within regions of discontinuous permafrost have a substantially higher resistivity than the surrounding terrain; geothermal areas where the subsurface ground is at elevated temperatures frequently exhibit anomalously high conductivity. An airborne system designated as E-PHASE has been developed to produce resistivity maps at a cost which is fractional when compared with ground surveys and at a speed which is at least an order of magnitude greater.

The system utilizes radio frequency fields transmitted by broadcast stations. It can be shown that in the far field region of these transmitters a measurement of the (complex) ratio of the horizontal to the vertical electric field components yields the wave impedance of the underlying terrain, normalized with respect to the intrinsic impedance of free space. Thus, in the case of a uniform half-space, measurement of this ratio gives the ground resistivity directly. Calculations for other geometries such as a layered earth and a vertical contact are shown. They indicate that the 'apparent resistivity' so deduced is satisfactorily accurate; is a well behaved function for the two layered earth; and is relatively independent of the direction of the primary field. By selecting a transmitter of appropriate frequency it is possible to vary the effective depth of penetration (and thus the vertical depth of over which the resistivity is integrated) over wide limits.

Extensive surveys have been carried out at VLF frequencies, and more recently several areas in Canada have been surveyed using a dual frequency system which simultaneously sense the electric field components at both VLF and standard broadcast frequencies. Effective penetration on the VLF channel varies from about 50 to 500 feet whereas the broadcast band channel varies from a few feet to about one hundred feet. Survey results at each frequency are plotted as contours of apparent resistivity.

The paper will describe the experience to date and will illustrate the results of several surveys in different environments.

S. PARKER GAY, Jr., *The Use of Stereo Contour Maps in the Interpretation of Aeromagnetic and Gravity Data.*

Stereo contour maps of topography were developed in Germany shortly after the turn of the century, and not in the United States in the 1930's as the writer had previously supposed. These 3D topographic maps never enjoyed widespread use, possibly because the details of topography are so much better illustrated by stereo pairs of aerial photographs than by contour lines. However, stereo contour maps appear to have found a natural application in the study of geophysical data, particularly aeromagnetics and regional gravity. A review will be made of the advantages of stereo viewing of geophysical contour maps, and these advantages will be compared to the results of present practice in computer processing.

One particularly applicable use of stereo viewing of geophysical data is wavelength filtering. The circular nature of the gravity low of the western U.S. (1800 km diameter) was recognized by this method. Stereo pairs of this feature, both filtered and unfiltered, will be shown in 3D and one theory of origin will be discussed. Another valuable use of stereo viewing is lineament recognition on aeromagnetic maps. It is now realized that lineaments are present, in varying degree, in all aeromagnetic maps of large areas. These lineaments coincide with profound crustal fractures. Thus, lineament studies of stereo aeromagnetic maps provide a new way of studying the earth's crust, and in the writer's opinion, pave the way of many exciting advances in crustal tectonics and in deciphering crustal history, particularly the history of continental crust. Examples of recent studies will be shown.

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G. V. KELLER, *Electrical Exploration for Geothermal Reservoirs.*

A good geothermal reservoir should possess three characteristics: storage capacity, elevated temperature and fluid permeability. In geophysical exploration for such reservoirs, it is desirable to use methods which are capable of providing information about these three characteristics.

Measurements of electrical resistivity have been found to be effective in estimating such reservoir capacity and temperature because porous rocks containing hot ground water are commonly far more conductive than surrounding rocks.

The audio-frequency magneto-telluric method is useful in reconnaissance for the surface expression of geothermal systems, while mapping of the electric field about a dipole current source and the electromagnetic sounding method are useful in studying the depth extent of geothermal reservoirs.

These methods have been used in estimating the power producing potential of geothermal systems in Nicaragua and Java.

K. Deppermann, *An Interpretation System for Geo-Electrical Sounding Graphs.*

In the case of two and three layers, geo-electrical sounding graphs can be rapidly and accurately evaluated by comparing them with an adequate set of standard model graphs. The variety of model graphs required is reasonably limited and the use of a computer is unnecessary for this type of interpretation.

In the case of more than three layers a compilation of model graphs is not possible, because the variety of curves required in practice increases immensely. To evaluate a measuring graph under these conditions a model graph is calculated by computer for an approximately calculated resistivity profile, which is determined for example by means of the auxiliary point methods. This model graph is then compared with the measuring curve, and from the deviations between the curves a new resistivity profile is derived, the model graph of which is calculated for another comparison procedure, etc. This type of interpretation, although exact, is very inconvenient and time-consuming, because there is no simple method whereby an improved resistivity profile can be derived from the deviations between a model graph and a measuring graph.

The aim of this paper is on the one hand to give a simple interpretation method, suitable for use during field work, for multi-layer geo-electrical sounding graphs, and on the other hand to indicate an automatic evaluation procedure based on these principles, suitable for use by digital computer.

This interpretation system is based on the resolution of the kernel function of Stefanescu's integral into partial fractions. The system comprises a calculation method for an arbitrary multi-layer case and a highly accurate approximation method for determining those partial fractions which are important for interpretation. The partial fractions are found by fitting three-layer graphs in a measuring curve. Using the roots and coefficients of these partial fractions and simple equations derived from the kernel function of Stefanescu's integral, the thicknesses and resistivities of layers may be directly calculated for successively increasing depths.

The system also provides a simple method for the approximative construction of model graphs.

D. Patella, *Master Curves for Induced Polarization Vertical Soundings.*

Starting from the hypothesis

$\overline{M} = -m\overline{J}$ (J. R. Wait, 1959, "Overvoltage research and geophysical applications", Pergamon Press, London)

where $\overline{M}$ is the discharge current density vector,

$\overline{J}$ is the primary current density vector and

m is the chargeability (dimensionless),

and assuming

$\overline{E}' = \rho\overline{M}$ (F. Mongelli and D. Patella, 1969, "On the electrical discharge of some sedimentary rocks", Atti dell'Ass. Geof. Ital., Napoli)

where $\overline{E}'$ is the induced polarization electric field

and ρ is the resistivity of the medium, gives the relation

$-\overline{E}' = m\rho\overline{J}$