The ophiolite problem: A perspective from drilling in the Western Pacific

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Ophiolites are fragments of volcanic and plutonic rocks that have been used to understand processes of crustal growth and mountain building. They have also been important sources of economic mineral deposits in both the ancient and modern worlds. There has been a long controversy about whether the large ophiolites, like those in Cyprus and Oman, form at mid-ocean ridges or above subduction zones. The two possible origins have very different implications for the interpretation of ophiolites in the geologic record. A modern analog for large ophiolites with subduction zone chemical signatures had not been identified until the work of the Ocean Drilling Program in the Western Pacific. Marine geologic studies and ocean drilling transects of the intraoceanic Izu-Bonin-Mariana (IBM) forearcs have shown that the initial phases of volcanism in these subduction zones developed nearly synchronously in the middle to late Eocene over a zone up to 300 km wide and thousands of kilometers long [*Bloomer et al.,* 1995; *Taylor,* 1992]. This early, or "infant," arc volcanism was characterized by the eruption of chemically distinctive volcanic rocks and occurred in extensional environments (as evidenced by dikes on Chichi-jima in the Bonin Islands). This "infant" arc volcanism was built on, or displaced, the preexisting oceanic crust and had igneous production rates much higher than those of mature arcs—eruption rates on the order of those in slow-spreading ridges (see figure). This initial arc volcanism is unlike that developed during the "normal" or mature phases of arc activity and is a plausible mechanism for developing supra-subduction zone ophiolites. In fact, the duration of volcanism, volcanic and plutonic rock compositions, and structural setting in the IBM forearc are virtually identical to those in the Cyprus ophiolite. These intraoceanic forearcs represent a previously unappreciated type of crustal construction and are the closest crustal analogs to supra-subduction zone ophiolites that have been found in *any* modern geologic environment.

References:

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