

Geographical Analysis of the Coastal Landforms of Canacona, Goa

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ABSTRACT

Of the total 247 nations of the Globe, 123 nations are characterized by coastline accounting to 1.6 million kilometers. Coastal areas are highly useful to humans because they have ecological, biological, social, and economic values. Since the antiquity of man, oceans and seas have served as a linkage amid humans and lands. They have bonded us together. Economic development in the world is concentrated in the coastal regions hence most thickly populated cities are found concentrated in these areas. The coastal ecosystems are composed of diversified landforms of different dimensions and forms.

India has 7516.6 km long coastline of which 130kms lies in Goa. The shoreline of Goa is characterized sandy beaches, rocky beaches, sea caves, estuaries, mangroves, bays, headlands, cliffs, hills, corals, ports, harbors and coastal islands. Of the 12 talukas of Goa, 7 talukas are gifted with coastline. Canacona taluka has the longest coastline among all the talukas. The coast of Canacona is very fragile and eco-geologically vital. The coast of Canacona is characterized by a number of coastal landforms created by both erosion and deposition. Hence, this paper make an attempt to investigate in to the coastal landscape of Canacona and identify important coastal landforms.

1. Introduction

Coastal Geography is study of the active interface amid Hydrosphere and Lithosphere, which involves understanding of important processes applicable to both Physical and Human Geography of the shore. Coastline is a geographic entity where the terrestrial environment meets the aquatic environment. The coastlines are dynamic in nature because of tidal forces and other coastal processes, therefore, it is difficult to determine coastlines hence, the term "coastal zone" best describes the coast, coastline or shoreline.

Since the antiquity of man, oceans and seas have served as a linkage amid humans and lands. They have bonded us together. The coastal areas play a significant role in the general environment of the region. They have great influence on the Climate and responsible for supplying nutrients to the sea. Similarly, coastal areas are the store houses of natural resources and have huge impact on the development of beach tourism. Across the world, tonnes and tonnes of garbage is produced and it is transported to the sea and the sea act as disposal of land refuses.

Most of the economic development in the world is concentrated in the coastal areas, as a result of which nearly 60 percent of human population resides in coastal areas in just 18 percent of the total area of the planet. Similarly, planet's most thickly populated cities are found concentrated along the coastlines.

Since the historic times, sea borne transport is one of the oldest and cheapest modes of transport available to the humankind. The coastal areas serve as the best natural ports and harbours. These ports and harbours are significant for intercontinental movement of goods and services. Similarly,

fishing is one of the oldest economic activities of man because before man became cultivator he was a hunter and fisherman.

The rate of erosion is very high in the coastal areas because of constant wave action and due to other coastal processes. Similarly, coastal area are prone to disasters. Due to increase in the instances of global warming and climate change, disasters in the coastal areas have become day today phenomena. Our coast acts as a soft cushion between the hydrosphere and lithosphere by absorbing the energy of waves, cyclones, storms, etc.

India has 7516.6 km long coastline of which, length of west coast accounts for 3040 kms. Goa is gifted with 130kms long coastline from Tiracol (Pernem) in the North to Polem (Canacona) in the South with a complex shoreline. Hence Ahmad E (1972) classified the coast of Goa as a 'submergent rocky indented coastline'. Sandy beaches, rocky beaches, sea caves, estuaries, mangroves, bays, headlands, cliffs, hills, corals, ports, harbors and coastal islands characterize the coast of Goa.

Of the 12 talukas, 7 talukas namely, Pernem, Bardez, Tiswadi (North Goa), Mormugoa, Salcete, Quepem and Canacona (South Goa) are characterized by coastline. Canacona taluka has the longest coastline among all the talukas. The coastline of Canacona is about 42kms long from Cape de Rama in the North to Ploem in the South with varying width. About 70 percent of Canacona coast is rocky. The coast of Canacona is very fragile and eco-geologically vital. The coast of Canacona is characterized by number of coastal landforms created by both erosion and deposition. Hence, this paper make an attempt to investigate in to the coastal landscape of Canacona and identify important coastal landforms.

2. Study Area

Canacona is a global tourist destination which is visited by 77,041 tourists (total population of taluka 45,172). The coastline of Canacona, which is 42kms long, is known for stunning, breath-taking and spectacular coastal landforms. At the same time, it is highly fragile from ecological and geographical point of view. Taluka cover 352.02 Sq. Kms of area and lies between $14^{\circ} 55' 00''$ to $15^{\circ} 10' 00''$ North latitude and $73^{\circ} 55' 00''$ to $74^{\circ} 15' 00''$ East longitude (Figure 1 & 2).

Geologically, Goan landscape including the coast of Canacona consists of greywacke-argillite and meta-basalt rocks belonging to Chitradurga group of Archaean to lower Proterozoic age. Canacona is a home of one the oldest rocks (*Trondhjemite gneiss*) which date back to 3400 million years. Beach sands and alluvium belongs to the quaternary formations. The narrow coastal plains are dissected by hills at many places. The coast of Canacona is characterized by a number of geomorphological features related to marine erosional and depositional processes. Long-shore and tidal currents and strong winds blowing from the Arabian Sea have played an important role in shaping the coastline.



Figure 1



Figure 2

3. Methodology and Data

The study is exclusively based on both primary and secondary facts. The primary data is gathered from various sources like field work and field observations. On the other hand, secondary data is collected mostly from Topographical Maps with following Index Nos. 48/E/10, 48/E/14, 48/E/15, 48/E/16, and 48/J/1 on a scale of 1:50,000 and Geo-coded false colour composite of IRS IC LISS III acquired on 5th April 1996 at 11:13:53 to the scale of 1:50,000 having an approximate resolution of 23.5 meters. Similarly, GIS portals such as Google Earth, Wikimapia, and Bhuvan Earth are also used for various purposes.

The Coastal Landscape of Canacona Taluka

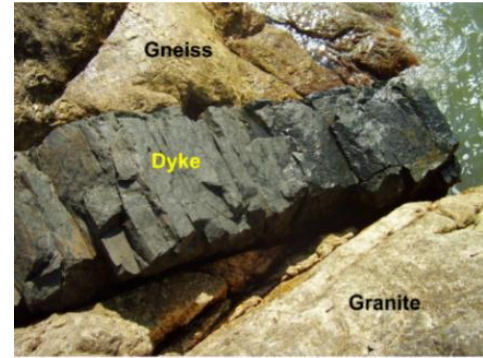
The Coastline:

The coast of Goa is combination of emergent and submergent coast. It is evident from the Geological Map of Goa that the coast between River Tiracol to Mandovi is Emergent Coast. Whereas, between River Mandovi and Zuari the coast is Submergent. Similarly, the coast of Salcet is emergent type of coast while the coast of Canacona is submergent type.

Dyke (Dike) Formation:

The shoreline of Canacona is marked by dykes. Dykes are wall like intrusion of igneous rocks formed as rose up through a near vertical crack, forcing the rock apart. As the magma cooled it formed a vertical sheet of rock with parallel sides cutting across bedding planes.

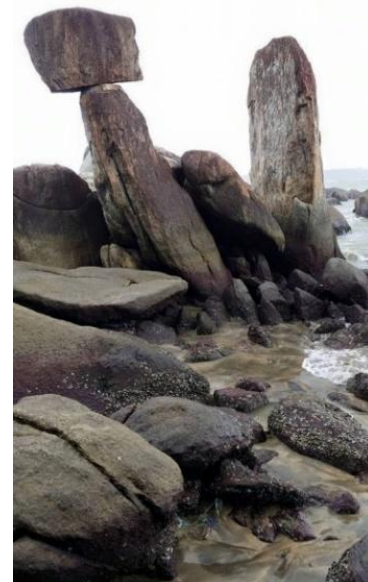
The coast of Canacona is known for spectacular intrusion of dykes into granite, dolerite and gneiss at many places. These exposures belong to Precambrian period. Dykes are very clearly visible in the rocky coast of Canacona more prominently found in Colamb and Patnem (Pix 1). These dykes are believed to be formed about 2395+390 Ma.



Pix. 1 Dyke formations at Patnem

Granite Tors:

Encyclopaedia of Britannica defines 'tor' as exposed mass of rock of jointed and fragmented blocks. Tors are also free standing rock outcrops. Tors are primarily formed due to weathering and erosion process. The coast of Agonda is characterized by these formations (Pix. 2)



Pix. 2 Formation of Granite Tors at Agonda

Beaches:

Beaches are significant ecological, social, entertaining, and economic resources. The sea beaches are most unlikely of landforms to be found facing the open sea (Pethick J., 1984). Beach is a deposit of stuff, which is in transit either alongshore or offshore. Along the shoreline of Canacona, as many as 15 beaches are identified. Table 1 illustrates different characteristics of beaches found in Canacona.

Table 1
Beaches of Canacona

Name of Beach	Type of Beach	Length in meters	Width in meters
Cabe de Rama Beach	Sandy and Rocky	383	14 – 59
Gal Beach	Lateritic & Rocky Beach	249	35-40
Khola Beach	Sandy Beach	319	15-20
Saleri Beach	Sandy Beach	1100	30-40
Agonda Beach	Sandy Beach	236	90-100
Butterfly Beach	Pocket Beach	35	10-15
Palolem Beach	Sandy Beach	1600	60-75
Colamb Beach	Rocky, Shingle & Pocket Beach	100	60-75
Patnem Beach	Sandy Beach	947	50-70
Rajbag Beach	Sandy Beach	1400	60-80
Talpona Beach	Sandy Beach	1100	90-100
Galgibag Beach	Sandy Beach	1800	50-60
Xandrem Beach	Sandy and Rocky Beach	415	30-35
Ploem Beach	Sandy Beach	685	40-45

Source: Calculated by using measurement tool of Wikimapia



Pix 3 World famous Palolem beach

Palolem is the longest beach whereas the butterfly beach is the smallest beach of Canacona (Pix 3). Similarly, Agonda Beach and Talpona Beach are the widest beaches.

According to Annual Traveller's Choice Awards, Agonda beach is ranked number one in Asia each whereas, Palolem is ranked 20th best in Asia.

The coast of Canacona exhibits both rocky and sandy beaches. The colour of the sand varies from beaches to beaches it is primarily because of the parent weathered material for example a beach adjoining Xandrem has black sand which is local called as tilmati whereas the sand in Palolem beach is whitish in colour.

Sand dunes are shield areas of sand and coastal vegetation which form because of sand, constant wind capable of moving the sand and ideal place for sand to accumulate.

Sand Dunes in coastal areas are vital because they protect beaches from wear and tear and also defend inland zones from invasion of Sea and also act as obstruction to destructive forces such as wind and sea waves.

There are many small pockets along the coast of Canacona where sand dunes are found concentrated. Rajbag beach is the most prominent beach where stabilized and newer sand dunes were established. But with the starting of five star hotel, either the sand dunes were destroyed or converted into landscape garden (Pix.4).



Pix. 4 Sand Dune converted as Golf Course

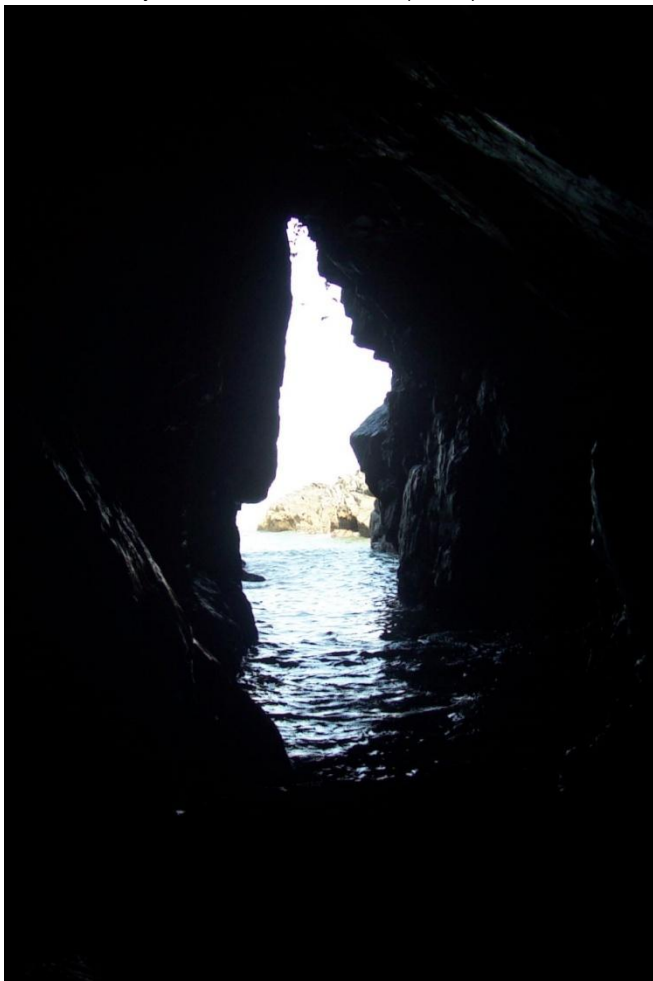
Sand Dunes:

Sea Caves:

A sea cave is formed predominantly because of the action of the sea wave. The prime process involved is in the creation of Sea Caves is erosion where sea waves attack areas of softness in the coastal cliffs.

Initially cave formation begins as a narrow crack into which sea waves infiltrate and put great pressure, cracking the rock by weight of the water and by compression of air. Similarly, weathered material (sand and rock) carried by sea waves cause extra destruction on the walls of the caves.

The coast of Canacona is manifested by a rocky sea cave. The magnificent well-developed rocky sea cave has formed near a place called Kupank-Loliem near Goa-Karnataka border. The cave is about 90 meters long is in 'L' shape. The main reason for the formation of Kupank Sea Cave is the massive erosional work carried by sea waves due to presence of dykes, intrusion of dykes into the Granitic rocks and also due to master joints found in the rocks (Pix. 5).

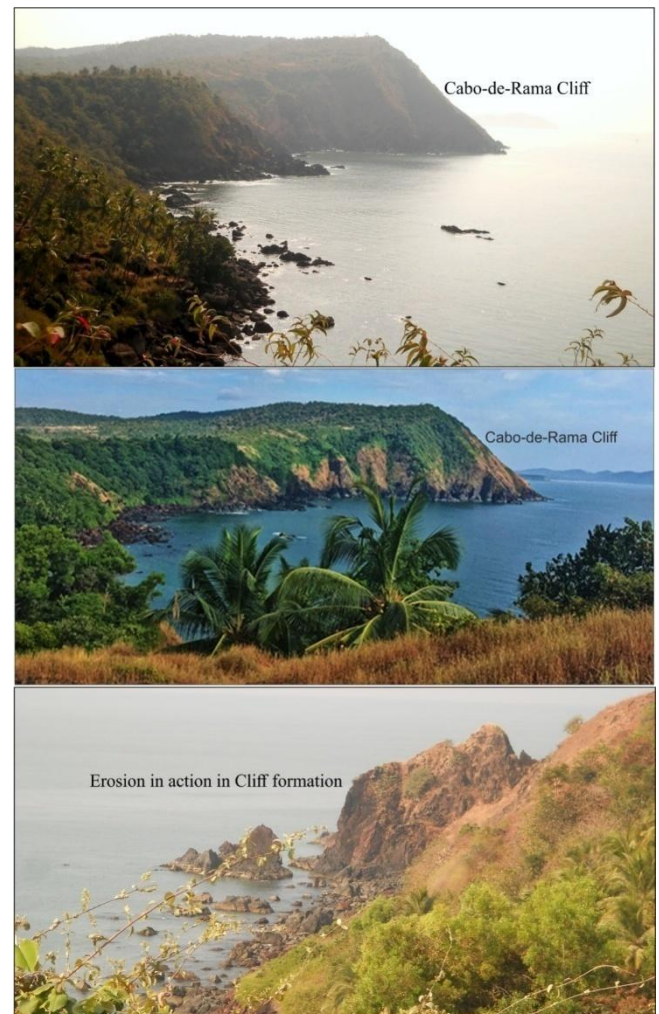


Pix. 5 Sea Cave at Kupank

Cliff or Headland and Bays:

Sea Cliffs are formed by undercutting work undertaken by sea waves leading to eventual collapse. The work of undercutting is subject to the factors such as nature, structure and types of rock, resistance of rock to erosion, and presence of cracks, joints and other weaknesses in the rocks.

The shoreline Canacona exhibits good number of Cliffs and headlands but the most prominent is Cabo-de-Rama Cliff located to the North of Canacona taluka (Pix. 6).



Pix.6 Cliff and Headlands

Spits and Bars:

Spits are prolonged sections of sand or shingles outspreading into the sea from the inland. Ordinarily, formation of spits is associated with transformation in the shoreline especially near the river mouth due to deposition of sediments transported by long-shore drift. At times, spits propagate across bays, and join headlands/cliffs. These features are known as bars.



Pix. 7 Spits and Sand Bars, Google Image

Canacona taluka is blessed with three important rivers namely, Saleri, Talpona and Galgibag. It is evident from the satellite images and field observations that these rivers have developed spits and bars and these spits and bars have become matured and grown into solid projections. It is interesting to note that river mouths are becoming narrower and if the rate of deposition continues unabated, the river mouths will be completely choked and it will have huge ramifications in this of the world (Pix. 7).

Islands:

Canacona taluka has two important Islands namely, Kanko Island and Anjadiv Islands. Kankon Island is popularly called Palolem Island is located within municipal area of Canaconataluka (Pix. 8).

Palolem Island is separated from world famous Palolem beach by a narrow channel of 80 meters. The Island is known for thick forest and is circular in shape about 315 meters long and 337 meters wide. The island can be reached by foot during low tide time.

Anjadiv Island is located near Karwar (Karnataka) about 20 kms from Goa border in the South. Anjadiv Island is a group of five islands namely, Anjadiva, Kurangal, Mudlingud, Devgad and Devargad. Anjadiv Island is popular for annual feast of Our Lady of Springs. The public is not allowed to visit this Island because it is under the possession of Indian Navy and Sea Bird.



Pix 8 Kanko/ Palolem Island

Coastal Arches:

Coastal Arches are natural openings or archs through a mass of solid rock. Natural arch are most commonly formed because of the coastal erosion. It is very interesting to note that Kupank has one the most beautiful and developed arch. This Arch is subjected to large scale erosion and weathering. Looking at it presence condition it appears that the arch may collapse any time (Pix. 9).



Pix 9 Coastal Arch at Kupank

Apart from above important coastal features the other important features includes ripples, berms, and estuarine systems.

4. Conclusion

It is evident from the above discussion that the coast of Canacona is stunning, breath-taking and ecologically fragile. From the geomorphological and geological point of view, it is highly diversified and no other coast in Goa is so rich. The coastal resources of Canacona can be utilized for the promoting of responsible tourism, adventure tourism, and sports tourism.

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