BEYOND THE BARRIER: A FINAL REPORT

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INTRODUCTION

This summer I participated in the Summer Fellowship program at Quest University. As a Summer Fellow, I spent twelve weeks working on an artistic research project in collaboration with Sommer Harris. This project consisted of researching, writing, directing and editing a documentary on the geology of the area surrounding Quest. While I focused on the research, Sommer was in charge of the filming and editing and we both collaborated on the idea-development and storyboarding. The final film can be described as such:

> "A 20 minute documentary exploring the geology of the west coast of British Columbia, specifically the area known as the Sea to Sky corridor, which runs through West Vancouver, Squamish and Whistler. Some of the hazards inherent in the surrounding landscape are investigated – one of these is the Barrier, a crumbling cliff over 300 meters tall that holds back Lake Garibaldi. Coupling geologic history with the dangers of the present, Beyond the Barrier takes a look at how living below hazards can change the way we see ourselves as humans with respect to the power of nature"

As an undergraduate student interested in both geology and human interaction with the environment, I am struggling with the knowledge that practical application of the field I am interested in often occurs at the expense of environmental conservation and protection. As a second year student at Quest, this concern is slowly shaping my course of study. This project provided an opportunity not only to gain an understanding of the geologic processes that created the west coast and to practice story-telling, but also to explore this concern tangentially. Through research, interviews with professional geologists, and construction of the documentary film's narrative, I have tried to find a space where the science of geology and respect for the environment intersect.

What I quickly discovered is that they are intrinsically entwined. Geology requires the use of a spectrum of time and physical size distinctly larger than the everyday human experience provides. When discussing geologic time, a common analogy is comparing the earth's 4.6 billion year history to a 24 hour day. In this day, the creation of the earth begins at 12:00 am, the oldest known fossils emerge as living creatures at six in the morning, and the entirety of human history (approximately 200,000 years) begins mere seconds before midnight (Grotzinger and Jordan, 18). Geological concepts share this sense of casual enormity as well; an example of this is the crust of the earth. This outermost layer is often described as extremely thin, almost like the skin of an apple; in reality, it is over 40 km thick in places (Grotzinger and Jordan, 11). Working at this magnitude shrinks the size and duration of human issues comparatively; civilizations rise

and fall in the time it takes two tectonic plates to bump shoulders. In this mindset, it is easier to respect the power of the landscape around us and to recognize the twelfth-hour nature of human habitation. A different kind of consciousness towards the environment is cultivated.

Emulating this consciousness within a different medium – documentary film – allowed us to better explore themes like the relationship between humans and nature, the *need* for humans to understand this relationship, and the implementation of this perceived relationship. Taking on the geologist's mentality allowed us to create something entirely different than solely using scientific fact would. It was so valuable to expose myself to this mentality, manipulate it, and eventually coax a narrative from it. Coupled with its broad and interdisciplinary reach, it truly became a foundation-style project entirely appropriate for my current place in my Quest education.

On the more practical side of things, creating this documentary was valuable because I had to learn all of the content before being able to present it in a way that was both educational and communicated why I find it fascinating and worthwhile. This content includes the history and formation of the Coastal Belt, a strip of land that runs parallel to the BC shoreline, and some of the important processes, features and hazards inherent in this mountainous landscape. As a research project, this did not involve adding to the general body of geological knowledge; instead, most of my research involved collecting, distilling and presenting existing knowledge in a new and novel way.

This report will focus on relaying this content to a similar caliber that the documentary does by presenting the current knowledge of the formation of the area in layman's terms instead of delving deeply into specifics. The utilization of the geologic feature of the Barrier as a framing device for this content is a large element of the project, and will also be discussed. I will also examine the process of compiling and presenting this information in the form of a documentary with a narrative, themes and characters, as well as the artistic tools used to cultivate these elements of the film. Again, note that although this project is based in scientific knowledge, it was not a traditional scientific project – more of an artistic endeavor to present this knowledge in a meaningful, relevant and interesting way.

THE GEOLOGY OF THE SEA TO SKY CORRIDOR

Understanding the formation of the Sea to Sky corridor is less about complex processes and hard-to-pronounce minerals, and more about bringing it back to the story of the land. What

was the landscape like millions of years ago? How has it changed from then to the present day? How can we tell? In what ways is it continually changing, and what processes are involved in that change?

It is easier to understand one part of British Columbia – namely the Coastal Belt which houses the Sea to Sky corridor – by understanding how it works in the scheme of greater Canadian geology. If you look at a geologic map of Canada, the majority of the country is dominated by a very large, continuous piece of rock, called a craton. This craton is a very old and stable piece of the earth's crust and is commonly known as the Canadian Shield. If you travel west towards British Columbia, the shield is replaced by northwest-southeast trending strips of different rock that almost look like they have been pasted one by one onto the edge of the craton. In fact this is exactly how these strips, known as suspect terrains, became part of the North American continent. The tectonic plates of the earth, large pieces of the earth's crust that move around at a very slow pace, are responsible for this stripy pattern of rock that makes up British Columbia. The Juan de Fuca plate is an oceanic plate that began subducting, or being pushed under the continental North American plate around 37 million years ago, around 12 minutes before midnight on our 24 hour clock of geologic history, and has been doing so ever since (Cannings, Cannings and Nelson, 43). At this subduction zone, a couple of things occur; firstly, islands, reefs and sedimentary deposits can be accreted onto the overlying North American plate. This action is almost like a paint scraper peeling paint from an old piece of wood; the oceanic plate is the piece of wood, and the continental plate is the paint scraper. Through this process, called accretion, the stripy suspect terrains of British Columbia were attached to the rest of Canada.

As you can imagine, forcing a giant piece of the earth's crust under another causes a certain amount of uplift in the overlying plate. When an oceanic plate subducts under a continental one, it displaces the plate above it and causes the land to physically move upwards, bowing it up into mountain ranges. The original Coast Mountains were formed in this way when the predecessor of the Juan de Fuca plate – known as the Farallon Plate – also subducted under the North American Plate. The present Coast Mountains began to grow as the Farallon plate splintered and became the Juan de Fuca plate and the process began once more.

Another process that occurs at a subduction zone like that of the Juan de Fuca plate is volcanism. When the Juan de Fuca plate is forced under the North American plate, it delves into a hotter, deeper part of the earth: the mantle. The mantle is a highly viscous layer of the earth between the crust and the core; because of its liquid state and closer proximity to the core, it is

at a far higher temperature than that of the crust. The combination of this heat and the ocean water dragged down by the subducting plate cause the material in the Juan de Fuca plate to melt. In its melted state, this material is less dense and more buoyant, and therefore has the tendency to rise. It forces its way through cracks in the overlying continental rock, pools in magma chambers, and eventually makes it to the surface to create volcanoes. If you look at British Columbia today, the Coastal belt is dominated by volcanic rock. After a suspect terrain was pasted onto the rest of Canada, the magma created at the subduction zone found its way to the surface and covered this terrain in volcanic features like flood basalts, lava flows and volcano peaks. Through the accretion, uplift and volcanism caused by the subduction zone, the land of the Coastal Belt became quite mountainous.

After 200 million years of tectonic mountain building, the landscape of British Columbia was dominated by tall mountains and V-shaped valleys (Cannings, Cannings and Nelson, 59). Then, at around 2 million years ago, or 37 seconds before midnight, the world entered the era of Ice Ages, geologically known as the Pleistocene Epoch. During these Ice Ages, the surface of British Columbia was covered by a giant ice sheet which was almost 2 km thick in places (Cannings, Cannings and Nelson, 60). Glaciers formed in the high reaches of mountains and flowed into the valleys. Mountaintops below the ice-line were rounded significantly by the passing ice, valleys were carved into U-shapes, the courses of rivers were changed by barriers of ice and huge lakes were created by the impounding glaciers. During this time, the volcanism of the Juan de Fuca subduction zone continued to occur, and volcanoes erupted sub-glacially, para-glacially and super-glacially, leaving behind interesting and unstable features like tuyas, glacially impounded lava flows, and flanks of volcanoes built on the surface of glaciers, such as Mount Garibaldi.

Throughout all of these processes, atmospheric factors continually broke down the landscape, and continue to do so today. Mountaintops are rounded as rain and wind removes loose rock from the peaks, and the sediments are moved down-slope by water, wind and gravity. Weathering is the process of the physical breakdown and chemical alteration of rock at or near the surface, whereas erosion is the physical removal of material by mobile agents such as wind, water and ice. Together, weathering and erosion act as slow-working demolishers of the landscape that tectonic activity continually constructs.

Although interesting, the story of the land lacks immediate relevance for the average audience; it is hard to relate tectonic plates or ancient glaciers to our daily lives. To deliver this

history in an interesting and more immediate way, Sommer and I decided to use the framework of a potential hazard that is not very well known in the area of Squamish: the Barrier.

Located near highway 99 on the way to Whistler, the Barrier is a steep, 250 meter high wall of unstable volcanic rock. It was formed when an eruption of lava originating from Clinker Peak flowed down into a drainage valley occupied by a glacier. The glacier blocked the flow of the lava, and the lava piled against the ice, eventually cooling and hardening into the dark grey and red volcanic rock we can see at the site today (Clague and Turner, 147). During the de-glaciation of the area around 11,000 years ago, this glacier melted and left the cooled lava flow as a sheer rock wall hanging over the valley. Removing the neighboring glacier resulted in a loss of the Barrier's support; imagine leaning your weight onto somebody only to have them pull away – the result is a decrease in stability. Another factor in the instability of the Barrier is the large volume of water resting behind it today. During the Barrier's early years, its valley home continued to act as a catchment for water flowing from higher elevations; with the Barrier as an obstruction, this water collected behind it and eventually formed Lake Garibaldi (Clague and Turner, 149). Today, the Barrier acts as a natural dam and holds back this lake; however, the factors of its creation – an over-thickening of lava, removal of glacial support – and continual erosional processes such as frost wedging threaten to destabilize it to the point of collapse. With an entire lake of water behind and a documented history of rockslides in 1855-56, this does not bode well for communities such as Squamish and Brackendale living below it (Monger and Matthews, 170).

The Barrier is a perfect framing tool because its formation and current condition encapsulate the four main processes that created the entire sea to sky corridor and the coastal belt; it is a smaller example of the macrocosm. The previously discussed processes of tectonic subduction, glaciation, volcanism and erosion all played significant roles in creating this hazard. Tectonic subduction of the Juan de Fuca plate under the North American plate created the mountains of the coast through uplift, accretion and volcanism; these mountains then acted as the seeding ground for glacial formation during the extensive ice ages of the past; continual volcanism occurred and eruptions of lava sometimes came into contact with these glaciers and formed features like the Barrier; erosion and weathering now chew away at these features, tearing apart what the volcanoes and glaciers together created.

The possibility of future landslides from the face of the Barrier limits land use below it. Debris from the most recent nineteenth-century landslides can be seen in the streambed of Rubble Creek (Stelling and Tucker, 12). The creek itself can be traced up to its source, which

gushes out of the fan of debris below the Barrier. There is speculation that the water originates from the lake behind the natural dam and is destabilizing it from below, creating the possibility of total collapse. The worst-case scenario of this collapse is the release of Lake Garibaldi into Rubble Creek Valley and the towns of Squamish and Brackendale. Smaller scale collapses could spill over onto highway 99, damage dams impounding other lakes of the area and cause flooding (Clague and Turner, 147). The comparatively recent human habitation of the area adds consequence to the possible collapse of the Barrier. It is not a matter of a major geologic event occurring only to be buried and softened by the passing of time; because of the human element, collapse is synonymous with very immediate catastrophe. This is where the story truly begins; this potential collapse is simultaneously the vehicle to provide geologic knowledge, the audience's hook and motivation, and an invitation for the philosophical questions I entered the project with.

THE PROJECT

In order to present the history of the Sea to Sky corridor to a non-science-oriented audience I simplified it into 'marketable' bits. As I mentioned previously, these bits took the shape of four main processes: tectonic subduction, glaciation, volcanism and erosion. Though these processes occurred continually over vast spans of time, breaking down this timeline into four main concepts made more sense for our 20 minute documentary than trying to cover the entirety of the geologic history at scale. Because of this, we fit the scientific content of the documentary around the four sequences of these processes.

Our next structural decision was to include examples of each process, such as features including the Stawamus Chief and Mt Garibaldi, both common sights from Squamish. My main goals were to showcase some of this amazing geology and to provide context and history for these formations. I was afraid when we decided to use the framing device of the Barrier that we wouldn't have time to include other, no less interesting features. However, because I was able to use the Chief and Garibaldi – the results of uplift and volcanism – to explain the marketable processes, I could explain them even though they were not the main topic of the film. Only after each of these sections were explained did we explain the formation of the Barrier, describing how each process played an elemental role in its creation, and how they shape it today.

With a general idea of how to present the condensed history of the Sea to Sky corridor and dedicated time to showcase interesting geology, the new challenge was to build a compelling film and narrative around this content. Colin Bates' syllabus for his course in scientific

filmmaking was extremely useful for this step as we used some of his techniques for developing the actual concept of the story. This took the form of three different project plans which briefly outlined the general story arc, the conflict, the characters, and the tone of our proposed documentary. From here, we whittled it down to one idea that we expanded on in a five page long project description. This included more details such as a working title, short description of the film, an outline of the story, and a description of the style. I have included an excerpt from our final project plan to provide insight into the thought process behind the stylistic, narrative and philosophical choices that were made before picking up the camera and beginning to film.

> The crux of the documentary is the theme of humans' relationship towards nature; a real-life example of this relationship is the Barrier and the danger it poses. In turn, the Barrier can only be fully understood through the geological forces that created it and will ultimately destroy it. This three tiered approach allows the film to be educational while providing entertain ment and deeper substance, ultimately questioning our place as humans in the relentlessly powerful landscape we inhabit.
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> Based on this theme, the tone of the documentary will primarily be reflective, contemplative and serious. As such, the style implemented will be a mixture of expositional and reflexive modes. For most of the scenes dedicated to scientific explanation, the narrator will deliver relevant information directly to the audience in the classical style of an informative documentary. To support this, interviews and animations will also be included to aid in explanation, and the images and footage used during this section to illustrate the concepts being described by both the narrator and the expert interviewees. However, since scientific explanation is not the only goal of the documentary, using a purely expositional style is ineffective. The true tone of the story emerges during the scenes with the nameless character from Squamish – these are the sections of the film that are told using the reflexive style. The voice-overs during these periods of the film will be more uncertain and questioning, and will aim to cause a subjective, emotional response in the audience that connects them to the deeper theme of their place within nature.

Interviews with experts on geomorphology, volcanology and city planning were the vehicle for the scientific content of the film, but the philosophical questions that the documentary poses were communicated through our one silent character, whose exploits we follow from couch potato to mountain climber. His story is more conducive to the emotional human interest of the audience: he lives in Brackendale, a place in danger if the Barrier were to collapse; he does similar things that the intended audience does, like hike and spend time in downtown Squamish; he is curious about the landscape around him, and consciously tries to

teach himself more about it. Because of this, we decided that this character's exploration would be a suitable access point for the audience. It is through him that all of the geologic learning takes place; he youtubes pre-existing videos of talking heads, which happen to be the actual geologic sequences of each process that we use in the film itself. These two narratives - of the scientific history of the land and of the personal journey of one man – were thus fit together.

To augment the interviews and the technical processes that they explain, some sort of visual was needed. We discussed using analogues for each process (i.e. lava lamp for formation of pluton chief, sandpaper for polishing of sub-glacial rocks, paint scraper for accretion at subduction zone), but decided that the simplest and most effective way of visually representing these processes was through stop motion animation. Stop motion is a technique where each frame of a video is a separate photograph in which the elements have been changed slightly frame to frame. When all of the frames are put together, this creates a sense of movement; in essence, these animations looked like moving drawings. While elucidating these processes, the stop motions also added a sense of continuing stylization to the documentary. They were all created through multiple white board drawings using black ink, simplified lines and cross-hatching. Other props such as the map the silent character refers to and the notes he takes are also in the same style. It looks like class notes that an avid student would take, and helped us convey the tone we were aiming to create: serious, contemplative, yet more casual than professional.

Another tool we used to stylize and cultivate the tone of the documentary was music. With our budget not exceeding the cost of the gas we used driving to different sites, buying the rights to use another person's music was out of the question. Instead, I wrote the soundtrack for the film with the help of some musicians on campus throughout the summer. Writing the music for a documentary story that I had also helped create was an interesting experience, and it was infinitely useful to know exactly the type of tone we were trying to cultivate. We used four general themes that are played throughout the film to act as subconscious – and sometimes not so subconscious – tone cues for the audience.

> 'Geology is fun' – Quirky and upbeat, this theme has a simple, plunky piano part and an alternating picking pattern on the electric guitar. This theme is meant to denote discovery and the beginning of a journey. It was used during scenes where the silent character is learning something new as well as during some of the expert interviews where geologic processes are being explained.

'The Tension Theme' – Slow, languorous electric guitar is coupled with an even acoustic baseline that hums on the minor keys. This theme builds to sharp electric edges, and is not a comforting or comfortable theme – hence the idea of tensions. It is used to denote conflict in the story, and is used in scenes where the potential collapse of the Barrier is discussed.

'Annoying Tinny Song' – The least subtle of the themes, Annoying Tinny Song is a loop of very upbeat guitar strumming that musically represents naivety and inattentiveness. It is annoying and tinny, as the name suggests. This theme is used in specific situations where the silent character is listening to his iPod and ignoring the world. As cacophonous as it is, this theme is a useful tool, especially when used to highlight the initial discord between the silent character and the nature surrounding him.

'Cloud watching' – The opposite of the previous theme discussed, Cloud Watching represents the silent character's paradigm shift; from ignoring the nature and geological hazards around him to seeking knowledge and appreciating the landscape. It has dreamy harmonics that act as a metronome throughout, and building baseline, percussion and electric guitar riff. The song reaches its highest point of energy as the silent character summits Panorama Ridge and looks out at the geologic features that he has been learning about throughout the film.

This project was truly interdisciplinary; music, storytelling, animation, film and geology all work together in order to deliver a message about how we view our surroundings. We have explored what it takes to be aware and present in a time where humans have a certain extent of power over the natural world – a power that can easily numb and distract us from the strength of nature itself. The name of the movie – Beyond the Barrier – represents this idea. Not only does it denote the geologic processes that created the Barrier and the proximity of Squamish and Brackendale to this hazard, this title represents the philosophical idea of moving beyond a block in our consciousness to see the world in a different way.

CONCLUSION

Despite the benefits of an interdisciplinary project, I found that having to focus on multiple subjects limited the depth to which I could go in any single one of them. Focusing solely on the geologic aspects of the project would have allowed me to learn a lot more in that specific field; for example, I wanted to complete a self-taught unit on geomorphology and how glaciers change the landscape but ran out of time to do so. Perhaps a purely scientific project would have

allowed me to conduct research of my own. Something our documentary does not do is evaluate the actual risk of the Barrier's collapse. If I had more time, I would have liked to delve into this issue further and present a more accurate depiction of the risk Squamish is at. However, this is research that I can take on in the future, and perhaps without this project, I would not be interested in doing so.

This project has created new questions for me, but has also answered a lot of the questions I entered with. Through many hours of frantic scribbles on storyboards, convoluted conversations with Sommer and hikes into the backcountry of Garibaldi Provincial Park, I subconsciously created a philosophy for myself on my own place within nature. No matter if I never go into a career of applied geology, this new paradigm will change the way I live my life. In my eyes, the landscape that surrounds us is a survivor of the huge and tiny processes that try to wear it away, and as humans we hopefully only experience the hang time between catastrophes. We are so small and so impermanent in comparison to Mount Garibaldi, which has had time to erupt itself into existence and fall apart, or to the Chief, which has been pushed to the surface and scoured down by glaciers. As these temporary tenants of an ever-changing landscape, we have to realize what we are getting ourselves into when we decide to call this beautiful, dynamic and potentially hazardous place home.

SOURCES

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