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Primitive Basalts from West Zealandia Seamount, southern Mariana Volcanic Arc

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Investigations using the ROV Hyper-Dolphin were conducted in June 2009 around the island of Sarigan and Zealandia Bank, at approximately 16 deg 45' N, in the southern Mariana Arc. Sarigan Island, with an altitude of 538 m, and Zealandia Bank, which comes within a few meters of sea level, are the highest parts of a series of closely spaced mostly submarine volcanoes and parasitic cones at the magmatic front of the Mariana Arc. This study focuses on samples recovered from West Zealandia seamount, which is at a depth of around 750 m. It is separated from Zealandia Bank by a 300 m deep saddle and the base of its western slopes is at about 2750 m. Bathymetric surveys reveal West Zealandia to have an unusual morphology with an arcuate summit region and ridges that are interpreted to be low viscosity lava flows extending far to the west. Earlier limited sampling of this volcano recovered primitive basalts. Some of the samples collected during the 200 9 cruise are also fairly primitive, with whole rocks containing up to 10.7wt.% MgO. In addition, some samples contain dunite and lherzolite crystalline aggregates. We analyzed these aggregates to determine whether they are mantle xenoliths. The maximum length of aggregates is 18 mm and single crystals range up to 9 mm. The aggregates are set in a fine-grained crystalline groundmass, which contains an additional phenocryst population of groundmass-supported olivine, pyroxene and feldspar crystals. Initial electron microprobe analyses show that olivines within the dunite and lherzolite aggregates have compositions ranging from Fo_{85-90}, and those in contact with the groundmass have rims of Fo_{80-85}. The cores of isolated olivine phenocrysts are more variable, ranging from Fo_{79-91}, with rims of Fo_{78-81}. Olivine crystals within the groundmass have cores of $Fo_{79-81}$and Fo_{76-80}rims. Phenocrysts with Fo-rich cores are likely to have a common origin with olivines in the aggregates. Although these olivines are primitive, their NiO contents are not high enough for them to be in equilibrium with mantle olivine (Takahashi, 1986, Bull. Volcanol. Soc. Japan, 30, S17 -S40). The highest NiO content measured is 0.24wt.%, which is from the most Fo-rich (Fo_{91}) olivine. At the same Fo content, the lower limit of the mantle array is 0.36wt.% NiO. At $Fo_{85}$the highest NiO content measured is 0.15wt.% compared to 0.28wt.% for the lower limit of the mantle array. Thus, it seems likely that the dunite and lherzolite aggregates are cumulates. Some olivine crystals within the aggregates also contain glassy melt inclusions. As the olivine host crystals appear to be cumulates, it is possible that the inclusions were trapped early in the evolution of the melt and thus will provide access to more primitive, or even parental, melts.

キーワード: submarine volcanism, primitive basalts, dunite and lherzolite crystalline aggregates, cumulate crystals, silicate melt inclusions

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