Hydrogen abundance in carbonaceous chondrites from thermogravimetric analysis

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Abstract

Carbonaceous chondrites are considered as amongst the most primitive Solar System samples available, because of their enrichment in volatile elements. The mineralogy of CM and CI chondrites is dominated by serpentines and montmorillonite type clays, respectively but mineralogy of CR chondrites is poorly constrained so far. Here, in order to characterize and quantify the abundance of hydrous minerals in carbonaceous chondrites, we performed thermogravimetric analysis (TGA) of fragments of Tagish Lake (TL, UCC), Murchison (CM2.5), Orgueil (CI) and EET 92159 (CR2).

Chunks of meteorites were extracted for TGA analysis following [1]. In the case of the CR chondrite, a matrix-enriched fraction of the sample was prepared and compared to a bulk rock fragment. TGA experiments were performed with TGA/SDTA 851^e Mettler Toledo under the following conditions: sample mass of about 15 mg, platinum crucible of 150 μl, heating rate of 10 °C min^{-1}, and inert N_2 atmosphere of 50 ml min^{-1}. About 15 reference minerals were analyzed as standards.

All meteorites studied show significant endothermic mass loss below 200°C. Two distinct peaks are present on the first derivative curve corresponding to adsorbed H_20 (peak at 70°C) and water molecules trapped in mesopores (peak at 130°C), in agreement with IR study [2]. The total amount of this "exchangeable" water is 2.8, 6.0, 7.8 and 3.9 wt % for Murchison, TL, Orgueil and the matrix of the CR, respectively.

In the case of Orgueil, a significant amount of mass loss is centered at 250°C, likely related to the decomposition of ferrihydrite, confirming previous studies [3]. In addition, mass releases are observed at 570°C and 730°C, attributed to Fe and Mg-rich phyllosilicates. In the case of Murchison, the occurrence of Mg-rich serpentine is suggested by the presence of a mass loss at 730°C, together with cronstedtite (mass loss at 380°C and 545°C). TL shows a particular behaviour since Mg-serpentine appears to be absent and the first derivative curve shows a mass loss occuring at 570°C with a shoulder at 520°C. In the case of EET 92159, a significant mass loss occurs between 200° and 900°C (7,5 wt %) indicating that the matrix is hydrated. The amount of hydration of the matrix suggests a very high proportion of phyllosilicates. Numerous peaks are present in the derivative curve indicating a complex hydrated mineralogy dominated by phyllosilicates

[1] Montes-Hernandez et al., *submitted*. [2] Beck, P. et al., *Geochim. Cosmochim. Acta* **74**, 4881-4892 [3] Tomeoka K. and Buseck P.R. 1988, *Geochim. Cosmochim. Acta* 52, 1627-164

Hydrothermal vents as a source of pyrite and trace metal- containing mineral nanoparticles to the oceans

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The mechanisms by which metals from hydrothermal vents may be transported through the ocean are still largely unknown. We demonstrate that pyrite nanoparticles as small as 4nm, and aggregated into clusters of 50-350nm, are emitted from high temperature black smokers at Lau Basin. These nanoparticles, which contain other metals, are characterized via chemical methods as well as by using a combination of physical chemical techniques (TEM, SEM-EDS and EELS). Laboratory experiments show that synthesized pyrite nanoparticles are stable in oxic seawater for months, and thus provide a potential transport mechanism for iron far from vent sources. All these nanoparticles as well as others including iron silicates, which are present, likely influence the transport of iron and other elements from the hydrothermal environment to the ocean. Hydrothermal vents may serve as nanoparticle 'factories' that fertilize the ocean.