Geochemistry and eruption depths of volcanic glasses from the Louisville seamounts

Alexander RL Nichols[1], Christoph Beier[2], Philipp A Brandl[2]

[1]IFREE, JAMSTEC, Japan, [2]GeoZentrum Nordbayern, FAU Erlangen-Nuernberg, Germany

E-mail: nichols@jamstec.go.jp

The Louisville seamounts form a ~4300 km-long trail in the south Pacific generally attributed to a mantle plume located at the south-eastern end of the trail until 1.11 Ma. IODP Expedition 330 (Dec. 2010-Feb. 2011) drilled five of the older seamounts (50 to 74 Ma) at the north-western end. Fresh glass samples were recovered from four of the seamounts and we present their major (microprobe), including F, S, and Cl, trace (LA-ICP-MS) and volatile (FTIR spectroscopy) element compositions. These allow us to test models regarding the origin of oceanic intraplate volcanism, how magmas evolve between and within seamounts, and infer the environment in which the magmas were emplaced.

Of the 61 glass samples so far analysed all but one are alkalic (SiO_2 44.5-50.2 wt%; Na_2O+K_2O 3.5-6.5 wt%; MgO 3.5-6.8 wt%), and fall in the basalt field with a few trachybasalts and basanites. There is minimal downhole variation in major and trace elements, even over the ~500 m drilled in Hole U1374 on Rigil Seamount, and there is less variation in the drill samples than in previously collected dredge samples. Thus, there is still no evidence in the Louisville seamounts for the dominant tholeiite shield-building stage of Hawaiian volcanoes. Immobile, source sensitive trace element ratios, e.g., La/Yb, Zr/Nb, show less variation over 24 Myrs and 76 Myrs in the Louisville drill and dredge samples, respectively, than over 5-6 Myrs in Hawaiian samples. Thus it appears that the Louisville seamounts are derived from an extremely homogeneous source.

Volatile elements show that glasses from the volcaniclastics are degassed (H_2O 0.07-0.12 wt%; S 160-662 ppm; CO_2 below detection limits of 20 ppm), implying eruption near, or above, the sea surface. It is possible that the sequences have moved downslope due to flank instability or are flow-foot breccia formed as subaerial flows entered the sea. Less degassed glass (H_2O 0.37-0.58 wt%; S 890-1088 ppm; CO_2 below detection) are only found on the chilled margins of sheets that intrude into the degassed volcaniclastics in Holes U1376, Burton Seamount, and U1377B, Hadar Seamount. Intrusion ~100 m below the surface can be inferred from the volatile contents. Even so, low H_2O/K_2O (0.26-0.58) suggest they have degassed, thus glass from the Louisville seamounts cannot be used to constrain source volatiles. Using inferred eruption and emplacement depths, the minimum subsidence that the seamounts have experienced since their formation can be estimated. Combining this with the expected subsidence of the oceanic lithosphere if no seamount was present, we find that the younger the seamount, the greater the subsidence exceeds that of normal oceanic lithosphere. This may reflect erosion of the seamount with age decreasing the rate of subsidence.