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Core re-orientation by integration of core measurements and Formation MicroScanner images of the borehole wall: application to the palaeomagnetic study of the Atlantis Massif oceanic core complex

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The inherent lack of azimuthal control on core material associated with the Integrated Ocean Drilling Program (IODP) is an ongoing problem. The dip of brittle features, such as veins or open fractures, can be measured directly on the core, but the strike of these features with respect to geographic north is not known. Furthermore, where core recovery is $<$100%, the true depth of any structural feature is also unknown. However, wireline logging data can provide a near-continuous record of the physical properties of the borehole wall. The Formation MicroScanner (FMS) tool images resistivity contrasts and distinct inclined planar features can be identified by their sinusoidal shape on unravelled images. Importantly, these structural features can be accurately oriented in the geographic co-ordinate system due to the inclusion of a three-axis magnetometer on the FMS toolstring. Therefore, features seen on the core surface can be correlated with features seen on the borehole wall images, enabling full re-orientation. This core re-orientation technique is applied to data from IODP Expedition 304/305, which sampled exhumed lower oceanic crust at Atlantis Massif, located on the western flank of the Mid Atlantic Ridge (MAR) at 30˚N. Hole U1309D reached a total depth of 1415 metres below sea floor (mbsf), had a high average core recovery of 74% and good quality FMS images. By re-orienting structural features seen on core pieces that have also been sampled for palaeomagnetic analyses, the resulting magnetic remanence

directions are re-oriented into geographic co-ordinates. Consequently, we perform a fully quantitative analysis of the amount and angle of rotation associated with a phase of tectonic tilting during the development of the oceanic core complex.