

## Hematite to Goethite Surface Weathering Scanning Electron Microscopy

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### Abstract

Weathering of hematite begins with growth of acicular crystals of goethite along steps on the (0001) faces. As these crystals become more numerous, they aggregate into spheres which form rows along crystallographic directions. The rows ultimately merge into a microcrystalline crust of goethite.

Additional information on the surface weathering of hematite to goethite (Bedarida and Pedemonte, 1971), has been obtained by scanning electron microscopy (S.E.M. Mark IIa, Cambridge Ltd.). The observations substantiate that hematite weathering starts along the steps of (0001) faces, with the formation of very small acicular crystals randomly

oriented (Fig. 1). The acicular crystals aggregate together to form small spherules or balls (Fig. 2) which, at a later stage, join together along the straight steps of the face (0001) (Fig. 3). This tendency to assume a spherical shape may suggest that, up to this point, the morphology is influenced by the surface tension properties of water which acts as a

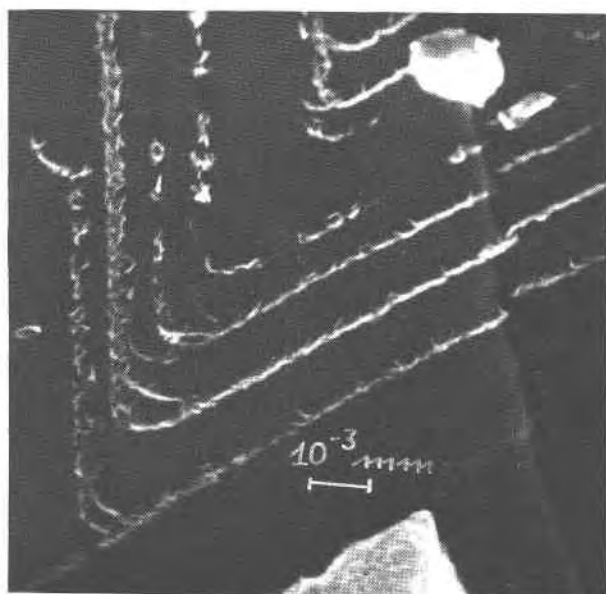


FIG. 1. First stage of weathering along the hematite steps.

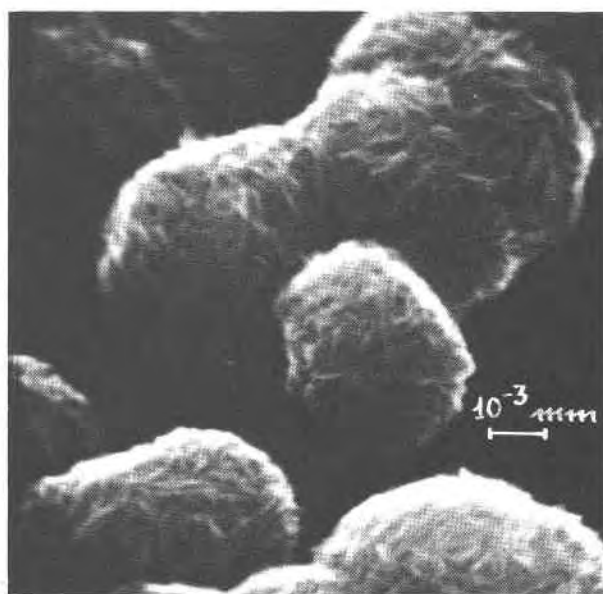


FIG. 2. Spherical arrangement of acicular crystals.

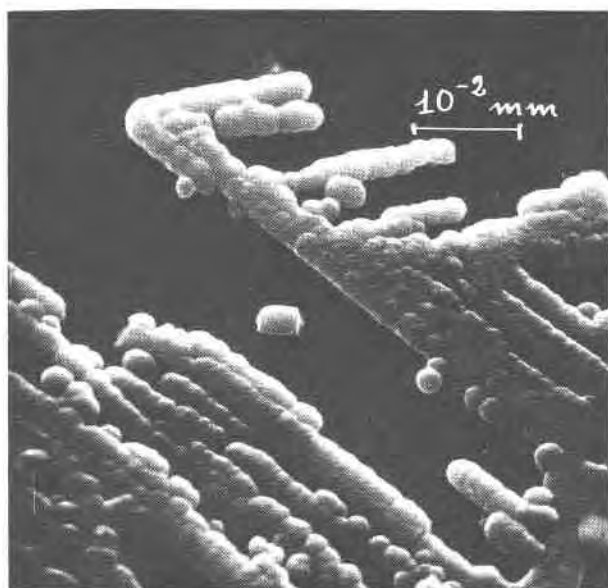


FIG. 3. Balls clustering along steps.

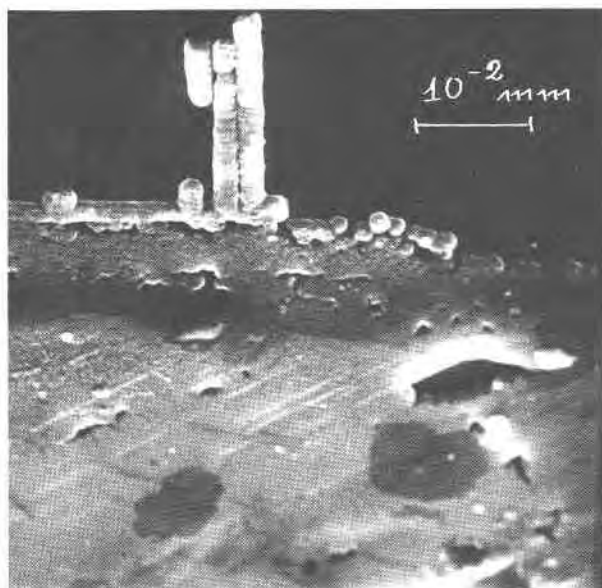


FIG. 5. Nearly smooth microcrystalline crust of goethite.

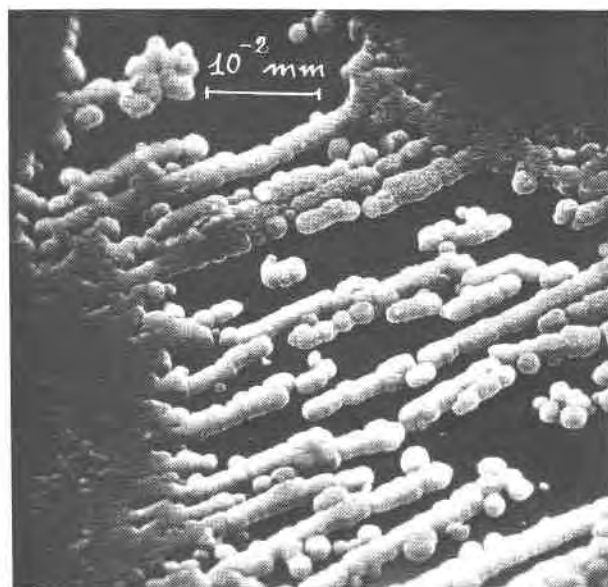


FIG. 4. Ball-rows joining together to build up the crust of goethite.

solvent. In other words, such a morphology is still strictly linked to the formation of the "water dendrites". As weathering proceeds, the balls of acicular crystals spread over the surface of the hematite in an ordered linear growth pattern along crystallographic directions (Fig. 4) until the rows merge to form the microcrystalline crust of goethite (Fig. 5). This process has been previously described by Bedarida and Pedemonte (1971).

Experimental observations suggest the following sequence of weathering may be inferred: Hematite  $\rightarrow$  aqueous surface solution of hematite  $\rightarrow$  goethite nucleation in water  $\rightarrow$  water evaporation  $\rightarrow$  formation of a microcrystalline crust of goethite.

#### References

- BEDARIDA F., AND G. M. PEDEMONTE (1971) Hematite to goethite surface weathering. *Amer. Mineral.* **56**, 1469-1473.

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