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SUBSALT IMAGERY of the DUMRE AREA, IONIAN BASIN, ALBANIA.

Anne Jardin (IFP, France), **Luan Nikolla** (National Agency of Natural Resources, Albania) and **François Roure** (IFP, France)

anne.jardin@ifp.fr, l.nikolla@akbn.gov.al, francois.roure@ifp.fr

This subsalt imagery study aims at illustrating the improvement obtained in structural interpretation of a deep carbonate subthrust prospect in a tectonically complex belt setting. A strong interaction between geologists and geophysicists was necessary to understand the failure of a former exploration well and to propose a new location for the potential closure of the carbonate structure.

Introduction

Albania shows a typical foreland fold and thrust belt system which is part of the Alpine-Mediterranean orogenic belt. Geological studies and seismic profiles show numerous thrust imbricates, both in the foothills and in the subsurface of the Periadriatic Depression (Nikolla, 2002). The northern part of the Ionian Zone is characterized by the occurrence of numerous productive oil, gas and gas condensate fields, as well as yet untested prospects (Gjermani, 2009). Many dry wells were drilled however on promising exploration targets probably due to difficulties in interpretation of seismic images in the time domain alone, and to insufficient geological control from deep wells. The objective of this presentation is to illustrate the advantages of a reinforced geological and geophysical data integration and the combined interpretation of both time and depth seismic images during the delineation of structural closure of potential subthrust carbonate traps.

Regional geological setting

The External Albanides are subdivided into distinct tectono-stratigraphic units, i.e., the Kruja Platform in the east, and the Berati, Kurveleshi and Cika belts of the Ionian Basin farther to the west, which are made up of pelagic limestone (Roure et al., 1995, 2004; Nikolla, 2002; Vilasi et al., 2009). Major strike lineaments control the sedimentary infill and tectonic style of the Dinarides-Hellenides region. Among them, the Vlora-Elbasan transfer zone constitutes a major lateral ramp which separates the Periadriatic Depression in the north from the Ionian Basin in the south, and extends from the External Albanides in the west to the Internal Albanides in the east (Fig. 1). The Dumre salt diapir is made up of Triassic evaporites and located along this major lineament. During the Triassic stage, the depositional environment was shallow marine with Late Triassic organic rich carbonates and Liassic blackshales being considered as the main source rocks for existing oil fields. A Triassic evaporitic level underlies both the reservoirs and source rocks, and has played as a major décollement level during the Late Oligocene to Plio-Quaternary thrust emplacement of the Outer Albanides. The present-day structure of the Ionian Zone is largely inherited from the Jurassic-Tethyan rifting episode. Subsurface data show that the basal detachment remains shallow in the Oligocene flysch and even in the Neogene clastics in the north beneath the Peridadriatic Depression, whereas it remains deeper, in the Triassic evaporites, beneath the Ionian basin. The stratigraphic column of the Ionian Zone comprises Upper Triassic evaporites, Upper Triassic to Eocene carbonates, Oligocene deep water turbidites, Lower Miocene to Serravalian "premolasse" and Tortonian to Pliocene clastics. Presently, the Cretaceous-Eocene carbonate

sequence sealed by the Oligocene flysch is the main target for hydrocarbon exploration within the Albanides thrust belt.

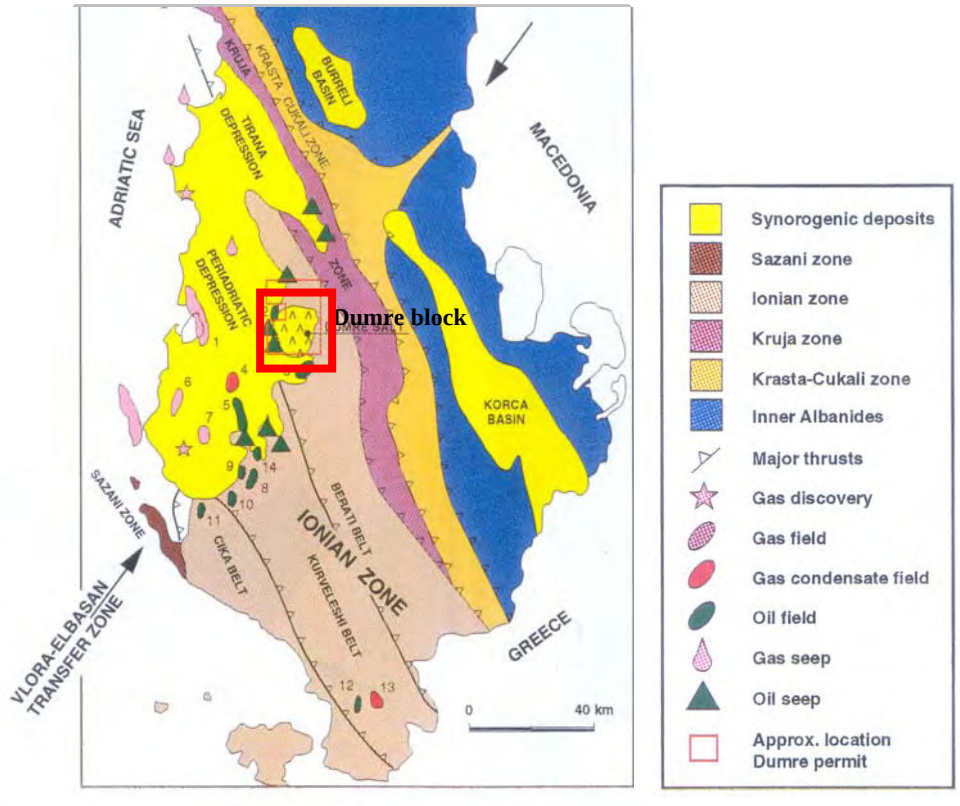

Fig. 1 : Regional structural map of south-western Albania with the location of the Dumre salt area

Seismic Imaging

Structural interpretation of onshore Albanian seismic profiles remains a challenge due to several limitations coming from land acquisition conditions and complex subsurface geology. A 2D seismic survey (of 60 km^2 size) aimed at imaging below the Dumre salt dome which crops out with an elliptic form with axes of 20x10 km. At depth the dome has a form of a diapir with a thickness of 6 km documented by the deep well Dumre-7. This diapir is un-rooted and has been thrust towards the west over 20-30 km (Velaj, 2001). On processed time stack seismic images, the salt layer is recognized both by the lack of seismic reflections inside the diapir and by the presence of stronger seismic amplitudes at the base of the evaporite body. Below the evaporites, seismic reflections help tracing the prospective carbonate underthrust platform, but its precise architecture cannot be easily determined due to the lack of continuity of these seismic events (Fig. 2). Good seismic imaging and confident time to depth conversion are particularly difficult in the Outer Albanides because of the strong lateral velocity variations: from 2500-2800 m/s in the Miocene-Pliocene clastics to 5000-5500 m/s for the evaporite and carbonate layers, resulting in distorted time seismic sections. Application of the depth migration processing is a technique which help avoiding these deformations and provide more realistic structural image of the subsurface. For this study, a layer velocity model was built integrating on one hand, all velocity and depth data coming from shallow and deep wells, and on the other hand, adapted velocity analysis using pre-stack

and post-stack seismic data. Control of the main structural features was performed integrating regional geological knowledge.

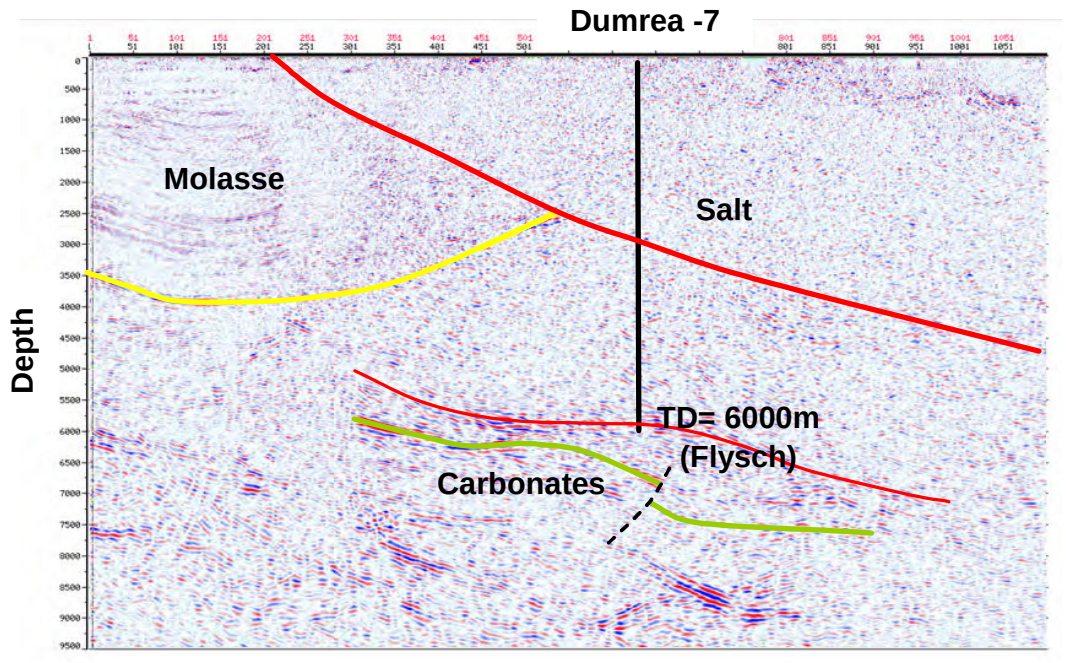

Fig. 2: Depth migrated seismic image (Line AAP01196) with interpretation and calibration with the well Dumre-7 drilled through the Dumre salt diapir until the Olygocene flysch at 6 km (above MSL). This well failed to reach the Ionian carbonates. Lithological variations from Miocene molasse to Ionian carbonates and Triassic salt induce high lateral velocity variations (from 2500 m/s to 5500 m/s) which lead to distorted time seismic sections.

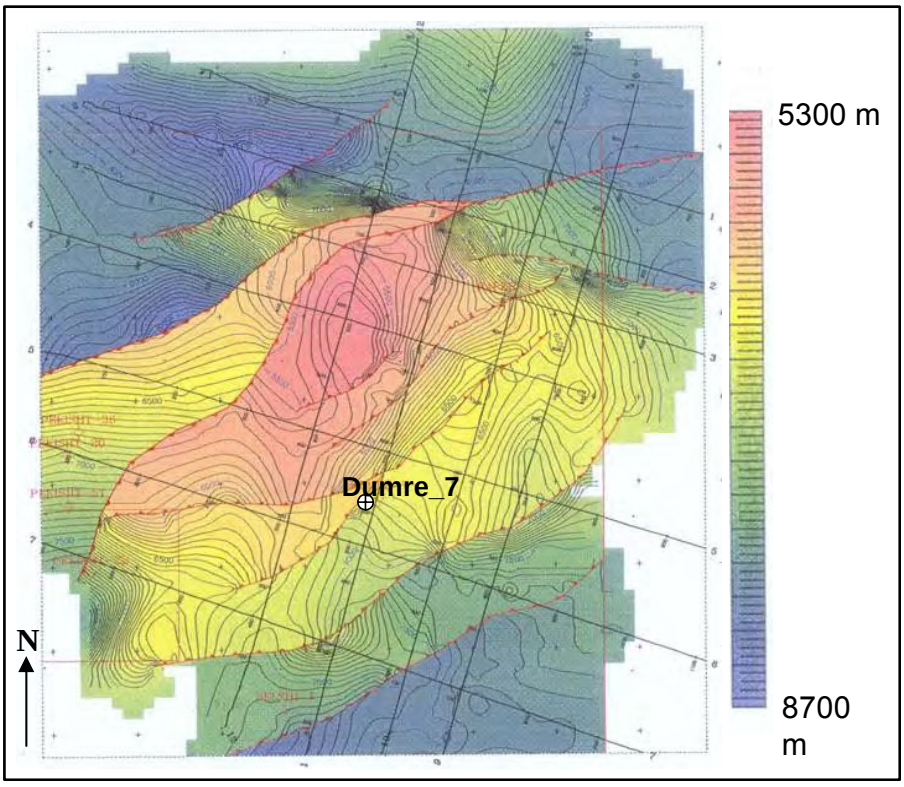

Fig. 3 : Depth surface map of top Ionian carbonates directly interpreted from depth seismic images. We clearly show that the top of the carbonate structure is now displaced to the North-West of the Dumre _7 well. Area size is 60 km^2.

Structural interpretation

The present integrated and iterative geological-geophysical modelling was successful in providing more realistic 1:1 scale 2D images of the structure. More accurate structural features have been estimated after direct interpretation of depth migrated seismic images (Fig. 2 & 3). The base of the salt is well calibrated in the Dumre-7 well (Fig. 2) and can be traced laterally, in most directions. In addition, intra-salt out-of-sequence structures are evident on most of the lines and connected superficially to a major thrust surface which brings the Oligocene flysch on top of the Neogene molasse. The thickness of the Oligocene flysch layers seems quite anisopachous and may change greatly depending on the structural interpretations. Numerous reflections seen below the basal salt surface are interpreted as the top of the Ionian carbonates. Nonetheless, as indicated by the attitude of the basal salt contact, there is no structural closure at the Dumre-7 well location. However, a structural closure is well defined westward of the previous site (Fig. 3).

Conclusion

Good quality of seismic images of deep structures below salt diapir and thrust sheets remains challenging and accurate time to depth conversion when strong lateral velocity variations requires adapted depth migration processing, as for instance in the Dumre area and other segments of the Outer Albanides. Integrated team of geologists and geophysicists was constituted in order to combine regional geological knowledge and depth seismic processing in a integrated approach to build accurate velocity model. Results led to a better understanding of dry wells and to propose a new prospect.

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