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In situ discovery of shock-induced graphite-diamond phase transition in gneisses from the Ries Crater, Germany

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ABSTRACT

Reflected-light microscopy and fine-scale laser microRaman spectroscopy of shocked garnet-cordierite-sillimanite gneisses in suevites of the Ries meteorite impact crater, Germany, led to the discovery of impact diamonds in their pristine graphite-diamond assemblages. Graphite-diamond textural relations permit a clear determination of the solid-state nature of the formation of diamond from graphite, which is estimated to have occurred at a peak-shock pressure between 30 and 40 GPa. Shock-induced transformations were promoted only in unkinked and undeformed graphite booklets at the graphite-garnet, graphite-sillimanite, or graphite-rutile interfaces, where the difference in shock impedance is very high. Reverberations of shock waves with short wavelengths similar to the grain sizes at the phase boundaries are probably important constraints for dynamic graphite-diamond phase transformation. Raman spectroscopic investigations of hard transparent carbon platelets intercalated between fine-grained diamond and deformed graphite revealed the platelets to be Raman inactive. The platelets are either dense amorphous carbon or an unknown dense crystalline carbon phase that is Raman inactive.