New constraints on the evolution of the Gibraltar Arc from palaeomagnetic data of the Ceuta and Beni Bousera peridotites (Rif, northern Africa)

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Abstract: The Betic Cordillera and the Moroccan Rif together form one of the smallest and tightest orogenic arcs on Earth and almost completely close the Mediterranean to the west. For the explanation of the geodynamic evolution of the orocline, palaeomagnetic data that generally found clockwise block rotations in the Iberian and anticlockwise rotations in the Moroccan part of the mountain belt, have played a key role in recent works. This palaeomagnetic study has found new constraints on the rotations and timing of the peridotitic bodies outcropping in the key position at the westernmost margin of the mountain belt, in Ceuta and Beni Bousera (Rif, northern Africa).

Detailed thermal demagnetization of 115 individually oriented samples from 14 sites was combined with rock magnetic and scanning electron microscopic experiments to analyze the magnetic mineralogy responsible for the remanences and the mechanisms and relative times of their acquisition. In Ceuta, up to three magnetic components, and in Beni Bousera, up to two magnetic components have been found, that have all been interpreted chemical remanent magnetizations (CRM).

The data suggests the following succession of geodynamic events a ecting the peridotites until recent times: (1) after their exhumation and subsequent cooling about 20 Ma ago, they recorded a characteristic remanent magnetization of both normal and reversed polarities, carried by (pseudo-)single-domain magnetite grains; (2) after their dismembering, the Ceuta peridotites were tilted southward by 22 º - 34° about a horizontal or nearly horizontal axis (up to plunge 50°) with an azimuth of 72°- 145º and the Beni Bousera peridotites were rotated anticlockwise by 72.3 +- 12.1° about a vertical axis and (3) both recorded another magnetic signal of normal polarity only, carried by multi-domain magnetite grains; and finally (4) the Ceuta peridotites rotated anticlockwise by 19.7 +- 5.9° about a vertical axis.

This study obtained the first palaeomagnetic data for the Ceuta peridotites that, with their tilt and recent small net rotation, had a distinct geodynamic evolution from the large net rotations about vertical axes in Beni Bousera and Ronda (Betic Cordillera). Moreover, earlier palaemagnetic data for Beni Bousera is improved, as mixed polarities have been found in the older of the remanences for the rst time, and its interpretation as a CRM changes the rotation timing that was proposed previously. The sequence of events exposed in this work contributes to important constraints that need to be incorporated in any geodynamic model of the evolution of the Betic-Rifean mountain belt.

Keywords: Palaeomagnetism; geodynamics; peridotites; Rif.