Experimental report

23/02/2022

Proposal: **1-02-329**

Council: 4/2021

Title: The correlation of polycrystallinetexture and magnetic anisotropy: Refining geophysical exploration forStrategic Ore deposits.

Research area: Other...

This proposal is a new proposal

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Samples: SiAlFeMgOK

Instrument	Requested days	Allocated days	From	To
D1B	3	2	12/09/2021	14/09/2021

Abstract:

Shear zones are recognized as essential pieces of that architecture, representing exploration targets worldwide for strategic resources like Sn-W-Au [1, 2, 3]. The interpretation of large-scale geophysical anomalies (e.g. seismic, magnetic, gravimetric), both in structural and lithological terms, during mineral exploration in complex orogenic contexts has to rely on a quantitative knowledge of the petrophysical properties of shear zones. When minerals are deformed in a shear zone texture often develops. Therefore the aggregate of minerals in deformed rocks will show macroscopic anisotropy and potentially become, for example, a highly reflective volume in the lithosphere [4], give rise to a magnetic anomaly or both [5]. Interestingly, the correlation of deformation flow vectors, texture and elastic/magnetic anisotropy is far from being completely understood [6]. In NW Iberia, extensional collapse and late magmatic activity of the Variscan orogen coincide in time and space with Sn-W-(Ta-Nb)-Au deposits. Large shear-zones control several large-scale deposits and geophysical anomalies reveal potential new targets in depth.

Experimental report 1-02-329 @ D1B _ ILL 12/09/2021 To 14/09/2021

The correlation of polycrystalline texture and magnetic anisotropy: Refining geophysical exploration for Strategic Ore deposits.

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Shear zones have been identified as common pathways for ore deposits. The correlation among geophysical properties, strain state and ore development along shear zones needs to be constrained in order to refine exploration strategies (brown to green field paths). In this experiment we have analyzed samples related to mid crust shear zones where strategic resources (Sn-W-Au), have been formed in W-Spain. The presence of large-scale geophysical anomalies (seismic/magnetic) in this context requires a quantitative knowledge of the petrophysical properties of shear zones. In particular, high-strain zones develop texture which result in anisotropy. The correlation of deformation flow vectors, texture and elastic/magnetic anisotropy is far from being completely understood [6]. In NW Iberia, extensional collapse and late magmatic activity of the Variscan orogen coincide in time and space with Sn-W-(Ta- Nb)-Au deposits. Large shear-zones control several large-scale deposits and geophysical anomalies reveal potential new targets in depth. We have conducted quantitative texture analysis of selected mylonites related to ore deposits in which a strong magnetic anisotropy has been recorded in the laboratory, to start to calibrate the geophysical interpretation of field anomalies in terms of both strain-state and, potentially, mineralizing state.

Experiment: The selected rock samples, cut in cubes of approximately 1 cm^3. each sample was mounted in transmission and measured with a scan grid of 10º by using 4-circle goniometer. Wavelength used was 2.52Å. Thanks to the low absorption of neutrons, acquisition time was, on average, 10 s per spectrum, resulting in 360 measured scans per sample (ϕ: 0$\rightarrow$355º; χ: -90$\rightarrow$0º). ω angle was set at 45º to make use of the detector 2θ full range (0-128º). In house standards (NAC and Si) were measured to refine experimental parameters at both wavelengths. Texture standards were used for symmetry control. Raw data was converted into *.F1B format with macro d1b_2_F1B at LAMP for latter refinement at MAUD (Lutterotti et al, 1999; Benítez Pérez, 2017). Quantitative texture analysis was done in Rietveld software package MAUD, computing ODF using E-WIMV. We used BEARTEX software for further ODF manipulation and modelling texture-based elastic/magnetic fabric. Selected pole figures were recalculated and rotated to show the foliation/and lineation reference system.

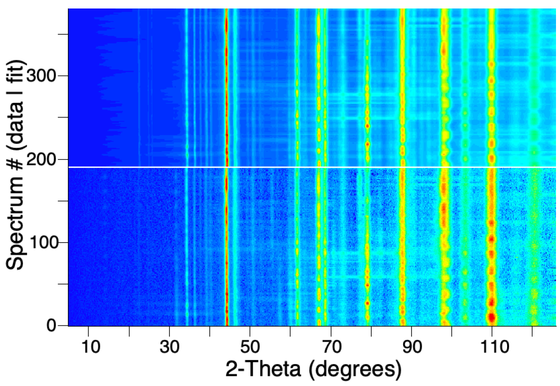

Figure 1: *Plot 2D showing experimental diffraction spectra (data) and Rietveld Model (fit). Note variations in peak intensity reveal preferred orientation or texture.*

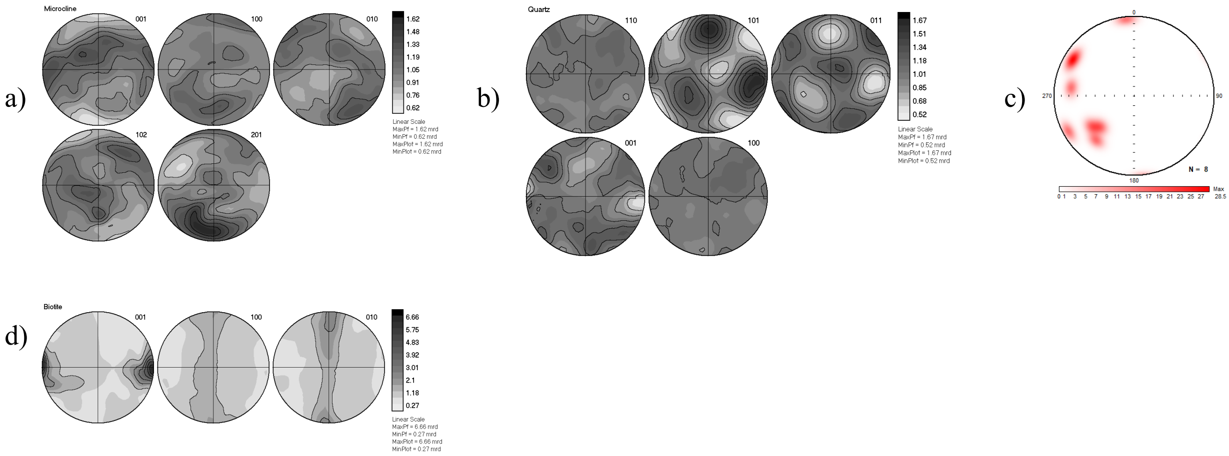

Figure 2: *a), b), d) Pole figures of main mineral phases calculated in BEARTEX. d) Anisotropy of the magnetic susceptibility (AMS) for the same tectonite.*

Our analyses show the presence of texture in most of the tectonites, with an inverse relationship between partial melting and texture index. AMS data show a complex correlation with texture, but overall, it is controlled by main textural components, so that magnetic anomalies, and particularly anisotropy would be evaluated in the field to constraint the exploration methodology. Texture of minor phases appears to be elusive by this technique, and further investigation will be required.

Conclusion

Correlation of magnetic properties and texture has been explored in the experiment. Overall, strain and magnetic fabrics are correlated but details are complex. The contribution of several ferromagnetic phases, in some cases below the minimum wt% for the technique needs to be evaluated and decomposed. Since strain and magnetic anisotropy appear to be correlated, ore prospection needs to incorporate anisotropy analysis at different scales.

References

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[5] Ayarza Arribas, et al. 2020. Characterizing the source of the Eastern Galicia Magnetic Anomaly (NW Spain): the role of extension in the origin of magnetization at the Central Iberian Arc. *Tectonics*.

[6] Gómez Barreiro et al. 2015, J. Struct. Geol. 71: 100-111