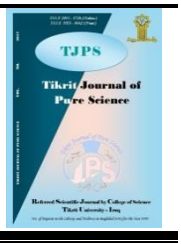
Tikrit Journal of Pure Science 23 (4) 2018

ISSN: 1813 – 1662 (Print)
E-ISSN: 2415 – 1726 (On Line)

TJPS

TIKRIT JOURNAL OF PURE SCIENCE

Journal Homepage: http://main.tu-jo.com/ojs/index.php/TJPS/index



Self-potential near surface and subsurface Investigation for soil and ground water in Farming land nearby Quldara Village /Northeast Kirtuk/Nothern Iraq

Dhahir K. ALI

Department of Physics , College of Education of pure science University of Kirkuk , Kirkuk , Iraq

ARTICLE INFO.

Article history:

-Received: 2 / 1 / 2017

-Accepted: 25 / 1 / 2018

-Available online: / / 2018

Keywords: Self-potential (SP), soil analysis, Ground water.

Corresponding Author:

Name: Dhahir K. ALI

E-mail: dhahirgeo1958@gmail.com

Tel:

Abstract

Near surface soil and subsurface self-potential investigations were carried out in farming land nearby Quldara Village/Northeast Kikruk town about 15 km at area about 63000 m^2. Nine soil samples has been taken to determine texture, organic materials percentage , PH, electric conductivity Ec and electric resistivity in the laboratory. Geophysical Self-potential method survey applied through six lines, the separation was teen meters between the electrodes of the employed instrument and teen measurement points has been taken , each line was 100 m. The self-potential data processed and presented as profiles and contour maps. Soil analysis proved that it is composed of homogeneous sandy clayey silt with normal content of organic materials and salt with moderate acidity, it is suitable for crop growin. Self-potential data interpretations indicated that the possibility of ground water in the study area.

1-Introduction

The present research concerning a land nearby Quldara village at Shuwan Suburb 15 km northeast of Kirkuk town fig.(1), Its area is about 63000 m^2. The aim is to change it to farming area of different vegetable grown in the future, especially there no any knowledge about the nature of soil and water resources which important to any agriculture projects.

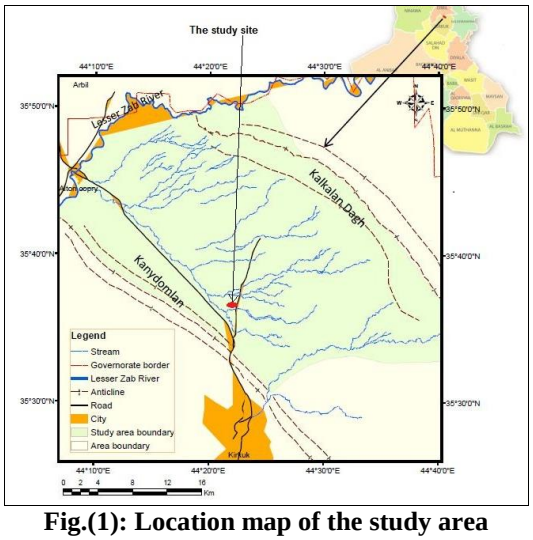


Fig.(1): Location map of the study area

The Self-potential method is playing a good role in achievement of great problems in geophysics, its principle is the measurement of natural occurring potential difference in the earth. The methods that can be used for the identification of underground water, it can be produces from electrochemical, electro kinetic and thermoelectric sources. It has been increasingly applied in groundwater and geothermal investigations, environmental and engineering applications mapping seepage flow associated with dams, geological mapping, delineate shear zones and near surface faults.

The Self-Potential method has been used in worldwide applications in many geophysical problems, it used to propose a least squares inversion algorithm [1] and determine the spatially variable depth of the water table in shallow unconfined aquifers. It applied in derivative analysis method to higher derivatives to estimate the depth and shape of buried structure from self-potential (SP) data [2]. A researcher studied the problem of a polarized cylinder with a small cross-section [3], the polarization geometry simulates the self-potential field produced by a horizontal flow. The SP was conducted in a study to map underground river flow in the karst area [4] to reduce the impact of drought during the dry

season. A study of Water flow in the subsoil generates electrical currents measurable at the ground surface with the self-potential method has been conducted [5] to estimate the water-table elevation from SP data measured at the ground surface. The geological research which enclosed in the study area are, the application of the electrical resistivity method in hydrogeology of Jolack basin by [6] and the study of Salinity of groundwater of Kirkuk by [7].

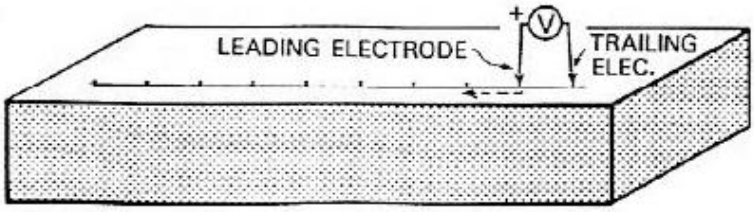
The objective of the study is to explore near surface soil characteristics and possible underground water existence.

2- Geological setting

The study farming land is situated in the basin area which is a part of the foothill zone in the folded area of unstable shelf in Iraq [8], structurally is located between the Kalkalan Dagh Mountain and Kirkuk with a width ranging from (15 –20 km). The area is characterized by the presence of some seasonal valleys nearby the site ranging from (20 -100 m) in width with a depth of (1-3 m) and its deposition consists mainly of Sand, Clay and Gravel, there is alluvial plain deposit (river terraces) which covers the site, the sediment composed of silt, clay, fine gravel and sand [9].

3-Material and methods.

The Self-potentials survey was carried out using the field techniques electrode configurations Potential gradient method fig.(2) which called (dipole/leap frog/gradient configuration), the separation between the 2 electrodes is 10 m which measures the potential difference between the two electrodes .



Fg.(2): leap frog configuration survey.

Self-potentials measurement was carried out using two non polarizable porous pot electrodes connected to precision voltmeters capable of measuring to at least 1 mV. Each electrode is made up of a copper electrode dipped in a saturated solution of copper sulphate which can percolate through the porous base to the pot.

Six survey line were conducted in the study area (line1, line2, lin3, line4, East line, west line) fig.(3), the separation between the two electrodes was (10) m ,ten leap points was taken in every line ,the total profile length line was (100)m.

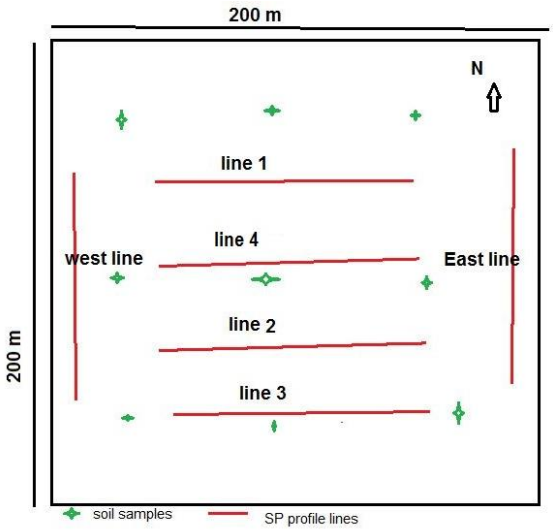


Fig.(3): Site map showings locations of survey lines and soil samples.

To hold near surface soil investigations in the agriculture laboratory nine soil samples was taken in (0.3) m depth at the site subjected to particles analysis, pH ,electric conductivity (Ec), organic material content percentage . Electric resistivity was determined for soil samples in the physics department table (1).

Table 1: Soil samples analysis results.

Sample no	Soil desciption	Ec (mS)	pH	Organic material %	Electric resistivity(Ω.m)
1	Clayey sandy silt	0.09	7.52	1.3	3.03
2	Sandy Clayey silt	0.1	7.69	2.2	2.88
3	Sandy clayey silt	0.06	7.8	1.37	3.19
4	clayey sandy silt	0.08	7.9	2.44	4.55
5	Clayey sandy silt	0.03	7.89	2.17	15.19
6	Sandy clayey silt	0.04	7.81	2.74	18.2
7	Clayey silty sand	0.05	7.95	3.9	30.2
8	Silty clayey sand	0.07	7.91	2.21	31.4
9	Clayey silty sand	0.04	7.83	1.81	30.8

The self potential measured observed constructed as contour maps using Surfer (8) Software, the gridding data procedure is applied by kriging data interpolation fig.(4). For construct regional contour map third order polynomial regression fig.(5) was applied by subtraction it from the observed one, the residual contour map fig.(6) could be interpreted.

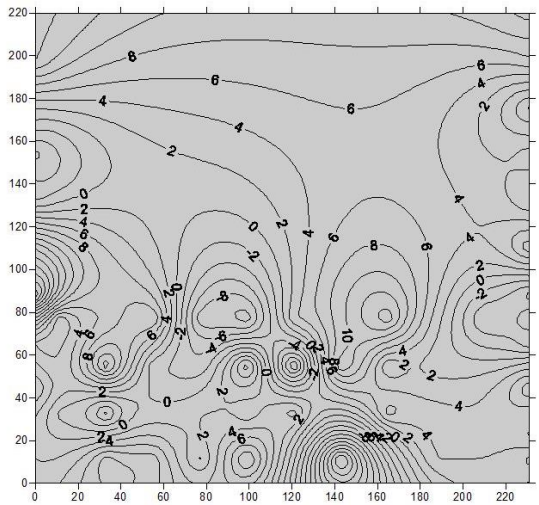


Fig.(4): Observed Self potential contour map.

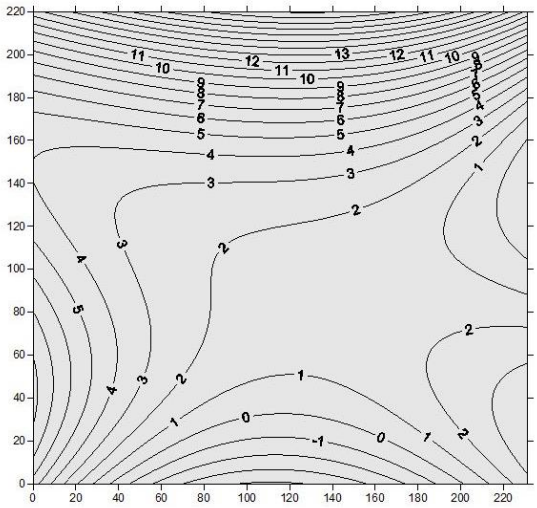


Fig.(5): Regional self potential contour map.

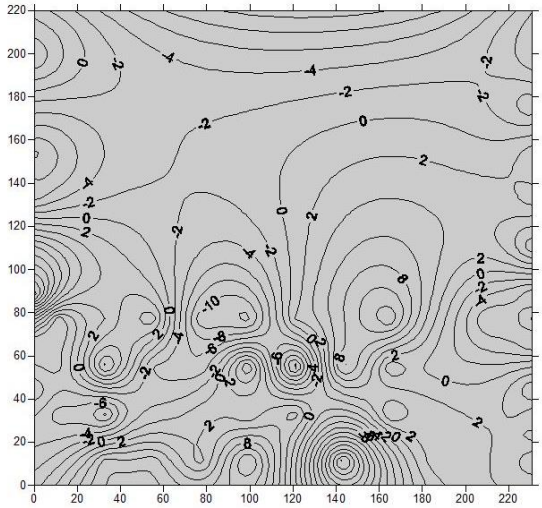


Fig.(6) : Residual self potential contour map.

The results of the self potential survey are represented as profiles fig.(7) and contour maps .
Self-potential anomalies are interpreted qualitatively as Contour model, Amplitude, Polarity in positive or negative manners and Profile shape.

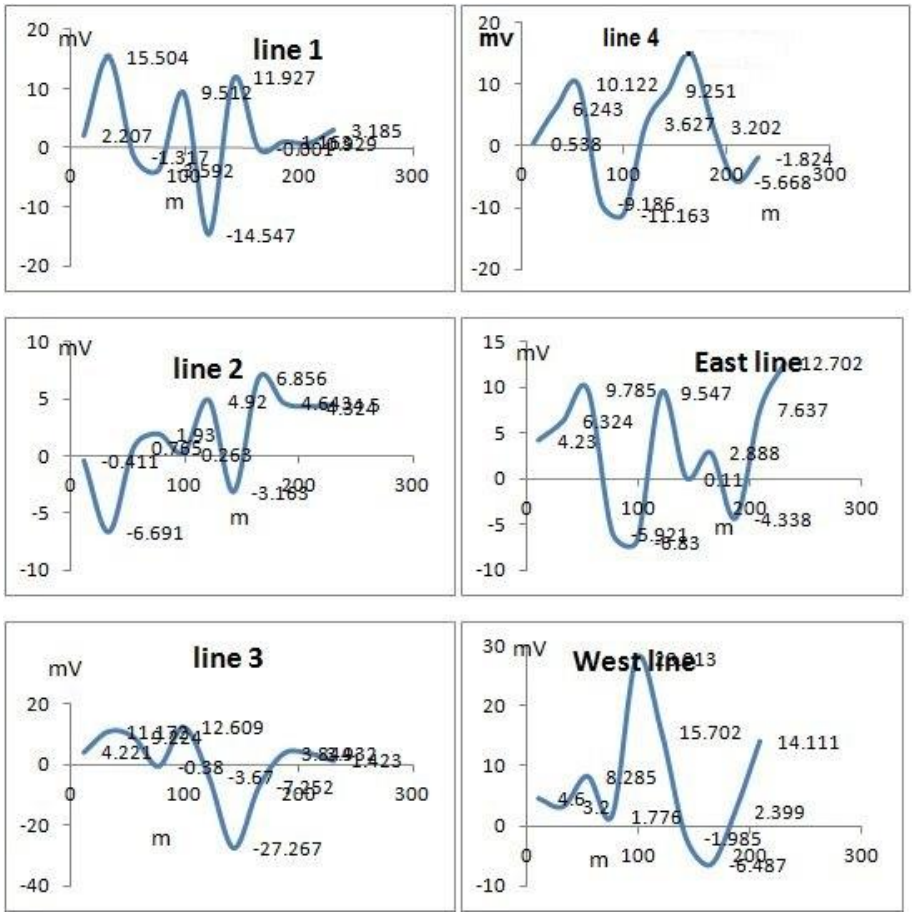


Fig.(7): Self potential line profile curves.

4- Result and Discussion

The soil samples results showing that the site is compose of sandy clayey silt generally ,the electric resistivity tests (2.8-30.8) ohm.m reflect the constituent nature of that lithology of low values. Electric conductivity value (0.03-0.1) mS denote little amount of total salt the soil content, with low percentage of organic materials(1.3-3.9), the soil sample have moderate reaction between acidic and basic (7.52-7.95) pH.

The self potential line profiles rapid view shows sinusoidal forms, it might reflect the effects of different sources in geophysical term upon the SP measurements ,it compose of low and relatively high amplitude of potential readings with negative and positive polarity ,minimum value is (- 27.26) mV (line 3)and the maximum is (+28.01)mV (west line) .

The divergence of Self-potential anomalies in value is maintained by its source [10]. In case of the value of self-potential is negative of hundreds mV, at that time the source is probably sulfide ore deposits and deposits of conductive minerals. Whether the self-potential positive of tens mV, the possible source will be quartz or pegmatite occurrence. If the self-potential value is less than hundred mV, it might because of chemical reactions. In condition the self-potential is positive or negative of one to hundred mV, it denotes the movement of ground water. Finally the self-potential will be negative value of three hundred mV due to bioelectric plants, but in our present research the geological setting in addition to wide information concerning present of ore or a likes deposit, in this situation we could infer that the self-potential anomalies are due to streaming of ground water. In other side the observed self potential contour map fig.(4) is consists of different source effects in geophysical term, some are from near surface others are from depth ones, the regional map fig.(5) indicates that deep effect, it shows wide broad shape regional anomalies spread all over the map. The operation of construct residual anomaly map fig.(6) which more likely represent the near surface effect relates the electrokinetic potential of soil source .The process of isolation the regional anomalies from the observed anomalies also indicates present of deep source which is more likely denote to existing of underground water situation print its effect upon the observe self potential measurements. That assumption of availability of underground water in subsurface of the study area which yield from geophysical self potential data processing supported by the borehole section fig.(8) (ground water table is 21 m depth) which confirm the possibility of ground water existing through its impact upon the observed Self-potential measured data especially in the regional scheme.

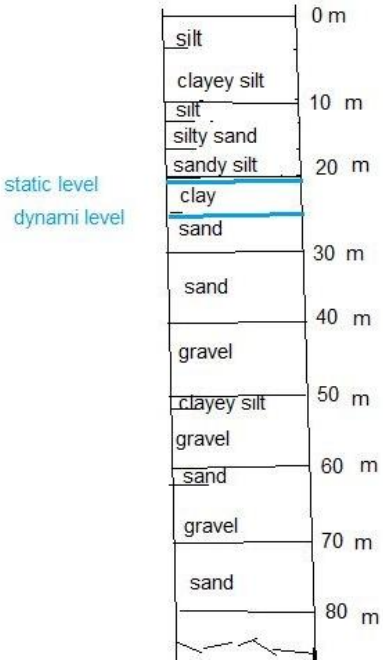


Fig.(8): Borehole geological section and water table.

5- Conclusions

Near surface soil analysis results which are in a good correlation proved that the nearby Quldara village land is a homogeneity contents composed of sandy clayey silt and normal amount of salt and organic materials with moderate acidity those properties are suitable for crop growing. Geophysical self potential survey and its data processing and qualitative interpretation in different presenting schemes could contribute as active tool to predict the possible existing of shallow ground water.

References

[1] Jardani A., Revil F., Akoa M., Schmutz N. F. and Dupont J. P., 2006, Least squares inversion of self-potential (SP) data and application to the shallow flow of ground water in sinkholes, GEOPHYSICAL RESEARCH LETTERS, VOL. 33, L19306.

[2] El-Sayed M. A., Hesham M., El-Araby A. G. and Mahfooz A. H., 2003, New methods for shape and depth determinations from SP data, GEOPHYSICS, VOL. 68, NO. 4 (JULY-AUGUST 2003); P. 1202–1210.

[3] Georgios A. S., 2012, The Self-Potential Anomaly Produced by a Subsurface
Flow at the Contact of Two Horizontal Layers and Its Quantitative Interpretation, International Journal of Geophysics Volume 2012, Article ID 483590, 8 pages.

[4] Adi S., S., Alexander T. S., Fitriah F. and Muhammad F. R. H., 2017, Identification of Underground River Flow in Karst Area Using Geoelectric and Self-Potential Methods in Druju Region, Southern Malang, Indonesia, International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 21 (2017) pp. 10731-10738.

[5] Juan L.M., Esperanza G.G. and Véronique N., 2010, Particle swarm optimization applied to solving and appraising the streaming-potential inverse problem, GEOPHYSICS, VOL. 75, NO.4 JULY-AUGUST 2010.

[6] Al-Ani J. M., 1983, Application of electrical resistivity for study the hydrogeological investigation in Jolack basin river, Unpub. M.Sc. thesis, University of Baghdad, 134 P. (In Arabic).

[7] Al-Sakini J. A., 1972, Salinity study of groundwater in some parts of Kirkuk
Muhafada, Jour. Geo. Soci. of Iraq, Vol. V, PP. 109-118.

[8] Buday T. and Jassim S. Z. , 1987, The Regional Geology of Iraq, vol. 2:
Tectonism, Magmatism, and Metamorphism. Publication of GEOSURV,
Baghdad, 352p.

[9] Haddad H. R., Al-Jawad, S. B., Haddad I., Younan A. I. and Salvo A. V., 1971,
Hydrogeological investigation in Jolack basin of the Altun Kupri project, Technical
Report, No. 25, Institute for Applied Research of Natural Resources, 38 P.

[10] Reynolds J.M., 2011, An Introduction to Applied and Environmental Geophysics, Second Edition, WILLEY - BLACKWELL, 696 p.

Tikrit Journal of Pure Science 23 (4) 2018 *ISSN: 1813 – 1662 (Print)*
E-ISSN: 2415 – 1726 (On Line)

تحري لجهد الذاتي قرب السطح و التحتسطحي لارض زراعية مجاورة الى قرية كولدرة / شمال كركوك / شمالي العراق

ظاهر خليل علي

قسم الفيزياء ، كلية التربية للعلوم الصرفة ، جامعة كركوك ، كركوك ، العراق

الملخص

اجريت التحريات بطريقة الجهد الذاتي تحت السطح و اخرى قرب السطح للتربة في ارض زراعية قرب قرية كولدرة شمال شرق مدينة كركوك (15 كم) في مساحة قدرها 63000 م^2. اخذت تسعة نماذج من تربة الموقع لايجاد النسيج, مواد العضوية، الحامضية، التوصيلية الكهربائية والمقاومية الكهربائية في المختبر. استخدمت الطريقة الجيوفيزيائية للجهد الذاتي لستة خطوط النشر وكانت المسافة بين اقطاب للجهاز المستخدم 10 م وحيث اخذت عشرة نقاط القياس لكل خط ليكون طول النشر 100 م. تم تحليل البيانات الماخوذة بطريقة الجهد الذاتي وفسرت على شكل مقاطع وخرائط كونتورية.اثبت تحليلات التربة انها مكونة من رمل وطين وغرين غالبا تحتوي على نسب اعتيادية من الملوحة ومواد العضوية والحموضية وبذلك تكون ملائمة لاغراض الزراعة. اشرت تفسيرات بيانات الجهد الذاتي الى احتمالية وجود مياه الجوفية في منطقة الدراسة.

الكلمات المفتاحية: الجهد الذاتي، حليل التربة، مياه الجوفية.