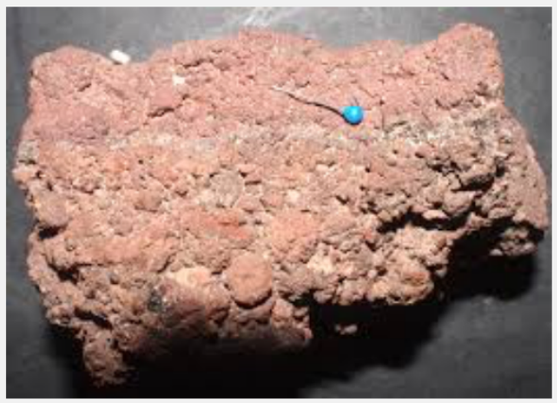
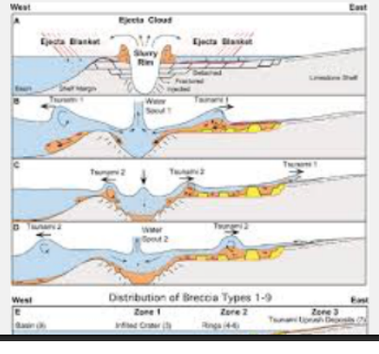
impact breccia

meteoritt nedslagsbreksje





Klaster av bergartene der meteoritt traff bakken.

Gardnos meteorittkrater

Gardnoskrateret er et meteorittkrater på Garnås i Nes kommune, Viken fylke (tidligere Buskerud). Krateret ligger nær riksvei 7 i Hallingdal og er lett tilgjengelig med et eget besøkssenter.

UTTALE: g'ardnos-strukturen

Man kan fremdeles se konturene av krateret og høyden i sentrum, men det er ikke lenger en sirkelformet grop i bakken. Den østlige kraterveggen har istidene tatt knekken på, og skog dekker store deler av området. I dag er det de spesielle bergartene og ikke kraterformen som forteller historien om hva som skjedde for 546 millioner år siden.

Gardnosbreksje
Av Øivind Thoresen/Naturhistorisk museum, UiO.
Lisens: Begrenset gjenbruk

Oppdagelse og undersøkelse

Krateret ble første gang undersøkt under kartlegging av Hallingdal i 1948, da statsgeolog O. A. Broch oppdaget en ringstruktur bestående

TABLE 7.3 Common Types of Sedimentary Rock

Clast Size*	Clast Character	Rock Name (Alternate Name)
Coarse to very coarse	Rounded pebbles and cobbles	**Conglomerate**
	Angular clasts	**Breccia**
	Large clasts in muddy matrix **2 kornstørrelser**	**Diamictite** **"dia" betyr 2, "mict" er miks**
Medium to coarse	Sand-sized grains	**Sandstone**
	▪ quartz grains only	▪ **quartz sandstone (quartz arenite)**
	▪ quartz and feldspar sand	▪ **arkose**
	▪ sand-sized lithic clasts	▪ **lithic sandstone**
	▪ sand and lithic clasts in a clay-rich matrix	▪ **wacke** (informally called **graywacke**)
Fine	Silt-sized clasts	**Siltstone**
Very fine	Clay and/or very fine silt	**Shale** (if it breaks into platy sheets) **Mudstone** (if it doesn't break into platy sheets)

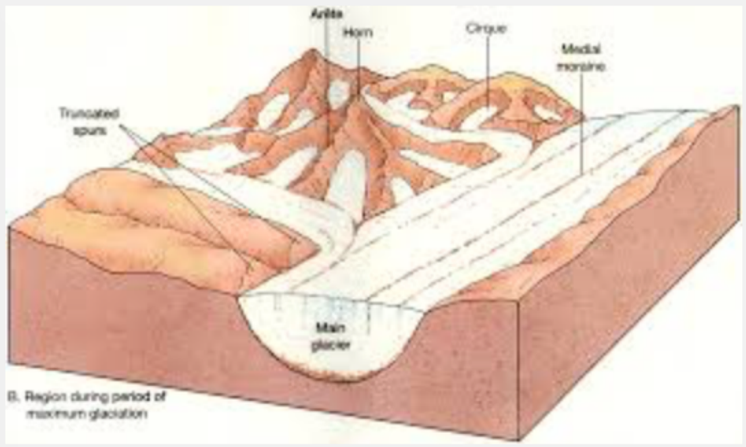
Neoproterozoic Glacial Diamictite, Namibia

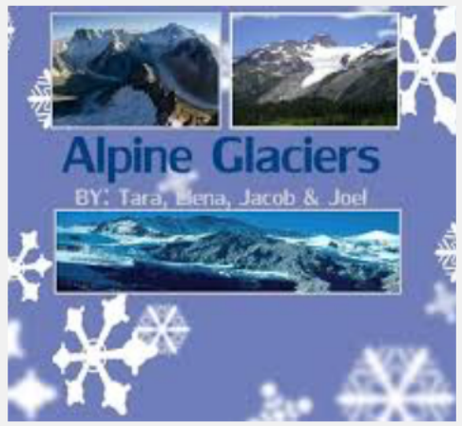
This closer view of the diamictite demonstrates the poorly sorted nature of the clasts. Dark clasts are limestone and tan clasts are dolomite. The softer limestone clasts sheared after burial, whereas the stronger dolomite clasts did not.

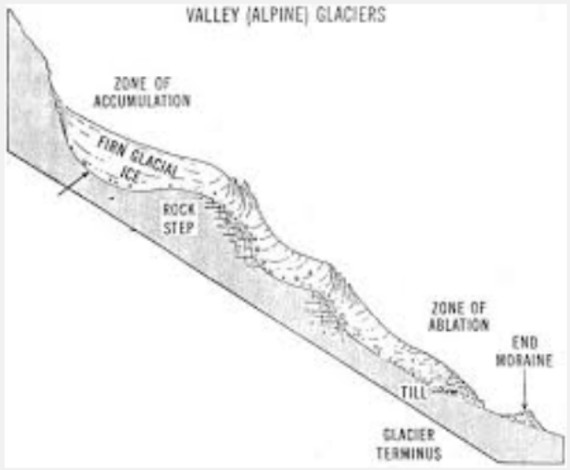
DIAMICTITE WITH COLOR AND TEXTURE TYPICAL OF THE CAYO DISTRICT OF CENTRAL BELIZE. FIGURE: DR. MICHAEL RAMPINO, DEPT. BIOLOGY, NEW YORK UNIVERSITY, NY 10003.

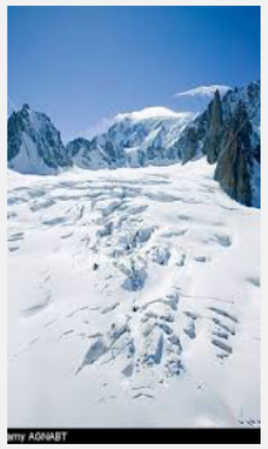
Isbre-avsetninger er en typ diamiktitt: klaster i leir-matiks

Isbre-avsetninger er en typ diamiktitt.







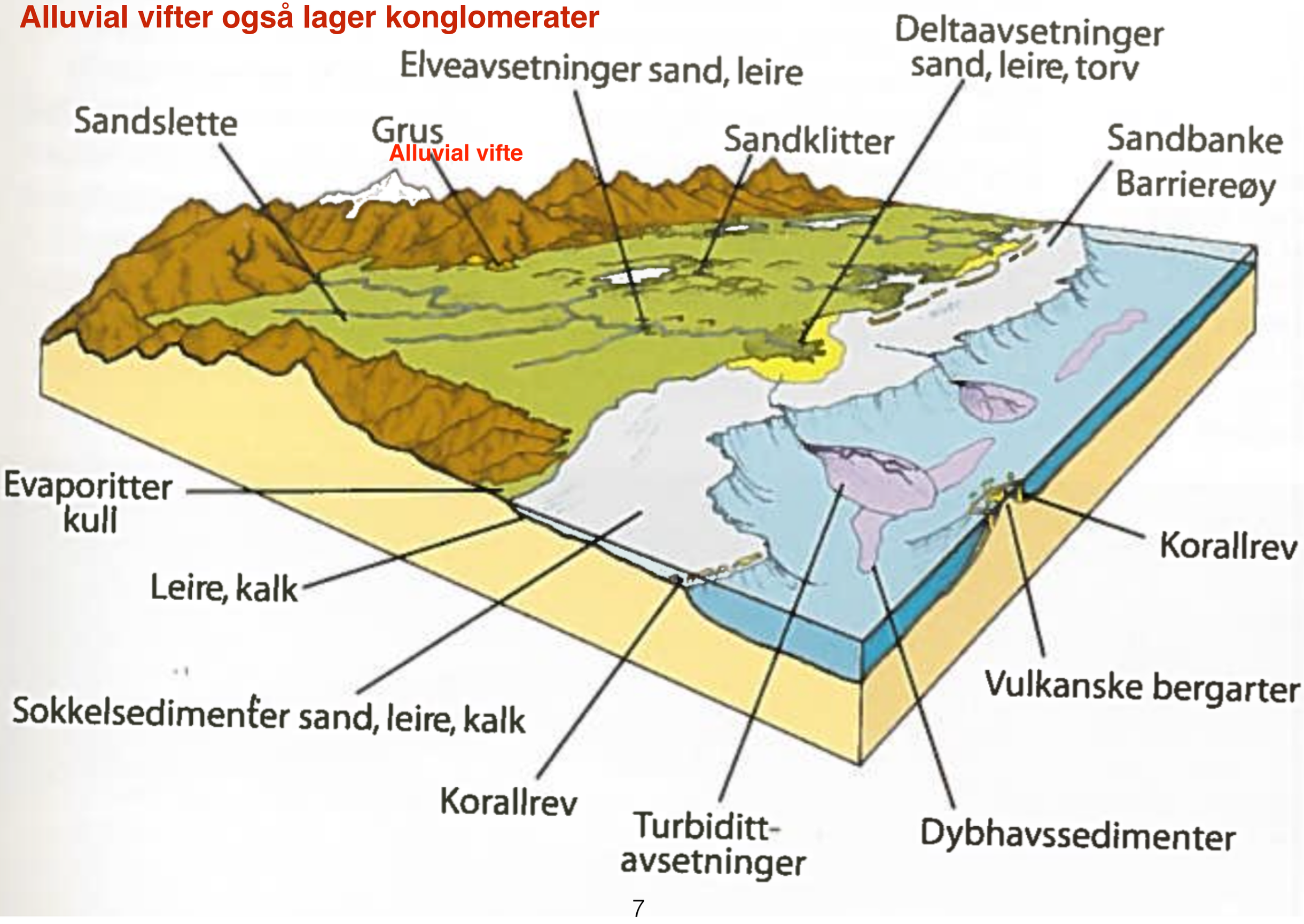


En isbre kan transportere alle størrelser. Avsetning heter “Till”

Isavsetning heter morene eller “till”.
“Tillitt” er *litifisert* till.
Matriksbåret klaster. En slags diamiktitt.

Jensen glemte å nevne glasiale avsetninger (till) og alluviale vifter (breksje/konglomerat) her.

Alluvial vifter også lager konglomerater



alluvial fan

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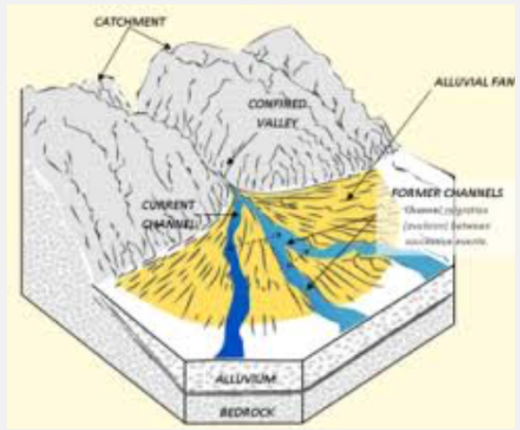
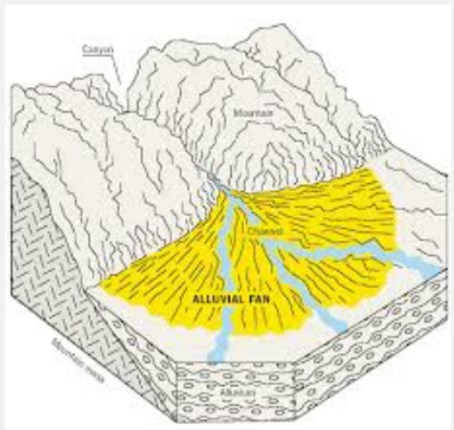
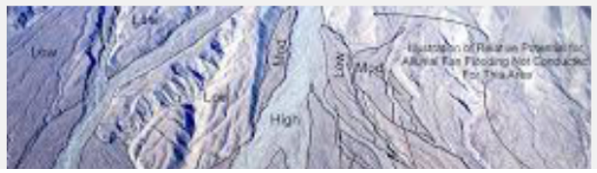
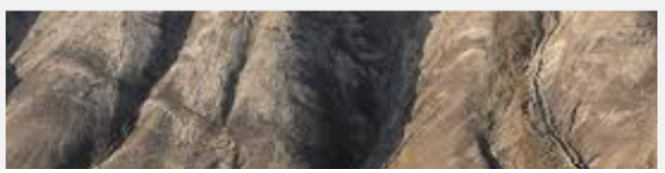






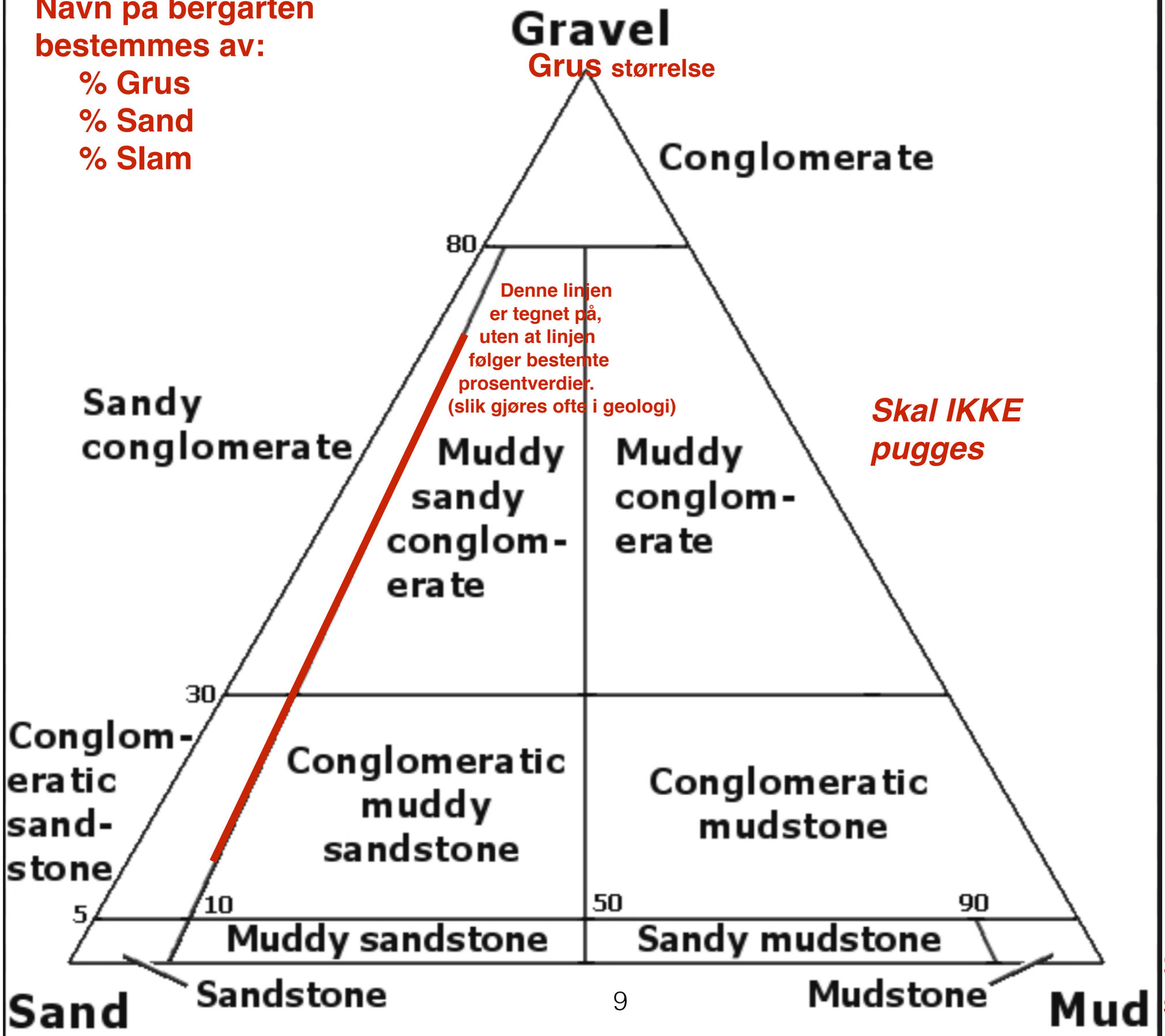



Alluvial vifte avsettes av periodisk rennende vann (bekk) som kommer fra fjellkløfter/daler. (Det er anerledes enn talus, som faller ned uten hjelp av rennende vann.)

Navn på bergarten bestemmes av:

- **% Grus**
- **% Sand**
- **% Slam**



Skal IKKE pugges

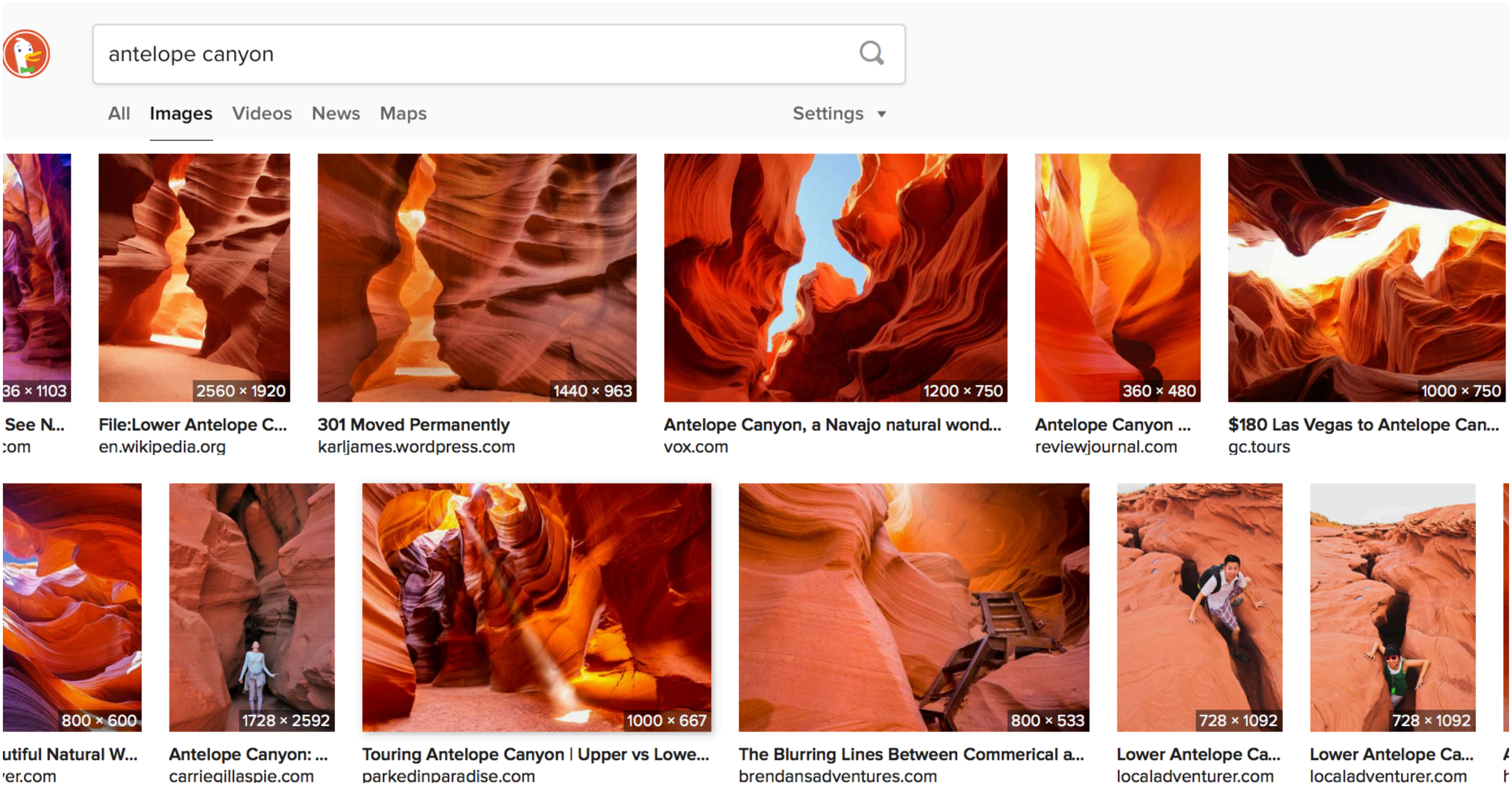
Slam= silt+leire

“Debris flow” er ofte muddy conglomerate, kanskje avsatt av en flash flood:

https://youtu.be/_yCnQuILmsM

Flash flood i Antelope Canyon:

https://youtu.be/m44gkjMukP0



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Sandsteiner
disse 4 bør du pugge

Sandsteiner er mer vanlig enn konglomerater.

Miljøet og kilden kan bestemmes, men bare med hjelp av tynnslip (og erfaring, og frekkhet).

Sandstein med bølgeslagsrifler (Jeløya utenfor Moss)

Dannet av strøm, ikke av "slag" fra "bølger". Derfor best å kalle disse for "strømrifler" eller "riflemerker"

ordbok:

rifle [2]

v. -et -ing (se også **RIFLING**)

frembringe rifler, ujevnheter i (noe) gi en ru overflate *sko med riflede såler*

mnty., besl. med rive

På engelsk:"ripple marks"
På norsk:"riflemerker".

rifle [1]

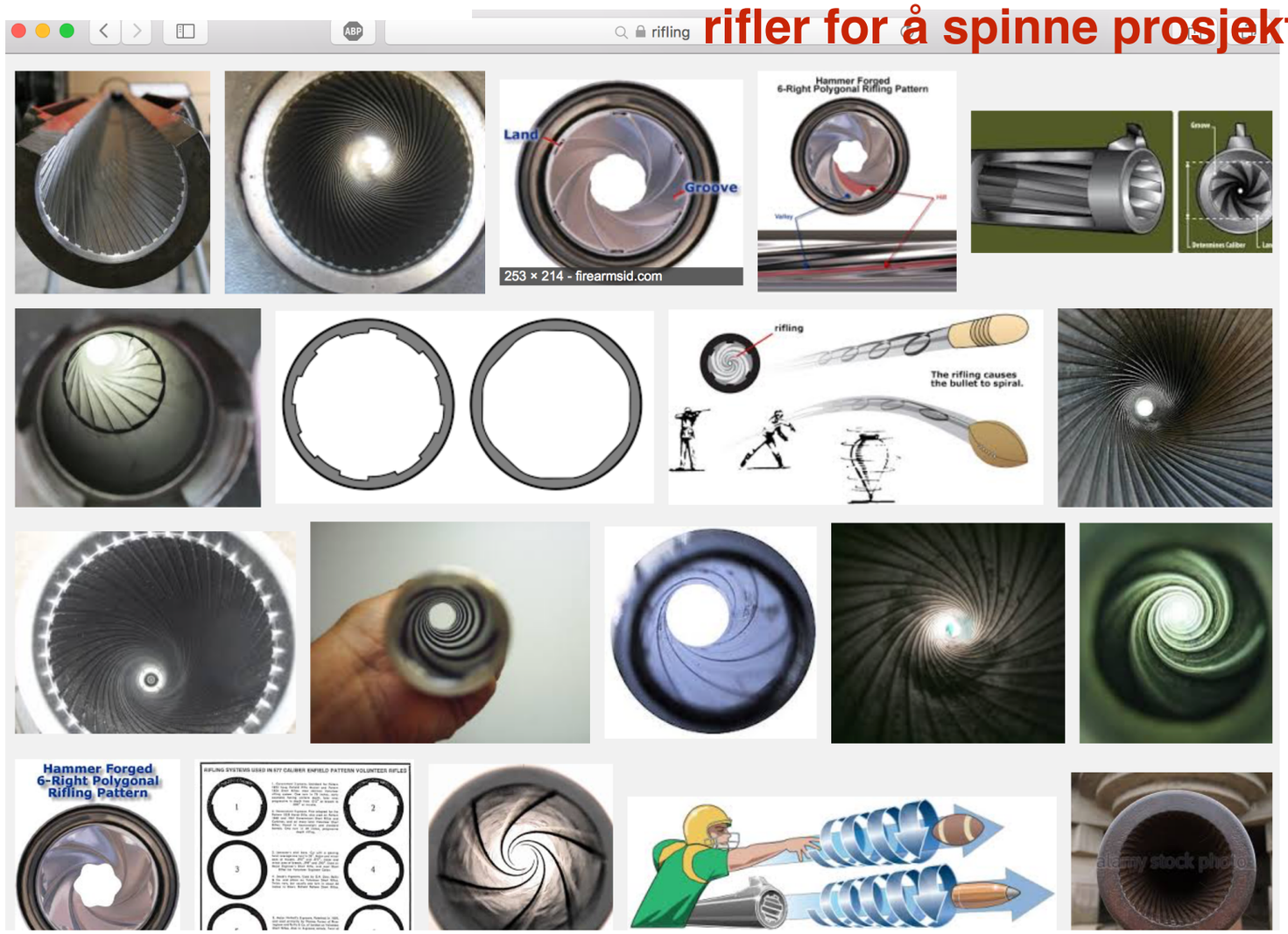
subst. -n, -r

1 fure

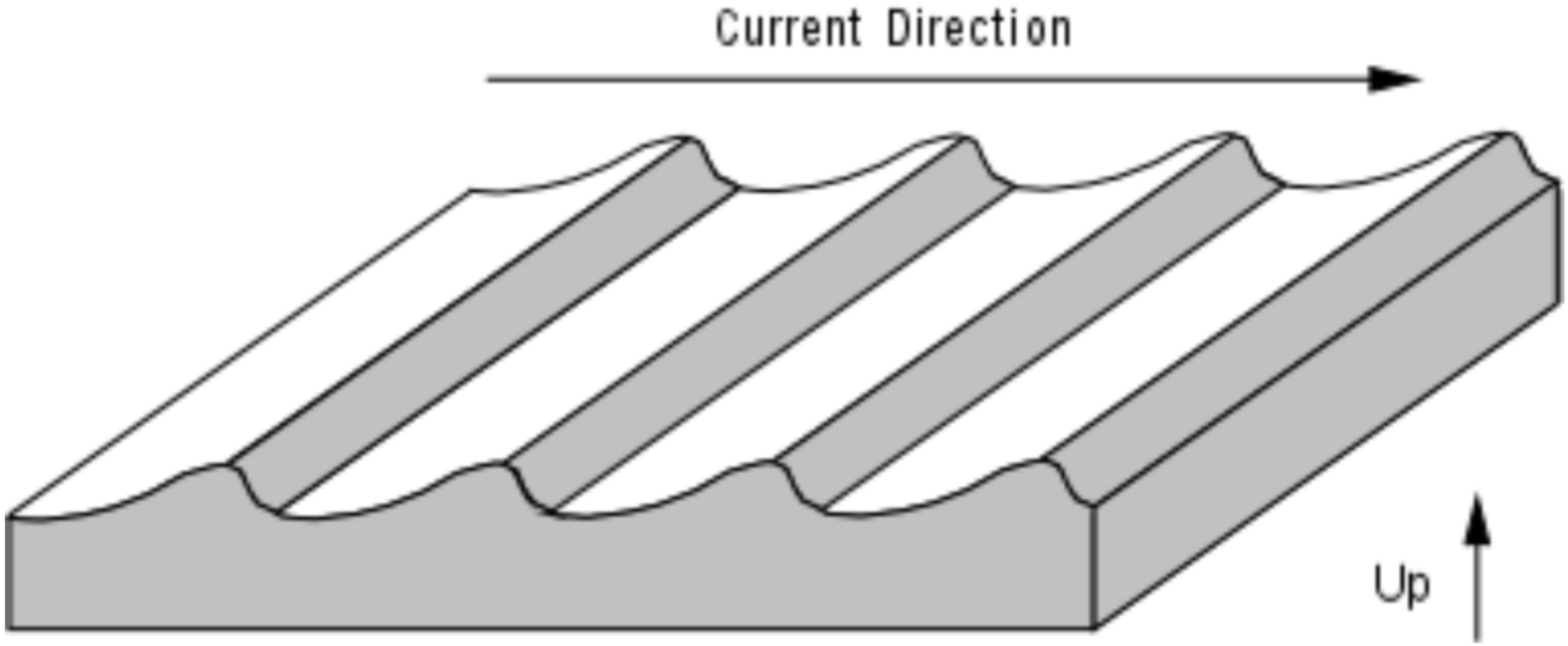
fordypning: *riflene i et bildekk*

2 gevær med riflet løp

Inne i en kanon eller gevær er det rifler for å spinne prosjektilen.



- ***Ripple Marks*** - Water flowing over loose sediment creates bedforms by moving sediment with the flow.



https://www.youtube.com/watch?v=cJo0fTpJypg

I tverrsnitt ser strømrifler ut som kryssjikninger.

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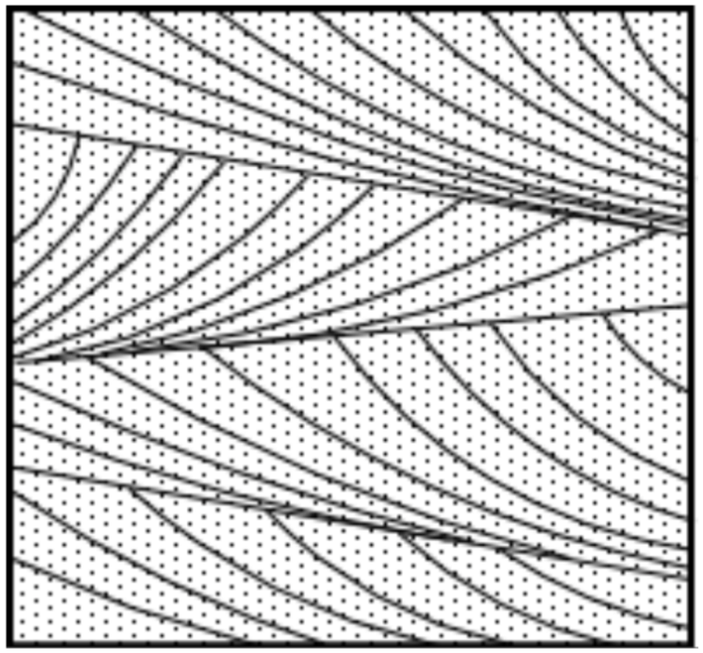
- ***Cross Bedding*** **-** Sets of beds that are inclined relative to one another. The beds are inclined in the direction that the wind or water was moving at the time of deposition. Boundaries between sets of cross beds usually represent an erosional surface. Very common in beach deposits, sand dunes, and river deposited sediment.



I tverrsnitt ser strømrifler ut som kryssjikninger.

Sandsteinsvegg av ringerikssandstein med tydelig kryssjikting, dannet i forbindelse med et flettverk av elver på slutten av silurtiden for ca. 400 millioner år siden (Jeløya utenfor Moss)

cross bedding sandstone

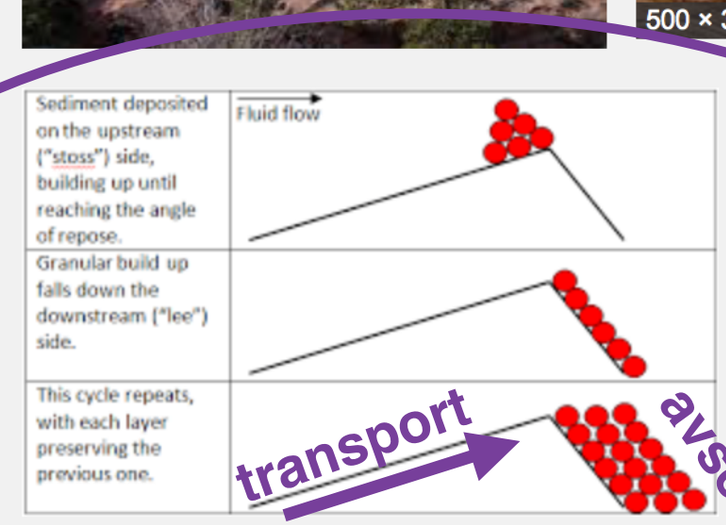
709 × 703 - throughthesandglass.typ…

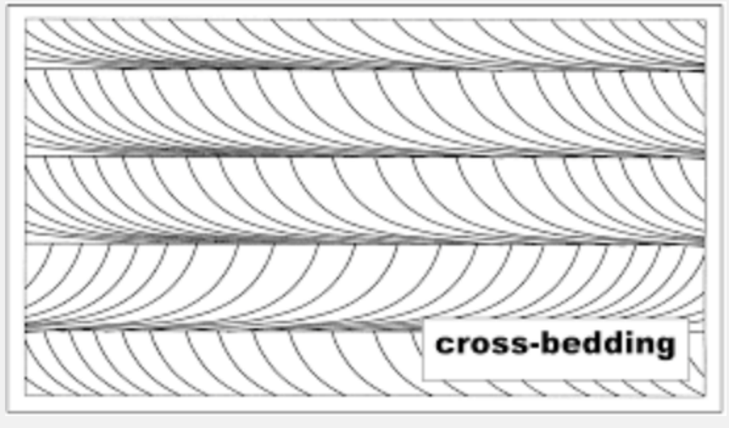
alamy stock photo

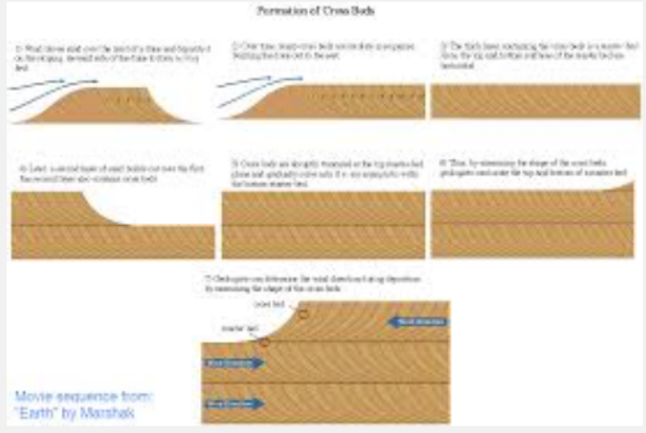
her ser vi kryssjikninger

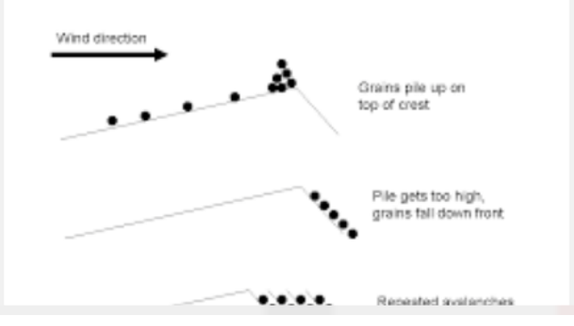
cross beds


500 × 303 - geol.umd.edu

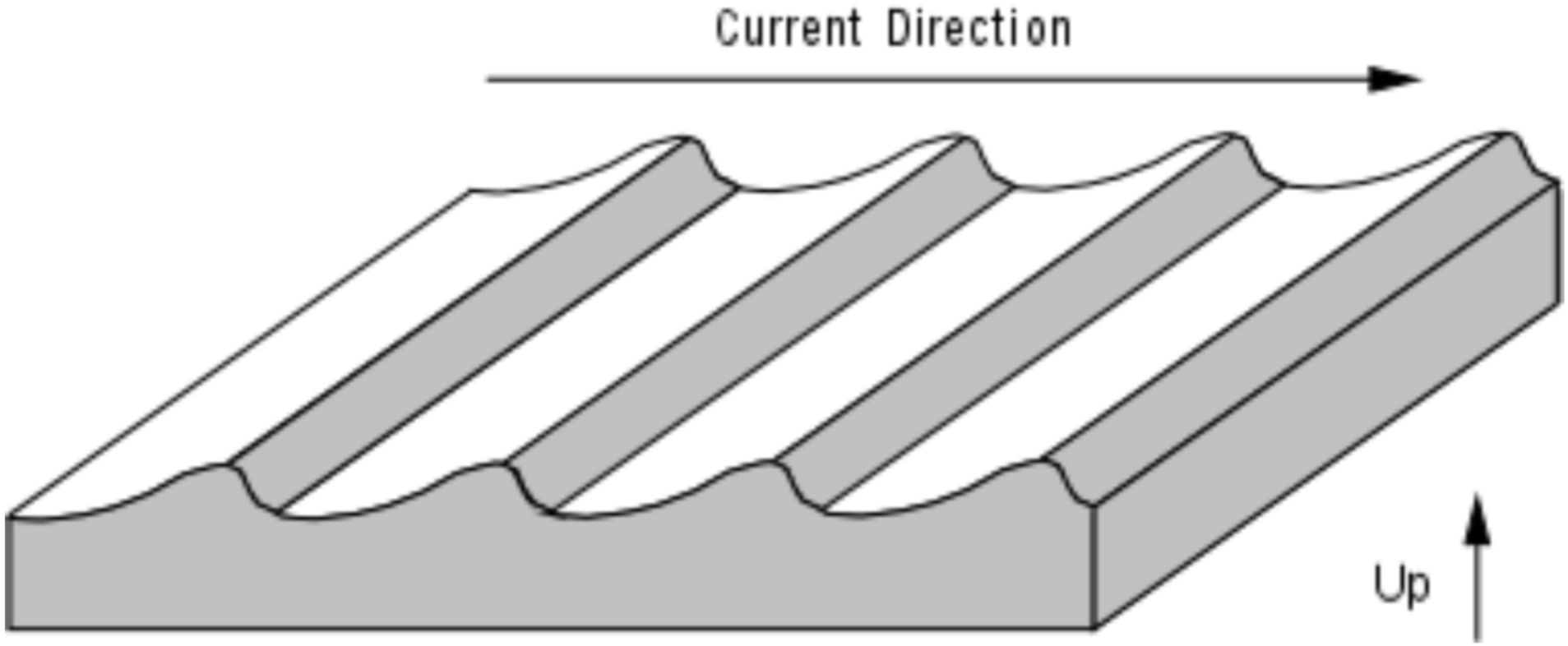

Sediment deposited on the upstream ("stoss") side, building up until reaching the angle of repose.
Fluid flow
Granular build up falls down the downstream ("lee") side.
This cycle repeats, with each layer preserving the previous one.
transport
avsetning


cross-bedding


Formation of Cross Beds
Movie sequence from:
"Earth" by Marshak


Wind direction
Grains pile up on top of crest
Pile gets too high, grains fall down front
Repeated avalanches

- ***Ripple Marks*** - Water flowing over loose sediment creates bedforms by moving sediment with the flow.



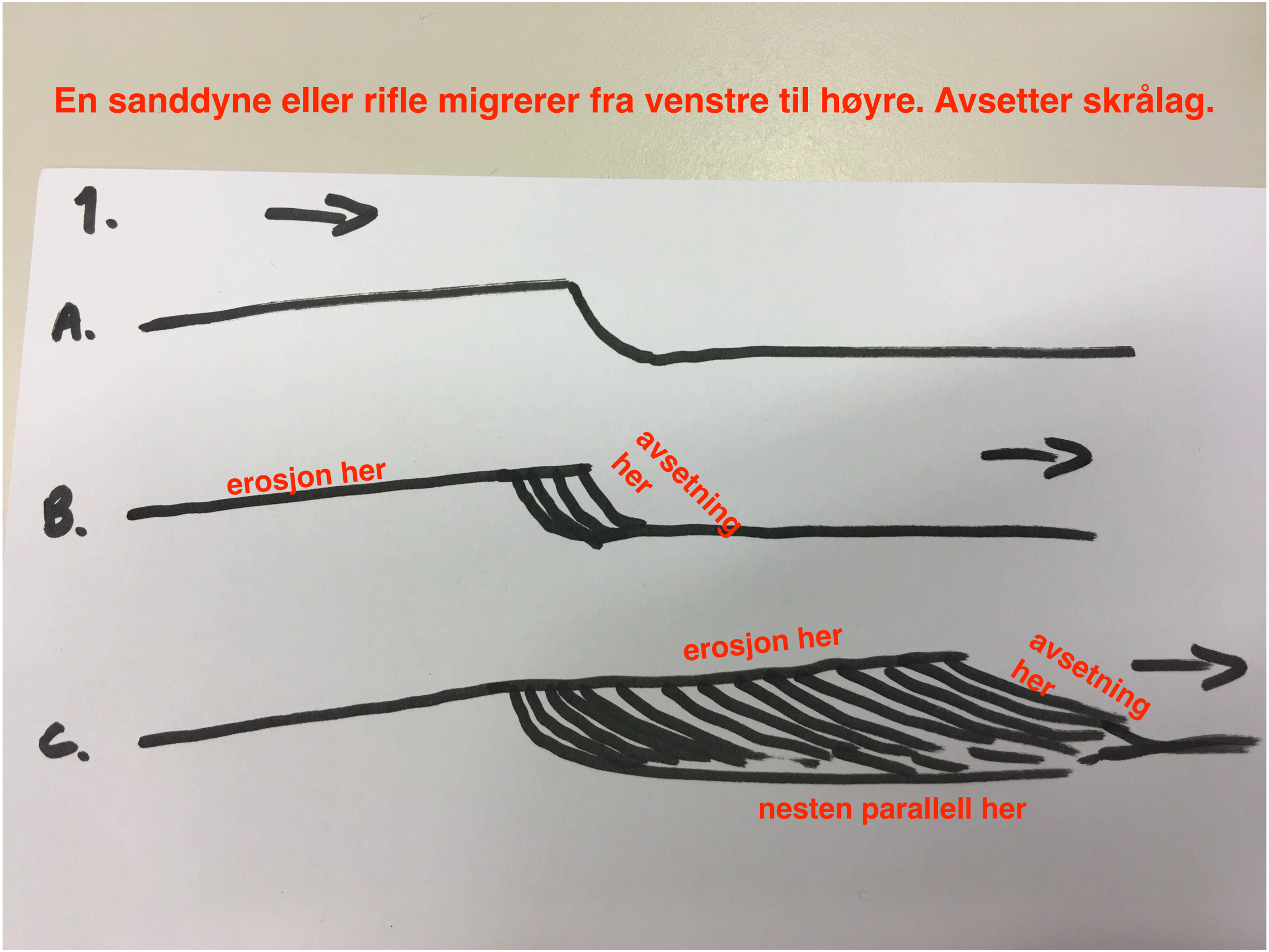
https://www.youtube.com/watch?v=cJo0fTpJypg

sand ripples / sandrifler
https://youtu.be/uY2QdZLLRP8

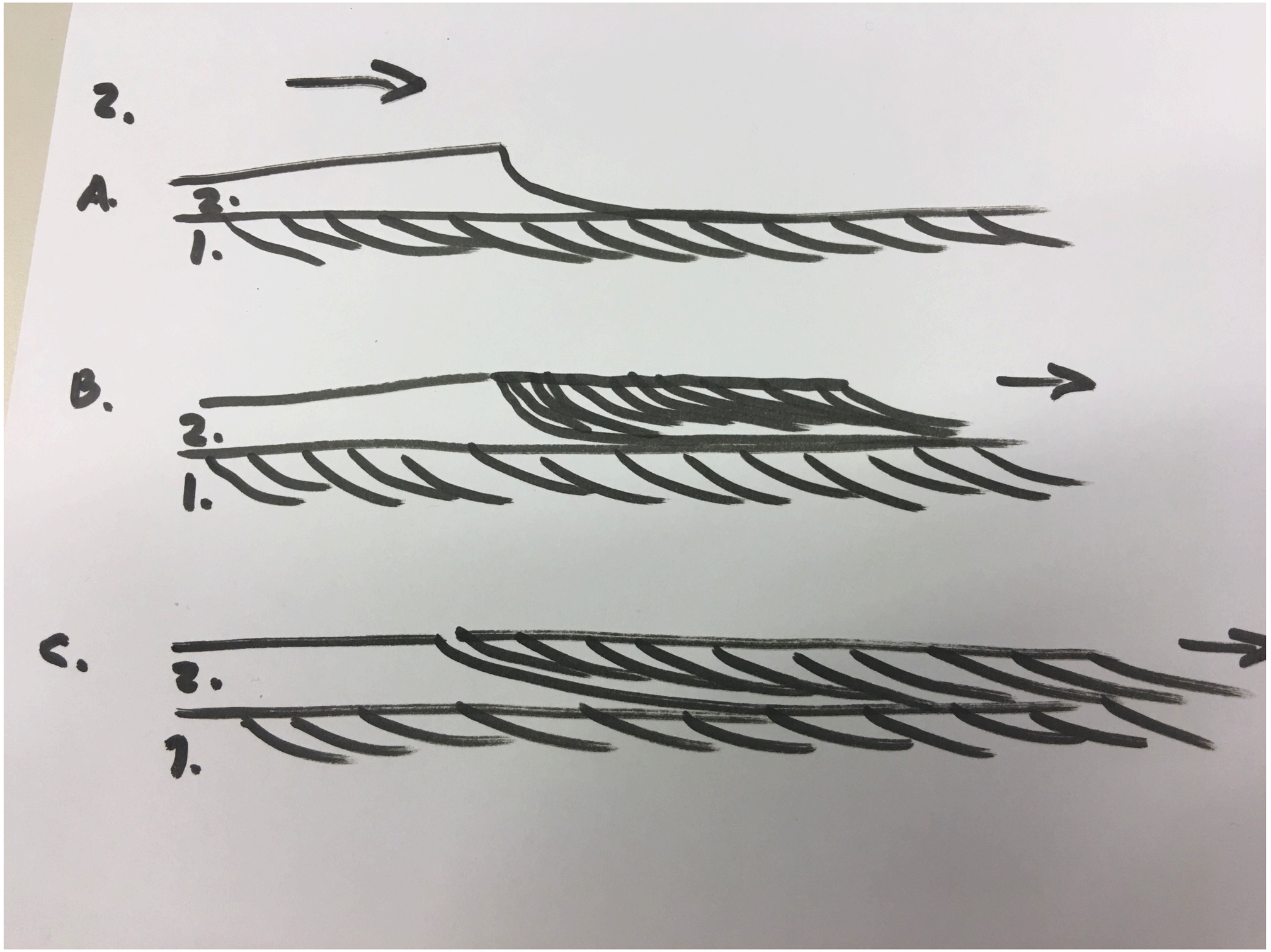
ripple migration / rifle migrasjon
https://youtu.be/KYvWwbEi0A0

https://www.youtube.com/watch?v=cJo0fTpJypg

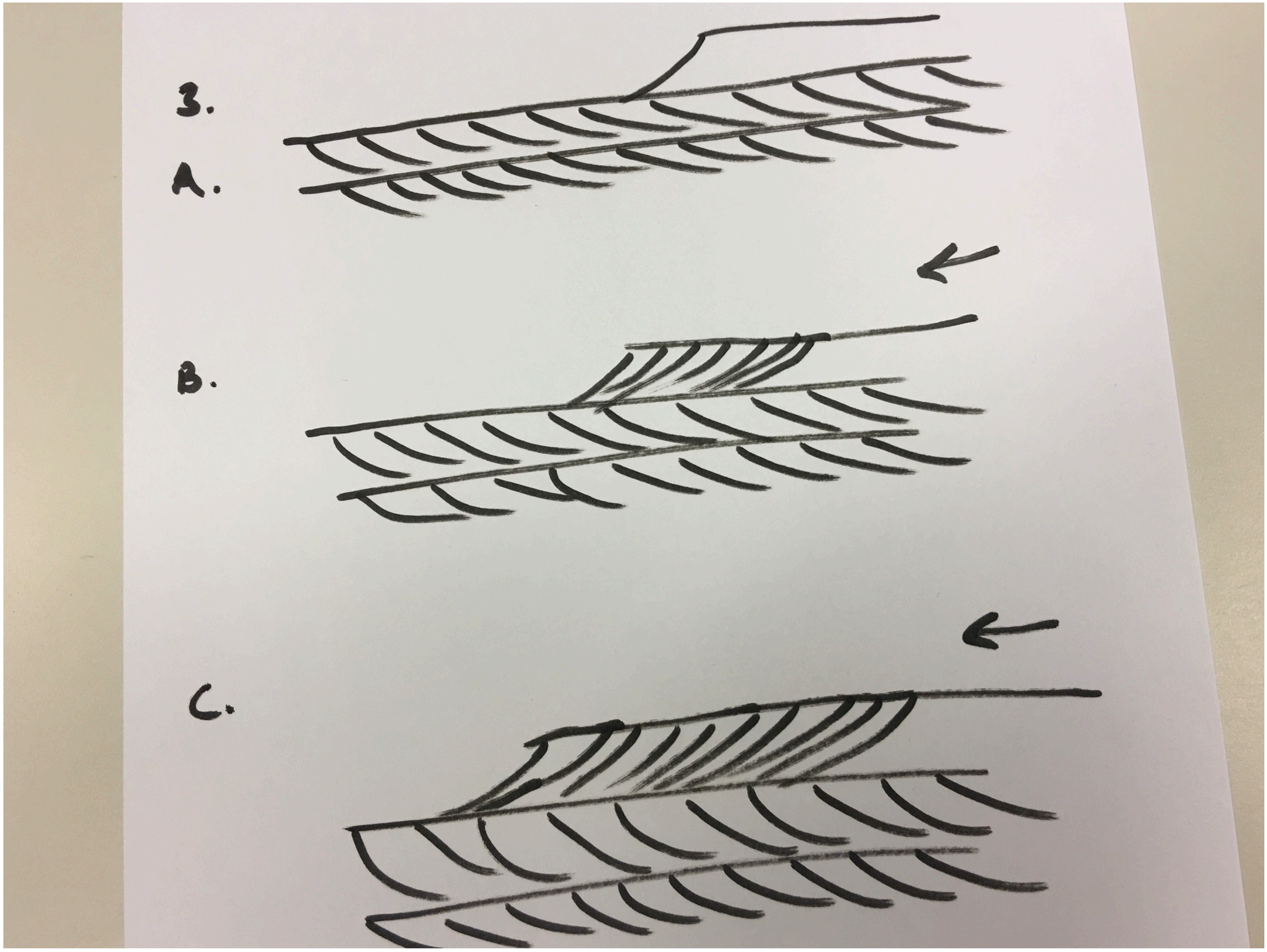
En sanddyne eller rifle migrerer fra venstre til høyre. Avsetter skrålag.



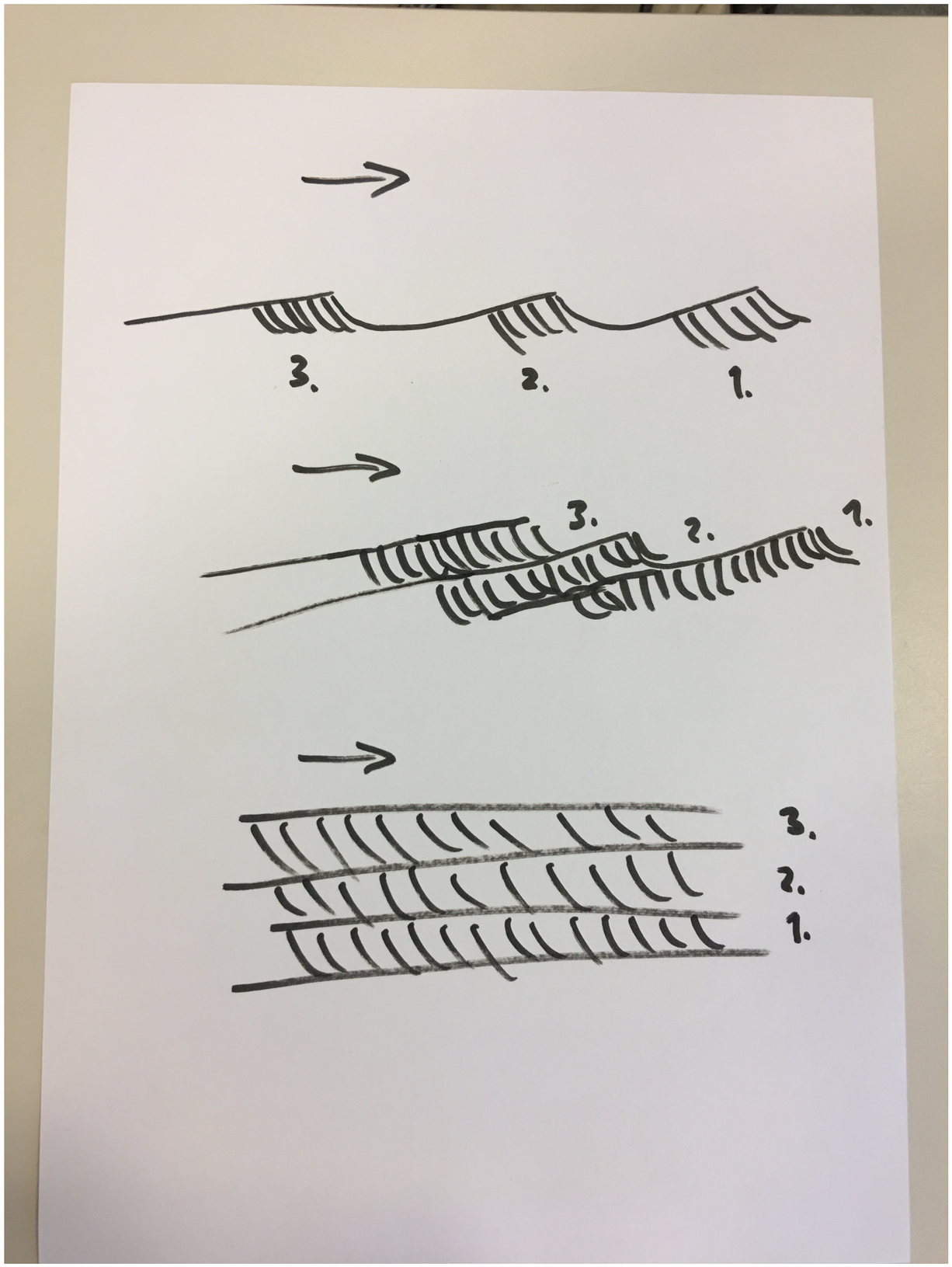
En ny rifle (2) migrerer fra venstre til høyre. Avsetter ny skrålag.



En rifle (3) migrerer fra høyre til venstre. Avsetter skrålag.



Tre rifler migrerer fra venstre til høyre samtidig. Avsetter skrålag.



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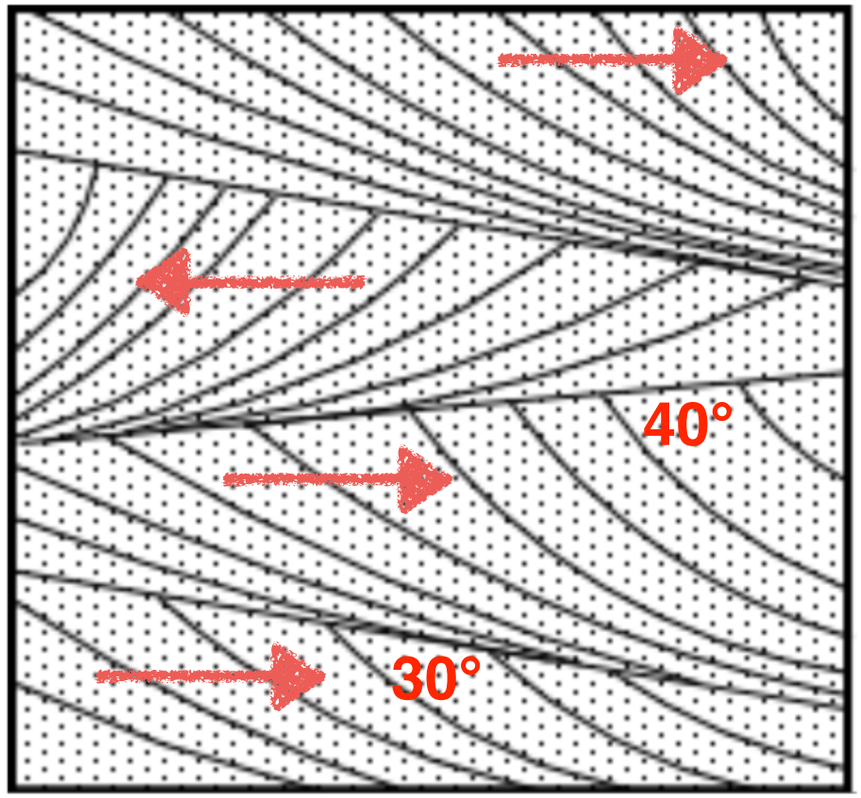

Skrålag er konkav oppover

Erosjon kun på toppen, gir avskåret skrålag på toppen.
Skrålag er nesten parallell på bunnen.

Maks fall på skrålagene er mindre enn 40°
fordi sand kan ikke hvile på brattere vinkel enn ca. 40°

strømretning

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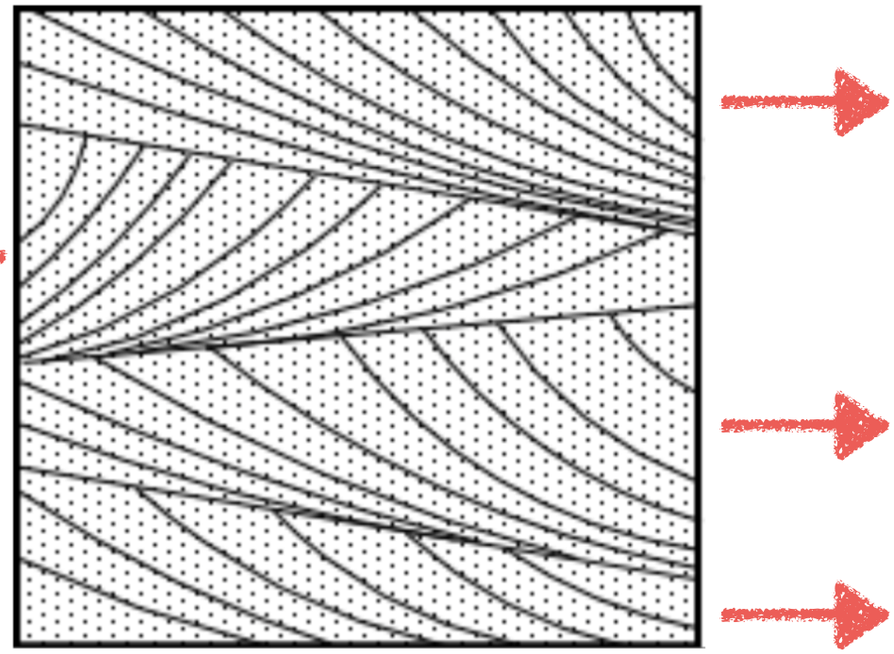

avsetning fra sandkorn som raser ned langs skrålag

(viktig å kunne tegne disse og forstå dem)

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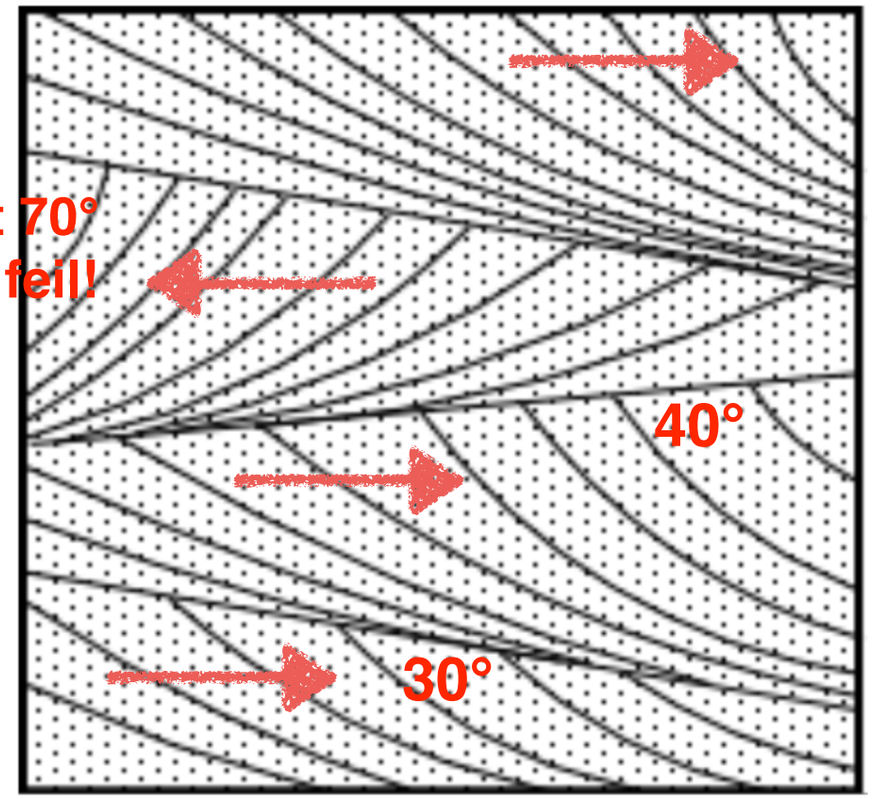

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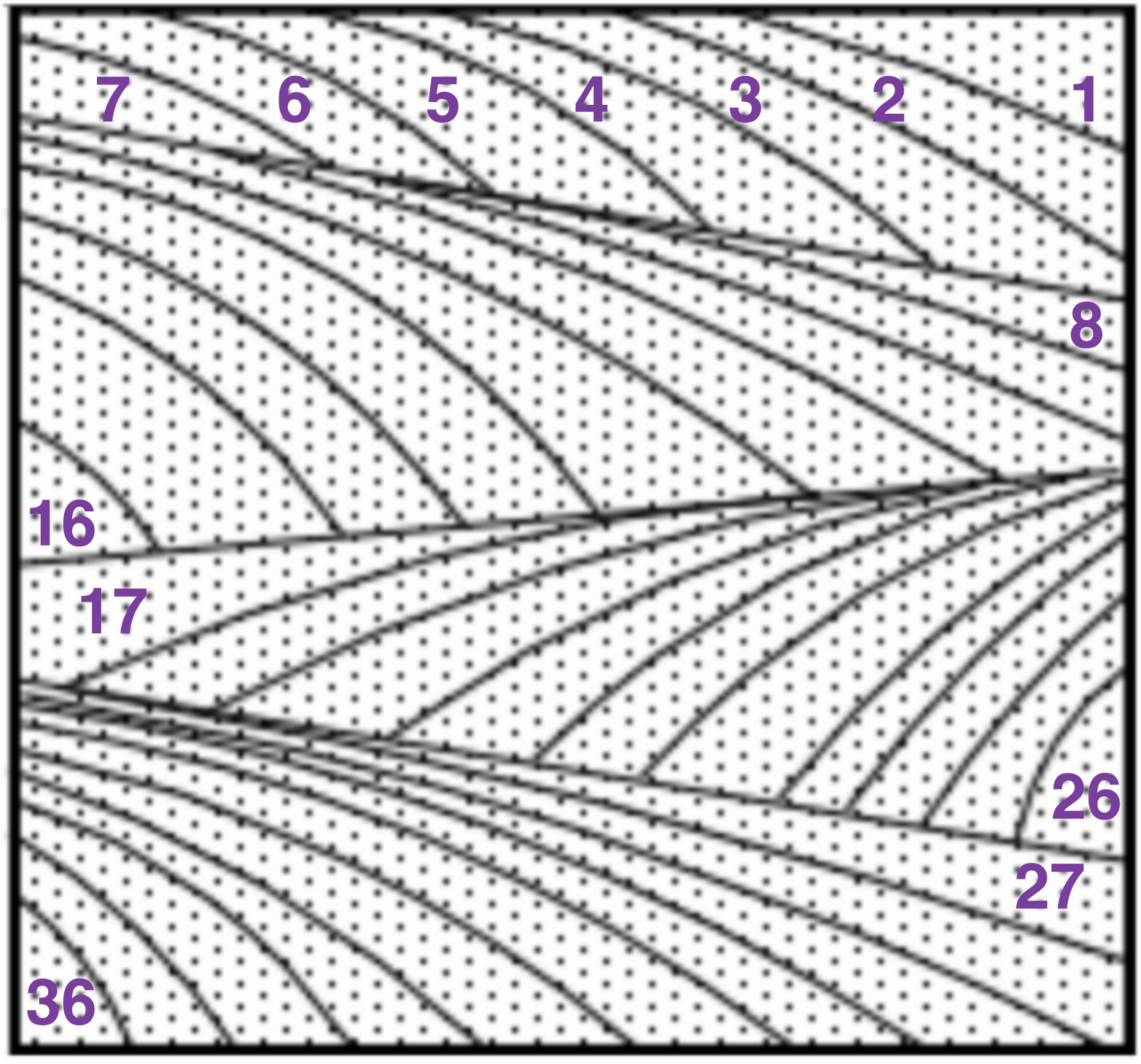
her har jeg snudd Nelsons tegning **opp-ned**

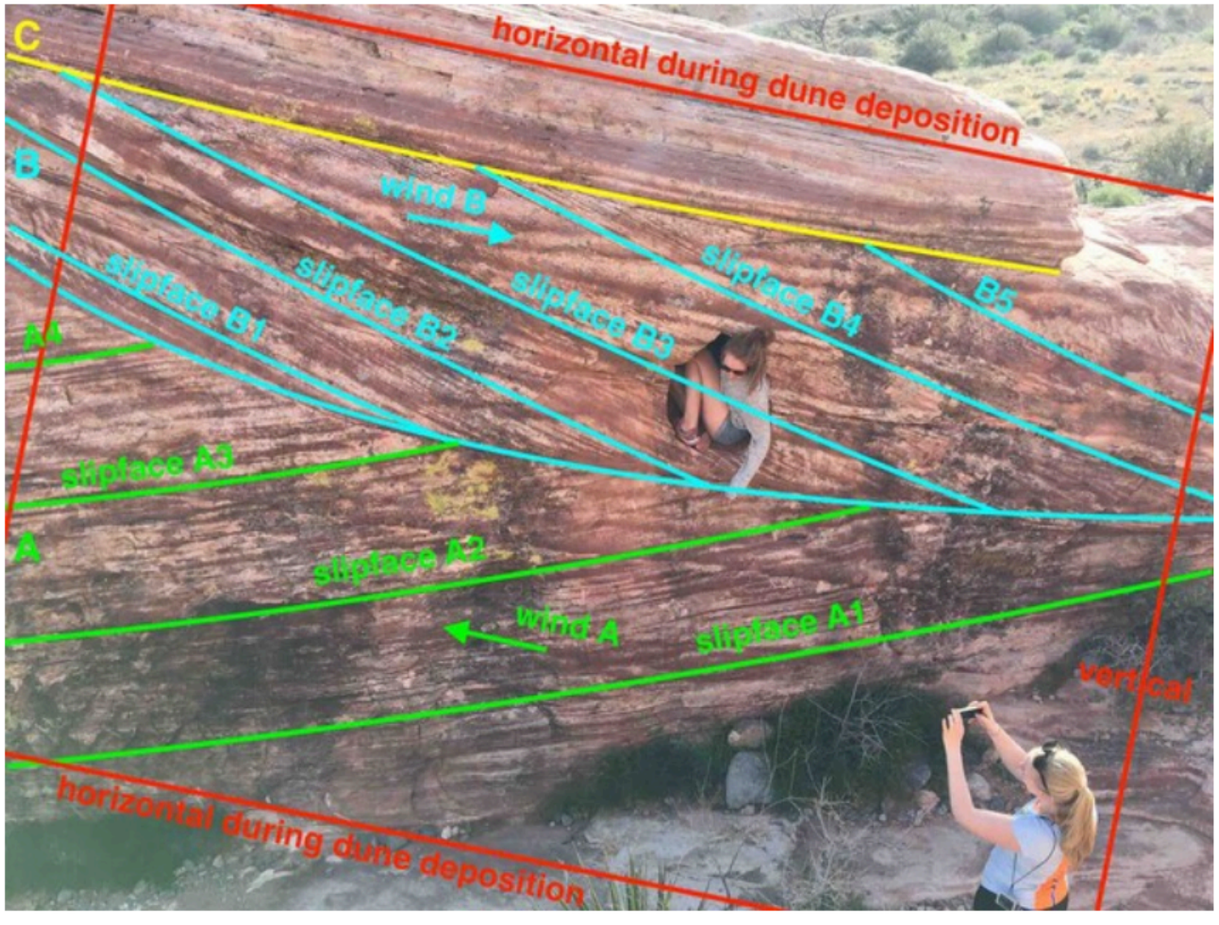


avsetnings rekkefølge

Lett å se når kryssjiktning er opp-ned (faguttrykk: “invertert”)
(dette er mer sikker å tolke enn putelava)

What do people know about the geology of these cross-bedded sandstones? Maybe you understand wh

https://groups.io/g/LasVegasROCKSandFossils/topic/98452852#20



Man finner kryssjiktninger alle steder der sand avsettes.

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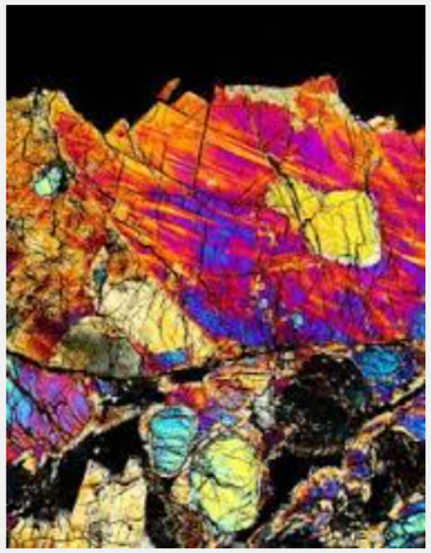
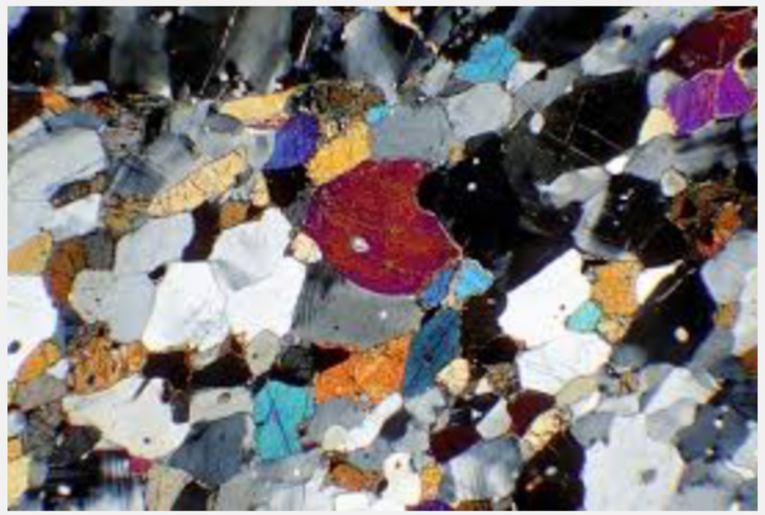
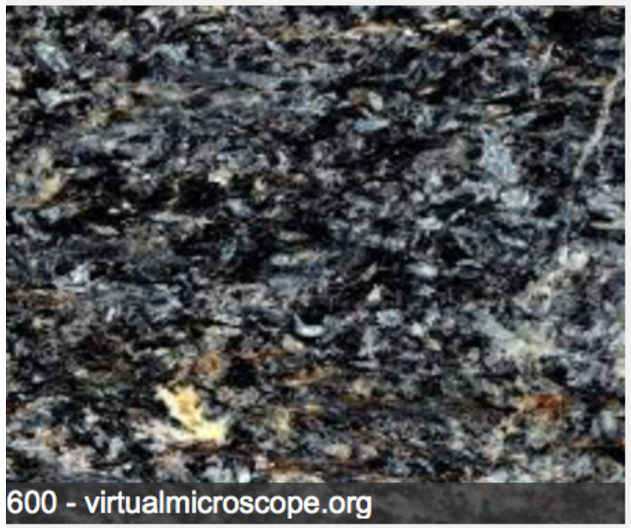
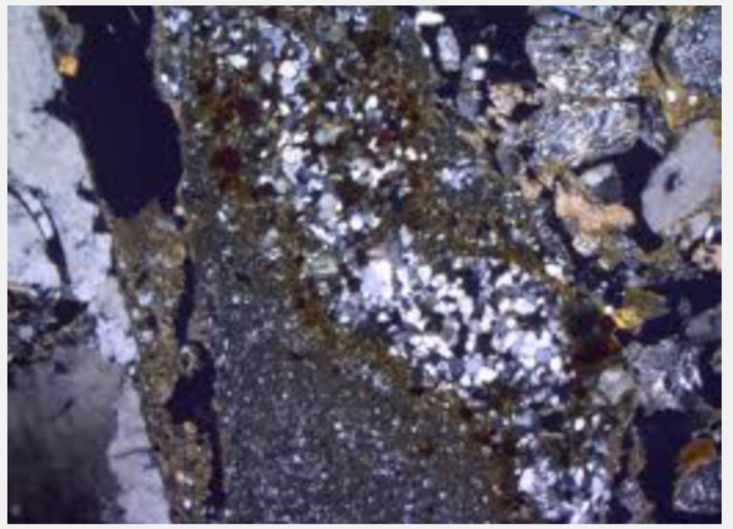
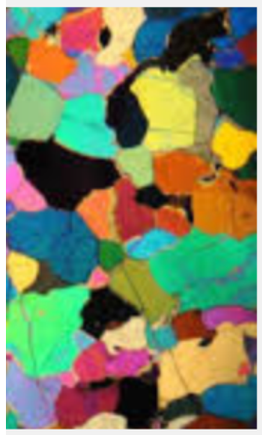
For å bestemme hva sandkornene består av, bruker vi tynnslip og petrografisk mikroskope



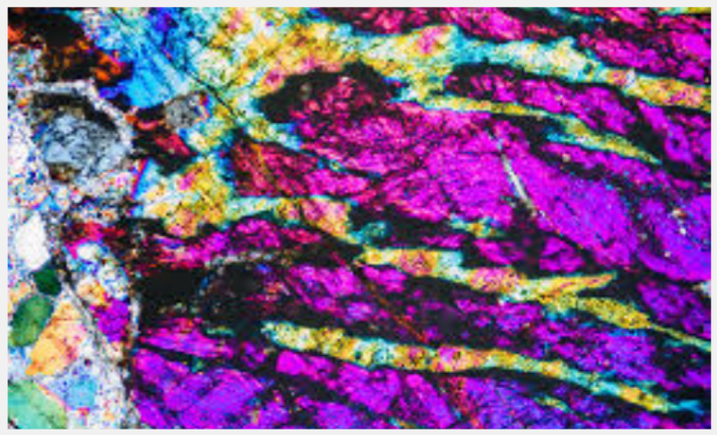


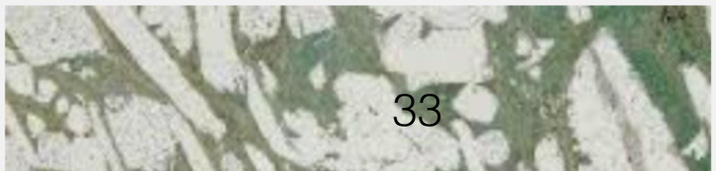

600 - virtualmicroscope.org



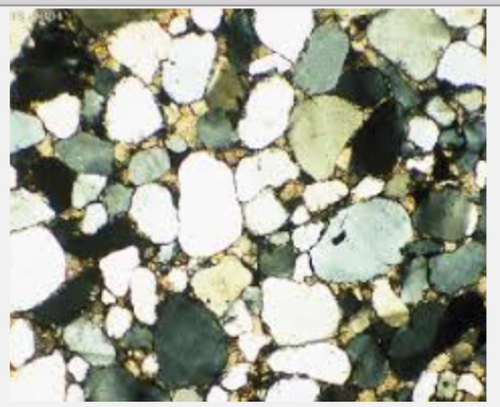
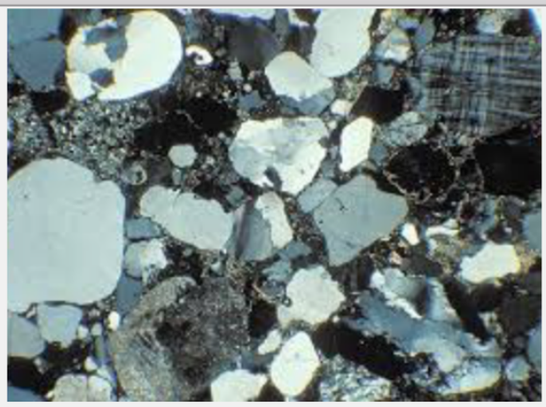
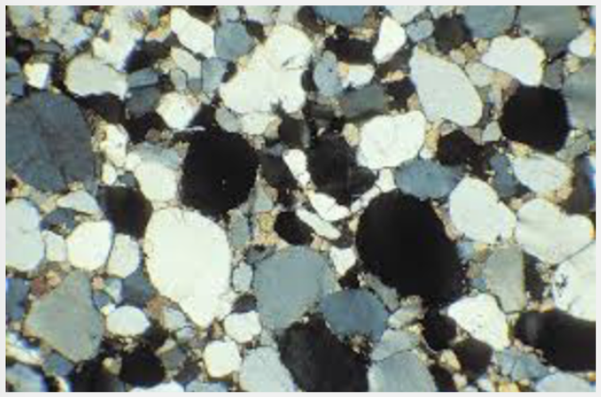



tynnslip

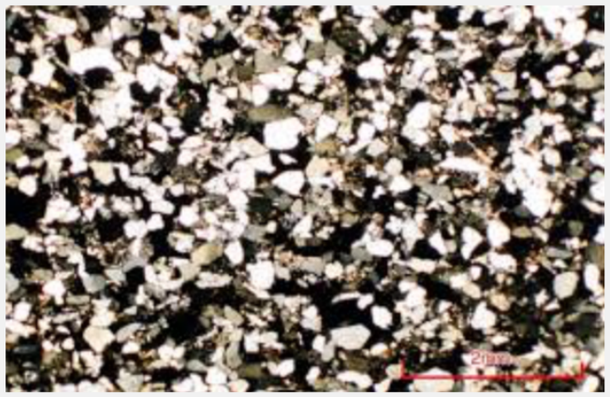


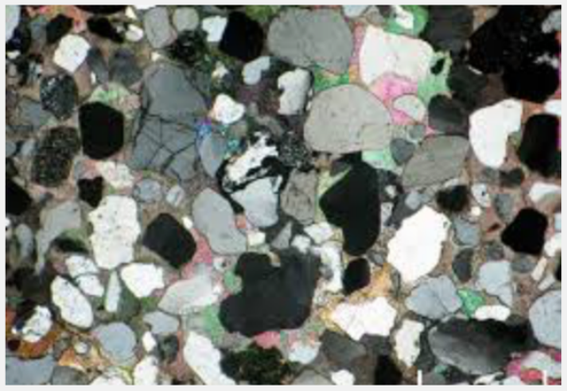

33

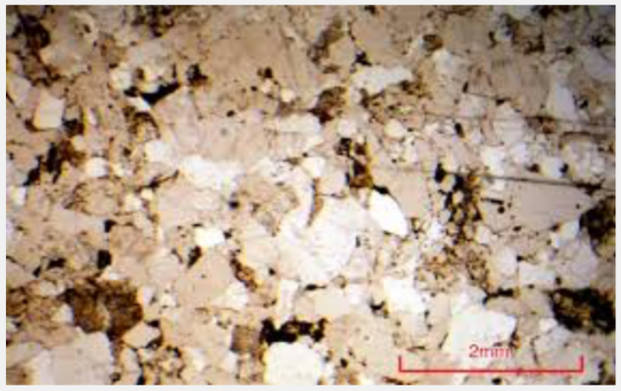


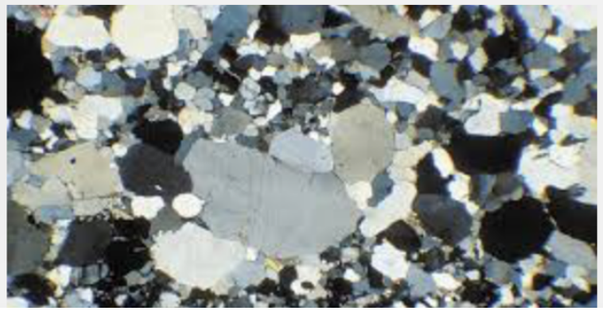














Korn sitter sammen og er sementert i sandsteiner. Matriks eller sement i mellom.
(Korn er ikke låst sammen, som i krystalline magmatiske og metamorfe ba.)

sandstone provenance diagrams

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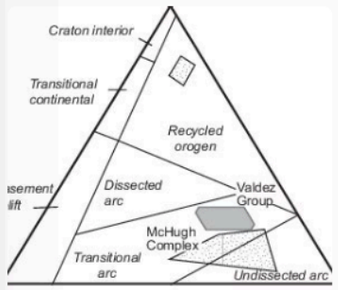
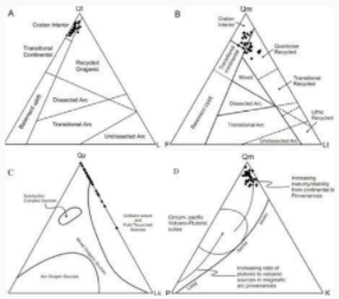
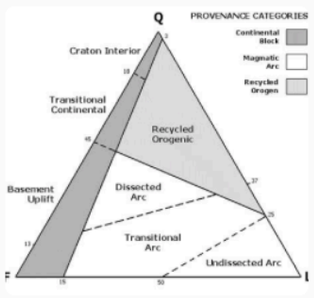
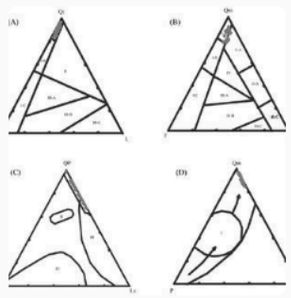
Man analyserer sandsteiner for å bestemme "provenance" (kilde/miljø)

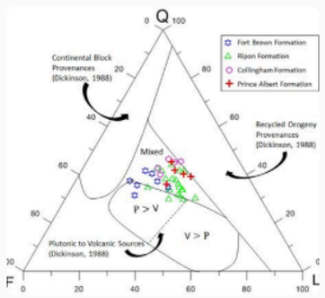
Privacy, simplif

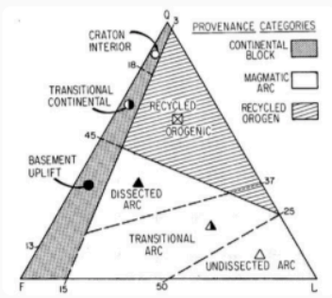


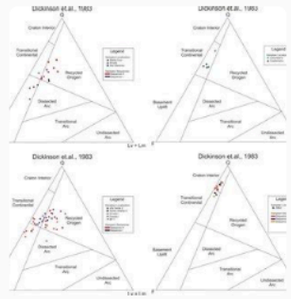


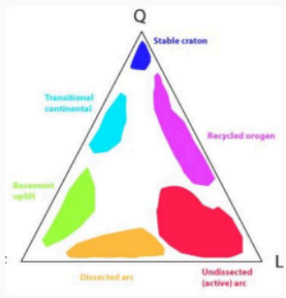


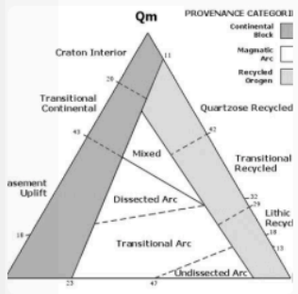


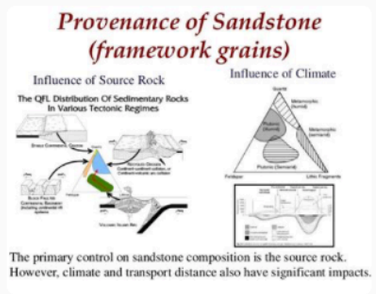


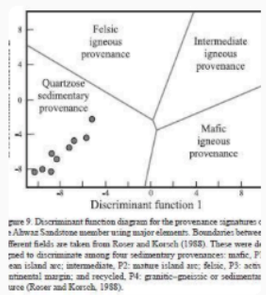


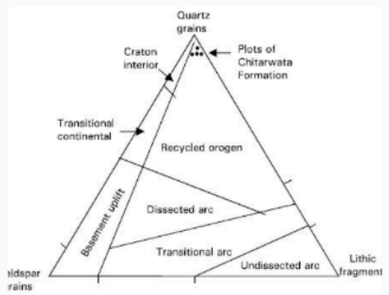


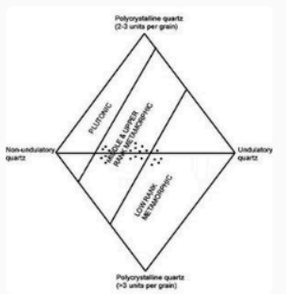


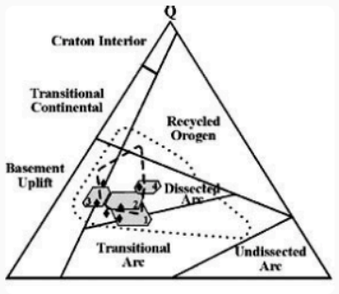


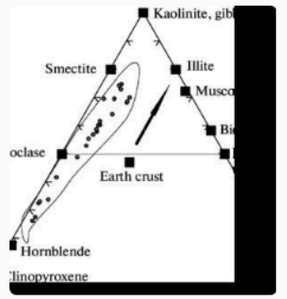


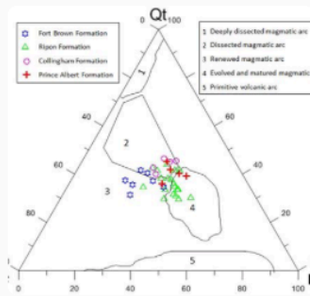


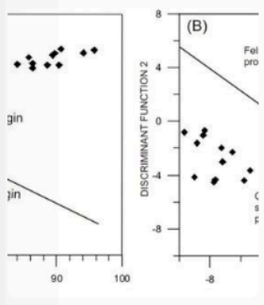


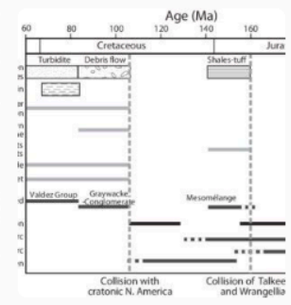


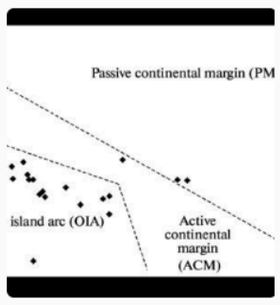


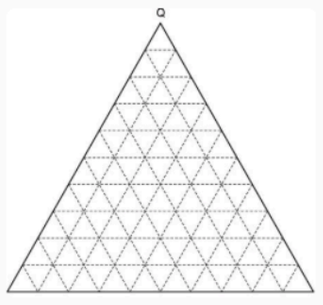


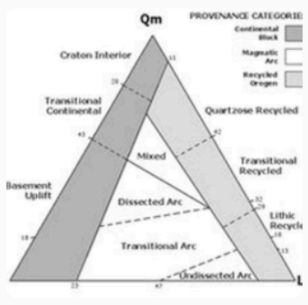


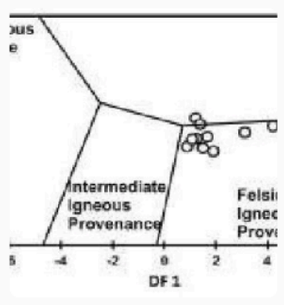


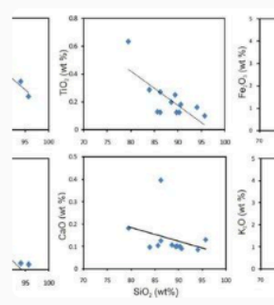


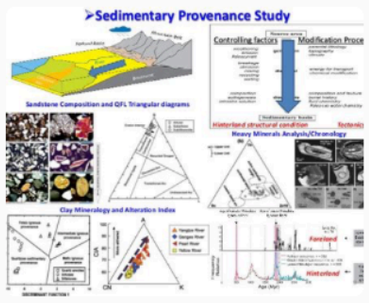


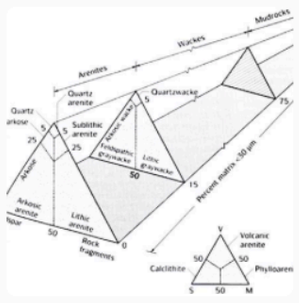


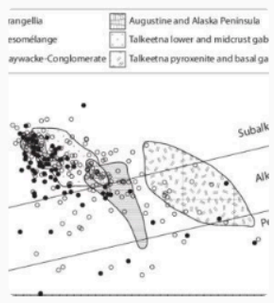


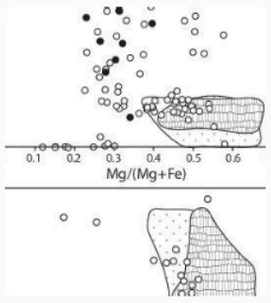


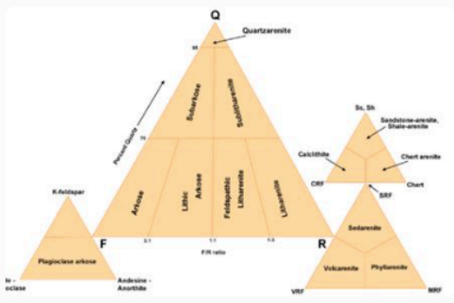


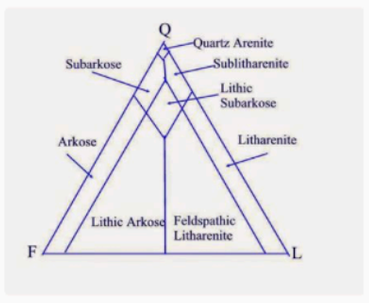




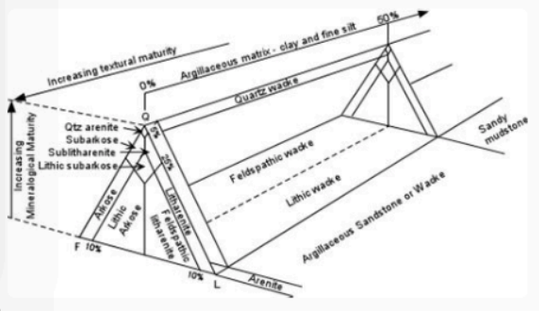


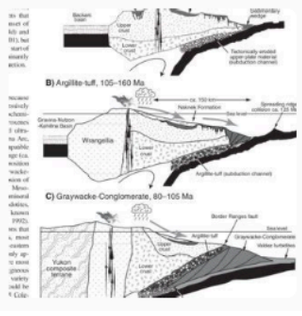


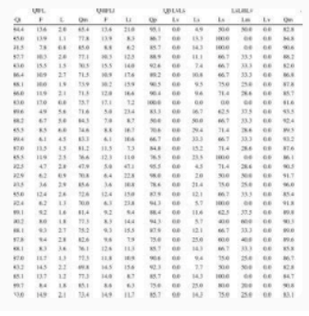


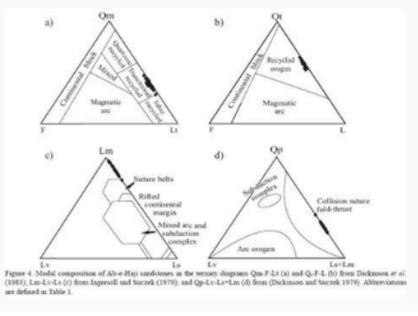


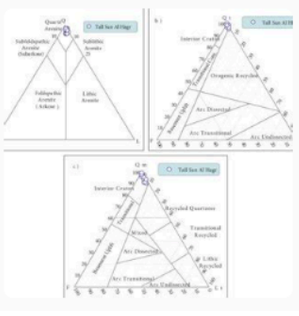
	BK17	BK20	BK25	BK35	BK4
72	86.36	79.50	88.60	94.11	95.7
44	9.12	10.88	5.32	5.15	3.5
13	0.27	0.63	0.20	0.16	0.1
69	1.28	2.81	4.24	0.27	0.1
02	0.02	0.12	0.07	0.00	0.0
48	0.29	0.81	0.16	0.05	0.0
10	0.12	0.18	0.11	0.08	0.1
11	0.15	0.16	0.11	0.05	0.0
71	3.18	3.34	2.14	1.37	1.6
05	0.05	0.07	0.05	0.03	0.0
		1.42			
45	100.85	99.92	100.98	101.27	101.5
87	69.93	72.12	66.48	75.04	62.3
85	95.04	94.85	93.49	95.72	91.7
77	92.27	92.48	89.04	94.10	84.4
16	9.47	7.31	16.65	18.28	26.8
36	20.93	20.88	19.79	29.13	31.5
43	33.77	17.22	27.29	32.38	37.1

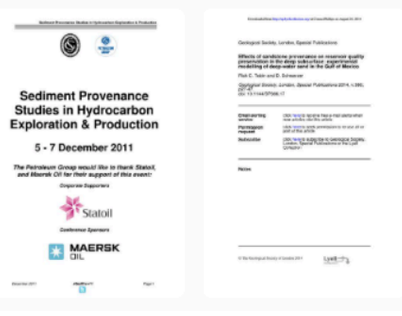












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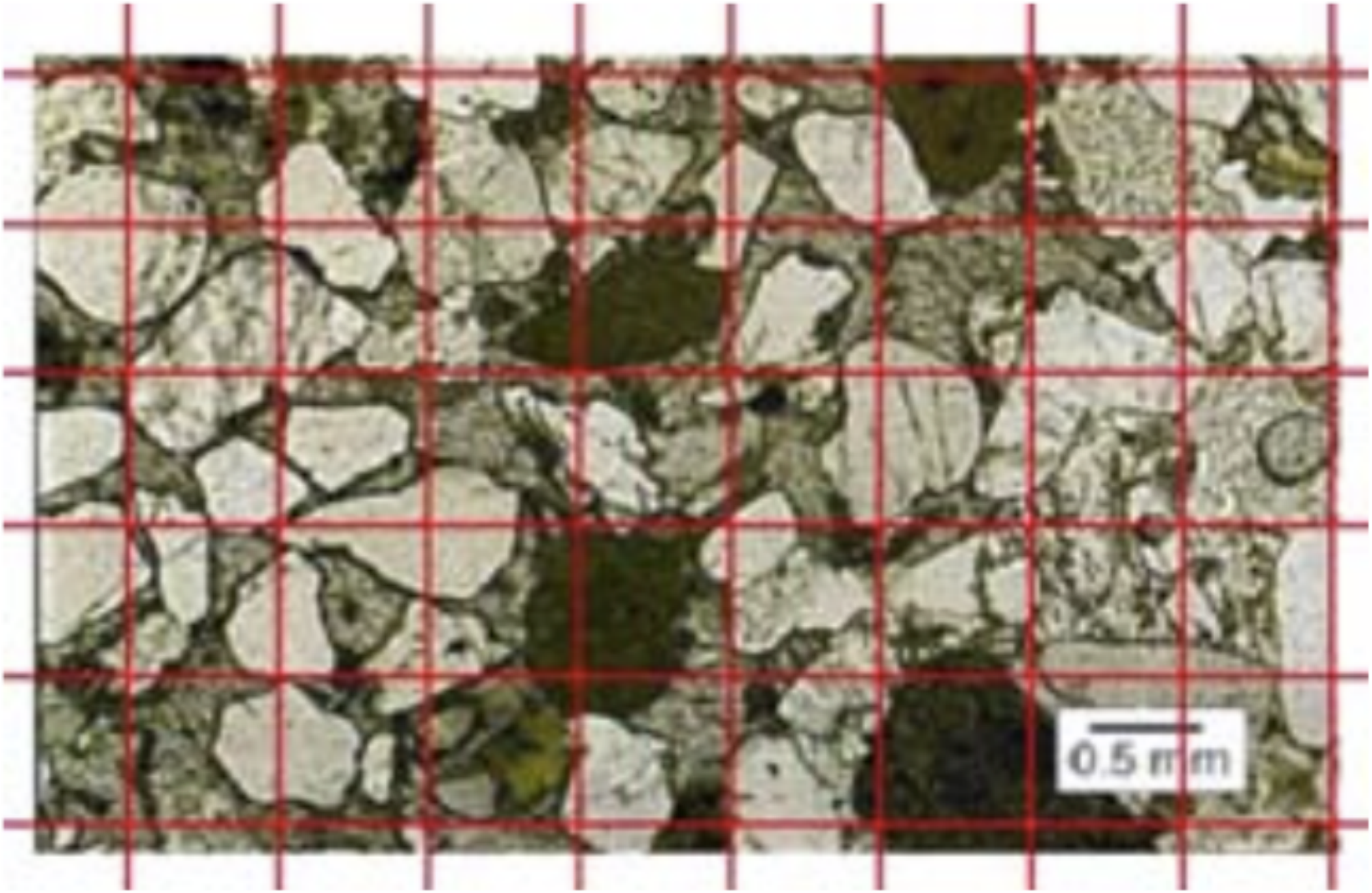
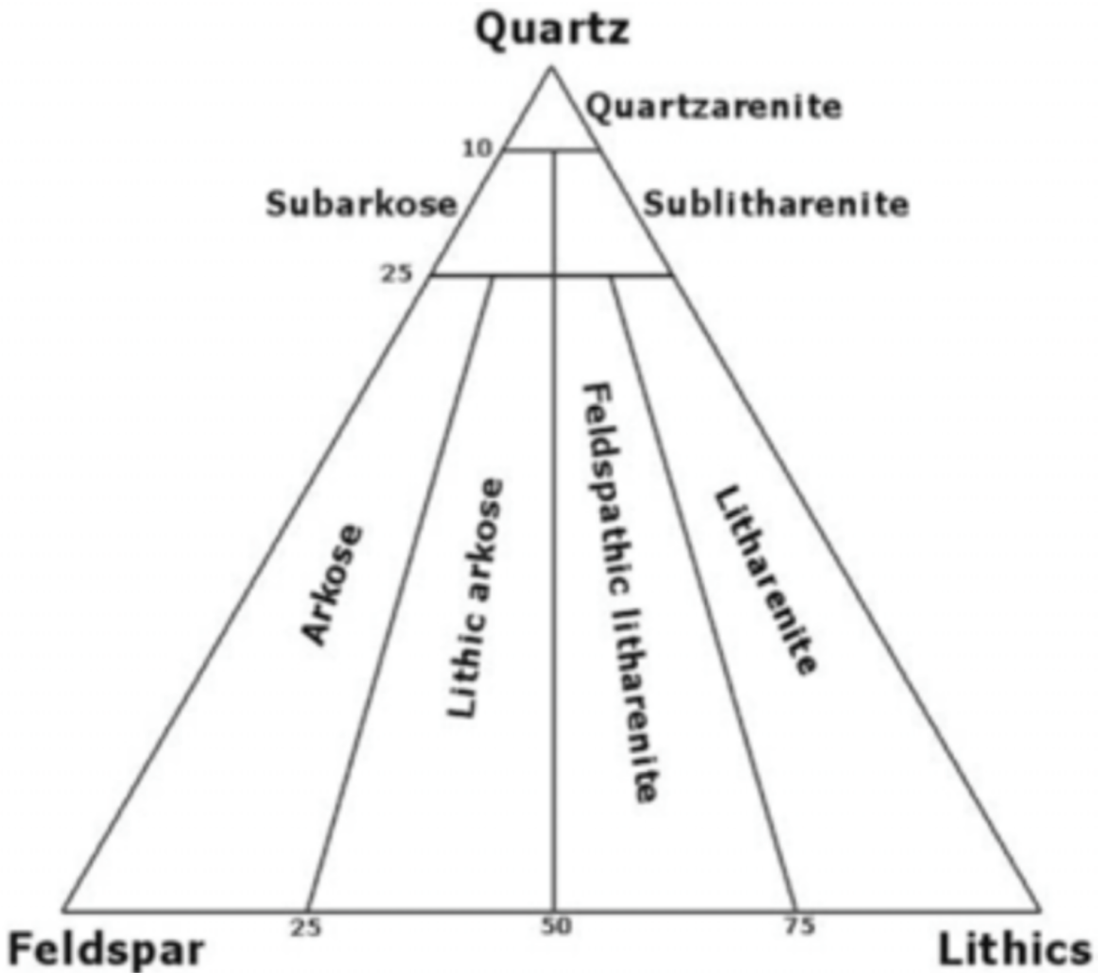


“Punkt-telling”
Man teller mineralkorn som ligger ved hvert rødt kryss (her er 54 punkter).
Man kan telle flere hundre punkter.
Da får man statistikk (hvor mye prosent av de ulike mineraltypene) som kan plottes på 3-kant diagram.

Et typisk eksempel av punkt-telling av sandkorn på et tynnslip:
4% andesitt korn
28% kalifeltspat korn
6% kalkstein korn
37% kvarts korn
15% plagioklas korn
2% porerom (dette er ikke sandkorn, kun sandkorn brukes
8% sement (dette er ikke sandkorn, kun sandkorn brukes)
100% totalt av tynnslipp

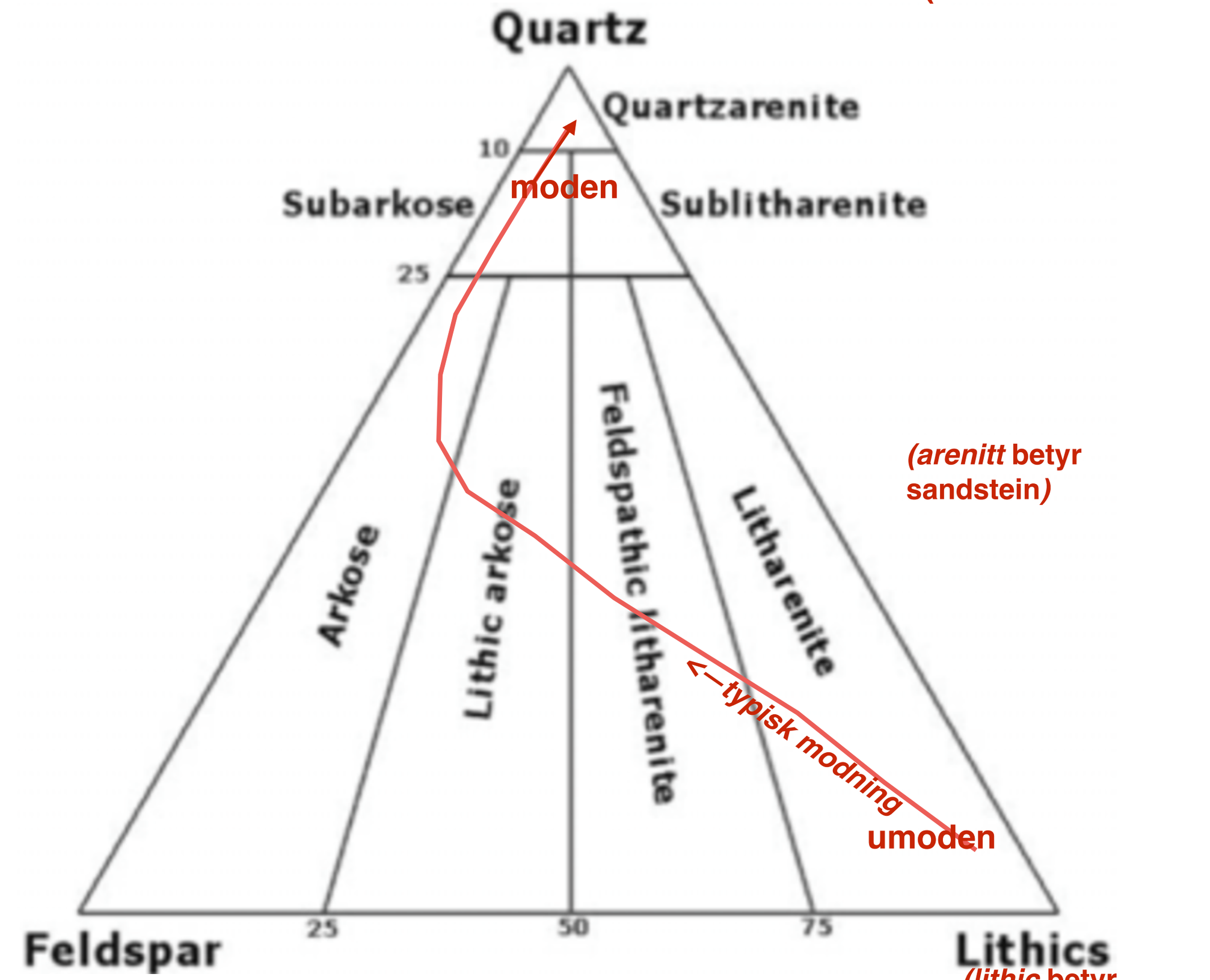
Trekantdiagram bruker bare sandkorn.
Må regne om (normalisere) til nye verdier:
4,4% andesitt korn
31,1% kalifeltspat korn
6,7% kalkstein korn
41.1% kvarts korn
16,7% plagioklas korn
100% totall av sandkorn



Her er resultatet vi trenger for å plotte i diagram:
“Quartz”: Kvarts = 41,1%
“Feldspar”: Kalifeltspat + Plagioklas = 47,8%
“Lithics” (sandkorn som er bergarter, ikke enkelte mineraler): Andesitt + Kalkstein = 11,1%
100%

Jeg forventer at dere forstår hvordan slik data omregnes og plottes i trekantsdiagrammer.

(En side tatt fra internett.)

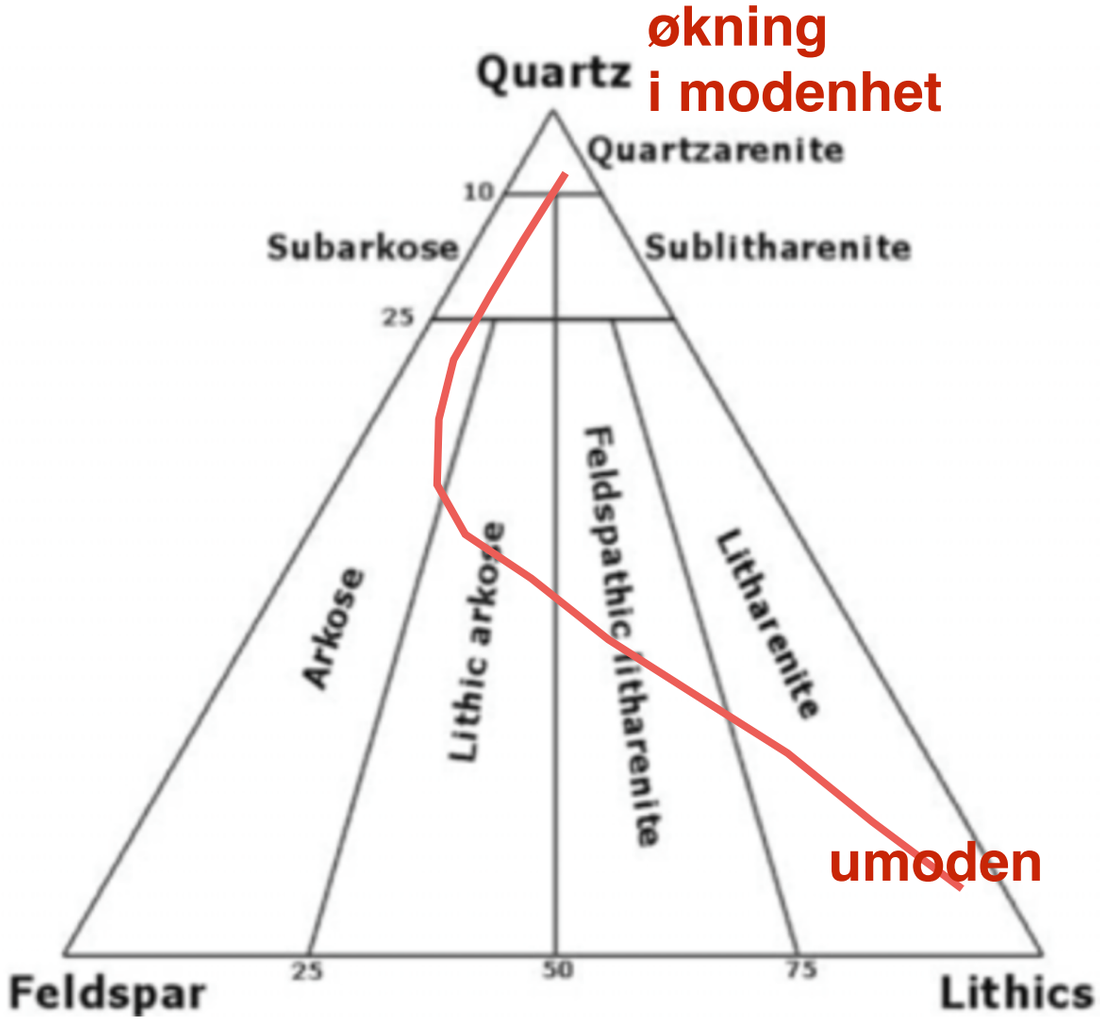


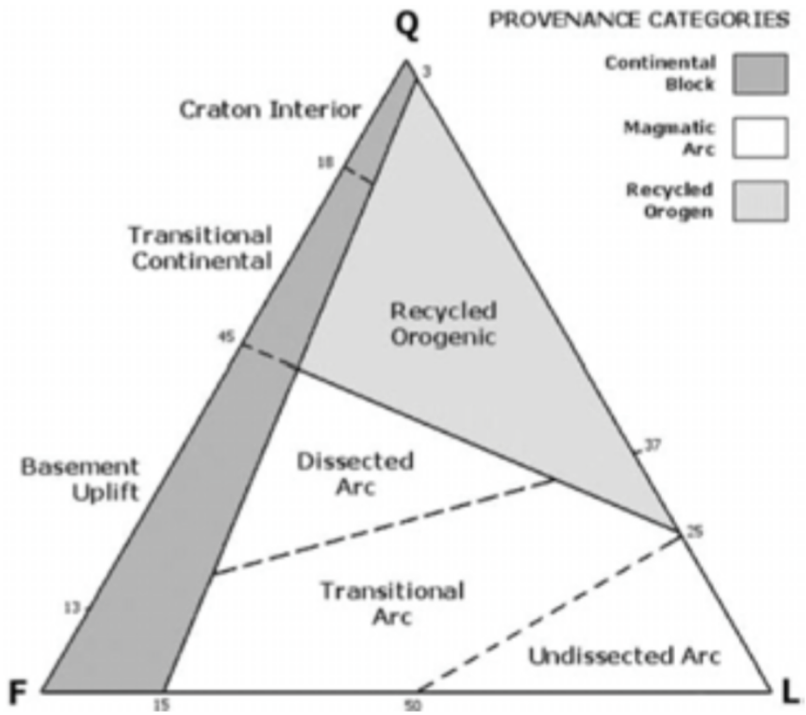
(arenitt betyr sandstein*)*

(kalifeltspat pluss plagioklas)

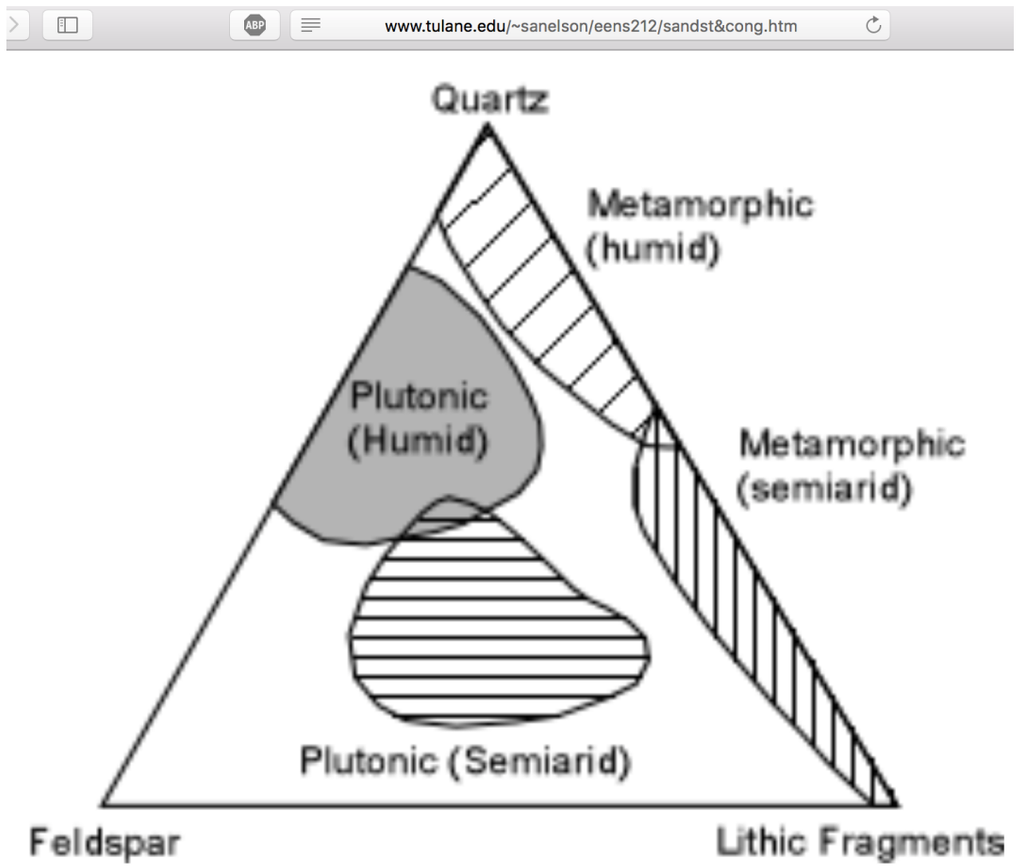
(lithic betyr bergart sandkorn, ikke mineralkorn)

(Sider tatt fra internett.)



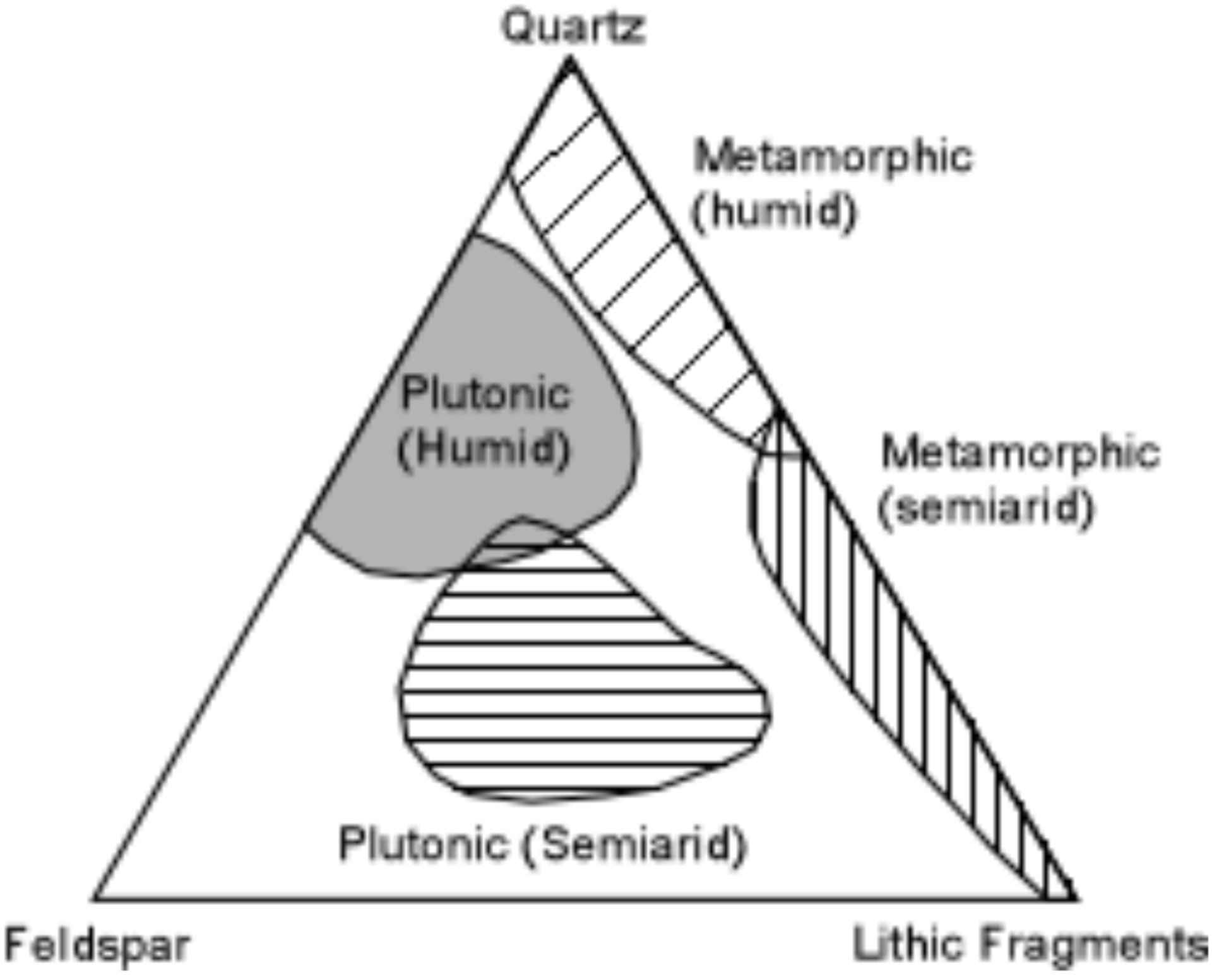


her er to ulike tolkninger av provenanse (kilde)

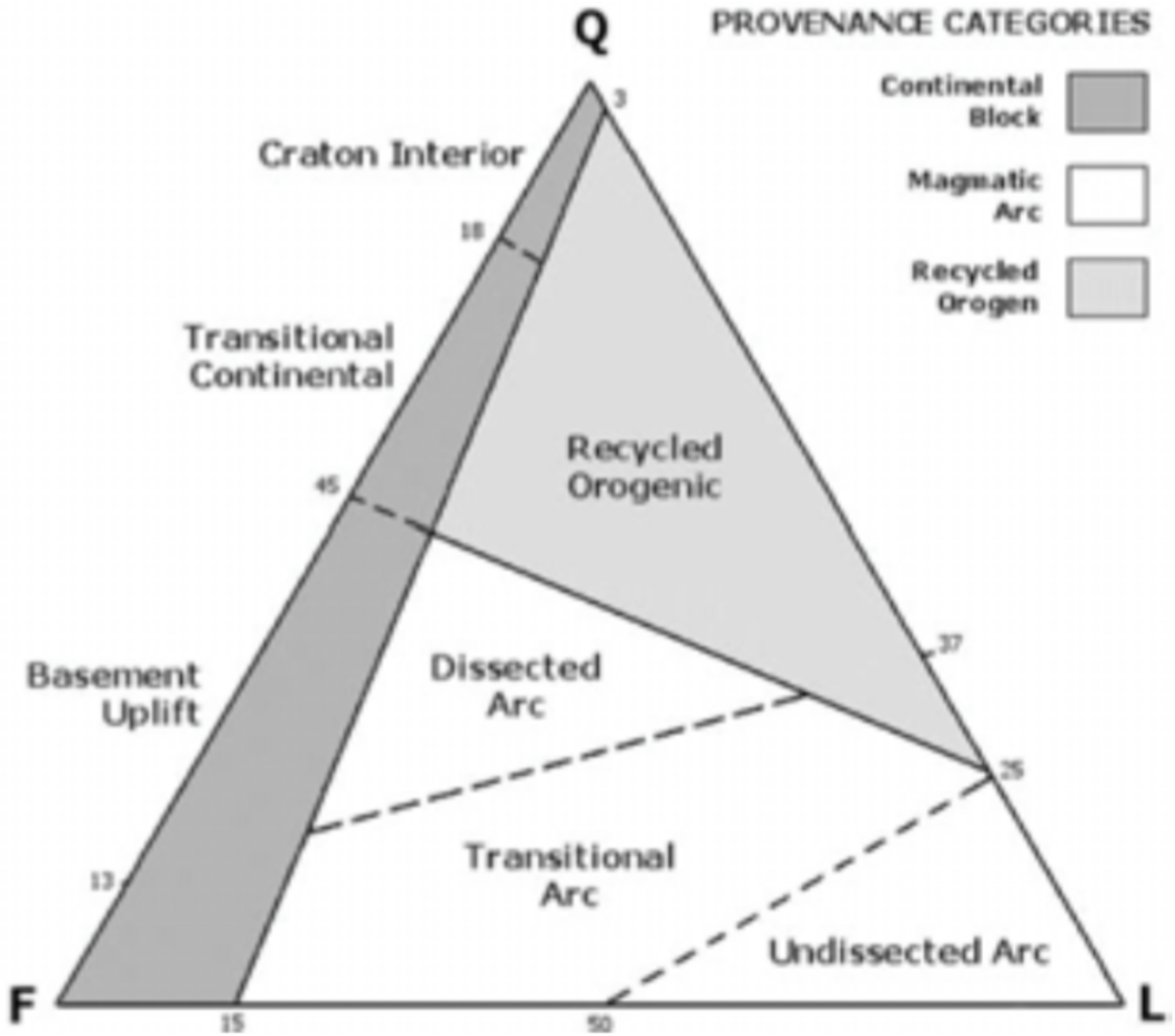


Ikke pugg selve diagrammene.
Men forstå at geologer anvender slike trekantdiagramer i sine tolkninger.

www.tulane.edu/~sanelson/eens212/sandst&cong.htm



ikke pugg diagrammet



gammel kontinentalskorpe

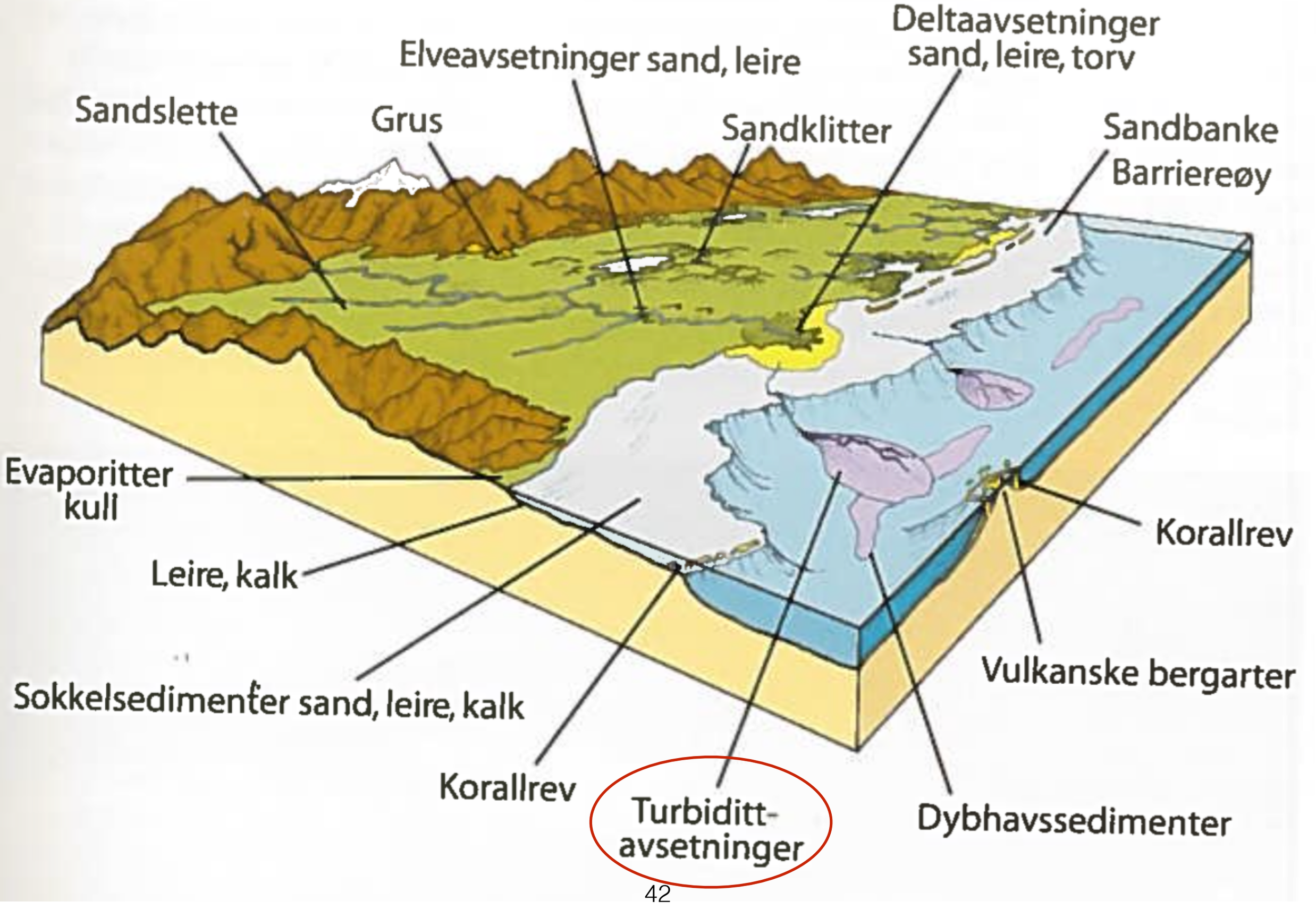
øybue eller magmatisk fjell

"orogen" betyr "fjellkjede"

ikke pugg diagrammet

Disse diagrammene skal ikke pugges av dere. De er til orientering.

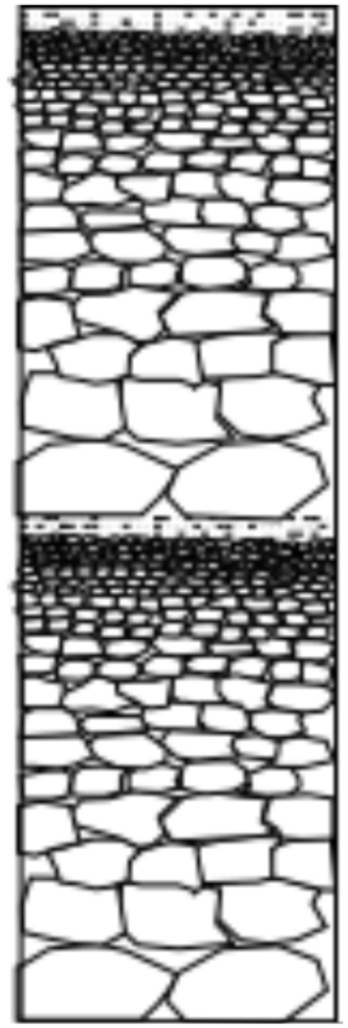
Det jeg forventer er at dere vet hvordan trekantsdiagrammer brukes. At dere kan plotte data på et F-L-Q diagram, for eksempel.

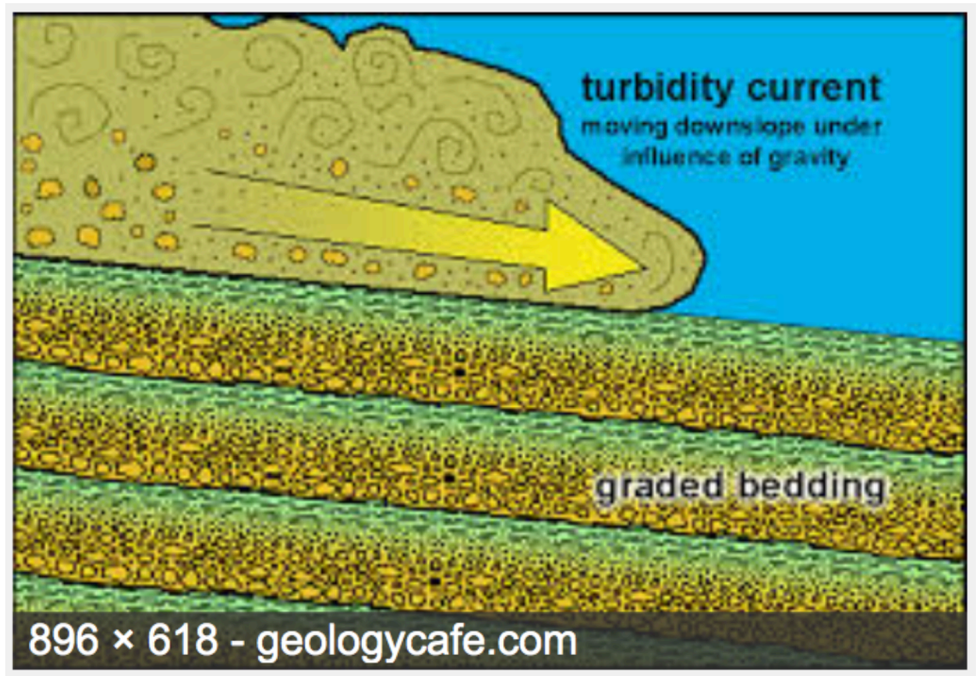

Deltaavsetninger
sand, leire, torv
Elveavsetninger sand, leire
Sandslette
Grus
Sandklitter
Sandbanke
Barriereøy
Evaporitter
kull
Korallrev
Leire, kalk
Vulkanske bergarter
Sokkelsedimenter sand, leire, kalk
Korallrev
Turbiditt-
avsetninger
Dybhavssedimenter

gradert lagning

- ***Graded Bedding*** - As current velocity decreases, first the larger or more dense particles are deposited followed by smaller particles. This results in bedding showing a decrease in grain size from the bottom of the bed to the top of the bed. Sediment added as a pulse of turbid water. As pulse wanes, water loses velocity and sediments settle. Coarsest material settles first, medium next, then fine. Multiple graded-bed sequences called turbidites (see figure 7.30 in your text).

turbiditter

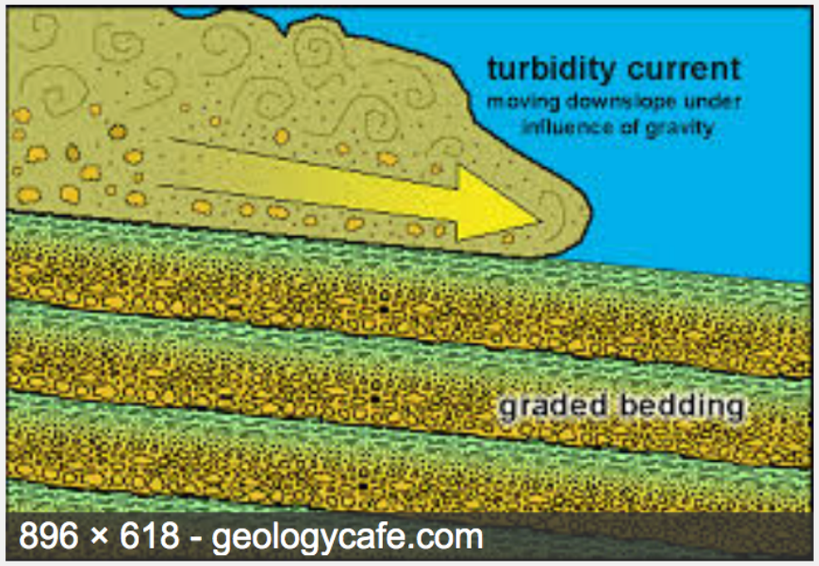


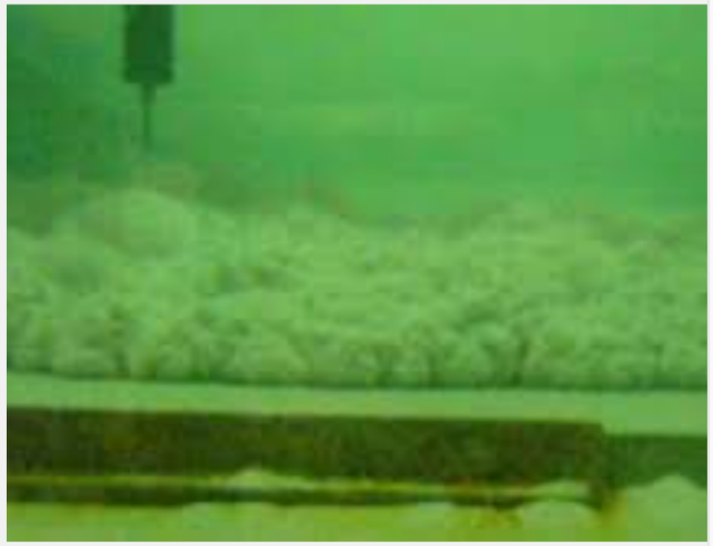


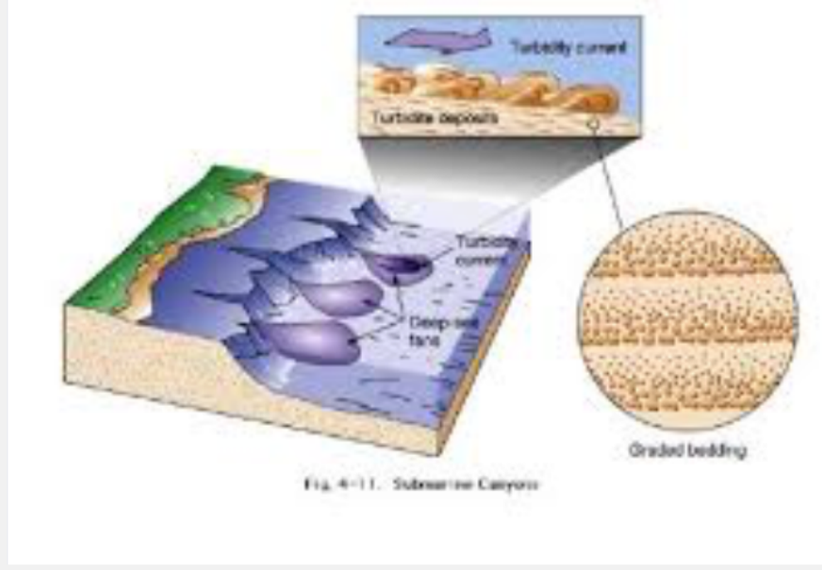
Nelsons 2 turbiditter er stygge.
Her til venstre er bedre tegning.

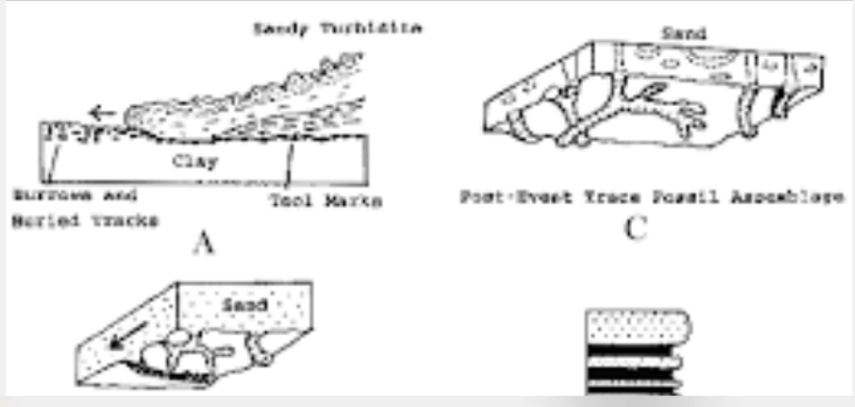
“turbiditter” avsettes av “turbidittstrøm”

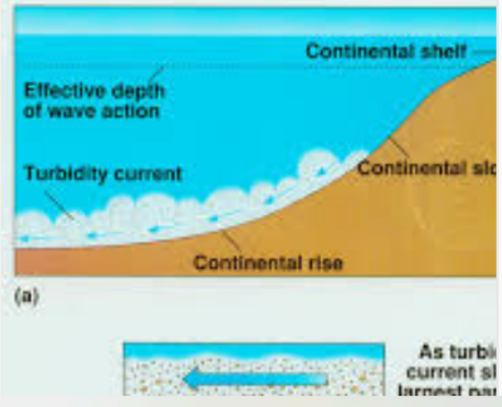
turbidity current











Turbiditt – gråvakke

Da den platetektoniske modellen fikk gjennomslag på slutten av 1960-årene, løste det samtidig et stort sedimentologisk problem. Rundt omkring i verdens foldefjell finnes det en vidt utbredt sedimentær bergart i sand-silt-leirfraksjonen som har en spesielt vakkert gradert lagdeling. Formasjoner av bergarten kan oppnå en tykkelse på opptil 1000 m. Denne sedimentære bergartstypen ble kalt gråvakke, uten at noen egentlig visste hvordan den var dannet. På jordoverflaten var det ennå ikke funnet noe sedimentologisk miljø der en slik struktur i bergarten kunne passe inn.

Eiendommelig nok forekom gråvakke sammen med bergarter som man antok var avsatt på svært dypt havvann. Disse bergartene viste at de var avsatt i forbindelse med svært liten sedimenttilførsel med ytterst finkornete, ofte silisiumrike avsetninger. I motsetning til disse kunne gråvakkene være temmelig grovkornete, også med usorterte sandsteiner i den grove delen av de enkelte lagene. Gråvakkens kornstørrelse passet altså ikke inn i dyphavs-miljøet.

Ved hjelp av utallige ekkoloddmålinger tvers over Atlanterhavet ble det i 1957 for første gang mulig å tegne et kart over Atlanterhavets bunn, og i 1960-årene foretok man de første boringene i havbunnen utenfor den nordamerikanske østkysten. Da oppdaget man plutselig at gråvakke dukket opp fra de dypeste delene av havbunnen, fra de såkalte dyphavsslettene på dyp ned til 4000–5000 m.

Endelig begynte brikkene å falle på plass. Utenfor de dype furene på kontinentalsokkelen, såkalte undersjøiske «canyons», bredte gråvakke-avsetningene seg utover dyphavsslettene. Nettopp utenfor slike steder var det mange ganger blitt observert voldsomme strømmer som beveget seg nedover kontinentalskråningen mot havbunnen. I 1929 var det blant annet observert en voldsom undersjøisk bunnstrøm ved Grand Bank utenfor New Foundland, der strømmen med sin kraftige bevegelse rev over flere trans-atlantiske kabler. Strømmens hastighet ble beregnet til 80–95 km/t.

Det som var blitt observert, var en såkalt turbidittstrøm, en undersjøisk, lavineaktig bunnstrøm som transporterte tonnevis av materiale fra den øverste delen av kontinentalskråningen ned gjennom de dype furene i kontinentalsokkelen til dyphavssletten nede på havbunnen. En turbidittstrøm dannes ved at materiale som over lang tid har hopet seg opp ytterst på kontinentalsokkelen, plutselig – kanskje utløst av et mindre jordskjelv – setter seg i bevegelse som en mudret vannmasse med sand og leire.

Ettersom en slik oppslemmet strøm av materialer er tyngre enn de klare vannmassene omkring den, vil den synke ned gjennom en av furene i kontinentalsokkelen og der bevege seg nedover med økende hastighet. Det tunge mudder-vannet, med en anslått mengde på 100 km³ oppslemmet materiale, vil rase ned gjennom furen og fordele seg ut på dyphavssletten. Turbiditten som dannes i forbindelse med slike undersjøiske laviner, vil kunne dekke et areal på ca. 100 000 km².

Turbiditt (Gilberga, Dalsland, Sverige)

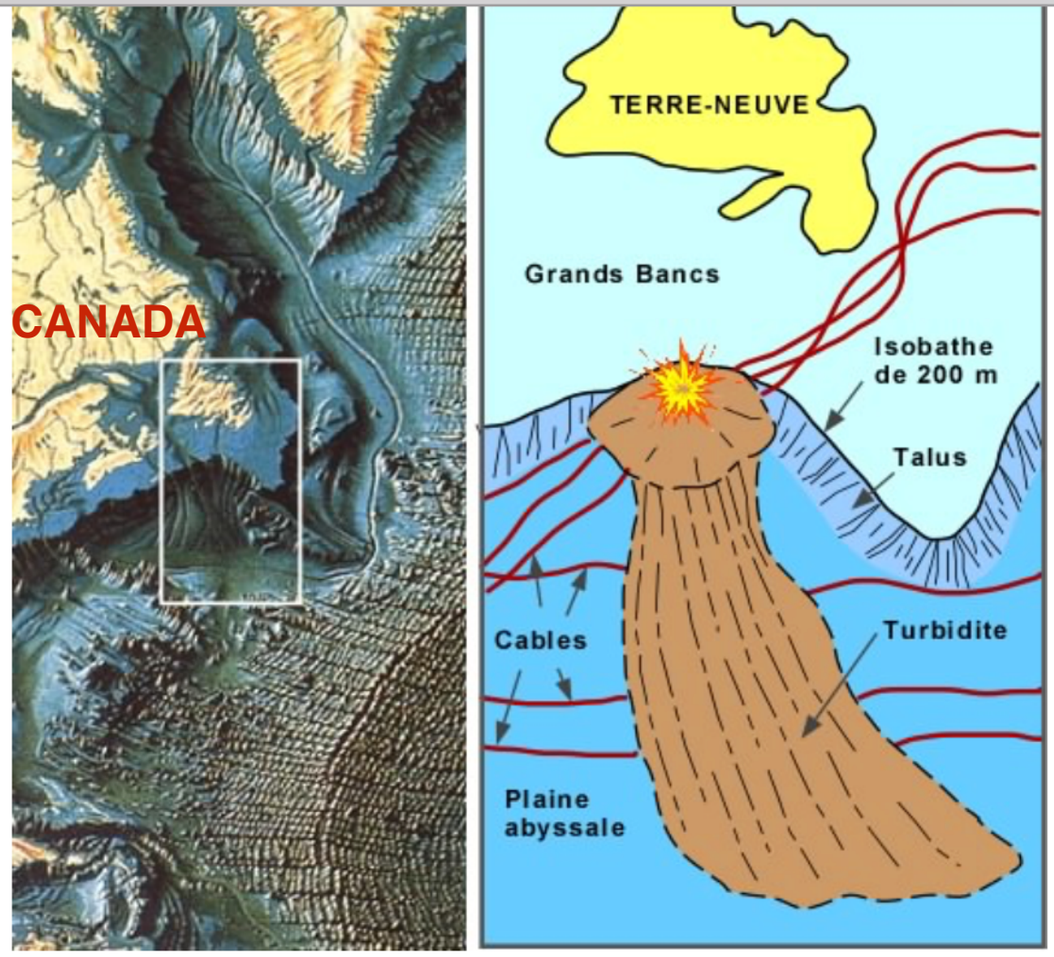
turbidity currents

https://youtu.be/8gYJJjxY8g0

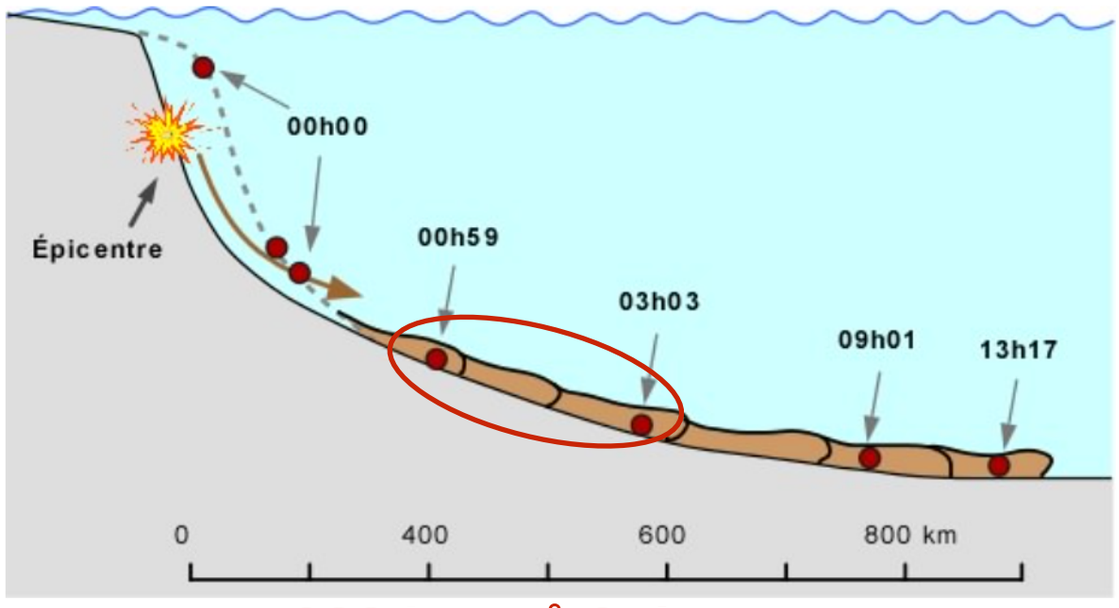
Turbiditter er en veldig vanlig sediment, som ikke var forstått av geologer.

Forståelsen begynte I 1929, da et undersjøisk ras i Atlanterhavet kuttet 6 telegraf kabler i løpet at 13 timer.

www2.ggl.ulaval.ca/personnel/bourque/s3/turbidite.html



sous-marins dans le secteur du séisme ont été brisés instantanément. Les autres cables, plus distants, ont été coupés à mesure qu'ils étaient fauchés par le
le chaque cable a été brisé (pour le besoin de la démonstration, le temps 00h00 sur le schéma correspond au déclenchement du courant).



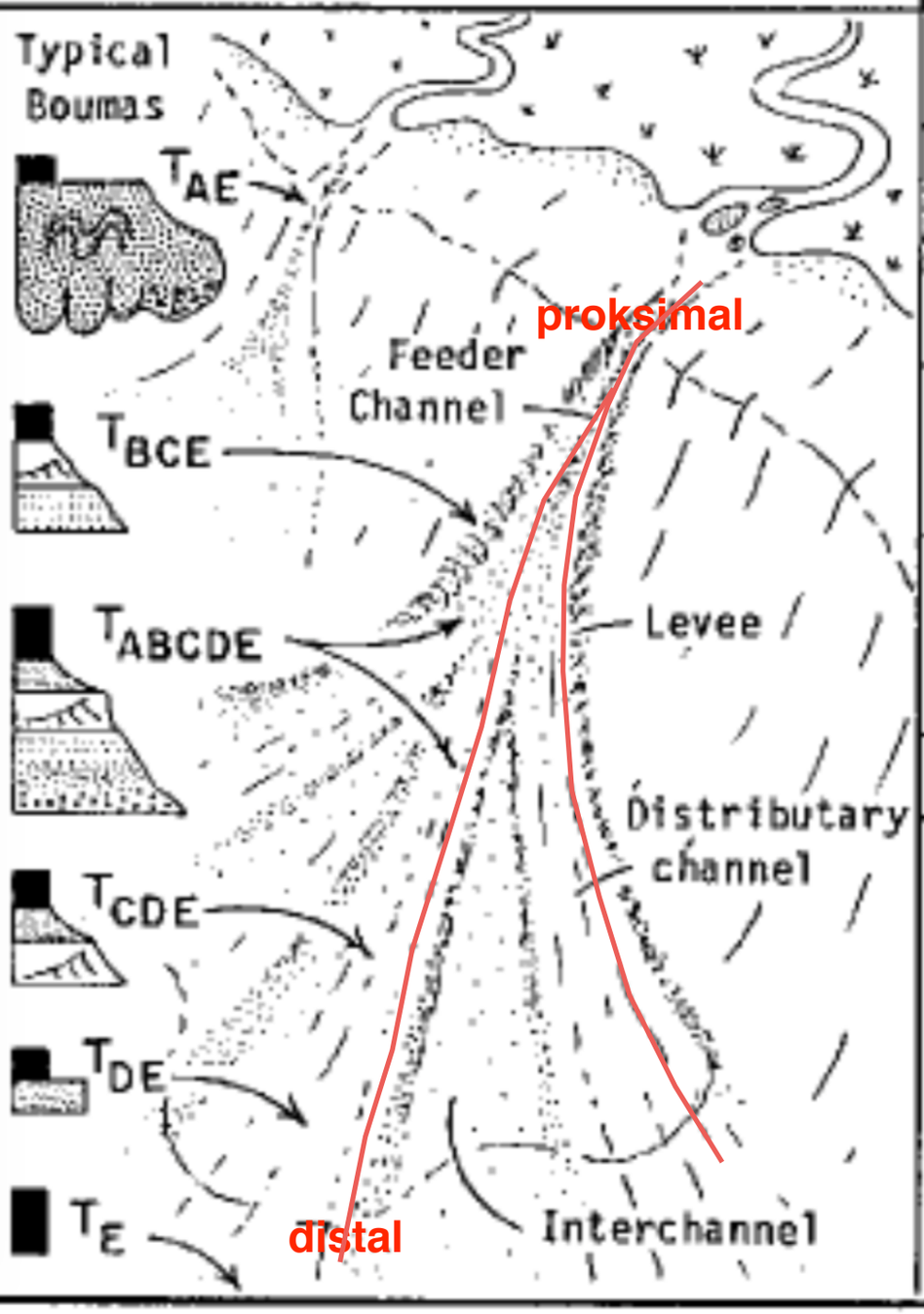
200 km på 2 timer

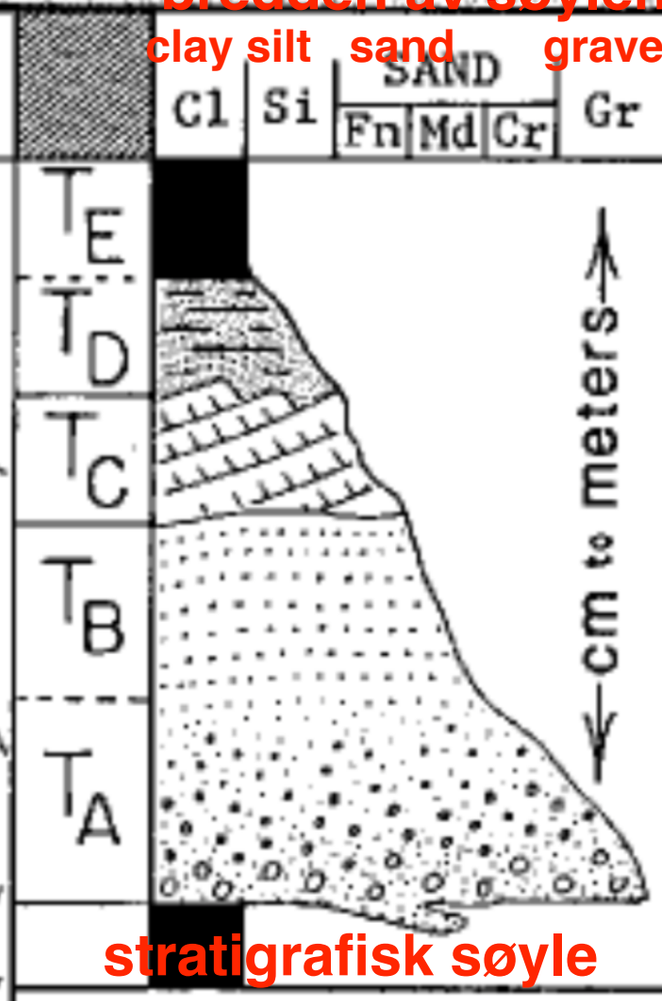
THE TURBIDITY CURRENT AND SUBMARINE FANS

bredden av søylen angir kornstørrelse

clay silt sand gravel

Bouma Sequence





Description

Clays (shales). Deposited in months to years.

Laminated silts/fine sands. Deposited in hours.

Small trough cross beds; ripples on top. Deposited in hours.

High velocity laminations; lower contact gradational. Deposited in minutes.

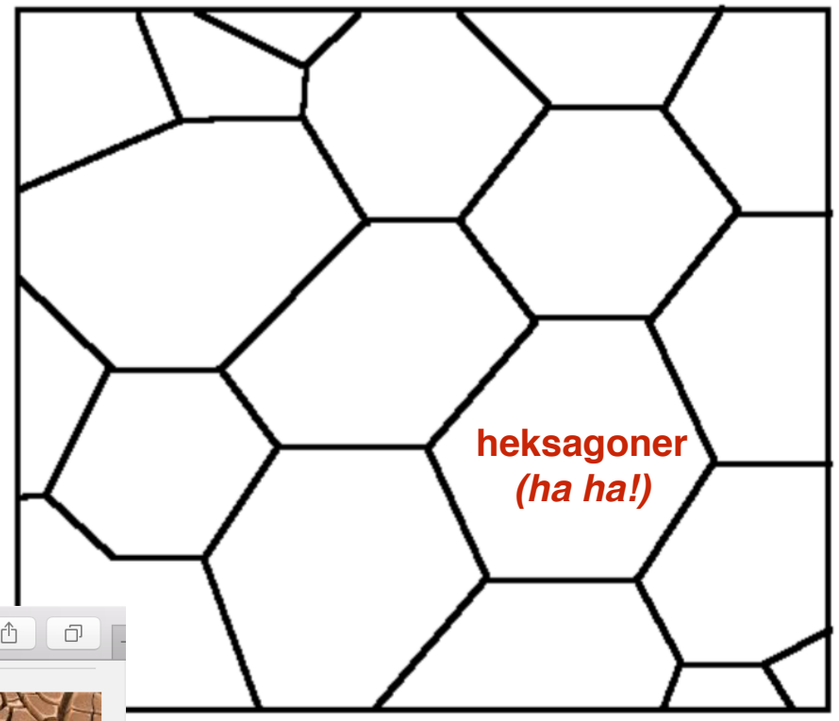
Sandy or gravely; graded bedding from obvious to inconspicuous. Current marks typical. Deposited in minutes.

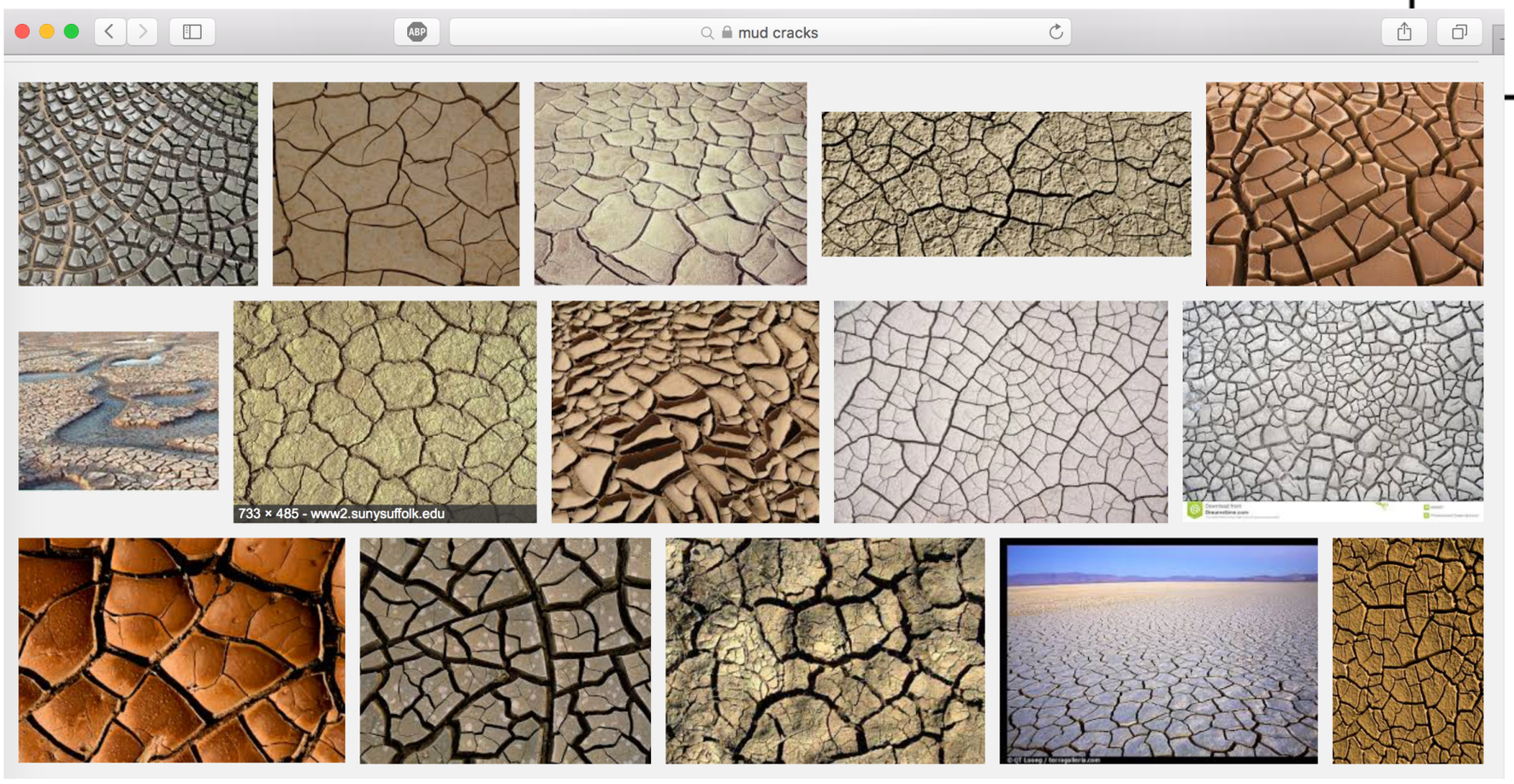
Bouma sequences are typical of, but not restricted to, submarine fans. Complete sequences (ABCDE) form only in mid-fan channels; incomplete sequences form in more proximal, distal, and/or lateral environments. In the more proximal feeder channels AE dominates (frequently with debris flows, load structures and slumps). More distally bottom units successively drop out and CDE, DE, and finally E sequences form. Laterally away from the channel, levees are CDE or BCE and interchannel areas DE and finally E.

“proksimal” nær kilden (og grov kornet), “distal” lenger vekk fra kilden.

- ***Mudcracks*** - result from the drying out of wet sediment at the surface of the Earth. The cracks form due to shrinkage of the sediment as it dries. When present in rock, they indicate that the surface was exposed at the earth's surface and then rapidly buried.

tørkesprekker i leire eller slam

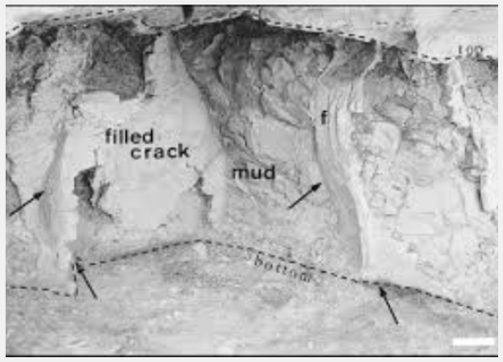


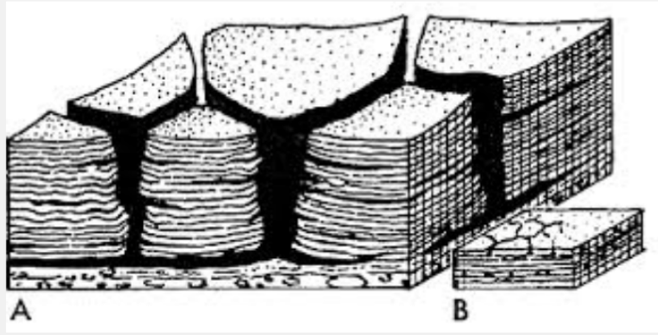


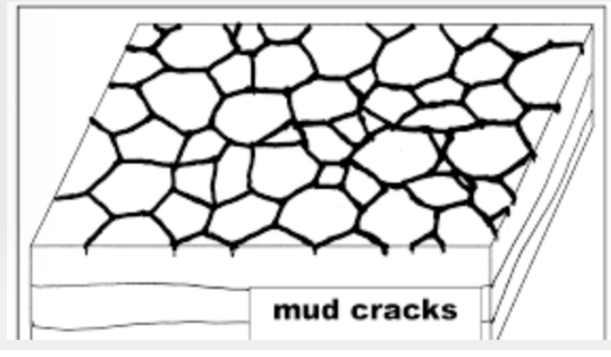
Etterpå, hvis sand avsettes over, vil sand fylle de åpne sprekkene. Da blir tørkesprekkene bevart.

mud cracks cross section

tverrsnitt i tørkesprekker.





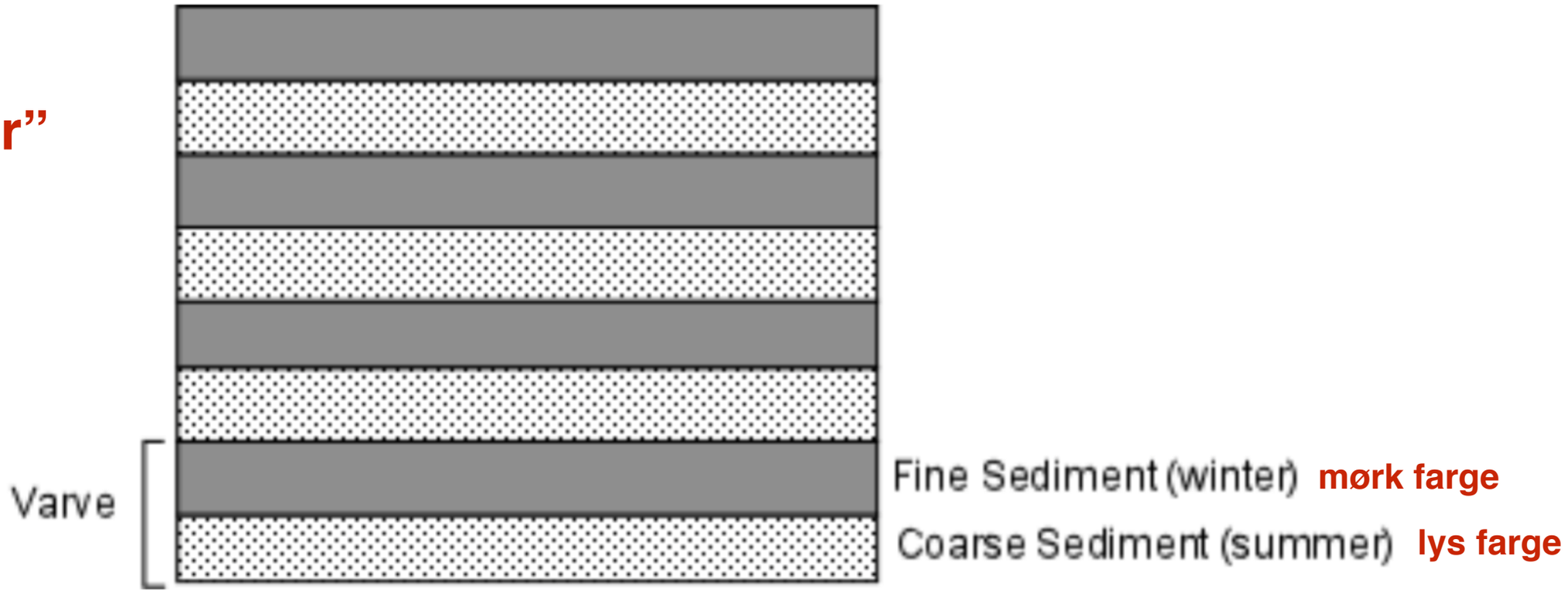


Etterpå, hvis sand avsettes over, vil sand fylle de åpne sprekkene.

- ***Rhythmic Layering*** - Alternating parallel layers having different properties. Sometimes caused by seasonal changes in deposition (***Varves***). i.e. lake deposits wherein coarse sediment is deposited in summer months and fine sediment is deposited in the winter when the surface of the lake is frozen.

Kun avsettes i innsjøer i kaldt klima (som Norge)

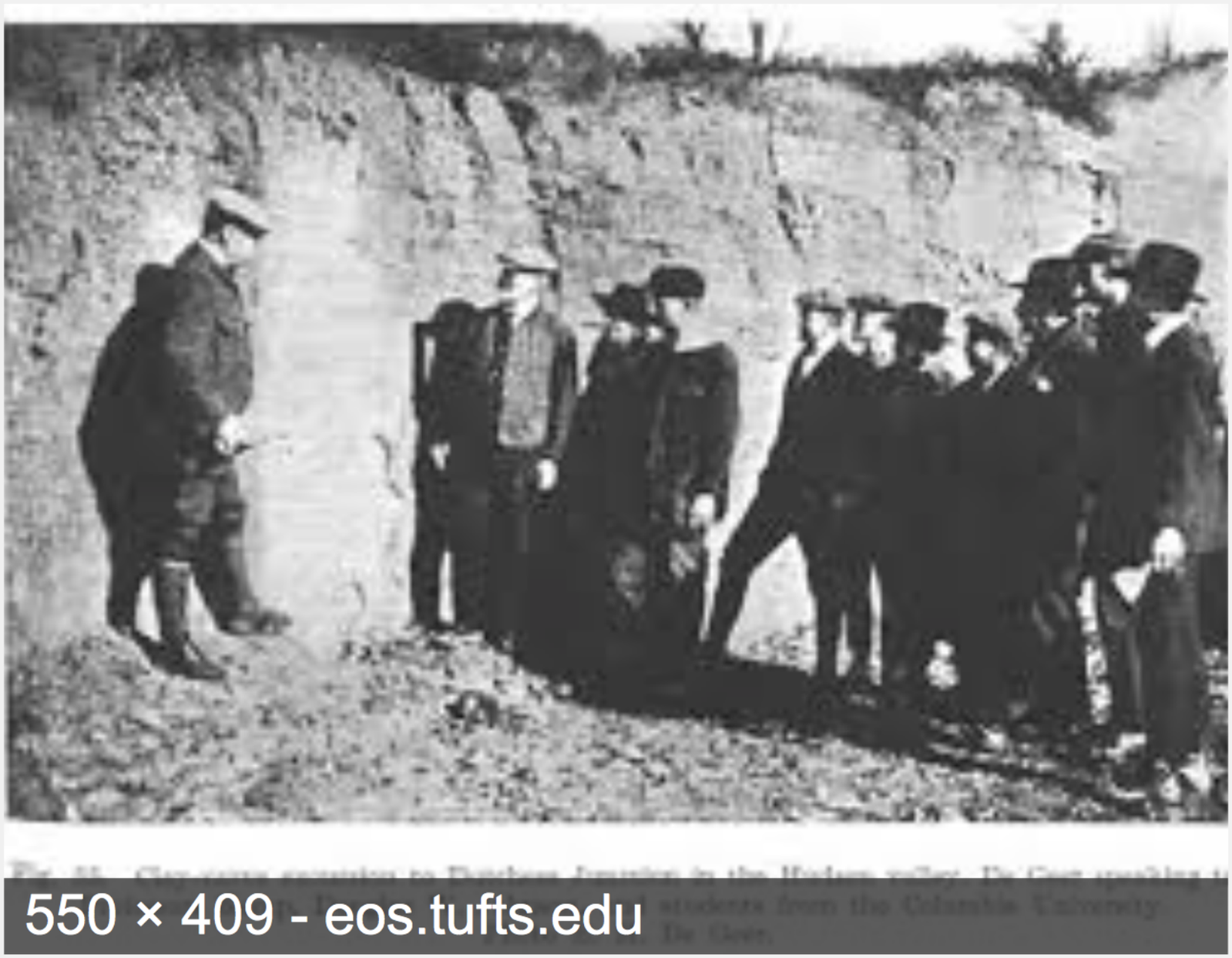
"varver"



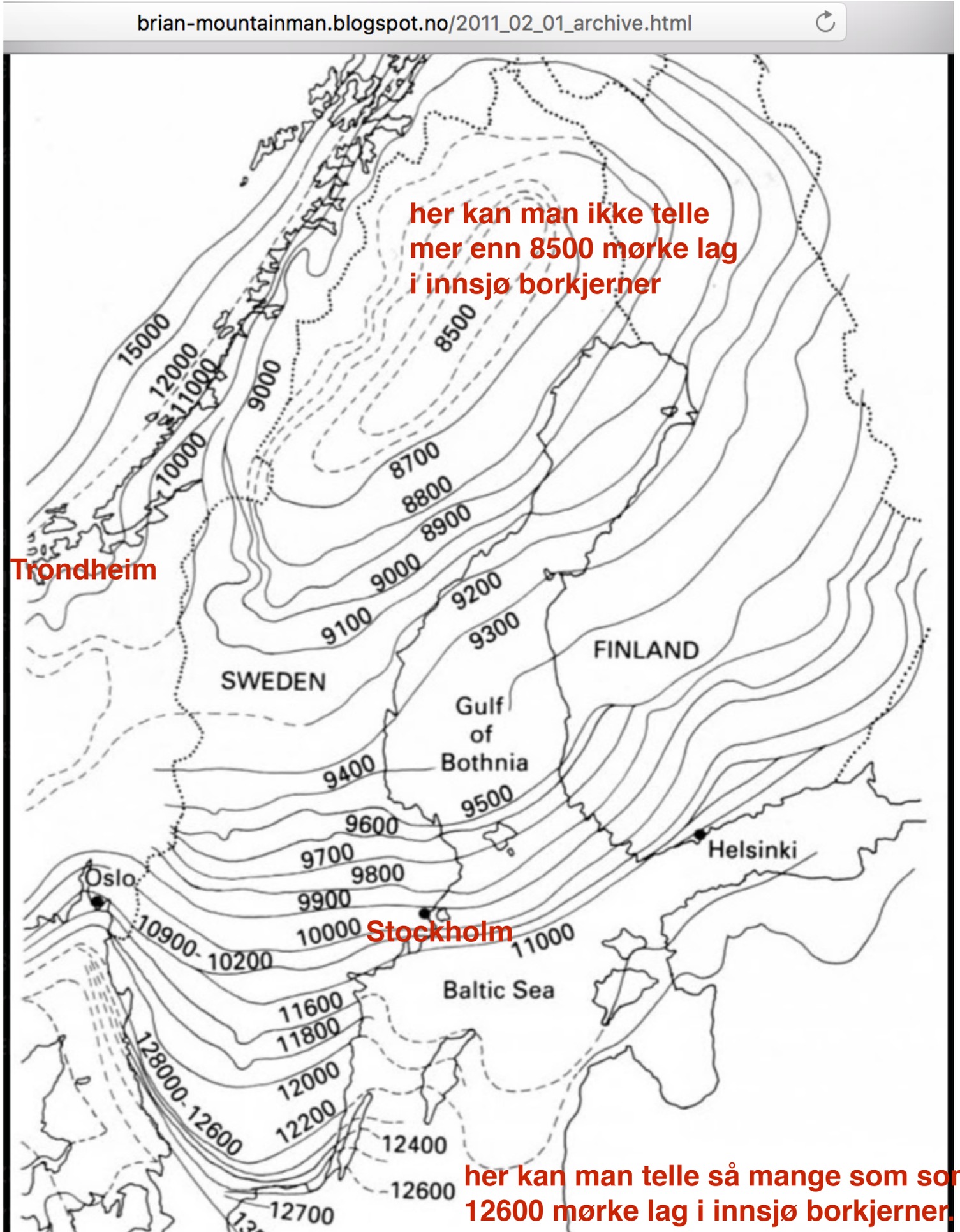
mørk farge

lys farge

Varver:
Lyse lag avsettes vår og sommer, når bekker har mye vann og transporterer lysfarget silt til innsjøen.
Mørke lag avsettes om vinteren, når bekker er frossen og mørk leire faller ned til bunnen av innsjøen.



Svensk professor De Geer på ekskursjon, for å demonstrere det han kalte for “varver”. ca. 1910.



**Ved å telle "varver",
kunne De Geer bestemme
hvor mange år siden innlandsis i
Sverige smeltet og innsjøene ble
dannet.**

**Sverige ble isfri
mellom 12600 og 8500
år siden.**

**Dette var et gjennombrudd
i geologisk aldersforståelse.
(ca. 1910)**

***(Her ble også nordmenn overrasket at
svensker kunne telle til mer enn 10.)***