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Uranium mining and Australia's energy debate

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Extended Abstract

In uranium mining, the in situ leach (ISL) technique is being used in Australia at the Beverley and Honeymoon uranium deposits, both relatively new mines that began operating in 2000 and 2001. Though ISL uranium mines are common in the United States, Beverley is the first ISL mine in Australia and has been scrutinized in the press attracting broad public and scientific criticism. In fact, the details of the ISL extraction technique being used are not the same in Australia and the U.S., nor are the environmental rehabilitation requirements. In Australia, ISL uses sulphuric acid as opposed to alkaline (U.S.) chemistry, with no requirement for restoration of the original groundwater geochemistry following mining (Mudd, 2001). Not only does sulphuric acid dissolve uranium, it also effectively mobilizes heavy metals (alkaline ISL is less effective and more selective).

Most uranium in Australia is mined in a conventional form (e.g. Ackland and Hunter, 2003). That is, ore is extracted from an open pit or underground mine and crushed in a mill and reduced (depending on the nature of the ore). The crushed extract is mixed in water to form a slurry, normally high in dissolved U content. The slurry is filtered and the residual dissolved uranium is extracted with a solvent. ISL is much less common. The general idea with ISL is for uranium to be extracted with minimal ground disturbance by injecting the mineralized area with a weak alkaline or acid solution. The solution circulates through an enclosed, underground aquifer dissolving the uranium. In the case of the Beverley uranium mine, proponents of ISL reason that untreated groundwater be returned to the aquifer because: the water was radioactive to begin with; the region is exceedingly remote; and the addition of heavy metals (such as lead and cadmium) to the groundwater should be contained within the aquifer in any case.

Uranium in the Earth's crust averages about 2ppm (Taylor and McLennan, 2002) and can be found as a trace element almost anywhere (U>Au, Ag, Hg; U~Sn; U<Co, Pb, Mo) including the world's oceans, though at lower concentrations. The Beverley uranium deposit is located 520 km north of Adelaide near Lake Frome in the Flinders Ranges, with an ore grade of 0.18% (taken from the Uranium Information Centre website). The geology and hydrogeology of the Beverley deposit and surrounding region are show on Figure 2 in Mudd, 2001. The uranium mineralization occurs within sandstone (called 'semi-isolated aquifer sands' (Mudd, 2001)), the deposit being restricted to 3 distinct, mineralized, paleochannel horizons. This sandstone mineralization is the result of leaching from the nearby Mount Painter Region (Brugger et al., 2003). Beneath the deposit aquifer, lies a mudstone sequence and the Cadna Owie sandstone, at 300m depth (Mudd, 2001). Faulting and deformation complicate the structure of the aquifer region, indicating that certain aquifers may be interconnected, and that others are likely truncated; this has consequences for any interpretation of the hydrogeology (Hancock, 1986). The environmental management plan that is in place has been developed to continually monitor the containment of the aquifer being mined. The major concern is the potential for horizontal seepage into adjacent aquifers and the necessity for prolonged environmental monitoring needed to deal with the toxicity of nuclear wastes.

Despite the extreme level of groundwater contamination that has been experienced by untreated acid ISL mines in (for example) the former Soviet Union (Mudd, 2001), operations continue at the Beverley and nearby Honeymoon mines. Uranium is sought after, and the world authorities on nuclear energy such as the World Nuclear Association and the Uranium Information Centre (Australia) support uranium mining (including Berverley) not just as economically valuable for the countries with large Uranium stores (Australia and Canada have the largest), but emphasize Earth's need for a clean energy source, especially in light of society's (meaning the 28% of us who use 3/4 of the world's non-renewable energy sources - World Nuclear Association) increasing energy demands. Australia is in possession of vast and largely untapped stores of Uranium, with approximately 27% of the planet's known, easily accessible, inexpensive to mine U deposits (Uranium Information Centre). Thus, Australia is and will continue to be a major source of U to power nuclear plants around the world. Paradoxically, there are no nuclear power plants within Australia: Australia's entire uranium product is exported to other countries. (Lucas heights in NSW is a small reactor for medical purposes only). For electricity, we are largely dependent on coal.

The evolution in government policies with respect to Australia's nuclear program began in the mid 1950s with the development of the Atomic Energy Act. The development of uranium orebodies halted in the 1980s owing to the 'three mines' policy. No new mines were developed until new policies with respect to nuclear energy and uranium mining were established in the late 1990s. The

Beverley Mine in South Australia began operations in 2000, and is the first new mine to open in addition to the 'three mines', subject to the the Environmental Protection and Biodiversity Conservation Act (EPBC). In addition to dealing with the treatment, transport of nuclear fuel and radioactive wastes, the EPBC act controls the mining or milling of uranium ores, and the establishment (or modification) of any nuclear installation. In the media, there has been much debate central to the issue of uranium extraction through mining. The fact that most mines are remote, is thought to be advantageous. However, uncertainties in evaluating environmental impact, the hazardous nature of radioactive mine tailings, and the location of the mines often on Aboriginal lands are cause for concern. Within the Flinders Ranges, the Beverley uranium mine is no exception; additionally, the controversial nature of the ISL (in situ leaching) extraction technique - new to this continent - has attracted the scepticism of protestors, aboriginal groups, and scientists. They are upset because, by allowing acid ISL to proceed at Beverley (in summary): a precedent for allowing acid ISL in Australia is set; extensive groundwater contamination will occur as a result of this method chosen preferentially over a less damaging, though more complicated, alkaline extraction technique; there is no requirement for mining companies to restore groundwater to pre-mining chemistry; and several groups are against providing fuel for any nuclear action.

Additional Information sources: The Uranium Section of the Department of Industry, Tourism, and Resources World Nuclear Association Uranium Information Centre, Australia.

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