Ancient wood from La Brea tar pits shows how trees respond to long-term carbon dioxide change

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(Phys.org)—Say "La Brea Tar pits," and most people imagine the saber-tooth cats and woolly mammoths that were trapped on sticky asphalt (now in modern-day Los Angeles), only to have their bones preserved for the ages. But other forms of life were also preserved in the asphalt, including the wood of ancient trees.

For Laci Gerhart, a doctoral researcher at the University of Kansas, the most captivating contents of the pits are juniper tree specimens that date back between 15,000-50,000 years in the past, when the Earth was in a glacial period marked by cold temperatures and drastically lower levels of atmospheric carbon dioxide (CO_2). This was critical since CO_2 from the atmosphere serves as the "food" source for plant photosynthesis.

Remarkably, the use of stable carbon isotope techniques allowed Gerhart to understand the physiology of trees even though they had died 20,000 to 50,000 years ago. Gerhart stated that is so important to have access to these amazing tar pit specimens, thanks to John Harris, the curator of the Page Museum in LA.

"There already had been studies on modern plants grown at low CO_2 and studies on glacial plant material in the lab of my adviser, Joy Ward," said Gerhart. "But because we had access to new specimens with clear tree rings, we were one of the first to look at every individual year. We could take a glacial tree and figure out its physiology when it was younger and when it was a mature tree."

Gerhart initially thought that "the trees would be opening the pores on their leaves more during the last glacial period in order to increase the entry of CO_2 into leaves under such limiting carbon conditions."

"But that's not what we found," said the KU researcher.

It appears that the glacial juniper trees were operating at less than half the available level of CO_2 for photosynthesis compared with modern trees. As a result, this limiting resource appeared to control the tree's physiology from one year to the next as deduced from tree rings, with relatively less effects from changes in water and temperature, which have dominant effects in southern California today.

Gerhart and Ward's research was published in a recent issue of the journal *New Phytologist*, one of the top journals in plant biology.

Currently, Gerhart is interested in understanding to what level the trees could grow under such low carbon conditions.

"Because you had half the available carbon, one would expect the trees to potentially have half the growth rate," she said. However, this response still needs to be measured in more detail, and there are preliminary indications that growth may not have been reduced as much as expected due to other compensating mechanisms.

The ramifications of Gerhart's findings apply to trees that lived thousands of years ago, as well as to future trees, since the legacy of adaptation to low CO_2 may affect future responses to rising CO_2.

"It is important to point out that trees are generally more responsive with photosynthesis and growth to an increase in CO_2 that occurs below the current value relative to the same amount of increase that occurs above the modern level," said Gerhart.

Thus, much of the plant response to CO_2 may have already occurred in the past. "We're trying to see what this means for the future. The only way we can find this out is to anchor our plant research across a large geological time period," Gerhart said.

Gerhart said that in coming years of boosted atmospheric carbon and warming, long-lived trees could adapt at different rates than short-lived plants: "We have to acknowledge that evolutionary adaptation may be key for surviving climate change, and different plant species have the potential to respond at different rates. To me, it is absolutely amazing that we can understand plant physiology in response to climate and CO_2 change from wood buried in tar pits so long ago."

Provided by University of Kansas

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