

## Compositional analysis of (52246) Donaldjohanson from the *Lucy* flyby

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The NASA *Lucy* mission was designed to provide the first reconnaissance of Jupiter Trojan asteroids. These primitive bodies hold important clues to the origin and evolution of the Solar System. The *Lucy* spacecraft is currently en route to its encounters with Trojan asteroids in the L<sub>4</sub> swarm in 2027 and 2028, and the L<sub>5</sub> swarm in 2033 [1]. On its way through the Main Belt, *Lucy* flew past the asteroid (52246) Donaldjohanson on April 20, 2025. The main purpose of the flyby was to support mission preparation for the primary science targets, the Trojan asteroids. The Linear Etalon Imaging Spectral Array (LEISA) mapping spectrometer [2,3], part of the L'Ralph instrument, collected multiple spectral datasets during the encounter with Donaldjohanson. LEISA covers the spectral range 0.97 – 3.95  $\mu\text{m}$  with a variable spectral resolving power ranging from  $\sim 50$  to 160 ( $\Delta\lambda < 10$  nm).

Several primitive asteroid families have been identified in the inner Main Belt. These families are of interest for their potential to deliver primitive material into near-Earth space, and potentially even sourcing the carbonaceous meteorites that fall to Earth. Donaldjohanson is a member of one of these families, the Erigone collisional family. The collisional disruption of the Erigone family occurred  $\sim 155$  Myr ago [4]. Ground-based observations have revealed that the Erigone family consists of primitive C-complex asteroids, the majority of which show evidence for a 0.7- $\mu\text{m}$  absorption due to Fe-bearing phyllosilicates [5] and spectral slopes that are neutral to slightly red [6]. The only ground-based near-infrared data published of Donaldjohanson itself [7] are too noisy for a reliable interpretation. We will report on the *Lucy* near-infrared spectral observations of Donaldjohanson, with a focus on a search for absorption features due to materials seen in ground-based spectra of Erigone family members and found in analog carbonaceous meteorites, including hydrated silicates and organic molecules. The spatially resolved LEISA data also enable assessment of any potential spectral heterogeneity on Donaldjohanson.

### Acknowledgements

The *Lucy* mission is funded through the NASA Discovery program on contract No. NNM16AA08C.

## References

- [1] Levison, H.F., et al. 2021. Lucy Mission to the Trojan Asteroids: Science Goals. *Planet. Sci. J.* 2:171 (13pp)
- [2] Reuter, D.C., et al. 2023. L’Ralph: A Visible/Infrared Spectral Imager for the Lucy Mission to the Trojans. *Space Sci. Rev.* 219:69.
- [3] Simon, A.A., et al. 2025. Lucy L’Ralph In-flight Calibration and Results at (152830) Dinkinesh. *Planet. Sci. J.* 6:7 (11pp).
- [4] Marchi, S., et al. 2025. A Pre-flyby View on the Origin of Asteroid Donaldjohanson, a Target of the NASA Lucy Mission. *Planet. Sci. J.* 6:59 (19pp).
- [5] Morate, D., et al. 2016. Compositional study of asteroids in the Erigone collisional family using visible spectroscopy at the 10.4m GTC. *Astron. Astrophys.* 585, A129.
- [6] Harvison, B., et al. 2024. PRIMASS near-infrared study of the Erigone collisional family. *Icarus* 412, 115973.
- [7] Sharkey, B.N.L., et al. 2019. Compositional Constraints for Lucy Mission Trojan Asteroids via Near-infrared Spectroscopy. *Astron. J.* 158:204 (13pp).