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Influence of drilling operations on drilling mud gas monitoring during IODP Exp. 338 and 348

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The history of scientific ocean drilling has developed some new techniques and technologies for drilling science, dynamic positioning being one of the most famous. However, while industry has developed newer tools and techniques, only some of these have been used in scientific ocean drilling. The introduction of riser-drilling, which recirculates the drilling mud and returns to the platform solids and gases from the formation, to the International Ocean Drilling Program (IODP) through the launch of the Japan Agency of Marine Earth-Science and Technology (JAMSTEC) riser-drilling vessel D/V Chikyu, has made some of these techniques available to science. IODP Expedition 319 (NanTroSEIZE Stage 2: riser/riserless observatory) was the first such attempt, and among the tools and techniques used was drilling mud gas analysis.
While industry regularly conducts drilling mud gas logging for safety concerns and reservoir evaluation, science is more interested in other components (e.g He, 222Rn) that are beyond the scope of typical mud logging services. Drilling mud gas logging simply examines the gases released into the drilling mud as part of the drilling process; the bit breaks and grinds the formation, releasing any trapped gases. These then circulate within the “closed circuit” mud-flow back to the drilling rig, where a degasser extracts these gases and passes them on to a dedicated mud gas logging unit. The unit contains gas chromatographs, mass spectrometers, spectral analyzers, radon gas analyzers, and a methane carbon isotope analyzer. Data are collected and stored in a database, together with several drilling parameters (rate of penetration, mud density, etc.). This initial attempt was further refined during IODP Expeditions 337 (Deep Coalbed Biosphere off Shimokita), 338 (NanTroSEIZE Stage 3: NanTroSEIZE Plate Boundary Deep Riser 2) and finally 348 (NanTroSEIZE Stage 3: NanTroSEIZE Plate Boundary Deep Riser 3). Although still in its development stage for scientific application, this technique can provide a valuable suite of measurements to complement more traditional IODP shipboard measurements. Here we present unpublished data from IODP Expeditions 338 and 348, penetrating the Nankai Accretionary wedge to 3058.5 meters below seafloor. Increasing mud density decreased degasser efficiency, especially for higher hydrocarbons. Blurring of the relative variations in total gas by depth was observed, and confirmed with comparison to headspace gas concentrations from the cored interval. Theoretically, overpressured zones in the formation can be identified through C2/C3 ratios, but these ratios are highly affected by changing drilling parameters. Proper mud gas evaluations will need to carefully consider the effects of variable drilling parameters when designing experiments and interpreting the data.