Trace metal dynamics and transport in a polar glacier-dominated watershed: Taylor Valley, Antarctica

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Anthropogenically introduced trace metals travel to even the most remote locations on earth including Greenland and Antarctica. Little is known about metal dynamics in the largest ice-free area in Antarctica, the McMurdo Dry Valleys, which includes Taylor Valley (~78°S). Previous work has examined metal concentrations in Taylor Valley glacier melt streams and lakes (Green *et al.*, 1989; 1986). In this work, concentrations of metals (V, Pb, Cd, Cu) in Canada Glacier snow is compared to stream and lake concentrations to determine melt evolution and to ultimately make predictions about stream chemistries.

Samples were collected using ultraclean techniques to minimize contamination. The sequence of median trace metal molar abundance in Canada Glacier snow is Cu>V>Pb>Cd. Canada Glacier's melt streams have different relative abundances than the snow. The western melt stream, Andersen Creek is V>Cu>Cd>Pb. Whereas the eastern melt stream, Canada Stream, is Cu>V>Cd>Pb. Median Na:Cl ratios increase from snow values (0.4) in both Andersen Creek and Canada Stream (0.9), suggesting in-stream chemical weathering and salt dissolution. The western and eastern lakes fed by these streams, Lake Hoare and Lake Fryxell have similar Na^+:Cl^- surface water values as the streams. In general V, Cu, Cd, and Pb to Cl^- ratios are all highest in Canada Glacier snow and lowest in its streams. The exception is Cu:Cl^-, which is highest in lake surface water followed by snow and streams. Total Hg:Cl^- ratios in the Lake Fryxell Basin indicate substantial removal of Hg relative to Cl^- as the waters evolve from snow to lake with the largest losses occuring from stream to lake (Lyons *et al.*, 1999). There is no net gain of trace metals relative to Cl^- through weathering as with Na^+. Their concentrations relate more to other processes such as adsorption, biotic uptake and/or removal by suspended matterial, which are connected to discharge, pH, and biomass abundance.

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Quaternary records of ocean pH

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Atmospheric CO_2 (pCO_2) is an important greenhouse gas that regulates the Earths climate on geological and shorter timescales. Proxy data for the ocean carbonate system in the past have a crucial role to play in the understanding how CO_2 is partitioned between the ocean and the atmosphere on these timescales. Of particular importance in this regard are the suite of proxies based on the isotopic and trace element composition of foraminifera, and in particular, the isotopic composition of boron ($\delta^{11}B$) which a number of studies have shown faithfully records the pH of seawater in which the foraminifera grew.

There are a number of factors complicating the application of the boron isotope pH proxy, some of which arise from the anlytical difficulties involving the precise and accurate measurment of its isotopic composition. We have recently developed an approach, using multicollector inductively coupled plasma mass spectrometry, that overcomes these anlytical problems. This technique is both rapid and precise (better than 0.3 ‰) allowing the routine determination of $\delta^{11}B$ in a small number of foraminfera. We present here the first application of this technique.

In contrast to previous work we find that the measured isotopic composition by MC-ICPMS for a variety of Holocene species (ranging in $\delta^{11}B$ from 16 to 21 ‰) from a range of depth habitats and physiology, is very close to that of the dissolved $B(OH)_4^-$ species predicted using an isotopic equilibrium constant of 1.0272 [1] and pre-industrial carbonate system parameters. This result greatly simplifies the use of the proxy. In this contribution we determine Quaternary and Late Neogene changes in pH on various timescales in several localities in the equatorial oceans (Carribean, Eastern Atlantic, Western & Eastern Pacific). Using these data to gain a global perspective, we can distinguish local short term changes in pH from changes relating to the global reorganization of the carbonate system that accompanied glacial-interglacial climate change, and use our pH reconstructions to estimate the magnitude of pCO_2 changes beyond the reach of the ice-cores.

Reference

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