

Non-Diapiric Salt Domes in the West Zanjan, Central Iran

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Abstract

The salt domes of the west Zanjan (Central Iran) are the most important structures in the study area. They have been formed by the uplifting and erosion together under low humidity and dry and warm climate condition. The salt rocks with near to 200 meters thickness are related to lower member of the Upper Red Formation (Early Miocene) that deposited in the inverted back arc basin. They have been formed in the Central Iran basin after the Arabian-Eurasian convergence. Based on field works and preparation of geologic map, salt domes have been cropped out during regional uplifting and erosion along hinge zone of a longitudinal anticline. Also, there is no evidence for salt diapirism and so, they are different from some salt diapirs in the southwestern margin of Zanjan that is investigated by other researchers.

Keywords

Non-Diapiric, Salt Dome, Zanjan, Central Iran

1. Introduction

The Miocene gypsiferous rocks are named Upper Red Formation by the National Iranian Oil Company geologists [1]. Its thickness in the type section, near Qom city, is about 3000 m and comprises alternations of red fine-grained sandstones, compact gypsum, conglomerate and marly sandstones. The Upper Red Formation overlies the Qom Formation but, in some parts of NW and Central Iran, the contact comprises thick salt and gypsum [1]. The Miocene Upper Red Formation in the study area was deposited in a Marine regression condition (firstly) and fluvial system under dry and warm climatic condition (later) [1]. Salt domes or positive topographical features which have been formed by evaporate minerals (mainly halite) are the index structures in Upper Red Formation [2].

There are many salt domes most of which have been cropped out and the aim

of this study is to determine diapiric or non-diapiric condition of salt domes in the Zanjan area, Iran.

2. Geologic Setting

Iran country has composed from different plates: Arabian plate in south and west (Zagros and Persian Gulf), Cimmerian miniplate in north and east, Eurasian plate in northeast margin [3] [4]. There are three physiographic-tectonic zones that have salt rocks: 1) Zagros Mountain, 2) Persian Gulf basin and 3) Central Iran basin on which the study area is situated. Dominant structural trends in Central Iran are NW-SE in northwestern part and N-S in eastern part. The basement of the plateau consists of Cimmerian miniplate. Volcanics of late Cretaceous—early Miocene age in Central Iran represent Urmieh-Dokhtar magmatic arc. Volcanic rocks, evaporates and Turbidites successions up to 3 km thick represent Eocene back-arc extension across Central Iran [5].

This succession is commonly overlain in Central Iran by terrestrial clastics, evaporates and volcanics of the Lower Red Formation of Oligocene age. Marine deposition resumed across much of Central Iran with the carbonates of the largely lower Miocene Qom Formation. The Qom Formation is overlain by middle Miocene terrestrial clastics and evaporates of the Upper Red Formation. The salt deposits belonging to Cenozoic of Central Iran basin have two separate origins: The old type related to Upper Eocene deposits and Lower Red formation; and younger type related to Upper Red formation [5].

Based on previous research [2], the study area is situated in Urmieh-Dokhtar physiographic province (Figure 1). Dominant structural trend in Urmieh-Dokhtar province is NW-SE. From tectonics view, it contains a magmatic arc that is result of subduction to beneath of southern active continental margin of Cimmerian plate. Also, Sahand and other cones (about 9) in lesser Caucasus hinterland are result of quaternary magmatism in this zone that it has marked by widespread Eocene volcanism. Urmieh-Dokhtar Province has continued to south of Black Sea and its width has increased from Naien city that many parts have covered by quaternary deposits of Dagh Sorkh Kavir, Southern Urmieh Lake, Namak and Hoz-e Soltan Lakes have formed on it. So, there are a few backland basins with Playa type sedimentation because of dip decreasing in Ben off zone (in NW part of magmatic arc). SE part of magmatic arc has formed on southwest margin of East-Central Iran microcontinent [3].

3. Material and Methods

Salt domes of Iran have been presented by the large variety of shapes and elevation from high relief to entirely eroded structures. These different morphologies are controlled by various factors, for example, position related to other structures, the time of emergence, the rate of salt dissolution, which is controlled by the rate of erosion, the bulk rate of salt emission from the source layer, and provinces have distinguished in Iran and the study area has situated on Tasoje-Zanjan eventually by the tectonic activity [6]. Based on recent research [7], nine diapiric

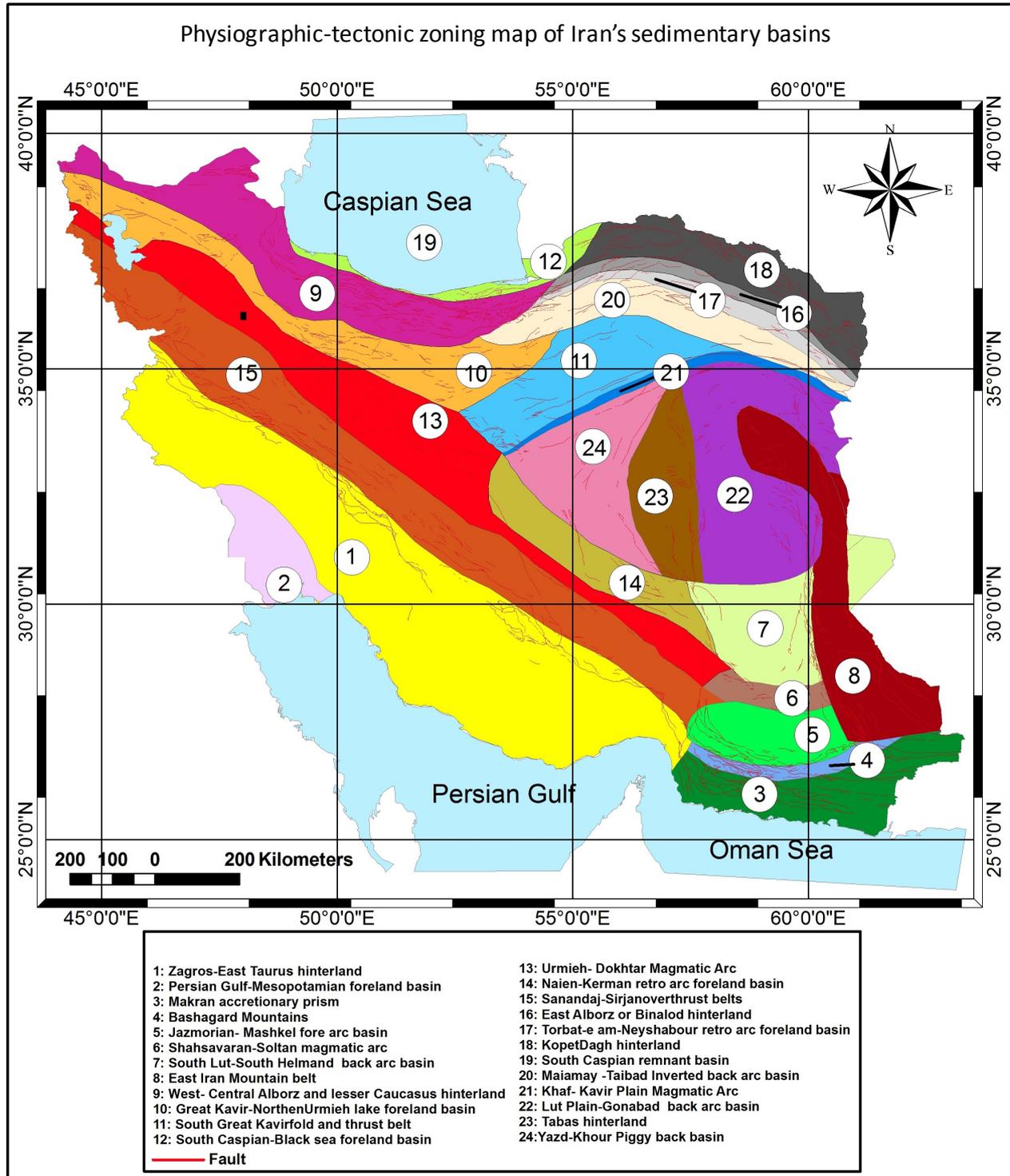


Figure 1. Physiographic-tectonic zoning map of Iran's sedimentary basins, modified from [2]. The study area is shown in the black rectangle.

Province.

The implemented studies indicate that the salts of this province are new type that cropped out along hinge zone of a burial longitudinal anticline on footwall of the Halab fault [8]. The salt domes of this province have occurred in an area

covering about 10 km². They have been covered by thin marl and separated from others by Quaternary deposits. The salt structures have not got diapiric cores, thus, they are not salt diapirs (**Figure 2** and **Figure 3**).

Also, there is a saline brine (**Figure 4**) that flows to the plain (**Figure 5**) for traditional mineral processing by evaporation.

4. Results and Discussion

Salt domes in the study area have been caused by evaporation (**Figure 6**) and weathering of salt rocks under low humidity (about 15%) and dry climate condition. The salt rocks of study area are related to the marine regression and evaporate conditions in inverted back arc basin (Central Iran). They are related to lower member (M₁) of Upper Red formation that has been under weathering now. Thus, they are different from other salt domes and diapirism in Iran that investigated by many researchers [9]-[20].



Figure 2. A far view (to NE) from some salt domes of the study area.



Figure 3. A near view from the horizontal salt rock of the study area.



Figure 4. A saline brine in the southern part of study area.



Figure 5. A view from evaporative pools in the study area.



Figure 6. Salt deposition by evaporation of brine.

Based on previous work on the mud diapirism [21] [22] and neotectonic regime in Iran [23]-[28], Zagros in south Iran is the most active zone [29]-[69]. Then, Alborz [70]-[116] and Central Iran [117]-[145] have been situated in the next orders. Thus, salt domes in the study area have not been affected by regional shortening. The main characteristics of salt domes in the study area have summarized in **Table 1**.

5. Conclusion

The geologic map has prepared and based on field works on the salt domes of the west Zanzan (north Iran), salt rocks in the study area are caused by evaporation in the last marine regression condition. Then, their weathering under low

Table 1. Main characteristics of salt domes in the study area.

Age of salt	Early Miocene
Name of Formation	Upper Red
Thickness of salt rocks	Near to 200 m
Salt deposition Setting	Inverted back arc basin
Setting of Salt structures Evolution	Retro arc Basin
Folding Type	Open to Gentle
Humidity of the weather	Low
Salt dome Position	Hinge zone of anticline

humidity and dry climate condition has been formed individual salt domes. In the other words, the salt domes of study area are related to Miocene lower member of the Upper Red Formation that deposited in the inverted back arc basin. But they have been formed in the Central Iran retro arc basin. Therefore, they have been formed by the uplifting and regional shortening under dry and warm climate. There are some structures such as Halab fault and folds that cause the uplifting and cropping out of salt rocks. Thus, there is no evidence for salt diapirism and they are results of the uplifting and erosion together.

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