



The Effect of Reduction of Elements on Their Dynamics During an Impact.

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1. Introduction

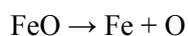
Lunar samples indicate efficient reduction of iron and formation of nanophase metallic iron particles in agglutinitic impact glasses and in amorphous rims of vapor deposits [1, 2]. Terrestrial impactites do not show sufficient reduction of iron but the presence of Fe-oxide spherules was reported for K-T boundary layer (e.g., [3]). It is highly probable that these Fe-oxide spherules had originated as Fe-metal droplets and then were oxidized during the long deposition. Our experimental investigation shows partial reduction of siderophile and even lithophile elements during the impact-simulated high-temperature processing of silicates.

2. Redox effects of impact-induced high-temperature processing.

High-temperature impact-induced processing results in noticeable redox changes of elements in silicates [4].

2.1. Reduction of iron.

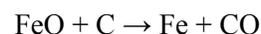
Two main mechanisms are responsible for the reduction of elements: thermal and chemical. Thermal mechanism produces metallic iron nanoparticles through the body of high-temperature siliceous melts due to direct dissociation of iron oxide



or reaction of disproportionation [5]



while chemical mechanism involves reducing components (C, H, etc.) in exchange reactions



All mechanisms are working in a multicomponent system providing rather efficient reduction.

Experiments also show sufficient reduction of siderophile, moderately siderophile, and to less extent of lithophile elements. Reduced elements have noticeable trend to concentrate in the forming metallic particles.

2.2. Concentrating of siderophile elements in metallic phase.

While metallic iron appears in the melt it absorbs siderophile elements from its vicinity. Such process is rather efficient even for short time of pulse experiments (milliseconds). Experiments with olivine shows formation of metallic iron droplets which contain up to several percents of Ni and half percent of Co.

3. Dynamics of reduced components during the cratering process.

Analyses of melted silicates in our experiments indicate their rather efficient depletion in iron. Complementary condensed siliceous materials did not show expected sufficient enrichment in iron and in some cases were also iron-depleted. Mainly all melts have droplets of metallic iron with dimensions ranging from nanoscale to micron-size. The transition of iron into metallic particles seems accounts for the loss of iron from both melt and condensate. Metallic iron particles can aggregate into larger spherules and due to immiscibility are easily removed from the

melt and dispersed into expanding vapor cloud. Being ejected metallic iron spheres remove sufficient portion of siderophile elements from impact melts.

Formation of metallic droplets, concentration of siderophile elements in them, and subsequent their dispersion from silicate melts provides efficient loss also for low volatile siderophiles (e.g. PGE). Such mechanism of elements dynamics depends more on their redox state but not on their volatility.

There is still a question can these metallic particles be concentrated on the macro-scale during or after cratering process to contribute for siderophile elements depositions.

Acknowledgments

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References

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