Dendrochronological Analysis of a Glace Bay Mine Adit

Amanda B. Young and Colin P. Laroque
MAD Lab Report 2010-04
Mount Allison Dendrochronology Laboratory,
Department of Geography and Environment,
Mount Allison University

Dendrochronological Analysis of a Glace Bay Mine Adit

Table of Contents

Abstract

During the mine activities of the Glace Bay mine, coal mine #7 caught fire twice. Each fire was put out by flooding the mine, which later had to be drained using a drainage adit. However, only one drainage adit can currently be located. Two samples were extracted from this drainage adit and were sent to the Mount Allison Dendrochronology Lab (MAD Lab). These samples were given the MAD Lab site label09AVL000. Samples were processed with standard dendrochronological techniques: slow drying, sanding, measuring, and cross-dating. The species and cut dates of the two samples differed. Sample 09AVL001 was balsam fir (*Abies balsamea*) and its age was deemed inconclusive. Sample 09AVL002 was eastern hemlock (*Tsuga canadensis*) and was cut in 1908. Due to the low sample size and only one firm date from the samples, it is inconclusive when the actual construction of the entire drainage adit occurred. The individual dated wood sample may have been recycled from older construction or replaced as reinforcements, but it is most likely that the right pillion was constructed with wood harvested in 1908.

Introduction

In the fall of 2009 the Mount Allison Dendrochronology Lab (MAD Lab) was contacted by Christian Wolkersdorfer of the Mine Water Remediation & Management group at Cape Breton University, Nova Scotia. Dr. Wolkersdorfer has recently been studying the mine workings of coal mine #7 of the Glace Bay coal mine (Figure 1). The interest in this mine comes from it having been flooded twice during the management of the mine due to fires in the shafts. After the fires, drainage adits were constructed into the mine to drain the water out of the shafts. Presently only one of these adits can be located. Dr. Wolkersdorfer and the Mine Water Remediation & Management group are interested in whether the current drainage adit can be dated using dendrochronological techniques to determine if the adit is from the first or second fire in the mine (Figure 1).

Figure 1. Image of the sampled mine adit of mine shaft #7 of the Glace Bay coal mine. Wood pillions are located in three rows Right (R), Left (L), and Centre (C).

Methods

Two samples were cut from the adit and sent to the MAD Lab. One sample was taken from the left pillion (HSO-2411-L01 renamed MAD Lab 09AVS001) and one from the right (HSO-2411-R01 renamed MAD Lab 09AVS002) (Figure 2 and 3). Samples were processed in the lab by slowly drying the samples to maintain their internal structures, and then by sanding them with progressively finer sand paper (80-400 grit) to bring out the cellular structures and annual rings of the wood. Rings were counted and measured from the bark to the pith (middle)

of each core sample using a Velmex measuring system with an accuracy of 0.001mm along three paths (Figure 3).

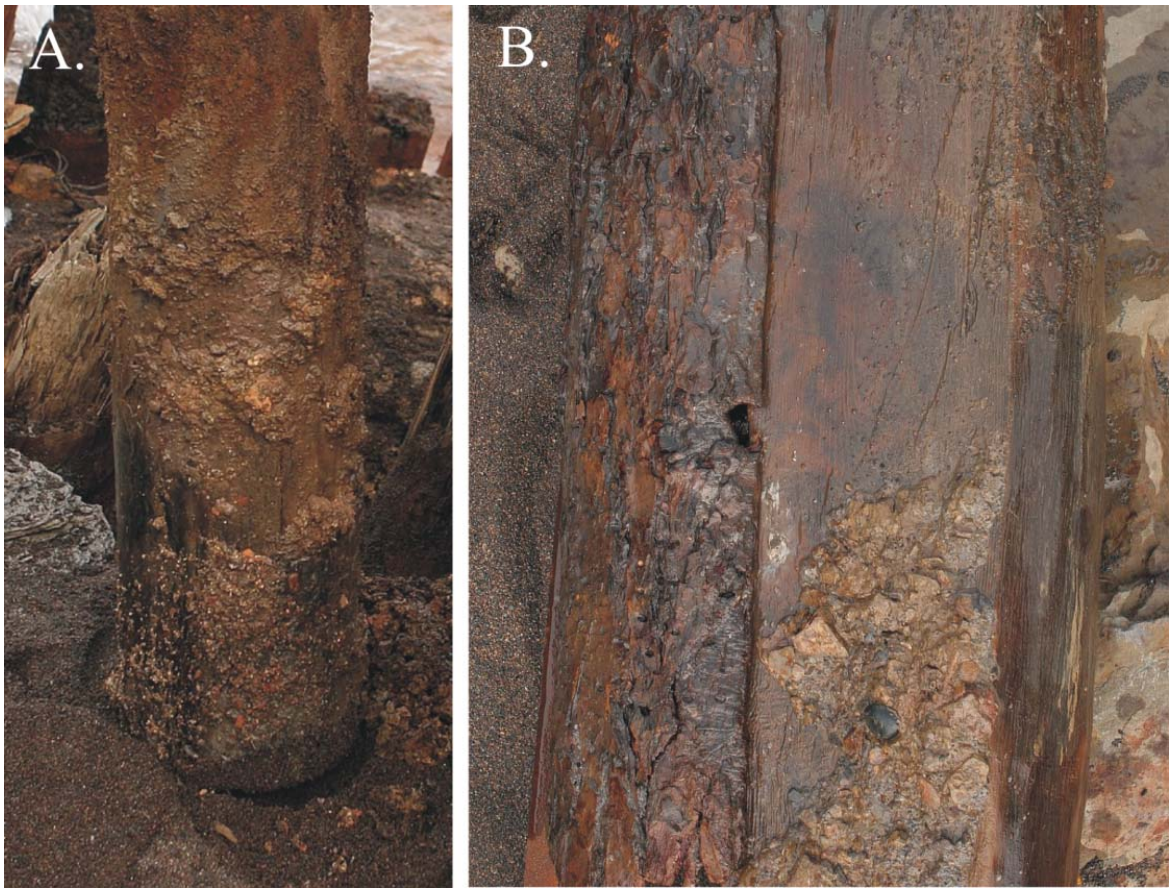

Figure 2. Samples dug out of the ground to expose the bark. A) 09AVL001 B) 09AVL002.

A time series of measurements from the two pieces of wood were pattern-matched to previously establish master chronologies from the area that are locked in time. Cross-dating is the practice of taking the pattern of growth from one sample and comparing it to that of another (Figure 4).

To assist in the cross-dating procedure, the statistical cross-dating program COFECHA (Holmes, 1986a) was used. COFECHA uses correlation values to assist in accurately dating samples. Higher correlation values indicate that the floating chronology corresponds well to the master chronology. Lower correlation values can indicate a variety of things such as ecological or climatic variation from the norm or that the sample is inaccurately dated. The floating chronologies were run against corresponding master chronologies of red spruce (*Picea rubens*) and eastern hemlock (*Tsuga canadensis*) available from the MAD Lab archives. Each of the floating and master chronologies were standardized to have a mean of one by using a negative exponential curve in the program ARSTAN (Holmes,1986b). This standardization was completed to allow samples of different ages to be compared.

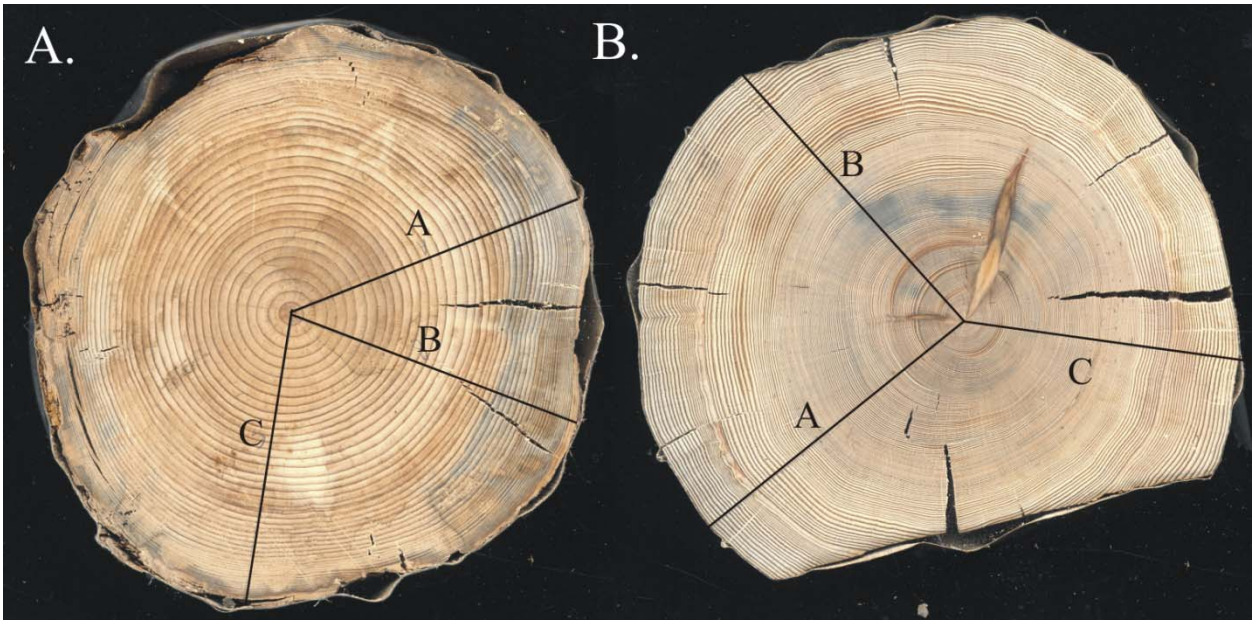

Figure 3. A) 09AVL001 with three measurement paths illustrated on the sample, B) 09AVL002 with three measurement paths illustrated on the sample.

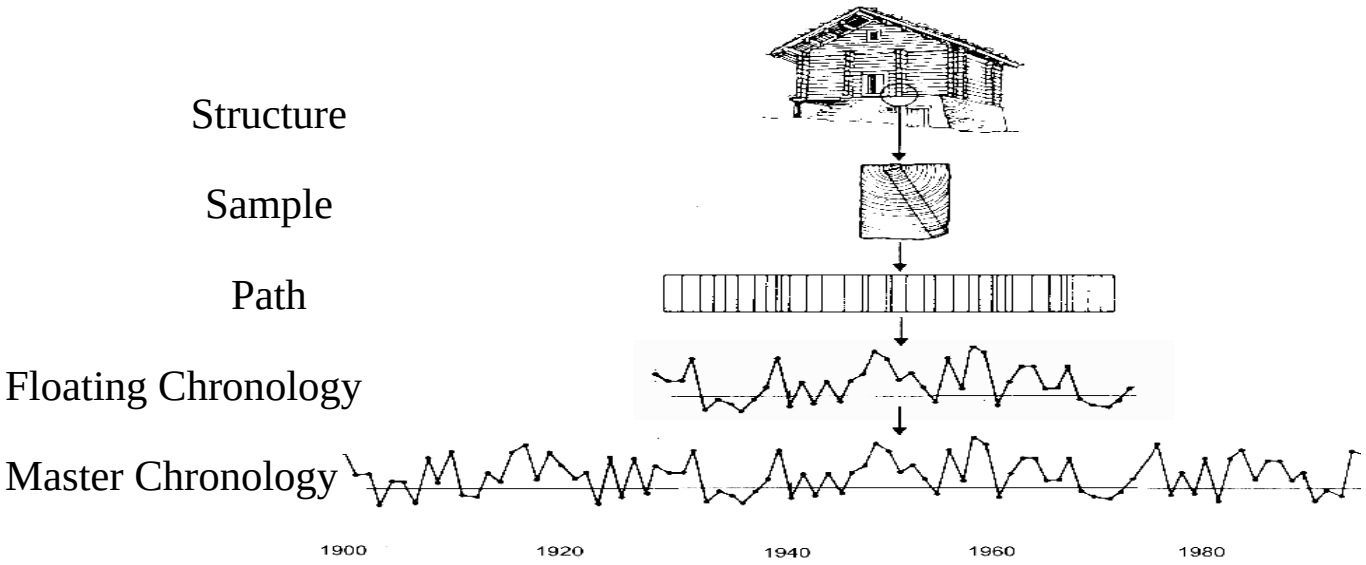

Figure 4. Example of cross-dating by using patterns from a structure (floating chronology) compared to the master chronology.

Results and Discussion

The two samples extracted from the mine adit differed in a number of ways. The two samples were of different species 09AVL001 is balsam fir (*Abies balsamea*) and 09AVL002 is eastern hemlock (*Tsuga canadensis*). There is a large difference in the age of the tree when it was cut down, 09AVL001 was 58 years old, and 09AVL002 was 236 years old. Balsam fir is a difficult species of wood to date, due to its complacent growth patterns and its relatively short life span. The MAD Lab has poor chronologies to use as master chronologies for dating balsam fir. However, balsam fir does respond to the environment and to insect outbreaks similarly to spruce. Thus spruce chronologies were used to attempt to date the sample 09AVL001. Sample 09AVL001 dated weakly to two potential time periods against the spruce chronology, 1940 and 1870 (Figure 5). However, the correlation between the sample and the master chronology is not significant 0.172 in for the best match (1940) and is statistically very weak for the other (-0.016 for 1870). Due to the lack of a master fir chronology back that far in time, the low correlations these values against the master spruce chronology, and the uncertainty associated with these two dates, we consider this sample presently undateable .

Sample 09AVL002 was dated to 1908 against a regional hemlock chronology (Table 1, Figure 6). The correlation between the standardized chronology and the master is significant (p-value <0.001) 0.370. Periods of highly suppressed growth were found in the 1750s and 1840s, which still matched the regional growth pattern for hemlock.

Table 1. Dates and correlations of the mine pillions. All correlation values above 0.3281 are significant to the 99% confidence interval based on 50-year segments.

	Path	Years	Length	Interseries correlation	Correlation to Master
09AVL002	A	234	1675-1908	0.585	0.415
	B	236	1673-1908	0.591	0.452
	C	236	1673-1908	0.532	0.501

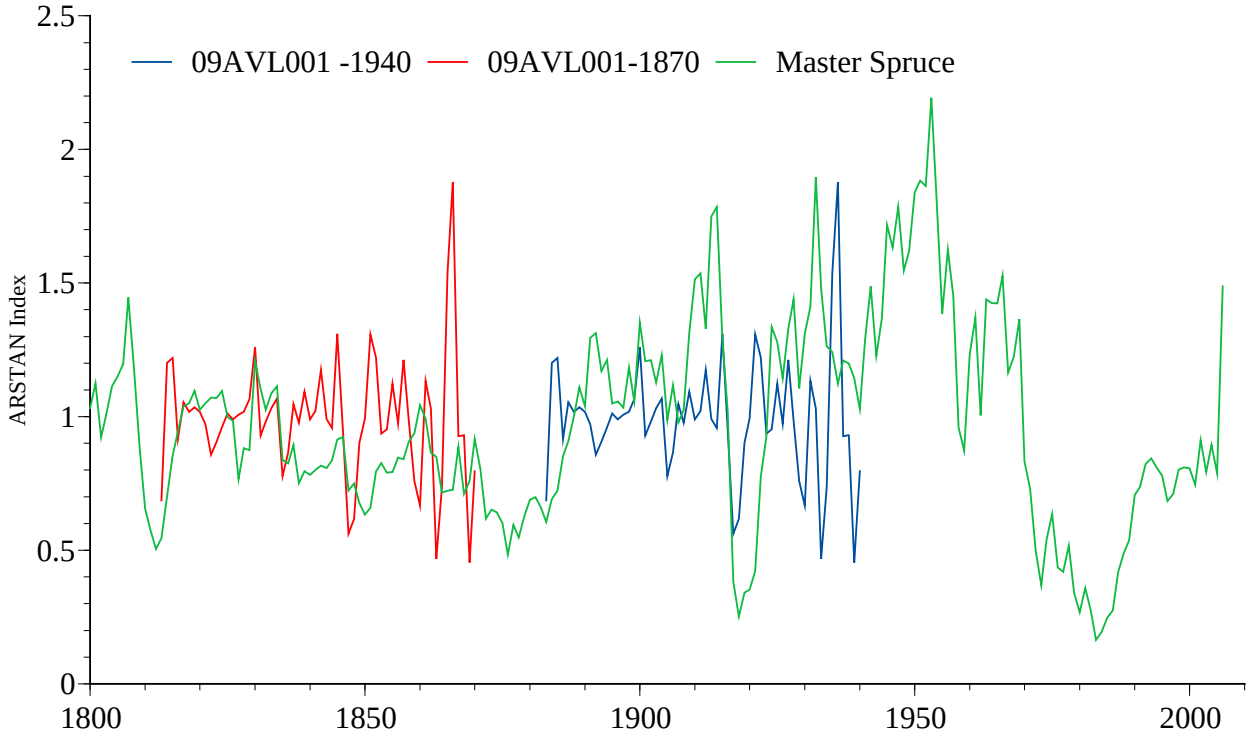

Figure 5. Comparison between the master regional spruce chronology and 09AVL001 at the two best potential dates.

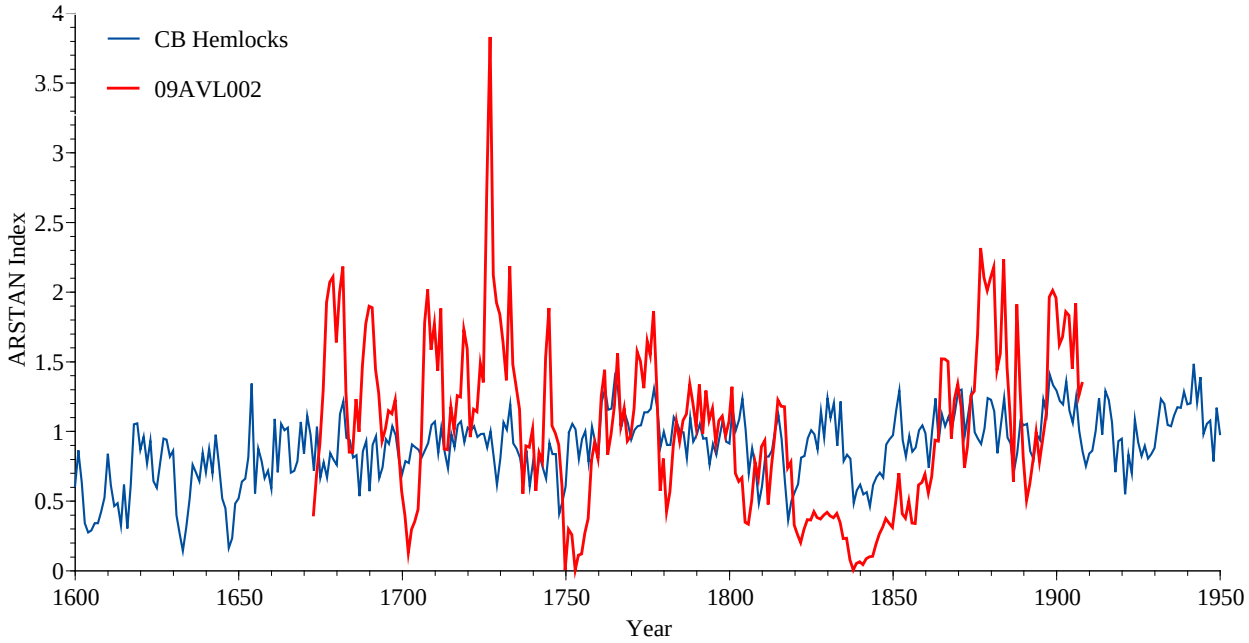

Figure 6. Comparison of the regional hemlock chronology (CB Hemlocks) and 09AVL002.

One sample from the right and left pillion of the mine adit were sampled. Due to this small sample size, and the fact that one of the two is undated, it is not easy to make firm conclusions as to when the mine adit was constructed. The results illustrate that the right pillion probably was constructed with wood harvested in 1908, and a construction date of the left pillion is unknown. However, each of these pieces of wood could have been recycled wood that was re-used in the construction of the adit, thus not dating the adit at all. Another possible option is that these dates represent the two drainage adits that were constructed, and the reason only one drainage adit can be found, is that it is the same adit with additional wood reinforcements was added to the first adit during after the second fire.

Additional samples to increase the sample size of the study could help in determining when the adit was built. More samples would allow for a potential clustering of dates in one of the three time periods that have been indicated by this study, thus better implying the date of construction of the adit.

Conclusions

Two samples were collected from mine shaft #7 drainage adit at the Glace Bay mine. This adit was built after one of the two fires that occurred in the mine and was used to drain water that was used to douse the fire. It is unknown whether this adit is a remnant of the first or second fire. Dendrochronological investigation illustrate that the sample from the right pillion was cut in or immediately after the 1908 growing season, while the sample from the left pillion is inconclusive. Due to having only one dated sample form the structure, it is impossible from a dendrochronological stand point to conclusively state when the adit was constructed. The wood may have been recycled from a previous structure or added as a reinforcement of the adit, but the strong pattern match of the sample to the regional pattern suggests that the sample was probably put in place in 1908 or 1909.

References

Holmes, R.L. (1986). Users manual for program COFECHA. In *Tree-ring chronologies of western North America: California, eastern Oregon, and northern Great Basin* (eds R.L. Holmes, R.K. Adams & H.C. Fritts), pp. 41-49. Laboratory of Tree-Ring Research, University of Arizona, Tucson.

Holmes, R.L., Adams, R.K., & Fritts, H.C. (1986) Users Manual for Program ARSTAN. In *Tree-ring chronologies of western North America: California, eastern Oregon, and northern Great Basin* (eds R.L. Holmes, R.K. Adams & H.C. Fritts), pp. 50-65. Laboratory of Tree-Ring Research, University of Arizona, Tucson.