Geochemistry of trace elements in gas phase of thermal springs

A.YU.BYCHKOV[1,2], I.YU.NIKOLAEVA[1] AND S.YU.NEKRASOV[1]

[1]Moscow StateUniversity, Moscow, Russia (bychkov@geol.msu.ru)
[2]Vernadsky Institute of Geochemistry RAS, Moscow, Russia

The composition of the thermal waters studied well, but there are only few articles on the geochemistry of trace elements in thermal springs gas phase. Samples of the coexisting liquid and gas phases were collected in thermal springs of Kamchatka peninsula (Russia): Mutnovsky volcano, Uzon Caldera, Geyser Vally, Karymsky volcano. For the sampling of thermal springs specially designed installation was used, wells of Mutnovsky geothermal plant was studied by standard two-phase separator of steam-water mixture. More than 200 samples of coexisting gas and liquid was collected. In samples the concentration of major and trace elements and hydrogen and oxygen isotope composition were determined.

The distribution of high volatile elements, such as boron and arsenic in geothermal wells steam-water mixture was found close to experimental data. However gas phase condensates from thermal springs compared with the liquid phase are enriched with boron and arsenic. This cannot be explained by the equilibrium distribution of components by experimental data. This effect is observed only for thermal springs with superheated steam and correlates with the isotopic composition of the condensates. Perhaps distribution of the superheated steam is determined by the equilibrium at high temperatures in the depth of hydrothermal system. Boron concentration of the condensate can be used to detect the temperature of the gas phase separation and deep boiling. The calculations show good agreement with other geothermometric methods.

For nonvolatile elements, such as REE, Ga and others, distribution coefficients were calculated. Some correlations between the partition coefficients were shown. So, for LREE they are higher than for HREE. These coefficients can’t be calculated from thermodynamic data, since the speciation of elements in the gas sufficiently studied. New experiments of solubility in the gas phase can explain distribution coefficients, as shown by the example of gallium. For this element the gas form $Ga(OH)_3$ was determined by gallium oxide solubility in vapor. This experimental data can explain the dependence of the distribution coefficient of the pH of thermal water.

This study was supported by RFBR 12-05-00957.

Subduction modification of Western North America lithosphere - Priming for destruction?

B.L. BYERLY* AND J.C. LASSITER

Jackson School of Geosciences, University of Texas at Austin, Austin, TX, USA (* benbyerly@utexas.edu)

Destruction of continental lithospheric mantle has been recognized to be an important process that may affect the preservation of continental crust [1]. Geochemical data from mantle xenoliths indicate that the majority of the Proterozoic lithospheric mantle beneath the central Rio Grande Rift (RGR) has been convectively removed [2]. Weakening of the lithospheric mantle by addition of metasomatic fluids/melts during Laramide flat-slab subduction followed by increased mantle flow due to Farallon slab roll-back may have triggered this lithosphere destruction. If metasomatism is related to the recent deformation/destruction of the lithosphere beneath the RGR, then mantle metasomatism recorded in remnant lithospheric mantle xenoliths should also be recent.

We examined the trace element and Sr-Nd-Os-Hf isotopic compostion of two suites of lithosphere-derived spinel-peridotite xenoliths from Cerro Chato (Eastern Colorado Plateau margin) and Elephant Butte (central RGR) to constrain the timing and source of mantle metasomatism. $^{187}Os/^{188}Os$ ranges from 0.114-0.126 and T_{RD} ages for the most depleted samples range from 1.6-2.2 Ga; similar to the age of the crust in the region [3]. Both suites of xenoliths are LREE-enriched with variable negative HFSE anomalies relative to REE. $(La/Sm)_N$ in cpx ranges from 2-14 and is correlated with $^{87}Sr/^{86}Sr$ which range from 0.7031-0.7045. ε_{Nd} ranges from 4-10 and ε_{Hf} ranges from 17-304. There is no correlation between $^{143}Nd/^{144}Nd$ and Sm/Nd which suggests metasomatism is recent. This is consistent with young (< 250 Ma) Nd model ages for the xenoliths. A Hf pseudoisochron (using WR Lu/Hf due to equilibration above Lu-Hf closure temperature) yields an age of ~1.0 Ga, which is younger than the Os model ages. The young Hf age may be the result of mixing and partial resetting of Hf isotopes by metasomatism as evidenced by a correlation between 1/[Hf] and $^{176}Hf/^{177}Hf$. The most radiogenic sample has a DM-model age of 1.45 Ga which is close to the age of the overlying crust. Arc-like metasomatic signatures and young Nd model ages are consistent with metasomatism being recent and related to Farallon slab subduction. This may have primed the Colorado Plateau for defomation similar to that observed in the RGR.

[1] Lee, C.T. *et al*. (2001) *Nature*, **411**, 69-73 [2] Byerly, B, Lassiter, J.C. (2012) *EPSL*, **355-356,** 82-93 [3] Wendlandt, E. *et al*., (1993) *EPSL*, **166**, 23-43

DOI:10.1180/minmag.2013.077.5.2
www.minersoc.org