A Holocene coastal soil chronosequence, Graham Island, British Columbia, Canada: initial reconnaissance

Paul Sanborn & **Hugues B. Massicotte** (University of Northern British Columbia, Prince George BC V2N 4Z9),
Ian J. Walker (University of Victoria, Victoria BC V8W 2Y2), **Stephen Wolfe** (Geological Survey of Canada, Ottawa, ON K1A 0E8)

A. Introduction

The only documented soil chronosequence in coastal British Columbia spans less than 1000 years ***[1]***. New optical and radiocarbon dates ***[2]*** suggest that a much longer chronosequence exists in Naikoon Provincial Park on Graham Island in Haida Gwaii (Queen Charlotte Islands).

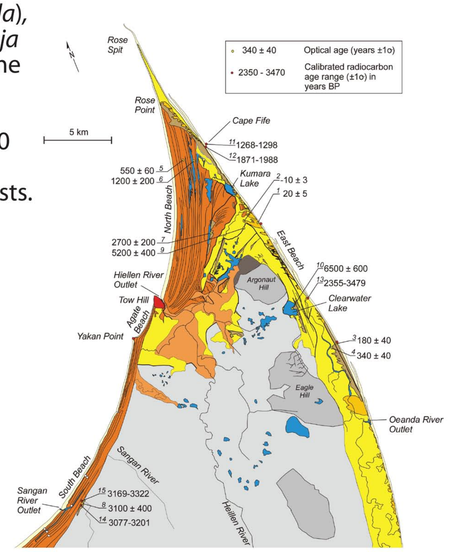
In June 2009, we examined soils and plant communities on dated sandy substrates in Naikoon, targeting well-drained sites across the age range of > 6500 years ***[2]***. Here we present some initial observations, and suggest potential follow-up studies.

B. Study Area

The low-lying coastal plain of northeastern Graham Island has been modified by declining relative sea levels, coastal erosion, and aeolian activity. These processes have created a complex landscape of beaches, foredunes, raised marine platforms, and estuaries.

Well-drained sites are dominated by Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), and western redcedar (*Thuja plicata*). In the cool maritime climate (mean annual temperature ~ 8˚C, mean annual precipitation ~ 1200 mm), paludification has created extensive bog forests.

Study area location.

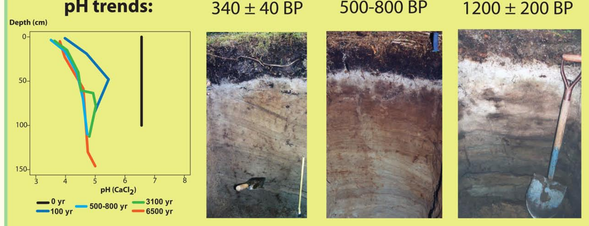


Landforms and date locations, northeastern Graham Island ***[2]***

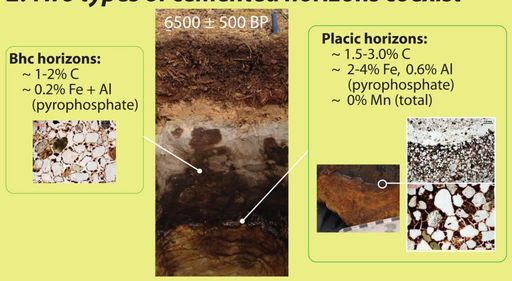
Acknowledgements:
We thank Ekaterina Daviel and Linda Tackaberry for their enthusiastic and resourceful field assistance, and Ralph Hausot and Erik Andersen for help with logistics. Our field work was authorized by BC Parks, and we thank Lucy Stefanyk (Area Supervisor, Haida Gwaii) and her staff for their interest in our research. Funding was provided by NSERC and UNBC.

C. Major Observations

1. Rapid acidification & development of Podzolic (Spodosol) morphology



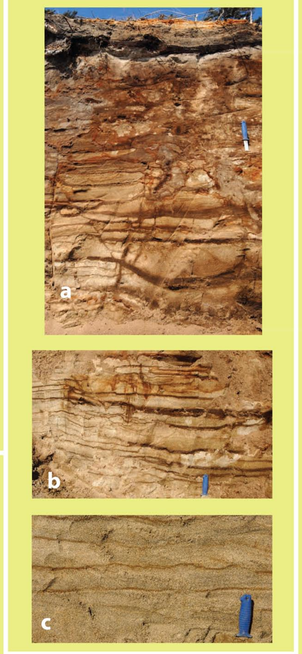
2. Two types of cemented horizons coexist



3. Placic horizon morphology related to bedding of aeolian sediments

A sea-cliff exposes > 3 m of buried mature Podzolic profile (equivalent to 3000-5000 year-old soils elsewhere at Naikoon).

Placic horizons become softer, less distinct with depth, resembling uncemented lamellae ***[3]*** at ~ 2 m below paleosurface.

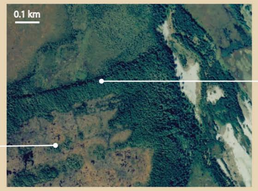


Spacing and orientation of placic horizons and lamellae correspond to subtle bedding structures in recently active dune sand.

D. Next Steps

1. Assess relationships between cementation & paludification

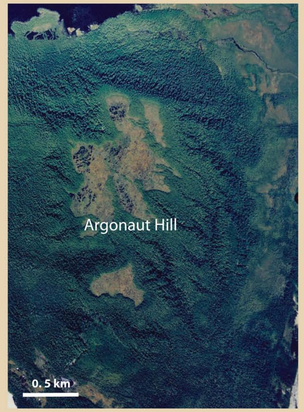
Typical bog forest, Naikoon Park

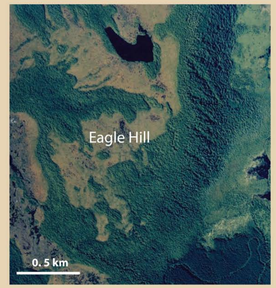


Hemlock - cedar forest on crest of wave-cut ridge (5200 ± 400 BP).

Paludification triggered by pedogenic cementation occurs on coastal lowlands in southeastern Alaska ***[4]*** and on northwestern Vancouver Island ***[5]***. The Naikoon chronosequence provides much finer time control for studying the development of these soil-vegetation patterns, and their local topographic variation.

2. Investigate upland glacial outwash surfaces to extend chronosequence back into late Pleistocene





Erosional remnants of late Pleistocene glacial outwash (ca. 20,000 BP; J. Clague, pers. comm.) provide surfaces > 100 m above the surrounding plain. Despite the coarse textures of the underlying sediments, these surfaces are largely occupied by bog forest and open wetlands, suggesting long-term persistence of impervious cemented horizons.

E. Conclusion

Evolution of an array of coastal landforms, formed of predominantly coarse-textured sediments, has created the longest Holocene soil chronosequence on the west coast of Canada. This remarkable area, with its well-documented geomorphic history, presents valuable opportunities for studying long-term soil formation and ecosystem development.

For more information, contact Paul Sanborn: sanborn@unbc.ca

References

[1] Singleton, G.A. & L.M. Lavkulich. 1987. *Can. J. Soil Sci.* 67: 795-810.
[2] Wolfe, S.A. et al. 2008. *Curr. Res.* 2008-12. Geol. Surv. Can. 16 p.
[3] Rawling, J.E. 2000. *Geomorphology* 35: 1-9.
[4] Ugolini, F.C. & D.H. Mann. 1979. *Nature* 281: 366-368.
[5] Maxwell, R.E. 1997. In: R.J. Hebda & J.C. Haggarty (eds.) *Occ. Paper, BC Parks*, 5: 4.1-4.49.