

Climate and Ocean Circulations During the “Boring Billion”

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Geological evidence suggests that no dramatic climate changes during the Boring Billion (1.8 - 0.8 billion years ago), at least in terms of permanent glaciation. In order to reconstruct the $p\text{CO}_2$ threshold and the ocean circulations in this warm and stable era. Here, we operate series of simulations by a fully coupled atmosphere-ocean global climate model (CCSM3) with two representative continental configurations, one with continents more clustered around the equator and the other near the north pole, corresponding to those in 1.42 billion years ago (Ga) and 1.52 Ga, respectively. We find that a CO_2 concentration of 20 times the present-day level, 7100 ppmv, is able to exclude the existence of permanent land glaciers for the two continental configurations. Permanent sea ice, however, could exist in the polar regions. The sea ice thickness is several meters or even less. Under this CO_2 concentration, the global-mean surface air temperature is about 4 °C warmer than the present-day Earth. The meridional overturning circulation can reach depth of 3000m with strength of 40Sv for both continental configurations. This implies that the exchanges between shallow and deep ocean, as well as between atmosphere and ocean, is efficient. Simultaneously, the climate sensitivity between these different continents is different especially when $p\text{CO}_2$ improved from 5 PAL to 20 PAL.

Reference: LIU, P., LIU, Y., HU, Y., YANG, J., & PISAREVSKY, S. A. (2019). Warm Climate in the “Boring Billion” Era. *Acta Geologica Sinica- English Edition*, 93(S3), 40-43.