

## NORWAY

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**T**he year 2003 proved to be a much better for the minerals industry than 2002. The exchange rate between the Norwegian krone and the US dollar remained unchanged, but was at least stable, and export prices rose. The State sold out its remaining interest in A/S Olivin, which has merged with North Cape Minerals. All Norwegian olivine producers are thereby united and probably, as a result, the market is already showing interest in olivine deposits in Greenland.

The mining and quarrying sector extracted approximately 66 Mt of material in 2003 (slightly more than in 2002), with a value of NK7.5 billion. In the aluminium sector, Norsk Hydro started up its refurbished and expanded Sunndal Verk smelter, which is now able to produce 350,000 t/y of aluminium. Elkem's expansion at Mosjøen was also completed.

Each year, the Norwegian Geological Survey publishes an extensive overview of the minerals sector ([www.ngu.no](http://www.ngu.no)).

### **Exploration**

There is considerable interest in gold. The well-known deposits of Bindalen in the northern part of central Norway are being tested again, and precious metals exploration is also under way in the vicinity of the Mofjellet copper-lead-zinc mine which closed about 15 years ago. Blackstone Ventures Inc is involved in an exploration joint venture with Falconbridge at the latter's two nickel-copper-cobalt properties, Espedalen and Vakkertien.

The coal-mining company Store Norske applied for a drilling permit to explore for gold in Spitzbergen at Svansen Mountain. The permit was granted but the decision was contested by the research community at nearby Ny Ålesund, the site of a former coal mine. The research is concerned with the Arctic environment and air quality and the programme receives a considerable amount of international investment. As a result of the protest, the Norwegian Government withdrew Store Norske's drilling permit, in spite of the fact that the increasing number of cruise ships visiting Spitzbergen probably pollute the atmosphere far more than the planned drilling programme would have done.

Many projects investigating high-purity quartz deposits are continuing, not least because Norway is a major producer of silicone and because Scanwafer, a major producer of solar cell wafers is expanding rapidly. (The company is maintaining an approximate 25% share of world production.)

### **Metral mining**

Rana Gruber, Norway's one remaining iron-ore producer, had problems with rock pressure at its underground mine during 2003 year and production was

suspended for much of the summer. The problems have been overcome and the mine is now operating at full capacity once more. The ore is predominantly haematite but also contains a relatively small amount of magnetite and this high-grade iron oxide can be upgraded into products such as pigments. The fact that an underground mine based on predominantly low-grade ore is still operating, is proof that Norwegian underground technology is well advanced.

### **Industrial Minerals**

With the virtual demise of metal mining, industrial minerals now comprise the most important part of the Norwegian minerals sector. The most notable development has been the steady increase in the production of limestone filler and coating products for the paper industry. The main producer is Hustadmarmor, a subsidiary of Omya. Norway's production has increased by an annual average of 200,000 t for a long period. Originally, the limestone was mined at some local quarries near the town of Molde, but, as filler production began to exceed the capacity of these mines, a new mine was started by Hustadkalk further north, near Brønnøysund, where the deposits are much larger. The highly metamorphosed dark limestone is shipped to a processing plant on the coast where the dark minerals are removed before micronising.

Until now, the Stjernøy nepheline operation, located near North Cape Minerals' olivine operations, has been operated as an underground mine, the ore being accessed via an adit close to the seashore at the base of the mountain. Mining has now moved to the top of the mountain, and the surface operation uses the former adit mine as a glory hole. Climatic conditions and the grazing rights of the reindeer-herding Lapps, restrict mining to only two months per year.

Skaland Grafitverk has restarted again as Skaland Graphite, owned by mining contractor, Leonard Nilsen og Sønner A/S. This firm formerly operated the Nikkel og olivine mine for Outokumpu prior to its closure, and is presently undertaking the transport of coal from mine to harbour on behalf of Store Norske.

The Skaland products continue to be graphite flakes and powder and although the existing deposit is nearly exhausted, the new owner probably has the will and resources to open a new mine some kilometres away. This will depend, of course, on market conditions. Production has recently been well below 10,000 t/y, and this could be the maximum capacity.

About 20 quarries along the southern and western coast of Norway produce aggregates, some for shipment to Europe. Of a total production of some 55 Mt/y, about 11 Mt are exported.

Total production of dimension stone and slate/flagstone was around 400,000 t in 2003 valued at nearly NK1,000 million. Operating costs in Norway ensure that only highly-priced stone is quarried, upgrading of the product normally being carried out in countries such as Italy. The most valuable stone is

larvikite named after the town of Larvik. This has long been the most profitable part of the Norwegian minerals sector, one reason being that available resources of the best quality larvikite are limited, ensuring that production is never sufficient to flood the market.

### **Metallurgy**

Norway's metallurgical sector is in transition, faced with higher power charges and more stringent restrictions on the emission of greenhouse gases. The sector is heavily reliant on cheap hydroelectric power for its electricity supply but many of these cheap power contracts will expire shortly and the new contracts contain higher charges, in the range NK0.22-0.28/kWh delivered at the power station. (The smelters are for historical reasons located close to their hydroelectric sources so power distribution cost tends to be low.) Approximately 25% of the Norwegian hydroelectric power production or 30,000 GWh goes to the process industries.

There has been considerable discussion about reduction targets for greenhouse gas emissions. The government wanted targets set for each company, but the industry insists that the whole process industry should be treated as one source. The industry could then co-operate in cutting the cheapest emissions first. After a long round of negotiations this has finally been accepted.

Norsk Hydro is Norway's largest aluminium producer. The rebuilding of the plant at Sunndalsøra is complete and capacity has been increased from 153,000 t/y to 350,000 t/y. Hydro considers its new HAL250 technology to be the world's most economical and environmentally-friendly electrolysis method. For example, an increase of power density from 250 to 275 kA in the cells provides 20,000 t/y of additional annual capacity. Hydro's plants at Karmøy, Høyanger and part of the facility at Årdal, still depend upon the old Söderberg technology. The smaller plant at Høyanger will be closed, but there is speculation that modernisation of the other plants will not be economically feasible because of expensive power forecasts.

Elkem celebrates its 100th anniversary in 2004. This company has been a pioneer in the development of electrometallurgical processes. It now produces ferrosilicon, silica, microsilica, and aluminium, both in Norway and abroad, mainly in the US. The expansion and modernisation of the Mosjøen smelter from 122,000 t/y to 188,000 t/y is complete and a minor expansion will take place at Lista this year.

CVRD of Brazil, which purchased the former ferrochrome plant operated by Elkem at Mo i Rana, has completed its first year of production under the new ownership. CVRD is using the rebuilt electric pig-iron furnaces, together with the old sinter plant, for the production of ferromanganese from fines.

The other successors to Norsk Jernverk at Mo i Rana are Fundia, a Finnish-owned scrap steel plant making rebars, and Fesil Rana producing ferrosilicon. As a result of the Outokumpu/Boliden reshuffle, the Norzinc operation at Odda has been taken over by Boliden. The production capacity is 150,000 t/y

of zinc and 28,000 t/y of aluminium fluoride for the aluminium smelters. During 2003 and 2004, €88 million is being invested to increase capacity by 10% and reduce the environmental impact. The smelter is situated in a valley close to a mountain well suited for constructing storage caverns for the disposal of jarosite waste, a major concern for competing zinc plants.

Falconbridge of Canada has its Nikkelverk nickel-refining operation at Kristiansand. The refinery processes the entire production of nickel matte from Falconbridge's Canadian mines, plus some purchased concentrates, mainly from Botswana. Last year, around 79,000 t of nickel, 4,000 t of cobalt and some 50,000 t of copper were produced. Nikkelverk also refines precious metals, notably palladium. Like Norzinc, Falconbridge disposes of its waste in underground caverns.

### Energy

The upward trend in Norway's oil production has stopped, having been stable for about five years. Only minor new discoveries are being announced, and these only just replace decreased production from the mature major fields. The most important factor in maintaining production has been enhancement. This has been most important for the Ekofisk field, which otherwise would have been shut down long ago. Gas fields are being developed more actively, with increased production as a result. Development of the Snøhvit gas field close to the North Cape is under way. Exploration in this region of the Barents Sea is strongly debated because of the importance of fishing and harsh weather conditions.

Store Norske, which operates on Spitzbergen, maintained its Svea Nord mine at full capacity. Production has gone far better than planned and was close to 3 Mt. One of the old mines, No 7 is still operating, producing for local electricity generation. A Russian coal company is planning to re-open the Grumant mine, 20 km from Longyearbyen, which was closed around 1960.

Low rainfall in the autumn of 2002 resulted in lower than usual production of hydropower during the winter months of 2003, and correspondingly high prices. The peak prices have now passed, but the electricity market has moved to an apparent higher level. Power plants fired by natural gas plants will now, therefore, probably be economical. Construction of such plants, however, is highly disputed because of the discrepancy between the very real problems Norway has in living up to the Kyoto agreement regarding greenhouse gases and the political wish to enforce it.

Table following page.

<b>Mineral and smelter production (t)</b>			
	2001	2002	2003
Iron and metal mines			
Nickel conc (12% Ni)	22,700	14,000	
Iron ore conc	380,000	476,000	399,000
Industrial minerals			
Nepheline syenite	340,000	320,000	320,000
Olivine	3,200,000	3,100,000	3,300,000
Graphite	9,000	6,000	1,300
Limestone	4,300,000	5,500,000	5,700,000
Delivered micronised*	2,350,000	2,750,000	2,900,000
Dolomite	810,000	570,000	na.
Quartz	1,300,000	1,140,000	n.a.
Metallurgical production	n.a.	n.a.	n.a.
Energy			
Coal (Store Norske)	1,788, 000	2,132,000	3,001,000
Oil ('000 t)	163,100	157,300	153,000
Natural gas (million m <sup>3</sup> )	57,000	69,000	74,000
Electricity (GWh)	122,000	131,000	106,100

\* to the paper industry