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Full analysis of feldspar texture and crystal structure by combining X-ray and electron techniques

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Abstract

Feldspar crystals typically show a range of exsolution and polysynthetic twinning textures that can present problems for their full characterization, but at the same time give important information about their genesis. We present an integrated procedure for the micro-texture analysis, twin law identification plus crystal structure refinement of all components in a feldspar intergrowth. This procedure was applied to perthitic intergrowths in feldspars from two different pegmatites in the Larvik plutonic complex in the southern part of the Oslo region, Norway. It revealed that the two starting high-temperature (HT) feldspars had similar global chemical compositions but underwent significantly different cooling histories, with cooling times probably differing by over an order of magnitude. Powder X-ray diffraction with Rietveld refinement was used for a preliminary identification of the mineral components and concluding quantitative phase analysis. Electron microprobe analysis was used to bracket the chemical compositions of the constituents. Electron backscatter diffraction was used to reveal the texture of the samples, twin laws and spatial distribution and crystallographic orientation of the crystal domains. Single-grain X-ray diffraction recorded by an area detector was applied for a simultaneous integration of reflection intensities for all crystallographic domains with different orientations and severe diffraction overlaps. The crystal structures were refined using the program JANA2006 that allows a simultaneous calculation for structurally different components. Combined results of various methods helped improve accuracy and resolve ambiguities that arise from the application of a single technique. The approach is widely applicable to the study of mineral intergrowths and bridges an existing gap in the routinely accessible data on the structural characteristics of rock constituents.

Keywords: Feldspar, perthite, X-ray diffraction, Electron back-scatter diffraction, mineral intergrowths, multiphase analysis