Revision of the Jurassic and Cretaceous Oil-Bearing Formations in Lebanon

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Introduction

The entire carbonate and marly sequences in the Nahr Ibrahim section, with clastic interfaces are presented below, based on previous work (Nader, 2000). The present work will briefly outline the hydrocarbon potential of the Mesozoic deposits in Lebanon as well as proposing a petroleum assessment for the area using up to date methods (e.g. with PetroMod; cf. Al-Ameri & Al-Musawi, 2009).

The main purpose of this LITERATURE REVIEW WORK is to link the source and reservoir systems of the Mesozoic in Lebanon in order to detail their hydrocarbon potential . A discussion of the Levantine system, for comparison, is also targeted.

The Mesozoic System

Eleven (11) geological FORMATIONS have been investigated based on original works dating since the late 19th century for the purpose of geological mapping in the Eastern Mediterranean (or Levant).
Only recently, it was found that these units have hydrocarbon potential and that they may show a link with each other, as part of a basin system (e.g. Nader, 2009, 2011; Bowman, 2011).

Early to Mid Jurassic

Rhaetian to Oxfordian (209.6-164.1 Ma): J1-4
Late-Middle Jurassic: Callovian to Oxfordian (164.1-154.9 Ma): J5-6

Late Jurassic

Kimmeridgian to Tithonian (154.9-144 Ma): J5-6
Tithonian to Valanginian (1441-132 Ma): J7a-C1b

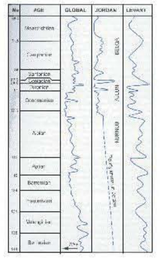
Early Cretaceous

Wealden-Barremian to Lower Aptian (132-121 Ma): C1b-C2a
Mid-Upper Aptian to Vraconian (121-98.9 Ma): C2b-C3

Late Cretaceous

Cenomanian to Turonian (98.9-89 Ma): C4-5
Senonian to Yppresian (89-60.9 Ma): C6-e1a

Table 1: The Powell & Moh'd (2011) table showing general sea level changes in the Cretaceous

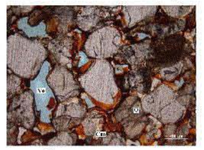


Impregnated hydrocarbon within the C6 maybe migrating from C1, indicating that this may be a reservoir or cap unit (e.g. Shaheed, 1969)

Table 2: The map codes have been extrapolated, based on the period of deposition of the identified Fm's and the actual map codes From Dubertret et al. (1955). The recent divisions have been estimated from Nader (2000), Doumar (2005), Bellos (2008), and others. Thickness were estimated from Tixier (1971-1972) and extrapolations from other (type) sections.

Toumatt-Jezzine/ Aazibi Lithofacies			
Map code	Period	Description anf lithofacies	Thickness in section
C6	Senonian to Yppresian(?)	Chalky-marly limestones with phosphate and Globotraunea (Cretaceous) and globorotalina (Eocene)	~ 570m
C5	Turonian	Marly limestones with Hippurites	~ 300m
C4	Upper Albian - Cenomanian	Alternating limestone and dolostones interbedded with chert nodules that contain radiolites	600m
C3b	Lower-Mid Albian	Alternating greenish marl and limestone-dolostone beds of 1-2m thick displaying typically Albian fauna	40m
C3a		Recurrence of ferruginous sandstone and oolitic ferruginous concretions	10m
C2b2	Upper Aptian	Alternations of marls and thinly bedded limestones, showing abundant internal mussels (e.g. Cardium; Orbitolina)	15m
C2b1	Mid Aptian	White compact subreefal limestone beds showing orbitolinid fossils in its topmost strata which appear steeped	45m
C2a	Barremian - Lower Aptian	Pisolitic limestones either embedded in sandstone or cemented by calcite, showing a gradual transition to a more marine sedimentation, containig fossils and charophytes	70m
C1b	Wealden-Barremian	Three units of sandstone strata have been analysed. The first and third mostly comprising marine ferruginous sandstones rich in clays and marine strata sandwich the middle unit of mostly submature-mature continental arenites	230m
J7a C1a	Tithonian Valanginian	Compact yellowish-ochre oölitic grainstones interbedded with arenaceous sandy limestones	15m
J5-6	Kimmeridgian to Tithonian	Volcanics (J5) and dolomitic limestone (J6)	~ 200m
J1-4	Rhaetian to Oxfordian	Various beds of limestones and dolostones	> 1000m

Quartz Arenites, affected by corrosion from migrating hydrocarbon, from C1, suspected source rocks of type-III Kerogen (Bellos, 2008)



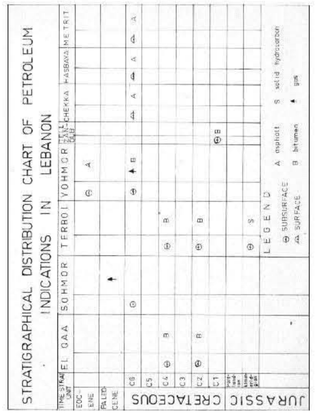


Fig. 1: Stratigraphic distribution of petroleum in Lebanon (Ukla, 1970)
Note
1- Solid Hydrocarbons in the Kimmeridgian Formations (*Terboi*)
2- Bitumen in the Chouf (*Tell el Zannoub*), in Aptian and Cenomanian Fm's (*El Qaa, Terboi*)
3- Asphalts (surface Metrit, Chekka, Hasbaya) bitumen (*Sohmor* and *Yohmor*) and gas (*Sohmor*) in the Chekka Fm.

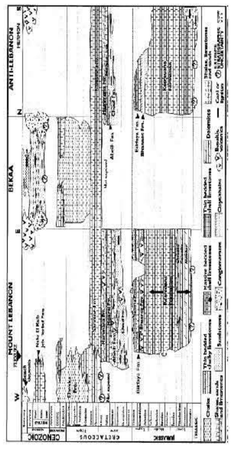


Fig. 2: Detailed stratigraphic sequence of Lebanon (cf. Walley, 1997).

Synposis

Current understanding of the Lebanese-Levantine petroleum systems is:
(1) Most of the later Cretaceous hydrocarbon in Lebanon and the Levant comes from earlier Triassic, Jurassic or even Cretaceous (i.e. deeper) sources (cf. Nader, 2011). This may be the cause of the later Hydrocarbon plays found (e.g. Nader, 2009, 2011 & Bowman, 2011).
(2) The onshore plays: the Qartaba Horst structure where Triassic (or Pre-Jurassic prospects are considered (Nader, 2009), and
(3) Offshore plays: In Northern Lebanon, where various Cretaceous rock are charged with Upper Cretaceous source rocks and sealed with volcanics, marl/clay and evaporites (Nader, 2009).

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