# 7 - Praias

# 7.1 Introdução

- As praias podem ser definidas como o ambiente de acumulação de areia ou cascalho na linha de costa
- Marinhas, Lacutres, Estuarinas ou Rios
- Agentes as ondas diretamente ou fluxo induzido por elas, vento
- Areia 20% da linha de costa mundo
- Cascalhos 10% (mais em altas altitudes)

# 3 Subssistemas

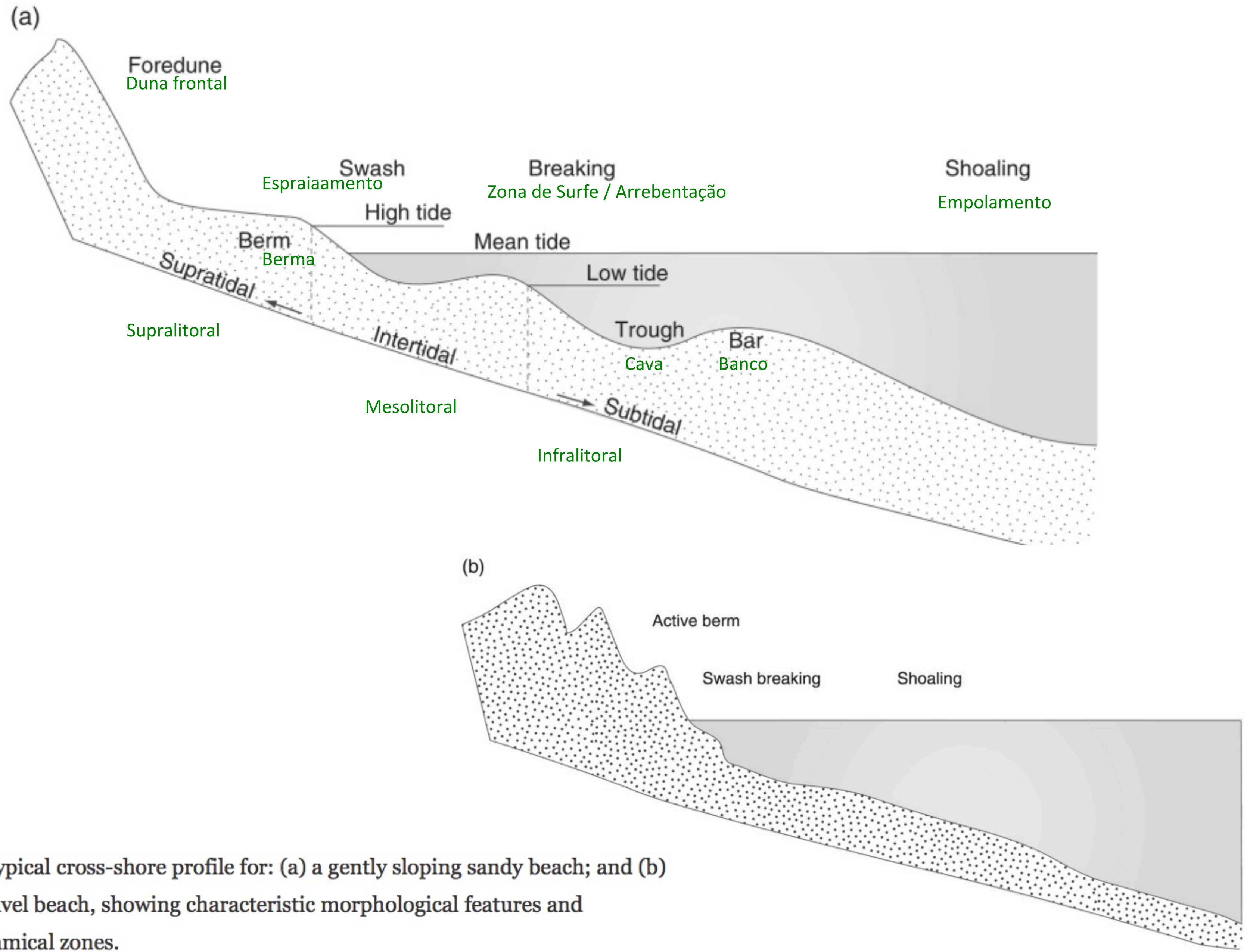
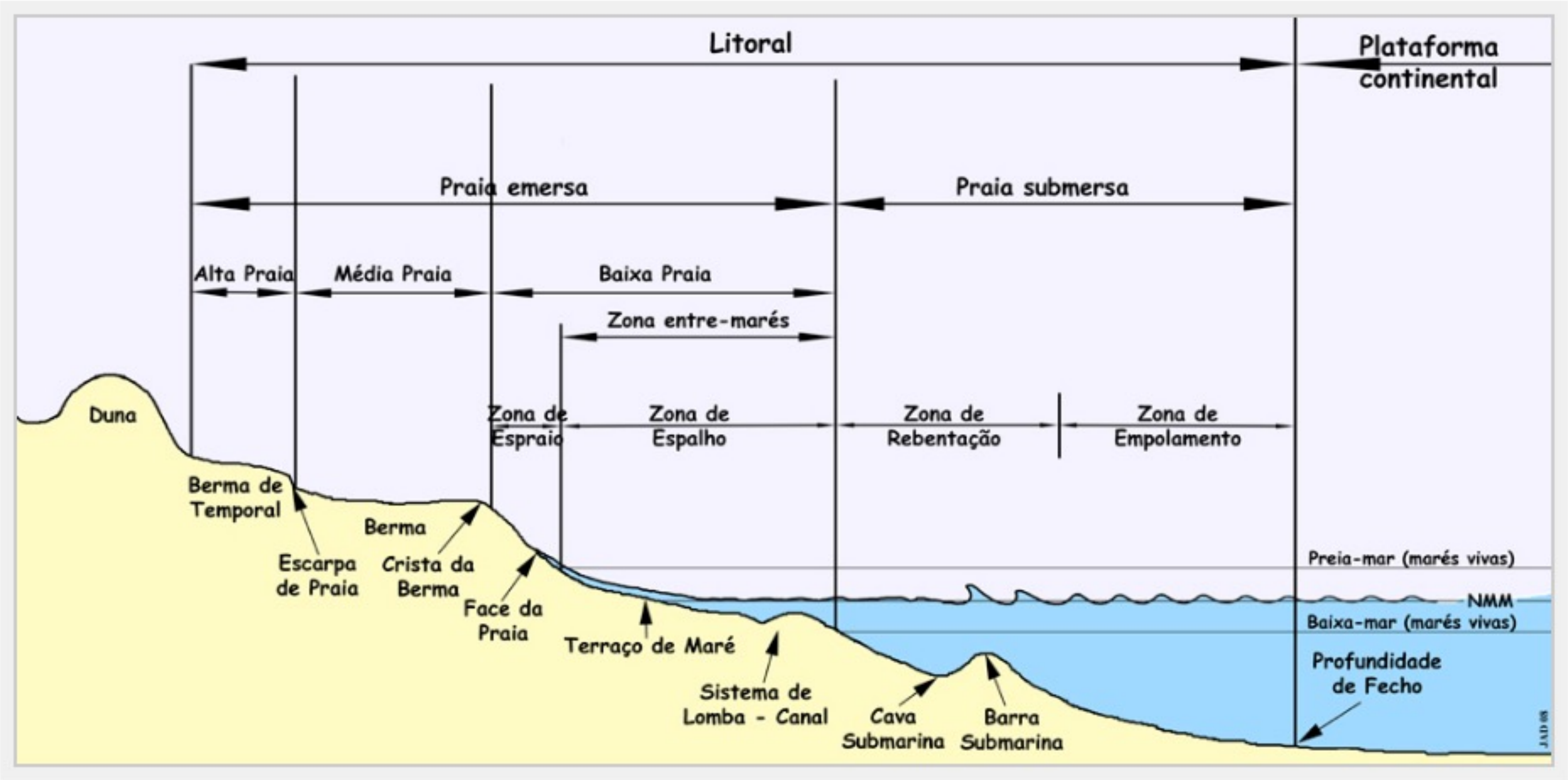



**Fig. 7.1** Typical cross-shore profile for: (a) a gently sloping sandy beach; and (b) a steep gravel beach, showing characteristic morphological features and hydrodynamical zones.




Zonas em que normalmente se divide a praia. Refira-se que a nomenclatura da praia apresenta grande variabilidade, quer na literatura científica em português, como em inglês.

http://www.aprh.pt/rgci/glossario/praia.html

# Infralitoral

- Tipicamente se estende da linha de água mais baixa até 5-10 m
- Essa é a região que se inicia desde onde a onda “sente o fundo” até a zona o final da zona de arrebentação (zona de surfe)
- O fundo pode ser simples ou conter bancos ou barras

# Mesolitoral

- Entre as marcas de maré alta e baixa
- A onda se espraia na zona de varrido
- Zona de transição entre as partes aérea e submersa
- A zona de irrupção e retorno (swash e backwash)
- Quando a altura da maré é muito alta ou as ondas “empoladas” podem ser ativas

# Supralitoral

- Esta acima da marca de maré alta até alguma marca fisiográfica: duna, falésia ou mesmo vegetação permanente
- O limite esta geralmente acima do maior varrido, com excessão de tempestades
- Essa região é dominada pelos ventos
- Em períodos de baixa atividade de ondas, pode haver a formação de uma berma

- As bermas são a primeira proteção contra ondas das dunas e falésias conta a erosão.
- Quando a erosão da berma é pronunciada, pode criar escarpas na praia

- Onde termina a praia?

- As definições são bastante variadas:

- As praias estão entre a zona mais profunda do infralitoral até a zona mais  “seca” do supralitoral
- Da zona de atrito de ondas até, por ex. A vegetação permanente

# 7.1.2 Escalas da morfologia de praias

- De pequenas ondulações (ripples) a grandes feições costeiras
- A recorrência é intrigante em 6 ordens de grandeza: cm a Km
-

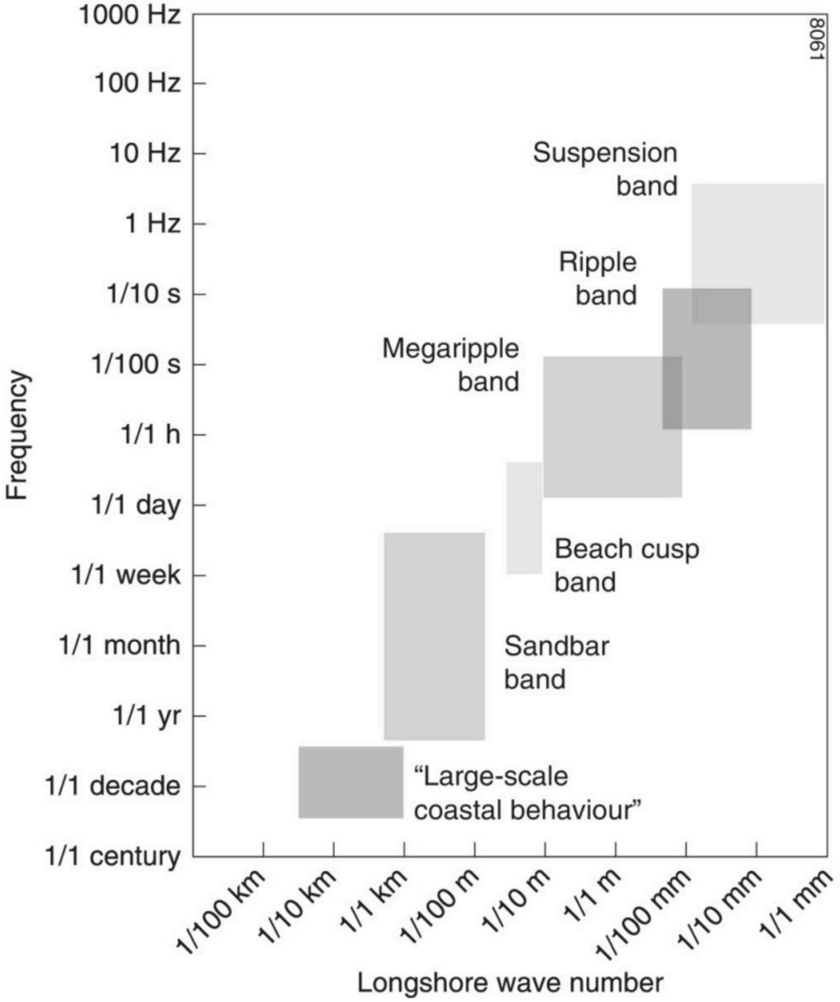



**Fig. 7.2** Temporal and spatial classification of typical beach features. Longshore wave number is the reciprocal of wavelength.


**Fig. 7.3** Examples of morphological patterns typical of sandy beaches: (a) ripples; (b) beach cusps; (c) alongshore sandbars; and (d) crescentic sandbar. The sandbars in (c) and (d) are located beneath the white high-intensity bands that are induced by the persistent wave-breaking above the sandbar crests (see Box 7.2).

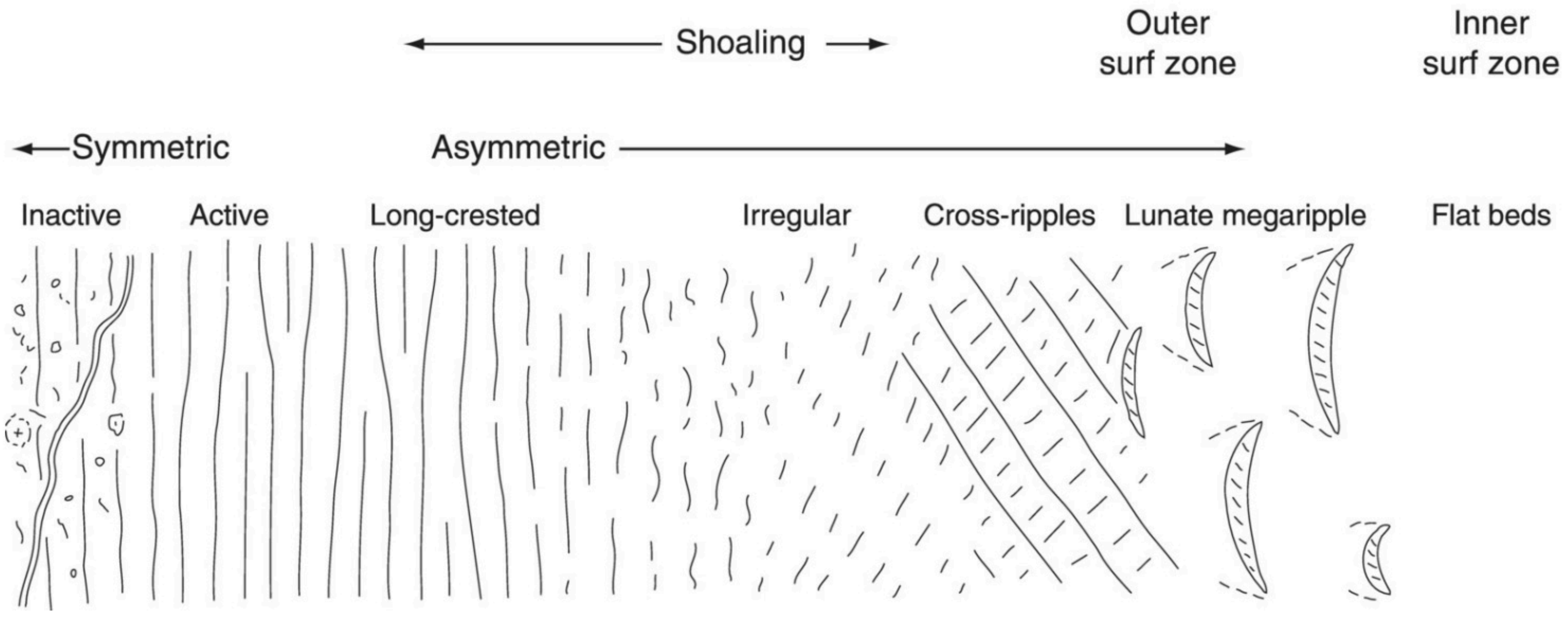
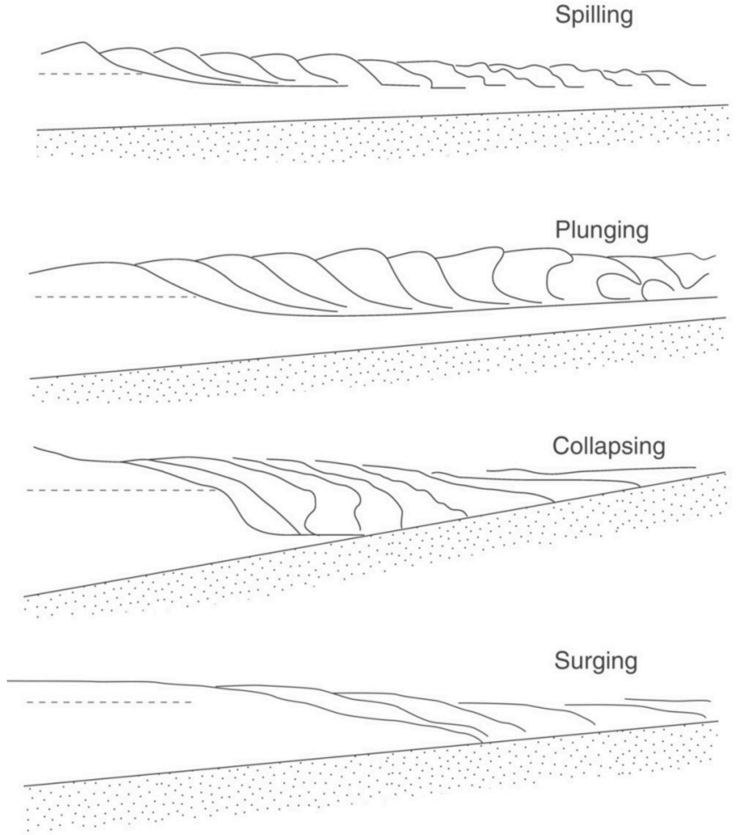



**Fig. 7.4** Cross-shore evolution of ripple types based on scuba-diver observations on planar beaches. See text for further explanation.

# 7.2.1 Tipos de arrebentação



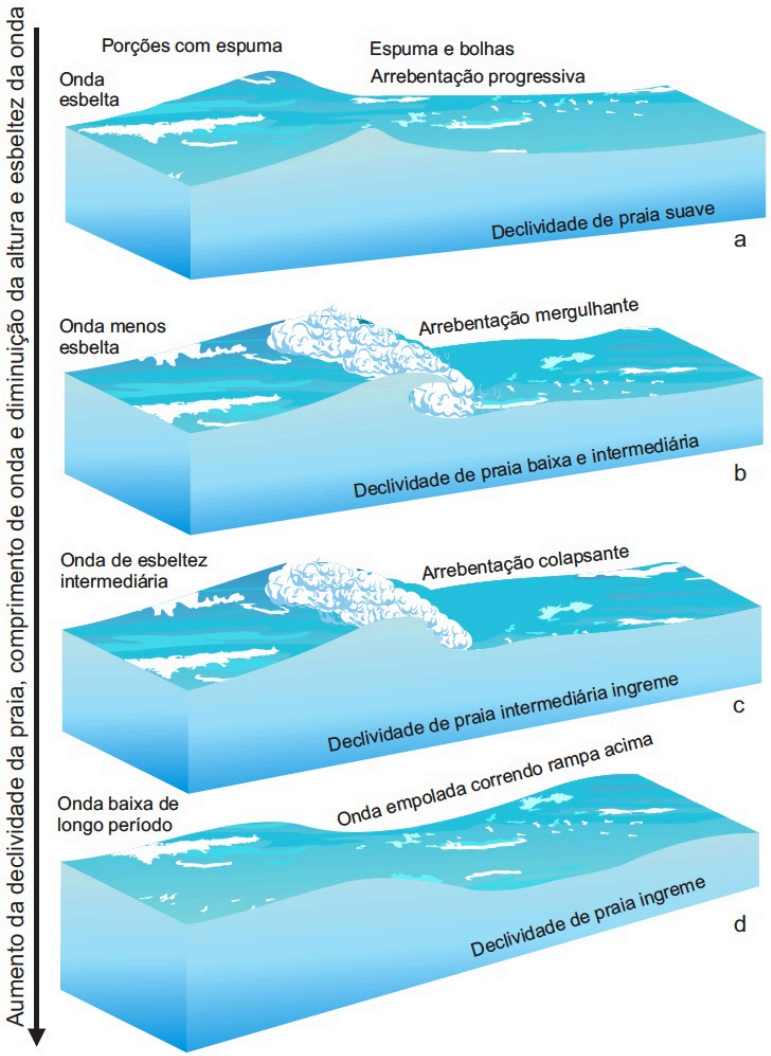
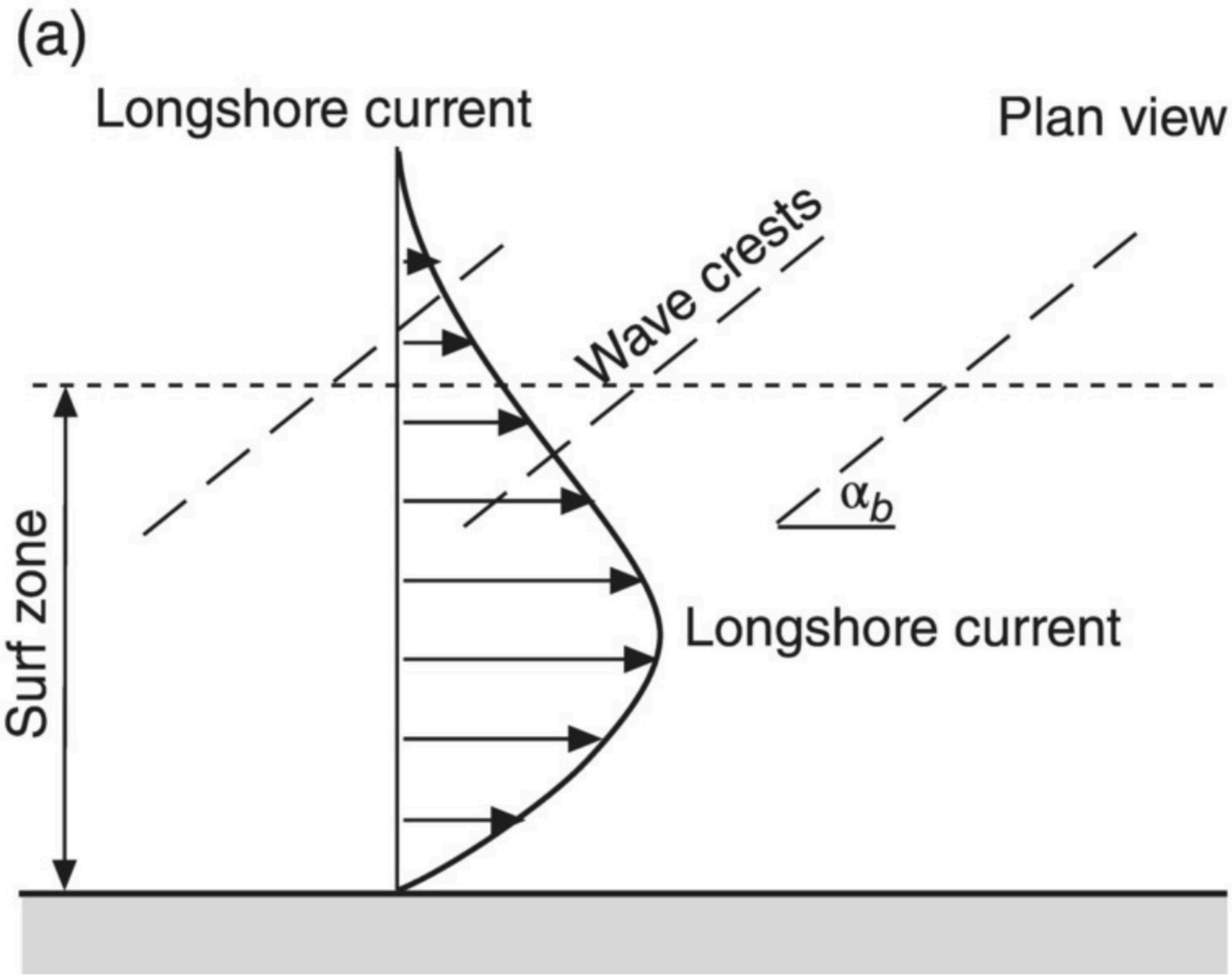




**Figura 8.18** Os quatro tipos de arrebentação (a - c) e suas relações com declividade da praia, período, altura, esbeltez e comprimento da onda. [Fonte: ALFREDINI et al., 1999].

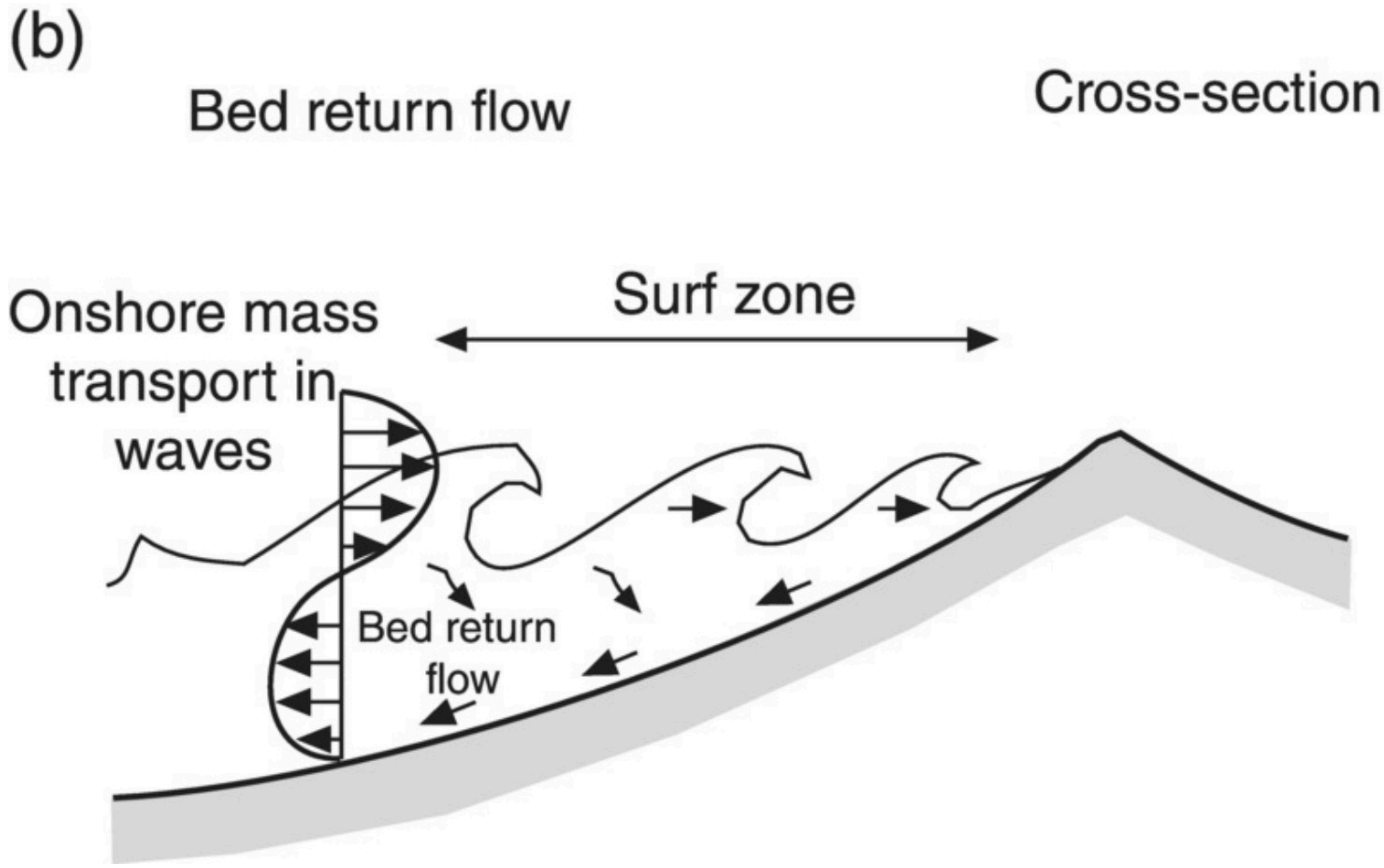
# 7.2.2 Correntes próximas a costa geradas por ondas

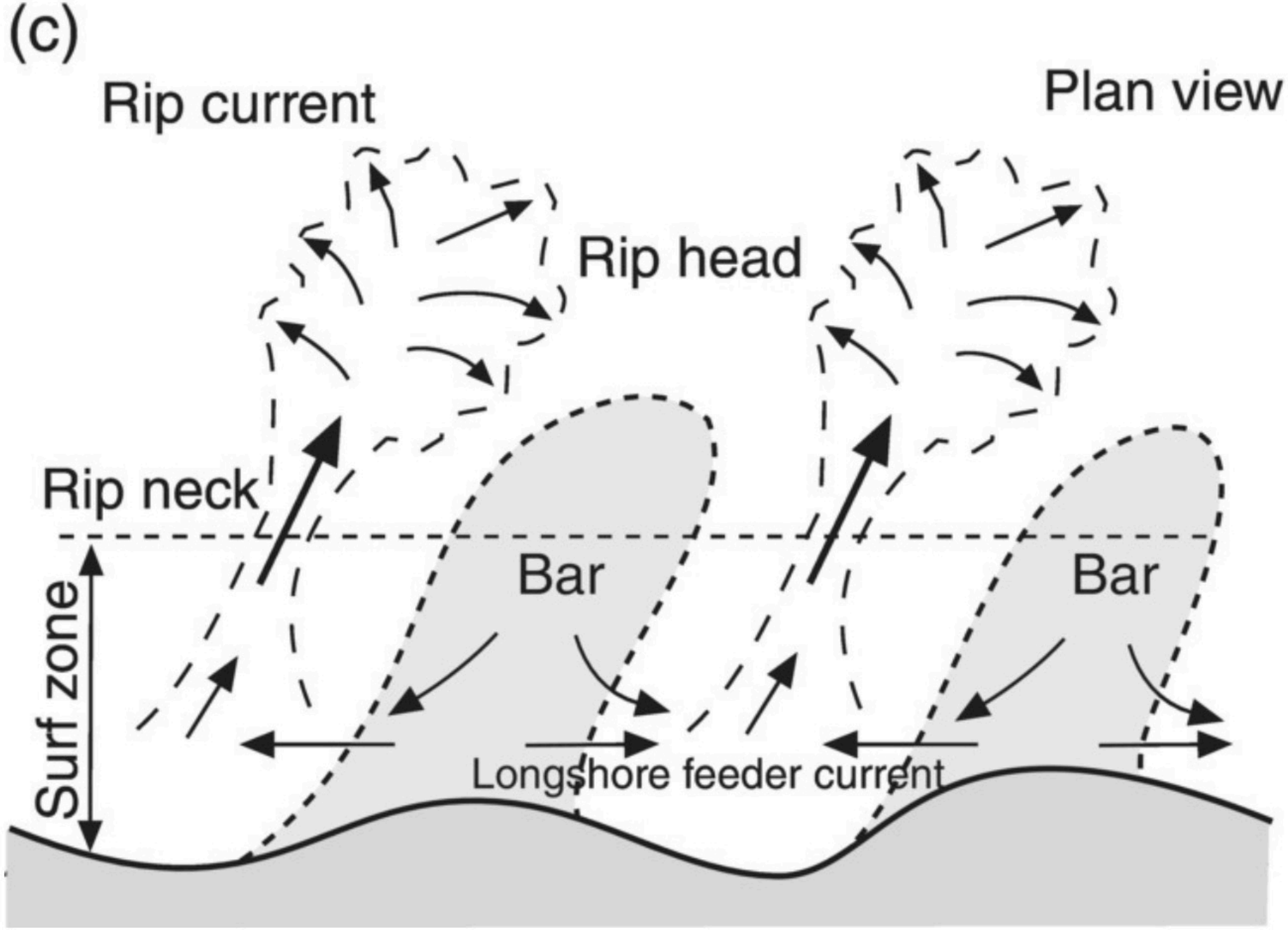
- 3 tipos:

- Longitudinais – Longshore current
- Transversais – Cross-shore current
- De retorno – Rip currents

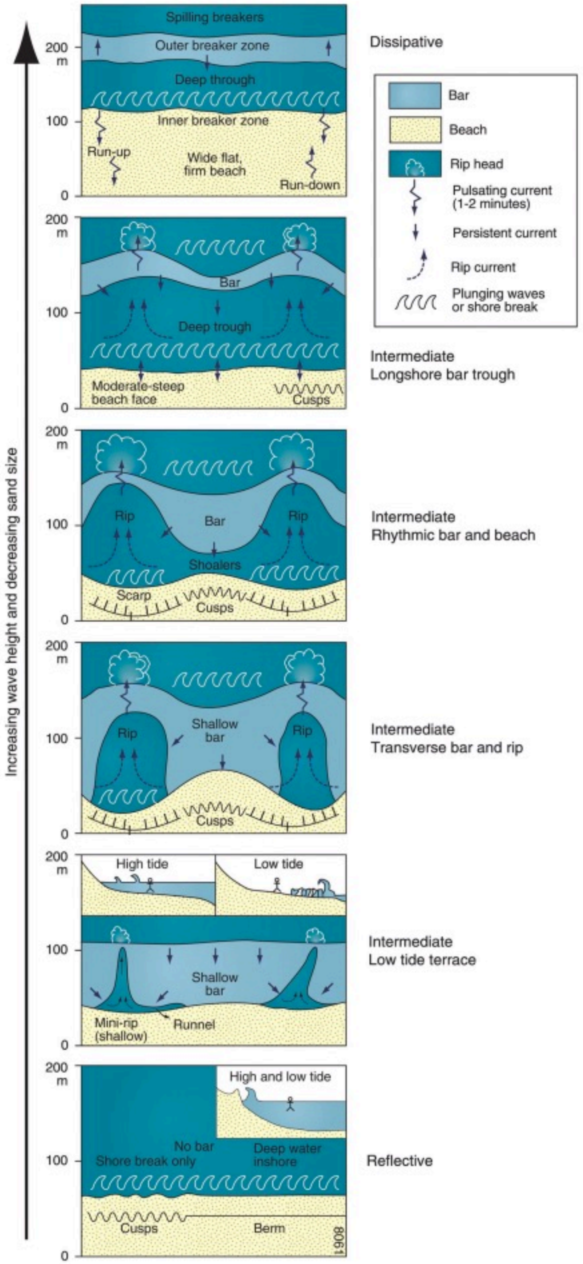


(a)
Longshore current
Plan view
Wave crests
Surf zone
αb
Longshore current


(b)
Bed return flow
Cross-section
Surf zone
Onshore mass transport in waves
Bed return flow


(c)
Rip current
Plan view
Rip head
Rip neck
Bar
Bar
Surf zone
Longshore feeder current

# Classificação de praias Morfodinâmica



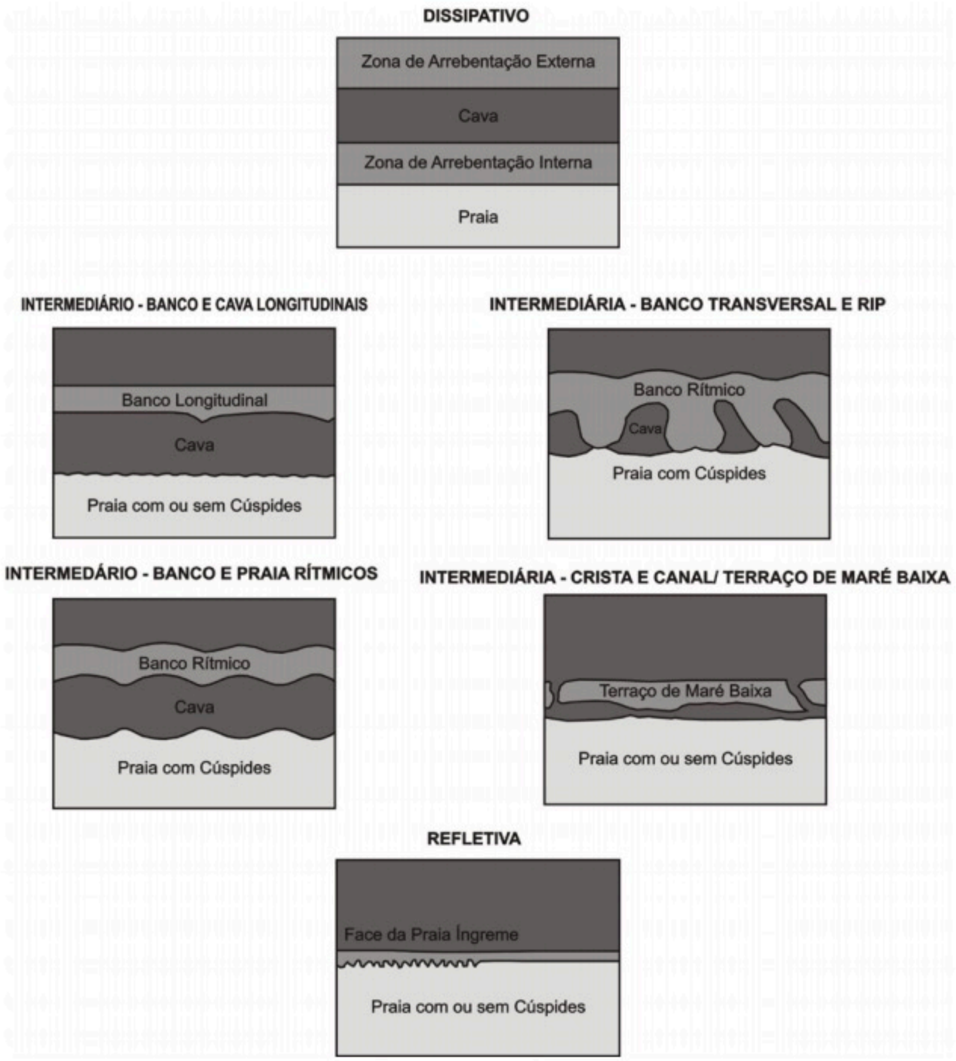



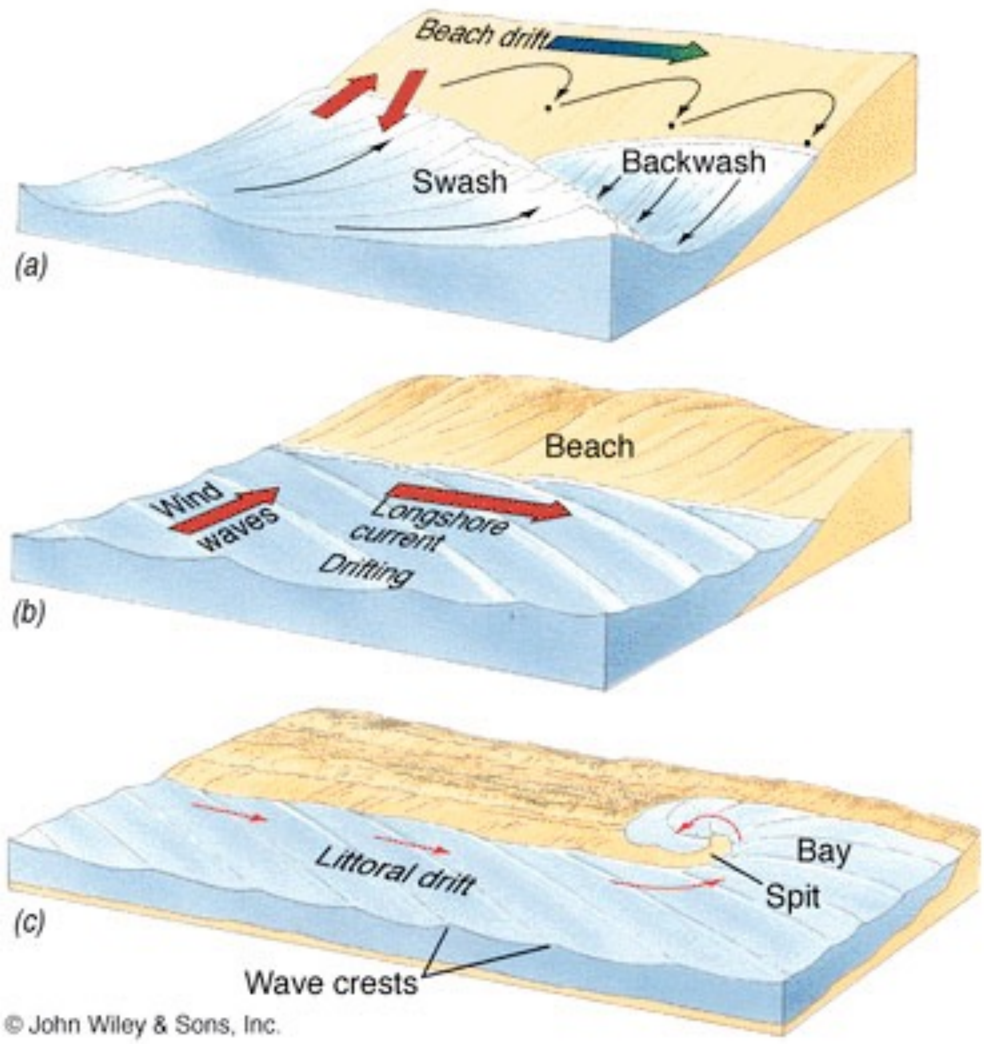

Figura 1 - Classificação morfodinâmica de praias desenvolvida por Wright e Short (1984).

**ÁREA DE ESTUDO**


Figura 2. Tipos morfodinâmicos de praias existentes no Estado de São Paulo (fotos da autora e de sobrevôos do DEPRN-SMA). **A**: Praia de Peruíbe – Dissipativa de Alta Energia; **B**: Praia de Santos: Dissipativa de Baixa Energia; **C**: Praia de Itamambuca (Ubatuba): Reflexiva de Alta Energia; **D**: Praia de Domingas Dias (Ubatuba) – Reflexiva de Baixa Energia; **E**: Praia de Maresias (São Sebastião) – Intermediária; **F**: Praia da Enseada (Guarujá) – Intermediária com tendências Dissipativas; **G**: Praia de São Pedro (Guarujá) - Intermediária com tendências Reflexivas; **H**: Praia da Enseada (São Sebastião-Caraguatatuba): Ultradissipativa (planície de maré).

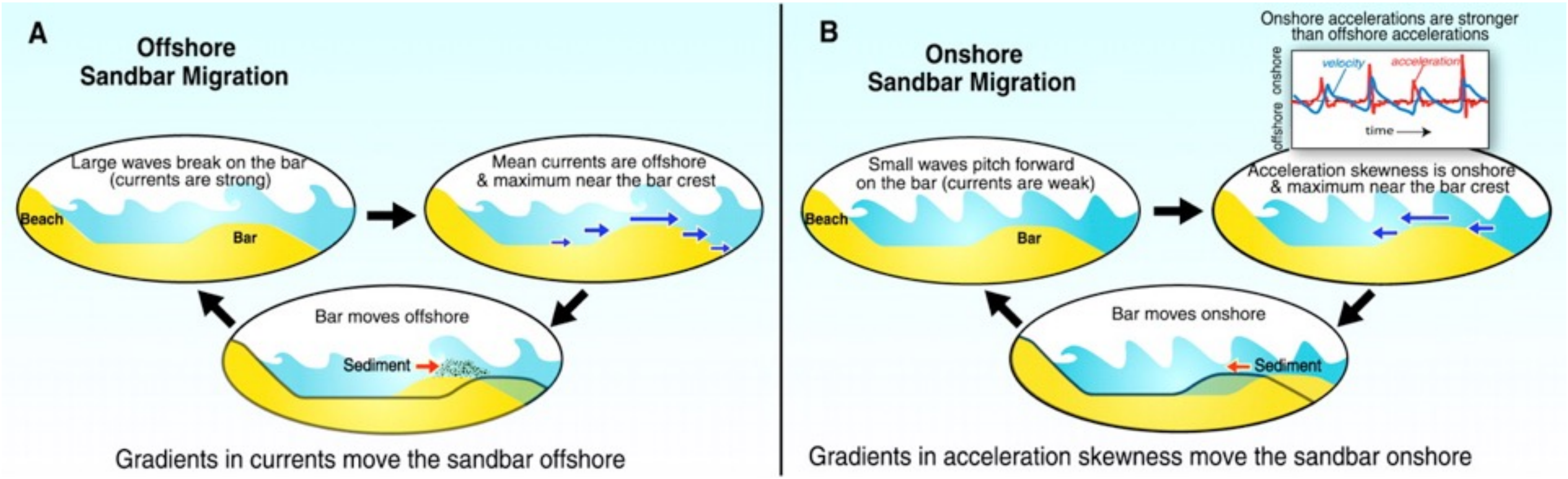
***Souza, C.R. de G. 2009. A Erosão nas Praias do Estado São Paulo: Causas, Conseqüências, Indicadores de Monitoramento e Risco. In: Bononi, V.L.R., Santos Junior, N.A. (Org.), Memórias do Conselho Cientifico da Secretaria do Meio Ambiente: A Síntese de Um Ano de Conhecimento Acumulado, pp.48-69, Instituto de Botânica – Secretaria do Meio Ambiente do Estado de São Paulo, São Paulo, SP, Brasil. (ISBN 978-85-7523-025-1).***

- Filme Praias




http://www.ux1.eiu.edu/~cfjps/1300/coasts.html

# A ação das ondas tem efeitos diversos no trasporte e deposição de sedimentos




Fernanda Hoefel, Steve Elgar *Science* 21 Mar 2003: Vol. 299, Issue 5614, pp. 1885-1887

- As praias servem para atividades múltiplas:
  - Recreação
  - Turismo
  - Conservação
  - Pesca
  - Etc.

- Quando mais que uma atividade acontece, geralmente causa conflitos

- Exemplo: construção de molhes / nevegação alteração no transporte de sedimentos erosão

Essa característica levou ao desenvolvimento de ferramentas de gestão integrada

# Em termos gerais o principal papel das praia é a proteção

- Nesse sentido, as ações são feitas de forma a preservar o estado atual das praias

- As primeiras ações foram tomadas na forma de estruturas rigidas:


1024 × 682 - gazetadopovo.com.br

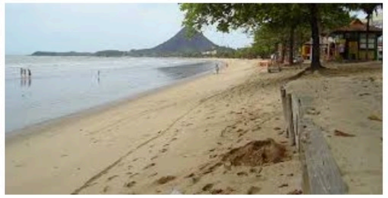





















# Esporões e quebramares
# groynes / breakwaters

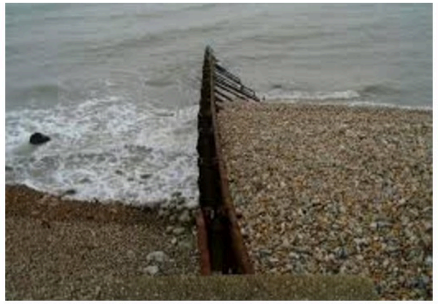
- São soluções rígidas de proteção

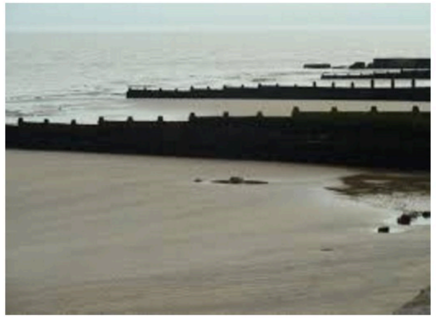




alamy stock photo

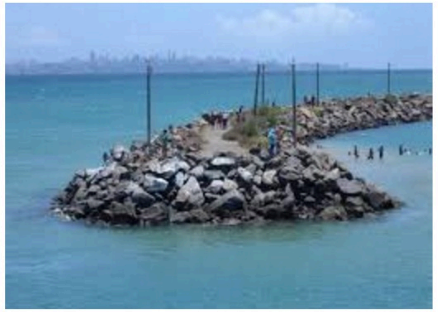
640 × 427 - glogster.com





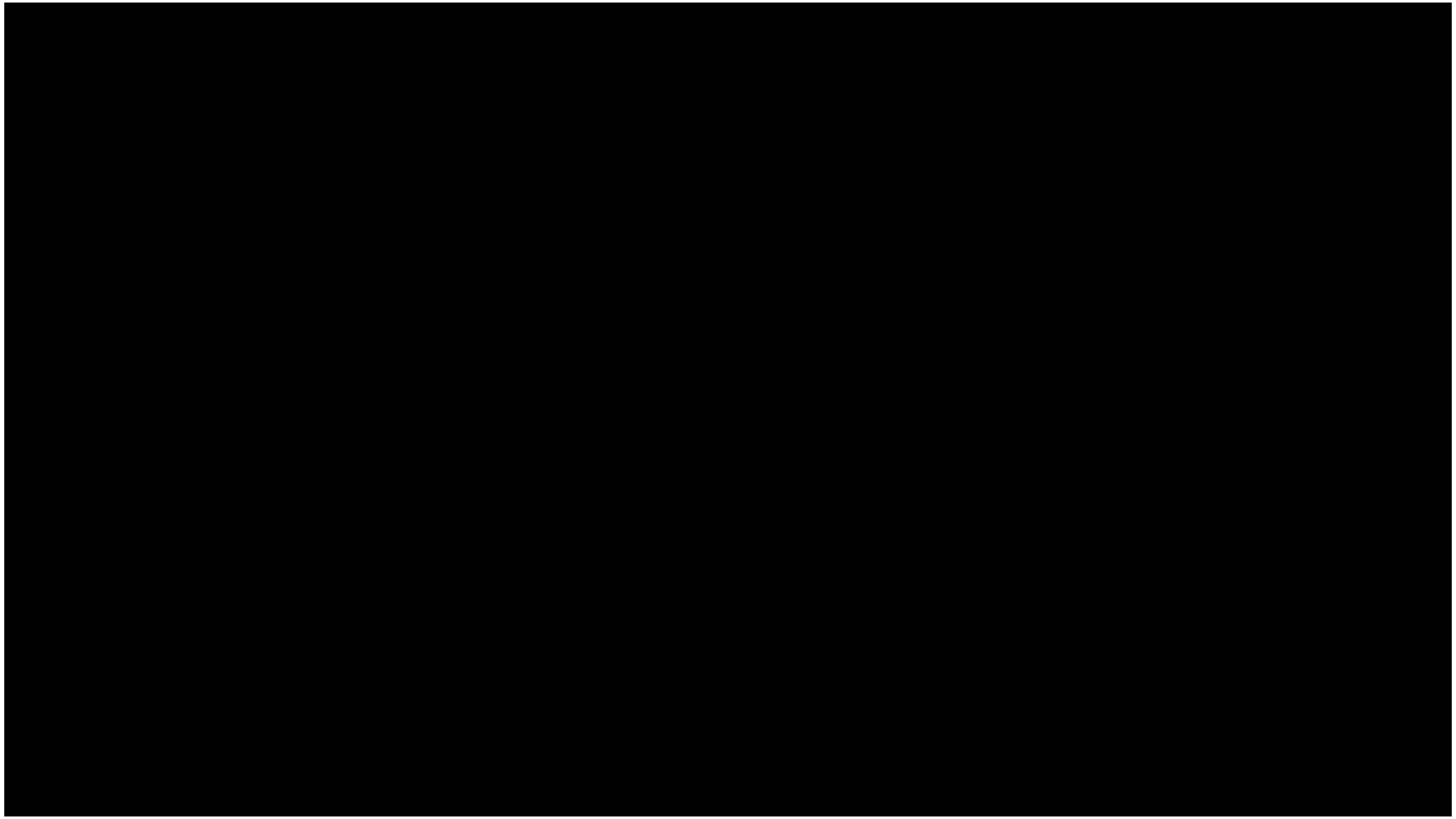








- Os esporões são feitos para reter o sedimento
- Impedem o transporte ao longo da costa
- Geralmente retém tanto sedimento que causam erosão em praias  à “jusante”
- Com o aumento do uso das praias e de seu significado, o uso dessas estruturas tem sido abandonado
- Os quebramares tem ação de proteger contra a ação de ondas



- Essas esruturas afetam de forma significativa toda a dinâmica e ecologia das praias

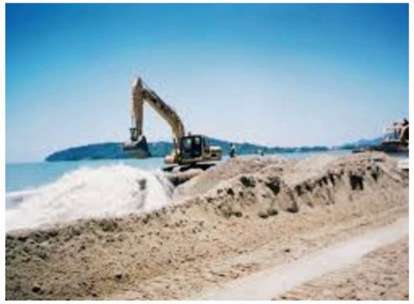
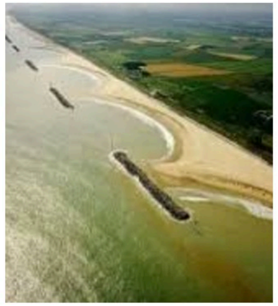
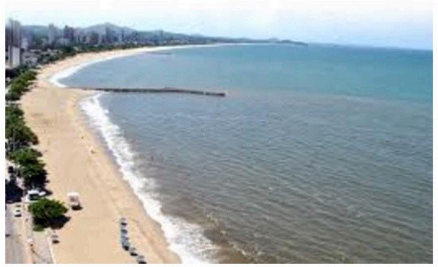
- Nos ultimos anos tens-se adotado o princípio “construindo com a natureza” building with nature

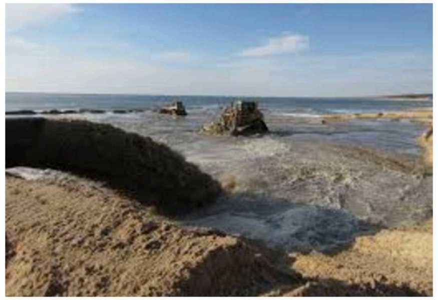
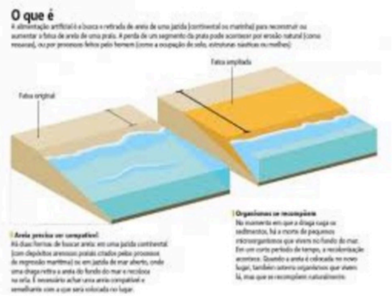
- Esse processo trata da alimentação ou engordamento da praia com sedimentos
- Como não age nos fatores, espera-se que as ondas, correntes e ventos redistribuam os sedimentos, não interrompendo o processo
- Dessa forma os sedimentos continuarão ser trasnportados sendo necessária a manutenção periódica

- Existem diversos fatores a serem observados para o engordamento, sendo o pricipal a qualidade dos sedimentos
- Geralmente se usa um sedimento ligeiramente mais grosso que o original
- Mais finos são trasnportados facilmente
- Mais grossos resultam em praias mais inclinadas

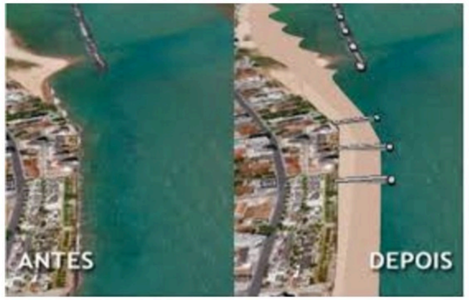
A imagem do entardecer na Praia de Copacabana é do dia 30 de maio.  O Brasil havia vencido a Costa do Marfim mantendo vivas as vãs esperanças na Copa de 2010.  Destacam-se as luzes que se acendiam, as camisetas [illegible]elas e o telão FIFA instalado na praia.



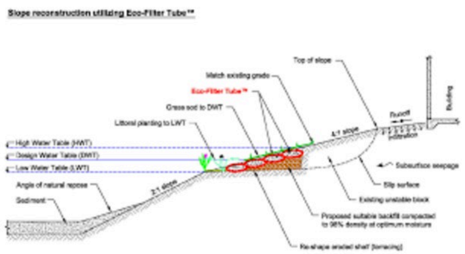




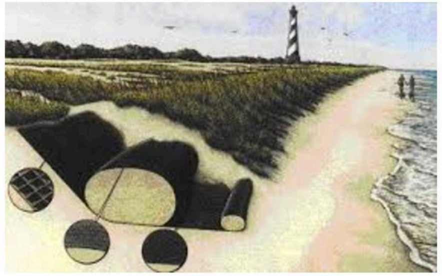

2048 × 1280 - soupraia.com


O que é



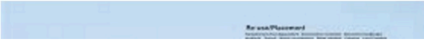

ANTES
DEPOIS

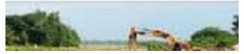
# Sea Defences

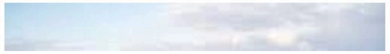

Slope reconstruction utilizing Eco-Filter Tube™
Top of slope
Match existing grade
Eco-Filter Tube™
Grass sod to DWT
Littoral planting to LWT
High Water Table (HWT)
Design Water Table (DWT)
Low Water Table (LWT)
Angle of natural repose
Sediment
2:1 slope
4:1 slope
Runoff
Building
Subsurface seepage
Slip surface
Existing unstable block
Proposed suitable backfill compacted
to 98% density at optimum moisture
Re-shape eroded shelf (terracing)




Back fill ready for sod
Existing
Shoreline
Erosion
B.E.S.T.
Reclaim your property!

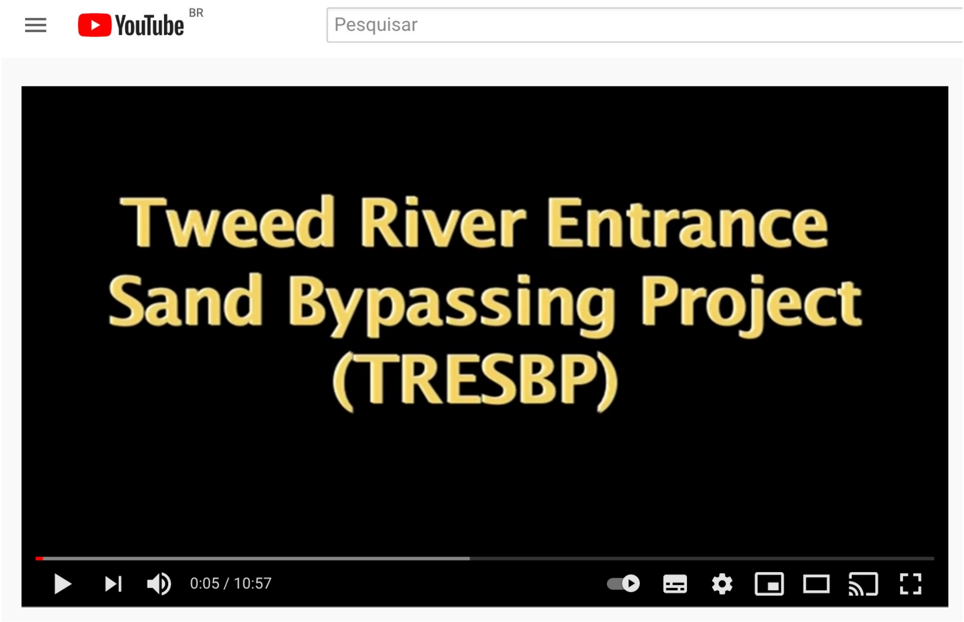







SUP

# Video youtube Tweed River Australia



# Mudanças Climáticas
# Impactos Potencias Futuros

- É esperado que mudanças climáticas afetem as condições de contorno do sistema de praias, alterando escalas temporais de curto e longo prazo

**Table 7.1** Potential first-order climate change impacts on beaches.

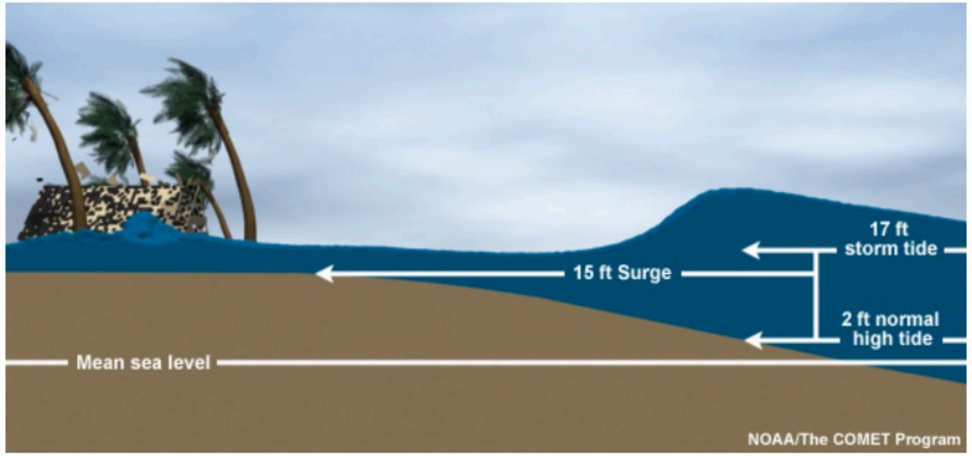
| Potential impact | Main driver |
| --- | --- |
| Permanent inundation of low-lying land and increased flood height | Sea-level rise |
| Extreme and sudden erosion and inundation due to failure of coastal defences | Sea-level rise, increasing intensity and frequency of storms, increase in storm surge |
| Coastline recession | Sea-level rise, changes in alongshore sediment transport gradients |
| Increased storm erosion | Increasing intensity and frequency of storms, increase in storm surge, changes in storm direction and wave period |

| | |
|---|---|
| Erosion/accretion due to permanent re-alignment of embayed beaches | Changes in mean offshore wave direction |
| Changes in cyclic erosion/accretion patterns at pocket beaches due to changes in El Niño Southern Oscillation (ENSO) driven beach rotation | Changes in mean and storm wave characteristics |
| Increased periodic inundation due to increased wave run-up | Sea-level rise, increasing intensity and frequency of storms, increase in storm surge |

# Introduction to Storm Surge

BOLIVAR PENINSULA IN TEXAS AFTER HURRICANE IKE (2008)

## What is Storm Surge?




**Storm surge** is an abnormal rise of water generated by a storm, over and above the predicted astronomical tide.

- It's the change in the water level

**Storm tide** is the water level rise during a storm due to the combination of storm surge and the astronomical tide.


### Inland Extent

Storm surge can penetrate well inland from the coastline. During Hurricane Ike, the surge moved inland nearly 30 miles in some locations in southeastern Texas and southwestern Louisiana.

https://www.youtube.com/watch?v=18Q8RLiLZEw

https://www.youtube.com/watch?v=XIfvVcVss7Y

# Outros Ambientes Costeiros

- Praias
- Dunas Costeiras
- Sistema de Barreiras
- Planícies de Maré e Pântanos Salgados
- Mangues
- Estuários e Canais de Marés
- Deltas
- Costas de Altas Latitudes
- Costões Rochosos
- Recifes de Corais

# Dunas Costeiras



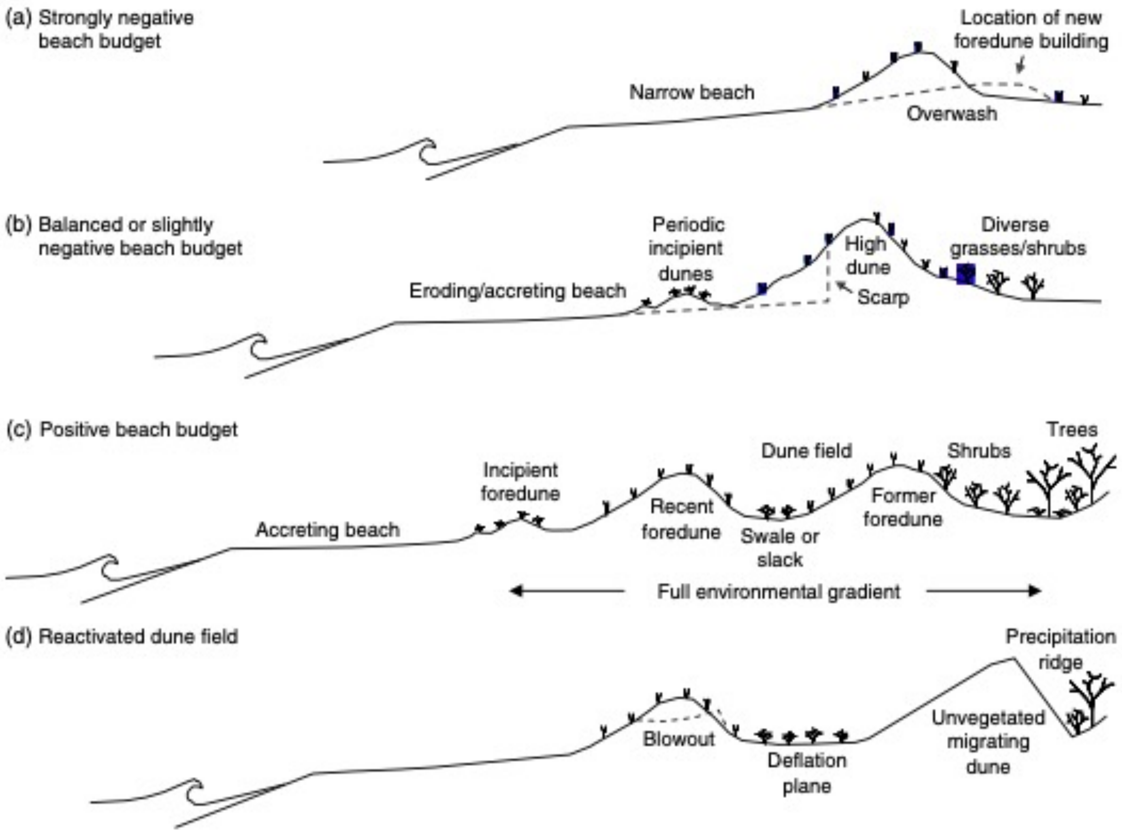



**Fig. 8.6** Scenarios for development of coastal dunes, based on beach and dune sediment budgets. (a) A narrow eroding beach leads to frequent dune erosion and overwash. New incipient dunes may form on the wrack lines delivered landward of the former crest, leading to an irregular, low and hummocky foredune that contributes to further overwash. (b) A balanced or slightly negative sediment budget leads to frequent wave erosion and scarp formation on the front of the dune followed by rebuilding by aeolian transport, resulting in a high foredune ridge. (c) Beach progradation allows new foredunes to grow seaward, leaving multiple foredune crests and intervening moister swales (or slacks) with different habitat value. Wide dune fields can be characterized by a complete environmental gradient, from the few species that can survive the stresses on the beach to the species-rich environment farther landward where trees can also survive. (d) A dune field can also be reactivated due to loss of stabilizing vegetation. The former dune surface can be deflated down to the water table, and an unvegetated ridge can migrate into adjacent areas, including developed lands. (Source: Adapted from Nickling and Davidson-Arnott 1990.)

# Sistemas de Barreiras

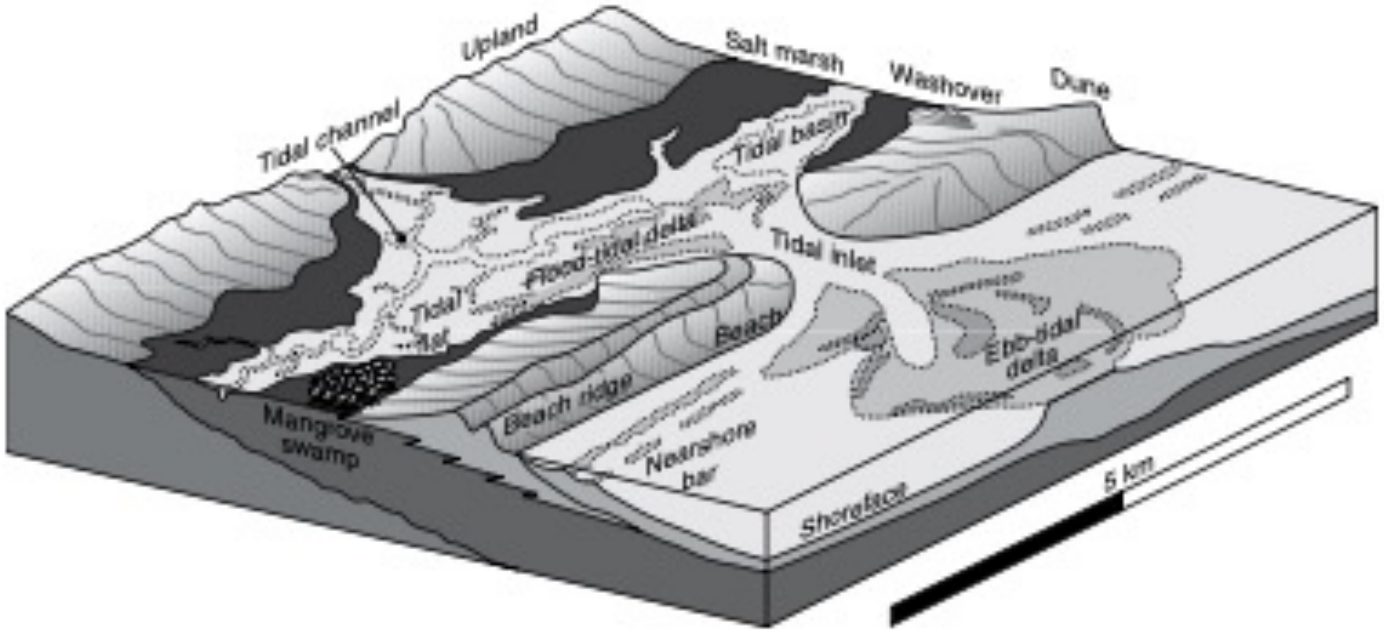



**Fig. 9.8** Barrier-system sub-environments. Open-marine elements include the shoreface, ebb-tidal deltas and nearshore bars. Back-barrier elements include flood-tidal deltas, tidal flats and channels, tidal basins, marshes and mangrove swamps. They are separated by the barrier proper, which consists of beaches, beach ridges, dunes and washovers. Tidal inlets may connect the open-marine and back-barrier sub-environments. All elements occupy set positions relative to each other, and show consistent morphodynamic inter-relationships. The cross-shore succession of morphosedimentary sub-units is termed a 'coastal tract' (Source: Cowell et al. 2003a). Scale is approximate.

# Planície de Marés e Pântanos Salgados

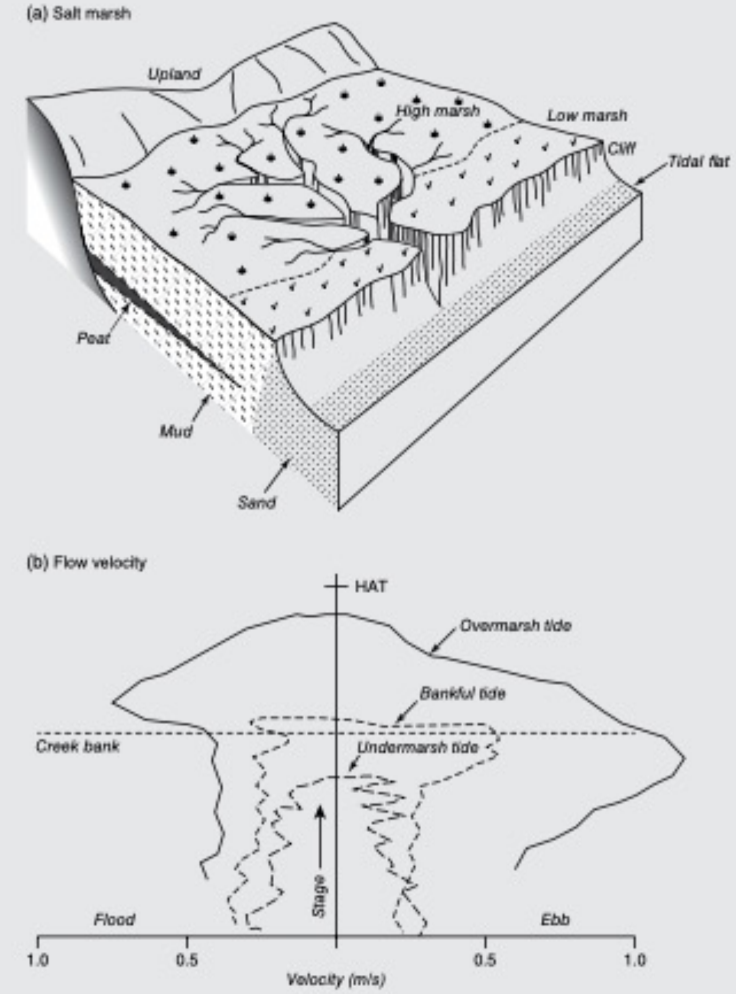



Fig. 10.5 Schematic illustration of tidal-creek system, showing: (a) a dendritic creek network traversing a marsh; and (b) the flow velocities during tides that do not overtop the banks (undermarsh), reach the banks (bankfull), and overtop them (overmarsh). Flow velocities illustrated with respect to highest astronomical tide (HAT). (Source: Adapted from Woodroffe 2003. Reproduced with permission of Cambridge University Press.)

# Mangues

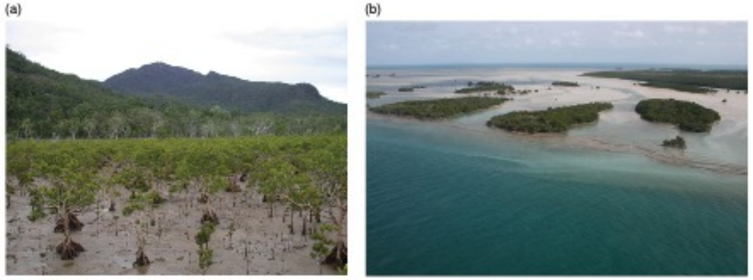



Fig. 11.7 (a) Scrub mangrove setting – a stand of *Ceriops* in Hinchinbrook Channel, northern Queensland, Australia, in which individual tree growth is stunted. (b) Carbonate settings – mangroves are not limited to muddy continental shorelines, but also occur in carbonate environments. These mangroves have developed on a reef platform in Torres Strait, Australia. (Source: Photographs by (a) Catherine Lovelock and (b) Javier Leon.) For colour details, please see Plate 26.

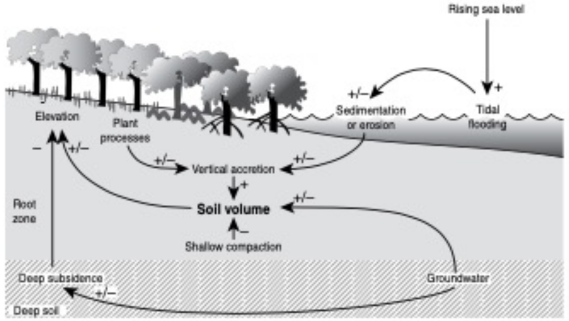



Fig. 11.8 Morphodynamic feedbacks on sedimentation in mangrove ecosystems. Relatively few studies have examined the contribution from organic and inorganic sediments, and the nature of the feedback, including the autocompaction of sediments. Many of these processes are likely to reflect the complexities that have been demonstrated for salt-marsh systems (see Chapter 10), but there have been fewer studies in mangrove forests. (Source: Adapted from Cahoon et al. 1999 with permission from Springer Science+Business Media B.V.)

# Estuários e Canais de Marés

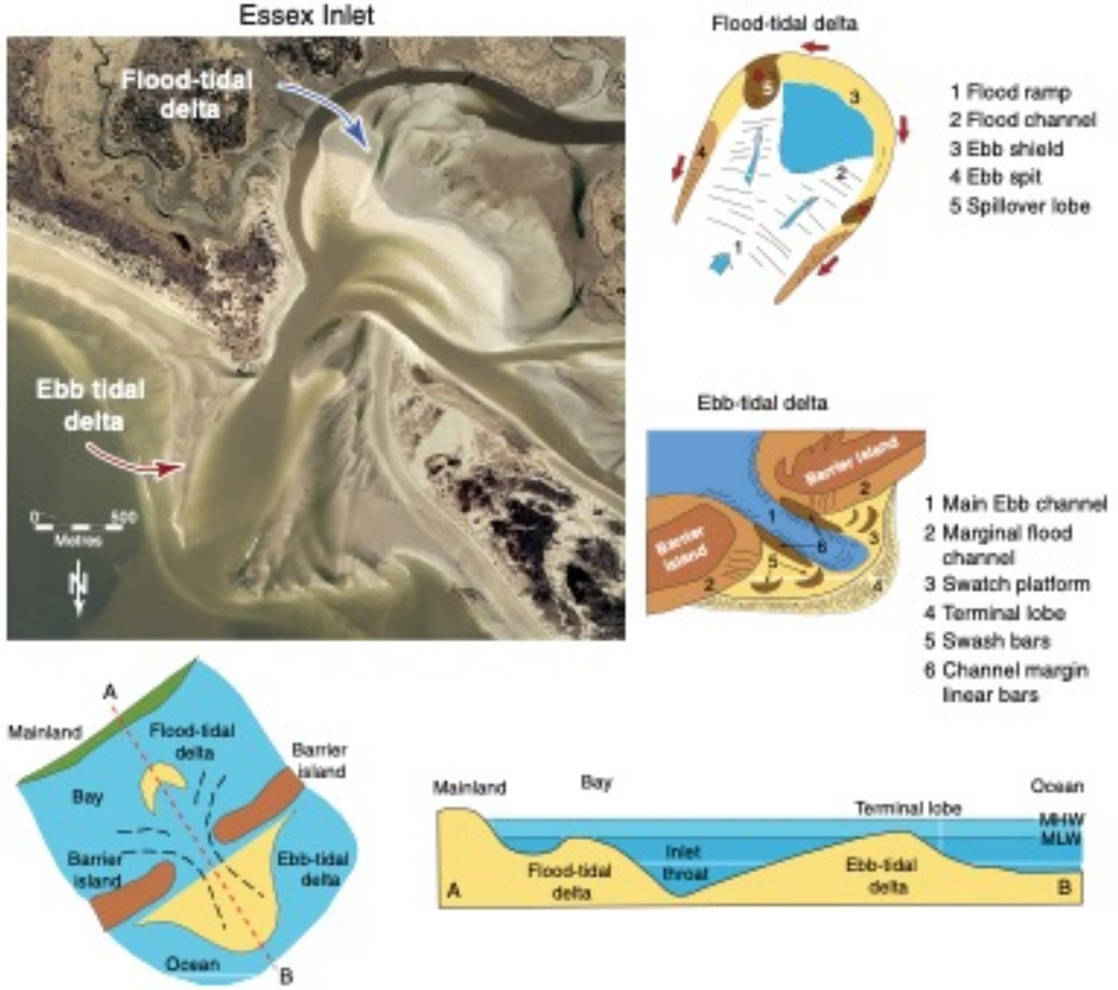



**Fig. 12.8** Ebb- and flood-tidal models. Aerial photograph of Essex Inlet, Massachusetts, USA. MHW, mean high water, MLW, mean low water. (Source: Hayes 1979. Photograph: FitzGerald 1996.) For colour details, please see Plate 29.

# Deltas



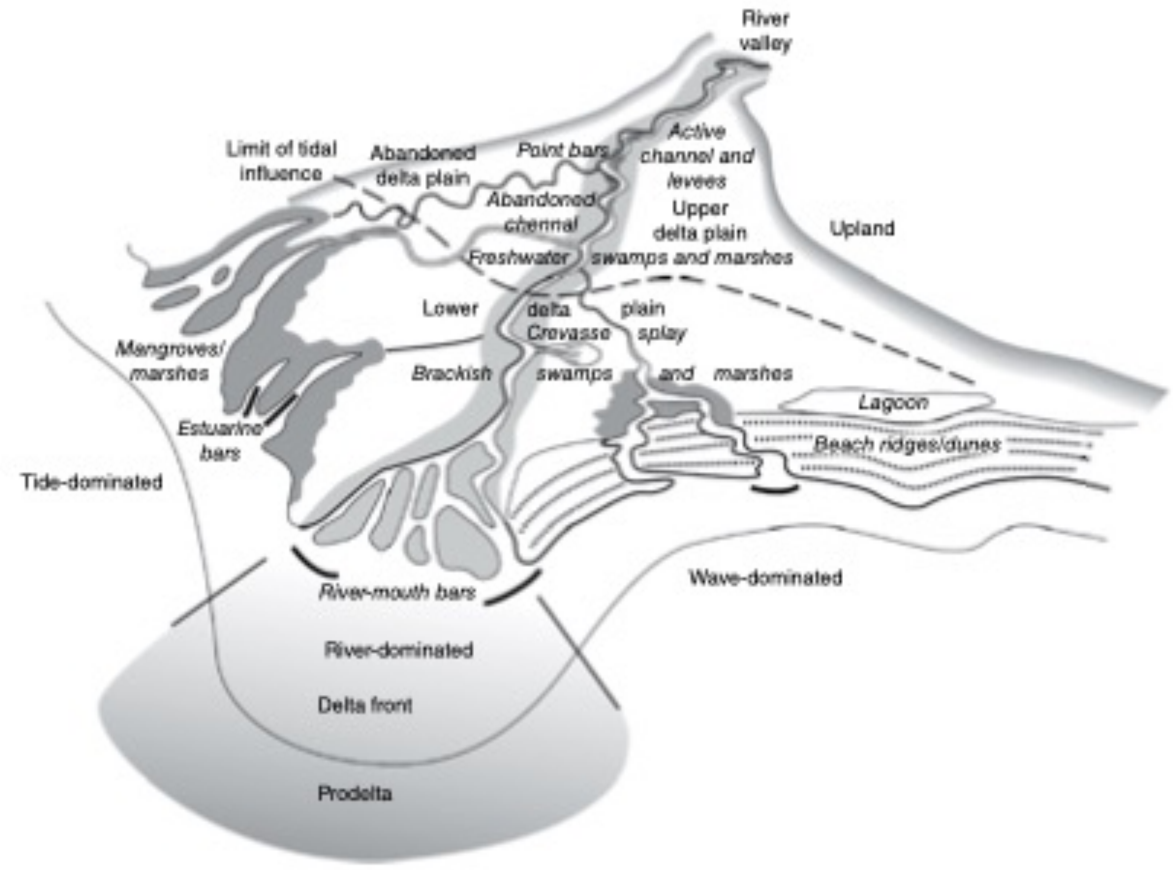



Fig. 13.7 Schematic synthesis of most features typical of subaerial deltas.

# Costas de Altas Latitudes

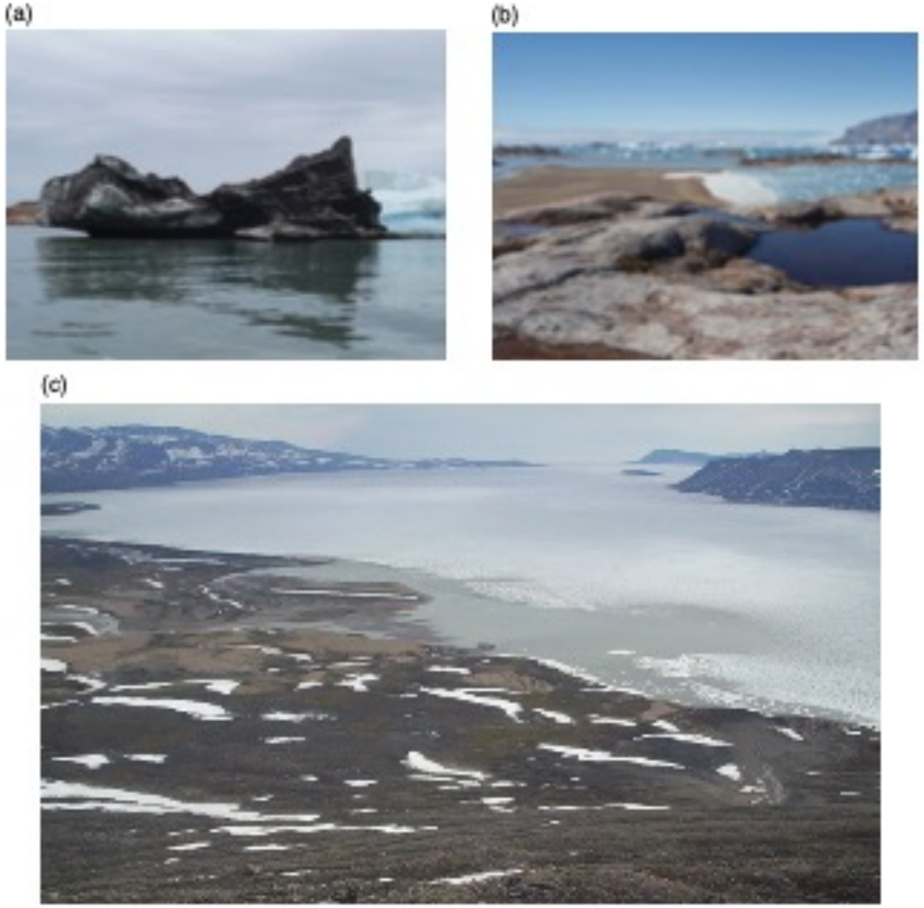



Fig. 14.5 (a) Sediment transport through drifting ice (icebergs) in the Sermilik fjord, southeast Greenland. (b) Slush ice on a beach and icebergs in a fjord. (c) Fluvial discharge and sediment delivery into a fjord during the break-up of the ice in early summer, Young Sound, northeast Greenland (26 June 2010). (Source: Day 178, 2010, GeoBasis Zackenberg.)

# Costões Rochosos

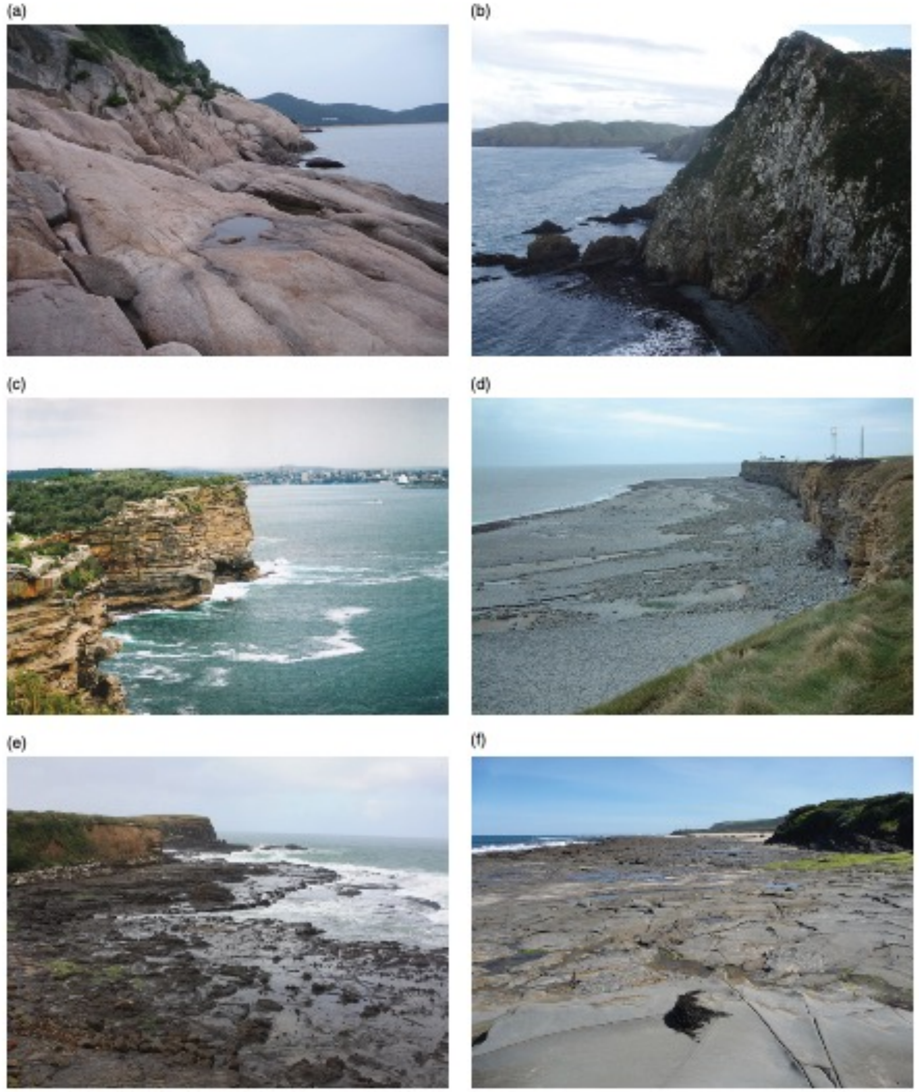



Fig. 15.2 Variety of rock coast morphologies in differing geological settings and rock types: (a) granitic coast, Putuo Island, East China; (b) cliff in greywacke sandstone, Catlins Coast, southeast coast South Island, New Zealand; (c) sandstone plunging cliff, Sydney Harbour, Australia; (d) sloping shore platform developed in Blue Lias limestone, Glamorgan Heritage Coast, South Wales, UK; (e) horizontal shore platform developed in Jurassic sandstone, Curio Bay, Southland, New Zealand; (f) horizontal platform developed in greywacke sandstone, Victoria, southeastern Australia; (g) sloping platform developed in mudstone with inactive sea cliff behind, Kaikoura Peninsula, South Island, New Zealand; and (h) cliff developed in consolidated glacial till, Lake Pukaki, South Island, New Zealand. (Source: Photographs by Wayne Stephenson.) For colour details, please see Plate 37.

# Recifes Coralinos

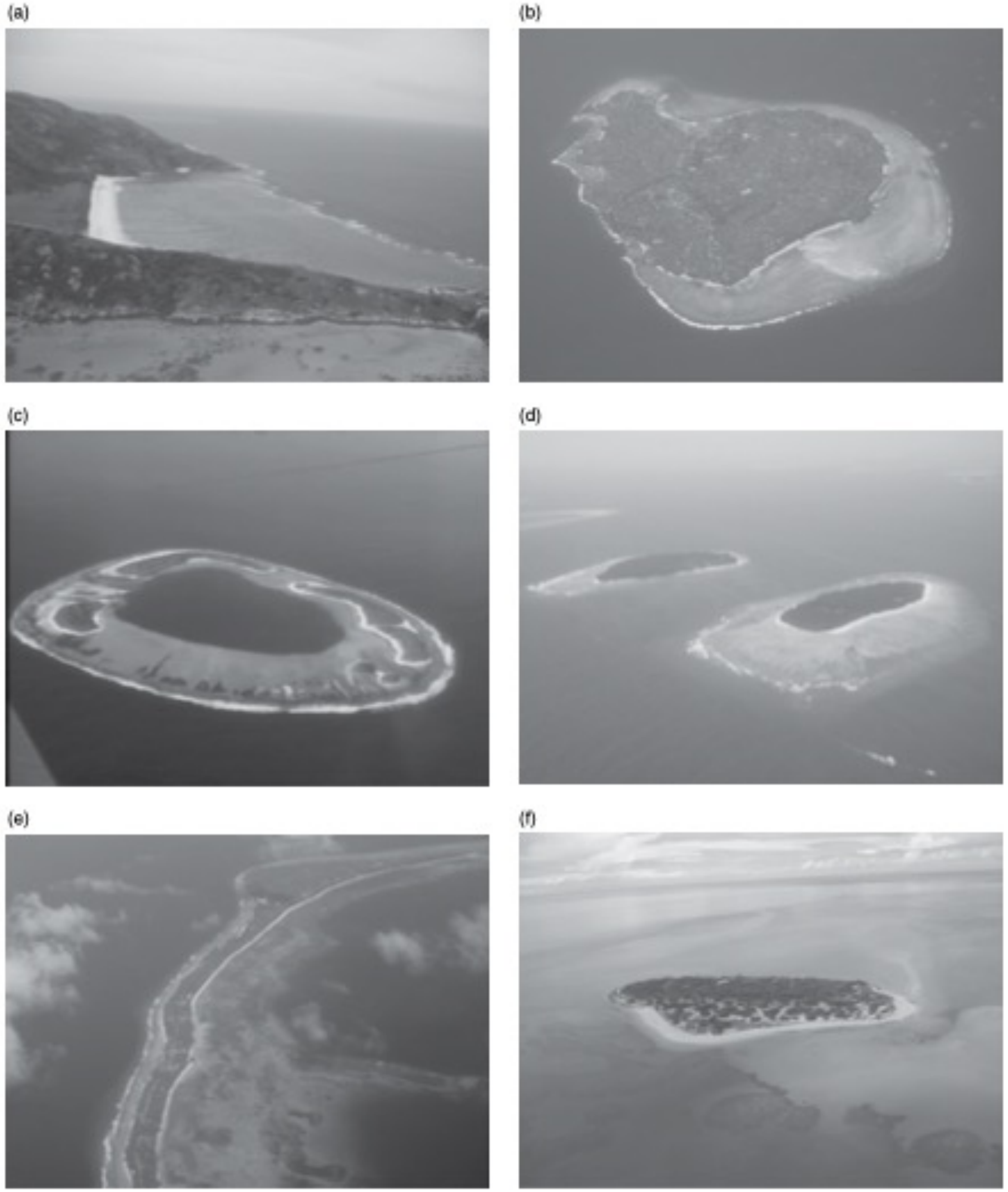
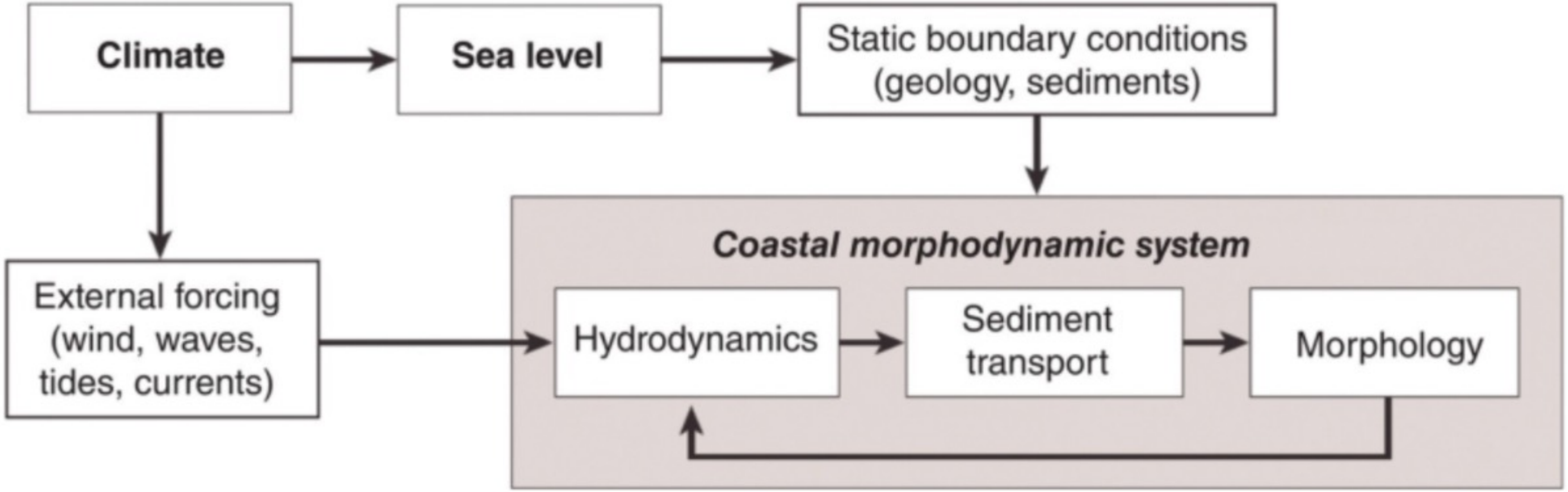



Fig. 16.2 Examples of coral reef landforms: (a) fringing reef, Great Barrier Reef (GBR), Australia; (b) fringing and barrier reefs around a high island in southern Japan; (c) mid-Pacific atoll; (d) reef platforms with platform islands, Maldives; (e) linear atoll island, Majuro atoll, Marshall Islands; (f) reef platform island, GBR, Australia; (g) productive forereef zone, Nadi Bay, Fiji; and (h) emergent reef flat, Jeh Island, Republic of Marshall Islands. (Source: (a, f, g, h) Paul Kench. (b–e) Kench 2013.)


Climate
Sea level
Static boundary conditions (geology, sediments)
External forcing (wind, waves, tides, currents)
Coastal morphodynamic system
Hydrodynamics
Sediment transport
Morphology