

ECONOMIC AND STRATEGIC VALUE OF OIL AND GAS POTENTIAL IDENTIFIED IN THE BATHURST MERA

G.R. Morrell and D.R. Smith

Introduction

Open File 3714 prepared by the Geological Survey of Canada has quantified the oil and gas potential within the park study area. The numbers quoted are substantial. Mean estimates of potential are 737 million m³ (4.6 Bbbl) of oil in place and 330 billion m³ (11.7 tcf) of gas. How significant are these numbers? Do they point to a potential resource of local, commercial or even national interest? This paper examines the identified potential in an economic and strategic context in attempt to answer these questions.

The assessment is accepted with the limitations of resource assessment in mind. Although based on promising geological observations and sound geological inference, the potential resource is nonetheless hypothetical in that no accumulations of either oil or gas have been penetrated by the handful of exploratory wells drilled.

The rigour of the assessment process is consistent with the scientific method used to assess potential under conditions of high uncertainty. Confidence intervals are large. It would be imprudent under these circumstances to use the assessment to make specific assertions as to potential, such as the selection of particular prospect or the mineral values of a parcel of Inuit lands. It remains a possibility (although estimated as highly unlikely) that no oil or gas accumulation exists on Bathurst Island. It is more probable that some may exist but that no commercial enterprise would bother to explore for them.

Note that a quantitative assessment of supply cost for potential resources on Bathurst Island has not been attempted: given the level of uncertainty about the nature of oil and accumulations in this area, such a figure would be impossible to estimate with any confidence. Observations in this overview are therefore qualitative and based on the expert opinion of the authors..

Implications of variation in potential within the study area

Figure 2 of OF 3714 illustrates variation within the study area of geological conditions favouring oil and gas. Within the Parry Island Fold Belt ratings vary from *low* to *moderate to high* for gas. The rating variation correlates with structure: closed anticlines are high, synclines are low. The body of the report includes an important caveat that, notwithstanding the assignment, "*vast area of only low to moderate potential may contain a significant proportion of undiscovered gas*", due to the inferred presence of unmapped closures.

A similar observation applies to the Cornwallis Fold Belt where potential varies from *low to*

moderate to high for both oil and gas. The authors conclude that “vast areas within the Cornwallis Fold belt given a moderate rating may actually contain the bulk of the undiscovered oil in unmapped blind structural closures”.

Programs designed to explore for oil or gas in frontier areas such as Bathurst Island need to be sufficiently extensive to sample the variation in indicated potential and allow companies to high-grade a choice of drilling targets. Assignment of high oil and gas potential ratings to relatively small areas should be viewed with caution: islands of land below a certain size, even those with high ratings of potential, would be unlikely to attract exploration companies since risk of failure could not be hedged: companies would be committing all to one throw of the dice.

The most significant variation in potential rating is the east-west split between the Cornwallis Fold Belt and the Parry Islands Fold Belt. The OF assigns consistently higher ratings values to the former (for both gas and oil). The authors argue that areas within the Parry Islands Fold Belt generally have lower potential and significant potential only for gas. Area for area, lands in the Cornwallis Fold Belt have higher potential and should be more attractive exploration targets than western Bathurst Island.

Whether exploration companies themselves would share this view of relative potential can only fairly be tested by an open call to industry to express their interest through the issuance of a Call for Nominations. This is the established procedure on frontier lands in Canada. The price subsequently bid on nominated blocks would indicate the perceived value.

Implications of potential of lands beyond the study area

For statistical reasons, OF 3714 examined the potential of the Cornwallis Fold Belt and Parry Islands Fold Belts throughout Bathurst Island and the Governor General Islands. The resource potential numbers include a large component from lands outside the Parks Canada Study area and Extended Study Areas. Specifically, the authors conclude that only 30% of Cornwallis Fold Belt potential falls within the lands withdrawn for the park study. (This proportion rises to 50% if Polar Bear Pass is included.) Some 60% of Parry island Fold Belt potential falls with the Study Area and Extended Study Area.

Other parts of the Cornwallis Fold Belt (in the offshore and to the southeast, east and northwest of Bathurst Island) were not assessed, but may be expected to have similar resource values. Similarly the Parry Islands Fold Belt offshore to the west of Bathurst Island and on Melville Island was not assessed. A reasonable assumption is that the potential of these areas is largely comparable. Without any further investigation, it would appear that lands within the Cornwallis Fold Belt on northwestern Devon Island, Cornwallis Island, eastern Prince of Wales island and western Somerset Island together with intervening submarine areas, may share similar positive indications of hydrocarbon potential.

The GSC study provides a quantitative estimate of potential. An important consideration for assessing economic and strategic value is the potential of other areas within the region relative to the study area. OF 3714 points to earlier resource estimates of potential for the Parry Island Fold Belt and the Sverdrup Basin. The assessment of this area in comparison with neighbouring regions is difficult because previous assessments are dated and assessments change with time. Nevertheless, the potential for oil in the Sverdrup basin identified in Proctor 1984 was twice that of the current estimate for the Bathurst Island Region. Gas potential was seven times as great. Clearly this is a large potential and includes significant resources proved by discovery.

It is important to see the proposed park area within its regional context. The entire region is isolated, lacking infrastructure and far from potential markets. The study area has undergone a certain level of exploration, including four exploratory wells and was found wanting. Other areas in the region have also undergone exploration which resulted in greater success, most notably the oil wells on Cameron Island and the significant gas and oil discoveries in the Sverdrup basin to the north. It would seem logical to place a higher priority and a higher resource potential to these areas.

Commercial prospects of the potential oil and gas resource

Petroleum exploration considers two principal raw commodities, crude oil and natural gas. These may be found in separate accumulations or in association. Exploration economics is usually based on the expectation of one or other of these commodities.

In the absence of discoveries the economics of developing potential oil and gas resources exploration must be evaluated on a full-cycle basis i.e. the profit of selling petroleum from an expected discovery versus the risked costs of exploration, plus the costs of developing and selling the petroleum, plus a return on investment.

Natural Gas

Exploitation of a gas discovery is typically by connection to a pipeline which feeds the gas to market. Although a pipeline to the High Arctic has been put forward in the past, such is not economically viable today and is not foreseen as viable in the 25 year outlook of the NEB, even though the largest gas field in Canada (Drake Point) has been discovered and delineated on the Sabine peninsula of Melville Island.

Recouping the costs of such a pipeline would require high rates of gas production based on large reserves. Maximum field size in the Cornwallis Fold Belt of $11.3 \times 10^9 \text{m}^3$ in place (400 billion cubic feet) suggests a maximum size of pool an order of magnitude smaller than the largest existing discovery along the southern margin of the Sverdrup Basin. Discovered resources at Drake Point partially onshore Sabine Peninsula, Melville Island are estimated at $98.5 \times 10^9 \text{m}^3$ (3.5 trillion cubic feet). Production qualities of potential gas reservoir rocks on Bathurst Island

rocks remain a question mark and would be unlikely to match the excellent reservoir qualities of the younger rocks at Drake Point field.

In addition to pipelines, there are several different options for transporting gas to market. The most popular alternative is liquefaction (LNG). This is an expensive technology and the supply cost for new LNG development is high. There are many existing LNG developments throughout the world including Norway, but most are in areas of relatively benign environment and reasonably close to markets. LNG projects in northern Canada would necessarily need to be large scale and focussed on large gas fields, preferably onshore and open to shipping. Other new technologies such as the Coselle CNG (TM) are improving the commercial prospects of gas fields remote from pipeline networks, but relatively close to markets. Other technologies such as conversion to methanol and large and small scale catalytic gas to liquid (GTL) conversions are operating in various areas of the world such as South Africa, Australia and Qatar, but again are located in reasonable proximity to market. Technological advances in shipping offer the best hope for exploiting remote gas fields and are likely to provide commercially successful solutions in many cases. However, they are unlikely to drive exploration, rather will focus on existing discoveries.

Scenarios for gas development from the High Arctic would be initially based on existing major discoveries on northern Melville Island. A pipeline south across Melville island to a tidewater LNG facility on Viscount Melville Sound would cross part of the Parry Island foldbelt with potential comparable to western Bathurst Island. This would seem a more likely option for a major investment in LNG from the High Arctic than new exploration on Bathurst.

Crude Oil

Production of crude oil into tankers and shipment to markets across the world characterise the development of offshore and remote oilfields. Tanker shipment is relatively cheap because the market is global and highly competitive.

Exploration for offshore oil is based on expectation regarding the chances of discovering fields above a certain size. The highly structured nature of the plays in the Bathurst Island area and especially in the Cornwallis Fold Belt detracts from their attractiveness from an exploration viewpoint, although it increases the number of potential traps and accumulations. OF 3714 indicates the possibility of field sizes for oil on Bathurst Island are smaller than those in the active plays in the Jeanne d'Arc Basin such as Hibernia and Terra Nova. A smaller size for the largest pool may critically deter investment of the exploration dollars needed to make the first discovery in a new basin. The OF states a mean value for the largest pool of 37 million m³ (227 million barrels). At a recovery factor of 0.3 the oil recoverable from such a pool would be 68 million barrels. This is approximately one tenth of the recoverable oil from the Hibernia field.

A second key factor to the commercial attraction of an oil discovery in the High Arctic is the quality of the crude oil. Heavy viscous oil with a high pour point would be especially difficult to

produce in this environment. Light oils with low pour points and low viscosity would be ideal. There are no direct indications of what the oils from the Bathurst Island plays would be like: the Bent Horn oil which had excellent production characteristics was reservoired in a play which is not considered to be present on Bathurst. This consideration adds economic risk for Bathurst plays.

Commercial exploitation of Bent Horn was based on a number of favourable circumstances. The oil discovery was onshore, the oil flowed well and was of excellent quality, and production rates from a single well were excellent. It is sobering to consider the exploration effort across the High Arctic which presaged production from Bent Horn. It is highly unlikely that this investment would ever have occurred if the sole reward had been known to be an accumulation like Bent Horn. Reserves are modest, the geology complex, the operating costs high. Bent Horn is an unlikely precedent for new exploration and was abandoned in 1996.

For companies operating in the contemporary exploration environment, the commercial interest would be in large productive oilfields. In the High Arctic these fields would be best located onshore or within 10 km of the coast to enable cheaper production operations. These large fields are usually discovered early in the exploration of basins based on wide area exploration techniques.

Exploration and production for local demand

The coincidence of high mineral and petroleum potential in eastern Bathurst is unusual and points to a possible synergy between oil and gas and mining development. It is, however, unlikely that a mineral company would embark on oil and gas exploration to find an alternative fuel source, just as it is unlikely that an oil and gas company would see profit in exploring solely to capture the limited market of a single mine. Such a combination might come about fortuitously but the high risks involved would make it unlikely as a deliberate strategy. This said, the proximity of valuable mineral deposits and local energy supply are clear assets for a resource extraction industry. The combination of these values is unusual.

Gas may also be exploited locally if a discovery is near to demand. The best recent example is the Ikhil discovery in the Mackenzie Delta which supplies gas to Inuvik via a 30 km 12 " pipeline. However, the association of a gas discovery and a demand in the Inuvik case has been fortuitous. The project was economic because the costs of exploring and discovering the resource had already been incurred by the original explorer in the early 1980s. It is unlikely that a gas field discovered in the subject area could be used to supply Resolute because it would require a subsea pipeline across the strait and the volumes could never justify the costs.

Implication for issuance of Oil and Gas exploration licences

There are currently no active exploration licences in the High Arctic. There has been some recent but restricted interest by oil and gas companies in seeing an issuance of exploration rights in the Arctic Islands but no specific interest has expressed to Government by companies wishing to explore on Bathurst Island. Companies perceive this region as high risk with little prospect of early returns on investment.

One way by which government can moderate the disincentive of high risk is to set terms and conditions in exploration licences conducive to exploration success in frontier areas. Key is the area of the exploration licence: this should be sufficiently large for a company to evaluate several prospects and hedge its bets. In the High Arctic, a very immature exploration region, attractive exploration blocks would have to be large to attract companies.

Experience onshore in the north and offshore suggest a size of 8 grids as reasonable. Grids in the Bathurst area are 30 minutes of longitude by 10 minutes of latitude. Two such licences could reasonably fit within the extended study area in the Governor General Islands plus seven within the area of lands currently withdrawn. One 8-grid licence would cover the whole of Cameron Island. In recent experience, such 100% coverage is an unrealistic expectation even in areas where companies are actively competing for land. Companies are reluctant to over commit and face the possible loss of sizeable deposits should they fail to explore the lands.

Northern Oil and Gas Directorate (DIAND) who is resource manager for Crown lands in the NWT and Nunavut, suggests that one or two such licences is a more probable case, nominated by a single company. Licences would likely be for terms of nine years, the maximum allowed under the legislation.

The issuance of exploration licences would initiate economic activity associated with oil and gas exploration for communities in the region.

Economic impact on northern communities/mines.

The exploration for, and possible later development, production and transportation of oil and gas in the study area would provide an important basis for expanding and diversifying the regional economy on a long-term, sustainable basis. Experience with oil and gas activities in Nunavut and elsewhere in the north has shown that the oil and gas sector can be an important source of employment, training and business supply and service opportunities, many of which are taken up by northerners and northern firms at the community and regional levels.

Typically, at the exploration stage, a seismic operation conducted on land above the tree line or on the sea ice gives rise to **25-50** person months of employment opportunities, the majority of which are often filled by northerners. At the exploratory drilling stage, each well drilled creates **25-75** person months of employment opportunities, more than a quarter of which may be taken up by northerners. Field development activities give rise to a substantial increase in employment

opportunities in the short-term and, once production begins, a smaller number of long-term, well paying jobs. Successful completion of training courses further increases northern participation levels at each stage.

Throughout the oil and gas exploration, development and production cycle there are many opportunities for northern businesses to grow and diversify through the provision of supplies and services to the oil and gas industry. At the exploration stage, major seismic programs or exploratory wells often require several millions of dollars worth in supplies and services, many of which are obtained via contracts with northern businesses. Industry's need for goods and services increases markedly during development before declining to a point where it still continues to provide a sustainable, long-term base load of contractual opportunities for a wide range of northern businesses. The construction, operations and maintenance of oil and gas transportation systems also provides many short and long-term supply and service opportunities for the northern business community.

What level of economic activity could be anticipated if active exploration were to take place? Taking the plausible case identified in the previous section an airborne aeromagnetic/gravity program, followed by two seismic exploration programs and a minimum of two wells is a likely activity scenario over the first 5-6 year period of the licences. Taking the above estimates for typical programs and using the exploration scenario of two seismic programs and two wells, a total of 100-250 person months (8-21 person years) of employment over 5-6 years might be expected from active oil and gas exploration on Bathurst.

There is also a potential growth opportunity for Resolute as a launch base for oil and gas exploration programs in the High Arctic. Significant employment in Resolute in supply/expediting and transportation was generated during previous periods of oil and gas exploration in the 1970s. Key to sustaining this activity level was the widespread nature of the operations over this period.

It should be noted that exploration companies already face high mobilization and crew transport costs to reach a trans-shipment base in Resolute: other communities could benefit from these activities, particularly if a reduction of opportunities to explore near Resolute resulted in switching of the exploration focus eastward toward Ellesmere Island.

National significance of oil/and or gas potential in this area.

The hydrocarbon resource base in the high Arctic has been estimated at 25 % of Canada's remaining oil and gas potential. The energy resource assessment conducted by the GSC-Calgary for the proposed park area indicates a significant amount of hydrocarbons should be contained within the sediments located on Northern Bathurst Island, particularly on the eastern side of the island. In order for these estimated resources to be economically significant, two events must occur. First, exploration must be undertaken to discover these hydrocarbons. Second, these

discoveries must be determined to be economic to produce compared to other areas of Canada.

For a project to be commercial, the cost of producing and delivering the hydrocarbon to market must be significantly less than the profit made in selling the product at market value (most companies would want a minimum rate of return on the order of 20%). The volume of available resource, the finding and lifting cost of this resource, the distance to market and the availability and proximity of infrastructure are all factors in determining the cost of the product at the market and all of these factors mitigate against oil or gas production from the High Arctic. If, however, large volumes of hydrocarbons were discovered concentrated in a small area, it would counter these factors. It appears that this potential does not exist in the Parry Islands Fold Belt but may possibly exist in the Cornwallis Fold Belt.

If prices for oil and gas rise sufficiently (which they may do as supply dwindles), the economics of exploring Bathurst Island can become more attractive. But this will also hold for many other areas in Canada and elsewhere in the world. As an example, there are thousands of orphaned gas wells in Alberta that would become economic to develop sooner than reserves found on Bathurst Island. It is also likely that, at a given and higher price, significant portions of unproven and/or unconventional hydrocarbon sources such as tight gas, heavy oil and coal bed methane located elsewhere in Canada would become economic before discoveries made in the Cornwallis Fold Belt. Potential resources on Bathurst Island are small in comparison to the volumes speculated for these other sources.

Technological advances that improve reservoir performance, reduce drilling time and lower exploration/development costs may not provide any particular advantage to northern discoveries. Such advances are generally applicable to other regions although advances in High Arctic/harsh environment engineering may preferentially improve northern development possibilities. Many other areas with greater hydrocarbon potential exist in northern Canada and in the offshore. The relative proximity of these resources (for instance the Mackenzie Delta) suggests that these basins would be developed before basins in the High Arctic when supply costs are considered.

Given the above considerations, it is unlikely that the potential Bathurst resource has much significance to the nation's supply, even in the long term. Economic activity generated by companies exploring for oil and gas, however has been recognized as an assertion of sovereignty by Canada over the High Arctic.

Other Strategic considerations:

Creation of national parks can have major implications for access to adjacent regions. The possibility that Bathurst Island could form part of a transportation corridor for resource development further north or even on Inuit lands partially enclosed by the park is a consideration, although the presence of Polar Bear Pass is already a potential barrier to such development.

In terms of oil from the central Sverdrup, landfall and transshipment on Cameron Island would seem more practical than coming further south to Bathurst Island. Gas development is more likely to take place on Melville Island and no pipeline route onshore on Bathurst would be envisaged. There have been technological advances that have reduced the costs of marine pipelining. Much pipelining in the Arctic would necessarily be marine and there is a strong possibility that a marine route would be preferred over an onshore route for a particular pipeline.

Discoveries made in waters adjacent to Bathurst Island could be affected if the adjoining shores fall within the Park. The area effectively removed from exploration could therefore be considerably larger than the lands withdrawn.

Exclusion of a substantial land areas with high oil and gas potential from exploration before their potential is fully understood could send a negative signal to petroleum companies industry planning to explore elsewhere in Nunavut. It would not support the perception that Nunavut is open for business.

Conclusions

Exclusion of lands with oil and gas potential on Bathurst within the study area could have the following negative implications.

- (1) It would remove a large area of onshore lands with oil and gas potential from exploration and potential development. This would reduce potential economic rent to the Crown of oil and gas which would forever remain undiscovered.
- (2) The image of Nunavut as a territory welcoming exploration to understand its resource base could be negatively impacted.
- (3) Absence of oil and gas activity would reduce potential employment and business opportunities, particularly for Resolute.
- (4) Particular companies with specific exploration ideas could be discouraged. Investment and risk taking occurs at the company level and is the basis for economic activity.
- (5) A lower limit on the size of effective exploration blocks could mean that lands (including Inuit lands adjacent to a park) would lose their attraction for oil and gas exploration. The effect of a park could be to reduce exploration interest in neighbouring lands, since the effectiveness of exploration techniques would be reduced. If, as is likely, a major oil field were the object of exploration environmental protection of the area accorded a national park could discourage investment in its vicinity.

On the other hand, when placed in a regional context many other areas of Arctic Canada have

much more defined potential than Bathurst Island, and it is unlikely that the western portion of the subject area would be a priority for exploration or result in any meaningful discovery. In addition, the resource potential identified, particularly in the western portion, will not likely contribute significantly to Canada's economic reserve base for either oil or gas. This will remain a higher cost hydrocarbon source relative to many other areas of Canada. The economic resource is therefore far lower than the estimated endowment.