Abbildungen für Riffvorlesung 27.05.2004

Riffdefinitionen und Rifftypen

Riffdefinitionen von Heckel 1974

Lowenstam, 1950; reaffirmed by Nelson and others, 1962

Organisms "passively" produced sediment, but not rigid, wave-resistant framework
BANK

Organisms actively built rigid, wave-resistant framework
REEF

Kornicker and Boyd, 1962

(BANK)

Organisms in growth position that influenced adjacent sedimentation
REEF

Dunham, 1970

Thick, laterally restricted mass of pure carbonate
STRATIGRAPHIC REEF

Organisms built & bound framework
ECOLOGIC REEF

This paper

No evidence of relief. (if high skeletal content, BIOSTROME)

Evidence of positive topographic relief
BUILDUP (if large, broad, PLATFORM, SHELF)

No evidence of type indicated at right
BANK

Evidence of potential wave resistance or of turbulent water, implying wave resistance & evidence of some degree of control over surrounding environments.
REEF (if built mainly by organisms, ORGANIC REEF)

wave-washed talus absent:

- Organic framework present, but no evidence of water turbulence — POTENTIAL REEF (in deep or calm water)
- Abraded-grain calcarenites + remains of rooted organisms — ORGANICALLY? BOUND SKELETAL-DEBRIS REEF
- Early rims of drusy spar — SPAR-CEMENTED DEBRIS REEF

wave-washed talus present — FRAMEWORK REEF:

- Talus calcilutite: if stromatolitic, STROMATOLITE REEF; if abraded mud clasts, MUD-FRAMEWORK REEF
- Talus inorganically bound by spar cement — INORGANIC-FRAMEWORK REEF; SPAR-CEMENTED FRAMEWORK REEF
- Talus organically bound + large skeletal fragments — ORGANIC-FRAMEWORK REEF

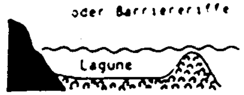
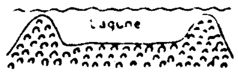
Aus Blatt 10

Riffdefinitionen(2) von Heckel 1974

DESCRIPTIVE TERMINOLOGY FOR CARBONATE BUILDUPS

PREDOMINANT CONSTITUENT	SKELETAL GRAINS	LIME MUD	NONSKEL. GRAINS
DOMINANT ROCK TYPES	PACKSTONE, GRAINSTONE BOUNDSTONE	WACKESTONE, MUDSTONE	(OVER 70% TOTALLY NONSKEL. GRAINS)
GENERAL TERM	SKELETAL BUILDUP	LIME-MUD BUILDUP	OOLITE (etc) BUILDUP
DISTINCTION AS TO SHAPE	SKEL. MOUND, KNOLL, BAR, BARRIER REEF, ATOLL, etc.	LIME-MUD MOUND, LIME-MUD BAR	OOLITE MOUND, OOLITE BAR
DISTINCTION AS TO TYPE OF SKEL. MATERIAL	e.g. SPONGE MOUND, CORAL-STROMATOPOROID PATCH REEF, BRACHIOPOD KNOLL, DIVERSE SKELETAL ATOLL		
DISTINCTION AS TO DOMINANT HABIT OF SKELETAL MATERIAL	Use ENCRUSTED for encrusting or otherwise permanently attached skeletal material e.g. ENCRUSTED BRYOZOAN MOUND, ENCRUSTED OYSTER REEF Use LOOSE for solitary colonies, unattached, whole or disarticulated skeletal material e.g. LOOSE FORAM MOUND, LOOSE GREEN ALGAL-PELMATOZOAN REEF Use ABRADED for material exhibiting abrasion e.g. ABRADED DIVERSE SKELETAL BAR Use MIXED for buildups in which no one form or component is dominant e.g. MIXED DIVERSE SKELETAL-LIME MUD-PISOLITE BARRIER REEF		

Rifftypen nach Geister 1983

	Geomorphologische Grundtypen von Korallenriffen / nähere Charakterisierung der Riffe	Saumriffe oder Kustenriffe 	Wallriffe oder Barriereriffe 	Atolle 	Korallenbänke 	Fleckenriffe 
Lage auf dem Kontinentalschelf oder Ozeanboden	Riffe auf dem Kontinentalschelf (Schelfriffe)	Schelfsaumriffe an der Küste von Jamaika, Kuba	Schelfwallriffe von Belize, Florida	"Arrecife Alacrán", ein Schelfatoll vor Yucatán	"Pedro Bank", eine Schelf-Korallenbank auf dem Nikaragua-Rücken	Schelf-Fleckenriffe von Veracruz
	ozeanische Riffe	ozeanisches Saumriff an der Südostküste von San Andrés	ozeanische Wallriffe der Inseln San Andrés und Providencia	ozeanische Atolle: Courtown Cays, Serrana Bank, Roncador Bank	ozeanische Korallenbank von Islote Aves	ozeanische Fleckenriffe vor St. Lucia
Lage auf Insular- bzw. Kontinentalschelf	Bankriffe	Banksaumriffe vor Kuba und an der SE-Küste von San Andrés	Bankbarriere-Riffe von San Andrés, Providencia, Florida, St. Croix	Bankatolle: Courtown Cays, Serrana Bank, Roncador Bank	—	—
	Schelfkantenriffe	?	Schelfkanten-Wallriff Belize	Schelfkanten-Atoll Glovers Reef	—	—
Lage im offenen Meer oder in einer Lagune bzw. Bucht	offenmeerische Riffe	offenmeerisches Saumriff an der SE-Küste von San Andrés	offenmeerische Wallriffe von Providencia, Belize, Florida	offenmeerisches Atoll: Glovers Reef, Courtown Cays, Serrana Bank	offenmeerisch sind alle bekannten westindischen Korallenbänke	offenmeerische Fleckenriffe (z.B. Kelchriffe) von Bermuda und St. Lucia
	Lagunenriffe	Lagunen-Saumriff "Little Reef" vor San Andrés, Bahía de Concha bei Sta. Marta	Lagunen-Wallriff, z.B. die innere Barriere bei den Riffkomplexen von Martinique und St. Croix	Lagunenatolle: "Rhomboid Shoals" von Belize	nicht beschrieben	Lagunen-Fleckenriffe von Glovers Reef-Atoll
Lage zum heutigen Meeresspiegel	seichte Riffe (Flachwasserriffe)	alle oben genannten Riffe	alle oben genannten Riffe	alle oben genannten Riffe	seichte Korallenbänke: Pedro Bank, Isla de Lobos, Islote Aves	alle oben genannten Riffe
	ertrunkene Riffe	?	ertrunkene Wallriffe von Florida, Barbados, San Andrés	ertrunkenes Atoll: Saba-Bank	ertrunkene Korallenbänke: Flower Garden Banks	ertrunkene Fleckenriffe von West Flower Garden Bank und Saba-Bank
	aufgetauchte Riffe	nicht beschrieben	aufgetauches Wallriff der Rosario-Inseln	nicht beschrieben	nicht beschrieben	nicht beschrieben
Lage zum Passat	luvseitige Riffe	luvseitiges Saumriff vor Galeta Point, Panamá	luvseitiges Wallriff von Providencia	—	—	luvseitige Fleckenriffe im NE und E von Bermuda
	leeseitige Riffe	leeseitiges Saumriff von Barbados und Curaçao	leeseitiges Wallriff von Barbados (ertrunken)	—	—	leeseitige Fleckenriffe vor Anegada, Jungfern-Inseln
Anzahl der parallelen Riffzüge	einfache Riffe	alle oben genannten Riffe	fast alle bekannten Wallriffe	alle genannten Atolle Ausnahme: Saba-Bank	—	—
	doppelte bzw. mehrfache Riffe	dreifaches Saumriff von Great Corn Island	doppeltes Wallriff von Martinique und St. Croix	doppeltes Atoll der Saba-Bank (ertrunken)	—	—

Dia 1219: Malediven-Atolle

Dia 1234: Inselsaumriff Lizard Island, GBR

Inselbarrierereriff, Providencia, Kolumbien

Barriereriff, San Andres (Foto Leinfelder)

Barriereriff, San Andres (Foto Leinfelder)

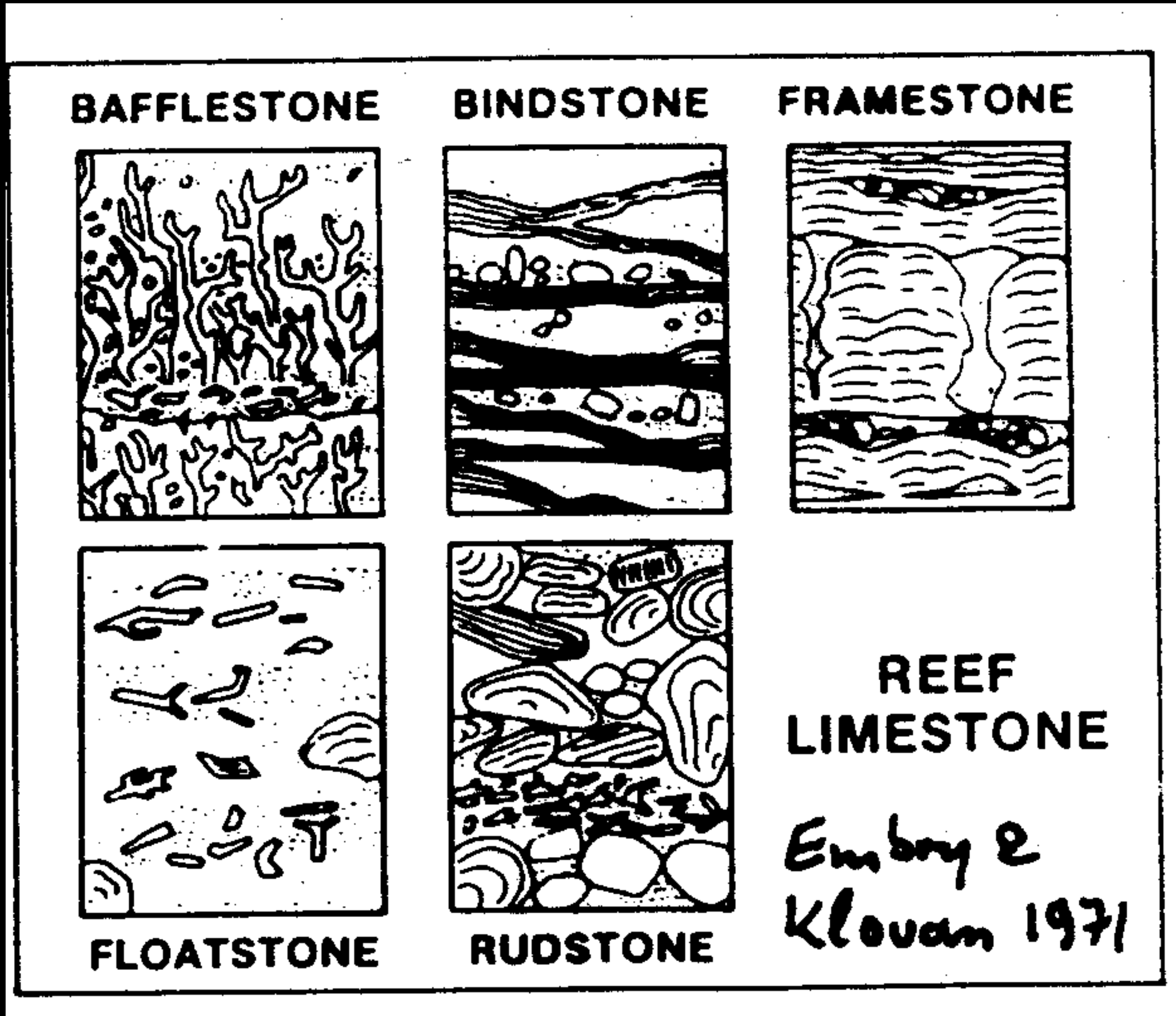
Saumriff, Fleckenriffe, Providencia (Foto Leinfelder)

Barrierereriff, Fleckenriffe, Providencia (Foto Leinfelder)

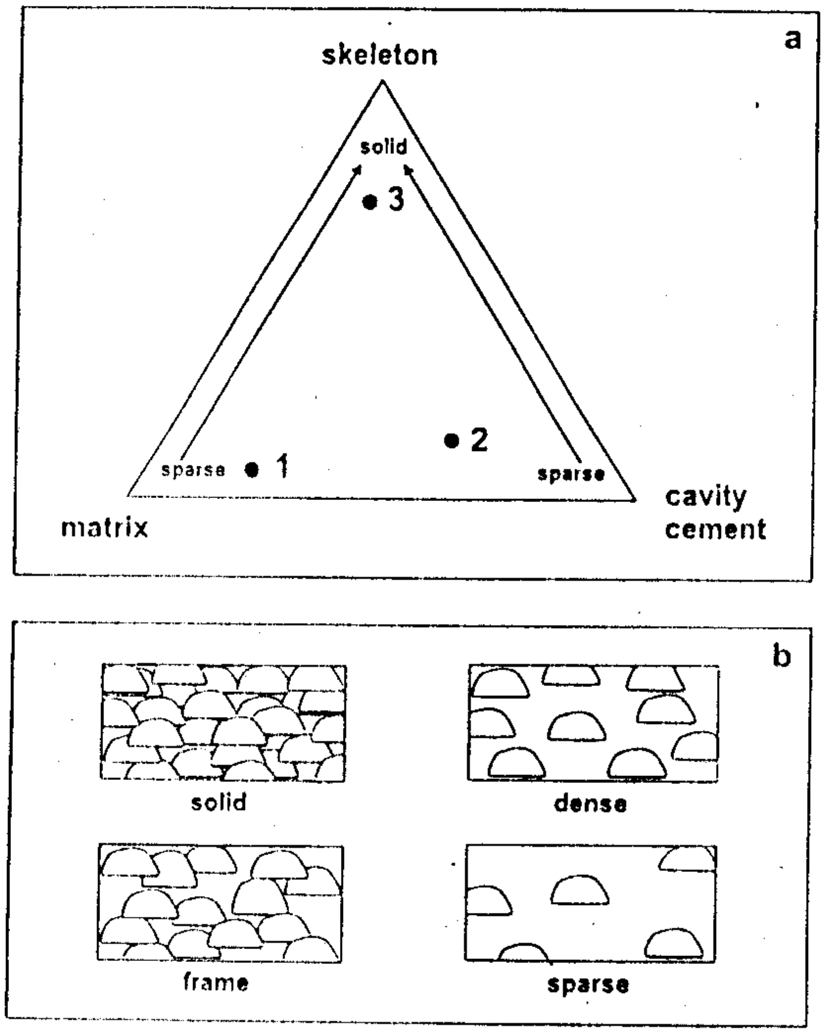
Barriereriff, Fleckenriffe, Providencia (Foto Leinfelder)

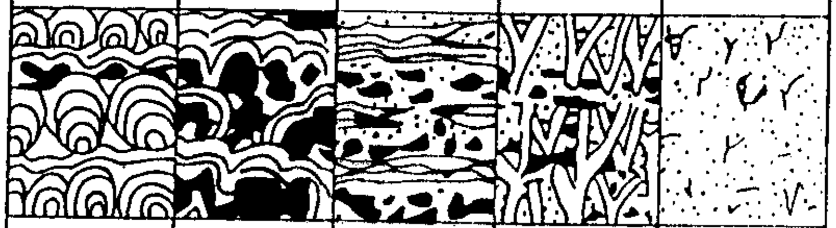
Barrierereriff, Fleckenriffe, Netzriffe Providencia
(Film Schmid/Leinfelder)

Weitere sedimentologische Charakterisierungsmöglichkeiten



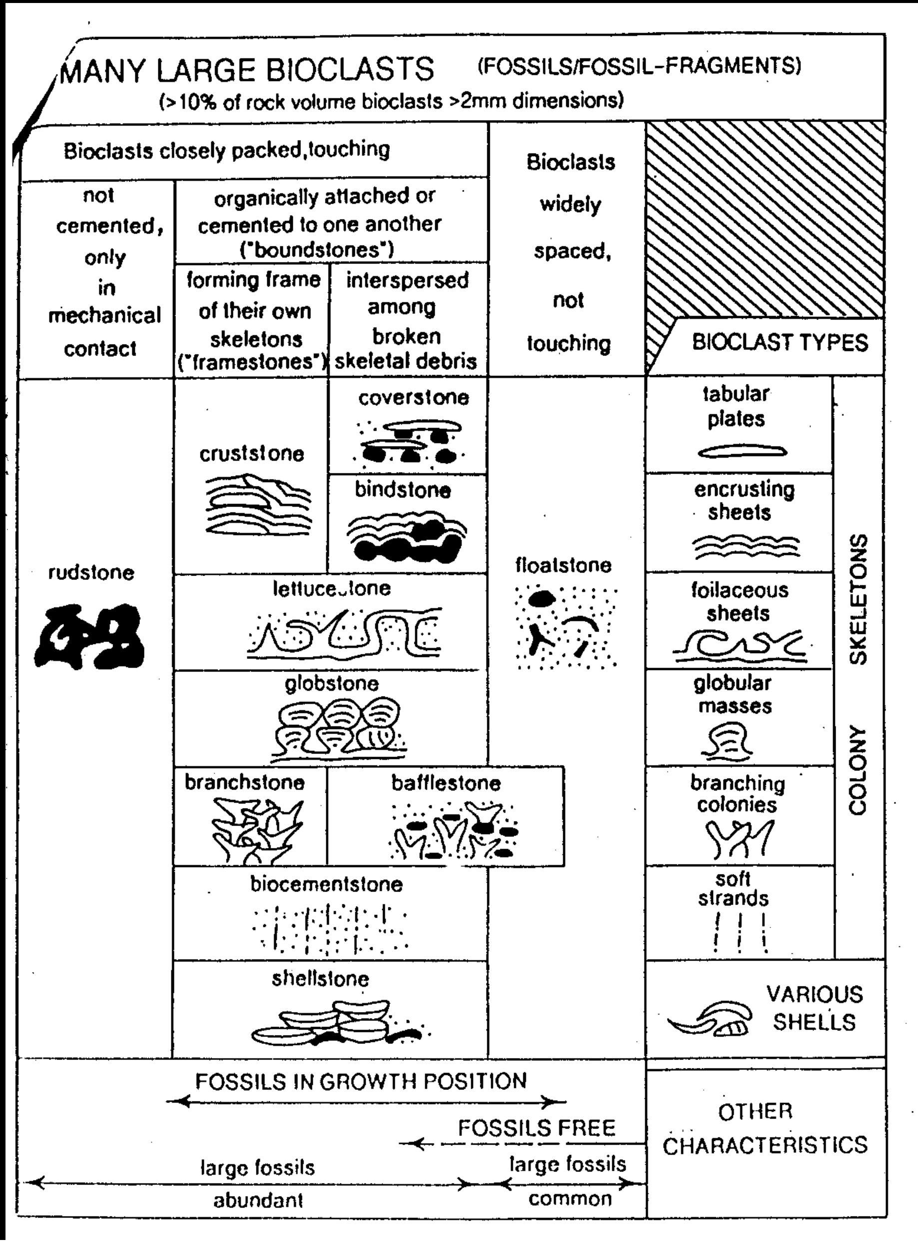
Weitere sedimentologische Charakterisierungsmöglichkeiten



Original components organically bound together during deposition				
By massive organisms which build a rigid framework	By encrusting organisms which encrust fragments	By tabular organisms which cover debris and sediments	By branching organisms which act as baffles	By vagrant organisms which cement debris and sediments
				
Framestone	Bindstone	Coverstone	Bafflestone	Biocement stone

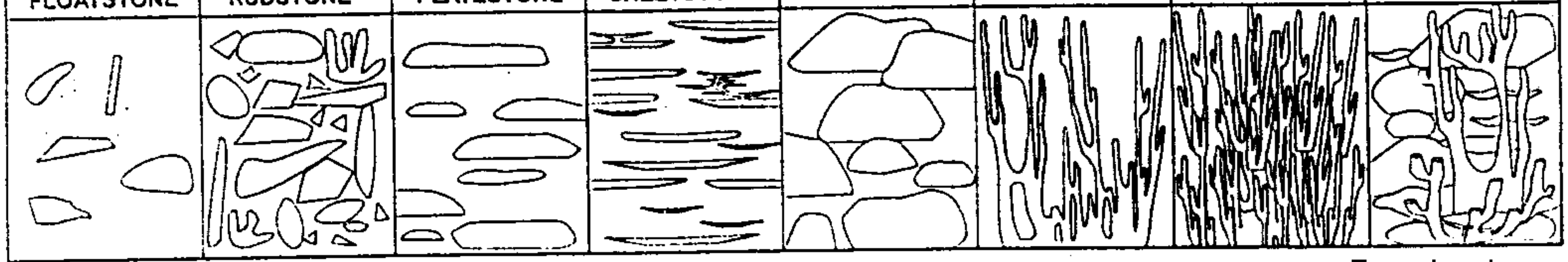
Aus Blatt 11b

Weitere sedimentologische Charakterisierungsmöglichkeiten



Weitere sedimentologische Charakterisierungsmöglichkeiten

ALLOCHTHONOUS		AUTOCHTHONOUS					
Depositional fabric dominated by bio- and lithoclastic reefal material. More than 10% of the fragments are greater than 1 cm in size.		Facies dominated by a growth fabric of *in situ* and *in growth position* skeletons of calcifying organisms.					
Matrix supported.	Supported by the greater than 1 cm component.	Growth fabric dominated by platy to tabular colonies where calcification in the horizontal plane dominates over that of the vertical plane (width to height ratio of dominant organisms: 30:1 - 5:1). These growth forms constitute more than 60% of the total CSV.	Growth fabric dominated by sheet-like & lamellar colonies where calcification in the horizontal plane greatly dominates over that of the vertical plane (width to height ratio: >30:1). These growth forms constitute more than 60% of the total CSV.	Growth fabric dominated by domal & irregular massive colonies which have the same calcification potential in all free directions. These growth forms constitute more than 60% of the total CSV.	Growth fabric dominated by organisms which have a dominant vertical component of growth and relatively restricted lateral growth (for example all types of branching colonies and rod and tubular solitary forms). These growth forms constitute more than 60% of the total CSV.		No one growth form dominate in terms of CSV.
					PILLARSTONE		
FLOATSTONE	RUDSTONE	PLATESTONE	SHEETSTONE	DOMESTONE	*Sparse*	*Dense*	MIXSTONE

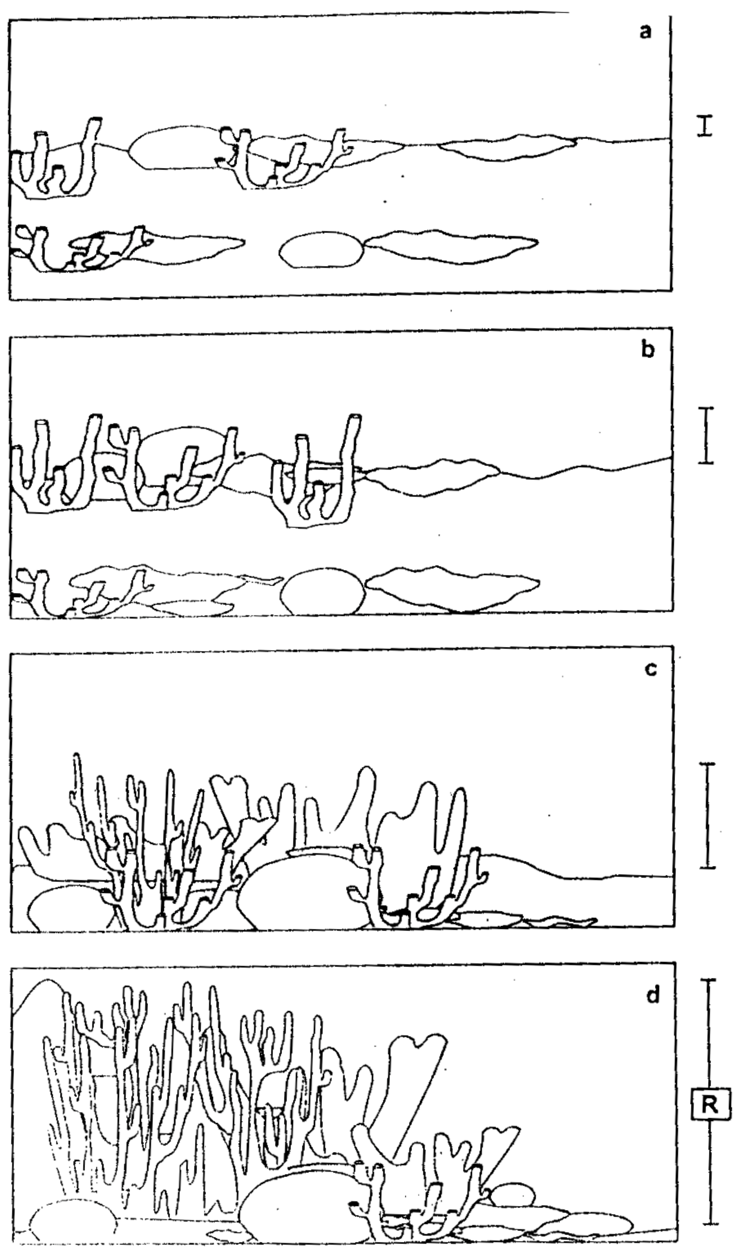


From Insalaco

Aus Blatt 11c,d

Weitere sedimentologische Charakterisierungsmöglichkeiten

Constratal growth



SUPERSTRATAL GROWTH

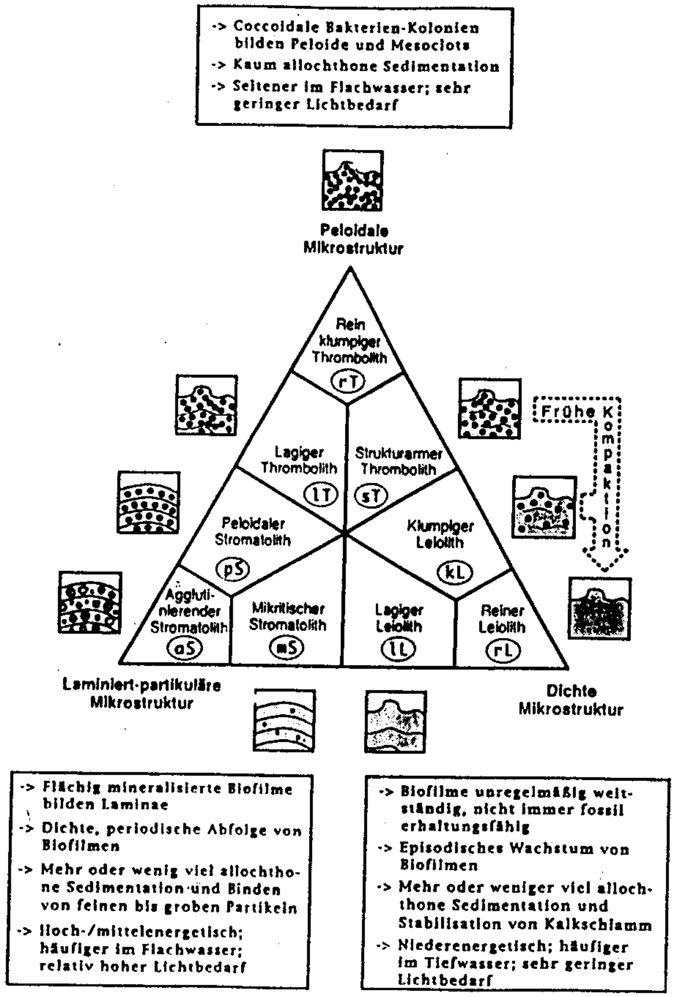


Abb. 10: Prozesse, welche für die Entstehung der drei Hauptgefügetypen von Mikrobolithen bestimmend sind.
Fig. 10: Processes determining the development of the three main fabric types of microbolites (cf. fig. 8).

Riffgefüge - Differenzierung

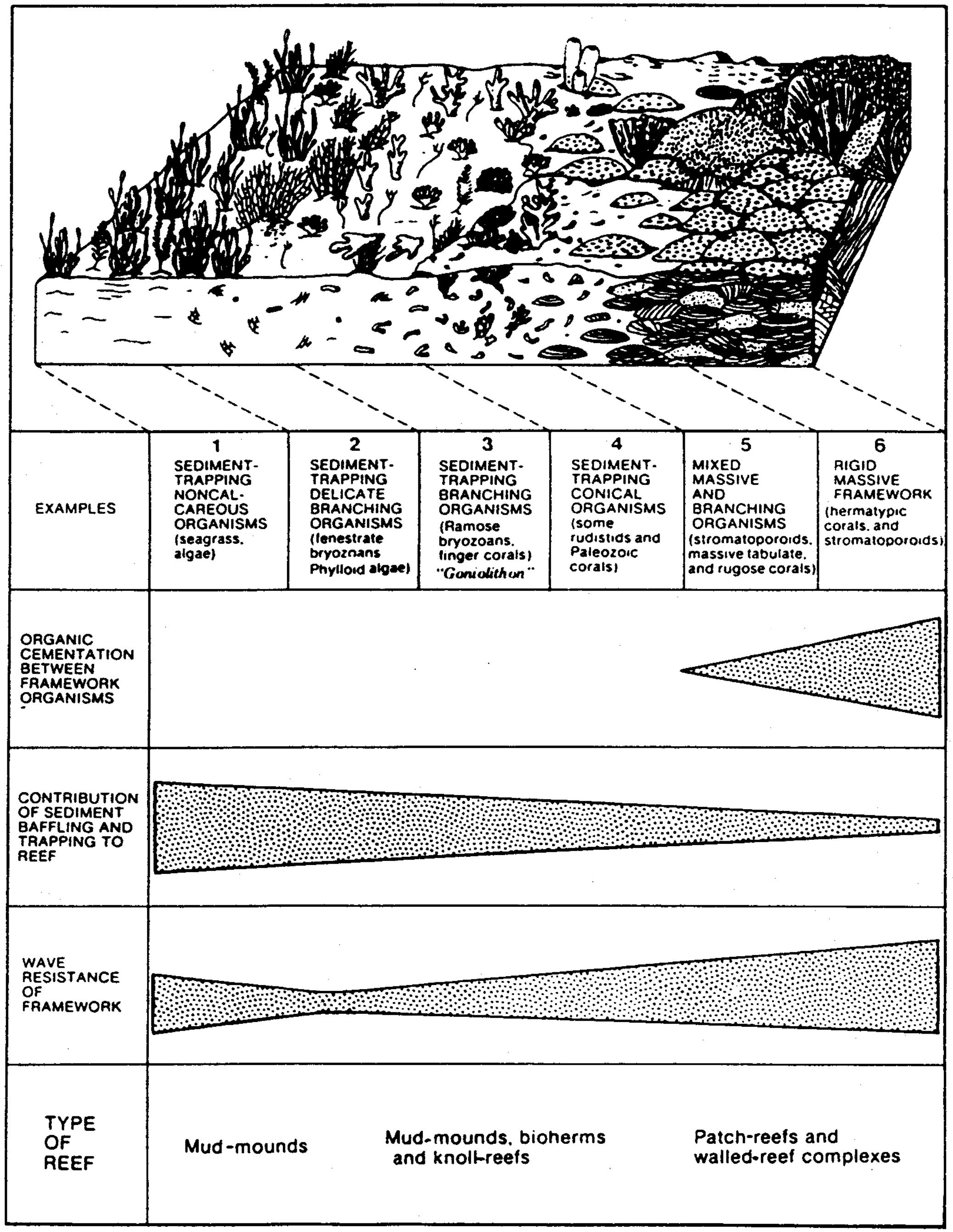


FIG. 5.—Variation in types of reef framework from non-calcareous "invisible" frameworks such as sea gras
might form to massive organically-bound skeletal biolithites.

Aus Blatt 12

Riffzonen - Übersicht (nach James 1984)

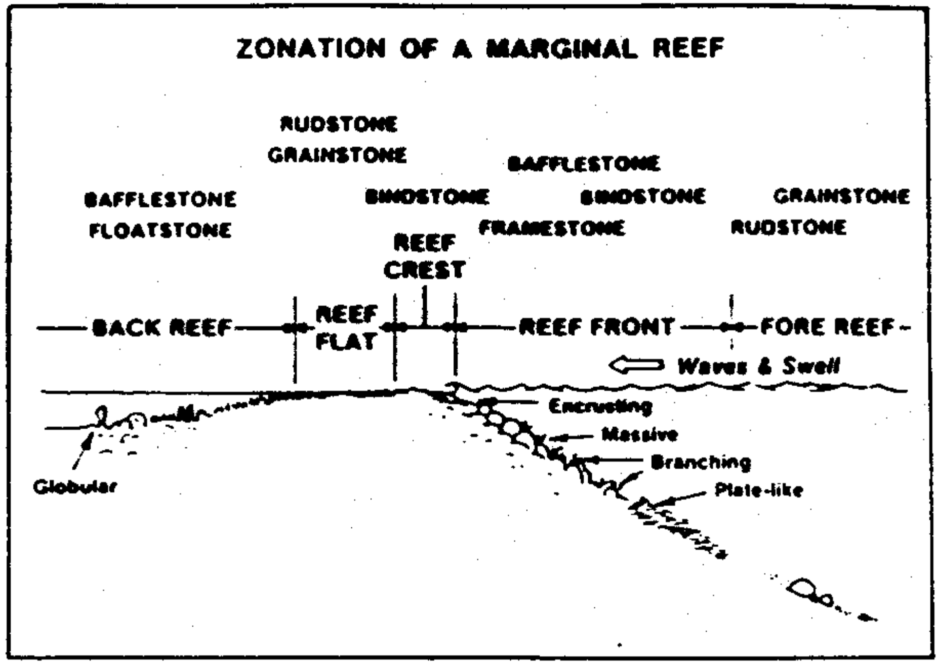


Figure 9
Cross-section through a hypothetical, zoned, marginal reef illustrating the different reef zones, spectrum of different limestones produced in each zone, and environment of different reef-building forms.

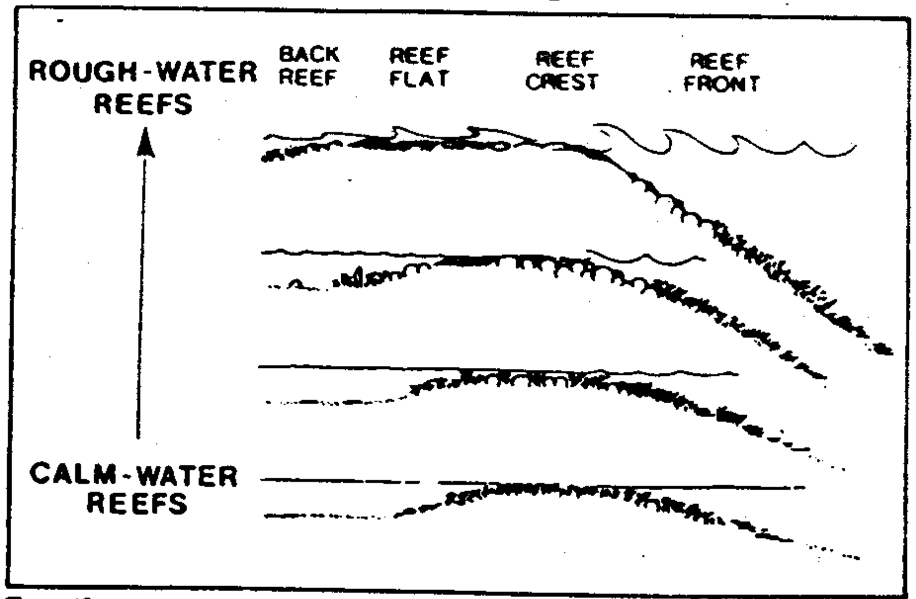


Figure 10

Dia 1171: Spurs and Grooves, Jamaica

An alternative reef framework concept

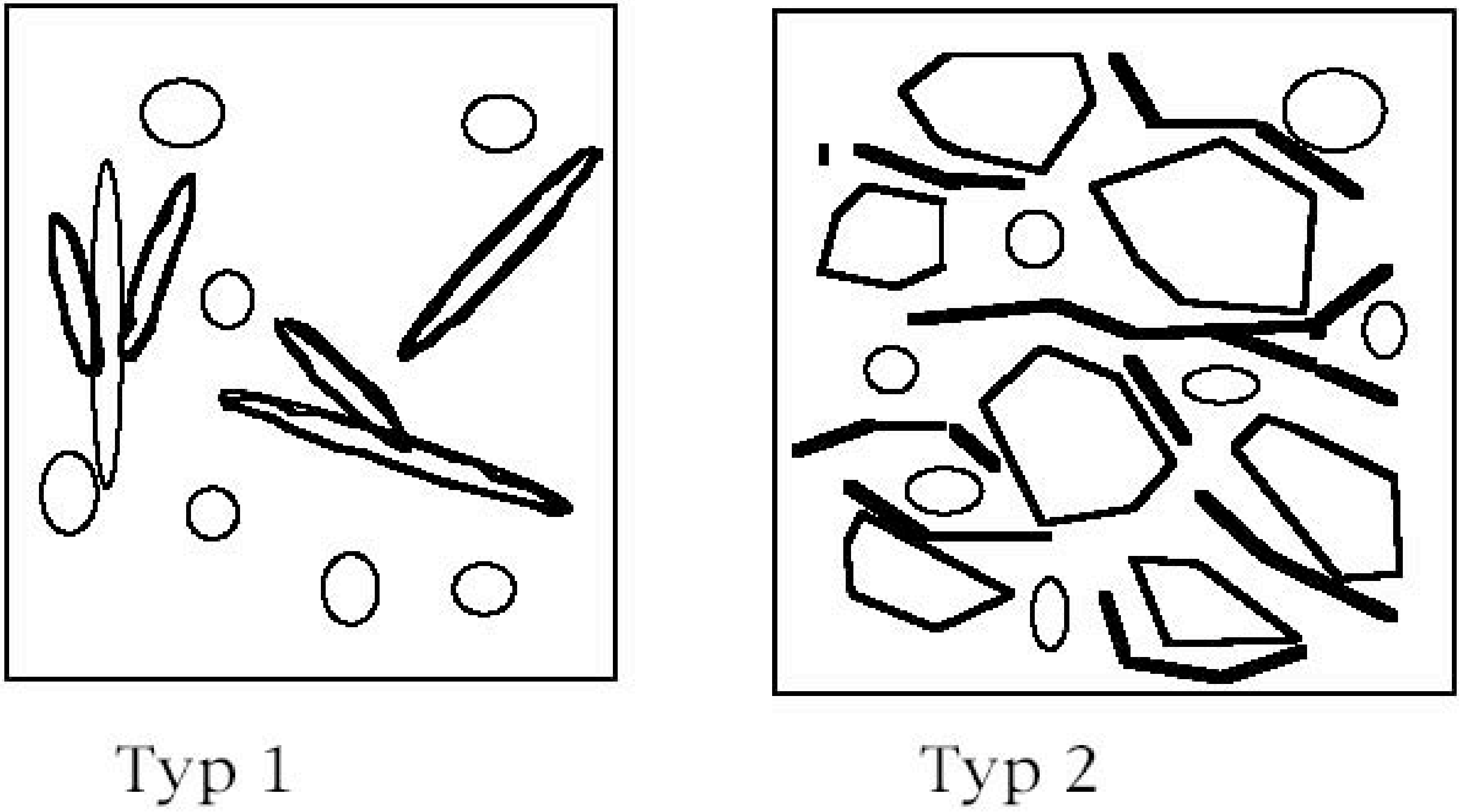
partly based on Geister 1985

- Central reef zone
  - Loose detrital sediments (interreef grooves etc.)
  - Reef frameworks
    - Unpreservable (‚loose‘) frameworks
    - Preservable (‚rigid‘) frameworks

An alternative reef framework concept

partly based on Geister 1985

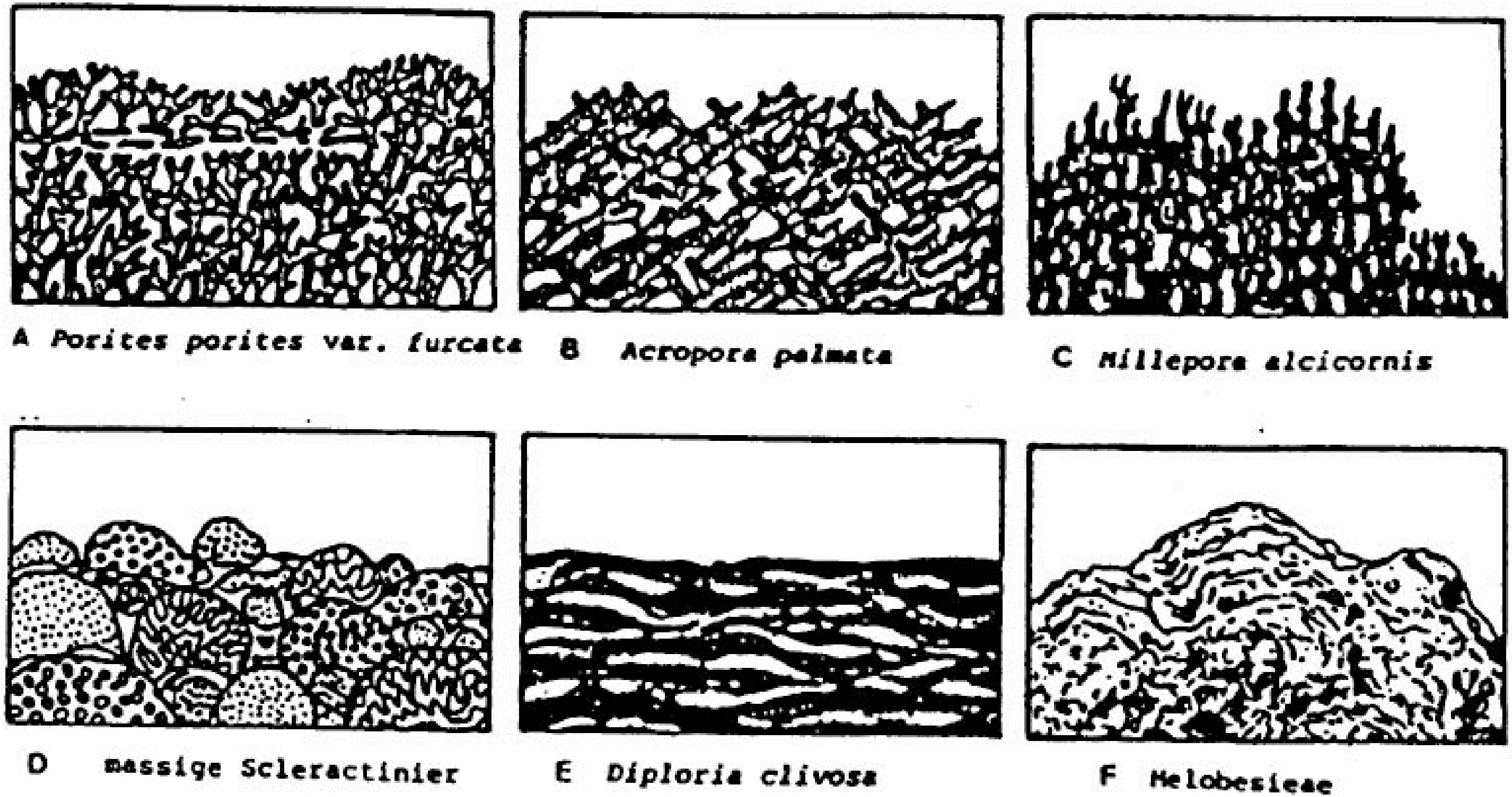
Non preservable, ‚loose‘ frameworks in Modern reefs



Low to moderate energy, caused mainly by bioerosion, no obvious binding

Highest energy, from storm-abrasive settings. Original framework destroyed and bound by coralline algae.

An alternative reef framework concept
‚rigid‘ frameworks in Modern reefs



B-F often from storm-/hurricane influenced reef zones, but similar fabrics C-E might also develop in tranquil deeper water.A is from tranquil waters.

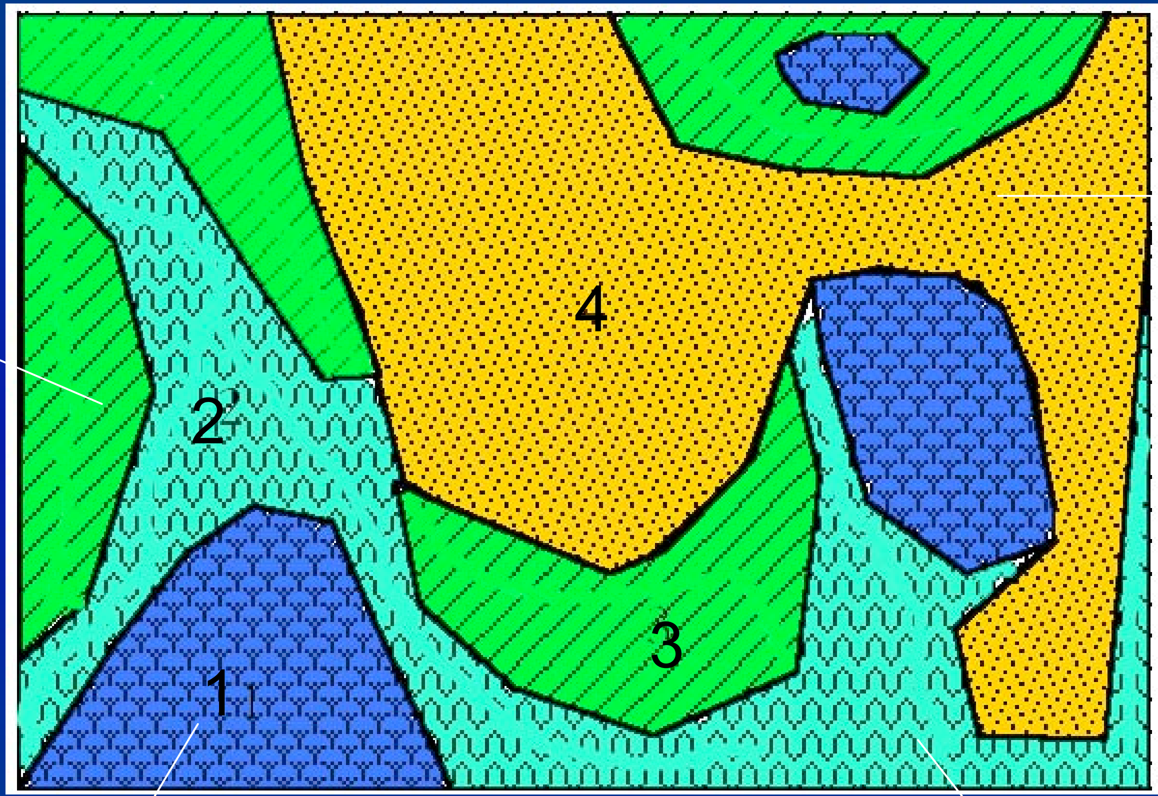
Modern high-energy barrier reef

(Provicencia, Caribbean, Colombia)

Riffe und Lagunen

Possible Framework preservation of a Modern-type high-energy central reef
(vertical cross-section)

(3) algal-bound debris, mostly transported material



(4) Sparitic Grain-/rudstones formerly loose sands

| <- 1 to 100s m -> |

(1) Rigid preserved framework, many corals in-situ

(2) coralline-bound, fragmented framework
some in-situ preservation(‚loose‘ framework, type 2)

Reef Fabric and Energy

Conclusion:

(1) Rigid and loose **frameworks** do **not necessarily say much about environment** and wave energy

(2) Often only **low-energy reefs** are preserved as bioframework (if at all)

(3) a lot of **debris** may be produced **both in low and high-energy reefs.**

(4) Need to **use additional criteria**

What about Reef Zonation and Faunal Zonation?

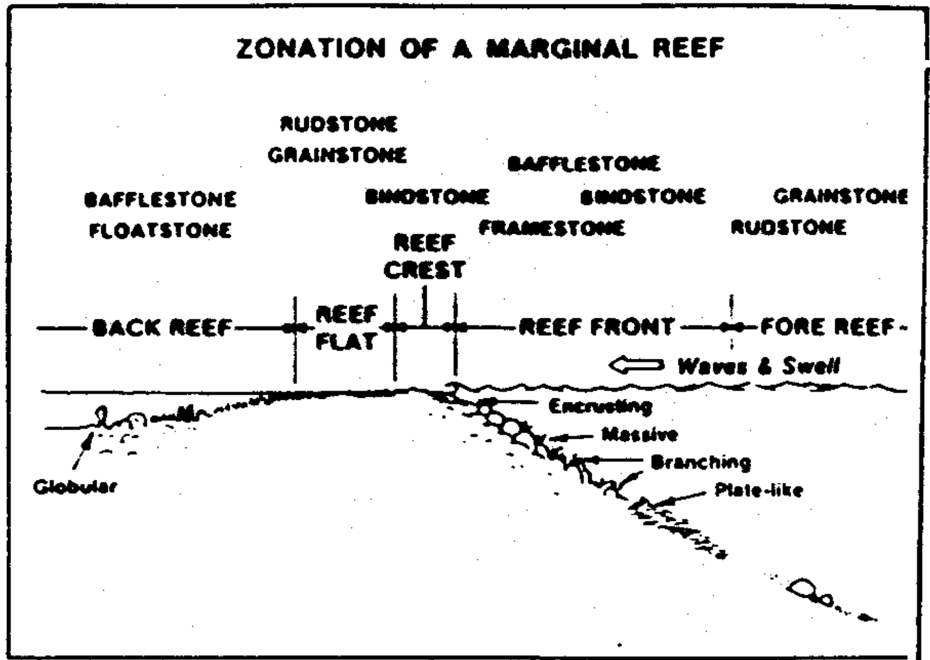
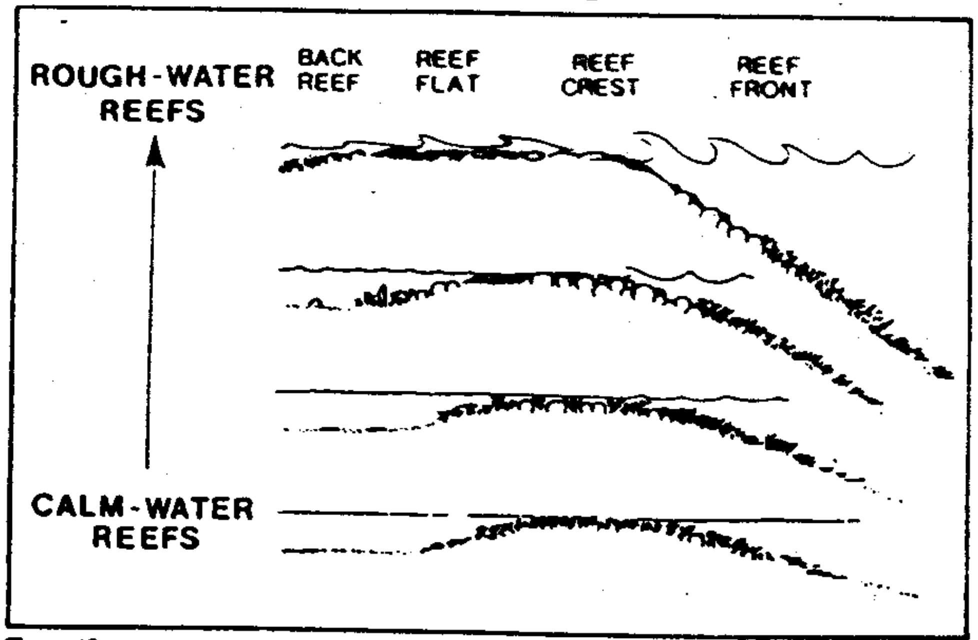
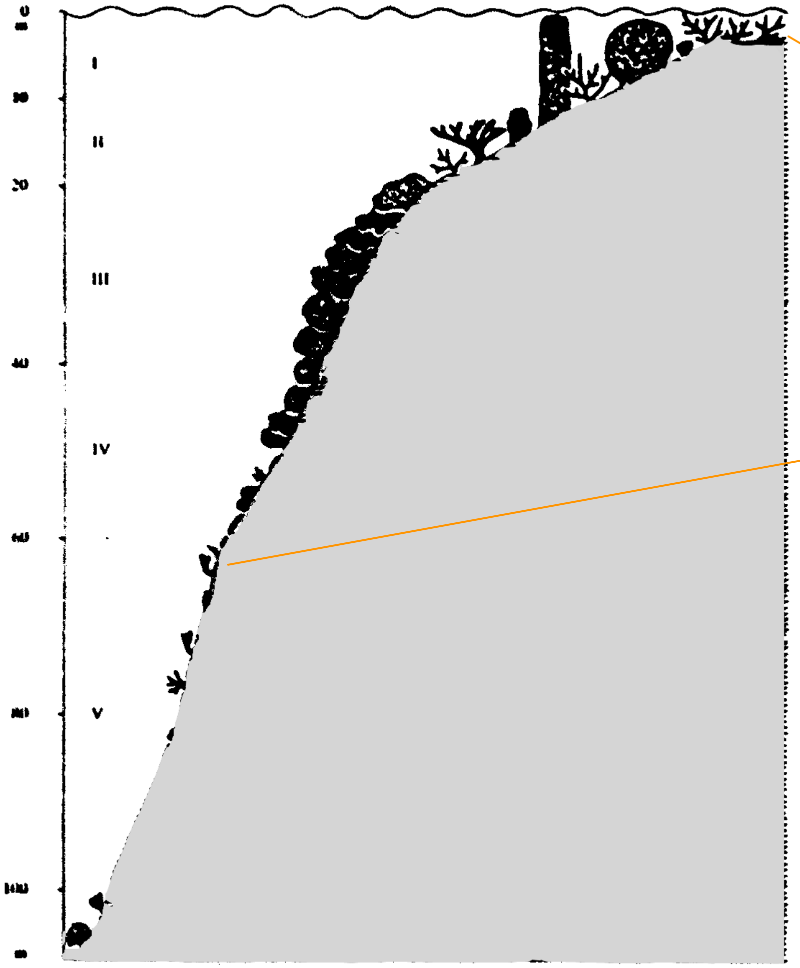


Figure 9
Cross-section through a hypothetical, zoned, marginal reef illustrating the different reef zones, spectrum of different limestones pr[o]duced in each zone, and environment of different reef-building forms.



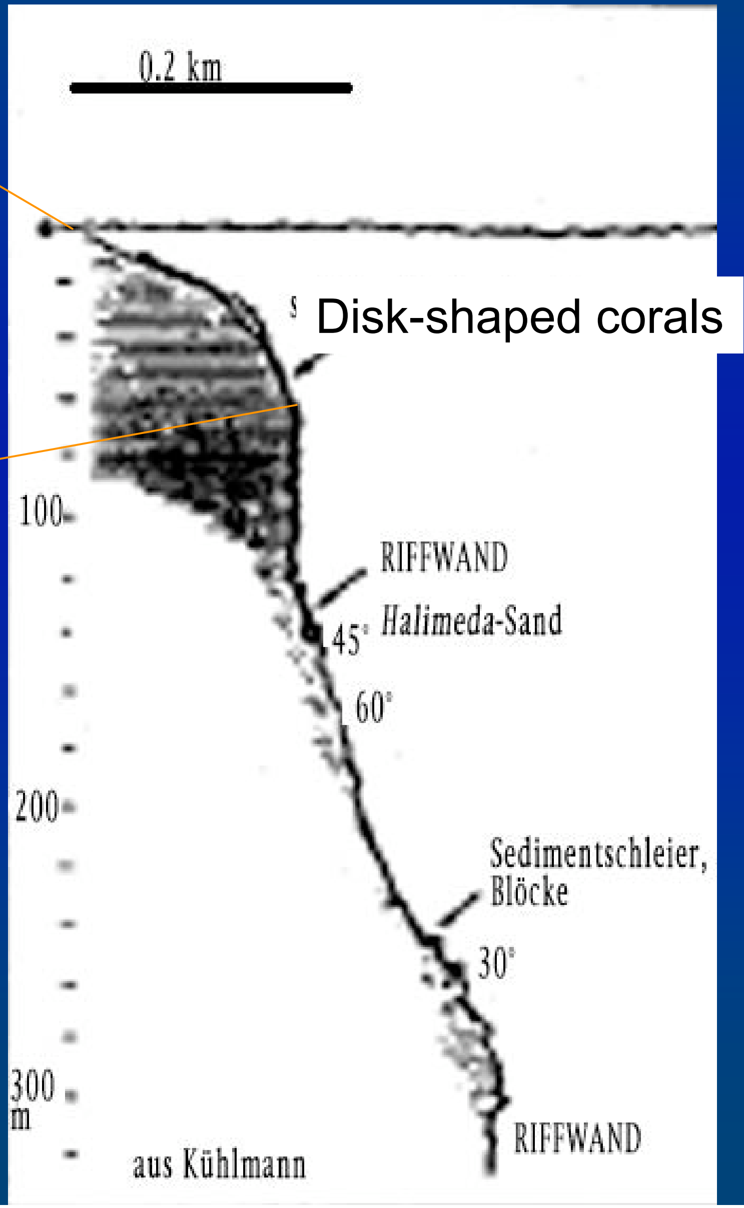
From N. James

Coral Morphology Trends

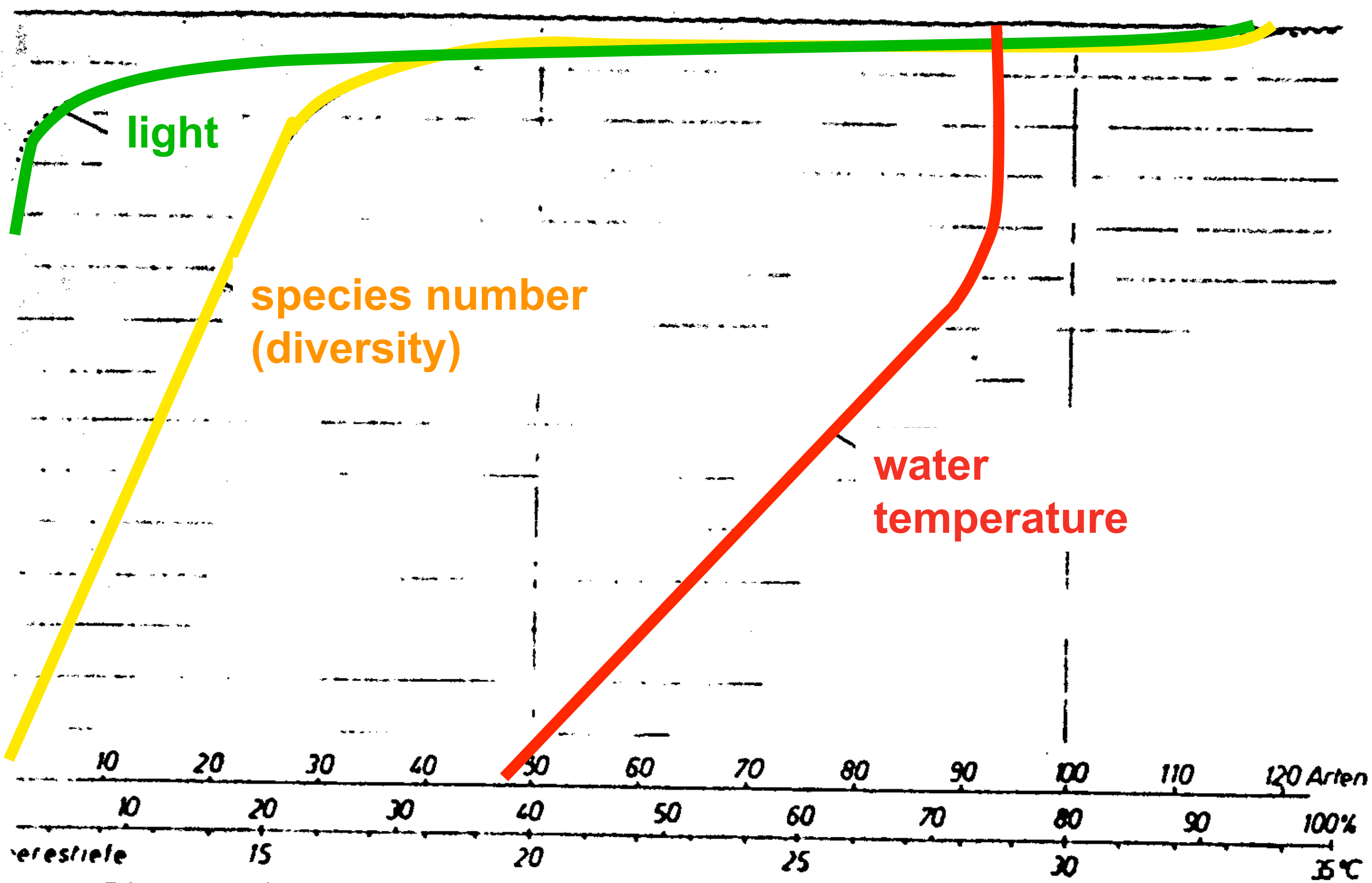


11 Der Steinkorallenbewuchs in den verschiedenen Lichtzonen
I „Rotzone" mit strauchigen Korallen. II „Gelbzone" mit massiven und strauchigen Korallen.
III „Grünzone" mit blattförmigen Korallen.
IV „Blauzone" mit blattförmigen und lockerem, krustigem Korallenbewuchs. V „Dunkelzone" mit spärlichem Bewuchs kleiner aposymbiotischer Korallen

Kühlmann 1984



Coral Diversity and Bathymetry



. 176. Die Artenzahl (Diversität) hermatypischer rezenter Hexakorallen bei Bikini (Pazifik) und ihre ängigkeit von der Meerestiefe bzw. dem Lichteinfall. Die Lichtmenge ist angegeben in % des Lichtes an der resoberfläche. Die Wassertemperatur übt keinen direkten Einfluß aus. Nach J. W. Wells.

Caribbean coral „depth zones“

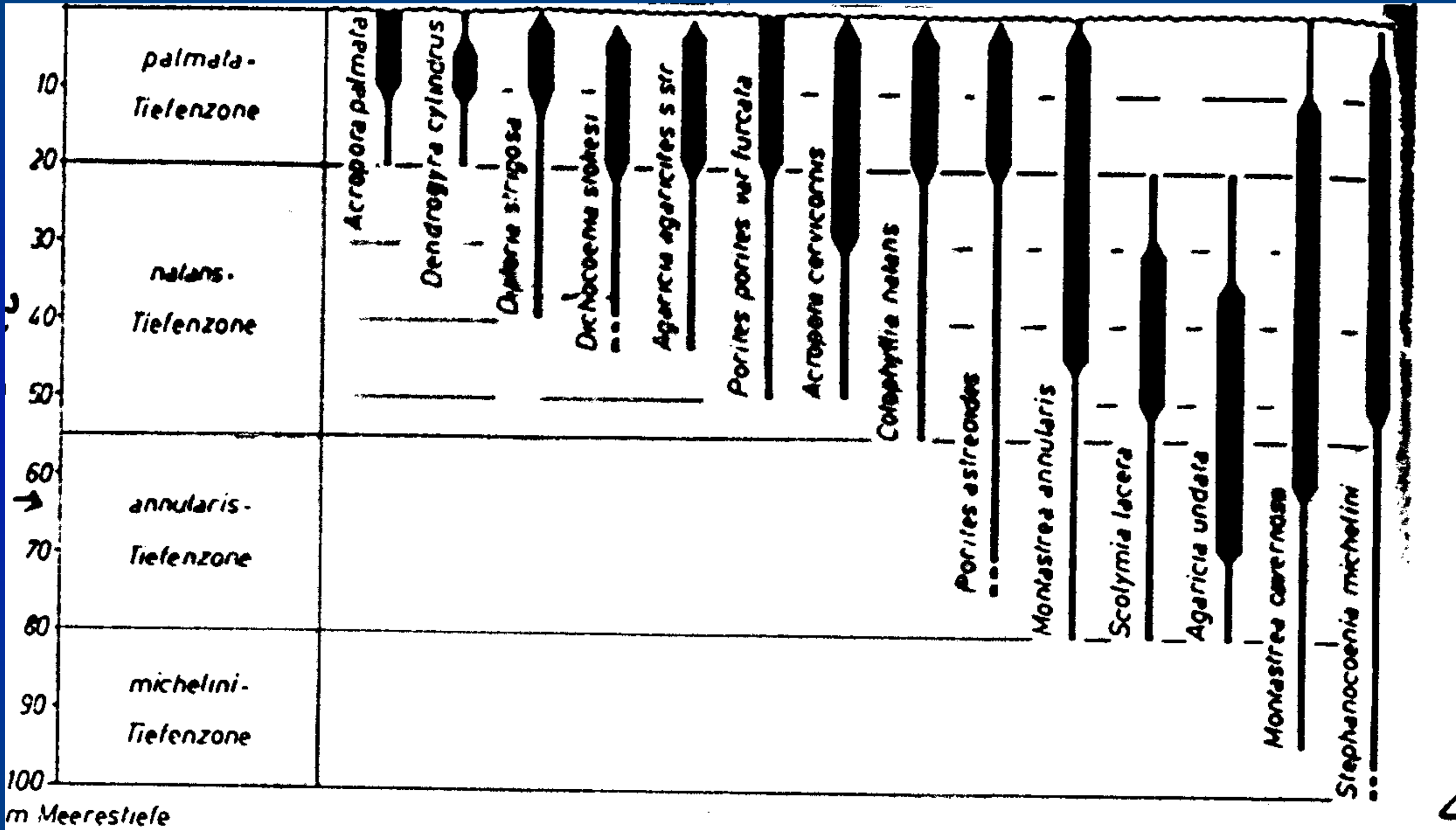
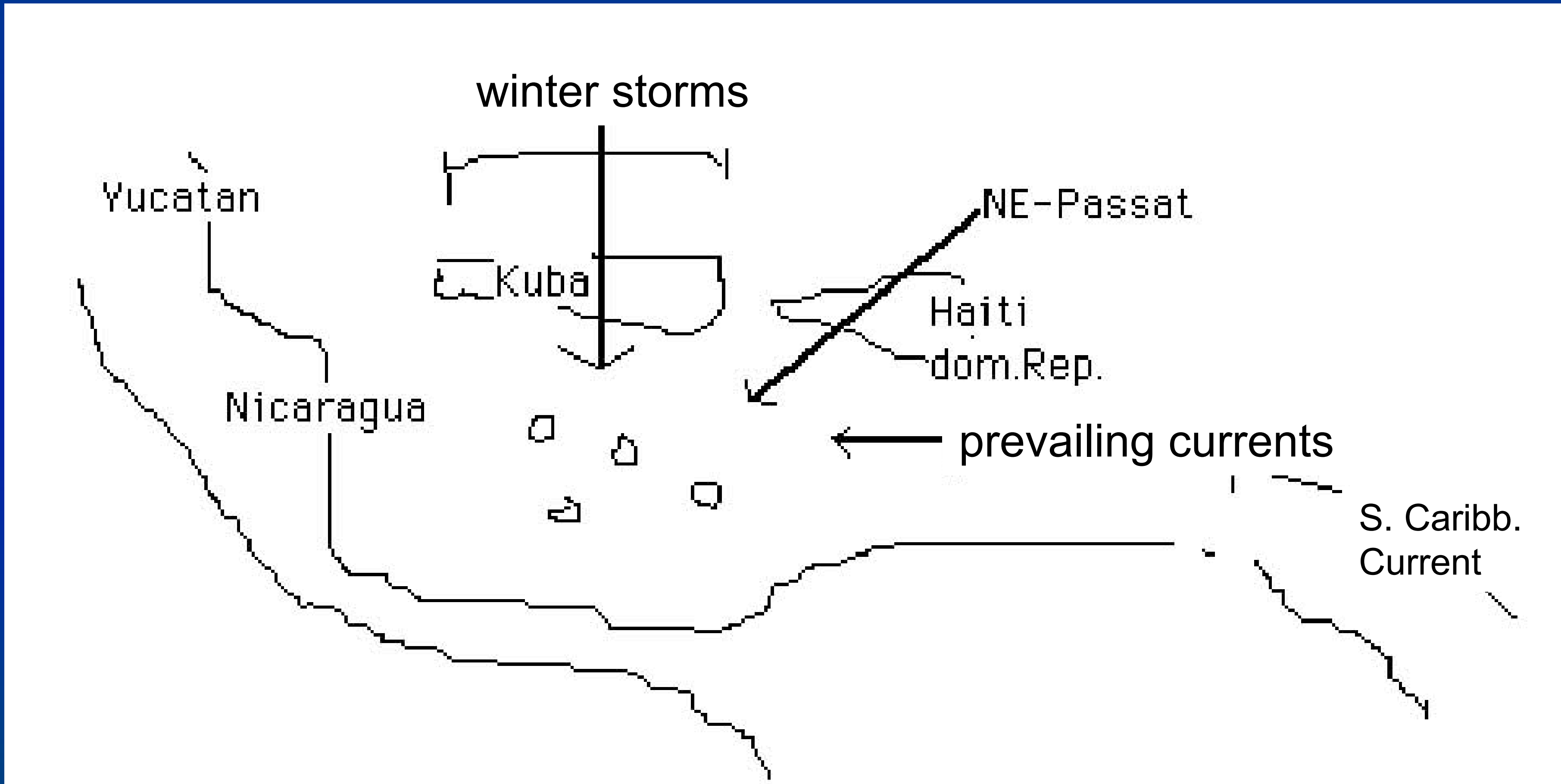


Abb. 177. Die bathymetrische Verbreitung einiger Scleractinier-Arten im Karibischen Meer. Nach J. GEISTER.

Caribbean zoned coral associations

(based on Geister 1975 and follow ups)



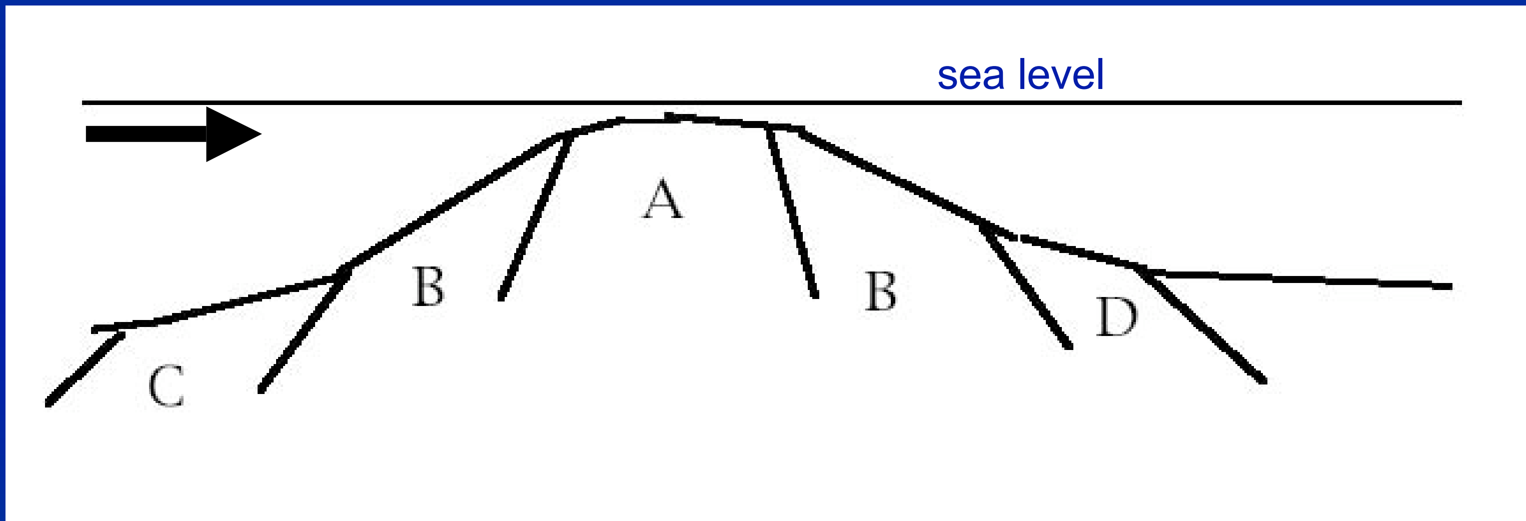
Prevailing hydraulic energy from eastern directions
Abrasive high energy from northern directions

Caribbean zoned coral associations

(based on Geister 1975 and follow ups)

Outer wave zones

Inner wave zones

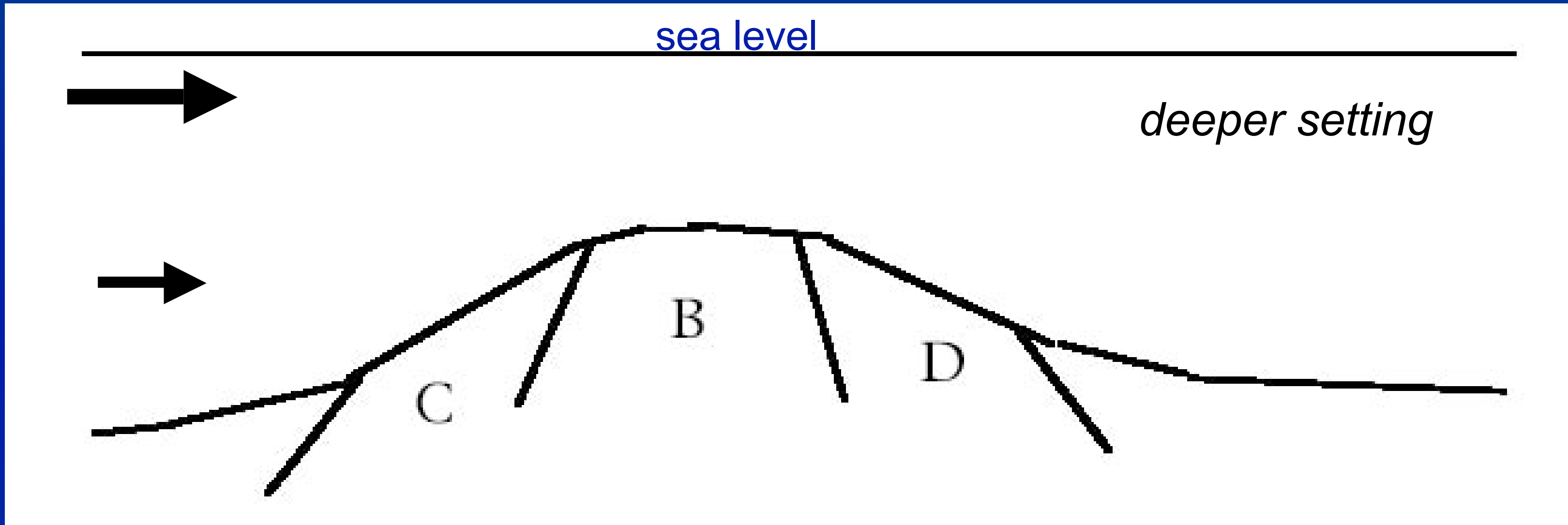


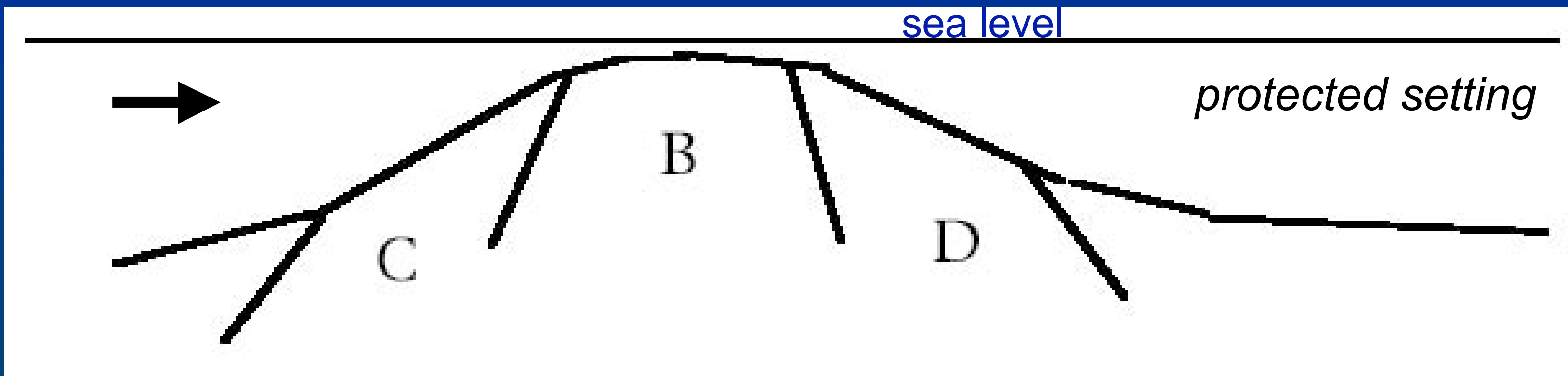
Caribbean zoned coral associations

(based on Geister 1975 and follow ups)

Outer wave zones

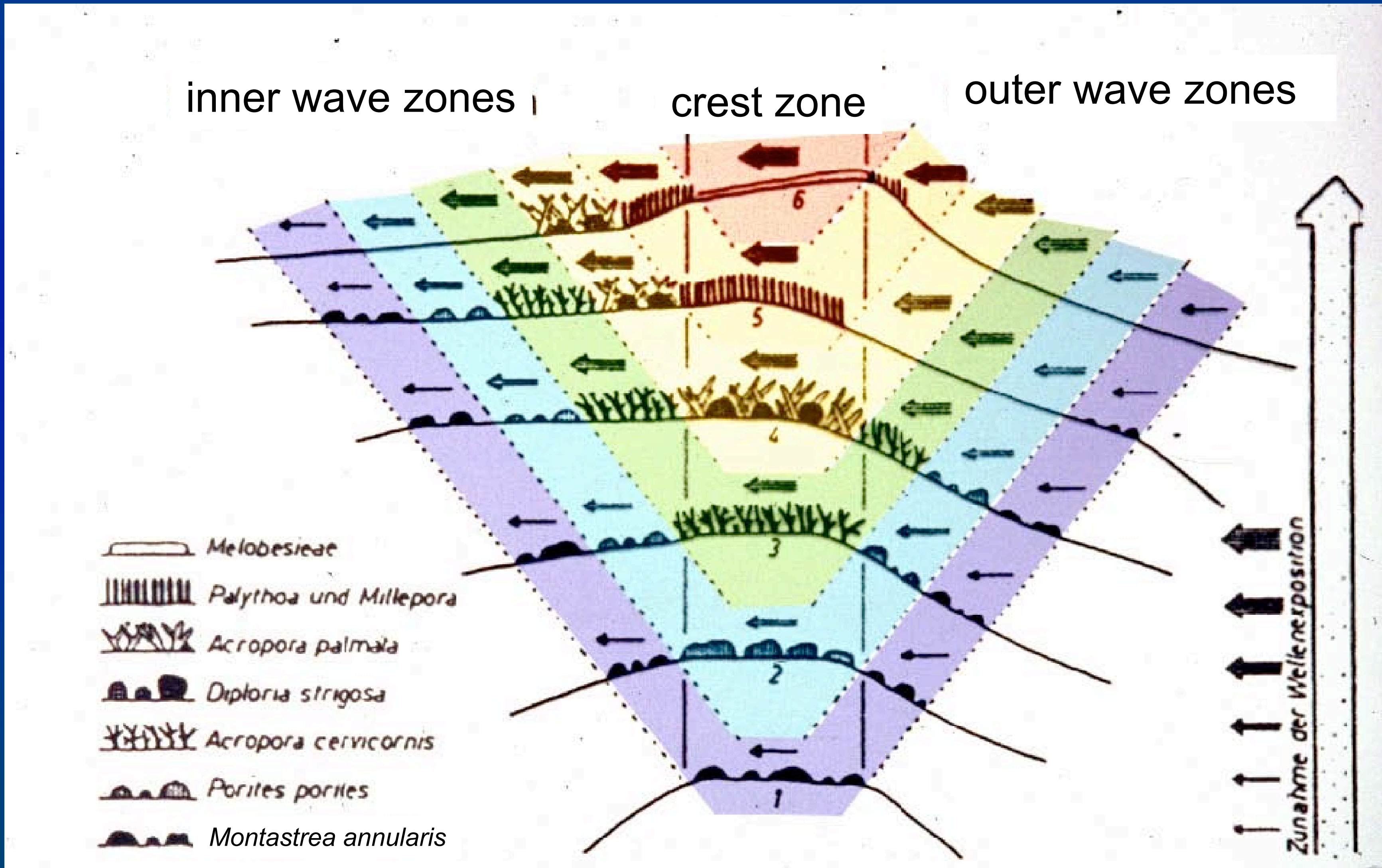
Inner wave zones



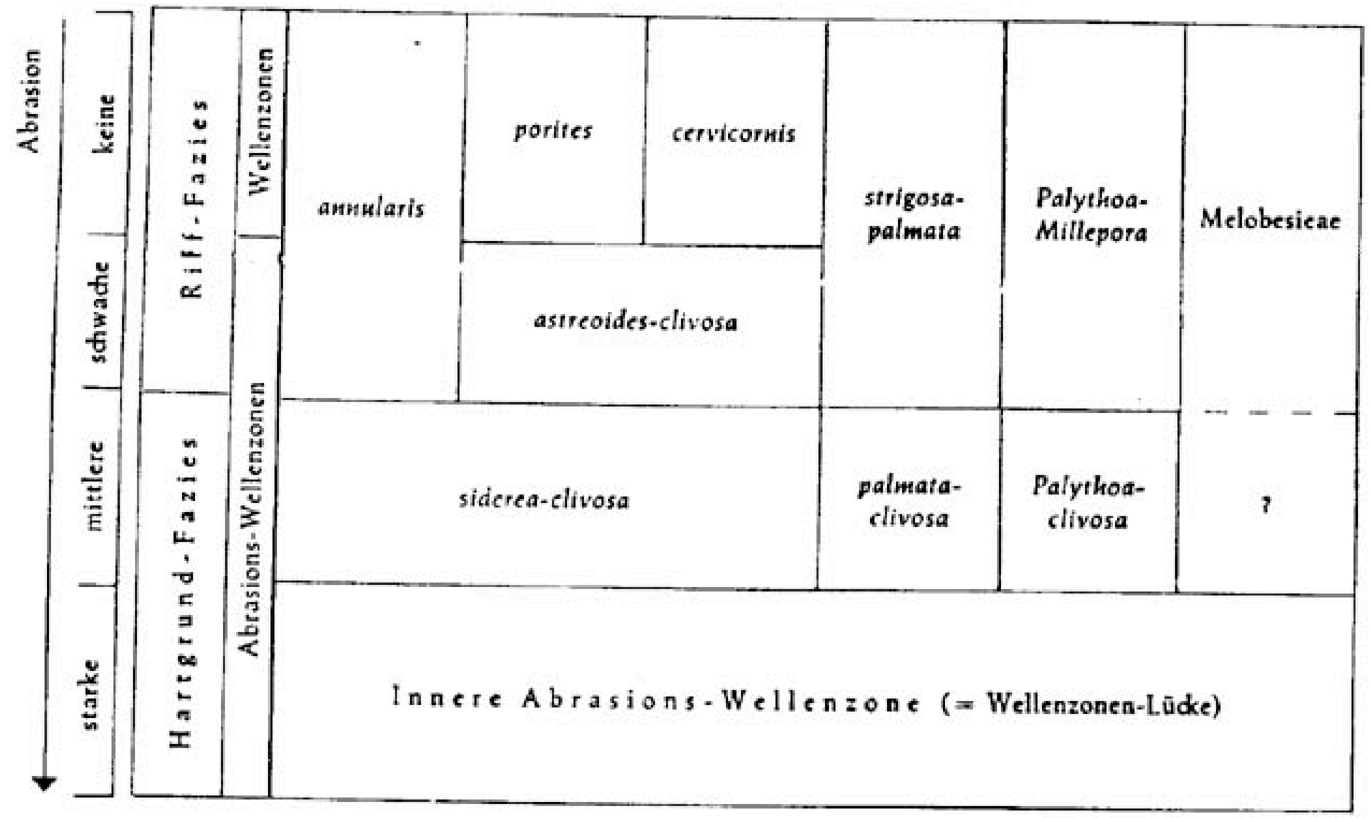


Caribbean zoned coral associations

(based on Geister 1975 and follow ups)



Zu Wasserenergie



Tab. 4. Einfluß von jahreszeitlich bedingter Abrasion verschiedener Intensität auf die Ausbildung der Wellenzonen und die Entstehung von Abrasions-Wellenzonen.

Influence of the degree of seasonal abrasion on the wave zonation pattern and development of abrasional wave zones.

Von Blatt 8