

THE SUSCEPTIBILITY OF PHASE Q TO PYRIDINE: ARE CI CHONDRITES UNIQUE?

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Introduction: The origin of the primordially trapped noble gases in the elusive phase Q is an unresolved question in meteoritics [1]. Acid-resistant residues, enriched in insoluble organic matter (IOM) in all meteorite classes contain Q-gases of remarkably similar composition, that are strongly fractionated relative to solar gases [2,3]. Q-gas signatures in achondrites and comet Wild 2 dust [4,5] show that phase Q was ubiquitously incorporated during accretion in the inner and outer solar system. Pyridine applied to the IOM of CI Orgueil released large amounts of Q-Xe due to swelling [6,7]. In contrast, pyridine did not affect phase Q in LL, CV, CR and CM chondrites [7-9]. This may suggest that different types of phase Q exist. Either phase Q was modified due to particular conditions on the CI parent body (e.g., severe aqueous alteration) or processes on all other parent bodies (e.g., mild thermal alteration) modified a pyridine-susceptible fraction. Here we present noble gas data on IOM from pristine meteorites. In particular, we show that phase Q in CIs Ivuna and Orgueil are not affected by pyridine.

Experimental: We used an IR laser to extract noble gases in IOM (<1-5 mg) of CIs Orgueil and Ivuna, CV3 Allende, L3.05 QUE97008, C2 Tagish Lake. IOM aliquots before and after treatment with pyridine were compared [see 8 for details]. Nb tubes were used to avoid sample loss during heating. As quantitative gas release has not been reached for all samples yet, we compare isotope and element ratios, which can readily distinguish the release of Q-gases [8,9], whilst avoiding ambiguity due to sample loss during preparation and extraction.

Results and Discussion: All residues contain large amounts of Q noble gases, in agreement with their primitive character. All isotope and elemental ratios are in the range expected for IOM [2,3]. As demonstrated earlier [8], the reported 60 % loss of phase Q [6] would be visible in the elemental ratios (favoring the lighter element) and also Xe isotopes (Xe-HL would be more dominant). However, even the most suitable Xe isotopic ratios are typically identical (within 3 %) in treated and untreated IOM. Similarly, the element ratios vary by typically 10-30 %, however, without a systematic trend, hence not supporting the idea of phase Q loss due to pyridine treatment. To the contrary, more ratios point to a depletion of presolar phases relative to phase Q, which hence may simply reflect sample heterogeneity. Most importantly, treated and untreated CI Ivuna IOM shows similar ratios and we do not observe a significant loss of Q-gases in Orgueil. The CI parent body acquired and still carries the same phase Q and its noble gases as all other groups, despite different alteration processes.

References: [1] Wieler R. et al. 2006. in *Meteorites and the Early Solar System II*: 499-521. [2] Busemann H. et al. 2000. *M&PS* 35:949-973. [3] Huss G.R. et al. 1996. *GCA* 60:3311-3340. [4] Busemann H. and Eugster O. 2002. *M&PS* 37:1865-1891. [5] Marty B. et al. 2008. *Science* 319:75-78. [6] Marrocchi Y. et al. 2005 *EPSL* 236: 569-578. [7] Matsuda J.-I. et al. 2010. *M&PS* 45:1191-1205. [8] Spring N. et al. 2010. *41st LPSC*. Abstract #2640. [9] Busemann H. et al. 2008. *39th LPSC*. Abstract #1777.