EXPERIMENTAL DETERMINATION OF ACTIVITY COEFFICIENTS OF SILICON IN METAL AND THEIR RELEVANCE FOR SILICATE-METAL EQUILIBRIA IN PLANETESIMALS. I. A. Vogel[1], A. Borisov[1] and H. Palme[1], [1]Institut für Mineralogie und Geochemie, Universität zu Köln, 50969 Köln, Germany, ingo.vogel@uni-koeln.de.

Introduction: The equilibration of silicate melts with iron-nickel metal is a fundamental process in planetary differentiation (e.g., core formation). A sensitive indicator for the conditions of metal separation is the amount of Si in metal. In calculating Si partitioning between metal and silicate the knowledge of the activity coefficients of silicon in iron-nickel alloys is essential. For pure iron there are some experimental data available in the literature [1, 2, 3]. However, little is known for FeNi-alloys. We therefore performed experiments to determine the activity coefficients at different temperatures in alloys with different iron-nickel ratios.

Experimental techniques: Loops of FeNi-alloys were equilibrated with silicates of an anorthite-diopside-quartz mixture, saturated in quartz, at temperatures from 1300 to 1400 °C in highly reducing CO/CO_2 gas mixtures. All experiments were carried out at 1 bar total pressure. After having reached equilibrium, the silicate melt was quenched to glass and the silicon content of the metal phase were determined by EMPA. Because of the low silicon content, a probe current of approximately 2 µA, a voltage of 10 kV and a beam diameter of 20 µm were used.

Results: Preliminary results indicate that at a given temperature, the activity coefficient of silicon in the metal phase shows a strong dependence on the nickel content. For 1400 °C, the activity coefficient decreased with increasing nickel content from $8.1 \cdot 10^{-4}$ (pure iron) to $4.6 \cdot 10^{-5}$ (pure nickel). At a temperature of 1350 °C, the activity coefficient had a value of $1.2 \cdot 10^{-4}$ for pure iron, and a value of $2.2 \cdot 10^{-5}$ for pure nickel. In addition, the activity coefficient is also strongly temperature dependent. Relevant measurements are in progress.

Implications: Using these data, model calculations were performed, for a silicate melt of eucritic composition in equilibrium with an iron-nickel alloy $Fe_{90}Ni_{10}$. Two scenarios were considered, equilibration of metal and silicate by partial melting at 1200°C and by fractional crystallization at 1600°C. Metal in equilibrium with a melt at 1200 °C would have 0.26 ppm Si, wheras at 1600 °C we calculate a factor of 25 higher Si content of 6.9 ppm.

Silicon concentrations in iron meteorites are below 30 ppm, e.g. Wai and Wasson [4]. More precise data are presently not known. It is, however, within the capability of modern micro-chemical instruments to determine Si in metal at the ppm level. Such data would be important for better understanding the formation of iron meteorites.

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