

Book news

1. Book review

● *Economics of mineral exploration in Australia*, by Brian W. Mackenzie and Michel L. Bilodeau. Australian Mineral Foundation (Private Bag 97, Glenside, South Australia 5065). 198 pp. \$A58. \$A45 for students.

Reviewer: D.G. Krige

The economics of mineral exploration are evaluated against the background of historical data in respect of exploration and mining projects in Australia. From these data, a historical footprint is defined covering the average pattern of cash flows for economic deposits over the exploration, development, and production phases. Expected value criteria are then developed based on the results from a large number of discoveries classified over the full range from successes to failures.

The main risk elements of metal price uncertainties, geological variability, and the uncertainty of discovering an economic deposit (specifically defined) are considered. Results are analysed to show the total potential monetary value to the country (i.e. before payments to the State), and also the after-tax value and risk of a project (i.e. the net value to the mining company concerned).

Data used from the Australian Bureau of Statistics cover exploration expenditure of \$1.6 billion (1980 terms) and 100 'discoveries' for the period 1955/78. Some 119 pre-1955 discoveries provided supplementary information. Cash flows for these projects were evaluated for variable time intervals between exploration and development of 1, 3, 5, and 10 years: The main uncertain parameters were covered by probability distributions, some of which are highly skewed with large variances.

Of the 100 discoveries during 1955/78, 43 were found to be 'economic' as specifically defined, with an average N.P.V. at 10 per cent real of \$4 million and an 11 per cent expected rate of return (IRR) over the full cycle from exploration to exploitation. At the start of development, the expected return was 32 per cent p.a. The sensitivity of these results at a variation in metal prices is clearly demonstrated; also, *inter alia*, the importance of realistic size and profitability hurdles to be set by the company and the effect of changing the exploration budget level. The distribution of the N.P.V.s was found to be highly skew, ranging from about 2 per cent of the average at the lower decile to almost 2½ times the average at the upper decile.

Of major significance are the conclusions regarding government policy. It is shown that a significant percentage of projects is rendered uneconomic by the 1982 tax and royalty system; these exclude gold mines, which are exempt from income tax. The need for a realistic taxation policy is stressed. This should cover all the phases from exploration to exploitation, and be aimed at maximizing the size of the 'pie' to be shared between the State and the mining companies, together with the provision of an adequate after-tax incentive to the latter.

The Australian Mineral Foundation is to be congratulated on this stimulating and important publication. It

provides essential study material for all exploration geologists, mine economists, mining engineers, and mining executives involved in exploration and feasibility studies; also for Government personnel, and for politicians who can exert some influence towards a more realistic structuring of the mining taxation system in Australia and in other mining countries.

2. Recent publications

● *Combustion of coal liquid mixtures*, by G.F. Morrison. London, IEA Coal Research, 1983, 52 pp.

Recent literature relating to the use of coal liquid mixtures (CLMs) as alternative fuels in oil-fired boilers is reviewed. Emphasis is placed on coal-oil mixtures (COMs) and coal-water mixtures (CWMs), although coal-oil-water mixtures and coal-methanol mixtures are discussed briefly. Preparation and stabilization techniques and procedures for CLMs and beneficiated CLMs are described. The transport and handling of CLMs at power stations are covered briefly. The influence of fuel volatility, coal particle size, atomization, and burner design on the mechanism of CLM combustion is described in detail. The relationship between fuel composition and the combustion products; and nitrogen oxides, sulphur oxides, and particulates, and the effect of ash on boiler equipment, are evaluated. It is concluded that, despite the advanced development of COMs, the technology has not found widespread application. The major effort is now being devoted to CWMs, the further development of which awaits large-scale combustion trials.

● *Hafnium: physico-chemical properties of its compounds and alloys*. Vienna, International Atomic Energy Agency, 1981. 408 pp. 620 Austrian schillings.

In this concept, this volume on hafnium follows closely the previous issues in this series of Special Issues, of which this is no. 8. Each chapter has been compiled and assessed by experienced authors, and gives a critical evaluation and documentation of the following data: thermodynamic properties, densities, crystallographic structures, equilibrium diagrams, and diffusion rates in the condensed state.

● *Canadian mines handbook 1984-85*, edited by C.D. Gardiner. Toronto, The Northern Miner, 1984. 500 pp. \$24.

Canadian mining, which has always been a cyclical industry, is finally emerging from its most severe slump since that suffered in 1931, the year of the first publication of the Canadian Mines Handbook. While most metal prices still have a way to go to permit the profitability levels that investors have grown to expect, most senior producers are once again operating in the black. With inventories shrinking, this process should accelerate in the months ahead. Although it looks like a different ball game now because of fierce and growing foreign competition for the all-important export markets, cost-cutting measures and spending controls of the past two years have put the industry in a much healthier operating position. This,

coupled with a weak Canadian dollar *vis a vis* its American counterpart in which currency most metals are sold, is another plus factor that will enable Canadian mines to meet competition head on.

● *Drilling equipment in Canadian mining and exploration—opportunities for the industry*, by A.J. Jakubek. Toronto, Micromedia Limited (144 Front Street, Toronto M5J 1G2, Canada), 1984.

Most of those familiar with the drilling machinery used in the Canadian mineral exploration and hard-rock mining industry will agree that a surprisingly small proportion of that equipment is manufactured in Canada. There will be much less agreement on what might be done about this and how to do it. This paper, which essentially reflects the views

of the author, is offered as a stimulant toward such discussion of opportunities in domestic design and manufacture.

● *Research report 1984*. Port Melbourne, Division of Mineral Chemistry, Commonwealth Scientific and Industrial Research Organization, 1984. 190 pp.

This account of the research activities of the Division of Mineral Chemistry covers the period 1981–1983. In general the material is organized in accordance with the list of research programmes of the Division and the Institute of Energy and Earth Resources, although some additional subheadings have been created to allow related areas of work to be grouped together. Each article title is followed by the names of the researchers associated with the work described.

Surface engineering

Wear is an unavoidable problem in virtually all products of the engineering industry, from the minute bearings of instruments to the cutting surfaces of earth-moving plant. Product life, before critical parts must be either replaced or scrapped, is determined by the performance of the surfaces subject to deterioration in service and, as a consequence, improvements in product life are increasingly an important feature of marketing strategy.

In manufacture, the cost of the wear-resisting components may represent a significant part of the overall cost of the product, and techniques that allow cheaper materials or more efficient production methods to be used are to be welcomed in a competitive market place. Moreover, product design may also be influenced by the coating or surface treatment used, with consequential effects on service performance and production efficiency.

Important, often dramatic, improvements are possible by the use of the latest technology. Much effort is therefore devoted world-wide to the development of improved or less costly coating materials, the enhancement of surfaces by thermal and chemical treatment, coating process and equipment innovation, research into the mechanisms of deterioration, and testing techniques for surface evaluation.

There is now a clearly identified need for a major international conference on surface engineering and The Welding Institute, in collaboration with the Surface Engineering Society, is arranging the first in a planned

series of conferences in this key area of technology, which will be held at Brighton (England) from 26th to 28th June, 1985.

It is expected that the Conference will be attended by a wide range of senior personnel from most sectors of the engineering industry. Research-and-development engineers, designers, metallurgists, coating engineers, mechanical and production engineers, and those concerned with product quality and costs will all benefit from the range of topics covered. The following are some of the topics that will be discussed.

- Developments and innovations in process and equipment for coating, surface treatment, and reclamation
- Coating by physical and chemical vapour deposition, electroplating, thermal spraying by plasma, arc, flame, laser, and electrostatic methods, welding, and mechanized and hydrostatic compaction
- Preparation of surfaces for coating and build-up
- Surface treatment by physical, thermal, and chemical methods
- Testing of coatings, and of coated or treated components
- Developments in surfacing consumables
- Coating structure, properties, and bond strength.

Enquiries should be directed to Mr John L. Sanders, Manager, Communications, The Welding Institute, Abington Hall, Abington, Cambridge CB1 6AL, England. Telephone: 0223 981162. Telex: 81183.

Safety in mines

About 50 papers will be presented at the 21st International Conference of Safety in Mines Research Institutes at Sydney from 21st to 25th October, 1985. Some 250 delegates from 30 nations are expected to attend.

Sponsored by the New South Wales Department of Industrial Relations, the Conference is being organized by a committee representing Australian mining companies, universities, research establishments, and the principal mining union, with State Government assistance.

The purpose of the Conference will be to exchange achievements among scientific workers engaged in the safety problems of the mining industry. The papers to be presented will be divided into eight sessions:

- General Environmental Science
- Fires
- Explosions
- Transport
- Safety Engineering
- Safety Aspects of Strata Control
- Accidents
- Explosives and Blasting.

Practically every aspect of mining safety is expected to be covered including environmental monitoring, methane drainage, lighting, airborne dust standards, fire detection and control, emergency management, control of live fires, testing methods of hazardous materials, environmental effect of fires, ignition sources, explosion suppression, non-destructive testing, fatigue analysis of haulage and winding components, braking of men and material transport, reliability

of components, hazard analysis, equipment design for safe operation, communication equipment, slope stability at surface mines, underground roof support, gas and rock outbursts, special studies for the avoidance of accidents, and safe transport of explosive materials.

In the selection of papers for the Conference, particular emphasis will be placed on the application of new technology and on advances made in modelling and prediction techniques. While the majority of papers will deal with underground mining, a number dealing with open-cut workings will be included.

Official languages for the Conference are English, Russian, German, and French. Simultaneous translation at the Conference will cater for Japanese and Chinese in addition to the four official languages.

During the week of the Conference, a Safety and Technology Display will be held at the Conference venue. This will involve apparatus of the type used for instrumentation, monitoring, control, communication, and signalling.

Immediately following the Conference an exhibition of mining equipment emphasizing safety aspects will be held at the Londonderry Industrial Safety Centre. This will be on a much larger scale than the display that is to be held at the Conference venue.

Enquiries should be directed to Mr M.R. Lloyd, Department of Industrial Relations, Londonderry Industrial Safety Centre, 132 Londonderry Road, Londonderry, N.S.W. 2753 Australia. Telephone: (047) 774261. Telex: LISC AA75729.

Professional development seminars

The following seminars are still to be held in the 1984-1985 programme in the Department of Mining and Metallurgical Engineering of McGill University, Montreal, Canada.

● March 18th-21st, 1985

Underground Blast-hole Mining

Since the first successful trials were reported by INCO/CIL at the Levack Mine in 1974, large-diameter blast holes have found wide and varied application in the Canadian and foreign mining industries. The purpose of this seminar is to review the underlying principles involved, to present state-of-the-art practice, to identify successful or appropriate procedures, and to consider new developments, trends, or problem areas related to this mining system that require attention. Competent speakers in this area of mining practice will be present. It is intended that participants at the seminar will feel free to ask questions and to input supportive commentary during the proceedings.

Seminar Leader: R.R. MacLachlan.

● May 1st-3rd, 1985

Mineral Processing of Gold Ores

This seminar examines the technological aspects of gold

recovery from precious-metal ores. Topics will include: cyanidation, dissolved-gold recovery, treatment of refractory ores, laboratory testing for flowsheet development and optimization, cyanide-destruction techniques, heap-leaching, plant sampling and mass balancing, modelling of cyanidation kinetics, gold sampling and assaying, and applied mineralogy. The course is designed for the plant metallurgist and the process-development engineer.

Seminar Leaders: A.R. Laplante and J.A. Finch.

● May 6th-10th, 1985

Mineral Comminution Systems

A review of the principles and practice of comminution systems in the mineral industry. Conventional crushing and grinding as well as new comminution equipment will be discussed. Topics such as design, sizing and costing, optimization, modelling and control will be presented. The course will also include two evening sessions to present simulation and statistical packages included in the course notes. The course is designed as an update for the practising engineer and the process-development engineer and scientist.

Seminar Leaders: J. Finch and A.R. Laplante.

● **May 13th-15th, 1985**

Processing of Metallurgical Residues

Dusts and residues from metallurgical plants can represent a loss of values and/or an environmental hazard. As the metallurgical industry matures, the need to treat these materials becomes more pressing. In the design of treatment processes, the materials must be characterized by phase, phase intergrowth, and particle size. Because of their fineness, electron-beam and X-ray techniques must be used. These techniques and their application will be reviewed. The information thus obtained can be used to guide process selection. Physical, hydrometallurgical, and

pyrometallurgical options and their integration must be considered. These options will be reviewed with reference to current and projected processes. Emphasis is on the development of a systematic procedure for evaluating process options for dusts, with particular reference to dusts from base-metal and iron/steel plants.

Seminar Leaders: N. Rowlands and J.A. Finch.

Further information is obtainable from Lorna McFadden, Department of Mining and Metallurgical Engineering, McGill University, 3480 University Street, Montreal, Quebec, Canada H3A 2A7. Telephone: (514) 392-5426. Telex: 05-268510.

Analytical chemistry

The Second Symposium on Analytical Chemistry in the Mining, Exploration and Processing of Materials is to be held in Pretoria from 15th to 19th April, 1985.

The Symposium is being held under the patronage of the International Union of Pure and Applied Chemistry (IUPAC), and it is sponsored by several associated research institutions and private companies. The secretarial services are supplied by the Symposium Secretariat of the Council for Scientific and Industrial Research (CSIR).

Analytical chemistry is vital to the mining and minerals industry. To meet the ever-increasing demands placed in the quest for better quality and the more economical exploitation of mineral resources, sophisticated analytical techniques must be constantly developed or existing methods improved. The need for regular and formal exchange of knowledge has resulted in South Africa, with its many mining interests and rich and varied mineral deposits, hosting the second symposium as a sequel to the first highly successful one, which was held in Johannesburg in 1976.

The objective is to highlight the importance of analytical chemistry in the production of materials from the initial stages of the exploration and assessment of ores to the beneficiation and, finally, to the refined product. The aim is to bring together from all over the world scientists specializing in the various fields of analytical chemistry to exchange information, to discuss progress in the analytical sciences, and to explore future developments. The Symposium should therefore be of interest to anyone working in the fields relating to the determination of the quality of materials, i.e. analytical chemists, mineral

physicists, metallurgists, geologists, and chemical and mining engineers.

The following analytical topics will be discussed:

- Atomic absorption spectrometry techniques
- Inductively coupled plasma techniques
- X-ray spectrometry and diffraction techniques
- Neutron activation techniques
- Ion beam analysis
- Surface analytical techniques
- Geochemical exploration
- Automation and on-line analysis
- Flow injection analysis
- Analysis of ferrous materials
- Analysis of non-ferrous materials
- Wet chemistry
- Reference materials
- Elemental analysis of coal
- Chemometrics
- Analysis of nuclear materials
- Analysis of gold, silver, and platinum-group metals
- Analysis of the environment.

All correspondence related to the Symposium should be addressed to

The Symposium Secretariat S.328

CSIR

Box 395

PRETORIA

0001 South Africa

Tel: (012) 86-9211 × 4412 (Mrs Meyer)

× 2077 (Mrs Rhodes)

International + 271286-9211

Telex 3-21312 SA.