

Acknowledgements. I have to thank Dr. Duncan McKie for critical discussion of the paper and Dr. M. V. Wilkes for the provision of computing facilities in the University of Cambridge Mathematical Laboratory.

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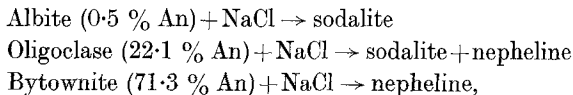
References

- DEMING (W. E.), 1938. Statistical adjustment of data, 1st edn. New York.
SMITH (J. V.), 1956. *Min. Mag.*, vol. 31, p. 47.

Plagioclase reactions

DURING experiments with plagioclase feldspars, two unexpected effects were observed that do not appear to have been reported elsewhere. Sufficient work was carried out to ensure that the effects were real, but no further investigation is intended: the results are merely reported here as interesting phenomena.

Reactions with NaCl. Powders of crystalline plagioclase and rock-salt were mixed in equal proportions by weight and heated in a covered platinum crucible to 700° C for a day or so and then quenched in air. X-ray powder photographs showed the following crystalline components after the heat-treatment:



while a subsidiary experiment showed that a naturally occurring nepheline heated with rock-salt under the same conditions gave:



and so the primary product in the plagioclase reactions might always be nepheline. However, although albite was heated with very small proportions of rock-salt (about 10 % by weight) so that no excess NaCl would be left for further reaction if nepheline were formed first, only traces of the *sodalite* pattern were found: thus nepheline does not seem to be the primary product with albite.

The albite reaction was studied in slightly more detail. Powdered albite glass and rock-salt also produced sodalite at 700° C, but at temperatures of 650° C and below neither glassy nor crystalline albite showed any reaction after heating for 1 day. At 700° C all mixtures

showed some change after 1 day and considerable change after 2 or 3 days.

The plagioclases used were a low albite of 0.5 % anorthite content, judged from its powder pattern; the oligoclase and bytownite were chemically analysed specimens, the former containing 3.5 % of orthoclase. All the heat-treatments were at atmospheric pressure and so no water could be present.

Plagioclase and quartz. A natural oligoclase of 16.5 % anorthite by weight, and containing also 19 % free quartz, was given heat-treatment to invert it to the high-temperature form. As the treatment proceeded it was noticed that the quartz reflections on X-ray powder photographs were diminished in intensity, finally vanishing completely. Several specimens were treated independently and all showed the same effect, complete disappearance needing typically about 7 to 8 days at 1000° C. No additional X-ray reflections appeared that might indicate a new crystalline phase.

The reciprocal lattice parameters of this specimen showed an unexpected value of c^* ($= 1/d_{001}$). Values of d_{001} for high-temperature soda-rich plagioclases lie in the range 6.352 Å to 6.358 Å with those for low-temperature materials all greater than this. Yet the oligoclase had d_{001} changing from 6.368 Å in its natural state to 6.344 Å on heating, even though other parameters indicated that it was still not fully inverted.

An artificial mixture of synthetic albite (5 % anorthite) with 20 % quartz was heated at 900° C for a total of 88 days with no change in the relative strengths of the albite and quartz reflections in the X-ray powder patterns. The lower temperature was necessary because the melting-point of albite is lower than that of oligoclase.

A specimen of bytownite (71.3 % anorthite) was mixed with 10 % of its weight of quartz and heated for 10 days at 1000° C, and a slight reduction in the relative intensity of the quartz reflections occurred. Simultaneously, another specimen of bytownite was heated alone and its powder pattern compared with the first after heat-treatment: not the slightest difference could be detected.

A specimen of oligoclase (22.1 % anorthite) was mixed with 20 % of its weight of quartz and heated for 4 days at 1000° C. Again a slight diminution of the intensity of the quartz lines resulted and this time there were also slight but detectable differences between the powder patterns of this specimen and those of one heated simultaneously without quartz.

These experiments suggest that in selecting natural specimens of

plagioclase for heat-treatment care should be taken to ensure the absence of free quartz. Interactions between plagioclases and other substances would possibly be more likely while the feldspar was going through a transition from a low- to a high-temperature structure. This might explain the negative result with the synthetic albite, which already has the high-temperature structure and thus undergoes no transition.

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THE occurrence of garnetized gabbro dikes from Byne Hill, one mile south of Girvan, was recorded by Bloxam (1954). These dikes are intrusive in serpentinite and have been considerably altered, containing chlorite, prehnite, pectolite, and garnet. Chemical analysis of the rock (Bloxam, *op. cit.*, p. 527) indicated affinities with the rodingites, and the refractive index and density of the garnet suggested that it might be a hydrogrossular (Hutton, 1943).

Similar dikes of doleritic texture cut serpentinite along the shore near the Sailor's Monument, 600 yards north of Lendalfoot. The marginal phases of the dikes are extensively garnetized and a pure extract of the mineral was obtained. Like the Byne Hill rock, the garnet occurs chiefly in the form of granules ranging in size from 0.05 to 0.01 mm, which are tightly packed and generally pseudomorph plagioclase in association with prehnite and chlorite.

The separated garnet powder is pale grey in colour and isotropic except for inseparable marginal zones, which are weakly birefringent with a refractive index of 1.683. The chemical analysis (below) must therefore be regarded as composite and probably includes uncertain proportions of grossular, plazolite, and hibschite (Hutton, *op. cit.*, p. 179). The chemical analysis and physical properties are comparable with the hydrogrossular of Hutton. The structural formula has been calculated following McConnell, 1942, and Deer, Howie, and Zussman, 1962: SiO₂ 34.59, TiO₂ 0.15, Al₂O₃ 20.81, Fe₂O₃ 0.99, FeO 0.29, MnO 0.05, MgO 1.20, CaO 36.13, Na₂O 0.01, K₂O nil, H₂O⁺ 4.91, H₂O⁻ 0.36, P₂O₅ nil, total 99.49 %; sp. gr. 3.30, *n* 1.683 to 1.712, *a* 12.08 Å; atomic ratios to 24 oxygen, Si 5.025, H/4 1.260 (sum 6.285), Ti 0.001, Al 3.563,