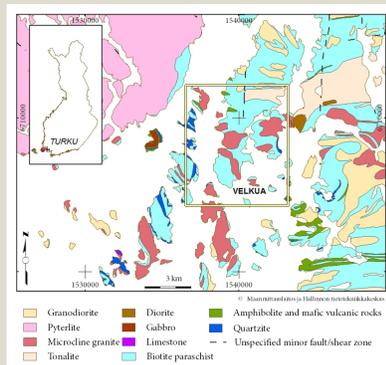


The Velkua gold prospect in the high metamorphic grade area of South-Western Finland

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Location

The Velkua Au occurrence in the Turku (Åbo) archipelago is situated in the high grade metamorphic Paleoproterozoic Svecofennian (1.9–1.8 Ga) bedrock in Southwestern Finland (Fig. 1). Regional metamorphism corresponds to upper amphibolite or granulite facies. The first observation of gold in this region occurred in 2006 from a sulphide-rich outcrop during follow-up study of a nationwide litho-geochemical mapping by GTK (Kärkkäinen et al. 2012a).



1) Figure 1. Location of the Velkua area. Bedrock map of Finland is based on DigiKP200 of GTK.

Lithology

Gold is enriched in an amphibolite formation which can be up to 100 m in thickness (Fig. 2). There are interlayers of felsic (quartz-plagioclase) or intermediate (biotite-plagioclase) gneisses and clinopyroxene-bearing gneiss. Amphibolite is surrounded by strongly metamorphosed and partly melted, migmatitic metagreywackes, where pelitic layers comprise large garnet aggregates and cordierite porphyroblasts. Coarse grained microcline granite is surrounding the supracrustal rocks.

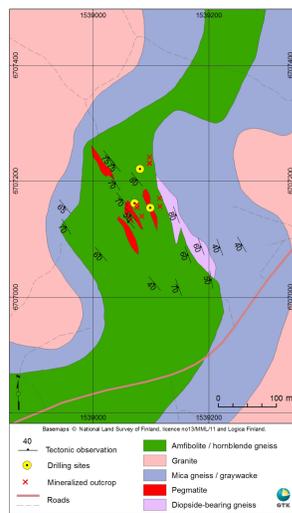


Figure 2. Bedrock map from the study area.

Alteration

The rock with highest Au grades is similar in appearance to barren rocks (see Fig. 3). Characteristic features for both mineralized and barren rocks are thin quartz veins, clusters of quartz and feldspar-quartz veins, patches of coarse-grained clinopyroxene in quartz-feldspar veinlets, biotitization and tourmaline. Tourmaline and biotite are most abundant in arsenopyrite-enriched zones. No retrograde features are observed in silicate mineralogy of the host rock.

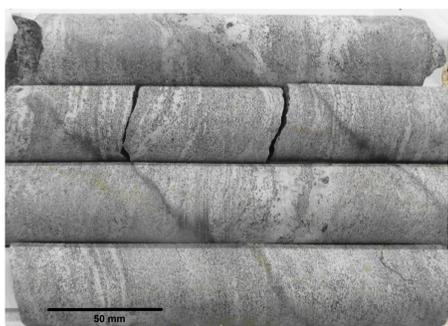


Figure 3. Au-mineralized quartz banded amphibolite from Velkua (24.2 ppm Au, R301 35.25–36.25 m). There are only small amounts of sulphides (arsenopyrite and pyrrhotite) in this section. Light bands are leucosomes and quartz veins.

Mineralization

Mineralized rocks are characterized by narrow quartz and quartz-feldspar veins and small lenses (Fig. 3). There are disseminated sulphides, and locally scheelite, tourmaline and apatite (Fig. 4). The ore minerals are pyrrhotite, arsenopyrite, löllingite, ilmenite, chalcopyrite, scheelite, ilmenomagnetite, native gold, native bismuth and ullmannite.

Elevated gold contents (>100 ppb Au) occur in a drilling sections up to 30 m long. The best drill section is 8 m with 5.3 ppm Au including 24.2 ppm at 1 m. Parallel 1–4 m sections contain lower grade ore with 0.5–2 ppm Au and between 0.2 and 1.3% As. Gold correlates with arsenic only when the Au values are relatively low (<2 ppm).

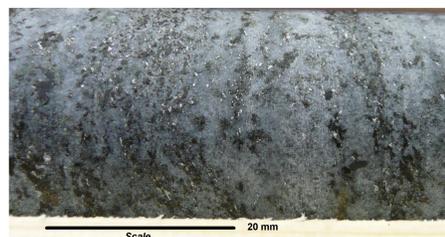


Figure 4. Typical arsenopyrite and pyrrhotite dissemination in (silicified) hornblende gneiss, drill hole R302.

Gold

Gold occurs as native grains (10 µm to 200 µm) associated with silicate minerals (Fig. 5) and as inclusions and composite grains with sulphides (Fig. 6). Native bismuth is a typical trace mineral with gold.

According to microprobe analyses the composition of gold averages 93% Au and 7% Ag (Kärkkäinen et al. 2012). Small gold inclusions in arsenopyrite and discrete large (zoned) Au-grains may contain more Ag. Some larger gold grains are zoned, so that major part of the grain is lighter-coloured Ag-Au-alloy, which is covered by a rim or patches of deep yellow pure gold (Fig. 7).

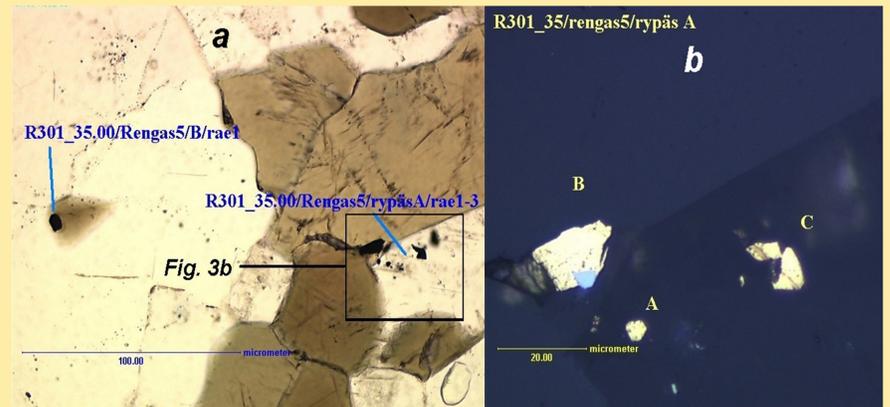


Figure 5. Gold inclusions in silicates of the Velkua Au-enriched amphibolite. Gold is in transmitted light (a) as the opaque mineral, and in the blow-up (b) reflected light the yellow minerals. The composition of gold is in all grains (A-C) 94% Au and 6% Ag. (Drill hole R301 depth 61.00 m).

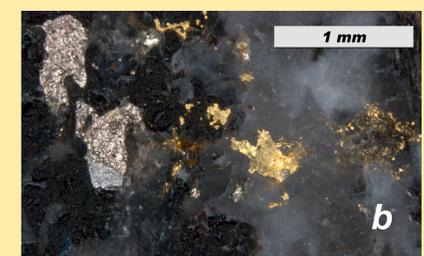


Figure 6. Gold inclusions in arsenopyrite (1). The composition of gold (2-3) is 95% Au 5% Ag. Heavy mineral concentrate R301-35.25 - 36.25.



Figure 7. a) A zoned gold grain composed mainly of lighter Ag-Au alloy (point 1: 81.4% Au, 18.5% Ag) and partially rimmed by darker pure gold (99.4% Au, 0.6% Ag). The grain is separated from a crushed bulk rock sample from the discovery outcrop. Analysis from Kärkkäinen et al. (2012) appendix 1, sample JA-29Ac-nc./gr B/p1 and p2.

b) a gold grain in drill hole R308, depth 90,60 m, together with pyrrhotite and arsenopyrite.



Discussion

The bedrock in the Velkua area is metamorphosed in conditions that caused partial melting of the rocks, and the silicate minerals of the host rock of the Velkua gold do not show features of retrograde alteration. As gold is observed within metamorphic silicate minerals it appears likely that the primary gold mineralization took place before the last regional metamorphism. South-eastern Finland has gone through two periods of regional metamorphism, 1.88–1.87 Ga and 1.83–1.80 Ga (Lahtinen et al. 2005) and remobilisation of the gold related to these events remains to be studied.

Zoning of gold grains has been observed at Velkua and elsewhere in SW Finland, in the Paimio and Kullaa gold occurrences (Grönholm et al. 2012, Kärkkäinen et al. 2012b). The Au grains occur both in drillcore and in non-weathered outcrop samples. Zoning of the gold grains could be explained as resulting from at least two hydrothermal stages.

Summary

The Velkua Au occurrence is a metamorphosed Au deposit. Ongoing studies by GTK at Velkua include an estimate of the economic potential, the dimensions and grade of the prospect. Future U-Pb geochronological analysis of the host rock will be carried out to constrain the age of mineralisation. Important for regional exploration in this area are studies of the role of the host rock, the amphibolite formation (common in the region) and processes that caused primary enrichment of gold.

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