

## Sulfur in mesosiderites

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A molten core is often considered as the source of metal in mesosiderites, but S contents in (most) mesosiderites are much lower than those estimated from iron meteorites (Chabot, 2004). IVB parent body is an exception with low S, but its siderophiles are quite different from those in mesosiderites, and therefore not appropriate as a metal source for mesosiderites. Also, FeS grains in many mesosiderites are not located on metal grains. One expects FeS to be on metal grains if a Fe-FeS melt solidified through the eutectic. These lines of argument suggest that a molten core is not the source of metal in mesosiderites. But we need more details on S abundance and FeS (the S carrier mineral) texture in order to understand the origin of S in mesosiderites. We made detailed observations with SEM-EDS of five mesosiderites and an eucrite (Agoutt). In addition, several mesosiderites were observed without making quantitative measurements.

A small amount of S is probably inherited from the silicate part of the HED-like parent body. Eucrites contain ~0.2 wt. % S. (Mittlefehldt+, 2021). But mesosiderites often contain more S.

Crab Orchard contains the lowest S at ~0.16 wt.%. ALH77219, Asuka882023, NWA1878, and NWA1827 contain 0.20, 0.28, 1.6 and 3.1 wt. % S, respectively, to be compared with 0.14 wt.% S in Agoutt. Note that bulk S contents in other mesosiderites range from 0.60 to 13.9 wt. % according to Planetary Materials (Reviews in Mineralogy 36).

Therefore, additional S sources in addition to that inherited from the achondritic parent body are needed and we looked for them by microscopic observations.

(1)Diogenite-like clasts contain some S (~1 wt.% S).

(2)S<sub>2</sub> gas reacted with silicates (mainly olivine), producing small amounts of small FeS grains.

Olivine clasts with a fine-grained FeS outer zone

FeS+Px clasts (olivine ghost)

FeS+Px veins through olivine (Lorenz+, 2010)

FeS+SiO<sub>2</sub> aggregates

S abundances in such areas are ~ 3 wt.% locally. The S<sub>2</sub> gas may be produced by impact events.

(3)Abundant, large FeS on metal grains and/or contiguous network of FeS in matrix.

These are observed in highly reheated mesosiderites (type3/4: Estherville, NWA4747, etc.)

In NWA1827, large FeS grains (~300 microns) exist. In such areas, metal is not abundant and a significant fraction is taenite. This suggests that FeS was produced by sulfurization of pre-existing metal. In NWA4747, FeS exists as a contiguous network that fills interstices of silicates. Presumably it existed as a melt. The abundant FeS may be directly derived from S-rich projectiles.

If all the mesosiderites have abundant FeS as observed in NWA4747, one may consider that FeS was (together with metal) derived from a molten core. But such mesosiderites are rare.

Such S enrichment is local rather than global on the parent body.

Summary

Mesosiderites contain more S than eucrites, but the S abundances and the FeS texture suggest that it did not accrete together with the metal. This means that the metal was not derived from a molten core.

References

Chabot, 2004, GCA, 68, 3607-3618.

Lorenz+, 2010, Petrology, 18, 461-470.

Mittlefehldt+, 2021, MAPS, 57, 484-526.

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