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Sedimentology and Tectonic Setting of Sachun Formation in Folded Zagros Zone (SW Iran)

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ABSTRACT

The Sachun Formation (Paleocene- Lower Eocene), has been formed in Zagros basin. Sachun Formation sequence at the southern part of Kuh- E- Mianjangal, in Folded Zagros Zone in southwest of Iran, with a thickness of 580 meters was formed of two members. The Lower Member consists of about 280 meters thin to medium bedded of marl, marlstone and argillaceous, silty and sandy limestone with color of light gray to bluish gray, and associated with gypsum inter-layers, which are repeated continuously upward. In each of the cycles, the terrigenous grains size increase upward which is due to the depth decreasing in each cycle. The Upper Member consists of about 300 meters alternation of gypsum and marl, light gray to bluish gray associated with inter- layers of argillaceous and silty limestone. Microscopic studies of argillaceous limestone, in both members, have showed micrite and pelmicrite microfacies. Sachun Formation facies have been deposited in a shallow depositional basin which has been controlled by a permanent sea level changes. Among the marine environments, peritdal environments show the most and the best correlation with the Sachun Formation facies. According to the sedimentary records, Sachun Formation has been deposited in a tectonically instable basin.

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1. INTRODUCTION

The Sachun Formation, have been formed in Zagros basin and its stratigraphy at the type section was first studied by James and Wynd [1]. The age of this formation have been reported Paleocene- Lower Eocene [2]. In its type section, Sachun Formation has 1415 meters thickness and was divided into three members on the basis of its lithological features: Ghorban Calcareous Member, which is dominantly crystalline limestone and compacted calcareous dolomite with alternative layers of yellow to brown marl and chert bearing limestone; Terrigenous Member, which consists of reddish brown clastic sediments such as multi color chert micro- conglomerate, sandstone, siltstone, and marl; and Marl Member, which consists of alternative layers of dark gray marl, marlstone and yellow to greenish gray siltstone [3].

Since there aren't any studies on the lithology and tectonic setting of Sachun Formation at Kuh- E-Mianjangal or the related reports are not available and also studies on other properties are not enough, so the main objectives of this paper are to (1) describe and interpret the lithology of deposits of Sachun Formation

and (2) describe and interpret the depositional environments and tectonic setting represented by the Sachun Formation.

2. STUDY AREA AND METHODOLOGY

The study area is located at the southern part of Kuh- E- Mianjangal, ~90 km southeast of Shiraz in the Folded Zagros Zone (Figure 1).

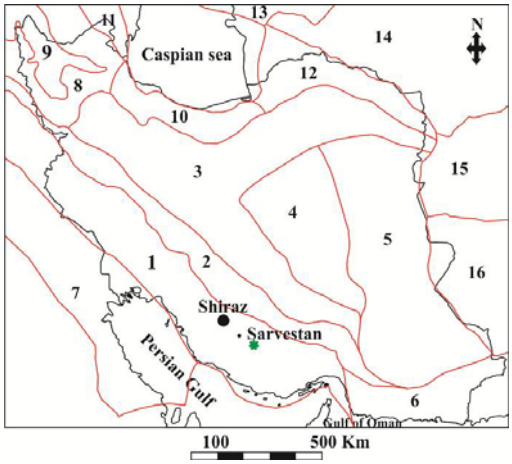

Figure 1. General map of geological states of Iran, the study area is located in Folded Zagros Zone (after [4]). (**1**) Folded Zagros Zone; (**2**) Zagros Trust Zone; (**3**) Central Iranian Basin; (**4**) Central Iranian Micro-continent; (**5**) Lut Block and Depression; (**6**) Makran, (**7**) Mesopotamian Fore-deep Basin; (**8**) Lesser Caucasus; (**9**) Arak; (**10**) Alborz Fold Belt; (**11**) Kura Basin; (**12**) Kopet-Dag Fold Belt; (**13**) Karabugaz-Karakum High; (**14**) Amu-Darya Basin; (**15**) Central Afghanistan; (**16**) Baluchistan; and (*****) study area.

Geographically, the area is part of the Fars Province. Field work was concentrated at the southern flank of Mianjangal anticline in the northwestern vicinity of Nezamabad village, about 13 km southeast of Sarvestan city. A section was measured in detail along the northeastern and southwestern slopes of a mountain crossing the southern flank of an anticline at N 29° 11′ 36"/ E 53° 19′ 28" (Figures 2- 4).

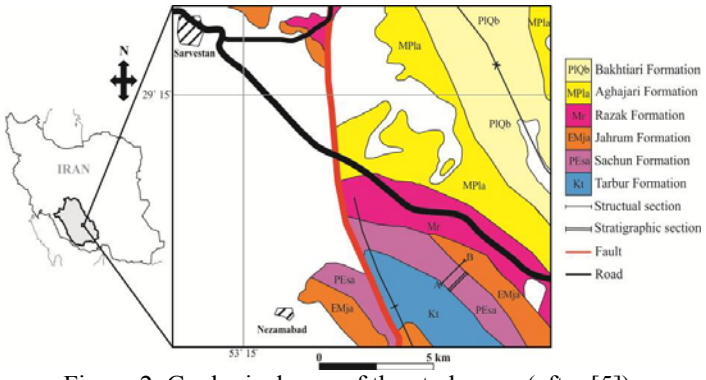

Figure 2. Geological map of the study area (after [5])

The field work is based on the lithology, sedimentary geology and stratigraphy of the area obtained in the field work. In this study, all of the layers were identified accurately and their thicknesses were measured and nominated using Miall [6] methods. Also, all structures in the sedimentary layers have also been carefully considered [7].

According to the measurements carried out in this section, the stratigraphic column was drawn (Figure 4). The thickness of the exposed Sachun Formation is 580 meters. Samples were taken from the limestone facies. More than 10 thin sections were prepared and stained with Alizarin Red S. carbonate rocks were classified following Dunham [8]. Depositional processes were interpreted from the presence of skeletal and non- skeletal components, sedimentary structures, rock textures, and bed continuity [9]-[13]. Sachun

Formation at Kuh- E- Mianjangal, with a thickness of 580 meters, is formed of two lithostratigraphic units (Figures 3, 4).

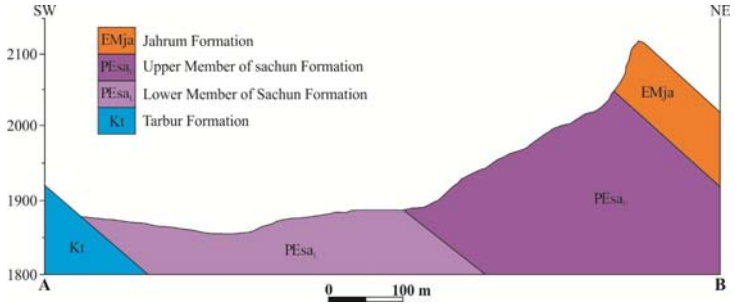

Figure 3. Structural section of the study area (see Figure 2 for the place of this section)

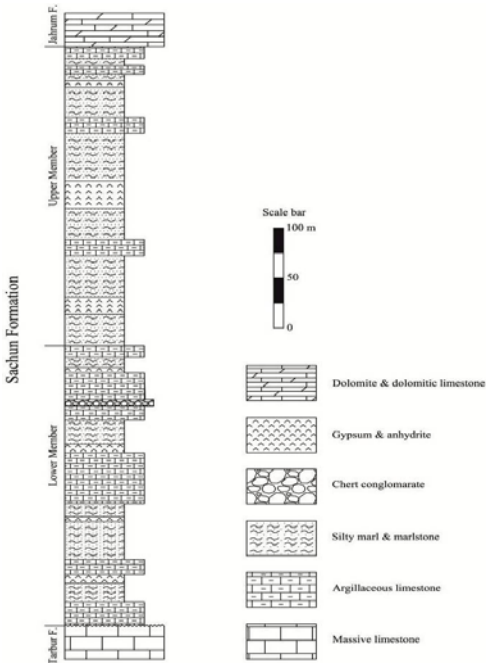

Figure 4. lithologic log of Sachun Formation in the study area

In the studied area, the lower contact of Sachun Formation with Upper Cretaceous Tarbur Formation (limestone) and the upper contact with Paleocene- Eocene Jahrum Formation (dolomite and dolomitic limestone) [3], both are sharp and conform. Due to the instability of Sachun Formation against erosional processes, the so- called members have formed a v- shaped morphology between the two stable and resistant underlying Tarbor Formation and overlying Jahrum Formation (Figure 5).

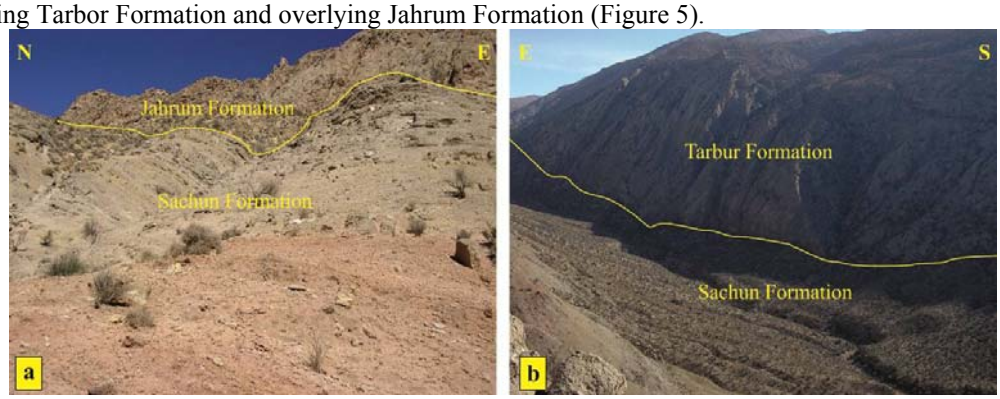

Figure 5. Field photographs showing: (a) upper bounadry of Sachun Formation with Jahrum Formation and (b) lower boundary of Sachun Formation with Tarbur Formation

3. RESULTS AND ANALYSIS

3.1. Lithofacies

Sachun Formation sequence at the southern part of Kuh- E- Mianjangal, 10 km southeast of Sarvestan, has 580 meters thickness and formed of two members (Figures 3, 4). The Lower Member consists of about 280 meters thin to medium bedded alternation of marl, marlstone, and argillaceous, silty and sandy limestone with light gray to bluish gray color, and associated with gypsum inter- layers, which are repeated upward continuously. In parts granule and fine pebble- sized chert grains with different colors are scattered in marl and limestone and occasionally form conglomeratic lenses (Figure 6). In each of the alternations or cycles, the terrigenous grains sizes increase upward which is due to the depth decreasing in each cycle.

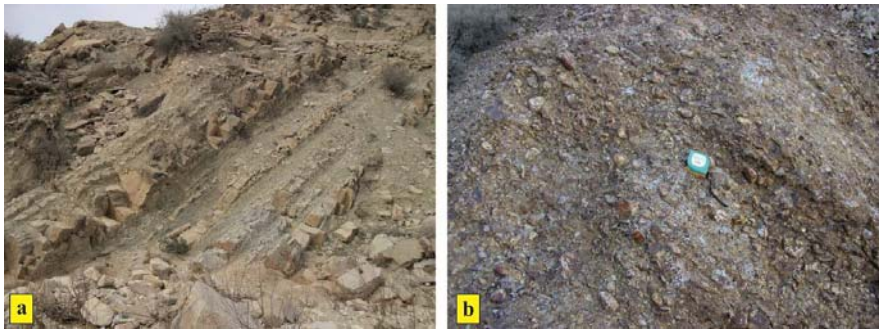

Figure 6. Field photographs showing: (a) alternation of marl, marlstone, and argillaceous, silty and sandy limestone and (b) chert micro- conglomerate lens in the Lower Member of Sachun Formation

The Upper Member consists of about 300 meters alternation of light gray to bluish gray gypsum, anhydrite and marl which are associated with inter- layers of argillaceous and silty limestone (Figure 7). Microscopic studies of argillaceous limestone, in both members, have showed micrite and pelmicrite microfacies (Figure 8). No distinct fossils, either microscopic or macroscopic, were found in these members in the studied section.

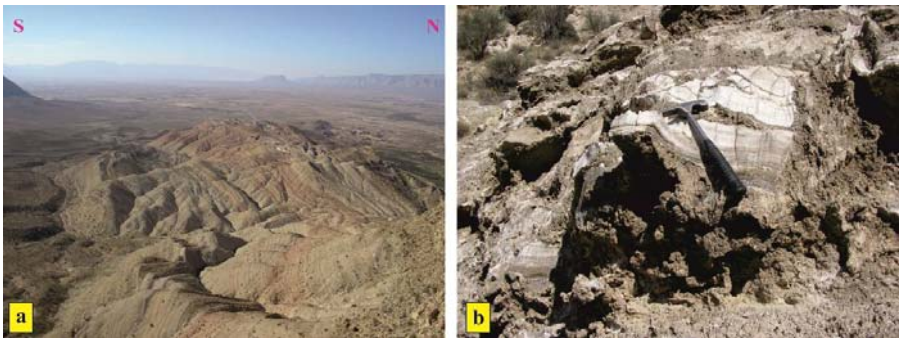

Figure 7. Field photographs showing: (a) Upper Member of Sachun Formation that consisting of alternation layers of gypsum, anhydrite and marl and (b) mixed layers of gypsum and marl in the Upper Member of Sachun Formation

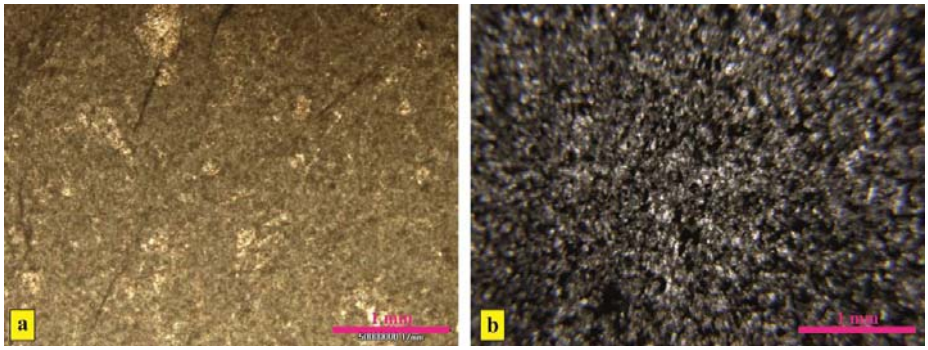

Figure 8. Photomicrographs showing micrite and pelmicrite in the argillaceous limestone facies of Sachun Formation

3.2. Sedimentary environment

Sachun Formation has been deposited in a shallow depositional basin which has been controlled by a permanent sea level changes. Among the marine environments, peritdal environments show the most and the best correlation with the Sachun Formation facies (Figure 9). Lime mud, with abundant pellets belongs to subtidal lagoon [14],[15]. Occasional drying, that occurs in the intertidal zone, means that the most organisms cannot survive there. The imported terrigenous particles (i.e. clay, silt and sand), salinity and water temperature also undergo extreme fluctuations, which further limits the types of organisms that can live there.

These limitations show inadequacy or lack of fossils in Sachun Formation. Repetitive shallowing upward sequences, at the Lower Member of Sachun Formation in the studied region, occur where there are repetitive changes in the relative sea level. In ancient times most parts of the continents were covered by epicontinental carbonate seas which had hundreds km^2 peritidal areas [16]. Thick sequences and upward shallowing carbonate tidal flats in the geologic records are very usual [17].Violent storm flooding has a severe effect on tidal environments and cause considerable local erosion [18]. This storm covers tidal flat with water which transport a lot of sediments and deposit a lag of debris and mud (the existence of clay, silt, sand, and chert granules within the limestone of Sachun Formation). In arid climates, such as tidal salt flats or sabkhas, the intertidal zones are areas where evaporates were deposited often forming lamina of gypsum, anhydrite and halite (the existence of gypsum and anhydrite in Sachun Formation).

3.3. Tectonic setting

A shallow sea, which merged the region in the Paleogene, and occasionally underwent fluctuations due to epirogenic movements, retrograded toward the south and southwest in Bourdigalian [19], and was replaced by a set of continental environments such as lacustrine, fluvial and alluvial fans. These environments received sediments originating from erosion of previously uplifted regions. There is significant evidence for the gradual continuation and intensity of tectonic forces. These include a gradual increase of chemical deposits in shallow depressions and their mixing with detrital clays (formation of marl). The creation of conditions that led to the formation of evaporates, such as gypsum and anhydrite (Sachun Formation).

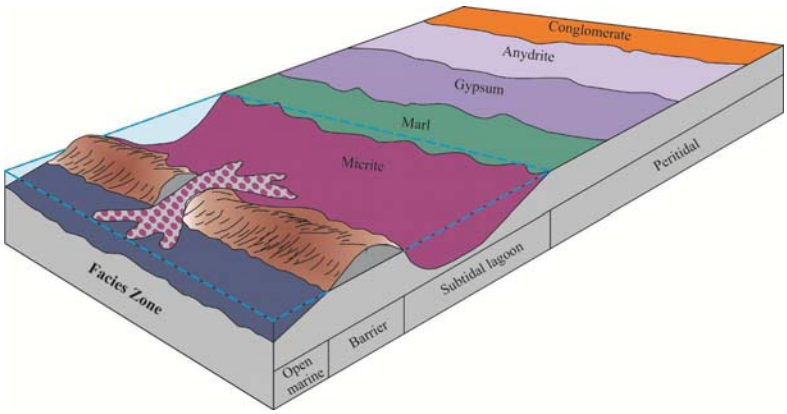

Figure 9. Depositional model of Sachun Formation at Kuh- E- Mianjangal

Sachun Formation facies are indicative of sedimentation in a restless basin and for this reason using the term multi- facies sedimentary basin for the Paleocene Series in the region is not so deviate from the reality [20]. With marine regression at the end of Campanian, which was due to the Laramide Orogeny [19],[21], and in passing of Maastrichtian Stage, this region changed to a carbonate reef (Tarbur Formation), which is an indication of basin depth decreasing due to taking impression of so- called tectonic phase (Laramide Orogeny). In this connection, the boundary of Cretaceous System and Paleogene Sub- system corresponds sufficiently with the upper contact of Tarbur Formation and Sachun Formation.

4. CONCLUSION

The Paleocene- Lower Eocene Sachun Formation, in Zagros Mountain Ranges, is commonly divided into three members on the basis of its lithological characteristics: Ghorban Calcareous Member, Terrigenous Member, and Marl Member. In this study area, however, Sachun Formation sequence, with a thickness of 580 meters, is formed of two members. The Lower Member consists of alternation of marl,

marlstone, argillaceous, silty and sandy limestone and associated with gypsum inter- layers, which are repeated upward continuously. The Upper Member consists of alternation of marl, gypsum, and anhydrite and associated with inter- layers of argillaceous and silty limestone. Microscopic studies of argillaceous limestone, in both members, have showed micrite and pelmicrite microfacies. The lower contact of Sachun Formation with Upper Cretaceous Tarbur Formation (limestone) and the upper contact with Eocene Jahrum Formation (dolomite and dolomitic limestone), both are sharp and conform. Sachun Formation has been deposited in a shallow depositional basin which has been controlled by a permanent sea level changes. According to micro- and macrofacies, a peritdal environment is proposed for Sachun Formation in the studied area. The Sachun Formation facies are indicative of sedimentation in a restless basin and for this reason the term multi- facies sedimentary basin is used for it.

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