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Structural geology of the eastern Nadaleen trend, Yukon Territory, Canada: Implications for recently discovered sedimentary rock-hosted gold

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ABSTRACT

Recently discovered gold-rich mineral deposits in the eastern Nadaleen trend of northeastern Yukon Territory occur in unmetamorphosed Neoproterozoic carbonate and siliciclastic rocks and their location is partly controlled by structures. Regional deformation largely resulted from mid-Cretaceous NNE-vergent, thin-skinned fold-thrust activity. However, structures in the eastern Nadaleen trend are more complex and include strike-slip and reverse faults, and SSW-, W-, and E-plunging folds. Local structures are cospatial with regional geologic features, including (1) an E-striking structural triangle zone defined by oppositely dipping reverse faults that verge toward the eastern Nadaleen trend, (2) a transition zone between Paleozoic Ogilvie platform rocks in the north to Selwyn basin rocks in the south, and (3) a change in regional deformation character from west to east, whereby to the west, rocks in the south are more deformed than rocks in the north, whereas to the east, rocks show no obvious change in deformation style. The structural complexity within the eastern Nadaleen trend probably resulted from these regional geological features and was further complicated by local competency contrasts between rock units. The cospatial location of the regional geological features may have been caused by a pre-existing, W-trending subsurface basement structure. Reverse faults bounding the E-striking triangle zone may have acted as low permeability aquitards that directed mineralizing fluids up-dip into reactive carbonate stratigraphy in the eastern Nadaleen trend. Gold-rich mineral deposits in the eastern Nadaleen trend occur preferentially in SSW-plunging anticlines and near faults, both of which probably influenced the migration of mineralizing fluid.

1. Introduction

Sedimentary rock-hosted gold deposits in ATAC Resources Ltd.'s (ATAC) Nadaleen trend occurs in intensely deformed, unmetamorphosed shelf to off-shelf carbonate and siliciclastic rocks located immediately north of the interface between the Paleozoic Ogilvie platform and Selwyn basin and at the eastern edges of the multi-hundred km-scale Dawson thrust and Kathleen Lakes fault (Fig. 1) (Moynihan, 2016). The area is located in northeastern Yukon Territory, 185 km ENE of Mayo, the nearest community, and in the eastern part of the Rackla gold belt (Fig. 1a, b). The Anubis and Osiris gold clusters, including the Anubis, Conrad, Ibis (formerly Isis East), and Osiris/Sunrise gold-rich mineral deposits (Fig. 1c, d), were discovered within the trend between 2010 and 2015. No official resource estimates for the deposits exist currently, but abundant gold has been discovered within drill holes (e.g., 42.93 m of 18.44 g/t gold at the Conrad deposit) and surface trenches (www.atacresources.com).

We investigated the structural setting of the eastern Nadaleen trend that includes the Conrad, Ibis, and Osiris/Sunrise deposits to assess the structural controls that contributed to the distribution and concentration of gold in the area. SSW-trending anticlines host gold in the Osiris/Sunrise and Ibis deposits (Fig. 1d) in a region that is otherwise dominated by W- and WNW-trending structures (Fig. 1c). Gold in the Conrad deposit (Fig. 1d) has previously been interpreted as occurring within (1) an E-W striking, brittle-ductile shear zone, primarily based on a regional lineament analysis (Venessa Bennett, 2012, ATAC Resources Ltd. internal report), and (2) a WNW-trending doubly plunging anticline, based on the apparent subsurface geometry of the Conrad limestone and the trace of gold mineralization in drill core (www.atacresources.com; Tucker et al., 2013). Within the context of regional

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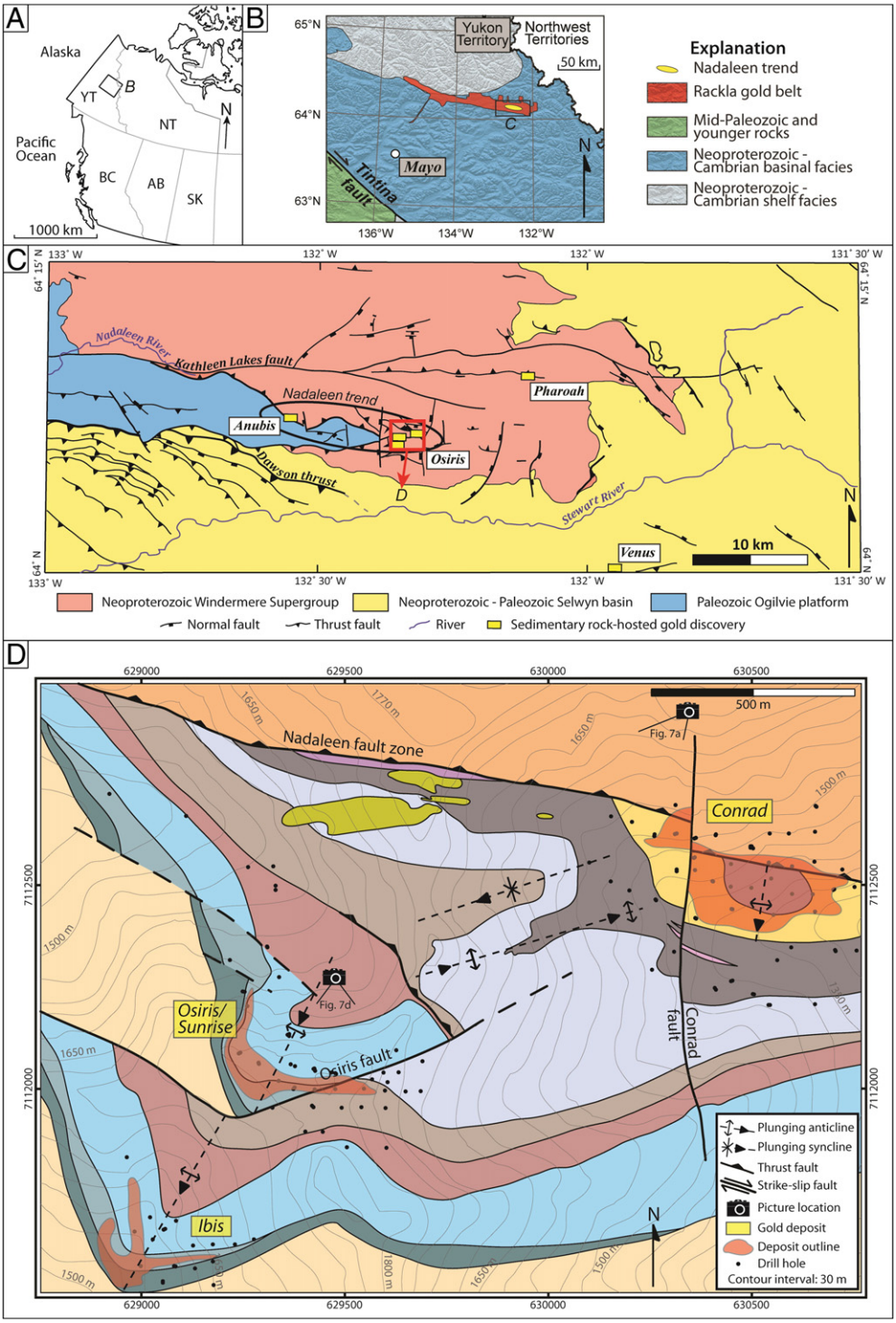

Fig. 1. A. Map of western Canada, showing location of (B). B. Generalized geologic map of northeastern Yukon Territory showing the outline of the Rackla gold belt, the Nadaleen trend, and the location of (C). C Regional map showing sediment-hosted gold zones, reverse and normal faults, and regional stratigraphic domains. Red box outlines the eastern Nadaleen trend study area (D). Modified from Moynihan et al. (2014). D. Geologic map of the eastern Nadaleen trend showing local stratigraphy, structures, and generalized outlines of gold-rich mineral deposits projected to surface from drilling results. See Fig. 2 for color explanation and stratigraphic description.

geology, both of these interpreted geometries are unique to the eastern Nadaleen trend.

The aim of this study was to reveal the structural setting of the gold deposits in the eastern Nadaleen trend (Fig. 1c), using a multi-scale approach. We investigated the structural architecture in the Conrad deposit through detailed surface mapping of the poorly exposed, structurally complicated outcrops and through analysis of several oriented drill cores. Surface structural mapping of other gold deposits in the eastern Nadaleen trend was also conducted to determine the structural setting of each deposit, and the structural history of the area. Finally, fold and fault trends from 1:50,000 scale regional quadrangle maps (Moynihan et al., 2014) were analyzed in order to interpret our results in a regional context, and to investigate the potential controls of regional structures on gold mineralization.