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Paterson of the South Dakota School of Mines and Technology, Heather Macdonald and Barb Tewksbury of NAGT, and *JGE* Editor Jim Shea for their indispensable aid in realizing the symposium and the published papers.

The authors hope that these papers will be of interest, and perhaps useful, to geoscience educators no matter where they are working. We also wish to encourage those individuals whom we have not yet met, Native or non-Native, actively or potentially involved in Native American geoscience education, to contact us, so that your knowledge can be brought into the circle.

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ABSTRACT

Innovative science education is necessary for First Nations' peoples who are under-represented in scientific professions yet moving swiftly to increase their role in natural-resource management within their traditional territories. Geoscience was chosen as an appropriate topic for a unique educational initiative involving First Nations' adult students studying in Prince Rupert, British Columbia, because the North Coast is tectonically active and a site of <250 year old lava flows. Legends of the volcanic eruptions figure prominently in local aboriginal oral traditions.

Two visiting geoscientists presented classroom materials on volcanoes and plate tectonics and discussed post-secondary geoscience education and career possibilities. A field trip to Nisga'a Memorial Lava Bed Provincial Park, an area which holds local historical significance to First Nations' peoples, served to focus this educational experience.

Aboriginal adult students benefited from this study by interacting with and learning from *practicing* geoscientists. In a spin-off benefit, the adults passed on their newfound geoscience knowledge by presenting interactive demonstrations to school children in nearby aboriginal communities, thereby arousing interest in geoscience in young First Nations' learners from throughout the North Coast.

Keywords: Education – geoscience; education – outside United States; education – special clientele; education – undergraduate; geology – women and minorities.

INTRODUCTION

First Nations' peoples are moving increasingly towards self-government and management of their own education systems and natural resources. Because the

North Coast of British Columbia, Canada (Figure 1) is an area of recent volcanism and active tectonism, geoscience knowledge is necessary and relevant to First Nations' peoples who live there. This is especially

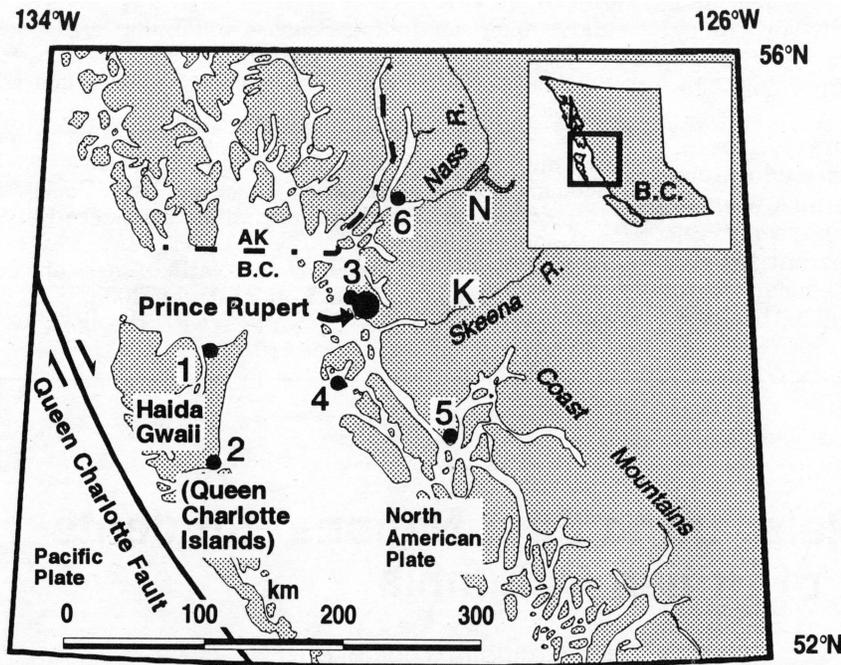


Figure 1. Map of the North Coast of British Columbia showing plate tectonic setting and locations of places referred to in the text. 1 = Old Massett; 2 = Skidegate; 3 = Metlakatla; 4 = Kitkatla; 5 = Hartley Bay; 6 = Kincolith; K = Kwinitsa quarry; N = Nisga'a Memorial Lava Bed Provincial Park.

true in light of recent treaty negotiations such as the Agreement-In-Principle that the Nisga'a First Nation signed with British Columbia and Canada in February 1996 (Government of Canada and others, 1996).

This paper describes a cooperative geoscience education initiative that targeted First Nations' adult students from the North Coast Tribal Council Education Centre (NCTCEC) in Prince Rupert (Figure 1) in order to give them personalized knowledge of geoscience and its relevance to aboriginal land use and culture. Judy Thompson, the Science and Math Instructor at NCTCEC, conceived the idea for such an initiative after attending a public lecture on North Coast geology given as part of community outreach for the ACCRETE research program (Hollister, 1995).

The funding necessary to complete this initiative came from Scientists and Innovators in the Schools (SIS). SIS, a provincially and federally funded program that is administered by Science World, is designed to sponsor scientists, engineers, and innovators for classroom visits at the request of local teachers. SIS seeks to enhance educational opportunities for traditionally disadvantaged groups. NCTCEC provided a venue that could benefit greatly from SIS visiting scientists, as First Nations' students who attend school there are drawn from a large, sparsely populated area.

THE TARGET POPULATION OF STUDENTS AND THE VENUE

Traditional ways of life prevail in many of the remote aboriginal communities on the North Coast. Aboriginal families have strong bonds to each other and to their communities, and the adults commonly find it difficult to leave home and go to the city to

obtain more education. However, the bands realize the necessity of having trained individuals to manage their natural resources, and therefore, they are working to advance their peoples' opportunities in today's society and economy.

The First Nations' adults who participated in this initiative originally fell through cracks in the educational system and either did not complete secondary school or graduated with only minimum requirements. At ages ranging from 19-50, these students chose to go back to school and either to obtain their secondary-school diploma or to upgrade their course background. Many of the adults come back to finish their education because their own children are now in school, and they wish to be good role models.

NCTCEC is a private post-secondary institution in Prince Rupert where students from small communities and the Prince Rupert area can come to further their education. Bands belonging to three nations, the Haida from Haida Gwaii (Queen Charlotte Islands), the Tsimshian from the mainland coast, and the Nisga'a from Kincolith, jointly administer the North Coast Tribal Council and its Education Centre in Prince Rupert. North Coast Tribal Council member villages are located in Figure 1.

Prince Rupert is a regional center, an active port city with an economy based on natural resources. The population of approximately 16,000 is about forty percent of First Nations' origin, although the majority of First Nations' people from the North Coast live in small, geographically isolated communities.

RELEVANCE OF GEOSCIENCE TO FIRST NATIONS' PEOPLES OF THE NORTH COAST

The North Coast economy is resource-based, dominated by forestry, fishing, and to a lesser extent, mining. All of these industries could be severely impacted by geologic events such as volcanic eruptions, large earthquakes, or landslides.

Geologically, the area is tectonically active because of its location near the Queen Charlotte transform fault boundary between the Pacific and North American plates (Figure 1). Bedrock in the area consists of belts of Paleozoic to Mesozoic meta-volcanic and meta-sedimentary rock that comprise accreted terranes of mainly oceanic origin (Wrangellia and Alexander terranes). These were intruded by voluminous plutons of the Mesozoic to Tertiary Coast Plutonic Complex (Wheeler and McFeely, 1991). Late Cenozoic uplift along the coast, combined with Quaternary glaciation, has created the dramatic Coast Mountains, forming fjords, U-shaped valleys, and

serrated mountain peaks. There are a number of historically active, rift-related volcanoes in the northern Coast Mountains (Souther, 1991), and some of the eruptions are recorded in Nisga'a and Tsimshian oral traditions.

COMPONENTS OF THIS INITIATIVE

This educational outreach initiative was designed so that First Nations' students could learn that geoscience is directly relevant to managing natural resources and assessing natural hazards on First Nations' lands. The four components of this initiative were (1) advance preparation by the students, (2) a classroom visit by the visiting geoscientists, (3) a field trip to a historic lava flow on traditional Nisga'a land, and (4) geoscience presentations to primary school children that were done by the adult students.

Advance Preparation

In advance of the NCTCEC site visit by the geoscientists, the students studied the British Columbia provincial grade-12 geology curriculum obtained from the Open Learning Agency, in particular, the modules on rocks and minerals, plate tectonics, and volcanoes. Nisga'a and Tsimshian legends about the Nass Valley lava flow within Nisga'a Memorial Lava Bed Provincial Park (Figure 1) were researched and compiled (see the Appendix for an example).

Classroom Visit

Two geoscientists (Bevier and Evenchick) visited NCTCEC and furnished information and materials for a classroom visit that emphasized hands-on activities. The geoscientists discussed themselves and their backgrounds, including how they got interested in geoscience as a career; what high school and university training is necessary for a geoscience career; who geologists are; what they do; whether any special problems are encountered along the career paths of female scientists; geoscience career options with industry, academia, and government; and the relevance of geoscience to traditional First Nations' concerns. Geologic and tectonic maps of the area, mineral and rock samples, physical geology textbooks, geoscience careers pamphlets, and university geoscience and geological engineering degree information were among the materials provided by the geoscientists.

Hands-on activities emphasized two subjects, with the goal of preparing the students for what they would see on the field trip. Evenchick, from the Geological Survey of Canada, discussed the geologic and tectonic history of the North Coast by using a series of maps and cross sections drawn to illustrate the geology and tectonic setting at different times over the last 200 My. The students colored these maps and cross sections as the geologic and tectonic events were discussed, thus gaining an appreciation of the geologic history of their traditional lands. Bevier, from the University of British Columbia (UBC), showed the students how to use a hand lens and let them examine a variety of volcanic products such as pahoehoe, spindle bombs, and scoria. She also

showed slides of different types of volcanoes, high-lighting cinder cones and basalt flows that are present on Nisga'a traditional lands in the Nass Valley, the site of the field trip. Based on their knowledge of local plate tectonics, the students were asked to think about why certain types of volcanoes are present in the North Coast and to think about the positive and negative effects of having active volcanoes so close by.

Field Trip

Students had the opportunity to be *practicing* geoscientists during the field trip, including being subjected to a long, hot, dusty bus ride. Because of the long distance one must travel to reach the Nass Valley and get back to Prince Rupert, only a few stops were made (Figure 1). The first stop was at Kwinitza quarry on the Skeena River about halfway between Prince Rupert and Terrace. This locality is typical of the metamorphic roof pendants within the Coast Mountains on the North Coast. Here the students got a chance to test their skills at mineral and rock sampling and identification. Armed with hammers, they were instructed in the proper technique for collecting samples. The students used hand lenses to identify garnet, biotite, and plagioclase in a spectacular garnet-biotite gneiss. One observant student was excited to find very large biotite crystals in a pegmatite that crosscut the foliation in the gneiss.

The highlight of the day, however, was an examination of the lava flow that erupted from a cinder cone in a side canyon and flowed down a tributary into the Nass Valley about 250 years ago, causing the destruction of two villages and the death of about 2000 Nisga'a ancestors (Appendix). Today the Nass Valley is the site of several Nisga'a villages built near the edge of the flow, adjacent to the buried sites. A lake was dammed by the lava flow, and a new river cut down through the flow and is now a tributary of the Nass River. The students determined that the flow was only several meters thick and of the pahoehoe type, and they observed lava levees, lava tubes, and collapse pits.

Primary-School Presentations

Because sharing of knowledge is a tradition with First Nations' peoples, the final component of this educational initiative involved NCTCEC students presenting their newfound geoscience knowledge to primary-school children in NCTCEC member communities. With advice from Dr. Alan McKinnon, a science educator from Simon Fraser University in Burnaby, British Columbia, the students developed a variety of imaginative demonstrations, including erupting papier-mache volcanoes and movable tectonic plates. Through these presentations, school children in NCTC member villages and Prince Rupert were exposed to information on plate tectonics and volcanoes that is relevant to their communities, and they also saw First Nations' adults as scientific role models. The sharing of knowledge benefited the NCTCEC students by increasing their comprehension of the geoscience material, increasing their self-confidence, increasing their pride because they could

communicate their newfound knowledge to First Nations' children, and increasing their awareness of the relevance of geoscience to their home communities.

SUMMARY

This geoscience education initiative was successful for a number of reasons. One of the most important was that the initiative was proposed from within the aboriginal community by an enthusiastic First Nations' teacher and not artificially imposed on aboriginal students by outside sources. Secondly, NCTCEC is a private post-secondary institution so that the curriculum is very versatile and can accommodate innovative initiatives. Volcanoes and plate tectonics are subjects with great relevance to traditional aboriginal cultural values and industries. Thirdly, all the NCTCEC students passed their provincial science course and some indicated an interest in pursuing additional post-secondary science education.

Using geoscience as a theme to reach out to First Nations' students who do not have easy access to higher education and spreading awareness of the relevance of geoscience throughout remote aboriginal communities should produce results in the longer term, as either some of the First Nations' adults who took part in this initiative or the school children who experienced the classroom presentations by the NCTCEC students go on to additional geoscience education or geoscience careers.

ACKNOWLEDGEMENTS

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About the Authors

Mary Lou Bevier teaches geoscience in the Department of Earth and Ocean Sciences at the University of British Columbia. Her specialties are radiogenic isotope geochemistry, volcanology, and geoscience education. Judy Thompson teaches science and math at the North Coast Tribal Council Education Centre in Prince Rupert. She enjoys challenging her First Nations' students with a different major science project every year. Carol Evenchick is a research scientist with the Geological Survey of Canada in Vancouver. Her specialties are structural geology and field geology. Jennifer Wyss is the projects coordinator with Scientists and Innovators in the Schools in Vancouver. She is working on setting up additional activities with First Nations' students and visiting scientists.

APPENDIX

One version of the Nisga'a legend of the Nass Valley lava flow

Long ago, this land began to shake and rumble. Nature's harmony had been upset.

It all started by the river, as one child took a humpback (salmon) from the water and slit open its back. Then he stuck sticks in its back, lighted them, and made the humpback swim. The children were amused to see the fish swim up river with smoke coming from its back. The child slit open another humpback and stuck a piece of shale into its back. Then he made it swim but the humpback floated on its side, weighed down by the shale. The children laughed, despite the elders' warnings and the ground rumbled.

Finally, a scout was sent to investigate the rumblings. From the top of Genuu'axwt, he saw smoke and flames up the valley. Immediately he ran to tell the villagers of their fiery destiny. In a panic, the villagers moved to the mountain top. Some canoed across the river and remained there but they were killed by the lava.

As they watched the lava flow over their villages, a supernatural being, named Gwa Xts'agat, suddenly emerged south of Gitwinksihlkw to block the path of the lava. Gwa Xts'agat was very powerful and also possessed the power of fire. For days the Gwa Xts'agat lay with its big nose fighting back the lava. Finally the lava cooled and Gwa Xts'agat went back into the mountain where it remains to this day.

To the Nisga'a, fish are very important. To ridicule the fish is the first and foremost taboo and to do so would surely cause misfortune. The children's disrespect for the fish led to the unfortunate death of many Nisga'a.

Source: Nisga'a Memorial Lava Bed Provincial Park pamphlet, British Columbia Parks.