EXPERIMENTAL STUDY OF FLUORINE LEACHING OF GRANITES AT ROOM CONDITIONS AND 90°C

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Fluorine is one of widely widespread chemical elements of natural underground waters and hydrothermal fluids. On the one hand, F plays important role in formation of fluorite and many rare metal deposits connected with granite magmatic and/or postmagmatic processes. On the other hand, F is ecologically important element of natural potable waters. Fluorine concentrations in drinking water in a range 0.6-1.5 mg/l are accepted ecologically safe for the person. Less concentration of fluorine in the waters causes caries, higher one causes fluorous.

Processes of fluorine leaching of rocks remain poorly experimentally studied. The most interesting objects for the experimental researches are granites. They very often contain the increased concentration of fluorine. Granites or related to the granite rocks represent also the most widespread source of fluorine in natural underground waters. Among experimental estimations such fundamental value as leaching rate of fluorine from rock (or rock powder) surface are interesting, first of all. Other important task of such experiments may be to estimate fluorine concentration level in the water reached during water-rock interaction.

The brief description of granite samples

In our leaching experiments the samples of two different types of granites with different contents of fluorine were used. The granites were sampled in area of the Orlovka Ta-Nb deposit located in East Transbaikalia. Brief data on chemical and mineralogical composition of the granites are presented in the table 1. In more detail see in [1, 2].

Table 1.

Initial chemical composition of granite

wt. %	Biotite leucogranite	Li-F ab-amz granite
SiO_2	73.64	72.74
TiO_2	0.17	<0.01
Al_2O_3	14.69	16.14
FeO	1.57	<0.3
MnO	0.03	0.12
MgO	0.34	<0.1
CaO	0.18	0.05
Na_2O	3.95	4.26
K_2O	4.36	5.78
F	0.12	1.4
Total	99.05	100.49

Initial mineral composition of granite

	Biotite leucogranite	Li-F ab-amz granite
Initial	surface of	powders
(m^2/g)	0.28	0.12
Mineral	composition,	vol. %
qtz	29.3	18.8
kfs	31.5	27.0
ab	28.8	42.5
bt	3.5	
ms/ser	6.2	
Li-mica		7.4
toz		3.5
access.	0.7	0.8

Biotite leucogranite contained initially 0.12 wt. % of F, but Li-F albite-amazonite, topaz bearing granite was rich in F more as 10 times, 1.4 wt. %. Initial specific surfaces of the granite powders were close, 0.28 m^2/g and 0.12 m^2/g, accordingly.

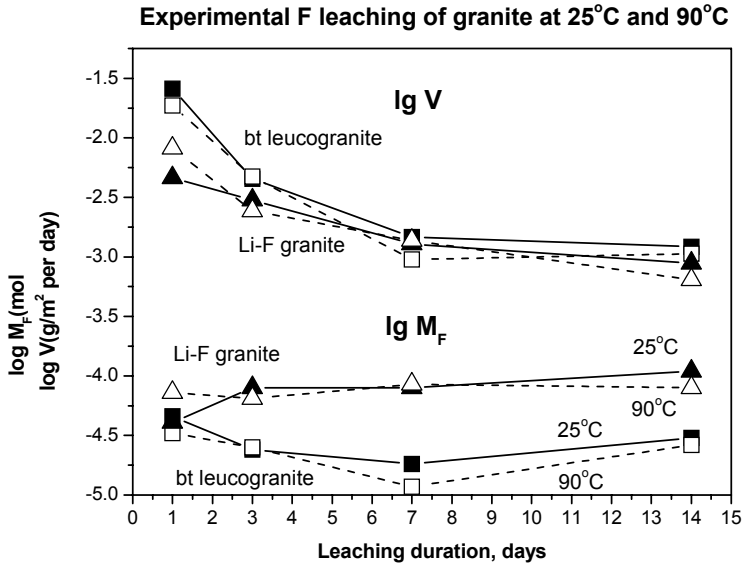
The experimental technique

Experiments were carried out in the closed polypropylene ampoules at room conditions and in a thermostat at 90°C. The rinsed fractions of the granite with the sizes 0.16-0.2 mm were used for the experiments. The 0.6-1.2 g of the fractions with preliminarily measured BET method specific surface placed in volume 15 ml together with water in the ratio 1:10. Initial pH of the three-distillired, saturated

with air water was 5.6-6.2. Each experiment consists of four stages with duration 1, 3, 7, and 14 days. After each stage all solution was taken off for the analysis and the new portion of water was added to the dried up powder. The new water-rock ratio maintained equal 1:10. The maximum leaching time after 4 stages was 25 days. Concentration of F in water was measured by standard ion-selective method. Experiments at two temperatures 25°C and 90°C allow estimate a temperature effect on the leaching processes.

Results of experiments

The used experimental technique allows to study fluorine leaching from a granite in some stages when each new stage of leaching begins with already modified on a past stage of run surface of the rock grains, but again with pure water. Schematically, it is a model of washing cracked granite by a series of portions of fresh superficial waters. Results of the experiments shows both the F leaching rate from granite on each stage of runs, and the kinetic of the leaching process in time.



Results of experiments have shown (Fig) that the F concentration in water in equilibrium with granite was in the range 10^{-5}-10^{-4} mol/l and varied in time not monotonously. For Li-F granite it remained almost 10 times higher as for biotite leucogranite. Temperature effect on the F concentration in water is ambiguous, but it remained rather small for the same granite in comparison with different granite types. Initial (after 24 hours) F leaching rate was about 0.025 g/m^2 day that decrease in time and approached for different types of granite. After 25 days the rates might decrease up to $6*10^{-4}$ g/m^{2}day. Temperature effect for the leaching rates is even less expressive, than for values of F concentration in water.

References

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