Rupture of serpentinized mantle wedge by self-promoting carbonation: Insights from Sanbagawa metamorphic belt

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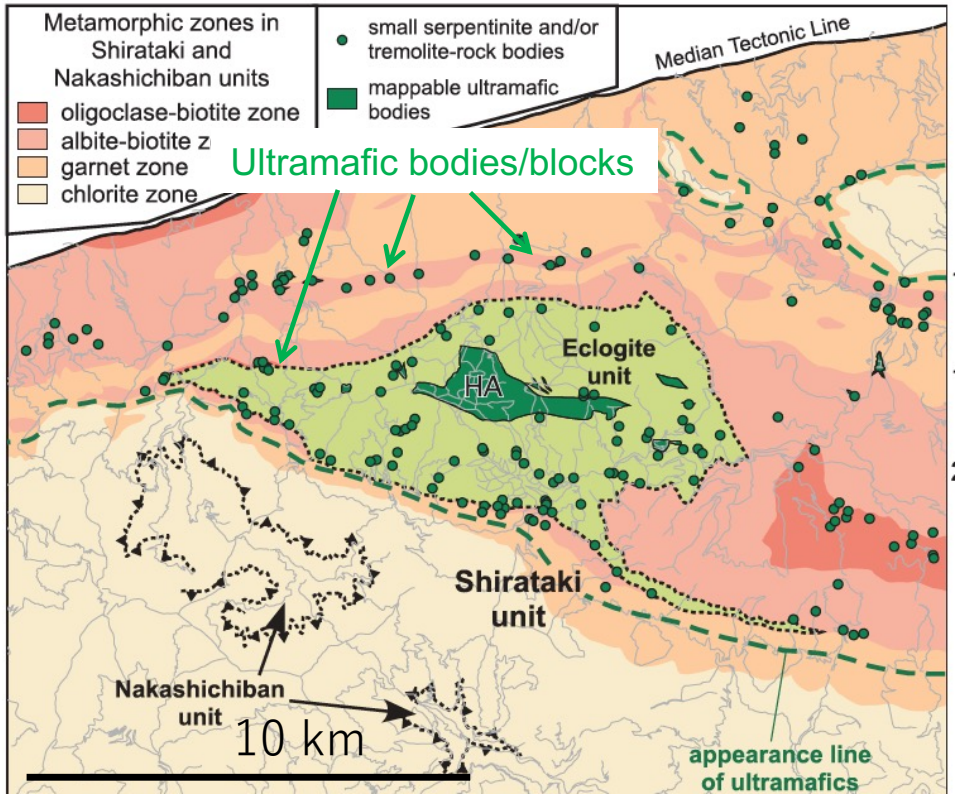
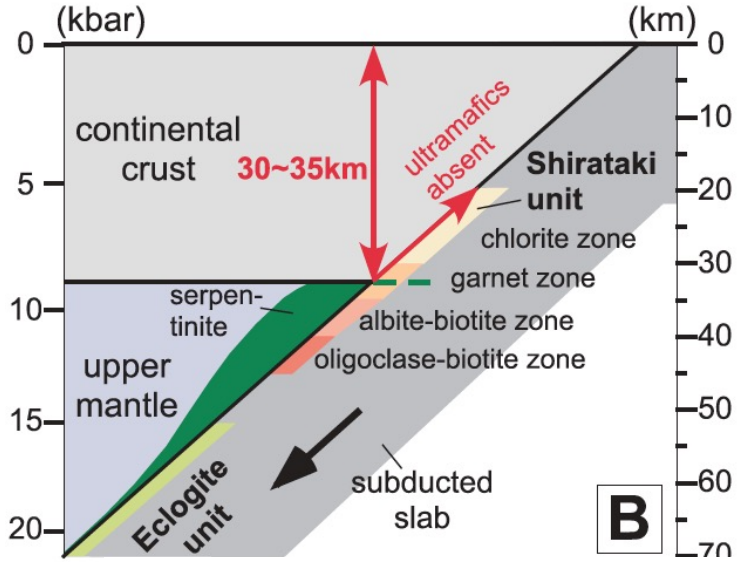
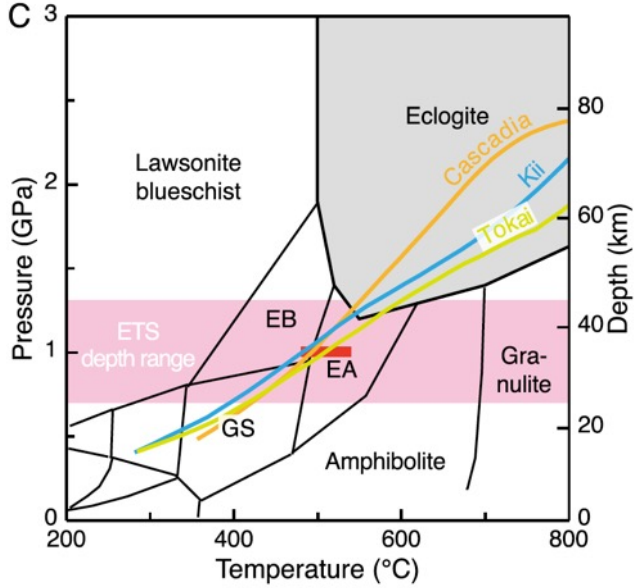
Ultramafic bodies/blocks within the Sanbagawa belt, Japan

Sanbagawa belt, Shikoku Aoya et al. 2013, Geology

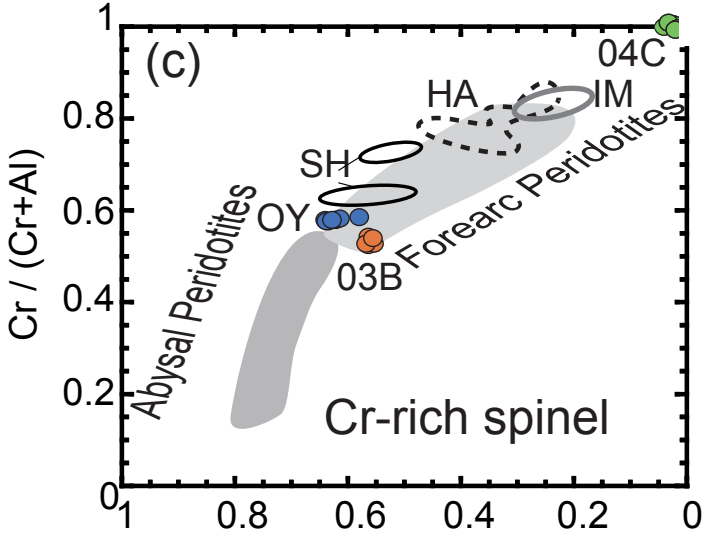


Mantle-wedge origin





Hirauchi et al. 2021
EPSL



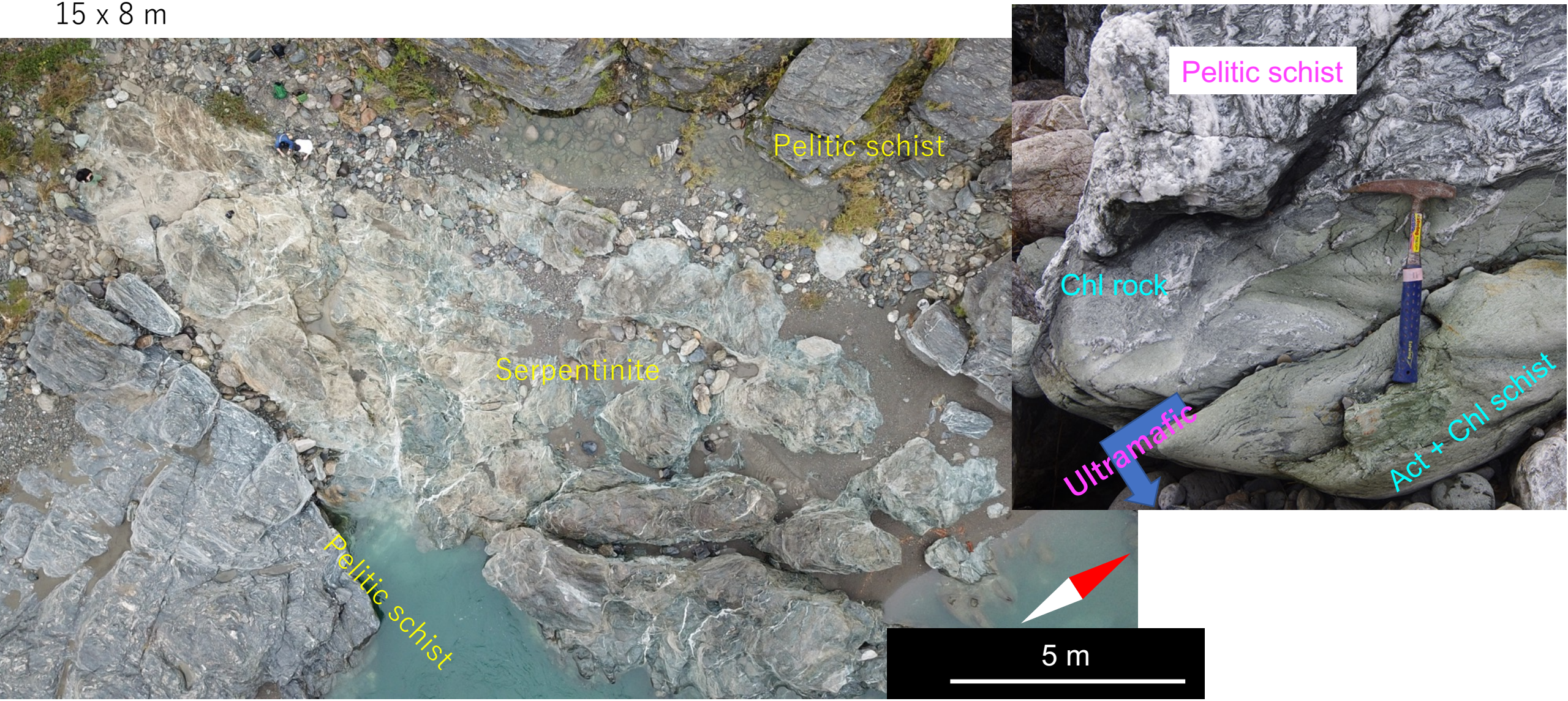
Okamoto et al. 2021
Com Earth & Env

- Many blocks of serpentinites and tremolite rocks at higher grade-zone.
- These blocks came from mantle wedge.

Higuchi Serpentinite body : Sanbagawa belt, Kanto Mountains

Okamoto et al. 2021 Com Earth & Env

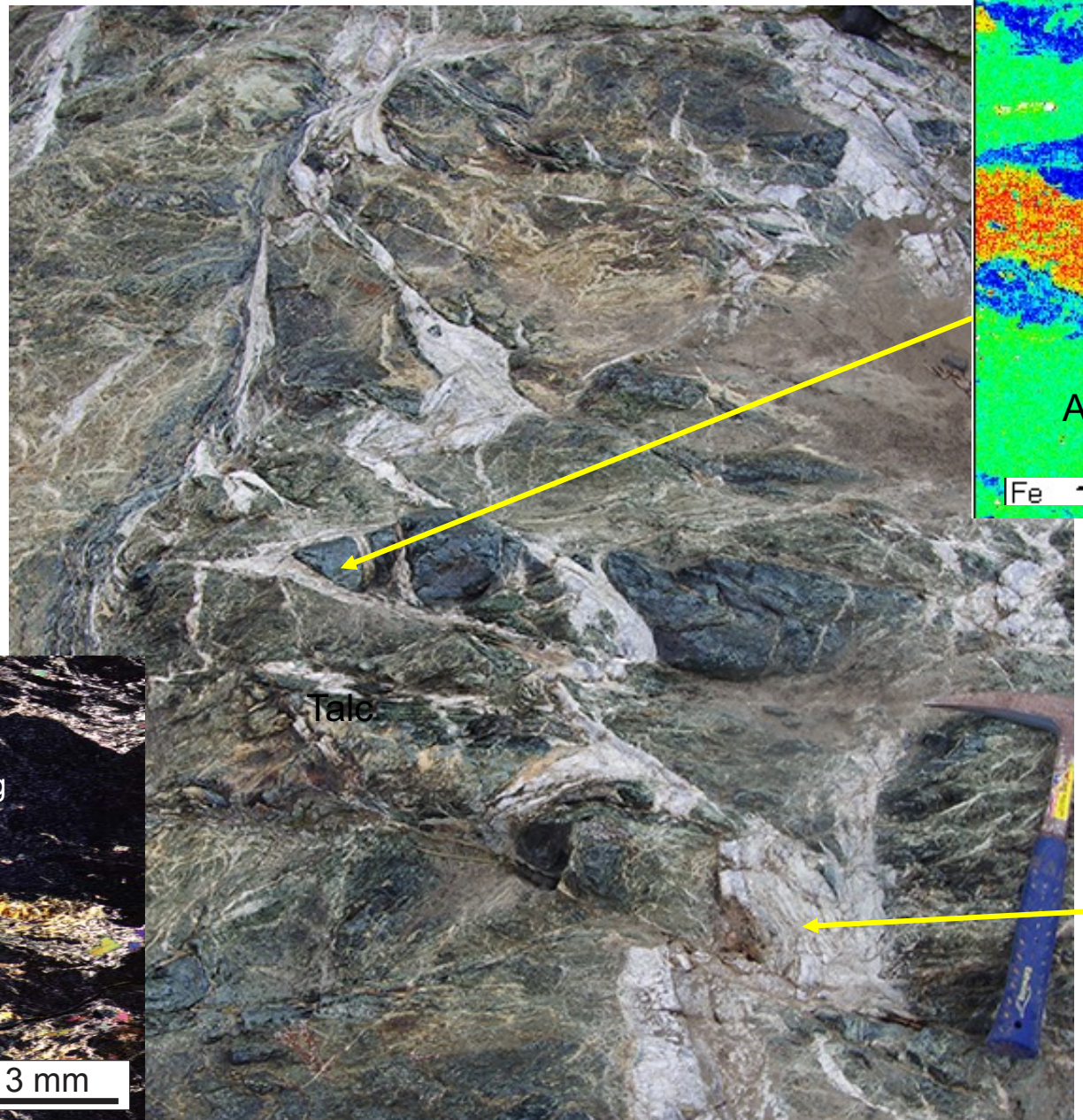
15 x 8 m

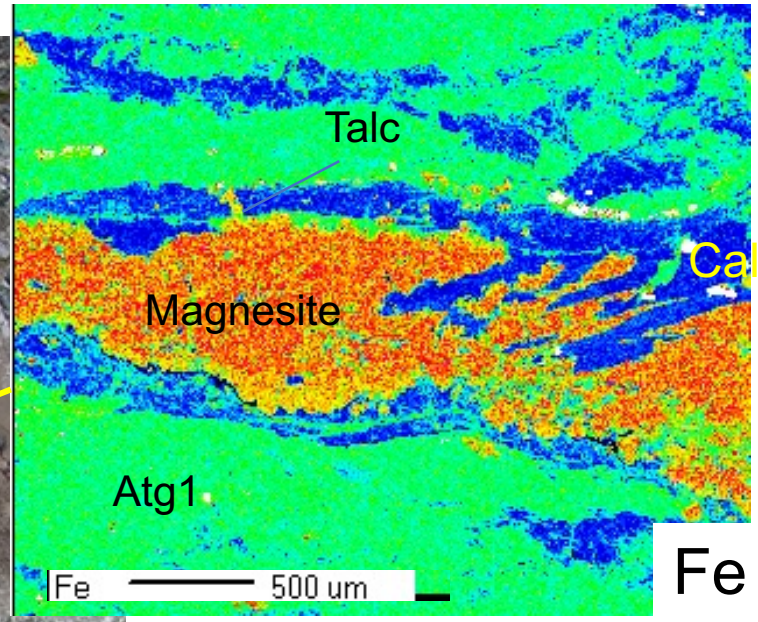


Serpentinites and magnesite + talc veins

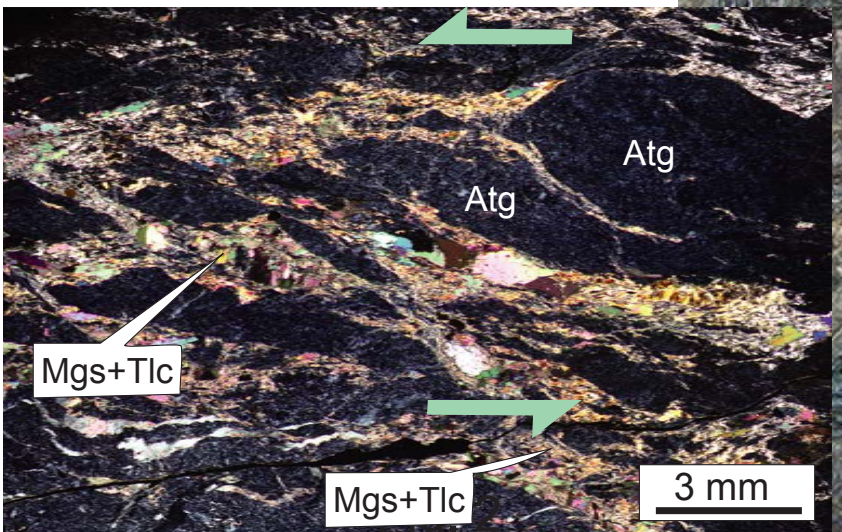
No relics of Ol and Opx, Cpx.

Atg, talc, carbonates, sulfides, relic of Cr-Spl



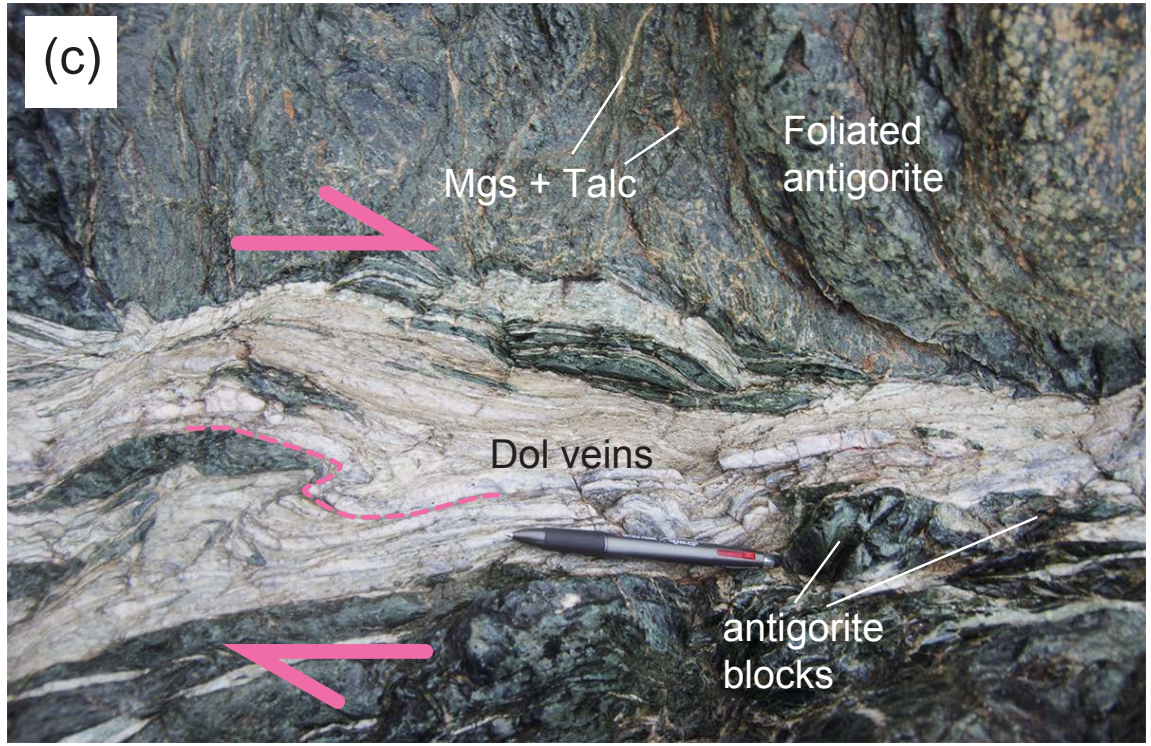


Fe

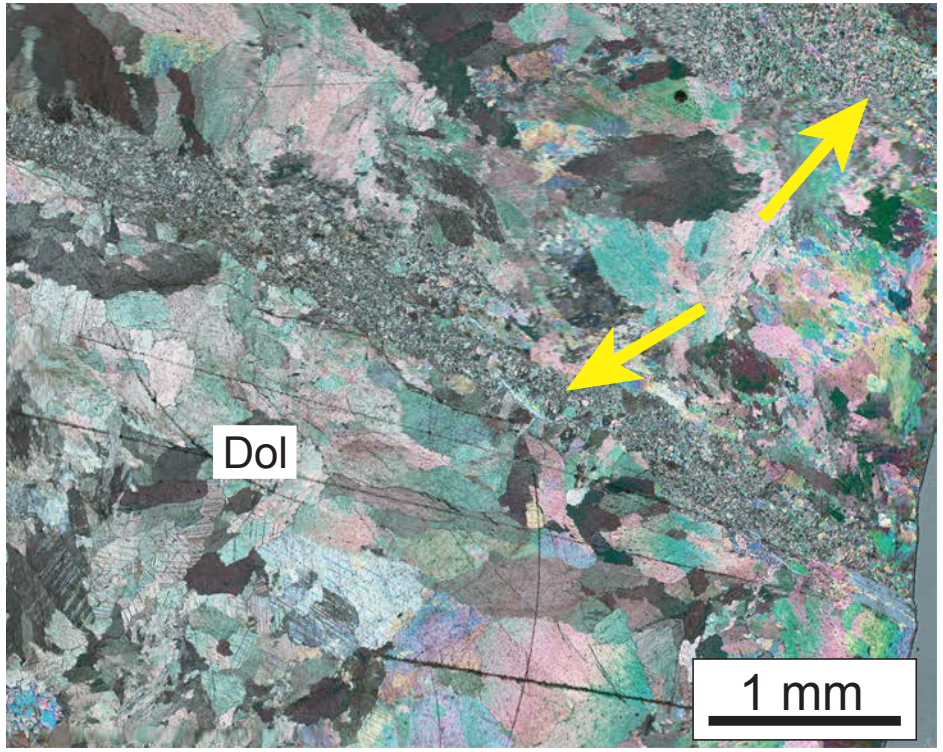


Dol + Talc veins

Dolomite-talc veins

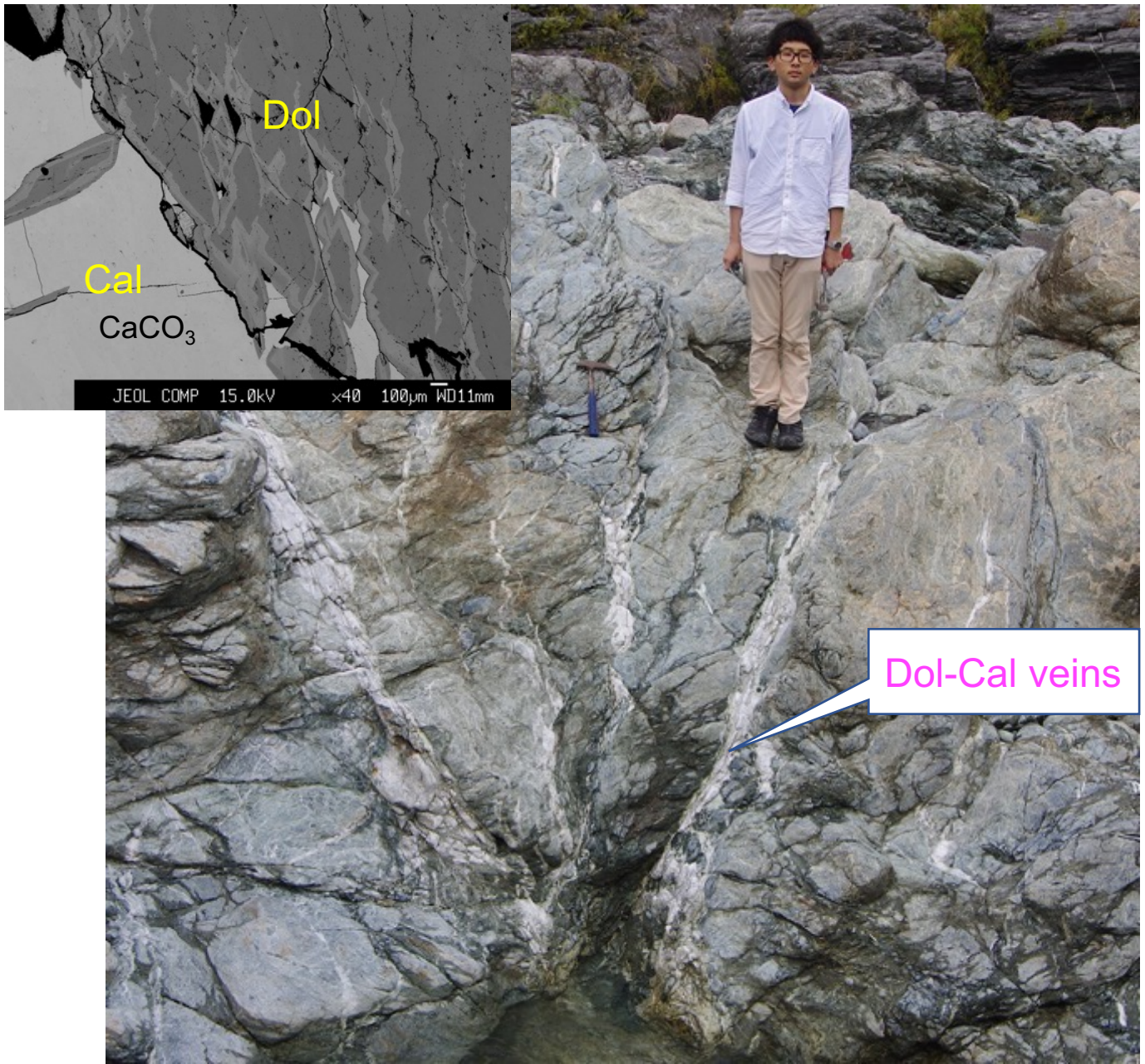


Distinct dolomite veins in meter length.

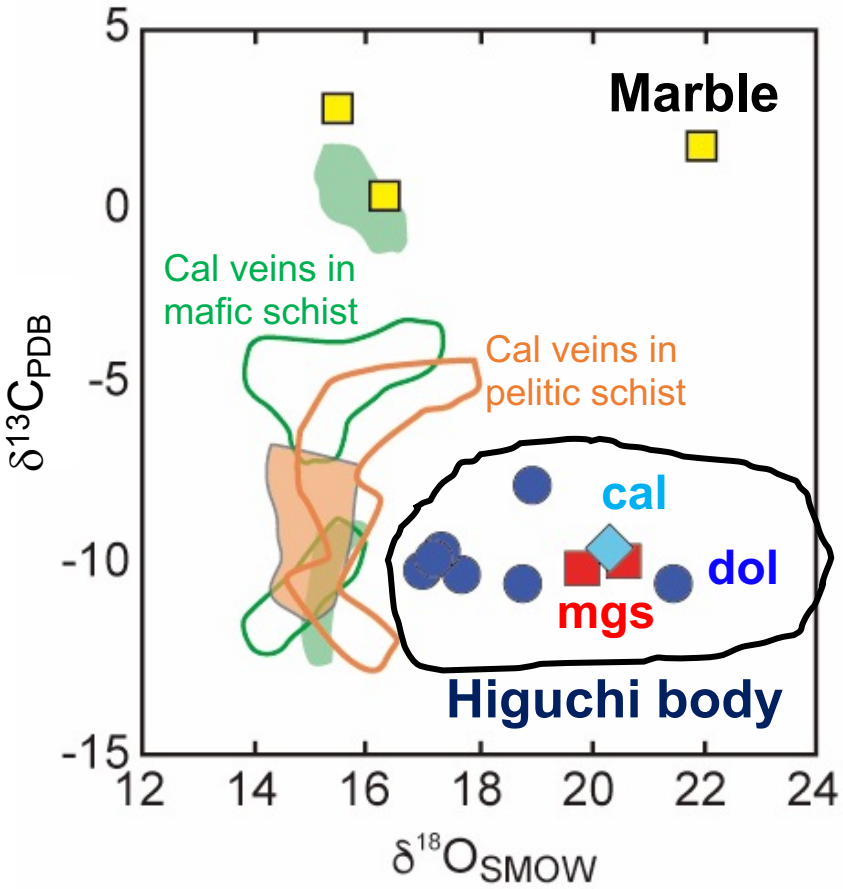


Dynamically recrystallized dolomite grains.

Dol + Cal veins & Stable C-O isotopes



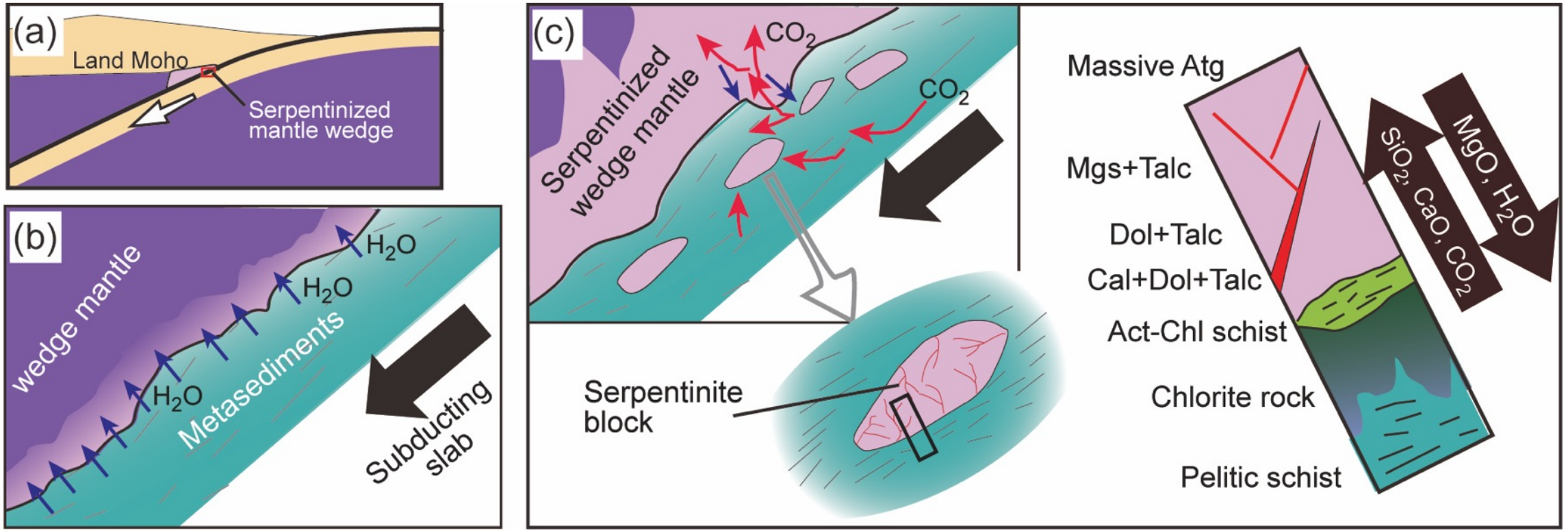
Stable C-O isotopes in carbonates



(1) CO_2 fluid was derived from the degradation of organic materials in the pelitic schists,

(2) Carbonic fluids were mixed with H_2O fluids produced by dehydration of serpentinite during carbonation.

Conceptual model of carbonation of mantle wedge corner



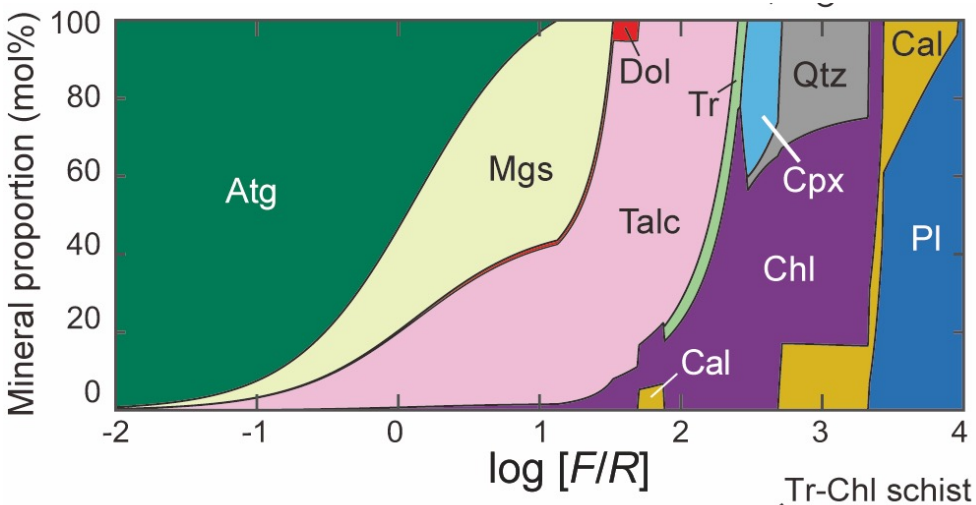
Initially, serpentinization occurs pervasively at the mantle wedge corner.

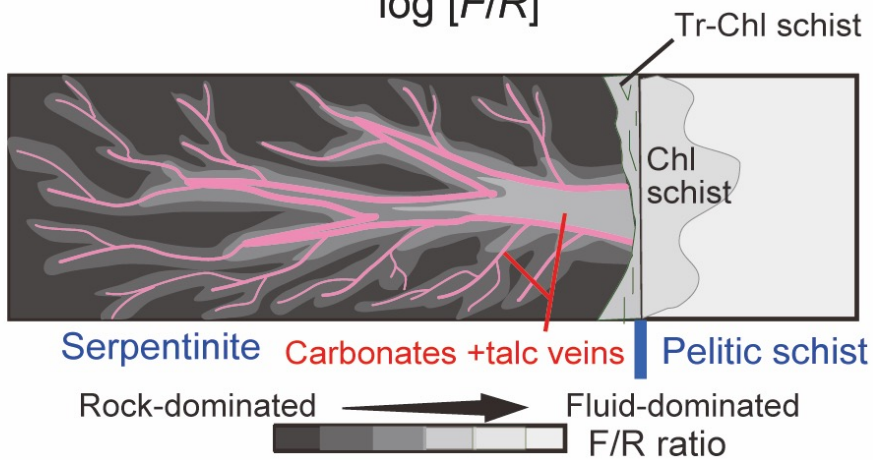
Carbonation of serpentinized mantle wedge occurred episodically.

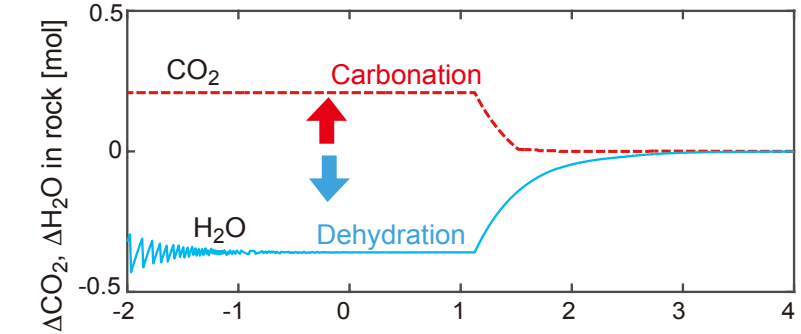
Geochemical Modeling of pelitic-derived fluids and antigorite

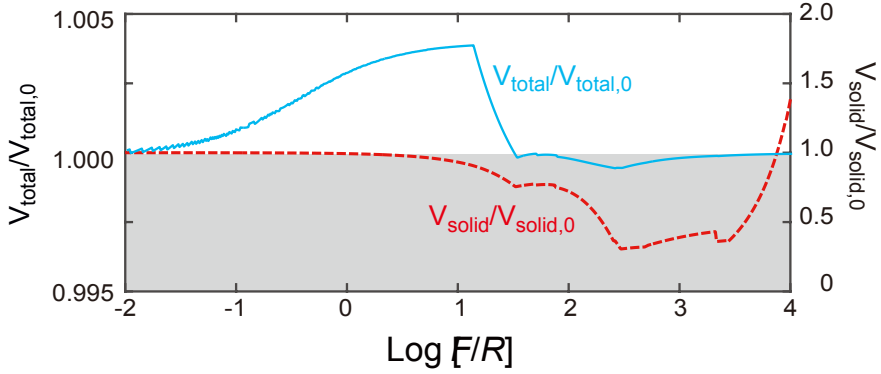
By EQ3/6 and DEW

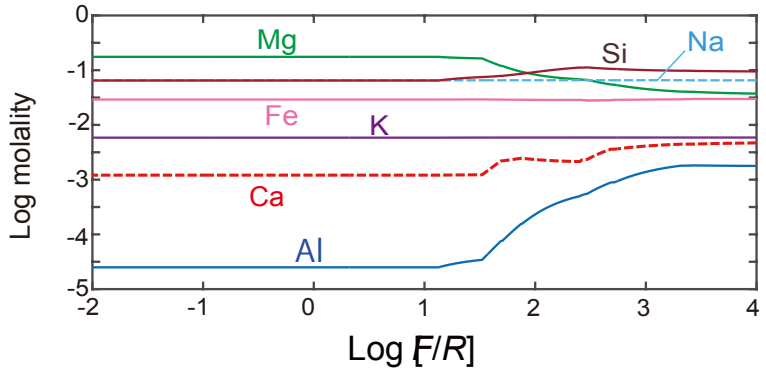
f_{O2} of the initial fluids: QFM+0.3. 400˚C, 0.5 GPa







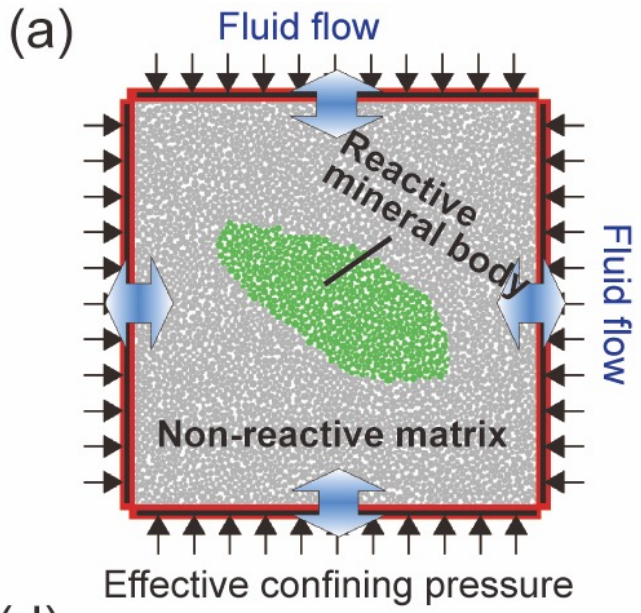


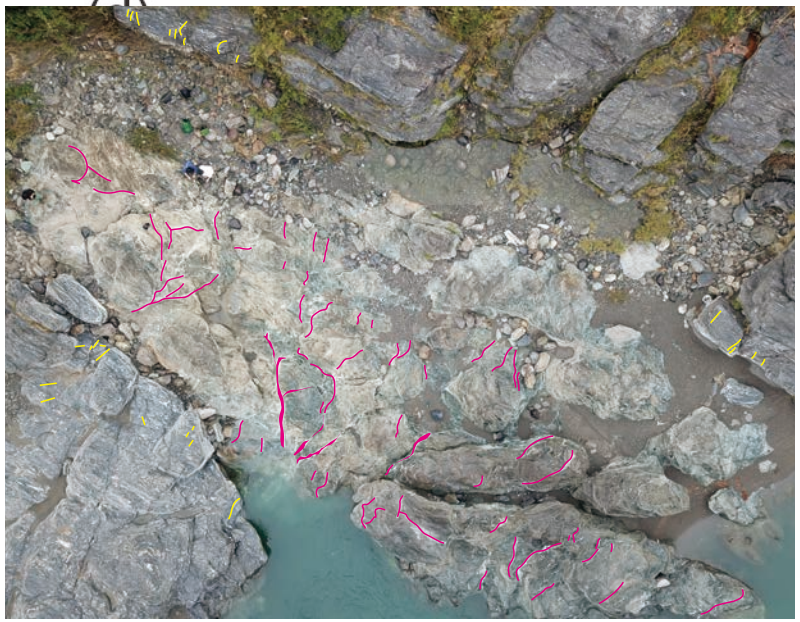


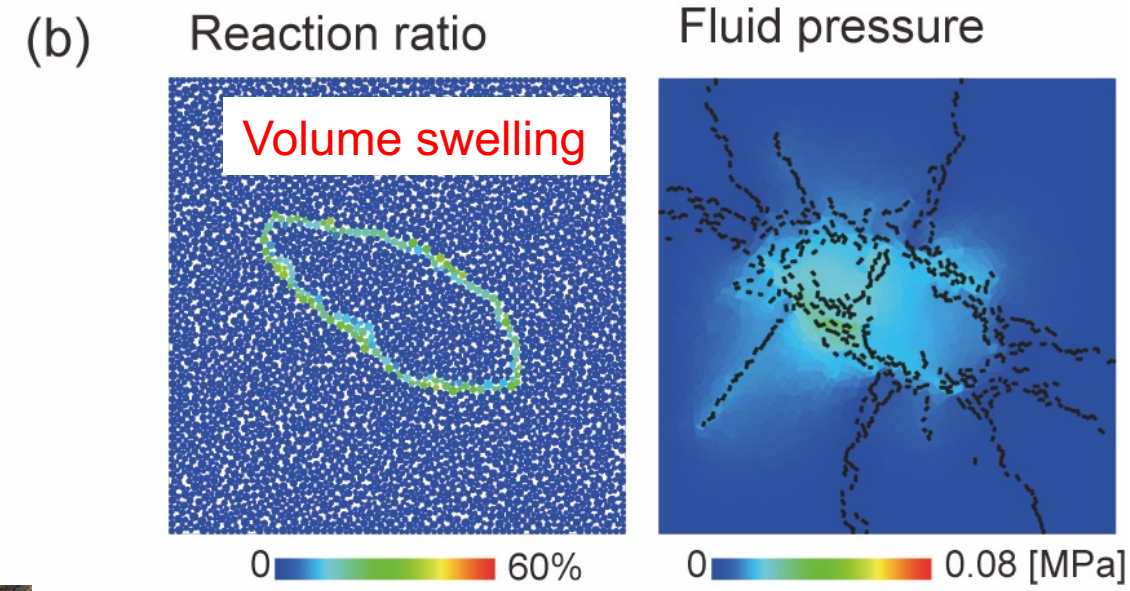
Carbonation of serp proceeds with solid volume decrease, fluid pressure increase and high Mg mobility.

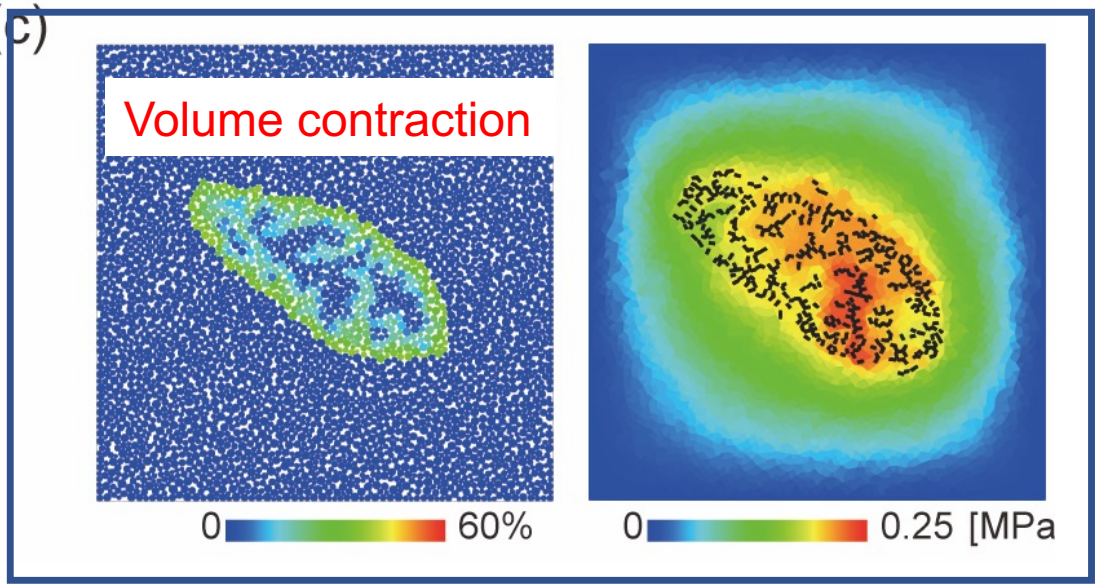
DEM Modeling of metasomatic dehydration reaction

Mineral A + Aqueous species S = Mineral B + H_2O









The case of Higuchi body

Summary

- The Higuchi body from the Sanbagwa belt records the carbonation of serpentinized mantle close to the conditions of mantle wedge corner.
- Carbonation of serpentinite was triggered episodically by the carbonic fluids, that was produced by degradation of carbonaceous materials in the sediments.
- Carbonation of serpentinized mantle wedge proceeds by self-promoting ways, involving solid volume contraction, high fluid pressure and high Mg mobility.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Okamoto et al. (2021),
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