# Crystal structure of MgO along the shock Hugoniot

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## Abstract

Of the more than 6,000 confirmed and candidate extrasolar planets discovered to date those that are 1-4 times the radius of the Earth are found to be the most abundant. The silicate compounds that dominate the Earth's mantle likely dissociate into component oxides at the extreme pressures (200-2,000 GPa) and temperatures (5,000-10,000 K) corresponding to conditions of super-Earth mantles. Magnesium oxide (periclase), an end-member of the ferropericlase solid solution (Mg,Fe)O and an important component the Earth's mantle, has been studied under static compression in the pressure and temperature range found within the Earth (_˜135 GPa, 2500-4000 K). However, as static compression techniques are typically limited to peak pressures of $<$ 200 GPa, much less is known about its behavior under high-pressure and -temperature conditions. In this study, the structure of MgO upon shock compression over the 200-700 GPa pressure range was examined at the Omega-EP Laser facility at the Laboratory for Laser Energetics, University of Rochester. Laser drives of up to 2 kJ over 10 ns focused onto a polyimide ablator were used to shock compress 50-$\mu$m thick polycrystalline or single-crystal MgO. At peak compression, the sample was probed with He-$\alpha$ X-rays from a laser-plasma source. Diffracted X-rays were collected using the PXRDiP diagnostic which consists of image plates lining the inner walls of a box attached to the target package. For each pressure we measure crystal structure, pressure (velocity interferometry), density (x-ray diffraction) and shock temperature (pyrometry). Along the shock Hugoniot MgO transforms from B1 to the B2 structure at _˜400 GPa and melts at _˜700 GPa. Additional experiments using a decaying shock geometry combined with temperature measurements at the shock front provide a continuous measurement of pressure and temperature changes across the B1-B2 and B2-liquid phase boundaries.

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