### THE MINERAL INDUSTRY OF

# **NORWAY**

### By Harold R. Newman

Since the discovery of North Sea petroleum in the late 1960's, petroleum production has become the most important mineral industry activity, and petroleum was the most significant mineral commodity, followed by industrial minerals and metals, in Norway (table 1). The Norwegian economy remained dependent on foreign trade. About 75% of the mineral commodities used were imported. About 95% of production of metallic minerals were exported as mineral concentrate with little or no refining. The increase in exports of aggregate, industrial minerals, and natural stone between 1989 and 1994 was considerable. This trend was also in some other commodities in 1999 (Norwegian Geological Survey, 1999, Economic growth in the minerals management industry, accessed October 3, 2000, at URL http://www.ngu.no/engelsk/ngu fakta/maal mineral.htm).

Sand, gravel, and aggregate deposits were some of Norway's important mineral raw materials. The Norwegian Geological Survey has established a gravel and aggregate data base that contains information on all the country's deposits of sand, gravel, and aggregates. This data base contains information on each deposit's location, composition, volume, quality, and operating status. The most important industrial mineral exports were calcium carbonate, dolomite, graphite, ilmenite, nepheline syenite, olivine, and talc (Norwegian Geological Survey, 1998, Mineral resources, accessed May 15, 1999, at URL http://www.ngu.no/engelsk/fagomraader/mineralres.htm).

For many years production of metallic ores has fallen gradually as existing mines—copper, lead, and zinc—were being depleted, and exhausted mines were not being replaced. This decline of metallic mineral output has been partially offset by increased production of such industrial minerals as aggregate. The Norwegian Government's involvement in the mineral industry remained substantial, especially in offshore hydrocarbon production. Through state-owned Den Norske Stats Oljeselskap A/S (Statoil), the Government continued to control all hydrocarbon production and refining. The rest of the mineral industry was dominated by Elkem A/S and Norsk Hydro A/S (table 2).

Elkem ASA intended to install new technology at its Lista aluminum plant to increase efficiency and reduce pollution. The conversions to existing Soderberg equipment would be fitted in two potrooms, and was expected to be completed by 2003 at a cost of about \$31 million (Mining Journal, 1999a).

The Norsk Hydro Group announced its aluminum smelter plans, which included the building of a 90,000-metric-ton-per-year (t/yr) aluminum remelt plant in Henderson, Kentucky, at a cost of \$33 million. The plant would recycle scrap aluminum and was expected to begin operation in 2002. Also, Norsk signed a nonbinding declaration of cooperation with Iceland on building an aluminum smelter at Reydarfjorduf in eastern

Iceland. The parties were to examine ways to build a smelter with a capacity of 90,000 to 120,000 t/yr (Mining Journal, 1999c).

Rana Gruber A/S, one of Europe's smallest iron ore mines still serving the metallurgical sector, was completing its project of converting from open pit operations to underground operations at the Kvannevann Mine; this mine had not been used since 1985. Production was expected to be 450,000 t/yr with a mine life of 8 years (Metal Bulletin, 1999a).

Arctic Bulk Minerals A/S (ABM), which was the Norwegian company that has been trying to restart the former Sydvaranger iron ore mine and pellet plant in Kirkenes, announced that it was delaying resumption for up to a year owing to the dire straits of the pellet market. ABM also announced that it intended to spend about \$100 million on the mine and plant during the next 5 years. The biggest cost item would be the stripping of overburden to expose new ore reserves that could be mined by open pit rather than by underground operation (Metal Bulletin, 1999b).

Elkem A/S entered into an agreement to sell its manganese business to Eramet S.A. of France for \$200 million. The agreement covered Elkem's Porsgrunn and Sauda plants in Norway, as well as Elkem's plant in Marietta Ohio. Elkem's decision to sell followed the cancellation of its contract with BHP of Australia for the supply of manganese ores. Although Elkem had been in discussions with potential ore suppliers, the company stated that the best long-term solution was to sell its plants to Eramet (Mining Journal, 1999b).

Fesil ASA announced that it planned to stop production of silicon metal at its Lilleby Metall A/S plant until further notice owing to difficult market conditions. The need to cut production was necessitated by the fall in orders from the chemical industry in Asia after the economic crisis. Lilleby Metall produced about 8,500 t/yr of silicon metal (Metal Bulletin, 1999c).

North Cape Mineral A/S was one of the world's major producers of nepheline syenite. The rock consists of 56% potassium feldspar, 34% nepheline, and about 10% other minerals (biotite and pyroxenes). Three main products are produced—glass-grade Altafloat, ceramic-grade Altaflux, and amber- and filler-grade Minex 10, 20, and 30 (Karlsen, 1998, p. 76).

Some of the world's largest resources of high-quality olivine are in the Sunnmøre-Nordfjord area on the southwestern coast of Norway. With mines and plants at Åheim and Stranda, A/S Olivin was the world's leading producer of olivine products and celebrated its 50th anniversary in 1998. Olivin's 2.5-million-metric-ton-per-year capacity open pit mine was 4 kilometers from the plant and the port. The olivine ore was transported in a tunnel by conveyor belt to the processing plant. About 85%

of Olivin's production was sold as raw olivine sand, and 15% was sold as refractory bricks. The primary application of olivine sand is as slag conditioner in the ironmaking industry, and the main application area for the refractories is in the metallurgical industry. Almost all production was exported (Karlsen, 1998, p. 73).

Production of stone, particularly dimension stone, had steadily increased as the industry, which constituted many small firms, had expanded. The most sought after stone was larvikite, which is a syenite with a feldspar lamellar structure that gives it a special luster. Banded dolomite from the Fauske area was also highly regarded.

Offshore hydrocarbon production was expected to remain the principal economic activity for the next several decades. Norway produced an average of about 3.03 million barrels per day of crude oil and was ranked sixth in world production. The country maintained its position as the world's second largest oil-exporting country after Saudi Arabia. At 10.9 billion barrels, it held about 1% of the world's proven reserves. Its oil holdings were located exclusively offshore, mostly in the North Sea. Norway consumed very little of the oil it produced, and its oil exports were its greatest source of revenue (U.S. Energy Information Administration, November 1999, North Sea, accessed November 8, 2000, at URL http://www.eia.doe.gov/emeu/cabs/northsea.htm).

Statoil put forward a plan to merge all the Government's petroleum interests into a group whose reserves would rival Exxon, Mobil, British Petroleum Amoco, and Royal Dutch Shell, which were the west's three biggest publicly quoted oil groups. Statoil proposed that State Direct Financial Interests (SDFI) be merged with itself; SDFI was a separate government entity managed by Statoil. The value of a combined SDFI and Statoil, which has an assumed market capitalization of about \$17 billion, would be more than \$50 billion. The Statoil plan further suggested a partial privatization and international stock

markets listings (Financial Times, 1999).

To counter an anticipated decline in production of petroleum during the next decade, the Government has been encouraging the discovery of new resources. Norway has extremely varied geology with a broad spectrum of rock types of interest for mineral exploitation. The country's long coastline and close proximity to the large European markets is a major competitive advantage for some raw materials, particularly natural stone, aggregate, and certain industrial minerals, such as nepheline syenite and olivine.

#### **References Cited**

Financial Times, 1999, Norway eyes \$50bn merger of state-owned oil interests: Financial Times, [London] no. 33977, August 4, p. 1.

Karlsen, T.A., 1998, Nordic minerals review—Norway: Industrial Minerals, no. 374, November, p. 73-76.

Metal Bulletin, 1999a, Fesil to close silicon furnace: Metal Bulletin, no. 8351, February 15, p. 8.

———1999b, Norwegian iron mine goes underground: Metal Bulletin, no. 8391, July 8, p. 20.

———1999c, Pellet market slump delays Norwegian restart: Metal Bulletin, no. 8377, May 20, p. 17.

Mining Journal, 1999a, Elkem to upgrade plant: Mining Journal [London], 332, no. 8528, April 23, p. 294.

———1999b, Eramet snaps up Elkem's manganese: Mining Journal [London], v. 332, no. 8517, February 5, p. 73.

———1999c, Norsk Hydro's aluminium smelter plans: Mining Journal [London], v. 333, no. 8538, July 2, p. 6.

#### **Major Sources of Information**

Norwegian Geological Survey
P.O. Box 3006 Lade
7002 Trondheim, Norway
Royal Ministry of Petroleum and Energy
P.O. Box 8148 Dep
0033 Oslo, Norway

 ${\bf TABLE~1} \\ {\bf NORWAY:~PRODUCTION~OF~MINERAL~COMMODITIES~1/~2/} \\$ 

(Metric tons unless otherwise specified)

Commodity	1995	1996	1997	1998	1999 e/
METALS					
Aluminum:					
Primary	846,794	863,002	918,558	995,619	1,020,215 3/
Secondary	55,685	59,702	58,635	62,400 r/	178,313 3/
Cadmium, smelter	317	274	290	270 e/	211 3/
Cobalt	2,804	3,098	3,417	3,851	4,009 3/
Copper:					
Mine output:	20.561	20,000	20,000	11 000 /	
Concentrate	28,561	30,000	28,000	11,000 e/	
Cu content	6,799	7,400	6,671	2,698	
Metal, primary and secondary, refined	34,322	33,900	32,639	31,658	33,262 3/
Iron and steel:	1 240	1 110	1 100 -/	1 100 -/	1 000
Iron ore and concentrate, Fe content thousand tons	1,348	1,118	1,100 e/	1,100 e/	1,000
Metal: Pig iron e/ do.	70	70	70	70	60
Ferroalloys:	70	70	70	70	00
	148	110	145 e/	170 e/	160
			215 e/	215 e/	235
Ferromanganese do.	213 210	215 210	215 e/ 210	215 e/ 210	235
Ferrosilicomanganese e/ do.					
Ferrosilicon (75% basis) do.	474	462	470 e/	470 e/	460
Silicon metal do.	101	110	110 e/	110 e/	100
Other e/ do.	15	15	15	15 e/	15
Total do.	1,161	1,122	1,170	1,190 644 r/ 3/	1,200
Steel, crude do.	503	511	570 r/ 3/		611 3/ 300
Semimanufactures, rolled e/ do.	300	300	300	300	300
Lead, mine output:	2.505	2 (00	2.600		
Concentrate Pb content	2,505	2,600	2,600		
	1,462	2,080	2,000	25 400/	25.000
Magnesium, primary	28,000 e/	37,800 r/	34,200 r/	35,400 r/	35,000
Nickel:					
Mine output:	24.027.2/	22,000	20,000	20,000	21 000
Concentrate e/	24,927 3/	23,000	20,000	20,000	21,000
Ni content	3,386	3,135	2,454	2,500	2,732 3/
Metal, primary	53,237	61,582	62,702	70,151 r/	74,137 3/
Platinum-group metals e/ 4/ kilograms	1,500	1,200	1,000	1,000	1,000
Titanium: e/  Ilmenite concentrate thousand tons	833 3/	750	750	590	600
Ilmenite concentrate thousand tons TiO2 content do.	833 3/ 325	340	750 340	260	260
Zinc:	323	340	340	200	200
Mine output:  Concentrate	18,995	19,000	9,000 e/		
Zn content	9,877	9,880	4,500 e/		
	121,576	134,900	137,400	128,000	132,600 3/
Metal, primary	121,370	134,900	137,400	128,000	132,000 3/
INDUSTRIAL MINERALS  Cement, hydraulic thousand tons	1,613	1,664	1,724	1,676 r/	1,700
Feldspar	75,397	76,000	75,000 e/	75,000 e/	75,000
Graphite e/	2,588	2,600	2,600	2,600	2,500
Lime, hydrated, and quicklime e/ thousand tons	100	100	100	100	100
Mica, flake e/	3,000	2,500	2,500	2,500	2,500
Nepheline syenite thousand tons	294	300	300 e/	300 e/	300
Nitrogen, N content of ammonia do.	289	295	279	245	300
Olivine sand do.	3,517	3,600	3,600 e/	3,600 e/	3,500
Pyrite e/ do.	5,517	6 3/	5,000 e/ 5	5,600 e/ 5	5,300 5
Stone, crushed:	J	0 3/	J	3	5
Dolomite e/ do.	797 3/	800	800	800	800
Limestone e/ do.	4,675 3/	4,600	4,500	4,500	4,500
Quartz and quartzite do.	4,673 3/ 963	4,600 960	1,000 e/	1,000	1,000
Quartz and quartzite do. Sulfur: e/	703	900	1,000 e/	1,000	1,000
Byproduct of:					
	80	80	60	80 r/	105
Metallurgy do. Petroleum do.	80 20		50	80 r/ 18 3/	105
	100	20 100	110	98 r/	117
		28	28		26
Talc, soapstone, steatite e/ do.  See footnotes at end of table	30	26	20	26	20
see organizes at end of table					

See footnotes at end of table.

### TABLE 1--Continued NORWAY: PRODUCTION OF MINERAL COMMODITIES 1/2/

(Metric tons unless otherwise specified)

Commodity		1995	1996	1997	1998	1999 e/
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades	thousand tons	343	261	260 e/	250	250
Gas, natural, marketed 5/	do.	27,800	37,400	42,600 e/	43,600	43,000
Peat, for agricultural use e/ do.		30	30	30	30	30
Petroleum:						
Crude 6/	thousand 42-gallon barrels	979,104	1,104,096	1,105,584	1,100,000 e/	1,100,000
Natural gas liquids e/	do.	40,560 3/	41,600	42,000	42,000	42,000
Refinery products:						
Naphtha e/	do.	22,100	26,350	26,000	26,000	26,000
Gasoline	do.	24,470	25,000	25,000 e/	25,000 e/	25,000
Kerosene e/	do.	8,378 3/	9,000	9,000	9,000	9,000
Distillate fuel oil	do.	45,140	45,000	45,000 e/	45,000 e/	45,000
Residual fuel oil e/	do.	12,361 3/	12,000	12,000	12,000	12,000
Other e/	do.	4,000	4,000	4,000	4,000	4,000
Refinery fuel and losses e/ do.		4,000	4,000	4,000	4,000	4,000
Total e/	do.	120,000	125,000	125,000	125,000	125,000

e/ Estimated. r/ Revised. -- Zero.

- 1/ Table includes data available through September 2000.
- 2/ Estimated data are rounded to three significant digits; may not add to totals shown.
- 3/ Reported figure.
- 4/ Data represent exports.
- 5/ Reported as total methane sales.
- 6/ Excluding natural gas liquids.

 ${\bf TABLE~2}$  NORWAY: STRUCTURE OF THE MINERAL INDUSTRY IN 1999

(Thousand metric tons unless otherwise specified)

	Major operating companies		Annual
Commodity	and major equity owners	Location of main facilities	capacity
Aluminum	Hydro Aluminium ANS (Norsk Hydro A/S 70%)	Smelters at Årdal, Hoyanger, Karmoy, and	600
		Sunndalsora	
Do.	Elkem Aluminium (Elkem A/S 50% and Alcoa 50%)	Smelters at Farsund and Mosjoen	250
Do.	Sor-Norge Aluminium A/S (Alusuisse 50% and		
	Hydro Aluminium 49%)	Smelter at Odda	50
Cadmium	Norzink AS (Boliden AB 50% and Rio Tinto Minerals		
	Development Ltd.)	Smelter at Eitrheimsneset	0.3
Cement	Norcem A/S	Plants at Brevik and Kjopsvik	2,150
Coal	Store Norske Spitsbergen Kulkompani A/S	Mines at Longyearbyen and Svea	450
Cobalt	Nikkelverk A/S (Falconbridge Nickel Mines Ltd., 100%)	Smelter at Kristiansand	3
Copper:			
Ore, Cu content	Grong Guber A/S (Norsulfid A/S, 100%)	Mines at Royrvik 1/ and Gjersvik	8
Do.	Nikkel og Olivin A/S (Norsulfid A/S, 100%)	Mine at Narvik	1
Metal	Nikkelverk A/S (Falconbridge Nickel Ltd., 100%)	Smelter at Kristiansand	40
Dolomite	Franzefoss Bruk A/S	Mine at Ballagen	350
Do.	Norwegian Holding A/S	Mines at Hammerfall, Logavlen, and Kvitblikk	500
Feldspar	Franzefoss Bruk A/S	Mine at Lillesand	100
Ferroalloys	Elkem Rana (Elkem A/S, 100%)	Ferrochromium plant at Mo i Rana	140
Do.	Elkem Salten (Elkem A/S, 100%)	Ferrosilicon plant at Straumen	85
Do.	Elkem Bjolvefossen (Elkem A/S, 100%)	Ferrosilicon plant at Alvik	60
Do.	Elkem Thamshavn (Elkem A/S, 100%)	Ferrosilicon plant at Orkanger	60
Do .	Finnfjord Smelterverk, Rana Metal (Fesil ASA 100%)	Ferrosilicon plant at Mo i Rana	140
Do.	A/S Hafslung Metal (Fesil ASA100%)	Ferrosilicon plant at Sarpsborg	75
Do.	Ila og Lilleby Smelterverk (Fesil ASA 100%)	Ferrosilicon plant at Finnsnes	60
Do.	Oye Smelterverk (Tinfos Jernverk A/S, 100%)	Silicomanganese plant at Kvinesdal	235
Iron, metal	Ulstein Jernstoperi A/S	Hordvikneset	10
Iron ore	Rana Gruber A/S (Norsk Jernverk Holding A/S, 100%)	Mine at Mo i Rana	2,000
Do.	Artic Bulk Minerals A/S	Mine and plant at Kirkenes	1,500
Lead ore, Pb content	A/S Bleikvassli Gruber (A/S Sydvaranger, 100%)	Mine at Bleikvassli	2

See footnote at end of table.

## TABLE 2--Continued NORWAY: STRUCTURE OF THE MINERAL INDUSTRY IN 1999

(Thousand metric tons unless otherwise specified)

nodity	and major equity owners		
	<u> </u>	Location of main facilities	capacity
	Hylla Kalkverk (Nikolai Bruch A/S 100%)	Verdal/Trondheim Mine and plant	80
	A/S Norsk Jernverk	Plant at Mo i Rana	4
			20
			20
	<u> </u>		
			1,60
	· · · · · · · · · · · · · · · · · · ·		80
			50
	· · · · · · · · · · · · · · · · · · ·	Plants at Porsgrunn and Sauda	50
		do.	500
million cubic meters	<u> </u>	Gama, Gullfaks, Sleipner Ost, and Statfjord Fields	12,270
do.	Phillips Petroleum Company Norway	Ekofisk Field	9,90
do.	Elf Petroleum Norge A/S	Frigg, Heimdal, and Ost-Frigg Fields	5,75
do.	Norsk Hydro Produksjon A/S	Troll-Oseberg Field	2,60
do.	BP Petroleum Development of Norway	Gyda and Ula Fields	1,04
do.	Esso Norge as	Odin Field	1,00
do.	Amoco Norway A/S	Hod and Valhall Fields	91
	North Cape Mineral A/S (Unimin Corp., 84%)	Mine at Stjernoy	35
	•	•	
	Nikkel og Olivin A/S (Norsulfid A/S, 100%)	Mine at Narvik	
		Mine at Tellnes	0
	· · · · · · · · · · · · · · · · · · ·	Smelter at Kristiansand	8:
	A/S Olivin		2,50
	do.	*	30
	Franzefoss Bruk A/S	•	50
barrels per day		700	1,069,30
	J	Fields	, ,
	Norsk Hydro Produksjon A/S	Brage, Mime, and Oseberg Fields	566,20
	Phillips Petroleum Company Norway	Ekofisk Field	237,50
	Saga Petroleum A/S	Snorre Field	170,00
	BP Petroleum Development of Norway	Gyda and Ula Fields	155,00
	A/S Norske Shell	Draugen Field	90,00
	Folldal Verk A/S (Norsulfid A/S 100%)	Mine at Hjerkinn	10
	Elkem Tana (Elkem A/S 100%)	Mine at Tana	540
	Elkem Marnes (Elkem A/S 100%)	Mine at Sandhornoy	200
	Vatnet Kvarts A/S	Mine at Nordland	150
	Snekkevik Kvartsbrudd	Mine at Kragero	110
			9
	,		60
	Tunda 115 (11015) von von von von and 1444 von von	Mo i Rana	00
	A/S Norwegian Talc (Pluess-Staufer AG 51%)	Mine/plant at Altermark/Knarrevik and Framfjord	9
	Kvam Minerals A/S	Mine/plant at Kvam	
e	Titania A/S (Kronos Norge A/S 100%)	Mine at Tellnes	80
	Grong Guber A/S (Norsulfid A/S 100%)	Mines at Royrvik 1/ and Gjersvik	1
	A/S Bleikvassli Gruber (A/S Sydvaranger 100%)	Mine at Bleikvassli	1
		Smelter at Odda	13
	do. do. do. do. do. barrels per day	Ardal og Sunndal Verk A/S Breivik Kalkverk A/S Mjoendalen Kalkfabrik Norcem A/S Vardelskalk A/S (Franzefoss Burk A/S, 100%) Breivik Klakverk A/S Norsk Hydro A/S (Government, 51%) Eramet SA million cubic meters Den Norske Stats Oljeselskap A/S do. Phillips Petroleum Company Norway do. Elf Petroleum Norge A/S do. Norsk Hydro Produksjon A/S do. BP Petroleum Development of Norway do. Esso Norge as do. Amoco Norway A/S North Cape Mineral A/S (Unimin Corp., 84%)  Nikkel og Olivin A/S (Norsulfid A/S, 100%) Titania A/S (Kronos Norge A/S, 100%) Nikkelverk A/S (Falconbridge Nickel Mines Ltd., 100%) A/S Olivin do. Franzefoss Bruk A/S barrels per day Den Norske Stats Oljeselskap A/S  Norsk Hydro Produksjon A/S Phillips Petroleum Company Norway Saga Petroleum A/S BP Petroleum Development of Norway A/S Norske Shell Folidal Verk A/S (Norsulfid A/S 100%) Elkem Tana (Elkem A/S 100%) Elkem Marnes (Elkem A/S 100%) Vatnet Kvarts A/S Snekkevik Kvartsbrudd Lilleby Metall A/S (Fesil ASA 100%) Fundia AB (Norsk Jenverk 50% and Rataruukki 50%) A/S Norwegian Talc (Pluess-Staufer AG 51%) Kvam Minerals A/S E Titania A/S (Kronos Norge A/S 100%) Grong Guber A/S (Norsulfid A/S 100%)	Ardal og Sunndal Verk A/S Breivik Kaltwerk A/S Mjoendalen Kalkfabrik Mjoendalen Kalkfabrik Norcem A/S Norcem A/S Vardelskalk A/S (Franzefoss Burk A/S, 100%) Breivik Klakverk A/S Norsk Hydro A/S (Government, 51%) Den Norsk Hydro A/S (Government, 51%) Den Norsk Hydro A/S (Government, 51%) Den Norske Stats Oljeselskap A/S Den Norske Stats Den