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Science diplomacy in the Arctic: Contributions of the USGS to policy discourse and impact on governance

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Research Article

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Abstract

Science diplomacy has been instrumental in facilitating cooperation in the Arctic region, yet through the projection of vast hydrocarbon potential in the region, it has also served to undermine the major transformation necessary in Arctic decision-making towards the goals of climate governance. This article surveys the translation of science from the United States Geological Survey (USGS) reports (i.e. the CARA study and Factsheet 2008-3049) on Arctic oil and gas and its transformation into common knowledge within Arctic discourse through repetition by the agents in between and its subsequent adoption into Arctic policy documents. In this process, we interrogate the production of the science underpinning US science diplomacy and the influence of this science on international Arctic discourse and policy use science diplomacy. This paper contributes to the literature of science diplomacy in the Arctic by examining the contributions of the USGS to Arctic policy discourses and its impact on Arctic governance at the nexus of science diplomacy on climate and energy.

Introduction

Two opposing points have been significant markers in popular, academic and policy discourse on the Arctic. The first point relates to the rate at which Arctic sea ice is disappearing both in the summer months and also in its multi-year accumulation, which scientific modelling finds difficult to explain outside of global warming trends (Stroeve & Notz, 2015). An unrelated but equally important data point is the projection that the Arctic will produce strategically critical quantities of oil and gas. While the Arctic has been a difficult environment for resource exploitation since nations began exploration, the changing climate reduces this barrier, and when coupled with modern technological capacity, it brings the dreams of ubiquitous Arctic resource exploitation, albeit briefly, closer to reality. Though not quite model geopolitical conditions, the tensions that surrounded the Cold War-era Arctic made a major turn several decades ago in the promotion of environmental collaboration emerging from Gorbachev's Murmansk Speech. Today, we find interstate cooperation in the region centered around the Arctic Council and that Arctic international governance is largely motivated by scientific collaboration. Yet, despite this strong collaboration toward the protection of the Arctic through environmental governance, there is an "elephant in the room" of Arctic policy discourse in their continuous recognition of Arctic energy resources as a significant factor in the discussion of Arctic governance. This paper contributes to the literature of science diplomacy in the Arctic by *interrogating* the contributions of the USGS to Arctic policy discourses.

This tension between the impacts of climate change versus the opportunities for hydrocarbon potential is the diegesis frequently repeated in the burgeoning set of Arctic policies which appeared in rapid succession since 2007. These policies emerged first in the policies of the Arctic states, which are peculiarly situated at the intersection of foreign and domestic policy, followed by policies from the growing set of observer countries to the Arctic Council. While the policies of the Arctic states included emphasis on similar and unsurprising themes given their national interests, such as sovereignty, economic development and environmental protection, it is the broader set of Arctic policies from non-littoral states which include references to energy that accentuates the focus of Arctic hydrocarbons. Although industry experts widely agree that extensive hydrocarbon development in the Arctic is unlikely for a variety of reasons, not least including the current low price point and the shale revolution, the subject of Arctic energy resources has retained a strong presence in conversations on the Arctic. This interest in Arctic hydrocarbons by the broader international community was arguably initiated by the publication of the USGS Factsheet 2008-3049. We argue that this single document, and the 2004 Circum-Arctic Resource Appraisal (CARA study) from which it emerged, has indelibly motivated the direction of Arctic policy discourse and that through this, the USGS has made a major contribution to science diplomacy in the Arctic.

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Science diplomacy and the Arctic

Science diplomacy is "about actions which either directly, or indirectly, advance a country's national interests" (Ruffini, 2020). Ordinarily embedded within the discipline of International Relations and its subdomain of diplomacy, science diplomacy has affinities with classical geography in its role of scientific knowledge of place and space contributing to the power geometries of the state and also with geopolitics. As a subfield, the study of diplomacy has come to recognise that diplomacy is more than "advising, shaping and implementing foreign policy" (Barston, 2013, p. 1) in collecting and communicating information that achieves national interests in the international sphere through formal diplomatic institutions, it now also recognises that "other factors can come into play in policy-making" (Maley, 2020, p. 3). Science, as an ingredient of evidence-based policymaking, but also as soft power, is one of these factors. While geography as a discipline has matured despite Mackinder's fears for the "end of history" for geographical institutions – with only the poles remaining blank (Mackinder, 1887), geographical knowledge and more broadly, science, has retained its critical role in diplomacy, now readily understood as science diplomacy.

Science diplomacy has been described as "backdoor diplomacy", using science and scientific collaborations as a mechanism to facilitate cooperation, build bridges and enhance relationships (Ruffini, 2017, 2020; Lord & Turekian, 2007; Turekian et al., 2015). While the techniques and actions of science diplomacy are recognised to have been practised for centuries (The Royal Society, 2010; Turekian, 2018), describing scientists and diplomats as "not obvious bedfellows", The Royal Society report on New Frontiers in Science Diplomacy launched the recent trend in a more formalised study of science diplomacy (The Royal Society, 2010, p. 1). Science diplomacy is considered to have three different dimensions where it either informs foreign policy objectives, facilitates cooperation in international science or facilitates international cooperation through science cooperation (The Royal Society, 2010), with the outcome of using science to achieve foreign policy goals. The taxonomy identifies these different dimensions as science in diplomacy, diplomacy for science and science for diplomacy (Bertelsen, 2020; Ruffini, 2020; The Royal Society, 2010). In its multiple dimensions, science diplomacy has been framed as actions advancing national needs, cross-border interest or global needs or challenges (Gluckman et al., 2017) and critically, it is identified as the intersection for the interests of science and foreign policy (Ruffini, 2017).

Within studies of science diplomacy in the Arctic, several trends emerge, many of which are strongly embedded in the dimension of science for diplomacy where scientific relations are used to build relationships. The first major trend is those studies that focus on the role of science, and specifically in the focus of environmental cooperation emerging from the Murmansk speech that culminated in the several decades of scientific cooperation through the Arctic Council (Berkman 2014; Berkman, Kullerud, Pope, Vylegzhanin, & Young, 2017; Bertelsen, 2020; Binder, 2016; Sztein & Burkins, 2015). A second major trend is found in the studies which look at the role of science diplomacy as a mechanism for non-Arctic states to collaborate or gain legitimacy for their presence in Arctic geopolitics (Bertelsen, 2015; Bertelsen & Xing, 2016; Bones, 2013; Goodsite et al. 2016; Graczyk, 2012; Langeigne, 2017; Luszczuk, 2015; Su, 2018). Two additional smaller themes consider the role of science diplomacy in the global governance that emerges from the Arctic (Berkman, 2019; Bertelsen, 2019) and, more recently, a new direction by Caymaz considers science diplomacy itself as a new form of Arctic governance (2021).

Finally, another smaller area to which this paper contributes is that highlighted by Albert and Knecht as the relationship between Arctic science and research in determining "geopolitical narratives and spatial logics about the region" (In Press). In particular where this paper focuses on the contributions of the USGS to Arctic discourse as *science in diplomacy*, as "science used to inform foreign policy, diplomatic action and diplomatic negotiations" (Bertelson, 2020, p. 235) and on its role in advancing national interests through what Ruffini identifies as the "diplomacy of interest" through soft power where a nation mobilises other resources – such as reputation – to exert influence with the result of causing other nations to "share its values" and "to reproduce its models" (2017, p. 13).

Methodology

To inform this study of the influence of the USGS on Arctic policy discourse, we conducted 40 semi-structured interviews to gain insights into the scientific and institutional processes used in the CARA study and the perceived impact of the 2008 Factsheet on Arctic policy discourse with Arctic policy and hydrocarbon experts. In addition, we analysed three forms of texts: newspapers, grey literature and policy documents. This included approximately 62 newspaper stories on Arctic oil and gas, from the Wall Street Journal, New York Times and Financial Times, which either directly cited or used measurements included in the USGS factsheet. In the grey literature, we assessed 11 think tank reports on the Arctic that cited the USGS, and finally, we assessed all Arctic policy documents published between 2008 and 2019.

The empirical substance of this discussion around the influence of the CARA study and 2008 USGS Fact Sheet on the geopolitical logics of Arctic policy has employed critical analysis methodologies, including critical discourse and policy analysis. The role of critical methodologies in research is to challenge and unpack the status quo of accepted narratives and roles, meaning and the norms between power and discourse. Using critical analysis is to adopt the assumption that language and the repetition of that language have the ability to create reality (Allen, 2017) while the how, where and why of these facts, events and practices are represented, onceptualized or interpreted based on social realities (Fairclough, 2013). These realities are ultimately founded on the privileges that are grounded in knowledge and power embedded in control of hierarchies or in unequal access to material and resources.

Using critical methodology in policy and discourse analysis is particularly expedient in the context of the Arctic policy domain by exploring relations between problematisation of the Arctic and the framing of the Arctic as a space requiring policy solutions. Through this analysis, certain flaws embedded in the Arctic policy process and discourses emerge from the scientific foundations to the contextual assumptions underpinning the logics of this policy environment. The strategy for this research includes two dimensions of critical analysis. The first dimension is an evaluation of the key information from the USGS publications, especially the CARA study, used and repeated by non-specialists on geology, such as the media and social scientists, and subsequently incorporated into Arctic policy documents. Secondly, we have interrogated the process and institutional context underlying the CARA study and the publication of the 2008 factsheet, evaluating how this same information is viewed from the perspective of a geological

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specialist. This process has allowed us to evaluate the authenticity of the translation of this information from science to discourse to policy and the use of this information by non-specialists. Set in the context of the policy development process, these perspectives are evaluated for their impact on the trajectory of Arctic policy discourse and development.

To evaluate the discourse produced by the agents in between science and policy, the media sources gathered for this research include published articles that specifically mention the USGS or their estimates of Arctic hydrocarbons and how these articles represent the information. The articles, published between 1995 and 2017, were evaluated for their quantification of fossil fuel resources and the terminology used to describe the hydrocarbons as well as the language of the article titles representing the context of this information. The sources have been selected based on the accessibility of their archives and on the likelihood of their readership, including policymakers, lobbyists and academics; these sources are certainly not the only places using this information, but they do demonstrate the trend in media reporting on the Arctic. We also evaluate the grey literature from think tanks or research institutes that cite the USGS. The policy sources gathered for this research include all Arctic policy documents produced by Arctic states and non-Arctic states from 2006 to 2019. It is interesting to note that there is a strong reliance (especially in the grey literature) for source citations to include newspaper articles as a primary source of information. While this research included only newspaper articles with strong reputational standards for reliable information and journalism, the citations found in the grey literature were less rigorous.

While this study is critical of the impact of the USGS reports on Arctic geopolitical discourses, it should not be read as a criticism of the scientists and the scientific merit of the geological studies behind the reports. A limitation of this research and analysis is the use of only English-language documents, which has the effect of emphasising US-Anglo/European business and political concerns. A second limitation is that it has relied on algorithms and boolean expressions to identify the documents for analysis, which may have inadvertently omitted relevant materials.

Geopolitical context

The geopolitical context of the Arctic has changed radically in a relatively short space of three decades. Emerging from the heavily militarised space of the Cold War, the international context of Arctic discourse was initially focussed on informal environmental collaboration, beginning in the *Arctic Environmental Protection Agreement 1991*. This accelerated into more formalised, but still flexible, institutionalised cooperation situated in the forum of the Arctic Council in 1996. Through the efforts of science diplomacy, this has since evolved from a discussion chamber for Arctic-state actors and permanent participants on four thematic pillars, morphing into a body with a permanent secretariat and a host of non-Arctic observers. The Arctic Council is responsible for having facilitated several international agreements on Arctic maritime safety, scientific collaboration and a moratorium on fishing the high seas of the Arctic Ocean. As the central pivot of Arctic international affairs, the members of the Council have resisted pressure to negotiate an Arctic Treaty, instead emphasising the right of states to make decisions regarding exploiting the resources of the region within internationally defined parameters on legal spaces of territory, using observer status of non-Arctic states in the Arctic Council to confirm that right through acknowledgement of the Arctic states' sovereignty.

During the period when the USGS Factsheet was published, the geopolitical environment of the Arctic was in rapid shift, a change that captured the gaze of many, including media, academics and policymakers. In 2007, a mean record was set when the sea ice covering the Arctic reached its lowest minimum ice extent since satellites began measuring in 1979. Global warming was given as a key factor in this decline (NSIDC, 2007). It was viewed largely in the context of improving conditions for resource exploration. Around this time, moment, an expedition was launched to place a Russian titanium flag at the seabed of the North Pole. Although widely perceived as having no legal significance, this event itself is situated in the timeline of many Arctic littoral states preparing their extended continental shelf claims to the UN Commission on the Continental Shelf per the 10-year deadline imposed by ratification of the United States Convention on the Law of the Sea (UNCLOS, 1982). With the USGS publication emphasising the potential of petroleum in the continental shelf, these factors together created a whirlwind of interest in Arctic international relations.

The significance of Arctic oil and gas is situated in the broader conversation of global energy supply and more directly in the context of national energy security agendas. For decades, a focus on dwindling global supply of hydrocarbon resources alongside rising demand resulted in domestic planning to reduce dependency on foreign energy, with the drive to secure energy supply resulting in foreign policy actions from strategic alliances to actual warfare (National War College, 1974; US House of Representatives, 2007; US Senate, 2000). In this context, the USGS' suggestion that significant supplies of oil and gas awaited in the Arctic created a climate of excitement that these supplies could extend peak global supply and provide energy security for the lucky owners and revenue streams for the developers. The Arctic was situated by USGS scientists as "the next great frontier" (Ahlbrandt, 2002, p. 1092). Accompanied with projections of the supply required to meet consumption demands, growth and changing source locations, it was suggested that significant international cooperation would be required given that most of the supply is located offshore.

Speculative projections of energy potential in the Arctic are nothing new and although the focus has shifted from whale oil in the mid-19th century to hydrocarbons today (Wood-Donnelly, 2016), the mindset of the Arctic as a resource cache prevails. As a spatial domain with multiple categories of jurisdiction, Arctic offshore supplies have a complicated matrix of exploitation rights based on the law of the sea. Emerging from both customary and treaty law, including the contemporary legal framework of the UNCLOS (1982), the ocean spaces of the Arctic are divided into territorial waters (absolute sovereignty), the exclusive economic zone and the continental shelf (exclusive exploitation rights) and the high seas. If the set of differing rights associated with the different zones is not complex enough, the situation is compounded by the rudimentary implementation stage of UNCLOS throughout this timeframe, as well as several ongoing minor maritime disputes.

The USGS and their Arctic reports

Situated in the United States' Department of the Interior, a branch of the US government with responsibility for land and natural resources, the USGS has a long history of supporting the government with the scientific basis for decision-making since it was created by Congress in the Organic Act of 1879 (Rabbitt, 1975). As a

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bureau of the US Department of the Interior, and its only scientific agency, it has a role in reporting to Congress on fossil fuel and water resources, natural hazards and ecosystems. As an organisation, it sits at the crossroads of science and policy and its scientific employees have research expertise in geology, biology, geography and hydrology. The mission of the USGS is "to monitor, analyse, and predict current and evolving dynamics of complex human and natural Earth-system interactions and to deliver actionable intelligence at scales and timeframes relevant to decision makers" (USGS, 2021).

One primary function of the USGS is mapping and surveying territories of the USA (USGS, 2019) and cataloguing mineral resources of national interest; its role is not to evaluate the moral appropriateness of resource exploitation. The organisation's genesis came in providing scientific knowledge for the early commercial American coal industry of the late 1700s and 1800s (Eby & Campbell, 1944), and eventually, it was involved in railway surveys in support of US westward territorial expansion. In terms of financing, the USGS is a giant in the world of geological surveys with an annual budget far exceeding that of other prominent geological surveys. For comparison, its 2021 budget was approximately $971 million compared to the British Geological Survey's annual turnover of approximately £45 million, with nearly half of that budget funded by the public and private sector (BGS, 2021). The USGS budget funds vast scientific work including monitoring worldwide earthquake activity, magnetic field activity, oceans and astrogeology research. It is an organisation with a dense network of global research connections and the CARA project reflects this, involving collaborations with partners across Europe, Russia and Canada.

Seen largely as an obvious follow-up study to the 2000 USGS World Petroleum Survey, the CARA study was launched at a technical workshop in Ilulissat, Greenland, organised by the Geological Survey of Denmark and Greenland (GEUS) and the USGS. In time, the CARA study resulted in three key publications; the Circum-Arctic Resource Appraisal (CARA) Professional Paper 1824 was slowly published in sections over the period 2008–2019, a USGS factsheet titled "Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle" (2008) and a scientific journal article co-authored by the study's lead geologist- "Assessment of Undiscovered Oil and Gas in the Arctic" (2009). The 2008 factsheet stated that "90 billion barrels of oil, 1,669 trillion cubic feet of natural gas, and 44 billion barrels of natural gas liquids may remain to be found in the Arctic, of which approximately 84 per cent is expected to occur in offshore areas" (USGS, 2008, p. 1). The *Science* article alluded to "about 30% of the world's undiscovered gas and 13% of the world's undiscovered oil may be found there, mostly offshore under less than 500 meters of water" (Gautier et al., 2009, p. 1175). The report documenting the study in full detail, CARA Professional Paper 1824, stated that "44–157 billion barrels (BBO) of undiscovered conventional oil and 770–2,990 trillion cubic feet (TCF) of conventional natural gas could be found north of the Arctic Circle" (Gautier & Moore, 2017, p. 4).

Beyond the presentation of percentages and volumes in the USGS document and the repetition of these numbers in Arctic discourses, interrogating the processes behind the factsheet in respect of the translation of this knowledge into policy discourses is a critical component of this discussion. With the scope defined by the USGS, the CARA study had four initial inputs: Colleagues and Literature, Tectono-stratigraphic Map of the Arctic, Geologic Analogue Database and Information Handling Services (IHS) Energy Database (now IHS Markit). These initial inputs fed into a more refined level of inputs: a Basin Evolution Chart/Models and Total Petroleum System and Assessment Unit Models. To help explain the nature of the highly uncertain resource estimates, the methods and inputs used by the USGS to generate the estimates, described with some oversimplifications of technical terminology, have been used in this discussion of the USGS methodology.

The process began with an Assessment Review Committee who discussed, evaluated, revised and finalised the forms of input data to be used, drawing on their scientific experience. Following this, the USGS constructed a map of the circumpolar Arctic using geological maps already available for different parts of the Arctic; however, at the end of the process, this map still had significant white spaces. To fill in these gaps, scientists performed a gap analysis of these areas by using any gravity or magnetic data available to map the edges of the basins, the geological rock accumulation in a low lying (often below sea level), and to estimate the approximate shape of these basins. In this process, they looked systematically at every basin accumulation and whether there was any seismic data or wellbore data available from external sources. Despite this, many white spaces still remained and an additional technique, analogue modelling, was used to project what could lie in these blank areas.

Using analogue modelling is to extrapolate comparable geological data from other regions and basins around the world; this method was widely used for the CARA assessment because of the sparsity of data in the Arctic region. As the USGS has studied almost every major basin in the world and maintains a database of all global data of these geological basins, there was ample archival data available for use. In the database, these basins are categorised based on identifiers including shapes, compositions and geological materials, such as "extensional basin composed of clastic rocks". In this process, if an Arctic basin was found that was "extensional", they would compare it to other extensional basins from another region of the world taking a median evaluation of similar basins in the database. However, the information in the basin database was, in some cases, already based on sparse and older data produced anywhere between the 1960s and early 2000s, with varying technological sophistication. They also adjusted other basin-related parameters where they felt it appropriate, although no details of this methodological process are included in the published study because they were not officially recorded for publication.

The methodologies used in the Arctic study are common in geological sciences and the USGS has a reliable and consistent methodology in its statistical modelling. Among geological scientists outside of the USGS, the research published has a reputation for reliability, as well as for transparency given that the scientists also frequently publish their studies in journals. Behind the simplified 2008 Factsheet, the CARA study is made up of 30 chapters, divided up into 5 sections based on geographical areas: North America, Greenland, North Atlantic Ocean, Eurasia and the Arctic Ocean. Both the introduction and methodology chapters were published in 2017 and most of the report was completed and published between 2017 and 2020, nearly a decade after the 2008 Factsheet made its entry into Arctic discourse.

The intent is not to attribute this delay to anything other than usual public sector delays in the civil service (e.g. competing project deadlines, staff changes, staff retirements) but more to highlight a process of prevailing scientific knowledge production informing a wide range of people and processes with no possibility to interrogate the methodological underpinnings of such data. Even if a non-geological user had the specialist knowledge needed to understand the methodology and content of the CARA study, most of the study

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was not available for analysis until its publication in 2017, some 9 years after the 2008 Factsheet of the CARA study had made its impact on Arctic discourse. While the CARA study, as with any similar geological study, can be viewed in the context of a lack of information and data available for the Arctic regions and is typical of this type of scientific work in geological sciences, the 2008 Factsheet does mention this uncertainty in its reference that "probabilistic results reflect the wide range of uncertainty inherent in frontier geological provinces such as those of the Arctic". (USGS, 2008, p. 4). This statement was lost in the announcement of anticipated oil and gas quantities or in the geological language.

The report clearly states some of the uncertainties, for example data sparsity and that "technically recoverable" does not consider economic factors, arguably critical factors in the history of oil and gas exploration. With no economic considerations included in these initial estimates, the results are presented without reference to costs of exploration, development or oil spill mitigation which will be important in many if not all of the assessed areas. Perhaps more importantly, the report also does not make mention of or consider atmospheric or climatic factors, such as methane and carbon emissions that would result from the combustion of these resources. It also does not consider the related health aspects: how many additional deaths could occur every year as a result of additional air quality deterioration from additional burning of these fossil fuel resources. Ecological factors are also not mentioned, including the impact on ecosystems where rigs and production platforms would be operating and the probability of an oil spill in a given area and nor is their mention of social factors. In addition to speculation on quantities, arguably all of these factor categories should be considered when discussing fossil fuel potential in any area, but particularly in a report of the Arctic regions. While perhaps this is not the responsibility of the scientist undertaking geological surveys, it certainly should be a part of science communications produced for public consumption.

Discussion

Science is rarely produced "just because"; it is often produced for some purpose and usually produced for the funders of the science (Mees, 1917). As part of the US federal machinery and with leadership by political appointment, the role of the USGS in facilitating science for evidence-based policy in the domestic sphere is widely acknowledged to be part of its organisational remit. Yet when its role transcends into the international sphere, this transforms the work of the USGS from the domestic science-policy interface into that of science diplomacy. In this regard, the impact of the USGS through science diplomacy in Arctic discourse has been nothing short of phenomenal. This has happened in several ways. First, and not related strictly to the Arctic, their knowledge of hydrocarbon potential globally has significant implications for US energy policy and energy security and will contribute to the foreign policy motivations of the US worldwide.

In the Arctic context, publications of the science underlying the CARA study would have likely gone unnoticed by a broader audience. The USGS factsheets are seen as "a powerful way for USGS scientists to rapidly communicate the results of their work directly to the public . . . they increase public awareness . . . [and] often touch on sensitive issues and must present a clear, unambiguous message to the general public" (Stauffer & Hendley, 1997). The 2008 Factsheet was delivered to a public audience with what should have been seen as a clear message: the message received was that the Arctic was rich in oil and gas.

Though there are a plethora of references to the existence of vast Arctic oil and gas resources, there is little definitive knowledge about the totality of oil and gas energy resources in Arctic regions. Despite this paucity of data, speculator expectations of a bonanza have been high, in a large part due to perception and interpretation of USGS publications. Yet several factors make the Arctic an increasingly unattractive frontier for hydrocarbon exploration, not least the price of oil in the global markets, poor yields in test sites, a shifting regulatory environment and the technological innovation that launched the shale revolution.

The USGS is, in fact, not the only source of information on Arctic hydrocarbons. There also exists a 2006 report of Arctic hydrocarbons published by the consulting company Wood-Mackenzie – which started with a noticeably lower estimate of Arctic hydrocarbons before an additional downgrade of that report in late 2007. This difference can in part be attributed no only to the use of different methodologies, but also to the differences in their organisational purpose: Wood-Mackenzie uses science to inform commercial products, while the USGS uses science to inform policy. While Wood-Mackenzie is a reliable source for data by the industry and the USGS information only appears as a minor footnote for in-house presentations, their report is infrequently cited in Arctic discourse. This difference demonstrates the strength of the USGS reports in both reputation and acceptance by the broader international community. A second point on the role of the USGS in science diplomacy is the lesser recognised aspect of international scientific collaboration. As an actor of *science in diplomacy*, the USGS scientists are seen as an important piece of the broader geological scientists' network. While formal collaborative projects with the USGS are infrequent, in part due to their funding structure and in part due to their own systems and methodologies for scientific study, knowledge and information sharing (where it does not compromise national security) between scientists is common. In the context of the Arctic, many geologists with expertise on Arctic hydrocarbon geology also have expertise on continental shelf geology. There is a general reflection in the geological community that there is a direct correlation between these two knowledge areas and state interest.

In fact, partly due to the limited availability of the expertise needed for this type of research, many of the same scientists work together on different "map-making" projects. This includes personnel overlaps between the CARA study and another study creating a "Tectonic Map of the Arctic", a project aiming to fill in gaps in geological knowledge of a great variety of tectonic crustal domains and overlying sedimentary accumulations in several Arctic basins. Within the wider geological science discipline, there is an intrinsic scientific interest and motivation, not to mention historical precedent, in map-making regardless of what is being mapped or who may eventually use that information. Even within natural science circles, there is a distinct lack of questioning the USGS on Arctic oil and gas estimates, and no visible discussions and debate about what the CARA estimates mean for policy directions.

Geological scientists' involvement has not directly led to the development of any international governance mechanism for the region, such as an Arctic Treaty; rather, the majority perspective is that it has contributed to the prevention of such a framework. Geology has played a dominant role in the scientific landscape over the past few hundred years and has evolved, in part, for and is intertwined in the processes and facilitation of the industrial revolution and the resulting energy systems existing today. The dominance of Western science can be seen in the dominance of the USGS and the knowledge it produces, embedded within a

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wider system of Western science knowledge production and modern resource exploration and exploitation. Geological knowledge production around resources serves many purposes, with both deep historical roots in colonial histories and consolidation of power and sovereignty of modern states over citizens and indigenous peoples (Simpson, 2019), while at the same time offering innovative and valuable knowledge about the natural world and providing solutions to some of the leviathan challenges faced by global society.

The work of the USGS in providing geological resource estimates (without economic or environmental analysis) positions its outputs as part of both the geological and political realms by providing geological knowledge and information to be used in policy. Although the USGS positions itself in a non-advocacy role, they have the explicit aim to directly support the Department of the Interior's "mission" of protecting and responsibly managing the Nation's natural resources' (Pierce, 2009) and to promote "national interests through science diplomacy" (National Research Council, 2012, p. 8). Without economic or environmental analysis applied to geological resource estimates, they very much stay in the geological and political realm, that is, provide geological information and perform a political role as a tool of soft power. As a long-standing and credible scientific agency, the USGS is positioned to serve as a reliable and legitimate source for geological information vis-à-vis Arctic fossil fuel resource information. This reputation contributed to the confidence of users citing the reports on the Arctic produced by the agency.

The Arctic oil and gas discourse change with each publication of information from the USGS. Before the 2000 global assessment, most of the conversation of Arctic energy came from US sources and focused on terrestrial opportunities in Alaska (i.e. Prudhoe Bay). After the 2000 global assessment by USGS scientists, the discourse began to frequently refer to 25% of global oil in the Arctic, although this discourse was limited and still largely from the US sources. With the publication of the 2000 (USGS, 2003) and 2002 (Bird & Houseknecht, 2002) studies, the language shifts away from reporting specifically on the US Arctic to reporting on Arctic energy resources in a broader context. This remained the accepted knowledge of Arctic resources until the 2008 USGS factsheet was published. Even though the data feeding into the 2008 study consisted similarly of only 2D seismic studies from older studies (when technological advances had made 3D studies possible and were predominantly used by industry for their internal oil and gas estimations), the representation of the quantity of resources in the Arctic changed and so did the volume of discourse and, ultimately, policy.

There is a noticeable impact of USGS publications on the reporting of oil and gas in the Arctic, not only in the frequency, but also in the language used and the citation patterns of that material. While the earlier coverage frequently directly cited the specific USGS report they were drawing from (i.e. 2000, 2002), in the years after the publication of 2008 USGS Factsheet, those using the information often left the specific document uncited. However, through consistency in the numbers reported, there is an indication that this knowledge from the USGS was accepted and well-understood. It is an important aspect that this reporting of science by the agents in between – academics, journalists and analysts – was entirely uncritical of the knowledge emerging from the USGS reports and relied on the institutional credibility of the USGS to underpin the presentation of the Arctic as a site of hydrocarbon potential.

Of striking import is the technical language used by journalists and academics to describe the contents of the report. When representing the USGS materials, authors made word choices that, while appearing plausible to the everyday reader, in fact, grossly misrepresent the contents of the USGS report. This includes the use of terms such as "undiscovered reserves" and "recoverable". To the layperson, this would translate as "treasure waiting to be found", but to a geologist it reads as "unknown" and "technically recoverable" if in existence. In its reports, the USGS report does not actually claim that these resources in the Arctic are "recoverable" as it is an impossible condition to be both "undiscovered" and "proven recoverable". However, by taking language shortcuts, without clear understanding of the terminology being borrowed from the geologists' toolkit, journalists and even academics made errors in representing the scientific knowledge to policymakers.

Contributing to the discussion of science diplomacy, policy analysis literature contains many clues on the wider policy process, which includes the steps that transform raw science into policy documents (i.e. Cairney, 2016; Fairclough, 2013; Kingdon, 2014). From this wealth of existing literature, we apply the findings of research on policymaking and critical analysis methods to our analysis of the logics underpinning Arctic geopolitics and policy and how science has been translated into Arctic policy and governance. Policymakers have an important role in setting the agenda for national approaches and strategies towards certain issues. Rarely are these individuals themselves experts in the issue areas in which they are creating policy, with temporary appointments and shifting legislative agendas. The result is that policymakers must rely on experts and external information to make decisions on a range of complex issues framed in the context of the national policy environment.

Policymakers gather information and make choices based on that information, and in this process, they cannot individually gather and analyse all the information. To create viable and credible policy, policymakers rely on "shortcuts, such as by using information from sources they trust and by adapting that information to the beliefs they already hold" (Cairney, 2016, p. 5). It is therefore entirely reasonable that policymakers use qualified scientific knowledge as information underpinning their policy prescriptions to a defined set of issues. Yet raw scientific data is rarely directly useful to policy writers, so rather the uptake and exploitation of science must proceed through a policy intake process where science can be converted to policy through communication and dissemination channels.

These communication and dissemination channels create the opportunity for knowledge exploitation by policymakers, and media, think tanks and some academic publications contribute to these channels. While newsmakers focus on events and moments, policymakers are concerned with long-term issues and each side is using the other to create the narratives around the events and issues which make up the corpus of their roles. As a result of these needs, the relationship between media and policymakers is symbiotic in nature (Dearing & Rogers, 1996), and it creates a point for scientific evidence to enter this equation. Since the "main channels by which policymakers are informed about scientific evidence are the press and media, lobbyists and parliamentary hearings" (European Commission, 2008), ultimately an issue area that receives heightened coverage by the media also results in increasing policymakers' focus on an issue, a rather symbiotic lifecycle (Yanovitsky, 2002).

Before the publication of the USGS (2008) Factsheet, only a few of the Arctic countries had Arctic policy documents. Since this

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time, there has been an explosion of interest in the Arctic region and now Arctic policies have been published by all of the Arctic states. For the Arctic states, policy documents reflect both domestic agendas and international concerns. While all of these states have "land" in the Arctic, the documents contain policy that spans both domestic and international space and includes policy over space that has indeterminate sovereignty status. In this way, they are both internal and foreign policy. In recent years, it has become a trend to appoint an Arctic ambassador, indicating the importance of the region in international relations.

Policy documents have also been produced by observers to the Arctic Council and by other political entities – such as the EU – and despite the stark difference in their relationship to the Arctic, these policies bear a striking resemblance to one another both in language and in content. The real *coup d'état*, though perhaps unintended, is the direct uptake of USGS science and knowledge into the documents of other states' Arctic policy, which recognises the sovereignty of the Arctic states, including its vast resources. Many of these documents directly cite the USGS publications and most of the documents refer to the two main dichotomies of the region: the challenges of climate change and the presence of vast resources. For non-Arctic states, Arctic policy is an international ambition and policy documents are cobbled together to align with other policy issues and, at the same time, reflect interests in the Arctic. Yet what serves as the foundation for the underlying drivers of this interest?

To take a few key examples which highlight the growing interest over the past decade, the first-ever Chinese white paper setting out China's Arctic ambitions was published in 2018. The paper's four proposed "policy propositions" set out the clear aim to "use" the Arctic and this theme of utilising the Arctic threads throughout the document (Government of the People's Republic of China, 2018). Perhaps more interestingly, an EU briefing document analysing the Chinese white paper, specifically cites the USGS resource estimates as a key motivating factor for China's interest in the Arctic, outlining the ongoing oil and gas activities in the Arctic the country is involved in (Grieger, 2018). The UK and German policy documents from 2018 and 2019, respectively, present the Arctic resource potential without any direct reference to the USGS CARA study but are clearly influenced by it. In the energy and extractives section of its policy document, the UK government states categorically that "supplying this demand will require exploration of new potential resources, with the Arctic, with its significant hydrocarbon reserves, potentially playing a major role" (UK Government, 2018, p. 27). This certainty on the existence of vast oil and gas resources is mirrored in the German policy document. None of the geological uncertainty, either contained within the CARA report or more generally following an analysis of the full CARA report, is communicated or alluded to in these policy documents when discussing Arctic oil and gas.

While policy on the Arctic published by non-Arctic states would be classified as foreign policy, the intent behind Arctic policies produced by Arctic states is often not quite domestic policy and not quite foreign policy. This demonstrates that Arctic policy is formed through the exchange of ideas across international contexts and that authority and legitimisation of this content are created through their references to other texts, dominating interpretations of reality (Aradau & Huysmans, 2013). Common themes amongst these documents include sustainable development, sovereignty, climate change and governance. Not only do non-Arctic states frequently legitimise the Arctic states' claims to resource exploitation and agenda setting in the Arctic, but they also reinforce the focus on the importance of the Arctic as a site of economic value. It is only in the most recently published documents that the language of responsibility for environment, climate and sustainable use of resources begins to emerge.

This cycle of absorb, adopt and project acts to continuously legitimise the dominant narratives of Arctic geopolitics. Policymakers rely on different types of information sources, including media, special interest groups, think tanks and specialists, such as government agencies or academics to inform their decisions. Media is a useful tool for the policymaker, with longitudinal research showing a strong and positive correlation between the media and policymakers (Tan & Weaver, 2007). The heavy citations of the USGS document, restatement and allusions to vast quantities of Arctic hydrocarbons in media, academic literature and policy documents demonstrate that fact has become normalised into the logics of the region, notwithstanding the actual science and scientific language behind these assumptions.

In addition to social scientists, academic geologists outside of the USGS accept the main premise of the CARA study and cite the reports to substantiate a claim of extensive oil and gas resources in the Arctic without mention of the speculative nature of the results (Haggart, 2015). More widely in natural science publications, the USGS numbers also appear in the context as motivation to explore scenarios for oil and gas as the ice melts. Although the inherent motivation for interest is the same as exists in the policy cycle, there is likely an implicit understanding of the nature of data limitations and geological uncertainty contained within this report within the geological discipline, although this is not addressed explicitly in publications citing the CARA study which are often geological and/or Arctic in nature and not focussed on oil and gas specifically. In these documents, the estimates would be considered as guidance, but would not take the place of rigorous fieldwork (borehole drilling and testing) to gain a more accurate understanding of what might be extractable.

So even though the CARA study was produced without enough new data for a study area of this size, predominantly using old data and produced with methodologies that provided only reasonably educated guesses of what might be possible, how this information was released for public consumption resulted in entirely different outcomes. The widely-read 2008 Factsheet did refer to the non-standard methodology due to sparse seismic and drilling data but made no appraisals of how this affects the reliability of the measurements. Rather the tables of numbers and brightly coloured maps all indicated certainty of hydrocarbons in the region. While the 2009 *Science* article includes much of the same information, it ends by saying "these *first* estimates are, in many cases, based on *very scant* geological information" (Gautier et al., 2009, p. 1178). Although these reports acknowledge the lack of evaluation of technological or economic risks, they make no mention of environmental, social or political risks. Possibly in light of the surge of interest and information in the USGS materials, the introduction chapter of the CARA study (2017) nods to a changing political, economic, environmental and scientific realm with regards to Arctic climate change and fossil resources since the completion of the 2008 study and also refers to the uncertainty. Yet this may have been too little too late to change the impact of the CARA study in the realm of science diplomacy and the underlying logics of the geopolitics of the Arctic.

At this pivot of opportunity, the impact of climate change on the Arctic region places the policy focus of hydrocarbons at an uncomfortable juncture. Yet with recent reports from the International Panel on Climate Change and the glaring evidence

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of the impacts of climate change on the Arctic region, from thawing tundra to warming sea temperatures, the conversation on the Arctic should be substantially different. The intense discourse on hydrocarbon development in an age when the focus should be on sustainable energies harks to *raison d'etat* and a policy development rooted in geopolitical logics that should be confined to the past, and which quite possibly reveals the inadequacy of policymakers to take the necessary steps towards a net-zero future. Taken together, the national and international background to the Arctic policy domain reveals a complex interplay between the strategic (but archaic) interests of the state, agenda-setting towards status quo economic development, environmental pressures, and finally, growing international calls to make radical and transformative changes towards net-zero economies.

Concluding remarks

What is remarkable in this entire process is not that this particular science and scientific agenda has been used in US policy and foreign policy, but that this material has been widely uploaded into the Arctic policies of many states. Through repetition of this study, scholars and policymakers internationally have in fact, been the representatives of US national interest through promoting the science created for supporting US national interests and foreign policy. The observations on the symbiotic relationships between science and policy and of scientists and policymakers are neither to denigrate the importance of science and research, nor to undermine the need for effective policy supported by scientific knowledge. Nor can this article be read as a critique of the system that perpetuates these institutions/structures. It is, however, a space to reflect on the underlying logics of Arctic policy.

The USGS has played a pivotal role in Arctic science diplomacy through their production of objective, scientific assessments that have been used as science in diplomacy, framing the region in the dichotomy between the Arctic as a region of economic/resource opportunity or as a place of environmental and climate concern. The science diplomacy that has culminated in the IPCC reports and the Paris Agreement should be shifting the discourse of the Arctic toward the possibilities of demonstrating the potential of international governance towards climate agendas, instead the USGS reports have been used as a significant force in focussing the discourse on resource exploitation.

The role of the USGS in supporting US domestic agendas and national interests is to be expected, given how it is situated in the US bureaucracy. Scientists from the bureau not only prepare information briefs for congressional committees, but also appear in person to testify to Congress. In the national context, the bureau serves an important role in ensuring the government has domain awareness, not only over exploitable resources but also in issues of human security. US Arctic policy has historically emphasised the importance of resource exploitation and of resource security. Since the Arctic entered into the discourse as a site of potential hydrocarbon energy reserves at a moment dominated by energy insecurity and the OPEC crises of the 1970s, the role of the USGS in identifying potential energy resources for national consumption does not seem unreasonable; this would be entirely expected in an era of gross energy insecurity. While energy security, and especially the security of supply, is a critical point of national security agendas today, what proves less expected is the dispatch of that scientific assessment into the public domain. The scientific assessment does not merely transfer from the USGS to the US Congress, either through reports or personal testimony.

The express role of the USGS in science diplomacy is somewhat less explicit. While there is certainly a list of expressed areas where the USGS is intended to support the national interests of the United States, the priorities of that list are unclear. For much of the post-Cold War period of Arctic geopolitics, US practice has "acted as a stabilising force in Arctic politics as their foreign policy reinforces and guides the expectations of the behavior" of other states with interests in the Arctic (Wood-Donnelly, 2018, p. 73). It would seem that the role of the USGS is not only to inform policymaking for the US domestic sphere, but also to pursue its mission of science diplomacy. It also serves to inform an external audience of the rationale behind US policymaking and signals to others how they should be expected to respond to those national interests. As part of this role, it has made USGS resource reports of Arctic oil and gas available to non-professionals in an easy-to-digest format where it is uploaded for reproduction in analysis and discussion of the geopolitics of the Arctic region.

While the CARA report produced scientific knowledge for use by geologists and industry experts, the USGS Factsheet and the *Science* article have proven to have immense uptake in the discourse on the Arctic and were meant for a wider audience/public consumption. Yet some scientists and industry experts seemed to be surprised at the impact of this piece of science communiqué on the public and international policy spheres. The long-term results are that the facts of this report have become so accepted in Arctic discourse that the documents went from directly citing the USGS Factsheet, to casually referring to the USGS as the source of information, to simply repeating the accepted fact of the presence of significant quantities of proven, exploitable oil and gas in the Arctic. This occurred widely in print media reports of the Arctic, which became a significant body of reference for both grey and academic literature and, ultimately, in Arctic policy documents.

While many Arctic policies are not powerful instruments in themselves, they often represent the concerns and interests of government bureaucracies or act as a conduit between other policies and regulatory instruments, bringing the national agenda to the international level. At the pivot of the interests and policy of the actors in Arctic geopolitics is science diplomacy. Given the role of scientific knowledge and science communication in influencing policy agendas, we consider the impact of scientific knowledge on policy environments when there is reliance from policymakers on the knowledge presented from the sciences by intermediaries, such as media and academic science communication. We argue that critically evaluating the role of scientific knowledge in policymaking creates the opportunity for a re-evaluation of the role of science diplomacy in the Arctic. We also suggest that removing oil and gas from the logics underpinning geopolitical decision-making is necessary to remove existing obstacles to climate governance.

Driven by the values of science such as objectivity, truth and rationality, science diplomacy can bring about a better international order. Science is directly intended to contribute to the development of human knowledge and to inform decision-making towards better and more productive policy. With much of science, as well as research and development historically and currently funded by governments, what is less clear is how those values are translated when science becomes an instrument of national interest and foreign policy and laden with other values, world views and subjectivities. From a scientific contribution, the values of science underpinning the science of global warming

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and climate change should be identical to the values underpinning the science of oil and gas. In the context of the Arctic, energy security and climate security are instead framed as opposing discourses.

With the dimensions of science for diplomacy or diplomacy for science, the outcome is rather clear with the "universality of science acting as a middleman" (Ruffini, 2020, p. 2) by its contribution "through the use of non-ideological language, to the mitigation of international political differences" (Copeland, 2016, p. 629). Assuming the scientific values behind these two discourses are indeed equal, the impact of climate and environmental science at the nexus of Arctic science diplomacy should be equal to that of the science underpinning energy. Yet "even worse, some politicians are using the effects of climate change to justify the urgent expansion of oil and gas exploration and development" (Sidortsov, 2016, p. 2). For science in diplomacy and for science produced directly to contribute to national interest in foreign policy through science diplomacy, it is seen that the translation of these values becomes murky. It becomes murky because science is no longer used to pursue the values of science but is instead used to pursue the values underlying the national interest.

In this process, the values of science are subverted to the objectives of the national interest, a point which has been little realised by those who continuously employ and repeat the "facts" of science in Arctic discourses, who themselves unknowingly become agents of science diplomacy by normalising these facts into the discourse. In this process, the values of science are reduced to the mere geopolitical logics that this scientific knowledge informs. In this case of Arctic discourses, the dominating logic is that of energy security, sovereignty and the mitigation or prevention of environmental damage – not through abstinence of activities that could lead to harmful outcomes, but through instruments that deal with the consequences of hydrocarbon development and increased economic activity in the region.

If the values in and of science were considered equally, then the underlying focus on the Arctic would be not on how the decision-making authority afforded through sovereignty (Wood-Donnelly, 2018), and the international recognition of that sovereignty could achieve energy security and resource dominance. Rather, there would be at least equal focus on how to achieve climate security despite the needs for energy security. With the prioritisation of resource sovereignty as an objective of national interest and science diplomacy, the idea of an Arctic treaty based on the model of the Antarctic Treaty System is unthinkable to the Arctic littoral states.

The science and methodology behind the CARA study place a significant amount of insecurity on the strength of the assessments of hydrocarbons in the Arctic, and even describing the study as an "estimate" lends itself to margins of error. Yet a summary of these scientific documents was produced in such a way that it could be and would be employed by laypeople, with the knowledge in that document becoming important in policymaking. Despite this uncertainty and many subsequent failed oil exploration ventures, it is market forces and technological innovation (such as seen in the 2008 shale gas revolution) making further development of hydrocarbon extraction an unattractive option rather than the logics of science value over the value of national interests. The USGS documents have been instrumental in shaping these logics and subsequent policy outcomes.

"Ultimately, diplomacy is about the practice of influence", (Chaban & Knodt, 2015, p. 461) and as "nation-states care first about their interests" (Ruffini, 2020, p. 3), and use science diplomacy with a "direct relationship to government interests and objectives" (Copeland, 2011, p. 1) there is need to be critical science used in policymaking and science diplomacy – especially when the science is produced within government agencies. When science is produced for a particular role and purpose, including science towards science diplomacy, we (scientists, journalists, policymakers) are all responsible for being aware of the context in which science is produced. While there is no "smoking gun" to suggest that the scientists at the production end of the USGS reports may have been strategic and purposeful actors of the US national interests in Arctic geopolitics, certainly the publication of that science in a way which could be grossly misrepresented should give them a reason to pause. The flawed logics of Arctic geopolitics premised on the significance of oil and gas in the region has resulted in an Arctic discourse that has undermined progress towards the goals of climate governance. It is time to remove this emphasis from the equation and to refocus the conversation on the contributions of science towards global human security over the values of national interests in a limited number of states.

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