Radiolytic alteration of biopolymers in the Mulga Rock uranium deposit

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Mulga Rock, a uranium and multi-element mineralized deposit in Western Australia, is hosted by mid-Eocene carbonaceous shale, silt and sands. The Ambassador deposit contains the highest uranium concentrations to which the mineralized layer between depths of 53 to 58.5 m consists of <200 to 5280 ppm uranium and bears a close spatial relationship with organic matter (OM). Petrological, bulk and molecular geochemical analyses verify low maturity of OM with a terrigenous and primarily vascular plant OM source. Solvent-extracted organic fractions mainly contain saturated hydrocarbons (HC) and ketones. In samples with low uranium concentrations, long-chain *n*-alkanes and alkanones (C_{27}-C_{31}) reveal an odd carbon preference indicative of extant lipids. Samples with high uranium concentrations contain intermediate-length *n*-alkanes and alkanones with no carbon number preference. The diversity of alkanone isomers decrease and the alkan-2-ones dominate the highly mineralized layers. The trends are inconsistent with aerobic and diagenetic degradation in oxic depositional environments and cannot be associated with thermal breakdown of HC. The close spatial association of uranium and organic matter resulted in the breakdown of aliphatic components *via* radiolytic cracking. A mechanism is proposed to explain the distributions and abundances of the *n*-alkanes and ketones.