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Some Sedimentary and Structural Evidences of a Possible Graben in Mawat-Chuarta Area, NE-Iraq

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ABSTRACT

Mawat-Chuarta area has a complex geological setting, which is manifested by highly deformed mixture of all type of rocks, sedimentary, metamorphic and igneous. Through the area these rocks have penetrated, as tongue, in to the autochthonous rocks. In the southeast and northwest of the area two large normal faults are identified which have more than 500m of throw. The area between these faults (Chuarta-Mawat area) has suffered clear subsidence as compared to the neighboring areas. This subsidence is attributed to the normal faulting accompanying graben. Much structural and sedimentological evidence are given to prove the presence of a graben. The evidence is illustrated by sketches and photos with suitable maps. The given evidences include striation, slickenside, triangular facet, bitumen seepage, nappe of sedimentary and ophiolite rocks and thick accumulation of conglomerates.

الدلائل الرسوبية و البنائية لوجود المنخسف في منطقة جوارتا-ماوات، شمال شرق العراق

الملخص

ان منطقة جوارتا-ماوات لها وضع جيولوجي معقد حيث تتكون من مزيج من الصخور الرسوبية والتحولية والنارية ذات التشوه العالي. تخترق هذه الصخور منطقة الدراسة بشكل لسان وهذا الاختراق يشمل الوحدات المتواجدة في نطاق التراكب كالتكاوين البلامبو والكومتان والشيرانش. وجد صدعان كبيران في الجنوب الشرقي والشمال الغربي في منطقة الدراسة. يبلغ مقدار الازاحة لهذين الصدعين بحوالي 600 م وهذه الازاحة ادت الى النزول لمنطقة جوارتا وماوت بشكل واضح مقارنة بالمناطق المجاورة كجبلي كورة كازاو وتاليشك في شرق و غرب المنطقة بالتوالي. وتم ايجاد وتحليل عدة دلائل رسوبية وتركيبة تؤكد وجود هذا الخاسف. هذه الدلائل تشمل: جوانب الانزلاق وخطوط الحركة وسمك الكبير لمدملكات متجمعة وطفح نفطي وواجهات مثلثة وطيات مندفعة من صخور الافيولايت والصخور الرسوبية حيث وضحت بواسطة المرتسمات والخرائط المناسبة.

INTRODUCTION

The area of the study is about 30km to the north and northeast of Sulaimaniya city which includes the famous Chuarta, Mawat and Basini towns at its eastern, western and northern boundaries respectively (Fig.1). The area consists of several mountains elongated from south to north, these mountains including Kato, Sarsir, Gimo, Pyr Mohammad and Gawraqul. It seems that these mountains were originally existed as one mountain but compartmentalized by three large streams such as Goga Sur, Sywail and Do Awan streams (Fig. 1).

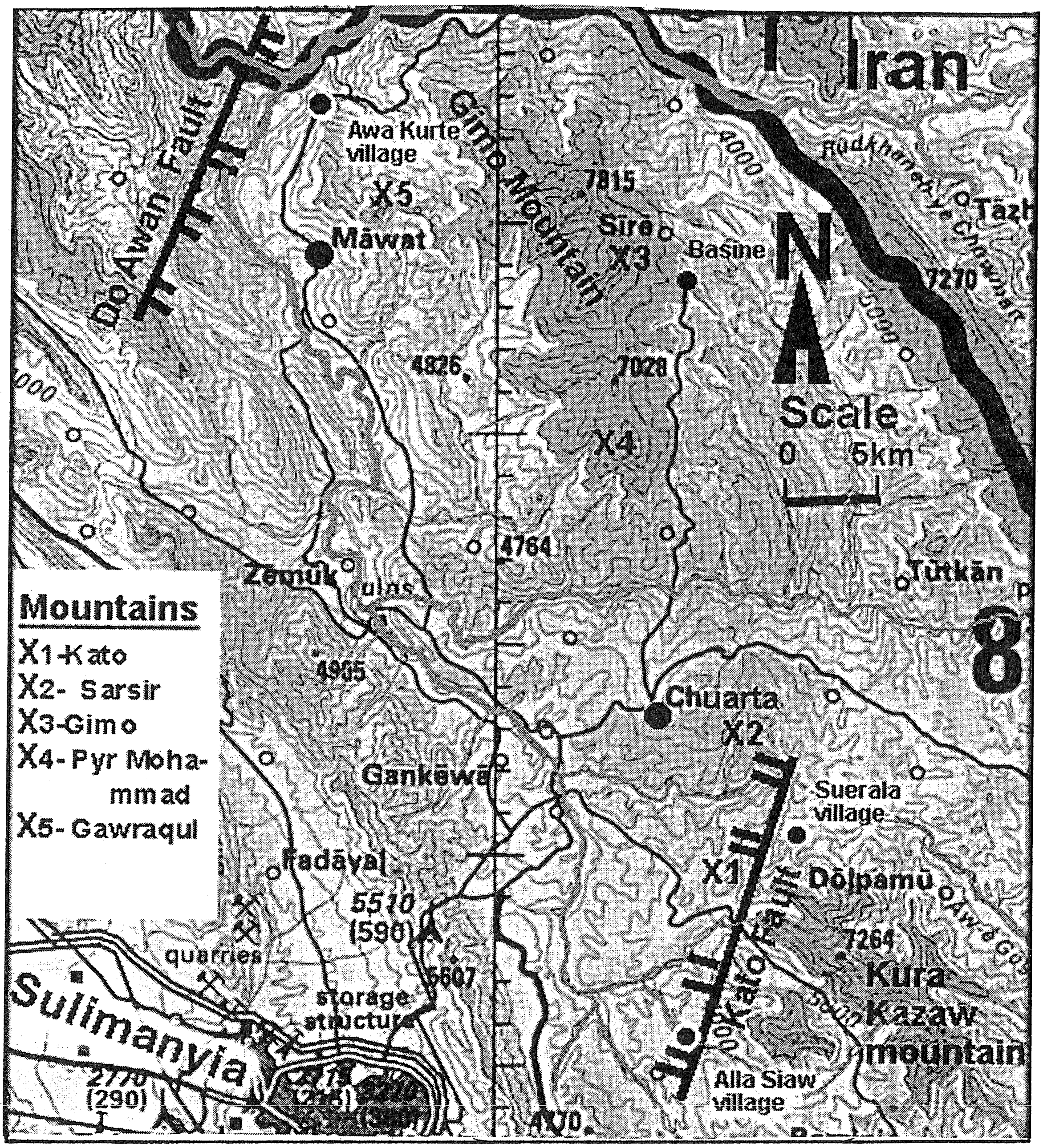

Fig.1: Location of the studied faults on the topographic map of the studied area (Modified from a map on the internet site of Iraq map).

GEOLOGICAL SETTING OF THE AREA

The geology of the area has structural and stratigraphic complexity as it is partly located in the Thrust and partly in Imbricated Zones of Buday (1980) and Buday and

Jassim (1987). The area represents partial area where the continental sides of Iranian and Arabian plates collided during Eocene (Numan, 1997 and Surdashy, 1997) or during Upper Cretaceous (Karim, 2004). The central part of the area is occupied by ophiolite and Naoperdan Series while the northern and southern parts are covered partly by Qulqula Group and Cretaceous Rocks respectively (Fig.2). The Qulqula Group and ophiloite are indicating the limit of Zagros thrust fault. The two faults area cut across the thrust fault.

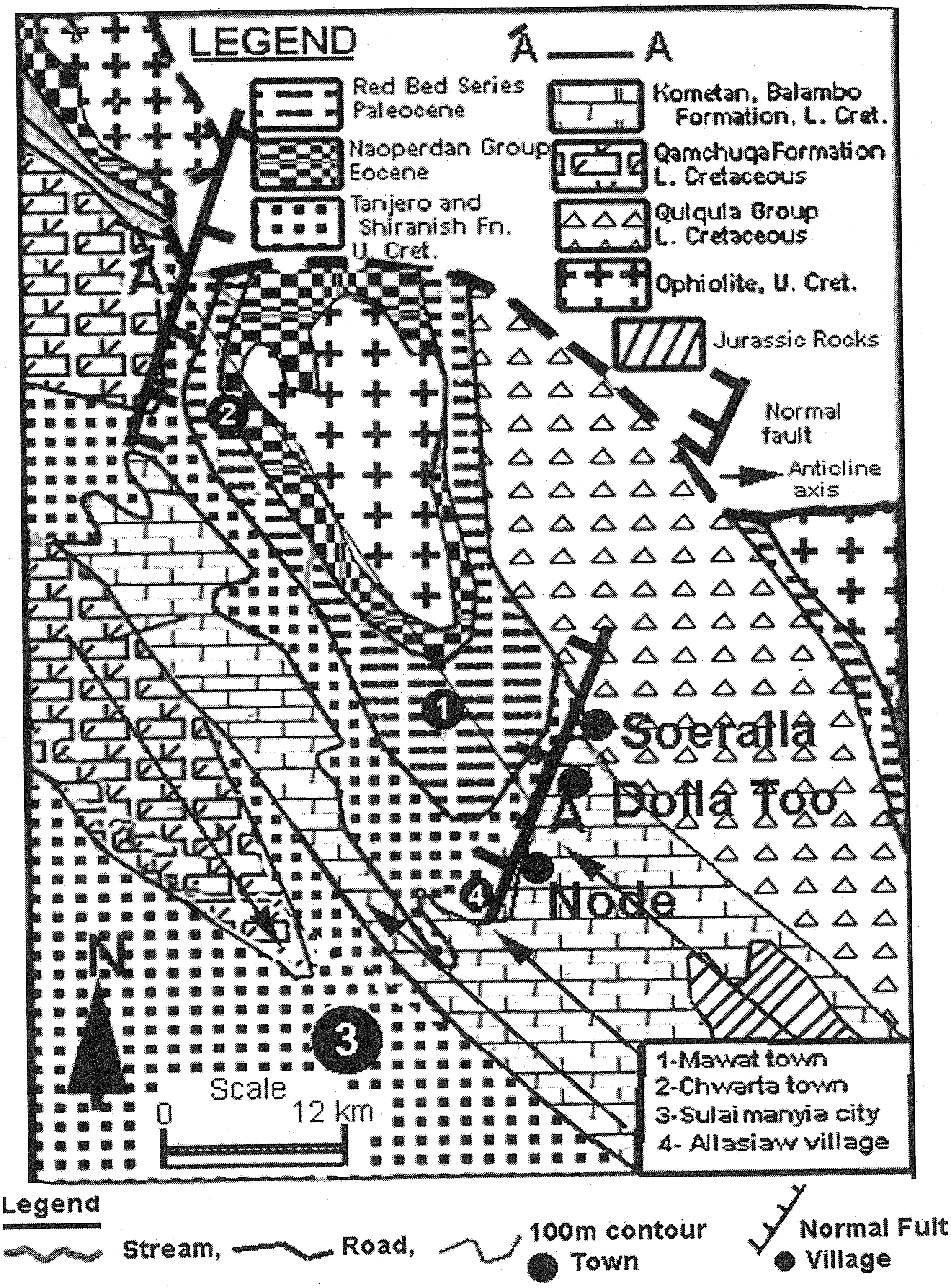

Fig.2: Geological map of the Chuarta-Mawat area.

Muhammad (2004) studied the geochemistry of the Mawat ophiolite and he proved that the area has suffered from extension during Eocene. The outcrops of these rocks form a tongue, which elongates from the north (from Iranian border) towards the south and ends near Chuarta Town. Its central part consists of ophiolite and metamorphic rocks surrounded by the outcrops of Red Bed Series and Nauprdan Series. This tongue is called Mawat Nappe by Al-Mehaidi (1975) who stated that this Nappe is underlain by Red Bed Series and Cretaceous rocks.

The inferred faults location:

Two large faults are identified at the eastern and western part of the studied area; namely, Kato and Do Awan faults respectively (Fig.1). These faults are large normal faults which have at least 600m of displacement between downthrown and up thrown blocks. They are striking in the direction of northeast-southwest Chuarta- Mawat area (Mawat Nappe) is located between these two faults and the area bounded by the two up thrown blocks of these faults. Therefore the area is most possibly representing a graben (Figs.1, 2 and 3). In the field the following features are found which all proves the existence of two normal fault and graben:

A-The structural evidences:

1-Triangular facets:

The Kurra Kazhaw, Kanasir and Weshka Shyw anticlines are trending northwest–southeast. These anticlines are all overturned and showing imbrication which are truncated (terminated) sharply and abruptly by the fault. This appears nearly as straight line normal to their trend. This line coincides with the Soeralla, Dolla Too and Node villages (Figs.1 and 3).

Along the termination (by Kato fault) the northwestern part of the anticlines disappeared rapidly and no plunge can be seen. Balambo and Kometan Formations are forming the southeastern side of the fault (up thrown block), which has been uplifted more than 600m. The other side (northwestern one) has subsided and only Tanjero and Shiranish Formations are exposed.

The uplifted side of the fault shows four triangular facets. These facets are physiographic features, which have broad bases and apexs point upward (Fig.3 and photo 1). These facets are part of fault scarp which has been modified through dissection by seasonal stream forming gullies and valleys. According to Bate and Jackson (1980), Thornbury (1969) and Bloom 1998), these represent remnant of the fault plane which my be more or less modified by erosion and weathering.

The triangular facets of Do Awan fault are not as clear as that of Kato because the fault plane is strongly modified by the two large streams in the area. These two streams join at the area of the fault. These streams are Qalla Chuallan (Kona Masy) and little Zab streams. This latter one enters Iraq territories near the fault. But the fault clear from the uplift of the Cretaceous rocks against the Tertiary ones on both side of the Doo Awan Fault (Photo 2A). It is important to mention that in the area there is many triangular facet parallel to strike (or parallel to anticline axes). These facets are called stratigraphic ribbons or iron flats which develops by stream differential erosion, but the facets described in this study are all perpendicular to strike (or normal to the axe).

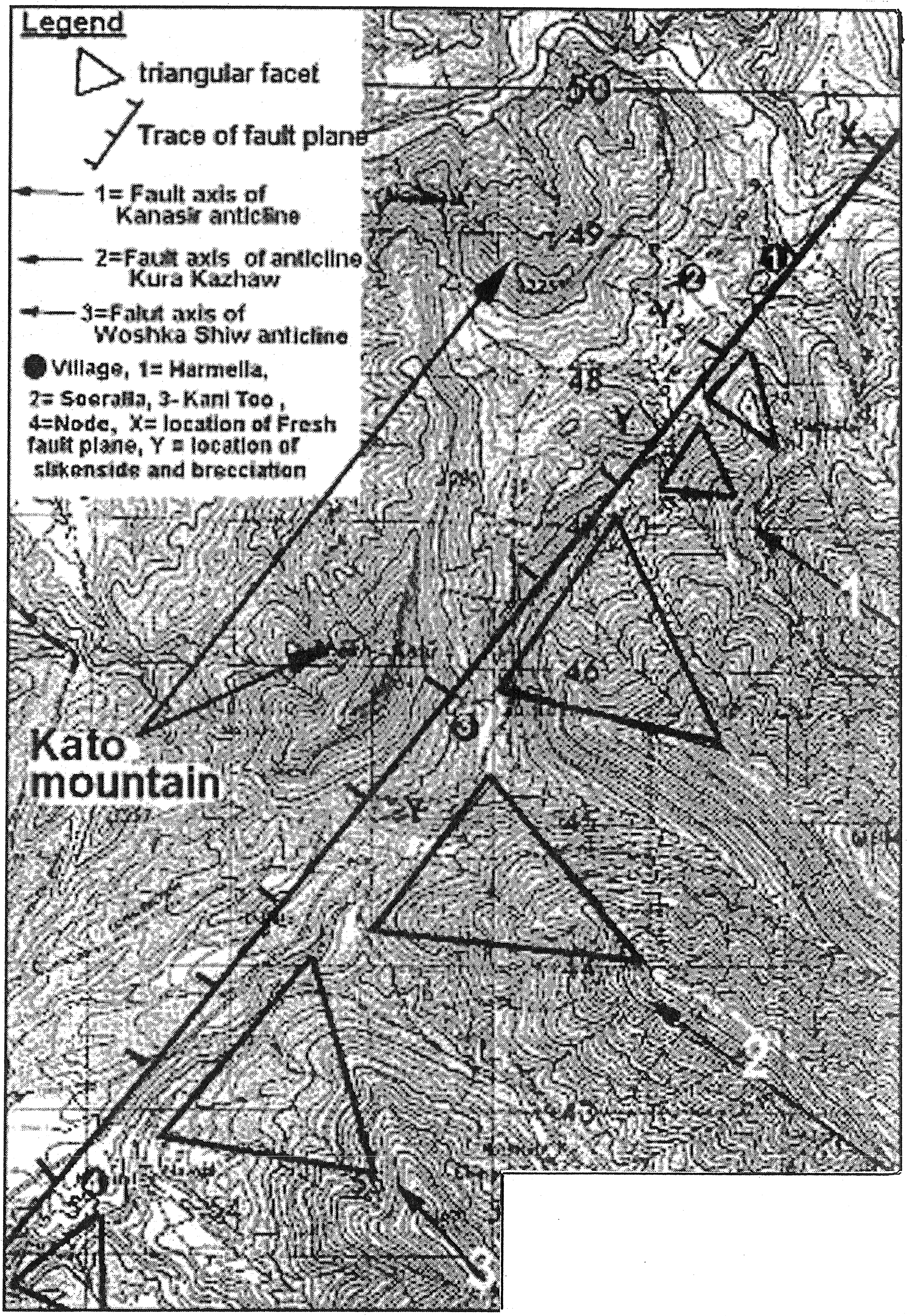

Fig.3: Detail of Kato fault, structural and physiographic features.

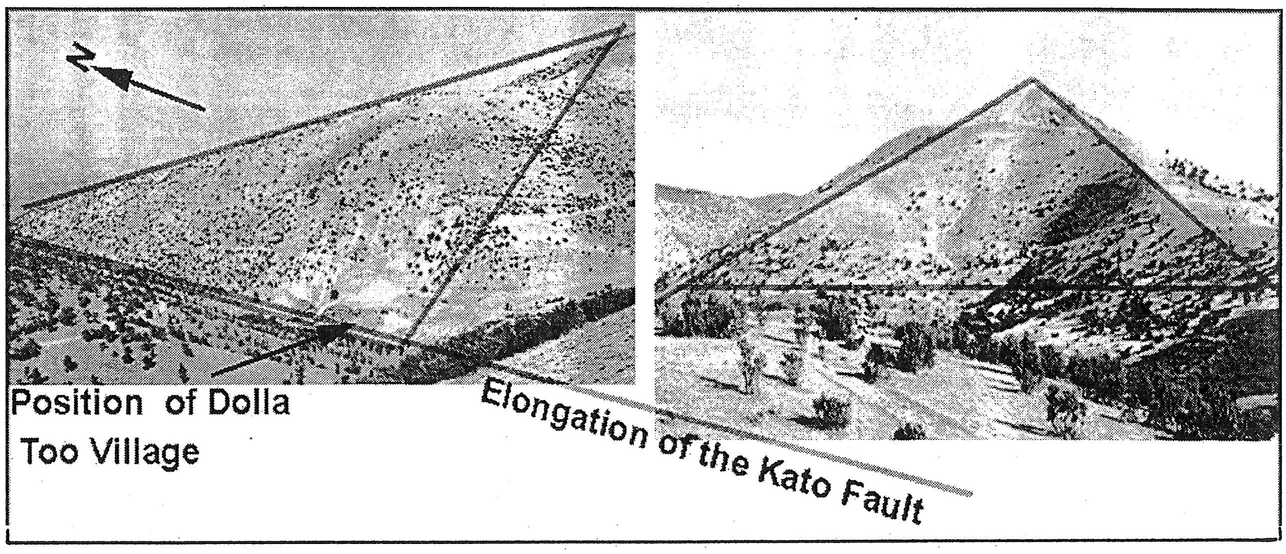

Photo 1: Two neighboring triangle facets of the Kato normal fault.

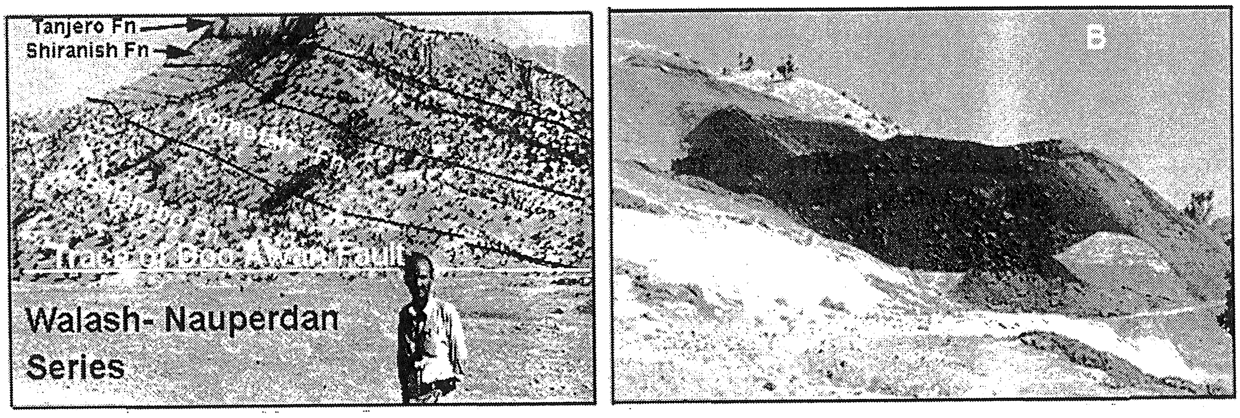

Photo 2: A. The Upper Cretaceous formations (at background) stand at higher elevation than the Tertiary ones (Walash Nauperdan Series) at the foreground.
B. Seepage of bitumen near Alla Siaw Village along Kato fault.

2-The striation and slickenside:

Along the trace of the Kato fault, one can see clear slickenside and striation on the fault plane. The locations of these features are indicated on the map titled fig. (3). In some cases, grooves are formed along the fault surface (Photo 3). These groves marked of the surface of lower limestone of Qulqula Formation overlied by bedded chert, they were formed when the bedded chert dragged over the lower limestone beds of this formation, the limestone is deeply grooved by harder chert ones (Photos 3 and 4). In this area the beds of limestone and chert of Qulqula Formation are described by (Karim, 2003a). The striations are normal to the fault plain (trend of the faults) showing the downward slipping of the two sides connected to the Chuatra-Mawat area at angle more than 75 degrees which their directions are shown in the figures (2, 4 and 5).

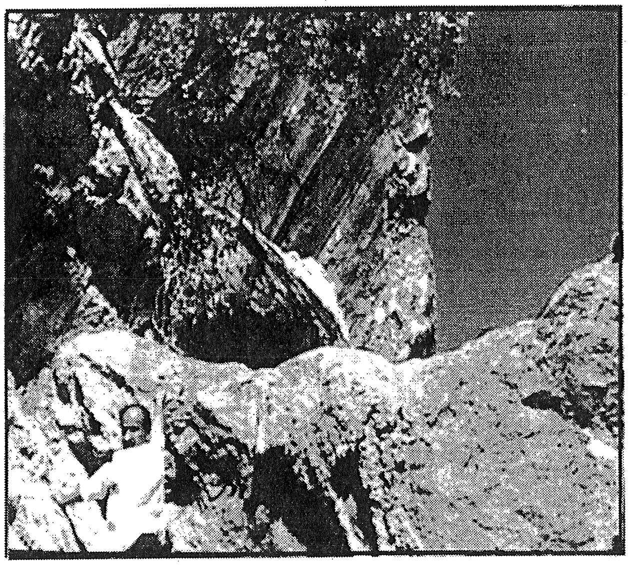

Photo 3: The Kato fault as seen from wider angle.

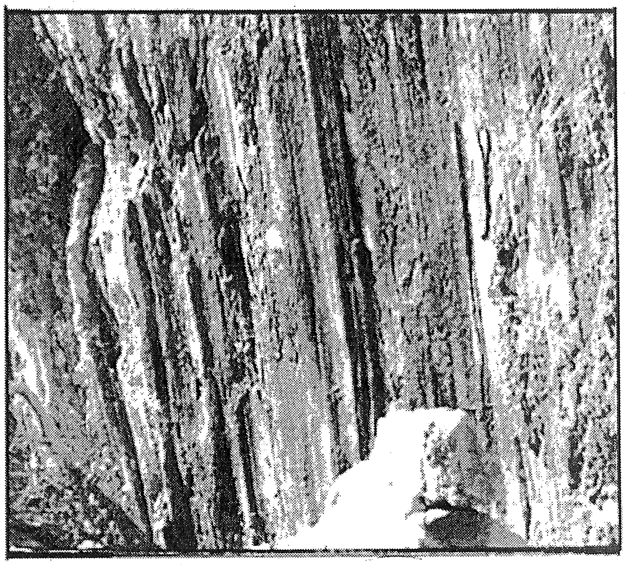

Photo 4: Shear striation and grooves on the surface of the Kato fault 1 km to the west of Sueralla Village.

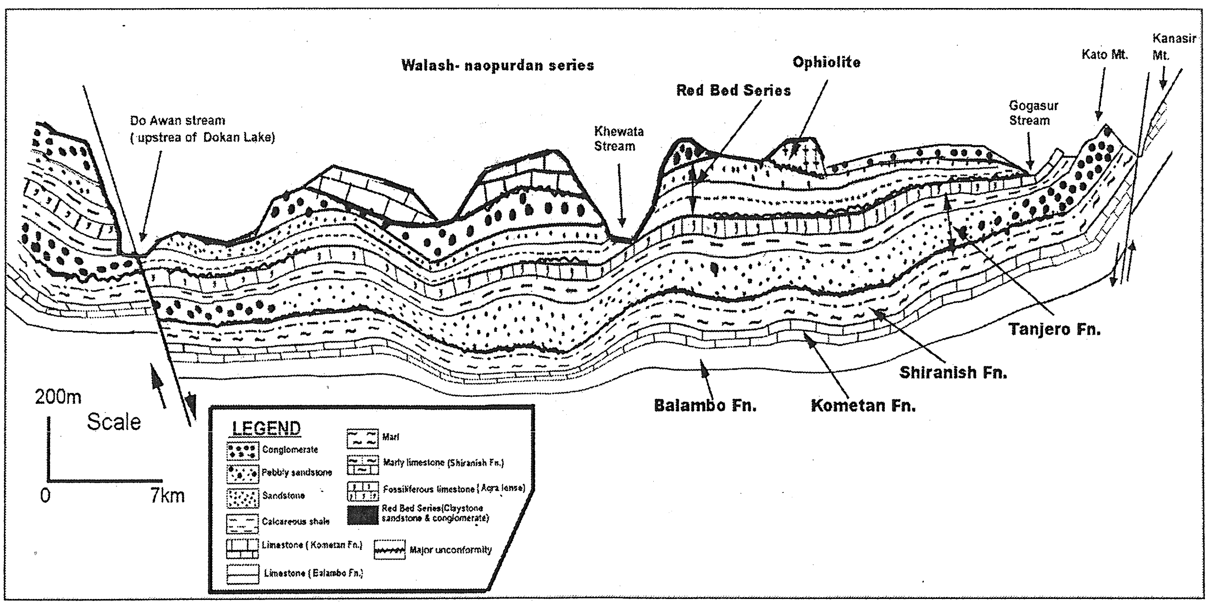

Fig.4: Simple geological cross section of Chuarta-Mawat graben.

3- Increase of frequency of joint and fractures:

When one walks on the outcrops of the Kometan and Balambo Formations and advance closer to the location of the Kato and Do Awan faults, the frequency of joint and fractures rapidly increase and reach it maximum at the trace of the fault. In some case the limestone shows more or less brecciation.

B-Sedimentary evidence:

The field evidences shows that along both side of the assigned faults, the young formations are more than 600m below the older ones (i.e. Shiranish and Tanjero Formations respectively). This difference in elevation takes place across the anticlines axis (trend of anticlines).

1-Seepage of Bitumen:

At the southwestern end of the Kato fault and near Alla Siaw village there is seepage of bitumen. The Bitumen is mixed with marl and silt. This seepage is the largest in the High Folded Zone of the northeaster Iraq. In outcrop it exists now as mixture of extremely deformed marl and bitumen in the middle part of Tanjero Formation (for detail description of this part see Karim 2004). This mixture occupying an area measured to be more than 2500m^2 in surface area (Fig.3B). During the nineties of the last century hundreds of tones of bitumen (mixed with marl) are excavated and transported to Sulaimanyia city for use as fuel but it was failed to burn so good to be used as coal. It is possible that the bitumen originally derived from the oil which has long accumulated in the Lower Cretaceous and Jurassic rocks. Then later and after faulting, seepage is promoted along the breakage generated by the fault.

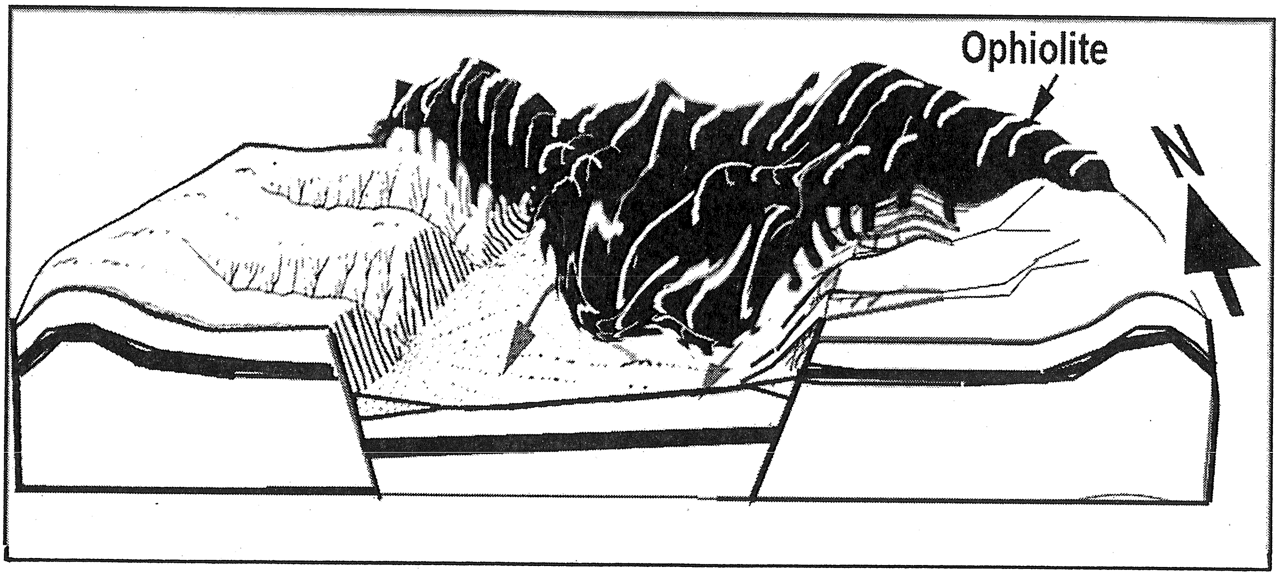

Fig.5: Suggested block diagram of the inferred graben showing thrusting and possible sliding of the ophiolite materials into the depression of the graben.

2-Thick accumulation of conglomerate:

Al-Mehaidi (1975) recorded about 1000m of conglomerate of Red Bed Series in the area of the proposed graben. In the same area, Karim (2004) recorded about 500m of conglomerate in the Tanjero Formation. He showed, by map, that the elongation of the conglomerate is toward southwest, which fill two Upper Cretaceous incised valleys. There are two possible relations between the conglomerate and the graben:

1-It is possible that the conglomerate is deposited, as a result of subsidence of the studied area and uplift of the surrounding area. Many authors mentioned that thick deposition of conglomerate in front of faults, i.e. Bruner and Smosa, (2000) and Einsele (2000). But there is no strong field evidence for this assumption.

2-Another possibility is that the faulting (graben) is generated in a direct response to the deposition of huge thickness of conglomerate and other rocks in the studied area. In addition to this, the area as a foreland basin (see Karim, 2004), heavily load by advancing front of Iranian plate. This loading with thick accumulation of sediments are induced the faulting of the studied area.

3-Advanced front of Wallash-Naoperdan Series and ophiolite:

In the area of proposed graben (area between the two faults), Wallash-Naoperdan Series and ophiolite crop out. The most south and southwestward advance of these rocks can be seen only in the studied area near Chuarta and Mawat (Fig.2). This front, as nappe, is most probably attributed to the subsidence of the studied area due to the graben which facilitates the thrusting or sliding of the sedimentary and ophiolite blocks south or southwestward more easily than other place of the Zagros thrust belt inside Iraq (Fig.5).

4-Broad outcrop of Red Bed and Walash-Nauperdan Series:

In the area of the inferred graben, the Red Bed Series and Nauperdan Series have relatively wider distribution of outcrops (Fig.2), than in the neighboring areas. In these areas such as Qandil Mountain toe and Penjween area these units have narrow outcrops. The wide outcrops of the two units are indirect evidence to the subsidence of the area. According to these and due to faulting the area taken the position of a depression, where the outcrops of the both above series are preserved from more tectonic deformations and intermittent erosion. It is certain, from field observation, that the faults are cutting all formations older than Late Eocene.

CONCLUSIONS

The followings can be concluded from this study:

1-Two large normal faults are identified in the field. These faults are named Kato and Do Awan faults.

2-Due to these two faults, the Chuarta-Mawat area has subsided to more than 600m below the surrounding area forming a graben, in this study it is called Chuarta-Mawat graben.

3-Many structural and sedimentological features are identified in the field, which corroborates the presence of the graben and the two faults. The features include striation, slickenside, triangular facet, bitumen seepage, nappe of sedimentary and ophiolite rocks and thick accumulation of conglomerate as verified by maps, photos and sketches.

4-The age of the faulting is not known exactly, but it cut the pre-Eocene stratigraphic units.

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