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Thawing Ground

A Newsletter of the US Permafrost Association



The River Erosion Issue

The mission of USPA is to encourage sharing of knowledge and data in permafrost science.

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The Active Layer

A Model for Thaw and Erosion of Permafrost Riverbanks

This article by USPA member Madison Douglas and Cal Tech Earth Scientist Douglas Lamb, published in AGU's *Journal of Geophysical Research Earth Surface* this year, offers a more comprehensive mathematical model of riverine erosion rates than those currently in use. Their model includes heat transfer and the development of a layer of thawed sediment which can act as an insulator on the riverbank's surface. They found that this insulation, even in a thin layer of thawed sediment, decreased the rate of permafrost thaw and bank erosion. What is particularly enlightening about this finding is that it offers an explanation for the disparity in previous model predictions of erosion and on-the-ground observations. Predicted rates have exceeded what was observed. And, while it is always good news when the damaging effects of a warming climate are *overestimated*, we need to know why and what parameters might improve models to greater accuracy.

There is a cautionary note, however. The authors suggest that when river waters warm in certain areas where conditions are thaw-limited, or where thawed sediment fails seasonally, we could still expect greater rates of erosion. Finally, reader, a spoiler alert: you'd better like equations!

Read the article here:

<https://doi.org/10.1029/2023JF007452>

Spotlight on ABR

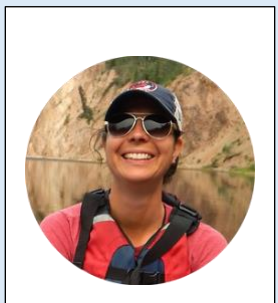
Led by President Adrian Gall, the environmental consulting firm based in Fairbanks and Anchorage is coming up on its 50th anniversary in 2026. Their services cover a broad spectrum: from biostatistics and modeling, to support for permits, to wildlife sciences, and more. Their researchers and scientists publish at a brisk rate. JJ Frost recently authored an article on the vegetation aspect of riverbanks, a topic that nests with the study of permafrost activity in the same, fragile, arena.

Learn more about ABR at www.abrinc.com.

Thank You, ABR, for supporting the work of USPA!



↑ Photo from another article by Madison Douglas, *et al.* on permafrost thawing and river Erosion (2023).



Adrian Gall, above, became ABR President in 2021:

"With [our] principles as our compass, the team I have the honor of leading will uphold our dedication to scientific integrity and remain passionate about serving our clients."

Quotes

However, the [permafrost] effects of such warming due to atmospheric climate change will only become apparent over many decades.... Over a period of a century or more, if warming trends continue, there will be important modifications of terrain and physiography.

Peter J. Williams, 1995

Spotlight on a Founder: Harley J. Walker

If we were to name a founding father of modern permafrost science, we could do no better than HJ Walker. The LSU professor published in many areas of our field, including riverbank and coastal erosion. A stalwart at ICOP meetings starting with the first in 1963, he contributed to the permafrost community up until his death in 2015 at the age of 93.

Thank you for all you have done, Dr Walker!



Erosion, Permafrost Thaw, and a Warming Climate: Historical Notes

Here, we briefly look at the research of erosion, permafrost thaw, and climate change over the past seventy years to see how scientists gradually linked these elements. We'll bear in mind that climate change was not well appreciated until this century, partly due to its acceleration in the past 25 years. But early studies explored coupling of two elements, laying groundwork for later studies of more complex relationships.

A search of Google Scholar back to 1940 revealed a few papers from the USGS on Alaska. What resources did this new state hold for a postwar America, and how did permafrost fit into the landscape?

A report by the USGS on Naval petroleum reserves in the Utukok-Corwin region from 1944-53 noted "slowly thawing" permafrost (p.64) and described its rising table near the Utukok River. Roger Waller of the USGS published a paper in 1957 describing the riverine erosion in the Beaver region, and while he noted that discontinuous permafrost is present all around the region and that erosion is occurring, he did not report any causative effect of permafrost.

At ICOP 5 (1988, Tromsø, NO), Lachenbruch and colleagues discussed changes in permafrost in the context of changing climates and its value as a benchmark of climates going back centuries. They made note of human actions contributing to warming surface air temperatures, this being the best-studied parameter, but also pointed to their recent work on rapidly thawing permafrost over the 20th century. Walker offered his own work on coastal erosion at ICOP 5, speaking on the close connection to permafrost, which is dominated by "thermal and mechanical energy working in combination," but did not mention a warming climate.

At ICOP 7 (1998, Yellowknife, CA), Sharkhuu presented a paper linking climate change to permafrost thawing in Mongolia and discussed the associated climate impacts in the Selenge River Basin, but did not report on any erosion. Also at ICOP 7, Wolfe and colleagues presented a paper on coastal erosion in Tuktoyaktuk, NWT, linking thawing massive ice, collapsing coastline, and higher mean annual temperatures along the waterline in a comparison of conditions in 1974 and 1994. They did not, however, discuss recently warming climate and manmade causes of it.

In the 2000's, we've shown evidence of all three elements interacting. An article in *Eos* from 2010 authored by five USPA members (and others) describing coastal and river erosion, landslides, and changing wetlands states: "These changes result from system-wide response to changing climate arising from a region-wide warming and thawing of permafrost." (p. 229)

Permafrost plays a key role in river ecosystems, and the last seventy years have seen scientists build a firm foundation and then a comprehensive body of scholarship on its effect. In the current spirit of interdisciplinary research, we can now benefit from a picture of rivers that brings together the entire ecosystem: permafrost, soils, plant life, fauna of all sizes, adjacent infrastructure, and the people who make their homes and livelihood along their banks.



Siberia's Kolyma River, courtesy of *Eos*, 2021

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Answer: D. A brief report, this pithy piece references a variety of ecosystem components. Check it out.
<https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2010eo260001>

Permafrost Corner
Which article discusses permafrost and riverine erosion in the context of climate change?

- A. Walker, 1983 ICOP #4
- B. Sharkhuu, ICOP #7
- C. Waller, 1957, USGS
- D. Rowland *et al.* 2010 *Eos*



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