Discovery of an Fe-rich hydrous phase in the deep lower mantle

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Subducted slabs of oceanic lithosphere may transport water down to the deep lower mantle through stable hydrous minerals [1]. A new Fe-rich hydrous hexagonal (NHH) phase was discovered stable up to 2400 K and 107-136 GPa in a laser-heated diamond anvil cell (DAC), implying that deep water can be stored in an Fe-rich phase. The NHH phase is the high-temperature phase relative to the pyrited-structured (Fe,Al)OOH (P-phase). The NHH phase was also coexisting with δ-AlOOH [2] in a Al-rich starting composition.

Determination of the unit cell for an unknown phase is a great challenge under high *P-T* conditions. The multigrain indexation [3,4] is the only effective approach to provide a definitive characterization for an unknown high-pressure phase especially when the new phase has an enormously large unit cell and its composition is complicated by chemical reaction [5]. More than 100 reflections were observed originated from one of the selected crystallites of the NHH phase and the hexagonal unit-cell (z=12) was unambiguously determined: a=b=10.5803(6) Å, c=2.5897(3) Å and V=251.06(3) $Å^3$.

The NHH phase is ~17% denser than the surrounding lower mantle and may sink ot the deepest lower mantle to form the unevenly distributed ultralow-velocity-zones (ULVZs).

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