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Superionic inner core and anisotropic structure driven by geomagnetic field

Yu He
Institute of Geochemistry, Chinese Academy of Sciences, China (heyu@mail.gyig.ac.cn)

Seismological observations suggested that Earth's inner core presents complex heterogeneity and anisotropic structure. The key to understand the structure of Earth's inner core is to study the mineralogical composition and dynamic mechanism of the anisotropic structure of Earth's inner core. Hexagonal close-packed (hcp) and body centered cubic (bcc) Fe alloys both have seismically anisotropic features under temperature and pressure conditions of the Earth's inner core. When the fast axis can be oriented along the Earth's rotation axis, the anisotropic characteristics of the Earth's inner core, which is fast in the north-south direction and slow in the equatorial direction, can be explained. The input of light elements into Fe alloys significantly changed the anisotropy of Fe alloys. Particularly, the fast axis orientation of superionic Fe-H alloys changes with the increase of H contents in those alloys. Interestingly, superionic Fe alloys present both ionic diffusion and seismic velocity anisotropy, which establish a potential connection between the lattice preferred orientation (LPO) anisotropic structure and dipole geomagnetic field. If the Earth's inner core is under the superionic condition, the directional diffusion of light elements driven by the geomagnetic field could result in the presence of the lattice internal stress which would then result in the LPO. The anisotropic superionic fibers explain the anisotropic seismic velocities in the IC, suggesting a strong coupling between the IC structure and geomagnetic field.