Our current understanding of the electronic state of iron in lower-mantle minerals leads to a considerable disagreement in bulk sound speed with seismic measurements if the lower mantle has the same composition as the upper mantle (pyrolite). In the modeling studies, the content and oxidation state of Fe in the minerals have been assumed to be constant throughout the lower mantle. Here, we report high-pressure experimental results in which Fe becomes dominantly Fe2+ in bridgmanite synthesized at 40–70 GPa and 2,000 K, while it is in mixed oxidation state (Fe3+/∑Fe = 60%) in the samples synthesized below and above the pressure range. Little Fe3+ in bridgmanite combined with the strong partitioning of Fe2+ into ferropericlase will alter the Fe content for these minerals at 1,100- to 1,700-km depths. Our calculations show that the change in iron content harmonizes the bulk sound speed of pyrolite with the seismic values in this region. Our experiments support no significant changes in bulk composition for most of the mantle, but possible changes in physical properties and processes (such as viscosity and mantle flow patterns) in the midmantle.