Periclinal Folding, Faulting and Trap Formation, Relation to Shearing: Part of Sabratah Basin West Offshore Libya

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1. ABSTRACT

The Pelagia block affected by an important tectonic activity of transtensional and transpressional related to the relative motion between African and European plats create en- echelon of Mesozoic and Cenozoic folds, grabens and normal faults. An interpretation of two volumes of 3D seismic data and 10 wells shows shows that the northern part of the Sabratah Basin is characterised by en-echelon folds aligned E-W (Slightly ENE-WSW), orientated in the direction N75°, two grabens trending N150° separated the folds. Three fault trends were recognised in the study area N150°, N110° and N60°. The seismic interpretation suggests that, the folds and grabens developed during the Alpine orogeny and right lateral shear between Africa and Europe. This motion was accompanied with E-W transcurrent fault which probably terminated in a horsetail composed of a fan of normal faults in the Bouri block. Two Alpine tectonic cycles have been recognised within the period from basal Tertiary to present, each cycle corresponding to topographic inversion. The first topographic inversion occurred between basal Tertiary and lower Eocene and the second between early and late Miocene. The topographic inversion is interpreted as a result of a change in the direction of convergence between the African and European plates. Fold B is a bathymetric high topped by the Derbil reef. These fold structures form a large closure including the giant Bouri Oil Field in the Lower Eocene within Farwah group, the main objective for hydrocarbon exploration in the Sabratah Basin.

2. INTRODUCTION

The study area is located between [11◦ 50”E–12◦ 57”E] and [33◦ 45”N–34◦ 00”N] (Fig. 1) in the Sabratah Basin which is part of the African plate that consists of two distinct terrains, the cratonic Saharan Platform and Pelagia. The Pelagian Block formed during the collision of the African plate with the Apulian plate during Carboniferous times to form the block of continental crust. Across southern Europe and North Africa a series of major dextral shear-zone were developed connecting the Uralian Ocean and Massif Central Ocean subduction zones. The dextral motion along the South Graben Fault Zone (SGFZ) and the Libyan Coastal Fault System (LCFS) resulted in compression and uplift in the area that was to become the Sabratah basin.

Two 3D seismic cubes and total of 10 wells were used to investigate the structure of the study area. There is mis-tie between the overlapping 3D-seismic surveys which has been resolved using the Interactive Mistie Analysis tools in Kingdom software.

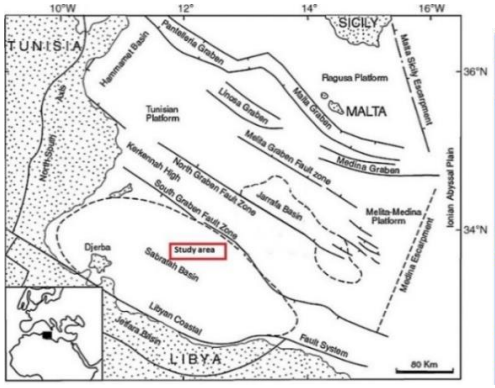


Figure 1: Location of the study area

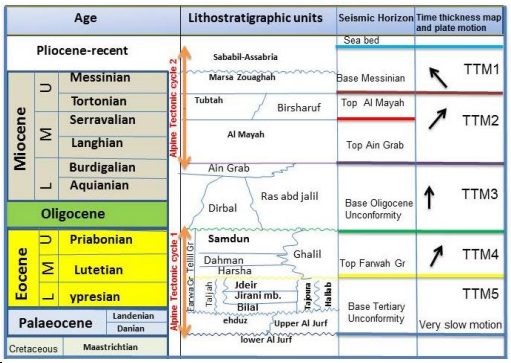
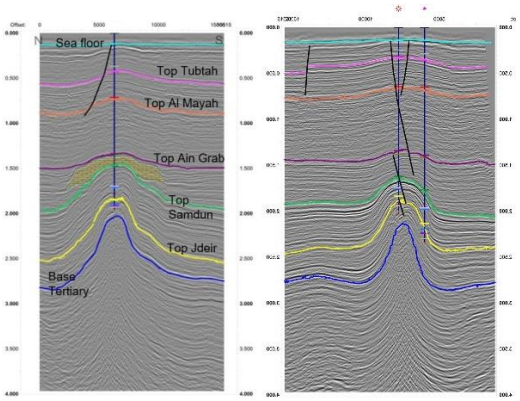


Figure 2: Stratigraphic correlation chart NW offshore Libya

3. PERICLINAL FOLDING AND FAULTING

Total of six horizons were picked over the two seismic cubes leading to generate six time maps and five time thickness maps. The interpreted horizons are shown in Figure 2. The study area is affected by an important tectonic activity of transtensional and transpressional related to the relative motion between African and European plates. The study area characterised by en-echelon Cenozoic folds aligned E-W (Slightly ENE-WSW), oriented in the direction N75°, two grabens trending N150° the main graben separated fold Al Jurf (B) from fold D and minor graben separated the fold D from fold Bouri Three trends of faults were recognised in the study area N150°, N110° and N60°. The N150° faults associated with main graben acts as transfer zones producing different fold geometries on both side of the graben. The fold belts within the study area is believed to be mostly generated by compressional tectonic phase during the late Cretaceous as the motion of the African plate relative to Europe changed from south eastward oblique divergence to north-eastwards convergence, marking the onset of the Alpine Orogeny (Dewey et al., 1989), such that the anticlockwise rotation of Africa was accompanied by right lateral strike slip in the Pelagian sea of NW-SE direction.



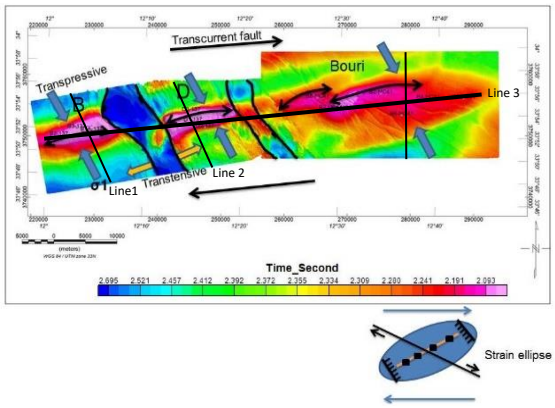
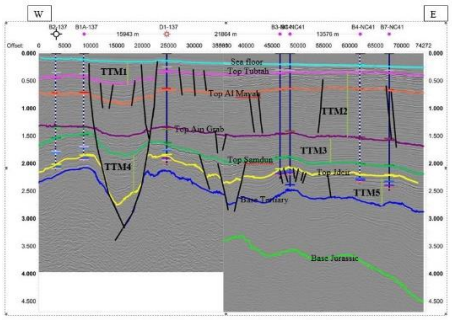


Figure 3: Time structure map of Top Jdeir formation

Line1 *Line2*



Line 3

4. TOPOGRAPHIC INVERSION (ALPINE TECTONIC CYCLES)

Two Alpine tectonic cycles were recognised within the period from the Base Tertiary to present (Figure 4). The first Alpine tectonic cycle was occurred between Base Tertiary- Lower Eocene and Lower Eocene- Base Oligocene. The second Alpine tectonic cycle was occurred between Lower Miocene- upper Miocene and upper Miocene-recent.

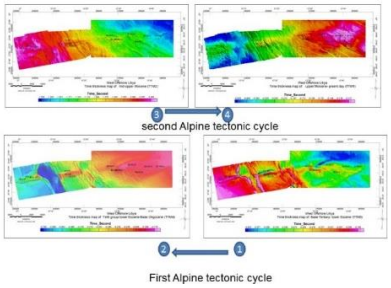


Figure 4: Two Alpine tectonic cycles