Microfacies & Depositional Environment and Diagenetic Process in Upper Surmeh Formation in Foroozan Oil Field in Persian Gulf

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Abstract:
Surmeh formation is equally, part of upper Arab formation that is consisting of alternation of carbonate and anhydrite beds. Arab formation is consisting of several members (A, A1, B, C, and D) that each member has a carbonate unit and anhydrite beds have a cap rock roll in this formation. Surmeh formation conformably overlay neyriz formation and its upper boundary is located under Hith formation. Since surmeh formation in this area has not been studies in detail, in this study, Microfacies, depositiononal environments and diagenetic process have been evaluated.

For this study, 2 subsurface stratigraphic sections from A&B wells were selected and more than 180 thin sections from core & cutting was studied. The thickness of surmeh formation in this study well is about 259 meters. It is mainly composed carbonate rocks. This study shows that this sediments may have been deposited in homoclinal ramp & consist of 3 facies assemblages and 15 subfacies. Also, these lithofacies indicate that sedimentation may occurs in shoal, lagoon and tidal flat (Intertidal & supratidal) environments. Carbonate rocks of surmeh formation may have been affected by 3 diagenetic stages including eogeneses, mesogeneses and telogeneses. Diagenetic processes such as neomorphism, cementation, micritization, silisification; dissolution, compaction, fracturing and calcite veins are affected on these rocks. Among of these, process such as dissolution and cementation increase the reservoir quality in surmeh formation. Diagenetic process affected these sediments in three diagenetic environments consist of marine, meteoric and burial that major process is meteoric. Petrography studied shows that primary mineralogy composition of Surmeh is aragonite & calcite and its diagenetic environment is tidal flat and low-depth coast.

1- Introduction
Surmeh formation (Dogger- Malm) is one of carbonates units of Khami Group that is one of the important hydrocarbon reservoirs Zagros Basin. This study is done on the carbonate sediments in upper surmeh formation (Arab formation) in (A & B) wells located in oil field in the southwest of Iran in Persian Gulf. Diagenetic processes such as neomorphism, cementation, micritization, silisification; dissolution, compaction, fracturing and calcite veins are affected on these rocks. Among of these, process such as dissolution and cementation increase the reservoir quality in surmeh formation.

The late Jurassic includes important sedimentary cycles of oil aggregates. The productive rock reservoir of late Jurassic is Arab formation which have been called D, C, B, A1, A members. Each of carbonate members are covered by evaporates sediments which the result of them is anhydrite.

2- Facieses
In this study, Surmeh formation are divided to 15 facies association include Bar, Lagoon & Tidal flat facies which describe as follows:
2-1- Carbonate facies association:
Based on composed part and other textural and structural properties many carbonate facies are determined which description followed.
2-1-1- A Barrier facies association
This association is included 4 facieses A1, A2, A3, A4.
2-1-1- A1: Algal ooid bioclast grainstone. (SMF11 – FZ6)
This facies has algal fragments in Dasycladacea type accompanied with benthic foraminifera like sodoukrizalidina, fanderina and cornobia, single ooid and ooid aggregates. This microfacies are equal with standard SMF11 standard microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and locted in FZ6 facies belt.

2-1-1- A2: Algal bioclast grainstone. (SMF11 – FZ6)
In this facies kinds of benthic foraminifera are accompanied with Dasycladacea type of green algal are funded in base of spars. This microfacies are belonged to standard SMF11 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and locted in FZ6 facies belt.

2-1-1- A3: Algal bioclast intraclast grainstone (SMF11 – FZ6)
This facies has algal fragments in Dasycladacea type accompanied with benthic foraminifera like Pseudochrisalidina, fanderina and curnobia, single ooid and composite ooid in less of them. This microfacies is belonged to standard SMF11 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and locted in FZ6 facies belt.

2-1-2- The analysis of sedimentary environment in A facies group (Barrier Environment)
The laboratory studies show that A facies group are occurred in skeletal barrier facies. In continue of these studies can pointed the follow point.
The existence of intraclasts and their large size, existence of ooids, lack or fewer lime mud show the turbulence lence current. The properties of them are lack or fewer lime mud among grains and in consequence replacing the space among allochems with sparite cement.
In some facieses lack of lime mud and matrix show the sedimentation under shallow and turbulence lent condition such as bars and ridges (Mess and et al 2003; sandoli and raspini, 2004). Also the existence of ooids in some facies in form of radial and base of sparite show the sedimentation under shallow and turbulence lent condition.
B1 facies due to exist of fossils diversity and skeletal parts maybe located in front of open marine, wheras, B3 facies due to lesser fossil content maybe located in front of lagoon.

2-1-2-1- Lagoon facieses association
This association is included 3 facieses B1 ,B2 and B3.

2-1-2-1- B1 :Algal peloid intraclast grainstone (SMF11- FZ6)
In this facies fund most amounts of intraclast and ploieds in base of sparite. Intraclasts have well sorted well rounded and dark color. This microfacies are belonged to standard SMF11 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ6 facies belt.

2-1-2-1- B2 :Laminated ostracod peloid wackestone- mudstone (SMF11- FZ6)
In this laminated facies found ostracod and peloid in base of lime mud. Also the existence of stylolite which is filled with iron oxide and bioturbation in this facies is observable. This microfacies are equal with standard SMF18 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ7 facies belt.

2-1-2-1- B3 :Green algal wackestone. (SMF25- FZ8)
The most important part of this facies could point to green algae fragment in Dasycladacea type which is located in base of microspalte. Micritization and neomorphism of allochems especially micritization of green algae fragment is the most important properties of this facies. This microfacies are comparable with standard SMF25 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ8 facies belt.
The analysis of sedimentary environment in B facies group (Lagoon facies)
By studied on facies of this group, is considered lagoon environment for their which are appointed of this facies related to lagoon environment in follow reasons:
The amount of lime mud in B1 facies compare with others of this association is less. This issue is clarified of the environmental energy in contrast with other facieses of this association is higher. Also the existence of intraclast is illustrated the lagoon environment are in front of the bar.
The amount of lime mud in B1 facies in contrast with other facies is lesser. This issue confirms that environmental energy in contrast with other facies is more than them. Also the existence of intraclast confirms that lagoon environment is in front of the bar.

2-1-3- Tidal Flat Facieses Association
This facieses association is included 6 intertidal facieses (C1, C2, C3, C4, C5 and C6) and 3 supertidal facieses (D1, D2, and D3).

2-1-3- A: Intertidal facieses association
2-1-3-1- C1: Algal peloid ooid intraclast grainstone with evaporate mineral (SMF11- FZ6)
In these facies different kinds of non skeletal grains such as superficial peloids, composite ooids and intraclast in base of sparite cement are found. This facies are equal with standard SMF11 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ6 facies belt.
2-1-3-1- C2: Bioclast intraclast grainstone (SMF11- FZ6)
The main parts of this facies in the base of sparite cement are connected to each other. This facies are comparable with standard SMF11 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ6 facies belt.
2-1-3-1- C3: Algal peloid packstone with keystone vug (SMF16- FZ8)
This facies has algal fragments in Dasycladacea type accompanied with peloide non skeletal fragments are the main part of this facies. The Filaments of green algae in Dasycladacea type which product stromatolithes. This microfacies are comparable with standard SMF16 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and located in FZ6 facies belt.
2-1-3-1- C4: Stromatolithes Bondstone (SMF20- FZ8)
This facies are totally composed of green algae in Dasycladacea type in which located in base of lime mud. Stromatolithes are frequently composed in middle to upper intertidal environment. This facies are equal with SMF20 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975).
2-1-3-1- C5: Peloid bioclast ooid wackestone- packstone (SMF20- FZ8)
This facies includes the different kinds of benthic foraminifera and gastropod and non skeletal fragments like peloid and ooid which are found in base of lime mud. This microfacies are comparable with standard SMF16 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and located in FZ8 facies belt.
2-1-3-1- C6: Intraclast peloid wackestone-grainstone(SMF16- FZ8)
In this facies peloids accompanied with intraclast are found in base of lime mud. Wavy and laminated structures due to tidal movement are seen abundant.

2-1-4- The analysis of sedimentary environment in C facies group (Tidal flat)
In order to facies properties could be concluded that this facies are formed in Tidal flat environment. The main important of this appointment is followed by:

In C1 facies, dominated intraclast non skeletal fragments are demonstrated the temporary high water and scour the intraclast of followed environment which related to tidal flat environment. The existence of ooid in C1 and C5 facies descriptive that these fragments are not depend on this environment and due to turbulence and disorder is transferred to this environment.

2-2- Supertidal facies association
This association is included 3 facieses D1 , D2 and D3.
D1: Fenestral mudstone (SMF21- FZ9A)
This facies is totally composed of lime mud and nearly is effect of skeletal and non skeletal fragment which are not seen. In this facies, fenestral fabric is seen frequently. This facies are comparable with standard SMF21 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ9A facies belt.
D2: Fenestral peloid wackestone with anhydrite (SMF21- FZ9A)
In this facies most amount of peloid are accompanied with fenestral fabric which is seen in lime mud. This facies are equal with standard SMF21 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ8 facies belt.
D3: anhydrite facies(SMF21- FZ9A)
The massive anhydrite is another part of the existence rocks in supertidal area which was fine and long anhydritic crystals and partially has folded small structures. The massive anhydrite are inter bedded with mudstone. This microfacies are equal with standard SMF20 microfacies of Flugel (Flugel, 2004) and Wilson (Wilson, 1975) and is located in FZ9A facies belt.

3- Conclusion
1-The thickness of surmeh formation in the study well is about 259 meters. It is mainly composed carbonate rocks. This study shows that this sediments may have been deposited in homoclinal ramp & consist of 3 facies assemblages and 15 subfacies in shoal, lagoon and tidal flat (Intertidal & supratidal) environments.
2-Skeletal fragments in upper surmeh formation consists of Gastropid, ostracod, dasycladacea algae and bivalve. Non skeletal fragments consists of peloid, intraclast and ooid.
3- upper surmeh formation is equally, part of upper Arab formation that is consisting of alternation of carbonate and anhydrite beds. Arab formation is consisting of several members (A, A1, B, C, and D)

References


A: A1 facies, Algal ooid bioclast grainstone. depth(2850), sample from well FA(XPL)
B: A2 facies, Algal bioclast grainstone. depth(2932), sample from well FA(XPL)
C: A3 facies, Algal bioclast intraclast grainstone. depth(2932), sample from well FA(XPL)
D: B1 facies, Algal peloid intraclast grainstone. depth(2853), sample from well FA(XPL)
E: B2 facies, Laminated ostracod peloid wackestone-mudstone. depth(2858), sample from well FA(XPL)
F: B3 facies, Green algal wackestone. depth(2923), sample from well FA(XPL)
A: C1 facies, Algal peloid ooid intraclast grainstone with evaporate mineral. depth(2852), sample from well FA(XPL)
B: C2 facies, Bioclast intraclast grainstone .depth(2852), sample from well FA(XPL)
C: C3 facies, Algal peloid packstone with keystone vug. depth(2843), sample from well FA(XPL)
D: C4 facies, Stromatolith bound stone. depth (2929), sample from well FA(XPL)
E: C5 facies, Stromatolith bound stone. depth (2929), sample from well FB(XPL)
F: C6 facies, intraclast peloid wackestone-grainstone. depth (2877), sample from well FA(XPL)
G: D1 facies, Fenestral mudstone. depth (2894), sample from well FB(XPL)
H: D2 facies, Fenestral peloid wackestone with anhydrite. depth (2843), sample from well FA(XPL)
I: D3 facies, anhydrite facies .depth (2873), sample from well FB(XPL)
Fault Trend Detection Using Three-Dimension Pole-Pole Array  
(A Case Study in Anarak Area)

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Abstract:  
Resistivity electrical changes in vertical, horizontal and in the direction that is perpendicular to the survey line, is measured in 3D surveys. 3D electric data illustrate a 3D image from subsurface layers, therefore combination of 3D electric results and surface geology is appreciated as helpful technique in electric data interpretation. What is carried out for performing a 3D survey is as follows: first a 2D survey is carried out in the survey field and then collected data are interpreted. When the subsurface layers are defined clearly, an area is selected and a suitable grid for 3D survey is designed. After data acquisition, by using a 3D interpretation software, data points are interpreted. Finally, the results are compared with the result of 2D configuration. In this study, the main objective is the detection of a fault trend by using pole–pole electrode array which is commonly used for 3D surveys. This survey method by using a 3D interpretation model gives accurate results of subsurface structures. In order to confirm the abilities of this method for fault detection, after checking the final results of 2D Shlumberger array on a fault trend in Anarak area in Esfehan province, an square grid with a 60 meters long, was designed and data acquisition was carried out. Then potentional values (476 data points) were inserted into a provided program in MATLAB software for calculation the apparent resistivity. After data interpretation by using RES3DINV software, the fault trend was detected in vertical and horizontal sections. At the end apparent resistivity values and the coordinates of data points were inserted into the Slicer/Dicer software and a 3D structural model of different horizons from surface to subsurface was produced. The results show considerable ability of 3D surveys for fault detection.

Keywords: Geo electrical 3D surveys; Pole-Pole array; Fault trend detection;

1- Introduction:  
The 3D survey is found to be a useful technique for 3D geo electrical interpretation. At the present time, what is carried out for performing a 3D geo electrical survey is as follows: first a 2D survey is carried out in the survey field and then collected data are interpreted. When the subsurface layers are defined obviously, an area is selected and a suitable grid for 3D survey is designed. After data acquisition, by using 3D interpretation software, data points are interpreted. Finally, the results are compared with the result of 2D configuration. Articles and reports published in this field, indicate the high ability of this method with an acceptable accuracy compared with 2D surveys. Based on this, after 2D measurements were done in Anarak area in Esfehan province, 3 fault trends was detected in the mentioned area. With studies on the location map and topography of the region, an area between sondages k12 and k13 (Figure 1), was selected for geo electrical 3D network designing.
2- The geology of the study area
This area in terms of geologic divisions is a part of central Iran. One of the areas in which metamorphic rocks are found, is along a fault trend what is visible in the study area. Obvious features of the area’s rocks are weathering and foliation. The metamorphic rocks of the study area are: mica schist, phyllite, gneiss, quartzite and chlorite schist. Figure 2 show a sample of field’s geology.

3- Data acquisition by using 3D pole-pole array
In this study, 3D pole-pole array, “cross-diagonal survey” technique, is used. In this technique for a 7 by 7 electrode grid, the number of datum point is 476. In the measurements sequence shown in figure 3, each electrode in turn is used as a current electrode and the potentials measurements are made at the electrodes along the horizontal, vertical and the 45 degree diagonal lines passing through the current electrode. Note that because of reciprocity, it is only necessary to measure the potentials at the electrodes with a higher index number than the current electrode. In practice, the ideal pole-pole array with only one current and one potential electrode does not exist. To approximate the pole-pole array, the second current and potential electrode (C2 and P2) must be placed at a distance which is at least 10 times the maximum separation between c1 and p1 electrodes used in the survey to insure that the error is less than 5%. So in this survey, the electrode p2 was placed at 300 meters and the electrode c2 was placed at 600 meters far from the network (Figure 4). Note that because of the large distance between the p1 and p2 electrodes, it picks up a large amount of telluric noise which can severely degrade the quality of the measurements so before carrying out these measurements, it is necessary to make sure there would be no solar storms which is the most factors to make these noises.

4- Horizontal sections
After applying the inversion, 6 sections were introduced by RES3DINVERS software as horizontal sections (Figure 5). These sections cover from the surface to the depth of 77.5 meters. As the figure shows, from the surface to the depth of 24.3 meters, apparent resistivity changes up to 350 ohm meter. From the depth of 24.3 meters to 35 meters, apparent resistivity changes between 350 to 800 ohm meters and from the depth of 35 meters to 75 meters, the value of apparent resistivity is about 2500 ohm meter. As sections number 1, 2 and 3 show, blue layer can be recognized from the surface up to the depth of 24.3 meters.

5- Vertical sections:
In figure 6, vertical sections which are parallel with the fault trend are shown. Vertical drop of blue layer from surface up to the depth of 19.7 meters is clearly visible. From the depth of 19.7 meters to bottom, layers are almost horizontal. It is proved that in line which is parallel with fault’s trend, apparent resistivity changes are very minor and the sections show this fact as well. Vertical sections which are perpendicular to fault’s trend are shown in figure 7 . From section 2 up to section 5, the fault trend is clear. It is proved that in line perpendicular to a fault, the change in the sections is totally clear which these sections confirm this fact as well.
6- 3D image of the subsurface layers by using Slicer/Dicer software
RES3DINV software enables the user to get the output under the extension gm after the inversion. The file is made with this suffix is used as an input for Slicer/Dicer software to provide a 3 dimensional structure. Figure 8, shows a 3D image of subsurface structure which has been produced by this software.

7- Discussion and Conclusion
This array has the widest horizontal coverage and the deepest depth of investigation so the pole-pole array might be a suitable choice for surveys with small electrode spacing and when good horizontal coverage is required. In a 3D survey, a large amount of data point is read so the user can get an image of subsurface layers with high quality and less noise. Nowadays, considerable researches in the field of geo electric exploration are done. However, because of the large number of data points, operation’s time and the cost are high but it is expected that in a near future with development in multi-channels measuring devices, which enable the users to read several data points simultaneously, and the progress in interpretation software, that enables the users to have the interpretation of a lot of data points (more than 8000 data), the mentioned problems will be solved and this method will be a suitable alternative for geo electric 2D surveys.

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Denchik, N. L, Marescot , Chapellier, D, 2005, Choice of effective electrode array for 3D electrical resistivity monitoring during rainfalls
Figures

Figure 1. The area which was selected between sondages k12 and k13 is shown

Figure 2. A view of field’s geology

Figure 3. An image of the way that the measurements are done

Figure 4. The electrode p2 is placed at 300 meters and the electrode c2 is placed at 600 meters
Figure 5. Horizontal sections

Figure 6. Vertical sections which are parallel to fault’s trend

Figure 7. Vertical sections which are perpendicular to fault’s trend

Figure 8. The 3D image made by Slicer/Dicer software
Tectenostratigraphic of the Qom Formation (Central Iran).

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Abstract:

In addition, Qom Formation is one of the most reservoir rock in the Central Iran zone. General study of lithostratigraphic characteristic indicates different thickness with distinct lithostratigraphic boundary. Tectonic activity which occur in the Eocene-Miocene is the main cause of disconformities in the upper and lower lithostratigraphic limit of the Qom Formation through the Central Iran.

KEYWORDS: Tectenostratigraphic, Qom Formation, Central Iran, reservoir rock

Introduction:

Qom Formation is a Carbonate unit of Ramp Which deposits in a shallow depth marine environments in a section of west central Iran (Qom, Makoo, Ta fresh, kashan Azarbajjan and…). In the previous studies, Qom formation were called Miocene Oligocene, or Lower Neogene Formation and Lepidocyclina Aquitanian Marl, but at the upper most of lithostratigraphic limit Qom Formation replaced former name. This formation included shallow depth Lime stones and marl with a alternation of Silty marl, sand stone, layer thin-bedded limestone, gray to reddish shale and evaporites. Laboratorial and field observations led to recognition of four sedimentary environment: shoal backreef, Lagoon and fourreef (Qodsi siab, Lasmi 1995).

History of Qom formation:

for the first time Loftoos (1855) and Abic (1859) Studied Qom formation at the oorumiye Lade, also Titz (1876) reported this formation from central Iran and Estall’s Qom (1912). Rezai et al (1998) has been reported that there are 6 different sedimentary section. Daneshhuyan and Bakhtiari (2002) have been studied foraminiferal constituents, Base on this study the age of Qom Formation is Upper Aquitanian- Lower Burdigalian. Qodsi siab and Lasmi (1995) distinct four sedimentary environment for Qom Formation at Soltan pond. Aghanabati et al (2004) with study on oily field of Seraje, Alborz and Aran in Qom
Formation have concluded that zagros Till Miocene- Eocene sea develop till west central Iran Margin.

Age changes Of Qom Formation on the basis of transgression and regression sea erosive circulation should be considered and so Qom Formation might introduce am or part of stages of Rupelian, Chattian Aquitanian, Burdigalian and even Tortonian till Holotian (Khosrotehrani, 1370). Also Bozorgnia laf (1966) believes that the presence of Nommolites intermedius and Eulcpidina in south of Kashan coutirm this possibility to knowe lower part of Qom Formation equivalent with lower part of Asmari Formation and knowe that Lower part of Qom Formation is Rupeliane, also upper Limestone of Qom Formation with the age of Burdigalian is synchronous with upper Asmari Formation.

Lower stratigraphic limit of Qom Formation is not similar facies everywhere but in most central Iran zone overlies on Lower Red Formation disconformable unconformity. Also upper lithostratigraphic limit is a erosive surface everywhere that usually is sharp and terminates to detrital row of Upper Red Formation and some times is accompanied by unconformity.

Stratigraphy:

with due attention to stratigraphy sections that places that Qom Formation is reported in them, vertical section choose on general procedure of central Iran (north of west- south east). Location of geologic section are presented in fig 1. Each section include some stratigraphic section that point them at the continue. Stratigraphic column information of selective station provide from 26 reports and geology organization 27, also from Dr saeedi,s article.

Research method:

In the view of the fact that sedimentary basins can record formation stages and effective tectonic episodes on them in themselves during their age, for reaching tectonic data and history of crust tectonic,s country of Iran, only can’t use tectonic phenomenosn that exist on external crust because the episodes of one age might be deleted and faded by effect of structural changes and metamorphosis special in multi-phase metamorphic regins. Sometimes the intensity of Structural changes is to the extent that make hard and practically impossible episodes commentary and interpretation. Therefore one of the methods that by it. Can calculate episodes intensty and time and crust changes and finally different ages of tectonic episodes, is study (research) method of stratigraphy columns and the comparison of formation thickness change in adjacent regions.

For this purpose from different points of studying region are selected and examined sections because of Tectonic denstiny determination and dominant system on it. In this research is tried that selected sections be in vertical direction on spread trend of studying region. Therefore with attention to the trend of central Iran’s north western-south eastern. Sections have selected in direction of north-eastern-south- western.

For the study and analysis and inquiry of strural condition. Tectonic condition, and the state of sedimentary basin settlement is used methods that are as follows:
1- the preparation of report article and maps around region (Table 1).
2- sections determination on the basis of stratigraphy columns settlement (figure 1).
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3- the preparation of Location map with 1:200000 seale and the determination of sections settlement place on it (figure 1).
4- the preparation of correlation Diagram and Making stratum columns correspondence of each section with each other on the basis of existing formations in every column (figures 3, 2, 4).

Conclusion:
After the upper Eosen event (pirnein event) Come into existence a erosion on Iran crust and products of this event settle in sedimentary environment, alluvial, and temporary lakes of tropical areas in oxid conditions that include conglomerata, san stone, gypsum, salt stone silt and clay that are from original maker of lower red formation. This formation settle in most of Iran arcas.
But This frontier is sudden and sometimes might accompanied whit slight unconformity but this unconformity is not reveal so much.
The advance of sea in the time of oligocen till upper miocen cause sedimentation of little depth lime- stone and marl in central Iran.
Regressive movement of upper Eocene causes the deposition of lower Red Formation which overlies by Qom Formation. Actually Qom Formation is an indication of transgressive of Oligocene movement.
However Qom Formation is the most transgressive sequence which is deposited in the main parts of Central Iran.
It is neccesary to note that, upper lithostigraphic limit of the Qom Formation show regressive movement. which is named upper Red Formation (URF).
Lithologic chovactevistic of URF, mainly consist of red bed red conglomerate which indicate as a continental sediments.
There fore URF is similar with LRF. Qom Formation is sandwiched between two continuted facics (LRF and URF).

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Tabel 1:

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<th>Region name</th>
<th>Thikness</th>
<th>Litology</th>
<th>Age</th>
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<td>Lower Red.Fr</td>
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<td>U.Oligocene-L.Miocene</td>
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<td>90m</td>
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<td>U.Oligocene-L.Miocene</td>
<td>Upper Red.Fr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nakhlak</td>
<td>982m</td>
<td>Limestone with Sand intercalation</td>
<td>U.Oligocene-L.Miocene</td>
<td>Upper Red.Fr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anarak</td>
<td>200m</td>
<td>Limestone and Marn</td>
<td>U.Oligocene-L.Miocene</td>
<td>Lower Red.Fr</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 2</th>
<th>Region name</th>
<th>Thikness</th>
<th>Litology</th>
<th>Age</th>
<th>Up limit</th>
<th>Down limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yazdan</td>
<td>1290m</td>
<td>Limestone with Shail intercalation</td>
<td>U.Oligocene-L.Miocene</td>
<td>Upper Red.Fr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do Baradaran</td>
<td>780m</td>
<td>Limestone</td>
<td>U.Oligocene-L.Miocene</td>
<td>Upper Red.Fr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soh</td>
<td>650m</td>
<td>Limestone with Shail and Sand stone intercalation</td>
<td>U.Oligocene-L.Miocene</td>
<td>Lower Red.Fr</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<thead>
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<th>Region name</th>
<th>Thikness</th>
<th>Litology</th>
<th>Age</th>
<th>Up limit</th>
<th>Down limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Julfa</td>
<td>600m</td>
<td>Limestone</td>
<td>U.Oligocene-L.Miocene</td>
<td>Upper Red.Fr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soltanie</td>
<td>200m</td>
<td>Limestone</td>
<td>U.Oligocene-L.Miocene</td>
<td>Upper Red.Fr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karevansara sang</td>
<td>1280m</td>
<td>Limestone with Shail intercalation</td>
<td>U.Oligocene-L.Miocene</td>
<td>Upper Red.Fr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nardaghi</td>
<td>1340m</td>
<td>Limestone</td>
<td>U.Oligocene-L.Miocene</td>
<td>Upper Red.Fr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arghoon</td>
<td>900m</td>
<td>Limestone with Conglomera and Sand stone</td>
<td>U.Oligocene- L.Miocene</td>
<td>..........</td>
<td>Lower Red.Fr</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>------</td>
<td>------------------------------------------</td>
<td>------------------------</td>
<td>----------</td>
<td>--------------</td>
<td></td>
</tr>
</tbody>
</table>

Lower Red.Fr ............. U.Oligocene- L.Miocene

900m Arghoon
Fig 1

LOCATION MAP OF SECTIONS

Scale: 1:30000000
Fig 3
Lithofacies and Architectural-Elements Analysis of Fluvial Deposits in the Shahrud Drainage Basin, Qazvin Province, Iran

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Abstract

A part of the Shahroud drainage basin located northeast of Qazvin province, consists of two sub-basins (Alamoutrud and Taleghanrud). Structurally, the study area is part of southern-central Alborz zone and geologically is composed of very thickly Eocene volcanic units and Miocene terrigenous sediments. Lithofacies identified in this drainage basin include gravelly (Gmm, Gmg, Gcm, Gh), sandy (Sp, Sh, Sm) and muddy (Fl, Fm). Architectural elements identified include CH, GB, SB, LA and FF. Base on architectural elements and lithofacies sedimentary models for Shahrud river from upstream toward downstream respectively are as follows: 1: shallow gravel braided river, 2: gravel wandering river, 3: gravel meandering river, 4: sandy meandering river and 5: fine grain meandering river.

Keywords: Lithofacies; Architectural elements; Depositional model; Shahroud Drainage Basin.

Introduction

The Shahroud drainage basin is a part of Caspian Sea great drainage basin and a part of this drainage located northeast of Qazvin province, consists of two sub-basins (Alamoutrud and Taleghanrud). Structurally, the study area is part of southern-central Alborz zone and geologically is composed of very thickly Eocene volcanic units and Miocene terrigenous sediments. This watershed has an elongate form and its surface area is more than 5070 square kilometer. More than 70 percentages of sediments in studied samples from upstream is gravel, while in the samples from downstream, more 70 percentage is dedicated to the sand and mud size. Studies indicate that, two factors, Hydraulic sorting or selective transport and abrasion, have important role in fining trend in this watershed basin.

Fluvial deposits are dominated by clastic material. The simplest classification is a three component one using gravel, sand, and fine-grained materials. Fine-grained components can include mud, silt, and very fine-grained sand. Some lithofacies also contain organic matter that is an undesirable contaminant for aggregate applications. Table 1 presents a list of 9 lithofacies classes with associated names, descriptions, structures, and genesis. Gravelly facies: Individual clasts may reach more than 20 cm in diameter but the mean size generally is within the pebble range (2-64 mm). Sorting is variable.
Sandy facies: Included in the sandy facies are deposits ranging from very fine to very coarse sand; the coarser beds commonly are pebbly. Sorting is extremely variable, and may be in part a reflection of the sorting in the source beds.

Fine-grained facies: Silt and clay may comprise a very small percentage of a braided-stream deposit, but their presence is of importance because of the genetic implications that can be deduced from their position in the bed sequence.

Architectural elements

Architectural elements can be found in various combinations in fluvial system channels. One additional element, floodplain fines (FF), is also considered here as it one of the elements of overbank environment that may be found in abandoned channels. The elements are the channel, gravel bars and bedforms, hollow deposits, sediment gravity-flow deposits, sandy bedforms, downstream-accretion macroforms, lateral accretion deposits, and laminated sand sheets. Each architectural element will be discussed in turn. Each element can consist of one or more lithofacies as given in Table 2. If these elements are sufficiently large they can be readily identified on low-level aerial photographs of modern rivers. One or more of these elements may be encountered in sand and gravel deposits suitable for aggregate. Relationships between elements can be complex, reflecting multiple truncations of one or more previous deposits and the overprinting of one or more new ones. The discussion that follows is more extensive for those architectural elements that are more likely to be likely sources of suitable sand and gravel.

Table 1: Lithofacies and sedimentary structures in fluvial deposits in the Shahrud Drainage Basin (modified after Miall, 1996)

<table>
<thead>
<tr>
<th>Facies</th>
<th>Facies code</th>
<th>Description</th>
<th>Structure</th>
<th>Genetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravely</td>
<td>Gmm</td>
<td>matrix-supported, mass</td>
<td>Weak grading</td>
<td>Plastic debris flow, high strength &amp; viscous</td>
</tr>
<tr>
<td></td>
<td>Gmg</td>
<td>matrix-supported</td>
<td>Inverse to normal Grading</td>
<td>Pseudoplastic debris flow, low strength, viscous</td>
</tr>
<tr>
<td></td>
<td>Gcm</td>
<td>clast-supported, mass</td>
<td>None commonly seen</td>
<td>Pseudoplastic debris flow (inertial bedload, turbulent flow)</td>
</tr>
<tr>
<td></td>
<td>Gh</td>
<td>clast-supported, crudely bedded</td>
<td>Horizontal bedding, Imbricated</td>
<td>Longitudinal bedforms, lag deposits, sieve deposits</td>
</tr>
<tr>
<td></td>
<td>Sp</td>
<td>fine to very coarse, may be pebbly</td>
<td>Solitary or grouped planar cross-beds</td>
<td>Transverse and linguoid (2-D) dunes</td>
</tr>
<tr>
<td></td>
<td>Sh</td>
<td>Very fine to coarse, may be pebbly</td>
<td>Horizontal lamination</td>
<td>Plane-bed flow (critical flow)</td>
</tr>
<tr>
<td></td>
<td>Sm</td>
<td>fine to coarse</td>
<td>Massive, or faint lamination</td>
<td>Sediment-gravity flow deposits</td>
</tr>
<tr>
<td>Muddy</td>
<td>Fl</td>
<td>Sand, Silt, mud</td>
<td>Fine lamination, very small ripples</td>
<td>Overbank, abandoned channel, or waning flood deposits</td>
</tr>
<tr>
<td></td>
<td>Fm</td>
<td>Mud, Silt</td>
<td>Massive, desiccation cracks</td>
<td>Overbank, abandoned channel, or drape deposits</td>
</tr>
</tbody>
</table>
Table 2: Architectural elements in fluvial deposits in the Shahrud Drainage Basin

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>Principal lithofacies assemblage</th>
<th>Geometry and relationships</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream channels</td>
<td>CH</td>
<td>any combination</td>
<td>Finger, lens or sheet; concave-up erosional base; scale and shape highly variable; internal concave-up secondary erosion surfaces common</td>
</tr>
<tr>
<td>Gravel bars and bedforms</td>
<td>GB</td>
<td>Gh</td>
<td>Lens, blanket; usually tabular bodies; commonly interbedded with SB</td>
</tr>
<tr>
<td>Sandy bedforms</td>
<td>SB</td>
<td>Sp, Sh</td>
<td>Lens, sheet, blanket, wedge; occurs as channel fills, crevasses splays, minor bars</td>
</tr>
<tr>
<td>Lateral accretion deposits</td>
<td>LA</td>
<td>Sp, Sh, less commonly Gmm, Gmg</td>
<td>Thin to thick blankets; commonly interbedded with SB; may fill abandoned channels</td>
</tr>
<tr>
<td>Overbank fines</td>
<td>FF</td>
<td>Fl, Fm</td>
<td>Wedge, sheet, lobe; characterized by internal lateral accretion surfaces</td>
</tr>
</tbody>
</table>

Sedimentary models:
Shallow gravel braided river: This model occurs in larger gravel-bed streams, such as Trunk Rivers, and in some large alluvial fans. The valley contains three or four distinct topographic levels, with the higher levels covered by sparse to dense vegetation. The lowest level is that of the active channel and is similar in all respects to that of proximal alluvial fan or outwash braidplain river. Higher levels are active only during high stage and characteristically accumulate deposits of SB. A floodplain may or may not form a significant part of the system, depending on valley width and channel stability. Lateral migration of channels, as for example by distributary shifting on alluvial fans, causes superimposition of successively higher terrace levels, and the generation of upward-fining sequences. These may be thicker than the depth of the channel if they are developed by distributary migration on a rapidly subsiding fan (Fig. 10).

Gravel wandering river: This model typifies gravelly rivers of high sinuosity. Typically there is one main, active channel with bars and islands and occasional subsidiary channels. The latter commonly are initiated as chute channels. Sedimentation occurs on large, flat-topped point bar and side bar complexes. These commonly show a downstream decrease in grain size, with gravel sheets, lobes or foreset bars at the head, and sand dunes or sand waves at the tail. Lateral accretion of these bar complexes is common, and the LA element should be recognizable in large outcrops. Information about the floodplain of this class of river is sparse, and it is not known whether crevassing and crevasse splay deposits are common (Fig. 2).

Gravel meandering river: This model represents the typical "coarse-grained meandering stream", with distinctive, gravel-sand or pebbly-sand point bar complexes. The accretionary face of the bar is crossed by numerous sandy bedforms, including dunes and sand waves. Meander scars and abandoned channels are common in the floodplain. Fining-upward cycles may or may not be developed, depending on meander sinuosity and flow patterns around the bend. The upper South Platte River and the Amite River are typical modern examples (Fig. 3).
Sandy meandering river: This model illustrates the classic sandy meandering stream. The point bar accretionary face usually is of simpler geometry, with fewer, smaller scale bedforms than in previous model. Accordingly, well-developed epsilon cross-bedding is to be expected in cross section. Meander scars, abandoned channels and crevasse splays are common (Fig. 4).

Fine grain meandering river: This model illustrates a highly sinuous, suspended load stream. The overall geometry is similar to that of model 6, but differs in detail because of the finer grained sediment load (fine sand, silt, mud). Point bar accretion surfaces dip steeply (up to 25°), and have a simple geometry, typically planar or with banks or benches indicating downstream flow separation and the development of incipient scroll bars. Ripple marks are typically the most abundant flow regime bedform present. Gravel lags and cross-bedded medium to coarse sands may occur at the base of the point bar. E.H. Koster reports that many examples of this model may be estuarine in origin (Fig. 5).

Fig. 1: major gravelly, low-sinuosity river with well-defined topographic levels.

Fig. 2: gravelly, high-sinuosity river.

Fig. 3: sand- and pebbly sand-bed "coarse-grained meandering" river.
Fig. 4: the classic sandy, mixed-load meandering river.

Fig. 5: muddy, fine-grained meandering river.

Reference


Image Map of Abarkouh mines

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Abstract
Image map both is a minimized image of zone and topography map used to present the specific topology. This is the most influential method to display and to train the topology. Cartographers use the integrated satellite images, various maps, and ground information. Displaying topography such as Abarkouh mines in the form of image map is the best method to specify the place of mines, its dispersion, topography condition, and road network. A problem of exploitation and investing in mine reservoir in Iran related to lack of general public and capitalist awareness about importance and profitability in mine section. In addition, the technical experts, noticeably, are not aware about the modern method and technology to find place of mine reservoir and new mines. Geographical information system (GIS) and using satellite images caused that experts achieved valuable mines without any difficulty and high cost to insure whether it is economical. GIS can discover the mineral area and it can distinguish the volume of reservoir and amount of material concentration into a specific area with aid of traditional surveying, desert operation and using GPS. Another problem to design extracting the mines at Iran is ambiguity in volume of mines reservoir, because geology of area was not considered precisely and traditional method used for discovering the mines. Therefore information about the volume of mine reservoir as a national wealth helps the economical decision makers. It is obvious that the best solution to achieving this proposes is geographical information system and images and information received from satellite. The statistic and information should be processed in the field of geology, mineralogy, soli science and final results should be supplied to users and designers in the form of scientific, information, maps, and image maps.

Keywords: Image map, mine, Abarkouh.

Introduction
The image map is overlaid aerial image or a satellite image with a map of specific topography. It displays the actual natural range and a map with conventional and symbolic signs. Image map is uses variously. It can be used as a guide for artificial structure to display different part of structure and it can display the earth with all dispersed components. Image map can be used as a guide for clients at the office, industrial, scientific, and artistic zone and even a factory which can be separable with satellite images. Also, image maps with bigger scale can show the position of natural, industrial, and artificial phenomenon. Almost the developed country, there is big map over a wall which it consist of detailed information about place and important center such as airport and railways used as a guide map. These images are not formal pictures or aerial images, but they are satellite images. Such images which contain information of important centers are called image map. It is not actually a map changed to image, but it is an image changed to map. Therefore, using
information technology, we can replace image map with formal map for public places. Image map means that information necessary for general public was added to satellite images or aerial images using software techniques. The final images publish as electronic material or hard copy.

**Material and method of research**

Studied area is located at north latitude 31° 8’ and east longitude 53° 17’ at Abarkouh, Yazd. The road to arrive mines passed Yazd, Taft, Dehshir, and Abarkouh. In this research, after collecting information about mines of Abarkouh, road network, height and layers of mines were prepared using Arcview and Excel software. Using RS and GIS software, image map was provided.

**Conclusion and result**

One of most important task of cartography is displaying the place and space of points and place over the earth with statistic and detailed information. A cartographer exports the data after analyzing numbers and digit traditionally or using modern method in GIS. Cartography expert activities result to different maps, diagrams, photomap tables, and image maps. This device displays a huge of information and statistic with at least volume and simple method and it has the most mental and visual effect on user. An expert simply achieved a lot of information about area when he/she see a map, diagram, or image map. It is not necessary to collecting information, spend time, or surveying the area.

At this project, we provide an image map from Abarkou mines. This image map involves useful information for geologist, pertrologist, mine experts, and researcher of mine. Concentration petrol ore in north and west north demonstrated the big geology reformation resulted to huge reservoir of marble stone and travertine.

With inspecting this images, a geologist can distinguishes the past geology reformation, material and composition of stone and soil, climate resulted to this material, ages of mines reservoir, and even volume of reservoir. Marble and travertine stone with sediment origin demonstrate the sedimental bed of this area. Probably there was a wide sea at the remote past. Marble as limy stone, designated the most important of area, and marble as metaphoric sediment stone shows heat and relative pressure in quarter period on sea sediments and sediments resulted from limy maker springs. Travertine stone demonstrated the warm spring at the past.

Paleontologists can distinguish ages of sediments and method of constituting them. In addition, it is possible to recognize the climate, morphology, and topography of area. Displaying topography of image map cause to comparison simultaneously the topography and maps displaying the topography and earth phenomenon. Therefore using this method recommended to experts to display topography and earth phenomenon.

Based on efficiency and aesthetic aspect, using image map to display topography predominate on other method of cartography.

Because the mines and earth reservoir as national wealth play an important role in economic, introducing them to community can be effective in exploiting and investing.
Hereby, we use the modern method of cartography. Image map which resulted from various map and statistic data with satellite images can introduce Abarkou mines dispersionally and concentrationally. Subsequently it can be supplied to user effectively.

**Figure 1: Image Map of Abarkouh mines**

**Reference**

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Determining the potential of the sand Ore with GIS and RS software at Mehriz, Yazd Iran

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Abstract
Sand is a material used in the field of civilization which it is available in the nature directly. Therefore, an exploration is needed to supply human requirement. This study aims that use GIS science and sediment data and laboratory result and integrate them with geology, civilization, hydrology, and geomorphology data and finally provide an applied map from sand Ore to use in building and civilization. Hereby, all activations focused on Mehriz area.

Key words: Ore, GIS, RS, Mehriz

Introduction
This study aims to extend the sand ore and consider its reservoir potential in Mehriz Area. Hereby, sand ore in rivers of Mehriz limited to longitude of 54.13 to 55.29 and latitude of 31.3 to 31.58. Their geology structure related to quaternary period and they consist of the most important part of this study. These sediments limited to conglomerate of Paleocene period from east and cretaceous calcified mountains of Shirkooh from west. Tectonic activations are as rift valleys which it is demonstrated by rift valleys lines near gravel mountain. This study carried out with the aid of natural trenches at the length of river and pitting new trenches. In addition, all geologic hydrology reports and satellites images, and processing aerial pictures were considered. Regarding the above performances, first proper trenches were selected and then desert surveys and sampling based on available standard were monitored. In continue, the samples were analyzed and results considered using GIS software. The different data integrated and the best model obtained by software. The map of extending the sands at the area was provided regarding to proficiency. Finally, the proper area designated to extract sands for various structural industry. Recommendations to continue exploration studied.

The method of prepare extending map

First method
Using satellite images and uphill places, the DEM map and hypsometry were prepared. Figure 1 and waterways map obtained. It is noted that just waterways can be used that located at a specific height. After preparing waterways layers, the area was considered and it was found that almost waterways located at height more than 1700 or 1800 m is not economical to extract. Therefore, waterways with proper height separated. Then the map of proper waterways classified. We could disassociate the fine- and coarse-grain sediment area. (figure 3 the base of waterways classification).
Regarding to first method in map 1, more waterways calcifications resulted to more fine grain. Therefore regarding to produced map, we can prepare the fine grain and coarse-grain based on industrial requirement.

**Second method**
Regarding to samples prepared from studied area, it is decided to prepare the extending map. Finally, 2 extending maps were prepared in 2 different conditions. In the first condition, values were prepared in GIS software of correlated granulation map. Then area of granulation value and extending map was prepared based on granulation. In the second condition, a restery map was provided for any size of granulation. Standard range for the final layer was modified for any materials separately and area located into standard range isolated. For example, areas which are extractable for base industry provided into basic extending map (figure 4). Areas which are proper to extract and use in basic industry changed to green color and area out of standard is red.

**Conclusion**
Because of importance of precise processing information and digital result from natural data integratedly (geology, sedimentology, hydrogeology, and …), quality and quantity of sand were evaluated at Mehriz area. An informational package was provided in form of different extending map using sedimentology data, GIS, and RE. It can be helpful for experts of civil engineering, geology, semidentology, hydrogeology, and environment.

![Figure 1: DEM map and height hypsometric](image-url)
figure 2: waterways map of altitude classification

figure 3: the base of waterways classification

figure 4: basic extend the sand ore map
Reference

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