

Pyrite in the Pepegoona, Pepegoona West and
Pannikan uranium deposits, Lake Eyre Basin, S.A.:
implications for regional uranium exploration

Thesis submitted in accordance with the requirements of the University of
Adelaide for an Honours Degree in Geology

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November 2012



THE UNIVERSITY
of ADELAIDE

TITLE

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RUNNING TITLE

Pyrite Geochemistry at Beverley North

ABSTRACT

The common sulphide mineral pyrite is abundant throughout sedimentary uranium systems at Pepegooona, Pepegooona West and Pannikan, South Australia. No in-depth geochemical and textural characterisation of this important mineral has previously been conducted. Multiple micro-analytical techniques have successfully constrained textural and chemical patterns within the pyrite. Results point to variation in fluid composition, sulphur source and precipitation conditions during a protracted mineralisation event.

In-situ micron-scale sulphur isotope analysis of pyrite demonstrated broad-scale isotopic heterogeneity ($\delta^{34}\text{S} = -43.9$ to $+32.4\%$ CDT), indicative of complex, multi-faceted pyrite evolution and sulphur derived from two or more sources. Preserved textures support this assertion and indicate a genetic model involving more than one phase of pyrite formation. Authigenic, pre-ore pyrite underwent prolonged evolution and recrystallisation, evidenced by a genetic relationship between archetypal framboidal aggregates and pyrite euhedra. Secondary hydrothermal pyrite commonly displayed hyperenrichment of several trace elements (Mn, Co, Ni, As, Se, Mo, Sb, W and Tl) in ore-bearing horizons. Hydrothermal fluids of magmatic and meteoric origin supplied metals to the system but the geochemical signature of pyrite suggests a dominant granitic source and influence of mafic lithologies. Irregular variation in $\delta^{34}\text{S}$, coupled with oscillatory trace element zonation in secondary pyrite, is interpreted in terms of continuous variations in fluid composition and possible cycles of diagenetic recrystallisation. A late-stage oxidising fluid, which mobilised selenium from pre-existing pyrite, caused ongoing pyrite re-crystallisation and precipitation of native selenium.

These results provide the first qualitative constraints on the formation mechanisms of the uranium deposits at Beverley North. Insight into depositional conditions and sources of both sulphide and uranium mineralisation allow for a preliminary paragenetic scheme for the ore systems. This new understanding of pyrite geochemistry can also underpin an effective vector for uranium exploration, not only at Beverley North, but throughout the sedimentary systems of the Lake Eyre Basin.

KEYWORDS

Pyrite, Beverley North, uranium exploration, sulphur isotopes, trace elements, Eyre Formation

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