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Palaeomagnetic evidence from IODP Expedition 304/305 for the mode of accretion of slow-spreading rate lower oceanic crust (Atlantis Massif, Mid Atlantic Ridge, 30°N)

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Integrated Ocean Drilling Program (IODP) Expedition 304/305 to Atlantis Massif, Mid Atlantic Ridge, sampled a 1.4 km faulted and complexly layered section that represents the most primitive interval of lower oceanic crust ever recovered, opening a window into lower crustal accretion processes. The core (Hole U1309D) is dominated by gabbroic lithologies with minor ultramafic rocks, and reflects the interplay between magmatism and deformation prior to, during, and subsequent to, a period of footwall displacement and denudation associated with detachment faulting and the development of an oceanic core complex.

Palaeomagnetic analyses demonstrate that the gabbroic sequences at Atlantis Massif carry highly stable remanent magnetizations that provide valuable information on the timing and style of lower crustal magmatism. Thermal demagnetization experiments recover high unblocking temperature components of reversed polarity throughout the gabbroic sequences. In a number of intervals, however, the gabbros exhibit a complex remanence structure with the presence of lower temperature normal or normal and reversed polarity components, suggesting a history of localised partial remagnetization of the gabbros during different polarity intervals. Sharp break-points between magnetic components of different polarity suggest that they were acquired by localised

reheating rather than by chemical alteration. The distribution and nature of the multi-component remanences are most consistent with a model in which the lower crustal section was constructed from a series of relatively thin sill-like intrusions over a protracted time period spanning several geomagnetic polarity reversals. Such a model is also support by previous palaeomagnetic and geochemical analyses of a more restricted section of gabbros recovered during ODP Leg 153 to the MARK area, south of Atlantis Massif (Gee & Meurer, 2002, JGR, 107).

On-going research aims to: (i) further quantify the nature, distribution and origin of the multi-component remanences in this unique core; (ii) integrate palaeomagnetic, geochronological and geochemical analyses to constrain the spatial and temporal scales of crustal accretion; and (iii) recover palaeomagnetic declinations by correlating core pieces with oriented formation microscanner images of the borehole wall to determine the role of tectonic rotations in the development of the oceanic core complex.