A ~2 billion-year assessment of paleogeographic influences on Earth's climate state

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Earth's baseline climate state is largely influenced by the partial pressure of atmospheric carbon dioxide (CO_2), which on multi-million year timescales is controlled by the long term carbon cycle. Current debates focus on which aspects of the carbon cycle were responsible for past icehouse–greenhouse transitions. Changes in silicate weathering rates—the primary CO_2 sink—have widely been accepted as the primary driver major climatic transitions; although, recent models proposed that changes in volcanic emissions—the primary source of CO_2—are were responsible for these transitions. Paleogeography is considered to play a first-order role in changing global weathering either by concentrating continents in the humid low-latitudes, which enhances weathering rates, or by emplacing mafic Large Igneous Provinces (LIPs) in equatorial regions thereby increasing the 'weatherability' of the crust. Here we use refined paleogeographic reconstructions to assess the role of continental dispersal on major climatic transitions. We calculated the total and proportional area of continents distributed in various latitudinal belts over the last ~2 billion years but find no consistent relationship between continental masses in the tropics and global cooling trends. Icehouses occur during times with high concentrations of low-latitude continents, as well as intervals with reduced tropical continents. Similarly, greenhouses occur with both high and low concentrations of low-latitude continents. This contrasts the hypothesis that the concentrating continents at low-latitudes will drive global cooling. Furthermore, distribution of LIPs shows no general relationship with regards to latitudinal zone of emplacement and climate. The paleogeographic distributions of continents may yield important influences on global climate; however, the record presented here implies that crustal distribution is not the principal driver of baseline climate shifts in Earth history.