

Incongruent evaporation of olivine at low temperature

K. OZAWA¹ AND H. NAGAHARA²

¹Dept. Earth Planet. Sci., Univ. Tokyo, Hongo, Tokyo 113-0033, Japan (ozawa@eps.s.u-tokyo.ac.jp)

²Dept. Earth Planet. Sci., Univ. Tokyo, Hongo, Tokyo 113-0033, Japan (hiroko@eps.s.u-tokyo.ac.jp)

Introduction

Partial evaporation of pre-existing minerals is one of important processes that caused chemical and isotopic fractionation in the solar nebula. Olivine was shown to evaporate stoichiometrically to magnesian olivine and gas with iron-rich olivine composition in both equilibrium and kinetic conditions (Nagahara et al., 1994; Ozawa and Nagahara, 2001), with large Mg-Fe fractionation. We, however, found that olivine evaporates incongruently to form Mg-rich pyroxene at low temperatures.

Experimental

San Carlos olivine (Fo91-92) was cut into slab parallel to three major axes, which was heated in vacuum at temperatures of 1300, 1400, and 1500°C for 3 to 240 hours. The surface was observed and analyzed with after the run, and the compositional zoning from surface to interior in a vertical section was measured.

Results

The olivine evaporated keeping stoichiometry at 1500 and 1400°C, and the residue has become magnesian at the surface with compositional zoning toward interior. On the contrary, it evaporates incongruently leaving small crystals with lower Mg/Si ratio on the residue surface at 1300°C. The phase appears to be enstatite on the basis of X-ray intensity with EPMA, but we have not yet confirmed it with the X-ray diffraction method.

Discussion

Incongruent evaporation of olivine to magnesian pyroxene indicates the selective evaporation of FeO and formation of pyroxene at the surface. This is interpreted to be due to much higher volatility of FeO than SiO₂ from olivine. The present results predict that evaporation of olivine and Mg/Fe fractionation between solid and gas are highly suppressed once the surface of olivine is coated by enstatite, which prolongs the lifetime of Fe-bearing olivine. Enstatite, on the other hand, is shown to evaporate incongruently to forsterite and Si-rich gas (Tachibana et al., 2002) at a very small rate, thus remains long. Fe-bearing olivine thus remains long at temperatures as low as 1300°C and chemical fractionation is suppressed.

References

- Nagahara, H., Kushiro, I., and Mysen, B. O. (1994) *Geochim. Cosmochim. Acta* **58**, 1951-1963.
Ozawa, K. and Nagahara, H. (2000) *Geochim. Cosmochim. Acta* **64**, 173-189.
Tachibana, S., Tsuchiyama, A., and Nagahara, H. (2002) *Geochim. Cosmochim. Acta* **66**, 713-728.

Features of metals distribution in the bottom sediments of the Malaya Talmovaya River.

N.V.OZHERELIEVA¹

¹ Institute of Geology SB RAS, Novosibirsk, pr.Koptuga 3, Russia (ecologs@uiggm.nsc.ru)

Bottom sediments and water of the Malaya Talmovaya River were researched in this work Kemerovo region, Siberia), where the first tailings impoundment of the Salair Ore Recovering Plant is located. There were discovered the significant excesses of metal contents (Zn, Pb, Cu, Cd) to the background in 41, 39, 10, 1000 times accordingly, in three checkpoints, which show a state and a level of metal concentration in water and bottom sediment of the Talmovaya River

Contents of water soluble species of Zn (Zn [W]) are 2, 0.9, 1.95 ppm from upper to lower reaches and higher than the background level in 60 times (on average), the content of Cu[W] are 0.5, 0.45, 0.7 ppm and higher than the background in 6 times, the contents of Pb [W] and Cd [W] are below the limit of finding

Contents of exchangeable species of Zn (Zn [S]) are 280, 230, 390 ppm from upper to lower reaches and higher than the background level in 400 times on the average, the Pb [W] isn't discovered in any sample Cu [S] are 124, 165, 114 ppm and higher than the background in 100 times on the average, the amounts of Cd [S] are 3, 1.7, 3.2 g/t (from upper to lower reaches)

On the basis of the received data the following conclusions are made.:

There are speciations in solution: Me^{2+} (Me = Zn, Cd); MeOH^+ , Me(OH)_2 (Me = Cu, Fe); MeHCO_3^+ , $\text{Me(CO}_3)_2^{2-}$ (Me = Pb).

The share of soluble forms of metals increases and the layer its contents raises by decrease of pH ,which is caused by the oxidation of FeS_2).

The irregular distribution of concentrations of metals in the water, sampled in different checkpoints, are bound up with sorption, which is fixed by content of organic substances in bottom sediments, area of clay surface, level of mineralization of water and accumulation of metals in phytoplankton. Moreover, there are different mechanisms of sorption for different metals (the higher content of Zn[W] in the middle checkpoint shows more active sorption of Zn in comparison with other metals).

As a whole, the contents of the mobile forms of metals increase from upper to lower reaches. The contents of Zn [W] and Zn [S] are higher than the background in 60 and 400 times accordingly, Pb [W] and Pb[S] no data, Cu [W] and Cu [S] are higher than the background in 6 and 100 times accordingly, Cd[W] is lower of the limit of finding, the content of Cd [S] is insignificant. Thus, the river is most polluted by Zn. It's danger for biota and consequently for people.

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