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# Driving mechanisms of Phanerozoic climate.

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The importance and relative contributions of fundamental drivers of Phanerozoic climate change remain unclear. Individual mechanisms, such as volcanic degassing or weathering of mafic and ultramafic rocks, have been shown to qualitatively correlate with warming and cooling periods. However, models which aim to quantitatively combine these long-term climate drivers still fail to reproduce deep time temperature trends. Here we use a new 'whole Earth' 4-D framework to integrate all of the purported mechanisms, including continental arc and suture distributions, biological forcings, degassing rates and palaeogeography. We show that our combined model successfully replicates most of the key aspects of Phanerozoic temperature change, and in our framework we are able to isolate individual drivers to quantify their significance through Phanerozoic time. Overall, degassing rates and weathering of sutures appear to be the most influential drivers of long-term climate change, but neither (nor any other driver) can replicate Phanerozoic temperature trends by itself. While our model captures the trend and trajectory of temperature over the Ordovician-Silurian and Carboniferous–Permian icehouses, it struggles to reproduce the broad lower background temperature across these periods. This could suggest a general process, which drove lower surface temperatures across the Palaeozoic Era, could be missing from our anlaysis, such as a reduced total crustal carbon reservoir in earlier Earth history and associated lower $CO_2$ degassing rates.