Mineralogical Society of America and *Geochemical Society*

Short Course Announcement

GEOCHEMISTRY OF GEOLOGIC CO_2 SEQUESTRATION

Dates: Short Course sessions are Saturday and Sunday, 7-8 December 2013 (in conjunction with the American Geophysical Union's 46th Annual Fall Meeting, 9-13 December 2013).

Location: Short Course sessions will be held at Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA. (Building 50 Auditorium)

Convenors: *Donald J. DePaolo*, Lawrence Berkeley National Laboratory, Earth Sciences Division, 1 Cyclotron Rd Mail Stop 74R316C, Berkeley CA 94720-8266 USA djdepaolo@lbl.gov

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Short Course description:

This Short Course will be accompanied by the AGU session V017. Geochemistry of Geologic Carbon Sequestration (schedule available October 1 at http://fallmeeting.agu.org/2013)

Given the public's interest and concern over the impact of atmospheric greenhouse gases (GHG), on global warming and related climate change patterns, it is timely to provide an authoritative summary of the fundamental geochemical and mineralogical processes associated with gas-water-mineral-interactions encountered during geological sequestration of CO_2. It is safe to say that geochemical and mineralogical processes encountered in the subsurface during storage of CO_2 will play an important role in facilitating the isolation of anthropogenic CO_2 in the subsurface for thousands of years, thus moderating rapid increases in concentrations of atmospheric CO_2 and mitigating global warming.

Global warming and the resulting climate change are arguably the most important environmental challenges facing the world today. Currently the global average temperature is about 0.7°C higher than during pre-industrial times, and model calculations show the temperature difference increasing to about 2-6°C by year 2100. There is a broad scientific consensus that global warming results primarily from increased concentrations of GHG, especially CO_2 emitted largely from the burning of fossil fuels. Increased anthropogenic emissions of CO_2 have raised its atmospheric concentrations from about 280 ppm during pre-industrial times to almost 400 ppm today, and based on several defined scenarios, atmospheric CO_2 concentrations are projected by the Intergovernmental Panel on Climate Change (IPCC) to increase to a range of 450-1,100 ppm at year 2100. Geologic carbon sequestration (GCS), in addition to energy conservation, increased efficiency in electric power generation and utilization, increased use of lower carbon intensity fuels, and increased use of nuclear energy and renewable sources, is now considered necessary to stabilize atmospheric levels of greenhouse gases and global

temperatures at values that would not severely impact economic growth and the quality of life on earth.

Geological formations, such as oil and gas fields, coal beds, and brine aquifers, are likely to provide the first large-scale opportunity for concentrated sequestration of CO_2. Currently, there are three industrial-scale GCS projects underway – the Sleipner saline formation storage project in the North Sea, the Weyburn enhanced oil recovery and CO_2 storage project in Canada, and the In Salah, Algeria brine storage project in a depleted gas reservoir. Additional large-scale projects are planned worldwide over the next 3-5 years. In the context of subsurface geochemical and mineralogical processes relevant to carbon sequestration we need to consider the nature of fluid properties and the complex interactions among fluids and between solids, fluids and microbial communities over broad ranges of temperature, pressure, fluid composition, spatial and temporal scales. The geochemical sequestration pathways of prime interest are: "sorption trapping" (sorption onto and within coal and other organic compounds), "solubility trapping" (dissolution and long-term retention of CO_2 in saline groundwater) and "mineral trapping" (the reaction of CO_2 with non-carbonate minerals to form stable carbonates).

Understanding and predicting these changes is important for determining how the subsurface will perform as a storage container. The specific scientific issues that underlie sequestration technology involve the effects of fluid flow combined with chemical, thermal, mechanical and biological interactions between fluids and surrounding geologic formations. Complex and coupled interactions occur both *rapidly* as the stored material is emplaced underground, and *gradually* over hundreds to thousands of years. The long storage times required for effective sequestration, the large scale of GCS globally that is necessary to significantly impact carbon emissions, and the intrinsic spatial variability of subsurface formations provide challenges to both geoscientists and engineers. A fundamental understanding of mineralogical and geochemical processes is integral to this success, and the fact that large-scale injection experiments will be carried out and monitored in the next decade provides a unique opportunity to test our knowledge of fundamental hydrogeochemistry and geophysics.

Fees:

		on or before 11/04/2013	*after 11/04/2013*
Professional Registration:	Member ‡	$200	$250
	Non-member	$280*	$330*
Student Registration:	Member ‡	$100	$150
	Non-member	$120*	$170*
Speaker		no cost	no cost

‡ Mineralogical Society of America (MSA) and Geochemical Society (GS) members.
*includes 2014 MSA membership dues and electronic access to *American Mineralogist*.

Registering: Online registration is at https://msa.minsocam.org/shortcourses.html. Print registration forms are also available online, and from the MSA Business Office, 3635 Concorde Pkwy Suite 500, Chantilly, VA 20151-1110 USA. phone: +1 (703) 652-9950; fax: +1 (703) 652-9951; e-mail: jaspeer@minsocam.org. Registration forms with payment must be returned to the MSA Business Office. Registration fees will be partially refunded if cancellation is received in writing on or before 9 November 2013. All participants and speakers must register.

Practical: Registration fee includes the following:

- MSA/GS short course sessions
- *Reviews in Mineralogy and Geochemistry* volume
- Meals: Morning/afternoon refreshments and lunch (Sat and Sun); dinner banquet on Saturday evening
- Round-trip shuttle transportation between the DoubleTree by Hilton Hotel at the Berkeley Marina, 200 Marina Blvd., Berkeley, California 94710, USA, phone: +1-510-548-7920 and Lawrence Berkeley National Laboratory, Building 50

Auditorium (pick-up from hotel in the morning and drop-off at hotel at the conclusion of the day)

Registration fee does not include lodging, other meals not specified, or other travel costs.

Recommended Hotels:

- Berkeley Lab Guest House (located at Lawrence Berkeley National Laboratory), 1 Cyclotron Rd, Berkeley, CA 94720, Ph: (510) 495-8000

- DoubleTree by Hilton Hotel at the Berkeley Marina, 200 Marina Blvd, Berkeley, CA 94710, Ph: (510) 548-7920
(Note: LBNL shuttle transportation arranged for this hotel)

Hotel reservations should be made as soon as possible as hotels will be filling up for the AGU Fall Meeting.

Short Course Topics and Lecturers

- Geochemistry of Geologic CO_2 Sequestration: An Overview ..... Don DePaolo (LBNL/UC Berkeley) and Dave Cole (Ohio State)
- Natural Analogues ..... Mike Bickle (Cambridge, UK)
- Thermodynamics of Carbonate ..... Alex Navrotsky (UC Davis)
- PVTX Properties of H_2O-CO_2 - "Salt" at PTX Conditions Applicable to Carbon Sequestration in Saline Formations ..... Bob Bodnar (VA Tech)
- Experimental Perspectives of Mineral Dissolution and Precipitation Due to CO_2 -Water-Rock Interactions ..... John Kaszuba (U Wyo)
- Molecular Simulation of CO_2 -and CO_3-Brine-Mineral Systems ..... Ian Bourg (LBNL)
- In situ Investigations of Carbonate Nucleation on Mineral and Organic Surfaces .... Jim De Yoreo (PNNL)
- Pore-Scale Processes Associated with Subsurface CO_2 Injection and Sequestration ..... Carl Steefel (LBNL)
- Carbon Mineralization: From Natural Analogues to Engineered Systems ..... Greg Dipple (U British Columbia)
- Acid Gases in CO_2 -Rich Subsurface Geologic Environments ..... Ariel Chialvo (ORNL)
- Geochemical Monitoring for Potential Environmental Impacts of Geologic Sequestration of CO_2 ..... Yousif Kharaka (USGS)
- Multi-Scale Imaging and Simulation of Structure, Flow and Reactive Transport for CO_2 Storage and EOR in Carbonate Reservoirs ..... Edo Boek (Imperial College)
- Caprock Fracture Dissolution and CO_2 Leakage ..... Jeff Fitts (Princeton), Catherine Peters (Princeton)
- Capillary Pressure and Mineral Wettability Influences on Reservoir CO_2 Capacity ..... Tetsu Tokunaga (LBNL)
- Geochemistry of Wellbore Integrity in CO_2 Sequestration: Portland Cement-Steel-Brine-CO_2 Interactions ..... Bill Carey (LANL)