Cooperation in the Development of Offshore Cross-border Deposits in the Arctic Circle

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Abstract: In order to exploit the Arctic Circle, one must carefully take into account the importance of the Arctic region, its unique characteristics and the nature of international relations in the area. The region is becoming increasingly important in national defence and trade strategies because it is melting. The region’s unique characteristics are determined by climate and the challenges posed by deep, offshore drilling. Conflicts and the instances of cooperation between Arctic neighbours have a considerable effect on the future exploitation of the Arctic. Overlapping claims are not helpful in attracting the huge investments needed for arctic drilling and cross-border offshore deposits cannot be sustainably exploited without the prior consent of the parties. This paper focuses on both the history of the extractive industry’s efforts to overcome the challenges of the Arctic Circle and on the timeline of cooperation in the development of offshore cross-border deposits.

Keywords: Arctic Circle, cross-border cooperation, hydrocarbons.

Introduction

The history of the oil industry has been defined by moments when experts felt either baffled or challenged to come up with ingenious technical solutions while being able to also protect the environment.

It was considered that drilling under lakes posed too great a threat to both the environment and crews for the industry to undertake. Then, it was thought that drilling in extreme weather conditions (desert, ice) or in places

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where geologists knew little about the subsoil was impossible. And still, the industry found ways and means to do the impossible and turn these phases into stepping stones, now considered revolutionary from a technological point of view. Nowadays, the new “impossible” is the Arctic Circle. There are voices saying that drilling in the Arctic should be forbidden and voices arguing that technology can offer safe exploitation methods.

What is sure is that the Arctic Circle is melting and, sooner or later, drilling will be possible on increasingly larger areas. The situation is complicated by political disputes between arctic states and their overlapping claims over lands, waters and natural resources. Thus, it is all the more important to find an exploitation method that is both technologically safe and politically resourceful.

Cross-border cooperation for the development of oil and gas deposits has proven efficient in both the Persian Gulf and in the Circle’s neighbourhood (the North Sea).

In order to understand why cross-border cooperation can be the best suited method to exploit the Arctic Circle, it is necessary to analyze the area’s characteristics and the regional dynamic. Thus, the following sections will analyze physical characteristics of the Arctic Circle, the history of drilling in the region, the history of relations between the arctic states, the cooperation and the joint development agreements in the extended Arctic Circle and, finally, the possible threats and opportunities to arctic cooperation.

**Physical characteristics of the Arctic Circle**

Because of global warming, the status of the Arctic has been in constant change from two perspectives: the hydrocarbons potential and the opening of new navigation routes, both important for military purposes
(Russia\textsuperscript{1}) and commercial ones (China\textsuperscript{2}).

In 2007, the summer with the lowest ice coverage ever recorded\textsuperscript{3}, a Russian submarine planted a Russian flag on the North Pole seabed\textsuperscript{4}. Speculations over a drive for resources started and it became apparent that regional jurisdiction has political weight.

Arctic sea ice reaches its maximum each March, at the end of winter. On February 25, 2015 Arctic sea ice reached its maximum extent for the year, at 14.54 million km\textsuperscript{2}. This year’s maximum ice extent was the lowest in the satellite record, with below-average ice conditions everywhere except in the Labrador Sea and Davis Strait. The maximum extent is 1.10 million km\textsuperscript{2}, below the 1981 to 2010 average of 15.64 million km\textsuperscript{2} and 130,000 km\textsuperscript{2} below the previous lowest maximum that occurred in 2011.

Arctic sea ice reaches its minimum each September, at the end of summer. September Arctic sea ice is now declining at a rate of 13.3\% per decade, relative to the 1981 to 2010 average\textsuperscript{5}. In 2014 Arctic sea ice reached the minimum sixth lowest level on record\textsuperscript{6}. According to some estimates, by mid-century, summers will be ice free\textsuperscript{7}.

Thus, ice retreat takes place in an accelerated rhythm compared to both last years’ levels and last decades’ average. This process is seen by some politicians as an environmental disaster and by others as an opportunity.

It is estimated that 13% of the world’s undiscovered oil and 30% of undiscovered natural gas resources are in the Arctic Ocean, mostly in water not exceeding 500 meters in depth. Also, it is estimated that Russia owns half of these gas deposits whereas the US owns half of the oil resources

Drilling history

Recent media attention to Arctic exploitation creates the false impression of a new trend in the development of these resources. However, the region has been successfully exploited for over four decades.

In 1968 ARCO and Standard Oil found oil in the largest North American deposit, the Prudhoe Bay, which became economically viable in 1977 after completion of the Trans-Alaska Pipeline System. Meanwhile, companies (Shell in the 1980s and BP in 2012 in the Liberty field) found more deposits but did not start production due to high costs. In the Canadian sector, natural oil seeps have been leaking since the 18th century.

Onshore drillings started in the 1920s and offshore drillings in 1972. Because of low oil prices, the production rate slowed down in the 1980s but picked up again in early 2000s. The largest Canadian offshore deposit (Hibernia) has been in exploitation since 1997. Greenland has had a more complicated history with hydrocarbon exploration and development, in part because the majority of its territory lies north of the Arctic Circle and is characterized by extreme ice conditions. In the 1970s, in offshore West Greenland, the first substantial seismic surveys were conducted and

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Exploratory wells were drilled but with little success. Even after the most recent exploration efforts by Cairn Energy in the ocean floor off Western Greenland in 2011, no discoveries of great commercial significance have yet been made. Despite all this, the industry remains optimistic as proven by Tullow Oil’s purchase of a 40% stake in an exploration block in Baffin Bay in October 2012. Norway began exploration activity in the 1970s and Russia in the 1980s. Neither country is a stranger to offshore development in extreme northern climates.

In 1984, Statoil discovered the Snøhvit development, the world’s northernmost offshore gas field. Norway has since constructed the world’s northernmost liquefied natural gas facility and has a good reputation for compliance with strict environmental standards. Russia discovered the first offshore Arctic gas field in the Barents Sea in 1983, and the first underwater oil deposits in the Severo-Gulyaevskoe field in 1986. Since then Russia continued pursuing exploration activities in its western Arctic waters in the Kara, Barents, and Pechora Seas. For Russia, represented by the state-run oil giant Rosneft, the Arctic oil and gas are a long term strategic priority that could be a significant source of production growth beyond 2020.

Rosneft and Gazprom enjoy exclusive rights to the Arctic shelf and already hold a combined 80% of the shelf currently in exploration and production. The government is looking to introduce tax incentives to make shelf exploration and production more economically viable.

Arctic oil is attractive for Norway also, due to its ageing fields in the North Sea and Norwegian Sea. Largely due to a predictable and stable regulatory environment for its offshore hydrocarbon developments, Norway has attracted more than $9 billion in investments over the past few years. It is important to note that, although a good deal of Norway’s future hydrocarbon potential lies in areas north of the Arctic Circle, the conditions do not meet true Arctic criteria, particularly in terms of the ice regime.

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9 “Opportunities and Challenges for Arctic Oil and Gas Development”, Washington DC,
Cooperation agreements in the extended Arctic

In the Arctic Circle there are precedents not only in drilling operations but also in cross-border cooperation. The history of common development follows the pattern seen in other regions. States begin by signing agreements stating that if resources are discovered, other agreements will be negotiated in order to establish the exploitation method. The next step is to recognize the deposit’s unity. Later on, states will transform signing agreements that state the exploitation method and the profit sharing scheme into state practice. Cooperation can take the form of border settlement or of implementing the unitization concept. All this represent a solid starting point for future common development projects.

Initially, agreements between Arctic states did not consider common deposits. The agreements between Norway and Denmark (1965 and 1979) only stated the necessity of another treaty on the discussed resources and the agreement between Canada and Denmark (1973) is even weaker than that, only asking that “the parties shall seek to reach an agreement”\(^\text{10}\).

Also, the US-USSR treaty of 1972 states that the two parties, in accordance with international law, will exercise sovereignty over their respective territories. However, none of the three treaties was followed by agreements detailing the problems discussed\(^\text{11}\).

The Netherlands and Denmark presented to the International Court of Justice their claims over the North Sea Continental Shelf. These claims

overlapped with Germany’s so the Court decided the two cases in a single Judgment\textsuperscript{12}.

The Parties asked the Court to state the principles and rules of international law applicable, on the basis of which they would define the boundaries. The Court rejected the position of Denmark and the Netherlands that the principle of equidistance should be the basis of boundary delimitation, stating instead that the boundary lines in question were to be drawn by agreement between the Parties and in accordance with equitable principles.

Also, it indicated certain factors to be taken into consideration during negotiations, such as the general configuration of the coasts of the Parties, the presence of any special or unusual features, the physical and geological structure and natural resources of the continental shelf in the areas involved, the proportionality between the extent of the continental shelf areas appertaining to each State and the length of its coast\textsuperscript{13}.

Recognition of the need to unitize comes with the Canada–Denmark Treaty of 1973 regarding the delimitation of the continental shelf. If a common deposit was to be found, the two parties were to reach another agreement as to its exploitation. Bilateral cooperation went a step further: the states agreed not to issue resource-exploration licenses in areas bordering the dividing line without the other state’s consent\textsuperscript{14}.

The North Sea continental shelf has several examples of cross-border unitization agreements. The first example is the 1976 unitization treaty between the United Kingdom and Norway for the Frigg gas field.


\textsuperscript{13} \textit{Ibidem}.

Subsequent agreements for the Murchison and Statfjord fields, signed in 1979, were largely based on the Frigg Agreement. Also, the United Kingdom signed an agreement with the Netherlands in 1992. The agreement is similar with those signed with Norway and it regards the unitization of the Markham field\textsuperscript{15}.

The 1976 Frigg unitization agreement was based on the boundary established in 1965. The parties would decide how to share profits and retain a significant degree of autonomy in regulating their area. The deposit was to be exploited by a single operator over which none of the parties was to have exclusive jurisdiction\textsuperscript{16}.

Norwegian state practice in the North Sea was further developed through the Statfjord exploitation agreement. In order to exploit it, the two parties entered boundary negotiations, but it took 14 years to agree on a unitization agreement. The Statfjord agreement mostly copied the Frigg agreement. The peak of this state practice came in 2005, when Norway and the United Kingdom signed a framework for the establishment of a mechanism for cross-boundary petroleum co-operation\textsuperscript{17}.

The agreement stated that deposits were to be exploited as single units\textsuperscript{18} and that the parties had considerable control over the operators exploiting these deposits. Norwegian state practice evolved from a time consuming process of unitizing each deposit to a very simplified mechanism.


\textsuperscript{16} J.L. Loftis et al., \textit{op. cit.}, p. 14-15.


\textsuperscript{18} Ibidem, cap. 3, art. 3.1.
The change from simply recognizing the importance of unitization to adopting joint development as a state practice is also seen in the 1981 agreement between Iceland and Norway. It was based on a UN Conciliation Commission report. The Commission was established to advice Iceland and Norway on continental shelf boundaries and, in 1980, it proposed a single line for both the continental shelf and the EEZ. Regarding the overlapping area claimed by both states, the Commission recommended the adoption of a joint development agreement covering the entire area thought to be rich in hydrocarbons. It also recommended the unitization of deposits found lying across the line.

The Commission’s approach was adopted in the subsequent 1981 Agreement on the Continental Shelf between Iceland and Jan Mayen. The signatories agreed to the extension of the Icelandic EEZ and to sharing of certain hydrocarbon resources. Also, they recognized that the continental-shelf and the EEZs would coincide. They further established a 45,020 km² joint-development zone that overlapped the two states’ EEZs—the Norwegian EEZ in the north and the Icelandic EEZ in the south.

Exploitation parameters were set for both sectors of the joint area as well as the percentage of each state’s participation. Finally, the agreement provided for the shared exploitation of deposits even partially located within the joint-development zone. The first production licenses in the JDZ were granted in 2013. They were also the first-ever production licenses in Icelandic waters.

Relevant when discussing this agreement is the importance of the unitization principle. This principle is the agreement’s centrepiece, even

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21 T. Praprotnik, op. cit., p. 17.
though conditions vary for the exploitation of every deposit in each subsector, located on either side of the JDZ. It applies to both present situations and future ones. Both the existing deposits (at the moment of the signing) and those subsequently discovered were to be exploited in common, so that each state’s interests are respected and the process is efficient.

The Denmark-Norway boundary dispute and resolution

In 1988, Denmark submitted an application to the International Court of Justice to decide the maritime boundary between Greenland (Denmark) and Jan Mayen (Norway). Norway argued that the maritime boundary between the two islands should follow the median lines, as previous maritime delimitation agreements involving states’ coastlines.

In June 1993, the ICJ held that the previous agreements did not determine the boundary in question and that it would, thus, have to be determined independently. The ICJ shifted the provisional median-line boundary eastward to allocate a larger portion of the shelf area to Denmark, citing the disparity in the lengths of Greenland’s coastline and Jan Mayen’s coastline and the access to fishery resources in the area. Also, the ICJ noted that access to the area’s mineral resources could also be relevant to the delimitation.

Based on the ICJ’s 1993 judgment, in 1995, Denmark and Norway concluded an agreement on the boundary between Greenland and Jan Mayen and created a cooperation mechanism regarding cross-border deposits. If a deposit extended across both states’ continental shelves and it could be exploited wholly or in part from the other side, then the parties will sign another agreement. The same would be applicable if the exploitation of the resources in the area by one Party would affect the possibility of exploitation by the other Party. The states also agreed that Iceland was to be included in the final agreements and delimitations, as
Iceland would be affected. In 1997, Iceland and Denmark concluded an analogous agreement with respect to their continental-shelf boundary, just south of the 1995 Denmark-Norway boundary. In accordance with the 1995 Denmark-Norway agreement, the Denmark-Iceland treaty noted that the northernmost boundary point was to be established in cooperation with a third party, Norway. The agreement also included a natural resource provision nearly identical to the provision in the Denmark-Norway 1995 treaty.

Similar to the 1997 Iceland-Denmark agreement is the 2006 agreement between Greenland (Denmark) and Svalbard (Norway), which outlines the maritime boundary. It went a step further than the maritime resources clause of the 1997 Iceland–Denmark agreement because it stated that a future exploitation agreement will establish the exploitation method and the profits sharing scheme.

The 2010 Norway-Russia Treaty Concerning Maritime Delimitation and Cooperation in the Barents Sea and the Arctic Ocean

After more than 40 years of negotiations the agreement set out the maritime boundary in the Barents Sea and the Arctic Ocean. Analogous to the 1990 U.S.-Soviet Agreement, the treaty specified that Russia could exercise EEZ jurisdiction over an area within Norway’s EEZ. Approximately 176,000 km$^2$ were now opened for exploitation.

The 1990 U.S.-Soviet Agreement recognized the line established by the 1867 Convention Ceding Alaska as the maritime boundary between the states’ EEZs as well as any potential continental shelf beyond them and created the so called “special zones”. The “eastern special zone” was on the American side of the 1867 line, at less than 200 miles from the Soviet

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23 *Ibidem*, p. 29.
24 Opportunities and Challenges for Arctic Oil and Gas Development, *op. cit*.
coastline but at more than 200 miles from the American coast. Conversely, the “special western zone” was on the Soviet side of the line, at less than 200 miles from the American coastline and at more than 200 miles from the Soviet coastline.

The parties agreed that in the “special eastern zone”, the US would have sovereign and jurisdictional rights that the USSR would have had without the agreement. The same went for the “western special zone”. The agreement did not extend EEZs to the “special zones”. It only gave economic rights over what would become disputed areas if both the 1867 line and the 200 mile EEZ principle had been applied. The United States ratified this Agreement and the Russian Federation applies it provisionally from the date of signature up to the present.

The 2010 “Norway-Russia Treaty Concerning Maritime Delimitation and Cooperation in the Barents Sea” demonstrates the parties’ efforts for efficient resources exploitation. The treaty creates the framework for the joint development of cross-border deposits and it attaches details about the conditions to be met by the unitization agreements, one for each deposit. The treaty offers both a safe judicial framework and the much-needed flexibility in negotiating each subsequent agreement. Also, it recognizes that private companies could play a significant role in making the unitization process more efficient.

In November 2012 Canada and Denmark signed an agreement on EEZs in the Lincoln Sea which could turn into the first step towards the settlement of other standing disputed delimitations. In 2014 Russia announced that it would increase its military presence in the Arctic. As a result, Canada decided to settle the dispute with Denmark so it could focus on other regions in the Arctic where it suspects

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Russia may infringe on territories claimed by Canada\textsuperscript{26}.

**Threats**

As we’ve seen, in the Arctic Circle there is precedent in terms of successful drillings for oil and gas. More than that, there is historical precedent in terms of agreements regarding unitization, cooperation and joint development. Thus, the region presents the needed preconditions for cross-border cooperation. Nonetheless, the region also presents threats to future cross-border cooperation.

Firstly, the climate remains the main enemy of the extractive industry in the Arctic. There are extreme temperatures for most of the year, long periods of darkness, the ice has a destructive effect on installations and the subsoil cannot be drilled in for some periods due to its physical characteristics.

Secondly, a mature oil industry requires not only drilling technology but also adequate infrastructure. From this point of view, the oil industry is severely limited by the high costs of drilling platforms and transport capabilities (pipelines, ice breakers, special ships) and by the considerable length of supply lines\textsuperscript{27}.

Thirdly, exploitation can be hampered by the long period between exploration and commercial production, as proven by previous exploitations (20 years in the case of Hibernia and Sakhalin fields)\textsuperscript{28}.

Also, despite the advanced drilling technology, the threat to the environment is still worrisome. After the 2010 Deepwater Horizon Oil

\textsuperscript{27} Arctic Oil and Gas, *op. cit.*.
\textsuperscript{28} Opportunities and Challenges for Arctic Oil and Gas Development, *op. cit.*
Spill\textsuperscript{29}, there are serious concerns that a technical fault would lead to serious environmental damages given how difficult it would be to clean the area. Those arguing that the industry cannot operate in the region were encouraged by Shell’s several conspicuous mishaps in 2012, when the anchors of two drill ships slipped (the Noble Discoverer drillship nearly ran aground and the Kulluk drillship actually ran aground)\textsuperscript{30}.

In other areas of the Arctic governments are trying to calm worries related to the environment while attempting to satisfy economic demands. Canada held an auction for more than 900,000 hectares in the Beaufort Sea and Mackenzie Delta only after the release of a National Energy Board review of offshore Arctic drilling. Also, the government called for bids to develop a five-year strategic plan to conduct oil spill research in the Canadian Arctic\textsuperscript{31}.

Those opposing drilling in the Arctic argue on behalf of upholding the Memorandum over the Arctic National Wildlife Refuge and toughening the legislation concerning the extended Arctic Circle.

Drilling in the Arctic faces not only the dangers related to the nature of the region but also political and bureaucratic ones. On one hand, despite various forms of cross-border cooperation enshrined in the agreements between Arctic states, territorial disputes continue to threaten the industry. The UN Convention on the Law of the Sea (UNCLOS) established ways of demarcating different types of maritime sectors, as well as the mechanism for settling overlapping claims.

According to UNCLOS, coastal states have the right to an exclusive economic zone (EEZ) of up to 200 nautical miles from their coast. Beyond this line, states can claim rights over seabed resources if they can prove that the seabed is a natural prolongation of their national territory. By allowing

\textsuperscript{30} Opportunities and Challenges for Arctic Oil and Gas Development, op. cit..
\textsuperscript{31} Ibidem.
governments the possibility of claiming rights beyond the 200 nautical miles line, UNCLOS created the perfect conditions for overlapping claims.

For example, Russia claims that its territory extends all the way to the North Pole, along the Lomonosov Ridge, an idea rejected by Canada\textsuperscript{32}, Denmark\textsuperscript{33} and the US. Russia, Canada and Denmark argue that the ridge is a natural prolongation of their own territory, whereas the US argues that the Lomonosov Ridge is an oceanic ridge which would mean that no country can extend its rights over it\textsuperscript{34}. Back in 2002, Russia submitted its petition to the United Nations but the bid was rejected on lack of evidence. On 3 August 2015 Russia re-submitted its petition to the United Nations claiming exclusive control over 1.2 million km\textsuperscript{2} of the Arctic sea shelf, backing their claim, this time, with what its foreign ministry calls "ample scientific data"\textsuperscript{35}.

Also, Canada has a standing dispute over the Beaufort Sea with the US. The two countries have competing views on how to draw the border. Thus, the 26 100 km\textsuperscript{2} between Alaska and Yukon are in a judicial limbo, together with their natural resources. The area is believed to be rich in resources, which could entice the parties to speed up negotiations\textsuperscript{36}. Unresolved Arctic sovereignty claims could substantially delay development of those oil and natural gas resources where economic

\textsuperscript{32} Arctic Oil and Gas, \textit{op.cit.}
\textsuperscript{36} T. Praprotnik, \textit{op. cit.}, p. 31.
sovereignty claims overlap.\textsuperscript{37}

Also, as opposed to Norway’s decision to turn unitization agreements into state practice, Canada, Denmark and the US have no record in this regard. On the other hand, red tape and unattractive fiscal policies decrease the chances of developing a profitable oil industry.

At the moment, in Arctic Alaska, the lease term is 10 years. Given the weather conditions and the lengthy permitting processes (that involve multiple federal and state-level government agencies), the time is hardly sufficient. Also, companies can lease blocks of up to only 3 square miles. The regulations can create situations when dropping exploration/exploitation plans is more profitable than continuing efforts to reach commercial production.\textsuperscript{38}

Perhaps the biggest hindrance to the exploitation of the Arctic Circle is the unpredictability of prices for a barrel of oil. On the one hand, a cheaper barrel, as it is now, means that the investments needed for Arctic drilling are not profitable. On the other hand, setting the Arctic business strategy is hampered by the long period between exploration and commercial production.

Because nobody knows how the oil industry and the global market will look like in 20 years, one might think that the oil companies cannot take the risk of being excluded from an area with great potential. It would not be the first time in history when, despite cheap oil and overproduction, multinational oil companies decide to make significant investments in regions where they would not have invested if they took into consideration the global oil prices. In this regard, we note Shell’s\textsuperscript{39} plans to continue


\textsuperscript{38} Opportunities and Challenges for Arctic Oil and Gas Development, op.cit.

\textsuperscript{39} Karl Mathiesen, “Shell gets final clearance to begin drilling for oil in the Arctic“, The Guardian, August 18, 2015, accessed at http://www.theguardian.com/environment/2015/aug/18/shell-gets-final-clearance-to-begin-
drilling in the Chukchi Sea even after the 2012 incident and in the context of the oil price dropping to about $50/barrel.

Opportunities

When analyzing the Arctic Circle, one can see the threats to cross-border cooperation and the precedent set by agreements that either settled disputes or created the necessary conditions for future cooperation.

Setting aside the steps that states take to cooperate in the development of their cross-border deposits, individual initiatives to boost the industry are worth discussing.

Given the very long time between exploration and commercial production, some countries look for new ways of attracting investments. One of these methods is changing the leasing terms, by increasing the number of years and decreasing royalties and taxes.

As opposed to the US, Canada encourages greater risk-taking by energy companies willing to commit capital and resources to the Arctic. Operators can acquire large territory with “work commitment bids” for 9 years. If discoveries are made, the Significant Discovery License (SDL) system allows operators to retain control over their field until it becomes economically viable to develop and produce the resource.

Canada is not the only country trying to cut unnecessary red tape in order to attract investments. Greenland permits operators to acquire much larger tracts of offshore blocks than the three square mile blocks offered by the United States. Furthermore, in the Northeast Greenland offshore, operators can extend the initial license term to 16 years. This area holds extremely promising resource development potential, but it also poses some of the most—if not the most—challenging ice conditions across the entire
Another individual initiative (if realized, it could consolidate Arctic resources exploitation) is the possible future change in the status of the National Petroleum Reserve in Alaska and its eventual opening towards commercial bids. The Reserve was established in the 1920s so that the American Navy, if needed, could tap into the oil of an area owned by the federal government. Multiple sectors have been leased and in the conversation about the future, multiple strong voices were heard: activists, oil companies, the federal government, local communities (some against and some in favour of drilling) and the authorities charged with the Reserve’s management. These authorities are, in turn, under the influence of numerous political parties.

Conclusions

The obvious and accelerated warming of the Arctic Circle reactivates a number of challenges and problems. On the one hand, the retreat of glaciers brings forward an opening of maritime routes with great commercial and/or military potential. On the other hand, the absence of glaciers means that the area can be exploited. At the same time, the exploitation of the melted Arctic Circle is hampered by climate, costs and conflicts between the riparian states.

40 Ibidem.
The industry has proven that it can overcome environmental challenges and that it can develop safe drilling and transportation methods. Also, interstate cooperation in the development of offshore, cross-border deposits has proven both efficient and sustainable from legal, political and commercial points of view. It remains to be seen if the Arctic states will be overwhelmed by the threats posed to the Arctic exploitation or whether they will take advantage of the opportunities for cooperation and the development of the industry in this difficult but rich region.

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