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Onshore study of syn-orogenic olistostromic deposits in the Gibraltar Arc: a tool to reveal mountain front uplift

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Syn-orogenic deposits provide key data which permit to relate tectonic pulses and evolution of relieves during orogenic building. In particular, when these deposits are olistostromes, the relationships between the type of blocks embedded in the sediment, the characteristic of the boundary between basement and deposits, together with the structure of large-scale olistoliths, permits to establish relative age constrain between the structural events that affected the basement rocks and the processes of erosion, transport and deposition that took place at the same time. With this point of view, we present coupled structural, sedimentological and stratigraphical data which constrain the evolution of the Betic-Rif orogenic belt (western Mediterranean) in terms of uplift of its mountain front.
The Betic-Rif internal zone is formed by metamorphic rock complexes (Alboran Domain) thinned during Miocene times though extensional structures coetaneous with the deposition of a thick sedimentary cover in most internal part of the Gibraltar Arc (Alboran Basin). The external zone is represented by a fold and thrust belt composed by sedimentary rocks derived from the South Iberian and Maghrebian paleomargin and by an accretionary prism, the Flysch Trough Complex, structurally emplaced over the paleomargin-derived unit. We focus on syn-orogenic deposits located on the Alboran Domain nearby the boundary with the external zone of this arcuate belt. These deposits were defined in previous works as a Flysch-type tectonic unit backthrusted over the Alboran Domain, the so-called Alozaina Complex, and attributed to lower Miocene age.
Our data show that this complex is an olistostromic formation, which seal the internal-external boundary. Its matrix is mainly argillaceous and shows a turbiditic character. The embedded blocks and olistoliths came from the nearby tectonic domains, belonging either to the internal or the external zones. Special attention can be paid to kilometre-scale olistoliths derived from the Flysch Trough Complex. Indeed, the olistoliths show a similar structure of thrust stacks, as those observed in the outcropping Flysch Trough Complex thrust belt, which in turn was build during Burdigalian times. We propose that the Alozaina formation results from a gravitational dismantling of the already structured units situated along the internal-external zone boundary. Brittle extensional tectonics in the Alboran Domain, coetaneous with the thrust stacking and uplift of the external zone mountain front, was likely an important factor for the production of mass-wasting process.
At larger scale, our data implies that very important vertical movements took place in the Gibraltar Arc orogenic system, at least during Middle Miocene times, as erosion took place along the mountain front meanwhile very large subsidence occurred at the same time in the nearby back-arc basin, and being both areas separated only by 100-150km of horizontal distance. The open question is now to propose a geodynamic process coherent with such drastic topographic evolution.

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