Contact-metamorphic effects of the Santa Eulália Plutonic Complex (Southern Portugal): Litological and structural constraints

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The Santa Eulália Plutonic Complex (SEPC) is a late-variscan granitic pluton in SW sector of the Iberian Orogen. This granite with 400 km^2 cross-cuts the regional NW-SE variscan structures, namely a major high-grade and high-strain shear zone in the contact between two axial geotectonic zones of the iberian varican belt. The host rocks of SEPC are composed by low to high grade metamorphic rocks from Upper Proterozoic to Lower Paleozoic. In the NE-sector of the shear zone a low grade metasedimentary Ediacaran unit (Série Negra) composed by siliciclastic rocks, including black cherts, is located adjacently to a high grade unit (migmatites and gneiss). In the SW-sector of the shear zone, a low-grade metasedimentary and metavolcanic Cambrian sequence has quartz-pelitic, carbonate and volcanic rocks. The lithostratigraphic units are also tectonic units bounded by major high-strain transcurrent faults placing side by side different rock types and different metamorphic grades, but always characterized by a well-developed vertical foliation. Both at east or at west, the host rocks are phyllite and quartz-phyllite, in chlorite zone conditions, without any thermal effects even at short metric distance from the contact. The metapelitic rocks show millimetric veins (2mm thick) with biotite, quartz, chlorite and apatite, concordant with foliation, without exhibiting any thermal effects on the walls. The Cambrian carbonate rocks outcropping in narrow bands near the ESE border of SEPC did not show any post-kinematic thermal effect. Unlike, in the western sector of SEPC the thermal effect is marked in the metasedimentary roof pendants, by metamorphic and metasomatic paragenesies in pelitic and carbonate hornfels, the later with large wollastonite crystals.

Our results highlight that the thermal effects of the SEPC in the host rocks are restricted to the roof pendants and the metasomatic effects are constrained by the carbonate rocks. The shape of the pluton, the absence of lateral thermal effects, the smooth bend of the vertical host rocks around the pluton in easthern border suggest a small thickness of the massif in the western border, and a deep rooting in the major vertical shear zone at the eastern border.

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Diverse capacity for 2-methylhopanoid production correlates with specific niches

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Molecular fossils of 2-methylhopanoids (2-MeBHPs) are important geological biomarkers and have often been interpreted as proxies for cyanobacteria and their main metabolism oxygenic photosynthesis [1]. However, substantial culture and genomic-based evidence indicates that organisms other than cyanobacteria can make 2-MeBHPs [2, 3]. Yet, these lines of evidence do not address which organisms produce 2-MeBHPs in the environment. In this study, we use metagenomic and clone library methods to address the environmental diversity of *hpnP*, the gene encoding the C-2 hopanoid methylase. We show that *hpnP* copies from alphaproteobacteria and unknown origin are found in diverse modern environments, including some representative of those preserved in the rock record, while cyanobacterial *hpnP* genes are more rare and localized to specific habitats. Moreover, *hpnP* diversity in any given locale can be spatially and temporally heterogeneous, stressing the need to sample environments rigorously before drawing general conclusions. Additionally, we asked if *hpnP* is overrepresented in organisms or environments with a specific metabolism or associated with a particular niche. We found the presence of *hpnP* to be significantly correlated with organisms and environments known to support plant-microbe interactions. Our results indicate that 2-MeBHPs can no longer be used as unambiguous biomarkers for cyanobacteria and hints at a potential interpretation for 2-MeBHPs separate from oxygenic photosynthesis that underpins the observed enrichment of *hpnP* in these contexts.

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