TOWARDS SYSTEMATIC STUDY OF THE TAGISH LAKE METEORITE. R.K. Herd[1] and C.D.K. Herd[2], [1]Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8: herd@nrcan.gc.ca , [2]Department of Earth and Atmospheric Sciences, 1-26 Earth Sciences Building, University of Alberta, Edmonton AB T6G 2E3: herd@ualberta.ca .

Introduction: The most important, pristine, samples of the unique Tagish Lake carbonaceous chondrite have been acquired by a consortium of university, (provincial) museum and (federal) government institutions in Canada, after negotiations that lasted six years. The opportunity now exists to conduct careful, systematic and collaborative research on material that has hardly been investigated to now.

History: After the fall of the Tagish Lake meteorite on January 18, 2000, fragments were recovered from the surface of Tagish Lake, northern B.C., Canada, on January 25 and 26. A subsequent heavy snowfall precluded further searching until the end of April, when 5-10 kilograms of altered samples were recovered from the lake ice [1]. Minor amounts of the meteorite were also recovered from the shoreline after the winter. The initially-recovered, pristine material was kept frozen in order to preserve it in a relatively uncontaminated state. About half of it was sent on loan to NASA's Johnson Space Center (JSC) where it remained until repatriated, still frozen, in 2006. The other half was kept frozen by the finder in Canada. All the pristine material was documented in 2000, for evaluation purposes, and its sample history tracked as much as practicable. After its acquisition, it has been placed in secure deep-freeze conditions pending development of long-term curatorial and analytical plans.

Preliminary Analyses: Preliminary destructive analytical work was carried out on not more than 3 fragments, and not more than 12 grams of the pristine material (totalling 48 fragments and 859 grams) between 2000 and 2006 by various researchers. One sample was completely disaggregated for analyses, while two others had small fragments removed for sectioning, and destructive or non-destructive analysis. While kept frozen, some of the pristine samples underwent gamma-ray analysis, and some yielded porosity measurements[2]. Various fragments and prepared samples remain from this preliminary work, in laboratories worldwide, apart from the rest of the pristine samples now in Canada. In addition there has been significant research on gram quantities of non-pristine Tagish Lake meteorites, bearing in mind their degraded nature. Minor amounts of this non-pristine material have been exported legally and are available from dealers; these have also provided research material and results. It is often unclear in research reports, what is the provenance of the samples being studied. To date over 120 abstracts and papers exist relevant to the Tagish Lake meteorite in the scientific literature. Search engines yield tens of thousands of hits for "Tagish Lake Meteorite" on the internet.

Putting Preliminary Analyses in Context: Regardless of the publicity and research interest, relatively little is known about the meteorite because so few of the pristine samples have been studied systematically. The matrix context of many preliminary analytical results may not be recoverable as they were carried out randomly on small portions of a few samples. An example from some recent detailed isotopic work serves to define the challenges for future studies. Preliminary textural observations [3] emphasized sample inhomogeneities, obvious also from casual inspection of the exterior of individual samples. Preliminary analyses have identified both refractory mineral grains formed at high temperatures [4], and delicate organic compounds formed at very low temperatures [5], both considered to have formed very early in the history of our solar system, or to be pre-solar. The refractory grains were found by destructive techniques (pyrolysis) that destroyed any matrix context – they could be anywhere in the material analyzed. The organic compounds were identified in carbonate-poor lithologies at the nanoscale. The textural observations that exist, from a few sections, suggest that there are multiple lithologies within even the smallest Tagish Lake samples – brecciated fragments within brecciated fragments [3]. In addition there are chondrule-like objects composed of olivine and pyroxene etc. that are armored against more oxidized and sulphidized matrices. Magnesian olivine in these "chondrules" contains native Fe/Ni, and inclusions of other high-temperature silicates and oxides [3]. Putting these textural observations together with the preliminary isotopic work on organic compounds, plus the evidence from pyrolysis of a rich content of early or pre-solar grains, means that a range of high to low temperature (preserved inorganic and organic) grains probably exists within the meteorite. Not all have been identified with their matrices, and future work should seek to identify them and where they reside in the meteorite samples.

The refractory grains would have survived subsequent heating events that the low temperature compounds would not; therefore some or all of the Tagish Lake materials may not have been significantly heated since the organic compounds were incorporated. It is therefore also possible that there are other primitive components, such as silicate dust and even ice grains, present when the organic compounds formed, and incorporated with them, still waiting to be identified within pristine Tagish Lake samples.

Summary and Conclusions: Many questions about the nature of this meteorite have yet to be formulated, pending systematic examination that has yet to occur. One possible result, if hints from unsystematic preliminary examination are confirmed, is that the Tagish Lake meteorite will yield abundant information on the oldest components to be found in meteorites, and therefore on the provenance and nature of pre-solar materials.

References:[1] Brown P.G. et al. (2000) *Science, 290,* 320-325. [2] Hildebrand A.R. et al. (2006) *Meteoritics & Planet. Sci., 41,* 407-431. [3] Herd R.K. et al. (2001) *LPS XXXII,* Abstract #1928. [4] Grady M.M. et al. (2000) *Meteoritics & Planet. Sci., 35,* A62-A63. [5] Nakamura-Messenger K. et al. (2006) *Science, 314,* 1439-1442.