Constraints on hydrothermal fluid fluxes from Tl geochemistry

R.M. COGGON[1]*, M. REHKÄMPER[1], C. ATTECK[1] AND D.A.H. TEAGLE[2]

[1]Dept. Earth Science and Engineering, Imperial College, London, UK (*correspondence: r.coggon@ic.ac.uk)
[2]National Oceanograph Centre, Southampton, University of Southampton, UK

Hydrothermal circulation of seawater is a fundamental process in the formation and aging of the ocean crust. This hydrothermal activity has a major impact on ocean chemistry, which in turn may be used to investigate past and present variations of the Earth's climate. The hydrothermal contribution to ocean chemical budgets depends on the composition and flux of hydrothermal fluids.

Thallium (Tl) exhibits distinct behaviour in axial and off-axial hydrothermal systems [1]. During on-axis high-temperature hydrothermal circulation, Tl is leached from the sheeted dikes with no fractionation in Tl isotope composition (ε^{205}Tl). In contrast, isotopically light Tl is added to the upper crust from seawater during low-temperature off-axis circulation. A simple Rayleigh fractionation model can be used to account for the decreasing extent of Tl-enrichment and isotopic fractionation with depth [1].

We present new MC-ICPMS measurements of Tl concentrations and isotopic compositions of ocean crust produced at slow- (Macquarie Island), intermediate- (Ocean Drilling Program Holes 504B and 896A, and the Juan de Fuca Ridge), and fast- (ODP Hole 1256D) spreading rates. These data allow us to constrain the axial and off-axial hydrothermal fluid fluxes required to produce the observed shifts in Tl concentration and isotopic composition, using simple mass balance.

The uppermost basement from ODP Hole 504B displays ε^{205}Tl = -20. Since seawater is characterized by ε^{205}Tl = -6, the off-axis uptake of Tl by the ocean crust is associated with a fractionation factor of 0.9986. We evaluate which minerals are responsible for Tl-uptake from seawater using analyses of samples that exhibit different styles of alteration.

[1] Nielsen *et al*. (2006) *Earth. Planet. Sci. Lett.* **251**, 120-133.

Geochemical and biotic records of marine anoxia: Disentangling local and global signals

A.S. COHEN[1]*, A.L. COE[1], C.R. PEARCE[2] AND B.A. CASWELL[1]

[1]Dept. of Earth & Environmental Sciences, CEPSAR, The Open University, Milton Keynes, MK7 6AA, U.K (*correspondence: a.s.cohen@open.ac.uk)
[2]LMTG, Université de Paul Sabatier, 31400 Toulouse, France

The widespread accumulation of marine organic carbon has been very uncommon during the Phanerozoic, but the occasions on which this did occur (Oceanic Anoxic Events, OAEs) are of great importance because they are inferred to represent times when the oxygen minimum zone expanded greatly. OAEs were also associated with other expressions of environmental change such as global warming, seawater acidification and large-scale species extinctions. How these episodes developed, and quantification of their duration and effects, are goals that are central to a full understanding of the Earth System not least because of their close similarities to some aspects of present-day environmental change. This study presents new and published geochemical and biotic data from the Toarcian OAE, the Tithonian and the Paleocene-Eocene Thermal Maximum in order to assess how and why large-scale seawater anoxia developed in the past.

The Toarcian OAE was a relatively brief interval *c.* 183 Ma ago when levels of organic carbon accumulation were unusually high worldwide [1]. The OAE was associated with a pronounced global carbon isotope excursion (CIE) and with a range of geochemical proxy data that are consistent with a global increase in the areal extent of marine anoxia [2]. Robust and complete records of the Toarcian CIE from many locations worldwide show a regular structure in both marine carbonate and organic carbon that bears a remarkable resemblance to the CIE that characterises the PETM [3]. Species distributions across the Toarcian OAE are closely allied to the pattern of the CIE and to the fluctuating environmental conditions that are implied by geochemical proxy data [4]. Widespread accumulation of marine organic carbon also occurred in the Tithonian (Late Jurassic), but the patterns and timescales of C- and Mo-isotope variations that are associated with the Tithonian deposits differ greatly to those of the Toarcian, and to the PETM CIE.

[1] Jenkyns (1988) *AJS* **288**, 101-151. [2] Pearce *et al*. (2008) *Geology* **36**, 231-234. [3] Cohen *et al*. (2007) *JGS* **164**, 1093-1108. [4] Caswell *et al*. (2009) *JGS* in press.