Gaps in the Ice:
Maritime Boundaries and Hydrocarbon Field Development in the Arctic
by J.L. Loftis, T.J. Tyler and E.E. Hawker

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Gaps in the Ice: Maritime Boundaries and Hydrocarbon Field Development in the Arctic

Timothy J. Tyler,
James L Loftis,
Emilie Hawker,
Vinson & Elkins LLP and RLLP

Abstract:

The paper argues that an effective legal framework for oil and gas exploration and exploitation must address two principal concerns: delimitation of international boundaries and rules for developing fields that may be under two or more states’ territories.

Delimitation is adequately covered by the existing framework and should not cause concern, because the majority of Arctic oil and gas resources either lie within single state’s sovereign land, or cross already delimited boundaries. Remaining boundaries can be delimitated based on well-established principles. Furthermore, the economic and political pressures impelling oil and gas production will ensure states turn their minds to the question of maritime boundary delimitation.

As for cross-boundary hydrocarbon-resource exploitation, the set of rules were sparse until the 2010 Barents Sea Agreement between Norway and Russia, which represents the state-of-the-art bilateral treaty that will effectively address cross-border hydrocarbon-field exploitation. This approach is expected to be preferred by the Arctic states. Following on the 2010 Barents Sea Agreement, other useful practices at a finer level of detail will likely form precedent for future bilateral treaties.

Unitization agreements and Joint Operating Agreements, including those among private parties, will provide the finer details of field-level treaties or protocols.

I. INTRODUCTION

The allure of the Arctic grows as the ice caps melt. The media remains fixated with the idea of a mother lode of offshore oil and gas setting off a “Great Game” in the North. The predictions of a “resource cold war” or maritime confrontations in the Arctic are further fuelled in the media by events such as Russia planting its flag on the seabed and purporting to stake its claim to vast portions of the Arctic.

1 The authors would like to express their gratitude to M. Imad Khan, Associate, Vinson & Elkins LLP and Kiran Bhat, summer associate at Vinson & Elkins in 2011, for their assistance in researching and editing this paper.
To this narrative, add the recent political tensions in a number of oil-rich regions that have highlighted the need for a stable supply of oil and gas. At the same time, Arctic oil and (especially) gas must compete with the immense, new gas potential that can now be exploited by hydraulic fracturing. Despite the hype, this economic imperative to develop Arctic hydrocarbon (and other) resources in this global market has encouraged Arctic states to delimit their boundaries and consider the most effective way to exploit their resources.

This paper examines whether the existing legal framework, coupled with the states’ commercial interests, can act to prevent such disputes. Upon inspection, it is expected that existing international law will render this potentially explosive argument quite routine in practice.

This is not to say that there are no more treaties to be concluded and cooperative regimes to develop; but the existing international legal framework, particularly in light of recent state practice on bilateral, cross-border hydrocarbon development, suggests that fear of a “new cold war” in the Arctic should be... put on ice.

Even though maritime border delimitation principles are well known, the current “system” on Arctic border-straddling hydrocarbon fields is neither codified nor complete. It has instead developed organically through state and private actors seeking a practical approach to ensure effective exploitation of the many resources available in the Arctic region. This patchwork of norms on border-straddling field regimes will be filled organically because those who fail to reach practical agreements will be unable to successfully exploit those resources.

Part II of this paper considers the legal norms that govern maritime borders in the Arctic, and the less-developed norms on cross-border field development. We then apply international law to the authoritative United States Geological Survey map of hydrocarbon resource potential. We conclude that the vast majority of hydrocarbon resources lie in undisputed, national territories. Part III turns to state practice on cross-border hydrocarbon development of fields that may straddle an international boundary. Here, the recent Norway-Russia delimitation treaty represents a breakthrough in the Arctic: a state-of-the-art treaty with both delimitation and resource-development rules. This recent treaty should not surprise, as it continues Norway’s state practice from the North Sea oilfields. Nonetheless, outside of this treaty, the state practice of the other members of the Arctic Five remains far less developed, as we know. Finally, Part IV considers other practice as precedent for field-level exploitation treaties or protocols to existing treaties.

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II. THE LAW OF BORDER DELIMITATION AND CROSS-BORDER HYDROCARBON DEVELOPMENT IN THE ARCTIC

A. The International Legal Framework Governing the Arctic

The background rule is the well-established international law principle that states have the sovereign right to resources under their land. This makes it important to determine under which state’s land natural resources sit. In the Arctic, terrestrial boundaries have long been agreed. But that question becomes more difficult when applied to offshore resources. As the Arctic ice caps melt and exploitation technology develops, states are foraging into areas that were until now largely inaccessible. The immense financial and energy-security stakes animating this drive into the Arctic offshore make the regulation of maritime boundaries and potential border-straddling fields more pressing.

Applied in this context, an international law of hydrocarbon resource development has to provide two sets of norms: boundary-delimitation rules and cross-border, hydrocarbon-field development rules. Those norms are found in a variety or sources, detailed below.

As for delimitation, the “Arctic Five” (Canada, Denmark, Norway, the Russian Federation, and the United States of America) have reached bilateral agreements that supersede the multilateral ones governing Arctic maritime borders. These bilateral treaties have mitigated the ambiguity and inflexibility of multilateral treaties. But the bilateral treaties do not cover all Arctic maritime borders. Therefore, multilateral legal regimes supply some rules for maritime boundary delimitation.

Cross-border hydrocarbon-development rules are necessary because oil and gas reservoirs can straddle lines on a map, resulting in two or more states having sovereignty claims over the same deposit. Until the 2010 Barents Sea Agreement between Norway and Russia, discussed below, there were very few clear norms on point in the Arctic. Nonetheless, though, the 2010 Barents Sea Agreement does not definitively resolve the issues everywhere in the Arctic because that treaty binds only Russia and Norway. Elsewhere in the Arctic, the ambiguity of potentially overlapping sovereign claims could obstruct efficient and effective exploitation of cross-border fields. With no legal framework, states may either act unilaterally, exposing them to the potential claims from the bordering state or states; or states may forego development entirely because of the risk of such claims.

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3 See e.g. UN Convention on the Law of the Sea, Article 56.

Outside of the Norway/Russia border, a patchwork legal system currently applies to exploiting potentially border-straddling Arctic hydrocarbon regions:

- International law, which includes both the multilateral and bilateral treaty system and customary international law ("CIL");
- National laws, which a state may apply to sovereign resource; and
- Private contracts between parties given rights on both side of the boundary, which often mirror the international law as agreed by the relevant states.

For current purposes we focus on the international framework.

B. The Multilateral Legal Framework


The United Nations Convention on the Law of the Sea ("UNCLOS"), which enjoys widespread acceptance with 160 state parties, presents the generally recognized framework on maritime boundary determination and represents a useful starting point to set out the current Arctic legal framework. UNCLOS does not present a completely binding pan-Arctic solution to border delimitation, however. Because the United States are not party to UNCLOS, it does not apply to any borders with the United States.

That said, UNCLOS (which does apply to four of the Arctic Five and which enjoys very broad acceptance) does address maritime border delimitation by requiring an equidistance rule as amended by special circumstances. While case law shows a willingness to amend the equidistance principle using special circumstances, there is some dispute over what constitutes “special circumstances.” Certain factors, such as the relative length of the state’s coastlines and configuration of the land frontier are generally accepted as special circumstances. The cases are less settled on whether other factors can be taken into account as special circumstances to amend the equidistance line. For example, in the Tunisia-Libya case the conduct of the parties in

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6 See e.g. Article 15 in relation to the Territorial Sea; Article 74(1) in respect of the EEZ; Articles 76(8) and 83 (1) in respect of the Continental Shelf. While Articles 74(1) and 83(1) do not directly provide for a principle of equidistance, Guyana v. Suriname demonstrates that this is what was intended. PCA, Award of the Tribunal, The Hague, 17 September 2007.

7 Special circumstances are established and applied to vary the equidistance principle in the mass of case law. But the Case Concerning the Continental Shelf (Tunisia v. Libyan Arab Jamahiriya) [1982] ICJ Rep 18 held that the principles of equidistance and special circumstances were mutually exclusive, allowing use of only one of the two.


9 Note that not all the cases referred to relate to UNCLOS; they do, however, relate to the use of the equidistance principle (in UNCLOS or CIL) and its adjustment by special circumstances (taking into account the Tunisia Libya
granting petroleum deposits was considered when adjusting the equidistant delimitation line.\(^{11}\) (No further cases have applied this factor, though.) That same case also held that economic principles would not be considered in amending an equidistant line. On the other hand, other cases, such as the Gulf of Maine case\(^{12}\), found that economic considerations should be taken into account as special circumstances if the failure to consider them would result in “serious economic repercussions”\(^{13}\). Furthermore, the tribunal in the Suriname-Guyana case\(^{14}\) found that the threat of the use of force may be a factor in delimiting a boundary\(^{15}\), but, again, subsequent cases have not confirmed this.

As for any principles governing cross-border resource deposits, UNCLOS says next to nothing. It merely requires that states act “in a spirit of understanding and cooperation,....[to] make every effort to enter into provisional arrangements of a practical nature and, during this transitional period, not to jeopardize or hamper the reaching of the final agreement”\(^{16}\). UNCLOS does not however, offer any non-contentious forum or procedure for reaching such agreement.

Even though UNCLOS does provide a forum for dispute resolution and limits the potentially applicable laws, many states wish to use a more certain procedure for delimiting boundaries and dealing with cross-border resources. States have thus generally favored the bilateral-treaty approach, using UNCLOS principles in negotiations.

2. 1958 Geneva Conventions

The 1958 Geneva Conventions are multilateral treaties that theoretically apply to the United States’ maritime boundaries. A number of treaties were signed in Geneva in 1958, two of which have relevance for our purposes: the “Convention on the Territorial Sea and Contiguous Zone” and the “Convention on the Continental Shelf” (the “Geneva Conventions”)\(^{17}\).

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10 Tunisia v. Libyan Arab Jamahiriya, supra note 7.
11 See also Case Concerning Maritime Delimitation in the Area between Greenland and Jan Mayen (Denmark v. Norway) [1993] ICJ Rep. 38.
12 Gulf of Maine, supra note 8.
13 Id., at 301.
15 The Tribunal referred to Article 293 of UN Convention on the Law of the Sea which provides for the application of UNCLOS and other rules of international law so far as they are not incompatible with UNCLOS. The Tribunal then applied M/V Saiga (No.2) in which ITLOS found that “considerations of humanity must apply in the laws of the sea as they do in other areas of international law.” Saint Vincent and the Grenadines v. Guinea, Judgment, ITLOS Reports 1999, pg. 7.
17 The United States is a party to both of the Geneva Conventions (see Appendix B).
The Geneva Conventions established a sparse delimitation regime for the territorial sea and continental shelf that UNCLOS later built on. They established the equidistance principle, but encouraged state parties to reach a further agreement addressing enforcement of equidistance. The cross-boundary resource-exploitation provisions in the Geneva Conventions are non-existent.

Nonetheless, a number of Arctic states remain signatories to one or both of the Geneva Conventions (see Appendix A), and these conventions remain in force for such states. But their relevance is unclear, and in any event slight, in light of later accession to UNCLOS. Article 311(1) of UNCLOS provides that “This Convention shall prevail, as between State Parties, over the Geneva Conventions on the Law of the Sea of 29 April 1958”. Article 311(2) of UNCLOS goes on to provide that “the rights and obligations of State Parties which arise from other agreements compatible with …[UNCLOS]… and which do not affect the enjoyment by other State Parties of their rights or the performance of their obligations under …[UNCLOS]” are not altered.

The Geneva Conventions are not thus expressly overruled by UNCLOS for all of the Arctic Five, so their provisions remain potentially relevant: To the extent the inter-state relationship involves purely parties to UNCLOS, their provisions will be superseded as opposed to overruled. But for two Arctic boundaries (where the United States is involved) the Geneva Conventions supplies principles:

- **Russia-United States border**: While the Geneva Conventions theoretically apply here, the 1990 bilateral agreement between the United States and the USSR delimits this boundary and supersedes the Geneva Conventions (which in any event envisaged states to reach mutual agreement); and

- **Canada-United States border**: Canada is only a party to one of the Geneva Conventions, that related to the Continental Shelf (which is the most relevant to the question of international delimitation). As multilateral treaties, only states party to the relevant Geneva Convention will be entitled to enforce its provisions, meaning the Convention on the Territorial Sea and Contiguous Zone is not applicable to this border.

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18 This position is similarly upheld in Article 30 of the Vienna Convention on the Law of Treaties. But only three of the Arctic five states are a party to such convention: Norway is not a party and the United States has yet to ratify the Convention.

19 Neither by express statement or the use of a different approach.

20 Convention on the Continental Shelf (1958). Canada has yet to ratify the Convention concerning the Territorial Sea and Contiguous Zone.

21 The Geneva Conventions must apply directly between two states for either state to be able to enforce it. In the Arctic this means any state wishing to enforce the provisions of the Geneva Conventions against the United States must also be a party to the Geneva Conventions. This principle is set out in Article 34 of the Vienna Convention on the Law of Treaties.
While the Geneva Conventions are outdated\(^{22}\), they are generally considered to have been adopted into custom, having been used as a basis for UNCLOS, and apply universally across the Arctic and the globe. Nonetheless, despite being bound by the Geneva Conventions, unofficially, it would seem that the United States\(^{23}\) really recognizes UNCLOS principles.

3. **Customary International Law (CIL)**

CIL largely mirrors UNCLOS’ maritime-boundary-delimitation principles. CIL delimits boundaries by importing a principle of equidistance\(^ {24}\), subject to certain conditions established in case law\(^ {25}\).

In a similar manner to UNCLOS, CIL also requires cooperation between states for the development of cross-border resources. But the method of such cooperation is not established. Some commentary\(^ {26}\) argues that there is a heavy presumption that terms similar to commercially used joint-development agreements must be used. Most authors do not share this view, suggesting that “‘there is no developed, crystallized [sic],\(^ {27}\) or express rule or custom under international law requiring unitization for apportioning… common petroleum deposits’”\(^ {28}\).

C. **The Bilateral Treaty Framework**

Given states eagerness to control the delimitation of their boundaries and act cooperatively, bilateral treaties have been a popular method to deal with international oil and gas deposits. These bilateral treaties obviate any further ineffective multilateral treaties.

Moreover, advances in technology have eased some of the difficulties of negotiating bilateral treaties for cross-border resource development, by creating greater certainty over a field’s potential profits. Because upfront resource estimates are better, *post-hoc* redetermination and reallocation are less critical, so “commercial terms” of a cross-border unitization can be

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\(^{22}\) This was achieved by updating the principles in UNCLOS and also seen with the specific reference in the preamble to UNCLOS: “Noting that the developments that have occurred since the United Nations Conferences on the law of the Sea held at Geneva in 1958 and 1960 have accentuated the need for a new and generally acceptable Convention on the Law of the Sea.”

\(^{23}\) From informal conversations with persons at the United States Office of Ocean and Polar Affairs.


\(^{25}\) See other papers in the Special Edition which discuss case law in greater depth.


agreed at an earlier stage. Greater certainty also opens up the possibility for earlier unitization of fields.\footnote{In the United States, domestic unitization agreements are usually only reached after primary production; however, the development of technology means that unitization can now be achieved immediately after the appraisal stage, while a development plan is being established.}

While bilateral treaties are a popular choice for states globally (and in the Arctic), if a bilateral treaty framework must nonetheless be comprehensive across the Arctic region. This requires considering the number of boundaries and location and type of resources.

1. **International Maritime Boundaries in the Arctic**

As detailed in Table 1 below and Exhibit 1, just seven Arctic international maritime boundaries require delimitation. Of these seven boundaries, four have bilateral treaties in place. That leaves just two to be governed by UNCLOS and one (between the United States and Canada) to be governed by the limited provisions of the 1958 Geneva Convention on the Continental Shelf and CIL.

But how much do these boundaries and gaps matter?

2. **The Arctic’s Oil- and Gas-Rich Provinces**

The United States Geological Survey (‘USGS’\footnote{United States Geological Survey, supra note 4.}) estimates that twenty-five Arctic provinces have significant hydrocarbon deposits. Seven of them are in disputed territory or straddle international boundaries\footnote{It should be noted that some commentators argue that the USGS is not an entirely accurate assessment of the oil and gas resources available in the Arctic, and it is by no means conclusive. However, for the purposes of this paper we have considered their assessment to be the most persuasive and extensive research carried out in the region.} and therefore require a legal framework for cross border hydrocarbon resources. These provinces are: the East Barents Basin (‘EBB’), the Amerasia Basin (‘AM’), the West Greenland-East Canada (‘WGEC’), the Eurasia Basin (‘EB’), the Lomonosov-Makarov Basin (‘LM’), the North Chukchi-Wrangel Foreland Basin (‘NCWF’), and the Hope Basin (‘HB’).\footnote{Phillip Budzik, US Energy Information Administration Office of Integrated Analysis and Forecasting Oil and Gas Division, Arctic Oil and Natural Gas Potential, available at http://205.254.135.7/oial/analysispaper/arctic/pdf/arctic_oil.pdf. See Appendix B.} These provinces are shown in Exhibit 2.

Some of these seven oil- and gas-rich provinces straddle a single international boundary, meaning one bilateral agreement can establish the legal framework for more than one hydrocarbon rich province.

Table 1 shows the maritime boundary delimitation treaties currently in place, and specifies the USGS provinces, if any, which straddle that boundary. This table provides an analysis of where the gaps in the treaty framework lie.
Two oil-rich provinces (EBB and EB) straddle the international boundary between Russia and Norway. The 2010 Barents Sea Agreement delimited this boundary and provided for pre-unification negotiations if hydrocarbon deposits straddle it.

Two more of the oil rich provinces, NCWF and HB, straddle Arctic boundaries between Russia and the United States. The 1990 Maritime Delimitation Agreement between the United States and USSR, still in effect today, delimits this boundary and would govern disputes over these resources.

One of the provinces, WGEC, is anticipated to have deposits under the Arctic boundaries between Denmark (through Greenland) and Canada. The border has been largely delimited, but the two states continue to dispute sovereignty over the tiny Hans Island itself.

Not all bilateral treaties deal with the entire international boundary between states. As can be seen from Exhibit 1, four of the seven boundaries have been delimited, but not in their entirety. The Canada-Greenland boundary is delimited only in part (in the Labrador Sea); the northern section of this boundary still requires delimitation. Similarly, small sections of the Denmark-Norway border remain undelimited.

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33 Id.; see Appendix B.
34 Id.
The bilateral treaties also address the cross-border resource issue by urging, requiring, or formalizing procedures for negotiations on unitization. The extent to which the different treaties achieve this, however, is questionable and will be discussed below.

This leaves two oil and gas rich provinces in which no bilateral treaty exists:

3. **Resource Provinces not Covered by Bilateral Treaties**

   a. **Amerasia Basin (AM)**

   The AM province has no bilateral treaty in place governing the delimitation of the region or how to exploit cross-border resource deposits. CIL, which provides for states’ sovereign rights to extend to 200 nautical miles beyond the continental shelf, both the United States and Canada would be able to lay claim to certain areas of the AM province.

   The applicable legal regime is the 1958 Geneva Convention on the Continental Shelf, as supplemented by CIL. As discussed above these establish some, very limited principles for use in delimiting borders.

   Baker suggests that “neither country [United States or Canada] has shown any strong interest in a model that would require harmonization of their legal and administrative regimes to jointly manage such common uses as hydrocarbon exploration”. But it is not anticipated that difficulties would arise if the two states sought to reach an agreement. Both have shown cooperation with other Arctic states in establishing frameworks, and Baker suggests that these other agreements reached could stand as a backdrop to any agreements negotiated by the two states. However, the assistance such agreements provide for cross-border resource development may be limited.

   Because political risk in this basin may create reluctance from private parties to invest the vast sums to exploit these resources, it is likely that private parties’ expressing interest will be necessary to ignite the United States’ and Canada’s desire to delimit the boundary and address cross-border resource development.

   b. **Lomonosov-Makarov Basin (LM)**

   The LM province crosses boundaries among three states and thus presents an added layer of complication. The boundaries between Russia and Greenland, Russia and Canada and parts of the Canada and Greenland boundary are still to be delimited. Based upon UNCLOS principles, the LM province apparently spans all three boundaries.

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37 Budzik, *supra* note 32.
39 Id. at 67.
40 Ong, *supra* note 26 at 801.
A tripartite agreement may therefore be necessary. But it is not urgent. The LM province lies so far north that ice covers much of the disputed region for the entire year. Exploitation, therefore, in the near or medium term is not feasible.

4. The Oil-Rich (and most economically viable) Provinces

Although the greatest challenge in border-straddling hydrocarbon development might appear to arise in the richest provinces, the economics of oil and gas exploration may prevent exploration in certain regions in the immediate future. A number of factors bear on whether to invest in the Arctic (see Nahkle and Shamsudinova41 elsewhere in this Special Edition), but a major factor will be the potential and type of reserves available42.

With oil being generally more transportable and thus generally more valuable than gas, interest turns to the Arctic Alaska (AA) province. That province has by far the most crude oil reserves in the Arctic: 29.96 billion barrels,43 i.e., 33% of the total projected crude oil reserves for the region. However, this province is indisputably within the United States’ territory.

The AM province has the second most extensive projected undiscovered crude oil reserves, with 9.72 billion barrels44 (10.8% of the total projected crude oil reserves in the Arctic45). As discussed above, this province has no effective legal framework within which to deal with the exploitation of the plentiful resources. If this legal impediment is removed, there are great rewards to be made, particularly from the projected 56.89 trillion cubic feet of natural gas.

The EBB province holds 8.24% of the total crude oil projected to be in the Arctic and is delimited by the 2010 Barents Sea Agreement. This treaty also deals with the boundary relevant to the EB province, which holds 1.5% of the Arctic’s projected crude oil reserves46. Given the extensive natural gas potential in the EBB region, the 2010 Barents Sea Agreement was eagerly awaited and is likely to be put to use over the coming years as these resources are developed.

The NCWF and HB basins are governed by the 1990 treaty between the United States and the Soviet Union. As can be seen from Appendix B these two regions have very low oil and gas potential in comparison to the other Arctic regions.

In conclusion, the vast majority of natural resource deposits in the Arctic face no sovereignty-related barriers to exploitation. Based on the delimitation principles in UNCLOS and CIL, over 70% of the projected crude oil and 72.5%47 of the projected natural gas deposits

41 Carole Nahkle and Inga Shamsudinova, Arctic Oil and Gas Resources: Evaluating the Investment Climate, OGEL SPECIAL EDITION ON THE ARCTIC (2012).
42 See Appendix B.
44 Id.
45 See Appendix B.
46 See Appendix B.
47 See Appendix B.
lie in regions belonging to one state only. Of the remaining provinces containing fields with reserves that sit across international boundaries, the majority have already been delimited, removing the potential for delimitation disputes. This leaves just 12% of the crude oil available in the Arctic with no governing bilateral treaty and 3.83% of the natural gas potentially in dispute.

However, current bilateral treaties do not all address the issues of cross-boundary resource exploitation, because disputes may arise on already delimited boundaries. The precedent set by other treaties and commercial practice will likely set the parameters for negotiations between states, and commercial players, to avoid such disputes.

It is to this second area of Arctic treaty law that we now turn.

III. **BILATERAL TREATIES AS PRECEDENTS FOR ARCTIC HYDROCARBON-FIELD DEVELOPMENT**

The difficulties of negotiating and reaching an effective multilateral agreement (across the Arctic or globally) will, in all likelihood, make it impractical to pursue a multilateral treaty to establish an effective and complete framework applicable to every boundary. That leaves bilateral treaties to deal with cross-border resource exploitation in the Arctic. Unitization, “the joint, coordinated operation of an oil or gas reservoir by all the owners of rights in the separate tracts overlying the reservoir or reservoirs”\(^48\), is widely acknowledged as the most efficient and fair method for producing oil and gas that spans boundaries\(^49\). The substance of such unitization, and the content of a bilateral unitization framework in the Arctic, is not yet clear, so current state practice may help establish it.

Russian and Norwegian state practice relating to cross-border hydrocarbon development is addressed in the recent 2010 Barents Sea Agreement\(^50\), but no similar examples by Arctic or non-Arctic states address this issue. Alternative sources of precedent must be considered for Canada, the United States and Denmark.

A. **The 2010 Barents Sea Treaty (Norway/Russian Federation)**

The 2010 Barents Sea Agreement demonstrates Norway and the Russian Federation’s commitment to exploit hydrocarbon resources in a timely and efficient manner\(^51\). The 2010 treaty sets out a framework for joint development of cross-border hydrocarbon deposits that extend across the maritime delimitation line\(^52\). Namely, joint development is to be carried out

\(^48\) Jacqueline Lang Weaver, Unitization of Oil and Gas Fields in Texas: A Study of Legislative, Administrative, and Judicial Policies 1, 7 (1986).

\(^49\) Weaver and Asmus, supra note 5.

\(^50\) 2010 Barents Sea Agreement, supra note 2.

\(^51\) See the recitals which recognize “the importance of efficient and responsible management of their hydrocarbon resources.”

\(^52\) With the delimitation line established in the treaty itself.
pursuant to the terms of a unitization agreement, some of the terms of which are set out in Annex II.

Annex II, Article 1 acts as a “heads of terms” for unitization agreements to be agreed on each time a field is found. This gives the necessary certainty to the key commercial terms of the agreement, leaving flexibility to tailor each agreement to the field in question. For example, one of the key commercial terms agreed in Annex II concerns quantifying the hydrocarbon reserves. Annex II, Article 1(3) requires the unitization agreement to include “[a] statement of the total amount of the hydrocarbon reserves in place in the transboundary hydrocarbon deposit and the methodology used for such calculation, as well as the apportionment of the hydrocarbon reserves between the Parties”. The Annex does not, however, address potential redeterminations, which the state parties may not consider necessary, or they may not consider it critical enough for inclusion in the Heads of Terms, given the technological advancements discussed above.

Some of the other key commercial terms are as follows:

- Article 5 upholds UNCLOS principles of sovereignty, providing that no exploitation can occur until a unitization agreement is reached. This creates an incentive to flesh out the exact terms of the unitization agreement according to the framework set out in Annex II. A trigger for the negotiation of the unitization agreement is set out and it is acknowledged that in some circumstances only one state may be able to exploit the cross-border resource.

- A consultation on health, safety and environmental matters should follow the unitization agreement, and both states have the right to inspect procedures put in place by the other state or by a private party. This acknowledges the importance and ever-developing nature of health, safety and environmental measures: while they have not dealt with in depth in the 2010 Agreement, a unitization agreement may give further detail of the consultation to take place.

- Private parties will be required to enter Joint Operating Agreements (“JOAs”) with one another but the provisions of these are not exhaustively listed in Annex II; however, such terms will likely largely mirror the unitization agreement.

- Annex II provides for dispute-resolution procedures that encourage rapid resolution. Ad hoc arbitration is envisaged for occasions when the two states fail to agree on a unitization agreement and expert determination for disagreement over the apportionment of hydrocarbon deposits.

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53 Barents Sea Treaty between Norway and the Russian Federation, supra note 2 at Annex II, Article 1(3).
54 Id. at Article 5(2).
55 Id. at Annex II, Article 1(10).
56 Some provisions, however, are given in Article 1(6) of Annex II.
57 This, of course, could potentially serve as a redetermination mechanism.
As unitization agreements are developed pursuant to the heads of terms in the 2010 Agreement, Norwegian and Russian state practice will evolve. But it is clear that, for now, the Annex II Heads of Terms demonstrate the states’ intent to develop cross-border resources cooperatively. This statement of intent is coupled with financial pressure (to reach an agreement before exploitation can occur) and political pressure (to expedite negotiations so as to incentivize necessary private-party participation) together, the treaty framework and practical financial imperatives will thus ensure unitization agreements can be agreed efficiently and effectively.

B. **Additional Arctic Five State Practice**

1. **Norwegian State Practice**

Norway first addressed cross-border resource exploitation in 1965 with an agreement with the United Kingdom\(^58\) for resources in the North Sea. Article 4 of this treaty provides that:

“If any single geological petroleum structure or petroleum field, or any single geological structure or field of any other mineral deposit, including sand or gravel, extends across the dividing line and the part of such structure or field which is situated on one side of the dividing line is exploitable, wholly or in part, from the other side of the dividing line, the Contracting Parties shall, in consultation with the licensees, if any, seek to reach agreement as to the manner in which the structure or field shall be most effectively exploited and the manner in which the proceeds deriving therefrom shall be apportioned.”

This demonstrates early Norwegian state practice of which three points merit attention. First, the mere existence of a cross-border field does not mandate cooperation in developing it; rather cooperation is necessary only when the reservoir can be exploited from the other side of the boundary. Second, unitization is not required to be the explicit mode of cooperation (although in practice, it eventually was). Finally, this provision enables existing licensees to assist in the unitization process, which creates a more efficient exploitation of the resource and recognizes the role played by private industry.

As a result of the 1965 agreement a further agreement was reached in 1976\(^59\), which provided for the Frigg field to be exploited as a single unit\(^60\). This 1976 treaty, based upon the

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\(^{60}\) *Id.* at Articles 1(1)-1(2).
delimitation line established in the 1965 agreement\(^{61}\), required the states to determine the split of profits from the reservoir\(^{62}\). The 1976 treaty further provided that, where no such agreement on soliciting profits is reached, production can proceed based upon a provisional proposal or equal shares. If no solution is reached, article 2(4) provides for arbitration to settle the apportionment dispute.

The 1976 agreement allows both states to retain significant control over the regulation of their respective parts of the field. Article 5 requires the field to be operated by a single operator over which neither state has exclusive jurisdiction and that each government may grant licenses and apply its own tax regime\(^{63}\). However, uniform safety principles are to be applied by both governments\(^{64}\).

Norwegian state practice was further developed in the North Sea in 1979, for a field much more promising than the Frigg field, the Statfjord field\(^{65}\). It was this field which triggered the two states to enter the 1965 agreement, but it took fourteen years for the unitization to be reached. This delay may have been due to the fact that no heads of terms were established in the 1965 Agreement.

The 1979 Stratfjord Agreement largely mirrored the Frigg unitization agreement\(^{66}\), one important difference, though, was to remedy the failure of the 1965 agreement to provide for the transportation of the product of the reservoir. The Frigg Agreement provides for product to be transported to the United Kingdom by the United Kingdom Pipeline and the Norwegian Pipeline.\(^{67}\) A further difference was that the Statfjord Agreement provided a greater time period for redetermination of the reserves, although this state practice has arguably been extinguished in the 2010 Barents Sea Agreement.

In 2005 Norway and the United Kingdom entered a new framework treaty to establish a mechanism that will apply to “cross-boundary co-operation between the United Kingdom Government and the Norwegian Government with regard to Petroleum activities”\(^{68}\). Article 3.1 of the 2005 Agreement provided for cross-border resources to be “exploited as a single unit in accordance with the terms of this Agreement, unless otherwise agreed by the two Governments”. Chapter Three of the 2005 Agreement provides a procedure for unitization, under which the

\(^{61}\) Id. at Article 2.

\(^{62}\) Id. at Articles 2(2)-2(3).

\(^{63}\) Id. at Article 9.

\(^{64}\) Id. at Article 7.

\(^{65}\) Bastida et al., supra note 28.

\(^{66}\) Agreement between Norway and the United Kingdom, supra note 59.

\(^{67}\) Id. at Article 13.

Blane-Enoch fields have been unitized, and hands greater control to licensees, while maintaining certain veto rights.\textsuperscript{69}

Norway’s state practice has therefore evolved over time moving from a lengthy field-by-field procedure and moving to the two-stage, heads of terms procedure used in the 2010 Barents Sea Agreement.

2. **Other “Arctic Five” State Practice**

There is little precedent demonstrating Canadian, Danish and US state practice of cross-border resource development. Treaties purely among Arctic states fail to address this issue in depth.

The two Denmark/Norway treaties\textsuperscript{70} require only another treaty: “an agreement concerning the exploitation of the natural resources in question”\textsuperscript{71}. The 1973 Canada/Demark treaty is weaker only requiring those states’ parties to “seek to reach an agreement.” The United States/USSR treaty\textsuperscript{72} provides for each state to have sovereignty over its respective lands\textsuperscript{73} by applying international laws, \textit{i.e.}, CIL. No further agreements have been reached under any of these three treaties. As a result, Canadian, Danish and United States state practice is unclear on cross-border field development in the Arctic. These states’ treaties with non-Arctic states\textsuperscript{74} add nothing to the story.

\textsuperscript{69} Id. at Article 3.7.

\textsuperscript{70} Agreement between the Government of the Kingdom of Denmark and Government of the Kingdom of Norway relating to the Delimitation of the Continental Shelf (1965); Agreement between the Government of the Kingdom of Denmark and the Government of the Kingdom of Norway concerning the Delimitation of the Continental Shelf in the Area between the Faroe Islands and Norway and concerning the Boundary between the Fishery Zone near the Faroe Islands and the Norwegian Economic Zone (1979).

\textsuperscript{71} 1979 Agreement between Denmark and Norway, \textit{supra} note 70 at Article 3.

\textsuperscript{72} Agreement between the Union of Soviet Socialist Republics and the United States of America on the Maritime Boundary, Article 3 (1990).

\textsuperscript{73} This wording is also reflected in 2010 Barents Sea Agreement, \textit{supra} note 2 at Article 3.

\textsuperscript{74} Agreement on the Continental Shelf between Iceland and Jan Mayen (Norway) (1981); Agreement between Sweden and Norway concerning the Continental Shelf (1968); Agreement between Sweden and Denmark concerning the Delimitation of the Continental Shelf and Fishing Zones (1984); Treaty between the German Democratic Republic and the Kingdom of Denmark on the Delimitation of the Continental Shelf and the Fishery Zones (1988); Treaty between the Kingdom of Denmark and the Federal Republic of Germany concerning the Delimitation of the Continental Shelf under the North Sea (1971); and Agreement between the Government of the Kingdom of Denmark and the Government of the United Kingdom of Great Britain and Northern Ireland relating to the Delimitation of the Continental Shelf between the Two Countries (1971).
C. State Practice Outside the Arctic

1. Trinidad and Tobago and Venezuela Agreement

To the extent that Arctic states look beyond the 2010 Barents Sea Agreement, the Framework Treaty between Venezuela and Trinidad and Tobago relating to the unitization of hydrocarbon resources, signed in 2007, may assist as a precedent for the United States Canada and Denmark. Article 2.1 provides that “any” hydrocarbon reservoir extending over the delimitation line “shall be exploited as a unit in the most effective and efficient manner”. This very wide-reaching provision goes further than the Frigg agreement, which only relates to resources that can be exploited from the other side of the delimiting boundary.

Further, the Trinidad and Tobago/Venezuela Treaty focuses establishing a ministerial commission to identify and determine the limits and volumes of reservoirs spanning the boundary and then to allocate them. Notwithstanding, development can proceed provisionally even without agreement on allocation. If no allocation is agreed, the dispute-resolution procedure (envisioning only negotiations) is followed.

This agreement gives each state jurisdiction over the area in which that state exercises sovereignty, meaning the respective laws of each state apply as relate to tax and other fiscal aspects and health and safety standards. Under article 9.1, however, the parties are jointly and severally liable for ensuring there is no damage to the marine environment, even though each state has jurisdiction over the implementation of pollution-regulation measures. This is a similar approach to the 1976 Norway and United Kingdom Treaty.

Finally, the Trinidad and Tobago Agreement uses the “heads of terms” approach, much like the 2010 Barents Sea Agreement. Moreover, Article 17 requires the states to cooperate in the development of projects to “facilitate the monetization of each party’s hydrocarbon reserves”. Treaties like this, which set out heads of terms, maintain flexibility, but progress to the development stage can be achieved quickly. Where no heads of terms are signed, the first agreement reached may be persuasive when negotiating in the second and third (as the Frigg Agreement was), but will not be binding.

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75 Framework Treaty relating to the Unitization of Hydrocarbon Reservoirs that Extend Across the Delimitation Line between the Republic of Trinidad and Tobago and the Bolivarian Republic of Venezuela (2007).
76 Id. at Article 3.
77 Id. at Article 21.
78 Id. at Article 15.1.
79 Id.
IV. **COMMERCIAL UNITIZATION FORMS AND COMMENTARY AS PRECEDENT FOR CROSS BORDER FIELD DEVELOPMENT**

Given that state practice on cross-border field rules is so sparse, and that the existing precedent (outside the 2010 Barents Sea Agreement) is nonetheless quite general, it makes sense to look to private parties’ arrangements when a field crosses a boundary. In the United States, this occurs frequently, as landowners have rights to the subsurface minerals.

In this respect, the Association of International Petroleum Negotiators (“AIPN”) 2006 Model Form International Unitization and Unit Operating Agreement is also of assistance as a precedent. While it is likely that this form will be persuasive as a recognized industry standard, the guidance notes to the agreement suggest it only applies to domestic unitization situations. Indeed, the complexities of cross-border unitization prevent a complete precedent being established to deal with coordinating, for example, two states’ regulatory or financial regimes. Nonetheless, the AIPN form adds a great level of detail to the general framework.

While certain provisions of the AIPN Model Form will be applicable to all unitization agreements, unitization is an art, and expertise in the precise nature of the resource in question and the legal systems of the two states is necessary. Therefore, the two-stage approach will be effective in establishing the heads of terms, leaving the precise terms to be addressed once the nature of the field is known. This is particularly relevant in the Arctic, where multiple external factors, including health, safety and environmental issues, will need to be addressed on a case-by-case basis ensuring that the two states (who may have differing health and safety regulations) provide adequate coverage for the sensitive Arctic environment. Nonetheless, unitization-agreement practice will be at the parameters of negotiations.

A. **Commentary as a Guide to Cross-Border Unitization**

Weaver writes authoritatively on the most important terms to include in a unitization agreement arguing that these include:

- **Unit Area, including surface area and depth:** Weaver argues that a unitization agreement, to be truly effective, should deal with more than one stratum;

- **Unitized substances:** Weaver argues that best practice is for a unitization agreement to address both oil and gas resources, both of which are found in the Arctic;

- **Effect of unitization:** and the considerations of financial impact once a field is unitized;

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80 David Pierce, Professor of Law, Washburn University School of Law, *Transactional Evolution of Operating Agreements in the Oil and Gas Industry*, presented at Rocky Mountain Mineral Law Foundation, Oil and Gas Agreements: Joint Operations (27 March 2008).

81 Guidance Notes to the AIPN Model Form International Unitization and Unit Operating Agreement.

82 The AIPN 2006 Model Form International Unitization and Unit Operating Agreement.

83 Weaver and Asmus, *supra* note 5.
• **Determination of tract and unit interests (including pre-unitization costs);**

• **Redetermination of Tract Interests (including the basis, time and number of redeterminations):** This question is particularly important in the Arctic, given the 2010 Barents Sea Agreement’s failure to address this issue. While it is clear that technology is developing in this area, there will likely be a particular need for redeterminations in the Arctic, given there has already been some dispute over the USGS survey’s findings;

• **Unit Decision making:** The 2005 United Kingdom and Norway Treaty addresses this by allowing licensees to appoint the unit operator. Other international treaties address this issue by establishing a joint development commission, such as the East Timor Agreement; and

• **Non-unit Operations:** and the conduct and financial agreements in place for those areas.

Weaver continues that the framework unitization agreement must take into account a number of additional considerations, including the effect of a failure to unitize, which generally precludes exploiting the field. If there is no unitization agreement, effective dispute resolution procedures should be included, as in the Trinidad and Tobago Agreement. Failing adequate dispute resolution, the resource may be inexplicable.

Weaver also argues that a bilateral treaty should address whether unitization is voluntary or compulsory. Arguably a purely voluntary unitization procedure would work only if states are dedicated to exploiting the resource. Weaver argues that best practice nonetheless dictates that domestic unitization laws should permit private parties to enter into unitization agreements voluntarily; but if agreement is reached, compulsory unitization should be enforced by means of international arbitration.

**B. Joint Development Agreements**

Contracts between private parties also have a part to play in establishing a framework for cross-border resource development, as is recognized in Annex II of the 2010 Barents Sea Agreement.

Many of the concepts included in the unitization agreement will also require address in a JOA or Licensee Agreement, but some will remain in the unitization agreement alone, such as those relating to the creation of the unit, the tract and unit interest and the non-unit operations. Given that JOAs will largely mirror unitization agreements they require little discussion. An authoritative commentator on this topic, Bastida, suggests that when establishing a successful joint development zone considerations include:

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84 Weaver and Asmus, supra note 5; see also Barents Sea Agreement, Annex II, art. 1(6)(a).

85 Weaver and Asmus, supra note 5.

86 Bastida et al., supra note 28.
• **Sharing of resources:** Lerer argues that equal sharing is by far the most popular approach; however, this is not universal, the Australia/East Timor Agreement provides for a 90% share to be given to East Timor;

• **Management:** There are various mechanisms for management of the unitized resource, including:
  
  (a) one state managing the resource on behalf of both states, as in the case of the Saudi Arabia, Bahrain Agreement of 1948 or

  (b) the two states entering a joint venture to operate the field or form a joint authority with a separate legal authority. Bastida argues that establishing a joint authority is the best approach and highlights that the authority can be multi-tiered, as was the case with the East Timor unitization agreement;

• **Applicable law:** in general environmental and criminal laws will be addressed by the host states’ domestic laws, but that this is not universally the case. In the Arctic context, due to the heightened environmental difficulties, it is arguable that disaster response may be addressed in greater depth in the unitization agreement than has been seen in the past;

• **Operator:** the party that is to act as Operator and that will deal with contractors;

• **Financial provisions; and**

• **Pre-determined dispute resolution.**

The 2010 Barents Sea Agreement deals with many of these provisions in respect of the unitization agreement and a JOA should mirror these.

V. **Conclusion**

An extensive legal framework already in place to deals with maritime boundary delimitation in the Arctic. This framework extends to the most oil- and gas-rich regions, leaving just a few minor gaps, in hydrocarbon provinces that are not the most hydrocarbon rich. Treaty gaps are likely to be filled by bilateral agreements among the Arctic Five. These bilateral treaties will rest almost entirely on UNCLOS principles, with some additional gap-filling from customary international law. The financial and political pressures to sort out claims to Arctic

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89 Bastida et al., *supra* note 28.

90 *Id.*
resources, so eagerly watched, will enable the final pieces of the delimitation puzzle to be completed without resorting to a multilateral treaty.

On the other hand, the issue of cross-border hydrocarbon resource development is a far greater challenge in the Arctic. There is no real “frame work” for this set of norms, but this gap is not immediately pressing for most provinces, because it is clear that the majority of oil and gas resources in the Arctic do not require cross-border unitization. The most extensive oil resource can be found comfortably within the United States and the vast majority of hydrocarbon resources are currently found within the territory of each of the states. Nonetheless, the framework must be developed for some resources provinces.

Here, as with maritime boundary delimitation, the regime is not likely going to be multilateral. Indeed, the Arctic states have not shown willingness to have a universally imposed regime in the Arctic. The Illulissat Declaration acknowledged that

“the [current] framework provides a solid foundation for responsible management by the five coastal states and other users of the Ocean through national implementation and application of relevant provisions. We therefore see no need to develop a new comprehensive legal regime to govern the Arctic Ocean. We will keep abreast of the developments in the Arctic Ocean and continue to implement appropriate measures”\textsuperscript{91}.

This illustrates how Arctic states wish to develop their resources: by establishing an effective bilateral series of agreements, which will maintain sufficient flexibility at the field level. As a precedent, the 2010 Norway-Russia Barents Sea Agreement represents the state-of-the-art state practice of two of the Arctic Five. In its basic approach, the 2010 Barents Sea Agreement’s a two-stage, heads-of-terms approach allows states to establish the parameters of their unitization agreements and consider the critical terms before the pressure of developing a particular hydrocarbon field arises.

Much can be learned from the 2010 Barents Sea Agreement, but given its infancy, further issues at the field level require clarification, such as that of redetermination and the terms of the relevant unitization agreements and JOAs. Existing commercial unitization agreements used by mineral-rights owners will doubtless provide the precedent forms for efficient and, necessarily, market-oriented Arctic field development.

\textsuperscript{91} Illulissat Declaration, 28 May 2008.
### Appendix A

State Parties to Conventions Applicable in the Arctic relevant for the Delimitation of Boundaries

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Canada</strong></td>
<td>Signed, but not ratified</td>
<td>🔄</td>
<td>🔄</td>
<td>1973 Canada / Denmark Agreement⁹²</td>
</tr>
<tr>
<td><strong>Denmark</strong></td>
<td>🔄</td>
<td>🔄</td>
<td>🔄</td>
<td>1965 Norway / Denmark Agreement⁹³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1979 Norway / Denmark Agreement⁹⁴</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1973 Canada / Denmark Agreement⁹⁵</td>
</tr>
<tr>
<td><strong>Norway</strong></td>
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<td>🔄</td>
<td>🔄</td>
<td>1965 Norway / Denmark Agreement⁹⁶</td>
</tr>
<tr>
<td></td>
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<td>1979 Norway / Denmark Agreement⁹⁷</td>
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<td></td>
<td></td>
<td></td>
<td>2010 Norway / Russia Agreement⁹⁸</td>
</tr>
<tr>
<td><strong>Russia</strong></td>
<td>🔄</td>
<td>🔄</td>
<td>🔄</td>
<td>1990 United States / Russia Agreement⁹⁹</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2010 Norway / Russia Agreement¹⁰⁰</td>
</tr>
<tr>
<td><strong>United States</strong></td>
<td></td>
<td>🔄</td>
<td>No</td>
<td>1990 United States / Russia Agreement¹⁰¹</td>
</tr>
</tbody>
</table>

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⁹³ 1965 Agreement between Denmark and Norway, supra note 70.

⁹⁴ 1979 Agreement between Denmark and Norway, supra note 70.

⁹⁵ Agreement between Denmark and Canada, supra note 92.

⁹⁶ 1965 Agreement between Denmark and Norway, supra note 70.

⁹⁷ 1979 Agreement between Denmark and Norway, supra note 70.

⁹⁸ 2010 Barents Sea Agreement, supra note 2.


¹⁰⁰ 2010 Barents Sea Agreement, supra note 2.

Appendix B

Estimates of Oil and Gas (technically recoverable) Reserves North of the Arctic Circle and spanning International Boundaries (based upon the USGS survey\textsuperscript{102})

<table>
<thead>
<tr>
<th>Province (As named in the USGS)\textsuperscript{103}</th>
<th>Crude Oil (billion barrels)</th>
<th>Crude Oil (% of total in the Arctic)</th>
<th>Natural Gas (trillion cubic feet)</th>
<th>Natural Gas (% of total in the Arctic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Barents Basin (EBB)</td>
<td>7.41</td>
<td>8.24%</td>
<td>317.56</td>
<td>19.03%</td>
</tr>
<tr>
<td>Amerasia Basin (AM)</td>
<td>9.72</td>
<td>10.80%</td>
<td>56.89</td>
<td>3.41%</td>
</tr>
<tr>
<td>West Greenland-East Canada (WGEC)</td>
<td>7.27</td>
<td>8.08%</td>
<td>51.82</td>
<td>3.11%</td>
</tr>
<tr>
<td>Eurasia Basin (EB)</td>
<td>1.34</td>
<td>1.49%</td>
<td>19.48</td>
<td>1.17%</td>
</tr>
<tr>
<td>Lomonosov-Makarov (LM)</td>
<td>1.11</td>
<td>1.23%</td>
<td>7.16</td>
<td>0.43%</td>
</tr>
<tr>
<td>North Chukchi-Wrangel Foreland Basin (NCWF)</td>
<td>0.09</td>
<td>0.10%</td>
<td>6.07</td>
<td>0.36%</td>
</tr>
<tr>
<td>Hope Basin (HB)</td>
<td>0.002</td>
<td>0.00%</td>
<td>0.65</td>
<td>0.04%</td>
</tr>
<tr>
<td>Total (basins crossing international boundaries)</td>
<td>26.942</td>
<td>29.94%</td>
<td>459.63</td>
<td>27.54%</td>
</tr>
<tr>
<td>Total (basins crossing undelimited international boundaries)</td>
<td>10.83</td>
<td>12%</td>
<td>64.05</td>
<td>3.83%</td>
</tr>
<tr>
<td>Total (in the Arctic)</td>
<td>89.98</td>
<td>-</td>
<td>1,668.66</td>
<td>-</td>
</tr>
<tr>
<td>Total (basins in a single state)</td>
<td>63.038</td>
<td>70.06%</td>
<td>1,209.03</td>
<td>72.46%</td>
</tr>
</tbody>
</table>

Key:

Provinces with undelimited boundaries

\textsuperscript{102} United States Geological Survey, \textit{supra} note 4.

\textsuperscript{103} \textit{Id.}
Maritime jurisdiction and boundaries in the Arctic region

- **Internal waters**
- **Canada territorial sea and exclusive economic zone (EEZ)**
- **Potential Canada continental shelf beyond 200 nm (note 1)**
- **Denmark territorial sea and EEZ**
- **Denmark claimed continental shelf beyond 200 nm (note 2)**
- **Potential Denmark continental shelf beyond 200 nm (note 1)**
- **Iceland EEZ**
- **Iceland claimed continental shelf beyond 200 nm (note 2)**
- **Norway territorial sea and EEZ / Fishery zone (Jan Mayen) / Fishery protection zone (Svalbard)**
- **Norway claimed continental shelf beyond 200 nm (note 3)**
- **Russia territorial sea and EEZ**
- **Russia claimed continental shelf beyond 200 nm (note 4)**
- **Norway-Russia Special Area (note 5)**
- **USA territorial sea and EEZ**
- **Potential USA continental shelf beyond 200 nm (note 1)**
- **Overlapping Canada / USA EEZ (note 6)**
- **Norway-Russia Special Area (note 5)**
- **Eastern Special Area (note 7)**
- **Unclaimed or unclaimable continental shelf (note 1)**
- **Straight baselines**
- **Agreed boundary**
- **Median line**
- **350 nm from baselines (note 1)**
- **100 nm from 2500 m isobath (beyond 350 nm from baselines) (note 1)**
- **Svalbard treaty area (note 8)**

Polar stereographic projection

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Notes

1. The depicted potential areas of continental shelf beyond 200 nautical miles (nm) for Canada, Denmark and the USA are theoretical maximum claims assuming that none of the states claims continental shelf beyond median lines with neighbouring states where maritime boundaries have not been agreed. In reality, the claimable areas may fall well short of the theoretical maximums (see the summary of the definition of the outer limit of the continental shelf below and the seabed relief map on page 3). It is also possible that one or more states will claim areas beyond the median lines.

Where the continental margin of a coastal state extends beyond 200 nm from the state’s territorial sea baseline, the outer limit of the continental shelf is defined with reference to two sets of points: (i) points 60 nm from the foot of the continental slope; (ii) points at which the thickness of sedimentary rocks is at least 1% of the shortest distance from the points in question to the foot of the continental slope. The outer limit of the continental shelf is defined by a series of straight lines (not exceeding 60 nm in length) connecting the seawardmost of the points in the two sets described above. This map does not attempt to depict such lines, which can only be identified with precision through bathymetric and seismic surveys. However, it is possible to depict the ‘cut-off’ limit beyond which states may not exercise continental shelf jurisdiction regardless of the location of the foot of the continental slope and the thickness of sediment seaward of that point. The cut-off limit is the seawardmost combination of two lines: (i) a line 350 nm from the state’s territorial sea baseline; (ii) a line 100 nm seaward of the 2,500 metre isobath. Both the 350 nm line and (where it runs seaward of the 350 nm line) the 2,500 m + 100 nm lines are depicted on the map. The 2,500 m + 100 nm line is derived from the US National Geophysical Data Center’s ETOPO2 bathymetry dataset.

2. The depicted claims of Denmark and Iceland to continental shelf beyond 200 nm in the northeast Atlantic Ocean are defined in the “Agreed Minutes on the Delimitation of the Continental Shelf beyond 200 Nautical Miles between the Faroe Islands, Iceland and Norway in the Southern Part of the Banana Hole of the Northeast Atlantic” of 20 September 2006. The agreed division of the continental shelf in this area is subject to confirmation by the Commission on the Limits of the Continental Shelf (CLCS) that there is a continuous continental shelf in the area covered by the agreement.

3. A summary of the Recommendations of the Commission on the Limits of the Continental Shelf in regard to the Submission made by Norway in respect of areas in the Arctic Ocean, the Barents Sea and the Norwegian Sea can be found at http://www.un.org/depts/los/clcs_new/submissions_files/nor06/nor_rec_summ.pdf.


5. Norway and the Soviet Union agreed a partial maritime boundary in Varangerfjord in 1957 but for many years were unable to agree on the alignment of their maritime boundary in the Barents Sea: Norway claimed the boundary should follow the median line, while Russia sought a sector boundary extending due north (but deviating around the 1920 Svalbard Treaty area). In July 2007 the Varangerfjord boundary was extended through the innermost 73 km of the disputed area, and in September 2010 an agreement was finally signed extending the boundary northwards through the Barents Sea to the outer limit of the two countries’ overlapping continental shelf entitlements in the Arctic Ocean. In the area to the east of the boundary which lies within 200 nm of the Norwegian mainland but more than 200 nm from Russian territory, the agreement grants Russia the EEZ rights that would otherwise fall to Norway (this “Special Area” is similar to those established in the vicinity of the Russia-USA maritime boundary in 1990 – see Note 7). The 2010 agreement renewed fisheries cooperation agreements originally signed in 1975 and 1976 for at least a further fifteen years, but the ‘Grey Zone’ fishing regime established in 1978 has been terminated. The agreement also includes provisions for cooperative exploitation and management of transboundary hydrocarbon deposits. The agreement still has to be ratified by the Norwegian and Russian parliaments.

6. Canada argues that the maritime boundary in the Beaufort Sea was delimited in the 1825 treaty between Great Britain and Russia defining the boundary between Alaska and the Yukon as following the 141° W meridian “as far as the frozen ocean”. The USA argues that no maritime boundary has yet been defined and that the boundary should follow the median line between the two coastlines. The area of overlap between the two claims is more than 7,000 km².

7. The Eastern Special Area lies more than 200 nm from the baseline of the USA but less than 200 nm from the baseline of Russia. Under the June 1990 boundary agreement between the two states, the Soviet Union agreed that the USA should exercise EEZ jurisdiction within this area. A second Eastern Special Area and a Western Special Area (in which the opposite arrangement applies) were established adjacent to the boundary south of 60° north. The agreement has yet to be ratified by the Russian parliament but its provisions have been applied since 1990 through an exchange of diplomatic notes.

8. Under a treaty signed in February 1920, Norway has sovereignty over the Svalbard archipelago and all islands between latitudes 74° and 81° north and longitudes 10° and 35° east. However, citizens and companies from all treaty nations enjoy the same right of access to and residence in Svalbard. Right to fish, hunt or undertake any kind of maritime, industrial, mining or trade activity are granted to them all on equal terms. All activity is subject to the legislation adopted by Norwegian authorities, but there may be no preferential treatment on the basis of nationality. Norway is required to protect Svalbard’s natural environment and to ensure that no fortresses or naval bases are established. 39 countries are currently registered as parties to the Svalbard treaty.

9. Under the 1981 continental shelf boundary agreement between Iceland and Norway, each country is entitled to a 25% share in petroleum activities on the other’s continental shelf within a 32,750 km² area between latitudes 68° N and 70° 35° N and longitudes 6° 30° W and 10° 30° W. The idea of a joint development zone straddling the boundary was proposed by a conciliation commission set up by the two governments when they were unable to reach a negotiated boundary settlement. The continental shelf boundary itself is located 200 nm from the coast of Iceland but less than 100 nm from Jan Mayen, reflecting the significant disparity in the lengths of the relevant coastal fronts (more than 18:1 in Iceland’s favour).

10. Canada claims that the waters of its Arctic archipelago are historic internal waters, and has enclosed them within a system of straight baselines. Under normal circumstances there is no automatic right of innocent passage through internal waters for foreign
ships. However, other states (particularly the USA) argue that the channels in the archipelago which form part of the ‘Northwest Passage’ through the Arctic qualify as straits used for international navigation under Part III of UNCLOS, and that there is therefore a right of transit passage through the straits for foreign ships. While the Northwest Passage was under permanent ice cover, the debate was largely academic - but with the polar ice cap retreating and the Passage becoming increasingly navigable, the question of which legal regime applies has become increasingly pressing. Similar issues affect the straits of the ‘Northeast Passage’ around Russia’s Arctic coastline.

Agreed maritime boundaries

Canada-Denmark (Greenland): continental shelf boundary agreed 17 December 1973.

Denmark (Greenland)-Iceland: continental shelf and fisheries boundary agreed 11 November 1997.

Denmark (Greenland)-Norway (Jan Mayen): continental shelf and fisheries boundary agreed 18 December 1995 following adjudication by the International Court of Justice.

Denmark (Greenland)-Iceland-Norway (Jan Mayen) tripoint agreed 11 November 1997.

Denmark (Greenland)-Norway (Svalbard): continental shelf and fisheries boundary agreed 20 February 2006.

Iceland-Norway (Jan Mayen): fisheries boundary following the 200 nm limit of Iceland’s EEZ agreed 28 May 1980; continental shelf boundary and joint zone agreed 22 October 1981 (see note 9).

Norway-Russia: maritime boundary in Varangerfjord partially delimited 15 February 1957 and extended 11 July 2007. Agreement on the maritime boundary in the Barents Sea and Arctic Ocean signed on 15 September 2010, but still to be ratified (see note 5).

Russia-USA: single maritime boundary agreed 1 June 1990 (see note 8).

Seabed topography

As discussed in note 1, the outer limit of the continental shelf is defined in relation to the geology and geomorphology of the continental margin. The Arctic Ocean seabed is currently rather poorly surveyed, but existing public domain datasets such as US National Geophysical Data Center’s ETOPO2 bathymetry dataset, from which the seabed relief map below was generated, suggest that in many areas of the Arctic the outer limit of the continental shelf may fall well short of the theoretical maximum limits shown on the main map. The Arctic coastal states are currently conducting hydrographic and geophysical surveys of the Arctic Ocean in order to identify the outer limits of the continental shelf with precision. Some data being acquired through collaborative ventures are being made available to the public, notably the International Bathymetric Chart of the Arctic Ocean (http://www.ngdc.noaa.gov/mgg/bathymetry/arctic).
Introduction

In May 2008 a team of U.S. Geological Survey (USGS) scientists completed an appraisal of possible future additions to world oil and gas reserves from new field discoveries in the Arctic. This Circum-Arctic Resource Appraisal (CARA) evaluated the petroleum potential of all areas north of the Arctic Circle (66.56° north latitude); quantitative assessments were conducted in those geologic areas considered to have at least a 10-percent chance of one or more significant oil or gas accumulations. For the purposes of the study, a significant accumulation contains recoverable volumes of at least 50 million barrels of oil and/or oil-equivalent natural gas. The study included only those resources believed to be recoverable using existing technology, but with the important assumptions for offshore areas that the resources would be recoverable even in the presence of permanent sea ice and oceanic water depth. No economic considerations are included in these initial estimates; results are presented without reference to costs of exploration and development, which will be important in many of the assessed areas. So-called nonconventional resources, such as coal bed methane, gas hydrate, oil shale, and tar sand, were explicitly excluded from the study. Full details of the CARA study will be published later.

A number of onshore areas in Canada, Russia, and Alaska already have been explored for petroleum, resulting in the discovery of more than 400 oil and gas fields north of the Arctic Circle. These fields account for approximately 240 billion barrels (BBOE) of oil and oil-equivalent natural gas, which is almost 10 percent of the world’s known conventional petroleum resources (cumulative production and remaining proved reserves). Nevertheless, most of the Arctic, especially offshore, is essentially unexplored with respect to petroleum. The Arctic Circle encompasses about 6 percent of the Earth’s surface, an area of more than 21 million km² (8.2 million mi²), of which almost 8 million km² (3.1 million mi²) is onshore and more than 7 million km² (2.7 million mi²) is on continental shelves under less than 500 m of water. The extensive Arctic continental shelves may constitute the geographically largest unexplored prospective area for petroleum remaining on Earth.

Methodology

A newly compiled map of Arctic sedimentary basins (Arthur Grantz and others, unpublished work) was used to define geologic provinces, each containing more than 3 km of sedimentary strata. Assessment units (AUs)—mappable volumes of rock with common geologic traits—were identified in each province and quantitatively assessed for petroleum potential. Because of the sparse seismic and drilling data in much of the Arctic, the usual tools and techniques used in USGS resource assessments, such as discovery process modeling, prospect delineation, and deposit simulation, were not generally applicable. Therefore, the CARA relied on a probabilistic methodology of geological analysis and analog modeling. A world analog database (Charpentier and others, 2008) was developed using the AUs defined in the USGS World Petroleum Assessment 2000 (USGS World Assessment Team, 2000). [Continued on back page]
PETROLEUM POTENTIAL OF ASSESSMENT UNITS AND PROVINCES IN THE CIRCUM-ARCTIC

In the Circum-Arctic Resource Appraisal (CARA), 33 provinces were examined, of which 25 were judged to have a 10-percent or greater probability of at least one significant undiscovered petroleum accumulation in any constituent assessment unit (AU) and were therefore quantitatively assessed. Shown in these three maps are the relative probabilities for all assessment units assessed and the estimated relative potentials for undiscovered oil and gas in the assessed provinces.

Figure 1. Assessment units (AUs) in the Circum-Arctic Resource Appraisal (CARA) color-coded by assessed probability of the presence of at least one undiscovered oil and/or gas field with recoverable resources greater than 50 million barrels of oil equivalent (MMBOE). Probabilities for AUs are based on the entire area of the AU, including any parts south of the Arctic Circle.

PROBABILITY (percent)

- 100
- 50–100
- 30–50
- 10–30
- <10
- Area of low petroleum potential
Figure 3. Provinces in the Circum-Arctic Resource Appraisal (CARA) color-coded for mean estimated undiscovered oil in oil fields. Only areas north of the Arctic Circle are included in the estimates. Province labels are the same as in table 1.

**UNDISCOVERED OIL**
(billion barrels)
- >10
- 1-10
- <1
- Area not quantitatively assessed
- Area of low petroleum potential

Figure 2. Provinces in the Circum-Arctic Resource Appraisal (CARA) color-coded for mean estimated undiscovered gas. Only areas north of the Arctic Circle are included in the estimates. Province labels are the same as in table 1.

**UNDISCOVERED GAS**
(trillion cubic feet)
- >100
- 6–100
- <6
- Area not quantitatively assessed
- Area of low petroleum potential
The database includes areas that account for more than 95 percent of the world’s known oil and gas resources outside the United States.

For each assessment unit, the CARA team assessed the probability (AU probability) that a significant oil or gas accumulation was present. This evaluation of AU probability was based on three geologic elements: (1) charge (including source rocks and thermal maturity), (2) rocks (including reservoirs, traps, and seals), and (3) timing (including the relative ages of migration and trap formation, as well as preservation). Each assessment unit was ranked according to its AU probability; those AUs judged to have less than a 10-percent probability of a significant accumulation were not quantitatively assessed.

In addition to the AU probability, the number of accumulations, the size-frequency distribution of accumulations, and the relative likelihood of oil versus gas were assessed for each AU and combined by means of a Monte Carlo simulation. The probabilistic results reflect the wide range of uncertainty inherent in frontier geological provinces such as those of the Arctic.

**Results—Resource Summary**

Within the area of the CARA, 25 provinces were quantitatively assessed; 8 provinces were judged to have less than a 10-percent probability of at least one significant accumulation in any AU and were, therefore, not assessed. Results of individual AU assessments are not reported here, but the AUs are shown as mapped areas on figure 1, where they are color-coded for the probability of at least one undiscovered accumulation of minimum size. The provinces are listed in table 1, in ranked order of total mean estimated oil-equivalent volumes of undiscovered oil, gas, and natural gas liquids (NGL). The provinces are shown in figures 2 and 3, where they have been color-coded with respect to fully risking (including AU probabilities) potential for gas and oil, respectively.

More than 70 percent of the mean undiscovered oil resources is estimated to occur in five provinces: Arctic Alaska, Amerasia Basin, East Greenland Rift Basins, East Barents Basins, and West Greenland–East Canada. More than 70 percent of the undiscovered natural gas is estimated to occur in three provinces, the West Siberian Basin, the East Barents Basins, and Arctic Alaska. It is further estimated that approximately 84 percent of the undiscovered oil and gas occurs offshore. The total mean undiscovered conventional oil and gas resources of the Arctic are estimated to be approximately 90 billion barrels of oil, 1.669 trillion cubic feet of natural gas, and 44 billion barrels of natural gas liquids.

**Table 1. Summary of Results of the Circum-Arctic Resource Appraisal**

<table>
<thead>
<tr>
<th>Province Code</th>
<th>Province</th>
<th>Oil (MMBO)</th>
<th>Total Gas (BCFG)</th>
<th>NGL (MMBNGL)</th>
<th>BOE (MMBOE)</th>
</tr>
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<tbody>
<tr>
<td>WSB</td>
<td>West Siberian Basin</td>
<td>3,659.88</td>
<td>651,498.56</td>
<td>20,328.69</td>
<td>132,571.66</td>
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<td>AA</td>
<td>Arctic Alaska</td>
<td>29,960.94</td>
<td>212,397.60</td>
<td>5,904.97</td>
<td>72,765.52</td>
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<td>EBB</td>
<td>East Barents Basin</td>
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<td>317,557.97</td>
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<td>61,755.10</td>
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<td>EGR</td>
<td>East Greenland Rift Basins</td>
<td>8,902.13</td>
<td>86,180.06</td>
<td>5,172.57</td>
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<td>YK</td>
<td>Yenisey-Khatanga Basin</td>
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<td>99,964.26</td>
<td>2,675.15</td>
<td>49,219.61</td>
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<td>AM</td>
<td>Amerasia Basin</td>
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<td>56,891.21</td>
<td>541.69</td>
<td>19,747.14</td>
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<td>WGEA</td>
<td>West Greenland-East Canada</td>
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<td>51,818.16</td>
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<td>LSP</td>
<td>Laptev Sea Shelf</td>
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<td>32,562.84</td>
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<td>Norwegian Margin</td>
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<td>32,281.01</td>
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<td>BP</td>
<td>Barents Platform</td>
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<td>EB</td>
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<td>520.26</td>
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<td>NKB</td>
<td>North Kara Basins and Platforms</td>
<td>1,807.26</td>
<td>14,973.58</td>
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<td>TPB</td>
<td>Timan-Pechora Basin</td>
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<td>NGS</td>
<td>North Greenland Sheared Margin</td>
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<td>LM</td>
<td>Lomonosov-Makarov</td>
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<td>71,165.25</td>
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<td>SB</td>
<td>Sverdrup Basin</td>
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<td>LA</td>
<td>Lena-Anabar Basin</td>
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<td>VLK</td>
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