How subduction proceeds: deformation and fluid migration across nascent, warm plate boundaries

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Frozen-in subduction plate interfaces formed during the first 1-2 My of the subduction history and preserved at the base of ophiolites allow to study the inception of mantle wedge metasomatism and interplate mechanical coupling shortly after subduction initiation, when crustal pieces get stripped off the slab.

Combining structural field and EBSD data, detailed petrology, thermodynamic modelling and geochemistry (including B and $\delta^{11}B$) on both sides, i.e. the base of the mantle wedge (basal ophiolitic peridotites) and the underlying accreted crustal fragments from the subducting slab (metamorphic soles), this study documents the continuous evolution of the plate contact and (focused) fluid transfer from 1 GPa 900-750°C to 0.6 GPa 750-600°C. Results obtained across the Oman-UAE territory, combined to available data worldwide, reveal how strain progressively localizes to allow subduction to proceed.

Peridotite metasomatism (through precipitation of new minerals, enrichment in FMEs, B concentrations and $\delta^{11}B$ values) is shown to result from the interaction with “subduction fluids” derived from the dehydrating metamorphic sole, coevally deformed and detached from the lower plate as successive tectonic slices.

This study has implications (i) for the behaviour of warm subductions (e.g., Cascadia, Nankai) where slab material gets amphibolitized at depths of ~40 km, (ii) for fluid fluxes into the mantle wedge and (iii) illustrates how mechanical coupling resumes at depth (i.e., beyond those where serpentine is stable).