

## Rapid uptake of calcium carbonate during ridge flank hydrothermal circulation reflects past oceanic conditions

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Whether the formation of new crust at oceanic spreading centres and its hydrothermal alteration at the ridges and across the vast ridge flanks is a source or sink of carbon to the oceans is an important parameter in understanding the Earth system. Changes in spreading rates (e.g. [1]) and the age-area distribution of the ocean crust (e.g. [2]) may impact the global carbon cycle if the uptake of carbon during ridge flank circulation is a persistent processes. The amount of carbon taken up by the ocean crust remains poorly quantified due to under sampling [3] but carbonate veins are much more abundant in Mesozoic ocean crust compared to Tertiary crust.

A new approach to estimate past seawater chemistry [4] from suites of carbonate veins formed within the ocean crust during ridge flank circulation, provides additional information on the timing and duration of carbonate vein forming events. This data shows that carbonate veins form in discrete events (<10 Myr. s) in relatively young crust although the time elapsed between crustal accretion and vein precipitation is variable. This suggests that carbonate vein formation is not a persistent process and that greater carbonate uptake by the oceanic crust during the Mesozoic reflects past oceanic conditions (e.g. pCO<sub>2</sub>, T). As calcium carbonate is one of the latest phases to form during ridge flank hydrothermal circulation, the timing of carbonate vein formation also gives a measure of the duration of effective chemical exchange between the oceans and ocean crust at a particular site.

[1] Muller *et al.* (2008) *Science* **319**, 1357. [2] Seton *et al.* *Geology* **37**, 687 (2009). [3] Alt & Teagle (1999) *Geochim. Cosmochim. Acta* **63**, 1527. [4] Coggon *et al.* (2010) *ScienceExpress*, 10.1126/science. 1182252. 4<sup>th</sup> Feb, 2010.

## Ca-isotopes of early diagenetic dolomite and porewater from the Peru Margin

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The highly active 'deep biosphere' that was detected at different locations on the Peru Margin during ODP Leg 201 provides a new context in which primary dolomite formation in a hemipelagic environment can be evaluated. In this study, we investigated dolomite and porewater samples from Site 1229 in an upper shelf basin. Previous studies by Meister *et al.* [1] proved that the dolomites have a diagenetic origin and are primary precipitates formed at the current sulfate-methane interface.

The  $\delta^{44/40}\text{Ca}$  values of five dolomite samples show a rather similar isotopic composition around 1.2 ‰ SRM915a. This indicates that dolomites have a rather heavy Ca-isotopic composition compared to other authigenic and inorganic carbonates. The results from Ca-isotopes also confirm that the dolomite is currently precipitated in the shallow sedimentary succession while the deeper samples are buried dolomites.

The  $\delta^{44/40}\text{Ca}$  values of the porewaters decrease in the upper 100 meters below seafloor by about 1 ‰ from seawater-like values. A similar decrease in  $\delta^{44/40}\text{Ca}$  in shallow marine sediments has previously been observed at the Cascadia Margin [2] and the North Atlantic [3] and is always accompanied by a correlation with ammonium concentration in the porewater. The basic process is probably an ion exchange reaction caused by the production of ammonium through the degradation of organic matter. In the deeper part of the sedimentary section, the upward diffusion of a brine dominates the Ca-isotopic composition of the porewater.

[1] Meister, P. *et al.* (2007) *Sedimentology*, **54**, 1007–1031.

[2] Teichert, B.M.A. *et al.* (2009) *EPSL*, **279**, 373–382.

[3] Ockert, C. *et al.* (2010) *GCA*, this volume.