

Visible-Infrared Spectroscopy of Ungrouped and Rare Meteorites Brings Further Constraints on Meteorite-Asteroid Connections

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Introduction

Study of meteorites brings us information on the Solar System and its evolution. To **interpret** their data in the larger context of the Solar System we need to **link** these meteorites to their source asteroids.

What we know

> 1.000.000 asteroids
~ 50 groups of meteorites
95-148 parent bodies represented in our collections
15-20 chondrites' parent bodies
11-17 parent bodies for ungrouped chondrites [1]

Meteorite collections

50 grouped meteorites
50 ungrouped iron meteorites
50 ungrouped chondrites [2]

Link meteorites - asteroids

VIS-NIR infrared spectra comparison
- In lab: 25 ungrouped meteorites (mostly chondrites) or from rare groups
- Telescopic analyses: 24 asteroid classes [3]

VIS-NIR spectra of meteorites compared to spectra of asteroids acquired

Our samples: petrographic groups

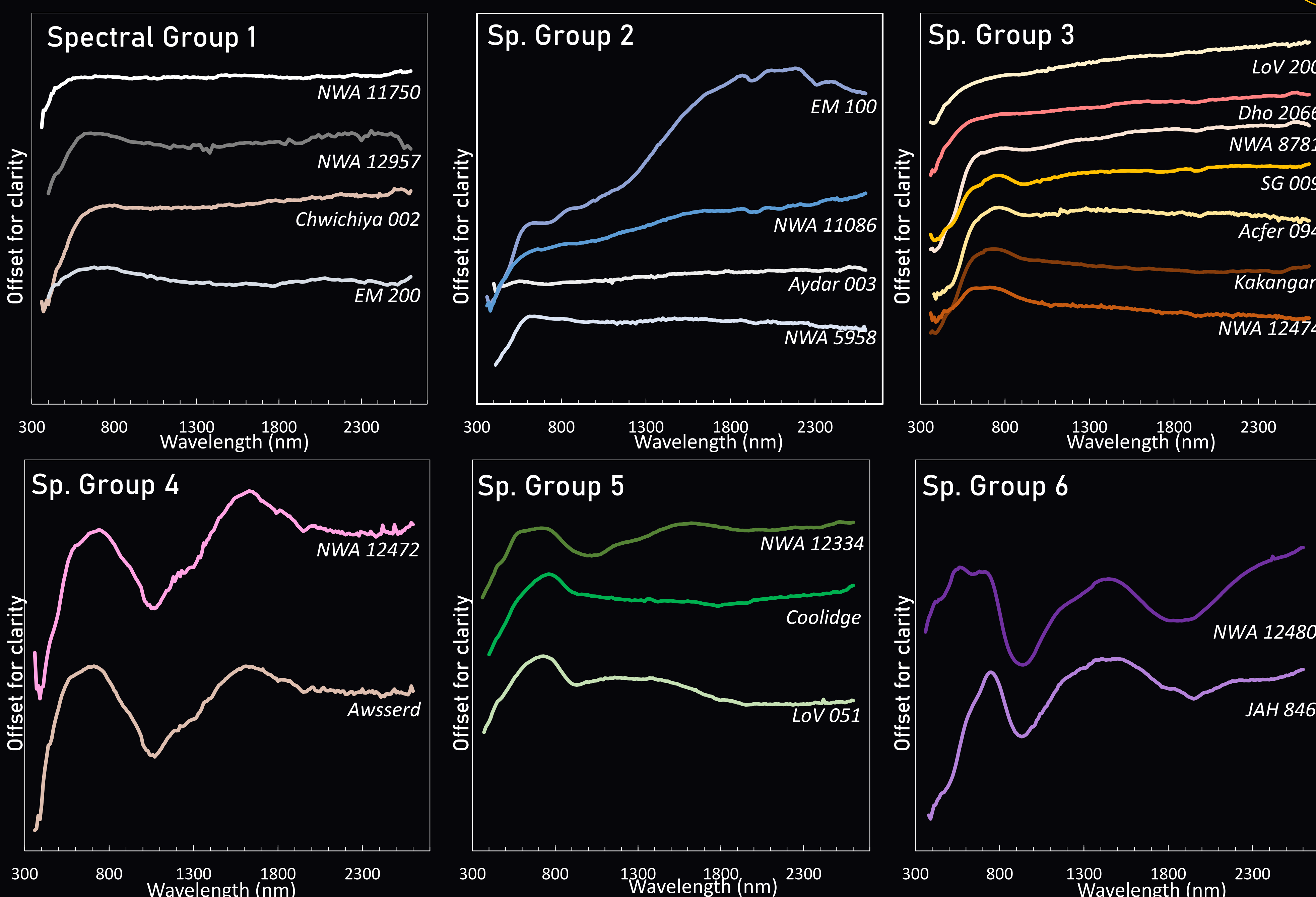
Group A	Group B	Group C	Group D	Group E	Group F
No thermal metamorphism No aqueous alteration	No thermal metamorphism Small aqueous alteration	Small thermal metamorphism Small aqueous alteration	Rumuruti chondrites	Significantly metamorphosed	Highly metamorphosed and achondrites
<i>CM-like petrography</i>	<i>CM-like petrography</i>			<i>CV and CR-like petrography</i>	
Chwichiya 002 (C3.00-ung) NWA 11750 (C3.00-ung) NWA 12957 (C3.00-ung) Acfer 094 (C2-ung)	Aydar 003 320 (CM1/2) NWA 11086 (CM-an) EM 100 (C2-ung) NWA 8781 (C-ung) NWA 5958 321 (C2-ung) EM 200 (C3)	LoV 200 (CH3) Sierra Gorda 009 (Chon-ung) NWA 12474 (CR3.1) Dho 2066 (C-ung) Kakangari (K)	Awsserd (R4) NWA 12472 (R3)	Sahara 00177 (C3/4-ung) LoV 051 (C3-ung) Coolidge (C4-ung) <i>Ordinary-like petrography</i> Jah 846 365 (OC3)	NWA 12334 (LL6-an) Mulga West (C5/6-ung) NWA 12480 (acapulcoite) NWA 6592 (lodranite)



VIS-NIR reflectance spectra of ungrouped meteorites

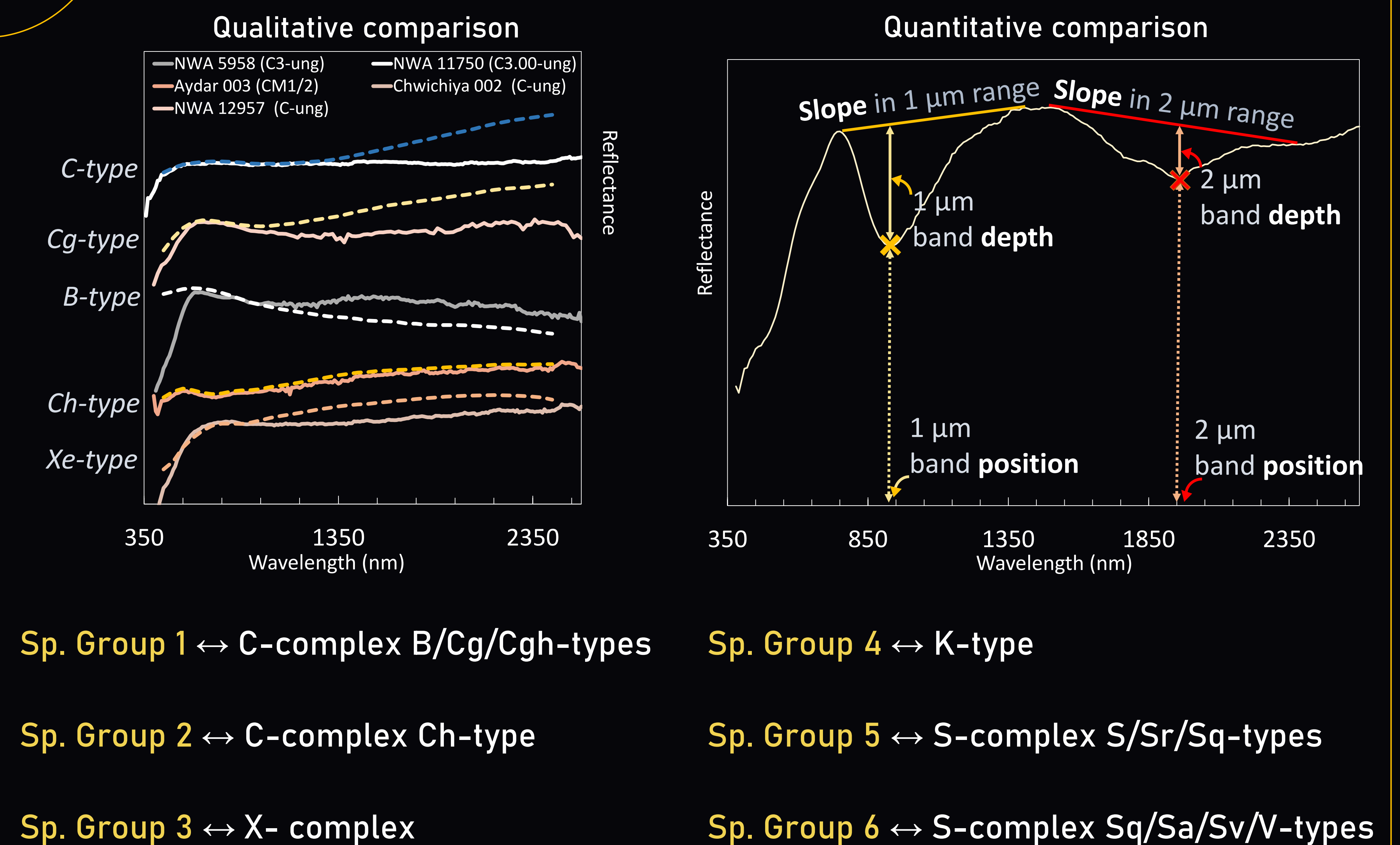
Spectral groups \approx petrographic groups

Spectra of meteorites done on Bulk powders and polished sections



Spectra comparison and meteorites-asteroids links

Quantitative and qualitative comparison between all meteorites and 28 types of asteroids



Sp. Group 1 \leftrightarrow C-complex B/Cg/Cgh-types
Sp. Group 2 \leftrightarrow C-complex Ch-type
Sp. Group 3 \leftrightarrow X-complex
Sp. Group 4 \leftrightarrow K-type
Sp. Group 5 \leftrightarrow S-complex S/Sr/Sq-types
Sp. Group 6 \leftrightarrow S-complex Sq/Sa/Sv/V-types

Difference of Bulk and Powders in asteroids-meteorites links

Matching asteroids-meteorites : Polished section \approx Bulk \neq Powder

\rightarrow Current meteorites-asteroids matching done on powder samples

\rightarrow Asteroid surfaces more complex than only regolith (ex : Bennu)

Need to refine current asteroids-meteorites links adding bulk spectra analyses

Conclusion

Unlinked asteroids to new ungrouped meteorites

B- and Cg-types asteroids \leftrightarrow C3,00 ung (Chwichiya 002, NWA 11750, NWA 12957)

Xe-type asteroids \leftrightarrow Slightly metamorphosed and aqueously altered ungrouped CCs

Complexifying known asteroids-meteorites links ?

S-types asteroids (linked to OCs) \leftrightarrow Sp. Group 5 and 6 (metamorphosed CCs)

Unknown asteroids ?

Sp. Group 2 \leftrightarrow Ch-type + hydration (resembling asteroid *Bennu* ? [4])