

Amphibolites and a garnetite: Geodynamic implications of crustal lithologies from the southeast Mariana fore-arc

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A transect of Shinkai 6500 dives in the Challenger segment of the Mariana fore-arc recovered samples mantle and crustal lithologies. One plutonic rock collected at 4900 meters depth has an age of 46.1 Ma and mingled boninitic to arc tholeiitic domains suggesting that it is a piece of the nascent IBM arc crust. Epidote amphibolites and a hornblende garnetite were retrieved from depths between 5938 and 6277 meters depth in an area dominated by peridotite. The amphibolites have trace element compositions similar to enriched MORB, whereas the garnetite appears to be the crystal cumulate of basalt fractionation or the residue after melting of deep crust at pressures of 1.2 GPa or higher and at temperatures exceeding 780°C. There is little evidence for the involvement of subducted fluids in the genesis of the amphibolites. The garnetite is enriched in fluid soluble elements, but this enrichment might have occurred during retrograde metamorphism. The amphibolites and garnetite have initial Hf, Nd, and Pb isotopic values suggesting that they represent metamorphosed fragments of Eocene to Cretaceous terranes akin to those at the north end of the Philippine plate. The high pressures achieved by the garnetite suggest that it represents a fragment of the delaminated root of one of these terranes. Coeval Sm-Nd, Lu-Hf, and 40Ar-39Ar ages of the garnetite indicate rapid ascent and cooling at 25 Ma. The amphibolites and garnetite were tectonically juxtaposed with peridotites by complex mantle dynamics in the S. Mariana Forearc associated with the opening of the Parece-Vela Basin and the collision of the Caroline Ridge.

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