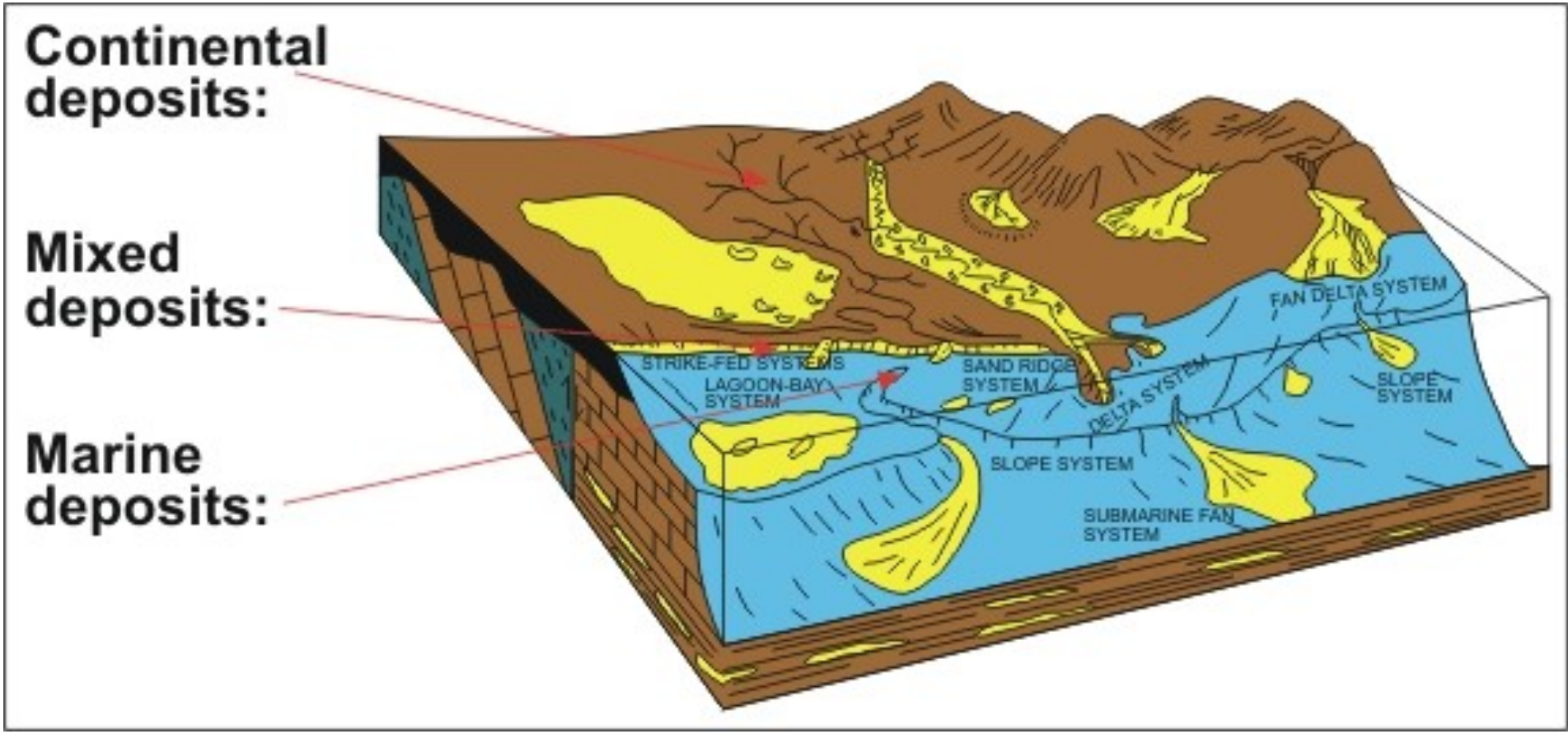
Sedimentary rocks are the product of the erosion, transport, deposition, and diagenesis of detritus and solutes derived from pre-existing rocks.

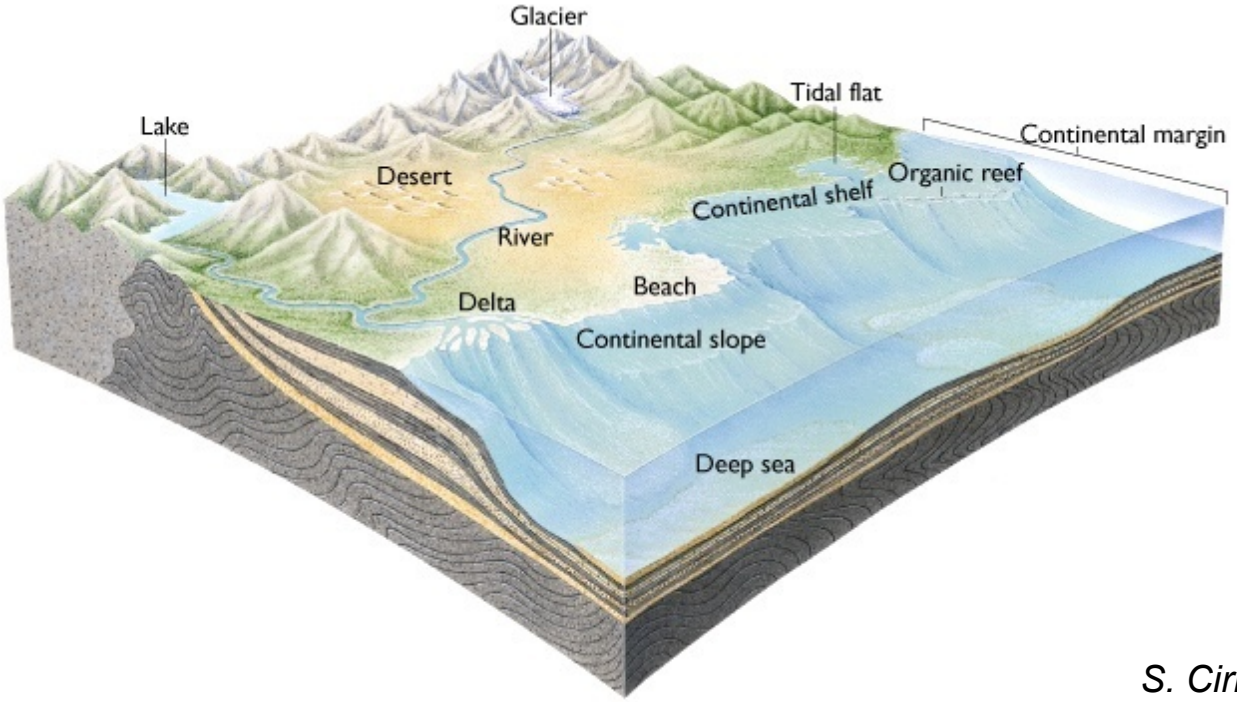

Continental deposits:
Mixed deposits:
Marine deposits:
STRIKE-FED SYSTEMS
LAGOON-BAY SYSTEM
SAND RIDGE SYSTEM
DELTA SYSTEM
FAN DELTA SYSTEM
SLOPE SYSTEM
SLOPE SYSTEM
SUBMARINE FAN SYSTEM

Sedimentation

- Transported particles and dissolved ions reach a place where they can be permanently deposited and accumulated.

- The sedimentary rocks that result from this accumulation are controlled by and record the *sedimentary environment* where they were deposited.

- We interpret ancient sedimentary rocks by comparison to modern environments where we can observe ongoing sedimentary processes and relate them to the composition, texture, and structure of the resulting rocks.



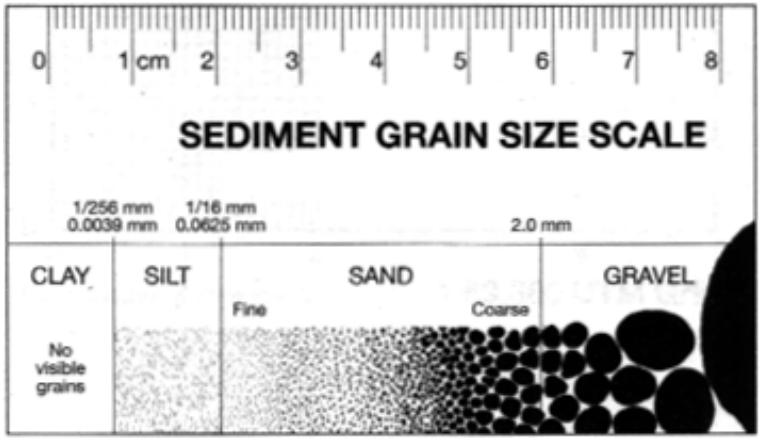
Siliciclastic Rocks

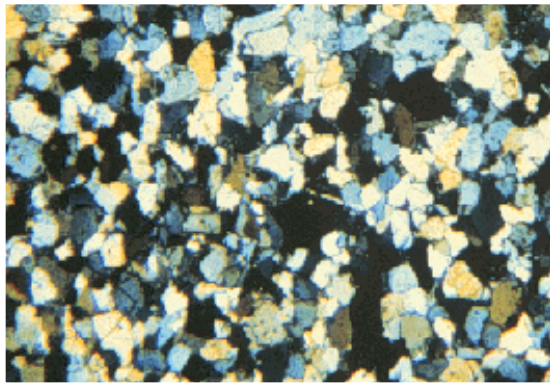
Rock composed mainly of silicate particles from weathering of rocks

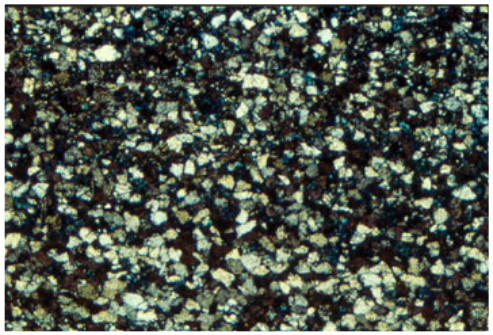
Sediment Sizes and Clastic Rock Types

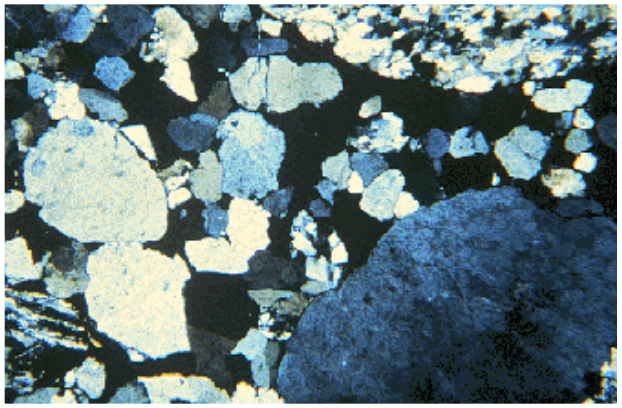
Rock Type	Sediment	Grain Size
Shale	Clay	less than 0.001 mm
Siltstone	Silt	.001-0.1 mm
Sandstone	Sand	.01-2 mm
Conglomerate	Gravel	>2mm

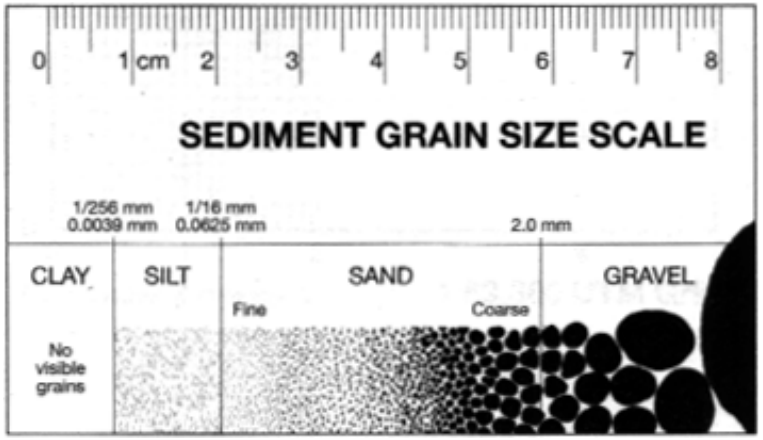
Sedimentary rocks made of silt- and clay-sized particles are collectively called ***mudrock***


0
1 cm
2
3
4
5
6
7
8
SEDIMENT GRAIN SIZE SCALE
1/256 mm
0.0039 mm
1/16 mm
0.0625 mm
2.0 mm
CLAY
SILT
SAND
GRAVEL
Fine
Coarse
No visible grains





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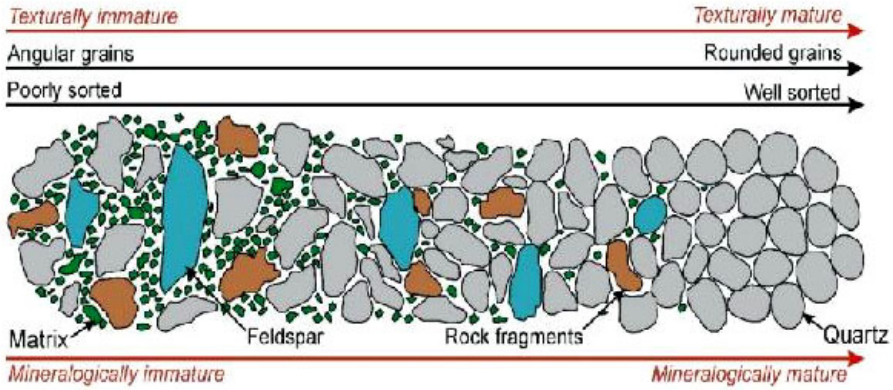
2.0 mm
CLAY
SILT
SAND
GRAVEL
Fine
Coarse
No visible grains

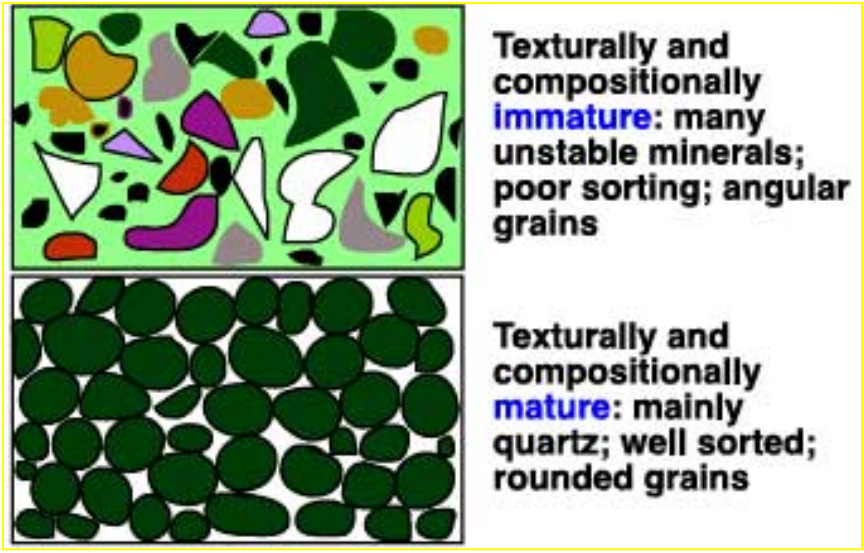
On the basis of the textural parameters and mineralogical composition in describing siliciclastic you may define:

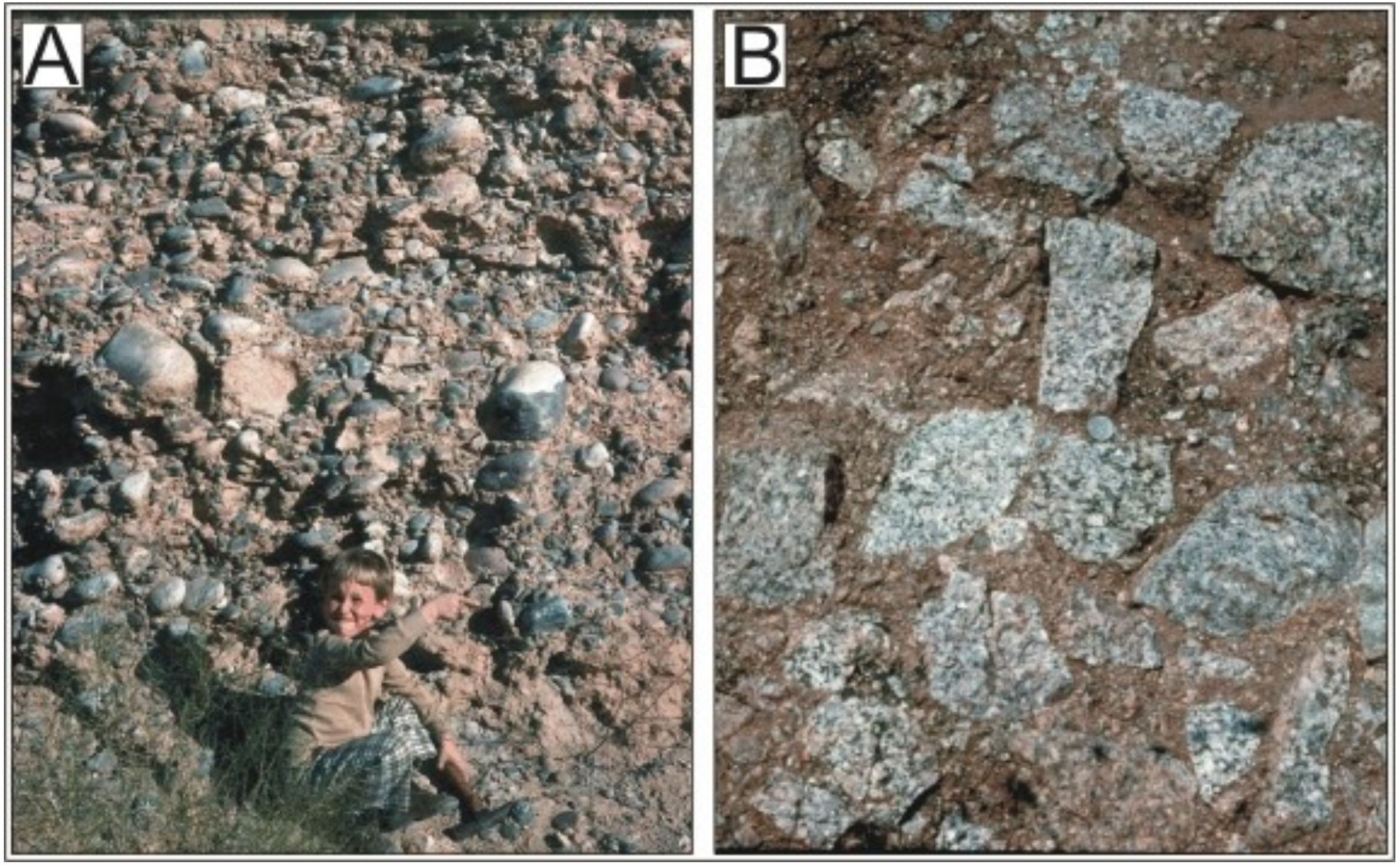
Maturity

Textural maturity, based on presence or not of matrix (sorting!) and rounding degree; it results from how long sediments are transported far from the source area



Compositional (or mineralogical) maturity, based on stable/unstable mineral ratio
Stable: quartz)
Unstable: Feldespars (or lithic fragments)




A
B

TEXTURE


CLAST SUPPORTED (OPENWORK)


CLAST SUPPORTED (BIMODAL)


CLAST SUPPORTED (POLYMODAL)


MATRIX SUPPORTED

On the basis of the textural parameters and mineralogical composition in describing siliciclastic you may define:

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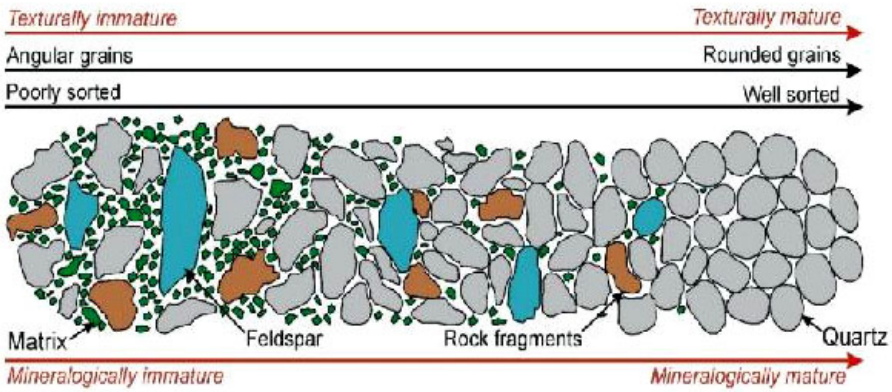

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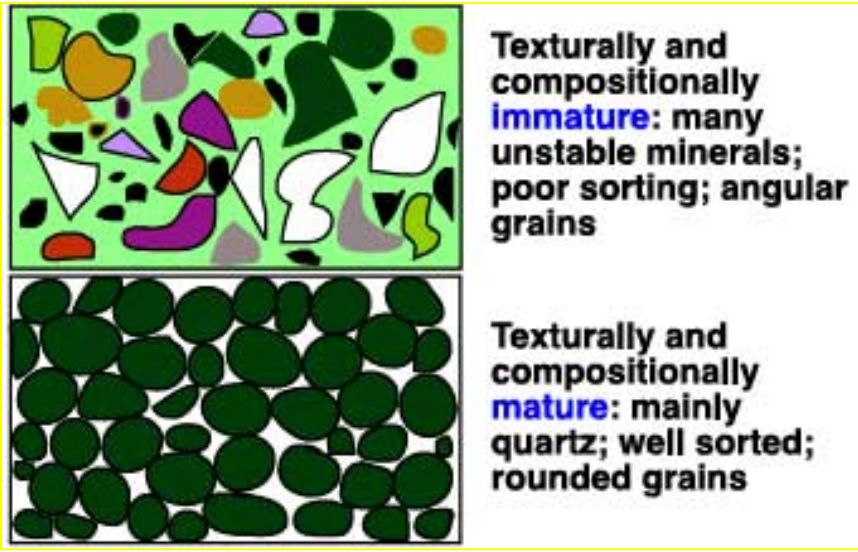
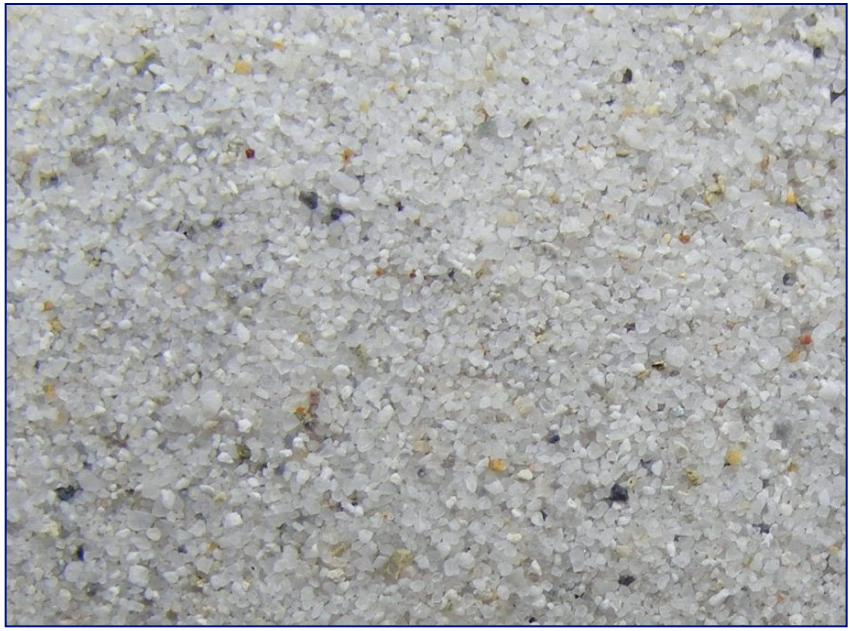


COMPOSITIONAL MATURITY

It is a measure of the proportion

of resistant and/or stable minerals in the sediment (high

proportion of quartz grains = compositionally mature)



Mineralogical Components of siliciclastics

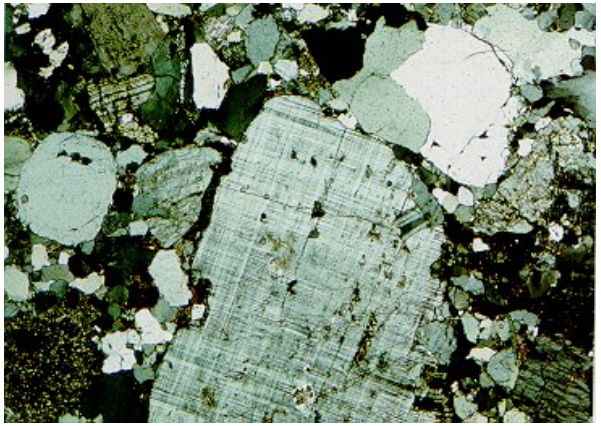
Quartz

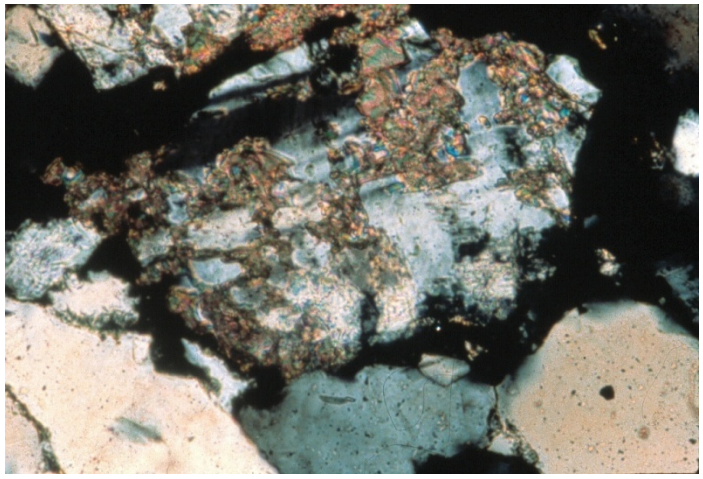
Qtz : THE MOST COMMON
mono, poly, ign, meta, qtzite, chert, volc, etc; mech & chem stable, abundant

Feldspar:

K-spar (sandine, microcline), Plag (Na-Ca), stains (Amaranth soln), abundance and mechanical stability (variable)

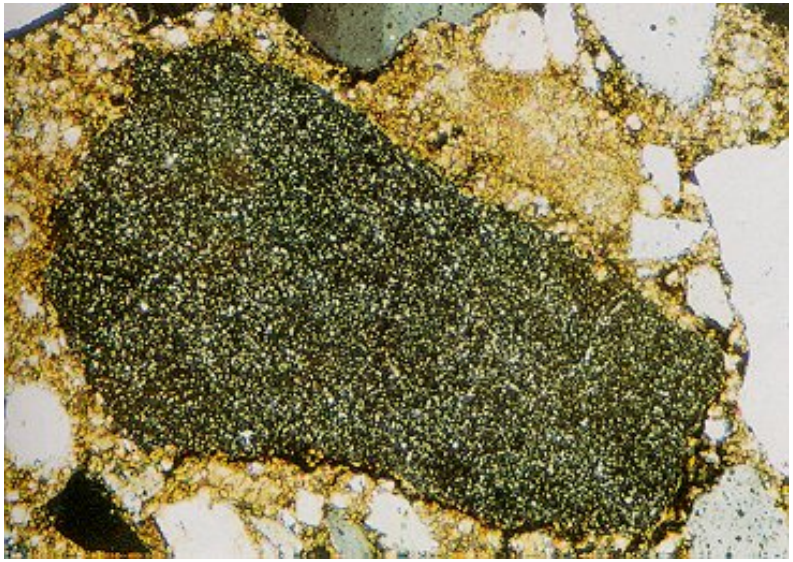
Minor chances to be preserved!!





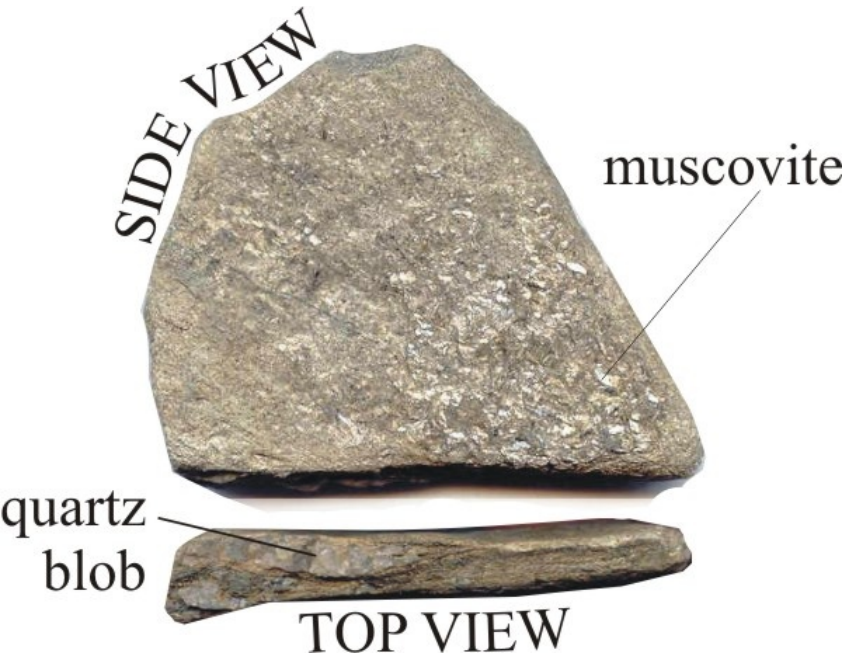
Rock Fragments:

all kinds of rocks;
abundant, variable stability

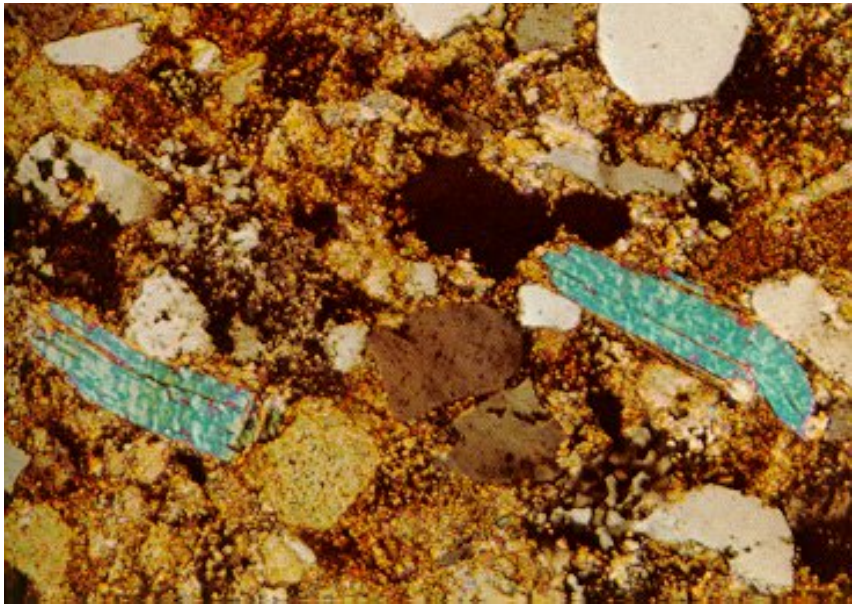


Accessory Minerals:

Micas



muscovite



biotite

Maturity Chart

Maturity is a relative measure of how close a sand sized sediment (or larger particles) has come to its ultimate weathering and sorting end product, quartz sand. Maturity refers to both texture and composition. A texturally mature sediment is one in which all the grains are the same size (a well sorted sediment), and are well rounded. A compositionally mature sediment is one in which all grains except quartz have been weathered away.

Sand Sized and Larger Grains Only

	IMMATURE	SUBMATURE	MATURE
COMPOSITION	Many minerals, especially feldspars and/or rock fragments	Quartz abundant, but other minerals or rock fragments common	Pure quartz (other minerals nonexistant or extremely rare)
TEXTURE	Poorly sorted; many sizes and/or Angular fragments	Sand common, but much silt and clay, or quartz conglomerate Grains beginning to round	Sorting excellent; (sand sized only) and Rounding excellent
EXAMPLES	Arkose/lithic breccia Arkose/lithic conglomerate Arkose/lithic arenite	Subarkose/sublithic arenite Quartz wacke Quartz conglomerate	Quartz arenite

Fig. 2-5. Distinction between mineralogical (composition) and textural maturity of siliciclastic sediments; after Fitcher & Poché (1993). The concept of textural maturity is elaborated in the next figure.

Siliciclastic Rocks

Rock composed mainly of silicate particles from weathering of rocks

Sediment Sizes and Clastic Rock Types

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Conglomerate	Gravel	>2mm

Sedimentary rocks made of silt- and clay-sized particles are collectively called ***mudrock***

CONGLOMERATES - Rudites

Composition:

- Grain Size:
  - 30% gravel size (>2mm in diameter) rounded clasts

Triassic Hawksmoor Formation, Needwood Basin, UK

Classification of Rudites

Rudites are classified on the basis of particle shape, packing and composition.

Conglomerate

A rudite composed predominantly of rounded clasts.

Rounded clasts may indicate considerable distance of transport from source. The significance will vary with the lithology of the clast (i.e., limestone clasts will become round a short distance from their source whereas quartzite will require much greater transport).

Breccia

A rudite composed predominantly of angular clasts.

Generally indicates that the clasts have not traveled far from their source or were transported by a non-fluid medium (e.g., gravity or glacial ice).

Diamictite

A rudite composed of poorly sorted, mud to gravel-size sediment, commonly with angular clasts.

Commonly refers to sediment deposited from glaciers or sediment gravity flows, particularly debris flows.

***S**. Cirilli-Sedimentology*

Siliciclastic Rocks

Rock composed mainly of silicate particles from weathering of rocks

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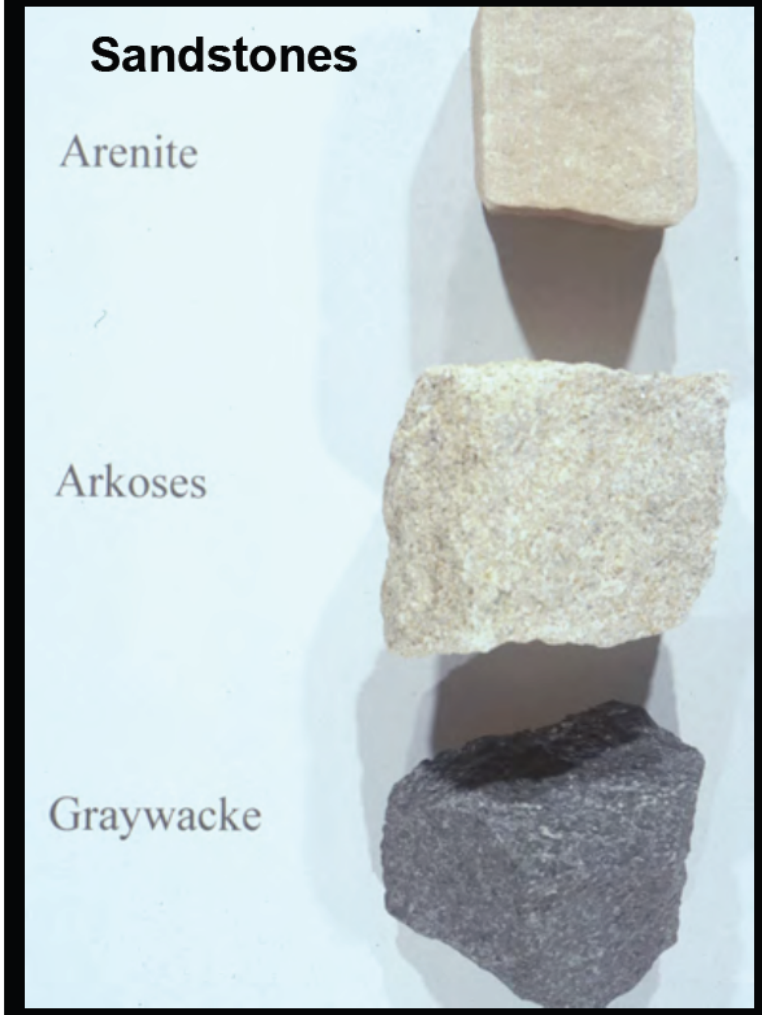
Sandstone



90+% rounded quartz grains
- several cycles of weathering, erosion, transport, deposition, compaction, lithification
- "mature"

More than 25% feldspar (plagioclase + alkali feldspar)

Heterogeneous mix
- lithic fragments
- angular quartz grains
- feldspars and clay
- matrix
- "immature"

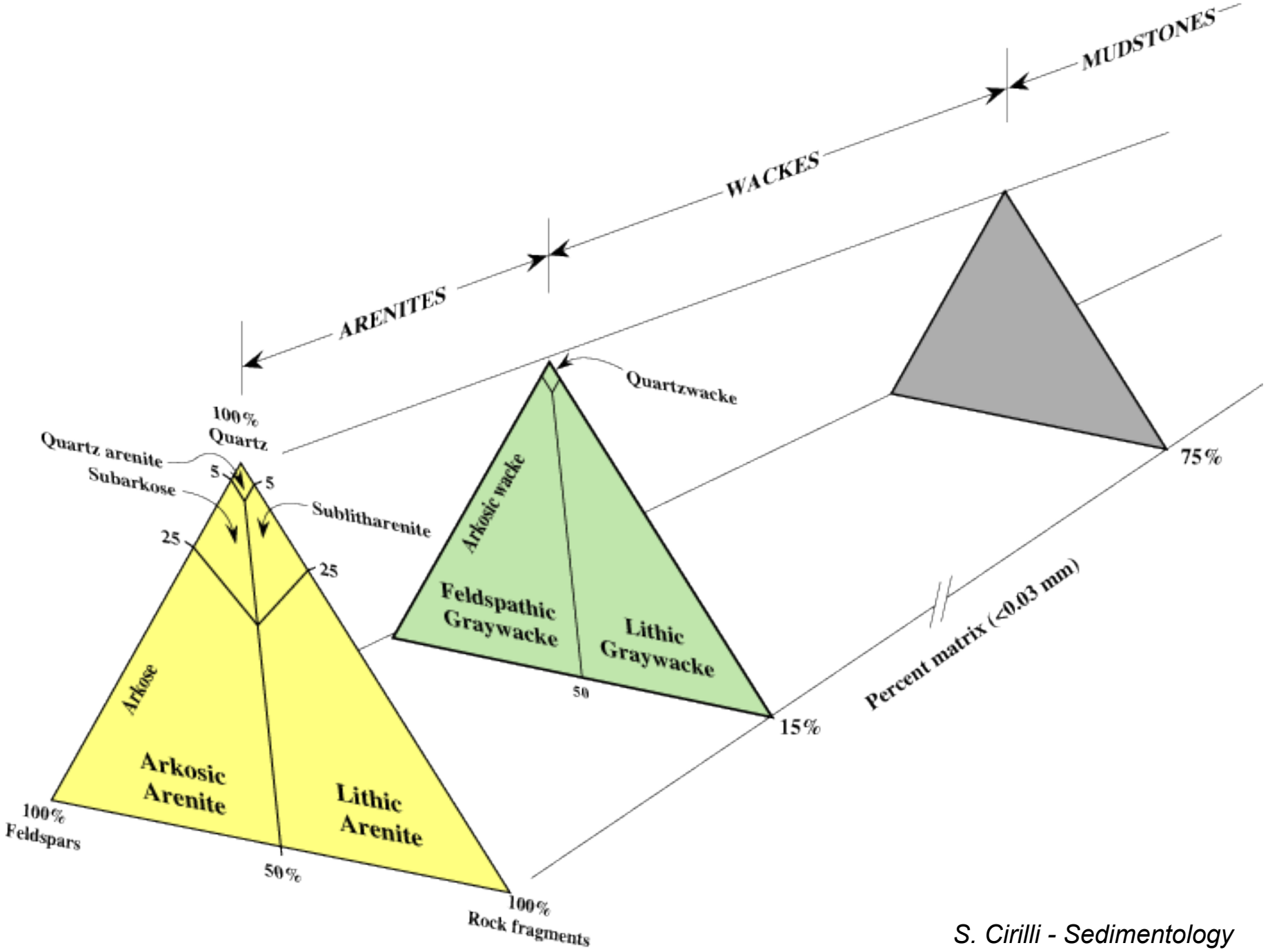
Sandstone	**Sand**	**0.0625 -2 mm**

Classification of Sandstones

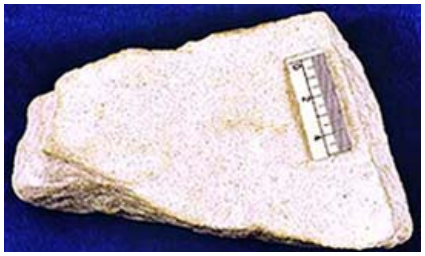
Most sandstone classifications are based on the composition of the rock.

Dott's classificaton scheme is based on the relative proportions of:

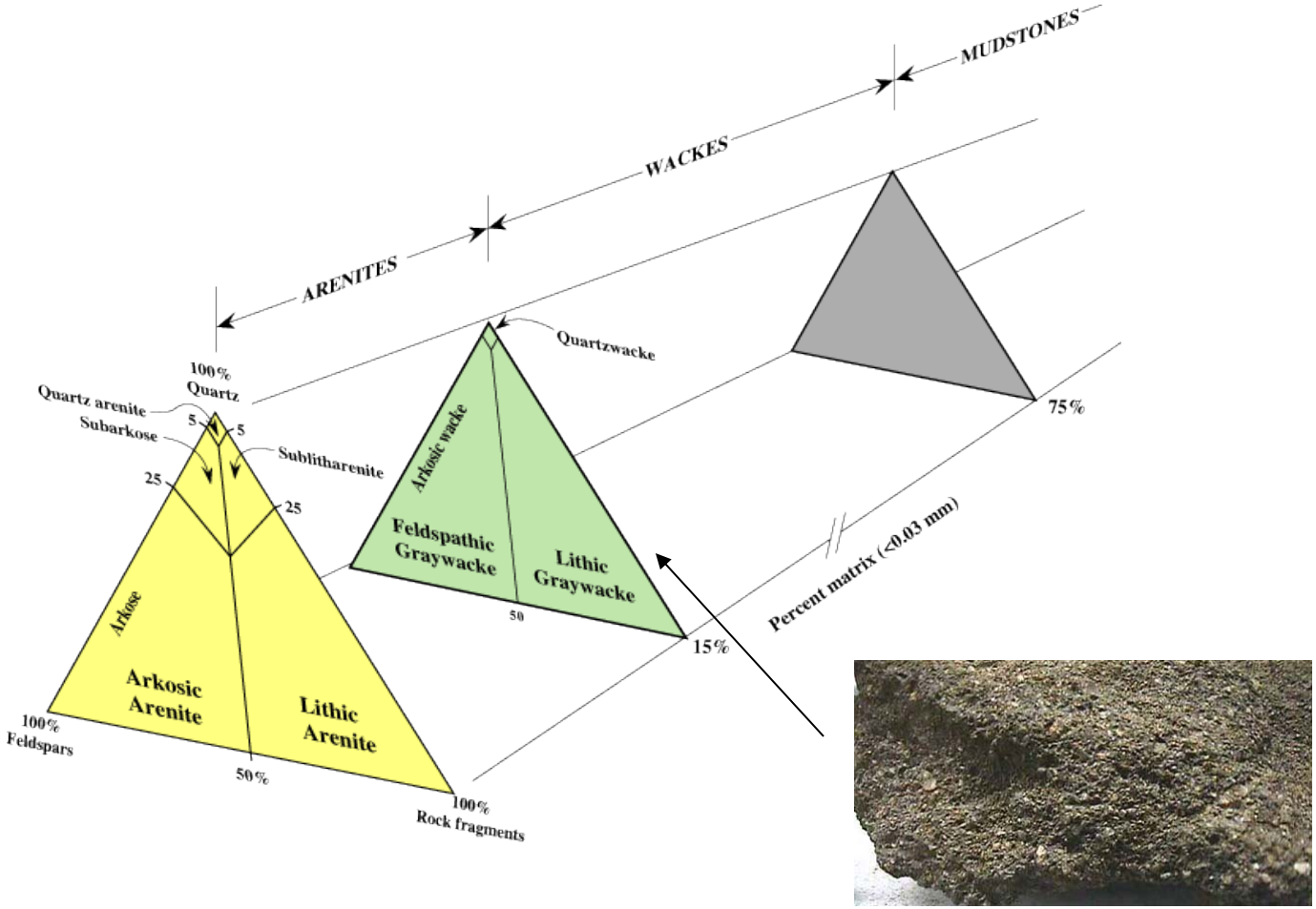
- **Framework Grains**:
  - relative abundance of mineral grains is a function of
    Availability, Chemical Stability, Mechanical Durability
  - **Qtz** :
    - mono, poly, ign, meta, qtzite, chert, volc, etc; mech & chem stable, abundant
  - **Feldspar**:
    - K-spar (sandine, microcline), Plag (Na-Ca), stains (Amaranth soln), abundance and mechanical stability (variable)
  - **Rock Fragments**:
    - all kinds (including limestone/dolomite RF's) ; abundant, variable stability



S. Cirilli - Sedimentology



MUDSTONES
WACKES
ARENITES
100%
Quartz
Quartz arenite
Subarkose
Sublitharenite
5
5
25
25
Arkose
Arkosic
Arenite
Lithic
Arenite
100%
Feldspars
50%
100%
Rock fragments
Quartzwacke
Arkosic wacke
Feldspathic
Graywacke
Lithic
Graywacke
50
15%
75%
Percent matrix (<0.03 mm)


MUDSTONES
WACKES
ARENITES
100%
Quartz
Quartz arenite
Subarkose
Sublitharenite
5
5
25
25
Arkose
Arkosic
Arenite
Lithic
Arenite
100%
Feldspars
50%
100%
Rock fragments
Quartzwacke
Arkosic wacke
Feldspathic
Graywacke
Lithic
Graywacke
50
15%
75%
Percent matrix (<0.03 mm)

Mudrocks

- abundant sedimentary rock type
- Source of much organic material precursor to fossil fuels
- Good indicators of chemical/biological conditions at the site of deposition
- Impermeable physical properties are important for subsurface fluid flow
- Most effectively studied using SEM/ XRD
- Both primary and secondary minerals in sedimentary rocks

Phi	Grade		Mm. (Wentworth)	Microns
-8	Boulder	GRAVEL	256	256,000
-6	Cobble		64	64,000
-2	Pebble		4	4,000
-1	Granule		2	2,000
0	Very Coarse	SAND	1	1,000
1	Coarse		0.50	500
2	Medium		0.25	250
3	Fine		0.125	125
4	Very Fine	SILT	0.0625	62.5
5	Coarse		0.0313	31.3
6	Medium		0.0156	15.6
7	Fine		0.0078	7.8
8	Very Fine		0.0039	3.9*
	Clay			

	MUDROCKS Rocks containing >50% mud			Rocks with <50% mud
	Silt dominant (>⅔ of mud)	Clay and silt	Clay dominant (>⅔ of mud)	Sand-sized or larger grains dominant
Non-laminated	Siltstone	Mudstone	Claystone	Conglomerates breccias diamictites and sandstones
Laminated	Laminated siltstone	Mudshale	Clayshale	

Common terms

Shale: The general term applied to this class of rocks (> 50% of particles are finer than 0.0625 mm).

Lutite: A synonym for "shale".

Mud (Mudrock): All sediment (rocks) finer than 0.0625 mm. More specifically used for sediment in which 33-65% of particles are within the clay size range (<0.0039 mm).

Silt (siltstone): A sediment (a rock) in which >68% of particles fall within the silt size range (0.0625 - 0.0039 mm).

Clay (Claystone): All sediment (rocks) finer than 0.0039 mm.

Argillaceous sediment: A sediment containing largely clay-size particles (i.e., >50%).

Argillite: A dense, compact rock (poor fissility) composed of mud-size sediment (low grade metamorphic rock, cleavage not developed)

Fissility: Refers to the tendency of shale to break evenly along parting planes. The greater the fissility the finer the rock splits; such a rock is said to be "fissile".


Pamela Gore, 1996


Pamela Gore, 1996