Causes and consequences of dramatic carbon cycle perturbations of the past

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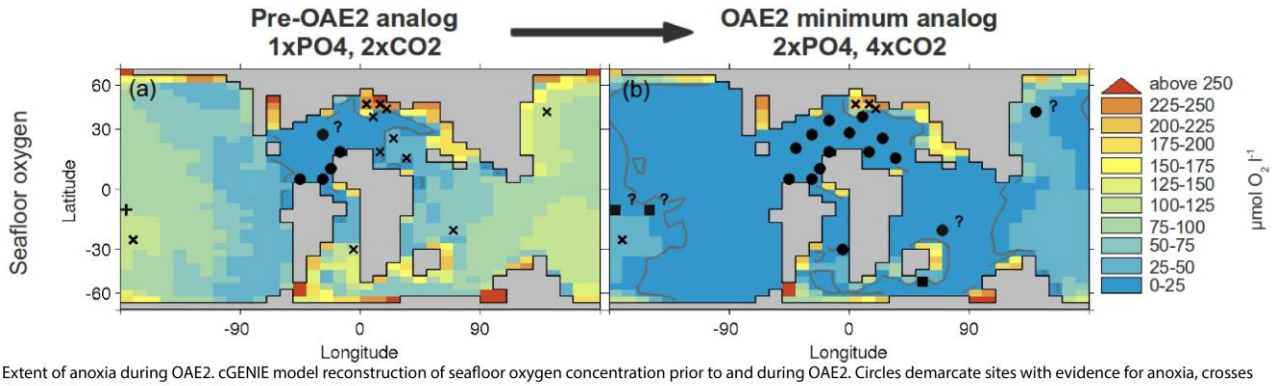
Project description:
The geological record shows evidence for major perturbations to the global carbon cycle during the Mesozoic era, causing large parts of the deep ocean to become extremely oxygen poor (anoxic) for long periods of time (10,000-100,000 years) as a result of carbon release. These events, called oceanic Anoxic Events (OAEs), are the most extreme climate events of the last 200 million years, with profound effects on paleoceanography, biogeochemical cycles, and marine biota. Although OAEs are comparatively geochemically well-characterised, there is still debate about which mechanisms triggered the onset and the recovery of OAEs. This project will investigate the causes and consequences of OAEs, providing key understanding of the impact of major CO2 release on ocean biogeochemistry and climate.



Extent of anoxia during OAE2. cGENIE model reconstruction of seafloor oxygen concentration prior to and during OAE2. Circles demarcate sites with evidence for anoxia, crosses demarcate oxygenated sites. Monteiro et al., 2012.

The global carbon cycle is replete with feedbacks operating on different timescales and so modelling represents an extremely powerful way to test hypotheses about OAE dynamics. In this PhD, the student will use the well-established Earth system model cGENIE to test fundamental hypotheses about the onset and recovery of OAEs and to reconstruct the rates of CO2 emissions and burial of carbon constrained based on observations from brand new proxy records of marine and atmospheric carbon reservoirs. In addition, the student will explore the role of nutrient cycling and the biological pump during OAEs (Monteiro et al., 2012). Some of the relevant questions that this modelling project will target include: What is the composition and source of the carbon release that triggered OAEs? What feedbacks played a role in eventual drawdown of atmospheric CO2 via development of widespread anoxia and promotion of organic carbon burial characteristic of OAEs? Which mechanisms triggered the termination of anoxia? How did paleogeography and the background greenhouse climate persistent through much of the Mesozoic contribute to earth system susceptibility to OAE onset?

Field locality at Port Mulgrave, Yorkshire, which hosts the Ealry Toarcian Oceanic Anoxic Event.

The successful candidate will learn how to use and develop an Earth system model, with the statistical and modelling skills developed being highly transferable to a wide range of jobs as well as being highly in demand worldwide in academic research. The student will also develop expertise in carbon cycling, ocean biogeochemistry and paleoclimate. There will be the opportunity to participate in fieldwork (UK or USA) and labwork geared towards constructing new geochemical records across OAEs.

References:

Monteiro et al., 2012. Nutrients as the dominant control on the spread of anoxia and euxinia across the Cenomanian-Turonian oceanic anoxic event (OAE2): Model-data comparison. Paleoceanography, Vol. 27(4),
PA4209.