Notes – *Notiser*

A scanning electron microscope investigation of some Norwegian aventurine feldspars

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Aventurine feldspars are those feldspars which exhibit a yellow to red schiller as a result of inclusions, mainly of iron oxide in the form of hematite platelets and needles. Other studies suggest that these inclusions are probably not the result of an exsolution process. The scanning electron microscope has been used to ascertain the detailed morphology of these hematite inclusions.

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Aventurine feldspars are those feldspars (usually oligoclase) which exhibit a yellow to red schiller as the result of inclusions, mainly of iron oxide in the form of hematite. A fuller account of aventurine feldspars has recently been given by Smith (1974: 623). Optically, it can be seen that these inclusions in the feldspars investigated in the present study occur as very thin well-shaped (often 6-sided) or irregular platelets (usually less than 0.2 mm in diameter) or needles and are shades of orange in colour. Some platelets appear to be interpenetrant or bent. A scanning electron microscope investigation of the morphology of the inclusions has formed part of a larger study of aventurine feldspars which has employed transmission and analytical electron microscopy, optical, X-ray and other experimental techniques and it is the purpose of this note to describe the results of this aspect of the investigation. The other studies (in progress) have confirmed the presence of hematite inclusions (some of which exhibit basal stacking faults) and that they are probably not produced by an exsolution process (Andersen 1915).

The samples studied all come from the classic SE Norway localities (Bamle, Arendal, and Havredal) and have approximate compositions of either An_{12} or An_{25}. Fragments of feldspar were etched in 60% HF for from 1 to 5 minutes, though the most satisfactory results were obtained using the shorter period. A white coating over the specimen produced by the etching was removed by ultrasonic cleaning in alcohol for about 20 minutes (Chapman & Meagher 1975). After mounting onto standard 13 mm aluminium SEM specimen stubs with Durofix most specimens were coated with Au/Pd and examined on a Cambridge Instruments Stereoscan S600 using a medium spot size and accelerating voltages of 7.5 and 15 kV. Other specimens were carbon coated and investigated on a Stereoscan S180 operating at 20 kV and fitted with microanalysis facilities (a Kevex Si(Li) energy dispersive detector and Link Systems electronics).

Hematite is insoluble in HF and there is preferential etching at the feldspar/hematite interface as well as at cleavages and dislocations in the feldspar. A typical euhedral platelet is shown in Fig. 1a. Microanalyses carried out on the S180 are consistent with such platelets being hematite. Fig. 1b shows several platelets in a single feldspar fragment which are in different orientations; at A there is evidence of interpenetration and one of the platelets consists of several layers which appear to have separated during etching. Hematite platelets which, in the optical microscope, appear bent are, in fact, two separate platelets parallel to different habit planes (e.g. at A in Fig. 2a). Surface markings are visible on the flat faces of some platelets but their significance is not immediately clear.

More prolonged etching makes the platelets appear more prominent; the extremely thin nature of this, and other, platelets is apparent when the specimen is tilted. Most platelets appear twisted (e.g. at B, C, and D in Fig. 1b). This twisting may be the result of any strain at

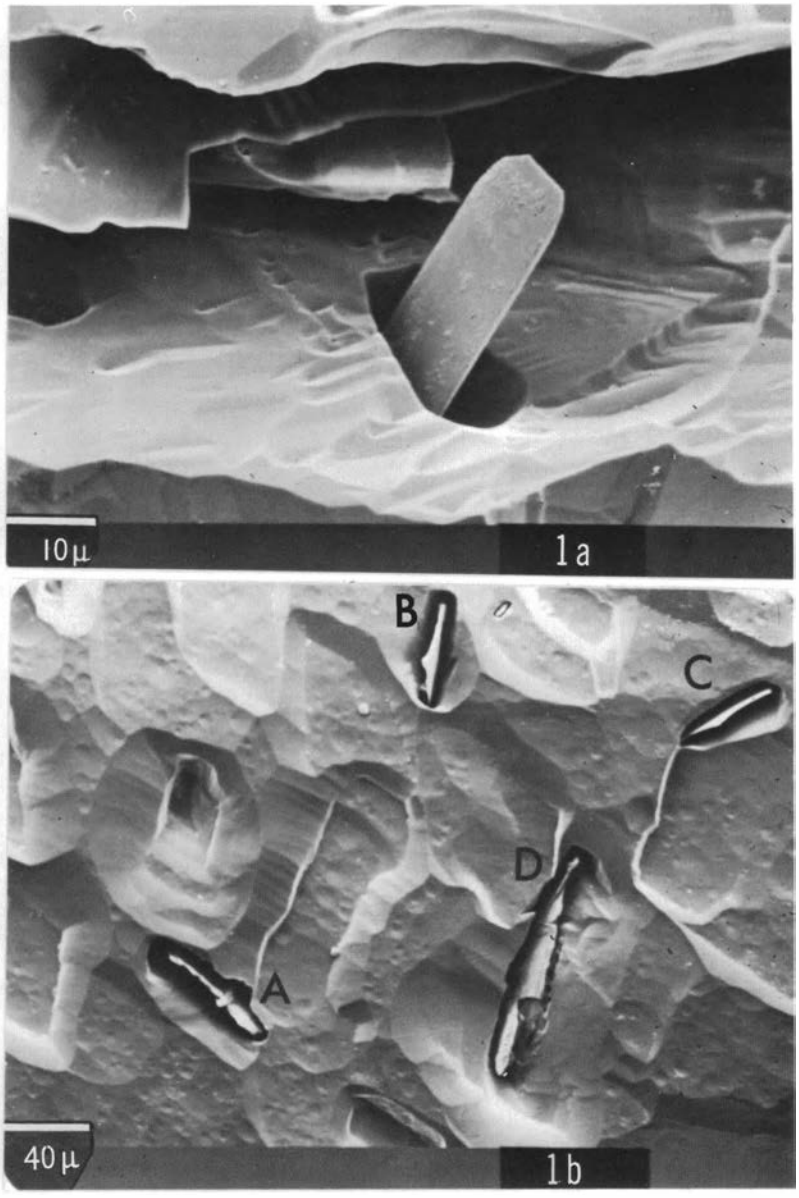

Fig. 1a. An_{25} from Bamle. A typical euhedral hematite platelet in a feldspar matrix. (The micron scale on the left of this and all other figures refers to the black bar).
Fig. 1b. An_{25} from Arendal. Several platelets in different orientations in a single feldspar fragment. Note the interpenetration of platelets at A and the twisted platelets at B, C and D.

the interface between the feldspar and the hematite being released when the feldspar matrix is etched away during sample preparation. Inclusions which, optically, have the appearance of needles can be seen to have an approximately square (Fig. 2b) or bladed cross-section.

These observations on the nature and distribution of the hematite inclusions emphasise the difficulties that must be expected when attempts are made to detect their presence by X-ray methods and to analyse their chemistry by means of the electron microprobe. They also suggest that there is the possibility of high strain at the feldspar/hematite interface which results in the twisting and distortion of the thin plates when the feldspar matrix is etched away. The splitting of certain platelets may reflect the strain due to stacking faults which are observed by trans-

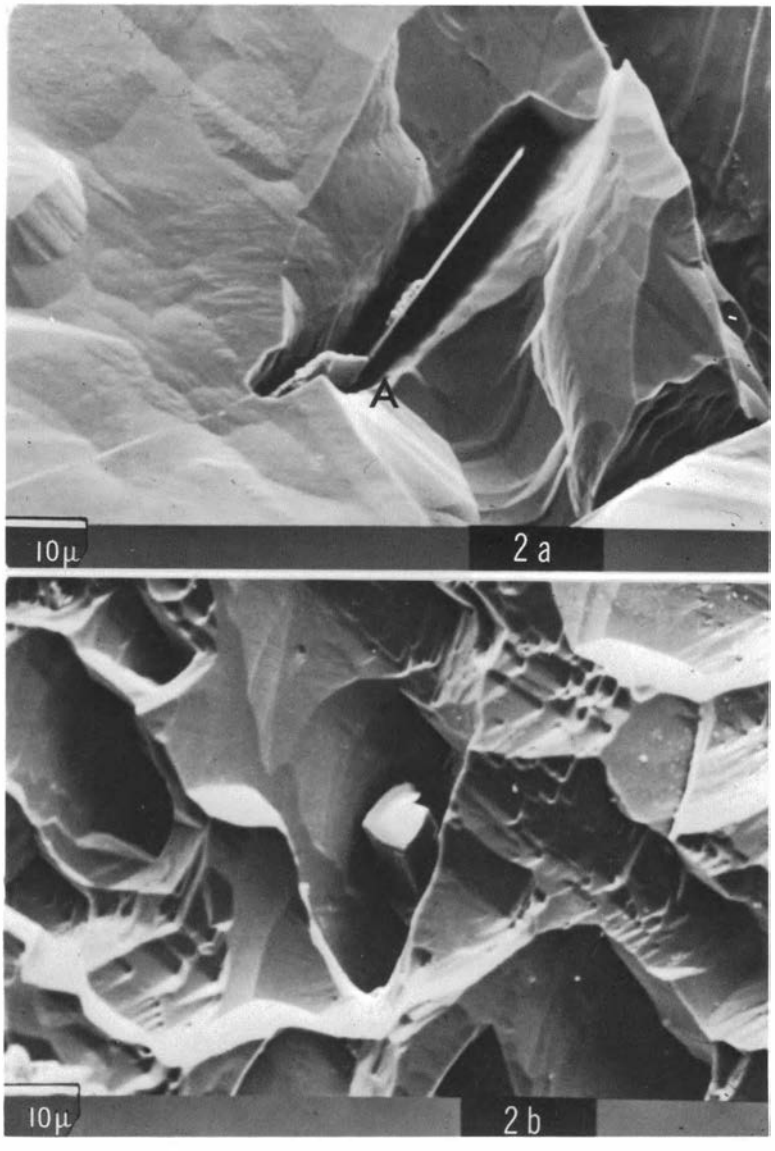

Fig. 2a. An_{25} from Arendal. Two platelets (approximately 0.4 microns in thickness) on different habit planes, giving the appearance of a 'bent' inclusion (at A).
Fig. 2b. An_{12} from Havredal. A needle-shaped inclusion (centre of micrograph) with an approximately square cross-section. It is about 4 microns in diameter.

mission electron microscopy. These and other features of the present observations will be discussed more fully in a later publication.

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