Oil shale

Australia's demonstrated resources of oil shale amount to over 57 billion tonnes, from which 3.8 billion m^3 of shale oil is recoverable. Most of these resources are contained in narrow but deep Tertiary basins near the coast in eastern Queensland and include the large **Condor**, **Yaamba**, **Rundle**, **Stuart**, **Nagoorin** and **Lowmead** deposits between Bowen and Bundaberg.

Inferred resources of shale oil are very much greater and amount to 40.6 billion m^3. Together with the large demonstrated **Julia Creek** deposit they are contained in a thin but extensive marine formation of Cretaceous age that extends south from the Gulf of Carpentaria and underlies much of north-western Queensland.

Shale oil was last produced in Australia in 1952, at Glen Davis west of Sydney. Presently all Australian resources of shale oil are classified as subeconomic; however, research and development into extraction technology are continuing.

Uranium

Australia contains nearly 30% of the Western world's 'low cost' resources of uranium. These resources, estimated at around 460 000 t in 1986, occur mainly in the Alligator Rivers area of the Northern Territory and at **Olympic Dam** in South Australia.

As a producer of uranium Australia, with 4150 t in 1986, ranks fourth behind Canada (11 700 t), U.S.A. (5200 t) and South Africa (4600 t), which together accounted for nearly two-thirds of Western world production (37 110 t). Australian production in 1986 was from only two mines.

The earliest exploited uranium deposits in Australia, at Radium Hill and Mount Painter (S.A.), were worked for radium from about 1910 to 1931. Stimulated by military requirements the Commonwealth Government encouraged exploration, resulting in the discovery of Rum Jungle (N.T.) in 1949, Mary Kathleen (Qld) in 1954 and the small South Alligator River deposits.

Government-owned Rum Jungle, 40 km south of Darwin, became Australia's first major uranium mine, producing from 1954 to 1971; Radium Hill was mined again from 1949 to 1961. Mary Kathleen was mined from 1956 to 1963 and several mines were worked in the South Alligator River valley. All production was exported.

The withdrawal of the U.S.A. and U.K. from the market in the 1960s led to declining production and exploration in Australia. The easing of export controls in 1967, however, and a growing need overseas for uranium for nuclear power generation resulted in renewed exploration and major discoveries in the early 1970s.

Ranger, **Nabarlek**, **Koongarra** and **Jabiluka** were discovered, confirming the existence of a world-scale uranium province in the Alligator Rivers region. New discoveries were also made—at **Yeelirrie** and **Lake Way** (W.A.), **Beverley** and **Honeymoon** (S.A.), and **Ben Lomond**, **Westmoreland** and Maureen (west of Tully) in north Queensland. In 1975 an enormous deposit of copper and uranium (with gold and silver) was found at **Olympic Dam** in central South Australia.

Mary Kathleen reopened in 1976 and closed finally in 1982, upon fulfillment of sales contracts. Of the newer discoveries only **Ranger** and **Nabarlek** have so far been mined though development of the **Olympic Dam** deposit is well advanced and production is expected to commence in the latter half of 1988.

The entire Nabarlek orebody was mined out in 1979 and on-site processing of the stockpiled ore is expected to be completed by 1990. Exports from Nabarlek commenced in 1980. The nearby Ranger mine, which began operating in 1981, is now the Western world's second largest uranium mine, with resources sufficient for a mine life of 30–40 years at the current production rate of 3000 t per year.

Uranium ore is mined and milled to produce uranium oxide, or 'yellowcake', which requires further treatment to upgrade it into a usable fuel for nuclear power stations, the principal use of uranium. Australian processing of uranium ore is confined to the production of yellowcake, all of which is exported under Government-controlled contracts to Japan, South Korea, U.S.A., West Germany, Sweden, Belgium and the U.K.

Australia has no nuclear power stations and domestic consumption of uranium is limited to minor quantities used in medical, industrial and scientific applications.

The Ranger opencut uranium mine (N.T.)

Industrial minerals

Industrial minerals generally comprise the non-metallic, non-fuel minerals. While many industrial minerals and rocks are used for the chemical elements they contain, for example phosphate rock and salt, others are used for their physical properties—as fillers in plastics and extenders in paints or as abrasives, weighting agents and absorbents. Thus industrial minerals and rocks are used in a wide range of products and industrial processes.

On the map 'Minerals other than Fuels' and in the following text industrial minerals are grouped according to their principal uses:

- gemstones;
- building and construction minerals;
- chemical and fertiliser minerals; and
- other industrial minerals, including clays and mineral sands.

Strict product specifications notwithstanding, industrial minerals often have low unit ex-mine values because they tend to be relatively common and are generally mined in simple, shallow, low cost surface operations. For some commodities (such as construction sand and aggregate) there is little scope for adding commerical value to the minerals as they can be used virtually unprocessed except for washing, crushing and screening.

The low unit values limit the distance over which products can be economically moved to market. Therefore the distribution of limestone, dolomite and some clay mining operations, for example, reflects not only geological factors (natural occurrence) but also economic factors such as market proximity and transport costs.

Some industrial commodities require beneficiation and other forms of chemical and/or physical modification, such as fine-grinding, all of which can substantially increase product values.

The high cost of transporting bulky, low value commodities has restricted export opportunities for many industrial minerals. Salt and gypsum, however, are notable exceptions because they are produced very near to the coast. Conversely, Australia imports a large proportion of its requirements of industrial minerals such as mica, felspar, fluorspar and barite. Even though deposits of these minerals occur in Australia they are often too remote from markets to make then competitive with imports.