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Hydrogen in chondrites: Influence of parent body alteration and atmospheric contamination on primordial components

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Hydrogen occurs at the near percent level in the most hydrated chondrites (CI and CM) attesting to the presence of water in the asteroid-forming regions. Their H abundances and isotopic signatures are powerful proxies for deciphering the distribution of H in the protoplanetary disk and the origin of Earth's water.

In this study, we report H contents and isotopic compositions (D/H) for a large set of carbonaceous and ordinary chondrites after the powdered samples were degassed under vacuum at 120°C for 48 hours to remove adsorbed atmospheric water (1). By comparing our results to literature data without pre-heating (2), we reveal that the H budgets of H-rich (and potentially H-poor) carbonaceous chondrites are largely affected by atmospheric moisture (Fig.1), and that their precise quantification requires a specific pre-degassing procedure to correct for terrestrial contamination. Our results show that indigenous H contents of CI carbonaceous chondrites usually considered the most hydrated meteorites (2) might be almost a factor of two lower than those previously reported with uncontaminated D/H ratios differing significantly from that of Earth's oceans.

After correction for contamination, the amount of H in CI and CM is not correlated with the matrix modal abundance (Fig.1) (3), suggesting that their respective parent bodies accreted variable amounts of water-ice grains. Our results also imply that thermal metamorphism play an important role in determining the H content of CV and ordinary chondrites but without affecting drastically their H isotopic composition since no clear D enrichment is observed with the increase of petrographic type. The absence of an increasing D/H ratio with increasing the metamorphism degree for bulk ordinary chondrites does not support the loss of isotopically light H_2 induced by metal oxidation (4), but is rather linked to the persistence of a thermally resistant D-rich component (5).

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