The Lau-Havre basins: Investigating backarc crustal formation from fast to ultraslow opening rates

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Backarc crustal formation involves pressure-release melting and hydrous fluxing in the mantle wedge. A controlling factor in the expression of these processes may be opening rate. Fast opening rates in the Lau basin (>97 mm/yr) decrease to ultraslow rates in the Havre trough (~15 mm/yr) and are accompanied by large changes in style of crustal accretion and composition. In the Lau basin crust forms along well-organized spreading centers with MORB-like basaltic compositions in arc-distal locations but abruptly switches to arc-like andesitic compositions with proximity to the arc volcanic front [1,2]. The Havre Trough also forms MORB-like and arc-like crustal domains but there they are arrayed in basins and volcanic chains respectively that trend across the basin [3]. We propose that opening rate fundamentally controls the style of crustal accretion. In the Lau basin fast opening rates force two-dimensional plate-driven advection dominated by pressure release melting in the mantle wedge that results in crustal accretion centered on an organized seafloor spreading axis. Subtle variations in ridge structure and composition correlate with the location of arc volcanoes, however. In the Havre Trough, ultraslow opening rates minimize plate-driven mantle advection. Melt formation and volcanism are dominated by water release from the slab and hydrous fluxing of the mantle wedge. The pattern of hydrous fluxing is believed to form diapiric upwellings in the form of “hot fingers” [4] above the slab with intervening areas of more MORB-like mantle, thus giving rise to arc-like volcanic cross chains separated by MORB-like basins. The change from organized spreading in the Lau basin to diffuse volcanism in the Havre Trough may be further conditioned by generally increasing water content in the mantle wedge as spreading rates decrease. Increasing water content has a strong effect on mantle rheology and may eventually inhibit formation of narrow plate boundary zones by broadly weakening the lithosphere.

[1] Martinez & Taylor (2002) *Nature*, **416**, 417-420; [2] Dunn & Martinez, (2011) *Nature*, **469**, 198-202; [3] Wysoczanski, et al, (2006) *JVGR*, **152**, 51-73; [4] Tamura et al., (2002) *EPSL* **197**, 105-116.