

Origin and evolution of the great Coastal cliff in Parque Nacional Pan de Azúcar, Northern Chile (~26°S): Insight from marine erosion modelling

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The coastal border along northern Chile exhibits an impressive coastal cliff, extending for c. 1.000 km between Arica and Chañaral (18.5° - 26.3°S). The cliff is bounded to the west by the coastal rasa and to the east by the low relief surfaces of the Cordillera de la Costa. Marine erosion in the coastal border is conditioned by climatic and tectonic factors, and also, by its paleogeographic evolution. Therefore, understanding and characterising the influence of these conditioning-factors on marine erosion will make it possible to assess the role that these factors can have on the morphological configuration of the coast. In Parque Nacional Pan de Azúcar, the coastal cliff presents a relief of c. 800 m and is separated from the coast by an emerged costal rasa, which indicates an inactive condition of the cliff. The cliff is limited to the north and south by creek mouths (Pan de Azúcar and Esmeralda creeks), where it is observed marine terraces dated in 400 – 130 kyr. Numerical models for the last 400 kyr, with 1, 2.5, 5 and 10 m²/a erosion rates and with published uplift rates between 0.25 – 0.35 mm/yr, show a final configuration with an active cliff and submerged coastal rasa. This configuration disagrees with the current geomorphological configuration in the studied zone. Hence, it is deduced that the published uplift rates would be underestimated or that the cliff evolution require a higher time-span. The modeling of the last 6 Ma scale shows an emerged rasa and an inactive cliff, consistent with the current configuration. Nevertheless, the current geomorphological configuration requires a 0.4 mm/yr uplift rate and a 10 m²/yr marine erosion rate. For marine terraces development in the creeks mouth, a minor marine erosion rate is required (1 -2.5 m²/yr). This suggests that the supply of continental sediment in the rasa plays a protective role and it's reducing the marine erosion, promoting the terraces formation to the detriment of the cliff development. A preliminary conclusion of this work is that the development of a coastal cliff would be explained by a long-term condition of high marine erosion rates and lower supply of continental sediment, which is directly controlled by the prevailing hyperarid climatic conditions in northern Chile.