Petrology of hornblende-bearing plutonic rocks in Central Graben, Northern Mariana Trough

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The KR 02-01 Cruise was conducted with the R/V Kairei form January 9 to January 31 2002 at the northern Mariana Trough (19 00'N-22 00' N and 142 00'E-145 00'E). The cruise was carried out to dredge upper mantle and crustal rocks form the deep grabens and back-arc basin basalts along the extension axis. Dredge hauls operated at west facing steep scarps on the east side of deep structural grabens (Central Graben South located at 20 08' N and 144 03'E) include diverse suite of upper mantle and lower crustal rocks. The dredged rocks include lherzolite, harzburgite, dunite, websterite, gabbronorite, hornblende-gabbro, tonalite, dolerite, mylonitized leucocratic tonalite (plagiogranite), basalt, amphibolite and metasediment. The tonalite is medium grained (up to 2 mm) undeformed rock, and intruded into amphibolite and mylonitized. The rock consists of mainly plagioclase, quartz and hornblende with subordinate amounts of opaque minerals. In someplace, chlorite replaced hornblende. Relative proportion of plagioclase, quartz and hornblende show a wide range of variation and there is continuous transition from leucocratic through melanocratic tonalite to hornblende gabbro in which quartz is a minor mineral constitutes (less than 5 %). Hornblende gabbro is medium - extremely coarse-grained rock. Pegmatitic hornblende gabbro, the coarsest grained group of hornblende gabbro, is composed mainly of hornblende (up to 5 cm length) and plagioclase grains (up to 3 cm length) with a small amount of interstitial quartz and opaque minerals. The pegmatitic hornblende gabbro intruded into highly deformed leucocratic tonalite. Whole rock compositions of hornblende-gabbros and tonalites exhibit continuous, monotonous and wide range of compositional variation (47-75 wt. % SiO2). The data suggest that the rocks belong to the low-K series. Their LIL and HFS element abundance are relatively higher than but N-MORB normalized patterns are comparable to those to those of back arc basin basalt. They have, however, lower CaO and higher Na2O than volcanic rocks in northern parts of the Mariana Arc system. Their petrographic and geochemical characteristics suggest derivation from an intermediate parental magma through crystal fractionation and accumulation processes, involving hornblende, plagioclase, and magnetite.

Relationships between the gabbronorite and peridotite (upper mantle suite) to the hornblende gabbro-tonalite and deformed leucocratic tonalite (lower mantle suite) are not clear. The former suite comprises the dominant group in the dredge hauls at the sites D01 and D03 operated at water depth from 5440-4625 m and 5359-5107 m, respectively, while the latter suite is the predominant group in the dredge haul at the site D05 (at water depth 4858-4309 m) in which only minor amounts of peridotite and no gabbronorite were recovered. This observation is broadly consistent to the inferred depth of petrologic Moho (at water depth of about 4-4.5 km) suggested by Stern et al. (JAMSTEC J. Deep Sea Res., 13, 1997).