

Fe ··· 0.108 (sum 3.672), Fe ··· 0.035, Mn 0.006, Mg 0.259, Ca 5.623 (sum 5.923).

*Dept. of Geology,
University College,
Swansea*

T. W. BLOXAM

References

- BLOXAM (T. W.), 1954. *Min. Mag.*, vol. 30, p. 525.
DEER (W. A.), HOWIE (R. A.), and ZUSSMAN (J.), 1962. *Rock-forming minerals*, vol. 1. London (Longmans).
HUTTON (C. O.), 1943. *Trans. Roy. Soc. New Zealand*, vol. 73, p. 174 [M.A. 9-61].
MCCONNELL (D.), 1942. *Amer. Min.*, vol. 27, p. 452 [M.A. 8-343].
-

Magnetite colloid in ore mineralogy

WHILE studying sulphide ores from the English Lake District, in which considerable amounts of fine-grained pyrrhotine were present, it was found that application of magnetite colloid to the polished surfaces facilitated identification and photography of the pyrrhotine, and the study of its relations with other minerals.

The technique was introduced to the writer by Miss Sylvia Rushton, of the Department of Physics, Nottingham University: it has been used extensively by physicists studying magnetic materials and domain structures, but it has not, to the writer's knowledge, been previously applied to ore mineralogy.

On a large scale, the use of iron filings in elementary experiments on magnetism is known to all; magnetite colloid acts in a similar manner. On applying the colloid to a polished surface, the magnetite particles congregate over magnetic minerals (pyrrhotine in this case), coating them with a brown layer, and leaving the other minerals clear: the colloid is here being used as a stain. Colloid may also be used on hand specimens which have been smoothed with 600-mesh 'Carborundum'; the staining so produced is visible to the naked eye.

Applied to microscopic examination of polished surfaces, the method is capable of many other uses, besides identification by staining. Domain structures in the pyrrhotine (fig. 1, A) are usually well marked, and may be used in the same way as any other directional structure in studying replacement (fig. 1, B and C). A permanent record of the distribution of magnetic minerals, and of their domain structures, may be obtained by taking a cellulose tape 'peel' of a colloid-coated surface that has been allowed to dry. Dr. F. Vokes (personal communication) has suggested

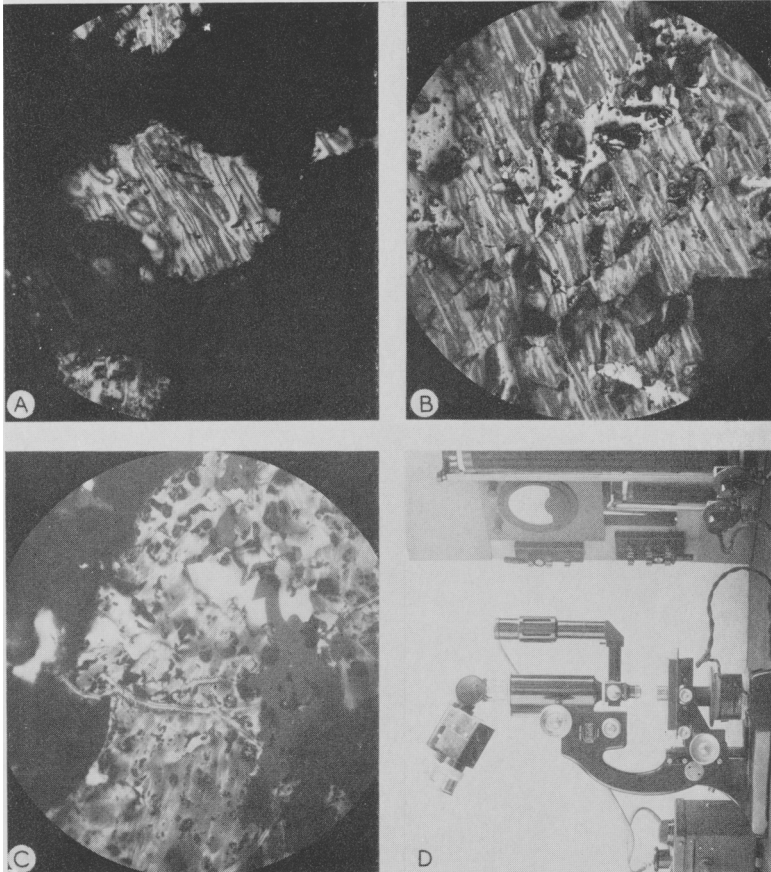


FIG. 1. A. Pyrrhotine, showing magnetic domains; $\times 70$. B. Pyrrhotine, in course of replacement by pyrite; note the constant domain orientation across the replaced area; $\times 70$. C. Pyrrhotine (grey, striped) being replaced by pyrite; note veinlets of pyrite running through the pyrrhotine; $\times 70$. D. Microscope set up for examination of magnetic minerals by magnetite colloid method; note electro-magnet under stage.

that the method may be of use in studying 'lamellar' pyrrhotine, and the orientation of pyrrhotine in deposits of metamorphic origin.

Since domains may be formed in the disordered surface layer produced by polishing, the orientation of domains may sometimes be related to the conditions of polishing, rather than the orientation of the mineral, so that slight etching is necessary.

The apparatus used is shown in fig. 1, D; the electromagnet beneath

the stage of the ore microscope is the only addition required, enabling domain structures to be seen clearly.

The discussion above relates only to pyrrhotine; obviously it also applies to other magnetic minerals. Preparation and use of the magnetite colloid are discussed by Bitter (1931), Elmore (1938), and Craik (1956), Craik and Griffiths (1957).

*Dept. of Geology,
University of California,
Berkeley 4, California*

R. G. J. STRENS

References

- BITTER (F.), 1931. *Phys. Rev.*, vol. 38, p. 1903.
 CRAIK (D. J.), 1956. *Proc. Phys. Soc.*, vol. 69, p. 647.
 — and GRIFFITHS (P. M.), 1957. *Ibid.*, vol. 70, p. 1000.
 ELMORE (W. C.), 1938. *Phys. Rev.*, vol. 54, p. 309.

BOOK REVIEWS

DEER (W. A), HOWIE (R. A.), and ZUSSMAN (J). *Rock-forming minerals*.
 London (Longmans), 1963. Vol. 4: *Framework silicates*. ix + 435 pp.,
 118 figs., 53 tables. Price £4. 15s.

This volume completes the series of five volumes, those previously published having been reviewed in this Magazine, vol. 33, pp. 434 and 525. Vol. 4 deals with the feldspar group, the silica minerals, the nepheline group, petalite, leucite, the sodalite group, cancrinite, scapolite, analcime, and the zeolite group.

The large section on the feldspar group includes 179 chemical analyses, nine being of Amelia albite alone. One of the most valuable features of this volume is the lucid account of the complex structural and thermal relationships between the members of the alkali feldspar and of the plagioclase series, together with a clarification of their nomenclature and classification. The grouping, in this volume, of the best available determinative charts relating to optical and other physical properties may, at last, lead to some consistency in routine petrographic work on the feldspars. The authors, with advice from Dr. W. S. MacKenzie, have succeeded in presenting an easily readable account of a subject that is formidable in its magnitude and complexity. At the same time, however, it is easier now to recognize those aspects in need of reform. For instance, a nomenclature that employs the term 'intermediate' with