CHAPTER 16

MINERAL INDUSTRY

GENERAL

Geology and mineral resources

General geology

Most of the western and central part of the Australian continent consists of basement rocks of Precambrian age. Younger Palaeozoic rocks, mostly of geosynclinal origin, form a discontinuous belt several hundred kilometres wide extending from north Queensland to Tasmania. Mesozoic platform sediments form a broad zone separating the Palaeozoic and Precambrian rocks and extending from the Gulf of Carpentaria to central New South Wales. Cainozoic rocks occur mainly in Victoria, south-western New South Wales and southern South Australia, and as residual basalt cappings over extensive areas of the Palaeozoic rocks of eastern Australia.

Economic geology

Minerals of economic significance occur throughout Australia, their geological age ranging from Precambrian to Recent. Many of the large deposits such as those at Broken Hill (N.S.W.), Mount Isa (Qld), the Kalgoorlie and Pilbara regions of W.A. and the Alligator Rivers area of N.T. are Precambrian in age. In eastern Australia the major deposits such as the Elura, Cobar, Woodlawn and Rosebery base-metal deposits and most of the black coal deposits, are Palaeozoic in age. The black coals of the Moreton district of Queensland, northeast New South Wales and Leigh Creek, S.A. are of Mesozoic age. Deposits formed in Tertiary times include the brown coal in Victoria, the bauxites of Weipa (Qld), Gove (N.T.) and the Darling Range (W.A.) and the nickeliferous laterites at Greenvale (Qld).

Mineral resources

Australia is self-sufficient in most minerals of economic importance (and much more than self-sufficient in some). Known adequate reserves of major minerals with production sufficient for domestic demand and exports include aluminium (bauxite and alumina), black coal, copper, gold, iron ore, lead, natural gas, nickel, salt, silver, tin, tungsten, uranium and zinc. Reserves sufficient for domestic demand include clays (except light grade china clay), brown coal and dolomite.

For further details of principal Australian mineral deposits, and notes on principal mineral resources, *see* Year Book No. 61, pages 925–932 and the Australian Mineral Industry Quarterly and Annual Reviews.

Administration

All mineral rights in Australia are vested in the Crown except those on land which was granted before the Crown began to reserve mineral rights. In practice, these private mineral rights are important only in the New South Wales coalfields. In the States, these rights are held by the State Governments. On 1 July 1980, executive authority with respect to mining and minerals except in relation to certain prescribed substances within the meaning of the Atomic Energy Act (principally uranium) was transferred from the Commonwealth Government to the Northern Territory Government. Private mineral rights in the Australian Capital Territory are vested in the Commonwealth Government. The Commonwealth Government is able also to influence overall development and production activity in the mineral industry by virtue of its statutory powers with respect to international trade, customs and excise, taxation and loan raisings. Certain specially-formed bodies such as the Joint Coal Board and the Australian Atomic Energy Commission have been given administrative responsibility in defined areas.

Mineral exploration and development

Onshore. Each State or Territory has its own mining Acts or Ordinances and regulations governing the prospecting for and working of mineral deposits. These Acts and regulations, although similar in principle are different in detail. They all make provision for a miner's right to prospect and for small mining leases for mineral production. The principles embodied were established many years ago when mining operations were generally small scale and labour-intensive. Although amendments have been enacted to modernise the legislation, it is generally inadequate for the large-scale capital-intensive operations often involved with modern mineral development. For this reason a large enterprise may take the course of acquiring mining titles by negotiations with the appropriate Minister for Mines and having the agreed terms and conditions embodied in an Act of the State Parliament. This method of acquisition has been used in several cases where the leasing company undertook an obligation (such as the erection of a large treatment works) in return for leases over large areas for a long period, and has become more common in recent years (e.g. iron ore in Western Australia, coal and bauxite in Queensland, bauxite in the Northern Territory). Mining legislation enacted in recent years is simpler and more suited to modern conditions.

As a result of the introduction of large-scale modern prospecting methods (particularly airborne prospecting), small prospecting areas were found to be unsuitable in some instances, and steps have been taken in the States and Territories to ensure the availability of large areas for prospecting by interested persons. Large areas may be made available by provision within the Mining Acts or Ordinances for the issue of authorities to prospect over an area defined by a written agreement which also sets out provisions as to the amount of money to be spent, methods of prospecting, tenure of the agreement, etc.

The tenure of such areas is limited (usually to one or two years) and, if renewed for a further period, is only over an area selected from the larger area (usually 50 per cent) as a result of work done during the life of the initial agreement. It does not give the holder any rights over, or authority to prospect on, land already held under a mining title within the agreed area. Unless specifically stated in an agreement, the discovery of minerals, whether inside or outside an area covered by an authority to prospect, gives the discoverer no legal rights except the right to apply for a mining lease over the area in which the discovery was made. Suitable prospects are converted to mining tenements by making application for lease under the appropriate mining Act.

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 within the outer boundary of the 3 mile territorial sea should lie with the States, while the Commonwealth should have responsibility for areas beyond.

The Minerals (Submerged Lands) Act 1981 passed by the Commonwealth Parliament in June 1981 follows the scheme of the offshore petroleum legislation amendments passed in 1980 and provides for Joint Commonwealth/State Authorities to be responsible for major matters under the legislation with the States being responsible for day-to-day administration. The legislation will be proclaimed to come into effect when complementary State legislation in respect of the 3 mile territorial sea is enacted. In the meantime administration of offshore mining is carried out under the States' onshore mining legislation on an interim basis.

The mining code under the new legislation provides for a two-stage system of titles: the exploration permit, which covers all forms of exploration, and the production licence, which covers development.

Petroleum exploration and development

Onshore. In Australia, all petroleum is the property of the Crown. Consequently, full control of petroleum mining rights is vested in the Government or Administration of each State or Territory. Any company, organisation or individual proposing to undertake petroleum exploration or development must first satisfy the Government concerned that the necessary financial and technological resources are available to carry out the operation.

There are three main types of petroleum title:

(i) the exploration title, where the holders are typically given exclusive rights over the area to conduct petroleum exploration, including the drilling and testing of wells;

(ii) the production title, which is required for the engagement in commercial production of petroleum and gives the holder the right to produce and sell the petroleum subject

to the payment of a royalty calculated as a fixed percentage of the well-head value of the petroleum produced; and

(iii) the retention licence recently enacted in the Northern Territory, covering onshore petroleum exploration and production under the *Petroleum Act 1984* and is intended to allow tenure over currently non-commercial discoveries.

Royalty arrangements vary from State to State. All States and the Northern Territory have calculated royalties derived from onshore production as a percentage of the derived well head value of all petroleum production. However, in June 1985, the Commonwealth and Western Australian Governments reached agreement to replace Commonwealth excises on LPG and crude oil and State ad valorem royalty with a Resource Rent royalty. Revenue will be shared between the Commonwealth and State Governments on a 75-25 basis.

Offshore. In the offshore constitutional settlement between the Commonwealth and the States reached in June 1979, it was agreed that, as in the case of mining for other minerals, responsibility for administering petroleum exploration and production within the outer boundary of the 3 mile territorial sea would be a State responsibility, while the Commonwealth would have responsibility for the continental shelf beyond the 3 mile territorial sea.

Amendments to the *Petroleum (Submerged Lands) Act 1967* passed by the Commonwealth Parliament in May 1980 and proclaimed on 14 February 1983, provide for a Joint Authority for the adjacent area of each State (beyond the 3 mile territorial sea limit) consisting of the Commonwealth Minister and the State Minister. The Joint Authorities are concerned with major matters arising under the legislation, and in the case of disagreement the view of the Commonwealth Minister will prevail. Day-to-day administration will continue to be in the hands of the State Minister as the Designated Authority and State officials.

The mining code applicable under the legislation provides for a two-stage system of titles: the exploration permit, which covers all forms of exploration including drilling, and the production licence, which covers development and production. The sharing of royalty between the State and the Commonwealth Governments is to continue on a 60-40 basis, and any override royalty payments will continue to be retained by the States. The offshore constitutional settlement and the operation of Commonwealth and State offshore petroleum legislation are being reviewed by the Commonwealth Government. Decisions on the outcome of the review and details of any changes are expected to be known in 1985.

On 27 June 1984, the Minister for Resources and Energy and the Treasurer announced final details of a resource rent tax to apply to offshore 'greenfields' petroleum projects from 1 July 1984. The resource rent tax is intended to replace royalties and excise and will constitute a deduction for company tax purposes. The *Petroleum (Submerged Lands) (Royalty) Amendment Act 1985* and the *Petroleum (Submerged Lands) Amendments Act 1985* exempt production in the Territory of Ashmore and Cartier Islands Adjacent Area from royalties. This exemption from royalties was made in advance of the overall Resource Rent Tax legislation to assist the developers of the Jabiru project and to demonstrate the Government's commitment to major and positive changes in the fiscal regime applying to 'greenfields' offshore projects.

Mineral royalties

The collection by governments of royalities for the production of minerals within their area of authority is an internationally-accepted practice. In Australia, the responsibility for mineral royalties is largely a State concern, and all States currently collect some form of mineral royalty payments.

In recent years there has been an important basic change in the system of establishing royalty commitments, and it is now quite common for State Governments to negotiate special royalty rates 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. The rates for a particular mineral may also vary between producers. Important examples of this type of royalty agreement are the iron ore development agreements in Western Australia and coal development agreements in Queensland. Mineral royalties received by Governments in recent years are shown in the following table.

MINERAL ROYALTY RECEIPTS: GOVERNMENTS

($'000)

	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84
New South Wales (*a*)	35,879	86,938	116,682	88,186	105,403	110,100
Victoria (*b*) (*c*)	60,111	90,554	118,611	108,782	124,861	180,585
Queensland (*a*)	53,638	73,473	73,274	81,382	89,703	107,579
South Australia	4,541	5,869	7,312	8,811	9,321	14,172
Western Australia	57,810	66,712	78,341	81,330	102,454	179,355
Tasmania	2,193	5,261	3,557	2,209	2,082	2,137
Northern Territory (*d*)	1,256	2,551	5,666	3,020	2,934	3,963
Commonwealth Government (*c*)	28,031	43,337	57,319	56,580	73,333	89,853
Total	**243,459**	**374,695**	**460,762**	**430,300**	**510,091**	**688,744**

(*a*) Includes royalties on sand and gravel from Crown lands. (*b* Includes royalties on brown coal paid by State Electricity Commission. (*c*) Includes royalties received under the *Petroleum (Submerged Lands) (Royalty) Act 1967–68*. (*d*) Excludes the mining royalties paid into Aboriginal Benefits trust fund prior to 1978–79.

Control of Exports

The Commonwealth Government exercises control over the export of certain minerals and metals. The legislative basis for export controls is contained in Regulations 9 and 11 of the Customs (Prohibited Exports) Regulations. These regulations prohibit the export of certain minerals and metals and of hydrocarbons and nuclear-sensitive material, unless permission is granted by the Minister for Trade or an authorised person.

Export controls serve different objectives. Among other things, they are used to ensure that:

(i) prices negotiated by Australian suppliers are in line with the market and other terms and conditions of sales contracts are reasonable;
(ii) Australia is able to meet its international obligations e.g. under the International Tin Agreement;
(iii) exports of uranium and nuclear materials are consistent with Australia's international obligations;
(iv) domestic requirements of petroleum and petroleum products are met before exports occur;
(v) supplies of copper scrap and copper alloy scrap are reserved for local industry; and
(vi) the provisions of the Environment Protection (Impact of Proposals) Act and the Australian Heritage Commission Act are taken into account.

Close control is exercised in respect of alumina, bauxite, coal (including lignite), iron ore, petroleum and petroleum products, primary tin, uranium and other materials of nuclear significance. Exporters are required to consult with the Department prior to the negotiation of contracts for sale of alumina, bauxite and coal and Determinations are made in relation to the negotiation of contracts for the sale of uranium.

Concerning the remaining minerals and metals subject to Regulations 9 and 11:

(i) in relation to ores, concentrates, matte and oxides of copper, lead, manganese, nickel, tungsten and zinc, blister and refined copper, lead bullion and salt: exporters, on application, are given automatic approval to export expected shipments over a twelve-month period;
(ii) in respect of mineral sands, approvals to export are freely issued except where the Commonwealth considers there are environmental reasons which would make such exports undesirable; in the case of monazite and xenotime, however, there are additional requirements to be met in relation to the Government's nuclear safeguards policy before export approval can be given; exports of copper scrap and copper alloy scrap are embargoed, and quotas apply to secondary copper ingots and other basic shapes made from scrap material.

No other minerals are subject to control.

The Government continues to review export controls in the light of changing circumstances.

Joint Coal Board

The Joint Coal Board was established in 1946 under joint legislation of the Commonwealth Government and of the State of New South Wales to carry out special administrative functions in regard to the New South Wales black coal mining industry. In summary, the Board's functions are:

(i) to ensure that coal is produced in the State of New South Wales in such quantities and with such regularity as will meet requirements throughout Australia and in trade

with other countries;

(ii) to ensure that the coal resources of the State are conserved, developed, worked and used to the best advantage in the public interest;

(iii) to ensure that coal produced in the State is distributed and used in such manner, quantities, classes and grades, and at such prices as are calculated best to serve the public interest and secure the economical use of coal and the maintenance of essential services and industrial activities; and

(iv) to promote the welfare of workers engaged in the coal industry in the State.

Government assistance

The Commonwealth Government and the various State Governments provide assistance to the mineral industry in a variety of ways. The main forms of assistance are discussed on the following pages.

Commonwealth Government assistance

Assistance provided by the Commonwealth Government takes the form of income taxation concessions, subsidies, bounties, and technical assistance, mainly through the work of the Bureau of Mineral Resources, Geology and Geophysics (BMR) and the Commonwealth Scientific and Industrial Research Organization (CSIRO) as well as through the National Energy Research, Development and Demonstration Program.

Income taxation concessions as at 30 June 1985. Income derived from mining principally for gold in Australia is exempt from tax. The exemption is also available in respect of income derived from mining principally for gold and copper if the value of the gold obtained is not less than 40 per cent of the value of the total output.

Special deductions for capital expenditure incurred in prospecting and mining for petroleum (including natural gas) are allowable to a petroleum mining enterprise engaged in these operations in Australia. Capital expenditure allowable to petroleum mining enterprises includes, broadly, the costs of exploratory surveys, drilling and well-head plant; plant for the liquefaction of natural gas; access roads; and housing and welfare. The enterprise is entitled to these special deductions against income from any source. While the special deductions for prospecting expenditure are deductible immediately against the net income of the enterprise, the deductions for capital expenditure on mining are allowable over the life of the oil or gas field or over ten years, whichever is the lesser, on a straight line basis.

An enterprise mining or prospecting for minerals other than petroleum and gold may also be allowed special deductions for capital expenditure. Broadly, allowable capital expenditure includes expenditure on exploration and prospecting; preparation of a site for extractive mining operations; buildings; other improvements and plant necessary for those operations; access roads; certain treatment plant; and housing and welfare.

The allowable capital expenditure of a general mining enterprise, other than costs of exploration, may be deducted against income from any source over the life of the mine or over ten years, whichever is the lesser, on a straight line basis. Expenditure incurred by a general mining enterprise in exploring for minerals is deductible immediately against the net income of the enterprise from any source.

Annual deductions for depreciation on petroleum mining plant or general mining plant may be allowed in lieu of spreading the cost over the life of the oil field or mine. The cost of exploration plant may also be deducted under the depreciation provisions of the law. The investment allowance scheme may permit a deduction at the rate of 18 per cent of the cost of certain new plant.

Special deductions are allowable for capital expenditure incurred on certain transport facilities for use in Australia primarily and principally, for the transport of raw minerals (other than petroleum or gold) and certain specified products obtained from the processing of such minerals, or for transporting petroleum between the oil or gas field and a refinery or other terminal. The special deductions apply to expenditure incurred on a railway, road, pipeline or similar transport facility and on certain port facilities or other facilities for ships. Allowable expenditure on transport facilities is deductible in equal annual instalments over a period of ten or twenty years at the option of the mining enterprise.

An income tax rebate of 27 cents for each dollar of share capital subscribed may be available to shareholders of petroleum mining companies exploring or mining for petroleum in Australia, including offshore areas, where those companies lodge appropriate declarations with the Commissioner of Taxation in respect of the moneys subscribed. By lodging those

declarations, certifying that the capital subscriptions have been, or will be, spent on eligible outgoings within a specified period, the petroleum mining companies forgo deductions to which they might otherwise be entitled for capital expenditure.

Payments to producers and importers of phosphate fertilizers. The *Phosphate Fertilizers Subsidy Act 1963* provides for a subsidy to be paid on phosphatic substances produced in Australia or imported and sold for use in Australia as a fertilizer. Phosphatic substances used as a supplement to stock food are also regarded as being used as a fertilizer. Subsidy is payable at the rate of $12 per tonne in respect of superphosphate where the available phosphorus content is not less than 8.5 per cent or more than 8.9 per cent by weight. Outside this range, subsidy is payable at $138 per tonne of the available phosphorus content of the substance. The intention of the Act is to assist consumers of phosphate fertilizers (primary producers). The Act expires on 30 June 1986.

Payments to producers and importers of nitrogenous fertilizers. The *Nitrogenous Fertilizers Subsidy Act 1966* provides for a subsidy to be paid on inorganic nitrogenous substances produced in Australia or imported and sold for use in Australia as a fertilizer. Nitrogenous substances used as a supplement to stock food are also regarded as being used as a fertilizer. Subsidy is payable at the rate of $20 per tonne of the nitrogen content of which the goods consist. The intention of the Act is to assist consumers of nitrogenous fertilizers (primary producers). The Act expires on 30 June 1986.

Bureau of Mineral Resources, Geology and Geophysics. The role of BMR is:

(i) to develop an integrated, comprehensive, scientific understanding of the geology of the Australian continent, the Australian offshore area and the Australian Antarctic Territory, as a basis for minerals exploration; this to be done where appropriate in co-operation with State Geological Surveys and other relevant organisations and having regard to priorities for the search for minerals approved by the Minister for Resources and Energy;

(ii) to be the primary national source of geoscience data and to publish and provide information; and

(iii) to undertake mineral resource assessments in accordance with programs and priorities approved by the Minister for Resources and Energy with the advice of the BMR.

At 31 August 1985, 550 officers were employed at the BMR, this included 172 professional officers (geologists, geophysicists, chemists, engineers, and mineral economists etc.), 78 research scientists, four chief scientists and seven in the Senior Executive Service.

BMR's research program is carried out by four Divisions—Geophysics, Continental Geology, Marine Geosciences and Petroleum Geology, and Petrology and Geochemistry. Mineral and petroleum resource assessments are undertaken by the Resource Assessment Division which includes Mineral Commodities Branch, a Petroleum Branch, a Mining Product Evaluation Branch, and a Geoscience Computing and Database Branch. Other branches are Planning and Programs and Special Projects and Geoscience Services.

The BMR maintains laboratories in Canberra engaged on geochemical, geochronological, organic geochemistry, and petroleum technological studies, and basic research into the design and testing of geophysical equipment. It also maintains geophysical observatories at Kowen Forest (Australian Capital Territory), Mundaring (Western Australia), Mawson (Antarctica), and Macquarie Island. The geophysical observatories are engaged in geomagnetic, ionospheric, and seismology research.

State Government assistance

In addition to free assays and determinations of rocks and minerals carried out for prospectors by the Mines Departments of the States and Territories, technical officers of these departments provide advice to the mining and allied industries where required, carry out field examinations of mining prospects, advise on exploration and development, select sites for water supply, and generally give a free technical service to the mining industry.

New South Wales. The primary objective of the Department of Mineral Resources is to promote the responsible development of mineral resources in New South Wales. The Department administers the various Acts (Coal, Petroleum and Mining) and grants titles to encourage and facilitate the exploration for, prospecting and development of, the State's mineral resources. The Department's staff is deployed in many diverse areas of activity to encourage and assist mining and resource development projects by the mining industry.

A wide range of services, information and advice is provided on many subjects including geological and geophysical investigations, scientific and chemical research, geological and

metallogenic mapping, prospecting, mining legislation and administrative procedures. The Geological and Mining Museum, one of the State's foremost specialist museums, is maintained by the Department, as is the reference library of geology, mining and allied topics situated at the Department's head office and Bore Core Library situated at Londonderry, near Penrith.

The Department is engaged in the continuous assessment of the State's mineral resources; its coal exploration and assessment programme in particular has identified many coal deposits of high commercial promise.

Victoria. The Department of Industry, Technology and Resources advises on, monitors, co-ordinates and implements minerals and energy policy. The Department conducts geological, groundwater and mineral surveys, produces geological maps, and issues scientific and technical reports thereon. Drilling operations are carried out and the results are used in sedimentary basin studies to evaluate the petroleum, mineral and groundwater potential of the State. A comprehensive library and a geological museum are maintained, while a core library retains cores and cuttings from Government and private drilling operations. The administration of petroleum, pipeline, mining and extractive industry legislation ensures that mineral, stone and petroleum exploration and production (both onshore and offshore), mining and quarrying are regulated and controlled. Technical assistance and advice are available for mineral, stone, groundwater and petroleum exploration and prospecting. Five stamp batteries located throughout the State provide an ore-crushing service to enable test crushing to be made at nominal cost. Information is available on mining law and mineral statistics. Assays of ores and analytical services are also available from the State Chemical Laboratory for a fee.

Queensland. The Department of Mines regulates, encourages and assists the search for and development of mineral and energy resources, including coal, petroleum and oil shale working through a system of authorities, leases and licenses issued under Acts of Parliament.

The Department provides assistance to mining by way of grants for construction and maintenance of roads in mining areas, repayable advances or subsidies for mine development, hiring of equipment, assistance to prospectors and geological services. Detailed information is collated from in-house geological studies and seismic surveys and continuous scientific appraisal of results achieved and reported by commercial exploration groups. The information effort is underpinned by a Departmental drilling program focusing on coal and mineral exploration and deep stratigraphic drilling.

The Department carries out a continuous inspection of mine safety and provides an expert technical advisory service to mining organisations. Other activities include research on mine safety and health and the administration of safety regulations on gas installations and storage of explosives. Additionally, the Department maintains an Assay Office at Cloncurry, a District Geologist's Office at Charters Towers and has Inspectors of Mines, both metalliferous and coal, stationed at various major centres throughout the State.

The Queensland Coal Board contributes to coal mining research programmes and undertakes sampling tests of Queensland coals. It can make funds available to colliery proprietors for equipment. It provides grants or loans for the provision of amenities for employees and for communities in Queensland coal mining areas. The Board also provides financial assistance for the Coal Miners' Health Scheme.

South Australia. The Role of the Department of Mines and Energy is:

- to provide an information service and advice to the Government, Government agencies, private industry and general public on exploration, development and processing of the State's mineral, energy and underground water resources;
- to ensure that the State's mineral, energy and underground water resources are assessed and developed in accordance with Government policy;
- to encourage private sector exploration for mineral and energy resources in the State;
- to provide advice to Government on overall energy development, utilisation and conservation, including alternative energy sources;
- to ensure that industries engaged in exploring, extracting and processing mineral and energy resources adopt effective safety precautions within their operations;
- to ensure that the Government's policies on environmental protection measures are adopted by organisations engaged in exploration and development of the State's mineral, energy and underground water resources;
- to provide geoscientific research and specialist services as part of an ongoing process of acquiring and updating geological and geophysical data throughout the State for the benefit of the mining industry, other Government Departments and the community.

Western Australia. The Western Australian Department of Mines operates thirteen State batteries throughout the goldfields, for the treatment of ore (principally gold) from prospectors and small mine owners, at a nominal charge. Through its Geological Survey Division, the Mines Department carries out geological investigations and surveys throughout the State. The results of this work are made available in both map and report format. The Government Chemical Laboratories Branch of the Mines Department provides analytical and research services to the mining and mineral exploration industry.

Tasmania. The Department of Mines provides financial assistance to mining lessees for the purchase of plant and machinery; for sinking, repairing or de-watering of shafts; for construction of dams and water races; for testing and proving a deposit of any mining product; for developmental work; and for diamond and other types of drilling. The Department has available for hire percussion and diamond drills for exploration. Other assistance is rendered to the industry through geological and engineering advice, ore-dressing research into metallurgical recoveries, and the selection and design of treatment plant.

Northern Territory. The Department of Mines and Energy encourages the development of an efficient mining and processing industry. Through six divisions the Department administers relevant legislation and provides a wide range of services.

Mines Division has primary responsibility for the development of policy and legislation relating to exploration and mining industries. It also provides advice to the government on special projects. The Division has regulatory responsibility in the fields of occupational hygiene, mine safety and environment protection to ensure the efficient, orderly and safe recovery and utilisation of the Territory's mineral resources. A range of technical and financial services are also provided to small miners and prospectors.

Energy Division has primary responsibility for policy development, and advice to Government, on all energy matters. Its regulatory function in the petroleum exploration and development area is administered from Darwin and Alice Springs.

The N.T. Geological Survey Division elucidates the regional geology and geophysics of the Territory, researches new mapping, geological survey and mineral search techniques and provides technical information through its computer indexes at Darwin and Alice Springs.

Water Resources Division is responsible for the assessment and management of water resources. Their activities include development of water supplies by construction of production bores and the provision of advice and assistance to the public developing private water supply. The Division carries out water pollution monitoring programs. Data compilation services are provided related to surface and groundwater resources.

Industrial Safety Division provides inspectorial, training and advisory safety services in the fields of construction safety, dangerous goods and machinery safety. These services are provided from the Division's offices at Darwin, Alice Springs, Tennant Creek and Katherine.

Regulation and orderly administration of mineral and petroleum tenure, and provision of essential drafting services fall within the ambit of the Administration Division.

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 their functions follows, for further information on research *see* Chapter 25, Science and Technology.

Australian Atomic Energy Commission

For a detailed description of the activities of the Australian Atomic Energy Commission *see* Chapter 18, Energy.

The Australian Mineral Development Laboratories

Technical consulting, contract research and process design for the mineral and associated industries is undertaken by The Australian Mineral Development Laboratories (Amdel). Operations are based in Adelaide with branch laboratories in Perth, Melbourne, Sydney, Brisbane, Darwin and Townsville. This organisation is controlled by a council comprising representatives of the mineral industry, the South Australian Government and the Commonwealth Government. Extensive facilities are available in the fields of analytical chemistry, mineralogy, petrology, hydrocarbon fuels, chemical metallurgy and mineral engineering, process instrumentation and control, water and waste water treatment and materials technology. Both long and short term applied research is carried out and all investigations are conducted on a strictly confidential basis. Services in the field of pollution and environmental control are also available through the Amdel group, Aspect.

The Baas Becking Geobiological Laboratory

In 1965, the Baas Becking Geobiological Laboratory was established in the Bureau of Mineral Resources building in Canberra under the joint sponsorship of the Commonwealth Scientific and Industrial Research Organization, the Bureau of Mineral Resources, Geology and Geophysics and the Australian Mineral Industries Research Association (*see* Research by private enterprise, below).

Subjects of current research are ore genesis and petroleum related investigations. Geological research is coordinated with the field research programs of the Bureau of Mineral Resources, Geology and Geophysics.

Bureau of Mineral Resources, Geology and Geophysics

The BMR 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 mineral exploration and resource assessment. BMR carries out programs in:

- Fossil Fuels: including their origin and distribution in space and time; onshore sedimentary basin analysis; geophysical investigations of the structure of onshore basins; framework studies of Australian offshore areas; and modern marine processes.
- Minerals: including their origin and distribution in space and time; metallogenic provinces; the weathered zone; and related resources; airborne geophysical mapping and interpretation; crustal geophysics; and the origin and distribution of offshore mineral deposits.
- Ground water, and basin hydrogeology.
- Earthquake hazards.
- National and international geoscience maps.
- Overseas programs: including land geoscience in Southeast Asia; marine geosciences in the Southwest Pacific; geoscientific co-operation with China; and Antarctica.
- Petroleum and mineral resource assessment.
- National geoscience data base.

Commonwealth Scientific and Industrial Research Organization

Minerals Research

Minerals research by the Commonwealth Scientific and Industrial Research Organization (CSIRO) is undertaken within the Institute of Energy and Earth Resources. The research has the objectives of improving methods of locating, evaluating, defining and characterising Australia's mineral resources and of planning their recovery, development and effective use consistent with the minimization of environmental stresses. Divisions of the Institute engaged in minerals research are the Division of Geomechanics at Syndal (Vic.); the Divisision of Fossil Fuels at North Ryde (N.S.W.); the Division of Mineral Chemistry at Port Melbourne (Vic.); the Division of Mineral Engineering at Clayton (Vic.); the Division of Mineralogy and Geochemistry at Perth (W.A.), and the Division of Mineral Physics and Mineralogy at North Ryde (N.S.W.). The Institute Headquarters is located in Canberra (A.C.T.).

Department of Resources and Energy

The functions of the National Coal Research Advisory Committee which was established in 1964 have been incorporated into the National Energy Research, Development and Demonstration Council (NERDDC) which is administered by the Department of Resources and Energy. For details of NERDDC, which advises the Minister for Resources and Energy on matters relating to national energy policy *see* Chapter 18, Energy, and Chapter 25, Science and Technology.

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 more than 70 members of AMIRA, 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. Research contracts worth approximately $3.0 million per annum are handled by AMIRA.

International relations

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 commitments are discussed below.

International Tin Agreement

The First International Tin Agreement (of the post-war period) was in operation for five years from 1 July 1956 to 30 June 1961. It was followed by the Second, Third, Fourth, Fifth and Sixth International Tin Agreements, which came into force on 21 February 1962, 21 March 1967, 1 July 1971, 1976 and 1982 respectively. Australia joined the Fourth, Fifth and Sixth Agreements as a 'producing' (i.e. exporting) member, whereas in the first three agreements Australia's status had been that of a 'consuming' (i.e. importing) member. Details of the Second and Third Agreements are given in Year Book No. 57, pages 911-12. Details of the Fourth Agreement are given in Year Book No. 61, page 942, and those of the Fifth in Year Book No. 66, page 376.

The objectives and provisions of the present (Sixth) Agreement are broadly similar to those of its predecessors. The International Tin Agreement establishes floor and ceiling prices for tin and, by the medium of a buffer stock and remedial trading, aims at confining the prices within these limits. The Sixth Agreement provides for a larger buffer stock than in the previous Agreements of up to 50,000 tonnes of tin metal. For the first time, financing of the buffer stock is being shared equally between producers and consumers. In the event of persistent market disequilibrium through causes beyond the control of the buffer stock mechanism, the agreement provides for the regulation of exports and stocks to stabilise the market.

The sixth International Tin Agreement is administered by the International Tin Council, which is made up of the following governments: *Producers*—Australia, Indonesia, Malaysia, Nigeria, Thailand, Zaire; *Consumers*—Belgium-Luxembourg, Canada, Denmark, Finland, France, Germany (Federal Republic of), Greece, India, Ireland (Republic of), Italy, Japan, Netherlands, Norway, Poland, Sweden, Switzerland, and the United Kingdom. The producing countries hold a total of 1,000 votes, distributed so that each country receives five initial votes and an additional number corresponding to its percentage as laid down by the Agreement. The consuming countries hold a total of 1,000 votes also distributed so that each country receives five initial votes and an additional number proportionate to quantities consumed. The allocation of votes in each category is periodically reviewed.

Association of Tin Producing Countries

The Association of Tin Producing Countries (ATPC) came into force on 16 August 1983. Membership is open to countries which are net exporters of tin. The current members are Bolivia, Indonesia, Malaysia, Thailand, Zaire, Nigeria and Australia. The main objective of the ATPC is to encourage greater consumption of tin through research, development and promotion.

International Lead-Zinc Study Group

With the cessation of stockpile buying of lead and zinc by the United States Government in 1958, world producers were faced with the prospect of a serious imbalance between world supply and demand for these metals. To meet this problem, a series of meetings of interested governments was held at which Australia was represented. These meetings culminated in the formation of the International Lead-Zinc Study Group which was established in January 1960. The Study Group comprises the following Governments: Algeria, Argentina, Australia, Austria, Belgium, Bulgaria, Canada, Czechoslovakia, Denmark, Finland, France, Germany (Federal Republic of), Hungary, India, Iran, Ireland (Republic of), Italy, Japan, Mexico, Morocco, Netherlands, Norway, Peru, Poland, South Africa (Republic of), Spain, Sweden, Tunisia, Union of Soviet Socialist Republics, United Kingdom of Great Britain and Northern

Ireland, United States of America, Yugoslavia and Zambia. The Group provides opportunities for inter-governmental consultations on international trade in lead and zinc and for studies of the world situation in lead and zinc.

Association of Iron Ore Exporting Countries (APEF)

Australia is a founder member of the Association of Iron Ore Exporting Countries (APEF) whose members account for about 44% of world iron ore exports. Other members are Algeria, India, Liberia, Mauritania, Peru, Sierra Leone, Sweden and Venezuela.

The Association was formed in 1975 with a Secretariat located in Geneva, Switzerland. The Agreement establishing the Association provides for a Conference of Ministers, which meets once every two years. A Board, comprising representatives of each member country meets twice a year.

The objectives of the Association are to promote close co-operation among member countries with a view to safeguarding their interests in relation to the iron ore export industry. The Association provides a forum for consultations and exchange of information on problems relating to the iron ore export industry.

The Association's Secretariat publishes a statistical bulletin twice a year as well as occasional papers on the iron ore industries of major producing countries.

Intergovernmental Council of Copper Exporting Countries (CIPEC)

The CIPEC was established in 1967 by the Governments of Chile, Peru, Zaire and Zambia as an intergovernmental consultative organisation.

Australia and Papua-New Guinea were admitted as Associate Members and Indonesia as a Full Member in 1975, the latter changing to Associate Membership from 1 January, 1986. Yugoslavia was admitted as an Associate Member in 1977. Associate Members may participate in meetings but have no voting rights and are not bound by CIPEC's decisions.

The key objectives of CIPEC are to co-ordinate measures to achieve continuous growth in real earnings from copper exports and to harmonise the decisions and policies of members relating to copper production and marketing.

International Bauxite Association

Australia joined the International Bauxite Association (IBA) as a founder member in October 1974. Other members are Dominican Republic, Ghana, Guinea, Guyana, India, Indonesia, Jamaica, Sierra Leone, Suriname and Yugoslavia. Members account for about three-quarters of world bauxite production with Australia accounting for nearly one third of world production.

The objectives of the Association are to promote the orderly and rational development of the bauxite industry; to secure for members fair and reasonable returns from the exploitation, processing and marketing of bauxite and its products for the economic and social development of their peoples, bearing in mind the recognised interests of consumers; and generally to safeguard the interests of member countries in relation to the bauxite industry.

The Association consists of a Council of Ministers which meets once a year, an Executive Board consisting of senior officials which meets three times a year and a Secretariat which is located in Kingston, Jamaica.

The IBA provides members with an opportunity to discuss common problems and evolve co-operative policies to facilitate further development of their bauxite/alumina/aluminium industries. The Association's work is mostly concerned with exchanging views and information on a range of industry matters. The commercial and technical aspects of formulating minimum export prices for bauxite and alumina have received particular attention. In November 1984 the Council adopted recommendations on minimum CIF prices for bauxite and alumina sold by member countries in 1985. Australia was not included in the majority that voted for the recommendations and is not bound by them. The Association publishes a Quarterly Review.

MINERAL INDUSTRY STATISTICS

Statistics in the following pages refer mainly to the mining industry, mineral production, mineral exploration, mineral processing and treatment, and overseas trade.

Mining industry statistics

This section contains statistics of the mining industry in Australia obtained from the annual census of mining establishments. The annual mining census is conducted throughout Australia

on an integrated basis with other economic censuses, e.g. the annual census of manufacturing establishments, electricity and gas establishments and the periodic censuses of retail, wholesale trade, construction, transport and selected services establishments.

Statistics are also available for *enterprises* engaged in the mining industry. The latest statistics for mining are in respect of 1982–83 and were published in the *Enterprise Statistics: Details by Industry Class, Australia,* 1982–83 (8103.0). Enterprise statistics for mining are now produced annually and should be available within two years of the end of the financial year to which they relate. A description of the statistics and broad summary tables, in respect of the 1981–82 and 1982–83 censuses and surveys are given in Chapter 17.

The following table shows key items of data for establishments in Australia for 1983–84 based on the 1978 edition of the *Australian Standard Industrial Classification* (ASIC).

MINING ESTABLISHMENTS: SUMMARY OF OPERATIONS BY INDUSTRY CLASS, 1983–84

Industry		*Establishments at*	*Average employment over whole year(a)*			*Wages and*		*Stocks*		*Total purchases, transfers in and*		*Fixed capital expenditure*
ASIC code	*Description*	*30 June*	*Males*	*Females*	*Persons*	*salaries (b)*	*Turnover*	*Opening*	*Closing*	*selected expenses*	*Value added*	*less disposals*
		No.	No.	No.	No.	$'000	$'000	$'000	$'000	$'000	$'000	$,000
	Metallic minerals											
	Ferrous metal ores											
1111	Iron ores	22	6,504	972	7,476	197,998	1,751,883	266,332	176,943	730,782	931,714	17,977
1112	Iron ore pelletising	2	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	Non-ferrous metal ores											
1121	Bauxite	8	1,931	190	2,121	53,519	337,920	18,551	19,977	75,580	263,767	19,624
1122	Copper ores	10	3,096	201	3,297	82,678	270,973	46,599	44,848	126,884	142,339	48,009
1123	Gold ores	120	3,703	246	3,949	94,553	488,150	59,527	66,649	206,985	288,287	177,906
1124	Mineral sands	11	1,218	105	1,323	28,465	166,940	63,301	46,494	77,703	72,430	15,465
1125	Nickel ores	4	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
1126	Silver-lead-zinc ores	16	6,981	365	7,346	176,707	762,160	140,633	158,348	290,341	489,534	48,692
1127	Tin ores	106	1,440	144	1,584	28,986	114,823	34,882	41,466	65,198	56,209	10,347
1128	Uranium ores	3	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
1129	Non-ferrous metal ores n.e.c.	8	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
11	*Total metallic minerals*	*310*	*28,504*	*2,612*	*31,116*	*776,174*	*4,722,452*	*841,728*	*776,709*	*1,893,962*	*2,763,471*	*413,460*
	Coal, oil and gas											
1201	Black coal	130	30,683	848	31,531	999,398	4,706,145	653,573	656,427	2,045,842	2,663,157	794,368
1202	Brown coal	6	2,420	13	2,433	65,199	169,881	22,173	16,529	51,017	113,221	13,384
1300	Oil and gas	22	3,176	603	3,779	112,537	2,860,022	58,055	108,072	198,482	2,711,557	1,141,273
12,13	*Total coal, oil and gas*	*158*	*36,279*	*1,464*	*37,743*	*1,177,134*	*7,736,048*	*733,801*	*781,028*	*2,295,341*	*5,487,935*	*1,949,025*
	Construction materials											
1401	Sand and gravel	393	1,733	190	1,923	37,044	256,503	15,004	15,933	119,900	137,532	6,900
1404	Construction materials n.e.c.	447	3,668	403	4,071	79,437	472,779	45,073	43,683	228,535	242,856	19,620
14	*Total construction materials*	*840*	*5,401*	*593*	*5,994*	*116,481*	*729,282*	*60,077*	*59,617*	*348,435*	*380,387*	*26,520*
	Other non-metallic minerals—											
1501	Limestone	61	754	26	780	16,823	71,800	7,104	6,960	36,363	35,293	3,956
1502	Clays	107	218	24	242	4,010	29,309	4,533	3,896	16,697	11,976	567
1504	Salt	19	568	74	642	15,032	81,172	18,499	20,584	26,639	56,617	3,014
1505	Non-metallic minerals n.e.c.	135	974	137	1,111	22,908	154,104	33,574	51,595	82,447	89,679	60,667
15	*Total other non-metallic minerals*	*322*	*2,514*	*261*	*2,775*	*58,773*	*336,385*	*63,710*	*83,035*	*162,145*	*193,565*	*68,204*
	Total mining (excl. services to mining)	**(c),1,630**	**72,698**	**4,930**	**77,628**	**2,128,562**	**13,524,166**	**1,699,315**	**1,700,388**	**4,699,883**	**8,825,357**	**2,457,209**

(a) Includes working proprietors (b) Excludes amounts drawn by working proprietors. (c) Includes a number of small establishments in Queensland from which data were not previously collected.

Mineral production

This section contains details of the output (quantity and value) of principal minerals produced and the metallic content of ores, concentrates, etc.

The statistics shown have been derived from data collected in the annual mining census and in returns to the various State Mines Departments, supplemented in some cases by information made available by the Department of Resources and Energy and from other sources.

For details of the scope of mineral production statistics and their relation to mining industry statistics, and the principles for measuring the output of minerals, *see* Year Book No. 61 and earlier issues.

Quantity of minerals produced

The following tables show particulars of the quantities of principal minerals produced and contents of principal metallic minerals produced during 1983-84 and earlier years. Further data are available relative to all minerals in the annual publication *Mineral Production, Australia* (8405.0).

QUANTITY OF PRINCIPAL MINERALS PRODUCED

Mineral		*1981–82*	*1982–83*	*1983–84*
METALLIC MINERALS				
Bauxite	'000 tonnes	24,690	n.p.	n.p.
Copper concentrate	„	905	n.p.	n.p.
Copper ore	„	23,067	15,864	40,371
Gold bullion (*a*)	kg	21,008	n.p.	n.p.
Iron ore	'000 tonnes	86,786	78,971	76,478
Lead concentrate	„	704	724	n.p.
Lead-copper concentrate	tonnes	31,999	24,968	20,835
Lead-zinc concentrate	„	41,179	40,205	37,932
Manganese ore—				
Metallurgical grade	'000 tonnes	1,198	n.p.	n.p.
Mineral sands—				
Ilmenite concentrate (*b*)	„	1,238	932	1,017
Rutile concentrate	„	220	195	163
Zircon concentrate	„	459	404	412
Nickel concentrate	„	423	483	506
Tantalite-columbite concentrate	tonnes	263	149	92
Tin concentrate	„	24,604	20,424	16,448
Tungsten concentrates—				
Scheelite concentrate	„	3,364	2,307	1,801
Wolfram concentrate	„	2,017	1,502	1,499
Uranium concentrate	„	5,086	n.p.	n.p.
Zinc concentrate	'000 tonnes	1,097	1,206	1,147
COAL				
Black coal—				
Bituminous	'000 tonnes	92,246	98,687	106,664
Sub-bituminous	„	7,172	8,880	9,463
Brown coal—				
For briquettes	„	2,658	1,956	1,900
Other	„	34,904	33,042	31,345
Briquettes	„	993	760	760
OIL AND GAS				
Crude oil (stabilised)	megalitres	22,378	22,069	26,826
Natural gas	gigalitres	11,550	11,654	12 098
Ethane	„	152	169	175
CONSTRUCTION MATERIALS				
Sand	'000 tonnes	28,712	24,312	24,760
Gravel	„	16,088	13,240	14,612
Crushed and broken stone	„	58,478	50,619	55,407
Other (decomposed rock, dimension stone, etc.)	„	34,105	30,066	29,239
OTHER NON-METALLIC MINERALS				
Asbestos (chrysotile)	tonnes	34,293	11,872	—
Brick clay and shale	'000 tonnes	7,882	6,198	6,476
Limestone (including shell and coral)	„	12,790	n.p.	10,333
Salt	„	4,985	n.p.	n.p.
Silica	„	1,895	n.p.	2,060

(*a*) Includes alluvial gold. (*b*) Includes ilmentite from which titanium dioxide is not commercially extractable and beneficiated ilmentite.

CONTENTS OF PRINCIPAL METALLIC MINERALS PRODUCED

Contents of metallic minerals produced		*1981–82*	*1982–83*	*1983–84*
Antimony	tonnes	1,218	768	719
Cadmium	"	2,083	n.p.	2,214
Cobalt	"	3,075	2,833	1,952
Copper	"	259,707	235,302	249,282
Gold	kg	22,328	25,825	33,881
Iron(*b*)	'000 tonnes	54,886	n.p.	n.p.
Lead	tonnes	454,776	n.p.	n.p.
Manganese	"	587,919	n.p.	n.p.
Monazite	"	10,636	10,536	15,207
Nickel	"	81,424	82,945	75,770
Palladium	kg	360	461	506
Platinum	"	65	55	71
Silver	"	887,569	n.p.	n.p.
Sulphur	tonnes	414,551	n.p.	345,094
Tantalite-columbite ($Ta_2O_5+Nb_2O_5$)	kg	129,635	78,975	50,013
Tin	tonnes	12,750	n.p.	8,688
Titanium dioxide (TiO_2)	"	940,946	n.p.	758,233
Tungstic oxide (WO_3)	mtu(*a*)	384,294	n.p.	239,236
Yttrium oxide (Y_2O_3)	kg	17,152	n.p.	15,060
Zinc	tonnes	623,904	n.p.	n.p.
Zirconium dioxide (ZrO_2)	"	299,201	266,565	275,153

(*a*) Metric ton unit (mtu) equals 10 kilograms. (*b*) Excludes iron content of iron oxide not intended for metal extraction. Includes iron contained in iron concentrate.

Value of minerals produced

The following table shows the value of principal minerals produced during 1983–84 and earlier years. Further data are available in the annual publication *Mineral Production, Australia* (8405.0).

VALUE OF PRINCIPAL MINERALS PRODUCED
($'000)

Mineral	*1981–82*	*1982–83*	*1983–84*
METALLIC MINERALS			
Bauxite	n.p.	n.p.	n.p.
Copper concentrate	231,952	264,144	275,385
Copper ore	8,110	1,174	2,242
Gold bullion(*a*)	200,408	n.p.	n.p.
Iron ore	1,131,186	n.p.	n.p.
Lead concentrate	252,136	n.p.	n.p.
Lead-copper concentrate	21,474	n.p.	n.p.
Lead-zinc concentrate	8,445	9,723	9,786
Manganese ore—			
Metallurgical grade	46,136	n.p.	n.p.
Mineral sands—			
Ilmenite concentrate(*b*)	36,610	26,737	37,022
Rutile concentrate	61,758	47,817	42,879
Zircon concentrate	37,526	40,892	43,431
Nickel concentrate	n.p.	n.p.	n.p.
Tantalite-columbite concentrate	11,091	3,971	2,411
Tin concentrate	141,716	133,405	n.p.
Tungsten concentrates—			
Scheelite concentrate	27,612	n.p.	n.p.
Wolfram concentrate	15,607	n.p.	8,891
Uranium concentrate	356,219	n.p.	n.p.
Zinc concentrate	n.p.	220,546	278,040
COAL			
Black coal—			
Bituminous	2,777,212	3,303,340	3,320,769
Sub-bituminous	143,903	205,531	234,686
Brown coal—			
For briquettes	..	..	..
Other	137,138	150,788	135,736
Briquettes	22,754	19,808	18,136

VALUE OF PRINCIPAL MINERALS PRODUCED—*continued*
($'000)

Mineral	*1981–82*	*1982–83*	*1983–84*
OIL AND GAS			
Oil and Gas	*1,779,989*	*2,089,401*	*3,024,008*
CONSTRUCTION MATERIALS			
Sand	110,239	112,502	123,520
Gravel	80,566	75,627	98,606
Crushed and broken stone	325,406	320,563	374,348
Other (Decomposed rock, dimension stone, etc.)	94,148	95,997	91,996
OTHER NON-METALLIC MINERALS			
Asbestos (chrysotile)	14,464	4,766	—
Brick clay and shale	27,029	18,996	21,007
Gems			
Opal(*c*)	45,374	42,131	45,987
Sapphire	22,675	21,566	13,627
Limestone (incl. shell and coral)	58,785	n.p.	54,767
Salt	52,177	n.p.	n.p.
Silica	18,494	18,357	23,466

(*a*) Includes alluvial gold. (*b*) Includes ilmenite from which titanium dioxide is not commercially extractable and beneficiated ilmenite. (*c*) Partly estimated.

Foreign participation of the mining industry in Australia

Summary information on foreign participation in the mining industry in Australia is shown in Chapter 24, Foreign Transactions. More detailed statistics are available in *Foreign Ownership and Control of the Mining Industry, Australia 1982–83* (5317.0) and *Foreign Control in Mineral Exploration, Australia 1975–76* (5323.0).

Mineral exploration (other than for petroleum and oil shale)

Definition

Exploration consists of the search for and/or appraisal of new ore occurrences and known deposits of minerals (including extensions to deposits being worked) by geological, geophysical, geochemical and other methods (including drilling). Exploration for water is excluded. The construction of shafts and adits is included if primarily for exploration purposes. Excluded are mine development activities carried out primarily for the purpose of commencing or extending mining or quarrying operations (including the construction of drives, shafts, winzes, etc. in underground mines, and the preparation of quarrying sites, including overburden removal, for open-cut extraction).

Sources of statistics

The statistics of exploration for minerals *other than petroleum and oil shale* are derived from the annual mineral exploration census conducted by the Australian Bureau of Statistics in each State and the Northern Territory (in New South Wales the census is conducted jointly with the State Department of Mineral Resources).

Classification

The data obtained in the mineral exploration census are divided into the following categories:

(a) *Private exploration on production leases*—relates to exploration carried out on the production lease by privately-operated mines currently producing or under development for the production of minerals.

(b) *Other private exploration*—relates to exploration carried out by private enterprises on areas covered by exploration licences, authorities to enter, authorities to prospect and similar licences and authorities issued by State Governments for exploration of minerals. Also included is exploration by private enterprises which is not directly connected with areas under lease, licence, etc,

(c) *Exploration by government*—relates to exploration of minerals carried out by Federal and State Government Departments, local government authorities and business undertakings operated by those departments or authorities.

Expenditure, metres drilled

The following table shows expenditure and metres drilled on private mineral exploration other than for petroleum and oil shale in Australia during the last six years.

PRIVATE MINERAL EXPLORATION (OTHER THAN FOR PETROLEUM AND OIL SHALE)

	1978–79	*1979–80*	*1980–81*	*1981–82*	*1982–83*	*1983–84*
Expenditure ($'000)—						
On drilling	50,729	72,408	126,088	141,872	89,723	92,647
Other	131,780	213,722	344,401	433,700	348,188	323,739
Australia	**182,509**	**286,130**	**470,489**	**575,572**	**437,911**	**416,386**
Metres drilled ('000)—						
Drilled-core	565	862	1,156	1,201	871	1,080
Drilled-non-core	1,763	2,055	2,808	2,824	1,882	2,106
Australia	**2,328**	**2,917**	**3,965**	**4,025**	**2,752**	**3,186**

Oil shale exploration

Statistics of exploration for oil shale are derived from an annual exploration census conducted by the Australian Bureau of Statistics.

Exploration consists of the search for and/or appraisal of new ore occurrences and known deposits of oil shale (including extensions to deposits being worked) by geological, geophysical, geochemical and other methods (including drilling). The construction of shafts and adits is included if primarily for exploration purposes. Excluded are mine development activities carried out primarily for the purpose of commencing or extending mining operations (including the construction of drives, shafts, winzes, etc. in underground mines, and overburden removal, for open-cut extraction).

In 1983–84 expenditure in Australia on private exploration for oil shale amounted to $22,298,000 with 14,000 metres being drilled.

Petroleum exploration

Source of statistics

These statistics of expenditure on petroleum exploration have been obtained by the addition of values collected in a quarterly survey conducted by the Australian Bureau of Statistics. Other data shown were collected by the Bureau of Mineral Resources, Geology and Geophysics. Further information relating to petroleum exploration is published by the Australian Bureau of Statistics in its annual publication *Mineral Exploration, Australia* (8407.0) and by the Bureau of Mineral Resources, Geology and Geophysics in *The Petroleum Newsletter* (issued quarterly) and *The Australian Mineral Industry Annual Review.*

Scope

Petroleum exploration consists of the search for and/or appraisal of deposits of crude oil and/or natural gas and natural gas liquids by geological, geophysical, geochemical, and other exploration methods, including drilling. Included in the expenditure are the costs of drilling exploratory oil and/or gas wells and the testing of such wells. Also included are the costs of access roads, site construction, permits, licences and similar fees, relevant office buildings and furniture, transportation equipment, storage facilities, plant and equipment, and review work where these are undertaken primarily for purposes of exploration for deposits of petroleum. Details of developmental oil and/or gas wells are excluded.

Operations

The following table shows particulars of expenditure, and wells and metres drilled in petroleum exploration in recent years.

PETROLEUM EXPLORATION

		1981–82	1982–83	1983–84
Expenditure—				
Private	$'000	803,983	927,405	823,692
Government	$'000	6,797	10,188	n.a.
Total	$'000	810,781	937,592	n.a.
Wells (a)—				
Drilled (i.e. those which reached final depth)—				
As oil producers	No.	21	36	43
As gas producers	No.	38	42	27
Plugged and abandoned	No.	99	143	141
Total	No.	158	221	211
Average final depth of wells drilled	m	1,999	2,047	1,976
Drilling still in progress at 31 December (uncompleted holes)	No.	17	14	14
Wells drilled or drilling over 3,000 metres	No.	18	31	39
Metres drilled (a)—				
Completed wells	m	296,818	426,208	390,050
Uncompleted holes	m	25,566	26,036	20,993
Total	m	322,384	452,244	411,043

(*a*) *Source*: Bureau of Mineral Resources, Geology and Geophysics. Data relates to years ended 31 December.

Mineral processing and treatment

The extraction of minerals from ore deposits, as in mining and quarrying, is only a part of mineral technology, as few minerals can be directly used in the form in which they are mined. In most cases minerals must undergo considerable processing and treatment before utilisation. The sectors of the economy which carry out this work are classified for statistical purposes to Manufacturing Industry (*see* Chapter 17, Manufacturing and Internal Trade).

Principal products

The following table shows particulars of the production of certain important manufactured products of mineral origin during recent years.

PRODUCTION (a) OF PRINCIPAL MANUFACTURED PRODUCTS OF MINERAL ORIGIN

Commodity		*1981–82*	*1982–83*	*1983–84*
METALS(*b*)				
Non-ferrous—				
Alumina	'000 tonnes	6,651	6,701	8,030
Refined aluminium	tonnes	380,457	403,917	617,921
Blister copper(*c*)	"	177,344	172,163	182,090
Refined copper	"	163,052	172,456	166,429
Lead bullion (for export)(*c*)	"	180,675	179,462	186,561
Refined lead	"	207,242	212,176	190,121
Refined zinc	"	301,266	288,250	299,738
Refined tin	"	3,617	2,898	2,937
Ferrous—				
Pig iron	'000 tonnes	6,607	4,990	5,258
Steel ingots	"	7,260	5,392	7,614
Precious—				
Refined gold(*d*)	kg	17,773	25,784	30,661
Refined silver	"	325,105	303,889	273,788
FUELS				
Coal products—				
Metallurgical coke	'000 tonnes	4,283	3,338	3,181
Brown coal briquettes	"	993	760	746
Petroleum products—				
Diesel-automotive oil	'000 tonnes	6,445	6,540	6,405
Industrial fuel and marine fuel	"	775	721	649
Fuel oil for burning	"	3,285	2,810	6,012
Automotive petrol	mil. litres	14,375	14,845	14,427

PRODUCTION (a) OF PRINCIPAL MANUFACTURED PRODUCTS OF MINERAL ORIGIN—*continued*

Commodity		*1981-82*	*1982-83*	*1983-84*
BUILDING MATERIALS				
Clay bricks	millions	2,234	1,694	1,771
Portland cement	'000 tonnes	6,136	5,350	4,655
Plaster of paris	"	480	n.p.	n.p.
Plaster sheets	'000 sq m	63,768	51,229	60,313
CHEMICALS				
Sulphuric acid	'000 tonnes	2,039	1,734	1,706
Caustic soda	tonnes	n.p.	n.p.	n.p.
Superphosphate(e)	'000 tonnes	3,464	2,877	2,668

(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 pig iron and steel ingots. *Source*: Bureau of Mineral Resources, Geology and Geophysics (non-ferrous and precious metals only). (c) Metallic content. (d) Newly-won gold of Australian origin. (e) Includes double and triple superphosphate and ammonium phosphate expressed in terms of single superphosphate, i.e. 22% P_2O_5 equivalent.

Overseas trade

Exports and imports

For particulars of the quantities and values of the principal minerals and products exported from and imported into Australia during recent years, *see* Chapter 24, Foreign Transactions.

Considerable quantities of metallic ores, concentrates, slags, and residues are exported from Australia for refining overseas. The following table shows selected items exported during 1983 and their principal metallic content as estimated by assay.

PRINCIPAL METALLIC CONTENTS OF SELECTED ORES AND CONCENTRATES ETC. EXPORTED FROM AUSTRALIA, 1984

	Metallic contents—estimated from assay							
Ores and concentrates, etc.	*Copper*	*Lead*	*Zinc*	*Tin*	*Iron*	*Tungstic oxides*	*Gold*	*Silver*
	tonnes	tonnes	tonnes	tonnes	'000 tonnes	tonnes	kg	kg
Copper concentrate	59,321	—	—	—	—	—	10	1,746
Blister copper	5,220	—	—	—	—	—	191	22,441
Copper matte, slags, etc.(a)	2,499	4,289	—	—	—	—	77	4,853
Lead concentrate	3,018	65,960	1,253	—	—	—	720	124,072
Lead bullion	—	201,104	—	—	—	—	57	354,334
Lead slags and residues	—	2,626	—	6	—	—	16	2,193
Zinc concentrate	69	7,904	422,424	—	—	—	—	19,688
Zinc slags and residues	—	—	6,457	—	—	—	—	—
Tin concentrate	—	—	—	6,144	—	—	—	—
Iron ore—								
Pellets	—	—	—	—	1,141	—	—	—
Fines	—	—	—	—	28,784	—	—	—
Lump	—	—	—	—	22,277	—	—	—
Scheelite concentrate	—	—	—	—	—	n.a.	—	—
Wolfram concentrate	—	—	—	—	—	1,117	—	—
Total metallic content	**70,127**	**281,883**	**430,134**	**6,150**	**52,202**	**n.a.**	**1,071**	**529,327**

(a) Includes copper matte, copper slags and residues and copper-lead dross and speiss.

REVIEW OF RECENT DEVELOPMENTS IN THE AUSTRALIAN MINERAL INDUSTRY

(*Source:* Bureau of Mineral Resources, Geology and Geophysics)

Major developments in the Australian mineral industry during 1984 are reviewed briefly in subsequent parts of this section. Additional information on developments in the industry is available in *Australian Mineral Industry Annual Review* 1983 published by the Bureau of Mineral Resources, Geology and Geophysics. That publication contains comprehensive reviews of mineral commodities of importance to the Australian economy, as well as a general review of the industry's performance during the year. The *Australian Mineral Industry Quarterly*, Volume 37, Number 4, details Australia's identified mineral resources, 1984.

General Review of 1984

The gross domestic product (GDP) of Australia in 1983–84 was $196,581 million, of which an estimated $11,300 million was generated by the mineral industry, excluding smelting and refining. If smelting and refining were included, an estimated $2,500 million could be added to this figure, thus making the mineral industry the largest primary sector contributor to the GDP. Australia's export trade increased substantially in both current and constant price terms to a new record level. Japan, the USA, the EEC and the UK, were the main markets for mineral commodities. The USA regained its ranking of second after Japan which it had lost the previous year, displacing the UK from second to fourth place after the EEC.

The ex-mine value of mineral products in Australia in 1983 reached a new peak of $10,570 million, $660 million higher than in 1982. More than half of this increase resulted from both higher output and prices for crude oil, and a significant contribution was made by the other energy minerals, natural gas, and coal. Performance of the metallic minerals group was subdued; gains made by bauxite, copper, gold and lead were offset by a decline in output of iron ore, mineral sands, nickel, tin, zinc, and uranium, resulting in a net fall of about $100 million. Diamonds contributed $65 million to the value of mine output in the first year of their production.

Imports—1984

The values of imports have been dominated by crude oil in the last few years, accounting for between 80 per cent and 90 per cent of Australia's mineral import bill. In 1984 imports of crude oil fell by 6 per cent or about $100 million to $1,681 million, resulting in a total mineral import bill of $2,063 million. This is marginally down on the $2,086 million recorded for 1983. Other significant mineral imports included gem diamonds, gold, phosphate, potassium fertilisers, and elemental sulphur. Imports of mineral primary products accounted for 8.0 per cent of the total value of merchandise imports compared with 9.6 per cent in 1983. Australia's mineral balance of trade was a record $9,161 million in 1984, compared with $7,609 million in 1983.

Exports—1984

The value of mineral exports rose by 15.8 per cent to $11,224 million in 1984 compared to $9,695 million in 1983. Minerals to show gains on their 1983 levels included alumina, aluminium, black coal, gold, iron ore, nickel, crude oil, uranium and zinc. Declines were recorded in copper, lead, silver, tin and LPG among the major minerals.

Black coal remains the largest single export earner, accounting for $3,911 million or about 35 per cent of the total value of mineral primary products exported. Iron ore was the second largest with a value of $1,618 million (an increase of 3 per cent) followed by alumina which increased by 8 per cent to $1,276 million. These three minerals account for nearly 61 per cent of the total value of mineral primary products exported. A significant contribution was also made by aluminium, copper, gold, lead, uranium, zinc, crude oil and LPG.

Pattern of mineral trade—1984

During 1984 Australia exported metals and minerals to more than 100 countries. Japan accounted for 40.3 per cent of these exports by value, a decline from the 42.4 per cent recorded in 1983. Principal mineral products exported to Japan included black coal, iron ore, alumina, aluminium, copper and mineral sands.

The EEC accounted for 15.4 per cent (including 4.9 per cent to the UK) of Australia's mineral exports. Major items comprised black coal, copper, iron ore, uranium and zinc. The USA accounted for a further 12.1 per cent of the total consisting mainly of alumina, bauxite and nickel.

Bauxite, Alumina and Aluminium

In 1984, production of bauxite increased by 32 percent to 32.18 million tonnes, while aluminium production increased by 58 percent to 757,798 tonnes. Australia was again the world's largest producer of bauxite and alumina.

The commissioning of the new alumina refineries at Wagerup and Worsley, W.A., commenced in February 1984. Initial rated capacities are 500,000 tonnes per year, and 1,000,000 tonnes per year respectively.

Work on the Portland, Victoria, smelter (initial capacity to be 132,000 tonnes per year) recommenced in November 1984 and the first pot-line is expected to be completed by the end of 1986.

Expansion of the Kurri Kurri, N.S.W., aluminium smelter was completed in 1984, increasing total capacity from 90,000 to more than 140,000 tonnes per year. Start-up date will depend on international aluminium prices. Comalco's aluminium smelter at Boyne Island, near Gladstone, Qld, is supplied with alumina from the nearby Queensland Alumina Ltd (QAL) refinery. The smelter has a capacity of 206,000 tonnes per year. The rated capacities of the other three Australian aluminium smelters, at Tomago, N.S.W., Point Henry, Vic., and Bell Bay, Tas., are 220,000, 165,000 and 117,000 tonnes per year respectively. Tomago uses alumina from the Northern Territory and Queensland, Point Henry uses Western Australian alumina, and Bell Bay obtains its alumina from Queensland.

Copper

A summary of the copper mining industry in Australia 1953 to 1975 and the sufficiency of present ore reserves was published in the *Australian Mineral Industry Quarterly*, Vol. 30, No. 1.

In 1984 mine production of copper decreased to 235,811 tonnes. Western Mining Corporation Holdings Ltd (WMCH) announced that the results of a feasibility study, commissioned for the Olympic Dam Project, S.A., should be available in 1985. The study involved plans for initial staged production rates of about 55,000 tonnes per year of copper, 2,000 tonnes per year of U_3O_8 (yellowcake) and 3,000 kg per year of gold, beginning in 1987 (gold) and 1988 (copper/uranium).

Exploration continued at a number of prospects including the WMCH Nifty prospect in the Throssell Ranges (W.A.), about 200 km east-southeast of Marble Bar, and the Scuddles copper-zinc project (W.A.), managed by E. Z. Industries.

Iron

A summary of growth of the Australian iron ore industry 1965 to 1975 was published in the *Australian Mineral Industry Quarterly*, Vol. 29, No. 1.

Production of iron ore in 1984 increased to 89.0 million tonnes, 28 per cent higher than in 1983. Ore stocks were considerably reduced as the recovery in demand outstripped production. Exports of iron ore and iron ore pellets increased by 15 per cent to 85.5 million tonnes valued at $1,615 million. Australia was the world's third-largest producer but was displaced by Brazil in 1984 as the largest exporter.

Production at Cockatoo Island, Yampi Sound, ceased at the end of the year with the exhausting of economic resources but shipments are expected to continue for a further two years from stockpiled ore.

Possibilities for increased iron ore and iron and steel trade with China emerged in 1984 and an agreement on economic co-operation in the iron and steel industry was signed by Australia and China in August 1984. China Metallurgical Import and Export Corporation and Hamersley Iron Pty Ltd also agreed in August to study the feasibility of joint development of an iron ore mine in the Channar area, 20 kilometres east of Paraburdoo to meet additional Chinese import requirements of iron ore.

Silver, lead and zinc

Mine production of lead (446,000 tonnes) and zinc (667,000 tonnes) declined in 1984 because of industrial disputation at some of the major mines in the first half of the year.

Production of primary refined lead increased slightly in 1983. Lead metal production including secondary was 217,689 tonnes and zinc metal production including secondary was 306,562 tonnes.

Detailed exploration of a number of deposits continued in 1984. These included Hilton, Lady Loretta, Thalanga, Liontown and Conjuboy, all in Queensland; Woodcutters, N.T.; Golden Grove and Blondevale (Lennard Shelf) in W.A.; Benambra, Victoria and Hellyer in Tasmania.

Black coal

Raw black coal production in 1984 was a record 139.1 million tonnes, 17 per cent higher than in 1983. The output of saleable coal rose by 16 per cent to the record level 114.8 million tonnes. Domestic consumption rose to the record level of 39.8 million tonnes in 1984, mainly due to the growth in use by both the electricity and steel industries. Exports rose by 25 per cent to 75.9 million tonnes in 1984 and the value of exports rose to $3,905 million. Of total exports 40.9 million tonnes were shipped to Japan. Australia was the world's leading coal exporter in 1984.

Demand for steaming coal on the international market remained high. As a result Australian exports of steaming coal rose from 18.3 million tonnes in 1983 to 28.8 million tonnes in 1984. At the same time, there occurred a growth in the exports of coking coal to 47 million tonnes.

Papers dealing with the Australian coal industry have been published in the *Australian Mineral Industry Quarterly*, Vol. 31, No. 1 and Vol. 34, No. 2.

Petroleum

At the end of 1984 there were 55 fields producing stabilised crude oil. In 1984, production of crude oil rose by 9.1 per cent, and the production of natural gas rose by 13.2 per cent.

Total refinery input declined by 3.8 per cent although the proportion of total input from indigenous sources increased from 73 per cent in 1983 to 76 per cent in 1984. Consumption of automotive gasoline (motor spirit) increased by 2.4 per cent. Consumption of all other major petroleum products except heating oil and industrial and marine diesel fuel also increased. The quantity of imported crude oil, enriched crude oil, and other refinery feedstock increased by 2.4 per cent compared with that in 1983, and its value increased by 1.1 per cent from $2,223 million to $2,247 million. Export of all petroleum products rose by 59.4 per cent in value to $2,057 million.

Exploration wells drilled increased from 211 in 1983 to 264 (221 onshore, 43 offshore) in 1984, and total metres drilled for exploration increased from 411,043 m in 1983 to 516,815 m in 1984, an increase of 25.7 per cent. Geophysical exploration also increased during 1984. Offshore exploration resulted in one oil, three gas and three oil and gas discoveries; onshore exploration produced 13 oil, 14 gas, and five oil and gas discoveries. Onshore development drilling continued in: Cooper/Eromanga Basins (S.A. and Queensland) (56 wells); Amadeus Basin (N.T.) (6 wells); Barrow Island (W.A.) (4 wells); Woodada (W.A.) (2 wells); Glentulloch, Grafton Range and Westgrove (Queensland) fields (one well each field). In the offshore, except for five wells in the North Rankin Gasfield, all development drilling was restricted to the Gippsland Basin in the West Kingfish, Cobia, Fortescue and Flounder fields.

New development projects included the completion of the first phase of the Northwest Shelf gas project by the Joint Venture participants and gas was supplied to the Perth market. This included the construction of a submarine pipeline linking the North Rankin 'A' platform with the onshore facilities. The first shipment of condensate from the gas stream was loaded at Withnell Bay in late 1984. The small Sundown and Blina oil discoveries commenced production via a short pipeline from the fields to the Great Northern Highway and thence by road tanker transport to Derby. An oil production licence was granted in May for the Mt Horner oilfield in the Perth Basin. Following the discovery of oil in the Jackson area of the Cooper/Eromanga Basins of Queensland in 1981 and 1982, a pipeline was laid to Moonie in 1983 and production commenced in 1984.

The Silver Springs LPG scheme began commercial production in late 1984 from the Boxleigh/Silver Springs fields and from the Sirrah field during 1985. The Kincora field LPG plant is due for completion about March 1985. Depending on successful negotiations with industry sources at Gladstone, the Denison Trough gas fields could be developed and a 600 kilometre pipeline, including gathering systems, built to Gladstone on the east coast.

In the Northern Territory, following on from the supply of natural gas from the Palm Valley fields to Alice Springs power station, there is a proposal under consideration to build a 1,500 kilometre pipeline from the Amadeus Basin north to fuel a new power station in Darwin and a possible spurline to an alumina plant along the coast on the Gove Peninsula. Since the completion of production facilities at Mereenie the Territory's first commercial production of oil was transported by road tanker to Alice Springs. A 300 kilometre pipeline is proposed between Mereenie and Alice Springs.

Economic and sub-economic demonstrated resources of crude oil increased marginally to 289.00 gigalitres and recoverable resources of natural gas increased by 0.05 per cent from 1,456 billion $(10^9)m^3$ to 1,521 billion m^3. Expenditure on petroleum exploration decreased 11 per cent to 823.7 million in 1984.

Nickel

A summary of the growth of the Australian nickel industry was published in the *Australian Mineral Industry Quarterly*, Vol. 28 No. 4.

Mine production of nickel in ore and concentrates was 76,889 tonnes in 1984. Australia was the third largest world producer after USSR and Canada. Concentrates from Kambalda, Agnew and Mount Windarra are smelted at the Kalgoorlie nickel smelter. Some of the matte produced is railed to the Kwinana nickel refinery to be refined to nickel metal and the remainder is exported. Nickel-laterite ore mined at Greenvale, Queensland, is treated at the Yabulu nickel treatment plant to produce nickel oxide sinter for export.

Mineral sands

The history of the mineral sands industry is presented in the *Australian Mineral Industry Quarterly*, Vol. 25, No. 1.

Australia is still the world's largest producer and exporter of natural rutile, ilmenite, zircon and monazite. Output of concentrates increased substantially in 1984; rutile production totalled 181,481 tonnes, ilmenite 1,159,756 tonnes, zircon 454,591 tonnes and monazite 16,707 tonnes.

Diamonds

Commercial production of diamonds from the alluvial deposits in the Upper Smoke creek and Limestone Creek alluvials and from the scree deposits overlying the Ak-1 Kimberlite pipe at Argyle commenced in January 1983; the alluvial and scree deposits will have been mined out by 1985. Production for the year was 5.69 million carats from 1.47 million tonnes of ore. The diamonds comprise approximately 10 per cent gem, 50 per cent cheap gem, and 40 per cent industrial quality. Production from the AK-1 pipe was planned to start in late 1985. When full production is reached the Argyle mine will become the world's largest producer of diamonds.

Uranium

Preliminary estimates of production of uranium in Australia in 1984 amounted to 5,677 tonnes of yellowcake (4,390 tonnes contained U) 36.7 per cent greater than in 1983. Exports for 1984 were 3,308 tonnes of yellowcake (preliminary estimates only).

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