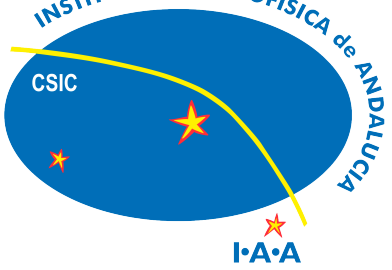
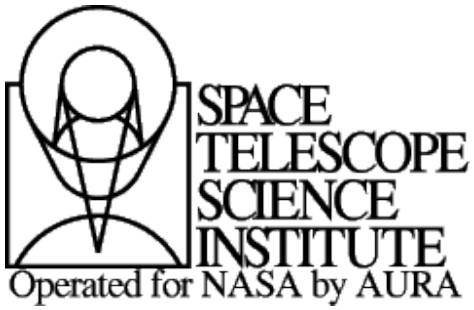
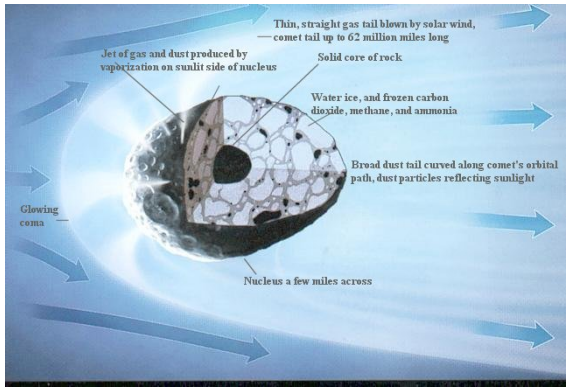
Compositional study of TNOs beyond 2.2 μm in preparation for the JWST

Estela Fernández-Valenzuela

In collaboration with Noemí Pinilla-Alonso and John Stansberry



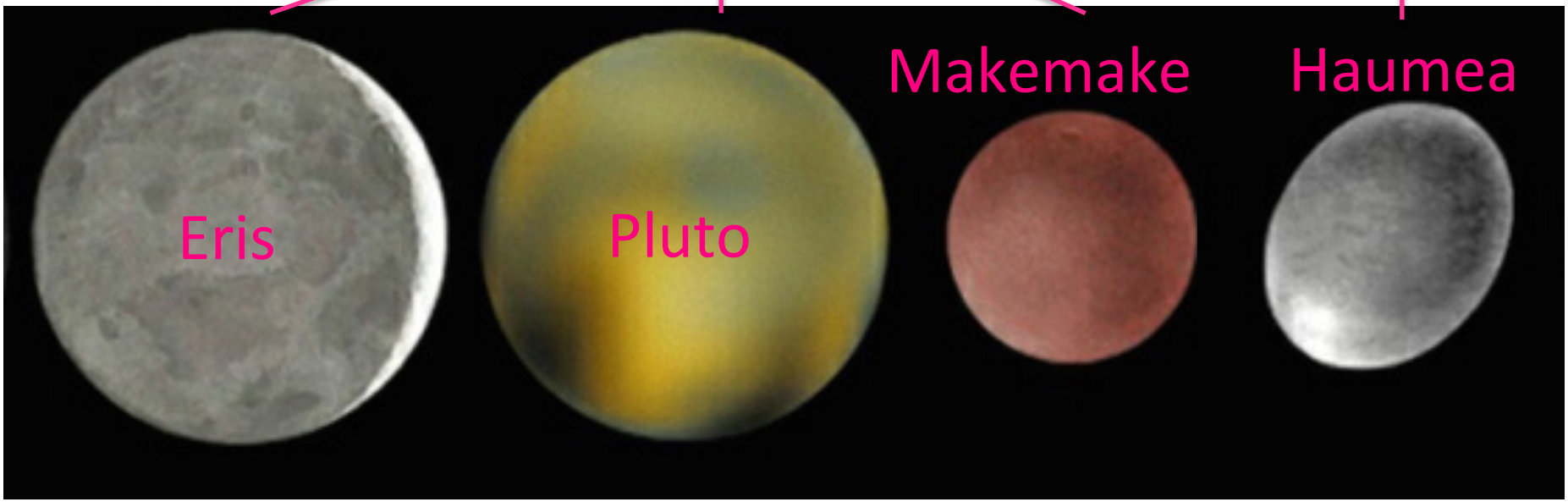




The most common ice is water ice, typically mixed with amorphous silicates and complex organics.

CH_4, N_2, CO

H_2O

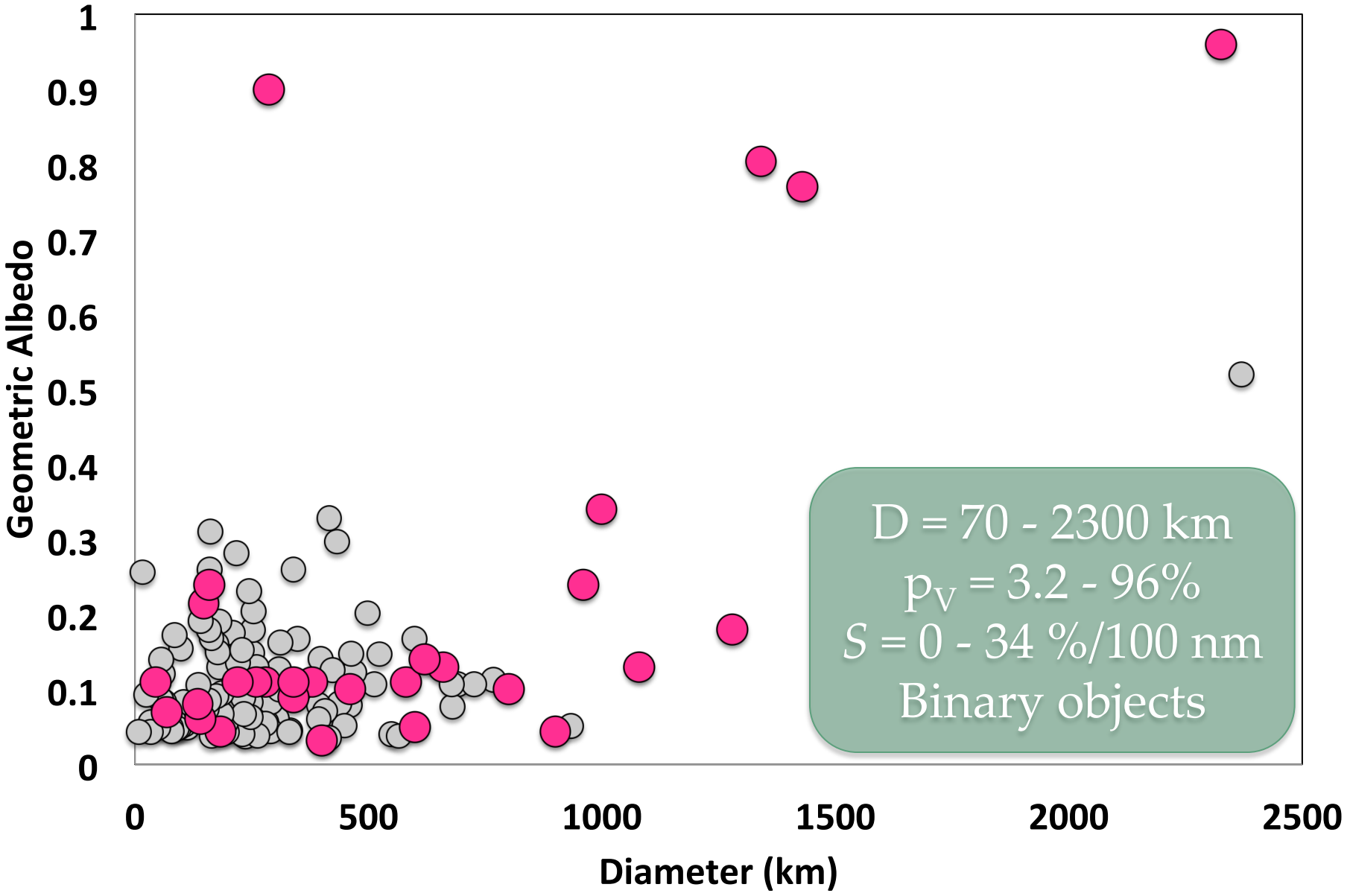


From cycle GO2 to cycle GO12

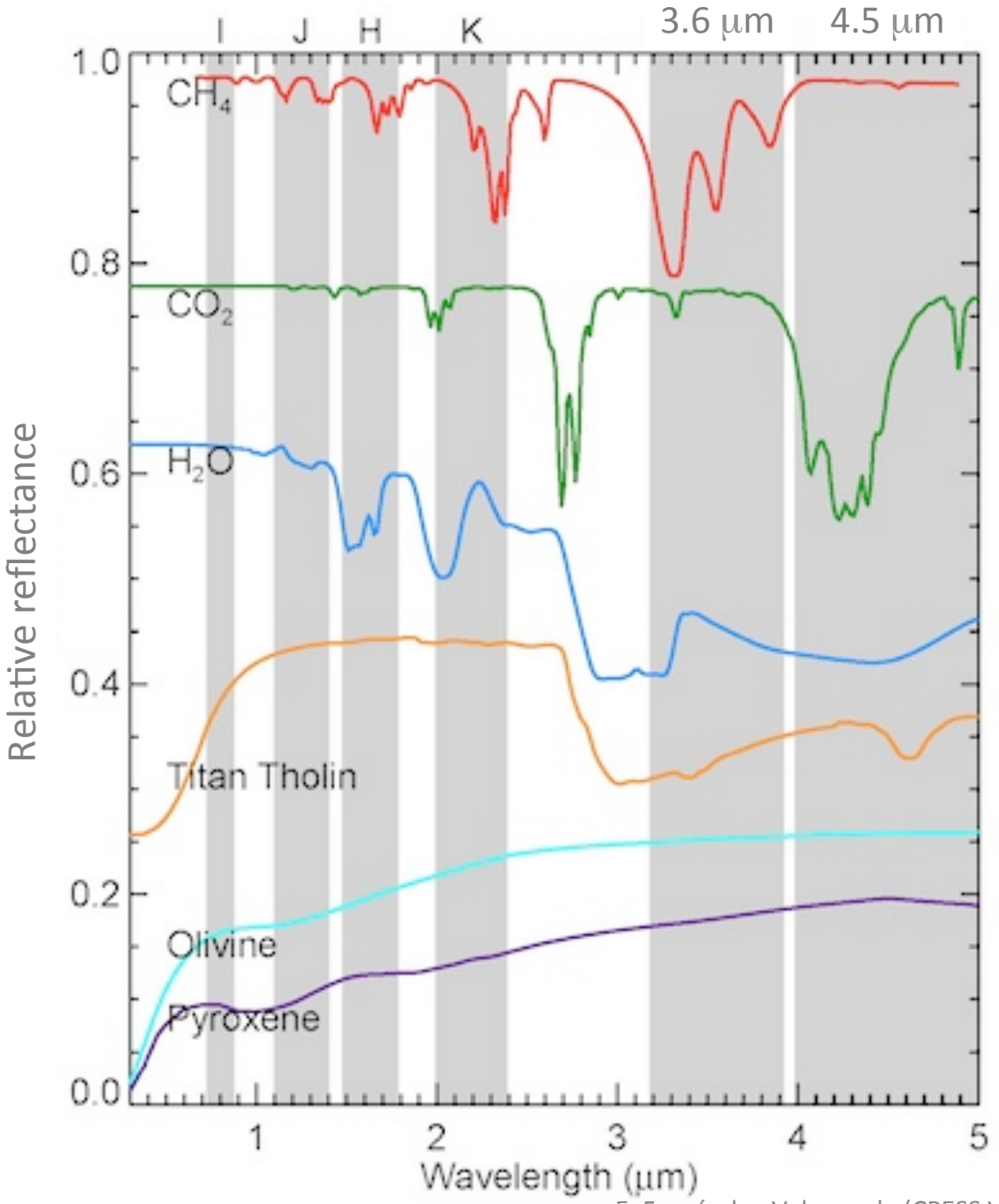
At 3.6 and 4.5 μm

From orbiterchspacenews.blogspot.com.es

Sample from "TNOs are cool" & our sample

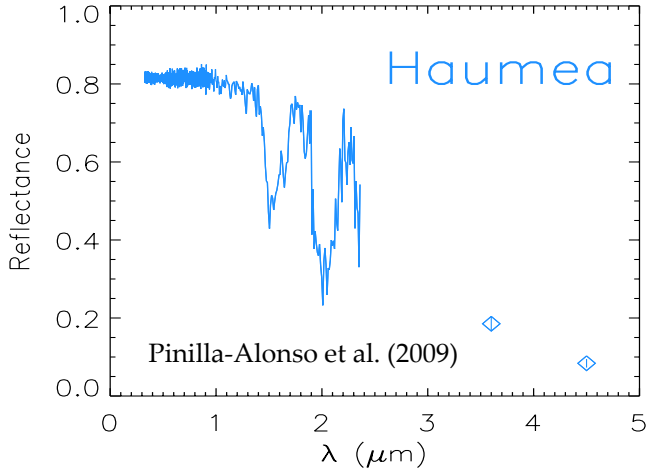


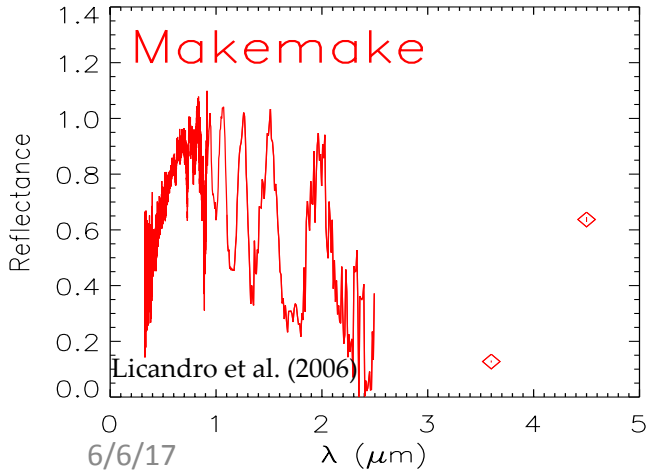
Using Spitzer

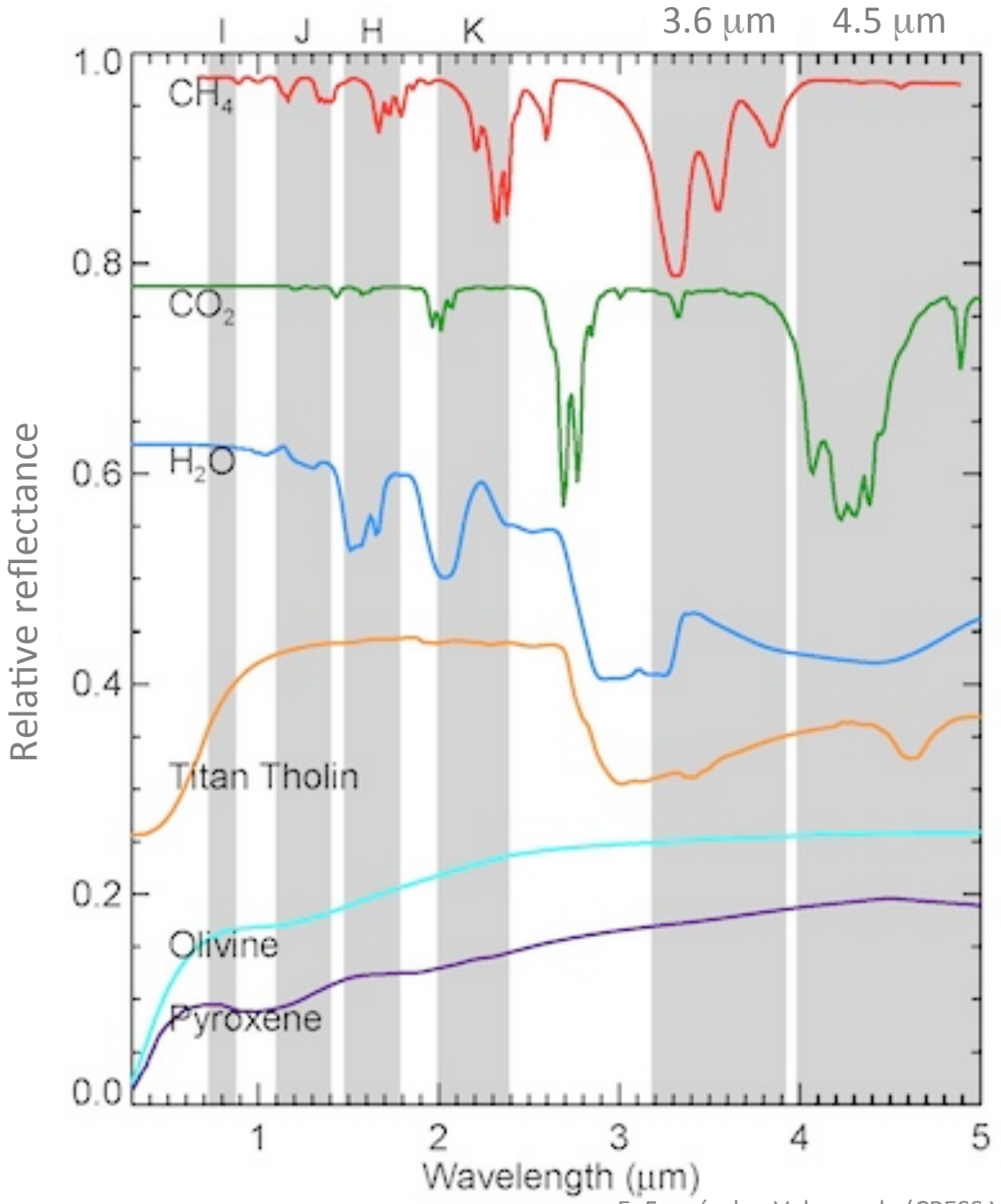


E. Fernández-Valenzuela (CPESS V)

Using Spitzer

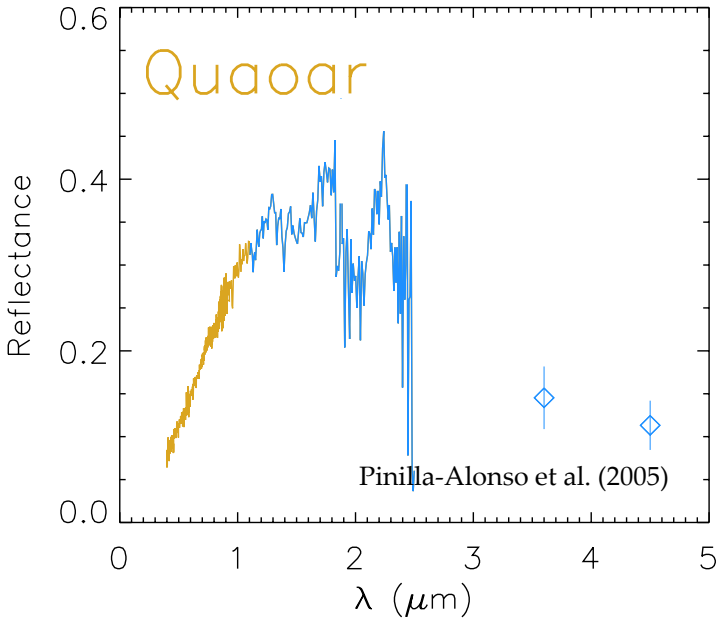


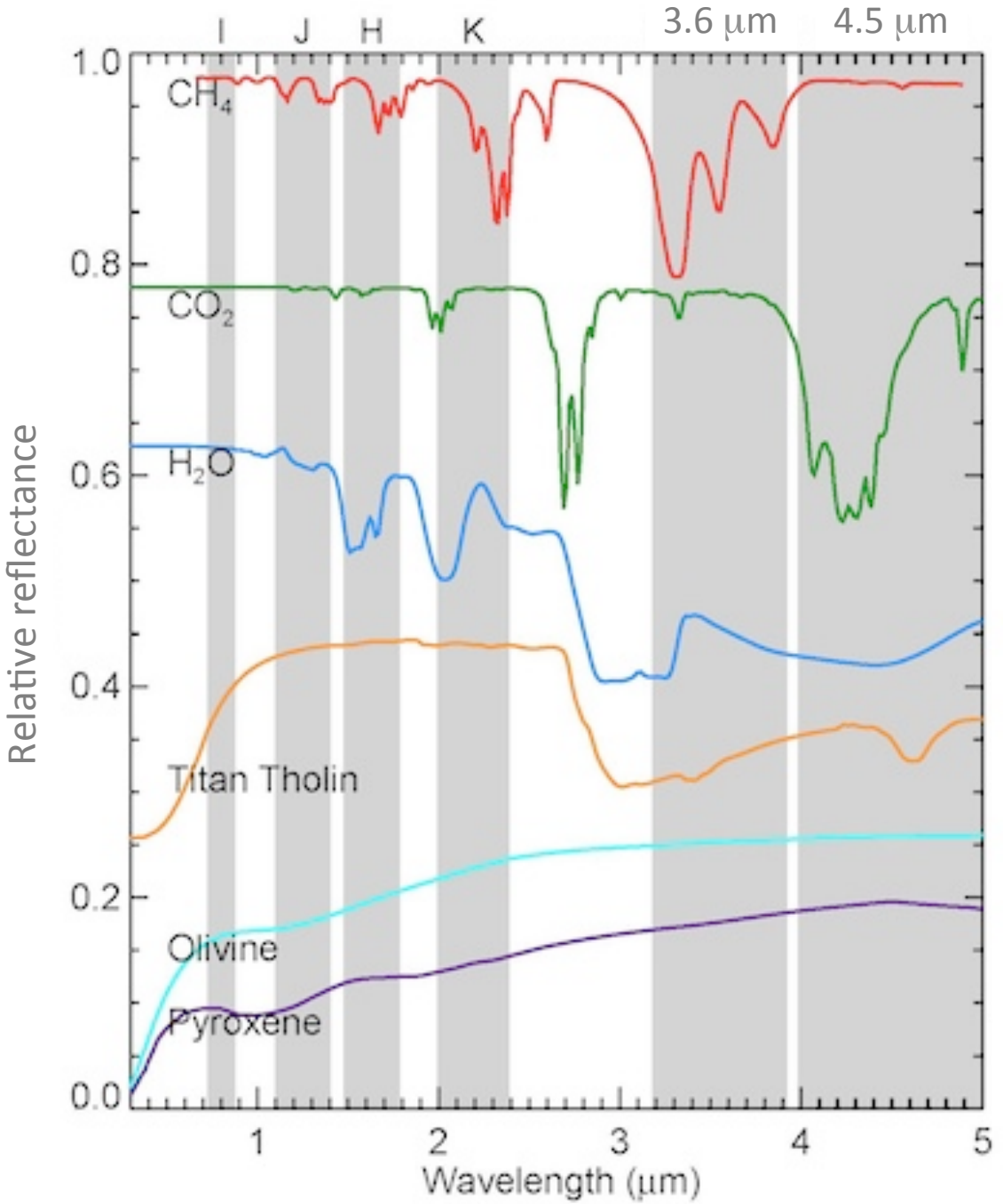




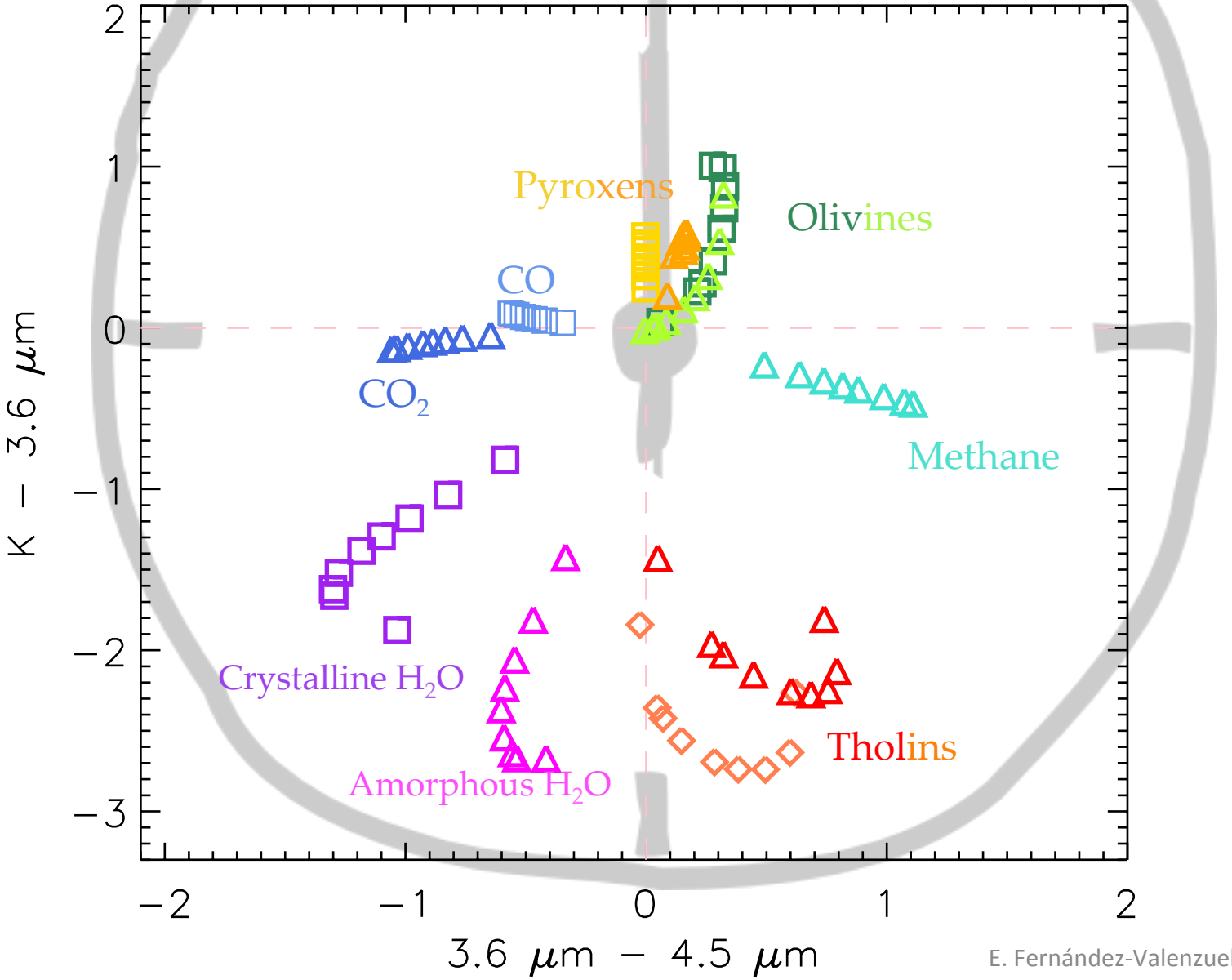
E. Fernández-Valenzuela (CPESS V)

Using Spitzer

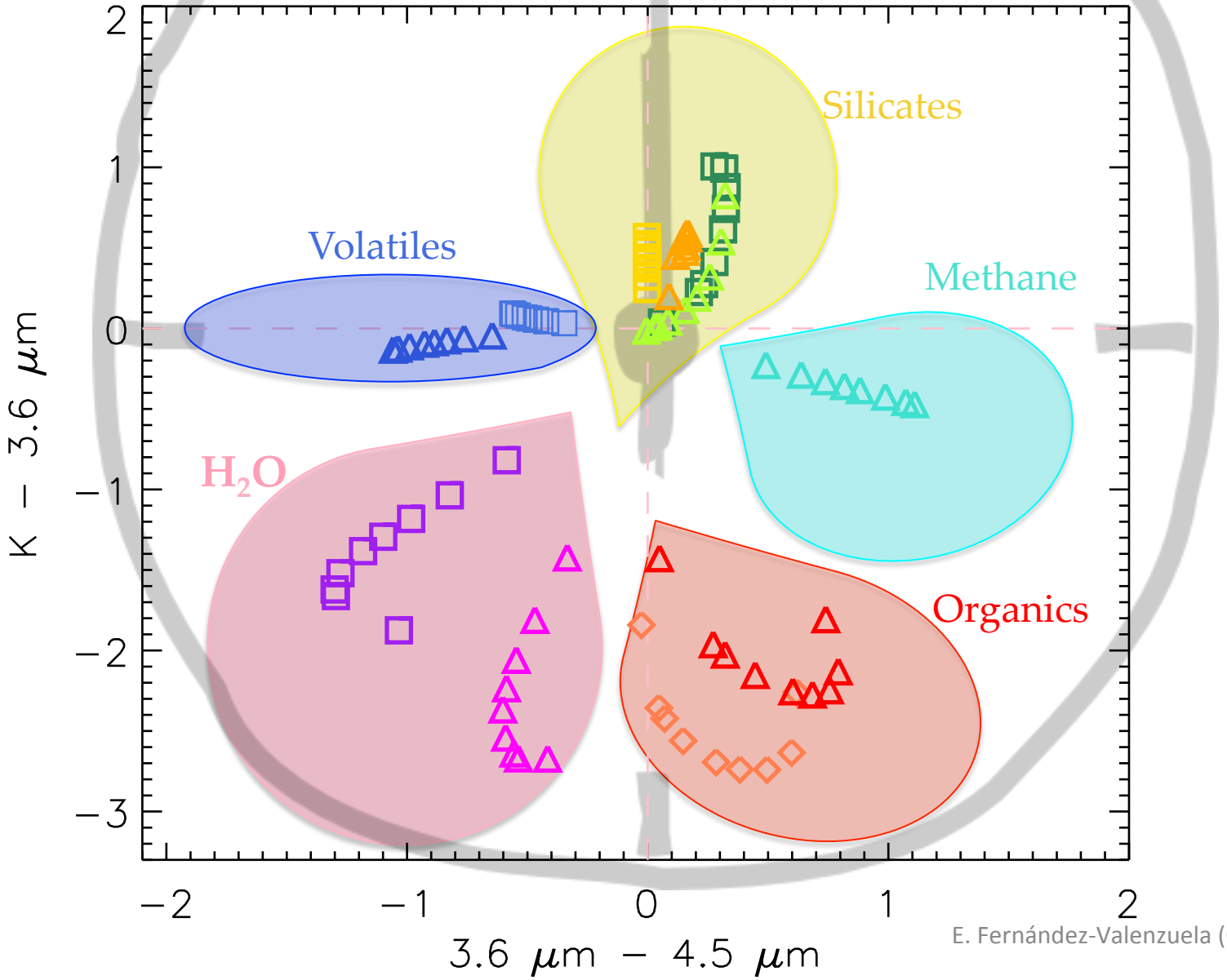




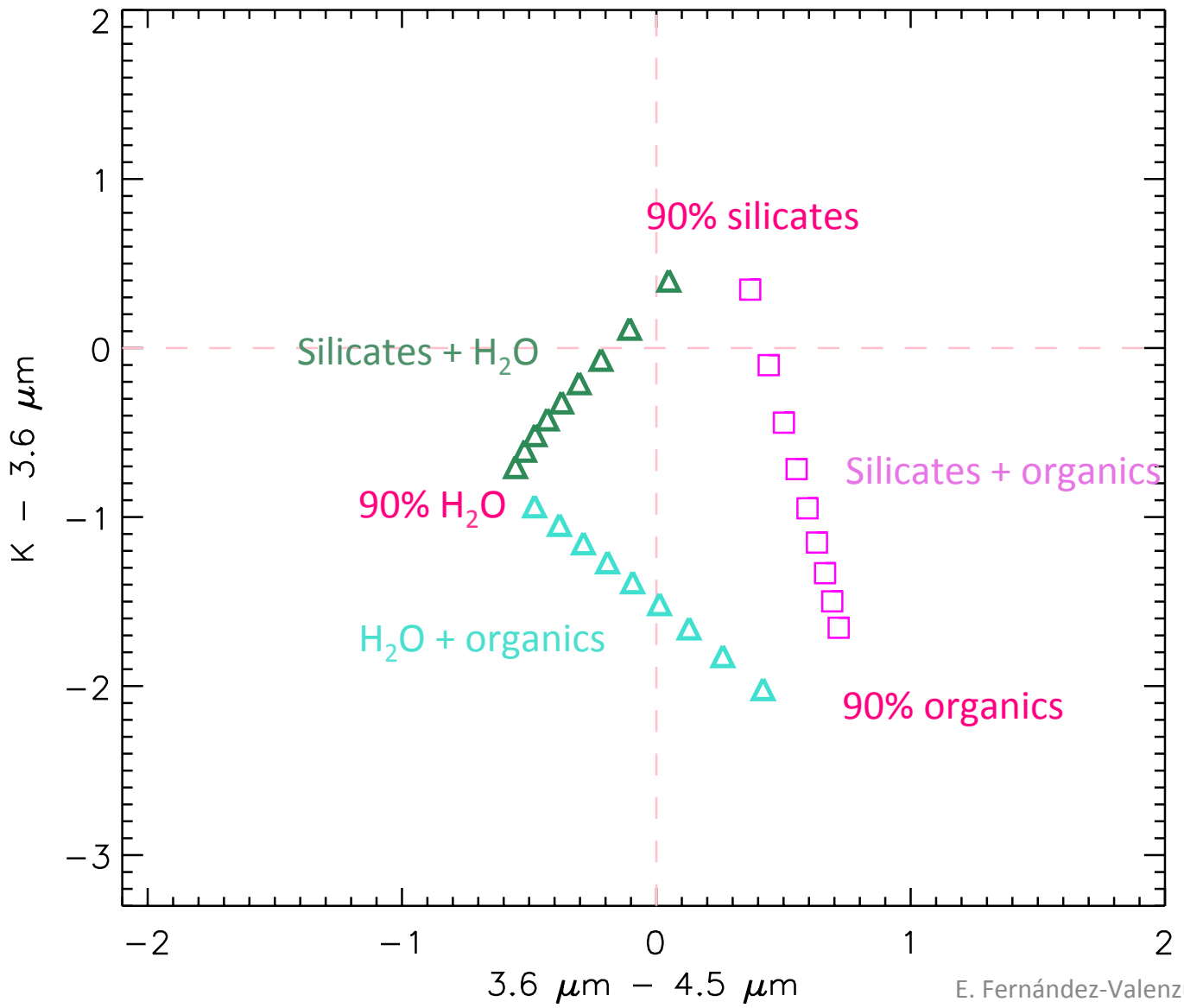
Compositional clock



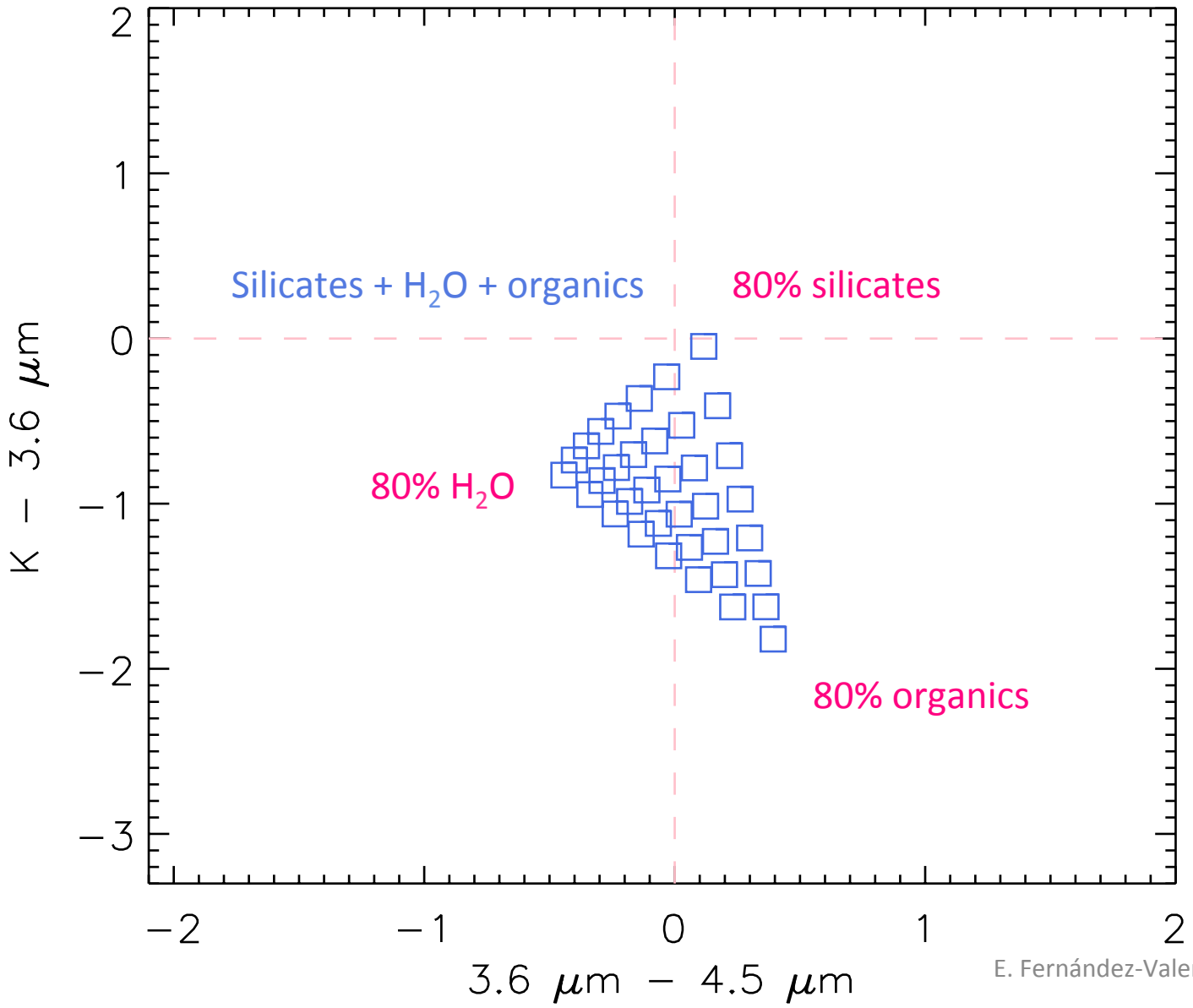
Compositional clock



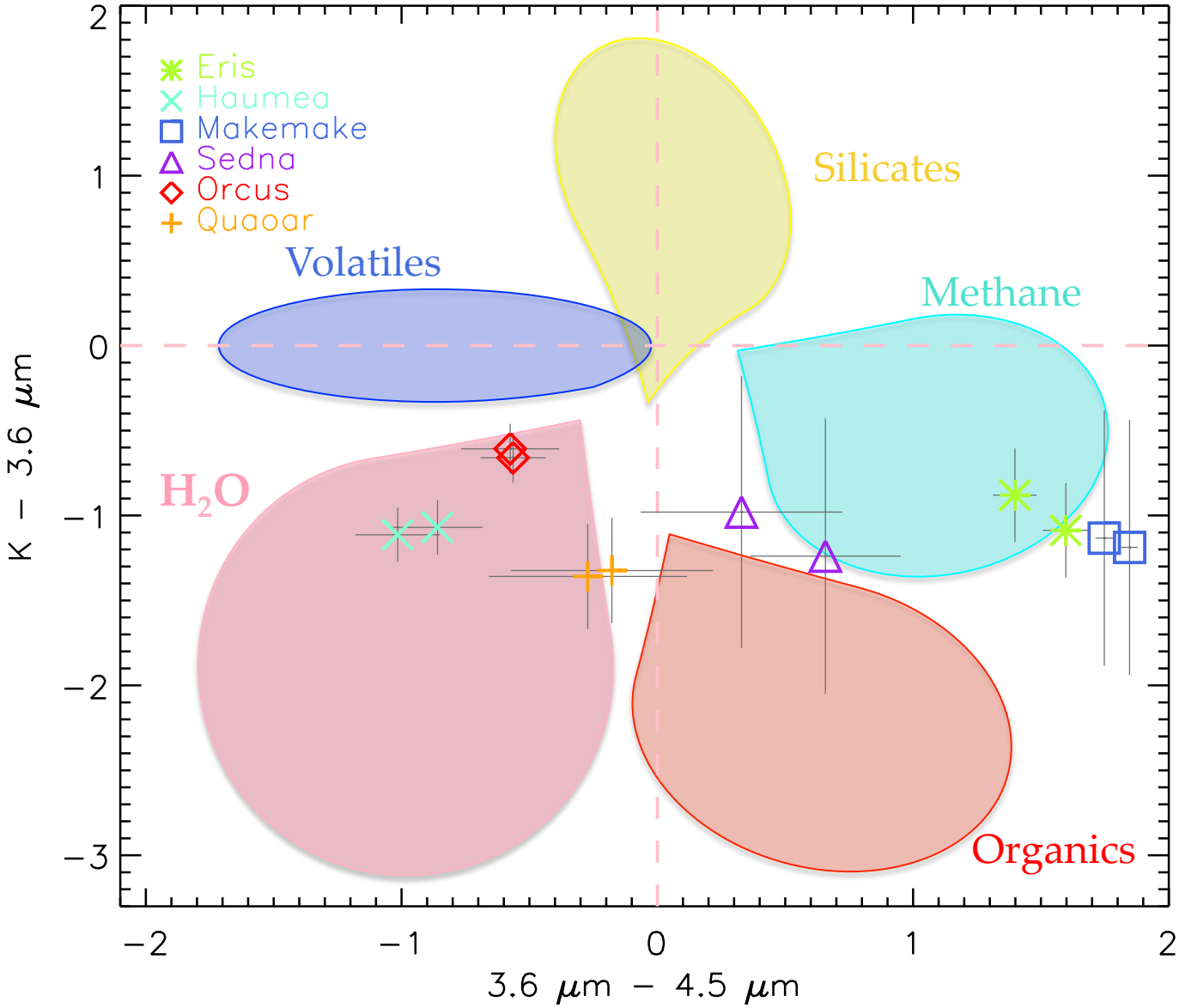
Mixture of 2 material

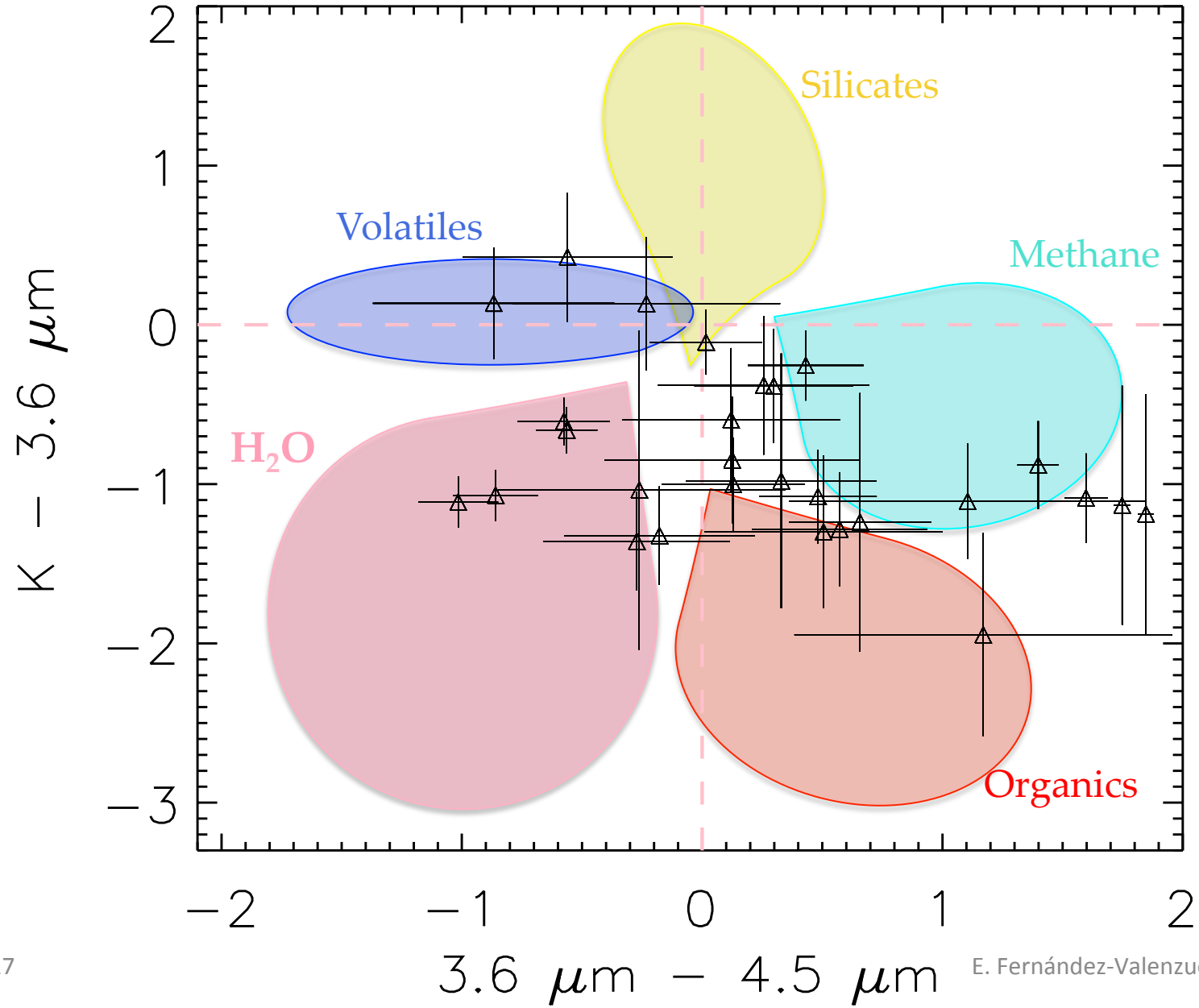


Mixture of 3 material



Validation method

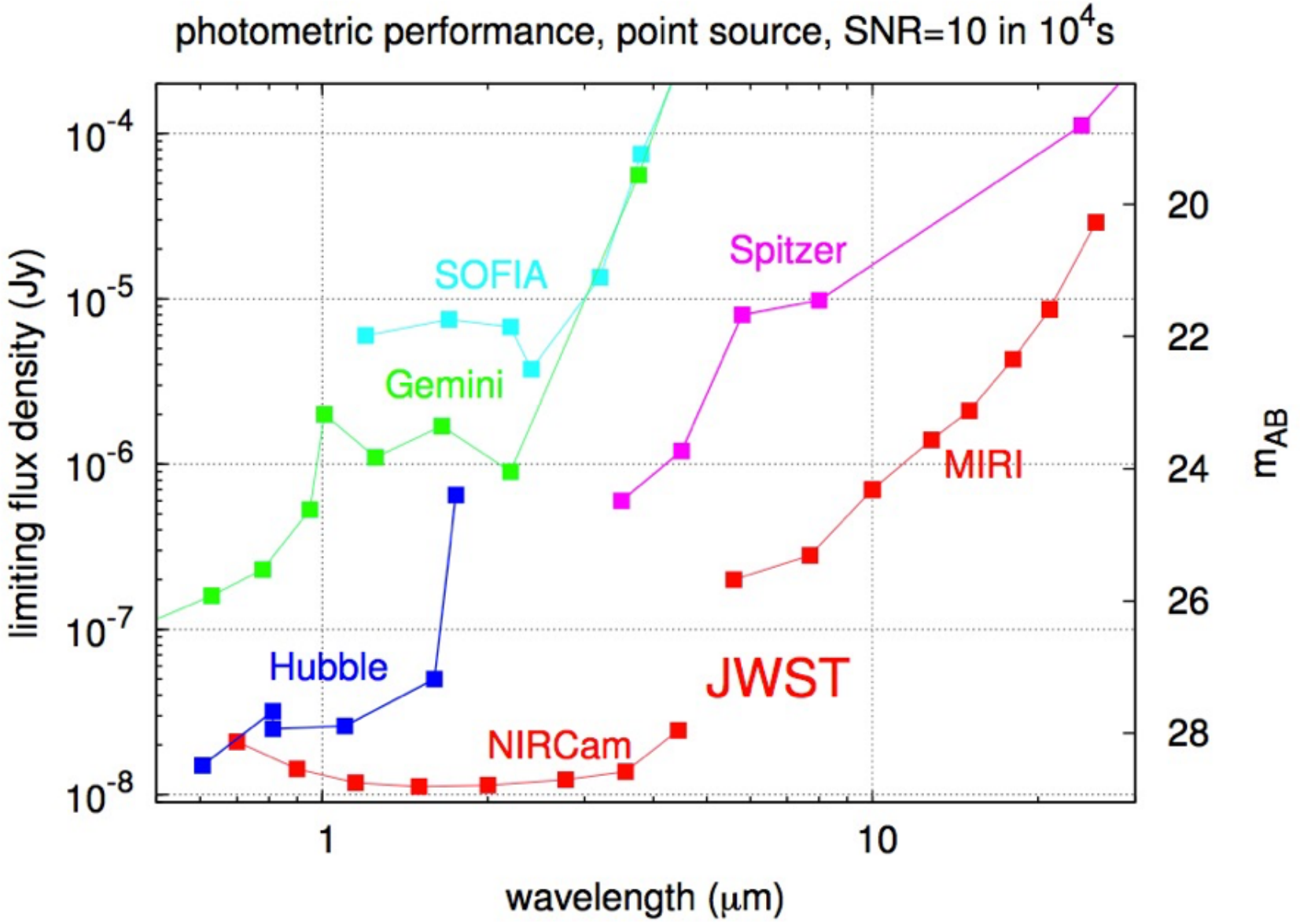



Silicates
Volatiles
Methane
H_2O
Organics
2
1
0
−1
−2
−3
−2
−1
0
1
2
K − 3.6 μm
3.6 μm − 4.5 μm

Conclusions

- Spitzer is very sensitive to ice as CH_4 and H_2O.
- Spitzer confirms low proportions of H_2O (which are not detectable in VNIR).
- Surfaces dominated by one or two materials are not common.
- Organics + silicates + H_2O is the most common composition.
- Objects as Orcus, Varuna and the dwarf planets are peculiar regarding to composition.

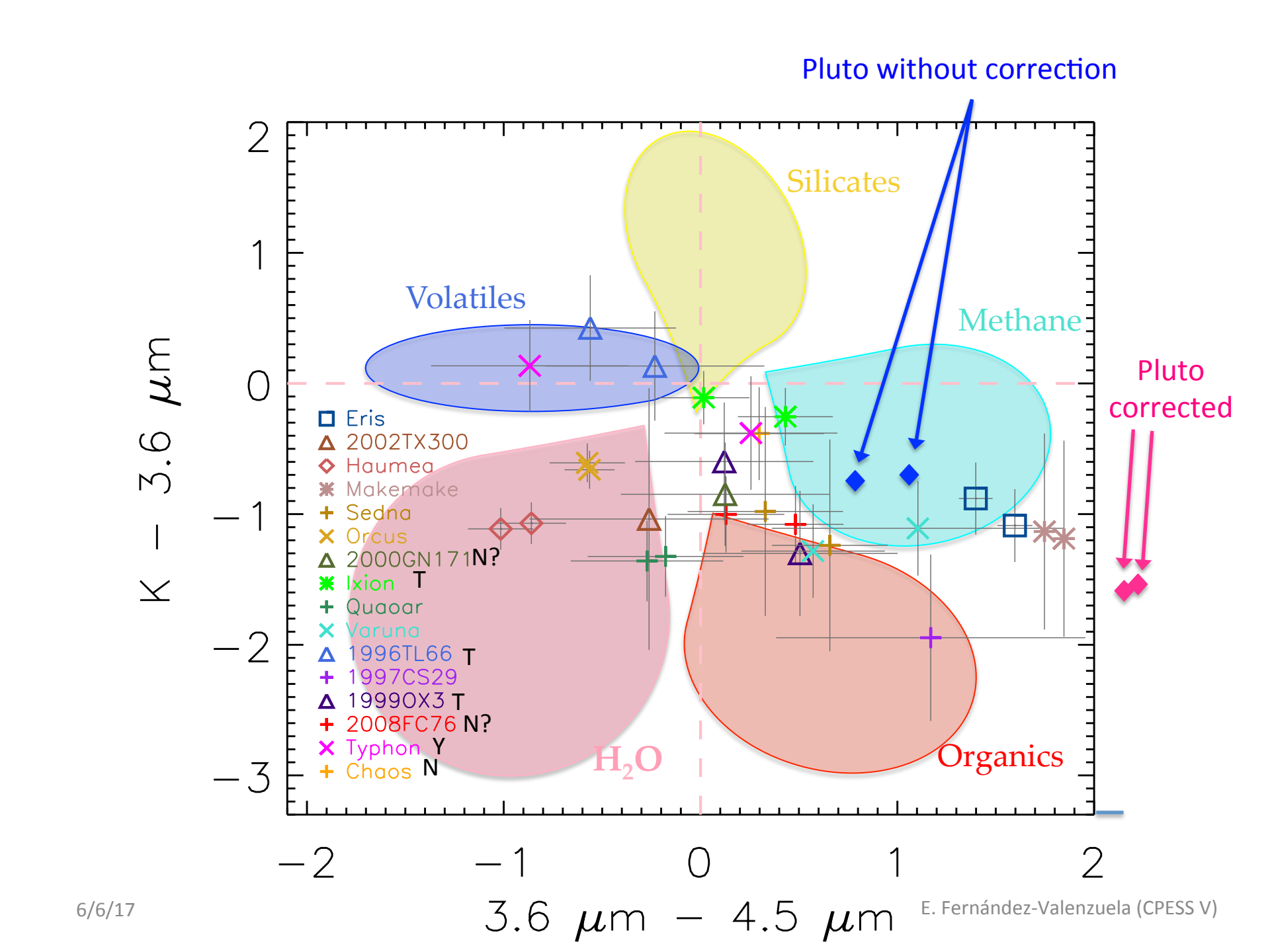
From jwst.stsci.edu

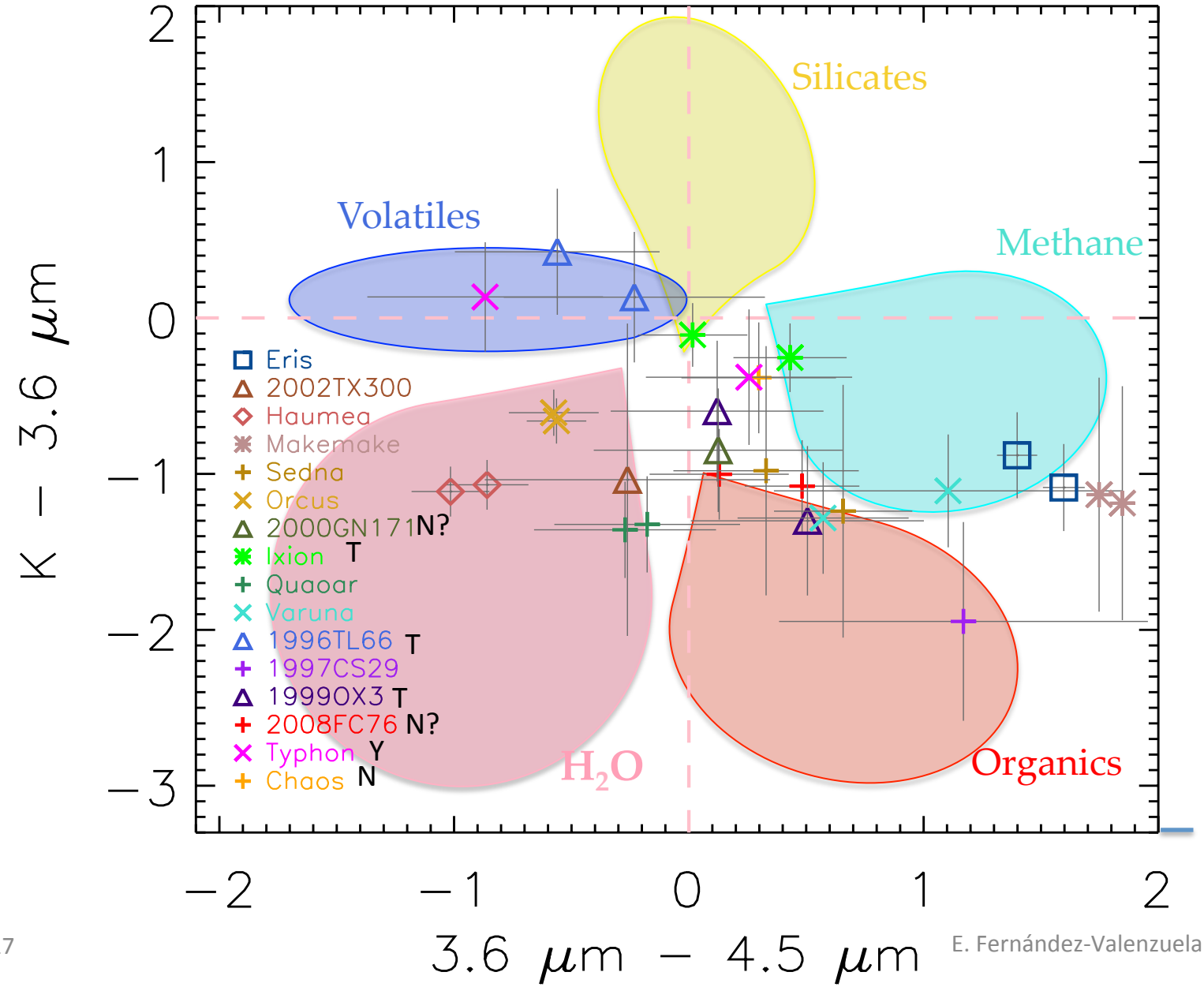


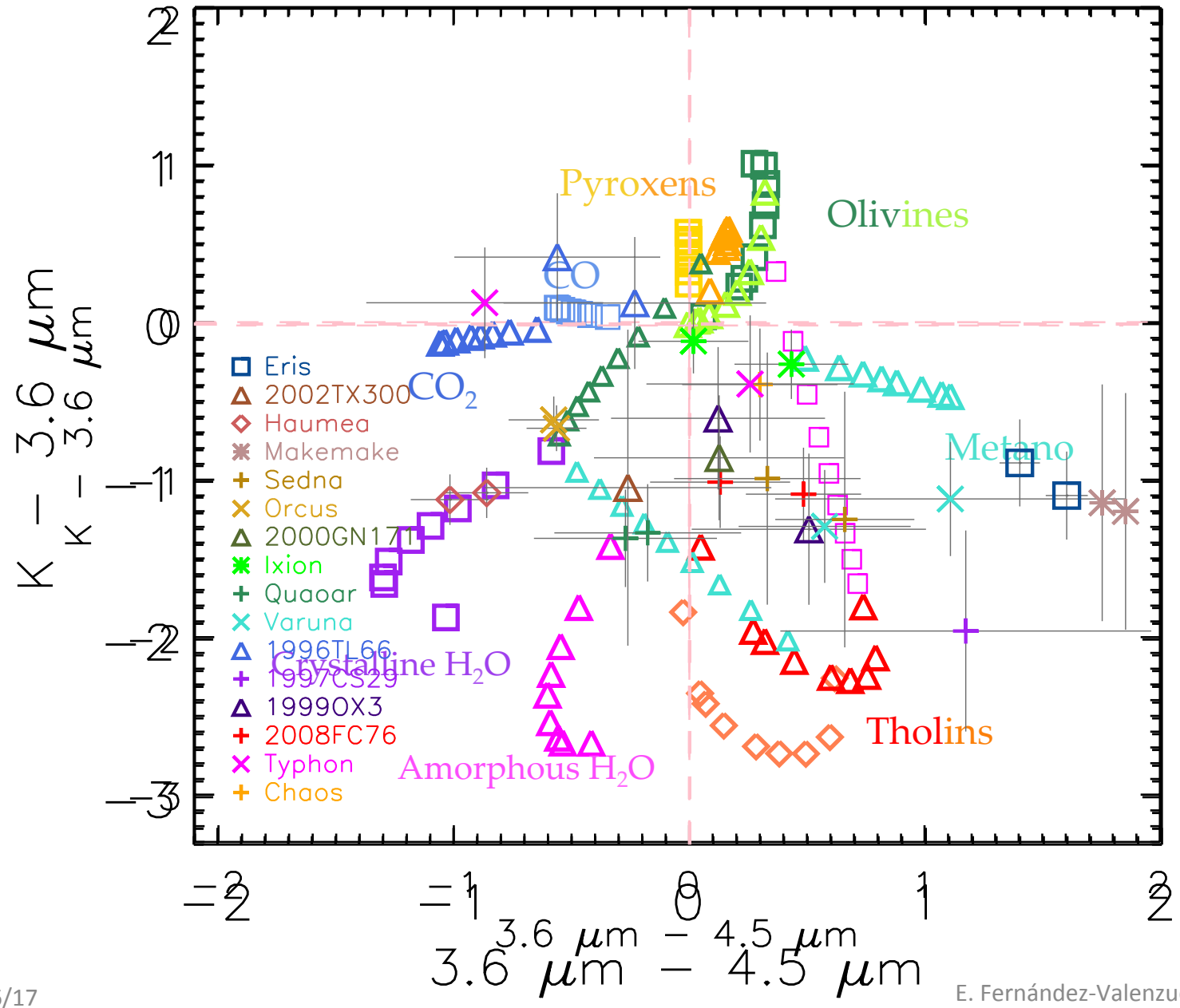
On going work

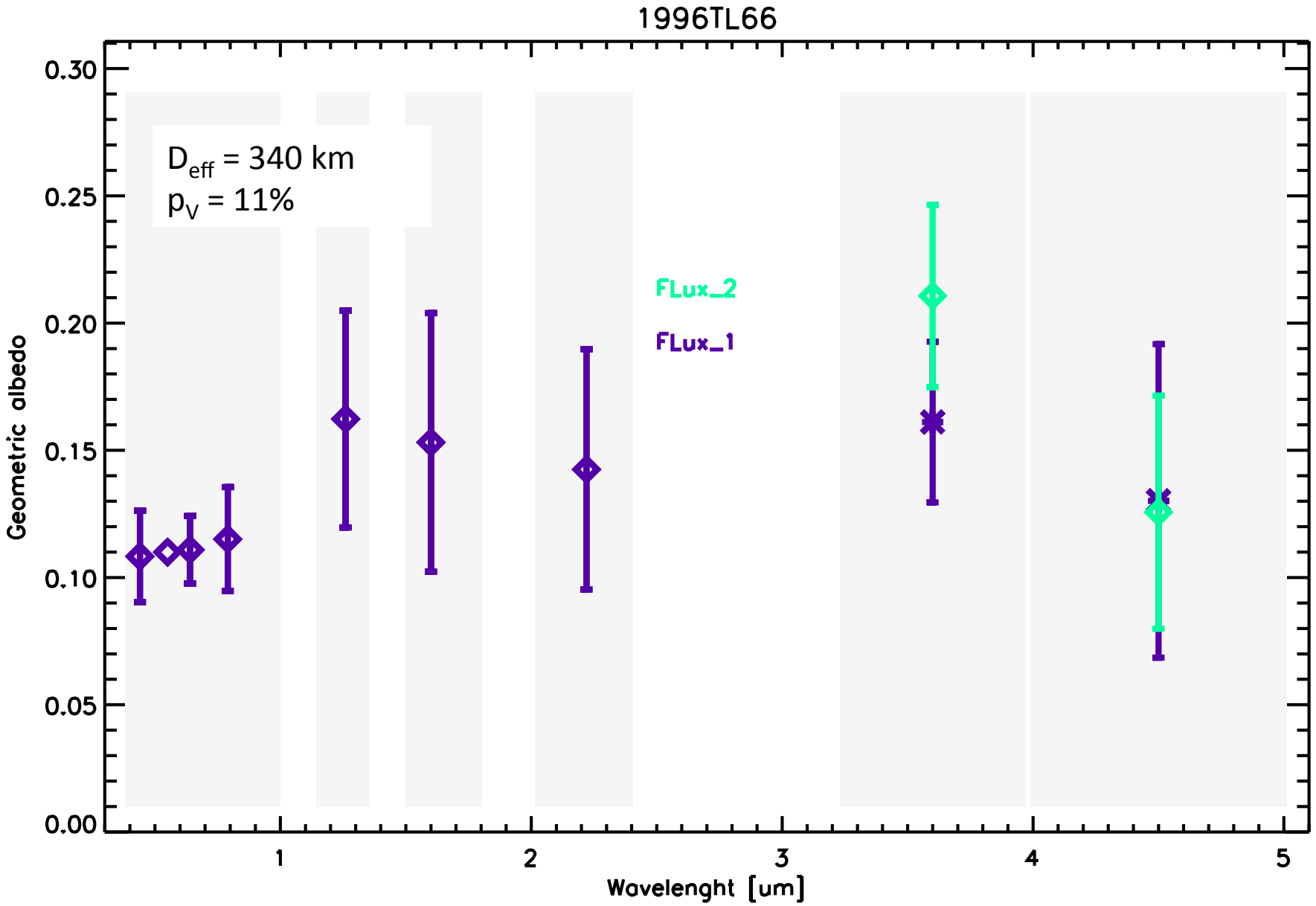
- How easy is to detect low amounts of CH_4.
- Which region corresponds to CH_3OH.
- Identification of exotic TNOs.

From www.dailymail.co.uk

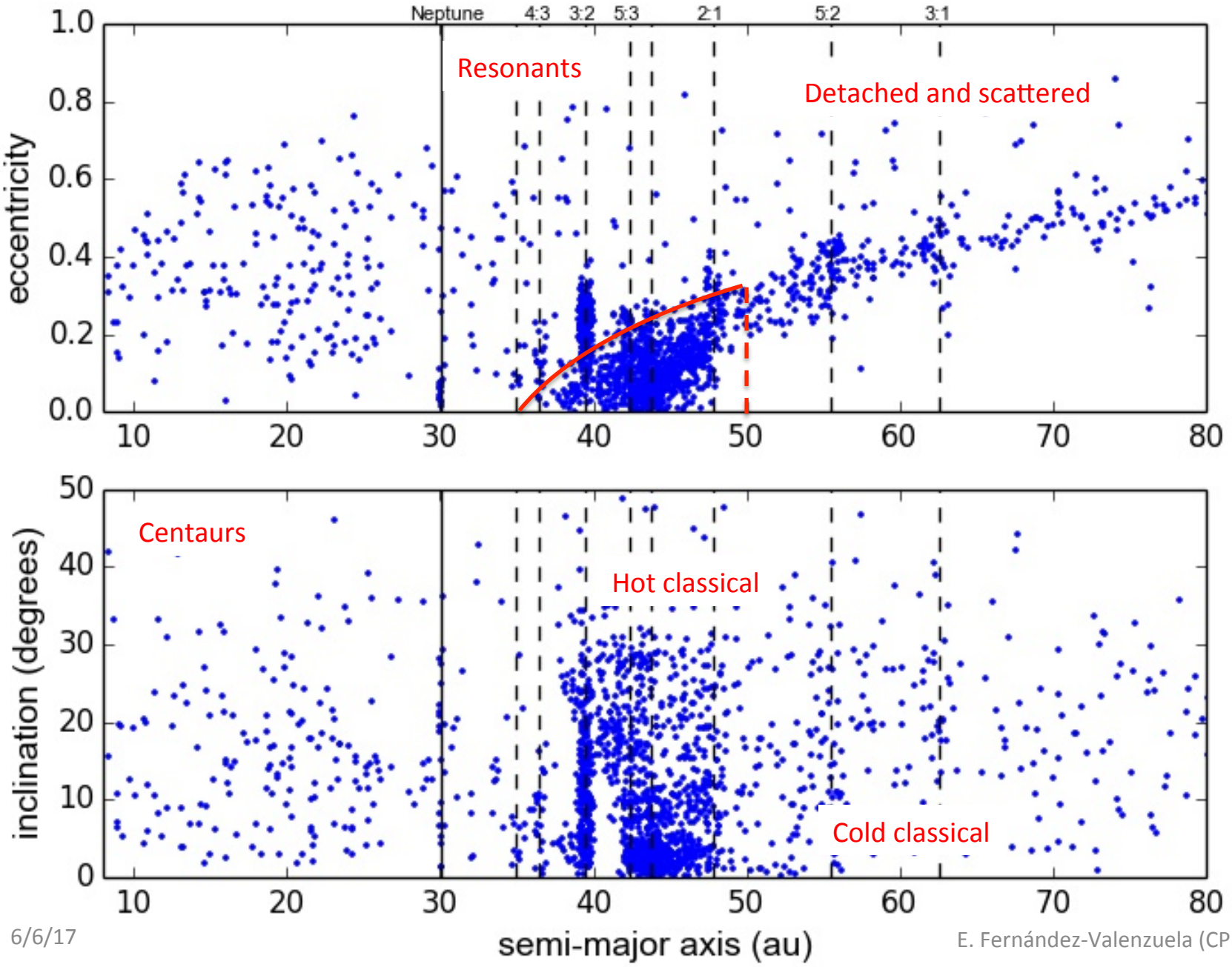

Pluto without correction
Pluto corrected
Silicates
Volatiles
Methane
Organics
H_2O
Eris
2002TX300
Haumea
Makemake
Sedna
Orcus
2000GN171 N?
Ixion T
Quaoar
Varuna
1996TL66 T
1997CS29
1999OX3 T
2008FC76 N?
Typhon Y
Chaos N
K − 3.6 μm
3.6 μm − 4.5 μm
2
1
0
−1
−2
−3
−2
−1
0
1
2

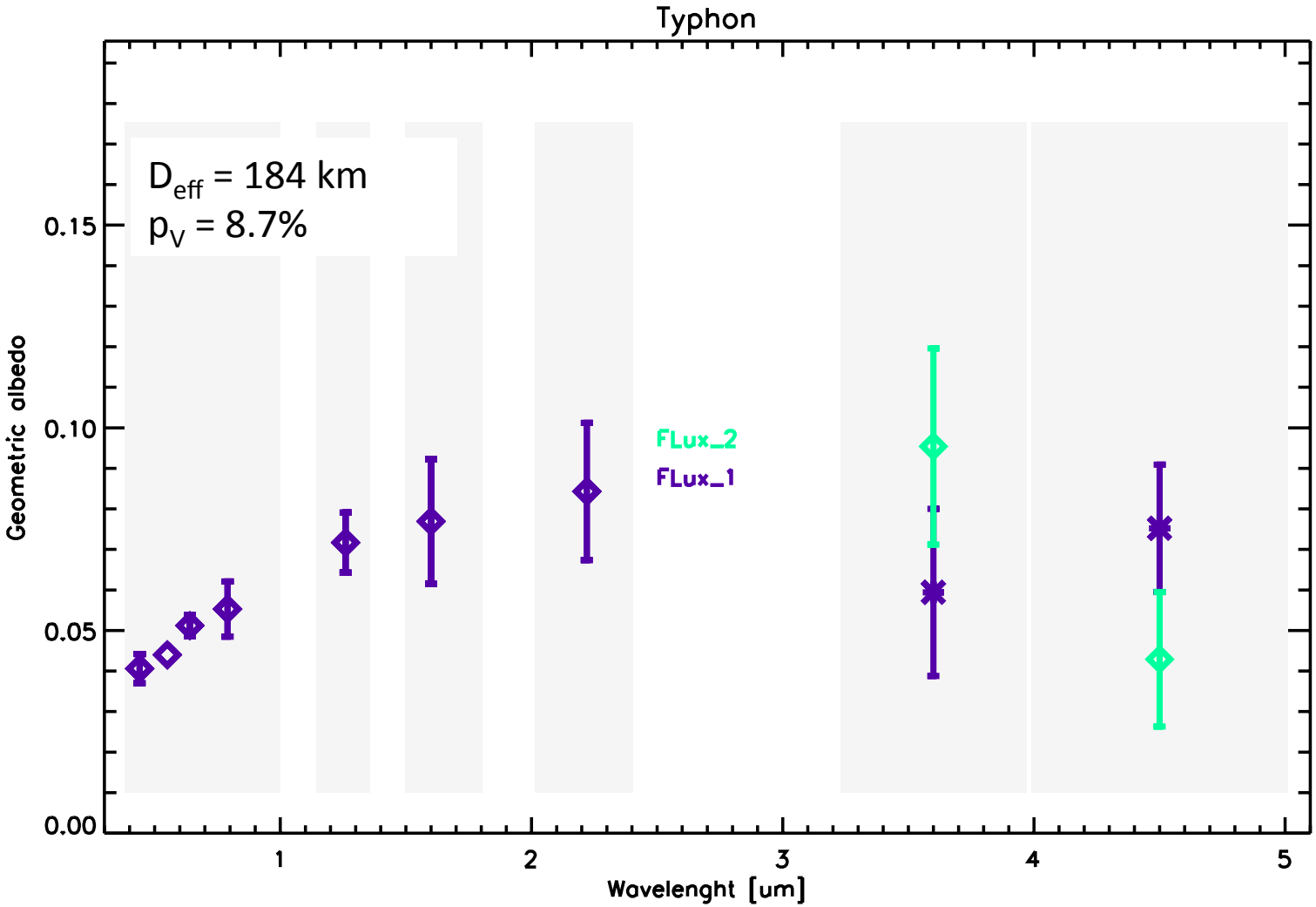

Silicates
Volatiles
Methane
Eris
2002TX300
Haumea
Makemake
Sedna
Orcus
2000GN171 N?
Ixion T
Quaoar
Varuna
1996TL66 T
1997CS29
1999OX3 T
2008FC76 N?
Typhon Y
Chaos N
H2O
Organics
K − 3.6 μm
3.6 μm − 4.5 μm
2
1
0
−1
−2
−3
−2
−1
0
1
2


Pyroxens
Olivines
CO
CO_2
Metano
Crystalline H_2O
Amorphous H_2O
Tholins
Eris
2002TX300
Haumea
Makemake
Sedna
Orcus
2000GN171
Ixion
Quaoar
Varuna
1996TL66
1997CS29
1999OX3
2008FC76
Typhon
Chaos
K − 3.6 μm
3.6 μm − 4.5 μm
3.6 μm − 4.5 μm


1996TL66
D_{eff} = 340 km
p_V = 11%
FLux_2
FLux_1
Geometric albedo
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1
2
3
4
5
Wavelenght [um]

De Leon et al. (accepted)




Typhon
D_{eff} = 184 km
p_V = 8.7%
Geometric albedo
0.00
0.05
0.10
0.15
1
2
3
4
5
Wavelenght [um]
FLux_2
FLux_1

Our sample

Sample from "TNOs are cool"