Chemical Signature Of Migmatite-Related Melts Migration In Lower Mafic Crust: Mineral Geochemistry And Zircon Dating Constraints (Variscan Lower Crust, SW Calabria, ITALY)

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Palmi area: Geological Setting

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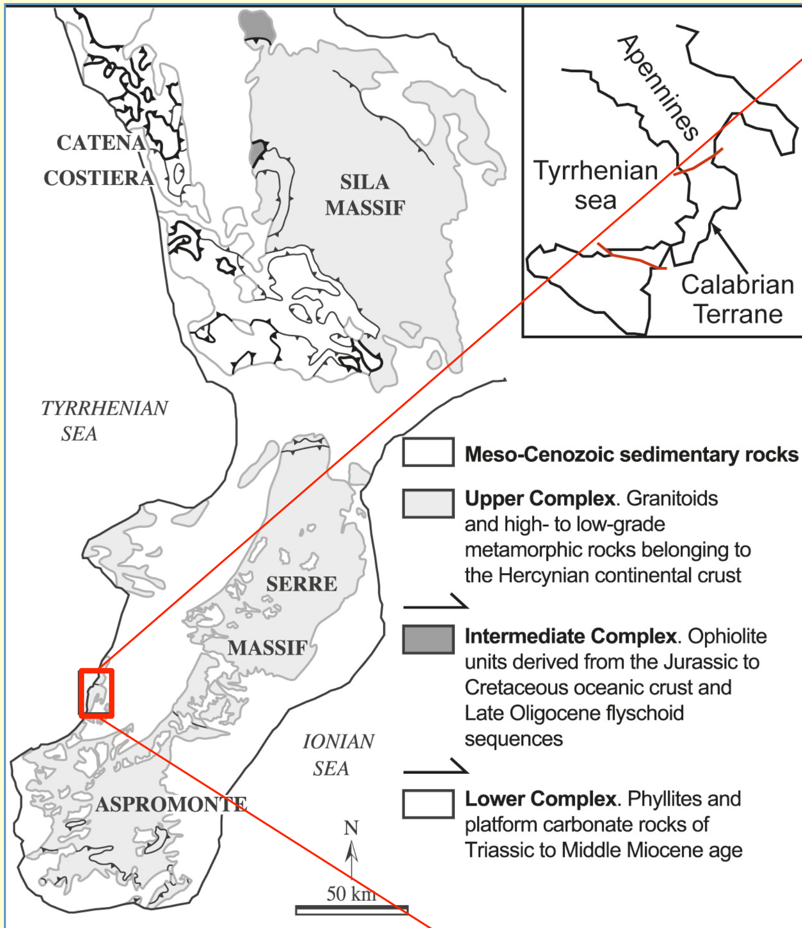
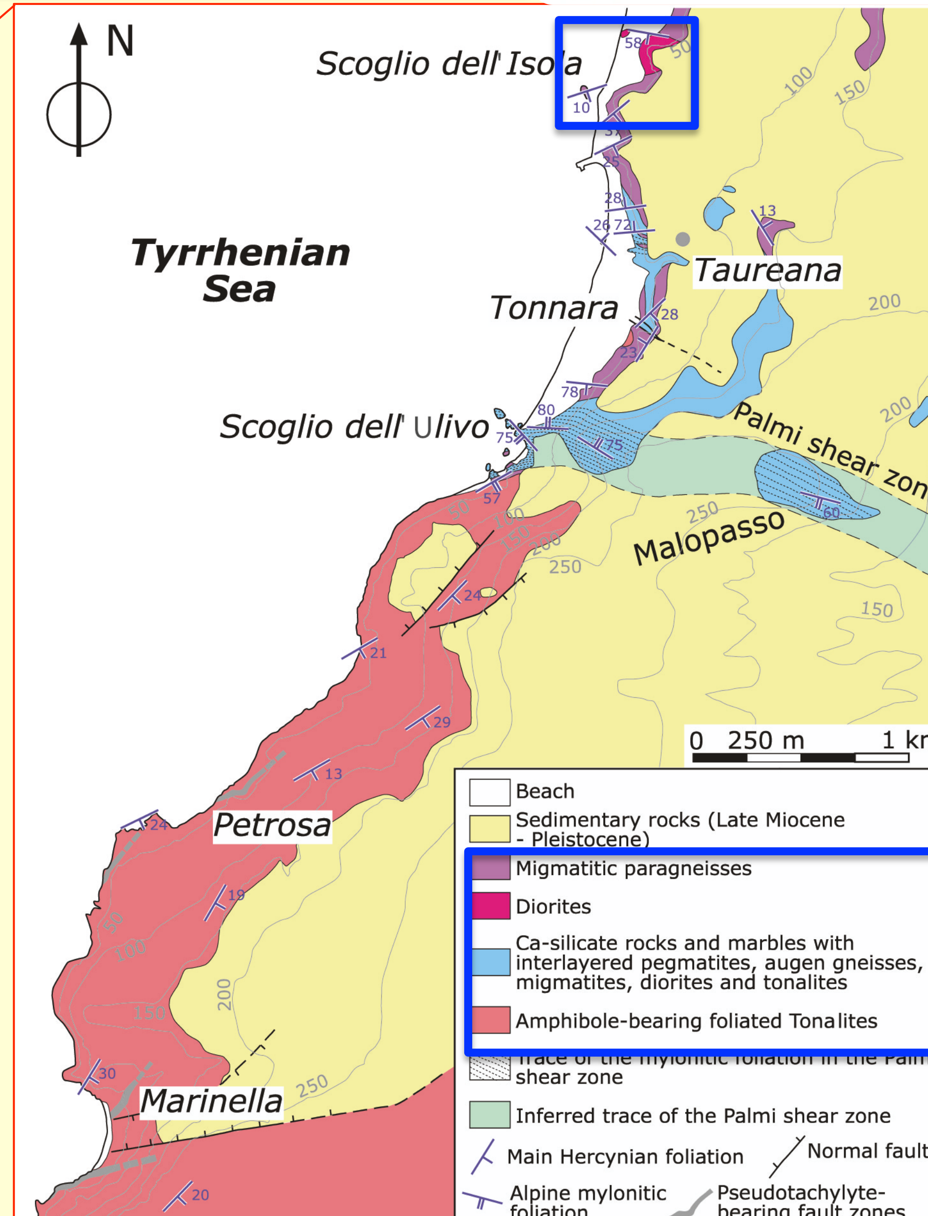


Geological sketch map of Calabria, slightly modified after *Festa et al., Geol. J., (2015)*



Geological sketch map of the Palmi area, slightly modified after *Caggianelli et al., Geol. Field Trips, (2013)*

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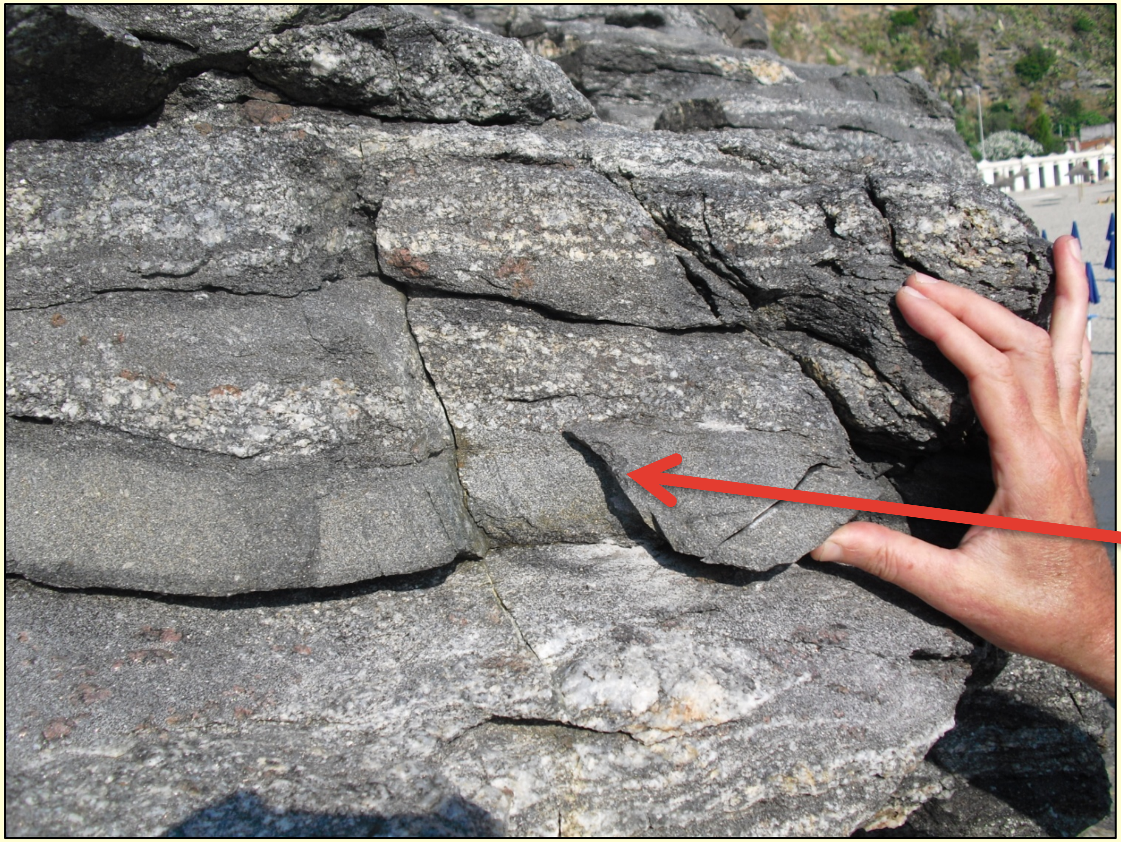
Pietre Nere (PN) main gabbro body

- Weakly foliated, coarse- to medium-grained portions
- Foliated, fine-grained portions are also locally present
- An-rich plagioclase (An_{80-88}) frequently developing triple junctions
- anhedral amphibole and subhedral biotite
- accessory zircon + ilmenite ± allanite

Migmatitic paragneiss



- Paragneiss: peak metamorphic assemblage: Bt + Kfs + Grt + Sill
- Decimeter-thick layers of fine-grained gabbro

- An-rich plagioclase (An_{86-89}) frequently developing triple junctions
- anhedral amphibole and subhedral biotite
- minor ***quartz***
- accessory zircon + ilmenite + ***allanite***

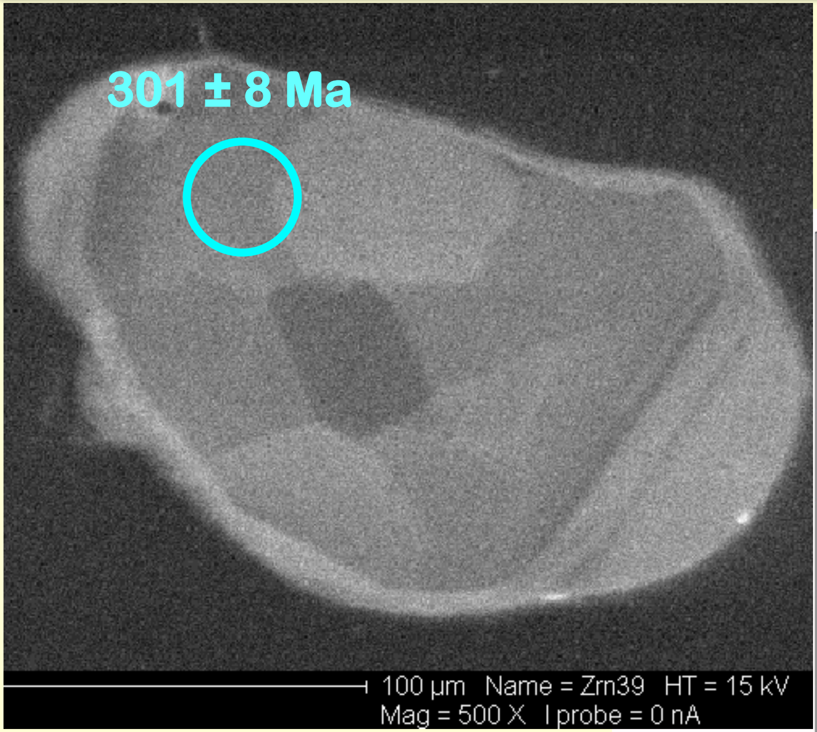
Aims and Objectives

This study reports ***major and trace element mineral data*** with ***U-Pb zircon dating*** of the gabbros.

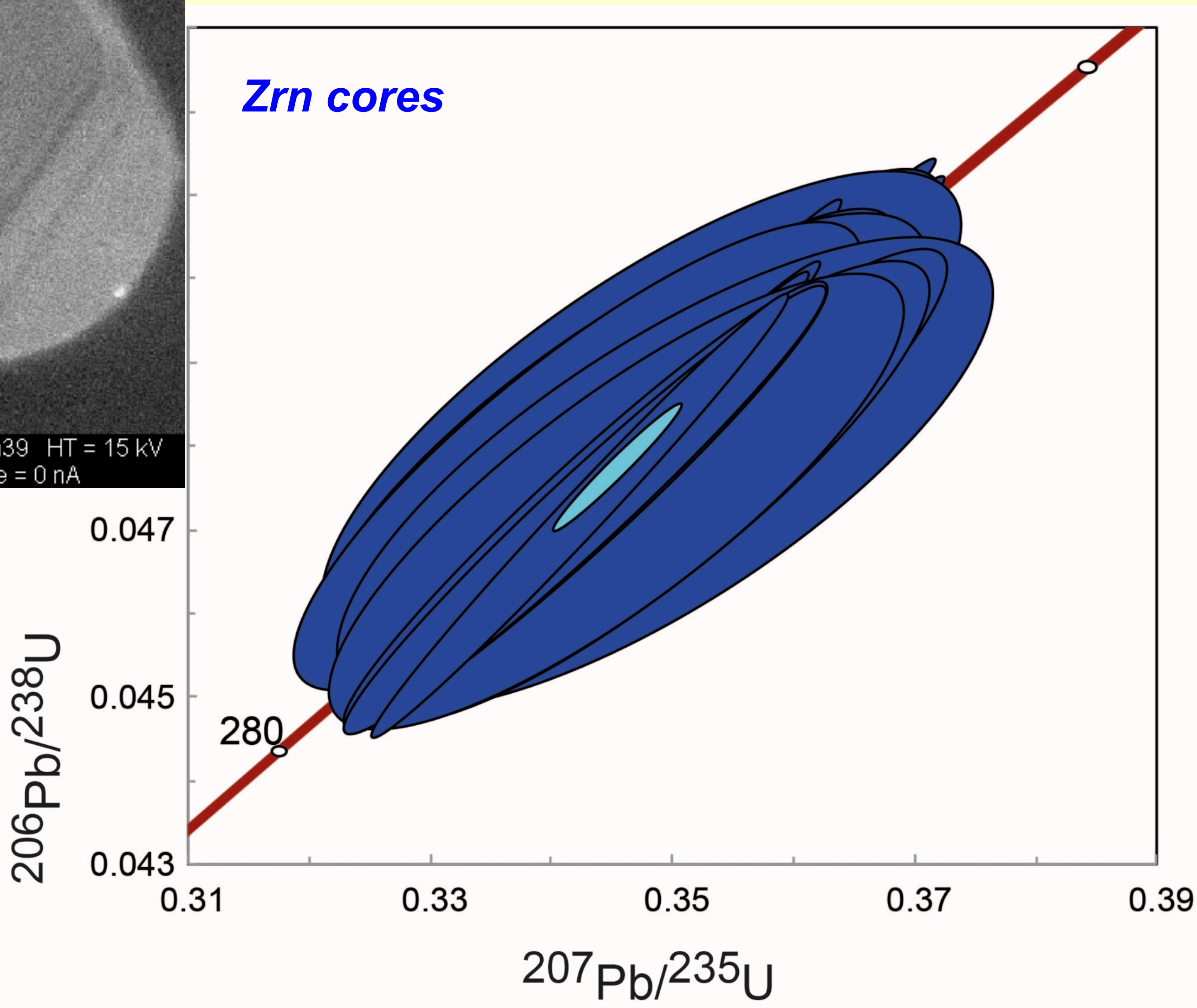
Data were mainly examined to investigate:

- ❑ the chemical effects triggered by the migration of migmatite-related melts into lower mafic crust
- ❑ their relationship with grain size and foliation variation

U-Pb Zircon dating



Fine-grained gabbro from the Pietre Nere main body



Concordia Age =

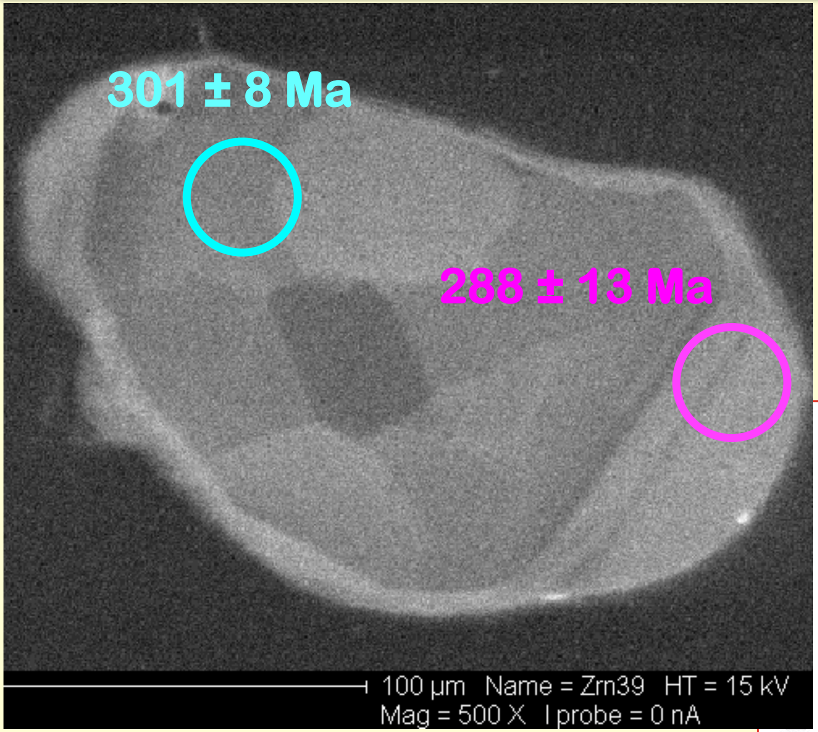
301.6 ± 2.5 Ma

(2σ, decay-const. errs included)

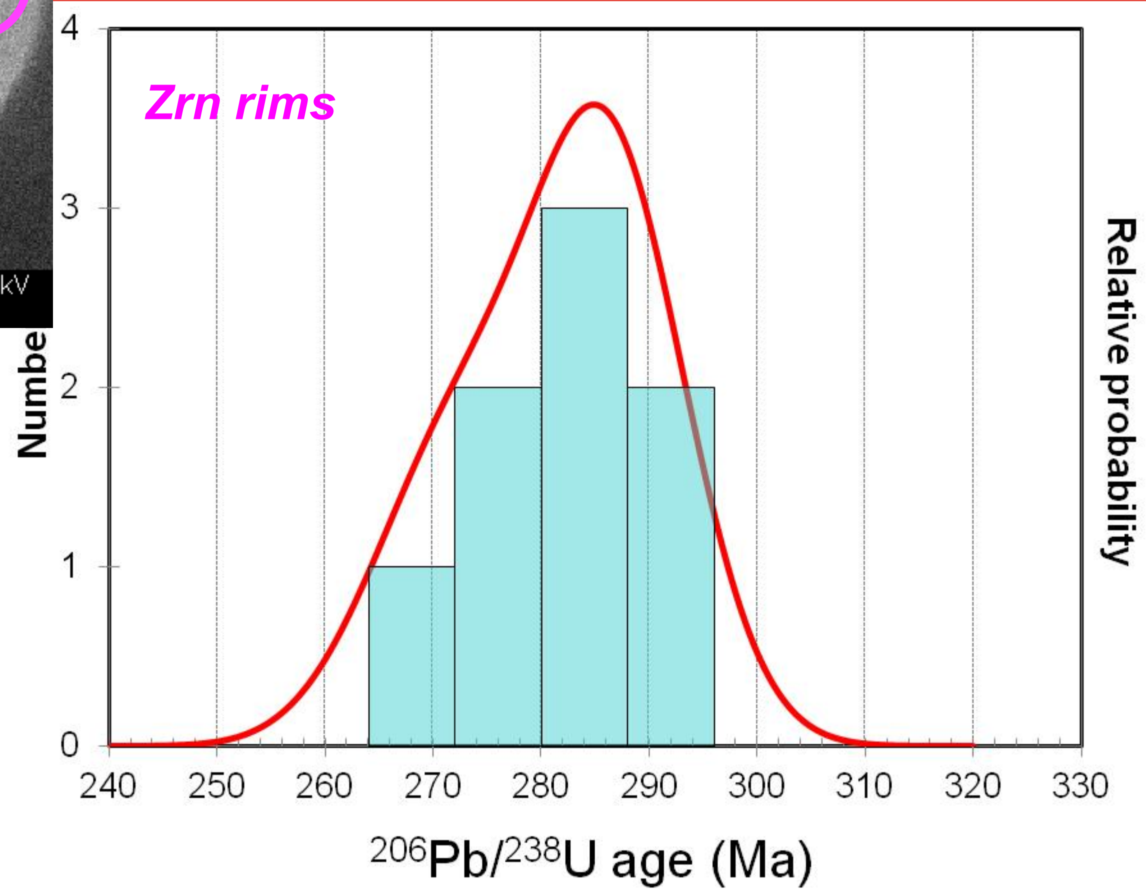
MSWD (of concordance) = 0.88

Probability (of concordance) = 0.35

U-Pb Zircon dating



Fine-grained gabbro from the Pietre Nere main body



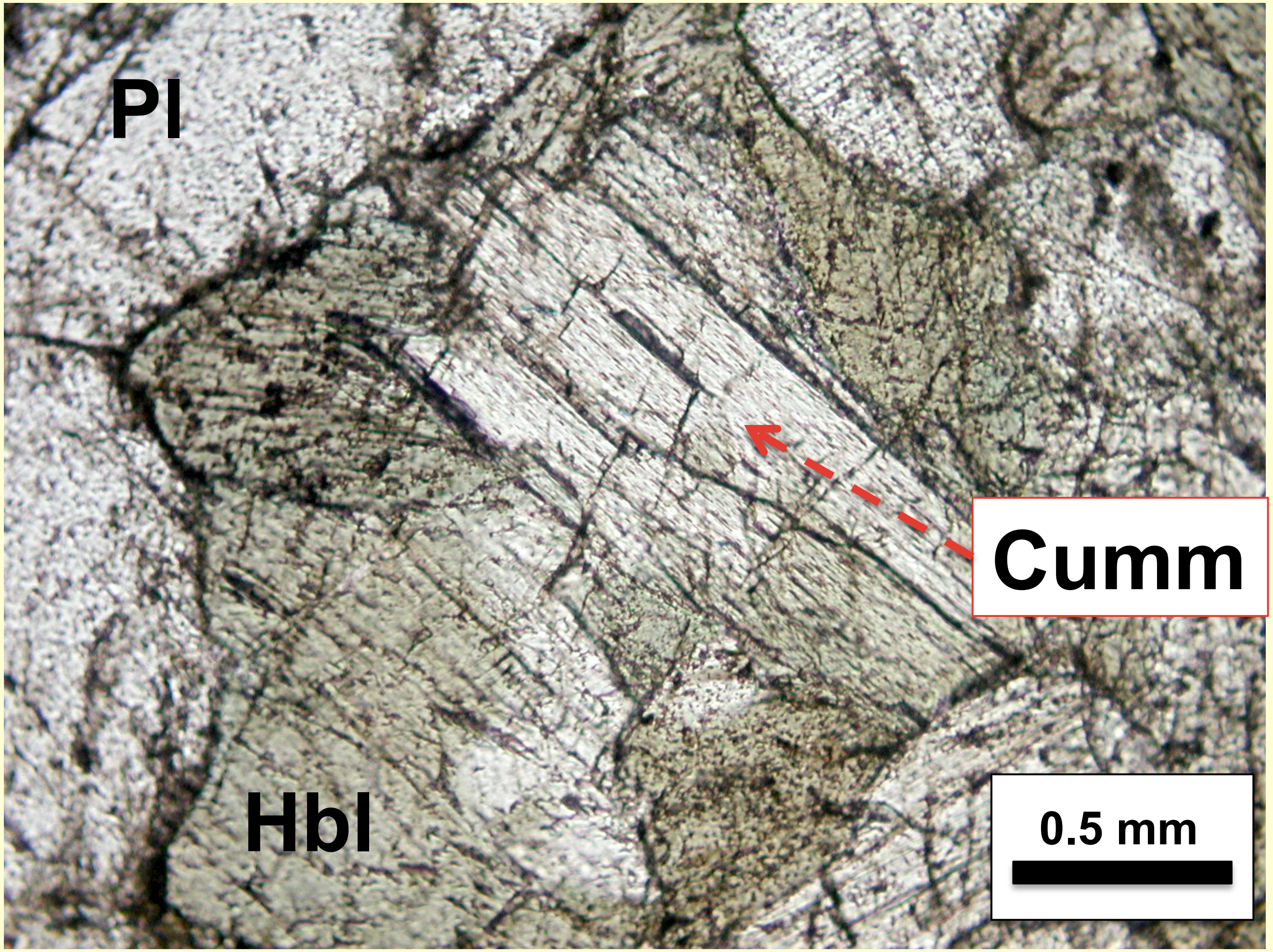
Weighted average

= **281.2 ± 4.7** 2σ

N = 8; MSWD = 1.5,

probability = 0.18

Cummingtonite-hornblende textural relationship



Amphibole consists of cummingtonite grading into hornblende on the rims

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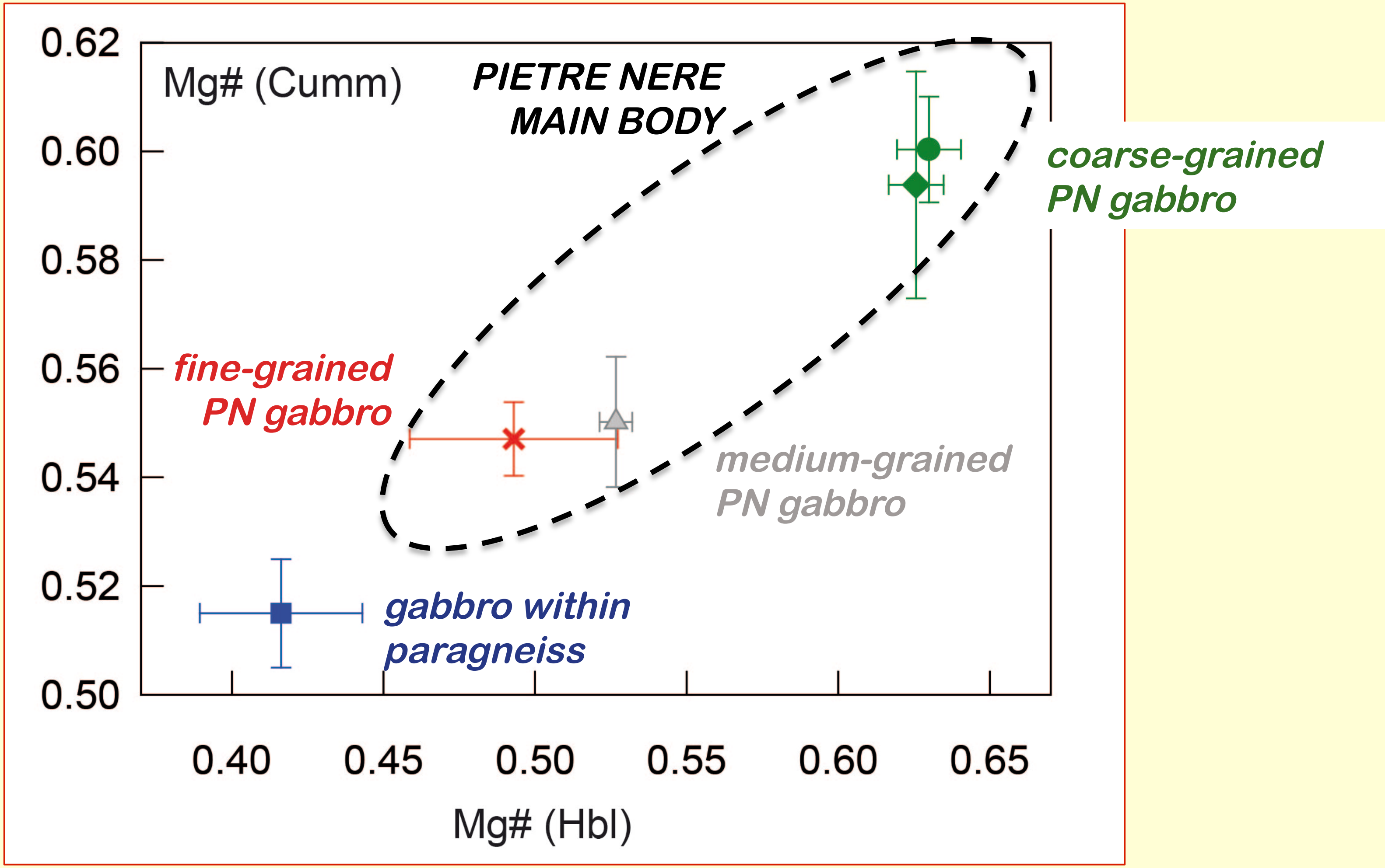
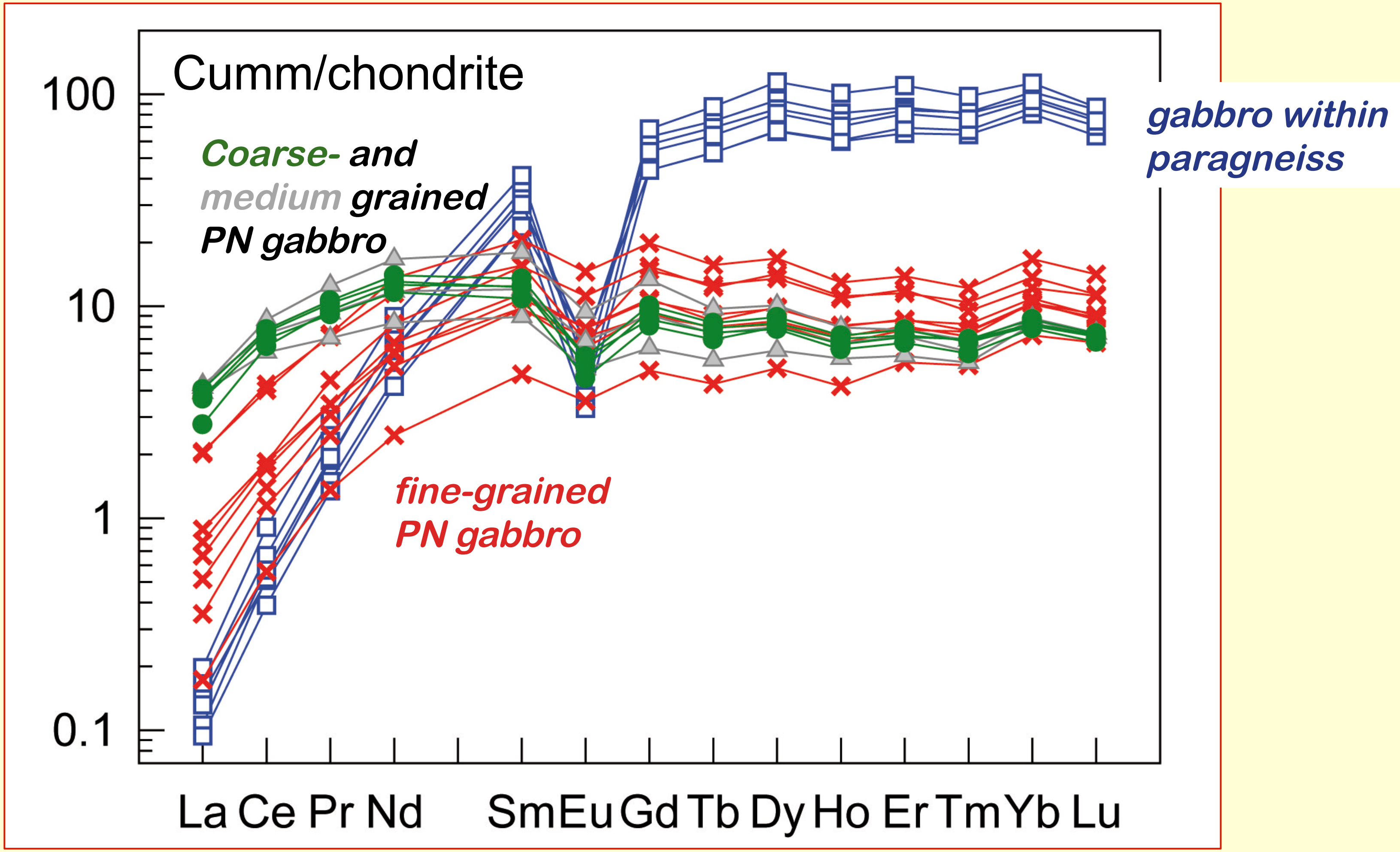
Major element amphibole composition



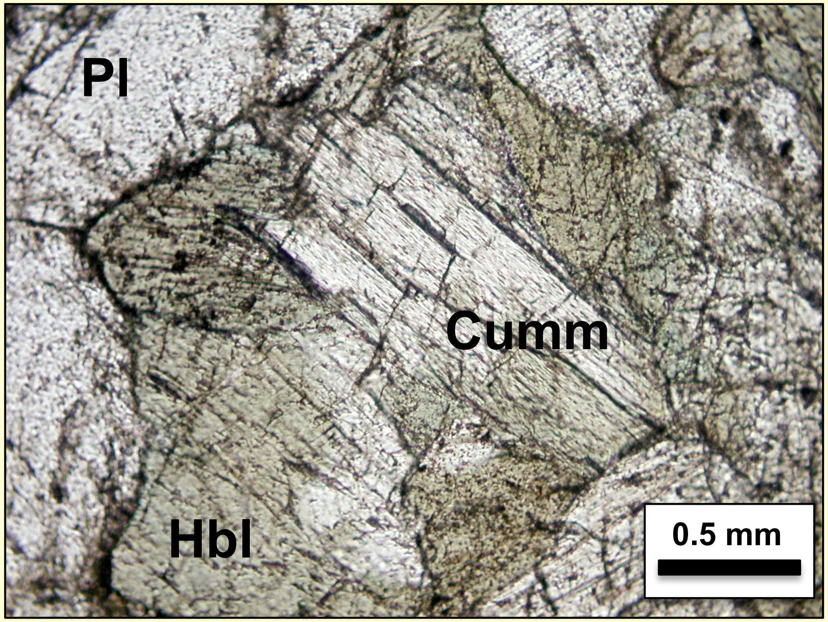
- In the main gabbro body the amphibole shows decreasing Mg# from the coarse-grained to the medium- and fine-grained portions.
- Amphibole from the gabbro interlayered with the paragneiss shows the lowest Mg#

Cummingtonite REE composition



- Cummingtonite from the gabbro interlayered with the paragneiss has a highly evolved REE geochemical signature
- Deep negative Eu anomaly ➔ extensive plagioclase fractionation
- LREE-depletion ➔ LREE-rich phase (i.e., allanite) fractionation

Cummingtonite origin



It has been experimentally demonstrated that cummingtonite coexists with a liquid of rhyolite composition at temperatures below 780°C (*Nandedkar et al., Contrib. Mineral. Petr., 2016*).

- **Opx + Qtz + H_2O ➔ Cumm** (Metabasite, Sila Massif, *Graessner & Schenk, J. Petrol., 2001*)

Low Mg#, highly evolved REE geochemical signature of amphibole from the gabbro interlayered with the paragneiss

➔

Involvement of a melt with an evolved geochemical signature,

Mafic mineral (Opx)+ volatile-rich melt ➔ Cumm

CONCLUDING REMARKS

- Intrusion of the gabbro at 302 ± 3 Ma
- Thermal event at 281 ± 5 Ma that caused the partial resetting of the U–Pb isotope system of zircons and was most likely related to the partial melting of the paragneiss.
- Anatectic melts from the migmatitic paragneiss migrated and interacted with the gabbro promoting the replacement of precursor mafic minerals (e.g., orthopyroxene) with amphibole (associated with segregation of biotite ± allanite).
- The migration of the migmatite-related melt governed a geochemical gradient within the gabbros, with the foliated and fine-grained domains recording the strongest modification of the initial compositions.

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