

SCG16-07

Room:201A

Time:May 28 15:30-15:45

Oligomerization and carbonization of polycyclic aromatic hydrocarbons at pressures to 16 GPa

CHANYSHEV, Artem¹ ; LITASOV, Konstantin^{2*} ; SHATSKIY, Anton² ; FURUKAWA, Yoshihiro³ ; YOSHINO, Takashi⁴ ; OHTANI, Eiji³

¹Novosibirsk State University, Novosibirsk, Russia, ²VS Sobolev Institute of Geology and Mineralogy, Novosibirsk, Russia,

³Graduate School of Science, Tohoku University, Sendai, Japan, ⁴Institute for Study of the Earths Interior, Okayama University, Misasa, Tottori, Japan

We have examined the stabilities of different polycyclic aromatic hydrocarbons (PAHs) at pressures up to 16 GPa and temperatures to 1273 K. Experiments were performed using a large-volume multi-anvil apparatus. Quenched products were analyzed by matrix-assisted laser desorption/ionization (MALDI) and Raman spectroscopy. The MALDI measurements revealed the considerable oligomerization of PAHs at 7 GPa and 773 to 873 K and insignificant PAH oligomerization at 16 GPa and 300 K. At 7 GPa and 773 K, oligomers with atomic masses up to 3400 Da and higher were found, while only a small number of dimers of the starting PAHs were detected at 16 GPa and 300 K. PAH decomposition at 7 GPa occurred from 873 to 973 K, and the decomposition products consisted of nanocrystalline graphite. We also obtained solid-liquid-(C+H₂) triple points by in situ X-ray diffraction and X-ray radiography and found that they are located at relatively low pressures of 1-2 GPa for naphthalene, acenaphthene, pyrene, and coronene. Previously determined melting lines to 4-5 GPa were thus subjected for revision. The determined decomposition temperatures of the PAHs (873-973 K) are much lower than Earth's geotherms and the subduction slab P-T profiles at 6-7 GPa; therefore, PAH inclusions in mantle-derived minerals, which can be crystallized at 6 to 7 GPa and 1600 to 1700 K, should be secondary phases and could be formed by the successive polycondensation of simple hydrocarbon molecules under natural catalysts during eruption processes at sub-ambient pressures and temperatures. We also rebutted the high-temperature stability of PAHs suggested by previous shock compression experiments and theoretical predictions. However, metastable formation of PAHs in shock experiments at high PT-conditions may still be possible.

Keywords: high pressure, polycyclic aromatic hydrocarbons, carbon, oligomerization