Do the Sunda Shelf and Barbados timings for mwp-1a agree?

J.D. STANFORD*, E.J. ROHLING AND P.G. CHALLENOR

National Oceanography Centre, Southampton, University of Southampton, Southampton, SO14 3ZH, United Kingdom (*correspondence: jstan@noc.soton.ac.uk)

Deglacial meltwater pulse (mwp) -1a is the largest of the known well-constrained meltwater input events with about 20 m of sea-level rise in about 500 years. Deglacial meltwater pulses are of great current interest, because these large-scale events offer important test-beds for numerical models of the responses of ocean circulation and climate to meltwater addition. To date, however, such applications of mwp-1a have been compromised by debate about its exact age based upon perceived discrepancies between the Barbados and Sunda Shelf records. Here, we show that by using a Monte Carlo style statistical analysis of uncertainties in both sea-level records, and by careful scrutiny of the available data, we find a mutually agreed timing and climatic scenario for mwp-1a.

Documenting the physicochemical and thermodynamic changes associated with all possible geochemical reactions in rocks using Gale vector space

C.R. STANLEY[1] AND D.M.K. MURPHY[2]

[1]Dept. of Earth & Environmental Science, Acadia University, Wolfville, NS, B4P 2R6 (cliff.stanley@acadiau.ca)
[2]School of Earth & Environment, University of Western Australia, Crawley, WA (davidmkmurphy@gmail.com)

Metasomatic reactions associated with many geological processes (e.g. metamorphism, diagenesis, hydrothermal alteration, weathering, etc.) are typically difficult to define because some reactants and products may be added or removed by a fluid as soluble species, so evidence for their involvement in the reaction may be absent from a rock suite. As a result, given a known (observed) reactant and product mineral assemblage, one is commonly able to identify a myriad of feasible geochemical reactions responsible for the observed mineralogical changes. Determining which reaction actually operated to produce the observed change in mineral assemblage may be intractable without other mineralogical, geochemical, physical, or thermodynamic constraints.

Matrices may be used to describe the compositions of minerals and aqueous species, and the coefficients of these in geochemical reactions. As a result, simple matrix operations can be undertaken to balance geochemical reactions, and thus provide insight into the nature of geochemical reactions involving these minerals and species.

One important result of these matrix operations is a geometric representation of geochemical reactions in a multi-dimensional Gale vector space. This space hosts vectors defining all possible reactions among the minerals and species under consideration, and thus can be used to systematically identify a subset of feasible geochemical reactions. Because changes to rock geochemistry (e.g. H^+, other soluble ions), physical characteristics (e.g. mass, volume, and density), and thermodynamic properties (e.g. ΔG_r, ΔH_r, ΔS_r) can be determined for each feasible reaction, Gale vector space can thus be used to conclusively identify all possible reactions consistent with observed or inferred constraints (e.g. constant volume, observed density change, adiabatic conditions, element conservation, or isothermal reactions). As a result, examination of geochemical reactions in a Gale vector space provides a comprehensive and systematic way to identify all feasible chemical reactions that could have occurred in a suite of rocks.