

New Insights on the Mineralogical Department of the ^{238}U Decay Chain Radionuclides at Olympic Dam

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ABSTRACT

Uraninite, coffinite and brannerite being the U-minerals within the Olympic Dam iron-oxide Cu-U-Au-Ag deposit are also the major mineralogical hosts to the ^{238}U decay chain radionuclides (RNs) ^{226}Ra , ^{210}Pb and ^{210}Po . However, other minerals (hematite, baryte, pyrite, chalcopryrite, bornite, chalcocite, molybdenite, sphalerite, other trace sulfides-selenides-tellurides, REE-minerals, apatite, aluminium-phosphate-sulfate-minerals, fluorite, carbonates) within the deposit also contain U, but at significantly lower concentrations, hence potentially host RNs. Uranium has been repeatedly remobilised and precipitated since the deposit formed at ~1590Ma. There is mineralogical, trace element and isotopic evidence of partial to complete decoupling of RNs and ^{206}Pb from uranium at the mineral scale. This has profound implications for the removal, or reduction, of U and the RNs during processing of Olympic Dam (OD) ores.

Ore delivered to the OD processing plant is in secular equilibrium, and remains in secular equilibrium until the sulfide concentrate and flotation tailings sulphuric acid leaching stages. Approximately 15% of the uranium in mill feed reports to the sulfide concentrate and 85% to flotation tailings. The concentrate is leached to extract fluorine and reduce uranium, while flotation tailings is leached to extract U and some Cu not recovered during sulfide flotation. Leaching significantly reduces the concentration of the U-minerals and hence ^{238}U , but is relatively ineffective at reducing the concentration of the RNs.

A significant amount of test work completed since the design of the initial OD flowsheet in the early 1980s has been unable to produce a copper concentrate that can be sold into the global sulfide concentrate pool. Determining the mineralogical deportment of the RNs from ore through concentrate and tailings leach has been the focus of recent research via the ARC Cu-U Hub project. Systematic mineralogical characterisation of various processing streams on a size-by-size basis has dramatically improved our understanding of the mineralogical deportment of RNs.