



Research on Climate Change

National High Magnetic Field Laboratory

DMR-Award 0654118

Geochemistry Program

Mountain building affects climate because the erosion of silicate rocks decreases the CO₂ content in the atmosphere.

We measure past climate from the tooth enamel of herbivores by measuring the carbon isotopic composition as plants that use the “C₃” photosynthetic pathway (colder-climate plants) have a different isotopic composition than “C₄” plants, which are more abundant in warm climates.

A detailed study in central Inner Mongolia reveals an increase in abundance of C₄ plants starting at about 8 million years and a retreat of C₄ plants starting at 3.6 million years. This variation indicates a period of mountain building of the Tibetan Plateau.

A complementary approach to silicate weathering is provided by lithium isotopes in seawater, which vary as a function of the silicate weathering intensity as well. We follow both research strategies at the NHMFL.

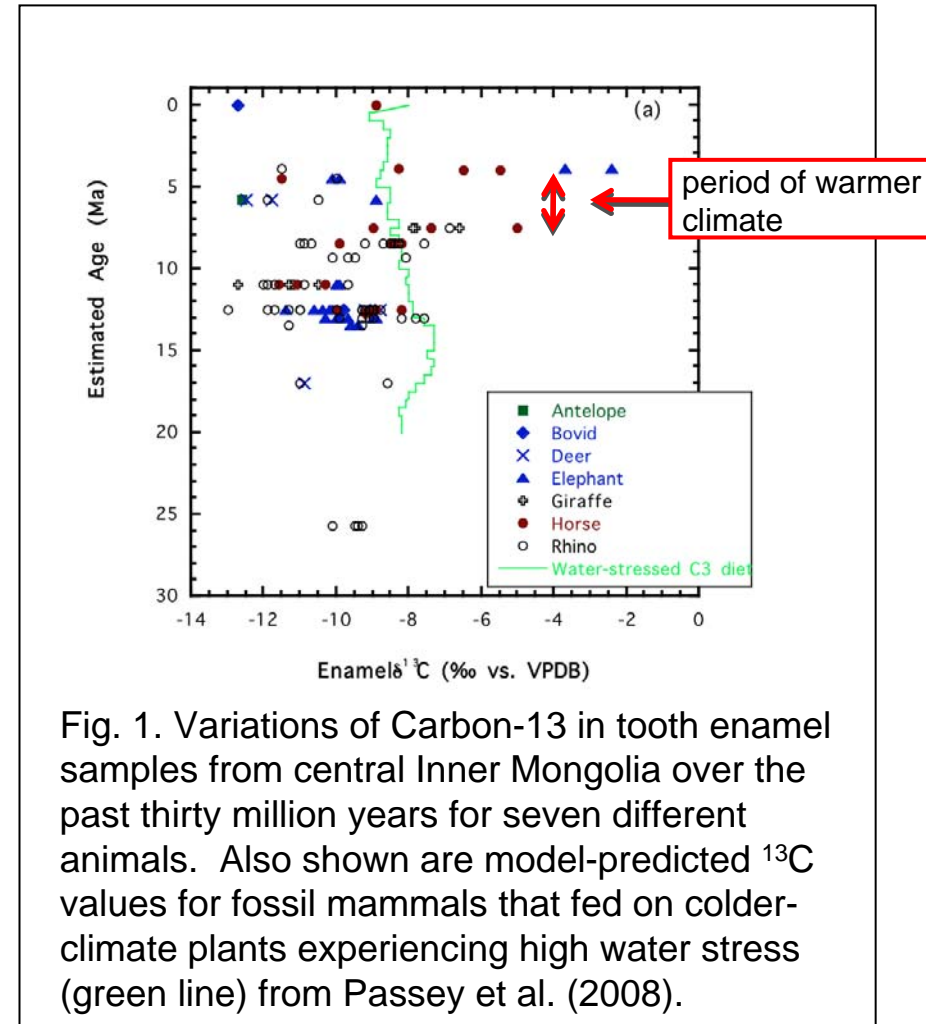


Fig. 1. Variations of Carbon-13 in tooth enamel samples from central Inner Mongolia over the past thirty million years for seven different animals. Also shown are model-predicted ¹³C values for fossil mammals that fed on colder-climate plants experiencing high water stress (green line) from Passey et al. (2008).



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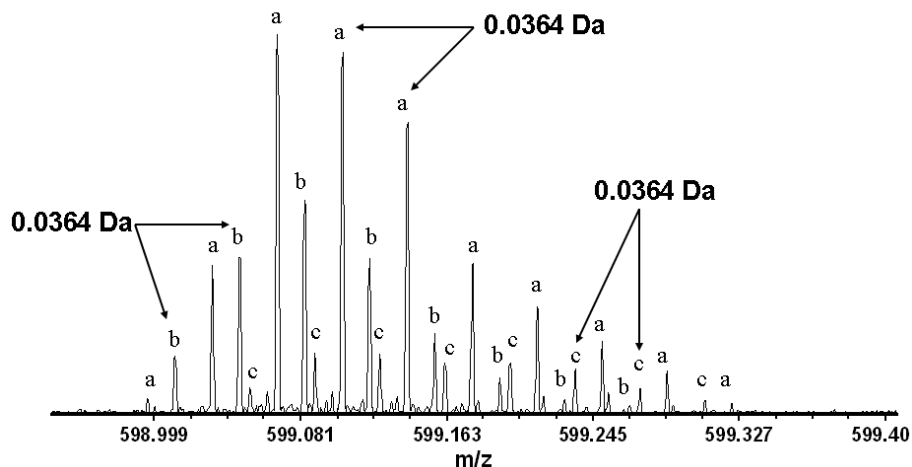
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Fen-type peats in the Glacial Lake Agassiz Peatland, Northern Minnesota



Mass spectrum of organic molecules dissolved in fen porewater. Spectra such as these from high-magnetic-field Fourier-Transform Ion Cyclotron Resonance (FT-ICR) are used to determine the composition of peat porewaters and to monitor changes.

Boreal and subarctic peatlands contain as much carbon as contained in the atmosphere by carbon dioxide gas. However, peatlands contain far more methane, which is a more damaging greenhouse gas than carbon dioxide.

It is expected that climate change will enhance production of methane in certain sub-ecosystems and curtail it in others, but the exact biological and geochemical processes controlling methane are not known.

Ultrahigh resolution mass spectrometry in high magnetic fields finds that water in organic matter in aromatic-rich peat bogs is less reactive than organic matter in fenland peats, suggesting a different hydrologic and/or biochemical control mechanisms for carbon sequestration in different kinds of peatlands.

The Magnet Lab Geochemistry program also supports research on climate records from cave deposits (Stalactites), ocean water chemistry studies through the Climate Variability and Predictability Program (CLIVAR) and Geotraces Program. Most Climate Change projects are supported by NSF Geosciences Divisions of Ocean Sciences and Earth Sciences.