Using fossils and plate tectonic reconstructions to detect deep-time climate change
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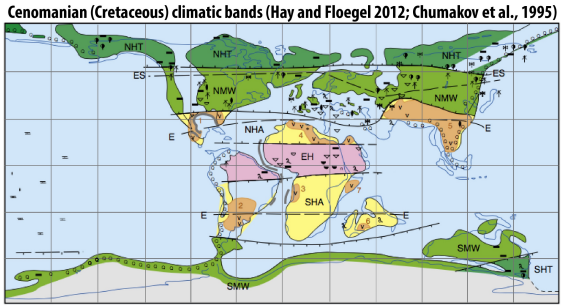
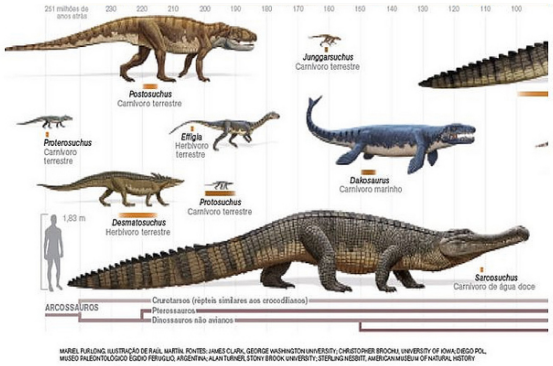
Earth's long-term climate has fluctuated between greenhouse and icehouse conditions during the Phanerozoic (540 million years ago to present), indicated by carbon and oxygen isotope proxies and other paleoclimatic indicators. These climatic changes typically shifted biogeographic zones towards the poles during warmer periods and towards the equator during cooler times, while some of these zones disappeared altogether during extreme climatic perturbations. Such changes should therefore be preserved in the fossil record, and when coupled to plate tectonic reconstructions it becomes possible to extract the time-varying latitudinal dependence of these biogeographic zones. This has been made easier with the availability of the data-rich and open access Paleobiology Database (https://paleobiodb.org/) that can be easily linked to plate tectonic reconstructions in the open source community GPlates software platform (www.gplates.org). The crocodilians are one example that has a strong latitudinal dependence (Cretaceous to present). The north-south motion, and/or narrowing or widening, of these latitudinal bands provides first-order indicators of climatic change, which can be modelled using GPlates in a matter of seconds or minutes, as opposed to fully-fledged numerical models of global climate that can take months to run on a supercomputer for a single geological timestep. Other fossil orders (and species) are likely to be equally powerful paleo-climatic indicators, and this project will explore what other fossil orders/species may provide robust indicators of climate change. This will require prioritising fossils with high occurrences and spatiotemporal sampling in the Paleobiology Database. The project will leverage existing workflows in GPlates, Generic Mapping Tools and the new Python-based pyGPlates libraries. The resulting analyses will provide first-order insights into the pace of climatic change in deep time and how that might compare to modern processes, as well as uncover potentially crucial paleo-latitudinal constraints for plate tectonic reconstructions.



Cenomanian (Cretaceous) climatic bands (Hay and Floegel 2012; Chumakov et al., 1995)



Crocodilians and relatives in the Jurassic and Early Cretaceous

GPlates is primarily developed at The University of Sydney, with contributions from California Institute of Technology and the Norwegian Geological Survey. This project will be run through the EarthByte Group as part of the *Sydney Research Excellence Initiative* and *the Deep Carbon Observatory.*

Prerequisites: [GEOS1001 or GEOS1003] and [GEOS2115 or GEOS2124]