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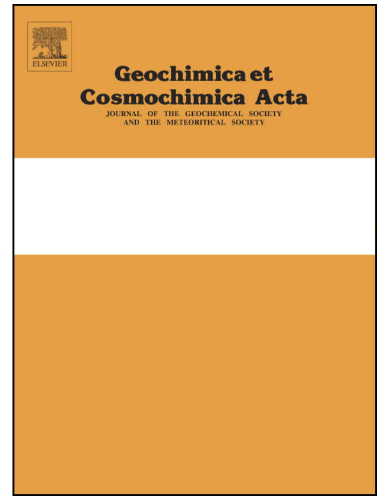

Back-transformation of high-pressure minerals in shocked chondrites: low-pressure mineral evidence for strong shock

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Back-transformation of high-pressure minerals in shocked chondrites: low-pressure mineral evidence for strong shock

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Abstract:

Post-shock annealing of meteorites can destroy their shock-induced features, particularly high-pressure minerals, and complicate the estimation of impact pressure-temperature conditions. However, distinguishing post-shock annealing features from thermal metamorphism effects can be practically difficult. Here we report results from Mbale, a highly shocked L chondrite, to investigate the mechanisms, kinetics and identification criteria for post-shock annealing of high-pressure signatures. Olivine fragments within shock-melt veins in Mbale occur as chemically heterogeneous nanocrystalline aggregates that contain trace wadsleyite and ringwoodite. Their strong variation in fayalite content provides evidence of iron partitioning during transformation of olivine to wadsleyite, followed by back-transformation to olivine after decompression. Experimental studies of transformation kinetics show that wadsleyite transforms to olivine in seconds at temperatures above ~1200 K and in hours at temperatures between 900 and 1200 K. Thermal models of shock-melt cooling show that shock veins in Mbale cooled to 1200 K in 1 s. The shock pulse must have been shorter than ~1 s to provide the