Deformation and diagenesis of sandstones in underthrusted sediments-An example from the Mugi Melange, Shikoku, Japan-

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Observations at various scales of sandstones in the Mugi Melange (Shikoku, Japan) of the Shimanto Belt, which is an ancient accretionary prism and is considered as a good analogue of current ones, clarify the processes of the deformation of sediments on top of the subducting plate. In particular, we investigated the stage where sediments are undergoing lithification, which is of prime importance for accretionary prism dynamics and shallow earthquake generation.

In this study, we focused on sandstones, which are one of the main components of sediments in Nankai Trough. We collected in the Mugi Melange, which is composed of blocks of sandstones embedded in a matrix of shales, many sandstone samples showing a boudinaged structure. Close observations of the internal structure of sandstones were done from meter to micrometer scale. The observations of thin sections under polarized microscope revealed the presence of the dark zone, an unknown structure in sandstones: domains constituted of particles made of quartz and feldspar enclosed in a dark, fine matrix.

Particles seem to be broken sandstones, as they contain web structures and mineral veins also observable in pure sandstone domains. The results of particle size distribution analyses of the dark zone show fractal distribution, meaning that particles in the dark zone were formed by cataclasis of pure sandstone domains.

Whole rock analyses of mineral composition using XRD (X-ray diffractometer) showed that the dark zones do no contain any original mineral, that is all the minerals present are also either included in pure sandstone domains or in the shales surrounding the sandstone blocks. Furthermore, whole rock analyses of chemical composition using XRF (X-ray Fluorescence spectrometer) revealed that the dark zone composition could be interpreted as the result of mixing of shale and sandstone.

Consequently, we interpreted the occurrence of the dark zone as the result of cataclasis of lithified sandstones followed by the injection of adjacent shales into the fragmented domain and final cementation of the mixture. This mechanism evidences the progressive lithification of subducted sediments: while sandstones were already lithified, surrounding shales were still behaving like fluids. Moreover, it evidences the strong internal rheological heterogeneity of subducted sediments, related to their original heterogeneous composition of mudstone and sandstone assemblage.