

Lithogenic inputs over the Kerguelen Plateau (Southern Ocean) traced by the dissolved REE concentrations and Nd isotopic composition

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The Southern Ocean is regarded as a key region in understanding the role of biogeochemical cycling on the variation of global climate (Marinov *et al.* 2006). Although this Ocean is characterized by HNLC conditions, areas of high biomass do occur including the Kerguelen plateau. These bloom occurrences are attributed to natural fertilisation due to iron inputs from the Kerguelen archipelago and plateau (Blain, Treguer *et al.* 2001). The major goal of the KEOPS project was to study the result of this natural iron fertilization, and in particular to identify its sources.

REE are an extremely coherent group in terms of chemical behavior (Elderfield and Greaves 1982). Seawater Nd isotopic composition is a tracer of water mass pathways and of their interactions with continental material. Although the oceanic cycles and sinks of dissolved Fe and REE are different, the dissolution of lithogenic material constitutes the main source for both dissolved Fe and REE in the ocean. Therefore, we propose to use REE concentrations and Nd isotopic compositions in the Kerguelen Plateau waters to 1) trace the origin of the observed iron enrichment and 2) quantify the fluxes of the lithogenic inputs.

We will present dissolved seawater REE concentrations and Nd isotopic compositions from 9 stations upstream from and above the Kerguelen plateau. The REE patterns display positive Eu anomalies in the water masses above the plateau, which are similar to those of the Kerguelen basalts, suggesting that the high dissolved REE contents observed in the waters above the plateau result from the dissolution of lithogenic material, such as from Kerguelen or Heard Islands. Lithogenic fluxes were estimated larger than 110 ± 21 ton Nd y^{-1} , and 37000 ton Fe y^{-1} , for dissolved Nd and Fe, respectively. The under processing Nd isotopic composition analyses will allow a better understanding of the dissolved/particulate exchange occurs at Kerguelen Plateau/water masses boundaries and also allow to quantify this exchange.

Spherical diffusion couple, closure of core composition, and geospeedometry

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In dealing with diffusion in minerals, a spherical diffusion couple is often encountered. Examples include diffusion between the core and mantle (or two concentric layers) of garnet, or spinel, or zircon. This problem does not seem to have been solved analytically before. I present an analytical solution for a spherical diffusion couple. The concentration evolution is shown in Figure 1 and differs from the one-dimensional diffusion couple in a couple of ways. One is that the mid-concentration position (or interface) moves to the shell with smaller radius as a function of time. Nonetheless, a spherical diffusion couple may be fit well by an error function: diffusivity obtained from such a fit is only slightly different from the actual diffusivity, but the interface position is noticeably away from the original interface. Therefore, the original boundary between two layers is not at the position of mid-concentration. The solution is applied to derive the closure conditions for the center of the core, which is compared with the numerical solution for the specific case of oxygen diffusion in zircon (Watson and Cherniak, 1997). Furthermore, given a measured concentration profile, if it can be shown that it is due to diffusion (not growth), the mean diffusion distance may be obtained, from which the cooling rate may be inferred.

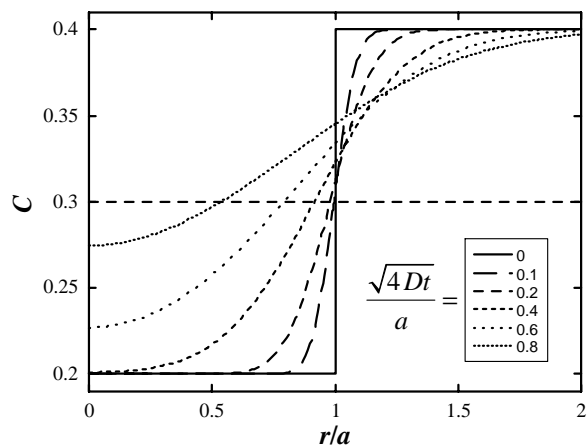


Figure 1. Concentration evolution for a spherical diffusion couple, where C is concentration, r is the radial coordinate, a is the radius of the initial core, D is the diffusivity and t is time.