

Meteor
Shower!



In addition to planets and their moons the solar system is also littered with three kinds of space debris

- Asteroids
- Comets
- Meteoroids
- Whatever Pluto is...



Which of these is a meteor?

- A. A chunk of metallic or stony matter found on Earth's surface
- B. A small body that is in the process of burning up in Earth's atmosphere
- C. A chunk of metallic or stony matter found in space
- D. A streak of light in the sky

Which of these is a meteor?

- A. A chunk of metallic or stony matter found on Earth's surface
- B. A small body that is in the process of burning up in Earth's atmosphere
- C. A chunk of metallic or stony matter found in space
- D. A streak of light in the sky

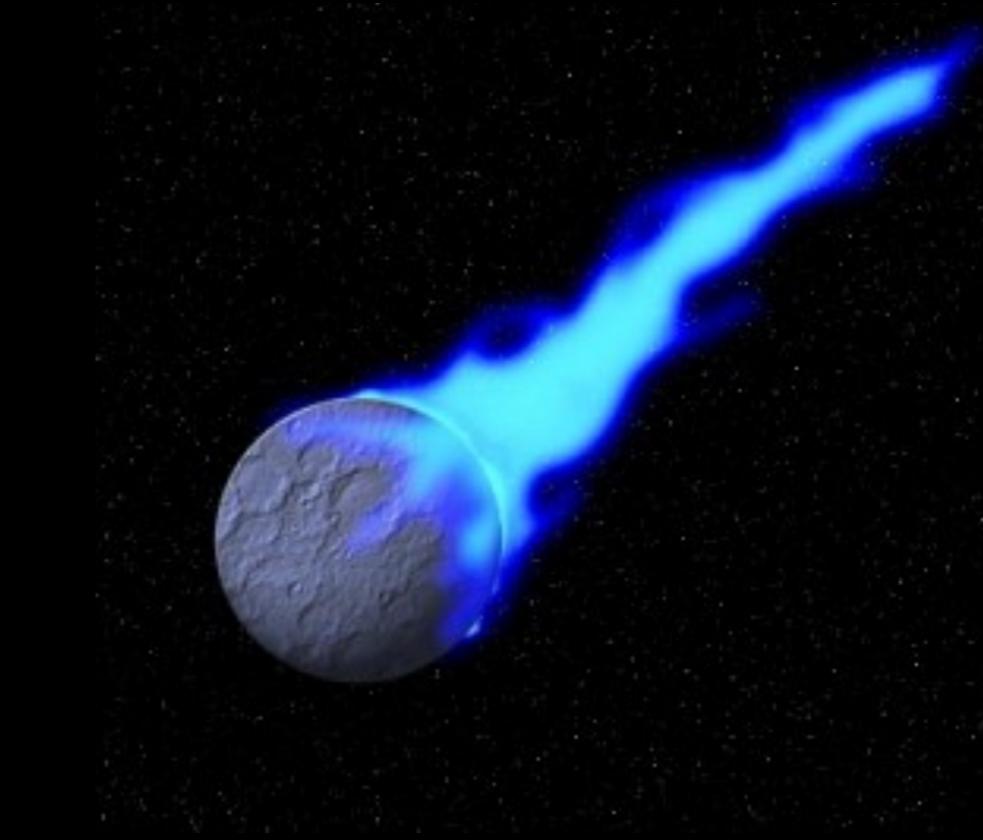
Have you seen a meteor??



Meteors: “shooting stars”

Why do they glow?

- These rocks are burning up as they go through our atmosphere, typically at altitudes of 80-130km.



What's the difference?

- **Meteoroid**: the object before it enters Earth's atmosphere. Most are destroyed about 80 km above the Earth's surface. They are small sand to boulder-sized particles of space debris.
- **Meteor**: They are often called shooting stars. We see them as glowing small particles as they enter the atmosphere. They glow because of heat from friction with the atmosphere.
- **Meteorites** = They are rocks that reach the Earth's surface from space.



Meteoroid



Meteorites



Meteors are falling all the time...

- “Sporadic” meteors are visible at a rate of about one every 10 minutes-- you just need to be in a dark spot to see them.
- “Fireballs” are more rare events that are very bright.
- Meteor showers are annual events when many more meteors than normal appear to come from a certain region on the sky

Meteors are falling all the time...



About 100 tons of material
rains down *per day!*

How big is the typical meteor?

- A. Like a grain of sand
- B. Pea sized
- C. Like a golf ball sized rock
- D. Similar to a boulder

How big is the typical meteor?

- A. Like a grain of sand
- B. Pea sized
- C. Like a golf ball sized rock
- D. Similar to a boulder



How can we see a “pea” that high up in the atmosphere?!?

- Meteors are moving at very high speed.
Speed is related to *energy*.
- The “pea” is surrounded by heated gas which disperses into our atmosphere

Have you seen a fireball?



How big is a fireball?

- A. Like a grain of sand
- B. Pea sized
- C. Like a golf ball sized rock
- D. Similar to a boulder

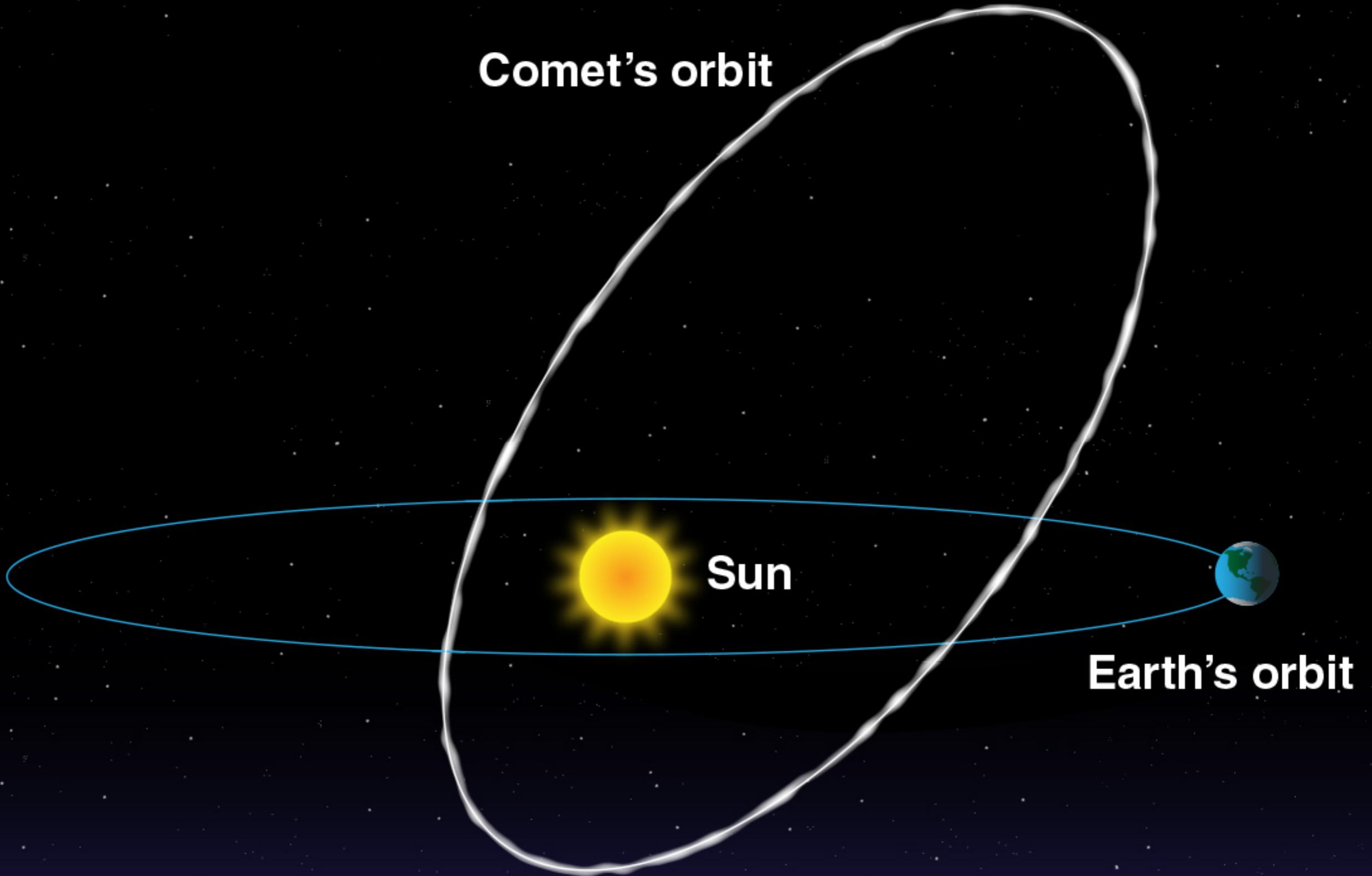
How big is a fireball?

- A. Like a grain of sand
- B. Pea sized
- C. Like a golf ball sized rock
- D. Similar to a boulder

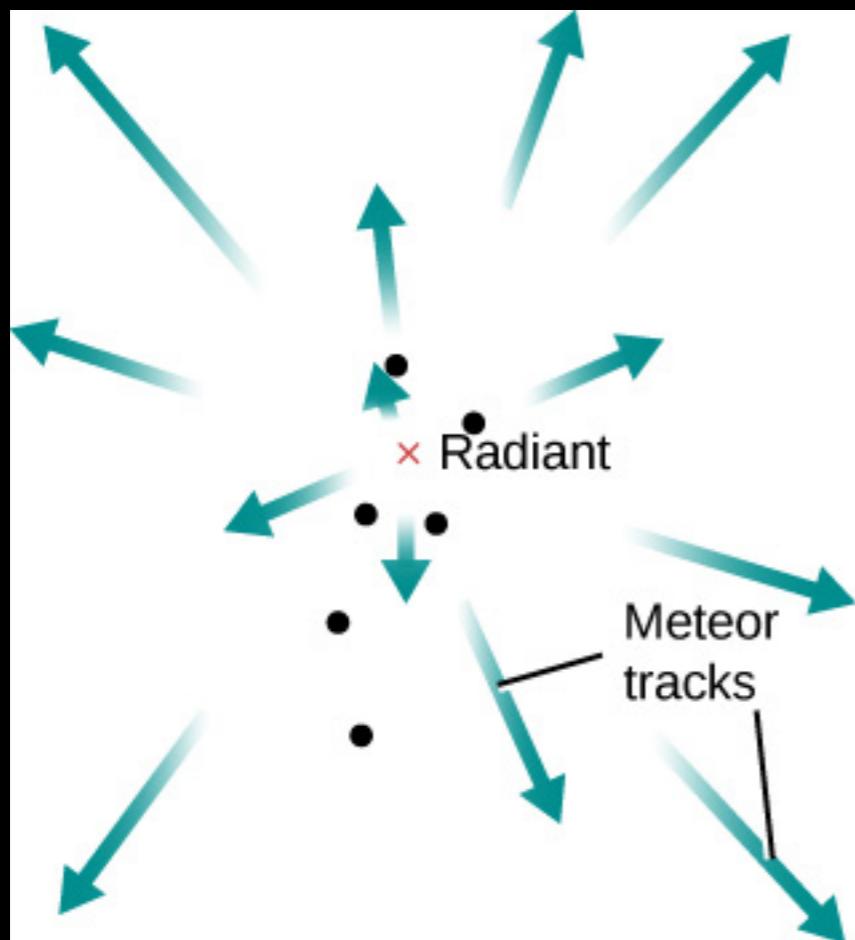
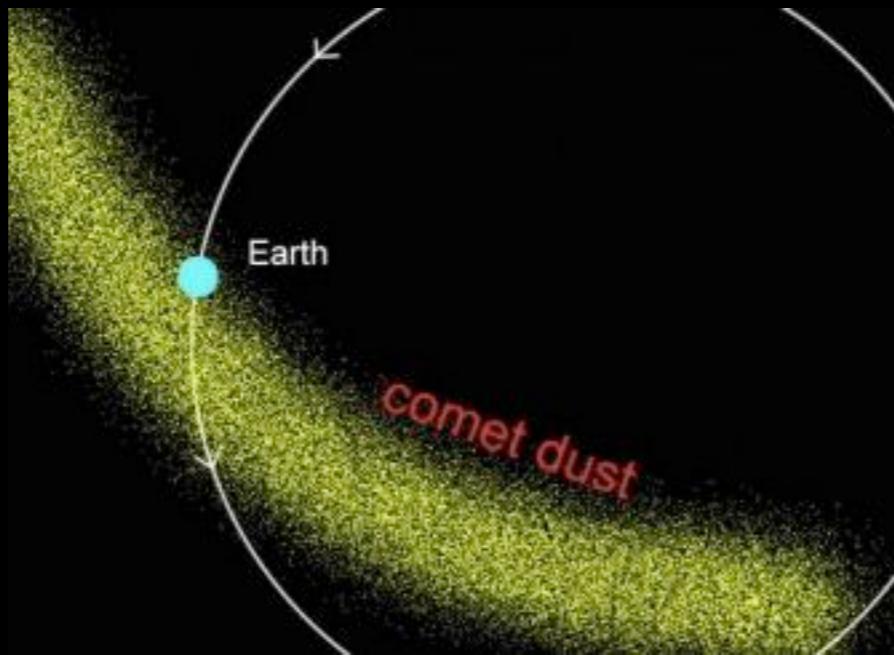
Meteor showers

- Happen about a dozen times per year, for a few hours
- Are associated with cometary debris
- Have a much higher meteor rate
- Involve meteors that appear to originate from one point on the sky
- The material is tiny- fluffy sand grains





Why do meteors appear to come from one point?



How big are the meteors that make it to Earth's surface?

- A. Like a grain of sand
- B. Pea sized
- C. Like a golf ball sized rock
- D. Similar to a boulder

How big are the meteors that make it to Earth's surface?

- A. Like a grain of sand
- B. Pea sized
- C. Like a golf ball sized rock
- D. Similar to a boulder
- E. Bowling ball sized

Meteorites: the ones that survive

- People have known about these odd rocks for hundreds of years
- Are associated with asteroids
- Several different compositions
- A few different ways to find them...

Types of Meteorite

stony, iron or
stony-iron...

Stony



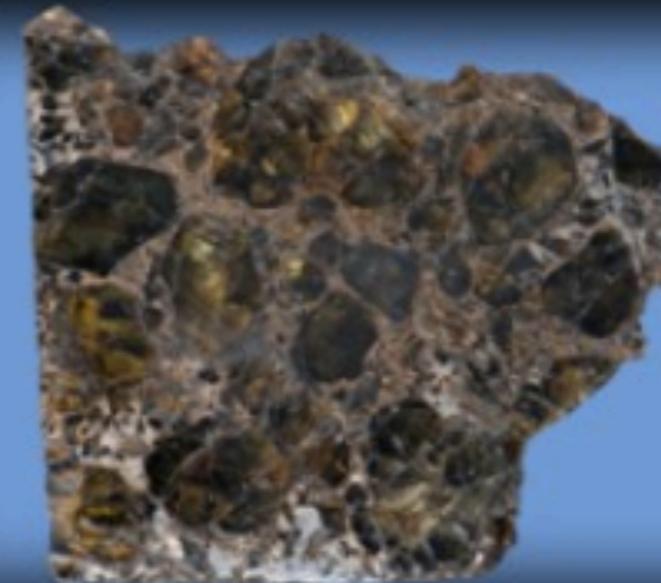
Chondrite

Iron



Iron Octahedrite

Stony-iron



Types of Meteorite

- Iron meteorites
- Stony meteorites
 - Chondrites
 - Achondrites

Iron →



Iron Octahedrite

Stony →



Chondrite

Stony →

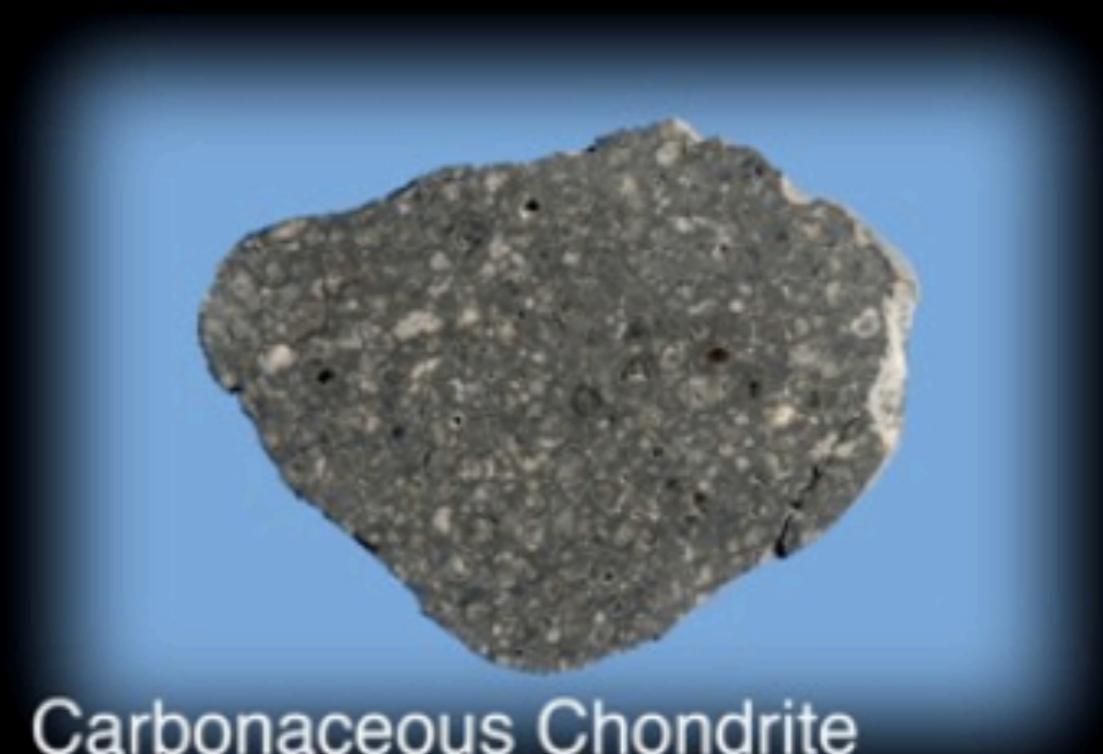


Achondrite (Eucrite)

Carbonaceous chondrites

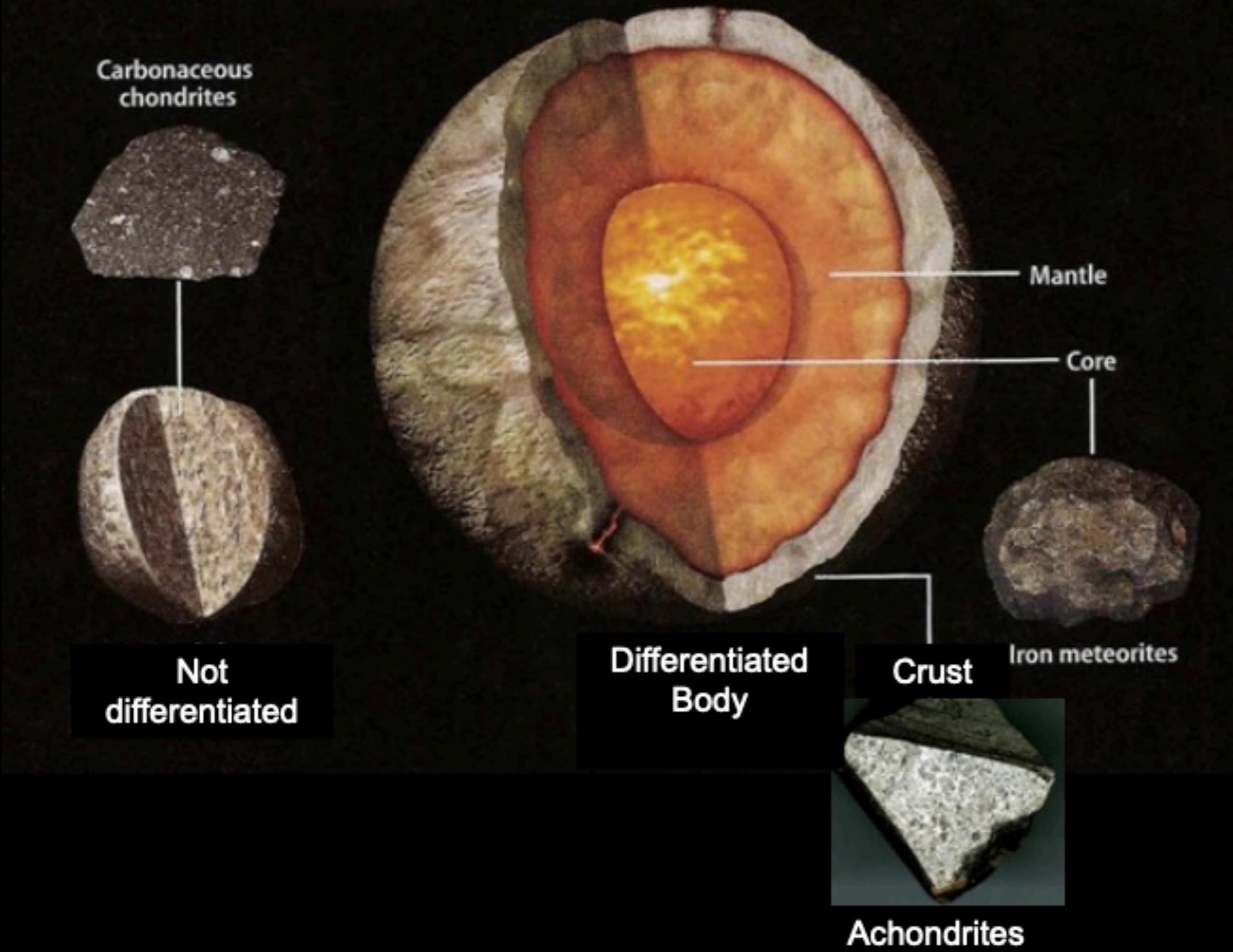


- Rare meteorites
- Most studied
- Formed in the solar nebula 4.56 billion yrs ago
- Contain elemental carbon and amino acids.

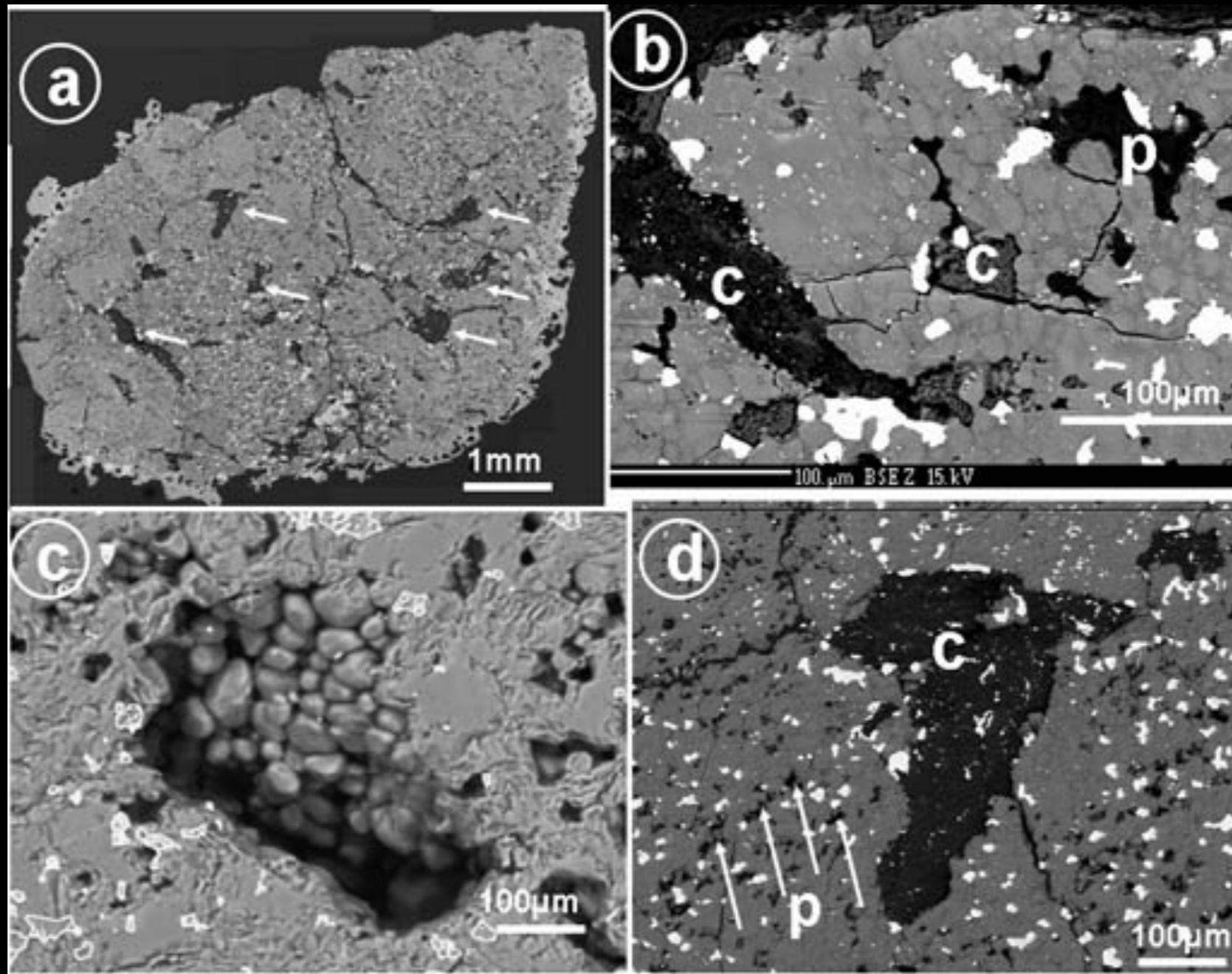


Carbonaceous Chondrite

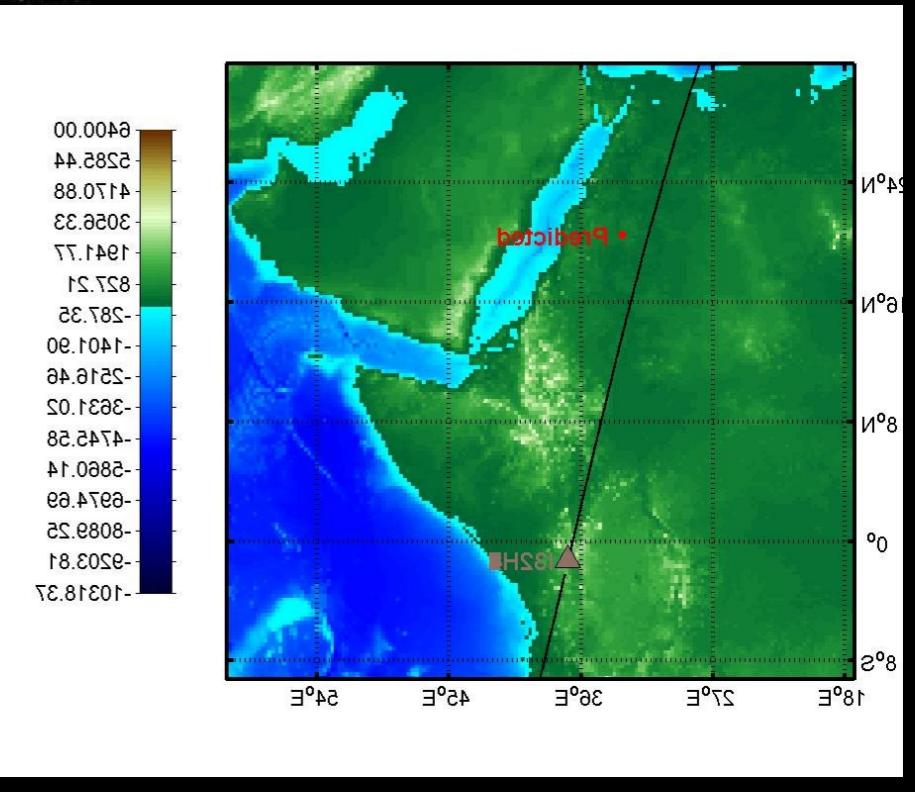
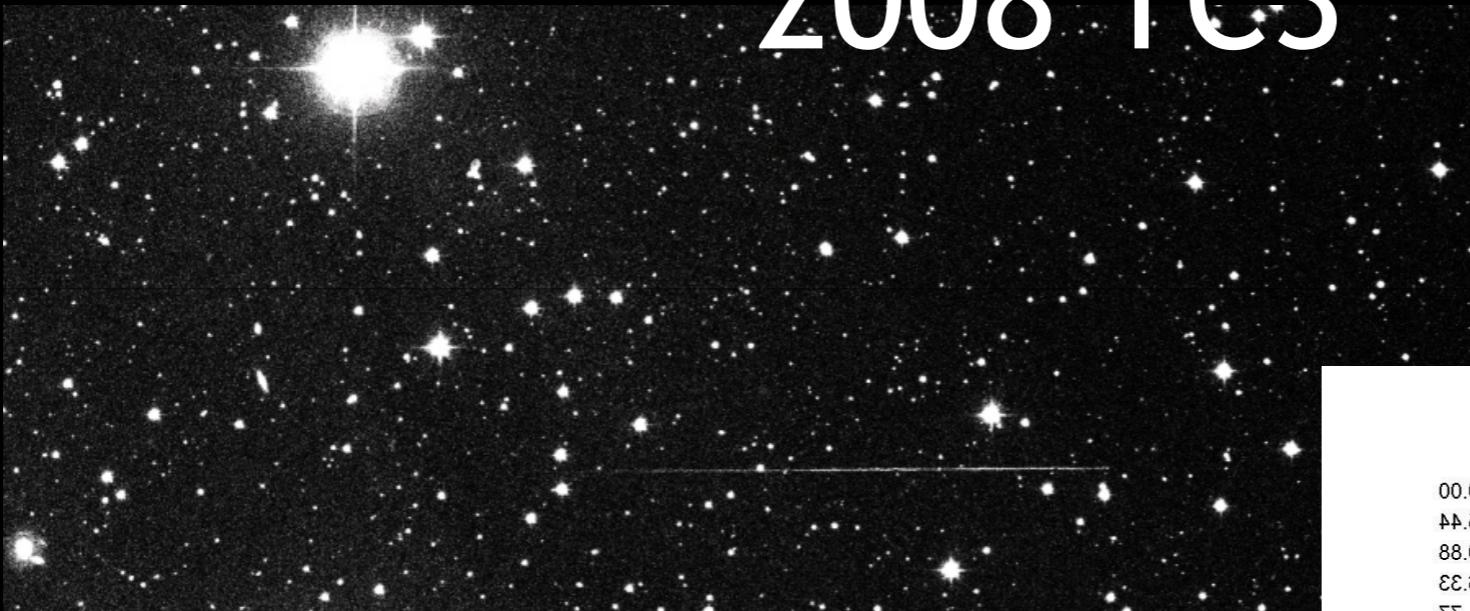
Meteorite origins



Microscope views tell us about the early solar system!



2008 TC3



- A Subaru-sized asteroid moving 27,700 mph!
- Created a trail of fire as it ploughed through Earth's atmosphere in October 2008.
- Exploded 121,000 ft up.

Searching for 2008 TC3 in the desert of Sudan



Describing the fireball

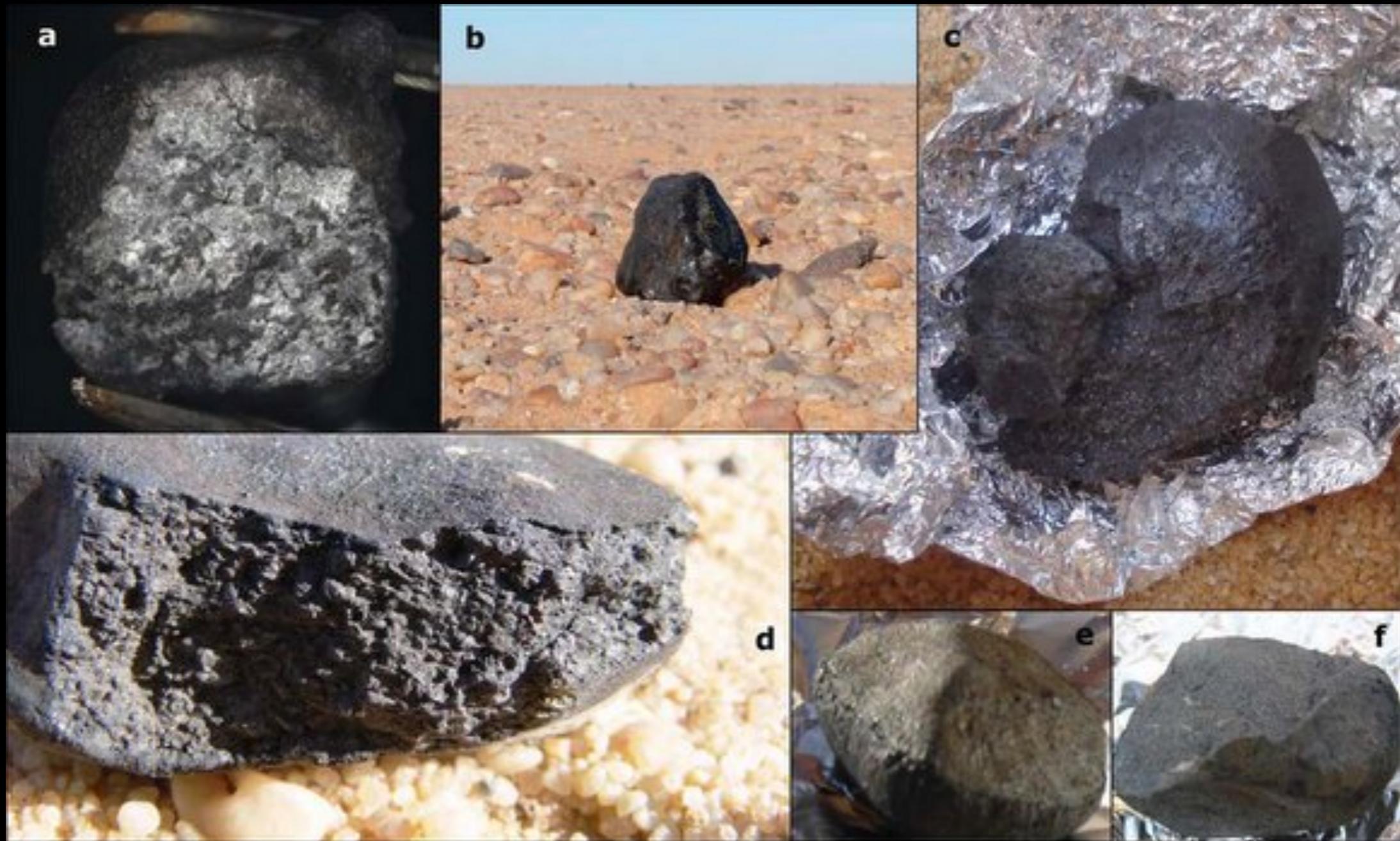


Student search team



18 miles later...

Meteorites that were found...



Rare type called a urealite meteorite!
It's like volcanic material on Earth...

First known extraterrestrial protein possibly spotted in meteorite

By [Mike Wall](#) 2 days ago

But the find is preliminary.



A meteor streaks across the sky. In a new study, researchers report finding a novel protein in the meteorite Acfer 086, which landed in Algeria in 1990.

(Image: © NASA)

A research team claimed to have found the first known extraterrestrial protein, spotting it in a space rock that fell to Earth 30 years ago.