FTIR imaging of carbon dioxide diffusion in cordierite-like structures

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Cordierites and beryls are isostructural minerals that may diffuse significant amounts of H_2O and CO_2 through their structural channels, running along the *c* axis, [1]. Experimental introduction of CO_2 in cordierite-like structure was studied by several authors [2, 3], who pointed out the extreme difficulty to reach sample saturation and homogenization.

In this work we treated cordierite and beryl volatiles-free single-crystals in CO_2-saturated environment at different PTt conditions. The run products were analyzed via micro-FTIR spectroscopy in order to quantify the CO_2 content and its distribution across the sample.

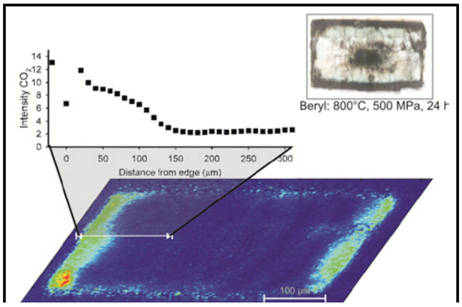

Figure 1 - FPA image and single spot IR transect of a

Preliminary results show that pressure plays a major role in diffusing gaseous CO_2 across both cordierite and beryl, whereas the effect of temperature is less pronunced. Detailed FPA (focal-plane-array of detectors) imaging shows that the diffusion occurs along the structural channels starting from the basal pinacoids along the *c*-axis direction. As expected, no diffusion occurs perpendicularly to the *c*-axis. The diffusion path of CO_2 does not exceeds 200 μm even after 10 days. Sample cracks formed during the experimental runs speed up diffusion; measured CO_2 contents along these cracks are even 4 times higher than in the rest of the sample.

[1] Goldman *et al.* (1977) *Am. Mineral.* **62**, 1144-1157. [2] Armbruster and Bloss (1982) *Am. Mineral.* **67**, 284-291. [3] Le Breton (1989) *Contrib. Mineral. Petrol.* **103**, 387-396.

Glacial-interglacial changes in ocean carbonate chemistry constrained by boron isotopes, trace elements, and modelling

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Deep ocean carbon storage and release is commonly invoked to explain glacial-interglacial CO_2 cycles, but records of the carbonate chemistry of the glacial ocean have, until recently, been scarce. Here we present new boron isotope ($\delta^{11}B$) data from detailed depth profiles and time series, that record the pH of the deep ocean at the last glacial maximum (LGM), and how it evolved over the deglaciation. We examine these data using a recently developed tracer fields modelling approach [1]. This has previously been applied to $\delta^{18}O$ data to investigate changes in circulation at the LGM. Here we extend this method to the non-conservative tracers $\delta^{11}B$ and $\delta^{13}C$, allowing us to constrain the roles of circulation, the biological pump of organic carbon and $CaCO_3$, and carbonate compensation, in setting deep ocean carbon storage at the LGM. Finally, we show how deep ocean carbon storage evolved over the deglaciation, with pulses of stratification breakdown in the Southern Ocean and North Pacific causing CO_2 release from the deep ocean to the atmosphere.

[1] Lund, D. C., J. F. Adkins, and R. Ferrari (2011), Abyssal Atlantic circulation during the Last Glacial Maximum: Constraining the ratio between transport and vertical mixing, *Paleoceanography*, 26, PA1213, doi:10.1029/2010PA001938.

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