Evolution of Western Pacific Arcs- the Ash record

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The concept of arc maturation commonly invokes geochemical changes coupled with crustal thickening, plausibly related to decreases in the distance between the subducted slab and base of the arc lithosphere [1]. While increases in alkalinity, La/Yb, H_2O content across arc strike exist in many active systems [2], equivalent temporal changes can be attributed to rearward migration of volcanism [3]. In all likelihood, no arc system matures simply by crustal thickening but rather is subject to a number of tectonic changes with accompanying variations in source inputs and subduction parameters. In the case of the western Pacific arcs, and in particular the Izu-Bonin-Mariana (IBM) system, we have an excellent record from arc inception through episodes of backarc basin formation to current evolutionary state from a combination of dredging and deep sea drilling. In the past few years, the application of microanalytical techniques such as LA-ICP-MS [4] and SIMS [5] have revolutionised our ability to characterise geochemically the pyroclastic record preserved in sediments within a few hundred km of the arc. The pyroclastic record is preserved within turbidites, "rafted" and plinian ash falls. This pyroclastic record is demonstrably biased in the case of IBM because the ~ 5 my record of boninite and low-K tholeiite activity following arc inception at 50 Ma is missing [6]. Nevertheless, the striking feature of the IB portion of the arc is the steady state, ultra low-K character of the volcanic front activity over the past 20 my despite cessation of backarc (Shikoku Basin) spreading and current nascent rifting (e.g., Sumisu Rift). In contrast, relatively alkali-rich magmas were erupted in the central Marianas during backarc spreading quiescence, and the Arc has not returned to the previous low-K activity following resumption of backarc spreading (Mariana Trough) over the past ~ 7 my. The respective roles of temporal-spatial changes in overriding plate, wedge, and subducted lithosphere contributions to these magmatic changes are subjects of active study.

References

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