Experimental quantification of plagioclase CSD during decompression of hydrous rhyodacite

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Few experimental studies [1,2] constrain the link between crystal size distributions (CSDs) and known chemical, thermal, or barometric histories. We determine CSDs of plagioclase forming during decompression experiments on hydrous rhyodacite magma. Samples were annealed at 130 MPa, subjected to continuous decompression at either 2 MPa hr^{-1} or 0.5 MPa hr^{-1}, and then quenched at ~20 MPa intervals to provide snapshots of the system along the decompression path [3]. Crystal nucleation and growth rates derived from CSDs using standard assumptions are compared with values obtained using 2D measurements of the largest crystals (L_{max} methods) as well as bulk crystal populations (batch methods). The characteristic growth rate in the rapidly decompressed series is approximately five times faster than the growth rate in the slowly decompressed series. Because crystal growth rate depends on decompression rate, CSDs are incapable of revealing decompression timescales or magma ascent rates without independent knowledge of crystal growth rate.

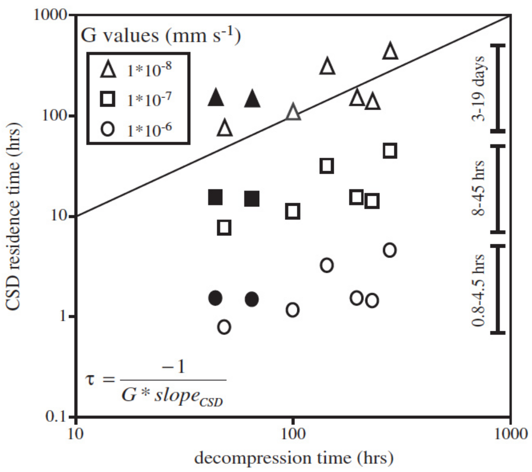

Figure 1: Residence time is computed using three published values of plagioclase growth rate. Only independent knowledge of G permits recovery of actual crystallization interval (1:1 line).

[1] Zieg and Lofgren (2006), *J Volcanol Geotherm Res* **154**, 74-88. [2] Pupier *et al*. (2008) *Contrib Mineral Petrol* **155**, 555-570. [3] Brugger and Hammer (2010) *J Petrol* **51**, 1941-1965.

Composition of Hippopotamid enamel: Paleoenvironmental reconstruction and enamel formation

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Bioapatite in mammalian teeth is readily preserved in continental sediments and represents an important archive for environmental reconstructions. Here we present electron microprobe data for fossil and modern molar enamel of Hippopotamids from different ecosystems in Eastern Africa, representing modern and fossil lacustrine (Lake Kikorongo, Lake Albert, and Lake Malawi) and modern fluvial environments of the Nile River system.

Fossil enamel from the saline Lake Kikorongo has a much higher MgO/Na_2O ratio (~1.11) than from the Neogene fossils of Lake Albert (MgO/Na_2O~0.4), which was a large fresh water lake. Similarly, the MgO/Na_2O ratio in modern enamel from the White Nile River (~0.36), which passes through several saline zones, is higher than that from the Blue Nile River (MgO/Na_2O~0.22). Thus, MgO/Na_2O is suggested be a fingerprint for environments where river and lake water have suffered strong evaporation.

Linear regression analysis reveals very tight physiological control on the MgO, Na_2O and Cl variations (R^2: 0.6-0.84) despite large concentration variations (40% to 300%) along sections perpendicular to the enamel-dentin junction (EDJ). MgO and Na_2O decrease from the EDJ towards the outer enamel rim, whereas Cl displays the opposite variation. Nevertheless, there are co-linear relationships among these elements which can be interpreted as binary mixing lines. Enamel crystallites precipitating during amelogenesis equilibrate with a continuously evolving fluid. During this process Na_2O and MgO behave incompatibly whereas Cl is incompatible to hydroxyapatite. This results in the formation of MgO, and Na_2O-rich, but Cl-poor bioapatite near the EDJ and MgO- and Na_2O-poor, but Cl-rich bioapatite at the outer enamel rim.