THE TAGISH LAKE METEORITE AS A POSSIBLE SAMPLE FROM A T OR D TYPE ASTEROID.

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Introduction: Since the Tagish Lake meteorite fell in January 2000, the one of the kind meteorite has become the hottest issue among meteoriticists as well as astrobiologists. Meanwhile, concerning the physical origin of the meteorite in our solar system, only Hiroi *et al.* [1] reported that it likely came from a D asteroid based on comparison of their visible-near-infrared (Vis-NIR) reflectance spectra. However, because asteroid classification is usually performed based on a limited range of wavelength, the asteroid classes and surface compositions may not necessarily have one-to-one correspondence. Also, Hiroi *et al.* [1] precluded the T-type asteroids simply because their average albedo is much higher than the visible reflectance of Tagish Lake although their spectral matches with Tagish Lake were good, and the 3-µm band spectra compiled in [1] were not enough to compare the degree of hydration or kinds of hydrous minerals between primitive asteroids and Tagish Lake. In this paper, we employ more spectral datasets up to the 3-µm range to address the possible connection between two particular asteroids, 773 Irmintraud and 308 Polyxo, and the Tagish Lake meteorite.

Experimental: Asteroid 773 Irmintraud is classified as D type [2, 3] and asteroid 308 Polyxo as T type by Tholen [4] and D type by Barucci [5]. Reflectance spectra [6-9] and the IRAS albedo data [10] of these two asteroids are compiled here. The 3-µm spectral data [11] for some G, B, and C asteroids are employed for comparison. We also performed J, H, K, and L band spectral observations of 773 Irmintraud using the IRCS spectrometer at Subaru Telescope in Mauna Kea, Hawaii [12]. The Tagish Lake meteorite sample (powder of <125 µm) whose reflectance spectra were originally measured by [1] has been remeasured with higher quality in the Vis-NIR range (0.3-2.6 µm) and under a new off-axis setting in the IR range (2.5-25 µm). In order to investigate the phase angle dependency, reflectance of the Tagish Lake sample at 0.55 µm in wavelength has been measured also at 14, 11, and 7° incidence angles and 0° emergence angle, relative to Spectralon as an assumed Lambertian surface.

Spectral Shape: Shown in Fig. 1 are comparisons of reflectance spectra of the Tagish Lake sample and asteroids 773 Irmintraud and 308 Polyxo. Both asteroids have reasonably similar Vis-NIR reflectance spectra to the Tagish Lake sample, confirming the results of [1]. However, their 3-µm band shapes have possibly significant differences from that of the Tagish

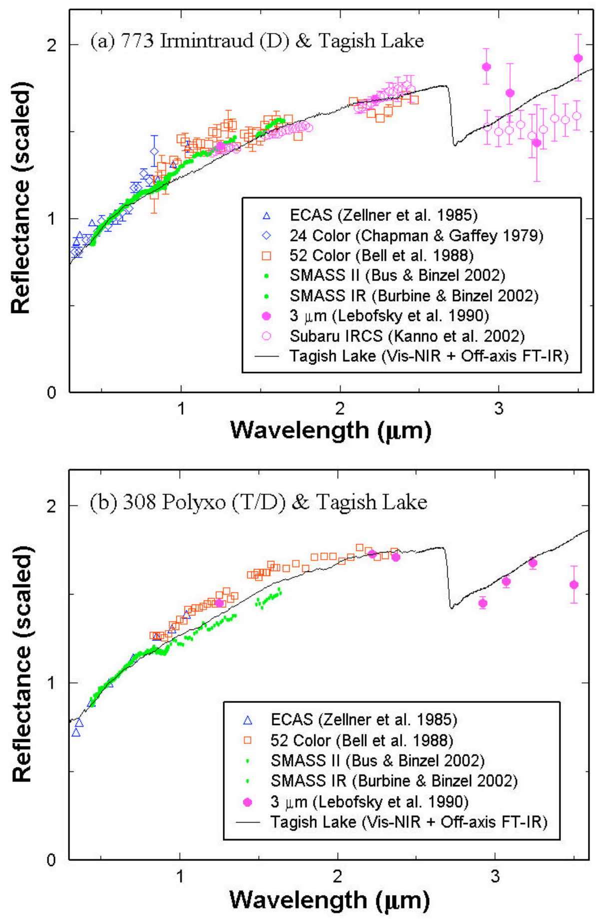

Fig. 1. Comparison of reflectance spectra of asteroids (a) 773 Irmintraud [4, 5, 6, 7, 8, 9, 12] and (b) 308 Polyxo [4, 6, 7, 8, 9] with a Tagish Lake meteorite sample.

Lake meteorite. In Fig. 1 (a) our new 3-µm data [12] greatly improved the prior data [9] and confirmed that 773 Irmintraud indeed has hydrated materials as in the Tagish Lake meteorite. However, the 3-µm band shape is significantly different between them. On the other hand, as seen in Fig. 1 (b) the 3-µm spectrum of 308 Polyxo seems similar to that of Tagish Lake except for one data point at 3.5 µm.

The reflectance value at 3.5 µm would depend highly on the thermal model assumed for 308 Polyxo [9] which determines the amount of thermal emission subtracted from the raw reflectance data. This kind of sudden drop in reflectance at 3.5 µm has not been known to occur in any carbonaceous chondrite. Thus, we reasonably assume the data point has much more uncertainty that is plotted as an errror bar in Fig. 1 (b).

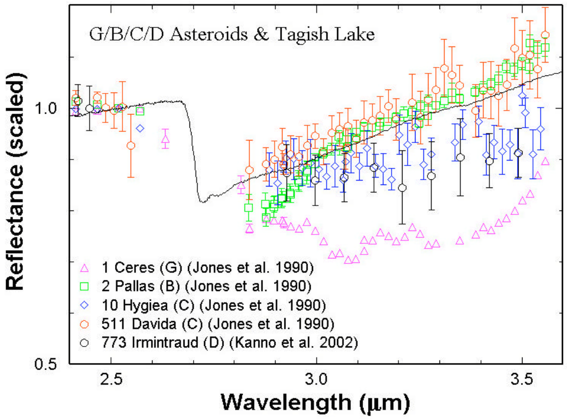

Fig. 2. Comparison of the 3-µm hydration band between several G, B, C, and D asteroids [11] and Tagish Lake.

Shown in Fig. 2 are relatively high-quality 3-µm band spectra of several asteroids in comparison with that of the Tagish Lake meteorite sample. Among the G, B, C, and D type asteroids plotted in Fig. 2, a C asteroid 511 Davida has the most similar 3-µm band to that of Tagish Lake. This suggests 511 Davida has similar hydrous minerals in its surface regolith to those in the Tagish Lake meteorite. On the other hand, 773 Irmintraud shows a different 3-µm spectrum from that of Tagish Lake while it has a similar Vis-NIR spectrum to Tagish Lake, suggesting its surface regolith may have a different degree of hydration and/or thermal metamorphism from the Tagish Lake meteorite.

Brightness: One last significant difference between the Tagish Lake meteorite and 773 Irmintraud or 308 Polyxo is brightness. Although the reflectance spectrum of our Tagish Lake powder sample has reflectance of about 2 % at 0.55 µm, the IRAS albedos [10] of 773 Irmintraud and 308 Polyxo are 4.4±0.2 % and 4.8±0.3 %, respectively. The results of measuring the reflectances of the Tagish Lake sample at various phase angles are plotted in Fig. 3 together with the IRAS albedo of these asteroids. The minimum phase angle possible by the instrument was 7°, and many potential problems such as polarization and opposition effect are expected to occur at small phase angles.

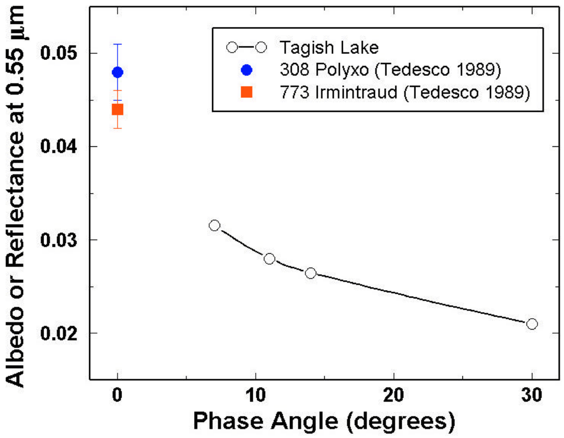

Fig. 3. Effect of phase angle on brightness which is measured by either albedo [10] for asteroids or reflectance at 0.55 µm for the Tagish Lake meteorite sample here.

Summary: A T/D-type asteroid 308 Polyxo possibly has a surface regolith which is very similar to the Tagish Lake meteorite powder. It is probable that the Tagish Lake meteorite came from such a T/D-type asteroid. Asteroid 511 Davida may have similar hydrous minerals to the Tagish Lake meteorite.

Acknowledgment: Reflectance spectra of the meteorite sample were measured at RELAB, a multi-user facility operated under NASA grant NAG5-3871.

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