

EGU24-8453, updated on 15 Jul 2024

<https://doi.org/10.5194/egusphere-egu24-8453>

EGU General Assembly 2024

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## The origin of tectonic mélanges and implication for the subduction interface processes

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Tectonic mélanges, penetrative mixes of sediments and basalts, are often interpreted as fossil subduction plate interfaces. These formations, marked by intense deformation, contain witnesses of past earthquakes and commonly include remnants of the oceanic crust of the subducting plate. The original process that led to penetrative mixing of sediments and basalts is often controversial, and classically relies either on tectonic slicing of the downgoing plate during subduction, or on pre-subduction, olistostrome-forming sedimentary mixing. In addition, magma emplacement in sediments of the downgoing plate may also explain the mixed lithologies of mélanges. This latter case should leave an aureole of contact metamorphism in sediments near basalts. In this work, we applied Raman Spectroscopy of Carbonaceous Material in the modern seafloor sediments where magmatism is reported, in order to evaluate the thermal influence from basalts onto carbonaceous material in the contacting sediments. Then, to check the potential contact metamorphism in mélanges, we employed the same methodology in several examples of sediment-basalt mélanges at (sub)-greenschist-facies conditions (Kodiak complex, Alaska; Shimanto Belt, Japan).

In modern ocean-floor settings, magmas intruding, and to a lesser extent, flowing onto sediments, resulted in higher crystallinity of carbonaceous material in a cm- to dm-thick contact aureole. In four of five studied mélanges, the crystallinity of carbonaceous material in metasediments increases toward basalts, indicating a ~1 cm-thick contact metamorphism aureole. Thus, we propose that for the studied mélanges the mixing likely occurred prior to subduction, with the preservation of contact metamorphism despite syn-subduction, low-temperature metamorphism.

As a consequence, the block-in-matrix structure observed in mélanges, as well as the occurrence of mafic bodies at seismogenic depths in accretionary prisms, is in many instances the result of pre-subduction structure, rather than tectonic slicing and step-down of the decollement into the oceanic crust. In particular, tectonic mélanges such as Mugi in Japan and Ghost Rocks in Alaska do not reflect simply the structure and thickness of the plate subduction interface, but a complex combination of pre-subduction geometry and tectonic processes during underplating and within

the accretionary wedge.

Furthermore, in two studied paleo-accretionary complexes, deposition ages of the trench sediments forming the matrix of three examined mélanges overlap ages of magmatism within uncertainty. Considering that the basalts from these mélanges exhibit MORB signatures, this age overlap suggests that the mélanges possibly formed at the trench just before ridge subduction. We thus conclude that basalt-sediment mélanges stand as potential records documenting ancient ridge subduction events.