Bright Future for Coalbed

A small coal basin located near the south central Oregon coast will soon be producing gas. Against all odds, this project provides an in depth look into how one man and a lot of persistence can pay off.

Thomas Smith, Associate Editor

Photo: Tom Smith

"We are blazing a new trail in Oregon. To allow us to develop this gas resource, the community and environment needs to benefit as well," says Steve Pappajohn, president of Methane Energy Corporation (MEC). Steve has worked in this area for over 25 years. His persistence and formation of a great support team has assured success over long odds.

Photo: Tom Smith

Coal is the earth's most abundant hydrocarbon-based energy source. Utilized for centuries, most of the world's coal basins and resources have been delineated.

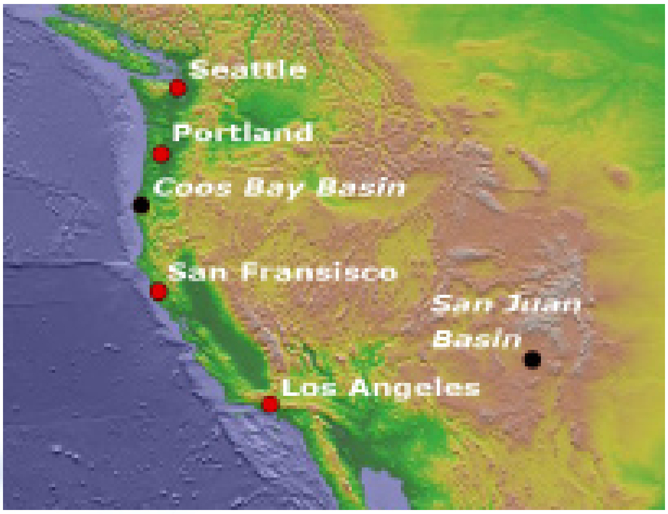
The presence of gas in coals, coalbed methane (CBM), is a major concern with coal mining operations. Scotsman William Murdoch was the first to recognize coal gas as beneficial rather than a hazard. He retorted coal and in 1792 was able to light his house with the resulting gas. Now, thanks to tax incentives and higher gas prices, CBM is more important than ever. Drilling to exploit this unconventional resource is occurring at a rapid pace and is providing increasing amounts of much needed clean energy.

Along with the positive of providing clean fuel, environmental issues surrounding the exploration, development and exploitation of CBM has promoted conflicts between mineral leaseholders, surface owners, and the public. Possible groundwater contamination and draw down, disposal of produced water, noise pollution, air pollution, and surface disturbance are some of the core environmental issues that complicate development.

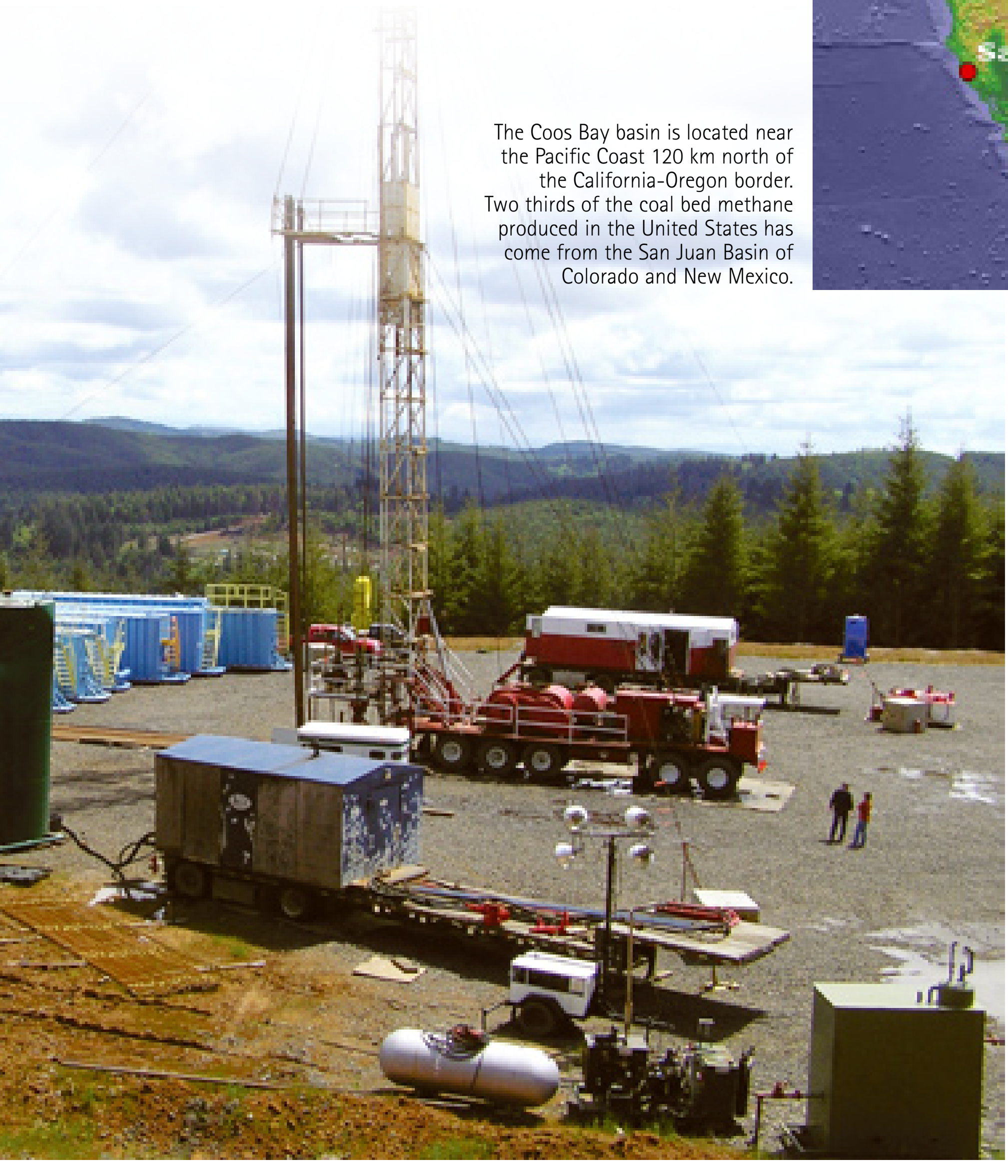
Now enters a new project in environmentally conscious Oregon. Located near the Pacific Coast, mostly on privately held forest lands, the Coos Bay basin contains Eocene coals that were previously mined from 1854 until about 1950, first to supply steam ships with fuel in the deep water ports of San Francisco and Coos Bay.

Some 20 exploratory wells were drilled between 1914 and 1993, most with gas shows but no discoveries of either oil or gas

Methane



The Coos Bay basin is located near the Pacific Coast 120 km north of the California-Oregon border. Two thirds of the coal bed methane produced in the United States has come from the San Juan Basin of Colorado and New Mexico.



Drilling for coalbed methane (CBM) in the Coos Bay basin will have year round access via existing private and government logging roads. Most of the drilling activity will take place on land previously used for logging operations and is obscured from view by the dense tree cover of the Coast Range.

resulted from the drilling. CBM exploration of the basin has been going on for years but started in earnest in 2004 after completion of a gas pipeline across the area. Production should commence later this year.

Swampy coastal plain

The Coos Bay basin is part of a series of discontinuous coal basins that lie along the western flank of the Cascade Range extending from southern Oregon into Canada. The coal-bearing sections were deposited along a Paleocene to Eocene coastal plain in a swampy deltaic environment. Oligocene Cascade volcanic activity started to bury and deform the sediments deposited in these basins. More extensive volcanic activity during the Miocene buried some

The Resource

Methane leaking out of coalbeds has long plagued underground mining operations. It had to be vented from the shafts and addits to prevent costly and dangerous explosions. Mine operators were always looking for ways to make the mining of deeper coalbeds safer. It was in the Black Warrior basin of Alabama, where the Bureau of Mines experimented with European technology designed to de-gas coal mines. This eventually led toward tapping into what is now a significant source of natural gas.

With just about every coal being slightly different and every coal basin differing in geologic history, exploration into extracting gas from coals went in many directions. Structure, stratigraphy, composition of the coal, depth of burial, rank, gas content, and the hydrodynamics all play key rolls into exploration and exploitation of this resource. Evaluation of each of these factors is a must for projects, both large and small, to be successful.

Currently, over 7% of the U.S. gas production is from coalbeds.

The resource potential is huge. The U.S. Geological Survey estimates the contiguous U.S. reserves to be at least 700 Tcf (126 Bboe), most of which is located in western states. Worldwide reserves are at least 7,500 Tcf (1350 Bboe), according to USGS. Areas in the world with the largest potential outside the contiguous U.S. include Alaska and Canada, the former Soviet Union, and the Asia Pacific region which includes China. Africa, South America and Europe contain less than 5% of the overall potential. The Middle East has no CBM resources.

of the coal-bearing sediments in western Washington.

Continued uplift of the Coast Range and Cascades in the Pliocene caused extensive folding and faulting of the coal-bearing sediments. This deformation may be a duel edged sword, possibly enhancing porosity and permeability of the coalbeds, but could allow methane to escape up through a faulted stratigraphic section. This deformation has also increased the geologic complexity of many of the basins and created variable coal ranks ranging from lignite into bituminous and anthracite.

The Coos Bay basin is elongated in a north-south direction covering over 600 km², most of which is underlain by the coal field and prospective for gas production. The Middle Eocene Coaledo Formation is estimated to be 1,950 m thick. The formation is divided into two members where the Lower member contains as much as 21 m of coal and the Upper member another 9 m of coal. Coal rank ranges from subbituminous to high-volatile bituminous.

Narrowing the Search

"While it would be nice to be able to produce gas from the entire basin, we know that would be neither practical nor economic," says Steve Pappajohn."

This is why they have used a wealth of information obtained from over 100 years of coal mining to narrow their search for the most prospective areas within the basin. Using this data, along with some existing seismic and well data, they compiled a detailed structural map of the basin. From existing CBM studies, they narrowed their search to exploration targets between 450 m to about 1,070 m. in depth. These were the areas they concentrated on leasing.

Good engineering practices will help ensure the success of any CBM project.

Treated, produced water will be discharged into saline estuaries and wetlands.

"By 2004, we were ready to test the gas content of the coals. In October of that year, a multi-hole coring program was commenced to obtain accurate gas content data."

Twelve wells have been drilled from 3 pilot sites. Two of the pilot projects were drilled in 2005-2006. The wells are currently shut-in pending construction of pipeline facilities to the area. The "Westport" pilot wells were drilled in 2007 and 5 wells are currently being tested. Water disposal and gas gathering systems will be constructed in early 2008 and production is expected by mid-2008. Full development for this field will include 51 locations.

In the Need of Permeability

"Reservoir engineering is where the project pivots. How do we treat the reservoirs to get the best results?" asks Steve Pappajohn. "Advancements in CBM drilling and completion engineering technologies in recent years play an important role in the viability of the Coos Bay basin deposit".

"Having suitable permeability in a coal reservoir is a key to establishing economic production," explains Steve. "Special care must be taken during drilling, cementing, perforating, and stimulation operations to protect the natural permeability of the coalbeds."

Coalbeds are generally characterized as water saturated gas reservoirs having low permeability through natural fractures and dual porosity. They also vary widely from basin to basin and can be highly heterogeneous within the same basin. Drilling, cementing, perforation, and stimulation fluids must be engineered for each situation to maintain reservoir performance and to avoid possible cleat plugging by one or more of the fluids used downhole.

"One example of advancement in technology that has helped us evaluate the reservoirs is the direct measurement of permeability. Measurements are conducted via injection/fall-off tests conducted in the well bore."

These tests have allowed MEC to measure permeability of the coalbeds in their pilot programs. The Westport field that will be developed first has an average permeability of 8.0 millidarcies (md) and a range of 4 to 15. The values are similar to prolific U.S. CBM basins such as the Raton, Appalachian, and Uinta. Using these permeability measurements and a 1,200 m depth cut-off, over 16 Bm³ (580 Bcf; 104 MMboe) should be commercially producible.

More than Just Geology

"By the end of 2003 we had a significant lease position, and based on geological considerations were convinced we could produce economic gas here," says Pappajohn. "Before production could start, a few key ingredients had to be solved. We needed a way to get the gas to market, community support, and finally a way to dispose of the water."

A pipeline was needed if they hoped to sell gas in the near future. The nearest was 100 km away along Interstate 5 that runs north-south from California to Canada. The project alone would not support that long of a connection. However, Coos Bay, the only deep water port between San Francisco and the Columbia River, was not connected to a source of natural gas. After years of debate, Coos County commissioners and the people of Coos County were able to promote a county bond issue combined with lottery funds to get a gas line built to the port city. While MEC supported and will benefit from the pipeline located adjacent to their prospective acreage, the project was primarily built to bring natural gas to the Coos Bay area.

"To get community support, we went to the source and hired Loran Wiese to keep the area's residents informed as the project progresses. Loran has lived here most of his life and has been involved in community affairs for years."

"Tell the truth and keep people informed," says the Coos County Project Manager, Loran Wiese (pictured right). "We have worked hard to educate the community. Our drilling and operations plans have been openly discussed in numerous public meetings. This way we benefit by showing how the community will also benefit from this project, says Loren Wiese".

"Finally comes the water issue," says Steve. "Producing coalbed methane is as much a water management program as it is an energy program. So far, we have been unsuccessful in finding a reservoir for injection purposes but expect to ultimately find a suitable zone. In the meantime, our environmental manager, Margaret Halferty has the solution."

"Our produced water is very clean with about 0.11% total dissolved salt," says Margaret. "With filtration and some low level metal removal, we are able to produce sparkling, clean water that meets all Federal and State discharge requirements. Our NPDES (National Pollution Discharge Elimination System) permit allows us to discharge the treated water from the first production wells into the nearby saline estuaries."

Bright Future

With worldwide CBM production increasing, new technologies like using sequestered greenhouse gases and microbial conversion of the coal into methane, hold promise to enhance CBM recovery. This way coals could provide both energy and environmental solutions.

While relatively small when compared to major CBM producers, like the Powder River and San Juan basins, projects such as the one described here in the Coos Bay basin can deliver major quantities of pipeline quality gas. Locally and globally, these projects can have a large, positive impact. Gas production could last for 30+ years.

"The local area must benefit for the project to have a real positive impact. Our goal is to create a local energy industry that will contribute economically to help stabilize the fortunes of southwestern Oregon," says Steve Pappajohn.

Cleat and Fracture Orientation

While some free gas exists in coal seams, most of the gas is absorbed in micropores. The gas is held there by water pressure.

Six to seven times as much gas as a conventional intergranular reservoir of equal volume can be stored because of the large internal micro-porosity of coal.

In order to produce gas, water is drawn off, lowering the reservoir pressure. The gas expands and begins to desorb from the coal. The fluids, both water and gas, flow to the wellbore through cleats and other natural fractures. Cleat spacing, permeability, and orientation all affect fluid deliverability and production rates.

"Common to the CBM industry, about 20% of the wells produce 80% of a field's gas," says Russell Ralls, a geologist working on the project who came up with a unique way to measure cleat orientation. "Knowing the orientation of permeability pathways in a coal, whether it is related to cleats or other stress fractures, helps in selecting drill sites, methods of drilling, completion, and stimulation that may bring greater success."

Small communities along the Oregon coast that have been hit by logging and fishing downturns will reap long term economic benefits from this CBM project.

Photo: Tom Smith