ferric oxide(?) admixed with muscovite ± chlorite) will not accept staining.

Several attempts were made to test the compatibility of the cobaltinitrite and amaranth stains with the trypan blue stain on sections of fine-grained microperthite-cordierite-oliglocase-bearing granofelses from western Maine. The chief difficulty seems to be in the K-rich feldspar retaining its cobaltinitrite stain through two successive short re-etchings over HF fumes. Judicious overstaining with cobaltinitrite followed by amaranth and trypan staining has so far yielded promising, but far from consistent results. However, no difficulty has been experienced in dual staining of K-rich feldspar and cordierite with cobaltinitrite and trypan blue.

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ON THE STAINING OF ANORTHOCLASE[1]

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Various staining procedures have been used to distinguish feldspar. Literature on the subject has been recently reviewed by D. Laduron

[1] Publication authorized by the Director, U. S. Geological Survey.

(1966). The effects of stain on anorthoclase, however, have not been thoroughly tested. Our recent work indicates that anorthoclase may be easily misidentified as plagioclase in routine modal analysis of stained rock slabs. Staining tests become particularly critical when the rapid modal analysis of porphyritic volcanic rocks is used as suggested by Williams (1960).

Staining effects of sodium cobaltinitrite on anorthoclase phenocrysts in volcanic rocks have been described by Chayes and Zies (1961) who point out that alkali feldspars, including sanidine and anorthoclase, of many volcanic rocks do not respond as readily to the potassium stain as do alkali feldspars of plutonic rocks. K-feldspars may be easily recognized by the yellow reaction produced by sodium cobaltinitrite on rock that has been previously etched by hydrofluoric acid (Gabriel and Cox, 1929; Keith, 1939; Chayes, 1952; and Rosenblum, 1956). Ca-bearing plagioclase is recognized by red reaction products when potassium rhodizonate is used after the slab is dipped in barium chloride solution (Bailey and Stevens, 1960) or when amaranth is used (Laniz, Stevens and Norman, 1964). Albite of composition even as sodic as $Ab_{97}An_{3}$ can thus be stained red according to Bailey and Stevens. The amaranth stain color on sodic plagioclase can be somewhat intensified if the slab is first dipped in a calcium chloride solution, but this method is not known to be effective on pure albite ($Ab_{100}An_{0}$), according to M. B. Norman (oral communication, 1967). None of these authors specifically mentions the results of their plagioclase staining procedures on anorthoclase.

Anorthoclase is an alkali feldspar containing from about 2 to 5 percent K_2O (Deer, Howie, and Zussman, 1963). Staining criteria should, therefore, be similar to that for orthoclase and microcline. Phenocrysts of sanidine and anorthoclase (both with about 40 weight percent Or) in volcanic rocks are poorly stained even after several repeated HF etchings and sodium cobaltinitrite immersions (Chayes and Zies, 1961). In our studies of anorthoclase in volcanic rocks from Antarctica (Boudette and Ford, 1966) we obtained similar staining results. The Antarctic anorthoclase took on a very faint and irregularly mottled yellow color when the sodium cobaltinitrite treatment was used.

The Antarctic anorthoclase reacted to the multifeldspar staining method outlined by Laniz and others (1964) as does plagioclase. Anorthoclase phenocrysts of trachytes from Cape Royds, Ross Island (2.8 weight percent K_2O; analysis recalculated to $Or_{16.8}Ab_{64.8}An_{18.4}$) and from the Crary Mountains, Byrd Land (2.6 weight percent K_2O; analysis recalculated to $Or_{15.7}Ab_{74.2}An_{10.1}$) reacted alike and took on a pale red purple (5 RP 6/2)[1] stain. The staining was carried out using a slight modification

[1] Color names and numbers are based on color chart by Goddard and others (1948).

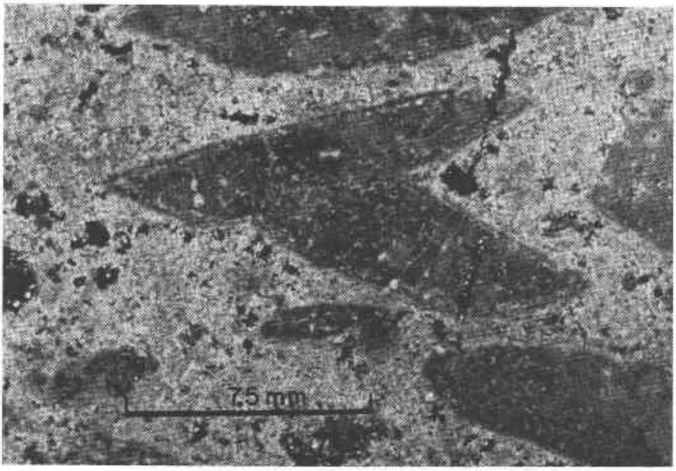

FIG. 1. Photograph of stained rock slab showing anorthoclase phenocrysts contrasted to lighter groundmass. The phenocrysts are grayish red purple and the groundmass is mostly bright yellow.

of the reported procedure of Laniz and others (1964) as recommended by M. B. Norman (oral communication, 1967). This modification is as follows: after staining the slab with sodium cobaltinitrite and rinsing and drying, the slab was immersed for 15 seconds in an approximately 15 percent solution of barium chloride, then rinsed again and dried before immersion for about one second in a concentrated amaranth solution. When the application of amaranth was preceded by a calcium chloride dip, the anorthoclase stained grayish red purple (5 RP 4/2). The phenocrysts thus stand out in strong contrast (Fig. 1) to the dense matrix in which the feldspars are stained bright yellow.

Anorthoclase of the above-mentioned composition is, therefore, indistinguishable from sodic plagioclase on the basis of the amaranth stain procedure. Calcic plagioclase takes a on deeper red stain than does anorthoclase. Presumably, anorthoclase containing more potassium and less calcium than our samples might yield different results. It is significant, however, that the alkali feldspar phenocrysts (from volcanic rocks) with the relatively extreme Or content described by Chayes and Zies (1961) react poorly to the cobalitinitrite stain. They concluded that their results ". . . are compatible with the suggestion that the relative insensitivity of many sanidines and anorthoclases merely reflect their lower K content, but it is possible that this is not the whole explanation." The staining results reported here obviously reflect the high An content of the Antarctic anorthoclase, but whether this is also true for sanidines or even other anorthoclases is not known. In conclusion we recommend that, if the presence of anorthoclase is suspected, supplementary thin-section and X-ray studies precede modal analysis of stained slabs.

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HYDRAZINE INTERCALATION—INTERSALATION FOR DIFFERENTIATION OF KAOLIN MINERALS FROM CHLORITES

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It has long been a problem to differentiate the diffraction peak of kaolinite (001) from that of chlorite (002) at 7 Å. Preferential changes in the intensities of these diffraction peaks by heating or acid treatments have been proposed as means of distinction. However, variations in crystallinity and chemical composition, mainly of chlorites, often result in inconclusive differentiation (Brindley, 1961, p. 85 and 262). Resolution of the kaolinite (002) and the chlorite (004) at about 3.5 Å by slow x-ray diffractometer scans (Biscaye, 1964) has merits in simplicity and clarity,