# Evaporation of planetesimals: theory meets laboratory experiments

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Differentiated planetary bodies exhibit small but discernible elevations in heavy/light stable isotope ratios among rock forming elements. Preferential evaporation of light isotopes from melt exposed to space is a possible mechanism. A theoretical framework has been developed for evaluating the isotopic effects of evaporation as a function of size of the body and the nature of any enveloping gas [1].

We are testing this framework in the laboratory by laser heating aerodynamically levitated samples in gases of controlled compositions. Our data bear on the effects of variable saturation on evaporative isotope fractionation, providing tests of the theoretical predictions. Example results in Fig. 1 show the $^{56}Fe/^{54}Fe$ ratios of residues following partial evaporation of synthetic E chondrite starting materials in both $N_2$ and Ar-rich gases at 2300 K. The vapor/melt isotope fractionation factors ($\alpha$) defined by the slopes in Fig. 1 are closer to unity than evaporation to vacuum ($\alpha$ = 0.982) and define Fe gas saturation values of ~0.7, corresponding to effective total pressures of 0.1 to 0.2 bar in the boundary layer of the flowing gas. Results like these constrain models for evapoative fractionation under ranges in relevant conditions.

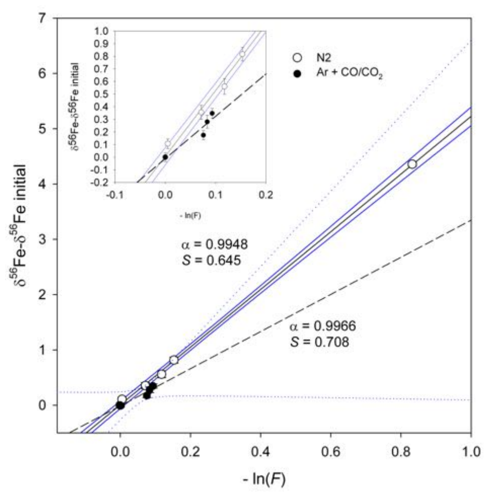


**Figure 1**. $\delta^{56}$Fe (‰) of E-chondrite evaporation residues vs fraction of Fe remaining, *F*. Best-fit lines define $\alpha$ values.

[1] Young et al. (2019) Icarus 323.