Geophysical Research Abstracts
Vol. 18, EGU2016-11203-2, 2016
EGU General Assembly 2016

Geochemical Characteristics and Petrogenesis of Adakites in Sikhote-Alin, Russian Far East

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The Sikhote-Alin orogenic belt and late Precambrian Khanka block are two major tectonic units in the southernmost Russian Far East. The Sikhote-Alin belt comprises several tectonostratigraphic terranes, including late Precambrian nappes, and Mesozoic accretionary prisms and turbidite basins. These terranes are overlain by Cretaceous to Paleocene felsic to intermediate volcanic rocks and intruded by granitoids. The magmatic rocks are collectively known as “the East Sikhote-Alin volcano-plutonic belt” (ESAVPB), and mainly characterized by acid-to-intermediate compositions. In this work we study the petrogenesis of adakitic rocks and discuss the possible tectonic implications.

Adakitic rocks of the Sikhote-Alin orogen were emplaced in two main periods: Early Cretaceous (132–98 Ma) and Eocene (46–45 Ma). They mainly occur in the Khanka block, with a subordinate amount in the ESAVPB. The adakites show a large range of chemical composition: SiO_2 = 57–74%, Al2O_3 = 15–18%, Na2O = 3.5–6.1%, K2O = 0.7–3.2%, Na2O/K2O = 1.1–3.9, Sr/Y = 33–145, and (La/Yb)N = 11–53. HREE and HFSE are remarkably depleted. The Early Cretaceous adakites show eNd(T) = -1.0 to +3.2; ISr = 0.7040 – 0.7090, and the Eocene adakites have eNd(T) = -2.0 to +2.2; ISr = 0.7042 – 0.7058. Thus, the Cretaceous and Eocene adakites show rather similar Sr-Nd isotopic compositions, but their Nd isotopic signatures (slightly negative to positive eNd(T) values) may distinguish them from the granitoids of the ESAVPB (only negative eNd(T) values).

Adakites may have different modes of generation, but partial melting of meta-basic rocks in a subduction zone is considered the most likely mode for the present case. The two periods of adakites have probably formed in the following scenario. The early Cretaceous emplacement ages for the adakites and the oldest granitoids of the ESAVPB, is considered as the time of initiation of the Paleo-Pacific subduction in NE Asia. The Eocene adakites were also generated in subduction zone, but accompanied by small amount of andesite and rhyolite. Contemporaneous granitoids were emplaced 200-400 km to the east of the study area in Sakhalin as well as in Hokkaido (Japan). With this scenario, we may speculate a roll-back of subducting Pacific plate during the Eocene, and a shifting of arc magmatism from the ESAVPB to Sakhalin Island and Hokkaido.

Note that abundant adakitic rocks of early Cretaceous and Eocene ages occur in the Kitakami and Abukuma Mountains of NE Japan. Consequently, geological correlation between Sikhote-Alin and Kitakami-Abukuma and between Sakhalin and Hokaido is highly probable, particularly before the opening of the Japan Sea.