Guffey SD, Piercey SJ, Ansdell K, Kyser TK, Kotzer TG, Quirt DH, Zaluski G, 2018, Geochemical footprint of the Millennium unconformity-type uranium deposit, Canada: implications for vectoring, Geochemistry: Exploration, Environment, Analysis, in press

The Millennium deposit, a c. 650-m deep monomineralic uranium deposit, is located in the southeastern Athabasca Basin, Saskatchewan, a region containing numerous highgrade unconformity-type U deposits. 3D modelling of the whole-rock lithogeochemistry of sandstones above the deposit reveals a distinct footprint with select major and trace elements showing increased concentrations towards mineralization. Molar Mg/K ratios increase from background levels 10 km north of the deposit, along the B1 conductive trend, whereas Mo, Co, Rb, and Ga exhibit elevated concentrations immediately above the deposit, extending vertically from the unconformity to surface. Lead, Ag, Bi, Sb, REE, and Y exhibit elevated concentrations up to 650 m above the main mineralized body. Increasing Mg/K values indicate the transition from diagenetic to hydrothermal alteration with shifts from illitic (K-dominant) to chloritic and dravitic (Mg-dominant) alteration, with the latter increasing more proximal to mineralization. Trace element enrichment patterns highlight that fractures and faults were conduits for fluid flow from the basement into the basin, both during ore formation and through tectonically driven postdepositional remobilization. Key indicators such as molar element ratios (Mg-K-Al) and trace elements related to redox reactions provide scalable vectors at the Millennium deposit that are likely applicable to similar unconformity-type U deposits elsewhere.

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