

International Symposium on Site Characterization for CO₂ Geological Storage (CO2SC)

March 20–22, 2006 (Monday through Wednesday)

March 23, 2006 (Field Trip)

Building 50 Auditorium
Ernest Orlando Lawrence Berkeley National Laboratory (LBNL)
1 Cyclotron Road, Berkeley CA, 94720

Symposium Agenda (Rev 3)

Sponsored by
U.S. Environmental Protection Agency (EPA)

Co-sponsored by
IAH, AIH, GWPC, IAHR

Organized by
Ernest Orlando Lawrence Berkeley National Laboratory, Earth Sciences Division
U.S. Environmental Protection Agency, Office of Air and Radiation and Office of Water

Agenda Outline

Monday, March 20, 2006

7:30 A.M.–8:30 A.M.	Registration
8:30 A.M.–12:30 P.M.	Oral Sessions
12:30 P.M.–1:30 P.M.	Lunch
1:30 P.M.–6:00 P.M.	Oral Sessions

Tuesday, March 21, 2006

8:00 A.M.–12:30 P.M.	Oral Sessions
12:30 P.M.–1:30 P.M.	Lunch
1:30 P.M.–3:00 P.M.	Oral Sessions
3:30 P.M.–8:30 P.M.	Poster Session and Barbecue Dinner

Wednesday, March 22, 2006

8:00 A.M.–11:00 P.M.	Oral Sessions
12:50 P.M.–2:00 P.M.	Lunch
2:00 P.M.–4:30 P.M.	Panel Discussion

Thursday, March 23, 2006

Field Trip (McDonald Island Underground Gas Storage Project)

Monday, March 20, 2006, Morning Sessions

7:30 A.M.	Registration, Building 50 Auditorium Foyer	
<i>Session Chair—Chin-Fu Tsang, LBNL</i>		
Welcome and Opening Remarks		
8:30 A.M.	Jens Birkholzer, Organizing Committee, Lawrence Berkeley National Laboratory	
	TBA, U.S. Environmental Protection Agency	
Keynote Lecture		
8:50 A.M.	Site Characterization for CO ₂ Geological Storage	Peter J. Cook, Chief Executive, Cooperative Research Centre For Greenhouse Gas Technologies (CO2CRC), Australia
9:20 A.M.	<i>Mid-morning Break</i>	
<i>Session Chair—Anhar Karimjee, EPA</i>		
Site Selection and Characterization: General Framework		
9:40 A.M.	The ICE Framework for Site Characterization, and a Description of Potential Due-Diligence Requirements (Invited)	Friedmann, J. (Lawrence Livermore National Laboratory)
10:10 A.M.	Experience with Site Screening and Selection for CO ₂ Storage (Invited)	Seeburger, D. (Chevron Energy Technology Company)
10:40 A.M.	Reservoir Seals: How They Work and How To Choose a Good One (Invited)	Christopher, C. (BP Americas), J. Iliffe, M. Osborne
11:10 A.M.	Site Characterization of CCS: Geomechanical Aspects	Yamamoto, K. (Mizuho Information and Research Institute, Japan)
11:30 A.M.	Measuring and Modeling for Site Characterization: A Global Approach	Jammes, L. (Schlumberger Carbon Services, France), D. Vu-Hoang, O. Faivre, T.S. Ramakrishnan, M. Sengul
11:50 A.M.	Site Characterization Needs from a Risk Assessment Perspective	Stenhouse, M. (Monitor Scientific), W. Zhou, R. Arthur
Regional-Scale Site Selection		
12:10 P.M.	Site Screening and Assessment for Testing Geological Sequestration in the Illinois Basin: A Doe Phase II Regional Partnership Program	Finley, R. J. (Illinois State Geological Survey), S. M. Frailey
12:30 P.M.	<i>Luncheon at the LBNL Cafeteria</i>	

Monday, March 20, 2006, Afternoon Sessions

Session Chair—Grant Bromhal, NETL

Regional-Scale Site Selection (continued)		
1:30 P.M.	Characterization of Potential Storage Sites in the West Coast States	Myer, L. (Lawrence Berkeley National Laboratory), C. Downey, J. Clinkenbeard, S. Thomas, S. Stevens, S. Benson, H. Zheng, H. Herzog, J. Price
1:50 P.M.	Assessing and Expanding CO ₂ Storage Capacity in Depleted and Near-Depleted Oil Reservoirs	Kuuskraa, V. A. (Advanced Resources International, Inc.), G. J. Koperna
2:10 P.M.	Regional Characterisation of a Major Storage System: Gippsland Basin, Southeast Australia	Gibson-Poole, C. M. (Cooperative Research Centre For Greenhouse Gas Technologies, Australia), L. Svendsen, J. Underschultz, M. N. Watson, J. Ennis-King, P. J. Van Ruth, E. J. Nelson, R. F. Daniel, Y. Cinar
2:30 P.M.	Site Selection for CO ₂ Storage in Deep Aquifers of the Paris Basin, France	Bonijoly, D. (BRGM, France), E. Brosse, C. Rigollet, T. Manai
2:50 P.M.	Opportunities for CO ₂ Geological Storage in Central Coal Basin (Northern Spain)	Loredo, J. (University of Oviedo, Spain), P. Cienfuegos, F. Pendás
3:10 P.M.	<i>Mid-afternoon Break</i>	
<i>Session Chair — Larry Myer, LBNL</i>		
Site Characterization Methods		
3:40 P.M.	Site Characterization Using Joint Reconstructions of Disparate Data Types	Ramirez, A. (Lawrence Livermore National Laboratory), J. Friedmann, K. Dyer, R. Aines
4:00 P.M.	Detecting Faults in the Caprock Using Seismic Imaging	Huang, L. (Los Alamos National Laboratory), M. Fehler
4:20 P.M.	Application of Cutting Edge 3-D Seismic Attribute Technology to the Assessment of Geological Reservoirs for CO ₂ Sequestration	Sullivan, C. (Pacific Northwest National Laboratories), K. Marfurt, F. Hilterman, S. Nissen, G. Goloshubin
4:40 P.M.	New Approaches for Transient Testing and Long-Term Pressure Monitoring of Low-Permeability Caprocks	Mishra, S. (INTERA, Inc.), J. F. Pickens, J. Delay
5:00 P.M.	Site Characterization for CO ₂ Geologic Storage and Vice Versa—The Frio Brine Pilot as a Case Study	Doughty, C. (Lawrence Berkeley National Laboratory)
5:20 P.M.	An Evaluation of Helicopter and Ground Methods for Locating Existing Wells	Veloski, G. (National Energy Technology Laboratory), R. Hammack
5:40 P.M.	<i>In Situ</i> Borehole Seismic Monitoring of Injected CO ₂ at the Frio Site	Daley, T. M. (Lawrence Berkeley National Laboratory), V.A. Korneev
6:00 P.M.	<i>Adjourn</i>	
Tuesday, March 21, 2006, Morning Sessions		
<i>Session Chair — Bo Bodvarsson, Director, Earth Sciences Division, Lawrence Berkeley National Laboratory</i>		
Keynote Lecture		

8:00 A.M.	The Future Energy Needs in the U.S. and the Role of Carbon Sequestration (Tentative Title)	Steve Chu, Director, Lawrence Berkeley National Laboratory
Site Characterization Case Studies I		
8:30 A.M.	Geological Characterization of the Weyburn Field for Geological Storage of CO ₂ (Invited)	Chalaturnyk, R. (University of Alberta), S. Whittaker
9:00 A.M.	Subsurface Characterization of CO ₂ Sequestration Sites—Example from a Carbonate Reef Setting	Holtz, M. H. (University of Texas at Austin), R. C. Smyth, B. McPherson, W. Han
9:20 A.M.	Site Characterization for Geomechanical and Flow Modeling at West Pearl Queen Pilot Site	Siriwardane, H. (NETL/West Virginia University), G. S. Bromhal, T. Wilson, D. H. Smith
9:40 A.M.	Results Obtained from Reconnaissance-Level and Detailed Reservoir Characterization Methods Utilized for Determining Hydraulic Property Distribution Characteristics at Mountaineer AEP #1	F.A. Spane (Battelle/ Pacific Northwest National Laboratories), P.D. Thorne, N. Gupta, P. Jagucki, T.S. Ramakrishnan, N. Müller
10:00 A.M.	Geomechanical Site Characterization To Constrain CO ₂ Injection Feasibility: Teapot Dome EOR Pilot	Chiaromonte, L. (Stanford University), M. Zoback, J. Friedmann, V. Stamp
10:20 A.M.	<i>Mid-morning Break</i>	
<i>Session Chair — Isabel Czernichowski-Lauriol, BRGM</i>		
Leakage from Storage Formations: Pathways, Effects, and Implications for Site Characterization I		
10:40 A.M.	On Leakage from Geologic Storage Reservoirs of CO ₂ (Invited)	Pruess, K. (Lawrence Berkeley National Laboratory)
11:10 A.M.	Alteration of Formation Barrier Due to CO ₂ Injection	Yamada Y. (Kyoto University, Japan), D. Tanaka, S. Murata
11:30 A.M.	Capillarity Trapping in the Overburden as a Defense-In-Depth Mechanism against Leakage from CO ₂ Storage Sites: The Case of the Tertiary Texas Gulf Coast	Nicot, J.-P. (University of Texas at Austin), S. Lakshminarasimhan, S.D. Hovorka
11:50 A.M.	Importance of Mineralogical Data for Groundwater Quality Affected by CO ₂ Leakage from Storage Sites	Xu, T. (Lawrence Berkeley National Laboratory)
12:10 P.M.	Surface Gas Measurements and Related Studies for the Characterisation and Monitoring of Geological CO ₂ Storage Sites: Experiences at Weyburn and in Salah	Jones, D. G. (British Geological Survey, United Kingdom), S. E. Beaubien, A. Annunziatellis, J.-C. Baubron, G. Braibant, C. Cardellini, D. Cinti, J. R. Davis, C. Scheib, S. Lombardi, K. Michel, N. Morgantini, L. Penner, F. Quattrocchi, M. H. Strutt, N. Voltattorni
12:30 P.M.	<i>Luncheon at the LBNL Cafeteria</i>	

Tuesday, March 21, 2006, Afternoon Sessions

Session Chair — Koji Yamamoto, Mizuho Information and Research Institute

Leakage from Storage Formations: Pathways, Effects, and Implications for Site Characterization II		
1:30 P.M.	Implications of Abandoned Wells for Site Selection (Invited)	Celia, M. (Princeton University), D. Kavetski, J. Nordbotten, S. Bachu, S. Gasda
2:00 P.M.	Degradation of Wellbore Cement Due to CO ₂ Injection—Effects of Pressure and Temperature	Strazisar, B. R. (National Energy Technology Laboratory), B. G. Kutchko
2:20 P.M.	Well Integrity in CO ₂ Environments: Performance, Risk, and Technologies	Gerard, B. (OXAND, France), R. Frenette, L. Auge, V. Barlet-Gouedard, J. Desroches, L. Jammes
Screening and Characterization Tools		
2:40 P.M.	Quick-Look Assessments To Identify Optimal CO ₂ EOR Storage Sites	Núñez Lopez, V. (University of Texas at Austin), M. H. Holtz, D. J. Wood, S. D. Hovorka
Poster Session Introduction		
3:00 P.M.	Introduction to Poster Session	Birkholzer, J.T. (LBNL), C.-F. Tsang
3:15 P.M.	<i>Mid-afternoon Break in the LBNL Cafeteria</i>	
Poster Session with Barbecue Dinner LBNL Cafeteria		
<i>Session Coordinator: Yingqi Zhang, LBNL</i>		
3:30 P.M.	Poster Session (details on pages 10 – 12) Symposium Dinner* Midway Through Poster Session (*We acknowledge, with many thanks, the co-sponsorship of Schlumberger Carbon Services and Errol L. Montgomery & Associates, Inc. for this event.)	
8:30 P.M.	<i>Adjourn</i>	

Wednesday, March 22, 2006, Morning Sessions	
<i>Session Chair—Neeraj Gupta, Battelle</i>	
Site Characterization Case Studies II	

8:00 A.M.	Regional Screening, Selection and Geological Characterization of the Saline Aquifer Structure “Schweinrich”, A Possible CO ₂ -Storage Site for a Large Lignite-Fired Power Plant in East Germany	Meyer, R. (BGR, Germany), F. May, C. Müller, C. Bernstone
8:20 A.M.	Casablanca Offshore Field, A Depleted Karstic Oil Reservoir for Geological Storage of CO ₂	Mignot, V. (Institut Français Du Pétrole, France), Y. Le Gallo, J.-C. Lecomte, T. Euzen, T. Vallaure, J. Mallo
8:40 A.M.	Site Characterization of Fluvial, Incised-Valley Deposits	Frykman, P. (Geological Survey of Denmark and Greenland, Denmark), K. Zink-Jørgensen, N. Bech, B. Norden, A. Förster, M. Larsen
9:00 A.M.	Geological Site Characterization of the Nearly Depleted K12-B Gas Field, Offshore The Netherlands	Geel, C.R. (TNO, Netherlands), R.J. Arts, R.M.H.E. Van Eijs, E. Kreft, J. Hartman, D. D’Hoore
Fundamental Processes and Technical Issues Related to Site Characterization		
9:20 A.M.	Effects of <i>In Situ</i> Conditions on Relative Permeability Characteristics of CO ₂ -Brine Systems	Bachu, S. (Alberta Energy and Utilities Board, Canada), B. Bennion
9:40 A.M.	Regional-scale Variable-Density Flow in Deep Saline Formations in the Midwestern United States: Implications for Large Scale Geologic CO ₂ Sequestration	Gupta, N. (Battelle), J. Sminchak
10:00 A.M.	<i>Mid-morning Break</i>	
<i>Session Chair — TBA</i>		
10:30 A.M.	Resolving Density Fingering during CO ₂ Sequestration: A Challenge for Reservoir Simulation	Hesse, M. A. (Stanford University), A. Riaz, H.A. Tchelepi
10:50 A.M.	Geochemical Processes with Implications for Site Characterization	Czernichowski-Lauriol, I. (BRGM, France), P. Audigane, I. Gaus, C. Kervévan
11:10 A.M.	Thermo-Kinetic Modeling of the Evolution of the CO ₂ -Rich Weyburn Brines at the Reservoir Inferred Conditions (P, T, Water-Gas Chemistry): First Results of a New Approach	Cantucci B. (University of Florence, Italy), G. Montegrossi, O. Vaselli, L. Pizzino, F. Quattrocchi, N. Voltattorni N.
11:30 A.M.	Modeling of Geomechanical Processes During Injection in a Multilayered Reservoir-Caprock System and Implications on Site Characterization	Rutqvist, J. (Lawrence Berkeley National Laboratory), J. Birkholzer, C.-F. Tsang

Wednesday, March 22, 2006, Morning Session (Continued)

Regulatory and Social Issues

11:50 A.M.	USEPA Recent Progress in Developing a Well Permitting Framework for the Underground Injection	Kobelski, B. (EPA, Office of Water), R.E. Smith, A.L. Whitehurst
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	of CO ₂	
12:10 P.M.	Alternative Pathways, Potential Obstacles, and Practical Solutions to Regulating CO ₂ Geological Storage	Paque, M. J. (Ground Water Protection Council), R. F. Van Voorhees, B. D. Day, B. W. Neuschafer
12:30 P.M.	Siting Geological Sequestration Projects: Public Perception, Regulatory Structures and Legal Considerations	Wilson, E. (University of Minnesota), C. Schivley
12:50 P.M.	<i>Luncheon at the LBNL Cafeteria</i>	
Wednesday, March 22, 2006, Afternoon Session		
Panel Discussion		
Discussion Moderator: Sally Benson (LBNL)		
2:00 P.M.	Summary, Overview, and Key Issues (Invited)	Benson, S. (LBNL)
2:30 P.M.	Panel Discussion Panelists: Stefan Bachu, Alberta Energy and Utilities Board Robert Finley, Illinois State Geological Survey Fred Molz, Clemson University John Tombari, Schlumberger TBA	
Concluding Remarks		
4:00 P.M.	Concluding Remarks	Tsang, C.-F. (LBNL), J.T. Birkholzer
4:10 P.M.	<i>Adjourn</i>	

Poster Session (Tuesday, March 21, 2006, 3:30 P.M.–8:30 P.M.)

Site Selection and Characterization: <u>General Framework</u>		
G1	Geologic Factors Controlling CO ₂ Storage Capacity and Permanence—Techniques and Case Studies based on Experience with Heterogeneity in Oil and Gas Reservoirs Applied to CO ₂ Storage	Ambrose, W. (University of Texas at Austin), S. Lakshminarasimhan, M.H. Holtz, V. Núñez-López, S.D. Hovorka, I. Duncan
G2	Remediation of Geologic CO ₂ Storage: Implications for Site Characterization	Stevens, S. (Advanced Technologies International, Inc.), J. Gale
Site Characterization <u>Methods</u>		
M1	Use of Instantaneous Frequency to Map Porosity in a Silurian Age Reef In Northern Michigan Basin in Preparation for CO ₂ Injection	Toelle, B. (Schlumberger Data & Consulting Services), L. Pekot
M2	Estimation of Field-Scale Relative Permeability Using Pressure Transient Data	Benson, S. M. (Lawrence Berkeley National Laboratory), C. Doughty
M3	CO ₂ Injection to Rock Specimens and Its Resistivity Measurements	Onishi, K. (Kyoto University, Japan), Y. Ishikawa, Y. Yamada, and T. Matsuoka
Regional-Scale Site <u>Selection</u>		
S1	Midwest Regional Carbon Sequestration Partnership, Preliminary Assessment of Potential CO ₂ Storage Reservoirs and Confinement, Cincinnati Arch Site	Rupp, J. (Indiana Geological Survey), W. Solano, S. Greb, L. Wickstrom, N. Gupta
S2	Potential for Geologic Storage of Carbon Dioxide from Coal-Fired Electrical Generating Stations In Arizona, USA	Shirley, D. H. (Errol L. Montgomery & Associates, Inc.), E. H. McGavock, E. L. Montgomery
S3	Evaluation of the Potential for CO ₂ Storage in Unminable Coal Beds and Selection of Large-Capacity Areas in the Alberta Basin, Canada	Bachu, S. (Alberta Energy and Utilities Board, Canada)
S4	Storage-Capacity Assessment for CO ₂ Captured from FCB Power Plants in France—Aquifer Storage Versus ECBM Recovery	Bonijoly, D. (BRGM, France), Z. Pokryszka, J.-M. Brunello
Site Characterization <u>Case Studies</u>		
C1	Geomechanically Constrained Simulation of CO ₂ Sequestration and Enhanced Methane Recovery in Coalbeds of the Powder River Basin, Wyoming	Ross, H. E. (Stanford University), M. D. Zoback
C2	Characterization of Greater Aneth Field, Paradox Basin, Utah, for Sequestration: Influence of Risk and Mitigation Requirements on Monitoring Strategies	Chidsey, T. C. (Utah Geological Survey), R. G. Allis, B. McPherson, J. Heath, S. E. Malkewicz, W. Groen
C3	Comprehensive Characterization of a Potential Site for CO ₂ Geological Storage in Central Alberta, Canada	Michael, K. (Alberta Energy And Utilities Board, Canada), S. Bachu, B. E. Buschkuehle, K. Haug, M. Grobe, A. T. Lytviak
C4	Reservoir Characterization of the Gage Sandstone, Perth Basin. <i>Issues of Scale: "Does my data look big in this"?</i>	Dance, T. (CO2CRC, Australia), S. Tyson
C5	Detailed Geological Site Characterization of a CO ₂ Storage Site: Otway Basin Pilot Project, Australia	Cook, P. J. (CO2CRC, Australia), S. Sharma

<u>Leakage from Storage Formations: Pathways, Effects, and Implications for Site Characterization</u>		
L1	Simulation of Cement Corrosion Due to Exposure to CO ₂ /brine mixtures	Huet, B., (Princeton University), A. Duguid, R. Fuller, G. Scherer, J. Prevost
L2	Near-Surface Monitoring of Geologic Carbon Sequestration	Strazisar, B. R. (National Energy Technology Laboratory), A. W. Wells, J. R. Diehl
L3	Hyperspectral Geobotanical Remote Sensing for CO ₂ Storage Monitoring	Pickles, W.L. (Lawrence Livermore National Laboratory), W.A. Cover
<u>Fundamental Processes and Technical Issues Related to Site Characterization</u>		
P1	High Resolution Numerical Investigation of CO ₂ Sequestration in Geologic Media Using the Massively Parallel Computer Code PFLOTTRAN	Lu, C. (Los Alamos National Laboratory), P. C. Lichtner
P2	Streamline-Based Simulation Of CO ₂ Injection in Saline Aquifers	Jessen, Kristian (Stanford University) And Franklin M Orr, Jr.
P3	Environmental Implications of Toxic Metals and Dissolved Organics Released as a Result of CO ₂ Injection into the Frio Formation, Texas, USA	Kharaka, Y.K. (U. S. Geological Survey), D.R. Cole, J.J., Thordsen, E. Kakouros, S. Pffiffer, S.D. Hovorka
P4	Thermo-Hydro-Chemical Performance Assessment of CO ₂ Storage in Saline Aquifer	Le Gallo, Y. (Institut Français du Pétrole, France), L. Trenty, A. Michel, T. Parra
P5	Mineral Trapping of CO ₂ in Geothermally Used Aquifers—Reactive Transport Simulation on Multiple Scales	Kühn, M. (RWTH Aachen University, Germany), C. Clauser
P6	Man-Made Earthquakes and the Importance of Accurate Site Characterizations for CO ₂ Geological Storage	Klose, C. D. (Columbia University)
<u>Screening and Characterization Tools</u>		
T1	Health, Safety, and Environmental Screening and Ranking Framework for Geologic CO ₂ Storage Site Selection	Oldenburg, C. M. (Lawrence Berkeley National Laboratory)
T2	Prototype Near-Field/GIS Model for Sequestered-CO ₂ Risk Characterization and Management	Bogen, K. T. (Lawrence Livermore National Laboratory), S. G. Homann, F. J. Gouveia, L. A. Neher
T3	A Coupled GIS and 3D Geologic Modeling System for Site Characterization	Wagoner, J.L. (Lawrence Livermore National Laboratory), D. John, L. Neher, S. Pack, L. Wilder
T4	Building a Mechanical Earth Model for Storage Integrity	Desroches, J. (Schlumberger Riboud Product Center, France), L. Jammes, T. Berard
T5	A Financial Decision Tool for CO ₂ Storage	Müller, N. (Schlumberger Doll Research), Y. B. Altundas, T. S. Ramakrishnan

Field Trip to McDonald Island Underground Gas Storage Project

Coordinators:

Jens Birkholzer and Pat Butler (LBNL), Joe Chan (Pacific Gas & Electric)

Note: Except for pickup time, all times are approximate. They depend on road and weather conditions.

- 08:00 A.M. Pickup at Doubletree Hotel
- 08:15 A.M. Pickup at Durant Hotel
- 09:30 A.M. Arrival at McDonald Island
(Short introduction to gas storage operation, visit of well sites, production and compressor facilities, operation/control station)
- 12:30 P.M. Bus leaves for Livermore
- 1:00 P.M. Lunch at Café Garre (Garre Vineyard and Winery in Livermore)
- 2:30 P.M. Bus Leaves for Steven Kent Winery in Livermore
Wine Tasting at Steven Kent
- 4:00 P.M. Bus leaves for Berkeley
- 5:15 P.M. Approximate arrival at Berkeley hotels

Note: Lunch is included for all non-LBNL participants. LBNL participants will have to pay for their own lunch expenses.