

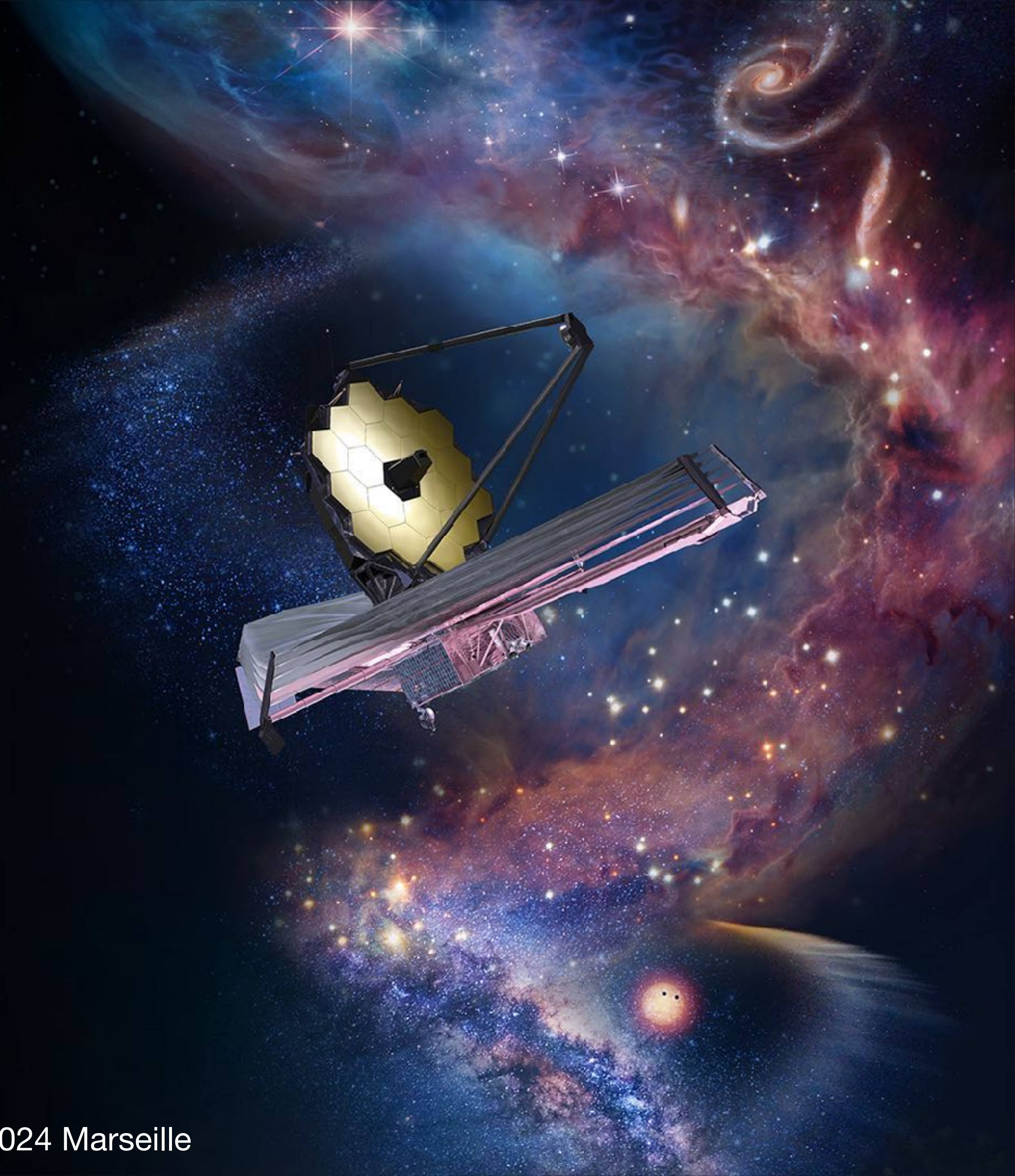
Ce que JWST nous révèle des objets transneptuniens

Aurélie Guilbert-Lepoutre

Elsa Hénault, Rosario Brunetto, Silvia Protopapa
John Stansberry, Bryan Holler, Ian Wong, Noemi Pinilla-Alonso,
Mario De Prá, Ana Carolina De Souza, Javier Licandro
Josh Emery, Will Grundy, Jason Cook

The Discovering Compositions of TNOs (DiSCo) Team
(large program 2418)

The JWST GTO Collaboration on TNOs
programs 1191 (J. Stansberry), 1231 (A. Guilbert-Lepoutre),
1254 (A. Parker), 1272 (D. Hines), 1273 (J. Lunine)



Structure of the Trans-Neptunian Solar System

2 key processes to form the solar system

- orbital migration
- dynamical instability

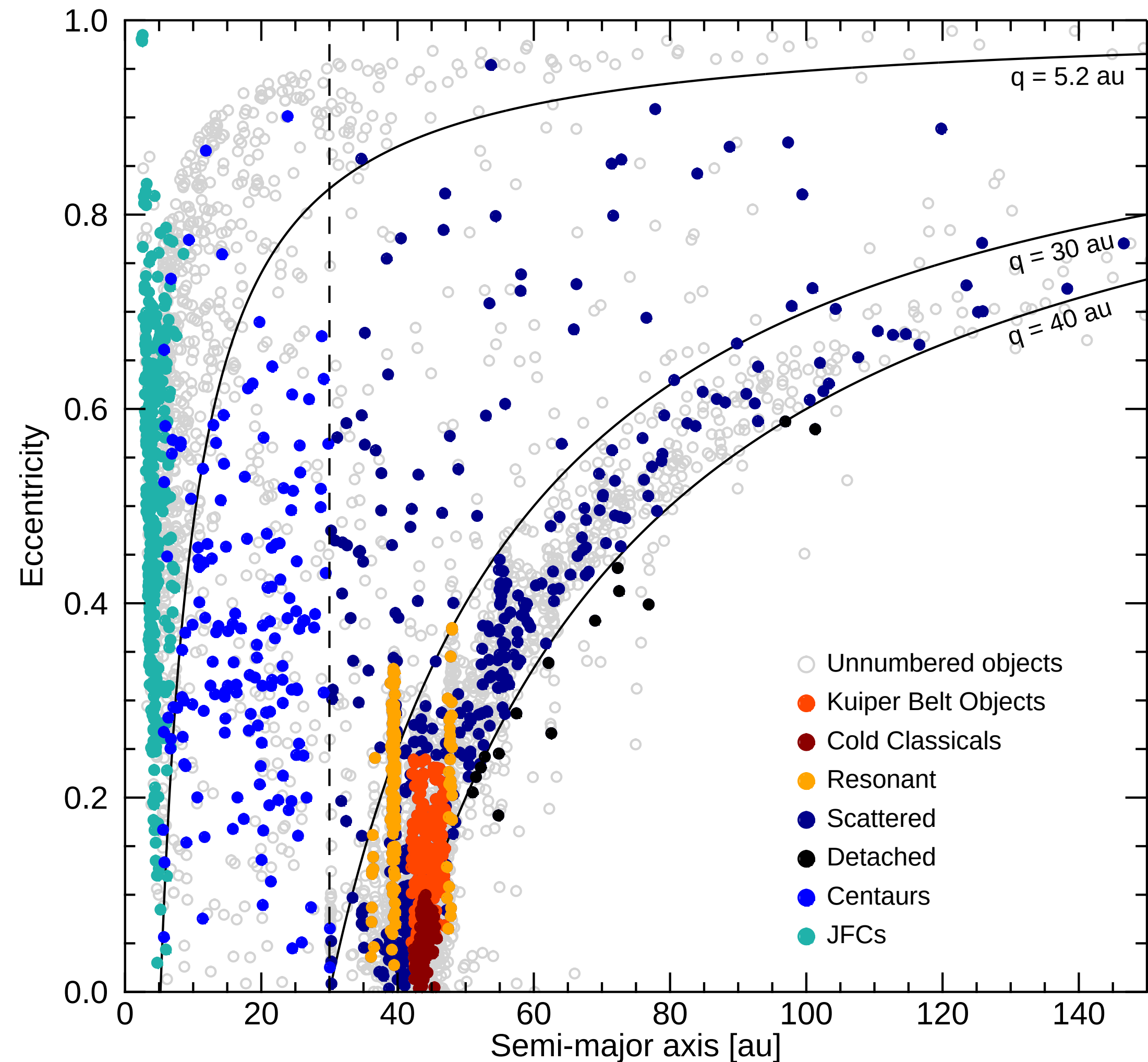
Many constraints

- orbits of the giant planets
- Asteroid belt
- Trojan populations (Jupiter and Neptune)
- Kuiper belt and scattered disk

Inventory of volatiles, organics...

Ices = preserved (?)

clues to the T,P conditions + chemistry in disk
link between ISM, disks and planetary systems



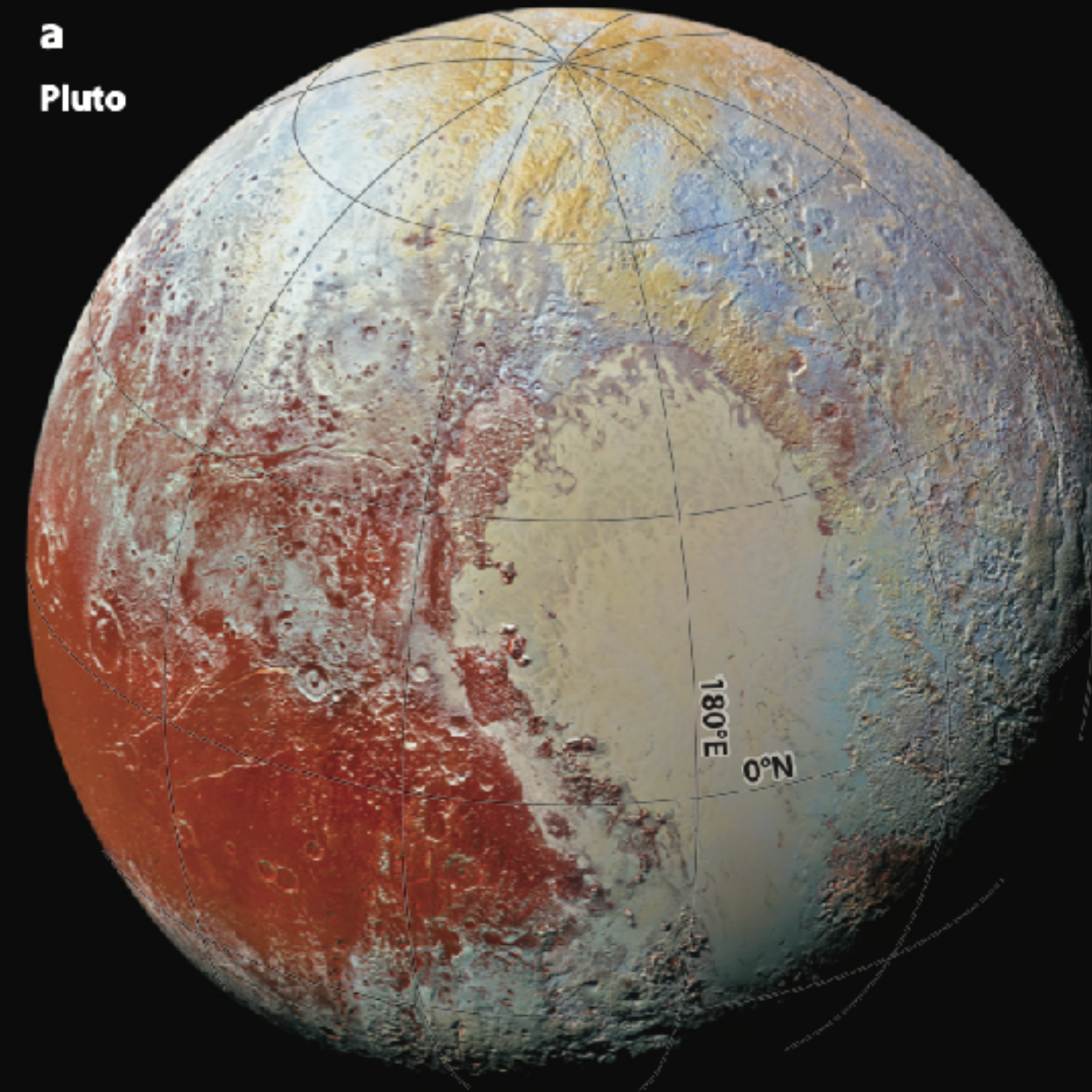
Dwarf planets and largest TNOs



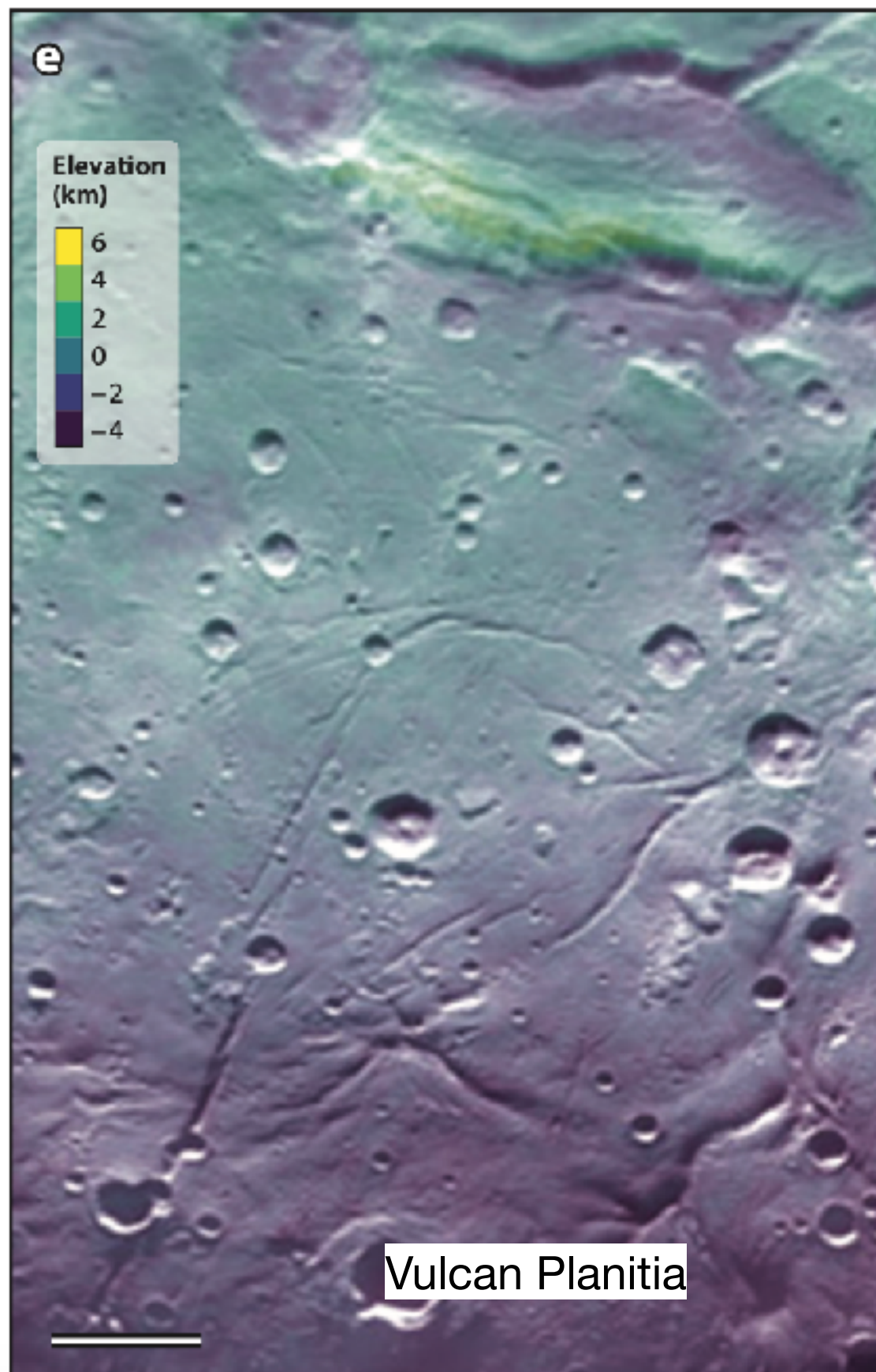
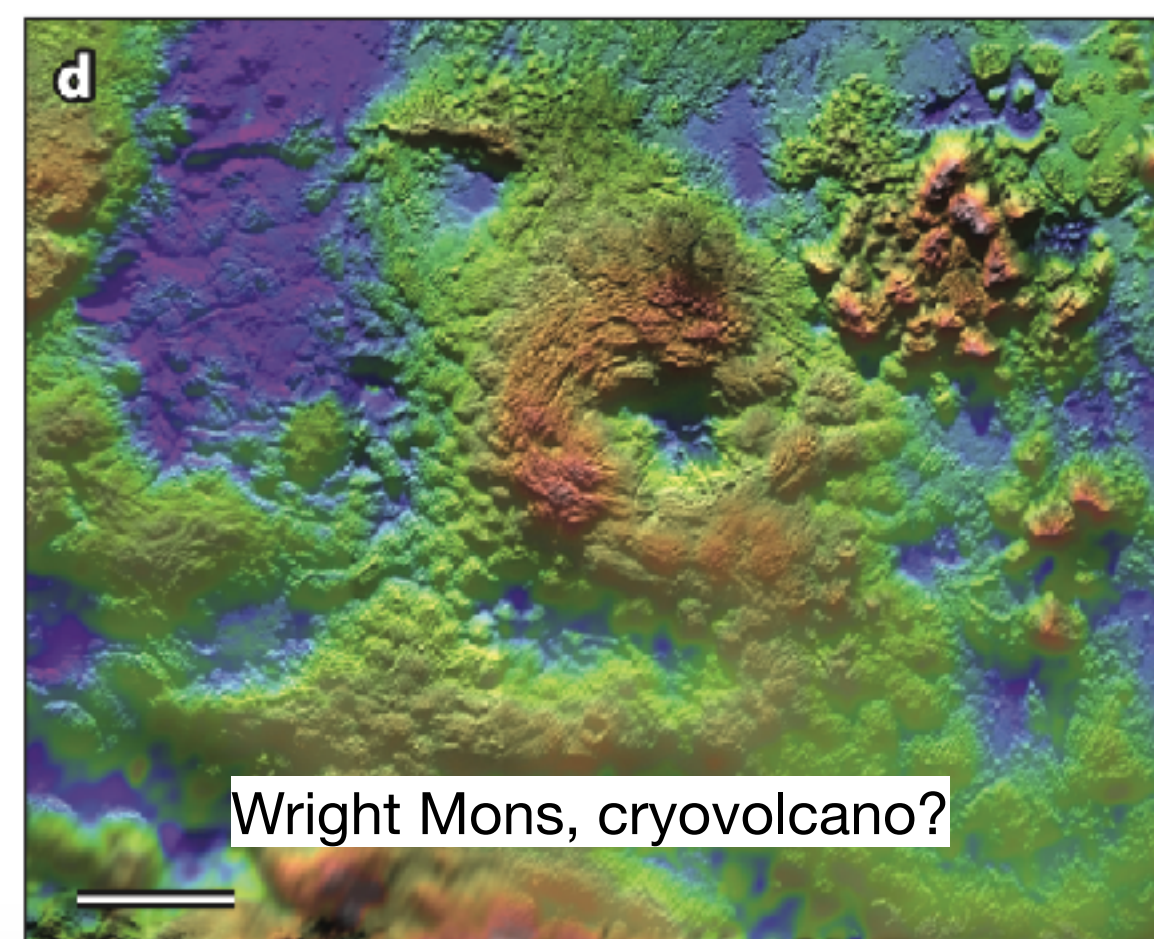
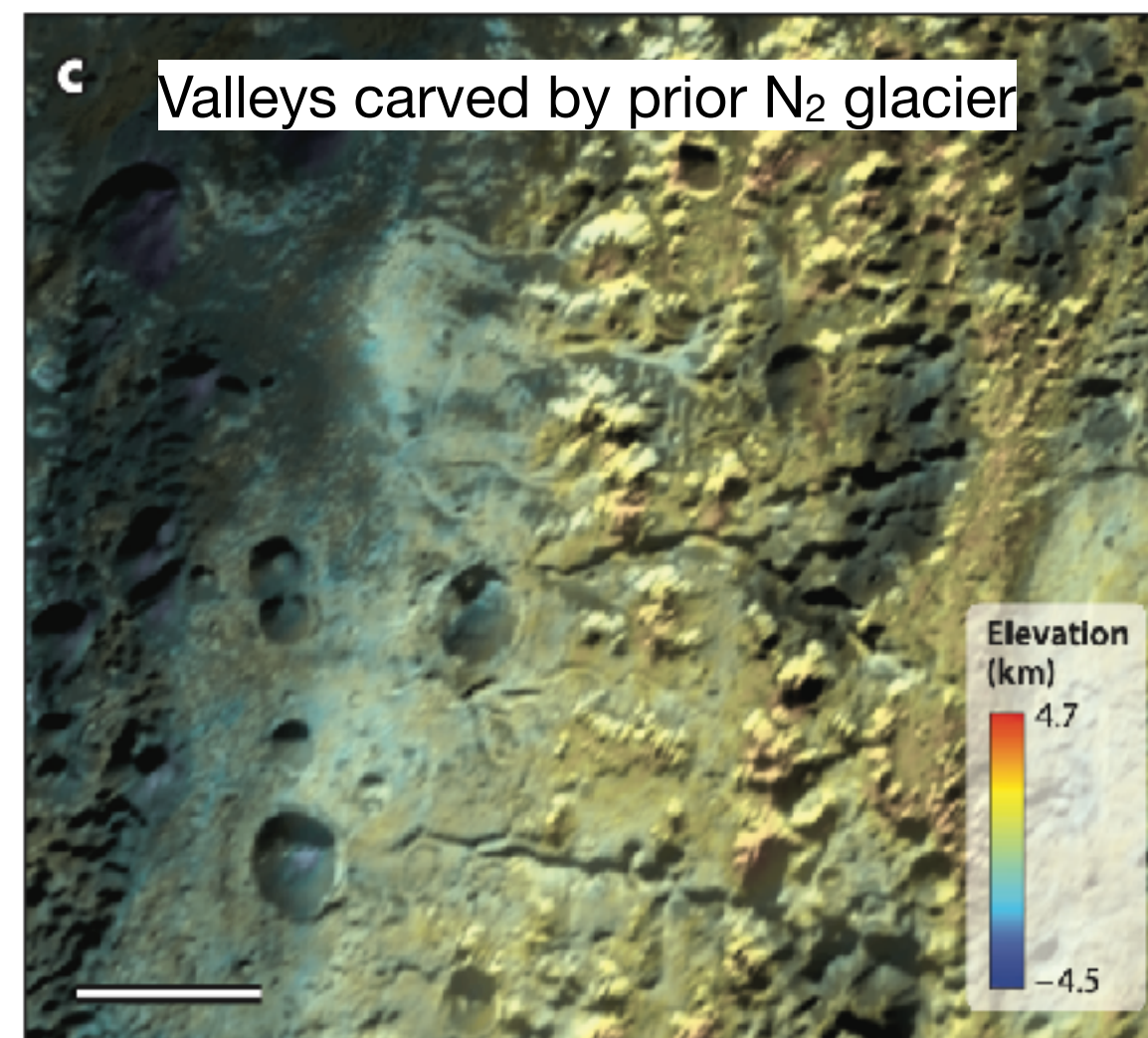
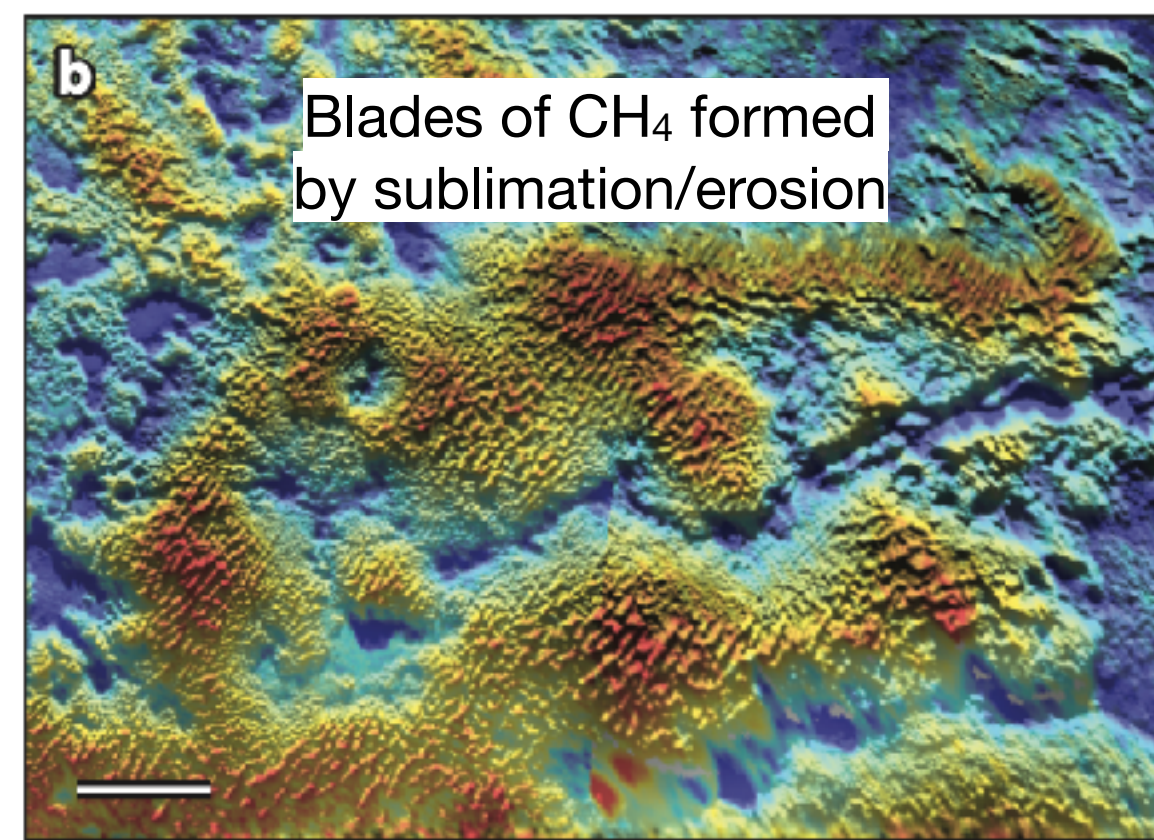
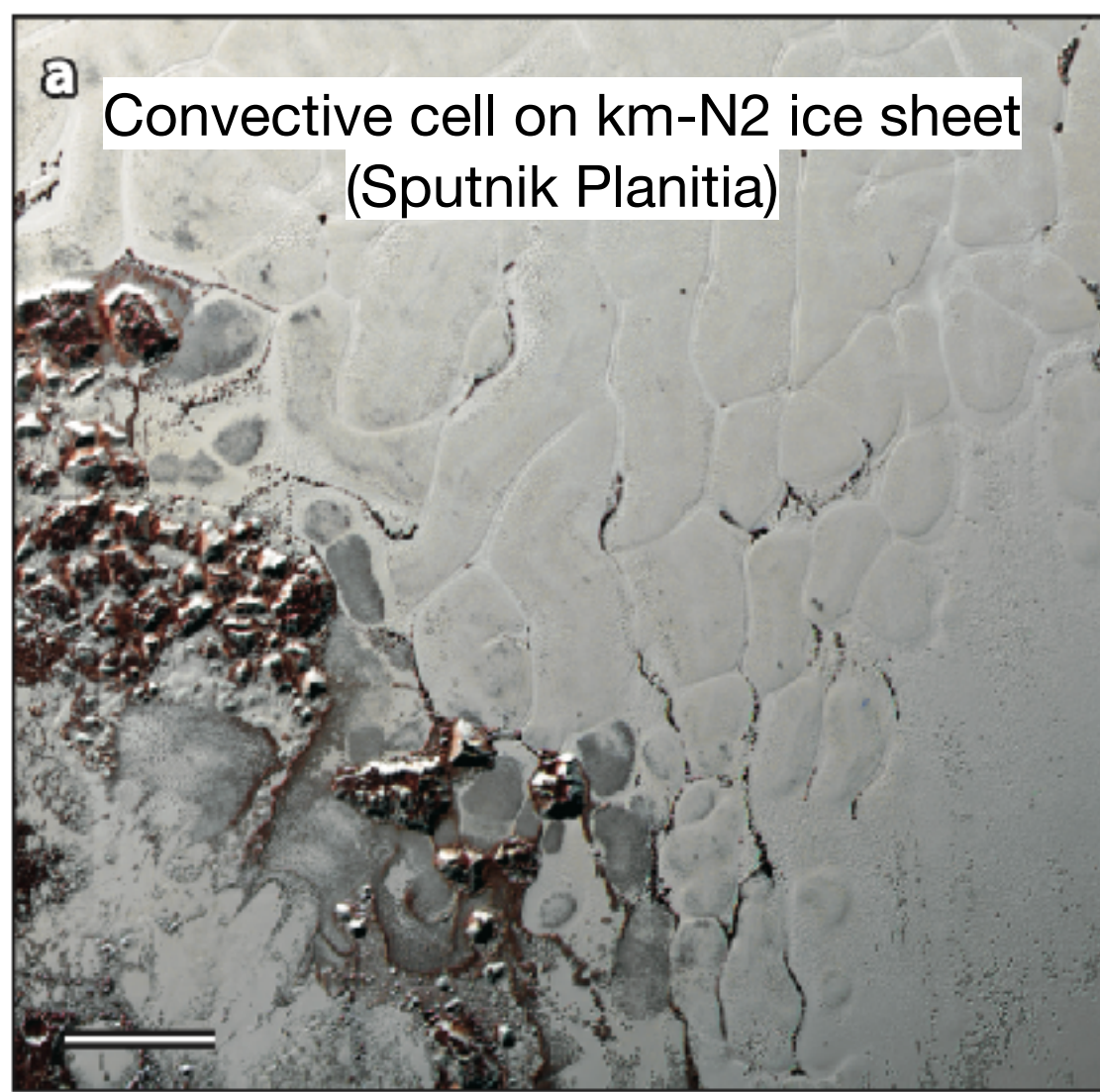
Pluto — Charon



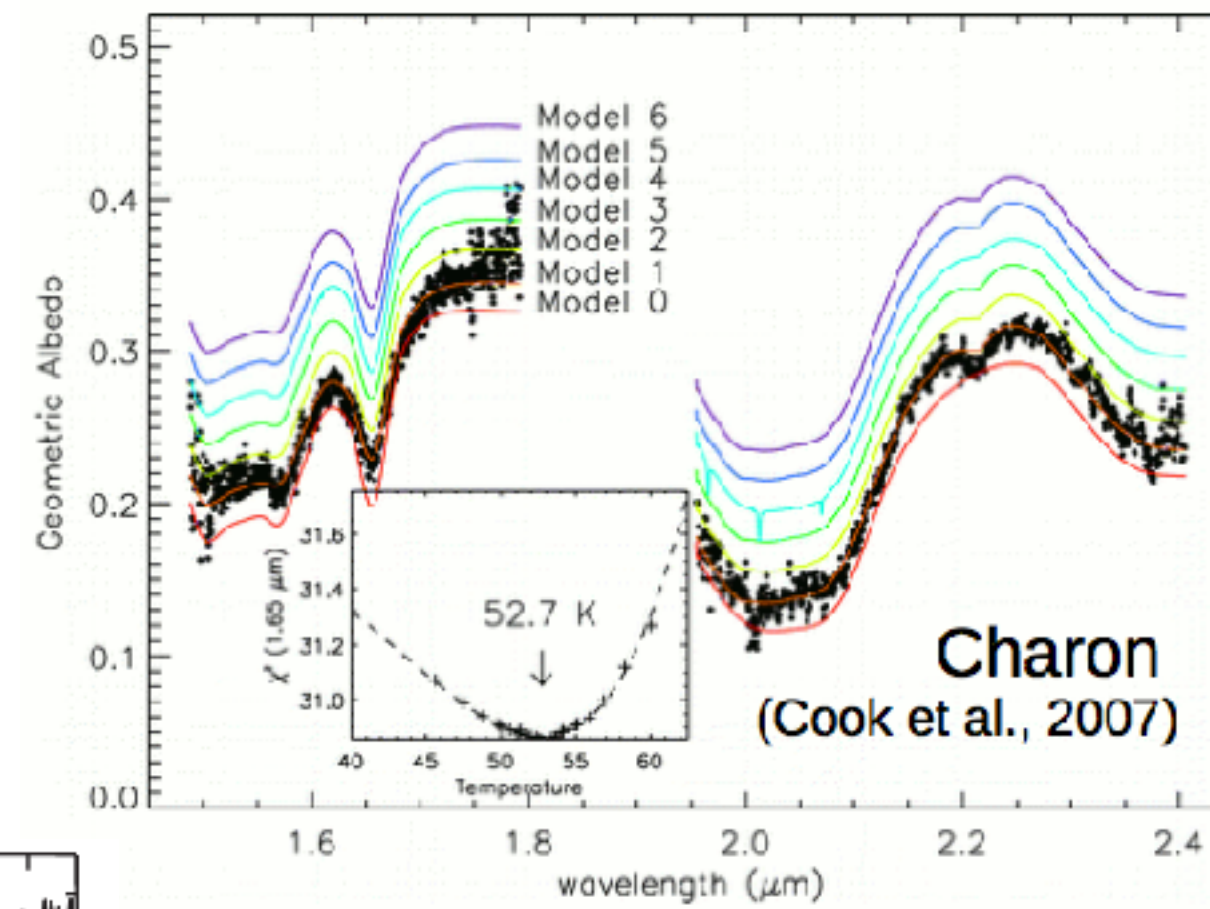
a
Pluto



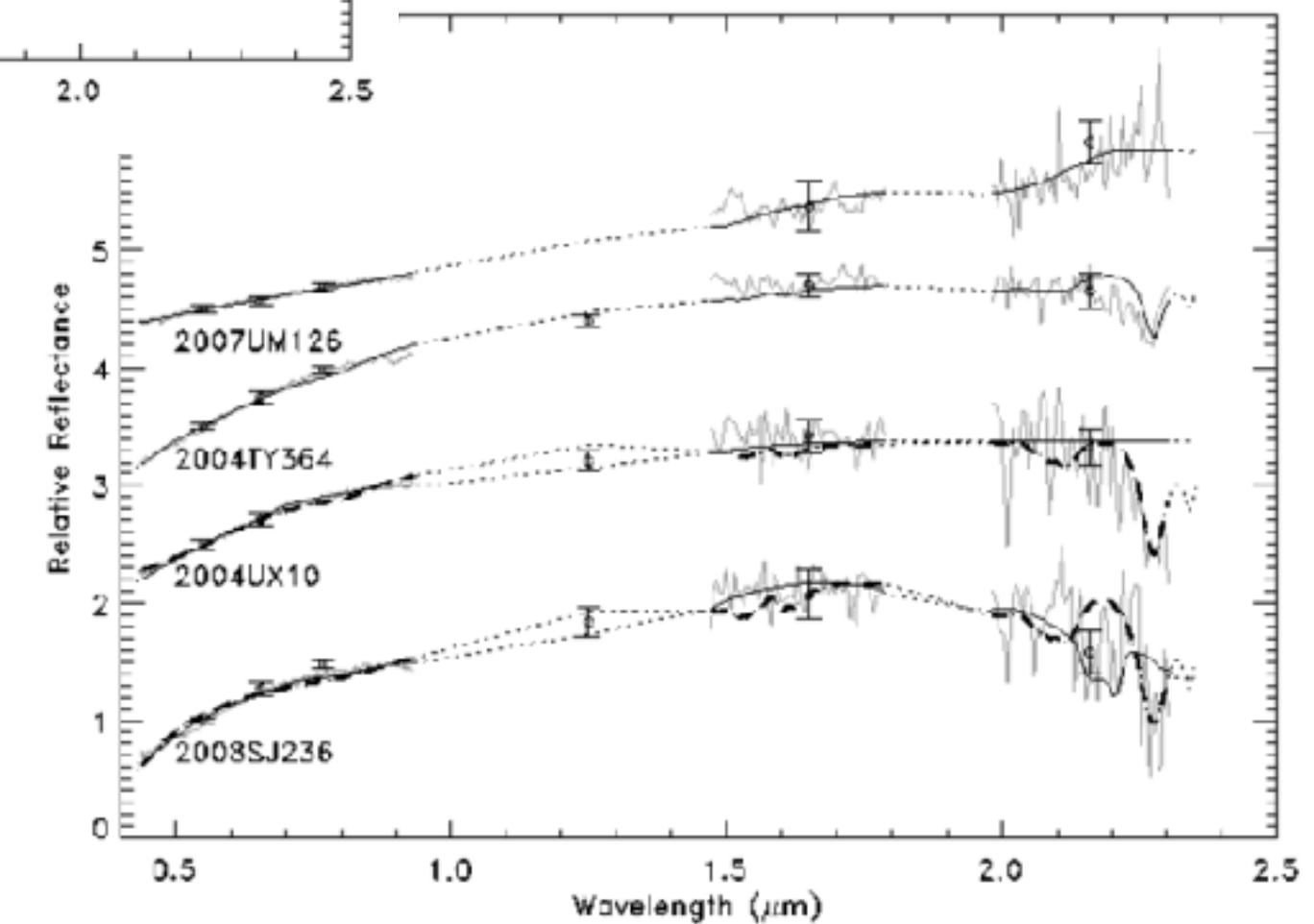
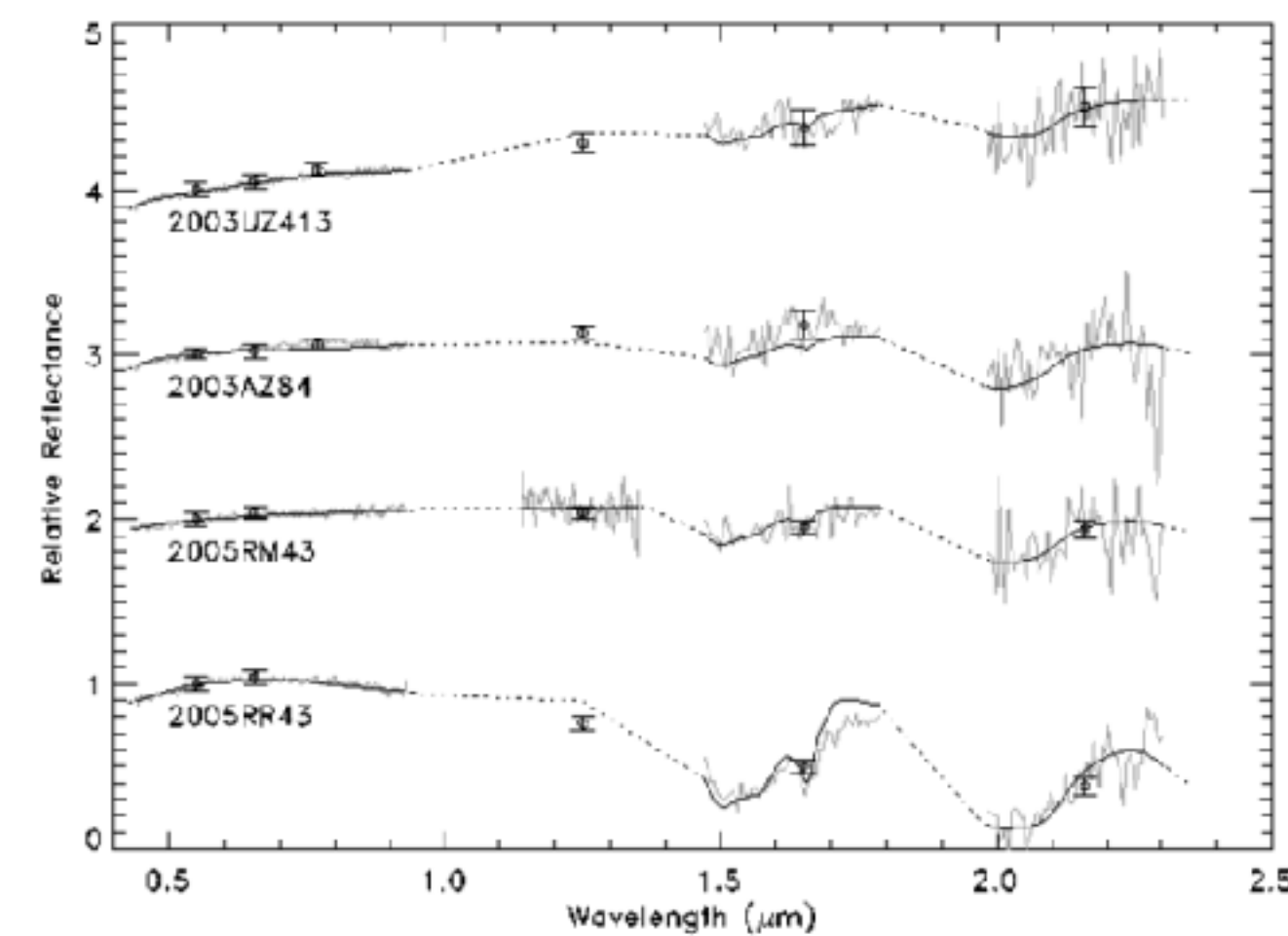
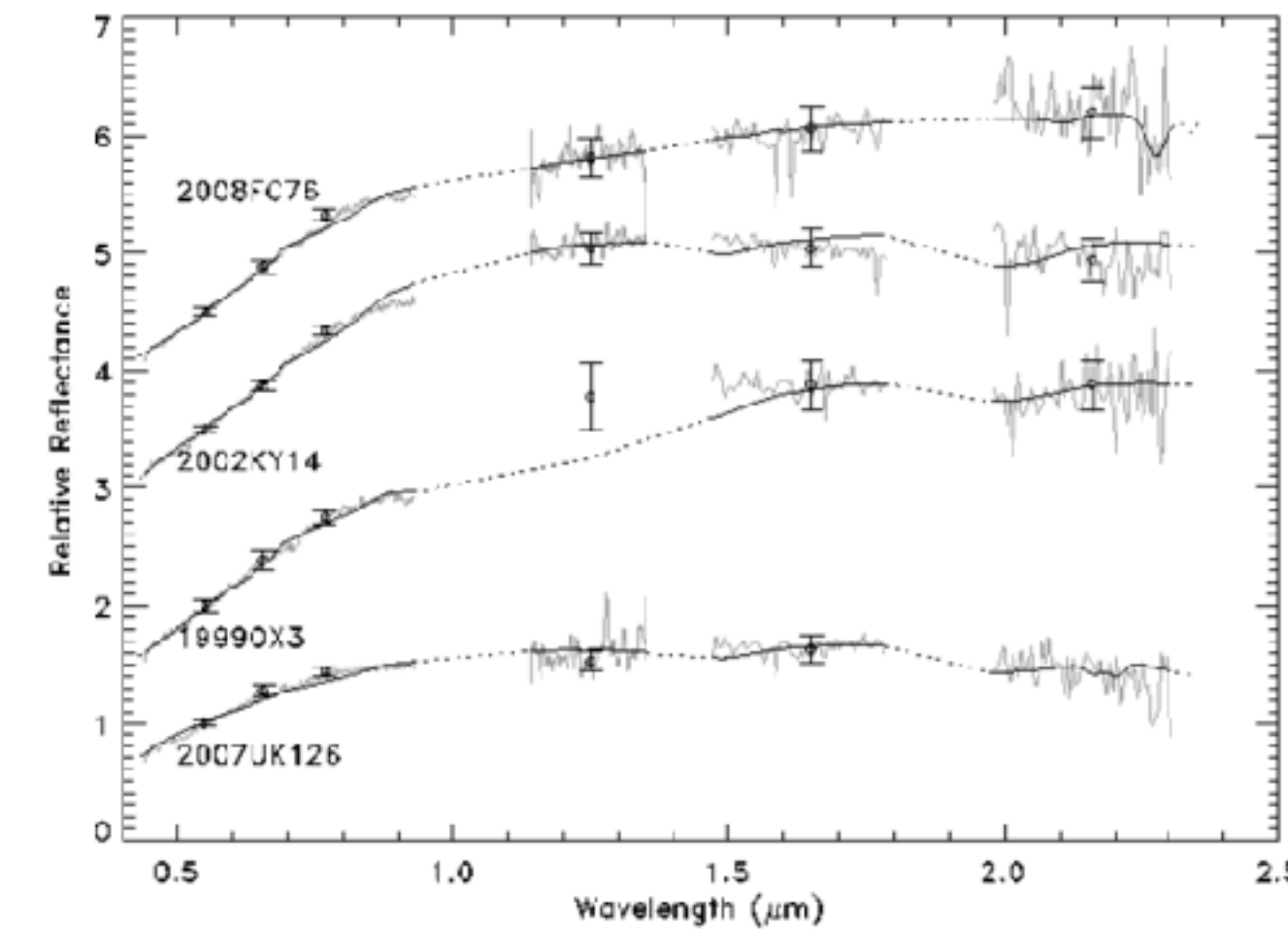
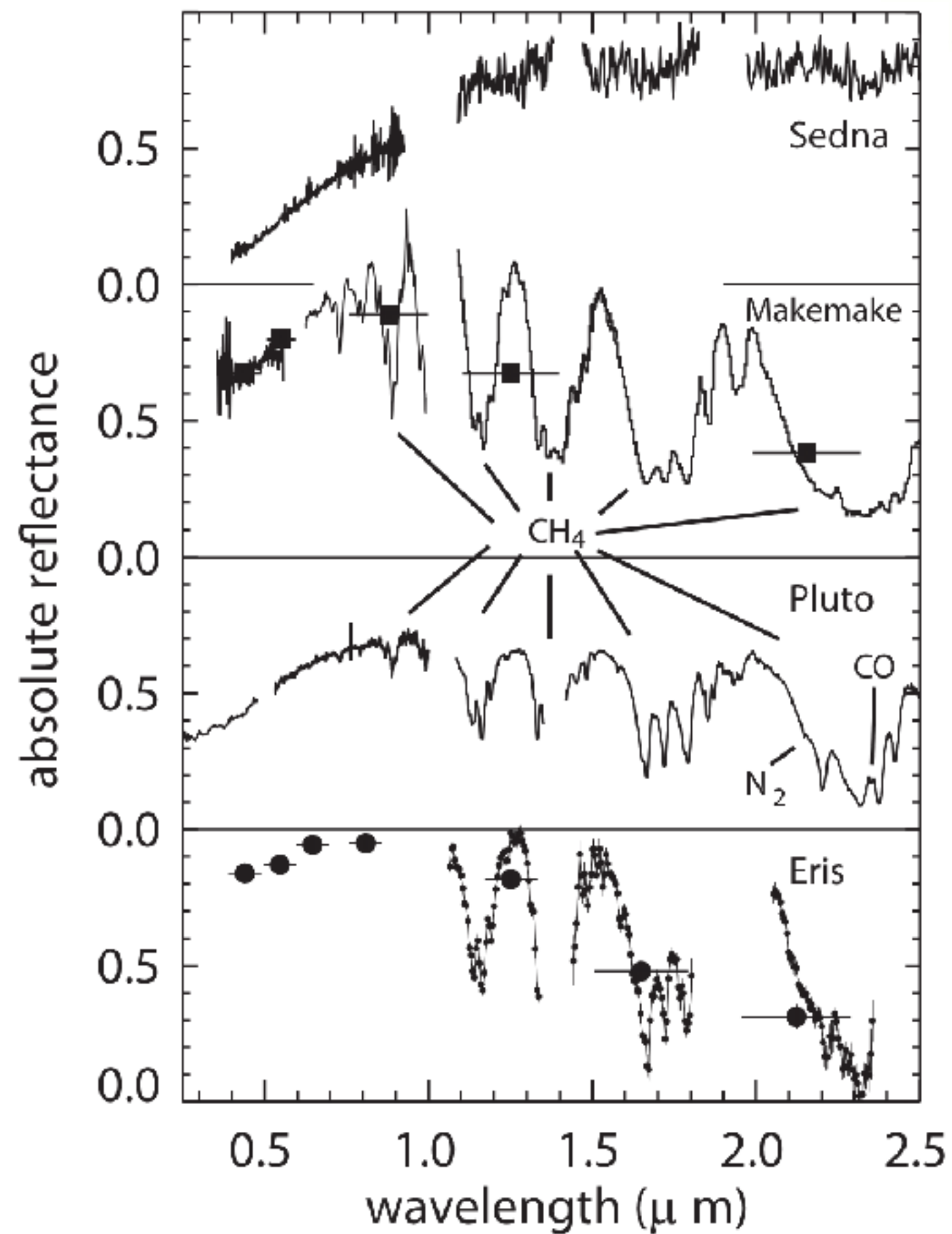
b
Charon



TNO spectroscopy before JWST

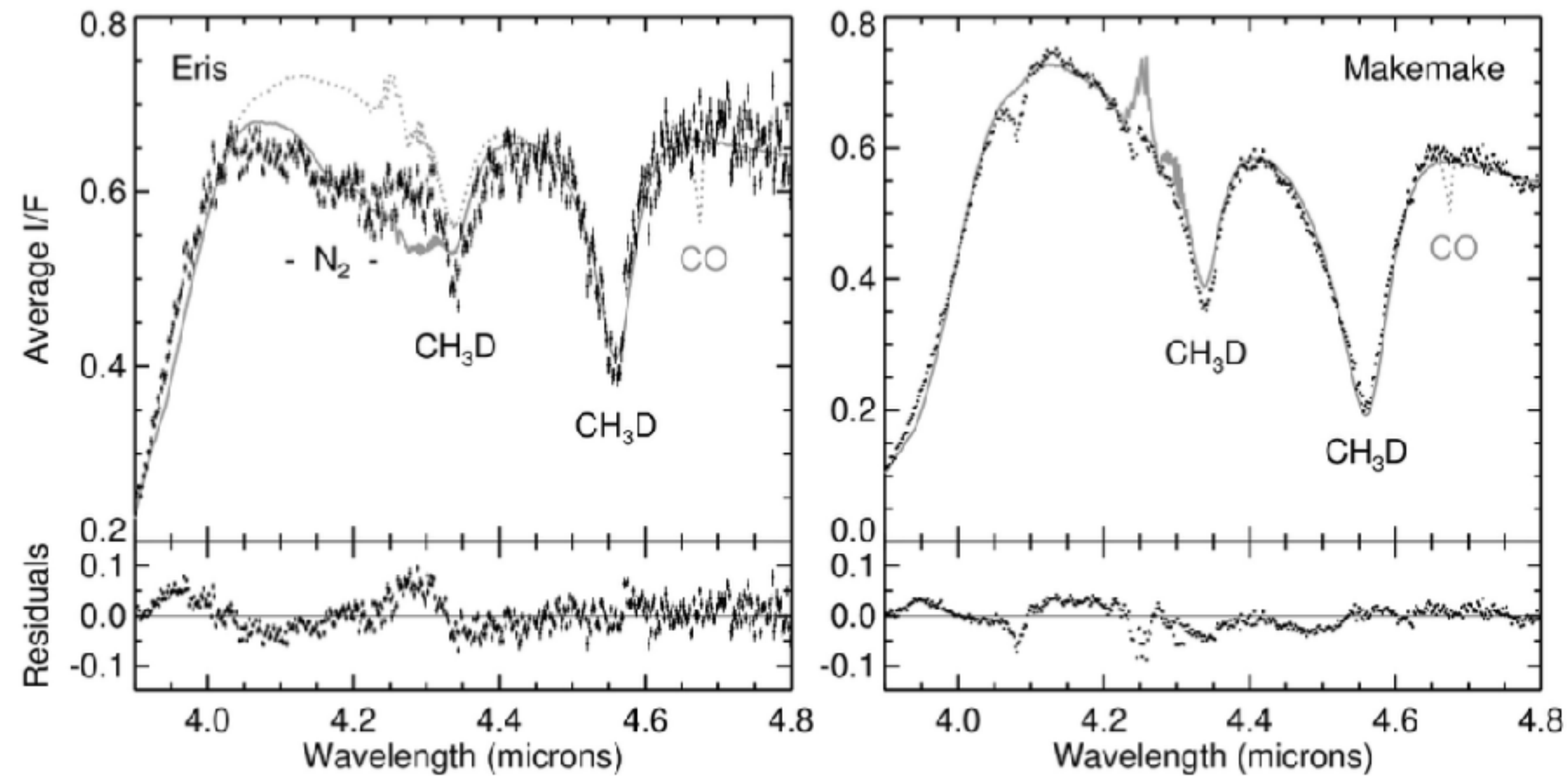


Brown 2011



Barucci et al. 2011

Eris & Makemake



— Grundy et al. 2024, Glein et al. 2024

D/H in methane suggest geochemical processing
 Similar to methane produced by geochemical process in
 Pluto *McKinnon et al. 2021* or Titan *Glein et al. 2015*

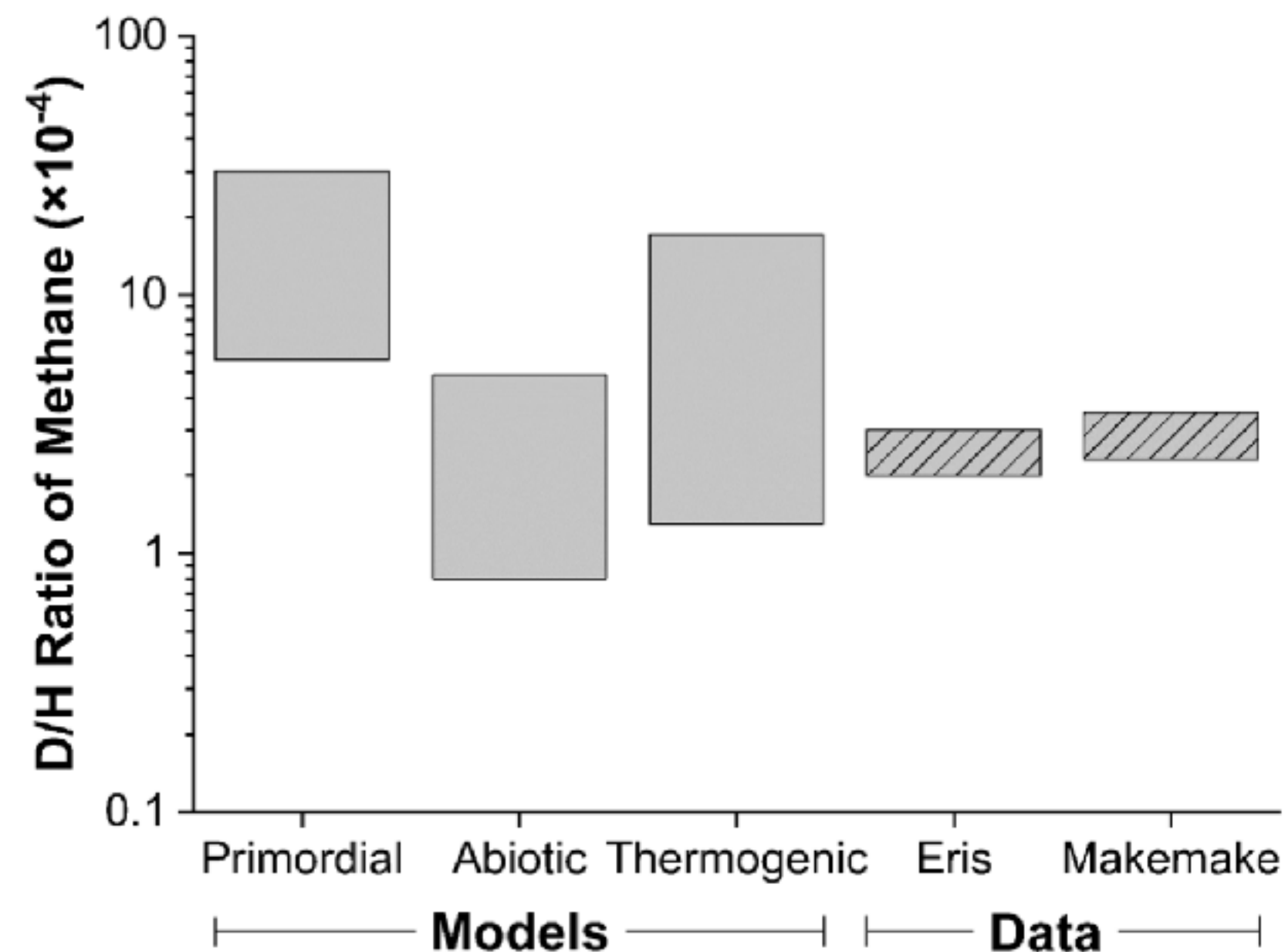
abiotic = water-rock reaction, with CO or CO₂ as source of
 carbon *Glein et al. 2008, Waite et al. 2017*

thermogenic = decomposition of organics caused by heating
 or source mineral, here phyllosilicates *Zandanel et al. 2022*

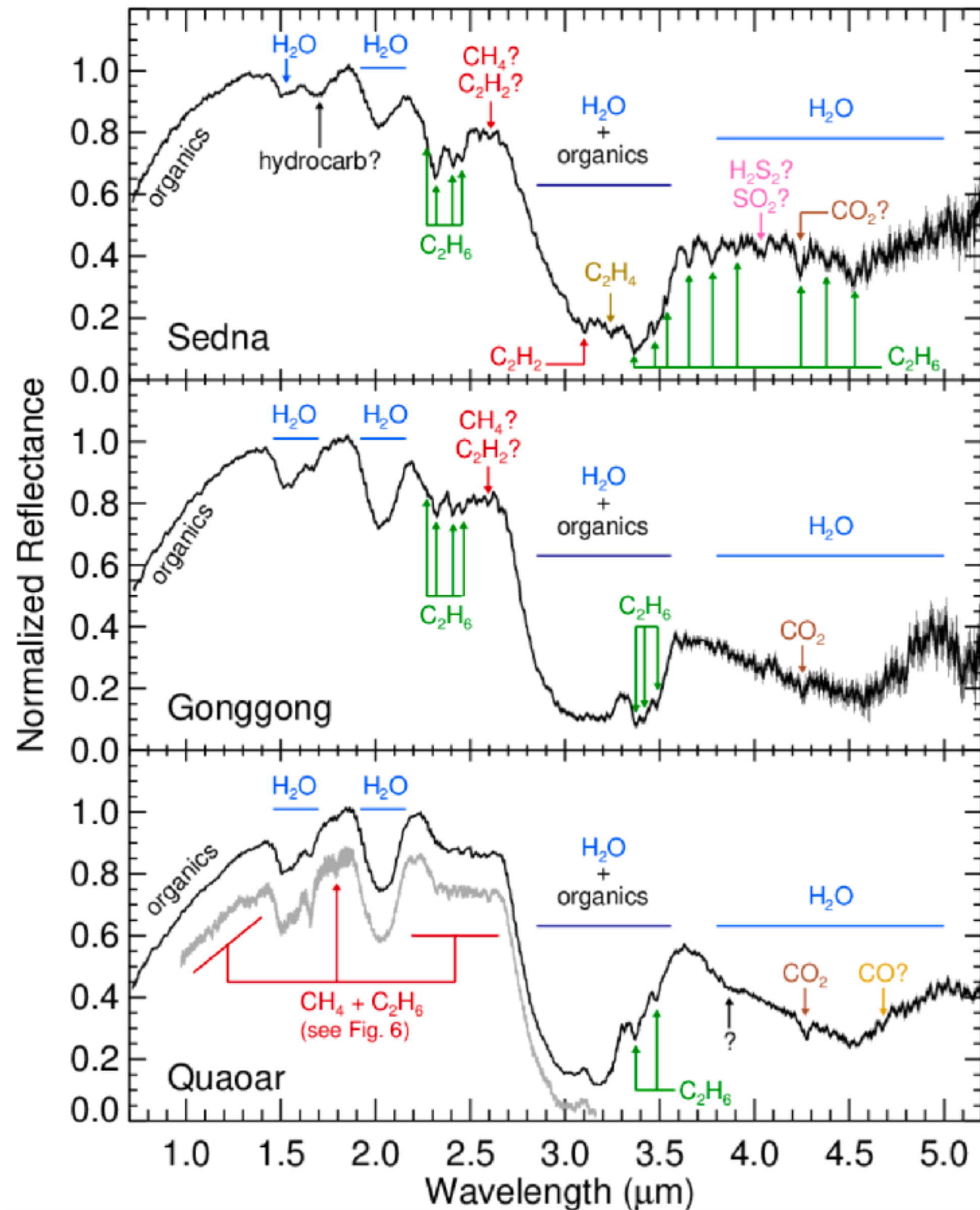
→ both require $T > \sim 420$ K

Yet no thermal evolution model dedicated to those objects...

→ Project OSSO BUCO (PI Reynard)



Gonggong, Quaoar & Sedna



— Emery et al. 2024

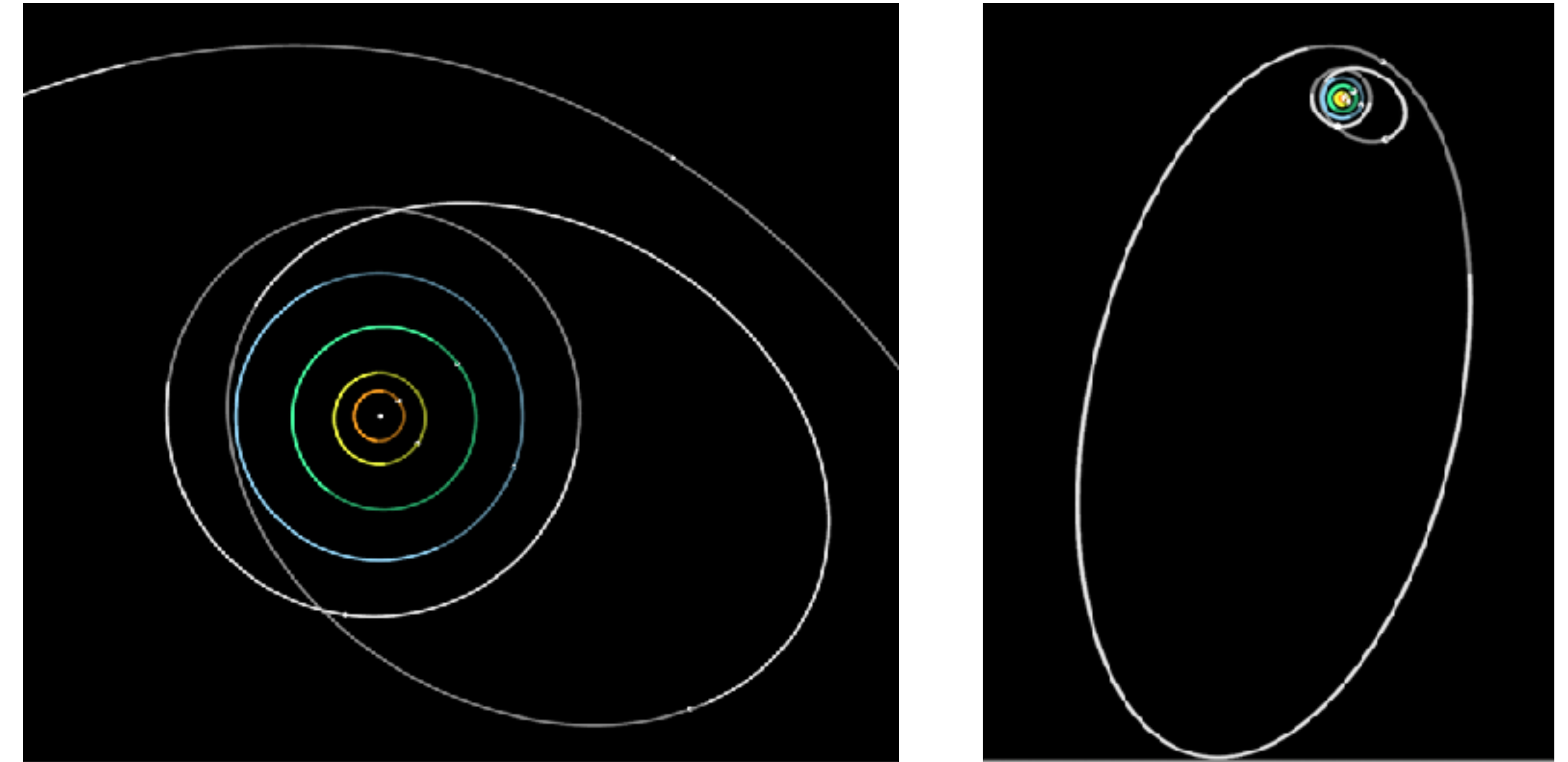
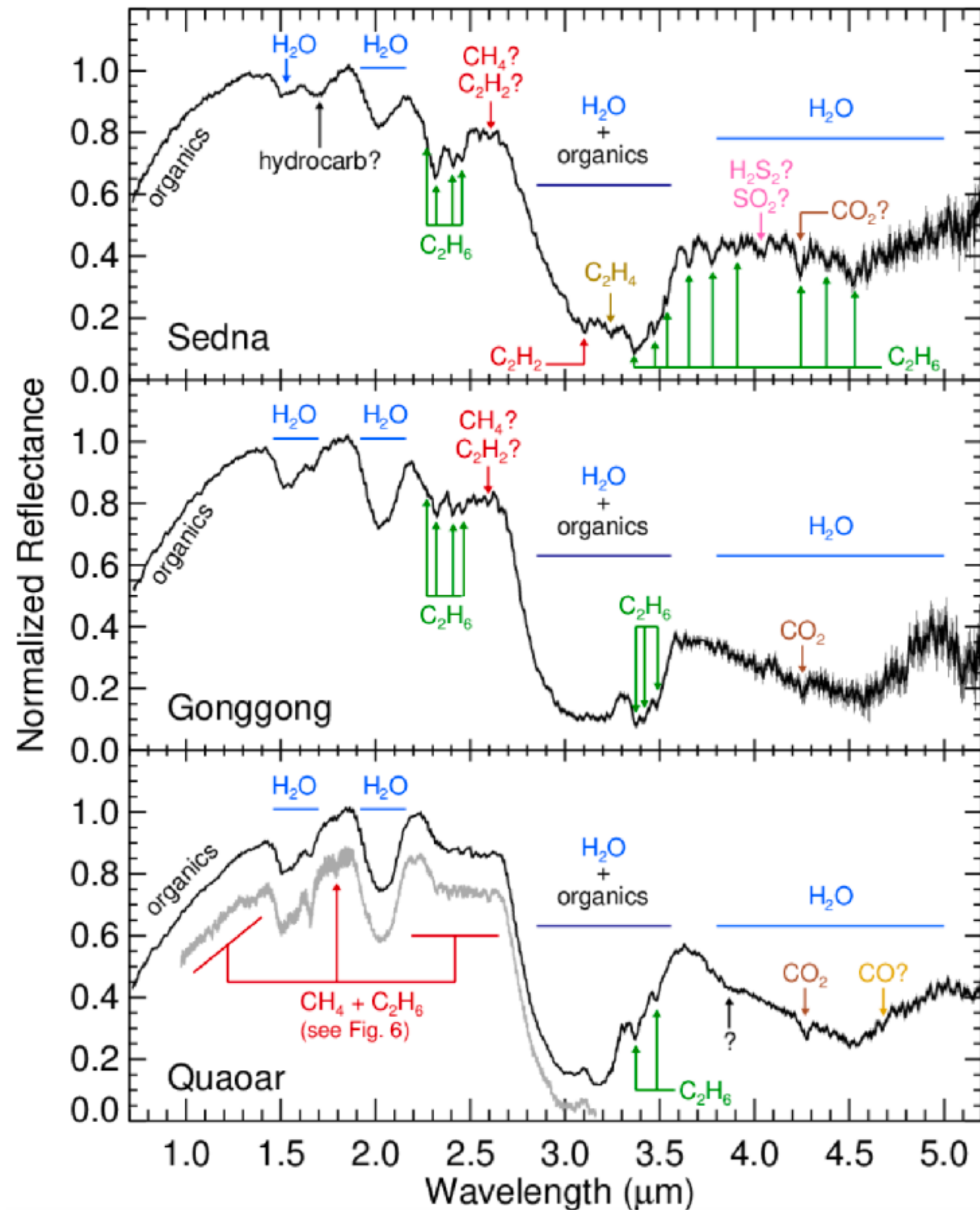
Smaller, yet large enough to be spherical, to have (maybe) undergone some internal melting and differentiation

Similar but different (can be related to orbit: retention of lighter elements and irradiation environment)

Continued presence of light hydrocarbons implies resupply to the surface

> geochemical evolution similar to larger dwarf planets?

Gonggong, Quaoar & Sedna



— Emery et al. 2024

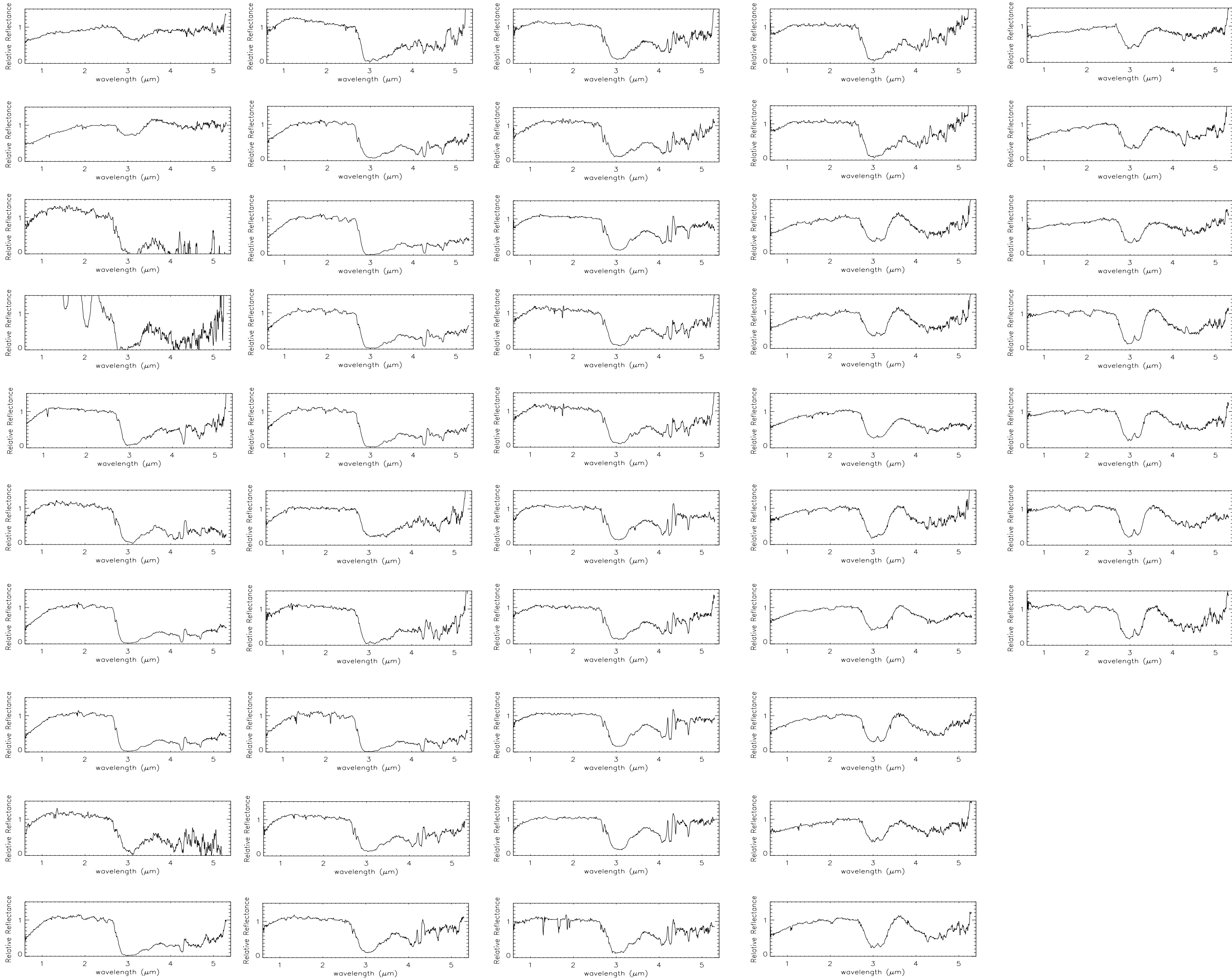
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Large Program – DiSCo TNOs



- 59 targets
- NIRSpec PRISM
- Diameters ~100 – 800 km
- All dynamical classes

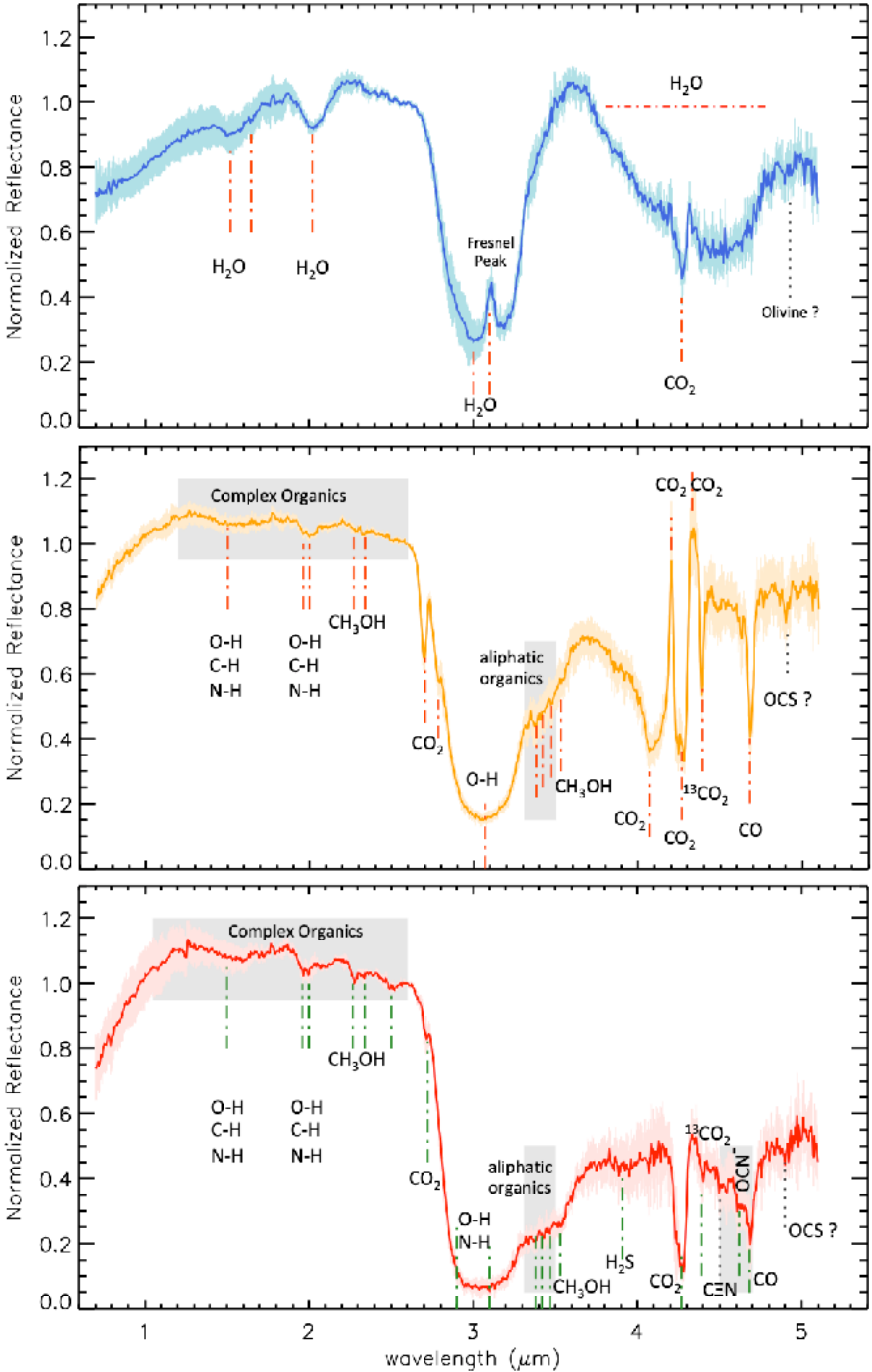
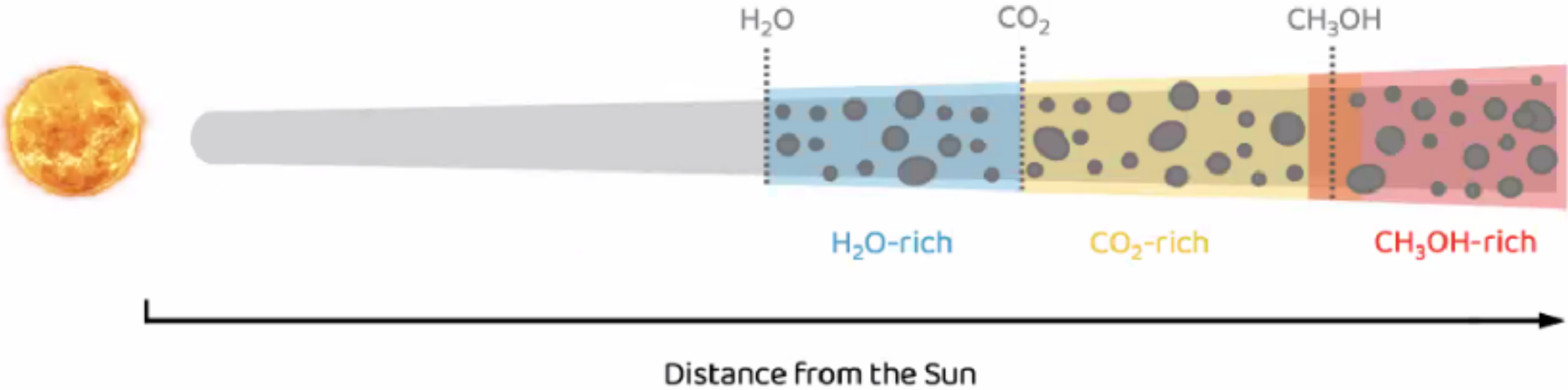
DePra et al. 2024

Pinilla-Alonso et al. 2024

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H₂O-rich

CO₂-rich

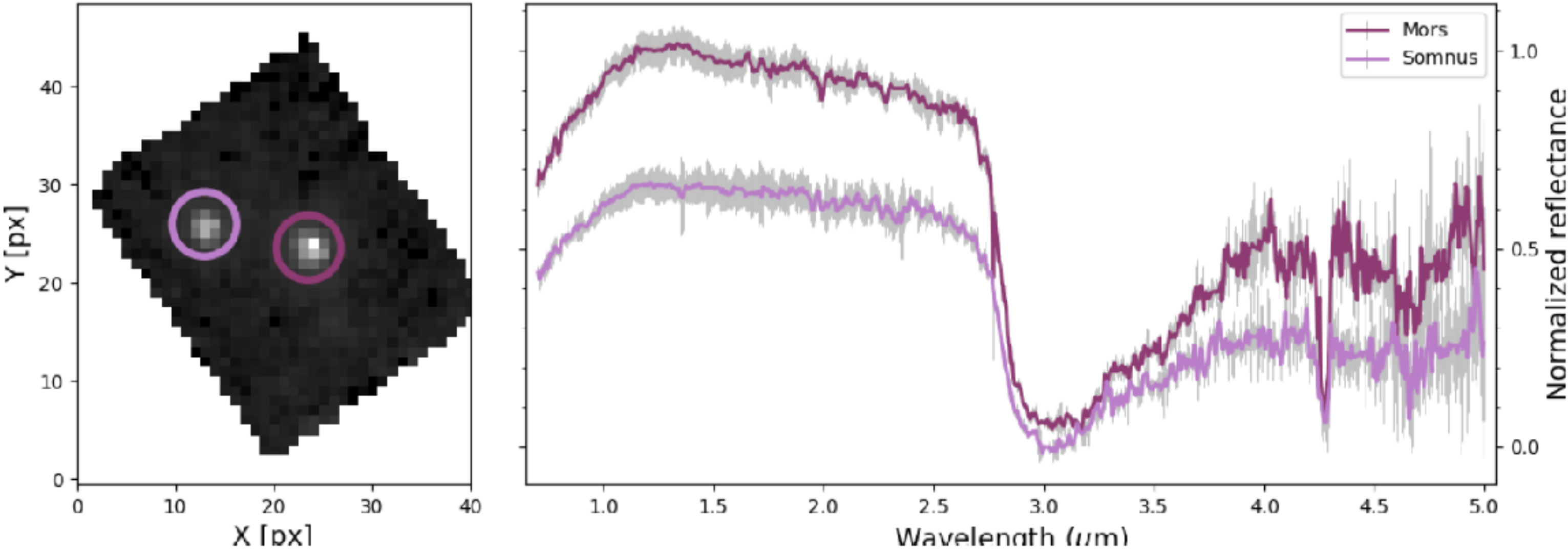
CH₃OH-rich

DePra et al. 2024
Pinilla-Alonso et al. 2024

Large Program – DiSCo TNOs

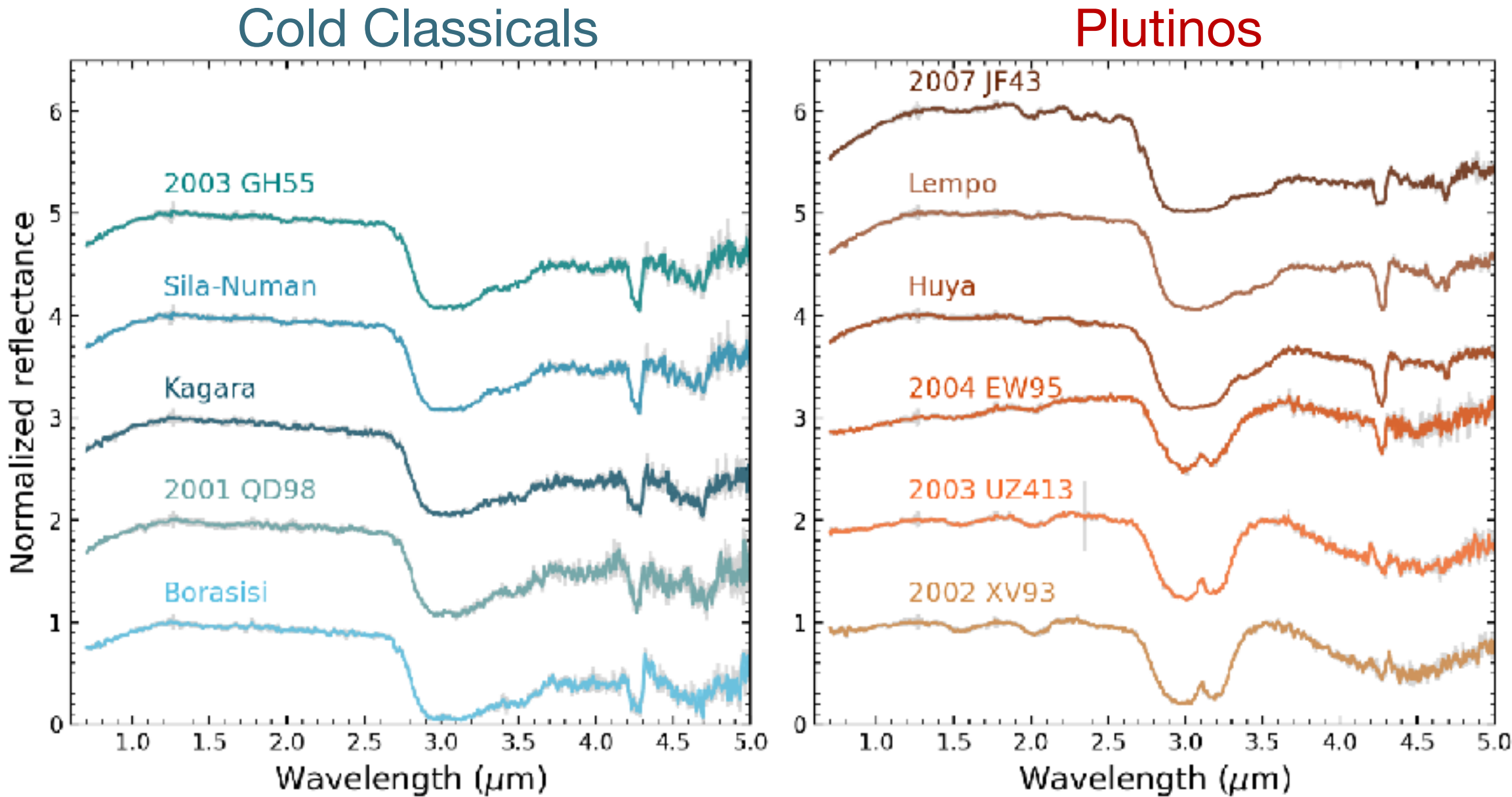
Mors - Somnus

~equal-sized, wide binary among Plutinos
~identical spectra

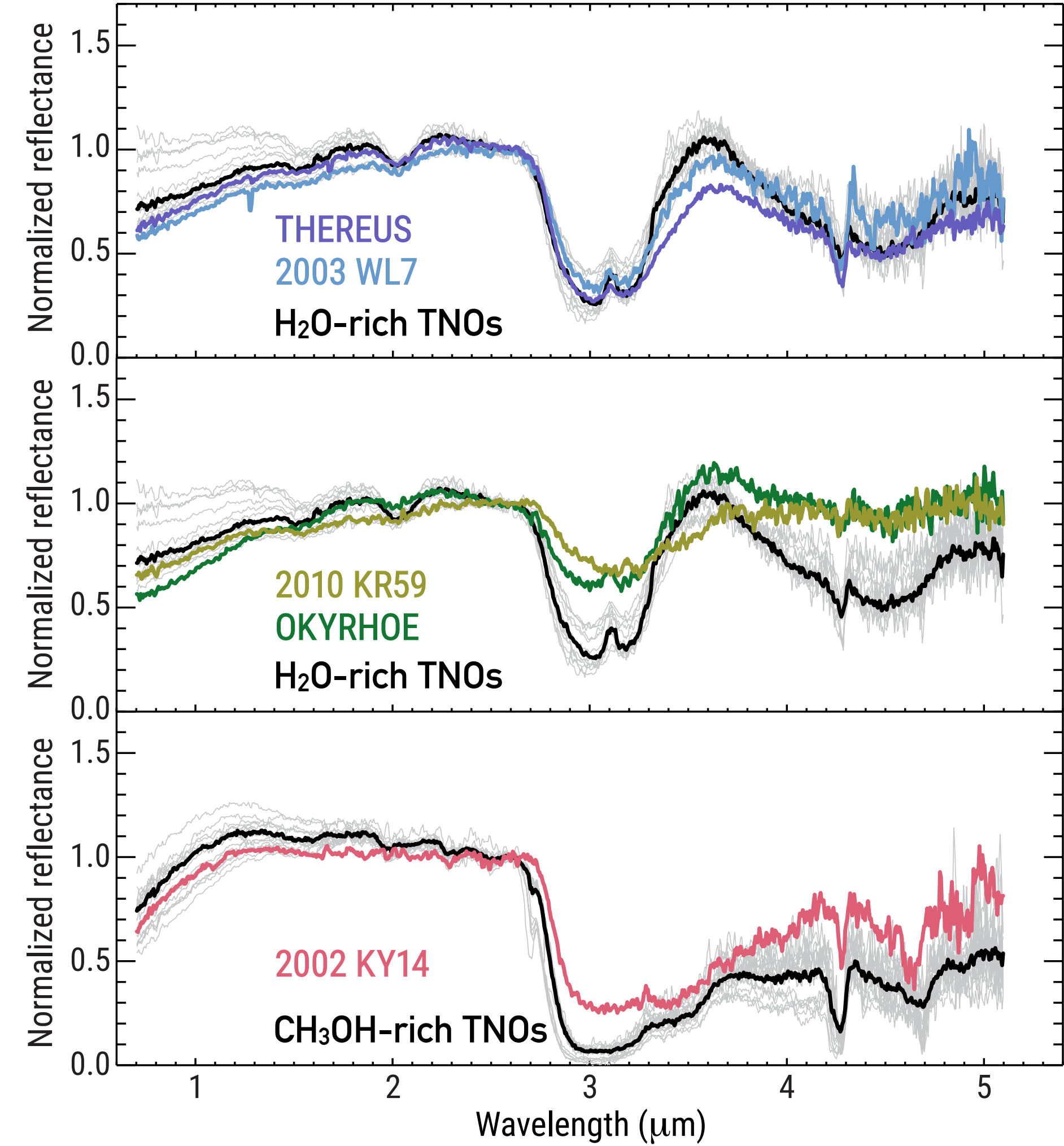
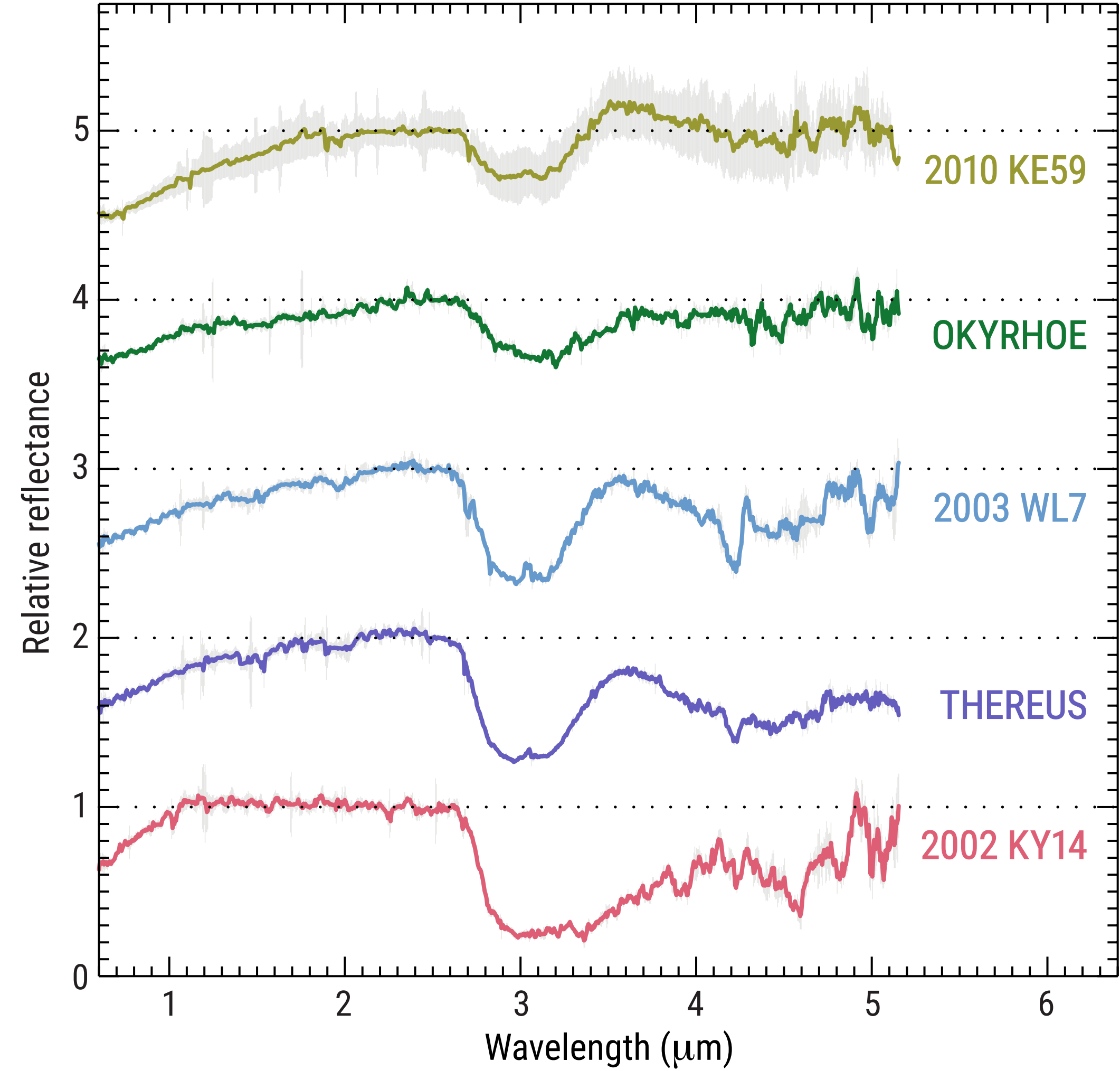


Suggest they formed together beyond 30au
Compatible with streaming instability

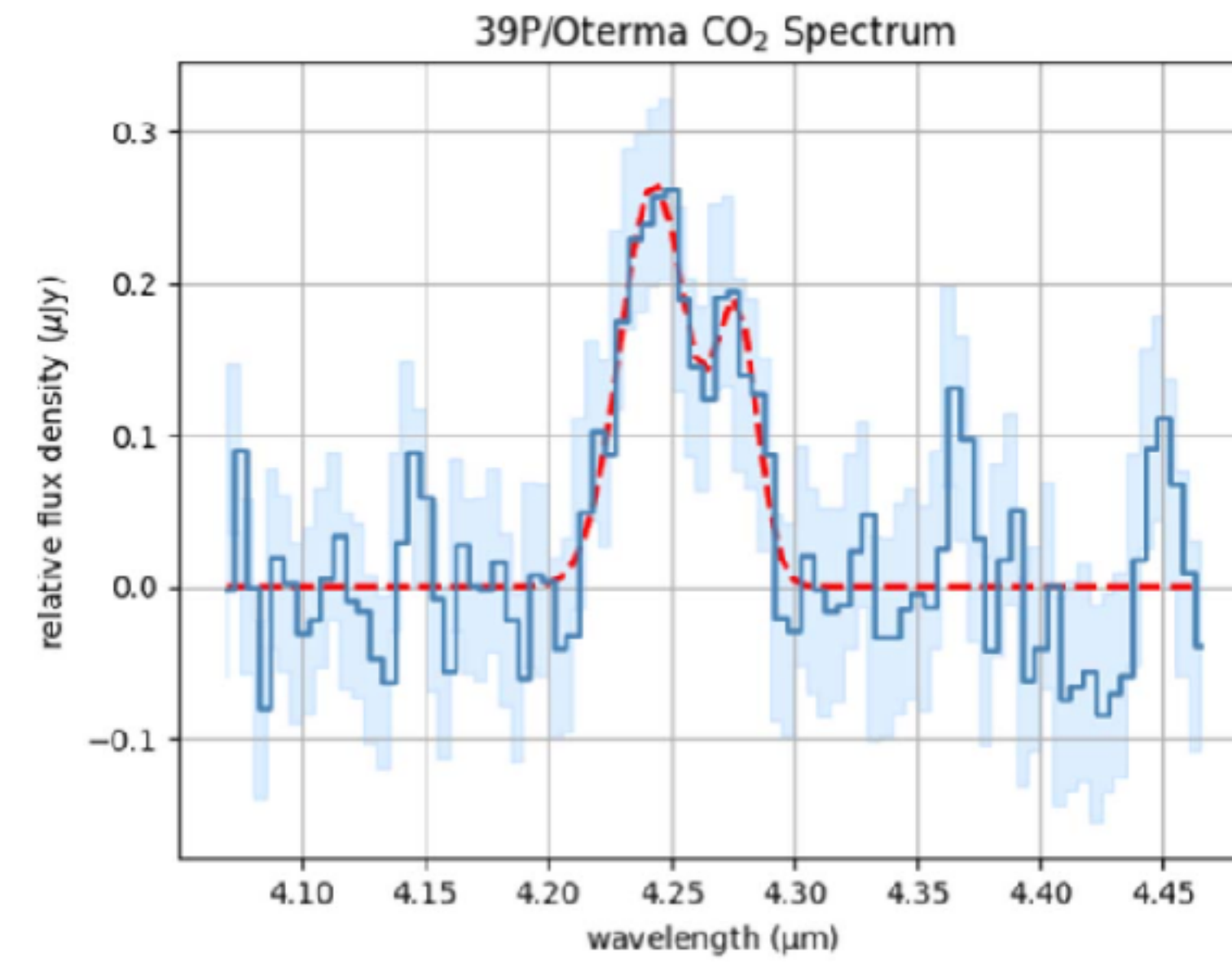
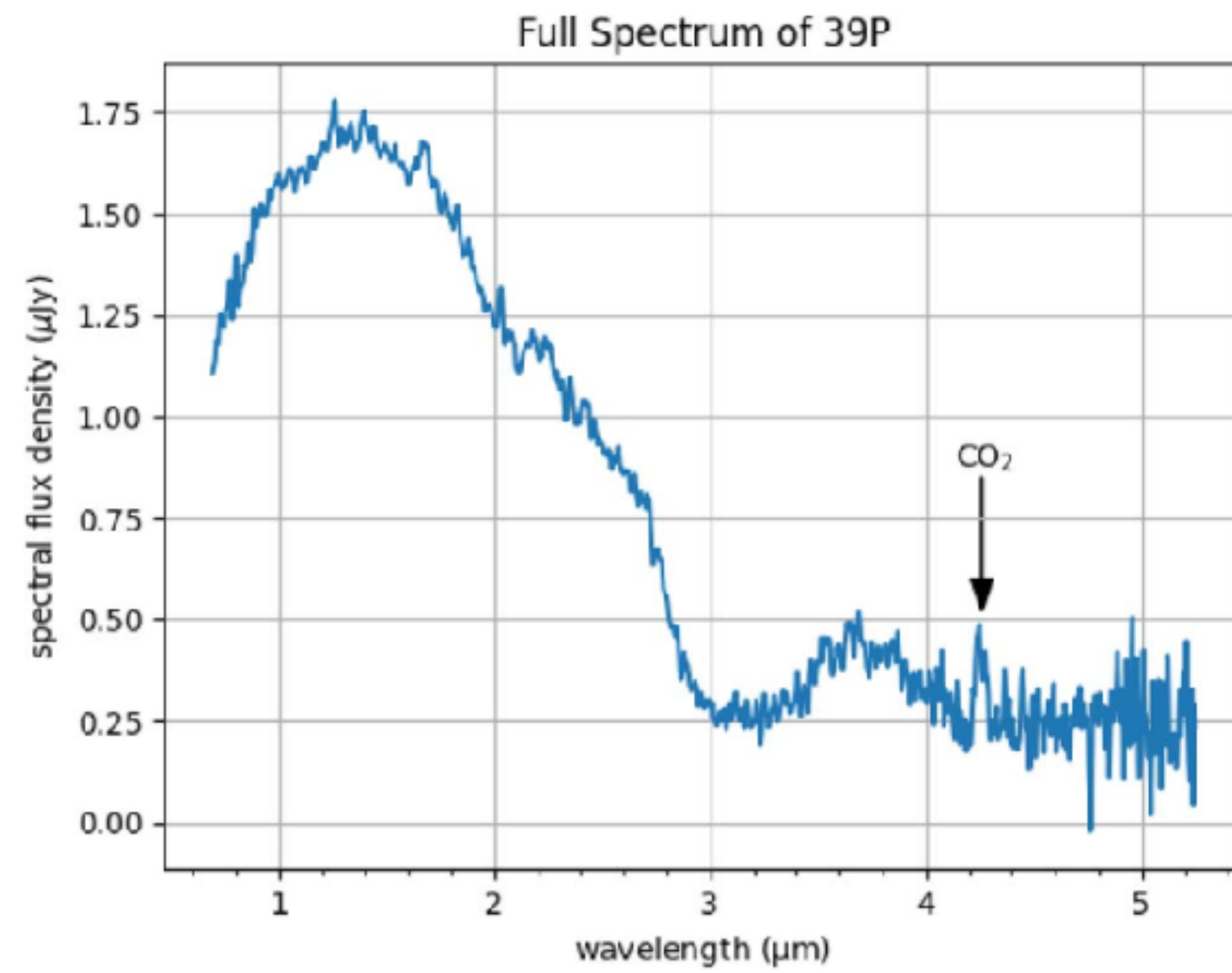
Souza-Feliciano et al. 2024



Studying Centaurs with JWST



Studying Centaurs with JWST

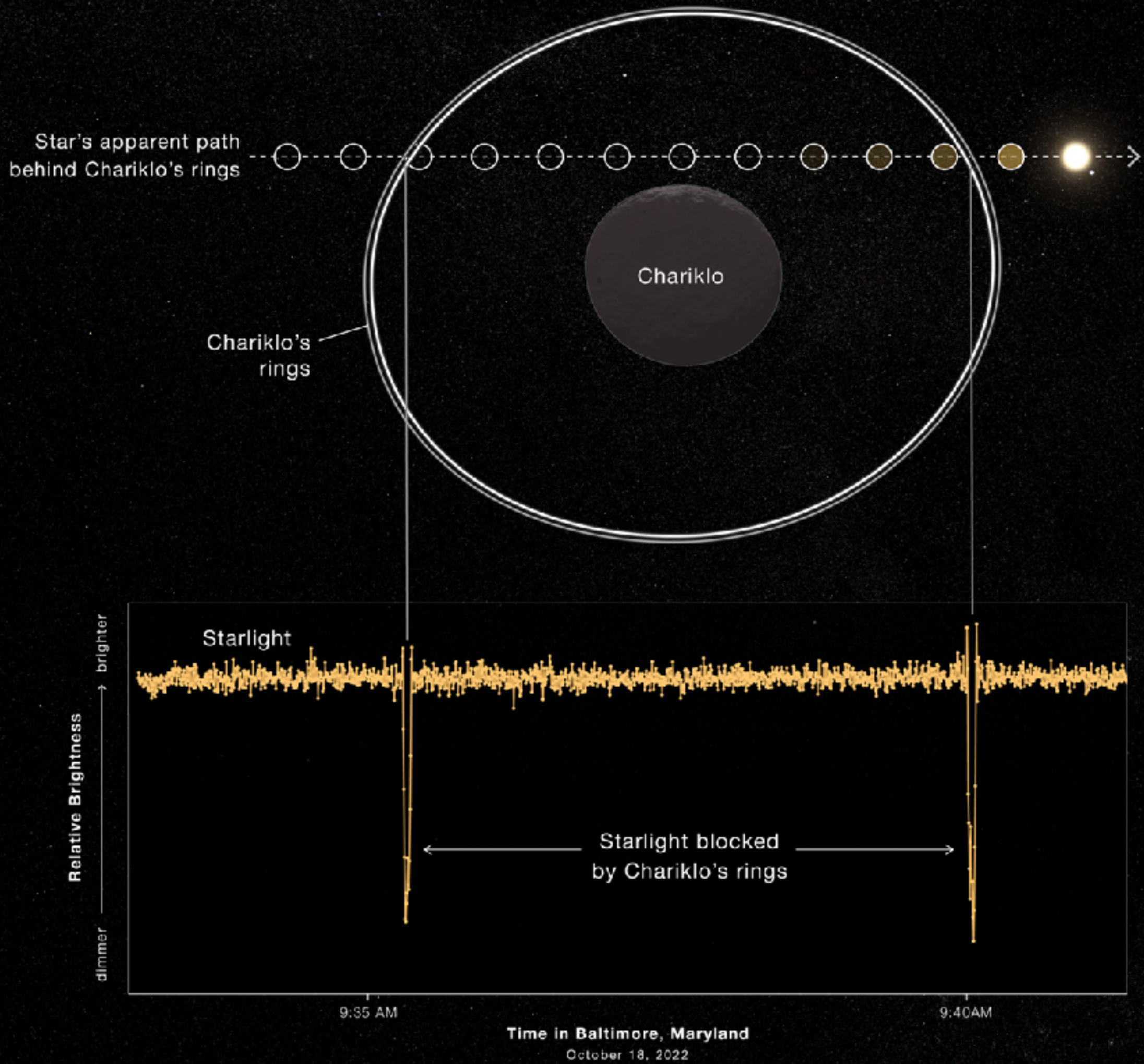


Harrington-Pinto et al. 2023

CENTAUR 10199 CHARIKLO

OCCULTATION LIGHT CURVE

NIRCam | Filter F150W



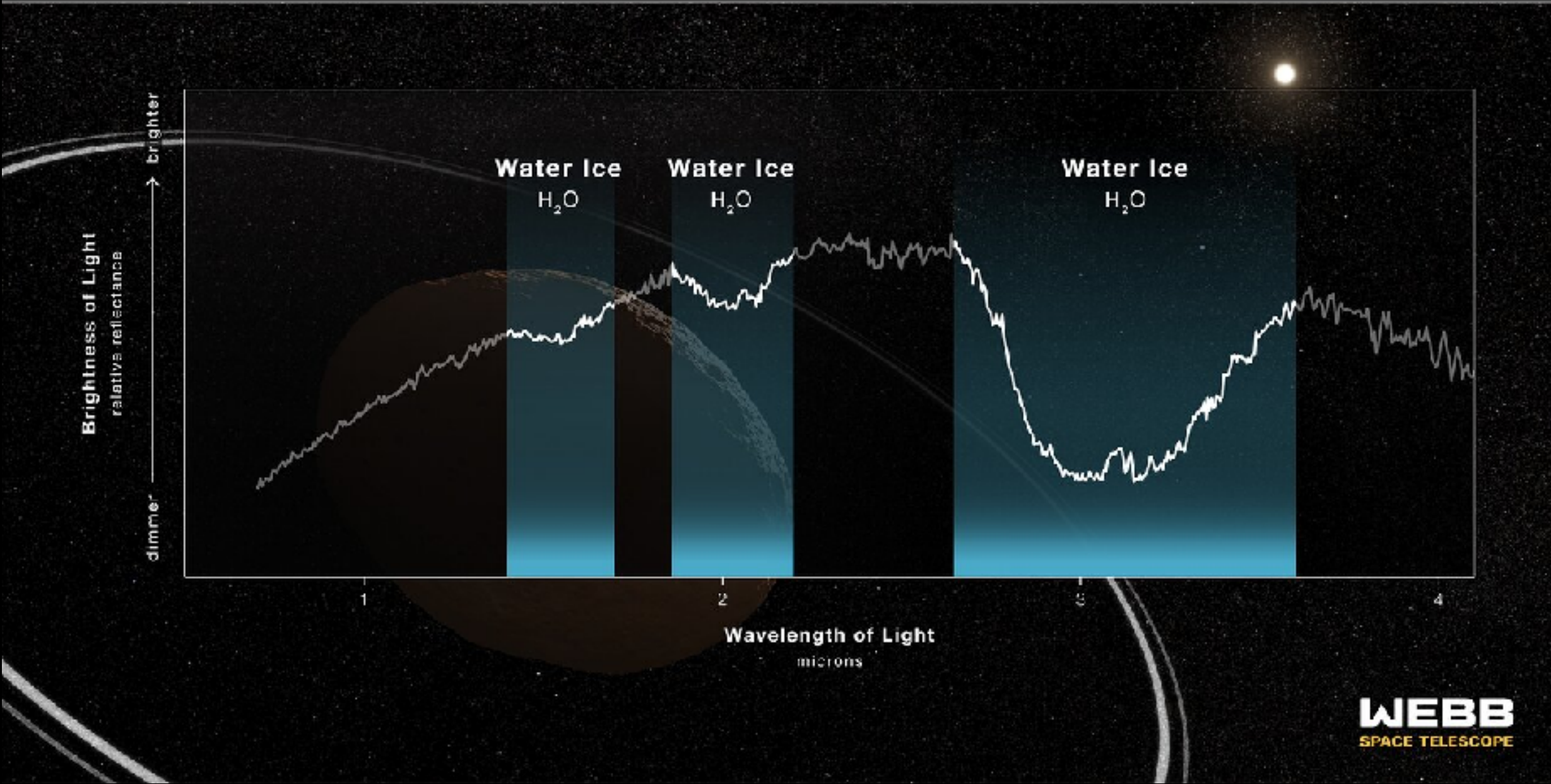
WEBB
SPACE TELESCOPE

Studying Centaurs with JWST

CENTAUR 10199 CHARIKLO

SURFACE COMPOSITION

NIRSpec | PRISM



WEBB
SPACE TELESCOPE

New era in the observation of TNOs (+MIRI)

Inventory of volatiles and organic species

all objects currently known (~4000) are accessible

+ LSST / Vera Rubin future detections (~40 000)

Interpretation requires

- laboratory experiments
- revision of models (spectral models, activity models...)

Many individual histories to unravel

Diversity — competition between irradiation, thermal processes (including cryovolcanism, cometary activity), collisions

Converging toward one consistent history of the region, and of the solar system

