



RECENT DEVELOPMENTS IN AUSTRALIA'S URANIUM MINING INDUSTRY

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Abstract

Uranium is produced at two mining/milling operations in Australia — Ranger in the Alligator Rivers Region of the Northern Territory, and Olympic Dam in South Australia. In 1996, Ranger produced 4138 tonnes (t) U_3O_8 from stockpiled ore mined from Ranger No. 1 Orebody. The capacity of the Ranger mill is being expanded to 5000 tonnes per annum (tpa) U_3O_8 to coincide with the commencement of mining from No. 3 Orebody in mid-1997. The Olympic Dam copper-uranium-gold-silver deposit is the world's largest deposit of low cost uranium. The operation currently has an annual production of 85 000 t copper, 1700 t U_3O_8 and associated gold and silver. WMC Ltd proposes to expand annual production to 200 000 t copper and approximately 4600 t U_3O_8 by end of 1999. The environmental impact of the expansion is being assessed jointly by both Commonwealth and South Australian Governments. A draft Environmental Impact Statement (EIS) was released in May. Since its election in March 1996, the Liberal/National Party Coalition Government has made a number of changes to the Commonwealth Government's policies relating to uranium mining, including removal of the former Government's "three mines" policy, and relaxation of the guidelines for foreign investment in Australian uranium mines. These changes, together with an improved outlook for the uranium market, have resulted in proposals to develop new mines at Jabiluka (Northern Territory), Kintyre (Western Australia) and Beverley (South Australia). Energy Resources of Australia Ltd proposes to develop an underground mine at Jabiluka with the ore to be processed at Ranger mill. Initial production will be 1800 tpa U_3O_8 which will increase to 4000 tpa U_3O_8 by the 14th year. The draft EIS was released for public comment in October 1996, and the final EIS is to be released in June 1997. Canning Resources Ltd proposes to mine the Kintyre deposit by open cut methods commencing in 1999 with an annual production of 1200 tpa U_3O_8 . Heathgate Pty. Ltd. proposes to develop an in situ leach mining operation at the Beverley deposit with capacity to produce 900 tpa U_3O_8 , commencing in the year 2000. Improved market conditions and recent changes to Commonwealth Government policies on uranium mining have encouraged Australian companies to commit to the expansion of existing operations and the development of new uranium mines. Australia's annual production is likely to increase from its present level of 5867 t U_3O_8 (for 1996) to approximately 12 700 t U_3O_8 by the year 2000.

1. INTRODUCTION

Major expansions in production are in progress at both the Ranger and Olympic Dam uranium mining operations. Recent changes in Commonwealth Government policies on uranium mining and milling, together with an improved outlook for the uranium market, have resulted in a number of proposals to develop new mines. These policy changes are briefly outlined. The expansions at Ranger and Olympic Dam operations, and the proposals for new uranium mines are described. These will result in major increases in Australia's uranium production by the year 2000.

2. CHANGES TO COMMONWEALTH GOVERNMENT POLICIES RELATING TO URANIUM MINING AND MILLING

Following its election in March 1996, the Liberal/National Coalition Government removed the former Government's "three mines" policy which restricted the development of new uranium mines in Australia. The current Government's policy is to approve new uranium

mines and exports provided they comply with strict environmental, heritage and nuclear safeguards requirements. Where Aboriginal interests are involved, the Government is committed to ensuring full consultation with the affected Aboriginal communities.

Uranium export contracts remain subject to Government approval but are no longer scrutinised for pricing purposes. The previous Government had required exporters to demonstrate that their prices were comparable to those received by other suppliers in the various markets.

In November 1996, the Treasurer announced changes in the Foreign Investment Review Board guidelines relating to foreign investment in Australian uranium mining. "The Government has decided that the foreign investment policy in relation to the uranium sector will be the policy that currently applies to the mining sector generally. This means that foreign investment above the notification thresholds in the uranium sector will be subjected to the well established contrary to national interest test and that no special investment restrictions will apply. The establishment of a new mine involving investment of \$10 million or more, or the acquisition of a substantial interest in an existing uranium mining business valued at \$5 million or more, requires prior approval and no objections will be raised unless the proposal is considered contrary to the national interest.

3. MINING OPERATIONS

Uranium oxide is currently produced at two mining/milling operations — Ranger and Olympic Dam. Australia's total production for 1996 was a record high of 5867 tonnes (t) U_3O_8 (4975 t U) of which Ranger produced 4138 t U_3O_8 and Olympic Dam produced 1729 t U_3O_8 . Total production for 1996 was 34% higher than 1995 as a result of the return to continuous milling and ore processing at Ranger during 1996, and production increases at the Olympic Dam operations following completion of the second optimisation project in mid-1995 and improved recovery rates. Australia is now the world's second largest uranium producer after Canada.

3.1. Ranger

Ranger is an unconformity-related deposit which occurs within the Palaeoproterozoic metasediments of the Pine Creek Geosyncline in the Alligator Rivers region of the Northern Territory (Fig. 1). Energy Resources of Australia Ltd (ERA) commenced operations at Ranger in 1991. Ranger No. 1 Orebody was completely mined out in December 1994 and stockpiled ore is sufficient to maintain milling operations through to 1999. The pit is now used as a repository for mill tailings.

The company has received approval from the Northern Territory Department of Mines and Energy to mine the Ranger No. 3 Orebody. Development work for the open cut commenced in late 1996 and production from this deposit is scheduled to commence in mid-1997. No. 3 Orebody has proven plus probable reserves of 19.9 million tonnes ore with average grade 0.28% U_3O_8 , containing 55 700 t U_3O_8 . The orebody is within the Ranger Project Area and was included in the original Environmental Impact Statement (EIS) for the Ranger Project which was submitted in 1975.

The capacity of the Ranger mill is currently being expanded from its previous level of 3500 tonnes per annum (tpa) U_3O_8 to 5000 tpa U_3O_8 . The tonnages of ore processed will increase

from the previous level of 1.3 million tonnes per annum to 2.0 million tonnes per annum. The mill expansion is scheduled to be completed by mid-1997 to coincide with the commencement of mining at No. 3 Orebody. In the event that ERA's current proposal for the development of Jabiluka is approved (permitting processing of Jabiluka ore at Ranger mill), capacity of the mill would be increased further to approximately 6000 tpa U_3O_8 .



FIG. 1. Uranium deposits and prospects in Australia.

3.2. Olympic Dam

The Olympic Dam copper-uranium-gold-silver deposit is the world's largest deposit of low-cost uranium. It contains in excess of 30 million tonnes of copper metal, 1 million tonnes of uranium oxide and 1200 tonnes of gold [1].

The orebody occurs within the hematite-rich Olympic Dam Breccia Complex which is a large hydrothermal breccia complex within the Roxby Downs Granite [1,2,3] (Figs. 2,3). The intrusive ages for the Roxby Downs Granite were determined from U-Pb zircon ages to be 1588 ± 4 Ma, i.e. Mesoproterozoic [4]. The deposit is unconformably overlain by approximately 300 metres of undeformed Neoproterozoic and Cambrian marine sedimentary rocks.

There is a variety of breccia types which range from granite breccias through hematite-granite breccias to hematite-rich breccias. Ore grade copper-uranium-gold-silver mineralisation forms a large number of ore zones mostly within hematite breccias.

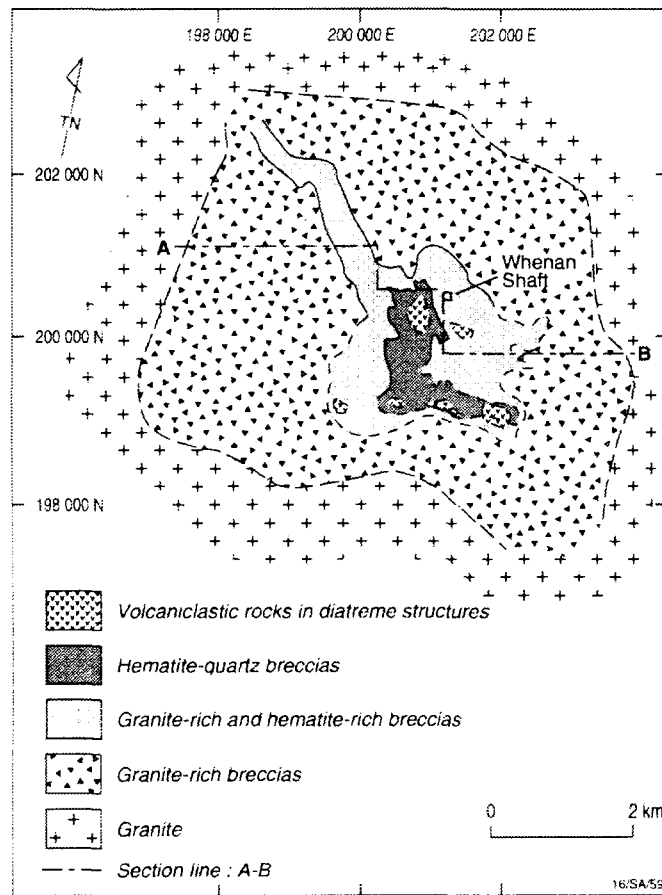


FIG. 2. Simplified geological plan of the Olympic Dam Breccia Complex (modified after Reeve and others, 1990).

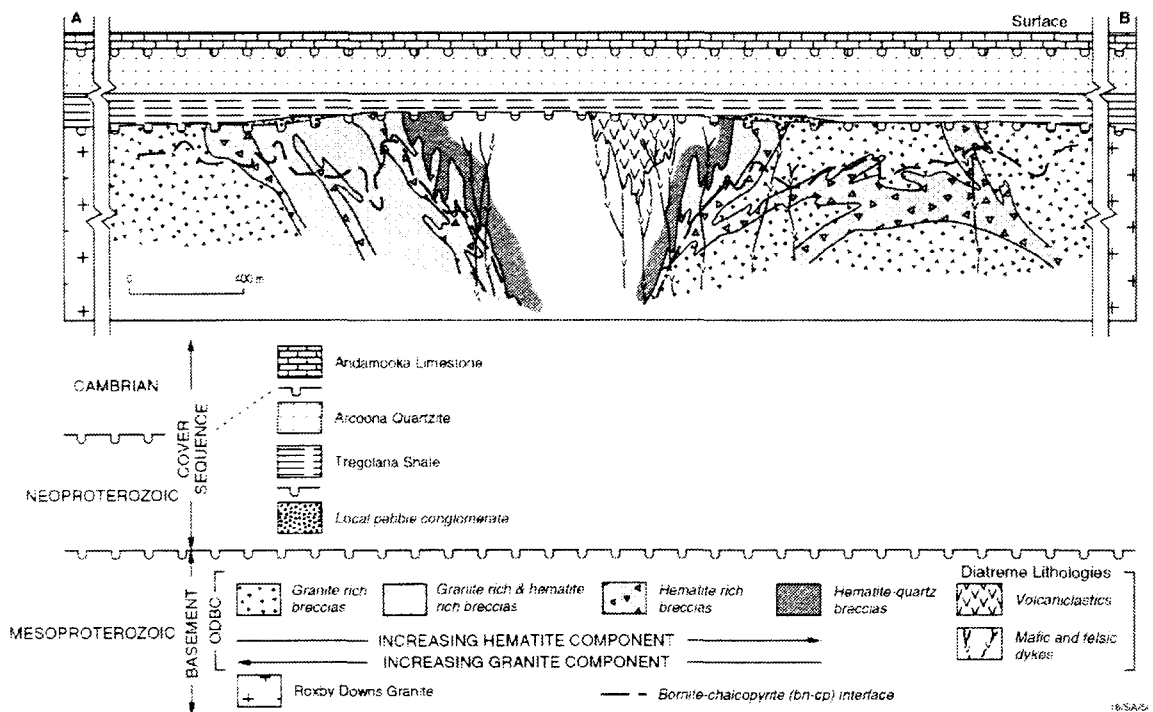


FIG. 3. Simplified geological cross-section of the Olympic Dam Breccia Complex (modified after Reeve and others, 1990) Refer Fig. 2 for location of section A-B.

The principal copper sulphide minerals are chalcopyrite, bornite and chalcocite. Throughout the deposit there is a well developed zonal distribution of the principal copper sulphide minerals (Fig. 3). Chalcopyrite (and pyrite) occur in the deeper and outer parts of the orebody whereas bornite and chalcocite occur in the upper and more central parts. The boundary between bornite-chalcocite mineralisation and chalcopyrite mineralisation (the bn-cp interface) is usually sharp [3]. Grades of 4% to 6% Cu are common in the bornite-chalcocite zones, whereas the chalcopyrite zones are usually less than 3% Cu [3].

Uranium occurs in association with all copper mineralisation. The predominant uranium mineral is uraninite (pitchblende) with lesser amounts of coffinite and brannerite. Ore reserves and resources for the Olympic Dam deposit are summarised in Table I.

TABLE I: OLYMPIC DAM ORE RESERVES AND RESOURCES AS AT JUNE 1996 [5].
NOTE: RESOURCES ARE IN ADDITION TO RESERVES

Reserves/Resources		Ore (Mt)	%Cu	%U ₃ O ₈	Contained U ₃ O ₈ (t)
Reserves	Proved	73	2.5	0.08	58 400
	Probable	486	2.0	0.06	297 600
Resources	Measured	0			
	Indicated	1220	1.1	0.04	488 000
	Inferred	400	1.3	0.04	160 000

The orebody is mined by conventional large scale underground methods. The processing plant comprises a milling circuit, concentrator, hydrometallurgical circuits, concentrate smelting, copper, gold and silver refining (including copper electro-refining and electrowinning), and uranium precipitation.

The Olympic Dam operation currently has an annual production rate of 85 000 t copper, 1700 t U₃O₈ and associated gold and silver. WMC Limited (WMC) recently announced that the operation is to be expanded and that annual production would be increased to 200 000 tpa of copper, 4600 tpa U₃O₈, 75 000 ounces gold and 950 000 ounces silver. For the processing plant to achieve a sustained production rate of 200 000 tpa copper, the mine would need to supply 8.7–9.2 million tonnes ore per annum, depending on the grade of ore processed. At least thirty stopes would need to be operated in any one year for this rate of production [6]. Based on the current production levels of existing mines, Olympic Dam will rank as one of the world's five largest uranium production centres. The overall capital cost of this expansion was estimated to be A\$1.48 billion and it is planned to be completed by the end of 1999.

WMC also announced it would seek the necessary approvals for the project to ultimately expand to 350 000 tpa of copper and associated products, although there are currently no plans to expand beyond 200 000 tpa.

Under the original Indenture Agreement between WMC and the South Australian State Government, the operation had approval to produce up to 150 000 tpa of copper and associated products. The Indenture was amended in 1996 to allow the project, subject to environmental clearances, to produce up to 350 000 tpa of copper. The draft EIS for the

project to expand to 350 000 tpa copper was released for public comment in May 1997. The final EIS will be assessed jointly by both Commonwealth and South Australian Government authorities.

Recent exploration drilling has discovered large tonnages of moderate to high grade copper mineralisation along the southeastern margin of the deposit [1]. Drill intersections of up to 84 metres averaging 2.1% copper have been reported. Uranium grades for these intersections are yet to be announced.

4. PROPOSED NEW MINING OPERATIONS

Since the removal of the "three mines" policy in March 1996, the Government has received formal proposals to develop three new uranium mining operations:

- Jabiluka deposit, Northern Territory (ERA Ltd),
- Kintyre deposit, Western Australia (Canning Resources Ltd, a subsidiary of Rio Tinto),
- Beverley deposit, South Australia (Heathgate Pty Ltd, a wholly owned subsidiary of General Atomics, which is a United States company).

4.1. Jabiluka

The Jabiluka deposit is 20 km north of Ranger and occurs within Palaeoproterozoic metasediments of the Pine Creek Geosyncline and lies immediately below the unconformity with the overlying Kombolgie Sandstone (Fig. 4). ERA Ltd purchased Jabiluka from Pancontinental Mining Ltd in 1991 for US\$100 million. The draft EIS for the Jabiluka project which was released in October 1996, examines a number of options for the development of the Jabiluka deposit. ERA's preferred option is for an underground mining operation, with the ore to be processed at the Ranger mill. The ore would be trucked for a distance of 20 km to Ranger via a haul road entirely within the lease area. This development option has the least environmental impact [7].

The key aspects of ERA's proposal include:

- no tailings dam and no processing plant at Jabiluka,
- surface facilities will cover only 20 hectares,
- total disturbed land including the transport corridor is estimated at 80 hectares which is much less than other options,
- tailings will be placed in the Ranger open pits which will be rehabilitated at the end of the mine life.

ERA is planning to develop Jabiluka by 1999. It is proposed that initially, 300 000 t of Jabiluka ore would be processed annually to produce approximately 1800 tpa of U_3O_8 . It is proposed that the capacity of the operation would expand to 900 000 t ore annually to produce approximately 4000 tpa of U_3O_8 in the 14th year.

Total proved and probable ore reserves for Jabiluka are 19.5 million tonnes ore averaging 0.46% U_3O_8 , and containing 90 400 t U_3O_8 . The total geological resource (which includes the ore reserves) was estimated to be 28.7 million tonnes ore averaging 0.52% U_3O_8 [7]. These estimates were made using a cut off grade of 0.2% U_3O_8 .

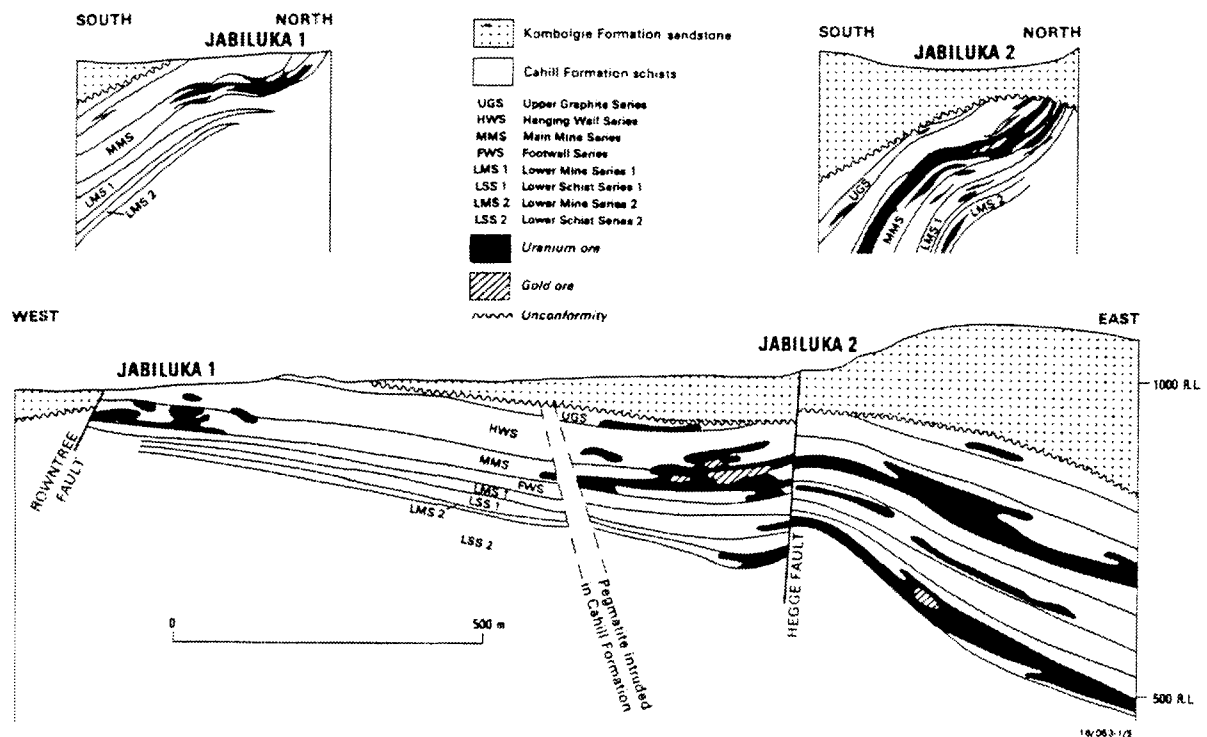


FIG. 4. Cross-section Jabiluka deposit (after Kinhill, 1996).

The final EIS is due to be released in June 1997.

ERA is negotiating with the Traditional Aboriginal Owners for consent to develop Jabiluka according to the company's preferred option. Aboriginal approval already exists for Pancontinental's original concept of a stand alone mill, underground mine and tailings dam on the Jabiluka lease [8].

4.2. Kintyre

The Kintyre deposit is located on the western edge of the Great Sandy Desert in the Eastern Pilbara Region of Western Australia, approximately 1200 km north-northwest of Perth. The project area is located immediately north of the Rudall River National Park.

Kintyre is a Proterozoic unconformity-related deposit which occurs in metasediments of the Rudall Complex and lies immediately below the unconformity with the overlying Neoproterozoic sandstones [9]. Host rocks are mainly chlorite-garnet-quartz schists, chlorite-carbonate-garnet-quartz schist, garnetiferous quartzite (metachert) and metamorphosed carbonate rocks (Fig. 5). Mineralisation occurs as narrow veins of high grade pitchblende within barren host rock. Multiple sets of closely spaced mineralised veins form ore zones.

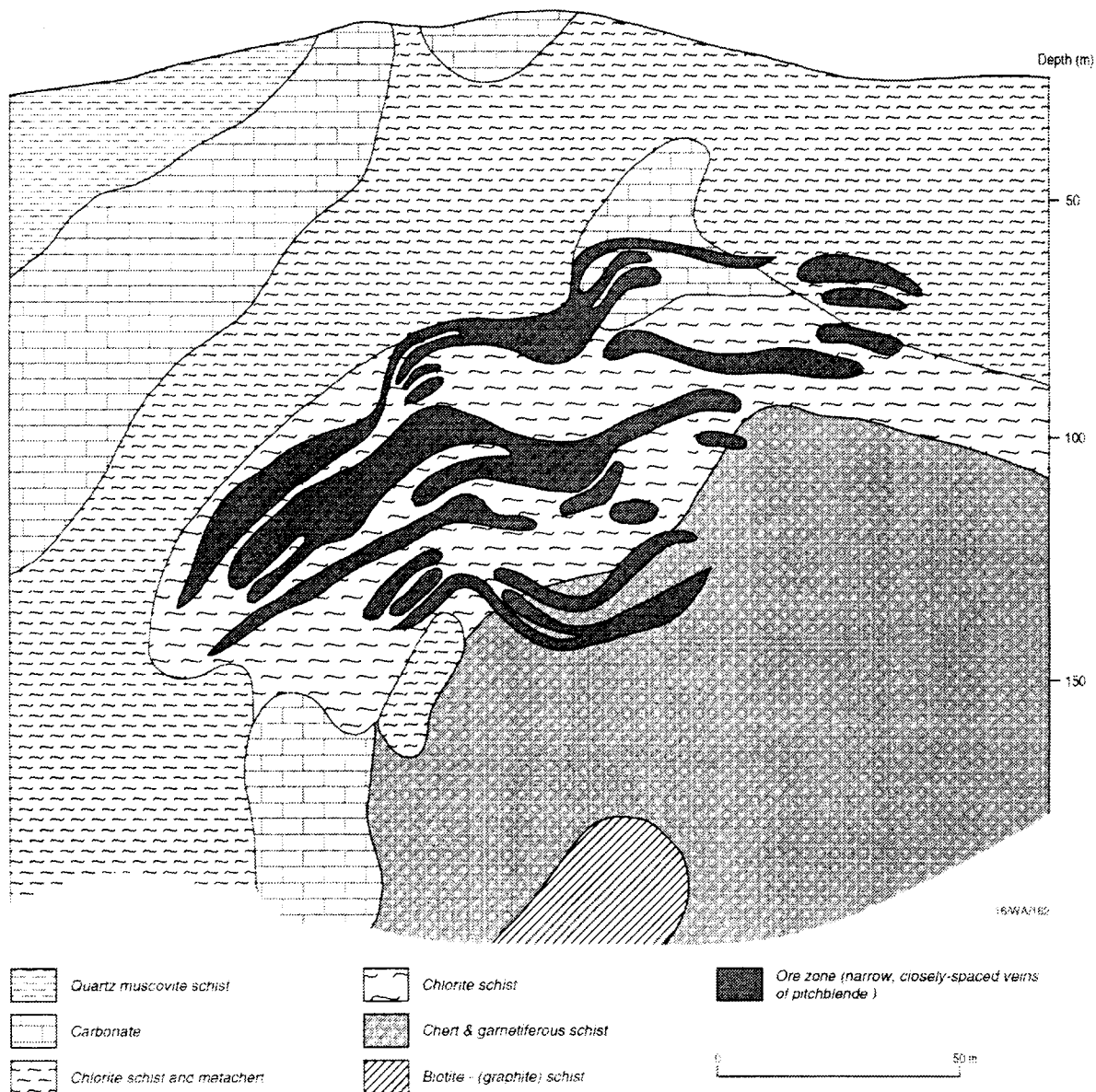
Canning Resources propose to mine the four orebodies which make up the Kintyre deposit by a number of separate open pits. The ore is suitable for radiometric sorting. Ore processing would be in two main stages:

- a *dry upgrading phase* in which the ore from the mine would be crushed and screened by size. The larger size fractions would be concentrated by radiometric sorting; and the smaller size fraction would be concentrated using ferrosilicon heavy media separation,

- a *wet phase* where the uranium is extracted from the ore in three stages — leaching, iron pre-precipitation and uranium precipitation [10].

Production is planned to start in 1999. Initially the operation would produce 1200 tpa U_3O_8 , with the potential to increase production up to 2000 tpa U_3O_8 over a twenty year period. Probable resources were estimated to be 24 500 t U_3O_8 , with an additional 11 500 t U_3O_8 of inferred resources [11].

Canning Resources has applied to the Commonwealth and Western Australian State Governments to develop Kintyre. A detailed EIS is being prepared and the final EIS will be assessed jointly by both Commonwealth and Western Australian Government authorities.



Note. Unconformity at base of Neoproterozoic sandstone not visible on this section

FIG. 5. Cross-section of the Kintyre deposit (published with permission of Canning Resources Pty Ltd).

4.3. Beverley

Beverley is a sandstone-hosted uranium deposit located near Lake Frome, approximately 530 km north-northeast from Adelaide. Heathgate Pty Ltd proposes to develop an in situ leach operation capable of producing 900 tpa U₃O₈ with production commencing in the year 2000. Heathgate considers that the deposit is particularly suited to in situ leaching because of its shape, grade and leachability [12]. Metallurgical and hydrological studies, including aquifer pump tests are currently being carried out.

The deposit comprises several large flat-lying lenses which are between 100 and 150 metres below surface. The deposit has an overall resource of 16 200 t U₃O₈ with an average grade of 0.27% U₃O₈, of which approximately 11 600 t U₃O₈ could be recovered by in-situ leaching [13].

The current proposal, is in the initial phase of a joint Commonwealth/State (South Australia) EIS process.

4.4. Other possible mine developments

Two other possible mine developments are Koongarra deposit in the Northern Territory, and Honeymoon deposit in South Australia. Koongarra is owned by Cogema which is expected to decide before the end of 1997 on whether to proceed with the development of a mining operation. The Honeymoon deposit was recently purchased by the Canadian controlled company, Southern Cross Holdings which is reportedly considering developing an in-situ leach mine by the end of 1998. Southern Cross is partly-owned (35%) by an Australian company, Sedimentary Holdings NL.

5. NATIVE TITLE

In 1992 the High Court of Australia handed down a decision known as the "Mabo Decision". This Court found that the common law of Australia recognised native title to land, that is, the entitlement of indigenous people, in accordance with the traditional laws and customs, to their traditional land. *The Native Title Act 1993* provides a framework for addressing where such native title exists, who holds it and the nature of native title rights in particular cases.

The Commonwealth Government has accepted that there are operational difficulties in the existing *Native Title Act*. It is consulting widely with indigenous people, industry and State Governments, and is preparing amending legislation to ensure that native title processes are workable and to remove uncertainty.

There are currently a number of claims under the *Native Title Act 1993* to existing and prospective uranium mines that have yet to be determined.

The Olympic Dam Project currently has three registered applications for determination. There are also several other applications over all or part of the water borefields and pipeline to the Project [6]. WMC is participating in statutory conferences and meetings convened by the National Native Title Tribunal.

In February 1996, a native title claim covering the Kintyre Project area was registered with the Native Title Tribunal by the Ngolibardue Peoples [14].

The Beverley deposit is held under Retention Leases issued under the South Australian Mining Act. The deposit is located on a pastoral lease (Wooltana) which is subject to a claim by Aboriginal interests in accordance with Commonwealth Native Title legislation [15].

The Ranger, Jabiluka and Koongarra leases in the Northern Territory are on designated *Aboriginal land under separate legislation, the Aboriginal Lands Rights (Northern Territory) Act 1976*. Aboriginal agreements with miners have been negotiated under this Act for each of these projects.

6. CONCLUSION

The abolition of the "three mines" policy means that several new uranium mines are likely to be developed to take advantage of market opportunities. Australia's annual production could increase from the 1996 level of 5867 t U₃O₈ to approximately 12 700 t U₃O₈ by the year 2000 as a result of proposed increases in production at Ranger and Olympic Dam, together with projected production from possible new mines (Jabiluka, Kintyre and Beverley). These increases in production will depend on market conditions.

The chief executive of ERA Ltd, Mr. Phillip Shirvington, recently stated that "Australian uranium miners are enthusiastic about the opportunities for increased production over the next few years. Buoyant market conditions and a supportive Government have encouraged Australian companies to commit to the expansion of existing operations and the development of new mines" [16].

ACKNOWLEDGEMENTS

The author wishes to acknowledge Dr Ian Lambert and Mr Yanis Miezitis (Mineral Resources & Energy Branch, Bureau of Resource Sciences); and Mr Peter G. Smith (Coal & Minerals Industries Division, Department of Primary Industries & Energy) for providing comment on the manuscript.

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