

## The past, present, and future of carbon capture and storage

ERIC H. OELKERS<sup>1,2,5</sup>, SIGURDUR R. GISLASON<sup>2</sup>,  
MARTIN STUTE<sup>3</sup> AND JUERG M. MATTER<sup>4</sup>,

<sup>1</sup>CNRS/UPS, UMR 5563, 14 Edourad Belin, 31000 Toulouse  
France (oelkers@get.obs-mip.fr)

<sup>2</sup>Institute of Earth Sciences, University of Iceland, Sturlagata 7,  
101 Reykjavík, Iceland

<sup>3</sup>Lamont-Doherty Earth Observatory, 61 Route 9W, Palisades,  
NY 10964, USA

<sup>4</sup>NOCA, University of Southampton, European Way,  
Southampton SO4 3ZH, United Kingdom

<sup>5</sup>UCL Earth Sciences, London WC1E 6BT, United Kingdom

Much of the initial motivation for research in carbon capture and storage was fear. The fear of global warming motivated the public. The fear of a carbon tax motivated industry. The fear of missed grant funding motivated the academic community. Much of this initial fear has been mitigated by a combination of negative publicity, the fear of carbon storage risks, and the fear of the costs of carbon capture and storage. This has resulted in the shutting of industrial carbon capture and storage pilot plants, and a growing public opinion against carbon dioxide injection beneath the surface of the continents. Most remaining carbon storage efforts are part of enhanced oil recovery (EOR) programs run by major petroleum companies, who 'sell' such efforts to the public to gain favorable publicity and to attract government research funds.

As such, most current industrial carbon storage efforts are part of EOR programs injecting more or less pure CO<sub>2</sub> into sedimentary rocks. Research shows that CO<sub>2</sub> injected into such sites remains as a separate phase for thousands of years or more, and much of this CO<sub>2</sub> will never transform into stable carbonate minerals. Towards a more permanent carbon storage solution, many geochemists have advocated developing enhanced global weathering rate technologies, by finding methods to accelerate the dissolution rates of Mg-silicates such as olivine. Is such a pathway realistic considering the fact that the global anthropogenic carbon flux to our atmosphere is ~10 Gt/year, but the annual carbon drawdown by global chemical weathering is just 0.1 Gt/year. Can we possibly accelerate the continental chemical weathering by two orders of magnitude worldwide? It seems more likely that the way forward is to look for different processes. Is it possible to inject greenhouse gases into the mid-ocean ridge basalts for mineral carbonation? Is it time to revisit enhanced ocean fertilisation leading to increase photosynthesis and burial? Perhaps the way forward is not by continuing on the paths emphasised during the recent past.