Flower structures and salt tectonics developpment in offshore of the Essaouira basin: Interpretation by episodic rejuvenation in transtension or transpression of brittle structures in a sinistral wrench shear zone from the Triassic to Upper Cretaceous

K. MEHDI[1] & C. BOBIER[2]

[1]*U.C.D, Dpt Of Geology, Labo de Géosciences Marines, 24000 El Jadida Morocco, mehdikhalid@hotmail.com;*
[2] *Univ. de Bordeaux I, D.G.O,UMR CNRS n° 5805, France, c.bobier@geocean.u-bordeaux.fr*

The Essaouira Basin and its platform are of special interest for the study of continental margins. They correspond to the western end of Atlasic systems of Morocco. Situated in the south-western part of the mega wrench faults corridor which separes the European and African Plates it bounds also the Eastern Atlantic Passive Margin, the Essaouira Platform appears also as the Northern end of the large continental platform of the African Shield. Due to this geographic position, the geodynamic evolution of Essaouira Region had been affected by the relative motions between African, North American and European Plates following the disintegration of the Pangea. The strains responsible for these relative motions induced tectonic heredity processes by rejuvenation of tardihercynian crustal discontinuities. Such a tectonic heredity has induced relative motions in a mosaic of more ore less rigid blocks separated by conjugated flower structures. Analysis of various seismic records permits to point out close relation between brittle structures and halokinesis, most of the diapiric structures being in line with basement discontinuities which were activated as en echelon active faults by regional stresses since the Upper Permian.

Three main steps have marked the geodynamical evolution of the Essaouira Region which induced along brittle structure affected by transtension salt tectonics. We can observe successively 1) the effects of Triassic to Liassic rifting of the Pangea, 2) the consequences of the subsidence of the continental margin by sedimentary loading following the Jurassic to Lower Cretaceous opening of the South Atlantic ocean, and 3) the effects of the Upper Cretaceous to Neogene compression associated with Atlasic Orogenesis. Neverthless, in the south western basin of Morocco variations in latitude of the salt tectonics processes appeared in the mode of formation of diapir wich can be explained partially by variations in the nature and thickness of the sedimentary cover. Indeed, Triassic evaporites important in the western part take turns lateraly to the East with siliciclastic and clayey continental deposits, while Jurassic levels thicken from the onshore to the offshore basins. In the western part of the Essaouira basin and in its continental shelf, the Triassic evaporites started off "passively" as salt pillows and domes along tension faults, triggered by sedimentary loading. Otherwise, analysis of magnetic anomalies shows that because of its relations with the South Atlasic Through, the Atlantic Continental Margin between Cap Hadid and Cap Tafelney has been split up by a system of strike-slip faults in different rhomb-grabens evolving differently:

To the north of the master strike-slip fault (Cap Hadid–Essaouira) the northern part of the Platform is limited westward by wrench faults with flower structures directing halokinesis active during Upper Triassic, Upper Jurassic and Early Cretaceous times. On the continental slope rich in tilted blocks listric faults are associated with diapiric structure already of Upper Triassic and Lower Jurassic ages. Nevertheless, in this northern part of the platform even if halokinesis remains active up to present time, diapirs did not rise through the Upper Jurassic sedimentary cover or the Cretaceous prograding sedimentary prism which outcrops on some parts of the sea bottom.

To the south of the master strike-slip fault (Esaouira–Cap Sim–Cap Tafelney), the halokinesis manifestations are significantly different. Halokinesis was more active on shelf and margin between Cap Sim and Cap Tafelney from the Upper Triassic to Upper Jurassic. The diapirs which rise through Jurassic sedimentary cover formed domes perhaps covered by reefs have also sometimes weared a hole through the cover to give evaporites sheets on an Upper Jurassic erosion surface. Halokinesis has been initially directed by normal faults bounding tilted blocks. These faults were reactivated as reverse strike-slip faults with westward throw during the Upper Cretaceous and so the sedimentary cover could escape lareraly toward ocean basin during Upper Cretaceous phase of compression due to Atlasic Orogenesis. Locally in canyons salt following toward the upper line of tilted blocks has supplied structures which can be interpreted as vents, passive walls and even evacuated allochthonous salt sheets in comparison with analog modelling of salt tectonic driven by progradation. Rim synclines and rollover synclines with high sedimentation rate have evolved during the Jurassic and Lower Cretaceous.

Collision belts of the Verkhoyansk-Chukotka orogenic area (North-East Asia)

V.S. OXMAN[1], G.YE. BONDARENKO[2] & S.D. SOKOLOV[2]

[1] *Institute of Geological Sciences, Yakutsk, Russia, v.s.oxman@sci.yakutia.ru;*
[2] *Geological Institute, Russian Academy of Science, Moscow, Russia, grisha@geo.tv-sign.ru*

The Verkhoyansk–Chukotka orogenic area consists of Verkhoyansk–Kolyma and Novosibirsk–Chukotka collision orogens (belts) (Zonenshain et al. 1990, Parfenov 1991, Sokolov et al. 1997, Fujita and Newberry 1982). These structures formed as a result of Anyui–Angayucham ocean closing. This ocean separated the Asian and Euro-American cratons in Paleozoic to Mesozoic times. The Verkhoyansk–Kolyma arcuate collisional orogen (Kolyma Loop) originated as a result of Late Jurassic to Early Cretaceous accretion of the Asian craton continental margin with the Kolyma–Omolon composite superterrane (Parfenov 1991). The Novosibirsk–Chukotka orogen formed in the Early Cretaceous by collision of the Novosibirsk–Chukotka microcontinent and Asian craton continental margin (Seslavinskiy 1979, Sokolov et al. 2000).

The outer part of the Verkhoyansk–Kolyma orogen (Verkhoyansk fold-and-thrust belt) consists of Paleozoic to Mesozoic shelf sediments and turbidite of the Asian continental margin. These rocks are deformed by different types of thrust structures with western and north-western vergency (Prokopiev 1998). The central part (Chersky belt) consists of several continental terranes which were rifted from Asian margin in the Late Paleozoic, being made by Paleozoic limestone shelf sediments, and Late Paleozoic to Early Mesozoic terrigenous and terrigenous-siliceous turbidite sequences. These complexes were tectonically overlapped by Paleozoic ophiolite allochthons – fragments of the Anyui–Angayucham ocean. The ophiolites associated with polymetamorphosed schists are characterized by the early ductile deformation and medium-pressure metamorphism connected with oceanic crust tectonic layering, which took place before ophiolite sequence obduction onto the Asian shelf. The back part (Alazeya–Oloy belt) includes compexly deformed Paleozoic to Mesozoic volcaniclastic rocks of island arc origin. This formation marks the complicated and long time existing convergent margin of the Asian and Anyui-Angayucham ocean.

Novosibirsk–Chukotka orogen is bordered from the south by island arc sequences of the Alazeya-Oloy belt. These sequences formed far off north vergent allochthonous slices which tectonically overlay the complexes of the South Anyui ophiolite suture zone. The complexes of the South Anyui suture and sequences of the Alazeya–Oloy belt build the north vergent deformed allochthons. The allochthons consist of dismembered ophiolite sequences of various age, volcaniclastic rocks of Late Mesozoic and Late Jurassic accretionary melange sequences. The autochthon consists of highly deformed Triassic turbidite of the Novosibirsk–Chukotka microcontinent passive margin. The Late Jurassic volcanic sequences probably of island arc origin are located along the allochthon front. These rocks were folded and thrust too. The nappe structures are overlapped with slow-deformed neoautochthon of Hauterivian to Barremian age.

Early deformations in the Verkhoyansk–Kolyma collision orogen (Middle Jurassic) were connected with the Kolyma–Omolon superterrane amalgamation and earliest stage of one and Asian craton collision. This event fixed accretionary thrusts, nappes, and recumbent and overturned folds of north-east vergency. Late collisional (Late Jurassic-Neocomian) structural assemblages characterized by combined kinematics with sinistral transpression component that was connected with oblique collision (Oxman, Prokopiev 1996, Oxman 1998), and counterclockwise rotation of convergent structures (Didenko and Bondarenko 1998, 2000). For the Novosibirsk–Chukotka collision orogen two main stages of the Mesozoic structural evolution were identified. The first stage is connected with Late Jurassic and probably Early Mesozoic convergence processes along the southern margin of the Anyui–Angayucham ocean. There the accretionary melange and duplex structures are formed – good indicators of accretionary wedge forming. The second stage is connected with the Asian