Proterozoic (1.85-1.7 Ga) Granitoid Rocks and Uranium in the Baker Lake – Thelon Basin Region, Nunavut

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Summary

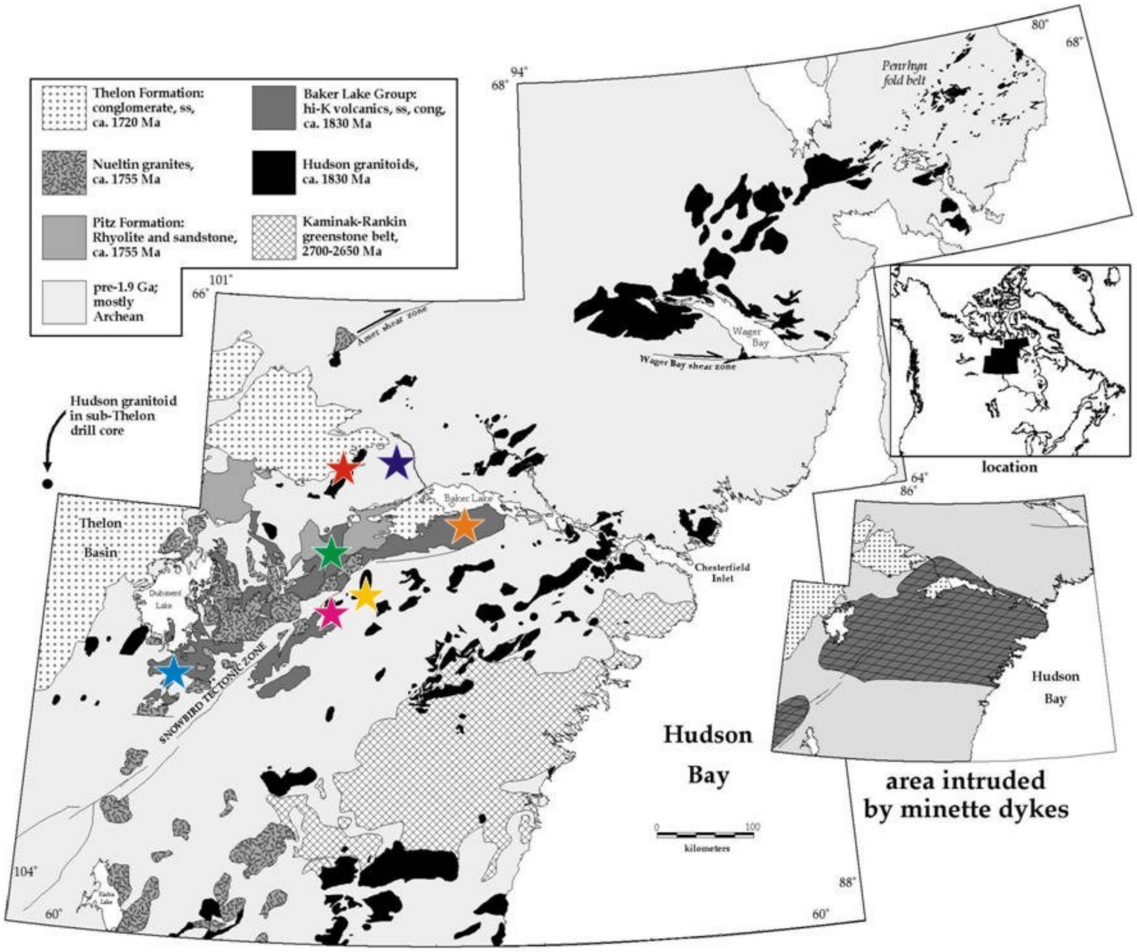
Areas prospective for U within the area encompassed by the Dubawnt Supergroup (DSG) in the Western Churchill Province contain two granitic suites: the Hudson suite (ca. 1.85-1.8 Ga), and the Nueltin suite ca. 1.75-1.7 Ga. The two suites have distinctive field relations and petrographic characteristics, but individual intrusions can have features of both suites, and U showings can be proximal to either suite. We present preliminary results of a study intended to resolve the ambiguous relationship to U mineralization in selected areas. The close association of the Nueltin (and comagmatic Pitz Formation rhyolite) with hypabyssal and surficial breccias, older and contemporaneous brittle faults, the Kiggavik Uranium Trend, the Nueltin Lake U-Au-Ag occurrence at Sandybeach Lake, and the Mallery Lake Au prospect indicate it is much more likely to be associated with additional undiscovered uranium and precious deposits.

Introduction

Following terminal collision in the Trans-Hudson orogen (THO), two regional granitic suites were emplaced in the Western Churchill Province (WCP) (Peterson and van Breemen, 1999). The older Hudson Suite (ca. 1.85 Ga – 1.8 Ga) is more extensive, with similar-aged plutons extending from the THO itself throughout the WCP and across Baffin Island through Greenland and into Baltica (Peterson et al., 2002). Within the central WCP, ultrapotassic (minette) dykes, plutons, and volcanic rocks of the Christopher Island Formation were emplaced/erupted at the same time. Identical-aged equivalents of these minette intrusives also are present in Greenland and Baltica. Some plutons are prospective for primary and secondary REE mineralization.

The younger Nueltin Suite (ca. 1.75 Ga-1.7 Ga) is much more restricted. Within the WCP it extends SSW through a corridor from the west end of Baker Lake towards Lake Athabasca. Within this corridor, Hudson suite plutons are rarely exposed, indicating that the corridor was down-faulted during or after Nueltin emplacement. Volcanic equivalents of the granites (Pitz Formation rhyolites) are present at the north end of the corridor but are absent at the south end, where the granites (e.g., in the type area, Nueltin Lake) are exceptionally coarse-grained and may contain pegmatitic biotite, indicating that down-faulting in the corridor was significantly greater at its northern end. Recent uranium exploration activity has been primarily conducted around the north end of the Nueltin corridor, where showings typically appear in or near Proterozoic granitoids/volcanics (Fuchs et al., 1986; Turner et al., 2003; Miller and LeCheminant, 1985).

Figure 1. Extent of granitic suites, ultrapotassic magmatism, and the Dubawnt Supergroup within the Western Churchill Province, ca. 1.85-1.65 Ga. Stars indicate the location of major U showings in this area from published data (see text). (red = Kiggavik, purple = Judge Sissons Lake, orange = Bissett Lake, green = Mallery Lake, yellow = Forde Lake, pink = Nutarawit Lake, blue = Kamilukuak-Noweleye Lake area)



Descriptions of the Granitoid Suites

Hudson Suite

The characteristics of the Hudson Suite are consistent with minimum granite melts of lower to middle crustal rocks, frozen into sill and laccolith forms. No extrusive equivalents of this suite have ever been identified. The plutons have unchilled margins, are rich in inherited xenocrysts such as zircons, and commonly bear a relic fabric inherited from wall rocks. The major mineral constituents are subequal plagioclase and potassium feldspar, with magnetite common and biotite content approaching 5%. The typically equigranular texture indicates that crystallization occurred over a narrow temperature interval. Compositions cluster around a point in Qz-Plag-Or space consistent with water-saturated minimum melts at ca. 20 kbar. Hudson samples have an initial Nd-isotopic composition nearly indistinguishable from wall rocks (van Breemen et al., 2005), and most lack significant Eu anomalies, have low Y contents and high LREE/HREE ratios (Peterson and van Breemen, 1999).

Hudson Suite plutons usually have a prominent positive magnetic signature which is isotropic, but reticulate or uneven on a scale of 0.5 km. As they usually form thin intrusions and have a granodioritic composition, they do not generally display gravity anomalies.

Nueltin Suite

The characteristics of the Nueltin Suite are consistent with rapakivi granites. Rapakivi texture is not extensively developed in the Nueltin Suite but is locally present. Nueltin plutons are typically stocks, with sharp, well-chilled contacts. Subvolcanic stocks are gradational to hypabyssal granite, rhyolite breccias, and rhyolite flows (Pitz Formation). Nueltin granites are porphyritic, with phenocrysts of alkali feldspar, plagioclase and quartz. Late-crystallizing biotite, often spatially associated with fluorite, is poikilitic with euhedral apatite, titanite and finely zoned zircon. Pitz rhyolites are usually porphyritic, but aphanitic rhyolite domes are present. Mingling between Nueltin granite and dioritic rocks is locally observed, and rhyolites contain microgabbro clots. These observations are consistent with the presence of a cogenetic basaltic magma which is exposed in a series of dykes at the north end of the Nueltin corridor, especially the McRae Lake dyke (LeCheminant et al., 1987).

Nueltin granites show a wide variation in composition which can be attributed to crystal fractionation and/or mixing with basaltic magma, are enriched in Th and U and have distinct negative Eu anomalies. The interpreted genetic model is that ponding of basaltic melt in the lower crust resulted in crustal melting, producing granite magmas which were locally superheated above the granite liquidus. Porphyritic textures were generated due to the wide temperature interval of crystallization, and enrichment in Th, U, and incompatible elements resulted from crystal fractionation.

Nueltin Suite plutons are magnetite-poor and do not generate magnetic anomalies, although some larger plutons are visible in anomaly maps as flat, low-susceptibility regions. However, even moderate-sized plutons are typically visible in gravity maps, due to their low density and significant depth to diameter ratios.

DSG Granites and U Showings: Examples

The Kiggavik (Lone Gull) uranium deposit has pitchblende disseminated partly within fluorite-bearing Lone Gull granite (Weyer et al., 1987) which has been interpreted as a Nueltin granite. Miller and LeCheminant (1985) record thermally altered miarolitic fluorite-bearing granites as potential source rocks for U-bearing polymetallic systems, citing vein U + Cu mineralization northwest of Forde Lake. In the Nueltin Lake area, west of Sandybeach Lake, Au-Ag showings occur in calc-silicate floats which are proximal to tourmaline-rich, uraniferous granite (Charbonneau and Swettenham, 1986). The Mallery Lake Au-Ag deposits are within quartz-chalcedony epithermal stockworks, hosted dominantly in fluorite-bearing Pitz Formation rhyodacite (Turner et al., 2003). Locales with substantial glass-rich Pitz Formation volcaniclastic deposits are also prospective source areas for uranium upon its release from devitrifying volcanic glass, drawing analogues from the Duobblon occurrence in northern Sweden (Miller and LeCheminant, 1985).

Typical Suite Distinctions

	Hudson Suite	Nueltin Suite
Contacts	Not chilled; locally gradational; numerous concordant apophyses; no alteration	Strongly chilled, never gradational; discordant apophyses; alteration of country rocks and adjacent pluton includes sulphide minerals.
Pluton forms	Mainly concordant; large sills or laccoliths most common	Discordant; stocks common; subvolcanic intrusions may be more sill-like
Extrusive forms	none	Porphyritic and crystal-free rhyolite; rhyolite breccia
Fabrics	Weak to moderate inherited foliation (biotite)	Crude igneous layering possible (phenocryst alignment)
Grain size	Usually fine to medium grained, locally pegmatitic	Fine (hypabyssal) to extremely coarse (plutonic or porphyritic hypabyssal)
Grain size distribution	Typically equigranular; may be weakly porphyritic at margins	Typically strongly porphyritic except in minor (filter-pressed?) apophyses and superheated rhyolites

Mineralogy	Dominantly plagioclase, quartz, and alkali feldspar; minor biotite and magnetite	Dominated by sanidine and quartz phenocrysts, subordinate plagioclase
Zircon grains	Cloudy, complex, subhedral	Clear, zoned, euhedral
Associated magmas	Minette plutons (Martell Syenite); mingling observed	Fractionated basalt (diorite/diabase) (McRae Lake Dyke); mingling observed in plutons and rhyolites
Magnetic	Strong reticulate pattern (magnetite)	Weak or none (magnetite is an uncommon component)
Gravity	Signature weak or absent (thin plutons, low density contrast with wall rocks)	Strong negative signature (stocks with strong lower density contrast)

The Hudson granitoids, emplaced in middle crust in ductile-deformed rocks, are much less prospective than the Nueltins, emplaced in previously brittle-faulted terrane in the upper crust to near-surface grading to extrusive Pitz rhyolite. Nueltin granite can easily be discerned by a strongly porphyritic character; chilled, discordant contacts; and lack of deformation.

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