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GRAVITY AND MAGNETIC EVALUATION OF THE DIKE PARAMETERS IN THE NORTHERN WESTERN DESERT; EGYPT

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ABSTRACT

In a large number of exploration problems, it is valied to assume a geological structure which is related to dike model. The evaluation of the dike parameters from the gravity and magnetic anomalies were carried out by studying the behaviour of the filter operator of the horizontal and vertical gradients as well as Durantny. Powell and Koulomzine methods. The dip angle, width, density contrast and susceptibility contrasts of the interperted buried dike bodies as well as the depths to their upper and lower shoulders were determined.

The anomalies along thirty two gravity profiles were interpreted, as a dikes. The dipangle (α) of these dikes measured clockwise from (x) axis ranging from 90° to 30°. The density contrast vary from 0.155 to 0.36 gm / cm^3 while the susceptibility ranges from 0.00043 to 0.0064^8 SI. The depths to the top range from 1.41 to 3.70 Km. and the depth to the bottom ranges from 2.35 to 5.98 Km. while their width ranges from 1.10 to 2.98 Km.

Also, the statistical analysis reveales that there are two major trends to the intrusion activities, namely N-W and N-E that are parallel to the direction of the Suez trend and the Qattara trend, respectively.

INTRODUCTION

The determination of the buried dike-like body parameters from its gravity and magnetic effects attracted the attention of many authors. This was achieved by using : - 1-some characteristic points on the anomaly profile (Heiland, 1940 & 1943; Jung, 1948 & 1953 & 1961); this yields uncomplete and unaccurate values for the parameters. 2- The curve matching techniques using a least square formulation (Hjelt, 1973 & 1975), this is ambiguous as long as the depth and / or the density contrasts are not known at first.. 3- The spectral analysis of the potential effect of the buried dikes (Sharma *et. al.,* 1970; Sengupta & Das, 1977; Bhimasankram *et. al.,* 1977; and Nielsen & Pedersen, 1978), but the re-extraction of the dike parameters from spectral functions of the finite length gravity and magnetic profiles is not sufficiently accurate for different reasons (Regan & Hinze, 1977; Rao *et. al.*, 1978; and Nielsen & Pedersen, 1978). 4-a complet analysis of the field profiles (Durantny *et. al.,* 1963; Powell, 1966; Koulomzine *et. al.,* 1970; Atchuta *et. al.,* (1981). 5- horizontal and vertical gradients using Hilbert-Transform (Nabighian, 1974; Abdel Rahman, 1983 & 1984; Porma, 1985 and Abdel All, 1988).

The present study deals with precise calculation of the dike parameters from its gravity and magnetic gradients, the modulus of the analytical signal fields, the modified gradients, theirbehaviour of the filter operator with different dip angles as well as Durantny (1963). Powell (1966) and Koulomzine (1970) methods.

Some statistical representation was carried out for the detection of the direction and magnitude of the geotectonic force causing or affecting the interpreted dike-like structures.

QUANTITATIVE INTERPRETATION TECHNIQUES

The quantitative interpretation problem of gravity and magnetic data consists essentially in determining all varying parameters such as dips, widths, density contrast susceptibility contrast and depths to top and bottom faces of buried causative bodies. In the study area, the most suitable methods applied were :

A) Hilbert Transform Techniques :

The selected profiles on the gravity and magnetic maps, Fig. (5) were taken perpendicular to the strikes of the anomalies. The horizontal gradients were computed by direct differentiation of the observed gravity and magnetic anomaly profiles. The vertical gradients wer computed by using Hilbert transform techniques according to the relation :

$$g_z(x) = g_x(x) * -1 / \pi x \qquad (1)$$

Where : -

$g_x(x)$ is the horizontal gradient of gravity or magneic anamaly.

$g_z(x)$ is the vertical gradient of gravity or magneic anamaly.

The modulus analytical signal of these gradients were calculated according to the relation.

$$[A(x)] = [g_x(x)^2 + g_2(x)^2]^{1/2} \qquad (2)$$

The functions of S (x) were calculated by dividing each value of $g_x(x)$ along the profile by the corrosponding one on the profile of the modules of the analytical [A (x)] as : -

$$S(x) = g_x(x) / [A(x)] \qquad (3)$$

and the function C (x) calculated by the same manner as : -

$$C(x) = g_z(x) / [A(x)] \qquad (4)$$

Where the S (x) has one vanshing point along the traverse. This function when plotted versus C (x) shows a circular shape. The intersection of this circle with S (x) gives the location of the point at which S (x) equal to sin (x), so the dip angle ($\propto$) can be calculated (Abded - Rahman 1984). Figs. (7C, 8C, 9C, 10C,).

The density contrast ($\int$) can be calculated using the function Q (x) in the following equations : -

$$\int = [A(x)] / 2G, \sin(\propto). Q(x) \qquad (5)$$

Where :

$$Q(x) = [Ln(\Upsilon 4. \Upsilon 1 / \Upsilon 3. \Upsilon 2)^2 + (\psi_4 - \psi_2 - \psi_3 + \psi_1)]^{1/2} \qquad (6)$$

and

$$(\Psi_{cont.} / Ln_{cont.} = \Psi_4 - \Psi_2 - \Psi_3 + \Psi_1 = (1-\tan\propto) / (1+\tan\propto) \quad .... (7)$$

Where :

$\Upsilon 1, \Upsilon 2, \Upsilon 3, \Upsilon 4$ are the distances to the corners of the dike.

$\Psi_1, \Psi_2, \Psi_3, \Psi_4$ are the angles between the corrosponding (Υ) and the X-axis measured in clockwise direction Fig. (2)

The amplitude function of the analytical signal of the second derivative of the gravity gradients shows four spikes for the position of the buried corners Figs. (7E, 8E, 9E, 10E). The value of (Ln) contribution function at the mid-point of the top and bottom of the dike (Yi & Xi) reduces to Ln ($\Upsilon 2 / \Upsilon 1$) and Ln ($\Upsilon 4 . \Upsilon 3$) respectively. Consequently it can be locate the top and bottom of the dike according to the following equations : -

$$ni = t / \tan\propto$$

$$oi = t / \tan\propto \quad .... (8)$$

Where

t is the depth to top of the dike.

T is the depth to bottom of the dike.

$\propto$ is the dip angle of the dike.

ni is the distance between the point (i) and the x-coordinate of the upper corner.

oi is the distance between the point (o) and the x-coordinate of the lower corners, Figs. (7E, 8E, 9E, 10E).

In the case of vertical dikes, it is characterized by both symmetrical vertical gradient and symmetrical amplitude function of the analytical signal about the origin where the dip angle equal to 90°.

All the evaluating parameters of the dip angle, density contrast, the depths to top (t) and bottom (T) have been processed through a computer porgram, which include the whole sequences of graphical and computional relations.

In the area under study; Fig (1); the Bouguer anomalies, Fig (3), was analysed. A total of (118) tectonic structures were traced; Fig. (4). A gravity profiles were taken in a perpendicular direction to these strucures. The horizontal and vertical gradients of each profile were calculated and poltted versus each other. A total of (32) buried dikes were identified; Fig. (5). They were indicated by an ellipsoidal relation figures, where their long axes makes an angle with the g_2 (x) axes equal to the dip angle of the dike plane while the normalized gradients, when plotted one against other, give a circular shape for the dikes with any dip angle; Figs. (7B, 8B, 9B, 10B). At the same location of the gravity interpreted dikes; a profiles were taken on the magnetic map Fig. (6). Twinty eight profiles from thirty two were interpreted as dike structures. The dip angles are directly computed and plotted. Accordingly, twinty one of these dikes were identified as inclined dikes, and eleven as vertical dikes. Concequently the depths to the upper and lower surfaces as well as the density contrast with the surrounding rocks were calculated. Table (1) represents all the calculated parameters. Figs. (7, 8, 9, 10) show plots of the different steps of the evaluting procedure along profiles

B) Koulomzine *er. al.,* (1970) method : -

For the direct interpretation of the magnetic anomalies caused by inclined dikes of infinite lingth, where the field profiles is decomposed into its symmetrical and antisymmetrical components, which are analysed seperatly.

The determination of the depth and width of these inclind dikes deponds on the position of their centers, which can be obtained from the graphical, computarional, and the slope techniques of Lamontagne (1970); Fig. (11).

Koulomzine *et. al.,* (1970) gave the following formulae for the determination of the depth and width of the dike structures.

$$\text{Depth (h)} = x_{1/2} \cdot [(Cl^2 - 1) / 2] \qquad \text{.............................(8)}$$

$$\text{Width (W)} = 2x_{1/2} \cdot [4 - (Cl^2 - 1)^2)^{1/2}) / 2]$$

Where (Cl), being a quotient, is scalar and is independent of any measurement units, and equal $X_{1/2} / X_{3/4}$; where $X_{1/2}$ and $X_{3/4}$ are the distances between the point of the half and three-quarters maximum values of the symmetrical components.

or.

$$\text{Depth (h)} = 2x_e \cdot [(1 - U)^2 / 4U]$$

$$\text{Width (w)} = 2x_e \cdot [4U^2 - (1 - U)^4)^{1/2}) / 2U] \qquad \text{........................ (8)}$$

Where (U) being a quatient, is scalar and is independent of any measurement units, and equal $X_{e/}$ $X_{e/2}$. X_e and $X_{e/2}$ are the maximum and half values of the antisymmetrical components.

The location of the centers (X - 0) of the profiles have been established by the Lamontagne method (1970) and Powell's method (1966). Fig. (11). Then the parameters of all interpreted dykes along (21) profiles are represented in Tabel (1)

C) Powell's method (1966) :

This method determines the minimum adjustment needed to give an observed profile that symmetry shown by all model dike, and vertical fault-step, anomalies. In this method the profile can be resolved into its odd and even components. It was applied to the previously interpreted profiles and the results are represented in Table (1), and Fig. (12).

D) Durantny *et. al.,* (1963) method :

It was introduced by Duranty and M.Karsin (1963) using the two components Z (vertical) and h (horizontal) of the earth's magnetic field. Further development was made by El-Diasty (1969) using the total force T.

The method satisfies the general case of a dyke which is magnetically homogeneous and polarized in any direction. To apply this method the symmetrical curve along profiles was computed and the maximum magnetic intensity value (Y max) was determined. if Y2 was the abscissa of the point with the value of Y = 1/ 4 max, and Y1 was the adscissa of the point with value of Y = 1/ 2 Ymax, the depth (h) and width (2h) of this dike can be computed from the following equations : -

$$h = \pm (Y2^2 - Y1^2) / (2Y1) \qquad b = \pm (Y1^2 - h^2)^{1/2} \quad \text{.................. (8)}$$

According to Diasty (1969) an apporximation value of the susceptibility contrast between the rock body and the surrounding rocks (taking no account of remanent magnetization) can be calculated as follows : -

The anamaly for a hemispherical body = 2 Π Y

hence $$2\,\Pi\, Y = \Delta T\,(180 / \emptyset) \quad \text{..................... (8)}$$

where

$\emptyset$ is the space angle of the body and $Y = \Delta KZ_0$; and Z_0 represents the vertical component of the earth's magnetic field, ΔK is the susceptibility contrast, then $2\,\Pi \Delta KZ_0 = \Delta T\,(180 / \emptyset)$ Knowing b and h then the space angle ($\emptyset$) of the body = 2 arctan b / h (El-Diasty 1969).

According to Ahmed *et. al.,* (1980), the vertical component of the earth's magnetic field (Z_0) in the study area is 29000 net. Then $\Delta K = (\Delta T\,(180/ \emptyset) / (2\,\Pi\, Z_0)$ where $\Delta T = 1/2\,\Delta$ Tmax. The parameters of the interpreted dykes along the magnetic profiles are represented in Table (1) and Fig. (13).

E) Statistical Analysis.

The trend analysis of the interpreted anomalies was carried out. The major trends of the evaluated dikes are represented in Table (2). They are represented graphically, as shown in Fig. (14), to give rise the relationship between the number of the major trends and their depths.

RESULTS

The application of the above methods to the selected profiles of the gravity and magnetic maps of the area under study lead to the following : -

1 - The area may be affected by intrusions represented by inclined and nearly vertical dykes having the NE - SW trend perpendicular to twinty three profiles and the NW - SE direction perpendicular to nine profiles; Fig. (14).

2 - The dip angle of the inclined dikes range between 30° and 69°, 87, the density contrast between the dikes and the surrounding rocks range between 1.55 and 0.36 gm/ cm^3 while the susceptibility contrast range between 0.00043 and 0.00648 SI. The depths to their upper shoulders range between 1.41 and3.70 Km. while the depths to lower shoulders range between 2.35 and 5.98 Km. The width of the dikes range between 1.10 and 2.98 Km.

3 - The statistical analysis reveals that there are two major trends of intrusion, namely, N-E and N-W that are parallel to the directions of the Suez trend and the Qattara trend respectively.

4 - It can be seen from Fig. (14) that the depth of the maximum number of anomalies representing the N-E trend is less deeper than that representing the N-W trend. This leads to the conclusion that the tectonic phase, which was responsible for the formation of the N-W structural trend is older than that which was responsible for the formation of the structural pattern having the N-E trend. Such tectonic phases are probabaly due to the rejuvenation of the tectonic activities occuring in the Pre- Cambrian.

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Table (1): The interpretd dike parameters of the gravity profiles.

Profil No.	Type of Dike	Parameters calculated using Amplitude Function of the Analytical Signal /A (x)/					
		Dip Angle	Dansity Contrast	ψ Contribution	Depth to Top	Depth to Bottom	Width of Dike
G (1)	Vertical	90.000	0.331	8.432	3.50	5.63	2.30
G (2)	Inclined	35.290	0.260	- 11.653	2.53	3.75	2.76
G (3)	Vertical	90.000	0.226	- 10.090	2.50	4.98	1.80
G (4)	Inclined	46.010	0.251	6.472	2.37	3.94	1.70
G (5)	Inclined	31.180	0.333	7.111	2.15	3.50	1.14
G (6)	Vertical	90.000	0.262	6.218	2.14	3.13	1.34
G (7)	Vertical	90.000	0.242	5.516	1.88	3.31	1.72
G (8)	Inclined	48.191	0.218	8.321	1.91	2.18	1.83
G (9)	Inclined	30.000	0.250	12.637	1.74	3.75	1.90
G (10)	Inclined	35.080	0.310	10.211	1.96	2.85	1.81
G (11)	Inclined	38.916	0.281	8.635	1.51	2.44	1.65
G (12)	Inclined	48.631	0.262	7.384	2.10	4.62	1.88
G (13)	Inclined	57.213	0.238	6.814	2.16	3.10	2.01
G (14)	Vertical	90.000	0.249	9.250	2.41	5.35	2.31
G (15)	Vertical	90.000	0.250	6.143	3.88	5.75	2.11
G (16)	Inclined	65.213	0.230	7.190	2.95	3.81	1.55
G (17)	Inclined	57.311	0.252	6.511	2.88	3.64	1.80
G (18)	Vertical	90.000	0.144	10.917	1.70	2.31	1.24
G (19)	Vertical	90.000	0.244	8.332	1.86	4.54	2.90
G (20)	Inclined	44.180	0.255	7.981	2.43	3.11	2.61
G (21)	Vertical	90.000	0.256	8.292	2.83	4.15	2.11
G (22)	Vertical	90.000	0.225	7.783	1.90	4.52	1.52
G (23)	Inclined	38.661	0.228	8.152	1.73	2.30	1.26
G (24)	Inclined	45.868	0.236	8.663	1.81	2.43	1.66
G (25)	Inclined	21.917	0.261	7.525	2.10	3.18	2.21
G (26)	Inclined	50.331	0.256	9.175	3.11	3.97	1.33
G (27)	Vertical	90.000	0.355	10.056	1.14	4.40	2.57
G (28)	Inclined	37.271	0.248	4.818	1.56	2.71	1.23
G (29)	Inclined	34.382	0.261	8.141	2.31	3.16	1.64
G (30)	Inclined	43.501	0.276	6.507	2.83	5.78	2.04
G (31)	Inclined	47.167	0.155	6.186	2.85	5.63	2.76
G (32)	Inclined	53.816	0.215	7.213	2.51	3.68	1.66

Table (2); The interpretd dike parameters of the magnetic profiles.

Profil No.	Type of Dike	Interpreted parameters of the Dikes Using: Amplitude Function of Analytical Signal / A (x)/								Interpreted parameters of the Dikes Using: Durantny Method				Koulomzine Method		
								Powell's Method								
		Dip Anglo	Density Contrast	ψ Contribution	Depth to Top	Depth to Bottom	Width of Dike	Depth to Top	Width	Depth to Top	Width	The Space angle	Sucep. Contrast	Depth to Top	Width of Dike	Dip Angle
M (1)	Vertical	90.000	0.234	6.321	3.70	5.85	2.40	3.41	2.25	3.25	2.21	37.556	.00320	--	--	--
M (2)	Inclined	35.290	0.361	8.080	2.80	3.98	2.88	2.48	2.19	2.66	2.43	49.098	.00276	2.60	2.31	38.15
M (3)	Vertical	90.000	0.322	9.321	2.85	5.25	1.90	2.45	1.71	2.33	1.58	37.459	.00132	--	--	--
M (4)	Inclined	47.167	0.155	6.186	2.85	5.83	2.76	2.30	1.65	2.21	1.54	38.418	.00257	2.28	1.66	48.80
M (5)	Inclined	31.180	0.213	6.181	2.18	3.75	1.18	2.18	1.10	2.01	1.13	28.742	.00215	2.13	1.11	37.11
M (6)	Vertical	90.000	0.252	8.316	2.16	3.60	1.45	2.09	1.28	1.96	1.23	34.841	.00319	--	--	--
M (7)	Vertical	90.000	0.324	7.134	1.95	3.83	1.81	1.75	1.69	1.68	1.65	52.308	.00118	--	--	--
M (8)	Inclined	48.191	0.331	4.611	1.99	2.39	1.84	1.88	1.75	1.75	1.71	52.077	.00118	1.71	1.80	51.33
M (9)	Inclined	30.000	0.260	0.384	1.83	3.88	1.99	1.78	1.81	1.61	1.76	57.320	.00108	1.59	1.88	36.18
M (10)	Inclined	35.080	0.220	9.643	2.01	2.91	1.91	1.88	1.73	1.81	1.62	48.218	.00128	1.91	1.78	38.31
M (11)	Inclined	38.916	0.353	9.717	1.68	2.62	1.73	1.78	1.55	1.44	1.53	55.950	.00220	1.39	1.60	42.16
M (12)	Inclined	48.631	0.322	8.432	2.17	4.98	1.96	2.09	1.79	1.96	1.76	48.358	.00255	2.02	1.81	51.86
M (13)	Inclined	57.213	0.341	8.416	2.23	3.44	2.15	2.10	1.98	1.98	1.91	51.490	.00241	2.00	1.89	60.76
M (14)	Vertical	90.000	0.329	9.158	2.61	5.72	2.45	2.51	2.10	2.37	2.02	46.163	.00134	--	--	--
M (15)	Vertical	90.000	0.351	8.231	3.95	5.93	2.22	3.80	2.01	3.71	1.94	29.304	.00211	--	--	--
M (16)	Inclined	65.213	0.338	6.240	[illegible].06	3.97	1.63	2.86	1.48	2.81	1.41	28.168	.00263	2.88	1.49	69.87
M (17)	Inclined	57.311	0.268	7.151	3.41	3.86	1.92	2.78	1.77	2.73	1.75	35.542	.00208	2.81	1.73	62.80
M (18)	Vertical	90.000	0.264	1.181	1.41	2.64	1.31	1.83	1.35	1.57	1.12	39.261	.00252	--	--	--
M (19)	Vertical	90.000	0.341	9.441	1.99	4.73	2.98	1.79	2.81	1.63	2.70	79.264	.00125	--	--	--
M (20)	Inclined	44.180	0.352	8.776	2.60	3.32	2.73	2.50	2.66	2.31	2.51	57.029	.00043	2.38	2.56	48.13
M (21)	Vertical	90.000	0.365	6.541	2.91	4.19	2.21	2.79	2.02	2.71	1.96	39.762	.00093	--	--	--
M (22)	Vertical	90.000	0.255	- 7.783	1.90	4.42	2.15	1.86	1.43	1.65	1.30	45.387	.00544	--	--	--
M (23)	Inclined	38.661	0,221	7.321	1.88	2.43	1.31	1.68	1.24	1.61	1.10	37.721	.00327	1.64	1.10	42.14
M (24)	Vertical	90.000	0.351	1.121	1.16	4.55	2.60	1.11	2.41	1.05	2.30	95.205	.00648	--	--	--
M (25)	Inclined	37.271	0.281	5.489	1.68	3.07	1.30	1.48	1.18	1.40	1.11	43.249	.00142	1.44	1.10	43.10
M (26)	Inclined	34.382	0.268	9.315	2.45	3.25	1.71	2.21	1.58	2.10	1.53	40.031	.00154	2.25	1.54	45.81
M (27)	Inclined	43.501	0.255	8.661	2.96	5.98	2.15	2.88	2.11	2.71	1.98	40.135	.00307	2.75	1.99	49.16
M (28)	Inclined	47.167	0.210	7.818	2.98	5.77	2.83	2.91	2.80	2.72	2.66	52.114	.00236	2.77	2.68	51.54

Fig. (12): Interpretation of dike geometry from even component of a djusted profiles "M4" and "M27".

Fig. (13): Analysis of the magnetic anomaly curve "M4" and "M27".

Fig. (14): Relation between No. of anomalies of the major trends of the interpreted dikes and their depths.

Table (3): Direction of major trend and their number of anomalies represented in the area

Direction of the major trend	Number of anomalies
N - W	9
N - E	23

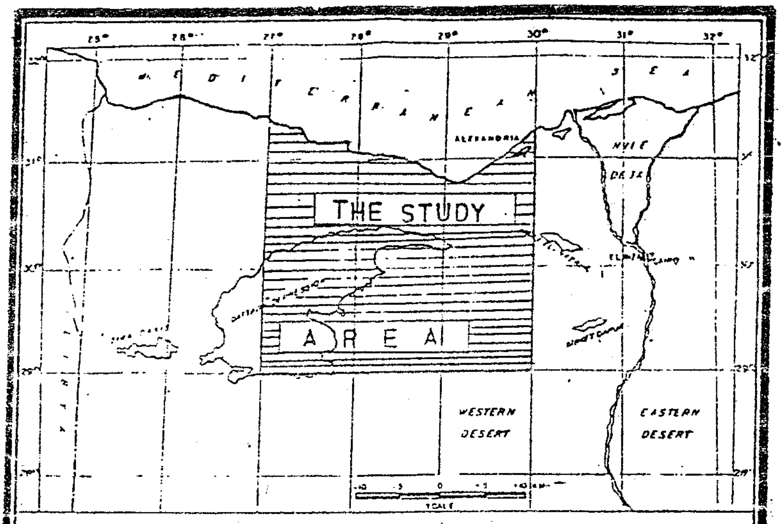

Fig. (1) : Location map of the study area

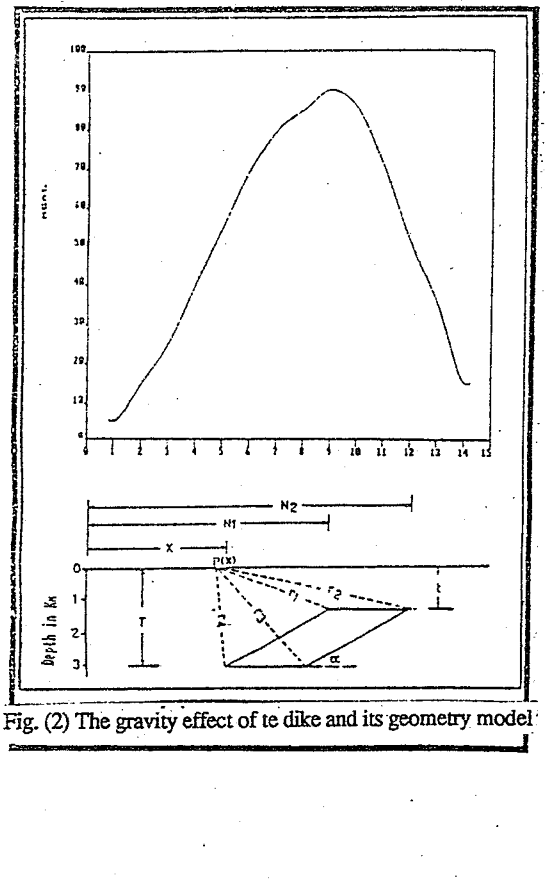

Fig. (2) The gravity effect of te dike and its geometry model

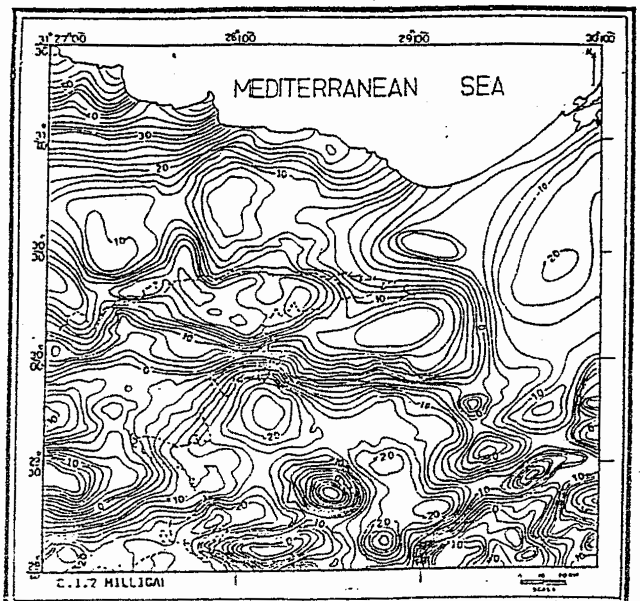

Fig. (3) : Bouguer gravity map of the area under study, (After G.P.C. 1986)

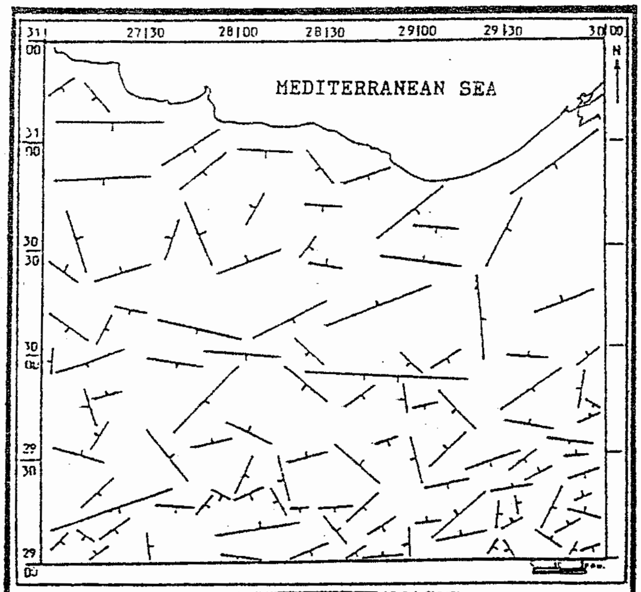

Fig. (4) : Tectonic pattern derived from bouguer gravity map

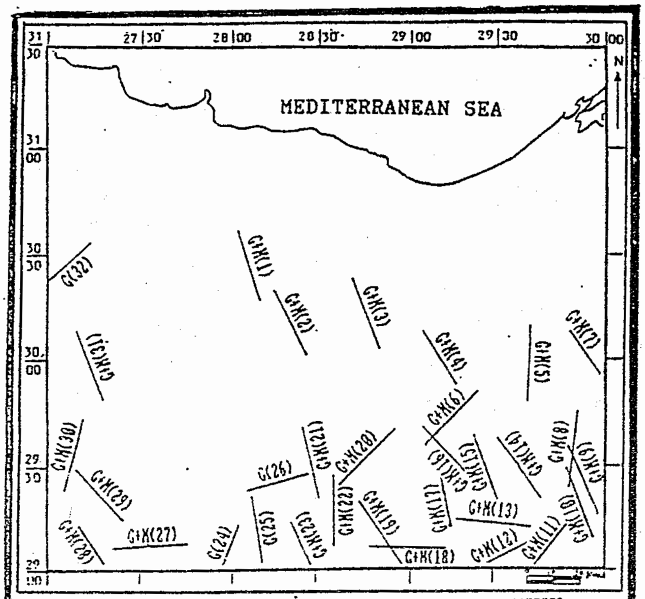

FIG.(5):TECTONIC PATTERN OF THE DIKES LOCATION DERIVED FROM BOUGUER GRAVITY AND TOTAL MAGNETIC INTENSITY MAPS

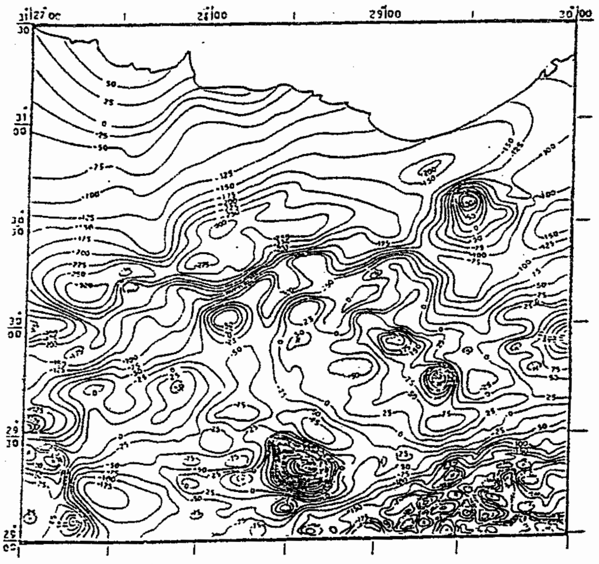

FIG.(6):TOTAL MAGNETIC INTENSITY MAP OF THE AREA UNDER STUDY (AFTER G.P.C.1986)

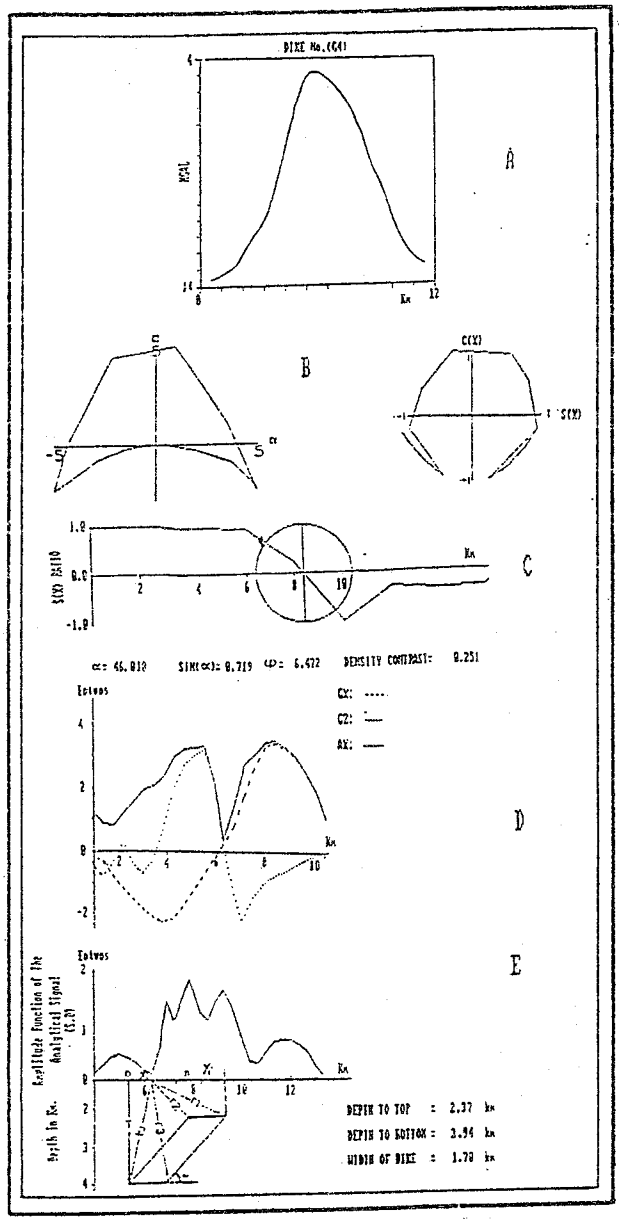

Fig. (7) : (A) The gravity effect along profile G(4), (B) Warner's types, (C) dip angle determination, (D&E) Interpreted parameter of Inclined dike

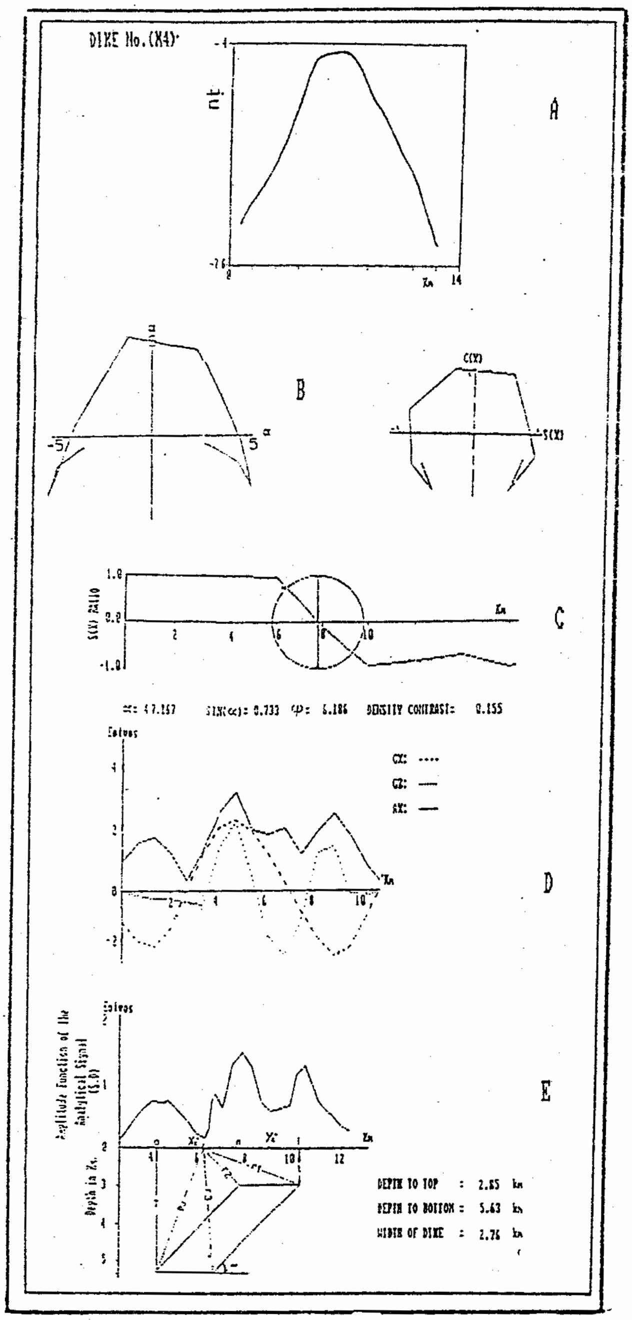

fig. (8) : (A) The gravity effect along profile M(4), (B) Warner's types, (C) dip angle determination, (D&E) Interpreted parameter of Inclined dike

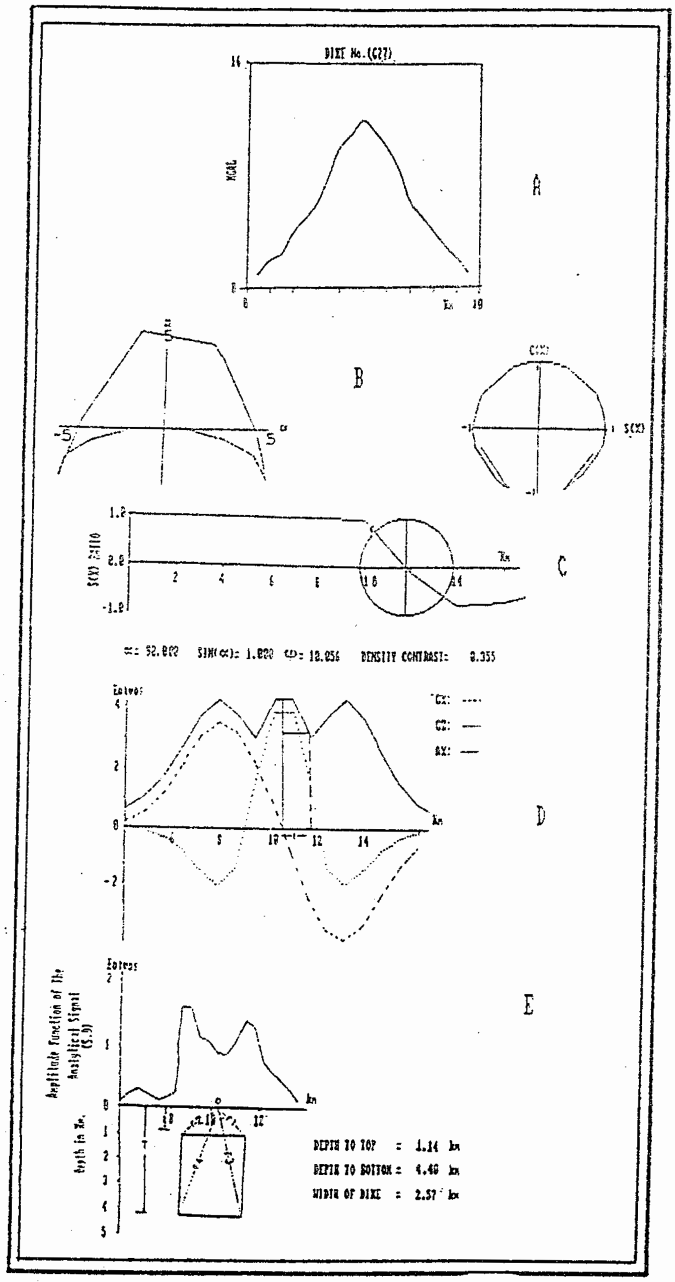

Fig. (9) : (A) The gravity effect along profile G(27) (B) warner's types, (C) dip angle determi nation, (D&E) Interpreted parameter of Vertical dike

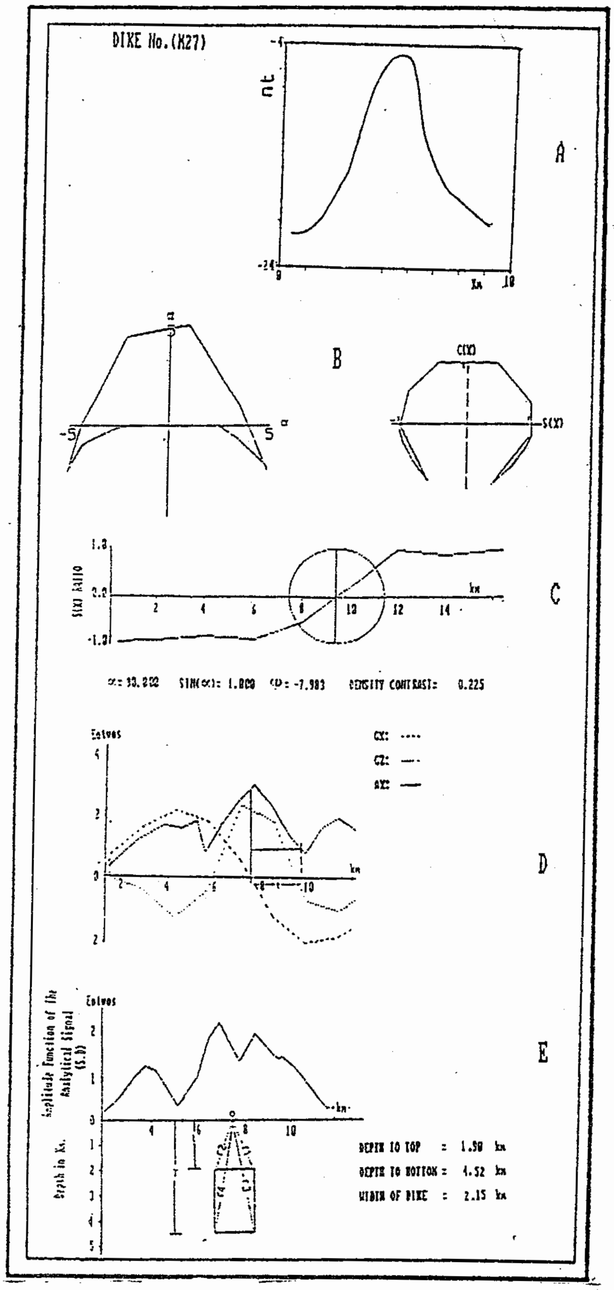

Fig. (10) : (A) The gravity effect along profile M(27), (B) Warner's types, (C) dip angle determination, (D&E) Interpreted parameter of Vertical dike

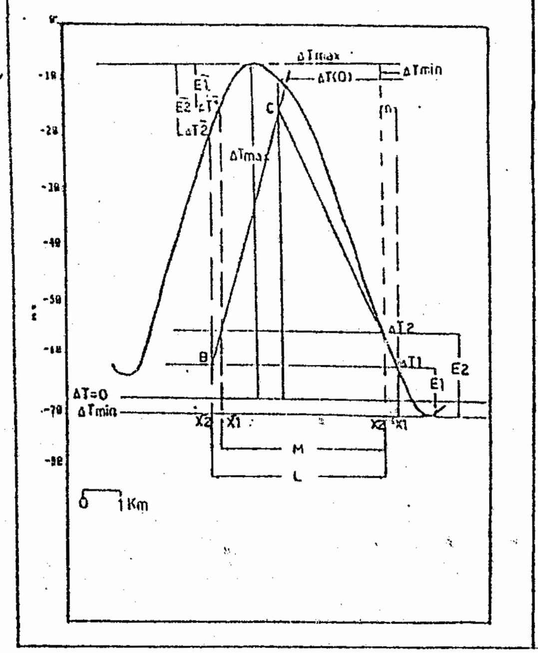

Fig. (11 A) : Location of the origin of the magretic profile "M4" using lamontagne, referred by koulomzire *et, al.*, (1970).

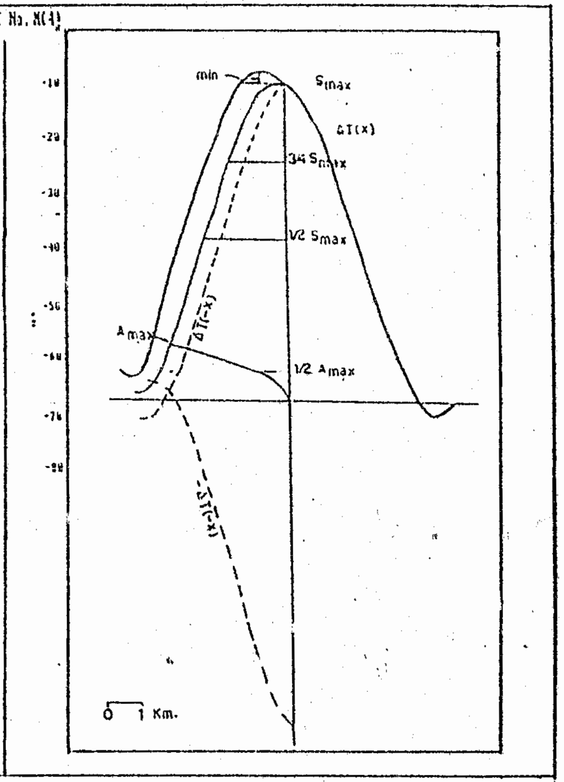

Fig. (11 B) : Seperation or the magretic profile "M4" into its symetrical and antisymmetrical compoments used to interpret the geometry of the magoetic dids. (Applying koulomzine, *et.. al.,* Method, (1970).

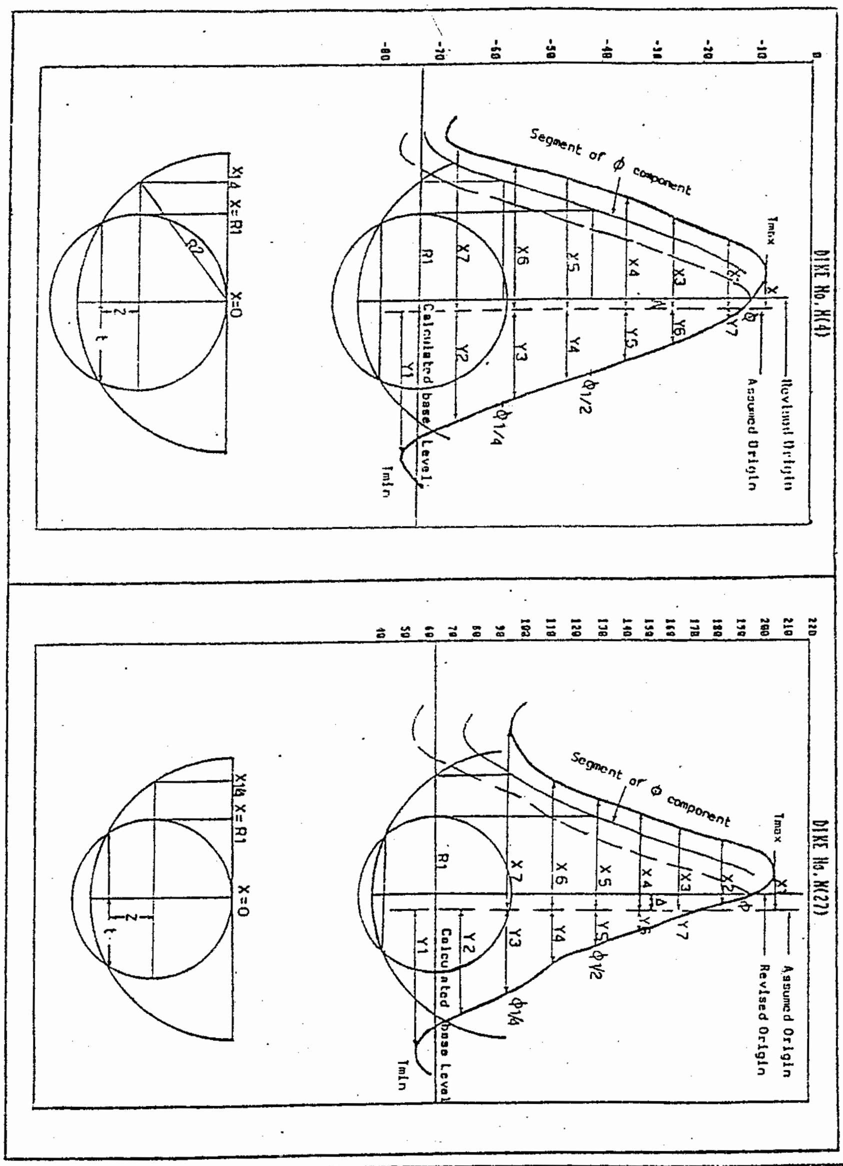

Fig. (12) : Interpretation of dike geometry from even component of djusted profiles "M_4" and "M_{27}".

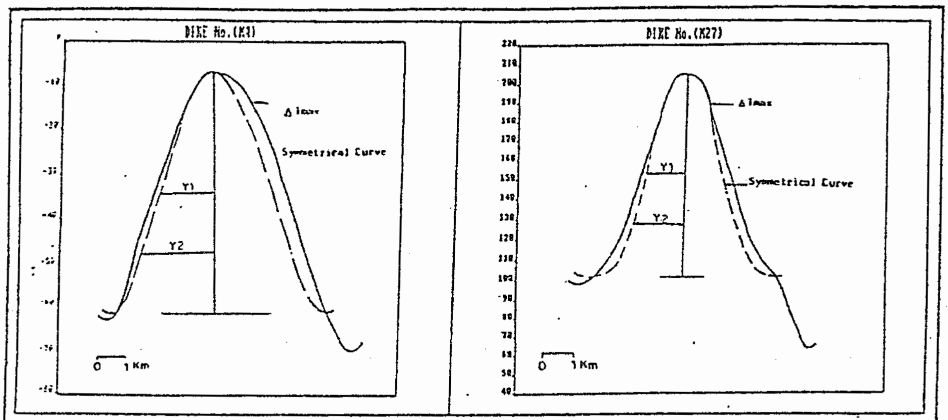

Fig. (13) : Analysis of the magretic anomaly curve "M_4" and "M_{27}"

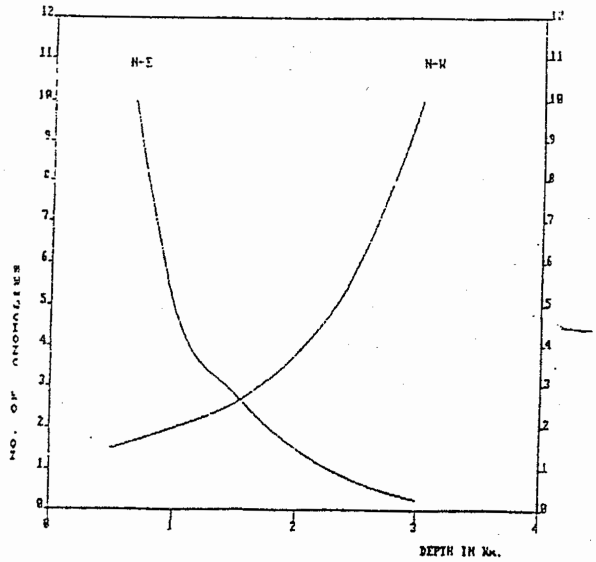

Fig. (14) : Relation between no. of anomalies of the major trends of the interpreted dikes and their depths.

التقييم التثاقلى والمغناطيسى لاحداثيات الجدد النارية
فى شمال الصحراء الغربية - مصر

محمد شرف	محمد العوضى	حسين توفيق
علوم بنها	علوم طنطا	المعمل المركزى - جامعة طنطا

يتناول هذا البحث دراسة الغرائب التثاقلية والمغناطيسية وتفسيرها للتعرف على تراكيب الجدد النارية حيث تم تحليل كيفى وكمى باستخدام تحويلات الهلبرت وطرق باول وديبورنت وكلوموزين لاستباط الاشكال الهندسية للجدد النارية وتشمل الزوايا وتحديد اعماق الاسطح العلوية والسفلية والكثافة المتباينة وقد وجد ان المنطقة متأثرة بعدد ٣٢ جدد نارى تم تحديدها بواسطة الطرق التثاقلية بينما تم تحديد ٢٨ جدد نارى فقط بالطرق المغناطيسية وقد تم تحديد عدد ٢١ جدد نارية مائلة وعدد ١١رأسية . كذلك فقد وجد ان عمق السطح العلوى للجدد النارية يتراوح ما بين ٤١ر١ و٧ر٣ كم وعمق السطح السفلى يتراوح ما بين ٣٥ر٢ و٩٨ر٥ كم وان الكثافة المتباينة بينها وبين الصخور المحيطة بها تتراوح ما بين ١٥٥ر٠ و٣٦ر٠ جم /سم٣ وكذلك فقد تم تعين Susceptibility contrast ويتراوح ما بين ٠٠٤٣ر٠ و٠٦٤٨ر٠ SI .