

DISTRIBUTION OF Ba AND Sr IN MICROCLINE IN SECTIONS ACROSS A GRANITE PEGMATITE BAND IN GNEISS

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A b s t r a c t. Spectrochemical determinations of Ba and Sr in microcline samples taken along 5 sections across a granite pegmatite band in plagioclase gneiss exhibit highly variable concentrations. Particularly low concentrations appear to occur within definite parts, which have apparently formed at later stages than the rest of the pegmatite.

A contour map showing roughly the Ba distribution within the examined part of the pegmatite band has been tentatively constructed.

This is a supplement to an earlier paper by the writer (1). That paper reported on spectrochemical determinations of Ba and Sr in feldspars, and conclusions drawn from this data. Special attention was paid to the granite pegmatite veins and bands within a small area of the plagioclase gneiss complex in the island of Justøy on the Skagerrack coast. It was found that within a single larger pegmatite band, 2 to 3 meters wide, the Ba contents of the microcline may vary by a factor of more than 50, and the Sr contents somewhat less. It might be of interest to examine this particular pegmatite band somewhat more in detail. Last summer I collected a considerable number of microcline samples along 5 sections across the band, all within a length of about 30 meters. Spectrograms of these samples were prepared by Mr. F. Chr. Wolff in the laboratory of the Institute, the conditions — spectrographic equipment, size and shape of the carbon cathodes, current, exposure time, type of plates, development — being exactly the same as in the earlier investigations. The standard

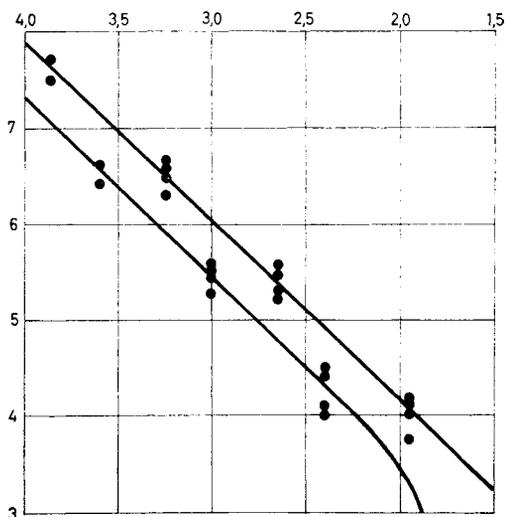


Fig. 1. Working curves. Upper: Ba 4554. Lower: Sr 4607. Dots represent intensity readings in the standard mixture spectrograms. Horizontal scale: concentrations of BaO and SrO in log. p.p.m. Vertical scale: no. of last step easily visible (due to rotating step sector).

mixtures, however, were new and improved. They were made with a Ba- and Sr-rich microcline which had been carefully analyzed for Ba and Sr by the chemist of the Institute, Mr. O. Hagberg, the base substances for 2 series of mixtures being as earlier amazonite and cleavelandite from Tørdal. The mixtures, including the pure analyzed microcline, contained the following concentrations: BaO — 0.72, 0.18, 0.045, 0.009 %; SrO — 0.40, 0.10, 0.025, 0.005 % (apart from a little Sr present in the amazonite). From duplicate spectrograms of each series the working curves shown in Fig. 1 were

obtained. The plots of the individual intensity readings show that the curves may be used with some confidence. The method does not give a very high degree of accuracy: the individual determinations may possibly be in error by as much as ± 50 %; in general they are probably better than this. At any rate this is more than sufficiently accurate for the present purpose.

Comparison with the curves used in earlier investigations (2) shows that the difficulties then met with have now been largely removed. The earlier standard mixtures contained the compounds BaO and SrO, and it is now evident that these mixtures do not evaporate in the carbon arc in the same manner as feldspars containing Ba and Sr in their lattices do. The old working curves for Ba and Sr in amazonite intersected, and the Sr curves obtained from amazonite mixtures did not agree with those obtained from cleavelandite mixtures. The new curves for Ba and Sr are largely parallel, and they are not perceptibly influenced by the base substance (amazonite or cleave-

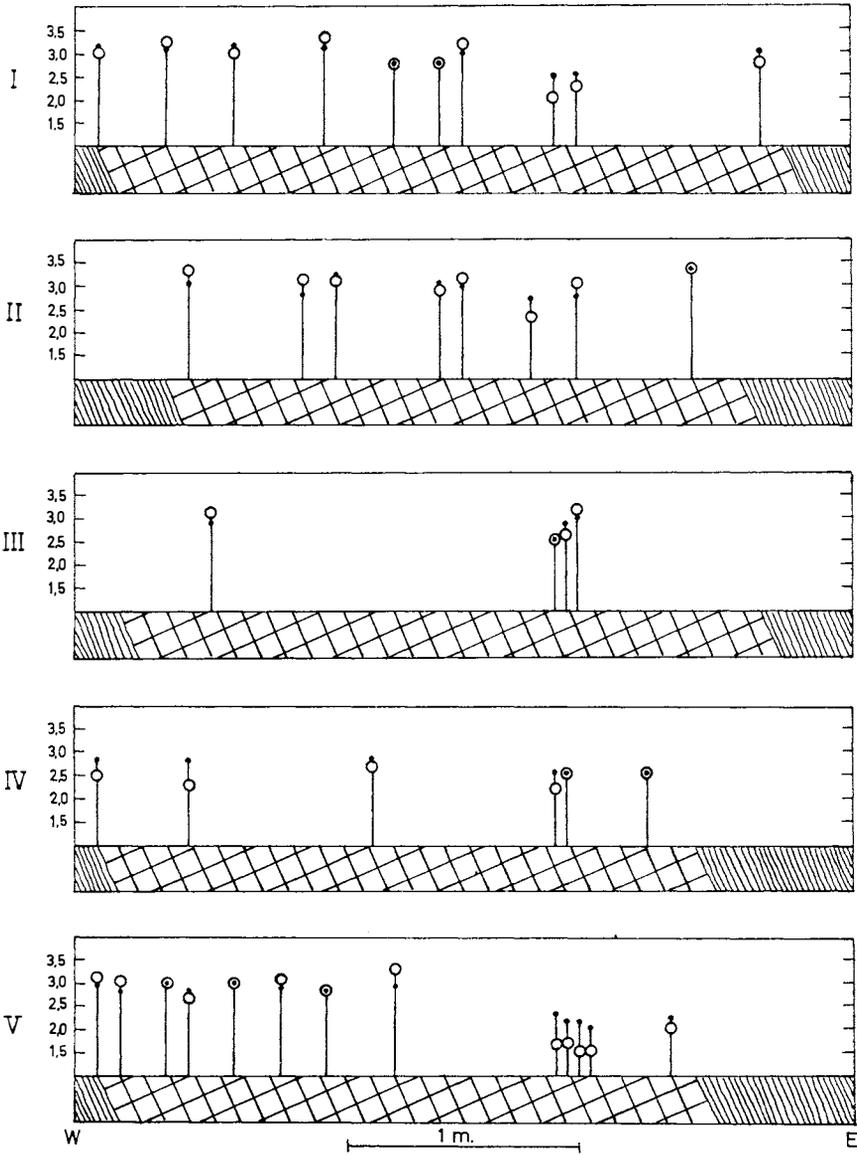


Fig. 2. Distribution of BaO (circles) and SrO (dots) in microcline in 5 sections across the pegmatite band. The gneiss is indicated left and right. Vertical scales: concentrations in log p.p.m.

landite) of the mixtures. Part of the discussion on this matter in the earlier paper (2) is therefore irrelevant. One conclusion to be drawn now is that the Sr line 4607 is more persistent when originating from an amazonite mixture containing the compound SrO than when originating from microcline containing Sr. In spite of this discrepancy the new curves do not give values notably different from the old ones, except in the case of Sr at low concentrations in microcline.

The results of the measurements are shown graphically in Fig. 2. In each of the 5 sections across the pegmatite band a number of ordinates show by their lengths the log p.p.m. of the BaO and SrO contents in microcline at the corresponding abscissae. It is seen that in each section there is a more or less marked drop in the contents near the eastern boundary of the pegmatite band. In section IV there are also low contents near the western boundary. Normally the BaO and SrO contents of the pegmatite microcline appear to oscillate somewhat about 1000 p.p.m., but in certain parts — containing usually particularly coarse and light coloured microcline — the contents may drop below 100 p.p.m. or even 50 p.p.m. for BaO and towards 100 p.p.m. for SrO. It is obvious that these latter microclines have not attained equilibrium with neighbouring microclines richer in Ba and Sr. They must have formed at late stages when the rate of diffusion of Ba and Sr was lower than the rate of crystallization. The interpretation given earlier (1) as to the origin and development of the pegmatites in this area I see no reason to modify in view of the new data.

Fig. 3 is a tentative contour map of the distribution of BaO in microcline in the examined part of the pegmatite band. (SrO is distributed in a similar way, but here the concentration variations are much less pronounced.) Only along the sections I to V the map is based on actual measurements. The contour lines connecting the sections are thus rather uncertain. They may in reality be much more irregular. This is evident from the fact that in some cases the BaO-content has been shown to vary greatly within a distance of a few centimeters; even within a single microcline crystal notable variations appear to be possible. Nevertheless the map gives a picture which must be correct in essentials. The “younger” Ba-poor microcline is found mainly within a zone which widens and narrows irregularly along the pegmatite band. Thus the shape of the Ba-poor part of the pegmatite is not that of a regular band, but it is still notably

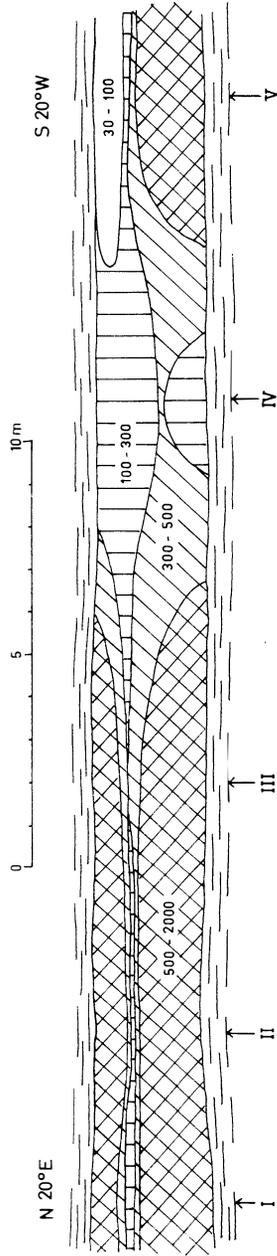


Fig. 3. Tentative contour map of the distribution of BaO in part of the pegmatite band. Position of sections I to V shown. The figures denote parts per million in microcline.

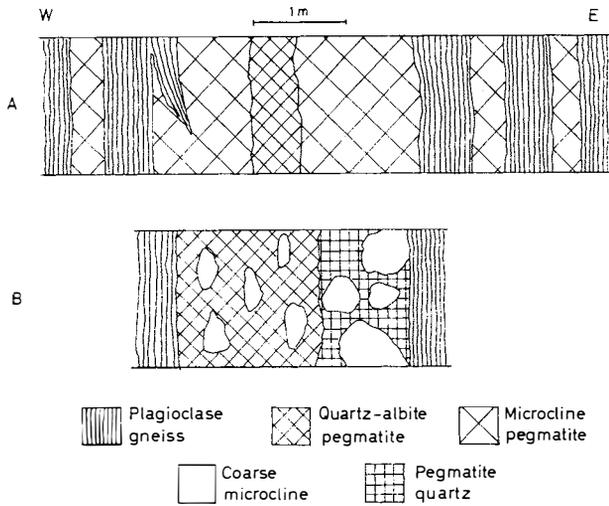


Fig. 4. Two somewhat schematic maps across the pegmatite band. A, near section II. B, at section V. Map A shows smaller companion pegmatite bands; the microcline of these belongs to the Ba- and Sr-rich type.

influenced by the tectonics of the area. The clusters of very coarse-grained and extremely Ba-poor microcline seem to have developed in complete absence of stress action; they are associated with massive pegmatite quartz. Much of the relatively Ba- (and Sr-) rich microcline occurs in the shape of patches within medium-grained quartz-plagioclase pegmatite, which in places forms apparently older parts of the pegmatite band (Fig. 4). The plagioclase (albite-oligoclase) of this kind of pegmatite tends to be somewhat poorer in Sr and Ba than the plagioclase of the country rock (plagioclase-quartz gneiss), but the differences are in general not very marked.

As pointed out above, equilibrium distribution of Ba and Sr between neighbouring feldspar crystals in this pegmatite is not a general rule. However, in some cases of microcline and plagioclase in close association there is a regularity which may possibly indicate equilibrium distribution:

	BaO, p.p.m.	SrO, p.p.m.
1. Microcline	1500	1200
Plagioclase	500	4000
2. Microcline	1000	1200
Plagioclase	600	2000

	BaO, p.p.m.	SrO, p.p.m.
3. Microcline	1000	1000
Plagioclase	500	2000
4. Microcline	5000	500
Plagioclase	500	5000

Number 4 represents 3 pairs taken from contacts between plagioclase of the gneiss and microcline of other, much smaller, pegmatite bands in the same area. In all of these examples the coefficient of distribution of BaO between microcline and plagioclase is seen to be very nearly equal to that of SrO between plagioclase and microcline, even if the actual concentrations vary considerably. In one or two other examined cases the distributions do not follow this rule; this may indicate that in these cases equilibrium has not been reached.

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Manuscript received October 10, 1959.

Printed December 1959.