Petrology and structure of the metamorphic sole of the Pınarbaşı ophiolite, central Turkey: preliminary results

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Introduction

Ophiolites with a so-called supra-subduction zone (SSZ) geochemical signature frequently have a several-hundred-meter thick sequence of metamorphic rocks below their mantle section: the metamorphic sole. These metamorphic rocks typically preserve an inverted metamorphic gradient with P-T conditions up to 10-15 kbar and 875˚C.
The cause of the relatively high pressures is uncertain since the present-day overburden of the overlying ophiolite, cannot account for such high pressures. In addition the relation of the sole to the synchronous formation of the SSZ oceanic crust is not understood.

What is the formation mechanism of metamorphic soles?

Petrography of the metamorphic sole

Mantle tectonite
serpentinite breccia near the contact

Garnet-amphibolite

Garnet + Hornblende + Plagioclase + Clinopyroxene ± Quartz ± Titanite ± Ilmenite ± Hematite ± Apatite
Dark, well foliated (close to mylonitic), asymmetric isoclinal folds and garnet porphyroblasts up to 1 cm. Light coloured m-scale layers with a granular texture.

Amphibolite

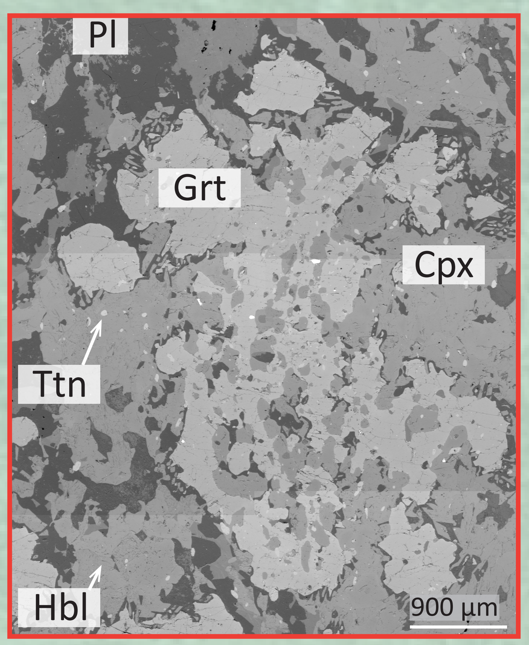
Hornblende + Plagioclase ± Quartz ± Rutile ± Titanite ± Apatite ± Hematite
Well foliated, asymmetric isoclinal folds, lineation defined by amphibole crystals, light coloured cm-scale bands with granular texture.
Fine-grained (< 1 mm) with more metapelitic layers at the bottom, and coarser grained (up to 3 mm) at higher levels with a predominant igneous origin.

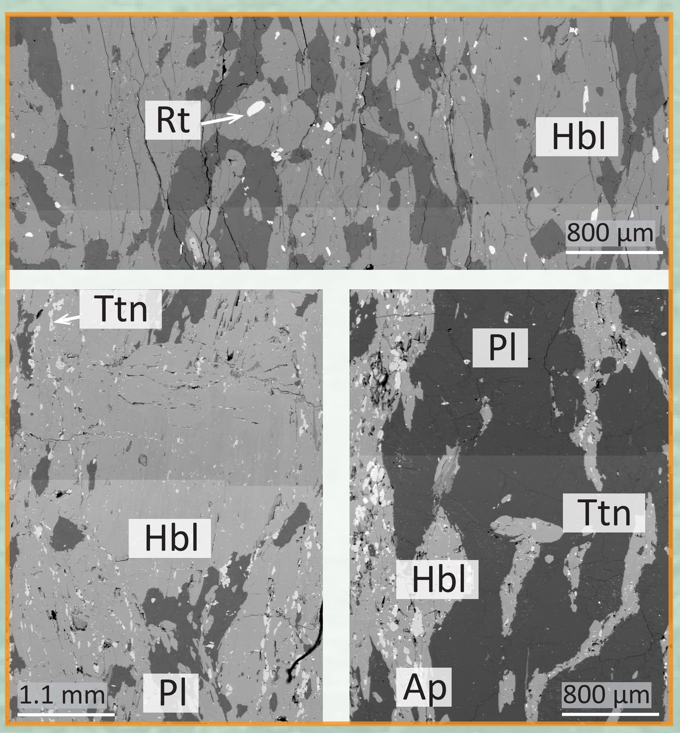
Greenschist facies phyllite

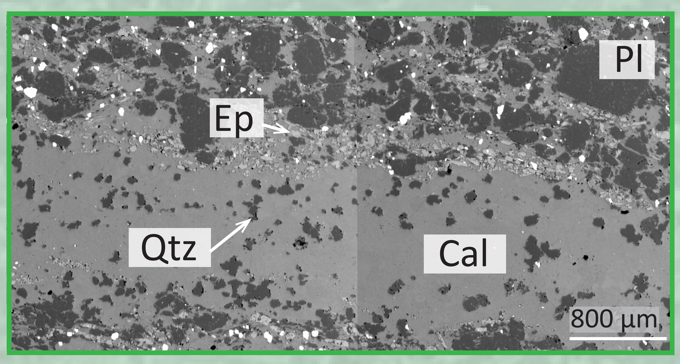
Calcite + Plagioclase + Epidote + Quartz + Mica ± Hematite
Foliated and folded (asymmetric open- and kink-folds), fine grained (< 1 mm) with a sedimentary origin.

Tectonic mélange

Tectono-stratigraphic column of the Pınarbaşı ophiolite







BSE images of metamorphic sole rocks

Outlook

Detailed P-T-t reconstruction by metamorphic study and age dating of both the metamorphic sole and the ophiolite, based on different field areas (Vourinos, Semail)

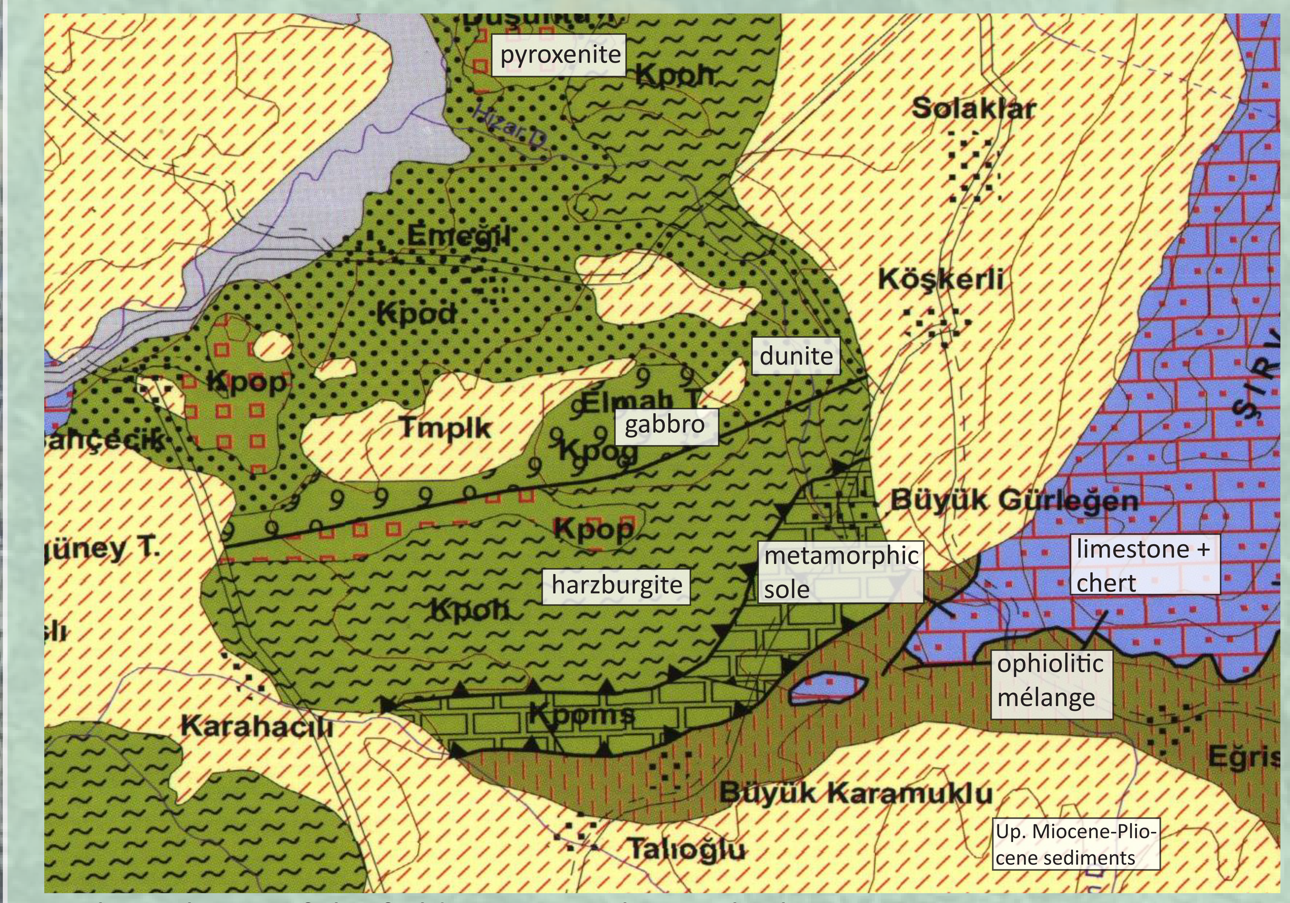
Metamorphic petrology
- petrography (optical microscopy)
- chemical analysis (EMP and XRF)
- calculation of pressure and temperature conditions
- Pseudosection modelling: stable mineral assemblages

Age of formation
- Lu-Hf in garnet (sole)
- U-Pb in titanite (sole) and zircon (oph?)
- isotopes in sulfides (ophiolite)

Cooling age
- ^{40}Ar-^{39}Ar on hornblende and/or plagioclase (sole and ophiolite)

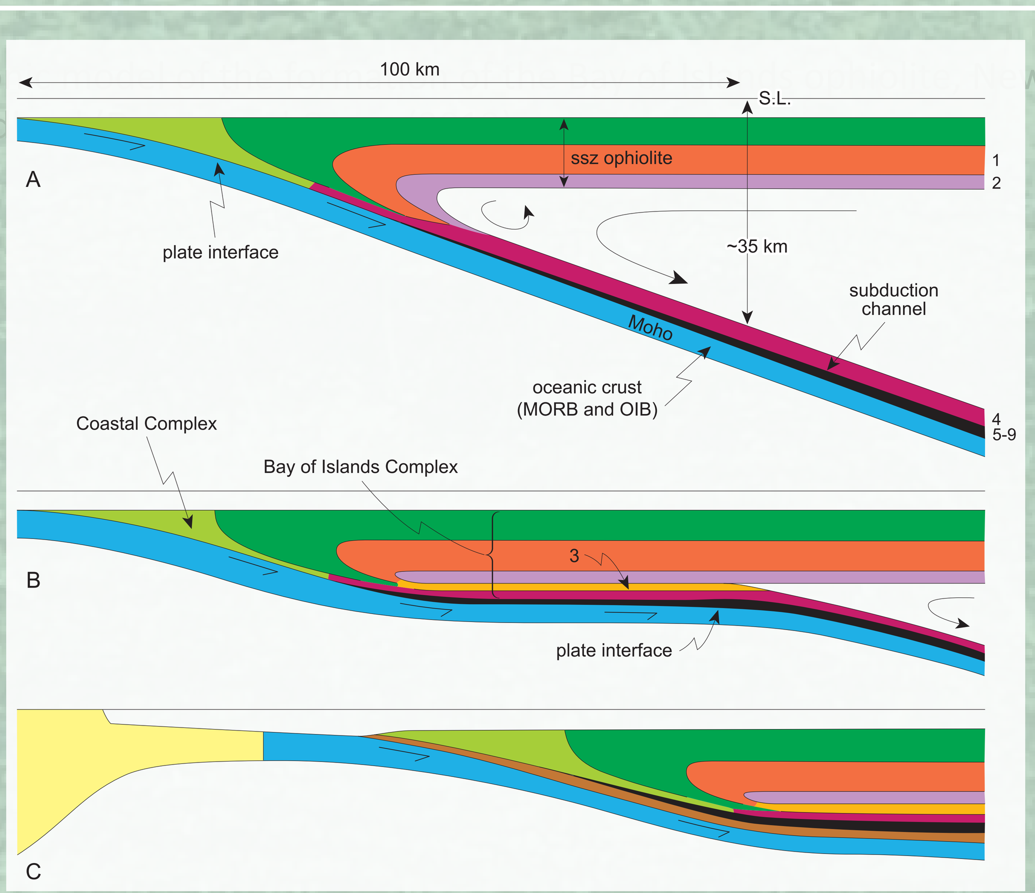
How are the metamorphic sole and the overlying SSZ ophiolite related?

Distribution of the Neotethyan ophiolites in the eastern Mediterranean region (Vergili and Parlak, 2005; after Robertson, 2002). The location of the Pınarbaşı ophiolite is indicated in red.

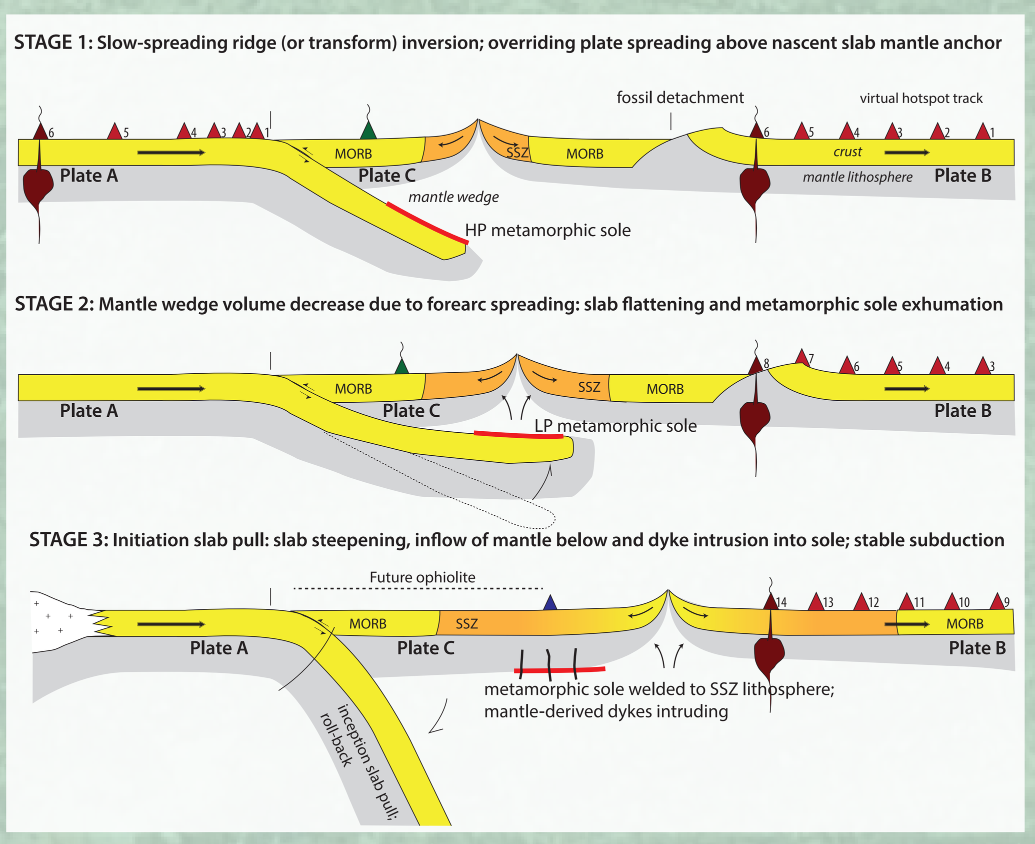


Geological map of the field area, Pınarbaşı ophiolite.

Working hypothesis



Tectonic model, Bay of Islands ophiolite (Dewey and Casey, 2013)



Tectonic model (Van Hinsbergen et al., internal report, 2013)

References

Vergili, Ö., Parlak, O., 2005. Geochemistry and tectonic setting of metamorphic sole rocks and mafic dikes from the Pınarbaşı (Kayseri) ophiolite, central Anatolia (Turkey). Ofioliti, 30, 37-52.
Robertson, A.H.F., 2002. Overview of the genesis and emplacement of Mesozoic ophiolites in the Eastern Mediterranean Tethyan region. Lithos, 65, 1-67.
Dewey, J.F., Casey, J.F., 2013. The sole of an ophiolite: the Ordovician Bay of Islands Complex, Newfoundland. Journal of the Geological Society, 170, 715-722.

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