

Proposal: 1-02-2 **Council:** 4/2008

Title: From Quantitative Texture Analysis to seismic velocities of rocks

This proposal is a new proposal

Research Area: Other

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Samples: Natural Rocks - Fe Mg Al Si O H Ca CO₃ H₂O

Instrument	Req. Days	All. Days	From	To
D19	3	3	25/11/2008	28/11/2008

Abstract:

Texture and the Orientation Distribution Function obtained from rock samples will be used to calculate seismic velocities and to relate them with respect to the preferred orientation of rock-forming minerals. We intend to extract Textures for each rock-forming mineral phase family and then calculate seismic velocities from each of them. The resulting velocities will be compared to seismic velocities previously measured on the same sample. Elastic properties and seismic anisotropy were already determined on these samples with different texture, chemical and mineralogical composition to study how these last three affected elastic properties and seismic anisotropy. Moreover, we will compare the elastic properties obtained from laboratory measurements and those from calculation based on texture measurements. Therefore, neutron diffraction is needed to perform QTA on these amphibolite samples to extend the results obtained so far. It would allow also a comparison between texture measurements performed via U-stage and neutron diffraction.

Experimental Report

Experiment n. : 1-02-2

Title: From Quantitative Texture Analysis to seismic velocities of rocks

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During the experiment 1-02-2 Quantitative Texture Analysis of rocks sampled across the Alpine and Apennine chains has been performed using the curved area position sensitive 2D detector of D19. Some selected samples, already measured during previous D20 and D1B experiments, were measured again with D19 in order to compare the results to those obtained on the D20 and D1B beamlines.

This experiment was also planned to assess the quality of the instrument in terms of quantitative texture analysis, with typical acquisition times of one hour for a full orientation distribution function determination using a 5° resolution grid.

Samples

We measured the glaucophanite sample (M26), a standard used for quantitative texture analysis at ILL on D1B and D20, using various acquisition times

We chose various samples from the Alpine chain, with different mineralogical composition, from monomineralic rocks (high temperature marbles and limestones with strong texture, quartzitic rocks, dunitic rocks, which are fragments of the Earth's mantle mainly composed by olivine) to amphibolites (rocks typical of the lower continental crust, mainly composed by amphibole and plagioclase).

Concerning the samples from the Apennines, we chose samples of sedimentary rocks of lacustrine origin containing a various amount and type of shale minerals,.

All the selected samples were chosen because they can give strong seismic signal, when associated with other rocks, in the context of large scale seismic investigations. Therefore it can be very interesting to calculate seismic velocities for these rocks.

Results

Concerning the comparison among the experiments conducted on different beamlines figure 1 shows pole figures for the sample M26 (internal standard for rocks), comparing D1B, D20 and D19 (this experiment). In table 1 are also shown the R values for the same samples. These results show very good quality reproducibility of texture analysis of rocks using 2D detector of D19.

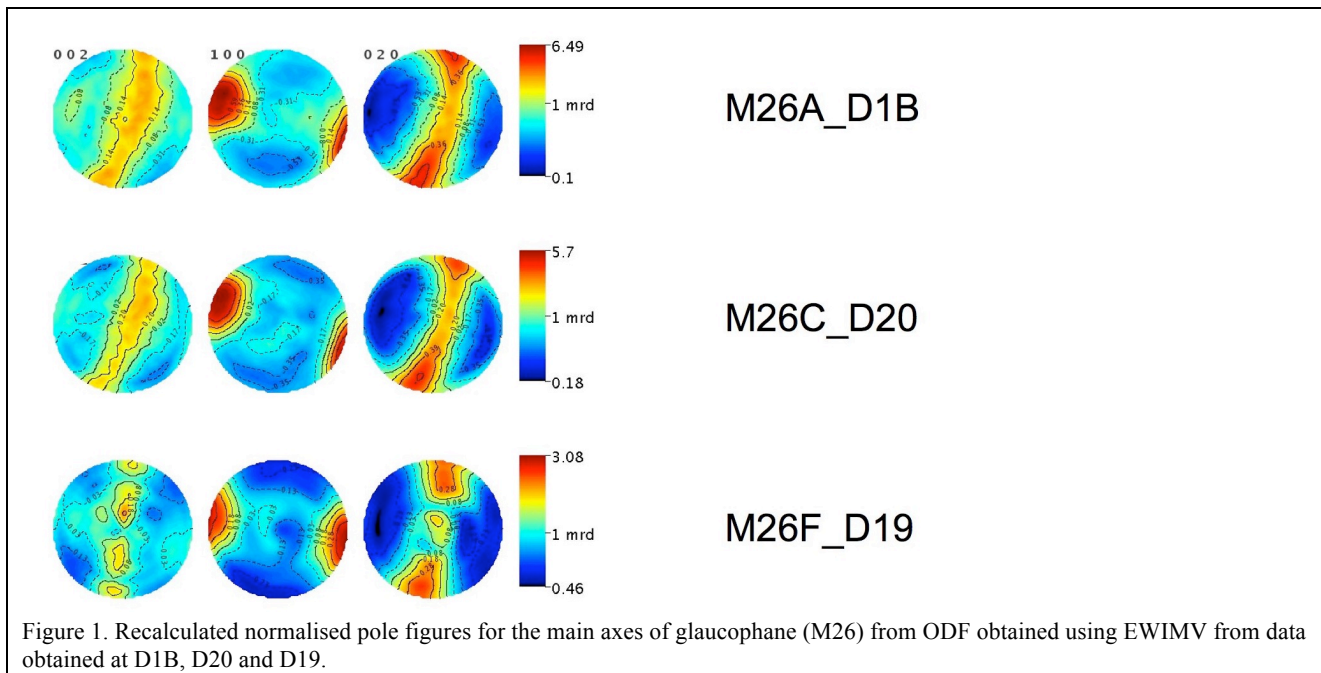


Figure 1. Recalculated normalised pole figures for the main axes of glaucophane (M26) from ODF obtained using EWIMV from data obtained at D1B, D20 and D19.

Sample	Instrument	year	lambda	acq time	RW (%)	Rexp (%)	chi ²	max m.r.d.	F ² (mrd ²)	ewimv
M26F	D19	2008	1.95	40 minutes	18.17	17.98	1.0201	3.08	1.58 y	
M26C	D20	2004	2.41	4 hours	16.02	1.73	37.9456	5.70	2.30 y	
M26A	D1B	2003	2.54	8 hours	10.15	2.67	14.2884	6.49	4.46 y	

Table 1. Experimental conditions and reliability factors for M26 sample at D1B, D20 and D19.

The texture analyses on the selected rock samples gave very good results in times shorter than previous experiments. In figure 2 are shown pole figures of mono- and polimineralic rocks. Even the measurements on rock containing low-symmetry and complicated minerals such as shale minerals gave very good results.

Conclusions

We consider the experiment 1-02-2 an important step for the use of D19 for texture analysis of rocks because : i) results are in agreement with those of D1B and D20 ; ii) the data have been obtained reducing the acquisition time to about 1/5 without any loss in data quality ; iii) the results are relevant not only for the quantitative texture analysis of rocks but also for the calculation of seismic properties of rocks that can be performed from the obtained ODF.