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Beryl and cleavelandite from Bihar, India

ABOUT ½ km NNW. of Rola village and 6 km E. of Hazaribagh, Bihar, a discordant body of beryl-bearing pegmatite occurs in a highly garnetiferous hornblende schist, which is in its turn a large xenolith in a fine-grained granite (23° 59′ 45″ N., 85° 25′ 22″ E.). The pegmatite, of perthite–cleavelandite–quartz type, is fine-grained on the margins and coarser inwards, and contains numerous pear-shaped masses of cleavelandite, grown radially around tapered crystals of beryl; the tapered habit of the beryl is probably due to interference by the growing cleavelandite (cf. Shaub, 1937). These cleavelandite–beryl bodies are almost always rimmed by about 5 mm of a pinkish-brown microcline–perthite, which in places penetrates between the radiating cleavelandite crystals. Columbite occurs occasionally adjacent to the beryl crystals; rarely the cleavelandite is associated with biotite, and in one or two places bismutite is present.

The beryl is fairly rich in alkalis; an analysis by the Analytical Division, Bhabha Atomic Research Centre, Bombay, gave: SiO_2 63·54, Al_2O_3 18·60, total iron as Fe_2O_3 0·75, BeO 13·25, MgO 1·26, CaO trace, Na_2O 0·65, K_2O trace, Rb_2O 0·02, Cs_2O 0·19, Li_2O trace, loss on ignition 1·52, total 99·78 %.

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Piercing-point analysis of the system anorthite–diopside–åkermanite

THE ternary system anorthite–diopside–åkermanite (de Wys and Foster, 1958) serves as an approximate partition plane within the quaternary system CaO–MgO–Al_2O_3–SiO_2. Later data (Schairer and Yoder, 1968) tends to indicate that the approximate plane An–Di_{ss}–$Åk_{80}Geh_{20}$ may be regarded as the partition plane instead. Such ternary planes serve to partition the interior of the tetrahedron into smaller tetrahedra that can be isolated and investigated separately. The established ternary system anorthite–diopside–åkermanite simply serves for practical purposes as a partition separating liquids that during crystallization must remain on one side of this partition from those that must remain on the other side. This is true whether fractional or equilibrium crystallization takes place. A number of investigators such as Osborn *et al.* (1954) and Prince (1954) have attempted to develop rapid insight into the quaternary system by developing phase distribution patterns at fixed oxide composition. The former authors investigated the quaternary at fixed five per cent intervals of alumina level while Prince investigated the ten per cent magnesia plane.

The above mentioned fixed oxide per cent planes are intersected by the system anorthite–diopside–åkermanite (fig. 1) and thus one would expect reasonably good correlations to exist between all the experimental data indicated by the phase relationships of the published planes. An attempt was made to determine, by means of a piercing-point analysis, if a good correlation may be observed.

Results and discussion of the piercing-point analysis. The results of the piercing-point analysis are projected on the anorthite–diopside–åkermanite partition plane (fig. 2).

The boundary curve, separating the anorthite and diopside primary fields, obtained experimentally by de Wys and Foster agrees quite well with that obtained from the data of Prince. The experimentally determined boundary curve (de Wys and Foster, 1958) separating the åkermanite (melilite) and anorthite regions also agrees with the one deduced from the published data by Osborn *et al.* (1954) but not too well with that obtained from the data of Prince (1954).

The initial trend of the diopside–melilite subtraction curves obtained by all authors is in general agreement but the various locations of the ternary eutectics show