Geophysical Research Abstracts
Vol. 13, EGU2011-13354-1, 2011
EGU General Assembly 2011

A natural CO_2 reservoir in the Peru Margin: what can we learn for CO_2 storage?

Patrick Meister
Max Planck Institute for Marine Microbiology, Celsiusstrasse 1, 28359 Bremen, Germany (pmeister@mpi-bremen.de)

The behaviour of CO_2 in subsurface storage reservoirs can either be simulated by theoretical models or in field experiments by pumping large volumes of CO_2 underground. These approaches, however, leave considerable uncertainty about the long term evolution of the CO_2 reservoir. A simple way to study the long term effects of CO_2 on subsurface geochemical conditions could be through observation of naturally occurring CO_2 reservoirs. CO_2 is produced in large amounts in zones of methanogenesis within the marine subsurface. In the absence of reactive electron acceptors such as oxygen, nitrate or sulphate, organic matter is microbially fermented to methane (CH_4) and CO_2 following approximately the following stoichiometry: 2 CH_2O (organic matter) –> CO_2 + CH_4.

A dissolved inorganic carbon concentration of up to 150 mM was measured at Ocean Drilling Program Site 1230, drilled at 5000 m water depth on the lower slope of the Peru Continental Margin (D'Hondt et al., 2003), which must have been produced in the form of CO_2 during methanogenesis. Considering a CH_4 concentration of up to 300 mM (Spivack et al., 2006) at this site, in situ CO_2 concentration may have been even higher but some CO_2 realeased during core recovery.

Although high partial pressure of CO_2 would have imposed acidic and highly corrosive conditions for carbonates, sediments at Site 1230 revealed the presence of more than 1wt% solid phase inorganic carbon. This amount of carbonate can not be explained by precipitation during core recovery and must have been present under in situ conditions. A possible explanation for this enigmatic occurrence of disseminated carbonate would be that acidifaction by CO_2 is efficiently buffered through silicate weathering (Wallmann et al., 2008) and such buffering is suggested by the measured alkalinity of 150 mM.

At measured Ca and Mg concentrations of 5 and 60 mM, respectively (Donohue et al., 2006), 150 mM alkalinity and assuming dolomite [$CaMg(CO_3)_2$] to be about saturated, a pH of 6 can be calculated (Meister et al., in prep.). Allowing DIC to be variable results in a DIC concentration around 350 mM. The excess 200 mM of CO_2 can be explained by degassing due to decompression during core recovery, while 300 mM out of 350 mM DIC can be produced by methanogenesis in a more or less 1:1 ratio with methane.

This example from ODP Site 1230 demonstrates that efficient buffering of CO_2 occurs in methanogenic zones, most likely as a result of silicate weathering. Further studies of CO_2 in deep sea methanogenic zones are necessary and could contribute to understanding interactions of deeply stored CO_2 with subsurface geochemistry and may help to predict the fate CO_2 reservoirs over long time periods.

D'Hondt, S., Jørgensen, B.B., Miller, J., and ODP Leg 201 Shipboard Scientific Party (2003) Proc. ODP, Init. Report 201.

Donohue, C.M., Snyder, G.T., and Dickens, G.R. (2006) Proc. ODP, Sci Results 201.

Meister, P., Gutjahr, M., Frank, M., Bernasconi, S.M., Vasconcelos, C., and McKenzie, J.A. (submitted).

Spivack, A.J., McNeil, C., Holm, N.G., and Hinrichs, K.-U. (2006) Proc. ODP, Sci Results 201.

Wallmann, K., Aloisi, G., Haeckel, M., Tishchenko, P., Pavlova, G., Greinert, J., Kutterolf, S., and Eisenhauer, A. (2008) Geochim. Cosmochim. Acta 72, 3067-3090.