Crustal and tectonic evolution of accretionary orogens in NE Asia and comparison with the Central Asian Orogenic Belt

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The Northeast Asian Orogenic Belt (NAOB) is a Mesozoic-Cenozoic accretionary orogenic collage, and it constitutes the northern and principal part of the “Nipponides” [1]. The orogenic style of the Nipponides has much in common with that of the Central Asian Orogenic Belt (CAOB) or the “Altaides” [1, 2]. The tectonic framework of the NAOB was formed in Mesozoic and Cenozoic, and it continues to evolve along the modern Pacific arc-trench systems. Generally, an oceanward younging of tectonic units may be discerned, but such a simple pattern is disrupted in many places by extensive strike-slip faulting, most of which is left lateral. In this talk, the issue of crustal evolution in the sector of Sikhote-Alin, Sakhalin and Japanese Islands will be discussed based on the geochemical and isotopic analyses of granitoids that intruded in various tectonostratigraphic terrains.

The majority of granitoids in the NE Asian Orogenic Belt formed from Jurassic to late Cenozoic, with Cretaceous as the dominant period of granitic magmatism and silicic volcanism. Though remnants of Paleozoic granitoids have been preserved in Japan [3], most granitic rocks were emplaced in the Mesozoic and Cenozoic times. Cretaceous granitoids are widespread in Sikhote-Alin [4] and Japan. However, granitoids were emplaced only in the Cenozoic in Sakhalin (ca. 44 - 42 Ma) and Hokkaido (45, 37 and 18 Ma) [5]. Most granitoids from Sikhote-Alin have I_{Sr} = 0.7040 to 0.7083, and $e_{Nd}(T)$ = +3.0 to -6.0 (mostly 0 to -5). The Sr-Nd isotopic data fall within the range of granitoids from SW Japan (0.704 to 0.712; +5.0 to -13.0), and the data of Cretaceous granitoids from Sikhote-Alin and SW Japan overlap almost completely. Cenozoic granitoids of Hokkaido are characterized by I_{Sr} = 0.7044 to 0.7061, $e_{Nd}(T)$ = +1.0 to +4.7, and Sm-Nd model-1 ages = 400-1000 Ma. They are remarkably similar to Sakhalin granitoids with I_{Sr} = 0.7047 to 0.7050, $\varepsilon_{Nd}(T)$ = +2.8 to +3.7, and model-1 ages of 700-1100 Ma. The isotopic data suggest that the granitoids of NAOB were generated by partial melting of sources with mixed lithologies, including subducted accretionary complexes and probably some hidden Paleozoic to Proterozoic basement rocks. The Nd isotopic data also suggest a proportion of 30-77% of juvenile component in the generation of Sikhote-Alin granitoids, whereas the proportion is much higher for the Cenozoic granitoids of Hokkaido and Sakhalin (about 65-95%). In any case, a significant amount of juvenile crust was produced and added to the NE Asian Orogenic Belt.

Many workers have proposed a geological correlation between Sikhote-Alin and Japan, as well as between Sakhalin and Hokkaido, based on several lines of evidence including lithostratigraphy, biostratigraphy (radiolarian assemblages) and geological structures [6]. The present work lends support to the general scenario. However, the significant difference between SW Japan and NE Japan in their crustal composition and probably tectonic evolution has to be reckoned. The two geologic entities might have evolved in very different ways. A brief comparison of crustal evolution in the NAOB and CAOB will be presented. (Supported by MOST 104-2913-M-002-005, Taiwan)

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