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Landslides Along Makhul Range (Msa`hak Dome) Central Part of Iraq

Varoujian K. Sissakian **Safa Al-Deen Fouad** **Hala A. Salih**
State Company of Geological Survey and Mining
Baghdad, Iraq

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ABSTRACT

Three large landslides have developed along the northern limb of Sa`hak dome, within Mkhool Range, which extends parallel to the Tigris River. The slided masses belong to the uppermost part of the Ft`ha Formation, which consists of cyclic deposits of marl, limestone and gypsum. Three stages of sliding occurred, they are few hudred years old, associated with few recent movements. Large block movements could be expected within the main moved masses and/or in the adjacent areas.

الزحف الصخري في سلسلة جبال حمرين (قبة مساحق) وسط العراق

الملخص

ثلاثة حالات من ظاهرة الزحف الصخري تم تحديدها ودراسة تطورها في الطرف الشمالي الشرقي من قبة مساحق في سلسلة جبال حمرين والتي تمتد موازية لنهر دجلة. الكتل الزاحفة تعود الى الجزء العلوي من تكوين الفتحة، هذا الجزء يتألف من دورات الصخور المارلية، الجيرية والجبسية، تم تحديد ثلاثة مراحل من الزحف الصخري، كما يقدر عمر هذه الزحف بعدة مئات ومن السنين والى الوقت الحاضر مع احتمالات كبيرة لحدوث الزحف حاليا. الزحف الرئيسي اتسم بحركة كتل كبيرة جدا من صخور تكوين الفتحة في منطقة البحث وفي اجزاء مجاورة لها.

INTRODUCTION

The northeastern limb of the Makhul anticline (range), Msa`hak dome suffers from landslides of multi stages. The studied area (Fig.1) is located 30 km northwest of Baiji town, which is in turn located 200 km northwest of Baghdad. It is along the Tigris River, starting from elevation 230 m down to 130 m (a.s.l.).

Beside field investigation, topographic maps of scale 1:25 000 (Hunting Aero Survey, 1958 and 1860), aerial photographs of scale 1: 40 000 and available geological maps were analysed and studied.

GEOLOGICAL SETTING

The studied area lies within the Foot Hill Zone of the Unstable Shelf (Buday, 1980, and Al-Kadhimi et al., 1997).

The exposed formation within the studied area is Fat`ha (Middle Miocene) (Al-Mubarak and Youkhana, 1976) which consists of cyclic deposits of marl, claystone,

Fig.1: Location map of the studied area.

limestone and gypsum. The marl is green, the claystone is red, both of them are conchoidally fractured and jointed, which are filled by secondary gypsum, the thickness ranges from 0.5-3 m, of individual bed. The limestone is whitish grey, hard, highly jointed and fractured, thickness of individual bed ranges from 0.2-0.4 m. The gypsum is white, massive, hard, thickness of individual bed ranges from 4-8 m.

The trend of the axis is NW-SE, with local swings, average dip amount of 40˚, in the studied area. The last two cycles of the Fat`ha Formation are involved by landsliding.

LANDSLIDES

The main areas involved by land sliding, in the studied area are shown in (Photo 1). Except small mass movements, no other large mass movement phenomena are recognized within the Makhul Range. The three involved areas are numbered from 1-3 from northwest to southeast direction. The middle one (No.2, Photo 2) is being the largest one.

The studied parameters within the three involved areas are tabulated in Table (1) and presented in figures (2,3 and 4) (Photos 1,2 and 3).

Table 1: Studied parameters of the three slided areas.

STAGES OF SLIDING

Three stages of sliding had occurred. The oldest one (No.1) is almost vanished, it could be observed only from aerial photographs and topographic map, comparatively it is very older than the other two stages.

The second stage (No.2) is observed only in the toe area. The blocks of this stage are smaller in size, as compared to the stage (No.3), with clear change in weathering degree. The average size of these blocks is 1x1.52x2 m, the surfaces of the blocks are almost smooth with curved edges and partly covered by recent flood plain deposits.

The third stage (No.3), which is the youngest, covers almost the whole three involved areas. The blocks are still with sharp edges, which indicates that they are less affected by weathering and erosion, as compared with the other two stages (1 and 2).

TYPE AND CAUSES OF SLIDING

According to the mass movement`s classification of Nemcock et al. (1972) and Varnes et al. (1978), the studied movements are normal type of land sliding, where coherent masses move along a well defined shear surface (plane). No rotational or block sliding was observed.

The main cause of the landslide is the Tigris River, although the river is now about 300 m far from the involved area. The under-cut erosion of the Tigris River to the scarpment of the northeastern limb of the Msa`hak anticline has decreased the stability of the steep slope, due to removing of the lower supporter rocks, increasing the water pore pressure, consequently decreasing the internal friction angle (Zaruba and Menel, 1969). Moreover, the presence of marl and claystone beds, between the massive gypsum beds act as lubricant media for accelerating the sliding of the steeply dipping (40˚) massive gypsum beds.

The abnormal have been right angle meander of the Tgris River near the studied area (involved by sliding) might caused by very old landslide, which caused the re-treatment of the Tigris River (off the scarpment) for about 300-400 m (forming flood plain) along a distance of 4 km parallel to the scarpment, then the river flows again adjacent to the scarpment of the anticline, without flood plain.

DATING OF THE SLIDES

According to the local people the slide occurred before not less than 100 years, since nobody of them can remember the event. The authors believe that the last stage (No. 3) is some 150-200 years old, this assumption is based on the shape of the slided blocks, their adges and the degree of weathering. The second stage (No. 2) is slightly older than the last (third) stage. Whereas the oldest stage (No.1) is much older, few hundred years , because it is almost vanished. Moreover ,the second stage is partly covered by recent flood plain deposits. It is worth mentioning that the crown and side cliffs suffer from recent and active toppling phenomenon . moreover, within the slided

blocks of the last stage, in area No. 2 some recent overriding movement between the blocks, occurred too.

CONCLUSIONS

1. Along the Makhul range only at the studied area such mass movements are recorded.
2. Three main landslides are developed.
3. Three stage of movement occurred.
4. The movement are few hundred years old, but they are still active, as indicated from the shear crarks.
5. The main reason of sliding is the under-cut erosion and increase in pore water pressure.
6. The last two cycles of the Fatha formation are involved in sliding.

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Photo 1

Photo 2

Photo 3