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SOME CHARACTERISTICS OF OIL & GAS BEARING FORMATIONS IN ALBANIA BEARING

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ABSTRACT

The oil and gas in Albania is related with external Albanides as part of Adriatic sedimentary basin. The Ionian and Preadriatic Zones contented all oil and gas field. Three main sequences and four rock formations are formed after Triassic rifting. The oils are formed within carbonate rocks, whereas pure gas is formed within molasses shales. The HC generation has occurred from Cretaceous to Pliocene age. The oil fields are related with carbonate reservoirs and sandstone layers whereas gas fields are related with sand and siltstone bodies.

The traps are related with top of anticlinal carbonate structures sealed from flysch and with tectonic of "wedge" form. Subtle traps are the other type. The molasses traps are related with paleogeomorphic and stratigraphic type.

KEY WORDS: Oil & Gas, Source Rock, Reservoir, Oil Accumulation, Trap.

1. GEOLOGICAL & TECTONIC FRAMEWORK

The current geological and tectonic framework of the Albanides is a result of the rifting, movement and collision of the continental margin Adria and the European plate. A specific lithology and tectonic events is formed that are reflected by two major subdivisions, the Internal and the External Albanides (Sadiku Y. 1990, ALBPETROL, 1993, Popescu B. 1994).

The external Albanides are the main subdivision that contents the Oil and Gas pools and a significant potential for new discoveries.

The external Albanides includes four isopic zones:

-the Krasta-Cukali Zone,

-the Kruja Zone,

-the Ionian Zone and

-the Sazani Zone.

The Krasta, Kruja and Ionian zones represent the Thrust Belt part of the Albanides (Fig. 1 a). The Sazani Zone (Apulian Zone) represents the Foreland (Fig. 1b). The post-collision basin or Neogene Pre-Adriatic Depression (PAD), overlying the Kruja zone, Ionian zone and Sazani zone represents Foredeep (Fig.la&b).

Most of the oil discoveries are located in the central part of the Ionian Zone, in Kurveleshi Belt (Fig. 1c). A part of the oil discoveries is situate in subjacent southeast margin of the Foredeep (Fig. 1b).

The gas discoveries are concentrated in the molasses anticlines in the west margins of the PAD. Both these parts are discused in this paper (Fig. 1b).

All the rest parts of the external Albanides have much oil seeps and gas shows.

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2. DEPOSITION SEQUENCES

Three main sequences, from Upper-Triassic to Pliocene inclusive are identified in the sedimentation evolution of the Ionian zone and PAD (Fig. 2). (Dalipi H. 1985, ALBPETROL, 1994).

Permian sediments are alluvial-plain continental deposits and represent Pre- rift Apulian Plate sedimentation. Sedimentation associated with the Triassic rifting was siliciclastic, carbonate and evaporite. The "Dumre" Complex Evaporites and Breccia Dolomite of the Ionian Zone are a basement of sedimentation sequences.

2.1.UPPER TRIASSIC-AQUITANIAN SEQUENCE.(Fig.2a): This comprises a transgressive series deposited to Lower Cretaceous (Neocomian) and a regressive series that lasted from Hoterivian to Aquitanian.

The first part, in basement is represented by *Halogen Formation* that consist of gypsum, anhydride, halite and dolomite. This Formation, overlaid by a carbonate series so called *Carbonate Formation* expends at Upper Triassic to Eocene. This Formation includes a wide variety of carbonate facies ranging from subaerian to deep water. Slope and deep water facies have a higher associated clastic component.

The *Flysch and Flyschoid Formation*, as second part of sequence (Fig. 2b), take place in Oligocene to Lower Burdigalian. This formation and his propagation were controlled by an eastern Albanide source area, and was the result of the Alpine tectonic activity. The flysch consists of turbidite shale, siltstones and sands with a decreasing thickness to the West.

2.2 BURDIGALIAN TO LANGHIAN SEQUENCE: This comprises a series, grouped into the *Pre-Molasses* or Shliri (Schliere) *Formation* (Fig.2b). This Formation is made up of an upward finning sequence of clays, marls and siltstones over the basal conglomerates and sands. Local olistolites, shallow water limestone or deep water slump structures have been noted.

2.3 SERRAVALLIAN-PLIOCENE SEQUENCES: This is also called *the Nolasses Formation.* This sedimentation stage is divided into two deposition sequences: Early Molasses and Late Molasses.

The Early Molasses (Serravallian-Messinian) deposits are associated with the regional transgression of Sea. A transgressive lithotamnium limestone marks locally the base of the Serravallian. Early Molasses sediments consist of marine shales, submarine fans and deltoid and coastal sands and shales. The regressive event was marked by the presence of gypsum bearing clastics, only in the west and northwest PAD.

Helmesi transgressive Formation as Late part of Molasses, begins with basal conglomerate with a local extension, upward it passes in siltstones and marine shales. Prodelta clays and submarine fans marl conclude this section. This molasses locally are associated with sandstone intercalations. "Rogozhina" regressive Formation has an increased proportion of rough gravel.

3. MAIN TECTONIC EVENTS IN IONIAN ZONE AND PAD.

Rifting and an extensive tectonic phase dominated the area through Lower Triassic to Middle Jurassic.

First significant compression tectonics phase took place in the Late Oligocene to Langhian (the Langhian phase) (Sadiku Y, 1990). (Fig.2b).

The main tectonic phase occurred in Tortonian Time. This resulted in the formation of gentle folds with a northwest to southeast trend. An other compression tectonic phase is recorded in the Pliocene (Aliaj Sh., Hyseni A. etc. 1996; Guri S., Sazhdanaku F., Dhima S., 1995).

The folding phases that reached the Ionian Zane are Late Oligocene-Early Miocene (Serravallian), Late Miocene and post-Pliocene. These folding phases associated with a stratigraphic (hiatus) and angular unconformities. Consedimentation effect is evidence of a gradual compressive regime in PAD.

4. GEOTHERMAL GRADIENT

Frasheri A, etc., 1995, notes that the geothermal gradient in the External Albanides reaches its highest value 1,87 °C/100 m in the center of the PAD. In the southern part of the depression lower predominate values of 1,15-1,30 °C/100 m with the lowest gradient of 0,7-1,1 °C/100 m observed in the depth of the synclinal belts. The contours of the temperature trend generally run parallel to the major direction of Albanides.

5. SOURCE ROCKS STUDIES

5.1 Oil and Gas Prone Sources

Autochthonous Mesozoic sedimentary rocks are the oil and gas source rocks (Çurri F., 1993). Six source rock levels can be identified from Upper Triassic to Lower Cretaceous (Fig. 2a). The source rocks have high contents of total organic carbon (to 44%), high hydrogen indexes. Source rocks are of algae and mixed marine origin (Types I and II). The hydrocarbons generated from these source rocks have a better to excellent potential for liquid hydrocarbon generation and a relatively high level of maturation.

Modeling of the burial history of the Burano source beds (upper Triassic), suggests that oil generation began in the Late Cretaceous with the main expulsion phase occurring in the Niddle to Late Eocene (Çuri F,1993).

The geodynamic history of the Zonian basin shows that the Mesozoic source rocks remained at shallow depths. Later, during Tortonian and Pliocene the burial depths increased continuously creating conditions for the supplementary and highest maturation of the source rocks.

5.2. Gas Prone Sources

The Molasses deposits, include large amounts of shales, which are the source rocks of the gas fields in the PAD. There are two geochemical units with different characteristics: The lower (Serravallian-Tortonian) and the upper (Messinian onward).

The organic matter is disseminated throughout the section. TOC varies from 0,2 to 0,4% and increases from lower to upper geochemistry thickness (Çurri F,. 1993). These deposits contain type III kerogen (Huminite Inertinite) which is gas prone. Vitrinite reflectance ranges from 0,3 to 0,5 suggesting production of biogenic gas that consists of 96% methane. The genetic types of gas show a different depth distribution in the basin.

6. THE HYDROCARBON MIGRATION

Three periods of expulsion and migration from oil prone source beds occurred in the Ionian Zone. These correspond with the periods of major tectonic activity, the Langhian-Tortonian and the Pliocene phase (Çurri F., 1993).

The vertical migration in the Ionian zone has ocurred by tectonic fracture and the micro-and macrofisure systems within the carbonate rock. Oils accumulated in Middle Miocene sandstone reservoirs emigrated from carbonate reservoirs through unconformity surfaces sandstone-eroded limestone.

Repeated overthrustings of the structures and dismigration of oils brought new fluxes of oils in the shallower traps. The lateral migration was facilitated by the low-amplitude fault pattern.

Generally the heavier oil accumulations were supplied by Langhian and Tortonian expulsions. Migration and accumulation of condenses and light and mature oils occurred during Pliocene and post-Pliocene. In PAD zone, first generation and migration of gas has occur along with sediments' consolidation. The intensive migration achieved during the moments of structural formation. For the most part, the undercompaction sequence and high pressure zone into molasses, have controlled the migration and the accumulation.

7. RESERVOIR CHARACTERIZATION

7.1. Carbonate reservoir

The core, outcrop, geophysical and reservoir engineering data suggest a characterization of the carbonate rock of Ionian Zone and Kurveleshi Belt (Foto Gj., 1997). Two facies (or zones) with markedly different reservoir properties and stratigraphic units, occurs across carbonate section:

"Zone A" from top limestone to the phosphate marker OF, represents pure limestone. This section is divided in three subzones. Lithologically subzone III is characterized by Mudstone (50%) and Packstone and Grainstone. There are present fractures, pore space and vugular porosity, and its age is Upper Cretaceous. This subzone is with better production than the subzone I and II.

"Zone B" that consists of shale, porcelaneous limestone and chert beds of Jurassic's, is characterized by vertical fractures.

As a conclusion, the first zone "A" has reservoir features better compared to the second one "Zone C" that encompasses all carbonates rocks as dolomite, breccia dolomite of Upper Triassic that have a high utility porosity better that Zone A.

7.2 Molasses reservoirs

There are two reservoir's units, that belong to eastern part and western part of PAD (Guri S., Sazhdanaku F., Dhima S., 1995).

In eastern part are predominant sandstone with a good porosity and permeability, whereas these of western part are siltstones predominant with a poor porosity and permeability. There are some reservoir units in western part such as "Bubullima, Marinza, Driza, Gorani" oil bearing. These reservoirs are localized in Patos-Bubullima region "Kuηova, Polovina" and "Arreza" oil bearing suite, localized in Kurηova region. (Gjoka M. et al 1986).

As gas bearing reservoirs in western part are some sand deltaic and turbiditic thickness, or "Divjaka" suite that is localized in top of Tortonian section.

8. THE TRAPS

a. Up today in Carbonate Rocks are discovered three kinds of traps:

1. Traps related with top of the anticlinal structures (Fig. 1c, Fig. 3, Fig.4).

In this type we can mention the traps of Ballshi (Fig.4 GCS1), Gorisht- Kocul, (Fig.4 GCS1), Amonica, Finiq-Kranea, Delvina (Fig.4 GCS 5), etc.

The structures have an elongated anticlinal form, overturned and faulted in western flank, a smooth dip and rare very dip eastern flank. Ballshi and Gorisht-Koculi structure, have a quaquaversal anticline form (Fig. 1 c).

Their dimensions range from (3-8)x(1-4) km. The full structural closur.e ranged some hundred meter to one kilometer. The reservoir's are full sealed from overlying flysh formation. In some cases the traps are formed from overlying flysch and after fault plane in western flank, partly of flysch formation of near western structure. The traps are located in continuation of each other with SE-NN orientation the same as the Albanides (Fig.1 c).

2. Traps related with carbonate tectonic blocks (Fig.3 Kremenare-Ballsh)

A typical trap of this kind is Karbunara, where the tectonic blocks as "wedges" are cutting up from western flank of a big saddle Kremenara structure. These blocs have an eastern dip and are sealed by some ten meters of flysch formation. The carbonate blocks dimensions and traps are relatively small.

3. Subtle traps with tilted oil-waters contact

These traps are related with the Patos-Verbasi big structure (Fig.1 c, Fig. 4, GCS 2, GCS 3) and Cakran-Mollaj ones (Fig. 4.GCS1). The trapping has occurred partly from flysch formation, partly from clay deposits of overlying Tortonian formation. In some cases trapping is formed partly from circulation connate pressure water, partly from undulated anticlinal crest line, partly from changes in permeability features of the carbonate rocks (Fig. 3 Visoke-Zharrez. Fig.4 GCS2, Fig.4a) (Foto Gj., 1991). The traps occurred in highest part of limestone and in southern periclinal are sealed only from flysch formation. (Fig. 1c, Fig. 3).

The traps dimensions are relatively small in Patos-Verbasi structure, whereas in Visoka that locates in southern periclinal, is bigger trap. The trap of Cakran-Mollaj-Kreshpani is a very bigger trap up to day and has formed the bigger field of oil&gascondensate in Albania.

a. In Sandstone rocks, the traps are related to molasses formation.

There are two kinds of traps, one in eastern part of PAD, related with erosion paleowalley. This trap is formed from carbonate and flysch formation Ionian Zone and overlying molasses formation, as paleogeomorphic trap (Patos- Marinza-Bubullima and Kuçova). In the other hand in western part of PAD, are stratigraphic traps, related with lenticular sand bodies within thick clay molasses section that construct the anticlinal structure.

1.The traps related with erosion paleowalleys.

la. Patos-Marinza-Bubullima-Kolonja region.

This region is represented by an elongated sandstone and clay monocline with a deep of 10-15° NW. This monocline is formed as transgressive unconformity (onlap type) in Tortonian and Messinian sea and shallow deposition (delta). Sedimentation rate is moderate too high. These sandstone beds have a "tongue" form that form potential traps in a thick Tortonian section. The sand beds located over carbonate rock in western part of paleovalley and in other eastern hand, over flysch formation that sealed these carbonate rock of Patos-Verbasi structure.

lb. Kuηova-Arreza region.

The reservoirs are represented by lenticular sand bodies (delta), sealed by shales that fills a marginal paleodeep formed from flysch and carbonate formation from Kuçova eroded structure. The length of sand lenses ranges among 100 to 1500m, and are in a horizontal position. The migration of oil from carbonate rock in this traps occurred throughout a dense grid of interformational faults and rare in direct contact with carbonate rock.

2. The traps related with western part of PAD

The traps in western part of molasses section of PAD are stratigraphics. This condition is related with sand and siltstone bodies, of Serravalian sea of the shale section (Panaja region in South of PAD). In NW at Durres region these are related with lower part of the Tortonian section (Rakipi N., Mesonjesi A.. Kurti Sh., Koçi N., Fezga F., 1995). Those of the uppermost part of the Tortonian belong a delta facies (Divjaka) and of a deep-sea deposition environment (Povelça). The upper part of the Messinian deposits represents a turbidite facies and a delta facies in upper part of the Frakulla. In the lower part (Povelra) is a deep-sea facies and a turbidite facies in Lower Pliocene deposits (Divjaka, Ballaj region).

These lenticular sands and siltstone bodies are located in some elongated anticline chains as Ardenica-Divjaka-Ballaj-Durresi; Panaja- Frakulla belt and in western part of PAD that Zverneci-Povelqe-Semani. Those chains are formed as positive flower structures in a thick shale section after a compressive tectonic. Panaja and Povelça structures have only a western flank fault with eastern dip. These anticline chains are associate with a high pressure zone and rare with a undercompacted shale.

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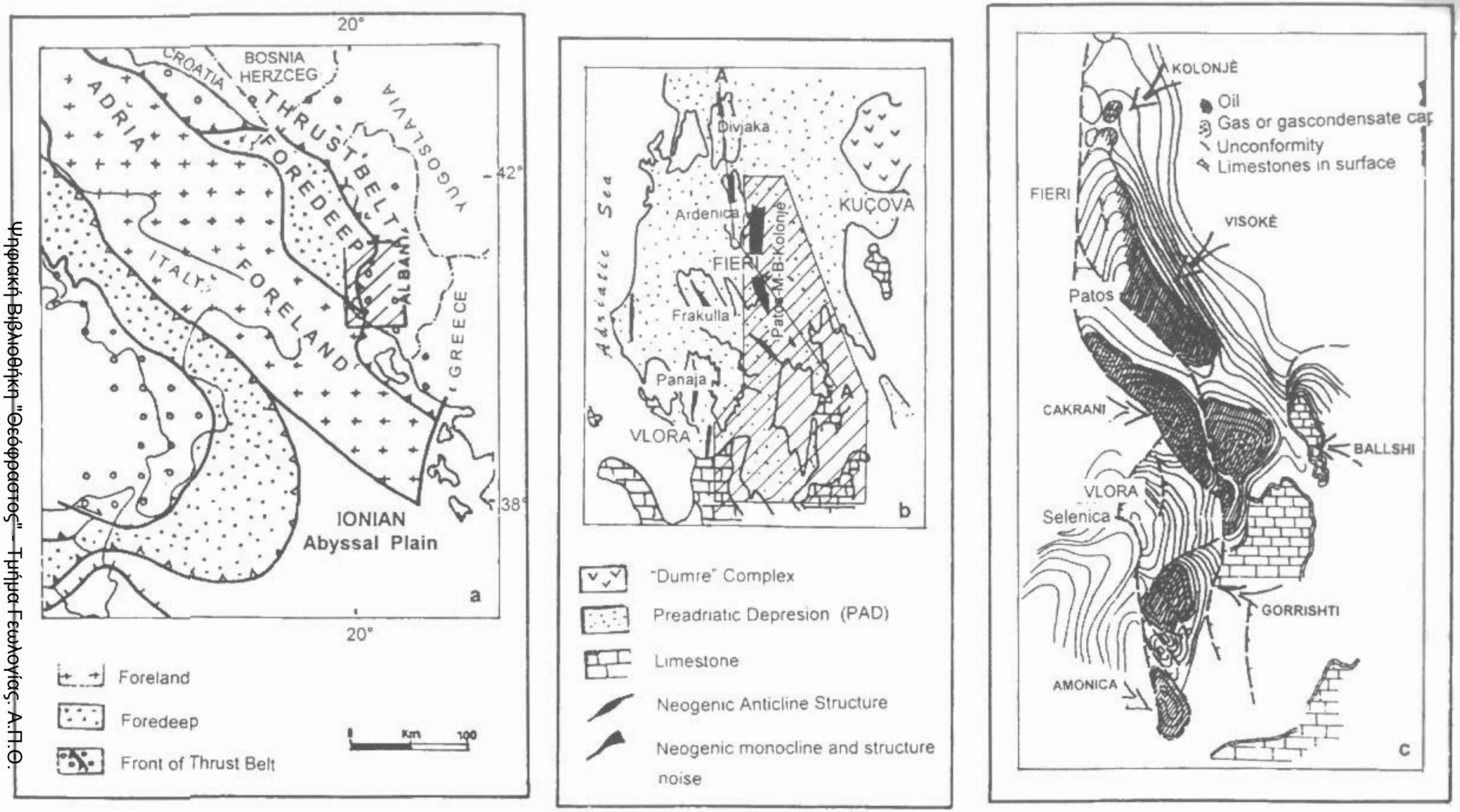

Fig. 1 Simplified tectonic maps of Periadriatic region (a), of Preadriatic Depression PAD (b) and Top of limestone's in the Kurveleshi Belt (Ionian Zone) (c)

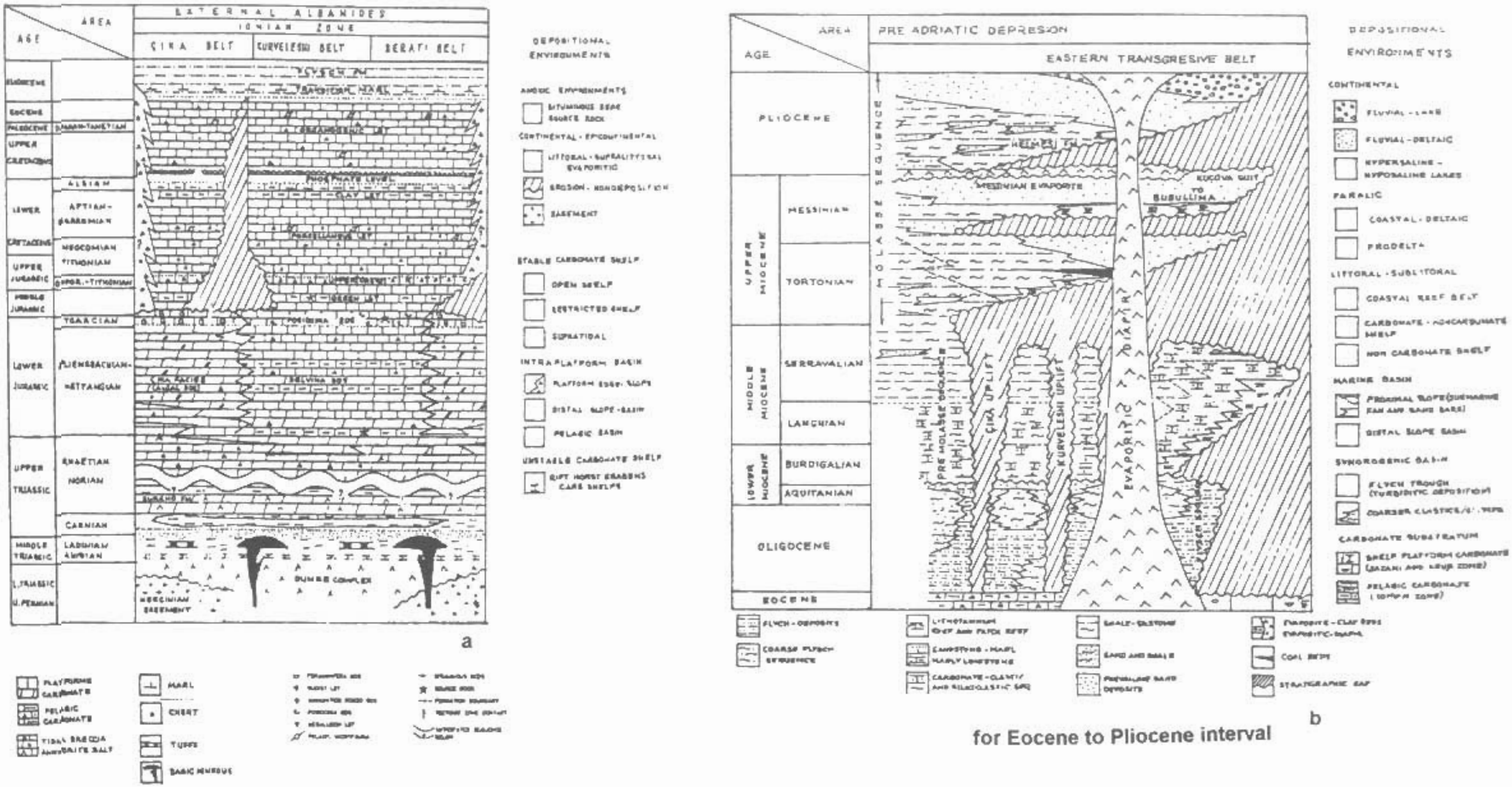

Fig.2 Generalized stratigraphic chart for Permian to Pliocene interval showing vertical and lateral relationships and sedimentation sequences in Ionian Zone and Preadriatic Depression (Modified from Albpetrol & Geological Institute)

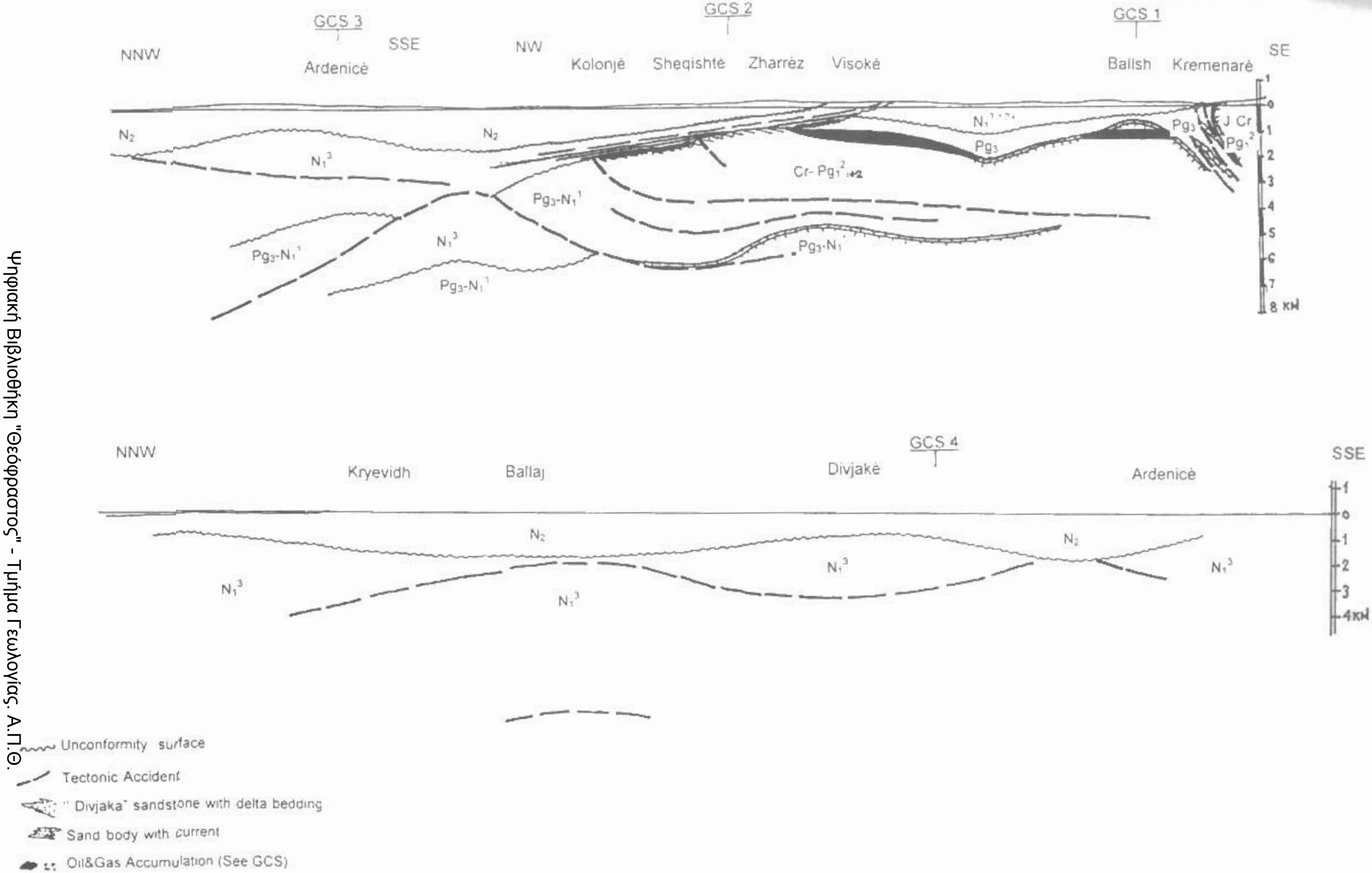

Fig.3 Geologic longitudinal Section A-A from Kremenara to Kolonja and Kryevidhi (Adriatic Sea).

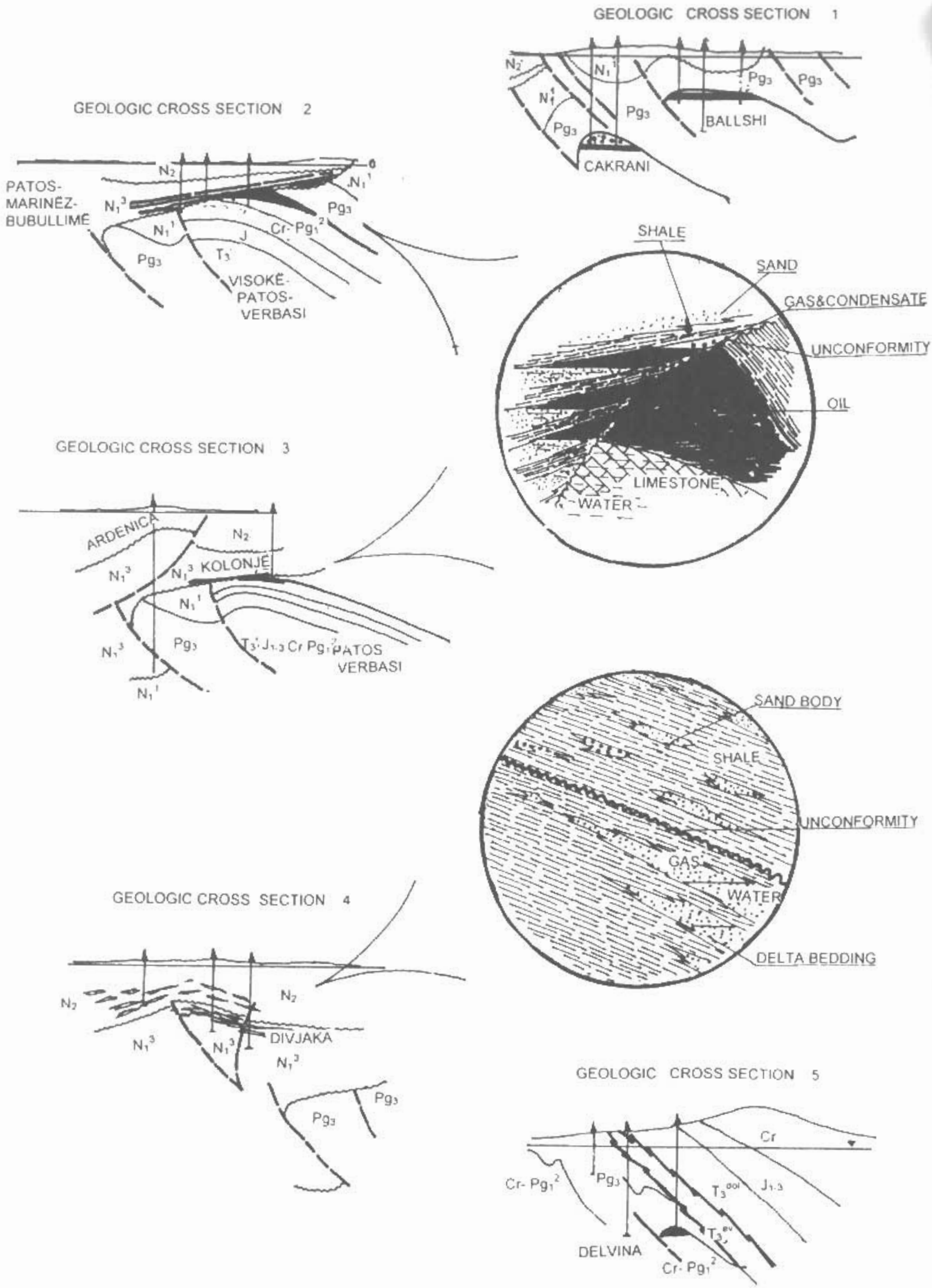

Fig.4 Geologic cross sections over some oil&gas fields in Kurveleshi Belt and PAD zone
(see their location in Fig.3 GCS)