Abstract ID: 84

Title: THE DEVELOPMENT OF INTRA-OCEANIC ISLAND ARCS AND BACK-ARC BASINS IN THE IZU-BONIN-MARIANA (IBM) AND SW PACIFIC SUBDUCTION SYSTEMS

Student: No

Topic: Tectonics

Medium: Invited Oral Presentation

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Keywords: subduction, volcanism, spreading, rifting, ophiolite, boninite, serpentinite, crustal structure

Abstract: Melting of aesthenosphere upwelling above foundering oceanic lithosphere creates an ophiolitic crust. The initial IBM subduction did not nucleate at a (large-offset) fracture zone: it cut across remnant arcs, fracture zones & spreading fabric. To reproduce this, models of subduction initiation will need to incorporate the 3-D effects of plate reorganizations such as evidenced by the Hawaiian-Emperor bend at ~50 Ma.

In IBM, boninitic & arc tholeiitic volcanism 49-45 Ma was succeeded by 46-41 Ma transitional arc suites further from the trench. Arc magmatism localized along a volcanic front by 41 Ma. Early IBM subduction was contemporaneous with 49-33 Ma W. Philippine Basin opening, requiring >1000 km of arc parallel stretching/magmatism in the Mariana forearc. Explosive arc volcanism peaked 34-29 Ma & overlapped with rifting that may have begun as early as 42 Ma. Early phases of back-arc spreading in the Parece Vela & Shikoku Basins (29/25-15 Ma) had a minima in arc volcanism (notably 23-20 Ma in the Izu-Bonins). Mild inversion of normal faults formed thrust anticlines in the inner Mariana forearc.

Partial hydration of forearc mantle generates serpentinite whose protrusion & episodic eruption forms mud volcanoes. Flank flows of serpentinite muds downlap forearc substrate. As the serpentinite seamounts grow they may slide radially along a decollement above over-pressured forearc sediments or incorporate them into basal thrusts.

Higher subduction rates result in less slab cooling of the mantle wedge (& higher Fe8 of basalts from Manus & Lau vs east Scotia & Mariana). The proximity of back-arc spreading centers to the arc determines their crustal productivity. Arc proximity has a greater control on ridge morphology & faulting than spreading rate. This is a mantle source composition effect, with slab proximity increasing melting due to hydration, but decreasing melting due to re-circulation of refractory material by mantle wedge corner flow. The result is thicker, then thinner, then normal oceanic crustal thickness with increasing distance behind the arc. However, heat input from mantle advection proportional to spreading rate, possibly in combination with fault permeability, controls hydrothermal activity more so than does crustal productivity. Hydrothermal plume

incidence on the well-surveyed Eastern Lau Spreading Center exceeds the global mid-ocean ridge averages as a function of spreading rate.

Seismic surveys of IBM arc crustal structure reveal a mid-crust velocity layer (~6 km/sec) consistent with (proto-continental) felsic compositions. Similar crustal structures have not been measured in the Aleutian arc, which has not been rifted apart. The location of rifting and break-up on the forearc (e.g., Lau) versus backarc (e.g., Izu-Bonin) sides of island arcs significantly affects the evolution of both the arc and back-arc basin by modulating the temporal/spatial interplay of slab-sourced versus decompression melts of the mantle wedge.