



Exolith Lab | What is Simulated?

Simulants made from natural terrestrial materials *will never be perfect copies of extraterrestrial regoliths*. Depending on your application you may need a lower or higher fidelity simulant, and may wish to modify our products further to meet your specific needs. Below is a basic guide to which properties are well emulated in our materials, and which are not.

Well-simulated properties

- **Mineralogy.** Our simulants are high-fidelity materials that accurately capture the major modal mineralogy of the reference materials, including both crystalline and amorphous phases.
- **Bulk chemistry.** The bulk major element chemistry of our simulants is generally accurate, except for excesses in Mg, Na and K, and deficiencies in Fe and Ca due to the crystal chemistry of terrestrial minerals.
- **Particle size distribution.** For lunar simulants there are good controls from returned samples and we target these distributions. For martian and asteroid simulants we use a natural power law distribution from crushing, with a reasonable maximum particle size.
- **Volatile release.** We have measured the evolved gases from the simulants during heating, and the martian and asteroid simulants accurately capture the total amount of water released compared to the reference materials. Lunar simulants are notionally dry.
- **Derivative properties.** Many properties such as reflectance spectra and magnetic susceptibility are mainly a product of the modal mineralogy. Our simulants should perform well in these properties, although we do not specifically target them.

Poorly-simulated properties

- **Particle shape.** We make no effort to control the particle shapes in the simulants. Most of our processing involves rapid crushing instead of gentle abrasion, but the particle shapes may still not be angular enough for lunar regolith in particular.
- **Oxidation and weathering.** Our simulants contain much more ferric iron than is likely present on the Moon, do not have nanophase metallic iron, and are affected by minor amounts of terrestrial weathering (particularly the plagioclase and pyroxene).
- **Trace elements and isotopes.** We make no effort to simulate trace elements, REEs, or isotopes in the simulants.
- **Hazardous components.** Exolith Lab simulants are made to be as safe as possible, and we make substitutions for polycyclic aromatic hydrocarbons (PAHs), asbestiform serpentine, and pyrrhotite/troilite in the asteroid simulants; we do not include perchlorates or other superoxide species in the martian simulants.
- **Reactivity.** Extraterrestrial regolith samples may rapidly react or change if exposed to a humid, oxygen-rich atmosphere. Because we synthesize the simulants on Earth, they are already equilibrated with the terrestrial atmosphere, and adsorb minor amounts of water vapor in humid conditions.