Investigation of occurrences of high-quality quartz mineral resources in south-eastern Austria: First results from the Rittis quartzite

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1) Introduction:

- In Austria there is a high demand for high-quality quartz mineral resources which, depending on the quality, are used in the glass, foundry or construction industries. The demand forecast indicates a continued upward trend for the next few years. Therefore potential deposits of quartz sand, quartzite, pegmatite quartz and quartz from mobilisate layers are investigated in the frame of the project "MRI_Quarzrohstoffe" of the research program "Initiative GBA-Forschungspartnerschaften Mineralrohstoffe – MRI" which is funded by the Federal Ministery for Education, Science and Research of the Republic of Austria.
- In this contribution, first results from the "Rittiser Quarzit" (Cornelius 1952) are reported. It forms layers within the "Grobgneiss" in the surrounding of the village Rittis/Krieglach (Styria) (Fig. 1). In the years, 1860 to 1935 quartz with high-purity was mined from 16 sites, both in open pits and underground (Fig. 3). A raw material geological study Erkan (1982) interpreted the quartz layers as Permoscythian metamorphic quartzite forming xenoliths within the orthogneiss. Geochemical investigations indicated an average purity of ~91% SiO_2, whereas material from the dumps reached a SiO_2 content of up to 99%.
- The aim of this study is to investigation the genesis of the quartzite. With geochemical and reserve investigations underway, the reserve potential will be evaluated.

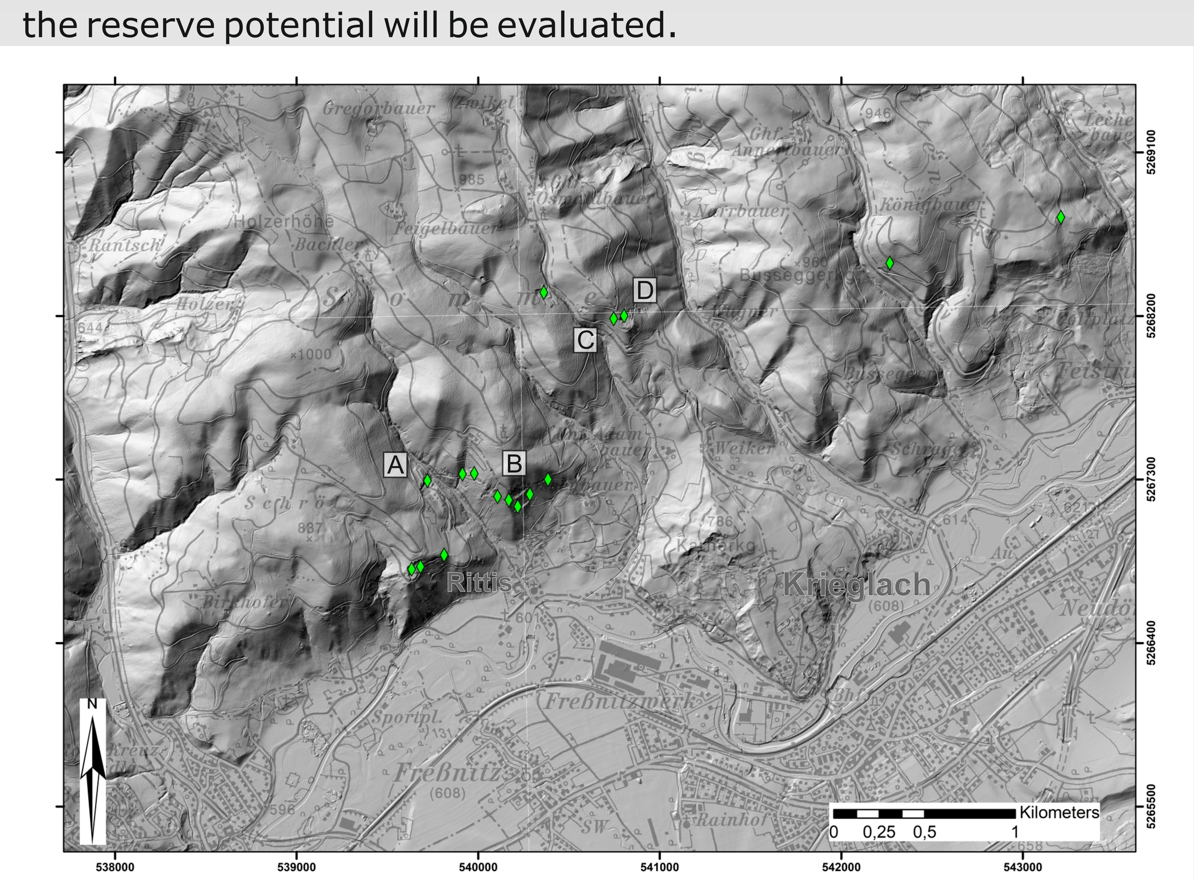

Fig. 1: Map showing the area near to Rittis and Krieglach in the Mürz valley (Styria). The green dots indicate abundant open pits and underground quartz mines shown and documented in Fig. 3: A-D.

3) Preliminary results:

Recent situation in the mining area (Fig. 3): In the mining area, a total of 16 quarries were registered, which have not been in operation for decades. The two biggest ones are located NE and SW of the lower part of the Rittisbach valley. The quarries are all not secured and completely renatured. Dumps are present in the middle and/or at the edges. Typically, small debris fans have formed from the stockpile material. Technical equipment and shoring are not present any more, except stonewalls and iron parts left behind. Additionally, trenches up to one meter deep can still be observed.

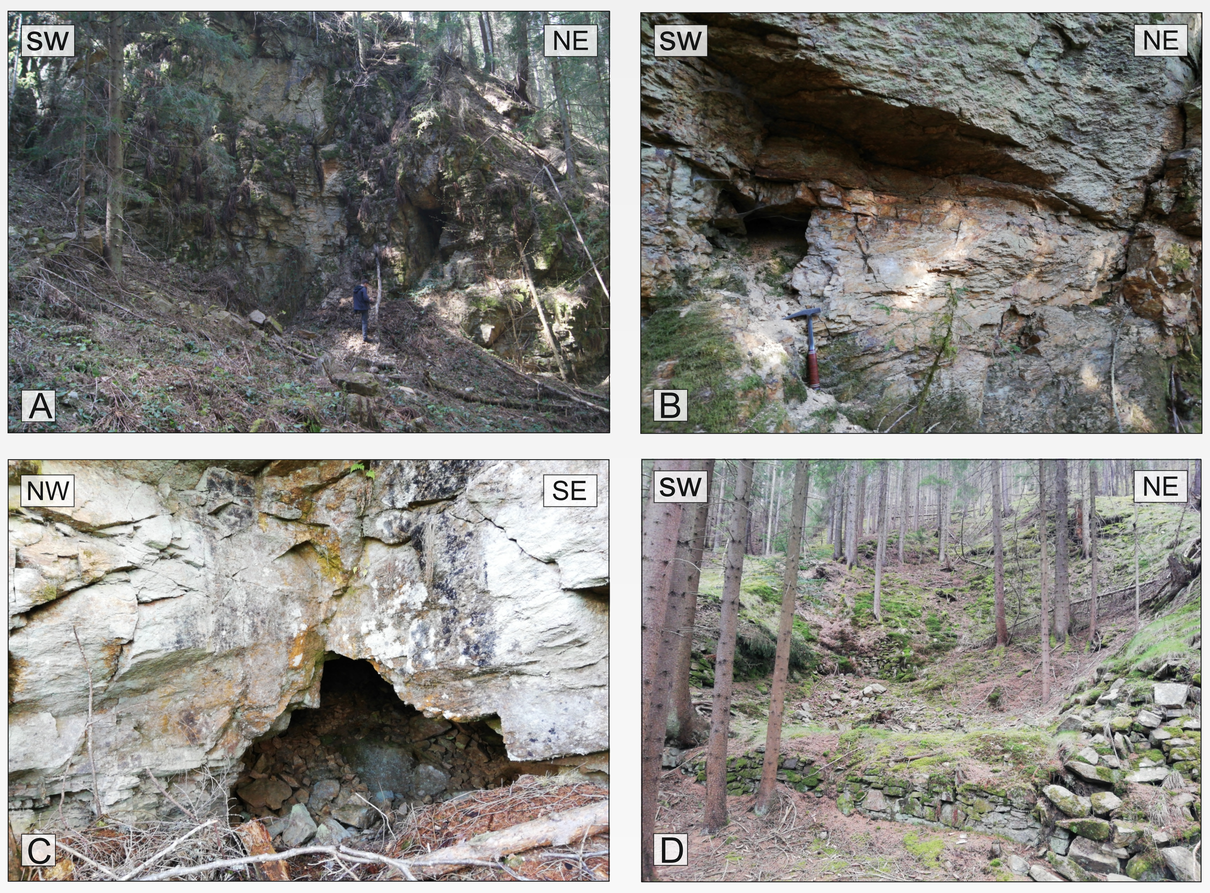

Fig. 3: A) Large open pit mine northwest of Rittis. B) About 2 m thick layer of Rittis Quartzite within the Pretul orthogneiss in a quarry wall of the open pit mine northwest of Rittis. C) Adit entrance in the area. D) Test pits and stonewalls in the area. The locations of these quarries are shown in the map above.

4) Conclusion:

- The Rittiser quartzite forms um to 2 m thick layers of more or less pure quartz within the Pretul orthogneiss.
- Due to the field and microscopic observations it is interpreted as quartz mobilisate layers formed during Eo-Alpine greenschist facies metamorphism.

5) References:

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2) Geological Setting:

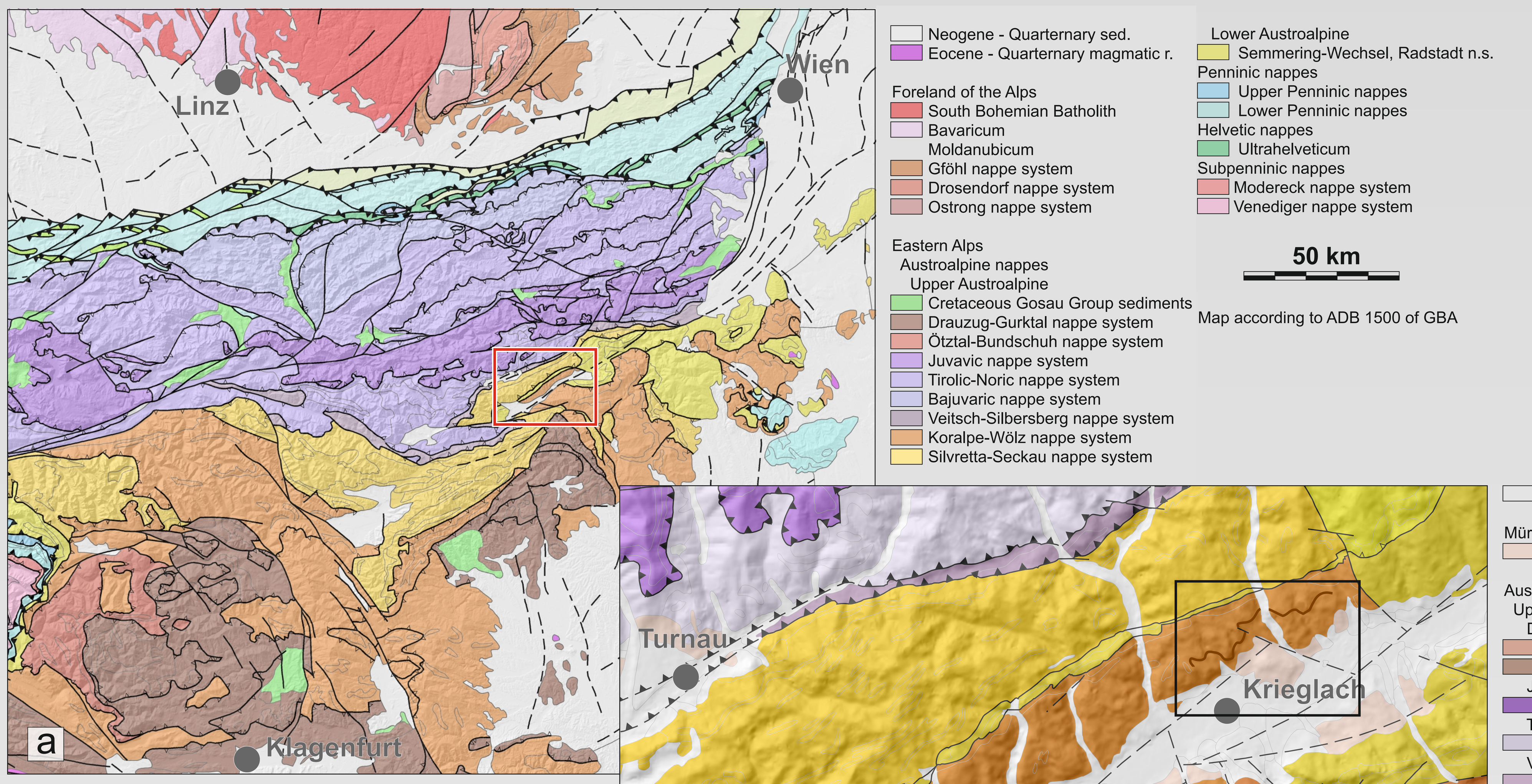
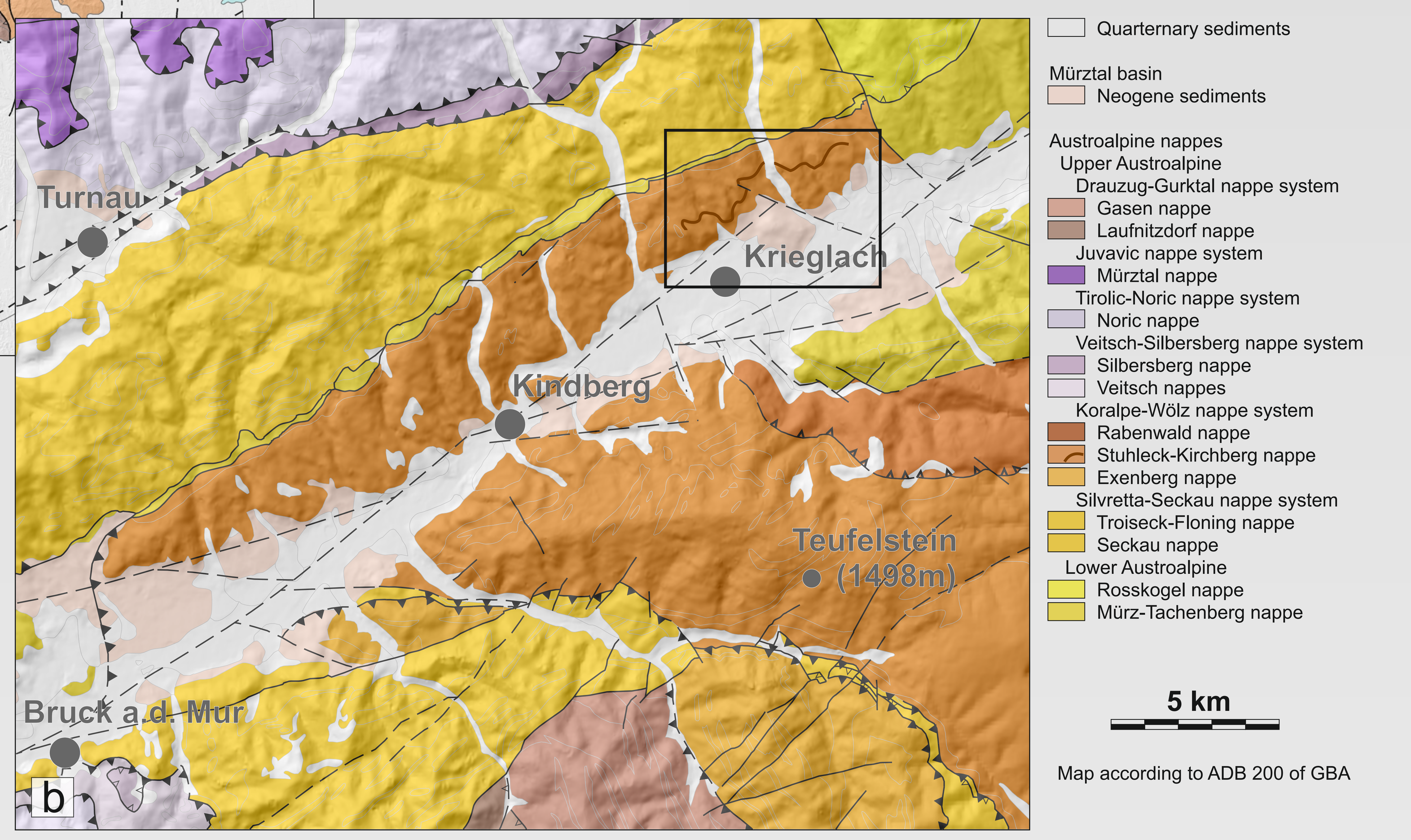


Fig. 2: a) Tectonic map of the eastern part of the Eastern Alps showing the working area with the red rectangle.
b) Tectonic map of the working area. The Rittis Quartzite forms up to 2 m thick layers within the Pretul orthogneiss of the Stuhleck-Kirchberg nappe signed as brownish line. The area of Fig. 1 is shown with the black rectangle.



According to the recent nomenclature of the Geological Survey of Austria the Rittis quartzite appears within the Pretul orthogneiss, which is embedded in phyllonitic mica schists and paragneiss ("Hüllschiefer"). Together they form the Teufelstein Complex building up the Stuhleck-Kirchberg Nappe of the Koralpe-Wölz Nappe System (Austroalpine) (Matura & Schuster, 2014) (Fig. 2). The Pretul orthogneiss developed from biotite and locally two-mica granite with K-feldspar phenocrysts up to a few centimetres in size.

LA-ICP-MS dating on zircons from several orthogneiss bodies yielded Permian intrusion ages in the range of 250-285 Ma (Pumhösl et al., 1999; Schuster et al., 2010; Yuan et al., 2020). For a sample from quarry Hadersdorf near to Rittis an age of 256±8 Ma was determined. The gneissic texture developed during the Eo-Alpine tectonothermal overprint at greenschist facies conditions.

3.1) Lithologies:

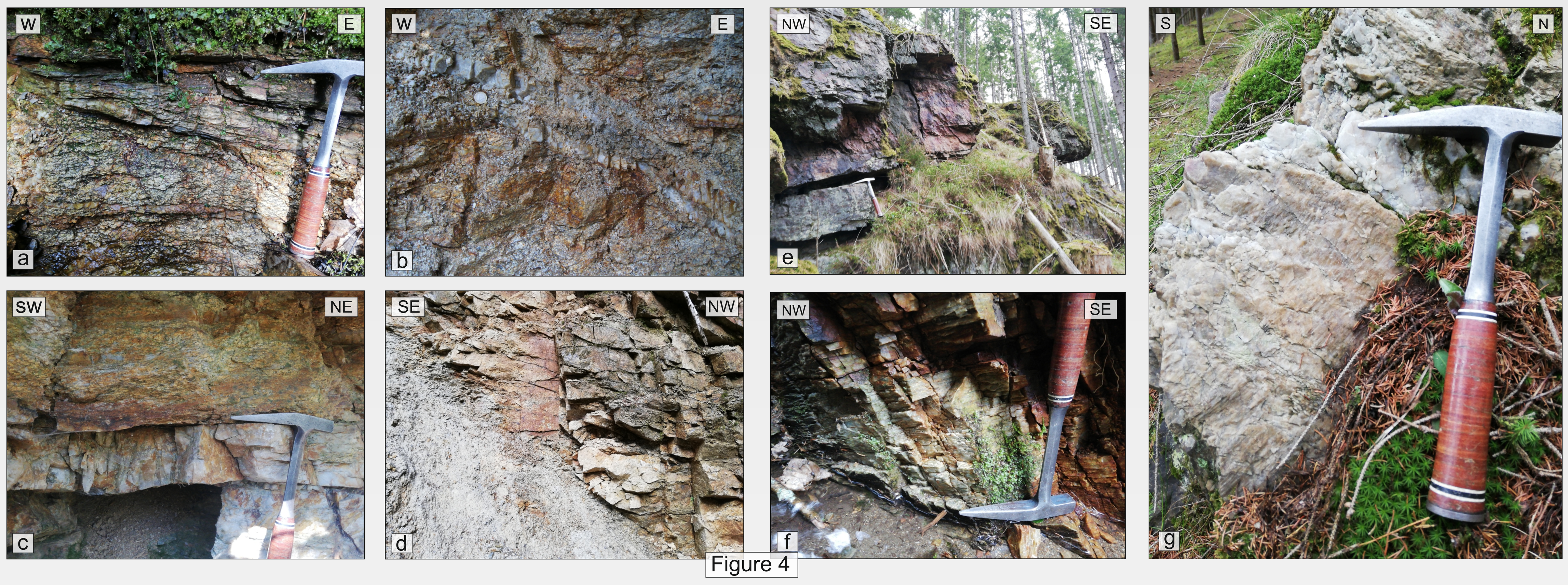


Figure 4

Geological field observations: Mapping revealed that areas designated as Rittis quartzite in the published maps are not homogeneous bodies, but rather represent areas in which more or less pure quartz layers with up to 2 m in thickness occur in the orthogneiss.

The Pretul orthogneiss shows a homogeneous appearance, with variations in terms of modal mineral content and grain size (Fig. 4a-d). Macroscopically, ductile deformed K-feldspar phenocrysts with a maximum size of one centimetre can be observed (Fig. 4a). The matrix shows a light grey to dark grey colour and is composed of quartz, muscovite, rarely biotite and chlorite. In contact to the Rittis Quartzite it is usually phyllonitized and rich in chlorite (Fig. 4c). At cleavage surfaces reddish and brownish weathering products are present (Fig. 4d), which originate from iron oxides. The Eo-Alpine deformation is expressed by a uniformly 20°-30° towards WNW dipping schistosity and top NW-directed kinematics (Fig. 6 & Fig. 4a). **The Rittis Quartzite** layers are parallel to the schistosity, showing distinct contacts to the orthogneiss. They are more or less homogeneous with no pronounced internal zoning or bedding, but macroscopic variations with respect to grainsize and colour exist (Fig. 4 e-g). In general, the schistosity gets more pronounced towards the contact to the orthogneiss (Fig. 4f) and sericitic white mica is sometimes present on the schistosity planes. Locally lenses of orthogneis xenolithes or up to a few millimetres large feldspar crystals are represent in the quartzite. Sometimes a stretching lineation dipping shallowly (10°-15°) to the SW is developed. Often the quartzite is highly fractured or cataclastically deformed (Fig. 4b & 4f) and rarely discordant quartz veins up to several centimetres in thickness cut through the quartzite and the surrounding orthogneiss (Fig. 4b).

3.2) Thin section observations:

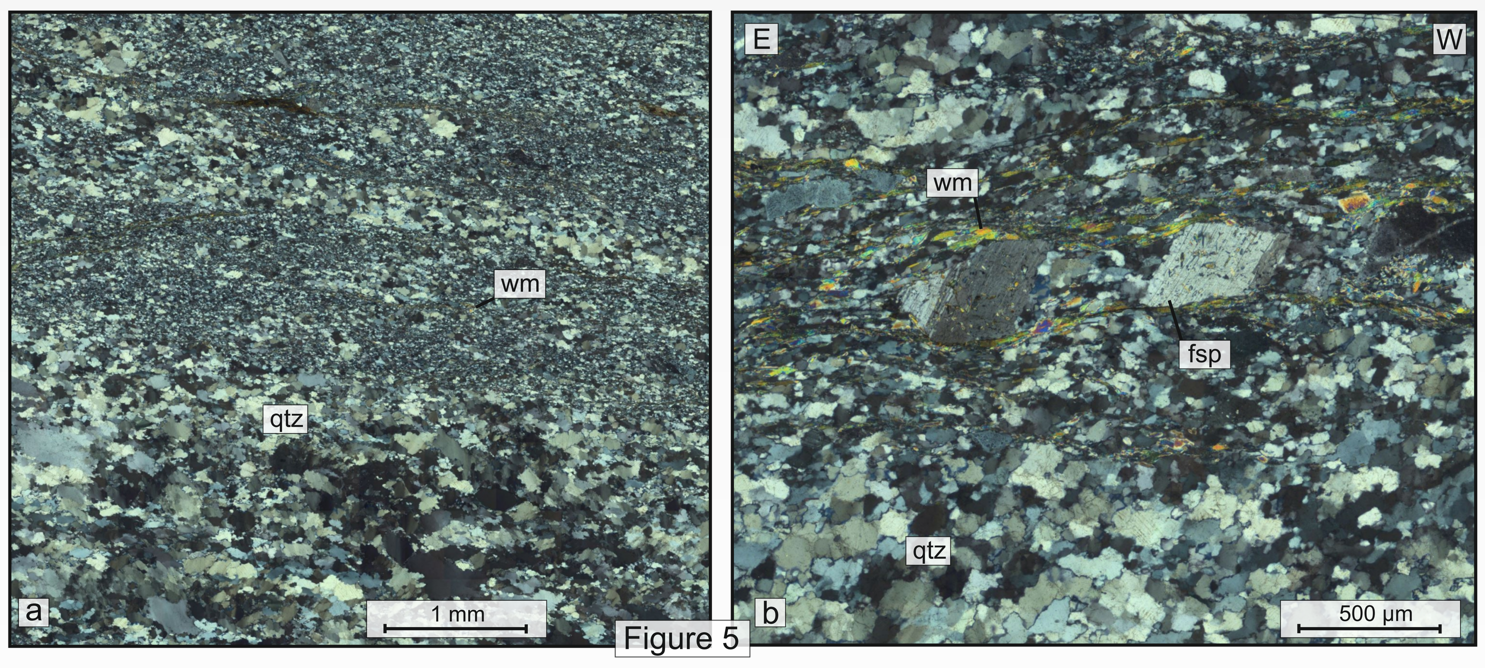


Figure 5

Thin section observations revealed that samples from the **Pretul Orthogneiss** consist of quartz, serictizied feldspar, white mica, and rarely occuring biotite, which is often chloritized. Accessory minerals are zircon and apatite. Commonly quartz veins crosscut the orthogneiss.

The Rittis Quartzite consists of quartz and rarely white mica on schistosity planes. This quartzite shows a bimodal grainsize distribution (Fig. 5a). Smaller grains can be found in white mica rich layers and in the contact zone to the orthogneiss, bigger grains in the more pure parts. Accessory minerals are seldom and identified as rutile and zircon. In contact zones to the Orthogneiss broken feldspar phenocrysts occur (Fig. 5b). Often fluid inclusion are incorporated in the quartz grains and along grain boundaries. **Microstructural observations** show a well-developed E-W shape preferred orientation of the occurring crystals. A cristallographic preferred orientation is poorly developed. The formation of subgrains in the quartzite and the brittle deformation of feldspar are indicators for deformation at greenschist facies conditions.

3.3) Structures:

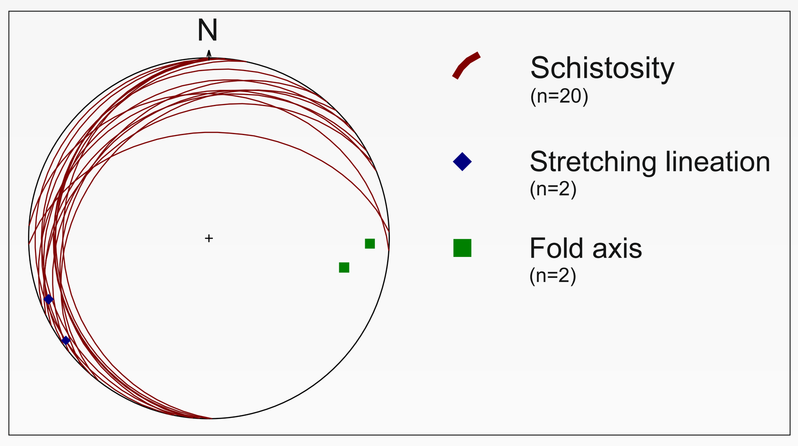


Fig. 6: The bedding of the lithologies show a uniform shallow dip of 20°-30° to WNW. Some outcrops, of the orthogneiss show a well-developed lineation dipping shallowly to the SW at 10°-15°. Rarely folds with a shallow E-directed dip are present.

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