**PHENOMENAL VARIATIONS OF RESISTIVITY AND THE PETROVOLTAIC EFFECT**

In 1892, Prof. Fernando Sanford of Stanford University performed experiments on the conductivity of a copper wire immersed in various dielectric fluids. Results published in Vol. 1 & 2 of the Physical Review were controversial, but a recent critical analysis of Sanford's data indicates that he observed unexpected temporal variations which were not related to temperature or other variables of which he was aware.

Studies conducted within the last six years by a number of investigators* appear to have extended the Sanford findings. These studies have provided evidence to include the possible contribution of a related phenomenon - the self-potential observed in many materials of relatively poor conductivity such as common basaltic and granitic rocks, The phenomenon, for which there is no ready explanation has come to be known as the Petrovoltaic Effect. Silver or copper electrodes are plated on opposite sides of (hand size) flat rocks, as with a simple capacitor. Potentials up to 700 mV (DC), which appear to be spontaneously generated, have been consistently observed on single specimens.

What appears to be more significant is the fact that these potentials are observed to undergo systematic -diurnal variations, sudden random spikes or bursts and long-.term secular variations over a period of years. The level of potential also varies when observations are made in various geological locations. In recent studies, these observations have been extended to include other dielectric materials, both solid and fluid, such as barium titanate, lead zirconate, lead monoxide bound in paraffin and various oils. It is, therefore, not limited to crystalline materials.

In all cases, the self-potential is observed to vary with time and place. Tests performed at 10,000 ft. elevation (Mt. Haleakala Observatory, Maui, 1974),at sea level (Maui, 1975). in a seismic vault (Hawaii Institute of Geophysics - 1975), within a mineshaft (U. C. Berkeley - 1976) and within a 90-ton radiation shield (NASA, Sunnyvale, - 1978) appear to indicate little, if any, attenuation due to shielding. No deep underwater tests have yet been performed but such tests are contemplated not only in water wells but also in the deep ocean.

The relation between self-potential of rocks (including other partially-conducting materials) and their resistivity is, at present not understood. It is suspected that electrical polarization may produce an emf or counter-emf in the material which affects its apparent resistivity.

It has been found that many, if not all, capacitors which have been tested share this phenomenon. It is believed to be present also in certain (massive) electrets where the potential is measurable Hence, a study of vestigial polarization in dielectric materials has been undertaken. Electrets (and capacitors), by classical definition, are supposed to retain no more than their initial charge. In time, this charge is supposed to decay through ohmic loss. No accretion of charge is understandable. Yet, in many cases tested, a polarization build-up occurs and the build-up of potential is characterized by diurnal variations and random "bursts" which appear to indicate an energy influx of possibly extreme penetrability.

Extensive shielding tests, both electric and magnetic, have been performed in the ten years or more that this phenomenon has been observed. Conflicting and rather puzzling results have been encountered. For example, when data obtained at U. C. (Berkeley) (4th floor of the Hearst Mining Building) were compared with those in the Lawson Adit (under 200 ft. of rock overburden) adjoining the building, an increase of over 200 % was noted in the mineshaft.

In tests performed in and out of screen rooms at Stanford Research Institute and in the 90-ton cobalt-steel radiation chamber at NASA Sunnyvale, no appreciable attenuation was noted in tile general level, but diurnals and bursts became less evident.,

In all tests, there are strong temperature effects in rocks and in some capacitors the effects are observed to be transient - sometimes negative and sometimes positive. It is suspected that temperature gradients within the material and pyroelectric effects are the cause. All long-term observations, therefore, are always conducted within constant temperature enclosures, held wherever possible to $.1^0$ C.

Correlations with humidity, atmospheric electricity, terrestrial magnetic variations, electrochemical activity, electromagnetic radiation and solar radiation, flares, etc., cosmic radiation or natural gamma radiation have as yet provided no answers, but all tests bear repeating under better controls. No correlations hove yet been made with possible neutrino flux.

Perhaps the most significant finding to date is the evidence that widely-separated matched sensors reveal similar variations with time. Concurrent "events', so-called "bursts", have been reported up to a distance of 80 Km, (Sunnyvale, Calif. & Concord, Calif.) This would appear to indicate a common external source, but further confirmation is needed. Evidence of concurrence from a number of world-wide locations is indicated before any conclusions can be drawn.

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