Scanning X-ray fluorescent elemental microanalysis with synchrotron radiation in geochemical research

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The traditional XRF analysis with high limits of detection is limited in application for geochemical researches. Use of synchrotron radiation considerably expands its opportunities [1]. Since 1985 in BINP analytical works with synchrotron radiation from storage ring VEPP-3 are carried out. A plenty of methodical and research works with geochemical samples has been executed. The range of energy excitation 15 - 50 keV is now accessible, that allows to determine the following elements in geological samples weight from 1 mg: P, Cl, K, Ca, Ti (LD=50 ppm, St.dev.=5 ppm); V, Cr, Mn, Fe, Co, Ni (LD=5 ppm, St.dev.=0.5 ppm); Cu, Zn, Ga, Ge, As, Se (LD=0.5 ppm, St.dev.=0.05 ppm); Br, Rb, Sr, Y, Zr, Nb, Mo (LD=0.1 ppm, St.dev.=0.03 ppm); Ru, Rh, Pd, Ag (LD=0.05 ppm, St.dev.=0.01 ppm); Cd, In, Sn, Sb, Te, I (LD=0.1 ppm, St.dev.=0.03 ppm); Ba, La, Ce, Nd, Sm (LD=1.0 ppm, St.dev.=0.15 ppm); Pb, Bi, Th, U (LD=1 ppm, St.dev.=0.1 ppm). The analysis is carried out in some stages with use various energy of excitation (usually – 15-18, 22 - 25 and 40-45 keV).

The first instrument of scanning X-ray fluorescent elemental microanalysis with synchrotron radiation from storage ring VEPP-3 (scan.XRFA-SR) was founded in BINP SB RAS in the 1988 and applied to study the spatial distribution of elements in geological samples [2]. Scan.XRFA-SR was used in paleoclimate reconstructions based on high-resolution sediments and tree-rings analysis [3, 4, 5]. Unique opportunities of XRF SR allow to carry out scanning microanalysis with spatial resolution 10 micron. The set of analyzed elements and range of concentration are determined by selection of energy of excitation and time of measurement in a point. In recent years, has been studied many different geological samples: diamonds, xenolith, ferromanganese nodules, bottom sediments. Studies have demonstrated the unique ability of scanning XRFA-SR: a simultaneous analysis of more than 30 chemical elements with a spatial resolution of 10-50 microns.