

# DEVELOPMENTS IN INDUSTRIAL MINERALS IN 1993

## A WORLDWIDE VIEW

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As with many years, 1993 was a mixed bag for industrial minerals. For example, commodities associated with fertilizers such as potash, sulfur, and phosphates did not fare well due to depressed demand, oversupply, and low prices. By contrast, after a somewhat disappointing 1992, the current year saw an increase in the sales of rough diamonds by nearly 30%. An exploration boom for diamonds occurred, mostly associated with kimberlite pipes in the Northwest Territories of Canada. A record was also broken during the year when the United States reported an all-time low of 98 fatalities from all types of mining.

### DIAMONDS

Judging from news releases, one can compare the diamond rush in Canada to the California and Alaskan gold rushes during the previous century. One important difference today is that the players are no longer individual prospectors but rather companies. Exploration has detected numerous, perhaps 100, kimberlite pipes in the Northwest Territories that are being evaluated, some with promising results. The flurry of activity in Canada really started with the encouraging test results of Dia Met Minerals in the Lac de Gras area of the

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### TEXT ABBREVIATIONS

Several words have been abbreviated throughout the text. They include:

M = million; t = tons; yr = year; ct = carats

Thus, an abbreviation like Mt/yr means million tons per year. Also, monetary amounts are in U.S. dollars unless otherwise noted.

Northwest Territories in late 1991. Now in a joint partnership with Broken Hill Proprietary, Dia Met continues to discover more kimberlite bodies, and core testing as well as bulk sampling continues to produce encouraging results. Their exploration has detected a total of 26 kimberlite bodies and bulk samples of both kimberlites and associated outcrops tested to date have shown significant quantities of both micro- and macrodiamonds of gem quality. Early test results suggest that these areas may have better quality and quantity than the South Africa mines worked by De Beers. The fact that an on-site sampling plant has been constructed and occupied by Dia Met lends further support to the idea of an economically viable operation in the future. Dia Met's stock price, by early 1993, had shown a price increase of over 1000% over the previous 12 months.

At present, there are probably 60-70 companies involved in exploration and/or evaluation of deposits in the Northwest Territories. Over 20 million acres have been staked. Most of the companies involved have formed joint ventures that allow smaller companies to participate at a reduced risk. Although it would be impractical to list all of the companies involved, a few ventures deserve mention. A joint venture of five companies has announced that numerous micro- and macrodiamonds have been obtained from samples collected from the Tli Kwi Cho kimberlite. In between this and the Dia Met kimberlites, 11 kimberlite bodies have been reported by Aber Resources in a joint venture with Kennecott Canada. A joint venture of three companies has found diamonds at the Yamba Lake property and a drill core obtained from the Torrie pipe revealed 191 diamonds (152 micro- and 39 macrodiamonds with 188 being clear/white in color and clarity).

Although the Northwest Territories have certainly captured the headlines, other areas of Canada are being explored for diamonds. The provinces of Alberta, Saskatchewan, and Ontario all have some degree of exploration. The Diask Syndicate plans to examine a number of circular magnetic features north and west of Regina, Aaron Oil Corporation in conjunction with Rhonda Mining plan to explore the Fort a la Corne area where microdiamonds and one macrodiamond have already been found, and Guardian Resource Corporation has acquired more land for diamond exploration in the Sturgeon Lake area, all in Saskatchewan. Microdiamonds have been found in the Bucke kimberlite pipe in Ontario by a joint venture of KWG Resources and Spider Resources.

It should be noted that despite the notoriety associated with diamond exploration and the uranium deposits of the Cigar Lake area, the Canadian mining industry as a whole is spending little for the future. At present, low prices associated with low demand and increasing taxes are the major reasons for this trend. In addition, the Canadian companies have begun to face the same problems as their southern neighbor and Australia with respect to land access, lengthy planning procedures, and environmental regulations. The industry feels the government is not doing enough to educate the general public about the importance of mining to the economy. However, the industry needs to do more for itself by educating the public, just as U.S. companies are realizing. Certainly the mining industry of Canada needs to invest in its future by increased spending for exploration and development of its mineral resources.

Considerable exploration activity for diamonds has been reported in other parts of the world during the year, including Alaska and Arkansas (Crater of Diamonds State Park) in the United States, Brazil, Venezuela, Madagascar, Russia, South Australia, Western Australia, New South Wales, Central African Republic, Zaire, Tanzania, Zimbabwe, Ivory Coast, and Namibia. In Central Australia, according to studies recently completed, there may be considerable diamond potential. Bedrock terrains under shallow overburden resemble some of the known mines and 60 geologic "bubbles" (presumably circular features) may be kimberlite bodies. Namibian Minerals Corporation has been formed to recover diamonds from marine diamond resources along the coastline of southern Namibia and northern South Africa. The company believes the total resources are 27 Mct, over 95% of which are gem quality, with an average size of 0.25 ct. One country that bears watching is Tanzania. Until recently, there were restrictions on foreign investment and at present, there is only one diamond mine operating in the country. With restrictions eased, there are several Canadian companies planning to explore for diamonds in the country.

Several diamond finds were reported. United Reef Petroleum (Toronto) announced results from their Bamingui property in Central Africa that included 36 gem-quality stones, several over 1 ct and one weighing 7.5 ct. Later in the year the company reported gem-quality stones in three pits as well as associated gravel deposits on the property. In New South Wales, Australia, Cluff Resources Pacific reported diamond shows in sediments believed to be associated with

local volcanic pipes. Stockdale Prospecting (De Beers) has recovered diamonds from their Nabberu Joint Venture with Great Central Mines in the Murchison area of Western Australia. Twinned diamond crystals were found in placer deposits in the Tortiya Field, Ivory Coast, by Hyder Gold. KWG (Canada) reported finding 31 gem quality diamonds totaling 79 ct in 19 days of operating a diamond concession in Brazil. In Russia, geologists have reported the discovery of diamond deposits near the Chinese border, close to the town of Lesozavodsk.

Early in the year, a 20% export duty was levied on Russian jewelry and that caused many jewelry operations including diamond-cutting operations to close. The timing of the duty seems poor in view of the fact that Russian production has been declining. The duty may cause the loss of \$150 million annually in diamond exports. Sales of diamond exports during the first half of the year were down sharply, less than a third for the like 1992 period. In addition, the long-term view is clouded because it is believed that many of the diamond mines, concentrated in the central Siberian district of Sakha, are nearing exhaustion. Sakha has announced that they would form their own diamond-cutting operations and market their own products. This does not set well with the Central Selling Organization of De Beers. A rich diamond deposit is known in the Ural Mountains but remains undeveloped.

Finally, an interesting development occurred in the United States. In June, the U.S. Defense Logistics Agency auctioned 1 Mct of diamonds from their National Defense Stockpile. This event was part of a sell-off of strategic materials to raise money. Although classified as industrial diamonds, mostly from Brazil and Zaire, the quality was such that many of the stones were near gem or gem quality. As a result, the auction raised \$77 million. The \$77/ct is an exceptional price for material classed as industrial diamonds. A similar auction is planned in the future.

#### OTHER GEMSTONES

Continuing the trend of recent years, large, top-quality stones are commanding high prices. However, demand for lesser-quality material is weak and probably related to poor market conditions in many countries. The Geological Survey of India announced the discovery of large emerald deposits in the western state of Rajasthan.

Recent geological studies indicate the possibility of precious gems in southeastern Madagascar.

### GRAPHITE

In Tanzania, Graphtan Ltd is developing an open-pit graphite project that will also involve the production of tanzanite, a blue gemstone form of zoisite. The total reserves (proven and indicated) of the deposit total 24.4 Mt with a grade of 7.1% graphite. A flotation plant will produce 15,000 t/yr of high-grade, large-flake graphite.

In Mozambique, a grant equivalent to \$3.9 million has been obtained to develop the Kenmare Resources flake-graphite deposit in the northern province of Cabo Delgado.

Citing low prices on the international market, Rossing Uranium is expected to close their Okanjande graphite project in Namibia.

### VERMICULITE

At its Hillside vermiculite prospect in New South Wales, Australia, Helix Resources has reported high recovery rates via flotation with product purities greater than 90% in some tests.

Dinidze Vermiculite Mining announced plans to have a beneficiation plant constructed to process reserves of high-quality vermiculite in the Buhera district of Zimbabwe. According to the company, reserves are sufficient to ensure a long life for the mine, but no figures or time frame was mentioned.

### WOLLASTONITE

Wollastonite,  $\text{CaSiO}_3$  or calcium metasilicate, is used in ceramic and metallurgical products and processes and has also been used as a substitute for asbestos in certain applications. Demand for this industrial mineral is limited but has grown sharply in recent years to 350,000 t/yr. Two Canadian deposits were reported this year. The largest is that of Montreal-based Orleans Resources whose exploratory drilling in the Lac St-Jean area indicates reserves of 8.7 Mt with a purity of 37%. The second deposit reported is that of Ram Petroleum's whose drilling of the Olden Township orebody in southeastern Ontario suggests a 1.5-Mt deposit with 32% purity. The

president of Orleans Resources, Mr. Jean-Guy Mass, believes that the market for wollastonite will approximately double (700,000 t/yr) by the year 2000.

### FLUORSPAR

Acting on complaints that China was dumping fluorspar in Europe at rates 40% lower than those offered by member countries of the European Commission, the Commission imposed temporary duties on imports of Chinese fluorspar to bring the prices into line.

The European Community has lent Okorusu Fluorspar of Namibia some \$3.5 million to allow the company to increase production capacity for a predicted 1994 recovery. The company currently exports about 4,000 t/month of 99% acidspar to Europe.

At year's end, interest was expressed by St. Lawrence Fluorspar Ltd in selling their mine and production facilities at St. Lawrence, Newfoundland, Canada.

### SODA

Located in Inner Mongolia, China's largest open-pit soda mine has now reached full production. The annual production capacities include 500,000 t of natural soda, 50,000 t of caustic soda, 50,000 t of sodium bicarbonate, and 25,000 t of mirabilite soda. With reserves of over 40 Mt, the mine has an expected lifetime of at least 80 years.

In the United States, numerous plant expansions have occurred in the Green River, Wyoming, area where the trona mines are located. These expansions, coupled with an oversupply of caustic and poor economic conditions caused a drop in exports to Europe. Some less efficient operations, under such conditions, naturally closed, notably plants in Mexico, Colombia, Germany, and Belgium. This may help the worldwide supply-demand relationship for sodium minerals, but until the caustic oversupply is corrected and Europe's economic conditions improve, not much improvement is expected for exports to Europe from the Green River suppliers.

### POTASH

As with recent years, overcapacity continues to plague the market for this commodity. The world's largest producer, Canada, had plants

operating at 80% capacity to as low as 40% capacity. World prices were little changed. In the United States, the weather worsened matters with a wet spring followed by flooding in the Midwest and drought in the Southeast. The flooding inundated large areas of farmland along the floodplains of the Mississippi and Missouri river systems. Furthermore, barge transportation along the upper half of the Mississippi River was essentially eliminated for a two-month period. Horizon Potash Company (formerly AMAX) permanently closed. IMC Fertilizer Corporation planned a two-week shutdown of their Saskatchewan, Canada, mine. Globally, large producers such as Kali & Salz in Germany and Mines de Potasse d'Alsace in France reported losses for the year.

Potash Corporation of Saskatchewan continued to grow by acquiring the Potash Company of America with operations in the Canadian provinces of Saskatchewan and New Brunswick. Mississippi Potash announced plans to expand its mine in Carlsbad, New Mexico. Companhia Vale do Rio Doce plans to expand their Brazilian operation Aracaju, double production this year, and eventually reach an annual production of 500,000 t/yr. An electrolytic potash-brine plant is planned by China using solution from the Quarhan Salt Lake in Qinghai province to produce 10,000 t/yr.

In Germany, the country's two largest potash producers (Kali & Salz and Mitteldeutsche Kali, formerly in East Germany) were to have merged, but by year's end the merger had not been completed. Major obstacles include the number of jobs to be eliminated and which mines should remain open. Mitteldeutsche has some mines scheduled for closure under the proposed merger that appear to have better reserves than some mines scheduled to remain open. Furthermore, Mitteldeutsche has already drastically cut its work force, far more than Kali & Salz, and many feel further reductions at Mitteldeutsche are not justified.

## SULFUR

Like potash, sulfur continues to be in oversupply and prices weakened during the year. By-product sulfur production from petroleum continued to grow. By contrast, sulfur production from the Frasch process as well as mined sulfur continued to decline. By-product sulfur from gas also increased this year, the result of Shell Canada's new plant in Alberta, Canada. At least two Frasch plants closed in the western hemisphere last year (Texas and Mexico).

## PHOSPHATES

Like potash and sulfur, phosphates were subject to the same depressed demand with respect to fertilizer usage. In the United States, several Florida operations closed, which should help lower the oversupply problem for this commodity in the future. Globally, total phosphate-rock production also fell.

In the interest of economics, IMC Fertilizer Group and Freeport McMoRan are forming a second joint venture, this one to operate their phosphate fertilizer business under the name IMC-Agrico Company. The same companies earlier formed a similar venture to manage their Frasch sulfur operations in the Gulf of Mexico.

In the area of new developments, FMC Corporation has opened a new phosphate-rock mine at Dry Valley in Idaho. Iraq reports that geologists have found a huge phosphate-rock deposit in the western desert portion of the country.

The Pacific Island of Nauru can be described as one gigantic phosphate deposit, or at least it was at one time. Aside from tourism, the island depends heavily on phosphates as a source of income. One writer recently described the island as a moonscape, no doubt due to the decades of phosphate mining that has occurred on the island. Australia has mined rock from the island for about 90 years and has agreed to pay Nauru \$120 million Australian dollars over a 20-year period to compensate the island.

## HEAVY MINERALS (MINERAL SANDS)

Heavy minerals are an important component of industrial minerals. These minerals are normally obtained from mineral sand deposits, hence the terms mineral sands and heavy minerals are often used synonymously. Individual minerals that occur in such deposits include rutile, ilmenite, leucoxene (a product from the weathering of ilmenite), zircon, garnet, magnetite, monazite, and xenotime. The latter two minerals often have varying degrees of radioactivity associated with them due to their possible thorium and uranium contents. Of these minerals, rutile, ilmenite, and zircon are the most important because they are the primary sources for titanium and zirconium metals and their respective compounds. Because titanium dioxide is such an important white pigment and could not normally

be economically processed or extracted from hardrock, mineral sands assume special importance. The titanium dioxide pigment market has been estimated to be valued at \$5 billion annually. Such mineral sands are normally processed by gravity and magnetic separations followed by froth flotation to obtain the desired products.

Tiomin Resources is developing its Natashquan deposit in Quebec, Canada. The company believes that the area is one of the largest mineral-sands deposits in the world, consisting of 1.18 billion tons at an average 6% heavy minerals. A recent 11 t sample treated by gravity separation yielded a clean 10% heavy mineral fraction. At year's end, the company reported they had doubled the magnetic-separation capacity at their pilot plant and the plant would produce ilmenite, magnetite, zircon, and garnet.

Consolidated Rutile Ltd (Australia) plans to acquire a 50% interest in Sierra Rutile Ltd from Nord Resources (U.S.). Sierra Rutile operates the largest rutile mine in Sierra Leone and last year produced 149,000 t of rutile and 60,000 t of ilmenite.

Richards Bay Minerals' hopes of mining dunes along the eastern shore of the Republic of South Africa (near St. Lucia) for ilmenite, rutile, and zircon were dimmed when a five-member panel reviewing the pros and cons of the proposed mining recommended the area should not be mined because of the area's special nature and uncertainties associated with the mining. Richards Bay felt the decision did not address the fact that mining and nature conservation could co-exist. The final decision will be made by the R.S.A. government. Previously, Richards Bay had drilled other areas but found the St. Lucia area to be the only economically viable deposit.

The mining of alluvial deposits near Tara in Omsk Oblast (southwestern Siberia) began this year. The deposit, discovered 30 years ago but never developed, contains ilmenite and zircon.

## ALUMINA

Continued weakness in aluminum and alumina (aluminum oxide) markets continued to hurt major bauxite-producing countries such as Jamaica and Surinam. Both countries depend heavily on bauxite as their major export commodity.

In Surinam, the government sharply devalued the guilder from 1.8 to 8.0 guilders per U.S. dollar as part of their economic reforms aimed in large part to saving the bauxite industry. Unfortunately, the devaluation also produced a sharp drop in earnings and a corresponding increase in the cost of living. In one month, the price of gas increased 500%. Some of the pain was lessened by a substantial pay increase for the 2,000 miners who went on strike.

In Jamaica, despite weak demand for bauxite and alumina, several companies are planning to expand production capacity.

After a five-year break, work has resumed on Brazil's Alunorte Aluminum project, led by Companhia Vale do Rio Doce. The project is expected to come on line during 1995 with an alumina production of 1.1 Mt/yr. New Brazilian partners and a return of Japanese investors has made the restart possible.

Noteworthy events also occurred in the eastern hemisphere. India plans to construct two alumina plants in eastern India aimed solely for exports with a combined capacity of 1 Mt/yr. The project involves Norway's Hydro Aluminum, Alcan Canada, and Tata Industries. Total bauxite reserves of India are believed to be 2.7 billion tons. Greece and Russia have formed a venture to build a 700,000-t/yr alumina plant northwest of Athens. Finally, Saudi Arabia has reported finding a bauxite deposit containing 57% alumina with an estimated reserve of 94 Mt.

#### OZONE VERSUS CHLORINE

An interesting development in chemical processing has occurred by using ozone to bleach viscose fibers instead of the more traditional bleaching-agent chlorine (or sodium hypochlorite). Lenzing AG, at their Lenzing, Austria, viscose plant has put the process into effect in order to meet wastewater restrictions on adsorbable halides, something impossible to do with the traditional chlorine agent. The company claims to be the first synthetic fiber plant to eliminate chlorine from the bleaching process and also say the costs are comparable to the hypochlorite-based method. No cost figures were given.

The reason for including this item in an article on industrial minerals is that it represents another possible step in moving away from the use of chlorine. Should paper producers decide to use substitutes for

chlorine in their bleaching processes and more fiber plants likewise abandon chlorine, there could eventually be a sizeable oversupply of chlorine, especially if environmental restrictions become more stringent. This trend, if it occurs, will also affect the caustic and soda markets since chlorine is produced by the electrolytic decomposition of salt brines.

### LEGISLATIVE ISSUES

Considerable debate occurred during the year on revising or discarding the U.S. Mining Law of 1872. As in the previous year, one of the major points of contention involves the royalty to be paid and what the royalty should cover. A House subcommittee has proposed an 8% net smelter return. Western states believe such a high royalty would drive many mines out of business and cost them 30,000 jobs while supporters believe the royalty sums could be used to help reclaim the existing and abandoned hard-rock mines, estimated to number some 550,000 in 32 states. The average estimated cost of such reclamation will be \$50 billion.

Also in the United States, the American Mining Congress has filed suit against the Environmental Protection Agency and the U.S. Army Corps of Engineers concerning the new wetlands protection plan, claiming the plan illegally expands the government's regulatory powers.

Finally, mention should be made of the problems recently encountered by the Australian mining industry with regard to mining on aboriginal lands. Decisions are yet to be made on several difficult issues of ownership, royalty, and the like, and it will probably be some time before final rules are established.

### SOURCES

The material in this article is a synopsis of articles from a variety of mining-related journals as well as Chemical and Petroleum Engineering.