THE EXPERIMENTAL INVESTIGATION OF SCANDIUM BEHAVIOR IN FLUORINE-BEARING MELTS Gramenitskiy E.N. and Shchekina T.I.

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<u>Key words</u>: aluminosilicate and salt fluoride melts, liquid immiscibility, fluoride phases, partition coefficients, scandium

Sc occurs in nature mainly as a minor element in rock-forming minerals. The bulk of this element in magmatic rocks is contained as an isomorphous admixture in clinopyroxene, amphiboles, ilmenite, and, to a lesser extent, micas. Sc deposits are also known to be related to granite pegmatites, albitized granites, and carbonatites (which contain such individual Sc minerals as thortveitite, bazzite, and jervisite). At skarn and greisen deposits, Sc is concentrated in micas, beryl, wolframite, columbite, and REE minerals. These deposits were always produced in the presence of fluorine.

The paper reports experimentally obtained data on Sc partition between aluminosilicate (L_{sil}) and salt fluoride (L_{salt}) melts that were brought about by liquid immiscibility in the system Si-Al-K-Na-Li-F-O-H at 800°C, $P_{H2O} = 1000$ bar. This research continues a series of our earlier papers devoted to the partition of trace elements Li, W, Ta, Nb, Zr, Hf, and REE [1-4] as determined in experiments conducted under analogous conditions in the same systems.

Fluoride phases in the experiments developed in the form of round globules from 10 to 300 μ m in diameter, whose composition corresponded to the formula Me₃AlF₆, where Me is Na, Na + K, or Na + K + Li. The correspondence of the Sc partition to the Henry law was checked in the K-Na part of the system.

In all portions of the system examined in our experiments, Sc was preferably partitioned into the fluoride phase. Depending on the system composition, three groups of the partition coefficients $K_P = C_{sil}/C_{salt}$ were recognized. In silica-oversaturated (granitic) Na and Na-K portions of the system, $K_P = 0.13-0.18$; and in the K portion K_P averages 0.1. The values of K_P monotonously decrease with the increasing SiO₂ concentration in the aluminosilicate melt. These values are significantly higher in compositions giving rise to nepheline-normative silicate melts, particularly agpaitic, whose K_P approaches 1. In this portion of the system, Sc exhibits nearly equal chemical affinity to the aluminosilicate and fluoride melts. With the transition to Li-bearing parts of the system, the Sc partition coefficients decrease to 0.02, although this decrease is not as dramatic as for Y and all REE [4]. In the K-Na quartz-normative parts of the system, the Sc partition coefficients are independent of the concentration and also remain constant, within the error, in the Li-bearing parts of the system with different substitution degrees of K or Na for Li.

The strength of the Sc-F chemical bond accounts for the higher Sc affinity to fluoride phases than to aluminosilicate phases, as was determined in our experiments at any system composition. Like the metals of group 3 in the periodic table, Sc forms complex fluorides of M_3ScF_6 type, which are also typical of these metals. Sc can dissolve in salt alkali-aluminium-fluoride melts in amounts as high as 11 wt %, being, perhaps, accommodated in them together with Al.

Based on our experimental data, we believe that Sc concentrating during the segregation of salt melts (in our experiments, they were of fluoride composition) from a granitic magma in the course of its differentiation provide the only explanation for elevated Sc concentrations in pegmatites, greisens, and albitized rocks, while Sc remained scattered throughout the whole magmatic process.

Another essential feature of Sc behavior determined in our experiments is the convergence of its K_P values for different parts of the system, which is in agreement with the highly scattered mode of Sc occurrence in nature at its abundance commensurable with those for Nb, W, and Sn. This phenomenon is caused by the dualistic character of Sc properties. Being an analogue of Y and HREE, Sc is crystalchemically close to Fe(II, III), Mg, Mn(II, III), Zr, and Al, i.e., elements with similar ionic radii at equal coordination numbers of 6. According to its behavior in the process of magmatic differentiation, Sc concerns to groupe of compatible elements and is correlated with Ti, Co, and V. As the silicity of rocks increases, their Sc concentrations decrease (Norman and Haskin, 1968). However, low Sc concentrations (<0.5 ppm) in the latest derivatives in granite and nepheline syenite magmatic complexes can hardly be explained by the fractionation of mafic minerals alone. Our data suggest that a significant contribution could be made by the segregation of fluoride salt liquids from the residual melt during the final differentiation stages of the plutons.

 $(K_P = C_{sil} / C_{salt}).$ № Part of C_{Sc} n C_{Sc} n K_P lg K_P 3 ε the (sil) (salt) aver. min. max. --+ 0/ ... 0/ 402 0.06 0.20 5 0.023 -1.63 -1.86 -1.48 К1 0.14 5 6.18 403 К2 0.08 0.02 5 8.65 0.25 5 0.010 -2.01 -2.14 -1.91 5 -3.48 -2.30 405 К3 0.01 6 0.31 0.003 -2.57 0.01 4.76 391 K-Na 0.11 0.04 5 0.59 0.04 5 0.18 -0.75 -0.93 -0.62 K-Na 0.15 2.15 0.08 5 0.18 -0.60 392 0.40 5 -0.73 -0.94 0.39 43 K-Na 0.03 10 2.64 0.23 10 0.15 -0.83 -0.89 -0.77 393 5 -0.79 K-Na 1.23 0.17 5 7.55 4.50 0.16 -1.20 -0.58 206 7 K-Na 0.63 0.06 6.78 0.56 10 0.13 -0.96 -0.92 -0.85 200 Na 0.42 0.02 5 3.20 0.30 5 0.13 -0.92 -0,92 -0,85 371 NaAl 0.72 2.80 2 2.96 0.03 3 0.24 -0.61 0.08 <-2.5 69 NaAl 0.05 0.03 10 0.35 0.04 10 0.15 -0.82 -1.07 -0.66 199 0.04 0.04 1.04 +0.02-0.13 Neph 0.76 4 0.73 6 0.13 390 4 2.21 0.59 -0.35 Neph 1.30 0,28 0.19 6 0.14 -0.13 4 0.70 284 Li-K1 0.18 0.15 8.83 4 0.021 -1.68 -2.46 -1.42 71 Li-K2 0.32 10 0.32 10 -1.21 0.65 10.6 0.062 -1.40 -1.08 70 LiKNa 0.09 0.08 3.96 0.07 4 0.023 -1.64 -2.57 -1.37 6 256 LiKNa 0.14 0.04 5 11.9 0.92 8 0.012 -1.93 -2.07-1.83 7.19 1.57 257 LiNa1 0.18 0.06 4 4 0.024 -1.61 -1.85 -1.46 4 0.42 4 285 LiNa2 0.20 0.04 7.33 0.024 -1.57 -1.69 -1.48

The result of scundium partitioning between aluminasilicate (sil) μ fluoride (salt) melts

This research was financially supported by the Russian Foundation for Basic Research, project no. 01-05-64512.

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Electronic Scientific Information Journal "Herald of the Department of Earth Sciences RAS" № 1(21) 2003 Informational Bulletin of the Annual Seminar of Experimental Mineralogy, Petrology and Geochemistry – 2003 URL: http://www.scgis.ru/russian/cp1251/h_dgggms/1-2003/informbul-1_2003/magm-25e.pdf Published on July 15, 2003

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