Towards a numerical model to constrain the time scales for vertically moving axial magma chambers beneath fast-spreading ocean ridges

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It is well accepted that AMCs ('axial magma chamber') under fast spreading ocean ridges are dynamic systems with the potential to oscillate vertically. Unfortunately, the time scales of these movements are poorly contrained by several multidisciplinary studies, varying between 10 and 100.000 years.

The IODP multi-cruise mission „Superfast Spreading Crust' (Site 1256, equatorial East Pacific Rise), offers the possibility to study natural samples from the lower sheeted dikes from the 1256D drillcore. Detailed petrographic work led to the conclusion, that the ascent of the AMC led to the formation of 'granoblastic dikes' due to an intense metamorphic overprint under granulite facies conditions [1].

In this study, we apply tools of diffusion profile modeling to relictic plagioclase phenocrysts occuring in the granoblastic dikes located above the AMC. Since the plagioclases were affected by the thermal imprint of the AMC (~1200°C), the detailed analysis and modeling of the concentration profiles allows us a quantification of the residence time of the heat source (AMC) in a high position and hence, temporal information about the vertical fluctuations of the AMC can be assessed.

First estimations on the basis of CaAl-NaSi interdiffusion profiles yield average time scales of 19000 years for the development of the profiles. Calculations based on Mg concentration profiles revealed different results: The durations extracted from the profiles are much shorter in the range of ~150-400 years. This discrepancy presumably reflects different processes contributing to the development of the element distribution patterns in these plagioclase phenocrysts and its meaning has to be evaluated in the near future.

[1] Koepke *et al*. (2008) Petrography of the dike-gabbro transition at IODP Site 1256 (equatorial Pacific) The evolution of the granoblastic dikes, *Geochem. Geophys. Geosyst.* **9**, Q07O09, doi, 10.1029/2008GC001939.

Sub-micromolar oxygen dynamics at redox boundaries of lakes

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The oxic-anoxic interface in stratified lakes is a habitat of intense microbial activity where a cascade of redox processes occurs at low O_2 concentration levels. Here we report well resolved profiles based on a two-sensor technique: The stable but slower signal from low-level optodes was verified independently with profiles from highly amplified amperometric sensors. Pre-exposure to anoxic waters reduced the drift of electrochemical sensors.

The sub-micromolar oxygen zone

An field survey of the permanently anoxic basin of Lake Zug (Switzerland) [1] revealed the spatial structure and temporal variability of the oxic-anoxic interface in the water column. The depth interval from 1 μM O_2 down to the detection limit had an extension of 0.5 to 5 meters. While most profiles showed a steady decrease, several observations revealed sharp excursions due to the effect of turbulent mixing in the weakly stratified water column with a stability frequency of $N^2 < 10^{-6}$ s^{-2}.

Fast fluctuations were also confirmed when sensors were depoyed at constant depth. Concentrations changed by about 1 μM O_2 within ~ 10 seconds and then remained quasi constant on time-scales of minutes.

The chemical gradients right at the oxic-anoxic interface were on the order of 1 mmol O_2 m^{-4}. Temperature profiles showed local maxima of >0.01°C over the sub-micromolar zone. These temperature changes were not compatible with short-term oxygen fluctuations. Therefore, the position of the oxic-anoxic interface seemed to oscillate over a limited depth range of meters. Microbial communities such as methanotrophs need to cope with oscillating conditions on the time-scale of minutes but will face a rather stable diurnal O_2 supply.

The new setup will facilitate the high-resolution sampling at the redoxcline, the measurements of the *in situ* concentrations for important microbial reactions, and boundary conditions for more detailed reaction-transport models.

[1] Maerki *et al*. (2009) *Limnol. Oceanogr.* **54**, 428–438.