

Emergence of the Isthmus of Panama: Paleoceanographic implications in the Atlantic and Pacific Oceans.

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Abstract

The formation and closure of the Isthmus of Panama during the Late Cenozoic has been considered one of the most important geological events that altered global paleoceanographic configuration, allowing important changes in the terrestrial faunas of the Americas and in the surrounding tropical marine provinces.

Several tectonic models have described the development of the emergence of the Isthmus of Panama; all of these have a common denominator that invokes the southern collision of the Panama arc (microplate) with the South American continent, and a northern shallow subduction of the Cocos ridge against the Chortis block. This geological process took place from the Middle Miocene (12.9 – 11.8 Ma) until Pliocene (3.6 – 3.5 Ma), and it is recorded by different methods which include: faunistic comparisons between the Pacific Ocean and the Caribbean sea with benthonic and planktonic foraminifera, observed changes in the calcareous nannofossil as well as radiolaria assemblages, and coral responses in the Atlantic Ocean after the closure, among others.

Paleocirculation patterns have also been inferred by stable isotopes ($\delta^{18}\text{O}$, $\delta^{13}\text{C}$), analyses carried out in Legs of the DSDP and ODP, which have shown the evolution of the currents during the Miocene to Holocene. All proxies reflect the modification of Caribbean and Pacific water masses from the beginning stage to complete closing of Isthmus of Panama, permitting the concomitant establishment of the Gulf Stream and North Atlantic Deep Water (NADW), that in turn altered marine productivity, coastal upwelling and faunal realms within the Caribbean Sea, and made it different from those of the Pacific Ocean.

Finally, the comparison between the Atlantic and Pacific Oceans, using the DSDP Leg LXVIII (Sites 502 and 503) and posterior conclusions presented by consecutive legs, allows an overall view of the paleoceanographic framework since the closure of the Central American Seaway began and also, corroborates some of the conclusions stated by previous authors by means of sedimentological analysis.