Origin of Some Limestone and Gypsum Natural Bridges at Northern Iraq

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ABSTRACT

The present study investigates the location and origin of some natural bridges in northern Iraq. They have been founded in two geological formations, the Sinjar and Al-Fai'ba formations. The rocks are consisting the bridges are in limestone and gypsum respectively.

The natural bridges have usually been considered as temporary phenomena with a short life span and, in general, have either major or minor sizes as in the case of the present study.

The rainfall and the underground water dissolved both the limestone and the gypsum rocks, which are considered classically as highly soluble rocks. The dissolution of rocks, especially their sub-surfaces, caused an underground tunnels and channels and parts of their roofs would collapsed, while the uncollapsed roofs, subsequently constitute natural bridges. The present study concluded that the origin of natural bridges is karstic, but other origins could be invoked. Usually the natural bridges at the present time considered as natural monument, which must be preserved and located on maps so that they could be used as tourists’ attraction sites.

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عملية هجرة الرواسب الطبيعية في الصخور الكاسمية والجبسية في شمال العراق

الملخص

الدراسة الحالية بحثت في مواقع وأصل بعض الجسور الطبيعية في شمال العراق، هذه الجسور الطبيعية تم الانتقال عليها وكذلك دراستها والوجود في تكوينات جيولوجية وهم تكوين سينجر، القحة. تم تحديد جسر طبيعي واحد في تكوين سينجر وذلك في الصخور الكلسية لهذا التكوين بينما تم تحديد عدة جسور في الصخور الجيبسية في مناطق مختلفة ضمن تكوين القحة. تعتبر الجسور الطبيعية نافذة أو أشكال قصديرية مؤقتة ذات عمر محتمل في غاية موجودة أما بعدة هي في الحال في شمال العراق.
INTRODUCTION

Natural bridge which is usually considered as temporary phenomena defined by Monroe and (Wicander, 1992) as "a variety of rock resulting from wave erosion, the partial collapse of cavern roof, parallel joint as in Archean national park in Utah (USA) and natural bridges that span a valley eroded by running water". (Moore, 1973) also defined the term as "A bridge or arch of natural rocks, sometime such a bridge is formed of valley spur cut through by stream. It is more common, however in limestone country where it is properly remnant of cave tunnel".

Both of the above definitions put emphasis on different origins of the natural bridges and one of them is the karstification as this is case of present study in northern Iraq. The natural bridges are identified within the Sinjar limestone rocks and in Al-Falha gypsum rocks where in the later formation both major and the minor types are found. Also, Al-Falha Formation contains numerous bridges of gypsum rocks which are studied by many authors such as: (Al-Sabti et al., 1989), (George, 1994), (Jibril, 1995), (Ussami et al., 1997), (Al-Dewachi, 2001) and (Al-Sellim and Thabit, 2001).

The purpose of this study is to investigate the origin of these natural bridges in Northern Iraq.

INITIATION, DEVELOPMENT AND GEOGRAPHICAL-GEOLICAL SETTING OF THE NATURAL BRIDGES

Lithology is the main factor behind the initiation of karstic processes leading to natural bridges. The highly soluble rocks such as limestone, marly limestone and gypsum or non classic one such as conglomerate of calcareous-matrix (calcareous conglomerate), (Belloni, et al., 1972) must be available to initiate or start the processes of karstification and subsequent the karstic phenomena.

The first group of natural bridges were observed in Sinjar Limestone Formation that exposed at southern limb of Jabal Sinjar which is located about (100) km west of Mosul city (Fig.1). The Sinjar Limestone Formation assigned by (Al-Hashimi and Amer, 1985) to Paleocene-Lower Eocene is described as carbonates and representing platform (neritic facies). (Bellen et al., 1959) recognized three facies in ascending order, these are: Algal reef
Fig. 1: Location of natural bridges.
facies, in which the natural bridge is recognized (Plate 1) associated with numerous caves and caverns; lagoonal millilid facies and shool nummulitic facies. The last two facies are devoid of any kind of karstic forms and/or any natural bridges, possibly the rocks of these facies are less vulnerable to dissolution by groundwater.

The second occurrence of natural bridges are located at three different areas as shown in (Fig. 1) within gypsum of Al-Fa’tha formation.

These localities appear at the southwestern limb of Jabal Kand, which is about (40) km. north east of Mosul City (Plate 2). An auxiliary analog occurs at Jabal Buttu (Plate 3), which located about (60) km. north west of Mosul City (3 at Fig.1).

At Abu-Fitika village which is located to the south of Mosul city a distance about (40) km. along highway between Mosul and Baghdad (4 at Fig.1). These major natural bridges are the largest in size and number (Plates 4, 5 and 6). As well as, many other major karstic forms are founded also in gypsum rocks such as caves and sinkholes, in the area of study.

Al-Fa’tha formation assigned by (Al-Hashini and Anser, 1985) as middle Mioceene and described lithologically as alteration of gypsum and limestone in its lower part, where the most of karstic forms, including natural bridge founded in these gypsum rock. The upper part is composed of gypsum, limestone and chert. The karstic forms are very rare in the gypsum rocks in this part of the formation. This probably due to variable texture of gypsum rock of these two parts, also the thickness of the beds which is described as very thick in the lower part, thin to very thin in the upper part could be the reason, (Selby, 1985).

The above discussion indicates highly soluble rocks in the two formation are available, and this condition necessary prior to any karstic process initiation. The other factors or conditions for karstification process to be initiated and developed is the validity of high rainfall and then high quantity of ground water flows. The natural bridges in northern Iraq found in semi-arid climate in which the annual rain fall is between (400-600) mm (Tamar-Agha, 1985). (Selby, 1985) concluded that in semi-arid and arid climate there is too little water for much solution to form karstic landforms.

(Chapman, 1976), (Al-Sabti et al., 1989) and (Al-Dewachi, 2001) assigned the Pliocene-Holocene time as been a wet climate promoting the initiation and development of high rate of rain water and then high underground water flow. The underground or running water naturally somewhat acidic, because of carbon dioxide in the air react with water to form carbonic acid, so both limestone and gypsum, are readily dissolved by infiltrating rain water.

Tectonically, all the natural bridges identified in the present study are located within the simple folded zone (Dunnington, 1958) or the unstable shelf zone of (Biday and Jassim, 1987) and were most of the rocks their are highly jointed and fractures. Joints as a zone of weakness can accelerate the infiltration as well as the surface water (Selby, 1985). Over long periods of time, underground water may dissolve large volume, of limestone or gypsum and slowly enlarge underground tunnels and, channels and eroding the support rocks from the land above. Continuation, parts of the roof of these tunnels and channels may collapse completely.
Plate 3: Natural bridge of Gypsum at the southern limb of Butmah anticline

Plate 4: Natural bridge of Gypsum at Abu-Fshika village anticline.
Plate 5: Second Natural bridge of Gypsum at Abu-Fahika village.

Plate 6: Third Natural bridge of Gypsum at Abu-Fahika village.
The gravity could help in where some parts of the roof sustain cohesion and remain not collapsed. These parts of the roof form the phenomena of natural bridges of karstic origin (Montgomery, 1997).

CONCLUSIONS

1- Natural bridges in, limestone and gypsum were identified in the Sinjar and Al-Fat’ha formation at northern Iraq.
2- The natural bridges in northern Iraq are of karstic origin and usually found accompanied by other karstic forms such as caves and sinkholes.
3- The present climatic condition of northern Iraq (semi-arid) is not held responsible for the initiation of the natural bridges associated with the other phenomena of karstic origin because of low average of annual rain fall which ranges between (400-600) mm. The wet climate of interpluvial Pleistocene-Holocene time is probably responsible for the initiation and development of natural bridges and other karstic forms.
4- The high quantity of rain during fall Pleistocene-Holocene time becoming acidic, and induced the dissolution of limestone and gypsum channels and tunnels which continue to be enlarged with time. Parts of roof of these underground tunnels and channels are collapsed by dissolution - gravity or both while other parts did not collapse and sustained their coherions. These parts of the roof formed the natural bridges of karstic origin.

REFERENCES


