Isotope-geochemical criterion in search for the Noril'sk-type massive PGE-Cu-Ni sulphide ores: Constraints from Pb, Nd and Sr isotope data

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Our study aims on isotope-geochemical speciation of main types of intrusive bodies at Noril'sk district (northern Siberia), with particular focus on isotope-geochemical estimation for the unique metallogenic potential of the Noril'sk-type intrusions that range in thickness to 360 m and length to 25 km.

This study presents the first results of a multi-technique approach, which utilized isotope systematics of Nd, Sr and Pb for rock-forming minerals (i.e. pyroxene, plagioclase and olivine) and associated sulphide minerals (disseminated ores) derived from main lithological units of various ultramafic-mafic intrusions (namely economic Noril'sk-1, Talnakh and Kharaelakh, subeconomic Zub-Marksheider and Vologochan, prospective Mikchangda and none-economic Nizhny Talnakh). Initial Sr and Pb isotope ratios have been also determined in massive sulphide ore samples at Talnakh and Kharaelakh.

Initial lead isotope compositions of plagioclase and sulphide (67 analyses) significantly differ from each other indicating their isotope heterogeneity. Similarly, contrasting difference in the Sr isotope composition has been observed for the rock-forming silicate minerals and sulphide ores. At Talnakh and Kharaelakh, concentration of Sr in massive sulphide ore varies from 4 to 30 ppm; $(^{87}Sr/^{86}Sr)_0$ varies in the range 0.7085-0,7111, whereas in plagioclase and pyroxene $(^{87}Sr/^{86}Sr)_0$ usually not exceeds 0.7076. This implies that sulphide ore melt appeared in its location site as isotopically heterogeneous mechanical admixture, marked by specific isotopic compositons of Pb and Sr, different from that of rock-forming minerals. It is noteworthy that sulphide ores, in comparison with silicate minerals, were essentially enriched by radiogenic Sr component at time of intrusion.

In Sr-Nd isotope systematics silicate matter from economic ore-bearing intrusions (about 60 bulk rock samples, plagioclase and pyroxene extracted from the bulk rocks) in comparison with silicates from none-economic weakly mineralised intrusions (81 sample) manifest clear contamination by the component, which along with relatively constant the Nd isotope composition (epsilon Nd about +1±0.5) is enriched with the radiogenic Sr. This feature can be employed as a prospective sign for the presence of significant quantities of the ore contaminant, which has isotope signatures close to that of massive sulphide ores.

Quantifying mineral aerosol inputs and the mobility of "immobile" elements in weathering studies

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Calculations of chemical weathering fluxes rely on a complete characterization of the mass balance for a given system. This study addresses two issues that may play an important role in these calculations. The first issue is that of mineral aerosol inputs, which can be a significant contribution to the overall atmospheric flux. Appropriate spatially and temporally averaged values for mineral aerosol fluxes are not easily established. The second issue is the use of "immobile" index elements such as Ti and Zr in the calculation of weathering losses of other elements. This study focuses on an analysis of mineral aerosol inputs and mobility of a wide variety of trace elements from the Rio Icacos watershed in the Luquillo Mountains of Puerto Rico. Additionally, this study puts the findings from the Rio Icacos in a global context based on literature review.

Results of our analyses in the Rio Icacos illustrate that Sr isotopes may be used to calculate watershed-scale average mineral aerosol deposition fluxes given a situation of a monolithologic catchment, a difference in the $^{87}Sr/^{86}Sr$ ratio between the bedrock and the mineral aerosol inputs, and Sr-bearing primary minerals weathering to completion in the regolith. Nd isotopes are used to demonstrate that mineral aerosol inputs are incorporated to a depth of >3 meters in the regolith.

Trace element and rare earth element data were analyzed in order to assess patterns on elemental mobility within Rio Icacos regolith. Of all elements, Zr indicates the least mobility in this system, yet Zr data indicate leaching losses of ~50%. Alternatively, the saprolite has expanded by a factor of 2x during formation, but volume expansion is considered highly unlikely based on textural evidence. Calculations of mass losses during chemical weathering based on normalization to trace elements therefore require careful consideration in the case of intense weathering environments.