The northern Gondwana margin and Pangaea tectonics revisited: Preliminary results in the Ossa-Morena Zone (SW Iberian Massif)

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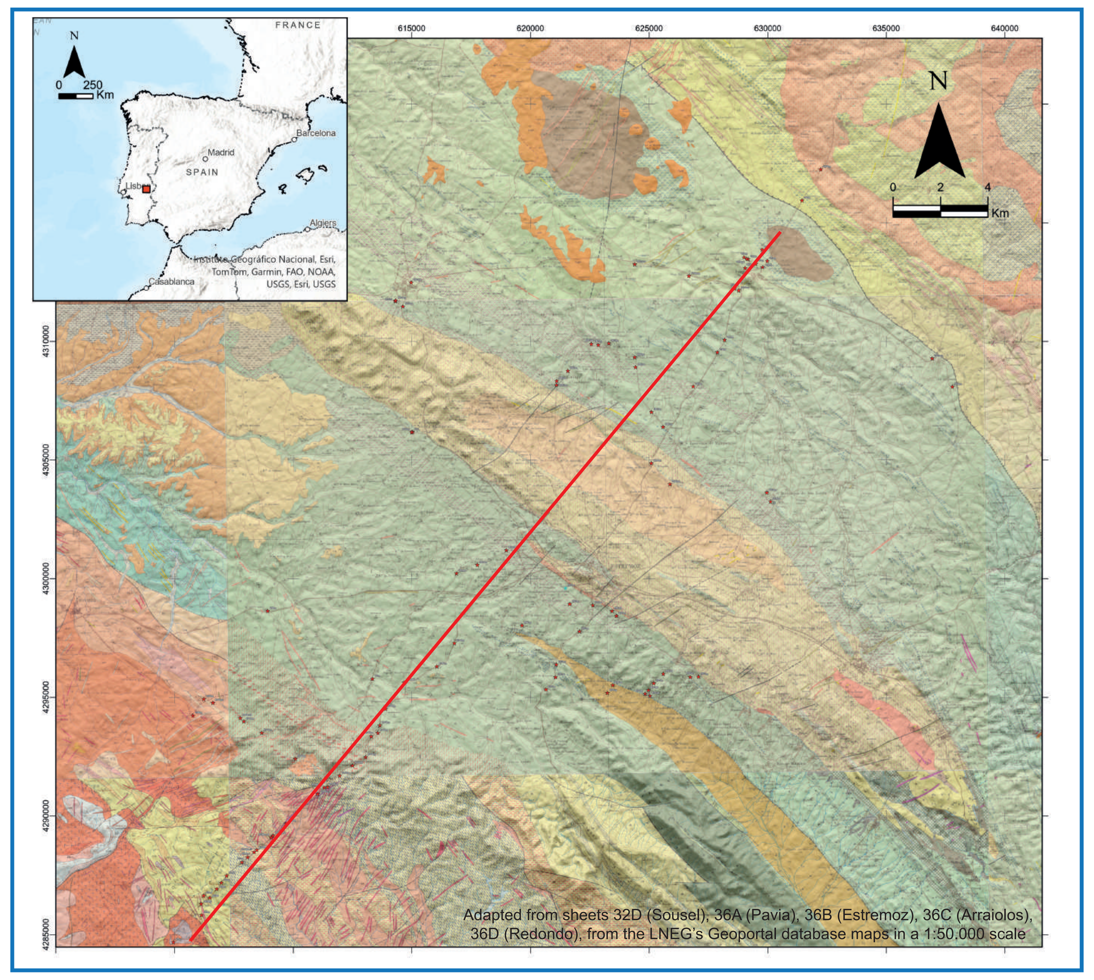
Introduction

Orogenesis involves a continuum of complex natural phenomena within the context of the Wilson Cycle, the backbone of modern plate tectonics. While topographic effects of present-day orogenic cycles are readily visible, eroded old orogens represent windows that expose the crust's interior and facilitate the study of complex lithospheric processes.

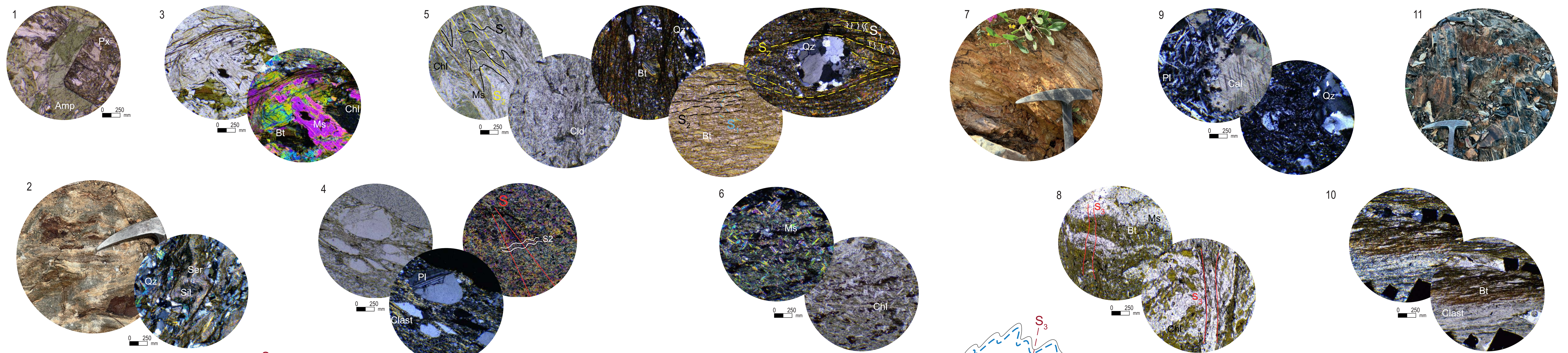
The object of this research lies within the Devonian-Carboniferous Variscan collisional orogen that extends from Southern Europe to Northern Africa. This orogenic belt resulted from the convergence and collision between the passive margin of north Gondwana and the active margin of southern Laurussia, forming the Pangea Supercontinent. The Iberian Massif, located in the core of Pangaea, is one of the best exposures of the Variscan orogen in Europe, and a unique natural laboratory to study deep-to-surface geodynamic phenomena. Studying this sector of the Pangea supercontinent raises new important questions about how modern collisional orogens evolve and how their crustal architecture develops.

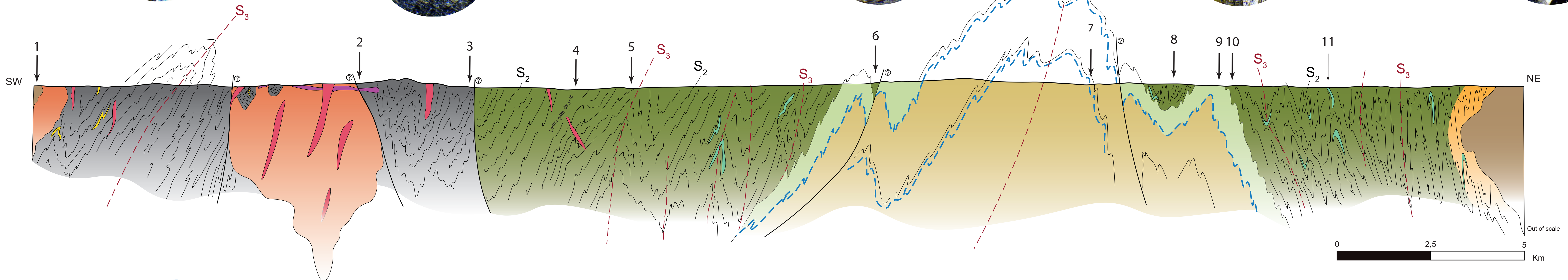
Field and analytical data compiled in the last 20-30 years in Iberia has revealed a complex basin-cover architecture derived from the deformation and metamorphism of the Ediacaran to Carboniferous stratigraphy. Ongoing research in a critical and representative region of the SW Iberian Massif (i.e. Ossa-Morena Zone), reveals a close relationship between the deformation, metamorphism, magmatism and sedimentary processes involved in deep to shallow lithospheric dynamics, during both orogenic thickening and gravitational collapse.

The systematic study of key outcrops was performed, to define first-order geological contacts between major tectono-metamorphic, stratigraphic and magmatic units. This information made it possible to draft the architecture of the crust along a transverse section across the central region of the Ossa-Morena Zone (Estremoz, Portugal). With the structural relationships well defined, the main units were sampled to control the ages of the orogenic events and to correlate the tectono-metamorphic fabrics found in the Variscan basement regionally.



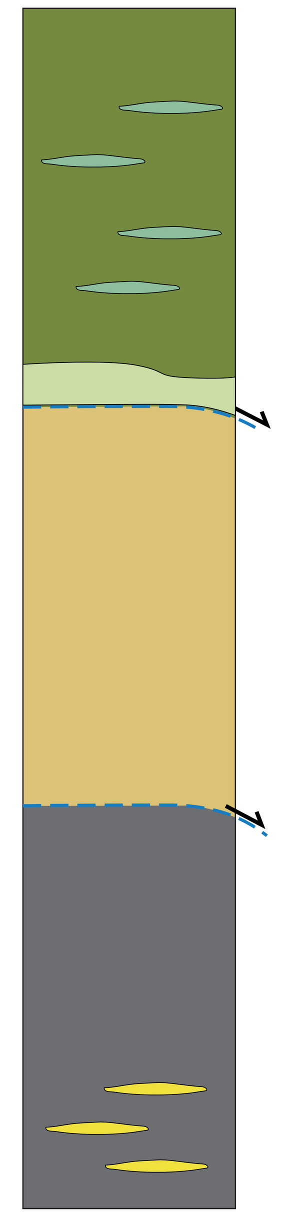
Results





Cross-section caption and tectonostratigraphic column

- Detachment
- Fault
- Spoted shists, due to contact metamorphism
- Shales and slates (Cambrian-Devonian)
- Volcanic tuffs and trachytic lava
- Marbles and Micashists (Ediacaria-Cambrian)
- Paragnaisses and micashists (Cambrian)
- Anphibolites (Cambrian)
- Lidites and graphitic slates
- Gabbro and Diorite (~340 Ma, Lains Amaral et al., 2022)
- Tonalite and granodiorite (~340 Ma, Dias da Silva *et al.*, 2018)
- Pegmatitic granite, locally tectonized
- Dolerite and microdiorite



The mineral identification in the thin sections pictures follows the abbreviations recomended by Whitney and Evans (2010)

Discussion and Conclusions

The study area is a complex sector of the Ossa-Morena Zone, that serves as a window to study the natural processes behind the Variscan Orogenisis.

As one might infer from the cross-section and field and petrographic results displayed above, the tectonostratigraphy is complex and suffers at least 3 deformation phases. In most cases, the S_0 and S_1 are no longer visible, being transposed by an S_2 and an S_3. It is also visible that the synorogenic basin associated with lthe displayed thrusts (that might have a transcurrent component associated with the third deformation stage), might be larger than initially thought, given the ammount of clasts and olistostromes found within the third tectono-metamorphic unit.

Furthermore, field evidence points towards a shear surface at the base of the volcanic tuffs, that might serve as a detachment for the emplacement of the Estremoz Anticlinal.

In future steps, these will serve as a base to understand the processes that this syorogenic basin underwent and which structures need dating and why. This will give important constraints to develop state-of-the-art conceptual and numerical models of the tectonic evolution of the Variscan Orogen during the assembly of the Pangaea supercontinent. The combination of field and petrography data with numerical modelling (next steps) can be very useful for better understanding the role of different lithospheric processes in orogenic building and gravitational collapse as Supercontinents are formed.

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