Experimental report

12/02/2019

Proposal:	**CRG-2559**	**Council:**	4/2018
Title:	Texture analysis of metallic oresGenesis and deformation processes		
Research area:			

This proposal is a new proposal

Main proposer: **Juan GOMEZ BARREIRO**

Experimental team: Juan MORALES
Santos BARRIOS SANCHEZ
Jose Manuel COMPANA
Juan GOMEZ BARREIRO

Local contacts: Ines PUENTE ORENCH

Samples: FeCuPbAgAuS

Instrument	Requested days	Allocated days	From	To
D1B	2	2	23/10/2018	25/10/2018

Abstract:

Experimental report CRG_2559 @ D1B _ ILL 23/10/2018 - 25/10/2018

Texture analysis of metallic ores: Genesis and deformation processes

Gómez Barreiro, J. [1] (PI) *Compaña Prieto, J.M.* [2] *et al.*

[(1)] *Dpto. Geología, Universidad de Salamanca, (Spain)* [(2)] *Servicio de Difracción. Universidad de Salamanca (Spain)*

It has been conducted a quantitative analysis of texture in polymetallic (Fe,Cu,Pb) sulphides and gold nuggets (Au-Ag alloys) collected in S-America and W-Spain. Metallic ores have been plastically deformed in major shear zones, and gold nuggets due to hammering action during fluvial transport. A contrasted rheological behavior was anticipated due to the macroscopic segregation of phases and microstructures in sulphides so distinct textures were expected. Five cubes (1cm3) were mechanized from selected mylonitic sulphide bands in order to quantify texture in mylonitic layers dominated by pyrite, sphalerite, galena, and chalcopyrite. Lineations and foliation were used as sample reference system. Seven gold nuggets with different aspect ratios were analyzed, using major axis and major/mid section as the reference system. Each sample was mounted in transmission and measured with a scan grid of 10º by using 4-circle goniometer. Wavelength used was 2.52Å for sulphides and 1.28 Å for gold samples. Thanks to the low absorption of neutrons, acquisition time was, on average, 20 s per spectrum, resulting in 360 measured scans per sample (ϕ: 0→355º; χ: -90→0º). ω angle was set at 30º 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.

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. Selected pole figures were recalculated and rotated to show the foliation/and lineation reference system. In the Figure 1 an example of mylonitic sulfide is showed in a) 2D multiplot (experimental data below/ Rietveld fitting above), b) total spectrum projection (dots: experimental data). Selected pole figures for this sample is depicted in Figure 2 where sphalerite shows the highest texture.

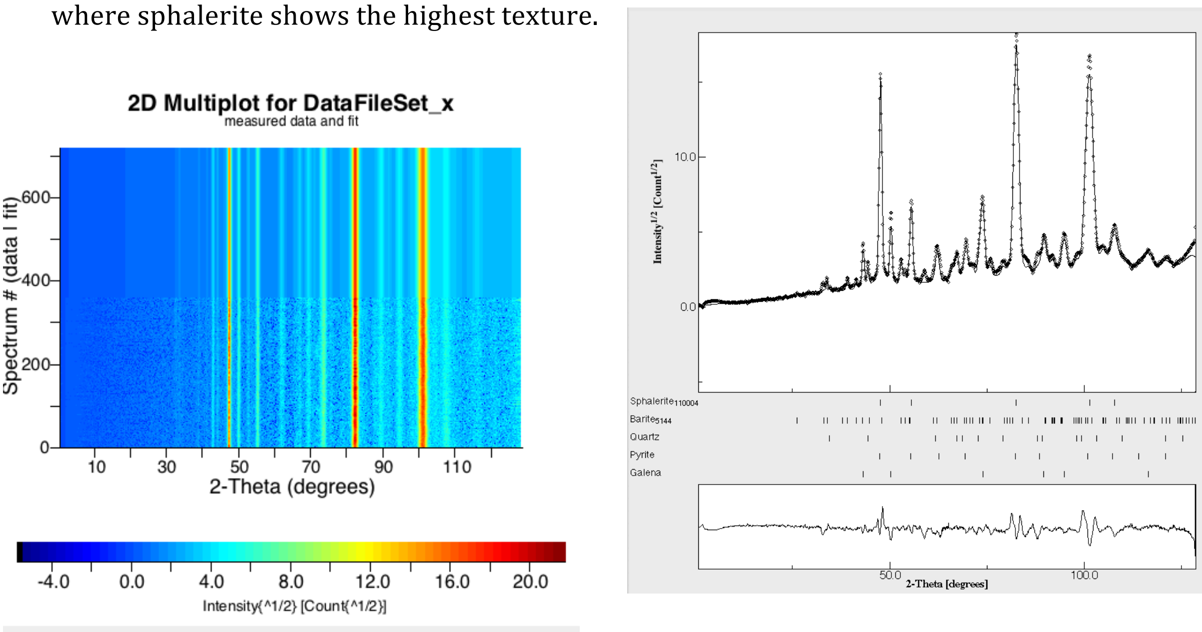

Figure 1*: Deformed Sulphide sample. a) 2D multiplot with experimental data below and Rietveld fit above. Note the low preferred orientation revealed as intensity variation along peaks. b) Total spectrum sum. Dots are experimental data and solid line Rietveld fit.*

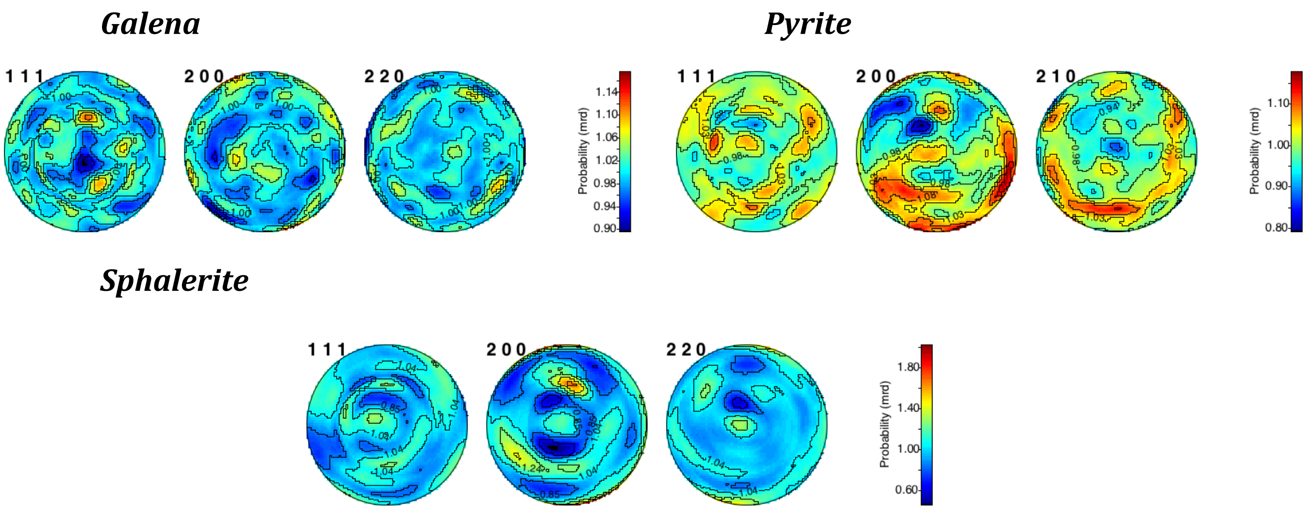

Figure 2: *Pole figures of selected planes and phases. texture in multiples of a random distribution (m.r.d.). Maximum values are 2.08 m.r.d.*

Overall, our prelimiar results in deformed sulphides, suggest that sphalerite and galena shows the strongest textures (2 - 4 m.r.d.), while pyrite has the lowest one, this is in correlation with microstructural observation (plastic/fragile behavior).

Preliminary results in gold nuggets showed a preferred orientation (Figure 3a) that increase with aspect ratio and reach maximum values (6.5 m.r.d) in fiber-like particles. An example of pole figures is presented in Figure 3b.

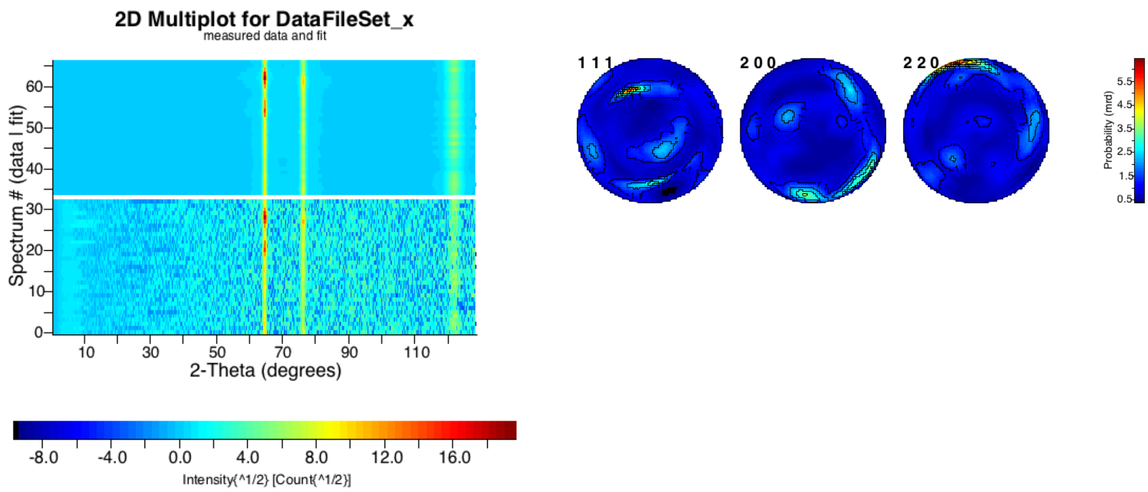

Figure 3*: a) 2D multiplot elongated gold nugget with strong texture. b) Gold pole figure of elongated particle.*

Conclusions

Neutron diffraction is the reference technique for polyphasic and dense materials, resulting in good grain statistics comparing with EBSD or Xrays. Our result, even in such a short beamtime were excellent and open the possibility to understand natural deformation and texture in strategic geomaterials improving not only basic knowledge on ore genesis but also prospection and exploitation.

References: Lutterotti et al 1999: ICOTOM-12, 2, 1599; **Benítez Pérez** (2017):Estudio cuantitativo de la textura en tectonitas mediante difracción. Contribución a la anisotropía sísmica y reología orogénica. PhD Universidad de Salamanca. 450pp.