Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07402, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07402
EGU General Assembly 2008

Cation incorporation in magnetites formed upon thermal decomposition of ankerites

C. Jimenez-Lopez (1), C. Romanek (2), A. Rodriguez-Navarro (3), T. Perez-Gonzalez (1), C. Rodriguez-Navarro (3)

(1) Dept. Microbiology, University of Granada, Spain, (2) Dept. Geology, University of Georgia, USA, (3) Dept. Mineralogy and Petrology, University of Granada, Spain (cjl@ugr.es / Fax: +34 958 249486)

It has been claimed that chemically pure magnetites (Fe_3O_4) can be obtained after thermal decomposition of ankerites [(Fe,Mg)CO_3] (Golden et al., 2004). Such an observation is critical, since it opens the possibility of obtaining inorganic magnetites with identical characteristics as those reported for magnetite crystals in Martian meteorite ALH84001, at least, with respect to chemical purity. Such a chemical purity is one of the parameters used so far to recognize bacterial origin of natural magnetites samples, both terrestrial and extraterrestrial (Thomas-Keptra et al., 2000), since it has been demonstrated that biologically-controlled magnetites are chemically pure (Bazylinski and Frankel, 2004). However, while Golden et al. (2004) obtained pure magnetite from an almost pure precursor, the ankerite cores in ALH84001 in which magnetites are embedded are far from being chemically pure, since they contain considerable amounts of Ca and Mg (Kopp and Humayun, 2003).

In this study we have performed several experiments to analyze the chemical purity of magnetites produced by thermal decomposition of four ankerites containing different amounts of Ca, Fe and Mg. Such a thermal decomposition was achieved by two procedures: (1) by heating the samples at 470ºC under 1 atm CO_2 pressure [equal to the hypothetical ancient CO_2 pressure in Mars (Kopp and Humayun, 2003)] and (2) by decomposing the ankerite “in situ” under the TEM (Transmission electron microscopy) electron beam. Magnetite produced by the first procedure was analyzed by XRD to determine whether or not the resulting solid was a mixture of oxides or rather a solid

solution of (Ca, Fe and Mg)oxide. Magnetites formed by the two methods were studied by High Resolution TEM. The chemical composition of about 20 crystals of each experiment was analyzed by EDAX. Under our experimental conditions, ankerites decomposed into magnetite crystals of about 5 nanometers in size. Magnetite crystals aggregates keep the morphology of the precursor (i.e., they form pseudomorphs). Our results confirm that none of these magnetites is chemically pure, but rather, each one of them is a solid solution of Ca and Mg. Therefore, chemically pure magnetites found in the meteorite ALH84001 cannot be obtained, as Golden et al. (2004) proposed, just by the thermal decomposition of the (Fe,Ca,Mg)CO_3 precursor in which they were embedded.

Bazylinski D. and Frankel R. (2004) Nature Reviews, Microbiology (2), 217 – 230.

Golden D.C., Ming D. W., Morris R.V., Brearley A.J., Lauer H.V., Treiman A.H., Zolensky M.E., Schwandt C.S., Lofgren G.E., and McKay G.A. (2004) American Mineralogist, 89, 681-695.

Kopp R.E. and Humayun M. (2003) Geochimica et Cosmochimica Acta, 67 (17) 3247–3256

Thomas-Keprta K.L., Bazylinski D.A., Kirschvink J.L., Clemett S.J., McKay D.S., Wentworth S.J., Vali H., Gibson E.K. Jr., and Romanek C.S. (2000) Geochimica et Cosmochimica Acta 64, 4049–4081.