Formation of precursors for biomolecules in post-impact plume on the early Earth

Taro Samejima[1]; Yoshihiro Furukawa[2]; Takeshi Kakegawa[3]

[1] Inst. Min. Pet. Econ. Geol. Tohoku Univ.; [2] Graduate School of Science, Tohoku Univ.; [3] IMPE., Tohoku Univ.

Oceanic impact of meteorite, especially ordinary chondrite containing carbon and iron as reductant, might have produced various organic compounds during late heavy bombardment using atmospheric CO_2 and N_2. Syntheses of organic molecules were successful when oceanic impact event was simulated in shock-recovery experiments, proposing new hypothesis for origin of life. On the other hand, difficulty exists to simulate various physical processes in the post-impact plume by the shock-recovery experiments. A new gas-flow glass line attached with a furnace was constructed to simulate the chemical reaction in the post impact plume. In particular, it is examined if any carbon and nitrogen compounds are formed. The experiments were performed at temperature of 400, 600, 800 and 1000^{o}C. Steam water and nitrogen gases were supplied to glass line continuously during the experiment. A mixture of solid carbon, iron and nickel with gold boat were placed in a furnace. They were analyzed with XRD and FE-SEM after the experiments. Gas phase was collected and analyzed with gas detecting tubes. Water soluble phases were trapped in the terminal flask with water and then analyzed using LC/MS.

It is found that most iron were converted into hematite and magnetite when temperatures exceed 800^{o}C. Carbon monoxide, ammonia and hydrogen cyanide were detected from gas and water soluble phases. Yields of ammonia and carbon monoxide depend on iron concentrations in starting materials and reaction temperature respectively. It is suggested that: (1) interaction of water and iron produced hydrogen: (2) this hydrogen reacted with nitrogen then formed ammonia: and (3) interaction of water and carbon produced carbon monoxide. Because these products are very important precursors for the synthesis of biomolecules such as amino acids, results of the present study further suggest that post-impact plume might be the place suitable for various organic syntheses.