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A Regional Study of the Ionian Sea and its Hydrocarbon Prospectivity, Offshore W Greece

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Background & Approach

The Ionian Sea can be distinguished in the northern and the southern part. The north part, above the Kefalonia Transform Fault (KTF), is characterized by the obduction of the Hellenides Thrust and Fold Belt (HTFB) to the Apulian margin (continental crust). The southern segment, south of the KTF, is characterized by the activity of two dextral strike-slip faults, the subduction of a thinned continental-oceanic crust below the HTFB (continental crust) and the development of the Mediterranean Ridge (MR), the Backstop and the Hellenic Trench. The methodology followed was the study of the available literature, the interpretation of the well data and the 2D seismic survey acquired by PGS in 2012, the 2D modelling and the integration in order to establish a framework for the assessment of the hydrocarbon prospectivity.

Results & Conclusions: Geological Evolution, Petroleum System and Plays

North Ionian Sea covers the southern margin of the greater Apulian platform. Seismic interpretation led to the development of a 2D model that simulates the evolution of the area. The reconstruction enables us to visualize and validate our seismic interpretation. North Ionian Sea has mainly carbonate plays equivalent to the ones in the Adriatic Sea and Italy the source rocks are expected to be Upper Triassic (Burano Fm.), Jurassic (Complesso Anidritico Fm. and Calcare di Aptici Fm.), Toarcian to Aalenian (Rosso Ammonitico Fm.), Late Valanginian to Hauterivian (Maiolica Fm.), Early Aptian (Selli OAE, Marne a Fucoidi Fm.) and Late Santonian to Early Campanian pelagic sediments (shales) (Beicip, 2014; Nikolaou, 2001; Kosmidou, 2018). Geochemical analysis from well samples suggest type I-II oil-prone source rocks with higher TOC values in the Cretaceous and Jurassic series (up to 11.7% and 19.1%); and Triassic shale fragments (up to 16.1%). Play A: Oligocene-Late Miocene shallow-water carbonate build-ups (eq. Castro Fm. and Novaglie Fm.) sealed by fine-grained pelagic marls. The trap is stratigraphic pinch-outs. Analogues are the Giove and Medusa discoveries in Italy. Outcrop data in Italy suggest efficient vertical communication between the Cretaceous karstified reservoir and the overlying Oligocene – Miocene carbonates. Play B: Reservoirs of microbreccious limestone and/or calcareous gravity-mass deposits (slope-fan) with locally bioclastic base-of-slope aprons (eq. Scaglia). The trap is stratigraphic pinch-outs sealed by muddy-cherty deep-sea sediments. The main challenges associated with this play are the lateral extent and the distribution of the reservoir quality properties. Analogue discoveries are the Aquila, Rovesti and Griffone in the Adriatic Sea. Secondarily; Play C: Intra-platform plays rimmed platform deposits/reefs with stratigraphic traps (pinch outs) with lagoonal silty sediments in the Cretaceous series. Play D: Karstified sections sealed by pelagic sediments.

The South Ionian Sea is the area offshore western Peloponnese which is subdivided into the MR to the west and the HTFB and its offshore extension. important unconformities (Burdigalian and Messinian) and mass transport deposits overlie the Mesozoic carbonates. The depositional environment is shallow marine/platform (eq. Gavrovo Fm. and Paxi Fm.) changing westwards to distal slope and deformed ramp anticlines have been interpreted. The presence of the Apulia platform south of the KTF is estimated only in offshore Kefalonia. The Burano evaporites play a key role as a decollement but they are found in three main geometric configurations: in place, as diapirs, and reworked. They are believed to have facilitated the migration of the hydrocarbons in the carbonate reservoirs. The Messinian evaporites are deformed, due to the westward movement of the MR. Both Triassic and Messinian evaporites act as cap rock in specific leads. The Backstop is the extension of the lower Hellenic continental margin and its geometry is a pop–up structure with a flat summit. Geophysical data suggest a unit of high seismic velocity. To the west, there is the MR, an accretionary wedge with fluidized mud from the decollement zone(s). The upper part is characterized by highly deformed Plio- Pleistocene sediments and Messinian Evaporites. There are signs of two decollement levels and structural elements in the Mesozoic carbonate units. The area is highly tectonized with intensive shortening and imbrication. The plays are mainly carbonate with clastic plays in channels originated from the Hellenides. The carbonate plays can be summarized in the following: Type A: Carbonate slope deposits/ reefs; the reservoirs are expected to be of Middle Jurassic - Eocene age charged by thermogenic mature type I-II source rocks Lower Cretaceous Vigla shales and Triassic Breccias. Type B: Carbonate faulted blocks with karstified tops sealed by evaporitic and shale deposits. It is believed to have the same source rocks as Play type A. Type C: Middle-Upper Pliocene intercalations of (calcareous) sandstone and shales/siltstone with gas shows with expected source rock in the Paleogene-Neogene clastic basins.

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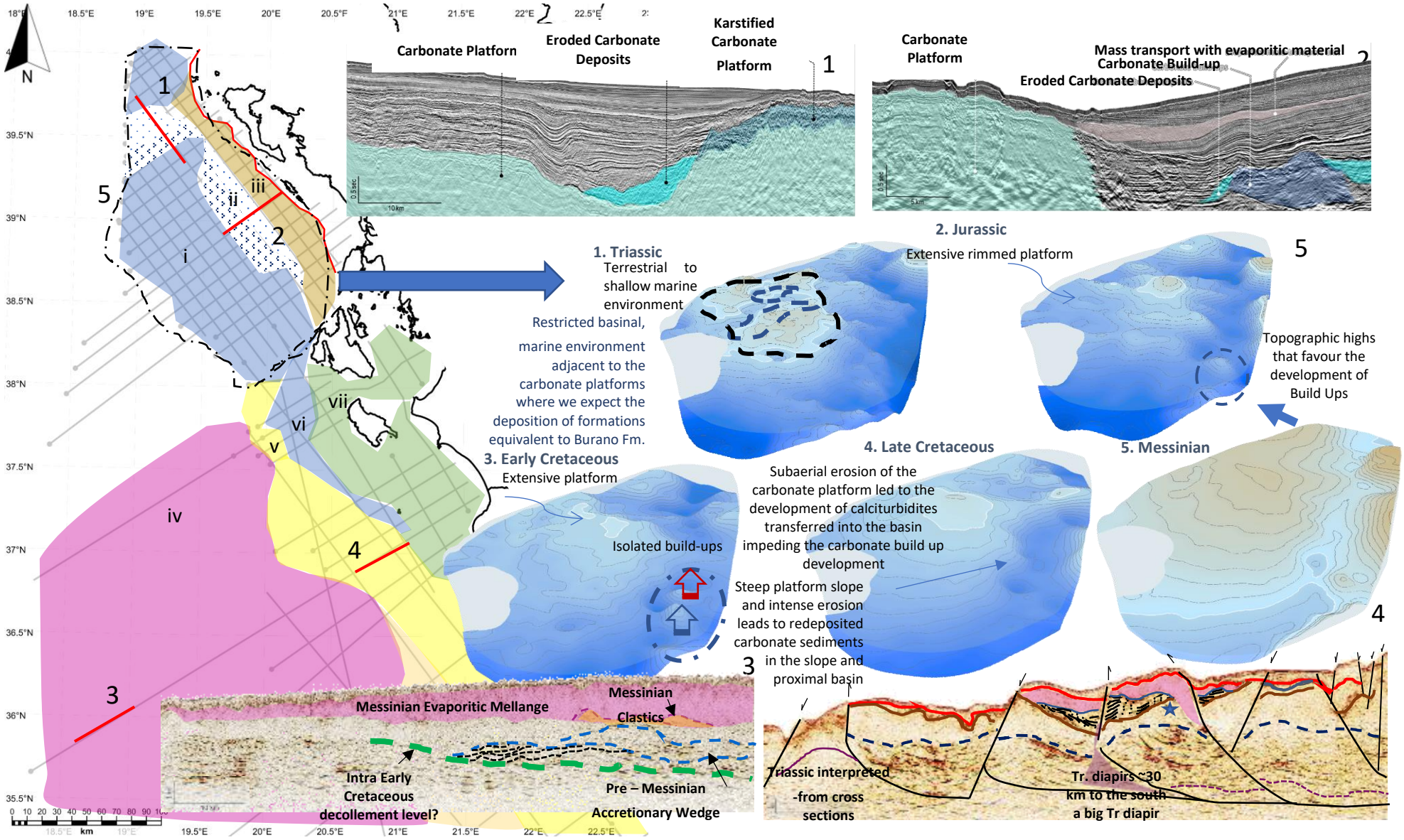

Figure 1. Geological interpretation from the 2D seismic data. i. Apulian Platform, ii. Rimmed margin, slope and redeposited carbonates, iii. deep pelagic basin, foreland basin after Oligocene, iv. Mediterranean Ridge, v. Backstop – Hellenic Trench, vi. Carbonate Platform, vii. Carbonate Platform, foreland(?) basin after the Oligocene