Characterization of mineral parageneses and metamorphic textures in eclogite- to high-pressure granulite-facies marble at Allmenningen, Roan, western Norway.

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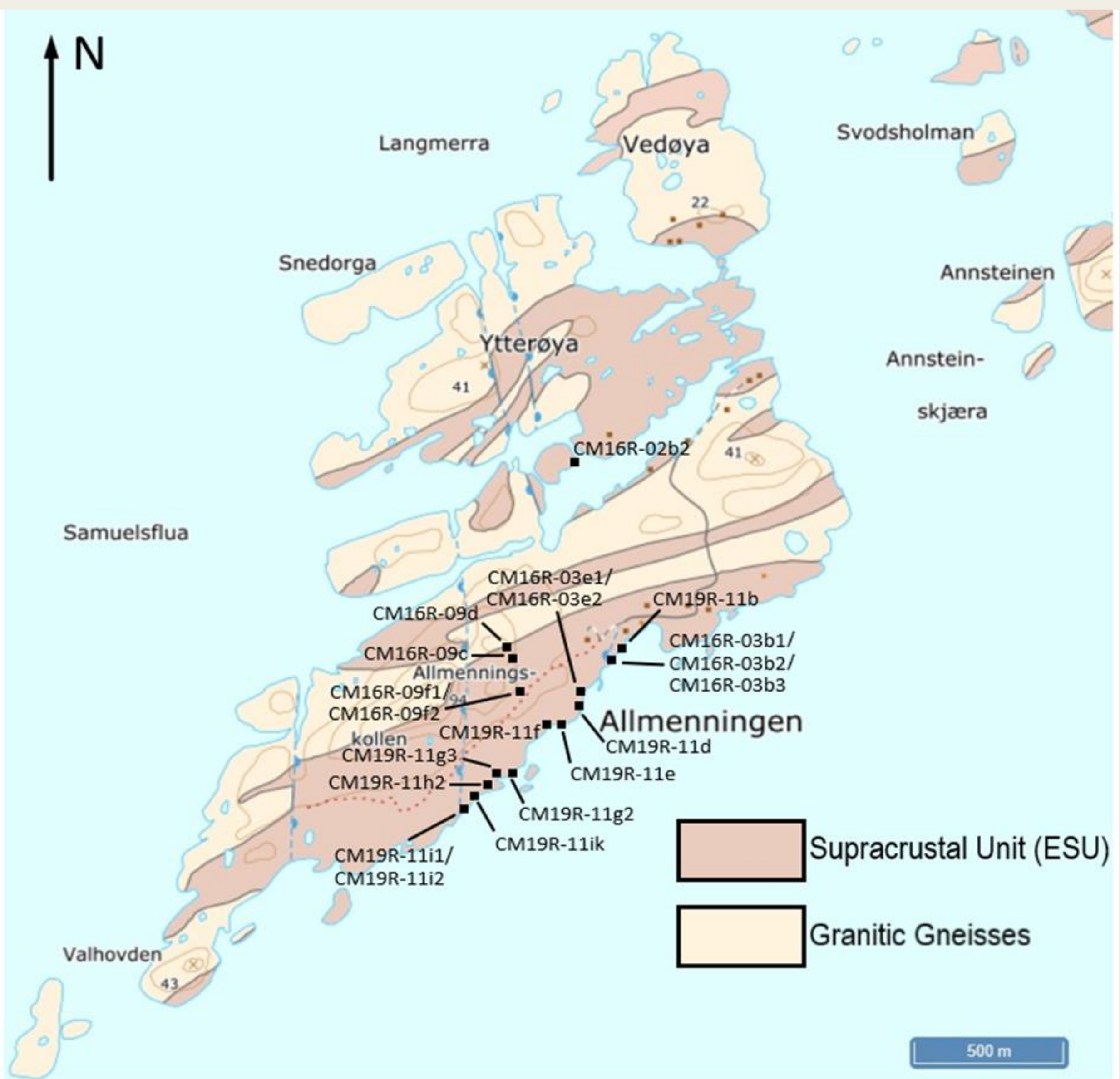


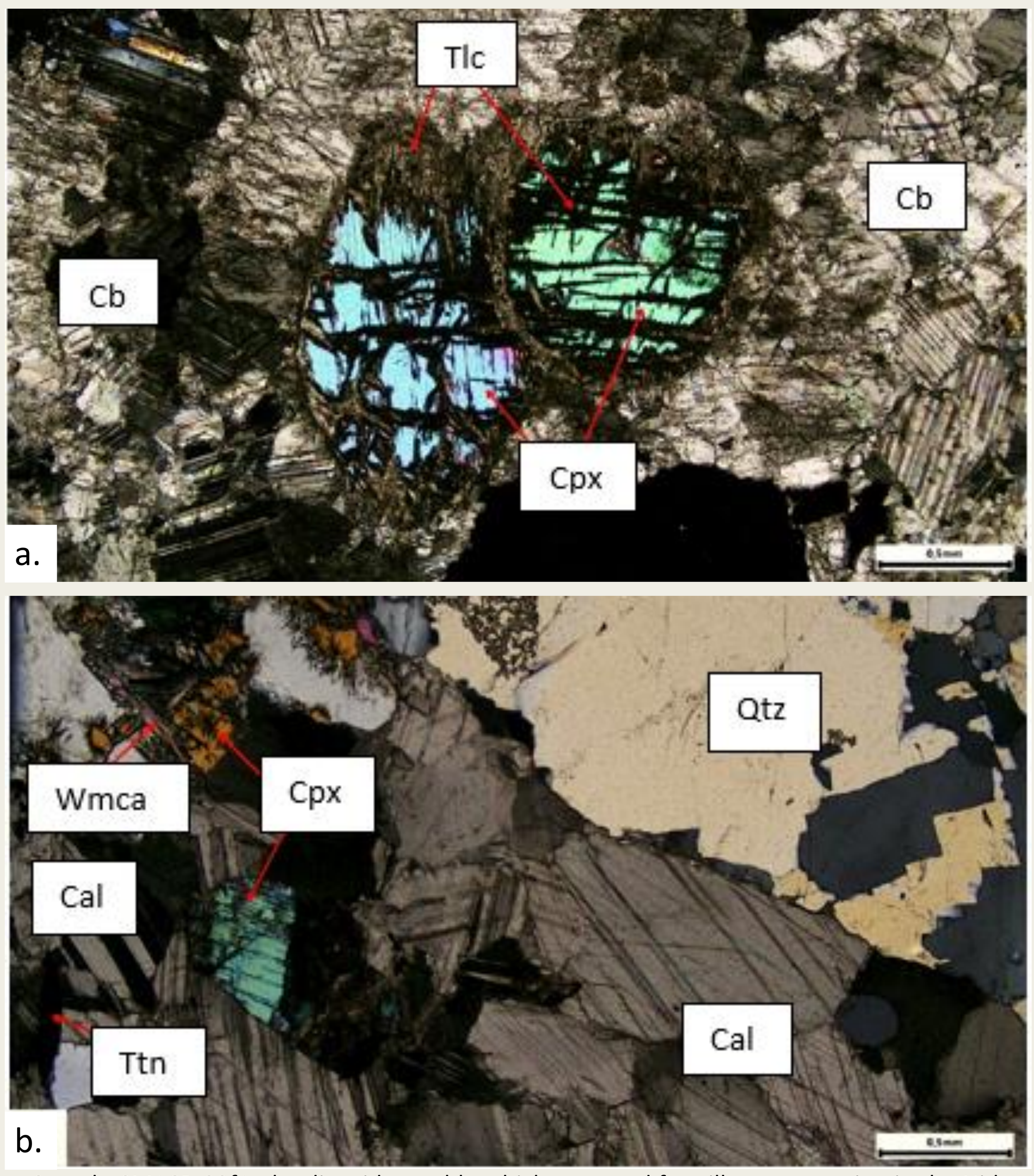
Geological map of Allmenningen and localities of the samples. Map acquired from the database of Norway's Geological Survey.

AIM

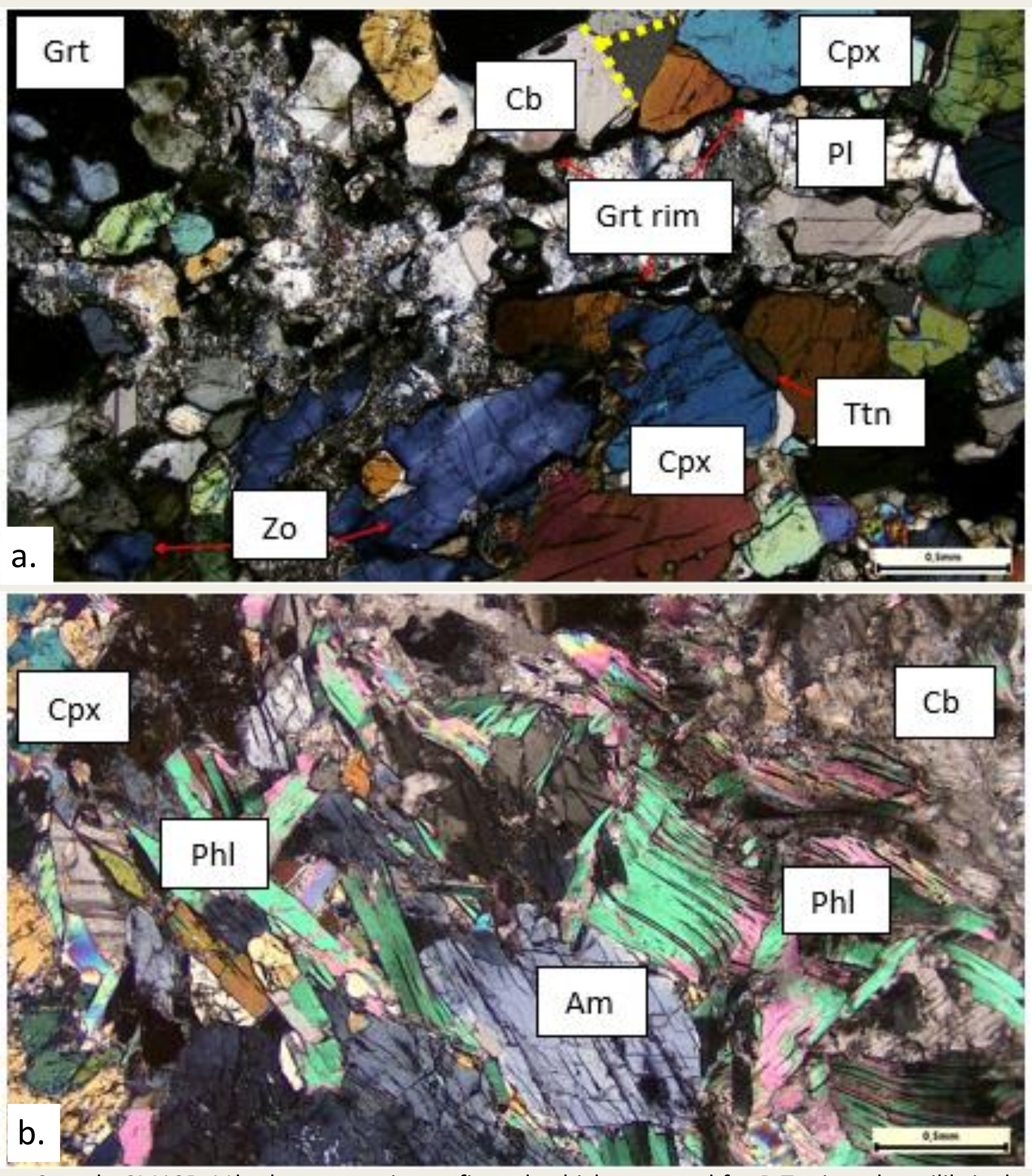
Mineral parageneses identification of marbles, calc-silicate rocks and intercalated mafic rocks and P-T estimation of peak metamorphism at Allmenningen, Roan, western Norway.

GEOLOGICAL SETTING

Allmenningen belongs to the Western Gneiss Region, one of the deepest parts of the Caledonian Orogen. Allmenningen is part of the Einarsdalen Supracrustal Unit (ESU), which is considered as the reworked parauthochthonous margin of Baltica. The study area is mainly composed of carbonate rocks that surround mafic bodies. The metamorphic conditions in Roan have been estimated at ca. 870°C and 14.5 kbar (Möller, 1988; 1990; Dallmeyer et al, 1992).



a. Sample CM16R-09f1, the diopside marble which was used for pillar construction in the Nidaros Cathedral of Trondheim. b. A characteristic pink marble from Allmenningen, sample CM16R-09c.



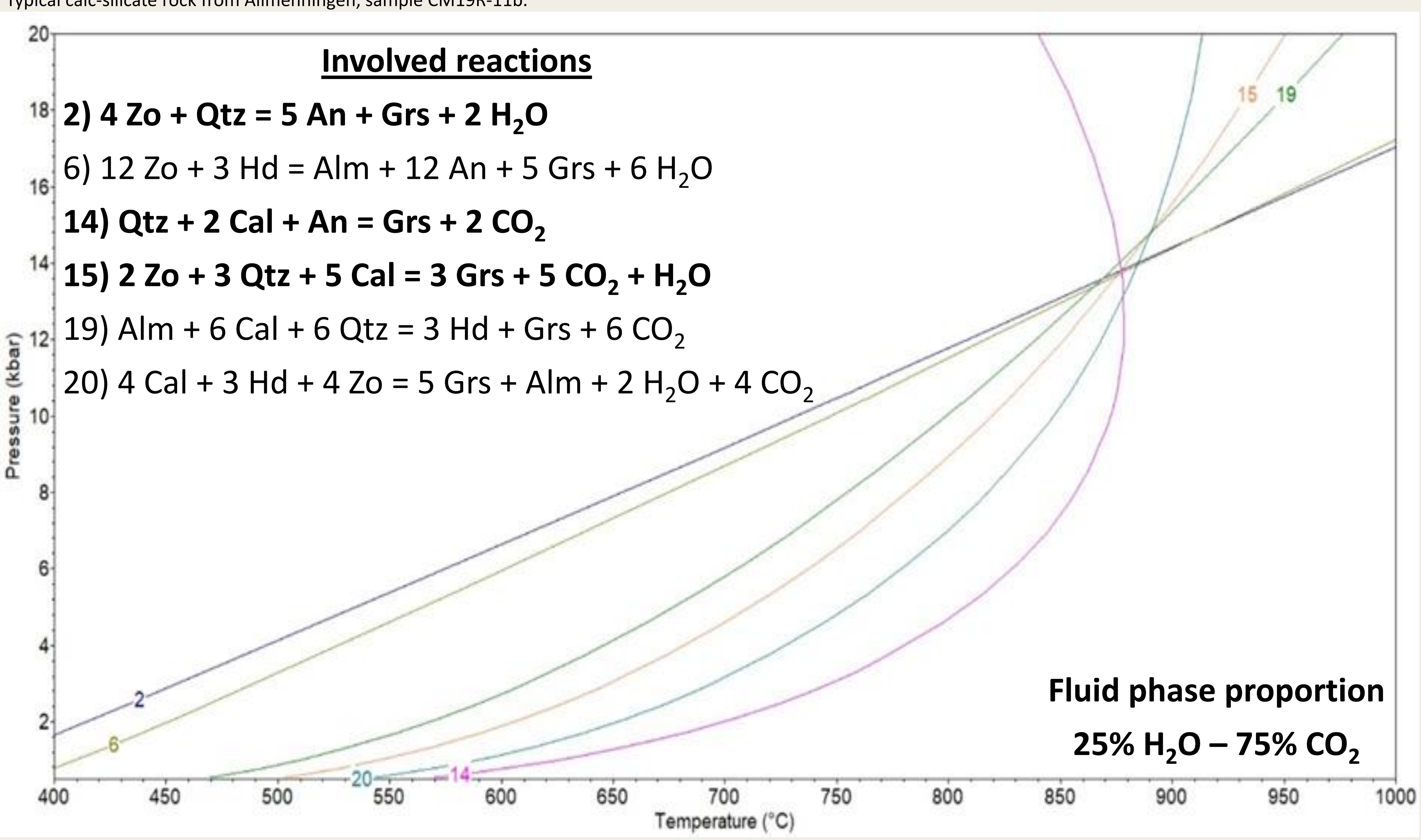
a. Sample CM19R-11k, the garnet-rim mafic rock which was used for P-T mineral equilibria. b. Typical calc-silicate rock from Allmenningen, sample CM19R-11b.

METHODS

The studied rocks were examined for macroscopical and microscopical observations. Petrographical microscopy was performed to identify the mineral parageneses and metamorphic textures in every rock type. Scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS) was used to detemine mineral parageneses chemistry and provide stoichiometrical data of the minerals. The winTWQ software was used for geothermobarometry and pressure-temperature estimation using mineral equilibria.

RESULTS: MINERAL PARAGENESES

The main minerals in marbles and calc-silicate rocks are calcite, dolomite and diopside. Other minerals that occur in these rocks are amphibole, scapolite, plagioclase, phlogopite and quartz. Rarely plagioclase and epidote can be observed. The dominant accessory minerals are titanite, apatite and opaque minerals. The mafic rocks differ from the marbles and the calc-silicates because, instead of scapolite and phlogopite mica, they contain garnet. The main constituents of the mafic rocks are garnet, diopside and plagioclase. Some of the mafic rocks may contain amphibole, zoisite and calcite. Accessory minerals are titanite, apatite and opaque minerals. In some samples, signs of retrograde amphibolite facies and/or low-grade, fine-grained alterations occur. Amphibole is pseudomorphing after clinopyroxene while talc fills the crevices of clinopyroxene's cracks. In some samples, plagioclase is affected by low-grade sericitization.



Temperature and pressure equilibrium diagram calculated using TWQ (Berman, 1991), with stable curves and metastable reactions of garnet-rich mafic knob in marble-amphibolite contact (sample CM19R-11k). The intersection of the selected chemical reactions implies that the metamorphic conditions during equilibrium reached high-pressure granulite to eclogite facies.

RESULTS: GEOTHERMOBAROMETRY

A garnet-rich mafic rock in marble-amphibolite contact was used for P-T estimation using mineral equilibria. Garnet in this sample is Ca-Al-rich (grossular) and occurs in porphyroblasts and very thin rims that surround the other minerals. It was observed that the rims are richer in grossular component compared to the porphyroblast cores. The mineral equilibria selected are grossular-forming reactions which consume zoisite, calcite and plagioclase. The results show that grossular formed during heating and devolatilization. Three reactions in the P-T plot intersect at ca. 875°C and 13.8 kbar. These conditions plot in the high-pressure granulite to eclogite facies. The fluid phase proportion at that moment was 25% water and 75% carbon dioxide. The garnet and diopside forming reactions consumed significant amounts of calcite and/or dolomite, respectively. The produced CO_2 from decarbonation during metamorphism can contribute to global warming, along with volcanic eruptions or ice cap melting.

References

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