

Investigation on sedimentary and depositional environment usage of cretaceous in south-east of Golpayegan Region

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Abstract

In this investigation, the facies and their usage in the environment of cretaceous rocks that crop out at 35 km south-east of Golpayegan is studied. The section with 811 m thickness is composed of compact, dark marly shale, shale dark sandstones, orbitolina-contained limestone, marly limestone and calcareous limestone of early cretaceous (Albian), and dark gray limestone marly limestone of late cretaceous ages. Field and microscopic (petrographic) studies lead to recognition of 7 carbonate and 2 clastic facies. Facies 1 (Bioclast lime mudstone) indicates medium open marine environments. Facies 2 (Bioclast wackestone). Facies 3 (Peloid wackestone), Facies 4 (Bioclast packstone), Facies 5 (Bioclast packstone), Facies 6 (Intraclast packstone) and Facies 7 (Lime mudstone) indicate shallow to medium (sub-tidal) inter-tidal and supra-tidal deposition. In some cases, such as Facies 8 (Lime mudstone) and Facies 9 (Sandstone) Facies refer to a clastic condition which has direct relationship with active tectonic periods. Meanwhile in normal cases, Facies 4, 5 and 6 Facies are representative of carbonate basin in shape of homoclinal ramp.

Keywords: facies, environment of cretaceous rocks, Golpayegan Region

Introduction

The region under investigation on west-eastern plain is at 35 km of Golpayegan province in Iran. Geographically, this area extends from approximately 33.14 to 33.18 northern global latitude towards 50/25 to 50.33 eastern global longitude; covering a section of the Dinab Mountain. Since each of the individual typical classification methods are inadequate for the introduced carbonate rocks and would not illustrate the full facies characteristics, in this paper an integration of 2 well-known and commonly used methods (Pettijohn et al., 1987; and Durham 1962) are used whilst the facies are also given nominations.

Stratigraphy

Sedimentary rows of post-cretaceous (Barmian-Albian) at central Iran form a large cycle which is naturally limited within the Early Cimmerian and Austrian events (Seyyed Emami et al.1971). From stratigraphic perspective, the zone under study contains conglomerate (covered with debris) and sandstone (grit) strata which indicates it had undergone corrosion prior to pre-cretaceous period and has significant unconformity on shale sediments and pre-Jurassic sandstone. Marl and orbitolina lime units lay in alternative layers on it and on top of this, marls and shales being isocline with each other lay on orbitolina lime. A homoclinal group of shale and dark slits with relatively remarkable unconformity are observed. These shales are gradually converted into marly lime in lateral direction and are referred to as post-cretaceous age.

Methodology

After data collection using published resources, field and laboratory studies at location under study were performed. To this end, from all units of shale, shale-lime, and limes belonging to cretaceous period at every 10 meters (vertical depth) of this region one sample was taken at 30 m

depth of the crop out surface perpendicular to the strata and thus 229 samples were taken for laboratory studies.

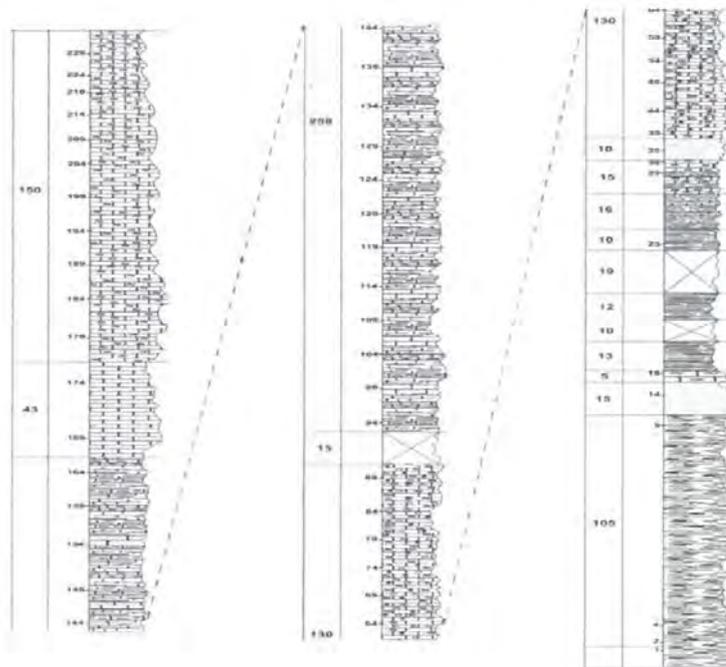


Fig. 1. Stratigraphy column of cretaceous units at south east of Golpayegan Province

Description of microscopic facies

According to the characteristic of thin microscopic sections including rock texture, its type, size, form and population, 2 groups of remarkable facies including 9 carbonate and clast facies were distinguished. In reviewing and comparing the above mentioned facies with the standard facies presented (by Flugel 1982 , Wilson 1975), it can be concluded that generally, a carbonate ramp area with a moderately homoclinal ramp at the direction of the area is formed. Included in the diagenesis events in most facies, micriting, silicating, hematiting, biological turbulency, dolomiting and sparrycalcite filled gaps at thin microscopic sections are seen.

Open marine facies group

Facies 1 is Bio-clastic Mudstone (Fig. 1) including 2 sub-facies entitled: echinoderm mudstone (Fig. 2) and orbitolina mudstone (Fig. 3). These facies include sub-facies and a little amount of just less than 10% allochems at thin sections of the above mentioned region. Most populated allochems in these samples are such allochems as orbitolina, echinoderm, brachiopoda, and gastropod which indicate the area has low energy.



Under-tidal facies group and tidal plain

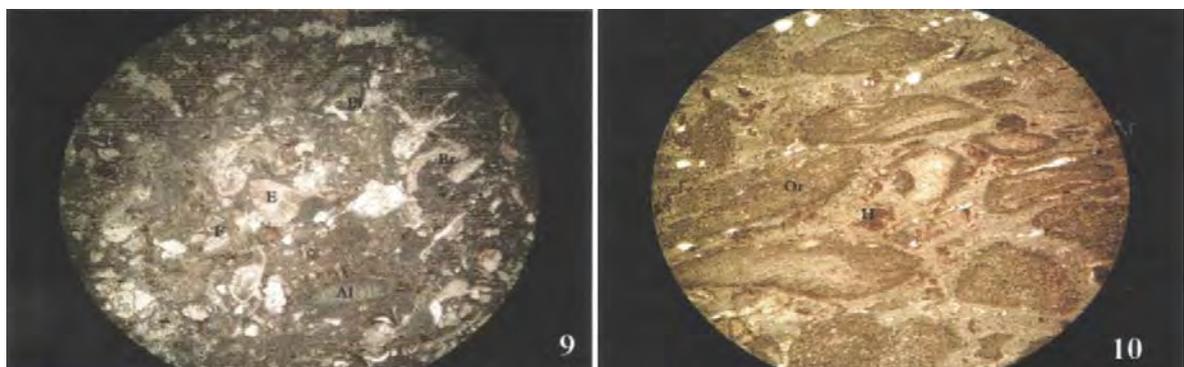
Facies 2 is Bio-clastic Wackstone (Fig. 4) including 3 sub-facies entitled: Allochems wackstone (Fig. 5) and orbitolina wackstone (Fig. 6) and sub-facies spicule sponge wackstone (Fig. 8). This facie includes sub-facie and is formed of 10 to 50% allochem. Fossil pieces include such substances as oncoides, chloritoid, echinoderm, spicule sponge, orbitolina, brachiopoda, bivalves and foraminifera allochem in the form of such substances as brachiopoda, spicule sponge which are less populated in some of the samples and this indicates there was formation in this environment.



Facies 3 is Ploide Wackstone (Fig. 8) and the amount of ploides in this facie is more than the fecal pellets. Ploides and fecal pellets are in 0.1 to 0.3 mm sizes and this indicates there was formation in this environment.



Facies 4 is Bio-clastic Packstone (Fig. 9) including orbitolina wackstone (Fig. 10) and this facie includes sub-facie and fossil pieces such as chloritoid, echinoderm, red alga, orbitolina, intraclast, ostracods, bivalves (Pelecypoda) and foraminifera. Allochems are in less population containing such substances as brachiopoda and spicule sponge. They are also seen in some samples accompanied by gripstone, ploides and pellets which denote a high-energy environment.



Facies 5 is Ploide Packstone (Fig. 11) wherein the amount of fecal pellets in the micrite matrix substance is more than ploides. Pellets are in 0.5 to 0.03 mm sizes and this denotes a high-energy environment.



Facies 6 is Intraclasts Packstone (Fig. 12) wherein there is seen a high population of intraclasts in some of the thin microscopic sections and in some samples together with sands which denotes high-energy environments.



Facies 7 is Mudstone (Fig. 13) which includes 2 sub-facies named ploide mudstone (Fig. 14) and sub-facies grit (Fig. 15). This facie having 2 sub-facies that include carbonate mud and its little amount of ingredients of less than 10 % sand and ploide. Sedimentary structure including stromatolite, fabric fenestral, laminate, synarsis fissure, and evaporative mold are witnessed which denote a high-energy environment.

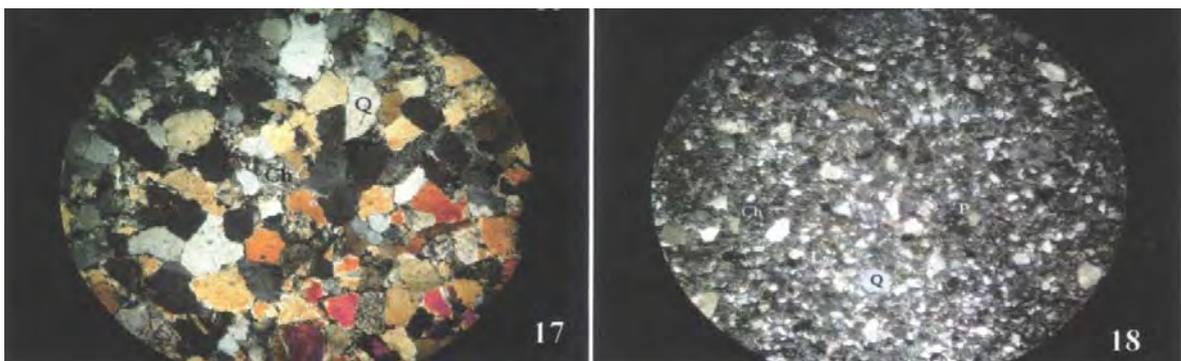


Facies 8 is Lichen which includes 2 sub-facies named shale and siltstone sub-facies (Fig. 16). This category of fine-grain carving rocks in the region under study can be segregated into two groups of facies: Dark grey thin lime shale strata containing organic material with weak micaceous

(leaf formation) which are seen at some microscopic thin sections in the form of various clayish, muddy and shale type siltstones being mainly of marly, sandy and even laminate shales.



Facies 9 is mudstone which includes 2 sub-facies named Litharenites (Fig. 17) and lythic wacky sub-shale (Fig. 18). Sandstones according to type and behavioral method can be segregated into 2 groups of sub-facies which are formed from major quartz mineral and rubbles particularly chert and some feldspot. Their granularity is medium to fine-grained and textured as immature to mature having medium sortation and roundness.



The sedimentary model

In presenting a sedimentary pattern together with Law of Walter (Walther 1894 in Middleton 1973), the principle of overlaying of strata is taken into consideration. The results were compared with current and past environments (for example making reference to scientific resources particularly Wilson, 1975; Corozzi, 1989; Flugel, 1982) and a sedimentary pattern of the above mentioned region was presented. As already described, at present, according to crop out conditions of the region under study at an open marine, barrier, water pool, and continental environment it appears that carbonate platforms are of ramp type with a more or less homoclinal ramp (a gradient surface).

Application

Based on sedimentary studies and sedimentary environment above, the type of sedimentary environment of the open marine was determined. This sedimentary environment has various applications since the sediment shales in this zone can be the place for formation and origin of organic material. This fact is confirmed by geochemical studies carried out on organic matters in the mentioned environment and even this region is considered very competent and viable and on the

other hand, the formed lime strata in this environment can be a great source of building and support material; for example: Limestone of similar environments used as building stones, quicklime and raw material in cement factories are very useful in applications. Thus, the mentioned region has also a diversified usage in such cases.

HOMOCLINAL RAMP

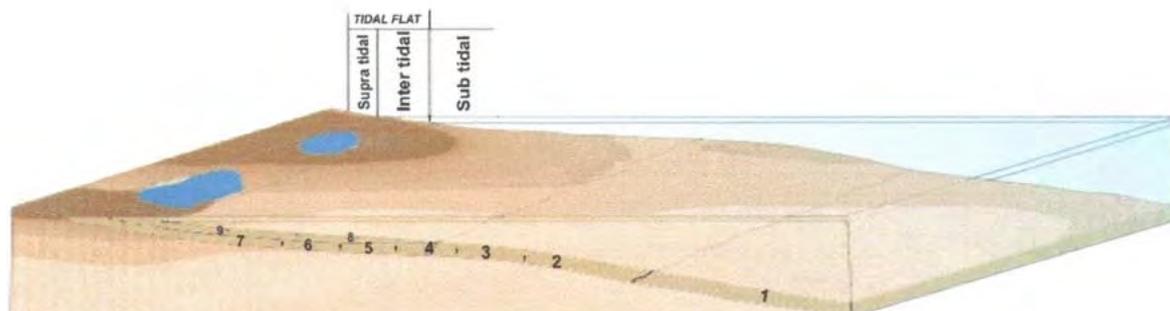


Figure 19. An image of the sedimentary model of cretaceous units at region under study

Conclusion

The most important results of cretaceous deposition units at about 35 km distance south-east of Golpayegan province are : 9 facies in the form of 2 groups of open marine environmental dependant and under-tidal environment, and tidal plain are identified in this study. Such groups of facies on a ramp-type carbonate platform with homoclinal gradient is cropped out in such a way that includes open marine region (facies 1) and under-tidal and tidal plain (facies 2, 3, 4, 5, 6, 7, 8, 9). For some conditions such as for facies as 8 (lichen) and 9 (sandstone) they refer to carving conditions with direct generative link to active topological periods whilst in normal conditions they are facies 4, 5, and 6. Generally, from this study the paleolithic geographical condition of the region during sedimentation period of cretaceous units in the region can be identified. In related comparative studies of the attained results and particularly constituent parts of rock facies and their vertical alterations, it is verified that a vast recess at the start of cretaceous period (also in region under study) had occurred which continued until Albian event; and following the crop out of microfacies in high-energy environment at this period, gradually, in the stratification transition sequence from carving microfacies to carving grain-contained bio-clastic limy microfacies, major amounts of quarts is identified. Extensive progression of cretaceous marine together with advancement of bio-clastic limy facies at upper cretaceous in the region under study is verified.

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