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# Early deglacial cyclic growth of the "Great Amazon Reef System" (GARS) during the last 2.5 Ma at the 400 kyr low eccentricity super-interglacial cycles

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## Résumé

Since the 1970s, scientists have speculated about the existence of a carbonate biogenic reef along the Amazon Continental Margin (ACM). However, it is only in 2016 that true reefal organisms were observed, consisting of black corals, sponges, and red algae, encrusting older eroded structures. Since, the name "Great Amazon Reef System" (GARS) has been used to describe this shelf edge reefal accumulation. This discovery sparked a lively debate among scientists and policy makers regarding the reef size, and its overall characteristics, particularly in the context of establishing, along the ACM, a marine protected area, excluding future oil and gas exploration.

Our study, based on a 3D seismic block, located to the north-west of the ACM, clearly images sea floor positive reliefs, in addition to sub-sea floor paleo-morphologies, therefore revealing the GARS evolution through time. The modern sea floor along the shelf edge reveals, an elongated ridge, 20 km in length, 1 km in width, and 50 m in height. However, the carbonate edifices were already initiated at the beginning of the Quaternary and exhibited, in the last 2.5 million years, a clear 400,000 years cyclic growth pattern. The oldest growth phases are characterized by bioconstructions limited to small patches measuring less than 1 km<sup>2</sup>, whereas the next phases reveal barrier-reef like morphologies. The most recent phase, spanning the last 450 ky, initiated during the high amplitude MIS 11 deglaciation, referred to the "Mid-Brunhes Transition", consists of biogenic reefs occurring approximately every 100,000 years with geometries similar to those observed today.

This study proposes that the intensification of Northern Hemisphere Glaciation, since 2.6 Ma, impacted the amplitude of sea level fluctuations which played a crucial role in triggering the development of the carbonate along the ACM. In summary, the long eccentricity cycle at 400,000 years, resulted in more extreme sea level lowstands, during which the Amazon plume was directly funnelled into the basin through canyons, keeping the shelf edge devoid of turbidity and, therefore, enhancing the reefal carbonate growth. Since the "Mid-Brunhes Transition", these necessary conditions for enhancing the carbonate reef build-ups appear to occur at a higher 100,000 years frequency.

**Mots-Clés:** Quaternary, seismic and sequence stratigraphy, sea level, carbonate biogenic reefs, Great Amazon Reef System (GARS), super, interglacial stages, Marine Isotopic Stage 11, 3D seismic geomorphology.

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