SCIENTIFIC NOTE

THE ORIGIN OF AMADIYA PLATEAU, DOHUK GOVERNORATE, NORTH IRAQ

INTRODUCTION

Amadiya is one of the largest and oldest towns in north Iraq, it is about 550 Km north of Baghdad, within Dohuk Governorate. It covers about one square kilometer, with almost circular shape, the southern edge being oval and slightly elevated from the northern side. It is located on a top of a plateau, with height of 1100 m (a.s.l.). The height of the plateau ranges from (85 – 100) m, with almost vertical cliffs, except the northern one, which is less steep than the others are. This special shape has given the town a natural defensive position through its history (Fig.1).

Fig.1: General view of the Amadiya Plateau and town
(a NE looking scene, in the background is Matina Mountain)

GEOLOGICAL SETTING

Amadiya town is located within the High Folded Zone of Iraq (Al-Kadhimi *et al*., 1996) of the Outer Platform (Unstable Shelf) of the Arabian Plate (Fouad, 2010). The exposed rocks below the plateau belong to the Mukdadiya Formation (Sissakian, 2000), which consists of alternation of sandstone, siltstone and claystone, some of the sandstone beds are pebbly, whereas the plateau is covered gypcrete. The plateau is developed on the top of folded beds, which form an asymmetrical syncline, the axis runs just below the central part of the plateau. The trend of the syncline is almost E – W. The dip of the northern limb ranges from

(55 – 75)° N (Fig.2), whereas the dip of the southern limb ranges from (5 – 23)° S. Locally, overturned beds could be observed in the northern limb. Towards the north of the plateau, the southern limb of Matina anticline forms continuous cliffs, starting from the clastics of Injana and Fatha formations (Late and Middle Miocene, respectively). Followed by limestones of Pila Spi Formation (Eocene), which forms the first cliff, and then soft clastics of Gercus Formation (Eocene). Followed by marls and limestones of Shiranish and Bekhme formations, respectively (both are Late Cretaceous) and limestones of Qamchuqa Formations (Early Cretaceous) (Fig.1).

Fig.2: Northerly steep dipping beds of the E – W trending syncline

Geomorphologically, the beds of the Mukdadiya Formation form hogbags and cuestas, due to the alternation of hard and soft rocks. These phenomena could not be observed below the plateau, because the hard nature of the plateau sediments has kept the underlying rocks from erosion; however, they form continuous synclinal ridges. The available geological map; at scale of 1: 20 000 shows that the plateau was formed due to an old and large landslide, from the adjacent Matina Mountain (Hagopian *et al*., 1982). Moreover, Hamza (1998) also considered Amadiya Plateau as a large landslide, as presented in the geomorphological map of Sarsang Quadrangle, at scale of 1: 100 000. However, Sissakian *et al*. (2008); though considered the plateau and the near surroundings as a zone of mass movements, within the other existing types of geological hazards, but they did not consider the plateau as a single landslide phenomenon.

DISCUSSION AND CONCLUSIONS

During the year 2010, the author and a group of GEOSURV's geologists had the opportunity to pay a visit to Amadiya town and near surroundings to check some geological ambiguities; among them is the origin of the plateau. Nevertheless, the authors have checked the plateau few years ago and convinced that it is not formed due to a landslide, as mentioned previously (Hagopian *et al*., 1982 and Hamza, 1998), but consists of thick calcrete.

Filed observation showed that the Amadiya Plateau consists of Quaternary sediments, mainly of calcrete, with angular fragments, the size of the fragments ranges from (1 – 50) cm, but the dominant size is about (10 – 20) cm. However, exceptionally the fragments may reach 1 m. The angular fragments consist mainly of limestones, though not paleontologically checked, but most probably belong to Pila Spi, Bekhme, and Qamchuqa formations, which are the only limestone-bearing formations; exposed in nearby areas to the Amadiya Plateau. The fragments are cemented by calcareous material, forming very hard groundmass (Fig.3), which forms the plateau. The thickness of the calcrete ranges from (8 – 15) m, increasing southwards (Fig.4). Many such plateaus are developed in the near surroundings, though are not in such uniform form, indicating the presence of an old peni-plain, which is dissected to small pieces due to active erosion, forming the nowadays plateaus.

The calcrete is developed, most probably during the ?Late Pleistocene, this is evidenced by founding conglomerates of Bai Hassan Formation (Pliocene – Pleistocene) below the calcrete, and not only rocks of Mukdadiya Formation, as was mapped by Hagopian *et al*. (1982). However, ?Early Pleistocene age also could be claimed, when considering the age of the Bai Hassan Formation is older than its known age, due its diachronous nature. The calcrete was developed during the prevailing of worm and wet climate phases during the Pleistocene. It is very similar to the Pleistocene terraces, which are well developed in the near surroundings, but with main differences in the shape and type of the constituents. Few kilometers eastwards from Amadiya Plateau, another plateau exists, on the top of which Der Al'lok town is located. However, there the river terraces form the plateau, not the calcrete.

The calcrete was formed as delluvial – fluvial sediments during Late Pleistocene, covering the main depression between Matina Mountain, in the north and Gara Mountain, in the south, along this wide depression the Amadiya Plateau is developed. The calcrete was developed as a continuous plain, due to flowing water, from both mentioned mountains towards the depression, carrying disintegrated rock fragments and cementing them by calcareous materials, giving them the hard nature of the calcrete (Fig.3). After the end of the fluvial wet phases, during Holocene, the erosion started to dissect the whole calcrete plain to blocks of different sizes, among them is the Amadiya Plateau. Many other plateaus and/ or isolated hills exist within the wide depression between Matina and Gara Mountains; others are covering the slopes of the mountains, confirming the coverage of the calcrete the whole depression during Late Pleistocene and early Holocene.

Fig.3: The details of the calcrete, which forms the bulk of the Amadiya Plateau

Fig.4: A westerly looking scene of the Amadiya Plateau,
note the difference in the thickness of the calcrete and
how it overlies the hard sandstone beds of Mukdadiya and Bai Hassan formations
(Late Miocene – Pliocene and Pliocene – Pleistocene, respectively)

The Amadiya Plateau was not formed by a landslide, this is confirmed by the following evidences:

- The plateau consists of calcrete and not a rock mass.
- No calcrete was found in higher elevation than the plateau, north of the Amadiya Plateau, along the slopes of Matina Mountain, from where it was slid; as was supposed previously by many workers (Hagopian *et al*., 1982 and Hamza, 1998).
- No trace of the crown area was found north of the Amadiya Plateau, along the slopes of Matina Mountain (the southern limb of Matina anticline, Fig.2) to indicate sliding of a mass, southwards to form the plateau.
- The horizontal and the continuous nature of the top of the plateau confirms that the plateau is not a slid mass, although horizontally lying slid masses occur, but very rarely, because the hummocky and uneven surfaces are characteristics of slid masses (Zaruba and Mencl, 1969; Rabruch-Hall and Varnes, 1976; Pulinowa *et al*., 1977 and Spiker and Gori, 2000).
- The contact between the calcrete and the underlying rocks (Fig.4) does not show any disturbance and/ or crushed rocks, as it is usually observed below such large slid masses, due to their weight and friction caused by the movement over the underlying rocks. Moreover, the bottom of the calcrete is in two levels, which indicates that the calcrete was deposited continuously, on the irregular surface of the exposed rocks and it is not resulted by a landslide, as mentioned by Hagopian *et al*. (1982) and Hamza (1998).

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REFERENCES

Al-Kadhimi, J.A.M., Sissakian, V.K., Fattah, A.S. and Deikran, D.B., 1996. Tectonic Map of Iraq, 2nd edit., scale 1: 1000 000. GEOSURV, Baghdad, Iraq.

Fouad, S.F., 2010. Tectonic Map of Iraq, scale 1: 1000 000, 3rd edit. GEOSURV, Baghdad, Iraq.

Hagopian, D.H., Abdul Lateef, A. and Barwari, A.M., 1982. Report on the regional geological mapping of Ain Sifni – Amadiya Area. GEOSURV, int. rep. no. 1379.

Hamza, N.M., 1998. Geomorphological Map of Sarsang Quadrangle, scale 1: 100 000. GEOSURV (not documented report).

Pulinowa, M.Z., Pawlak, W. and Worpajew, E., 1977. A contribution to the problem of morphogenetical principles of landslide mapping. Bull. Int. Ass. Eng. Geol., No.16, p. 56 – 62.

Rabruch-Hall, D.H. and Varnes, D.J., 1976. Landslides, Cause and effect. Bull. Int. Ass. Eng. Geol., No. 14, p. 205 – 216.

Sissakian, V.K., 2000. Geological Map of Iraq, 3rd edit., scale 1: 1 000 000, GEOSURV, Baghdad, Iraq.

Sissakian, V.K., Abdul Ahad, I.D. and Ala'a, Sh. Qanbar, 2008. Geological Hazard Map of Zakho Quadrangle, scale 1: 250 000. GEOSURV, int. rep. no. 3129.

Spiker, E.C. and Gori, P.L., 2000. National landslide hazards mitigation strategy. Open File Report 00 – 450, U.S.G.S.

Zaruba, E.C. and Mencl, V., 1969. Landslides and their Control. Czechoslovak Academy of Science, Prague, Elsevier.