Unconformity-related Uranium Potential:clues from Wernecke Breccia

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Introduction

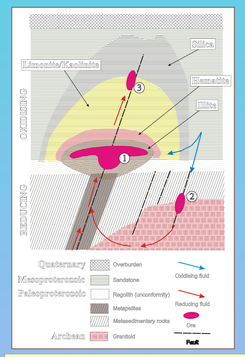
Unconformity-type uranium deposits are the highest grade, lowest cost uranium resources in the world (*cf.* Jefferson *et al.,* 2003). They are best known from the Athabasca Basin, Saskatchewan, Canada and the Pine Creek area in the Northern Territory of Australia. The mineralisation is spatially related to regional tectonic discontinuities and occurs at, or below, a regional unconformity between late Paleoproterozoic to Mesoproterozoic clastic rocks and underlying, locally carbonaceous, Paleoproterozoic metasedimentary rocks (*cf.* Ruzicka, 1995; Tourigny *et al.,* 2001). In a generally accepted genetic model, uranium deposition results from mixing of saline, oxidised, uranium-bearing basinal brines with basement-derived reduced fluid at, or near, the intersection of fault zone(s) with the unconformity (*cf.* Kotzer and Kyser, 1995; Ruzicka, 1995; Fayek and Kyser, 1997).

In the Wernecke and Ogilvie Mountains of the Yukon uranium is hosted by Paleoproterozoic Wernecke Supergroup metasedimentary rocks and ?Paleo- to Mesoproterozoic Wernecke Breccia that are unconformably overlain by Mesoproterozoic Pinguicula Group sedimentary rocks; the Richardson Fault Array, a long-lived, regional-scale fault system is located just east of the Wernecke Mountains (*cf.* Abbott, 1997; Thorkelson, 2000). Brannerite and pitchblende returned ages considerably younger than those of the host strata and may be reflecting uranium mobilisation during tectonic and/or thermal events (*cf.* Archer *et al.,* 1986). The possibility that uranium occurrences in the Wernecke and Ogilvie Mountains fit the unconformity model needs to be verified by further study, but is intriguing and raises the possibility that significant deposits may be found.

Unconformity-type Uranium: model

Athabasca Basin

#	Deposit	Ore (tonnes) (1993)'	Grade (%U)	U (tonnes)
Monometallic				
1	Rabbit Lake	5,840,000	0.27	15,769
3	Eagle Point	1,944,000	1.27	24,720
11	P2 North	2,371,000	4.22	100,000
13	Dominique-Peter	1,756,000	0.66	11,587
13	Claude	583,000	0.36	2,097
13	Cluff N	505,000	0.34	1,729
13	Cluff OP	60,000	0.28	150
13	Dominique-Janine N	23,000	3.8	874
13	Dominique-Janine	95,000	5.8	5,510
Polymetallic				
10	Cigar Lake	902,000	12.2	110,000
13	Cluff D	128,000	3.41	4,370
2	Collins Bay A	140,000	4.83	6,500
2	Collins Bay B	3,000,000	0.38	11,400
2	Collins Bay D	120,000	1.86	2,500
12	Key Lake	3,518,000	1.99	70,000
6	McClean Lake	352,000	1.53	5,385
9	Midwest	1,200,000	1.6	19,300



Conceptual model for unconformity-associated deposits in the Athabasca Basin. Arrows indicate flow paths of oxidised and reduced fluids. *After Ruzicka (1995).*

KEY FACTORS:

- Paleoproterozoic basement that contains carbonaceous material (& is enriched in U)
- Unconformably overlying permeable Mesoproterozoic sedimentary rocks (e.g. sandstone, conglomerate)
- Oxidised, saline, Ca-Na brines that are capable of scavenging U
- Reducing environment to precipitate U out of the fluid (e.g. carbonaceous rocks)
- Mineralisation is structurally controlled (regional and local scales) and likely related to tectonic/thermal events

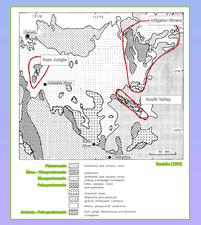
Mineralisation occurs:

① At the unconformity

② In rocks below the unconformity

③ In sedimentary rocks above the Unconformity

Pine Creek area


Zamu Dome
Rum Jungle
South Alligator River
Mount Bonnie Formation
Kombolgie Formation
Cahill Formation
Koolpin Formation
Kybrook Formation
Golden Dyke Formation
Nourlangie Schist
Nanambu Complex
Cullen Batholith
Burnside Granite
Oenpelli Dolerite
Zamu Dome
Mount Partridge Rhyolite
Cooper Creek Granite
Nimbuwah Complex
Archaean
Paleoproterozoic
Mesoproterozoic
Neoproterozoic
Phanerozoic
Sandstone and volcanics: mainly Kombolgie Formation
Siltstone, dolomite, chert and volcanics: (mainly Koolpinyah Formation)
Granite, granodiorite, diorite and pegmatite
Regional metamorphic rocks: schists, phyllites, quartzites, gneisses, migmatites
Rum Jungle, Mount Bonnie and Nanambu Complexes
Zamu Dome
Rum Jungle
South Alligator River
Mount Bonnie
Mount Partridge
Cooper Creek
Nimbuwah
Cullen
Burnside
Oenpelli
Nourlangie
Nanambu
Zamu Dome
Rum Jungle