



Textural record of an intra-oceanic subduction: the Careón ophiolite (NW Spain)

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Abstract: Texture analyses were done in mylonitic amphibolites from the Careón ophiolite (Órdenes Complex, NW Iberia). Experiments were carried out using time-of-flight (TOF) neutron diffraction and electron back scattered diffraction (EBSD) techniques to determine crystallographic preferred orientation of the principal phases. While both techniques appear to be complimentary, neutron diffraction plus Rietveld data refinement showed better resolution of low-symmetry phases. Results are discussed within the geological context (Gómez Barreiro *et al.*, 2007a) supporting a continuous deformational evolution from the closure of the Rheic Ocean to the Variscan accretion.

Keywords: texture, neutron diffraction, EBSD, ophiolites, Rheic Ocean, Órdenes Complex.

Tracking the evolution of deformation fabrics in old ophiolites is not trivial since we commonly deal with partially preserved sections, tectonically reorganized, with several stages of retrogression and metamorphism. Moreover, mafic rocks have been commonly ignored in fabric analyses, mainly due to the complex mixture of low symmetry phases, which requires sophisticated techniques to retrieve information (Gómez Barreiro *et al.*, 2007b). However, it has been shown that texture analysis can provide independent and valuable evidence about the condi-

tions of deformation and the kinematics. Deformative stages and correlation of ophiolitic units could be explored based on quantitative texture characterization in a similar way as it is on petrological and geochemical features.

We investigate crystallographic preferred orientation (or texture) in amphibolites of the Careón Unit from the crustal section of a supra-subduction zone ophiolite in NW Iberia (Díaz García *et al.*, 1999; Arenas *et al.*, 2007a, 2007b; Sánchez Martínez *et al.*, 2007).

This ophiolite records structural and petrological features which suggest that early intraoceanic subduction textures, generated during the closure of the Rheic Ocean, have been preserved. Textural analyses on selected amphibolites from a high temperature shear zone, corresponding to a metamorphic sole (Díaz García *et al.*, 1999), and a crustal shear zone inside the Careón ophiolite were carried out using time-of-flight (TOF) neutron diffractometer HIPPO (High-Pressure-Preferred-Orientation) at LANSCE (Los Alamos Neutron Science Center) (Wenk *et al.*, 2003) and electron back scattered diffraction (EBSD) technique (Prior *et al.*, 1999) at the Department of Earth and Ocean Sciences (University of Liverpool), in order to determine crystallographic preferred orientation of the principal phases, amphibole and plagioclase. Results dis-

play a clear correlation of amphibole texture and shape fabric (E-W lineation). Plagioclase (010) (100) (001) pole figures tend to reflect a monoclinic symmetry which is coherent with general kinematic criteria (top-to-the east). The prevalence of top-to-the east kinematic criteria for the variscan structures in the region supports a continuous flow direction in the Careón unit from the High-T deformation to the final stages.

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References

- ARENAS, R., MARTÍNEZ-CATALÁN, J. R., SÁNCHEZ-MARTÍNEZ, S., FERNÁNDEZ-SUÁREZ, J., ANDONAEGUI, P., PEARCE, J. A. and CORFU, F. (2007a): The Vila de Cruces Ophiolite: A Remnant of the Early Rheic Ocean in the Variscan Suture of Galicia (Northwest Iberian Massif). *J. Geol.*, 115: 129-148.
- ARENAS, R., MARTÍNEZ CATALÁN, J. R., SÁNCHEZ MARTÍNEZ, S., DÍAZ GARCÍA, F., ABATI, J., FERNÁNDEZ-SUÁREZ, J., ANDONAEGUI, P. and GÓMEZ-BARREIRO, J. (2007b): Paleozoic ophiolites in the Variscan suture of Galicia (northwest Spain): distribution, characteristics and meaning. In: R. D., HATCHER JR., M. P. CARLSON, J. H. MCBRIDE and J. R. MARTÍNEZ-CATALÁN (eds): *4D Framework of Continental Crust. Geol. Soc. Am. Mem.*, 200: 425-444.
- DÍAZ-GARCÍA, F., ARENAS, R., MARTÍNEZ-CATALÁN, J. R., GONZÁLEZ DEL TÁNAGO, J. and DUNNING, G. (1999): Tectonic evolution of the Careón ophiolite (northwest Spain): A remnant of oceanic lithosphere in the Variscan belt. *J. Geol.*, 107: 587-605.
- GÓMEZ-BARREIRO, J., MARTÍNEZ-CATALÁN, J. R., ARENAS, R., CASTIÑEIRAS, P., ABATI, J., DÍAZ-GARCÍA, F. and WIJBRANS, J. R. (2007a): Tectonic evolution of the upper allochthon of the Órdenes complex (northwestern Iberian Massif): Structural constraints to a polyorogenic peri-Gondwanan terrane. In: U. LINNEMANN, R. D. NANCE, P. KRAFT and G. ZULAUF (eds): *The evolution of the Rheic Ocean: From Avalonian-Cadomian active margin to Alleghenian-Variscan collision. Spec. Pap. Geol. Soc. Am.*, 423: 315-332.
- GÓMEZ-BARREIRO, J., LONARDELLI, I., WENK, H. R., DRESEN, G., RYBACKI, E., REN, Y. and TOMÉ, C. N. (2007b): Preferred orientation of anorthite deformed experimentally in Newtonian creep. *Earth Planet. Sc. Lett.*, 264: 188-207.
- PRIOR, D. J., BOYLE, A. P., BRENNER, F., CHEADLE, M. C., DAY, A., LÓPEZ, G., PERUZZO, L., POTTS, G. J., REDDY, S., SPIESS, R., TIMMS, N. E., TRIMBY, P., WHEELER, J. and ZETTERSTRÖM, L. (1999): The application of electron backscatter diffraction and orientation contrast imaging in the SEM to textural problems in rocks. *Am. Mineral.*, 84: 1741-1759.
- SÁNCHEZ-MARTÍNEZ, S., ARENAS, R., DÍAZ-GARCÍA, F., MARTÍNEZ-CATALÁN, J. R., GÓMEZ-BARREIRO, J. and PEARCE, J. A. (2007): Careón ophiolite, NW Spain: Suprasubduction zone setting for the youngest Rheic Ocean floor. *Geology*, 35: 53-56.
- WENK, H. R., LUTTEROTTI, L. and VOGEL, S. (2003): Texture analysis with the new HIPPO TOF diffractometer. *Nucl. Instrum. Methods*, A515: 575-5.