in the range quoted the scattering was aerosol controlled. A further disturbing feature of the results shown in this paper was that the background noise varies rapidly with height, which seems to indicate a noise source connected with the transmitted laser pulse. The most likely source seems to be fluorescence, as Bain and Sandford[7] have also suggested.

No doubt the Maryland technique will have been developed since their paper was published and we look forward to their more recent results giving more information about this atmospheric region and its scattering cross section. We consider the laser radar method for examining the upper atmosphere to be highly promising. It is important, however, not to exaggerate its capabilities at this time. With more powerful transmitters, larger collectors and operation at shorter wavelengths the method is certain to provide definitive evidence on the existence or otherwise of dust about the 80 km altitude.

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Authigenic High Sanidine from Western Australia

AUTHIGENIC minerals grow in sedimentary rocks near the surface of the Earth or at moderate depths in the crust, supposedly at temperatures rarely exceeding 100° C. An authigenic origin has been postulated for many potassium feldspars described as microcline, orthoclase and adularia[1], though in igneous and metamorphic rocks they normally form at temperatures above 100° C. Sanidine characteristically grows at temperatures far higher than the other potassium feldspars, and is restricted, with some exceptions[2], to volcanic rocks. Its authigenesis is unusual and deserves discussion. The outgrowths described here are composite and contain high sanidine [$2V_\alpha = 0°–60°$, optic plane //(010)], low sanidine [$2V_\alpha = 0°–25°$, optic plane ⊥(010)], and orthoclase [$2V_\alpha = 25°–70°$, optic plane ⊥(010)]. There is commonly a slight departure from monoclinic optics in these minerals, with either Y or Z deviating a few degrees from the normal to (010). Low sanidine has been recorded before[3], but as far as we are aware, this letter is the first report of authigenic outgrowths composed partly of high sanidine.

The authigenic feldspar has grown on clastic potassium feldspar grains in Devonian sandstones and limestones of the Nannyarra Greywacke and Gneudna Formation at their type sections on the eastern margin of the Carnarvon Basin, Western Australia (close to lat. 23° 58′ S., long. 115° 13′ E.). The Nannyarra Greywacke is a transgressive unit resting nonconformably on a Pre-Cambrian granitic and metamorphic complex, and in this area contains little greywacke as defined by Pettijohn[4]. The formation is about 190 ft. thick and is mainly arkose and subgreywacke. The conformably overlying Gneudna Formation consists of 1,700 ft. of fossiliferous limestone, dolomitic limestone, arkose and calcareous shale. Both formations contain abundant authigenically enlarged quartz grains. The units dip west into the Carnarvon Basin at about 35°.

There is no evidence in these sedimentary rocks of temperatures greater than those generally associated with diagenesis. It is unlikely that they have been deeply buried in the past because of their marginal position in the basin. The rocks have not been intruded, strongly folded or generally sheared, and they are not near later igneous bodies that might have metasomatized them. Fossils in the Gneudna Formation are well preserved.

Most of the feldspar grains contain clear or slightly kaolinized subspherical cores of potassium feldspar somewhat flattened in the {001} plane. The cores range between 0·15 mm and 0·8 mm long, and their clear, authigenic envelopes are up to 0·1 mm thick. Many envelopes have developed faces of the forms {001}, {110} and {1$\bar{1}$0}, but {010} seems to be represented only by irregular surfaces. There are no chemical data on the cores or outgrowths, and the influence of variations in composition on their optics is unknown. Principal optical directions, optic axes, cleavages and faces were located with the four-axis universal stage and plotted by the Federow procedure. Optic axial angles were measured by the direct method of Fairbairn and Podolsky[5], and most are reproducible to within 2°. Cleavages and faces were identified by measuring the angles between their normals and X, Y and Z, and comparing them with Nikitin's data in ref. 6. Pinacoid and prism cleavages pass from core to envelope without apparent break, but twinning in the core is truncated at the boundary.

Of the twelve grains investigated in detail, eleven contain microcline cores ($2V_\alpha = 78°–84°$) and one orthoclase ($2V_\alpha = 57°$). Each envelope is composite. The walls that have grown out to faces of {001} are composed mainly of high sanidine, and those that have grown out to irregularly developed {010} surfaces are generally made up of orthoclase and low sanidine. Authigenic feldspar between the core and faces of {110} and {1$\bar{1}$0} commonly consists of all three varieties. Boundaries between segments of markedly differing optics are fairly sharp, and although some of them are roughly parallel to (010) and ($\bar{1}\bar{1}$1), they are not planar. Variations in optics within some individual segments cause wavy extinction and make precise measurements impossible in thin outgrowths. Precise measurements of optic axial angles include twenty-three in high sanidine ($2V_\alpha = 17°–56°$), two in low sanidine ($2V_\alpha = 18°$, 20°) and twenty-two in orthoclase ($2V_\alpha = 30°–67°$).

The presence of feldspar modifications in apparently anomalous environments has been the subject of extensive discussion, and it is now thought by some authors[1,7,8] that the symmetry and optics of feldspars formed at low temperatures may be strongly influenced by their rate of growth. In this view, fast growth at low temperature may prevent the development of a highly ordered aluminium–silicon distribution in the lattice. The ordering in individual authigenic feldspars from the Carnarvon Basin is related partly to their position in the outgrowth. If the rate of growth was indeed the dominating influence, the highly disordered portions either grew faster than the authigenic potassium feldspars described in the literature, or their inversion to the usual, more highly ordered states has been prevented.

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