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Are marine clathrates tied to the abrupt atmospheric methane events recorded in ice cores?

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Atmospheric methane (CH_4) levels recorded in ice cores covering the last 800,000 years vary on timescales ranging from tens of thousands of years to decades. One explanation for the millennial scale CH_4 oscillations that are prevalent during glacial periods involve the destabilization of clathrates located along the continental margins. The destabilization is thought to be a result of warmer thermocline waters that are nearly coincident with warming events recorded in Greenland ice.

Marine clathrates have a well-defined deuterium/hydrogen (D/H) isotopic signature that is distinct from all terrestrial CH_4 emissions. As such, a record of the D/H ratio of atmospheric CH_4 provides a powerful means of assessing whether or not clathrate destabilization events have contributed CH_4 to the atmosphere in the past. If an atmospheric CH_4 increase, observed in the ice cores, is the result of clathrate degassing, then the D/H ratio of atmospheric CH_4 should increase. A new high-resolution record of the D/H isotopic composition of atmospheric methane has been constructed with special emphasis on the previously documented rapid CH_4 increases associated with the last glacial termination. Results indicate no observable increase in the D/H ratio of atmospheric CH_4 during the three abrupt CH_4 events. I conclude from this data that, during these rapid CH_4 events, clathrate destabilization has not contributed to the increased atmospheric CH_4 concentrations.

It is important to note that high-resolution sampling ($\sim$30 years) is needed to assess clathrate destabilization events in the past. At this stage, only three such events have been measured with sufficient detail. Additional work on other events will be necessary to determine whether clathrates may have been involved. These results also have little bearing on the future stability of clathrates as global temperatures continue to

rise.