# Geochemistry of eastern North American CAMP diabase dykes

S. CALLEGARO[1]*, A. MARZOLI[1], H. BERTRAND[2], L. REISBERG[3], M. CHIARADIA[4] AND G. BELLIENI[1]

[1]University of Padua, Department of Geosciences, Italy (*correspondence: sara.callegaro@unipd.it, andrea.marzoli@unipd.it, giuliano.bellieni@unipd.it)
[2]Laboratoire de Géologie de Lyon, UMR-CNRS 5570, Lyon, (herve.bertrand@ens-lyon.fr)
[3]CRPG (CNRS UPR2300), Université de Lorraine, France (reisberg@crpg.cnrs-nancy.fr)
[4]Université de Genève, Switzerland (Massimo.Chiaradia@unige.ch).

Swarms of diabase dykes and a few sills of the Central Atlantic magmatic province (CAMP) intruded the Piedmont area of the Appalachians and the coastal plains of eastern North America (ENA) between 202 and 195 Ma [1]. Based on field observations, an age progression can be defined from NW- to N- and NE-oriented dykes. The basaltic dykes are Mg, Cr-, and Ni-rich, which may only in part reflect accumulation of mafic minerals. Incompatible trace element contents are fairly homogeneous and generally low, e.g. $La_{Ch}/Yb_{Ch}$ (0.54-2.39), typical of melts issued from a quite depleted shallow mantle-source. The incompatible trace element contents are not correlated with isotopic compositions of ENA dykes, which display a considerable spread in initial isotopic signatures, i.e. $^{87}Sr/^{86}Sr_{200Ma}$ (0.7043-0.7088), $\varepsilon Nd_{200Ma}$ (-6.8-+2.1) and $^{206}Pb/^{204}Pb_{200Ma}$ (17.41–18.61). Pb isotopic compositions plot above the NHRL, at positive Δ7/4 (10-17) and Δ8/4 (19-73). Generally low $^{188}Os/^{187}Os_{200Ma}$ ratios (0.127–0.144), which argue for negligible amounts of crustal contamination, coupled with the large range of Sr-Nd-Pb isotopic compositions, suggest generation from a strongly heterogeneous mantle source, probably metasomatized lithosphere. The alternative, a deep enriched mantle source, is unlikely because the crystallization temperatures calculated [2] for high-Fo (up to $Fo_{89}$) olivines (ca. 1350 °C) are not supportive of a very hot (i.e. mantle-plume) origin (see also [3]). Considering the isotopic compositions of ENA lava flows, some dykes may have fed eruptions chemically similar to the Newark Preakness and Hook Mt. flows, i.e. the youngest flows from the Newark Supergroup basins, whereas none of the analyzed basaltic dykes yields geochemical compositions similar to the slightly older Orange Mt. basaltic flows.

[1] Nomade S. *et al*. (2006) *Paleo3* **244**, 326-344. [2] Putirka K. (2008) *Rev. Mineral*. **69**, 61-120. [3] Herzberg C. (2009), *Nature,* **458**, 619-623.

# Productivity and circulation changes during the last deglaciation from biomarkers and Nd isotopes

E. CALVO[1]*, L.D. PENA[2], C. PELEJERO[3] AND I. CACHO[4]

[1]Institut de Ciències del Mar, CSIC, Pg. Marítim de la Barceloneta 37-49, Barcelona, Spain (*correspondence: calvo@icm.csic.es)
[2]Lamont-Doherty Earth Observatory of Columbia University, 61 Route 9W, Palisades, NY 10964, USA
[3]ICREA and Institut de Ciències del Mar, CSIC, Pg. Marítim de la Barceloneta 37-49, Barcelona, Spain
[4]GRC Geociències Marines, Dept. d'Estratig., Paleontol. i Geociències Marines, Universitat de Barcelona, Spain

The Eastern Equatorial Pacific (EEP) is thought to have exerted a strong control over glacial/interglacial $CO_2$ variations through its link to circulation and nutrient-related changes in the Southern Ocean. Changes in phytoplankton productivity and composition associated with increases in equatorial upwelling intensity and influence of Si-rich waters of Sub-Antarctic origin have been recently detected in ODP Site 1240 (0º 01.31'N, 86º 27.76'W; 2,921 mbsl) [1]. However, these changes do not seem to have been crucial in controlling atmospheric $CO_2$, as they took place during the deglaciation, when atmospheric $CO_2$ concentrations had already started to rise. New results from Nd isotopes in foraminifera shells of *Neogloboquadrina dutertrei* from the same intervals corroborate this interpretation. *N. dutertrei* preferentially dwells in the lower thermocline, at the core of the Equatorial Undercurrent (EUC). Therefore, changes in the Nd-isotopic composition of these foraminifera will reflect the composition of the EUC, which, in turn, reflects changes in the advection of Sub-Antarctic Mode Water and Antarctic Intermediate Water and the composition of the Southern Ocean end-member. Our evidence indicates that diatoms outcompeted coccolithophores at times when the influence of Si-rich Southern Ocean intermediate waters was greatest as recorded by low $\varepsilon_{Nd}$ values (-2.8). This shift from calcareous to non-calcareous phytoplankton would cause a lowering in atmospheric $CO_2$ through a reduced carbonate pump, as hypothesized by the Silicic Acid Leakage Hypothesis. However, the concomitant intensification of Antarctic upwelling brought large quantities of deep $CO_2$-rich waters to the ocean surface. This process very likely dominated any biologically mediated $CO_2$ sequestration, and probably accounts for most of the deglacial rise in atmospheric $CO_2$.

[1] Calvo, E., *et al*. (2011), *Proceedings of the National Academy of Sciences* **108** (14), 5537-5541.