

UC SANTA BARBARA
Department of Earth Science

Earth Science Colloquium

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Does the geography of the tropics
set Earth's climate state?

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On multimillion-year time scales, Earth has experienced warm ice-free and cold glacial climates, but it is unknown whether transitions between these background climate states were the result of changes in carbon dioxide sources or sinks. Low-latitude arc-continent collisions are hypothesized to drive cooling by exhuming and eroding mafic and ultramafic rocks in the warm, wet tropics, thereby increasing Earth's potential to sequester carbon through chemical weathering. The ongoing arc-continent collision in Indonesia and New Guinea, which has exhumed two of the three largest ophiolites on Earth, is estimated to account for ~9 to 14% of the modern global carbon sink. We propose that the increasing subaerial exposure of mafic and ultramafic rocks in Indonesia and New Guinea has been a driver for Middle Miocene to present cooling by increasing global weatherability. We explore this hypothesis by coupling the GEOCLIM weathering model to a climate model, and estimating changes in $p\text{CO}_2$ over the Neogene with changes in subaerially exposed land area from paleoshoreline data. To extend this framework deeper in Earth History, the paleogeographic position of all major Phanerozoic arc-continent collisions was reconstructed and compared to the latitudinal distribution of ice sheets. This analysis reveals a strong correlation between the extent of glaciation and arc-continent collisions in the tropics.