Generation of Carbon Compounds by "Low" Velocity Impacts

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Impacts are common phenomena through the history of the solar system. Some evidence shows that there was a period of extremely high impact flux that is called late heavy bombardment occurred approximately 3.8-4.1 Ga [e.g., 2]. In this period impacts might have affected the surface environment of planets significantly. Asteroids and comets, which are survivors of planetesimals in the early solar system, include a large amount of carbon. The redox state of carbon-bearing gas species released after impacts is important for early Earth and early Mars. For example, precursors of life on early Earth (and early Mars) must have preferred a reductive environment to an oxidative one.

Simulated impact vaporization experiments that used laser irradiation to vaporize meteorites and/or meterorite analogue have shown that the impact-generated gas has oxidative composition because of oxygen released from silicates included in the samples [3, 4].

In this study we focused on relatively "low" velocity impacts. In general the required velocity for incipient vaporization of silicates is ~10 km/s and for complete vaporization a few tens of km/s [5]. Impacts with the velocity where silicates does not evaporate or partially evaporate might generate reductive chemical species.

We conducted impact experiments using a two-stage hydrogen gun to investigate the composition of the impact-generated gas. The target samples were mixture of SiO_2 powder and polyethylene powder, which were used as simplified carbonaceous chondrite analogue. The impact velocities were ~5-7 km/s. The generated gas was measured with a quadrupole mass spectrometer. The preliminary analysis shows that a large amount of CH_4 and little CO_2 was produced, which suggests that the composition of the impact-generated gas under the condition that silicates do not vaporize is reductive. More detailed results will be presented at the conference.

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