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SEISMIC ANISOTROPY FORMED BY CRYSTALLIZATION FROM LIQUIDS: RELEVANCE TO THE MOR PROCESS, TO UPPER MANTLE ANISOTROPY AND TO THE INNER CORE

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In metal castings the liquid commonly crystallizes as columnar or dendritic forms grown from the cooling contact with the mould. Similarly, the crystallization of high-Mg komatiite magmas typical of the Archaean often developed spinifex textures, in which large columnar or platy olivine crystals grew with their a-axes perpendicular to the cooling surface. Hitherto, the reason for such growth has been uncertain but it is now likely that the highly anisotropic thermal conductivity of olivine (twice its seismic anisotropy) (Chai et al. 1996) is responsible. Crystals with other orientations, less able to conduct latent heat from the low-thermal-conductivity silicate liquid, will get crowded out.

The author proposed (IUGG95) a model of the MOR process in which magma rising in a deep and narrow mantle crack fed the ridge, and a mixture of restite and cumulate accreted to the crack walls to generate the oceanic plate and immobile upper 50km(?) of the LVZ. This model can now be sustained, with benefit for the understanding of many features of MORs, including the generation of seismic anisotropy. Mantle flow seen in hot-emplaced ophiolites cannot be relevant to MORs (!), because of high-pressure evidence preserved within mantle tectonites and metamorphic soles.

Seismic transmission through the Earth's inner core is faster in the axial direction. Axially oriented crystallization and axially-preferred growth (cigar-shape) of the inner core may both be present and contribute to the effect. Such crystallization could indicate cool polar downflow in the outer core.