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The relevance of T, p_{tot} and fO_2 for the evaporation of Na and K from silicate melts

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Chondrites and planetary bodies show various degrees of volatile element depletion. Temperature, fO_2 and pressure conditions, at which the elemental losses occured, are still under debate (evaporation or incomplete condensation)[1].

Heating experiments with simple synthetic silicate melts (peralkaline and albitic) were performed in gas mixing and vacuum furnaces. Time series at 1450 °C, fO_2 from air to IW -2 and p_{tot} from 1 atm to 10^{-4} bar were done. Evaporative losses were determined by weighing and microprobe analysis.

Peralkaline samples release Na (less) and K (more) already under oxydizing conditions and 1 atm. Losses are increasing with time and declining fO_2. At low p_{tot}, losses of Na are more pronounced than those of K. In silicates of unity alkali/Al ratio (e.g., albitic), volatile losses are inhibited due to the strongly polymerized melt structure. However, this barrier is overcome either by intense reducing conditions or low absolute pressure. As albite is the main Na carrier of condensing solar disk matter, our results provide additional constraints on p_{tot} and fO_2 conditions in the early solar system.

[1] Richter, F. et al. (2011) MAPS 2011, 1-27.

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