EXPERIMENTAL STUDY OF QUARTZ SOLUBILITY IN HF-H_2O SOLUTIONS AT 1000°C AND 0.3 GPa (3 kbar) PRESSURE

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Quartz is the mineral widely distributed in the nature and participating in formation of many magmatic rocks at high temperatures and pressure. Concentration of silica in a fluid is one of major factors of many hydrothermal and metasomatic processes. Quantitative its estimation in natural fluids is one of actual problems of modern geochemistry. On the other hand, rich fluorine fluids accept active participation in formation of many rocks, first of all, rare metal granite, pegmatite and deposits. Estimations of concentration of fluorine in the fluids which were taking part, for example, in formation of Ta-Nb deposits Orlovka and Etyka, show, that these concentration can reach up to 2m (mol/kg H_2O) [1]. In fluoride solutions, at increased concentration HF in a solution, solubility of silica can sharply grow, when in a hydrothermal fluid start to prevail hydroxide-fluoride complexes.

Solubility of quartz in fluoride solutions remains still poorly investigated especially at high *P-T* parameters. The given message is devoted to preliminary results of an experimental study of quartz solubility at 1000°C and 0.3 GPa (3 Kbar). Solubility of quartz was determined by a method of weight loss of a monocrystall. Natural quartz from a nucleus ceramic pegmatite (North Karelia) has been used as an initial material. Experiences are carried out in a gas bomb, in Pt ampoules, in solutions with concentration HF in a range 0.01-5m. Duration of runs made 1 day. Results of experiments are presented in table 1 and on fig. 1.

Table 1. Results of experimental study of quartz solubility in HF-H_2O solutions at 1000°C and 3 Kbar (0.3 GPa) pressure

No	weight loss of Qtz, g	weight of solution, g	weight of H_2O, g	log m_{HF}	log m_{SiO2}	m_{HF}	m_{SiO2}
1	0.00278	0.09671	0.09669	-2	-0,32011	0.01	0.47851
2	0.00324	0.09828	0.09808	-0,97062	-0,25980	0.107	0.54980
3	0.0044	0.10003	0.09926	-0,38722	-0,13207	0.41	0.73779
4	0.00593	0.09692	0.09511	0	0,016054	1	1.03766
5	0.00816	0.0987	0.09579	0,20412	0,15162	1.6	1.41781
6	0.00863	0.09079	0.08691	0,37107	0,21818	2.35	1.65265
7	0.01465	0.09893	0.09375	0,46389	0,41512	2.91	2.60087
8	0.05012	0.10721	0.09829	0,67943	0,92877	4.78	8.48721

According to calculations on equation by Manning [2] at 1000°C and 3 Kbar solubility of quartz in pure water should make 0.82926 m (log m_{SiO2} = - 0.08131). In our runs SiO_2 concentration in solutions were 0.48 m at 0.01m HF and grew up to 7.78 m at 4.8m HF. At the least concentration HF the SiO_2 concentration appeared almost in 2 times below as for pure water. From fig. 1 it is visible, that at concentration 0,01m HF the silica concentration should be already close to solubility in water to which it asymptotically aspires at reduction of concentration HF in water. It is obvious, that results of calculation of quartz solubility in water at these parameters are not correct and the author of work [2] notes fairly, that the settlement range of his equations is 25-900°C.

From fig. 1 it is visible, that at 1000°C solubility of quartz starts to grow quickly with concentration HF already above 0.1m and especially sharply accrues, when concentration HF exceed 1m. In experience with concentration 4.78m HF the initial crystal of quartz was dissolved practically completely. Approximately solubility of quartz in the investigated range of parameters can be described by a relation:

$$\log m_{SiO2} = 0.23862\ m_{HF} - 0.2789\ \ (\pm 0.052).$$

A plenty white powder amorphous silica is marked in hardening solutions of runs with high concentration of HF.

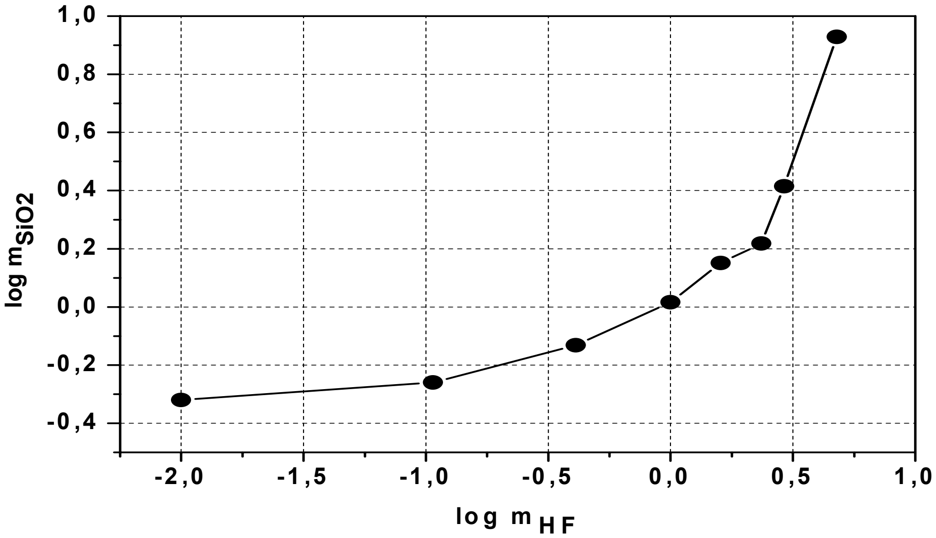

Fig.1. Solubility of quartz in fluids, according to experimental data at 1000°C and pressure 0.3 GPa (3 Kbar).

If to accept fourfold coordination of dissolved silica particles at the highest, investigated by us, concentration HF in a solution where prevail hydroxyl-fluoride silica complexes then the total "apparent" complex should be close to $SiF(OH)_3$.

X-ray diagrams (operator O. Samokhvalova, IEM RAS) show that quartz after experience keeps structure of initial quartz. Hardening amorphous silica forms well expressed "halo" with a precise maximum near to reflection with d = 4.167 and to several pinnacled "fluctuations" on "slopes" "halo", repeating on several of the investigated samples.

Microprobe analysis of amorphous hardening products shows presence at their structure of fluorine at amount up to 4-5 wt. %.

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