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Papers

Historical Cartography (NE, Brazil): A Study of Coastal Geoforms Cartographed Post-Discovery

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Abstract
Geomorphological studies are crucial for understanding the evolution of relief, and when associated with cartography, they enhance the interpretation and knowledge of environmental dynamics. Hence, historical cartography is essential for the documental rescue of landscapes, which, based on the mapped geoforms, enhances post-discovery studies for the state of Ceará, Brazil. Historically, this state was intermittently mapped in the sixteenth and seventeenth centuries but gained greater attention from Portugal in the eighteenth and nineteenth centuries after its separation from Pernambuco. Despite this, cartographic studies on coastal geoforms are not typical for the Ceará coast over a given period, highlighting the importance of this investigation. Therefore, this article aimed to study the environmental history of the coastal geoforms mapped on the extreme west coast of Ceará in the seventeenth and eighteenth centuries. This research had a qualitative and exploratory basis, with cartographic documental surveys online and *in loco*, covering the municipalities of Jijoca de Jericoacoara, Camocim, and Barroquinha. Fifty maps of different origins were collected, three of which were used: a French sketch and two Portuguese maps. In the French material of 1615, geoforms in the Cape de la Tortue indicated the presence of a rocky island separated from the mainland. From the Portuguese map of 1629, a well-cut coastline was noted, identifying Buraco das Tartarugas, where there were two islands of different sizes. In the 1794 map, an island in the cove called Geri qua Coá was noted, differing in landscape from the previous ones, as it did not have tombolos connected to the continent. The cartographies presented particularities for revealing a possible advance in the local sea level. Thus, it is possible to motivate future research in the area of historical cartography as a tool for the analysis of the paleogeographic evolution of the coastal zones of Ceará.

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INTRODUCTION

Geomorphology and its study areas (structural surface, morphological compartmentalization, and landscape physiology) allow for an improved understanding of landforms and their social relations. However, without cartography, interpreting and understanding the environmental dynamics and realities become more difficult on a contemporary scale. Thus, historical cartography contributes to studies of geoforms (coastal and continental zones), the evolution of ecosystems, water and mineral resources, and populations and their occupational practices, in addition to the new features that focus on spatial, geopolitical, and even such things as the mapping and modeling of pandemic times (BONDESAM; FURLANETTO, 2012; BOULOS; GARAGHTY, 2020; JAMES et al., 2012; LIMA, 2018, 2021; SANDERSON, 2016; VALJAREVIĆ et al., 2020; ZLINSZKY; TIMÁR, 2013).

The historical cartography of Brazil after its discovery or after 1500 has been associated with the territorial description, consisting of the locations of fortifications, human settlements, and water bodies. Faced with new territorial delimitations and the challenges established by the Treaty of Tordesillas in 1494, Portugal initially paid little attention to Brazilian lands, resulting in low occupation, protection, and environmental knowledge, in addition to negative disproportionality in the production of maps when compared to other explored regions. More than thirty years were required for a definitive proposal, and the project of hereditary captaincies was considered the fundamental impulse of the colonist to resume cartographic productivity and geographic detailing for a better understanding of the new territory. At this time, the disadvantage of remaining on African soil was notable, both because of the precariousness of trade and the loss of possessions to the Muslims, as well as the possible loss of domains on the other side of the Atlantic, given the presence of the French who did not accept the Iberian agreement (HERMANN, 2007; MANZANO, 1988; OLIVEIRA, 2015).

In the hereditary captaincies that existed in the sixteenth century, a few had protection from the attacks of foreigners and indigenous people. Among them were Pernambuco and Bahia, located in the south-central area of the northeast, with the former supported by sugarcane production and extraction of an important Brazilian tree, Brazilwood (*Pau-Brasil*), and the latter converted into the center of the Portuguese general government in Brazil. In addition to strength, they conquered the Portuguese crown of the favourable geophysiographic conditions of lands and rivers, proportionally concentrating a greater quantity of mapped and studied regions that were more thoroughly described. Another essential government system in the seventeenth century was the Maranhão, where the emptiness and indecision on the borders between Luso Hispanic America gravitated, but the transit of both in these domains generated thematic maps of high diplomatic and environmental value (ALVES, 2013; ARRAES, 2017; CARDOSO, 2011; CUNHA; NUNES, 2016; FAUSTO, 1996; HERMANN, 2007; MAGALHÃES, 2009; PRADO, 1945; ROCHA, 2005).

The territories of Paraíba, Rio Grande do Norte, Ceará, and Piauí, which included the captaincies of Pernambuco and Maranhão, gained autonomy due to population, cultural, and economic growth during the seventeenth and eighteenth centuries. Thus, they naturally came to be better understood, especially in the physical and political geographic aspects, which provided more coverage and detail when added to cartographic records. Thus, it can be said that Ceará, with a favourable northern geographic position, did not arouse the interest of Portuguese settlers. However, it appeared in Spanish and Portuguese maps and descriptions from the sixteenth century and French and Dutch records from the seventeenth and eighteenth centuries. Finally, it was only in the eighteenth century and after its separation from the government of Pernambuco that Ceará became a province that was rapidly modernizing, urgently leveraging the spatial representation of mines, roads, agriculture, and borders (AMORIM, 2012; ARRAES, 2016; CHAVES JÚNIOR, 2017; CURVELO, 2019; GIRÃO, 1982; LIMA, 2020; MANZANO, 1988; MARTINS, 2011; NETO, 2010; STUDART, 2004; TEIXEIRA, 2017).

Given the above, the importance of cartography developed in the colonial period for Ceará is shown, as its coastline and interior regions presented peculiar environmental aspects compared to other border provinces, which became favourable for mapping, detailing, and exploring. Furthermore, the information from these cartographic records, combined with toponymic references to water resources and geographic and human impacts, helped in the evolutionary understanding of the territory, allowing for the sequence of rivers, inlets and promontories, dunes, vegetation, and bathymetry, and the positioning of its hills, including those that were visible from the high

seas to be demonstrated with each new map (FARRAPEIRA NETO, 2017; MATOS, 2009; NETO, 2010; PAULA et al., 2015, 2020; SOUSA, 1540-1591). This fact was so remarkable that the province became a parameter for nautical guidance for settlers and foreigners, bringing directions for local trade that were distinguished through spices (such as balsam, oils, peppers, and tobacco), yellow wood (Tatajuba) used for fabric dyes or the furniture production (violet stick '*Dalbergia cearensis*'), and whale ambergris (AMORIM, 2012).

Even with the remarkable historical cartographic contribution mentioned previously, studies that thoroughly identify and describe coastal geoforms mapped on the west coast of Ceará after discovery have not yet been documented. Thus, this investigative proposal is highlighted for its importance and innovation, which, in addition to exposing the academic community to little-discussed cartographies, allows for the consolidation of this kind of research in Ceará, in the area of coastal geography. Therefore, the objective of this study was to determine the environmental history of coastal geoforms mapped on the extreme west coast of Ceará during the post-discovery period of the seventeenth and eighteenth centuries.

STATE OF THE ART

Environmental history is a complex diachronic study of the relationships and interrelationships between society and nature, as Hughes (2006) well defined in What is environmental history? In this sense, environmental history is set within the economy, climate, natural resources (e.g., water and soil), the development of society, social and cultural representations, the landscape and its geoforms and the dangers, disasters and technological accidents, for example (AGNOLETTI; SERNERI, 2014; BEINART, 2000; MCNEILL, 2003; SIMMONS, 2022; WORSTER, 1988).

Natural resources have, over the centuries, been unsustainably exploited by different human actions, making environmental history a very representative approach between social and natural sciences. Frioux (2014) highlights that the Industrial Age (1780-1960 in the West) was crucial to define the relationship between society and nature. However, this construction also dates back to the period of the great maritime expansion that took place between the 15th and 16th centuries, especially when it comes to the South Atlantic and its colonies, as was the case of Brazil.

Along these lines, the historical understanding of the society/nature relationship is intrinsically associated with environmental history, into which it is necessary to incorporate geographic, pedological, historical, climatic, oceanographic, biological, archaeological information and more (WINIWARTER, 2014).

Pádua (2010) highlights that environmental history, as a field of science, aims to understand much more than the natural influence on the history of society, developed from the second half of the 20th century. Still according to the author, in this consolidation, sociological and epistemological factors are at the genesis of the environmental history as a social science, in which studies involving societies must always take into account the history and dynamics of environmental systems.

Environmental history is based on interdisciplinary methods that go beyond understanding non-human nature (BUTZER, 2005; ISENBERG, 2014). In this study, colonial cartography and colonial documents constitute an important analytical basis to understand the occupation of the territory, based on a power relationship between the metropolis and the colony. Thus, environmental history is a way of interpreting the dynamics, processes and contexts involving society and nature, (re)examining diverse, but fundamental, issues, from climate and environmental changes for development, to hunger and social inequalities throughout the planet (BUTZER, 2005).

This article examines the occupation of a stretch of land in Ceará, by colonizers and corsairs, through exceptionally well-preserved documentation and from a variety of different positions from the colonial cartography along with the gazing perspective of different nations. In this sense, environmental history and environmental geography approach each other in holistic terms, with the former having a denser historiographical basis, while the latter is dedicated to describing the spatial aspects of the interactions between humans and the natural world (CASTREE; DEMERITT; LIVERMAN, 2009; NAPOLETANO ET AL., 2019).

This context makes the importance of Environmental History, as a new frontier of knowledge, be noted and, since its idealization, as highlighted by Hughes (2003), it has been erasing the contours of the sciences and growing rapidly around the world (e.g.: Europe, Australia, India, Brazil and South Africa). In addition to considering the countless gains and possibilities of application, it is honorable to say that geography, anthropology, philosophy, history, ecology, ecological economics, geology,

even the areas of technology, are the most benefited when the central theme is the environmental evolution (COLACIOS, 2017; MASTRANDREA; PÉREZ, 2020; MYLLYNTAUS; SAIKKU, 2001; PADUA, 2010; PAWSON; CHRISTENSEN, 2015).

Given its breadth, it is evident that this field has generated numerous contributions and *insights* that could be applied to geology, geomorphology and, respectively, its continental and/or coastal geoforms. Thus, the Anthropocene-scale studies of urban geoarchaeology, paleogeographic evolution of the coast and its landscapes, for purposes of territorial planning and management and environmental behavior, developed by Barral e Barrera (2002); Escayol (2019); Farrapeira Neto (2017); Mastrandrea e Pérez (2020); Norman (2016); Paula (2020; 2015); Viczián e Zatykó (2011) are landmarks that environmental history has become a contribution to more efficient, effective and efficacious environmental management.

Therefore, as much as its greatest potential is to contextualize and systematize information between the past and the present, we emphasize that environmental history, according to Agnoletti e Serneri (2014), in addition to being a reflection of history itself, it is a key element to meeting needs and scaling up opportunities for a rethought environmental future that is consistent with the new realities, as emphasized by Coulter e Mouch (2011). And, as very well put by the following authors, Franco et al. (2012); Guimarães e Amorim (2016); Martinez (2011); Santos (2021), this is the only way which the necessary attention will be devoted to avoiding problems in public management that are commonly linked to flawed actions in the fields of health, conservation of ecosystems and biomes. Even the very understanding of the history of the climate, which, together with the effects of its changes, has been enhancing racism and climate/environmental injustice and its types of associated conflicts.

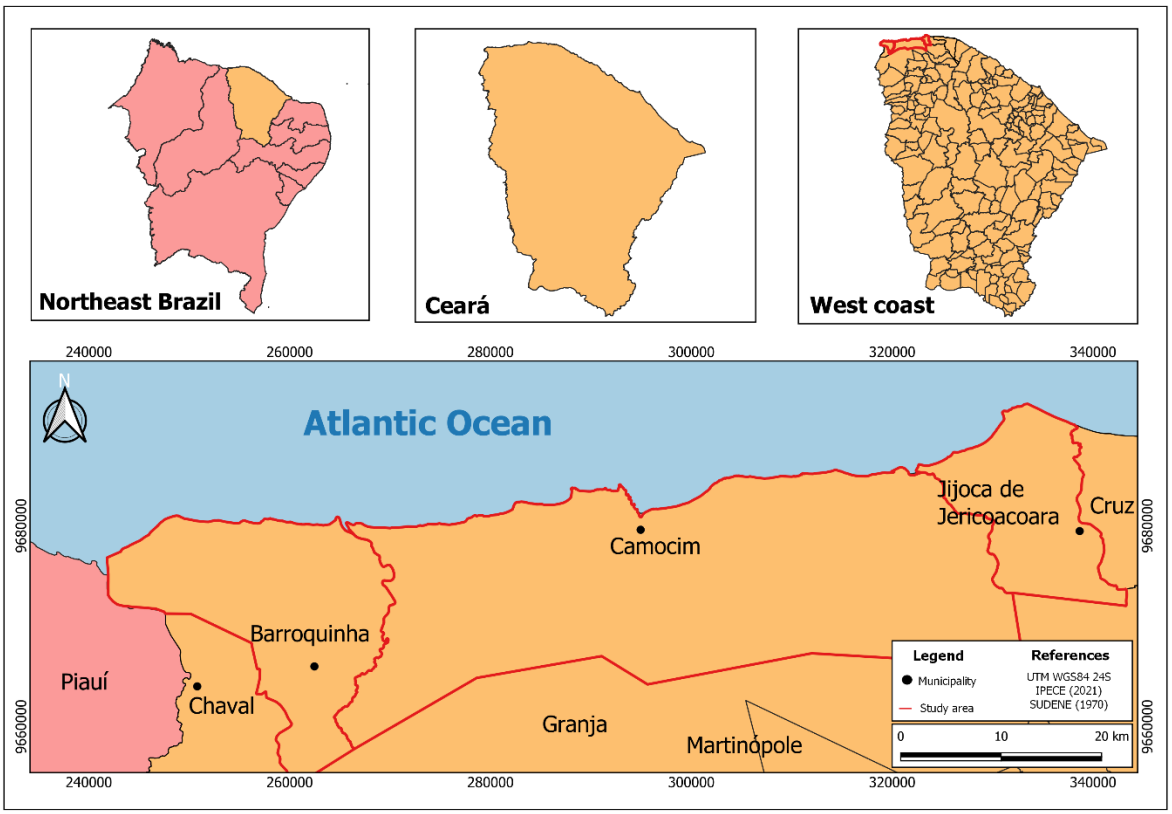
MATERIAL AND METHODS

The territory of Ceará after its discovery

Throughout history, there have been different interpretations of the Ceará territory, with natives and foreigners having perspectives on the potential existing in the natural environments between irregular borders. After the discovery of Brazil, the Ceará domains were demarcated and undertaken by the Rio Grande's hereditary captaincies, which now constitute Rio Grande do Norte and Maranhão (SOUSA, 1540-1591). It is estimated that due to the territorial interest and protection by the Portuguese in Maranhão, the Ceará domains gained attention and, consequently, importance. Thus, from the evolution of Brazilian and northeastern lands, there was also a readjustment of its limits, whereby it became the boundary of the captaincies of Pernambuco, Paraíba, Rio Grande do Norte, and Piauí between the eighteenth and nineteenth centuries (ASSIS; SAMPAIO, 2012; CÂMARA, 1956; CAVALCANTI, 1888; NETO, 2012; STUDART, 2004).

Ceará's territorial margin was restricted to a strip extending from the east coast to the western continent in the sixteenth century. Located in the northern northeast, it gained dimension throughout the seventeenth, eighteenth, and nineteenth centuries, with other formats and boundaries that have been adapted and formalized politically and administratively to the present (Figure 1) (SOUSA, 1540-1591). Thus, in these centuries, Ceará was observed and described as a territory whose coastlines were small, interspersed with rivers, and had limited depths for navigation. Its coastal coral banks and short continental shelf were accompanied by clay and fine and intermediate quartz sand when not permeated by gravel. Away from this scenario were the Jaguaribe, Pacoti, Ceará, Curú, Acaraú, Coreaú and Timonha rivers, which, due to their perpetuity, favored the possibility of disembarking and moving and developing commercial activities. Another relevant scenario was the sequence of coastal lagoons distributed offshore, which were prevented from reaching the Atlantic Ocean by dunes ranging from 10 m to 60 m. Furthermore, many maps and historical reports have highlighted the presence of the rocky points of Iguape, Mucuripe, Paracuru, and Jericoacoara which were covered by mobile dune fields and sometimes interspersed with red barriers. A low relief was present in its continental extensions except in the mountain ranges, hills, massifs, and plateaus (Baturité, Uruburetama, Itapipoca, Serra Grande, Araripe), which provide exceptions to the Sertaneja depression. In general, the soils were dry, differing from those irrigated by tidal fluctuations at the mouths of large rivers or the rainy periods between January and April (AMORIM, 2012; CAVALCANTI, 1888; CLAES, 1912; FILHO, 1969; NOGUEIRA, 1889; PAROUPABA, 1912; RIBEIRO, 1920; SOUZA, 1988, 2000).

Figure 1- Localization map of the study area.



Source: The authors (2022).

From this framework, it is emphasized that even given the non-profitability declared by the Portuguese crown, the lands of Ceará were cited several times as relevant for some nations, with the Dutch and French in charge of such considerations. It is noted in the seventeenth and eighteenth-century literature concerning the regularity of the winds, whereby it was indicated for installing windmills for possible water collection. In addition, the coastal lakes and rivers were seen as potential sources of fresh water for agriculture and livestock. Salt pans were also of interest for local production by the Dutch to replace salt prospecting in the West Indies. Other materials were also available, such as ambergris, redwood, tobacco, cotton threads, peppers, hammocks, and small animals, as well as the possibility of available minerals, which induced exploratory expeditions for gold and silver, although they were below the expected quality (AMORIM, 2012; CLAES, 1912; FILHO, 1969; PAROUPABA, 1912).

Therefore, the extreme west coast of Ceará was chosen because it was a historical area sought by various nations (such as Portugal, Spain, France, and the Netherlands) that had a base of maps to analyze geoforms that had greater visibility in the seventeenth and eighteenth centuries. This scenario has become a stimulus to broaden the discussion of paleogeographic scenarios occurring after the discovery of Ceará.

Research and cartographic support

This research is classified as qualitative and exploratory, based on online and *in loco* cartographic documentary surveys for the rescue of Ceará's environmental geography during the seventeenth and eighteenth centuries, given some restrictions on access to maps and manuscripts held by individuals in the national territory or abroad, and the loss or poor conservation of materials over time.

Geographers, historians, collectors, and the Brazilian and Ceará historical archives have been the primary entities responsible for the preservation, exploration, and construction of new historical cartographic databases, helping to overcome some of the difficulties identified and contributing to discussions related to the evolution of landscapes and the territorial, economic, and cultural characteristics of Ceará (AMORIM, 2012; CASTRO, 1997; FARRAPEIRA NETO, 2017; GONÇALVES; MATOS, 2013; MATOS, 2009; NETO, 2010; 2012; PAULA et al., 2015, 2020; SANTOS, 2010; SILVA, 2012).

Thus, to search for literary references in

online periodicals, the following base keywords were employed: Cartography of Ceará, Colonial Ceará, Coast of Ceará, Fortaleza, Fortifications of Ceará, and Settlements of Ceará, for consultation in English, Portuguese, Spanish, French, and Italian. After obtaining these materials, specific literature was selected on the current municipalities of Jijoca de Jericoacoara, Camocim, and Barroquinha, located on the extreme west coast of Ceará, for the study, interpretation, and advancement of environmental history knowledge through mapped geoforms.

In an exploratory stage to obtain maps, a virtual consultation was performed in the collections of the Biblioteca Nacional do Brasil (National Library of Brazil), Arquivo Nacional da Torre do Tombo (National Archive of Torre do Tombo, in English), Portugal, British Library, and Bibliothèque Nationale de France (National Library of France, in English) using keywords such as Cartography of Ceará, Manuscripts of Ceará, Ceará maps, and Ceará charts. In order to obtain copies or access materials only available *in loco*, a face-to-face visit was made to the *Biblioteca Central de Marina* (Institute of History and Naval Culture, in English) and the *Servicio Geográfico del Ejército de España* (Army Geographic Center, in English) in Madrid, Spain, and finally, the *Archivo General de Indias* (General Archives of the Indies, in English) in Seville, Spain. Records were accessed and handled in Portugal at the Biblioteca Nacional de Portugal (National Library of Portugal), Biblioteca da Ajuda (the Ajuda Library, in English) in Lisbon, and the Biblioteca Pública Municipal do Porto (Municipal Public Library of Porto) in Porto, Portugal.

The documental base obtained was gathered, totaling fifty maps, including Portuguese, Spanish, French, Dutch, German, English, and Italian contributions, and were interpreted and analyzed for the best scale for viewing the study area. Thus, among the collected information, three cartographic records between the seventeenth and eighteenth centuries were used: a sketch of French origin from 1615 and two Lusitanian maps from 1629 and 1794 (Table 1).

Table 1- List of maps used to perform the geomorphological evolution of the extreme west coast of Ceará.

Nº	Year	Reference	Author	Collection	Origin
1	*Circa* 1615	French sketch of the coast of Ceará and Maranhão	Amorim (2012)	Without reference	France
2	*Circa* 1629	Small Atlas of Maranhão and Grão-Pará	Albernaz I, João Teixeira	Biblioteca Nacional do Brasil	Portugal
3	*Circa* 1794	Without reference	Without reference	Biblioteca Central de Marina	Portugal

Source: The authors (2022).

Finally, with the previously mentioned materials, a description of the geoforms graphed over 179 years was performed. Combined with the local scientific literature, it allowed a better understanding of the landscape and environmental scenarios associated with the post-discovery times of Ceará's extreme west coast. Therefore, this analysis established the possibility of using historical maps as a primary tool for paleogeographic studies, as seen in the visual and historical testimonies in the following section.

RESULTS AND DISCUSSION

The extreme west coast of Ceará and the French sketch circa 1615

The coast and its geoforms, as observed by the French, are documented in a sketch *circa* 1615, which graphically contemplates much of what is today the extreme west of the state of Ceará, including coastal and continental areas. It is essential for detailing and describing Ceará's geography as it provides relevant historical data on the environment, local land use, and occupation.

Based on Amorim (2012), many French people visited Brazil throughout the sixteenth and seventeenth centuries, with natural ports being allowed as entry points to explore overseas

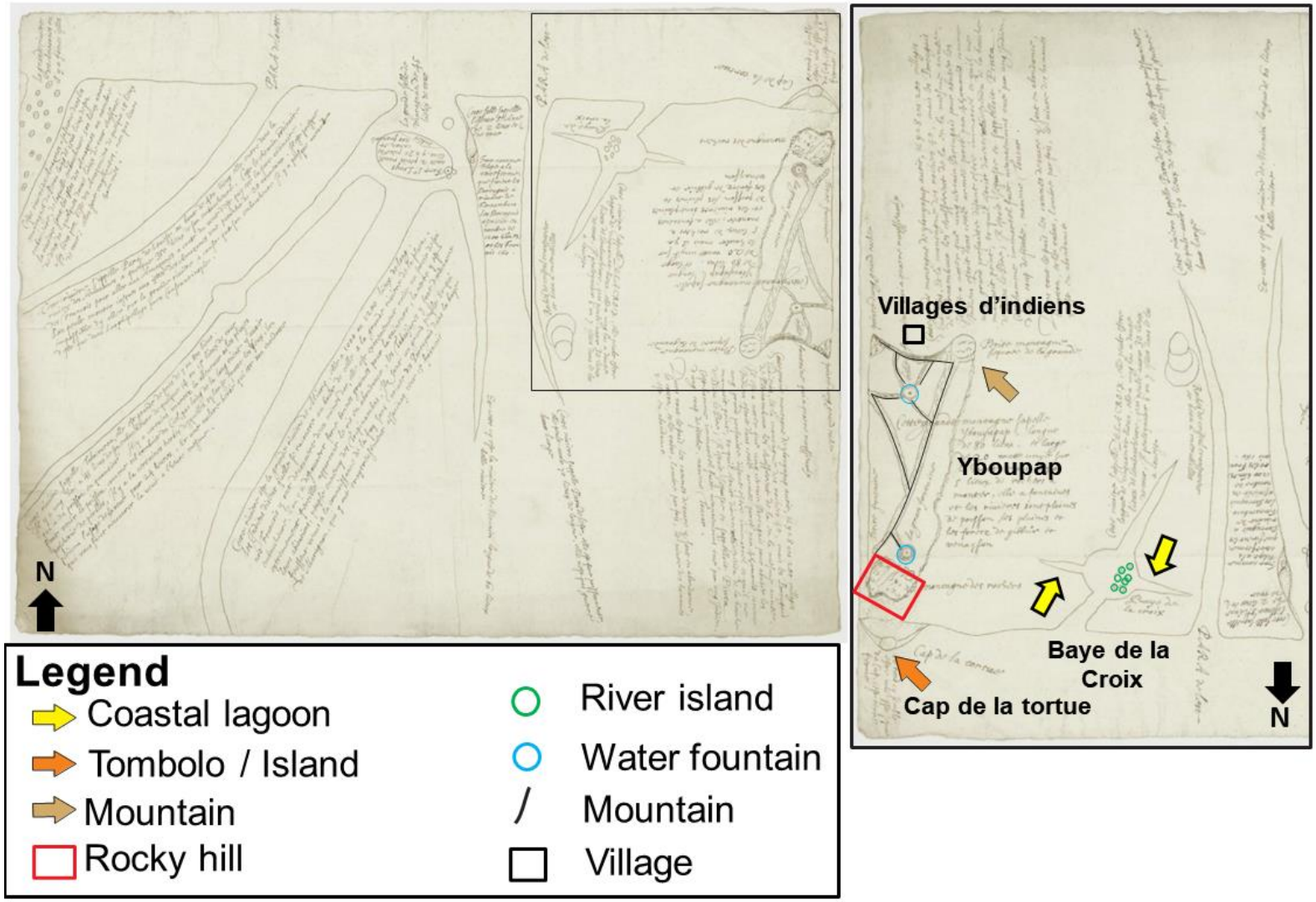
territories, as its political-administrative system did not adhere to international treaties. It differed from the Portuguese and Spanish viewpoints toward fulfilling treaties; therefore, these visitors were considered pirates in American lands. However, as they travelled through Ceará's lands, they produced manuscripts and/or records similar to the French document, which could further detail the local environmental history.

Thus, it can be said that the author of this sketch is unknown, even though there are historical and informal indications that the Jesuit priest *Francisco Pinto* prepared the highlighted document during the French occupations in *Yboupap* (currently *Chapada da Ibiapaba*) around 1615. Given the above, the material's lack of technical cartographic rigour can be seen, and the problems of geographical representation for some of the region's natural resources and geomorphological formations are marks of the inaccuracies generated during the production of documents.

Similar to previous statements and the observations in (Figure 2), the named mountain of *Yboupap* was located just upstream of *Cape de la Tortue* (present-day Jericoacoara inlet), between *Rivière de la Croix* (present-day Coreaú River) and *ouvest* (west and today Timonha River). However, the Ibiapaba *plateau* is found more than 100 km away from the coast; therefore, even with its technical limitations, this material gave the study a base as the first contact with the environmental geography of Ceará in the early seventeenth century, thereby providing information to understand later maps, regardless of the viewpoints of other cartographic schools.

Given the geomorphological reports, the coastlines alternated between straight patterns, shallow creeks, and those with greater curvatures. Furthermore, the promontory at the eastern end was a geoform that served as a control point for downstream sedimentary distribution. Finally, these sequences were only interrupted by fluvial marine recesses between the current limits of Ceará and Piauí.

Figure 2- French sketch of the west coast of Ceará *circa* 1615.



Source: Adapted from Amorim (2012 p.27).

An interesting feature of the *Cape de la Tortue* inlet that shelters the current village of Jericoacoara indicated the possible presence of a rocky island separate from the continent called *Montagne des Rochers*. This elevation corresponds to the current Jericoacoara hill, composed of sandstones from the São Joaquim Formation, exposed to marine abrasion over geological time.

Baye de la Croix (corresponding to the current Coreaú River) supposedly has the shape of a cross, as it receives two tributaries from the east and west quadrants, and seven fluvial islands can be seen close to its left bank. The current Lago Seco could be the water body (coastal lagoon) associated with the main bed in the western portion. In the east, such a connection could have occurred with Laguinho and Lagoa Grande.

The information described can be justified by the extensive and volumetric presence of the dune fields concerning the beach and fluviolacustrine systems, which increase the loss of temporal contact with the river bed. Unfortunately, because of the cartographic imprecision of the document, the details provided could not indicate the existence of other water bodies in the locality, which enables the opportunity for new geophysical and geotechnical investigations related to the paleopositioning of offshore watercourses.

Some natural resources were found toward the south, such as freshwater sources from small and large bodies of water. A mountain range was also noted, which in 1615 was called *Yboupap* or *Chapada da Ibiapaba* and currently borders the state of Piauí.

Finally, even further south of *Yboupap*, indigenous communities comprising eight to twenty villages were identified according to Amorim (2012), most of which were inhabited by natives who migrated from the coast to the interior of Ceará due to slavery and continued attacks by the Portuguese. According to the Revista do Instituto do Ceará (Institute of Ceará Magazine, in English) (1907), it was confirmed that during the period indicated by the document, the Portuguese people coming from Pernambuco were already living with the local inhabitants, and engaging in activities in the seventeenth century with cotton, cotton threads, tobacco, and arrows called *Toucar*.

New coastal forms in Portuguese cartography circa 1629

For the Small Atlas of Maranhão and Grão-Pará produced in Portugal *circa* 1629, an attempt was made to portray an even more extensive parcel of land located between the states of Ceará and Maranhão to expose complementary territorial details or unpublished material when compared to the previous French sketch.

In general, the Portuguese document explored the coastal geoforms with increased detail, providing data on sequential inlets and angles that substantially enhanced the information acquired from continental geomorphology. In addition, although few toponyms were mentioned, the material brought a better spatial distribution of human settlements and rivers and a more straightforward representation of the local marine dynamics. Dotted and continuous lines revealed the depth and sedimentation that could affect the docking or passage of boats.

The map shown in Figure 3 proved to be better parameterized cartographically than the *circa* 1615 sketch, using lines and a geographic coordinate system expressed by graphic scales. This provided more accurate measurements for displacement, whether via the ocean or continent. In addition, it was clear that the purpose of the material was to map the water bodies, the occupation, and the protection of territories.

In sequence, a coastline can be observed with rivers of different dimensions connected to the sea. Thus, the geographic and environmental characteristics were quite different when compared to the previous fourteen years defined by the French material.

When the map was read and interpreted from east to west, it was possible to identify Serrote Buraco das Tartarugas or *Iura coaquara* (currently Jericoacoara), which qualified as a natural harbour and a good bay for anchoring. In front of this inflexion point were two islands of different sizes that no longer had the rocky elevation shown in 1615. Despite the quantitative differences and the landscape descriptions, it was seen that such islets could be associated with the Jericoacoara hill (São Joaquim Formation) and also indicate a possible sudden rise in sea level.

Rio da Crúz (currently the Coreaú River) regressed in detail from the previous document, whereby its hypothetical cross geoform was not as evident. However, the two lateral tributaries can still be observed, one to the east and the other to the west, which could today be associated with some of the water mentioned above bodies: Guriú, Lagoa Grande, and Laguinho to the east and Lago Seco to the west.

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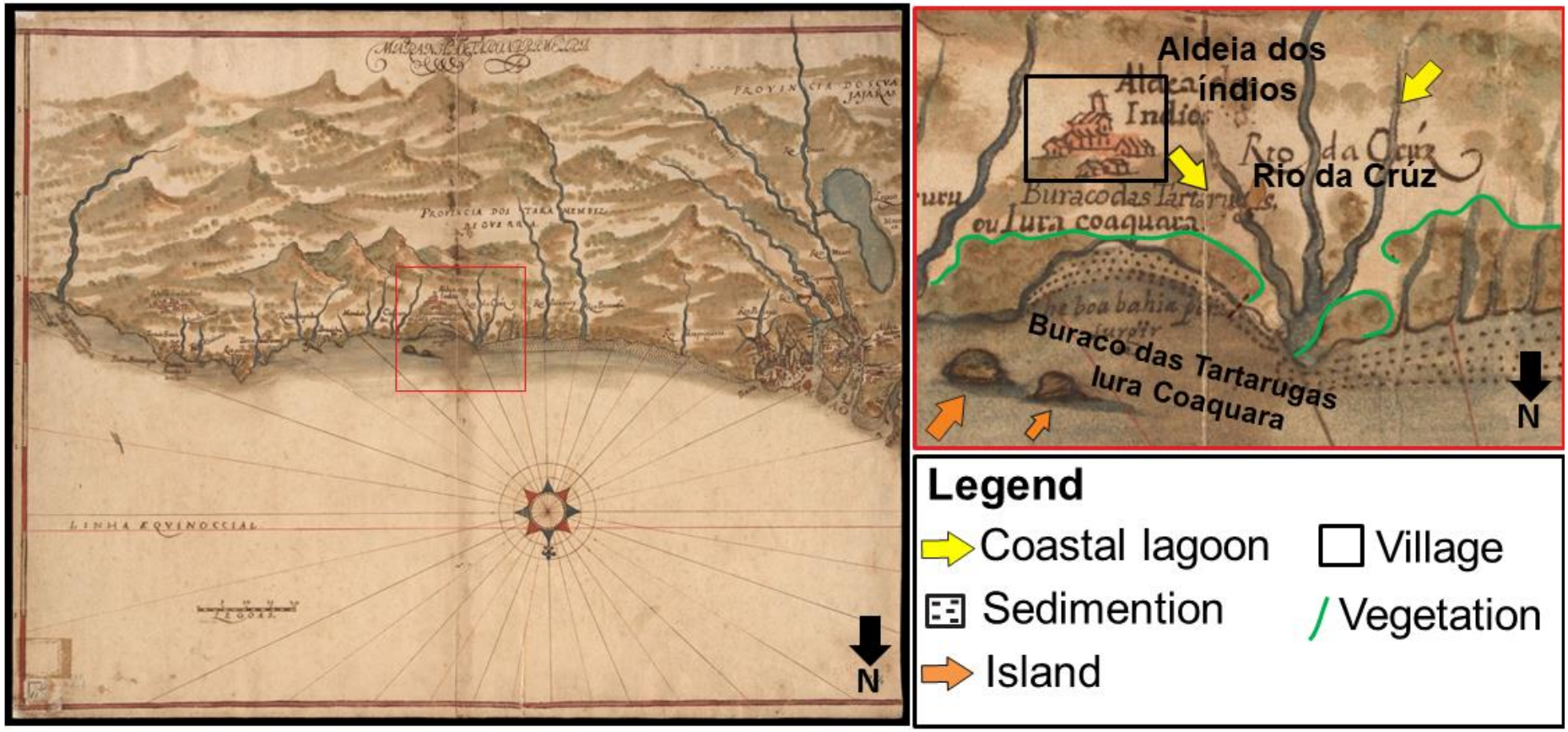
Figure 3- Portuguese chart of the coast of Ceará *circa* 1629 shows some of its natural characteristics.



Source: Adapted from Albernaz (1629).

Finally, undifferentiated green areas were observed, which may be associated with coastal and continental vegetation. South of *Iura Coaquara,* a small indigenous village was represented by the same group of natives located in the 1615 French document.

The Portuguese map circa 1794 and some revelations for the west coast of Ceará

In the final map of this cartographic rescue of the environmental geography of Ceará, the geographic characteristics reported in 1794 by the Portuguese were analyzed. On that occasion, the temporal spacing was approximately two centuries from the first document and more than a century and a half from the second, containing references to the extreme west coast of Ceará, with a predominance of toponyms, settlements, and coastal geoforms.

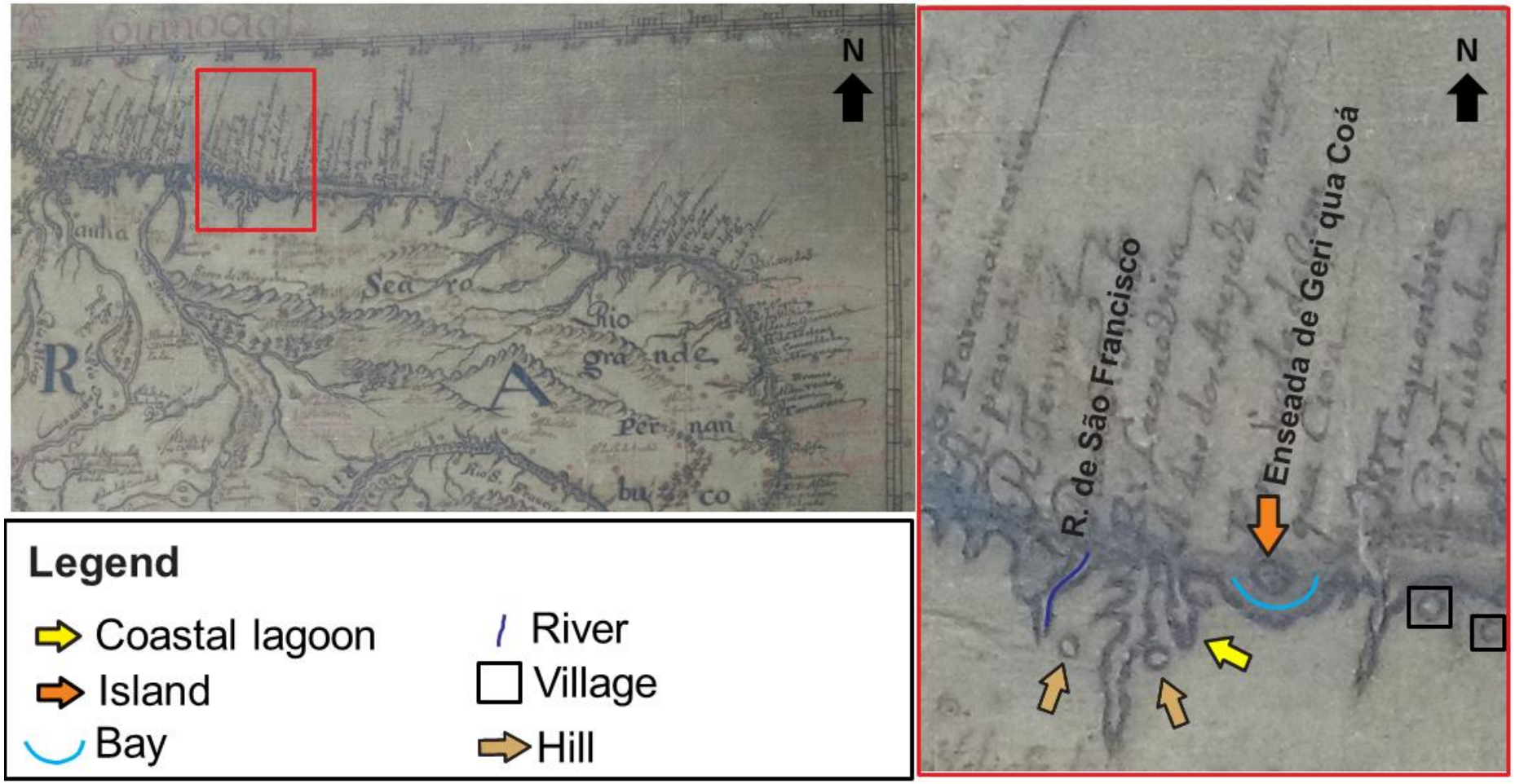
Therefore, changes in the names of localities were noted in this material when compared to the French and Portuguese documents from the seventeenth century. In addition, it was found in this territorial portion that the presence of numerous toponyms was not explored preliminarily, differentiating it from the other materials.

Based on the geoforms presented in (Figure 4), the map was shown to have had a better orographic reproduction of continental and coastal areas, even without altimetric precision. For example, the limit of the west coast of Ceará was seen as furrowed, being carved by small, medium, and large rivers, and in a sequence from east to west, it is possible to locate a promontory, inlets of different scales, and a small bay that sheltered a small island.

Once again, the site represented an island unit in the inlet designated *Geri qua Coá* (today Jericoacoara) that differed in landscape terms from the last two maps covered, as it did not present the possible tombolos connected to the mainland in 1615, and neither did the two islands disconnected from the coast in 1629. Nevertheless, from what can be qualitatively inferred, there was an indication of a rising sea level in the area studied. The 1794 map may be the historical cartographic document that presumably confirms these advances since a sequence was identified that covered more than 179 years of coastal geomorphological evolution.

Rio de São Francisco (possibly the Coreaú River) presented different toponymy and physiography from a cross between 1615 and 1629, as its connections with other tributaries were open to the Atlantic Ocean. With this, the current Laguinho, Lagoa Grande, and Guriú Rivers are indicated as possible recesses in its eastern portion and before the inlet of *Geri qua Coá*. Furthermore, it indicates zones of longitudinal currents and submerged sandy banks. Finally, four unnamed coastal communities were marked, two to the east of *Geri qua Coá* and two close to the banks of the Rio de São Francisco and other water bodies.

Figure 4- Portuguese spatial reading of the geographic configurations of northern Brazil, with an area highlighted to the west coast of Ceará *circa* 1794.



Source: Adapted from an unknown author.

Given the above, Ceará's cartography produced after the discovery period (seventeenth and eighteenth centuries), which contemplates the environmental geography of the extreme west coast, proved to be an effective tool for the evolutionary perception of coastal landscapes, generated mainly from its qualitative characteristics and visual results capable of projecting discussions and answering questions generated by descriptions and transcriptions of historical manuscripts that are often difficult to interpret (FARRAPEIRA NETO, 2017; PAULA et al., 2015, 2020).

Thus, it was shown that under these productions, the west coastline of Ceará has been mapped with a sequential presence of rivers, inlets, and small bays, with the Jericoacoara promontory being the most notable among these physiographies. Even in the face of spatial representation and scale errors, this geoform has not ceased to be represented in a single document. Therefore, the landscape is a portrait on a historical scale compared to what has previously been published in the local scientific literature. It has been identified as an area with the tectonic activity of the Transbrasiliano Lineament that exerts offshore influences in combination with climatic or oceanographic factors, which has resulted in dynamic morphogenesis and accumulations over geological time which are capable of generating geomorphological indicators that explain changes in sea level in the study area (CADORINI, 2017; IRION et al., 2012; MEIRELES, 2006, 2012; MORAIS, 2000; SILVA; MORAIS, 2013; SILVA FILHO, 2004, 2007; SOUZA, 1988, 2000; XIMENES NETO, 2018).

Given the relevance of the previous literary position, the history of environmental geography in Ceará was also present, according to D'Oliveira (1969, p.4), in Pleitos de Colón through the navigation charts of *Juan de la Cosa* from 1500. They were the first descriptions of the Ceará coast that brought paleogeographic indicators and corroborated the results. Among the evidence was the *Punta del Medano* or *Jurucoacoara*, seen as a sharp outline with two rounded elevations, more than a hundred meters high. In addition, a half-moon-shaped river called *Rio adonde if halló una cruz* or, in modern times, the Coreaú River was identified, accompanied by the *Cabo de Arenfas* or *Cabo de Arrecifes* sandstone point, which then sheltered the *Río Negro*, now the Timonha River.

Historical cartography can be used as a qualitative visual resource for empirical and invasive research and, thus, serves as a complementary geohistorical testimony for investigations requiring more recent time and space information. Therefore, the materials studied were able to contemplate or at least sequentially assume a probable period of a sudden rise in sea level, as referenced (MEIRELES; RAVENTOS, 2002, p.84) below:

> The Ponta de Jericoacoara promontory is formed by quartzite and gneissic rocks from the Pre-Cambrian and was susceptible to sea-level changes, mainly during the two transgressive events defined for this region (123,000 BP and 5,100 years BP). It acted as a tombolo at sea level conditions above the current one, providing a peculiar dynamic in the construction of the coastal plain as it potentiated the change in the direction of winds, waves and sediment transport to the beaches (longitudinal currents) and the mainland (plains of deflation).

The qualitative and quantitative parameterization attributed in the studies by Meireles et al. (2005) for the study area made it possible to identify the similarity between geological events and their landscape configurations, which were mapped on a historical scale. In other words, the Jericoacoara promontory and the island(s) connected by a tombolo(s) to the continent were the critical points of this study, which helped to validate, with an admissible degree of precision and confidence, their spatialization in the collected maps.

According to Martin et al. (1998) apud Meireles et al. (2005), the natural events studied here can be interpreted as the last marine regression marked by episodes of high-frequency sea level rise, reaching marine amplitudes between two and three meters, over three hundred years. For this reason, the historical documents that portray the coastal zone of Ceará in the post-discovery period were able to provide detailed information on the geoforms and their geographical positions and environmental contexts, which, in addition to the objective of this study, can be addressed for research local flora, human settlements, and different toponyms.

CONCLUSIONS

It can be concluded that the historical

cartography of the seventeenth and eighteenth centuries shared information directed to water bodies, natural ports, human settlements, and natural resources, emphasizing the details of the coastal geoforms of the extreme west coast of Ceará. However, the materials elaborated by the French and Portuguese differed in technical and cartographic aspects, generating challenges in the interpretation of spatiotemporal information and linked toponyms.

When analyzed and described individually, the maps showed particularities endowed with given originality, with the *circa* 1615 sketch being the graphical representation with more specificities in its data, allowing the reader to understand the environmental geography of Ceará more accurately. In these reports, the continental and coastal physiographies are valued, highlighting the *Cape de la Tortue* (a current inlet of Jericoacoara), which had an islet in front connected to two lateralized tombolos. Therefore, could this material show aspects, even if inconclusive, of a rise in sea level at the beginning of the sixteenth century? Or is it just a mark of intense and recurrent local sedimentation?

For the Portuguese map *circa* 1629, there is a scenario close to those mentioned earlier, but with one more islet in front of Buraco das Tartarugas or *Iura coaquara* (currently Jericoacoara), showing a panorama of rapid marine advance at the site. Would there then be a possibility of a sudden rise in sea level between 1615 and 1629?

Therefore, for the record *circa* 1794, the panorama of 1615 is again reproduced, but with particularity, as there was only one island and no connection to the inlet designated *Geri qua Coá* (today Jericoacoara). So would this period have reached the maximum of the sudden marine advance towards the west coast and even the state of Ceará?

The apparent evolution of the Ceará landscape over these 179 years has become the vanguard to raise such questions, as it is believed that motivating future research in the area will generate more answers and, consequently, greater possibilities for consolidating the proper use of historical cartography in the analysis of natural phenomena. However, it is still appropriate to say that such qualitative predictions should be validated through geotechnical applications and the use of C-14 dating, as they will help to create empirical scenarios that are better able to define the paleogeographic evolution of the western coastal zone of Ceará.

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AUTHORS CONTRIBUTION

Carlos de Araújo Farrapeira Neto conceived the study proposal, collected, analyzed and wrote the text. Antônio Jeovah de Andrade Meireles guided the analysis of sea level variation data in Ceará. Davis Pereira de Paula guided, provided historical literature and analyzed evolutionary data on the use and occupation of the coast of Ceará. Francisco Borja Barrera directed searches to obtain historical cartography in Europe and analyzed environmental evolution data obtained from documents (cartographies and manuscripts). Rafael Cámara Artigas contributed with the technical interpretation of maps. César Borja Barrera contributed with the evolutionary interpretation of sedimentary landscapes in the coastal zone. Miguel da Guia Albuquerque collaborated with the interpretation of local environmental compartments and their evolution. Josafá Terto de Amorim provided and translated historical maps and helped interpret local socio-environmental information.