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Basal Twinning of Hematite

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When two crystals share a plane, there is a twinning composition plane. The result is an intergrowth of two separate crystals in a symmetrical manner. Crystallographers classify twinned crystals by a number of twin laws. These twin laws are specific to the crystal system. The type of twinning can be a diagnostic tool in mineral identification and characterization. Many twin laws cannot be recognized in ordinary optical analysis. So, the advent of diffraction techniques to describe punctual crystallographic orientation facilitated the identification of many twinned crystals in rocks. Samples containing hematite of the Quadrilátero Ferrífero, Minas Gerais, Brazil, were analyzed by EBSD technique. Crystallographic orientation data were obtained from automatically indexed EBSD patterns collected on a JEOL JSM-5510. EBSD analysis was carried out on thin sections cut perpendicular to the foliation (XZ plane) and parallel to the stretching lineation (X-direction). Thin sections were polished before EBSD analysis. EBSD patterns were indexed using CHANNEL 5 software from HKL Technology, Oxford Instruments. The resulting data are presented in form of pole figures (upper hemisphere, equal angle, stereographic projection) and of colour-coded maps using Coincidence Site Lattice ($\sum 3$) and Twin Boundaries Components. Through electron backscatter diffraction analysis of hematite grains was possible to detect twin boundaries similar to Dauphiné twinning in quartz that is not described for hematite. Dauphiné twinning in trigonal α-quartz consists of a 60° rotation around the c-axis resulting in a reversal of the crystallographic positive and negative forms (Frondel 1962). As both minerals show similar symmetry, the same mechanism can be described for hematite in this analysis. The basal twinning of hematite developed pervasively during the incipient stage of deformation. This paper investigates the relationships between this kind of twinning, deformation conditions and microstructural modifications in hematite grains. The results show that the presence of twins exerts an important role in the distribution of the intracrystalline plastic deformation in hematite, as well as in the activation of different sets of slip systems. We estimate that basal twin bands can be preferred sites for dynamic recrystallization.