

Temp of early earth

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This suggests new thoughts on temp of earth when life began.

The Evolution of the Primitive Atmosphere

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Environmental conditions on the early Earth are important for both the origin and the early evolution of life. Two variables are of particular significance: 1) the atmospheric redox state, and 2) the mean surface temperature. Most recent models of Earth's prebiotic atmosphere (Walker, 1977; Kasting, 1993) suggest that it was weakly reduced, with N₂ and CO₂ dominating over NH₃ and CH₄. Some CH₄ may have been present, however (Hashimoto et al., 2007), particularly if hydrogen escape was relatively slow (Tian et al., 2005). Ongoing work should help to resolve the hydrogen escape question and may shed light on whether a more highly reduced atmosphere could have existed.

The climate of the early Earth is also controversial. Despite the faintness of the young Sun, the early Earth appears to have been warm, or perhaps even hot. Taken at face value, oxygen and silicon isotopes in ancient cherts imply a mean surface temperature of 70(±15)°C at 3.3 Ga (Knauth and Lowe, 2003; Robert and Chaussidon, 2006). Ancient carbonates also yield high Precambrian surface temperatures (Shields and Veizer, 2002), as does a recently published analysis of the thermal stability of proteins which are inferred to be ancient (Gaucher et al., 2008). This evidence for hot early surface temperatures must be weighed against the previously mentioned dimness of the young Sun, as well as geomorphic evidence for glaciation at 2.9 Ga, 2.4 Ga, and 0.6–0.7 Ga. Climate models with high

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CO₂ and CH₄ concentrations can potentially explain hot climates, but can they explain climates that transition from hot to cold, and back again, multiple times? Such models must also account for the well documented correlation between the rise of O₂ at 2.4 Ga and the Paleoproterozoic glaciations which occurred at that same time. Some of the secular variation in oxygen isotope ratios may be accounted for by changes in seawater isotopic composition (Kasting et al., 2006), although that interpretation remains controversial and cannot account for the observed variation during the Phanerozoic (Came et al., 2007). When all the arguments are weighed, the early Earth appears to have been warm, rather than hot, but more work remains to reconcile the different pieces of evidence.

Comment?

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