New insight to the evolution of backarc basins: Leg 135 drilling transect

James W. Hawkins, Geoscience Research Division, Scripps Institution of Oceanography

Backarc basins are small extensional basins formed at oceanic plate convergent margins. Upwelling and partial melting of the mantle forms magmas similar in most respects to mid-ocean ridge basalt (MORB) but also includes arc-like and transitional (backarc basin) basalt (BABB) while adjacent mantle sources form arc magmas. Heterogeneous sources, temporal changes, and complex mantle dynamics are implicit. [*Hawkins,* 1994; *Parson and Hawkins,* 1994].

Leg 135 drilling data support a two stage rifting model. Crustal extension and rifting of the Lau Ridge volcanic arc and its forearc began at about 6 Ma. Small rift basins (basin-range structure) were filled with arc-derived clastics and basalt flows mainly having MORB chemistry with Pacific MORB isotopic composition. Basin rifting and BABB/MORB magmatism were synchronous with Lau Ridge rifting and arc magmatism. At about 4.5 Ma a southward propagating spreading center began to form MORB crust. Small, ephemeral, intra-basin seamounts with arc-like chemistry formed adjacent to the MORB-like spreading ridge. MORB-source and island arc-source mantle were juxtaposed under the Lau Basin. A second propagator began at 1.5 Ma and forms MORB crust with Indian Ocean mantle isotope chemistry. The active Tofua (Tonga) arc postdates initial backarc seafloor spreading; it is imprinted on older "backarc," or remnant forearc, crust. The ages and variations of magma types suggest that the mantle wedge retained isolated, small domains of multiply depleted mantle, variably re-enriched in a subduction component, whereas the major source for the BABB crust is relatively more fertile MORB-source mantle. Temporal change from a Pacific source to an Indian MORB-source mantle suggests eastward mantle counterflow above the subducted Pacific plate. Lau Basin geology resembles that of the Mariana Trough; it may offer a general model for western Pacific convergent margin systems.

References:
Hawkins, J.W., Petrologic synthesis: Lau Basin transect (Leg 135), *Proc. ODP, Sci. Res., 135,* 879-905, 1994.
Parson, L.M. and J.W. Hawkins, Two stage ridge propagation and the geological history of the Lau backarc basin, *Proc. ODP, Sci. Res., 135,* 819-828, 1994.

SCHEMATIC CROSS - SECTION LAU BASIN