



# Early engagement with First Nations in British Columbia, Canada: a case study for assessing the feasibility of geological carbon storage

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**Abstract.** This work describes early engagement with 21 First Nations or alliances, which represent 41 Nations, in British Columbia, Canada. Geological researchers conducted this work as a case study to assess the feasibility of carbon storage in serpentinite rocks. The priorities for engagement were to inform people about the project idea and its implications, get consent for geological fieldwork, have a discussion, and start building relationships before discussing any future development plans. Aside from the geology and logistics of a site for a carbon storage project, the permitting and acceptance by the local community and the traditional lands' rights holders are needed for a successful project.

The engagement levels and timelines varied from short phone calls to emails and video meetings. The general reception was positive, and people showed an interest and appreciated being contacted early. Common areas of discussion were water quality, salmon habitat, and involving the youth. This work outlines the first step for engagement, and further work will be done if a proposed CO<sub>2</sub> storage project is to proceed.

## 1 Introduction

One of the initiatives that is needed to reach global climate goals is to capture CO<sub>2</sub> and store it safely and permanently (IPCC, 2021; Fuhrman et al., 2024). This can be conducted via mineralization in mafic formations, such as

basaltic rocks, as has been demonstrated using the Carbfix technology (e.g., Snæbjörnsdóttir et al., 2020); in ultramafic formations, such as serpentinite (e.g., Goff and Lackner, 1998; Kelemen et al., 2011); or in sedimentary rocks via conventional storage methods (e.g., Furre et al., 2017). This can be done in combination with other industries, for example geothermal production (e.g., Buscheck et al., 2016; Marieni et al., 2018; Medici et al., 2023). Furthermore, carbon dioxide removal (CDR) and carbon capture and storage (CCS) must be initiated and operated in a just way for local communities (e.g., Bushman and Merchant, 2023; Goldberg et al., 2023). Community acceptance can often be increased by good communication practices and knowledge transfer (Desbarats et al., 2010; Wallquist et al., 2010; Brunsting et al., 2011a; Wallquist et al., 2012; Haug and Stigson, 2016; Eberenz et al., 2024).

Research and practice have shown that to get a successful carbon storage project implemented, it is critical to have acceptance, support, and partnerships with local communities throughout the project (Anderson et al., 2012; Carbon Business Council, 2023; Satterfield et al., 2023; Bushman, 2024). Engagement with local communities at early stages of carbon storage projects is critical to address concerns that may lead to delays. Examples of where community support led to a stop or halt in projects include the ocean alkalinity project in Cornwall, England (Weeks, 2023) and the CO<sub>2</sub> injections in Barendrecht, Netherlands (Brunsting et al., 2011b), and

In Salah, Algeria (Verdon et al., 2015; Carbon Capture and Sequestration Technologies program at MIT, 2016).

Many areas globally that host volumetrically large mafic or ultramafic formations where a carbon storage project via mineralization could be done are on Indigenous lands, such as in interior British Columbia (BC), Canada (e.g., Mitchinson et al., 2020). Currently, no large-scale carbon storage project has been implemented in BC, but it is being explored (e.g., Geoscience BC, 2023; CICE, 2024; Solid Carbon, 2024). Other projects in BC include acid gas ( $H_2S$  and  $CO_2$ ) injected for disposal in sedimentary rocks (Bachu and Gunter, 2005), and forest carbon emission offsets have been generated (Coastal First Nations Great Bear Initiative, 2022; Connolly, 2022). For a carbon storage project, Indigenous Peoples will be affected and have the opportunity to benefit, as is also the case in renewable energy or mining projects (Schlosberg and Collins, 2014; Dharapak, 2022; Parmenter et al., 2023; Jones, 2024). Both BC and Canada have now endorsed the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), which includes free, prior, and informed consent for projects (British Columbia, 2019; Government of Canada, 2024b). As has been discussed extensively, for example at the First Nations Major Project Coalition conferences (FNMPC Conference, 2023), shared decision-making and equity partnerships are the way forward, and the first step for that is engagement (Wilson-Raybould, 2022).

This study presents a case of early engagement with First Nations in BC for fieldwork and a project concept of carbon storage in serpentinite rocks (e.g., Geoscience BC, 2024). The priorities for engagement were to inform people about the project and its implications, get consent for fieldwork, generate discussion, start building relationships, and provide understanding before any development is proposed. Early engagement can be challenging to navigate, takes time, needs self-reflection, and is vital to starting a project (e.g., Haggart et al., 2011; Smith and McPhie, 2022).

## 2 Background of project

The Carbfix  $CO_2$  storage technique has been proven in basaltic rocks in Hellisheidi, Iceland (e.g., Snæbjörnsdóttir et al., 2020). The  $CO_2$  can be captured either from point source emissions or directly from the atmosphere. The  $CO_2$  is then dissolved in water and injected into shallow rock formations, where it reacts with the rock and forms safe and permanent carbonate minerals (e.g., Snæbjörnsdóttir et al., 2020) within 2 years (Matter et al., 2016; Clark et al., 2020). One of the reasons to study if serpentinite can work for this method is to open up new areas around the world not previously considered for geological  $CO_2$  storage, which increases the opportunities to pair sinks and sources and effectively decreases transport costs.

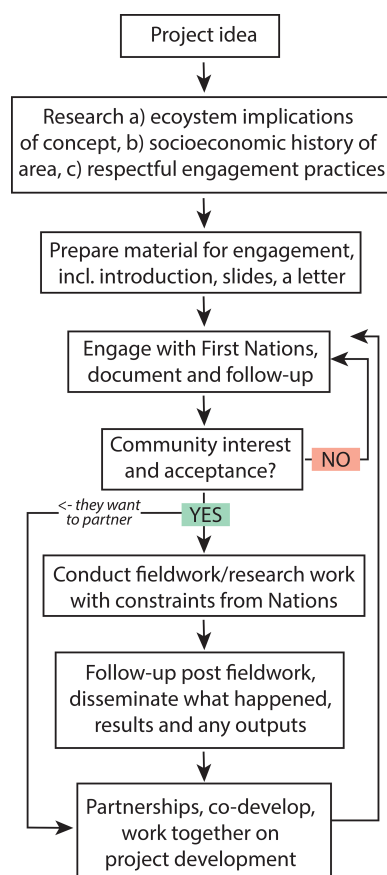
The project concept is to find a place in BC to research the feasibility of serpentinite for  $CO_2$  storage via shallow injection. This project is a collaboration between researchers at the University of British Columbia (UBC), Geoscience BC, and Carbfix. The location primarily depends on (1) the geology (a volumetrically large serpentinite is present); (2) the logistics, such as electricity, a water source, and access; and (3) permitting and acceptance by the local community and traditional land owners and rights holders for fieldwork, drilling, and a pilot injection. Work to date has revealed many areas in BC that show potential (Mitchinson et al., 2020; Cutts et al., 2021). Three of those areas were chosen to do further work on, start early engagement, and collect geological data.

Currently, there is no clear engagement system in BC for geological researchers to contact local communities or Indigenous People, and traditionally, there has been little or no engagement prior to fieldwork. This study aims to test and model an engagement process that would respectfully establish a relationship with Indigenous People and geologists whose fieldwork is on their traditional lands. With a successful process, the time and cost that need to be put in during the planning stage could be decreased. Additionally, the model of engagement allows for mutually agreed-upon project timelines and depth of engagement wanted by or necessary to the communities. This model of engagement also explores perspectives of different groups' impact fieldwork or future partnerships regarding carbon storage.

We engaged with multiple First Nations in BC with traditional lands encompassing the three chosen sites. All of the sites are in areas where First Nations do not have treaties in place with the government and where they have not ceded sovereign rights as Nations. These First Nations and alliances representing multiple Nations vary in size, from ca. 50 to 3000 people, and history. The objectives of the early engagement for the project were to provide information about the project and  $CO_2$  storage potential; ask for consent to access the land and conduct fieldwork; ask if they have any concerns, criteria, or recommendations for fieldwork, such as being accompanied by a representative; ask if we should reach out to any other interested groups or individuals; and propose collaboration or ask if there are any suggestions or recommendations for this project or potential future stages of research.

## 3 Methods

Before any community engagement was started, an engagement and adaptation process plan was set up (e.g., Gamble and McQueen, 2019; Association for Mineral Exploration, 2020; Office of Indigenous Strategic Initiatives, 2020; Kennedy and Keenan, 2023; Coastal Conservancy, 2024), as is summarized in Fig. 1. This work started 9 months (November 2022) before anticipated fieldwork. Since there



**Figure 1.** Overview of engagement plan for the project.

is no systematic engagement system in BC (e.g., Government of Northwest Territories, 2024), it can be hard to navigate the best way for such outreach. However, some Nations have their own referral system, and when that was the case, we followed that process. The engagement plan included researching potential implications of the planned work and research for local communities, Indigenous Peoples, and the ecosystem while considering the socioeconomic state and historical or recent work in the areas. Additionally, we researched respectful engagement practices (e.g., Adams et al., 2014; Wong et al., 2020; Smith and McPhie, 2022; Reid et al., 2024) that included learning and reflecting on how we might have a different way of knowing or worldview than many communities (Wilson-Raybould, 2022; McGregor et al., 2023). An individual's worldview can be shaped by their culture and education and impacts presuppositions, beliefs, and actions (e.g., De Santo et al., 2023; Oxford Reference, 2024).

While working on this engagement process, we submitted an ethics application to the Behavioural Research Ethics Board within UBC (H23-02376). The Behavioural Research Ethics Board reviews research by and with Indigenous Peoples and communities, including research on Indigenous lands and traditional place-based knowledge (UBC Office of

Research Ethics, 2024). As most geoscience work does not consider ethics approval, there was uncertainty around the requirements for when an application should be submitted. We wanted to characterize the constraints around the dissemination of the engagement process itself and the information gained from the Indigenous representatives we had discussions with. It was decided and agreed upon that for this topic, we did not need to complete the ethics review process as long as we kept Nations and representatives anonymous and did not document traditional knowledge.

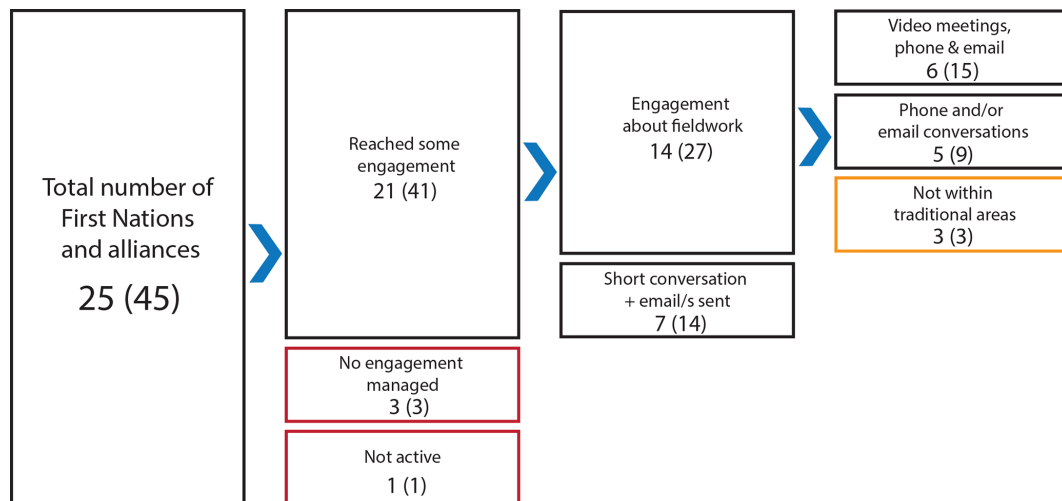
We compiled the names of communities whose land and territory encompass the field sites (e.g., First Peoples' Cultural Council, 2021; British Columbia, 2023; BC Assembly of First Nations, 2024; Native land digital, 2024). There are 45 First Nations and First Nation groups within the field areas. We started reaching out 7 months (January 2022) before the anticipated fieldwork, beginning with the First Nations alliances. When a phone number was available, a call was made to the general offices of the First Nations/alliances listed within consultation areas. When the contact was by phone, either the first time calling or later, we introduced the project and inquired as to whom we should talk to regarding prospective fieldwork. In most cases, we were referred (via phone or email) to someone, such as a natural resource director or lands manager. When that was not the case, voice messages and/or emails to general email addresses were left.

For these discussions, we had notes ready to guide the discussion for the phone calls and for voice mail. For following up after phone calls or through primary emailing, we had a one-page description ready to send, including the project background, prospective fieldwork, possible implications, and an offer to meet via phone or video call for further discussion (Appendix A). In most cases, there was follow-up a few weeks later and again at a later time.

For some Nations, there were further discussions with a representative or representatives via a phone call or video meeting. We had prepared a PowerPoint with information of the project background, fieldwork objectives, timelines, maps, and implications in plain English. Topics of discussion varied in content and detail. They often included areas of priority identified by the community, collaboration potential, follow-up meetings for further discussion prior to fieldwork, sample collection and data storage, and other suggestions and criteria. The timing of reaching out and conversations, who was talked to, phone numbers and email addresses, and what was discussed were documented. Furthermore, discussions included a plan for post-fieldwork follow-up and dissemination of any work done, results, outcomes, and possibly future collaboration.

## 4 Outcomes

In total, there are 45 First Nations and First Nation alliances (either tribal councils, Nation alliances, or joint ventures)



**Figure 2.** Engagement levels and number of First Nations and alliances. The first numbers represent the number of Nations or alliances that represent the number within parentheses (e.g., there were 25 Nations or alliances that represent 45 Nations).

represented by 25 Nations or alliances. The engagement levels that were reached are tabulated in Fig. 2. We contacted the seven alliances first. Of those alliances, one told us to contact the First Nations they represent directly, and another was no longer functioning. Three Nations did not respond. Of the rest of the 21 Nations or alliances, representing 41 Nations, we held phone or email conversations about fieldwork with 14 of them. Three answered that the areas were not within their traditional lands; for five, there were back-and-forth phone or email conversations; for six there were video meetings.

After initial contact, through a phone call or email, we sent the general letter the same day and followed up via email 2 to 3 weeks later. In some cases, if we heard nothing back, we followed up again a few weeks later. Two Nations answered the first email after a phone call without a follow-up. Two other Nations replied that they would like to meet but did not reply again about when. Video meetings with representatives took place between 3.5 to 5.5 weeks from the first phone call. In Fig. 3, the total hours have been accumulated for the engagement process for one Nation (~ 43–49 h) and the project in total, representing roughly 124–264 h, or 15 to 33 d. Additionally, there is an approximate timeline shown for the engagement process from the start of getting an engagement plan ready in November 2022 until follow-up conversations in May to November 2023.

Three of the Nations referred us to other Nations closer to the site. Some Nation representatives asked for more information regarding the location and what the field plan encompassed as well as who would be there and when. The general reception was positive for all the conversations that took place through a phone call or video meeting. Many representatives showed an interest in the project, knowing more about opportunities, future collaboration, and how to get the

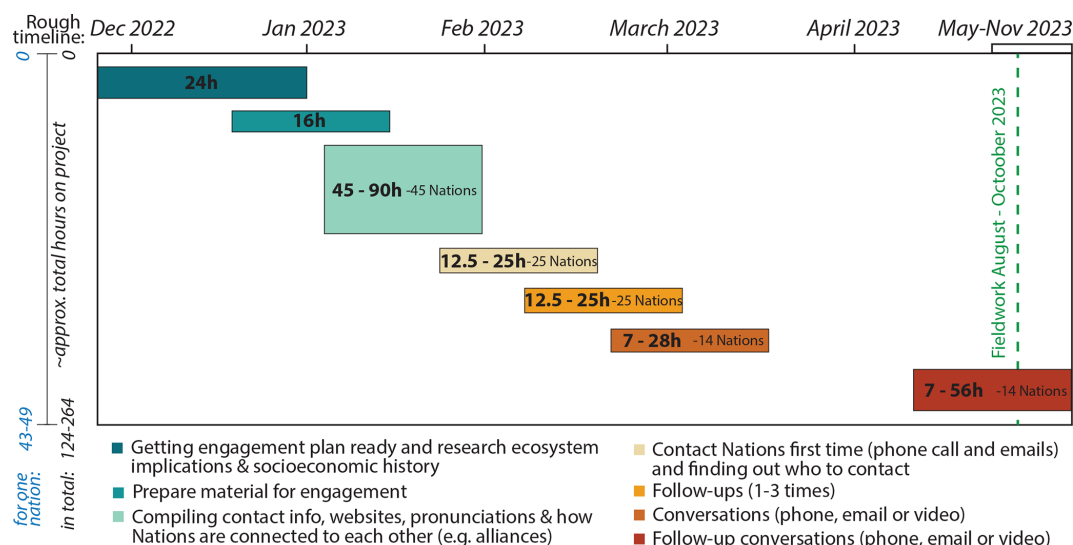
youth involved. A few people mentioned an appreciation for being contacted so early. One discussion included the idea of having the project put into their newsletter. Some people expressed surprise, in a somewhat positive way, that the project was different than mineral exploration or mining. Common themes had to do with water quality and salmon habitat.

Two Nations showed an interest in having a representative from the Nation join fieldwork, one because of possible later collaboration and to assist. However, this did not work out due to conflicting schedules. The other Nation sent a cultural monitor to join fieldwork to monitor and assist in trail finding and other logistics. Because of wildfires, the timing of fieldwork was changed and delayed, but the Nation reached out at the end of the summer to check in and see if we were still interested in coming. During planning and in the field, there were multiple discussions with the cultural monitor and others about the field area. This included sharing of Indigenous knowledge, such as place-based stories; land use; animal habits; and stream, trail, and outcrop locations. We will not report on these data as they are not our findings, and we do not have permission from the people, as well as to be respectful and due to constraints around the ethics application from the university. The fieldwork was carried out successfully except for in one instance. Although we had support from the First Nation, a local individual did not support our work, and so we halted our field studies.

## 5 Discussion

### 5.1 Engagement levels

The engagement with the 25 First Nations or alliances went generally well. However, the depth of engagement, discussions, and timelines varied between Nations, from no responses or short phone calls to multiple meaningful video



**Figure 3.** Rough timelines and approximate total hours for the engagement process for one Nation and in total.

meetings (Figs. 2 and 3). This variability can have many reasons. It is recognized that First Nations, in some cases, do not have sufficient resources or staff to engage in all requests. Lack of responses might also reflect external impacts such as wildfire, insufficient interest or comfort in the project, or no sense of relevance (e.g., Nawaz et al., 2023). The engagement levels likely also reflect each Nation's different sizes and capacities.

Engagement with 14 Nations or alliances resulted in a discussion about fieldwork (Fig. 2). With all of these conversations, the representatives showed an interest in learning more. Some representatives were excited about the benefits of storing CO<sub>2</sub> and the opportunities that could come with it for their Nation, especially their youth. Surprisingly, there were no negative reactions about CO<sub>2</sub> storage, but rather questions about the implications for the water quality and fish health, similar to what has been observed in other projects (e.g., Kennedy and Keenan, 2023). Some asked if we would use a helicopter for the fieldwork, if drilling were involved, and where we would stay and cook. In some instances, these questions were related to possible disturbances for wildlife or potential partnerships with their Indigenous businesses. There was also an appreciation of being contacted so early, months before anticipated fieldwork, especially since we were only doing simple fieldwork, not dispatching a multiple-person team and drilling.

Coming from a technical background, we were expecting questions about how this project might impact seismicity and if it is similar to fracking (e.g., Satterfield et al., 2023), and, thus, we showed and discussed those differences. There was not much conversation about this but rather about how this project was mining-related. This could be because of the local geology that hosts mineral deposits, past experiences with mineral exploration companies in the region, and the fact that

oil and gas regions within BC are far away. Positive engagement at this time might also be due to the project being in the research stage; collaboration with a not-for-profit; its purpose in the area of climate action (e.g., Thomas et al., 2018; Cox et al., 2020); and/or an openness to fieldwork changes, questions, and collaboration. There was more interest and support from the Nations than we expected.

## 5.2 Representatives and relationships

We talked to and met administrative assistants, referral coordinators, land managers, natural resource directors, and chiefs through the engagement process. These people have different roles and responsibilities within their Nations or alliances. During the initial outreach, they were often unsure who to forward our request to, as this kind of outreach is seemingly rare. In some instances, we were referred to housing or education departments, which then referred us to other departments, such as lands or resources.

Similarly, which Nation or alliance took “ownership” of the project varied. Some of the alliances of Nations that we talked with were the spokespersons for those Nations they represent. In one instance, they brought in a representative of one of the Nations to a video meeting, and in other cases, they sent the contact information of the one or few Nations that should be contacted. In another case, the alliance's representative told us to contact each Nation separately. When a conversation was reached, some Nations' representatives told us to contact another Nation but would like to be kept in the loop during the project development. On another occasion, a representative inquired if we would have a monitor from another Nation that was closer to the area join fieldwork; then, there would be no need for them to send a monitor. This is different to a previous project and fieldwork some of the au-



thors took part in, where two Nations with traditional lands in the area both sent a monitor for the fieldwork (Steinhorsdottir et al., 2020). Additionally, it varied if the representative we interacted with asked if other Nations in the area had been contacted or not. This shows how varied the relationships are between Nations due to their different opinions, their history working with each other, or other reasons. Understanding the relationships within and between communities is complex and takes time and work (e.g., Anderson et al., 2012).

There may be different reasons why the Nations that showed an interest in sending a monitor or representative to join the fieldwork chose to do so. One of the Nations has a consulting service and a geologist who works there who wanted to join fieldwork to learn about the carbon storage, what that entailed in the field, and the possibility of collaborating on a future project. For the other Nation that sent a cultural monitor, this seems to be a criterion for either doing research or industry work on the land, possibly partly because they have the resources and want to ensure that work is respectfully conducted. They showed interest in the project and discussed the possibility of collaboration.

There are many advantages of having a representative or someone from the area accompanying fieldwork, and it should be recommended or even enforced on Indigenous lands for research, government, or industry purposes (e.g., Association for Mineral Exploration, 2020). However, this, of course, depends on each Nation and their willingness and resources. At the very least, approval of planned work and a discussion about the area is helpful before engaging in fieldwork. A lot of information – such as some trails, road conditions, landslide damage, or recent encounters with wild animals – is hard to find without local input, even with the help of Google Earth, blog posts, or news articles. For our fieldwork, it benefitted us to have a representative joining, especially when we met a Nation's member in the field who did not appreciate us being there unannounced. It was immensely helpful that the representative accompanied us and that we had engaged and spoken with representatives from the other Nations whose traditional lands also encompass the area. Additionally, a significant benefit of successful engagement for both the researchers and the Nations is having positive relationships for any future development and collaborations for a project.

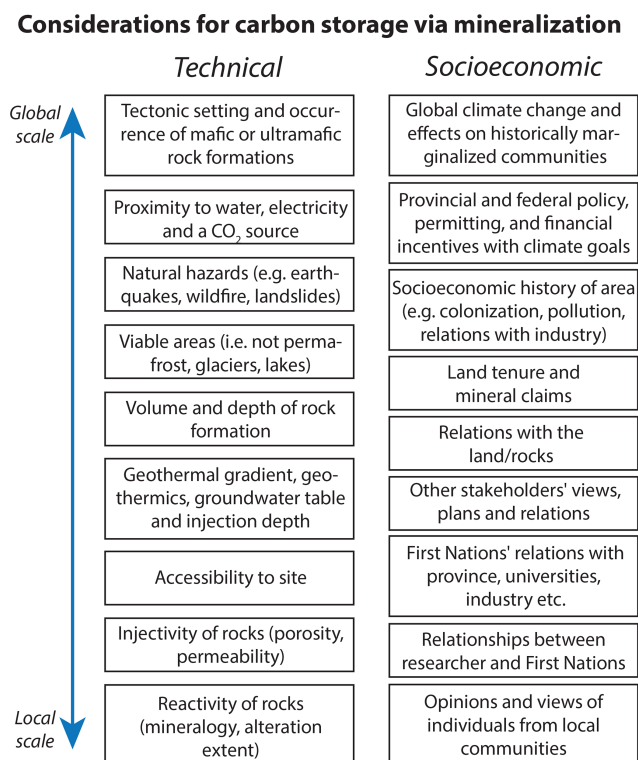
As has been shown by recent events, such as at the Juukan Gorge in Australia (Antar, 2023) and by the San Andres mine in Honduras (Radwin, 2022), people, in some cases geoscientists, have different end goals or knowledge, and that can affect what and where they mine or sample. This can lead to negative impacts on spiritual or archeological sites. Furthermore, understanding different opinions and perspectives of rights holders and stakeholders can be critical for project development and decision-making. Different opinions can affect trivial things such as not being allowed to sample rocks, access roads, or get permits to drill. This might not have significant consequences at the time but can have meaningful

implications for timelines and sunken costs and, thus, for a project's success. Additionally, for the First Nations, there may be potential consequences in regard to sovereign rights and further exacerbating historical trauma.

### 5.3 Geoscientists' responsibility and role

Research has shown that to get a successful project up and running, community support or involvement from the beginning of a project can help things go smoother and on shorter timelines (e.g., Wilson et al., 2016; Mathisen, 2021; FN-MPC Conference, 2023; Jones, 2024). Community support can be achieved if the community owns and leads a project, such as the projects Tu Deh-Kah Geothermal (Tu Deh-Kah Geothermal, 2024) and Atlin's Hydro Opportunity (THEL, 2024) in northern BC. However, what is not often incorporated in timelines is the time frame for obtaining community support or establishing a partnership in the beginning, the early engagement. As we experienced, even finding out who to talk with takes weeks to months, and the follow-ups and decision-making take even longer (Fig. 3). It may be well known, but we want to emphasize the importance of having the discussions and getting the information about a potential project and its implications to a community as early as possible and having that information in an easy-to-understand format (e.g., Mackenzie et al., 2020). Indigenous or local communities' opposition can delay or stop a project (e.g., Lavoie, 2018; Centre for Social Responsibility in Mining et al., 2023).

Geoscientists are often the first ones to interact, answer questions, and meet the people living in the area before or during fieldwork (e.g., Mackenzie et al., 2020). Scientists can also have an important role in getting innovative projects up and running (e.g., Becattini et al., 2024). Although they are trained in many of the technical considerations for a project, they are not trained in socioeconomic considerations. Some considerations to keep in mind are shown in Fig. 4 and range from the global scale of climate change effects to individual opinions (e.g., Snæbjörnsdóttir et al., 2020; Huggins et al., 2023). Different perspectives and views might cause friction that could be improved with training in science communication, Indigenous socioeconomic history, and engagement practices (e.g., Eberenz et al., 2024). Typically, these aspects are not included in a geoscientist job description, but this is changing as there is a shift happening in BC and elsewhere. More people are acknowledging that early engagement is essential and takes time. This can be seen in changes in the industry, government, and research practices (e.g., McGregor et al., 2016; Association for Mineral Exploration, 2020; Office of Indigenous Strategic Initiatives, 2020; Rogers et al., 2022; FN-MPC Conference, 2023; Stein et al., 2024). In the earth sciences department at UBC, which some of the authors are affiliated with, we have created a document containing guidelines for engagement practices with Indigenous People that was in part developed from this case study (EOAS



**Figure 4.** Technical and socioeconomic considerations on different scales when it comes to implementing a successful carbon storage via mineralization project.

Indigenous Engagement Committee, 2025). In some cases, there is a duty to consult, such as for federal employees (Government of Canada, 2024a), and there is the recent court decision to change the Mineral Tenure Act, the process of staking mine claims in BC, to include Indigenous consultation (Abell, 2023). However, considerable work still needs to be done within geosciences to change the narrative, take responsibility (Gillette, 1972; Peppoloni and Di Capua, 2017), and move away from colonization practices that geosciences are in many ways still linked with (Sangwan, 1994; Pico, 2019; Cartier, 2021; Gewin, 2021; Radwin, 2022). Below we discuss several topics to improve for the geosciences.

### 5.3.1 Communication and collaboration

It is critical, but often difficult, to develop a communication strategy for communicating simply, yet in-depth, with a diverse audience, and this often requires preparatory work and flexible timing. Furthermore, it is currently not traditionally encouraged or taught within the geosciences (e.g., Wong et al., 2020; Rogers et al., 2022). If researchers collaborate successfully with Indigenous Peoples, an essential part of that will be effective communication and dissemination before, during, and after the project starts. Even if no collaboration is planned, or there are not obvious implications of the project,

researchers should still engage and discuss with the land's rights holders.

For projects such as carbon storage, early engagement outlining risks and benefits and having the local community in the loop from the beginning can help with project development (Brunsting et al., 2011a). Furthermore, if the community has all the information, they can make informed decisions and even participate in the project as project leaders or partners (Bushman, 2024). The local community is likely to be most affected in case of gas leaks or infrastructure changes and reap the benefits of job opportunities and possibly project ownership. If the community is part of early and ongoing discussions, they can, for example, put agreements into place for job creation from the local community (Bushman and Merchant, 2023; Goldberg et al., 2023; Low et al., 2024).

### 5.3.2 Meaningful engagement

To reach meaningful engagement, we first need to assess what that entails. It will look different for different Nations or communities, types of research, and development stages of projects (Wilson et al., 2016; Plunk and Gehlert, 2018). In general, meaningful engagement means a back-and-forth conversation, including listening and involvement, and that the communities' needs or priorities are met in some way. That could be everything from a long phone call to several meetings or the opportunity to join fieldwork, sign official documents, or collaborate (Adame, 2021). As shown in this study, early engagement can take months, and reaching meaningful engagement can take many years. This can be a conundrum for academic researchers and graduate students as timelines of project scopes and funding are often relatively short, and the engagement timelines are not usually incorporated (e.g., Adams et al., 2014).

In many instances, it was not clear which department within the First Nation was an appropriate contact to host engagement because the nature of engagement was unfamiliar. Additionally, in some instances the researchers' lack of experience with engagement work made it confusing, and there was uncertainty around protocols. It might be beneficial for both sides to have the start of engagement more streamlined, with some engagement recommendations or system (e.g., Nunavut Research Institute, 2021; Government of Northwest Territories, 2024; Government of Yukon, 2024). A streamlined system could help with the uncertainty of whether and when engaging with communities is appropriate. Some fieldwork research can feel like it falls through the cracks due to it consisting of small or short projects, such as collecting a rock sample, picking up float samples, gathering water samples, or conducting non-destructive analyses or observations. Additionally, starting earlier might encourage engagement, as we were told that it was a positive surprise that we reached out months ahead of time.

### 5.3.3 Reflecting on roles

To prepare for engagement, give yourself time to learn about communities' values, norms, and culture and how to communicate and behave respectfully (e.g., Wong et al., 2020; Smith and McPhie, 2022). Additionally, one needs to consider multiple aspects (e.g., Fig. 4), perspectives, and one's own and others' intentions and identities. Your identity can have benefits and implications for first impressions, connecting with people, and interpreting the project or findings. Researchers must take time to self-reflect on their privilege before and during engagement and how it affects our worldview, the questions we ask, how we do research, and how we plan for and feel during fieldwork. This includes your ethnicity, gender, and educational background, but also who you, or the project, are affiliated with, such as a university, local community, or company, and if there are any biases or stereotypes associated with them (e.g., Wilson-Raybould, 2022). Additionally, differences in specialties, language skills, cultural background, and what words are used to introduce the project can affect first impressions or cause friction (Smith and McPhie, 2022). We realized through this process that it is better to talk about how the project is different compared to other projects that may have had a bad reputation from the start (e.g., fracking or mining) instead of being asked later because there is more uncertainty around it.

The role of the representative/s you speak and meet with during engagement can vary. Their past experiences with other researchers or their relationships with the land might affect their professional or private opinions, impressions, and/or consent. Furthermore, opinions can be different between representatives and other members of the Nation, which can affect decision-making (e.g., Hunt, 2013; Kennedy and Keenan, 2023). For example, in one of our previous projects, where there was an active non-disclosure agreement with a mineral exploration company, we spoke with and received consent from the Nation's chief to conduct fieldwork. We then had a follow-up meeting with the elders of the Nation, who had different questions and opinions. However, the meeting ended with an agreement and a memorandum of understanding between the Nation and the researchers. During this project, there was the example of meeting a Nation member that did not allow sampling of rocks even though the representatives we discussed with had previously allowed it. This clearly shows how important it is to have good communication skills, reach out early, and engage meaningfully.

### 5.3.4 Data ownership

For this project, we had discussions with Nation representatives about data collection and sharing and what they expected. In the follow-up plan, there is the commitment to share both the preliminary results from fieldwork and the full results when ready. As discussed earlier, everyone involved

needs to have the data early on to make their own decisions in order to initiate or be part of a project (Kennedy and Keenan, 2023). This is especially important for projects that may affect local communities, such as in the event of leakage, oil spills, or mining potential.

The unceded traditional and ancestral lands of many First Nations in BC are now on what is called "crown" land, that is, public land or waters that are "owned" by the provincial government. The discussion around who owns the land and who owns the rights to it as well as to develop it is a complicated matter that is being scrutinized (Simmons, 2022) and, in some cases, revised (e.g., Abell, 2023). For discussion purposes here, we focus on collecting, owning, and disseminating data generated on traditional lands, such as through geological fieldwork. That includes letting the Nations know and getting permission to collect data (communication and engagement), even if those data do not have any apparent implications at the time for the communities (e.g., Nyblade and McDonald, 2021). Once raw and interpreted data are collected, there can be uncertainty regarding who owns them as well as how and where they are stored and shared with other stakeholders or interested parties (Gewin, 2021). Once the data have been written up, put into models, or compared to previous work, which often takes years, where and to whom those interpretations go need to be defined (Nyblade and McDonald, 2021; FNIGC, 2024; GIDA, 2024; USGS, 2024). Sometimes data are published as part of theses or journal articles, often behind a paywall, or disappear in a notebook.

### 5.3.5 Responsibility for climate action

For geoscience, we study and work on many environmental and climate action topics to help society. These include assessing and mitigating natural hazards, finding and developing renewable energy sources (e.g., geothermal), mineral exploration for metals, monitoring contamination and groundwater resources, and storing CO<sub>2</sub>. Additionally, we need to acknowledge that geoscience is in many ways rooted in colonization practices and has a troubling history with resource extraction on Indigenous lands (e.g., Radwin, 2022). It might be the duty of today's geoscientists to use our knowledge of earth systems to help with climate action projects; communicate risks and solutions; work equitably; and use our platforms to elevate other voices, such as Indigenous and historically marginalized peoples (e.g., Peppoloni and Di Capua, 2017; Nwankwoala, 2019; Stein et al., 2024).

Developing equitable climate justice projects is a challenging task, one of the reasons being the variability in the projects, places, and groups of people. However, globally, the majority of individuals support climate action (Andre et al., 2024), although perceptions vary on type of carbon removal, and there are also country-specific differences (Low et al., 2024). Groups of people can include researchers, collaborators, local communities, representatives that you engage with and people you meet on the way to or in the field,



companies that work in the area (e.g., mineral exploration or logging), other visitors (e.g., tourists or hunters), representatives of municipalities and regional districts, and the general public (e.g., Fig. 4). These represent groups of different scales that can be slightly to heavily involved or interested in a project. This is why engaging respectfully, collaborating if applicable, and informing at every stage of a project is crucial (Bushman, 2024).

#### 5.4 Considerations and recommendations

There are many considerations for implementing respectful engagement processes for geological research. Below are a few recommendations for researchers to build upon.

1. It would benefit geoscientists to have relevant insights and training in engagement practices where applicable or to work together with appropriate experts. This could be as part of undergraduate education and with changes in engagement practices. This would include the following:
  - a. The potential implications of your planned work and research, especially for local communities and Indigenous Peoples, should be considered where applicable. Additionally, effects on focus areas that communities may ask about, even if the project does not affect those, should also be considered.
  - b. It is important to bear in mind and reflect on how you might have a different perspective or worldview than many communities. This can affect the communication strategy, including how to approach Indigenous Peoples and the selection of words.
  - c. The current state and history of the area and community should be considered, including any past work by geoscientists, other researchers, and relationships of other groups with the community (e.g., Wong et al., 2020; Smith and McPhie, 2022). Furthermore, how the different communities work together and what their relationships in the area are should also be considered.
2. During engagement, provide background information and be ready to discuss and answer questions. Listen to suggestions and recommendations and present options to collaborate. Incorporate and work with communities as much as possible: as the saying goes, “nothing about us without us” (FNMPC Conference, 2023). Additionally, follow up during engagement and post-fieldwork with updates and disseminate results.
3. In any of the relevant outputs, credit the help received, e.g., with co-authorships, land acknowledgements in presentations, or acknowledgements in papers. Local place names should be used on maps and in text, and

take other recommendations from communities into consideration (e.g., Wong et al., 2020; Adame, 2021).

4. To develop a successful project, early engagement is the first step towards obtaining the free, prior, and informed consent (e.g., Kennedy and Keenan, 2023; Reid et al., 2024) that is needed, such as within UNDRIP (British Columbia, 2019; Government of Canada, 2024b). Additionally, researchers are responsible for making relevant findings known to relevant parties.
5. On a department-, company-, and up to federal-scale, have recommended or mandatory guidelines for engagement with Indigenous People prior to fieldwork. This could include a list of recommendations, have it as part of an ethics review, or a provincial-wide online engagement system for researchers to get through for both early engagement and for deeper consultation.

#### 5.5 Summary and evaluation of objectives

For this case study, we set up an engagement process that is tabulated in Fig. 1. The process was successful as we received the support and acceptance of the First Nations for geological fieldwork at the three sites within the expected timelines. We did not hear back from a few Nations which might not be interested or do not have the resources for engagement. In one case, there was an exception where an individual allowed us access for observations but did not allow us to sample rocks; the discussion greatly benefitted from the previous engagement with the Nations in the area and the fact that a representative joined us for that part of the fieldwork.

It takes time to engage with communities. For this project, we started engagement roughly 7 months before fieldwork, and it took a total of ~124–264 h to engage with Nations within the areas (Fig. 3). The engagement work to date took approximately 10 months, or roughly a third of the overall project length (the first author’s PhD project), which also included a feasibility assessment and lab work. The project is still recent, making it too early to determine whether this model of best practices can effectively reduce overall project time and costs. Nonetheless, we expect that, in the long term, the project will be more successful, and costs will be lower as there is more alignment with First Nations. Depth of engagement varied between representatives, with conversations leading to fieldwork discussions for the majority of the Nations (Fig. 2). Although it is arbitrary, one sign of success is the conversations with the First Nations whom we worked with and who thought our engagement was respectful and sufficient at that time.

Lastly, there is a range of opinions within and between Nations, but for the most part, there seemed to be an interest in the project, for both the geological fieldwork and the proposed carbon storage project. Early conversations are valuable to start building relationships and to understand Nations’ priorities. A few of the Nations showed an interest in

collaborating later on if the proposed project became a reality. The potential (positive) impacts on collaborations and the model's long-term success could also be evaluated in the future as part of further research. Community participation and/or partnerships would be an important component of a successful carbon storage project (Fig. 4).

## 6 Conclusions

This paper reviews the steps taken and outcomes of early engagement with multiple First Nations in British Columbia, Canada. The discussions were aimed at providing information about a project concept for CO<sub>2</sub> storage via mineralization in serpentinite and receiving consent for geological fieldwork. We engaged with 21 First Nations or alliances representing 41 Nations or alliances directly or indirectly. The total timelines, hours spent on the engagement process, representative roles, discussion topics, and depth varied immensely.

The general reception of engagement was positive, and First Nations' representatives showed an interest in the project. This resulted in consensual geological fieldwork and discussions with multiple Nations on implications, criteria, and suggestions.

Throughout the process, we kept learning about and reflecting on respectful engagement practices. Additionally, we reflect on the roles of geoscientists, especially for CO<sub>2</sub> storage implementation. The early engagement and the start of relationship building documented here form the first step of further work on the proposed CO<sub>2</sub> storage project. If the proposed project continues, future work will include more engagement with the Nations and hopefully foster equitable partnerships. The project's success depends on many technical and socioeconomic considerations, from choosing a site to rock properties in the subsurface, funding, and meaningful and successful community engagement.

**Appendix A: General letter to First Nations**

XX XXXX 2023

XXX

XXXXXX – address

XXXXXXXX

XXXXXXXXXX

Re: Proposed UBC research visit to study geology and carbon storage potential

Dear XXX,

Thank you for the phone call and discussion on XXdateXX.

My name is Katrin, and I am part of a research group at the University of British Columbia (UBC) that studies the potential of carbon dioxide (CO<sub>2</sub>) storage in rocks as a mitigation method for fighting climate change. Specifically, rocks called serpentinite. For some time, Professor Greg Dipple and our team have been researching serpentinites as they contain high amounts of magnesium that can bind safely with CO<sub>2</sub>, forming new natural carbonate minerals that are permanent and stable over thousands to million years.

A carbon storage method that is already operating in Iceland is called the Carbfix technology that imitates and accelerates natural processes, as vast quantities of CO<sub>2</sub> are naturally stored in rocks. It is a proven method based on scientific research and has been operating in basaltic rocks since 2012 (see [www.carbfix.com](http://www.carbfix.com)) with high public acceptance at the local and broader community scale. The technology consists of dissolving CO<sub>2</sub> in water – forming sparkling water of sorts – and then injecting it into the subsurface to more than 350 m depth, where it reacts with the rocks and forms carbonate minerals.

As part of my PhD research, I am assessing the feasibility in British Columbia of the Carbfix method into serpentinite rocks. The first part of this work is to identify suitable sites for research. The site XXX, located XX km from XXX, has suitable geology and access, and so is a potential site for my research.

I would like to discuss my research ideas with you and also talk about how to work with your Nation. Initially, I would like to visit the area to assess the carbon storage potential sometime in summer 2023. Possible fieldwork would comprise of field observations of outcrops and geography and taking 10–20 kg of representative rock and water samples for analyzing in the laboratory. Additionally, we would like to identify locations and assess the natural rate of groundwater flow through the rocks.

The implications of this work may be that we can collect data to support a potential future pilot-scale project capturing CO<sub>2</sub> and safely storing it as carbonate minerals. This bigger project could bring together technical developments from researchers at UBC, public geoscience (Geoscience BC), and world-renowned expertise in sequestering carbon (Carbfix).

I would like to arrange an in-person, phone or video meeting to discuss research ideas and how to work with your community's staff or leadership.

Sincerely,

Katrin Steinhorsdottir, MSc. (She/Her/Hers)

PhD candidate. Earth, Ocean and Atmosphere Sciences

University of British Columbia

UBC is located on the unceded traditional lands of the x<sup>w</sup>məθl<sup>k</sup>wəyəm (Musqueam) nation.

Email: [ksteinth@eoas.ubc.ca](mailto:ksteinth@eoas.ubc.ca); mobile: XXX XXX XXXX

**Data availability.** All the data that is not already given in the paper and figures has been kept anonymous due to the ethics review recommendation (application no. H23-02376).

**Author contributions.** KS and SP planned the campaign. GMD, RT, and SÓS helped with conceptualization. KS prepared the manuscript with contributions from all co-authors.

**Competing interests.** The contact author has declared that none of the authors has any competing interests.

**Ethical statement.** As discussed in the Methods, we submitted an ethics application to the Behavioural Research Ethics Board within the University of British Columbia (H23-02376). It was decided and agreed upon that for the topic of documenting the engagement process, we did not need to complete the ethics review process. The agreement included keeping Nations and representatives anonymous and not documenting others' knowledge.

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