**Appendix A: Supplementary Data**

*Methodology*

*Secondary Ion Mass Spectrometry (SIMS).* Primary beam conditions utilized 20 keV133Cs+ ions focused to 6 µm and 8 µm diameter, using beam currents of ~0.1 – 0.5 nA. Negative secondary ions were extracted through 10 kV to the grounded secondary column (transfer section). Conditions for the transfer section included an entrance slit width of 80 µm, field aperture of 5 x 5 mm, and a field aperture-to-sample magnification of 100×. Automated tuning of the secondary ions in the transfer section preceded each analysis. The energy slit was fully open.

Both 32S- and 34S- were analyzed simultaneously in Faraday cups (L'2 and FC2 using 1011 Ω amplifier circuits) at mass resolutions of ~2000 and 3500, respectively. Count rates for 32S- and 34S- ranged from 0.6 – 1.5 x 108 counts/s and 3.0 – 6.0 x 106 counts/s, respectively, determined over a 60 s total counting interval for each analysis. The analytical protocol interspersed analyses of unknowns with the pyrite RM in a 4:1 ratio (pyrite S0302A with δ34SVCDT = 0.0 ±0.2 ‰).