"Meteorites: An Introduction"

Shekhar
Assistant Professor
Department of Geology
Patna Science College
Patna University
E-mail: sharan.srk@gmail.com
Mob: +91-7004784271

INTRODUCTION

- A ***meteor*** is a piece of solid matter from space which after entering the atmosphere become incandescent (due to atmospheric friction). Outside the Earth's atmosphere, it is known as ***meteoroid***; any part that survives passage through the atmosphere and reaches the earth surface is called ***meteorites***.
- ***Asteroid*** is bigger than a meteoroid and orbits around the sun. An asteroid or meteoroid which glows when close to the Sun is calld ***comets***; it should have a tail like a comma.

METEORITES

- Meteorites are believed to originate in the *asteroid belt between the planets of Mars and Jupiter.*
- Meteoritic matter is continually falling on Earth, nearly around *30,000 – 150,000 tonnes/year*.
- Meteorite consist essentially of:

  - *Ni-Fe alloy,*
  - *crystalline silicates,*
  - *Fe-S minerals*

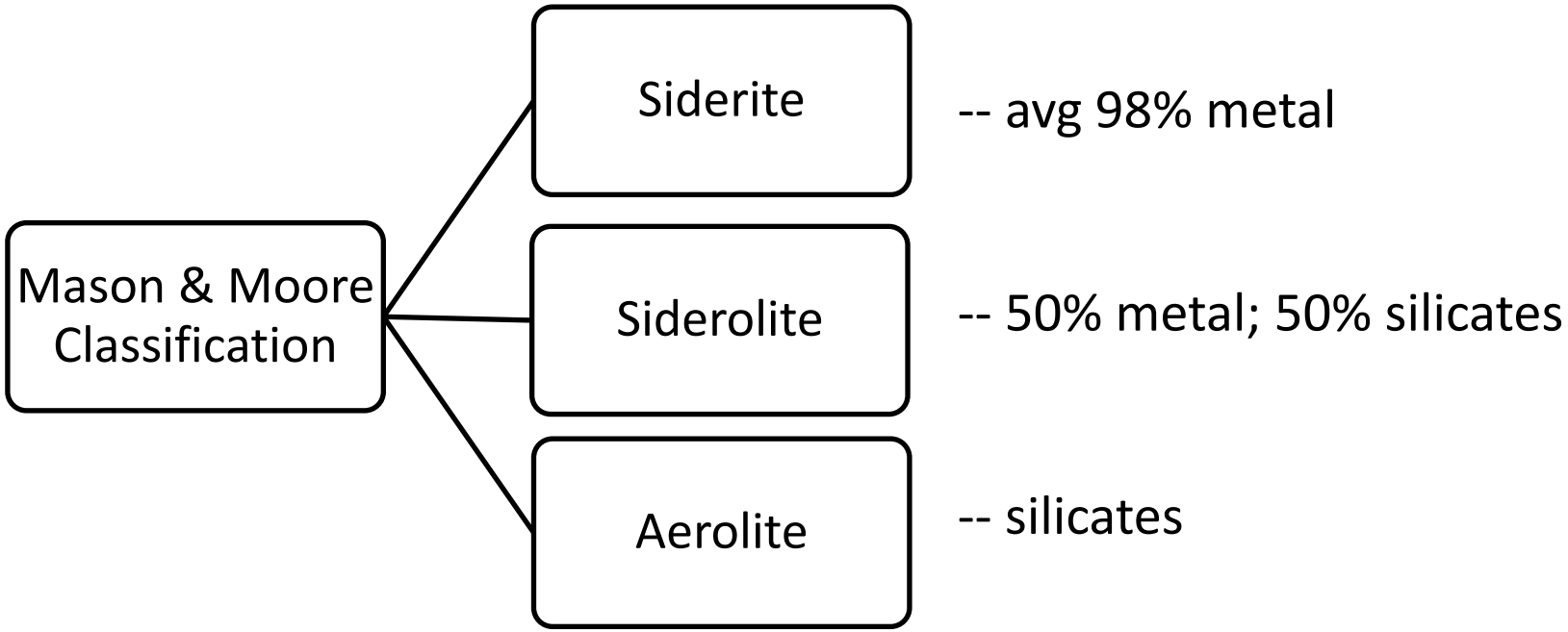
HISTORICAL BACKGROUND

- In *1974*, *Ernst Friedrick Chladni* summarised his work on meteorites in his book.
- In *1802*, *Edward Charles Howard* was first to chemically analyse stone meteorites.
- *Karl Ludwig von Reichenbach (in 1857)* was first to study the meteorites under microscope.
- *In 1863*, *Nevil Story Maskelyne* studied thin section of meteorite under cross polar light.
- *1863* is marked as the beginning of classification schemes with *G. Rose's classification* of the meteorite collection at the University Museum of Berlin and *Maskelyne's classification* of the British Museum collection.

HISTORICAL BACKGROUND

- Rose was the first to split stones into *chondrites and non-chondrites.*
- Maskelyne classified meteorites into *siderites (irons), siderolites (stony-irons), and aerolites (stones).*
- In 1833, Tshermak's modified the Rose's classification. It was further modified by Brezina.
- *1907, Farrington* classified meteorites on the basis of chemical composition.
- These schemes were further modified by *Prior (1920)* and *Mason (1967)*, which is still the fundamentals for the meteorite study.

MASON & MOORE CLASSIFICATION



SIDERITES OR IRONS

- Ni-Fe alloy (Ni is 4 - 20%)

- Accesories minerals:

  troilite (FeS),

  schreibersite $(Fe, Ni, Co)_3P$

  graphite,

  Daubreelite $(FeCrS_4)$,

  Cohenite (Fe_3C),

  Chromite $(FeCr_2O_4)$

**These are present as small rounded or lamellar grains scattered through the metal.*

- Widmanstatten figure is displayed normally by the metals.
- The structure is characterised by lamellae of kamacite bordered by taenite.

SIDERITES OR IRONS

Siderite are grouped into 3 class:

i. Octahedrite:

Lamellae are parallel to octahedral faces (exsolution due to very slow cooling).
characterised by widmanstatten structure.

ii. Hexahedrite:

Lamellae are parallel to hexahedral faces.
Iron-Nickel alloy, consisting entirely of Kamacite.

iii. Ataxites:

Iron-nickel alloy
Nickel > 14%, and consist largely of taenite.

SIDEROLITES OR STONY IRONS

- Consist of *Fe-Ni alloy and silicates* in approximately equal proportions.
- *Siderolite are grouped into 2 class:*

i) Pallasites:

Made of continuous base of Ni-Fe enclosing olivine grains of euhedral forms.

ii) Mesosiderites

It shows a discontinuous base (metallic phase) and silicates are plagioclase and pyroxene with accessory olivine.

AEROLITES OR STONES

Essentially consists of silicates.

- Includes two group:

i) Chondrites

- characterised by the presence of chondrule which are small rounded bodies made of olivine and pyroxene.
- further categorised in different groups based on composition.

ii) Achondrites

- composed of: Olivine~40%, pyroxene~30%, nickel-iron~10-20%, plagioclase~10% and troilite~ 6% .
- coarsely crystalline than chondrules.
- resemble terrestrial silicate rocks and hence probably crystallized from a silicate melt.

e.g., similar to basalts and gabbros.

TEKTITES

- Made of silica-rich glass (~75% SiO_2)
- Also consists Al, K, and Ca, with low Mg and Na.
- Usually small (200-300gm) and occur in areas where no volcanic activity is known.
- Nobody has seen them as falls so their origin is controversial.

PICTURE GALLERY OF DIFFERENT METEORITES

Stony iron meteorites

Stony meteorites chondrites

Stony meteorites Achondrites

Iron meteorite

REFERENCES AND FOR FURTHER STUDIES

Albarde Francis (2003): Geochemistry-Introduction. Cambridge University press.

Mason, B. and Moore, C.B. (1991): Introduction to Geochemistry, Wiley Eastern.

https://www.meteorite.com/