Cretaceous volcanism in the Syrian Coastal Chain

M. Mouty[(1)]

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ABSTRACT

Within Cretaceous sedimentary series in the Syrian coastal chain, there are two levels of magmatism, one at the base of the series as aerian lava basalt, the other in the middle of the series, in the form of sub-marine lava basalt "interbedded". According to the paleontological and micropaleontological study of the formation which contains the lower magmatic level (Bab Janneh Formation), it appears that this formation is of Barremian-Aptian age, and that the lower basalt is of Barremian or pre-Barremian.age The formation containing the higher magmatic level (Ayn Al Beida Formation) is of the Albian, and the basalt is situated at the Middle Albian - Upper Albian boundary.

Key words: Syrian Coastal chain, Cretaceous, Volcanism, Barremian, Aptian, Albian.

[(1)] Prof., Department of Geology, Faculty of Sciences, Damascus Univirsity, Syria.

البركنة الكريتاسية في السلسلة الساحلية السورية

ميخائيل معطي[1]

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الملخص

يلاحظ في صلب الزمر الرسوبية الكريتاسية في السلسلة الساحلية السورية مستويان من الصخور المغماتية، أحدهما في قاعدة الزمر الكريتاسية، على شكل لابة سطحية من البازلت، والثاني في صلب هاه الزمر،على شكل لابة تحت بحرية من البازلت "بيني التطبق". وقد بينت الدراسات الباليونتولوجية والمكروباليونتولوجية أن التشكيلة التي تضم المستوى المغماتي السفلي (تشكيلة باب جنّة) هي من عمر الباريميان - أبسيان، فمستوى البازلت الموجود في قاعدتها يعود من ثمَّ إلى ما قبل الباريميان الأعلى، وأن التشكيلة التي تضم المستوى المغماتي العلوي (تشكيلة عين البيضا) هي من عمر الألبيان، فمستوى البازلت الموجود في صلبها واقع من ثمَّ على الحد بين الألبيان الأوسط والألبيان الأعلى.

الكلمات المفتاحية: السلسلة الساحلية السورية؛ الكريتاسي؛ البركنة، الباريميان، الأبسيان، الألبيان.

[1] أستاذ، قسم الجيولوجيا، كلية العلوم، جامعة دمشق، سورية.

Introduction

Syria is a privileged region in the Arabian Plate that presents different stages of volcanic activity from Jurassic to Quaternary, among other, they are observed in the coastal chain of the country **(Fig. 1).** This chain is generally the western flank of an arched anticline which axis is NS and is formed during the Neogene. The anticline is cut along its axis by a rift (Boukeaa and Ghab depressions) belonging to the Levantine system that extends from Aqaba in the Red Sea to the Kara So in Hatay.

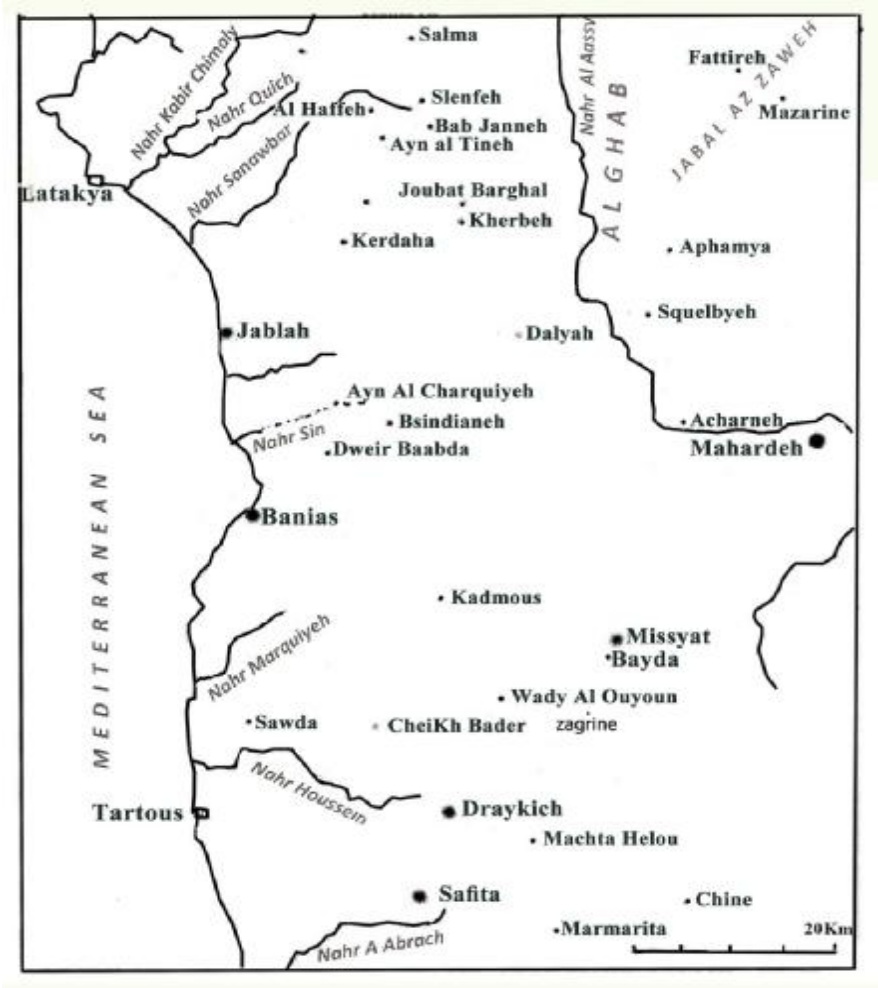

Fig. 1 – Geographical map of the studied area

The sedimentary series of the chain is essentially Mesozoic. It began in the Triassic, on the eastern flank of the massif, then followed by the Jurassic on the ridges and in large valleys, while the Cretaceous forms the major part of the western flank. The Paleogene outcrops in the northwestern region.

In general, sedimentation corresponds to a shallow platform environment. And note that there is a big gap between the sedimentation of the Upper Jurassic and the Lower Cretaceous.

The Coastal Chain is particularly interesting because of basaltic magmatism "interbedded" (old submarine lava, sills, dykes and as well as aerian lava) can be observe at the base and within the sedimentary Cretaceous.

The relationship between these manifestations of the magmatism are not always obvious. The authors have interpreted them by different ways (Dubertret, 1937- 1966; Ponikarov, 1966; KOZLOV *et al*.,1966; SHATSKY *et al.*,1966). That is why we have undertaken a systematic study of the region with paleontological dating. This paper describes our stratigraphical results of Cretaceous volcanic phase.

Geology and stratigraphy

Two major volcanic activities were manifested in the Coastal chain during the Cretaceous time which produced two big volcanic levels: one at the base of the Cretaceous, the other in the middle.

Lower level:

The Lower Cretaceous volcanism is represented by the unique basalt outcrop in the village of Kherbeh north of the chain **(Fig. 2; Fig. 2a)**. This magmatic level was eroded and completely absent outside of this region. It is based directly on an eroded surface of Jurassic limestone beds which contain characteristic microfauna (*Kurnubia palastiniens, Alveosepta jaccardi*) of the Kimmeridgian age (Upper Jurassic). It is located at the base of a carbonated formation (Bab Janneh Formation) (Mouty, 1967), which contains the following microfauna: *Choffetalla decipiens* SCHLUMBERGER, *Pseudocyclammina heldbergi* MAYNC, *Cuneolina laurentii* SARTONI & CRESCENTI, *C. scarselai* DECASTRO, *Hemicyclammina* aff. *sigali* MAYNC, *Nezzazata simplex* OMARAand and the following microflora : *Salpingoporella dinarica* RADOICIC, *Cylindroporella sudgeni* ELLIOTT, *Lucernella ampulacea* GRAMBAST & LOECH, *Acicularia* sp., of the Barremian-Aptian age **(Fig. 3)**.

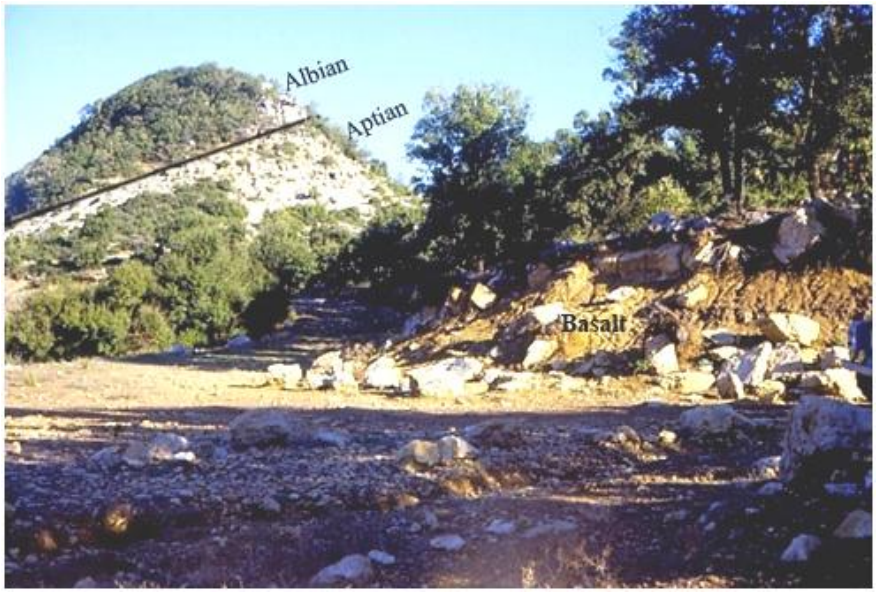

Fig. 2 – The Bab Janneh Formation in Kherbeh village showing the thick basaltic flow at the base.

Fig. 2a – The contact between Jurassic limestone and Lower Cretaceous basalt in the Kherbeh village

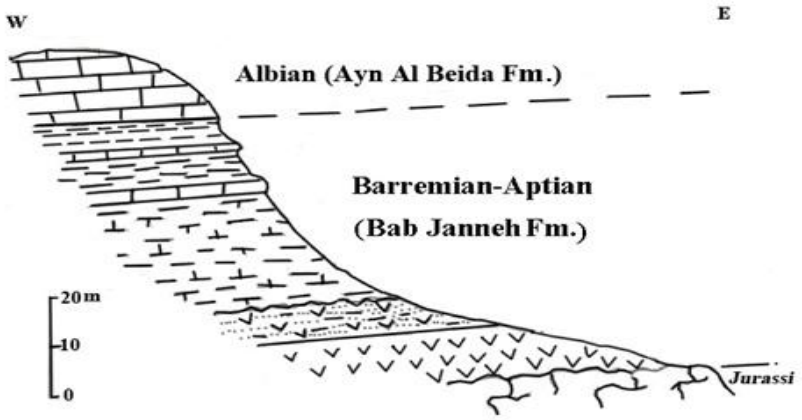

Fig. 3 – Geological cross-section in Kherbeh village showing the basaltic flow at Bab Janneh Formation.

Basalt alteration products are present as big blocks at the bottom of some large paleokarst (joubets = sinkholes) Joubet Bargal, Joubet Al rbind **(Fig. 4)** and in some valleys in the region near Al Yabisseh village. They contains xenoliths as granitoids,amphibolites and granulites.

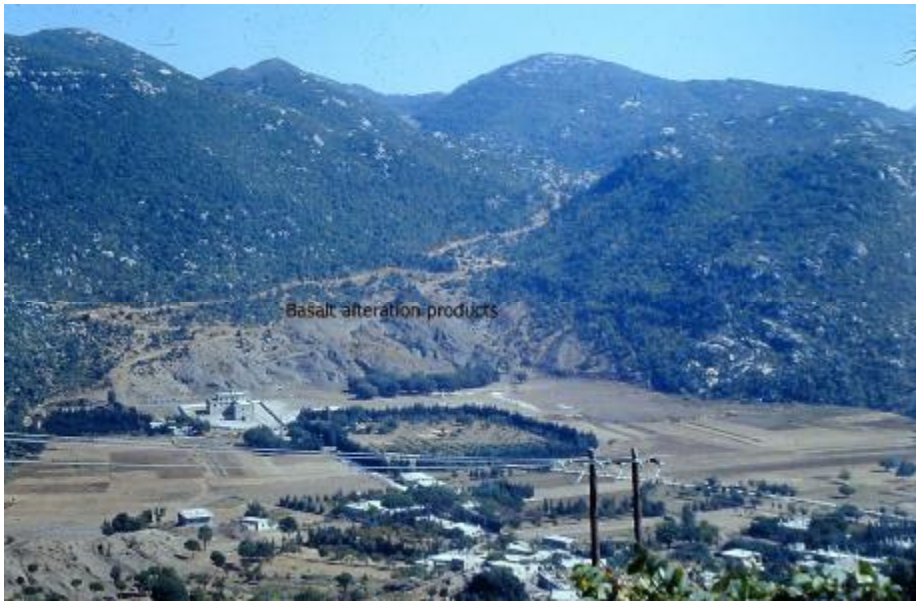

Fig. 4 – Basalt alteration products are well stratified with Jurassic limestone pebbles in Joubet Bargal,

They are finely well stratified with limestone and basalt pebbles. Micropaleontological analysis of a large number of limestone pebbles present with the volcanic product in some paleokarst, especially in Joubet Bargal, indicate the Jurassic age. Radiometric analysis of some pebbles of the volcanic products in Joubat Bargal indicate the Barremian age (Mouty et al., 1992).

Several basalt dykes cut the Mesozoic carbonate series. We observed these events in the Jurassic, a vein at the western entrance to Mashta Helou. It consists essentially of augite basalt and should correspond to one of the sources that fed the lava of this magma level at the base of the Cretaceous. The radiometric dating of this basalt vein, indicate the same age in Joubet Bargal, which is the Barremian (Mouty et al., 1992).

Based on these observations of geological, micropaleontological and radiometric data, we can say that the lava eruption took place on emerged land of eroded upper Jurassic area during the Barremian, in contradiction with the Neogene age which was attributed before (Ponikarov, 1966).

The Cretaceous marine transgression was deposited, generally around this area, as finely well stratified basalt alteration products, which are replaced in the southern part of the Chain by incrusted pebbles of ferruginous crust **(Fig. 5)** and by fine alteration basalt products in a mixture of a reddish argiliceous marl. Near the village of Kadmous the **b**asalt alteration products are represented by thick beds and lenses of ironstones with basal ferruginous matrix.

Fig. 5 – Incrusted pebbles of ferruginous crust in a reddish argiliceous marl at the base of Bab Janneh Formation.

Upper level:

Dubertret (1937) was the first to report the presence of interbedded volcanic levels in the Coastal chain **(Fig. 6)**. This basalt is enclosed in a carbonate formation (Ayn Al Beida Formation) (Mouty, 1976). It lies in the Middle of the southern part of the chain. This level which is lenticular in shape, has its maximum thickness (50m) in the region of Wadi Al Ouyoun.

Fig. 6– A thick volcanic flow interbedded between two limestone cliffs in Zagrine area.

It decreases in thickness towards the north, and becomes gradually thinner towards the south **(Fig. 7).** There, it will be replaced at its extremity by alteration products of basalt, with pebbles of basalt and limestone, all forming a conglomerate with basaltic dominance in front of the lava flow. One notices, in some places like Mheilbeh village (Wadi Al Ouyoun area) an oblique and cross-bedding stratification **(Fig. 8).** This ensemble pass at the southern part of the Chain, like at Marmarita area, to a series of thin detritic beds, sometimes microconglomeratic with generally carbonate cement and brown color **(Fig. 8a).** This phenomenon disappears completely in the extreme south of the chain.

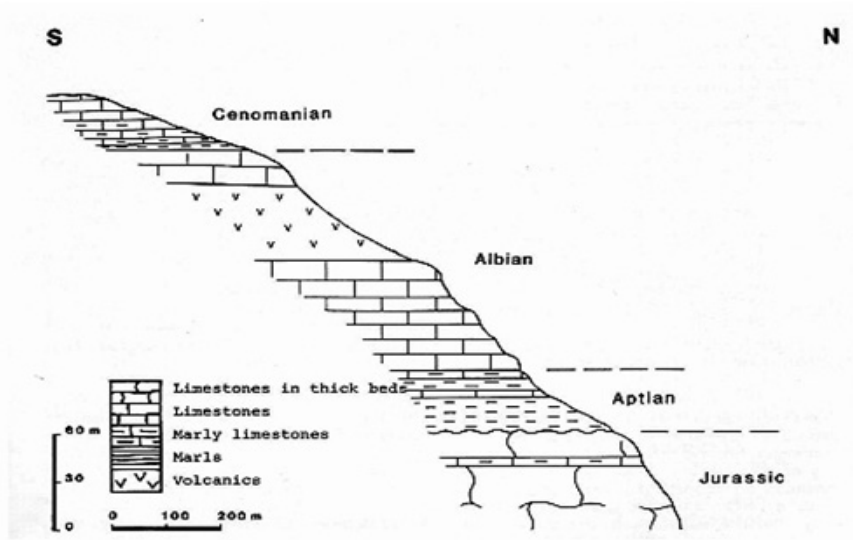

Fig.7– Geological cross-section near Wadi Al Ouyoun showing the basaltic flow in the Albian sediments.

Fig. 8 –Thin detritic beds of alteration products of Albian basalt in Mheilbeh village (wadi Al Ouyoun area)

The basalt bedrock level is a limestone which surface is covered with a ferruginous crust and it shows in the southern part of the chain,

ripple marks figure **(Fig. 9).** Note also, that the sediment has no trace of baking and the limestone bed covering this level shows at its base basalt pebbles. In addition, in some places, there are pillow lavas features **(Fig. 10)**.

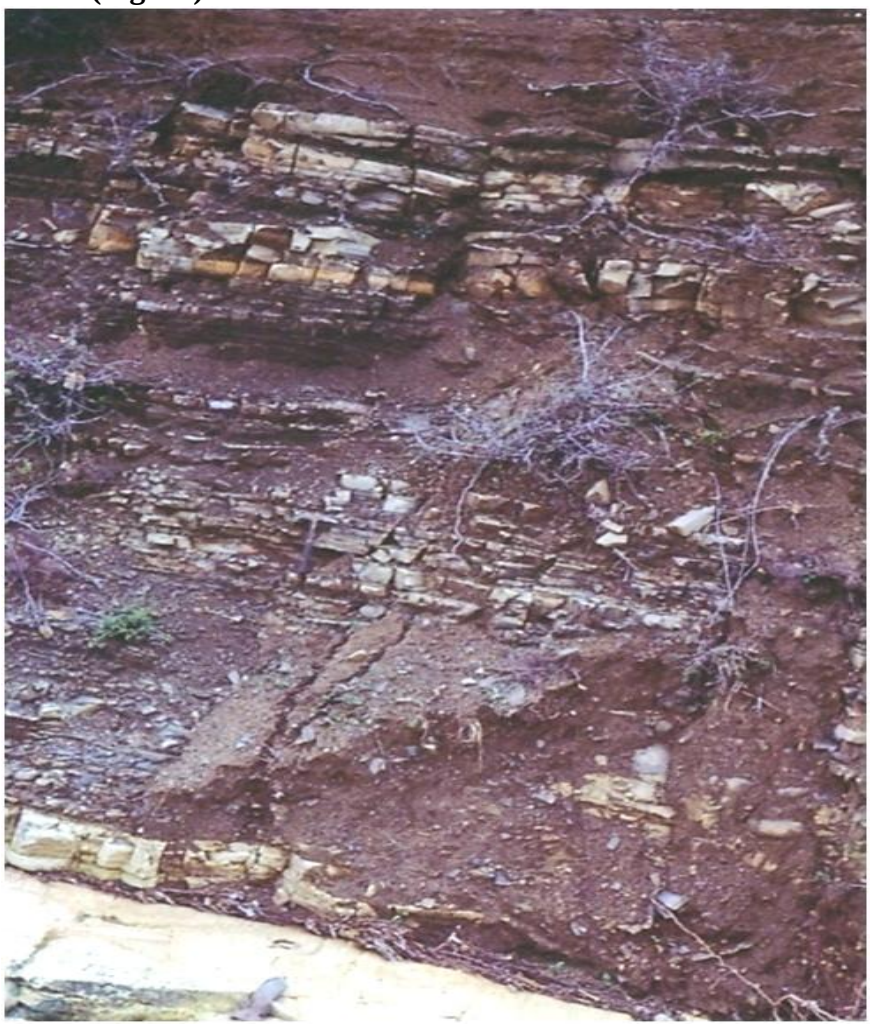

Fig. 8a –Thin detritic beds of alteration products of basalt and dolomitic limestone (North of Marmarita).

Fig. 9 – Ripple marks figures at the basaltic bedrock surface (North of . Marmarita).

Fig. 10 – Pillow lavas within the thick basaltic flow in Wadi Al Ouyoun Valley (Deyroun area).

From all these observations, we can say that the lava was erupted at the bottom of a very shallow sea.

The lower part of the basaltic lava consists of olivine, while the upper part is an augite basalt.

In the region of Zagrine, we see two distinct levels of basalt, separated by a series of thick beds of dolomitic limestone. Basalt is similar in the two levels. The upper level is as a lens that extension does not exceed a few kilometers. It is important to mention that the contact with the sediment shows a zone of brecciation and baking phenomena **(Fig.6).** This seems to indicate that one is in the presence of a sill which correspond to a later magmatic activity, presumably from the same magma chamber. The lower level is the main lava previously described.

The basalt is situated, according to Dubertret (1937), in the Albian - Cenomanian (approximately between the two stages). Koslov et al. (1966) attributed this basalt to the base of the Cenomanian. According to a micropaleontological study, of the mid-Cretaceous in the Coastal Chain (Mouty and Saint-Marc, 1982), it appears that the carbonate formation containing this basalt (formation of Ayn Al Beida) is Albian. It is largely composed of dolomitic limestone, and intercalations of bioclastic limestones sometimes with Rudists and thin greenish beds of marls. The auther reports the presence of the following micro-and macrofauna: *Knemiceras syriacum* BUCH, *Eoradiolites lyratus* CONRAD, *Hemicyclammina sigali* MAYNC, *Cuneolin pavonia* D'ORBIGNY, *Sabaudia minuta* (HOFKER), *Nummoloculuna heimi* BONET, *Nezzazata simplex* OMARA. This faunal content indicates the Albian. In addition, the base of the overlying formation (Slenfeh Formation) contains *Planomalina buxtorfi* CANDOLFI, foraminifera indicating the uppermost Albian (Vracomien) (Saint-Marc, 1974).

In conclusion, the "interbeded" basalt in Ayn Al Beida Formation is situated at the base of Upper Albian.

Conclusions

Syrian Coastal chain was the siege of magmatic events during Cretaceous. This magmatism mainly calc - alkaline is associated in places with a series of plutonic rocks encountered at the surface, most often in the form of pebbles, in veins. It is locally characterized by the abundant of xenoliths of garnet (Mheilbeh) and enclaves (J.Bargal).

Biostratigraphic studies led to the following results:

- The biostratigraphic study revealed an age of Barremian to the Lower Cretaceous volcanism in the Syrian Coastal chain and Middle Albian age for the Upper to Middle Cretaceous volcanism.

-Micropaleontological dating confirm the radiometric dating made before by the authors (Mouty *et al.*, 1992).

The lower Cretaceous volcanism is manifested on a large part of the Syrian platform: in Lebanon, Anti-Lebanon (Zebdani area), Palmyrides Chain (Rmah Mountain) and in several wells inside Syria (Quaryatein well for example).

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