A multiproxy approach to constrain the origin of the natural fertilisation on the Kerguelen plateau

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The Kerguelen Ocean and Plateau compared Study (KEOPS) took place during the austral summer (19 Jan-13 Feb 2005, R/V "Marion-Dufresne", 68°-78°E/ 49°-52°S sector). One of the KEOPS objectives was to determine the mechanisms responsible for the bloom occurring on the Kerguelen plateau and allocated to natural fertilisation due to island inputs.

Coupled with physical measurements, a multi-proxy investigation was carried out in order to better constrain the sources of iron, but also the water mass and particle pathways. REE concentration and Nd isotopes suggest that weathering of Heard Island brings significant amounts of iron to plateau waters (Zhang *et al.*, in rev.), in agreement with radium isotopes (van Beek *et al.*, in rev.) and consistent with total dissolvable and particulate iron results. Th isotopes allow the quantification of particle settling velocities on and off the Kerguelen plateau and the identification of strong boundary scavenging along the south-east Kerguelen slope, likely due to the occurrence of nepheloid layers (Venchiarutti *et al*, subm.). Slow particle settling velocities are observed on the Kerguelen plateau, consistent with the high mineralization rates characterizing this area, deduced from the barite concentrations which were used as proxy for twilight zone mineralization of organic matter (Jacquet *et al.*, in rev.).

This talk highlights the main results deduced from each proxy, underlining both coherences and contradictions. A synthetic and simplified scheme of the potential sources and sinks of iron over the plateau is finally discussed.

References

All the papers cited in revision will be published in the KEOPS special issue, Deep Sea Research II.

Venchiarutti C., Jeandel C. and Roy-Barman M., ^{230}Th and ^{232}Th isotopes in the wake of Kerguelen *Deep Sea Res.* (submitted)

Geochemical monitoring of CO_2 storage: Natural analogues studies using isotopic composition of gases and travertines

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Studies of natural analogues can be used to understand long-term processes affecting CO_2 in geological storage, because CO_2 can remain trapped for geologically significant times.

Noble gases are useful tools for tracing CO_2 and track its leakage toward surface. They also provide information about the origin of CO_2; its migration, physical processes such as diffusion, solubilization in water and residence time.

We collected gas samples from natural CO_2 reservoirs and surface seeps in French carbo-gaseous province: Sainte Marguerite seeps (Allier, France), Montmiral natural CO_2 field (Drôme, France), and in the Colorado Plateau (Green River seeps (Utah), Springerville St Johns natural CO_2 field (Arizona)).

The preliminary results obtained provide strong evidence for a mantle-derived magmatic source for CO_2 in all sampled accumulations, and show various physical processes affecting CO_2 during its migration.

For example, natural CO_2-degassing springs near Sainte Marguerite, Allier, France show evidence of Rayleigh fractionation on argon, neon isotopes and elementary ratio of atmospheric-derived noble gases. This distillation process highlights rapid migration of CO_2 toward surface, consistent with small accumulation of radiogenic/nucleogenic isotopes.

The Helium concentrations range between 0.28 and 8.22 ppmv, consistent with a magma degassing at depth. Such low concentrations imply that solubilization of CO2 in water occurs at shallow depth, thus CO2 migration mainly occurred in the gaseous state.

Active and fossil travertines were present in all sampled areas. They represent geological record of the movement and discharge of CO_2 and associated fluids to the Earth's surface. They also provide information about the origin of CO_2 from which they precipitate. We present here our first petrographical observations as well as isotopic results for the travertines, including $\delta^{13}C$ and $\delta^{18}O$. The samples from Green River have $\delta^{13}C$ values typical of thermogene carbonates and presumably associated with deep magmatic degassing. On the contrary in Montmiral, the $\delta^{13}C$ values are more typical of the meteogene travertines, associated with atmosphere-derived CO_2.