ELECTRON PROBE MICROANALYZER DATA COLLECTED ON SAMPLES FROM THE CHENA AND STEESE PROJECTS, YUKON-TANANA UPLANDS, ALASKA

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ELECTRON PROBE MICROANALYZER DATA COLLECTED ON SAMPLES FROM THE CHENA AND STEESE PROJECTS, YUKON-TANANA UPLANDS, ALASKA

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INTRODUCTION

During the 2024 field season, geologists from the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted 1:100,000-scale bedrock geologic mapping of a 9,635 km^2 (~3,720 mi^2) area of the Yukon-Tanana Uplands of eastern Interior Alaska, including parts of the Big Delta, Circle, Fairbanks, and Livengood quadrangles (fig. 1). The field area for the Steese project stretches from 25 miles west of Fairbanks to 100 miles northeast of Fairbanks. The Chena project area stretches approximately 50 miles south and east of Chena Hot Springs. These projects will improve our understanding of the geologic framework of Alaska, result in the publication of more accurate and modern geological maps, and promote mineral resource exploration in eastern Interior Alaska (Buchanan and others, 2025; Moshrefzadeh and others, 2025).

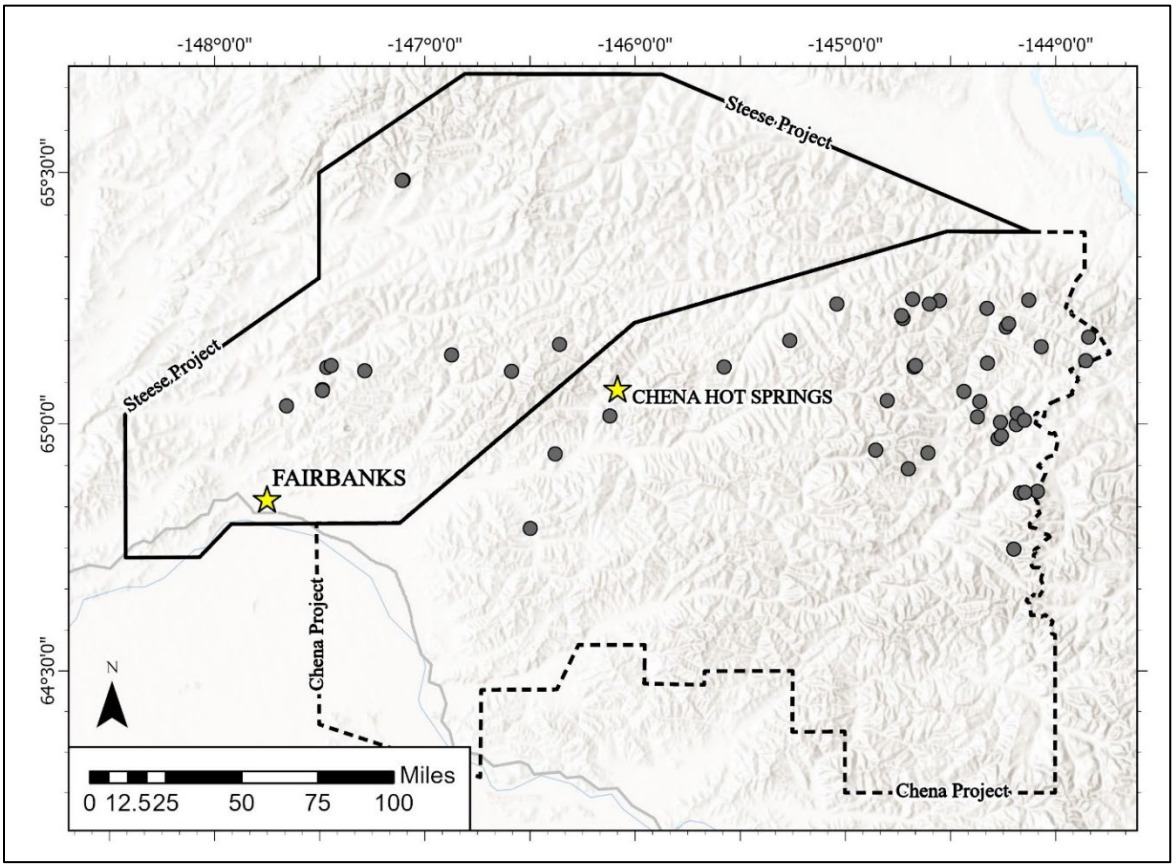

Figure 1. Station locations (gray points) corresponding to the samples analyzed with the electron probe microanalyzer (EPMA) in this study. The black solid line and the black dashed line represent the Steese and Chena project outlines, respectively.

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This report provides electron probe microanalyzer (EPMA) geochemical data for individual mineral phases targeted in selected rock samples collected during the 2024 field season, along with one sample each from the 2023 and 1995 field seasons. EPMA is an analytical technique in which X-rays are excited by an electron beam. When introduced to an electron beam, each element produces X-rays with characteristic wavelengths. Therefore, EPMA allows for non-destructive quantitative analysis by comparing wavelength intensities of samples to those emitted from standards of known composition (Reed, 2005).

The elements analyzed are presented as weight percent (wt.%) oxide (for most samples Na_2O, MgO, Al_2O_3, SiO_2, K_2O, TiO_2, CaO, FeO, and MnO; for ultramafic samples Cr_2O_3 instead of TiO_2 and NiO instead of K_2O). We do not report concentrations for elements present below detection limits—for example, TiO_2, MgO, and MnO in plagioclase. The lithologies selected for electron microprobe analyses presented in this report include ultramafic, amphibolite, eclogite, schist, syenite, and paragneiss. The mineral phases analyzed from these samples include feldspar, amphibole, pyroxene, olivine, spinel, mica, garnet, epidote, chlorite, ilmenite, rutile, tourmaline, serpentine, and aluminosilicates. The geochemical data associated with this report are available digitally and as a comma-separated value (CSV) file that can be downloaded from https://doi.org/10.14509/31537.

STUDY OBJECTIVES

We acquired quantitative data as a check on previously acquired energy-dispersive analyses and for the following five objectives.

1. To better characterize ultramafic and meta-ultramafic rocks from the Seventymile Terrane (Dusel-Bacon and others, 2006, and references therein) to compare them to meta-ultramafic rocks of uncertain origins in the Harper (2022), Chena (2023), and Steese (2024) Earth MRI project areas in the Yukon-Tanana Uplands.
2. To better characterize eclogitic and schistose rocks from the Chatanika assemblage (Dusel-Bacon and others, 2006, and references therein). The eclogitic rocks include so-called "garnet amphibolite" (Swainbank and Forbes, 1975), leading to confusion concerning the actual metamorphic facies (i.e., eclogite versus amphibolite) for the assemblage. Our goals were to determine if the amphiboles were low-Ca types not generally associated with amphibolite-facies rocks and to attempt pressure-temperature estimation (e.g., Krogh, 1988; Pattison and Newton, 1989) based on clinopyroxene-garnet analyses.
3. To determine plagioclase and amphibole compositions from amphibolite samples in the 2024 study area. Newberry and Twelker (2021) demonstrate that compositions of these minerals could help distinguish between Fortymile River and Lake George assemblage amphibolites (terminology of Dusel-Bacon and others, 2006). Twelker and others (2025) show that Fairbanks–Chena assemblage units (terminology of Dusel-Bacon and others, 2006) occur in an area previously mapped as Lake George assemblage in the Richardson district. The results of this study will allow us to determine if such discrimination can also be applied to

Fairbanks–Chena amphibolite. We also checked the validity of energy-dispersive analyses of previously analyzed rocks.

4. To determine pressure-temperature conditions for representative samples from the study area based on garnet-biotite geothermometry (Hodges and Spear, 1982; Perchuk and Lavrent'eva, 1983) and plagioclase-garnet-mica ± aluminosilicate ± ilmenite geobarometry (Bohlen and others, 1983; Koziol and Newton, 1988). We wished to determine if Fairbanks–Chena assemblage rocks yielded lower pressure-temperature conditions than those of the Lake George assemblage, as suggested by previous studies (Newberry and others, 1996; Graham, 2002).
5. To characterize mafic mineral compositions from two samples from the Roy Creek alkaline intrusion. Burton (1981) suggested that aegirine-augite and ekermanite were present, but insufficient documentation to support the presence of these phases has led to confusion. This study aims to remedy these issues.

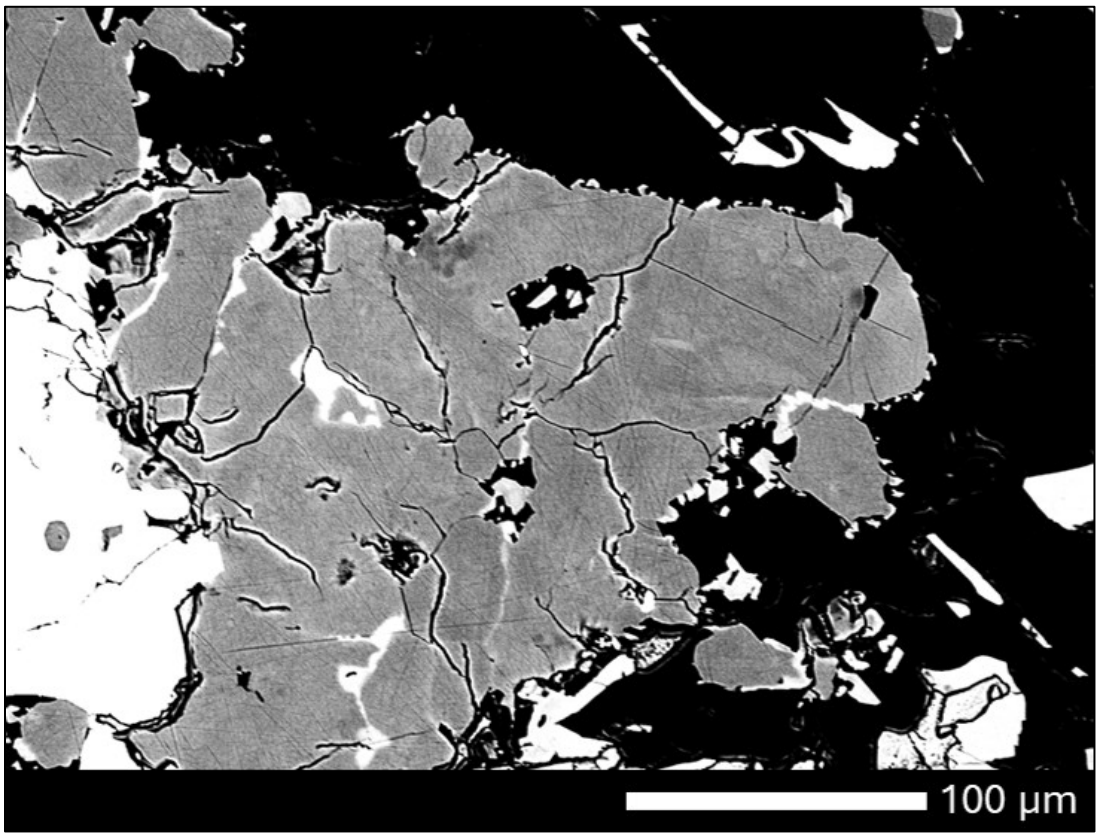

Figure 2. Backscattered electron image of a clinopyroxene aggregate (medium gray) analyzed in this study.

DOCUMENTATION OF METHODS

Of the 2,606 samples collected during the 2024 field season, 357 petrographic thin sections were made from samples of interest. Of these, 212 were appropriately polished for microprobe studies. In addition, one polished thin section from the 1995 Fairbanks project (95SL146) was

selected for quantitative analysis. All thin sections were then carefully studied and further characterized with a petrographic microscope; 70 were selected for microprobe analysis. Most of the polished sections were examined with semi-quantitative energy-dispersive techniques to check that the appropriate minerals and/or assemblages were present for quantitative analysis. We recorded coordinates of specific areas for further examination and generated backscattered electron images (fig. 2) of areas during the semi-quantitative analyses to use as references for the quantitative microprobe analyses.

We conducted quantitative geochemical analyses of individual mineral phases at the University of Alaska Fairbanks (UAF) Advanced Instrumentation Laboratory (AIL). The UAF AIL is equipped with a JEOL JXA8530F EPMA, which is automated with Probe for EPMA software (Donovan and others, 2011). Depending on the composition of the targeted mineral phase, we used either a 20 KeV, 20 nA, and 10 mm working distance focused beam; 20 KeV, 10 nA, and 10 mm working distance focused beam; or a 15 KeV, 10 nA, and 10 mm working distance 2 μm beam for quantitative analyses. We employed well-characterized natural mineral standards, including olivine, augite, diopside, enstatite, plagioclase, albite, alkali feldspar, hornblende, biotite, garnet, wollastonite, ilmenite, and chromite. Mineral compositions were obtained from raw counts using ZAF correction that is automated in the Probe for EPMA software that considers the effects of atomic number, absorption, and fluorescence excitation on characteristic X-ray intensities of the analyte.

Separate locations within petrographic thin sections were identified as target areas based on the presence of multiple mineral phases within the analytical viewing window. Within these areas, mineral phases of interest were identified for quantitative analyses. Depending on the size and abundance of the mineral phase, crystals were analyzed with two to nine individual EPMA spot analyses to effectively characterize their composition.

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