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Two primary basalt magmas from NW Rota-1 volcano, Mariana arc, and its heterogeneous mantle diapir

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Primitive basalts are rarely found in arcs. The active NW Rota-1 volcano in the Mariana arc has erupted near-primitive lavas, which we have sampled with ROV Hyperdolphin (HPD). Samples from the summit (HPD480) and eastern flank (HPD488) include 17 magnesian basalts (51-52 wt % SiO₂) having 7.5-9.5 wt % MgO and Mg# of 61-67, indicating little fractionation. Olivine phenocrysts are as magnesian as Fo₉₃ which contain 0.4 wt % NiO; Cr/(Cr+Al) of spinels are mostly 0.5-0.8, indicating equilibrium with depleted mantle. There are three petrographic groups, based on phenocryst populations: 1) cpx-olivine basalt (COB); 2) plagioclase-olivine basalt (POB); and 3) porphyritic basalt. Geochemical characteristics suggest that POBs formed from lower degrees of mantle melting, or that the COB mantle source was more depleted. On the other hand, they also suggest that COB has a greater subduction component than POB. The calculated primary basaltic magmas of NW Rota-1 volcano (primary POB and COB magmas) indicate segregation pressures of 1.5- 2 GPa (50-65 km deep). These magmas were formed by 15-25 % melting of mantle peridotite having Mg# ~89.5. These two basalt magmatypes are similar to those found for Sumisu and Torishima volcanoes in the Izu-Bonin arc, with COB representing wetter and POB representing drier magmas, where subduction zone-derived melt components are coupled with the water contents. Hydration and partial melting along subducting slabs can trigger Rayleigh-Taylor-like instabilities. Deep subduction components, derived from melting of subducting sediments, play an important role in the generation of NW Rota-1 magmas. Thus, the sediment melting in the underlying slab could have triggered partial melting of hydrous mantle and mantle diapir formation. Moreover, sediment melts may have mixed heterogeneously with hydrous peridotite, which resulted in a mantle diapir consisting of two parts, one poor and another rich in sediment melt.

Keywords: primary magmas, mantle wedge, basalt, arc magmas