Name that rock

Astronomy magazine

Scientists classify meteorites by what they're made of and where they come from. /// BY MICHAEL E. BAKICH

ALL METEORITE IMAGES: ROBERT HAAG

Meteorites fall into three general classifications. Stone meteorites have low metal content, originating, as they did, in the outer, stony mantles of asteroids. Iron meteorites are the opposite of stones — they come from asteroids' metallic cores. Stony-iron meteorites form at the transition zone, which contains both metal and rock.

Beyond these three classifications, however, scientists divide stone, iron, and stony-iron meteorites into many subcategories. Stone meteorites fall into either of two classes: chondrites or achondrites. Stony-irons divide into mesosiderites and pallasites. Iron meteorites have three structural subgroups (ataxites, hexahedrites, and octahedrites) and any of 14 chemical subgroups, which meteoriticists base on the ratios of certain chemical elements.

THE CAMEL DONGA (Australia) stone meteorite (eucrite achondrite) has an unusually high iron content of 2 percent. The shiny crust indicates a calcium-rich specimen.

STONE	Achondrites	Primitive	Acapulcoite	
			Brachinite	
			Lodranite	
			Ureilite	Main group
				Polymict
			Winonaite	
		Evolved	Angrite	
			Aubrite	
		HED group	Howardite	
			Eucrite	Non-cumulative (originated in asteroid 4 Vesta's upper crust)
				Cumulative (originated in Vesta's magma chambers)
				Polymict (breccias with 90-percent eucritic material and 10-percent diogenitic material)
			Diogenite	
		Martian	SNC	Shergottite
				Nakhlite
				Chassignite
			Orthopyroxenite	
		Lunar	LUN A	
			LUN B	
			LUN G (gabbro)	
			LUN N (norite)	
	Chondrites	Ordinary	Amphoterites (LL group) — low total-iron content; low metallic-iron content	
			Olivine-bronzites (H group) — high total-iron content	
			Olivine-hypersthenes (L group) — low total-iron content	
		Carbonaceous	CH	
			CI	
			CK	
			CM	
			CO	
			CR	
			CV	
		Enstatites (E group)	EH (high iron content)	
			EL (low iron content)	
		Forsterites (F group)		
		Kankagariites (K group)		
		Rumurutiites (R group)		

DAR AL GANI 400 (Libya) originated on the Moon. Classified as an achondrite stone meteorite, it was found March 10, 1998.

IRON

Chemical classifications

IAB
IC
IIAB
IIC
IID
IIE
IIF
IIG
IIIAB
IIICD
IIIE
IIIF
IVA
IVB

Meteoriticists base this classification scheme on the abundance of nickel to gallium, germanium, and iridium. As the numbers increase (down the scale), so does the ratio of nickel to these three elements.

Structural classifications

Ataxites	Nickel-poor (less than 6-percent nickel)	All ataxites belong to chemical classification IIICD. They have no internal structure (no Widmänstatten lines).
	Nickel-rich (more than 11-percent nickel)	
Hexahedrites	These meteorites contain roughly 92 percent of the mineral kamacite; named for kamacite's six-sided (hexahedral) cleavage; total nickel content between 4.5 and 6.5 percent. All hexahedrites belong to chemical classification IIAB. Widmanstätten bands are wide (>50mm) and may not be visible in small specimens.	
Octahedrites	Named because of the way taenite and kamacite plates arrange parallel to the eight triangular faces of an octahedron.	

Mean width of kamacite layers		Chemical classification subgroups
Coarsest (Ogg)	greater than 3.3 millimeters	IIAB, IIIF
Coarse (Og)	1.3mm to 3.3mm	IAB, IC, IIE, IIIAB, IIIE, IIIF
Medium (Om)	0.5mm to 1.3mm	IAB, IID, IIE, IIIAB, IIIF
Fine (Of)	0.2mm to 0.5mm	IID, IIICD, IIIF, IVA
Finest (Off)	less than 0.2mm (layers are continuous)	IIC, IIICD
Plessitic (Opl)	less than 0.2mm (layers form spindles)	IIC

STONY-IRON

Pallasites

	Composition
Main group	iron, olivine
Eagle Station	iron, olivine, pyroxene
Pyroxene grouplet	iron, pyroxene

Mesosiderites

	Metamorphic grade
Class A (basaltic)	1A, 2A, 3A, 4A
Class B (ultramafic)	1B, 2B, 3B
Class C (orthopyroxene)	2C

Key:
1= fine-grained, fragmented;
2 = some recrystallization;
3 = much recrystallization;
4 = melted breccia

THE SANTA CLARA (Mexico) iron meteorite is a nickel-rich ataxite. It contains more than 16-percent nickel.

THE SANTA ROSALITA pallasite fell in Mexico. It is 75-percent olivine, and its iron contains 11.7-percent nickel.