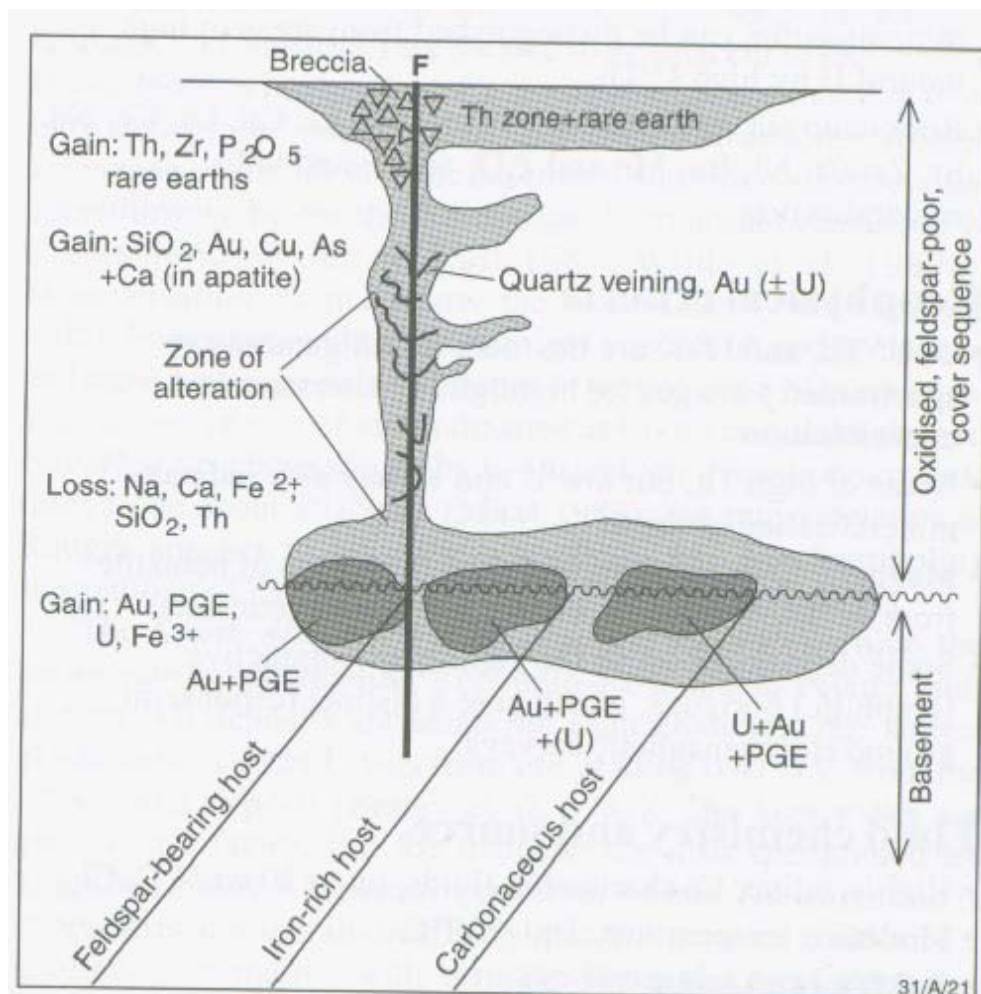


Model 37a Proterozoic Unconformity related uranium-gold	
Alternative Model Name	
Description	Includes Australian and Canadian deposit types hosted in basement rocks below a late Palaeoproterozoic unconformity and Canadian types at or just above the unconformity 37A
Commodities	U, Au, PGEs, Co, Ni, Cu, Pb
% Global Production	40% in 1998
% Australian Prod.	55% in 1999
World Class Deposit Size	
World Class Deposit Examples	<ul style="list-style-type: none"> • Below unconformity – Australia – Ranger, Jabiluka, Coronation Hill; Canada - Rabbit Lake • At or above unconformity; Cigar Lake, McArthur River, Fond du Lac – Canada
Geological Setting	<ul style="list-style-type: none"> • Orebodies may occur below, above or may straddle an unconformity separating an Archaean/Palaeoproterozoic basement, of pelitic metasediments in intracratonic basins on flanks of Archaean domes, from overlying late Palaeoproterozoic to Mesoproterozoic sandstones. Previously the sandstones in the Alligator Rivers Region and the Athabasca Basin were believed to be of Mesoproterozoic age. Recent research shows that at least some if not all of the sandstones are of late Palaeoproterozoic age.
Age	<ul style="list-style-type: none"> • Sm-Nd and Rb-Nd ages for Jabiluka, Koongarra and Nabarlek (1600-1650 Ma, Maas, 1989) suggest that the uranium mineralisation took place after the deposition of the Kombolgie sandstone and post-dates the unconformity. • The uranium mineralisation at Ranger (U-Pb data indicate a 1737 ± 20 Ma age, Ludwig et al, 1987) is significantly older than the other deposits and its age in relation to the deposition of the Kombolgie Subgroup is uncertain. • In the Alligator Rivers field the age of the overlying Kombolgie Subgroup is constrained between 1822Ma (youngest age of the underlying basement) and 1720Ma (age of a microgranite intruding overlying sediments) (Sweet et al. 1999). • It is still possible that the Ranger mineralisation predates the unconformity.
Components:	

Source	Archaean and Palaeoproterozoic igneous and metamorphic rocks. Archaean and Palaeoproterozoic granites of the Alligator Rivers and South Alligator Fields have uranium contents well above the crustal average of 2.8 ppm U and range in some rock types up to 50 ppm U (Wyborn, 1990). Wyborn suggested that the underlying crust is enriched in uranium. High background uranium levels are also present in the Palaeoproterozoic metasediments and in the late Palaeoproterozoic volcanics in the Kombolgie sandstone above the unconformity.
Transport/Pathway	<ul style="list-style-type: none"> • The overlying late Palaeoproterozoic to Mesoproterozoic sandstones acted as a reservoir of oxidised metal-rich fluids which migrated along the unconformity and fault structures into the reduced environments at the unconformity or in the underlying basement. • The movement of oxidised uranium enriched waters may have commenced along the pre-unconformity surface and fault structures before the deposition of the Palaeoproterozoic sandstones to account for the older deposits such as Ranger and continued after the deposition of the sandstones.
Trap	<ul style="list-style-type: none"> • Fault structures in reduced Palaeoproterozoic lithologies beneath the unconformity, the unconformity itself and less so in fault structures above the unconformity. • Ore deposition is related to redox/pH changes due to mixing of highly oxidised saline ground waters, flowing along the unconformity and down fault structures, with upwelling reduced fluids emanating from the underlying Archaean/Palaeoproterozoic basement. • Ore deposition may also take place with direct interaction with highly reduced carbonaceous and ferruginous units. • Ore deposition often close to brecciated contacts between carbonaceous/chloritic metasediments and carbonates of the Palaeoproterozoic sequence.
Other	
Critical Elements	<p>Geoprovince scale criteria: Unconformities separating</p> <ul style="list-style-type: none"> • Flat-lying thick neutral to oxidised Palaeoproterozoic to Mesoproterozoic sandstones in intracratonic basins from • A crystalline Archaean/Palaeoproterozoic basement that • Includes Archaean granitic domal structures flanked by • Metamorphosed highly reducing Palaeoproterozoic graphitic/chloritic and carbonate metasediments. • Major dilatant fault structures and breccia zones. • Adjacent lithologies with contrasting chemical oxidation potentials and separated by either an unconformity or a fault. • Evidence of large scale alternation zones and circulation of highly oxidised fluids. • Presence of regolith at top of the basement rocks.

Other Comments	Large highest grade uranium deposits (+10% U ₃ O ₈ , Cigar Lake and McArthur River, Canada) are at or immediately above the unconformity, followed by large world-class moderate grade deposits in fault structures below the unconformity (generally <1%). In Canada, low grade sub-economic deposits are further above the unconformity (~30 metres) in the overlying sandstones.
Key References	Eckstrand, O.R., Sinclair, W.D. & Thorpe R.I., 1995. Geology of Canadian Mineral Deposit Types. Geological Survey Canada Geology of Canada, 8, 197-210. Mernagh T.P., Wyborn L.A.I. and Jagodzinski E.A. 1998. 'Unconformity-related' U±Au±platinum-group-element deposits. AGSO Journal of Australian Geology and Geophysics. 17(4), 197-205.



Model of possible relationships between different styles of unconformity related U±Au±PGE deposits (After Mernagh, Wyborn and Jagodzinski, 1998).