NOTE ON THE SIGNIFICANCE OF "TURBID" FELDSPARS

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One commonly reads in most textbooks on the subject that the turbid, brownish appearance of many feldspars (especially orthoclase) when viewed in thin section is due to the presence of a kaolin-like mineral. If examined under high power, however, the objects responsible for the "turbidity" are manifestly not kaolin-like clay minerals, but on the contrary represent simply liquid-filled vacuoles, similar in nearly every respect to the liquid-filled vacuoles in the quartz of igneous rocks. The evidence for this is: (1) the "turbid" objects have a high relief with refractive index well below that of the feldspar; the relief, though not measurable, is sensibly the same as that of liquid inclusions in quartz. This definitely rules out kaolinite as a possibility because both of the indices of this mineral are above the indices of potash feldspar; the only possibility other than liquid is that they are allophane or some other clay mineral with a very low index. (2) The "turbid" objects appear brownish in transmitted light and milky in reflected light, exactly like the liquid-filled vacuoles in granitic quartz or in chalcedonic quartz (Folk and Weaver, 1952). This is probably due to some complex dispersion effect, as nearly every object of lower index appears brownish when immersed in a medium of higher index; because both kaolin and sericite possess indices higher than that of the feldspar, they do not give this brownish appearance. (3) The "turbid" objects are isotropic, whereas kaolinized feldspars show a pinpoint birefringence in shades of gray to black, and sericitized (or illitized?) feldspars normally show white to yellowish birefringence. (4) The "turbid" objects have an irregular shape, with rounded protuberances; they frequently are somewhat elongated parallel with the crystal directions in the host feldspar. Other than the rather consistent elongation, their shape corresponds closely with the shape of known liquid-filled vacuoles in granitic quartz. (5) The "turbid" objects rarely contain a spherical, movable gas bubble.

To summarize, the brownish-appearing objects of high negative relief responsible for the turbidity of feldspars are liquid-filled vacuoles; both kaolin and sericite, on the other hand, have only moderate relief with indices higher than the potash feldspars, hence give no brownish cast and are anisotropic.

The significance of turbid feldspars is not clear. Under the assumption that the brownish "turbidity" was caused by a kaolin-like mineral, the phenomenon was easily explainable as a stage in the alteration of the feldspar either because of hydrothermal attack or weathering. If, on the contrary, the turbidity is caused simply by bubbles of water, a different implication is thrown on the subject. Examination of several hundred thin sections in the teaching collections both at The Pennsylvania State College and The University of Texas has revealed the following tendencies: (1) feldspars of acid plutonic rocks and pegmatites are usually richly clouded with vacuoles which occur throughout most of the feldspar grain in a dense, pervading swarm; (2) feldspars of basic plutonic rocks and of both acid and basic extrusive rocks tend to have few vacuoles and the vacuoles that are present do not form dense pervading clouds but instead tend to be strung out along cleavages, fractures or certain crystallographic directions; (3) feldspars in weathered igneous rocks and in sediments, which are dull, whitish and soft in hand specimen, may either have legitimate clay-mineral alteration (shreds of clay with higher index than host feldspar) or else may be pervaded by the same dense swarms of vacuoles. That these turbidity-producing vacuoles do form in part by weathering is shown by specimens of the Upper Cambrian Gatesburg Formation of Pennsylvania; fresh specimens contain detrital and authigenic feldspars that are perfectly clear and free of bubbles, but in weathered float specimens both detrital and authigenic feldspars are thickly crowded with brownish-appearing bubbles.

Thus the following conclusions may be in order: (1) Some of the vacuoles may be primary to deuteric, trapped during crystallization from a magma or by attendant hydrothermal activity. Crystallization in a more hydrous environment (as in granites and pegmatites) favors entrapment of considerable water in the feldspars, therefore the feldspars in these rocks are usually "turbid" because they are richly clouded with vacuoles; feldspars crystallizing from a less hydrous magma (as in extrusive rocks) trap less water and are generally clearer. (2) Some of the vacuoles form on weathering, by a yet unknown mechanism (see Frederickson, 1953).

References

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SPOT GRINDING, A TECHNIQUE FOR FINISHING ROCK THIN SECTIONS

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While preparing thin sections for petrographic study in the Mineralogy Department of the University of Utah, the authors encountered some difficulty in the preparation of sections in which the hardnesses of