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Hydrocarbon Potential, Sediment Characteristics and Facies Analysis of a Lower Jurassic-Eocene Carbonate Succession in Western Greece

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Introduction

The thrust belt in the Balkan Peninsula along the margin of the Apulian foreland is known as the External Hellenides in Greece,which has been divided into three tectonostratigraphic zones which are from east to west: the Gavrovo Zone, the Ionian Zone and the Pre-Apulian (or Paxoi) Zone.
The rock successions in these zones consist of Mesozoic and Cenozoic strata, which have been thrust westwards onto the Apulian foreland. Form Eocene to Miocene, the migrating internal Hellenide orogeny to the west caused the simultaneous migration and the compressional deformation of the foreland in front of the orogen. (Underhill, 1985; Karakitsios, 1995; Karakitsios and Rigakis, 2007; Karakitsios, 2013)
The major structural trends are recognized in Western Greece. In the first place, major thrust fault trend NNW-SSE. These are locally offset by east-west oriented faults, some of which, such as those in the Gulf of Corinth, may have been inherited from Early Mesozoic rifting (Robertson et al., 1991). In the Cenozoic, they acted either as wrench faults during thrusting (e.g. the Petoussi Fault) or as basin bounding normal faults (e.g. in the Gulf of Patras). Thirdly, a series of dextral NE-SW trending strike-slip faults are presented in Cephalonia fault in the South. These strike-slip faults appear to have taken up relative motion in the Neogene between the Anatolian-Aegean Plate and the African-Apulian Plate north of the Hellenides subduction zone (Walcott and White, 1998).

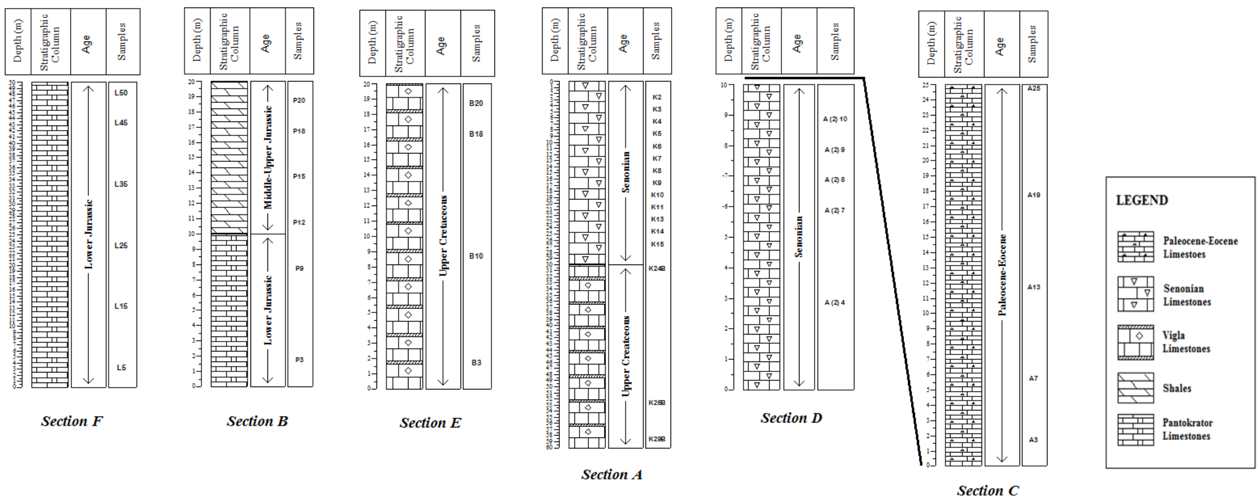

Figure 1. Stratigraphic columns of study sections (A to F). The stratigraphic columns are presented by aging order, from the older (Lower Jurassic) to the younger (Paleocene-Eocene) formation.

Materials & Methods

For the purpose of this study, a detailed investigation has been made in the Ionian zone. Six sections have been studied, and 150 samples collected in order to make extended laboratory analyses. The reservoir parameters that examined are porosity and permeability through an Accupyc 1330 pycnometer and a Geopyc 1360, from Micrometrics respectively. Furthermore, thin sections have been constructed in order to verify the sedimentological characteristics of the involved carbonate rocks.

Results

The principal lithofacies of Section F (Louros Section) is *biolithitic (boundstone)*. Section B (Perivleptos Section) is characterized by the lithofacies *biosparite (grainstone)*. The Pantokrator limestones give evidence of a depositional environment characterized by a carbonate platform with characteristics of both intertidal and subtidal settings. Vadose diagenesis of some redeposited carbonate clasts points a partly subaerial exposure. Section E (Vigla Section) consists of *radiolarian biomicrite (wackestone)* characterizing a low energy deep environment. In Section A (Koloniati Section), *pisoid lithoface*, is the only distinguished from all the other lithofacies. Pisoids have been described in the classical paper of Dunham (1962) and interpreted as caliche soil pisoids formed by subaerial vadose diagenesis during episodic lowstands of sea level. The range of depositional interpretations of these pisoids includes caliche formation in continental or coastalspray-zone, supratidal settings, vadose-marine inorganic precipitation in inter and subtidal environments of formation in marine seepage or groundwater springs (Flugel, 2010). Within this section, the following lithofacies have been observed as well: *biomicrite (mudstone-wackestone)* which refers to deep depositional environment. In Section D (Asprageli-2 Section), the following three lithofacies have been observed: *bioclastic (packstone)*, which represents a medium energy environment. Possibly, sediments have been transported within the basin from the platform, *biomicrite (wakestone-packstone-floatstone)* with plaktonic foraminifera, deposited in a medium energy pelagic depositional environment and *biolithitic (bounstone)* corresponding to the margin of the platform. In Section C (Asprageli-1 Section) the lithofacies that have been identified is *biomicritic (packstone)*. Within this lithofacies pelagic foraminifera have been observed, that represent a medium energy environment, possibly corresponding to a deep depositional environment.

Although it is natural to assume that permeability values depend on porosity, it is not simple to determine which the appropriate relationship is since this would require a detailed knowledge of size distribution and spatial arrangement of the pore channels in the porous medium. Generally, it is known that the higher the porosity, the higher permaebility we should have. However, because of the complexity and the large number of related parameters no simple single functions can exist. In our samples, it has been observed that as the porosity increases the permeability values seem to decrease. For instance, in Section E (Vigla Section), sample B3 with porosity 6,85% has higher permeability value (2,7017) than sample B10 which presented a higher porosity value (23,1%) but a lower permeability measurement (2,6811). This principle can be observed in several samples within our study area.
For section F, the average porosity is 3,92%, while permeability values range between 2,6496 (sample Λ45) and 2,7319 (sample Λ25). For Section B the average porosity is 8,46%. According to the permeability measurements, for Section B, range between 2,6496 (sample Π18) and 2,7319 (sample Π12). For Section E the average porosity is 8,67%. For the permeability measurements, sample B1 showed the highest value (2,7277), while sample B10 showed the lowest value (2,6811). The average porosity from section's A samples is 7,57%. On the other hand, permeability measurements range between 2,6707 (sample K28) and 2,718 (sample K8). For Section D the average porosity is 11,59%. Permeability values, for Section D, range between 2,6204 (sample $A_2$9) and 2,7411 (sample $A_2$4). For Section C the average porosity is 6,29%. The highest porosity value has been reported in sample A1 (16,88%) and the lowest value within the sample A13 (2,50%). For the permeability measurements, the highest value presented in sample A23 (2,7193), while the lowest appeared within sample A3 (2,5799).

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