Nitrate reduction and fermentation access different carbon sources in anaerobic degradation experiments

J. ABELL[1], A. LAVERMAN[2] AND P. VAN CAPPELLEN[3]

[1]Humboldt State University, Department of Oceanography, Arcata, CA 95521, USA (ja49@humboldt.edu)
[2]UMR 7619 Sisyphe, Universite Pierre et Marie Curie, 75005 Paris Cedex 05, France (Anniet.Laverman@upmc.fr)
[3]Georgia Institue of Technology, School of Atmospheric Sciences, Atlanta, GA 30332, USA (pvc@eas.gatech.edu)

Flow-through reactors were used to characterize anaerobic carbon degradation in sediments from the freshwater portion of a eutrophic estuary. Sediments were supplied for several months with or without the terminal electron acceptor nitrate and were periodically sampled for dissolved inorganic carbon (DIC) and a number of other analytes to compute carbon mineralization rates. Fermentation and nitrate reduction were responsible for the majority of carbon mineralization, with iron reduction and methanogenesis contributing minor amounts. Fermentation was largely independent of nitrate supply and was responsible for at least 50% of mineralization in both sets of reactors. Fermentation may thus be responsible for a large fraction of the DIC efflux from similar organic-rich, nearshore sediments. Nitrate reduction was driven by the simultaneous degradation of two carbon pools with different maximum oxidation rates and half-saturation constants. This mineralization was in part due to DOC release from fermentors, but primarily reflected degradation of a separate pool of organic matter. Together these data suggest that fermentation and nitrate reduction were relying on different pools of sedimentary organic carbon for their metabolism.

What was the role of the Iceland plume in triggering the Eocene-Oligocene cooling?

MEIR ABELSON[1]* AND JONATHAN EREZ[2]

[1]Geological Survey of Israel, Jerusalem, 95501, Israel (*correspondence: meira@gsi.gov.il)
[2]Institute of Earth Sciences, Hebrew University, Jerusalem, 91904, Israel

The largest cooling event of Cenozoic at the Eocene-Oligocene transition (EOT) has occurred in two main steps of $\delta^{18}O$ and $\delta^{13}C$ increase [1, 2]. In the first step, the *precursor*, the increase in the $\delta^{18}O$ is related to cooling and minor glaciation, attested by Mg/Ca ratio and the absence of sea level decline [2, 3]. The 2nd step in the $\delta^{18}O$ increase is related to domination of the Antarctica glaciation, attested by dramatic sea level fall [3].

Abelson *et al*. [4] have shown that the shut down of the Iceland plume at the EOT, and the plume renewal at the late Oligocene, strikingly correlate with the global signal of $\delta^{18}O$ and ε_{Nd} in the southern Atlantic. This suggests that the Iceland plume suppression enabled the overflow of deepwater from the Nordic seas, initiating one of the major engines of global thermohaline circulation for the first time in the Cenozoic. This notion is confirmed by several sedimentary records from the North Atlantic [4].

We suggest that this initiation of the proto-NADW due to the suppression of the Iceland plume has triggered a vigorous intensification of the thermohaline circulation [4], that in turn was the trigger for global cooling and CCD deepening during the *precursor* event; this event promoted the oceans stirring that increased the availability of nutrients [5] which has increased productivity of primary producers contributing to drawdown of Atmospheric CO_2. The CO_2 decrease could initiate the Antarctic glaciation, hence forming the proto-AABW that has contributed to further invigoration of the thermohaline circulation, which initiated the 2nd event of the EOT cooling accompanied by dramatic sea level fall. This scenario of bipolar perturbation via 2-steps of cooling may be corroborated by the shift in occurrences between the $\delta^{18}O$ and $\delta^{13}C$ increase, indicated in several sites: in the first step, the $\delta^{18}O$ increase slightly lags the $\delta^{13}C$ shift, whereas in the 2nd step, it shows the opposite relationship.

[1] Coxal *et al.* (2005) *Nature* **433**, 53-57 [2] Katz *et al*. (2008) *Nat. Geosci.* **1**, 329-334 [3] Miller *et al.* (2008) *GSA Bull*. **120**, 34-53 [4] Abelson *et al*. (2008) *EPSL* **265**, 33-48.