Geophysical Research Abstracts, Vol. 8, 07349, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07349

REE distribution as a tool for understanding origin of the Norilsk-1 differentiated ore intrusion

L. E. Mordberg, A. V. Antonov, O. V. Petrov, V .P. Klindukhov, I. N. Kapitonov, K. N. Malich, E. O. Petrov, S. A. Sergeev

Russian Research Geological Institute (VSEGEI), St Petersburg, Russia,
Leonid_Mordberg@vsegei.ru / +78123289209

We present new data on REE distribution in rocks and minerals from differentiated ore intrusion Norilsk-1 and their interpretation. Bulk contents of REE were determined by ICP-MS (ELAN-DRC-6100), while their contents in apatite and plagioclase were determined by LA ICP-MS (Element-2 with DUV-193) after preliminary microprobe analysis (analytical SEM CamScan MX-2500S). The number of bulk analyses is 40, including samples which represent the entire cross-section of the intrusion. Also analyzed were 26 apatite crystals (30 analyses) and 30 plagioclase crystals (30 analyses) from various rock types. All the analyses were made in VSEGEI, St Petersburg, Russia.

Chondrite-normalized (C1) REE distribution patterns of all rocks are similarly monotonous with prevailing light REE (LREE) and absence of clearly distinguishable Ce or Eu anomalies. REE distribution pattern of apatite is characterized by LREE prevailing, a pronounced negative Eu anomaly and a slightly less pronounced negative Ce anomaly. The latter is not quite typical for magmatic rocks of similar composition. Generally, no variations in REE distribution pattern type is observed for analyzed apatite crystals, although they were separated from different layers and differ by F and Cl contents. A characteristic feature of apatite is comparably low U and Th contents and high Th/U ratio which is close to this ratio in high-uranium zircons from the same intrusion.

REE distribution pattern of plagioclase shows LREE prevailing and a positive Eu anomaly, while a Ce anomaly is either absent or quite weak. REE contents in plagioclase are three orders of magnitude lower than in apatite.

The observed peculiarities in REE distribution patterns could be explained from the point of view of magmatic melt geochemistry and crystal chemistry of studied minerals. During plagioclase crystallization, Ce existed in melt in trivalent form, while a part of Eu was reduced to divalent presumably as a result of sufficient sulfur amount. The presence of Eu^{2+} provided Eu excess in plagioclase lattice and its deficit in residual melt.

The presence of a negative Ce anomaly in apatite REE distribution pattern evidences that after plagioclase crystallization Ce was oxidized to Ce^{4+}, probably after melt Eh increase. This could be related to the process of magmatic melt fractional crystallization in intermediate crustal centers. Apatite crystallization occurred at the latest stage after intruding melt impoverished by U and Th in volcanogenic and sedimentary sequence.

The existence of a negative Ce anomaly in apatite REE distribution patterns thus could be a criterion for prospecting industrial type intrusions of the Norilsk type.