

Lithospheric mantle beneath East Antarctic (Oasis Jetty)

LIA N. KOGARKO

Vernadsky Institute of Geochemistry and Analytical Chemistry, Kosygin str. 19, Moscow, 119991, Russia (kogarko@geokhi.ru)

Some mantle-derived East Antarctic rocks have bulk-rock and mineral trace element and isotopic compositions that provide evidence of strong carbonate metasomatism. 46 peridotite xenoliths from lithospheric mantle beneath Lambert-Amery Rif were studied. The age of hosting ultrabasic alkaline dykes is cretaceous. Investigated xenoliths represents about 80 km thick cross of subcontinental lithospheric mantle.

Distinct correlations is observed between contents of MgO and other petrogenetic elements. Comparison of these correlations with estimated trends of batch and fractional melting of initially fertile mantle peridotite [1] demonstrate, that Jetty peridotites plot at lower values for SiO₂. Garnets are characterized by unusual high LIL element concentrations (Ba/La=4000) and clinopyroxenes from the spinel peridotite suite are highly enriched in LREE [(La/Yb)_N =14] and in HFSE. The decoupling of major and REE elements and observed mineral assemblages (which include dolomite, calcite, apatite, Ti- Ba-rich phlogopite, titanite, perovskite, henrymeierite) indicate that the upper mantle of East Antarctic has been affected by very strong metasomatism. Henrymeierite was found in mantle material for the first time [2]. Our isotopic data showed complete absence of isotope equilibrium among the rock forming minerals in the xenoliths. Garnets are characterised by the most radiogenic Sr isotope composition (0.709024-0.714127), whereas Cpx exhibits the lowest ⁸⁷Sr/⁸⁶Sr ratios (0.702861-0.703711). Garnets are depleted in terms of Sm-Nd system and they are significantly enriched in radiogenic Sr. Such anomalous signature in Antarctic mantle rocks confirm the influx of carbonate metasomatising fluid (or melt) from the source with a time integrated LIL-elements enrichment and more rapid Sr but not Nd diffusion to garnets compare to Cpx. It is probable, that that the interaction of primary dolomitic melts-fluids with mantle material according to reactions: 2Mg₂Si₂O₆ + CaMg(CO₃)₂ = 2Mg₂SiO₄ + CaMgSi₂O₆ + 2CO₂ (1) 3CaMg(CO₃)₂ + CaMgSi₂O₆ = 4CaCO₃ + 2Mg₂SiO₄ + CO₂ (2) resulted in wehrlitization and carbonatization. The fluids responsible for this metasomatism were probably derived from the plume that arrived beneath the region at this time.

References

[1] Niu Y. (1997) *J. Petrology*, **38**, 1047-1074. [2] Kogarko L., Kurat G., Ntaflos T. (2007) *Can Min*, **45**, 497-501

Identification of distinct sources of water and solutes from temporal variations of chemical and isotopic compositions during a pumping test in a test borehole

DONG-CHAN KOH^{1*}, GI-TAK CHAE¹, KWANG-SIK LEE², YOON-YEOL YOON¹ AND KI-HWA PARK¹

¹Korea Institute of Geoscience and Mineral Resources, 92 Gwahang-no, Yuseong-gu, Daejeon 305-350, Republic of Korea (chankoh@kigam.re.kr, gtchae@kigam.re.kr, yyyoon@kigam.re.kr, pkh@kigam.re.kr)

²Division of Isotope Geoscience, Korea Basic Science Institute, Daejeon 305-333, Republic of Korea (kslee@kbsi.re.kr)

Chemical and isotopic compositions of groundwater were measured during a 70-hr pumping test for a test borehole drilled in volcanic aquifers consisting of trachytic rocks, scoria and hydrovolcanic tuffs, where natural land cover is dominant. Groundwater from initial sampling using a bailer was Na(Ca)-HCO₃ type with low mineral contents. ³H levels indicated recent recharge, which was similar to those of rainwater. However, chemical and isotopic compositions of groundwater showed significant temporal variations during the pumping test. The mineral contents steadily increased with pumping by three-fold and water types varied from Na(Ca)-HCO₃ to Mg-HCO₃ with little traces of anthropogenic contamination. Among solutes, concentrations of HCO₃ and Mg significantly increased and those of other cations increased in lesser extent whereas concentrations of Cl, SO₄, NO₃ and SiO₂ were nearly invariant indicating increases in mineral contents were mainly attributed to water-rock interactions. However, pH decreased with mineral content increase suggesting additional CO₂ sources. δ¹³C of dissolved inorganic carbon clearly showed the sources of HCO₃. Depleted δ¹³C (-18.6‰) was observed in the early stage of pumping showing dissolution of biological CO₂ from soil zones while enriched δ¹³C (-6.1‰) in the later stage of pumping indicating contribution of deep-seated, presumably, magmatic CO₂. ³H values varied from 3.0 TU to 2.1 TU during pumping, seemingly indicating water was still contributed from recent water in the later stage because high-mineral water is likely to have negligible ³H, which was corroborated by very low levels of CFCs. The chemical and isotopic characteristics suggested that contribution of high-mineral water was significant for most solutes but, not for water in groundwater obtained from continued pumping.