A reinterpretation of monalbite

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Summary. A neutron activation analysis of one of the crystals of 'monalbite', which was monoclinic at room temperature, shows that it contains a large proportion of potassium. It is thus not a polymorph of pure $NaAlSi_3O_8$. The contamination occurred by transfer of K through the atmosphere of the furnace from potassium-bearing ceramic materials.

In recent years evidence has accumulated to show that natural albites become monoclinic on long heating at temperatures in the range 900–1050° C, as shown by the development of microcline-type twinning on cooling (Baskin, 1956; Schneider, 1957; Brown, 1960; Robinson, 1961). Such material was called monalbite when monoclinic (Schneider and Laves, 1957). One sample of very pure albite from Schmirntal, Austria, after prolonged heat treatment, remained monoclinic at room temperature (Brown, 1959, 1960; Robinson, 1961). The monoclinic material was considered to have been produced by further disorder (Brown, 1960; Laves, 1960). The exact nature of the crystals that were monoclinic at room temperature was not clear soon afterwards because of the failure of other workers using other materials to reproduce monalbite (see MacKenzie and Smith, 1961), the fact that sodium exchange of high-sanidine yields high-albite and not monalbite (experiments of the writer and also D. B. Stewart, personal communication), and the inability of Hall and Quareni (this vol., p. 78) to reproduce monalbite using the same starting materials as the writer.

It was suggested to the writer by D. B. Stewart (personal communication, October 1964) that albites heated for long periods in furnaces with potassium-containing walls might become contaminated with potassium. It was therefore decided to investigate the composition of the heated Schmirntal specimen (Brown, 1960, pp. 312–313, no. 66).

A neutron activation analysis was therefore carried out on specimen no. 66 (weight $5{\cdot}6 \pm 0{\cdot}1 \mu g$) and on a fragment of the original unheated

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albite for comparison (weight 8·9±0·1μg). The two samples were irradiated for 12 hours in a neutron pile at Harwell and counted 8–10 hours later; such a long irradiation period was necessary because of the very small weights of the samples. Sodium was determined by counting 2·75 Mev X-rays and potassium by counting 3·6 Mev electrons. The count rates for both K and Na were converted to the amount of element present by standards of weight about 40 mg irradiated under the same conditions. Because the samples were so small, the precision is not high.

The sample of unheated albite was found to contain 0·63 μg of Na_2O corresponding to 5·3 μg of albite, and little or no K. The sample of 'monalbite' contained 0·10 μg of Na_2O and 0·47 μg of K_2O, corresponding to 0·9 μg of Ab and 2·9 μg of Or and a total feldspar weight of 3·8 μg. Both results are low in comparison with the directly observed weights, by roughly the same proportion; this is possibly due to geometrical factors in the counting set-up, when samples and standards are of such different size. In any case it is clear that the heated sample was highly contaminated with potassium. The bulk composition found from this work (about Or_{75}) is richer in K than would have been predicted from the lattice parameters of the specimen (about Or_{30-40}). It is not certain whether this discrepancy is outside the limit of error of the counting experiment. When studied in 1958 (Brown, 1960) it was observed under a microscope that the specimen consisted of a crystalline core and a glassy margin. It is not known whether this difference in state also represents a difference in composition. Unfortunately, the crystal was lost on reweighing after the neutron activation analysis and the observation that the crystal had turned to glass (Hall and Quareni) could not be repeated.

The observation of changes in lattice parameters on heating other materials[1] may also be due to potassium contamination. Since care was always taken by the three workers to avoid contact of the samples with ceramic containers[2] or the walls of the furnace, it seems certain that transfer of potassium was through the atmosphere of the furnace, a most surprising conclusion.

It does not follow that all reported effects of heating high-albite are to be ascribed to contamination by potassium. Thus the possible

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[1] An increase in α^* by at least 20′ found in ten ternary plagioclases of composition up to about An_{32}, and none failed to show similar changes (Brown, 1960, table 3). Robinson (1961, tables 2–5) obtained similar results with four albites.

[2] The samples were always placed in platinum boats inside ceramic boats. Neutron activation analyses of two of the boats used gave values of 2·5 and 2·9 % K_2O and of 0·27 and 1·0 % Na_2O respectively.

existence of a monoclinic form of pure $NaAlSi_3O_8$ at high temperatures is not necessarily excluded (see new evidence by Grundy, Brown, and MacKenzie, this journal, p. 83), but there is now no evidence for its existence at room temperature.

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