ABOUT TAGISH LAKE AS A POTENTIAL PARENT BODY FOR POLAR MICROMETEORITES ; CLUES FROM THEIR HYDROGEN ISOTOPIC COMPOSITIONS. C. Engrand[1], M. Gounelle[1], M. E. Zolensky[2], J. Duprat[1]. [1]CSNSM CNRS-IN2P3, 91405 Orsay Campus, France (engrand@csnsm.in2p3.fr, gounelle@csnsm.in2p3.fr), [2]NASA JSC, Houston TX 77058, USA (michael.e.zolensky1@jsc.nasa.gov).

Introduction: The origin of Antarctic micrometeorites (AMMs) is still a matter of debate. Their closest meteoritic counterparts are the C2 chondrites, but the match is not perfect, and the parent body(ies) of AMMs is(are) still to be identified. Tagish Lake is a new meteorite fall which bears similarity with CI1 and CM2 chondrites, but is distinct from both [1]. Based on the mineralogy of phyllosilicates, Noguchi *et al.* [2] proposed that the phyllosilicate-rich AMMs and the Tagish Lake meteorite could derive from similar asteroids.

The hydrogen isotopic compositions of extra-terrestrial samples can be used to get some insight on their origin. The D/H ratios of AMMs [3] and of Tagish Lake [4, 5] have been measured, but using different analytical techniques. They are therefore not directly comparable. We performed additional hydrogen isotopic analyses of fragments of Tagish Lake using the same experimental setup previously used for the measurement of the hydrogen isotopic composition of AMMs [3]. In this work, we could also analyze separately both lithologies of Tagish Lake (carbonate-poor and –rich).

The distributions of δD values measured in the two lithologies of Tagish Lake are very similar, indicating that fluids with similar hydrogen isotopic compositions altered the meteorite on the parent body for the two lithologies. Yet, the hydrogen isotopic composition of Tagish Lake is different from that of AMMs, suggesting that they do not derive from the same parent body.

Samples and methods: The two principal lithologies of Tagish Lake [carbonate-poor and –rich, see 1] were mounted in polished section for mineralogical characterization and isotopic measurements. The hydrogen isotopic composition of Tagish Lake was measured by ion microprobe (Cameca 3f and 1270) in CRPG, Nancy, following the procedure formerly used to measure the hydrogen isotopic composition of AMMs [3]. A primary O^- beam was focused to a diameter of ~ 15 µm, and the secondary H^+ and D^+ ions were pulse counted on an electron multiplier. The uncertainty on the hydrogen isotopic composition in this case is ~ 40‰. It has been shown [6] that with an O^- primary beam, the emission of hydrogen coming from the hydrated minerals is ~ 500 times higher than that from organic matter. Ion microprobe analyses by Messenger [4] were performed on crushed grains of Tagish Lake in gold foils and by counting H^- and D^- secondary ions extracted with a primary Cs^+ ion beam. The data given by Pearson *et al.* [5] represent whole-rock analyses and are expected to give the average D/H value for the meteorite.

Results and discussion:

The hydrogen isotopic compositions measured in this work in the two lithologies of Tagish Lake are shown in Figure 1. The distributions for the carbonate-poor and –rich lithologies are very similar, with average δD values of 267‰ and 278‰, respectively. Zolensky *et al.* [1] proposed that the carbonate-rich lithology formed after the carbonate-poor one. In this case, both lithologies would be genetically related. The oxygen isotopic composition of the Tagish Lake water cannot help clarifying the sequence of alteration [7] ; our results suggest that the same kind of fluid was used in the successive hydrous alteration episodes of Tagish Lake that produced the two main lithologies.

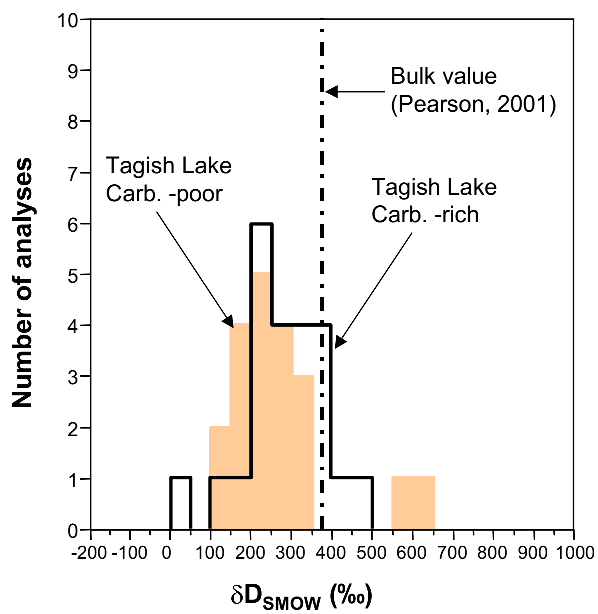

Figure 1: Frequency distribution of the δD values measured for the two lithologies of Tagish Lake (carbonate-poor and carbonate-rich, this work).

Figure 2 illustrates the comparison of our data for Tagish Lake with that of Messenger [4], and of Pearson *et al.* [5]. The average value measured in our samples is $\delta D = 273‰$, whereas the bulk hydrogen isotopic composition of Tagish Lake is $\delta D = (374 \pm 19)‰$ [5], and the average δD value is ~ 450‰ for the data taken by Messenger [4].

The bulk value measured by Pearson *et al.* [5], actually well matches the average of all ion microprobe analyses: $\langle \delta D \rangle \sim 360‰$. This implies that the bulk value well accounts for both the contributions of hydrogen coming from the organic matter and from water. It should be considered as the representative average value for Tagish Lake. Both ion microprobe analysis setups have experimental biases. It was known that the O^- primary beam setting favors the emission of hydrogen from hydrated minerals [6]. The data shown on Fig. 2 suggests that the Cs^+ primary beam setup should enhance the emission of hydrogen from carbonaceous matter over that from hydroxylated minerals, and that a D-rich organic matter must be present in Tagish Lake.

The significant difference observed between the data obtained by the two ion microprobe techniques illustrates the need of comparing hydrogen isotopic compositions measured using the same experimental setup.

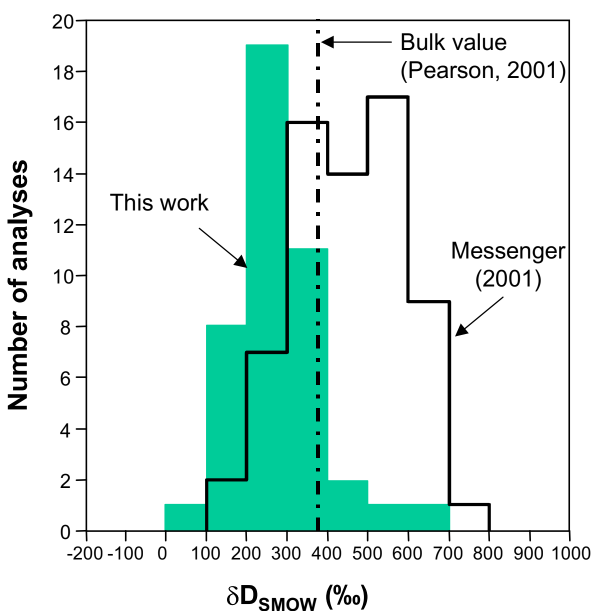

Figure 2: Comparison of the δD values measured by Messenger [4], Pearson *et al.* [5] and in this work. The shift in the distribution measured by Messenger might be due to the presence of D-rich organic matter, which is not taken into account in our analyses, given our experimental setup.

The frequency distribution of D/H ratios measured in Tagish Lake and in Antarctic micrometeorites is presented in Figure 3. These data were taken using the same ion microprobe technique, and are therefore directly comparable. Although they show some overlap, the two distributions have distinct maximum and average values. The average D/H ratio for AMMs is 154.1×10^{-6} ($\delta D = -10‰$) [3], whereas the average measured D/H value for Tagish Lake is 198.3×10^{-6} ($\delta D = 273‰$).

Since there is some overlap in the D/H distributions, and as Noguchi *et al.* [2] only analyzed phyllosilicate-rich AMMs, one could suggest that the water-rich AMMs could be related to Tagish Lake. In this case, one might expect that the AMMs showing high D/H ratios (in the Tagish Lake range) should exhibit higher water content than the other AMMs. This is not the case, we do not see any correlation between the D/H ratios and the water content of the AMMs [3].

Therefore, it is difficult to consider Tagish Lake as a valid candidate for the micrometeorite's parent body.

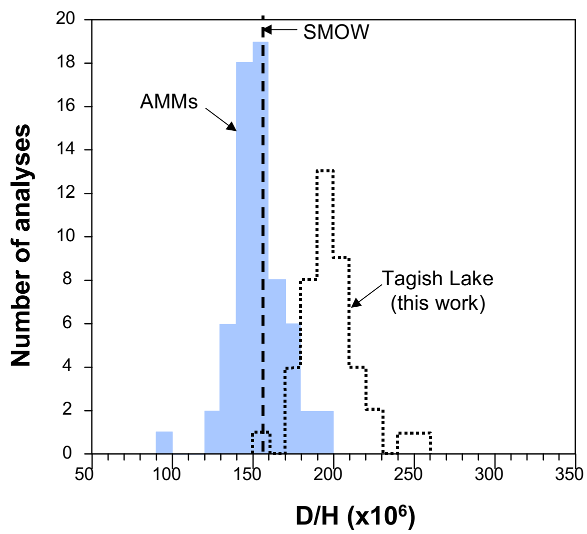

Figure 3: Frequency distribution of D/H ratios measured in Antarctic micrometeorites (AMMs) [3] and in the two lithologies of Tagish Lake (carbonate-poor and –rich, this work).

References:

[1] Zolensky M.E., *et al.* (2002) *MAPS* **37**, 737-761 ; [2] Noguchi T., *et al.* (2002) *EPSL* **202**, 229-246 ; [3] Engrand C., *et al.* (1999) *MAPS* **34**, 773-787 ; [4] Messenger S. (2001) *LPSC* **XXXII**, #1916 (CD-ROM) ; [5] Pearson V.K., *et al.* (2001) *LPSC* **XXXII**, #1861 (CD-ROM) ; [6] Deloule E. and Robert F. (1995) *GCA* **59**, 4695-4706 ; [7] Baker L., *et al.* (2002) *MAPS* **37**, 977-985.