PROFESSIONALISM AND PRACTICING PHILOSOPHY OF EXPLORATION GEOCHEMISTRY

Exploration geochemistry is playing a vital role in mineral prospecting and exploration. Typically, exploration geochemical orientation surveys are planned and executed on primary and secondary dispersions involving bedrock, soil and stream sediments. Based on critical evaluation of controlling parameters, regular surveys are professionally planned and executed. Subsequently, the data is processed and geologically interpreted. Generally, such data is subjected to rigorous computerized geostatistical processing. The results of such an exercise should lead to identifying pathfinders and guide mineral prospecting and exploration for finding a mineral prospect/deposit. In this note, an attempt has been made in the evaluation of various techniques of data processing methods and interpretation.

Briefly speaking, the geostatistical processing consists of estimation of basic statistics like mean, standard deviation, variance, covariance etc. Advanced processing consists of cluster, factor, trend surfaces, Fourier transform analyses etc. A critical examination in retrospect of such exercises indicates negligible successes and continue to be only of academic interest. This is a fact to be noted with all seriousness. The main reason being inadequacies that exist in true translation of statistical quantities into meaningful geological entities. One has to understand very clearly the concepts of statistics together with its merits and demerits coupled with a meaningful geological understanding.

Choosing the appropriate mean and its estimation method, identification of existing population in a data, dealing strategy with subnormal and abnormal distributed data, handling of normal and log normal transformed data and its geological implications are fundamental requirements to begin with. Coming to the application of advanced geostatistics, unless the basic statistical estimation is obeying the geological attributes, no worthwhile interpretation is possible. The geostatistical technique being adopted should be relevant and apt in terms of geological deductions.

For instance in a cluster analysis, the derived geochemical clusters, in factor analysis the various loadings and the principal components should and in fact obey the geological truth established and guide exploration. But it is hardly seen. Either it reiterates theoretical details or mostly remains as characterization of data without meeting the envisaged objectives. In trend surface analysis, the regional trend surface is to give its regional trend, generally it does but the same can be easily deciphered from raw data too. Its residual map is supposed to identify areal and local trends. Generally it is confused, perhaps due to artifacts. The areal trend is expected to depict mineralized belts and normally it is not much different from regional trend; however, it displays smoothened data and the main grain even otherwise decipherable. Its residual trend is supposed to identify the local mineral targets, again which has hardly met with success, on the contrary, generation of artifacts cannot be ruled out. The trend surface estimations so far did not find success in exploration geochemistry. Similar observation is true in case of Fourier transformation also. One of the main reason for the lack of success is a lack of in-depth geological reasoning in the selection of appropriate window for filtering and inability to translate the data into geological reality.

With the same drawbacks, the digital geochemical landscape is subjected to image processing techniques including statistical and colour image outputs are generated like element-wise or in combination, stretched, enhanced, principal component, ratios, multiple combination of some merged components etc. In addition, multiple data set integration and manipulations are attempted involving remote sensing, airborne or ground geophysical data like aeromagnetic, gravity etc. This entire process is being done without understanding the real physical significance of resultant output, which is a dangerous process. They do posses the inherent deficiencies as discussed above and the result being purposeless. In addition, they do suffer from inappropriate colour manipulation deficiencies, because the geological inputs either are not considered or their ability and applicability appreciably not understood and applied.

The basic reason for unsuccessful nature of statistical data processing is because of assumptions like – isotropy, homogeneity, and linearity in interpolations, harmonic functionality etc. But in nature the converse is true for the simple reason that "mathematics does not obey nature's laws and nature is not governed by mathematics." That is why the geochemical data processing and interpretation has to be carried out with in-depth geological reasoning and perhaps, as some statisticians feel, some amount of intuition is required for success.

Even though all the above sophisticated data processing techniques are available, still the conventional and classical techniques of interpretation of elevated geochemical landscape in accordance with the principles of geochemistry like elemental and/or heavy mineral associations, path finders, ratios etc., with geological reasoning are always

found to be successful. A matter to be noted with justifiable pride.

The procedures adopted in the computation of additive and multiplicative geochemical anomalies are having strong scientific basis. Especially in tracing the extensions of mineralized zones and in determining the vertical and horizontal depth extensions and their geological relationship in time and space. Thus, it can indicate termination of mineralized zone either vertically or horizontally of an ore body. Hence it has got potential application in geochemical exploration.

In secondary dispersion, sometimes elevated metal values are due to scavenging caused by iron and manganese oxides and hydro-oxides, thus generating false anomalies followed up by drilling and resultant colossal loss of money. Thus, recognition of true and false anomalies is of paramount importance. Statistical methods are not able to provide satisfactory solution in such a context.

Researches carried out in sequential and selective chemical extraction techniques have met with reasonable success, but indepth research is still required. The attempts made in characterizing the anomalies using chemical extractions have also given an insight in understanding and identifying various components that are associated with total extraction in terms of metal ions located in ion exchangeable position. For example, scavenged metals by Fe and Mn, metals associated with organic-metal-complexes, metals located in silicate lattice etc. In addition to this, further characterization was made in terms metals associated with carbonate, sulphide, sulphate phases and computation of differential quantities and identification of their geological responses etc. Work was also carried out in understanding, the behaviour and nature of chemical extraction reactivity properties, which established that some of the sequential extractions were extracting other chemical phases than what they were supposed to extract, thus not only the results were erroneous but also disturbing the structure of other phases, which were not supposed to be disturbed and which were meant for subsequent extraction processes. After recognizing the inapplicability, further research established more precisely the metal phases that were extracted in various techniques and geological reasoning was also adduced.

In summation, in exploration geochemistry endeavour, one has to accomplish the envisaged objectives taking into consideration geological inputs and within the enunciated geochemical doctrine for a meaningful geological success.

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EXTENDED ABSTRACT

The economic development of any nation can be measured by its energy consumption and hydrocarbons are known primary energy resources in the world. Hence, the hydrocarbon exploration will continue to be of primary importance. The prerequisite for hydrocarbon exploration is the presence of a sedimentary basin and its geological understanding.

The Krishna-Godavari (KG) Basin with an areal extent of 45,000 sq km (up to 200 m isobath) is located at the centre of the East Coast of India. It attained importance since late seventees by the presence of hydrocarbons in commercial quantities in the first well drilled in the basin. Since then, over these 25 years, the continued exploratory efforts by seismic data acquisition and deep drilling have resulted in voluminous subsurface data. The data volume include nearly 40,000 GLK of 2D seismic data, 1000 sq. km of 3D seismic data and more than 325 deep wells. The exploratory efforts till date have resulted in identification of 48 oil and gas bearing prospects out of 170 structures drilled. The deepest well onland went up to

**Lecture delivered at the monthly meeting of the Geological Society of India at Bangalore on 28 August 2002.*