HYDROGEN ISOTOPIC MEASUREMENTS OF THE TAGISH LAKE METEORITE. S. Messenger, Laboratory for Space Sciences, Physics Department, Washington University, St. Louis MO, 63130; dbunny@howdy.wustl.edu

Introduction Many primitive meteorites and interplanetary dust particles (IDPs) exhibit substantially elevated D/H ratios relative to terrestrial materials [1, 2]. These anomalies likely mark the preservation of molecules which formed in a presolar cold molecular cloud [3]. The D-enrichments vary considerably among individual IDPs and among different classes of meteorites, with the largest values occurring in 'cluster' IDPs, Unequilibrated Ordinary Chondrites, and CR chondrites. These isotopic variations are due to differing degrees of alteration and dilution of the presolar component with solar system materials. Isotopic measurements thus provide a means of comparing the degrees of alteration of the primordial H-bearing components among different solar system materials.

The recently recovered Tagish Lake meteorite is the first representative of a new class of primitive chondrites. Its chemical, mineralogical, and oxygen isotopic compositions are intermediate between CI and CM chondrites [4]. It has been suggested [4] that Tagish Lake is a sample of the precursor materials to CI chondrites, and thus ought to harbor better preserved primordial and presolar materials. We have performed an initial H isotopic survey of this meteorite in order to assess to what extent molecular cloud material has been preserved, and to provide an additional point for comparison with other primitive chondrites.

Experimental 66 dark fragments 5-20 μm in size were selected from 10 mg of crushed matrix material for isotopic analysis. The fragments were individually dry transferred with a tungsten needle and pressed into a gold substrate. Isotopic analyses were performed with the Washington University CAMECA IMS-3f ion microprobe. Hydrogen isotopes were measured at low mass resolving power with a Cs^+ primary ion beam, following previously described techniques [5].

Results As shown in Figure 1, all measured fragments exhibited elevated D/H ratios relative to terrestrial standards. The δD values of the fragments range from +150 to +700 ‰, with most (~70 %) falling between +300 and +600 ‰. Because these are bulk measurements, the true isotopic range is likely to be larger. Here, and in the follwing, we use the term 'bulk' to refer to measurements of chemically untreated samples regardless of sample size.

In Figure 2 these data are compared with bulk D/H measurements of IDPs, CR, LL3, CI1, CM2, and CV3 chondrites. Isotopic measurements of chemical extracts, pyrolysis and combustion of these meteorites have yielded larger ranges of D/H ratios, but these are not considered here for ease of comparison with the present dataset. With the exception of the Bells CM2 chondrite, Tagish Lake exhibits significantly larger bulk D/H than previously measured CM2 and CI meteorites. This suggests that the abundance of presolar matter in Tagish Lake may be somewhat higher than is typically observed in these meteorite classes, though the anomalies are much smaller than those observed in IDPs, CR and LL3 chondrites. It is possible that the bulk D/H of Tagish Lake is higher than that of CM and CI chondrites because the water of hydration is more deuterium rich. The D/H ratios of phyllosilicates are generally low among chondrites (-110 ‰) [7], including CM and CI chondrites, but very high among CRs (+1,050 ‰) and LL3s (+3,800 ‰) [10]. D-enrichments are also common among phyllosilicate-rich IDPs, though the actual D/H of the water of hydration is not yet established [5].

Several lines of future investigation are warranted from these initial studies (1) determining the D/H ratios of phyllosilicates and organic compounds, (2) high spatial resolution ion imaging studies to locate potential very D-rich material, and (3) correlated N isotopic measurements, as an additional means of identifying presolar material.

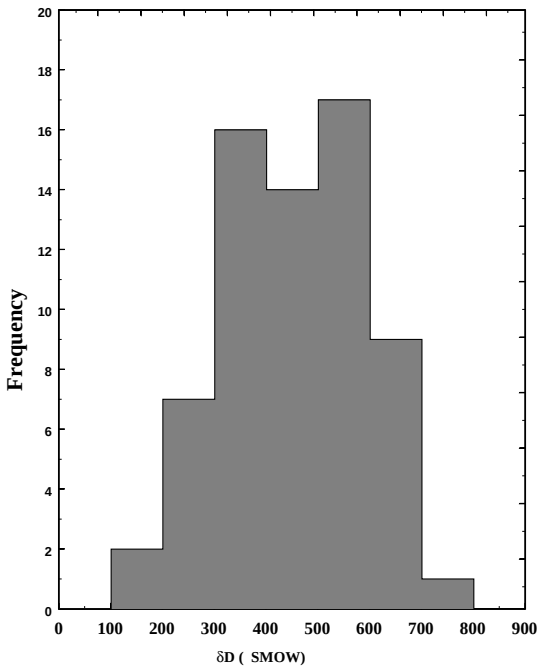

Figure 1: Hydrogen isotopic measurements of Tagish Lake matrix material expressed as delta values, where δD = ([(d/h)measured/(d/h)smow]-1)*1000. SMOW is standard mean ocean water.

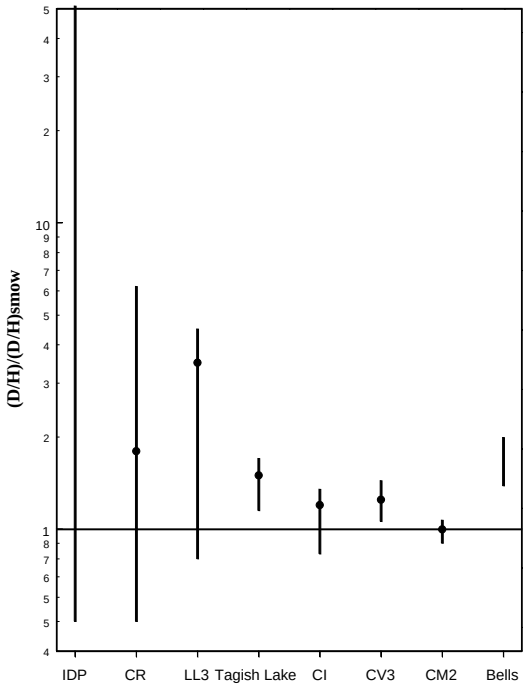

Figure 2: Comparison of bulk D/H measurements of Tagish Lake with IDPs [2], CR [6], LL3 [7], CI1 [8], CV3 [7,9], and CM2 [7, 8] chondrites. Circles represent whole rock average D/H ratios, bars denote range of observed matrix D/H values.

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