Petrotectonic associations and mineral resources in late Cenozoic NE Honshu arc

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he NE Honshu magmatic arc was formed by three main geologic events subsequent to the preliminary continental margin volcanism after 28 Ma, those are, a back-arc spreading during 21-18 Ma (Yamato basin), a rifting of the Northern Honshu rift system (NH rift) during 18-13.5 Ma and an island-arc uplifting from 13.5 Ma to the present. The secular and lateral variations of metallogenic provinces as well as the progressive change of volcanic-sedimentary associations are closely related to the tectonic evolution of the magmatic arc.

The Yamato basin is entirely composed of spreading oceanic crust consisted with the MORB affinity. The NH rift system consists of parallel three volcanic zones, the Aosawa-Hachimori rift (AH rift), Ani intra-rift range and Kuroko rift from west to east. The rift volcanism is characterized by the bimodal activity with increasing felsic volcanics from the western to eastern volcanic zone. In the Kuroko rift, the rift volcanism consists of approximately 80 % of dacitic flows and two basalt layers in the top and bottom of the volcanic sequence. The chemical composition of the rift basalt changes laterally from back arc basin basalt (BABB) in the western rift (AH rift) to island-arc tholeiite type (IAT) in the eastern rift (Kuroko rift). The felsic rocks in rift stage, irrespective mode of occurrence, are commonly characterized by quartz-free dacite with aphyric to often plagioclase-phyric texture. The normative Q-An-Ab diagram indicates that the felsic volcanism in the Kuroko rift was derived from relatively deeper magma chamber rather than the other felsic equivalents. The Nb-Zr variation diagram of an individual zone shows a positive linear trend from basalt to rhyolite, of which the inclination gradually increases from the western to the eastern volcanic zone.

The island-arc stage is characterized by differential tectonic movements. Yamato and Aosawa-Hachimori rift had taken place subsiding with thick bathyal sediments. The eastern half of the NH rift had performed uplifting with intensive felsic volcanism. The felsic volcanism is characterized by a caldera-forming pumice eruption with granitic intrusion in the final stage. The petrographical and geochemical characteristics of the felsic rocks indicate that they were derived from a shallow magma chamber in which was equilibrated 5 km deep by the normative composition.

The tectonic and volcanic differences between the back-arc rift and island-arc settings produced different metallogenic provinces. Various size and types of massive sulfide deposits are generated within the rift-stage sequences depending on the intensity of the felsic activity. A few high grade but small Kuroko analogue exist in the AH rift, some stockwork deposits equivalent to the feeder vein system of the Kuroko deposits are recognized in the AH rift and the Ani intra-rift range. The typically zoned large Kuroko deposits are restricted in the Kuroko rift. The stockwork or assembly of numerous vein deposits are generated in the island-arc volcanics associated with caldera-forming felsic activity in the island-arc sequence of the Kuroko volcanic zone and the fore-arc range at that time. Large vein deposits in granite affinity are formed in the intra-rift range and/or the adjoining area of individual rift in the Kuroko volcanic zone.