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Was the Antarctic glaciation delayed by a high degassing rate during the early Cenozoic?

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The Cenozoic is a period of drastic environmental changes marked by the formation of the Antarctica ice sheet at the Eocene/Oligocene (E/O) boundary. The opening of the southern ocean seaways and the decrease in atmospheric pCO_2 are two processes generally evoked to explain this change. The debate is still opened but modeling studies tend to demonstrate that the decrease in atmospheric pCO_2 is the main driver of the cooling. This decrease in atmospheric pCO_2 is shown by CO_2 datasets and begins near the E/O boundary. However the main driver of this decrease remains unknown. In this study, we test the impact of the continental drift, of the lithology and of the degassed CO_2 on the atmospheric carbon dioxide concentration during the Cenozoic with a coupled climate-carbon model (GEOCLIM). The tectonic forcing induces low atmospheric CO_2 levels except for a part of the Miocene period during which the northward drifting of the African plate and of India have decreased the continental surface exposed to the chemical weathering and have generated high atmospheric CO_2 levels. Drifting of India and of the Deccan traps across the intertropical convergence zone associated to the outpouring of the Ethiopian trap substantially contribute to modeled low atmospheric CO_2 levels for the Eocene and the early Oligocene (around 350 ppm). A high degassing flux, such an increase of 50 %, is required to simulate atmospheric CO_2 levels above 840 ppm during the Eocene to prevent the build up of the Antarctic ice-sheet at this time. We conclude that the decrease in atmospheric pCO_2 from the Eocene to the Oligocene may be due to a decrease in the source of CO_2 rather than an increase in the silicate weathering. Finally, the uplift of the Tibetan plateau from the Miocene to the present-day induces an increase in silicate weathering through the intensification of the South-Eastern Asian monsoon and brings back the atmospheric CO_2 level to the preindustrial value.