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On the gel of silica formed by the acid decomposition of eudialite concentrate

V. A. Zaitsev, A. A. Gruzdeva, N. P. Starshinova, R. Kh. Khamizov, L. N. Kogarko
V. I. Vernadsky Institute of Geochemistry and Analytical Chemistry RAS, Moscow

alkaline@geokhi.ru

We studied silica-rich gel, formed by the acid decomposition of eudialine and nepheline. The gel shows week sorption selectivity of rare metals. Gels of silica are formed in various geological processes, including ultroagpaite rocks and pegmatites as intermediate compounds and can be fixed due to formation of opal, sometime containing significant concentrations of admixture elements. It can be supposed: if the gel of silica is formed in the way of migration of low-temperature solutions, the selective sorption of metals can be effective mechanism of local differentiation of components.

Key words: experiment, acid decomposition of eudialite,gel-type silica, sorption

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Acid leaching is one of the key stage of any technology for recovery rare-element from eudialite. We experimentally studied eudialite decomposition by HCl and HNO_3 to search the optimal parameters of obtaining the solutions of rare- and rare-earth elements for their further separation.

The sample of eudialite concentrate, provided by the Lovosersky GOK, was used as a starting material. The concentrate contained eudialite (71.1 %), aegirine+arfvedsonite (12.3%), nepheline(8.9%), feldspar (2.4%), loparite (0.4%), lamprpophyllite and lorenzenite (4.41%). During the experiment, the sample of concentrate was treated by the acids for 1–3 days.

X-ray diffraction spectra show reflexes of aegegine, arfvedsonite, feldspar and loparite, but do not show presence of nepheline and eudialite. Nepheline and eudialite are decomposed with formation of gel, which can be filtrated through a red-dot filter, but do not penetrate through the white-dot filter. Mass-balance calculations show, that water content in the gel strongly depends on the concentration of used acid: the weak acid (3%) forms gel, containing 90% of water, whereas the gel, formed by the 30% acid contains only 75% of water. The gel also contains rare and rare-earth elements, and this determines the importance of the elaboration of eudialite technology.

At study of properties of the gel, the filter cake was washed by distilled water with the use of step-by-step technique. Composition of liquids was determined by ICP-MS and ICP-AS methods (GEOKHI RAS).

Concentration of metals in wash liquid (C) can be approximated by exponential function $C= C_o*B*\exp(A*V)$, where V is the volume of filtered solution and C_o is the concentration of element in initial material (before experiment). A and B are empirical coefficients.

We found that metal/metal ratios are gradually change from earliest portions of water to the lasts: for example, Ce/La increases from 2.56–2.66, to 2.77–5.23, Y/La ratios in the earliest solutions are 2.11–2.19, but in the latest one it goes up to 2.71. Zr/Y ratio changes from 14–18.3 to 16–41. It is interesting, that the gel mostly selective on Zr/Y do not show selectivity to REE. Zr/Ti values decrease from 11.2–13.1 to 5–7, sometime, the intermediate stage show the lowest ratio: 2.2–3.5. We suppose that it is the evidence of sorption selectivity which strongly vary from experiment to experiment.

Gels of silica are formed in various geological processes as intermediate compounds and can be fixed due to opal formation in various geological setting, including ultroagpaite rocks and pegmatites. For example, opals, containing significant concentrations of Na, Al, and Zr were found in Lovosero massif [*Pekov, 2000*], opals with Na, Cl, Ca, Zn, Hg – in Yellowstone hot springs field [*Channing, 2007*].

It can be supposed: if the gel of silica is formed in the way of migration of low-temperature solutions, the selective sorption of metals can be effective mechanism of local differentiation of components.

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