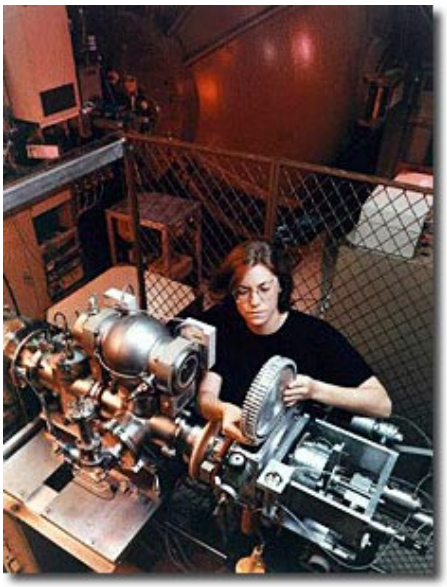
New tooth enamel dating technique could help identify disaster victims



The radioactive carbon-14 produced by above-ground nuclear testing in the 1950s and 1960s is providing forensic scientists with a more precise way to determine a person's age at the time of death. The method could help in the identification of victims of Hurricane Katrina and other large-scale disasters.

Image: Researcher Michaele Kashgarian loads the 64-sample source turret of the mass spectrometer at LLNL's Center for Accelerator Mass Spectrometry.

The new technique, developed by researchers at Lawrence Livermore National Laboratory (LLNL) and the Karolinska Institute in Sweden, determines the amount of carbon-14 in tooth enamel. Scientists can relate the extensive atmospheric record for carbon-14 to when the tooth was formed and calculate the age of the tooth, and its owner, to an accuracy of within about 1.6 years.

"Unlike most other tissue, dental enamel doesn't turn over," said Bruce Buchholz of LLNL's Center for Accelerator Mass Spectrometry, where the enamel samples were analyzed. "Whatever carbon gets laid down in enamel during tooth formation stays there, so tooth enamel is a very good chronometer of the time of formation.

"We were surprised at how well it worked," he said. "And if you look at multiple teeth formed at different times, you can get (the age range) even tighter." Previous techniques, such as evaluating skeletal remains and tooth wear, are accurate only to within five to 10 years in adults, Buchholz said.

The research was reported in this week's edition of the journal *Nature*.

Buchholz said Swedish forensic scientists already have used enamel dating to help narrow the search for victims of last December's tsunami in Southeast Asia. "After a few days in the water, it's very hard to identify someone," he said. "You can't use (enamel dating) to identify a person – that requires a DNA analysis – but you can narrow down the number of people you need to look at from a list of missing people."

Livermore officials are providing information on the enamel dating technique to federal agencies as part of the Laboratory's scientific and technical assistance in response to Hurricane Katrina. LLNL also is assisting in setting up emergency high-bandwidth communications and wireless networks. The Laboratory's Micropower-Impulse Radar (MIR) technology also is being deployed to assist search and rescue crews in locating hurricane victims. This same technology was deployed in the days following the September 11 attacks in New York's World Trade Center rubble.

Carbon-14, or radiocarbon, is naturally produced by cosmic ray interactions with air and is present at low levels in the atmosphere and food. Atmospheric testing of nuclear weapons from 1955 to1963 produced a dramatic surge in the amount of radiocarbon in the atmosphere, Buchholz said.

"Even though the detonations were conducted at only a few locations, the elevated carbon-14 levels in the atmosphere rapidly equalized around the globe," he said. Since atmospheric testing was banned in 1963, the levels have dropped substantially as the carbon-14 reacted with oxygen to form carbon dioxide, which was taken up by plants during photosynthesis and mixed with the oceans.

"Because we eat plants and animals that live off plants, the carbon-14 concentration in our bodies closely parallels that in the atmosphere at any one time," he said.

Buchholz and his colleagues analyzed 33 teeth from 22 different people whose ages were known. The enamel separations were done at the Karolinska Institute, and sample preparation and accelerator mass spectrometry analysis was done at Lawrence Livermore.

The enamel dating technique doesn't work for people born before 1943, because all of their teeth would have been formed before testing began in 1955.

In their *Nature* paper, Buchholz and his colleagues note that the technique for carbon-14 analysis using accelerator mass spectrometry is becoming increasingly sensitive and inexpensive, suggesting that even though nuclear testing was conducted decades ago, enamel dating could be used for precise age determination "for a long time to come."

Source: Livermore National Laboratory

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