Geochemical researches in situ (LA-ICP-MS) of accessory and ore minerals from multimetal (PGE, Cu-Ni) deposits in the Arctic zone (Fennoscandian Shield) of the Russian Federation

Svetlana Drogobuzhskaya¹, Tamara Bayanova², and Andrey Novikov¹
¹Tananaev Tananaev Institute of Chemistry – Subdivision of the Federal Research Centre «Kola Science Centre of the Russian Academy of Sciences», Russian Federation, Apatity, drogosv@yandex.ru
²Geological Institute – Subdivision of the Federal Research Centre «Kola Science Centre of the Russian Academy of Sciences», Russian Federation, Apatity

The laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS) is a unique method for local analysis that allows studying mineral grains in situ. The aims of these geochemical researches are to estimate concentrations and distributions of REE, Hf, U, Th, Y, Ti, PGE and other elements in accessory and ore minerals from complex deposits in the Arctic region (Fennoscandian Shield), using the LA-ICP-MS local analysis of trace elements. Accessory minerals of zircon and baddeleyite are much valued to study distributions of rare and rare earth elements (REE). Besides, pyrite, pentlandite, pyrrhotite and other sulfides are important for determining platinum-group elements (PGE), REE, etc.

The electron (LEO-1415) and optic (LEICA OM 2500 P, camera DFC 290) spectroscopy have been applied to study the morphology of the samples. Analytical points have been selected on baddeleyite, zircon crystals and sulfide minerals based on analyses of their BSE, CL and optical images. REE, PGE and other elements have been estimated in situ by ICP-MS, using an ELAN 9000 DRC-e (Perkin Elmer) quadrupole mass spectrometer equipped with UP-266 MACRO laser (New Wave Research).

More than 19 elements were profiled during each measurement in zircon or baddeleyite. For the first time, LA-ICP-MS techniques have been applied to estimate PGE, REE and other (S, Cr, Fe, Cu, Ni, Co, As, Se, Mo, Cd, Sn, Sb, Re, Te, Ti, Hf, W, Bi, Pb, Th, U) elements in sulfide minerals. NIST 610, NIST 612 and tandem graduation (using solutions), considering sensitivity coefficients of isotopes have been used to check the accuracy of estimations. Fe, Ni and Cu have been used as internal standards, being most evenly distributed elements in minerals, when concentrations of elements in sulphides were calculated. The estimates have been carried out, using inter-laboratory standards of chalcopyrite, pentlandite and pyrrhotite, which had been preliminarily prepared and studied using micro probe analysis ( Cameca MS-46).

These techniques had been used to estimate elements in zircon extracted from basic and acidic rocks of the Lapland belt (1.9 Ga), the Keivy zone (2.7 Ga), the Kandalaksha and Kolvitsa zone (2.45 Ga) and from the Cu-Ni deposit (Terrace, Mt. Nyud, 2.5 Ga). Novel techniques have been used to
analyze baddeleyite from rocks of layered PGE intrusions of the Monchegorsk ore area (2.5 Ga) and carbonatites of Kovdor and Vuorijarvi (380 Ma). Elaborated LA-ICP-MS techniques have been applied to provide in situ measurements of PGE, Au, Ag, siderophile and chalcophile elements in sulphide minerals from the Pechenga and Allarechka Cu-Ni deposits (1.98 Ga), Fedorova Tundra and Severny Kamennik PGE deposits (2.5 Ga).

The scientific researches are supported by RFBR Grant No 18-05-70082, scientific themes 0226-2019-0032 and 0226-2019-0053.