

Book news

1. Book reviews

● *Phosphate rock, a bibliography of world resources*. London, Mining Journal Books Limited, 1984. £10 (surface mail), £12.25 (airmail).

Reviewer: P.L.C. Grubb

Published under the combined auspices of the International Union of Geological Sciences and UNESCO, this book forms a contribution to the International Geological Co-operation Programme Project 157 on Phosphorites. It was compiled in response to the 'considerable need for systematic and comprehensive geological reference data on known deposits and occurrences of phosphate rock'.

As the title indicates, the book is essentially a bibliography, and contains more than 2000 references. As such, it will be a welcome acquisition to those who are specifically interested in this field. Apart from a very short general section, the bibliography lists references specifically on a country-by-country basis within a broader geographical framework.

An account describing some of the essential features of the industry is provided in an introduction of 21 pages. Despite the wealth of information provided, it might be questioned whether the objective is satisfied. The text fails to make an effective distinction between technical and commercial fields. In particular, the introduction provides no geological section, and the references to mineralogy and geochemistry are limited. Furthermore, in view of the apparent interrelationship between ore type, beneficiation, and chemical extraction, it is a pity that this is not expanded on — possibly with the assistance of simplified flow sheets.

Tables indicating the distribution of reserves (including tonnages, geological type, age, etc.) would have been most useful to a reader.

The book has no index, which is a pity as this would have been useful in helping readers to locate references relating to specific technical subjects. Perhaps, too, the book could have been expanded to include brief abstracts of the references cited.

In spite of these criticisms, the bibliography appears to be fairly comprehensive, and the book will find a useful place in most mineral-resource libraries.

● *Ok Tedi*, by William S. Pintz. London, Mining Journal Books Limited, 1984. 206 pp. £19 (surface mail), £22.25 (airmail).

Reviewer: R.P. Plewman

This interesting book deals with the establishment of the first sizeable mine in Papua New Guinea. Ok Tedi was established to exploit the Mount Fubilon orebody in the Star Mountains, a remote and almost inaccessible site with an average rainfall of over 9000 mm. The orebody is unusual in that it contains copper and gold, with a considerable concentration of gold in the leached capping.

The main thrust of the book is related to the problems of the Government of the newly independent Papua New Guinea in dealing with the exploitation of its first major mineral discovery. The history of the development of

policies to cover such wide-ranging aspects as taxation, social and environmental impact, resource utilization, and the provision of infrastructures, among many others, is fascinating, as is the detailed account of the assembly of the consortium that was finally to undertake the work, its financing procedures, and the negotiations that eventually led to the Ok Tedi Agreement. The author ends with a postscript that takes the story to mid 1983, so that it is clearly topical.

I believe this book will be of value to anybody concerned with industrial or commercial ventures in Third World countries, or with an interest in how Third World governments may react to Western attitudes towards commercial ventures.

2. Publications of the Canadian Mineral Policy Sector

● The following reviews of the activities and developments during 1982 in respect of the chief minerals produced or consumed in Canada are available at \$1.25 per copy from the Canadian Government Publishing Center, Supply and Services Canada, Ottawa, Canada K1A 0S9.

Lime by D.H. Stonehouse. 5 pp.

Phosphates by G.S. Barry. 9 pp.

Statistical summary of the mineral industry in Canada. 77 tables.

Talc by M. Prud'homme. 6 pp.

Zirconium by M.A. Boucher. 6 pp.

Cement by D.H. Stonehouse. 13 pp.

Gypsum and anhydrite by D.H. Stonehouse. 7 pp.

Regional review by T.M. Buch. 12 pp.

Salt by G.S. Barry. 7 pp.

Silicon, ferrosilicon and silicon carbide by D.G. Law-West. 6 pp.

Sulphur by B.W. Boyd. 9 pp.

● Mineral Report 31. *Canadian Minerals Yearbook 1981*. Available from the above address at \$40.75 per copy.

This is a report of developments in the industry during 1981. The chapters dealing with specific commodities, a General Review, a Regional Review, a list of Selected Mineral Commodities, and a Statistical Summary were issued in advance as individual loose-leaf reviews.

3. Mintek reports

The following reports are available free of charge from the Council for Mineral Technology, Private Bag X3015, Randburg, 2125 South Africa.

● **Report M18D**

The recovery of pyrite and gold from acid-leach residues from the Merriespruit Gold Mine. (First issued Feb. 1982; reissued Mar. 1984).

Batch flotation tests on acid-leach residue from Merriespruit Gold Mine showed that concentrate grades of up to 40 per cent sulphur can be readily obtained, although at low recoveries.

Flotation tests at the pilot plant gave better results than did the batch tests. The initial results showed that 76 per cent of the sulphur content of the feed can be recovered in a concentrate that assays 47,0 per cent sulphur. Attempts to improve the recovery at the expense of the grade were not successful, the highest recovery obtained being 79,7 per cent at a concentrate grade of 36,8 per cent sulphur. The gold recovery at that stage was 47,2 per cent.

A gradual deterioration in flotation response was noted as the tests progressed, and this was attributed to possible deterioration of the feed material due to oxidation. However, this was not proved conclusively.

It was concluded that, by use of the flotation conditions recommended by the sponsor, the required grade of 38 per cent sulphur could be readily obtained at recoveries of more than 75 per cent of the sulphur present in the feed material.

In a second phase of the project, cyanidation tests were carried out on roasted and unroasted flotation concentrates produced in the pilot plant. The average gold extraction for the roasted material was 68 per cent. Additions of lime were found to be important, and an excess of lime resulted in lower gold extractions. The extraction of gold from unroasted material was not as successful as from the roasted material. The maximum recovery from unroasted material after fine grinding was 63 per cent. The consumption of lime was high in all these tests, and 22 kg of lime per ton of concentrate was used for the test in which the maximum gold extraction was obtained.

Finally, settling tests were carried out on tailings so that the settling characteristics in an acid medium could be established. It was found that, in the pH range 3,5 to 4,5, the settling rate was two to three times lower than it had been at a pH value of 11,0.

● Report M20D

The separation of ore from Cooke into high- and low-grade fractions. (First issued Feb. 1982; reissued Mar. 1984).

The separation of the ore by sizing alone was not very successful, and the recovery of uranium to the high-grade fraction did not exceed 73 per cent.

The use of a combination of size and gravity separation was attempted, and the tailing from the gravity circuit contained 33,9 per cent of the uranium at a grade of 60 g/t.

The circuit recommended includes autogenous grinding to liberate part of the ore matrix containing the values into the fine fraction. This should be followed by heavy-medium separation for the recovery of the high-grade portion of the coarse fraction. The size at which this heavy-medium separation is carried out should be determined.

● Report M33D

Explanatory tests on the reduction of the sulphur content of sponge iron. (First issued Apr. 1982; reissued Mar. 1984).

Tests were done on a batch of sponge iron, of which the particles were between 1 and 3 mm in size, so that its sulphur content could be reduced to 0,015 per cent or less; the average sulphur content of the original material was 0,034 per cent.

The sulphur content of sized fractions of the material increased as the particle size decreased; the 10,8 per cent of the material that was smaller than 1 mm assayed 0,061 per cent sulphur.

Much of the sulphur content of the sample (Sample J76) is in the form of coatings on the surfaces of the particles; dust removed by washing in alcohol assayed 0,40 per cent sulphur. In addition, some discrete grains with high sulphur contents were observed; particles separated by a heavy liquid (relative density 2,95) assayed 0,17 per cent sulphur.

The tests done aimed at the removal of the surface coatings by attrition with sand or the action of the grinding medium in a ball mill, or both, the removal of sulphur-bearing particles (discrete or attached) by 'selective' magnetic separation or by grinding in a ball or rod mill, or both, and the removal of material smaller than 1 mm by screening.

Variations of these three operations were tested in combination to demonstrate their effectiveness, but they were not optimized because optimization of small-scale tests would not be of practical value.

In the last test done, the material was tumbled with sand in a ball mill with 8 to 15 mm balls, screened on a 1 mm screen, and separated on a Ball-Norton type of magnetic separator. It was found that 68,1 per cent of the original (with a sulphur content of 0,012 per cent) or 83,5 per cent of the original (with a sulphur content of 0,013 per cent) could be recovered.

The lowest sulphur content observed in any test was 0,010 per cent, but the yield was only 66,3 per cent of the original.

● Report M43D

Beneficiation tests on andalusite-bearing shales from a farm near Thabazimbi. (First issued Aug. 1982; reissued Mar. 1984).

Several samples of andalusite-bearing shales from a farm in the Thabazimbi district were evaluated in batch and pilot-plant tests.

The batch tests showed the samples to contain andalusite of a high quality (59,0 per cent alumina, 0,6 to 0,9 per cent ferric oxide) at yields varying between 8 and 12 per cent.

Pilot-plant tests on bulk samples of the ores, which were done in an attempt to establish a commercially feasible procedure for their treatment, confirmed these results, a concentrate assaying 59,6 per cent alumina and 0,71 per cent ferric oxide being produced from the major samples. The yield of andalusite was 12,2 per cent. Tests on a duplicate sample gave a concentrate assaying 59,9 per cent alumina and 0,60 per cent ferric oxide, but the yield decreased to 10,5 per cent. The high grade of the final concentrates is noteworthy, and was obtained by treatment on a new type of magnetic separator.

The ore is considered eminently suitable for beneficiation by a technique developed at the laboratories of the Council for Mineral Technology (Mintek) — albeit on a pilot-plant scale — but it should also respond favourably to the conventional beneficiation procedures currently in use.

The major items of equipment that would be required for a plant to treat 100 t of shale per hour are included.

● Report M129

The determination of tin, niobium, and tantalum in pegmatite by X-ray-fluorescence spectrometry.

The effect of interferences from yttrium, uranium, and thorium in the niobium analysis, and from hafnium, copper, and nickel in the tantalum analysis, was investigated. The results for the excitation of tin by a rhodium tube and by a gold tube are compared. A simple background-ratio technique of matrix correction is used and was found to be satisfactory for up to 2000 µg of analyte per gram in fused pegmatite samples.

In an assessment of the accuracy of the method by the use of in-house reference materials, the results for tin processed by the pressed-powder technique were within 6 per cent of the accepted value over the range 13 to 700 µg/g when the fusion technique was used, those for niobium for the same range were within 4 per cent, and those for tantalum within 6 per cent over the range 200 µg/g to 1 per cent. The relative standard deviation for the fusion method varies from 0,014 for tin at 900 µg/g to 0,019 for niobium at 200 µg/g.

The limits of detection in the fused samples are 3, 1, and 2 µg/g for tin, niobium, and tantalum respectively, which represent four times these values in the original sample. On the assumption that the limits of determination are twice the limits of detection, the lower limits of determination in the unfused (original) samples are 24, 8, and 16 µg/g for tin, niobium, and tantalum respectively.

The two methods, one using the fusion technique and the other the pressed-pellet technique, are detailed in appendices. A third appendix gives a computer programme for the calculation of the results obtained by the two methods.

● Report M131

The determination of copper and nickel in iron- and chromium-bearing materials by a pressed-powder technique and X-ray-fluorescence spectrometry.

A method was developed that is suitable for the determination of copper and nickel in ores such as those from the Merensky and UG-2 Reefs.

The sample was ground finely and diluted with river sand so that matrix variations were avoided as much as possible. After the addition of a wax-polystyrene binder, the material was pelletized. The matrix effects of iron and chromium, and the effects of their mutual interferences on the determination of copper and nickel, were then investigated.

Equations were derived for the corrected copper and nickel K α intensities, and were applied to the analyses of head, concentrate, middling, and tailing samples. Comparative values obtained by atomic-absorption spectrophotometry were found to be in reasonable agreement with the X-ray values; the average deviation was +0,3 per cent for copper and -1,6 per cent for nickel relative to the AAS values.

The limits of detection of the method for copper and nickel are 31 and 40 µg/g respectively; the limit of determination for copper is 92 µg/g and for nickel is 119 µg/g. The relative standard deviation at 900 and 2400 µg of copper and nickel per gram is 0,02.

● Report M135

The installation of a 100 kVA plasma furnace at Mintek.

The selection and installation of a 100 kVA a.c. plasma furnace at the Council for Mineral Technology (Mintek) are described. A series of commissioning tests demonstrated that the furnace is capable of smelting ore and coal fines to yield various ferro-alloys.

The stability of the arc is primarily a function of furnace temperature, but at low temperatures the influence of the system reactance, the type of plasma-injection gas, and the addition of feed material are significant. Under some furnace conditions, usually at high temperature, the mode of electrical conduction between the electrodes includes the molten-metal bath.

Further work is recommended so that the detailed metallurgical performance of the furnace can be established for various materials.

● Report M136

The determination of gold in activated charcoal by use of a loose-powder technique and X-ray-fluorescence spectrometry.

The method of analysis described is applicable to samples of activated charcoal with a gold concentration of 15 g/t and higher. The use of a loose-powder technique minimizes the time taken for the preparation of samples. A platinum internal standard is used for the correction for matrix effects and for differences that could be caused by the packing of the loose charcoal into liquid-sample cups. The precision of the method ranges from a relative standard deviation of 0,085 to 0,016 for concentrations of gold from 67 to 3800 g/t respectively. The agreement between the recommended values for a set of reference samples and the values obtained by the X-ray-fluorescence method is better than 3 per cent.

The overall time required for the analysis of ten samples and standards is approximately 1 hour.

A detailed laboratory method and a computer programme for the calculations are given as appendices.

● Report M140

The effect of physical and chemical factors on the corrosivity of a synthetic mine water.

An investigation is reported in which the corrosivity of a synthetic mine water (based on samples of machine water) on mild steel was measured by laboratory techniques involving loss in mass, the extrapolation of Tafel plots, and polarization resistance. The effects on corrosivity of systematic variation in important properties of the water, such as dissolved-oxygen content, pH, flowrate, temperature, and concentration of ammonium ions, are quantified.

The results indicate that the rates of two cathodic reduction processes (reduction of dissolved oxygen and evolution of hydrogen) control the corrosion rate of mild steel. The effects on corrosivity of much of the dissolved solids (such as chloride, sulphate, and nitrate ions) and of the total hardness of the water is minimal. This invalidates the use of corrosivity indices based on concentrations of dissolved solids.

Details of projected laboratory and field tests on the corrosivity of mine waters are included.