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New approach to date the extensional tectonics in the Betic Chain (Spain)

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The Betic Cordilleras, in southern Spain, represent a good example of a collisional orogen disaggregated by extensional collapse in a convergent setting during the Miocene. The Alpujarride and Malaguide Complexes, in the Internal Zone, are bounded by an extensional detachment, previously interpreted as a thrust-nappe.
In the western Betics, the Malaguide Complex overlies the Los Reales nappe (one of the tectonic slices that conforms the Alpujarride Complex) and although their boundary is characterized as a brittle-ductile extensional detachment, little is known about its age of movement. In order to constraint the age of the detachment, two dolerite dykes cut by the boundary were dated by U-Pb SHRIMP on zircons along with nine samples, from the lowest to the upper structural levels of the Malaguide Complex, by zircon fission-track analysis (ZFT).
Zircons separated from dolerite dykes display rounded or eroded edges bounded by light or dark luminescent rims. Zircons cores with igneous appearance (euhedral, oscillatory zoning, high Th/U content) yield 206Pb/238U ages between 1799 and 264 Ma, which cannot be correlated with dolerite dyke intrusion, as similar dykes appear within Middle-Upper Triassic pelites in other Alpujarride sections. Otherwise, the external rims yield ages between 1187 to 28 Ma. Four of the youngest analysed zircon rims show Th/U ratios consistent with a metamorphic origin. These zircons define a mixing line intersecting the Concordia at 20.9 $\pm$ 9 (2σ), that agrees with the age of the thermal Alpine metamorphism. Two of the youngest rims display high Th/U contents, common in igneous zircons. They give concordant ages of 33.1 $\pm$ 1.5 (2σ) and 39.0 $\pm$ 2.5 (2σ) Ma. However, the youngest is the only one that has geological meaning, as similar ages have been reported using different geochronological systems. Therefore, it could be considered as the age of dolerite dyke intrusion.
The ZFT samples yield ages between 18.6 $\pm$ 1.8 (2σ) and 25.8 $\pm$ 3.0 (2σ) Ma, each level overlapping statistically. They do not yield a clear positive correlation with the topographic elevation, but they do show such a correlation with the relative structural position. This correlation is still evident even when other published data from the larger region are plotted together, suggesting that a) Los Reales nappe and Malaguide Complex cooled as a single and thinned crustal domain from at least latest Oligocene ($\sim$ 25 Ma), b) the structural emplacement was set before the rocks reached the zircon closure temperature (260 ºC) and c) no evidence of partial annealing is evident from dyke intrusions.
According to the new U-Pb SHRIMP and ZFT data, we suggest that the Los Reales nappe - Malaguide Complex were already tectonically in place over each other between 33 and 25 Ma, which enables that the extensional tectonic of the Betic Cordilleras may be delayed up o Oligocene times.