GEOLOGY AND STRUCTURE OF WADI SHALGHAH AREA, EAST ERBIL, NORTH IRAQ

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ABSTRACT

The structure of the studied area is a simple anticlinal limb and located within the Foothill Zone of Iraq, which is a part of the Zagros Simply Folded Belt, it is a part of the western limb of NW – SE trending Bana Bawi Anticline. This is confirmed by four constructed cross sections and a structure contour map constructed on the top of Pila Spi Formation. However, a small parasitic terrace like structure imposed on the limb of the major Bana Bawi Anticline occurs in the extreme eastern margin of the studied area, which is attributed to the northwestern plunge of Taq Taq Anticline.

The studied area is built up of clastic rocks of Injana, Mukdadiyah and Bai Hassan formations, which form almost badland morphology with continuous strike ridges that are formed due to differential weathering.

جيولوجية وتركيبة منطقة وادي شلغة، شرق أربيل، شمال العراق

هالة عطاء الموسوي

المستخلص

إن تركيبية منطقة الدراسة هي من النوع البسيط وتتمثل بجناح طية محدبة واقعة في نطاق أقدام التلال والذي يمثل جزء من حزام زاكروس، وهي تمثل الجناح الجنوبي الغربي لطية بنا باوي ذات اتجاه شمال غرب – جنوب شرق. وقد تم تأكيد هذا بواسطة إعداد أربعة مقاطع جيولوجية وخريطة كنتورية تركيبية على الحد الأعلى لتكوين البيلاسبي، ولكن يوجد هناك تركيب صغير من النوع الطفيلي مكونا شكل طية على طية بنا باوي الكبيرة في الجزء الشرقي من المنطقة ويعزى هذا الى الغاطس الشمالي الغربي لطية طق طق المحدبة.

وتتكون منطقة الدراسة من ترسبات فتاتية عائدة لتكوينات انجانة والمقدادية وباي حسن والتي تكون مناطق وعرة ذات جروف صخارية مضربية متوازية نتيجة للتعرية التفاضلية بسبب اختلاف صلادة الصخور.

INTRODUCTION

The studied area and the near surroundings are considered as one of the important areas, in the northern Iraq, due to the expected hydrocarbon occurrence. The aim of this study is to identify and evaluate the structure of the studied area and to prove or otherwise the presence of an anticline within the area.

The studied area is located within Erbil Governorate, 14 Km east of Erbil city (Fig.1), it is near by to the two oil provinces, KirKuk, which is located to the south, and Taq Taq oil field to the southeast. The exposed rocks in the studied area belong to Late Miocene – Pleistocene age. Although the studied area is a part of the SW limb of major Bana Bawi Anticline (Sissakian and Youkhanna, 1979 and Sissakian, 1997 and 2000), it was believed that the studied area forms a double plunging anticline, called Hamza Anticline and was assigned to an oil company for exploration.

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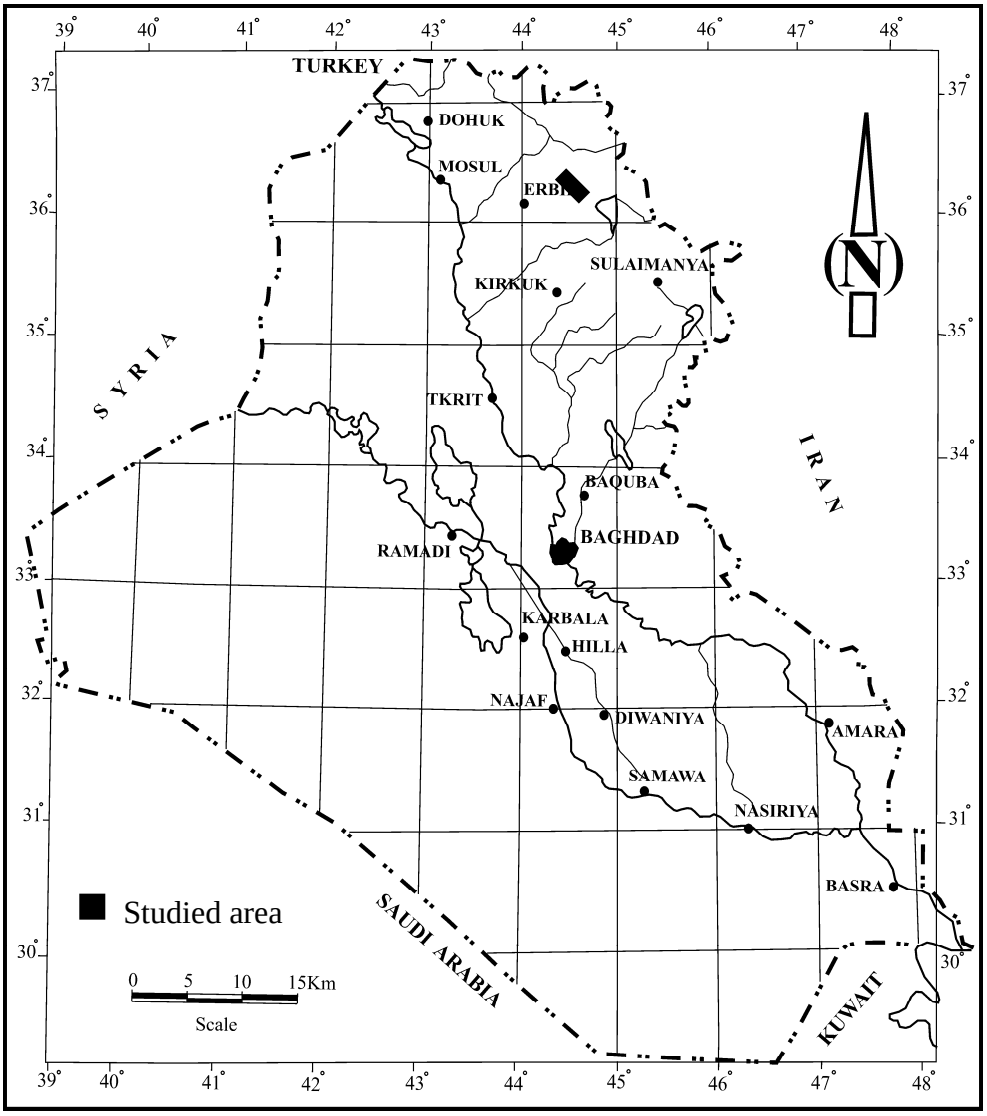


Fig.1. Location map of the studied area

To prove the presence or otherwise of this anticline, a detailed geological mapping was executed by the State Company of Geological Survey and Mining (Baghdad) with cooperation of the ex-General Establishment of Oil, Gas and Petrochemicals (Erbil) in 2006.

To acquire the structural form of the studied area the following materials were used:

Topographical maps 1: 20 000 scale
Aerial photographs 1: 42 000 scale
Landsat images 1:100 000 scale

The work is executed in following steps (Abdul Hassan *et al*., 2006):

- Detailed geological mapping of the studied area, which is about 300 Km^2. Two description points/ Km^2 were conducted with dip and strike measurements. Thirty stations were concluded for joint measurements, as a station per 10 Km^2. GPS was used to indicate the location of joint stations, descriptive points and dip and strike of beds.
- Four traverses were executed to construct four geological cross sections.
- A structure contour map was constructed on the top of the Pila Spi Formation, using the acquired data from the four cross sections.

GEOLOGICAL SETTING

▪ Geomorphology

The studied area is a part of the Foothill Zone, within Bana Bawi Anticline. It is dissected by dense drainage net. Four geomorphological units are developed, these are:

- **Units of Structural – Denudational Origin**. They are formed due to the uplifting of SW limb of Bana Bawi Anticline and due to the differential erosional processes, among them are anticlinal ridges, flat irons, cuestas and hogbacks.
- **Units of Fluvial Origin**. They are restricted to Wadi Shalghah and its tributaries, forming Flood plain and Infill valley Units.
- **Unit of Depositional Origin**. Pediments are the only unit of this origin, which are developed in the studied area and they indicate wet climate followed by intense erosion.
- **Unit of Denudational Origin**. Badlands are developed in the studied area, the main reason for this is the presence of clastics of Bai Hassan and Mukdadiyah formations, beside the active erosion.

▪ Stratigraphy

The studied area is built up of sedimentary rocks ranging in age from Late Miocene – Pleistocene, beside various types of Quaternary sediments, the exposed formations are described briefly (from older to younger) (Fig.2):

– **Injana Formation** (Late Miocene)

Injanah Formation is exposed in a very small part within the eastern margin of the studied area (Fig.2). It consists of alteration of claystone, siltstone and sandstone in coarsening upwards cycles; it reaches 160 m in thickness. The lower contact is not exposed, whereas the upper contact with Mukdadiyah Formation is conformable based on first appearance of pebbly sandstone.

– **Mukdadiyah Formation** (Late Miocene – Pliocene)

Mukdadiyah Formation is exposed along the eastern half part of the studied area (Fig.2). It consists of alternation of sandstone, siltstone and claystone in fining upwards cycles; some of the sandstone layers are pebbly. The thickness of the formation is (500 – 600) m. The lower contact with Injana Formation is conformable based on the first pebbly sandstone bed.

– **Bai Hassan Formation** (Pliocene – Pleistocene?)

Bai Hassan Formation is widely exposed and covers most of the studied area (Fig.2). It consists of alternation of conglomerate, claystone and sandstone in fining upwards cycles. The thickness of the formation is 1200 m. The lower contact with Mukdadiyah Formation is conformable and marked at the base of the first conglomerate bed.

– **Quaternary Sediments**

Quaternary sediments include the following types (Fig.2):

∗ **Slope Sediments** (Pleistocene – Holocene)

These are developed mainly in the western corner of the studied area in small patches. They usually consist of gravel, which are derived from Bai Hassan Formation. The thickness of these sediments varies from 20 cm to 1.5 m.

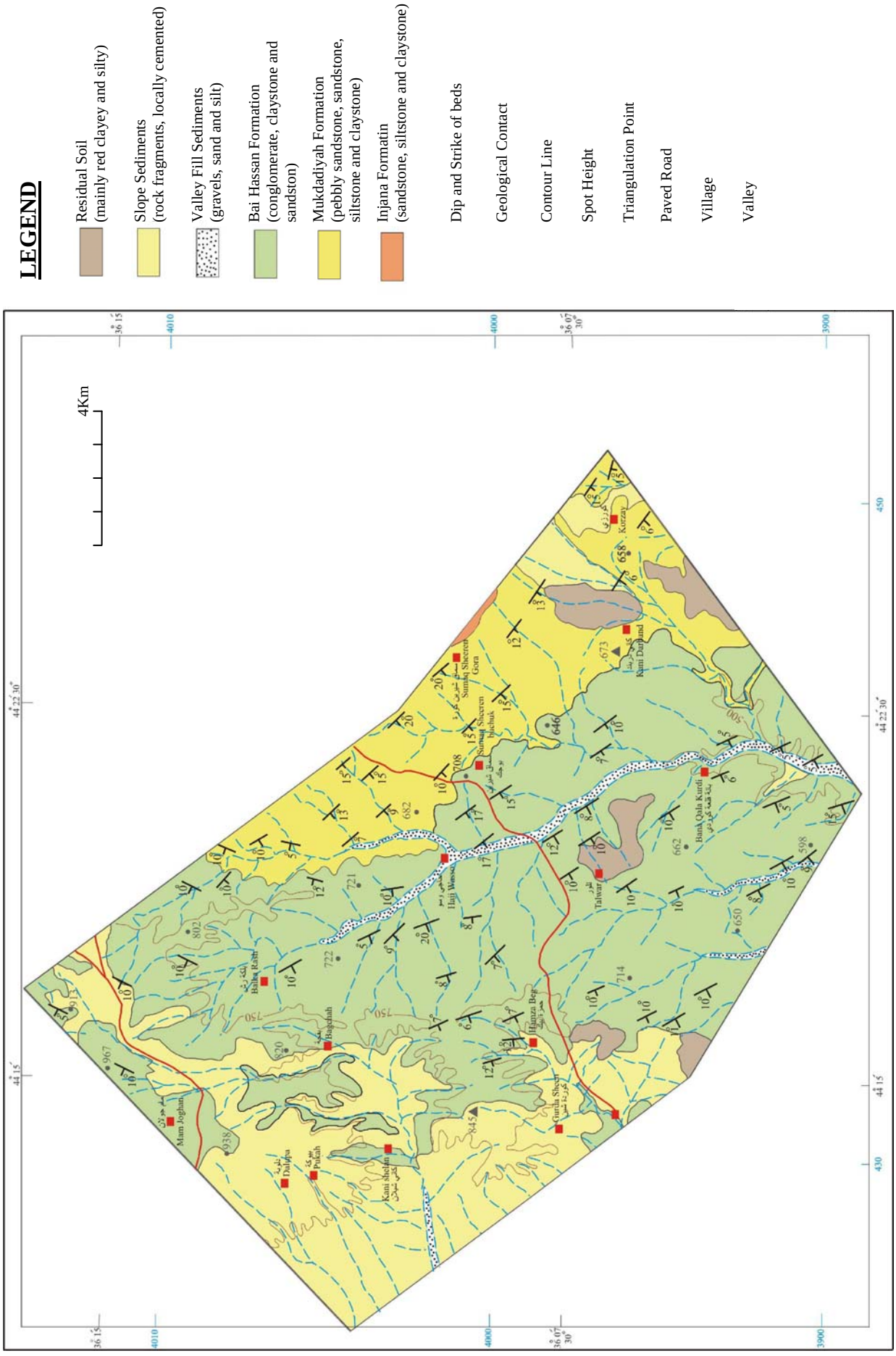


Fig.2: Geological Map of the studied area (Abdul Hassan *et al.*, 2006)

∗ **Residual Soil** (Holocene)

It is developed in small part only and it is mainly of clayey and silty types. The thickness varies from 20 cm to 1.0 m.

∗ **Valley Fill Sediments** (Holocene)

These sediments are developed in Shalghah, Batanok and Ishkaft valleys. They consist mainly of gravels of different sizes, sand and silt. The thickness ranges from less than one meter to 2 m.

▪ **Structural Geology**

The studied area is located within the Foothill Zone of Iraq (Al-Kadhimi *et al*., 1996). The zone is a part of the Zagros Simply Folded Belt, where Mesozoic and Cenozoic rock units are folded into series of NW – SE trending anticlines and synclines

The studied area is a part of the outer arcs of the southern limb of Bana Bawi Anticline (Sissakian and Youkhanna, 1979), the dip increases from the outer arcs of the folds towards the inner arcs, whereas the strike maintain a general NW – SE direction, except at the vicinity of Wadi Degala (eastern part of the studied area) where the strata show some departure from this general trend. However, no displacement was noted in the field along wadi Degala, so may be there is a NE – SW trending subsurface fault along wadi Degala.

To reveal the structure of the studied area and to describe it in detail, four traverses normal to the general trend of Bana Bawi Anticline were executed, (Sissakian and Fouad, 2006) (Figs.3, 4, 5 and 6) starting from Pila Spi – Fatha formations contact (just outside the studied area).

Along each traverse, every change in dip amount and attitude was measured, formation boundaries were located, lithological changes were noted (Abdul Hassan *et al*., 2006). Then the obtained data were used to construct four geological cross sections using the kink construction method (Suppe, 1985).

By using the four closely spaced cross-sections, the depth of the top of the chosen marker horizon (the top of Pila Spi Formation) is measured on each cross-section. The obtained data are transferred to map view then contoured (Fig.7), with the mean sea level as the datum plane. The obtained structure contour map displays a simple southwest dipping surface that follow the general attitude of the southwestern limb of Bana Bawi Anticline.

Nonetheless, along the D – D' cross-section (Fig.6) a broad open pattern of the contour lines between the intervals -250m and -500m is clearly visible. No full closure of the contoured marker surface is present; alternatively, it forms a minor "parasitic" terrace like structure on the major southwestern limb of Bana Bawi Anticline. As already mentioned, this structural form is attributed to the effect of the nearby northwestern plunge of Taq Taq Anticline (Sissakian and Fouad, 2006).

However, the pattern of the contour lines changes gradually (northwestward) towards C – C' cross-section where they become close to each other, then regaining their normal regional pattern. Reflecting that, the structural terrace does not extend further north.

From reviewing the documented dip and strike of the strata in the studied area, it is clear that the majority of the recorded strike direction is almost uniform and trends 210°. East and north of Balka Rash village it reaches 290° and continues till the northern corner of the studied area (Fig.2). The amount of the dip is almost uniform; it is 20° near Sumak Shirin Kabeer village and decreases southwest to about 10°, with some exceptions. From reviewing all available geological maps aerial photographs, landsat image, structural contour map (Fig.7) and field observations, no structural closure is observed, in the concerned area.

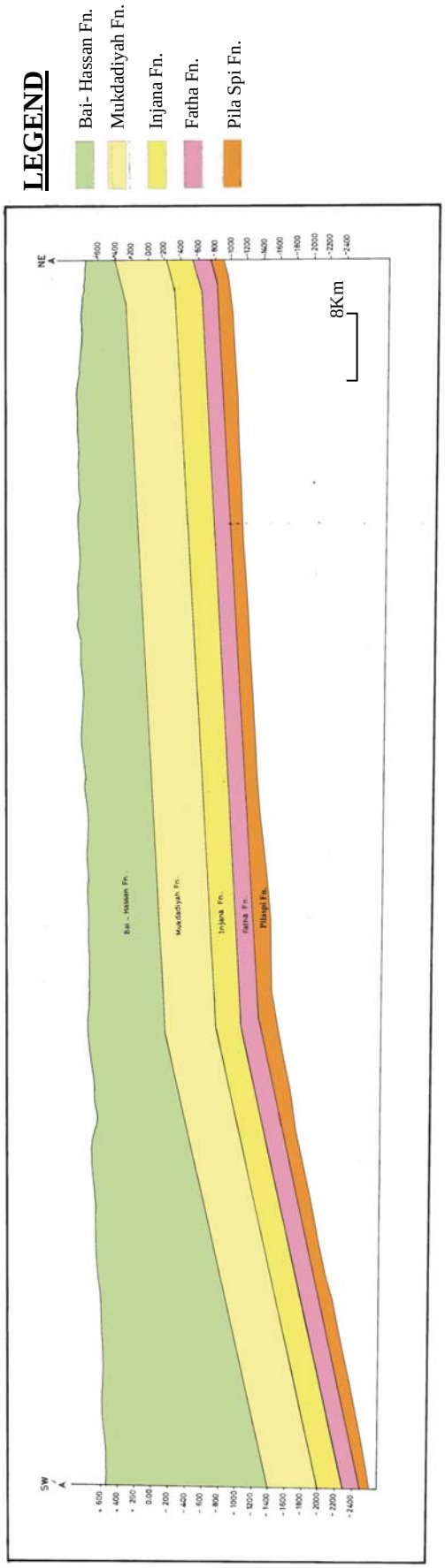


Fig.3: Geological cross section A – A' (Sissakian and Fouad, 2006)

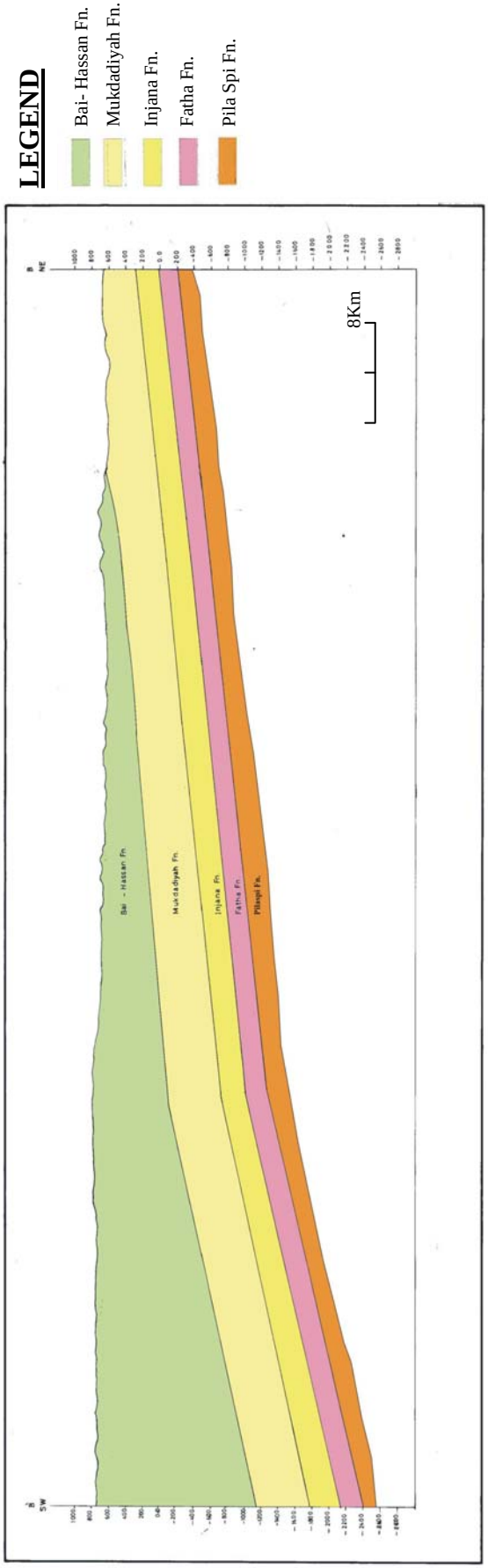


Fig.4: Geological cross section B – B' (Sissakian and Fouad, 2006)

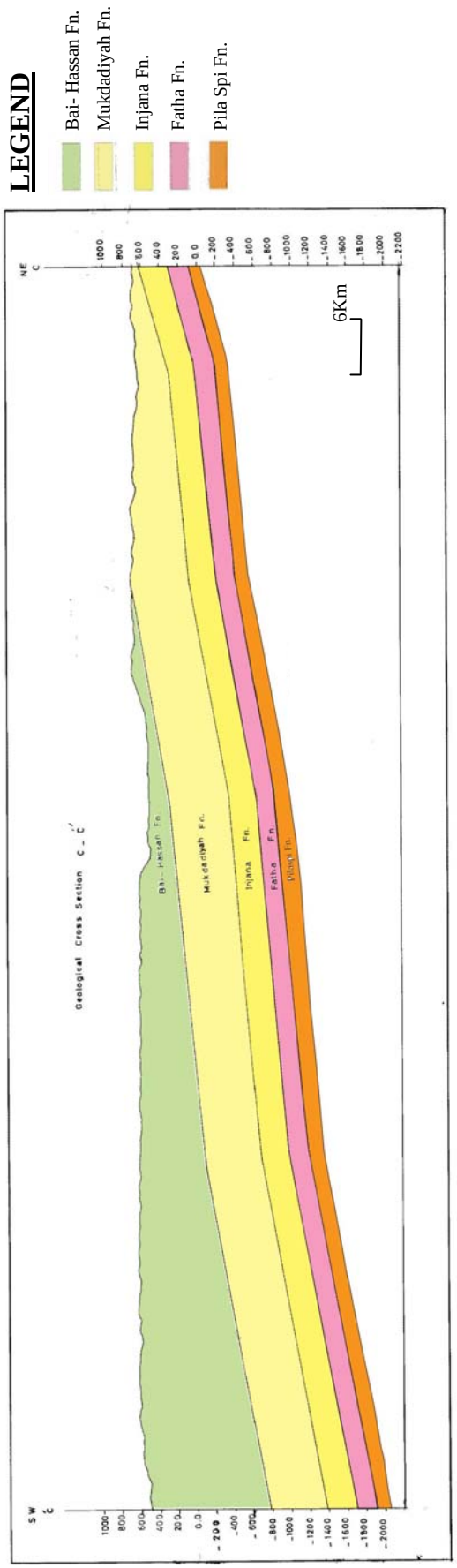


Fig.5: Geological cross section C – C' (Sissakian and Fouad, 2006)

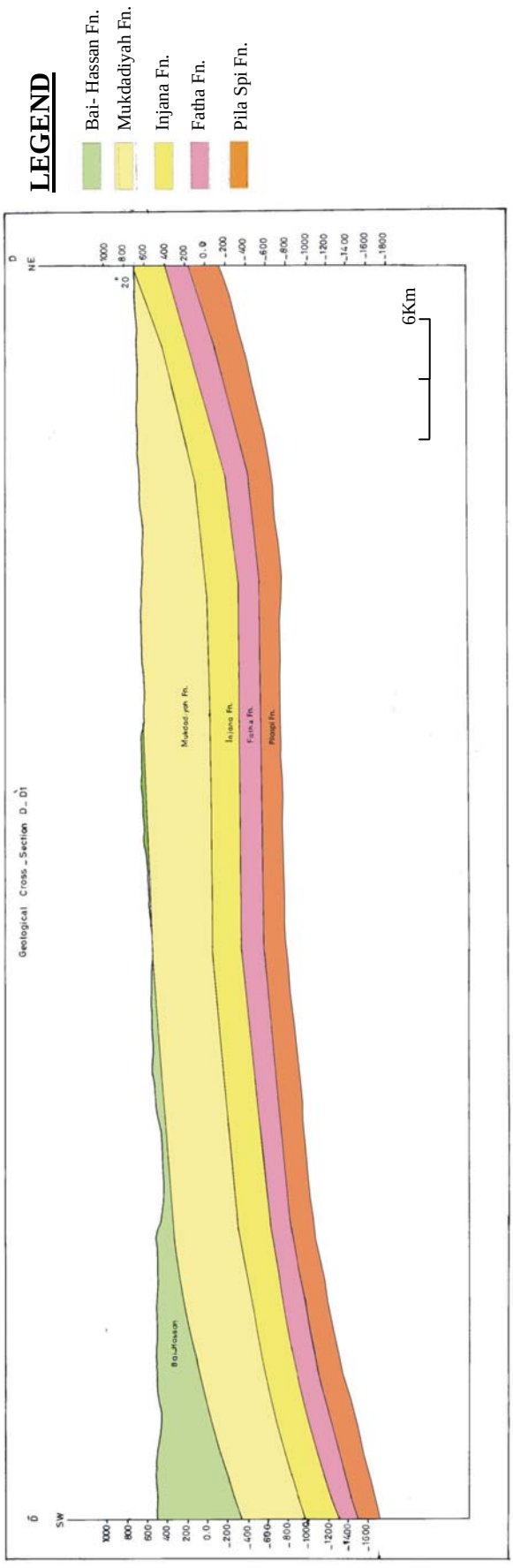
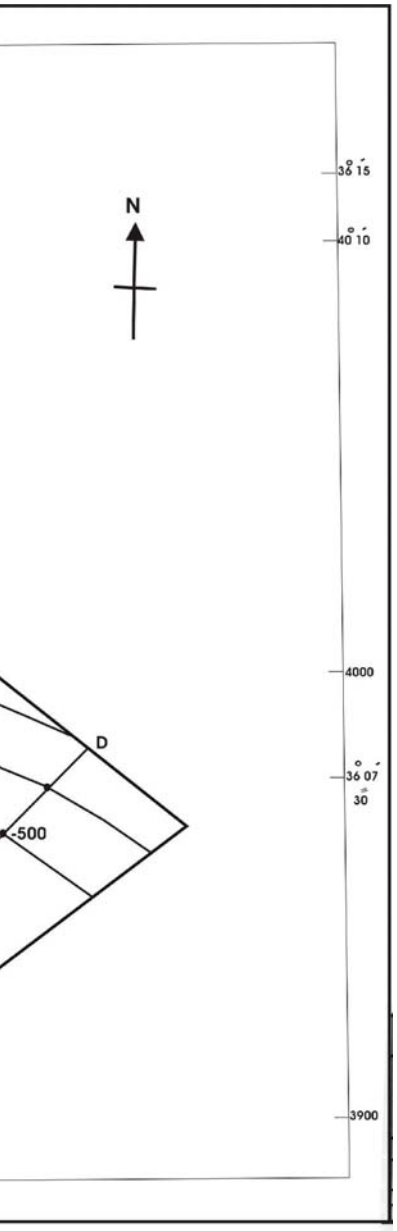


Fig.6: Geological cross section D – D' (Sissakian and Fouad, 2006)



4Km

LEGEND

-500 Contour line

B B Geological cross- section

Contour interval 250 m

(Datum is sea- level)

Fig.7: Structural contour map on top of Pila Spi Formation (Abdul Hassan *et al*., 2006)

CONCLUSIONS

The following could be concluded:

- The geomorphological units in the project area are of structural – denudational, fluvial, depositional and denudational origins.
- Three formations crop out; they are Injana, Mukdadiyah and Bai Hassan, all of them consist of clastic rocks, in cyclic nature. Different Quaternary sediments are developed.
- The studied area, as whole is a part of the outer areas of the southwestern limb of the major Bana Bawi Anticline.
- The geometrical shape of the folded strata is not quite uniform as shown by the cross sections. Although the strata maintain their regional dip direction, they may exhibit some dip changes along the sections.
- Structure contour map and cross sections data reflect the presence of a small parasitic terrace like structure, with no closure, imposed on the limb of the major Bana Bawi Anticline. This geometrical style is attributed to the effect of the nearby northwestern plunge of Taq Taq Anticline.
- The structural terrace is rather small and limited to the extreme southeastern part of the studied area. It has no extension further northwards.

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