NOTES

GEOCHEMISTRY OF PLATINUM—GROUP ELEMENTS

To mark the centennial year of the birth of the great pioneer of geochemistry V. M. Goldschmidt, a conference was held at Baltimore in May 1988, sponsored by a group of organisations promoting this discipline. The Association of Exploration Geochemists (AEG), one of the sponsors conducted two of the twelve symposia of the conference on: (i) International Geochemical Mapping and (ii) The Geochemistry of the Platinum Group Elements (PGE). A volume containing nine of the sixteen papers presented at the platinum symposium has been brought out as a 'special issue' by the Journal of Geochemical Exploration (Vol. 37, No. 1, March 1990, pp. 1-169).

The first three papers deal with the analytical techniques developed and advances made in instrumentation. The first paper describes biogeochemical methods as a prospecting tool for PGE. A very low level of determination of Au, Pd and Pt in ashed vegetation (1–2 gm sample is enough) is reached by ICP-mass-spectrometry and graphite furnace atomic absorption spectrometry. It is mentioned that by the latter method, a detection level of 0.2 to 0.3 ppb could be reached but, at the sacrifice of high production in analyses by the former method, where detection level of 0.5 to 2 ppb is obtained. The second paper on radiochemical techniques (radiochem NAA) describes simultaneous analytical determination of precious metals (gold and PGE) and associated chalcophile elements in common silicate rocks at low ppb levels (0.004 ppb for Au and 0.03 to 3 ppb for Ir, Os, Pt, Ru and Pd). The authors state that though this method is a highly sensitive one and can take large samples (50–100 g), it is time-consuming and if the samples are relatively small, errors may result due to nugget effect. The third paper suggests that nitrite-ammonium ratios in soils could be reliable pathfinders to platinum mineralisation as nitrite-ammonium are more mobile in weathering environment than the platinoids. The field studies involving rocks and soils have indicated that nitrite-ammonium ratio is higher in the presence of platinum than in its absence. It appears, however, that application of this methodology in arid areas would be more successful than in temperate or tropical regions.

In another interesting paper, the use of Ni and Cu to PGE ratios as a tool in evaluating the PGE potential of mafic and ultramafic intrusions is discussed. Plots of Pd/Ir *versus* Ni/Cu and Ni/Pd *versus* Cu/Ir are used to distinguish the effects of olivine and chromite fractionation and sulphide segregation, and the prior sulphide segregation is supposed to scavenge PGE. The studies of metal ratios in the chilled margins of ultramafic-mafic intrusive bodies could be an effective prospecting method. If the chilled rocks are not depleted in PGE relative to Ni and Cu, the intrusion may host a PGE deposit, according to the author.

There are five papers on case histories in varied geologic millieu: In the J. M. Reef, Stillwater Complex (a late-Archaean mafic to ultramafic layered intrusion), Pd and Pt occur in solid solution in base metal sulphides and as discrete PGE minerals. The As, Bi, Hg, S, Sb, Sn and Te geochemistry demonstrates the existence of local inhomogeneities in the composition of sulphides, as

element ratios of the sulphide-enriched rocks constituting the reef differ significantly from those rocks with minor sulphides immediately adjacent to it.

The late stage differentiation of Mesozoic (Jurassic) diabase sheets in Gettysberg basin, Pennsylvania, are enriched in Fe and Cl, and contain anomalously high contents of Pd, Au and Fe in iron and chlorine-rich ferro-gabbro at Reesers Summit section. The analytical methods adopted and petrological variations supported by geochemical data provide useful information on fractionation of Pd and Pt during differentiation of a High-Ti (1.1%) quartz-normative tholeiitic magma.

Comparative geochemistry of PGE of Ni-Cu sulphides associated with mafic-ultramafic intrusions in the Appalachian orogen is explained by different source region characteristics and different environments in the magmas involved resulting in depletion or increase in PGE content.

The last two papers are on PGE-bearing chromite deposits in the Acoje block, Zambales Ophiolite Complex, Phillippines. The PGE-rich high-Cr chromitites are stratigraphically localised in basal cumulate peridotites, while sulphide segregation during chromite accumulation from magmas previously enriched with PGEs also account for anomalous values in Acoje mine. The results obtained from the study of PGE chemistry of chromitites in ophiolites establishes the need to evaluate them as potential producers of the precious metals—PGE and Au - Ag, contradicting the generalisation that ophiolites are not economically potential sources for these metals. In the Indian context too, the ophiolite belts should be the targets for PGE exploration. In another study on the role of halogens and carbon in the Acoje ophiolite block, a cogenetic crystallisation with chromite is suggested for the Ru-Ir-Os minerals, whereas Pt and Pd were redistributed and later precipitated as tellurides, bismuthides and arsenides. It is mentioned that halogens played minor role during the redistribution of Pt and Pd as there is no correlation between Cl and PGE-bearing rock units.

It must be remembered, while considering the PGE geochemistry and analytical advances made, that overall precision will vary from one sample to another depending upon the degree of homogeneity; platinum seems to have least homogeneous distribution. Lot of work remains to be done in this country by way of comparison wiih data obtained by different methods to decide which method provides accurate results for a particular type of material.

This special issue is an useful reference volume, especially for those engaged in PGE exploration considering the information made available from several of the case histories described.

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ORIENTATION COURSE IN GEMMOLOGY

Indian subcontinent, from time immemorial, has been known to be the home for a large variety of gems. Gem industry too is very active and cut gems are exported to different parts of the globe. Gemstone export generates appreciable foreign exchange for the country. Despite the fact that gemmology is a part of earth science, there is a lack of interest in the scientific study of gemstones. Though several techniques of identifying gem minerals are known, the average student of geology appears to lack a proper orientation in applying his/her geological knowledge to the study of gems.

In recent years, many new techniques have been developed aimed at enhancing the quality of an inferior stone to one of more desirable value. Several gemstones have been successfully synthesized. New varieties not known in nature have been produced in the laboratory. Identification of synthetic and imitation stones is becoming a challenging task.

In order to focus attention on recent developments, the Geological Society of India proposes to hold a training programme some time in January, 1991, with the aim of imparting knowledge on all aspects of gem identification and trading. The training will be of four-day duration, consisting of lectures and practical demonstrations in the art of gem cutting. A visit to a gem processing factory is also planned.

Persons who are desirous of undertaking the course are requested to contact: B. P. Radhakrishna, Editor, Geological Society of India, P.B. No. 1922, Gavipuram, Bangalore 560 019, before 30th September, 1990.

HAROLD JEFFREYS

(The following eloquent tribute paid by E. G. Nisbet to the memory of Sir Harold Jeffreys who passed away on March 18, 1989 is extracted from 'Geology', Jan. 1990 for the information of our readers.)

The passing away of Harold Jeffreys on March 18, 1989, gives our historians much thought, and the need for better tools. Jeffreys was one of those who gave wings to science. His publication record stretches from 1910 to 1989. For those of us like myself, who was taught geology after 1967, it is worth remembering both what he did and what he opposed.

We are now in the throes of a third revolution in earth science: the arguments about global change and about *Gaia* have many similarities to the debate about drift. Have we as a science, improved in our ability to handle controversy and to search for truth? Perhaps not,—we tend to be suspicious of inventive thought, except when it is hidden behind mounds of data. The giants of the past, if they appeared today, would probably be regarded as too versatile to be serious or too thoughtful to be funded, or would be accelerated into administration. It is worth remembering the battles of the past, to respect both *inverted* and creative opposition and to search for the ability to listen, but with rigour.

E. G. NISBET