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Role of subducted ocean islands in the genesis of serpentinite seamount: proposal of Yokose-Maekawa model

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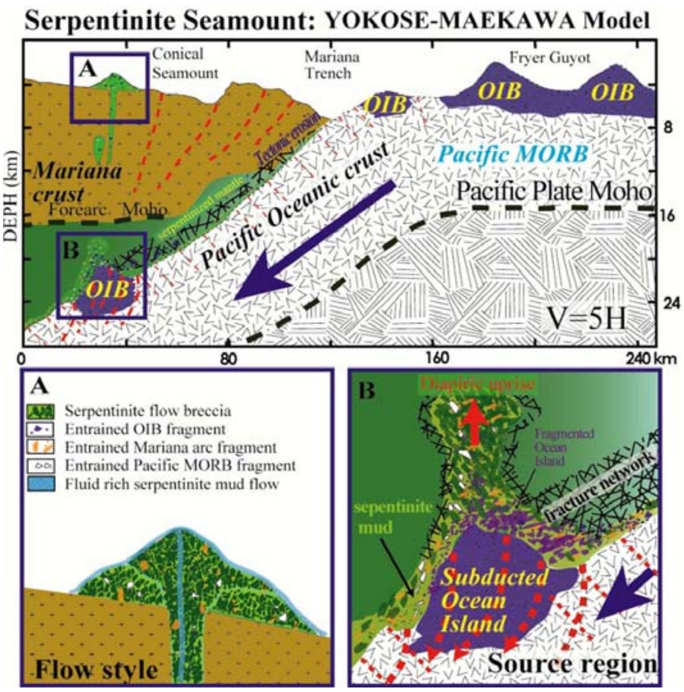

To understand the genesis of serpentinite SMs in the Mariana forearc, four cruises, YK03-07, KR06-15, YK08-08 and YK09-06, were carried out. Three large serpentinite SMs (Fujin SM, Raijin SM, and Babel SM) were newly discovered.
Distribution pattern of the serpentinite SMs The distribution pattern of serpentinite SMs in the Mariana forearc was examined using the topographic features, sidescan sonar reflection images, and submersible investigations obtained during the four cruises. The spacial distribution is quite different from those of the Quaternary volcanoes of the Mariana arc, which are aligned regularly along the volcanic front. This irregular distribution of serpentinite SM is unlikely to be controlled the simple steady state subduction process.
The distribution areas of the clustered serpentinite SMs are always accompanied with polygonal tectonic graven. Because SM chains, Mageran SMs and Marcus-Wake SMs, are arranged to the southeast of the graven. These local tectonic graven may be surface expression of the subducted ocean islands. Subducted ocean island produces many deeply rooted fracture zone in the ridged forearc region and then the zone will be a available path for serpentinite mud flows (Fryer et al., 1999). Tectonic maps of the Mariana forearc (Stern and Smoot, 1998), however, show the distribution of regional large fracture zones, as a lineament, that are more greater in size than those distributed around the serpentinite SMs.
Serpentinite flow breccia: Thick serpentinit breccias (> 60 m) were observed in the outcrops of the submarine flanks and summit of serpentinite SMs during submersive investigations. Serpentinite mud flow layers were observed only in the outcrops of surface and are very thin (< 4 m). Based on the bathymetric study of serpentinite SMs and submersible observations, it is revealed that serpentinite SMs are mainly consist of viscous thick serpentinite flow breccias (>100m). Serpentinite mud flows were likely to erupt as a secondary flows from the brecciated serpentinite diapir.
Recycled OIB in the wedge mantle : Several metamorphic rocks were recovered from serpentinite flow breccias. Basic metamorphic rocks recovered from Twinpeaks SM and Babel SM, which have blueschist facies were newly discovered. The amphibolite recovered from Twinpeaks SM is enriched in LREE and the other incompatible elements. The chemical characteristics of trace

element abundance are similar to OIB type rock. The other metamorphic rocks with mineral assemblage of blueschist facies are similar to N-MORB type rock. The chemical characteristics of the N-MORB type metamorphic rocks are slightly different from reported Pacific type MORB. Recovery of blueschist facies rock with OIB affinity supports that subducted ocean island play an important role for recycling system in the subduction zone.
YOKOSE-MAEKAWA MODEL: In this paper, we propose a new comprehensive model for the genesis of serpentinite SM in the Mariana forearc based on the geological, petrological, and geochemical studies combined with crustal structure of Oakley et al. (2008). We believe that the unique tectonic setting of Mariana forearc, where subducted ocean islands can be dragged into the wedge mantle without accretion to the forearc crust, is the most important factor for the genesis of serpentinite SM. Some components of a subducted ocean island, such as volcanic rocks and coral reefs, may be recycled to the surface by entrainment of the serpentinite diaper. The deeper part of mantle probably be contaminated with the majority of the unrecycled components of the ocean island. It may be a contaminant for island arc volcanism in their source region at the western side of Mariana arc.

<Reference>

Fryer et al., (1999) Geology 27:103-106; Stern and Smoot (1998) The Island Arc, 7, 525-540; Oakley et al., (2008) Geochemistry, Geophysics, Geosystems, 9.

Keywords: serpentinite seamount, Mariana forearc, blueschist facies, Serpentinite flow breccia, subducted ocean island, Yokose-Maekawa model