Schlumberger Report

This reconnaissance was carried out on virgin territory of the property where no mineral occurences were known exist. The results are shown on Map. No. 2. This is not, strictly speaking, a map since the scale which is 1" for 150 feet along the profiles, is 1" for 50 feet per pendicular thereto. It is therefore, merely an ideal representation of the reconnaissance work, the purpose of which is to outline broadly the area of electrical activity discovered.

Five profiles of spontaneous polarization number P1 to P5 were traced. They show alarge belt of intense negative electrical activity running all through the property in an east-west direction from profile P1 to Profile P5. The axis of this zone of activity may be approximately located along line M'M.

As soon as the electrical results were obtained, our observer advised that a shallow pit be dug in the neighbourhood of profile P2, where the electrical reaction is particularly strong. This first mining research led to the discovery of a massive orebody under a very shallow overburden. We are of the opinion that this orebody extends across the property between profile P1 and P5, and we advise a systematic investigation of it. In all probability the orebody dips steeply towards the north.

EXTRACT FROM CASE HISTORIES MINING GEOPHYSICS

Primarily, however, exploration procedures based on the flow of natural currents, rely on the "self-potential" currents which arise spontaneously in certain mineral bodies, due to the polarization of these bodies. In other words, such mineral deposits are natural batteries, buried in the ground. In utilizing this phenomenon, the geophysicist is profiting from a natural field of force offered ready to his hand. He is spared the necessity of taking into the field apparatus, more or less cumbersome, to apply an artificially created field of force to the earth. On the other hand, he can neither vary the place of application nor the magnitude of the force, but must accept it as nature provides it.

From near the apex of the sulphide body, the electrical current travels down the vein, lens or other form of deposit, to some point in depth (the lower terminus of the deposit, or possibly the zone of minimum acidity or of maximum alkalinity) where it passes into the wall rocks. It spreads through the country rock as it returns towards the surface, finally to converge on the sulphide apex. Its return into the sulphide apex to complete the circuit creates a negative pole there, and produces a centre of negative polarity at the ground surface in that vicinity.

A second factor influencing the potentials observable at the surface, is the electrical continuity of the metallically conductive mineral deposit. A body of massive sulphides, for example, will yielc a higher potential than a body of disseminated mineralization. This presumably due to higher internal resistance offered by a vein struc in which the conductive mineralization is not in sufficiently close contact to offer a continously good condutive path for the current. In consequence, the voltage drop within the resistance vein structure itself is considerably more pronounced than in the case of more massive, conductive sulphides. This causes proportionately lower potential drops in the "exterior", or near-surface, portion of the circuit available for observation.

A rough correspondence often exists between the percentage of conductive sulphides present, and the maximum potential observable at the surface, above a shallow sulphide body apex. A potential of 50 millivolts (1 millivolt is 0.001 volt) usually indicates about 5 per cent total conductive minerals, or possibly less. Increasing content of conductive mineralization is suggested by higher potentials, and when potentials of 300 mv. and higher are recorded, it may be assumed that the causative body carries heavy sulphide mineralization, say 30 per cent or more.

A third factor in the strength and distribution of potentials observable at the surface, is the extension in depth of the reacting body. A well- mineralized sulphide, or other conductive body, extending to considerable depth will have its upper and lower ends bathed in contrasting electrolytes, and will generate strong potentials. The negative (near surface) and positive (deep-lying) poles of this natural battery will be widely separated, and the current will spread far into the country rock in its return to the surface. This will produce a broad electrical field centred more or less above the mineral apex, w noticeable increases in ground potentials, commencing as much as 30C or so away from the vein, in the wall rocks on each side. The pot increase in value from there to arounded maximum over the vein apex. This maximum will be a maximum of negative potentials.

In resume, electrical currents are spontaneously generated by the electrochemical reactions between metallically conductive minerals (mostly the sulphides, arsenides, antimonides, tellurides, etc.) and electrolytes in the surrounding rocks and soils. The strength of the electrical potentials thus created depends on the chemical nature of the metallic and the electrolytic conductors in contact with each other. The strength of potentials observable at the surface, over a deposit, depends also on the percentage of sulphides present on the vertical size of the deposit, and on the depth of overburden.

The instrument used for measuring spontaneous polarization potentials is a potentiometer-voltmeter, sensitive to 1 millivolt. In this apparatus, a measured current is drawn from some flashlight batterie and used to neutralize the ground current between two contacts with the earth, a "null-method" of measurement. By opposing the ground current with an equal and opposite current from the batteries, no current is drawn from the ground. Were the current drawn from the earth, a new, and unrelated, circuit would be set up, distorting the original electrica field and invalidating the observations.

Another disturbing factor is occasionally encountered in mountainous country, namely, the "topographic effect". This effect is to be suspected where the profiles of electrical potentials show striking similarity to the topographic profiles. Unfortunately, it produces negative centres on or near hill tops. It has been ascribed, on occasion to the potential gradient in the atmosphere. Since neighbouring hills of similar slope and altitude can show radically different topographic effects, and since the topographic effect is frequently absent altogther, nothing as uniform as the atmospheric potential gradient is likely to be the cause. Rather, the factor to be considered is the phenomenon of electro-filtration.

In the search for sulphides and related minerals (sulpharsenide sulphantimonides, arsenides, antimonides, tellurides, etc.), the spontane polarization method furnishes a rapid and economical spearhead for the attack. In competent hands, such a survey can be and should be thoroughl intergrated in the program of geological exploration and diamond drilling Correlated also with findings by other geophysical techniques, such an overall program furnishes a powerful tool for economy of time and money in the finding of new ore deposits and, of equal importance, in lessening the cost of not finding ore.