

The SELFRAG Lab is a laboratory scale solution for the selective electric pulse fragmentation (EPF) of composite materials. The Lab uses high voltage electric discharges to fragment materials along grain boundaries. This study highlights the application of EPF in the crushing of pure mineral separates to remove inclusions and produce a finer product with narrow size distribution.

Olivine Fragmentation for simulation of fluid-rock interaction on icy planetary moons

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Purpose of Study

Olivine is a common magnesium-iron silicate mineral found primarily in mafic and ultramafic igneous rocks on Earth, and is also a principal component of stony meteorites called chondrites, making it a suitable analogue for extra-terrestrial material.

The aim of the research is to understand fluid-rock alteration processes at chemical and physical conditions that simulate subsurface ocean environments found on icy planetary moons such as Enceladus, Ceres, and small trans-Neptunian objects (TNO's).

San Carlos forsterite olivine ($Mg_{0.90}Fe_{0.10}SiO_4$), will be reacted in the presence of aqueous fluids containing salts, CO_2 , and up to 20 wt.% NH_3 over a wide range of temperatures (-80 to 250°C). Fluid-rock interaction experiments required forsterite with a uniform grain size range of approximately 3-4 mm.

Sample Treatment

76.5g of olivine separate was treated in the SELFRAG Lab system using a vessel with integrated 3.0 mm sieve – during treatment, crushed olivine falls through this sieve and is protected from further treatment, enabling a narrow size distribution and reducing over-crushing.

Cycles of 25 discharges, inspecting the sample between each cycle, were repeated until all material passed through the sieve. A total of 300 discharges were applied at the machine settings in the table below.

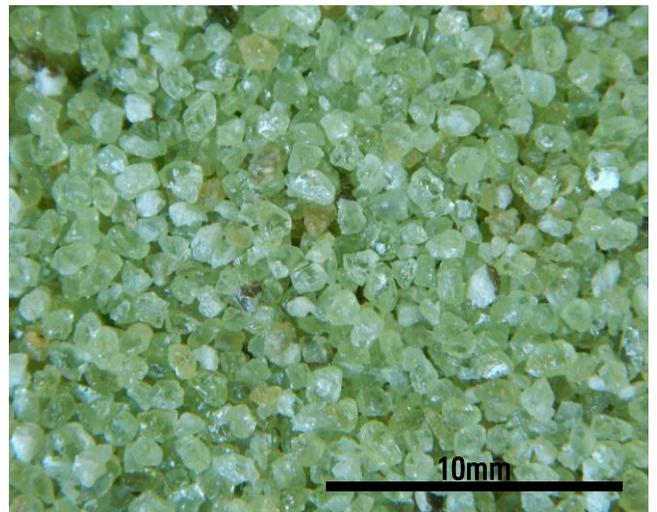
Electrode Gap	Pulse rep. rate	Voltage	Total # discharges	Sieve diameter
10 mm	5Hz	175kV	300	3.0 mm



Olivine crystal separate. Scale bar = 20 mm

Quality of treated product

EPF perfectly shattered the original grains (up to 10mm) to the required size. In addition, this technique avoided the production of small fines, and also led to the separation of inter-grown pyroxenes from the olivine.



Crushed forsterite after SELFRAG treatment. Previously unseen inclusions from within olivine crystals were liberated

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