Timing and duration of metamorphism and melting recorded in garnet: Fiordland, NZ

HAROLD H. STOWELL[1]*, A. TULLOCH[2], D.K. TINKHAM[3] AND M.P. GATEWOOD[1]

[1]Dept. Geological Sciences, Univ of Alabama, Tuscaloosa, Alabama 35401 (*correspondence: hstowell@geo.ua.edu)
[2]GNS Science, Dunedin Research Center, Dunedin, NZ
[3]Dept. Earth Sciences, Laurentian University, Sudbury, Ontario P3E 2C6

Metamorphism and high Sr/Y melt production in continental arc crust is recorded in Grt compositions. Grt amphibolite shows little evidence for melting and Grt preserves peak history. 1.5 cm Grt porphyroblasts from amphibolite, N. Fiordland, are unzoned in major elements with no sign of polymetamorphism or retrograde changes. Grt Sm-Nd ages indicate peak metamorphism initiated ca. 126.0±2.1 Ma. Phase equilibria (Theriak-Domino 2007) indicate activity of $H_2O \geq 0.4$ and peak metamorphism <740ºC & 10-14.5 kbar. 2 cm Grt porphyroblasts from S. Fiordland amphibolite are strongly zoned in major elements and include a break indicating 2 phase growth. Sm-Nd indicates Grt core growth ca. 317.9±4.6 Ma and retention of late Paleozoic history. Grt diorite gneiss throughout Fiordland shows evidence for melting. 1.5 cm Grt from migmatitic gneiss, N. Fiordland, are unzoned in major elements, but display complex trace element zoning. Grt maps show pronounced annuli of low Yb & Lu; however, Sm & Nd are unzoned. Core & rim Grt ages are synchronous ca. 122.6±2.0 Ma. A Grt Sm-Nd age for 0.5 cm Grt in a melt vein, S. Fiordland, indicates partial melting ca. 109.7±1.9 Ma. Integration of ages and phase equilibria, for N. Fiordland, indicates near isobaric heating with peak metamorphism and melting lasting < 8 m.y., and melting of diorite gneiss over < 4 m.y. Melting of the WFO, S. Fiordland, occurred ca. 109 Ma and phase equilibria indicate T>690 at P>10.5 kbar. Results suggest widespread high P melting in Fiordland over ca. 15 m.y.

Timescales and causes of secular change in the Izu Bonin-Mariana volcanic arcs

S. M. STRAUB

Lamont Doherty Earth Observatory, Palisades, NY, USA (smstraub@ldeo.columbia.edu)

It is well established that the outflux of volcanic arcs is a compositional blend of the contributing mantle, slab and crust reservoirs. Since these reservoirs evolve at timescales comparable to the life of arcs (tens of million years), their relative influence on arc magma fluxes may be discernible in the long-term variability of arcs.

In the intraoceanic Izu Bonin-Mariana Volcanic arcs (IBM), the comprehensiveness, quality and temporal resolution of the rock record allows for assessing these influences. Subduction in the IBM initiated ~50 Ma ago with a short (~5 Myr) period of compositionally distinct, low-K tholeiitic and boninitic volcanism in a rift-like extensional setting (‘proto-arc’). Subsequently, a classical arc/backarc system was rapidly established, that is characterized by alternating periods of arc formation, along-arc rifting and backarc spreading. Since then, the IBM has produced a broad spectrum of low-K to medium-K, and subordinate high-K, tholeiitic and calc-alkaline basaltic to rhyolitic magmas that vary systematically in space and time.

The geochemical outflux of the IBM is interpreted as balance between the input from the convecting mantle (Indian MORB-type mantle) and the subducting Pacific slab (sediment, basaltic crust, serpentinized lithosphere). The subarc mantle shows no overall compositional change with time, and thus provides the ‘background’ against which the variability of the slab flux can be discerned. The slab flux is a primary control on the variability of the IBM through space and time. The slab flux varies in composition owing to the heterogeneity of the subducting slab. This allows for example to confirm a link between arc initiation and major plate reorganization at the Hawaiian-Emperor Bend time. The slab flux also varies in strength, suggesting that the mass fluxes respond to changes in subduction geometry of these mobile and dynamic systems at the scale of several million years. Surprisingly, the current data show no dependency of the arc outflux on the evolution of the arc crust. This questions the role of the crust as ‘filter’ where arc melts accumulate and primarily differentiate. In summary, the sensitivity of the IBM arc outflux toward the slab fluxes suggest a strong ‘trench-arc’ connection that emphasize the potency of slab processing in the evolution and maintainance of the habitable Earth.