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Magnetism of Fe under pressure from SQUID magnetometer and Mössbauer spectrometer measurements

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Iron is believed to be the major constituent in the cores of terrestrial planets; however, there is little knowledge on the magnetic properties of iron under high pressure. Such knowledge is important for understanding details of high-pressure phase transitions and can have potentially important implications for dynamo processes. Although contentious, a hexagonal closed packed (hcp) phase is favored for Fe in Earth's inner core. Different experimental techniques find highly disparate conclusions for the magnetic state of hcp Fe. Our Mössbauer experiments on iron powder in a diamond anvil cell show consistent results with former studies: sextets characteristic of a ferromagnetic phase disappear by 19.2 GPa. Conversely, full vector measurements of the remanent magnetization using a superconducting quantum interference device (SQUID) magnetometer reveal hcp-Fe still possesses measurable magnetic remanence up to our maximum-imposed pressure of 21.5 GPa. We conclude that the Mössbauer technique loses signal in the hcp stability region but that the loss in signal is due to resolving power of the technique rather than conclusive evidence for non-ferromagnetic hcp Fe. Enhanced magnetic remanence of Fe with increasing pressure is linked to a structurally distorted (martensitic) phase.