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Finding the Spontaneous/Self Potential of the Surface

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Abstract:- Measuring the spontaneous/self potential of the ground at different points in a line to now the subsurface structure.This helps us to show the high potential and low potential points of the ground,actually these are the elevation and steep areas of the subsurface structure.basically,these points together forms in the shape of the countor map of the area which shows the characteristics of the subsurface. This experiment is carried out by the voltmeter.
Keywords: - voltmeter, countor map, spontaneous/self potential

I. INTRODUCTION

Fig.1 Resistivity meter

Spontaneous potential (SP), also called self potential, is a naturally occurring electric potential difference in the Earth, measured by an electrode relative to a fixed reference electrode. Spontaneous potentials are often measured down boreholes for formation evaluation in the oil and gas industry, and they can also be measured along the Earth's surface for mineral exploration or groundwater investigation [1]. The phenomenon and its application to geology was first recognized by Conrad Schlumberger, Marcel Schlumberger, and E.G. Leonardon in 1931, and the first published examples were from Romanian oil fields. The origin of SP across formation can be attributed to two processes involving the movement of ions: Streaming potential (Ek), Electrochemical potential (Ec), Small potentials of the order of a few millivolts are produced by two electrolytic solutions of differing concentrations that are in direct contact, and by the flow of groundwater through porous materials (streaming potential).

Applications in Boreholes

The most useful SP component is the electrochemical potential, since it can cause a significant deflection opposite permeable beds. The magnitude of the deflection depends mainly on the salinity contrast between borehole and formation fluid, and the clay content of the permeable bed. The SP log is therefore useful in detecting permeable beds and to estimate formation water salinity and formation clay content. Due to the nature of the electric current, SP can only be recorded in conductive mud.

Determination of R_w

As established earlier, static SP is defined as follow:

SSP = $-K \log (R_{mfe}/R_{we})$

Static SP (SSP) can be obtained directly from the SP curve if the bed is clean, thick, porous, permeable, and only moderately invaded. When these conditions are not met, the recorded SP will need to be corrected. Various correction charts are available for this purpose.

To convert the measured mud filtrate resistivity R_{mf} into an equivalent mud filtrate resistivity R_{mfe}, the following rules are employed:

If R_{mf} at 75 °F is greater than 0.1 Ω·m, use $R_{mfe} = 0.85\ R_{mf}$ at formation temperature. If R_{mf} at 75 °F is less than 0.1 Ω·m, derive R_{mfe} from R_{mf} using Schlumberger Chart SP-2 or equivalent.

Schlumberger Chart SP-2 can then be used to convert R_{we} to obtain R_w.

Applications on the surface

Electrodes can be placed on the ground surface to map relative changes in the SP value, typically with the goal of identifying the path of water flow in the subsurface from an earthen dam. A voltmeter measures the voltage between a fixed liquid-junction electrode and a mobile one (rover), which is moved along a dam face or over an area of investigation to collect multiple readings. Anomalies observed may indicate groundwater movement or seepage.

Interpretation

SP can be affected by several factors that complicates the interpretation. Beside petrochemical component, SP is also affected by electro kinetic potential and bimetallism. Besides, SP is also affected by the following factors:

- Bed thickness (h); Since SP is a measurement of electrical potential produced by current in the mud, its amplitude approaches the SSP value only when the resistance to current due to formation and adjacent beds is negligible compared with that of the mud. This condition is met only in thick bed. In thin beds, the SP is proportionally reduced.
- True resistivity (R_t) of permeable bed; As R_t/R_m increases, the SP deflection decreases, and the bed boundaries are less sharply defined. Presence of hydrocarbons also attenuates SP.
- Resistivity of invaded zone (R_{xo}) and mud resistivity (R_m); SP increases with increase of R_{xo}/R_m
- Diameter of invasion (d_i); SP decreases as invasion deepens
- Ratio of mud filtrate to formation water salinities: R_{mf}/R_w
- Neighboring shale resistivity (R_s); SP increases with increase of R_s/R_m
- Hole diameter (d_h); With increasing hole size, the value of SP is reduced

II. PROCEDURE

Standard SP surveys utilise non-polarising, porous pot electrodes, which have been specially adapted to minimise contact voltages. Readings are typically taken with one electrode fixed at a base station and a second, mobile 'field' electrode that is moved around the survey area. Reading stations are spaced at regular intervals along linear profiles, closed loops or grids depending upon the desired application. The self potential method is traditionally used as a mineral exploration tool and for downhole logging in the oil industry. More recently it has been adapted for hydrogeological and water engineering applications, by the use of more sensitive equipment and the careful application of data correction process.

Fig.2 Arrangement for resistivity analysis

III. OBSERVATIONS

		TRACK:01	TRACK:02	TRACK:03	TRACK: 04	TRACK: 05
S.NO.	DISTANCE(M)	MILLI VOLTS	MILLI VOLTS	MILLI VOLTS	MILLI VOLTS	MILLI VOLTS
1	2	227	160	172	199	165
2	4	152	120	162	130	186
3	6	224	76	183	96	195
4	8	225	126	182	165	205
5	10	225	110	203	155	115
6	12	163	169	251	144	230
7	14	202	140	298	206	205
8	16	228	115	180	148	175
9	18	253	205	243	172	250
10	20	162	204	205	170	210
11	22	192	271	210	140	235
12	24	232	243	144	178	215
13	26	208	215	194	70	299
14	28	193	198	339	160	370
15	30	182	201	240	157	86
16	32	157	150	238	120	198
17	34	167	125	200	130	110
18	36	201	163	255	264	178
19	38	202	82	212	200	218
20	40	164	0	120	111	185

IV. COUNTER MAKING

By the given points of the given tracks we can now find the structure which is beneath the surface of the ground. With these points, we have to plot it on a paper or sheets were the plotted points can be perfectly jointed to each other. So, this is how we can found a counter of the earth or any ground, by this specific method.

V. RESULTS

The result is drawn or presented in chart which allows us to see the approximate contour map of the surveyed land. That is the reason it has been done in the chart to look like a map which shows the sub surface characteristics, which will be helpful in any mineral survey or other project to be conducted on the surveyed land. The high potential zones indicate the elevated area. The low potential zones indicate the inclination or steep sides of the area. The highest potential area in this land survey is 300. The lowest potential area in this land survey is zero.

VI. CONCLUSION

This project has helped us a lot in how to study characteristics of the land. These also explain how the early deposition of sediments or any other changes in the land came and how it had affected the land. The above mention changes also include folding and faulting of the land and earthquakes also. It is helpful for petroleum industries for survey or any mining survey to be conducted on the land.

REFERENCES

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