

Glass forming ability of sub-alkaline silicate melts

VALERIA MISITI¹, FRANCESCO VETERE^{2,3}, GIANLUCA IEZZI^{1,2}, HARALD BEHRENS³, FRANCOIS HOLTZ³, GUIDO VENTURA¹, ANDREA CAVALLO¹, MARCEL DIETRICH³ AND SILVIO MOLLO¹.

¹Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605 00143 Rome, Italy

²Dipartimento di Ingegneria & Geologia, Università G. d'Annunzio, Via dei vestini 30, 66100 Chieti, Italy

³Institute for Mineralogy, Leibniz University of Hannover, Callinstr. 3, Hannover, D-30167, Germany

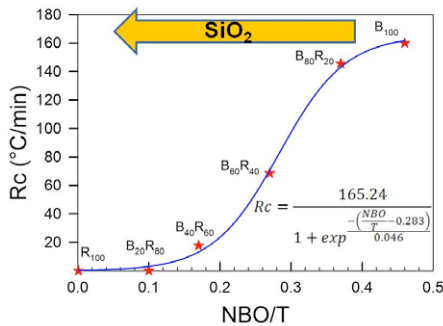
The glass forming ability (GFA) of six sub-alkaline silicate melts is quantified *via* the experimental determination of their critical cooling rate R_c (the minimum rate at which a liquid can be frozen to a solid with crystals < 2 vol.%). The selected compositions vary from basalt (B) to rhyolite (R) (B_{100} , $B_{80}R_{20}$, $B_{60}R_{40}$, $B_{40}R_{60}$, $B_{20}R_{80}$ and R_{100}).

For each composition, six cooling rates (150, 30, 3, 1, 0.116 and 0.0167 °C/min) are investigated between 1300 °C (liquidus region) and 800 °C (quenching temperature).

The crystallized phases and their contents are determined by image analysis on backscattered SEM pictures and include glass, pyroxene, spinel, plagioclase and, occasionally, olivine and melilite.

The estimated R_c values are 0.02, 0.12, 10, 50 130 and 160 °C/min for R_{100} , $B_{20}R_{80}$, $B_{40}R_{60}$, $B_{60}R_{40}$, $B_{80}R_{20}$, and B_{100} respectively.

R_c increases by 4 order of magnitude from R_{100} to B_{100} and can be related to the NBO/T (non bridging oxygen per tetrahedron) parameter as shown by the following figure:



Our results on the crystallization kinetics of the most abundant and common silicate melts in nature can be applied to retrieve solidification conditions of volcanic rocks as well as to design glass-ceramics with inexpensive starting materials.

Lithium Isotope History of Cenozoic Seawater: Changes in Silicate Weathering and Reverse Weathering

SAMBUDDHA MISRA^{1,*} AND PHILIP N. FROELICH²

¹Department of Earth Sciences, University of Cambridge, CB2 3EQ, UK, *correspondence: sm929@cam.ac.uk

²Froelich Education Services, 3402 Cameron Chase Dr., Tallahassee, FL, 32309. USA.

Weathering of uplifted continental rocks plays a central role in controlling both climate and seawater chemistry by consuming CO_2 and releasing cations to the ocean. Lithium isotopes provide a unique record of these changes because Li, unlike other tracers of ocean chemistry change, is hosted entirely in silicates. The isotopic composition of dissolved Li in seawater ($\delta^7\text{Li}_{\text{SW}} \sim 31.0\text{‰}$) reflects a balance between river dissolved Li inputs ($\delta^7\text{Li}_{\text{Riv}} \sim 23\text{‰}$), hydrothermal Li input ($\delta^7\text{Li}_{\text{HT}} \sim 8.4\text{‰}$) and large fractionation ($\Delta_{\text{SW-SED}} \sim 15\text{‰}$) during seawater-Li removal into marine authigenic clays via reverse weathering ($\delta^7\text{Li}_{\text{SED}} \sim 16\text{‰}$). A geologic record of $\delta^7\text{Li}_{\text{SW}}$ change is sensitive to the very large Li-isotope fractionation factors and to changes in silicate sources and sinks on time scales of the Li residence time in seawater ($\tau_{\text{Li}} \sim 1.5$ Ma). From the Paleocene (60 Ma) to the Present $\delta^7\text{Li}_{\text{SW}}$ rose 9‰, requiring large changes in continental forward weathering and seafloor reverse weathering consistent with pulsed tectonic uplift, more rapid continental denudation, increasingly incongruent continental weathering and more rapid CO_2 drawdown.

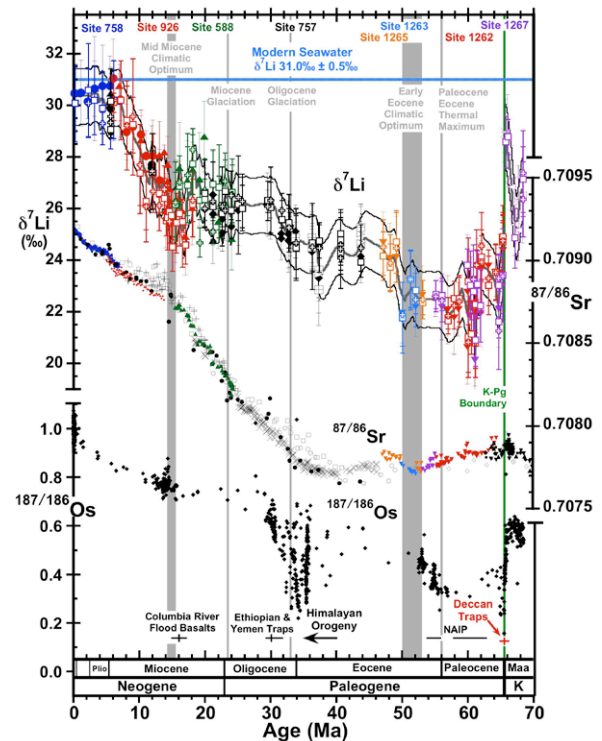


Figure: Li-, Sr-, and Os-isotope records over the past 68 Ma [1]. [1] Misra and Froelich, *Science*, 2012