Composition within and between Tonga arc/Lau Basin backarc eruptions reveal wide variety of parent melts linked to eruption styles

KEN H. RUBIN[1], P. MICHAEL[2], F. JENNER[3], D. CLAGUE[4], S. GLANCY[1], E. HELLEBRAND[1], R. ARCULUS[5], J. GILL[6], E. TODD[7], J. LUPTON[8] AND R. EMBLEY[8]

[1]Univ. of Hawaii Manoa, Honolulu, HI; (krubin@hawaii.edu)
[2]Univ. of Tulsa, Tulsa, OK; (pjm@utulsa.edu)
[3]CEPSAR, Open University, Milton Keynes, UK
[4]MBARI, Moss Landing, CA; (clague@mbari.org)
[5]RSES, ANU, Canberra, AUS; (richard.arculus@anu.edu)
[6]Earth and Planetary Sciences, UCSC; (gillord@ucsc.edu)
[7]Alaska SC, USGS, Anchorage, AK (etodd@usgs.gov)
[8]PMEL, NOAA-Vents, Newport, OR

The Northern Tofua Arc and adjacent NE Lau Basin host a wide variety of volcano types reflecting dynamic and diverse tectonic settings (e.g., rapidly opening basin, migrating microplate boundaries, within-plate discrete rear arc volcanoes, and weak on-arc magmatism, all in close spatial proximity). Frequent contemporaneous eruptions of high-MgO magmas and their differentiates from closely spaced volcanoes provide an uncommonly detailed view of the diversity of parent magma types formed in the broader suprasubduction zone environment. They show how mantle lithological variations couple with local tectonic setting to control magmatism, and influence magma accumulation, storage, and subsequent eruption. The results of 6 recent research expeditions to this relatively small region show how these attributes collectively result in systematic relationships between eruption style, inferred duration, size, intensity, location, and compositional variability. In particular, we can constrain magmatic conditions and timescales from single eruption deposits that we sampled with high-spatial-resolution in the context of detailed deposit mapping, high resolution ^{210}Po-^{210}Pb eruption chronologies, and U-Th-Ra disequilibrium. At the same time, variations between eruption deposits reveal how quickly parent melt compositions drawn from the mantle wedge can change in space and time. We will discuss and interpret diverse phenomena from the region, including high rates of temporal variability seen in magma compositions within single eruptions, ultra-high variability in source compositions sampled at sub-km scale on neighboring small Mata volcanoes, highly productive and frequent volcanism on the NE Lau Spreading center, and the petrogenetc links between boninite and high MgO basalt magmas with extensive contemporaneous dacite volcanism in the region.