Isotopic and geochemical features of formation of volcanic rocks of the southern part of the Sakhalin island

Antonina Alenicheva and Yuri Yurchenko
A.P. Karpinsky Russian Geological Research Institute (VSEGEI), Department of regional geology and mineral resources of Eastern areas of Russia, St.Peterburg, Russian Federation (antonina_alenicheva@vsegei.ru, Yuri_Yurchenko@vsegei.ru)

Under the federal project «Geological mapping at 1:1,000,000 scale» volcanic rocks of southern part of the Sakhalin island were studied by U-PbSHRIMP, K-Ar, Sm-Ndand LA-ICPMS methods. In this study the volcanic rocks were classified based on the isotopic and geochemical data (major, trace and the REE elements). The new date show, that the basalts of studied area represent the three magma series: tholeitic, the calc-alkaline and sub-alkaline. The petrological characteristics and genesis of volcanic rocks closely relate to dynamic conditions of their formation. Tholeitic basalts of Tonino-Aniva zone (Vavaysky unit) exhibit low K₂O (0,57), TiO₂ (0,44) and Al₂O₃ (11.5%). Despite the fact that a positive value εNd = 6.6 indicates a significant contribution of mantle component, high Ba (702 ppm) and Nb-Ta minimum indicates lithospheric component in the sources of these rocks. Such geochemical features characterize subduction zones or ensimatic island arcs. Basalts Sm-Nd age (195-145 Ma) corresponds with the Jurassic time of the convergent interaction of the Asian continent with oceanic plate. Vavayskysub-alkaline and alkaline basalts (trachyandesibasalt and pikrobazalt) display high TiO₂ (2,3-3,9%) and highest incompatible trace elements (Zr, Nb, Ta,Hf) contents, ΣREE=210-267 ppm. Basalt geochemical enrichment occurred under the influence of mantle injection an environment of continental rifting on the Asian continental margin. This event took place in the Early Cretaceous (Berriasian-Barremian) after the termination of subduction. Early Cretaceous high-alumina calc-alkaline basalts (West-Sakhalin zone) exhibit high Al₂O₃ (16-21%) and high Ba, K, Ba, Sr, K Rb contents. Nb negative anomaly on spidergram indicate continental marginis land arcs. Basalt Sm-Nd age 142+29 Ma (εNd=4.6) corresponds with the Barremian–Albian age of existing island-arc system along the eastern margin of Eurasia. This age corresponds to the U-Pb age (127.7 ± 1.4 Ma) of the youngest populations of detrital zircons from sandstones vavaysky unit. It sedimentation occurred simultaneously with the volcanic process.

Miozen-pliozandesites (anivavolcanic complex) are characterized by low TiO₂ (0.2-0.9%), higher contents of Ba, Sr, Zr, Hf, and Ta Nb shortage. Their formation took place in back-arc spreading condition. Andesites K-Ar age (15+1 Ma) and concordantage U-Pb (13.5±0.2 Ma) is consistent with the time of completion of the Japan Sea rifting.