Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05872, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05872
EGU General Assembly 2008

Plumeless Oceanic Volcanism Challenges Whole-Mantle Convection

D. Presnall (1,2,3), and G. Gudfinnsson (2)

(1) University of Texas at Dallas, Texas, USA, (2) Bayerisches Geoinstitut, Bayreuth, Germany, (3) Geophysical Laboratory, Washington, D. C., USA (dpresnall@ciw.edu)

Here we apply petrological constraints that test the existence of hot mantle plumes and whole mantle convection. Model-system phase relations show that if basaltic melts are extracted from a lherzolitic source at high P and T ($>\sim$ 1.5 GPa, 1280˚C), they are picritic. Fractional crystallization of these magmas in a crustal magma chamber at low pressures would show an initial trend of olivine-controlled crystallization. In a global compilation of 6,937 MORB glass analyses (389 from Iceland), mainly from the petDB database, we find no indication of such a trend. Therefore, despite claims of extensive olivine-controlled crystallization of MORBs based on hypothetical olivine-addition calculations, we find that observed MORB glasses, including those from Iceland, show no evidence of extraction from the mantle at P $>\sim$1.5 GPa, 1280˚C (Presnall *et al.*, 2002, *Geochim. Cosmochim. Acta*, 66, 2073; Presnall and Gudfinnsson, *J. Petrol.*, in press). We conclude that no hot plumes (Jan Mayen, Iceland, Azores, St. Helena, Tristan, Bouvet, Easter, Galapagos, Afar) exist along or near oceanic ridges. The strong olivine-controlled crystallization trend at Hawaii indicates a much higher temperature of melt extraction, and this might seem to support the existence of a plume at Hawaii. However, model-system phase relations and the existence of diamonds show that the pressure of melt-extraction at Hawaii must also be much higher than that of MORBs. Thus, the Hawaiian picritic magmas are consistent with melt extraction from a greater depth along a geotherm similar to that beneath oceanic ridges, and the existence of hot plumes in the ocean basins has no support even at Hawaii. As hot plumes are the dominant component of return flow from the deep mantle in a whole-mantle convection model, their total absence severely challenges the exis-

tence of whole-mantle convection. We replace hot mantle plumes with fracturing of the oceanic seismic lithosphere in response to stresses imposed by continental plates (Presnall and Gudfinnsson, *J. Petrol*., in press). These fractures induce explosive escape of CO_2 vapor from the slightly melted seismic low-velocity zone, which assists the transport of MORB melts to the surface and explains the constant association of strombolian and effusive eruptions at oceanic ridges (Clague *et al*., 2003, *AGU Mon.* 140, 111). Shifting stress fields over time cause the birth, propagation, and death of spreading ridges.