Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06860, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06860
EGU General Assembly 2008

Magma sources in economic and non-economic ultramafic-mafic intrusions of the Noril'sk area (Russia): constraints from U-Pb and Hf isotope data on zircon

K.N. Malitch (1), E.A. Belousova (2), O.V. Petrov (1), W.L. Griffin (2), N.J. Pearson (2), E.V. Tuganova (1)

1 - All-Russia Geological Research Institute, Sredny pr. 74, St. Petersburg, 199106, Russia (Kreshimir_Malich@vsegei.ru), 2 - GEMOC ARC National Key Centre, Department of Earth and Planetary Sciences, Macquarie University, Sydney, NSW 2109, Australia

World-class platinum-group-element (PGE)-Cu-Ni deposits closely linked to intracontinental paleorift-related ultramafic-mafic intrusions are located in the northwestern corner of the Siberian craton, Russia. Recent U-Pb SHRIMP studies (*Petrov et al*., 2006a,b; *Malich et al*., 2007; *Malitch et al*., 2007) identified distinct age groups of zircon from economic Noril'sk-type (Noril'sk-1, Talnakh and Kharaelakh), subeconomic Chernogorsk, Zub-Marksheider and Vologocahn intrusions and the non-economic Nizhny Talnakh mafic-ultramafic intrusion. Most of concordant U-Pb ages lie in the range 230-270 Ma. Minor zircon populations show U-Pb ages, which cluster around 300 and 340 Ma.

This report presents the first results of Hf isotope measurements (110 analyses) performed on the dated spots within single zircon grains, which were extracted using *ppm-mineralogy* technique (NATI Research JSC, St. Petersburg, http://www.natires.com) from the main lithological units at Talnakh and Nizhny Talnakh. Rock samples from the Talnakh intrusion (drill core OUG-2) are represented (from top to bottom) by gabbro-diorite, olivine-containing gabbro, olivine gabbro, plagiowehrlite and taxitic-textured varieties of ultramafic and mafic rocks, whereas at Nizhny Talnakh rocks investigated (drill core TG-31) include olivine-free gabbro,

melanotroctolite and plagiowehrlite alternated with plagiodunite. In situ Hf isotope analyses were carried out with a New Wave LUV213 laser-ablation microprobe attached to a Nu plasma MC-ICP-MS at GEMOC, following the analytical procedures reported by *Griffin et al*. (2002).

Zircons at Talnakh (n=40) with U-Pb ages between ca. 230-280 Ma yielded epsilon $_{Hf}$(T) (parts in 10^4 deviation of initial Hf isotope ratios between the zircon sample and the chondritic reservoir) values from + 6 to + 18, which straddle the mean value of the depleted mantle at that times. Zircons from gabbro-diorite, olivine-containing gabbro, olivine gabbro and plagiowehrlite show similar ranges in Hf isotope values (mean eps $_{Hf}$(T) +10.2, +11.1, +9.8 and +9.0, respectively). Only zircons from taxitic rocks have slightly less radiogenic Hf isotope compositions (mean epsilon $_{Hf}$(T) value +7.7). In contrast, zircons at Nizhny Talnakh (n=70) with U-Pb ages between ca. 215-305 Ma yielded epsilon $_{Hf}$(T) values from –5.2 to +6.5 and depleted-mantle model ages (T_{DM}) of 0.6-1.1 Ga (mean 0.85 Ga) implying a contribution from a protolith generated in Late Proterozoic time. At Nizhny Talnakh, the Hf isotope values of zircon in olivine-free gabbro, melanotroctolite, plagiowehrlite and plagiodunite are characterized by mean eps $_{Hf}$(T) +3.1, +2.0, -0.1 and +0.5, respectively.

Noril'sk-type intrusions are frequently interpreted as being genetically linked to 250 Ma Siberian flood-basalt volcanism. U-Pb data provide no evidence for the genetic link between the chalcophile element-depleted basalts and sulphide-rich Noril'sk-type intrusions implying that their relationship is most likely coincidental and that they are not related to each other.

Hf isotope data suggest that zircons from economic intrusions, as exemplified by Talnakh, are characterized by the signature of a juvenile mantle-derived magma. Less radiogenic Hf isotope values of zircons from non-economic intrusion as reflected at Nizhny Talnakh show features of magma sources, which had isotope compositions with both mantle and crustal values. Our new findings are consistent with an assumption about the interaction of distinct magmas and a prolonged duration of a component fractionation in the magmatic system. Consequently, these processes could lead to high degrees of separation and concentration of ore elements and formation of specific ore magmas of unique scales and concentrations. Finally, we propose that "radiogenic" Hf isotope compositon of zircon can be employed as an effective fingerprint for identifying prospective intrusive hosts and consequently is useful in exploration for sulphide-rich ores associated with Noril'sk-type intrusions.

References: Griffin, W.L. et. al. (2002) Lithos **61**, 237-269. Malich, K.N. et. al. (2007) GCA **71**, 15S, A616. Malitch, K.N. et. al. (2007) Geophys. Res. Abstr. **9**, 09674 EGU (CD-ROM). Petrov, O.V. et. al. (2006a) Geophys. Res. Abstr. **8**, 09205 EGU (CD-

ROM). Petrov, O.V. et. al. (2006b) GCA **70**, 18S, A486.