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Coccoliths as recorders of upper ocean temperature evolution of the Eastern and Southern Indian Ocean over the Eocene

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The Eocene (56 to 33.9 million years ago) was characterised by high temperatures and atmospheric CO_2 concentrations, making it a possible geological analogue for near future climates. However, the scarcity of long-term records and apparent discrepancies between proxy data and model reconstructions pose significant challenges for reconstructing Earth's thermal state during this period. While recent global climate models can account for polar amplification during the Eocene, the predicted sea-surface temperature distribution may differ significantly from proxy estimates, particularly in the high-latitude Southern Ocean during the Early Eocene, where temperatures can differ by 15°C. These uncertainties have long complicated reconstructions of ocean temperature gradients and surface ocean evaporation, preventing a detailed understanding of heat-transfer mechanisms during the warmest periods in Earth's climate history. In this project, we propose to combine $\delta^{18}O$ and Δ_{47} signatures of coccoliths to reconstruct sea surface temperatures in the Eastern and Southern Indian Ocean during the Eocene. Coccoliths are biogenic carbonate liths produced by coccolithophores, single-celled phytoplankton algae that calcify exclusively in the photic zone. In recent years, significant progress has been made in understanding the $\delta^{18}O$ and Δ_{47} signals carried by these particles, enabling the use of coccoliths as a robust proxy for reconstructing greenhouse climates. Collectively, these new records will provide insight into the long-term evolution of the Indian Ocean's thermal state during the last transition from greenhouse to icehouse climate and will provide additional constraints for data–model intercomparisons of the early Eocene.