Shock reaction of phenanthrene

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[2]Facutter occur ubiquitously in the universe and their interaction (shock reaction) is a common phenomenon. In the shock reaction, organic matter may decompose or recombine into other organic materials under high pressures and temperatures characterizing transient shock waves. In order to examine the shock behavior of organic matter, we compressed phenanthrene and analysed the recovered samples. The reason why phenanthrene is selected as a starting material is that phenanthrene is one of the most abundant organics detected in carbonaceous chondrites and interplanetary dust particles.

The sealed phenanthrene in stainless steel-capsule was impacted with a projectile accelerated by a vertical powder-gun. The shocked samples of phenanthrene were analysed by FID-GC, GCMS, and elemental analyser. Phenanthrene was subjected to shock impact over the pressure range of 7.9-33GPa. In this pressure range, phenanthrene experienced temperatures from 600 to 2000K.

The shocked samples contained polycyclic aromatic hydrocarbons (PAHs) with the molecular weight ranging from 128 to 354, amorphous carbon, and unreacted phenanthrene. Major component of these PAHs was phenanthrene dimers. Unreacted phenanthrene and atomic ratios of hydrogen to carbon (H/C) of shocked samples decreased with increasing shock pressure. Above 28GPa, unreacted phenanthrene was little in the shocked samples.

The chemical composition of the products indicates that the shock reaction consists of dehydrogenation including carbonisation and intermolecular coupling reaction. Concentrations of unreacted phenanthrene suggest that carbonaceous chondrites containing phenanthrene never experienced over 28Gpa, in the processes of the break-up of the parent bodies by their mutual collisions and the fall of chondrites on the Earth traversing the atmosphere.

^{13}C and ^{15}N in bone collagen of prehistoric human from northeast Asia and North Pacific coastal regions

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Stable carbon and nitrogen isotope ratios of bone collagen of prehistoric human from Pacific and north-east Asia (Polynesia, Japan, Sakhalin, Aleutian islands and Siberia coast) were studied to reconstruct dietary pattern and characterize their feeding habit. Collagen was extracted as gelatine fraction from about 350 human bone specimens. Cabon and nitrogen isotope ratio were measured by conventional combustion method using quartz tube and isotope ratio mass spectrometers.

Isotopic composition of bone samples from every sites showed distinct characteristics as a group, reflecting different dietary habit for plants, animals and marine food. Bones from the sites in Jomon period (ca. 4000 BP) at Japan showed extremely broad isotopic range in both carbon and nitrogen compared with historic and modern human, suggesting that in prehistoric Japan the usage pattern of terrestrial and marine resources could be distinctive in locality. Populations in northern Japan showed relatively high ^{15}N content ranging 15 to 21 ‰ and were comparable with the groups at northern coast around the Okhotsuk sea and Aleutian islander. The Polynesia groups at Cook island also showed intense adaptation to marine resources.

Stochastic analysis was applied to estimate the dietary contribution of five food sources of which isotope ratio is distinctive one another (Minagawa, 1992). The isotope ratio and nutritional condition of five food groups was estimated by analysing both archaeological specimens and modern natural resources.

Marine animals like seal and dolphin were estimated to account almost 40 % of dietary protein for populations in Hokkaido, Sakhalin and Aleutians. On the other hand such strong dependence on marine food was not identified for other populations in south-west Japan (southern from 40⁻N) and Siberia interior group.

The isotopic values appear to change chronologically in south-west Japan probably due to introduction of rice agriculture, however the basic structure of feeding habit, such as dependence for animal or marine resources, seems to be basically stable since 6000 BP in Japan.

For more accurate analysis in future, emphasis has been placed how to estimate abundance of C3 and C4 plants in prehistoric ecosystem.

References

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