

Deciphering sulfur cycling, porewater geochemistry and carbonate mineralogy in modern dolomitic sediments

B. MORGAN^{1*}, S.A. WILSON², S.G. JOHNSTON³,
E.J. GAGEN⁴, E.D. BURTON³, G. SOUTHAM⁴

¹School of Geosciences, The University of Sydney,
Camperdown, NSW 2006, Australia (*correspondence:
bree.morgan@sydney.edu.au)

²School of Earth, Atmosphere & Environment, Monash
University, Clayton, VIC 3800, Australia

³Southern Cross Geoscience, Southern Cross University,
Lismore, NSW 2480, Australia

⁴School of Earth & Environmental Sciences, The University
of Queensland, St Lucia, QLD 4072, Australia

Dolomite [CaMg(CO₃)₂], a highly stable mineral store for CO₂ pollution, is thermodynamically favoured to precipitate from seawater, but kinetically inhibited to form under Earth surface conditions. Although it is well established that low-temperature dolomite precipitation is promoted by microbial sulfate reduction [1], our mechanistic understanding of the coupling between S cycling and dolomite formation, particularly from the perspective of reactions at the porewater–mineral interface, is incomplete.

Rare formations of modern dolomite occur in a handful of sedimentary systems worldwide, including the Coorong Lakes in South Australia [1], and are likely to co-occur with sulfidic minerals, which are also byproducts of sulfate reduction. However, there have been no detailed investigations of S speciation in the solid phase, nor has porewater chemistry been previously investigated, throughout sediment profiles in these settings.

Here, we decipher coupling between S and C cycling at the mineral–solution interface in Coorong Lake sediments by characterising mineralogy (X-ray diffraction), S speciation (S K-edge XANES) and porewater geochemistry in 50–60 cm profiles at 2.5–5 cm depth increments. Interestingly, although some dolomite-rich sediments contain high porewater sulfide concentrations (0.2–4.1 mmol/L), others do not, suggesting a contrast in sulfide mineral abundance and speciation between sites. Additionally, dolomite only exists as the sole crystalline carbonate species when sediment pH decreases from ~8 to neutral, which may coincide with the decomposition of less stable carbonate phases. Unravelling CO₂ capture in sedimentary dolomite within this unique natural laboratory will support development of cost effective carbon sequestration technologies.

[1] Wright & Wacey (2005), *Sedimentology* 52, 987–1008.