Magnesium isotope composition of presolar silicate grains

JÁNOS KODOLÁNYI* AND PETER HOPPE

Max Planck Institute for Chemistry, Mainz, 55128 Germany (*correspondence: j.kodolanyi@mpic.de)

We have measured the Mg isotope compositions of presolar silicate grains, to gain insights into the stellar nucleosynthesis and Galactic chemical evolution (GCE) of Mg isotopes.

More than half of the Mg in the interstellar medium (ISM) is hosted by oxide and silicate dust produced by evolved stars [1]. The Mg isotope composition of dust grains predating our Solar System could provide information about the Mg isotope 'inventory' of the local ISM at the time of Solar System formation. This is of particular interest, as the $^{25}Mg/^{24}Mg$ and $^{26}Mg/^{24}Mg$ ratios of the Sun (and the Solar System) appear to be substantially lower than that predicted by GCE models for stars of solar metallicity (Z_{solar};[2]). Presolar silicate grains represent the silicate fraction of the interstellar dust at the time of Solar System formation. They are 200-300 nm crystalline or amorphous grains, which escaped Solar System processing, thereby retaining their pristine isotope compositions [e.g. 3, 4].

Presolar silicate grains of the present study were found in the matrix of Acfer 094 (an ungrouped carbonaceous chondrite), based on their O isotope compositions and Si-Al-O systematics. These were determined by the NanoSIMS, as were the grains' Mg isotope compositions (for analytical conditions see [5]). Based on their O isotope composition, the identified 26 grains were produced in the stellar winds of AGB stars, with initial masses (M) of 1.15-2.2 × M_{solar} and Z ~ Z_{solar} [6], similar to the majority (~80 %) of presolar silicates reported in the literature previously [e.g. 4]. Two of the 3 grains analysed for Mg isotopes so far have solar $^{25}Mg/^{24}Mg$ ratios within analytical uncertainty (1 σ) whereas a third grain shows a slight enrichment in ^{25}Mg relative to solar ($\delta^{25}Mg$ = 32 ± 20 ‰). The ^{25}Mg-enriched grain also has elevated $^{26}Mg/^{24}Mg$ ($\delta^{26}Mg$ = 39 ± 20 ‰), as do one of the other two grains ($\delta^{26}Mg$ = 35 ± 16 ‰). Interestingly, in a $\delta^{25}Mg$ vs. $\delta^{26}Mg$ plot our silicate grains fall along a line with slope ~1 as predicted by the GCE model of [2] for stars with ~solar Z; however, at much lower $^{25}Mg/^{24}Mg$ and $^{26}Mg/^{24}Mg$ ratios than predicted, similar to presolar oxide grains from akin stellar sources [7].

[1] Fitzpatrick (1997) *Astrophys J* **482**, L199–L202. [2] Fenner *et al*. (2003) *Publ Astronom Soc Australia* **20**, 340–344. [3] Nguyen & Zinner (2004) *Science* **303**, 1496–1499. [4] Vollmer *et al*. (2009) *GCA* **73**, 7127–7149. [5] Kodolányi & Hoppe (2010) *Proc Sci (NIC XI)* 142 [6] Nittler (2009) *Publ Astronom Soc Australia* **26**, 271–277. [7] Zinner *et al*. (2005) *GCA* **69**, 4149–4165.

Fe acquisition from natural organic matter by an aerobic *Pseudomonad*: Siderophores and cellular Fe status

K. KOEHN[1], C. DEHNER[2], J. DUBOIS[2] AND P. MAURICE[1]*

[1]University of Notre Dame, 156 Fitzpatrick Hall, Notre Dame, IN 46556, USA (kkoehn@nd.edu, *correspondence: pmaurice@nd.edu)

[2]University of Notre Dame, 251 Nieuwland Hall, Notre Dame, IN 46556, USA (cdehner@nd.edu, jdubois@nd.edu)

Aerobic microorganisms have evolved various strategies to acquire nutrient Fe (often limiting in circumneutral environments), including the release of Fe-chelating siderophores. The potential importance of siderophores in Fe acquisition from natural organic matter (NOM) in the form of reverse osmosis (RO) and aquatic XAD-8-isolated humic samples (both with naturally associated Fe) was investigated using a wild type strain (WT) of aerobic *Pseudomonas mendocina* that produces siderophore (s) and an engineered mutant that cannot. Microbial growth under Fe-limited batch conditions was monitored via optical density, and a biosensor assay was used to report on transcriptional output as a measure of cellular Fe status. Both WT and mutant strains acquired Fe from NOM. Bacterially sensed Fe deficiency in the presence of the RO sample decreased with increasing [Fe] and was less for the WT than for the mutant. However, for both WT and mutant, maximum growth in the presence of the RO sample increased as: 1 mgC/L (0.2μM Fe) < 100 mgC/L (20μM Fe) < 10 mgC/L (2μM Fe); the highest concentration of NOM appeared to diminish numbers of free-swimming/planktonic bacteria, perhaps by inducing biofilm formation and/or as a result of associated Al. Growth was slightly more robust on the XAD-8 compared to the RO sample at 2 μM Fe, although there were no apparent differences in internal Fe status. Chelex® treatment to partially remove metals associated with the RO sample increased Fe stress but did not substantially affect growth. It was concluded that: (1) siderophores are useful but not necessary for Fe acquisition from NOM by *P. mendocina* and (2) NOM may have complex effects on microbial growth, related not just to Fe content but potentially to the presence of other (trace)metals such as Al and/or to effects on biofilm development.