Geochemical evolution of brackish waters and gases in coastal area of Japan Sea

G.A. CHELNOKOV[1], N.A. KHARITONOVA[2], I.V. BRAGIN[3] AND A.A. KARABTSOV[4]

690022, Russia, Primorsky region, Vladivostok, Prospect 100-letya 159, Far East Geological Institute Russian Academy of Science ([1]geowater@mail.ru, [2]tchenat@mail.ru, [3]bragin_ivan@mail.ru)

The sodium bicarbonate water with TDS- 2.5–6.0 g/l, high contents of B (~5 mg/l) and F (4.5-15 mg/l), is located in coastal area of the south of Primorye (Far East of Russia) at the depths of 100-314 m in Mesozoic terrigenous rocks. Water is pumped with the outflow rate ~ 6 m^3/day and using for balneological treatment and bottled as 'Lotos'. The composition of deep HCO_3-Na mineral water reflects the geochemical and biogeochemical processes that occur over time in this territory and provides important clues to an understanding of the geologic and hydrologic controls on the generation of gases. The investigations of the waters and gases allowed us to draw the following conclusions:

- the brackish waters aquifer of HCO_3-Na mineral waters was related to the transformation of organic matter in the host rocks. Biogeochemical reactions alter the chemical and isotopic signature of the water. Major components of bubbling gases are CH_4 (68 vol%), N_2 (28%) and CO_2 (4%). These processes are accompanied by the formation of a predominant CH_4–N_2 gas component of the waters and CO_2 release. The water–CO_2 interaction leads to increase of the hydrocarbonate-ion content in the water, while the sodium influx is provided by leaching of feldspars. Shallow surface water, a mixed cation (Ca, Mg, Na) and mixed anion (HCO_3, Cl) type water, was altered to a Na–HCO_3 type water by (1) the precipitation and dissolution of calcite, dolomite; (2) exchange of Ca and Mg for Na on abundant smectites and (3) methanogenesis.

Water isotopic composition ($\delta^{18}O$ from -11.8 to -13.7‰; δD from -85 to -90‰ V-SMOW) indicates its essentially meteoric origin. The tritium concentrations of the Razdolnaia River is 12, 3TU and for coastal sea water 12, 1 TU, while deep HCO_3-Na mineral water have 5, 3 TU. Results indicated that residence times of water were less then 50 years.Carbon isotopic composition of CO_2 (-19.4‰, V-PDB) and CH_4 (-74‰) suggests a microbiological origin of C-bearing gases derived probably from deeper buried marine sediments. High N_2/Ar (~130) shows the presence of non-atmospheric nitrogen derived from the same sedimentary source.

Petrology and Os-Nd-Sr isotopes of the Gaositai Alaskan-type ultramafic complex from the northern North China Craton

B. CHEN[1,2]*, W. TIAN[2] AND K. SUZUKI[3]

[1]School of Geology and Exploration Enginering, Xinjiang University, Urumchi 830046, China (*correspondence: binchen@pku.edu.cn)
[2]School of Earth and Space Sciences, Peking University, Beijing 100871, China (davidtian@pku.edu.cn)
[3]Institute for Research on Earth Evolution, 2-15 Natsushima, Yokosuka, 237-0061, Japan (katz@jamstec.go.jp)

We report petrological and Os-Nd-Sr isotopic data for the Permian Gaositai ultramafic complex from northern North China Craton (NCC) to reveal its mantle source characteristics, petrogenesis and geodynamic setting. The complex shows features of Alaskan-type intrusions, including (1) the concentric zoning from dunite core, to clinopyroxenite and hornblendite in the rim, and the common cumulative textures; (2) the abundance of olivine, clinopyroxene and hornblende, and the scarcity of orthopyroxene and plagioclase, and (3) the systematic decrease in Mg# of ferromagnesian phases from core to rim, accompanied by the Fe-enrichment trend of accessory spinel. We found high Mg# (93-96) clinopyroxene inclusions in chromian spinels from the dunite, which have chemical compositions similar to the high Mg# clinopyroxenes of primitive ankaramite. This, along with the chemical and Re-Os isotopic data of the chromitites and dunites, suggests that the parent magma to the complex is high Ca picritic in chemical composition, with Mg#>90, $CaO/Al_2O_3>1$, high f_{O2} (up to FMQ+2.83), and depleted Nb and Ti, typical of primitive ankaramitic magma originated from a subduction-related, hydrous-carbonatite fluxed mantle source.

Other rock types (clinopyroxenite and hornblendite) show highly varied, radiogenic Os isotopic ratios (0.13-5.2), and unradiogenic Nd isotopic composition (ε_{Nd} (t) = −8 to −15). The $(^{187}Os/^{188}Os)_i$ ratios are found to be anti-correlated with ε_{Nd} (t) values and whole-rock Mg# as well. These data suggest significant crustal contamination during magma evolution. Isotopic modeling suggests that the crustal contaminants are dominantly Archean mafic rocks and TTG gneisses in the lower crust. The zoned pattern of the complex formed probably through 'flow differentiation' of a rapidly rising crystal mush along a fracture zone that was developed as a result of lithospheric extension in a back-arc setting in the northern margin of the NCC at ca. 280 Ma.