The great U-turn: the resurgence of uranium and an overview of deposit types

Derek H.C. Wilton
Department of Earth Sciences, Memorial University, St. John's, NL, A1B 3X5.

Uranium exploration is enjoying a renaissance due to a five-fold increase in price to $37.0/lb since 2001. The increase reflects a growing shortfall in uranium production compared to reactor requirements worldwide. The shortfall has been filled until recently by recycling from obsolete nuclear weapons. The declining amounts of this source coupled with the increasing supply demands of new "Greenhouse Gas-friendly" reactors has acerbated the supply equation. In 2005, Canada contained 12% of the world's resources, but was also the world's largest uranium producer.

Uranium is intrinsically an incompatible element that has great mobility in oxidizing hydrothermal fluids. In its primary origin, uranium is associated with felsic magmatic rocks, but can be mobilized into a variety of other rock types to form mineral deposits. Uranium mineralization is predominantly a high-level phenomena associated with crustal processes.

Uranium occurs in a number of different deposit types. The main ones are: 1) unconformity-related (along unconformities between sandstones and basement rocks, *e.g.*, the Athabasca Basin, Saskatchewan, 2) roll-front sandstones (as reduction fronts within permeable sandstones), 3) IOCG (iron-oxide-copper-gold) deposits (byproduct), 4) granitic (primary magmatic mineralization), 5) shear zones, 6) Archaen paleoplacers (detritus in quartz-pebble conglomerates), 7) simple vein deposits, and 8) surficial environments (calcrete).

Uranium ore minerals are dominated by primary uraninite (UO_2) and brannerite ($(U,Ca,Ce)(Ti,Fe)_2O_6$) and a range of secondary phases such as carnotite ($K_2(UO_2)_2(VO_4)_3\text{-}3H_2O$) to coffinite ($U(SiO_4)_{1-X}(OH)_{4X}$). Uraninite has proven to be notoriously difficult to date due to the ready mobility of U from the crystal lattice by oxidizing meteoric fluids. Remobilized Pb from uraninite can produce galenas with very radiogenic signatures. Uraninite incorporates abundant REE and derived REE patterns are often diagnostic of the type of deposit.