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Palaeomagnetism of Aptian-Albian sedimentary formation in Lebanon and structural implications

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In order to estimate the block rotations in the central part of the Dead Sea Transform, 325 cores of Aptian and Albian rocks were sampled in 38 sites in Lebanon under the frame of the MEBE (Middle East Basins Evolution) program. Sites are situated in the cores and limbs of the Mount Lebanon and Mount Anti-Lebanon anticlines, with a widespread regional distribution. In order to correctly isolate and identify the magnetisation components, both thermal and Alternating Field demagnetisation treatments with numerous steps were performed on pilot-specimens, with increments ranging from 50˚C in the lowest temperatures to 20˚C in the highest ones, whereas the increments range from 2.5 mT to 5 mT during the AF-demagnetisation (maximum used field intensity: 90 mT). The intensity of the Natural Remanent Magnetisation (NRM) is mostly low, in average of the order of 10^{-3} A.m. Hysteresis loops indicates presence of at least two magnetic phases, one having high coercivity and possibly Curie temperature lower than 580˚C. AF-demagnetisation experiments appear to be the most efficient to recognise the main magnetic characteristics of the samples. In most samples, the NRM include two components, a component A (carried by magnetite) eliminated after 5 to 10 mT treatment and a component B (carried by high coercive minerals) clearly defined on orthogonal vector plot between 10 and 40 to 55 mT.

The mean direction of component B is slightly different before (D=308.9˚, I=33.3˚, k=11 and α_{95}=7.0˚) and after (D=307.1˚, I=23.7˚, k=18 and α_{95}=5.5˚) bedding correction, with a better clustering after the correction. In details, progressive bedding correction for all the 37 sites gives the best clustering (maximum k value=17.8) for 85% of unfolding, but without significant difference with 100% unfolding (k=17.6).

Positive reversal test in one site strongly suggest that component A is a primary magnetisation. The direction of component C has a coherent orientation before bedding correction, with a mean inclination (49.2˚) close to that of the present day Earth magnetic field (49.8˚) and is always of normal polarity. Its high clustering, its only normal polarity, and the significant fold test strongly argue for a single component acquired after folding.

From comparison of the declination of the magnetisation component B with the African Apparent Polar Wander Path, a mean counter-clockwise rotation of $28.0 \pm 6.4^{\circ}$ affected all our sites since Lower Cretaceous period. According to the orientation of the component C, part of this rotation ($17.7 \pm 3.8^{\circ}$) occurred after folding that is after Late Miocene. Because folds in Lebanon are thought to be related to the obliquity of the Arabia-Nubia transform plate motion relative to the strike of the main transform fault, the Yammouneh fault (YF), this late rotation is very likely related to transform faulting. Our data exclude that the YF initiated with an original N-S strike parallel to the plate motion, but suggest that its bend to the right is primary.