What's in the Jupiter Trojan Asteroids? Analyses, observations, and explorations for evolution of materials in space

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The Jupiter Trojan asteroids are a group of asteroids located on the Lagrangian points (L4, L5) in Jupiter's orbit. Their spectral types are mainly D/P type with some C-type [1], and thus they are considered to be primitive and richer in volatile components than the main belt asteroids. Therefore, the Jupiter Trojans are expected to be intermediate objects between the primitive main belt asteroids (e.g., C-type) and the comets, and thus they are the key to seamless understanding of the material evolution of small bodies beyond the snowline, particularly for organic matter and ices. In addition, the origin of the Jupiter Trojans has been proposed to the same origin as outer solar system objects disturbed by the giant planet migrations [2]. Thus, the Jupiter Trojans would also provide the aspects of planetary formations.

However, the materials in the Jupiter Trojan asteroids are not well known. Many meteorites are derived from the main belt asteroid, but the D/P type materials are very limited, and the Tagish Lake meteorite is the only meteorite attributed to the D-type asteroids [3]. We have been searching for primitive objects trapped in meteorites as "xenolithic clasts". The dark clast in the Zag meteorite is rich in organic matter, and phyllosilicates which are produced from aqueous alteration [4]. Organic and isotopic analyses of the clast indicated the relationship to the Tagish Lake meteorite, although various shape and molecular structures of organic matter in the clasts indicated complex and various origins of the materials in the clast parent body [5, 6].

On the other hands, aqueous alteration in the D/P type asteroids (or Jupiter Trojans) are not empirically known. Water ice is also less common (<10%) on the surface of the Trojan asteroids [7]. However, VNIR spectra of the Trojan surface suggested abundant organic materials [e.g. 8]. These spectral characteristics are limited for relatively larger Trojan asteroids. Thus, more comprehensive observations are needed to understand the materials in the Trojan asteroids. SPICA allows us high-sensitive IR observations for 12-230 μm region which includes features of water ice, carbonates, PAHs, graphite, olivine, pyroxene, and amorphous silicates. SPICA observations as well as other Trojan explorations –Lucy and OKEANOS –would provide new insights into the Solar System history as well as other planetary systems.

[1] DeMeo F. E. and Carry B. (2014) *Nature*, **505**, 629-634.
[2] Morbidelli A. et al. (2005) *Nature*, **435**, 462-465.
[3] Hiroi T. et al. (2001) *Science*, **293**, 2234-2236.
[4] Zolensky M. E. et al. (2017) *Philosophical Transactions of the Royal Society A*, **375**.
[5] Kebukawa Y. et al. (2019) *Scientific reports*, **9**, 3169.
[6] Kebukawa Y. et al. (2020) *Geochimica et Cosmochimica Acta*, **271**, 61-77.
[7] Yang B. and Jewitt D. (2007) *The Astronomical Journal*, **134**, 223-228.
[8] Emery J. P. et al. (2006) *Icarus*, **182**, 496-512.

