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X-ray fluorescence simulations from Solar-System regoliths: Effects of volume fraction and particle size distribution

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We present results from a numerical study of soft X-ray fluorescence from solar system regoliths. We have employed a ray-tracing Monte Carlo technique to simulate the fluorescing effect of the Solar irradiance from surfaces consisting of spherical particles. We have used different volume fractions (i.e., packing densities) and particle size distributions to study the effect these geometrical properties have on the measured fluorescence signal at different viewing geometries. We have also employed a rough surface model which simulates the macro scale surface roughness. Our studies indicate that the viewing geometry can have a noticeable effect on the measured elemental ratios of, e.g., iron and calcium. The simulated signal shows higher iron content in relation to calcium at smaller phase-angles. Increase in volume density increases the total fluorescent signal. The increase is most prominent at small phase-angles.

We conclude by discussing the implications our results have on the science output of future space missions in the inner Solar-System, e.g. BepiColombo, which carry next generation X-ray spectrometers with high spatial and spectral resolution.