Origin of mélanges in accretionary wedges : the examples of Kodiak (Alaska) and Shimanto Belt (Japan)

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Résumé

The peri-Pacific accretionary wedges in Japan (Shimanto Belt) and in Alaska (Kodiak and Afognak islands) provide a wealth of information regarding the structure and dynamics of the shallow, seismogenic portion of subduction margins. In particular, these two areas contain basalt occurrences, mainly in the form of lenses embedded along with various deep seafloor sediments in mélange units. The origin of these mélange units has been controversial for many years, as several processes (sedimentary, magmatic, tectonic) can result in a similar imbrication of various lithologies.
To decipher this issue, we have studied the Raman spectra of particles of carbonaceous matter (RSCM) present in sediments at various distances to basalt bodies. RSCM spectra have been shown to be influenced by the thermal history of the host rock, giving rise to the widespread RSCM paleothermometer.

We have first applied the RSCM approach to modern sediments retrieved from deep sea drilling campaigns carried out in geological examples where abundant magmatism is present, such as oceanic ridges (Ninety East ridge) or hotspots (Hawai-Emperor Chain). In all these examples, a clear Raman spectral anomaly is recorded in the carbonaceous particles included in the sediments next to the basalt contact, compared to reference host sediment far from the contact, reflecting the thermal imprint of the magmatic body onto carbonaceous particles cristallinity.

Second, in three mélange units investigated (Mugi, Hyuga mélange units in Japan, Ghost Rocks in Alaska), a clear anomaly in the Raman spectra is also present in carbonaceous particles in the sediment in contact with the basalts, compared to a reference sediment far from the contact. This Raman anomaly is interpreted as reflecting short-lived heating during basalt intrusion into or basalt flow onto the sediments, preserved throughout the geological history of these mélange units.
As a consequence, the subducting crust forming the Alaskan or Japanese wedges was not simply composed of sediments overlying a mafic crust, but was constituted of a complex succession of interlayered sediments and basalt bodies. In such a structure, many sediment-basalt lithological limits are present and are potential weak interfaces for the décollement to localize and for mélange units to be underplated.

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Mots-Clés: Tectonic mélange, décollement, basalts, raman spectroscopy, organic matter