Perturbing Phytoplankton: A polar view on anthropogenic change

R.E.M. RICKABY*, K. HENDRY, J. YOUNG AND P. HALLORAN

Department of Earth Sciences, University of Oxford, Parks Road, Oxford, OX1 3PR
(*correspondence: rosr@earth.ox.ac.uk)

The input of carbon dioxide to the atmosphere from fossil fuel burning since the Industrial revolution represents a perturbation to the ocean-atmosphere system of geological proportions. In order to predict the future response of phytoplankton to abrupt change, it is possible to impose a perturbation to a laboratory culture or mesocosm experiment or to look to the geological record for signatures of biological response to analogous past periods of major carbon release. Alternatively, we have investigated rapidly accumulating sediments which hold the potential to resolve the phytoplankton response, already underway, to the anthropogenic perturbation of the last two centuries. We shall present high resolution geochemical and microfossil records from a North Atlantic open ocean and a coastal site on the Antarctic peninsula, which indicate that the phytoplankton communities are already starting to respond to the current environmental change.

The Antarctic peninsula has experienced rapid warming with associated retreat of 87% of marine and tidewater glacier fronts. Our evidence from diatom opal Zn/Si and diatom assemblages indicate that the recent accelerated input of freshwater from retreating glaciers has resulted in greater diatom productivity, likely as a result of enhanced stratification of the water column. Increasing diatom production and export in these coastal waters, which are thought to contribute up to 50% of total Southern Ocean productivity, could represent a signficant additional sink of carbon and a negative feedback to carbon release.

Between 1780 and the modern day, in the high latitude North Atlantic, whilst the coccolithophore assemblage remained invariant, the average mass of calcite produced by the dominant species of coccolithophore *(Coccolithus pelagicus)* increased by up to 40%. The net impact of such an increase in calcification on pCO_2, will depend on the extent of response in other oceans, and on ballasting. Nonetheless, a global increase in calcification by coccolithophores could represent a positive feedback to the anthropogenic emissions. In light of this field evidence, we will explore how the contrasting carbon metabolism of diatoms and coccolithophores, reminiscent of their evolutionary histories, may determine their response and feedback to elevated carbon in the ocean and atmosphere.

New constraints on the pyrolitic model under lower mantle conditions

A. RICOLLEAU[1]*, Y. FEI[1], E. COTTRELL[2], H. WATSON[1], L. ZHANG[1], G. FIQUET[3], A. AUZENDE[3], M. ROSKOSZ[4], G. MORARD[5] AND V. PRAKAPENKA[6]

[1]Geophysical Laboratory, Carnegie Institution of Washington, USA (*correspondence: a.ricolleau@gl.ciw.edu)
[2]Smithsonian Institution, National Museum of Natural History, Department of Mineral Sciences, USA
[3]Institut de Physique du Globe de Paris, IMPMC, France
[4]Laboratoire de Structure et Proprietes de l'Etat Solide, Lille, France
[5]European Synchrotron Radiation Facility, Grenoble, France
[6]Center for Advanced Radiation Sources, University of Chicago, USA

Composition of the Earth's lower mantle remains an essential question in Earth sciences. The composition of the lower mantle is generally modelled by comparing mineral physics data and seismic observations, using measured properties of the lower mantle end-member phases such as perovskite and ferropericlase. In this study, *in situ* X-ray diffraction patterns were collected from 30 GPa to 110 GPa and from 1400 K to 2500 K using KLB-1 peridotite as starting material. The experiments were performed in laser-heated diamond-anvil cell at the Advanced Photon Source and at the European Synchrotron Radiation Facility. The sample was loaded in neon pressure medium.

We report molar volume changes as a function of pressure and temperature for the three lower mantle phases, i.e., magnesium-iron silicate perovskite, ferropericlase and calcium silicate perovskite. We notice the high spin to low spin transition of iron in the ferropericlase at room temperature. The equations of state (EOS) of the two perovskites and ferropericlase are determined using Au as internal pressure standard. We used the Fe/Mg partitioning values between Mg-perovskite and ferropericlase from the literature. Using the volume data and chemical composition information, we calculate the densities of peridotite along geotherm of the Earth. Our calculated density profile allows us to make direct comparison with the seismic observations. The partitioning coefficient does not affect the trend of the density profile in any significant way. The result shows that the pyrolite density profile cannot match the seismic density profile of the entire lower mantle.