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New Structural and Petroleum System Models of the Ionian Zone, North-Western Greece

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The existence of active petroleum systems in Western Greece has been known since the 5th century B.C. (Karakitsios, 2013), when the Keri oil seep was documented by Herodotus in Zakynthos. In more recent times, over 5000km of 2D seismic data have been acquired and over 40 exploratory wells have been drilled in the western Greece onshore area, in search of commercial hydrocarbon accumulations. Success has been limited to date, largely due to the complexity of the shallow geology and surface topography, which results in a poor subsurface seismic image. In 2014, Energean Oil & Gas started a new phase of exploration activities in the area, encouraged by oil discoveries in the Mesozoic carbonates at Katakolon in NW Peloponessos (Greece) and Shpiragu, Ballsh and Cakran in Albania. While these discoveries confirm the hydrocarbon potential of NW Greece, much work is required to enhance our subsurface models and improve our geological understanding of the area.

NW Greece lies on the external part of the Dinaride-Hellenide fold and thrust belt, next to the boundary with the Apulian platform. This orogen is traditionally divided in 5 different units:

- Pre-Apulian zone, which consists of Triassic to Miocene deposits that characterize the transition zone between the Ionian basin and the Apulian platform.
- Ionian basin, characterized by Triassic evaporates, Jurassic to Eocene carbonates with minor shales and Oligocene flysch.
- Gavrovo / Kruja zone, which contains shallow water carbonates in the Eocene and Cretaceous. No older formations have been drilled yet or outcrops exist in the area.
- Distal Pindos / Crasta-Cukali, which represents the envelope between the Gavrovo zone to the West and the Pelagonian nappe in the East. It contains Mesozoic deep sea sediments and Upper Cretaceous to Eocene flysch.
- Pindos unit, characterized by oceanic domain sediments and ophiolitic rocks. Despite the still undergoing discussion on the origin of this unit, it is generally accepted that it was created during the opening of the Pindos Ocean in the Jurassic and obducted during the closure of the Neotethys Ocean (Papanikolaou, 2009).

Several structural models have been proposed in the past with significant implications for the deep and shallow prospectivity, since the Filiates-1 well (1966) drilled Cenozoic sediments below Triassic evaporites. One group of authors believe that several imbricates of Ionian basin are detaching one on top of the other with the Triassic evaporites acting as the major detachment in the area (Pieri, 1990). Permian sediments and basement remain unknown due to lack of well penetrations and outcrops. The alternative theory argues that the Ionian basin could be overthrusting the Apulian platform (Velaj, 2015).

In this review, we focus on the northernmost part of the Ionian Basin in Greece (Fig. 1) where four new structural sections have been constructed based on detailed surface geological data, well information and vintage 2D seismic. Our study integrates published and non-published information in order to build a consistent structural model that allows the definition of the major structural elements across the region.

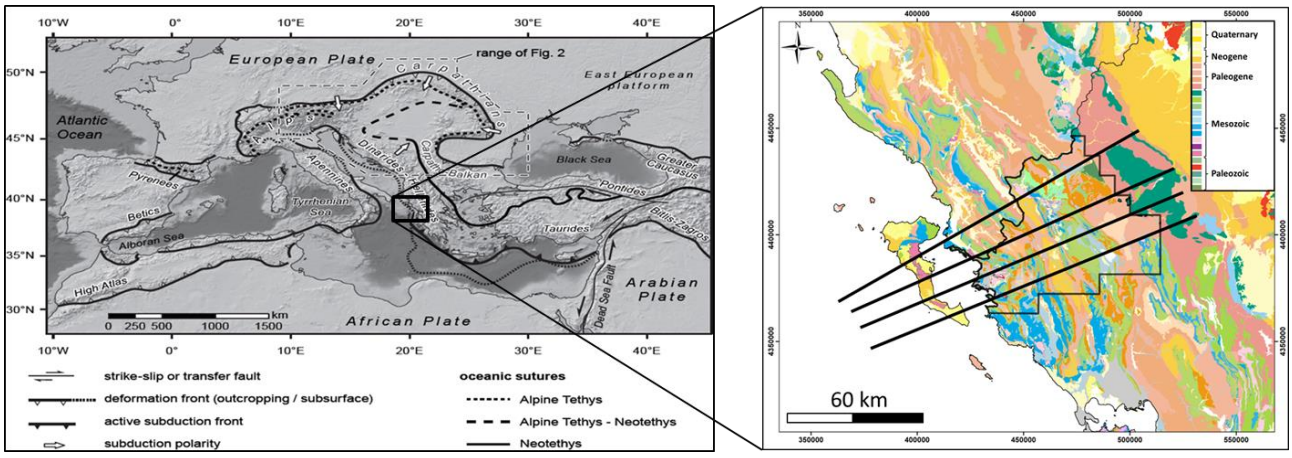

Figure 1. Circum-Mediterranean orogenic belt and geological map of the Hellenide fold and thrust belt and Ionian basin (modified from Cavazza *et al.*, 2013).

Our interpretation (Fig 2) is consistent with gravity and magnetic modeling, and also balanced and sequentially restored. This interpretation reflects the clear influence of salt tectonism since the early Jurassic, similar to what has been documented in Albania (Bega *et al*., 2017). The main processes affecting this restoration are: tectonic loading, erosion, decompaction, flexural isostasy, thermal subsidence and shortening from Oligocene times. The results of this restoration have been used for the construction of a 2D thermal maturity model. This modelling exercise shows that the burial and maturation history of the potential petroleum sources are strongly influenced by the kinematics of the deformation and thus, the onset of expulsion is modelled to become younger towards the West.

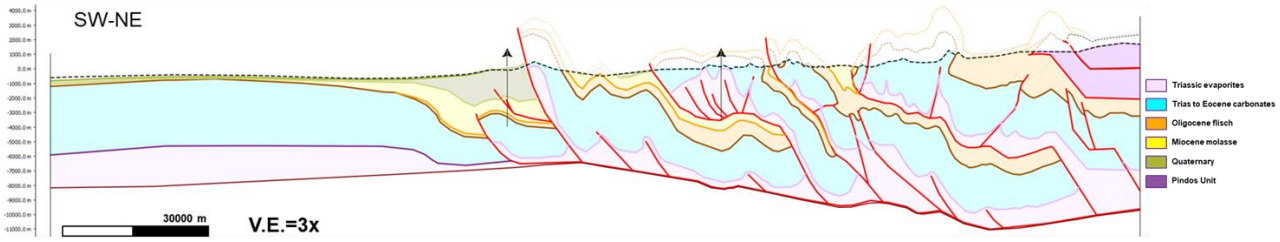

Figure 2. Regional structural section with SW-NE orientation.

Despite the high uncertainties that remain in the area, we believe that this work will help to understand the evolution of the Hellenide fold and thrust belt. In the near future, this will be done with the support of new seismic coverage being acquired at present times.

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