ESEG-4: Evolución tectónica del arco de Scotia en Sudamérica y la Península Antártica

New assessment of basement units in the fitz roy area: implications for an early mesozoic tectono-metamorphic event at southern patagonia

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Introduction

Among the complex collage of metamorphic belts exposed in the Patagonian Andes, the Triassic metamorphic rocks are poorly represented. They only outcrop at the southern Chilean coast within the Chonos Metamorphic Complex (CMC), a subduction complex (Hervé *et al*. 2008), which witness of an active subduction during the Late Triassic (Hervé and Fanning 2001). Recently, U-Pb dating in detrital zircons performed in metasedimentary rocks from the Nunatak Viedma, which crops out west of the Fitz Roy area, within the Southern Patagonian Ice Field, revealed grain-ages youngest at Late Triassic (Suárez *et al*. 2018). We proposed to define the Nunatak Viedma Unit (NVU) in the Southern Patagonian Andes (SPA; Suárez *et al*. 2018) on the basis of these new observations. The rocks of the NVU exhibit a main phase of ductile to brittle-ductile deformation tentatively correlated with the Late Triassic-Early Jurassic Chonide deformation event (Suárez *et al*. 2018) identified in the southern Chilean coast (Thomson and Hervé 2002; Hervé *et al*. 2008). However, the age of the NVU's tectono-metamorphic event, as well as its tectonic significance, are still unknown. New geological mapping carried out in the Fitz Roy region (Fig. 1) reveals that outcrops previously mapped either as Bahía de la Lancha Formation (BLF) or as volcanic rocks of the El Quemado Complex, shows lithological and structural similarities with the rocks of the NVU (Fig. 1). The preliminary structural results presented in this contribution aim to better constrain the deformation phase of the NVU and to discuss its age and tectonic significance.

Geological Background

The basement exposed in the eastern foothills of the SPA is made of very low- to low-grade metasedimentary rocks (Giacosa and Márquez 2002). South of 48°30´, the outcrops are traditionally assigned to the BLF (Giacosa and Márquez 2002). Further North, the basement is tentatively correlated with the Río Lácteo Formation cropping out in the surroundings of the Pueyrredón-Cochrane, Belgrano, and Buenos Aires-General Carreras lakes (Bell and Suárez 2002; Giacosa and Márquez 2002). The maximum depositional age of the BLF has been constrained by U-Pb dating in detrital zircons at ~330 Ma (Augustsson *et al*. 2006). The BLF is affected by a main deformation phase with ~E-W oriented deformation structures, developed during the late Paleozoic Gondwanide orogeny (Giacosa *et al*. 2012). Recently, the NVU was defined inside the southern Patagonian Ice Field based on U-Pb dating in detrital zircons, which yield a Late Triassic maximum depositional age (~223 Ma, Suárez *et al*. 2018). The protoliths of the NVU could have been deposited in a back-arc basin (Nunatak Viedma basin) related to a subduction-related (back-arc) extensional tectonic setting (Wever *et al*. 1994). The deformation and subsequent closure of the Nunatak Viedma basin could be related to the Late Triassic-Early Jurassic Chonide event defined by Hervé *et al*. (2006, 2008). This deformation event was primarily identified in the Chonos Metamorphic Complex of the Chilean coast (Thomson and Hervé 2002) and correlated with another deformational events recognized in the Antarctic Peninsula and in New Zealand (Vaughan and Livermore 2005; Hervé *et al*. 2006). However, little is known about the tectonic significance of the observed deformations. Current interpretations point out plume-plate interaction (Vaughan and Livermore 2005; Dalziel *et al*. 2013).

Results

In the Paso del Viento area, South of the Fitz Roy massif, shales and (meta?) sandstones and (meta?) conglomerates are cropping out, and are mapped as part of the NVU (Upper Triassic). The metasedimentary rocks are unconformably overlain by Late Jurassic volcanic rocks belonging to the El Quemado Complex and intruded by felsic and mafic dykes of unknown age.The metasedimentary rocks exposed in the Paso del Viento area exhibit deformation structures develop in ductile, then brittle-ductile and brittle domains. In this contribution, the characterization will be focused on the deformation structures developed in ductile and brittle-ductile domains. We differentiate an early main phase of deformation (D_1) whose structures have been deformed by at least a second phase of deformation (D_2). The first phase of deformation (D_1) is characterized by the folding and shearing of the beds (S_0), which are principally oriented NW-SE dipping to the SW. The folds (F1) are tight- and inclined-type and their fold axes are gently plunging to the NW (Fig. 1). A pervasive axial plane slaty cleavage (S_1) globally oriented NNW-SSE and dipping to the WSW develop almost parallel to the S_0, associated to the F_1 folds. Locally, in the southern sector, we observed a reverse shear zone (S_2) with the top-

to-the-NE sense of shearing (Fig. 1). In agreement with S_1-S_0 geometric relationship and the vergence of the shear zone, the D_1 exhibits NE- to E-vergence in response to a contraction oriented ~ENE-WSW. At meso-scale the slaty (S_1) cleavage is (re)folded by tight- and chevron-type folds (F_2), which fold axes plunge towards the SW with moderate- to high-angle (Fig. 1). The folding pattern produced during both D_1 and D_2 may be explained by continuous steady-state deformation or alternatively by two coaxial shortening phases.

Discussion

Timing considerations. The rocks of the NVU exhibit the main phase of deformation (D_1) responsible for the development of folds and associated slaty cleavage, and small-scale shear zones. The structures produced during D_1 show ~E-to-NE-vergence in the Paso del Viento area and are (locally) affected by the second stage of mesoscale folding. According to zircon detrital ages in the NVU and its stratigraphic location under the El Quemado Complex (~155-145 Ma), this event of deformation accompanied by very-low grade metamorphism is constrained between 223 Ma and 155 Ma. The Chonos Metamorphic Complex bears witness of similar ages, post-metamorphic cooling ages constraining the metamorphism and related deformation event at 219-186 Ma (Thomson and Hervé 2002). In the same way, Late Triassic-Early Jurassic ages are coincident with the uplift and erosion of plutonic units in Central Patagonia (Zaffarana *et al*. 2014). Despite sparse data on the "Chonide event", this early Mesozoic tectono-metamorphic event seems to be widespread within western and central Patagonia.

Tectonic interpretations.

The mesozoic western margin of southern Patagonian is an example of transitory plate coupling and tectonic mode switching between extension and contraction in the upper plate. Back-arc basins were opening during extension stages in Late Triassic and Late Jurassic, and were subsequently closed during contraction stages in Late Triassic-Early Jurassic and mid-Cretaceous, respectively (Calderón *et al*. 2016). The transitory increase of coupling between subducting and overriding plates in accretionary orogens is a mechanism still under debate. In one hand, tectonic mode switching could be purely explained by slab dynamics (Guillaume *et al*. 2009); in the other hand, Cawood and Buchan (2007) propose three combined mechanisms: flat-slab subduction, terrane accretion or tectonic plate reorganization. More precisely, the switch from Late Triassic extension to Late Triassic-Early Jurassic contraction was postulated as part of a global process triggered by plume-plate interactions (Dalziel *et al*. 2013; Vaughan and Livermore 2005). Dalziel *et al*. (2013) suggested that the deformation was triggered by flat-slab subduction due to a mantle plume impinging beneath the oceanic subducted slab. Alternatively, Vaughan and Livermore (2005) showed that the deformation occurring at 202-197 Ma was coeval with the onset of both the Pangea super-continent break-up and of the magmatism of the Central Atlantic Magmatic Province. They suggest that the plume impact beneath Pangea increased plate coupling at the margins and drove subsequent deformation. To sum-up, the Chonide tectono-metamorphic event in southern Patagonia produced crustal deformations linked to very low-grade metamorphism in the NVU. In a tectonic and geodynamic frame, this event seems to be a stage of strong plate coupling possibly driven by tectonic plate reorganization, in which a super-plume event triggered Pangea break-up and deformation in the marginal basins.

Conclusion

Geological mapping carried out in the Fitz Roy area reveals new outcrops of the recently defined Nunatak Viedma Unit (Upper Triassic). Structural analysis allows characterizing an early E to NE-verging phase of deformation (D_1), which develops during the Chonide tectono-metamorphic event in Late Triassic-Early Jurassic times. Chonide event at southern Patagonia reflects a tectonic regime switching from extension to contraction tectonics. Geological significance of this deformation remains a matter of debate, but could be related to the secondary effects of a large mantle-plume impact beneath Pangea.

References

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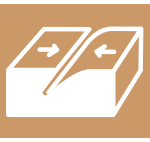

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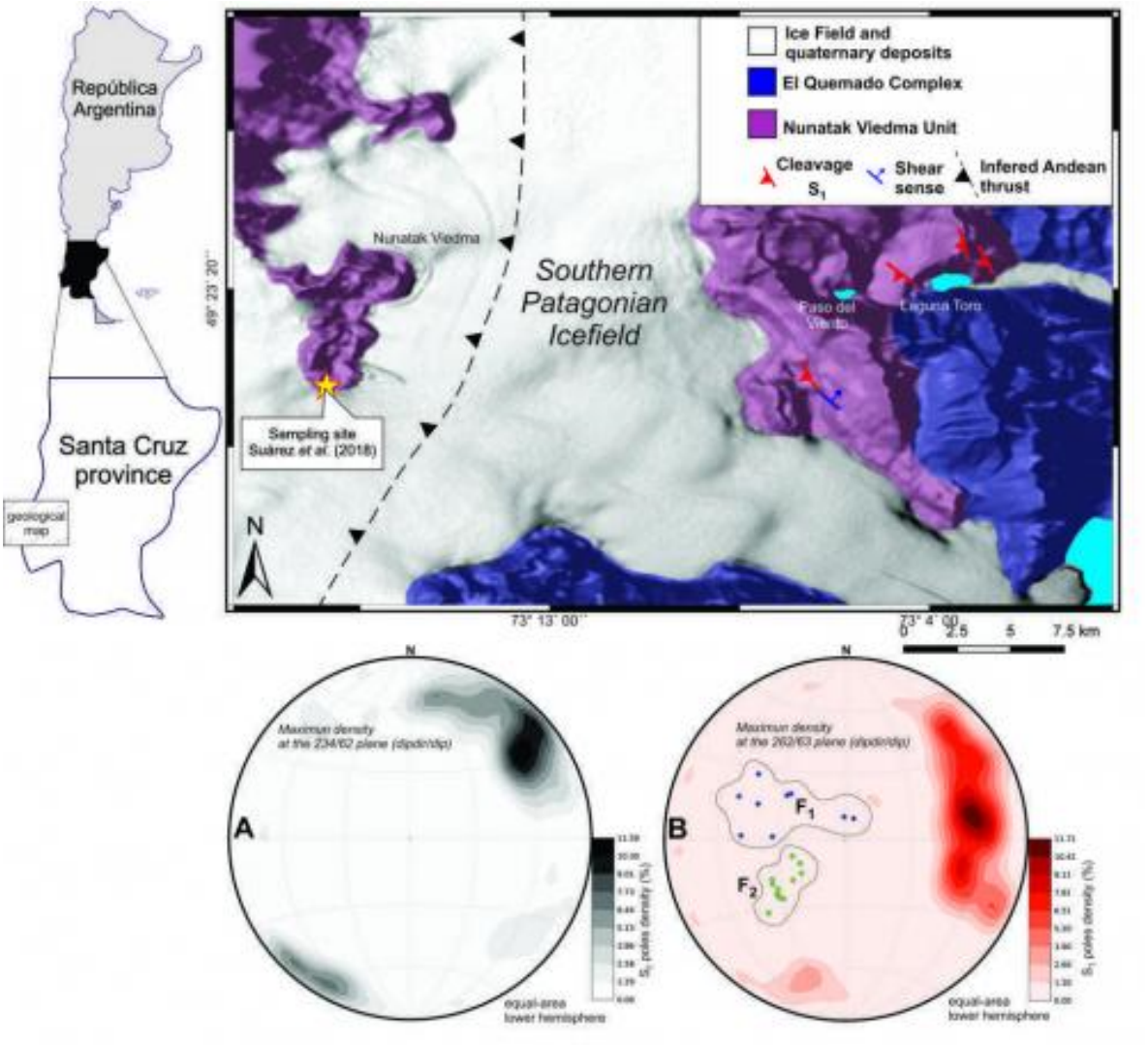

Figure 1. Geological-structural map of the Nunatak Viema Unit in the Southern Patagonian Andes. Structural data are plotted at stereoplots as density contours of poles to S_0 (n=60; at grey scale) and of poles to S_1 (n=60; at red scale). In the B plot, also are plotted the fold axes from F_1 (n=9; blue diamonds) and F_2 (n=12; green diamonds) to visualize the geometric relationship between these structural elements. Contour plots were generated with the free software OpenStereo made by Grohmann and Campanha (2010).