ODs of low symmetry polyphase materials using neutron diffraction: a granodioritic rock from Palm Canyon, California

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Introduction

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 three phases rock from the Santa Rosa mylonite zone, Palm Canyon, California.

Experimental

We used the D1B instrument at the high flux reactor of ILL, with its Euler cradle and 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° at 2.52Å, and with 5°x5° scans for Euler rotations. The complex diffraction patterns of a composite of quartz, biotite and albite were treated with a special Rietveld-like 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

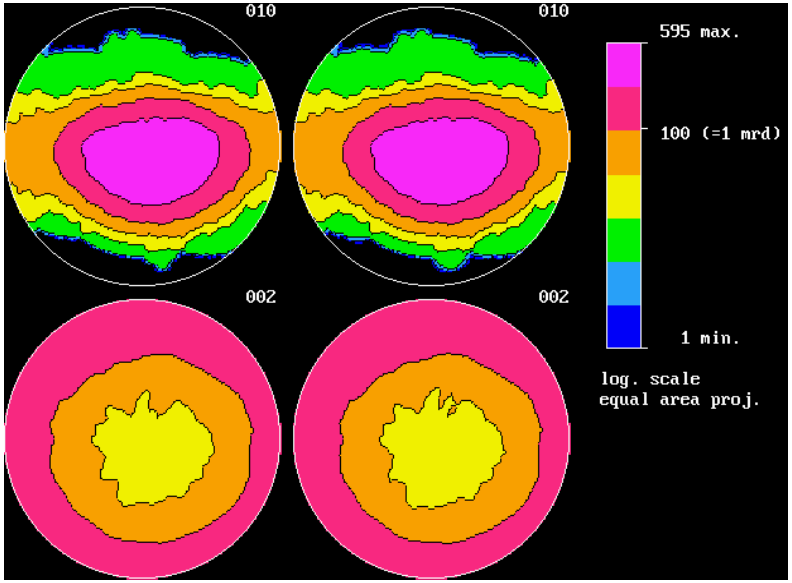
step using the WIMV algorithm (2) of the Beartex package (3), for instance, the 102 and 012 reflections of quartz. Also, we assumed triclinic texture symmetry. Particularly interesting is the case of biotite for which only the 010 reflection and the overlapp of 002 and 110 peaks were considered for the refinement (0.85% and 0.15% resp.), which gave enough orientation space coverage.

Results

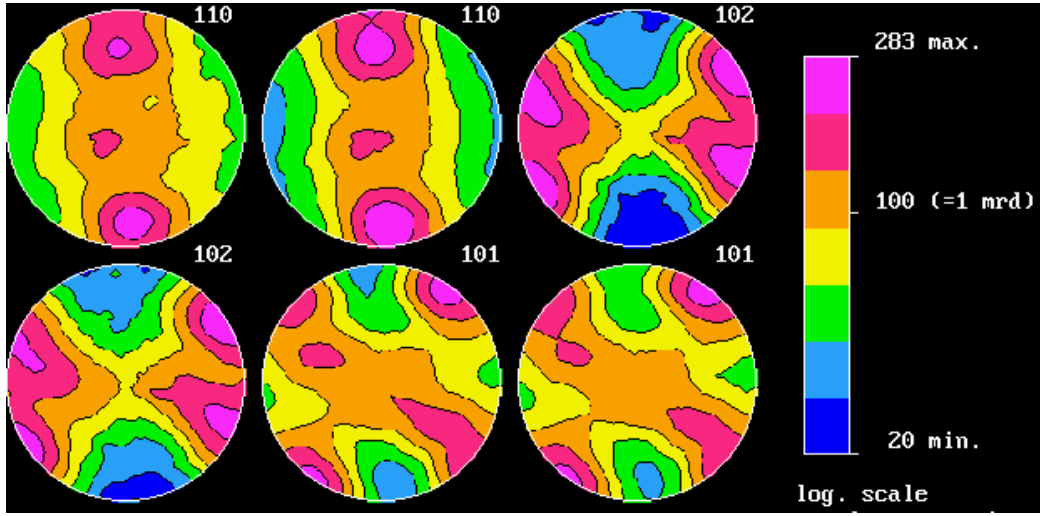
The following Table summarizes the main texture information such as maxima in the OD, texture index F^2, entropy S, and averaged R factors. Both averaged Rs and pole figures recalculation from OD are found satisfactory, as an

indication of the resolution of this technique. Blind areas in the center of the pole figures, which come from the geometry, are correctly completed after OD determination. 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, and a broad dispersion in the foliation plane.

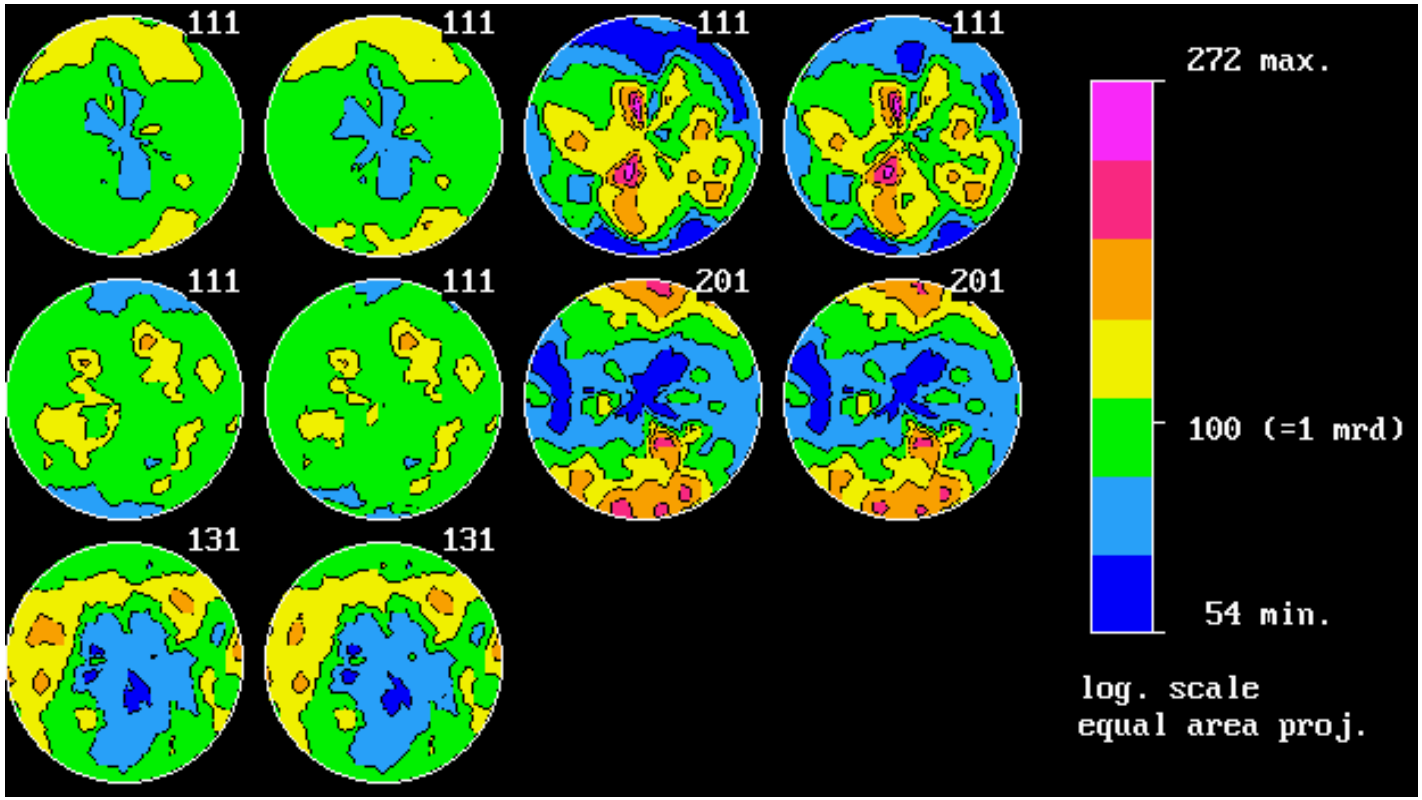
Biotite


010
010
595 max.
100 (=1 mrd)
1 min.
002
002
log. scale
equal area proj.

Quartz



Albite



Experimental-normalized and OD-recalculated pole figures

	Biotite	Quartz	Albite
OD minima (m.r.d.)	0	0.02	0.06
OD maxima (m.r.d.)	11.3	12.05	9.9
S	-0.81	-0.58	-0.15
F2 (m.r.d.2)	3.05	2.81	1.35
RP0 (%)	2.06	9	2.25
RP1 (%)	1.15	5.9	2.05
Rw0 (%)	1.7	4.8	1.52
Rw1 (%)	1.17	3.73	1.53

Conclusion

Quantitative texture studies which have been largely restricted to single phase materials by conventional technique are now possible in polyphase materials with neutron diffraction. A good reliability can be obtained, and is demonstrated in this work even for the lowest crystal symmetry and in the case of many overlaped reflections. Combined with the possibility of using restricted measurement ranges of the pole figures (5), reasonably lower time consuming experiments at neutron sources become feasible. This study opens up new possibilities in the mechanical behaviour calculations from OD analysis.

References

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