Nd isotopic signatures of the Drake Strait water masses

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The Drake Passage is is a key route for main water masses involved in the thermohaline circulation. One of the objectives of the ANT XXIII/3 DRAKE cruise (R/V Polarstern, http://www.lodyc.jussieu.fr/~fslod/DrakeWiki/) was to understand the role of the southern American tip and of the Antarctic Peninsula on the circulation and composition of the water masses flowing through the Drake Passage.

In this goal, selected trace elements and isotopes have been measured on dissolved and particle samples. Among them, the Rare Earth (REE) concentrations and $^{143}Nd/^{144}Nd$ ratio, expressed as $\varepsilon_{Nd}=[(^{143}Nd/^{144}Nd)_{sample}/(^{143}Nd/^{144}Nd)_{chur}]-1)*10{,}000$ where "chur" means a reference), are known to trace the origin, pathway and mixing of water masses. In addition, it is strongly suspected that water masses change their ε_{Nd} value when they flow close to a margin having a different signature, allowing the identification of a process called "Boundary Exchange" (BE [1, 2]). ε_{Nd} is among the parameter endorsed by the international GEOTRACES program (www.geotraces.org).

Dissolved REE concentrations and Nd isotopic compositions measured along the DRAKE section will be presented. North of 56°S, Nd concentrations increase linearly with depth, ranging between 1.2 ng/l in surface waters and 3.8 ng/l close to the bottom. Concentrations are slightly higher south of the Polar Front (2ng/l at the surface, more than 4 ng/l at depth), the highest surface Nd content being observed below 60°S, close to the Antarctic Peninsula (almost 3 ng/l). This north-south gradient will be discussed together with the ε_{Nd} of the same profiles. These data will be compared with the REE and ε_{Nd} values measured on three profiles of suspended particles filtered using large volume filtration systems collected off the Antarctic Peninsula and in the Bransfield Strait, and that already indicate a radiogenic contribution of the Peninsula on the nearby waters. The whole set of data will allow us to discuss the signature of the DRAKE Strait water masses, with regard to their Pacific origin on the one hand and the potential impact of the shelf of the Antarctic Peninsula on these water mass composition on the other hand.

[1] Arsouze *et al.* (2007) *Chemical Geology* **239**, 165-177.
[2] Lacan & Jeandel (2007) *EPSL* **232**, 245-257.

Geochemical monitoring of an industrial analogue of CO_2 storage

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Due to the lack at the present date of a pilot reservoir for CO_2 storage in France, natural underground gas storages provide a unique opportunity to test the feasibility of a monitoring methodology for future CO_2 storages. Chemically inert, noble gases are the natural tracers proposed to explore CO_2 behavior and verify the integrity of CO_2 storage.

We performed a noble gas tracer study in an operational natural underground gas storage located in the Paris Basin, operated by Gaz de France. Samples were collected almost every month from producing wellheads. The sampling period covers injection of the natural gas in summer 2007, and gas withdrawal in winter 2007.

Major gas chemistry was measured at IFP, by standard techniques, and $^{13}C/^{12}C$ ratios were determined for the major hydrocarbon species (C_1-C_5) and CO_2. He, Ne and Ar abundances and isotopic compositions were obtained using a VG 5400 mass spectrometer.

Important variations of noble gas abundances as well as isotopic ratios were observed. The gases sampled at the producing wells exhibit mixing trends between the different injected gas end-members. The impact of the mixing processes depends on the sampling date and the location of the wells. These mixing trends attest of the incomplete homogenization of the isotopic and elemental composition in the gas storage, at a human time scale.

Moreover, significant partitioning between water and the gas phase also occurs as shown by a $^{4}He/^{40}Ar$ versus ^{40}Ar diagram, apparently related to changes of the gas to water volume ratio during gas production.

Despite the complexity of the physical processes involved, including mixing and solubilization in water, noble gases appear like a promising tool to monitor CO_2 storage.