Appendix S3.

Limits to implant fluences

There are two factors which limit the implant fluence: (1) radiation damage and (2) potential effects on RSF from the implant.

(1) Some implant radiation damage should be acceptable because, at least in insulators, SIMS secondary ions are produced from an amorphous layer produced by primary ion bombardment. This layer, at least qualitatively, resembles that produced by radiation damage from an ion implantation. However, in metals where rapid recrystallisation can occur, there may be greater differences in the radiation damage produced by the implanting ion beam and the primary ion beam in SIMS analysis. In the absence of detailed understanding, large implantation doses of heavy ions should probably be avoided. We strive to keep implant doses less than around 10^{15} cm^{-2} because Melcher *et al.* (1981) showed large changes in the diffusion properties of Xe implanted into feldspar after fluences greater than 10^{15} cm^{-2}. This result may or may not be relevant for SIMS RSF. Xenon is a very heavy ion and produces a lot of radiation damage per ion. Our 10^{15} cm^{-2} limit may be very conservative. The examples given in manuscript Figures 2 and 3 were for fluences in the 10^{13} range.

(2) An additional reason to stay below the 10^{15} cm^{-2} fluence limit is to maintain the peak concentrations of the implanted ions at trace levels, so eliminating possible changes in RSF due to the presence of the implanted ion (implanted ion matrix effect). For example,

using SRIM, the peak concentration of a 1 x 10^{15} cm^{-2} Mg implant of 43 keV into Si was only about 0.2 atomic percent.

References

Melcher C.L, Burnett D.S. and Tombrello T.A. (1981)
Diffusion of Xe following ion implantation in feldspar: Effects of implantation dose. **Proceedings of the Lunar and Planetary Science Conference, 12**, 1725–1736.