Universidad de Granada

Clays in Antarctica from millions of years ago reveal past climate change

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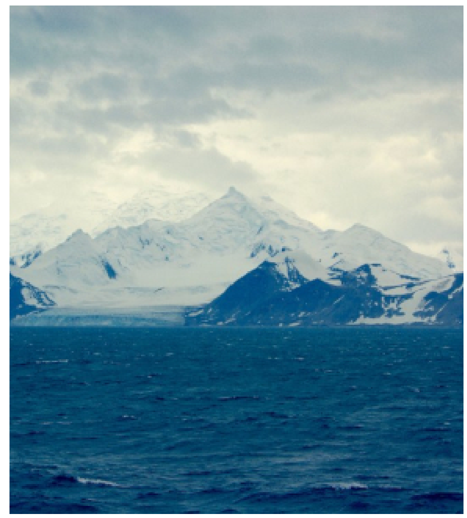
Research news



> **Paleoclimate analysis enables scientists to subject climate models to boundary conditions—such as rising sea levels—for developmental purposes**

Members of the TASMANDRAKE research group of the Andalusian Earth Sciences Institute (IACT), which pertains to the University of Granada and CSIC, have published a research paper in the prestigious international journal Scientific Reports (part of the Nature group) describing their analysis of clays from Antarctica dating back 35.5 million years, to reconstruct past climate changes.

Their study was conducted in the area known as Drake Passage—the body of water that separates South America from Antarctica, between Cape Horn (Chile) and the South Shetland Islands (Antarctica). The results help to better understand the climatic conditions prior to the formation of the Antarctic Circumpolar Current, thus evaluating possible links between the development of the ice sheet in Antarctica and the changes in the tectonic and paleoceanographic configuration. Such questions constitute key facets of past climate functioning that provide boundary conditions for today's climate models, which predict a general rise in sea levels over the coming centuries.

The article analyses the relevance as a climatic indicator of the mineral commonly known as 'glauconite', which is more properly termed 'the glauconia facies' or 'glauconia'. This is a type of green clay, formed mainly in shallow marine environments (<500 m) with temperatures below 15° C, under very specific oxygenation conditions.

The existence of this clay formation in the Antarctic region has received little scholarly attention to date compared to other geological records on the planet. The characteristic green-coloured mineral has been observed around Antarctica and the Antarctic Ocean in sedimentary sequences of the Terminal Eocene Event—that is, before one of the main climatic transitions in Earth's history. The Eocene–Oligocene climate transition took place approximately 34–33.6 million years ago.

This scientific contribution describes, for the first time in the Antarctic Ocean, a glauconitisation event (in which glauconia was formed) approximately 35.5 million years ago in the Weddell Sea, northeast of the Antarctic Peninsula between South America and Antarctica.

The formation of glauconia 35.5 million years ago marks the onset of progressive sea level rise in the north Weddell Sea during the Terminal Eocene. The results of this scientific study thus provide new insights regarding changes in paleoceanographic conditions just prior to the Eocene–Oligocene climate transition and the controversial opening and deepening of Drake Passage.

Studying the weather of the past to predict the future

The separation of the Antarctic continent from South America and Oceania allowed bodies of water to transfer freely between the Pacific and Atlantic Oceans. This new circulation of bodies of water resulted in the Circumpolar Current and, with it, the thermal insulation of the Antarctic and the formation of the ice cap on a continental scale. The opening of Drake Passage between South America and the Antarctic Peninsula is therefore considered one of the most important events in the history of the Earth's oceanic and atmospheric circulation. However, in the absence of dating for the formation of the sedimentary basins of Drake Passage, it is difficult to specify the precise age when the Passage began to open up and the Circumpolar Current started to form. The glauconia analysis conducted by the TASMANDRAKE research group contributes to progress in this area of study.

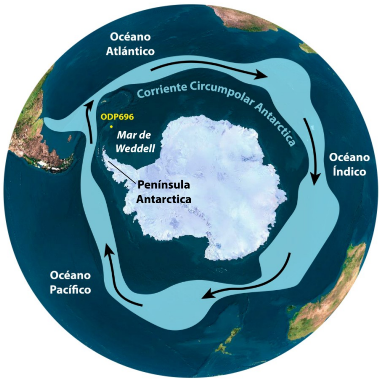
To put these changes into perspective, Adrián López Quirós, the principal author of the research, notes that "it is necessary to study the past to understand the present and help predict the future," by better understanding the tectonic, climatic, and paleoceanographic conditions that led to the onset and subsequent evolution of this important ocean current.

The United Nations' Intergovernmental Panel on Climate Change (IPCC), a major reference source for climate forecasts, established several possible future climate scenarios in 2014. However, the new data, when comparing simulations with realworld data, predict even greater impacts than those previously foreseen in the IPCC climate scenarios. Therefore, climate change is developing faster than previously thought. With its research, the TASMANDRAKE group aims to provide new variables for these models—focusing on sediments and geophysics—to ensure that its results reflect real-life events even more accurately, especially in terms of the transoceanic currents, global warming, and rising sea levels.

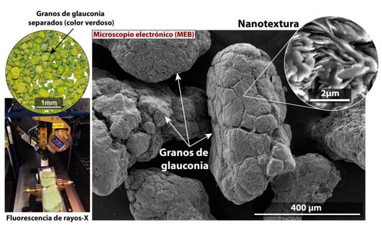
The research group responsible for this study comprises: Adrián López-Quirós (principal author and PhD scholar in Marine Geosciences, on the doctoral programme in Earth Sciences at the University of Granada); Dr. Carlota Escutia (Andalusian Earth Sciences Institute); Antonio Sánchez-Navas (Lecturer, Department of Mineralogy and Petrology, UGR); Fernando Nieto (Lecturer, Department of Mineralogy and Petrology, UGR); Antonio García-Casco (Lecturer, Department of Mineralogy and Petrology, UGR); Agustín Martín- Algarra (Lecturer, Department of Stratigraphy and Palaeontology, UGR), Dimitris Evangelinos (PhD scholar, Andalusian Earth Sciences Institute), and Ariadna Salabarnada (PhD scholar, Andalusian Earth Sciences Institute).

Image captions:

Principal author of the research, Adrián López-Quirós



Map of Antarctica showing the location of the Antarctic Circumpolar Current (ACC), which flows from west to east. The ACC is a fundamental element in the deep global circulation connecting the Pacific, Atlantic, and Indian Oceans. It is therefore an important part of the global ocean circulation network that distributes heat around the Earth.



Glaucony grains observed under an electron microscope.

Northwest region of the Antarctic Peninsula (South Shetland Islands).

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Algarra, A., Evangelinos, D., Salabarnada, A. (2019). Glaucony authigenesis, maturity and alteration in the Weddell Sea: An indicator of paleoenvironmental conditions before the onset of Antarctic glaciation. Scientific Reports, 9 (1), 1–12.

Media enquiries:

Adrián López-Quirós

Andalusian Earth Sciences Institute (CSIC–UGR)

Department of Stratigraphy and Paleontology, UGR

Tel.: +34 958 230 000 (ext. 190132)

Email: alquiros@iact.ugr-csic.es