A preliminary account to the Mesozoic Succession of Jabal Nefusah, NW Libya

Esam O. Abdulsamad
Earth Sciences Department,
Garyounis University

This preliminary and brief account presents an analysis of the exposed Mesozoic succession at Ras Abu Gidrin area (Abu Zayyan Quadrangle) of Jabal Nefusah. The investigated area has a thick sequence of Lower Jurassic to Upper Cretaceous shallow marine carbonates, which has yielded substantial stratigraphical and palaeontological data. Five formations are distinguished: the Lower Jurassic Bir al Ghanam Formation, the Lower Cretaceous Kiklah Formation and the Upper Cretaceous Sidi as Sid, Nalut and Qasr Tigrinnah Formations.

A comprehensive account detailing and illustrating the Mesozoic macro- and microfauna of the region, providing a biostratigraphical scheme for these Mesozoic strata, is to be published at a later date.

These data are found useful for palaeontological modeling and stratigraphical correlation on a regional scale.

INTRODUCTION

Jabal Nefusah is located in the northwestern part of Libya, extending over 300 Km, with relief reaching 900 m above sea level. It trends approximately eastnortheast - westsouthwest, extending from near Al Khums in the east to Nalut and further west into Tunisia. The central part of Jabal Nefusah is extending about 70 Km south of Tripoli. To the south of the escarpment lies the broad dissected plateau of Al-Hamadah al Hamra, while to the north of the escarpment lies Jiffarah Plain (Fig.1). Quaternary deposits cover this plain, although some limestone escarpments of older age are found in the south. Outcrops of variable thickness of Triassic to Upper Cretaceous age form the main escarpment. Exposed successions about 1500 m thick (particularly in the central part) and over 2000 m thick in offshore locations have been reported.

This preliminary and brief account reviews the exposed Lower Jurassic to Upper Cretaceous succession at Ras Abu Gidrin area (Abu Zayyan Quadrangle) of Jabal Nefusah. The study area is

located between longitudes 12°-46' and 12°-52' and latitudes 32°-2' and 32°-6' (Fig.1). The investigated area is bounded from the north and northeast by Wadi Baybuk, from the south by Ras Abu Ghattos, from the east by Hinshir Awlad Sinan and from the west by tributaries of Wadi Zaret (Fig.1). The northern part of the study area can be reached by several tracks extending from the main asphalted Kiklah-Rabtah road through Wadi Zaret, while the southern part can also be reached by many tracks descending from the main Garyan-Yefern asphalted road.

A more comprehensive account detailing and illustrating the Mesozoic fauna of the region, and providing a biostratigraphical scheme for the Mesozoic strata is to be published by the author and Mr. Ahmed Muftah (AGOCO) at a later date. These data are useful for palaeontological modeling and stratigraphic correlation at a regional scale (e.g. the Mesozoic sequence of Somalia).

The author collected material for this work in the summer of 1986 during the mapping program, which organized by the Earth Sciences Department of the Garyounis University. Additional samples were collected also in the mid nineties. Many of these localities situated in the central region of the Jabal Nefusah were visited, logged and sampled. About 150 samples were collected from the Mesozoic succession.

However, in this brief account only a small part of the data, together with field observations, have been considered. It is hoped that a detailed palaeontological study, including microfacies and matrix-free microfaunal assemblages, will be available in the second phase of this study. The studied material is deposited in the collection of Abdulsamad at palaeontological unit, Earth Sciences Department of the University of Garyounis.

STRATIGRAPHY

Five stratigraphic units, ranging in age from Lower Jurassic to Upper Cretaceous, represent Ras Abu Gidrin area. These rock units consist mainly of evaporites, clastics (mainly sandstones) and carbonate rocks (mainly limestones and dolomites). The stratigraphic significance of these deposits is based on the integration of our data with others derived from the literature. However, references used in the compilation of this review are those mentioned in this section. For example the nomenclature used herein is largely based on the works of Christie (1955), El Hinnawy and Cheshitev (1975), Fatmi *et.al.* (1978), Banerjee (1980), Fatmi *et.al.* (1980) and Megerisi and Mamgain (1980). Figure (1 & 2) demonstrates the location and the general description of the studied stratigraphic sequence. In the following section a brief assessment of

the studied formations and their characteristics have been summarized in a stratigraphic order.

Bir al Ghanam Formation (Lower Jurassic)

The Bir al Ghanam Formation (Christie, 1955) is composed basically of white to gray gypsum, with interbeds of gray limestone, dolomitic limestone and minor clays (Fig. 2). Many limestone beds, some of moderate thickness (Pl. 1, 1), occur interbedded with gypsum. In a more detailed work, it may be possible to correlate them within a regional framework. Laminated anhydrite interbeds, with bands of fractured dolomites and local bands of clastic origin, occur at outcrops, suggesting very shallow water origin. However, the presence of several cycles of alternating gypsum and limestones reflect change in water level within a lagoonal, shallow marine, to open platform environment (Banerjee, 1980 and Abdulsamad, 1987). Fossils of Jurassic age are limited to a thin limestone bed occurring immediately below the overlying Kiklah Formation; it is hoped that precise determinations of fauna will be available in the second phase of this study. The thickness of this formation is variable throughout the study area. It attains a maximum thickness of about 40 m. in the northwest, decreasing considerably in the southern. In the northeast, this rock sequence is almost completely covered by Quaternary sediments. Moreover, the topography of the terrain

underlain by the gypsum is quite characteristic, as it forms small, scattered and isolated hills of similar size and shape. Similar observation was recorded by Christie (1955) and Banerjee (1980) in other localities.

Kiklah Formation (Lower Cretaceous)

Kiklah Formation (Christie, 1955) rests unconformably above the Bir al Ghanam Formation. Here, the lithofacies is essentially formed by medium to thick bedded and highly weathered reddish to brown sandstones (Fig. 2). Pink conglomeratic sandstones (usually strongly cross-bedded) are fairly regular. The pebbles, commonly up to one centimeter in diameter, are mainly composed of quartz. The Kiklah Formation sandstones are immature, but locally mature. The grains fall within medium to coarse sand-size range; they are poorly sorted, subangular and poorly consolidated. Cross bedding (mostly planar); it is quite common; consists usually of three sets forming a coset (Pl. 1, 2). No fossils, other than indeterminate large fragments of silicified wood, have been found in the field (Pl. 2, 1). The nature of these deposits is typical of continental fluviatile environment. El Hinnawy and Cheshitev (1975) have described similar lithofacies within the eastern Kiklah facies. Meanwhile, El-Zouki (1980) further distinguishes three basic and regional

lithofacies for this rock-unit, namely, eastern, central and western Kiklah facies.
The suggested Lower Cretaceous age of this formation, reported in the local literature, is principally based on its stratigraphic position. The total measured thickness of this map-unit is about 50 m and the upper contact with the Sidi as Sid Formation (Pl. 2, 2) is unconformable.

Sidi as Sid Formation (Upper Cretaceous)

Sidi as Sid Formation (El Hinnawy and Cheshitev, 1975) is subdivided into two members, the Ain Tobi and Yifran (Christie, 1955). Lithologically, the lower map-unit of this formation consists of thick-bedded gray to yellow limestones and dolomitic limestones with marly intercalations, particularly at the lower part of the section (Fig. 2). Casts probably (radiolaria) have been observed in its upper part. Radiolarian's presence in this interval probably provided the silica necessary for developing chert-bed (Pl. 3, 1). Meanwhile, a local sandy layer characterizes the lower disconformable contact with the underlying Kiklah Formation.

Highly bioturbated units are found at several stratigraphic levels within the deposits of the Ain Tobi Member. The best is found immediately below the well-known marker bed (rudist limestone) of this

member. Bioturbation structures found within this unit (Pl. 3, 2) are attributed to pelecypods and echinoids acting. The rudist limestone, or *Ichthyosarcolites* band of Christie (1955) is well developed in the investigated area, reaching up to 4 meters in thickness.

These fauna and their associations with other abundant pelecypods (diverse species of *Trigonia* and *Exogyra*) require particular attention. Rudists are common in the Tethyan domain, usually found in carbonate deposits related to transgressive episodes. They are common in open marine and ramp environments (e.g. southern Italy). However, rudists of the Ain Tobi strata are not always preserved in their growth position. Instead, they constitute accumulations of mechanical origin, as they occur in fragments of different shapes and sizes. In this case the distribution reflect the last depositional mechanism.

These accumulations are remarkably useful, both locally (age determination and water-depth) and on a regional scale (worldwide correlation). Similar lithofacies have been described and used for hydrocarbon exploration from the Arabian Gulf (e.g. the Fateh field in Dubai, the Bu Hasa field in Abu Dhabi and the Fahud and Natih fields in Oman). It is hoped that a depositional model of these accumulation will be available in the second phase of this study.

For a generalized stratigraphic and microfacies review for the Tertiary deposits of the Arabian Gulf region see Abdulsamad (1991, and 1999).

The contact that marks the top of the Ain Tobi Member from the overlying Yifran Member can be recognized in the field simply by the break of the slope (Fig. 2). Here, the lower part of the Yifran Member is mainly made of alternating relatively thick bedded limestones and soft marly limestones. Some bedded gypsum, clays and yellow calcareous marl are limited to the middle and upper parts. Unlike the Ain Tobi Member, the macrofauna are mainly gastropods (diverse species of *Turritella*). At microfacies level small benthic foraminifera, such as miliolids and rotalids, are common in the middle part of Yifran Member.

Conclusions regarding the age and depositional environment of the Sidi as Sid Formation, reported from the local literature, are apparently reasonable. A shallow marine environment of deposition, with local lagoonal condition has been reported. The total thickness of the Sidi as Sid Formation reaches 150 m.; its upper contact with the overlying Nalut Formation is conformable.

Nalut Formation (Upper Cretaceous)

Nalut Formation (Zaccagna, 1919 *in:* El Hinnawy and Cheshitev, 1975) conformably underlies Qasr Tigrinnah Formation and overlies Sidi as Sid Formation. Nalut Formation is widely exposed, capping the upper escarpment of Jabal Nefusah. In the study area the thickness of this formation reaches 80 m. It consists of thick to very thick beds of gray to dark greenish dolomitic limestones, intercalated with white to gray and fine to medium grained limestones (Fig. 2). Chert nodules (of various sizes and shapes) are found frequently along bedding planes, particularly at the top of the section. No fossils have been recovered from this formation, probably due to its recrystallized and dolomitic character. Megerisi and Mamgain (1980) suggested a shallow marine environment of deposition, with open sea connection based on macrofauna (mostly mollusca) collected by Christie (1955) and microfauna (mainly small benthic foraminifera) reported by Desio *et. al.* (1963).

Qasr Tigrinnah Formation (Upper Cretaceous)

The Qasr Tigrinnah Formation (Christie, 1955) is the youngest of the pre-Quaternary deposits found in the investigated area (Fig. 2). The first lower 15 m consists of poorly bedded and slope-forming calcareous

sediments. In the middle and upper parts, soft and medium thick yellow limestones, interbedded with marly limestone and marl, are prevalent. Gastropods (mostly large-sized *Turritella* and *Cerithium*), pelecypods (mainly *Cardium* and *Ostrea*) and fragments of echinoids are common. A long list of molluscs, echinoderms, foraminifera and ostracods have been reported in the local literature (Banerjee, 1980 and Megerisi and Mamgain, 1980 among others). Again, the environment is shallow marine with local development of lagoonal environment, as suggested by Megerisi and Mamgain (1980).

The total thickness of this formation reaches 65 m and the upper contact is not exposed (covered by the rich agricultural land of the Al-Assabaah plain).

CONCLUSIONS

The investigated Lower Jurassic to Upper Cretaceous succession reaches a total thickness of about 400 m. At the foot of the escarpment it is represented by gypsum and anhydrites of the Bir al Ghanam Formation (Lower Jurassic). This unit is separated by apparent unconformity from the overlying highly weathered and cross-bedded sandstones of the Kiklah Formation (Lower Cretaceous).

The Upper Cretaceous rocks of the Sidi as Sid Formation rests unconformably over the Kiklah Formation. It is represented by a thick sequence of

limestones intercalated with marls, gypsum and dolomites. Rudist facies characterizes the lower unit of this formation. This facies are widespread in the Tethyan region, in circum-Mediterranean Middle Eastern countries.

The contact of the Sidi as Sid Formation is conformable with the overlying Nalut Formation (Upper Cretaceous). Here, the lithofacies is dolomitic limestone that is mostly siliceous. This hard and massive lithology forms most of the resistant capping of several hills in the area. The contact of the Nalut Formation with the overlying Qasr Tigrinnah Formation (Upper Cretaceous) is conformable. The latter rock unit is the shallowest and youngest of the pre-Quaternary deposits recognized in the study area. It is composed of soft marl and limestones. Large size gastropods (mostly *Turritella* and *Cerithium*) and pelecypods (mostly *Cardium*) are quite common in the soft and calcareous sediments of the Qasr Tigrinnah Formation.

ACKNOWLEDGEMENT

I wish to thank my colleagues in the Earth Sciences Department of the Garyounis University, particularly Dr. A. El-Zouki and Professor. R. Al-Khazmi, for their supervision during the fieldwork as

well as during the preparation of the original work. Many thanks also to Professor A. El Hawat for the critical review of the current text. Particular thanks are due to my friends in the Gulf Oil Company (AGOCO), especially, Mr. T. Younis, who helped during the fieldwork, Mr. A. Muftah and Mr. F. Bu-Argoub for their support and encouragement to publish this contribution.

REFERENCES

ABDULSAMAD, E. O., (1987): Geology of Ras Abu Gidrin area, Abu Zayyan Quadrangle, Al Jabal Al Gharbi, NW Libya. Unpublished Bsc. Thesis, University of Garyounis, Benghazi, Libya.

ABDULSAMAD, E. O., (1991): Larger Foraminifera and associated Calcareous Microfossils from a part of the Arabian Gulf. Unpublished Msc. Thesis, University of Southampton, England.

ABDULSAMAD, E. O., (1999): Stratigraphy and Microfacies from the Tertiary deposits of the Arabian Gulf. Proceedings to the European Union of Geosciences (EUG-10), Strasbourg, France.

BANERJEE, S., (1980): Stratigraphic lexicon of Libya. Bulletin no. 13, Industrial Research Center, Tripoli, Libya.

CHRISTIE, A. M., (1955) reprinted, (1966): Geology of the Garian Area, Tripolitania, Libya. Geol. Section, Bulletin no. 5, Libya, Ministry of Industry: *Willimer Bros. Ltd. Birkenhead*, UK.

DESIO, A., RONCHETTI, R., POZZI, C., CLERICI, F., INVERNIZZI, G., PISONI, C. AND VIGANO, L., (1963): Stratigraphic Studies in the Tripolitanian Jebel (Libya). *Riv. Ital. Paleont. Strat. Mem. IX*, Milano.

EL HINNAWY, M. AND CHESHITEV, G., (1975): Geological map of Libya, 1:2500,000, Sheet: Tarabulus, NI 33-31, Explanatory Booklet. Industrial Research Center, Tripoli, Libya.

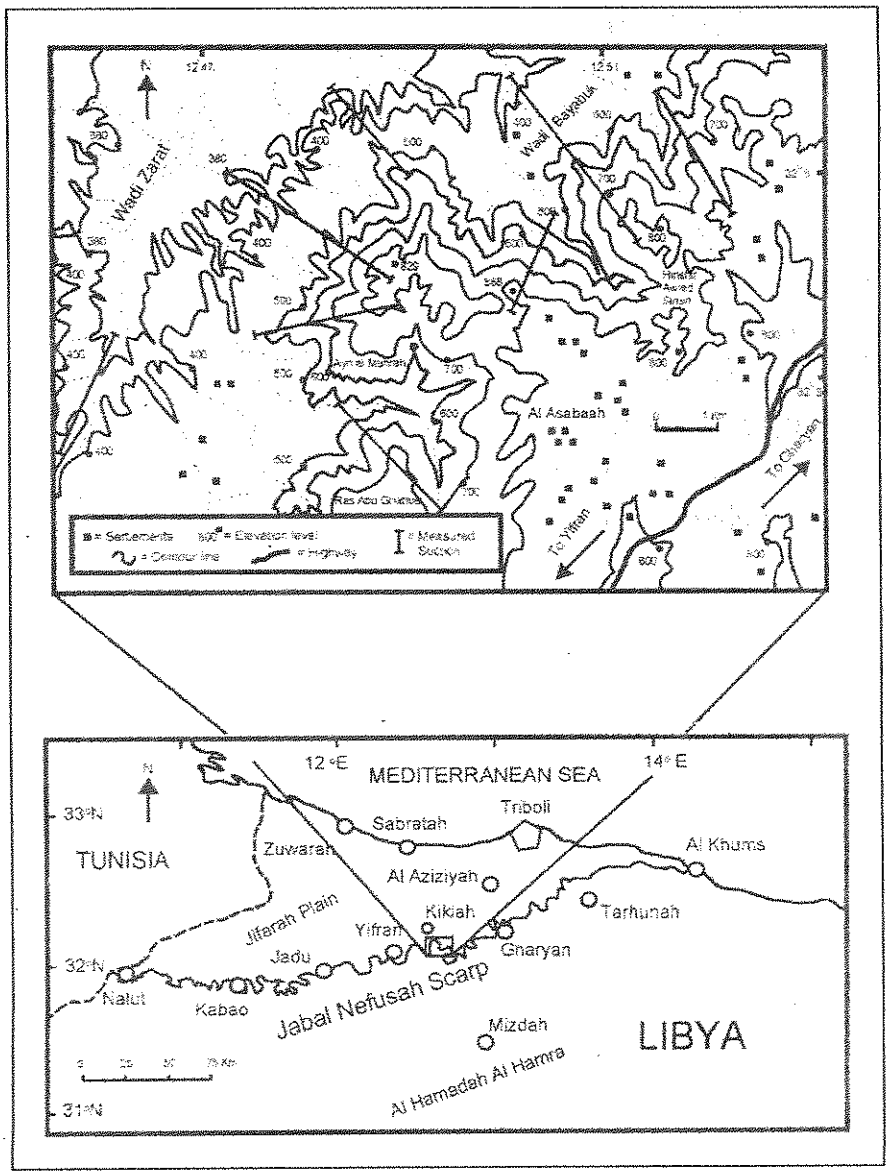
EL-ZOUKI, A. Y., (1980): Stratigraphy and Lithofacies of the Continental Clasts (Upper Jurassic and Lower Cretaceous) of Jabal Ṇefusah, NW Libya. *In:* Geology of Libya (*eds* M. J. Salem & M. T. Busrewill). Academic Press, London, II, 393-418.

FATMI, A. M., SBETA, A. M. AND ELIAGOUBI, B. A., (1978): Guide to the Mesozoic Stratigraphy of Jabal

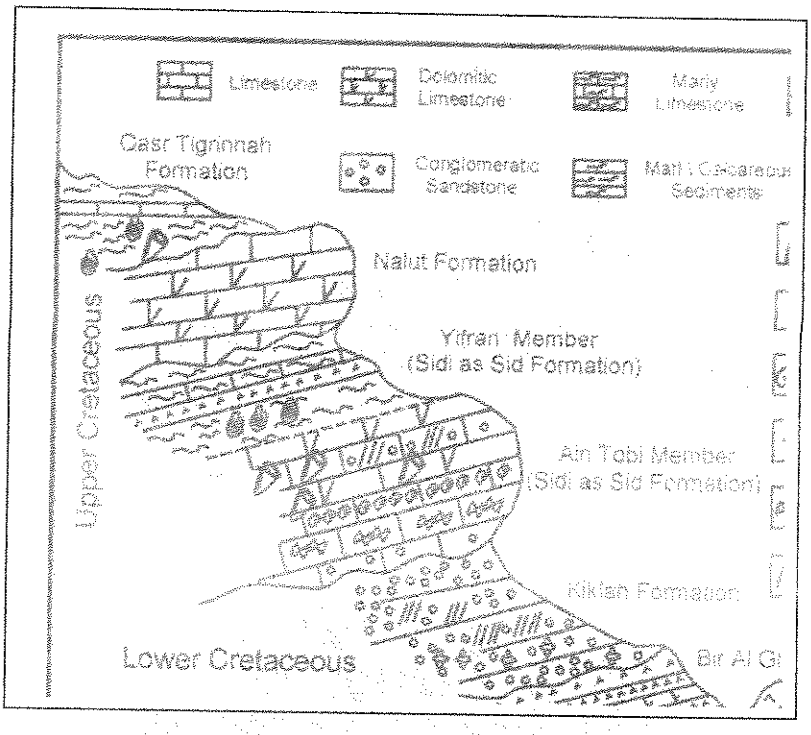
Nefusah, Libyan Jamahiriya. Arab Development Institute, Publication no. 7, Tripoli, Libya.

FATMI, A. M., ELIAGOUBI, B. A., AND HAMMUDA, O. S., (1980): Stratigraphic nomenclature of the pre-Upper Cretaceous Mesozoic rocks of Jabal Nefusah, NW Libya. *In:* The Geology of Libya (*eds* M. J. Salem & M. T. Busrewill). Academic Press, *London, I, 57-60.*

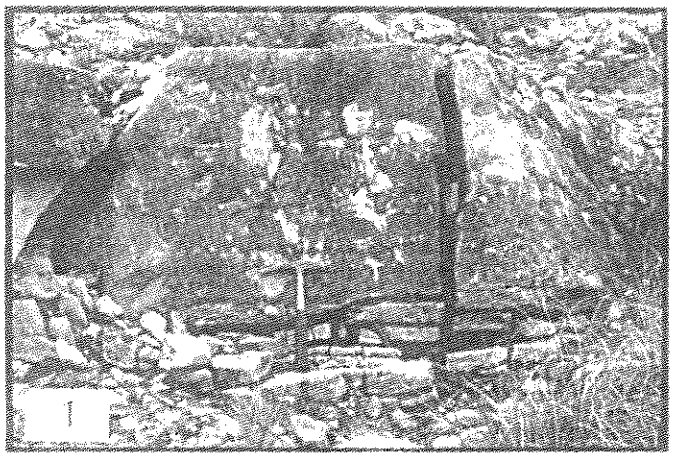
MEGERISI, M. F., AND MAMGAIN, V. D., (1980): The Upper Cretaceous-Tertiary Formations of Northern Libya: A Synthesis. Bulletin no. 12, Industrial Research Center, Tripoli, Libya.

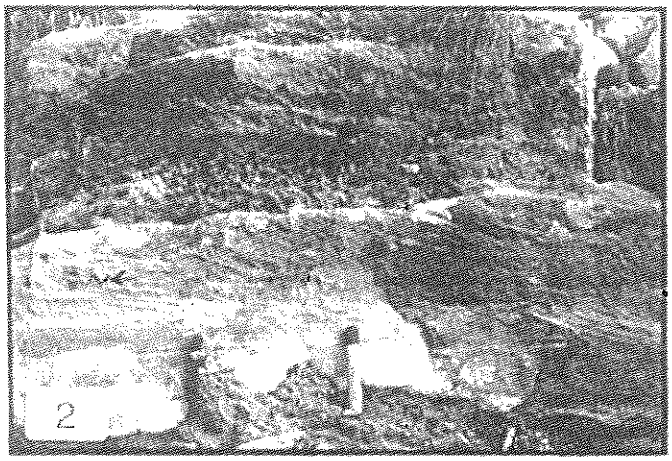


صورة من الشكل رقم 1
خريطة الموقع (موقع الدراسة) + خريطة ليبيا الغربية.

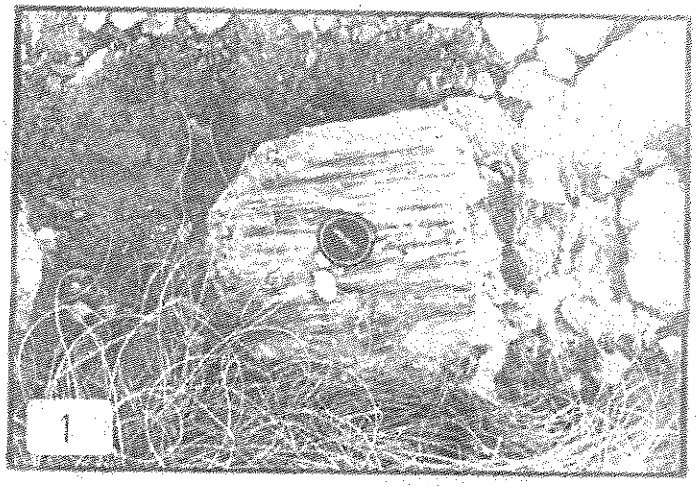


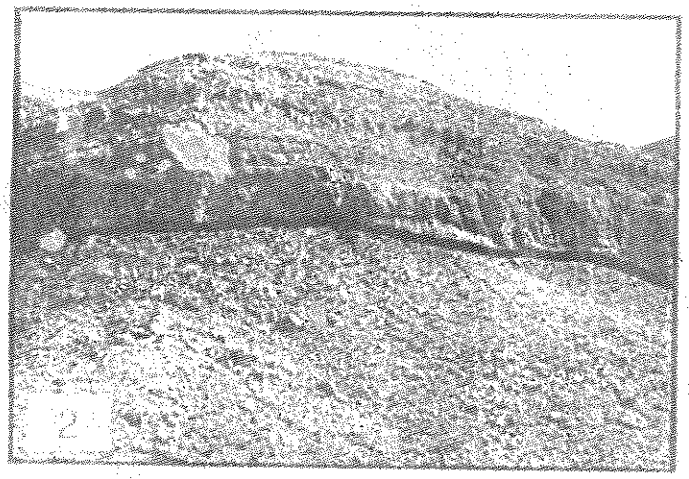
صورة من الشكل رقم 2
العمود الطبقي لمنطقة الدراسة



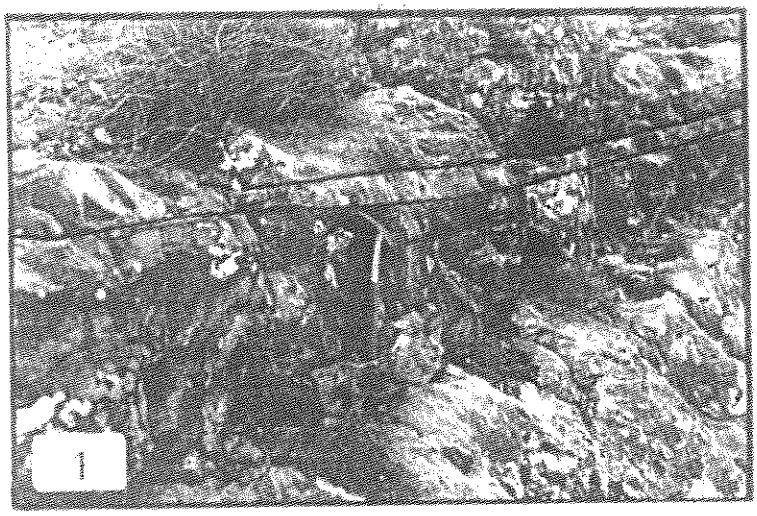


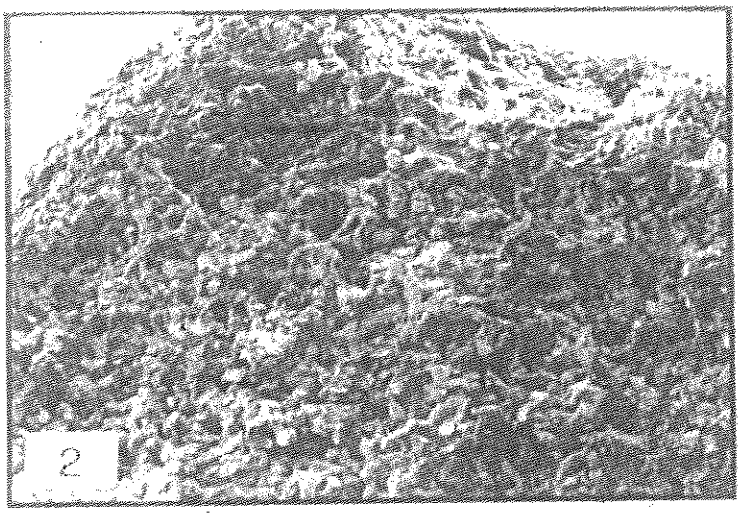
صورة من لوحة رقم 1 تحوي الشكل 1 + 2





صورة من لوحة رقم 2 تحوي الشكل 1 + 2





صورة من لوحة رقم 3 تحوي الشكل 1 + 2