

## **IAN C BOURG**

Assistant Professor, tenure-track

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### **Education and Training**

National Institute of Applied Sciences, Toulouse, France, BEng in Chemical Engineering (1999).

National Institute of Applied Sciences, Toulouse, France, MSc in Chemical Engineering (1999).

University of California, Berkeley, PhD in Civil and Environmental Engineering (2004).

### **Research and Professional Experience**

Princeton University, Princeton, Assistant Professor, Civil and Environmental Engineering (2015-present).

Lawrence Berkeley National Lab, Berkeley, CA, Research Scientist, Earth Sciences (2009-2014).

Lawrence Berkeley National Lab, Berkeley, Postdoctoral Fellow, Earth Sciences (2005-2009).

University of Chicago, Chicago, Visiting Postdoctoral Fellow, Geophysical Sciences (2008).

### **Books**

Tournassat C, Steefel CI, Bourg IC, Bergaya F (Eds.) *Natural and Engineered Clay Barriers*, Developments in Clay Science, Vol. 6, Elsevier (2015).

Smit B, Reimer JA, Oldenburg CM, Bourg IC. *Introduction to Carbon Capture and Sequestration*, The Berkeley Lectures on Energy, Vol. 1, Imperial College Press (2014).

DePaolo DJ, Cole DR, Navrotsky A, Bourg IC (Eds) *Geochemistry of Geologic CO<sub>2</sub> Sequestration*, Reviews in Mineralogy and Geochemistry, Vol. 77, Mineralogical Society of America (2013).

### **Peer-Reviewed Publications**

Kulasinski K, Bourg IC, Lammers LN. The impact of aqueous solution composition on frayed edge site formation in illite. *Environmental Science and Technology*, in review (2017).

Gadikota G, Dazas B, Rother G, Cheshire MC, Bourg IC. Hydrophobic solvation of gases (CO<sub>2</sub>, CH<sub>4</sub>, H<sub>2</sub>, noble gases) in clay interlayer nanopores. *Journal of Physical Chemistry C* 121, 26539-26550 (2017).

Bourg IC, Ajo-Franklin JB. Clay, water, and salt: Controls on the permeability of fine-grained sedimentary rocks. *Accounts of Chemical Research* 50, 2067-2074 (2017).

Bourg IC, Lee SS, Fenter P, Tournassat C. Structure and energetics of the Stern layer at mica-water interfaces. *Journal of Physical Chemistry C* 121, 9402-9412 (2017).

Lammers LN, Bourg IC, Okumura M, Kolluri K, Sposito G, Machida M. Molecular dynamics simulations of cesium adsorption on illite nanoparticles. *Journal of Colloid and Interface Science* 490, 608-620 (2017).

Tournassat C, Davis JA, Chiaberge C, Grangeon S, Bourg IC. Modeling the acid-base properties of montmorillonite edge surfaces. *Environmental Science and Technology* 50, 13436-13445 (2016).

Tournassat C, Bourg IC, Holmboe M, Sposito G, Steefel CI. Molecular dynamics simulations of anion exclusion in clay interlayer nanopores. *Clays and Clay Minerals* 64, 374-388 (2016).

Bacle P, Dufreche J-F, Rotenberg B, Bourg IC, Marry V. Modeling the transport of water and ionic tracers in a micrometric clay sample. *Applied Clay Science* 123, 18-28 (2016).

Tinnacher RM, Holmboe M, Tournassat C, Bourg IC, Davis JA. Ion adsorption and diffusion in smectite: Molecular, pore, and continuum scale views. *Geochimica et Cosmochimica Acta* 177, 130-149 (2016).

- Bourg IC. Sealing shales versus brittle shales: A sharp threshold in the material properties and energy technology uses of fine-grained sedimentary rocks. *Environmental Science and Technology Letters* 2, 255-259(2015).
- Bourg IC, Beekingham L, DePaolo DJ. The nanoscale basis of CO<sub>2</sub> trapping for geologic storage. *Environmental Science and Technology* 49, 10265-10284 (2015).
- Bourg IC, Tournassat C. Self-diffusion of water and ions in clay barriers. In: *Natural and Engineered Clay Barriers* (C Tournassat, CI Steefel, IC Bourg, F Bergaya, eds.), Developments in Clay Science, Vol. 6, Elsevier, Chapter 6 (2015).
- Tournassat C, Bourg IC, Steefel CI, Bergaya F. General surface properties of clay minerals. In: *Natural and Engineered Clay Barriers* (C Tournassat, CI Steefel, IC Bourg, F Bergaya, eds.), Developments in Clay Science, Vol. 6, Elsevier, Chapter 1 (2015).
- Chagneau A, Tournassat C, Steefel CI, Bourg IC, Gaboreau S, Esteve I, Kupick T, Claret F, Schafer T. Complete restriction of <sup>36</sup>Cl<sup>-</sup> diffusion by celestite precipitation in densely compacted illite. *Environmental Science and Technology Letters* 2, 139-143 (2015).
- Holmboe M, Bourg IC. Molecular dynamics simulations of water and sodium diffusion in smectite interlayer nanopores as a function of pore size and temperature. *Journal of Physical Chemistry C* 118, 1001-1013 (2014).
- Eiler JM, Bergquist B, Bourg IC, Cartigny P, Farquhar J, Gagnon AC, Guo W, Halevy I, Hofmann AE, Levin N, Schauble EA, Stolper D. Frontiers of stable isotope geoscience. *Chemical Geology* 372, 119-143(2014).
- Hamm LM, Bourg IC, Wallace AF, Rotenberg B. Molecular simulation of CO<sub>2</sub>- and CO<sub>3</sub>-brine-mineral systems. In: *Geochemistry of Geologic CO<sub>2</sub> Sequestration* (DJ DePaolo, DR Cole, A Navrotsky, IC Bourg, eds.), Reviews in Mineralogy and Geochemistry, Vol. 77, Mineralogical Society of America, pp. 189-228 (2013).
- Hofmann AE, Bourg IC, DePaolo DJ. Ion desolvation as a mechanism for kinetic isotope fractionation in aqueous systems. *Proceedings of the National Academy of Sciences of the U.S.A.* 198, 18689-18694 (2012).
- Bourg IC, Steefel CI. Molecular dynamics simulations of water structure and diffusion in silica nanopores. *Journal of Physical Chemistry C* 116, 11556-11564 (2012).
- Nielsen LC, Bourg IC, Sposito G. Predicting CO<sub>2</sub>-water interfacial tension under pressure and temperature conditions of geologic CO<sub>2</sub> storage. *Geochimica et Cosmochimica Acta* 81, 28-38 (2012).
- Bourg IC, Sposito G. Molecular dynamics simulations of the electrical double layer on smectite surfaces contacting concentrated mixed electrolyte (NaCl-CaCl<sub>2</sub>) solutions. *Journal of Colloid and Interface Science* 360, 701-715 (2011).
- Bourg IC, Sposito G. Ion exchange phenomena. In: *Handbook of Soil Sciences, Properties and Processes*, 2<sup>nd</sup>ed. (PM Huang, Y Li, ME Sumner, eds.), CRC Press, Boca Raton, Chapter 16 (2011).
- Bourg IC, Sposito G. Connecting the molecular scale to the continuum scale for diffusion processes in smectite-rich porous media. *Environmental Science and Technology* 44, 2085-2091 (2010).
- Bourg IC, Richter FM, Christensen JN, Sposito G. Isotopic mass-dependence of alkali metal cation diffusion coefficients in water. *Geochimica et Cosmochimica Acta* 74, 2249-2256 (2010).
- Bourg IC, Sposito G. Isotopic fractionation of noble gases by diffusion in liquid water: Molecular dynamics simulations and hydrologic applications. *Geochimica et Cosmochimica Acta* 72, 2237-2247 (2008).
- Bourg IC, Sposito G, Bourg ACM. Modeling the diffusion of Na<sup>+</sup> in compacted water-saturated Na-bentonite as a function of pore water ionic strength. *Applied Geochemistry* 23, 3635-3641 (2008).

- Bourg IC. Comment on "Modeling sulfur isotope fractionation and differential diffusion during sulfate reduction in sediments of the Cariaco Basin" by MA Donahue, JP Werne, C Meile and TW Lyons. *Geochimica et Cosmochimica Acta* 72, 5852-5854 (2008).
- Bourg IC, Sposito G. Molecular dynamics simulation of kinetic isotope fractionation during the diffusion of ionic species in liquid water. *Geochimica et Cosmochimica Acta* 71, 5583-5589 (2007).
- Bourg IC, Sposito G, Bourg ACM. Modeling the acid-base surface chemistry of montmorillonite. *Journal of Colloid and Interface Science* 312, 297-310 (2007).
- Bourg IC, Sposito G, Bourg ACM. Modeling cation diffusion in compacted water-saturated Na-bentonite at low ionic strength. *Environmental Science and Technology* 41, 8118-8122 (2007).
- Bourg IC, Sposito G, Bourg ACM. Tracer diffusion in compacted water-saturated bentonite. *Clays and Clay Minerals* 54, 363-374 (2006).

## Teaching

### Courses taught:

*The Environmental Nexus*, Princeton University (2017)

*Interfacial Waters in Natural Systems*, Princeton University (2016)

*Intro to Environmental Engineering*, Princeton University (2015, 2016, 2017)

*Carbon Capture and Sequestration*, University of California, Berkeley (2011, 2013, 2014)

### Undergraduate research advising:

Advisor of 8 senior thesis students at Princeton University: M Williams '16, S Wang '16, A Chang '17, K Shizuru '17, Sylvania Jacobson '17, V Amaral '17, A Byrnes '18, L Watt '18.

## Honors & Awards

Winner, US DOE Life at the Frontiers of Energy Research Video Competition, for the video *Carbon in Underland* (2011).

Doctoral Fellowships, Civil & Environmental Engineering, UC Berkeley (2000, 2002) (Joseph Dias fellowship, Eugene Henry fellowship).

Doctoral Fellowship, French Agency for the Management of Radioactive Waste (1999-2002).

Leonardo Scholarship for research abroad, European Union (1999).

## Invited Presentations (with IB as invited presenting author)

### Plenary keynote presentation:

2012 – 5<sup>th</sup> International Meeting on Clays in Natural and Engineered Barriers for Radioactive Waste Confinement (Montpellier, France).

### Other invited presentations:

2017 – 2 invited talks: ACS mid-Atlantic regional meeting (Hershey); 7<sup>th</sup> International Meeting on Clays in Natural and Engineered Barriers for Radioactive Waste Confinement (Davos).

2016 – 10 invited talks: ACS meeting (San Diego); CMS meeting (Atlanta); Goldschmidt conference (Yokohama); ACS meeting (Philadelphia – two talks); Geodynamics seminar series (Lamont-Doherty Earth Observatory); Geosciences seminar series (U Delaware); EPS and EECE seminar series (Washington University in St Louis); Pierce seminar series (MIT).

2015 – 6 invited talks: ACS meeting (Denver – two talks); Goldschmidt conference (Prague – one invited talk, one keynote talk); DOE EFRC PI meeting (Washington DC); AGU meeting (San Francisco).

2014 – 8 invited talks: Center for Isotope Geochemistry seminar series (UC Berkeley); CMS meeting (College Station, TX – two talks); workshop on the Characterization of Nanoporous Materials (Stanford U); Molecular Foundry users' meeting (LBNL); Réunion des Sciences de la Terre (Pau); SKB Task Force meeting (Berkeley – two talks).

- 2013 – 1 invited talk: ACS meeting (New Orleans).
- 2012 – 7 invited talks: International Seminar Series on Environmental Radioactivity (Hokkaido University); APS workshop on Metal Ion Adsorption at Interfaces (Argonne National Laboratory); 2012 Young Engineers & Scientists Symposium (Berkeley); Environmental Engineering seminar series (University of Connecticut); Geology seminar series (University of Illinois at Urbana-Champaign); Geophysical Laboratory seminar series (Carnegie Institute in Washington, DC); Center for Frontiers of Subsurface Energy Security (CFSES) seminar series (Sandia National Laboratory).
- 2011 – 5 invited talks: Symposium on Application of Nano-geosciences in Petroleum Engineering (Kyoto University); Goldschmidt conference (Prague); EFRC Summit and Forum (Washington DC); LBNL Advisory Board meeting (LBNL); Energy and Environmental Systems Seminar Series (Hokkaido University).
- 2010 – 4 invited talks: DOE workshop on the Chemistry of Novel Isotope Effects in the Geosciences (San Francisco); Seismology Lab seminar series (UC Berkeley); Center for Isotope Geochemistry seminar series (UC Berkeley); Ecosystem Sciences seminar series (UC Berkeley).
- 2009 – 1 invited talk: ACS meeting (Salt Lake City).
- 2007 – 3 invited talks: DOE Workshop on Molecular Dynamics and Structure of Geofluids (Berkeley); European Union workshop on Surface Reactions & Electrical Interfacial Layer (Opatjia, Croatia); Workshop on Environment, Neutrons and Molecular Dynamics (U of Grenoble).
- 2005 – 2 invited talks: International Workshop on Waste Management (Hokkaido U); International Clay Conference (Tokyo).

## **Service & Outreach**

### Scientific leadership:

Executive Committee member and Thurst Area lead for the *Center for Nanoscale Controls on Geologic CO<sub>2</sub> (NCGC)*, a DOE-supported Energy Frontiers Research Center (2011-present).

### Organization of international workshops and short courses:

*Molecular dynamics simulations*. Workshop organized at the Goldschmidt conference in Paris, France. Co-conveners: M Holmboe, LN Lammers, K Kulasinski (2017).

*Geochemistry of geologic CO<sub>2</sub> sequestration*. Mineralogical Society of America (MSA) short course organized in Berkeley. Co-conveners: DJ DePaolo, DR Cole, A Navrotsky (2013).

*Microscopic-scale view of CO<sub>2</sub> sequestration*. Workshop organized with support from the European Center for Atomistic and Molecular Modeling (CECAM) in Lausanne, Switzerland. Co-conveners: B Rotenberg (2011).

### Organization of conference sessions:

*Goldschmidt conference* (2009, 2009, 2015, 2017).

*ACS meeting* (2014).

*AGU meeting* (2008, 2010).

### Reviewing:

Reviewer of 101 manuscripts for over 15 scholarly journals, most frequently for *Geochim. Cosmochim. Acta* (29), *Environ. Sci. Technol.* (21), and *J. Phys. Chem.* (8).

Ad-hoc reviewer of 20 proposals for the US DOE (7), the NSF (6), the French Agence Nationale de la Recherche (ANR) (2), the US Defense Threat Reduction Agency, the Swiss NSF, the German Research Foundation (DFG), the Portuguese Science and Technology Foundation (FCT), and the Foundation for Polish Science (FPS).

Participant on three proposal review committees for the NSF and the US DOE.

Service on scientific panels:

*Gordon conference on Carbon Capture, Utilization, and Storage (CCUS)*: invited session chair (2015).  
*Basic Research Needs for Environmental Management* workshop of the DOE Office of Science: invited panelist (2015).

Service to professional societies:

Clay Minerals Society: editor of the bi-monthly CMS News page published in the journal *Elements* (2013-2015).

Clay Minerals Society: member of the Committee on Council Nominations (2016-present).

Doctoral dissertation committees:

Doctoral dissertation defense committees at Princeton University: H Deng (2015), B Guo (2015), Z Zhang (2016).

Doctoral dissertation qualifying examination or first proposition committees at Princeton University: M Ruiz (2015), K DeCarlo (2015), L Golston (2016), K Gong (2016), K Spokas (2016), X He (2016), K Yang (2016), E McCaslin (2017), J Young (2017), J Willemsen (2017), H Hunter (2017), A Sherman (2017).

Doctoral dissertation qualifying examination committee at UC Berkeley: LN Nielsen (2010).

Princeton University committees:

Committee on Committees (2017-present).

Other academic committees:

Geological Engineering Program Executive Committee (2015-present) .

PEI Anniversary Committee (2017-present).

Other academic service:

Freshman advising (2016-17 academic year).

12/27/2017