Deep differentiation of island arc basalt in Mindanao, Philippines: implications for growth of arc lithosphere

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Magmatism provides the primary fluxes of heat and new crust into arc lithosphere. The distribution and composition of magmatic rocks can be used to understand how arc lithosphere evolves as these fluxes develop. The east Philippine subduction zone is propagating southward along the eastern margin of the Philippines and provides a site to study the onset and development of crustal growth above a nascent oceanic subduction zone.

Adakitic magmatism is a relatively common feature during the early stages of subduction in the Philippines [1]. Adakites from Surigao peninsula, in northeast Mindanao, represent the youngest, widespread magmatic event associated with the east Philippine margin and were generated 2-3 million years after subduction initiated at this latitude. New data for Surigao demonstrate that such magmas are not, as commonly concluded, the result of slab melting but reflect differentiation of basic arc magma at depths where garnet is stable [2]. The melts interacted with peridotite prior to emplacement in the crust, indicating that the adakitic signature was produced within the mantle. In contrast, more mature sections of the arc, to the north, are dominated by more typical arc andesite suites.

Generation of adakites in Surigao places important constraints on arc lithosphere evolution during the early stages of subduction. First, there is little petrological or geochemical evidence for differentiation of adakitic melts within the crust suggesting that large-scale magma plumbing systems had not developed. Second, despite the lack of shallow-control the composition of adakitic rocks are strongly related to tectonic features at the surface. This indicates that the arc lithosphere plays an important role in determining the composition of melts emplaced into, or onto, different parts of the crust. Finally, a buoyancy and/or mechanical boundary within the mantle, at more than 30km depth, is required to inhibit the movement of basaltic melt derived from the mantle wedge. This boundary may have been ephemeral or, if it is also present in more mature arc systems, its influence may be obscured by shallow-level magmatic processes.

References

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