METHODOLOGY FOR GEOCHEMICAL SCREENING OF THE BEDROCK – A CASE STUDY OF AN ARSENIC-RICH BASEMENT AT ARLANDA-ROSERSBERG

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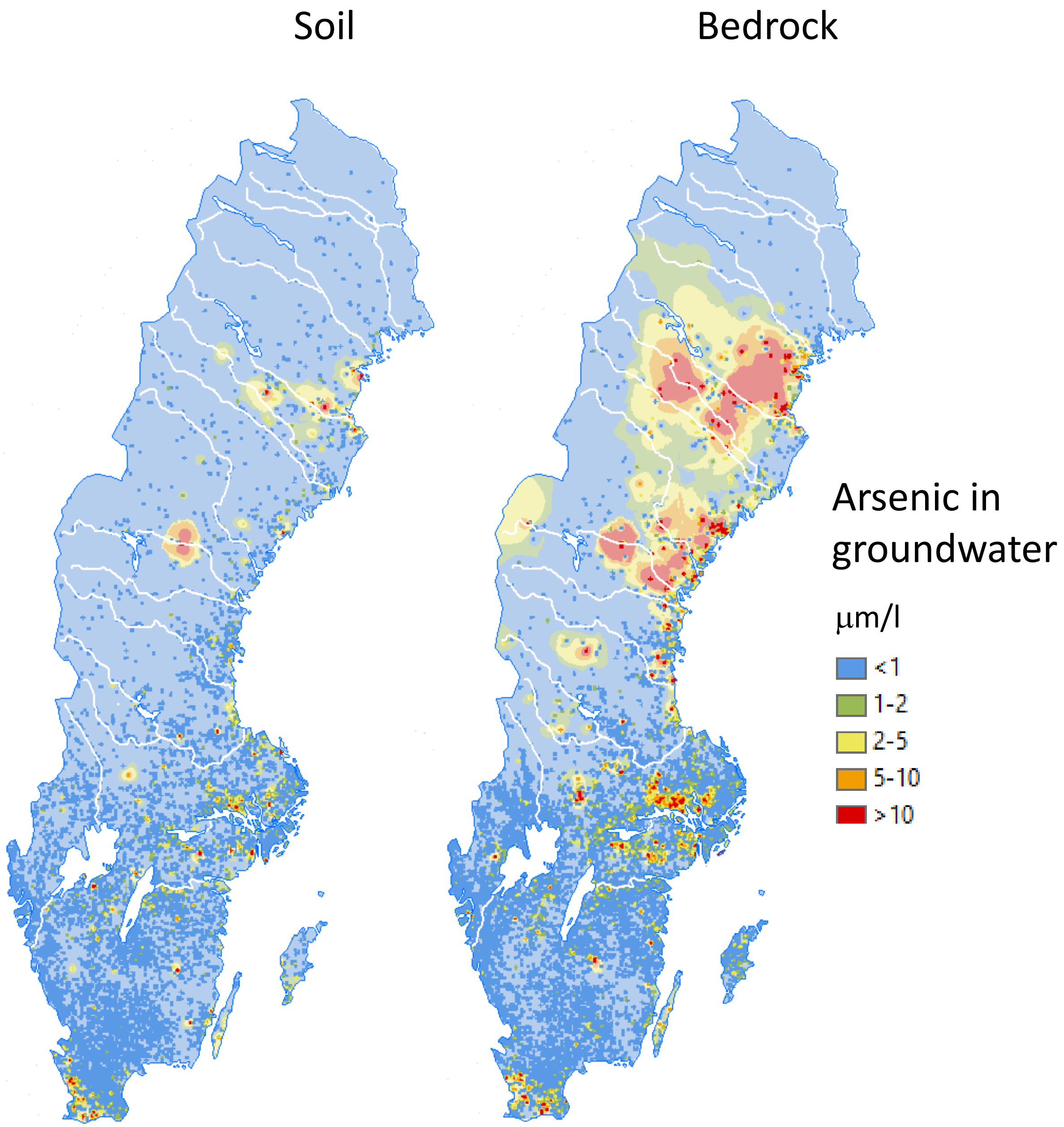
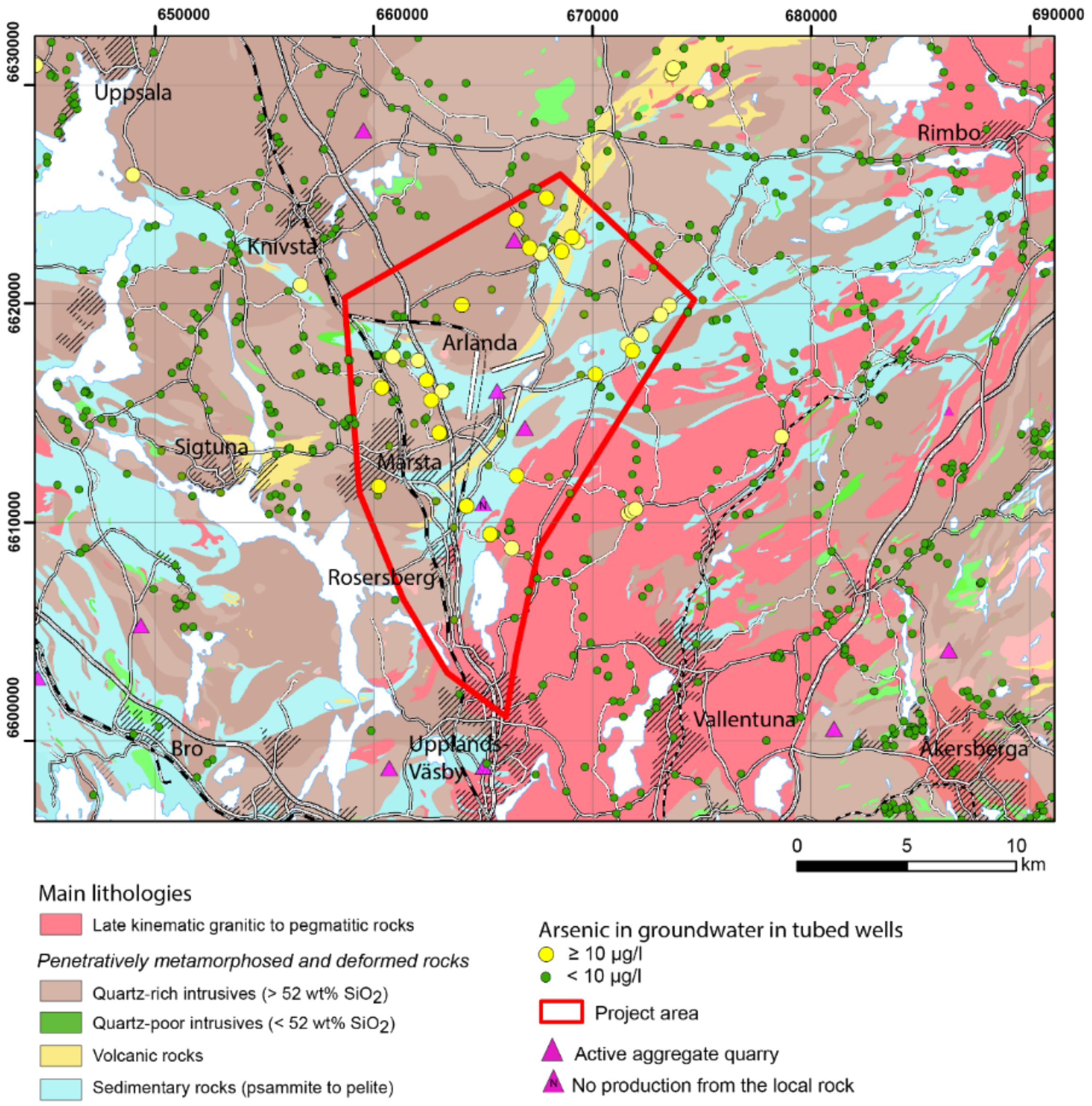


Contamination of groundwater in areas with naturally elevated levels of arsenic in the bedrock

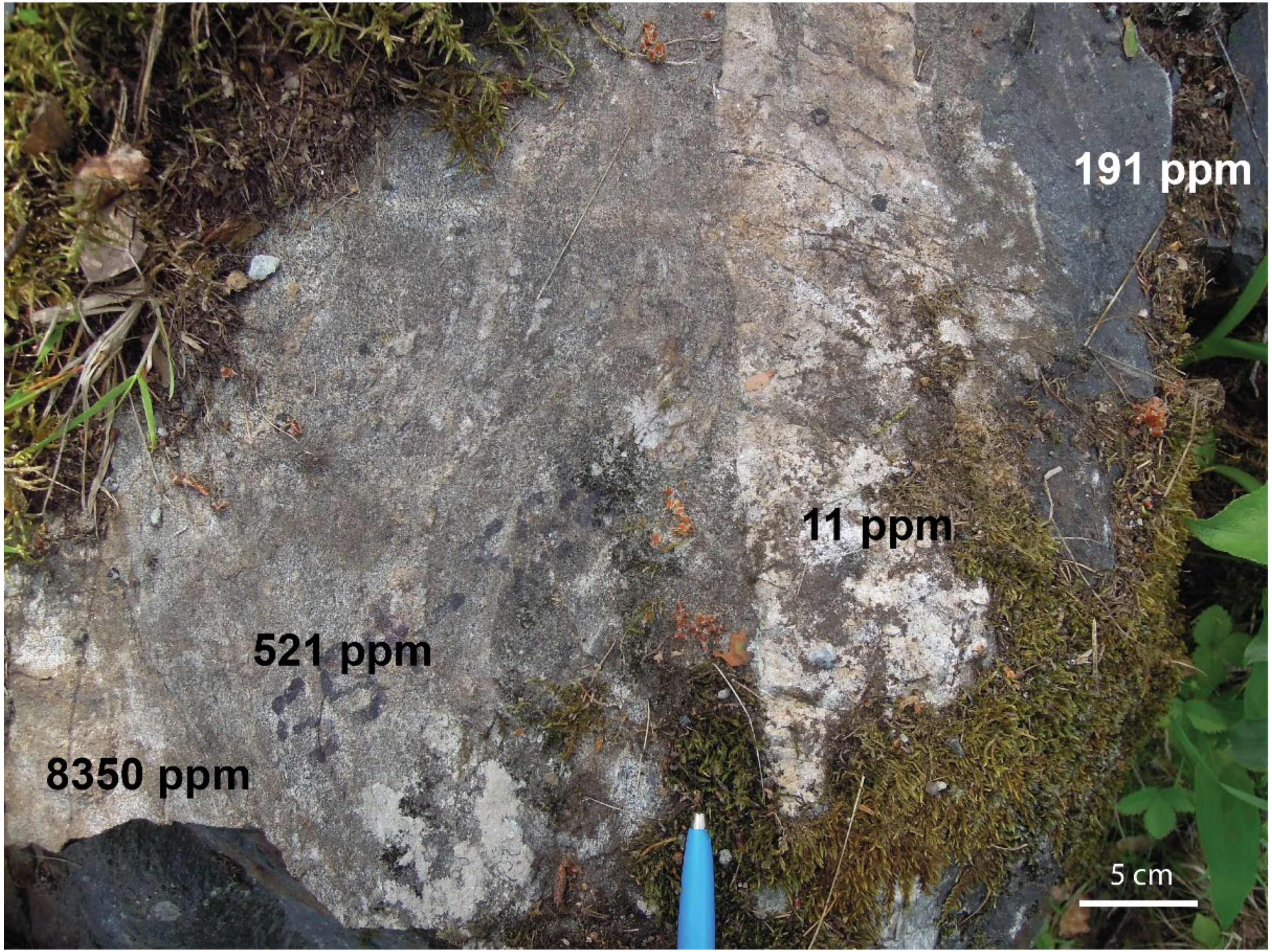
As-geochemistry of unfiltered raw water in tubed wells (private wells) in soil and in the bedrock. Data from Maxe, SGU-report 2021:10.

Arsenic contamination of groundwater in the Arlanda-Rosersberg area



Bedrock map of the Arlanda-Rosersberg area with project area marked as a red polygon. Bedrock map based on the SGU bedrock map database at scale 1:50 000. Arsenic geochemistry of unfiltered raw water from Maxe (SGU-report 2021:10). Reference value for As concentration in potable water for large drinking supplies (>50 persons) follows recommendations by the Swedish Food Agency.

Local extreme enrichments of arsenic in the bedrock

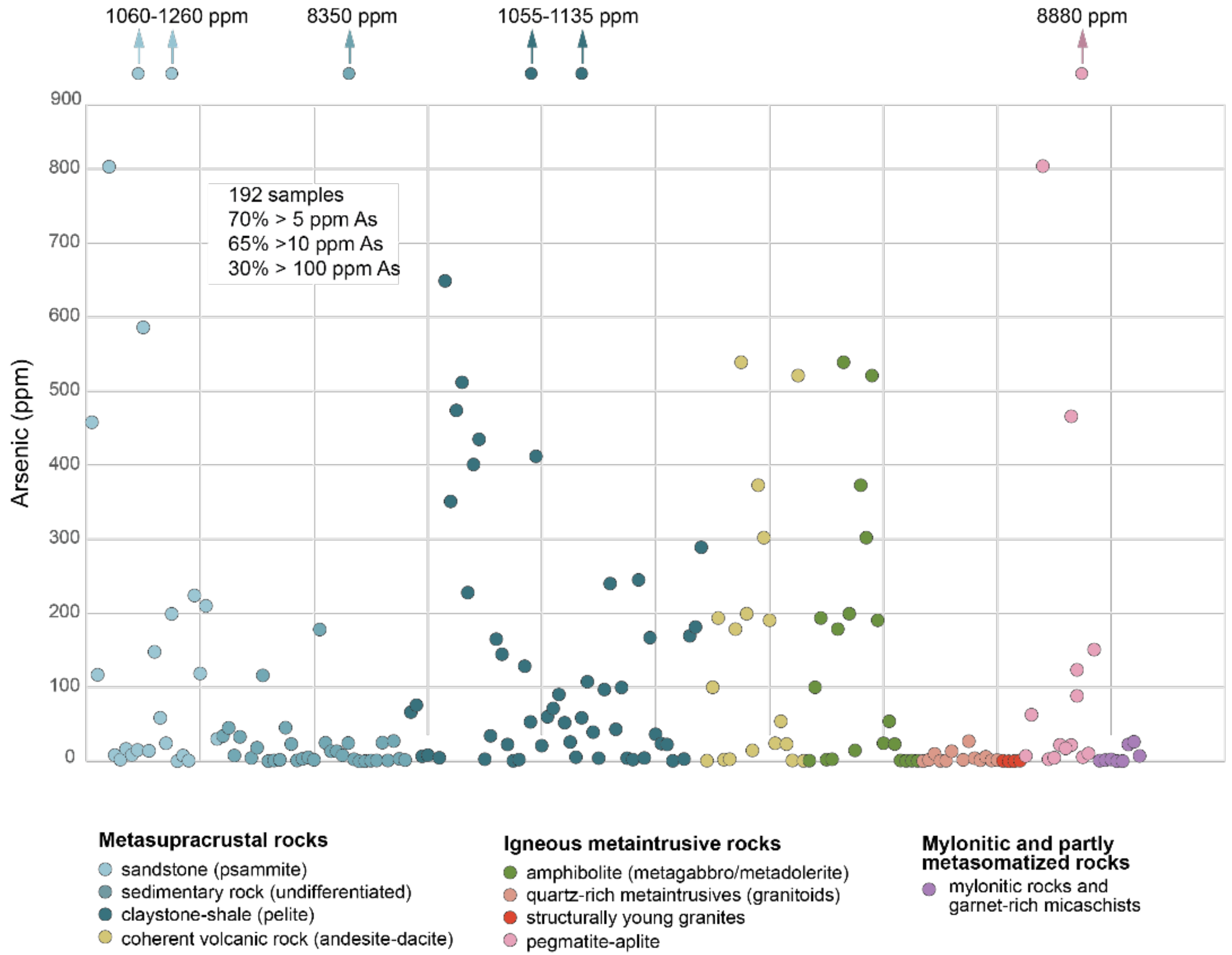


Top surface of road cut in arsenic-rich metasupracrustal belt at Arlanda with total content of arsenic indicated (bulk rock analyses).

The bedrock is composed of a metasedimentary rock highly enriched in arsenic (to the right in photo) with layers of metagabbro injected by an aplite dyke (white dyke).

The enriched zone is not rusty or weathered. Arsenic minerals are well dispersed in the ground mass.

Local extreme enrichments of arsenic in the bedrock at Arlanda



Geochemical mapping of the bedrock in the Arlanda-Rosersberg area shows that significant enrichments of As of >100-1000 ppm, locally up to almost 1 wt%, occurs in a ca ametasupracrustal belt in the south-eastern Arlanda area. Such high As concentrations are highly anomalous for a non-mineralised quartz-feldspathic bedrock.

As concentrations >100 ppm occur in metasedimentary, preferentially mica-rich units, in intermediate- to mafic sills and dykes, and in fractionated tourmaline bearing pegmatites. Tourmaline bearing pegmatites appear to be spatially associated with As-enrichments of the country rocks and may be tracers for high-As units. Silica-rich intrusive rocks (granitoids and reworked equivalents) are low risk lithologies

Arsenic minerals in the field: arsenopyrite (FeAsS)and löllingite ($FeAs_2$) in a metasandstone.

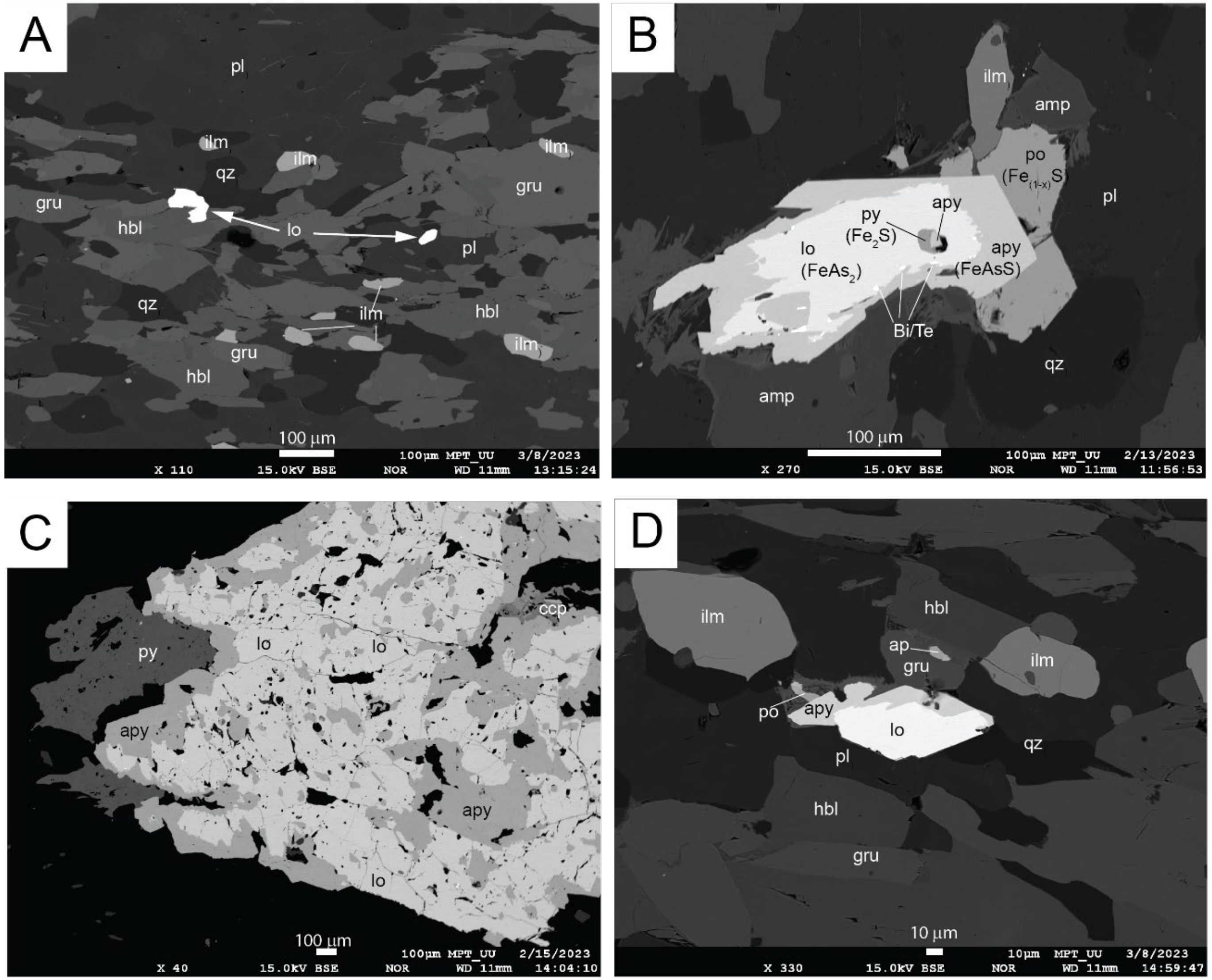
Silvery arsenopyrite and löllingite in fine-grained metasandstone.

Discrete shear zone in a metasedimentary rock with silvery arsenopyrite and löllingite. Yellowish metallic minerals are pyrite and pyrrhotite.

Arsenic minerals in the field: arsenopyrite (FeAsS)and löllingite ($FeAs_2$) in pegmatite dykes.

Large chunk of arsenopyrite from a pegmatite dyke collected during the construction of runway 3 at Arlanda airport.

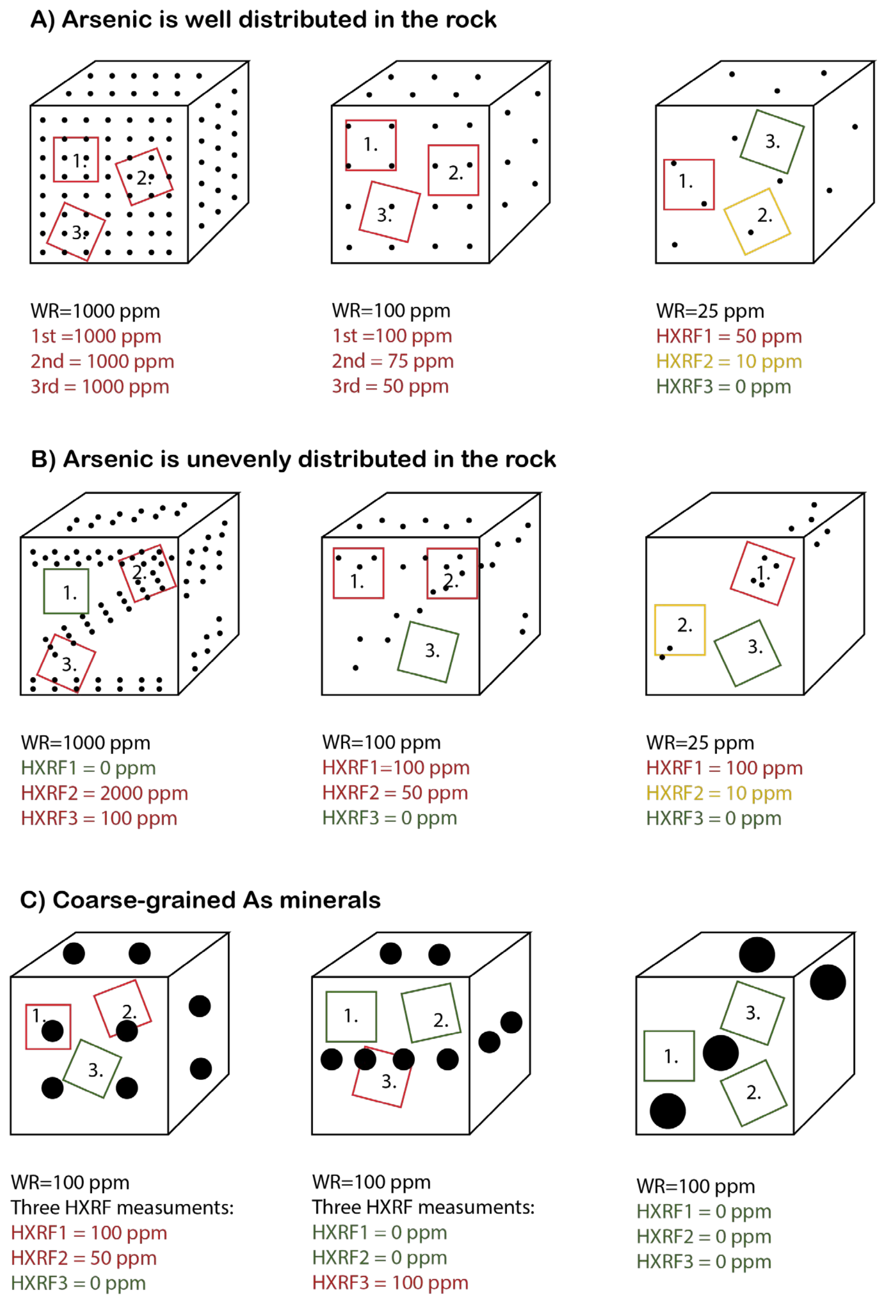
Widespread löllingite occurrence in non-mineralised basement rocks revealed by electron microscopy



Electron back scattered images of arsenic minerals in rocks in the high-As zone at Arlanda.

A) Single löllingite crystals growing along grain boundaries in the rock matrix of a metagabbro.
B) Löllingite overgrown by arsenopyrite and pyrrhotite and with dissolution of Bi/Te at the contact between löllingite and arsenopyrite.
C) Löllingite megacryst intergrown with arsenopyrite and with pyrite at the left tip.
D) Euhedral löllingite growing together with euhedral pyrrhotite in a high-As amphibolite.

Mineral name abbreviations: lo=löllingite; apy=arsenopyrite; po=pyrrhotite; py=pyrite; ccp=chalcopyrite; pl=plagioclase; qz=quartz; amp=amphibolite; gru=grunerite; hbl=hornblende; ilm=ilmenite; ap=apatite. Bi/Te=bismuth/tellurium.



WR ≠ HXRF

Whole rock bulk analyses includes analysis of a rock volume. Handheld X-ray fluorescence (HXRF) measurements analyse the geochemistry of heavy elements in at a restricted surface (≤1 cm^2)

Schematic illustration of how the grain size and distribution of As-minerals (black dots) in a rock volume may affect the success of geochemical analysis using HXRF measurements on rock surfaces. Note that an uneven mineral distribution may also contribute to measurements giving higher values with HXRF than those obtained by WR analysis (the right box in B).