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Full permeability and porosity profile across the Kumano Basin

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During the Integrated Oceanic Drilling Program (IODP) expedition 319, part of the NantroSEIZE project, the C0009 borehole has been drilled within the Kumano Basin, a forearc basin related to the Tô-Nankai subduction trench offshore the Kii peninsula. This was the first IODP borehole drilled with the riser technology, which enables the use of drilling mud. Because of its higher density, mud was overpressurized relative to the in-situ fluid pressure. By quantifying this process, we could quantify the hydraulic parameters along the borehole.

The HRLA (High Resolution Laterolog Array) simultaneously records apparent resistivity for different depths of penetration. By inverting the HRLA data, we could compute the invasion diameter along the borehole, which is afterwards converted into permeabilities. Permeability correlates with the results with point-wise hydraulic tests performed with the Modular Testing Tool (MDT) and enables their extrapolation to the full borehole.

Permeability is strongly controlled by lithology. It decreases with depth, even when reaching the accretionary prism. This surprising result can be explained by the porosity logs. We could get both the full profile of macroporosity, determined from both sonic log, and the full profile of total porosity, determined from density log. Their comparison documents the clay content of the formation. The accretionary prism has larger fracture density, but also higher clay content.