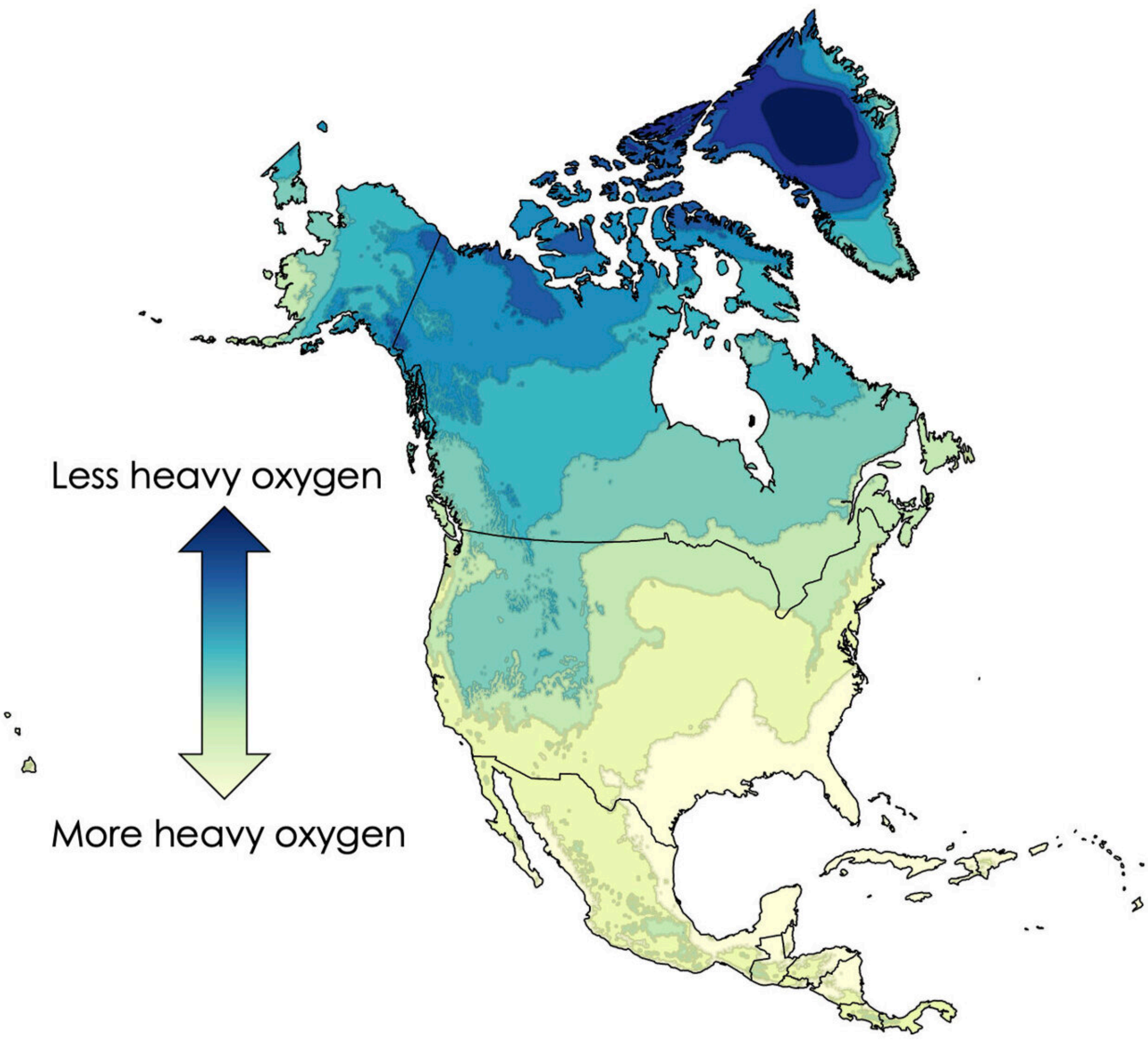
Geologists and dentists create tooth database to help ID remains of missing service members

September 17 2024, by Sophia Friesen



Map of how much heavy oxygen there is in local groundwater. Credit: Bowen Lab

More than 80,000 American service members remain missing from previous wars, most from World War II. When remains are found, decomposition often makes identification difficult—but not impossible.

Even without a name, fingerprints or facial features, our history leaves indelible marks on us, locked in the atoms of the toughest structures in our bodies: the enamel of our teeth. Subtle differences in tooth chemistry could help determine the identity of fallen soldiers and other human remains—if we can learn to read that history.

Now, a collaboration between geography and dentistry researchers aims to find ways to map a person's remains to the region where they grew up, based on slight differences in tooth enamel that are determined by the composition of local tap water.

While the researchers' immediate goal is to help identify fallen soldiers, the project has the potential to strengthen the field of forensic investigation as a whole, according to Gabe Bowen, professor of geology and geophysics at the University of Utah and the lead on Project FIND-EM.

"The ultimate goal is to produce a resource that will be very broadly useful," Bowen said. "Cold cases, border crossers, humanitarian crises—any situation where we end up with individuals of unknown identity." (Read about Bowen's work in 2019 during a solo 10-day cross-country flight, gathering water samples for isotope analysis, here.)

The waters of home

The researchers' identification scheme hinges on isotopic differences in the oxygen atoms of tooth enamel.

More than 99% of the oxygen atoms in the world—and in our teeth—contain exactly eight protons, eight neutrons and eight electrons. But a small minority of oxygen atoms have two extra neutrons, making them slightly heavier. These different varieties of oxygen are called isotopes.

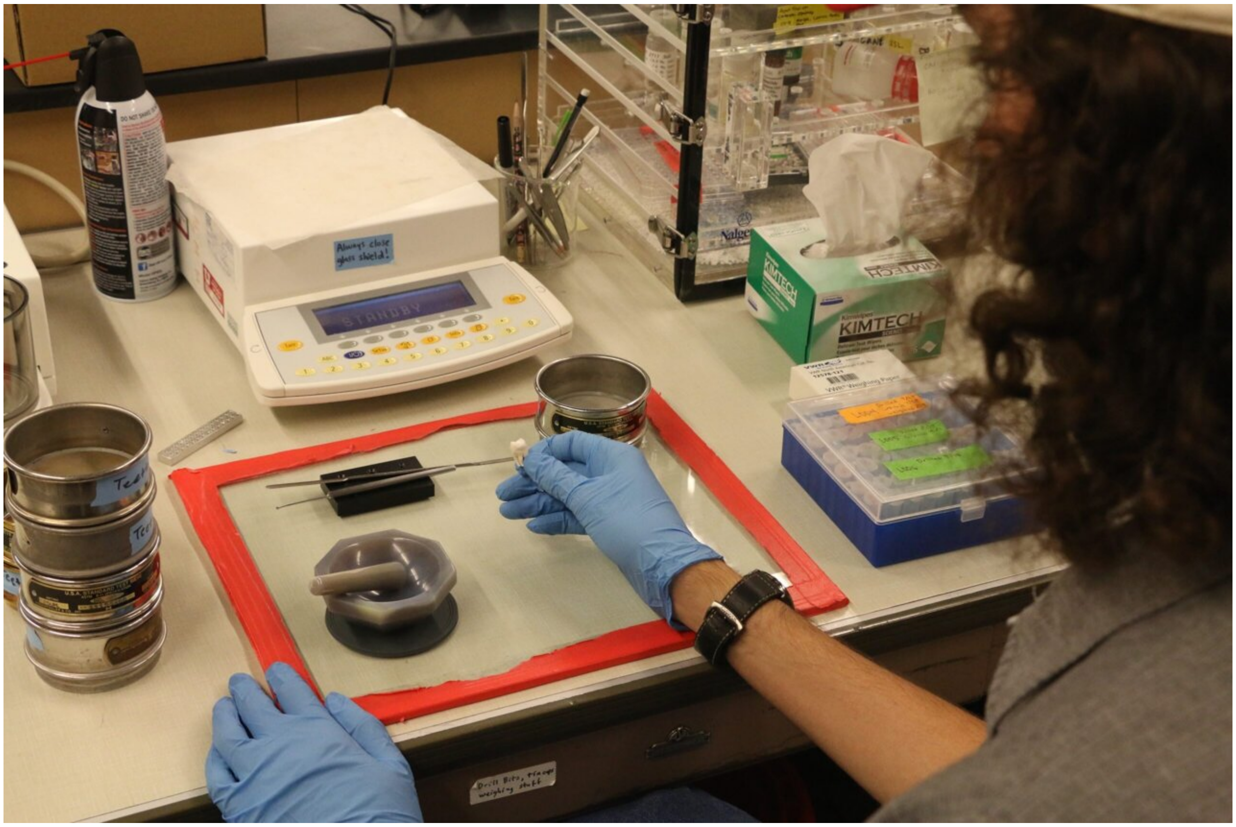
The amount of heavy oxygen in tooth enamel is different from person to person, depending on how much heavy oxygen was present in their environment when their teeth formed.

"Most of the oxygen in our tooth enamel gets into our body through the water that we drink and the food that we eat," Bowen said. "To the degree that those are local, that's where the signal is coming from." After the enamel forms, those location-specific differences are permanent.

Critically, the amount of heavy oxygen in groundwater changes between regions of the country in predictable ways. When a cloud rises from the ocean and moves over the land, water molecules containing heavy oxygen are slightly more likely to fall as rain.

This means that the Gulf Coast, which is right next to the ocean, has the most heavy oxygen in its water. The Rockies have the least; by the time the clouds get to the mountains, they've already dropped much of their heavy oxygen.

The research team confirmed these general patterns by rigorously testing groundwater across the U.S. for heavy oxygen.



Ben Rivera, a technician in the Bowen Lab, prepares a wisdom tooth for analysis. Credit: Bowen Lab

The molar code

The next step? Teeth, and a lot of them.

To match someone's teeth to where they grew up, the researchers are amassing a database of teeth donated by volunteers nationwide and comparing their enamel composition to groundwater data. They're using wisdom teeth, which are commonly removed in modern dental care.

"I think it's beautiful that in the natural progression of people's treatment, we would be removing these teeth anyway," said Michael

Bingham, clinical research coordinator in the School of Dentistry at the University of Utah. "We can take something that would, in theory, be discarded, and use it to do this beautiful project of reuniting families with their service members' remains."

While the researchers need more tooth donors to get a comprehensive map, their results so far are promising. According to Bowen, differences in the amount of heavy oxygen in tooth enamel are very strongly associated with differences in drinking water. This strong association increases the chance of being able to map a set of remains to a particular region of the country.

The level of public enthusiasm for the project is inspiring.

"It's been cool to see the swell of support from patients," Bingham said. "Anybody you talk to is like, 'I'm really excited to be a part of the project. How can I help?'"

While much work remains to be done, Bowen is hopeful that the project will make a real difference for forensic analysis, seeing it as a way to put his enthusiasm for geochemistry to immediate use.

"Isotopes are fascinating," Bowen said. "They connect all these environmental, human, and ecological systems that surround us and are changing all the time. And this is a very real and applied problem that I think a lot of people can connect with. It's a way of leveraging some of the more esoteric work and bringing it into a context where it can make a difference in peoples' lives."

Provided by University of Utah

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