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Texturing in the Earth s inner core due to preferential growth in its equatorial belt

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We propose an extension of the model by Yoshida et al. (1996), where deformation in the inner core is forced by preferential growth in the equatorial belt, by taking into account the presence of a stable compositional stratification. Stratification inhibits vertical motion, mposes a flow parallel to isodensity surfaces, and concentrates most deformation in a shallow shear layer of thickness proportional to $B^{-1/5}$, where B is the dimensionless uoyancy number. The localization of the flow results in large strain rates and enable the development of a strong texture of iron crystals in the upper inner core. We couple our dynamical model with a numerical model of texture development and compute the time evolution of the lattice preferred orientation of different samples in the inner core. With sufficient stratification, texturing is significant in the uppermost inner core. In contrast, the deeper inner core is unaffected by any flow and may preserve a fossil texture. We then investigate the effect of an initial texture resulting from solidification texturing at the ICB. In the present inner core, the deformation rate in the shallow shear layer is large and can significantly alter the solidification texturing, but the solidification texture acquired early in the inner core history can be preserved in the deeper part. Using elastic constants from ab initio calculations, we predict different maps of anisotropy in the modern inner core. A model with both solidification texturing and subsequent deformation in a stratified inner core produce a global anisotropy in agreement with seismological observations, both in magnitude and geographical distribution, with a weak anisotropy in the uppermost layer and stronger anisotropy in the deeper parts.

Keywords: Inner core, Iron, anisotropy, texturing