Submarine tholeiitic volcanism (ca. 3.6 to 4.9 Ma) West of Ka‘ena Ridge, Hawaiian Islands: Implications of low magma productivity in the evolution of the Hawaiian Plume

ANDREW R. GREENE[1], DOMINIQUE WEIS[2], MICHAEL O. GARCIA[1], MAIA KUGA[3], GARRETT ITO[1] AND JOEL ROBINSON[4]

[1]University of Hawaii at Manoa, Honolulu, HI, USA
[2]University of British Columbia, Vancouver, BC, Canada
[3]Ecole Normale Supérieure de Lyon, Lyon, France
[4]Volcano Hazards Team, U.S.G. S., Menlo Park, CA, USA

The largest gap in volcanism in the Hawaiian Islands is between the islands of Kaua‘i and O‘ahu, where the volume of the islands is the smallest. Volcanic cones west of Ka‘ena Ridge are samples of the Hawaiian plume at a time of low magma productivity along axis of the Hawaiian chain. Ka‘ena Ridge is an elongate, relatively flat-topped submerged terrace 35-55 km wide that extends ~80 km from the western edge of O‘ahu. The volcanic cones west of Ka‘ena Ridge were sampled by Jason II from R/V *Kilo Moana* in 2007. The flat-topped and conical cones are <400 m high and <2 km in diameter at water depths ranging between ~2700 to 4300 m, and consist predominantly of pillowed flows and mounds. Ar-Ar ages of eight lavas are between 4.9 and 3.6 Ma; three additional K-Ar ages range from 4.7 to 4.3 Ma. These ages overlap with shield volcanism on Kaua‘i (5.1-4.1 Ma) and Wai‘anae volcano shield basalts (3.9-3.1 Ma) on Oah‘u. Half of the volcanic cones contain high-SiO_2 basalts (51.0-53.5 wt % SiO_2). Isotopic compositions of West Ka‘ena lavas diverge from the main Ko‘olau-Kea shield mixing trend in binary isotope diagrams and extend to lower $^{206}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$ ratios than any Hawaiian tholeiitic lava. Several West Ka‘ena samples are similar to SiO_2-enriched, Loa-trend lavas of Ko‘olau Makapuu stage, Lāna‘i, and Kaho‘olawe, which are thought to be from an ecologite source. Our results demonstrate that Loa-type magmatism extends beyond Ko‘olau volcano. Loa-type volcanism persisted when there was not a dual chain of volcanoes or bilateral asymmetry in the Hawaiian plume. A correlation is apparent between magma productivity and isotopic compositions in the Hawaiian Islands. The temperature structure and distribution of heterogeneities in the plume, and position relative to the plume center, controls emergence of greater eclogitic component relative to peridotite.

Electrochemical processes in pressure solution

GEORGE W. GREENE, [1] KAI KRISTIANSEN, [2] MARKUS VALTINER, [2] JIM BOLES[3] AND JACOB ISRAELACHVILI[1,2]

[1]Materials Department, University of California, Santa Barbara, CA 93106. USA
[2]Department of Chemical Engineering, University of California, Santa Barbara, CA 93106. USA
[3]Department of Earth Science, University of California, Santa Barbara, CA 93106. USA

Experiments were carried out using a recently developed *in situ* electrochemical cell in a Surface Forces Apparatus (SFA) to investigate the dissolution of silica surfaces in close proximity to muscovite mica as a function of both time and electrochemical potential. We have measured changes in the electrical potential difference between quartz and mica surfaces that correlate strongly with the changing quartz dissolution rate when surfaces are pressed together at relatively low pressures (2-3 atm) in acidic electrolyte solutions of 30 mM $CaCl_2$ at 25 °C. The origin of the electrical potential is interpreted as overlapping of the double layer of dissimilar surfaces when they are forced into close proximity. In addition, we have applied external electric fields across amorphous silica and mica surfaces and investigated its effect on the observed silica dissolution rate. We find that, depending upon the polarity and strength of the electric field, the rate of silica dissolution can be either enhanced or retarded suggesting the dissolution is driven, at least in part, by electrochemical reactions.