CHAPTER A: INTRODUCTION TO THE NORTHEAST TANACROSS GEOLOGIC MAP

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INTRODUCTION

The Mineral Resources section of the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted 500 mi^2 of 1:63,360-scale geologic mapping in the northeastern Tanacross Quadrangle (Tanacross D-1, and parts of the C-1, C-2, and D-2 quadrangles), located 15 miles southeast of Chicken, Alaska (fig. 1). The project took place during two periods: a reconnaissance mapping effort June 12–22, 2017, and a detailed campaign June 18–July 16, 2018. This map is located within an area of current industry interest; it includes the Taurus porphyry copper-gold-molybdenum ± rhenium deposit and several other occurrence types including gold, copper, and molybdenum in porphyritic intrusions, structurally controlled silver-lead-zinc prospects, and placer gold deposits (fig. 2). The economic value of the map area is described in detail in chapter F of this report (Twelker and Newberry, 2021), whereas the geochemical properties, similarities, and differences of the intrusive sites are addressed in chapter E (Wypych, 2021).

Prior to DGGS work in the area, the most-detailed mapping was a reconnaissance map at 1:250,000 scale (Foster, 1970). The region also was the focus of a detailed structural study (Hansen and Dusel-Bacon, 1998). In the decades following publication of Foster's map, U.S. and Canadian researchers established a regional geologic and tectonostratigraphic framework (for example, Colpron and others, 2006; Dusel-Bacon and others, 2006) that involves two fundamental components: the allochthonous Yukon-Tanana terrane (YTT) and the parautochthonous North American margin (pNA) from which the YTT initially rifted, and to which it was eventually re-accreted. The boundary between the allochthonous YTT and pNA is one of the fundamental suture zones in the northwestern Cordillera. It has a complex, multiphase structural and metamorphic history (Hansen and Dusel-Bacon, 1998), and the northeastern Tanacross Quadrangle is one of the rare areas in which it is exposed. The conceptual framework has been developed in the literature but it is not fully represented in published geologic maps of eastern Alaska (for example, Wilson and others, 2015). Chapters C and D (Naibert and others, 2021; Naibert, 2021) addresses the newest structural findings as well as detailed mapping of the YTT/pNA boundary in the area using $^{40}Ar/^{39}Ar$ dating techniques in conjunction with field data. Recent detailed studies in the northeastern Tanacross and adjacent area include geophysical surveys (Emond and others, 2015; Burns and others, 2011, 2015; fig. 2). These studies can be used for three-dimensional magnetic modeling of features present under the surface, as shown in chapter G (Emond and Wypych, 2021). The complexity of the geophysical data, ongoing U.S. Geological Survey (USGS) studies (Jones and others, 2017a, 2017b), previous 1:63,360-scale mapping in the Eagle A-1 and A-2 quadrangles immediately to the north (Szumigala and others, 2002; Werdon and others, 2001) and resurgent mineral industry interest in the area prompted DGGS to conduct new 1:63,360-scale geologic mapping in this area (chapter G; map sheet 1 in chapter B).

GEOLOGIC BACKGROUND

The northeastern Tanacross Quadrangle is characterized by a very complex geologic history, which can be distilled to four main periods. Prior to the Late Devonian the region experienced passive margin deposition equivalent

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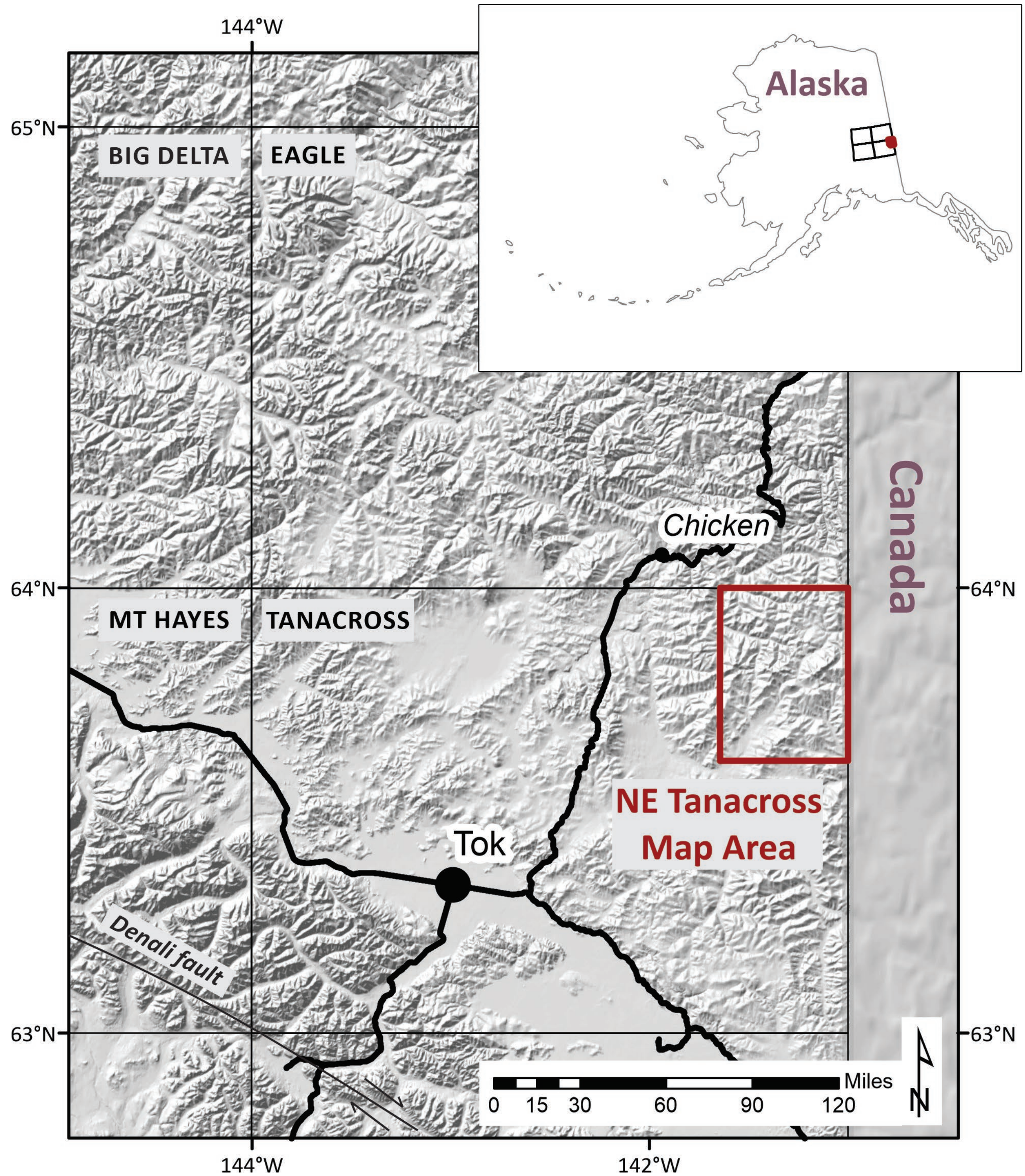

Figure 1. Location of the Northeast Tanacross geologic map area, Tanacross D-1, and parts of the C-1, D-2, and C-2 quadrangles, Alaska.

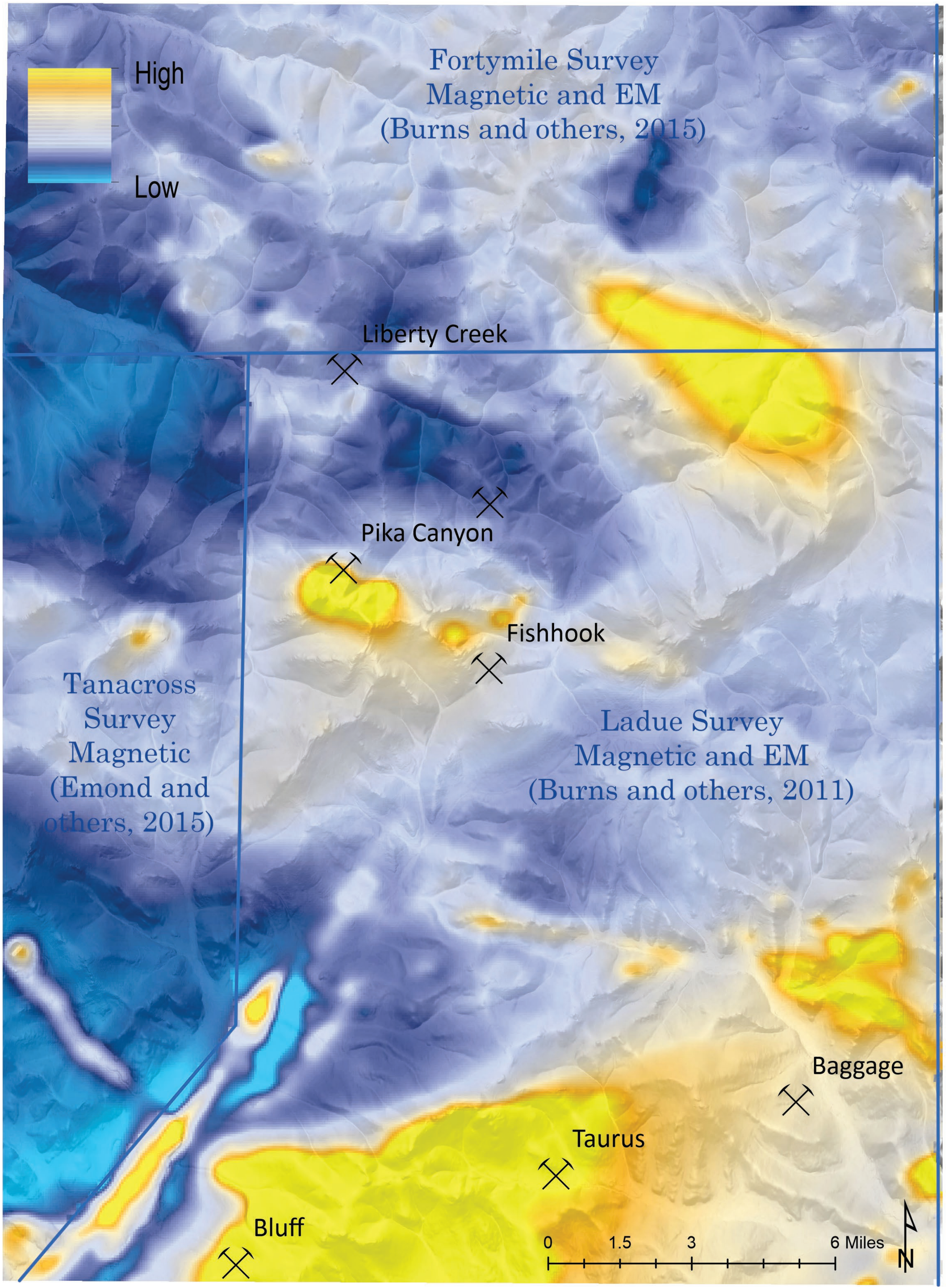

Figure 2. Magnetic surveys overlain on hillshade relief map with location of main prospects in the Northest Tanacross map area.

to Selwyn basin. In the Late Devonian to Early Mississippian the YTT rifted away from the North American margin, which resulted in a major magmatic episode, emplacing plutons and depositing volcanic rocks, and in the formation of an ocean basin—the Slide Mountain/Seventymile ocean (Dusel-Bacon and others, 2013). From the Mississippian through the Permian, the YTT underwent multiple episodes of arc magmatism while pNA was magmatically quiet. During the Permian the Slide Mountain/Seventymile ocean was consumed by subduction beneath the Klondike arc, and prolonged re-accretion of YTT began (Dusel-Bacon and others, 2013; Beranek and Mortensen, 2011). This resulted in polydeformed metamorphic rocks that underwent regional metamorphism up to amphibolite grade and subsequent exhumation and cooling in the Jurassic to mid-Cretaceous (Hansen and Dusel-Bacon, 1998; Dusel-Bacon and others, 2002). Triassic to Paleogene magmatism variably affected the YTT and pNA as the YTT was re-accreted to form the integrated southern Alaska margin.

Previous 1:250,000-scale reconnaissance mapping of the Tanacross Quadrangle does not address the terranes present; however, it does delineate general amphibolite faces, greenschist faces and carbonaceous Paleozoic units, Tertiary mafic volcanic rocks, Mesozoic granitic rocks, and Paleozoic or Precambrian metamorphic units (Foster, 1970). Coney and others (1980) proposed a "suspect Yukon-Tanana composite terrane" due to the existence of fragments of oceanic arcs and an unknown origin of the metamorphic rocks in this region. The composite Yukon-Tanana terrane concept evolved and was eventually defined as both a parautochthonous continental margin of North America, represented in the southern part of the map area by the Lake George assemblage, and an allochthonous YTT, which is represented by the Fortymile River assemblage in the northern half of the map area (Colpron and others 2006, Dusel-Bacon and others, 2006; Dusel-Bacon and Hansen, 1992).

Lithotectonic units of the allochthonous Yukon-Tanana terrane (locally represented by the Fortymile River and Nasina assemblages; Dusel-Bacon and others, 2017; Szumigala and others, 2002; Werdon and others, 2001) present in the northern part of the Tanacross map area are interpreted as arc and basinal deposits formed on top of, and adjacent to, the rifted YTT during the early Mississippian and thrust over pNA during Permian to Jurassic time (Dusel-Bacon and others, 2006, 2017). Detailed mapping in the Eagle A-1 and A-2 quadrangles revealed the complexity of this terrane immediately north of the field area, and provided a very detailed framework to guide mapping within the Fortymile River assemblage in the northeastern Tanacross Quadrangle (Szumigala and others, 2002; Werdon and others, 2001).

Regionally, metamorphic assemblages of YTT and pNA are intruded by Triassic, Cretaceous, Quaternary, and possibly Neogene volcanic and plutonic rocks. The oldest Mesozoic magmatic body in the region, the Taylor Mountain batholith, is described by Werdon and others (2001) as a multi-phase intrusion with structural fabric present only on the margins of the batholith. This pluton has a complex intrusive history but, based on a titanite U-Pb crystallization age, it was emplaced around 214 Ma (Dusel-Bacon and others, 2009). Mid-Cretaceous intrusions include granites such as the ca. 117 Ma Crag Mountain pluton in the Yukon (Yukon Geological Survey, 2019) as well as gabbro, granodiorite, and quartz monzonite ranging in age from ca. 97 to 101 Ma along the Alaska Highway (Solie and others, 2019). Regionally, vein, scarn, and porphyry-style mineralization is often attributed to the mid-Cretaceous intrusions (Allan and others, 2013). Late Cretaceous intrusions include the Mount Fairplay syenite (Foster, 1967), a known rare earth element prospect (Newberry, 2020), and other granodiorite, diorite, monzonite, trachyandesitic porphyries, and andesite bodies in the region, which have a narrow age range between ca. 68 Ma and ca. 76 Ma (Benowitz and others, 2017). Cu-Mo-Au porphyry mineralization is often associated with Late-Cretaceous rocks in the uplands, for example, Taurus porphyry present in the map area (Harrington, 2010). The youngest igneous rocks in the adjacent Eagle A-2 and A-1 quadrangles are gabbro/diabase emplaced ca. 58 Ma ($^{40}Ar/^{39}Ar$ crystallization age; Werdon and others, 2001) and basalt with a ca. 14 Ma $^{40}Ar/^{39}Ar$ whole rock age (Szumigala and others, 2002), respectively. Small fault-bounded sedimentary basins were mapped in the Eagle A-1 and A-2 quadrangles (Szumigala and others, 2002; Werdon and others, 2001).

The sedimentary successions consist of conglomerate, sandstone, coal, siltstone, and graywacke, with local felsic tuff, and are Cretaceous to Paleogene (Szumigala and others, 2002; Werdon and others, 2001).

CHAPTERS INCLUDED IN THE REPORT:

- Chapter A: Introduction to the northeast Tanacross geologic mapping project
- Chapter B: Northeast Tanacross geologic map and map units and descriptions
- Chapter C: Metamorphic cooling history of the Fortymile and Lake George assemblages from $^{40}Ar/^{39}Ar$ data from northeast Tanacross
- Chapter D: Structural geology observations in northeast Tanacross
- Chapter E: Geochemical interpretation of samples of igneous rocks from northeast Tanacross
- Chapter F: Observations on the economic geology of northeast Tanacross
- Chapter G: Magnetic modeling of northeast Tanacross

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