

Large (9° C) Glacial-Interglacial Temperature Difference Derived From an Aquifer in Maryland

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Abstract

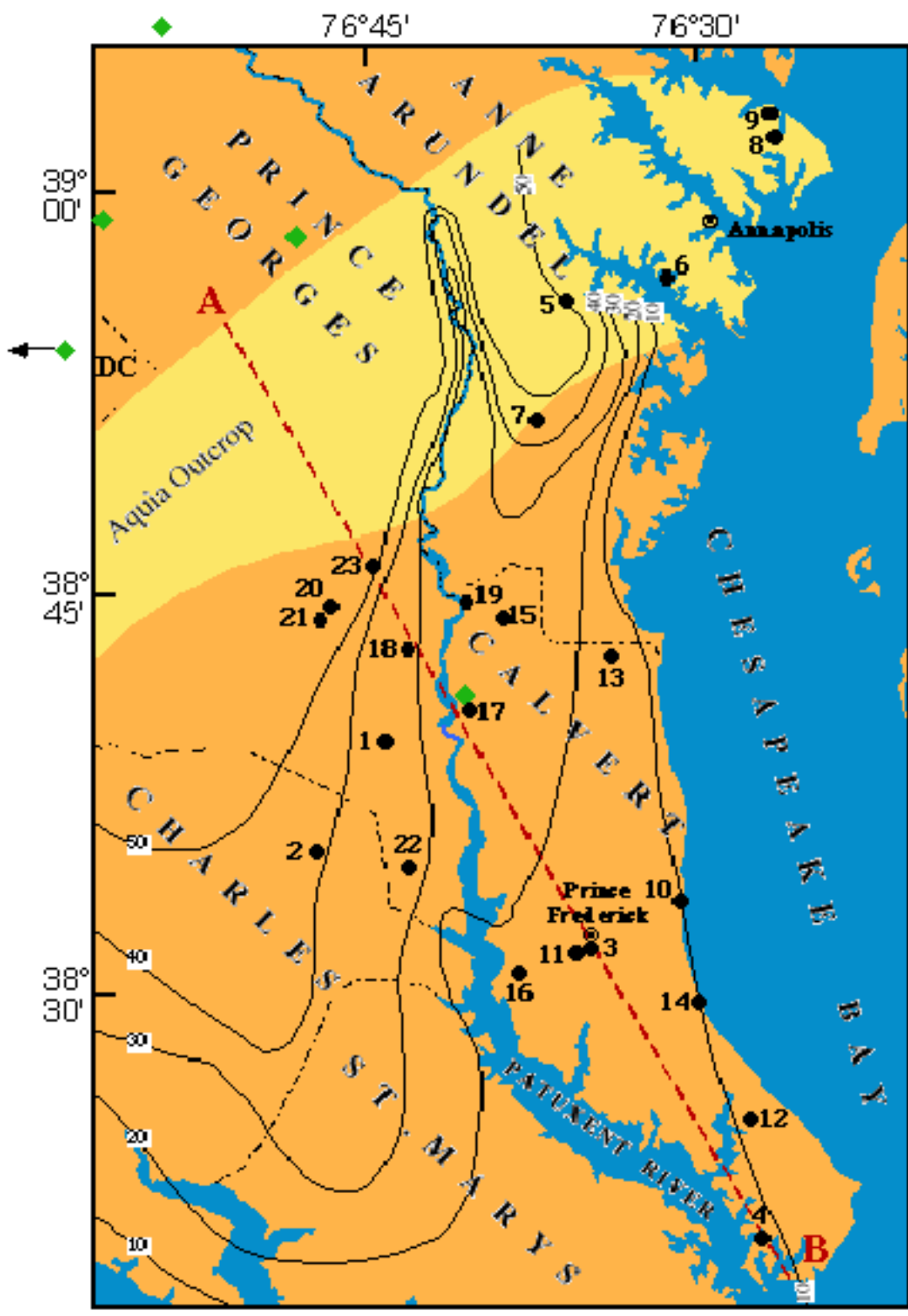
The concentrations of atmospheric noble gases dissolved in groundwater reflect the mean annual ground temperatures at the time of recharge. In suitable confined aquifers, this climate signal is preserved over the past 30,000 years and can be used to reconstruct paleotemperature records.

We present a noble gas temperature record extending beyond the last glacial maximum obtained from ^{14}C dated groundwater from the Aquia aquifer in Maryland. The temperature difference between the Holocene and the last glacial maximum at this coastal site at 39° N is found to be approximately 9° C. This value is considerably larger than previous estimates for the Americas which

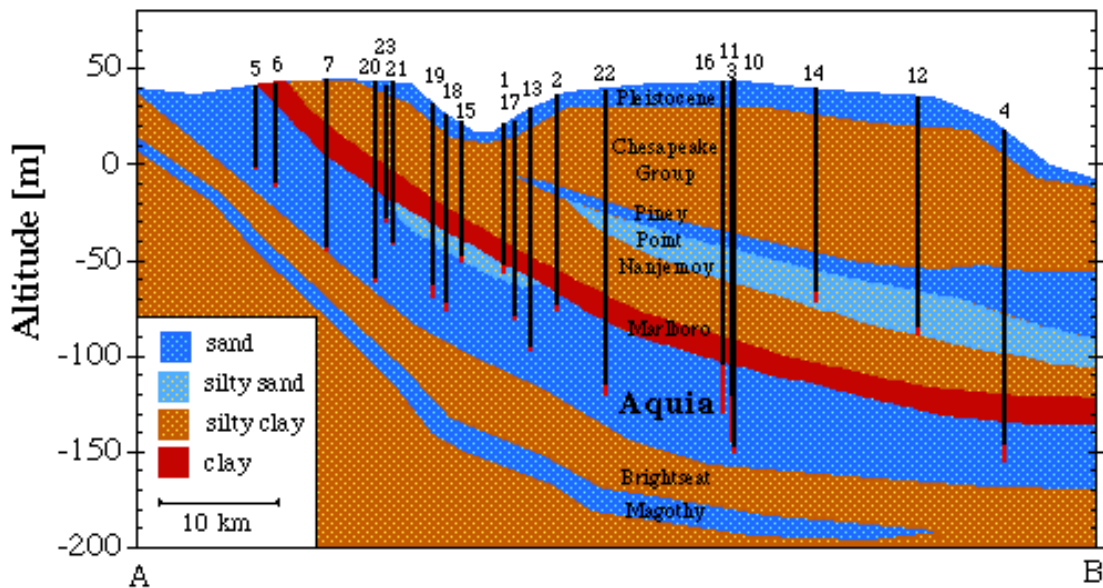
indicated a rather uniform glacial cooling of about 5° C in a broad zone between 35° S and 40° N. In particular, a cooling of about 5° C has been derived from aquifers in the southern United States (Texas, New Mexico, and Georgia).

The larger glacial cooling in Maryland may be due to the relative proximity to the Laurentide ice sheet during glaciation (distance ca. 250 km). It represents an intermediate value between the 5° C cooling in low to mid-latitudes indicated by many continental records and the 15° C cooling in high latitudes recently reconstructed from Greenland records of borehole temperature and ice-core d¹⁸O.

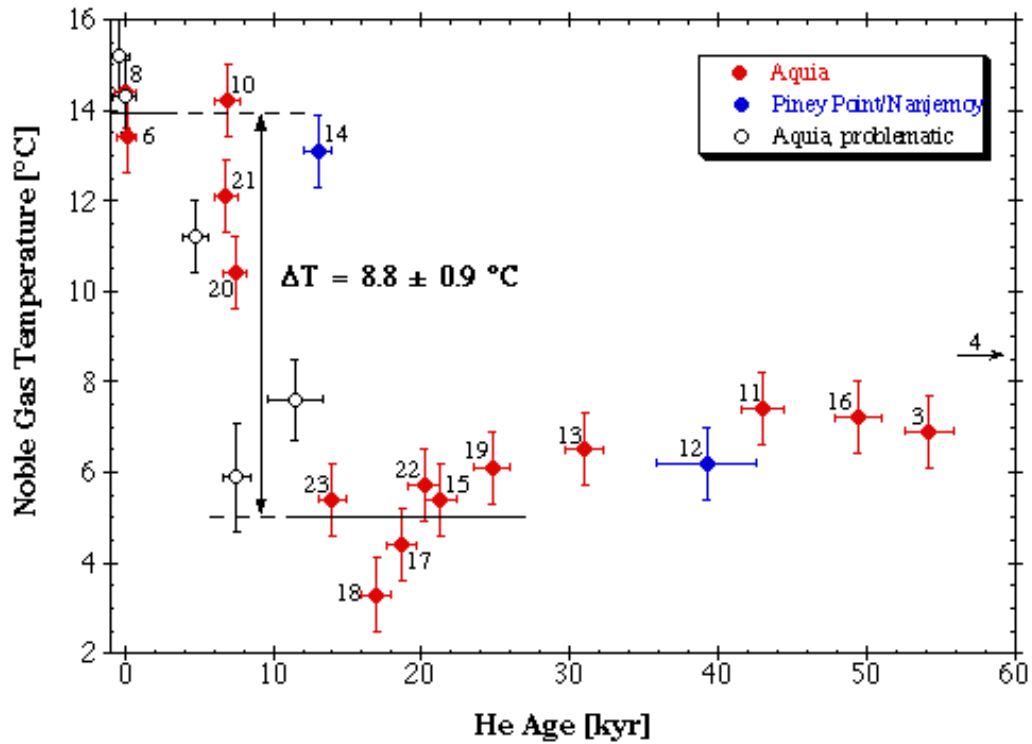
In the Aquia aquifer, a correlation between noble gas temperatures and Cl⁻ concentrations is found, which corroborates the hypothesis that the Cl⁻ record of this aquifer reflects sea level changes.



Map of the study area in southeastern Maryland. The sampled wells are indicated with black dots and labeled with a number. The Aquia formation outcrops in a band (yellow area) between Washington D.C. and Annapolis. Isolines of the hydraulic head (in ft) are shown. Groundwater flow is in general towards east/southeast. Green diamonds indicate temperature stations used to estimate modern mean annual air temperature (12.8° C).



Schematic cross section along line A - B (see map).



Noble gas temperatures obtained from the wells of the Aquia aquifer versus helium age calculated from in situ production of radiogenic helium. A glacial-interglacial temperature difference of 8.8°C is derived.