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Albite ordering under hydrothermal conditions

A. R. Kotelnikov[1], T. I. Tschekina[2]
[1]Institute of Experimental Mineralogy RAS, Chernogolovka
[2]M. V. Lomonosov Moscow State University, Department of Geology, Moscow
kotelnik@iem.ac.ru, fax: 8 (496) 524 4425, tel.: 8 (496) 524 44-25

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Structural state of albite is a good indicator of mineral genesis conditions. Earlier it has been shown [*McKenzie,* 1957; *Taylor,* 1967] that aluminum distribution between unequivalent positions in albite structure depends on the temperature. Quite disordering "high" albite contains ¼ aluminum atoms in every alumosilicic tetrahedron $(Al,Si)O_4$. But in quite ordering "low" albite all aluminum places in tetrahedron $T_1(0)$ [*Taylor,* 1967; *Deer, et al.,* 1966]. Cell parameters of albite change depending on structural condition [*Kroll&Ribbe*, 1980]. It has been shown [*Bambauer, et al.,* 1967a, b] the connection between albite structural state and distance between 131 and 1-31 peaks which is usual to mark as Δ131. For high albite Δ131 is 2.01 (Cu-K_α) and for low albite Δ131 is 1.06(Cu-K_α). The dependence of Δ131 parameter of synthetic albite on temperature was studied in works of different authors [*McKenzie*, 1967; *Mason*, 1979; *Martin*, 1969; *Senderov, et al.,* 1971]. It has to mark the works of Martin and Senderov in which the high alkalinity of solution is shown to essentially influence to the structural condition of albite: the increase of solution pH promoted the forming of more ordering albites. The experimental data connected the Δ131 parameter and temperature have been obtained in temperature interval 350–1000°C. But because of some causes estimated by kinetics of ordering processes the experimental data obtained at the temperature >400°C are in better agreement. The purpose of our work was to study the processes of ordering albite synthesis at low temperature (200–500°C) and to obtain the dependence of Δ131 on temperature at T<500°C. Albite synthesis was carried out under hydrothermal conditions at temperature 200÷500°C and pressure 0.5÷1.0 kbar. Gel mixtures of albite composition with addition of 10 wt% amorphous SiO_2 were used as initial mixtures. Synthesis was carried out in NaOH and $Na_2SiO_3*9H_2O$ solutions with the concentration of 2÷10 wt%. The alkaline solutions activate the synthesis of ordering feldspars as it has been previously shown [*Martin,* 1969; *Senderov, et al.,* 1971]. Experimental duration was up to 65 days.The natural low albite was added to initial mixture (1÷2 wt% of charge mass). Low albite and quartz (and sometimes sodium silicates) were detected in run products. Microprobe analysis has shown a good correspondence of synthetic albites to $NaAlSi_3O_8$ formula. Cell parameters of albites were calculated by X-ray study data. The data obtained are presented in tabl. 1 and fig. 1. These high degree ordering albites with Δ131=1.087 (for Cu-K_α) were synthesized first at 200°C and 0.5 kbar.

The analytical dependence of albtite ordering degree on temperature has been calculated. This dependence may be used as geothermometer for albite-bearing mineral paragenesis:

t,(°C)=[-1255.2+1356.6*(Δ131)] ±20°C.

This equation is worked adequately in temperature interval 100÷500°C.

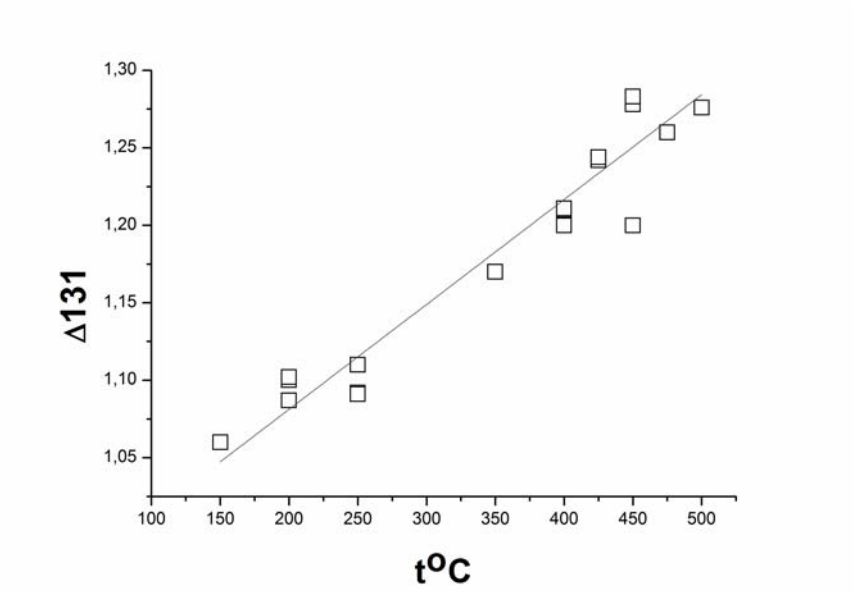

Fig. 1. Temperature dependence of Δ131 parameter of synthetic albite

Table 1. Cell parameters of albite synthesized under hydrothermal conditions (*t*= 200 ÷ 500°C; *P*=0.5-1.0 kbar) in solutions of sodium hydroxide and sodium silicate

N	*t/p*[1)]	a,[A][2)]	b, [A]	c, [A]	α, [°]	β, [°]	γ, [°]	V, [A]^3	Δ131[3)]
6311	200/0.5	8.136	12.786	7.159	94.26	116.59	87.69	664.1	1.10
6312	200/0.5	8.137	12.788	7.159	94.25	116.60	87.71	664.2	1.087
6313	200/0.5	8.137	12.787	7.159	94.26	116.60	87.69	664.2	1.102
6338	250/0.5	8.137	12.787	7.159	94.27	116.60	87.70	664.2	1.107
6339	250/0.5	8.139	12.786	7.159	94.26	116.61	87.70	664.2	1.092
6340	250/0.5	8.136	12.783	7.160	94.29	116.59	87.65	664.0	1.091
5703	400/1	8.141	12.795	7.154	94.21	116.60	87.96	664.6	1.211
5834	400/1	8.140	12.793	7.154	94.20	116.60	87.97	664.4	1.210
5840	425/1	8.140	12.795	7.152	94.16	116.58	88.08	664.4	1.242
5841	425/1	8.140	12.791	7.151	94.12	116.57	88.11	664.3	1.244
5846	450/1	8.141	12.802	7.148	94.11	116.57	88.20	664.5	1.278
5746	450/1	8.141	12.802	7.146	94.09	116.55	88.23	664.5	1.283
5850	500/1	8.141	12.801	7.147	94.08	116.55	88.24	664.6	1.281

1) *t/p* – temperature (°C)/pressure (kbar);
2) parameters means are presented in angstrom, angles – in degree;
3) Δ131 – distance between 131 and 1-31 peaks (Cu-$K_{\alpha 1}$)

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