

Continental growth periods deduced from river sand U-Pb-dated zircons with O and Lu-Hf isotope analyses

C.M. ALLEN^{1*}, I.H. CAMPBELL² AND T. IIZUKA³

¹RSES, ANU, Canberra Australia 0200

(*correspondence: charlotte.allen@anu.edu.au)

²RSES, ANU, Canberra Australia 0200

(ian.campbell@anu.edu.au)

³Earth and Planetary Sciences, University of Tokyo 113-003

Japan (iizuka@eps.s.u-tokyo.ac.jp)

To evaluate continental crustal growth through time we have compiled an isotope data base for ~1400 zircons from Australian sand dunes and the world's major rivers. The data base comprises zircons that show no age zoning as shown by drilling 25 microns into zircons mounted on tape by LA-Q-ICP-MS. These selected dated zircons are mounted in epoxy and polished, cathodoluminescence imaged, analysed for oxygen isotopes using SHRIMP and analysed for Lu-Hf isotopes using LA-MC-ICP-MS. The premise behind this work is that zircon Hf model ages date the formation of continental crust. Primitive continental crust melts to form granitoid magmas from which the zircons crystallize and we can calculate this "incubation time". The Hf model ages have two major sources of uncertainty: 1. the growth curve for ¹⁷⁶Hf/¹⁷⁷Hf for the depleted mantle, 2. the ¹⁷⁶Lu/¹⁷⁷Hf used in the model age calculation. Using only those zircons with δ¹⁸O of that of the mantle (5.3±1‰) reduces the uncertainty in the ¹⁷⁶Lu/¹⁷⁷Hf used in the calculation principally by excluding those grains that have a mixed supracrustal component indicated by δ¹⁸O > 6.3‰. We define juvenile zircons as those grains with incubation times <250 Ma and they are rare leading us to important model refinements and re-evaluation of when major additions to the continental crust occurred. Our data indicate that the major crustal growth periods were 3.4-2.9 Ga, 2.2-1.8 Ga, and 1.0-0.6 Ga.

Volatile solubility in phonolites from Erebus volcano: Towards a multi-component degassing model

M. ALLETTI*, A. BURGISSE, B. SCAILLET AND C. OPPENHEIMER

ISTO/CNRS, 45000, Orléans, France (*correspondence:

marina.alletti@cnrs-orleans.fr, burgisse@cnrs-orleans.fr,

bruno.scaillet@cnrs-orleans.fr, co200@cam.ac.uk)

The interpretation of the chemistry of volcanic gas emissions demands a firm understanding of the deep processes that control partition of volatile species between melt and gas. Volatile solubility in silicate melts is greatly affected, among other factors, by the composition of magma. Erebus volcano (Antarctica) hosts one of the few persistent active lava lakes on Earth, and the only one of anorthoclase-phonolite composition. Despite its remoteness, the lake is closely studied and its gas emissions measured during the austral summer field season using infrared spectroscopic methods. Melt inclusions (MI) in anorthoclase and pyroxene crystals have H₂O concentrations similar to or lower than those of halogens (i.e. Cl and F), indicating extensive degassing. The first studies [1] attempting to link MI data to gas composition used degassing models that neglected the multi-component fluid phase, and which did not account for experimentally-determined solubilities for Na-phonolitic melts.

In order to model the degassing path at Erebus in *f-X* space, we performed experiments of (i) H₂O solubility and (ii) partitioning of Cl between a hydrous fluid phase and the melt (expressed as $D^{fl/melt}_{Cl}$). The starting material was anorthoclase phonolitic lava from Erebus (ERE 13-29 Dec 05). Experiments were carried out in the pressure range of 250-10 MPa and at a temperature of 1000 °C. Our results for H₂O solubility are in good agreement with previous studies on similar melt composition [2] and can be interpolated by the following law:

$$H_2O (wt\%) = 0.182 * f_{H_2O} (MPa)^{0.677}$$

Our results for Cl partitioning indicate a more complex behavior. We found that $D^{fl/melt}_{Cl}$ varies between 6.0 and 1.7 from 250 to 100 MPa, and increases again from 50 MPa up 10.2 at 10 MPa. This variable trend with ascent supports the idea proposed by Shinohara [3] of a heterogeneous chloride system with respect to decompression, with NaCl stable at high pressure and HCl stable from 100-50 MPa and to lower pressures still. Separating our experimental data into low and high pressure ranges, we propose a fugacity-based model of equilibrium degassing for Cl [4] and discuss our preliminary results.

- [1] Oppenheimer & Kyle (2008) *J. Volcanol. Geotherm. Res.* **177**, 743-754. [2] Schmidt & Behrens (2008) *Chem. Geol.* **256**, 259-268. [3] Shinohara (2009) *Chem. Geol.* **263**, 51-59. [4] Burgisser *et al.* (2008) *J. Geophys. Res.* **113**, B12204.