



Timing of mountain building and deformation rates in the High Atlas of Morocco (magnetostratigraphic, paleontological and structural data from Ouarzazate foreland basin)

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The Cenozoic Ouarzazate basin contains the best record of the building of the High Atlas mountains of Morocco. The sedimentary infill of this foreland basin is characterised by terrestrial sediments, imprecisely dated to the moment. A magnetostratigraphic study in these formations aims to constrain their age, sedimentation rates and the timing of deformation in the adjacent High Atlas mountain chain.

Two profiles covering the entire basin infill are being studied. The first comprises the lower part, corresponding to the Hadida Formation which conformably overlies dated Middle Eocene marine carbonates. The second covers most of the unconformable Ait Ouglif and Ait Kandoula Formations, previously ascribed to the Oligocene and Neogene.

The Hadida profile consists of 490 m of red sandstone, shale and gypsum, deposited in coastal sabkha to aeolian and distal alluvial fan environments. The Amekchoud section is about 780 m thick, comprising a basal level of conglomerates (Ait Ouglif Fm.), channelised sandstones, shales and lacustrine carbonates (Ait Kandoula Fm.). On top of the measured section, the uppermost Ait Kandoula Fm. is made of 300 m

of conglomerates and shales. Paleomagnetic Thermal demagnetization analyses allow characterising stable and double polarity and high coercivity components unblocking between 500 and 670°C.

An initial correlation between the local polarity sequence and the GPTS has been strongly based on the magnetozone pattern. The Amekchoud base may start at chron C5ABn (Serravalian), and the profile probably ends at chron C4An (Tortonian). This interpretation is consistent with the micromammal remains found at the top of the section, which include *Myocricetodon* sp., *Africanomys* sp. and *Muridae* indet. *Myocricetodon* sp. that is close to the *Myocricetodon seboui-M. ouaichi* group; therefore, a late Miocene age is supported for this upper part of the section. The Hadida section is not so unambiguously defined and could start at chron C20N (Lutetian), probably ending at C13r (Priabonian-Rupelian).

The Eocene Hadida Formation, regarded as the first foreland basin deposit, predates local deformation in the High Atlas frontal thrust belt, and may be attributed to early mountain building in the internal parts of the orogen. It is followed by a marked hiatus of about 20 m yr, which appears widespread in southern Morocco; generalized deformation in the frontal thrust belt occurred in this period. Sedimentation was resumed in mid-Miocene times (*Ait Ouglif* and *Ait Kandoula* Formations), contemporaneously with continued thrusting. In conclusion our data suggest that the main thrusting in the High Atlas southern thrust belt took place from the late Oligocene - early Miocene to the early Pliocene.