

# Investigating the Nanoscale Complexity of Lunar Space Weathering

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## Introduction

“Space weathering” – the physical and optical changes incurred by surfaces exposed to the harsh environment of space – has been studied in lunar soils since the first Apollo samples were returned. Over the last three and a half decades, we have come to understand many of the basic processes, products, and consequences of space weathering, but questions remain about the rates and relative importance of these processes and the compositional dependence of the various components of the weathering process. New instruments are allowing us to investigate the products of space weathering with detail never seen before and are providing fresh insight into these complex processes.

## Methods and Discussion

The newly installed JEOL 2500SE 200 keV field-emission scanning-transmission electron microscope (FE-STEM) at JSC is equipped with an X-ray (EDX) spectrometer, which allows us to obtain spectrum images of lunar soil grain rims in ultramicrotome thin sections (~50 nm thick). Spectrum images were acquired with a 4 nm incident probe. Successive image layers were combined in order to achieve suitable counting statistics in each pixel.

The typical lunar grain below displays a complex rim consisting of a vapor-deposited nanophase iron-rich layer that is chemically distinct from the underlying grain overlain by a Fe-Ti-rich melt splat. Complex multilayered rims of this type are found to be quite common in mature lunar soils.

