Rotating magnetic shallow water waves in a sphere

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It has been suggested that there may be a stably stratified layer a few hundred kilometres thick just below the Earth's core mantle boundary. Thin stable layer models can also give insight into the dynamics of the solar tachocline. We have examined the type of waves that occur in such shallow layers in the presence of a magnetic field. We generalise the method of Longuet-Higgins (1966) to solve the differential equations that arise in shallow water MHD (Zaqarashvili et al.2007). Using an expansion in associated Legendre polynomials, we reduce the differential system to a matrix eigenvalue problem. Taking the original system of five MHD equations, we find the coefficients of the polynomial expansion, which give the eigenvectors, and the eigenvalues which give the frequencies of the modes. We can then reconstruct the spatial form of the eigensolutions for each eigenvalue, giving a complete solution dependent on time, colatitude and longitude. The result of the model shows the presence of Fast and Slow Magnetic Rossby Waves, Magneto Inertial Gravity Waves and Magneto Kelvin modes. The Magnetic Rossby modes could be related to short time secular variation of the Earth's magnetic field.