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New evidence for Paleogene exhumation in the Betic-Rif domain from low-temperature thermochronology

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The Western Mediterranean Sea opening started around the Eocene-Oligocene boundary in the context of large-scale Africa-Europe convergence. There is multiple evidence of Eocene-Oligocene compressional tectonic deformation, in various places, both in the Rif and Kabylides, in the Betics and in the Valencia trough. There are also numerous evidence for exhumation and thrust-related shortening all over Iberia and in the Pyrenees.
In the Betics, evidence for Eocene-Oligocene deformation are usually considered to be restricted to the uppermost unit of the internal zones, that is the Malaguide unit of the Alboran domain. This is attested by the stratigraphic age of the first foreland sediments belonging to the Malaguide unit as well as by low temperature thermochronology data on the same syn-orogenic sediments.
On the other hand, compressional deformation in the external zones is generally estimated to take place during the early-middle Miocene, with a younging of the deformation towards the west. This is associated with the westward migration of several hundred kilometers of the Alboran domain, the closure of the Flyschs Trough, with the flyschs units emplaced as thrust nappes on the external zones and the deformation of the South Iberian paleomargin sediments.
New apatite fission-track (AFT) and (U-Th)/He data performed on Early Cretaceous turbiditic units of the Betic external zones document a cooling phase starting $\sim$ 40-30 Ma ago. It is interpreted to reflect an early stage of exhumation in the internal Subbetic units. This result suggests that the South Iberian paleomargin and the Alboran domain came into contact during the Late Eocene-Early Oligocene, much earlier than usually admitted, although in a much easterly position than nowadays.
In addition, detrital AFT analyses carried out on some lower Miocene turbidites of the Mauretanian flyschs units yielded three grain-age populations at 27$\pm$2Ma Ma, 55$\pm$3 Ma and a minor one at 159$\pm$10 Ma, revealing that these rocks experienced limited burial (< 3.5 km for a geothermal gradient of 30°C/km) allowing the preservation of the original rock source age signatures. Similar grain-age populations (P1: 28-44Ma P2: 158-195Ma) are found in the Malaguide foreland sediments in the eastern part of the internal zones thus making the Malaguide unit a potential source for the detritial material contained in the Mauretanian flyschs. Overall, our thermochronological data suggest that the Mauretanian Miocene flysch basin developed over a compressional domain already emplaced on the Iberian margin in the Late Eocene. These results are in agreement with a reduced amount of shortening associated with the early-middle Miocene emplacement of the flysch units.

This study is included to the Orogen research project, a tripartite partnership between academy and industry (Total, BRGM, CNRS).