BIG SKY CARBON
SEQUESTRATION PARTNERSHIP

Newsletter Fall 2013

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Stop By Our Field Office in Shelby, MT

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Welcome

The Big Sky Carbon Sequestration Partnership (BSCSP) is part of Montana State University's Energy Research Institute and is supported by the U.S. Department of Energy. Our partnership works to research and develop novel approaches for carbon storage in the Big Sky region. Our team combines top level science, cutting-edge technology, and lessons learned to store CO_2 safely and foster clean energy solutions. This newsletter will focus on our two active field projects, the Kevin Dome Carbon Storage project located in Toole County, Montana, and a Basalt Pilot project near Wallula, Washington.

The Kevin Dome Carbon Storage Project Updates

Vibroseis trucks conduct seismic surveys

For the Kevin Dome Carbon Storage Project, BSCSP has recently completed key steps in the permitting process including complying with the National Environmental Policy Act (NEPA). We are excited to be moving ahead with the project field activities. The work will include detailed analysis of the geology within the project area to prepare for the injection and storage of up to 1 million tons of CO_2 into the Kevin Dome geologic formation. During 2013, BSCSP team members will perform the following field operations:

- **Seismic Activities** - BSCSP is resuming the 3D seismic survey in November 2013.
- **Baseline Monitoring** - In fall of 2013, BSCSP scientists collected water samples within the field area for long-term monitoring purposes.
- **Drilling of Characterization Wells** - BSCSP is planning to drill the first two wells this winter. One well will be a production well and the other will be a monitoring well. Both wells will be cored and logged and provide useful data.

Results from this project will provide scientists, community leaders, and decision-makers with a better understanding of the long-term storage capacity of CO_2 within Kevin Dome and other similar geologic features in the region.

Kevin Dome Study
Upcoming Field Activities

Seismic Activities

In late fall of 2013, BSCSP will resume seismic surveys in the project area. The purpose of the seismic survey is to assess the geologic properties, including the location, depth, and thickness of the rock layers located beneath the earth's surface. The process involves using specialized vehicles (Vibroseis or "thumper" trucks) to send sound waves through the ground and lines of receivers to "listen" for those sound waves when they are reflected back to the surface. Much like a medical ultrasound can provide images of the inside of a human body, these reflected sound waves can be mathematically processed to provide images of the rock layers deep below ground. Based on the seismic survey information, BSCSP will gain a greater understanding of the subsurface geology. Seismic survey crews are anticipated to be in the field until March 15, 2014.

Seismic trucks working in the field

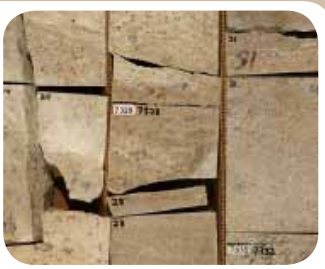
Baseline Monitoring

An important aspect of the Kevin Dome project is the long-term monitoring of the injected CO_2. Part of this process involves researchers collecting water samples from surface waters and water wells within the project area. Water samples will provide the scientists with valuable baseline data and information. BSCSP is testing general water quality including pH level, oxygen content, temperature, conductivity, and water chemistry. Having this scientific database will allow researchers to detect any geochemical changes in the underground environment while also providing local landowners with an assessment of water conditions in the area. BSCSP appreciates the landowners providing access to BSCSP scientists to their water wells and ponds.

Water sampling activities

Drilling Activities

While seismic surveys are a very powerful tool to understand subsurface geology over a large area, it is important to get more detailed information in specific areas. This is done by drilling wells. When the well is drilled, measuring devices can be lowered down the borehole on wirelines. These sophisticated "logging" instruments can not only give images of the rock, they can also measure a wide variety of rock properties, including the types of minerals that make up the rock, how porous the rock is, and what type of fluid is in the pores. Additionally, during the drilling process a hollow bit can be used to remove long cylinders of rock (called cores) for laboratory studies. The cores will be studied to get detailed rock property information including porosity, permeability, and geochemical response to CO_2. This information will be used to confirm that the storage reservoir has the right properties for CO_2 injection and that the cap rocks have the correct properties to seal it deep underground.



Rock cores will be collected from the well

Small Scale Pilot Study
Basalt Project Update

Basalt Project Update...

Basalt project injection site, Wallula, WA

In late July, BSCSP kicked off the injection phase of a field demonstration project to determine if greenhouse gases can be permanently stored in underground geologic formations. One of the most unique aspects of the project is the type of geologic formation: layers of ancient basalt flows formed by cooling lava. "We are excited to be conducting, through our partners, the world's first injection of pure carbon dioxide into basalts," said Lee Spangler, BSCSP Director.

On behalf of BSCSP, researchers at Battelle are teaming with Boise, Inc. to conduct the test on Boise property in southeastern Washington State, near Wallula. Over a two-week period, the team injected nearly 1,000 tons of CO_2 one-half mile underground into porous layers of basalt. Above and below the porous layers are impermeable rock layers that will trap the CO_2 in place. In addition, laboratory experiments have shown that basalt rocks can rapidly convert injected CO_2 to solid carbonate minerals, permanently trapping and securing the carbon dioxide.

"We have been conducting laboratory tests on basalts from the region for several years that have conclusively demonstrated the unique geochemical nature of basalts to quickly react with carbon dioxide and form carbonate minerals or solid rock, the safest and most permanent form for storage in the subsurface," said Battelle project manager Pete McGrail. "However convincing the laboratory data may be, proving the same processes operate deep underground can only be done by conducting a successful field demonstration."

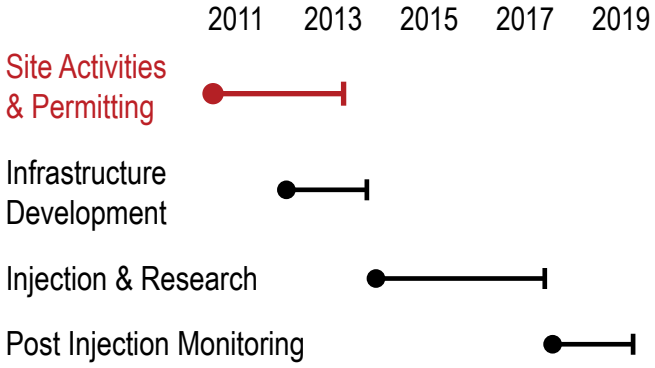
With the initial injection complete, the research team has begun a 14 month monitoring period during which time they will examine fluid samples from the injection well to look for changes in chemical composition, as well as compare actual results to predictions made with the supercomputer at the Pacific Northwest National Laboratory (operated by Battelle for the Department of Energy). At the end of the monitoring period, rock samples taken from the well are expected to exhibit the formation of carbonate mineralization, or limestone crystals, as a result of the CO_2 reacting with minerals in the basalt.

Pipeline infrastructure for injecting CO_2

If the demonstration project is successful, basalt flows in many parts of the world could serve as storage locations for CO_2 emissions from a variety of industrial facilities. "Basalts have the potential to store over 300 years of the carbon dioxide emissions in the six-state Big Sky region," Spangler said. "Perhaps more important is their storage potential in countries with rapidly increasing energy use, specifically China and India."

Other News

Kevin Dome Project Timeline



BSCSP Frequently Asked Questions:

1. Who funds BSCSP? BSCSP is one of seven regional partnerships supported by the National Energy Technology Laboratory (NETL) and the Department of Energy (DOE). It is part of Montana State University's (MSU) Energy Research Institute.

2. Who is affiliated with BSCSP? BSCSP routinely collaborates with universities, national research laboratories, and private partners. BSCSP also works closely with government agencies, city officials, and local landowners on activities such as permitting and regulatory compliance.

3. Where are BSCSP main offices? The main headquarters of BSCSP is based at MSU in Bozeman, Montana. In addition, there is a field office located near the Kevin Dome project area in the town of Shelby, Montana.

4. How long has BSCSP been around? In 2003, MSU was awarded a grant to become one of seven regional CCS partnerships. Work on the Kevin Dome study and other related CCS projects will continue through 2021.

PARTNER PROFILE: LAURA DOBECK

Growing up in rural north-central Wisconsin Laura realized she wanted to focus her interest in science on the physical sciences after being inspired by an exceptional high school chemistry teacher. After pursuing an undergraduate degree in chemistry at UW-Madison she completed a Ph.D. in physical chemistry at Cornell University, where she used lasers to study how energy moves around in molecules. Loving the lab but wanting to get out in the field Laura did a short stint in oceanography at UC-Santa Barbara. Soon after that she joined the research lab of Lee Spangler at MSU-Bozeman. In 2006 she was able to combine her love of instrumentation and desire to be outside when she became field site manager for the Zero Emissions Research and Technology field experiment on the MSU campus testing and evaluating CO_2 surface monitoring techniques. She is applying this experience currently as the Surface Monitoring Manager for BSCSP. In this role, she works closely with Rick Czech, BSCSP's Field Manager to coordinate, perform, and supervise the surface monitoring activities for the project.

As an avid recreationalist, Laura loves the outdoors and spends her free time hiking, skiing, wildlife and bird watching and exploring Montana's remote and scenic areas. She is excited to have the opportunity working in the Shelby/Sunburst area to learn more about another beautiful part of Montana. BSCSP is fortunate to have Laura's expertise in the field and her affable personality makes her a valued colleague and research team member.