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DESCRIPTION AND INTERNAL STRUCTURE OF THE CONDENSATE SERIES: AN EXAMPLE FROM THE BEYŞEHİR-HOYRAN NAPPE

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ABSTRACT.- The condensate sequence exposed around Üzümlü-Huğlu, about 30 km SW of Beyşehir, whose typical section is located in the Boyalı Tepe, is one of the best examples of these kind of occurrences in the Beyşehir-Hoyran nappes. This pelagic sequence with a total thickness of 25-30 m overlies the platform type limestones and presents a continuous sedimentation between Early Jurassic and Late Cretaceous. This condensate sequence, formed by a minimum sedimentation in a wide time interval, is composed of 3 parts from bottom to top: 1- Ammonite bearing with red-nodules (Jurassic: total thickness is 7-9 m); 2- White, reddish, and multi-colored, radiolarite interbedded, Calpionella sp. and Globigerina sp. bearing limestones (Lower Cretaceous: total thickness is 3-4 m); and 3- Reddish colored, silica banded or noduled, Globotruncana sp. limestones (Upper Cretaceous: total thickness is 15-17 m).

The condense character of this pelagic sequence described, is determined by the criteria given below:

a- Repetetive deep sea erosional surfaces or hardgrounds. These erosional surfaces are characterized by iron microcrusts and dense filament accumulations which were derived from pelagic lamellibranches (probably Bositra sp.), particularly in Jurassic samples.

b- Deep see fractures and the fractures filled with internal sediments.

c- The abundance of nanno-organism in the pelagic matrix; but their poor preservation due to early diagenesis.

d- The activities of deep sea and micro-endolithic organisms. Especially, active borings of micro-endolithic organisms in the Globotruncana sp. sections,

e- Excess hardness due to early diagenesis and compression and stilolite in the following diagenetic stages.

INTRODUCTION

Condensed sequences are formed either as a result of extreme slows down or stagnant sedimentation. Moreover, submarine erosions are another important factor. These sequences, in spite of having a negligible thickness, precipitated in a wide time interval.

After studying the Swiss Alpine, Heim (1934) concluded that in condensed sequences fossils of different age might be in the same layers and these layers might have settled down slowly in a very long period of time. He also indicated that reworking was the major factor for development of this sequences.

Rod (1946) defined the stratigraphic condensation based on the following features: 1- Enrichment of well-preserved fossils and fossil fragments. 2- Fauna mixing. 3- Widespread distribution and negligible thickness. Rod (1946) also added that reworking was envisaged as a process acting on condansation, but it was not the main reason for its development. Heim (1958) and Wendt (1970) proposed faunal mixing *as* a criterion of stratigraphic condensation. Mensik (1960), when referring of condensed sequences in the Spanish Jura, pointed out the presence of confusion over the terminology and concluded that there was a need for a new definition to overcome this confusion. Jenknyn (1970; 1971) suggested that in an environment where most of the sediments is swept away before it has the chance to settle, the term "reworking" is hardly acceptable and this cannot be considered as a reliable criterion in defining condensation. Holmann (1964) who studied the condensed sequences in the Jurassic red limestones of North Italy, suggested that the role of currents had been considerable although extensive mechanical reworking had not taken place. Flügel (1967) expressed similar opinions on the genesis of the Austrian Stenmühl-Kalke. Some radiolarite and limestone sequences in the Alps have been interpreted as starved basin deposits (Garrison and Fischer, 1971). The maximum floddy surfaces with lowest sedimentation current have arised condensed sequences (Schlager, 1992). The close relationship between sequences and current activities can be explained by occurrence of hardgrounds. The hardground of Western Sicillian Jurassic represents a most typical example for these occurrences (Wendt, 1963, 1970; Jeynkyns, 1961). Some hardgrounds and stratigraphic condensed sequences in Turkey are observed in red coloured Jurassic ammonite- bearing limestones (Ammonitico Rosso). Their descriptions related to internal structure have been described by Varol and Gökten (1994) and Akkaya (1994) in the vicinity of Ankara and Jurassic Amasya sequences, respectively. The condensed sequences of these regions are mainly Lias and Dogger in age. On the other hand, the condensed sequences studied in this paper are located in Beyşehir-Hoyran Nappe of Taurus tectonic units including pelagic limestones and deep-sea sediments. Detailed stratigraphic studies on this nappe and the definition of condense sequence of Lower Jurassic-Upper Cretaceous age have been made by Gutnic and Monod (1970), Özgül (1971, 1976). Brunn and et al. (1971), and Monod (1977). Moreover, a preliminary sedimentologic study on this nappe has been summarized by Varol and Tunay (1994). This paper is based on a study of mode of occurrences and genesis of internal structure of condensed sequence within the Boyalıtepe section of the Beyşehir-Hoyran nappe. Sedimentologic, petrographic and electron microscopy studies of samples taken from this section were performed in detail.

Geological and Stratigraphic Setting

The condensed sequence in the Beyşehir-Hoyran Nappe is situated about 30 km SW of Beyşehir, around Üzümlü-Huğlu (Fig. 1). The Boyalıtepe Triassic-Lower Jurassic limestone is found at the bottom. This unit is overlain by a condensed sequence with a thickness of 25-30 m (Fig. 2). Moreover, the condensed sequence is also overlain by volcanite, volcanic sandstone, volcanic breccia, lavas and silicified radiolaria bands. The unit, named as volcanic series by Monod (1977), contains large limestone block in places originated from the platform type Boyalıtepe limestones, which forms the basement of condensed sequence.

The platform-type limestones forming the basement of condensed sequences are dolomitic in character. The non-dolomitic series consists of oolitic rocks, algae and foraminiferous mudstones. Some Involute sp. observed in this section are Upper Triassic-Lower Liassic in age (Monod, 1977). The upper most section (about 10 m) of the platform-type massive limestones consists of reddish, thin layered limestones characterizing Megalodont-bearing wackstones and packestones. At Boyalıtepe, the condensed sequences with 25-30 m thickness overlying the limestones are diveded into the three sections as shown below (Plate 1, Fig. 1).

1- Red nodules and ammonite-bearing, marl (Jurassic, total 7-9 m. in thickness), 2- White and red coloured radiolarite interbeded and Calpionella sp. and Tricinella sp.-bearing limestones (Lower Cretaceous, total 3-4 m. in thickness), 3- Red coloured, silica interbedded and banded, globotruncana-bearing stilolitic limestones (Upper Cretaceous, total 15-17 m in thickness).

1-Jurassic: The Jurassic limestones comprising the first of condensed sequences that lie over the platform-type limestones, show characteristic red coloured, nodules and breccia textures and their layer surface show bumpy character (Plate 1; Fig. 2, 3). In these surfaces, ammonites represent syndepositional and post-depositional dissolution of the original aragonitic shell material which makes up irregular surfaces on the bedding surface. The presence of these textures due to the submarine surface erosion and dissolved shell-fragments which charecterize the hardgrounds (Garrision and Fisher, 1971). Morever, micritic grains and ammonite shell fragments originated from chipped surfaces, as internal sediments filling the dissolution voids also indicate the submarine erosion.

The majority of Jurassic condensed sequences are breccia in character. These breccia show maily grain to grain lesser clay filled stilolitic texture; sporadic stilo-breccia texture are also observed. Besides clay mineral, as a laminar (from a few mm to a few cm) hematite and limonite shells within the "Jurassic condensed sequences are quite widespread. Iron shells are also frequently observed, around ammonite shell traces at nearby of internal sediment filled microcracks (sedimentcrack) and on the corrosion surface developed parallel to the layer.

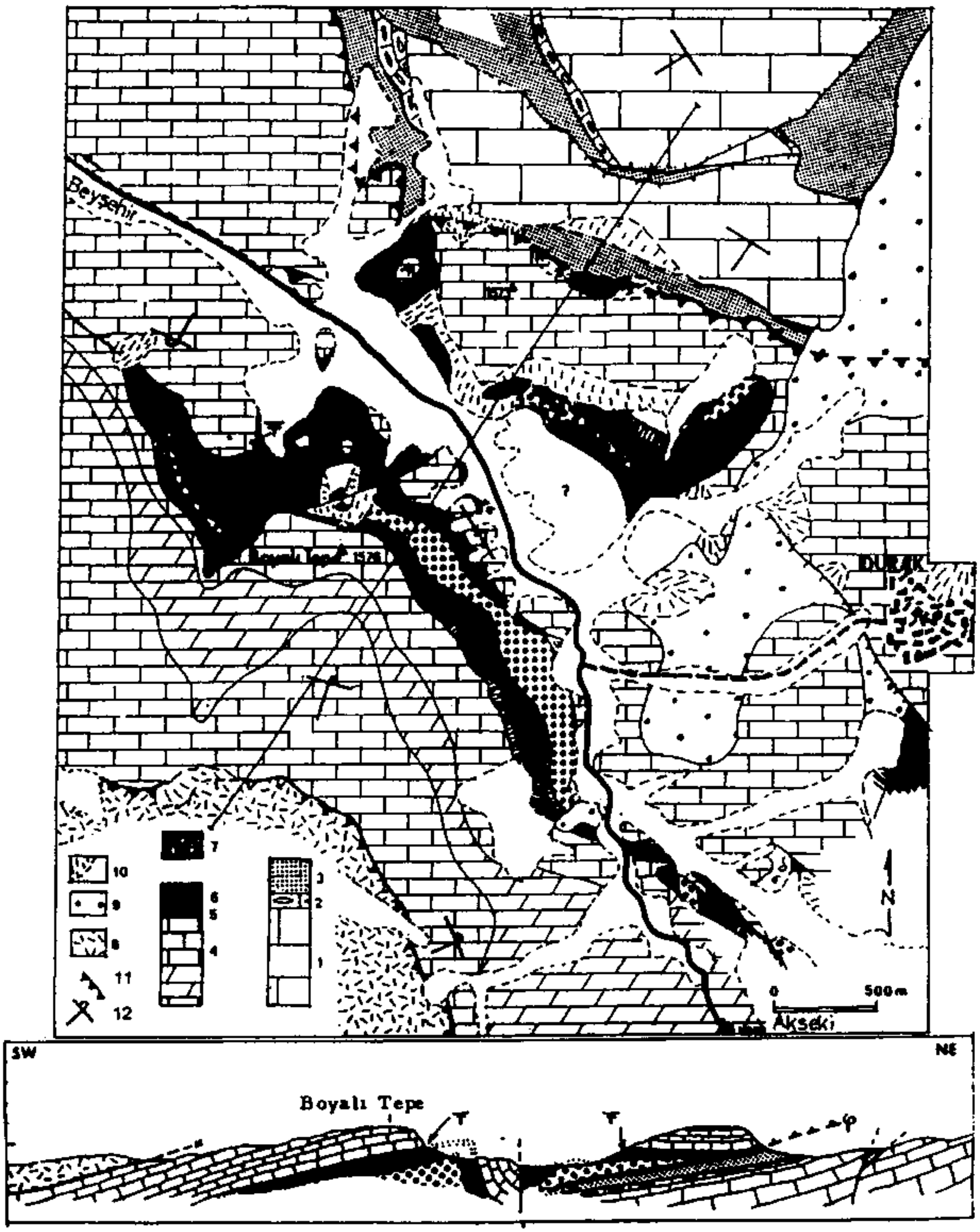

Fig. 1- Geological map and cross section of the Boyalı Tepe condensed sequence (From Monod, 1977). 1- Autochthonous Mesozoic limestones, 2- Nummulitic limestones, 3- Eocene flysch, 4- Boyalı Tepe limestone, 5- Condensed sequence (Liassic-Senonian), 6- Ridiolaria and breccia, 7- Wild flysch, 8- Huğlu tuffites, 9- Neogene deposits, 10- Quaternary, 11- Trust, 12- Overturned bedding.

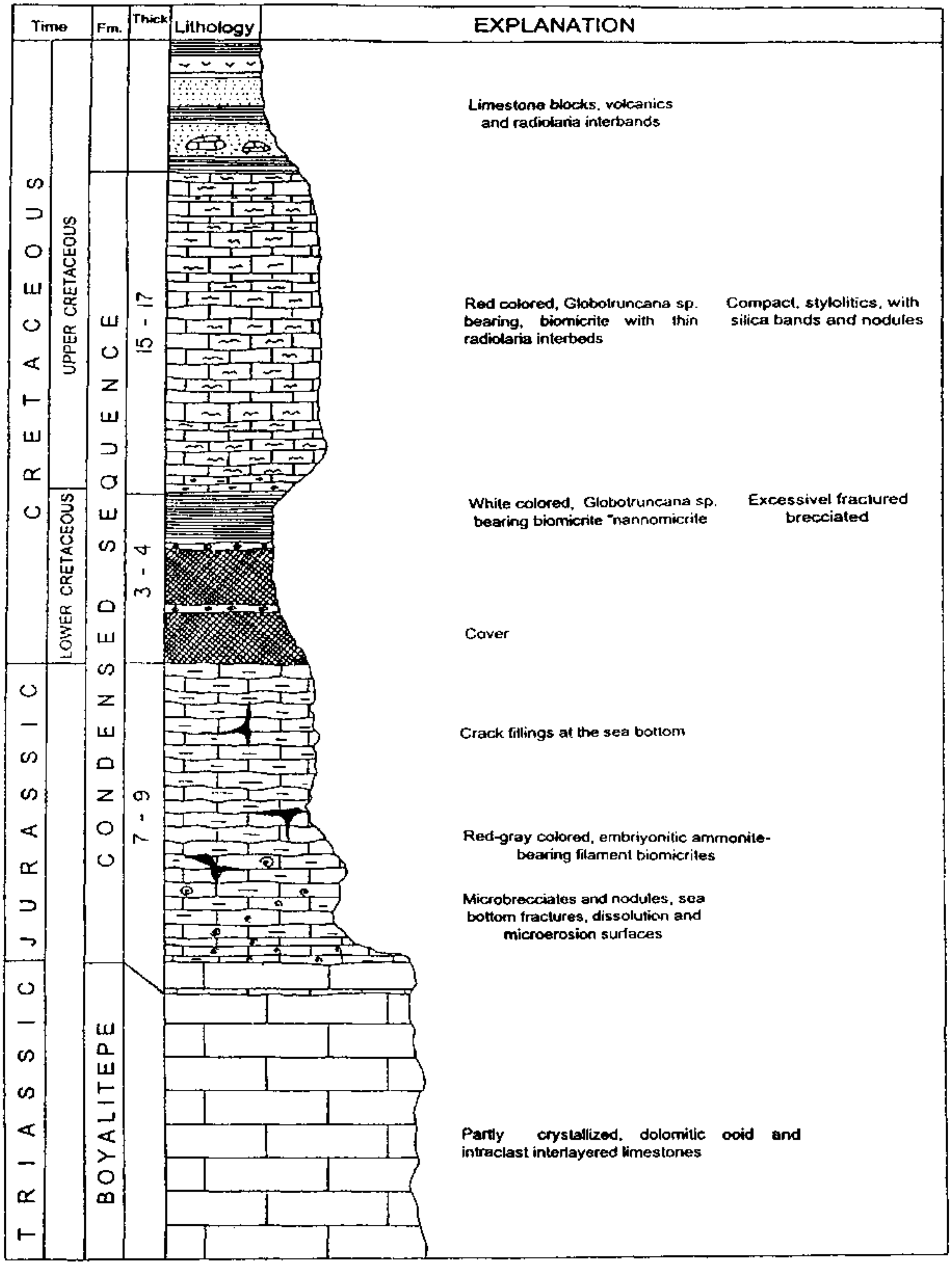

Fig. 2: Stratigraphic columnar section of the Boyalı Tepe.

2- Lower Cretaceous: Due to a probable fault, boundary definition between Jurassic and Lower Cretaceous units is not clear, but Lower Cretaceous-Upper Cretaceous boundary is well observed: The white coloured, clayey limestone section (40-50 in thickness) of Lower Cretaceous is overlain by thin bedded limestone section of Upper Cretaceous (Plate 1, Fig. 4). In some part of the Boyalıtepe cross-section, Jurassic/Lower Cretaceous transition is (from bottom to top) is given below: Nodular Jurassic Limestone (a few m in thickness) and poorly-bedded radiolarites, white and grey coloured, quite hard, massive and thin-bedded Lower Cretaceous limestoes. In places, a microconglomeratic series observed at the upper most section of the radiolarites consist of limestones pebbles of Lower Cretaceous.

3- Upper Cretaceous: The upper most section of Upper Cretaceous aged condensed sequences is represented with red coloured, rather hard and stylolitic-type plaket limestone with interbedded silica layers or irregular nodules of silica (Plate. 1, Fig 5). Around these nodules, in place, manganese and iron coatings are observed. Regularly, stylolite occurs along the layers and follows the layer boundaries. In some sections of the unit, it is difficult to distinguish the real bedding planes from the stylolitic surfaces. Some microlaminations, irregular cracks, and breccia occurrences are also clearly observed within the unit.

MICROFACIES

The microfacies present within the Lower Triassic-Upper Cretaceous condensed sequence are given below; Jurassic, represents two main microfacieses, filaman-type and ammonite bearing limestones. Generally, the definition of the boundaries between two microfacies is quite difficult. Nevertheless, the ammonite bearing limestone is rather hard, light-grey coloured partly brecciated and have nodules textures, whereas, filaman-bearing limestones is red colored, sandy, soft and has a matrix appearance (Plate'1, Fig. 6). At the beginning of sequences of condensed unit, wackestone-packestone-bearing filaman limestone microfacies is dominant. The filamans as massive files have been deposited along the layers (Plate. 1, Fig. 7-8). To the top, the ammonite-bearing limestones and nodular sequences. Moreover, these filaments also fill the micro cracks surrounded by iron and manganese. No paleontologic description has been done yet on these filaments, but some similar forms have been defined as shell fragments of Bositra species by Jenkyns (1971). The ammonites which characterize the Jurassic microfacies, occur in wackestones of 10-20 % and are entirely embrionic in character. The aragonite composition of ammonite shells has been mainly have transformed to calcite and lesser amount has been dissolved. The secondary sparry calcite cementation along with the micritic internal sediments were observed within these dissolved section. The specimens taken from the condensed micritic limestones of Jurassic, indicated that no nanno-organism or their relict are present. Electron micrographs of the specimens show that recrystallized biogenic fragments have given rise to this micritic matrix (Plate I, Fig. 9). Lower Cretaceous section of condensed sequences which is mainly limestone facies in character, consist of Globigerina sp. and Ticinella sp. bearing mudstone-wackestones. Within the this microfacies, the ammonite of micritic-clays fairly high in comparision to other condensed limestone sequences (10-15%). Moreover, amount of nanno-organism is also higher than that of limestones, and well-preserved (Plate I, Fig. 10). In some globigerina chambers, occasionally glauconite mineralisation has occurred in the form of green occurrences. Fe and Mn shells occurrences have not been observed here, but within the Jurassic specimens these shells are abundant. Moreover, similar to this microfacies, a completely calpionella species-bearing and brecciated another microfacies has separated Lower Cretaceous from Jurassic and exposed in a small area. The lateral extension of this microfacies has been restricted by a probable fault.

In Upper Cretaceous, alternation of three microfacies; as red pelagic micrits, radiolarite-bearing micrits and radiolarite levels have been observed. At the bottom and medium level of sequences, the red pelagic micrits are dominant. To the top, they have been replaced by the radiolarite-bearing micrits and radiolarite microfacies. The red pelagic jmicrits microfacies has been represented by the Globotruncana and Globigerina-bearing mudstone and wackestone. Particularly, microlamines formed by Globotruncana accumulation are widespread (Plate II, Fig. 1). The stilolites are very abundant and most of than are filled by iron. In radiolarite-bearing micritic microfacies, in places micritic cements has been replaced by silica. The remainings of the planktonic foraminiferous (Globotruncana and Globigerina species) have been observed within irregular silica patches. The amount of radiolarites has increased around these fossil remainings. Radiolarite microfacies is pure, but occasionally comprises a various amount of remainings of silicified micritic limestone. These specimens appear red and white in colour.

The most abundant nanno-organism has been observed within the electron micrographs taken from the micritic matrix of pelagic limestone levels. But, these are not well-preserved and most of them are broken and intensly are recrystallized (Plate II, Fig. 2).

DEFINITION PROPERTIES OF CONDENSED SEQUENCE

The condensation of the condensed sequence is controlled by various parameters. The most important is stratigraphic and erosional (reworking) condensation. Since nanno-organisms are not still developed completely in Jurassic, the carbonate production within the pelagic facies has been restricted, eventually it has given rise to stratigraphic condensation (Jenkyns, 1971). In addition, the flow movements on the seamounds causes erosion and sweeping as well as dissolution of carbonate which is controlled by depth (carbonate compensation depth) (Garrison and Fisher, 1971). The condensation factors of the Boyalı Tepe condense are determined and explained below.

Submarine Erosions: The submarine erosions of the condense sequence of the study area is developed dominantly in ammonitic Limestone, microfacieses of Jurassic. The erosion surfaces are covered by microbreccia grain and flaman limestones (plate II, Fig. 3). Milimetric and centimetric scaled iron and manganese crusts are common on the erosion surfaces. In this type submarine erosion samples, sudden lithology changes in the vertical direction, microbreccia grain mixed with filament, the orientation and imbrication are common (Plate II, Fig. 4).

At the same time, the upper part of the biogenic grains is affected by the submarine errosion. Typically ammonite crusts could be seen in samples of Plate II, Figure 5. The upper sections of the ammonite shells situated on the surface of these submarine erosions surfaces which separated ammonite-bearing limestones from flamant limestones as a microdiscordans, are eroded in various scales. In our specimens, this kind of erosion surfaces indicated a hardground occurrence.

The submarine surfaces are also observed within the Lower and Upper Cretaceous section of condenced sequences. The breccia grains with Calpionella sp. and Ticinella sp. of Lower Cretaceous present within the limestones almost in some age and lithology explained that the sea floor erosion has developed during deposition or just after. No microbreccias have been observed in pelagic micrites of Upper Cretaceous. The submarine erosions are very small but widespread. On these surface oriented and micrograted pelagic microorganism shells are common. Late diagenetic stiolilization commonly present within the Upper Cretaceous limestones, mostly prefered the surface of interbedded layers which was developed by micro erosion surfaces.

Neptunian Dykes: This structure is actively seen in Jurassic age sequences. These are lateral and obliques cracks which are developed in the layers. They are different in size, and they are mostly thined and diaspeared ant the width of them vary from a few centimeter and decimeter. The cracks dominantly developed in ammonitic limestones are filled with filament limestones (Plate II, Fig. 6). These could be seen in breccia and nodular structured Jurassic condensed sequences. No atmosphere condition and meteoric diagenesis have been seen near and around the crack system. All the cracks are filled with marine sediments, therefore it shows that cracks were developed at the sea bottom.

Dissolution Voids: Different size or dissolution void effects could be seen in all condense levels. The dissolution voids are present in micritic matrix (mainly in ammonit shells). They are developed as a dissolution mold or irregular voids. The inner side is filled with crystal silt and drusty cement. Very small (in micron size) voids are also very common. Mainly in Jurassic samples, they developed both on organism shells and micritic matrix (Plate II, Fig. 7). These are similar to the holes of the endolitic organisms. Absence of organism marks in the environment, it supposes to the biogenic genesis. Most of the dissolution voids are open. But SEM analyses showed that the wall of the voids are cemented with very fine grained marine materials.

Early Cementation: The most widespread hardground occurrences within condensed sequence are present mainly in Jurassic, and partly in Cretaceous. The recrystallised micrit crystals, clay, iron, manganase minerals and activity of endolitic organisims clearly showed an early cementation. The matrix is made up of irregular shaped crystals, 4-7 micron in size; party they are come together in heaps. These features showed that the genesis was biogenic (Fisher at al; 1967). The crystals originating from aragonite shells Jurassic specimens are common. Most of them were transferred to calcite. In Upper Cretaceous specimens, the micritic matrix presenting early cementation was made of magnesium-calcite. The micritic crystals originated from nanno organism shell walls were partly or completely crystallized. When the recrystallization was not strong enough, the nanno organisms were partly protected. The micrit matrixes (nanno micritic) in all specimens, have been intensely hollowed by the micro organism hollowing hardground. This clearly indicated a hardground occurrence.

Early diagenetic mineralization is another indication for hardground occurrence in condensed sequence. All clays, which are illite in character, crystallized either in dissolution surfaces or in dissolution voids (Plate II, Fig. 8). Iron mineralization is represented by mainly hematite and limonite stains. They are mainly seen as thin films on the surfaces of erosional hardground or on the microcrack walls and in the microcracks. Ot the other hand, in brecciated Jurassic hardgrounds, they surrounded all brecciated grains as a thin film. When the sedimentation rate was minimal or zero, it brecciated that the iron mineralization concentrated on the hardgrounds was in relation with the oxidation of sea floor (micrit matrix) effected by sea water in a long time (Jenkyns, 1970). In addition, the presence of breccias which accompany with this mineralization, also explains a dissolution and erosion on the early hardground (Hollman, 1962 and 1964).

Bioerosion: The maximum activity of endolites has been observed within the Upper Cretaceous aged pelagic micrites. The tubes varying from a new microns to tens microns, as indicated above, have caused intense burrowing of both micritic cement and biogenic grains. These microorganisms are composed of a few types. Coloni-type microorganisms have various type branchies and sinusoidal structures. These mainly cause burrowing of micritic cements (Plate II, Figs 9,10). Up to date, these endolitic fossils occurring in the deep sea have not been mentioned yet. The fossils within the Boyalı Tepe specimens are probably the first fossils defined. In respect to appearance, these are smilar to the types, which caused the microbiologic alteration described in the Bahama recent deep sea carbonates. They were described as mushroom-type endolitics living at 210-1450 m. depths below the light zone (Marjone and Perkins, 1979).

DISCUSSION AND RESULTS

With maximum 25-30 m thickness, conformably development of the Lower Jurassic-Upper Cretaceous aged pelagic limestones interbedded with radiolarites within the Beyşehir-Hoyran nappe, clearly indicated a condensed sequences occurrence. Generally, sedimentation in lesser amount occurs in the condensed sequences, but similar sequences show much thicker sedimentation within the same geological time (Jenkyns, 1971). Here, the rate of sedimentation is too slow, namely, the thickness of the unit is 25-30 cm in a million year. The development of microerosion and microunconformity surfaces have indicated a sea floor erosion and removal of sediment. This may give rise a condensation. However, a sedimentation deficiency in the form of sediment removal, may not be resulted in the Boyalı Tepe condensed sequences alone. Such sea floor erosions have been mainly observed in the Jurassic-Lower Cretaceous periods.

In the Boyalı Tepe columnar section, the lack of the Calpionella-bearing series of Lower Cretaceous age and as its being intracalated, indicated that these thin condensed Calpionella-bearing units might have been removed during sea floor erosion, wheras, along Upper Cretaceous in Globotruncana the sequence of traces of the sea floor erosion have been observed in minor amount. This observation explained that the condensed sequences of the Boyalı Tepe have been occurred by both stratigraphic and erosional (reworking) condensation due to undeveloped nanno-organism (Jenkyns, 1971). Lack of nanno-organism has been observed in the electron micrographs of the Jurassic samples. Studied condensed sequences indicated that only Upper Cretaceous pelagic limestones are rich in nanno-organism that their matrix are nanno-micritics in character. The globotruncana-bearing micrites of Upper Cretaceous also comprise essential amount of nanno-organism. But these are poorly preserved due to intense recrystallization in the Boyalı Tepe Column section. This clearly explains that the condensation within the Lower Upper Cretaceous sequences has developed after the nanno-organism deposition. Wheras this phenomena has not been observed within the Jurassic sequences has not been explained using by electron microscopy. It is quite difficult to say that these closely interlocked subhedral and anhedral crystals (4-5 micron in size) have been originated by chemical processes. However their irregular crystal shapes and partially accumulation forms support their organic origin. Besides, presence of highly altered and dissolved macroshells, development of many caves in micritic matrix at the ammonite-bearing sequences of Jurassic and filling of them by large and small micrites, emphasizes mobility of carbonate materials related to sea floor dissolutions and erosion.

The main point of this study is to define events giving rise to condensation and environmental development. Although the evidences obtained up to date, are not sufficient to explain these events, but some vital clues have been obtained. From the literature, it is evident that some different opinions are present on genesis and depths of condensed sequences. These have formed on the seamounts with a few meters in depth (Jenkyns, 1971) or formed within the bathyal abyssal environment (Garrison and Fisher, 1971). The stromatolies formed within the condensed sequences support the first opinion, silica and radiolarite alternation which is associate with pelagic mudstone supports. the second opinion. At the Boyalı Tepe condensed sequence, the lack of stromatolites defines a depth below a light zone (max. 200-300 m). On the other hand, from the studied condensed sequence, it is believed that the beginning parth of the sequence (Lower Jurassic) is not very deep. Because the beginning parth of condensed sequence (red micrites), as seen in Fig. 2, was developed on the platform-type limestones as coating. Lack of algaes within the these sequences, most probably due to stable environment and current action rather than environment depth. The development of condensed sequence on the drowned platform straight away is most probable. Abundant sedimentary cracks on (neptunion dykes) occurred in Jurassic, explain strain tectonic regime formed on the deepening platform. The floor currents arisen from fast deepening, have prevented sedimentation, sea floor carbonate sweeping and erosion are the main features for the Jurassic-Lower Cretaceous condensation. Within the these sequences, abundant embrionic ammonite-bearing micrite intraclasting and their mixing with laminated filaman limestones support a current action. Moreover, large amount of iron mineralization indicates a slow sedimentation caused by these current and presence of aerobic conditions at the sea floor. Before hematite mineralization, abundant carbonate dissolution formed on the floor, particularly on hardgrounds is another importants points. These dissolution surfaces and/or voids have been covered by a thin hematite layer or filings. Besides, Illite-type clays have been observed in the some dissolution voids. All these occurrences are the simple examples of mineralization on the sea floor, at carbonate sedimentation stages partly slowing down and breaking in some cases. After Jurassic, the radiolarite sequences with few meter thickness within the condensed sequence, passed from carbonate deposition to silica deposition. As proposed by Garrision and Fisher (1971), this might be below the carbonate equilibrium level depth (CCD). This depth varies from 4100 to 4500 m for actual oceans. At the Boyalı Tepe condensed sequence, by end of Jurassic, environment depth should have reached these depths. At the beginning of Lower Cretaceous, reworking of carbonate deposition and starting of the intense nanno-micrite deposition have clearly indicated shallow environment for a while. Particularly, the lack of Calpionella-bearing unit within this sequence most probably due to erosion during this shallowing phase. Moreover, there is no evidence that this shallowing phase developed as a terrestrial cycling and later eroded. Unfortunately, here these evidences can not explain this absence. As well as fault actions controlling basin, deepening and shallowing and causing the submarine erosions by sedimentation are quite possible.

Upper Cretaceous is represented completely by globotruncana-bearing mudstones and interbedded radiolarites. This suggests that sea floor depth would reach the CCD level and is instable of equilibrium. In this way, passing from carbonate to siliceous sediments and radiolarites may attribute to variation of sea floor depth and also sea floor current actions of CCD and temperature variations.

According to above given information, it is concluded that the Boyalı Tepe condensed sequence is represented by the abundant amount of pelagic limestone and radiolarite-bearing deep sea sediments forming on the platform-type limestone. From the present study on the limestone facies, it is evident that the environment has deepened continuously, but became shallow for a while Particularly, in Upper Cretaceous, variations of the CCD level have mostly controlled the condensations. The current actions giving rise to forming of condensed may be directly resulted from this rapid deepening. Many works have confirmed this idea. This action, improved by the control of a probable fault, has deepened the environment from platform-type limestones to the distance (4500-500 m.) in which.

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PLATES

PLATE-I

Fig. 1: General view of the Boyalı Tepe condensed, sequence; a- Platform limestones, b- Condensed sequence. Sequence has an overturned structure.

Fig. 2,3: Jurassic condensed limestone levels; brecciated and nodular character is typical. Iron coating, clay and phosphate minerals are typical in dark colored parts, indicated by arrows.

Fig. 4: Lower-Upper Cretaceous transition in the condensed sequence; the thickness of this part of sequence is 1 m; a- Radiolarite brecciated limestone bands; b- Pelagic limestones (Lower) with a white clayey appearance; c- Red colored, compact and silica banded pelagic limestones (Upper Cretaceous)

Fig. 5: Close pan view condansede Upper Cretaceous red pelagic limestones. Stilolizations along microfolding and beddings are typical.

Fig. 6: Reddish levels showing red-white color differentiation in the Jurassic condansede sequence. White (light colored) parts are ammonite limestone, red (dark colored) partsare flaman limestone. Flaman limestone are observed as matrix and matrix and microfissure fillings.

Fig. 7,8: Jurassic flaman limestones; intense packings formed by flamans represent the microshells deposited on hardgrounds in the condensede sequence. Due to the sea floor-currents, these are generally oriented.

Fig. 9: Nanno-organism well preserved in the Lower Cretaceous pelagic micrites. All the micrite matrix are probably derived from the nanno-organisims "nannomicrite".

Fig. 10: Electron microscope image of highly recrystallized micritic matrix in the Jurassic condensede sequence. Irregular grain size distribution probably supports the biogenic origin.

Baki VAROL and Gürkan TUNAY PLATE-I

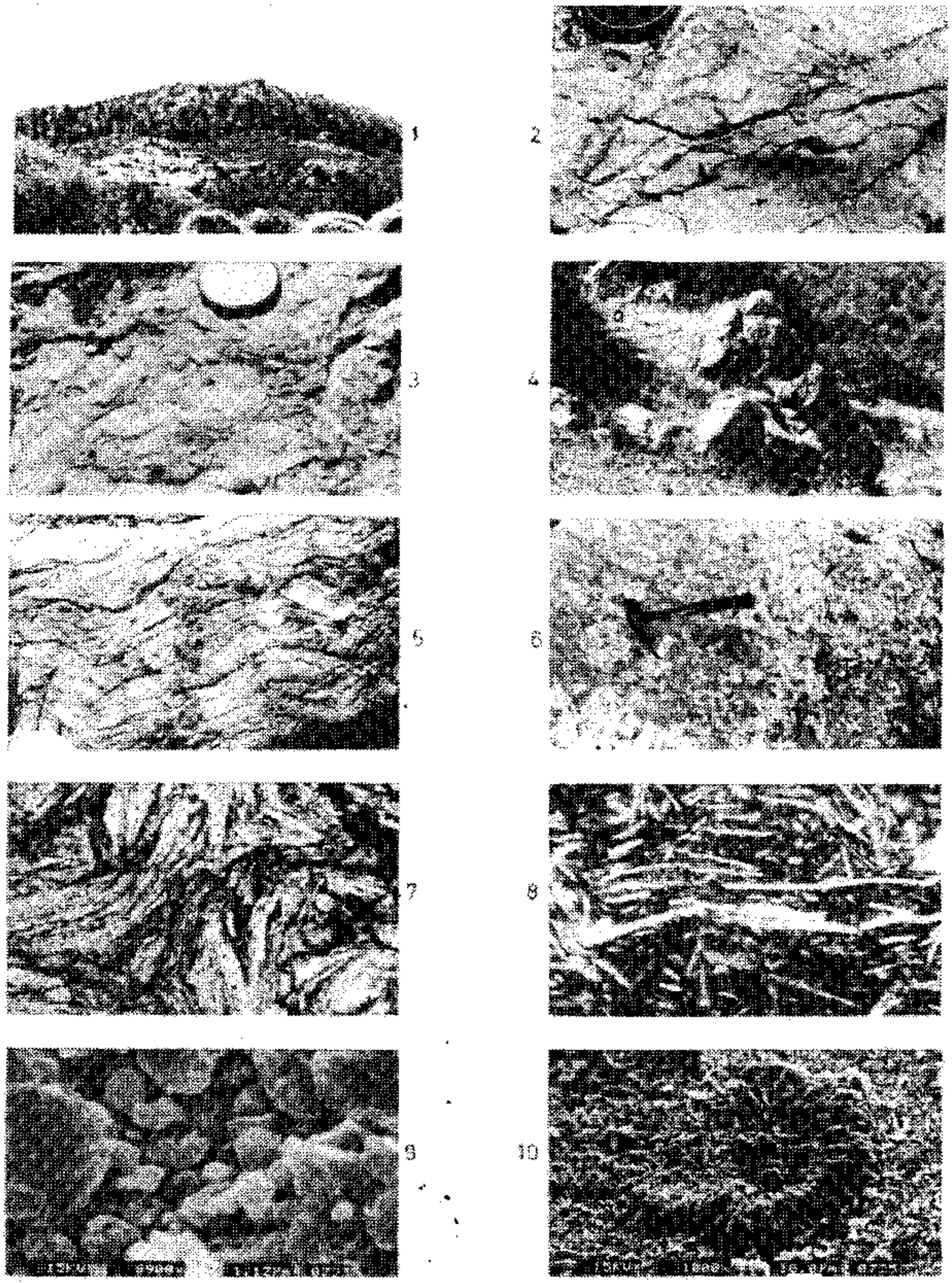


PLATE-II

Fig. 1: Microorganism laminations in the Upper Cretaceous pelagic limestones. They are formed by sweeping and election from the micritic matrix.

Fig. 2: Electron microscope view of micritic matrix of Upper Cretaceous red pelagic limestones. Highly recrystallization causes nanno-organisms being poorly preserved.

Fig. 3: Compact and irregular transition between flaman limestones (a) and ammonite limestones (b) indicates a sub-marine microerosion surface.

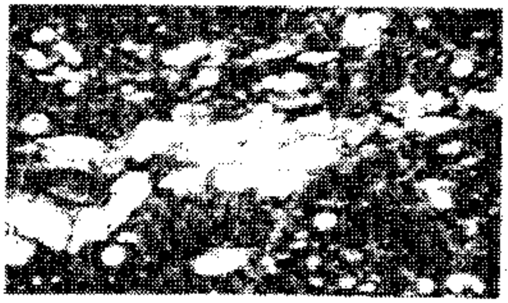
Fig. 4,5: Flaman limestones are either transported into the ammonite limestone fragments (hard sea floor erosion) (4) or fill in their microfissures (sea floor cracking) (5).

Fig. 6: Dissolution on the hardgrounds representing the Jurassic condensed sequence. Micro dissolution voids, internal sediment fillings anderosional surfaces in the dissolving part of the hardgrounds are typical (a). Ammonite shells in these sections are also partially dissolved and fractured.

Fig. 7: Electron microscope view of a sample from the Jurassic condensed sequence. Many microspaces (sieve texture) on the biogenic grains are the indicative of active carbonate dissolution on the hardgrounds.

Fig. 8: Clay mineralizations in the micritic levels of the condensed sequences. Filling of microspaces in the limestones by the illite type clay minerals may indicate that day mineralization was developed after the carbonate dissolution.

Fig. 9,10: Tupes micro burrowing organism colonized on the Upper Cretaceous red micrites of the condensed sequence (9). The fact that they burrow micrite matrix and nanno-organisms (10) next to them is an important for the formation of early sea floor hardening (hardground).



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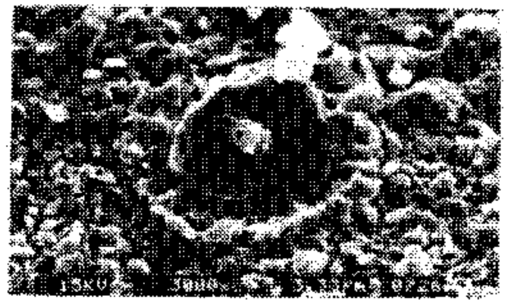

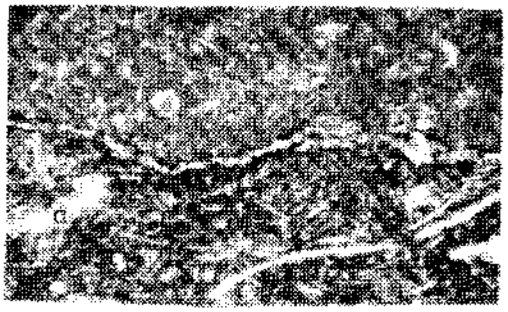

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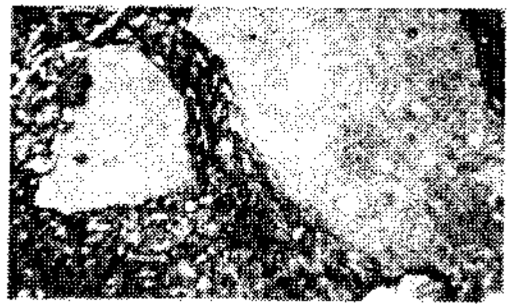

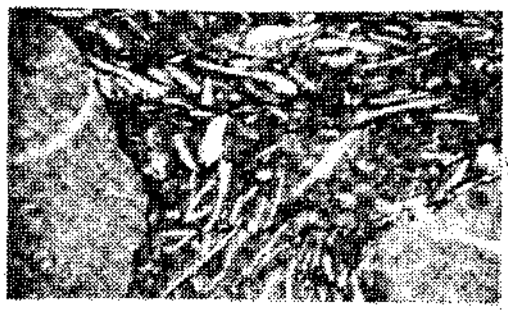

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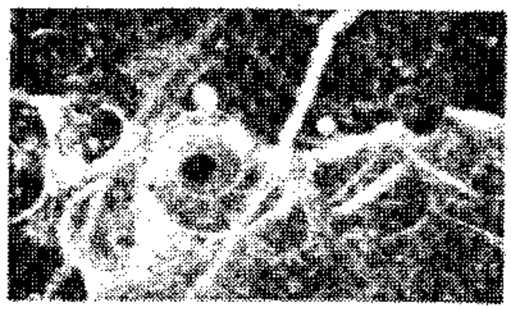

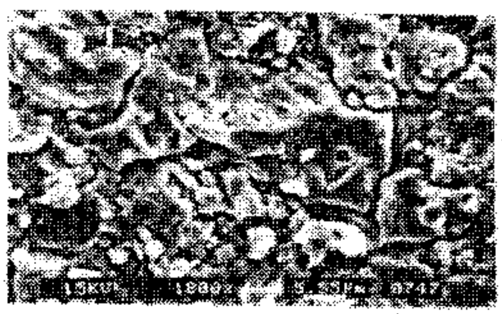

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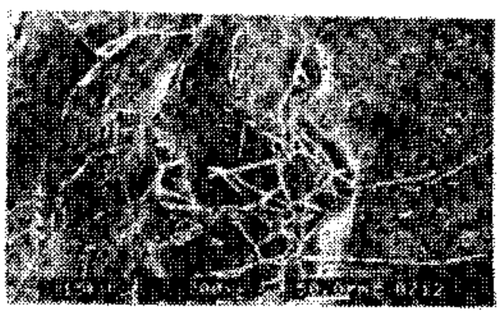

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