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Abstract

This study, a part of the GEM2 South Rae Mapping Project, was carried out during 2015 and 2016 in the southeastern portion of the Canadian Northwest Territories, in the area comprising the South Rae craton (NTS map sheets 75B, H, G, A). During the regional mapping four new radiometric anomalies were recognized and several locales of hydrothermal alteration were outlined. All the radiometric anomalies are located in the northeast (Gemelo showing) and southwest (Sarita, Hidden, Triple-X) portions of NTS 86B along the Black Bay fault. Regional geochemical assay samples were taken to investigate the metal signature of rocks at these locales and in potentially prospective samples throughout the study area.

Here we report concentrations for major, trace, rare earth, and platinum group elements, and precious and base metals of 65 samples, including a number showing anomalous concentrations. We report the first ever showings in NTS 86B and G: new REE (Gemelo; 0.8 wt.% REE) showing. The Gemelo showing occurs nearthe northeastern terminus of the Black Bay fault. The geochemical results obtained from material collected at the southwest Black Bay fault radiometric anomalies show no particular U, Th and rare earth element enrichments.

Introduction

The western Churchill Province, west of Hudson Bay, comprises dominantly Archean rocks of the Rae and Hearne cratons (Hoffman 1988), and the intervening Chesterfield block (Berman et al. 2007). Rocks from the Rae craton have been affected by multiple Archean and Paleoproterozoic orogenic events (Berman et al. 2007) and Paleoproterozoic rifting with development of marginal sedimentary basins (Rainbird et al. 2010).

The South Rae mapping project is located in the southeast portion of the Northwest Territories in the Rae craton of the Churchill Province (Fig. 1). This area of the Northwest Territories has seen little research since it was first mapped by canoe and float plane at reconnaissance-scale in the 1950-1960s. The new, three-year, 1:250,000 scale South Rae bedrock mapping project of the Geological Survey of Canada's Geo-mapping for Energy and Minerals program was initiated, in collaboration with the Northwest Territories Geological Survey, to improve understanding of the South Rae tectonic evolution and economic potential, and its role in the assembly of the Canadian Shield.

Field work was conducted in 2015 and 2016 and focused on the NTS 75A, B, G and H map sheets in order to provide insights on new, informally named geophysically and isotopically defined domains, each with a distinct record of magmatic and tectonometamorphic events and metallogenic

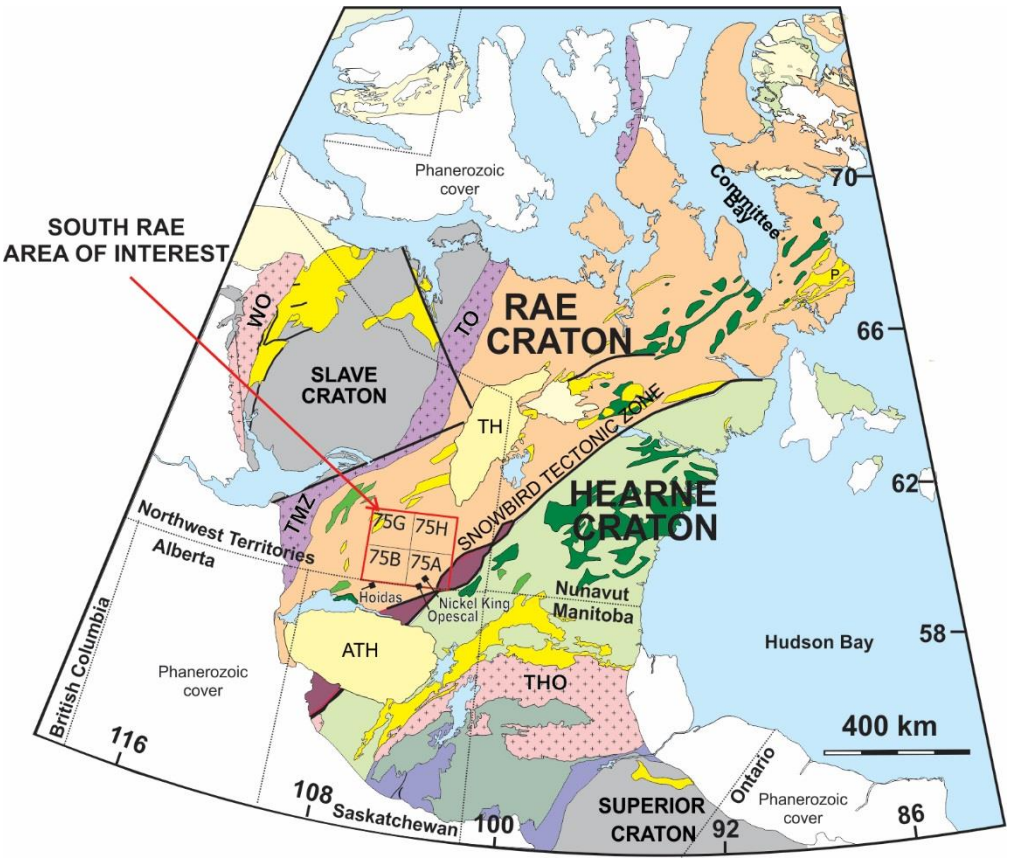

Figure 1. Simplified geological map of the Rae Craton in relation to the Hearne, Slave and Superior cratons and the bounding orogens (TO: Thelon Orogen, TMZ: Taltson Orogen, THO: Trans-Hudson Orogen). Location of the major deposits in or surrounding our map area are indicated (Ni-Cu: Opescal and Nickel King; REE: Hoidas). The area of interest shown in red outlines area of 2015 and 2016 fieldwork.

potential (Pehrsson et al., 2015; Martel et al., 2015; Percival et al., 2016; Martel et al., 2016; Fig. 2). Relevant to this study are the Snowbird and MacCann domains (Fig. 2)

In our map area, the most significant known deposit type is ultramafic-hosted Ni-Cu mineralization such as the Nickel King and the Opescal deposits located in the Snowbird domain. The Nickel King deposit has a NI 43-101 compliant geological resource model (PEG Mining Consultants, 2010) that yielded 11.1 Mt grading at 0.40 wt.% Ni, 0.10 wt.% Cu and 0.018 wt.% Co containing 44,500 t of Ni, 10,600 t of Cu and 2,200 t of Co in the indicated category. The total inferred resource of the Nickel King deposit is 33.1 Mt grading at 0.36 wt.% Ni, 0.09 wt.% Cu and 0.017 wt.% Co containing 119,300 t of Ni, 29,000 t of Cu and 5,600 t of Co. The reported base case resource was determined at a 0.2 wt.% Ni cut-off.

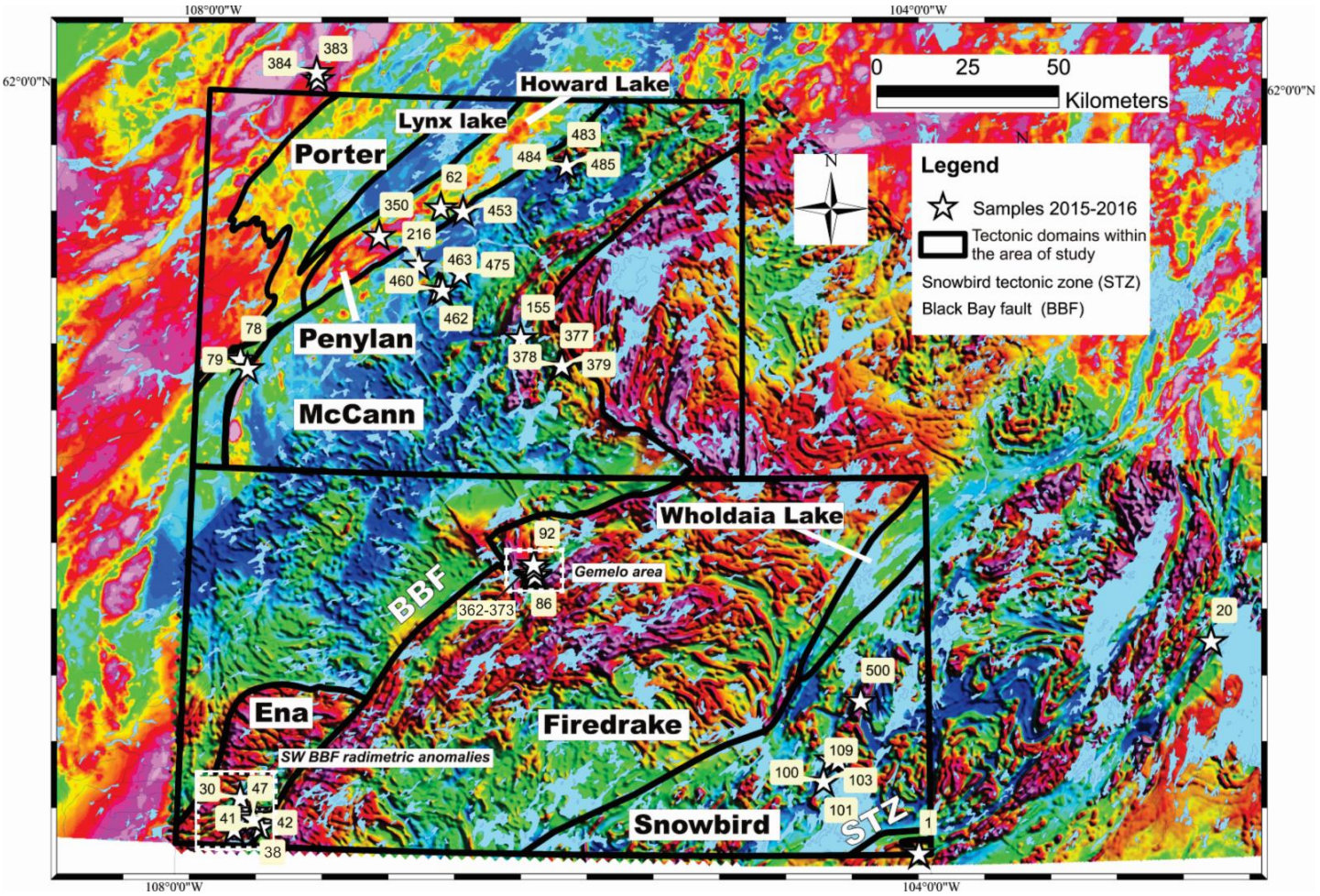

Figure 2. Location of the geochemistry samples collected during the 2015 and 2016 field mapping campaigns are shown by the star symbols. Domain boundaries shown as black lines after Martel et al. (2015) and Martel et al. (2016). Shaded residual total magnetic field map after Kiss and Coyle (2012). Samples with map numbers between 86 and 92 (2015 field season) within the Gemelo area are not labelled in the map, but their locations (stars) are shown. In the same area, samples with map numbers from 362 to 373 (2016 field season) are not individually labelled due to the scale of the map. The white rectangles show the area where radiometric anomalies were found; individual locations of the anomalies are not labelled due to the scale of the map. All sample and radiometric anomaly locations are in Appendix 1, Abbreviations: BBF, Black Bay fault; STZ, Snowbird Tectonic Zone. identified. A. Outcrop where sample 15PA385B was collected which returned 0.9 wt.% rare earth elements (Gemelo showing). B. Hydrothermal vein with clinopyroxene, hyalophane and allanite cutting a syenite intrusion at the Gemelo showing. C and D. Outcrops where Sarita radiometric anomaly was identified. E. Outcrop photograph of the diorite (sample 16DJ139A) with elevated Au concentrations. F. Rusty diorite from which sample 16DJ139A was collected. Abbreviations: cpx, clinopyroxene; mag, magnetite; allanite, aln; hyap, hyalophane.

Figure 3. Field photographs of outcrop where showings and radiometric anomalies where identified. A.Outcrop where sample 15PA385B was collected which returned 0.9 wt.% rare earth elements (Gemelo showing). B. Hydrothermal vein with clinopyroxene, hyalophane and allanite cutting a syenite intrusion at the Gemelo showing. C and D. Outcrops where Sarita radiometric anomaly was identified. E. Outcrop photograph of the diorite (sample 16DJ139A) with elevated Au concentrations. F. Rusty diorite from which sample 16DJ139A was collected. Abbreviations: cpx, clinopyroxene; mag, magnetite; allanite, aln; hyap, hyalophane.

South of our map area in Saskatchewan, the Hoidas Lake property consists of 11 claims covering about 30 historical REE showings distributed along and adjacent to the Nisikkatch–Hoidas Shear Zone

(Harper, 2012). Recent work by Great Western Minerals Group (GWMG) focussed on the JAK Zone where a REE deposit has been outlined and contains a NI 43-101 compliant total resource of 2,560,835 tonnes at 2.03 wt.% total rare earth element (Barr Engineering, 2014). The REE are concentrated in hydrothermal diopside-hyalophane veins, hyalophane-allanite pegmatitic granitic dykes, and apatite breccia.

This study reports the results of geochemical analyses for major, rare earth (REE), and platinum group (PGE) elements and base and precious metals of 65 samples. Also reported are four new radiometric anomalies identified along the northeastern and southwestern trace of the Black Bay fault (Fig. 2). The samples were collected during regional mapping in the project area during 2015 (year 1) and 2016 (year 2).

Sampling procedure

Fifty-five samples were collected on daily traverses during regional mapping (Fig. 2). Additionally, ten drill-core samples from the Strongbow Exploration Inc. collection of the Nickel King deposit (Thye Lake area) were acquired as part of a targeted study (Appendix 1; Fig. 2). The samples are briefly characterized in this report according to their field descriptions (Appendix 1). The majority of the samples collected during traverses are fist-sized hand-samples that weigh between 0.3 and 1 kg and the remainder consist of multiple chip fragments.

Samples were sent either to Activation Laboratories Ltd. in Ancaster, Ontario or to ALS Global Laboratory in Vancouver, British Columbia for geochemical analyses. The specimens were crushed and pulverized at the laboratories facilities (see details in Appendix 2). Gold and PGE values were obtained for selected samples via instrumental neutron activation analysis (INAA; for Au) and fire assay in combination with other mass spectrometry techniques (Au-PGE) (Appendix 2). Rare earth and other trace elements and base metals were acquired by four-acid digestion or fusion combined with inductively coupled plasma spectrometry (Appendix 2). The geochemistry results and the respective locations (UTM coordinates, Zone 13 NAD 83) are presented in Appendix 1, and the analytical methods and their analytical detection limits are given in Appendix 2.

For a result to be considered as an ‘anomalous’ occurrence (or new mineral showing), this must have elemental values that meet or exceed the Minimum Commodity Grades for NORMIN showings as defined for NWT mineral showing database (NORMIN). The full listing is found at http://old.nwtgeoscience.ca/normin/cutoffs.html. Values referred to as ‘elevated’ in the text are below the Minimum Commodity Grade values, yet elevated relative to other samples from this study.

The radiometric measurements were obtained with a RS-230 BGO Super–SPEC handheld gamma ray spectrometer during the daily traverses. The term "radiometric anomaly" is used for a measurement where the record of counts per second (cps) is at least 3 times greater than the background rocks (commonly ~200-300 cps). The instrument was calibrated every morning before a measurement was taken.

Results

Geochemistry

Results from the study area show locally anomalous REE and Sn and one sample with elevated Au values. In the northeast section of the Black Bay fault a series of syenite-hosted REE anomalous (up to 0.9 wt.% REE; minimum cutoff value of 0.2 REE wt.%) clinopyroxene-hyalophane-magnetite-allanite veins and pods where recognized and termed as the Gemelo area (Figs. 2; 3A, B; Acosta-Gongora et al., 2017). Some of the Gemelo samples also contain elevated amounts of Ba (>1 wt.%) that is contained in hyalophane (Ba-rich K-feldspar). Various radiometric anomalies in the area of the Gemelo showing were recorded in association with the mineralized veins and pods (up to 1362 cps). The southwest portion of the Black Bay fault hosts the Sarita (up to 11 000 cps), Hidden (1342 cps) and Triple X (1676 cps) radiometric anomalies (Figs. 2 and 3C, D); however, geochemistry samples taken from these radiometric anomalies have REE, Th and U concentrations at background values or slightly above. At these locations, only weathered rock fragments were sampled (Fig. 3D). Therefore, it is possible that enriched material lies a few centimeters below the weathered rock surface. The host for these anomalies is a highly strained metagranodiorite with variable overprints of potassic and sodic alterations. Notably, in the Howard Lake domain, sample 16PA11B (map number 350; Fig. 2) has elevated REE (0.07 wt.% REE) values relative to the other rocks collected in the 2016 field season.

The sample containing elevated Au (0.38 ppm; minimum cut-off value of 0.5 ppm) was taken in the vicinity of the Black Bay fault (McCann domain; Fig. 2) from an oxidized surface of a pyrite-bearing dioritic unit (Fig. 3E,F). Lake sediments from this region also show elevations in Au, suggesting further potential for showings along this important structure.

Conclusions

We present major and trace element, REE, base metal, PGE and Au geochemical results from 65 samples collected during regional bedrock mapping. This study highlights two new REE and Sn showings, and

4 new radiometric anomalies and one elevated Au occurrence. Our new discoveries show that the host rocks and fault system that host the Hoidas REE deposit in Saskatchewan are continuous into the NWT and extend through our map area. In addition, this study highlights the economic potential of the McCann domain for Sn.

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