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The early anthropogenic hypothesis — challenges and responses

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Ruddiman (2003) proposed that CO2 values just before the industrial era were anomalously high by 40 ppm relative to similar intervals in the three previous interglaciations, and CH4 values were higher by 250 ppb. These conclusions were based on the Vostok methane time scale of Ruddiman and Raymo (2003). The Vostok gas time scales of Petit et al. (1999) and Shackleton (2000) indicate smaller but still substantial anomalies: 30-35 ppm for CO2, and 175-220 ppb for methane. Tests of the three time scales based on varying rates of ice accumulation/preservation and on the relative timing between ice-core O18(atm) and marine O18 signals generally favor larger anomalies close to those proposed in the hypothesis.

Stage 11 has been examined as the closest interglacial insolation analog to the Holocene. The approach taken by the EPICA group – aligning terminations V and I and counting forward in elapsed time – suggests that the warmth of the current interglaciation is natural and will continue for another 16,000 years. Their method, however, aligns the present-day northern hemisphere summer insolation minimum against a stage 11 insolation maximum 409,000 years ago. This alignment is not an optimal choice of a 'closest insolation analog', and it contradicts the Milankovitch ice-age hypothesis and the Kutzbach orbital-monsoon hypothesis, both of which call on northern summer insolation as the critical climatic driver. The optimal insolation analog in stage 11 is an insolation minimum 398,000 years ago. At or near that time, CO2 and CH4 concentrations fell to the levels predicted by the early anthropogenic hypothesis, and Antarctic temperatures (based on deuterium trends) were nearing full-glacial levels. The peak interglacial warmth of stage 11 had ended by the time equivalent to the present day. The challenge now at hand is to explain how human activities created greenhouse-gas anomalies of such large magnitude.