Atom Probe study of carbonate-silicate melts immiscibility and implication to REE distrubution

P. VASILYEV[1,2], D. FOUGEROUSE[1,2], S. REDDY[1,2], D. SAXEY[2,3], W. RICKARD[2,3], K. EVANS[1], G.YAXLEY[4]

[1] Dept. Applied Geology, TIGeR, WASM, Curtin Uni, Aus. (*Cor.: Prokopiy.Vasilyev@curtin.edu.au) (K.Evans@curtin.edu.au; S.Reddy@curtin.edu.au;) Denis.Fougerouse@Curtin.edu.au)

[2] John de Laeter Centre, Curtin University, Australia

[3] Dept. Physics and Astronomy, Curtin University, Australia. (David.Saxey@curtin.edu.au; W.Rickard@curtin.edu.au)

[4] Research School of Earth Sciences, ANU, Australia (greg.yaxley@anu.edu.au)

Carbonatites are associated with the largest REE-deposits on Earth, however their origin and evolution are not well understood. The model of Yaxley & Brey, (2004) suggests that reaction of mantle peridotites and melting products of carbonate-bearing subducting oceanic crust can lead to production of silica under-saturated carbonate melts (or carbonatites) with high abundances of LREE. Experiments were performed on model REE-doped eclogite with 10%Dolomite or 15%Calcite at P=3.5 GPa, T=900-1200 ^{o}C and at fO_2= 'FMQ-0.5' in a piston-cylinder apparatus to test this model. At 1000 ^{o}C the samples contained both carbonate and silicate-rich immiscible quenched liquids, however at 1100 ^{o}C the samples had "apparently homogenous" silicate-rich melt with ~15% CO_2. We used Atom Probe Microscopy (APM) at Curtin University (LEAP4000X HR) in laser assisted mode to study the nanoscale immiscibility of carbonate and silicate melts at higher temperature conditions, otherwise 'invisible' with conventional methods. The unique ability of APM to investigate the atomic scale composition with low detection limits (~100ppm) of any element showed detailed distribution of REE in micro-scale carbonate-silicate glasses. Our results lead to a better understanding of carbonate and silicate melt immiscibility and trace element partitioning, and consequent carbonatite enrichment in LREE.

Yaxley and Brey (2004) *Contrib.Min.Petr.* 146(609)