

Supplementary Material 2: Analytical Methods, Laser Ablation Inductively Coupled Mass Spectrometry

Trace element and isotopic analysis was performed by Laser Ablation Inductively Coupled Mass Spectrometry (LA-ICP-MS) using a RESOLUTION-LR ArF excimer laser ablation system (Australian Scientific Instruments) equipped with a large format S155 sample chamber (Laurin Technic Inc.) and coupled to an Agilent 7900x ICP-MS. Reference standards used were GSD-1G and NIST-610 glasses. Operating conditions were set at 5 Hz and a fluence of 3.5 J/cm². This dataset supplements the EPMA data by: providing quantitative data for (H)REE elements at low concentrations approaching the mdl by EPMA; and concentration data for other potential trace elements well below EPMA mdl values.

Spot size was generally 9 µm, although occasionally up to 29 µm where the mineral grain in question was large enough. Following 5 pulses of pre-ablation cleaning, 30 s of gas background was collected, followed by a sample ablation of 40 s, giving 70 s of instrument analysis. Isotopes measured were ²³Na, ²⁷Al, ²⁹Si, ³¹P, ⁴³Ca, ⁴⁵Sc, ⁵⁵Mn, ⁵⁷Fe, ⁶⁵Cu, ⁷⁵As, ⁸⁸Sr, ⁸⁹Y, ⁹⁰Zr, ⁹³Nb, ¹³⁷Ba, ¹³⁹La, ¹⁴⁰Ce, ¹⁴¹Pr, ¹⁴⁶Nd, ¹⁴⁷Sm, ¹⁵³Eu, ¹⁵⁷Gd, ¹⁵⁹Tb, ¹⁶³Dy, ¹⁶⁵Ho, ¹⁶⁶Er, ¹⁶⁹Tm, ¹⁷²Yb, ¹⁷⁵Lu, ¹⁷⁸Hf, ¹⁸¹Ta, ¹⁸²W, ²⁰²Hg, ²⁰⁴Pb, ²⁰⁶Pb, ²⁰⁷Pb, ²⁰⁸Pb, ²⁰⁹Bi, ²³²Th, and ²³⁸U. Dwell times for ²³Na, ²⁷Al, ²⁹Si, and ³¹P were 0.005 s, ²⁰⁶Pb and ²⁰⁷Pb were 0.02 s, ²³²Th, and ²³⁸U were 0.03 s, and all others were 0.01 s giving a total sweep time of 0.513 seconds. ²⁰²Hg was collected in order to correct for the interference of ²⁰⁴Hg on ²⁰⁴Pb. Calibration used Ce as the internal standard element based on the wt.% Ce measured from each location by EPMA. Supplementary Table S4 details the set up and mdl values.

Data reduction was performed using the software Iolite v3.4 [1] and processed using the “Trace_Elements_IS” data reduction scheme. LA-ICP-MS data presented in Table 3 of the manuscript shows mean and range data values for textural and mineral groupings. Filtered mean and range LA-ICP-MS values (excluding more than 20% deviation from the mean) was used for the chondrite-normalized REE fractionation patterns given as Figure 9b of the manuscript to aid in the visibility of the individual ranges. The full LA-ICP-MS dataset can be found in supplementary Table S6.

Supplementary Material 2 References

1. Paton, C.; Hellstrom, J.; Paul, B.; Woodhead, J.; Hergt, J. Iolite: Freeware for the visualisation and processing of mass spectrometric data. *J. Anal. Atom. Spectrom.* **2011**, 26, 2508.