NOTES

FUTURE OF EXPLORATION GEOPHYSICS IN INDIA

Understandably, the quality of geophysical practice varies between developing countries and the developed countries. Several factors, like the nature of the organisation, the technology available to it, the financial constraints, the time at the disposal and the needs of the client or user agency, largely influence the quality and quantity of the geophysical work turned out by the practitioners. Within India also there is wide variation in geophysical practice from over simplification to excessive sophistication. But each geophysicist believes that he is combining the right amount of common sense and sophistication and anything outside the limits of his knowledge is simply harmful. If so, which geophysical practice is good and which is bad? How far should we practice sophisticated geophysics in our country?

By the time we acquire the latest instrument or a computer, spending a lot of time and money, a still later model which is claimed to possess advantages not present in the earlier one is ready in the market. In a developing country's budget, mineral exploration cannot be certainly a top priority item like food or energy and as such, foreign exchange would not be coming just for asking, to procure the ever-changing state-of-art technology. At the same time, nothing appears more retrograde than contesting the need for sophistication. Thus, it is with great strain on the resources that developing countries try to keep pace with technology. Their condition is like that of a person who is tied to a galloping horse by his nose. Of course, he has a choice either to run with the horse or not, but either way it hurts him.

But are we going to succeed better in mineral exploration by merely importing the state-of-art technology? Is it the only factor that contributes to success in mineral exploration or is it only one of the important factors that has to be supported and supplemented by inventive and innovative approach in the context of the field investigation? Do we clamour for better equipment and better facilities only to project them as constraints which do not allow our best to be offered? Here I am reminded of Dr. Amalendu Roy who wrote (the Oil and Gas Journal, No. 7, 1960) 'low cost is precisely the reason less-expensive methods are generally neglected. One dislikes to be associated with simple schemes. It is so much more spectacular to be handling staggering sums of money, complicated instruments and a large contingent of personnel'. If this is the attitude in acquiring the latest, biggest or the most sophisticated equipment, then obviously it is not a very healthy sign for a developing country.

Let us remember that sophisticated means, lacking in simplicity. Once anything lacks simplicity, it tends to become complicated. It is seldom realised that *more the data, more complex is the situation and less certain is the interpretation.* This may look anomalous in the first instance, but gets clarified when we try to theorise the complex conditions at the subsurface. The number of variables we can peg down outnumber those we can. Thus, more the parameters or methods to deal with, more the number of uncontrolled variables and greater the uncertainty in interpretation.

An aura of sophistication today surrounds all aspects of exploration right from instrumentation to data acquisition, processing and interpretation, making only sophisticated geophysical practice look like good geophysical practice. If some one speaks about the inferences he has drawn about the subsurface from the geophysical data, the audience are more concerned to know whether 'modelling' is done, rather than examine the accuracy and authenticity of the numerous field evidences and parameters that should really go into modelling to bring out a fairly accurate prediction of the subsurface. Also, paradoxically qualitative interpretation is always made to appear less respectable than quantitative interpretation or modelling, though we are aware that unless our interpretation is qualitatively right, quantitative pursuits may lead us to chaos. Forgetting that each method or technique has its own superiority depending on the context, we encourage the belief that always IP is superior to SP or EM, seismics is superior to gravity, and modelling or inversion is superior to simple or qualitative interpretation. Once we build up such a complex around us, it may appear that without the latest instruments and computers we cannot find any ore bodies or solve geophysical problems.

We are almost a quarter century behind the West in adopting modern techniques in mineral exploration – be it the introduction of geophysical surveys in general or seismics, IP or airborne and shipborne surveys or modern data processing in particular. Fortunately, petroleum exploration in the country has always been on a different footing with its ability to bring down the technology gap to about 5 years, by investing millions of dollars which are of course returned several fold in the form of precious oil resources. However, it is neither easy to bridge the technology gap in mineral exploration nor to keep pace with it without spending large amounts of money. Even then, the success in mineral exploration in the country cannot be as spectacular as that in the West or Australia, or stand comparison with petroleum exploration within the country. The reason is not difficult to guess. India is an ancient civilisation where hunt for minerals as well as their consumption (excluding petroleum) have been going on for centuries or millennia making our job at locating new mineral deposits extremely difficult.

While these are special problems for India, the average geophysicist in any developing country is so spell-bound by the fast development in technology that he is unable to decide what type of geophysics he should practise, to be both useful and respectable. He, in his anxiety to catch up with the advances, at best acquires a peripheral knowledge and jargon without being aware of the intricacies and limitations involved in sophistication. When we talk of average geophysicists, they along with the below average group perhaps form the majority. Naturally it is on them, the quality of geophysical practice in the country depends. Now, how to keep training this large number of people in advances in exploration techniques continuously and year after year? For any developing country it is not only a tall order but it is impossible to keep its men exposed to the advances taking place continuously in geophysical technology at costs which are bound to be prohibitive.

Is there an alternative for the developing countries? Perhaps the situation will not be that serious or bleak if only we changed a bit of our outlook regarding what is good geophysical practice, that can claim to be respectable too. Also, perhaps we can increase our success in tackling the many geophysical problems by a more cautious approach to the field problem and a detailed analysis of everything that is already available to us. It is necessary that we try the simple approaches without

prejudice, before discarding them for the complicated ones. In actual field practice, there are a number of instances where small details and simple approach rather than sophistication, have helped solve various geophysical problems, be it a regional-residual separation in gravity or locating a groundwater point on the basis of resistivity survey or even identifying faults in a coal-bearing sedimentary basin. In our eagerness to go sophisticated, we are often dropping some valuable field clues which cannot be retrieved even by the most sophisticated modelling techniques, thus ending up in confusion.

It is not my intention to underestimate the need for updating our technology at back-breaking costs or our younger generation to keep abreast of the tremendous advances in exploration geophysics that we are witnessing. But updating technology does not necessarily mean acquiring the latest instruments and merely repeat what the West has done or comparing our ore bodies, rift valleys and heat-flow values with those in North America, Europe or Australia. In a recent International scientific meet in one of the developing countries in South America, the contribution from the host country, after acquiring some sophisticated instruments, was limited to just an imitation of what was done earlier in advanced countries. This is inevitable if sophistication is followed mechanically, without trying to be original in concept and approach. In fact, during some groundwater surveys in Africa, there was a considerable pressure from the client for conducting the costly seismic surveys, though the problem was already solved by the simple resistivity method.

If the theoretician, designer of instruments, the manufacturer and the software men are all duty bound to sophisticate the technology, the practitioner of geophysics who is committed to finding ore bodies or solving geological problems is equally duty bound to combine the right amount of sophistication and 'field sense' – a thing that cannot be taught but cultivated, to solve our problems as economically as possible, applying simple techniques wherever possible. Unless this approach is encouraged and respected, the frustration arising out of the technology gap will continue to haunt us for ever. As a developing country with meagre resources and tremendous brain power, the future of the exploration geophysics in India lies more in the minds of the vast scientific community than in the machines they handle.

Though this article is written with a bearing on geophysical practice, it is very evident that it applies equally well to other disciplines of earth sciences or for that matter any applied science.

T. S. RAMAKRISHNA

Geological Survey of India,
Training Institute, Hyderabad

NRSA DATA CENTRE

The NRSA Data Centre (NDC) of the National Remote Sensing Agency (NRSA) under the Department of Space (DOS), Government of India, is the focal point for the distribution of different types of data products obtained from remote sensing satellites. The primary function of NDC is user interface for providing complete information on data products and their availability, processing of users requirements for data covering areas of their choice and despatch of products. Counselling and providing assistance in the use of satellite data products is also extended by NDC.

At present NRSA acquires data from the following remote sensing satellites :

1. IRS-1A launched by India,
2. Landsat -5 launched by United States of America (USA),
3. SPOT -1 launched by France, and
4. National Oceanic and Atmospheric Administration (NOAA) meteorological satellite launched by USA.

NDC offers a wide range of data products like bulk corrected, geocoded and precision corrected products. Special products with enhancements are also offered by NDC. Also, the data is supplied in different formats suitable to the user requirement, viz.,

Film products in 70 mm and 240 mm,
Paper prints in 1X (240 mm), 2X (480 mm), 4X (960 mm) enlargements, and
Digital data on CCT, cartridge tape and floppy media.

In order to provide the efficient and quick service to the users, it is necessary that all aspects of the required data is given by the user as per the order form (which are available from NDC) while placing the order. Any missing detail leads to further correspondence, thus causing delay in getting the data at the user's end. For some products, it may be necessary to have certain amount of dialogue, e.g., verification of plots for coverage of the area in case of geocoded products, marking of the area of interest on the film by the user in case of special enlargements, etc. In such cases, quick feedback from users enables quick supply of products.

For any clarification on satellite data products or services, the queries may be directed to :

Head, NRSA Data Centre National Remote Sensing Agency, Balanagar, Hyderabad-500 037. Telex : 0425-6522 ; Telephone : 262960 or 262572 Extn : 318 ; Grams ; REMOSEN ; Fax : 0842-263648.

MY FATHER'S EARLIER EXPERIMENT

During his campaign for Governorship in New Jersey in 1940, Charles Edison, son of the great inventor, introduced himself by explaining 'People will inevitably associate me with my father, but I would not have you believe that I am trading on the name Edison. I would rather have you know me as the result of one of my father's earlier experiments'.

ASSISTANCE TO TALENTED YOUNG SCIENTISTS

The Department of Science and Technology has brought out a pamphlet designed to assist talented young scientists in choosing a subject for research and in seeking assistance to get trained in the best institution in the world. Eligibility criteria are :

i) *Academic Qualifications:* Bachelors/Masters Degree in Engineering, Technology or equivalent or Ph.D. in Science or Technology or equivalent or M.D. Degree in Medicine or equivalent.

ii) *Age:* Less than 35 years (on the date of application).

iii) *Employment:* A regular position in a recognised S and T institution. Candidates must be officially sponsored (their applications to be formally forwarded) by the employer/head of the institution or agency with commitment to depute them for research/training under BOYSCAST programme.

iv) *Area of work:* Areas proposed by the candidates should be in line with the chosen areas identified in Annexure.

v) *Place of work:* The fellows should be accepted by a foreign scientific/technological institution which is internationally recognised as an outstanding institution where major work in the identified chosen area is in progress.

vi) *Willingness of the foreign institutions* to accept and extend necessary support to the candidates for the work proposed. Candidates are required to produce evidence, such as letter of acceptance from the institution to be visited by them.

vii) Young scientists and technologists having established credibility in the proposed area of work will be preferred.

viii) Candidates must not have earlier availed of this fellowship at least during the past three years.

ix) The institute, where the candidate belongs to, should have either already initiated major research activities in the chosen area or should have immediate plans to initiate such programmes based on the expertise of the individual and his proposed training abroad.

Those who fulfil the above conditions should contact: Secretary, Department of Science and Technology (Attn : SERC Secretariat, BOYSCAST Scheme), Technology Bhavan, New Mehrauli Road, New Delhi 110 016 and get full details.