

Textural Analysis of Enriched Poikilitic Shergottites

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Poikilitic (or lherzolitic) shergottites are cumulate martian meteorites composed primarily of olivine and pyroxene with minor amounts of oxides, maskelynite (shocked plagioclase), sulfides, and phosphates. They display two discrete textural regions: (1) a poikilitic region, which consists of large pyroxene oikocrysts enclosing olivine and chromite chadacrysts, and (2) a non-poikilitic region. Previous research suggests formation from basaltic magmas under polybaric conditions. Here we present crystal size distribution (CSD) analyses on olivine grains in three geochemically enriched poikilitic shergottites (Northwest Africa – NWA 7397, NWA 10169, and NWA 4468) to better understand and compare their crystal growth history. Textural analysis of this rare, relatively unstudied meteorite group will provide a more complete picture of their magmatic evolution and might help determine if they originated from a similar intrusion.

CSD analysis generates a population density versus grain size profile whose slope indicates crystal residence time and crystal growth rate. Variations in slope or trend of the CSD profile may arise due to changing crystallization conditions and processes (i.e., assimilation and/or magma mixing). For this purpose, olivine grain boundaries from both poikilitic and non-poikilitic regions were identified and outlined in *Adobe Illustrator* and their dimensions were measured using *ImageJ*. These measurements were then input into the *CSDslice* and *CSDcorrections* software to generate CSD profiles.

The profiles of the three different meteorites show a similar negative linear slope indicating continuous, steady-state nucleation and growth of olivine grains. Comparable slope steepness suggests similar growth rates within the three meteorites. All profiles display slope flattening at the largest grain sizes (>1.25 mm) indicating accumulation of the earliest-formed olivine grains. Flattening is slightly more dramatic in NWA 7397 and NWA 10169 profiles. A downward kink at the smallest grain sizes (<0.5 mm) in all profiles implies either coalescing of small grains or termination of nucleation with continued olivine growth. These CSD analyses demonstrate that the three enriched poikilitic shergottites underwent a similar crystallization history.