

ABSTRACT

Uranium mining and exploration has made a significant contribution to the economic development of the Northern Territory since the first discovery was made in 1954 at Rum Jungle. Production from deposits in the Northern Territory to the first quarter of 2006 totaled 120 064 t U₃O₈ and about 301 000 t U₃O₈ is classified as resources.

Uranium occurrences in the Northern Territory can be grouped into four main styles of mineralisation: Proterozoic unconformity-related; vein-type; Westmoreland-Murphy-type; and sandstone-type. Almost all mined deposits, and most of the currently known resources, are of the Proterozoic unconformity-related type and occur within Palaeoproterozoic rocks of the Pine Creek Orogen, near the unconformity with overlying platform cover sandstones of the McArthur Basin. Deposits vary in size from a few tonnes to more than 100 000 t contained U₃O₈, with grades generally in the range 0.2–2% U₃O₈. Large deposits of this type, in the *Alligator Rivers Uranium Field*, account for 96% of past production and 95% of known resources in the NT. As well as uranium, these deposits may contain economic quantities of gold, platinum and palladium (eg *Jabiluka*, *Coronation Hill*). Genetic models for the formation of these deposits are still the subject of some discussion. Most researchers favour a model in which oxidised fluids, sourced from overlying platform cover sandstone successions and carrying soluble U⁶⁺, were reduced by reaction with suitable lithologies in Pine Creek Orogen rocks, resulting in the deposition of insoluble U⁴⁺ in the form of uraninite. The location of deposits was controlled by a combination of structure and lithology, and tectonised contacts between carbonate and metapelite units represent the most favourable conditions. Unconformity-related uranium deposits are the main exploration target in the NT, because of the potential for large-tonnage, low- to medium-grade resources. However, a large proportion of the most prospective areas are included within the boundaries of Kakadu National Park and are therefore quarantined from exploration.

Vein-type deposits are small and generally contain less than a few hundred tonnes of U₃O₈. Most occur in Palaeoproterozoic rocks of the Pine Creek Orogen, although occurrences are also known in the Tennant and Arunta regions. Production was limited to small-scale mining operations in the 1950s and 1960s, and this type of deposit does not contribute significantly to resources in the NT.

Westmoreland-Murphy-type deposits occur within the lower McArthur Basin succession, on the northern side of the Murphy Inlier, straddling the NT–Queensland border. Production from two small operations in the 1960s totaled 35 t U₃O₈. The largest known deposits of this type are in Queensland and occur where dolerite dykes cross-cut sandstone. Other styles of this deposit type occur at contacts between rocks of different oxidation states, and appear to have formed by reduction of oxidised uranium-bearing fluids. Small occurrences of uranium mineralisation occur in similar geological settings in Katherine River Group rocks, near the western margin of the McArthur Basin, and appear to have been formed by similar processes.

Sandstone-type deposits are restricted to Palaeozoic (Devonian–Carboniferous) continental red-bed sedimentary successions in the Ngalia and Amadeus basins. Deposits of this type represent about 5% of uranium resources in the NT. Uranium mineralisation occurs at a redox boundary that formed either by flushing oxidising groundwater through reduced sandstone beds (Amadeus Basin deposits), or by interaction with detrital organic matter (Ngalia Basin deposits). *Angela*, in the Amadeus Basin, is the largest deposit of this type and contains 10 250 t U₃O₈ grading 0.1% U₃O₈.

Surficial (calcrete) and metasomatite/intrusive-type uranium occurrences are also known in the NT, but have attracted little exploration interest. However, recent demand in uranium may stimulate exploration interest in these styles of mineralisation.