Forsterite, 𝑀𝑔2𝑆𝑖𝑂4, is expected to be a major component of the mantles of rocky exoplanets. Experimentally proving the predicted phase changes of forsterite is extremely important because it provides insight into the formation, evolution, and habitability of rocky exoplanets. Forsterite is theorized to undergo incongruent melting and form a liquid silicate, similar to 𝑀𝑔𝑆𝑖𝑂3, and crystal magnesium oxide, MgO, at high pressures. The purpose of this investigation was to determine if signs of incongruent melting were reflected in the conducted experiments. In these experiments, laser shock compression was used to achieve the necessary pressures (150 GPa and 206 GPa) on samples of polycrystalline forsterite. Analyses of x-ray diffraction patterns were used to determine the crystal structure of the laser compressed forsterite. Since x-rays scatter differently depending on the composition of the sample, the x-ray patterns can be interpreted as d-spacing (inter-atomic spacing in the lattice). Each substance can be identified by its unique combination of d-spacing patterns. This method was used to identify forsterite, forsterite III (solid polymorph of forsterite), and MgO in the experiments. It was found that evidence for crystalline MgO and melted forsterite was present at 206 GPa, and only evidence for crystalline forsterite was present at 150 GPa. From these results, it can be concluded that incongruent melting of forsterite is occurring at 206 GPa (but not at 150 GPa). These results indicate complex changes to the physical and chemical properties of forsterite at high pressures, affecting the understanding of rocky exoplanets interiors.