

## Tracking a Play Without Borders

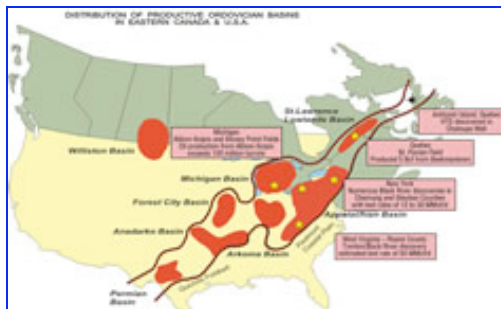
# Canadians Eye the Prolific Trenton

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Editor's note: This is the first report on a three-part series that examines Canadian activity in the prolific Trenton-Black River Trend.

The Trenton-Black River Trend, a successful target in the United States, extends north of the country's border and is proving to have similar value in Canada.

Courtesy of Questerre Energy



Some geologists refer to it as "HTD," or hydrothermal dolomite. Others call it thermobaric or zebra dolomite.

Whatever the descriptor, this rock is characterized by coarsely crystalline, high temperature saddle dolomite, and forms the prolific reservoir trends of the Trenton-Black River that stretch across continental North America.

The Trenton-Black River fairway -- containing the world class Albion-Scipio and Lima-Indiana oil fields -- crosses into Canada, where it is virtually unexplored to date.

An exploration renaissance, however, is under way in Canada's eastern provinces of Ontario, Quebec and Newfoundland. Fueled by a new understanding of the mechanisms that create hydrothermal dolomites -- and the critical role that wrench faults play as conduits for high pressure, high temperature dolomitizing fluids -- Canadian oil and gas companies are re-evaluating geological and geophysical data bases for Trenton-Black River potential in eastern Canada's Appalachian front.

Using a tool kit developed to explore for HTD plays in the Devonian and Mississippian strata of western Canada and the Northwest Territories, Canadian E&P firms are tackling Appalachia with new exploration analogs. Canadian firms familiar with the Rocky Mountain front have identified both thin-skinned and thick-skinned tectonics in Appalachia -- analogous to leading edge or Triangle Zone geometries observed in the Rockies -- that set up large thrust plays involving the Trenton-Black River formations.

The development of pipeline infrastructure in Eastern Canada -- and the proximity to large North American markets -- has also generated renewed interest in the Ordovician Trenton-Black River play. For a relatively small, up-front exploration investment, Canadian companies ranging in size from "start-ups" to large independents are picking up contiguous blocks of provincial government lands on the scale of hundreds of thousands of acres.

## Ontario

The Goldsmith/Lakeshore Field is situated on the shores of Lake Erie in southern Ontario, and Talisman's green pump jacks dot the countryside -- in farmyards, beside lakeshore cottages and even inside the loop at the Leamington Race Track. Soil berms fringed with evergreens provide visual relief for residents and cottagers.

Talisman Energy of Calgary has unlocked the key to producing the heterogeneous, hydrothermal reservoirs of the Trenton-Black River. Since acquiring majority interest in the Goldsmith/Lakeshore field in late 1998, Talisman has drilled 100 horizontal wells, extending the field to the northwest and southwest, under the

[Part II: Looking for New Found Oil in Newfoundland Structure. Dolomites Look Good](#)

[Part III: Hydrothermal Dolomite Ideas Sparks Play Zebra Hunt May Lead to Elephants](#)



The Canadian Trenton-

Black River play has been and will be in the spotlight at geological meetings.

► **Last March**, the Geological Society of America and the Atlantic Geoscience Society held their first joint meeting in Halifax, Nova Scotia, where AAPG members Skip Hobbs and Tom Martel (for AAPG's Eastern Section) offered a technical session titled "Energy Resources of the Paleozoic." Eight speakers presented papers focusing on HTD reservoirs ranging from Indiana, New York, West Virginia, Ontario and Anticosti Island (Quebec).

► **AAPG's annual meeting in Dallas** this April will

feature two SEPM sessions on "Hydrothermally Altered Carbonate Reservoirs: Models and Case Studies." Papers will investigate HTD reservoirs from Appalachia, the Western Canadian Sedimentary Basin, the North Sea, offshore Nova Scotia and onshore Ireland.

shores of Lake Erie -- some of these wells extend 5,000 meters under the lake, and include multi-lateral arms off existing horizontals.

Along the way, Talisman has broken Canadian records for the longest horizontal and multi-lateral horizontal wells.



Drilling operations and everyday life seem to mix well at the Romney 5-9-1 Horizontal #1 well in the Goldsmith/Lakeshore Field, thanks in part to the soil berms and trees planted to help shelter residents from the infrastructure.

Photo courtesy of Talisman Energy

The Goldsmith/Lakeshore Field is 14 kilometers long, and varies in width from less than 400 meters to 1,200 meters. Since its discovery in 1985 the field has produced five million barrels and three bcf of gas. Production hovers around 700 barrels per day and 1 mmcf per day of gas. Estimated remaining reserves are in the order of two million barrels and 1 bcf of gas.

Ontario government regulations stipulate that oil cannot be produced offshore; if a well encounters oil, it must be abandoned. Talisman, however, operates offshore, currently producing about 20 mmcf per day (net) of natural gas from Silurian-age clastic and reef reservoirs.

A day at the races: Horses run fast and explorers go deep at the Leamington Race Track in southern Ontario, also a part of the Goldsmith/Lakeshore Field.

Photo courtesy of Talisman Energy



As Talisman chased the Trenton-Black River trend to the southwest, it came to the shores of Lake Erie. An extensive grid of 2-D data confirmed that the collapse graben structures containing the productive Sherman Fall member of Trenton-Black River trend extended offshore, under the lake.

In 1998, Talisman commenced an ambitious horizontal drilling program to tap the riches under Lake Erie. Designed to cut across the collapse grabens characteristic of southern Ontario's Trenton-Black River play, the horizontal wells provided maximum exposure to the reservoir, increasing chances of success and production rates.

"In spite of all of this science, there's always a surprise because the reservoir is very heterogeneous," said Bob Bonnar, Talisman's exploration manager for Ontario and Appalachia. "The critical risk is lack of reservoir."

Horizontal wells, Bonnar said, increase the chance of success (COS) from approximately 30 percent to 90 percent.

"On a full cycle basis, the COS of commercially viable wells increases to about 70 percent with horizontals," Bonnar added. It costs, on average, \$C 2.5 million to drill a horizontal well at the Goldsmith/Lakeshore Field.

"There's a lot of geosteering involved in these wells," said Gerry Waugh, a development engineer with Talisman. "The reservoir is compartmentalized, so you can find virgin pressures in infill wells."

Waugh said that one-third of the oil production comes out of fractures, and two-thirds out of the matrix.

"But you can't get to the matrix without fractures," he said, adding that production from the fractures comes on hard and fast, then drops off dramatically, perhaps by 60 percent. That leaves you with a long-life producer that is draining the matrix porosity.

"The flush production from fractures poses a bit of a challenge," Bonnar explained. "You have a horizontal treadmill with production ramping up and then dropping off

quickly."

During the past five years, Talisman developed new drilling technologies and introduced proven technologies from Alberta to Southern Ontario. With the long-reach horizontal wells, the height to length ratio of the borehole becomes critical -- in other words, the wells are drilled to roughly 850 meters true vertical depth before they turn the corner, drilling horizontally for an additional 3,000 to 4,000 meters.

Waugh experimented with methods to keep weight on the bit and to reduce friction while drilling -- he tried roller bearings strapped to the outside of the drilling pipe and now extols the virtues of biodegradable vegetable oil. "We probably use more canola oil than McDonald's restaurants," he said.

Last year, Talisman exported its exploration expertise, drilling technology and proven track record in the Trenton-Black River to New York state. In a number of corporate transactions (totaling \$US 250 million), Talisman's wholly owned subsidiary Fortuna Energy purchased 55 mmcf per day of natural gas production and facilities, and 115 bcf of reserves in upper New York. Talisman now controls in excess of 400,000 acres of prospective lands in New York's Finger Lakes district.

Bonnar, whose team works New York's Trenton-Black River from Calgary, calls this the "early days" with respect to his team's success south of the border. Additionally, he points out that this is still a relatively new play concept for New York. However, Talisman reported that the first two of its four wells drilled in 2003 reported test rates of 2.4 mmcf per day and 10.4 mmcf per day.

Bonnar's team is poised to prove that it's got the "right stuff" to unlock this complex HDT play in the Trenton-Black River of New York state.

## Quebec

Just across the New York border, in nearby Quebec, Calgary-based Questerre Energy is preparing to drill Sainte Sophie #1, its first test into the Trenton-Black River play. Questerre currently holds more than 700,000 acres of exploration acreage in the St. Lawrence Lowlands, situated between the cities of Montreal and Quebec City. The acreage is held in 16 permits, and is grouped into six permit groups for work commitment allocations.

Sainte Sophie #1 will be drilled to 2,300 meters at an estimated cost of \$C 2.1 million. The lease is prepared; Questerre is waiting for a rig that's currently drilling gas injection wells at the Saint Flavien gas field, located about 100 kilometers to the northeast. Drilled by Shell Canada in the 1970s, Saint Flavien produced 5.7 bcf of natural gas from the Ordovician Beekmantown formation before being converted to a gas storage facility.

During the 1980s and 1990s, several operators explored for the Trenton-Black River and the deeper Beekmantown formations in the St. Lawrence Lowlands. At that time, conventional wisdom involved drilling the highest, central parts of the horst blocks on the carbonate platform; conventional wisdom also involved avoiding faults that were viewed as dangerous conduits for produced water. The result of this exploration phase was a series of dry wells with little or no HTD reservoir facies. However, most wells that tested the autochthonous carbonate platform -- including many of those drilled for mineral exploration -- encountered non-commercial amounts of natural gas in the Ordovician and in shallower units.

"Sainte Sophie was never drilled, because it was so heavily faulted," explained John Brodylo, Questerre's exploration manager. Brodylo intends to drill right down the side of a wrench fault, into a collapse or sag feature. Sainte Sophie #1 will test a structural low that is seismically mapped over 31 square kilometers. According to Brodylo, this structure could contain an upside resource potential of 650 bcf.

The origins of these collapses or sags -- often described as "negative" flower structures -- are trans-tensional or strike-slip faults that are deeply rooted in the basement. Hydrothermal, high pressure brines move up these faults: When the fluids hit porosity layers -- usually high energy grainstones, packstone and wackestones -- they move laterally, preferentially dolomitizing the carbonate rock.

Brodylo is using Talisman's exploration analogs in southern Ontario and, more recently, keying in on their gas discoveries in New York.

Questerre brings a unique Western Canadian perspective to Appalachia gained during the exploration for HTD reservoirs in northern British Columbia, and has re-

interpreted 3,000 kilometers of trade, proprietary and public domain 2-D seismic data.

"It's been a pretty multi-faceted approach," said Brodylo, a geologist, as he described combining the seismic data with public domain aeromagnetic data, cores, well logs and outcrop work to identify the major trans-tensional fault systems that create reservoir rocks and traps in the St. Lawrence Lowlands.

"Quebec is still a plum to be picked," said Michael Binnion, Questerre's president, who cited several fiscal drivers that attract him to Quebec:

- Royalty rates of 10 percent on daily production less than 3 mmcf per day, and 12.5 percent on production thereafter.
- 15 percent cash back exploration credits.
- Proximity to the TCPL gas pipeline and to a large industrial base in the St. Lawrence Lowlands between Montreal and Quebec City.
- Natural gas consumption in Quebec averages 200 bcf.
- Opportunities for gas storage.

"It's a bit of a paradox," Binnion said. "Storage reservoirs get valued on a rate-of-return while producing reservoirs get devalued on depletion."