

Chapter Seventeen

Mining and Minerals

Contents	Page
THE MINING INDUSTRY	503
Main features of 1990–91	503
New South Wales	503
Victoria	503
Queensland	503
South Australia	504
Western Australia	504
Tasmania	505
Northern Territory	505
Mineral production	505
Exports	506
Imports	506
Selected commodity review	506
Gold	506
Iron ore	506
Nickel	506
Petroleum	507
Bauxite and alumina	507
Coal	507
Diamonds	507
Uranium	508
Mineral processing and treatment	508
MINERAL GEOLOGY	509
MINERAL EXPLORATION	509
Mineral exploration expenditure	509
Petroleum exploration expenditure	509

Contents	Page
ADMINISTRATION	509
Mineral rights	509
Mining and exploration for other than petroleum	
— legislation	510
Onshore	510
Offshore	510
Petroleum mining and exploration — legislation	510
Onshore	510
Offshore	510
Mineral royalties	511
Government assistance	511
RESEARCH	512
Australian Geological Survey Organisation	512
Commonwealth Scientific and Industrial	
Research Organisation	512
University research	512
Research by private enterprise	512
INTERNATIONAL ASSOCIATIONS	512
BIBLIOGRAPHY	513

THE MINING INDUSTRY

Mining, as defined in the *Australian Standard Industrial Classification, Volume 1 — The Classification, 1983* (1201.0), broadly relates to the extraction of minerals occurring naturally as solids such as coal and ores; liquids such as crude petroleum; or gases such as natural gas.

The mining sector contributed \$18,679 million or 5.0 per cent of Australia's Gross Domestic Product (GDP) of \$377,114 million in 1990–91 up from \$17,243 million or 4.6 per cent of GDP in 1989–90.

Main features of 1990–91

Table 17.1 provides a summary of the operations of the mining industry in 1990–91. Turnover increased in the mining industry by 19 per cent to \$28,886.4 million whilst employment in the industry dropped by 5 per cent to 65,778 people.

The industries most responsible for the rise in turnover were oil and gas, up \$3,004.1 million to \$8,606.9 million; coal, up \$737.8 million to \$8,294.1 million; and iron ore (including pelletising), up \$504.4 million to \$3,043.8 million. Other industries to increase turnover were gold, up \$358.5 million to \$4,338.2 million and bauxite, up \$191.6 million to \$664.9 million.

Industries that declined in turnover were: mineral sands, down \$138.2 million to \$580.3 million; silver, lead, zinc ores down \$241.8 million to \$1,254.3 million.

New South Wales. Mining in New South Wales in 1990–91 generated a turnover of \$4,473.3 million, an increase of eight per cent over the 1989–90 total of \$4,135.5 million, and employed 19,367 people, down from 20,006 the year before. Total wages and salaries amounted to \$1,146.2 million.

The black coal industry dominated mining in New South Wales with turnover in 1990–91 of \$3,821.5 million (85% of total turnover). Coal employed 16,258 people and generated \$994.8 million in wages and salaries. Coal mining occurs in the Hunter Valley and South Coast regions.

New South Wales accounts for 15.5 per cent of national mining turnover and 46.1 per cent of national turnover from black coal.

Lead, silver and zinc are mined at Broken Hill in the west of the State.

Victoria. Victorian mining turnover in 1990–91 was \$4,037.9 million or 14 per cent of the national total. Mining activity in Victoria consisted almost exclusively of brown coal, oil and gas production, with Bass Strait oil and gas production completely dominant in the State and also dominating oil and gas production nationally.

In 1990–91, the Gippsland Basin produced 50.6 per cent of Australia's crude oil and 40.7 per cent of its natural gas.

Production of crude oil and condensate was 14,782 megalitres and natural gas production was 6,352 gigalitres in 1990–91.

Brown coal production, almost all in the Latrobe Valley south-east of Melbourne, totalled 48,884,000 tonnes valued at \$367.1 million.

Gold bullion production continued to rise reaching 4,862 kilograms and valued at \$70.9 million.

Queensland. Mining turnover in Queensland in 1990–91 was valued at \$6,428.4 million, an increase of 0.3 per cent over the previous year's total of \$6,410.0 million and 22.3 per cent of national turnover. The State's mining industry employed 16,583 people at 30 June 1991, a drop of 738 or 4.3 per cent from the 1989–90 total of 17,321.

The coal industry contributed \$4,097.5 million (64%) of the total turnover and 63 per cent of employment in mining. Wages and salaries from mining generated \$895.3 million with \$585.3 million coming from coal, \$292.7 million from metallic minerals and \$17.3 million from oil and gas.

Gold was dominant amongst the metallic minerals with a turnover of \$548.0 million.

Coal mining is concentrated in the Bowen Basin; copper, lead, silver and zinc mining at Mt Isa; bauxite mining at Weipa and gold in central and northern Queensland.

17.1 MINING ESTABLISHMENTS: SUMMARY OF OPERATIONS BY INDUSTRY CLASS, 1990-91

ASIC code	Description	Establish- ments at 30 June	Employ- ment at end of June(a)	Wages and salaries (b)	Turnover	Stocks		Total purchases, transfers in and selected expenses	Value added	Fixed capital expend- iture less disposals (c)
		no.	no.	\$m	\$m	Opening	Closing	\$m	\$m	\$m
	Metallic minerals									
	Ferrous metal ores									
1111	Iron ores	} 19	9,123	449.4	3,043.8	264.2	308.8	925.2	2,163.1	279.8
1112	Iron ore pelletising									
	Non-ferrous metal ores									
1121	Bauxite	11	2,109	90.7	664.9	43.2	48.5	146.2	523.9	170.0
1122	Copper ores	12	2,409	123.1	855.9	150.7	143.3	251.6	597.0	99.7
1123	Gold ores	165	7,878	391.9	4,338.2	553.7	544.7	1,946.8	2,382.5	416.4
1124	Mineral sands	18	2,106	81.5	580.3	118.4	161.8	248.7	375.1	381.1
1125	Nickel ores	10	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
1126	Silver-lead-zinc ores	19	4,742	274.7	1,254.3	162.3	198.2	583.8	706.3	278.5
1127	Tin ores	6	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
1128	Uranium ores	2	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
1129	Non-ferrous metal ores n.e.c.	7	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
11	Total metallic minerals	269	31,667	1,571.8	11,985.4	1,559.6	1,626.4	4,597.9	7,454.3	1,770.9
	Coal, oil and gas									
1200	Coal	148	28,846	1,680.8	8,294.1	644.3	762.0	3,621.0	4,790.7	834.6
1300	Oil and gas	109	5,265	297.6	8,606.9	236.6	223.2	549.2	8,044.3	1,156.1
12-13	Total coal, oil and gas	257	34,111	1,978.5	16,901.0	880.9	985.1	4,170.2	12,835.1	1,990.7
	Total metallic minerals, coal oil and gas	526	65,778	3,550.3	28,886.4	2,440.5	2,611.5	8,768.1	20,289.3	3,761.7
New South Wales		104	19,367	1,146.2	4,473.3	428.7	448.7	2,026.6	2,466.7	642.2
Victoria		9	1,517	100.4	4,037.9	35.2	33.2	130.6	3,905.3	194.4
Queensland		139	16,583	895.3	6,428.4	577.7	732.8	2,572.2	4,011.4	566.3
South Australia		17	2,040	99.9	1,179.0	171.5	154.6	235.3	926.9	132.5
Western Australia		202	22,442	1,093.9	10,316.4	881.6	965.6	3,200.4	7,200.0	2,038.9
Tasmania		13	1,867	120.1	458.7	65.8	54.3	256.1	191.2	32.1
Northern Territory		42	1,962	94.5	1,992.7	279.9	222.2	347.0	1,587.9	155.2

(a) Includes working proprietors. (b) Excludes the drawings of working proprietors. (c) Excludes own account capital works.

Source: Mining Industry, Australia (8402.0).

South Australia. The State's largest operations are the Cooper Basin oil and gas project and the Olympic Dam project at Roxby Downs.

The \$1.5 billion Cooper Basin Liquids Project, completed in September 1984, is the largest onshore petroleum development in Australia. Crude oil production in 1990-91 was 1,939 megalitres while natural gas production amounted to 4,364 gegalitres.

Metallic mineral production included iron ore from the Iron Triangle as well as gold, copper, silver and uranium from Olympic Dam.

The mining industry in South Australia employs around 2,040 people in the metallic

minerals, coal, oil and gas sectors and generates \$99.9 million in wages and salaries.

Turnover in 1990-91 was \$1,179.0 million, 4.1 per cent of the national mining total.

Western Australia. Turnover in the Western Australian mining sector in 1990-91 was \$10,316.4 million, up from \$7,660.7 million in 1989-90. This represented 35.7 per cent of national turnover. The largest contributors were: the gold industry with production of 186,408 kilograms of gold bullion and turnover of \$3,325.4 million, iron ore with production of 107.6 million tonnes and turnover of \$2,870.7 million, and oil and gas with a turnover of \$2,429.7 million.

Total employment (at 30 June 1991) in the metallic minerals, coal, oil and gas industries in Western Australia was 22,442 persons with wages and salaries totalling \$1,093.9 million.

Gold mining was the mainstay of the State's mining industry from the 1890s through to the 1960s, when iron ore, nickel, bauxite and oil assumed prominence.

In 1987-88 gold again became the single most valuable mineral produced. Major gold mine developments and expansions have occurred, not only in the traditional areas around Kalgoorlie and other Eastern Goldfields centres, but also in the Pilbara and at Boddington in the south-west.

Other significant mineral projects in Western Australia are the large iron ore mines in the Pilbara, nickel in the Eastern Goldfields, bauxite on the Darling Scarp, mineral sands principally at Capel and Eneabba, and diamonds in the Kimberley.

The North West Shelf Project, which supplies liquefied natural gas (LNG) for export, gas for industrial and domestic purposes and condensate, is the most important project in the State's oil and gas sector.

Tasmania. Coal was the first mineral mined in Tasmania in 1834, gold was discovered in 1849, tin oxide in 1871, silver-lead ore in 1882 and copper in 1883. Iron ore mining at Savage River began in 1967. Most of the mining activity is concentrated in the north-west of the island.

Metallic minerals account for almost all mining production in the State. In 1990-91, turnover for the State was \$458.7 million or 1.6 per cent of national mining turnover.

In 1990-91 concentrates of copper, lead, zinc, molybdenum, scheelite, tin and iron were produced as well as gold bullion and iron ore pellets.

Most production is destined for mainland Australia and overseas refineries. Total employment for metallic minerals and coal at 30 June 1991 stood at 1,867 persons earning \$120.1 million in wages and salaries.

Northern Territory. Mining is the dominant sector of the Northern Territory economy contributing about a quarter of its GDP. By contrast it accounted for only about three per cent of Northern Territory

employment at 30 June 1991, (1,962 persons) earning \$94.5 million in wages and salaries.

A variety of minerals is produced including bauxite, copper, gold, silver and uranium as well as oil and gas. In 1990-91 turnover from metallic minerals, oil and gas reached \$1,992.7 million (seven per cent of the national mining total) with much of the increase in recent years coming from increased oil production.

Bauxite is mined on the Gove Peninsula, uranium at the Ranger mine and gold at a number of locations across the Territory.

Mineral production

Australian production in the metallic minerals, coal, oil and gas sectors for 1990-91 was valued at \$26,293 million an increase of 12.9 per cent over the previous year. Metallic mineral production dominated with \$10,909.9 million or 41.5 per cent of the total, while coal was 25.7 per cent of the total and oil and gas 32.8 per cent.

By value the largest two components of metallic mineral production were gold and iron ore which accounted for \$3,567.7 million and \$2,944.6 million respectively or a combined share of 59.7 per cent.

Western Australia accounted for both the largest share of metallic mineral production with \$6,887.2 million or 63.1 per cent and the largest share of total mineral production with \$9,760.8 million, 37.1 per cent of the total.

The overall growth in the value of mineral production in 1990-91 was spread unevenly across the sectors. The major contributor to growth was the oil and gas industry with an increase of 44.2 per cent to \$8,629.4 million from the 1989-90 figure of \$5,983.3 million.

The increase was a result of increased production particularly of liquefied natural gas from the North West Shelf Project in Western Australia and higher prices during the second half of 1990 in the lead up to the Gulf War.

The value of metallic minerals increased only marginally, rising 0.7 per cent while the value of coal production rose 4.3 per cent primarily due to increases in production. The total value of the coal industry (excluding Tasmania) was \$6,753.7 million in 1990-91. New South Wales and Queensland are still the major coal

producing States with 48.1 per cent and 47.1 per cent of the market respectively.

In 1990 Australia remained the world's largest producer of bauxite (37% of total world production); diamonds (35.6%); lead (16.7%); and the mineral sands concentrates of ilmenite (43.4%); rutile (45.2%); and zircon (42.4%).

Exports

Exports of mining products rose in value by 2.6 per cent in 1991-92 to \$14,639 million or 26.6 per cent of total merchandise exports. This followed a rise of 20.0 per cent in 1990-91.

The percentage contributions of the major mineral products to total exports have remained fairly stable over the period 1989-90 to 1991-92. Black coal remains the largest single export item and the main mineral exported, with a value of \$6,848 million in 1991-92, 12.4 per cent of total exports. Gold was the next most valuable mineral exported with a value of \$4,023 million in 1991-92. Other major exports were iron ore (\$2,850 million, 5.2% of total exports), crude oil (\$1,590 million, 2.9%), zinc ores (\$627 million, 1.1%) and uranium (\$247 million, 0.4%).

Exports of mining products together with basic manufactures of mineral origin grew by one per cent in 1991-92 following growth of 15.3 per cent in 1990-91. However, as a proportion of total exports they declined from 43 per cent in 1990-91 to 41 per cent in 1991-92.

The major contributors to the increase in export value were refined gold, up \$346 million (9%) to \$4,003 million; steaming coal, up \$291 million (12%) to \$2,822 million; iron ore, up \$287 million (11%) to \$2,849 million; and diamonds, up \$134 million (37%) to \$500 million.

Substantial falls were recorded for alumina, down \$541 million (19%) to \$2,284 million; aluminium, down \$357 million (19%) to \$1,571 million; and crude oil, down \$169 million (9%) to \$1,624 million.

Imports

In 1991-92, mining sector imports were \$1,798 million, a rise of 4.5 per cent on the 1990-91 total of \$1,720 million.

With the inclusion of basic manufactures of mineral origin, mineral resource imports totalled

\$4,384 million in 1991-92. The major changes in individual commodity values over this period were for gold, up \$416 million (67%) to \$1,036 million; petroleum refinery products, down \$213 million (32%) to \$460 million, and crude oil and other refinery feedstock, down \$105 million (4%) to \$2,302 million.

Selected commodity review

Gold production in Australia during 1990-91 was 264,993 kilograms valued at \$3,567.7 million. Western Australia accounted for most production with 70 per cent, followed by Queensland with 17 per cent, Northern Territory (7%), New South Wales (4%) and Victoria (2%).

Gold is Australia's second biggest export earner having overtaken wool in 1990-91. In 1990-91 it accounted for 7.1 per cent of total exports at a value of \$3,700 million. The main markets were Singapore (\$1,058 million), Japan (\$995 million), Switzerland (\$710 million) and Hong Kong (\$447 million).

Australia accounts for 12.1 per cent of estimated world gold production with South Africa being the world's biggest gold producer.

Iron ore production in 1990-91 was 111.5 million tonnes of which 93.6 per cent or 104.4 million tonnes was exported. Iron ore mining employs over 9,000 people nationally.

Almost 97 per cent of production takes place in Western Australia's Pilbara region. Iron ore is also mined in South Australia and Tasmania.

Iron ore accounted for \$2,564.2 million or 4.9 per cent of total exports in 1990-91. Japan is Australia's largest market, taking over half of its exports (54% in dollar terms). Australia is Japan's major supplier accounting for 47 per cent of their imports. Other important markets are Korea (9.2%), China (8.5%), Taiwan (4.8%) and Germany (4.4%).

Nickel mining operations are located in Western Australia mainly around Kambalda and in Queensland at Greenvale, west of Townsville.

Production is dominated by Western Mining Corporation's Western Australia operations. Export revenues from nickel, nickel alloys and nickel oxide were \$543 million in 1990-91.

Over half of nickel oxide exports were to the Netherlands.

Petroleum. Production of crude oil and concentrate in 1990-91 was 29,189 megalitres valued at \$6,327.7 million. Liquefied natural gas (LNG) production increased from 2,015,000 tonnes in 1989-90 to 3,577,000 tonnes in 1990-91, an increase in dollar terms of \$500 million.

Australian petroleum production is dominated by the ESSO-BHP Bass Strait operation which accounts for around 50.6 per cent of total production.

Oil and gas are produced in all States except New South Wales and Tasmania with 90 per cent of Australian crude oil production occurring offshore.

Exports of LNG commenced in mid-1989 from Western Australia's North West Shelf. Development of the North West Shelf natural gas resource is the largest resource project ever undertaken in Australia, with a capital cost of more than \$12,000 million.

Crude oil exports in 1990-91 totalled \$1,785.5 million. The major markets were the USA, Singapore, Japan and Indonesia.

Bauxite and alumina. Australia is the world's largest bauxite and alumina producer and the fourth largest aluminium producer.

Bauxite mining employed 2,100 people nationally (June 1991) at mines in Western Australia south of Perth and in the Northern Territory on the Gove Peninsula. Generally the bauxite ore is not sold but processed to alumina for sale or for conversion to aluminium. Alumina production reached 11.4 million tonnes in 1990-91 while refined aluminium production was 1,236,000 tonnes.

In 1990-91 alumina ranked fourth by value among major commodity exports with 5.2 per cent of total exports, 8.7 million tonnes valued at \$2,729 million; aluminium ranked seventh with 4.1 per cent, 995,406 tonnes worth \$2,154 million.

Japan was the major market for aluminium taking 43.7 per cent while East and South-East Asia together accounted for over 90 per cent of exports.

Coal. Black coal is Australia's biggest export earner accounting for 12.1 per cent of the

total value of exports in 1990-91 or \$6,336 million, up from \$4,639 million (and 10.7% of total exports) in 1989-90. By far the biggest market for Australian coal was Japan which bought 58.5 million tonnes for \$3,316 million, 52.3 per cent of total sales. South Korea bought 10.4 million tonnes for \$580 million (9.2%) and Taiwan 7.4 million tonnes for \$397 million (6.3%).

Two-thirds of black coal production consisting of steaming coal, and hard and soft coking coal is exported.

Black coal production in 1990-91 was 166.5 million tonnes valued at \$6,387 million (ex mine value, excluding freight and other charges). Two States dominated black coal production, New South Wales (\$3,133.4 million) and Queensland (\$2,950.4 million).

More than half of New South Wales coal production is from underground mines whereas over 90 per cent of Queensland coal production is from open cut mines.

Black coal produced in South Australia is used for electricity generation as is most of Western Australia's black coal, and by industry in Tasmania.

The black coal industry was the single largest employer in the mining sector employing almost 29,000 people or 44 per cent of total mining employment in the metallic minerals, coal, oil and gas sectors.

Australia also produces brown coal in Victoria where it is used for electricity generation. In 1990-91 brown coal production was 48.9 million tonnes valued at \$367 million.

Diamonds were first extracted in 1982 in Western Australia.

Australia is now the world's largest producer of diamonds with 35.6 per cent of world production. Most of this is from the Argyle Diamond Mine in the Kimberley region of Western Australia, the world's biggest single mine producer.

Argyle's 1991 production was 35 million carats of mainly industrial quality diamonds. The mine commenced operations in December 1985.

Australia's other producing diamond mine at Bow River, also in the Kimberleys produced 960,000 carats in 1990-91.

Uranium. The Australian Government maintained its 'three mines' policy with regard to uranium mining, the mines being the Ranger and Nabarlek mines in the Northern Territory and Olympic Dam in South Australia.

The Ranger deposit was discovered in 1969, 250 kilometres east of Darwin, and mining commenced in 1981.

The Nabarlek deposits were discovered in 1970. The Nabarlek 1 deposit is completely mined out and the mine has been on care and maintenance since 1989 while negotiations proceed over the Nabarlek 2 deposits.

The Olympic Dam deposits were discovered in 1975 and mining commenced in 1988.

Production of uranium for 1990-91 was 4,309 tonnes, 2,467 tonnes from Ranger and 1,842 tonnes from Olympic Dam.

Uranium exports in 1990-91 were valued at \$372 million.

All Australian uranium production is exported, principally for use as fuel for nuclear power stations. Minor quantities are used in medical, industrial and scientific applications.

Australia has no nuclear power stations.

In 1989 Australia produced 11 per cent of the world's production (excluding the centrally planned economies). Canada was the largest producer amongst the market economies with 32 per cent of production.

Mineral processing and treatment

As few minerals can be directly used in the form in which they are mined, most minerals must undergo processing and treatment before utilisation. Table 17.2 shows the production of the main manufactured products of mineral origin during recent years.

17.2 PRODUCTION(a) OF PRINCIPAL MANUFACTURED PRODUCTS OF MINERAL ORIGIN

Commodity		1989-90	1990-91	1991-92
METALS (b)				
Non-ferrous				
Alumina	'000 tonnes	11,041	11,402	11,824
Refined aluminium	'000 tonnes	1,235	1,236	1,234
Refined copper	'000 tonnes	245	237	277
Lead bullion (for export)(c)	'000 tonnes	198	176	202
Refined lead	'000 tonnes	197	220	228
Refined zinc	'000 tonnes	295	320	325
Refined tin	tonnes	381	321	288
Ferrous				
Pig iron	'000 tonnes	6,188	5,600	6,394
Precious				
Refined gold(d)	kg	r234,230	255,318	281,835
Refined silver(e)	tonnes	r404	409	382
FUELS				
Petroleum products				
Diesel-automotive oil	megalitres	r10,280	10,284	10,279
Industrial fuel and marine fuel	megalitres	r143	172	111
Fuel oil for burning	megalitres	r2,477	2,623	2,572
Automotive petrol	megalitres	16,314	16,454	17,192
BUILDING MATERIALS				
Clay bricks	millions	r2,077	1,765	1,655
Portland cement	'000 tonnes	7,075	6,110	5,709
CHEMICALS				
Sulphuric acid	'000 tonnes	1,464	986	816
Superphosphate(f)	'000 tonnes	2,659	1,574	1,337

(a) Some products exclude production of single establishment manufacturing establishments employing less than four persons and production of establishments predominantly engaged in non-manufacturing activities but which may carry on in a minor way, some manufacturing. (b) Excludes secondary metal with the exception of basic iron. (c) Metallic content. (d) Newly won gold of Australian origin. (e) The unit of quantity for silver has been amended from kilograms to tonnes. (f) Double and triple superphosphate expressed in terms of single phosphate, that is, nine per cent P equivalent.

Source: Australian Bureau of Agricultural and Resource Economics (non-ferrous, precious metals and petroleum products only).

MINERAL GEOLOGY

Minerals of economic significance occur throughout Australia, their geological age ranging from Pre-Cambrian to recent. Many of the large deposits such as the base metal deposits at Broken Hill (New South Wales), Mount Isa and Hilton (Queensland), McArthur Rivers (Northern Territory), the copper-uranium-gold deposit at Olympic Dam (South Australia); gold deposits of the Kalgoorlie region and iron ore deposits of the Pilbara region, both in Western Australia and the uranium deposits of the Alligator Rivers area of the Northern Territory, are Pre-Cambrian in age. In eastern Australia major deposits such as the Elura, Cobar, Woodlawn, Hellyer and Rosebery base metal deposits, the Renison tin deposit, Kidston, Mount Leyshon and most other gold deposits, and most black coal deposits, are Palaeozoic in age. Deposits formed in Tertiary times include the brown coals of Victoria, the oil shales of eastern Queensland, the bauxites of Weipa (Queensland), Gove (Northern Territory) and the Darling Ranges in Western Australia, nickeliferous laterites at Greenvale (Queensland) and the mineral sands deposits of the Murray Basin.

Petroleum has been identified in the Australian sediments as old as Pre-Cambrian. Australia's major petroleum bearing basins are under Bass Strait (mainly Tertiary) and offshore north-western Australia (mainly Mesozoic). The main onshore basins are the Amadeus, Bowen/Surat, Cooper/Eromanga and Perth Basins.

Australia is self-sufficient in most minerals of economic importance (and much more than self-sufficient in some). Major minerals with known reserves adequate for domestic demand and export include bauxite (aluminium), black coal, clays, copper, diamonds, gold, iron ore, lead, magnesite, manganese, mineral sands (titanium and zirconium), natural gas, nickel, salt, silver, uranium and zinc. Major discoveries of new deposits continue to be made. In recent years discoveries have included the Century and Cannington lead and zinc deposits and the

Osborne copper and gold deposit in Queensland.

MINERAL EXPLORATION

Exploration consists of the search for new ore occurrences and undiscovered oil or gas, and/or appraisal intended to delineate or extend the limits of known deposits of minerals and oil or gas reservoirs by geological, geophysical, geochemical and other methods. This includes drilling but excludes activities of a developmental or production nature. Exploration for water is excluded.

Mineral exploration expenditure

Table 17.3 shows expenditure on private mineral exploration other than for petroleum in Australia during the last six years.

Petroleum exploration expenditure

Table 17.4 shows expenditure on private petroleum exploration in Australia during the last six years.

ADMINISTRATION

Mineral rights

Mineral rights in Australia are held by the State and Territory Governments and the granting of exploration and mining titles is administered by them under the respective State or Territory legislation. The Commonwealth Government holds rights to minerals in Federal Territories and to certain prescribed substances in the Northern Territory, within the meaning of the Atomic Energy Act (principally uranium). The Commonwealth Government is also able to influence overall development and production activity in the mineral industry by virtue of its constitutional powers with respect to international trade, customs and excise, taxation and foreign investment and has also established consultative mechanisms, such as the Australian Coal Industry Council.

17.3 PRIVATE MINERAL EXPLORATION EXPENDITURE (OTHER THAN FOR PETROLEUM) (\$ million)

	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
New South Wales	47.6	64.5	50.6	55.1	60.6	63.3
Victoria	15.5	33.9	21.7	21.0	12.7	12.6
Queensland	120.6	159.3	139.8	128.4	124.1	109.9
South Australia	11.0	18.9	16.6	13.2	15.5	19.7
Western Australia	323.3	466.3	387.2	315.4	324.8	332.8
Tasmania	10.9	10.4	13.1	11.8	9.9	7.9
Northern Territory	27.9	48.9	68.6	62.6	53.9	57.8
Australia	556.8	802.2	697.6	607.5	601.7	604.0

Source: *Actual and Expected Private Mineral Exploration, Australia (8412.0)*.

17.4 PRIVATE PETROLEUM EXPLORATION EXPENDITURE (\$ million)

	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
Onshore	171.0	271.9	233.6	143.2	217.1	135.3
Offshore	134.1	223.2	405.7	439.4	365.4	338.8
Total	305.2	495.1	639.3	582.6	582.6	473.9

Source: *Actual and Expected Private Mineral Exploration, Australia (8412.0)*.

Mining and exploration for other than petroleum — legislation

Onshore. Each State or Territory has its own Mining Acts and Regulations governing the prospecting for and working of mineral deposits. These Acts and Regulations although similar in principle are different in detail.

Rights to explore for minerals are awarded by granting prospecting licences and (for larger areas) exploration licences or exploration permits. Each tenement sets out conditions such as minimum exploration expenditure each year, methods of prospecting and tenure of agreement. The tenure is usually limited. Most States and Territories make provision for Miner's Right which permits an individual to prospect or fossick for minerals on Crown Land.

Offshore. Following the enactment of the *Seas and Submerged Lands Act 1973*, the High Court confirmed that the Commonwealth has sovereignty over the territorial sea and sovereign rights over the resources of the whole of Australia's continental shelf. However, in the offshore Constitutional Settlement between the Commonwealth and the States reached in June 1979, it was agreed that responsibility for mining of the seabed of coastal waters (that is, the area on the

landward side of the outer limit of the three nautical mile territorial sea) should lie with the States, while the Commonwealth should have responsibility for areas beyond. This division of responsibility was embodied in the *Minerals (Submerged Lands) Act 1981*.

Petroleum mining and exploration — legislation

Onshore. In Australia, full control of petroleum mining rights is vested with the relevant State or Territory Government. Any organisation or individual proposing to undertake petroleum exploration or development must first satisfy the relevant government that it has access to the necessary financial and technical resources to undertake the proposed operations.

Offshore. The situation is the same as that detailed above for mining exploration and development, with the Commonwealth having sovereignty but administrative responsibility divided; in the case of petroleum, under the *Petroleum (Submerged Lands) Act 1967*.

The offshore legislation provides for:

- exploration permits, providing exclusive exploration rights over a specific area;

- production licences to authorise development and commercial production from discovered fields; and
- retention leases to allow security of tenure over discoveries not currently regarded as economic to mine.

Offshore projects except the area around the North West Shelf Gas Project are subject to Petroleum Resource Rent Taxation (PRRT). The tax is levied at a rate of 40 per cent on net project revenues. All exploration expenditures incurred by the explorer in PRRT liable areas are allowable deductions. The North West Shelf Project is subject to an excise on crude oil production and a royalty on the net wellhead value of all petroleum production.

The Timor Gap Zone of Cooperation Treaty designates an area of the Continental Shelf between Australia and Indonesia subject to control by a Joint Administration. Revenue collected from petroleum production taxation is shared between the two nations. The Treaty has provisions to prevent double taxation.

In order to encourage offshore petroleum exploration, the Commonwealth conducts a coordinated strategy involving the regular release of exploration acreage, improved collection and dissemination of exploration data to explorers and enhanced company awareness about Australia's title acquisition and taxation agreements. A major feature of the strategy is that explorers are given advance notice of future releases of exploration acreage.

Mineral royalties

Mineral resources are owned by the Crown in Australia, either by the State and Territory Governments, within their borders (and up to three nautical miles offshore), or by the Commonwealth Government in offshore areas outside of the three nautical mile limit. Accordingly royalties are collected by State and Territory Governments for mining onshore and up to three nautical miles offshore and by the Commonwealth outside that limit.

State royalties regulations vary in regard to types of royalties, rates levied and those commodities subject to royalties.

In recent years some State Governments have negotiated special royalty arrangements with companies which are seeking mineral leases for large-scale developments. These royalty rates may vary, depending on whether production is for export or for domestic processing. Examples of this type of royalty agreement are the Argyle Project in Western Australia and the Olympic Dam mine in South Australia. Mineral royalties received by governments in recent years are shown in table 17.5.

Government assistance

The Commonwealth Government and the various State Governments provide assistance to the mineral industry in a variety of ways. These were described in detail in *Year Book Australia 1990*.

17.5 MINERAL ROYALTY RECEIPTS: GOVERNMENTS(a)
(S'000)

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
New South Wales(b)	118,569	135,486	97,166	99,387	128,966	155,006
Victoria(c)	r46,728	r51,805	r55,920	r60,043	r60,146	53,359
Queensland(b)	r196,330	r176,619	196,013	178,301	r207,954	227,566
South Australia	58,352	33,592	36,011	34,914	44,004	80,570
Western Australia(d)	r158,508	r150,156	r158,896	r168,479	r244,330	284,842
Tasmania	r1,811	r1,715	3,048	3,800	6,394	5,350
Northern Territory	r8,190	r7,219	10,642	9,514	24,079	28,350
Commonwealth Government	r393,566	272,501	285,052	182,670	273,077	361,791
Total	r982,054	r829,093	r842,748	r737,108	r988,950	1,196,834

(a) Significant revisions have occurred to some figures due to the reclassification of petroleum royalty payments and payments to the States under arrangements relating to the collection of offshore petroleum royalties. (b) Includes royalties on sand and gravel from Crown lands. (c) Includes royalties on brown coal paid by State Electricity Commission. (d) Includes prepaid royalty of \$50 million in respect of diamond royalty agreement.

Source: Federal, State and Territory departments responsible for mining.

RESEARCH

Research investigations into problems of exploration, mining, ore-dressing and metallurgy are conducted by government bodies, universities, private enterprise, or by the combined efforts of all these. A summary of the main organisations and their functions follows.

Australian Geological Survey Organisation (AGSO)

AGSO is the largest geoscience research organisation in Australia. Its role is to develop an integrated scientific understanding of the geology of the Australian continent, its territories and offshore areas, as a basis for the management of Australia's mineral, petroleum and ground water resources. Its activities also contribute to understanding natural changes in the environment and natural hazards such as earthquakes and volcanic activity. AGSO was formerly the Bureau of Mineral Resources, Geology and Geophysics.

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Minerals research by the CSIRO is primarily undertaken within the Institute of Minerals, Energy and Construction (IMEC).

Research and development activities of the Institute are designed to play a major contributing role in the development of sustainable and competitive minerals, energy and construction industries in Australia and in the creation of a better living and working environment for all Australians through:

- The provision of high quality research, development and service capabilities which support existing and emerging industries as well as providing for the next generation of technology, products and processes.
- Helping to bring about safe and ecologically sustainable development for all Australians through research and advice on environmental issues related to IMEC's client industries.
- Working closely with industry, government and other organisations to help transform research outcomes into new or improved business opportunities including, where

appropriate, the championing of individual projects.

University research

The various universities in Australia carry out research into various aspects of the mineral industry such as geology, ore mineralogy and genesis, mining techniques, mineral processing, extractive metallurgy, and materials and metals technology.

Research by private enterprise

The Australian Mineral Industries Research Association Limited (AMIRA) is a non-profit organisation which was set up in 1959 by the Australian mineral industry to manage jointly sponsored research and development on behalf of the industry. There are approximately 140 AMIRA members, drawn from all parts of the mineral, coal and petroleum industries. Membership ranges from small exploration companies to large mining houses and includes suppliers of services to the industry. The policy of the Association is determined by a council elected by members.

AMIRA has no research facilities so organisations such as CSIRO, universities, consultants, suppliers or member companies carry out the research as contractors to AMIRA.

INTERNATIONAL ASSOCIATIONS

Because Australia is a large supplier of certain minerals to the rest of the world, and because the welfare of the domestic industry depends to a large extent on the maintenance of a high level of exports, international relations are of considerable importance to the industry, and the Commonwealth Government takes an active role in international consultations and discussions relating to minerals. The most important international links are:

- Association of Tin Producing Countries (ATPC);
- International Lead and Zinc Study Group (ILZSG);
- UNCTAD Intergovernmental Group of Experts (IGE) on Iron Ore; and
- International Nickel Study Group (INSG).

BIBLIOGRAPHY

ABS Publications

Actual and Expected Private Mineral Exploration, Australia (8412.0)

Foreign Trade, Australia: Merchandise Exports, 1990-91 (5424.0)

Foreign Trade, Australia: Merchandise Imports, 1990-91 (5426.0)

Mining, Australia, Preliminary (8401.0)

Mining Industry, Australia (8402.0)

Mining Production, Australia (8405.0)

FOR MORE INFORMATION

The ABS has a far wider range of information on Australia than that contained in the *Year Book*. Information is available in the form of regular publications, electronic data services, special tables and from investigations of published and unpublished data.

For further information contact ABS Information Services at one of the addresses listed on the page facing the Introduction to the *Year Book*.

