

Orbital Controls on the Oxygenation of Marine Habitats on Earth and Beyond

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Increasing oxygenation of Earth's surface environments is often attributed to biological innovation or a change in geological boundary conditions. However, Earth's orbital parameters also strongly influence biogeochemical cycles and may lead to changes in oxygenation state. For example, rotation rate shapes large scale ocean circulation patterns, including the upwelling of nutrient rich waters and the transfer of oxygenated waters to depth. Obliquity further affects ocean circulation and thermal stratification of the ocean by modulating the spatiotemporal distribution of incident stellar energy. Both of these orbital parameters have changed through Earth's history and can differ dramatically among other habitable worlds. This presentation will discuss the consequences of Earth's orbital evolution for Earth's oxygenation and will explore how alternative orbital scenarios may affect the potential for thriving photosynthetic biospheres and animal-grade complexity beyond Earth.