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Direct observations of polymorphism and melting of shock-compressed silicates from ultrafast X-ray diffraction

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Constraining shock-induced transformations of major silicates and their kinetics is necessary to constrain planetary formation models of the terrestrial planets and to understand how meteorites and planetary surfaces have been affected by repetitive shocks. The recent coupling of ultrafast in situ X-ray diffraction (XRD) and shock compression techniques (gas guns and laser facilities) enables the direct investigation of transition mechanisms at short time-scales (from hundreds of picoseconds to hundreds of nanoseconds). In this study, we probed the structure at peak pressure of shocked SiO2 and MgSiO3 glasses and of their crystalline forms (respectively α-quartz and enstatite) by coupling ultrafast XRD to laser-driven shock compression at LCLS MEC end-station of SLAC XFEL facility (Stanford, USA). Our results provide strong insights on the phase transformation mechanisms and kinetics in shocked silicates. I will compare them to theoretical investigations and experimental measurements obtained under static compression, and I will discuss their implications in shock metamorphism and planetary science.

Choix de session parallèle

6.4 Résultats scientifiques récents obtenus avec les XFEL

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