Subduction -Releted Geochemical Imprints on PhilippineOphiolites: Implications for the Geodynamic Evolution of the Western Pacific

Subduction – Related Geochemical Imprints On Philippine Ophiolites: Implications For The Geodynamic Evolution Of The Western Pacific

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Ophiolites representing basement complexes in the Philippine archipelago correspond to exhumed oceanic lithosphere fragments, which display geochemical signatures akin to rocks collected from modern subduction related geodynamic settings. The mantle sequences of these ophiolites consist of rocks exhibiting textures similar to those of plastically deformed residual peridotites. These rocks contain olivines with high NiO (wt%) concentrations consistent with their mantle origin. In addition, the high X_{Mg} in coexisting olivines and orthopyroxenes, the broad range in spinel X_{Cr}, as well as the generally low Al_2O_3 (wt%) concentrations in the orthopyroxenes in the rocks indicate that the peridotites are more refractory than the mantle underlying actual mid-oceanic ridges. The peridotites show contrasting chondrite-normalized rare-earth element spectra: first, a progressively decreasing pattern from the heavy through the middle to the light rare-earth elements typical of partially melted mantle residues and, second, U-shaped patterns similar to those shown by mantle rocks affected by metasomatic processes. Mantle-melt interactions in harzburgites and dunites are suggested by the textural relationships of clinopyroxenes and spinels, as well as the relatively high Ca/Al ratios and TiO_2 (wt%) concentrations in the clinopyroxenes and the spinels, respectively. The liquids reacting with the peridotites show transitional IAT-MORB affinities and they appear to be chemically similar to the volcanic sequences that are spatially associated with the peridotites. Nearly all olivine-spinel pairs from the rocks record $\Delta\log f(O_2)$ [at FMQ buffer] above 1 and mostly ~2, implying that these peridotites partly evolved under highly oxidizing mantle conditions.

Isotropic gabbros dominate the lower portion of the crustal sequences. These gabbros contain clinopyroxenes and plagioclases showing a wide range of X_{Mg} and An values, respectively. Some of these gabbros exhibit mineral chemistries suggesting their derivation from basaltic liquids formed from mantle sources that underwent either high degrees of partial melting or several partial melting episodes. Moreover, the gabbros display a crystallization sequence where orthopyroxene and clinopyroxene appeared before plagioclase. Basalts, basaltic andesites, andesites, dacites, trachytes and a basanite compose the volcanic units representing the top of the crustal sequences. These rocks display geochemical signatures similar to normal mid-oceanic ridge basalts (N-MORB), enriched mid-oceanic ridge basalts (E-MORB), ocean island basalts (OIB), island arc volcanic (IAV) rocks and transitional N-MORB-island arc tholeiites (IAT).

A simplified scenario regarding the geodynamic evolution of the western Pacific is proposed on the basis of the geochemical signatures of the ophiolites, their ages of formation and the ages and origins of the oceanic basins actually bounding the archipelago, including basins presumed to be now totally consumed. This scenario envisages the region to have experienced opening and closing of subduction-related oceanic basins since the Cretaceous and throughout the Cenozoic.

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