Wedge and slab inputs to boninite magmas in the NE Lau Basin

SARAH GLANCY[1]*, KEN H. RUBIN[1], ERIC HELLEBRAND[1],
FRANCES JENNER[2], RICHARD ARCULUS[3]
AND ROBERT W. EMBLEY[4]

[1]Univ. Hawaii Manoa, Honolulu, HI sglancy@hawaii.edu, krubin@hawaii.edu, ericwgh@hawaii.edu
[2]Open Univ, Milton Keynes, UK Frances.Jenner@open.ac.uk
[3]RSES, ANU, Canberra, AUS Richard.Arculus@anu.edu.au
[4]PMEL, NOAA, Newport, OR Robert.W.Embley@noaa.gov

Spatial variations in wedge depletion and slab inputs are important but incompletely understood aspects of subduction zone magmatism. The tectonically active NE Lau Basin is an excellent place to examine such variations because of its high number of young volcanoes in arc, rear arc and backarc settings. Here we focus on a series of small, young, submarine rear arc volcanoes (the Matas), located in an extensional basin trending obliquely from the arc. Collectively, they have erupted boninite and other mafic/ultramafic magmas. Fresh, crystal-rich lavas contain olivine, clinopyroxene, and orthopyroxene, but lack plagioclase phenocrysts. Despite their location behind the arc, the Mata Volcanoes have strong arc compositional affinities. These characteristics are aparrent in both glass and whole rock data, even though glasses have significantly lower MgO content (mostly 3.5-8.5 wt%) than the whole rocks (mostly 10-20 wt%).

Results of comprehensive major-trace element petrogenetic modeling of mantle and crustal processes indicate that multiple components are required to explain the chemical compositions of our large sample set from the Mata volcano group (collected by XRF on whole rocks, and EMPA and LA-ICPMS of glasses). The main magmatic component is a melt of a highly depleted mantle wedge, with superimposed variable additions by subducted components. Most lavas have relatively large fluid-mobile incompatible element (e.g., U, Ba, Rb, Sr, K) enrichments compared to interoceanic arc lavas in general, requiring small amounts of sediment melt and/or fluids dehydrated from the slab. Interestingly, higher Ti, Nb, and Zr relative to the heavy REE can not be explained by just melts of a depleted mantle wedge. Rather these seem to require addition of a minor amount of slab eclogite melt. MELTS modeling of crystallization conditions that generate observed major element compositional trends in erupted glasses indicate the samples differentiated under low pressures (500-1000 bars), under oxidizing conditions (QFM 0 to +1), and with a minimum of 1.7-2.5 wt% H_2O.