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Mantle plume and the formation of marginal sea depressions

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Kuno (1968) proposed and idea on systematic distribution of different types of *basalts series* across of islands arcs: tholeites formed in the fore arc portions of the arcs while high-aluminum and then more high-temperature alkali basalts formed in back arcs portions. This is because of the shift with pressure of the liquidus boundaries involving olivine, pyroxene and silica minerals in the mantle wedge. Later on this effect has been experimentally proven by I. Kushiro (1975). While the systematic in the distribution of tholeitic and alkali basalts across an island arc reflect distribution of temperatures with depth, metamorphic complexes show mainly lateral change of temperatures, which increase toward the continent.

Towards the continent, the trench-arc system gives a place to marginal sea floors that has never contain new metamorphic rocks but still preserve relict continental crust at borderlands. Bottoms of the marginal sea floors are composed of young tholeitic basalts related to the extremely high heat flow. In this portion of the system *trench–island arcs–marginal sea floor–continental margin* (TIMC) heat transfer increases dramatically resulting in the back arc zone direct interaction ultramafic magma with lower crust and in the formation of mixed magmas whose composition is intermediate between mantle peridotite and upper crust acid material, i.e. Mg-rich andesites and boninites (Bindeman & Perchuk, 1993). This conclusion follows from the systematic change with time deepwater volcanism in the marginal sea floors from rhyolites via andesites to basalts (e.g., Perchuk, 1987; Frolova et al., 1992), and replacement of lower crust island arcs by ultramafic magmas (Kushiro, 1983; Tatsumi, 2001, 2006). Thus, temperature increases while the depth of magma generation decreases across the TIMC system reflecting in the formation of the following metamorphic-magmatic zonation: HP-LT metamorphic terrenes => LP-UHT metamorphic belts => intense acid magmatism => intense tholeitic magmatism. This supports a model for geodynamic evolution of active continental margins due to the interaction of a mantle plume with the crustal rocks (Frolova et al., 1992). Recent treatment of seismic data (Zhao, 2001, 2004) reproduces this model in terms of distribution of P-anomalies. Thus, evolution of both the magmatic and metamorphic complexes in the Western Pacific type continental margins reflects evolution of mantle derived plume. The intensity of the interaction, i.e. tectonic extension and magmatic replacement of continental crust that increases from the Okhotsk Sea on North via the Japan Sea to the Philippine Sea on South.

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