Pyroxene microstructures in eclogite from UHP domains and an interjacent area, WGR, Norway

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Introduction

The Western Gneiss Region (WGR) in W Norway is the lowermost tectono-stratigraphic unit in the nappe pile of the Scandinavian Caledonides. Exposed high-grade gneiss hosts ultrahigh pressure (UHP) metamorphic eclogite in domains that alternate without evidence for being separated from one another by tectonic shear or ductile flow [1, 2]. We studied five eclogites from two UHP domains and the interjacent HP area in the Storfjord–Moldefjord region for mineral chemistry and microstructures to constrain differences and similarities in their metamorphic evolution. This study aims on the reason for the apparent bimodality in metamorphism that is the source for contrasting models of tectonic UHP rock exhumation [3, 4, 5].

UHP rocks in the WGR

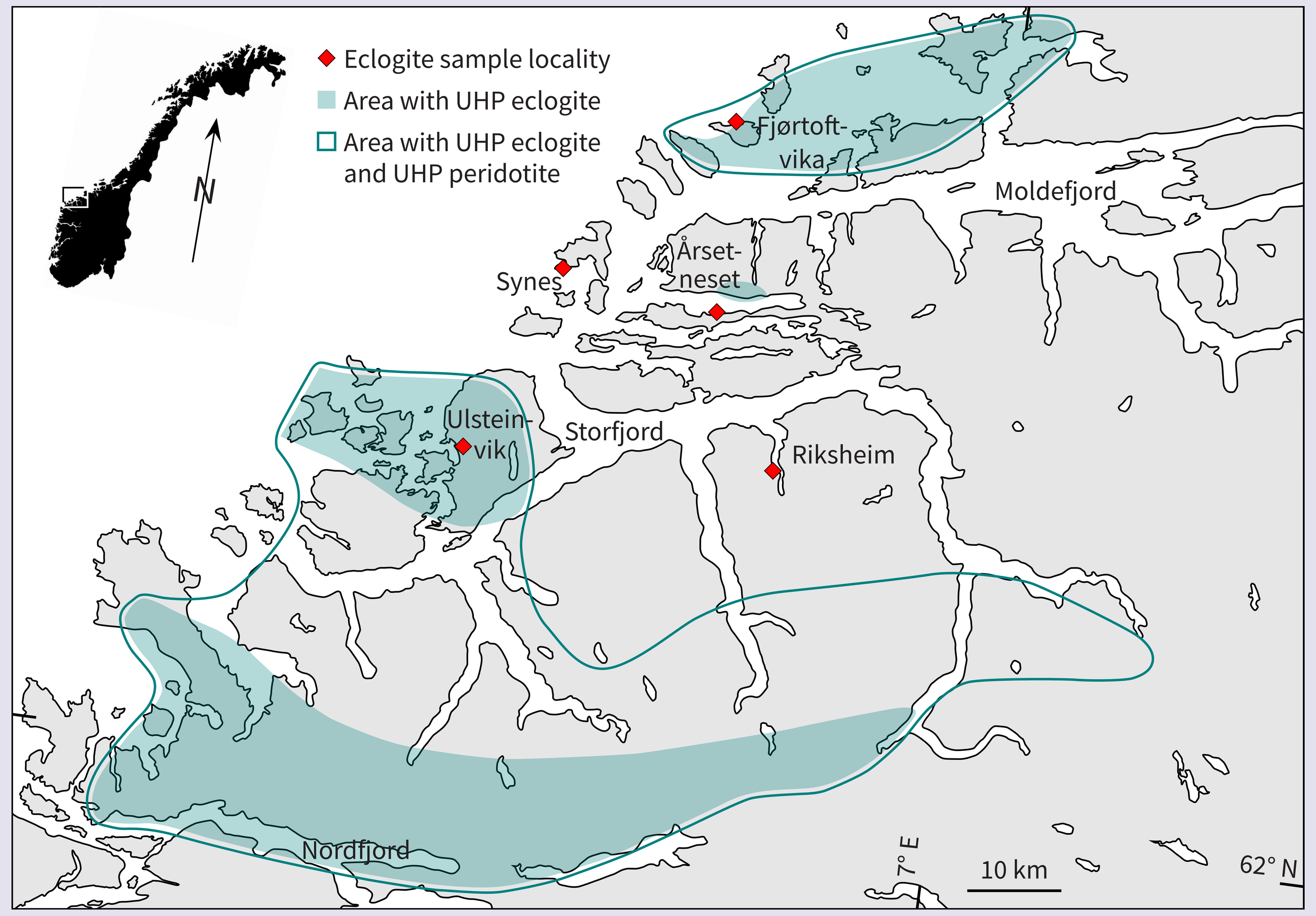

Fig. 1: Simplified map of the WGR that shows sample locations and known areas of UHP metamorphism from eclogite [1, 6] and peridotite [7].

Mafic rocks (eclogite) define three large UHP domains (or areas) that spread along the coast (shaded in Fig. 1). Ultramafic rocks (garnet pyroxenite enclosed in orogenic garnet peridotite) define UHP exposure that partially overlaps that of eclogite and partially fills the space in between (outlined in Fig. 1). When taken together, evidence for UHP metamorphism is concentrated in two areas that are separated by a gap between Storfjord and Moldefjord.

Oriented inclusion petrography

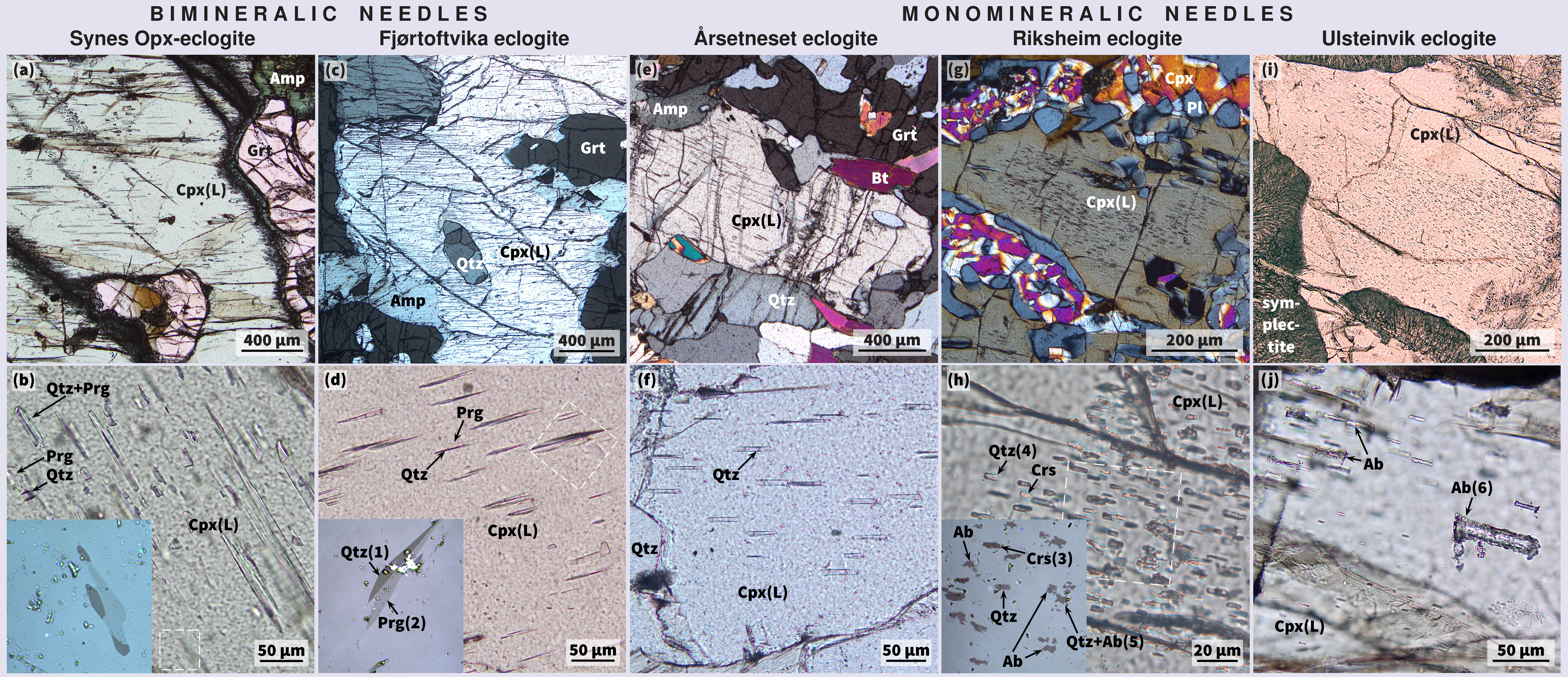

Fig. 2: Oriented inclusions in clinopyroxene (PPL; except c, e, g nearly XPL). (a–d) Bimineralic needles. (e–f) Monomineralic needles show a transformation by the reaction Qtz + Jd = Ab. Dashed frames display positions of inset photos (reflected light). Label numbers refer to Raman spectra shown in Fig. 3.

Phase identification

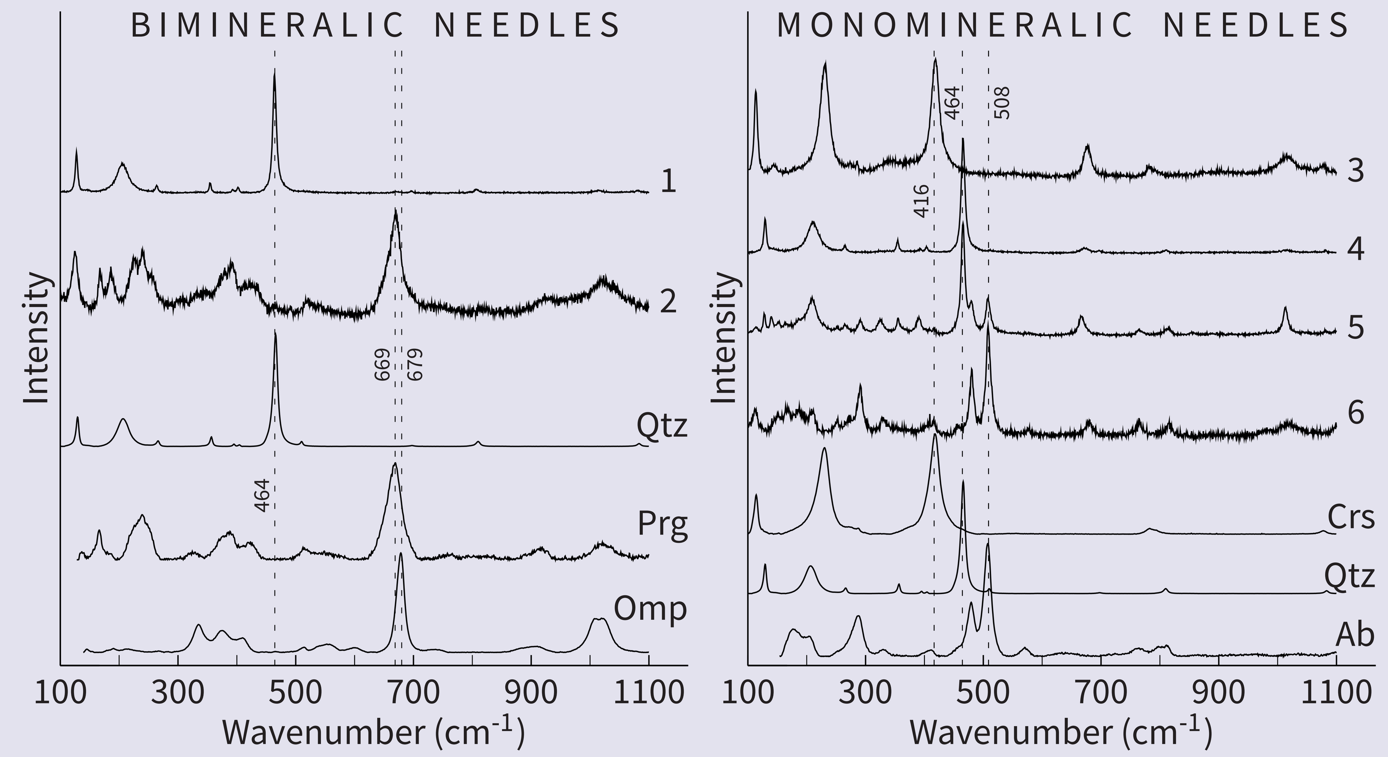

Fig. 3: Raman data of inclusions (numbered, Fig. 2) and reference material.

Clinopyroxene chemistry

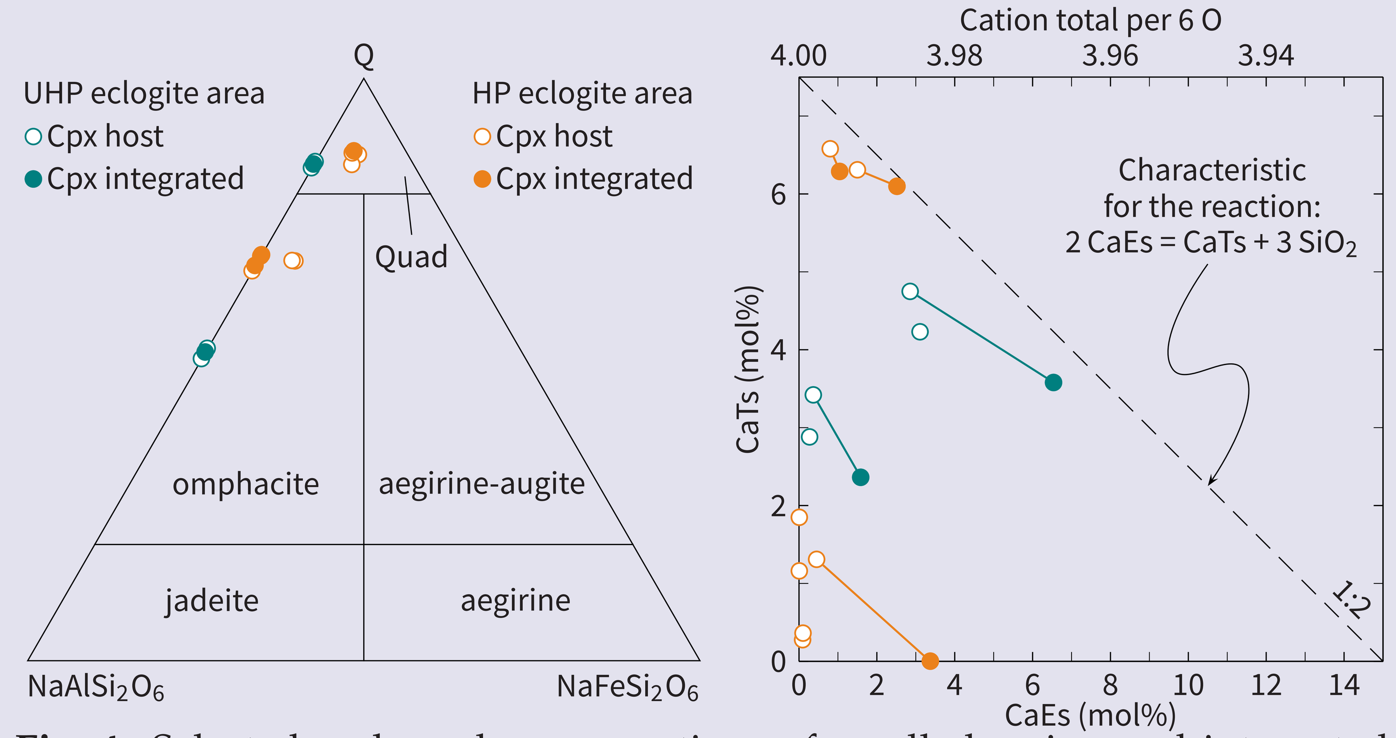

Fig. 4: Selected endmember proportions of needle bearing and integrated clinopyroxene. Solid lines connect compositions of individual grains.

Thermobarometry

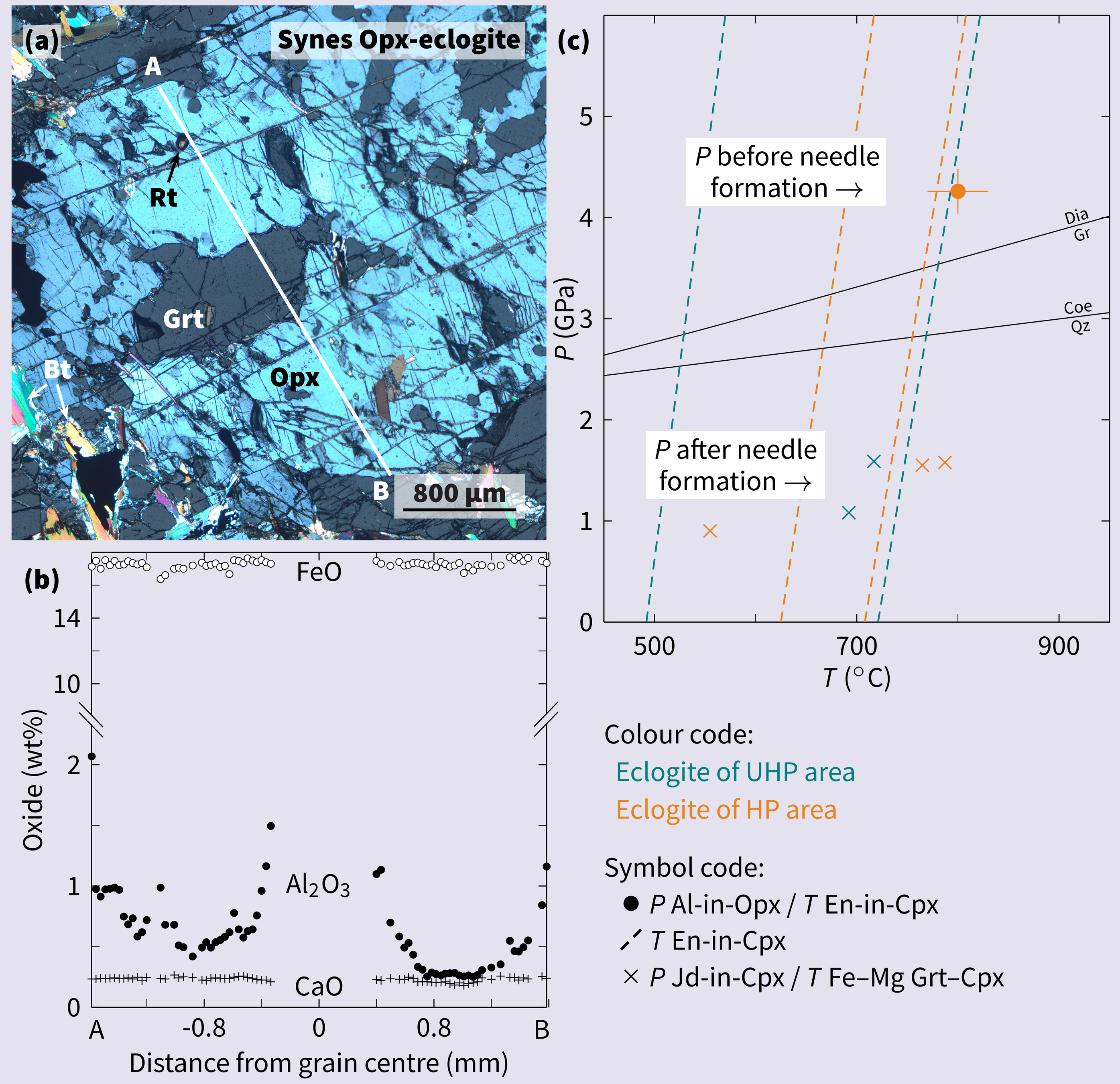

Fig. 5: Thermobarometry based on mineral chemistry. (a) Orthopyroxene with inclusions of irregularly shaped garnet (nearly XPL). (b) Element oxide concentrations along the profile shown in (a). (c) *PT* diagram with metamorphic estimates using classical thermobarometry [8, 9, 10, 11].

Conclusions

Eclogites exposed within and interjacent to UHP areas share:

(1) oriented mineral inclusion microstructures after Ca-Eskola
(2) variable transformation of Qtz needles to Ab that show variable degrees of retrogression across area boundaries
(3) similar metamorphic *P*&*T* after eclogite facies decompression

Funding

The research leading to these results has received funding from the Norway Grants 2014–2021 operated by National Science Centre under the Project Contract No 2020/37/K/ST10/02784 granted to D.S.

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