

## Evolution from Tethys to Mediterranean Basins

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Résumé : La confrontation des données concernant la structure actuelle de la Méditerranée, les positions relatives de l'Europe et de l'Afrique déduites de l'étude des anomalies magnétiques de l'Atlantique et l'histoire géologique des marges du domaine méditerranéen permet de proposer un schéma d'évolution depuis 180 MA. Celui-ci, encore provisoire, montre deux stades différents : le premier, antérieur au Maestrichtien, correspond à une ouverture limitée de la Tethys entre l'Europe et l'Afrique avec formation de trois plaques intermédiaires (Ibérie, Apulie, Anatolie), la taille des zones océaniques et la paléogéographie restant très imprécises ; le second stade, correspond à la fermeture des espaces océaniques créées, à la collision et à la fragmentation continentale et à l'initiation de petits bassins océaniques ou subocéaniques.

The present structure of the Mediterranean region corresponds to small oceanic areas included in the Alpine belt that have progressively developed for 180 m.y. between the European and African continental blocks. Starting with this present structure we shall try to reconstruct the geological evolution within the framework of plate tectonics, i.e. to show how the superimposed tectonic events, the distribution of epicontinental or pelagic facies, the evidence of distensional phases are related to relative plate motions of Europe and Africa since Triassic times. Is it possible to recognize old oceanic margins ?

1) - The model used for these plate motions is only one of the different possible models. 2) - The size of continental margins exceeds 100 km and their deep structure is intermediate, so exact reconstructions of old continental margins are very difficult. 3) - Several maps have been drawn : Tortonian (9 m.y., anomaly 5) Stampian (35 m.y., an. 9), Lutetian (44 m.y., an. 21), Ypresian (49 m.y., an. 24), Maestrichtian (68 m.y., an. 31) ; before the Upper Cretaceous because of geological considerations, the Up. Jurassic-Berriasian and Dogger periods were chosen. Then the pre opening reconstruction, very hypothetical, has been used to situate the late Triassic paleogeography: - although the maps of recent paleogeography are relatively good, the previous stages are less and less precise, especially before the Cretaceous. - Reconstructions do not require the use of more than three intermediate plates : Iberia, Apulia, Anatolia. - Each map shows : the posi-

tion of continental and oceanic areas with a transition zone for the margins ; - the facies distribution ; - the plate boundaries, subduction zones, volcanism, etc. ; - the tectonic setting of the ophiolites during the Upper Jurassic and late Cretaceous times.

4) - Some hypotheses concerning the former positions of the tectonic units in the different portions of the orogenesis have been used. On the other hand, the major lineaments observed in the satellite imagery have been considered as crustal structures linked to continental collision and have been used to choose the main zones of dislocation.

Conclusions :

- 1) - Two main periods and two major tectonic styles must be distinguish :
  - The first between 180 and 68 m.y. when the ocean-continent distribution allows a comparison to be made with present oceanic margins. This is the time of the senestrial rotation of Africa ( $40^\circ$ , 2-3 cm/year), the opening of oceanic areas between Africa and Europe with only three intermediate plates, and the difficulty to specify the possible formation of marginal seas.
  - The other, since the late Cretaceous, corresponds to the blocking at 68 m.y., the inversion of movement (Europe moving faster than Africa between 68 to 49 m.y.), then the closure of the eastern Mediterranean (counterclockwise rotation of Africa). These movements are due to the continental collision which generates an intracontinental fragmentation, the dislocation of the intermediate plates in several masses, a horizontal wrench faulting, and the formation of small marginal basins.
- 2) - A great many unsolved problems have been raised :
  - The most important are due to the very imprecise fit at 180 m.y. The initial positions and sizes of Iberia, Apulia and Anatolia are subject to caution. The size of the protoeastern Mediterranean is also greatly dependant on this initial fit.
  - During the Jurassic no reliable data exist to specify the exact position of Apulia and Anatolia. In the Upper Jurassic the obduction of ophiolites has been considered as due to the continental collision between Apulia and Europe, but another solution could be looked for.
  - The Isparta line (Turkey) has been taken as a border between two distinct plates in spite of very little field evidence.
  - The closure of the eastern Mediterranean since the Maestrichtian must necessarily correspond to the formation of an active margin of which very little evidence can be found S of Apulia.
  - Etc...