Exploring the effects of spreading rate and slab-derived water on melting processes in the Lau-Havre backarc systems

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The large changes in backarc opening rates and arc proximity along the Tonga-Kermadec subduction system correlate with significant changes in the style of crustal accretion. At its northern end, crustal formation in the fast-opening Lau basin occurs along well-organized spreading centers, while the ultra-slow (20-15 mm/yr) Havre Trough (HT) lacks a focused center of spreading, and its crustal accretion is poorly understood. Recent mapping and sampling in the HT suggest the seafloor is paved primarily with young, magmatically accreted crust rather than rifted arc crust, and that volcanism occurs contemporaneously across the basin with no consistent age progression [1,2]. HT is dominated by high standing volcanic chains, which extend across rather than along the basin, separated by a series of rift basins, some of which show signs of localized seafloor spreading. Lavas from the more 'arc-like' volcanic cross-chains exhibit stronger enrichments in slab-derived components on average. Differences in fractionation-corrected Fe-(Ti,Na) systematics indicate lower average melting pressures for rift basin samples than arc regime samples, and lower extents of melting in HT than Lau. We propose that the observed differences in lava composition and crustal accretion style partly reflect differences in underlying mantle upwelling patterns. In the fast-spreading northern Lau, mantle melting is dominated by 2-D plate-driven mantle advection, with along-axis compositional variations primarily dependent on ridge-arc distance. In the ultraslow HT however, the amount of melting generated by plate-driven mantle upwelling is much lower, while high water contents lead to enhanced hydrous fluxing and buoyancy-driven mantle advection and melting, producing more 3-D variability in melting zone geometries and processes. We present preliminary modeling of mantle melting and magmatic processes in these two backarc regions, emphasizing the important role that mantle upwelling dynamics can play in generating lava compositional variations in arc and backarc settings.

[1] Todd et al. (2010) *G^3 11*:Q04009. [2] Wysoczanski et al. (2010) *JVGR 190*:39-57.