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Detailed magnetic field around oceanic core complexes, Mid-Atlantic Ridge 13º-14ºN

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We measured magnetic field at the sea surface and along several near-bottom transects in the complex tectonic environment of the Mid-Atlantic Ridge (MAR) axis at 13º-14ºN. The area includes one active and several dying or defunct detachment faults delineating oceanic core complexes (OCC). Sea-surface track spacings were ∼2km. Sea-surface measurements confirm previous observations that the central positive magnetisation anomaly (CMA, Brunhes) has extremely variable width here. Positive total field anomalies are aligned E-W, approximately over core complexes at 13º20'N and 13º30'N, but standard inversion to crustal magnetisation reveals a weakly N-S lineated magnetisation poorly correlated with tectonic pattern. The CMA is mostly narrower than predicted by regional spreading rate, and sometimes absent. The OCC1320 dome has strongly negative magnetisation, extending weakly eastwards across the MAR axial valley. AUV Autosub 6000 measured total field ∼120 to 200 m above seafloor. When corrected for vehicle heading, and pitch up to +/-50º, anomaly amplitudes are correlated with tectonic structures over and around OCC1320 (they do not extend to OCC 1330). The OCC dome shows small amplitude anomalies implying low or uniform magnetisation. High amplitudes flank the OCC to north, east and south, where near-bottom bathymetry shows recent, hummocky volcanic terrain. A strong dipole anomaly (negative to the north) characterises a prominent, recently active 2 km-wide volcano in the axial valley west wall between OCCs. Strongly negative anomalies occur just south of OCC1320 but are not fully delineated by our data. Moderate amplitudes occur west of the OCC. Although many Autosub lines have large navigation errors due to the doppler navigation system losing bottom lock, two E-W lines were judged adequate for modelling. We forward modelled magnetic field in 2.5D to retain resolution, using a half-strike of 7.5 km and magnetic source thickness of 0.5 km. One line, across OCC1320, confirms low magnetisations (<∼8 A/m) in the top 500 m of the smooth dome. The highest magnetisation (∼70 A/m) occurs near the axial valley centre, 2.7 km E of the footwall cutoff. The Brunhes width is 11 km, 60% of that predicted. A Jaramillo anomaly is not seen on this line, though it should be present if spreading were symmetric. A broad mismatch in the profile centre can only be removed assuming a deeper negatively magnetised body below the axial valley. We currently have no explanation for such a body or the mismatch with sea-surface field inversion. Resolution of this may require detailed, fully 3D modelling. The second line, midway between OCC1320 and OCC1330, shows more variable magnetisation distribution with several peaks and troughs to +/-40 A/m. Maximum magnetisation is 60 A/m over the prominent volcano in the axial valley wall. The Brunhes is probably >12km wide here but its western edge is not clearly resolved. There is a possible Jaramillo of 5–20 A/m 13 km E of the Brunhes edge, at approximately the expected distance.