EFFECT OF SODIUM ON PHASE RELATIONSHIP: APPLICATION TO CHONDRULE FORMATION.

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In our quest to understand the formation of chondrules, alkalis received much of the attention because of their complex behavior, i.e., lithophile but incompatible at low temperature, they become volatile at high temperature and/or under reducing conditions. With up to a tenth of % in chondrule mesostases of several classes of chondrites, alkalis clearly may help to put some valuable constraints on chondrule formation processes ([1]-[4]). Even at minor concentration levels, numerous experimental works ([5]) have yet demonstrated that alkalis affect significantly the physicochemical properties of silicate melts, including melting temperature, diffusion, viscosity, etc…. This feature is well explained in terms of structural changes occurring in the melt structure in response to the dual role of alkalis in molten silicates, acting either as network modifying cations and/or as charge compensating cations, according to the melt composition.

In order to document the behavior of alkalis in chondrule-like compositions, we have developed a new device ([6], [7]) to control the sodium-metal oxide activity in molten silicates ($aNa_2O$) by equilibration of melts with gaseous environment of known Na partial pressure ($P_{Na}$) at high temperature and fixed oxygen fugacity ($P_{O_2}$). This design allows to establish a new set of phase diagrams in the system CaO-MgO-Al$_2$O$_3$-Na$_2$O-SiO$_2$ at fixed oxygen fugacity and under isobaric isothermal iso-Na partial pressure conditions. In this paper, we will show that this new approach is pertinent to determine the effect of sodium on chondrule phase relationships and better constrain Na crystal-melt partitioning.