

are clear, simple diagrams (many of which are stability diagrams). There is a brief subject index and also a rather longer and more comprehensive index of the minerals referred to in the text.

This is a well written and well produced book; even more importantly, it is a very timely survey of a field that is rapidly growing in importance with the much greater emphasis on 'environmental' geochemistry and mineralogy. It is to be strongly recommended to all mineralogists and geochemists with interests in these fields.

D. J. VAUGHAN

Kazmi, A. H. and Snee, L. W., Eds. *Emeralds of Pakistan: Geology, Gemology and Genesis*. Pakistan (Geological Survey of Pakistan) and New York (Van Nostrand Reinhold Co.), 1990. xii + 269 pp., 90 colour photos, 49 maps. Price £29.00.

This attractively presented book, with a foreword by Edward Gübelin, contains nine chapters by a variety of international experts. Each chapter has its own references but there is also a selected bibliography on worldwide emerald occurrences, with some 530 references.

In northern Pakistan the spectacularly rugged Himalayan ranges dissected by the awe-inspiring canyon of the Indus River, which reaches over 6100 m of relief in places, provide a fascinating background to the discovery and working of the emerald deposits in the Surat-Malakand-Mohmand area.

The gemmological characteristics of the Pakistan emeralds are fully documented by a chapter by E. Gübelin, who notes that they have refractive indices rather high for gem-quality emeralds, but which are in agreement with emeralds containing appreciable iron. This chapter also deals with both primary and secondary fluid inclusion from the petrographic viewpoint. In a later chapter, the chemistry of these inclusions is considered by R. R. Seal, who concludes that they were probably entrapped at 250–449 °C at a confining pressure of 900 bars. A joint contribution from staff of the U.S. Geological Survey and of the Geology Department of Oregon State University deals in detail with the major, minor and trace element composition of the emeralds from several Pakistan localities and also their host rocks; most of the emeralds owe their colour to the substitution of chromium for aluminium in the beryl structure (though a green beryl from Gandao has 13300 ppm V but only 340 ppm Cr). A further chapter by Jane Hammarstrom of the U.S.G.S. reports on the colour zoning shown by some of the emeralds and also demonstrates that

the substitution of magnesium for aluminium in the octahedral site is charge-balanced by the entry of sodium into the channel site (these emeralds are notably poor in Rb and Cs).

The remaining five chapters are concerned with the geology and genesis of these emerald deposits, and in these the work of A. H. Kazmi, Director General of the Geological Survey of Pakistan, and of L. W. Snee of the U.S.G.S., point the way to a more fundamental understanding of the genesis of emeralds. In Pakistan all the emerald deposits are located in the Indus suture zone; most are associated with the Mingora ophiolitic mélange which has provided the chromium, whereas the beryllium came from later mineralising fluids from the younger granitic rocks. In a wider consideration of all known emerald occurrences worldwide, a possible classification takes into account the geochemical incompatibility of Cr and Be and lists emerald deposits according to the source of the chromium (suture zones, granite-greenstone terrain or shale—metashale) and of the beryllium (generally pegmatitic or hydrothermal fluids but more rarely metamorphic fluids). With the exception of the Colombian occurrences, most emeralds exist as a result of crustal plate movements that juxtaposed chromium-bearing ultramafic oceanic plate movements with beryllium-bearing felsic continental rocks. Thus as the Editors suggest, we may marvel at each emerald crystal not only for its intrinsic beauty, but also for its untold tale of continental collisions.

R. A. HOWIE

*World Gold '91 2nd Australian IMM-SME Joint Conference*. Parkville, Australia (Australasian Institute of Mining & Metallurgy), 1991. 448 pp.

This publication contains sixty-five of the presentations made at a conference on gold deposits and mining held at Cairns in April 1991. The topics cover a variety of aspects, but fall into three categories: Metallurgy, Geology, and Mining, Finance, and the Environment. The majority (over half) deal with metallurgical aspects, and in particular concentrate on new advances in processing gold-bearing ores. The geological papers cover case histories of projects and mines, mostly in Queensland, but also in west Australia, Indonesia, and the western United States. The final section also concentrates on Australian Mining projects.

This is a well-produced publication which will be of most interest to those specifically interested in gold mineralisation and the working of gold

deposits. Although the hectic exploration activity for gold has subsided recently this book still contains much which is of topical interest. Probably the most useful aspect is the presence of

several interesting case histories outlining the stages of exploration and mine development, and the practices involved.

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