SULPHATE- BEARING SODALITE STABILITY UNDER HYDROTHERMAL CONDITIONS

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Introduction

As it was shown in work [1], NaCl- bearing sodalite stability (rather nepheline) at different temperature is in dependence on NaCl concentration in water solution.

The position of monovariant reaction: 6 $NaAlSiO_4 + 2NaCl = Na_8Al_6Si_6O_{24}Cl_2$ (1) was determined in coordinates: temperature - NaCl- concentration.

The equilibrum concentration of NaCl in a solution (for reaction 1) at various temperature is presented in Table 1. Sulfur has the important role in mineral forming fluid. Therefore the aims of this work were: (1) to study the stability of SO_4-bearing sodalite (nosean) in dependence on temperature and concentration of Na_2SO_4 in a solution (at $Ð_{fl}$ = 2kbar); (2) to study the anion isomorphic replacement in the join NaCl- sodalite - nosean solid solutions.

Experimental Study

1. The runs on nosean stability were carried out by the capsule method in cold-seal hydrothermal vessels with external heating (accuracy of temperature control was ±5°C; pressure ±50 bar). The run duration was 4-21 days. Method of "the large ampoule" was used for the control of the Na_2SO_4 - concentration in fluid: the ratio sample:fluid was 1:20.

The analysis of the run products was carried out by the immersion method and X-ray method. It was shown, that SO_4- sodalite is stable relatively nepheline at concentration Na_2SO_4 (≥2 wt.% - 600°C; ≥1wt.% - 700°C; and ≥5wt.% - 800°C). Data of nosean stability is listed in Table 1.

The refinement of the unit cell parameters of the Na_2SO_4- bearing sodalites synthesized at various temperature was caried out. It was shown, that they do not differ (within the limits of accuracy of calculation).

2. The runs on synthesis of (Cl, SO_4)- sodalites solid solutions were carried out under hydrothermal conditions at temperature 700°C and pressure of fluid 3 kbar. Starting material for the sodalite solid solution synthesis was gel of $NaAlSiO_4$ composition. The composition of the synthesized sodalite solid solutions was set by a ratio ($NaCl/Na_2SO_4$) in an initial solution. Run duration was 15 days. The composition of sodalite solid solutions was determined by microprobe method (accuracy not worse 2 mol.%); the X-ray study have allowed to refine unit cell parameters of the synthesized sodalite solid solutions.

The data of microprobe and X-ray study of sodalite solid solutions have shown, that in the investigated join of solid solutions (NaCl- sodalite - nosean) there is an immiscibility gap at composition X_S^{Sod} = 0.024(4) ÷ 0.71(7). The unit cell parameters of synthesized solid solutions are listed in Table 2.

Conclusions

1. The field of nosean stability is determined depending on temperature and Na_2SO_4 concentration in hydrothermal solution.

2. The solid solutions chlorine sodalite - nosean are investigated. The existence of extensive area of immiscibility of solid solutions is shown. The unit cell parameters of synthesized sodalite solid solutions are specified.

1. Kotelnikov A.R., Zhorniak L.V. Stability of NaCl-sodalite under hydrothermal conditions. Geochemistry, 1994, N 12, pp.1809-1812.

Table 1

Stability of NaCl- and Na_2SO_4- bearing sodalites in dependence on the salt concentration of the hydrothermal fluid at different temperature (P_{fl} = 2-3 kbar)

NaCl- sodalite		Na_2SO_4 - sodalite	
t, °C	Equilibrium concentration of NaCl (wt.%)	t, °C	Equilibrium concentration of Na_2SO_4(wt.%)
600	17.5	600	2
700	25	700	1
800	37.5	800	5

Table 2

Unit cell parameters of sodalites solid solutions (NaCl- sodalite - nosean)

Run no	X_S^{Sod}(I)[1)]	X_S^{Sod}(II)	a,[A] (I)	a,[A] (II)	V,[A]^3 (I)	V,[A]^3 (II)
4953	0.024(9)[2)]	0.67(6)	8.880(1)	9.048(1)	700.1(2)	740.7(1)
4954	0.022(6)	0.75(7)	8.879(2)	9.060(2)	700.0(2)	743.6(2)
4955	-	0.71(3)	-	9.047(1)	-	740.3(2)
4956	-	0.74(4)	-	9.053(1)	-	742.1(2)
4957	-	0.82(1)	-	9.060(2)	-	743.7(1)
4958	-	0.90(1)	-	9.065(1)	-	744.8(2)
4959	-	0.90(5)	-	9.068(2)	-	745.7(3)
4960	-	1.00	-	9.070(1)	-	746.2(1)

1) phases of sodalite solid solution coexisted in run products: (I) - the chlorine sodalite, (II) sulphate- sodalite.

2) The errors of accounts are given in brackets and concern to last decimal place.