

Preface

The *Redox Complex* (Redox Potential, Magnetic Susceptibility, Spectral Reflectance and Soil Geochemistry) is a complex of unconventional geophysical-geochemical exploration techniques, used for indirect detection, characterization and evaluation of various metal targets, which is based on the *Geochemical Principle of Metal Ions Vertical Migration*. This procedure offers information on the shallow terrain modifications, over any metallic target, controlled, under the referred Geochemical Principle, through their composition, grade, geometric features and lying characteristics. Its final product consists of: a map with the cartography of the vertical projection of the metal target; a central section with its geometrization, together with the behavior of the attributes that characterize it; the parameters defining the nature and quality of metallic source and a resource estimate. This complex is successfully applied in various fields: oil and gas and metal ores exploration; studies of oil and metal contaminants in soils; and the search for metallic archaeological burials. The use of these techniques is intended to complement the conventional prospecting complex with the purposes of reducing areas and/or the selection of the most favorable targets, resulting in an increase in economical-geological effectiveness of investigations. The *Redox Complex* is implemented without physical or chemical damage to the environment.

The combined application of Redox Potential and Magnetic Susceptibility of soils to geological prospecting, which is the *Redox Complex* antecedent, is determined by the possibility of detecting the reducing column that is formed directly on hydrocarbon and metal occurrences and reaches the upper part of the section. Within this column, the conversion of non-magnetic iron minerals to more stable magnetic diagenetic varieties is favored, which explains the observed inverse correlation between the attributes and justifies integration of methods.

It is outlined the general features characterizing the processes of metal mobilization, vertical transport to the surface, and the resultant accumulation of these vertically transported metals in surficial media from hydrocarbon deposits and buried ore bodies: microbial activity and water-rock reactions with gas (hydrocarbons, N, CO₂, H₂, and others) generation during target oxidation; ascending

reduced gas microbubbles (colloidal size) with reduced metal ions attached, which results in ‘reducing chimneys’ reaching the surface; barometric pumping and capillary rise moving upward ions and sub-micron metal particulates, into the unsaturated zone; redistribution of ions in the near-surface environment by downward-percolating groundwater (after rainfall) as well as by the upward effects of evaporation and capillary rise, all of which explain the soil metal accumulations in a very shallow (10–30 cm) ‘metal accretion zone’.

It is designed a database and applications system (*Redox System*) to solve in a quick and reliable way, all the storage processes, reports, graphics and the corresponding interpretations of the *Redox Complex*. To carry out the design of the different kinds of applications, which answer to the qualitative and quantitative data interpretation, it is model, mathematically, the expert’s experience. For this objective, the methods of the Knowledge Engineering and the techniques of the UML (Unified Model Language) diagrams are used. The *Redox System* transcends the limits of a simple calculation and storage program, which it can be used by other specialists without being expert in the topic to obtain results on interpretation. A User Manual of the Redox System is drawn up.

The illustrations of some of the applications of geophysical-geochemical unconventional methods for oil exploration in Cuba are presented. These consider the regions of Habana-Matanzas (Varadero Oil Field, Cantel Oil Field and Madruga Prospect) and Ciego de Ávila (Pina Oil Field, Cristales Oil Field, Jatibonico Oil Field, Jatibonico Oeste Prospect and Cacahual Prospect). The methods considered contemplated, in some cases, airborne gamma spectrometry (K/eTh ratio) and reduced Redox Potential (ORP) and, in others, the *Redox Complex* with reduced or standard attributes. In all cases, the anomalous complex of interest corresponds to the correlation of minimum K/eTh ratio, minimum ORP and, in the case of *Redox Complex*, Magnetic Susceptibility highs with ORP lows, Spectral Reflectance lows and maximum Content of Chemical Elements.

Unconventional Methods for Oil & Gas Exploration in
Cuba

The Redox Complex

Pardo Echarte, M.E.; Rodríguez Morán, O.

2016, XII, 69 p. 18 illus., 4 illus. in color., Softcover

ISBN: 978-3-319-28015-8