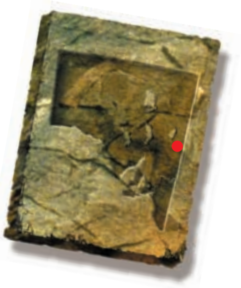

Honeymoon uranium project update

Trina Reif (Project Facilitator, Honeymoon Uranium Project, Office of Minerals and Energy Resources, PIRSA)

Introduction

Honeymoon and East Kalkaroo deposits, ~400 km northeast of Adelaide and 75 km northwest of Broken Hill, are natural concentrations of uranium minerals occurring in the Tertiary age Yarramba Palaeochannel, one of several similar palaeochannels developed between the Olary Ranges and Lake Frome in northeastern SA. Current resources at Honeymoon and East Kalkaroo total ~7900 t U_3O_8 equivalent, and there is potential to significantly increase this with further resource delineation. Goulds Dam deposit, 80 km northwest of Honeymoon, has formed in the Billeroo Palaeochannel (Fig. 1), and a resource potential of 17 600 t U_3O_8 equivalent has been delineated. The Yarramba and Billeroo Palaeochannels are located in the Frome Embayment, a southern lobe of the Jurassic–Cretaceous Eromanga Basin.

Southern Cross Resources Australia Pty Ltd proposes to establish a commercial in situ leach (ISL) mining operation based only on the Honeymoon and East Kalkaroo deposits. This will be capable of producing 1000 t/year of U_3O_8 equivalent as uranium peroxide ($UO_4.2H_2O$) for export and use in the electricity generation industry.

Background

Ore-grade uranium was discovered by the Minad–Teton–CEC Joint Venture in Tertiary palaeochannel sediments at the Honeymoon deposit in 1972, and further drilling and exploration were conducted over the next four years to establish the extent of the mineralisation. The conclusion from these investigations was that the deposit was unsuitable for conventional open-cut or underground mining techniques. However, more recent advances in ISL technology in the USA prompted laboratory and ISL testing which confirmed that the Honeymoon deposit possessed characteristics suitable for ISL extraction of uranium.

The Honeymoon Uranium Project comprises a number of mining and exploration tenements, the majority of which Southern Cross Resources acquired from previous title holders in 1997 (Fig. 1).

Geology of the Honeymoon deposit

The Yarramba Palaeochannel is one of several located in buried Tertiary-age sediments of the Eyre Formation. The palaeochannel is deeply incised into a basement of weathered Precambrian rocks of the Curnamona Province. It is filled by up to 50 m of Eyre Formation sand, silt and clay, overlain by Namba Formation clay. The palaeochannel sequence and basement are covered by ~30 m of Quaternary sediments, mainly clay, which blanket the region (Fig. 2).

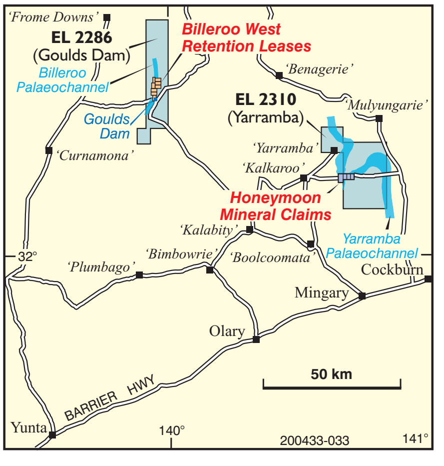

Fig. 1 Location diagram and tenements, Honeymoon project.

At Honeymoon and East Kalkaroo, uranium mineralisation occurs at a depth of 100–120 m, predominantly within 'basal sand' of the Eyre Formation on the outside margin of a major bend in the Yarramba Palaeochannel (Fig. 1). The 'basal sand' is the lowest of the three sand members, including the 'middle' and 'upper sands', which are separated by clay layers. Mineralisation occurs within coarse-grained pyritic sand where the 'basal sand' pinches out between overlying clay and the palaeovalley slope. The 'basal sand' mineralisation extends for 4000 m along the channel margin, is up to 400 m wide, and averages 4.3 m in thickness.

Roll-front uranium deposits are typically formed within extensive aquifer sand at a reduction–oxidation boundary. The passage of uranium-bearing groundwater oxidises the sediments on the up-current side of the roll-front, while sediments on the down-current side remain unoxidised. The characteristics displayed at Honeymoon are typical of the well-developed, planar lower limb of a roll-front uranium deposit. Uranium is present primarily as coffinite, with quartz and kaolinite as the major gangue minerals.

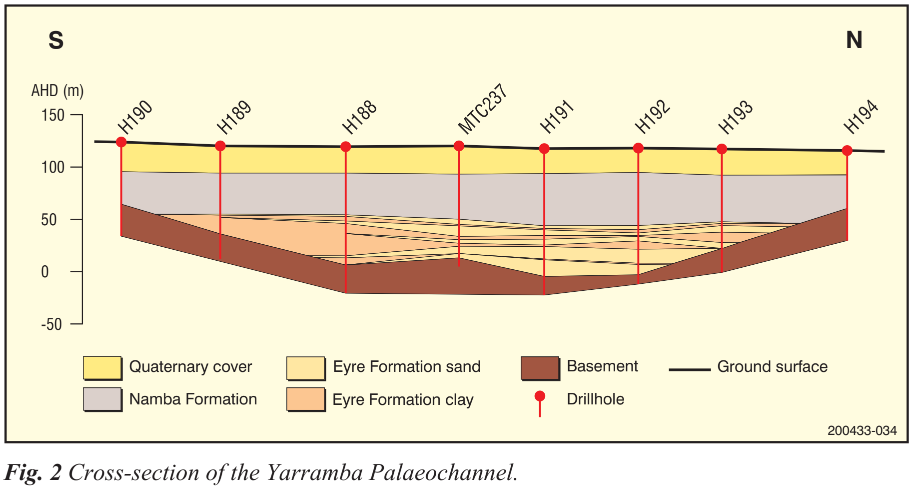

Fig. 2 Cross-section of the Yarramba Palaeochannel.

Hydrogeology

Water flow in the palaeochannel at Honeymoon is confined as the sediments are bounded by the channel sides of Precambrian basement rock and overlain by Namba Formation clay.

Groundwater in sand members of the Eyre Formation at Honeymoon has naturally occurring high levels of salinity, radionuclides and Total Dissolved Solids (TDS), rendering it unsuitable for general stock watering or agricultural uses. Salinity is typically >9000 mg/L in the 'upper sand' aquifer and ranges to >20 000 mg/L in the 'basal sand', which is above the accepted maximum tolerance of all stock animals. Concentrations of radionuclides in the groundwater exceed the current National Health and Medical Research Council (NHMRC, 1996) guidelines for safe drinking water, with an average of 60 times the level of uranium and 340 times the level of radium.

Water treatment, using reverse osmosis, is necessary to produce potable water for human consumption from the 'upper sand'. Such treatment is not viable for stock watering purposes due to high capital and maintenance costs.

Relationship to the Great Artesian Basin

The most southerly extent of the Great Artesian Basin (GAB) in the Frome Embayment is ~70 km to the north of Honeymoon, in the vicinity of Lake Frome. Geological cross-sections and data from wells drilled near the lake indicate that the Tertiary Eyre Formation aquifers overlie sediments of the GAB. A subgroup of sediments, comprising grey-green shale, minor sandy shale and sand, lies between the Eyre Formation and GAB sediments. These act as a confining layer to the GAB aquifer and are an effective barrier to water movement between the GAB aquifer and overlying Eyre Formation sediments.

Additionally, wells drilled in the Tertiary sediments do not flow to the surface in the area underlain by the GAB aquifer, indicating that the potentiometric head in the Tertiary aquifer is likely to be lower than in the GAB aquifer. This potentiometric head relationship implies an increasing hydraulic gradient from the Tertiary aquifer system to the GAB aquifer, precluding the downward movement of water into the GAB system.

For the above reasons, water from the Yarramba Palaeochannel cannot enter the GAB.

ISL process

For a uranium deposit to be suitable for ISL mining it must:

- occur in unconsolidated sandstone or permeable rocks
- be confined between impermeable strata
- be located below the watertable
- have an ore zone chemically suitable for leaching.

The ISL technique is used successfully in Europe, North America and Asia, with ~15% of world uranium now produced by this method. In the USA, most uranium is presently recovered by this process and, in many instances, ISL mines operate in close proximity to townships and pastoral areas. This technology, developed nearly 25 years ago, has evolved to a point where a mine can now be developed with low capital and operating costs, will operate in a safe and controlled manner, and will have minimal impact on the environment.

In comparison to open-pit or underground mining, ISL technology is widely recognised as a relatively low-impact mining method, since there is minimal surface disturbance, no tailings disposal requirements and comparatively little waste generation. On completion of operations, wells can be filled and capped, process facilities removed, and the land surface rehabilitated with little or no evidence of the uranium recovery activities.

Uranium is extracted by injecting a leach solution into the uranium-bearing strata via injection wells. This solution migrates through the host sand, oxidising and mobilising uranium as a soluble complex, and is then drawn to pro-

Northwesterly aerial view of the Honeymoon demonstration plant. (Photo 47628)

Injection wellhead. (Photo 47629)

Portion of the Honeymoon demonstration plant well field. (Photo 47625)

Inside the Honeymoon wellfield reticulation plant. *(Photo 47626)*

duction wells and pumped to the surface (Fig. 3). The solution is passed through a conventional processing plant where uranium is recovered by solvent extraction to produce the commercial product, commonly known as yellowcake. After processing, the 'barren' solution is reconditioned and recirculated continuously to the well field as leach solution (Fig. 4).

Field leach trials

In March 1998, following the review of the Declaration of Environmental Factors submitted by Southern Cross Resources, the SA Minister for Primary Industries, Natural Resources and Energy approved the operation of a Field Leach Trial (FLT) at Honeymoon. Under the FLT, a demonstration ISL plant and wellfield were operated at a design rate capable of treating pregnant solution at 25 L/sec. Operation of the demonstration plant was completed on 9 August 2000 and wellfield operations are expected to be completed by early October, radiation and environmental monitoring will continue.

The FLT provided technical, financial and environmental data for use in determining the feasibility, engineering and final design of a commercial operation. Through the simulation of a commercial operation, the FLT has shown that the ISL process can be successfully employed in a safe and efficient manner for the extraction of uranium at Honeymoon.

Projected production

The project will produce ~5500 t of U_3O_8 equivalent during the first six years of operation at the Honeymoon and East Kalkaroo deposits, at a recovery rate of 70%. This tonnage will be increased with the final delineation of resources at and near Honeymoon, and development of other areas of known mineralisation. These include the Yarramba deposit and other locations in the Yarramba Palaeochannel with potential similar to that of the Honeymoon deposit.

Sample collection inside the demonstration plant. *(Photo 47627)*

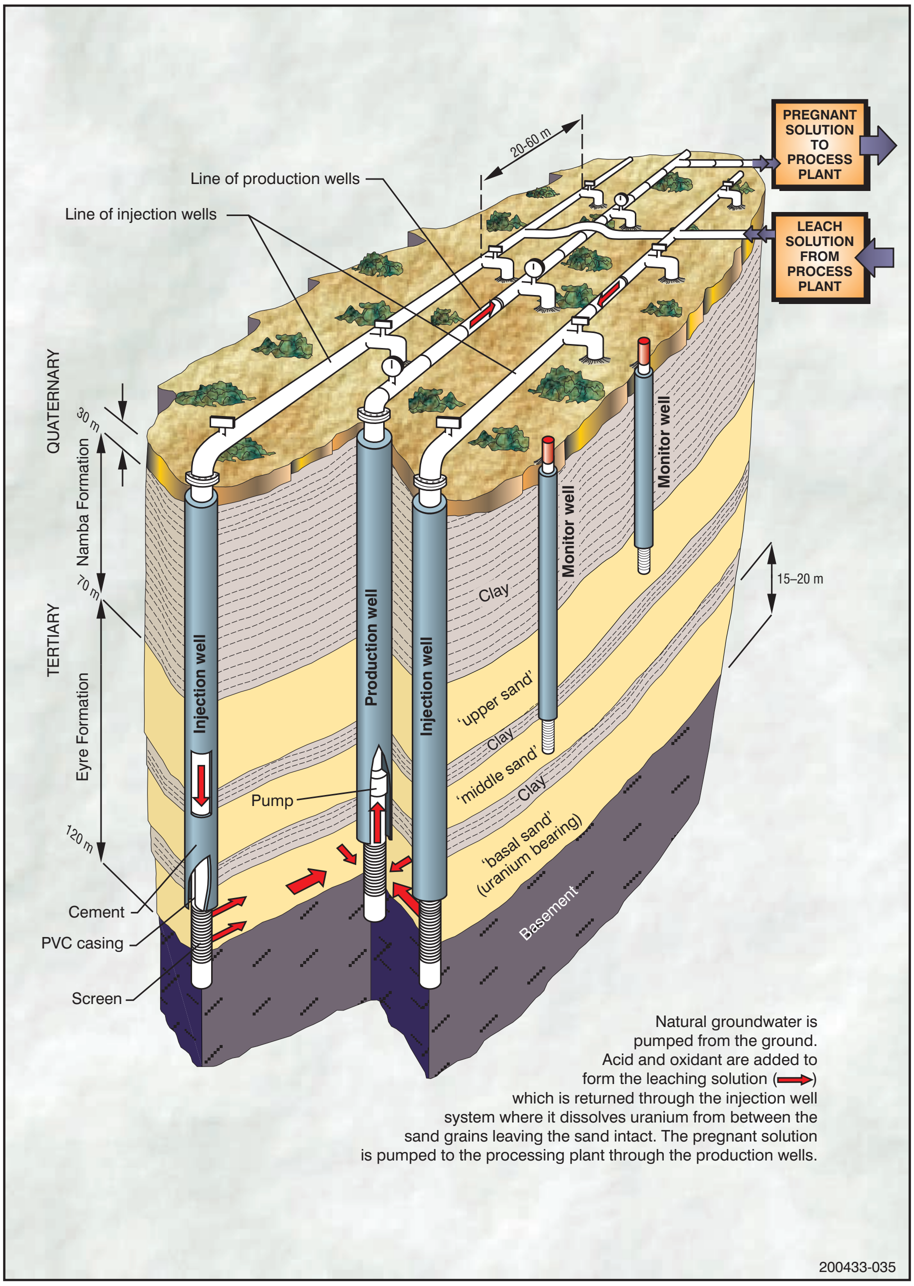

Fig. 3 *Schematic ISL wellfield (courtesy Southern Cross Resources).*

Environmental impact statement

Numerous investigations, surveys and studies have been undertaken since the discovery of ore-grade uranium at Honeymoon which have confirmed the feasibility of the present development proposal and contributed to the preparation of an Environmental Impact Statement (EIS). These include the field leach trial and demonstration plant, and geological and geophysical, environmental impact, hydrological, anthropological, radon and radiometric, socio-economic, flora, fauna, landform and soil studies.

An EIS for commercial development of the Honeymoon Uranium Project was submitted to the SA Government on 7 June 2000. This initiated an eight-week public consultation period which ended on 2 August. Southern Cross Resources is now assessing the EIS submissions and a response document will be prepared for State and Commonwealth assessment.

Conclusions

Development of the project will result in significant economic benefits at regional, State and national levels. The annual contribution to Real GDP is estimated to be $20 million at State level,

Yellowcake precipitation tanks. (Photo 47624)

with a further $10 million in the rest of Australia. Direct and indirect employment generated by the project is estimated at 200 jobs.

The project will benefit regional areas such as Broken Hill through the location of a permanent workforce, opportunities for employment and provision of contract services, upgrade of facilities such as the Mulyungarie Road, maintenance of the airstrip, and improved communications for first aid and emergency assistance.

For further information contact Trina Reif (ph. 08 8463 3049).

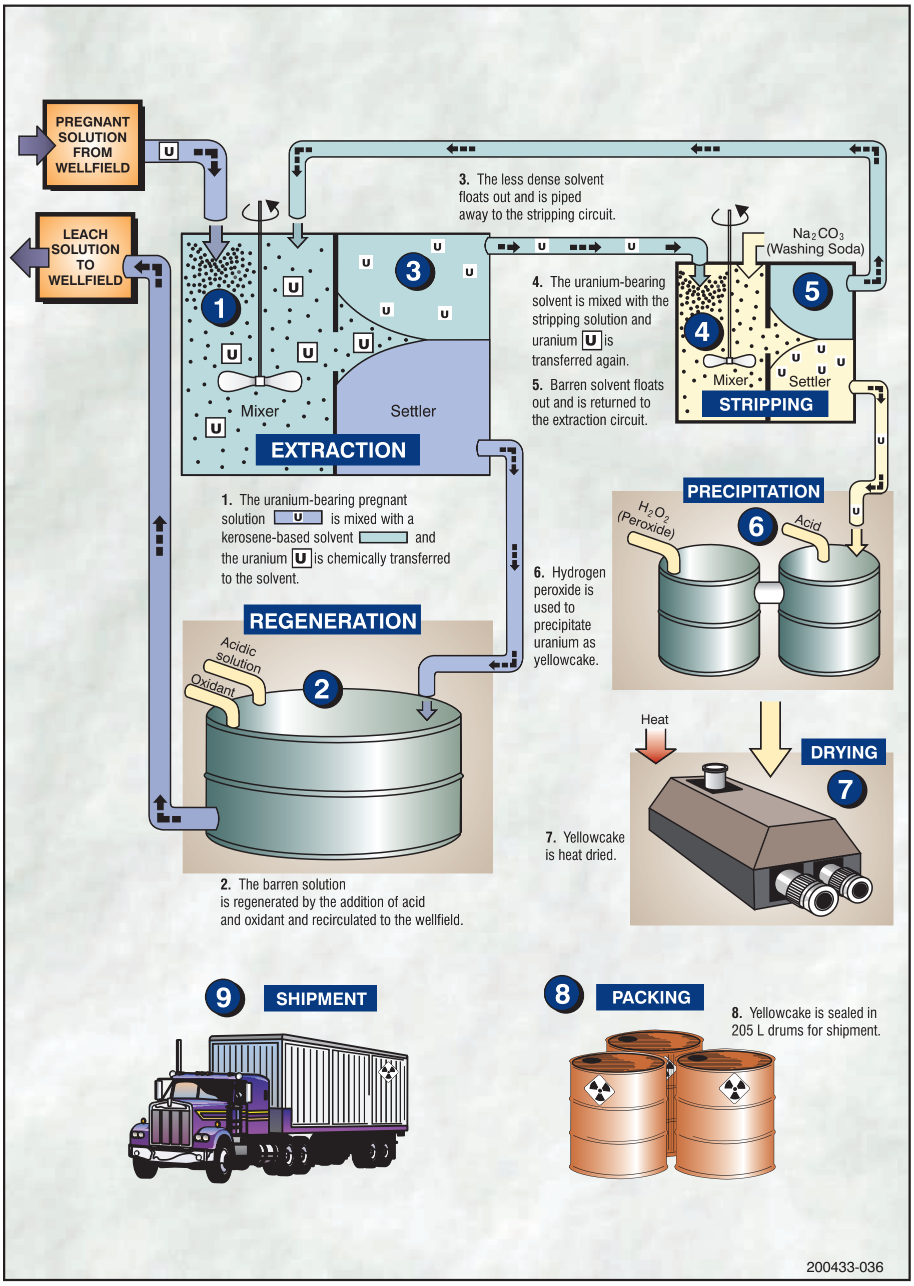

***Fig. 4** Schematic uranium solvent extraction plant (courtesy Southern Cross Resources).*

Acknowledgement

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References

NHMRC, 1996. *Australia drinking water guidelines*. National Health and Medical Research Council and the Agriculture and Research Management Council of Australia and New Zealand, Canberra.

Southern Cross Resources Australia Pty Ltd, 2000. *Honeymoon Uranium Project Environmental Impact Statement.* Southern Cross Resources Australia Pty Ltd, Toowong, Queensland.