Preeruptive Sizes of Bubbles in Bishop Tuff Rhyolitic Magma

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CO_2 dissolved in glass inclusions in quartz phenocrysts decreases with differentiation, and this relationship has been interpreted to reflect gas-saturated crystallization. However, bubbles of gas are virtually absent in rapidly cooled glass inclusions in Bishop quartz phenocrysts. If pre-eruptive bubbles were much smaller than glass inclusions, then they should be present in the glass inclusions. Therefore, pre-eruptive bubbles plausibly were too large to be captured in glass inclusions, and the glass inclusions are smaller than about 0.4mm diameter. Bubbles enclosed within reentrants and hourglass inclusions are up to about 0.1mm diameter, and this indicates that bubbles as large as about 0.06mm (before decompressive expansion) might be trapped within totally enclosed glass inclusions that formed in the Bishop magma. Pumice clasts contain vesicles that are up to about 10mm in diameter and commonly several mm in diameter. Textures of bubble-bearing hourglass inclusions and H_2O concentrations in glassy reentrants suggest that the pressure at which the vesicles stopped expanding is several hundred atmospheres. Therefore the decompressive enlargement of the pre-eruptive bubbles during eruptive ascent is by a factor no greater than about 10 by volume or about 2 by diameter. Evidently a 10mm diameter bubble quenched at 300 atm would be about 5.8 mm diameter at 1500 atm. Taking account of H_2O exsolution during bubble growth only further diminishes the inferred maximum size of pre-eruptive bubbles. Thus the pre-eruptive bubbles are evidently smaller than about 6mm in diameter. Although questions about selective preservation of small inclusions, mechanisms of hourglass formation and a possible role of surface tension gradients allow some uncertainty, the pre-eruptive sizes of bubbles that accompanied crystal growth in the Bishop magma can thus be constrained to lie between about 0.06mm and 6mm in diameter.

10,000 year nitrogen isotope record from Lake Ontario, understanding carbon and nitrogen dynamics from a paleo-perspective

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In order to understand future changes in trophic levels in lakes, it is important to investigate the paleolimnologic records from different basins. Paleo-investigations can give insight through proxy records of productivity and ecological changes throughout a lake's evolution. Here we present an isotopic investigation of the organic matter (OM) preserved in the last 10ka from the Rochester Basin, eastern Lake Ontario. A series of piston cores were collected in June of 2000, from which two cores were used to construct a composite sedimentary record (cores LO-1 and LO-3). The entire composite record is 514 cm long, where the upper 420 cm consists of a grey-brown laminated mud, which is underlain by a massive brown mud (421 to 514 cm).

Nitrogen isotopic analyses were measured on whole sediment samples, whereas carbon isotopic analyses where only measured on decarbonated samples. Additional supporting analyses were also carried out on the core including: magnetic susceptibility, total OM, total carbonate, biogenic silica and C/N ratios. Isotopic analyses were measured on 2 cm intervals, yielding a relatively high-resolution record. The $\delta^{15}N$ values ranged from 3.0‰ to 7.5‰, with an average of 4.2‰. The highest $\delta^{15}N$ values occurred in the upper 10cm of the core, representing recent anthropogenic forcing. The nitrogen isotopic record also displays up to 6 sub-millennial scale enrichment-depletion cycles of up to 1‰. C/N ratios indicate that a majority of the preserved OM in the core consists of lacustrine phytoplankton with values less than 12. Additionally these data indicate that the degree of N-limitation has changed over the last 10ka. The nitrogen isotopic data also displays a unique decoupling from the carbon isotope data, indicating that changes in primary production and/or nutrient limitation have occurred back in time. Further work is being carried out on linking climate change to the natural variability of Lake Ontario's trophic state.