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Phase relations in the system Fe-Ti±Mg±Al-O – new calibration data for the Fe-Ti, two-oxide thermo-oxybarometer

U. Sauerzapf (1), D. Lattard (1), M.S. Ghiorso (2)

(1) Universität Heidelberg, Germany, (2) The University of Chicago, USA
(ursula.sauerzapf@min.uni-heidelberg.de / Fax: +49 6221 544805 / Phone: +49 6221 544802)

Formulations of the titanomagnetite-ilmenite (Tmt- Ilm_{ss}) thermo-oxybarometer[1][2] have been widely used to estimate T and fO_2 in magmatic rocks. However, they have turned out to extrapolate poorly at high fO_2 [3][4] and also at low fO_2 and high T. This is partly due to the limited T-fO_2-range of experiments used for the original calibrations.

The present experiments are designed to support a new calibration of the thermo-oxybarometer: We have synthesized Tmt+Ilm_{ss} assemblages in the Fe-Ti-O system at 1000˚C-1300˚C, 1 bar and NNO –5 to +5. Oxygen fugacity was controlled by CO/CO_2 gas mixtures or by using a solid state buffer sealed together with the sample in an evacuated silica glass ampoule. Samples were examined and analysed with SEM and EMP. In order to approach natural magmatic compositions we have been performing experiments in the systems Fe-Ti-Mg-O, Fe-Ti-Al-O and Fe-Ti-Mg-Al-O.

In the system Fe-Ti-O Ti-content of Tmt increases with increasing temperature at constant ΔNNO over a broad range of fO_2. At low fO_2 and high T, Tmt is Ti-richer than ulvöspinel end member, which points towards cationic vacancies. This is supported by our current investigations on Tmt nonstoichiometry.

In the system Fe-Ti-Mg-O MgO contents of Ilm_{ss} are independent of temperature and generally higher than those of coexisting Tmt. MgO contents of Tmt are increasing with increasing temperature. In the system Fe-Ti-Al-O the maximum Al_2O_3 content of Ilm_{ss} is about 1 wt%.

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