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The shock-ramp capability at Sandia National Laboratory's Z machine, a pulsed power facility, enables the probing of off-Hugoniot parameter spaces by initially shocking a material and subsequently driving a further shockless compression. We have used this drive method to measure the equation of state of iron along an elevated quasi-isentrope from 275 GPa to 400 GPa, reaching pressure and temperature conditions similar to the core of the Earth. We derive the EOS using a hybrid backward integration – Lagrangian technique on particle velocity traces from symmetrically-loaded sample pairs. Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.