

LV1 – Grundlagen der Sedimentologie und Faziesanalyse
(1 SWS – Vorlesung, Kursnummer 600176)

LV2 – Laborübungen zur Sedimentologie und Sedimentpetrographie
(5 SWS – Übung Kursnummer 600179)



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Volker Karius
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Sedimentologie/
Umweltgeologie



HvE / SED - Grundlagen

LV2 – Laborübungen zur Sedimentologie und Sedimentpetrographie

(5 SWS – Übung Kursnummer 600179)

Vorbesprechung: 05.11.14, 14.15 Uhr, MN16

Der Kurs findet als Kompaktkurs im Anschluss an die Vorlesungszeit statt

Termin: 09.02. – 20.02.2015

Die Teilnahme an der Vorbesprechung ist verpflichtend.

Bitte tragen Sie sich bereits vorab in die Liste am Schwarzen Brett ein.

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Literatur

Füchtbauer, H.: Sedimente und Sedimentgesteine, 1988.

Hsü, K.J.: Physics of Sedimentology. 2nd edition, Springer, 2004.

Miall, A.D.: The Geology of Fluvial Deposits, 1996.

Ricci Lucchi, F.: Sedimentographica – A Photographic Atlas of Sedimentary Structures, 1995.

Stow, D.A.V.: Sedimentgesteine im Gelände. Spektrum 2008.

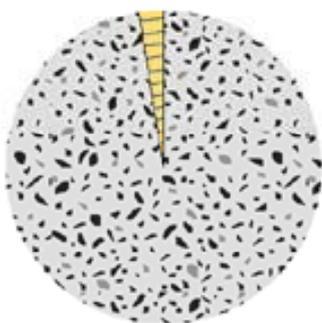
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Tucker, M.E.: Sedimentary Petrology, 3rd edition, 2001.

<http://www.sediment.uni-goettingen.de/skript.html>

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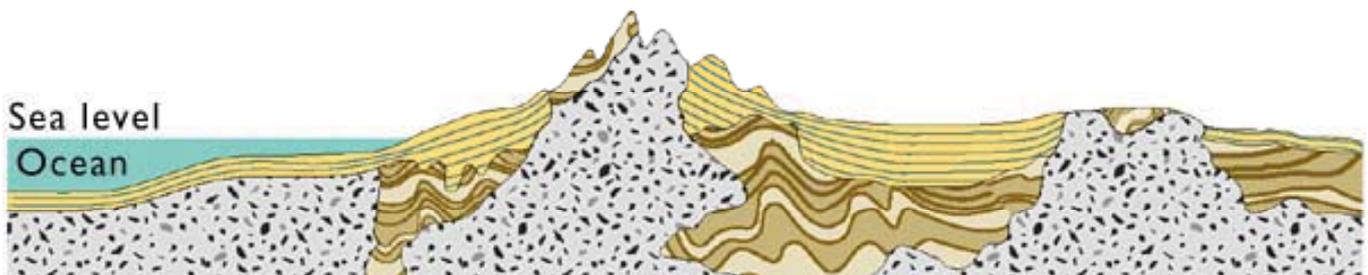
Verbreitung der Sedimente und Sedimentgesteine



Crustal volume



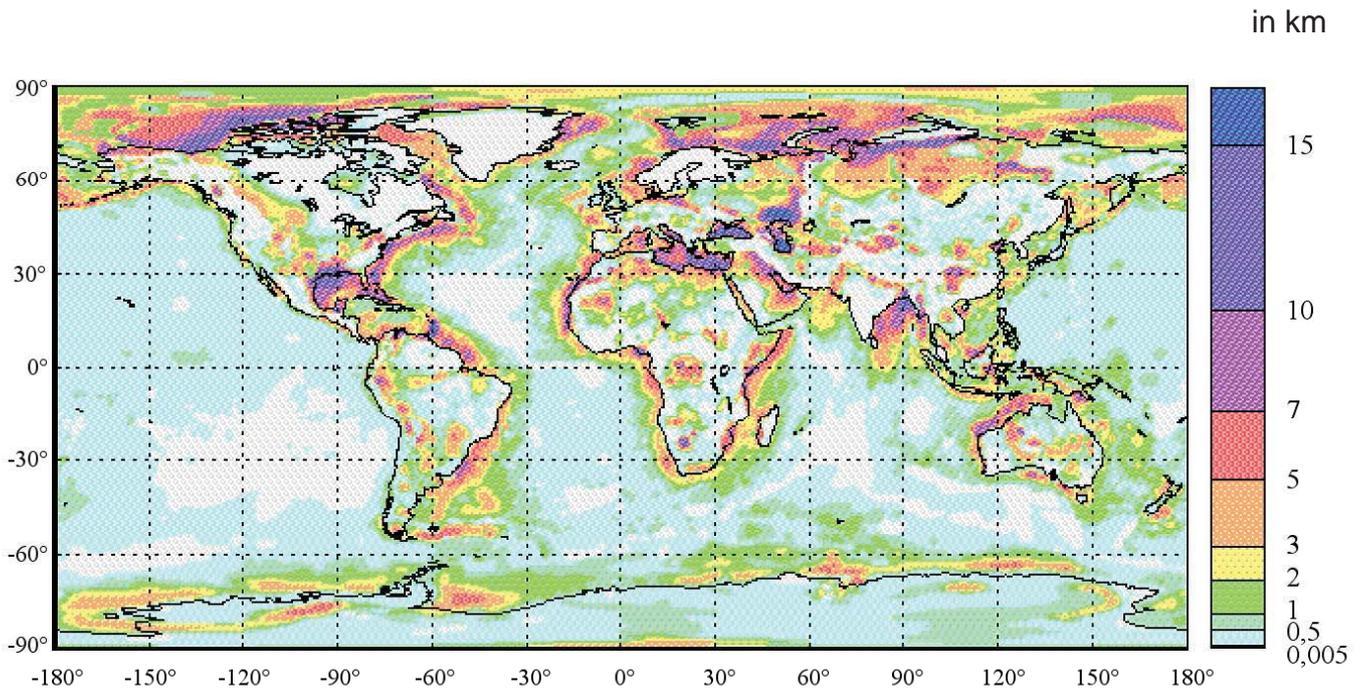
Land surface area



Press & Siever 2001

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Verbreitung der Sedimente und Sedimentgesteine



Laske & Masters 1997, <http://mahi.ucsd.edu/Gabi/sediment.html>

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Bedeutung der Sedimente und Sedimentgesteine

- enge Kopplung mit endogenen Prozessen
- sehr gute Klima- und Umwelt- "Archive"
- großer Anteil an den Bodenschätzen
- Grundwasser-Aquifere größtenteils in Sedimenten
- Standorte für Deponien und Endlager

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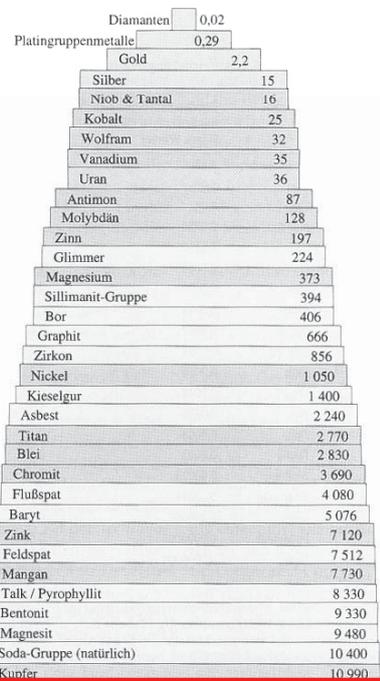
Massenrohstoffe

- Edelmetalle, -steine
- Metalle
- Energierohstoffe
- Industrieminerale

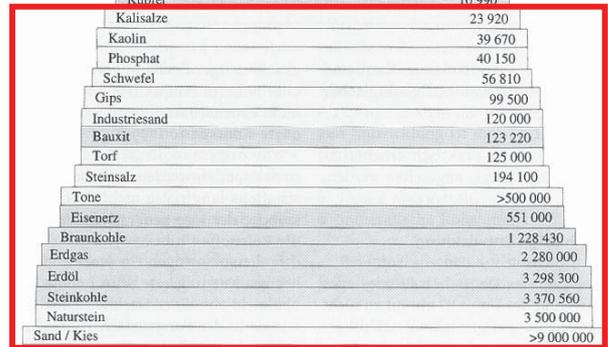
Die wichtigsten Massenrohstoffe sind sedimentär entstanden

Produktion mineralischer Rohstoffe in der Welt im Jahr 1996 nach ihrer Menge (1000 t, Erdgas in Mio. m³); Wellmer & Becker-Platen (1999)

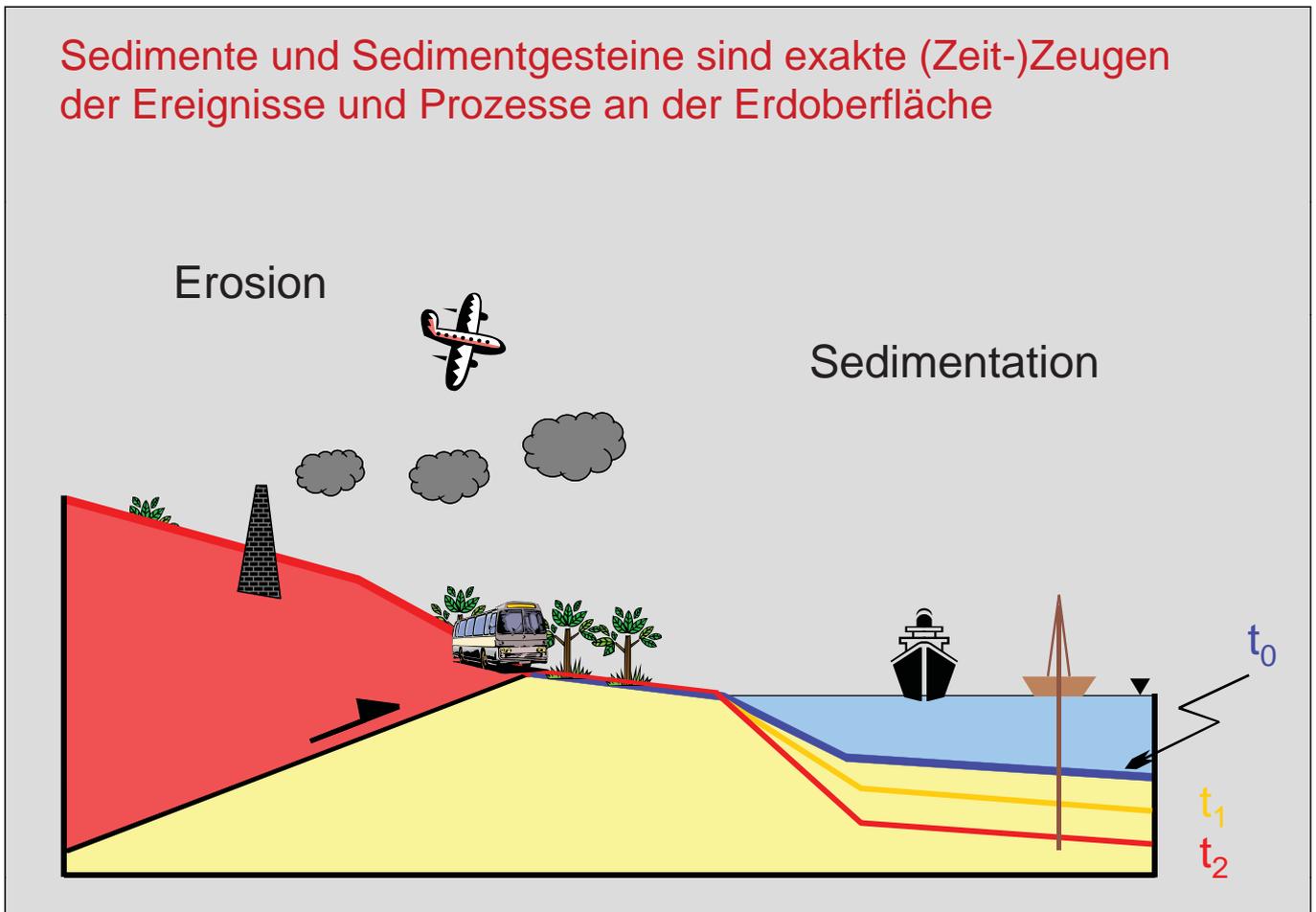
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± ausschließlich sedimentäre (exogene) Rohstoffe



Sedimente und Sedimentgesteine sind exakte (Zeit-)Zeugen der Ereignisse und Prozesse an der Erdoberfläche



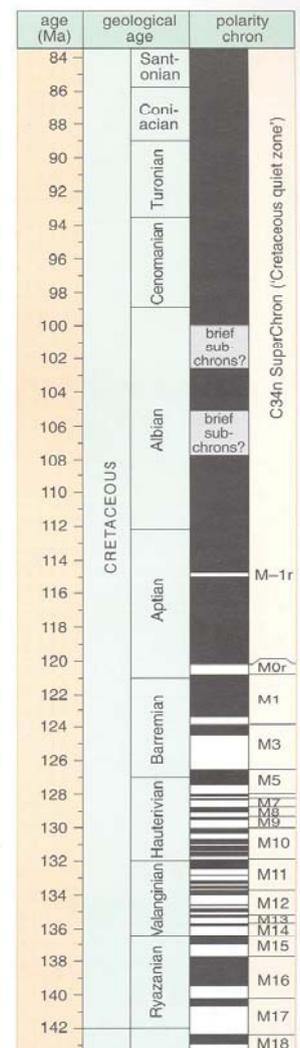
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Zeitzeuge ⇒ (möglichst) exakte zeitliche Kalibration

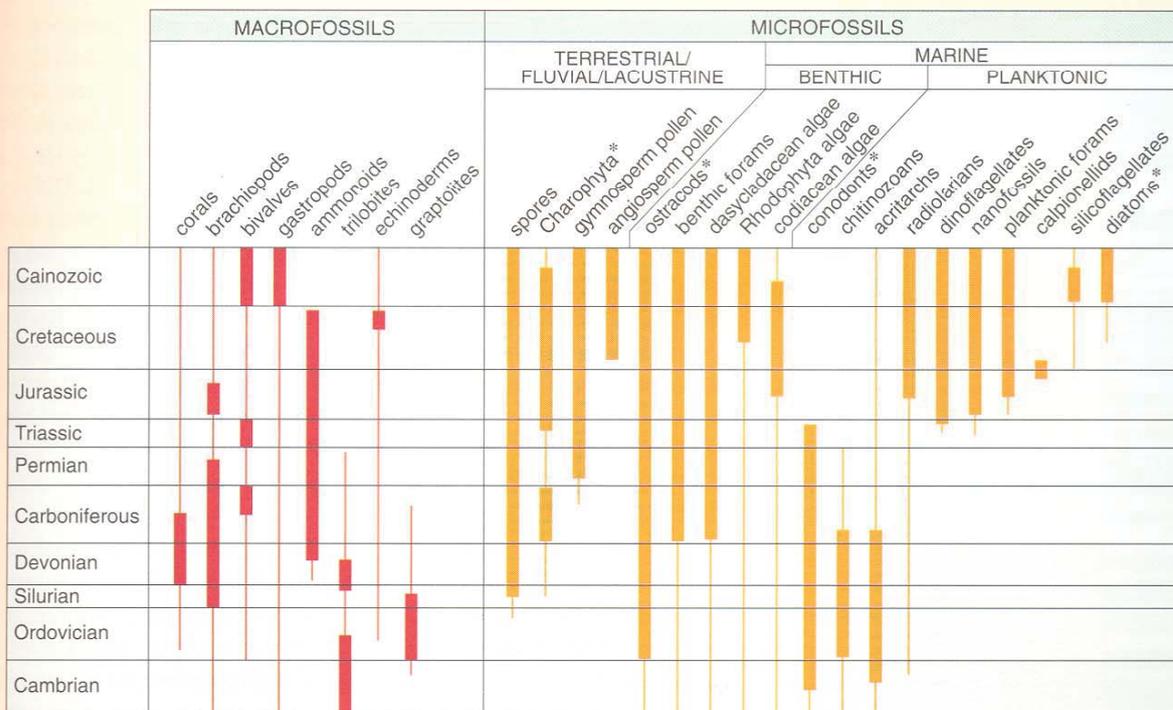
Wie ?

- Biostratigraphie
- Radiometrische Datierung
- Magnetostratigraphie
- Chemostratigraphie

Figure 2.5 Changes in the Earth's magnetic field through part of the Jurassic and Cretaceous. (Ogg, 1995.)



Coe et al. (2003)



* Freshwater ostracods, brackish water charophytes, benthic and freshwater diatoms and benthic conodonts also exist

Figure 2.3 Biostratigraphically useful groups of organisms preserved as macrofossils and microfossils in the stratigraphical record and their age ranges. The thick part of the line indicates the interval where the fossil group is used most extensively. Benthic organisms live on the sea-floor or in the sediments, whereas planktonic organisms live in the water column and have limited ability to move through the water column. (Left: Nichols, 1999; right: Emery and Myers, 1996.)

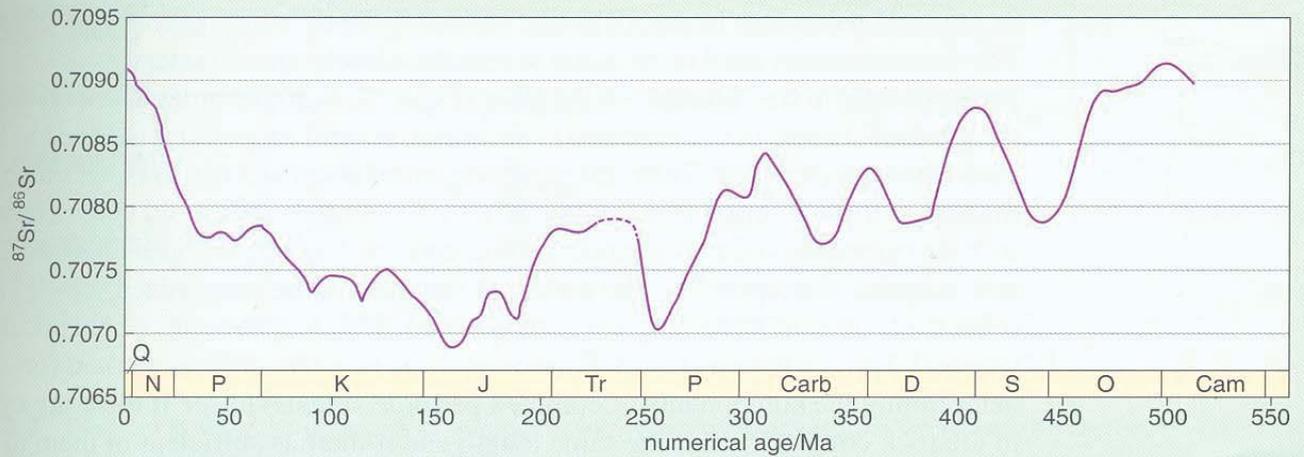


Figure 2.6 Sr-isotope curve for the Cambrian to Quaternary. Q = Quaternary, N = Neogene, P = Palaeogene, K = Cretaceous, J = Jurassic, Tr = Triassic, P = Permian, Carb = Carboniferous, D = Devonian, S = Silurian, O = Ordovician, Cam = Cambrian. Note that this curve is generalized and does not show all the detail. (McArthur, 2001.)

Coe et al. (2003)

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Aufgabengebiete der Sedimentologie

Stratigraphische Aufnahme

Petrographische Aufnahme
(makroskopisch/mikroskopisch)

Faziesmodell und Paläo-
geographische Rekonstruktion

Phasenanalyse, Geochemie

„Genetische“ Stratigraphie

Liefergebietsanalyse

Beckenanalyse

Diagenesemodell

→ **Geodynamische Modelle**

Anwendungsgebiete in Erdöl-/Erdgasexploration und –förderung, sonst. Rohstoffexploration, Hydrogeologie, Umweltgeologie, Ingenieurgeologie, ...

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2. Fazies / Faziesanalyse

Was ist Fazies ? Gesteinskörper mit spezifischen Merkmalen

Aufschluß/Bohrkerne: Farbe, Schichtung, Textur, Zusammensetzung
Fossilgehalt, Sedimentstrukturen, ...

→ **Lithofazies**

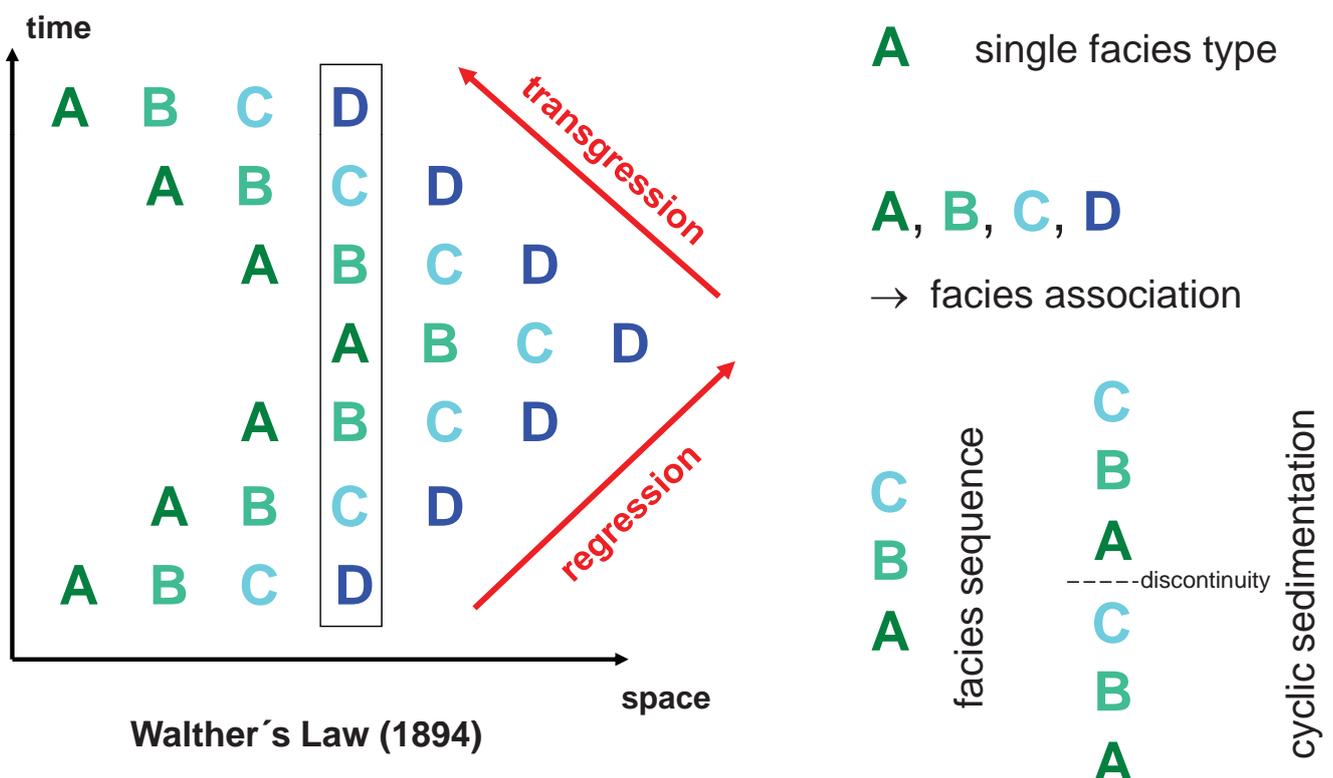
→ **Biofazies**

Log Fazies: basiert auf Bohrlochmessungen:
→ akustische, elektrische, radioaktive Eigenschaften

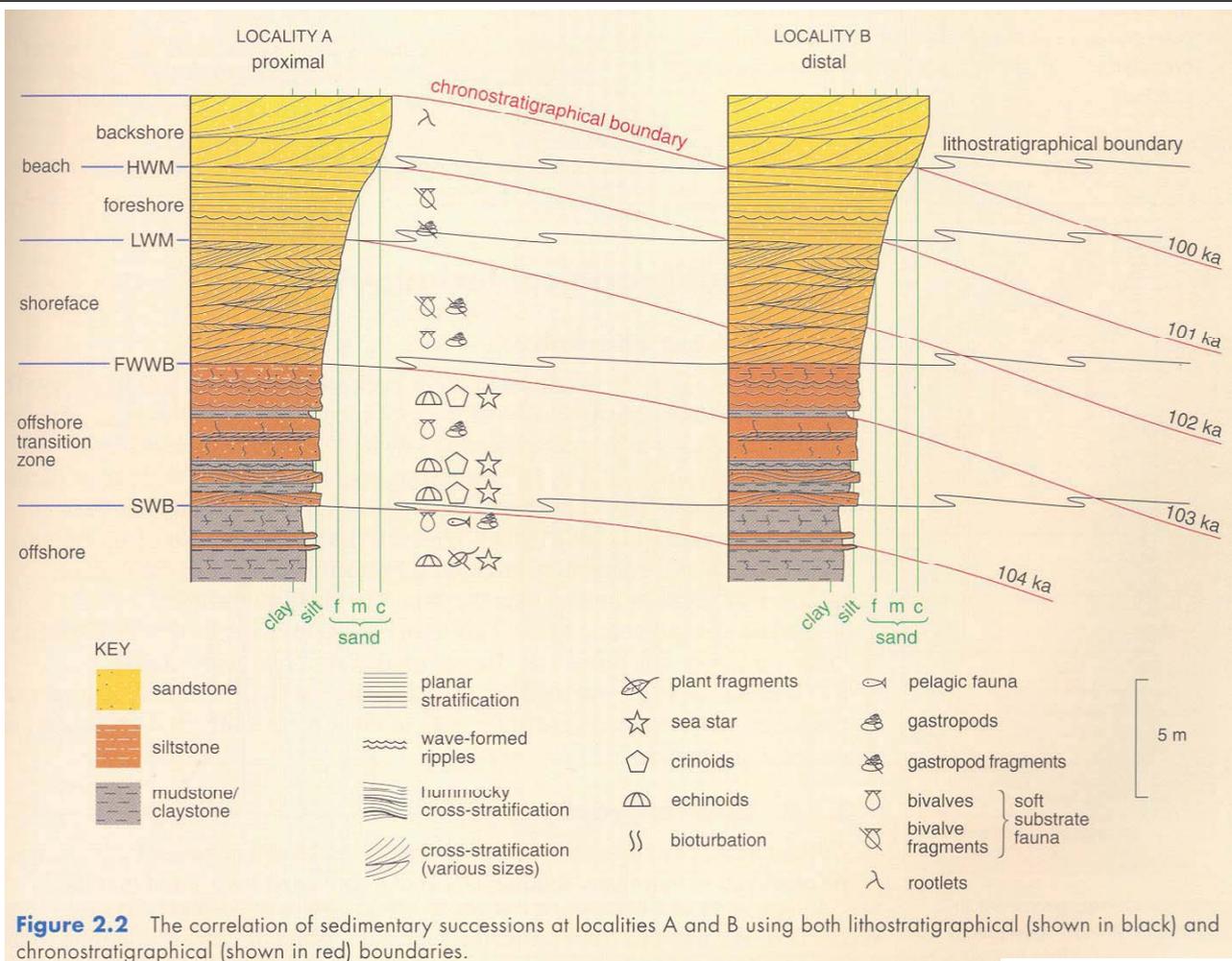
Weitere Verwendung: Tektofazies, „Fluviatile Fazies“ (→ environment), ...

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Fazies – Faziesassoziation – Faziessequenz



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Fazies - Interpretation

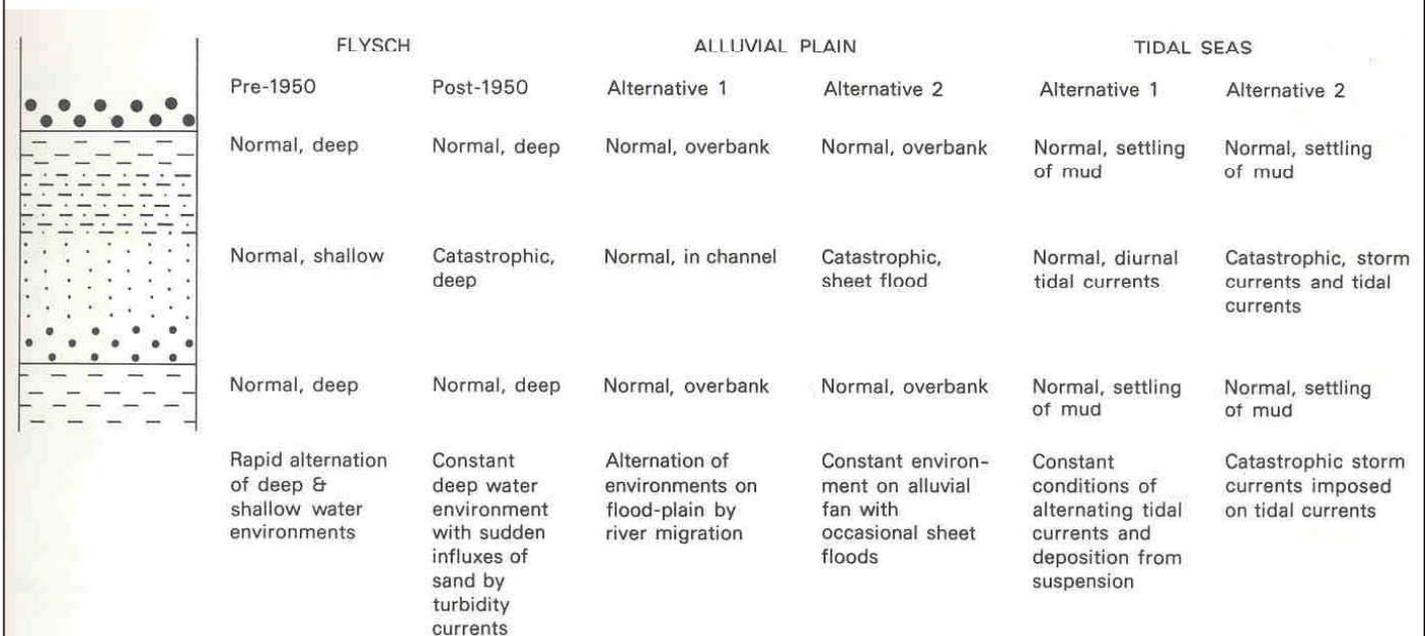


Fig. 2.5. Differing interpretations of graded beds and fining-upwards sequences in flysch, alluvial plains and tidal seas depend on distinction between normal and catastrophic sedimentation.

Kontrollfaktoren der Faziesentwicklung und -verteilung

- Sedimentäre Prozesse
- Sedimentzufuhr
- Subsidenz (→ Tektonik)
- Meeresspiegelschwankungen
- Klima
- Biologische Aktivität
- Wasserchemie
- Vulkanismus

Akkommodationsraum

unterschiedliche Bedeutung in unterschiedlichen Ablagerungsmilieus!

→ Konservierungspotential

3. Lithofazies (Gelände, Bohrkern-Lager)

A) Lithologie / Nomenklatur

Korngrößen

$$\Phi = -\log_2 d$$

(d = Durchm. in mm)

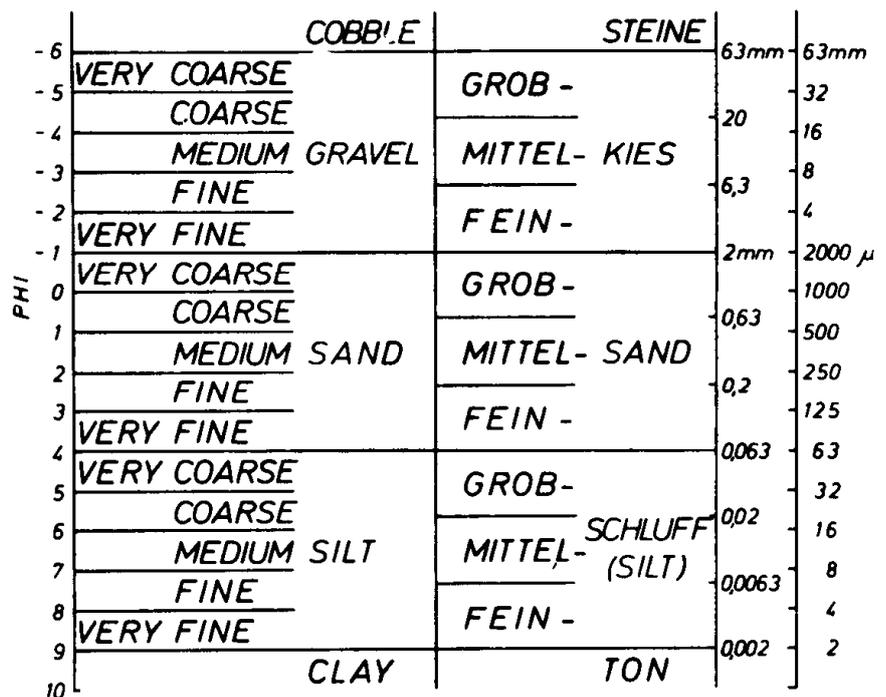


Abb. 4-18. Korngrößenbenennung. Links die Skala nach WENTWORTH (1922) und DOEGLAS (1968), rechts diejenige nach DIN 4022.

Füchtbauer 1988

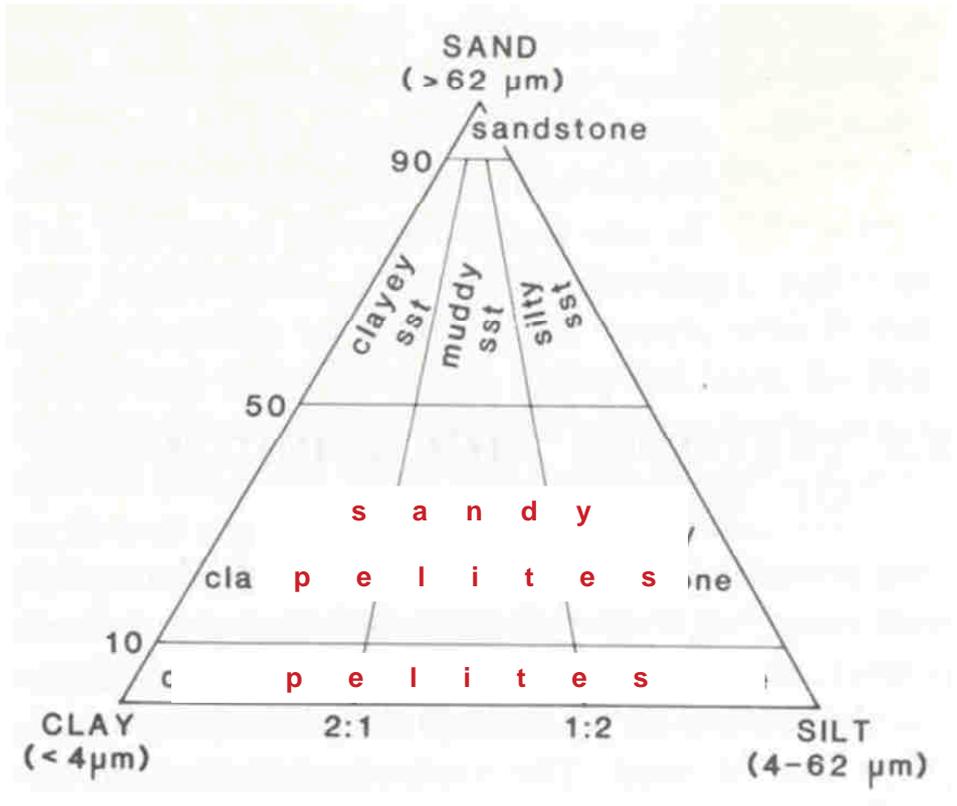


Fig. 3.1 Classification of siliciclastic sediments based on sand, silt and clay content. After Folk (1974).

Tucker 1991

Psammite
Arenite

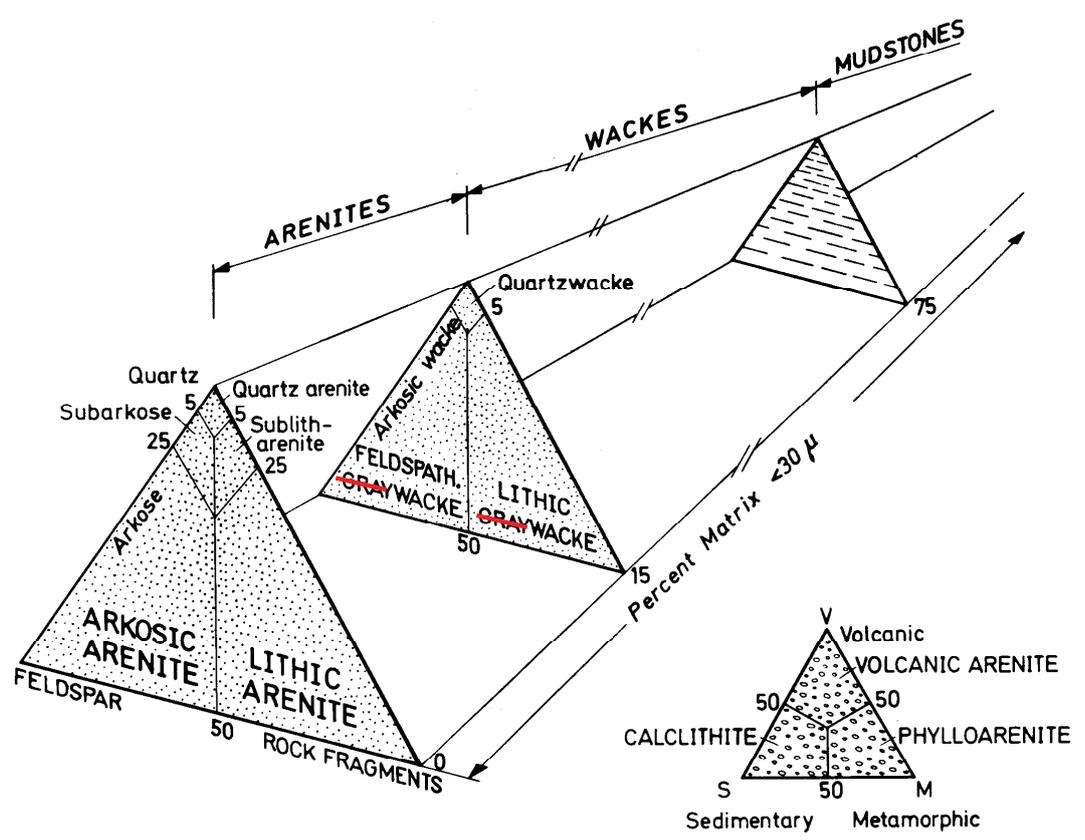
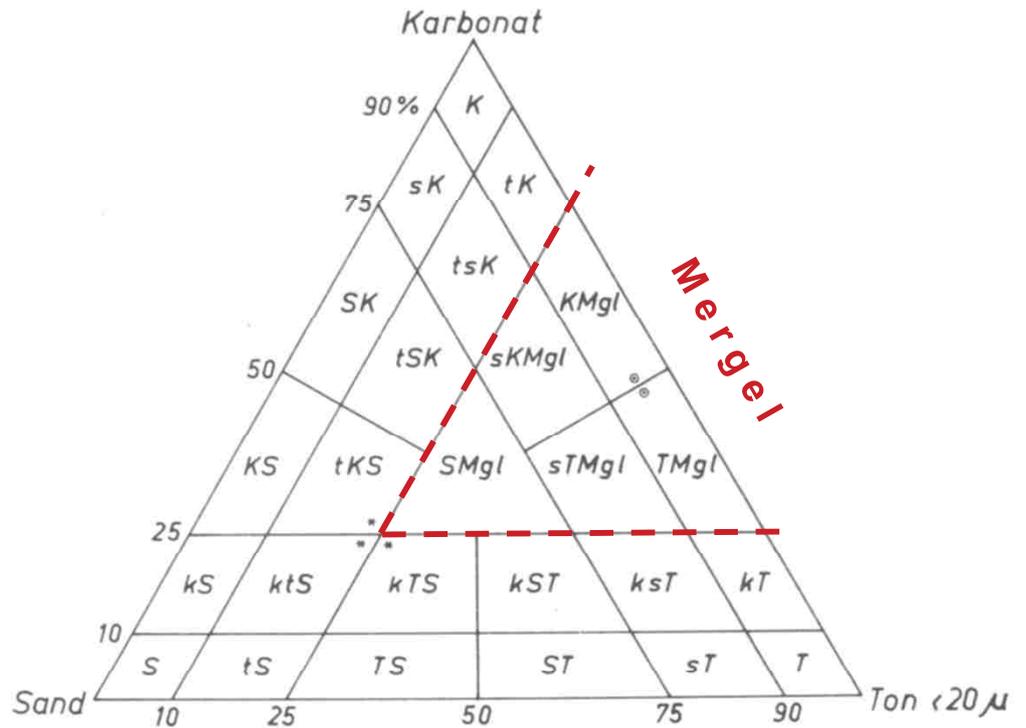


FIGURE 5-1. Classification of terrigenous and sandstones. (Modified from Dott, 1964, Fig. 3)

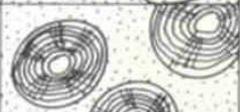
→ **Mergel**

- > 25% Ton/Silt
- > 25% Karbonat
- < 50% Sand



Füchtbauer 1988

Kalksteine

Principal allochems in limestone	Limestone types	
	cemented by sparite	with a micritic matrix
skeletal grains (bioclasts)	biosparite 	biomicrite 
ooids	oosparite 	oomicrite 
peloids	pelsparite 	pelmicrite 
intraclasts	intrasparite 	intramicrite 
limestone formed in situ	biolithite 	fenestral limestone -dismicrite 

Tucker 1991

Fig. 4.35 Classification of limestones based on composition. After Folk (1962).

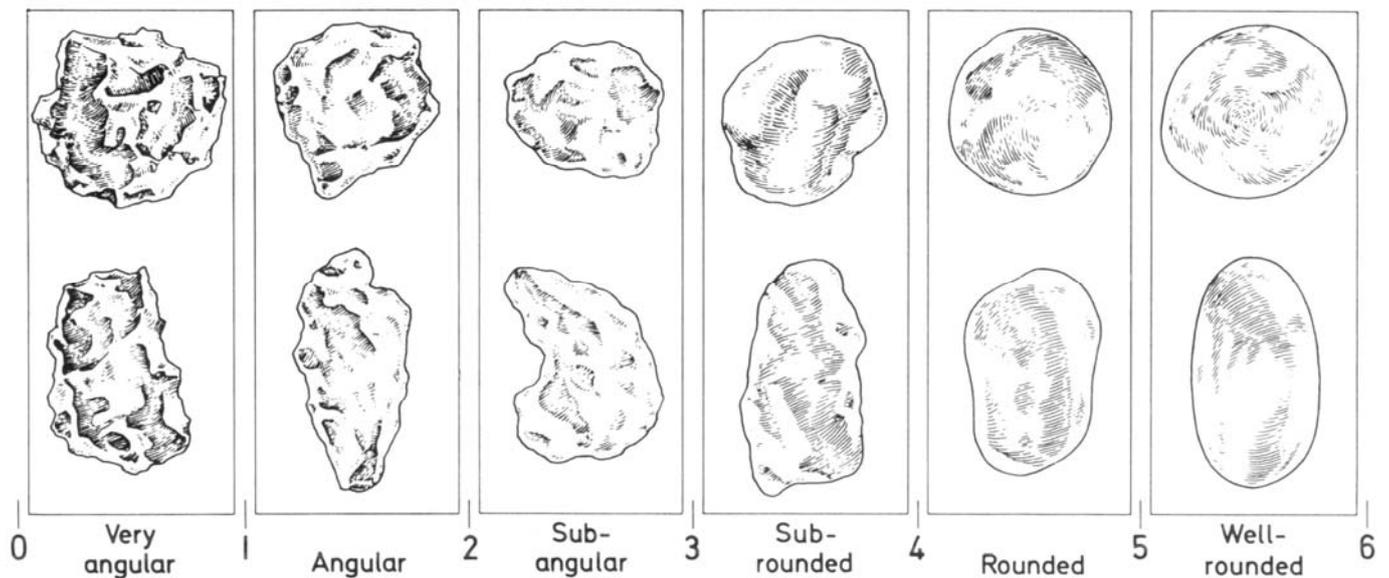
Klassifikation der Kalksteine basierend auf der Textur (nach Dunham 1962):

original components not bound together during deposition			lacks mud and is grain supported	original components bound together	depositional texture not recognizable crystalline carbonate
contains lime mud		grain-supported			
less than 10% grains	more than 10% grains				
mudstone	wackest.	packstone	grainstone	bound stone	crystalline

Tucker 1991

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B) Textur

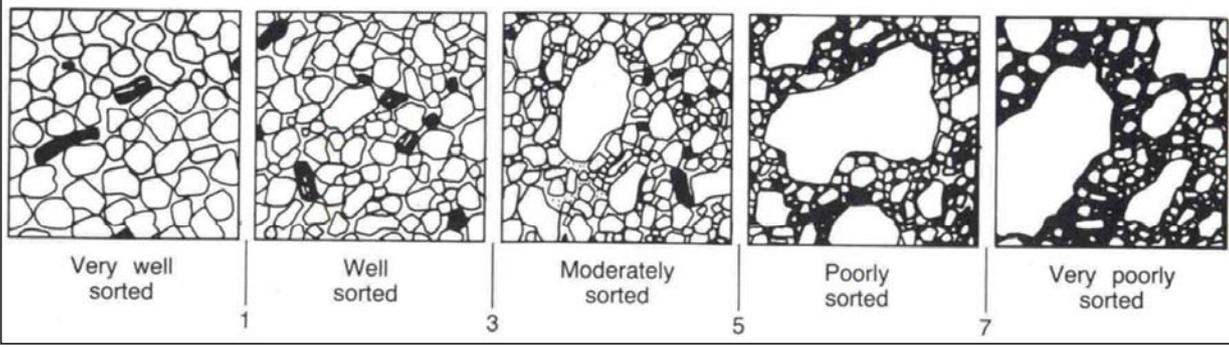
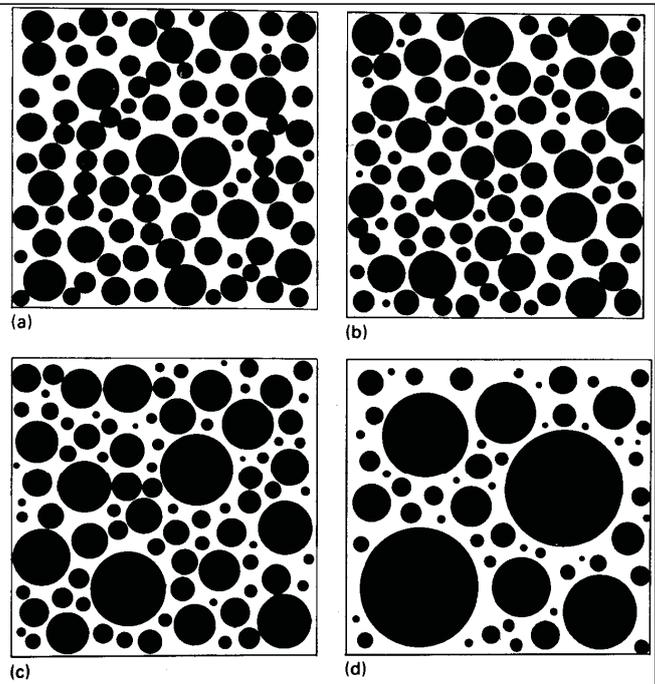
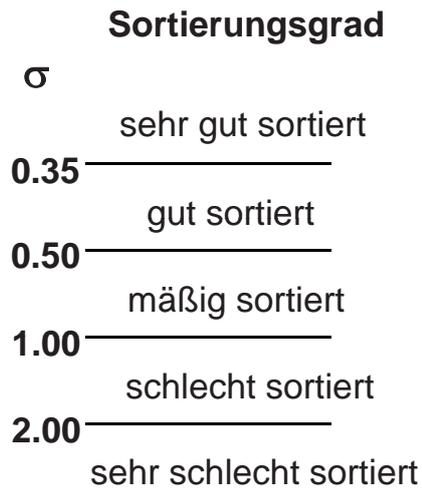


Kornrundung

Einstufung nach Vergleichsbildern in 6 Klassen; die Spalten zeigen Körner gleichen Rundungsgrades, aber unterschiedlicher Sphärizität.

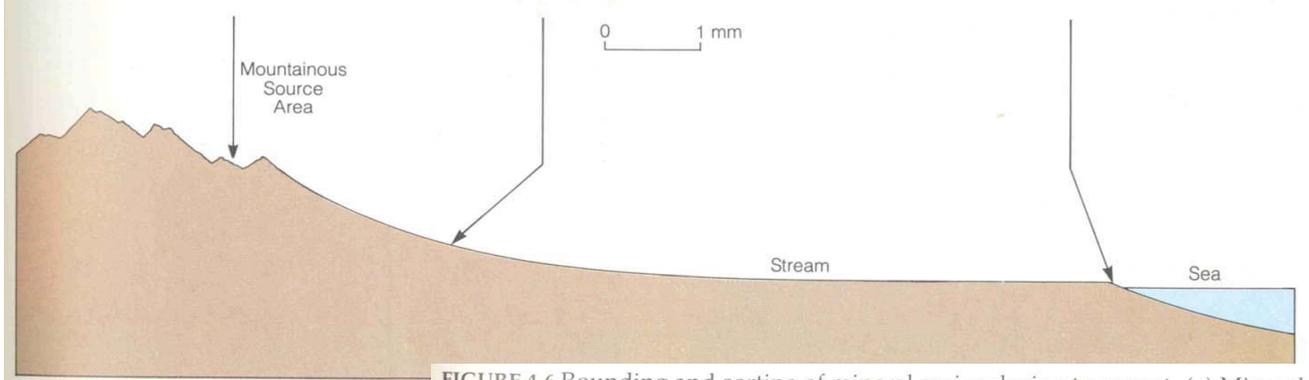
HvE / SED - Grundlagen

Kornsorrierung



Tucker 1991

Transport ⇒ Korngröße, Rundung, Sortierung

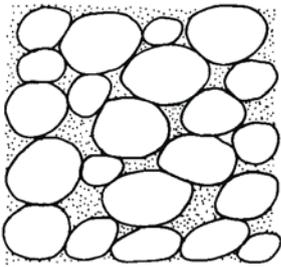


Skinner & Porter 1989

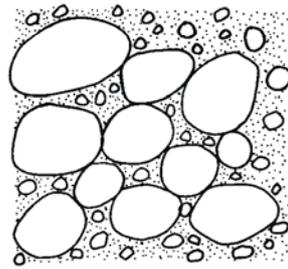
FIGURE 4.6 Rounding and sorting of mineral grains during transport. (a) Mineral grains loosened and separated from igneous and metamorphic rocks by mechanical and chemical weathering have the same angular shapes they assumed when the minerals crystallized in the parent rock. (b) Carried downslope by streams, the sand experiences abrasion and grains become rounder. (c) By the time the sediment reaches the mouth of the stream, it has traveled a great distance and the well-sorted grains have become well rounded.

Korn- bzw. Geröllgefüge

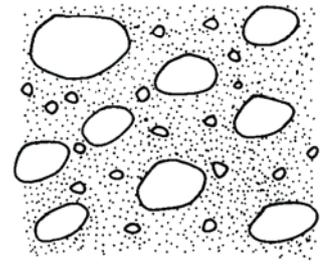
1 Sorting size distribution



Clast supported
bimodal
matrix well sorted

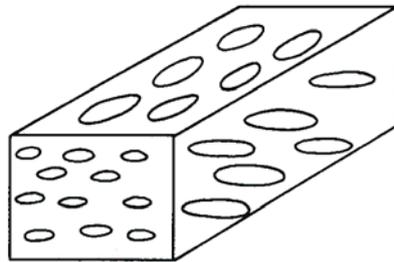


Clast supported
polymodal
matrix poorly sorted



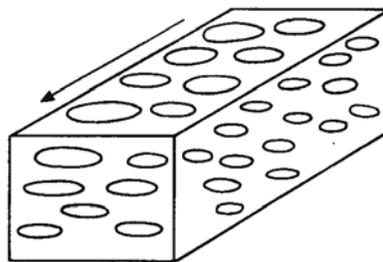
Matrix supported
polymodal

2 Fabric



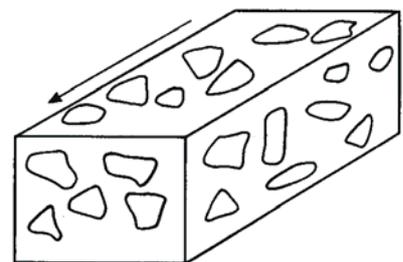
a (p) a (i)

Flow



a (t) b (i)

Flow

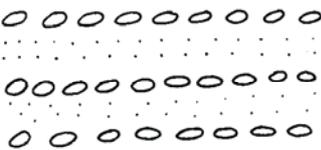


Unordered fabric

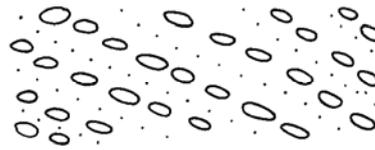
HvE /

C) Schichtung / Sedimentstrukturen

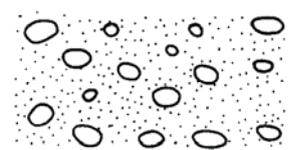
3 Stratification



Horizontal

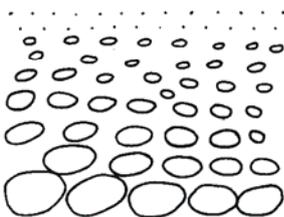


Inclined

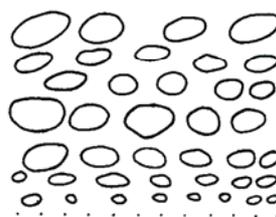


Unstratified

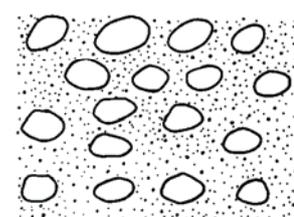
4 Grading



Normal



Inverse



Ungraded

Fig. 2.1. Features used in a textural and structural classification of conglomerate (from Harms, Southard & Walker, 1982). Under fabric, codes a and b refer to long and intermediate axes respectively; p = parallel to flow, t = transverse to flow, i = imbricate. (Reproduced by permission of SEPM.)

Graham1988

Schichtung vs. Lamination

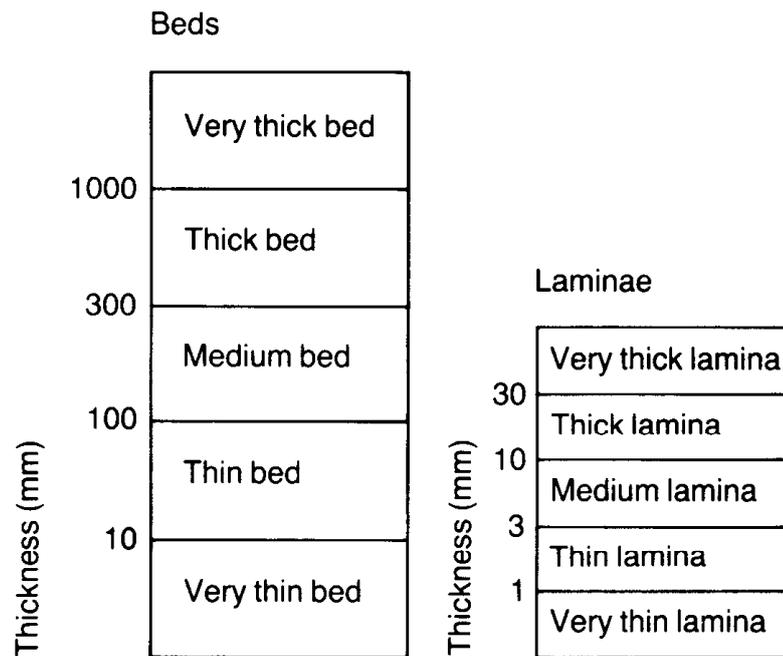
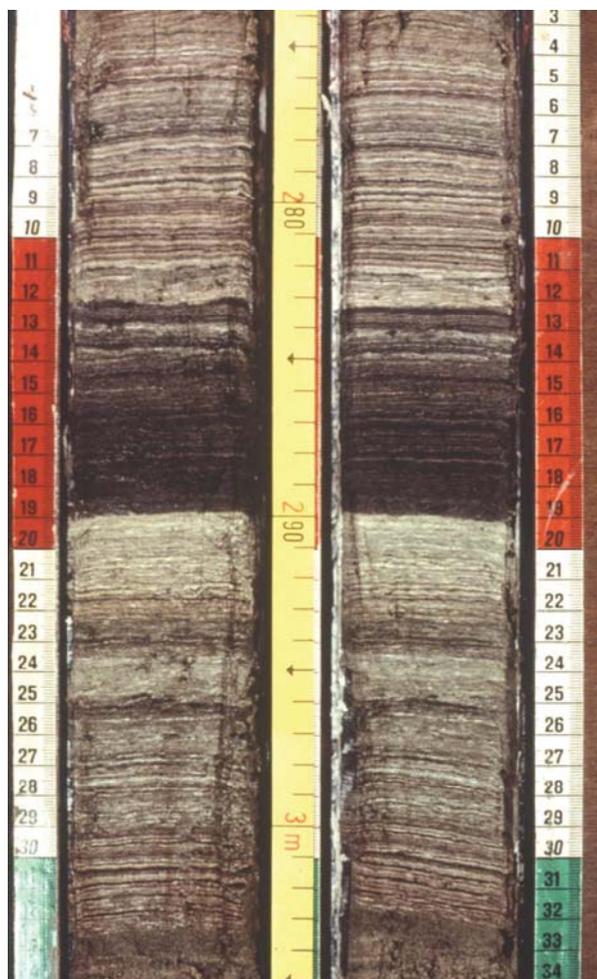


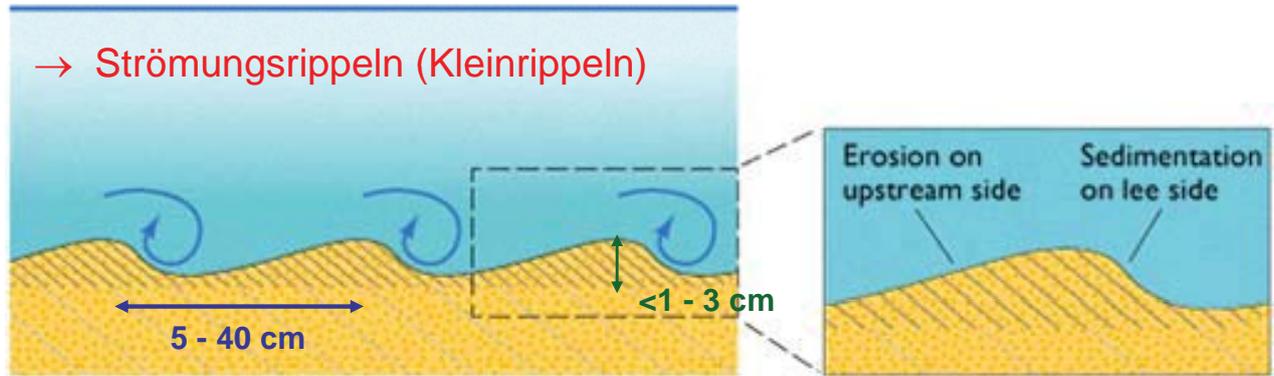
Fig. 2.13. Terminology for thickness of beds and laminae (modified after Ingram, 1954, Campbell, 1967 and Reineck & Singh, 1975). (Reproduced by permission of Springer.)

Beispiel Lamination



Flow surface

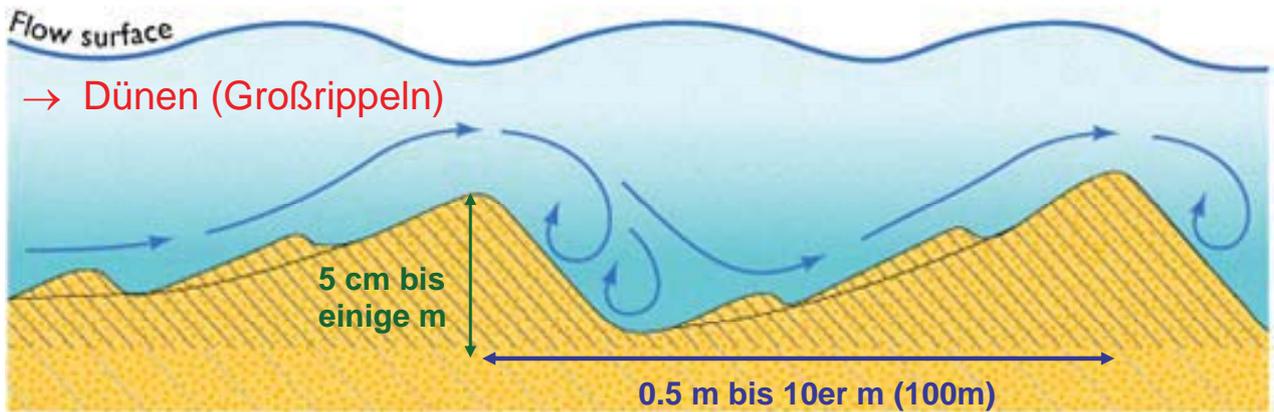
→ Strömungsrippeln (Kleinrippeln)



(a) Lower velocity

Flow surface

→ Dünen (Großrippeln)



(b) Higher velocity

Flow of water and ripples and dunes

HvE / SED - Grundlagen

Press & Siever 2001

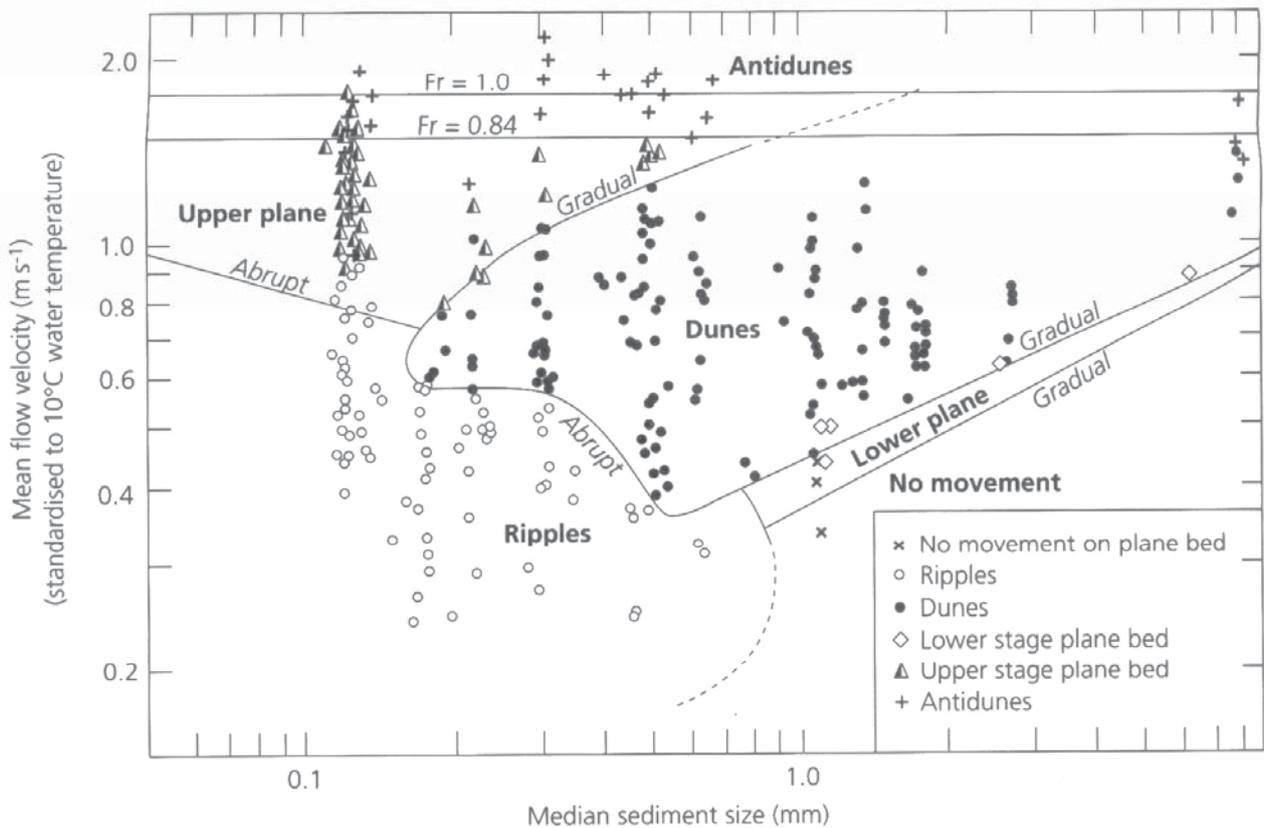


Fig. 5.17 Plot of mean flow velocity against median sediment size (both standardized to 10°C water temperature) for a mean flow depth of 0.25–0.40 m to show the existence fields of bedforms. After Southard (1991) [31].

Allen 1997

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Kammformen vs Schrägschichtungstypen

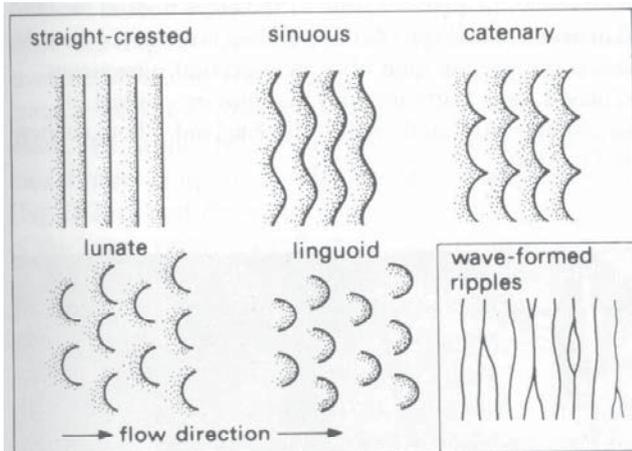
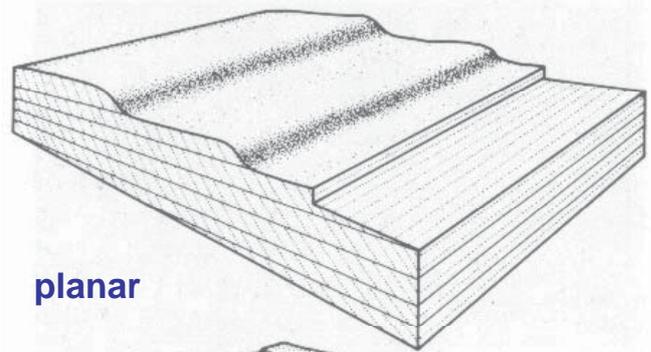
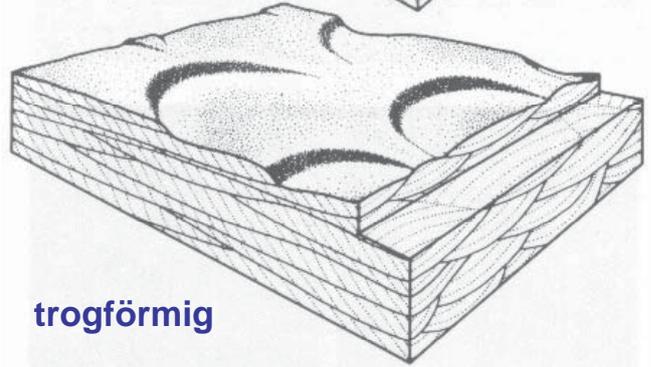


Fig. 2.19 Terminology for the shape of the crests of ripples and dunes formed by unidirectional currents. For comparison, the typical crest pattern of wave-formed ripples is also shown.



planar



trogförmig

Fig. 2.21 Block diagrams showing the two common types of cross stratification: planar and trough. Above: planar cross stratification, chiefly formed through the migration of straight-crested (i.e. two-dimensional) ripples, producing planar cross lamination, and straight-crested dunes, producing planar cross bedding. Below: trough cross stratification, chiefly formed through migration of three-dimensional bedforms, especially lunate and sinuous dunes, producing trough cross bedding (illustrated here). Linguoid ripples give a trough cross lamination.

Tucker 1991

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Beschreibung

- Farbe (Farbtafeln), z.B. GSA
- Korngröße (DIN 4022 bzw. Wentworth 1922)
- Kornform
- Kornrundung
- Kornsortierung
- Korngefüge, Klasteneinregelung (Imbrikation)
- Schichtung bzw. Lamination
- Zusammensetzung der Komponenten (qualitativ & semiquantitativ)
- Zusammensetzung von Matrix und/oder Zement
- Festigkeit, Bruchverhalten
- Verwitterungs-/ Alterationsmerkmale
- Sonstige Merkmale / Besonderheiten
- Gesteinsname (Klassifikationen)

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D) Profil- bzw. Log-Aufnahme

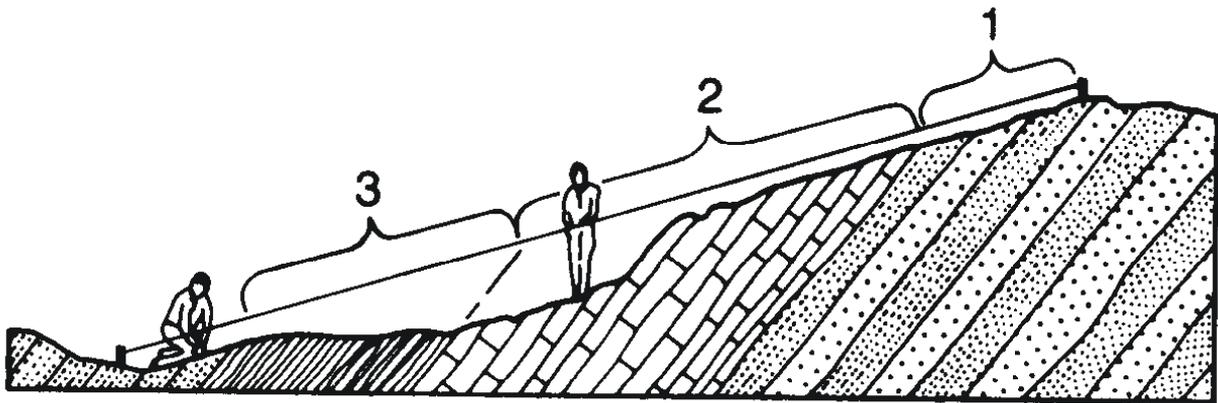


Fig. 2.18. Measurement of strata on a slope by reference to a stretched tape. Note the projection of contact between units (2) and (3) to the tape (from Compton, 1962). (Reproduced by permission of Wiley.)

Graham1988

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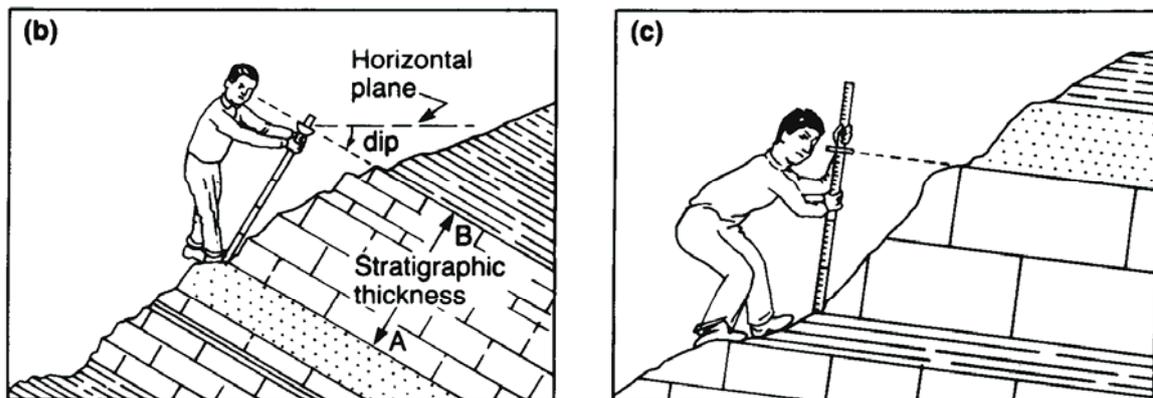
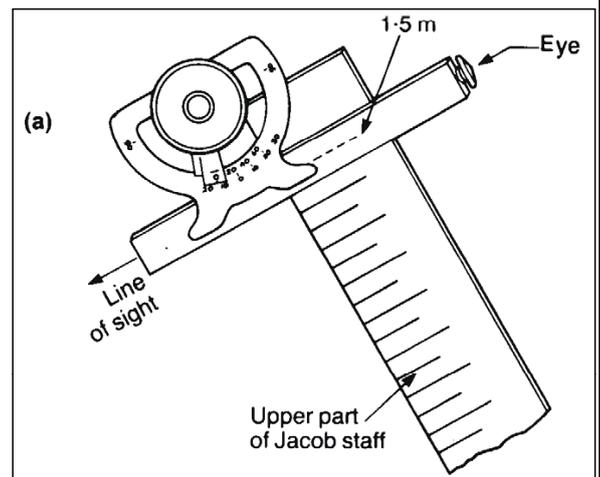


Fig. 2.20. Use of the Jacob staff for measuring sections (from Kottowski, 1965).

- (a) Setting dip on clinometer of Abney hand level used with a Jacob staff.
 - (b) Measuring stratigraphic thickness AB.
 - (c) Measuring a unit with thickness less than the length of a Jacob staff.
- (Reproduced by permission of CBS.)

Graham1988



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Beispiele von Profilaufnahmen und Bohrlochaufnahmen

Graham 1988 (in Tucker, Ed.)

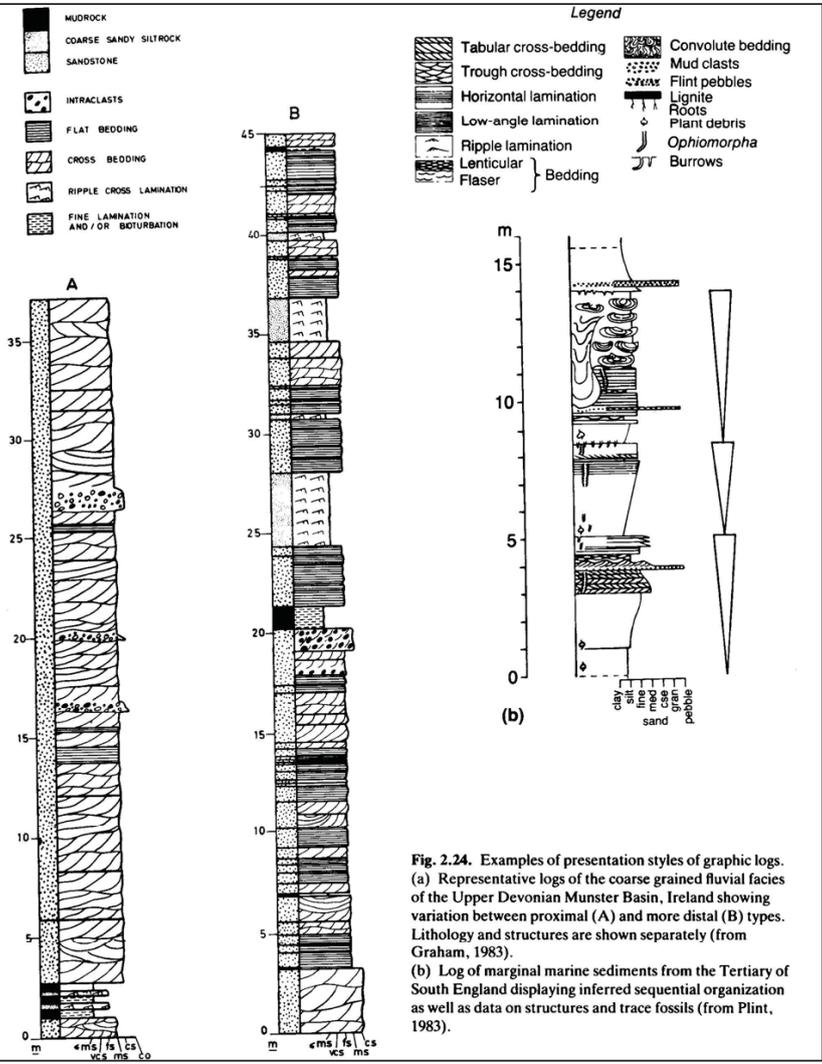


Fig. 2.24. Examples of presentation styles of graphic logs. (a) Representative logs of the coarse grained fluvial facies of the Upper Devonian Munster Basin, Ireland showing variation between proximal (A) and more distal (B) types. Lithology and structures are shown separately (from Graham, 1983). (b) Log of marginal marine sediments from the Tertiary of South England displaying inferred sequential organization as well as data on structures and trace fossils (from Plint, 1983).

Beispiele von Profilaufnahmen und Bohrlochaufnahmen

Graham 1988 (in Tucker, Ed.)

