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Source Rock Potential and Petroleum Systems of the Triassic and Paleozoic Successions of the Hayan Block, Central Syrian Palmyrides

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Abstract
Recent INA Oil Company discoveries in the central Syrian Palmyrides (Hayan Block) accentuate the Triassic Kurrachine Dolomite Formation as a major play for hydrocarbon generation and accumulation. Previously Triassic and especially Paleozoic source rocks and Petroleum Systems were not been studied in more detail. The evaporate/carbonate succession, and their associated lithofacies of the Triassic Kurrachine Dolomite Formation, become increasingly attractive exploration targets. The characteristic play definition is shown for the Hayan Block based on three defined elements: petroleum charge systems, the source-reservoir formation characteristics and the trap-seal type. Three Petroleum Systems of the Paleozoic, Triassic and Cretaceous/ Paleogene successions were recognized. It was presumed that hydrocarbon generation and migration (accumulated in the Triassic reservoirs) occurred from deeper Middle-Lower Paleozoic Formations. Exploration results show that the generative potential of the Triassic source rocks in the Hayan Block was underestimated. Correlation and calibration of the petrophysical parameters from well logs, geochemical analyses and 3D seismic show a much larger volume of mature source rocks than that predicted purely from geochemical analyses. A calculated volumetric characteristic of Triassic source rocks indicates their high hydrocarbon generating capability. Intensive tectonic activity formed fractured zones as favorable reservoir rocks, so in some areas, practically no or very short migration pathways exist. Expelled hydrocarbons (within explored area) have not been accumulated into discrete reservoirs, thus the system is generating oil *in situ*. The results accentuate the existence of a key Triassic Petroleum Systems in the area of the Hayan Block. Triassic Petroleum System incorporates the Triassic Kurrachine Dolomite, Amanus Shale Formations and the Permian Amanus Sand Formation. Paleozoic succession is rather (dry) gas prone or being overmature, while Cretaceous/Paleogene Petroleum System is immature in this area and is capable to produce only heavy oil, thus, it is not evaluated in more detail.

1. Introduction

INA Oil Company discoveries at the Hayan Block area indicate that the Kurrachine Dolomite petroleum system is the most important for the Hayan Block. Well test data from a number of wells shows existence of the three different hydrodynamic units regarding Paleozoic and Triassic successions. First discovery results were presented (e.g. by Lučić et al., 2002, Takač and Husnjak, 2003; Foršek et al., 2005). Leško et al. (2005) defined

Triassic source rocks, according to the basin modeling, as being oil prone but restricted in volume. Lučić et al. (2005, 2010) pointed out the cyclic sedimentation during Triassic and their implication on Petroleum Systems definition. On the area of the Hayan Block authors extract four (A, B, C, D) Triassic Megacycles considering Early Triassic as syn-rift and Late Triassic as post-rift sediments. Megacycles (A and B) are addressed to Triassic. Seismic modeling in depth domain was done by Takač et al. (2006).

Vulama and Špiljak Vulama (2007, 2009) recognized a significant volume of mature source rocks of the Kurrachine Dolomite Formation, especially within lower (D2-2) reservoir. They found that the generative potential of the Kurrachine Dolomite Formation of the Hayan Block was underestimated and that Triassic (source rock/reservoir pair) is a mayor play in the area.

Mitchels and Malaltre (2007) defined the existence of active source rocks in the Triassic, with two oil types in the Kurrachine Dolomite Formation. They recognized similarities in the content of biomarkers and maturity between the Triassic rocks and oils. Hips and Argyelan (2007) explored Kurrachine Dolomite Formation in a nearby area. They determined that the expelled hydrocarbons migrated within Formation, or in some cases, to Permian sandstone sequences.

Recently, Vulama (2011) describes in detailed the Triassic Kurrachine Dolomite Formation source rock potential and Triassic Petroleum System as a key system in the area of Hayan Block. That research identified the source rocks properties, reservoir/seal rock type and trap configuration, their spatial distribution and significant volume of source rock and hydrocarbons generated (Figure 2).

2. Geologic Setting

In the general geological survey it can be established that Syria mainly belongs to the marginal, northern part of the Arabian plate (Arabian Syria), in surrounding area of the active zone of collision with Eurasia, beginning from Precambrian until today. Syria partially grips a part of the Levantine plate (Levantine Syria). The plate separates the Dead Sea (Levantine) faulting system (Figure 1). During the Neogene, individualization of the Arabia plate affected the Levant with the development of the Dead Sea (or Levant) Fault (Brew et al., 2001; Homberg and Bachmann 2010). The Arab plate separates from the African plate in the middle of the Cenozoic age. The orientation and the position of the plate, influenced by the tectonic movements, multiply has been changed, what was reflected in climate oscillation, depositional conditions and tectonic-structural setting with the elements of both passive and active margins (Alsharhan and Kendal, 1986; Metwalli et al., 1974; Webb and Thomson, 1994; Brew et al., 2001). Distribution of tectonic provinces and structural boundaries on the northern margin of the plate, are largely controlled by tectonic events during Cenozoic. The most significant boundary at the present day is the Zagros fold and thrust belt that trends northwesterly (west Iran and eastern Iraq). It accommodates the convergence of Arabia with Eurasia by widespread thrusting, folding and crustal shortening. West boundary is defined with sinistral Dead Sea fault system which accommodates the different northward motion of the Arabian and African plates created by the opening of the Red Sea (Brew et al., 2001). Four major ‘tectonic zones’ can be recognized in Syria: the zone of Palmyride foldbelt, the Sinjar-Abd El Aziz Uplift, the Euphrates Depression and the Dead Sea Fault System. Only one - Dead Sea Fault System is non-hydrocarbon production zone. Cumulative, the best producer is Mesopotamian foredeep, a flexural depression of regional extent which extends from Iraq into NE Syria. The studied area is located in the central Palmyrides (Figure 1). The Palmyrides can be considered as a type example of an intracontinental transpressive mountain belt representing the most significant structure in central Syria (Ponikarov, 1966. Chaimov et al., 1992, 1993, Brew et al., 2001). The Palmyrides strike N45°E from the Anti-Lebanon Mountains and the Dead Sea fault system toward the Euphrates Graben in the northeast, under which they plunge and vanish. The Palmyride mountain chain is 400 km long and 100 km wide with maximum elevation of about 1400 m. Mountain belt is sandwiched between two structural highs, Alepo at northwest and Rutbah towards southeast (Figure 1). In Neogene, simultaneously with the tectonic activities in the surrounding area; Red Sea opening, Dead Sea Fault System activation, Eastern Mediterranean opening, convergence and obduction in southeastern Turkey and Iran and final collision of the Arabian and Eurasian Plates occurred. The deposits from the Plamyrides depocentre were uplifted and inverted into recent shape. The area is still under compressional phase. The process should be divided in at least three phases. First uplift was observed to be at the end of Createaceous (-65Ma), second uplift and local onlap was during mid-Eocene, the last and the most important uplifting process started some 20 Ma years ago (Early Miocene) and is still active (Chaimov et al., 1992).This latest uplifting was very important because it most probably represents the critical event in the historical evolution of the Syrian terrains. Inversion process included folding, reverse faulting, translation and small blocks rotation along numerous strike-slip faults (Figures 2, 3, 4, 9). Because of the different tectonic styles, Palmyrides should be generally divided into northern and southern, separated by regional Jihar fault and wide Al Daww depression (McBride et al., 1990; Searle, 1994.). The north Palmyrides consist of broad, relatively symmetric anticlines, with reverse faults along the southern and northern flanks of the belt that dip towards the interior of the belt. On the northern side are the Salamieh and Homs depression while towards the south is Jihar fault. In between are two structural blocks; Bishri and Bilas block. Bilas block is strike-slip duplex structure bounded on southern part with Jihar dextral strike-slip fault and on the northern flank with Bishri dextral strike-slip fault. Jihar fault is one of the most significant strike-slip fault systems in Palmyrides clearly separating SW Palmyrides from the NE Palmyrides. The fault has been traced for 200 km in an ENE direction and shows an average of 1000 m of uplift. Al Daww depression is a type example of intramountain basin and represents depocentre from Miocene onwards (Figures 2, 4). In depression more than 5 000 m of Mesozoic and 6 000 m of Paleozoic deposits exists. From deep exploration wells (INA Oil Company) in the Palmyrides, stratigraphically, the depositional succession from Ordovician to Miocene was defined. Rocks outcropping in the area of Hayan Block consist of Upper Triassic to Miocene deposits and Quaternary sediments. Deposits are classified and described according to the accepted lithostratigraphical nomenclature established by Syrian Petroleum Company (SPC). The only exceptions are Triassic deposits defined in terms of Megacycles (Lučić et al., 2005, 2010). Ordovician deposits of Affendi Formation and Silurian deposits of Tanf Formation on Hayan Block have been drilled by one deep well only. Ordovician deposits consist of intercalated sandstones, shales and siltstones deposited in shallow marine, near shore and glacial? environment. Post glacial Silurian deposits are transgressive, predominately consist of shale with thin strikes of sandstone. Thick, more than 2000 m are deposits of the Carboniferous Markada Formation. It is unique depositional sequence clearly defined with Devonian unconformity at the base and Permian unconformity at the top (Ayed and Lučić, 2005, 2009). Sediments are mostly shales and siltstones with numerous sandstones and rare carbonate intercalations, deposited in the transitional, fluvial/deltaic environment with sporadically marine influence. In Permian, continental deposits (shale interbeded with sandstone) of Amanus Sand Formation are deposited in most of the Syria. The late Permian to Triassic deposits of the Arabian Peninsula are mainly widespread carbonates and evaporates that were deposited during a period of relative tectonic stability. Their deposition on an epiric shelf was punctuated by a series of transgressions and regressions.

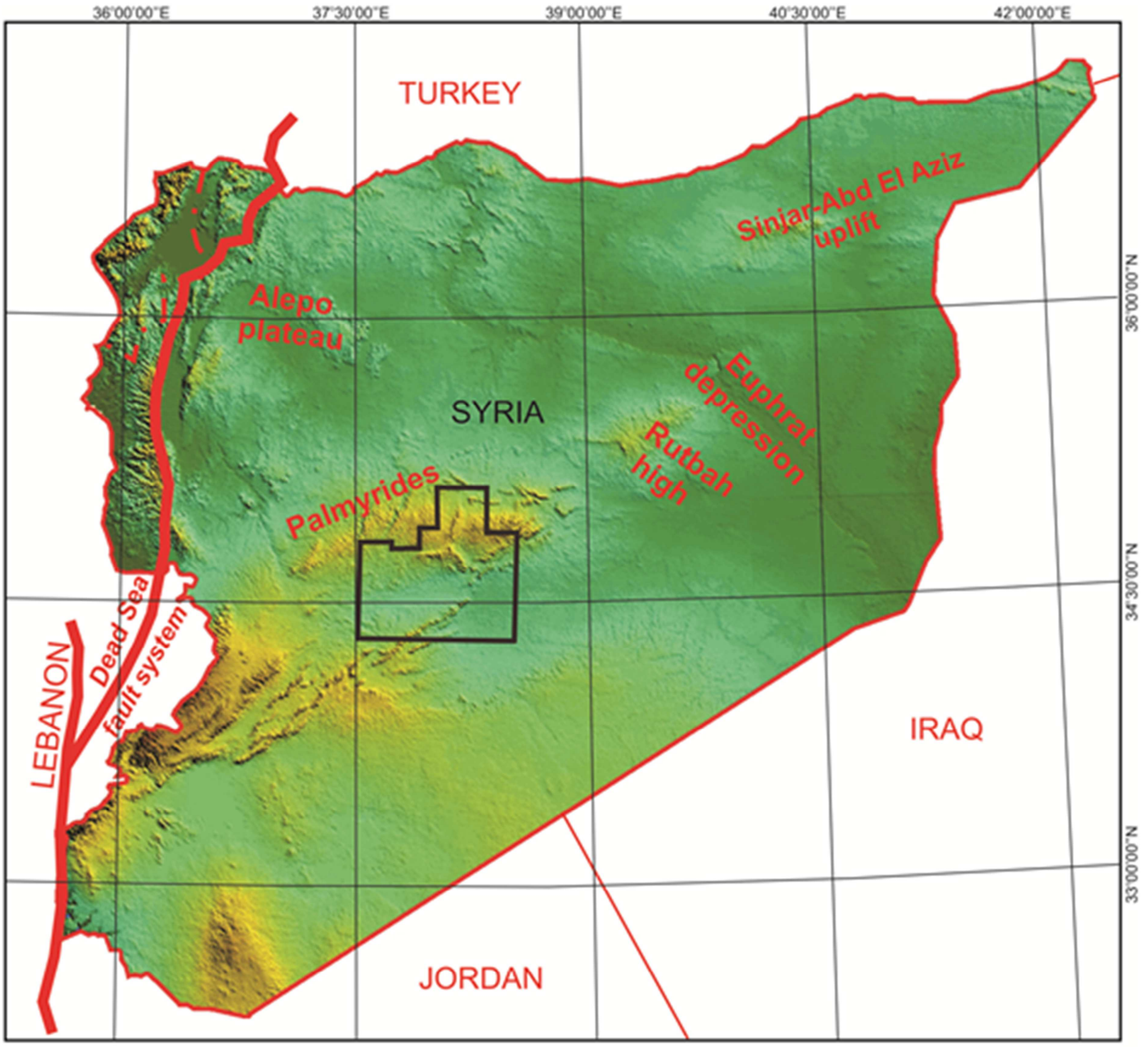

Figure 1. *Location of the Hayan Block in central Syrian Palmyrides.*

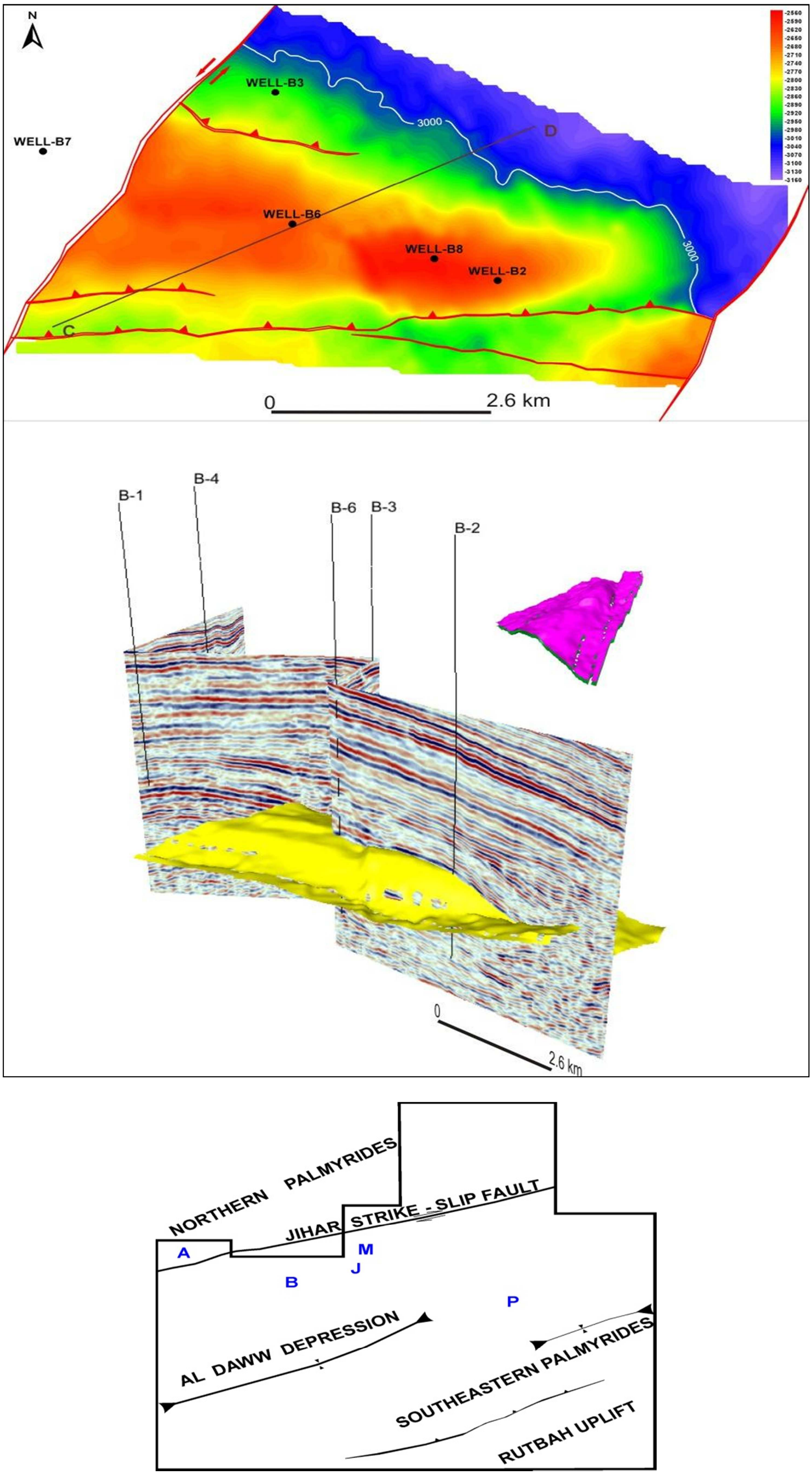

Figure 2. *Structure map on the top of the mature source rocks of the Kurrachine Dolomite Formation ("B" oil/gas field, position above); Seismic section with extracted top of the source rock Unit (yellow) and 3D shape of the source rock body (magenta). -Volume of Unit =* $1.4x10^9 m^3$*; mass of hydrocarbons generated HCG=* $1.27x10^{10}$ *kgHC; Oil generated =* $0.8x10^8$ *bbl or* $12.7x10^6$ m^3 *of oil equivalent (Vulama, 2011).*

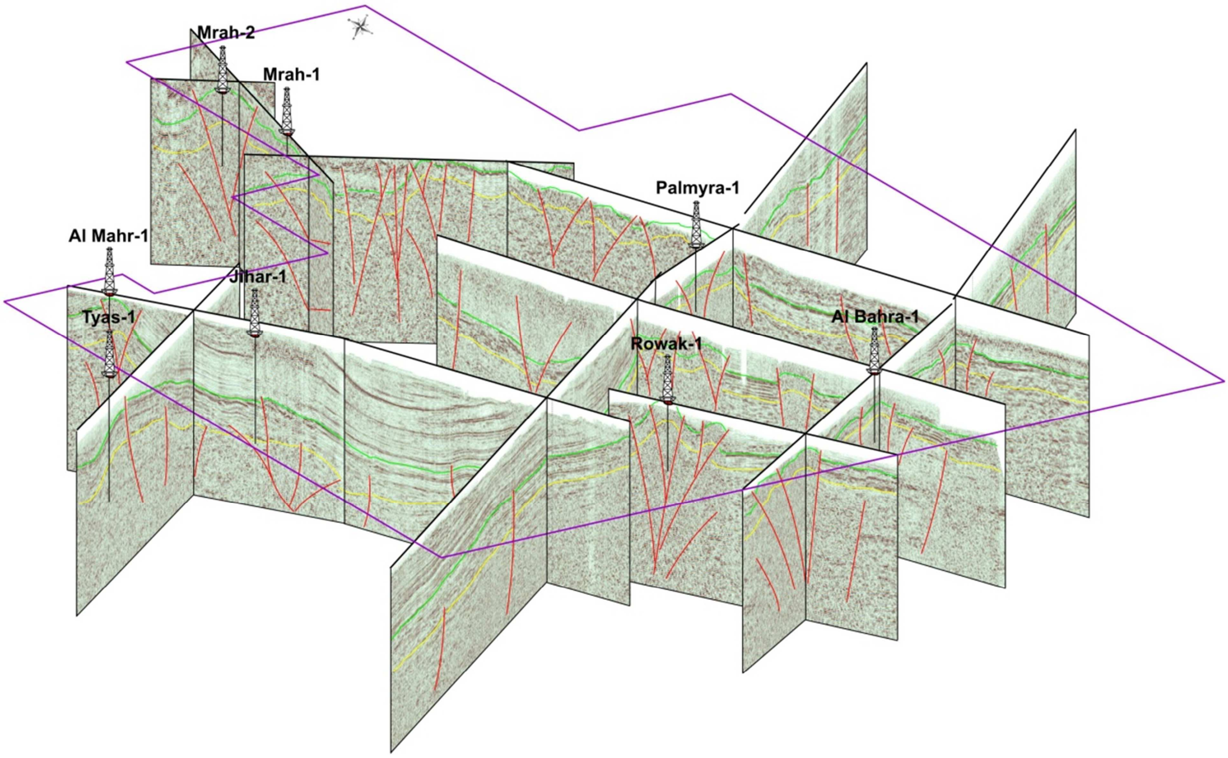

Figure 3. *Fancy diagram show tectonic complexity of the Hayan Block (green Shiranish Formation, yellow Kurrachine Dolomite Formation.*

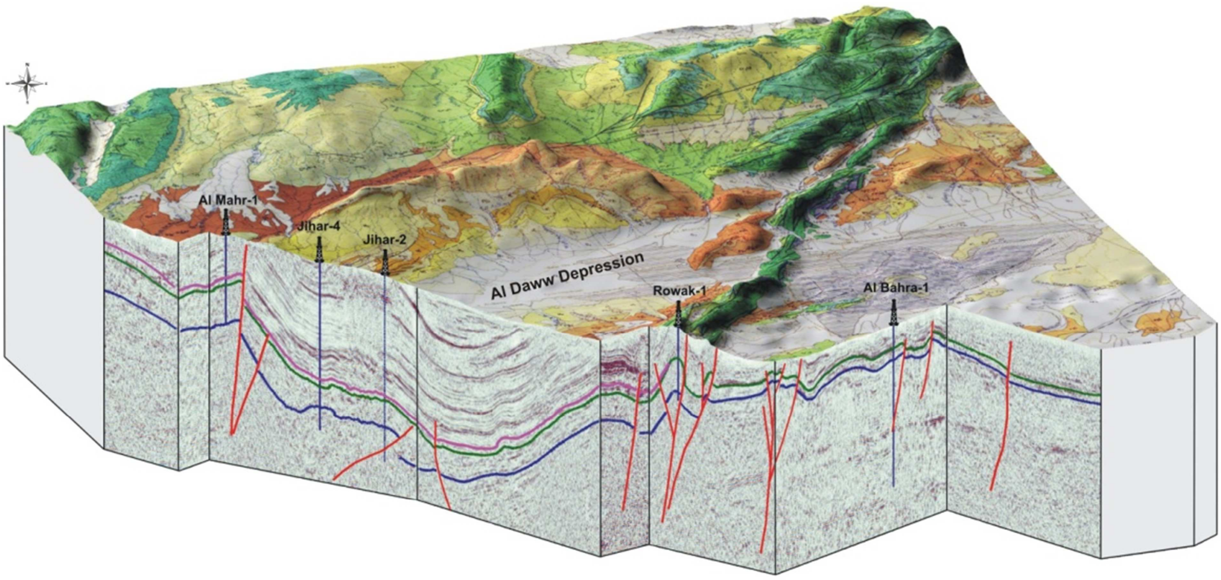

Figure 4. *Block diagram of Hayan Block. Violet - top D2-2 (main source rock, Kurrachine Dolomite FM), green - bottom source rock, blue - top Markada FM..*

The stable-shelf depositional environment established during the Permian and Triassic continued through the Mesozoic. Mesozoic succession is due to sinking (rift phase) dominate by carbonates and evaporates (Figure 5). At the beginning of the Triassic smaller continental microplates were separated from Gondwana, creating "Neo-Thethys" Ocean. At the same time, the Apulia Plate separates from Africa, creating Eastern Mediterranean basin that is through Syria connected with Neo-Thethys along Palmyride and Sinjar Trough. In the meantime the movement of the plates followed by the fault tectonic causes the sinking of the area of today Syria (Webb and Thompson, 1994). Deposits are syn-rift, transgressive shale and limestone. During Middle and Upper Triassic the predominantly clastic section of the Paleozoic being replaced in Triassic by post-rift mainly carbonate platform deposition. At the end of Triassic the area was uplifted and eroded. Upper Triassic Rhetian, clastic deposits are missing in most of the area on Hayan Block. Marls intercalated with gypsum which crop out in the cores of anticlines could be correlated with Carnian evaporate deposits, of Kurrachine Anhydrite Formation as defined in the subsurface. The opening of the Eastern Mediterranean caused that Jurassic deposits in Syria are transgressive onto the eroded Triassic surface and are mostly present in paleo-depressions. Apulian plate in Jurassic moves far to the northwest, and the western marginal parts of the Arab plate become passive. Sedimentation of the internal basin of the Palmyride and Sinjar Trough continues through Jurassic, but is thinner than the Triassic because of epiorogenetic uplifting. Middle to Upper Jurrasic sediments within the Hayan Block are unconformable on the Triassic and belong to the Haramoun Formation consisting of various carbonate types dolomites and limestone with minor shale deposited in restricted shelf (Mouty and Zaninetti, 1998). At the end of Jurrasic and during Lower Cretaceous the western parts of the Arabian plate (Levant terrains) were uplifted and mostly continental sandstones and shales of Rutbah Formation (Baremian-Aptian) were deposited in most of Syria. Locally deposits are accompanied with basaltic volcanic rocks. Once the territory was over flooded with sea water during Upper Cretaceous and because of slow subsidence, the conditions for carbonate platform deposits were established. Deposits are divided in the Albian-Cenomanian Hayane Formation and the Upper Cenomanian-Turonian dolomites and limestone of the Judea Formation. In the Paleocene the deposition is still taking place in deep water environment (fossils rich marls and clayey limestone of the Kermav Formation). During the Eocene sea level slightly fall and deposits of Jaddala Formation (foraminiferal limestone, calcite marls with chert, chalky limestone) were deposited in open shelf and only locally in deeper water environment (Karashenikov et al., 1996; Hernitz-Kučenjak et al., 2006). During Oligocene age, regressive phase culminated while massive, recrystalline algal and reef limestone of the Chilou Formation has been replaced by the Neogene continental clastic deposits.

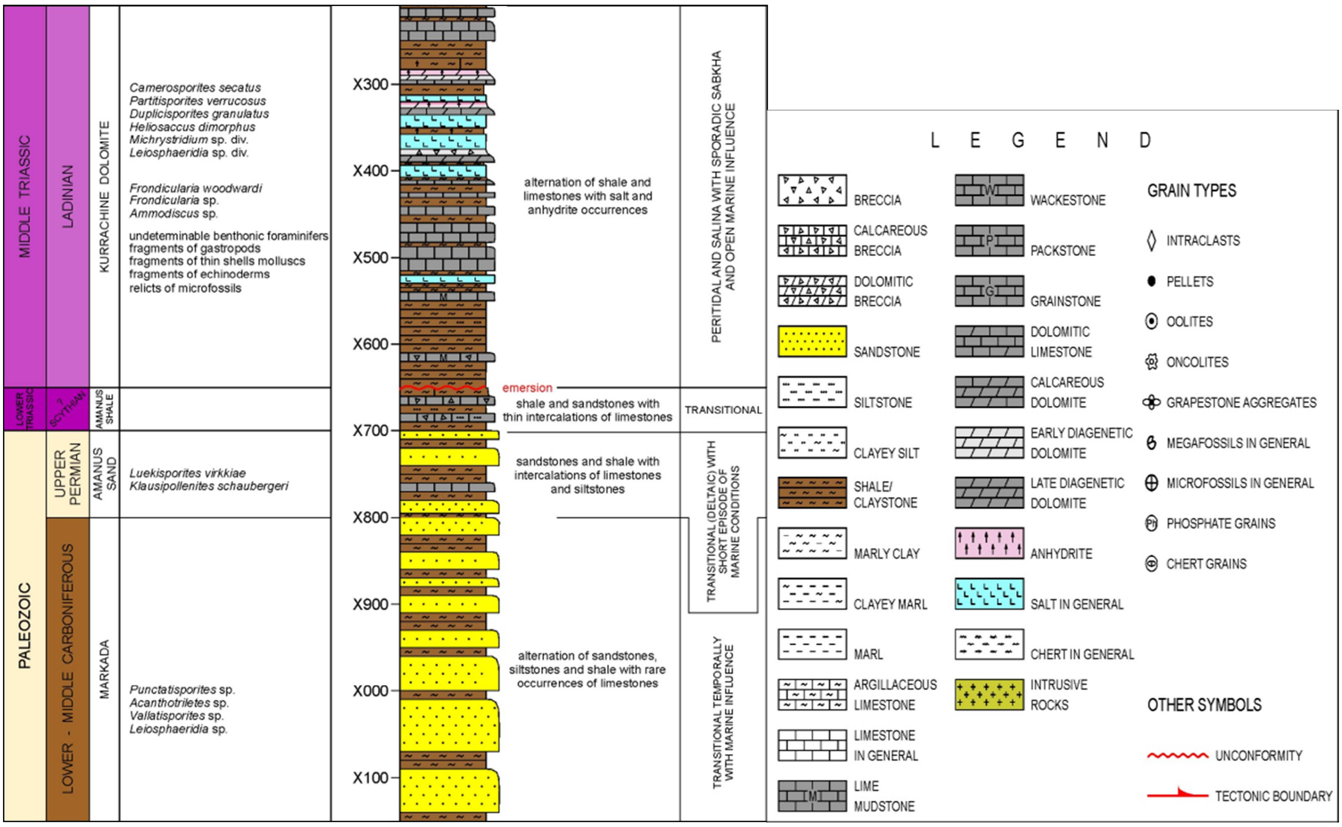

Figure 5. *Typical Paleozoic and Triassic successions of Hayan Block with local lithology, depositional environment and biostratigraphical assemblage (modified after V. Veseli, personal communication).*

3. Source Rocks, Hydrocarbons and Reservoirs of the Palmyrides (Hayan Block)

Source rocks of the Palmyride Trough were classified as proven and potential (Metwalli et al., 1974; Webb and Thompson, 1994). Proven exists in three levels of Triassic and two levels of Cretaceous age. Triassic, as proven source rocks were represented by Amanus Shale which consists of black, calcareous marine mudstones and shales with Corg up to 20 % (averaging 8-9 %). Kurrachine Dolomite Formation comprises interbedded dark grey dolomite, mudstone and limestone with Corg averaging 2 %. The basal part of Butmah Formation contains several 6-8 m thick beds of anhydritic mudstones with Corg up to 2 %. There are two proven Cretaceous source rocks. In the Euphrates Trough the Soukhne Formation (Rmah Chert and Arak Marl) black, bituminous, calcareous, cherty marine mudstones reaches Corg up to 8.6 % and Shiranish Formation up to 14.3 % (Metwalli et al., 1974; Webb and Thompson, 1994; Abboud et al., 2005; Hips and Argyelan, 2007). The Paleocene to Eocene source rocks of Jaddala Formation comprises open marine carbonates and mudstones. They reach Corg up to 4 %

in Euphrates Trough and by analogy these formation could be potential source in the Palmyride Trough. However they are mostly immature throughout because of shallow buried depths. Recent oil window starts from beginning at 2.000-2.100 m to end at 3.000 m. The Carboniferous source rocks of Markada Formation were mostly considered potential in the Palmyride Trough and they are proven in the Euphrates Trough. The Markada Formation considers gas prone shales and clayey shales of the terrestrial/sapropelic origin which passed through phases of oil window and wet gas/condensate window in early Cretaceous (Barić and Smoljanović, 2007). The early Silurian Tanf Formation comprises dark partly silicified marine mudstone. They are correlative with known source rocks of similar age in Oman, Saudi Arabia and South Iran. By analogy Barić and Smoljanović (2007) presumed that the Tanf Formation to be potential source in Hayan area. The Tanf Formation is believed to be overmaturing for oil throughout Syria, except shallow parts beneath the Aleppo platform (Webb and Thompson, 1994, Michels and Malaltre, 2007). Hydrocarbon occurrences in Syria are proven in two Petroleum Systems - Triassic and Cretaceous. Triassic oil system comprises source rocks of Amanus Shale, Kurrachine Dolomite, Mulussa and Sergleu Formations. Reservoirs are Triassic and Cretaceous carbonates. This system was actively generated oil in late Cretaceous, and wet gas and condensate during Neogene.

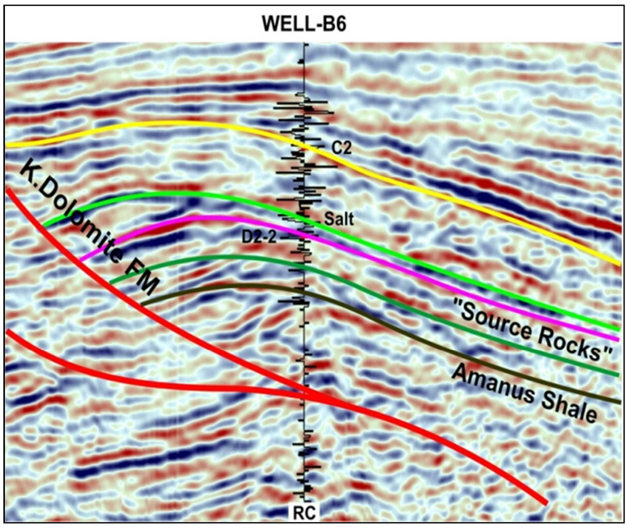

Figure 6. Reflectivity coefficient (RC) calculated from well logs indicate tight correlation of well data with the seismic data (see CD position on Figure 2).

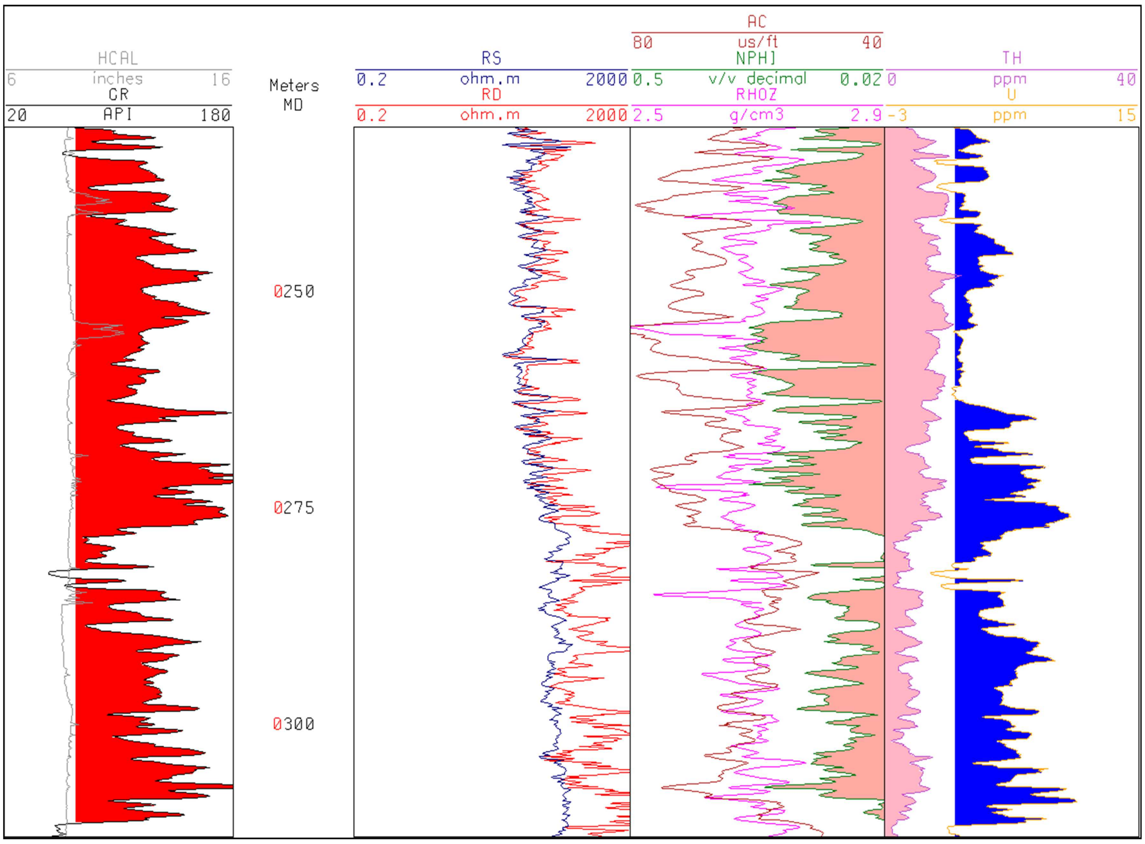

Figure 7. Composite log of the Kurrachine Dolomite Formation, "B"-6 well. Note high Uranium (U) content of total GR.

Second oil system is of the late Cretaceous age - the Shiranish Formation (and their lateral equivalent Palmyra Marl) was sourced from the late Cretaceous shales and bitomenous marls. Reservoir rocks were the Cretaceous and Tertiary carbonates. Oil was generating during Neogene. Webb and Thompson (1994) consider Silurian oil system of the Tanf Formation and Carboniferous Markada Formation speculative, unproved systems, as well as Michels and Malaltre (2007). Alsharhan and Kendall (1986) pointed out that small Butmah oil field in northern Iraq produces light oil from Kurrachine limestone. This formation has both reservoir and source rock characteristics and it is composed of limestone with intercalations of thick-bedded dolomite and silty shale. Source rocks of the Carboniferous, Triassic, Cretaceous and Paleogene age were determined in the Hayan Block. Paleogene marl and limestone of the Kermav Formation were immature. Cretaceous deposits of the Shiranish and Soukhne Formation are rich in organic matter, but mostly immature. Occasionally they reached maturity level of early catagenetic phase (Barić and Smoljanović, 2007). During early Triassic shales, limy-clayey-silty dolomites with rarely limestone and sandstones of the Amanus Shale formation have been deposited. Shales and dolomite shales are rich in organic matter. Middle to late Triassic source rocks of the Kurrachine Dolomite Formation comprises intercalations of shales and mudstones with different dolomite varieties. They are rich in organic matter and they represent significant source rock in regional sense. Recognized source rocks properties and reservoir/seal rock type (by correlation of well logs, geochemical analyses and 3D seismic; Figures 6, 7, Table I) characterize a system *in situ* (Vulama and Špiljak Vulama, 2007 and Vulama, 2011). Paleogeographically, these conditions of local and restricted alternation of transgressions and regressions resulted with alternation of dolomite, limestone, anhydrite and shale. Sedimentary environment, which dominated during the Triassic (and Jurassic) Periods, may be interpreted as the result of a fluctuation of marine and lagoon sedimentary facies. Carboniferous shales and clayey shales of the Markada Formation also indicate increased level of organic matter of terrestrial/saproelic origin. Dark shales were classified as medium to good source rocks which reached gas prone and condensate thermal alternation phase or it is overmature in deeper sections (Figure 10, 11; Tab. I).

4. Results

4.1. Seal

Characteristic geological development of Hayan Block area is expressed by thick salt/evaporate layers, significantly fractured reservoirs, intensively fault-trusted and compression tectonic which is at a standstill phase (Figures 8, 9, 11). Compressional tectonic played mayor role in structure forming and salt thickness during Cretaceous time till present (Figures 3, 4, 8, 9). The thickness of overburden formation (Kurrachine Anhydrite Formation) at the B-wells area is in range from 70 to 500 m, while at the A-wells area is reaching 800 m. Such a big variation in the formation thicknesses (at only 20 km distance) is the result of the compressive tectonic and reverse faulting. The thickness of Kurrachine Anhydrite Formation has been artificially increased due to evaporate movements (evaporate “escape”; Figure 8). The salt, as a very ductile media is forming undulatory deformation during compression phase. The elements of evaporate movements have been recognized on the seismic data. It’s called evaporate “escape”, from the zone of vertical compression to the zone of vertical extension. The overlying nonevaporate layers are moving away (escaping) from evaporates creating the „empty room“, since evaporates are acting as the gliding surface. The evaporate (salt) thickness at the A-wells area was not the result of the primary sedimentation processes, but compressional tectonics and reverse faulting, respectively (D. Takač, personal communication).

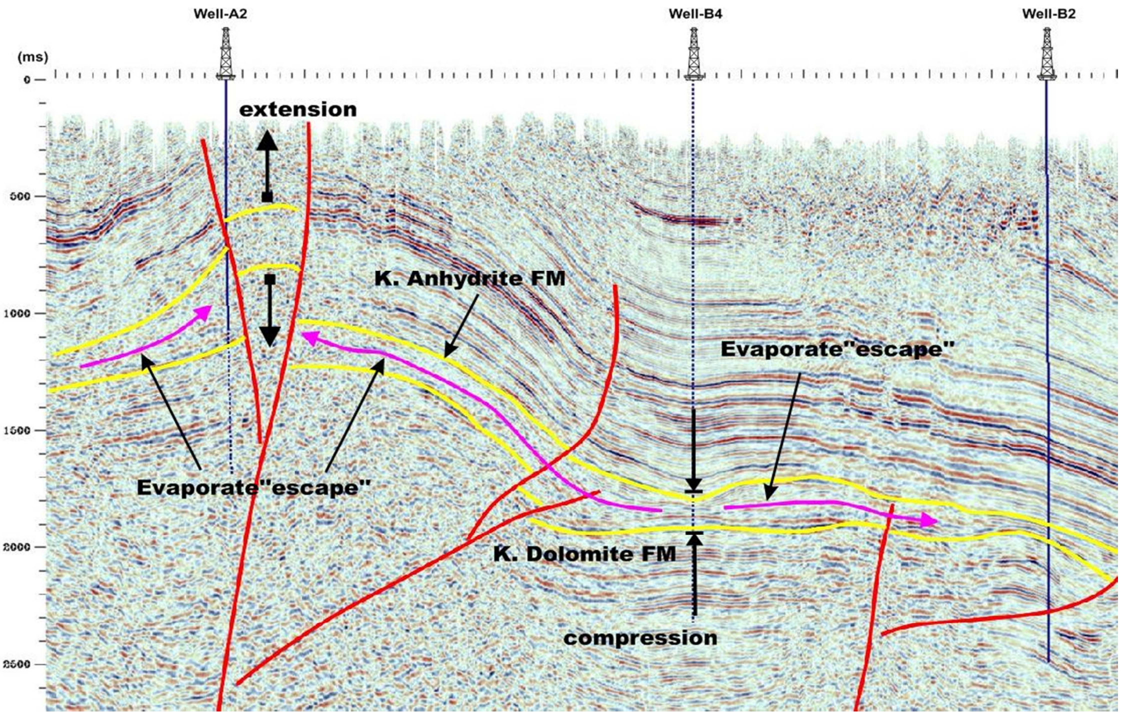

Figure 8. *Escape of evaporates as a consequence of the compressional tectonic which also created positive flower structure in area of A2 well and highly influenced the thickness of evaporates.*

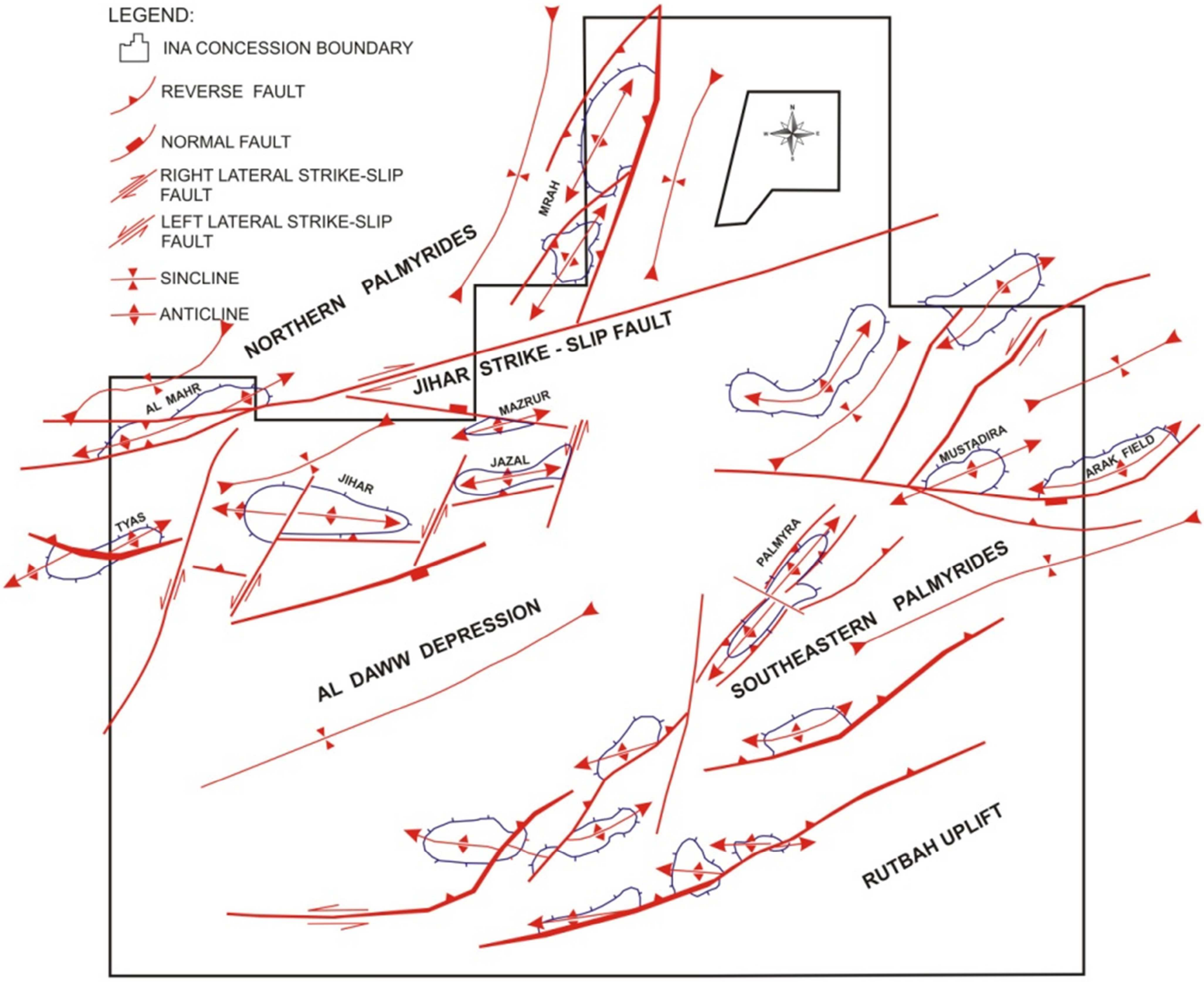

Figure 9. *Schematic tectonic map of the Hayan Block (modified after Takač and Husnjak, 2003).*

4.2. Reservoir

Intensive tectonic activity (resulted in formation of fractured zones), the maturity of these rocks and good generative potential produced favorable, *in situ* Reservoir/Source Rock system. Petrophysical properties were evaluated from well logs and cores. Evaluation of FMI logs indicates numerous conductive (open) fractures in the zone of source rocks (Vulama, 2011).

4.3. Source Rocks and Maturity

Geochemical analyses of the Paleozoic, Triassic and Cretaceous/Paleogene source rocks were performed. Triassic source rocks of “A”, “B” and “P” fields of the Hayan Block (Figure 2) show good to excellent generative potential and they are in a thermal oil generating phase. Triassic kerogene is of Type II and III. Significant source rock volume and hydrocarbons generated were calculated from the lower part of D2-2 reservoir (Vulama, 2011; Figures 2, 11). Burial history chart shows essential elements for Kurrachine Dolomite petroleum system. Critical moment occurred at the end of Cretaceous - beginning of Paleogene age. Paleozoic source rocks produce mostly dry gas, occasionally wet gas (Markada) or they are overmaturing (Tanf; Figures 10, 11; Tab. 1).

Table 1. *Geochemical parameters of Hayan Block (“B wells“).*

Paleogene	Cretaceous	Triassic	Carboniferous
Corg = 0.4 – 14.4 %	Corg = 0.4 – 7.59 %	Corg = 0.48 – 5.32 %	Corg = 0.66 -1.26 %
S2 = 0.33 - 31.13	S2 = 1.6 - 35.08	S2 = 0.63 – 12.11	S2 = 0.86 – 6.13
TAI = 1+- 2+	TAI = 2 - 2+	TAI = 3 - 3+	TAI = 3 - 3+

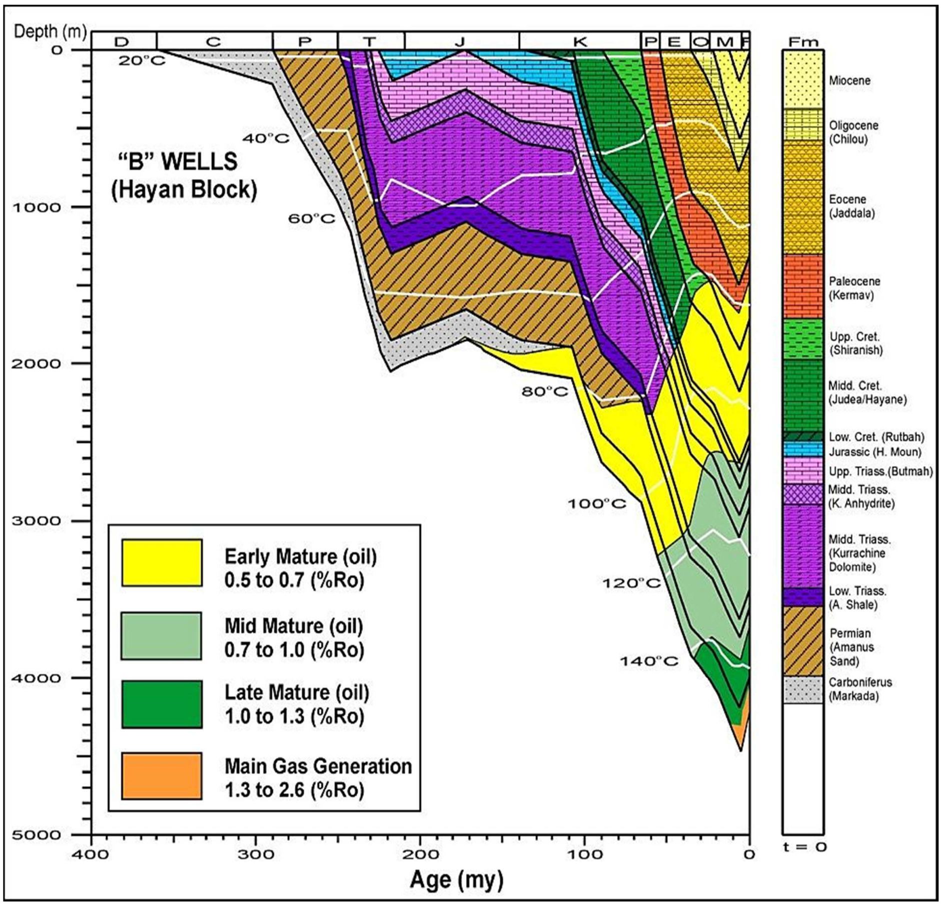

Figure 10. *Burial history chart of "B" wells of the Hayan Block, (modified after Leško et al., 2005).*

4.4. Petroleum Systems

Considering all of this presented data and previous works on Hayan Block it was defined three Petroleum Systems and three Hydrodynamic Units of the Hayan Block (Vulama and Špiljak Vulama, 2007, 2009; Vulama, 2011 and D. Lučić personal communication; Figure 11).

1) Rmah chert – Jaddala (!) Cretaceous/Paleogene - Immature, heavy oil from the Eocene Jaddala Formation which is correlative with extracts of the Rmah chert source rocks.
2) Kurrachine Dolomite (!) Triassic - K. Dolomite (D2)/Amanus Shale/Amanus Sand top - Main Play.Hydrocarbons from C2, D1, D2-2, Amanus Shale and top of the Amanus Sand Formations (Permian) are correlative with source rocks from deeper part of the Kurrachine Dolomite Formation (D2).
3) Markada/Tanf (.) - Markada/Amanus Sand bottom. Paleozoic - Mainly dry (wet) gas/overmature. Hydrocarbons from the Markada and bottom of the Amanus Sand Formation originate probably from source rocks of the Markada and Tanf Formations?

4.5. Hydrodynamic Units

Hydrodynamic unit 1

Carbonate reservoirs C2 and D1 of Kurrachine Dolomite Formation with oil and gas/condensate saturations. The seal rock represents thick salt layers of Kurrachine Anhydrite Formation. This hydrodynamic unit belongs to megacycle B.

Hydrodynamic unit 2

Carbonate reservoirs D2/2, Amanus Shale and sandy reservoir of Amanus Sand Formation saturated with oil and gas/condensate. Seal rock represents salt layers of D2 member (Kurrachine Dolomite Formation). The hydrodynamic unit belongs to the megacycle A.

Hydrodynamic unit 3

Sandstone reservoirs of Amanus Sand and Markada Formation saturated with gas/condensate.

Seal rock represents shale layers of Amanus Sand Formation.

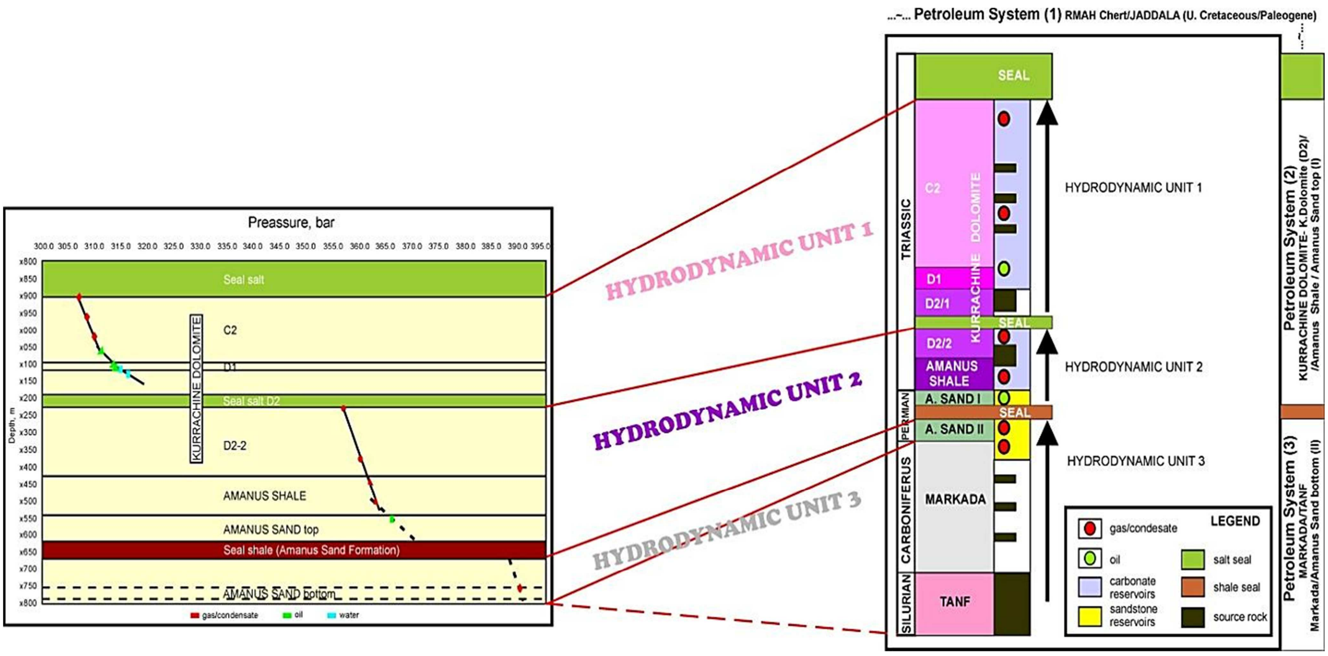

Figure 11. Petroleum Systems (1, 2, 3) and Hydrodynamic Units (H1, H2, H3) of the Hayan Block: Petroleum system (1) Rmah Chert/Jaddala - Cretaceous/Paleogene (immature, not evaluated in detail); Petroleum system (2) Kurrachine Dolomite/Amanus Shale/Amanus Sand - a major play (oil and gas/condensate, H1 and H2 Unit); Petroleum system (3) Markada/Tanf (dry gas (wet) / overmature, H3+ Unit); (Modified after Vulama and Špiljak Vulama, 2009; Vulama, 2011 and D. Lučić personal communication).

5. Conclusion

Outstanding stratigraphic, diagenetic, and tectonic histories of the Paleozoic and Triassic successions of the central Syrian Palmirides (Hayan Block) produced an astonishing combination of geologic elements and conditions favorable for petroleum formation, migration, and accumulation. These include (1) extensive geographic distribution of rich, mature source rocks, good-quality reservoir rocks, and highly efficient seal rocks and (2) the formation of structural traps during or subsequent to peak oil and gas generation. Three petroleum systems of the Paleozoic, Triassic and Cretaceous/Paleogene successions were recognized. Within two oldest petroleum systems three Hydrodynamic Units exists. First two Units (H1 and H2) belongs to the Triassic succession while third (H3) is typical for the Paleozoic succession. The Triassic Units belongs to the A and B Megacycles, recognized by Lučić et al. (2005). Regarding Hayan Block, most important is the Kurrachine Dolomite petroleum system (Vulama and Špiljak Vulama, 2007, 2009 and Vulama, 2011). Triassic petroleum system is represented by the fractured source rock and reservoir system *in situ* (Kurrachine Dolomite and Amanus Shale Formations, and in some parts (when uplifted) conventional Permian Amanus Sand reservoirs). Extraordinary sealing was represented by thick salt-evaporite layers: D2 salt and salt on top of the Kurrachine Dolomite Formation - bottom part of Kurrachine Anhydrite Formation. Lower Paleozoic succession (Tanf) is rather (dry) gas prone, or being overmature, while upper Paleozoic (Markada), in shallower sections, also produces condensate. Youngest Cretaceous/Paleogene petroleum system is immature in this area and is capable to produce only heavy oil, thus, it is not evaluated in more detail. Additional data (especially for Paleozoic) to improve this up to date research is necessary, to give final conclusion about petroleum systems of the Hayan Block and surrounding area.

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