

SEARCHING FOR A CONCENTRATION OF OLIVINE-RICH BODIES IN ASTEROID COLLISIONAL FAMILIES IN THE MAIN BELT

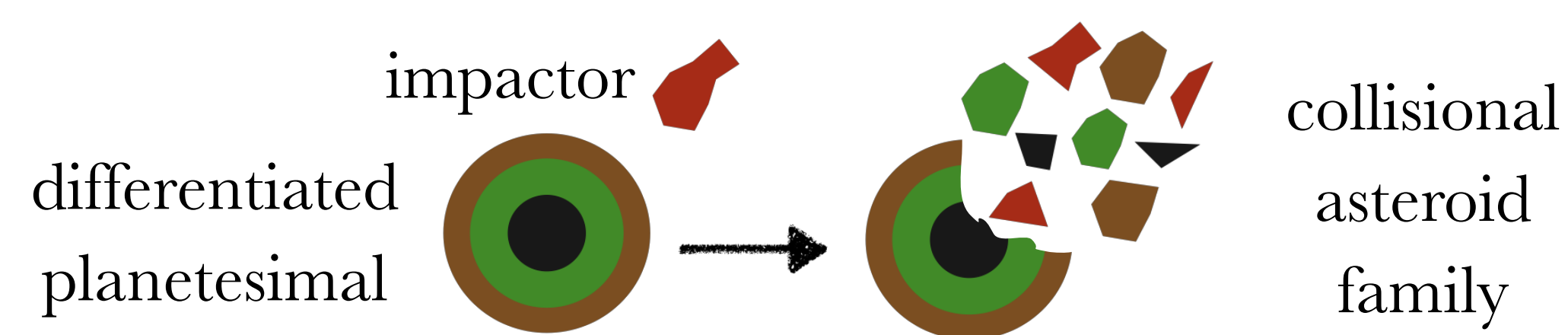
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INTRODUCTION

The "missing mantle problem"

- Planetesimals **differentiation**: formation of a basaltic crust, an olivine-rich mantle, and an iron core. [1]



- Observations: **scarcity of olivine-rich material in the main belt.**

- Olivine-rich asteroids are evenly distributed with **no statistically significant concentration in any asteroid family.** [2]

METHODS

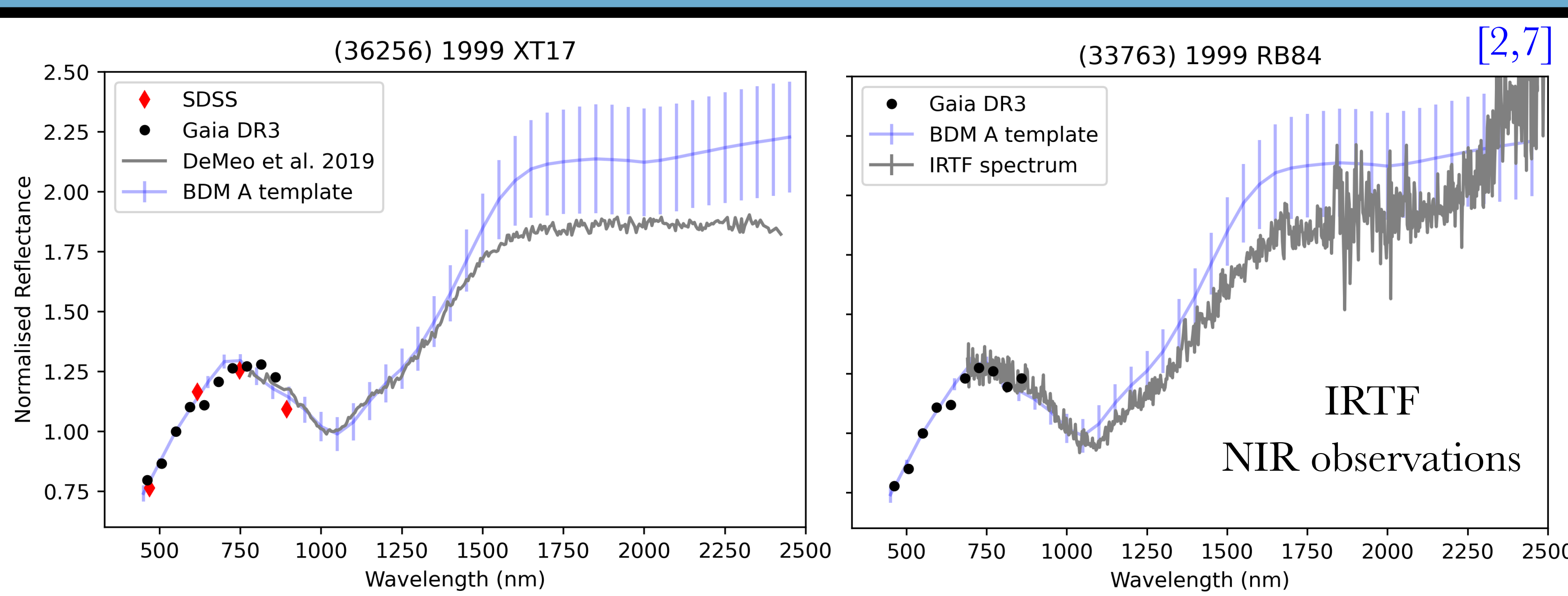
Curve-matching

- Classification of the 15 Gaia DR3 asteroids with a **curve-matching** method using **Bus-DeMeo templates.** [9]
- Calculation of a **reduced χ^2** based on χ^2 Gaia, χ^2 NIR and χ^2 SDSS [10]
- Wavelength range : [0.45-0.90] microns.

Asteroid Number	D (km)	p_V	Avg S/N	H	spectral class
15610	5.84	0.30	35.32	13.3	A, L
16789	6.62	0.18	38.25	13.5	A, Sv
20975	5.24	0.28	36.01	13.6	A, Sv
25356	-	-	66.49	12.8	A, Sa
27565	5.92	0.19	20.74	13.6	A, L
33763	-	-	48.07	13.4	A, Sa
34902	4.15	0.15	14.7	14.4	Sq, Sr
36256	10.21	0.19	66.56	12.4	A, Sa
40671	-	-	28.09	13.6	A, Sa
57276	7.20	0.31	128.7	12.9	A, Sv
66676	6.55	0.22	52.28	13.3	L, A
83124	-	-	14.88	14.7	S, Sr
88057	-	-	20.75	14.5	K, S
99004	3.83	0.10	13.93	14.6	L, A
140349	3.69	0.20	13.86	14.7	Sv, A

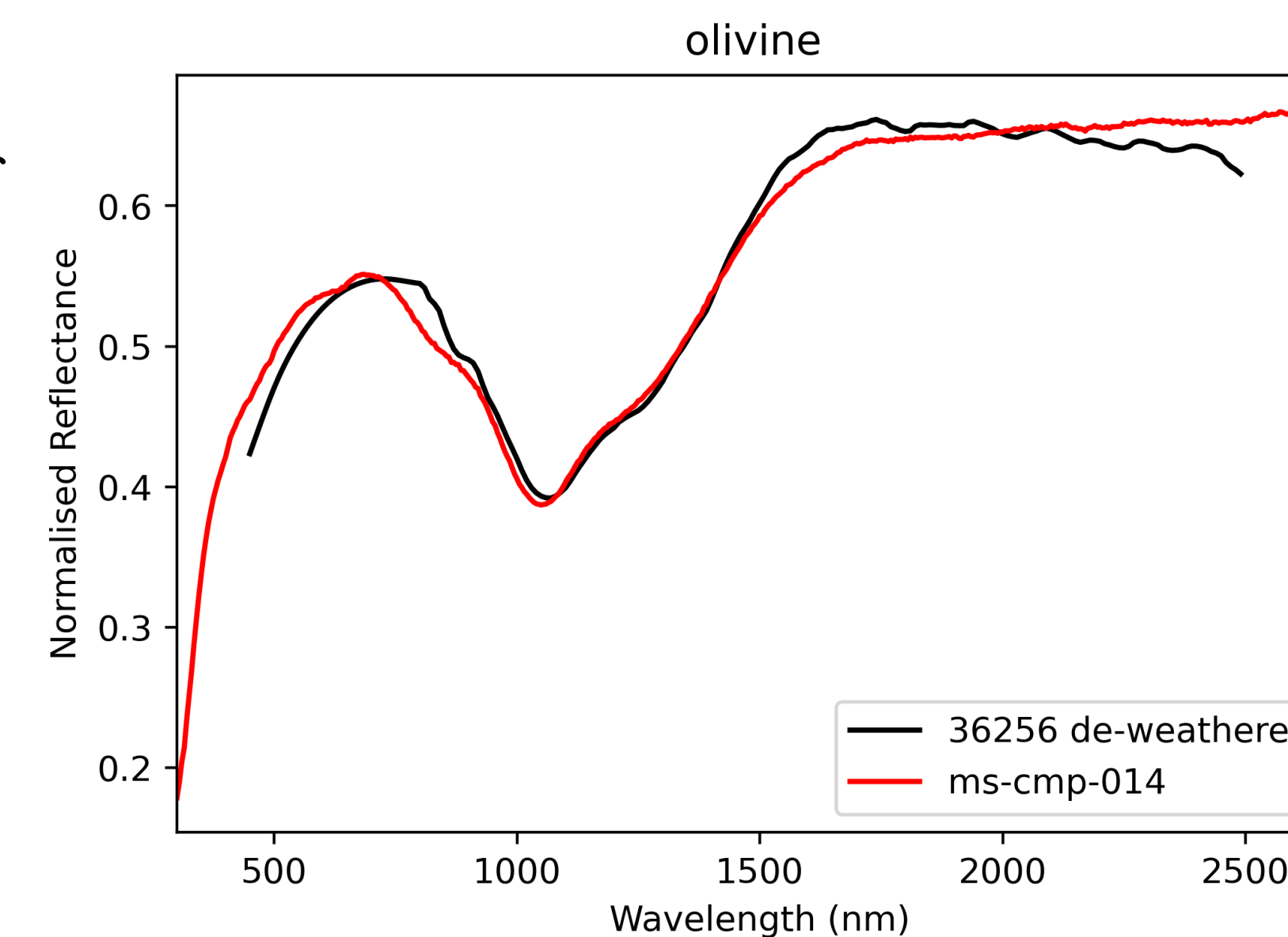
Literature

- 36256 : **NIR** spectrum + VIS photometry SDSS [2,7]
- 25356, 40671 : **NIR** colours MOVIS [5]
- 99004 : VIS SDSS [7]



Comparison with meteorites

- Ratio between the **VISNIR** spectrum of asteroids 36256 and 33763 and the spectra of **every sample of the Relab database**
- De-weather the asteroids spectra** using an exponential space weathering model [11]

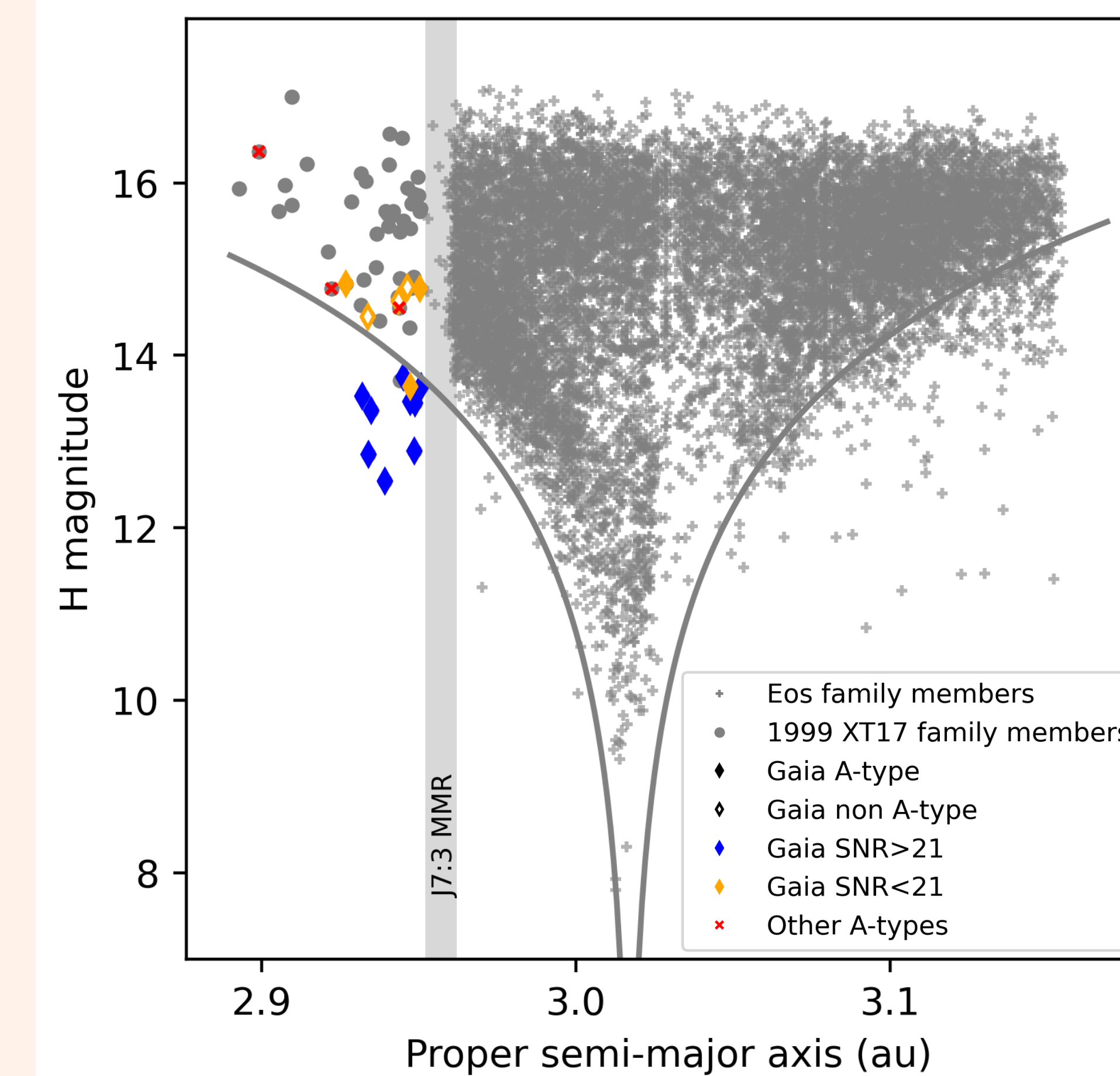


- Curve matching** method to find best meteoritical analogues of the de-weathered asteroid spectra.
- Calculate the **equivalent geometric visible albedo** of the meteorites to discriminate between the best spectral matches. [10,12]

RESULTS

12 out of the 15 asteroids having a Gaia spectrum are classified as A-type as first or second best class.

- 2 confirmed A-types from NIR spectroscopy
- 2 confirmed A-types from Gaia DR3 + NIR MOVIS
- 7 asteroids with a SNR < 21 : classification less reliable. Members of the S-complex
- Best meteoritical analogue: **olivine-rich meteorites**
 - CK6 meteorite LEW87009
 - R-chondrites Rumuruti and LAP04840, R4 chondrite MIL07440
 - Shergottite ALHA77005
 - Brachinites NWA4882 and ALH84025
- V-shape** : 8 asteroids SNR > 21, clustering outside the V-shape of Eos



Hypothesis:

- Some S-types are badly classified A-types
- Some S-types are interlopers in the family, part of Eos fugitives [13]
- A-types family: **breakup of a common olivine-rich parent body, once part of a differentiated body?**
- A-types + S-types family: parent body partially differentiated?

CONCLUSIONS

- Among the 36 family members classified, **16 are potential A-types** (44.4 %). Secondary class : 30.5 % of potential S-complex
- Best meteoritical analogues: **olivine-rich meteorites.**
- Need **NIR observations** to study more objects of the family and confirm or rule-out the different scenarios.

Gaia DR3 spectral dataset
Dataset of **60 518 reflectance spectra in the visible wavelength range** ([374,1034] nm) of Solar System small bodies, released in the **Gaia DR3.** [3]

(36256) 1999 XT17 family

- 57 members
- located in the pristine zone of the main belt (2.825 - 2.955 au)
- 15 asteroids have a Gaia DR3 reflectance spectrum.**

Literature:

- 36256 is an **A-type** from NIR spectroscopy [2]
- 25356, 40671, 76627 are **Ad-type** from MOVIS colours [5]
- 27565, 34902, 66676, 99004 are part of the **S-complex** from photometry [6,7,8]
- 58777, 201232, 254896 are **A-types** from photometry [6,7,8]
- 7 are **S-complex** asteroids from photometry [6,7,8]
- others: L, K, C, D, V or X from photometry [6,7,8]

Goal

Determine if the 36256 family contains a concentration of olivine-rich bodies using Gaia DR3 spectral data.



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REFERENCES

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- [5] Popescu et al. (2018)
- [6] Carvano et al. 2010
- [7] DeMeo & Carry (2013)
- [8] Sergeev et al. (2022)
- [9] DeMeo et al. (2009)
- [10] Avdellidou et al. (2022)
- [11] Brunetto et al. (2006)
- [12] Beck et al. (2021)
- [13] Broz & Morbidelli (2019)