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Origin of intraplate deformation in the Atlas system of Algeria: from Jurassic rifting to Cenozoic-Quaternary inversions

D. FRIZON DE LAMOTTE & R. BRACENE

Université de Cergy-Pontoise, CNRS ESA 7072, Av du Parc, 95 031 Cergy Cedex, France

Based on the analysis of data from petroleum exploration and a compilation of available paleostress data, this paper aims to discuss the origin of deformation observed in the western and central Saharan Atlas, which is an intraplate foreland fold-thrust belt fringing the Sahara platform. From a general point of view, this intraplate area has recorded the break up of Pangea (upper Triassic), the opening of the Maghrebian Tethys (since the Dogger) and then its closure (Tertiary to present).

However, we show that the Atlas build up occurred during two phases of Late Eocene and Pleistocene-Lower Quaternary ages respectively. These phases are distinct and do not represent end points of a progressive deformation. The development of the Tell accretionary prism, bounding the Mediterranean sea, occurred during Oligocene and Miocene times (i.e., between the two steps of the Atlas building) and is related to subduction rollback of the Maghrebian Tethys. The accretion of this prism to Africa at 18–15 Ma did not generate far stress field in Africa.

So the two periods of strong coupling between Europe and Africa, which correspond to rapid uplifts of the Atlas system, are not collision-related. They can be correlated to the beginning and the end of the development of the western Mediterranean sea (i.e., to the initiation and the cessation of the subduction processes active in the western Mediterranean region).

The use of features of foreland basins to constrain the development of the adjacent orogenic edifices

Z. GARFUNKEL[1] & R.O. GREILING[2]

[1]*Institute of Earth Sciences, Hebrew University, Jerusalem, Israel*
[2]*Geological-Paleontological Institute, Ruprect-Karls University, Heidelberg, Germany*

The history of foreland basins can provide important insights into the development of the adjacent orogens, e.g., the progress of emplacement of orogenic wedges over the foreland and changes in the taper angle of the wedge. This can supplement the often fragmentary record provided by the complex and incompletely preserved internal parts of orogens. This also applies to depressions (e.g., flysch basins) that form in front of major nappes during stacking of orogenic edifices. Such information should, whenever possible, be incorporated in the interpretation of mountain belts.

The simplest situation is that of flexural basins in front of wedge-shaped loads that advance over an otherwise undeformed foreland. Many studies have shown that in this case at any given moment the deepest part of the basin is located next to the edge of the load, while the basin depth depends on the shape of the load and on the flexural strength of the foreland. This allows, using the migration of the deepest part of the basin and the history of basin subsidence, to gain a better understanding of the relative roles of displacement of orogenic loads and changes in their cross sections.

The situation becomes complicated when the foreland and/or the basin fill are deformed and thrust/fold complexes develop in front of the main orogenic wedge, which thickens the rock pile overlying the foreland. This is equivalent to an extra load, in addition to the main tectonic wedge, but the tectonic thickening actually fills at least a part of the frontal flexural depression. Modelling