FE - MG MIXING IN BIOTITE: PRELIMINARY EXPERIMENTAL RESULTS AT 800°C/2 KBAR

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The reaction-displacement technique was applied to the end-member reaction annite = sanidine + magnetite + H_2 in order to determine the activity of the annite component (a_{Ann}) in Fe-Mg biotites. A similar study was performed by BENISEK et al. (1996) for Tschermak's substituted Fe-biotites at 700°C/2 kbar (more details of the experimental design used can be found there). Based on the simplified relation $a_{Ann} = f_{H2}/f_{H2}^{o}$ (f_{H2}^{o} = hydrogen fugacity of the end-member reaction at 800°C/2 kbar = 103.6, taken from DACHS, 1994), the assemblage Fe-Mg biotite + sanidine + magnetite + H_2O was exposed to lower f_{H2} conditions equivalent to the NNO buffer (f_{H2} = 8.58, calculated from the data of O'NEILL & POWNCEBY, 1993). As biotite starting composition, we used pure phlogopite in all runs. Several experiments having run durations of 3, 5, 8, 12 and 14 days yielded an identical final biotite composition of $Ann_{49}Phl_{51}$ (determined by electron microprobe and XRD analysis), which can be interpreted as the equilibrium biotite composition at these P, T, f_{H2} conditions. The ideal annite activity for this composition is $a_{Ann}^{id} = 0.118$, whereas $a_{Ann} = f_{H2}/f_{H2}^{o} = 0.083$. Thus, our preliminary data would indicate that there is a slight negative deviation from ideality along the annite – phlogopite join at 800°C/2 kbar (W_{AnnPhl} = - a few kJ mol-1). However, taking errors into account, which are in the order of ± 0.02 for mole fractions and activities, the data are equally well compatible with ideal Fe–Mg mixing in biotite. More experiments are being performed in order to constrain the a – X relation along the annite – phlogopite join for a broader set of biotite compositions.

BENISEK, A., DACHS, E., REDHAMMER, G., TIPPELT, G., AMTHAUER G. (1996): Activity - composition relationship in Tschermak's substituted Fe biotites at 700°C/2 kbar. - Contrib. Mineral. Petrol., in press.

DACHS, E. (1994): Annite stability revised: 1. Hydrogen-sensor data for the reaction annite = sanidine + magnetite + H_2. - Contrib. Mineral. Petrol., 117, 229–240.

O'NEILL, H.St.C., POWNCEBY, M.I. (1993): Thermodynamic data from redox reactions at high temperatures. I. An experimental and theoretical assessment of the electrochemical method using stabilized zirconia electrolytes, with revised values for the Fe-»FeO«, Co-CoO, Ni-NiO and Cu-Cu_2O oxygen buffers, and new data for the W-WO_2 buffer. - Contrib. Mineral. Petrol., 114, 296–314.