

The echoes are being analysed in terms of the individual strokes comprising a discharge to ground, with special reference to the junction-streamer process described in a recent paper by Malan and Schonland¹.

It is suggested that the echoes originate from ionized portions of the cloud charge. A detailed paper is being prepared for publication.

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¹ Malan and Schonland, *Proc. Roy. Soc., A* 106 (1951).

Anomalous Properties in Quartz

ATTEMPTS to estimate quartz in certain New Zealand clays by the differential thermal method have revealed the occurrence of a variety with abnormal inversion properties.

The phenomenon was first observed¹ in clays occurring in the North Auckland peninsula as residual deposits formed by the weathering of dacite and rhyolite flows. These clays consist of 40–60 per cent of quartz, the balance being halloysite with minor amounts of feldspars and accessory minerals. The quartz exists in two forms, one of which shows the normal $\alpha \rightleftharpoons \beta$ inversion at 573° C., while in the other form the inversion is more sluggish than usual and occurs at 555–560° C. The abnormal form is usually concentrated in the sizes below 75 microns.

Since the original observation in 1945, similar phenomena have been observed in decomposed rhyolite at Mount Somers, South Canterbury, and in well-weathered greywacke at Glen Massey, Newcastle Survey District. The associated clay mineral in these cases is kaolinite. In the North Auckland occurrences cristobalite and tridymite are frequently present.

When treated by the pyrosulphate fusion technique of Trostel and Wynne², the 0–10 micron fraction of clay from Parua Bay, Whangarei, yields pure quartz of the low-temperature (560° C.) inversion type. Measurements on this material show: (1) chemical composition, 99.3 per cent SiO₂; (2) X-ray diffraction pattern indistinguishable from normal quartz; (3) thermal expansion curve of the quartz type, but with a total expansion at 600° C. of 0.85 per cent, as against 1.10 per cent for normal quartz of the same particle-size; (4) the $\alpha \rightleftharpoons \beta$ inversion although more sluggish than normal, and the accompanying heat effect approximately half the normal value; (5) normal conversion to cristobalite above 1,470° C.

The evidence indicates that there exists a modification of quartz in which the mechanism of inversion differs from the normal. The ceramic implications of this observation will be obvious, and in particular the use of the differential thermal method for the quantitative estimation of quartz requires more critical consideration than it has hitherto received.

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¹ McDowall, I. C., and Dunn, L. R. L., *N.Z. Pottery and Ceramics Research Association, Tech. Rep. No. 1* (1947).

² Trostel, L. H., and Wynne, D. J., *J. Amer. Ceram. Soc.*, 23, 18 (1940).

Abnormal Thermal Behaviour of α -Quartz from some New Zealand Soils

IN 1947, McDowall and Dunn¹ reported the differential thermal curves for free quartz in eight New Zealand clay deposits. They pointed out that the peaks of the α - β inversion were broader than those of quartz-alumina mixtures, and that in one case a small sharp peak at 573° C. was associated with a broader one at 555–560° C., resulting in an unusual double peak. The properties of these unusual forms of quartz are further described by McDowall and Vose².

In 1948, during an investigation of minerals in New Zealand soils, a number of soils were found to contain a form of quartz which, although shown by X-ray to be normal, well-organized α -quartz, failed to give the usual pronounced thermal effect due to $\alpha \rightleftharpoons \beta$ inversion in differential thermal analysis. The soils in which this form of quartz occurs include Mangatea silt loam from Katoa, Whirinoki clay loam from Hokianga, and Puhoi clay loam from Waiwera. These are weakly or moderately leached yellow-brown earths derived from sandstone or mudstone. They occur in locations some hundreds of miles apart and there is no suggestion at present that their parent material has a common origin. Their mineral colloids contain appreciable amounts of quartz, illite and montmorillonite. Quartz is highest in their silt fractions (between 2 and 20 microns equivalent diameter).

Characteristic behaviour is illustrated by the quartz from the silt fraction of the B horizon of the Mangatea silt loam. This silt appeared from X-ray diffraction to contain about 50 per cent of α -quartz, but its thermal pattern, judged by peak height and area, corresponded to less than 5 per cent of α -quartz. 53 per cent of free silica was separated from the silt by the pyrosulphate fusion method of Trostel and Wynne². The separated material contained more than 99 per cent of SiO₂ and appeared from X-ray diffraction to consist almost entirely of α -quartz; but its thermal pattern corresponded to less than 10 per cent of α -quartz.

This form of quartz differs from the form of quartz in clay deposits described by McDowall and Vose². The quartz from clay deposits has broadened peaks in the neighbourhood of 560° C., whereas the form from soils has a characteristic peak at 573° C., much smaller than that expected from the amount of α -quartz present. The thermal expansion of the quartz from clay is abnormal, whereas that of the soil quartz is normal. Cristobalite and tridymite are present in the quartz from some of the clay deposits, but none is detected in the soil quartz, although cristobalite has sometimes been reported in soils containing montmorillonite.

Berkelhamer³ has stated that chalcedony registers a perfect quartz X-ray pattern but gives a reaction at the $\alpha \rightleftharpoons \beta$ inversion point equal in magnitude to that produced by approximately 1–4 per cent of quartz. This result is confirmed with New Zealand samples of chalcedony.

Optical examination of the silica residue of Mangatea silt loam was made by Mr. J. J. Reed, Geological Survey, New Zealand Department of Scientific and Industrial Research, who found that the sample contained a small amount of normal quartz, but consisted mainly of glassy isotropic material of refractive index 1.50, which is lower than that of chalcedony (1.537), the latter being