Shock reaction of benzene up to 28.5 GPa –Experimental approach

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Body impacts are ubiquitous phenomena on the earth and in the space. Shock waves generated by the impacts propergate the bodies and raise tempereature and pressure of materials in the bodies. When carbonaceous chondrites and comets experience impact events, the organic materials in them should react under the high temperature and high pressure conditions (shock reaction). The shock reaction play an important role in chemical reactions of organic materials under space environments. Benzene is the most simple aromatic hydrocarbon, which is found in carbonaceous chondrites [1] and is believed to be omnipresent in the interstellar medium [2]. The shock experiments of benzene provide us fundermental information on mechanisms of shock reaction. Here, we report chemical composition of products in shocked benzene up to 28.5 GPa.

Benzene was enclosed in a reactor and impacted by a projectile accelerated with a vertical powder gun. After the impact, the shocked benzene sample was extracted by organic solvent (dichloromethane) and analyzed with GC-MS and elemental analyzer.

Shock pressures and shock temperatures were calculated 5.9-28.5 GPa and 380-1020K. Starting benzene decreases with increasing shock pressrue and was not detected in 28.5 GPa sample. The products were insoluble materials (soot like materials) and soluble mateirals (polycyclic aromatic hydrocarbons: PAHs). The yield of insoluble products simply increases with increasing shock pressure. H/C of the products was constant (nearly 0.2, although H/C of benzene is 1) independently of shock pressure. The H/C decrease of products suggests that the shock reaction causes dehydrogenation. The yield of soluble products increases up to 24 GPa and then decreases. The soluble products were not detected in 28.5 GPa sample. Thirty of PAHs from naphthalene (molecular weight 128) to coronene (molecular weight 300) were determined in the products. Methyl-derivatized PAHs were also detected in the products. These results show that cleavage of benzene rings is one of chemical mechanisms in the shock reaction.

[1] T. Belsky and I. R. Kaplan (1970), *Geochim. Cosmochim. Acta*, **34**, 257-278.
[2] B. M. Jones et al., (2011), *PNAS* **108**, 452-457.