

**POLYCYCLIC AROMATIC HYDROCARBONS ARE EVERYWHERE IN ALLAN HILLS 84001.**

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**Introduction:** Polycyclic aromatic hydrocarbons (PAHs) observed on fracture surfaces of the Martian meteorite ALH 84001 were suggested as a major evidence for possible relic biogenic activity on our neighboring planet [1]. In general, the origin of PAHs is not restricted to biological processes, but the proposed spatial association of PAHs with carbonates that in turn contain internal structures resembling terrestrial microfossils was taken as evidence for a genetic link between both observations [1]. This, however, would contradict the results of an earlier study of ALH 84001 that demonstrated (i) that the PAH enrichments do not *always* correlate with carbonates and (ii) that some carbonates in this meteorite do not contain PAHs [2]. With the technique used in both these studies, microprobe two-step laser mass spectrometry ( $\mu\text{L}^2\text{MS}$ ), an unambiguous determination of a spatial association is limited by the lateral resolution of the instrument, about 50  $\mu\text{m}$ , a size that is comparable with the typical dimension of the carbonates.

We used time-of-flight secondary ion mass spectrometry (TOF-SIMS) with a lateral resolution of about 0.2  $\mu\text{m}$  to investigate the possible relationship between PAHs and carbonates. Here we report on our research of the spatial distribution of PAHs in two more sections of ALH84001 that continues our previous study of another section [3].

**Results:** Time-of-flight secondary ion mass spectrometry analyses of all three investigated thin sections revealed PAHs. The secondary ion mass spectra have identical characteristics. The preferential occurrence of low-mass PAH ions and the presence of positively charged radical ions are both attributed to fragmentation by the primary ion bombardment [3]. The previously found general trend of a lower content of PAHs in carbonates than in orthopyroxene or feldspatic glass is corroborated by the present follow-up analyses. Moreover, no pronounced PAH enrichment was detected with TOF-SIMS in any of the investigated carbonates.

Surface contamination is a major concern in TOF-SIMS analysis since the information depth in a typical measurement is of the order of a few atomic monolayers. The three investigated thin sections stem from

three different chips of ALH84001 and were prepared at different times in two different laboratories. This should minimize the probability of a common contamination with external PAHs during processing. A section of Chassigny [4] that was treated exactly like one of our ALH 84001 sections and measured directly before and after ALH 84001 contained no PAHs. In an attempt to further investigate the (possible) contamination problem we employed various sputtering techniques: (i) extensive sputtering and analyzing with  $\text{Ga}^+$  ions alone, (ii) simultaneous sputtering with  $\text{Ar}^+$  and analyzing with  $\text{Ga}^+$ , (iii) analyzing with  $\text{Ga}^+$  after sputtering with  $\text{Ar}^+$ . The complex results open a variety of interpretations. In one case we observed a slight increase of the PAH signals during sputtering. Another section first had a rather uniform distribution of PAHs on the very surface, and, after extensive sputtering, the PAH signals decreased but did not vanish. Their intensities vary between different minerals and again reveal the previously observed “anti-correlation” of PAHs and carbonates. Their uniform distribution before sputtering might indeed be the result of polishing, i.e., of redistribution of PAHs that are indigenous to the meteorite.

**Discussion:** The origin of the omnipresent PAHs in ALH 84001 cannot be deduced as yet from our TOF-SIMS experiments. However, we exclude a spatial association of PAHs with carbonates and consequently also with nanostructures supposedly present within carbonates. Therefore, a genetic link between the proposed nanofossils and PAHs appears to be improbable. Both observations are to be understood independently. Since the biogenic interpretation of the phenomena observed in ALH 84001 relies mainly on their collective explanation [1] it seems to be highly questionable.

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**References:** [1] McKay D. S. et al. (1996) *Science*, 273, 491–504. [2] Thomas K. L. et al. (1995) *LPS XXVI*, 1409–1410. [3] Stephan T. et al. (1998) *LPS XXIX*, #1263. [4] Greshake A. et al. (1998) *LPS XXIX*, #1069.