

Potential for mineral trapping during CO₂ storage in sedimentary basins

PER AAGAARD*, HELGE HELLEVANG,
BINYAM L. ALEMU, VAN T.H. PHAM AND ANJA SUNDAL

Department of Geosciences, Univ. Oslo, Norway
(*correspondence: per.aagaard@geo.uio.no)

A system perturbed by CO₂ injection reacts by dissolving primary minerals and form new secondary phases, and is also accompanied by an increase in solution trapping. The importance of such mineral reactions for safe long-term storage is highly system dependent.

Based on mineralogical and sedimentological information from siliciclastic reservoirs suitable for CO₂ storage (Sleipner (Utsira fm), Snöhvit (Tubåen fm), Johansen fm, Skagerrak (Gassum- & Haldager fm), a.o.), we performed numerical simulations on geochemical reactions induced by the CO₂ injection. The Norwegian offshore clastic reservoirs considered, represent a wide range in mineralogical composition, burial history and present day P, T, and salinity conditions. The sensitivity of dissolution and secondary mineral growth were analysed with respect to temperature, pressure, salinity and initial mineral assemblage.

In low-temperature quartz rich reservoirs, such as the Utsira fm. (Northern North Sea), we see that the potential for secondary carbonate growth is both limited by slow nucleation and growth rates of the carbonates, and on the limited amount of divalent metal cations present in primary phases such as glauconite, smectite, and chlorite. At higher temperature, the rate of carbonate growth is higher with faster response to the release of divalent metal cations. Aluminum released by feldspars and micas is preferentially precipitated out in non-carbonate secondary minerals, as dawsonite (NaAl(OH)₂CO₃) is not likely to form as it is only thermodynamic stable relative to other NaAl-phases at low temperatures [2].

[1] Pham *et al.* (2011) IJGGC In Press. [2] Hellevang *et al.* (2011) *Oil & Gas Sci. Technol.* **66**, 119-135.

Variable radiogenic isotopic compositions in Saharan dust across the Atlantic

S. AARONS*, S. ACIEGO AND J. GLEASON

University of Michigan, Ann Arbor, MI 48109-1005, USA
(*correspondence: smaarons@umich.edu)

Isotopic characterization of aerosol mineral particles (dust) of varying sizes is essential in classifying potential source areas and determining the correct source of dust deposited over oceans and icesheets. The Sahara is considered a dominant source of aerosol dust in the Northern Hemisphere. Weathering, size, and mineral sorting can have an effect on radiogenic isotope compositions [1]. In order to investigate the isotopic variability of Hf, Nd and Sr we analyzed ten airborne dust samples in 2 size fractions collected during cruise M55 that intersected a cross-Atlantic dust storm originating in the Sahara in late 2002.

Past measurements of the isotopic composition of Hf, Nd and Sr of dust has focused primarily on coarse sized particles (1-30µm), whereas far-reaching deposition is primarily of a smaller size fractions (~2µm). Studies have shown that ⁸⁷Sr/⁸⁶Sr varies with grain size [2], but no systematic work has been done to show if there is a fallout distance effect on the isotopic composition. Weathering and sorting of minerals has a negligible effect upon the Nd isotopic composition [3]. The Hf isotopic composition however has been hypothesized to be highly variable due to a depleted "zircon effect" in the dust over time and distance [4].

⁸⁷Sr/⁸⁶Sr measurements were performed on a Finnigan MAT 262 TIMS (¹⁴³Nd/¹⁴⁴Nd measurements pending), and measurement of ¹⁷⁶Hf/¹⁷⁷Hf was performed on a Nu Instruments MC-ICPMS. Hf isotopic compositions show an east to west trend toward more radiogenic compositions across the Atlantic. While no Sr isotopic sorting trend based on distance from the dust storm is evident, the fine grained samples are consistently more radiogenic than the coarse grained samples from each site. A shift of >400 ppm in the ⁸⁷Sr/⁸⁶Sr ratio between coarse and fine fractions is found, with an average ⁸⁷Sr/⁸⁶Sr ratio of 0.7159, consistent with a Saharan dust source. The silicate versus water soluble fractions show a shift in ⁸⁷Sr/⁸⁶Sr ratios with ~70% of the Sr in the water soluble fraction attributable to seasalt and ~30% from dust.

[1] Dasch (1969) *Geochim. Cosmochim. Acta* **33**, 1521-1552.
[2] Grousset & Biscaye (2005) *Chem. Geol.* **222**, 149-167.
[3] Goldstein *et al.* (1984) *Earth Planet. Sci. Lett.* **70**, 221-236. [4] Rickli *et al.* (2010) *Geochim. Cosmochim. Acta* **74**, 540-557.