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FROM ROCKS COLLECTED IN 2015 IN THE  
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# MAJOR-OXIDE AND TRACE-ELEMENT GEOCHEMICAL DATA FROM ROCKS COLLECTED IN 2015 IN THE WRANGELLIA MINERAL ASSESSMENT AREA, ALASKA

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## INTRODUCTION

Late Triassic mafic to ultramafic intrusions in the Wrangellia terrane are host to magmatic sulfide nickel–copper–cobalt and platinum-group element (PGE) mineralization (for example, Greene and others, 2005). The mafic intrusions of the Yukon Territory’s Kluane ranges have been extensively studied and explored in the vicinity of the Wellgreen Ni–Cu–Co–PGE deposit (Hulbert, 1997); in Alaska, this includes several prospects in the Mount Hayes Quadrangle in the eastern Alaska Range (Bittenbender and others, 2007; Barker, 1988). Mapping in the Talkeetna Mountains B-4, B-5, C-4, and C-3 quadrangles (Twelker and others 2015; Werdon and others, 2002; Schmidt and others, 2003) and geophysical interpretation (Glen and others, 2007) show that these mafic–ultramafic intrusions and their extrusive equivalent, the Nikolai Greenstone, continue at least 60 km to the southwest of the previously-mapped extent shown by Csejtey and others (1978). To extend our understanding of the mafic–ultramafic complexes as well as to improve mapping, the Alaska Division of Geological & Geophysical Surveys (DGGS) undertook the task of compiling previous data as well as field mapping to the east of the previous years’ projects.

DGGS’s mineral-resources group carried out a geologic mapping project in the eastern Denali Highway region between Watana Creek and Paxson from July 29 through August 7, 2015. This project is part of a multi-year effort focusing on improving the publicly available geological and geochemical data and assessing the mineral potential of the less-explored extension of the western Wrangellia terrane; other data resulting from this project include geophysical surveys and several geochemical datasets (Burns, and others, 2014; Twelker, and others, 2014; Werdon, and others, 2014; Wypych, and others, 2014). This program of geologic mapping and rock sampling was conducted as part of the State of Alaska’s *Strategic and Critical Minerals Assessment* project, an initiative designed to evaluate Alaska’s potential for rare-earth elements, PGEs, and other similarly supply-challenged resources.

Highlights of this project include identification, sampling, and characterization of a broad section of Wrangellia stratigraphy, including Late Triassic ultramafic and mafic intrusions thought to be a part of the Ni–Cu–Co–PGE- and Cu–Ag-mineralized Wrangellia large igneous province. This dataset includes four samples with high copper values (1.6 to 4.62 percent) and elevated silver values (10.15 to 18.25 ppm) and two samples have elevated copper (1,400 and 4,610 ppm); those samples are scattered throughout the area. Two samples (15ET101 and 15ET102) from the Caribou Dome area show elevated platinum (0.113 and 0.101 ppm) and palladium (0.141 and 0.193 ppm).

To accurately understand and represent the complexity of the mafic–ultramafic systems in the region we analyzed more than 100 samples for major oxides. In addition to finding dunite and the typical basalts, we found a significant amount of picrite.

Eight samples from the Caribou Dome (also known as Denali Copper) underground workings were obtained from the University of Alaska Fairbanks collection (15RN361, 15RN362, 15RN363, 15RN364, 15RN365, 15RN366, 15RN367, and 15RN368). Those samples are characterized by very high Cu concentrations (0.46 to 20.6 percent) and elevated Ag (3.4 to 54.4 ppm).

The analytical data tables associated with this report are being released in digital format as comma-delimited text (CSV) files. Additional details about the sampling project can be found in the metadata file associated with the digital version of this report, which is available from the DGGS website (doi:[10.14509/29518](https://doi.org/10.14509/29518)).

## DOCUMENTATION OF METHODS

### SAMPLE COLLECTION

**Rock samples** were collected for two different purposes. First, samples of visibly mineralized or altered rock were preferentially collected and analyzed for trace-element geochemistry. Second, igneous and meta-igneous rocks showing little alteration or weathering were collected for whole-rock major-oxide, minor-oxide, and trace-element analyses to aid in classification and study of petrogenesis and tectonic setting. Most samples are ‘grab’ samples, which were collected for their overall representation of the outcrop. However, a few samples are ‘select’ samples, which were deliberately collected from a specific feature, as noted in the sample field description.

**Location data** were collected using Trimble Juno T41/5 WAAS-enabled GPS devices running ArcGIS for Windows Mobile. Data were merged into an ArcGIS geodatabase. WAAS-enabled GPS devices have a reported error of about 1 m. Latitude and longitude are reported in the WGS84 datum.

**Magnetic susceptibility measurements** were collected using Terraplus KT 5, 6, 9, and 10 model handheld magnetic susceptibility meters. The values reported here are the average of four individual measurements performed on representative surfaces of the sampled rock outcrop.

### SAMPLE PREPARATION

**Rock samples** were processed by ALS Minerals using their PREP-31 package. The samples were crushed to better than 70 percent passing 2 mm, and a 250 g split was pulverized to better than 85 percent passing 75 microns. Prior to crushing, samples for whole-rock analysis were trimmed by DGGS staff to remove weathering, and cut surfaces were sanded to remove any saw metal.

### ANALYTICAL METHODS

Samples were analyzed for a variety of suites of major and trace elements depending on the sample type. In addition to ALS Minerals’ accredited (ISO/IEC 17025–2005) internal quality-control program, DGGS monitored analysis quality with one standard reference material per batch of 20 analyses.

- a. Major- and trace-element including rare-earth element compositions for rock samples were determined by ALS Minerals method ME-ICP61r: Four-acid digestion followed by inductively-coupled plasma–atomic emission spectrometry (ICP-AES) and inductively-coupled plasma–mass spectroscopy (ICP-MS).
- b. Platinum, palladium, and gold values were analyzed by 30 g fire assay with ICP-MS finish (ALS Minerals method PGM-MS23).
- c. Samples that exceeded detection limits for elements of interest were reanalyzed using specific elemental tests. Over-limit values for Cu were reanalyzed using four-acid digestion and ICP-AES (ALS Minerals procedure ME-OG62).
- d. For whole-rock geochemistry samples, major and minor oxides were analyzed by lithium metaborate fusion digestion and ICP-AES (ALS Minerals method ME-ICP06). Trace elements, including rare-earth elements, were determined using lithium metaborate fusion digestion and ICP-MS (ALS Minerals method ME-MS81). Ag, Cd, Co, Cu, Li, Mo, Ni, Pb, Sc, and Zn were determined by four-acid digestion and ICP-AES (ALS Minerals method ME-4ACD81); and As, Bi, Hg, In, Re, Sb, Se, Te, and Tl were determined by aqua regia digestion followed by ICP-MS (ALS Minerals method ME-MS42). Total C and S were analyzed by LECO furnace (ALS Minerals method C-IR07 and S-IR08, respectively).

For each sample, data tables either contain assay values or they contain coded-value place holders (null = not analyzed; -1 = the element’s assay result is less than the lower detection limit for the method; -2 = the element’s assay result is greater than the upper detection limit for the method). Detection limits for each of the reported elemental values obtained by the various methods are documented in the metadata file.

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