SUPPLEMENTARY MATERIAL TEX 1.

Identification of the mineral phases was carried out by optical microscopy followed by energy-dispersive spectrometry (EDS). The identification of minerals by energy-dispersive spectrometry (EDS) was carried out with an INCA 200 system from Oxford Instruments attached to a JXA-733 (JEOL) microprobe at the Institute for Geological and Geochemical Research, Hungarian Academy for Sciences. Quantitative EDS analysis was applied to certain minerals (garnet, calcite, etc.) with 20 to 80 s integration time. Backscattered electron images and quantitative–electron microprobe analyses were performed using a JXA-733 (JEOL) microprobe. Pyrochlore grains were analysed with wavelength-dispersive spectrometers (WDS), with a 20kV accelerating voltage, an 80nA electron beam current, and 20s counting time on the peaks. The following standards were applied: glass from NBS (K-412) for Si, Al, Fe, Mg and Ca; glasses from Drake and Weil for REE; $SrTiO_3$ for Sr and Ti, albite for Na, zircon for Zr, $SrBaNb_4O_{10}$ for Nb, ThO2 for Th, URuSi for U, and $BaF_2$ for F. Matrix effects were corrected using the ZAF method. In order to prevent analysis of inclusions, the spots of the analyses were selected after careful backscattered electron (BSE) imaging investigations.

Silicates, other oxides, phosphates, and calcite analyses were made on carbon-coated thin sections using an automated CAMEBAX SX 50 electron microprobe and an automated CAMEBAX SX 100 microprobe (Universidad de Oviedo, Spain). Analyses conducted using an automated CAMEBAX SX 50 electron microprobe the accelerating voltage was 15 kV with a current of 15 nA and a beam diameter of 2 μm. The counting time was 10 seconds per element. For Nb and Ce the accelerating voltage was 20 kV with a current of 20 nA, a beam diameter of 2 μm and the counting time was 20s per element. Natural standards were used for Si (orthoclase), K (orthoclase), Ca (wollastonite), Na (albite), Ti (titanite), Fe (andradite), and synthetic minerals for Sr ($SrF_2$), Ba ($BaSO_4$), Mg (MgO), Al ($Al_2O_3$), Mn ($MnTiO_3$), Nb ($Nb_2O_5$) and Ce ($CeAl_2$). A ZAF matrix correction was applied.

On the other hand, during the analysis made with an automated CAMEBAX SX 100 microprobe three different conditions were used: for Si, Ti, Fe, Mn, Mg, Ca, Sr, Na, K, Ni, P, Al, Cl, Cr, and Ba 15kV accelerating voltage ($V_0$) and 15nA electron current ($I_e$), while for Zr, Nb, Ce and F $V_0$=20kV and $I_e$ =20nA were applied (in feldspars, pyroxenes, amphiboles, micas, nepheline, apatite, magnetite, ilmenite and calcite). Natural and synthetic standards were used (albite for Si and Na, MnTi for Ti and Mn, andradite for Fe, MgO for Mg, apatite for Ca and P, celestite for Sr, orthoclase for K, NiO for Ni, $Al_2O_3$ for Al, vanadinite for Cl, chromite for Cr, $BaSO_4$ for Ba, zircon for Zr, $Nb_2O_5$ for Nb, $CeAl_2$ for Ce, LiF for F). For perovskite, titanite and garnet 25kV accelerating voltage ($V_0$) and 100nA electron current ($I_e$). Natural and synthetic standards were used (albite for Na, MnTi for Ti and Mn, andradite for Fe and Si, MgO for Mg, apatite for Ca, $SrF_2$ for Sr, orthoclase for K, almandine for Al, vanadinite for V, zircon for Zr, $Nb_2O_5$ for Nb, $LaPO_4$ for La, $CePO_4$ for Ce, $PrPO_4$ for Pr, $NdPO_4$ for Nd, $SmPO_4$ for Sm, $GdPO_4$ for Gd, $TbPO_4$ for Tb, $DyPO_4$ for Dy, $ErPO_4$ for Er, $HoPO_4$ for Ho, $YbPO_4$ for Yb, Y for $YPO_4$, LiF for F). The electron beam was defocused to 2μm in all cases. The counting time was 20s per element.

Major and trace elements of whole-rock samples were analyzed at Activation Laboratories Ltd. (Ancaster, Ontario, Canada). Major elements (Si, Al, Ti, Mg, Fe, Mn, Ca, Na, K, P) and some trace elements: Sr, Y, Zr, Ba, and V, were measured on fused lithium metaborate/tetraborate glass using Inductively Coupled Plasma (FUS-ICP). Most of the trace elements (Cu, Co, Ni, Zn, Ga, Rb, Nb, Hf, Ta, Pb, Th, U and REE)

were analysed by Inductively Coupled Plasma Emission Mass (ICP/MS). Cr and Sc were measured by Instrumental Neutron Activation Analysis (INAA). Volatile components of the rock were determined as loss on ignition (LOI) at 1000ºC.