Study on geomorphology dynamics of limestone-shale collapse in the Kollah-Ghazy Area, south Esfahan, Iran

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Abstract
The focus of geomorphology is concerned with an analysis of the nature, arrangement and differentiation of landforms and an understanding of the processes that have shaped or are shaping these landforms. Uplift at the end of Cretaceous and beginning of the Tertiary created asymmetric domes. Foresets of limestone and shale in stratigraphic units of shear folding area to Cretaceous in the Kollah-Ghazy of south and south-east of Esfahan have resulted in many collapse features that have developed several shapes like cuesta. Erosion of these uplifted rocks produced the present landscape. Resistant sandstone that are ordered near the shale layer has been formed the cuesta like form. Results of morphology showed in spite of these forms lay in folded structure, they have any characteristics that they have contained in monoclimb structures such as foresets of hard and weak layers with temperate slope in construction simple and agreeable limb. In this paper we have tried to investigate the relationship between slope particulars and speed of destruction and layer dynamics, with measuring some geomorphology quantitative parameters. Analysis of regression showed a significant relationship between slope of weak layers with slope and thickness of hard layers. Also the slope of weak layer desire to angle of repose because of weathering effects, gravity and friction forces. So if the slope of weak layers exceed from the slope of repose, the hard layer destroy slowly and vice versa. According the results the among of the weak slope is suitable generally for velocity of destroy forests and study its dynamics. Conclusion of limestone and shale and formation of the forms like cuesta in this area has led to different problem in environmental management because of the cuesta limb ready for rock falling. Appreciation of the landscape of these geomorphologic features involved in the activity of human for quarry of stone that should be considered in land use planning in the south and south-east of Esfahan city where urban population need to the natural landscape for refreshment.

Key words: Geomorphology, cuesta like from, angle of repose, forests, Kollah – Ghazy, Esfahan.

1. Introduction
The science of geomorphology has certain common elements, regardless of the scale of investigation or the system being examined. A fundamental proposition of geomorphology was proposed in which landscape stability was described as a function of the temporal and spatial distributions of the resisting and disturbing forces. Land future is frequently the driving force in many systems and human activity acts as a modifying influence understanding and predicting change is not, however, merely a matter of understanding the mechanics of the change process. It requires the recognition and comprehension of the nature of the links between individual system components concepts such as thresholds of change (Schumm, 1977), response time and magnitude, rates and paths of change and recovery, are all important if the full nature of changes are to be appreciated (Brunsden, 1990). There is little doubt that the resistance of natural systems to change, be they
geomorphological is complex and poorly understood subject. Stratigraphic units and its sensitivities is considered by most of moderns geomorphologists to be one of several independent variables that effect the morphology and evolution of landscapes (Kinghton; 1984, Ritter; 1986, Schumm; 1977, Schumm and Lithy; 1965). Whereas advances have been made in understanding many of the processes leading to changes in landscapes, recent scientific advances have shown the joint nature of forms and processes driving many geomorphic system changes and the nature of feedback processes between physical and morphological systems (e.g., Zeng et al., 1999). Detail on the coupling effects between these two systems, however, is poorly understood (e.g., Scheffer et al., 2001). Thus, with increasing pressures on the environment, a strong trend exists to manage environmental changes (Thoms and Parsons, 2002). Terzaghi (1969), Robertson (1970), Einstein et al (1995), Eberhardt et al (2001) and several researchers developed some physical and mechanical approach for stability of slope with complexity equation. Morphological study of slope dynamic is less than physical study. At present geomorphologists decide to solve this problem by investigation morphometric relations.

One of the active and sensitive slope hills is cuesta and pseudo cuesta like forms. changing in ancient sedimentation environmental was caused to establish its landscape. Foreset of limestone and shale in stratigraphic units of shear folding area and uplift process at the temporal period was affected to appear pseudo cuesta like forms. Erosion of these uplifted rocks produced the present landscape. The difference between soft and hard layers resistance has been formed geomorphic form that they are susceptible of change.

The objective of this paper is to quantity several morphological of hillslope of topographic development to find a single relationship that can be used to characterize sensitivity of landscape.

2. Regional setting of study area

The study area is in the Kollah Ghazy national park in southern Isfahan city in Iran (fig.1). The area is about 40 km². major rock groups are the Albian with genus of calcareous grey shale containing ammonites and small gastropods, Turorian-coniacian kind of bedded limestone containing \textit{Inoceramus} and \textit{Globotruncana}.

3. Methods

Morphological parameters were studied by analyzing and relating of downhill slope containing among of slope, thickness of soft and hard layers and the direction and the shape of forehead of hard bedrock layer. Analysis of regression was applied for investigation the relationship between slope particulars and speed of destruction and layer dynamics, with measuring some geomorphology quantitative parameters.

4. Results

The physiographic and geologic structure of the Kollah Ghazy has found two wrinkled mountainous string from lower and middle part of Cretaceous sediment. The study area (pseudo cuesta like form) has been fixed during several minor fault and uplift process has been done present of limestone-shale collapse from upper Cretaceous. results of analysis of regression for hillslope parameters has been showed in tab.1.
Results showed a significant relationship between two scopes with the coefficient of determination ($R^2$) of 0.763. Also, soft hillslope with thickness of hard layer has a significant relationship with $R^2$ of 0.532. The highest coefficient of determination belong to multivariate regression between soft hillslope and two parameters of hard hillslope (slope and thickness) with $R^2$ of 0.838. Comparison of among of slope for two scopes (tab.2) illustrates a significant difference ($\alpha<0.001$) between means (tab.2). Measurement angle of repose for shale of soft slope with field examination obtained equal 25.47 percent.

5. Conclusions
A series of limestone-shale collapse are located in study area and the base of the formation is two beds of soft and hard layers that they have been formed a cuesta like form in a folding system and appearance these features along several fault because of uplift process. On these geomorphic form two type of hillside, a simple bedrock slope and a compound slope of alternate soft and hard layers. with due attention to obtained the relation ship between slope of compound hillslope (soft layer) and simple bedrock hillslope (slope and thickness) can be state increasing in the bedrock slope and thickness was cased increasing the slope of soft hillslope. if slope of compound hillside were as big as the angle of repose, destruction speed in bedrock would be fixed. Therefore comparison slope of soft layer and angle of repose itself can be state for bedrock destruction. So if the slope of weak layers exceed from the slope of repose, the hard layer destroy slowly and vice versa. According the results the among of the weak slope is suitable generally for velocity of destroy forests and study its dynamics. Conclusion of limestone and shale and formation of the forms like cuesta in this area has led to different problem in environmental management because of the cuesta limb ready for rock falling. Appreciation of the landscape of these geomorphologic features involved in the activity of human for quarry of stone that should be considered in land use planning in the south and south-east of Esfahan city where urban population need to the natural landscape for refreshment.

References


Tab.1. The validation statistics of different relationship for data set.

<table>
<thead>
<tr>
<th>No</th>
<th>Relationship(Variable)</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Soft slope &amp; Hard slope</td>
<td>0.873</td>
<td>0.763</td>
<td>28.917</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>Soft slope &amp; Hard thickness</td>
<td>0.729</td>
<td>0.532</td>
<td>15.902</td>
<td>0.001</td>
</tr>
<tr>
<td>3</td>
<td>Soft slope &amp; (Hard thickness and slope)</td>
<td>0.915</td>
<td>0.838</td>
<td>20.630</td>
<td>0.001</td>
</tr>
<tr>
<td>4</td>
<td>Soft slope &amp; Soft thickness</td>
<td>0.090</td>
<td>0.008</td>
<td>0.116</td>
<td>0.739</td>
</tr>
<tr>
<td>5</td>
<td>Hard slope &amp; Soft thickness</td>
<td>0.460</td>
<td>0.211</td>
<td>2.140</td>
<td>0.155</td>
</tr>
<tr>
<td>6</td>
<td>Hard slope &amp; Hard thickness</td>
<td>0.419</td>
<td>0.175</td>
<td>1.915</td>
<td>0.200</td>
</tr>
<tr>
<td>7</td>
<td>Hard thickness &amp; Soft thickness</td>
<td>0.381</td>
<td>0.145</td>
<td>2.380</td>
<td>0.145</td>
</tr>
</tbody>
</table>

Tab.2. Mean comparison of soft slope with soft slope without bedrock (angle of repose).

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std.Deviation</th>
<th>N</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft slope in collapse</td>
<td>29.6</td>
<td>1.18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft slope without bedrock (angle of repose)</td>
<td>25.47</td>
<td>0.92</td>
<td>14</td>
<td>12.848</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Fig.1. Typical exposure of limestone-shale landscape in Kollah Ghazy, southern Isfahan, Iran
Microbiostratigraphy and Paleoecology of bentic foraminifers study based on the Microfacies and Sedimentary Sequence identification and interpretation in Asmari Formation of South- East of Shiraz (Fars province)

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Abstract
In this research, two stratigraphic sections were chosen from Asmari Formation. These sections include Shamsabad and Runiz plus 280 meters. For this investigation, 251 thin-sections were prepared, and 14 samples analyzed by XRF. We studied paleobiotope that includes biozone and sedimentary sequence. These index biozones and percentage of elements that appear in paleobiotope are identified. Principally index bentic foraminifers, identified in the studied sections, are listed below:

- Nummulites fichteli
- Nummulites intermedius
- Nummulites vascus
- Spiroclineus ranjanae
- Rotalia viennotti
- Pearhapsaydina delicata
- Austroterillina howchini
- Peneroplis evolutus
- Peneroplis thomasi
- Archaias sp.
- Pyrgo sp.
- Archaias krikukensis
- Valvulinid sp.
- Spirolina cylindracea
- Triloculina trigonula
- Borelis melo
- Meandropsina iranica
- Dendritina rangi
- Peneroplis sp.
- Austroterillina sp.
- Borelis sp.
- Meandropsina anahensis
- Triloculina tricarinata
- Valvulinid sp.1
- Valvulinid sp.2
- Miliola sp.

Based on aforementioned foraminifers, the age of studied sediments is Oligocene to early Miocene and also three biozones have been identified for these sediments. Regarding the frequency, sedimentary sequence (parasequence and system tract), type of wall and paleobiotope percentage ratio of each foraminiferal biozone, there are different paleobiotopes that indicate change in the trend of paleoecologic conditions of Asmari formation.

Keywords: Biozone; Paleobiotope; Sedimentary Sequence; Foraminifer; Asmari Formation;

1- Introduction
the Asmari Formation in Fars region overlays the Jahlur Formation with an erosional disconformity. The first time, the type section of Asmari Formation has been studied by R.K. Richardson (1924) in the Strait of Goltorsh. In the type section exists only middle and upper part of Asmari Formation. The age of Asmari Formation has been said Oligocene to Burdigalian by Thomas (1948). And the Asmari Formation has been divided by three part, lower Asmari with the Oligocene age, middle Asmari with the Aquitanian age of Miocene and upper Asmari with the Burdigalian age of Miocene. The lithology of this Formation consists of cream to brown limestone with the fossil shell and the thickness of the sediments is 314 m.(Motiei 1372, Khosrotehrani 1384, Darvishzade 1385)
2- Geographical situation of the studied stratigraphic sections

The studied stratigraphic sections are situated in South-East of Shiraz (Fars province). we can approach it through the main road of Shiraz-Estahban. The geographic coordinates of Runiz section is N 29°, 19’ – E 53°, 25’ and The geographic coordinates of Shamsabad section is N 29°, 13’ – E 53°, 23’.

3- Introducing Biozonation of the studied stratigraphic sections

Actually, in the studied stratigraphic sections, three biozones have been determined for benthos foraminifers in the sediments of Upper Oligocene (Chatian) to Lower Miocene (Burdigalian) which are as follow:


3-1- Biozone No. 1 - Nummulites fichteli – Nummulites intermedius – Nummulites vascus assemblage - zone

The thickness of this biozone in Shamsabad section is 56 m. and in Runiz section is 25.5 m. and its microfossils includes: Pearhapsydionina delicate , Spiroclypeus ranjanae, Rotalia viennoti , Ditrupa sp. which indicates the age of Chatian. According to Thomas ’s definition, this assemblage zone is equivalent to lower Asmari.

3-2- Biozone No. 2 - Austroterillina howchini – Peneroplis evolutus assemblage – zone

The first time, this assemblage zone has been recognized by Wynd (1965) and according to division of Thomas, it is equivalent to middle Asmari (Aquitanian) and its phonetic contents includes: Peneroplis thomasi , Archaias sp. , Pyrgo sp. , Archaias krikukensis , Valvulinid sp. , Spirolina cylindracea , Triloculina trigonula . The thickness of this biozone in Shamsabad section is 46 m. and in Runiz section is 49 m.

3-3- Biozone No. 3 - Borelis melo group – Meandropsina iranica assemblage – zone

This assemblage zone is equivalent to Borelis melo group – Meandropsina iranica assemblage – zone ( Adames and Bourgeois, 1967 ) and according to division of Thomas, it is equivalent to upper Asmari (Burdigalian). its microfossils contents includes: Dendritina rangi , Valvulinid sp. , Pyrgo sp. , Triloculina trigonula , Peneroplis sp. , Rotalia viennotti , Austroterillina sp. , Borelis sp. , Meandropsina anahensis. The thickness of this biozone in Shamsabad section is 45 m. and in Runiz section is 58.5 m.

4- Description of Sequence Stratigraphy and microfacies of Asmari Formation in the Studied Stratigraphic Sections

Actually, based on the sequence stratigraphic studies, the studied sections of (Shamsabad and Runiz) includes two 3rd order sediment sequence and 6 facies groups is recognized.

4-1- Sediment sequence 1

The age of this sequence is Chatian to Aquitanian and it consists of lower and middle part of Asmari Formation. lower boundary of SB1 type is placed on Jahrum Formation and upper boundary of SB2 type is in the end of middle part of Asmari Formation. The thickness of this
4-2- Sediment sequence 2

The age of this sequence is Burdigalian. The thickness of this sediment sequence in Runiz section is 57.5 m. and in Shamsabad section is 45 m. Lower boundary is SB2 type and upper boundary is SB1 type. Maximum flooding surface (mfs) is in studied sections is Packestone facies with microfossils for example Globorotalia sp., Triloculina tricarinata, Meandropsina sp. (TST) facies is open marine limestones that the thickness of it in Runiz section is 27 m. and in Shamsabad section is 14 m. HST consists of shoal and lagoon facies that the thickness of it in Runiz section is 30 m. And in Shamsabad section is 31 m. (Lassemi, 1980)(Flugel, 2004) (Dunham, 1962). Parasequence stacking pattern of TST and HST show a regressive form. (Fig.1, Fig.2) (Sarg, 1988) (Emery & Myers, 1996) (Sloss, 1963)(Khosrotehrani, 1386)

5- Paleoecology

The most abundant rate of foraminifers is in lower part of the studied stratigraphic sections (Biozone No.1). And this amount is decreased in middle and upper part (Biozone No.2 & 3). The variety of species in lower part is more than middle and upper part. The percentage of Na2O in biozone no.1 is the most amount and this percentage is decreased biozone no.2 & 3. Increasing in becoming thick of porcelanuse test is the mot amount in biozone no.1. In fact, fauna test in order to resist collision of waves to bar is became thick in this biozone. The percentage of Cao and Mgo is decreased. but in biozone no.3, becoming thick Hyalin test is observated for example Rotalia viennotti, that in this biozone, the percentage of Mgo and Cao is increased. The most availability of foraminifers with Agglotinate test and Porcelanous test are observed in paleobiotope related to TST facies and the most availability of foraminifers with Hyaline test is in paleobiotope related to HST facies. (Fig.3, Fig.4, Fig.5, Fig.6) (Khosrotehrani, 1382) (Zavarei, 1387)

6- CONCLUSIONS

a) Two stratigraphic sections of Runiz and Shamsabad have a lot of similarities in view of biozonation and sequence stratigraphy.

b) Based on the investigation of foraminifers of the studied sections, there are these biozones that have been identified which includes:

Biozone No. 1- Nummulites fichteli–Nummulites intermedius–Nummulites vascus assemblage – zone of Chatian.

Biozone No. 2- Austroterillinia howchini–Peneroplis evolutus assemblage–zone of Aquitanian.
Biozone No. 3- *Borelis melo group – Meandropsina iranica* assemblage–zone of Burdigalian. However the age of both stratigraphic sections is from Chatian to Burdigalian.
c) The most availability of foraminifers with Agglutinate test and Porcelanous test were observed in paleobiotope related to TST, facies and the most availability of foraminifers with Hyaline test was in paleobiotope related to HST facies.
d) The lower border of the Asmari Formation (SB1) has been distinctive with an erosion-made disconformity as the result of an Peirmean Orogenic phase operation and the upper border of Jahrum Formation is erosion-made disconformity.
e) According to the biostratigraphic limits of the studied sections, datum line is determined in U.Oligocene (Chatian).

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Fig 1: Sequence Stratigraphy description of Runiz stratigraphic section

Fig 2: Sequence Stratigraphy description of Shamsabad stratigraphic section

Fig 3: The distribution of index elements in Runiz stratigraphic section sediment

Fig 4: The distribution of index elements in Shamsabad stratigraphic section sediment
Fig 5: The process of changes in abundant rate of microspheric, megalospheric form, bentic and pelagic foraminifera and changes rate of test kinds of foraminifera in biozones and different facies of the studied stratigraphic sections

<table>
<thead>
<tr>
<th>Facies</th>
<th>Biozone</th>
<th>Increasing Hyspor Test</th>
<th>Increasing Porcelanous Test</th>
<th>Increasing Ampholot Test</th>
<th>Increasing Meogramspheric</th>
<th>Increasing Benthic Foraminifera</th>
<th>Increasing Bontic Foraminifera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagoon</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open marine</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagoon</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back bar shelf</td>
<td>(Open marine)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Biozone No 1: Nummulites sichelli - Nummulites intermedius - Nummulites baccata assemblage - zone
Biozone No 2: Austrotrilina howchi - Peneroplis evolutus assemblage - zone
Biozone No 3: Borelis melo group - Meandroopsis iranica assemblage - zone

Fig 6: The block diagram of Asmari Formation sedimentary basin in the studied stratigraphic sections, according to sedimentary facies condition and sequence facies sets condition and biozones
Effect of Biosolid Application on Bioavailability of Potassium in two Different Kinds of Soils Textures and Yield of Corn Plant

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Abstract

One of the most important problems in semiarid and arid regions soil is the organic matter loss. The majority of calcareous soils in arid and some semiarid regions of Iran are low in fertility, organic matter content and productivity. These soils are usually characterized by high pH due to the presence of carbonates and by low contents in organic matter. Interaction between macronutrient and organic matter is considered important on the bioavailability of these elements to plants. Biosolids application on agricultural land as fertilizer is commonly in many countries. Manure is one of the biosolids that rich in macro and micro nutrients. The objective of this study is the evaluation of the effects Macronutrients uptake by corn from biosolid treated soils. This study was carried out in 48 pots in a greenhouse using factorial experiment design as completely randomized and each treatment was replicated three times. Treatments included tree levels for 0 or control, 25, and 50 Mg ha⁻¹ Manure and soil including two different calcareous soils. The soil texture were clay loam with 39% clay, 34% silt and 27% sand and sandy loam with 7% clay, 24% silt and 69% sand. Plants were cut for analysis 8 weeks after planting and made ready for chemical analyses. Macronutrient concentrations in shoots, roots of the plants and soils were determined separately. Soil samples were air-dried, sieved (2 mm), and analyzed for pH and electrical conductivity (EC) in soil saturation extracts and organic carbon (C) by standard methods. The results showed that organic matter treatment had positive and significant effect on the shoot dry matter weight and the uptake index of potassium was increased significantly compared to the control. Manure application (50 Mg ha⁻¹) increased potassium transfer-coefficient significantly in sandy loam. Manure application (50 Mg ha⁻¹) increased significantly, concentration of potassium in shoot and root. In general, corn yields increased significantly in the biosolid treatment in clay loam soils. Increasing yield related to nitrogen and phosphorus rates that existing in biosolid. Soil organic matter content has long been suggested as the single most important indicator of soil Productivity. This can result in beneficial effects biosolid on soil fertility and plant nutrition. It seems necessary to provide reasonable levels of organic matter for achieving higher yield and sustainable agriculture one of the strategies is using organic fertilizer among them manure.

Keywords: Biosolid; Manure; Macronutrient; Potassium; Corn Plant; Calcareous Soils;

1. INTRODUCTION

Agricultural land use could result in declined soil fertility, especially reduced soil organic carbon and soil N [8]. Land application of biosolids has received increased attention in the last 2 decades [5, 14] and it could help to replenish the reduced soil organic matter, supply nutrients, such as N, P, K, S and essential micronutrients to plants, improve soil texture and water holding capacity, and have beneficial effects on microbial biomass and activity [6,12].
Of all farming practices, rational fertilization is among the most important measures for the sustainable crop production required to meet the food demand of the growing population of the country. There have been concerns that soil degradation threatens the sustainability of cropping systems [4, 16]. Use of manures is generally seen as a key practice for maintaining soil fertility and agricultural sustainability in the wheat–maize rotation and rice-based cropping systems [10, 17, and 18]. These difficult climatic conditions have favored greenhouse production of many kinds of crops (e.g., vegetables, ornamental plants). Our aims were to (i) determine effects of compost application on yield of plant (maize); (ii) to investigate the effects of manure usage on potassium concentration in two soils and plant.

2. MATERIALS AND METHODS

2.1. Greenhouse Study
The experiment was conducted at the Isfahan Azad University Research Station, located approximately 12 km north east of Isfahan city (32 40 N; 51 48 E). A pot experiment was conducted to compare manure that the study was carried out in a greenhouse using a factorial experiment design: biosolid applications such as manure, with levels (25 and 50 Mg ha⁻¹), control and soil (Clay Loam) with three replications. The soil textures were two soils (Clay Loam, Sandy Loam) with three replications. The soil texture were clay loam with 39% clay, 34% silt and 27% sand and sandy loam with 7% clay, 24% silt and 69% sand. Some properties of the soil and manure are shown in (Table 1).

2.2. Sampling and analysis in soil and plant
Soil samples were air-dried, sieved (2 mm), and analyzed for pH and electrical conductivity (EC) in soil saturation extracts and organic carbon (C) by standard methods [2], for CEC using the [15]. Total N (Kjeldahl method), phosphorus (P) (vanado-molybdate spectrophotometer method), and potassium (K) were determined by (flame photometry) [3, 11, 13]. Some properties of the soil and manure are shown in (Table 1).

Zea Maize was selected for this experiment. The plants were grown in a greenhouse for 75 days, and in a day/night temperature regime of 25/18 °C. The pots were regularly adjusted by weight to 40% of water holding capacity (WHC). Shoots and roots were harvested separately. Roots were washed free of soil with tap water, and then rinsed with double-distilled water. All the plant samples were dried at 65°C for 48 h, weighed, and then ground with an agate mortar to pass through a 2-mm sieve. Plant dry matter yield was determined 10 weeks after planting. The digestion quality for each plant part was tested using repeated preparation and determination of three replicates. The standard deviation of the results for each plant part was less than 5%. The concentrations of K in shoot and root were determined (dry Ashing) [7]. Finally, concentrations of elements K in soil and plant were determined by flame photometry technique.

2.3. Statistical analysis
All statistical analyses were performed using SAS version 6.10 for personal computers. Means of different treatments (level of sludge application after the last application) were compared using LSD (P B 0.05) test.
3. RESULTS

3.1. Effect of manure on Concentration of K in two soils and plant
Biosolid such as manure addition significantly (P < 0.01) increased CEC, %OM, and K concentrations in (Clay loam) soil compared to the control. All the treatments were significantly higher, to two levels of manure additions had with control (figure 1). Soil organic matter content has long been suggested as the single most important indicator of soil productivity [9]. Potassium is an element with high solubility that can be transmission easily with soluble anions in sandy soils [1]. The organic matter treatment had positive and significant effect on the shoot dry matter weight and the uptake index of potassium was increased significantly in clay loam soil compared to the control. The uptake index at a 50 Mg ha\(^{-1}\) manure rate was increased, because this treatment has higher biomass compared to other treatments (figure 2). However, dry yields of maize (75% respectively) increased significantly (p<0.01) in the manure (50Mg ha\(^{-1}\)) treatment in clay loam soil (figure 2). Manure gave the highest shoot biomass, an intermediate level as follows control. Root biomass levels were much lower than shoot biomass levels. Manure application (50 Mg ha\(^{-1}\)) increased potassium translocation factor significantly in sandy loam more than clay loam (figure 2). Manure application (50 Mg ha\(^{-1}\)) increased significantly, concentration of potassium in shoot and root. In all treatments with the manure a significantly higher levels of K were present compared with the levels in the controls. But must be attention to kind of soil texture as index, for biosolid such as manure usage especially in the arid and semi-arid. In calcareous soils with high CaCO\(_3\) and pH, the available potassium is low; also application of potassium fertilizers can reduce the available micronutrient. The results showed that the Manure is a suitable fertilizer for providing the macronutrient (N, K, P), of the plants in the soils, especially in calcareous soil of Isfahan’s region. Some long-term fertilization experiments show that organic amendments have positive effects on yield trends, i.e. continue to increase yield [17].

4. CONCLUSIONS
This study showed that application of manure not only provides extra organic carbon and major nutrients such as nitrogen (N), phosphorus (P) and potassium (K), but also improves soil physical and chemical properties and consequently traces metal retention or mobility. The increase in organic C and CEC after manure application could be explained by the large amount of organic matter in the manure and the large CEC of the organic matter. It seems necessary to provide reasonable levels of organic matter for achieving higher yield and sustainable agriculture one of the strategies is using organic fertilizer among them manure.

REFERENCES


Table 1- Selected chemical properties of the soils and manure used in the experiment.

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Figure 1. Comparative between two different levels of manure and control in two soils.

Figure 2- Effect of Manure on dry matter (a), Translocation Factor of K (b), uptake index of K(c), between two different levels of manure and control in two different soils.
An introduction to some Polygnathid conodonts from Shirband, Damghan

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Abstract
Late Devonian deposits (Geirud Formation) in Shirband area is located with conformal discontinuity on the Mila Formation and under the carbonate and dark gray shale deposits of Mobarak Formation. These sediments start with a relatively thick layer of limestone and white-brown siltstone and convert to yellow Dolomite and shale and marn limestone with some fossils. Between about 100 conodont samples, some Polygnathuses like Polygnathus alatus, Polygnathus communis communis, Polygnathus brevilaminus, Polygnathus webbi, Polygnathus communis mugodzharicus, Polygnathus symmetricus and Polygnathus delicatus is identified here that assign the upper Devonian age to the studied section.

Keywords: Shirband, Conodont, Devonian, Alborz

Introduction
Shirband area is located in 25 Km away from Damghan that belongs to eastern Alborz zone. This area is accessible by Damghan to Dibaj and Damghan to Shahroud roads (Figure 1). To date, no study is carried out on the Formations of this region and studies is limited to preparing of Geological map (1/100000) by Geological survey of Iran and some sparse studies on Shemshak Formation by Eastern Alborz Coal Company. Conodonts are significant in connecting the Iranian studied region and neighbor countries. Also this fauna can be influential in Devonain Paleogeography determination. In order to perform this study, 35 samples of the defined section were collected. After doing preparation procedures like Acid wash, 100 conodont samples were prepared. Apart from that other fossils like scolecodonts, placoderms, and crinoids stems were found. Based on found Conodonts, Upper Devonian age is suggested for this section.

Discussion
Probably, Paleothetis oceanic crust genesis and separation of Touran plate from North Iran plate (Gondwana) has occurred in early Devonian, so facies of Iran’s Devonian stones progressively cover the pre-Devonian discontinuity. At the start of early Devonian, sea level dropped down. By advancement of the sea at the time of formation of upper Devonian deposits, Devonian rocks located on the lower silourian or older rocks in the most parts of Iran. These stone layers have thickness about 167 meters in Shirband area and consist of recurrence of limestone, white to brown siltstone, Dolomite, thin layer limestone frequency to gray brachiopoda middle layer with shale and lime shale inter layers and dark gray limestone layer containing Spiriphids, Briosoe, Coral. This sequence is considered as Geirud Formation and is located with conformal discontinuity on the Mila Formation and under the carbonate and dark gray shale deposits of Mobarak Formation.
Results
Fossil and biostratigraphic evidences showed that upper Devonian deposits in Shirband section are marine and surface. Six polygnathid was identified in this study (Polygnathus alatus, Polygnathus communis communis, Polygnathus brevilaminus, Polygnathus webbi, Polygnathus communis mugodzhariicus, Polygnathus symmetricus and Polygnathus delicatus) and based on them Upper Devonian (Famenian) age is suggested for this section. Based on these conodonts, surface marine, coastal and warm sedimental environment is characterized. Considering paleontological and biostratigraphic evidences it seems that transit of Famenian facies to Tournaisian facies is gradual in Shirband area.

References


Plate:
1- *Polygnathus alatus* (Huddle, 1934) 128x
2- *Polygnathus communis communis* (Branson and Mehl, 1934) 107x
3- *Polygnathus communis communis* (Branson and Mehl, 1934) 96x
4- *Polygnathus brevilaminus* (Branson and Mehl, 1934) 65x
5- *Polygnathus brevilaminus* (Branson and Mehl, 1934) 117x
6- *Polygnathus webbi* (Stauffer, 1938) 132x
7- *Polygnathus communis mugodzharicus* (Gagiev, Kononova and Pazukhin, 1987) 169x
8- *Polygnathus brevilaminus* (Branson and Mehl, 1934) 144x
9- *Polygnathus brevilaminus* (Branson and Mehl, 1934) 101x
10- *Polygnathus brevilaminus* (Branson and Mehl, 1934) 108x
11- *Polygnathus brevilaminus* (Branson and Mehl, 1934) 115x
12- *Polygnathus symmetricus* (Branson and Mehl, 1934) 114x
13- *Polygnathus delicatus* (Ulrich and Bassler, 1975) 97x
14- *Polygnathus* sp. 106x
15- *Polygnathus communis communis* (Branson and Mehl, 1934) 92x
16- *Polygnathus brevilaminus* (Branson and Mehl, 1934) 164x
17- *Polygnathus communis communis* (Branson and Mehl, 1934) 106x
18- *Polygnathus communis communis* (Branson and Mehl, 1934) 150x
Study of Ostracodes in Abderaz Formation in Kopet – Dagh Basin

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Abstract
Kopet-Dagh sedimentary basin is located in the east northern of Iran and contains sediments of Jurassic to recent ages. One of the lithostratigraphic units in this basin is the Abderaz Formation. The formation is made up of calcareous shales, marly shales, and chalky limestone. In order to study paleontology and recording of ostracoda of this formation in Hamam Ghaleh section samples. Some of the samples proved to be rich in Ostracodes and some 23 genera and 42 species were recorded. Age of Abderaz formation is Late Turonian – Early Santonian and too the formation was deposited in a shallow – open marine environment with warm climate conditions.

Discussion
Abderaz Formation is the one of Formations Kopet Dough basin in North East Of Iran. Lithology composed of green to bluish calcareous shale, marly shale and 3 to 4 chalky limestone band. This Formation is located on the Aitamir Formation with disconformity and Abderaz Formation very slow transverse to Abtalkh Formation. This section located in 20 kilometer in Mashhad to Kalat road befor Hamam Galeh Village. In this section Abderaz Formation had 607 meter thickness. This study is perfect and universal study on the Abderaz Formation, removed 44 sampels in this sections collected and sampels identified after labrotary methods and take photo with electronic microscope. recognized 23 Genera and 42 Species to osteracods. Frequency of osteracoda in samples are very variable.identified this osteracods in this section are as follow: Alatacythere sp., Bairdia pseudoseptentrionalis, Bairdia sp., Bairdoppilata gliberti, Brachycythere romboidales, Brachycythere sphenoides, Brachycythere sp., Cythereis cf. bicornis, Cythereis dallasensis, Cythereis lixula, Cythereis ornattissima, Cythereis sp1., Cythereis sp2., Cytherella cf. parallela, Cytherella ovata, Cytherella speetonensis, Cytherella sp1., Cytherella sp2., Cytherelloidea granulosa, Cytherelloidea stricta, Cytherelloidea sp. Cytheropteron fossatum, Dolocytheridea polymorpha, Eucythere solitaria, Haplocytheridea cf. H.plummeri, Haplocytheridea sp. Krithe whitecliffsensis, Macrocypris sp. Neocythere virginea, Nigeria cf. N.arachoides, Nigeria sp. Paijenborchella sp. Paracypris wrothamensis, Paracypris sp. Polycope sp. Pontocyprella harrisiana, Pontocyprella recurva, Pontocyprella sp. Pterygocythereis sp. Schuleridea sp. Trachyleberidea geinitzi, Veenia cf. V.para triplicate(plate1)

Numerous of osteracoda from this formation are two family Platycopeda and Podocopeda. From frequency genous in family Platycopeda are Cytherella, Cytherelloidea .(Abdol Mohsen, E. Morsi, S. 2000). and Podocopida are Schuleridea, Pterygocythereis, Macrocypris Pontocyprella, Bairdoppilata .Analysis of diversity diagram (fig1) exict variable in diversity in this formation indicate variable depth because tectonic in basin abderaz formation. depth and lithology and nutrient, and diversity in this fossils group is effected. with high depth, osteracoda is low and with low depth osteracoa is high Genous in this formation Cythereis
with 6 species 29% from fossils group and *Bairdia* with 2 species 20% from fossils group, this genus exist in most of samples. *Cytherelloidea* with 2 species 15% from fossils group and *Cytherella* 5 species 14% and *Nigeria* with 8% and *Brachycythere* with 4%. Age of Abderaz formation in this section basis of osteracoda Upper Turunian – Coniacian – Lower Santonian, corolated with ages of index dinoflagellates and foraminifera, bivalvia, echinodermata. In this formation created many progradation and retrogradation in the active basin. For example *Cytheropteron, Pracypris* in 1, 2, 9, 10, 11, 14, 15, 19, 24, 25, 29, 30, 36, 42, 43 samples indicates progradation and high depth (Moore, R.C., 1961) and *Bairdia* with *Bairdia pseudoseptentrionalis Bairdia* sp, *Brachycythere* sp *Cythereis lixula Cythereis dullasensis Brachycythere romboidale Cythereis cf. bicornis* in 4, 6, 7, 16, 17, 18, 20, 23, 27, 32, 33, 34, 35, 38, 39, 41, 44 samples indicates regression and low depth.

**Conclusion of study osteracoda** *Alatacythere, Cythereis, Cytherelloidea Cytherelloidea granulosa Cytherelloidea stricta* *Cytherelloidea* sp in most of Abderaz samples indicates warm climate in Abderaz formation environment.

**Reference**


of the Southern Baltic sea coast", Aquatic sciences, 67: 142-155

Pazeli, D., Sremac, J., Sokac, A. 2007, "Palaeoecology of the late Badenian foraminifera and osteracoda from the SW central Paratethys". "Geologia Croatica" 60: 139-150

Ruiz, F., Gonzaleza, M., Abed, M. 1879, "Pliocene osteracods of Southwestern Europe", "Geobios", *Vol 41: 845-859*
1. *Krithe whitecliffsensis*
2. *Paracypris* sp.
3. *Krithe whitecliffsensis*
4. *Cytherella* sp.
5. *Krithe whitecliffsensis*
6. *Cytherella ovata*
7. *Cythereis lixula*
8. *Cythereis ornatissima*
9. *Cythereis dullasensis*
10. *Cythereis* sp.
11. *Cytherelloidea stricta*
12. *Cythereis* sp.
13. *Cytherelloidea stricta*
14. *Haplocytheridea* sp.
15. *Cythereis cf. bicornis*
16. *Haplocytheridea* cf. *H. plummeri*
Figure 1: diagram of osteracoda diversity
**Oxygen fluctuations during depositional period of the Sarcheshmeh Formation in Anjirbolaghi section, East of Kopet Dagh (Accordingly palynology observation)**

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**Abstract**

The Sarcheshmeh Formation is one of the lower Cretaceous Formations that located Kopet Dagh basin in NE Iran. Anjirbolaghi section next to Mazdavand village was collected in order to determine oxygen variation during the course deposition of Sarcheshmeh formation then it was studied. In order to estimate the amount of oxygen in palaeoenvironmental, statistical studies is worked on three main groups of palynological ingredient, as well as depositional rate is determined by some of the ecological factors, too. In this research, four main factors that they preserve organic matter were studied in order to estimate the amount of oxygen. With regard to non or very little appearance of brown palynomorphs, lability factor is very low that indicated the condition was far from beach and environment had low oxygen. With regard to ratio of translate SOM to opaque SOM in samples that it always was more than one and confirm that the condition was low oxygen or non-oxygen during deposition. In majority samples ratio of translate SOM to marine palynomorphs is exceeded that indicate the condition was non-oxygen and the rate of deposition was low. In majority samples also low ratio opaque SOM to marine palynomorph show that the condition was low oxygen or non-oxygen.

**Keywords:** Sarcheshm Formation, Palaeoenvironment, Palynomorph

**Introduction**

Studied section is located in the northeast city of Mashhad in Khorasan Razavi province between "38°39'60" E and "35°5'36" N (Figure 1). This section is available in Mashhad – Mozdoran way, in 9 kilometers East Mozduran and next to Anjirbolagh village. This section is measured 413 m, and mainly is composed of the shale and marl with limestone interbeds. This Formation overlies Tiran Formation and underlies Sangane Formation conformably, respectively (Afsharhrb, 1994).

**Discussion**

Statistical study of elements in each sample of Palynological slides, 2 or 3 slides were prepared and each slide randomly selected 20 visual field and were studied. Palynological elements were separated, counted and calculated to determine more accurately the environment. Factors affecting the degree of organic materials are factors maintaining protect organic materials (Lability) and ratio of marine Palynomorphs to translate SOM, marine Palynomorphs to opaque SOM and also opaque SOM to translate SOM. Evaluation and Comparative Study show quantity of oxygen, sedimentation rate and palaeoenvironment energy rate (table 1).
Lability Factor
Factor protecting organic material (Lability), is defined as ratio of brown Maseral to dark Maseral (BP/OP). Brown Palynvmasral is depended of land plants and show environment is nearshore and opaque Palynvmasral has a dark colour that show suboxic, semi quiet and the offshore environment, also show that the degree of preserved organic material and indicate rate of sea level changes.

Study of Lability factor in Sarcheshme section (fig.2) shows that the ratio of brown Palynvmasral to opaque Palynvmasral is low. However, for increased confidence and accuracy, Lability factor must be evaluated with other factors. This factor represents the suboxic conditions (fig.)

The ratio of translate SOM to opaque SOM
If oxygen levels and the rhythm of sedimentation become low, it is lead to convert palynomorphs into translate SOM, and if oxygen levels become high and sedimentation rhythm become low, marine palynomorphs turn into opaque SOM. If ratio of translate SOM to opaque SOM become more than one, this shows none oxygen conditions and if this ratio is less than one indicates oxygen conditions.

Review and calculation of these factors in samples of Sarcheshme Formation show that translate SOM to opaque SOM is more than one in stratigraphy column (fig.3). It represents low-oxygen or lack of oxygen conditions during depositional period of the Sarcheshmeh Formation in Anjirbolagh section.

The ratio of translate SOM to Marin palynmorph and opaque SOM to Marin palynomorph
Palynomorphs especially Dinolagellata have most preservation in non-oxygen conditions with high sedimentation rate. Increased ratio of translate SOM to Marin palynomorphs show non-oxygen conditions and low sedimentation rate (fig.4). Increased opaque SOM to marine Palynomorphs indicate oxic conditions. Increased marine palynomorphs indicate non-oxygen conditions and high sedimentation rhythm. As in this Formation, measured percentage of translate SOM to Marine Palynomorphs was more than one that represent low-oxygen conditions. The Opaque SOM to Marine Palynomorph is less than one which indicate non-oxygen conditions (fig.5).

Conclusion
Study of paleoenvironment in Sarcheshme Formation (Anjirbolagh section) based on Palynomorphs and by using statistical studies on factors such as ratio of translate SOM to opaque SOM, ratio of translate SOM to marine palynomorphs and opaque SOM to marine palynomorphs. Lability factor shows that depositional condition is a low-oxygen environment with low sedimentation rate.

References


Table 1: \% frequency of Organic materials

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Figure 1. Location of studied section

Figure 2: BP/OP

Figure 3: SOM T/SOM Op
Figure 4: SOM T/Mp

Figure 5: SOM Op/Mp
Microfacies of Abderaz Formation in the Padeha Section, East of Kopet-Dagh

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Abstract
In order to identification of sedimentary facieses and reconstruction of paleoenvironment of Abderaz Formation, an outcrop of this formation near the Padeha Village, East of Kopet-Dagh basin was selected and studied. The Abderaz Formation with the age of Turonian – Santonian that composed of intercalation of shale, marl and chalky limestone, is extended throughout the Kopet-Dagh sedimentary basin. Field and lab scrutinizes are led to recognition of two major terrigenus and carbonate sedimentary facieses that belong to open marine environment. Presence of some bioturbated structures specially in carbonate parts, periodic and suddenly changes in its sedimentary facieses present unstable base for sedimentary basin. Gradual changes in rate of limestone and increase of macrofossil shells’ thickness from the base to top of the Formation represent warming up the environment in this time.

Key words: Kopet-Dagh, Abderaz Formation, Microfacies, Biomicrite.

Introduction
Abderaz Formation is one of the lithostratigraphic units remained from Late-Cretaceous in Kopet Dagh sedimentary basin. The name of this formation is derived from the name of a village located in the east of Mashhad. Its best outcrop in Mazdavand pass is introduced by Afshar Harb (1994) alternatively from shale and marl with interbedded chalky limestone. The lower border of this and Atamir Formation are of disconformity and its upper border is in the same gradient with Abtalkh Formation and continuous (Aghanabati, 2004). Vahidi Nia (2007) believes that the lower border of this formation is of paraconformity type. The under-study shear located on the east of the type section and the north of Padeha Village, with the eastern longitude of 60°, 44’, 50” and the northern latitude of 36°, 5’, 9”. This section follows the general process of North-West to South-East (figure 1). In this section, Abderaz Formation includes shale and marl with a frequency of 4 bands of chalky limestone of a thickness of 518.6m. The lower border of the unit is in paraconformity with Atamir Formation (figure 2) and its upper one with Abtalkh Formation is continuous and gradual which is considered at the end of the last limestone band (figure 3).
The microfossils were introduced on the basis of Cushman (1945), Postuma (1971), Loeblich and Tappan (1988), Bolli (1989) and Keller and Pardo (2004).

Considering the morphologic and lithographic characteristics, this formation may be divided into eight separate sections:
1. Lower shale including 35.5m. Green dark grey shale.
2. Lower chalk including 9.4m. of limestone
3. Second shale- lower marl including 31.9m.
4. Second chalk including 13.3m.
5. Mid marl including 80.4m.
6. Third chalk including 18.2m.
7. Upper marl including 305.7m.
8. End chalk including 24.2m.

**Discussion**

The changes of Abderaz Formation from the base towards the top are generally accompanied with increasing the rate of carbonate. They are seen as lithologic changes from shale (at the beginning of the formation) to marl and limy marl (at the end of the formation). Another evidence for this claim is increasing the thickness of lime bands of this unit from the lower to the upper part.

In lateral sequence, the thickness of Abderaz Formation increases from the east towards the west of the basin. While the lower border of this lithostratigraphic unit is reported to be discrete everywhere and indicate the erosive cycle of the early Late Cretaceous period (Aghanabati, 2004) and it becomes younger from west to east. This phenomenon may be associated with the elevation of the east part of the basin during the formation of Abderaz Formation due to the protrusion of Agh Darband region. The upper border is approximately continuous and gradual everywhere. On the basis of the fossil content, the age of this unit in this shear is estimated to be during Late Turonian to Late Santonian. The studies done on sediments of Abderaz Formation in this section indicate two main facieses including detritus and calcareous facieses. Considering the abundance of allochems, calcareous facies includes the following six microfacies, that were entitled on the basis of the classification of Folk (1962) and Dunham (1962).
- Inoceramid biomicrite (Inoceramus wackestone)
The matrix is micritic and in some parts of which there is a little amount of microsparite. About 60-70% of its allochems are the broken pieces of Inoceramus with different sizes. From among the other allochems, we may refer to oligosteginidea and the broken pieces of foraminifers.

- Bioclastic biomicrite (bioclastic wackestone)
In micritic matrix of the rock, there is 30-45% of oligosteginidea with the same varieties of the former facies. The most abundant kind of allochems is of the varieties of benthic and planktonic foraminifers. From among benthic foraminifers, we may refer to Lenticulina montseri and from planktonic foraminifers to Marginotruncana marginata. We may refer to bivalves' pieces, crinoids, green algae and ostracod from among the other available allochems.

- Biomicritic oilgosteginidea facies (Oligosteginidea wackestone- packstone).
The matrix of the rock is micrite and 50-70% of the allochems are formed from Oligosteginidea. The varieties of this family that are seen in this facies include Pithnella ovalis, Stomiosphaera sphaerica and Calcisphaerula innominata. From the other allochems, we may refer to bivalves' pieces (inoceramous), different varieties of foraminifera, bryozoans and pieces of crinoids.

- Inoceramid biomicrite facies (Inoceramous wackestone- packstone)
The matrix of the rock is micritic and 50-70% of allochems are formed by pieces of bivalves crust especially inocermous in different sizes. From among the other allochems, we may refer to different varieties of Oilgosteginidea, foraminifera, bryozoans, and pieces of crinoids from among the other allochems. A very little percentage of glauconite is seen among the other allochems.

- Oligostginid biomicrite facies (Oligosteginid Packstone)
The matrix of the rock is micritic and most of the allochems are formed of varieties of oligosteginidea. We may refer to different broken and intact varieties of foraminifera, bryozoans, the broken pieces of inoceramous and pieces of crinoids from among the other allochems.

- Bioclastic biomicrite (bioclastic packstone)
In the micritic matrix of the rock of more than 50% of allochems, there are different broken or intact varieties of foraminifera. There is Oligosteginidea in this facies but they are not abundant. From among the benthic foraminifera, we may refer to Lenticulina montseri and from among the planktonic foraminifera to Marginotruncana marginata. We may refer to bivalves' pieces from among the other available allochems, crinoids and ostracod.
The microscopic studies show that the sedimentary environment is an open relative deep sea with a unstable floor of basin and turbulent environment. The depth of the basin in various times is variable; although its depth has been reduced several times, but in general, the depth of the basin has gradually increased.
Conclusion

According to this study, Abderaz Formation is composed of 8 unites. The lower border of this Formation with Atamir Formation is paraconformity and the upper border is continuous with Abtalkh Formation. The studies done on microfossils of this Formation indicate that they belong form Late Turonian to Late Santonian. This formation has two main clastic and calcareous facieses. The comparison of the facies identified with Wilson Standard Model (1975), suggests the sedimentary environment including SMF2 and SMF3 and at the tow of the slope, with a range of medium or low energy. This microfacies introduce FZ2 and FZ3 associated with open sea and the sedimentary environment with a range of medium to deep. The difference of facieses is related to unsteady of the basin when was formed this lithostratigraphic unit.

References

- Wilson, S. L., 1975, Carbonate facieses in Geological History: Springer-Verlag, p. 471.
Plate

1- Inoceramid Wackstone.
Grains: Inoceramus debris (In), foraminifer's debris. ×20. Late Santonian

2- Inoceramid Wackstone-Packstone.
Compacted structur (Arrow). ×20. Late Santonian.

3- Bioclastic Wackstone.
Grains, foraminifera & a few oligostegina, ×10. Late Santonian.

4- Oligosteginid Packstone.
Grains: Foraminifera (white arrow), micritic matrix with comprosed & flood of Oligostegina species, bearing lammination. ×45, Turonian.

5- Bioclastic Packstone.
Grains: foraminifera (arrow), oligostegina species, micritic matrix, ×10 Coniacian.

6- Oligosteginid Packstone;
Grains: Foraminifera (white arrow), bivalve debris, micritic matrix with flood of Oligostegina species, feary lammination. ×45, Turonian.

7- Oligosteginid Wackstone-Packstone.
Grains: foraminifera, oligostegina, some debris of bivalves, ×45 Late Coniacian.

8- Bioclastic Wackstone.
Grains: foraminifera (arrow), some debris of bivalves, ×10, Late Coniacian.
paleoenvironment Analysis of Abderaz Formation in Kopet Dagh Basin

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Abstract

Kopet – Dagh sedimentary basin is located in the east-northern Iran. Abderaz Formation is one of upper cretaceous units which is Late turonian –Early santonian in age. Three palynofacies in this formation were distinguished. Also, presence of environmental index dinoflagellates like Klithrosphearidium, Oligosphearidium, Spiniferites, assigns the sedimentary environment of this formation to shallow- coastal open marine. Ratio of light SOM to dark SOM also indicates predominant low oxygen conditions governing on the sedimentary environment of abderaz formation.

Discussion

Kopet-Dagh sedimentary basin is one of tectonic structural units in east north part of Iran in which thick marine and detritial sediments were being deposited Jurassic through Oligocene. Kopet-Dagh successions are the perfectest and thickest cretaceous deposits in Iran. Transgression and regression of the sea in cretaceous were repeated due to tectonic movements (orogeny and epeirogeny) and sedimentation in this area was not continuous. Abderaz Formation is one of sedimentary units of Kopet –Dagh basin of upper cretaceous age whose name has been adapted from Abderaz village which is situated on the east part of Kopet-Dagh in north-west of mazdon village. The mentioned section is placed near Hamam-Qaleh village and is 25 kilometers far from Kalat Naderi city. Abderaz Formation in this section is 607 meter thick from which 44 samples were collected. The lithology of this formation includes mainly bluish grey shales, grey marl shales and calcareous shales and four chalky limestone bands. In order to determining the sedimentary environment are as follows:

1) Allochthonous elements

Including maceral types. Maceral sizes, colors, frequency and their preservation state is important to determine the palaeoenvironment. If maceral are blade, they show more buoyancy. If macerals are larger, this means there has been less transportation and these elements were reworked from outside of the basin to inside of it and they include following types:

A-Palynomaceral type 1: dark brown orange organic matter with structure or without it.
B-Palynomaceral type 2: brown orange organic matter with regular shapes.
C-Palynomaceral type 3: pale organic matter which is pale in color and somewhat thin and irregular with primary structure.
D-Palynomaceral type 4: black or somewhat black equihedral elements which the blade from has buoyancy characteristics and travels long distances.

2) Autochthonous elements

Including dinoflagellates, acritarchs, marine green algae, microforaminifer test lining, and structureless organic matter (SOM).

300 palynomorphic elements such as types of dinoflagellate, palynomacerals and SOM has been counted by chance in palynological studies of Abderaz formation and result of it is
distinguishing and verifying three palynofacies. (Tyson, R.V.; 1993 Van Der Zwan, C.J.; 1990) 

Palynofacies I in which SOM are low and 0-30 % which are mainly light in color.palynomacerals are 10-35 % and marine palynomorphs are 40-70 %. Samples 26-28-29-37 are placed in this palynofacies. This palynofacies indicate an open marine environment (Fig 1). Palynofacies II in which palynomacerals are 20-50 % and SOM are 20-30 % and marine palynomorphs are 10-35 %. this palynofacies is placed in open marine environment which is shallower more than palynofacies I. palynofacies III in which arine palynomorphs are 0-10 %,palynomacerals are 20-80 % and SOM are 20-30 % which are mainly light in color. This palynofacies indicate a decrease in depth of the basin environment.  

Dinoflagellates are palynomorphs which play a basic and usefull roll in determining the basin environment.study of the palynological slides of Abderaz Formation shows that dinoflagellates are the most abundant palynological elements in the slides.from this point of view ,52 genus and 85 species of dinoflagellates was recognized .Index dinoflagellates are one of the most important factors in paleosedimentary environment analysis (Suiljs, A., Pross, J.; Brinkhuis, H.; 2005). which chorate and cavit forms are more frequent and proximates and proximochorates are less frequent.when the environment is suitable for reproduction and nourishment accompanied by transgression , dinoflagellate frequency and diversity rises.the genus Spiniferites with various species Surculsphaeridiunm, Oligosphaeridiunm, Cymososphaeridiunm, Tanyosphaeridiunm and Florentina occures on samples 25-26-28-29-37.the numbery chorate forms increased dramatically in comparision with cavit forms in some samples which attributes to increasing of the basin depth. The taxonomic dinocyst diversity decreased in samples 27-31-36 and some kinds of the genus Dinogymnium Glaphyrocysta, Palaeoperidinium, Spinidinium, Apteodinium and indicate a restricted and more shallow marine environment. The increasing of cavit form in comparison with chorate forms also is an indication of becoming more shallow and restricted environment.presence of spiniferites in association with high amounts of palynomacerals evidence of being shallow and regression of the sea and the dinoflagellate frequency and diversity is very low or zero in samples 41-42-43-44. 

Other factors determining the type of palaeoenvironment is the Lability factor.this factor is the ratio of brown macerals to opaque macerals.the brown macerals are of teresterial plants and indicates near coast environment. (Schioler, P.; Crampton, J.S.; Laird, M.G.; 2002). Opaque macerals are dark in color which indicate an environment of half oxic and usually increase in offshore environment.his factor varies throughout Abderaz formation.the increase of this factor is evidence of shallowing of the basin where the palynomorph number is decreasing in palynofacies III. (Lability digram)

The increase of this factor in samples 2-6-8-18 in association with high preservation of organic matter. Light SOM to dark SOM ratio is another environmental factor. (light SOM to dark SOM diagram). Light SOM is created in an environment of low oxygen a little below the sedimentation level by action of anaerobic bacteria.transparent SOM is caused by lack of oxygen and low sedimentation rhythm conditions (Fig2). (Zonneveld, K.; Versteegh, G.; Lange,G.; 1997).anaerobic bacteria hydrolyze organic matter by using the oxygen dissolved in water and dark SOM is beingcreated. If light SOM to dark SOM ratio is more than 1, it shows conditions of low oxygen and how much this ratio is less than 1, this indicates oxic
conditions. (Bombardiere, L.; Gorin, G.E.; 2000, Waveren, I.; Visscher, H.; 1994) Studies and calculating of this factor in samples of this formation is more than 1 which indicates low oxygen conditions governing the sedimentary environment during accumulating of sediments in Abderaz formation. This ratio in samples 7-8-9-13-21 is less than 1. Presence of few amounts of dinocysts in these samples in association with high amounts of dark SOM shows that oxic conditions predominated the environment but these conditions were not stable.

Conclusions

Three palynofacies were distinguished in Abderaz formation on the basis of palynological studies. Palynofacies I, II, III which correspond to open marine environment, more shallow open marine environment and shallow coastal environment respectively the sedimentary environment of this formation is open marine to shallow coastal environment on the basis of index dinoflagellates.

the factor of light SOM to dark SOM ratio indicates a predominant low oxygen environment for this formation.

References


1-Palynofacies diagram
2-Light SOM to dark SOM diagram
Palynology of the Abderaz Formation in Hamam Ghaleh in Kopet Dagh sedimentary basin

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Abstract
Kopet Dagh sedimentary basin is located in the NE of Iran and is like as inter continental basin which there are sediments with the thickness about 6000 m in it. Abderaz Formation is in Kopet Dagh basin which is consists of limy-shales, marly-shales and limy bonds, we could identify 52 genus and 85 species of dinoflagellates. Abderaz Formation is located in two interval superzones: Conospheraeridium striatoconum interval superzone & Odontochitina porifera interval superzone. Age of Abderaz formation is Late Turonian-Early Santonian.

Discussion
Kopet Dagh sedimentary basin is located in the NE of Iran and is one of the most important sedimentary basins in this country. This basin encompasses 3.3% of the whole area of the country. Moreover, a wide part of Turkmenistan and the North of Afghanistan are belonging to this basin. Kopet Dagh sedimentary basin is a sedimentary trough which created after the early Cimerian orogeny and the sedimentary deposition is continued in it from Jurassic to Tertiary. The depth of Kopet Dagh sedimentary basin was changing constantly during cretaceous period because of tectonic movements and the cretaceous sea was retrograding and prograding continually. These changes led to deposit of different lithologies during this period in Kopet Dagh basin.

For palynological studies, 44 samples were gathered from Abderaz Formation and 270 slides were prepared in laboratory. The organic contents of palynological slides are including of palynomorphs, Structureless Organic Matters (SOM) and palynomacerals. Dinoflagellates are the most important and abundance palynological elements in Abderaz Formation. We could recognized 52 genus and 85 species of these cysts in this formation. Most of their forms are chorate, cavate and a few are proximate. Dinoflagellates are unicellular eukaryote planktons that are mainly marine and can appear on the surface of water as mobile cellules. They can feed into two ways: heterotrophic & autotrophic. The most important dinoflagellates of Abderaz formation are as follow:
Heterosphaeridium heterocanthum, Hystrichodinium palchrum, Hystrichosphaeridium bowerbankii, H. conispinum, H. recurratum, H. tubifrum
Palambages morolusa, Pervosphaeridium intervelum, P. monasteriense, P. truncigerum, Protoellipsodinium touile, pterodinium aliferum, Raphidodinium facatum, Spinidinum echinatum, Spiniferites perforatus, S. pesadoforcatus, S. ramsus, S. twistringesis, Surculsphaeridium longiforcatum, Tanyosphaeridium variecalamus, Thalasiphora pelagica, T. delicata, Trithyrodinium suspectum, Xiphophoridom alatum, Xenascus ceratoides

The investigation of dinoflagellates diversities of Abderaz Formation shows that dinoflagellates are very diverse especially in upper part of the formation. This diversity is accompany with progradation of sea level and shows that the water was contain of high oxygen rate and feeding matters which are necessary for dinocycts grow up. Also in addition to suitable product conditions, environmental conditions for dinoflagellates conservation were suitable. These conditions reduced toward the end of formation and the species diversity was going to reduce when the sea level was retrograding (Ghasemi- Nejad, et al, 1990).

Shale samples are contain of high species diversity and also the shale beds which are consist of high percentage of limy and marly shales have the lowest diversity of species. It shows the effect of lithology which is related to conditions changing of sedimentary environment. Abderaz Formation is located in two interval superzones: Conosphaeridium striatoconum interval superzone & Odontochitina porifera interval superzone. The age of Conosphaeridium striatoconum interval superzone is upper turonian-lower santonian and is contain of index species such as follow: Achomosphaera ramulifera, Achomosphaera regensis, Circulodinium distinctum, Florentinia mantelli, Odontochitina coastata, Spiniferites poros, Spinidinum echinatum and also the age of Odontochitina porifera interval superzone is santonian-lower campanian (Helby, et al, 1987) and is contain of index species such as follow: Apteodinium deflandre, Chatangilla decorsa, Chatangilla porosa, Chatangilla williamsii which Abderaz formation is located in the primary parts of this superzone.

Index dinoflagellates are one of the most important factors in paleo sedimentary environment analysis (Bombardiere, Gorin, 2000). Chorate dinocycts with long processes which are index of environments far from the shore increased in sea level In samples No: 2, 6, 10, 18, 25, 26, 28, 29 and 37 the followed genus are maximum: Surculsphaeridium, Spiniferites, Oligosphaeridium, Cymososphaeridium, Tanyosphaeridium and Florentina. Some dinoflagellates without any processes which are the index of shore and near to shore environment decreased in sea level in samples No: 4, 8, 11, 12, 13, 14, 15, 16, 17, 19, 20, 24, 27 and 31 the followed genus maximum: Glaphyrocysta, Palaeoperidinium, Spinidinum, Aoteodinium and Dinogynmnium.

Conclusions
52 genus and 85 species of dinoflagellates are identified in this formation. This formation is located between two interval superzones: Conosphaeridium striatoconum & Odontochitina.
*porifera*. Age of Abderaz formation is Late Turonian-Early Santonian. According to the study on environmental index dinoflagellates, open marine environment with low depth and various energies is considered for Abderaz Formation.

References


Corals from the member C of Mobarak Formation in the Vali-Abad section (Central Alborz – North part of Iran)

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Abstract
The study is based on the corals of member C of the Mobarak Formation in Vali-Abad section (south of Marzan-Abad, Central Alborz). In the Vali-Abad section Mobarak Formation overlying Girud Formation conformably, and it is covered with Dorud Formation (Early Permian) unconformably. The member C of Mobarak Formation reaches about thickness of 60 meters, and its lithology has composed of limestones with black shale intercalations. Up to 12 species of Rugosa and tabulate corals belonging to 9 genera have been identified. The following species are: Kailingophyllum sp., Marzanophyllum chalusense, Marzanophyllum grassiseptum, Hapsiphyllum sp.1, Hapsiphyllum sp.2, Zaphrentoides sp.A, Zaphrentoides sp. B, Ufimia sp., Hapsiphyllidae indet, Zaphrentites parallela, Syringopora sp. and Favositidae indet.

The assemblage is composed of small undisepimented solitary rugosa corals belonging to Cyathaxonia fauna and it is occur at oolitic limestones. Corals of member C of Mobarak-Abad having endemic character and in base of fauna and stratigraphical position has been assigned to Upper Visean-Namurian in age.

According to study of microfacies of the member C, this part of the section belongs to the basin margin to the shelf lagoon, from the 3rd to 4th zone of Wilson model. Moreover a shallow carbonate Platform dominated in this area during the Carboniferous.

Keywords: Mobarak Formation, Vali-Abad section, corals, Upper Visean-Namurian, Microfacise

Introduction
The Mobarak Formation is developed in the NorthWest through the NorthEast of Iran. It comprises thick Lower Carboniferous succession (Tournaisian through the Namurian) in different parts of Central Alborz. Its lateral equivalents are developed in the Central Iran and East Iran Basins, and extended from northwest to northeast of Iran. The Mobarak Formation is represented by dark fossiliferous limestones with subordinate black shale intercalations in its lower part. In the type section, it rests unconformably on sandy-argillaceous beds of the Upper Devonian and is overlain by marly limestone with ironstone lenses Upper Permian fossils (possibly, the Nesen Formation).

The first systematic research on Iranian Carboniferous corals was made by Douglas (1948), who described Permo-Carboniferous corals from Iranian Baluchestan. Since then many scholars studied corals in various parts of the country. Rugose and tabulate genera were used for correlation of different sections. Rugose complex typically includes solitary genera; only in the Vali-Abad a patch reef built by colonial Siphonodendron is known. Tabulate corals are widely distributed in Carboniferous deposits of the Iranian Platform.
Some descriptive papers have been published on Lower Carboniferous corals from several localities in the Central Alborz (Flugel, 1963; Khaksar, 1994, 1996). The paper by Flugel (1963) is the most important for understanding of the Lower Carboniferous coral fauna of Iran. Carboniferous sequence of the Central Alborz is represented by more than 400 m of limestones yielding abundant rugose corals, brachiopods, foraminifers and other fossils. The Mobarak Formation developed in this area contains rich and diverse coral fauna (Assereto, 1963). Biostratigraphy of the Mobarak Formation is based on conodonts and brachiopods (Ahmadzadeh-Heravi, 1971), and also on corals (Flugel, 1993, Khaksar, 1994).

**DISCUSSION**

The lower boundary of Mobarak Formation in the ValiAbad section is Gairud Formation (Upper Devonian) conformably and it has covered by Dorud Formation (Early Permian) unconformably. This section is located in Central Alborz Mountains- North of Iran, about 40 km south of Marzan-Abad. Geographic coordinates of the section are: 36º 14' 52.61" N and 51º 17' 38.36" E and the altitude is 1779.5 m.

The sedimentary succession can be divided into three members A, B and C; it reaches up to 200m thick. Member C was considered, because it exists only in this part of the Alborz region and it has never reported in other sections of the Mobarak Formation yet, particularly in the type section.

**Stratigraphy**

The thickness of member C reaches about 60 meter of the upper part of Mobarak Formation and its lithology has composed of:

- Median to thin beds of Limstone containing oolithic grainstones and wackestones – bioclastic packstones with some dolomitic sparry cement and black marlyshale intercalations.

Based on the corals assemblage and the present microfossils and the stratigraphical position, the age of this part of the formation is determined Upper Visean – Namurian.

The diameter of marlyshale intercalations piecemeal increases upward in this section. Absence of Lower carboniferous corals after the early Namurian, relates to sea-level and an off lap sequence of erosional Alborzian phase. Indeed the off lap sequence has occurred later as compared to the Eastern part of Alborz in this period.

The recovered corals in this member of the Formation belong to two Suborders of Rugosa and Tabulata, up to 12 species of 9 genera have been identified and they are as follows:


The small undissepedmental solitary Rugosa corals belonging to Cyathaxonia fauna, and the attendant fauna is containing Brachiopods, Bryozoans, Dasycladal Algae, Foraminifera and Gastropods.

These evidences of microfacies and the existent biota confirm totally that they have occurred in the back reef zone, the cyathaxonia and tabulata corals available in this area can tolerate this condition. The cyathaxonia adaptive morphology enables them to exist in lagoon condition to 4000m depth. A relative abundance of these corals is in two habitats of the
subnatural terms of marine for purposes of salinity, temperature, amount of Oxygen and nutrient currents.

Some of the recorded micro fauna and flora in this facies are:

*Archeodiscus planus*, BOZORGANIA, 1973 from Foraminifera and *Windsporella tulayae* (CHANTON-GUVENC, 1972) VACHARD, 1980 from Algae, they estimate upper Visean to Namurian age for this part of the section.

Also the identified microfacies among the vertical and horizontal subsequences suggests that a shallow carbonate Ramp has dominated in this region during the Lower Carboniferous epoch and as for the Iran location in the SouthWest of the old Tethys, presence biota belong to warm condition, indicate the current rotation of warm water from the higher latitude flowed around the Alborz zone.

**Results**

1-up to 12 species belong to 9 genera of corals has been recognized in this part of the section.
2- There are a new genus and 2 new species of corals among them.
3- The corals assemblage is representative of a subnormal marine environment which these corals can tolerate this condition.
4- Based on the biostratigraphical and lithostratigraphical characteristics the Mobarak Formation in this section have been determined Upper Visean–Namurian in age.
5- According to these studies represent there was a retrogressive sea which had extended from open sea to lagoon.

The Carboniferous sea regressed in Southern and Eastern parts of Alborz in the Middel Visean whereas it has continued to Namurian in the studied area.

**References**

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Tab1: Various species of corals are found in the member C of the Mobarak Formation in the Vali-Abad section

<table>
<thead>
<tr>
<th>Species</th>
<th>Early Carboniferous</th>
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<tbody>
<tr>
<td>Hapsiphyllidae indet</td>
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<tr>
<td>Hapsiphyllum sp.1</td>
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<td>Hapsiphyllum sp.2</td>
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<td>Kailingophyllum sp.</td>
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<td>Marzanophyllum chalusens</td>
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<td>Marzanophyllum grasiseptum</td>
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<td>Zaphrentites parallela</td>
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<td>Zaphrentoides sp.A</td>
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<tr>
<td>Zaphrentoides sp. B</td>
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<tr>
<td>Ufimia sp.</td>
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<tr>
<td>Favosites indet.</td>
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<td>Syringopora sp.</td>
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</table>

Fig 1. Geographical Location of Studied Area

Fig 2. Location of the studied section

Fig 3. Cyathaxonia fauna restricted in back reef zone
Fig 4. Paleogeographic sketch suggestion the position of Alborz and the counterclockwise oceanic current around the Alborz region. Kiessling et al. 1999

Fig 5. Grainstone & micro fossils of Foraminifera & Algae
1- Marzanophyllum chalusens, transversal section x1.4
2- Hapsiphyllum sp., transversal section x1.4
3- Kailingophyllum sp., transversal section x2
4- a, b- Favositidae indet.
4a- Longitudinal section x1.5  4b- Transversal section x2.4
Evaluation of Current Pattern with two Modules of HD and BW in Mike21 Software

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Abstract
In this paper, the stabilized jetty structure on the mouth of Kiashahr port located in southern Khazar in Iran country, Guilan province is evaluated using Mike21 package. Considering the results of Hydrodynamic model, it can be concluded that stabilized jetties disordered total flow in the vicinity of mouth in a manner that eastern waves-generated flows like to pass from the structure. Meanwhile north-western, northern and north-eastern waves-generated flows produce eddies turning around the mouth of port whereas increasing wind and waves height, velocity of waves shall grow and eddies will be stronger. To investigate the effect of jetty structure on Kiashahr port, current velocities are computed for port entrance for two distinct cases of prior and after the construction of jetty. Considering the littoral flow simulation in hydrodynamic model, the flows generated from north and north-west waves are aligned from west to east. The littoral flow velocity in coastal zone growing from breaking zone to border line and are limited between 0.1 to 0.5 meter per seconds. For flows of north east direction, the coastal flows are redirected from east to west. The result of hydrodynamic simulation indicates that for deep water conditions and in the vicinity of boundary conditions, the flow velocity is not changed considerably. The reduction of flow velocity is obvious in vicinity of jetties. Finally, the plots of flow velocity from hydrodynamic analyzing of two HD and BW modules show that at the entrance of port, flow velocity from BW is less than HD as a result of waves of this module have not broken yet and generated any flows.

1 Introduction
The process of developments inside sea environment with progressive construction of ports and other coastal structures have influenced the current coastal regime and its sediment transportation characteristics. Sediment transportation itself causes the problems of sedimentation and erosion in coastal zones and these will introduce problems on the efficiency of coastal structures or their facilities[1].

Jetties are used in order to prevent the interference of waves and currents in the river to sea links in the gulf and its domain. The Kiashahr lagoon in Iran is one of the challenging locations that will be studied in the present paper. Two jetties on both sides of Kiashahr lagoon will interface the current movement to Caspian Sea while they provide a navigation channel for ferry traffic on this location. Due to the complex effect of active Delta and Sefidrood river and the littoral currents from west to east of this lagoon, a lot of sedimentation are accumulated on the back of jetty [2].

Karami Khaniki et al. (2005) considered the capability of Mike 21 software for modeling of tidal currents at Zohreh estuary. In this study, the current velocity and their parameters on the water surface have been measured for 4 days and the measured data have been compared with the simulation model results. [3].
2 Model Descriptions

One of the famous mathematical models of the sea environment in the world is used in the mathematical model of MIKE21. This computer software has been programmed by Danish Hydraulic Institute and Water Quality Institute of Denmark and has been developed during last 20 years.

2.1 The Spectrum modules of waves induced by wind in nearshore area (NSW)

The flows induced by waves are the causes of stress gradient radiation in breaking zone while NSW module is capable of the radiation stress gradient analysis. The wave heights for three perpendicular directions with wind duration of 3, 6 and 9 hours are computed for both prior to jetty construction and after its construction. The topographical condition of study area is shown in Fig.1-2.

2.2 The Hydrodynamic modules (HD)

HD module is useable in extensive area of Hydraulic and its phenomenon. This module, includes modeling tide Hydraulic, wind, currents due to wave…. This module simulates currents in a single layer vertically equal fluid. Equations of this module include Continuity Equations and Averaged Momentum in depth. HD module runs for three perpendicular directions with wind duration of 3, 6 and 9 hours for both prior to jetty construction and after its construction same as NSW module.

2.3 The Boussinesq wave modules (BW)

There are two different modules of BW in MIKE21 software based on the numerical solution of Boussinesq equations in time domain. With inclusion of these terms on Boussinesq equations, the modules has been enabled to model wave train propagation from deep water to shallow water. The maximum ratio of depth to wave length is considered as h/L=0.5 for deep water conditions.

3 Environmental Conditions of Kiashahr fishing port

Kiashahr fishing port is located in Guilan province with 51 km distance from Rasht city between Pounel and Langerood. The port is on geographic position of 39°, 57’ East Longitude and 37°, 27’ North Latitude.

The structural hydrodynamic characteristics of Kiashahr fishing port are given in Table 1. The wind conditions are estimated based on a return period of 30 years. The wind data of Synoptic station of Anzali port is used with 30 years data and the wind rosette is found for this zone. About 47.1% of the year, the wave climate is a calm condition and the prevailing wind direction is the north-west direction.

3.1 Characteristics of Wave Climate in Deep Water

In this research, the wave prediction graphs (calibrated for the study area) are determined from corresponding wind speeds. The position of study area will mean from certain directions, wave heights may be limited by fetch or water depth. The extreme mean wind data, the effective fetch length for different directions and statistical analysis of wind data for different directions are used in prediction of wave heights from empirical relationships. After the extreme wave data are obtained based on all corrections of SPM (Shore Protection Manual) and transformation of wind stress in SMB model.
3.2 Preparation of wind data for prediction of wave climate
The wind data for synoptic station of Anzali port are used in the prediction of extreme wave heights. The wind speed corrections consist of temperature and length corrections with total five correction factors for the estimation of wind speed. The modified wind speeds of three governing directions are given for three different intervals of 3 hours, 6 hours and 9 hours respectively.

4 Current Pattern Analyses
4.1 Current Pattern from HD Model
In this section, the HD module results are presented for two conditions of port without jetty and after its completion. The current patterns are computed by using radiation stresses of NSW module while the vectors in the plots are indicating the average wave currents for different conditions (Fig.3-6).

4.2 Investigation of Current pattern by BW module
In this section, the BW module of Mike21 is used for the estimation of Current pattern prior to the construction of jetty and after completion of them. The vectors are indicating the flow speed for different conditions and the counter lines are the wave height distribution (Fig.7-10).

5 Comparison of results of current pattern for BW and HD modules
In this section, two modules of BW and HD are compared for a section prior to the jetty construction and after completion of the jetties. The numerical results are compared for different wind directions (Fig.11-15).

6 Results and Discussion
6.1 Analysis of HD module
Depending to the wave velocity and its phase angle with coast line, different flows and directions of littoral currents are observed from wave breaking in coastal zones. According to the results of current pattern simulation in modeled zone, currents generated by north and north-west waves are oriented from west to east. Littoral current velocities near coast in wave breaking zone to coast line are greater than other and the flows are bounded from 0.1 to 0.5 m/s. Moreover, the results of present simulation indicate that after construction of the jetty, the littoral current velocity in deep water and at the points near to restricted boundaries would not have any remarkable changes. However, the reduction of current velocity in the vicinity jetties is obvious from simulation results.

6.2 Analysis of BW module
In this module, the wave characteristics and currents are studied including the breaking wave and coast line movement. The comparison of current velocity of two modules of BW and HD indicate that at the entrance of port, flow velocity from BW is less than HD because waves of this module have not broken yet and generated any flows.

References


I. CHARACTERISTICS OF KIAHSHAR PORT

<table>
<thead>
<tr>
<th>Basin Depth (m)</th>
<th>Beneficial area of basin (m²)</th>
<th>Turning Radius (m)</th>
<th>Arm Length (m)</th>
<th>The entrance width (m)</th>
<th>Berthing Length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On port</td>
<td>Entrance</td>
<td></td>
<td>Western</td>
<td>Eastern</td>
<td></td>
</tr>
<tr>
<td>-4</td>
<td>-5</td>
<td>3000</td>
<td>80</td>
<td>993</td>
<td>350</td>
</tr>
</tbody>
</table>

Fig.1. Topographical condition of study area, Prior to Jetty Construction

Fig.2. Topographical condition of study area, after construction of Jetties.

Fig.3: Current pattern for wind velocity of 11 m/s, 3 hours north direction

Fig.4: Current pattern for wind velocity of 14 m/s, 3 hours north west direction

Fig.5: Current pattern for wind velocity of 11 m/s (after jetty construction), 3 hours north direction

Fig.6: Current pattern for wind velocity of 14 m/s (after jetty construction), 3 hours north west direction
Fig. 11: Comparison of two modules of BW and HD
Fig. 12: Horizontal current velocity comparison for BW and HD modules for wind velocity of 14 m/s, 3 hours north direction

Fig. 13: Horizontal current velocity comparison for BW and HD modules for wind velocity of 14 m/s, 3 hours north west direction

Fig. 14: Horizontal current velocity comparison for BW and HD modules for wind velocity of 14 m/s, (after jetty construction) 3 hours north west direction

Fig. 15: Horizontal current velocity comparison for BW and HD modules for wind velocity of 14 m/s, (after jetty construction) 3 hours north east direction
Soil Science for peace, cutting edge challenges to the 1 wheat production in Pakistan

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Abstract
Soil science and wheat production are the road map for food security and ultimately the peace in region and in the world. The global climatic changes have effected the provision of water and rise in temperature. These changes have reduced the food production. Seven wheat varieties including two exotic varieties were tested under two set of environments. The exotic varieties due to their better adaptability behaved best in contrasting environment. The paper comprehend the modern use of soil science to the production of new varieties of wheat that can with hold the water stress with regard to climatic changes. The soil science future research can combat the poverty, peace global climatic changes and food security cutting edge challenges.

Key words. Contrasting Environment, Exotic, Food security, Peace, Road map and Temperature

Introduction
The global village is under the threat of burgeoning population; there is only one hope to safe guard food issues, which is Agriculture. It is said that the twenty-first century is a century of food security. The United Nations has estimated that 65% increase in the world’s population between 1995 and 2050, particularly in the developing countries. As observed by Voortman,(1985), an increase in agricultural products may be achieved by intensive land use and soil science planning. By the healthy projections, it is suggested that rise in agricultural production over 3% annually is must. Fresco,(1989). So, growing more crops and cultivating more land is need of hour but it is also a limiting factor in the context of water stress and soil health, Thompson and Dodson, (1958). The changing global climatic conditions have affected not only day length, growing season and water availability but also soil moisture availability, reduction in agricultural crops yields, Gao et al.(1993). Change in temperature and short spell of rain fall played a negative role in field crop production in Pakistan, Qureshi and Iglesias (1992). Water is blood life for agriculture and water crisis has affected sustainability in agriculture in most of the Asian countries, Huaqi et al. (2002). Pakistan is facing unrelenting water stress from last more than six year, Ahmad (2005), Ahmad et al. (2004) Responses to such issues require inter alia, the generation of scenarios constructed with detailed biophysical data coupled to process-simulation methods. Today after witnessing the prevailing situations of demand and supply of agricultural products, land use and water stress, an enormous challenge is for all policy makers, planners and scientists, Voortman, (1985).

The present research was initiated to evaluate the following Objectives.

i. To identify the soil properties of study area and minimizing water requirements of wheat crop.

ii. To identify the constraining factor for land use.
iii. To evaluate the genotypes under normal irrigation and water-stress condition by assessing the physiological basis of water-stress tolerance.

iv. To find the best way of eliciting and structuring expert knowledge, to overcome yield barriers

**Materials and Methods**

The present study was initiated at University of Agriculture, Faisalabad, Pakistan during the 2005-06. In Pakistan water availability and occasional rainfall are neither sufficient nor reliable, so shortage of water may occur at any stage. In this study two exotic and five local wheat genotypes were selected and sown under normal irrigated and water stress conditions (simulated by totally withholding irrigation after sowing). A 1.5 m buffer zone separated both experiments. All agronomic practices, i.e. hoeing, weeding and fertilization etc were maintained the same for both experiments, however the same irrigation was applied only to the normal irrigation experimental site.

**Soil analysis of experimental site**

The experimental site was precisely leveled so that even distribution of water and inputs may be insured. The soil samples were collected from 0-15cm, 16-30cm and 31-60cm depths and analysis were made according to the methods described by (Chapman and Pratt, 1961) and Watanabe and Olson, 1962) Field experiment was conducted to evaluate the soil characteristics that was sandy clay loam. The pH of soil was 7.05, ECe was 0.21S m⁻¹ and organic content was 0.80%.

The data of following traits were recorded and statistically analyzed.

1. Plant height
2. Flag leaf area
3. Number of tillers per plant
4. Grain yield

**Results**

According to the economic survey 2006-07 the year wise area, production and yield of wheat (Anonymous, 2007)

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (000 Hectare)</th>
<th>Production(000 Tons)</th>
<th>Yield (Kgs/Hec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-03</td>
<td>8034</td>
<td>19183</td>
<td>2388</td>
</tr>
<tr>
<td>2003-04</td>
<td>8216</td>
<td>19500</td>
<td>2375</td>
</tr>
<tr>
<td>2004-05</td>
<td>8358</td>
<td>21612</td>
<td>2568</td>
</tr>
<tr>
<td>2005-06</td>
<td>8448</td>
<td>21277</td>
<td>2519</td>
</tr>
<tr>
<td>2006-07(P)</td>
<td>8494</td>
<td>23520</td>
<td>2769</td>
</tr>
</tbody>
</table>


According to Table 1, the economic survey results, it is shown that area and production of wheat is increasing every year but due to burgeoning population pressure and global climatic changes, the Pakistani Government has to spend more than US$1.0 billion annually. (Anonymous, 2007) to feed the nation.
The seven wheat genotypes comprising both exotic and local under this study showed that all physiological and yield contributing traits tend to decline in response to water stress. The mean values under normal irrigation as well as water stress environment are evident from Table 2.

Table 2. Mean values of 7 genotypes in wheat under normal irrigation and water stress conditions

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Plant height (cm)</th>
<th>Plant height (cm)</th>
<th>Flag leaf area (cm²)</th>
<th>Flag leaf area (cm²)</th>
<th>No. of tillers/plant</th>
<th>No. of tillers/plant</th>
<th>Economic yield (g)</th>
<th>Economic yield (g)</th>
<th>Percent decrease in yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nesser</td>
<td>99.01c</td>
<td>87.02bc</td>
<td>25.71bc</td>
<td>18.14ab</td>
<td>11.67a</td>
<td>10.17a</td>
<td>27.10a</td>
<td>21.85a</td>
<td>19.37%</td>
</tr>
<tr>
<td>Dharwar Dry</td>
<td>113.33a</td>
<td>100.01a</td>
<td>32.27a</td>
<td>21.21a</td>
<td>12.07a</td>
<td>10.50a</td>
<td>27.30a</td>
<td>21.81a</td>
<td>20.10%</td>
</tr>
<tr>
<td>GA-2002</td>
<td>108.33a</td>
<td>85.33bc</td>
<td>23.59bc</td>
<td>16.74b</td>
<td>9.96b</td>
<td>8.83b</td>
<td>16.98bc</td>
<td>12.40c</td>
<td>26.97%</td>
</tr>
<tr>
<td>Bakhar-2002</td>
<td>108.01a</td>
<td>84.67c</td>
<td>24.10bc</td>
<td>16.62b</td>
<td>9.01b</td>
<td>13.24c</td>
<td>10.01bc</td>
<td>20.40c</td>
<td>26.92%</td>
</tr>
<tr>
<td>Chakwal-86</td>
<td>106.02b</td>
<td>90.33b</td>
<td>21.29d</td>
<td>11.40a</td>
<td>9.17b</td>
<td>16.83bc</td>
<td>12.30c</td>
<td>26.92%</td>
<td>26.92%</td>
</tr>
<tr>
<td>Inqulab-91</td>
<td>108.67a</td>
<td>75.67a</td>
<td>26.17b</td>
<td>20.68a</td>
<td>11.50a</td>
<td>9.43a</td>
<td>15.97bc</td>
<td>12.06ab</td>
<td>24.48%</td>
</tr>
<tr>
<td>Kohistan-97</td>
<td>110.01a</td>
<td>90.01b</td>
<td>22.38cd</td>
<td>19.54ab</td>
<td>11.77a</td>
<td>10.07a</td>
<td>19.03b</td>
<td>14.47bc</td>
<td>23.96%</td>
</tr>
<tr>
<td>LSD Mean</td>
<td>6.981</td>
<td>5.1123</td>
<td>3.637</td>
<td>3.54</td>
<td>1.1122</td>
<td>NS</td>
<td>5.702</td>
<td>2.667</td>
<td>NS</td>
</tr>
</tbody>
</table>

Percent decrease in economic yield under water stress condition
The climate has played negative effect, by pulling down most of the traits which ultimately depicted downward trend in economic yield of genotypes. The genotypic percent decline are shown in (Table 3) was as follow; genotypes Nesser (19.37%), Dharwar-Dry (20.10%), GA-2002 (26.97%), Bakhar-2002 (20.40%), Chakwal-86 (26.92%), Inqulab-91 (24.48%) and Kohistan-97 (23.96%). The minimum effect of water stress was shown by genotypes Nesser (19.37%) and Dharwar Dry (20.10%).

Discussion
It is imperative to know the mechanism of water stress resistance and the interaction of crop plant and how plant try to adopts water stress in growth period. The natural climatic condition effects on plant growth mainly so we have to develop such types of varieties which may not largely depend upon the provision of ample supply of water. According to Fischer and Sanchez (1979) various facets of water stress effects crop grain yield and biomass. In the present study it was noted that water stress has cumulative and an important role to alter the normal growth functioning. The yield contributing characters are affected.
badly which ultimately declined economic yield. The similar results were reported by early researchers like Subhani and Chowdhry (2000), Rana et al. (1999), Angus and Van Herwaarden (2001), Nabipour et al. (2002).

Under both irrigation and water stress environments all seven genotypes showed significant effects in response to water stress. In trait plant height the genotype Dharwar Dry achieved top position under normal irrigation and water stress condition while the genotype Nesser and Inqalab-91 remained dwarf under normal irrigation and water stress conditions respectively. Due to their dwarfism nature they elicited good yield and less yield decline percentage (Table 2). The flag leaf area contribute maximum photosynthetic activities so its measurement has significant effect in plant yield contribution, Muller (1991). In this study the genotype Dharwar Dry achieved top position by attaining maximum flag leaf area under both normal and water stress irrigation condition. As the number of tillers per plant is also has a prime role in yield enhancement of a genotype and reduction in tillers results reduction in economic yield. Sukhorukov(1989). The genotype Bakhar-2002 attained maximum number of tillers per plant under normal irrigation condition. As the treatment of water stress is concerned, the exotic genotype Nesser once again behaved well as compared to local genotypes. The grain yield is a cumulative effect of all yield contributing traits and grain yield has prime role in selection of a genotype. Atale and Zope (1991). Total dry matter production decreases under dry conditions (Kramer, 1983), Mohammad (1998) and Hassaan (2003). With regard to economic yield per plant, the exotic genotype Dharwar Dry once again attained maximum economic yield per plant under normal irrigation condition while another exotic genotype Nesser revealed best position under water stress environment. The similar results were reported by researchers like Rana et al. (1999), Chowdhry et al. (1999), Nabipour et al. (2002), Hassaan (2003), Noorka et al. 2009 a. To improve economic yield is the moral duty and prime aim of a researcher and by this way the world food security and peace can be ensured by using soil science in utmost best way in the service of humanity, in the context of changing climatic conditions. The crescendo of the alarming bells has in recent years grown much louder, alerting the right thinking people from all walks of life to the urgent need to take the bull by the horns and spare humanity the sufferings from a likely strangle hold of a virtual catastrophe. Unless a well orchestrated action plan is launched on a fast track, it is feared the planet will be hard to rescue from getting caught into a chain reaction that can impose a dangerous fresh water deficit spawning from a structurally disturbed global environment. Thus there is a unfolding a desperate situation unable to sustain a modernizing soil science use and therewith the continuity of human life on the earth insured against all forebodings of doom and gloom. Rasool, I, (2008) and Noorka et al, 2009 b.

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Foramini Fera Biostratigraphy of the Gurpi Formation Southeast Jahrum

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⁴.Surface Geology Office Exploration Section, National Iranian Oil Company.

Abstract
In order to biostratigraphic study of the Gurpi Formation, Kuh-e-Jahrum section located at southeast Jahrum, in Fars province have been selected. The Gurpi Formation in the Kuh-e-Jahrum composed of 335 meter limestone, argillaceous limestone with interbedded cherty limestone and unconformity overlies the Ilam Formation and underlies the Tarbur Formation. The study of 195 sample from Kuh-e-Jahrum section, 12 genera and 29 species of planktonic foraminifera and 13 genera and 13 species of benthonic foraminifera were identified. On the basis of stratigraphic distribution of planktonic foraminifera, the formation is Campanian to Maastrichtian.

With respect to stratigraphic of planktonic foraminifera Formation, the section is comparable with Caron's biozonation and 6 biozones were identified. The biozones are as follow: 1- Globotruncanita elevata Interval Range zone, 2- Globotruncanita ventricosa Interval Range zone, 3- Radotruncanita calcarata Total Range Zone, 4- Globotruncanella havanensis Partial Range Zone, 5- Globotruncanita aegyptiaca Interval Range Zone. Because of lacking the Gansserina gansseri and Abathomphalus mayaroensis in Maastrichtian, this study section cannot identified biozonation of Caron. Therefore, two biozones Contusotruncanita contusa and Muricohedbergella monmouthe nsis in Maastrichtian Kuh-e-Jahrum section identified. Also Gurpi Formation in Kuh-e-Jahrum section comparable with biozones Globotruncanita elevata total range zone, and Globotruncanita stuarti- Pseudotextularia varians assemblage zone of Wynd.

Key word: Gurpi Formation, foraminifera, biostratigraphy, Jahrum, campanion, maastrichtian.

1. Introduction
In the summery Gurpi Formation developed in Fold Zagross in Provinces Khuzestan, Lorestan and Fars. Age sediment reported in restrict stage santonian to maastichtian. It formation in named derived of Kuh-e-Gurpi in province Khuzestan, in local type section in north square oil Lali in north-east Masjed- Soleiman composed of 320 meter argillaceous limestone, shale Marl gray tend blue. Purpose of paper is study biostratigraphy Gurpi Formation in Kuh-e-Jahrum, on the basis planktonic foraminifera. Lithology Gurpi Formation in section Kuh-e-Jahrum is compose of limestone and argillaceous and cherty limestone. Section Kuh-e-Jahrum with coordinate 28° 21' 42" latitude north and 55° 40' 17" longitude east is in south east city Jahrum in province Fars. The map shows position geography Kuh-e-Jahrum section.

2. Biostratigraphy
Biostratigraphy section study carried out on the basis comparable with biozonation planktonic Foraminifera Caron, 1995. Biozones identified in section Kuh-e-Jahrum as follow: Globotruncanita elevata Interval Range Zone (Early Campanian).
Thickness biozone in Kuh-e-Jahrum section is 30 meter, and lower boundary biozone with first appearance Globotrancanita elevate of sample number RAP 243 and upper boundary biozone is determine with first appearance Globotrancana ventricosa to sample number RAP.253. Associated Foraminifera biozone as follow: Heterohelix striata, Globotruncana bulloides, Marginotruncana paraventricosa, Macroglobigerinelloides bollii, Archaeoglobigerina blowi, Muricohedbergella holmdelensis, Heterohelix globolusa, Contusotruncana foricata, Cibicides montanus, Cibicides minimalis. 

Globotruncana ventricosa Interval Range Zone, (Middle Campanian)

Thickness biozone in Kuh-e-Jahrum section is 37 meter, and lower boundary biozone with first appearance Globotruncana ventricosa to sample number RAP.253. and upper boundary biozone is determine with last appearance Radotruncana calcarata of sample number RAP.265 and upper boundary biozone is determine with last appearance Radotruncana calcarata to sample number RAP.270. Associated Foraminifera biozone as follow: Spiroplectacta sp., Globotruncana bulloides, Macroglobigerinelloides bollii, Macroglobigerinelloides ultramicrocrus, Marginotruncana paraventicosa, Archaeoglobigerina blowi, Muricohedbergella holmdelensis, Heterohelix globolusa, Contusotruncana foricata, Globotruncana linneiana, Macroglobigerinelloides prairiehilensis, Rugoglobigerina rugosa, Globotruncana lapparanti, Rotalia skouensis, cibicides montanus, Cibicides minimalis, Quinqueloculina sp., Gavelinella sp.

Radotruncana calcarata Total Range Zone (Late Campanian)

Thickness biozone in Kuh-e-Jahrum section is 14 meter, and lower boundary biozone with first appearance Radotruncana calcarata of sample number RAP.265 and upper boundary biozone is determine with last appearance Radotruncana calcarata to sample number RAP.270. 

Associated Foraminifera biozone as follow: Spiroplectacta sp., Globotruncana bulloides, Macroglobigerinelloides bollii, Macroglobigerinelloides ultramicrocrus, Heterohelix globolusa, Globotruncana linneiana, contusotruncana foricata, Rugoglobigerina rugosa, Globotruncana arca, Globotruncanita stuartiformis, Gavelinella sp. Globotruncanella havanensis Partial Range Zone. (Late Campanian)

Thickness biozone in Kuh-e-Jahrum section is 17 meter, lower boundary biozone with last appearance Radotruncana calcarata of sample number RAP.270 and upper boundary biozone is determine with first appearance Globotruncana aegyptiaca to sample number RAP.274. Associated Foraminifera biozone as follow: Spiroplectacta sp., Globotruncana bulloides, Muricohedbergella holmdelensis, Heterohelix globolusa, Globotruncana linneiana, Macroglobigerinelloides prairiehilensis, Rugoglobigerina rugosa, Globotruncanita stuarti, Globotruncanita stuartiformis, Macroglobigerinelloides subcarinatus, Quinqueloculina sp. Globotruncana aegyptiaca Interval Range Zone. (Late late Campanian)

Thickness biozone in Kuh-e-Jahrum section is 30 meter, lower boundary biozone with first appearance Globotruncana aegyptiaca of sample number RAP.274 and upper boundary biozone because of lacking Gansserina gansseri, is determine with first appearance Contusotruncana contusa to sample number RAP.284. Associated Foraminifera biozone as follow: Spiroplecta sp., Heterohelix striata, Muricohedbergella holmdelensis, Rugoglobigerina rugosa, Globotruncanita stuarti, Globotruncana falsostuarti, pseudotentulatula elegans, Globorotalioides subconicus, Muricohedbergella monmouthensis, Bolivinoides darco, Bolivina primatumida, Marssonella sp.

Also because of lacking index Foraminifera include Gansserina gansseri and Abathomphalus mayaroensis, two bizone local identified by writer as follow. Contusotruncana contusa total range zone. (maastrichtian)

Thickness biozone in Kuh-e-Jahrum section is 12 meter, lower boundary biozone with first appearance Contusotruncana contusa of sample number RAP.284 and upper boundary biozone is determine last appearance Contusotruncana contusa to sample number RAP.289.
Associated Foraminifera biozone as follow: Muricohedbergella holmdelensis, Globotruncanita conica Minouxia sp., Bolivinoides sp.
Muricohedbergella monmouthensis Partial Range Zone (masstrichtian)
Thickness biozone in Kuh-e-Jahrum section is 200 meter, lower boundary biozone with last appearance Contusotruncana contusa of sample number RAP. 289 and upper boundary biozone is determine with last appearance Muricohedbergella monmouthensis to sample number RAP. 359. Associated Foraminifera biozone as follow: Muricohedbergella holmdelensis, Rugoglobigerina rugosa.
Biostratigraphic chart shows Gurpi formation in kuh-jahrum section.

Reference

fig1: The map shows position geography Kuh-e-Jahrum section
fig2: Biostratigraphic chart shows Gurpi formation in kuh-jahrum section.
1.

Fig 1. Muricohedbergella holmdelensis, No. RAP. 259.
Fig 2. Muricohedbergella monmouthensis, No. RAP. 330.
Fig 3. Heterohelix globolusa, No. RAP. 247.
Fig 4. Globotruncanita elevata No. RAP. 246.
Fig 5. Contusotruncanana fornicata No. RAP. 263.
Fig 6. Contusotruncanana contusa No. RAP. 290.
Fig 7. Globotruncanana limeiana No. RAP. 258.
Fig 8. Globotruncanana bulloides No. RAP. 264.
Fig 9. Globotruncanana aegyptiaca No. RAP. 280.
Fig 10. Archaeoglobigerina blowi No. RAP. 246.

Fig 11. Globotruncanana ventricosa No. RAP. 258.
Fig 12. Globotruncanita conica No. RAP. 294.
Fig 13. Globotruncanita stuarti No. RAP. 277.
Fig 14. Globotruncanita stuartiformis No. RAP. 265.
Fig 15. Radotruncanana calcarata No. RAP. 267.
Fig 16. Globotruncanella havanensis No. RAP. 273.
Fig 17. Rugoglobigerina rugosa No. RAP. 262.
Fig 18. Macroglobigerinelloides bollii No. RAP. 260.
Fig 19. Macroglobigerinelloides subcarinatus No. RAP. 266.
Fig 20. Rotalia skourensis No. RAP. 351.
Study rate of oxygen in sanganeh formation from Ghareh – soo section basis of palynological data

Vazire, M. Allameh, M. Moradian, F

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Abstract

Sangameh formation is one of the lower Cretaceous formations in kopet-dagh sedimentary basin, NE of Iran. It's name is gotten from a village in 70 km NE of Mashhad. The lithology of this formation consists of dark grey to greenish shales. 150 slides prepared. In studying of 3 main groups of palynologic elements (Thet in the primary parts of the formation, the oxygen conditions were low and the rate of deposition was high, but in the end parts of the formation despite low oxygen condition and also non-oxygen condition, the preservation of palynomorphs is low and turned to light some. Because of the low rate of deposition. By the way, the low oxygen condition is so important in hydrocarbon creation and it must study as well.

Introduction

Sanganeh formation is the Lower Cretaceous formation in sedimentary basin kopet-dagh in the North East of Iran. One of the faces of the structures in Gharesou section in the gharehsou beautiful waterfall located in 5 kilometers kalat nader which its lithology included shale dark gray to green squash disposed between siltstone silt layers thickness is 219 meters(Fig1). the Study on the sanganeh structure Paelpalinology and report dinoflag species, sedimentary environment, palynofacies and oxygen levels at the time of sedimentation is the formation. the samples in the laboratory using acid HF, HCL and heavy material processing ZnCl2, and 150 palinological slides were prepared.

Discussion

With review and statistical studies were done on 150 palynological slides in the cutting of these factors Lability, compared to SOM transparent dark, and the ratio of SOM to palynomorphs were measured and for to restore the oxygen environment changes and rhythm past sedimentation were used. Figure 2: SOM ratio curve changes transparent to dark SOM in sanganeh formation samples Lability:

macerals according to Transparency divided two (OP) and brown (b).fig3 the brown maseralls depend to land plants and show near shore environment APEC maseralls have dark color and semi-oxic environment - semi warm was shown. and in the remote offshore, are found, increased with increasing factor Lability Palynomorpha abundance and diversity and reduce marine preserve Shdgy SOM shows high organic material is the lability Tvrkly obtained in this formation indicate a low oxygen environment and in the end, make no oxygen the ratio of light SOM to darkSOM:

Anaerobic bacteria in the environment without oxygen, a little below the sediment surface SOM to create transparency in terms of organic matter to Ahyayy nitrate and sulfate decomposition and as a result, nitrogen, carbon dioxide, water and methane production must.
When the bacteria is high sedimentation rate in limited time can not decay and destruction of organic matter, so more chances Shdgy organic materials are preserved in conditions without oxygen and low sedimentation rhythms of other elements Palynvmrf clear SOM is produced, Aerobic bacteria in water, oxygen and organic matter to parse, if the amount of organic material decomposition is above all the oxygen and hydrogen to lose and only a small amount of carbon remains and therefore should be dark SOM.

As the amount of SOM transparent conditions shows no oxygen and oxygen conditions corroborated SOM is dark, than these two measurements can estimate the amount of oxygen is in the past, if this ratio is more than a lack of oxygen and conditions If is less than one. Terms of oxygen in the formation Snganh this factor in all samples and confirmed more than one environment without oxygen.

Ratio of SOM to Marine Palynomorph:
Most maintain Shdgy Palynomorph Dinoflagellate especially in conditions without oxygen and high sedimentation, if sedimentation and low oxygen level is low, because not maintain their Shdgy Palynvmrfha into SOM is clear, but if sedimentation is low and oxygen high, Palynomorph sea, to SOM changes can be made by dark, so to increase transparency SOM Palynomorph marine conditions and lack of oxygen in the low sedimentation makes visible. Marine Palynomorph high ratio indicates high sedimentation rate in the formation Snganh more than one of these factors and conditions without oxygen and in some areas shows low oxygen

Conclusion
Review and determine the percentage of 3 main groups elements Palynomor ph, PM, SOM and the review of protection factors than organic materials SOM clear dark Lability than clear and dark with SOM Palynomorph marine shows low oxygen conditions and lack of oxygen environment sedimentary ruling is.

References


Tyson, R.V.; 1989. Late Jurassic Palynofacies trends ,Piper and Kimmeridge clay Formations ,U K onshore and northern North Sea, the British Micropalaeontological Society Ellis Horwood limited, 135-172.


![Fig1:diagram of stratigraphy column](image-url)
Fig 2: SOM ratio curve changes transparent to dark SOM in sanganeh formation samples

Fig 3: ratio of Lability changes
Presentation of Dinoflagellates in Sanganeh Formation in Ghareh so section

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Abstract
Sanganeh formation is form sections of kopet basin, for palynological studies on this formation in Ghareh so section 30 samples collected and processed. In slide palynological dinoflagellates elements are perfected. In sanganeh slides dinoflagellates high diversity dinocysts had three shape Chorate. Cavate, cavate. Proximate. Chorate shape in this section had very high genus and high diversity. Analysis of diagram diversity indicates first of formation environment for product and preservation dinoflagellates is very good. When diversity is high and end of formation environment not good for living dinoflagellates. Sedimentary environment sanganeh formation section of inner neritic of open marine with low energy. Identified age of sanganeh formation base of dinoflagellates indicates Aptian, Albian.

Introduction
Sanganeh Formation of Lower Cretaceous units Kopet Dagh sedimentary basin in the North East of Iran. Lithology this formation composed of greenish shale gray to dark Shale is a very thin layer of silt are acetone. Wide spread elements in the territories Palynomorph marine environment as well as reconstruction of the past can provide Palynomorph elements as indicators of good Water depth, location coastline sea level changes, variable temperature changes, oxygen and water cycles can be used. In this study factor "protecting organic materials" for the determination of sedimentation rate changes and is used to review and statistical studies were done using the slides were Palynological garlic.
The slides in a laboratory Palynologicaly following was done.
1 - made up of samples
2 - leaching initial 24 hours
3 - Use two percent of HCL for 24 hours for removing calcareous materials
4 - leaching loss until the acid
5 - HF 38 percent of removing the existing Silicates
6 - leaching completely neutral until the samples
7 - passing the 20 micron sieve
8 - steam bath for 15 minutes
9 - centrifuge with Zncl
10 - Crossing the 20 micron sieve
11 - glue on the Lam
After preparing microscopic slides were studied.

Discussion
Diversity available in Dainoflagellates Sanganeh formation in Nagorno-hand cut:
Being rich sediments of the environment determines the currents Dainoflagellates Climbing is because the currents are carrying food (wall et al .1977). High diversity of marine Palynvmvrfhay (especially dinoflagellates) resulting conditions are favorable for their production. In addition to favorable conditions for the production, preservation Shdgy also very important and effective factor in diversity and abundance is reduced severely. (sluuuijs et al.2005;). Relative value Palynomorph shallow sea platform towards the platform interior basin that can be increased due to reduction in material stiffness with increasing distance from rivers or delta mass increase in biological production (Biomass) is marine. The diversity of species Dainocyst platform to platform built by the cluster (intra platform basin) is increased. Chart review of diversity Dainoflagellates Sanganeh formation in cutting Snganh shows this formation has a relatively high diversity, especially in the middle parts are cut. The sedimentation rate and oxygen environment can be a The species diversity to increase their food and suitable (fig1).environmental conditions (oxygen levels and high sedimentation rate) to produce and maintain than Shdgy Palynomorpha to make the middle while the optimum conditions to by the end of cutting samples are reduced and species diversity is less. Classification based on existing Dainoflagellates cyst:
The following table classified Dainoflagelletes fossils found in the formation Sanganeh cut morphological groups based on the Nagorno-hand shows. First, should keep in mind that this classification is presented based on Willsams 1993.

<table>
<thead>
<tr>
<th>Sanganeh formation Age</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>The formation and Dainoflagellates available in comparison with studies elsewhere over many cyclonephelium, oligosphaeridium, odontochitina, Canada Aptian boideaux sediments has been reported (kimyai 2000). The presence of species such as coronifera oceanica, hystrichosphaeridium Prolixophearidium paruispinum, surculosphaeridium the basin sediments Ptn vocontian France (heimhofer) and sediments Aptian cismon Apticoare South Alps, Italy (Torricelli 2000) has been reported. These findings, the results obtained by raisossadat (2004,2006) will confirm. Due to his age Sanganeh formation in the formation of cuttings from the middle to upper Aptian and some cuttings from the lower Ptn is reported. Age the formation Sanganeh fossil collection in the Nagorno-hand cut is Ptn that the existing development Zmay fossils Dainoflagellates Albian also appears likely.</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusion**

In this study 45 species and several generaDainoflagellates is identified which indicates formation of Palynomorph being rich, and age make the fossil collection Aptian, Abtin Is.

**References**


<table>
<thead>
<tr>
<th>Classification</th>
<th>Dainoflagellates fossils in the form based on cyst formation Sanganeh</th>
</tr>
</thead>
</table>
| Proximate      | *Batiacasphaera* sp.  
*Cerbia* sp.  
*Cerbia tabulate*  
*Cribroperdinium orthoceras*  
*Cribroperdinium* sp.  
*Fragilis*  
*Framea*  
*Gonyalacysta* sp.  
*Gonyalacysta Orthoceras*  
*Paleoperdinium cretaceum*  
*Paragonyalacysta callouensis*  
*Phelodinium* sp.  
*Sentusidinium* sp.  
*Tarsisphaeridium* sp. |
| Chorate         | *Callaiosphaeridium* cf. *asymmetricum*  
*Cleistosphaeridium* polytrichum  
*Cleistosphaeridium* sp.  
*Coronifera ocenica*  
*Cyclupeplium* cf. *paucipum*  
*Cyclupeplium distinctum*  
*Florentina berran*  
*Florentinia deanei*  
*Hystrichosphaeridium* sp.  
*Hystrichosphaerina schindewolfii*  
*Oligosphaeridium poculum*  
*Oligosphaeridium albertense*  
*Oligosphaeridium* cf. *fenestratum*  
*Oligosphaeridium* cf. *perfuratum*  
*Oligosphaeridium complex*  
*Oligosphaeridium pulcherrimum*  
*Oligosphaeridium* sp.  
*Prolxosphaeridium anasillium*  
*Surculosphaeridium longifurcatum*  
*Tanyosphaeridium* sp. |
| Proximochorate  | *Achomosphaera* sp.  
*Achomosphaera Ramulifera*  
*Spiniferites dentatus*  
*Spiniferites ramosus*  
*Spiniferites* sp. |
| Cavate          | *Eucludinium* sp.  
*Odontochitina operculata*  
*Odontochitina* sp.  
*Pseudoceratium pelliferum*  
*Subtilisphaera* sp. |
Fig1: diversity of dinoflagellates diagram in Garch soo
Palynofacies and Palaeoenvironment Sanganeh formation in gharesoo section

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Abstract
Sanganeh formation is one of the lower cretaceous formations in the kopet – Dagh basin. The asnganeh formation for palynological studies and a sum of 150 shedes of samples 90 processed Using thress mian groups of palynological elements (palynomacerals, palynomorphs and amorphous organic matter) were distinguished distinguished three palyn facies for the environment was determined open marine neritic is to dinoflagellates and in some index genera in upper partso.

Introduction
Snganeh Formation of Lower Cretaceous constructor Kopet Dagh sedimentary basin in the North-East country.
In order to study the formation Palynofacies Nagorno-hand cut 150 slides in the laboratory and the Palynofacies were studied by microscope.

Discussion
After the slide show of 300 particles of various components Palynofacies Dainoflagelates, the Palynomacral and several types of SOM with selected field of view were counted randomly, and then using the software excel percent Palynofacies elements in the main role Palynofacies to play a, respectively.
Resulting separation of these elements, 3 Palynofacies following are the sedimentary environment of the formation is shown
A) Palynofacies I: The high percentage SOM Palynofacies approximately 60 to 70 percent and 20 percent to 30 percent and some Palynomaceral Marine Palynomorph specified. Palynofacies II and the equivalent vnderzovan (1990) is.
B) Through compliance and to plot samples in three-dimensional diagram (Tyson, 1993) Distal Suboxic-Anoxic Basin environment was that thin layers of silt between Estonia Shylhay largely uniform in this formation are Palynofacies instead, that can be Sedimentation concluded silt layer below Estonia and the period of relative sea level than that.
B) Palynofacies II: percentage of elements to this Palynofacies Palynomaceral high proportion of about 80 to 90 percent and the percentage is low Palynomorphy Marine and SOM are Palynomacral and fourth type are the most and the next day Palynomacral blade 3 to 2 is. Palynofacies aerobic conditions is the average energy AEROBIC. This Palynofacies with Palynofacies IV and Vndrzan (1990) as is, and plot samples in three-dimensional diagram (TYSON 1990) environment to marginal dysoxic - anoxic basin proximal shelf or basin shows and mostly Shales are dark gray to Shdgy Palynomrpha is well preserved.
C) palynofacies III: This Palynofacies SOM also very low percentage Palynomaceral average between 30 to 70 and high sea Palynomrphy specified conditions of semi-aerobic and low-
energy shows, the high concentration Palynofacies Palynomrphphy keeping marine and Shdgy frequency diversity is seen with conditions shows the open sea.(Fig1)

Figure 2: plot of samples in three-dimensional diagram (TYSON 1993) environment MUD-DOMINATED OXID SHELF shows.

Conclusion
The review includes three main elements Palynunorpha Palynvmacr, the organic materials and no building Palynvmrfha three Palynofacies Snganh formation was separated for the interpretation of this facies Palynofacies help the environment as most of the formation PROXIMAL SHELF MUD DOMINATED OXIC SHELF as part of the OPEX MARINC AZ INNEO NERITIC semi-aerobic conditions and are low energy, respectively.

References
Tyson, R.V.; 1989. Late Jurassic Palynofacies trends ,Piper and Kimmeridge clay Formations ,U K onshore and northern North Sea, the British Micropalaeontological Society Ellis Horwood limited, 135-172.
Figure 1: Palynofacies in Sanganeh Formation
Figure 2: Tayson diagram
Environmental response of benthic foraminifera in Asalooye coastline sediments (Persian Gulf)

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Abstract
Benthic foraminifera of the Persian Gulf and their distribution were investigated in Asalooye coastline sediments in year 2009. Asalooye is located in Booshehr province in south of Iran. The studied region is near the gas refineries and Petrochemicals Company that it is one of the most important places of toxic and heavy metals. The faunal studies were accomplished by measurement of physico-chemical properties of water and geochemical analyses of surface sediments. Physico-chemical properties included the salinity, temperature, dissolved oxygen and acidity of water was measured on board. The temperature and salinity showed a pronounced seasonality. Average of temperature was determined 23.5 °C. Acidity of water didn't show important changes. Average of dissolved oxygen exceeded 6.1 mg/lit. Samples for geochemical analysis were powdered and amount of Ba, Sr, Cu, Zn, Pb, Ni and Cr was determined by X.R.F examinations. The samples for foraminifer's analysis were stored in a fridge for 8 hours to effect a sufficient staining with Rose Bengal. The samples were first passed and washed through 4 sieves (50 µ, 100µ, 0.5mm and 1 mm). After drying foraminifera tests were picked out, then normal and abnormal tests were counted separately. The abundances were expressed as a number of specimens per 1cm³ of sediment. The main species were photographed by using a Scanning Electronic Microscope (SEM). The living benthic foraminifera communities in Asalooye coastline sediments were dominated Elphidium ceraticulatum, Amphistegina lobifera, Dendritina ambigua, Quinqueloculina agglutinans, Quinqueloculina seminulum were common. In this research, we recorded high frequencies of test abnormalities. The majority of abnormal tests were observed in Quinqueloculina agglutinans, Quinqueloculina seminulum. Elphidium ceraticulatum is highly opportunistic and capable to tolerate elevated levels of nutrients and trace metals.

Keywords: Persian gulf, Elphidium ceraticulatum, Asalooye, Heavy metals, Abnormal foraminifera.

Introduction
Booshehr province is one of the south’s west of Iran that its coastline has much pollution of hydro-carbon and oil. In addition to the gas refineries and Petrochemicals industries were located in Asalooye city of Booshehr province. The aim of this study is to determine the possible causes of abnormality on benthic foraminifer's tests. Benthic foraminifera are single-celled organisms similar to amoeboïd organisms in cell structure. Foraminifera are covered with an organic test that varies from a single chamber with an aperture to calcite wall or agglomeration of mineral grains. Foraminifera occupy a wide range of marine environments, from brackish estuaries to the deep ocean basins (Ernest et al, 2006). They are good biomarkers for environmental pollution of natural or artificial causes.
The heavy metals adversely affect the biota and cause morphological abnormalities in individuals. Benthic foraminifera of the Persian Gulf were investigated in 2009. By systematical and ecological studies were determined foraminiferal assemblages in coastline sediments of Asalooye.

Material and method
The current study is based on 14 surface sediment samples collected in May 2008 on 2 cruises. The surface samples were placed into a glass vial thoroughly mixed and subsamples for organic and inorganic geochemical analyses were taken from this mixture at first. The remaining was transferred to a PVC vial, and preserved and stained with a solution of 2 grams Rose Bengal per litre ethanol in order to mark living foraminifers (Murray et al, 2000). According to Physicochemical properties measurements the salinity, temperature, acidity and dissolved oxygen content of the super standing water in core tube were measured on board.

For geochemical analysis subsamples were freeze-dried and powdered and amount of Ba, Sr, Cu, Zn, Pb, Ni and Cr was determined by X.R.F examinations.

The subsamples for foraminifera analysis were stored in a fridge for 8 hours to effect a sufficient staining with Rose Bangal. Living individuals are recognised by staining (Biocenosis). The samples were first passed and washed through 4 sieves (50 µ, 100µ, 0.5mm and 1 mm). After drying foraminifera tests were picked out, both normal and abnormal tests were counted separately.

Results and Conclusion
The temperature and salinity showed a pronounced seasonality. Average of temperature was determined 23.5 ° C. Acidity of water didn't show important changes. Average of dissolved oxygen exceeded 6.1 mg/lit.

The concentrations of Cu, Zn, Pb, Ni and Cr in subsamples of Asalooye were showed in table 3. Accumulations of elements have relation to grain size of sediments, mean' while amount of them in muddy sediments is more than sandy.

The surface sediment pollution by Cu, Zn, Pb, Ni and Cr principally could be considered as moderate because the levels of metals are comparable to elsewhere in Persian Gulf. According to previous studies mean concentration of Cu is increased but the others didn't show important changes.

The living benthic foraminiferal communities were dominated by: Elphidium ceraticulatum. The other common speices of benthic foraminifera in Asalooye coast line sediments are Ammonia beccarii, Amphistegina lobifora, Cymaloporetta sp., Dendritina ambigua, Penereplis planatus, Pseudohauerina sp. Pseudohauerinella dissidens, Quniqueloquilina agglotinananas, Quniquila seminulum Rotalia trochidiformis, Rupertianella rupertiana, Spiroloculina depressa, Spiroloculina excavata, Triloculina inflata, Triloculina tricarinata. Our results infer that genra or species with hylaine tests have more abundancy than the porcelanose or aglutina tests. Aboundance of living individuals (or biocenosis) more than dead forms of foraminifera (or taphocenosis). Investigation on test size of foraminidera showed living individuals in studied region is smaller than normal size.
The results of comparison between dimensions of test and grain size of sedimentary bed showed that silty or muddy beds have small or tiny tests. In this type of beds, the amount of total organic matter is high and the concentration of metals, especially Cu, is more than sandy beds. According to Alve (1995), abundant and geographically widespread species are to be considered as most tolerant to environmental pollution. *Ammonia beccarii* is commonly frequent in coastal environments (Stouff et al. 1999). Species of *Ammonia beccarii* is abundant because of its opportunistic behavior and high potential to survive under high input of nutrients and metals concentration. In our studied region, *Elphidium ceraticulatum* has high abundance but with abnormal tests. The majority of abnormal tests were observed in *Ammonia beccarii* and *Elphidium ceraticulatum*. However, during spring time, we observed an increase in abundance of abnormal tests, which was correlated to high metal levels. We suggest that this mirrors the production of benthic foraminifera during spring, and the juveniles were especially sensitive to environmental stress.

**References**


Table 1 - Summary of foraminifer’s population in studied region

<table>
<thead>
<tr>
<th>NO</th>
<th>Genera &amp; Species</th>
<th>Biocensis</th>
<th>Taphocenosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Elphidium ceraticulatum</em></td>
<td>70</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td><em>Ammonia beccarii</em></td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td><em>Amphistegina lobifora</em></td>
<td>54</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td><em>Cymaloporeta sp.</em></td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td><em>Dendritina ambiguа</em></td>
<td>43</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td><em>Peneroplis planatus</em></td>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td><em>Pseudohauerina sp.</em></td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td><em>Pseudohauerinella dissidens</em></td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td><em>Quinquelooquina agglutinans,</em></td>
<td>30</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td><em>Quinquelooquina seminulum</em></td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>11</td>
<td><em>Rotalia trochidiformis</em></td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td><em>Rupertinella rupertiana,</em></td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td><em>Spiroloculina depressa</em></td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td><em>Spiroloculina excavata</em></td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td><em>Triloculina inflata</em></td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>16</td>
<td><em>Triloculina tricarinata</em></td>
<td>33</td>
<td>21</td>
</tr>
</tbody>
</table>

Table 2 - Mean concentration of Cu, Zn, Pb, Ni and Cr (ppm)

<table>
<thead>
<tr>
<th>Cu</th>
<th>Zn</th>
<th>Pb</th>
<th>Ni</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>34</td>
<td>4</td>
<td>17</td>
<td>4</td>
</tr>
</tbody>
</table>

Figure 1: the position of Asalooye in Persian Gulf
Plate 1

1: Ammonia beccarii  
2: Amphistegina lobifera  
3: Ammonia tepida  
4: Rotalia trochidiformis  
5: Elphidium craticulatum  
6: Cymbaloporella sp.  
7: Peneroplis planatus  
8: Pseudohauerina sp.  
9: Pseudohauerinella dissidens  
10: Quinqueloculina seminulum  
11: Quinqueloculina agglutinans  
12: Triloculina inflata  
13: Dendritina ambigua  
14: Rupertianella rupertiana  
15: Spiroloculina depressa
Biostratigraphy of Middle Eocene deposits on the base of benthic foraminifera in Shurab, Qom, Central Iran

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Abstract
In order to biostratigraphy and determine the age of Eocene deposits, a stratigraphic section was studied in Shurab area. The area is located in 40 km SE. of Qom city, in Central Iran. Eocene deposits could be divided in to 6 informal rock-unites in this region including E1 to E6. Lithological characteristics and stratigraphic position of the examined rocks indicate that the oldest part of the section is equivalent to E4 member which predominantly consists of volcanic rocks. E5 unit includes various sequences of carbonate, terrigenous and pyroclastic sediments. E6 unit is composed of conglomerate and sandstone. The thickness of this stratigraphy section is 406 m and 90 samples were collected. Eocene succession in the studied area reveals a coincidence of volcanic activities and sedimentation in a shallow marine basin having influenced the diversity of fauna. According to diversity of benthic foraminifera in the area investigated, 12 genera and 7 species were identified. Based on chronostratigraphic value of the identified taxa, the Late Lutetian- Bartonian age was ascribed to the Eocene deposits in Shourab section.

Introduction
Shurab village lies about 40 Km south east of Qom in central Iran. The oldest Tertiary sediments in this region are related to the Eocene. Based on previous studies (Hajian 1970 & Emami 1991) Eocene deposits have been divided in to 6 informal rock units in this region (E1-E6). E1 member consists of red, terrigenous rocks. These sediments have been assigned to Early Eocene on the base of stratigraphic position. E2 unit which is called lower volcanic member basically includes volcanic rocks. An age of Early Lutetian could be ascribed using two nummulitic horizons at top and base of the unit.

E3 member (Lutetian in age) which is called lower green series dominantly consists of green tuff and nummulitic limestone. E4 member or middle red unit mainly composes of volcanic and pyroclastic rocks. Presence of a nummulitic bed on top of E4 indicates the Late Lutetian age for this member. E5 rock unit, (so-called as upper green series) consists of green tuff, tuffite and nummulitic limestones with an age of the Lutetian-Bartonian. E6 member dominantly composed of volcanic rocks, conglomerate, sandstone and pyroclastics partly interbedded with marl, is considered to be Late Eocene.

Lithological characteristics and stratigraphic position of the studied deposits reveals that, the oldest outcrop in study section is equivalent to E4 member. This member is overlain by sedimentary and pyroclastic rocks of E5 series. E6 member in Shurab area consists of conglomerate alternated with medium to thick bedded sandstones.

Stratigraphy
In order to biostratigraphic studies on the Eocene deposits in Shurab area, a complete section was measured and sampled in detail. The investigated area located at 51° 08' 15" to 51° 09' 50" E longitude and 34° 20' 10" to 34° 22' 15"N latitude (Fig.1)
From lithostratigraphic point of view E4 member is the oldest rock unit which is exposed in Shurab area. At this locality, this member comprises of dark green to grey porphyritic andesite. The member is disconformably overlain by 42 meters grey conglomerate of the base of E5 member which gradually changes to calcareous sandstone to sandy limestone. Upsection, the sedimentary sequence is followed by 85m brown to cream thick bedded limestone interbedded with grey thin bedded limestone. Benthic foraminifera have a conspicuous variety in this interval. After that, the succession is followed by 2m calcareous sandstone, and 7m conglomerate that are followed by 19.5m green tuff and 21m conglomerate. The conglomerate beds are topped by 30m brown, medium to thick bedded limestone enriched by benthic foraminifera. The upper most part of the E5 member includes 65m of green medium bedded tuffaceous limestone, tuff and tuffite. E6 member with a thickness of 128m includes alternation of brown to red thick bedded conglomerate and sandstones, disconformably resting on E5 rock unit. After a covered zone, red and green, silty shale with intercalations of sandstones belonging to Lower Red Formation with an Oligocene age unconformably overlie E6 member (fig 2).

Biostratigraphy of the Eocene deposits

In this study a total of 90 samples from the 406m thick sequence were collected in Shurab section. Only the middle part of E5 member of the Eocene deposits is characterized by presence of larger benthic foraminifera. Based on micropaleontological studies 12 genera and 7 species were identified. On the basis of diversity, appearance and disappearance of various taxa, four biozones and one barren interzone were suggested that including:

1- *Rotalia trochidiformis*, *Fabiania* sp. Interval zone
This biozone includes lower carbonate part of the E5 member and with a thickness of 85m. Base of the zone is marked by appearance of *Rotalia trochidiformis* and top by the first occurrence of *Fabiania*. The identified benthic foraminifera indicate the Late Lutetian-Bartonian age for this interval.

2- *Nummulites aturicus*, *Nummulites globulus* Assemblage Zone
This assemblage zone occurs just above *Rotalia trochidiformis*, *Fabiania* sp. interval zone and includes a thickness of 24m of E5 member. This biozone is characterized by the presence of *Nummulites aturicus* and *Nummulites globulus*. The foraminiferal association is also accompanied by *Asterigerina* sp., *Eorupertia* sp., *Orbitolites* sp., *Nummulites* sp., *Fabiania* sp. and *Rotalia trochidiformis*. Based on chronostratigraphic value of the identified taxa the Late Lutetian-Bartonian age is suggested for this part of E5 member.

3- *Assilina granolusa* Taxon Range Zone
This biozone immediately begins above *Nummulites aturicus*, *Nummulites globulus* assemblage zone and includes a thickness of 26m of the E5 member. This zone is recognized by the total occurrence of *Assilina granolusa*. Based on the identified taxon the Late Lutetian-Bartonian age is suggested for this interval of E5 member.

3- Barren interzone
This barren zone begins above *Assilina granolusa* taxon range zone and includes 79m of E5 member. Lithologically, this interval consists of green tuff, tuffaceous limestones and conglomerate.

4- *Discocyclina nummulitica* Taxon Range Zone

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This taxon range zone include 31m of the upper part of E5 member and it is marked by the total appearance of *Discocyclina nummulitica*. Based on the identified taxon, the Late Lutetian-Bartonian age is suggested for this interval of E5 member. According to chronostratigraphic value of the identified taxa, the Late Lutetian- Bartonian age was ascribed to the Eocene deposits in Shourab section.

**Conclusions**
Based on lithostratigraphic characteristics, the oldest rocks of Eocene outcrops in Shurab area are equivalent to the E4 member. Eocene deposits in this region include various sequences of carbonate, terrigenous, pyroclastic and igneous rocks. Three lithological members (E4, E5 & E6) can be distinguished in Eocene rocks in Shurab area. The study succession reveals a coincidence of volcanic activities and sedimentation in a shallow marine basin having influenced the diversity of fauna. Twelve genera and 7 species were identified in this study. On the basis of diversity, appearance and disappearance of various benthic foraminiferal taxa, four biozones and one barren interzone were identified and introduced. Based on chronostratigraphic value of the identified taxa, the Late Lutetian- Bartonian age was ascribed to the Eocene deposits in Shourab section.

**References**
Rahaghi, A., 1980 Tertiary faunal assemblage of Qom - Kashan Sabzewar and Jahrum areas. NIOC Publication No. 8
Fig. 1. Location map of the studied area, SE. of Qom, in central Iran.

Fig. 2. Stratigraphic section and distribution of foraminifera at Shurab section.
Fig. A: *Discocyclina marthae* X.37, Fig. B: *Calcarina longispina* X.27, Fig. C: *Asterigerina* sp. X.30, Fig. D: *Discocyclina nummulitcia* X.30, Fig. E: *Rotalia trichiformis* X.40, Fig. F: *Orbitolites compalanatus* X.19, Fig. G: *Eorupertia* sp. X.15, Fig. H: *Fabiania* sp. X.18, Fig. I: *Operculina* sp. X.20, Fig. J: *Nummulites globulus* X.20, Fig. K: *Nummulites aturicus* X.5, Fig. L: *Assilina granolusa* X.18.
The Modeling of Nebkha dune with vegetation factors

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** Assistant Professor of Natural Resources and Agriculture, Shiraz University.

Abstract
One of the most important process in shaping of aeolian landscape specially nebkha landscape in arid land environment is vegetation. This paper has evaluated the Modeling of Nebkha dune with vegetation factors in desert Sirjan. Dominant species that it has been formed Nabkha is Tamarix mascatensis. This shrub has been adapted with conditions of Aeolian transition area. Results of analysis of regression showed a strong significant relation between volume of Aeolian dune and vegetation horizontal parameter with 0.90 of determination index and 0.60 of standard deviation estimated error. In the next grade are placed relation of Nebkha volume and volume of plant with 0.84 for coefficient of determination and 0.76 of estimated error value. Also results illustrated a weak significant between volume of dune and vertical parameters of plant with determination index of 0.50 and standard deviation estimated error of 1.34. Therefore the best relation between Nebkha dune and vegetation morphology explained intentionally with its canopy cover.

Key words: Modeling, Morphology, Nebkha, Sirjan, Vegetation

Introduction
Nebkhas result of interaction systems, wind, and sediment production are biological systems that can process during the formation stages of growth, stability and decline to show Nebkhas a group which forms an uneven Sequestration and their development is influenced by various factors. In the formation of different viewpoints are research Nebkhas Wang et al (2004) that the formation Nebkhas due to factors such as increased by reduced rainfall or wind energy is controlled. Marston (1986) and Khalaf (1995) reported that plant growth patterns and also provide resources essential factors in determining sediment size and development are Nebkha. Narrow leaves and Chen (1995) factors determining growth and development stages of harvest time Nebkhas antibody sediments introduced to the carrying amount and source of sediment supply, wind their strong relationship with the density of vegetation in semiarid areas of their results show that very important factor in the development and growth of song is Nebkhas Plant ecology. Nick Ling and Wolf (1994) have reported that due to the disturbance Nebkhas Vision Nebkha Morphologic are formed largely by the growth patterns of plant species forming is controlled. The important point in the process of development to create vegetation condition is Nebkha. Ecological factors such as tolerance of plant species in the development landscape has Nebkha role because they create Nebkha ability in different species are Nebkha morphology largely by vegetative patterns of plant species that are controlled constituent. Modeling as a tool for understanding the complex communications
Ecogeomorphology evolution of irregularities and vegetation may be prevailing in the management of environmental changes or human systems in dry and semi-arid areas is effective. In general, research results conducted on the characteristics and communication in the formation and development to achieve results Nebkhas Ali figure considerable lower than quantitative criteria to follow and always results in the formation of classic view these forms are unstable. This study is trying to rely on the quantitative characteristics in Geomorphology and landscape Nebkhas study the relationship between factors will determine the yielding Nebkhas. Since Nebkha Morphology several factors are involved in this study tried to keep constant some of these factors as the amount of vegetation in the morphology Nebkha factor will be investigated. In other words, selecting a limited area studied climatic factors (wind, rain and ...) Sequestration factors (size, grain classification and ...) and operating time is assumed constant and the result of changes and communication performances species forming Nebkha is paid. The main purpose of the research relationship between factors Poll vegetation Nebkha with sediment volume measurements apply numerical techniques and statistical analysis based on Poll base year is planned to also always other researchers able to apply quantitative methods to compare their results with the results this study are.

The study area
Study area called the salt desert of Sirjan range latitud 57° 54 and ‘27 ° 56 East is located. Figure (1) position of the study area shows. Salt desert of Sirjan with average height 1688 meters above sea level and average level of rainfall 100 mm and mean annual temperature of 17.1 ° C in the southern city of Sirjan is the dominant wind direction in south-eastern desert is135 ° (Web mail Meteorological Office city Sirjan 1381).

Method
First use of aerial region, range and then study specific reference to attendance area development and Nebkhas territory were determined. Then 10 samples along the entire pan Transkt 1000 meters have took cover along each Transkt Nebkhas Morphometric characteristics were measured in sample size depending on the location to place Nebkha Transkt has been settled. Nebkha a total of 105 species Tamarix mascatensis has been evaluated. In order to get the height and size parameters Nebkha. Nebkha measured cross section then through the year (1) Nebkha size characteristics were determined for the study of vegetation forming factors Nebkha plant morphology, including canopy cover and plant height measured and the measured was. Canopy cover to calculate a mean of two crown diameter measurements to calculate a plant and plant height, branch plant to the highest peak ground operation has Nebkha. The relationship of plant size (2). Respectively. Technique Poll relationship between traits plant with the capacity of sediments Nebkha regression analysis and correlation with spss software is based. Profile botany species Tamarix mascatensis Table (1) are listed (Mozaffarian, 1375).Relationship (1):

$$v = \frac{1}{2}(0.33\pi r^2h)$$

Research findings
Results between the size characteristics of plant morphology and sediments Nebkha coefficients established relationships between vegetation components with a cone size Nebkhas species Tamarix mascatensis tables (2) and (3) is expressed. The results showed
most tables between the horizontal component of plant Nebkha size coefficient determined 0.899 and the lowest estimated error rate of 0.601 is the horizontal component of the plant after the highest relationships with Nebkha size plant size coefficient of component explained 0.837 and the error estimate 0.764 is capable. The results of this table shows that the vertical component of plant coefficient determined 0.496 and the error rate estimate 1.343 for the least connection with the volume of Nebkha sediments.

### Conclusion

The important point in the process of development to create vegetation condition is Nebkha. Ecological factors such as tolerance, species Nebkha role in the development prospects and ability to create because they are Nebkha different species are different. Some species are more talented Nebkha formed alongside such species (Ziziphus lotus), which form wide estepian areas of North Africa by (Kilian 1945, Lang 1954, Menshing and Ebrahim 1977, Tengberg 1994) reported the species Nebkhas Acacia by Tengberg and chen (1998) in Burkina Fasou is. Therefore, this study characteristics of plant morphology and properties by the Nebkha Morphometric species Tamarix mascatensis was created to justify some characteristics Represent Nebkha Morphometry species by the morphology characteristics are.

Communication between components volume sediment of Nebkha and morphology of plant species Tamarix mascatensis shows the highest correlation between volume sediment of nebkha and horizontal component plant with coefficient determined 0.899 and the lowest estimated error rate of 0.601probability level less than one percent error. After the horizontal component is the relationship between plant volume and volume sediments of Nebkha with coefficient 0.837and the error estimate 0.764 at the level of error probability less than one percent is placed next Rank. The results of this table shows that the vertical component of plant coefficient determined 0.496 and the error rate estimate 1.343 for the least connection with the volume of sediments Nebkha. These results show that the most important factor in the sediment trapped by the horizontal component species Tamarix mascatensis plant or vegetation canopy is the same, ie what is more vegetation canopy plant is capable of higher levels of sediment to Sequestration.

### Table (1): Profile Tamarix mascatensis species in the study area

<table>
<thead>
<tr>
<th>Vegetative forms</th>
<th>Life forms</th>
<th>family</th>
<th>Persian name</th>
<th>Scientific name</th>
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<tr>
<td>phanerophytes</td>
<td>Shrub</td>
<td>Tamaricaceae</td>
<td>Gaz</td>
<td>Tamarix mascatensis</td>
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</tbody>
</table>

### Table (2) Summary Relation between vegetation components with a cone volume Nebkhas species Tamarix mascatensis.

<table>
<thead>
<tr>
<th>Relations</th>
<th>Correlation Coefficient</th>
<th>Coefficient determined</th>
<th>adjusted coefficient</th>
<th>error estimates</th>
<th>ANOVA F</th>
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<tr>
<td>Plant height and size Nebkha</td>
<td>0.704</td>
<td>0.496</td>
<td>0.491</td>
<td>1.343</td>
<td>101.222</td>
<td>0.000</td>
</tr>
<tr>
<td>Canopy cover and Nebkha volume</td>
<td>0.948</td>
<td>0.899</td>
<td>0.898</td>
<td>0.601</td>
<td>917.436</td>
<td>0.000</td>
</tr>
<tr>
<td>Plant volume and Nebkha volume</td>
<td>0.915</td>
<td>0.837</td>
<td>0.835</td>
<td>0.764</td>
<td>528.560</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Table (3) coefficients established relationships between vegetation components with a cone volume

Nebkhas species Tamarix mascatensis

<table>
<thead>
<tr>
<th>Relations</th>
<th>standard coefficients</th>
<th>Unstandard coefficients</th>
<th>T</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Standard deviation error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canopycover and Nebkha volume</td>
<td>0.948</td>
<td>3.561</td>
<td>0.118</td>
<td>30.289</td>
</tr>
<tr>
<td>Constant</td>
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<td>0.769</td>
<td>0.130</td>
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<tr>
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<td>0.704</td>
<td>3.139</td>
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<td>41.447</td>
<td>6.380</td>
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<tr>
<td>Plant volume and Nebkha volume</td>
<td>0.915</td>
<td>1.263</td>
<td>0.055</td>
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<tr>
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<td>0.022</td>
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<td>2.693</td>
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</tbody>
</table>

Figure (1): position of the study area

Figure (2) Appearance Tamarix mascatensis formed by species in the study area

Sources and origin
1. Web mail Meteorological Office Sirjan – 1381


Lower Cretaceous Agglutinating Larger Benthic Foraminifera from the Sarvestan Section, south of Esfahan, Iran

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Abstract
The Lower Cretaceous limestones and marls in central part of Iran having recently been attended for hydrocarbon exploration by NIOC contain a comparatively rich assemblage of orbitolinids. The Barremian-Aptian orbitolinid bearing strata in this area are considered to constitute the Mesozoic main reservoir rocks in prospection point of view. The detailed and satisfying stratigraphic results are of great importance for hydrocarbon exploration studies therefore this study tries to improve the knowledge of Lower Cretaceous shallow marine biostratigraphic studies in Central Iran using larger benthic foraminifera (mainly orbitolinids) constituting the main representatives of foraminiferal assemblage in this area. For the purpose of this study one section (Sarvestan) located in South of Esfahan was measured and sampled. Three assemblages of larger benthic foraminifera were recognized indicating Early Barremian to Late Aptian age (Eopalorbitolina assemblage = Early Barremian, Palorbitolina assemblage = Late Barremian-Early Aptian, Mesorbitolina assemblage = Late Aptian). The identified taxa are dominated by agglutinating larger benthic foraminifera including Eopalorbitolina, Palorbitolina, Mesorbitolina, Orbitolinopsis, Dictyoconus, Paleodictyoconus, Vercorsella, Mayncina, Charrentia, Trocholina and Pseudolituonella.

Geological Setting and Stratigraphic Framework
The sections studied, namely Sarvestan is located in Central Iran, south of Esfahan. The Lower Cretaceous deposits in the area investigated range from the Barremian to Aptian (Amiri 2009). The proposed lithostratigraphic subdivisions for the area studied follow Seyed Emami et al. (1971) and Nabavi (1972) (Fig. 1).
Lithostratigraphically the Sarvestan stratigraphic section starts with grey to brown medium bedded porous dolomite followed by grey to buff medium to thick bedded orbitolinid bearing limestones. These strata are followed by grey to olive grey thin bedded argillaceous limestones interbedded with medium bedded carbonates containing orbitolinids. The succession is again overlain by thick to medium bedded carbonates followed by shales and marls interbedded with thin bedded argillaceous limestones. Finally, the marine succession of the Sarvestan section is topped by thick bedded to massive purple carbonates.

Material and Methods
For the purpose of this study, a complete section located in south of Esfahan was measured and sampled in detail with a sampling interval of 3m. (Fig.1). A total number of two hundred and sixty two samples were collected and thin sections were made of all the collected samples. Generic classification of orbitolinids is based on Loeblich and Tappan (1988). Chronostratigraphic subdivisions of the section are based on stratigraphic ranges of the recognized orbitolinid taxa.
Biostratigraphy
Continuous distribution of orbitolinids allowed us to recognize three orbitolinid assemblages. We have compared our biostratigraphic data with references on the Early Cretaceous orbitolinids of the Tethyan realm and the Middle East (Schroeder, 1965; Schroeder & Conrad, 1968; Schroeder et al., 1982; Schroeder, 1997; Simmons et al., 2000; Bernaus et al. 2002; Schroeder & Cherchi, 2002).

Eopalorbitolina assemblage: Early Barremian
This assemblage is characterized by presence of *Eopalorbitolina* sp.and *Eopalorbitolina charollaisi* together with *Paracoskinolina sunnilandensis* and *Orbitolinopsis cuvillieri*. The Early Barremian age is confirmed by the determined foraminiferal association.

Palorbitolina assemblage: Late Barremian-Early Aptian (Bedoulian)
The main orbitolinid representative of the foraminiferal association is *Palorbitolina lenticularis* which is accompanied with *Pfenderina globosa*, *Pseudolituonella gavonensis*, *Praechrysalidina infracretacea*, *Trocholina odukpaniensis* and *Vercorsella laurenti*. Available biostratigraphic information support the Late Barremia-Early Aptian age for the assemblage.

Mesorbitolina assemblage: early Late Aptian (Gargasian)
The foraminiferal association of this assemblage is composed of *Mesorbitolina lotzei*, *Mesorbitolina parva*, *Dictyoconus pachymarginalis* together with *Voloshinoides murgensis* and *Sabaudia minuta*. The occurrence of *Dictyoconus pachymarginalis* suggests that the assemblage is not younger than Gargasian and the co-occurrence of *Mesorbitolina lotzei* together with primitive forms of *Mesorbitolina parva* coincides with Early / Late Aptian boundary.

Conclusions
Analyses of orbitolinid associations in Lower Cretaceous shallow marine carbonates of the study section led to recognize three orbitolinid assemblages ranging in age from Early Barremian to early Late Aptian. The Lower Barremian orbitolinid bearing limestones are recorded for the first time from Esfahan area. As a stratigraphic guide, our biostratigraphic data were correlated with references for the Tethyan realm and the Middle East. The results also prepare more detailed biostratigraphic data for hydrocarbon exploration goals in Central Iran.

References


Fig. 1 Showing stratigraphic range chart of the study section.
The study of microfacies and sedimentary environments of Tirgan Formation southeast of Ghochan (Dodanlu section).

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Abstract
Tirgan Formation southeast of Ghochan (Dodanlu section) is composed of 615 meters of carbonate-clastic rocks. Its lower contact is gradual with Shurijeh Formation and Its upper contact with Sarcheshmeh Formation is gradual too. In this research, Dodanlu section was measured and 100 thin section have been provided. Based on microfossils, Barremian-Aptian age has been determined for Tirgan formation. In this study 14 carbonate microfacies and 2 lithofacies have been recognized. Each of carbonate microfacies has been deposited in different parts of Intertidal, Lagoon, Barrier and open marine sedimentary environments. Facies analysis of Tirgan Formation in the study area and comparison with modern system environments indicate that these facies have been deposited in a homoclinal ramp type of carbonate platform.

Key words: Tirgan formation, microfacies, platform, Barremian-Aptian

Introduction
The Kopet Dagh Basin is located in north-east Iran where sedimentation continued throughout the Jurassic-Tertiary. Th area studied was located in southeast of Ghochan in Khorasan Razavi state. The main road is Mashhad-Ghochan. Due to study microfacies and stratigraphy of Tirgan Formation, Dodanlu section in southeast of Ghochan was studied.

Description
Due to exact study microfacies of Tirgan Formation, thin section have been studied. In this research, skeletal and non-skeletal grains, cement, and matrix in the section have been indicated. In exact study, 14 carbonate microfacies and 2 lithofacies have been recognized. Classification of carbonate rocks are based on Danhum(1962) and classification of clastic is based on Folk(1959,1962). Carbonate microfacies from shoal to open marine is:

A group

Intertidal microfacies
The most important allochems in this facies was composed of radial ooids, superfacial ooids, compound ooids, intraclast, bioclast,. These allocems was located in sparite cement. Intertidal zone was suggested for these facies. These facies are equivalent 18,17,15R standared facies Willson(1975) and are equivalent FZ7,FZ8,FZ9B belt facies.
B group  Lagoon microfacies
This facies was composed of pelloids. Ploid was formed in low depth and low energy same as Lagoon environments. Then this facies was deposited in lagoon environment. This facies is equivalent standared facies 16 Willson(1975) and is equivalent FZ8 belt facies.

C group  Barrier microfacies
The most important allochems in this facies were interaclast, radial ooids, and skeletal grains same as briozoer, gastropods. These allocemes were located in sparite cement. This facies was formed in low depth and high energy. These facies are equivalent standared facies 18,17,15R Willson(1975) and is equivalent FZ7,FZ8,FZ9B belt facies.

D group  Open marine
These facies was included orbitolina packstone-wackestone and oncoid floatstone, pellet orbitolina packstone. These facies was composed of Orbitolina, Gastropods, Briozoer, Milliolids and Textularia. This facies was indicated low energy and high depth. These facies are equivalent standared facies 10,11,13 Willson(1975) and is equivalent FZ7,FZ6,FZ5 belt facies.

E group  Lithofacies
Clastic deposits was interlaminated with carbonate rocks. This facies was composed of Shale and Sandstone. Sandstone was included arcoz, sublitarenite and subarcoz.

Conclusions
1-The environments of Tirgan Formation in southeast of Ghochan was insisted of Intertidal zone, Lagoon, Barriers and Open marine.
2-Facies analysis of Tirgan Formation in the study area and comparision with modern sedimentary environments indicate that these facies have been deposited in a ramp type of carbonate platform.
3-Based on index microfossils, Barremian-Aptian was suggested for this section.
4-Its lower contact is gradual with Shurijeh Formation, and upper contact with Sarcheshmeh Formation is gradual too.

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The Origin Of Indian Coin age: An Archaeo-Literary Approach

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Symbols represent the earliest records of man's urge for self expression. Art and religion constitute a significant factor in civilization. The material and spiritual aspects of a culture are represented in the artistic and religious manifestation. The significance of symbology in Indian art depicts human beings and their environs in specific framework of time and space in the context of an edifying story, sacred myth, legend, etc. However, symbols also play a role as a language.

While studying TC discs, I came across many designs related to early Indian symbols which were mostly found on punch-marked coins. Some of these designs/motifs may be seen in the folk and tribal arts of India even today. Perhaps it is due to some innate power within the motifs which makes them immortal to the ravages of time. In this research paper I have tried to compare the signs found on TC disc with the symbols found on punch-marked coins. Surprisingly, most of the signs are similar and in some cases, their technologies are also similar.

It is historically well known that a considerable quantity of TC discs have been generally found during the excavations at PGW & NBPW sites. Regarding the occurrence of TC discs in the Ganga-Yamuna doab, I have taken only Jakhera and Atranjikhera site for my present study. Total number of disc found on the above mentioned sites are as follows-

1- Atranjikhera (PGW & NBPW) 565
2- Jakhera (PGW & NBPW) 1,290

The present study of TC discs was undertaken to understand its pattern of designs, motifs, symbols and other traditional use, if any, within a cultural period and its transition from one culture to another. I have also made an attempt to focus on its variations in shape, size and weight. To show their significance and probable purpose of the object, I have categorised the study of TC discs into following two divisions:

1- Origin, technique, shape, size and weight
2- Designs, motifs and symbols

The TC discs, a small and common item, generally reported from the PGW and NBPW sites, have not received the attention they deserve. They are casually described as minor objects like amulets, beads, bangles, toys, tools and other small objects of daily use. However, such objects also help us in perception of our past. By studying these small implements historians/archaeologists have tried to arrive at some inference regarding the society beings and the stage of the life. Through the frequency and quality of these artefacts we are also able to conceive the affluence of the society. At most of the sites TC discs occur in a very large number such as Allahpur1, Ayodhya2, Bateswara3, Jajmau4, Masaon5, Nagda6, Noh7,
Pariar, Prahladpur, Rajghat, Sravasti, Sarai-Mohana, Ujjain, Atranjikhera, Hastinapur etc.

**Origin**
Atranjikhera and Jakhera have not yielded any terracotta disc in period I (OCP) and period II (Black and red were). However, tradition of using pottery discs was prevalent in the period I at Atranjikhera and in period II at Atranjikhera and Jakhera, both. The tradition of making pottery disc possibly starts from the OCP period but their use could not be determined. They are fairly good in numbers at both the sites. They were usually made by chipping off pot sherds. As far as the tradition of making TC discs is concerned, probably it started from the proto PG level at (Pd. IIIA) Jakhera and continued in the following periods IIIB and IV, characterised by PGW and NBPW, respectively. At Atranjikhera it started from PGW level.

**Shape/Colour**
Generally, discs are flat and circular objects made of well-fired clay. Here it is worth-while to mention that a few unbaked TC discs and squarish TC discs were also unearthed from the stratified layer of the Jakhera excavations.

It is interesting to note that diameters of discs collected at Jakhera varied from 2.00 cm to 6.50 with almost a uniform increase of 0.25 cms. in ascending order in PGW and NBP phases. The disc, varied from 0.25 cms. to 3 cms in thickness. Here it is worthwhile to mention that the disc having the diameter of 3 cms., 3.25 cms and 3.5 cms. were most popular sizes at both the sites. However, 0.75 cms. thickness of the discs was also much popular. At Atrrajikhera the tradition of using terracotta discs continued in Period IV with all the characteristic features of the preceding period. A new size, 5.5 cms. diameter, was, however, introduced, which raised the number of groups from 13 to 14.

The TC discs, in general, have medium to fine fabric and are found in red, grey and black colour. Some of them are treated with fine red lustrous slip. Most of them are well baked and only a few show signs of ill-firing. However, in Jakhera unfinished and unbaked TC discs have also been found. The majority of the TC discs are wheel or mould, made but hand-made disc, have also been found at Jakhera.

**Technique**
Unlike the pottery disc, TC discs are fashioned intentionally for use and are exclusively decorated by making incised designs on both the surfaces. The designs are executed preferably on the edges along the periphery but are also seen on the centre and even scattered all over the surface. One remarkable thing from the Jakhera is that some of the discs have thin as well as thick groove around the thickness, according to the size of discs.

The discs were made of well-levigated clay and fired under oxidising conditions, giving them a bright red, grey and black surface. The marks are made on discs just prior to firing. All the signs were incised or stamped on the surface of the discs before firing and most probably when the discs were ready, they were dried before setting in the kiln. Many marks were produced by sharp engraving tools made of wood, or other material and numerous other categories were made by the finger nail. Sometimes two different tools were used to obtain a
mark. In these cases, the sign had perhaps a different significance as compared to a similar sign produced with a single tool. Before making a disc the loose soil/clay appears to have been well levigated, since, we hardly see any crack mark on the discs. They are so hard and intact that even today one can not break them by hand easily.

**Designs/Motifs**
It is worth mentioning that the marks/signs were mostly executed on both the sides. Sometime thumb impression is also seen, though some plain discs have also been found. The plain discs found in Jakhera in PGW period were 3% of the total number, while in NBPW it was 2% of the total. Similar is the case with Atranjikhera excavation wherein the PGW plain discs were 5% of the total and in NBPW the number was 4% of the total. It shows that making of symbols or using any decoration pattern on TC discs were the essential parts and had some purpose or objective. It was not merely a decoration.

The disc have also been classified according to their decoration patterns. They can be classified under two groups:

1. Plain discs
2. Discs having decoration or symbols

In the earlier indigenous coinage also an extensive use of symbols and other devices are found. The punch marked coins, which are the earliest in the numismatic series, constitute a rich repertoire of symbols. Theobald\textsuperscript{18}, who first closely examined these coins, has classified them into six groups, viz. 1. Human figure; 2. Implements, arms and the stupa or chaitya, bow and arrow etc., 3. Animals; 4. Trees or their branches and fruits; 5. Symbols connected with solar, planetary or saivite worship and 6. Miscellaneous and unknown objects.

**Surya**
The Sun is the most dominant deity, described as 'all creating and all seeing' and the Lord of all creations. It was given the highest veneration in the process of dedication to the natural forces and elements because of it's beneficial effect in the form of warmth and energy. In India, Surya is the principal cult deity amongst the five chief cults of Brahminic religion.

A site of north India, Rajghat, has yielded several TC discs. Here the Sun is mainly found on fifteen TC discs. It is shown with curved rays, emanating from a centre. On one disc the symbols is found on both the sides, where the radiating curved rays are shown in broken lines.\textsuperscript{19} Stylized depiction of the symbol of the Sun is noticed on discs from Prahladpur. Here the Sun is represented by curved rays without any regular circles.\textsuperscript{20} The TC discs from Sravasti represent two varieties of the Sun symbols. The first and more frequent starts from a common point but with curved rays is rarely provided with small circle or a circular gap in the centre. The second variety shows radiating small rays but without a circle. We find an interesting representation of the sun with curved radiating lines emanating from a common point and on the reverse of the same disc a large form of the sun in the centre with identical nine smaller suns depicted all around.\textsuperscript{21}
Chakra

The Chakra, i.e. wheel, is considered to be one of the most popular symbols of ancient Indian art and tradition. We find deep meaning of the chakra in the ancient Indian literature. Chakra symbolizes creation and is known as Brahma-Chakra. It also stands for the Sun or time and is known as Kala Chakra. Chakra has also been identified with the supreme moral order in the form of Dhram-Chakra and Sudrashan Chakra.

The symbol of Chakra in various forms has also been widely used on early Indian coinage. It was equally used on punch-marked, tribal and local coins. On these coins, there are no limitations on the number of spokes. We find more variations of wheel on coins, as compared to the sculptures and other objects.

Swastika

The Swastika, the sacred and mystic symbol, is one of the most ancient auspicious motifs of mankind found more or less all over the world, continuing even up to present day. The symbol consists of a cross of equal arms but at the end of the arms there is a line drawn at right angle on the same relative side showing a common rotary direction in relation to the centre. Like the Chakra, Swastika is also interpreted as a symbol of sun.

The Swastika symbol has been interpreted in several ways. It is also a sacred symbol of benediction, blessings of long life, fortune and good luck. In Indian context, Swastika encompasses all the ancient religions of the Vedic, Buddhist and Jain. The Swastika was also regarded as an auspicious sign in the Harappan period, as provided by the discovery of a significant seal bearing the symbol. Excavations at Prahladpur and Rupar have yielded TC discs incised with Svastika marks. The examples from Prahladpur (late phase) show both clockwise and anti-clockwise Svastika with rounded arms. The discs from Masaon bear incised marks of trident, Swastika, circles, radiating lines from one central point. TC discs from Noh have incised and scalloped margins.22

Some scholars opine that these discs served as gaming counter.23 But the decorated symbols representing the Sun, the moon (crescent), the Stars, Chariot and other motifs depicting two eye-like design intersecting each other, arrows etc. may suggest that these had some religious significance. The arrows and chariot invariably are items of the Aryan life, having religious sanctity. However, these discs, with sharp symbols on them, apparently do not favour the idea of their being used as gaming counters, lest the symbols might be rubbed off during constant handling. Could then they be used as votive or ritualistic objects24? The numbers of pecked marks or circles on them may be indicative of some auspicious numbers denoting heavenly bodies etc.

Money begins with man since Primitive man, primitive money progressive man, progressive money. Therefore, from time immemorable money has had different forms; from berry, bone to bonds from stone to sterling and from disc to dollar. The natural setup of man and of community condition shape and form money, coin or currency. Currency trade and commerce are inseparable, may be a barter or banking economy. Money is associated with life and practices of ancient communities. These tools of production, actual produce and religious practices, have played a formative role in shaping the money.
Here I am enumerating few points in support of considering TC disc as the non-metallic coins i.e. the token money. They are as follows:-

1- that the characteristics feature of the punch-marked coins are their various symbols. Majority of the TC discs also bear similar or identical impressions or symbols. These symbols, like those on coins are generally found on both the sides on the discs.

2- that the sizes of the discs are generally small and always circular, possibly because small and circular objects are easy to handle and carry.

3- that we have the tradition of Pottery disc making even in the OCP period.

4- that the tradition of making TC discs begins from PGW period and continues till the NBP period. After this period it declines, when the punch-marked coins made their appearance.

5- that punch-marked coins and their symbols did not came suddenly into existence. Before taking their shapes as punch-marked coins, there must have been a primitive stage. Why not terracotta disc.?

6- that the concept of currency is associated with particular value to the object /coin, which may not be the actual value of the object. TC disc with specific symbols (Governance) may be a demonstrative example of the earliest form of coinage in India. For example, the market value of paper currency is on account of the figures, and other motifs such as the Ashokan pillar, etc. printed on it. Otherwise, it is simply a piece of paper.

7- that the punching technique has been used in making TC discs. The idea of punching on metal coins appears to have been taken from it.

8- that in some TC discs there is a hole while in other there is cavity. The hole in TC discs appear to have reduced their easy to carry and store. Even in the early fifties Indian coins had big holes in the centre.

9- that during the PGW period no coinage system seems to have evolved. No excavation reveals a single coin thus confirming the simple barter system. Essential commodities were obviously exchanged. Thus, TC disc may be used as token money, a symbol of exchange, a pre-urbanised culture without coinage?

10- that the majority of the symbols found on punch-marked coins are identical to those found on TC disc. They are as follows:-

   a. Human figure  
b. the Sun

c. the Moon (Crescent)  
d. the Mountain (Chaitya)

e. the Swastika  
f. the Chakra ( four,-six,-eight,-or multi- armed)

g. the Star  
h. Triratna / Nandi pada

   i. Tree ?  
j. Arrow

k. Fish

l0. Eye or leaf design

m. Circles / Checker / square/ rectangle and other geometrical lines etc.

11-"Some small objects are significant to prove contacts of these people with those of the other sites. The ghat-shaped beads occur from Rupar and Sardargarh in the west to Chirand and Sonpur in the east. Even at the sites of the eastern Ganga Valley, where PGW is not found, occurrence of this type of bead has been noted. Almost similar types of bone points and discs have also been found at all these sites".25


Thus, although no large-scale commerce is testified to, a trade of restricted kind with the neighbouring places is well attested. This shows that though the PGW society was basically a village-based one, it had certain advanced technical knowledge like iron, copper and glass manufacturing and art of terracotta objects, like beads, discs etc.

12-that circle and crescent are the main features of the early Indian coinage.
13-that the availability of several identical discs of a particular type testifies my theory
14-that varieties in symbol and gradation in size indicate that TC disc were probably manufactured by an institution or a local body.
15-that if it is a ritualistic object, why did it not continue further?
16-In the last, if it is not a coin or a token of money, what else it could be?

Thus we see that the process of advancement of culture and technology had started during the PGW phase. With a favourable atmosphere and availability of abundant iron ores in Bihar, the culture sprang up fast during the succeeding NBP phase and with growing need for sophisticated trade, a system of coinage was introduced. Guilds began to come to existence, when trade routes connected big centres with each other.

Here, I would like to mention emphases that it is quite possible that the symbols on punch-marked coins may have been derived from the long tradition of the disc having marks on them. Majority of the symbols found on the TC discs are generally identical or tally to a great extent with those depicted on punch marked coins. The symbols commonly found on both are the Sun, the Moon (crescent) the Star, circle, the Swastika, the Chakra, fire-altar, tree, fish, mountains, dotted line, triratna and other geometrical lines etc. As demonstrated by the discs collected from the Jakhera site. The hypothesis, however, is too tentative and merely a suggestion.

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“O That Awful Deepdown Torrent”

by

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Abstract

The overflow of deep-water from the Nordic Seas through the Faroe-Bank Channel and the Denmark Strait into the North Atlantic proper is presented and discussed. These fluxes are of considerable importance for the global thermohaline circulation, and it is shown here how they can be modeled on the basis of rotating hydraulic theory. The study is concluded by noting how this formalism successfully has been applied to describe deep-water flows in the Baltic Sea, and it is suggested the same might be done for the underflow of highly saline deep-water debouching from the Persian Gulf through the Straits of Hormuz.

1. Introduction

The immortal words of Molly Bloom [1] reflected in the title of the present review refer to the Atlantic-bound transport of high-saline Mediterranean deep-water through the straits of Gibraltar. Similar fluxes of comparatively fresh (~34.9 ‰) but very cold (~ -0.5°C) dense deep water take place through the Faroe-Bank Channel as well as through the Denmark Strait between Iceland and Greenland. These are the two deepest passages through the Greenland-Scotland Ridge, which delimits the deeper regions of the Nordic Seas from the North Atlantic proper (cf. the map in Fig. 1), and hence play an important role as choke-points affecting the global thermohaline circulation.

Fig. 1: Map of the Greenland-Scotland-Ridge Area

The characteristics of the Denmark Strait have been known since the 1890s when it was surveyed by Danish scientists, but due to its narrowness the Faroe-Bank Channel was not discovered until the 1940s, when echo-sounding equipment had come into general use. The
first hydrographic surveys here were undertaken somewhat later, and in 1960 the International Council for Exploration of the Seas (ICES) organized the first international, multi-ship investigation of the deep-water overflow into the Atlantic [2], an undertaking which was repeated [3] in 1973.

2. Ongoing Field Investigations
Modern research on these overflows has to a considerable extent been undertaken within the Nordic-WOCE programme and its successors, i.e. as collaborative efforts between the Nordic countries as well as Germany and Scotland. In addition to periodic hydrographic surveys, the focus of these efforts has been on the maintenance of a number of Acoustic Current Doppler Profiler (ADCP) arrays as well as conventional recording current meters to monitor the fluxes across the Greenland-Scotland Ridge. Two ADCPs have been dedicated to investigating the deep-water transports through the Faroe-Bank Channel and the Denmark Strait, both upward-looking meters deployed on the thresholds of these passages.

The Denmark-Strait deep-water flux varies considerably over shorter time-scales. The hydrographic structure above the threshold is rather complex since the water column may comprise a number of different water masses. The mechanism behind this variability is presently not fully understood, but when estimating the transport over longer time-scales the overflow can be dealt with using rotating hydraulic theory, cf. [4].

![Fig. 2: Isotherm distribution across the Faroe Bank Channel](image)

The Faroe-Bank Channel overflow is known to be almost steady over shorter time-scales, and is at all times in reasonable geostrophic balance, cf. Fig. 2 showing the isotherm distribution across the passage. The TS-diagram in Fig. 3 shows that in the Faroe region only two watermasses are involved, viz. cold Norwegian Sea Deep Water and warm North Atlantic Surface Water, and furthermore that in this region the temperature is a useful proxy for density, cf. Fig. 5.

It should, however, be pointed out that this deep-water flux shows a significant seasonality, with transports varying between around 2.5 Sv (1 Sverdrup=10^6 m^3 s^-1) in summer and 1.5 Sv during winter, cf. Fig. 4. Based on satellite altimetry it has been demonstrated [5] that this
variability is not (as erroneously stated in [6]) due to changing upstream conditions in the Norwegian Sea, but rather to the fact that the stronger wintertime atmospheric forcing of the flow of Atlantic surface water through the Faroe-Shetland Channel associated with an increased barotropic pressure gradient across the passage which inhibits the deep-water transport feeding the overflow, cf. the map in Fig. 1 as well as Fig. 4.

3. Rotating hydraulic theory

In [7] the formalism describing rotating hydraulic flow with a finite potential vorticity (PV) through a box-like channel was generalized to cover the case of a parabolic topography, cf. Fig. Q, which in many cases may serve as a reasonable approximation of bathymetries encountered in nature. The problem is governed by a set of nondimensional algebraic equations for the intersection points \( a, b \) of the interface with the sloping walls of the passage:

\[
a^2 = r(1 - \frac{\Delta_{\infty}}{D_{\infty}} - \frac{r}{D_{\infty}^2}(\hat{\Psi}_r + \frac{1}{2}) - \frac{1}{2r} \left( 2 + r \right) \tanh \left( \frac{a + b}{2} \right) - 2a \),
\]

\[
b^2 = r(1 - \frac{\Delta_{\infty}}{D_{\infty}} - \frac{r}{D_{\infty}^2}(\hat{\Psi}_i - \frac{1}{2}) - \frac{1}{2r} \left( 2 + r \right) \tanh \left( \frac{a + b}{2} \right) - 2b \).
\]

Here \( \hat{D}_{\infty} \) is a nondimensional measure of the upstream-reservoir depth and \( \hat{\Psi}_{r,i} \) specifies the distribution of the volume flux between the side-wall boundary layers of this basin, whereas \( r \) and \( \Delta \) are morphological parameters describing the passage bathymetry. For a discussion of the finer points of these equations as well as their derivation, the reader is directed to [7]. The problem can be treated numerically, but additional insight is gained by dealing with the problem using analytical techniques. In [7] it was demonstrated how the problem could be resolved analytically by using a regular perturbative expansion with the solution for non-rotating hydraulic flow serving as the lowest-order result, whereas in [8] the analogous expansion was based on the zero-PV solution. In both cases problem requires a preliminary
rescaling before the governing equations above can be dealt with on the basis of series expansions

**Fig. 5: Parabolic bathymetry.**

### 4. Phenomenology of the Deep-Water Flow

From Fig. 2 it is recognized that the Faroe-Bank Channel cross-passage isotherms show a tendency towards pinching behaviour on the Southwestern side of the passage. One possible explanation [9] for this almost persistent feature is that the overflow also comprises a third water mass, which, if its potential vorticity is conserved, gives rise to precisely this feature. The TS-diagram shown in Fig. 3 comprises data from situations with pinching as well as without, and it may be recognized that for the “pinched” states the diagrams show indications of the presence of a third water mass constituted by North Icelandic Winter Water/Arctic Intermediate Water.

In [7] it was shown that the Froude number assumed the following form:

\[
F^{-2} = \left( \frac{\hat{D}_s}{r} \right)^4 (2 + r)^2 \left( (a + b) - 2 \tanh \left( \frac{a + b}{2} \right) \right)^2 \times
\left[ \left( a + b - (2 + r) \tanh \left( \frac{a + b}{2} \right) \right)^2 + 2r(a + b) \coth(a + b) - 2r - r(2 + r) \tanh \left( \frac{a + b}{2} \right) \right].
\]

In [10] it was shown (cf. Fig. 6) that the application of this formula to the results from the long-term ADCP records yields convincing evidence that the deep-water flow across sill of the Faroe-Bank Channel is controlled in the classical hydraulic sense, viz. that no signal emanating downstream can penetrate into the upstream reservoir.

**Fig. 6: Deep-water flow Froude number during 1997/98.**
Other interesting features that have been investigated on the basis of field measurements during a period when three ADCPs were deployed across the Faroe-Bank Channel threshold are the consequences of the fact that the deep-water flow is not characterized by a uniform potential vorticity, *viz.* one of the basic assumptions underlying the theoretical treatment of the rotating hydraulic-flow problem. As, however, demonstrated in [11], the cross-channel variations are so small that the maximal-flow predictions based on the assumption of critical flow at the sill of the passage are not seriously impaired.

5. Outlook

In this review (which has focused on research topics the author has been directly engaged in) it has been demonstrated how useful rotating hydraulic theory has been for analyzing the large-scale overflows across the Greenland-Scotland Ridge. The same has proved to hold true for the Baltic Sea, where the saline deep-water originating from the Kattegatt and Skagerrak makes its way towards the interior basins via a series of constrictions and sub-surface conduits. A number of analyses [12-14] of these smaller-scale overflows have been undertaken, all with remarkably successful results.

In view of how versatile this formalism has been found, it would be highly interesting to launch a research programme aimed at subjecting the outflow of highly saline deepwater from the Persian Gulf into the Arabian Sea to an analysis based on rotating hydraulic theory.

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**References**


Verification of the Persian Gulf Sea level changes in Holocene through sedimentary core obtained from sea floor of Bushehr neighboring area

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Abstract
The Persian Gulf is a sedimentary epicontinental and marginal basin located in a dry climate. The climate, morphology, hydrology, current, waves and tide specifications determine its sediments’ types. To study the paleoceanography of the Persian Gulf, a core having the length of 15m from shallow water close to the coastal areas of Bushehr in form of an undisturbed sample was prepared. After cutting the sample, macroscopic verifications, photography, and description of cores, 50 subsamples were prepared and granulometry and ICP analyses implemented. Results obtained by granulometry and percentage of particles, plus outcomes of chemical analysis and microscopic observations indicate that there is a positive correlation between calcium value and particle sizes. It means when Ca value increases, the percentage of sand also increases. In comparison with sedimentary facies, Ca value is similar to coastal and continental facies. When facies are marine, particle sizes decrease, but the values of Al, Mg, Na and K increase. In fact, rising of the Sea level is along with decrement of particle sizes, and increment of clay minerals, like Al, Si, K & Mg. But Ca value is increased by decrement of sea water level and increment of particle sizes. Therefore, when seawater level is high, the minimum of Sea level conditions occurred in 204, 396, 516 and 673 centimeters from the surface. The Maximum of Sea levels has been seen in 280, 510,593 and from 714 to 140 centimeters below the surface.

Keywords: Holocene, Sea level change, Persian Gulf, Cores,

Introduction
The Persian Gulf is a back arc basin and marginal sea, and its average depth is about 35m. Its area is about 226000sqkm having the maximum depth of 104m (Purser, 1976). The Persian Gulf floor is unstable from tectonics point of view and has a sharp slope on the Iranian side. It is stable in the Arabian shield, has a mild slope and does not have continental shelf. In the northern part, its source of fresh water is Shatt-ol-Arab or Arvand Rood (originating from the Tigris and Euphrates Rivers in Iraq) and certain small rivers along the Iranian coasts. The arid climate of this region is intensively impressed by oceanographic and sedimentary processes of the Persian Gulf (Emery, 1956; Pilky and Noble, 1966; Khalaf et al., 1979; Evans, 1988). A surficial current produced an oceanic water entry cycle clockwise along the Iranian coastline (Hartman et al., 1971). Water salinity varies from 36.6% at the beginning point of the Hormoz Strait to 40.6% at the end part in the northwestern area (Swift & Bower 2006).

The recent sediments of the Persian Gulf are riverine clastic, biogenic and aeolian deposits (Lak, 2010). Riverine clastic deposits originate from Shatt-ol-Arab certain small rivers of the northern coats. Shatt-ol-Arab flooding has a small role in sediment supply because most of them are trapped in the delta area, and only a small amount of them (about 10%) reaches the
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This region located between the Zagros Mountains in northeast and Arabian Platform in the southwest having a 990km length and 370km width (Kampf & Sadrinasab 2006). After the Gulf of Mexico and the Hudson Bay, the Persian Gulf is the third biggest gulf in the world. This gulf connects the Hormoz Strait and Oman Sea to the Arabian Sea in the east. It also ends in the Arvand Rood Delta that is the result of merging of the Tigris, Euphrates and Karoon Rivers. Since plenty of relatively comprehensive environment and organic geochemistry studies of Holocene sediments were carried out by various scientists, such as Kirkham, 1997; Al-Ghadban et al., 1996 & 1998; Whittle et al., 1998 & Al-Sharhan and Kendel, 2003), therefore, it seems compulsory to implement studies respecting these subjects in northern coasts (Iranian part) of the Persian Gulf. The study area located in shallow water close to the coastal areas of Bushehr city north of the Persian Gulf (figure 1).

Methodology
In this research, an undisturbed core having a length of 15m and 5 diameter was prepared by drilling device. 23 cores having 60cm dimensions were prepared in polika (PVC) pipes, after numbering and marking the upper part of layers, two ends of samples were protected and transferred to marine geology laboratory of applied geology research center in Karaj. Cores were longitudinally cut to two parts by core-cutting device. The facies characteristics, such as sediments' grain sizes, color, fossils' contents, organic matters and their contact were severely considered, and possibly sedimentary environment of each facies was determined. Cores' photos were taken by a Canon 12 megapixel digital camera. Then, 1cm slabs of some parts of core that did not have coarse grains were prepared. X-ray images of slabs were provided by radiography device. 50 sub-samples were produced from cores (figure 2). The properties of sub-samples vary by facies changes. Prepared samples were verified by granulometry, ICP and organic matters determination analysis. granulometry of particles having diameters of more than 63µ were done with wet sieve shaker and particles with diameters of less than 63µ carried out by Laser Particle Sizer device by Germany Fritsch Company. Some samples were crushed and powdered to determine the percentage of their major and trace elements. They were analyzed by ICP-OES Variant model. Employed standards were specific to marine sediments for analyzing the samples.

Results and discussion
Facies’ descriptions, sediments’ granulometry results and ICP were inserted in Excel and Log Plot data sheets. These results plus digital photos, radiography and facies’ descriptions were merged, and then stratigraphical column and seawater fluctuations for Holocene were designed. Table 1 show 12 facies from surface to 15 meters below seabed with environment, lithology, description and total organic carbon contain. Besides, along the length of core, granulometery result, percentage variations of elements such as iron, aluminum, Calcium, Magnesium and etc. were plotted in form of graph (figure 3, 4 & 5).
12 Facies were determined along the core indicating, riverine, coastal, intertidal, lagoonal and open sea environments. Meanwhile, 5 sedimentary types, including clayey silt, silty clay, sandy mud, gravelly mud plus gravelly and muddy were determined. Verification of sedimentary environment indicates that calcium values decrease in lagoonal and marine environments, and increase in intertidal, coastal and riverine environments. The graph of elements' percentage variations is completely in harmony with sedimentary facies. When water level is high and development of lagoonal and marine environment occurs at the site of core preparation, calcium value decreases, but Si, Fe, Mg, K and Al values increase. These variations are along with other specifications of facies, including availability of foraminifers, grey color, percentage increment of organic matter and evidence, such as fenestral fabric. When the seawater level goes down, the conditions are vice versa. It means that calcium percentage increased, but Fe, Si, Al and Mg elements' percentage increased. when Ca value increases, the percentage of sand also increases. When facies are marine, particle sizes decrease, but the values of Al, Mg, Na and K increase. In fact, rising of the Sea level is along with decrement of particle sizes, and increment of clay minerals, like Al, Si, K & Mg. But Ca value is increased by decrement of sea level and increment of particle sizes. Sediments color varies from cream and yellow colors towards brown. Fossil contents intensively decreased, and often these contents are exclusive to bivalves that only one of the valves is available. When these changes are very clear in the sedimentary environment, the above-mentioned elements are observed on the peak of related graphs.

Vertical sequence of the Persian Gulf are; facies, including shell fragments, benthic foraminifers, fenestral fabric, bioturbation, variation of the sedimentary particle size, sediment types, etc. These are the evidence that assist us to reconstruct the sedimentary environment of the Persian Gulf sediments (Tables 1). With regard to these studies, it is possible to realize that the studied core in the Bushehr Province introduces 12 facies indicating riverine, coastal, intertidal, lagoonal and marine environments.

Conclusion
Results obtained by granulometry and percentage of particles, plus outcomes of chemical analysis and microscopic observations indicate that there is a positive correlation between calcium value and particle sizes. It means when Ca value increases, the percentage of sand also increases. In comparison with sedimentary facies, Ca value is similar to coastal and continental facies. When facies are marine, particle sizes decrease, but the values of Al, Mg, Na and K increase. In fact, rising of the Sea level is along with decrement of particle sizes, and increment of clay minerals, like Al, Si, K & Mg. But Ca value is increased by decrement of sea level and increment of particle sizes. Therefore, when seawater level is high, the minimum of Sea level conditions occurred in 204, 396, 516 and 673 centimeters from the surface. The Maximum of Sea levels has been seen in 280, 510,593 and from 714 to 140 centimeters below the surface.

References


### Table 1: Core description, lithology and facies

<table>
<thead>
<tr>
<th>FACIES</th>
<th>ENVIRONMENT</th>
<th>LITHOLOGY</th>
<th>DESCRIPTION</th>
<th>(TOC %)</th>
<th>Depth (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fluvial</td>
<td>gM</td>
<td>Yellowish gravelly mud without shell</td>
<td>0.03</td>
<td>0-55</td>
</tr>
<tr>
<td>2</td>
<td>Coastline</td>
<td>gmS</td>
<td>Grayish yellow gravelly muddy sand with a few shells</td>
<td>0.05</td>
<td>55-135</td>
</tr>
<tr>
<td>3</td>
<td>Intertidal</td>
<td>cZ</td>
<td>Yellowish clayey silt with minor limy pebel and fenestral fabric, without shell</td>
<td>0.03</td>
<td>135-215</td>
</tr>
<tr>
<td>4</td>
<td>Intertidal</td>
<td>cZ</td>
<td>Thin interbeded grayish bioturbated clayey silt and organic laminae with sparse gas bubbles</td>
<td>no data</td>
<td>215-240</td>
</tr>
<tr>
<td>5</td>
<td>lagoon</td>
<td>cZ</td>
<td>Grayish clayey silt with dark gray sand lenses and a few shells</td>
<td>0.04</td>
<td>240-290</td>
</tr>
<tr>
<td>6</td>
<td>lagoon</td>
<td>cZ</td>
<td>The same as facies 6</td>
<td>0.07</td>
<td>385-430</td>
</tr>
<tr>
<td>7</td>
<td>Open marine or Barrier</td>
<td>sM</td>
<td>Grayish yellow sandy mud with shells</td>
<td>no data</td>
<td>372-385</td>
</tr>
<tr>
<td>8</td>
<td>Shallow marine</td>
<td>sM</td>
<td>Grayish yellow sandy mud with benthic shells</td>
<td>no data</td>
<td>430-512</td>
</tr>
<tr>
<td>9</td>
<td>Marine</td>
<td>cZ</td>
<td>Grayish clayey silt with fenestral fabric, deeper than facies 8</td>
<td>0.05</td>
<td>512-520</td>
</tr>
<tr>
<td>10</td>
<td>Shallow marine</td>
<td>sM</td>
<td>The same as facies 8</td>
<td>no data</td>
<td>520-578</td>
</tr>
<tr>
<td>11</td>
<td>Marine</td>
<td>cZ</td>
<td>The same as facies 9</td>
<td>0.06</td>
<td>578-660</td>
</tr>
<tr>
<td>12</td>
<td>Marine</td>
<td>zC-cZ</td>
<td>Interbeded grayish yellow clayey silt and organic laminae with gas bubbles and benthic shells(Gastropoda and Pelecypoda)</td>
<td>0.08</td>
<td>660-718</td>
</tr>
<tr>
<td>13</td>
<td>Marine</td>
<td>cZ</td>
<td>Interbeded light to dark gvaish silty clay and organic laminae, richer than facies 11</td>
<td>no data</td>
<td>718-990</td>
</tr>
<tr>
<td>14</td>
<td>Marine</td>
<td>cZ</td>
<td>The same as facies 11</td>
<td>0.07</td>
<td>990-1000</td>
</tr>
<tr>
<td>15</td>
<td>Marine</td>
<td>zC</td>
<td>The same as facies 12</td>
<td>0.11</td>
<td>1200-1240</td>
</tr>
<tr>
<td>16</td>
<td>Marine</td>
<td>cZ</td>
<td>The same as facies 11</td>
<td>0.09</td>
<td>1240-1500</td>
</tr>
</tbody>
</table>
Figure 1: Location of the Bushehr core, shallow water of the Persian Gulf

Figure 2: Core cutting, Preparation of sub samples and determination of facies

Figure 3: Clay and silt percentages graphs from the surface to 15 meters below the Seabed

Figure 4: Value of Calcium & Aluminum changes from the surface to 15 meters below the Seabed. Sea level changes according to the Aluminum curve.
Some elements changes from surface to depth in Bushehr

Figure 5: Na, Mg, K and Fe value changes from the surface to 15 meters below the Seabed.
DEPOSITIONAL ENVIRONMENT OF THE PABDEH FORMATION (PALEOGENE) ELUCIDATED FROM TRACE FOSSILS, ZAGROS BASIN, W IRAN

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ABSTRACT

In the present study the Pabdeh Formation (late Paleocene-early Oligocene) was investigated in the Zagros Basin (W Iran). The main goal of this research was elucidating the depositional environments of this formation. This research was performed based on field observations and measurements, thin section petrography, trace fossil studies and OM (TOC % and kerogen type) measurements, from which seven microfacies assemblages were recognized. The Pabdeh Formation comprises alternation of thin to thick limestones and dark to light gray shale beds, rich in planktonic microfauna. These facies are interpreted as pelagic facies in the Zagros Basin and consist of mudstone (md), wackestone (wk), packstone (pk) and shale beds. Based on systematic study of the ichnofossil content of these facies, five ichnogenera grouped in two separate assemblages were recognized. The first assemblage present a relatively high ichnodiversity (Arenicolites, Chondrites, Planolites and Neonerites) and occurs in md-wk-pk facies. This assemblage represents the Cruziana ichnofacies, formed in relatively moderate-energy conditions. The second assemblage with lower ichnodiversity (Zoophycos and Chondrites) is found in shale, wk, md and pk beds and represents the Zoophycos ichnofacies which were formed in low energy and deeper conditions. Vertical stacking of these facies suggest a shallowing-upward trend with these facies deposited in a distally steeped carbonate ramp, where the depositional settings evolved from an outer ramp with pelagic and turbidite facies (Microfacies 4B and 4C) and reducing condition to oxygen depleted waters (TOC> 2.5%; kerogens type ΙΙ and less amount ΙΙΙ) that gradually changed into a middle ramp where marine currents (e.g. turbidity currents) had an important impact on sediment reworking and resedimentation.

Keywords: Pabdeh Formation, Zagros Basin, Depositional Environment, Ichnofossil, Carbonate ramp, Turbidite facies.

FACIES, ICHNOFACIES AND DEPOSITIONAL ENVIRONMENTS

In this study, two exposed sections of the Pabdeh Formation were selected from the NW of Illam city (Reno Pass and Hajbakhhtiar sections) and more than 380 samples collected for petrographic and organic geochemistry analysis (Fig.1). Field observations focused on trace fossils content and sedimentary structures. Ichnofacies were classified based on Seilacher’s method (1967; after Bromley 1990) for environmental interpretations. Bioturbation index was calculated according (Taylor & Goldring 1993) based on sharpness of primary sedimentary fabric, burrow abundance and amount of burrow overlap. Depositional environment was inferred based on Pedley’s (1998) model. According to trace fossils, ichnofacies and petrographic evidences, this formation was divided into three units (lower, middle and upper)
that comprising microfacies 1 to 4B, microfacies 4C to lower part of 6C and upper part of microfacies 6C to 7C, respectively. The zoophycos ichnofacies was recognized in the lower and middle units whereas the cruziana ichnofacies was recognized in the upper unit (Fig.2). Kerogen type and TOC content of some selected nonbioturbated samples were measured by type III Rock-Eval pyrolyze in the Petroleum Industry Research Institute of Tehran.

TRACE FOSSIL ASSEMBLAGES
Five different ichnogenera grouped into two distinct assemblages were recognized within the Pabdeh Formation. Moreover, Chondrites of different size are registered throughout the formation.

ARENICOLITES-CHONDrites ASSEMBLAGE
This assemblage included Arenicolites, Chondrites, few Planolites and Neonerites? (diversity 2-4). Bioturbation index varies between 2-4 (mainly 4). This assemblage is frequent in the upper unit of the Pabdeh Formation (microfacies 7). Penetration depth of Arenicolites varies between 2 to 10 cm and maximum burrow diameter is 10 mm in this assemblage. Large specimens of Chondrites (4-6 mm in diameter) are usually common in this assemblage. The details of cross-cutting relationships of ichnotaxa are as follows: 1- In few cases Arenicolites and Neonerites are cut by large Chondrites. 2- Planolites is cut by large Chordrites and Neonerites.

ZOOPHYCOS-CHONDrites ASSEMBLAGE
This assemblage comprises Zoophycos and Chondrites (diversity 1-2). Bioturbation index varies between 3-5 (mainly 4). This assemblage is restricted to middle and lower units of the Pabdeh Formation (microfacies 3 to 6C). This assemblage begins with umbrella shape Zoophycos, sperite bearing Zoophycos (4 to 8 mm in diameter), and Chondrites (2mm in diameter) and terminated to irregular Zoophycos (3 mm in diameter) and small Chondrites (1 mm in diameter) (Fig.3). In several cases Zoophycos is cut by small Chondrites.

DISCUSSION
Evidences such as trace fossils, microfacies and turbidite facies (e.g., calciturbidite of microfacies 4B and 4C) suggest that the depositional environment of the Pabdeh Formation was a distally steepend ramp (Fig.4). Absence of facies attributable to processes common on a rimmed shelf (e.g., breccia and megabreccia, shallow protected rimmed shelf with barrier reef/shoal) support these conclusions. Basinal sediments comprise rhythm facies rich in OM (Droste 1990) (Microfacies 2 and 4A) or bioturbated sediments (Read 1985; Calvert et al. 1996) (Microfacies 3). These parts of the ramp that are relatively more deep and located at oxygen minimum zone, are suitable for deposition of reducing OM rich facies (microfacies 2 through 7A); these are called intrashelf basins. Bordenave and Huc (1995) interpreted OM rich facies of the Gurpi and Pabdeh Formations as deposited in such intrashelf basins. Al-Sharhan and Nairn (1995) also believe that some parts of the Pabdeh Formation were deposited in intrashelf basins.

There is a pronounced relation between ichnofacies, TOC content, kerogen type and depositional setting throughout the vertical section of the Pabdeh Formation. Obviously the
lower and middle units of this formation (Zoophycos ichnofacies, outer ramp) contain kerogens type II, I and less amount III with high TOC content (more than 2.5%) (except the base of the formation that coincide with microfacies 1 which has been interpreted as a deltaic facies with kerogen type III). Upward of the section (upper unit; middle ramp), the dominant kerogen type is III accompanying Cruziana ichnofacies with relatively low TOC content (2.8%-0.6%). In comparison with these facies, we concluded that depositional environment of the Pabdeh Formation was a steep ramp that passed basinward to intrashelf basins, wherein shallow facies of middle ramp gradually prograded on the outer ramp facies (middle and lower units of the Pabdeh Formation).

CONCLUSIONS
1- The Pabdeh Formation was divided into three units: a lower unit (composed of microfacies 1 to 4B), a middle unit (microfacies 4C to lower part of 6C) and an upper unit (upper part of microfacies 6C to 7C) based on trace fossils, ichnofacies and petrographic evidences.

2- Arenicolites-Chondrites assemblage (BI: 2-4) were related to more oxygenated conditions in the upper unit of the Pabdeh Formation, whereas Zoophycos-Chondrites assemblage (BI: 3-5) reveals relatively oxygen depleted conditions in the middle and lower units of studied area.
3- Depositional environment of the Pabdeh Formation was distally steeped ramp terminated to intrashelf basin wherein OM rich facies was deposited.

REFERENCES
Fig.1- Location map of the study area in W Iran.

Fig.2- Detailed stratigraphic columns of the Pabdeh Formation at the Reno Pass section.

Fig.3- Zoophycos – Chondrites assemblage of Zoophycos ichnofacies at the lower unit of the Pabdeh Formation. I.Z=irregular Zoophycos, S.CH = small Chondrites.

Fig.4- Depositional model proposed for the Pabdeh Formation in NW Illam.
Microbiostratigraphical and microfacies study of the Jahrom Formation, north of Shiraz (Lapouei Section)

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Abstract
In this paper, a section of the Jahrom Formation was selected and its prominent microfacies and foraminifera were identified. The section of Zarghan Mountain (Lapouei) with 199 meters of the Jahrom Formation sediments were studied through 109 microscopic sections. On the whole, the prominent microfacies of the section under study are Packestone, Wackestone, Grainstone, Microfacies Dolomite. The and destructive elements of these microfacies are Intra claste, bioclaste, and peloide.

Altogether, the amount bioclast is more than the other Allochem elements. The prominent foraminifera identified in this section, in top-down order, are as follows:

Regarding the above-mentioned foraminifera in this section, the ages of the microfacies are different from each other. But, on the whole, the age of the Jahrom Formation in this section ranges from Middle Eocene to Middle Paleocene.

Keywords: Jahrom Formation; microfacies study.

1- Introduction
The subject of this paper is the study of lithostratigraphic and biostratigraphic characteristics of the Jahrom formation, Fars, owing to its paramount importance. Since long ago and during different stratigraphic stages, this formation has received great attention owing to its wide expanse and biostratigraphic and lithostratigraphic diversity. In the studies first carried out by James and Wynd (1965) and later by H. Motiee (1993), this formation was found to date from Paleocene-Eocene. This paper is organized as follows. In Section 2, the geographical location and stratigraphic description of the section under study are pointed out. Section 3 considers the microbiostratigraphic units of the Jahrom formation, and in Section 4, the microfacies of Lapouei stratigraphic section (Zarghan Mountain) are quantitatively studied.

2- Geographical location of the section under study
The stratigraphic section considered in this study lies in the Zagros structural zone, and is located between 52 50" E and 29 50" N. This section is located 20 km to the north of Shiraz, Fars Province, and can be accessed through the main Shiraz-Zarghan road.
2.1- Description of the stratigraphic section
The study of the foraminifera in the Jahrom formation in Lapoui section reveals an age of middle Paleocene-lower Oligocene. (See Table 1). This formation can thus be stratigraphically divided into three main parts:

a) Lower part: containing 87 m thick-layer to massive dolomite lime rock. The foraminifera identified are: Lithuonella roberti, Morzovella sp., Planorotalites sp., Miscellanea sp., Fallotella sp., Kathina sp., Glomoalveolina sp., Opertoorbitolites sp., with an age of middle Paleocene to lower Eocene (Jahrom formation).

b) Middle part: containing 72 m middle- to thin-layer limestone and dolomite lime. The foraminifera identified are: Somalina stefani, Alveolina sp., Nummulites sp., Lockhartia sp., Rhapydionia sp., Coskinolina sp., with an age of lower to middle Eocene (Jahrom formation).

c) Upper part: containing 40 m middle-layer limestone, with the following foraminifera: Astrotrillina asmaricus, Archiace sp., Triloculina sp., Rhapydionia sp., with an age of lower Oligocene (Asmari formation).

3- Introducing microbiostratigraphic units of the Jahrom formation in the stratigraphic section under study
Biozones of Lapoui stratigraphic section (Zarghan Mountain)
The biozones of the Jahrom formation in the Zagros region were identified by James and Wynd in 1965. In Lapoui section, two biozones can be introduced according to their study:

1) Nummulites-Alveolina assemblage zone: identified by the extension and abundance of Nummulites sp. and Alveolina sp., with associated fauna in the middle Eocene part of Lapoui section with Somalina stefanini, Dictyoconus sp., Olssonina sp., Valvulammina sp., Lockhartia sp., Coskinolina sp.

2) Operorbitolites sub-zone: identified by abundance of Operorbitolites sp., and accompanied by the following bioaccumulation (assemblage fauna) in the lower Eocene part of Lapoui section:
Lithuonella roberti, Rhapydionia sp., Valvulammina sp., Alveolina sp., Coskinolina sp., Dictyoconus sp.
Moreover, this biozone is in agreement with the biozone introduced by James and Wynd (1965), considered as a sub-zone.

4-Quantitative study of the microfacies of Lapoui stratigraphic section (Zarghan Mountain)
In the quantitative statistical study of the elements constituting the microfacies, orthochem elements, allochem elements and destructive elements were considered. The amounts of these elements were different in the samples taken from the stratigraphic section under study. In this section, the bioclast distribution curve undergoes great variation in the middle part. The minimum amount of bioclast is observed in the beginning of the lower part (0%), and the maximum amount is observed in the upper part (50%). The intraclast distribution curve exhibits the minimum amount (0%) in the beginning of the lower part, and the maximum amount (40%) in the upper part. The peloid percentage curve exhibits an almost uniform variation, with little variation in the lower part but the greatest increase in the percentage of
peloids (60%) in the beginning of the middle part. At the upper contact of this section with the Asmari formation, an increasing trend is observed in the bioclast-intraclast curve.

5-Conclusion
The findings of the study of this stratigraphic section reveal that the amount and diversity of bioclasts (especially bentic foraminifera) increases in the direction from open sea to subtidal and intertidal regions. Bioclast diversity is in direct relation with factors such as depth, temperature, pressure, and ambient energy. The increase in the bioclasts in the middle and upper parts of this section is related to the extension of bioclast elements. The greatest extension of bioclasts coincides with packstone and grainstone faces, both of which are related to subtidal and intertidal regions. The smallest amount of bioclast is related to wackestone face, which is related to open sea and probably lagoon sides. Altogether, the middle and upper parts of the section under study feature a more suitable environment for the growth of organisms, considering the percentage of bioclasts.

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Table 1. STRATIGRAPHIC COLUMN SECTION OF LAPUIE
Table 2. Microfacies Distribution curve in Lapouli section
Oxygen relative changes and sedimentary rate of the Shemshak formation in Binalood basin based on studies Palynology

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Abstract

the gradual zone Binalood geological unit between Central Iran and Alborz, real development of this zone between areas north of Sabzevar, Neyshabor, Mashhad. Shemshak formation is one of the late and middle Jurassic formation series eastern Alborz basin in east of Iran and its consists shale and carbonaceous sandstone. The studied section is located in the 3 kilometers of Bar village east longitude and 36,28,49.5 north latitude and have thickness about 255 meters and the mostly lithology dark gray shale. In order to study amount oxygen relative changes and sedimentary rate mentioned formation in section the Bar village take on the number of 28 sample and proved to be 112 Palynological slides and according to Palynomorphic elements which exists in Palynologic slides and considering three main of group of palynological elements including; Palynomaseral, Palynomorphs and structures less organic matter (SOM) and SOM ecological factors such as; Lability, SOM(t)/ SOM (op), SOM/marine Palynomorphs, SOM/Palynomaseral(b) and M.E/C.E, Oxygen amount and sedimentation rate have been studied during deposition this formation. Based on oxygen amount and sedimentary rate during the deposited of formation become changeable but in general rates obtained from study ecologic factors during formation and study of section Palynofacies can thus deduce that: In general, one can result in that the main part of Shemshak Formation in the section of Bar village has been formed in a relatively high oxygen condition and sedimentation low rate.

Key words: Shemshak, Palinology, Binalood, Palynomaseral, Palynomorph, SOM

Introduction

The general outcrop of Binalood ranges have north-western to south-eastern trends. These mountains which are placed between Tooran solid plate and Central Iran Micro-continent are geographically deemed as continuance of Alborz ranges. But despite of some facies similarities and folds effect, it causes Binalood ranges to be seemed as a gradual platform between Central Iran and Alborz. Together with other sedimentary-structural platforms of Central Iran and Alborz during Paleozoic era, this region form sedimentary basin unit which totally placed in Central Iran platform (Nabavi, 1355).

Jurassic sediments constitute one of the thickest geological trends in Iran. Such sediments which are placed in Alborz and Central Iran areas, characterized as Shemshak Formation (Assereto, 1966). Shemshak formation is extended throughout Iran, especially in Alborz ranges and Northern Iran (Fursich et al., 2005). The existing Biota in Shemshak formation sediments includes several types of and Palynomorphs, plant and animal fossils.
So far, Shemshak formation has been studies in terms of various views. In this article, Shemshak formation sediments have been examined based on palynomorphic elements. The studied section is located in the 3 kilometers of Bar village east longitude and 36,28,49.5 north latitude and have thickness about 255 meters that consist of gray dark shales.

Discussion
In order the relative changes in sedimentation rate of oxygen and formation of these, the number of samples harvested 28 and 112 of them were prepared slides Palynology and were carefully reviewed and selected several random field of view, including 400 bit Palynological Dinocysts, Palynomaserals and structures less organic matter (Som), ... Per slide were counted and the percentage of each element was Palynology. The presence of organic substances depends on two other reasons i.e. sedimentation speed and the existence of oxygen-poor waters which appropriate for their protection and maintenance other than the suitable conditions for their production.

In fact, what remain in palynology slides are resulted from organic materials selective safety (protection). Such factors are served as the most important factors for protection of organic materials. Organic materials protection factors have been examined based on how much ratio percent they have of three main palynomorphic elements, that are Lability Factor, transparent SOM ratio to dark one, Amorphous materials ratio (SOM) to marine Palynomorphs and som ratio to brown macerals in Shemshak formation to determine the way of sedimentation rate and oxygen relative variations.

**Ratio of structures less organic matter(SOM)/marine Palynomorph(MP)**
If the depositing environment of less-oxygen sediments as well as sedimentation speed are low, it leads to lack of Palynomorphs maintenance and their conversion into som; however, the case where this ratio is low for sedimentation with high level oxygen, marine Palynomorphs are changed into dark SOM(op). By and the highest maintenance level in Palynomorphs, particularly of dinoflagellates occurs in lack of oxygen and conditions of highly rhythm sedimentation. Thus, the rise of transparent SOM(t) to marine Palynomorphs represents the low rate to lack of oxygen and the condition of low sedimentation rate; while, the rise of dark SOM(op) to marine Palynomorphs indicates having adequate oxygen with low rate of sedimentation(Bombardier & Gorin,2000). Regarding to this fact in the section of this case study the ratio of transparent SOM to marine Palynomorphs is lesser than unit and dark som rate to marine Palynomorphs is greater than 1, this shows that it refers to adequate oxygen conditions with sedimentation low rate(fig.1,A).

**Ratio of SOM(t)/ SOM(op)**
The abiotic bacteria in oxygen-less ambience create transparent SOM(t) rate lesser than sedimentation level and due to reduction conditions, they decompose organic materials to nitrates and sulphates, then to create nitrogen, carbon dioxide, water and methane. Therefore, in the occasion of sedimentation highly rate, bacteria could not decompose and decay organic materials, so there will be more chance for organic materials maintenance.

By the oxygen which exists in water, biotic bacteria decompose organic materials. If decomposition rate is high, organic materials lose all their oxygen and hydrogen and little
carbon remains; and for this reason, SOM is darkened. With respect to the fact that the quantity of transparent SOM(t) shows the condition of lack of oxygen, and dark SOM(op) denotes the adequate oxygen in the given condition, measurement of their ratio may be served as an approximation about oxygen amount in the past. If such ration is greater than one, it indicates lack of oxygen and vice versa (Bombardier & Gorin, 2000).

In all samples derived from the studied section, the ration of transparent SOM(t) to dark(op) ones is lesser than unit which represents the adequate oxygen during sedimentation time. In general, we observe a rising trend in ambient oxygen from Formation base toward its altitude (fig.1,B).

Lability factor
According to their transparency, Macerals are divided into two categories: Opoc (Op) and Brown (b). Brown macerals rely on land plants and show offshore environment. And Op Macerals which are dark and indicate a hemi-oxic, semi-calm environment while they are increased away beach. Lability factor is resulted from brown Palynomacerals ratio to Op Macerals, so that the greater ratio of brown Macerals to (Op)Macerals, the more variability factor, while it shows a good maintenance (Bombardier & Gorin, 2000). However, it is possible Opoc Macerals enter to the basin from another path. They may be carried again and/or be created due to temperature rise on the beach and entering to basin; therefore, by juxtaposition of Liability factor to other conditions and factors, they should be examined in order to increase certainty and accuracy of this factor.

Generally in the samples which derived from the studied section, brown Palynomacerals ratio to (Op)Palynomacerals is less than one, so this may shows oxygen low level in environment; however, by considering the mentioned issues as well as the evident existing in the slides, one could conclude that the rise of (Op)Macerals has been due to temperature on the beach (fig.1,C).

Ratio of Marine elements/Non marine elements (K factor)
Counting of marine Palynomorphs (ME) (especially Dinoflagellates) Non-marine Palynomorphs (CE) and determination of CE/ME ratio as K coefficient, is considered as Non marine to marine Palynomorphs rate, that is the greater K coefficient, the nearer environment to beach. Regarding to the diagram which exists at the beginning of Formation, the K coefficient rate is less than one so it means sedimentation environment is shallow where the environment is changed into very shallow to beach surface by increase in K coefficient from Formation middle part (fig.1,D).

Results
According to this study, one can generally infer so that with respect to Palynological elements and K factor and other mentioned factors, the Shemshak Formation sedimentation environment is too shallow to seashore, with adequate oxygen and low sedimentation rate in this section where the ambient oxygen volume is increased from the beginning part of Formation to the middle part.
The presence of spore, pollen, and fungus body in the existing slides denotes existence of water, and warm weather during deposit of sediments. Similarly, the presence of foraminiferal test lining in some slides emphasizes in the existing oxygen in sedimentation environment.

**Reference**


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**Text-Figure 1.**

Stratigraphy Column in studied area and percentage ratio diagram organic matter; A, Ratio of structures less organic matter(SOM)/marine Palynomorph(MP); B, Ratio of SOM(t)/SOM(op); C, Lability factor; D, Ratio of Marine elements/Non marine elements.
Biozonation and Sequence Stratigraphy and Lithostratigraphy of Late Palaeocene to Middle Eocene in South east of Shiraz (Fars Province)

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Abstract
In this research, Stratigraphic section was chosen from the Late Palaeocene to Middle Eocene (Jahrum Formation). This section includes Kuh-e Tudej plus 190 meters of Late Palaeocene to Middle Eocene sediments. Jahrum Formation composed of Brown and Gray medium and thin and massive limestone, dolomitic limestone. In general, 7 lithostratigraphic units have been distinguished in the study area. Considering the identified index foraminifers in the studied section such as the following taxaons: Fallotella alavensis, Nummulites sp., Lockartia sp., Orbitolites shirzeinsis, Operorbitolites, Somalina stefaninii, Rhapsydonia urensis, Coskinolina- liburinica, Discocyclina sp., Nummulites cf. aturiscus, Nummulites cf. guettardi, Coskinolina sp. Actually. Based on the sequence stratigraphic studies, the sediments of studied section include a 3rd order sediment sequence. This sequence with sequence lithostratigraphic limit of SB2 type is placed on Sachun Formation. Upper limit of the aforementioned sequence is of SB1 type which is placed under Asmari Formation and is distinctive with an erosional surface disconformity. Most forwarding surface (mfs) is observed in the mentioned section of limes with Wackstone facies. The mentioned sequence encompasses HST and TST facies sets.

Key words: biozone, Jahrum Formation, Lithostratigraphy, Sequence stratigraphy, Shiraz

1. Introduction
Jahrum Formation outcrops are mainly distributed in Fars province. At first, it has been studied by James and Wynd (1965). The type section of Jahrum Formation is chosen in the Kuh –e Jahrum which is located near the Jahrum town in the south of Shiraz. The lower Lithostratigraphic limit of the Jahrum Formation over lays the Sachun Formation and it underlays in Asmari Formation succession, with an erosional disconformity. However, based on James and Wynd (1965) studies the age of the Jahrum Formation is upper Palaeocene to Middle Eocene. The Jahrum Formation has been interested for national Iranian oil company geologists. There are many of the large foraminifers are identified in the Jahrum Formation (Rahaghi 1978. P. 32–160, 1980 and 1983).

2. Geographical situation of studied stratigraphic section:
The studied stratigraphic section is situated in the folded zone of Zagros and their geographical limits are as follow:
2.1. Tudej stratigraphic section
This section is south – east of Shiraz city, Fars province (Iran) and we can approach it through the main road of Shiraz Stahban. The geographic coordinates of this section is $Y: 29^\circ 10' 00''$; $X: 53^\circ 47' 00''$.

3. Description of mapped stratigraphic section:
This stratigraphic section has been mapped from Jahrum Formation, in Kuh -e Tudej which is introduced in short “Tudej section” the lower stratigraphic limit of this section is synchronized with Sachun Formation and its upper limit in the form of an erosional surface disconformity with Asmari formation (Fig 1).

Based on the existence of foraminifers (Rahaghi 1978. P.20 -75, Loeblich & Tappan 1989) of this section Sachun:
Fallotella alavensis, Nummulites sp., Lockartia sp., Orbitolites shirazeinsis, Opettorbitolites, Somalina stefaninii, Nummulites sp., Rhapydionina urensis, Coskinolina liburnica, Discocyclina sp., Nummulites cf. aturiscus, Nummlites cf. guettardi, Coskinolina sp.

The age of this section is form upper Palaeocene to Middle Eocene the total measured thickness is 190 m. in litho-stratigraphic point of view, this section is divided in to three parts as follow:
A. The lower part is 82 m. including limestone and dolomitic limestone from brown and gray medium-bedded.

Considering the existence of foraminifers such as:
Fallotella alavensis, Nummulites sp., Lockartia sp., Orbitolites shirazeinsis, Opettorbitolites.

The age of this part has been determined from upper Palaeocene to lower Eocene.
B. The middle part is 35 m. includes dolomitic limestone from buff and yellow thin to thick bedded. Considering the existence of the foraminifers Sachun:
Somalina stefaninii, Nummulites sp., Rhapydionina urensis, Coskinolina liburnica.

The age of this part is determined to be from Middle Eocene.
C. The upper part is 73 m. includes limestone from brown thick bedded to massive. Considering the existence of foraminifers such as:
Discocyclina sp., Nummulites cf. aturiscus, Nummulites cf. guettardi, Coskinolina sp.

4. Introduction Biozonation of the studied stratigraphic section:
Actually, in the studied stratigraphic section, four biozone have been determined for benthic foraminifers in the sediments of Upper Palaeocene to Middle Eocene (Alegret & Thomas 2001, Gibson et al. 1993, Khosrotehrani et al. 2005, Leoblich & Tappan 1989, Rahaghi 1978, 1980 p .31-58, 1983).(Fig.2)

4.1. Biozonation No. 1 – Miscellanea-Kathina (Assemblage-zone)
The thickness of this biozone in Tudej Section is 50m. and its microfossils includes:
Fallotella alavenis, Nummuites sp., Luckartia sp., Orbitolites shirazeinsis. Which indicates the age of Upper Palaeocene.
4.2. Biozonation No.2 - Opertorbitolites (Acro-zone)
This biozone includes the sediments of Lower Eocene related to studied stratigraphic section of Tudej and determines the limit of appearance and Evanishing of Opertorbitolites type. The thickness of this biozone in Tudej section is 45m.

4.3. Biozone No. 3 - Nummulites- Alveolina (Assemblage-zone)
This biozone includes all sediments of Middle Eocene in the studied stratigraphic section of Tudej. The thickness of this biozone in Tudej section 34m. and its microfossils includes: Dicocyclina sp., Nummulites cf. aturiscus, Nummulites cf. guetardi, Coskinolina sp.

4.4. Biozonation No.4 - Dictyoconus-Coskinolina-Orbitolites complanatus (Assemblage-sub zone)
This bizone includes all sediments of Middle Eocene in the studied stratigraphic section of Tudej. The thickness of this biozone in Tudej section 61m. and is microfossils includes: Somalina stefaninii, Nummulites sp., Rhapydionina urensis, Coskinolina liburnica

5. Description of Sequence Stratigraphy of Jahrum Formation in the Studied Stratigraphic Section
Actually, based on the sequence stratigraphic studies, the studied section of (Tudej) includes a 3rd order sediment sequence. This sequence with sequence boundary of SB2 type is placed on Sachun Formation and the upper lithostratigraphic limit of the mentioned sequence is of SB1 sequence lithostratigraphic limit type which is placed under Asmari Formation and is distinctive with an erosional surface disconformities as a result of a Pyrenean Orogenic phase activity. Most forwarding surface (mfs) is observed section of medium to thin-bedded limestone with Mackstone facies (Adams & Mackenzi 1984 p.45-53, Mial 1997 p.125-200, Emery & Myers 2005 p.153-173). The mentioned sequence encompasses HST and TST facies set. Actually, TST facies in the studied stratigraphic section is of Upper Palaeocene to Lower Eocene and HST facies is of Middle Eocene (Fig. 3).

6. Conclusions
a) Based on the investigation of foraminifers of the studied section, there are four biozone that have been identified which includes:
Biozone No.1 – Miscellanea- Kathina (Assemblage-zone). Which indicates the age of Upper Palaeocene.
Biozone No.2 – Opertorbitolites (Acro-zone). Which indicates the age of Lower Eocene.
Biozone No.3 – Nummulites Alveolina (Assemblage-zone). Which indicates the age of Middle Eocene.
Biozone No.4 – Dictyoconus-Coskinolina-Orbitolites complanatus (Assemblage-zone). Which indicates the age of Middle Eocene.

b) In view of age, TST facies synchronic with biozones No.1, 2 and HST facies are synchronic with biozone No.3, 4.

c) Actually, in studied stratigraphic section, a3rd order sediment sequence with lower lithostratigraphic limit of SB2 type and upper stratigraphic limit of SB1 was identified which encompasses HST and TST facies set.
d) The upper border of the studied sequence (SB1) has been distinctive with an erosional surface disconformity as the result of Pyrenean Orogenic phase activity.

6. References


