EXPERIMENTAL STUDY OF Ta_2O_5 SOLUBILITY IN FLUORIDE SOLUTIONS AT T=550°C AND P=1000 BAR

Kotova N.P., **Zaraisky G.P.** (IEM RAS)

kotova@iem ac.ru ; Fax: 8(252) 4-44-25; Phone: 8(252) 4-44-25

Key words: oxide tantalum, hydrothermal solubility, fluoride solutions, "apogranite", hydrothermal transport

Hydrothermal transport and redeposition of tantalum by hydrothermal solutions to quantities sufficient for formation of its deposits was assumed by many geologists for a long time. However, the possibility of hydrothermal transport of tantalum has never been demonstrated experimentally. In the literature the reliable data about behaviour of Ta and Nb in hydrothermal solutions are absent. The decision of this question has required of special experimental researches at T-P and the solution composition corresponding to physico-chemical parameters of postmagmatic hydrothermal processes in the lithium-fluoric granites domes.

This investigation is directed on the decision of a specific task of experimental study of oxide tantalum (Ta_2O_5-tantite) solubility in fluoride solutions at high temperatures and pressures for a quatitative estimation of the possibility of hydrothermal mass transfer and precipitation of tantalum at formation of its deposits connected with albitized and greisenized granite (apogranite) [1].

The experiments on studying dependence of pentoxide tantalum (Ta_2O_5) solubility on F-ion concentration were carried out at T=550°C, P=1000 bar in HF, KF solutions of 0.01, 0.1, 0.3, 1.0 and 2.0 mole/kg H_2O, NaF solutions of 0.01, 0.02, 0.05, 0.1, 0.5, 1.0 mole/kg H_2O and LiF solutions of 0.01, 0.03, 0.05, 0.1, 0.3 mole/kg H_2O at the presence of the oxygen buffer Co-CoO. Earlier [2], it was shown that tantalum solubility is higher at more reduced conditions (buffer Co-CoO) than at oxidized conditions (buffer Ni-NiO). Experiments were carried out in sealed platinum capsules (80 mm long, 8 mm diameter). The run durations were about 15-20 days. Weight of Ta_2O_5 powder was 50 mg. Pt capsules were filled in fluoride solutions of 1 ml. Sealed capsules were placed in hydrothermal vessel. After the runs all capsules were weighed on electronic balances "The Ohaus ANALYTICAL Plus Series balances" for control of leaks during the experiments. The quench solutions were analyzed for tantalum and impurities by ICP/MS and ICP/AES methods.

The experimental results have showed that tantalum solubility is not very high (10^{-5}- 10^{-6} mole/kg H_2O) at low concentrations of fluorides (up to 10^{-2} mole/kg H_2O). At such conditions hydrothermal mass transfer of tantalum is not possible. However, Ta_2O_5 solubility increases considerably with increasing F-ion contents and reaches significant values (10^{-3}- 10^{-2} mole/kg H_2O) at high concentrations of fluorides (1.0 mole/kg H_2O and greater). It provides the possibility for mass transfer of tantalum by hydrothermal solutions. It has been estimated that dependences of Ta_2O_5 solubility on F-ion concentration are similar in all fluoride solutions (HF, NaF, KF, LiF) and have strongly positive trend at low concentrations of fluorides (0.01 and 0.1 mole/kg H_2O). The highest tantalum content was detected in HF solutions (up to 10^{-1} mole/kg H_2O) at high concentrations of fluorides (1.0-2.0 mole/kg H_2O). At that, Ta_2O_5 solubility has distinct linear dependence on HF concentration. A little bit below Ta_2O_5 solubility was detected in KF solutions (up to 10^{-2} mole Ta/kg H_2O in 2.0 m KF).

Ta_2O_5 solubility is also high enough in NaF and LiF solutions. It has linear dependence on NaF concentration at low concentrations of fluorides (0.01-0.5 mole/kg H_2O) but then, having achieved 10^{-2} mole Ta/ kg H_2O in 0.5 m NaF, stops practically to change with increasing NaF content that can be explained by limited solubility of NaF at T-P of the experiments.

The high tantalum content ($0.5 \cdot 10^{-3}$ mole Ta/kg H_2O) was also detected in LiF solutions at low concentrations of F-ion (0.1 mole/kg H_2O) that can be compared with Ta_2O_5 solubility in 0,1m HF ($0.1\ 10^{-3}$ mole / kg H_2O).

May be concluded that Ta_2O_5 solubility has positive linear dependence on the total F-ion content in fluoride solutions of different cationic composition (HF, KF, NaF, LiF) having achieved maximum in 2.0 m HF (10^{-1} mole/kg H_2O) at T=550°C, P=1000 bar; buffer Co-CoO.

The obtained data (fig. 1) show similar dependences of Ta_2O_5 solubility on F-ion concentration in all investigated fluoride solutions (HF, NaF, KF, LiF). All curves can be approximated by straight lines having close slope. All available data correlate well. The values of Ta_2O_5 solubility can differ 1 order of magnitude in different solutions. Sharp curve on a plot at level of 0.1 mole/kg H_2O for NaF can be explained by limited solubility of NaF at high temperatures. Our experimental results provided evidence that the solubility of Ta_2O_5 depends on F-ion content and also demonstrated the importance of complexing agents, especially fluorine, in the transport of such elements as tantalum.

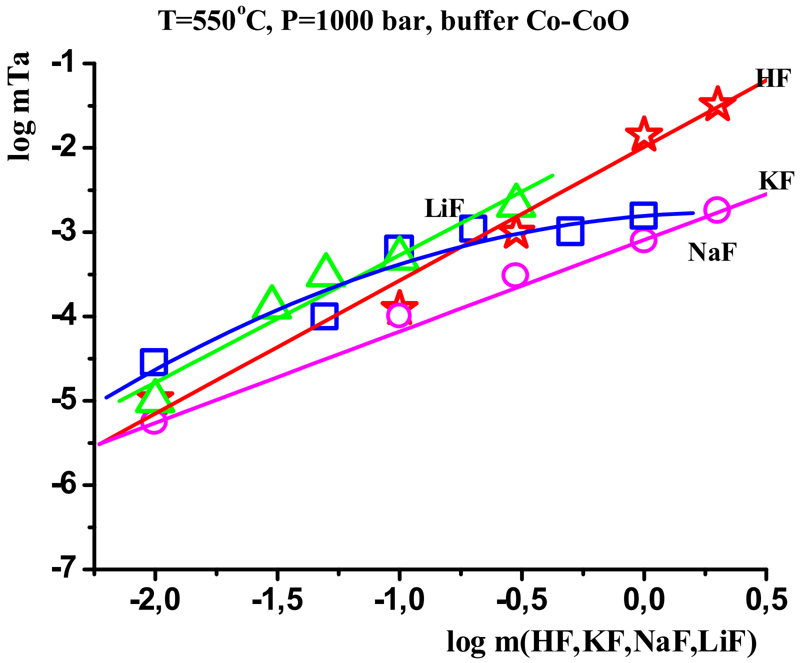

Fig.1. Concentration dependence of Ta_2O_5 solubility at T=550° C, P=1000 bars in fluoride solutions HF, KF, NaF, LiF (Co-CoO buffer)

Financial support by RFBR, projects 05-05-65233 and Science school grant SS-7650.2006.5.

References

1. *Beus A.A., Severov E.A., Sitnin A.A. and Subbotin K.D.* Albitized and greisenized granites (apogranites). Moscow. Akademiia Nauk SSSR. 1962. 196 p. (In Russian).
2. *Zaraisky G.P., Korzhinskaya V.S.* Experimental study of columbite solubility in fluoride, chloride and carbonate solutions at T = 300, 400, 500°C, P =500 and 1000 bar at the presence of the oxygen buffer NiO and Co-CoO // International Conference "New Ideas about the Earth Sciences". Math. Dokl. V. 2. - M.: MSGPU. 2005. PP.86.

Electronic Scientific Information Journal "Herald of the Department of Earth Sciences RAS" № 1(24)'2006
ISSN 1819 – 6586
Informational Bulletin of the Annual Seminar of Experimental Mineralogy, Petrology and Geochemistry – 2006
URL: http://www.scgis.ru/russian/cp1251/h_dgggms/1-2006/informbul-1_2006/hydroterm-10e.pdf