

Disclaimer

Any gaps or mistakes in the presented Information are entirely the responsibility of the Presenter.

If you spot any, feel free to point them out – this is part of good scientific discourse :)

SPACE ROCKS

THE ORIGINS

SO...WHAT'S THE DEAL WITH METEORITES?

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What to expect when you're expecting Meteorites...



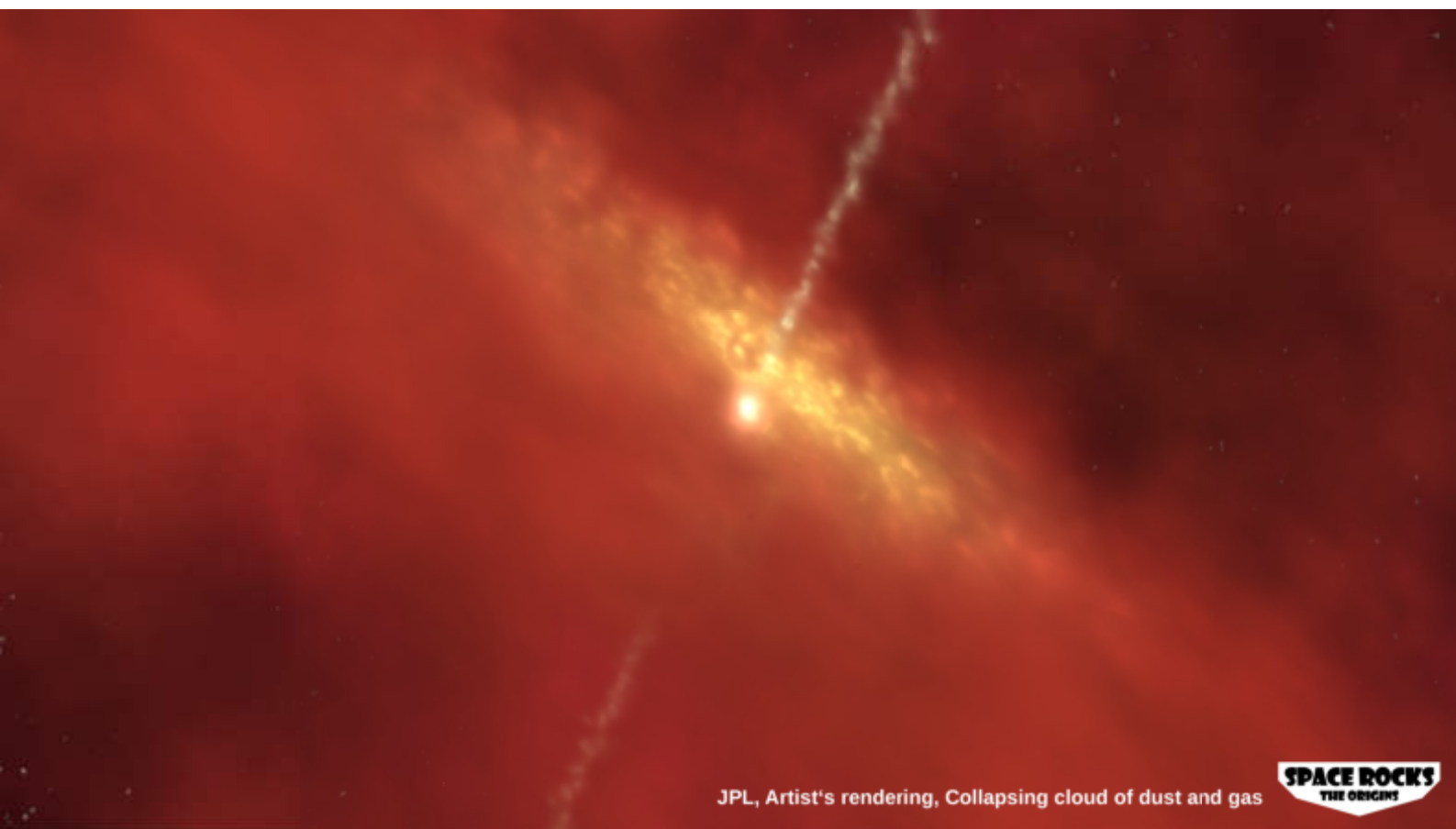
- Pieces of debris from impacts between Solar System bodies
- Contain silicates, oxides, metals, sulphides, hydroxides, occasionally diamonds and a few other bits and bobs
- Record processes ranging from the formation of the Solar System to planet building

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Spitzer Space Telescope, Star Nursery near the tip of Orion's Sword

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JPL, Artist's rendering, Collapsing cloud of dust and gas

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JPL, Artist's rendering, Start of star formation

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NASA, Artist's rendering, Protoplanetary collisions

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NASA, Artist's Rendering

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Meteorite Classification

Undifferentiated Meteorites

Differentiated Meteorites

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Meteorite Classification

Undifferentiated Meteorites

„Primitive“ \Rightarrow Chondrites. Genesis linked to formation of the sun and planetary disc (cosmogenic)

Differentiated Meteorites

„Evolved“ \approx Genesis linked to planetary processes

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Meteorite Classification

Undifferentiated Meteorites

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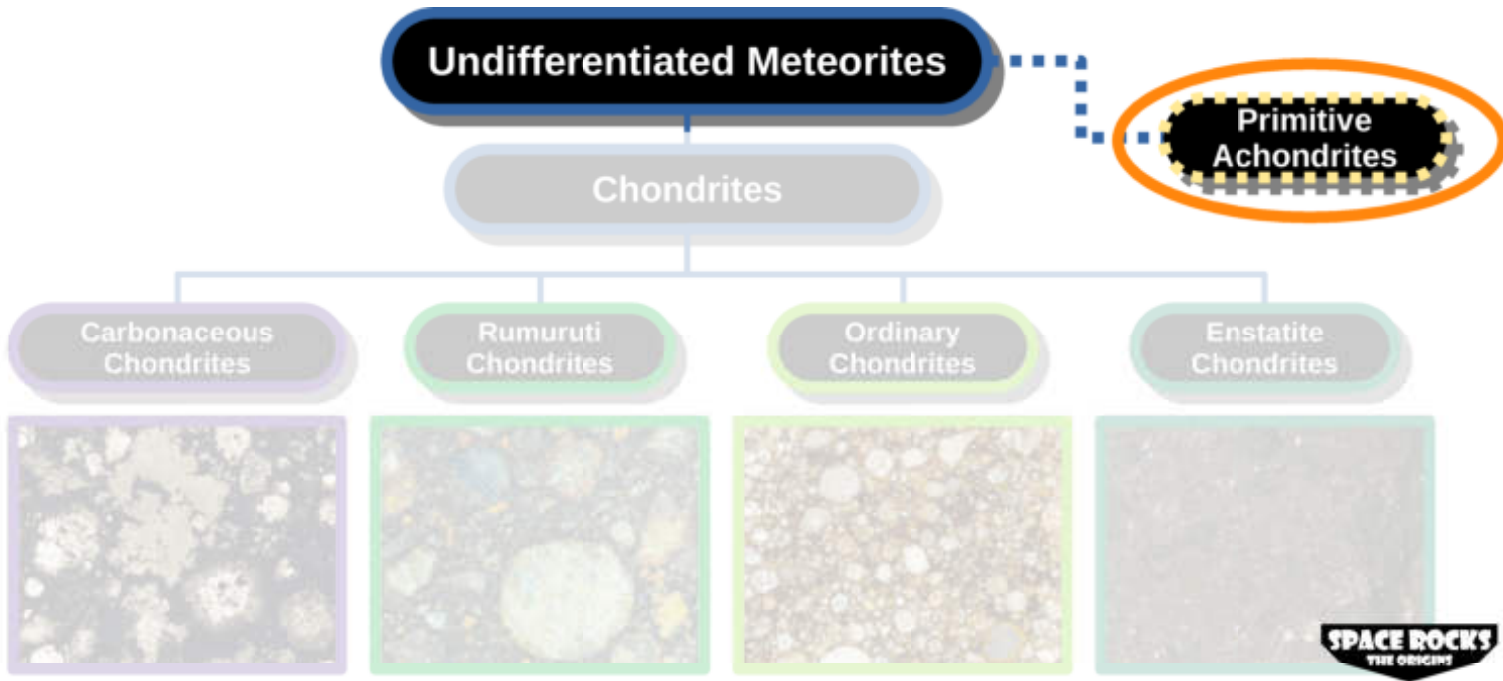
Differentiated Meteorites

„Evolved“ \approx Genesis linked to planetary processes

Cosmogenic and planetary processes yield different chemical signatures

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Meteorite Classification (simplified)

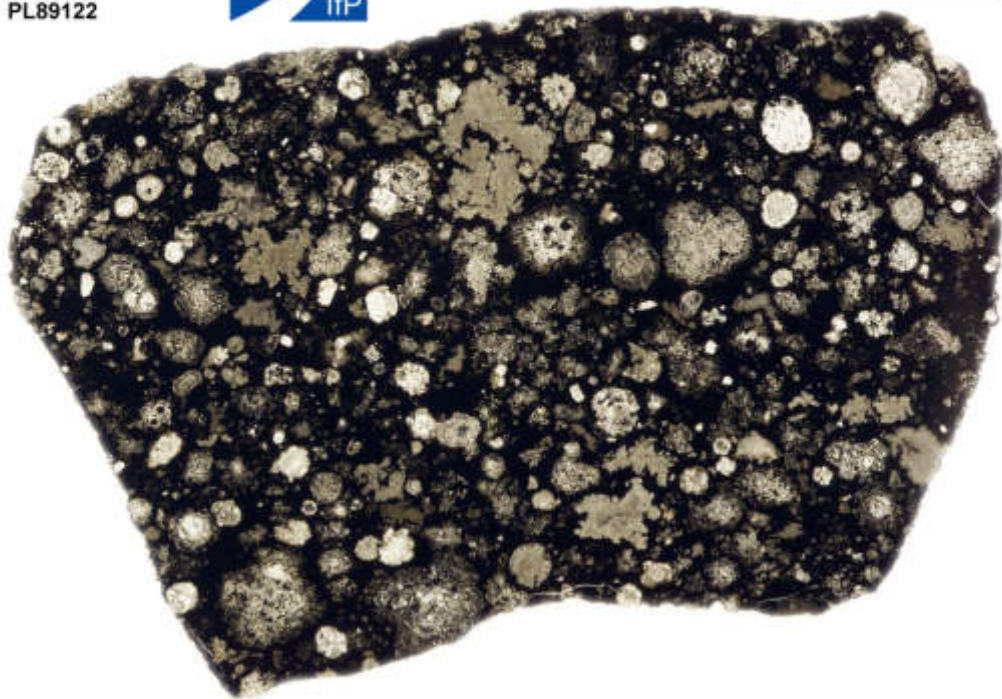


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5 mm



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CAI

5 mm

Matrix = fine
grained stuff
in between...

Matrix = fine
grained stuff
in between...

Chondrules

Matrix = fine
grained stuff
in between...

Chondrules

CAI

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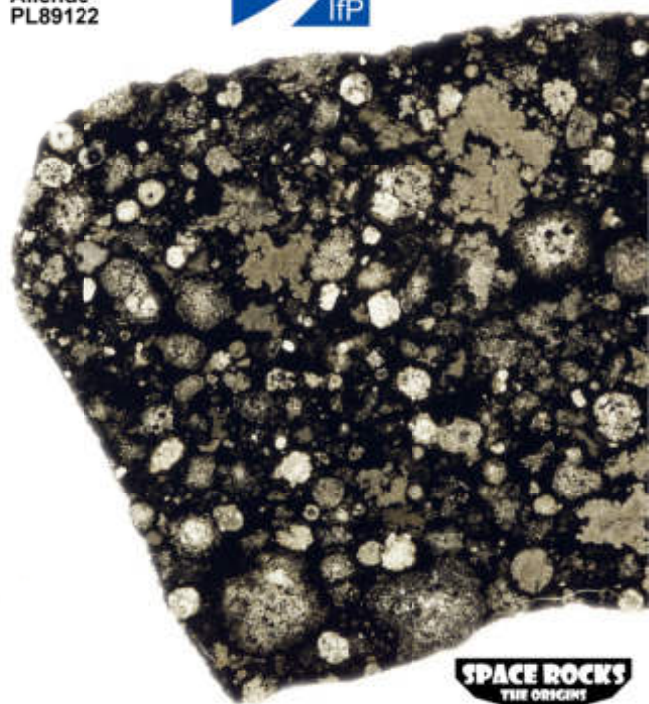
Processes in the fledgeling Solar System led to a separation of high temperature (refractory) and low temperature (volatile) elements

High Temperature Phases

- CAI (e.g. Al, Ca, Ti)
- Chondrules (e.g. Mg-Silicates
 - Fe/Ni Metal
 - Nitrides / Carbides
 - (- Sulphides)

Low Temperature Phases

- Hydroxides (Water)
- Organics
- Nobel Gases
- Nitrogen
- Carbonates
 - (-Sulphides)



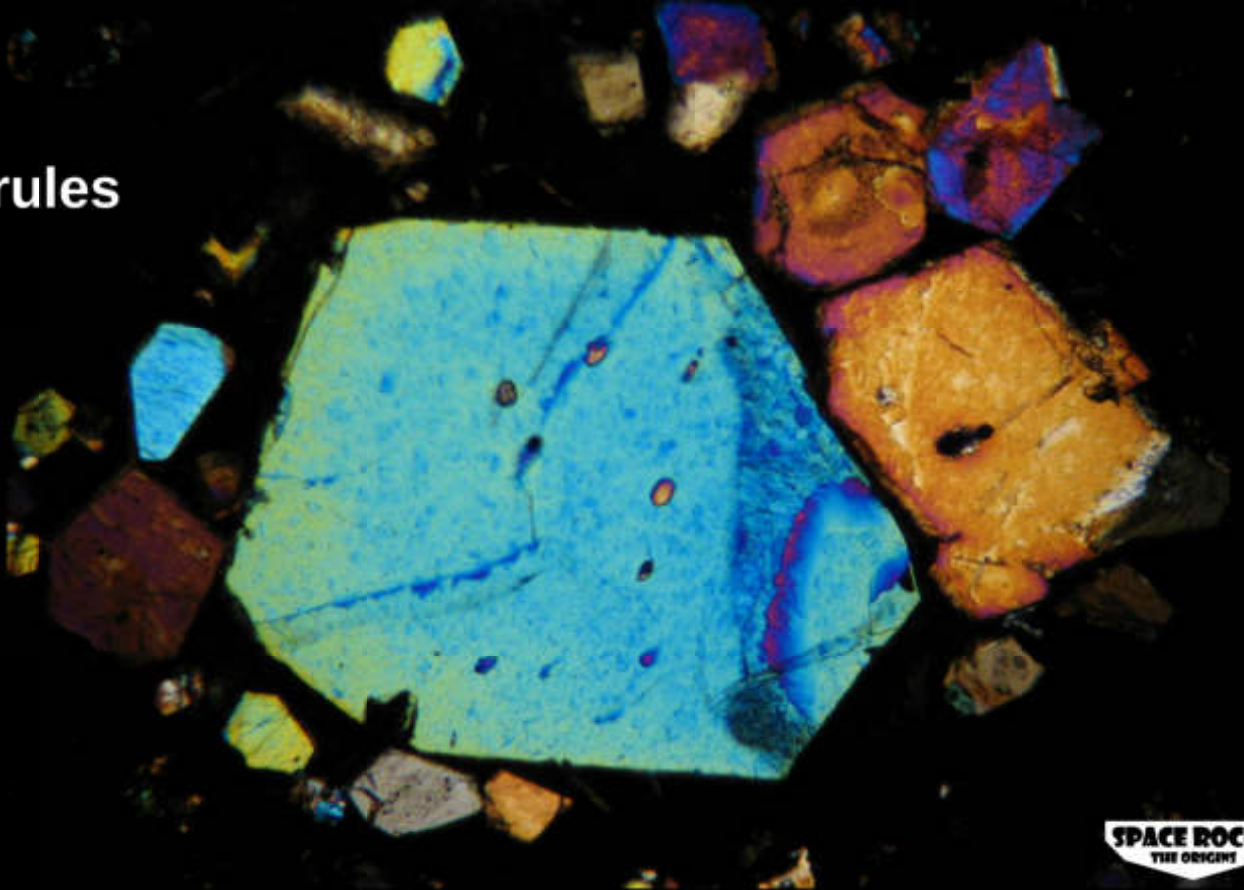
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Calcium-Aluminium-rich Inclusions (CAI)

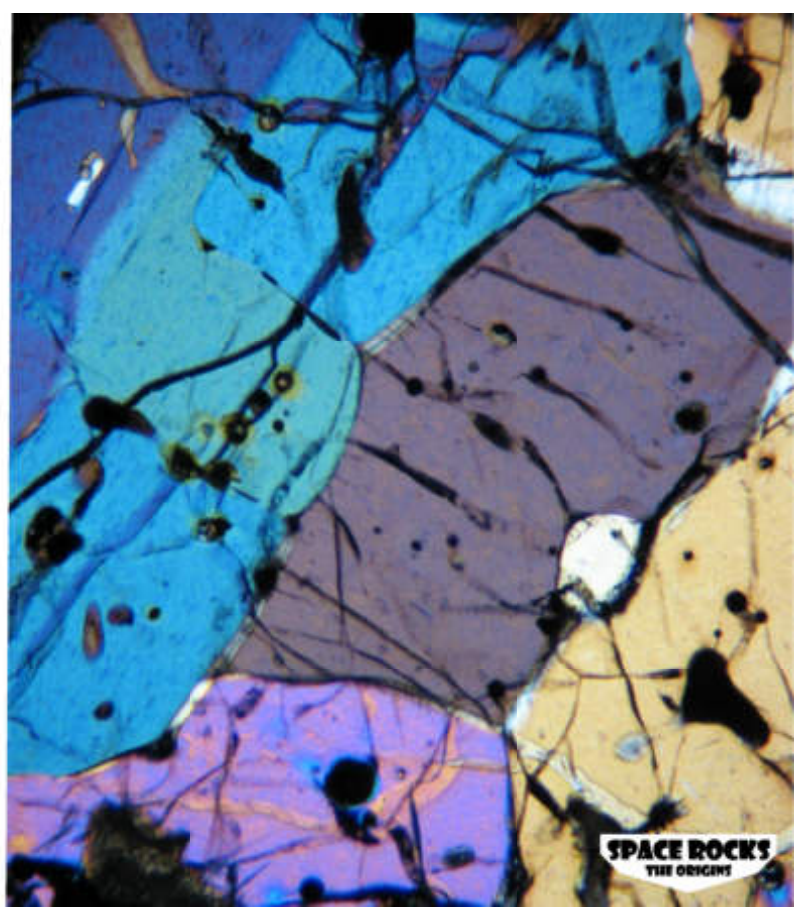
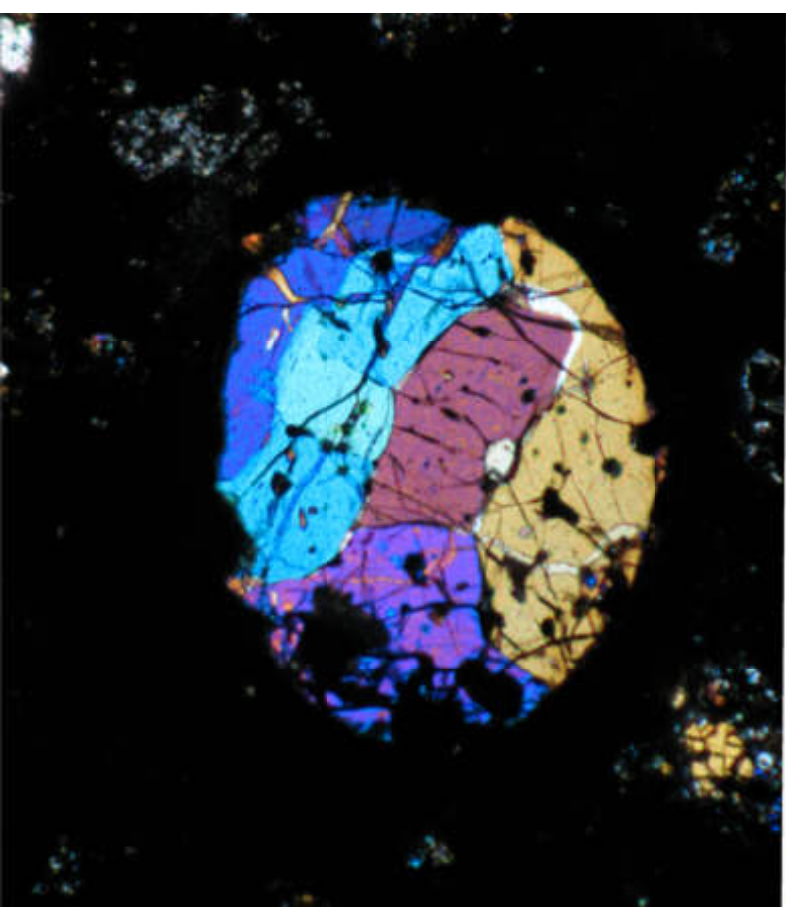
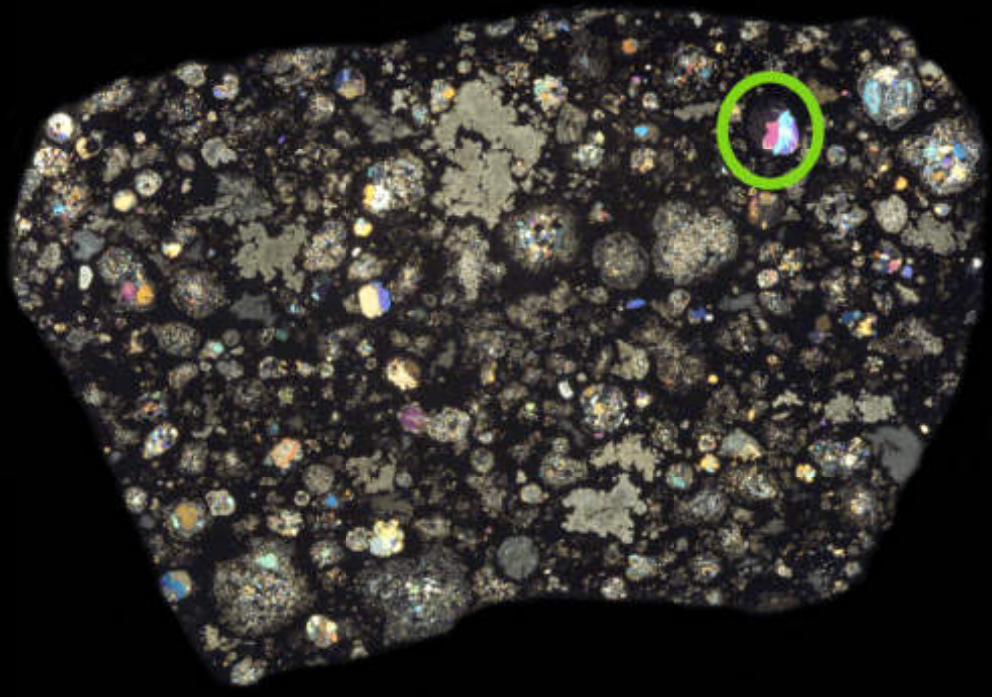
- Oldest objects from the Solar System with well-known ages (~ 4568 Myr)
- Most refractory objects from our Solar System
- Consist of high temperature mineral phases like Ca-Al-Spinel, perovskite etc.
- Only found in chondrite meteorites
- Thought to be the first solids to crystallize from a cooling gas cloud

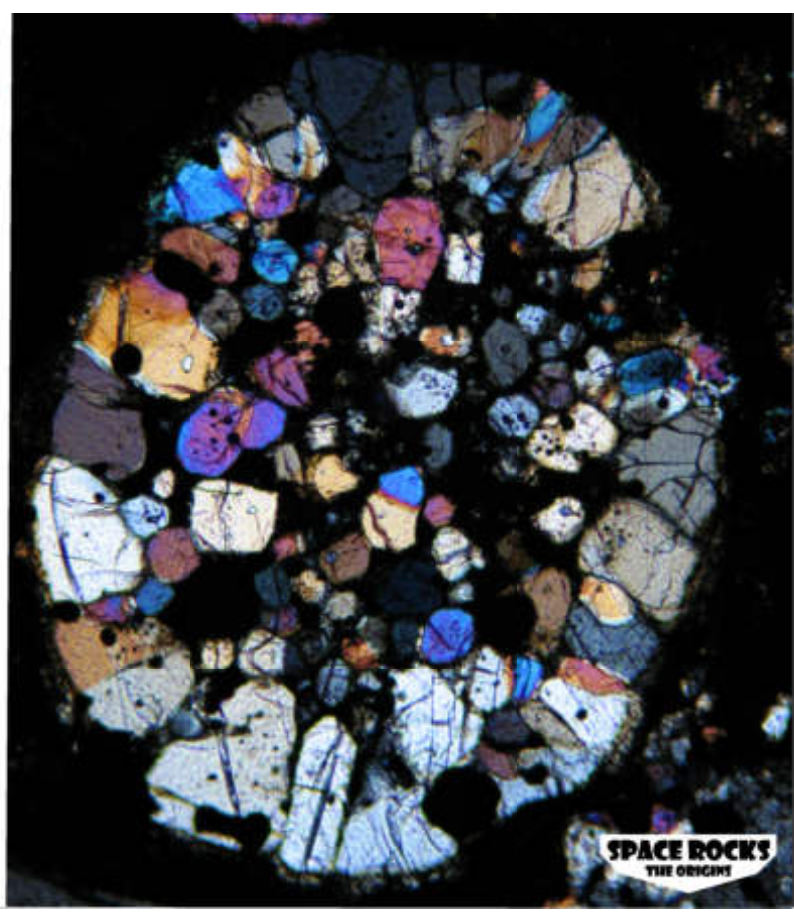
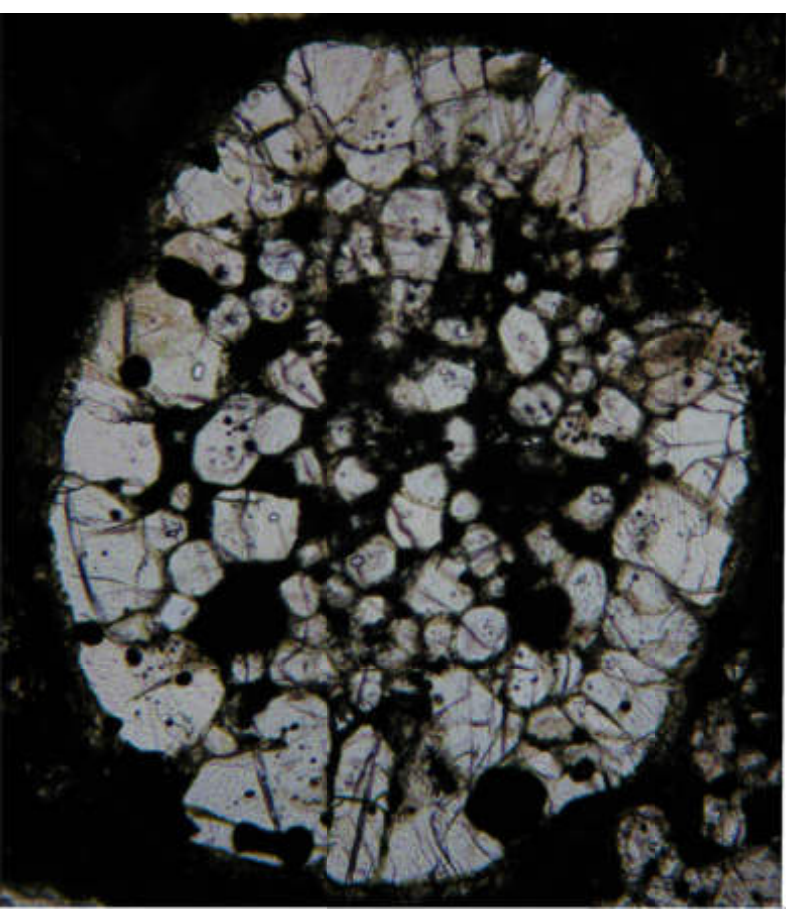
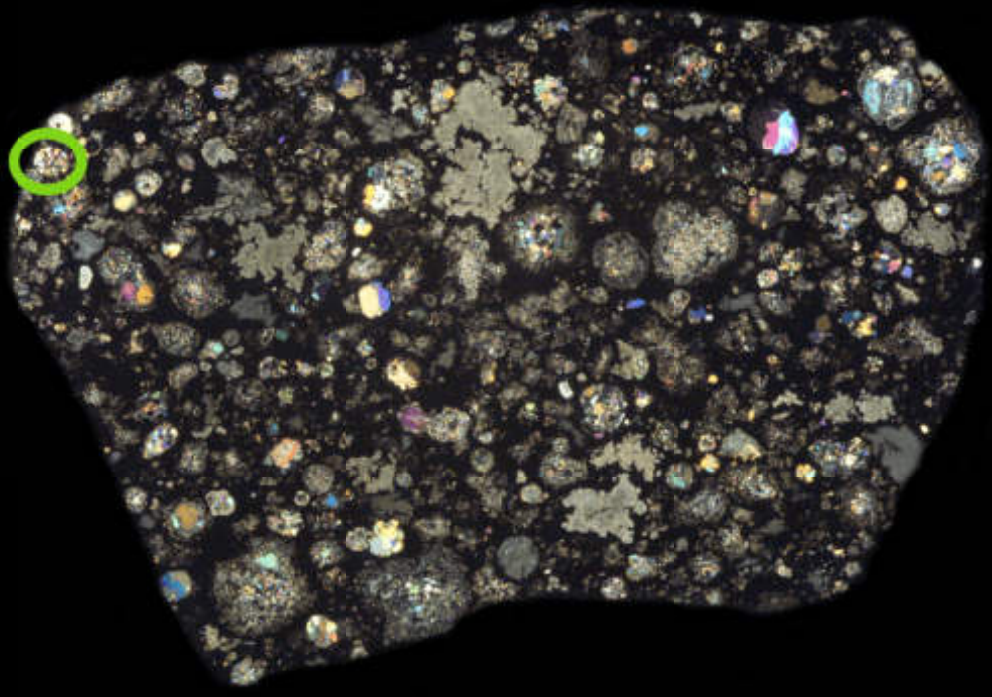
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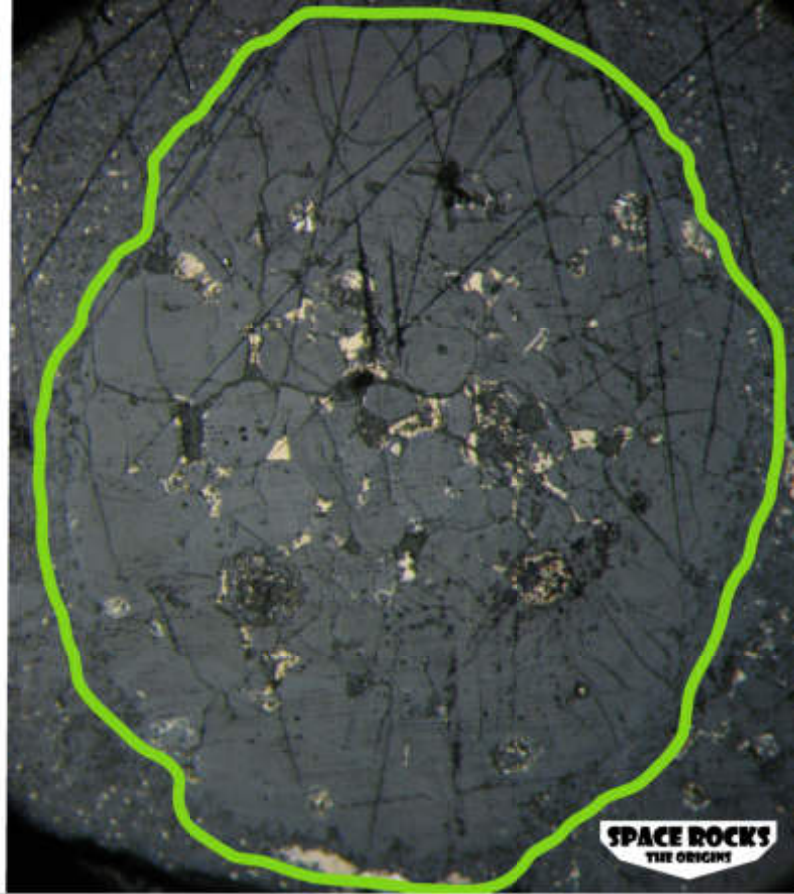
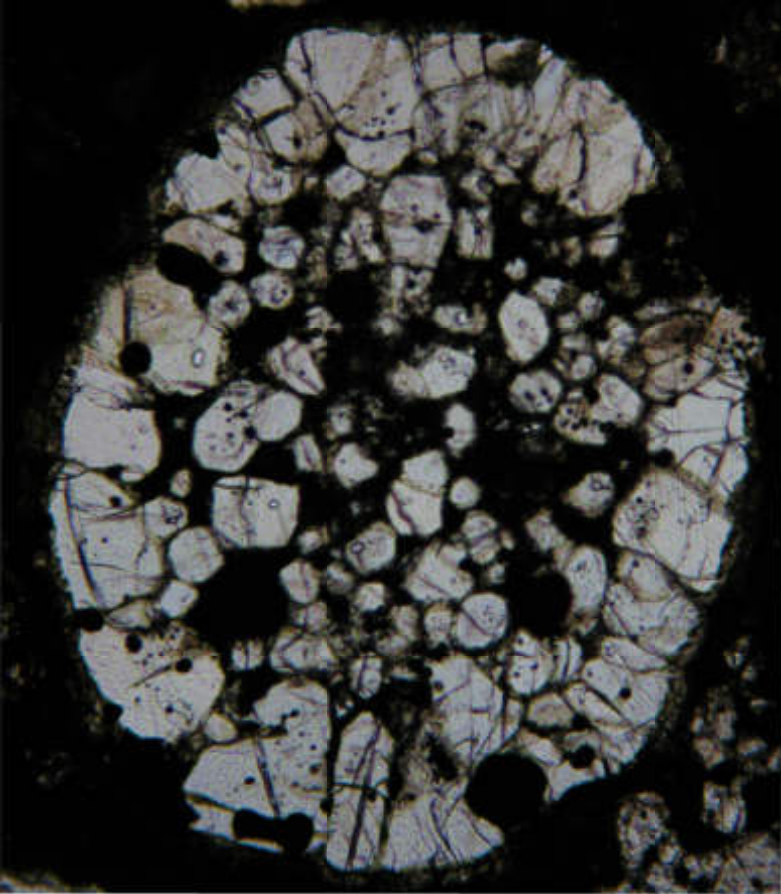
Chondrules



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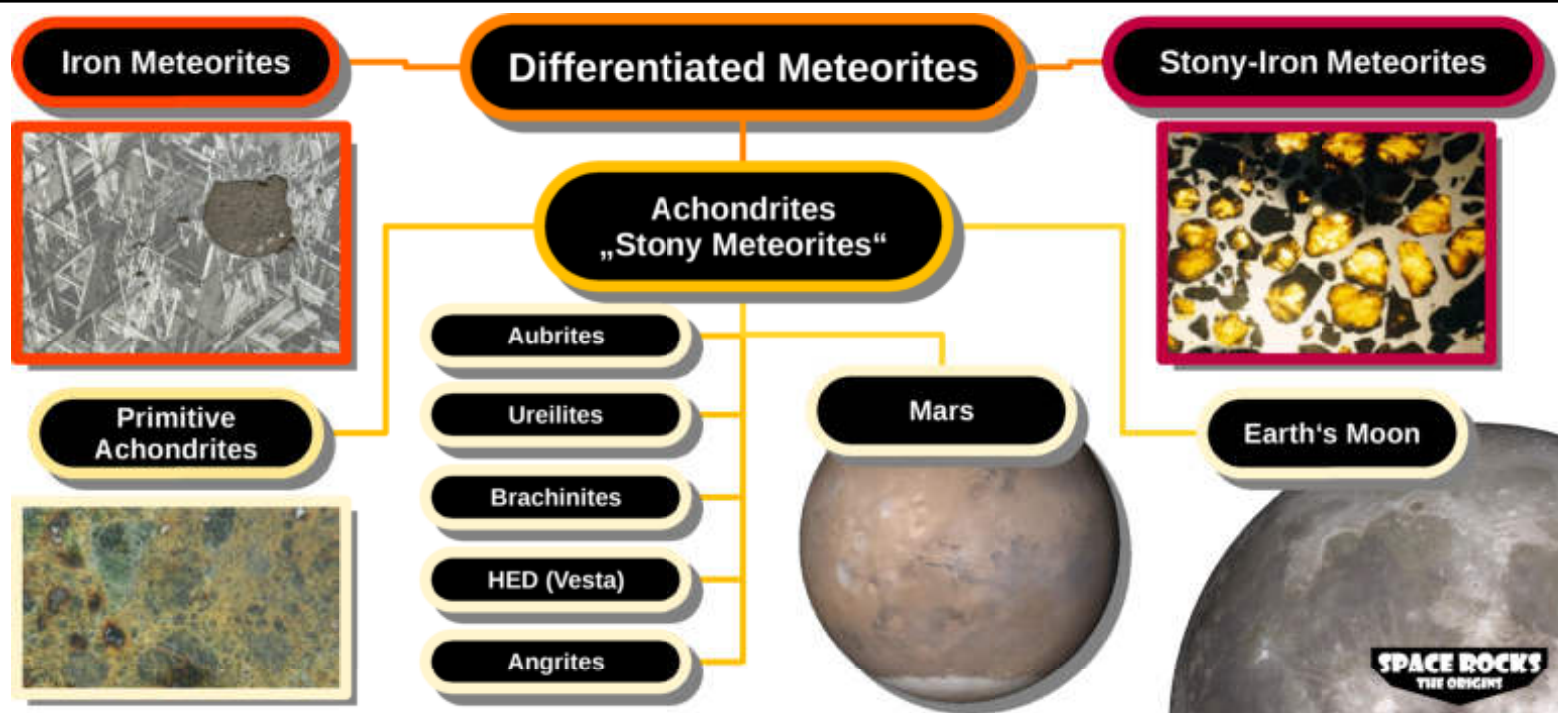






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Meteorite Classification (simplified)



Gibeon Meteorite

<https://www.meteorite-recon.com/home/meteorite-documentaries/gibeon-iron-meteorites/p2>



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Cosmogenic and planetary processes yield different chemical signatures

Tungsten in a cosmogenic setting

Superhot gasses cool down and the first solids condense

Tungsten condenses in a solar setting at $\sim 1500\text{ }^{\circ}\text{C}$

Tungsten partitions into the first phases (high temperature phases)

TUNGSTEN FIRST

Tungsten in a planetary setting

Magma chamber on Earth – Temperatures around $1500\text{ }^{\circ}\text{C}$

The magma cools and the first phases crystallize

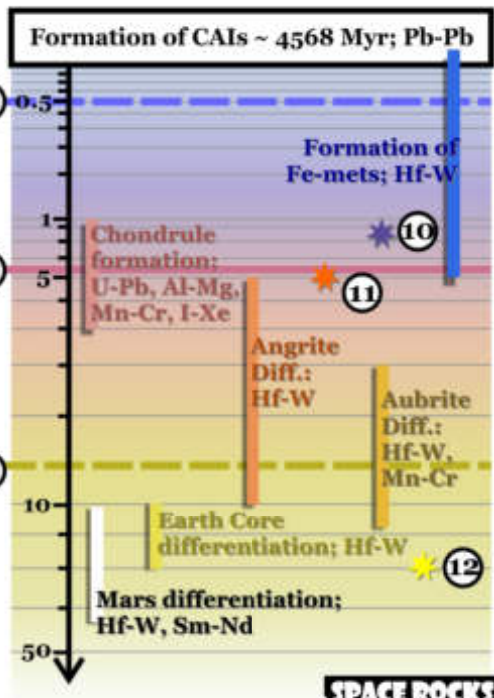
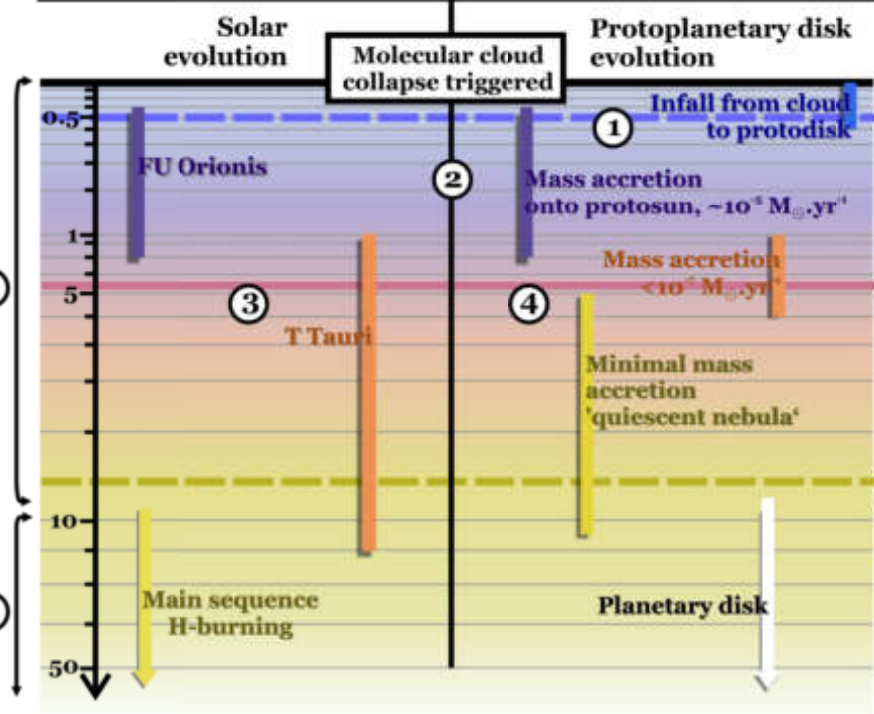
Tungsten is not compatible in first phases and remains in the magma until much later

TUNGSTEN LAST

Solar System evolution according to modelling and astronomical observations

Solar System evolution according to isotopes

Time in Million Years after CAI Formation



Thanks for listening

Questions?

Hubble Telescope, Carina Nebula