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Orthogonal switching of AMS axes during type-2 fold interference: Insights from integrated X-ray computed tomography, AMS and 3D petrography

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Abstract

We applied X-ray computed microtomography (µ-CT) in combination with anisotropy of magnetic susceptibility (AMS) analysis to study metamorphic rock fabrics in an oriented drill core sample of pyrite-pyrrhotite-quartz-mica schist. The sample is extracted from the Paleoproterozoic Martimo metasedimentary belt of northern Finland. The µ-CT resolves the spatial distribution, shape and orientation of 25,920 pyrrhotite and 153 pyrite grains localized in mm-thick metapelitic laminae. Together with microstructural analysis, the µ-CT allows us to interpret the prolate symmetry of the AMS ellipsoid and its relationship to the deformation history. AMS of the sample is controlled by pyrrhotite porphyroblasts that grew syntectonically during D1 in subhorizontal microlithons. The short and intermediate axes (K3 and K2) of the AMS ellipsoid interchanged positions during a subsequent deformation (D2) that intensely crenulated S1 and deformed pyrrhotite, while the long axes (K1) maintained a constant position parallel to the maximum stretching direction. However, it is likely that all the three AMS axes switched, similar to the three principal axes of the shape ellipsoid of pyrite porphyroblasts from D1 to D2. The superposition of D1 and D2 produced a type-2 fold interference pattern.

Keywords: microtomography; AMS; microtectonics; magnetic fabric; pyrrhotite; strain

1. Introduction

X-ray computed micro-tomography (µ-CT) is increasingly being applied in structural geology and ore petrology due to its ability to resolve the three-dimensional (3D) shape and spatial distribution of minerals and associated textures in metamorphic rocks (e.g., Sayab et al., 2015; Macente et al., 2017). Sulfides and oxides yield brighter gray values than rock-forming silicates owing to high X-ray