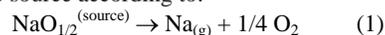


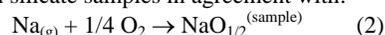
SODIUM SOLUBILITY IN MOLTEN SYNTHETIC CHONDRULES

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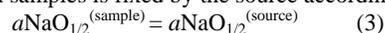
The fact that alkali contents in chondrule mesostases vary by almost three orders of magnitude is still poorly understood [1,2]. Variable degrees of evaporation, direct condensation from gaseous nebular environments [3] or low temperature alteration in the parent body are some of the possible explanations. In the lack of thermodynamic properties of alkali metals (mainly Na and K) in molten silicates, we have developed, to go further on chondrule formation, a new device that allows to measure the Na solubility in molten silicates under a known Na partial pressure (P_{Na}) at high temperature and fixed oxygen fugacity (P_{O_2}). Our method, mimicking condensation of Na into chondrule melts under nebular conditions, consists in equilibrating in a closed system at high temperature molten silicates with alkali vapour established by a Na_2O - $xSiO_2$ binary melt. The sodium evaporates from the source according to:



bathing the samples in alkali vapor, which dissolves in the molten silicate samples in agreement with:



At equilibrium conditions, the alkali metal oxide activity in molten samples is fixed by the source according to



With the above design, sodium solubility have been investigated at 1400°C and 1 atm total pressure in molten silicates belonging to the CaO-MgO-Al₂O₃-SiO₂ system (130 samples) and covering a large range of compositions (0 < CaO and MgO < 40; 0 < Al₂O₃ < 45; 0 < SiO₂ < 85; in wt%) with bulk polymerization (NBO/T) varying from 0 to 3. Different Na_2O - $xSiO_2$ sources [4,5,6] were used to impose Na partial pressures in the range of 10⁻⁴ atm to 10⁻⁶ atm. At equilibrium, the solubility of sodium: S_{Na} (mole.g⁻¹.atm⁻¹) and the sodium oxide activity coefficient: $\gamma_{NaO_{1/2}^{(sample)}}$ are calculated. From this set of experiments, it is possible to derive simple equations of Na solubility and sodium oxide activity coefficient as function of melt composition that shed light on how melt composition (and melt structure, i.e., Q species) controls sodium solubility in molten silicates. Applications to chondrule formation will be then discussed.

References [1] Hewins et al., (2005) ASPCS, 341, 286–317. [2] Grossmann and Alexander, (2008) LPSC, 2084. [3] P. Georges et al, Meteorit. Planet. Sci. 35 (2000) 1183. [4] S. Yamagushi, et al, Japan Inst. Metals, 45 (1983) 736.B [5] V. Piacente, J. Matousek, Silikaty, 4 (1973) 26. [6] D. N. Rego et al, Met. Trans. B, 19B (1988) 655.