THE SOUTHERN GREAT BASIN

Anderson, R.E., 1977, Geologic map of the Black Canyon 15-minute quadrangle, Clark County, Nevada: U.S. Geological Survey Map GQ-1344.

Best, M.G. and Brimhall, W.H., 1974, Late Cenozoic Alkalic basaltic magmas in the western Colorado Plateaus and the Basin-and-Range transition zone, USA and their bearing on Mantle Dynamics: Geological Society of America Bulletin, v. 85, p. 1677-1690.

Carr, W.J., 1982, Volcano-tectonic history of Crater Flat, southeastern Nevada, as suggested by new evidence from drill hole USW-VH-1 and vicinity: U.S. Geological Survey Open File Report 82-457.

Crowe, B.M., and Carr, W.J., 1980, Preliminary assessment of the risk of volcanism at a proposed nuclear waste repository in the southern Great Basin: U.S. Geological Survey Open File report. 80-357, 15p.

Crowe, B.M., Vaniman, D., Carr, M.J., and Fleck, R.J., 1980, Geology and tectonic setting of a Neogene volcanic belt within the south-central Great Basin, Nevada and California: GSA Abstracts/Programs,p. 409.

Crowe, B., Amos, R., Perry, F., Self, S., Vaniman, D., 1982, Aspects of possible magmatic disruption of a high-level radioactive waste repository in southern Nevada: Los Alamos National Laboratory report LA-9326-MS.

Damon, P.E., Shafiqullah, M., and Scarboough, R.B., 1978, Revised chronology for critical stages in the evolution of the lower Colorado River: Geolgical Society of America Abstracts with Programs, v. 10, no. 3, p. 101-102.

Ekren, E.B., Hinrichs, E.N., and Dixon, G.L., 1972, Geologic map of the Wall quad., Nye County, Nevada:USGS Misc. Inv. Map I-719

Ekren, E.B., Rogers, C.L., and Dixon, G.L., 1973, Geologic and Bouguer gravity map of the Reveille quad., Nye County, Nevada: USGS Misc. Inv. Map I-806.

Scott, D.H., and Trask, N.J., 1971, Geology of the Lunar Crater Volcanic field, Nye County, Nevada: USGS Prof. Paper 599-I, p. I1-I22.

Smith. A.L., and Carmichael, I.S.E., 1969, Quaternary trachybasalts from southeastern California: Am. Min., v. 54, p. 909-923.

Smith, E.I., 1984, Geologic Map of the Boulder Beach Quadrangle, Nevada: Nevada Bureau of Mines and Geology Map 81.

Snyder, R.P., Ekren, E.B., and Dixon, G.L., 1972, Geologic map of the Lunar Crater quad., Nye County, Nevada: USGS Misc. Geol. Inv. Map I-700

Trask, N.J., 1969, Ultramafic xenolilths in Basalt, Nye County, Nevada: USGS Prof. Paper 650-D, p. D43-D48.

Vaniman, D. and Crowe, B.M., 1981, Geology and petrology of the basalts of Crater Flat: applications to volcanic risk assessment for the Nevada nuclear waste storage investigations: Los Alamos Scientific Lab Report LA-8845-MS, 67p.

Vitaliano, C.J., and Harvey, R.D., 1965, Alkali basalt from Nye County, Nevada: Am. Mineralogist, v. 50, p. 73-84.

Wise, W.S., 1969, Origin of basaltic magmas in the Mojave Desert area, California: Contr. Min. and Pet., v. 23, p. 53-64