

Beyond classification: Building Italy's National Collection of Extraterrestrial Material (CoNME)

T. Cuppone, X. Shehaj, A.R. Landi,

A. Franza, G. Pratesi

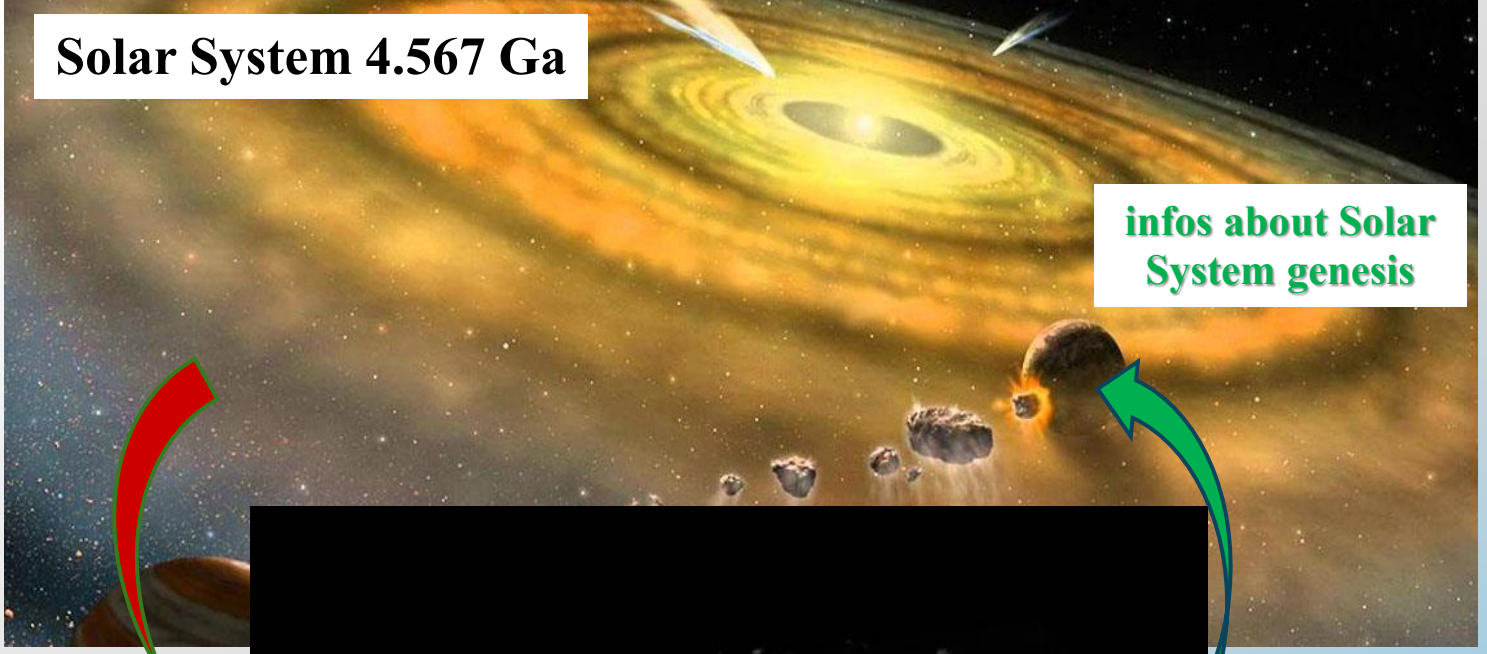
Museo di Scienze e Archeologia - Fondazione Museo Civico di Rovereto, 6-7 novembre 2026 Rovereto (TN)

UNIVERSITÀ DEGLI STUDI FIRENZE
DST DIPARTIMENTO DI SCIENZE DELLA TERRA
INAF ISTITUTO NAZIONALE DI ASTROFISICA
iaps

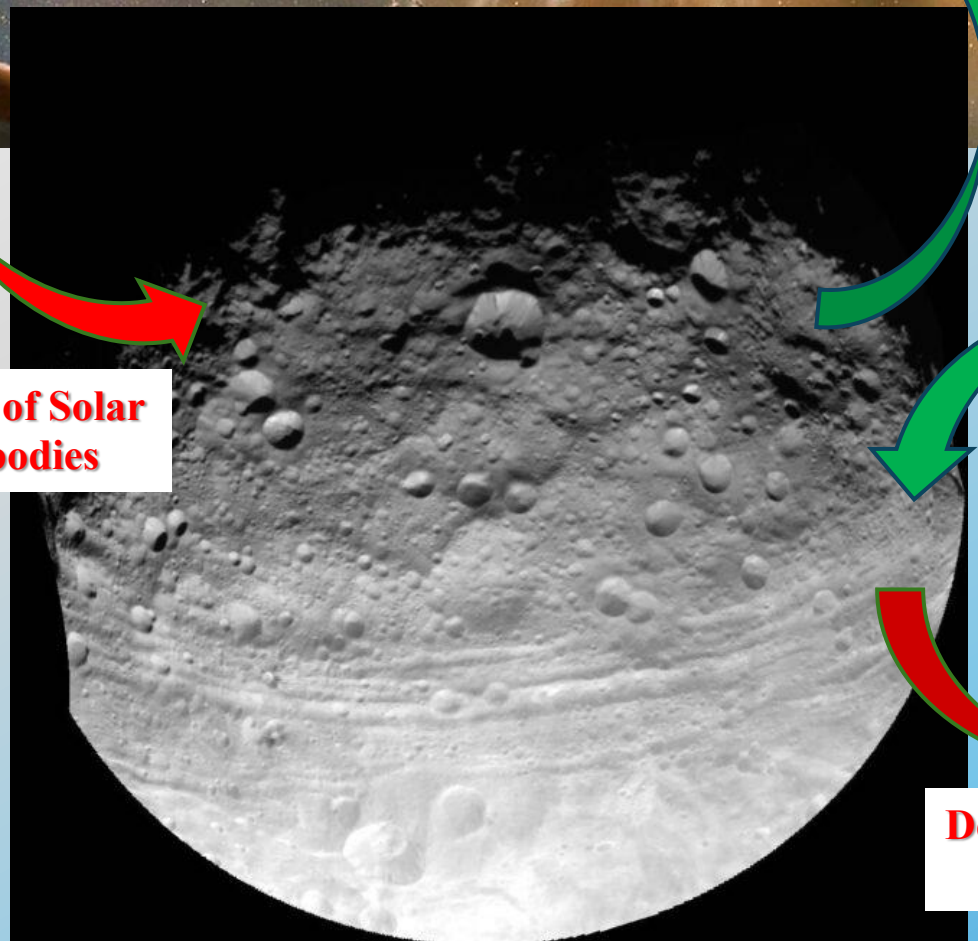
From space to Earth…

The possibility of unraveling the Solar System's history, especially if done by studying a piece of extraterrestrial rock (i.e. a meteorite), tantalized scientists in the last two centuries.

A **meteorite** is a fragment of a planetary body (rocky planet, moon, asteroid, comet) that lands on another planetary body (Earth).



infos about Solar System genesis



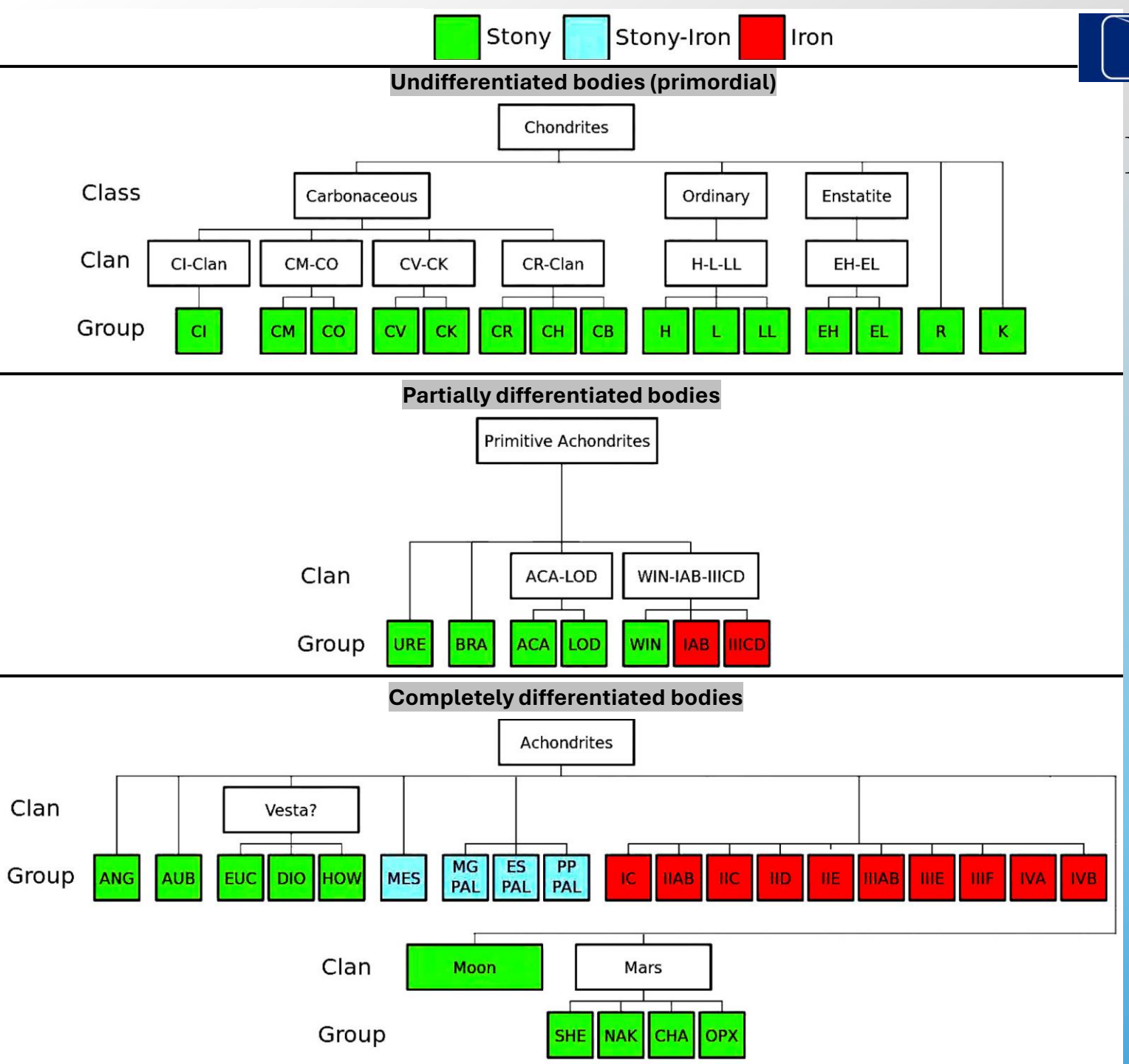
Formation of Solar System bodies

Delivery to Earth of rocky fragments



From meteorites infos about parental bodies

Meteorite!



How do we classify a meteorite?

Until november 6th, 2026, 80673 meteorite classified on Meteoritical Bulletin DataBase (MBDB) in 47 groups (others not yet official)

Criteria for meteorites classification:

- **petrographic** (texture, modal proportions)
- **mineralogic** (mineral compositions)
- **geochemical** (whole rock composition)
- **isotopic systematic** (elemental isotopic ratio composition like O, Cr and many others)

How do we study a meteorite?

Sample preparation before analyses: cutting, polishing, casting in epoxy resin…



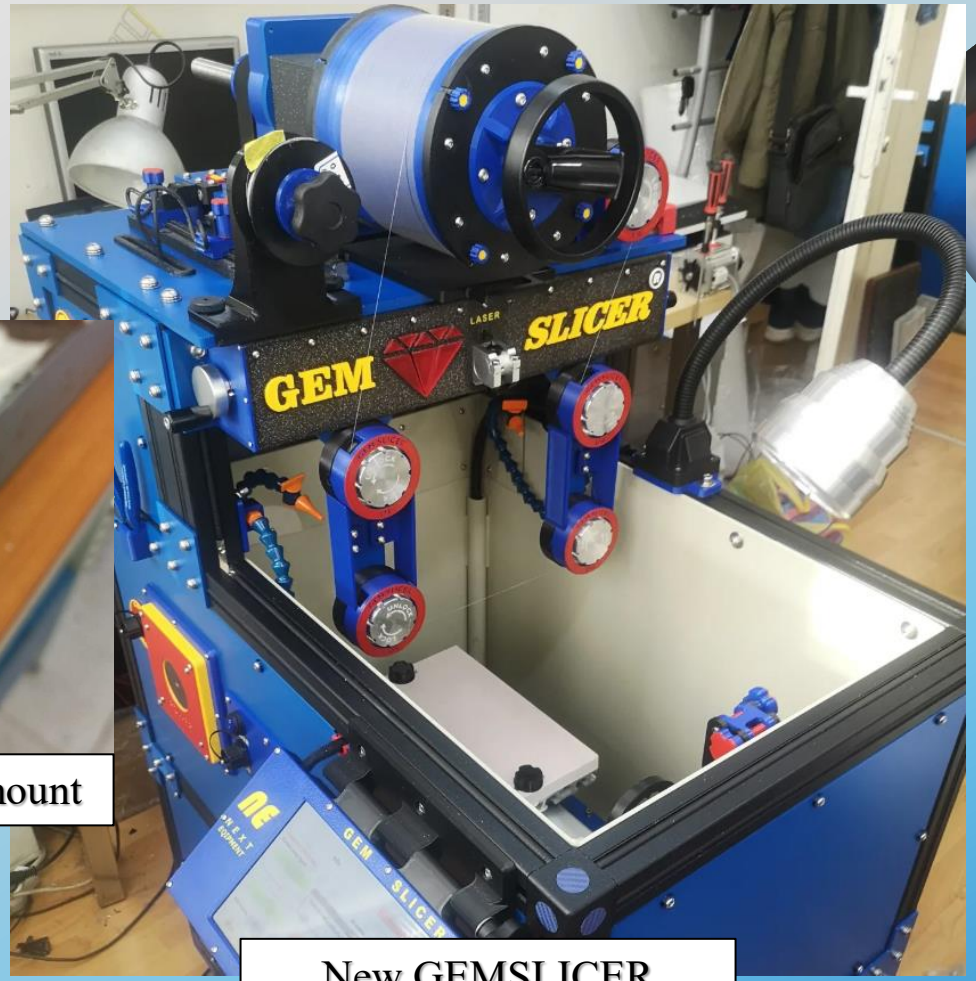
Cutting machine



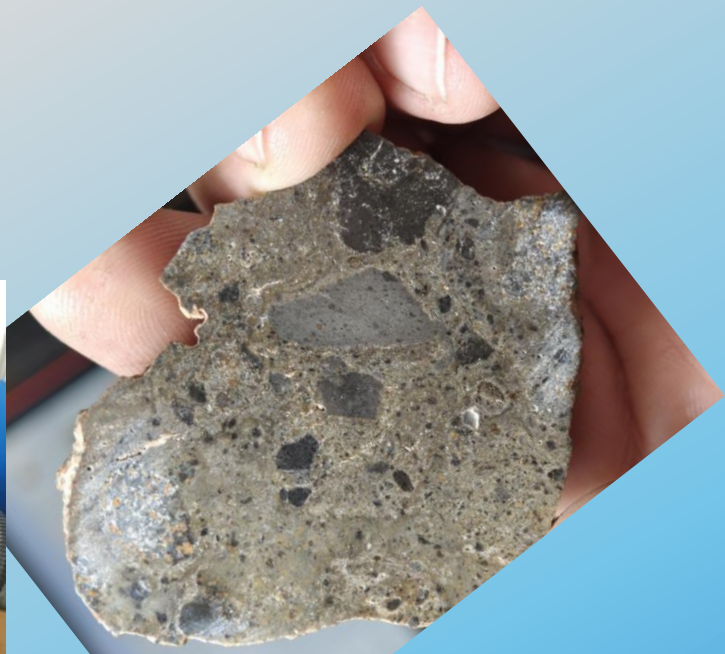
1 inch epoxy mount

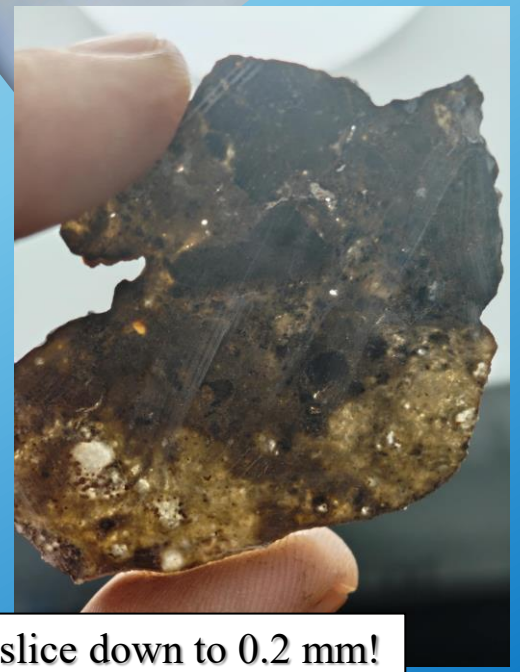


Polishing machine



New GEMSLICER cutting machine with numeric control coming!

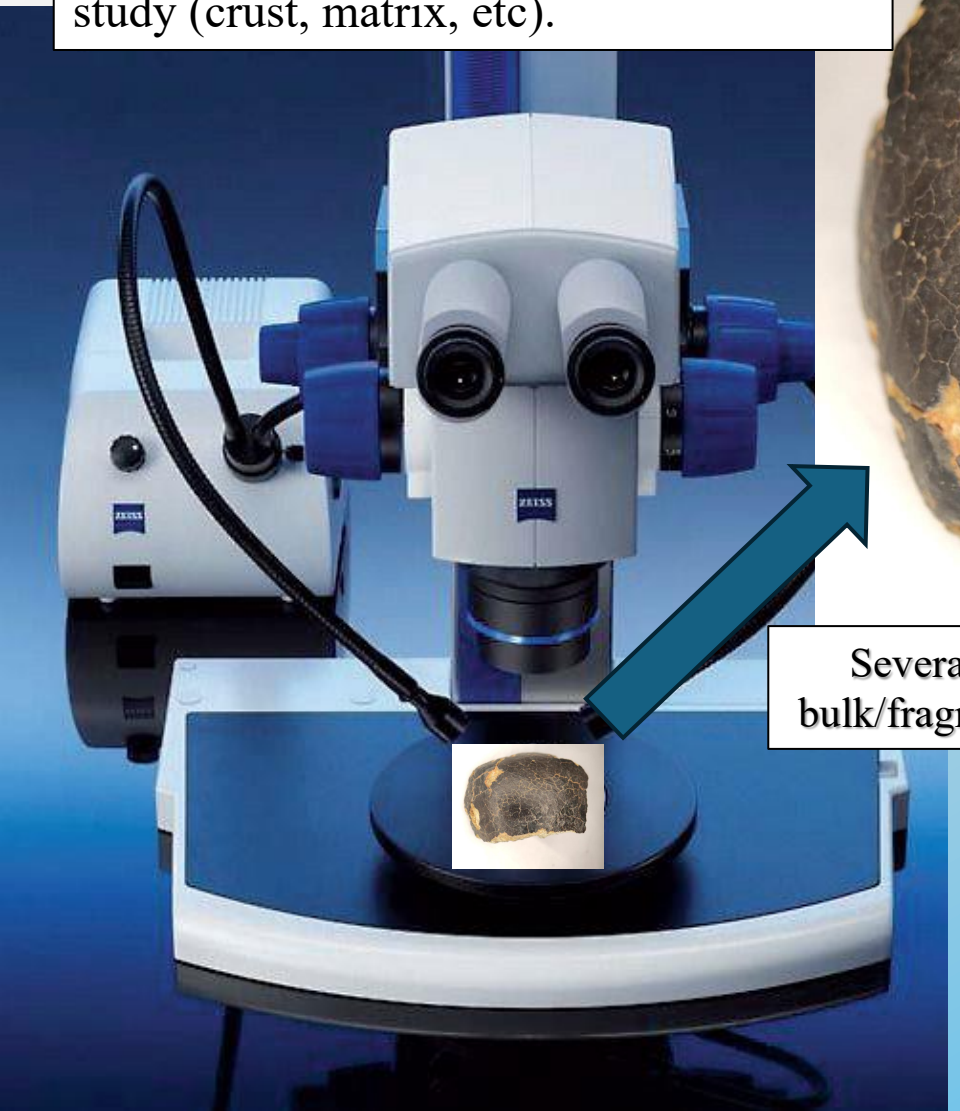


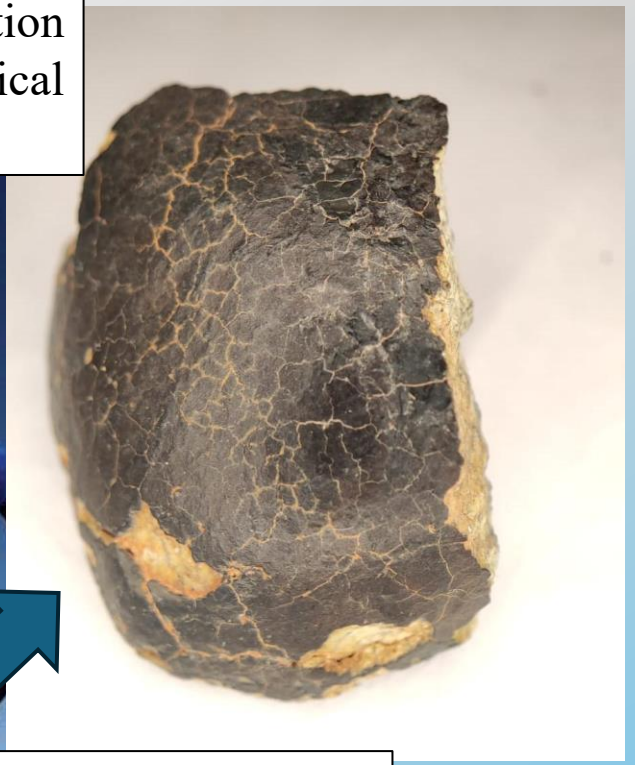


Thin slice down to 0.2 mm!

How do we study a meteorite?

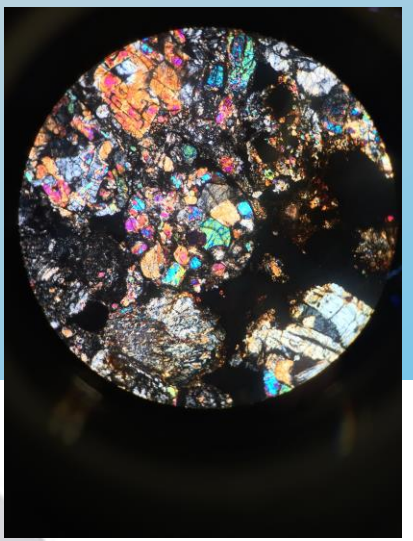
Stereomicroscope for low-magnification of bulk samples for a first morphological study (crust, matrix, etc).





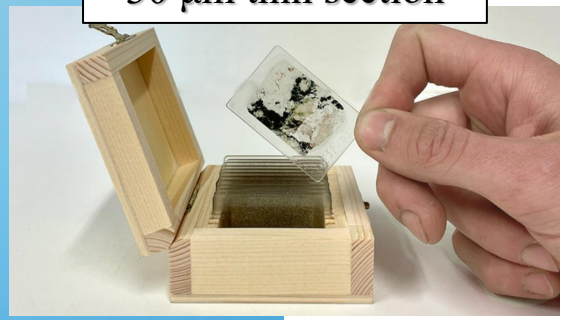
Several cm-size bulk/fragment sample

Polarizing petrographic microscope to study mineral optical properties and textures





30 µm thin section



How do we study a meteorite?

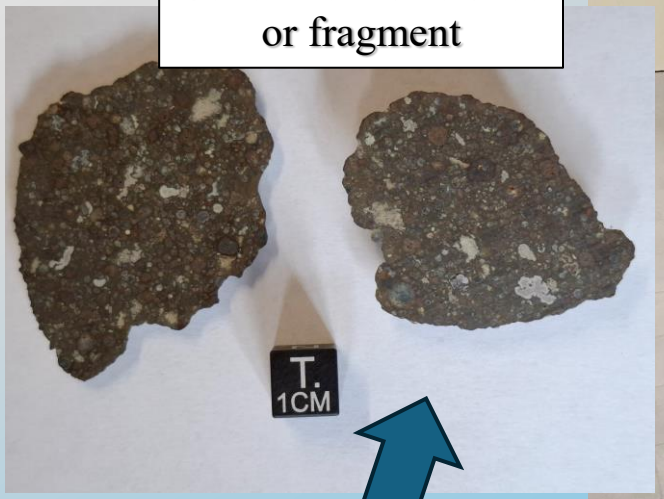
Two scanning electron microscopes, a FEG-SEM-EDS Hitachi SU-8700 and SEM-EDS Zeiss EVO MA15.

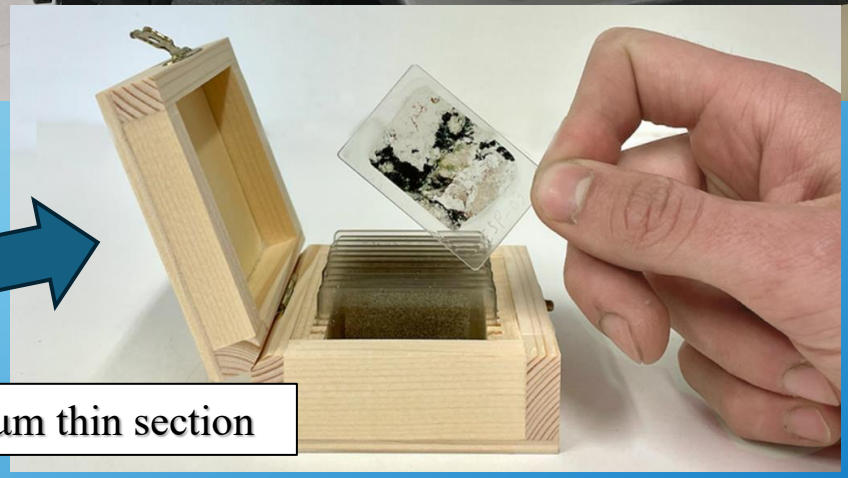


1 inch epoxy mount



Several cm-size slice or fragment

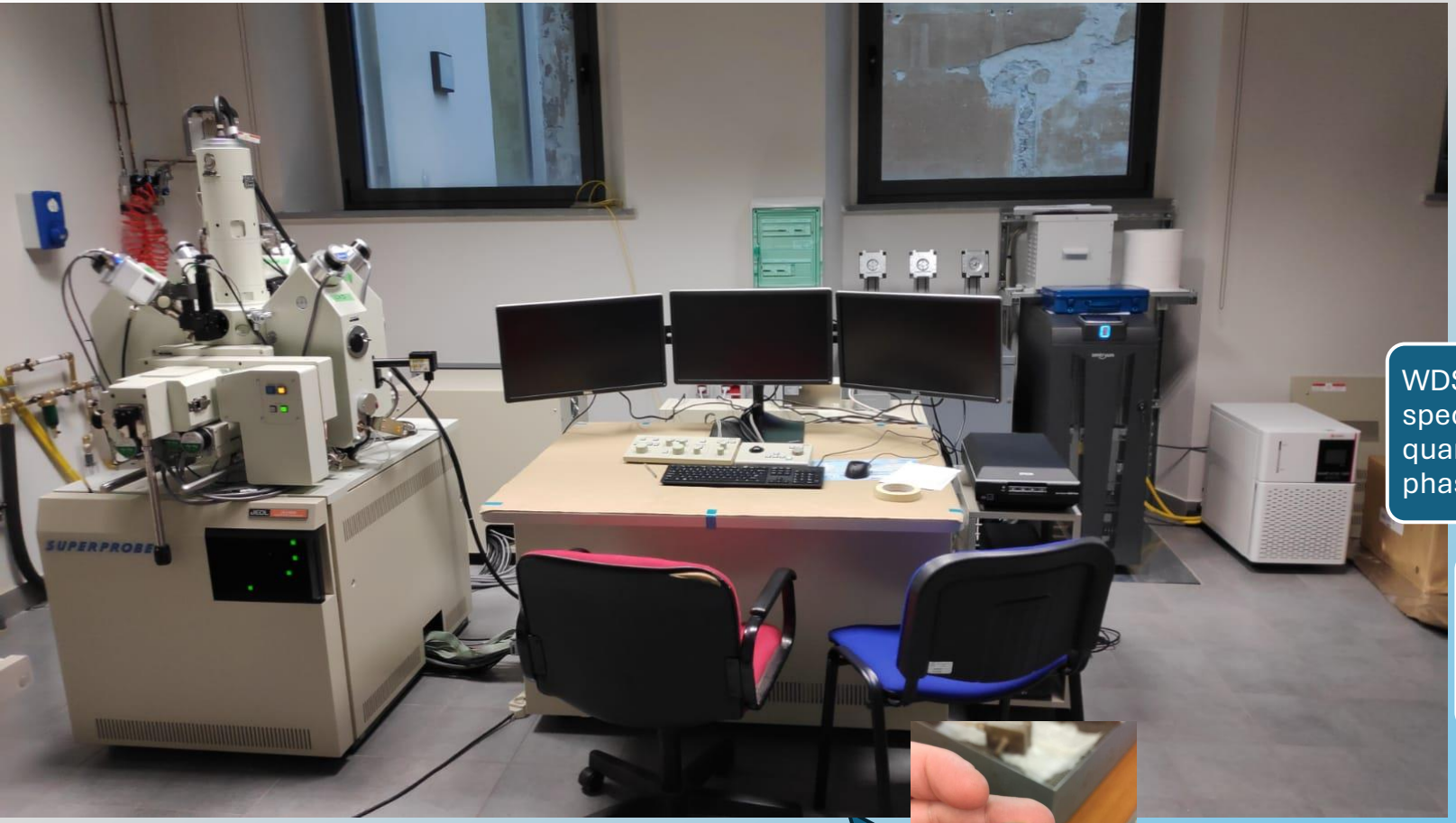




30 µm thin section

Possibility to analyze a meteorite in different formats!!

How do we study a meteorite?



Electron microprobe analyzer (EMPA) JEOL Superprobe JXA-8230 of CNR-IGG

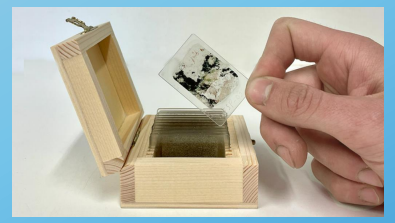
WDS (Wavelenght dispersive spectroscopy) microanalysis for a quantitative (very PRECISE!) mineral phase punctual/raster/areal composition

Area multi-elemental mapping (for modal mineralogy, phase chemical zoning)

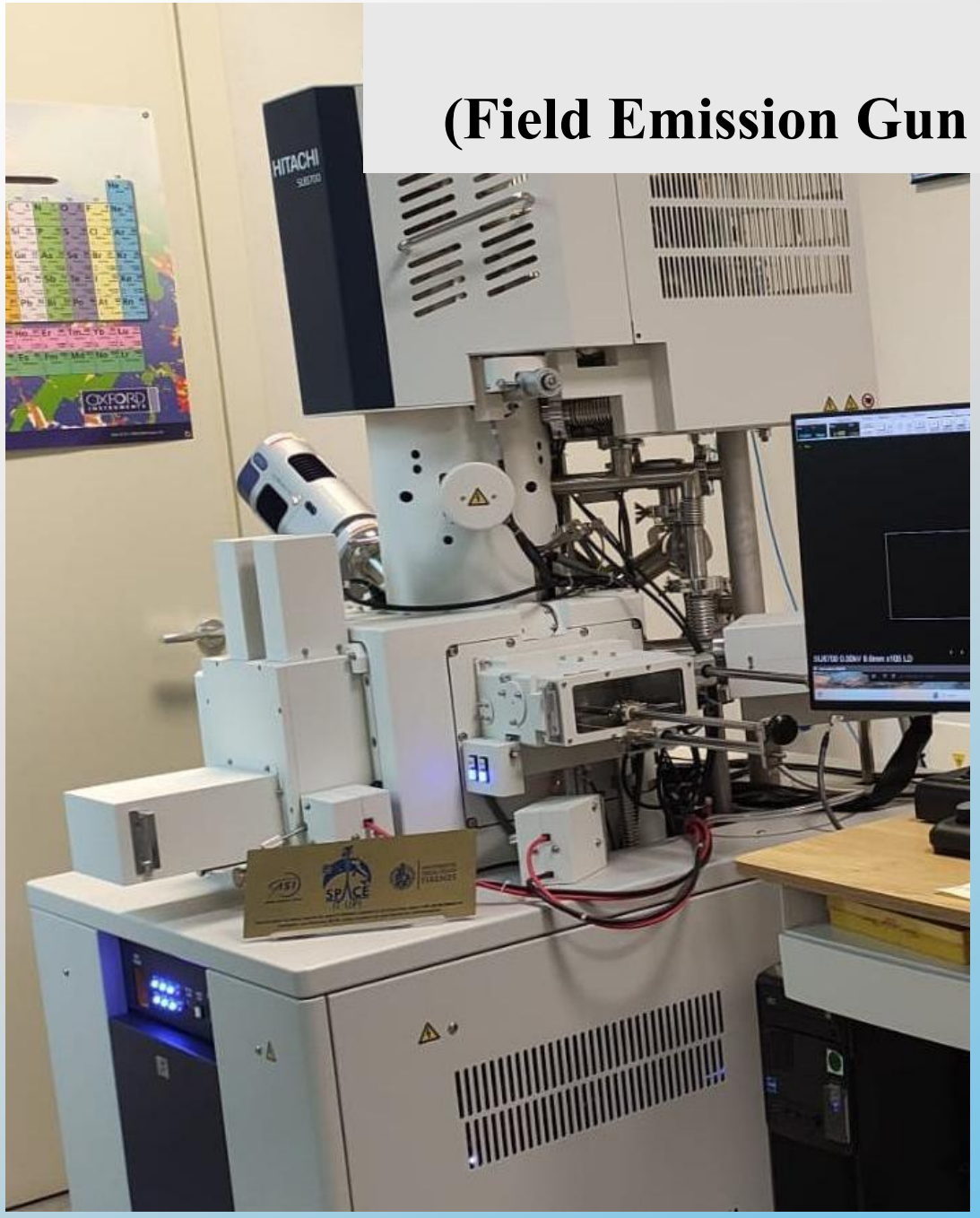
High-resolution (1 micron, with optimized analytical conditions) topographic and morphology imaging

Analyses possible only on epoxy mounts and thin section.





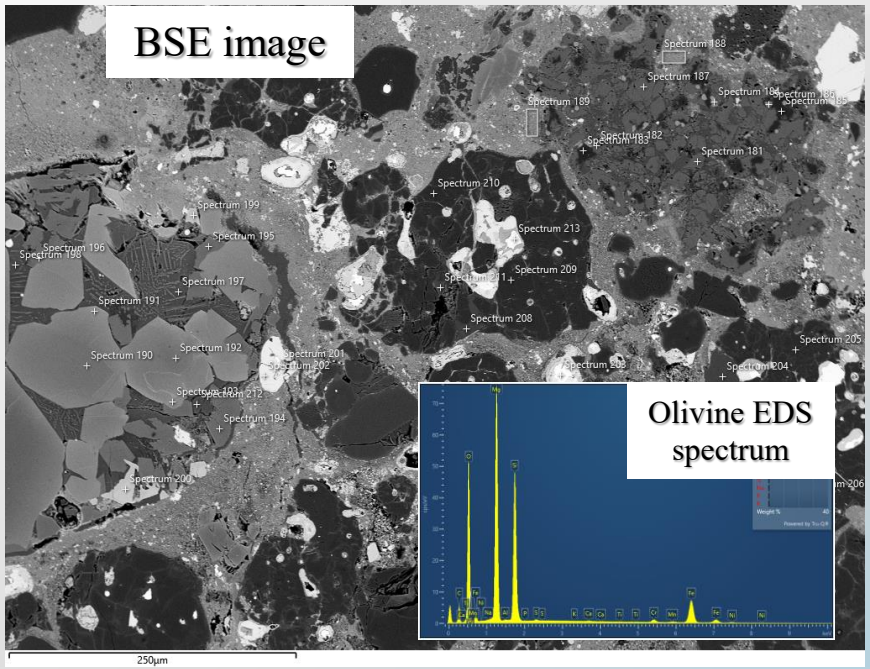
FEG-SEM
(Field Emission Gun – Scanning Electron Microscope)

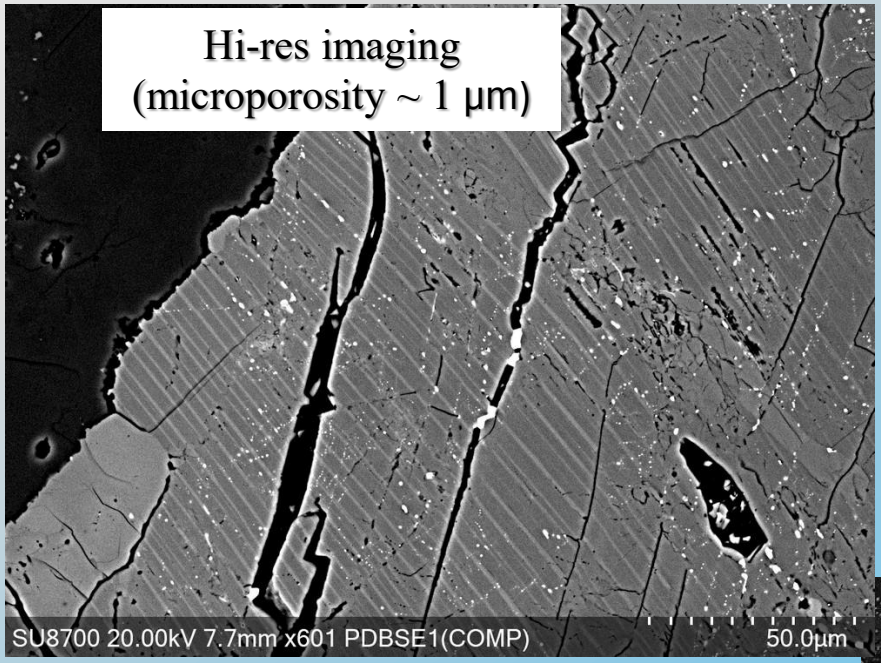


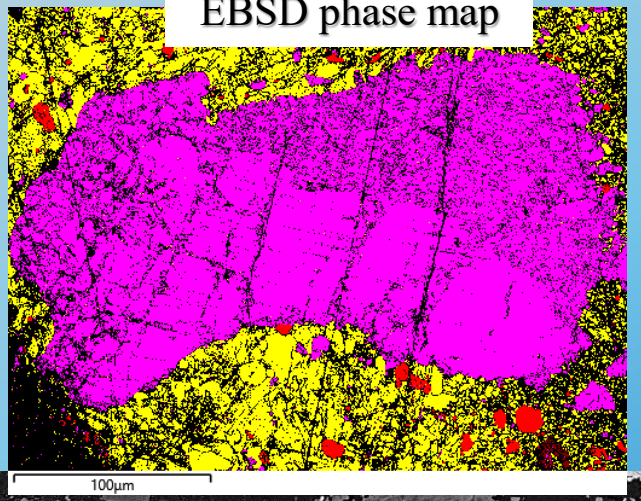
The Hitachi SU-8700 is a state-of-art instrument has been recently acquired with SpaceIt Up! funds. It is installed at MEMA (Centro Servizi di Microscopia Elettronica e MicroAnalisi, Dipartimento di Scienze della Terra - UniFI) and it is equipped for multiple analytical tasks:

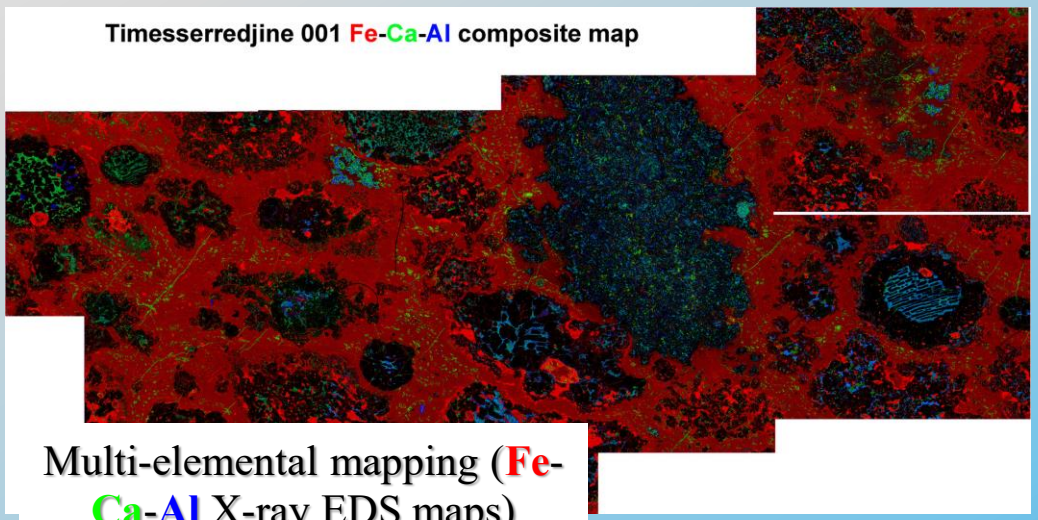
- EDS (Energy dispersive spectroscopy) microanalysis for a semi-quantitative mineral phase punctual composition
- Large area multi-elemental mapping (for modal mineralogy, phase chemical zoning)
- High-resolution (0.8-1 nm, with optimized analytical conditions) topographic and morphology imaging
- EBSD (Electron Back-Scattered Difraction) analyses for microstructural and crystallographic orientation

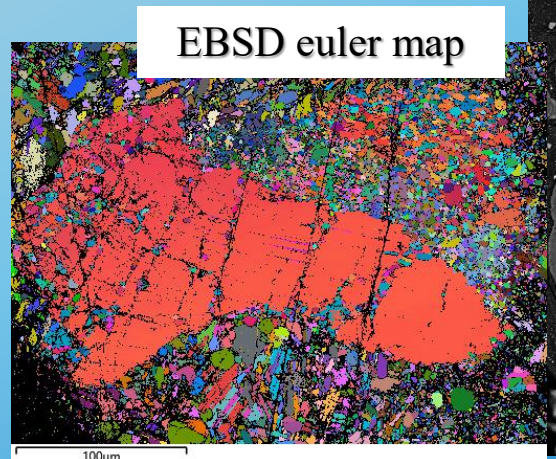
FEG-SEM
(Field Emission Gun – Scanning Electron Microscope)

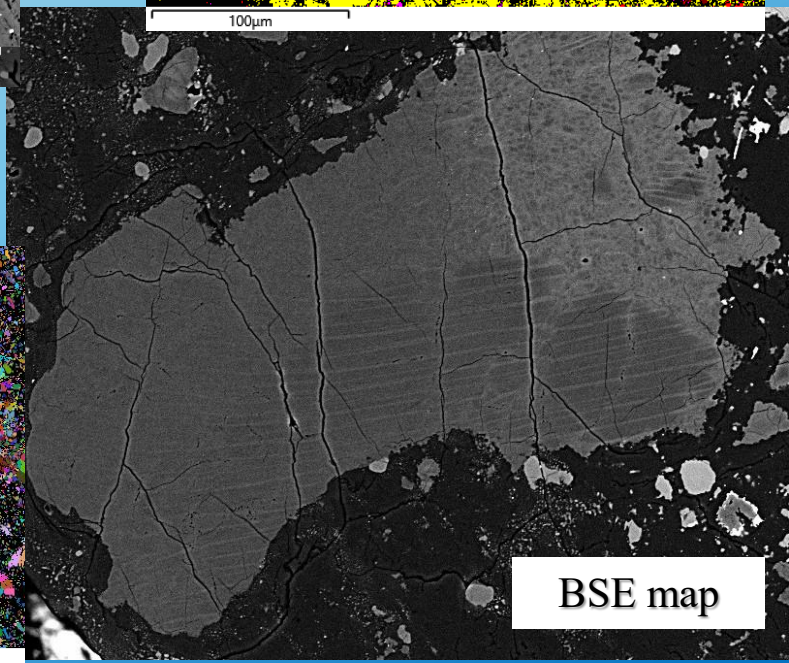












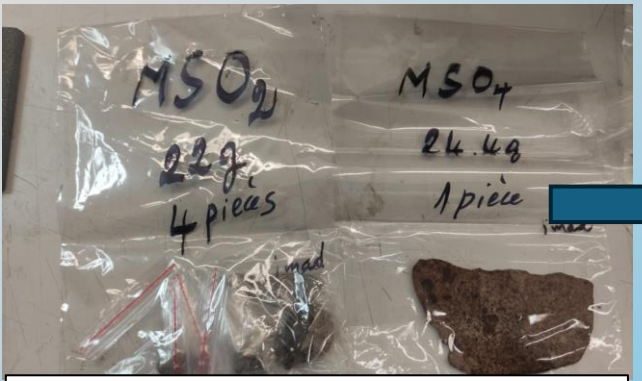
Classification activity

We have a wide network of meteorite supplier, from:

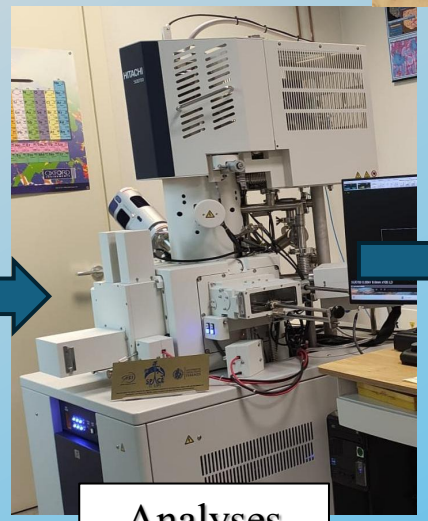
- Italy
- United States of America
- Chile (south America)
- Northwest Africa (Morocco, Algeria, Western Sahara, Mauritania)

Usually these are known and trustfully meteorite dealer, other are meteorite hunters.

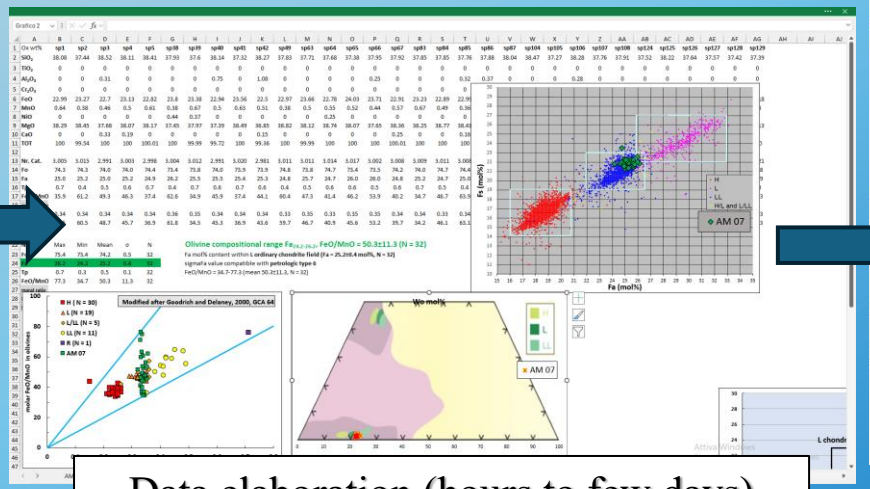




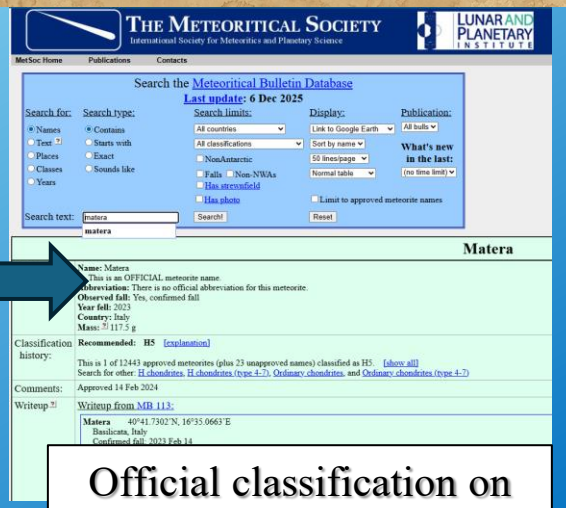
Unclassified meteorite (20-40 gr)



Analyses



Data elaboration (hours to few days)



Official classification on MBDB (weeks to months)

Classification activity results

From the beginning of activity (Jan'25), **173** samples have been analyzed, 134 of them are genuine meteorites (39 are terrestrial rocks). But we are still working and many new samples are waiting for a classification!

B88 | LC 11

LISTA delle CLASSIFICAZIONI UNIFI (dal 1 gennaio 2025)

Working name (Pratesi)	Working name (pers.collec.)	Proposed classification	OC	CC	Other chondrites	HED	prim. Acho.	Lunar	Mars	iron rich	other acho.	Terrestrial	Official MBDB
LC 01		Lunar						x					NWA 16717
LC 03		Lunar						x					NWA 16718
LC 06		Lunar						x					Tisserlitine 005
LC 07		Lunar						x					Tisserlitine 006
NA 001		CO 3.0-3.1		x									NWA 17489
NA 002		H5	x										NWA 17492
NA 003		LL 3.9-4.0	x										NWA 17490
NA 004		Eucrite breccia				x							NWA 17941
NA 005		L/LL 3.5-3.6	x										NWA 17493
ML 01		Aubrite									x		Timimoun 003
ML 02		Lunar						x					Adrar 017
ML 03		Lunar						x					Ourgla 008
ML 04		L5/6	x										NWA 18219
ML 05		OC4	x										NWA 18220
ML 06		LL3.5	x										NWA 18221
ML 07		ureilite					x						NWA 18222
ML 08		Eucrite				x							NWA 18223
ML 09		diogenite				x							NWA 18224
ML 10		L3.9	x										NWA 18225
ML 11		CK3-5		x									NWA 18226
OB 001 (K13)		ureilite					x						NEA 121
OB 002 (K23)		H6 breccia	x										NWA 18120
OB 003 (K26)		H6	x										NWA 18121
H24		LL6	x										NWA 18839
H25		L6	x										NWA 18840
H23		terrestrial										x	
H27		ureilite					x						

TOT CAMPIONI

N = 173

OC	72	41.6%
CC	11	6.4%
Other chond.	2	1.2%
HED	17	9.8%
Prim. Achon.	9	5.2%
Lunar	18	10.4%
Mars	1	0.6%
Iron rich	3	1.7%
Other achon.	1	0.6%
TERRESTRIAL	39	22.5%
MBDB official	64	47.8%
Under revision	70	52.2%

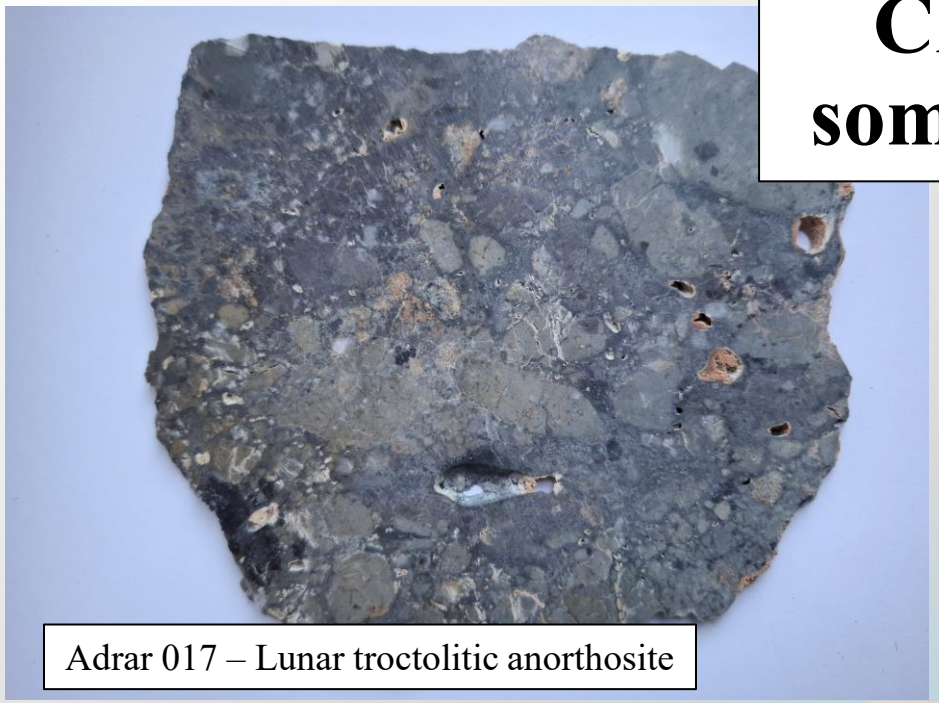
Almost 50% with official classification

The goal is to acquire the best meteorite samples (especially lunars) in order to increase the future **National Collection of Extraterrestrial Material (CoNME)**, a project supported by ASI, UniFi, UniPi, INAF, Comune di Prato and Regione Toscana.

Attiva Windows
Passa a Impostazioni per attivare Windows.

Foglio1

Classification activity: some classified meteorites



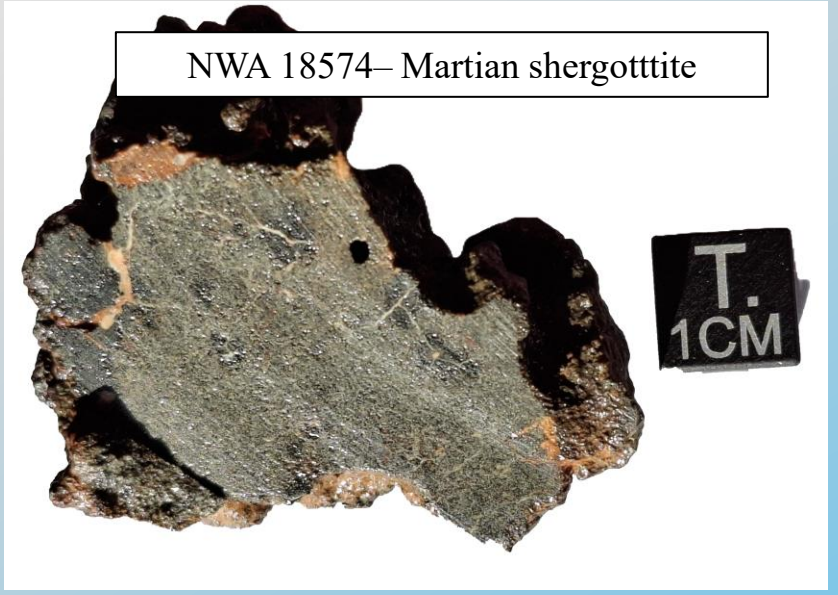
Adrar 017 – Lunar troctolitic anorthosite



NWA 18222 – Ureilite



Ouargla 008 – Lunar fragmental breccia



NWA 18574– Martian shergotttite



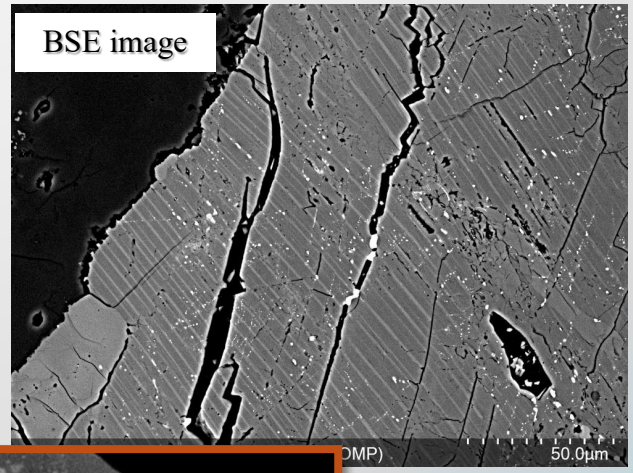
NWA 18573 – Lunar feldspatic breccia

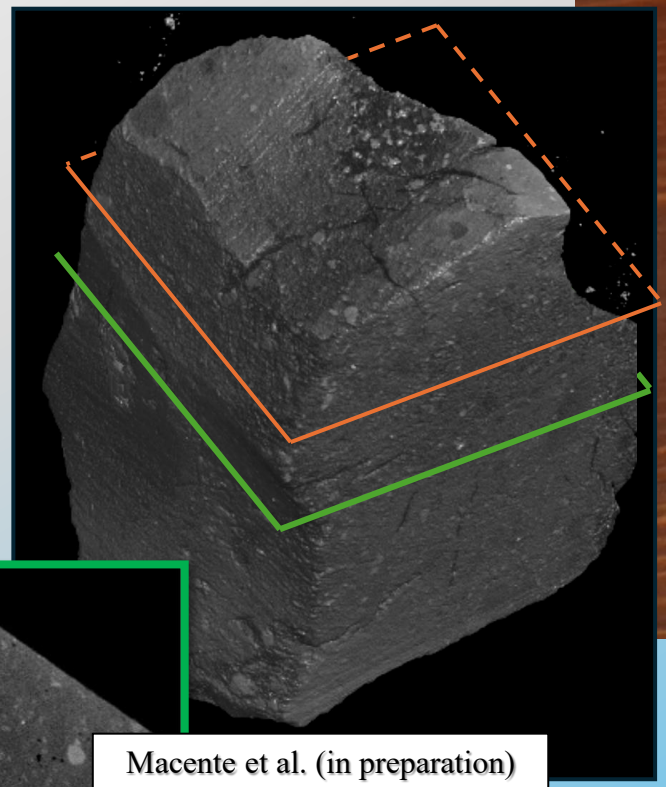


NWA 18489 – Lunar feldspatic breccia

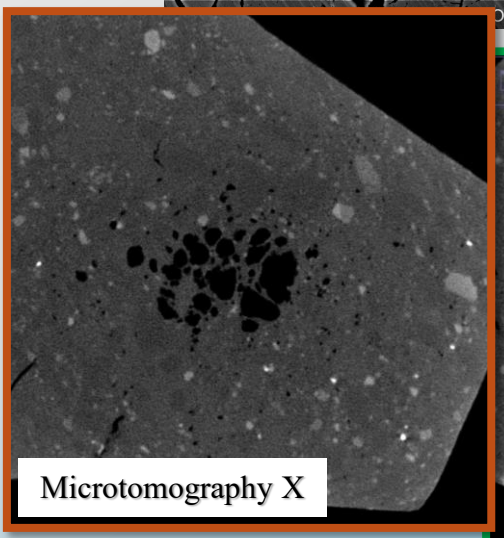
Classification activity (case study #1)

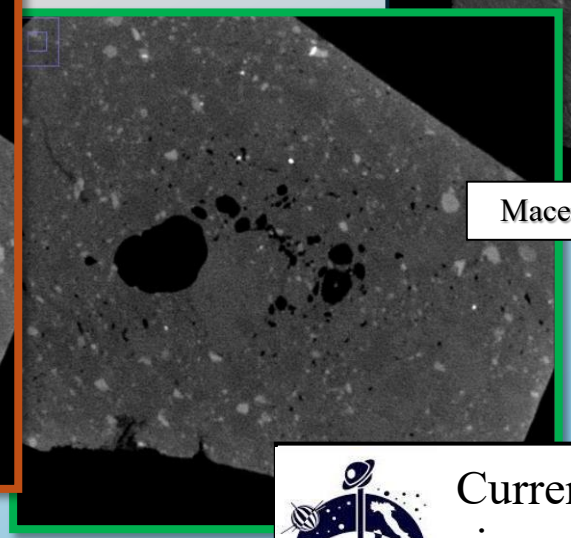
The lunar Tisserlitine 005 (paired with 003/006) have a total known mass of 53 kg!

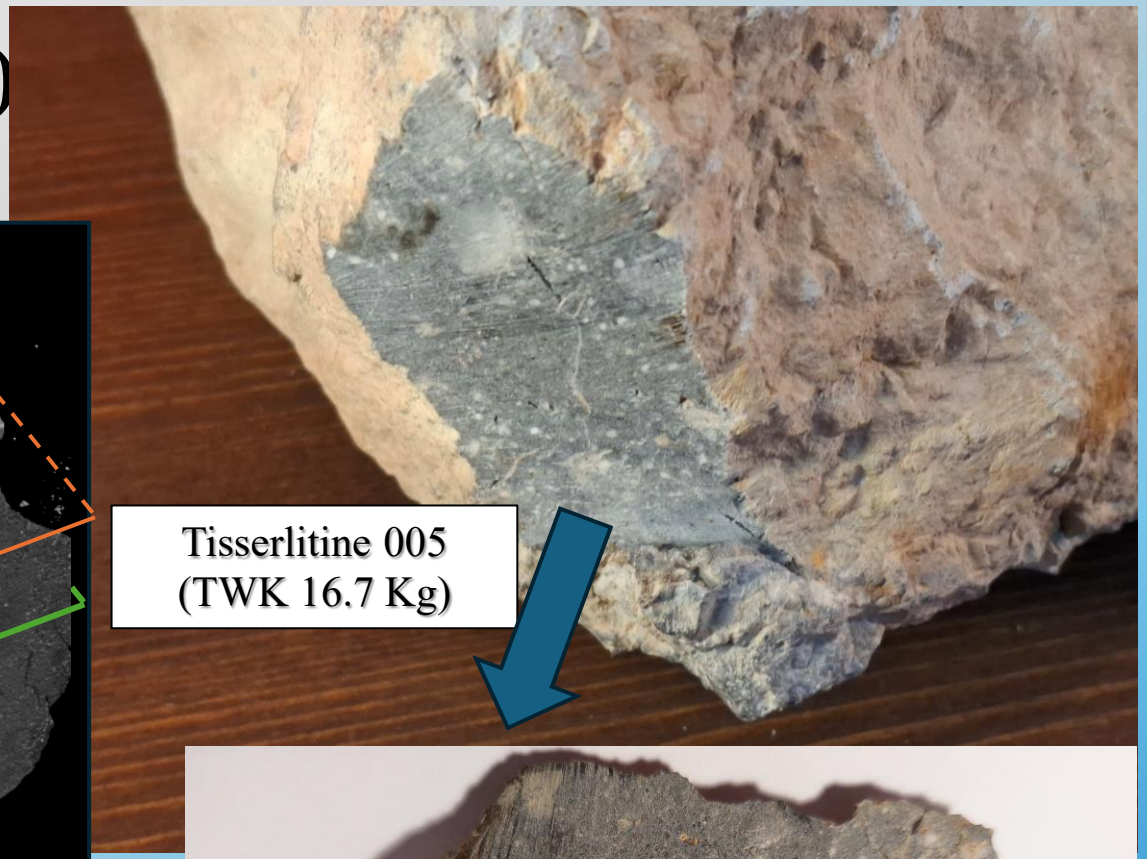




Macente et al. (in preparation)





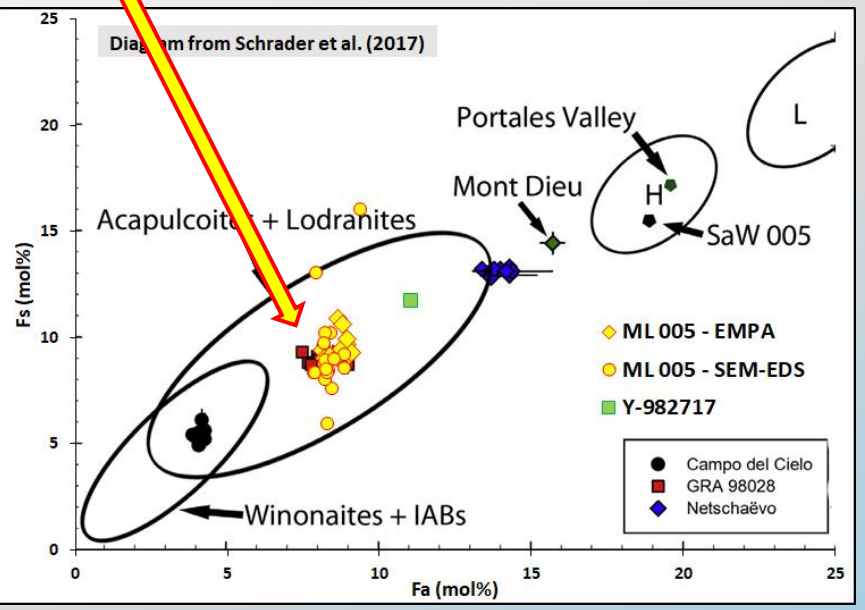




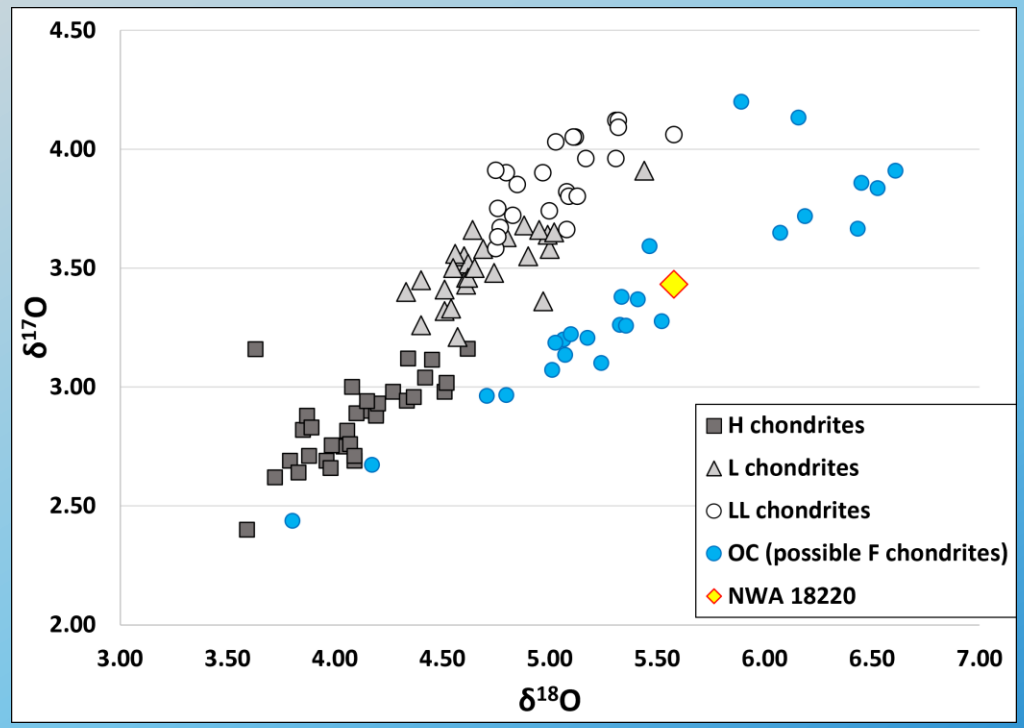
Currently is object of multiteam study within a project funded by SpaceIt UP! since representing natural analogues for investigating lunar regolith properties and supporting experimental research in fields such as ISRU and space agriculture.

Classification activity (case study #2)

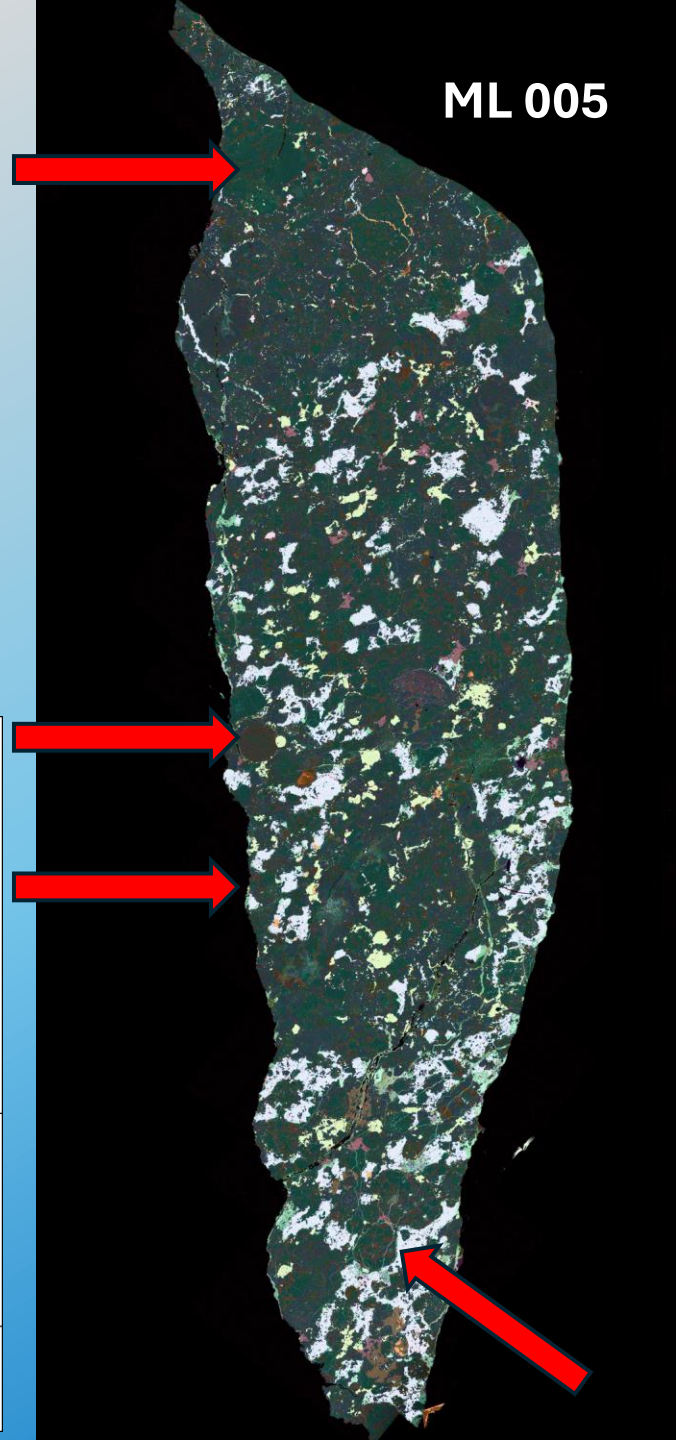
Sample ML 005 has a fairly visible chondritic texture (**red arrows**), but olivine (Fa mol%) and low-Ca pyroxene (Fs mol%) composition fall in the acapulcoite-lodranite field (yellow points), a very interesting primitive achondrite group.



The presence of chondrules in a primitive achondrite is **VERY** important (few known in aca-lod group), if it weren't for oxygen isotopes which **DO NOT** plot in aca-lod ($\Delta^{17}O = +0.53$)!



Now ML 005 is classified as **NWA 18220 OC4**… a probable **F-chondrite** (extremely rare meteorites)!!







a_clowwwt Really? I mean really? The visitor's center was built literally 50,000 years after the crater was created.

1w 154 likes Reply

Thanks for your attention
and any questions are welcome!