

the increasing emphasis on ecology, a chapter has justifiably been devoted to pollution caused by oil industry operations and the efforts being made by the oil companies to combat it.

Several statistical tables have been given. At least in respect of oil and natural gas reserves, a cautionary note could have been given that statistics are notoriously fickle. Sources of information are authentic: World Oil, United Nations, Petro-consultants etc; but they more often than not furnish contradictory figures. For instance, the industry takes 6000 cft of natural gas as equivalent in thermal value to a barrel of crude oil, but U. N. statistics take 4440 cft as the equivalent, since most natural gases contain substantial proportion of inert constituents. The motives are honourable but the ultimate picture gets distorted.

Also tons and imperial barrels are going out of fashion and today it is tonnes (also written as metric tons and generally taken as equivalent to 7.33 barrels on world average sp. gr. considerations) and American barrels that prevail.

Let us consider two tables. In Table-7 on page 194 (Worldwide natural gas production and reserves) the source of information has not been given but presumably it is the highly respected world oil figures given in cubic feet and converted to cubic metres. The sources for Table-10 on page 207 are equally respectable and equally useful in as much as it gives the break up between onshore and offshore, but the totals of Table 7 and Table 10 do not match. In Table-6 on page 191, the figures could desirably have been given in tonnes. In Table-8 on page 204, the units are million tonnes of oil equivalent; to the layman this is mysterious and the author could have elaborated on the meaning and significance of this derived units.

Although this write-up on statistics is long, the lapse is minor and does not detract from the overall merits of the book. To the common man to whom it is addressed it still remains a fine introduction into the exciting world of petroleum.

Bangalore

S. N. VISVANATH

'EXPLORATION GEOCHEMISTRY: DESIGN AND INTERPRETATION OF SOIL SURVEYS' by W. K. Fletcher, S. J. Haffman, M. B. Mehrtens, A. J. Sinclair and I. Thomson. Reviews in Economic Geology, Vol. 3, Society of Economic Geologists, 1987, 180 pages.

This volume brought out by the Society of Economic Geologists (SEG) with the active collaboration of the Association of Exploration Geochemistry (AEG) has emerged from an initial version that was utilised for an SEG-AEG sponsored short course in Exploration Geochemistry. Therefore, special emphasis is laid on 'real life' situations to which the reader is urged to respond and the ground truth is bared to him for a critical evaluation.

It is the appreciation of the geochemical environment of a given landscape that enables one to discriminate between a false anomaly and a genuine but more subtle anomaly, that may receive a low priority or remain altogether unrecognised.

The publication is divided into eleven chapters starting with the first step of choosing the survey method and optimisation of the survey techniques. Orientation surveys, literature study and a theoretical orientation specific to the exploration

targets in a particular geological environment are essential steps if the effort is to succeed. Hastily executed exploration geochemistry without much thought being bestowed on the above essentials is doomed to failure from the word – go.

Geochemical contrast in soil samples is dependent upon the primary contrast between mineralised and unmineralised rock, the relative mobility of the elements in the secondary environment and the dilution by barren unmineralised material. Several examples are cited to underscore the importance of selecting the suitable soil horizon for sampling purposes.

The second chapter is devoted to soil surveys wherein the unconformity related Uranium Deposit is used as a model to illustrate the general principles. Here also the author emphasises the necessity of the essential exploration objective to be clearly defined in terms of the type of deposit that is the focus of the exploration effort. Further, great importance is accorded to the detailed recording of descriptive observations of the time of sample collection to assess the role of organic matter, soil texture, Fe/Mn Oxides, clay content, proximity to bed rock, drainage, pH, soil horizon and bed rock composition.

Mobility of some common trace elements in the surficial environment and soil sampling techniques are outlined in the next chapter. Chapter 4 is devoted to the actual analytical techniques used in exploration geochemistry with a comparative evaluation of these techniques with their advantages and disadvantages. Analysis of geochemical sampling inter alia includes sample preparation, dissolution and analysis *sensu stricto*. Each of these stages can contribute to the ultimate errors in the reported data.

It is absolutely imperative for the exploration geologist to have an appreciation of the capabilities and limitations of the principal analytical techniques employed in exploration geochemistry. It is in the interest of the geologist to identify samples with either unusual or high metal content. This is required because each instrumental method has its own specific limitations, interference and suitability for different elements at different levels/ranges of concentration. Random and systematic errors in the analysis of geochemical samples is also discussed in this Chapter.

Chapter 5 is a succinct introduction to the statistical interpretation of the soil geochemical data where the fundamentals are lucidly explained. The author warns at the outset, that any 'attempt to carry out blind evaluation of data by submitting them to anyone of the ever increasing number of packaged software systems and expect a computer to do our thinking is patently wrong'. The obvious interpretation will emerge through rigorous examination of the data by relatively simple statistical methodologies. Several types of distribution patterns of trace elements are also dealt with in this Chapter. Confidence limits, F and t tests, probability graphs and correlation are also touched upon here.

Chapter 6 deals with geochemical modes, interpretation and follow-up work.

A model may be looked upon as a synthesis of existing data that provides an overall understanding of the mechanism of geochemical dispersion and framework into which further data can be fitted or interpreted upon.

Chapter 7 to 11 deal with case histories of geochemical exploration for different genetic types of deposits like porphyry copper deposits, epigenetic gold deposits, volcanogenic massive sulphide deposits etc.

The accumulated professional, research and teaching experience of the authors is reflected in the clarity of presentation and the practical utility of the several case histories for the professional exploration geologist. The authors warn that 'the effectiveness of soil surveys is often compromised when the conceptual simplicity of the method leads to its unthinking application'.

This volume will be of immense utility to all those engaged in mineral exploration who would like to obtain the maximum benefit from geochemical soil surveys.

*AMSE, Geological Survey of India
Nagpur*

M. S. RAO

CORRIGENDUM

The sequence in the order of authorship of the NOTE in Vol. 40, No. 2, August 1992, p. 195, should read as follows :

R. H. Naik and N. Rajendran
Geological Survey of India, Bangalore
H. L. Bhadrapur and K. T. Ramachandra
Chitradurga Copper Unit, Chitradurga.

LIFE IS GEOCHEMISTRY

Animals, plants and cells are composed of chemical elements and are fed by other chemical elements, all of them coming ultimately from the bedrock via soils and transported by water and wind. When Nature is healthy there is a balanced circulation of elements and the mineral, plant and animal kingdoms flourish. Now the balance is wavering.

It seems that one species within the kingdom of animals wants to rule over all. Mankind has adopted a course of uncontrolled growth. Man is filling the world, terrorizing his environment taking what he lusts after. Ruthless robbery. Even a gentle benefaction of Earth and its treasures both leave a mark, of course, but the results will be of totally different order viewed from the perspective of the coming generations.

From the Earth we came and to the Earth we will return. It is impossible to live without contacting the Earth, without using it, without somewhat changing it. But let us try to live so that the changes will, if possible, improve the environment and, if possible, do little harm. Too many "possibles" in one and the same sentence, but that reflects our present situation—our fears and uncertain conjectures.

L. K. KAURANNE