TECHNIQUE FOR OPTICAL IDENTIFICATION OF IRON-BEARING DOLOMITES: A MODIFICATION AND AN EVALUATION[1]

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During an exploratory study of the distribution of $MgCO_3$ between co-existing ankerite and siderite within thin cherts in the Precambrian Brockman Iron Formation (MacLeod *et al.*, 1963) of Western Australia the problem arose of accurately determining both carbonates. The method of Howell & Dawson (1958) seemed suitable for determination of the ankerite. If this were known the $MgCO_3$ of the siderite would be calculable, with a few reasonable assumptions, from a bulk chemical analysis.

In Howell & Dawson's method an ankerite grain in contact with the mounting cement is oriented with its *c*-axis horizontal and north-south, and is then rotated about the outer east-west axis of the universal stage. A graph relates ϵ' for a given rotation to the composition of the ankerite.

In the cherts studied, the ankerite usually forms rhombs about 0.15 mm. across in a random quartz mosaic of average grain diameter about 0.015 mm. The average refractive index of the enclosing chert, which was used as a standard for equalising the ϵ' of the ankerite, was taken to be 1.545. In Howell & Dawson's method, the interface used for balancing ϵ' changes its orientation with respect to the microscope axis during rotation. This was overcome by orienting the ankerite grain so that its *c*-axis coincided with the east-west axis (of a 4-axis stage), then rotating about this axis until a chosen planar interface was vertical, and then balancing ϵ' with the enclosing chert by rotation of the microscope stage. An added advantage here is that four positions of equal refractive index are available, instead of two.

The change in ϵ' is given by

$$\epsilon' = \frac{\epsilon\omega}{\sqrt{\omega^2 \cos^2 \alpha + \epsilon^2 \sin^2 \alpha}}$$

where α is the angle between the *c*-axis and the vibration direction of ϵ'. From this

$$\alpha = \cos^{-1} \sqrt{\frac{\left(\frac{\epsilon\omega}{\epsilon'}\right)^2 - \epsilon^2}{\omega^2 - \epsilon^2}}$$

Taking ϵ and ω for iron-free dolomite and theoretical magnesium-free "ankerite" to be 1.500, 1.679 and approximately 1.557, 1.765 respectively

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(various authorities, from Deer, Howie & Zussman, 1962) the relationship between α and the molecular percentage of Fe in the (Fe, Mg) position of the dolomite-ankerite series is given in figure 1 for $\epsilon' = 1.545$. Such a

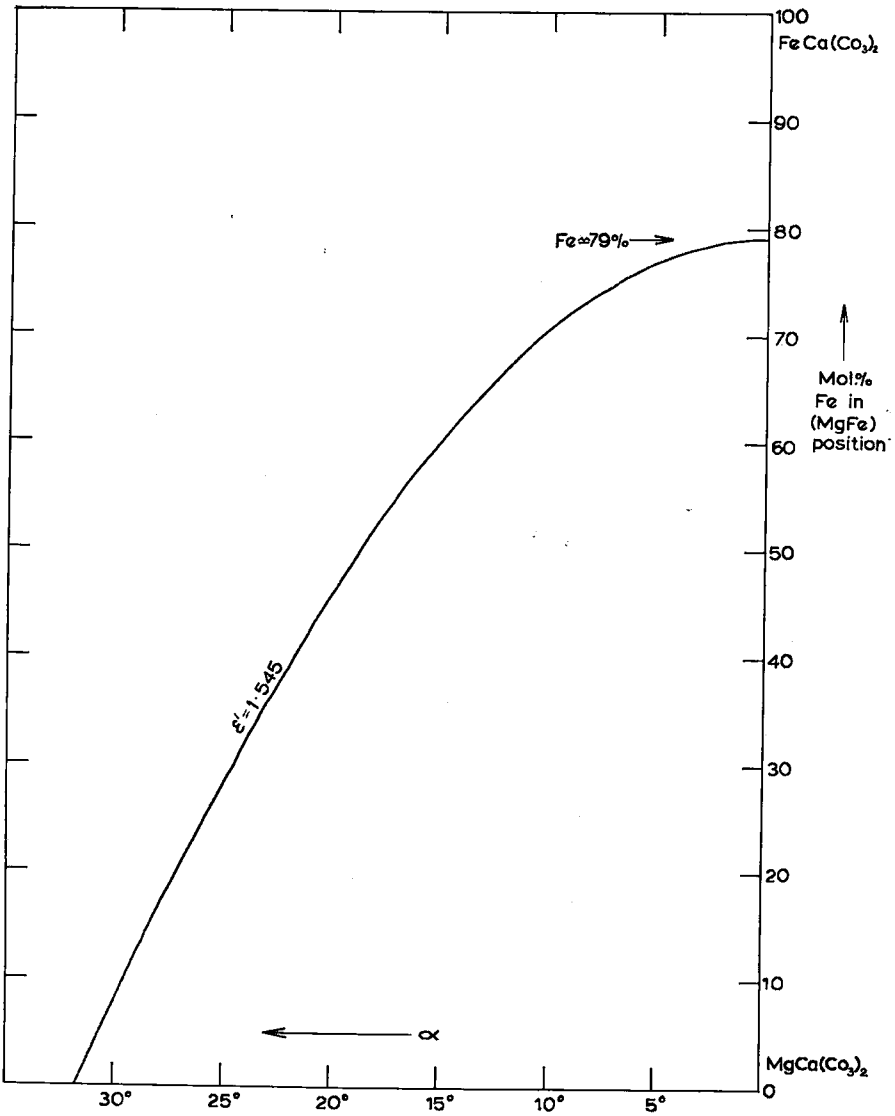

FIG. 1. Angle of rotation of the microscope stage required to change the transmitted ray of dolomite-ankerite from ϵ to ϵ', where $\epsilon' = 1.545$, plotted as a function of the molecular percentage of Fe in the (Fe, Mg) position.

curve, cutting the ordinate at about Fe = 79 per cent (70 per cent for $\epsilon' = 1.54$) is more accurately representative of the relationship than the straight line of Howell & Dawson's figure 1, and would be a better fit for most of their plotted points.

In practice, using various magnifications and conditions of illumination, results on a single ankerite grain have not been reproducible to less than $\pm 5°$. The resultant error of about ± 15 per cent Fe over the central part of the range is too great for the results to be of use. It is possible that the precision could be improved by using phase-contrast illumination, but this is not available to the writer, and at the time of writing the best method for determining accurately two intimately mixed carbonates (x-ray emission methods excepted) seems to be the time-consuming determination of ω on cleavage fragments in crushed material. No staining technique so far published appears to be sufficiently sensitive quantitatively. It would be interesting to hear of any successful solution to this problem.

References

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NEW MINERALOGICAL DATA FOR XANTHOPHYLLITE FROM JAPAN

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Introduction

Recently, in a mineralogical study of the contact zone in the Doshinkubo ore body of the Chichibu Mine, located in Saitama Prefecture, Japan, a number of well-developed crystals of xanthophyllite associated with vesuvianite and calcite were discovered. The first description of xanthophyllite from this mine, but from another ore body (Hashikakezawa ore body) was given by Abé (1944). This paper provides additional mineralogical data on this rather uncommon mineral.

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