[EE] Evening Poster | S (Solid Earth Sciences) | S-IT Science of the Earth's Interior & Tectonophysics

[S-IT22]Interaction and Coevolution of the Core and Mantle in the Earth and Planets

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Recent observational and experimental investigations have significantly advanced our understanding of the structure and constituent materials of the deep Earth. Yet, even fundamental properties intimately linked with formation and evolution of the planet, such as details of the chemical heterogeneity in the mantle and light elements dissolved in the core, remained unclear. Seismological evidence has suggested a vigorous convection in the lower mantle, whereas geochemistry has suggested the presence of stable regions there that hold ancient chemical signatures. The amounts of radioactive isotopes that act as heat sources and drive dynamic behaviors of the deep Earth are also still largely unknown. We provide an opportunity to exchange the achievements and ideas, and encourage persons who try to elucidate these unsolved issues of the core-mantle evolution using various methods, including high-pressure and high-temperature experiments, high-precision geochemical and paleomagnetic analyses, high-resolution geophysical observations, geo-neutrino observations, and large-scale numerical simulations. Since this session is co-sponsored by geomagnetism, paleomagnetism and rock magnetism division of the SGEPSS, contributions in geomagnetism and geodynamo simulation are also encouraged.

[SIT22-P35]The effect of an azimuthal background magnetic field on waves in a stably stratified layer at the top of the Earth's outer core

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We investigated waves in a stably stratified thin layer in a rotating sphere with an imposed magnetic field. This represents the stably stratified outermost Earth's core or the tachocline of the Sun. Recently, many geophysicists focus on the stratification of the outermost outer core evidenced through seismological studies (e.g. Helffrich and Kaneshima, 2010) and an interpretation of the 60-year geomagnetic secular variations with Magnetic-Archimedes-Coriolis (MAC) waves (Buffett, 2014). Márquez-Artavia et al.(2017) studied the effect of a toroidal magnetic field on shallow water waves over a rotating sphere as the model of this stratified layer. On the other hand, MAC waves are strongly affected by a radial field (e.g. Knezek and Buffett, 2018). We added a non-zero radial magnetic perturbation and magnetic diffusion to Márquez-Artavia et al.(2017)'s equations. Unlike their paper's formulation, we applied velocity potential and stream function for both fluid motion and magnetic perturbation, which is similar to the first method of Longuet-Higgins(1968).
In the non-diffusive case, the dispersion relation obtained with the azimuthal equatorially symmetric field ($B_{\φ}$(θ) ∝ sinθ, where θ is colatitude) is almost the same as Márquez-Artavia et al.(2017)'s result, which includes magneto-inertia gravity (MIG)

waves, fast magnetic Rossby waves, slow MC Rossby waves and an unexpected instability. In particular, we replicate the transition of the propagation direcition of zonal wavenumber m=1 slow MC Rossby waves from eastward to westward with increasing Lamb parameter (ε=4Ω^{2}a^2/gh, where Ω, a, g and h is the rotation rate, the sphere radius, the acceleration of gravity and a equivalent depth, respectively) and Lehnert number (α=v_A/2Ωa, where v_A is Alfvén wave speed). As a consequence, fast magnetic Rossby waves and slow MC Rossby waves interact, and the non-diffusive instability occur.
Next, we are examining the case with an equatorially antisymmetric background field, which is more realistic in the Earth's core. In this case, if the magnetic diffusion is ignored, the continuous spectrums appear owing to Alfvén waves resonance (similar to the continuous spectrums in inviscid shear flow, e.g. Balmforth and Morrison, 1995). To solve this difficulty, our numerical model includes the magnetic diffusion term.