THE NATURAL REMANENT MAGNETIZATION AND MAGNETIC MINERALS OF TAGISH LAKE (CI2).

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Introduction: Tagish Lake (CI2) is the most primitive among any known meteorites [1], [2]. Magnetite and pyrrhotite are very abundant, but pentlandite is minor. The hysteresis (Js-H) and low temperature magnetic studies [3] yielded magnetite of mostly multi-domain. We studied natural remanent magnetization (NRM) of Tagish Laka and its carrier minerals based on the basic magnetic properties and microscopic observations.

NRM: Four samples with an orientation were obtained from the interior. Their NRMs were AF demagnetized to 100 mT, and were relatively stable up to 30mT. The directions made a cluster when they were demagnetized to 25 mT. A piece of sample was demagnetized thermally from room temperature to 630˚C in the vacuum to 10^{-3}Pa. The intensity decayed gradually up to 530˚C and then it increased, while the direction was not drastically changed to 630˚C.

Thermomagnetic (Js-T) and Js-H curves: Js-T curve of was obtained under the steady magnetic field 1.0 T. The sample showed irreversible curve with clearly defined Curie point at 610˚C and minor ones at 340˚ and 510˚C in the heating curve and 610˚C in the cooling curve. Although the Curie point at 610˚C is much higher than that of magnetite, it may overprint to magnetite and the other minerals with high Curie point (taenite or awaruite). Temperature dependence of coercive force (Hc) was stepwise decreased at 130˚, 330˚ and 580˚C, suggesting more complicate magnetic mineral assemblage as pyrrhotite, pentlandite and magnetite.

Microscopic observation: Iron sulfide grains and aggregate of fine-grained sulfide were confirmed around chondrule and clast, but larger magnetite were not recognized. In the state of NRM, no obvious clusters of magnetotactic bacteria appeared, while small and weak clusters were confirmed on some sulfide grains and some area on the matrix. When the sample was artificially magnetized, the strong clusters appeared on phyllosilicate around rims of clasts and chondrules.

Discussion: The magnetic mineral has been reported as magnetite of mostly multi-domain with Hc=25-28 mT in Tagish Lake [3], inferring unstable NRM. However, our data indicated the relatively stable NRM up to 25 mT of the AF demagnetization and up to 630˚C of the thermal demagnetization. The Hc values are large enough in comparison with paleomagnetic samples of the terrestrial rocks. From the viewpoints, the NRM of Tagish Lake seems to be significant. The magnetic minerals may consist of magnetite, pyrrhotite, pentlandite etc. to the contrary of the estimation by [3]. Distribution of these minerals on phyllosilicate suggests that the magnetic minerals were formed by hydrothermal alterations in the parent body. We concluded that the magnetic field existed in the Taghish Lake parent body during the hydrothermal alteration.

References: [1] Hiroi et al. (2001), Science 293, 2234-2235. [2] Zolensky et al. (2002), Meteorite & Planetary Science 37, 737-761. [3] Thorpe, et al. (2002), Meteorite & Planetary Science 37, 763-771