New Nouveau Brunswick

Natural Resources
Lands, Minerals and Petroleum Division

Petroleum

Mineral Commodity Profile No. 5

Petroleum (crude oil) and natural gas are naturally occurring compounds containing carbon and hydrogen (i.e., hydrocarbons). They form when decaying plant and animal (organic) matter sinks to the bottom of lakes, rivers, or deep ocean basins. As the organic matter is buried under many layers of sediment, rising temperatures and pressures generate oil and natural gas from the decaying matter. The less dense hydrocarbons then migrate upward through porous sedimentary layers until they become trapped in reservoirs capped by impervious rocks.

The petroleum resources of New Brunswick include oil, natural gas, shale gas, and oil shale. All known petroleum deposits are located in the Late Devonian-Carboniferous Maritimes Basin, which underlies the eastern part of the Province. New Brunswick has produced petroleum from all four of these sources at some point during its 350 years of mining history (Martin, 2003).

January 2001 test flare at the McCully Natural Gas Field.

Uses

Petroleum is highly flammable and can be burned to create energy; derivatives from crude oil make excellent fuels. Major oil refinery products include: asphalt, diesel fuel, various fuel oils, gasoline, kerosene, liquefied petroleum gas, various lubricating oils, paraffin wax, tar, synthetic rubber, nylon, and plastic.

Natural gas, which is almost entirely methane (CH_4), is highly combustible and burns almost completely. During complete burning, only carbon dioxide and water are produced as by products. It is a valued resource because it is reliable, efficient, and convenient to use.

More economical than electricity, natural gas is primarily used for residential heating/cooling, cooking, lighting, and running appliances such as water heaters, ovens, barbeques, and clothes dryers. It is also used as a raw material to produce petrochemicals, plastics, paints, and fertilizers.

World Production and Reserves

In 2008, global production of oil reached about 82 million barrels daily and production of natural gas reached about 31 trillion cubic metres. The major oil suppliers - the Middle East, North America (Canada = 2.3%), Russia, and Africa -

- The word petroleum comes from the Greek word "petros" and the Latin word "oleum" meaning "rock" and "oil". Before the term "petroleum" was coined by a German mineralogist in 1556, people simply called it "rock oil".
- New Brunswick is one of the oldest 'oil provinces' in the world. One of the first oil wells in North America was drilled in 1859 about 15 km southeast of Moncton on the east side of the Petitcodiac River. The well, along with three others, produced a small quantity of oil (Hea, 1974).
- Due to its consistency, petroleum differs in colour from clear to tar-black and in viscosity from water to that of nearly a solid.
- Oil and natural gas are non-renewable resources. Therefore, at some point in time, supplies will be exhausted, and substitutions will have to be established.
- Oil and natural gas are termed sweet and sour according to their sulphur content. They are "sweet" if they contain less sulphur and "sour" if they contain more sulphur.
- Oil is measured in barrels (bbl). One standard barrel is 159 litres or 42 US gallons. Quantities of natural gas are measured in normal cubic metres (m^3 - at standard temperature and pressure).
- Because natural gas is odourless, gas companies add a "rotten egg" smelling chemical to it making it easier to detect a gas leak.
- Experiments with biomass are showing how to produce natural gas from plants and waste products. Methane gas is already being recovered from sanitary landfills.

provided 72.5% of the oil market while the major natural gas suppliers - North America (Canada = 5.7%), Russia, the Unites States, and Asia Pacific - provided 59.8% of the natural gas market (BP p.I.c., 2009).

The United States was, by far, the largest oil consumer with 22.5% of the global share in 2008. China and Japan were the second and third largest with 9.6% and 5.6 %, respectively. Canada consumed 2.6%. The United States was also the largest natural gas consumer in 2008 with 22.0% of the global share. Russia was the second largest with 13.9% and Iran was the third with 3.9%. Canada consumed 3.3 % (BP p.I.c., 2009).

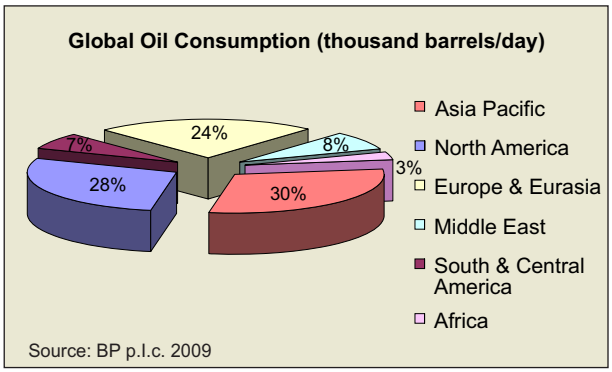
Although global production of oil and natural gas increased in 2008 by 0.4% and 3.8% respectively, global oil consumption decreased by 0.6% (the first decrease since 1993 and the largest since 1982) whereas global natural gas consumption increased by 2.5% (BP p.I.c., 2009). Short-term projections suggest an overall weakness in the oil market due to rising inventory and weak consumption.

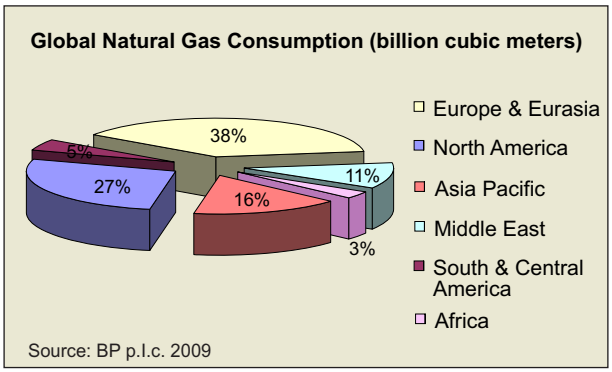
Long-term projections suggest an increase in the demand for oil and natural gas as economies recover from the current recession (Energy Information Administration, 2009a, b).

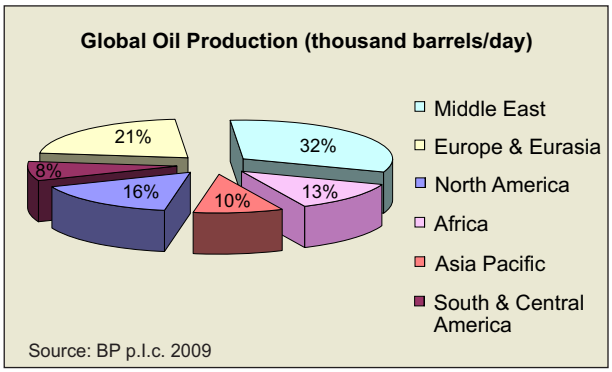
At the end of 2008, worldwide oil reserves were estimated at 1258 billion barrels and natural gas reserves were estimated at 185 trillion cubic metres. The Middle East accounts for 60% of the oil reserves while Russia, Venezuela, and Africa account for the majority of the remainder. The Middle East and Russia account for 64% of the natural gas reserves while Asia Pacific, Africa, and the United States account for the majority of the remainder (BP p.I.c., 2009).

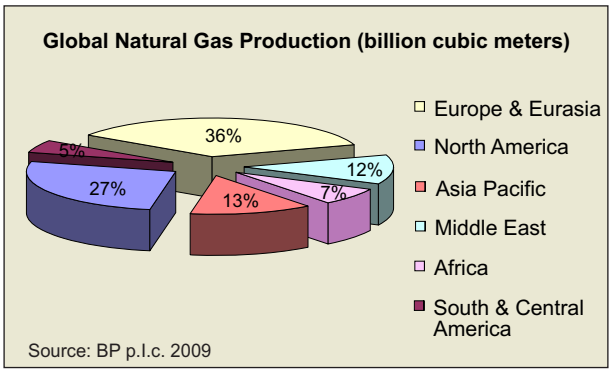
Sedimentary Basins in New Brunswick

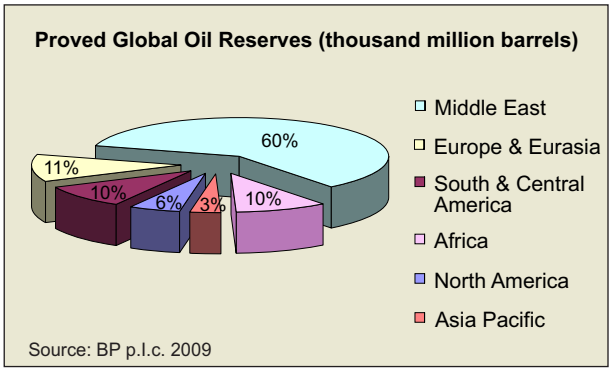
Three basins in New Brunswick hold potential for oil and natural gas. The Matapedia Basin - an early Paleozoic marine basin in the northwest and north; the Maritimes Basin - a late Paleozoic continental and marine basin in the east; and the Fundy Basin - a Mesozoic terrestrial basin in the south and beneath the Bay of Fundy (Fig. 1).

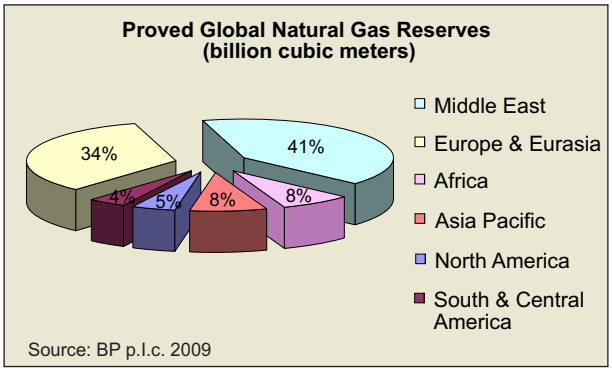












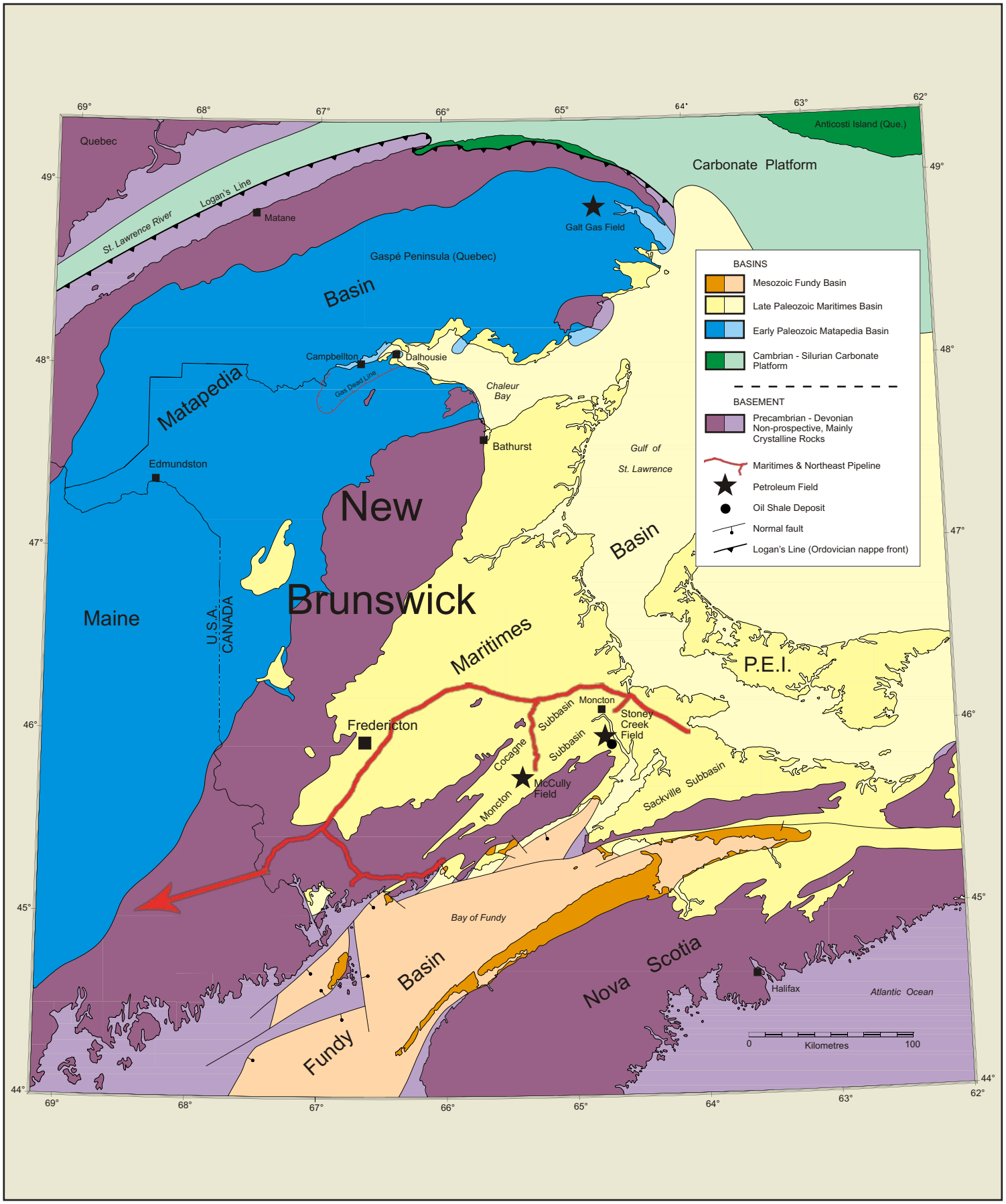


Figure 1. Basin distribution map indicating the location of the Maritimes & Northeast Pipeline, known petroleum fields, and oil shale deposits.

Matapedia Basin

The Matapedia Basin is a frontier area. It is only in the last few years that the petroleum potential of this northern New Brunswick basin has been realized. The production of natural gas from fractured limestone of the Early Devonian Forillon Formation in the eastern Gaspé Peninsula, near Galt, by Junex Inc., has resulted in a reassessment of the oil and gas potential of the northwestern end of the Matapedia Basin. Most of the Matapedia Basin in Gaspé is presently held under oil and gas permits.

Recent work by New Brunswick and Federal government geologists indicated that the Matapedia Basin in the Campbellton area in New Brunswick is within the gas window and at least a part of the area is within the oil window. Potential source rocks, organic shales, have been identified in the Ordovician Grog Brook Group. Carbonate reefs within the Silurian Limestone Point Formation and Late Silurian to Early Devonian West Point Formation, are potential traps and reservoirs in the New Brunswick part of the Basin. (Wilson et al., 2004)

Maritimes Basin

The Maritimes Basin, with its terrestrial (river, lake, and swamp) to shallow marine deposits, contains the only known petroleum reservoirs in New Brunswick. It formed as a successor basin following the Devonian Acadian Orogeny. Basin fill is regionally divisible into two parts, separated by a basin-wide unconformity. Below the unconformity, the fill comprises a basal grey terrestrial sequence (Horton Group), overlain by a terrestrial redbed sequence (Sussex Group), a mainly marine carbonate-evaporite sequence (Windsor Group), and another terrestrial redbed sequence (Mabou Group). Horton to Mabou strata are interpreted to fill a complex system of subbasins that collectively evolved in a transtensional-transpressional tectonic setting. Unconformities between the Horton and Sussex groups and between the Windsor and Mabou groups may reflect alternations between tensional and compressional regimes. Above the unconformity, the terrestrial grey to red sequences of the Cumberland and Pictou groups are interpreted to be infill of a sag basin formed by thermal subsidence.

The Maritimes Basin contains three subbasins: the Moncton Subbasin, the Sackville Subbasin, and the Cocagne Subbasin (Fig. 1). The Moncton Subbasin has proven petroleum and natural gas resources as well as several prospective areas of interest. The Sackville and Cocagne subbasins are worthy of more detailed investigation to properly assess tentative areas of interest.

Fundy Basin

The Mesozoic Fundy Basin has a half-graben shape, with a hinge margin on the south and a more complex faulted boundary on the north. It is largely untested. Only two exploration wells have been drilled in the basin; both were greater than 2500 m deep and both were located just offshore in the Bay of Fundy in New Brunswick.

Deep borehole records and surface sections (mainly in Nova Scotia) indicate the sedimentary fill comprises terrestrial clastics and a thick basalt. The basal unit, the Wolfville Formation, is over 1 km thick and comprises large-scale cross-stratified feldspathic to very mature quartzose sandstones interpreted (at least in part) as aeolian dunes. The clean quartzose sands are considered to be excellent reservoir beds. The Wolfville is succeeded by the Blomidon Formation, which consists of up to 1.5 km of red shale and siltstone. If the Wolfville sands are anywhere charged, the regionally distributed and thick Blomidon shales should provide an excellent seal.

Oil and Natural Gas

McCully Natural Gas Field: The completion of the Maritimes & Northeast Pipeline (Fig. 1) in 1999 to deliver Sable Island gas to New England created interest in natural gas exploration in southern New Brunswick. In the fall of 2000, Corridor Resources Inc. and PotashCorp made a major discovery of natural gas in sandstone of the Horton Group near Sussex. The natural gas reservoir, referred to as the McCully Field (Fig. 1 & 2), is estimated to contain an in-place gas resource of 30 billion cubic metres. Production began in 2003 with two wells providing gas to the PotashCorp mill at the rate of 60 thousand cubic metres per day. Corridor completed the construction of a 50 km long lateral pipeline connecting the McCully Field to the Maritimes & Northeast Pipeline in 2007. As of 2009, total natural gas production from 26 wells in the McCully Field averaged about 600 thousand cubic metres per day.

In the cross-section of the McCully Field illustrated in Figure 3, the natural gas reservoir (hatched) is located directly beneath a younger fluvial (river deposits) sedimentary sequence (Sussex Group) that was laid down horizontally on an older tilted fluvial and lacustrine (river and lake deposits) sedimentary sequence (Horton Group). The boundary that separates the older and younger sequences is called an angular unconformity.

The source rocks for the natural gas in the McCully Field are the Horton organic-rich shales, which were deposited in deep lakes some 350 million years ago. The natural gas migrated out of these shales into overlying Horton sandstone where it became trapped beneath the unconformity at the base of the Sussex Group.

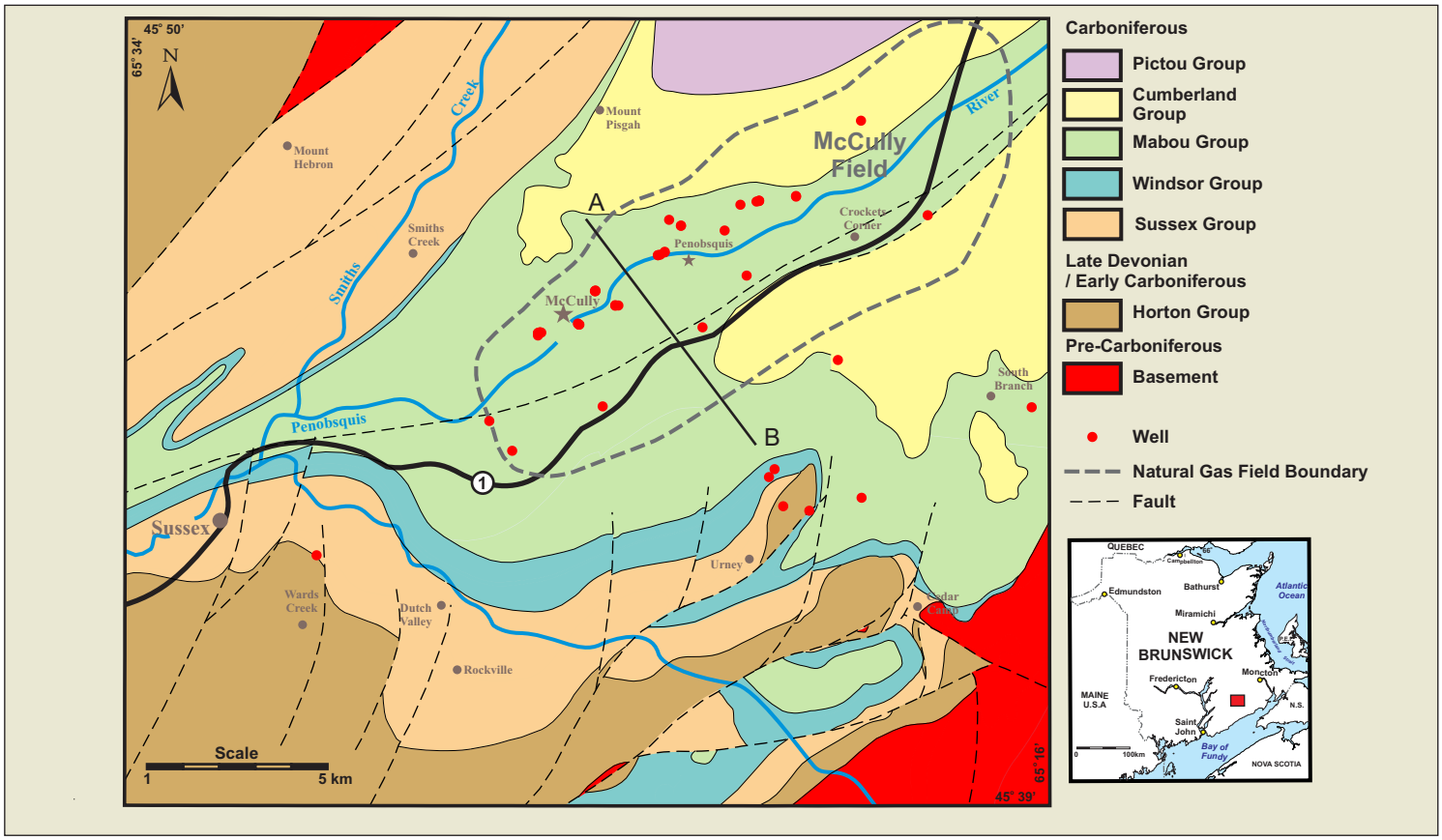


Figure 2. Surface geology map of the McCully Natural G as Field. Modified from Hinds and St. Peter, 2006.

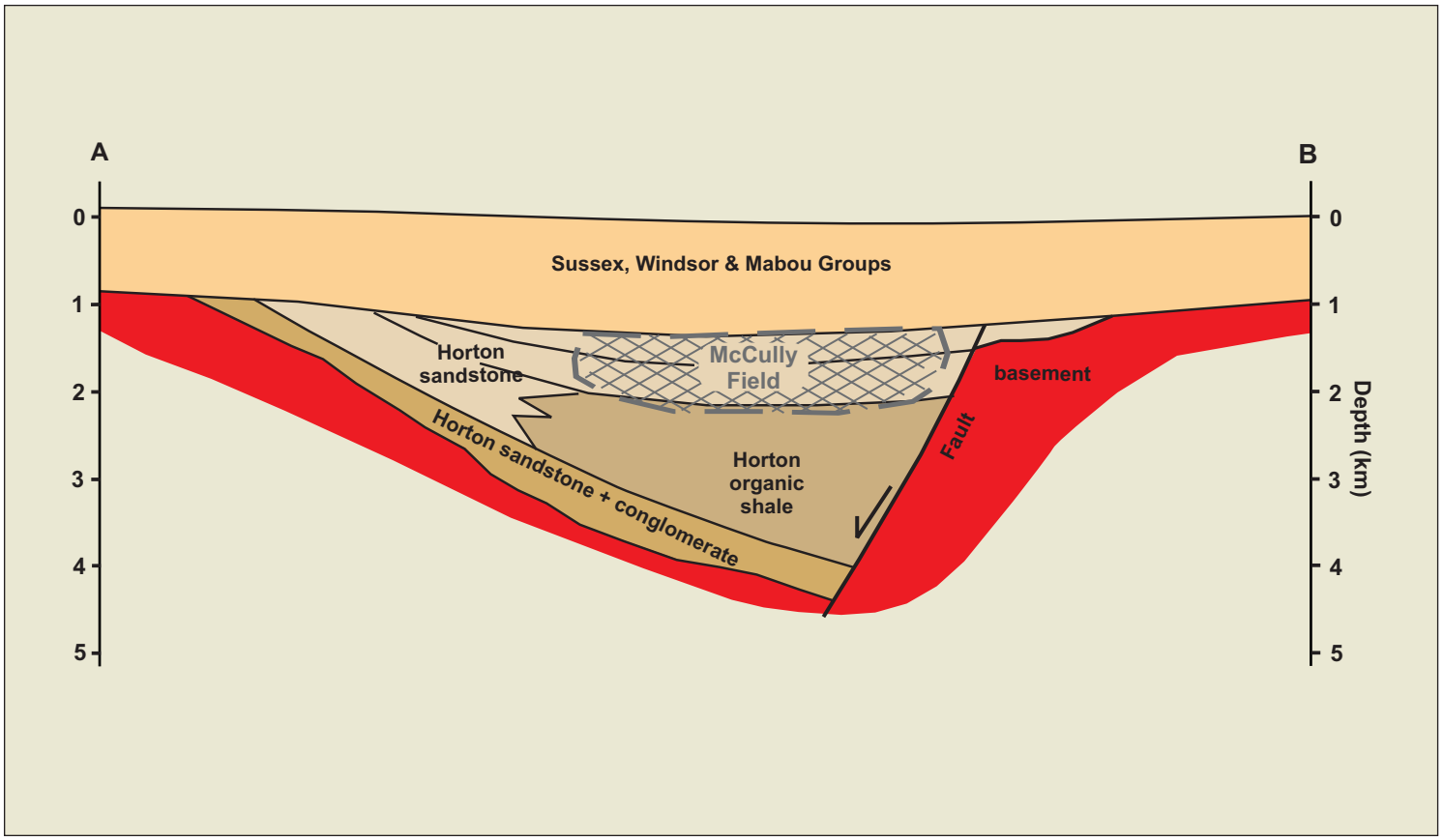


Figure 3. Schematic cross-section A - B of the McCully Natural Gas Field. Simplified from Hinds and St. Peter, 2006.

Stoney Creek Oil and Gas Field: Maritime Oilfields Ltd. discovered petroleum in sandstone of the Horton Group on the west side of Petitcodiac River near Hillsborough in 1909 (Fig. 1). A total of 156 wells were drilled in this oil and gas-bearing reservoir, referred to as the Stoney Creek Field, prior to its shut down in 1991. Production during this period totalled about 804,000 barrels of oil and 850 million cubic metres of sweet gas. Interest in the Stoney Creek Field was renewed in 2005 due to significant increases in oil and gas prices. Contact Exploration Inc. began producing oil in 2007 from two horizontal wells drilled in the Field the previous year.

A directional well drilled in 2008 and several re-entered past-producing wells are now operational. The Stoney Creek Field is estimated to contain proven and probable reserves of 1.2 million barrels of oil and 180 million cubic metres of natural gas.

Other recent exploratory drilling in the Hillsborough area led to new finds including an oil discovery in 2000 by Columbia Natural Resources Canada Limited near Edgetts Landing south of Stoney Creek, and a natural gas discovery in 2007 by PetroWorth Resources Inc. near Dawson Settlement west of Stoney Creek.

Shale Gas

Shale gas is rapidly becoming a source of energy in North America and is presently supplying about 10% of the natural gas market in the United States. In New Brunswick, Corridor Resources Inc., Contact Exploration Inc., and PetroWorth Resources Inc. are currently assessing the gas potential of the organic-rich shale in the Horton Group of the Maritimes Basin. One well in Corridor's McCully Field near Sussex is now producing natural gas from Horton shale at a rate of about 5 500 cubic metres per day.

Oil Shale

Oil shales of the Horton Group, locally containing cross-cutting veins of solid bitumen referred to as 'albertite', were first reported in the Hillsborough area of southeastern New Brunswick by Abraham Gesner in 1839, when he visited there in his capacity as Provincial Geologist. The oil shales can reach up to 350 m in thickness and yield between 50 and 200 litres of oil per tonne. The Horton oil shales have had a long history of exploration and attempted development (Martin 2003; St. Peter and Johnson 2009). In 2008, Altius Minerals Corporation drilled eight holes west of Hillsborough to further evaluate the size and extent of the oil shale deposit at Albert Mines (Fig. 1). The deposit is estimated to contain 35 million tonnes of oil shale to a depth of 200 metres with an average yield of 100 litres per tonne for a total in-place resource of 22 million barrels of oil.

Drilling of the I-88 directional well (Well 749) of Contact Exploration Inc. in the Stoney Creek Field.

Summary

New Brunswick's known oil and natural gas deposits are located in the Late Devonian-Carboniferous Maritimes Basin. Organic rich shales are the source rocks of the gas in the associated sandstones of the McCully Natural Gas Field and oil and gas in the sands of the Stoney Creek Field. Gas potential of the organic-rich shale in the Horton Group is currently under assessment.

Potential for oil and natural gas also exists in the Matapedia and Fundy Basins. In 2006, the first oil and gas licences ever granted in the New Brunswick portion of the Matapedia Basin were issued. Sandstone sequences of the Wolfville Formation are a potential hydrocarbon reservoir in the largely untested Fundy Basin.

Selected References

BP p.l.c. 2009. BP Statistical Review of World Energy, June 2009. http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2008/STAGING/local_assets/2009_downloads/statistical_review_of_world_energy_full_report_2009.pdf (accessed August 2009).

Energy Information Administration 2009a. Short-term Energy Outlook. http://www.eia.doe.gov/emeu/steo/pub/contents.html (accessed August 2009).

Energy Information Administration 2009b. International Energy Outlook 2009 with Projections to 2030. http://www.eia.doe.gov/neic/speeches/howard052709.pdf (accessed August 2009).

Hea, S.P. 1974. Petroleum potential of the province of New Brunswick, Canada. Unpublished Report, Weaver Oil and Gas Corporation, 51p.

Hinds, S.J. and St. Peter, C.J. 2006. Stratigraphy and structure of the Moncton subbasin in the Urney-Waterford area, Maritimes Basin, New Brunswick: implications for the McCully Natural Gas Field. In Geological Investigations in New Brunswick for 2005. Edited by G.L. Martin, New Brunswick Department of Natural Resources; Minerals, Policy and Planning Division, Mineral Resource Report 2006-3, pp. 73-102.

Martin, G. L. 2003. Gesner's Dream: the trials and triumphs of early mining in New Brunswick. Canadian Institute of Mining, Metallurgy and Petroleum - New Brunswick Branch/G. L. Martin, Fredericton, New Brunswick, 328 p.

New Brunswick Department of Natural Resources. 2009a. Mineral Occurrence Database. http://dnre-mrne.gnb.ca/mineraloccurrence (accessed January 2009).

New Brunswick Department of Natural Resources. 2009b. Industrial Mineral Database. http://dnre-mrne.gnb.ca/industrialmineraloccurrence (under development).

St. Peter, C. 2000. Oil shales and oil and natural gas in New Brunswick: Historical and current industry related activities. New Brunswick Department of Natural Resources and Energy, Minerals and Energy Division, Information Circular 2000-5, 14 p.

St. Peter, C.J., and Johnson, S.C. 2009. Stratigraphy and structural history of the late Paleozoic Maritimes Basin in southeastern New Brunswick, Canada. New Brunswick Department of Natural Resources; Minerals, Policy and Planning Division, Memoir 3, 348 p.

Wilson, R.A., Burden, E.T., Bertrand, R., Asselin, E. and McCracken, A.D. 2004. Stratigraphy and tectono-sedimentary evolution of the late Ordovician to Middle Devonian Gaspé Belt in northern New Brunswick: evidence from the Restigouche area. Canadian Journal of Earth Sciences 41: pp. 527-551.

For More Information

For more information on petroleum and other New Brunswick mineral commodities, please see the NBDNR Mineral Occurrence Database (NBDNR 2009a) and Industrial Mineral Database (NBDNR 2009b), or contact:

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