A role of chemical reaction between meteoritic matter and the atmosphere during oblique impacts in the early Earth atmosphere

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A large amount of reducing materials, such as metallic iron and organic carbon, are thought to be delivered by asteroids to Earth and other planets during the heavy bombardment period. Both laboratory calculations and hydrocode calculations, however, show that the meteoritic materials brought by oblique impacts go through sever interaction with the ambient atmosphere. The chemical aspects of the interaction, nevertheless, have not been investigated extensively. In order to understand the chemical reactions between meteoritic materials in an impact vapor within an oxidizing atmosphere, we performed a series of impact experiments using carbon-rich projectiles, high-impedance metal targets, and N2-O2-Ar model atmospheres. The emission spectra of the impacts were observed with high-speed spectrometers. The spectroscopic observation indicates that vaporized carbon readily reacts with atmospheric nitrogen and forms CN radicals, which are unstable in an oxidizing condition. This experimental result strongly suggests that a carbon-rich meteoritic body vaporized in an oxidizing atmosphere may create a reducing local environment, which may help synthesizing organic matter from once destroyed meteoritic organic matter. Such re-synthesis of organic matter may increase the effective survivability of meteoritic organic matter greatly.