Petrogenetic history of granulitic eucrites, A-881467 and Y-791195: Implication for impact history of early eucritic crust

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Eucrites are the oldest basalts or gabbros in the solar system, and record early geologic events such as volcanism, metamorphism, and impacts on the parent body, asteroid 4Vesta. To better understand the impact history of the parent body, we performed mineralogical and geochemical studies of two granulitic eucrites, A-881467 and Y-791195

A-881467 displays a granulitic texture composed of pigeonite, augite, plagioclase, and minor minerals (Yamaguchi et al., 1997). Some plagioclase laths could be relicts of basalt. The REE abundances of A-881467 are 9-12 x CI with a slight positive Eu anomaly. The mg# is within the range of noncumulate eucrites. In contrast, Y-791195 was classified as a cumulate eucrite based on the relatively mg-rich composition and low REE abundances compared to noncumulate eucrites (this work, Mittlefehldt and Lindstrom, 1993). Y-791195 has a coarser grained portion with finer-grained recrystallized veins. This indicates that the precursor of Y-791195 is likely to be a recrystallized breccia. Although A-881467 and Y-791195 are strongly recrystallized rocks, pigeonites in these eucrites are not inverted into orthopyroxene, in contrast to those of other cumulate eucrites and highly metamorphosed type 6 basaltic eucrites (e.g., Yamaguchi et al., 1996). This is explained by the rapid cooling from high temperature after metamorphism. The remnant basaltic texture and bulk compositional data imply that A-881467 was originally crystallized on the surface or in a shallow intrusion. In contrast, the bulk compositional data may indicate that the precursor of Y-791195 could be a breccia rich in cumulate materials, probably formed in a deep magma chamber. Although these eucrites may have formed initially in different portions in the crust, the post-crystallization thermal and impact histories are very similar. It seems that the eucritic crust experienced impact events during initial cooling shortly after its formation.

References

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Origin of atmospheric Benzene using its stable carbon isotopic composition as a tracer

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The sources and behaviors of trace benzene in the atmosphere are great interest because of their association with human health problems. The major sources of benzene are from evaporative losses from petrol as well as the internal combustion process itself. The burning of biomass also results in a release of benzene and plant and animal matter may also emit small amounts. The carbon isotopic composition could be highly useful tracer to distinguish the origin of benzene in atmosphere.

In this paper, the carbon isotopic compositions of trace benzene in both polluted urban atmosphere (Sapporo and Muroran) and in clean maritime atmosphere (western Pacific) are determined. Besides, the compositions of various possible sources for atmospheric benzene, such as gasoline, car exhaust, and biomass burning exhaust are also determined $\delta^{13}C$ for their included benzene. The average $\delta^{13}C$ values of benzene in gasoline was -31.3±2.2‰$_{PDB.}$ On the otherhand, the $\delta^{13}C$ values of benzene in the automobile exhaust completely differ from those of gasoline, -20.2±0.2‰$_{PDB}$ for exhaust of 2002 automobile and -24.5±0.8‰$_{PDB}$ for exhaust of old 1966 automobile. The $\delta^{13}C$ values of benzene emitted from biomass burnings of rice straw (C-3 plant), pine tree (C-3 plant) and corn(C-4 plant) were from -28.3±1.0, -24.6±0.4, -14.3±1.7‰$_{PDB}$ respectively. These studies revealed that each source exhibited its original carbon isotopic composition, so that the $\delta^{13}C$ values of atmospheric benzene can be a useful tracer. The $\delta^{13}C$ values of atmospheric benzene exhibit large variation from -24.0 to -30.4‰$_{PDB}$ in Sapporo and always -24.8±0.2‰$_{PDB}$ in Muroran. The isotopic signature can be highly useful signature in tracing atmospheric benzene in urban atmosphere. The $\delta^{13}C$ values of the maritime atmospheric samples also varied greatly from -18.1 to -29.4‰$_{PDB}$. The heavy values are always characterized by lower mixing ratio. The results of maritime atmosphere suggest that we can apply the isotopic signature to decide not only the origin but also the behavior of benzene in atmosphere.