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HIGH PRESSURE GEOCHEMISTRY OF IRON; TOWARD A DEEP LOWER MANTLE DISCONTINUITY

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We measured the spin state of iron in magnesiowüstite ($Mg_{0.83}$ $Fe_{0.17}$)O at high pressure and found a high-spin to low-spin transition occurring in the 60–70 gigapascal pressure range, corresponding to depths of 2000 km in the Earth's lower mantle. This transition implies that the partition coefficient of iron between magnesiowüstite and magnesium silicate perovskite – the two main constituents of the lower mantle – may increase by several orders of magnitude, depleting the perovskite phase from its iron. This indicates that the lower mantle would therefore be composed of two different layers. For a given bulk composition, the upper layer would consist of a phase mixture with about equal partitioning of iron between magnesium silicate perovskite and magnesiowüstite, whereas the lower layer would consist of almost iron-free perovskite and iron-rich magnesiowüstite. This observation could explain reported seismic variations at this depth. It also strengthens the idea that iron-free magnesium silicate perovskite is the dominant mineral in the deepest lower mantle and at the core-mantle boundary.