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Supplementary Material

Evidence for Large Subduction Earthquakes along the fossil Moho in Alpine Corsica

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Supplementary Figures

The supplementary material is organized in 3 main figures. DR1a-g, DR2a-d and DR3a-b are included as additional documentation for some of the interpretations presented in the main text.

Figure DR1 provides additional evidence for generation of the large volumes of pseudotachylyte (PST). The supplementary images in DR1 show that melt vein complex is mostly without a temporal hierarchy except for some large, up to 0.2 m thick injection veins that truncate the network of veins. This supports the main text and demonstrates that at most a few large rupture events along the main gabbro mantle peridotite fault zone. All pictures are from the mantle peridotite in the footwall of the main fault.

Figure DR2 shows PST textures and fabrics in thin sections. These images document that mantle-peridotite gabbro melted and quenched. DR2-d show an example of EBSD data from the PST and their wall rocks, supporting previously published interpretations that there was ductile deformation as a precursor to faulting.

Figure DR3 provides additional information regarding the post-faulting shearing and shows that the main Moho fault has been partially reactivated as a blueschist facies shear zone.


S1- a
Compositonal layering in peridotite
PST injection vein
~10% PST
~30-50% PST
PST fault/injection vein complex
0.2m
S1- b
S1- c
S1- d
S1- e
2
1

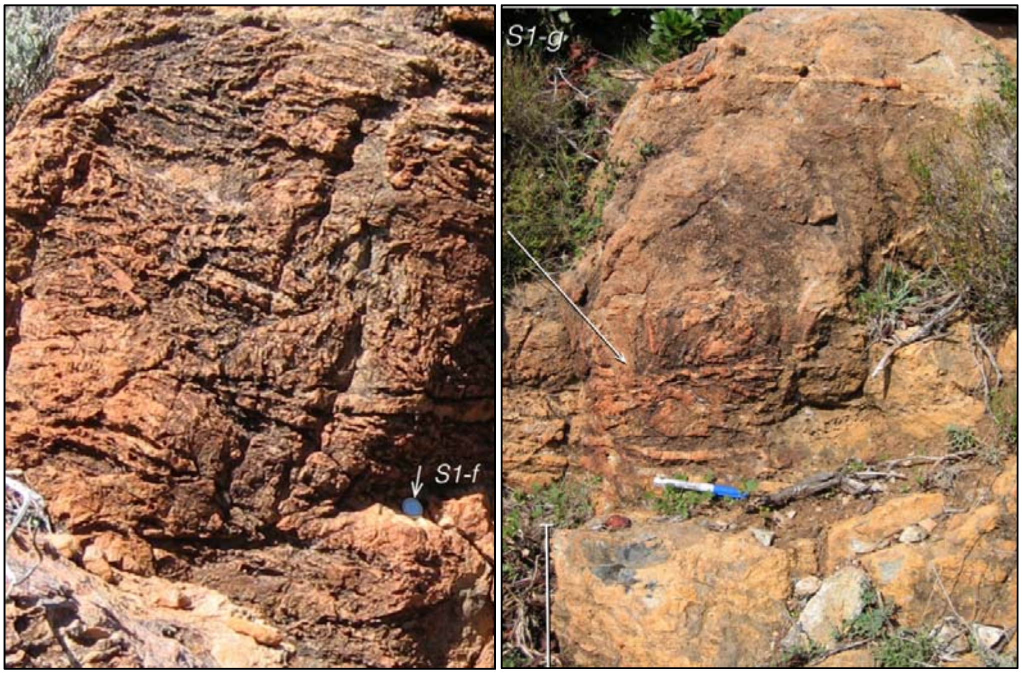

Fig. DR1-a: A 1.9 m cliff-face at locality 2 (see Fig. 1 in main text) below in the mantle peridotite with compositional layers (top) penetrated by a dense network of PST fault and injection veins (highlighted in black on line drawing, top right). Notice the near vertical, thick (up to 0.2 m) cross cutting, but rootless ultramafic PST injection vein, which probably record a secondary major melt-generating event.

Fig. DR 1-b and c: Images from a major fault parallel to the main gabbro mantle-peridotite fault zone at locality 1 (Fig. 1). This single-rupture fault-vein in *b* is up to ~0.4 m thick and occur in the center of the 2 to 3 m wide fault damage zone with a ladder network and net-veins shown in *c*.

Fig. DR 1-d: Intense PST net-vein/breccia in from the main fault zone at locality 2. More that 50% of the rock is ultramafic PST formed by complete melting of the mantle-peridotite. There is no obvious hierarchy of the PST veins in this outcrop, where the PST veins form positive topographic features on the weathered surface.

Fig. DR 1-e: Cliff-face, 50 m below the Moho fault at locality 1, showing two stages (marked 1 and 2) of thick (up to 0.42 m) ultramafic PST injection veins. Notice the different weathering surfaces on 1 and 2. Hammerhead is 0.14 m long

Fig. DR1-f: Cliff face with abundant PST without an obvious hierarchy of veins in the peridotite at the main fault contact at locality 1. We interpret these veins to have formed in a single PST-forming rupture event. Total thickness seen in the outcrop is >0.7 m (limited by the outcrop). The positive topographic features on the cliff face are PST, depressions are wall-rock (2 Euro coin for scale (arrow).

Fig. DR1-g: Details from a 2-3 meter thick fault-strand (also shown in S1-c) in the Moho fault damage zone at locality 1 (Fig.1, main text). The star-shaped pattern of radiating melt-veins (arrowed) apparently formed by a single stage explosive expulsion of ultramafic PST into the wall rock. Notice the more than 30 cm (vertical scale bar) massive PST fault vein at the base of the section and the prominent injection vein near the top of the outcrop.

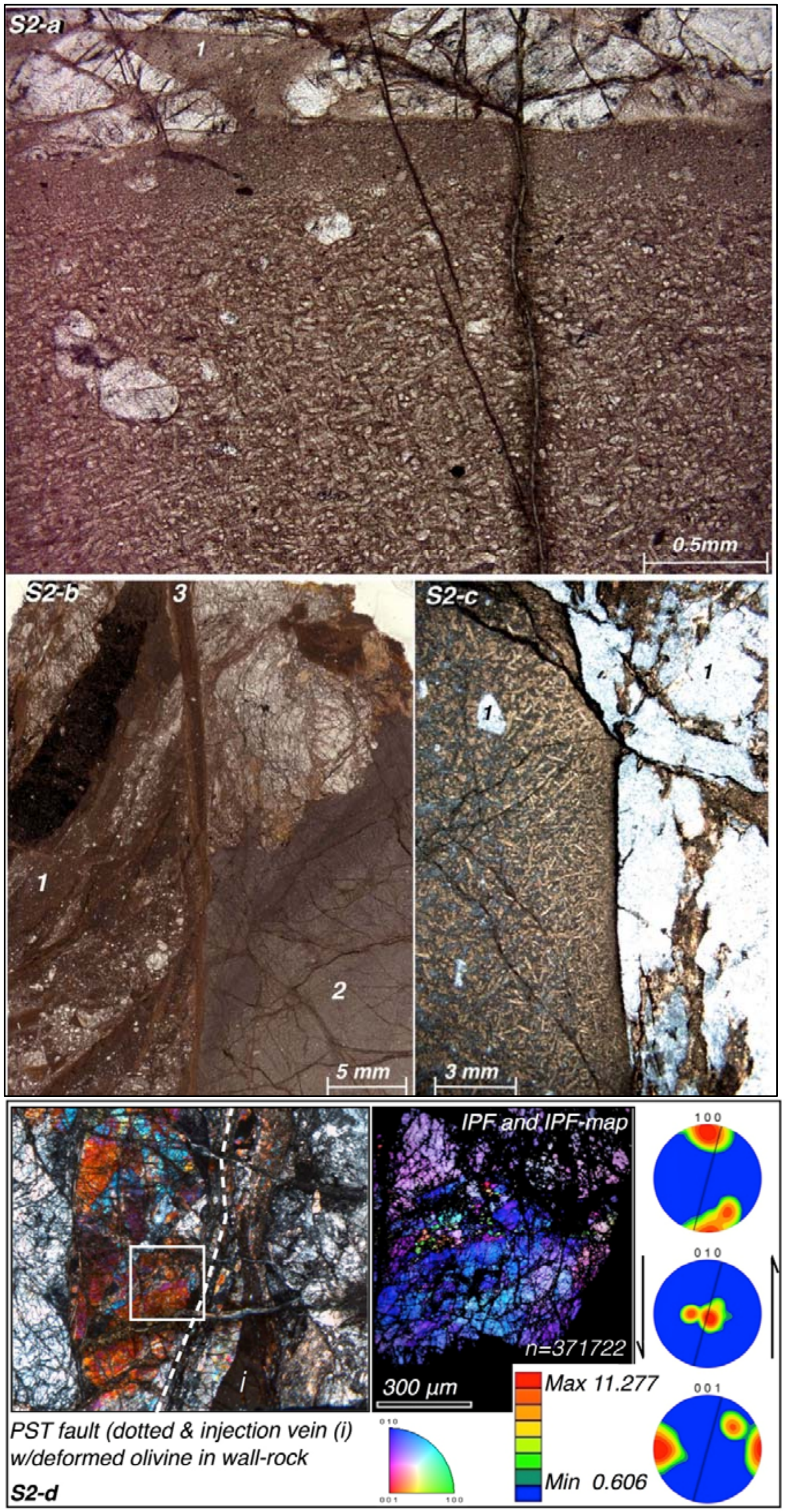
S2-a
1
0.5mm
S2-b
3
1
2
5 mm
S2-c
1
1
3 mm
IPF and IPF-map
n=371722
300 µm
i
Max 11.277
Min 0.606
100
010
001
PST fault (dotted & injection vein (i)
w/deformed olivine in wall-rock
S2-d

Fig. DR2-a: Photomicrograph (parallel light) of ultramafic PST showing chilled glassy margin and minor injection veins (top), and thermally rounded olivine wall-rock fragments. Small needle shaped and aligned diopside crystals define a vague flow during quenching of the melt.

Fig. DR2-b: Two (or three?) stages of faulting (1 and 3) and injection (2) of PST near the Moho fault near loc. 1. Notice intense deformation of the peridotite wall rock and the preserved chilled margin (darker) in the thicker injection vein marked 2.

Fig. DR2-c: Statically hydrated PST-injection vein where original olivine in the wall rock and the fragments marked 1 are all altered to serpentine. The needle shaped diopside crystals defining the chilled margin similar to (S2-a) are also altered, but the quench texture is preserved through static hydration and recrystallization after faulting.

Fig. DR2-d: Micrograph and Electron Backscatter Diffraction (EBSD) data with Inverse Pole Figure (IPF), IPF-map and contoured pole-figure data from Silkoset (2013). The mantle-peridotite wall-rock olivine is truncated by a small PST-fault vein and an injection vein marked (i). The wall rock olivine (and olivine clasts in the PST, not shown here) shows pre-PST lattice preferred orientation (LPO) with slip on the [100](001) system corresponding to an E-type fabric (Jung et al. 2006) associated with high temperatures and very high stresses. EBSD data is based on n=371722 index points in olivine.

Fig. DR3-a: The reworked and partly mylonitic gabbro mantle-peridotite fault zone at locality 1 (Fig. 1). The large (~~0.5 m) orange weathering domains are fragments dominated by PST veins (below overhang, top right) set in a blueschist facies mylonitic matrix.

Fig. DR3-b: Detail from the same zone showing a 7 x 28 cm lozenge shaped fragment of ultramafic PST truncated by numerous fractures in the mylonitic matrix, which also contains numerous small PST fragments.

References

Jung, H., Katayama, I., Jiang, Z., Hirago, T., and Karato, S.I., 2006, Effect of water and stress on the lattice-preferred orientation of olivine: Tectonophysics, v. 421, 1-22, doi:10.1016/j.tecto.2006.02.011

Silkoset, P., 2013, Microtexture of ultramafic pseudotachylyte fault veins from Corsica, an SEM-EBSD analysis: Master thesis, University of Oslo, 196 p.