In-Situ X-ray Tomography Study of Cement Exposed to CO2 Saturated Brine

For successful CO2 storage in underground reservoirs, the potential problem of CO2 leakage needs to be addressed. A profoundly improved understanding of the behavior of fractured cement under realistic subsurface conditions including elevated temperature, high pressure and the presence of CO2 saturated brine is required. Here, we report in situ X-ray micro computed tomography (μ-CT) studies visualizing the microstructural changes upon exposure of cured Portland cement with an artificially engineered leakage path (cavity) to CO2 saturated brine at high pressure. Carbonation of the bulk cement, self-healing of the leakage path in the cement specimen, and leaching of CaCO3 were thus directly observed. The precipitation of CaCO3, which is of key importance as a possible healing mechanism of fractured cement, was found to be enhanced in confined regions having limited access to CO2. For the first time, the growth kinetics of CaCO3 under more realistic well conditions have thus been estimated quantitatively. Combining the μ-CT observations with scanning electron microscopy resulted in a detailed understanding of the processes involved in the carbonation of cement.

General information
State: Published
Organisations: Department of Physics, Neutrons and X-rays for Materials Physics, SINTEF, Norwegian University of Science and Technology, Universite du Maine, University of Copenhagen
Number of pages: 8
Pages: 9344-9351
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Environmental Science and Technology
Volume: 51
Issue number: 16
ISSN (Print): 0013-936X
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 6.58 SJR 2.535 SNIP 1.941
Web of Science (2017): Impact factor 6.653
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.26 SJR 2.559 SNIP 1.902
Web of Science (2016): Impact factor 6.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.61 SJR 2.546 SNIP 1.838
Web of Science (2015): Impact factor 5.393
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.5 SJR 2.777 SNIP 2.003
Web of Science (2014): Impact factor 5.33
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.52 SJR 2.952 SNIP 2.102
Web of Science (2013): Impact factor 5.481
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.17 SJR 3.115 SNIP 2.043
Web of Science (2012): Impact factor 5.257
ISI indexed (2012): ISI indexed yes