Alteration of volcaniclastic deposits; geochemical insights on mineralizing environment and climate during the Late Miocene in Antarctica

K. PANTER[1], J. ANTIBUS[1], T. WILCH[2], N. DUNBAR[3], W. MCINTOSH[3], A. TRIPATI[4], I. BINDEMAN[5] AND J.BLUSZTAJN[6]

[1]Bowling Green State University, Bowling Green, OH, 43403, USA (kpanter@bgsu.edu)
[2]Albion College, Albion, MI 49224, USA
[3]New Mexico Inst. Technology, Socorro, NM, 87801, USA
[4]University of California Los Angeles, USA
[5]University of Oregon, USA
[6]Woods Hole Oceanographic Institution, USA

Volcaniclastic deposits at Minna Bluff provide an excellent opportunity to investigate conditions of alteration and the use of secondary minerals as monitors of past climates. Our results show that $\delta^{18}O$ of carbonates and chalcedony is highly variable, ranging from -0.50 to 21.53‰ and 0.68 to 10.37‰, respectively, and δD for opaline quartz is extremely light (-187.8 to -220.6‰) corresponding to Antarctic meteoric water. A mean $^{87}Sr/^{86}Sr$ of 0.70327 ±0.0009 (1σ, *n*=12) for carbonates by LA-ICPMS is comparable to fresh lava and confirms a fresh water source. Temperatures by ^{13}C-^{18}O and quartz-calcite thermometry are 5° to ~100°C. Calculated $\delta^{18}O$ water for carbonates (-15.8 to -22.9‰) shows a shift to heavier values (Δ 6‰) in the Late Miocene between 11 and 8 Ma, consistent with a warming climate. These findings agree with the interpretation of glaciomarine sequences in nearby drillcore (AND-1B).

Using the same glaciovolcanic sequences [1] has reconstructed paleo-ice conditions at Minna Bluff and concludes that the ice was warmer (thawed-bed) relative to that at AND-1B (frozen-bed) over the same time period. This interpretation appears to disagree with our conclusion that the prevailing conditions were similar; that is, the shift from polar to sub-polar conditions at AND-1B was roughly contemporaneous (~9.5 Ma) and in agreement with the change in oxygen isotopes at Minna Bluff. However, our results do not preclude a difference in basal ice conditions but suggest only that the climate in this region changed uniformly, as would be expected given the proximity and moderate paleo-elevation difference (≤ 1000 m). We propose that warmer ice conditions were a consequence of high local heat flow associated with the Minna Bluff magmatic system. The influence of recent subglacial volcanic activity on ice flow in Marie Byrd Land has also been used to infer wet-based conditions in a polar environment [2].

[1] Smellie *et al* (2014), *Geology* **42**, 39-41. [2] Lough *et al* (2013), *Nature Geoscience* **6**, 1031-1035.