

# IS IT ALIENS?

# YES

Dogbone Bond Bone of the  
(Every Other) Week #1  
(Valentine's Day Edition)

Feb 14 2022

# TECH INSIDER





# Metallic Meteorites

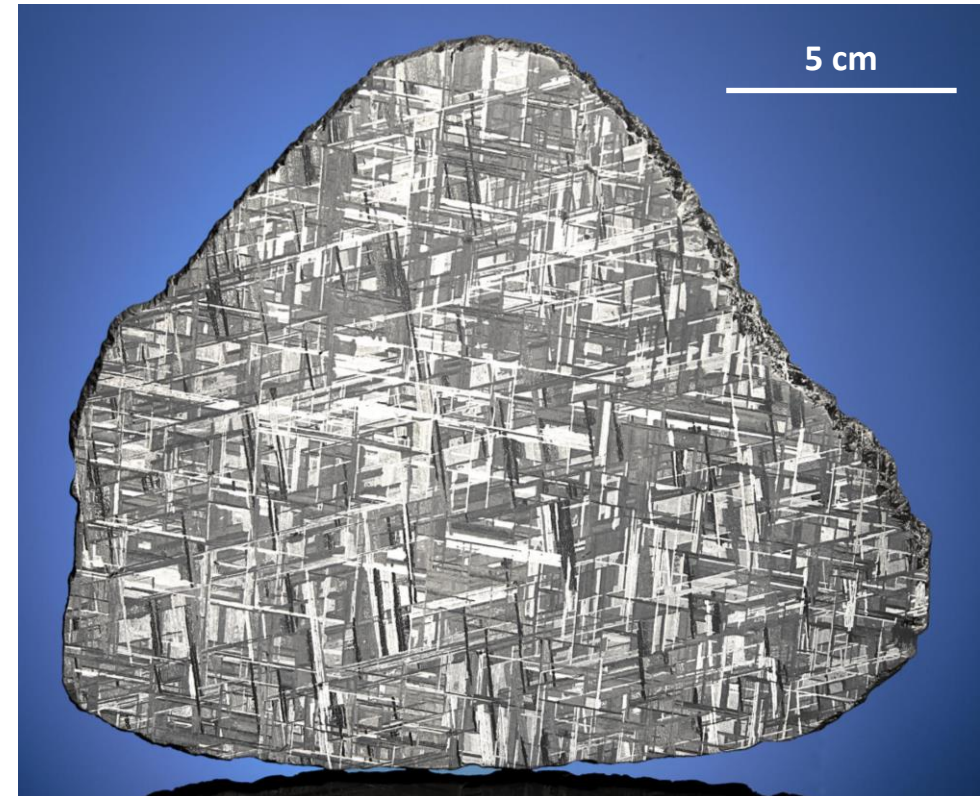
The Muonionalusta meteorite  
Found in Sweden, 1906  
4.57 billion years old

What are they?

How did they form?

What is that microstructure?

Why are they significant?



# Formation of metallic meteorites

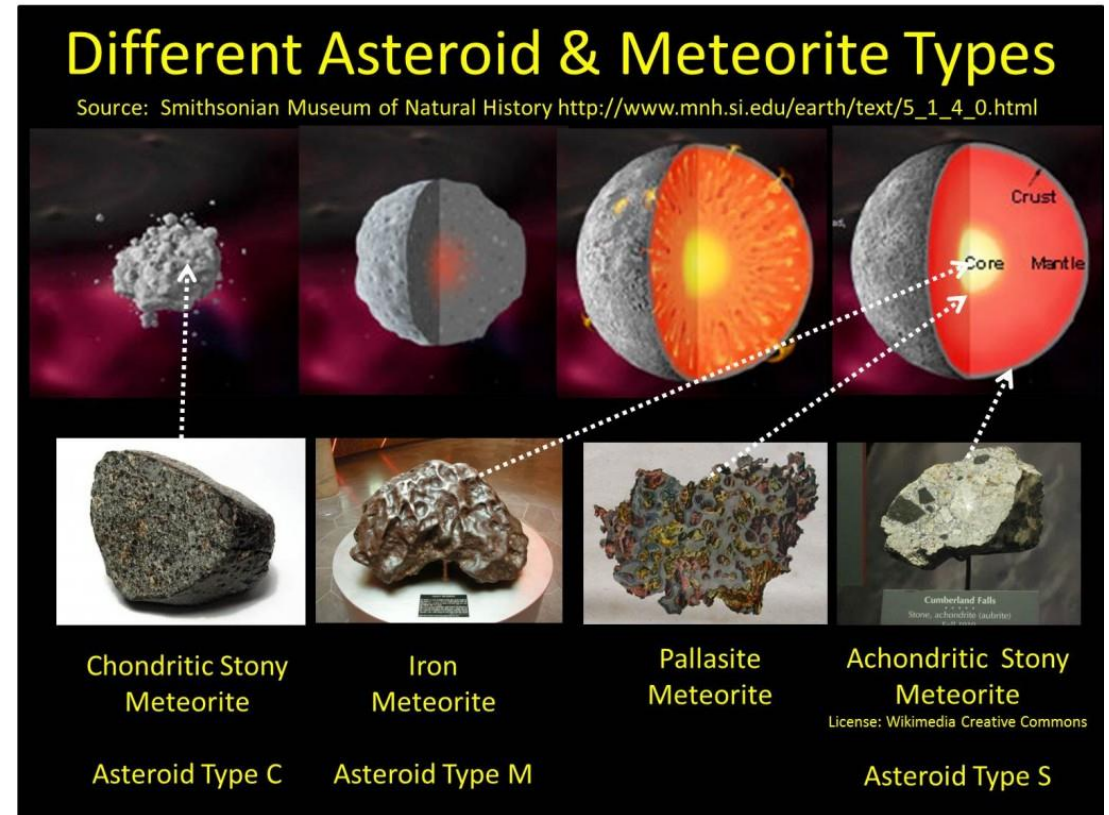
Asteroids that grew so large (on their way to becoming planets) their interiors melted under the extreme pressure

Metals, such as iron and nickel, sunk to the middle because they are denser than the rocky crust

The asteroids get smashed up and fragments collide with Earth

~60,000 meteorites have been found so far

~3,000 are metallic



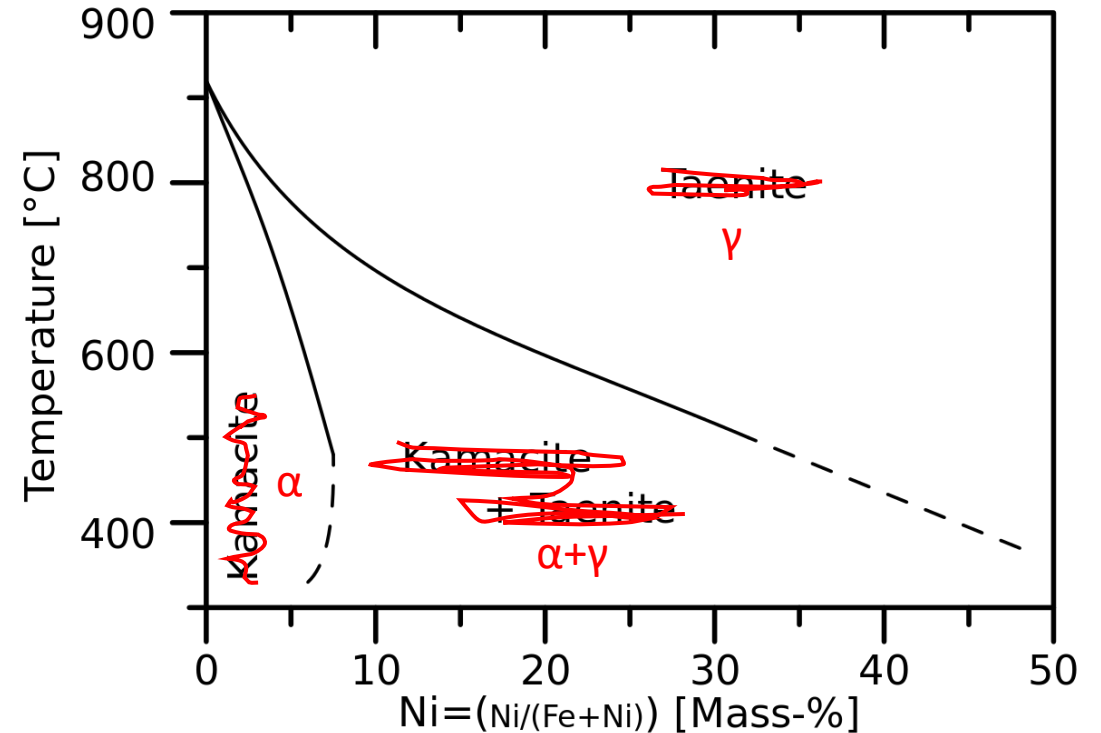
# Composition & Phases

Predominantly iron and nickel

Nickel: 3-35%, but vast majority are 5-10%

Small amounts of cobalt, copper (<1%)

Trace sulfur, phosphorus, carbon (<0.01%)



Geologist Name	Nickel (mass %)	Crystal Structure	Metallurgist Name
Kamacite	0-8%	BCC	Ferrite ( $\alpha$ )
Taenite	20-65%	FCC	Austenite ( $\gamma$ )



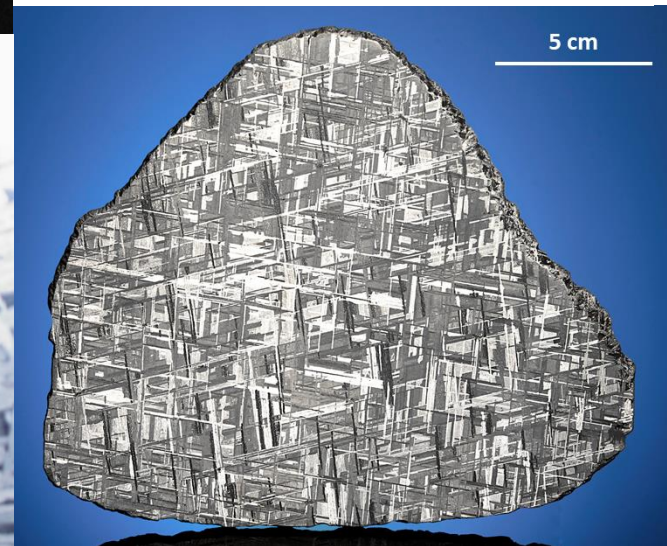
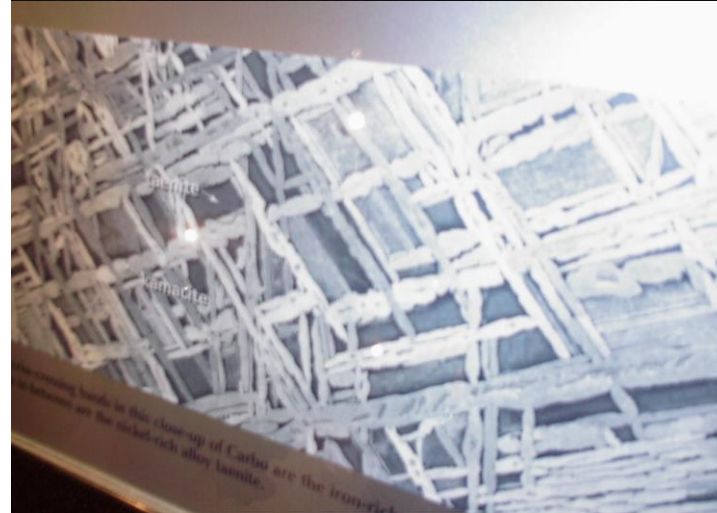
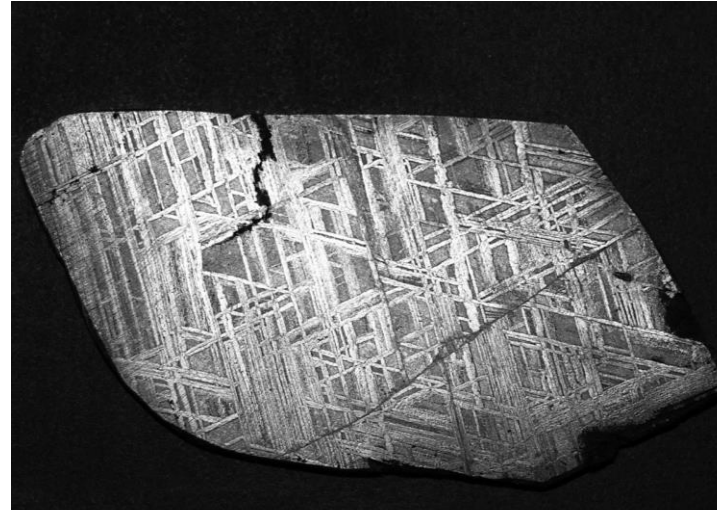
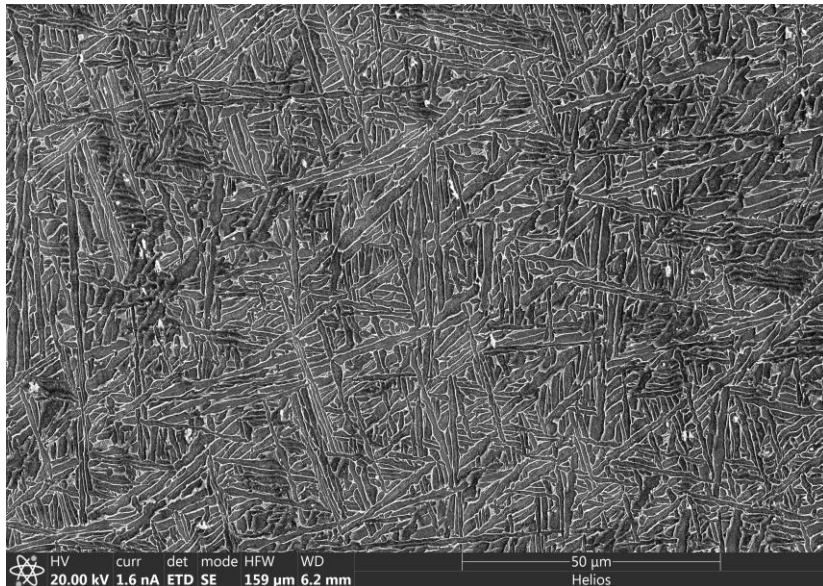
# Microstructure

Widmanstätten pattern

Ferrite nucleates within the prior austenite grains

Cooling rate:  $\sim 1\text{K} / \text{million years}$

EBF3 Ti-6Al-4V





# Meteorite Artifacts

Meteorites were the only source of iron before the Iron Age (1200-600 BC)

King Tut's dagger (Egypt, 1350 BC)

Harpoon: narwhal tusk w/ meteorite head (Inuit, 1100 AD)

Spears/axes (Shang Dynasty China, 1400 BC)

Axe (Syria, 1400 BC)

Beads (Egypt, 3200 BC)

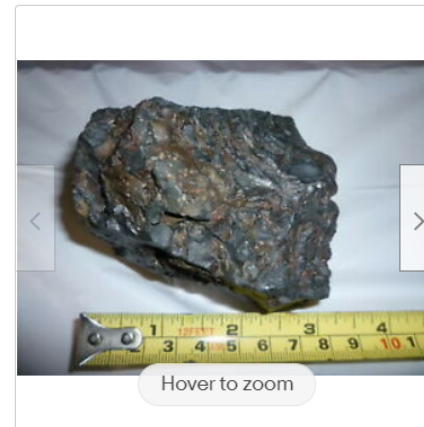


# Meteorites in the Modern Day

Planetary Research  
Museums  
Collectors



Smithsonian National Museum of Natural History, Washington DC



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# Meteorites in the Modern Day

Rolls Royce Phantom “Tranquility” Edition

Only 25 made

\$2+ million



Muonionalusta meteorite



# Sam's Method to Counterfeit a Meteorite (Hypothetically)

- 1) Create ingot of correct composition
- 2) Model meteorite in wax
- 3) Cast meteorite using lost wax process
- 4) Nickel plate
- 5) Heat treat to form microstructure
- 6) Strip nickel plate
- 7) Extended salt fog corrosion
- 8) Travel somewhere remote
- 9) "Discover" meteorite



# References

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