

Arsenic rich metasedimentary belts in the Mälardalen region – a primary source of contamination

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Arsenic (As) is a toxic and carcinogen element that locally occurs at high background levels in the bedrock from which it may be mobilized and spread to the environment. At present, this is an acute problem in parts of the Mälardalen region with extensive demands for exploitation of the bedrock. The lack of knowledge on the geological setting, petrography, and mineralogy of the As-rocks is hampering safe production and use of rock masses.

To address this problem, a field campaign targeting high-As rocks was carried out in the Arlanda-Rosersberg and the Mariefred-Södertälje area. Documentation of the field context, petrography, mineralogy, and bulk rock geochemistry is used to pin down where and in what form As is sitting in the rocks.

In the Arlanda-Rosersberg area, high-As rocks (>10 ppm As) occur along a NNE trending steeply dipping ca 5-10 km wide metasupracrustal belt. Geothermobarometry coupled with phase equilibrium modelling indicate amphibolite facies metamorphism at pressures of 3.0–5.5 kbar and temperatures of 490–640 °C (Skoog, 2022). Elevated levels of As are preferentially found in rocks of a sedimentary origin, pegmatites and in mafic meta-intrusions. Associated rhyodacitic to andesitic volcanic rocks are low in As. Highly elevated levels of arsenic at 100 ppm to near 1 wt.% occur in a ca 1 km wide zone in the central-eastern part of the supracrustal belt. Here, arsenic rich lithologies include epiclastic metasedimentary rocks, structurally concordant sills and dykes of metagabbro, metagranitoids with As-rich xenoliths, and fractionated pegmatites and aplites. There is no clear correlation between high-As and enrichment of sulphur in the rocks. Arsenopyrite (FeAsS) is the most common As-mineral but Löllingite (FeAs₂) is also common. It occurs as a single phase (in places euhedral) or as overgrown with a rim of arsenopyrite, in places followed by an outer rim of pyrrhotite which is the dominating sulphide. Pyrite is less common but often present in late micro-shear zones together with albite, K-feldspar, and chlorite.

The bedrock in the Mariefred-Södertälje area is dominated by upper-amphibolite to granulite facies metatexitic to diatexitic ±garnet±cordierite±sillimanite paragneiss with abundant disrupted dykes and lenses of metamafic rocks and late kinematic granitoids. The metamorphic complex is cut by unmetamorphosed NNW to WNW trending, less than 1 dm to several meter wide dolerite dykes that crosscut the migmatite structures. The gneisses, the late kinematic granitoids and the dolerites are with few exceptions low in As (≤ 10 ppm). As contents at 300-400 ppm have only been encountered in mafic granulite (opx+hbl+plag) and in 1-3 dm wide disrupted garnet-rich dykes and lenses of intermediate chemical composition. Reconnaissance petrographic work in the metagabbro shows that arsenopyrite and löllingite occur as 100-200µm large crystals in the matrix or as <10 µm minute crystals at the grain boundaries of hornblende or inside hornblende. Minute grains of löllingite and probably also cobaltite occur inside pyrrhotite but has not been observed in orthopyroxene. Arsenopyrite is the dominating As-mineral and pyrrhotite is the dominating sulphide, pyrite is absent.

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References

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