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Crystallographic Fabrics, Grain Boundary Microstructure and Shape Preferred Orientation of Deformed Banded Iron Formations and their Significance for Deformation Interpretation

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The characterization of grain boundaries and shapes along with crystallographic preferred orientations (CPOs) are a key aspect of investigations of rock microstructures for their correlation with deformation mechanisms. Rapid developments have occurred in the studying rock microstructures due to recent improvements in analytical techniques such as Electron Backscatter Diffraction (EBSD). EBSD technique allows quick automated microtextural characteritzation.

The deformed banded iron formations (BIFs) occurring in the Quadrilátero Ferrífero (QF) province in Brazil have been studied extensively with EBSD. All studies have focused mainly in CPOs. The general agreement is that dislocation creep was the dominant process of deformation, for the strong c-axis fabric of hematite crystals. This idea is substantiated by viscoplastic self-consistent models for deformation of hematite. However there are limitations to analyzing natural CPOs alone, or those generated by deformation models. The strong c-axis fabric could be taken as equally powerful an evidence for other known deformation mechanisms.

Some grain boundary types in BIFs of the QF are irregular and comprise equant grains in granoblastic texture (Figure 1a). CPOs for this kind are strong and consistent with a predominance of dislocation creep. Others are very regular and long parallel to basal planes of hematites forming large elongated crystals (lepidoblastic texture, Figure 1b). Such crystals are called specularite, and their formation has been previously attributed to dislocation creep. This is erroneous because of the high strains which would be required. Their shape must be due to anisotropic grain growth. Other types lie between the above end-textures.

Both types of grain shape microstructures have the same core deformation mechanism. Describing their genetic differences is crucial, since specularite owe its shape to anisotropic grain growth. It is not possible yet to confirm that dislocation creep was the dominant deformation mechanism. BIFs with granoblastic texture and strong CPOs do support dislocation creep, as do the specularite-bearing rocks. We reinterpret specularites as originating in post-tectonic grain growth, after major dislocation creep produced strong crystallographic fabrics.