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Pressure-volume-temperature studies of metal-oxide pairs

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Pressure-volume-temperature relations for the Fe-FeO, Ni-NiO, and Re-ReO<sub>2</sub> metal-oxide pairs were measured by synchrotron X-ray diffraction in both a multi-anvil press and a laser heated diamond anvil cell. The results offer several points of interest, including: (1) Simultaneous measurement of both the metal and its oxide provided a measure of the volume difference between the two phases that is more precise than comparisons between independently determined equations of state. This allows more precise evaluation of the thermodynamics of the metal-oxide system, for example oxygen fugacity buffer curves at high pressure. (2) Comparisons are made between results from different experimental methods, i.e. multi-anvil press and diamond cell. These can be made independent of the NaCl pressure standard when viewed as V(metal)-V(oxide)-T data. (3) Nonstoichiometric effects in wustite were eliminated by high-PT equilibration with Fe, allowing the equation of state of stoichiometric FeO to be measured. (4) Simultaneous measurement of three phases (metal, oxide, and NaCl) provided checks on the accuracy of previously determined equations of state, although high-PT data on some of these phases were scarce. (5) No new compounds were formed at high pressure by reaction between these metals and their oxides.