Are polycyclic aromatic hydrocarbons in carbonaceous chondrites altered by aqueous alteration?

CLAUDIA-CORINA GIESE[1,2]*, INGE LOES TEN KATE[2], OLIVER PLÜMPER[2], HELEN E. KING[2] AND XANDER TIELENS[1]

[1]Leiden Observatory, Leiden University, 2300 RA Leiden, The Netherlands (*correspondence: c.c.giese@uu.nl)

[2]Department of Earth Sciences, Faculty of Geosciences, Utrecht University, 3584 CD Utrecht, The Netherlands

Polycyclic aromatic hydrocarbons (PAHs) have been detected within interstellar medium (ISM), where they are formed in situ [1], and in carbonaceous chondrites (CCs) [2]. The largest PAH extractable from CCs has 24 carbon atoms (coronene) [3], whereas PAHs in ISM can have up to 400 carbon atoms (cluster) [1]. If we assume that PAHs in CCs originated in the ISM [4] why are only small PAHs detected in these meteorites? To investigate this we have explored whether aqueous alteration of minerals, observed in CCs [5], can induce the breakdown of PAHs.

In this study we have run batch reactor experiments with four different PAHs (naphthalene $C_{10}H_8$; fluoranthene $C_{16}H_{10}$; coronene $C_{24}H_{12}$; hexabenzocoronene $C_{48}H_{24}$) in the presence of olivine (Fo_{90}), an analogue for a reacting meteoritic matrix. Experiments were carried out at 21 ˚C and 150 ˚C for 70 days under anoxic conditions. The reacted solids were analysed using Raman spectroscopy and scanning electron microscopy. The resultant fluids were analysed by high-pressure liquid chromatography. Additionally, melting experiments (40-150˚C) were performed to investigate the melting behaviour of the four different PAHs in water.

Our results show that naphthalene and fluoranthene alter solely as a result of melting and are not influenced by the aqueous alteration of olivine. Moreover, coronene and hexabenzocoronene do not exhibit any modifications upon exposure to aqueous alteration conditions. Thus we conclude that PAH breakdown to form small organic compounds is not promoted by aqueous alteration of the meteorite mineral matrix. However, thermal metamorphism due to e.g. heat released during radiogenic element decay may alter PAHs.

[1] Tielens (2008) *Ann. Rev. of Astronomy and Astrophys* **46**, 289-337 . [2] Basile et al. (1984) *Org Geochim* **5**, 211 . [3] Sephton (2002) *Nat. Prod. Rep.* **19**, 292-311 . [4] Plows et al. (2003) *Geochim Cosmochim Ac* **67**, 1429-1436 . [5] Brearley (2006) *Meteorites and the early solar system II, edited by Lauretta D. and McSween H. Y.Jr. Tucson:* 587–624