

THE EFFECT OF SHEARING ON  
SEDIMENTARY BASINS IN THE AREA  
BETWEEN ABU ZENIMA AND ABU DURBA  
IN WESTERN SINAI, EGYPT.

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ABSTRACT

*Bouguer anomalies between Abu Zenima and Abu Durba reflect relative block movements in the region. Studying the relationship between faults identified using Bouguer anomalies shows the presence of three possible shear zones. Two shears run in a northwest-southeast direction, parallel to the Gulf of Suez, and show right lateral sense of motion. While the third assumes a northeast-southwest direction and is also of right lateral sense of motion. Relative vertical movement could not be deduced from the Bouguer anomalies for the three shear zones. Two dimensional gravity models along three profiles indicate the presence of a sedimentary basin, the depth of which varies between 1.8 km and 8 km. This basin is affected by two intersecting right lateral shear zone, possibly being the cause directing it towards the Gulf of Suez in the northern sector of the area.*

INTRODUCTION

The location of the area on the western side of the Sinai Peninsula makes it part of the Cenozoic structure known as the Suez Rift which cuts through the once continuous Arabo-African platform. Basement rocks exposed in Sinai (Fig. 1) consist of older metamorphics intruded by granites

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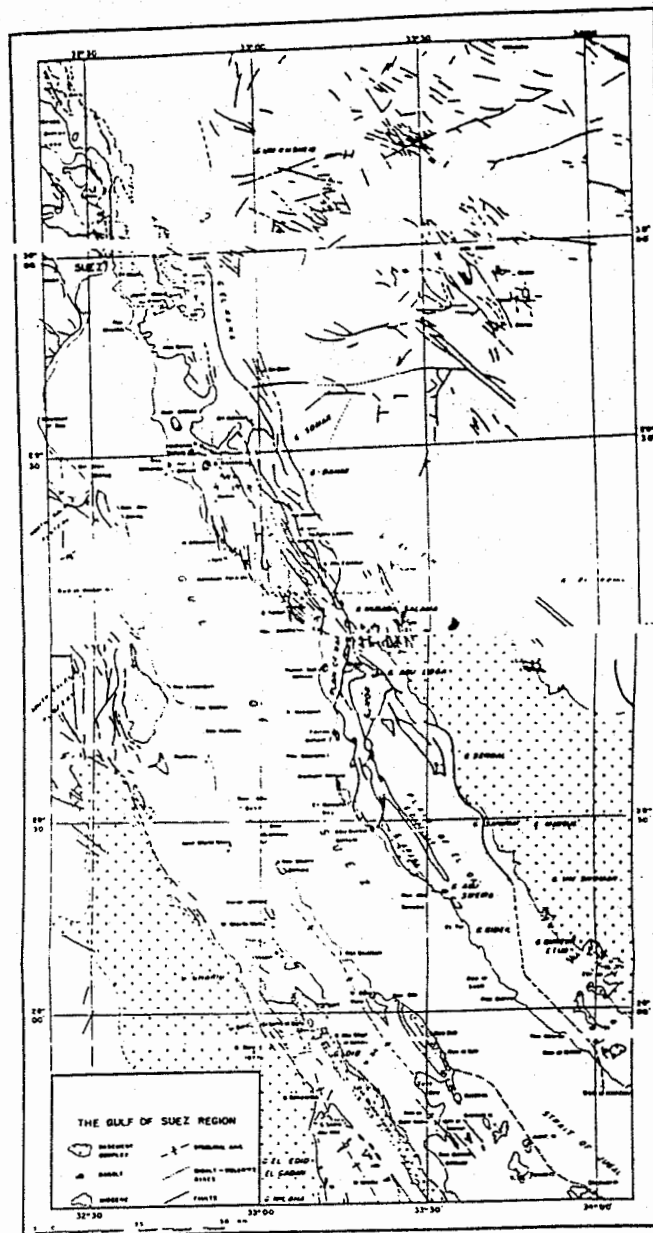


Fig. 1 Geologic map of the Gulf of Suez region (after Said, 1962).

and plutonic rocks (Said, 1962; Schurmann, 1965; Bentor et al., 1974). These rocks form the eastern boundary of the Abu Zenima/Abu Durba area .

Faults dominate the rift structure, which the area borders, breaking down rocks of pre-Miocene age into numerous blocks. These are only exposed in the border structures and underlie most of the Suez rift under the central trough of the Gulf ( El-Shinnawi & Sultan, 1973). The rifting of the Gulf of Suez strongly influences the structural pattern of the area. This is evident from the step-faults at both the northern and southern parts of the Abu Durba/Abu Zenima area (Martinez and Cochran, 1988 ). Strike-slip movement along the Gulf results in several tectonic models as the left-lateral offset of Gebel Araba in western Sinai (further south of the area being discussed) along N-S faults (Le Pichon & Francheteau, 1978; Garson and Krs, 1976; Robson, 1971; Abdel Gawad, 1969). Major lineation in the Gulf of Suez - Sinai area which reflect block faulting in the basement, form a dual conjugate pattern (Bradly, 1975)

Bouguer anomalies are used in identifying faults. Zones of dense contours distinguish the presence of faults. The extent, orientation and direction of decrease in the value of the contours determine the length, orientation and downthrow of these faults. Faults belonging to one and the same system but showing opposite directions of down-throw along their strike, may indicate the presence of horizontal displacement along their strike directions (Riad, 1977).

## **RESULTS and DISCUSSION**

Faults affecting the area are identified from the Bouguer anomaly map (Fig. 2 & 3). Statistical manipulation of the fault parameters (number,

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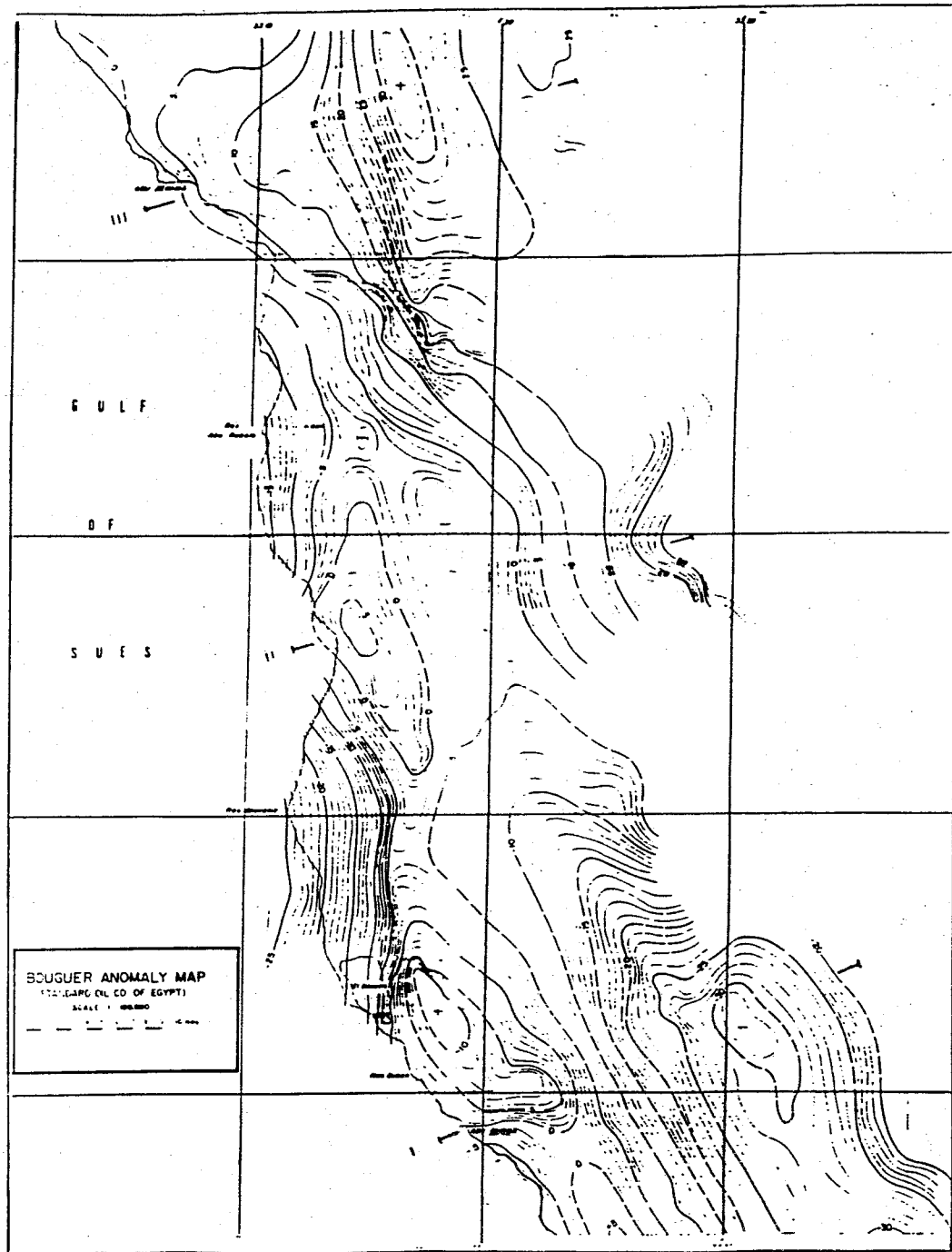


Fig. 2 Bouguer anomaly map for the area between Abu Zenima and Abu Durba.

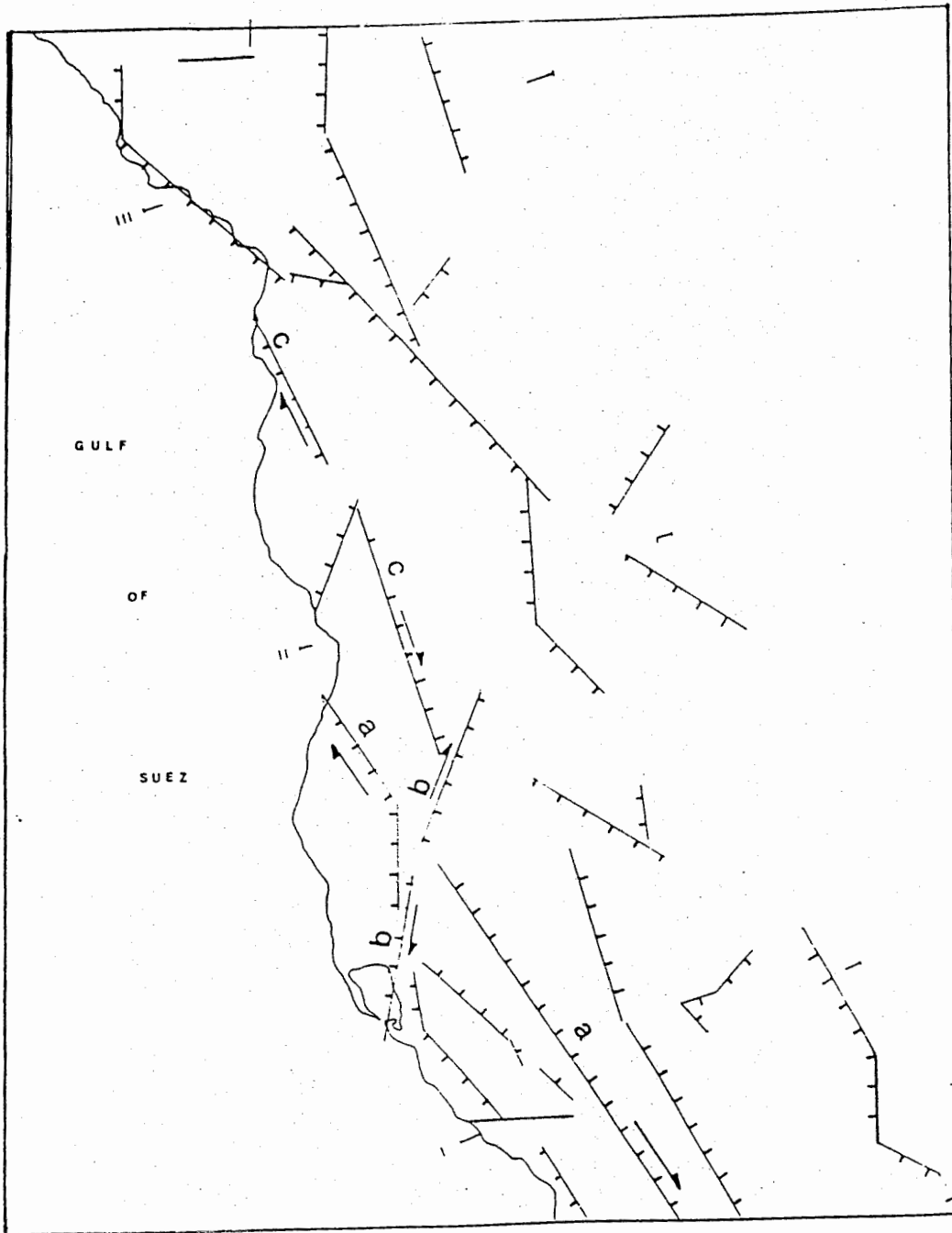


Fig. 3 Faults and deduced shear zones influencing the area between Abu Zenima and Abu Durba.

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azimuth, length) shows three main fault directions, N 40°- 50° W, due North and N 10°- 20° W (Fig. 4). From a total of 38 faults, 42% are found to have areal extent ranging between 5 - 10 km, and 29% ranging between 0 - 5 km (Fig.5 ).

Alternating changes in the downthrow direction of faults believed to belong to one and the same system identified three possible shear zones (Riad, 1977) labelled "a,b and c" (Fig. 3 & 6). Shears zones "a and c" assume directions parallel to the Gulf of Suez (NW-SE), with shear "a" showing a horizontal displacement of about 40 km. The third shear zone "b" follows a NE-SW (Aqaba) trend and shows a horizontal displacement of about 13 km. All three shears show right lateral horizontal sense of relative block movement. The presence of a vertical component of relative movement accompanying the lateral motion could not be deduced from the relations of the Bouguer anomalies.

Two dimensional models along the three profiles "I,II and III", which cross the region at its southern, middle and northern sections ( Fig. 2 ), are based on average densities of 2.3 gr/cm<sup>3</sup> and 2.7 gr/cm<sup>3</sup> for the sedimentary section and basement rocks respectively ( Fig. 7 ).

The two dimensional models and their schematic 3-D representation (Fig. 7 & 8 ) indicate the presence of a sedimentary basin progressively shifting west as one proceeds northwards. This westward shift is probably the result of the combined influence of the two conjugate shears "a" and "b" (Fig. 3 & 6). The sedimentary basin reaches a maximum depth of 8 km in the south ( Fig. 7, profile I) becoming shallower to the north (Fig. 7, profiles II & III).

Trend Analysis  
(Frequency)

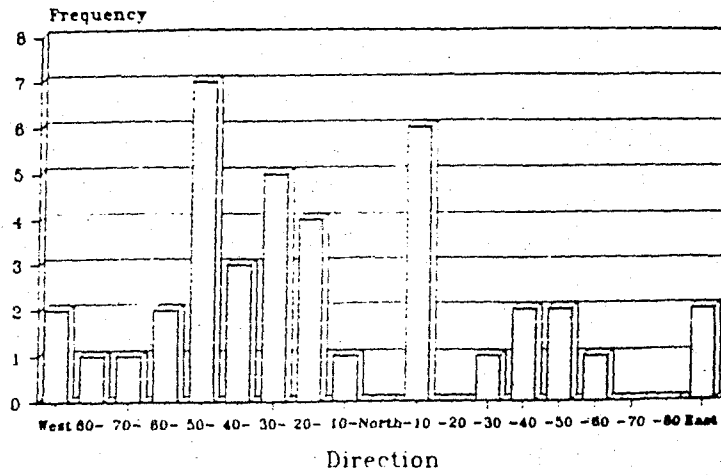


Fig. 4 Azimuth frequency distribution of faults in the area between Abu Zenima and Abu Durba.

Trend Analysis  
(Length)

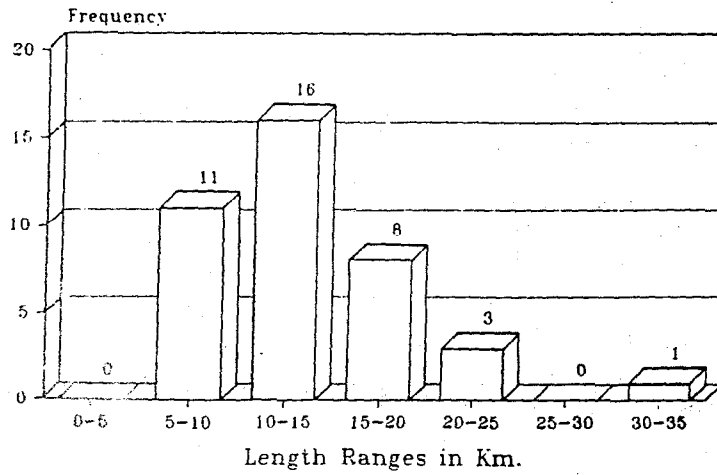


Fig. 5 Length frequency distribution of faults in the area between Abu Zenima and Abu Durba.

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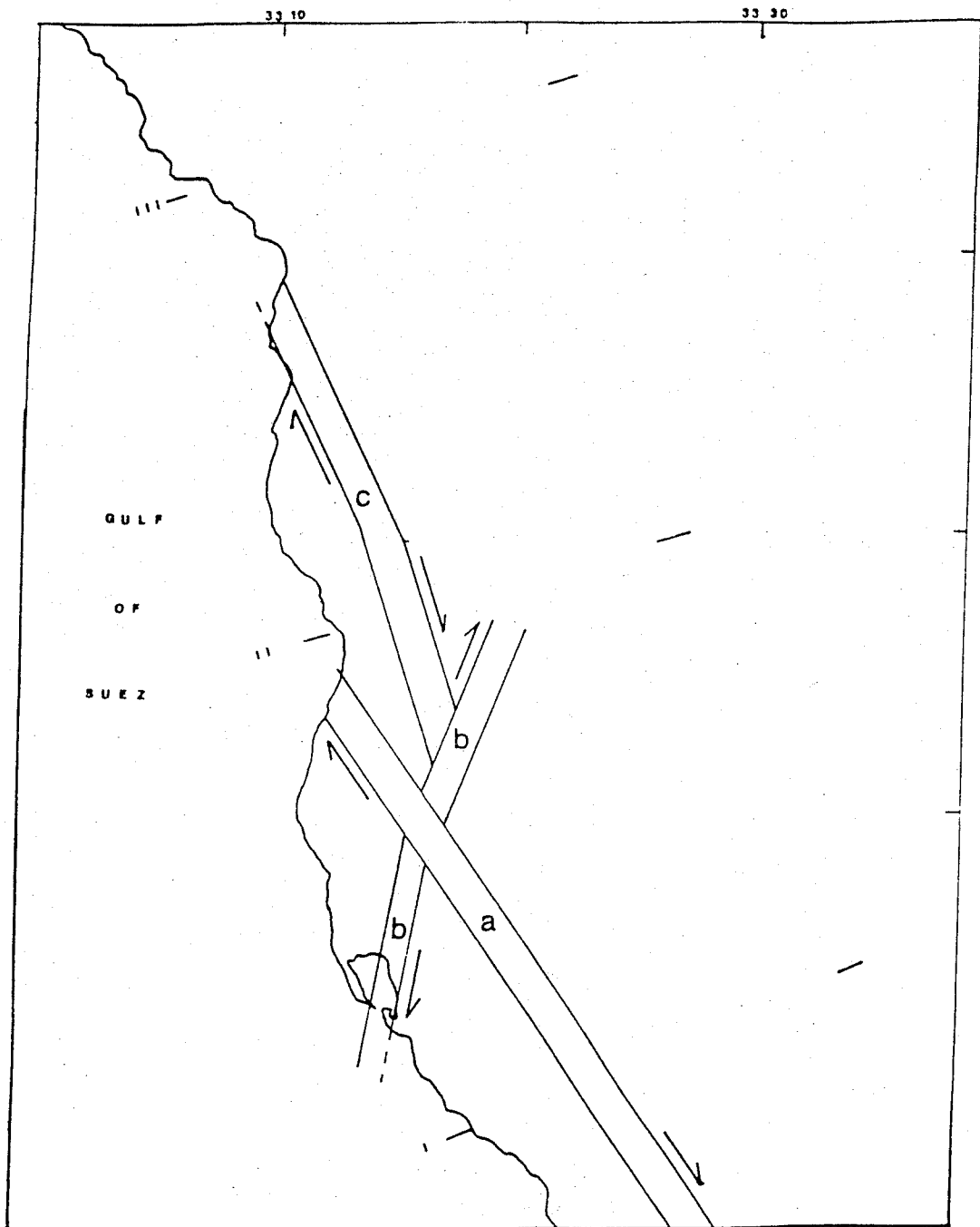


Fig. 6 Shear zones affecting the area between Abu Zenima and Abu Durba.



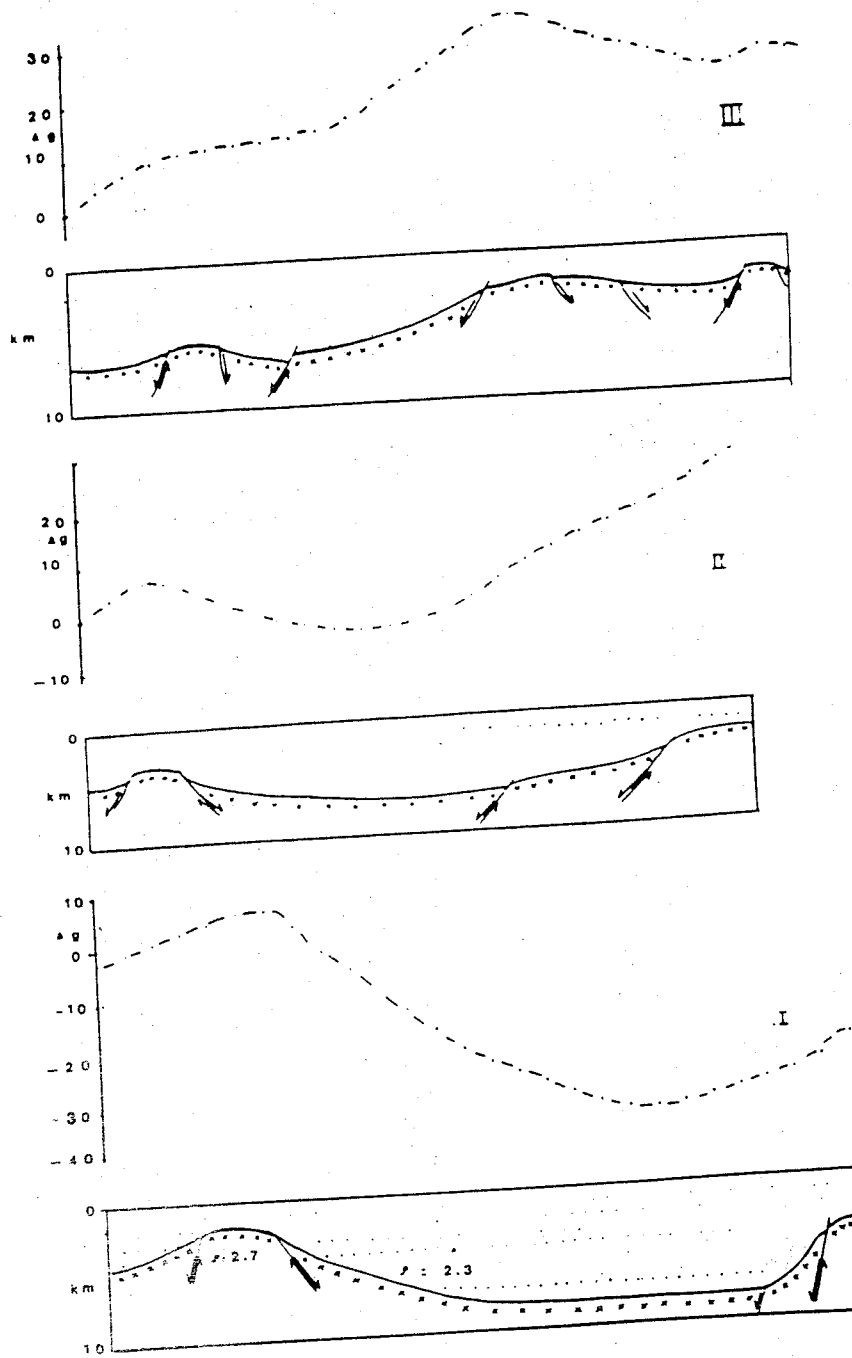


Fig. 7 2-D models of profiles I, II and III.

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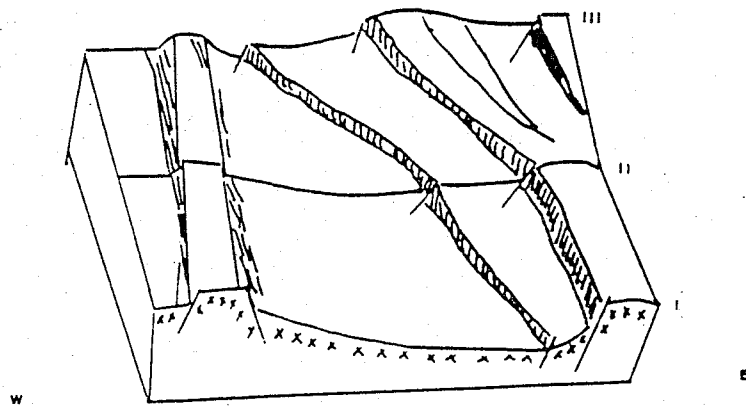


Fig. 8 3-D schematic representation of deduced sedimentary basin.

## CONCLUSIONS

1. Thirty eight faults affect the tectonic blocks in the region between Abu Zenima and Abu Durba.
2. Step faults in the north and south sections indicate the influence of the tectonics of the rifting of the Gulf of Suez.
3. Three major fault trends are noticed N 40°- 50° W, due North and N 10° - 20° W.
4. Three shear zones are identified from the relation between the identified faults. Two shear zones are found to assume a direction parallel to the Gulf of Suez (NW- SE) while the third is parallel to the Gulf of Aqaba (NE-SW). A horizontal displacement of about 40 km characterizes one of the two shears parallel to the Gulf of Suez. The three shears are characterized by right lateral sense of horizontal displacement. Non are accompanied by components of vertical displacement. These shears are probably due to the north-south compressive force resulting on a regional scale from the interaction between the African and European plates.
5. An 8 km deep sedimentary basin deduced from gravity models, is aligned with the Gulf of Suez. It is shifted westward in the middle and northern part of the Abu Zenima/Abu Durba are as a result of the combined influence of the two conjugate shear zones "a" and "b" in the southern part.

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**تأثير الحركات الأرضية الأفقية على الأحواض  
الرسوبية بالمنطقة الواقعة بين  
ابوزنيمة وابدوربه غرب سيناء - مصر  
محمود غالب**

تعكس شذات المجال التثاقلي «بوجير» بالمنطقة الوضع النسبي للبلوكات. من دراسة العلاقات بين الفوالق المستتجة يتضح وجود ثلاث حركات افقية مؤثرة على المنطقة. اثنتان منهما يصحبهما حركة رأسية نسبية الى جانب الحركة الأفقية.

من التشكيل التثاقلي الثنائي الإتجاه خلال ثلاث قطاعات يتشع وجود حوض رسوبي يتراوح عمقه ما بين ١.٨ كم و٨ كم. ويقع هذا الحوض تحت تأثير هذه الحركات الأفقية التي تؤثر عليه بتوجيه غربياً الى خليج السويس.