Orientation Distributions of low symmetry polyphase materials using neutron diffraction: application to a rock sample from Palm Canyon, California

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Texture of polyphase materials are inherently difficult to determine. Rocks which are composed of more than one phase are the most common types in the Earth's crust and in the mantle. Most investigations of the mechanical behaviour of rocks have treated them as homogeneous, not considering that the various phases have different grain shapes and a different orientation distribution. By using neutron diffraction we have determined the orientation distributions of a rock from the Palm Canyon, California. Therefore we have made use of the D1B instrument at the high flux reactor of the Institut Laue Langevin, Grenoble, with high resolution geometry and a Position Sensitive Detector (PSD). The rock is granodioritic in composition, consisting in quartz (rhombohedral), biotite (monoclinic) and plagioclase (treated as triclinic albite).

Diffracted intensities at different sample orientations, were recorded in a 2θ range of 80°. The complex diffraction patterns of a composite of quartz, biotite and albite were treated with a special procedure (1) applying peak deconvolution and integrated intensities. Pole figures were constructed from the remaining intensities of 3 peaks for quartz, 5 for albite and 2 for biotite. Many overlaped peaks were treated during the OD refinement step using the WIMV algorithm (2) of the Beartex package (3), for instance, the 102 and 012 reflections of quartz. Particularly interesting is the case of biotite for which only the 010 reflection and the overlapp of 002 and 110 peaks were considered for the refinement, which gave enough orientation space coverage.

The following Table summarizes the main texture information such as maxima in the OD, texture index F^2, entropy S, and averaged RP factor. Both averaged RP and pole figures recalculation from OD are found satisfactory, as an indication of the resolution of this technique. A strong maximum of the quartz c-axes (up to 5.6 m.r.d.) is found at 90° from the macroscopic lineation, in the foliation plane, with a-axes aligned with the lineation. For biotite, a strong c-axes alignment is observed perpendicular to the foliation plane (with 5. m.r.d. at maximum), with b-axes along the lineation. Even if less pronounced, texture of albite is documented with a-axes maxima (at 1.7 m.r.d.) along the lineation, with broad dispersion in the foliation plane.

	Biotite	Quartz	Albite
OD maxima (m.r.d.)	11.3	12.1	9.9
S	-0.81	-0.58	-0.15
F^2 (m.r.d.^{2})	3	2.8	1.3
RP	2	9	2.3

Quantitative texture studies which have been largely restricted to single phase materials by conventional technique are now possible in polyphase materials with neutron diffraction.

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