CNWRA A center of excellence in earth sciences and engineering

A Division of Southwest Research Institute™
6220 Culebra Road • San Antonio, Texas, U.S.A. 78228-5166
(210) 522-5160 • Fax (210) 522-5155

August 15, 2001
Contract No. NRC–02–97–009
Account No. 20.01402.461

U.S. Nuclear Regulatory Commission
ATTN: Mrs. Deborah A. DeMarco
Office of Nuclear Material Safety and Safeguards
Two White Flint North, Mail Stop 8 A23
Washington, DC 20555

Subject: Submittal of Abstract Geologic Constraints on Conduit Formation at Explosive Basaltic Volcanoes (AI 20.01402.461.070)

Dear Mrs. DeMarco:

Enclosed is an abstract for presentation at the December 2001 American Geophysical Union Meeting. This abstract is based on investigations conducted as part of the Igneous Activity KTI project and demonstrates how geologic data can be used to constrain models of volcanic processes. Work presented in this abstract directly supports models used in the NRC total system performance assessment for Yucca Mountain, Nevada. In addition, this work will be used to evaluate data and models developed by the U.S. Department of Energy.

Presenting this investigation at a wide-ranging scientific conference directly supports several NRC goals, such as building public confidence that the NRC independently develops a wide range of techniques to evaluate safety issues. This presentation also will demonstrate that the modeling approach used by the NRC for licensing decisions is based on data and models, which have been reviewed and discussed by experts in volcanology. Following programmatic acceptance by the NRC, this abstract will be submitted to the organizing committee for presentation at the December meeting in San Francisco, California. If you have any questions please contact Dr. Brittain Hill at (210) 522-6087 or me at (210) 522-5252.

Sincerely,

Budhi Sagar
Technical Director

/rae
Attachment

cc: J. Linehan, W. Reamer, B. Leslie, E. Whitt, D. Brooks, B. Meehan, J. Greeves, J. Piccone, S. Wastler, T. Essig, J. Trapp, W. Patrick, CNWRA Directors, CNWRA Element Managers, B. Hill, C. Connor (USF), T. Nagy (SwRI Contracts)

D:\GLGP Group\letters\ia\abs-08-15-2001bs.wpd

Geologic Constraints on Conduit Formation at Explosive Basaltic Volcanoes

Brittain Hill, (CNWRA, Box 28510 San Antonio TX 78228, bhill@swri.edu)
Philip Doubik (State University of New York, Buffalo NY 14260)
Charles Connor (University of South Florida, Tampa FL 33620)

Models of explosive basaltic processes often are sensitive to shallow (<2 km) conduit dimensions. Geologic data constrain how these conduits can evolve. Xenoliths in the 1975 Tolbachik, Kamchatka, violent strombolian basalt eruption are derived from Quaternary volcanic (0–1 km deep) and Tertiary sedimentary (1–4 km) rocks. Xenolith abundances in the lower half of fall deposits from the Cone 1 eruption stage are 0.001–0.01 vol%. This period sustained 6–10-km high eruption columns and lacked lavas. Xenolith abundances increase to 0.01–1.0 vol% in the upper half of the deposits, which correlates with lava effusion and columns 2–6-km high. The 3×10^5 m^3 total xenolith volume represents a cylindrical conduit 15±2 m in diameter and 1.7±0.2 km deep. Eruption of Cone 1 ended with 12 hr of hydromagmatic falls containing 3×10^6 m^3 (70 vol%) xenoliths. The conduit must have widened from 15±2 to 48±4 m to produce this xenolith volume. The subsequent Cone 2–3 eruption stage produced abundant lavas and eruption columns ≤4-km high. Xenolith abundances are 0.01–0.1 vol%, indicating progressive widening of the conduit to 6±1 m extending to 2.8±0.4 km depth. Simultaneous eruptions of tephra and lava suggest an annulus of degassed magma developed on conduit walls, enhancing xenolith entrainment; little entrainment occurred early at Cone 1 with an apparent droplet flow regime.

Alkali basalt plugs and dikes representing 1±0.5 km paleodepths are exposed in the 4 Ma San Rafael volcanic field, Utah. Dike-plug complexes represent typical dimensions for basaltic volcanic eruptions and are interpreted as subvolcanic conduit systems. Mapped conduits range from 2-m wide buds along dikes with little wall-rock disruption, to 10–60-m wide cylindrical plugs having ≤5-m wide conduit margins with abundant xenoliths. These margins may represent typical wall-rock plucking and conduit widening during annular flow (i.e., late Cone 1 and Cone 2–3). Several larger conduits, however, have a 1–6 m xenolith-poor annulus with a 10–40 m inner core of extensive wall-rock breccia and pervasive low-temperature hydrothermal alteration. Xenoliths in the inner breccia often are derived from deeper stratigraphic units. These brecciated conduits appear analogous to late-stage hydromagmatic events at Cone 1. Models of explosive basaltic cinder cone eruptions should consider that subvolcanic conduit diameters to <2 km depth may progressively widen to order of 10–60 m.

Work supported by U.S. Nuclear Regulatory Commission (Contract NRC-02-97-009) and is an independent product of CNWRA that does not necessarily reflect NRC views or regulatory positions.