IS IT ALIENS?

YES

Dogbone Bond Bone of the (Every Other) Week #1 (Valentine’s Day Edition)
Feb 14 2022
Metallic Meteorites

What are they?

How did they form?

What is that microstructure?

Why are they significant?

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

<table>
<thead>
<tr>
<th>Geologist Name</th>
<th>Nickel (mass %)</th>
<th>Crystal Structure</th>
<th>Metallurgist Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kamacite</td>
<td>0-8%</td>
<td>BCC</td>
<td>Ferrite ($\alpha$)</td>
</tr>
<tr>
<td>Taenite</td>
<td>20-65%</td>
<td>FCC</td>
<td>Austenite ($\gamma$)</td>
</tr>
</tbody>
</table>
Microstructure

Widmanstätten pattern
Ferrite nucleates within the prior austenite grains
Cooling rate: ~1K / 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
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


