Lithostratigraphic and structural controls of uranium mineralization in the Kiggavik East, Centre and Main Zone deposits, Nunavut

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The Kiggavik uranium deposits are located in the central part of the Rae subprovince, approximately 80 km west of Baker Lake, Nunavut, and are primarily owned and operated by AREVA Resources Canada Inc. The deposits are hosted in highly-deformed Archean and Paleoproterozoic rocks proximal to, and underlying, the Thelon basin. The tectonic history of these rocks is remarkably protracted and complex, extending from the Archean (2.8 Ga) to the Mesoproterozoic (1.5 Ga). The tectonic complexity of the region has made identifying the relationships between rock units and the controls on U mineralization in the Kiggavik deposits difficult. The aim of this study is to determine the lithostratigraphic and structural relationships of rocks hosting the Kiggavik East, Main, and Centre Zone deposits. In 2015, detailed drill core investigation and mapping around the Kiggavik East, Main, and Centre Zone deposits reaffirmed the presence of <2.7 Ga metasedimentary rocks of the Archean Woodburn Lake group (WLg), ~2.6 Ga metavolcanic rocks of the Snow Island Suite (SIS), and quartzite belonging to the early Paleoproterozoic Ketyet River group (KRg). Furthermore, this study revealed that a unit of metavolcaniclastic rocks, inferred to be of epiclastic origin and part of the SIS suite, is more extensive than previously thought, occupying drill core intervals up to 100 m thick, and appears to be a major host of U mineralization. Drill core in the Kiggavik East area also shows that the KRg quartzite, and other rock types define a homoclinal sequence of alternating gently NNW-dipping units. Regional age and stratigraphic relationships indicate that there are numerous down-hole younging direction reversals suggesting that the stratigraphic repetition of units is tectonic. The tectonic repetition of stratigraphic units is also supported by the ubiquitous transposition of primary bedding and highly-strained contacts into being parallel to foliation as well as the presence of ENE-trending mesoscopic-scale isoclinal recumbent folds. The current geometry of these units is attributed to regional-scale, early, ductile D_1 or D_2 structures with sheath-style nappe folding along a décollement, with possible local over-thrusting of the basement unit. While U mineralization is localized in part along early ductile structures, especially in the epiclastic unit next to the quartzite, it also bears a close spatial relationship to larger regional-scale brittle structures (ENE- and NE-trending faults). The degree to which older, ductile structures versus younger, brittle structures control U mineralization remains unclear. Future study will be aimed at better determining the degree to which each of these structures control U mineralization.