

SISTEMAS EÓLICOS - DESERTOS

1 - Generalidades

- Vento: agente segregador efetivo:
 - depósitos: predomínio de areia
composição uniforme
- Reconhecimento:
 - grandes unidades eólicas: relativamente fácil.
 - áreas eólicas subsidiárias a outros sistemas (ilhas barreira):
preservação rara, reconhecimento difícil.
- Principais características:
 - estratificação cruzada de grande escala;
 - poucos fósseis (exceto nos Loess);
 - grãos foscos;
 - razão grãos/matriz alta;
 - seleção muito boa;
 - bom arredondamento;
 - minerais micáceos ausentes;
 - agentes cimentantes químicos;
 - conglomerados raros.
- Estruturas sedimentares:
 - estratificações cruzadas de grande escala (30m).

2 - Desertos

- Acumulações importantes de depósitos eólicos tropicais.
- $R \text{ precipitação} < R \text{ evaporação}$.
- Origem: razões meteorológicas (faixas de alta e baixa pressão).

- **Precipitação de chuva:**

- distúrbios meteorológicos originados fora dos desertos
- frequência variável: 1/10 anos; 1/50 anos
- chuvas torrenciais: sedimentos transportados em cursos temporários
- (WADIS)

- **Geomorfologia e ambientes sedimentares:**

- leques aluviais e correntes efêmeras (wadis)
- sabkhas interiores-playas
- mares de areia (Ergs)

Fig. 15.31, 15.34

T-5; Figs. 300; 302

3 – Processos sedimentares:

- **Erosão:** alteração química.
esfoliação (Δt)
abrasão

- **Deflação:** depósito residual grosso = deserto rochoso:

SERIR ou REG.
ventifactos

Fig. 305; 4.28

4 – Transporte eólico:

- **Sedimentos secos**

- argila (<0,15 mm) – suspensão – Loess
- fração areia: até 1 mm – saltação (1,5m acima solo)
- 2 mm – rolamento
- 5 mm – rastejamento

Fig. 1.12↑

5 – Depósitos eólicos:

- Dunas
 - Zonas inter-dunas
 - Lençóis de areia
 - Dunas
- } depósitos de baixo ângulo

- suprimento + decréscimo velocidade do vento
- carga em saltação
- tipos de dunas: (f) suprimento

constância dos ventos
velocidade dos ventos

15↑ Fig. 5.9 – 5.10

- Depósitos de baixo ângulo

- carga de arrasto
- partículas em saltação aprisionadas

Fig. 10.7

6 – Processos / Estruturas sedimentares:

- Duna

Fig. 10

- Processos / Feições geradas

- laminação paralela
- laminação cavalgante
- laminação por queda de grãos (suspensão)
- laminação por fluxo de grãos (avalanche)

Fig. 11

Fig. 2.22

7 – Precipitados químicos:

Fig. 3; 33

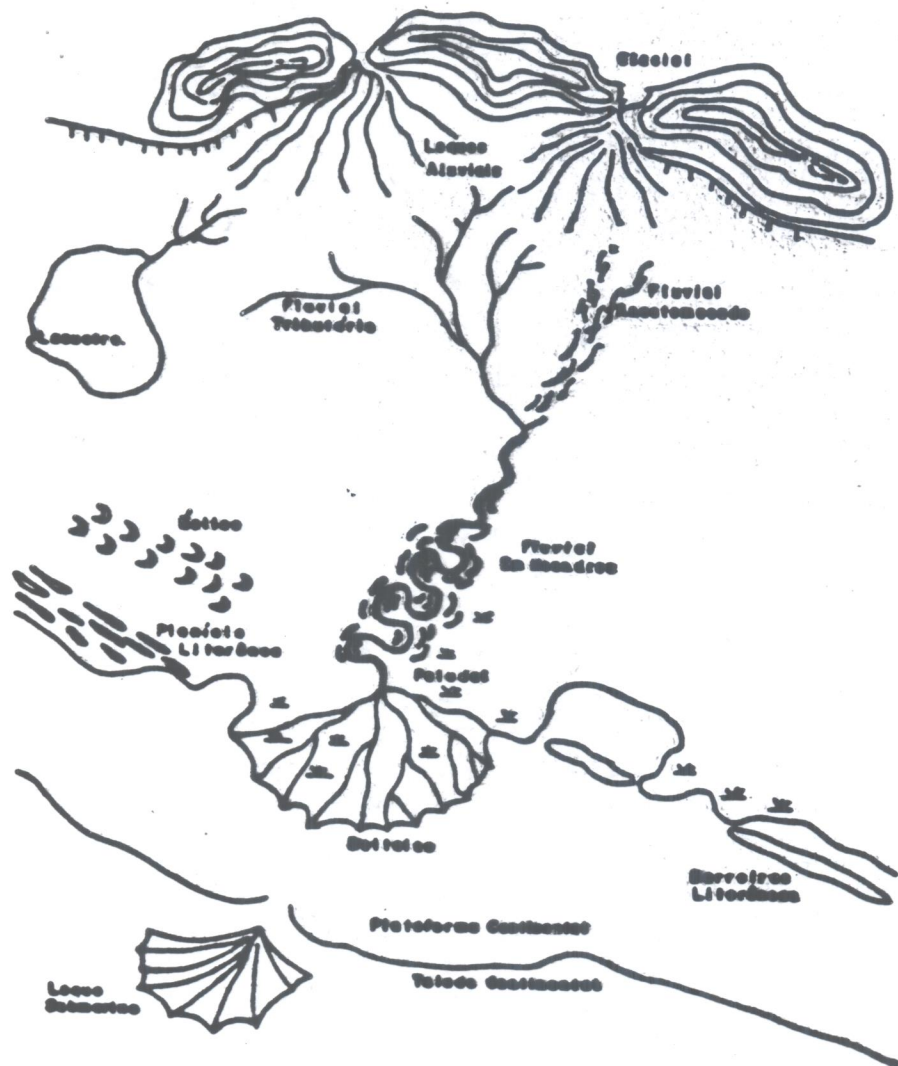
8 – Critérios para reconhecimento de depósitos eólicos:

- **Características:** ■

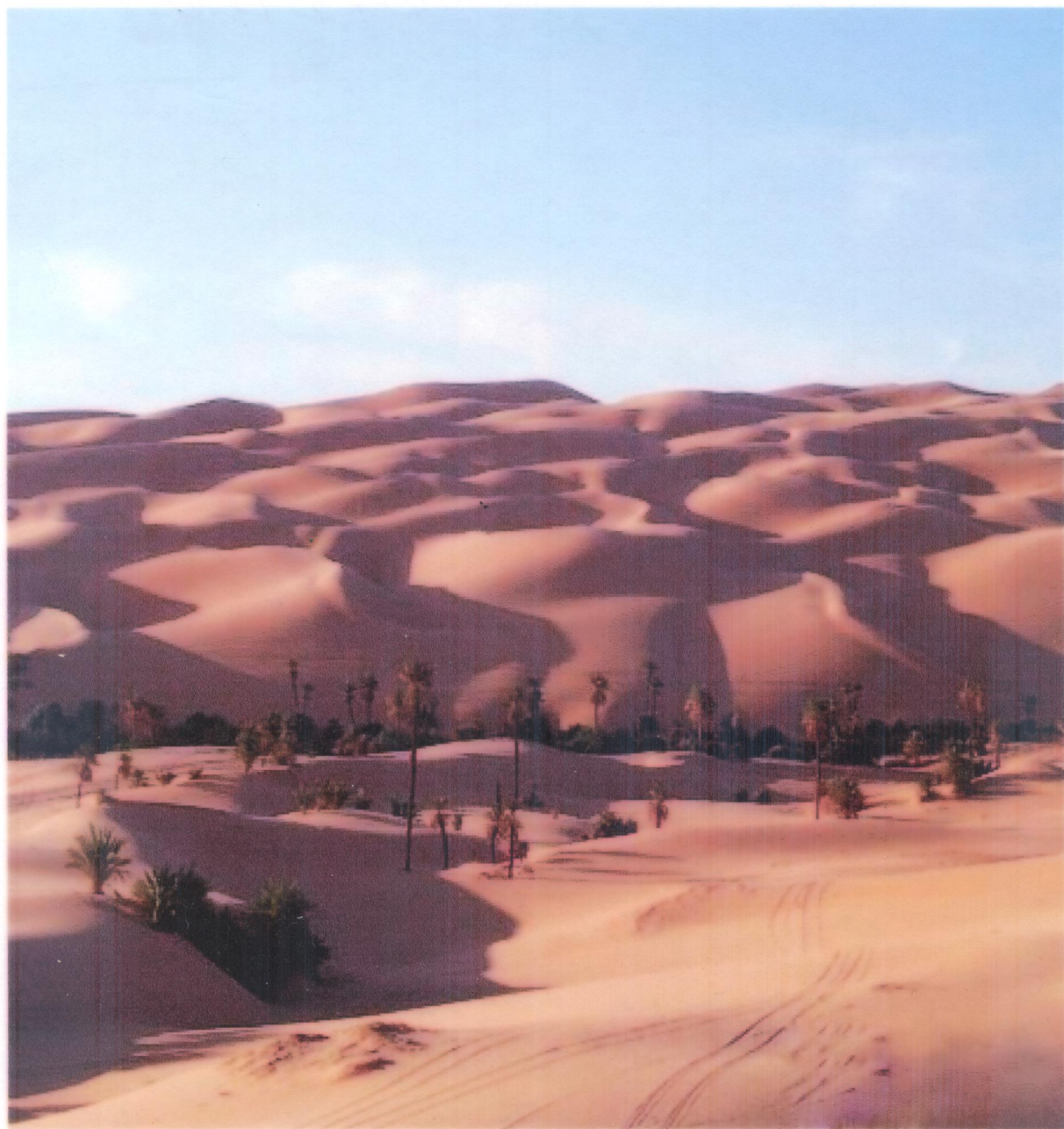
- Estratos cruzados gigantes (migração de dunas)
- Ondulações frequentemente orientadas com cristais paralelas ao mergulho ao invés da direção da superfície de escorregamento (foreset)
- Foresets com baixo ângulo (10-15°). Menores do que o ângulo de repouso da areia (35°)
- Lobos de avalanche (fluxo de grãos) frequentemente ocorrem nos foresets.
- Pegadas de animais, marcas de chuva, ventifactos (dreikanter). Superfície de concentração de clastos. (residual).
- Podem estar associados com leitos de calcários, evaporitos (sais), playa lake, depósitos de correntes efêmeras (wadis).

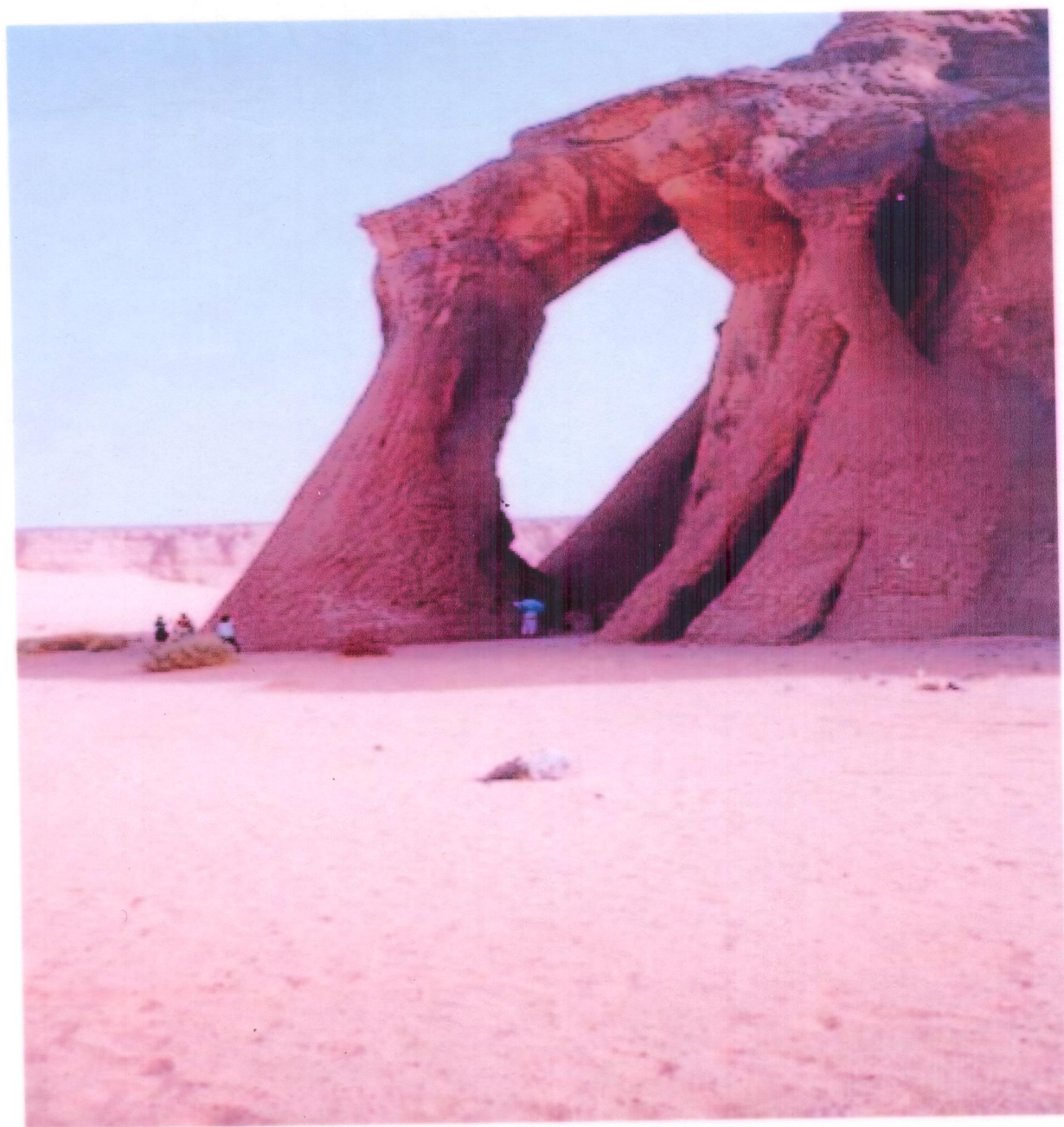


SISTEMAS DEPOSICIONAIS

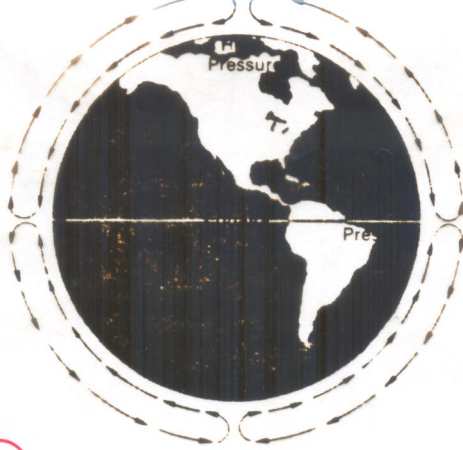








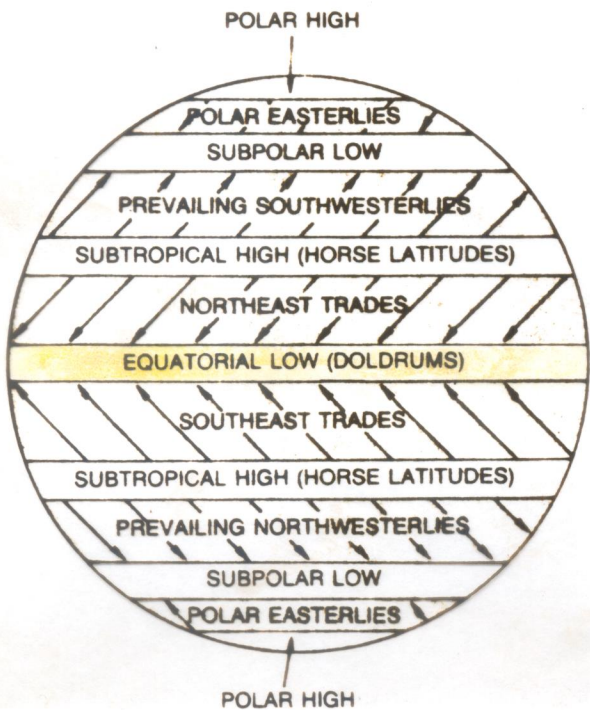
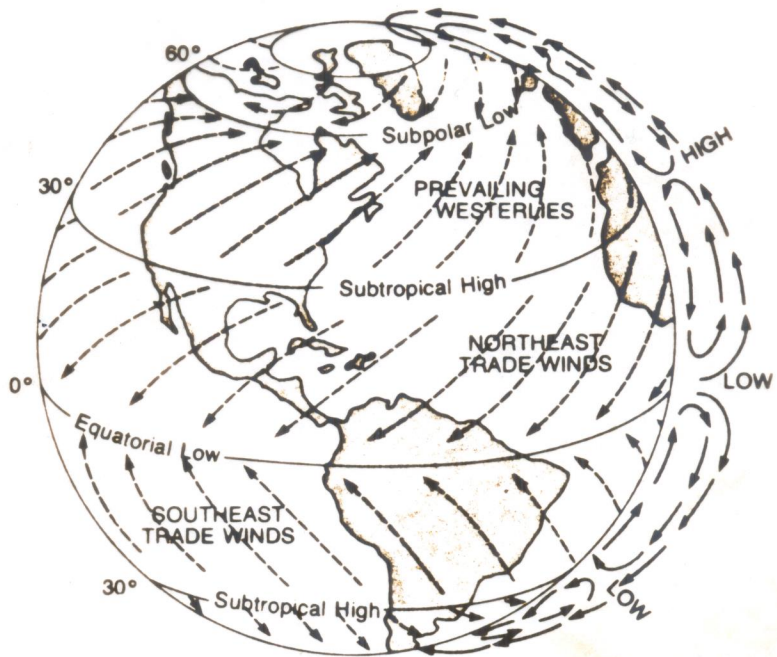




1 Surface winds would come from the north in the Northern Hemisphere and from the south in the Southern Hemisphere



2 Simplified model of prevailing surface winds and location of major high- and low-pressure zones.



3 Prevailing surface winds and pressure patterns. (From Navarra, J.G., *Contemporary Physical Geography*, Saunders College Publishing, 1981.)

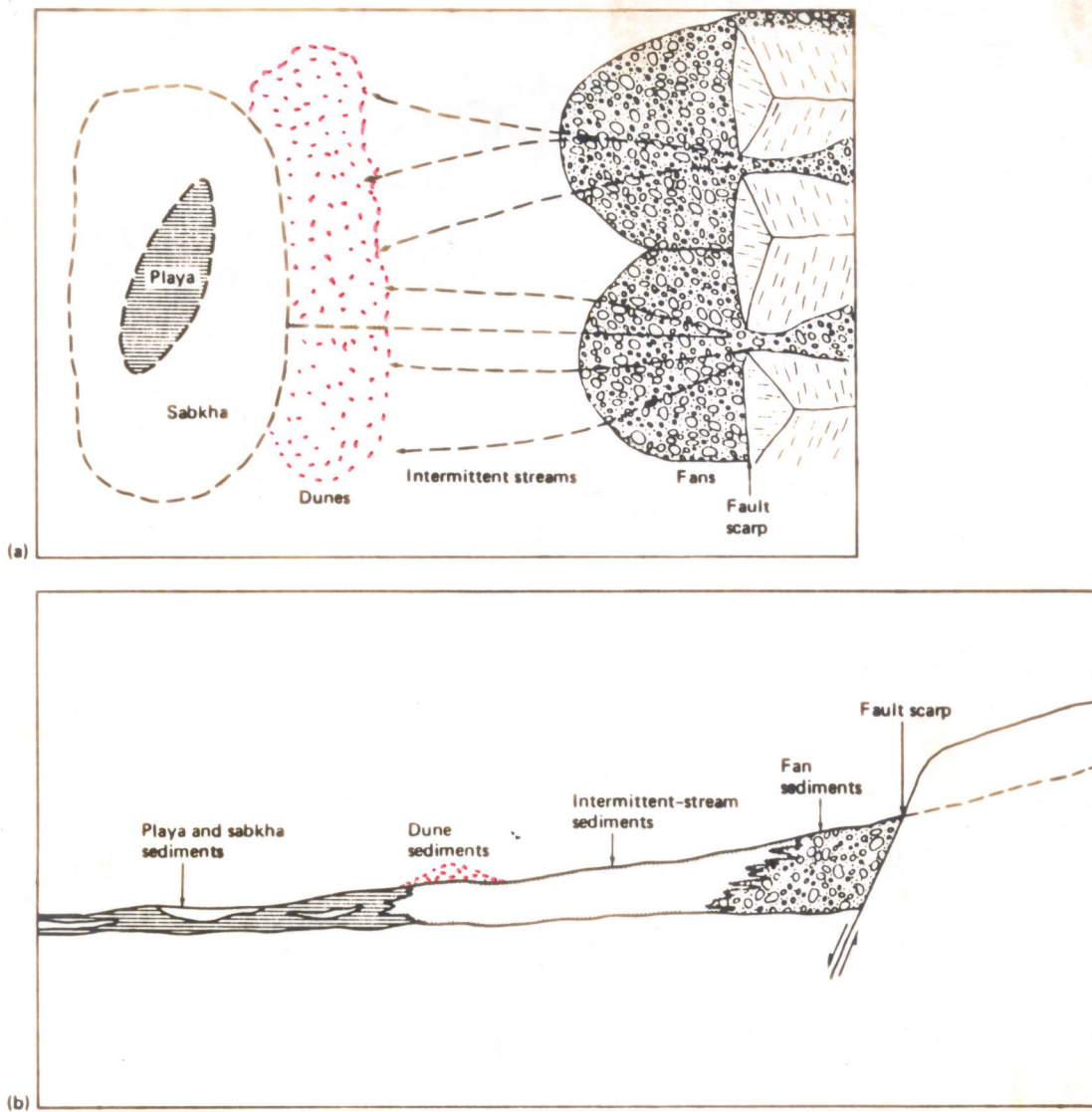


Figure 6-2 Schematic diagram showing major sedimentary environments of the desert depositional system: (a) plan view; (b) cross section. (After Friedman and Sanders, 1978, p. 203.)

T-5



GRANDES ÁREAS DESÉRTICAS.
DESERTOS C/ DUNAS DE AREIA.

ÁREAS COSTEIRAS SECAS.
DIREÇÃO DE MOVIMENTO DE DUNAS.
PADRÃO SIMPLIFICADO DAS DIREÇÕES
PREDOMINANTES DOS VENTOS.

T-4

Figura 13. Distribuição dos desertos atuais no mundo. Modificado de Glennie (1970).

PROCESSES AND PROBLEMS AT THE EARTH SURFACE

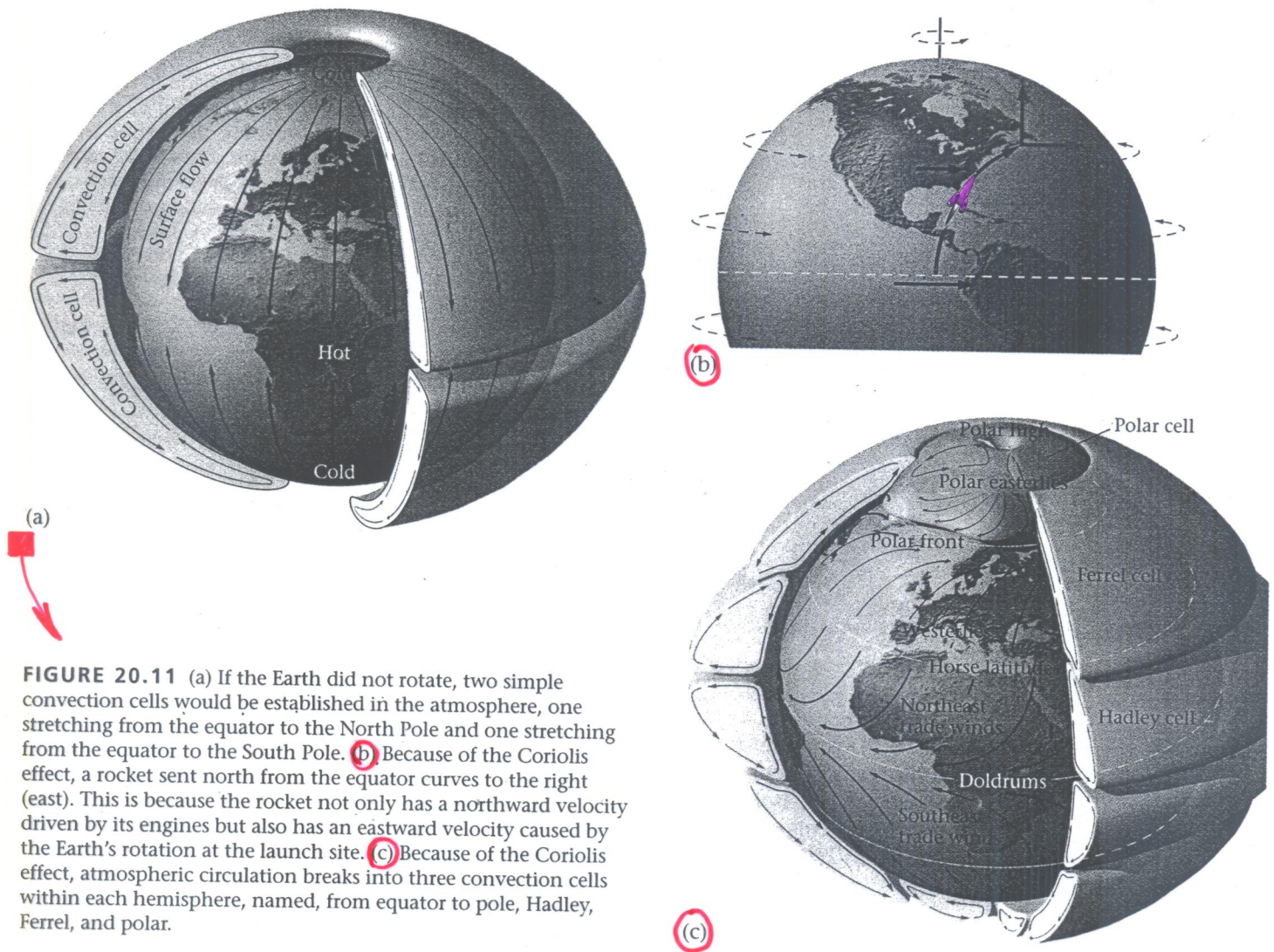


FIGURE 20.11 (a) If the Earth did not rotate, two simple convection cells would be established in the atmosphere, one stretching from the equator to the North Pole and one stretching from the equator to the South Pole. (b) Because of the Coriolis effect, a rocket sent north from the equator curves to the right (east). This is because the rocket not only has a northward velocity driven by its engines but also has an eastward velocity caused by the Earth's rotation at the launch site. (c) Because of the Coriolis effect, atmospheric circulation breaks into three convection cells within each hemisphere, named, from equator to pole, Hadley, Ferrel, and polar.

TIPOS DE DESERTOS

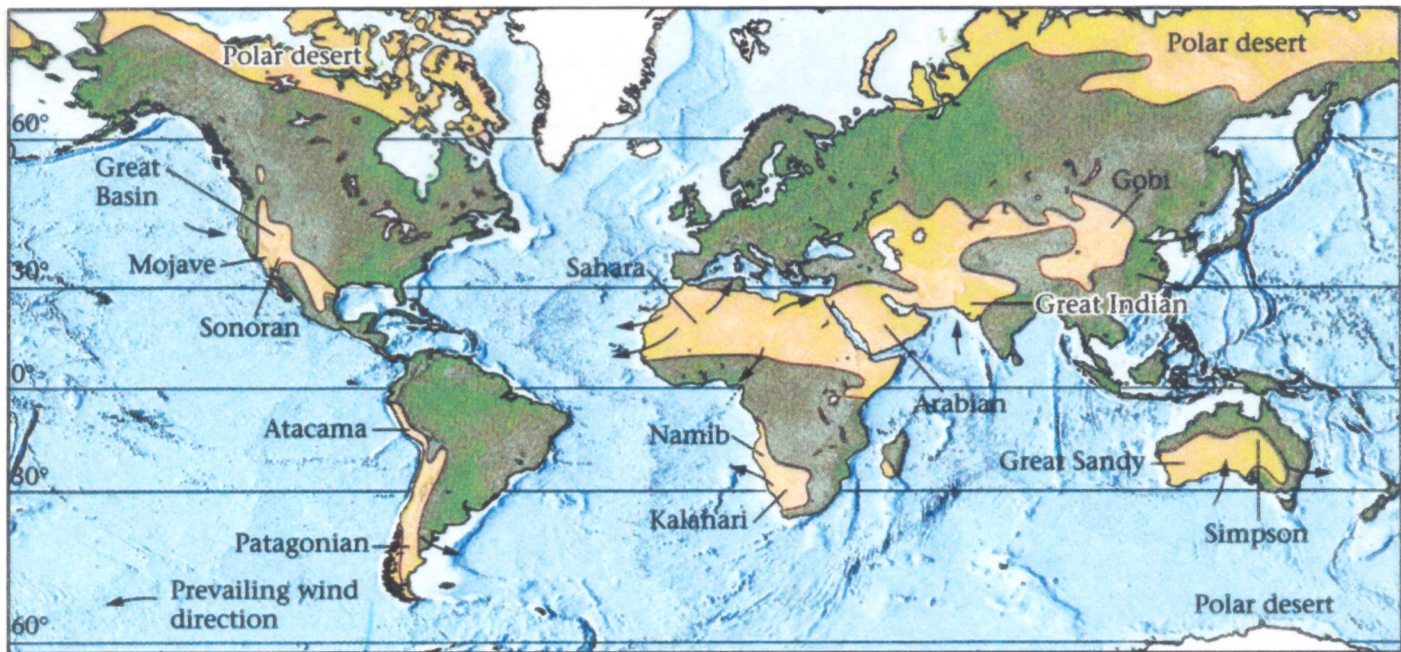


FIGURE 21.3 The global distribution of deserts. Note that the largest lie in the subtropical belts.

+ Sabkhas

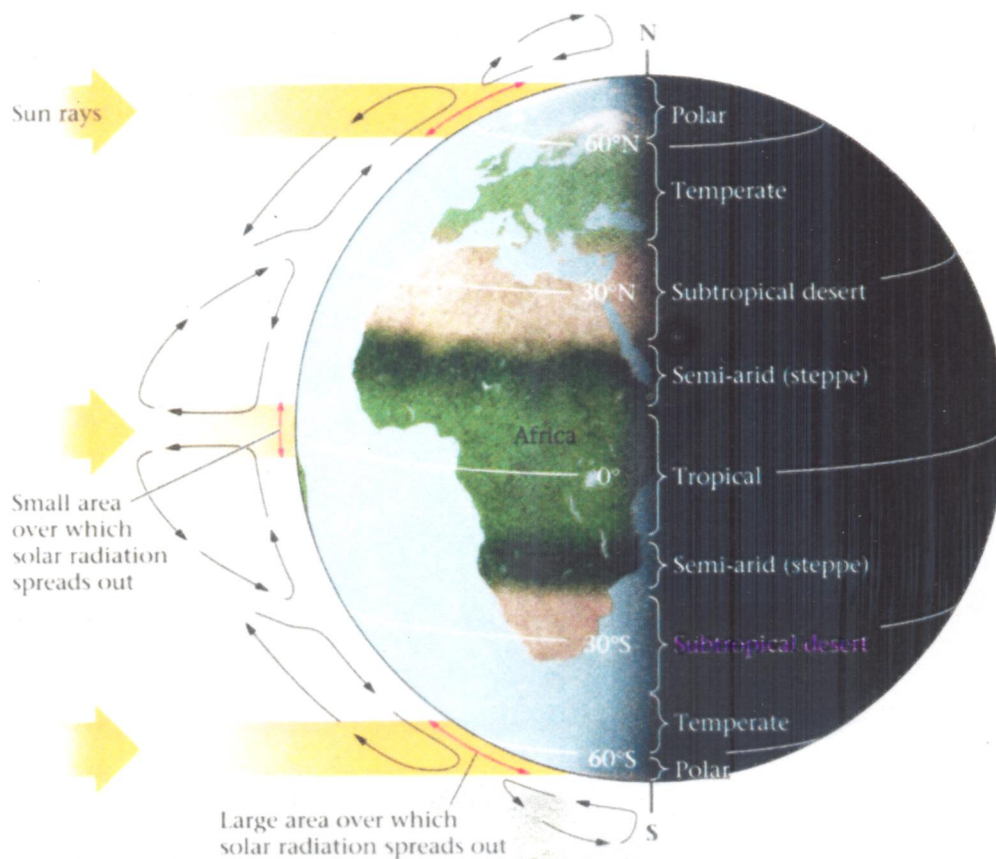


FIGURE 21.4 Rising air at the equator loses its moisture by raining over rainforests. When the air sinks over the subtropics, it warms and absorbs water. Thus, rainfall rarely occurs in the subtropics.

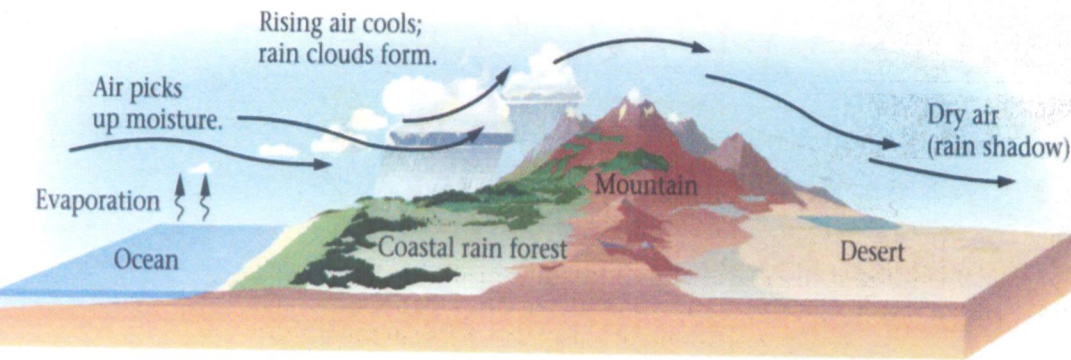
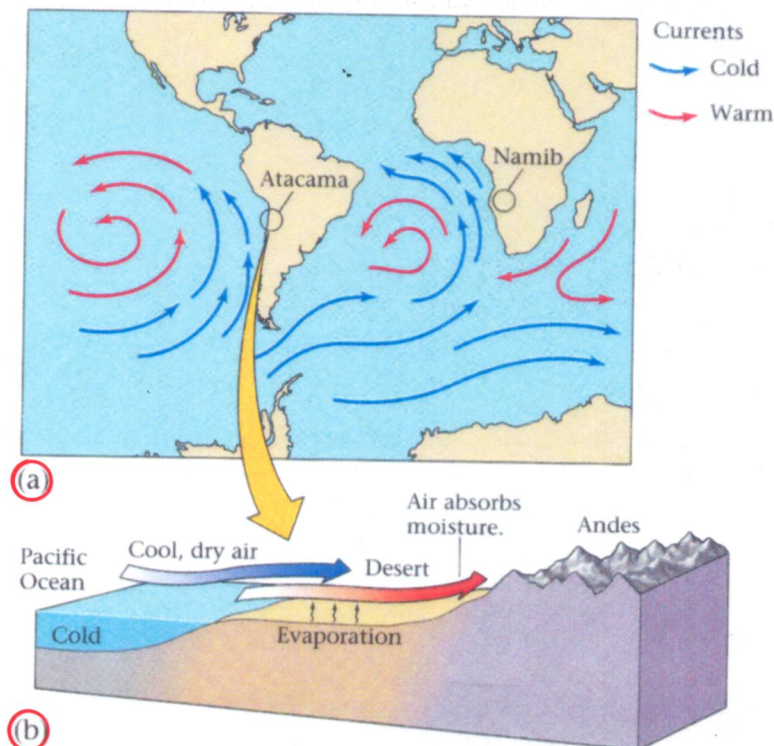


FIGURE 21.5 Moist air, when forced to rise by mountains, cools. As this happens, the moisture condenses and rain falls, nourishing coastal rain forests, so by the time the air reaches the inland side of the mountains, it no longer holds enough moisture to rain. Deserts form in the rain shadow of mountains.

FIGURE 21.6 (a) Currents bringing cold water up from the Antarctic cool the air along the southwestern coasts of South America and Africa. (b) The cool, dry air absorbs moisture from the adjacent coastal land, keeping it dry, so coastal deserts form. (c) The Atacama Desert of South America is the driest place in the world.



+ Interior
continental
+ Polares

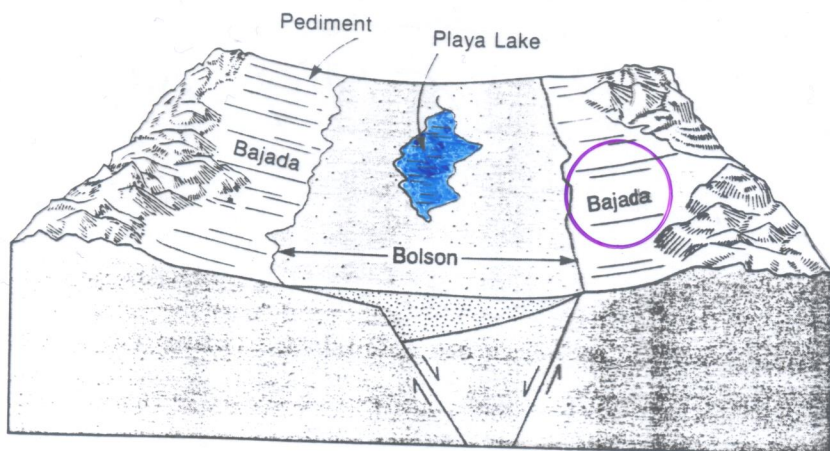


Figure 15-31 Playa Lake formed on the bolson between adjacent pediments.

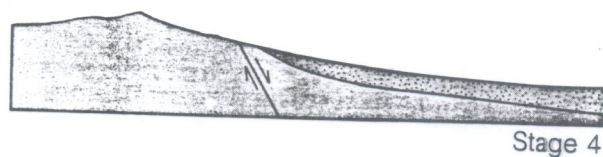
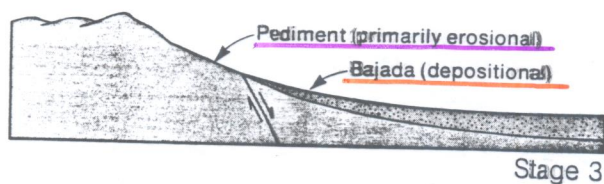
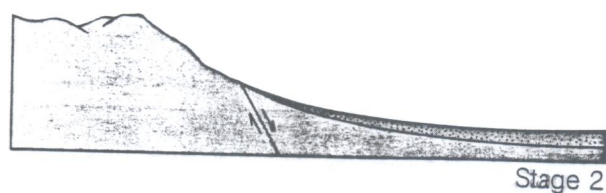
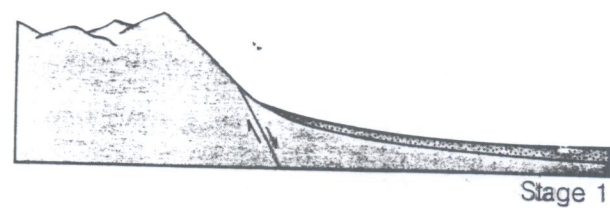


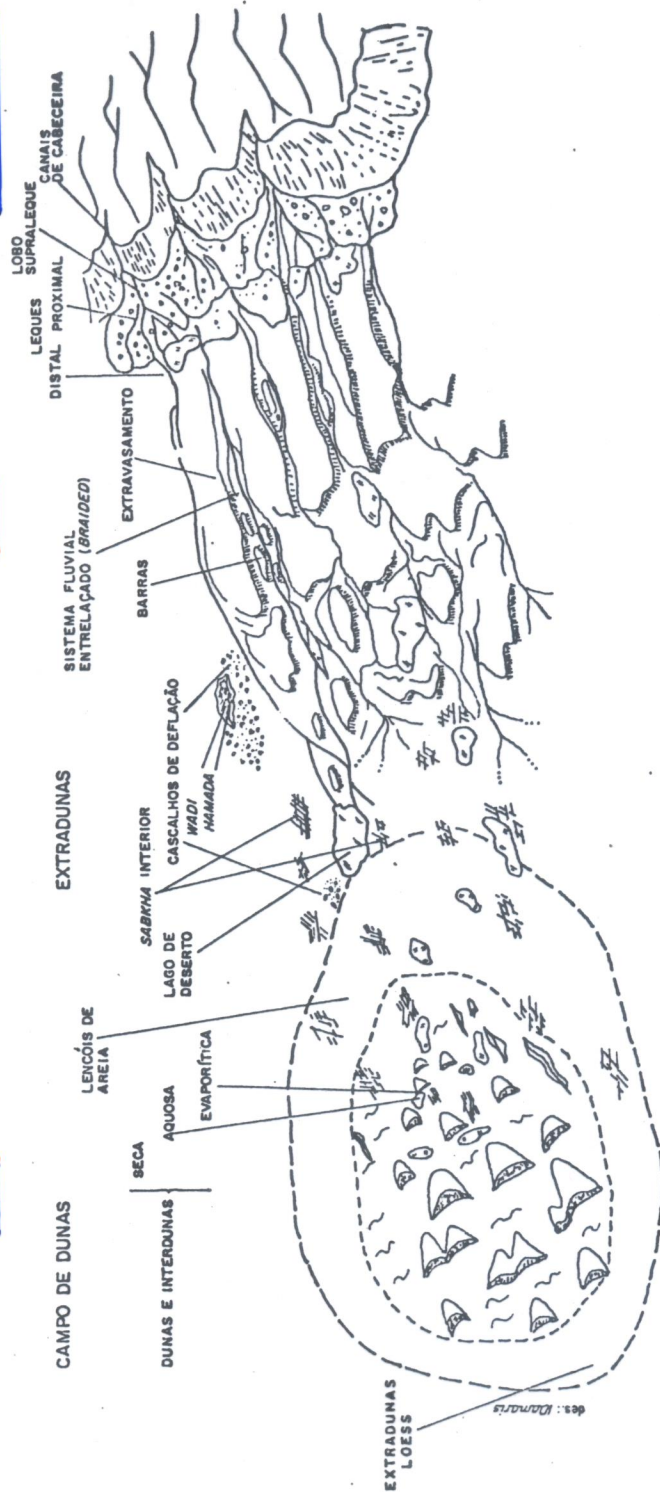
Figure 15-34 The development of a pediment and bajada.

AMBIENTE DESÉRTICO

SISTEMA EÓLICO

SISTEMA FLUVIAL

SISTEMA DE LEQUES ALUVIAIS



ambiente desértico

e depósitos associados.

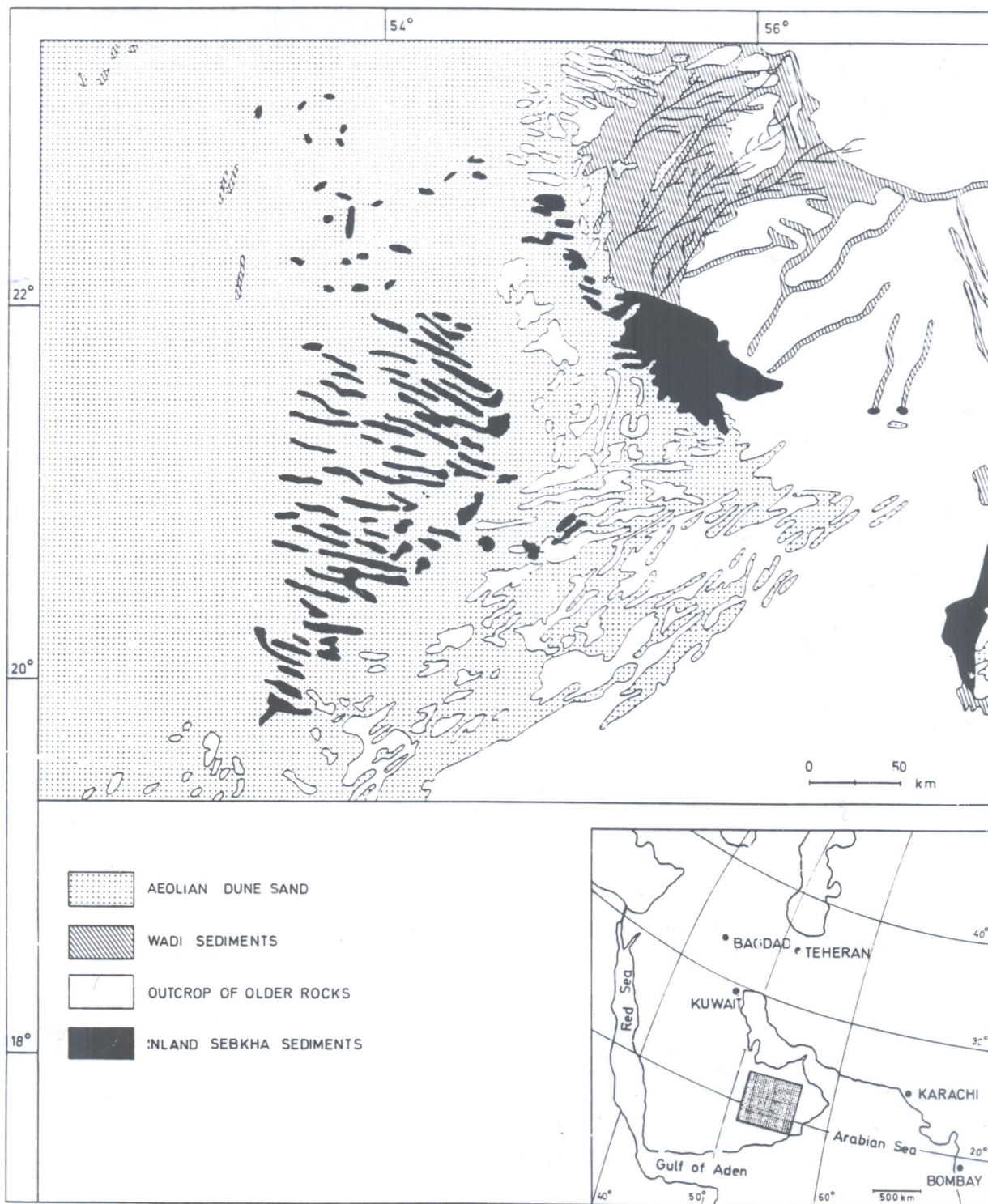


Fig. 300. Map showing the characteristic distribution of various types of subenvironments in a desert region. Note that the sandy region is only a smaller part of the environment. (Modified and simplified after Glennie 1970)

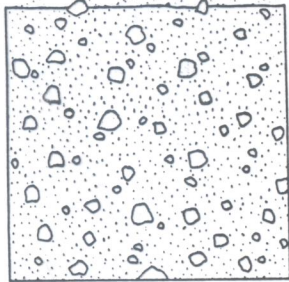


Fig. 302. A general view of a desert environment showing bare rocks and wadi systems. Coarse-grained debris usually accumulates near the exposed rocks. Sudan (After Solle 1966)



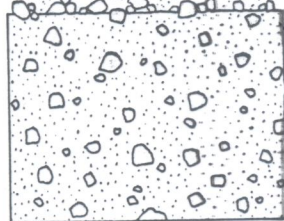
Fig. 305. A closer view of aserir surface. (Photograph by G. Solle)

Deflation



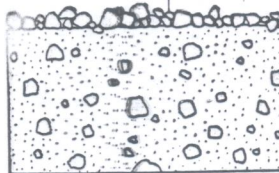
Deflation begins

Deflation

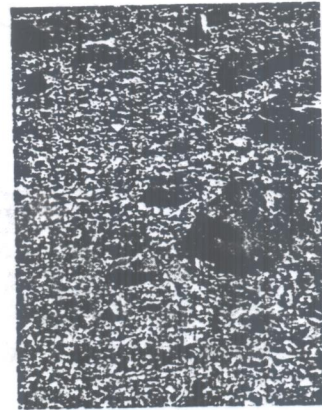


Deflation continues
to remove finer
particles

Desert pavement



Desert pavement
established,
deflation ends



Desert
pavement

Figure 4.28

Formation of desert pavement. Coarse particles gradually become concentrated into a tightly packed layer as deflation lowers the surface by removing sand and silt. If left undisturbed, desert pavement will protect the surface from further deflation. (Photo by Peter Kresan)

Fig. 1.12. Diagram showing the three principal modes of aeolian transport of grains: surface shear stress exerted by the wind causes grain (A) to lift off the surface, carries it downwind back to the surface where it bounces (B) back into flight; this motion is termed *saltation*; grain at (C) hits a large rock – possibly causes some erosion – and elastically rebounds to a relatively high saltation trajectory; grain at (D) strikes the surface and ‘triggers’ other grains into saltation; grain at (E) strikes the surface containing very fine particles (too fine to be moved by the wind alone in this case; see threshold curve, Fig. 1.2) and sprays them into the wind where they are carried by turbulence in *suspension*; grain at (F) strikes larger grain and pushes it downwind a short distance in a mode of transport termed *impact creep*, or *traction*.

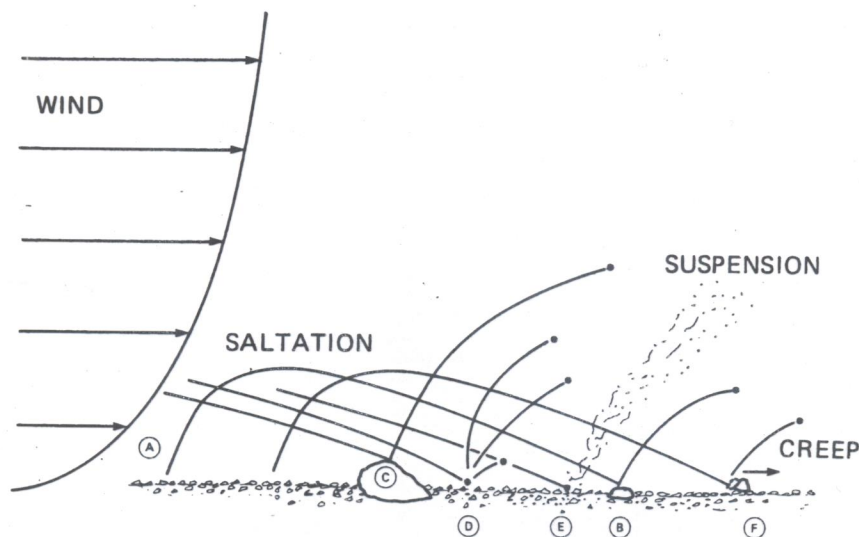
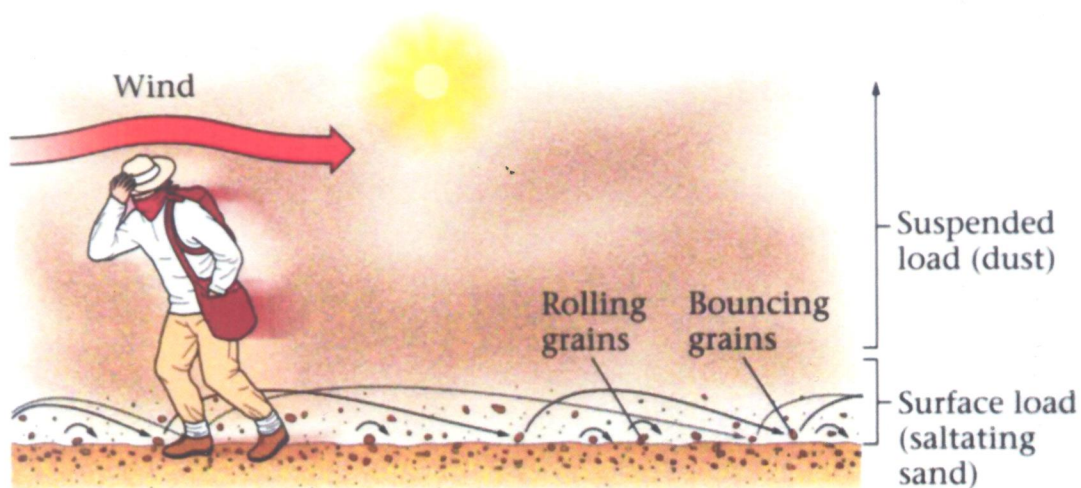


FIGURE 21.10 During saltation, sand grains roll and bounce along the ground surface. As they bounce, they follow parabolic paths.



MODELO DEPOSICIONAL DO AMBIENTE DESÉRTICO

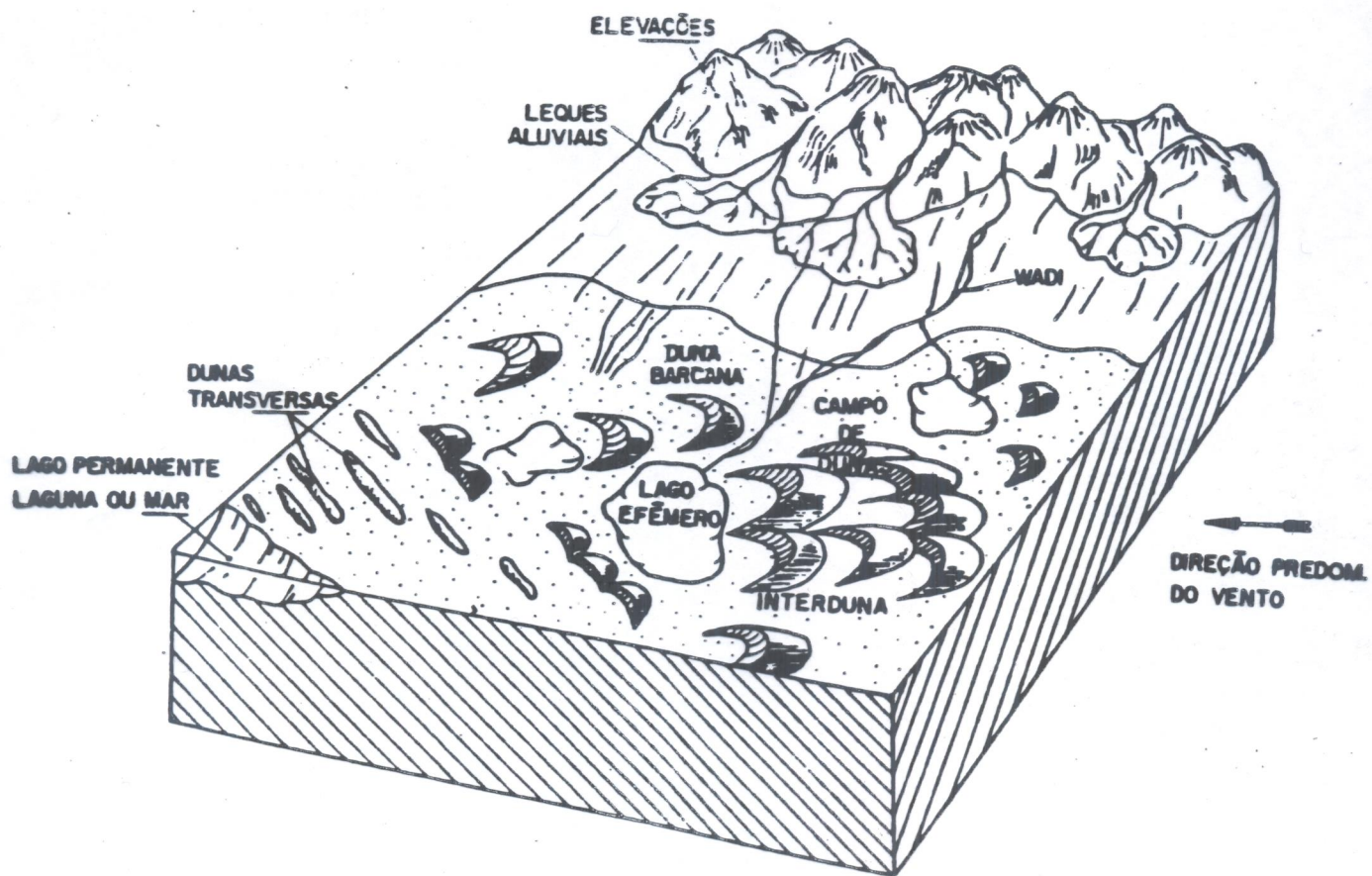
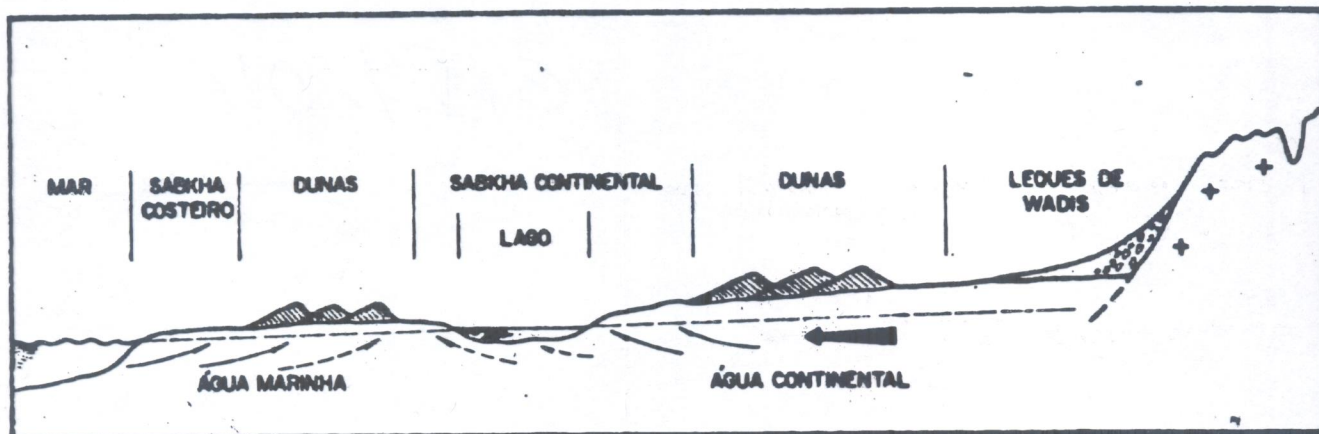
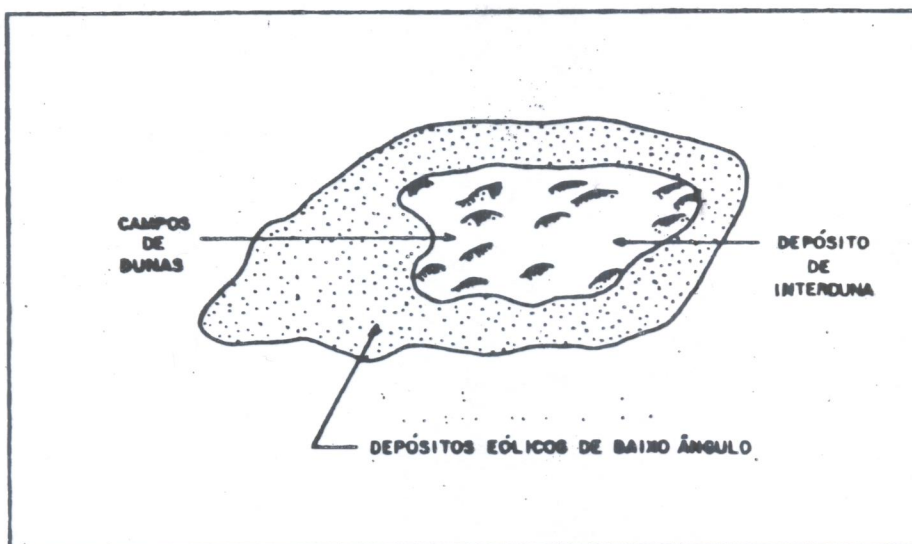


Figura 15. Modelo deposicional do ambiente desértico mostrando a associação de subambientes.



Seção esquemática através de uma costa desértica mostrando a distribuição dos ambientes e/ou depósitos associados. Modificado de Shearman (1978).



SUBAMBIENTES DE ACUMULAÇÃO DOS DEPÓSITOS EÓLICOS (ADAPTADO DE FRYBERGER et alii, 1979).



Fig. 5.9. Diagrams illustrating the principal dune types and the winds responsible for their formation. (From McKee, 1979a.)

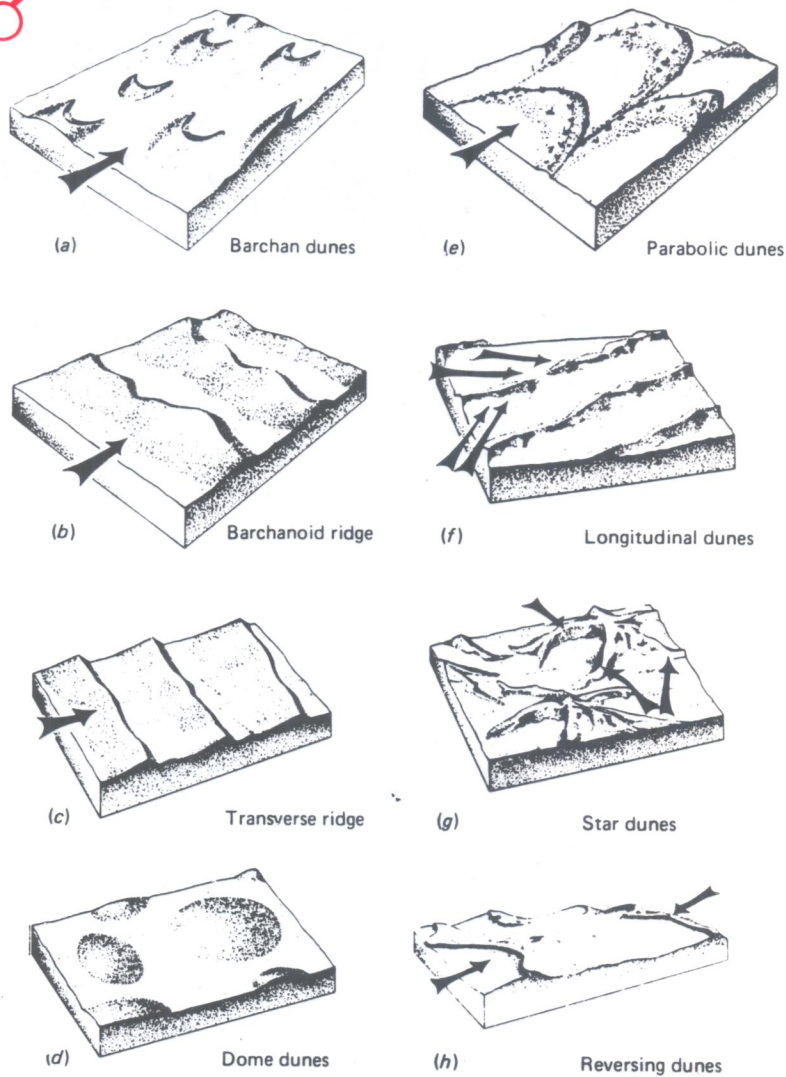
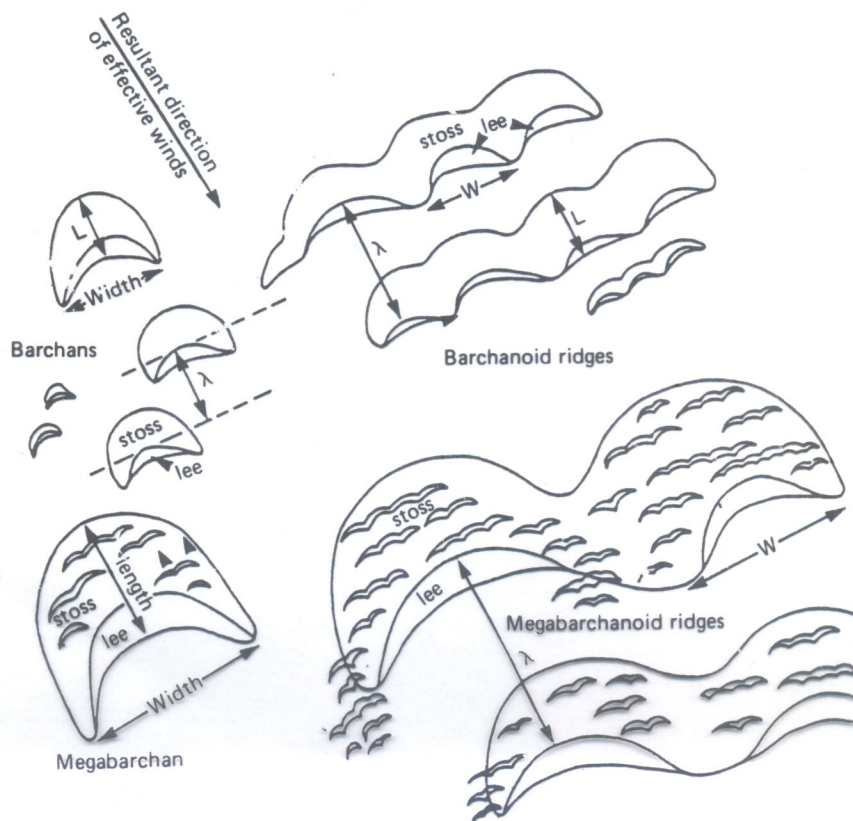


Fig. 5.10. Diagrams illustrating common forms for transverse dunes and the conventions for measuring width, W , length, L , and wavelength, λ . (From Breed, 1977.)



SISTEMA EOLICO

ILUSTRAÇÕES

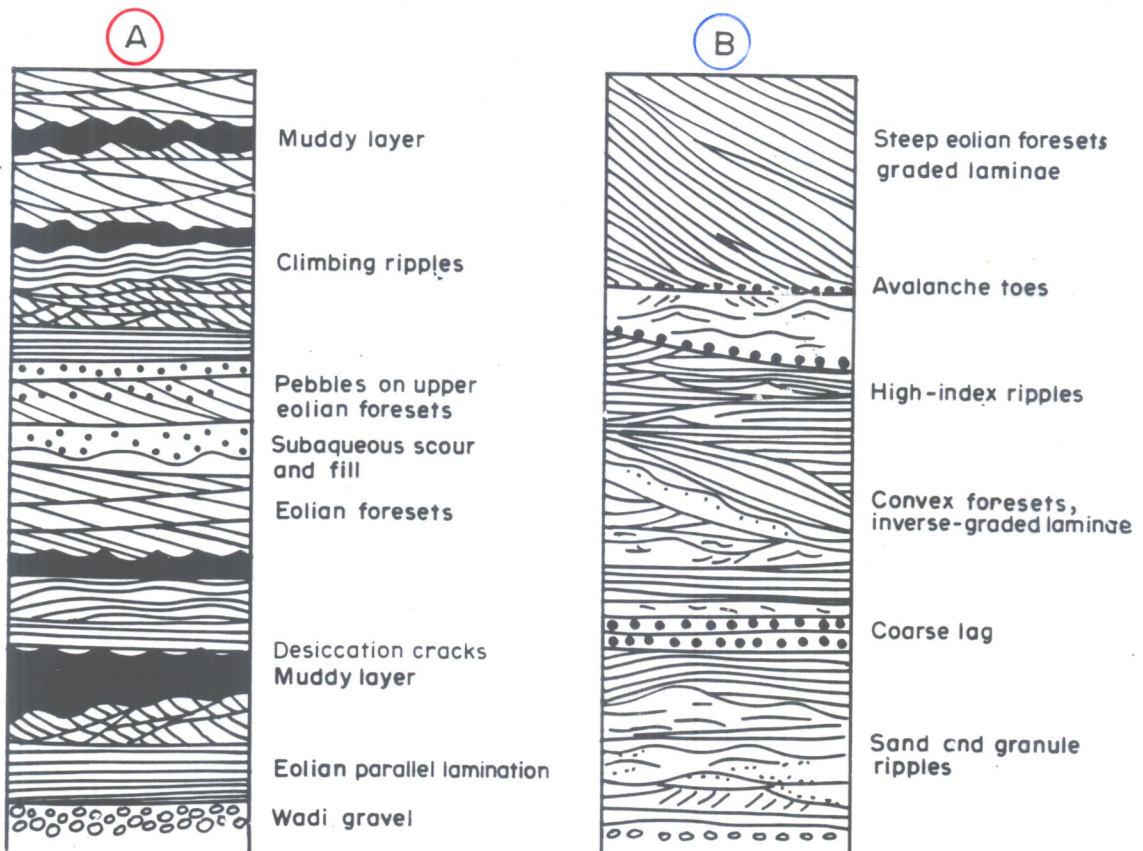
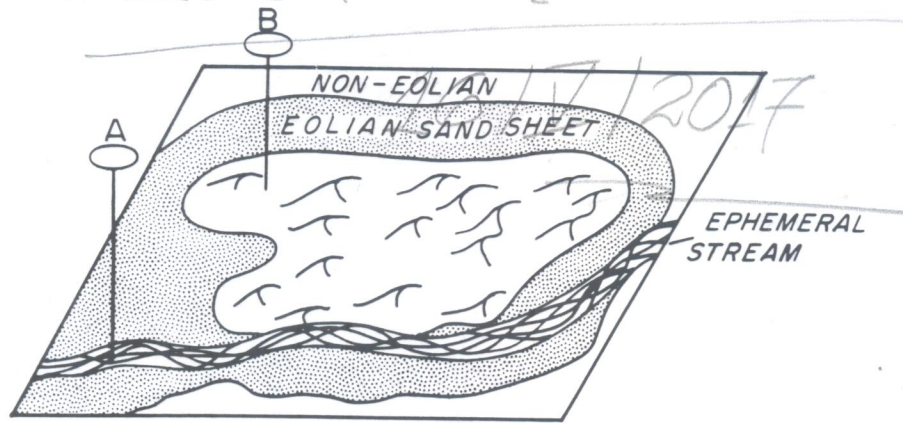


Figure 10-7. Schematic areal distribution and stratigraphic relationships of: **A.** eolian sand sheet and ephemeral stream deposits; and **B.** eolian dune deposits with large-scale foresets. (After Fryberger *et al.*, 1979.)

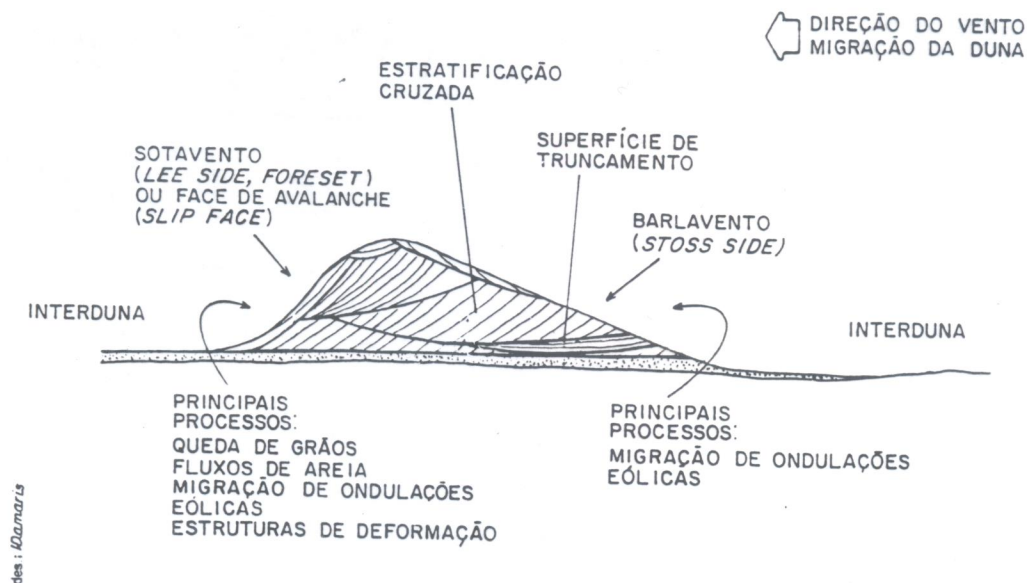


Figura 10: Perfil esquemático simplificado de uma duna com denominações e principais processos sedimentares.

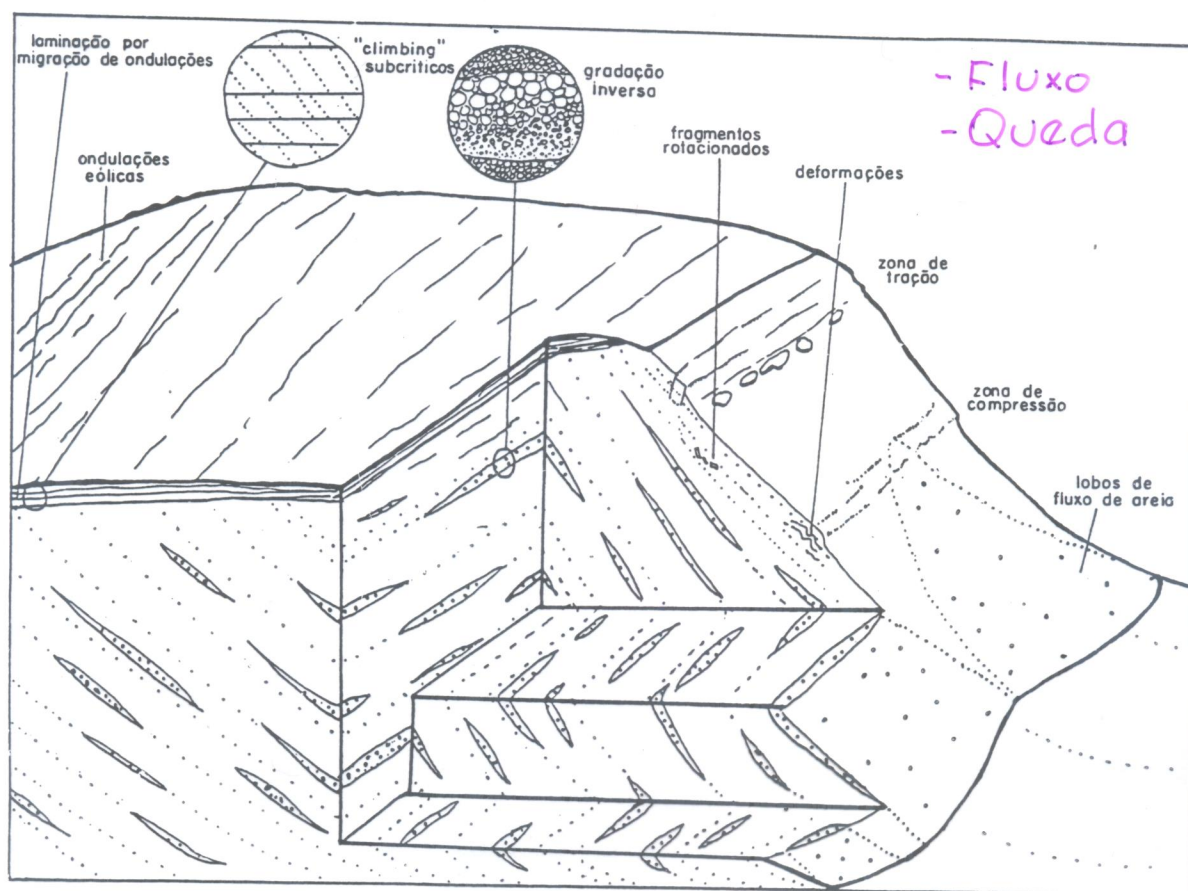


Figura 11: Principais processos e feições geradas em depósitos de dunas eólicas (Modif. de Hunter 1977).

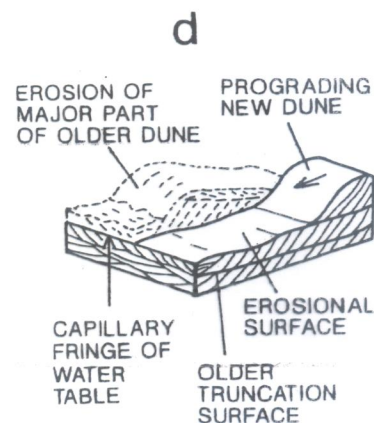
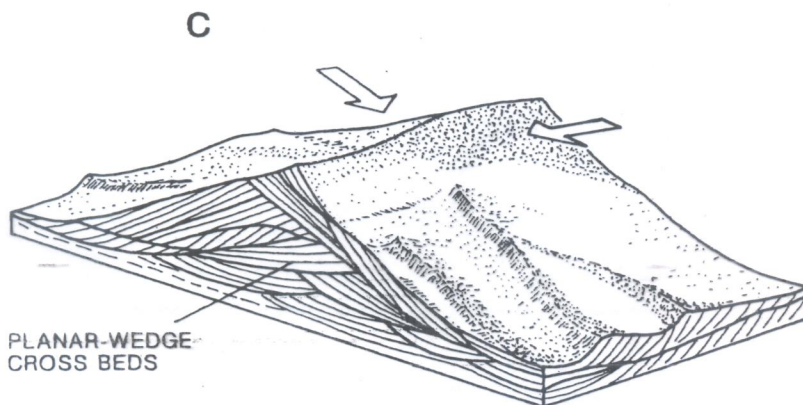
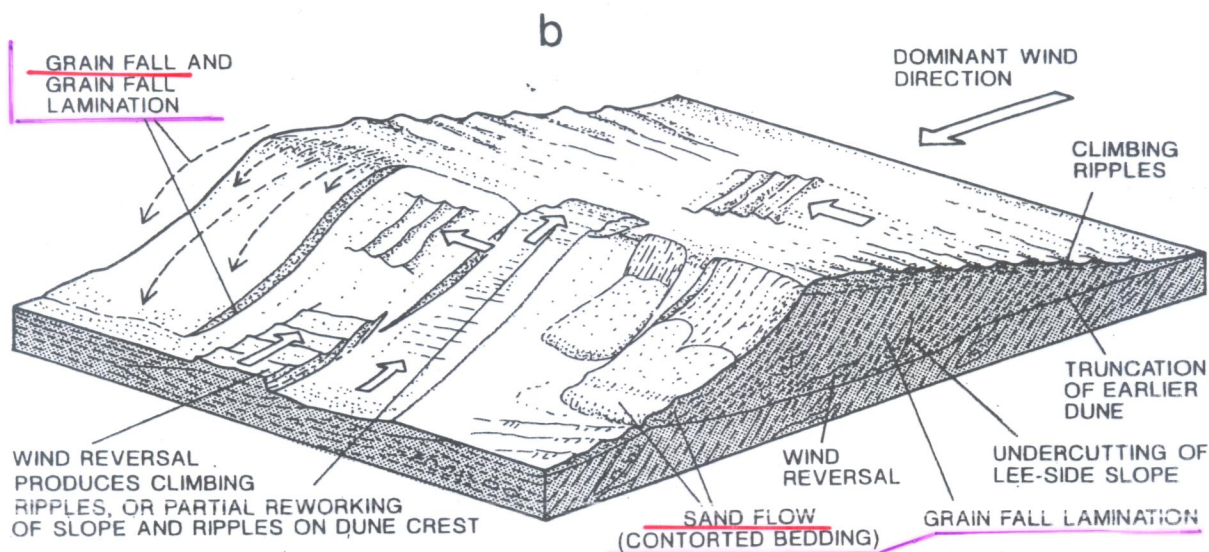
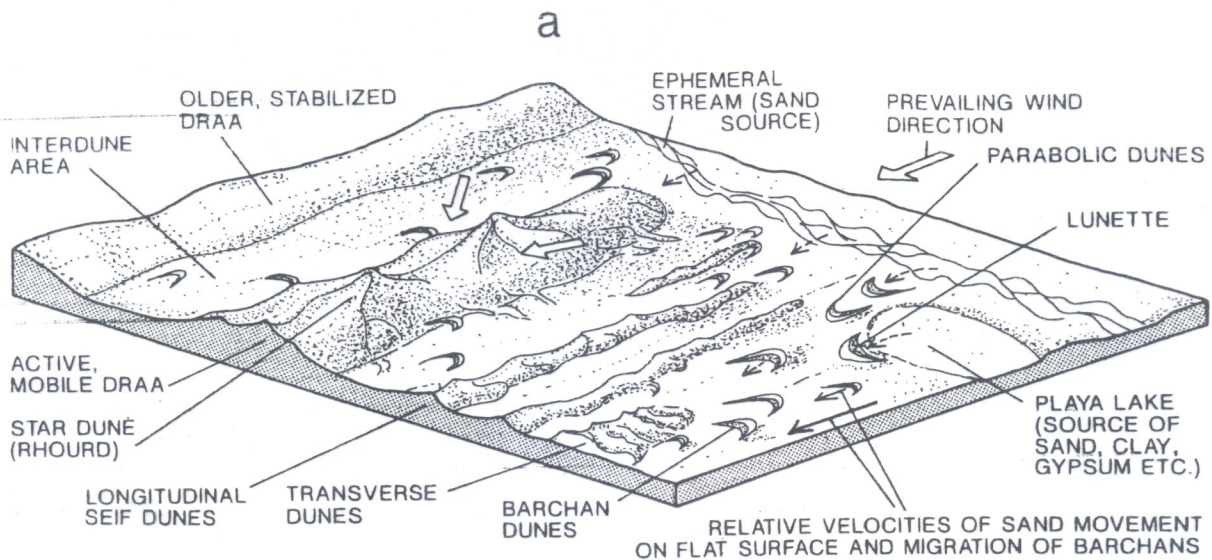


Fig. 2.22. a Most important dune forms in relation to prevailing wind directions. From right to left increase in sand supply and volume of sand accumulation, but decrease in the velocity of dune migration. Playa lake provides sand-size clay aggregates, carbonate, and evaporites (e.g. gypsum) which make up part of the neighboring dunes. (Based on various sources, e.g., Cooke and Warren 1973; McKee 1979). **b** Large transverse or barchan dune with unidirectional grain-

fall lamination and sand-flow cross bedding, superimposed by small-scale climbing ripple lamination caused by various subordinate, wind directions. (Modified from Hunter 1981). **c** Hypothetical cross section of longitudinal dune. (After McKee 1979). **d** Truncation of older dune at capillary fringe of groundwater table and prograding new dune over erosion surface

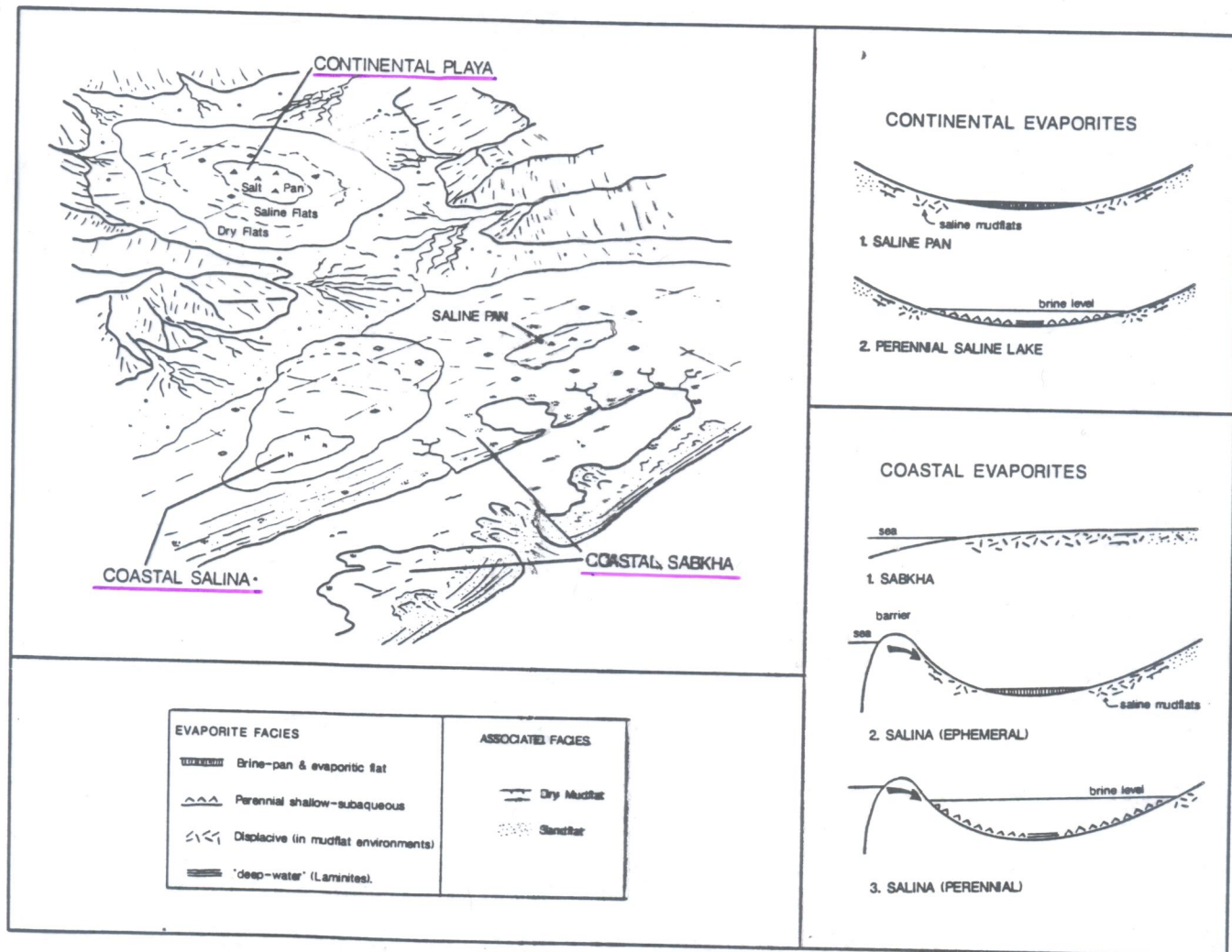


Figure 3 Modern evaporite depositional environments; diagram courtesy of C.R. Handford. Evaporites form in non-marine interior basins with playa lakes, salt pans and mud flats (continental sabkhas), coastal supratidal mud flats (marine sabkhas) and marine-fed, coastal lagoons and salt pans (salinas).

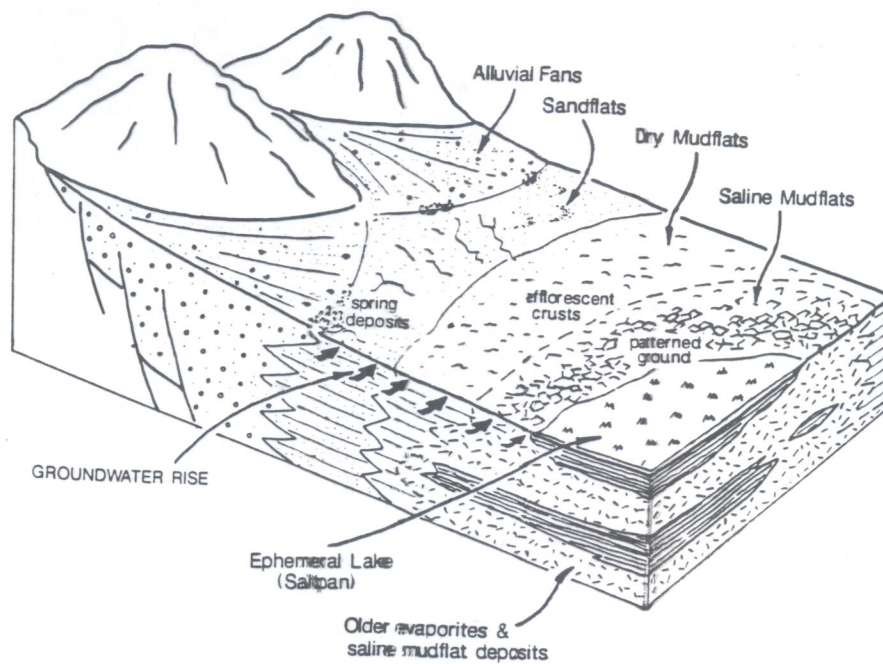


Figure 32 Schematic block diagram showing depositional framework for the continental evaporite (playa complex) model. Modified from Eugster and Hardie (1975).

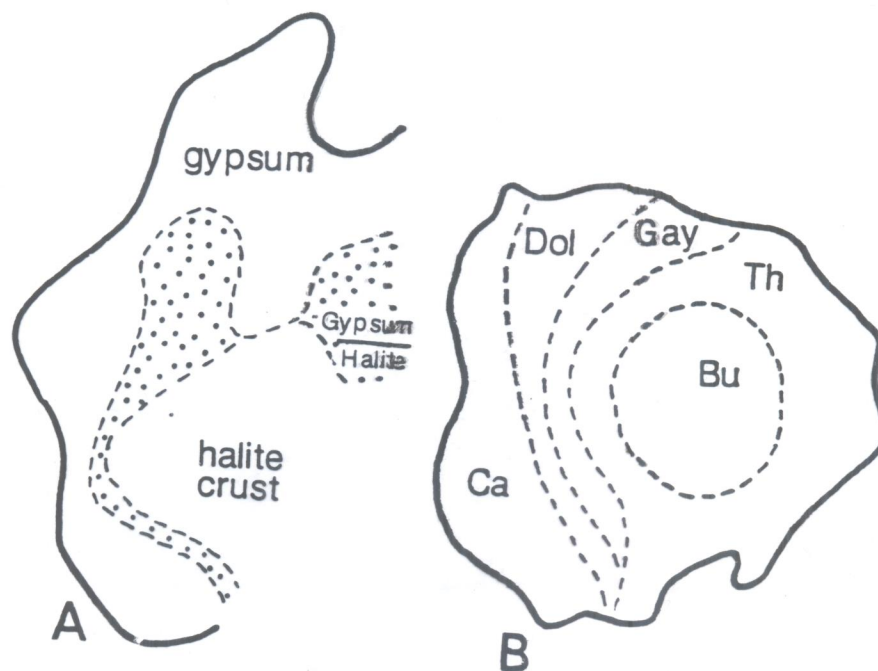


Figure 33 Saline mineral zonation in playas. A) Yotvata Sabkha (Israel), after Amiel and Freidman (1971). B) Deep Spring Lake, California, after Jones (1965). Ca = calcite/aragonite, Dol = dolomite, Gay = gaylussite, Th = thenardite, Bu = burkete.

AMBIENTE DESÉRTICO

Sistema	Aso. Faciéd.	FÁCIES OU DEPÓSITOS DE	CARACTERÍSTICAS	PRINCIPAIS DOS DEPÓSITOS
EÓLICO	Campo de dunas	Dunas		• Arenitos com estratificações cruzadas de médio a grande porte. • Arenitos pobremente selecionados, com laminação subhorizontal descontínua. • Arenitos pobremente selecionados, com intercalações de silte e argila. Gretas, cimentação carbonática, <i>curled mud flakes</i>, bioturbação. • Areia, silte, argila e sais evaporíticos intercalados. Marcas de cristais, fragmentos de argila, bioturbação. • Arenitos maciços ou com estratificação de baixo ângulo; calcrites, bioturbação.
	Lençóis de areia			
	Extradunas	• Lagos de deserto e <i>sabkhas</i>¹ interiores • Cascalhos de deflação • <i>Wadis</i>² • Hamada • <i>Loess</i>	• Estratos delgados de arenitos com graduação normal, terminados por pelitos. Feições de ressecção, ondulações de adesão, crostas salinas, marcas de cristais, bioturbação, marcas onduladas. Cimentação carbonática e calcrites. • Sedimentos pobre a moderadamente selecionados, arenosos, intercalados com conglomerados, em estratos subhorizontais. Frequentes ventifactos. • Arenitos com graduação normal grosseira, terminada por lama, gretas, intercaladas com depósitos eólicos. • Detritos angulosos, às vezes intercalados com sedimentos eólicos. Ocorrem ventifactos. • Siltitos quartzosos, às vezes carbonáticos, em bancos com laminação incipiente.	
		Canais	• Barras longitudinais e transversais. • Extravasamento (fluxo em lençol, <i>crevasse splay</i>) • Fluxo de detritos • Canal (barras longitudinais e fundo) e peneira (<i>sieve</i>) • Barras linguiformes e transversais e ondas de areia • Em lençol	• Arenitos com estratificações cruzadas acanaladas de médio a pequeno porte, com clastos de argila. Ondas de areia (dunas e ondulações subaquosas). • Arenitos siltosos, siltitos, lama em estratos subhorizontais pouco espessos, intercalados. Laminação subhorizontal, mal definida. • Cascalhos sustentados por matriz argilosa, maciços. • Cascalho grosso com estratificação horizontal e imbricamento frequente. • Areias (com ou sem cascalhos) com estratificação cruzada tabular, cascalhos finos e com matriz arenosa. • Areias e lamitos com estratificação subhorizontal.
FLUVIAL ENTRELACADO (<i>braided</i>) PSAMÍTICO	Planícies de transbordamento			
LEQUES ALUVIAIS	Porção proximal			
	Porção distal			

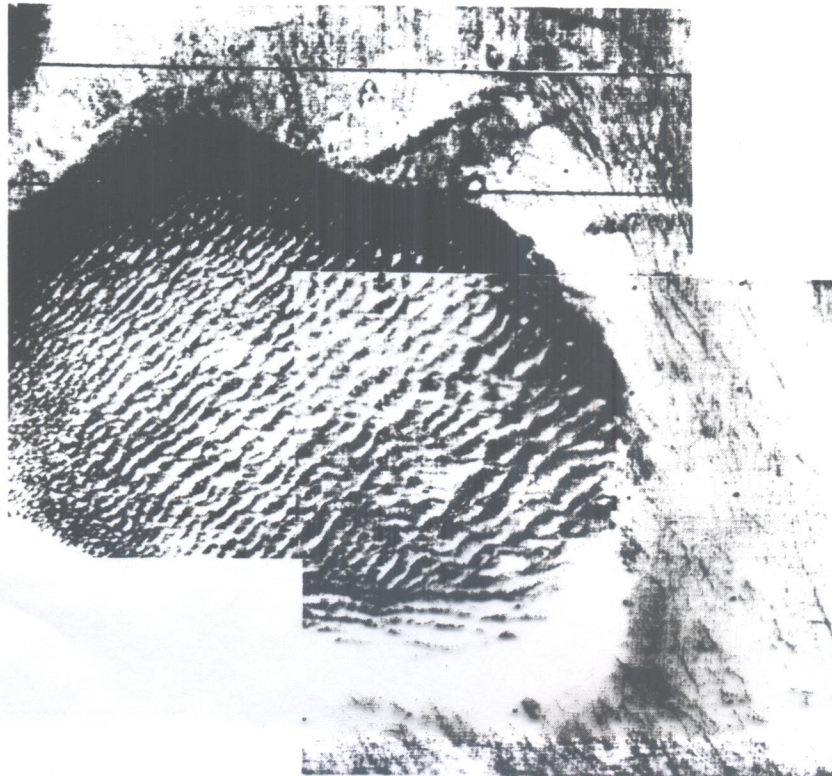
1 - A FORMA PLURAL CORRETA DE *sabkha* É *sabkhas*. ENBORA INCORRETA, NA LITERATURA CONSAGROU-SE A FORMA *sabkhas*.
2 - A FORMA PLURAL CORRETA DE *wadi* É *wadis*. ENBORA INCORRETA, NA LITERATURA CONSAGROU-SE A FORMA *wadis*.

- Ambientes sedimentares e depósitos associados

Fig. 5.32. Small dune field, ≈ 25 km long, associated with an impact crater on Mars. (VO frame 571B53.)



Fig. 5.31. Dune field within a ≈ 200 km impact crater in the Hellespontus region of Mars. (Mariner 9 frames MTC 4264-15, 19.)



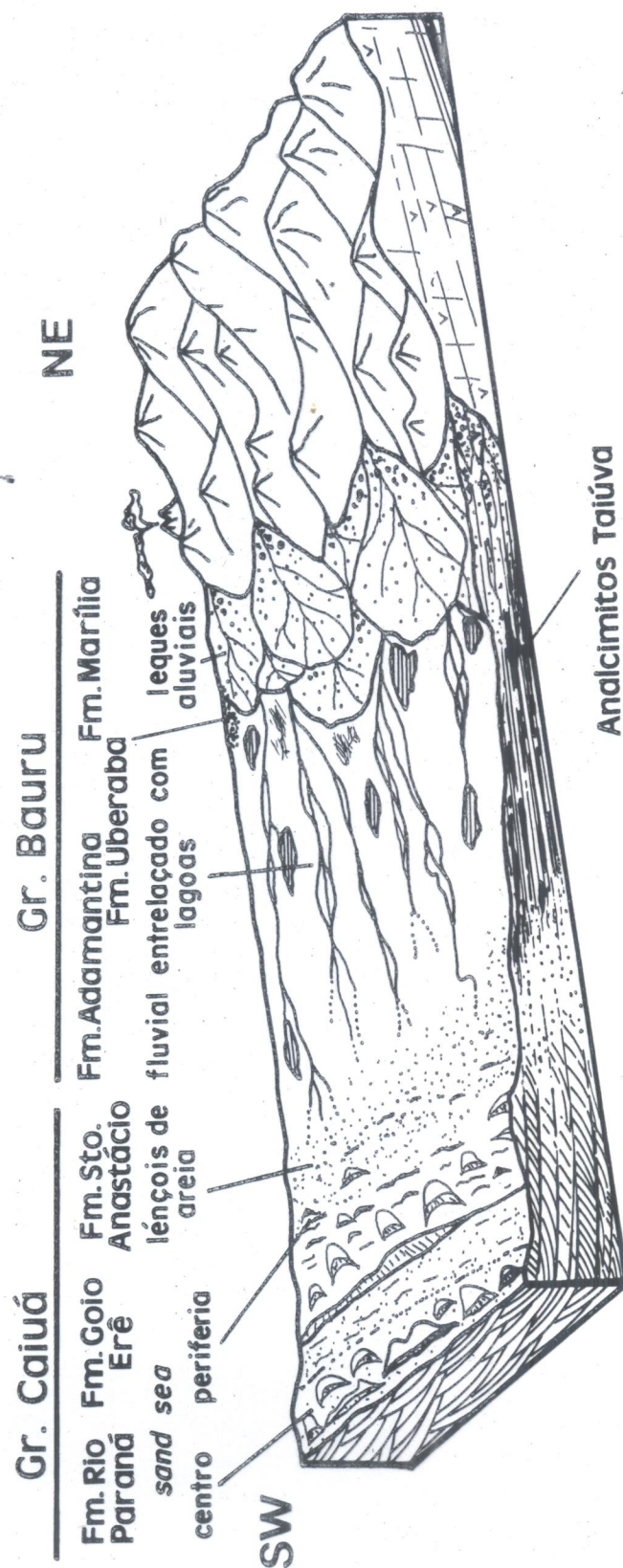


Fig. 5 — Distribuição dos sistemas deposicionais e depósitos correspondentes, na Bacia Bauru.

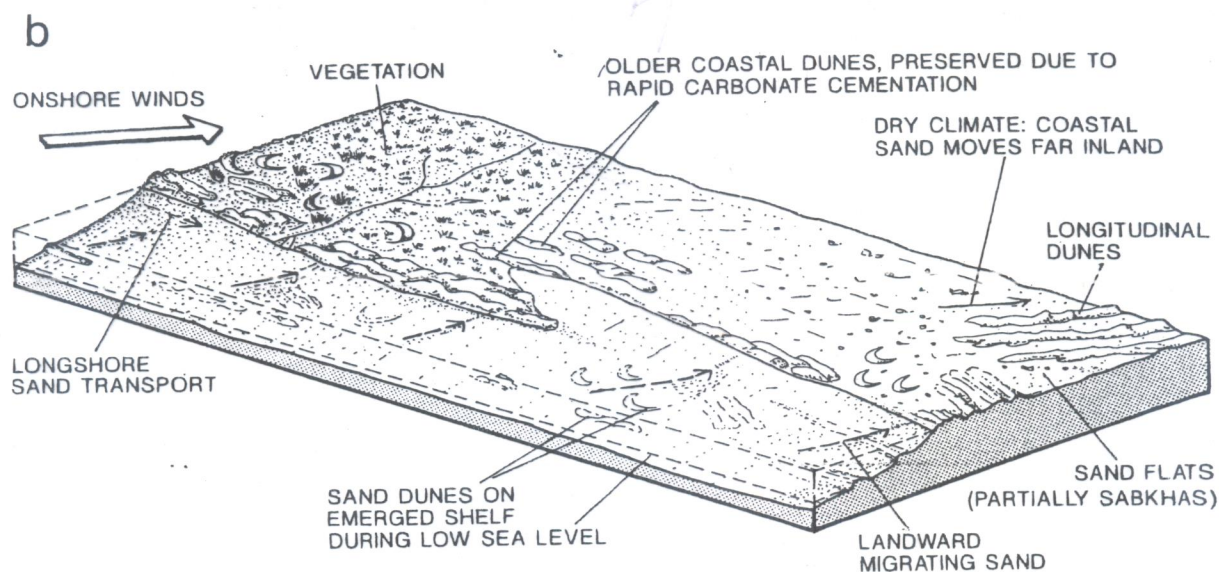
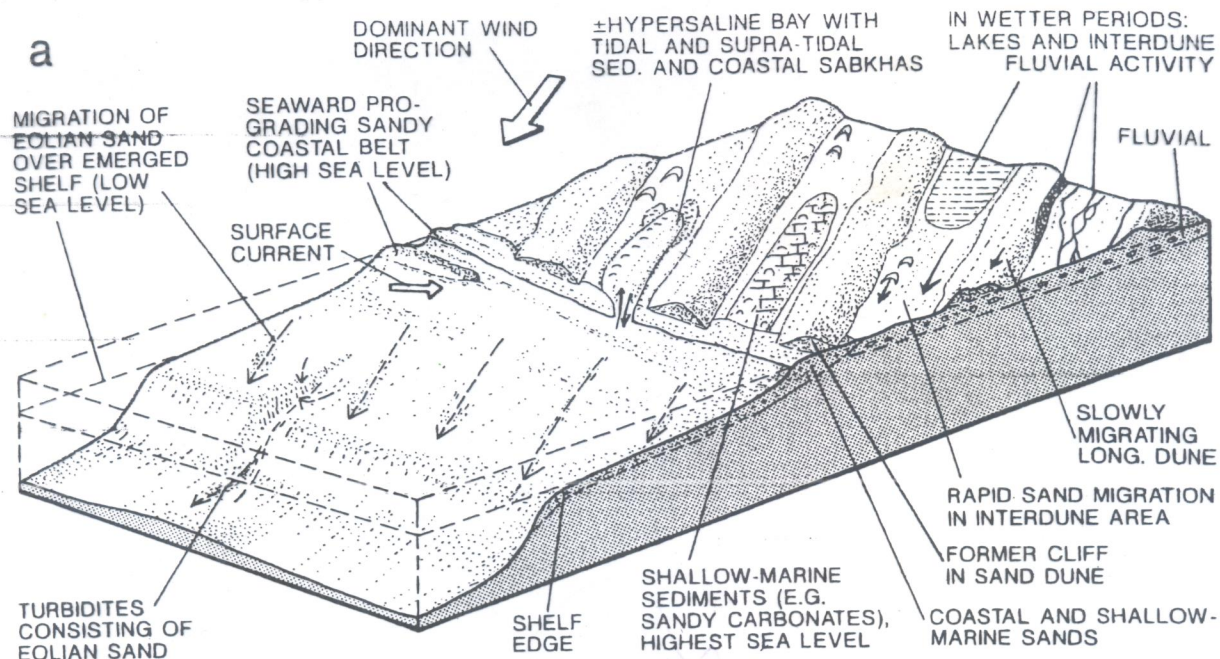


Fig. 2.23. a Interaction between seaward migrating eolian sands and marine processes including relative sea-level changes. In interdune areas, lakes or fluvial systems may develop. (Mainly based on Sarnthein and Diester-Haass 1977; Schwarz et al. 1975; Einsele et al. 1977). **b** Various types of coastal dunes result-

ing from onshore winds. In arid regions, the coastal sand can migrate far inland to feed interior sand seas, while it is stabilized by vegetation in the more humid zones. During low sea level, shelf sand can contribute to the buildup of coastal dunes. See text for further explanation