Connecting faults and fractures with clay formation and fluid movement in the accretionary prism of the Nankai Trough: NanTroSEIZE IODP Expeditions 338/348, Site C0002

*Maria Jose Jurado[1], Anja Schleicher[2]

1. Institute of Earth Sciences Jaume Almera-CSIC, Barcelona, Spain, 2. Helmholtz Center Potsdam German Research Center for Geosciences GFZ, Potsdam, Germany

During the International Ocean Discovery Program (IODP) Expeditions 338 and 348, which is part of the NanTroSEIZE (Nankai Trough Seismogenic Zone Experiment) project, three deep riser holes were drilled south of the Kii Peninsula at Site C0002. The site is located in the Kumano forearc basin above the seismogenic portion of the plate boundary thrust. Hole C0002F (Expedition 338) was drilled down to 2004.5 mbsf. Hole C0002N/C0002P (Expedition 348) was drilled down to 3058.8 mbsf. Hemipelagic mudstone and sand/silt sediments are the predominant lithologies (Moore et al., 2014; Tobin et al., 2015). A complete set of logging while drilling (LWD) data, including borehole images, was collected during IODP Expeditions 338/348. Also rock-cuttings and spot cores. Distinct sections of intense fracturing and faulting within the very clay-dominated lithology were characterized on LWD borehole oriented images and other geophysical logs (Boston et al.,2016). The intense deformation of the generally homogenous lithology is characterized by bedding that dips steeply (60-90˚). Smectite and illite are the most common clay minerals. Underwood and Song (2016) documented the abundance of smectite expandability of clay minerals in both holes. However, the properties and the role these minerals play in influencing fluid flow specifically in fractures, faults and folds within the accretionary prism is still not well understood.

The main focus of this contribution is on the analysis and potential link between structure development and the associated formation of clay minerals in the accretionary prism. We analyzed the relationship between the fractures, faults and the changes in clay mineralogy as derived from post-cruise cutting sample analyses. The comparative analysis of clay mineralogy reveals an increase of intensity observable in smectite and illite at specific depth intervals that are related to fault and fracture zones at 2350-2400 mbsf, at 2600-2800 mbfs, and also at 2150 mbsf. This increased intensity reflects an increase in the amount of smectite and illite in those areas, that could be related to due to abundant fluid-rock interaction processes. The connection between structures characterized on borehole images and the changes in clay mineralogy for Hole C0002P suggests that mineralogical changes are associated to structures of the Nankai accretionary prism. This is critical for a better understanding of clay-fluid interaction and mechanical properties during fault displacements and seismogenesis. We interpret a defined connection between the occurrence of fracture and/or faults in the accretionary prism and the abundance of illite and smectite clay minerals. Ongoing postcruise research on hole C0002 N and C0002P (Expedition 348) should confirm these results.

References

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