



Eocene Granitoids of the Okhotsk Complex in Sakhalin Island, Russian Far East: Petrogenesis and tectonic implications from zircon U-Pb ages, geochemical and Sr-Nd isotopic characteristics

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Sakhalin Island represents an important part of the Western Pacific Orogenic Belt (or “Nipponides”). The island comprises several accreted terrains that have recorded strike-slip displacements and block rotations from Cretaceous to Tertiary. These terrains include fore-arc basins, accretionary complexes and island arc assemblages. The stratigraphic features of most terrains can be correlated to those of Hokkaido Island of Japan. However, little research has been undertaken on the magmatic activities on Sakhalin, so a direct comparison of crustal development and tectonic activities with Hokkaido has not been fulfilled. We intend to study the petrogenesis of granitic complexes of Sakhalin to resolve this problem. In this work, we present new results of age determination and geochemical analyses of the Okhotsk Complex and discuss the tectonic implications.

The Okhotsk complex is one of the three main granitoid complexes in Sakhalin Island. It intruded into the Ozersk accretionary terrain that is composed of island arc assemblages and marine sediments and has traveled northward and accreted to Sakhalin Island in Eocene. Eleven samples from the Okhotsk Complex, including 7 granitoids, 1 enclave, 2 rhyolites, and 1 dacite, were subject to zircon U-Pb dating, whole-rock geochemical and Sr-Nd isotopic analyses. The results show that the entire complex was emplaced within 42 to 44 Ma. The 7 granitoids are slightly peraluminous, ferroan, and alkali-calcic. The REE abundances of granitoids show consistent patterns with weak LREE enrichment and negative Eu anomaly. The spidergrams show negative Ta-Nb-Ti anomaly as expected in most granitoids. They possess transitional characteristics between I- and A-type granites. For isotopic signatures, the granitoids have $\epsilon\text{Nd}(t)$ values of +2.8 to +3.7, initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of 0.7047 to 0.7050, and Sm-Nd model ages (TDM-1) of 700-1100 Ma.

The middle Eocene magmatic episode (42-44 Ma) of the Okhotsk Complex can find its counterpart in Hokkaido. The geochemical and isotopic characteristics are also comparable for granitic rocks from the two islands. The granitoids from Sakhalin show arc geochemical characteristics, and their isotopic signatures suggest a generation by partial melting of sources rich in juvenile (mantle-derived) component. In fact, the source nature of the granitoids is quite similar to the Eocene and Miocene granitoids of Hokkaido. However, the Okhotsk granitoids with transitional characteristics between I- and A- granite types were probably generated in more complicated magmatic processes or tectonic regime, making it more ambiguous to define their petrogenesis and tectonic setting.

Since the Okhotsk Complex was emplaced in the Ozersk accretionary terrain in southern Sakhalin, we infer that the granitic magmatism was probably related to a tectonic transition from a subduction phase to a strike-slip phase and recorded a signature of supra-subduction, post-accretionary and strike-slip processes. Thus, the age of 42-44 Ma may hint an important period of tectonic change in southern Sakhalin.

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