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Signatures of Cu (-Au) mineralisation reflected in inorganic and heavy mineral stream sediments at Vähäkurkkio, north-western Finland

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ABSTRACT

In this orientation study, stream sediments were assessed as a sample medium to detect Cu (-Au) occurrences discovered in Geological Survey of Finland (GTK) investigations at Vähäkurkkio in the Lätäseno Schist Belt. The Vähäkurkkio target area is situated in an environmentally sensitive Arctic area, thus requiring an exploration method with minimal environmental impact, such as analysis of stream sediments. Cu (-Au) mineralisation was detected by GTK in drill holes at two different sites near the Lätäseno and Piippujoki rivers. The geochemistry results for the < 177 µm fraction of inorganic stream sediment showed a 2.7 km long section of elevated Cu, S, Te and Bi concentrations immediately downstream from the mineralised site by the Lätäseno river. Stream sediments from the same section contained chalcopyrite and other Cu-bearing mineral grains, detected by automated scanning electron microscopy (SEM-EDS and FE-SEM-EDS), in the fine fraction (< 63 µm) of heavy mineral samples. Inorganic stream sediment geochemistry was thus capable of revealing Cu (-Au) occurrences in the Lätäseno Schist Belt, but only when the topographical and geological characteristics were favourable. Heavy mineral analyses showed that the fine fraction (< 63 µm) is beneficial for automated SEM-EDS studies of stream sediments, but sample processing procedures need to be tailored to suit the target of the investigation. At present, only native Cu and Cu-sulphides can be considered reliable indicator minerals for Cu (-Au) mineralisation in the study area.

1. Introduction

Identification of metal dispersion in streams in order to detect mineralisation has a long history (e.g. Ottesen and Theobald, 1994). However, in Finland the use of stream sediment geochemistry for mineral exploration did not start until the early 1960s and continued only until the 1980s (e.g. Wennervirta, 1968; Nikkarinen and Salminen, 1982; Bølviken et al., 1986; Isomaa, 1988; Lahermo et al., 1996). Research in the 1980s showed that the geochemistry of the fine fraction of till (< 63 µm) is a better sampling medium than stream sediment in reflecting the composition of underlying bedrock geology in the areas of subdued topography that characterise Finland (Björklund et al., 1994). In Finland, till has gradually replaced stream sediments as a preferred geochemical exploration sampling medium (e.g. Peuraniemi, 1982; Sarala and Peuraniemi, 2007). However, stream sediment surveys are used to some extent in environmental surveys (e.g. Pietilä et al., 2014).

Environmental issues have to be taken into account in active mineral exploration. The demand for more sensitive methods has resulted in the development of new exploration techniques (Sarala, 2015) and the revival of established exploration methods and re-evaluation of their impact on the environment. Stream sediment sampling is an environmentally friendly exploration method, because it has a minimal impact on the landscape. Analytical methods have also improved in recent years, so that an extensive suite of elements (65+) can be determined with low detection limits. Improvements have also been made to processing techniques for recovering heavy and indicator minerals from surficial sediment samples (Lehtonen et al., 2011; Lehtonen et al., 2015). For all these reasons, stream sediments were selected for the present orientation study to test their effectiveness for detecting the presence of mineral occurrences in the environmentally sensitive Arctic area of Vähäkurkkio in northern Finland.

The Vähäkurkkio area is about 300 km north of the Arctic Circle, in the Lätäseno Schist Belt of the Fennoscandian Shield. The Schist Belt is mainly composed of mafic metavolcanic and metasedimentary rocks (Karinen et al., 2015a; Bedrock of Finland – DigiKP, 2016). In 2012, the Geological Survey of Finland (GTK) discovered Cu (-Au) mineralisation, potentially of iron-oxide-copper-gold (IOCG) style, at Vähäkurkkio (Richard et al., 2016). The mineralised sections consist of magnetite-Cu sulphide-bearing breccias with disseminated native Cu.

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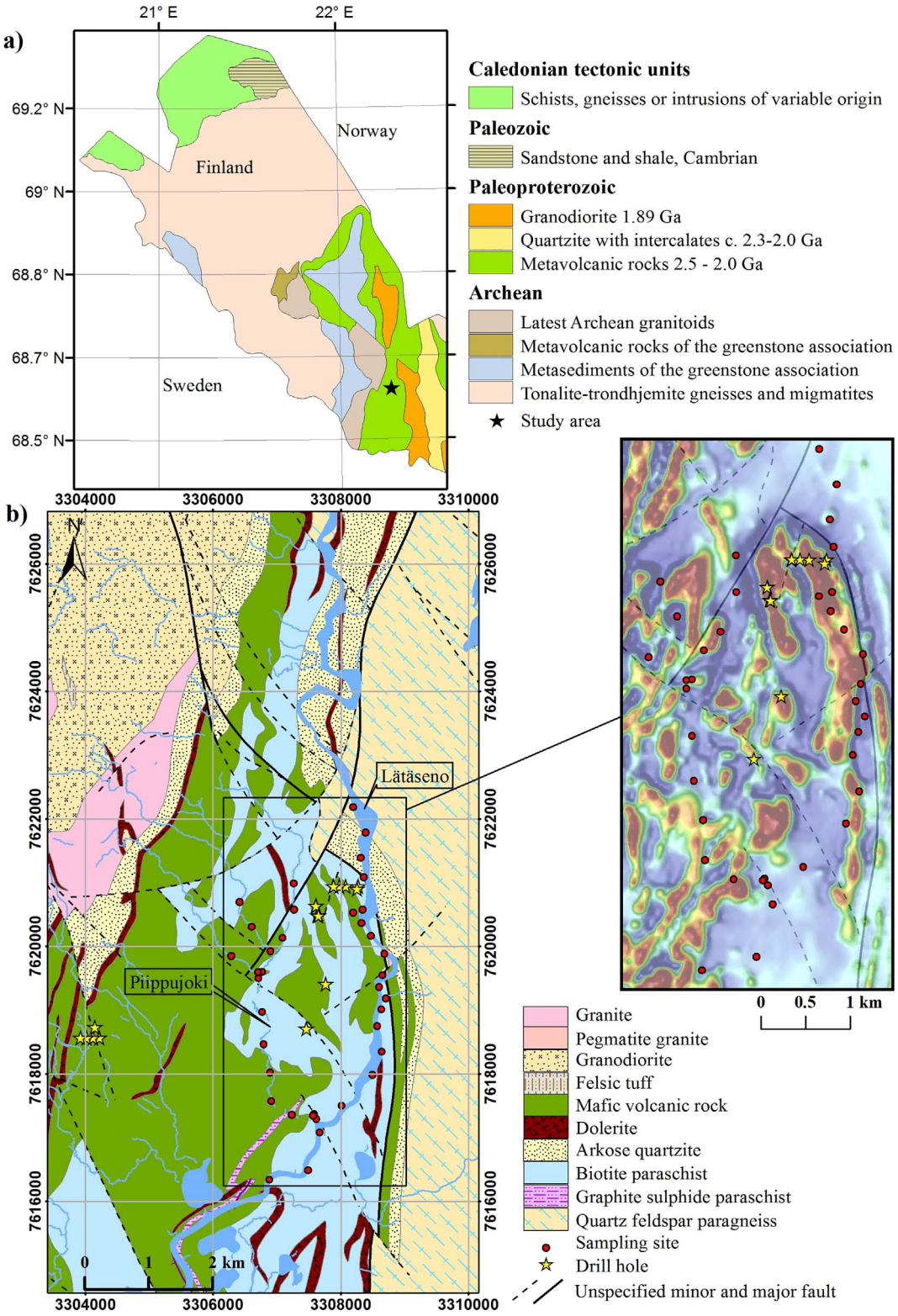

Fig. 1. a) Regional geological map of north-western Finland, showing the Vähäkurkkio study area (Bedrock of Finland 1:5000 000 ©Geological Survey of Finland). b) (Left) Local bedrock geology map (Bedrock of Finland, DigiKP) and (right) detailed aeromagnetic map produced by GTK showing the sampling sites and the diamond drill holes. On the magnetic map, red denotes high and blue low magnetic field intensity. Basemaps ©National Land Survey of Finland and Geographical coordinate system: Finnish KKJ Zone 3. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)