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Supporting Information for

The Effect of Ocean Salinity on Climate and its Implications for Earth's Habitability

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Introduction

This supporting information includes three figures that highlight key aspects of the ocean circulation in our present-day Earth configuration. These figures serve to (1) illustrate that our model reproduces key aspects of the Atlantic Meridional Overturning Circulation (AMOC) despite our assumption of a relatively shallow ocean to save computational expense, (2) demonstrate that AMOC and associated ocean heat transport increase with increasing salinity, and (3) support our conclusion that dynamical effects are the primary contributor to the climate sensitivity to salinity in Figures 1 and 2 in the main text.

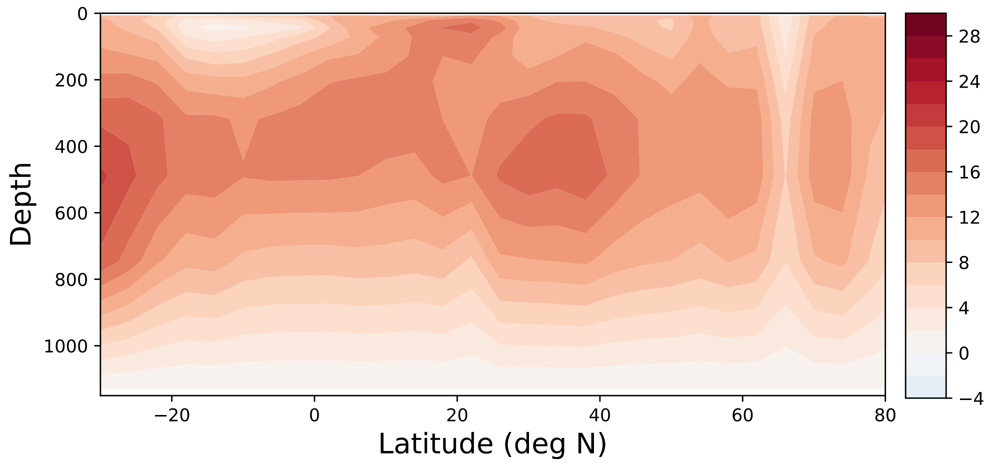

Figure S1. Atlantic streamfunction for our present-day Earth scenario. Our model qualitatively reproduces the AMOC, despite our assumption of a shallow, flat-bottom ocean.

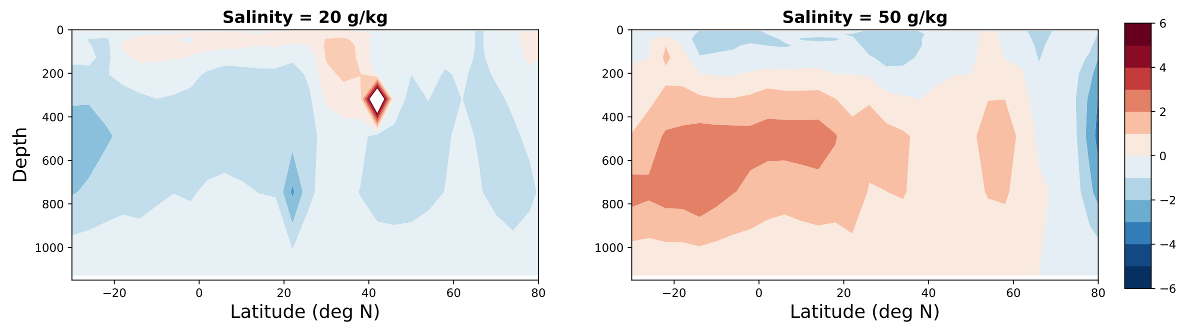

Figure S2. Atlantic streamfunction sensitivity to salinity in our present-day simulations. Shown are the differences between the streamfunctions for our 20 g/kg (left) and 50 g/kg (right) salinity scenarios and the streamfunction for our present-day salinity scenario (Fig. S1) in units of Sv.

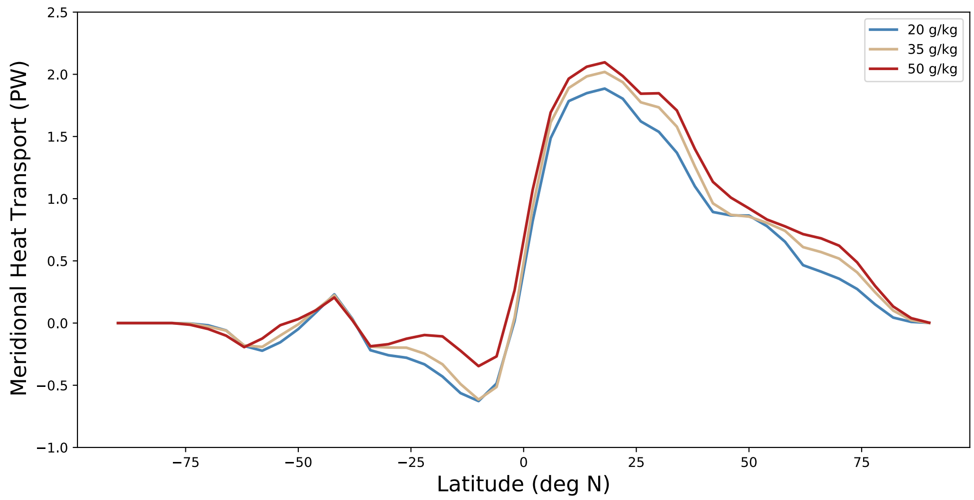

Figure S3. Meridional ocean heat transport in our present-day simulations. The colored lines correspond to salinities of 20 g/kg (blue), 35 g/kg (tan), and 50 g/kg (red). Heat transport to the northern high latitudes increase with ocean salinity, but this effect is muted in the southern hemisphere. This asymmetry is also reflected in the sensitivity of surface temperature and sea ice cover to ocean salinity (Fig. 1, 2).

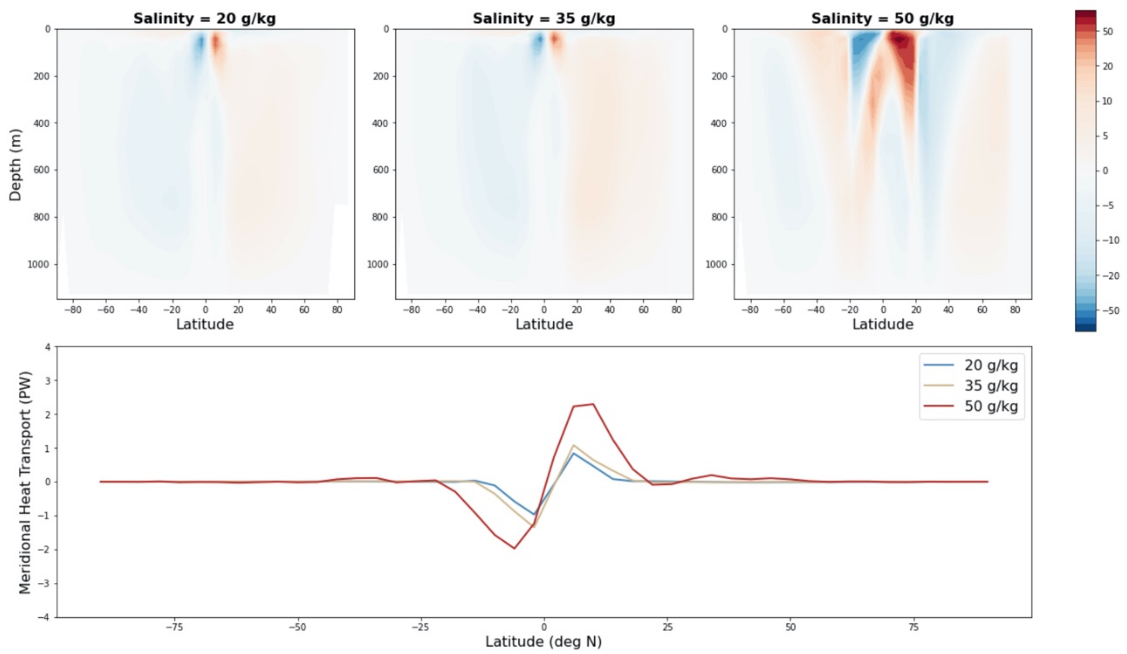

Figure S4. Global streamfunction (top) and meridional ocean heat transport (bottom) in select Archean scenarios. Shown here are Archean simulations with differing salinities and 60x PIL pCO_2, corresponding to the middle row of Figure 4 in the main text. Note that the 20 g/kg and 35 g/kg salinity scenarios (top left and middle panels; tan and blue lines in bottom panel) are water belt states whereas the higher salinity scenario has considerably more open water (see Figure 4), complicating direct comparison and interpretation. Ocean circulation and associated heat transport are influenced by both salinity and the position of the ice line, introducing the possibility of feedbacks between ocean circulation, ice extent, and surface temperature that may amplify the direct effects of salinity.