

Sedimentary Rocks II

Three Sediment Types:

- **Terrigenous Clastic** (Detrital) Sediments
 - the residual and Secondary particles produced by weathering;
 - shale, sandstone and conglomerate
- **Orthochemical** (Chemical Precipitate) Sediments
 - from the dissolved ions
 - evaporates
- **Allochemical**
 - biochemical particles, shell/test fragments
 - most limestone

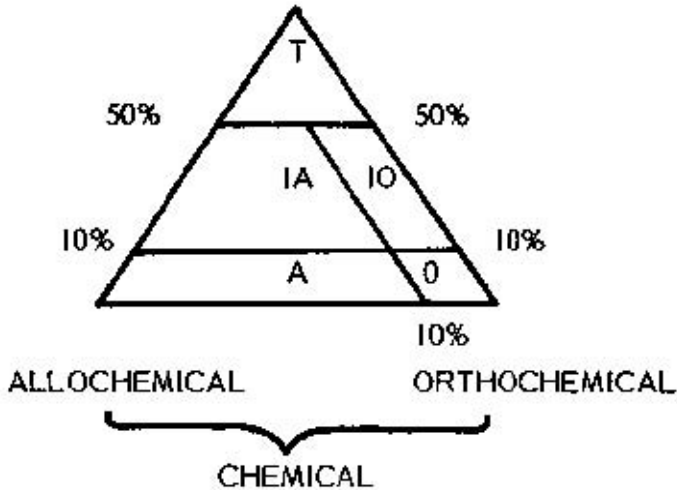


Figure 1: IO=impure orthochemical and IA=are impure allochemical

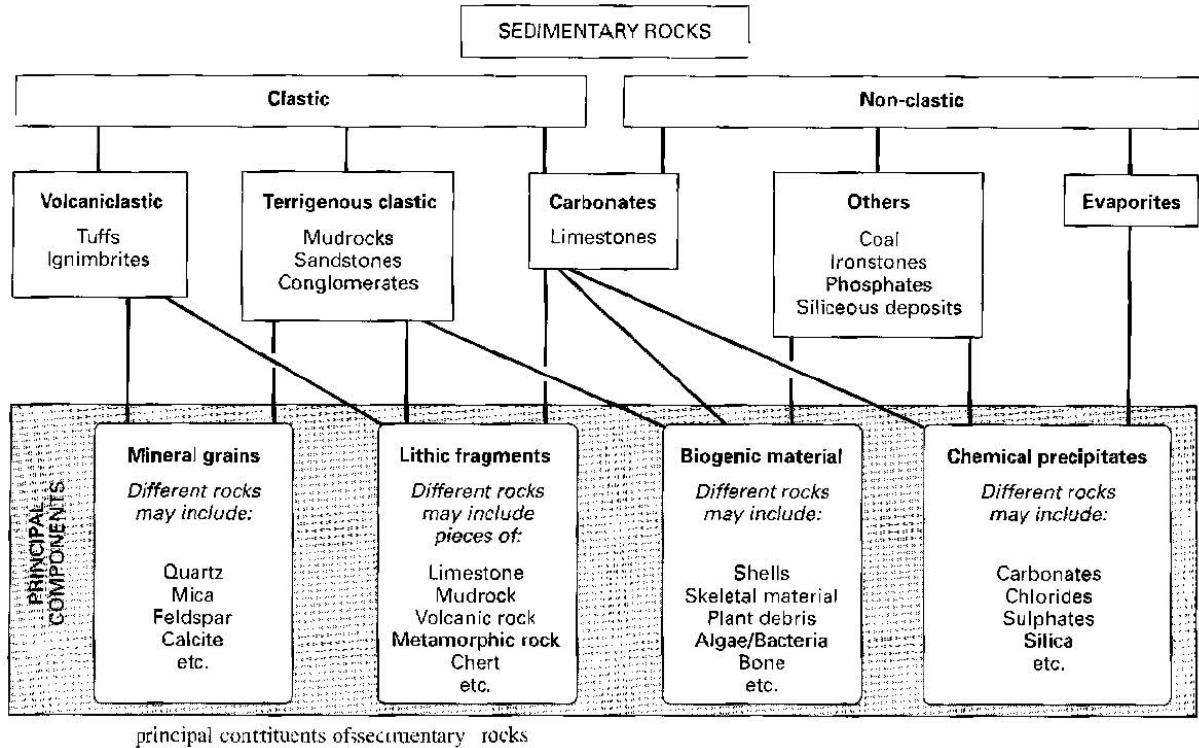


Figure 2: Nichols, 1999

Lithology of Mudrocks

The term "Mud" refers to all clastic particles less than 63: (0.063mm). This includes both silt and clay size particles. Because these particles are far too small to identify mineralogically textural properties are the criteria for classification

For unconsolidated, mud-rich sediment the terms "Silt", "Mud", and "Clay" are used in accordance with the relative proportions shown in Figure 3. The best method for determining the relative proportions of silt versus clay is the "taste test". Yea, take a bite. If you "crunch" grains, they are probably silt.

The term fissile is defined as a strong planar fabric. When it is parallel to bedding it is called laminated. This texture is a product of the flat and parallel alignment of clay size particles (phyllosilicate minerals are the most common "clay size" particles). Siltstone is not commonly fissile.

	MUDROCKS Rocks containing >50% mud			Rocks with <50% mud
	Silt dominant (>2/3 of mud)	Clay and silt	Clay dominant (>2/3 of mud)	Sand-sized or larger grains dominant
Non-laminated	Siltstone	Mudstone	Claystone	Conglomerates breccias diamictites and sandstones
Laminated	Laminated siltstone	Mudshale	Clayshale	

Figure 3

Lithology of Gravel and Conglomerate

Terrigenous clastic sediments and rocks consisting of >30% gravel and larger size particles are referred to as gravels (disaggregated), conglomerates (rock), breccias (rock), and diamictite (rock).

1. **Conglomerate:** Sub- to well-rounded, clast-supported (clasts touch one another)
2. **Breccia:** Angular, clast supported
3. **Diamictite:** matrix supported (gravel clasts not touching), rounded or angular

Lithology of Sand and Sandstone

The classification of sandstone on the bases of mineral content requires an estimate of normalized Quartz, Feldspar, and Rock Fragments. These normalized proportions are plotted on a ternary diagram (Figure 4) and a rock name is determined. Sub-quartzose sandstone (<75% quartz) are normally considered (mineralogically) immature sandstones. Such sandstones are associated with sedimentary basins adjacent to areas where tectonic activity has produced significant topographic relief. The ternary QFR diagram can also be used for unconsolidated sand simply by adding the adjective "disaggregated".

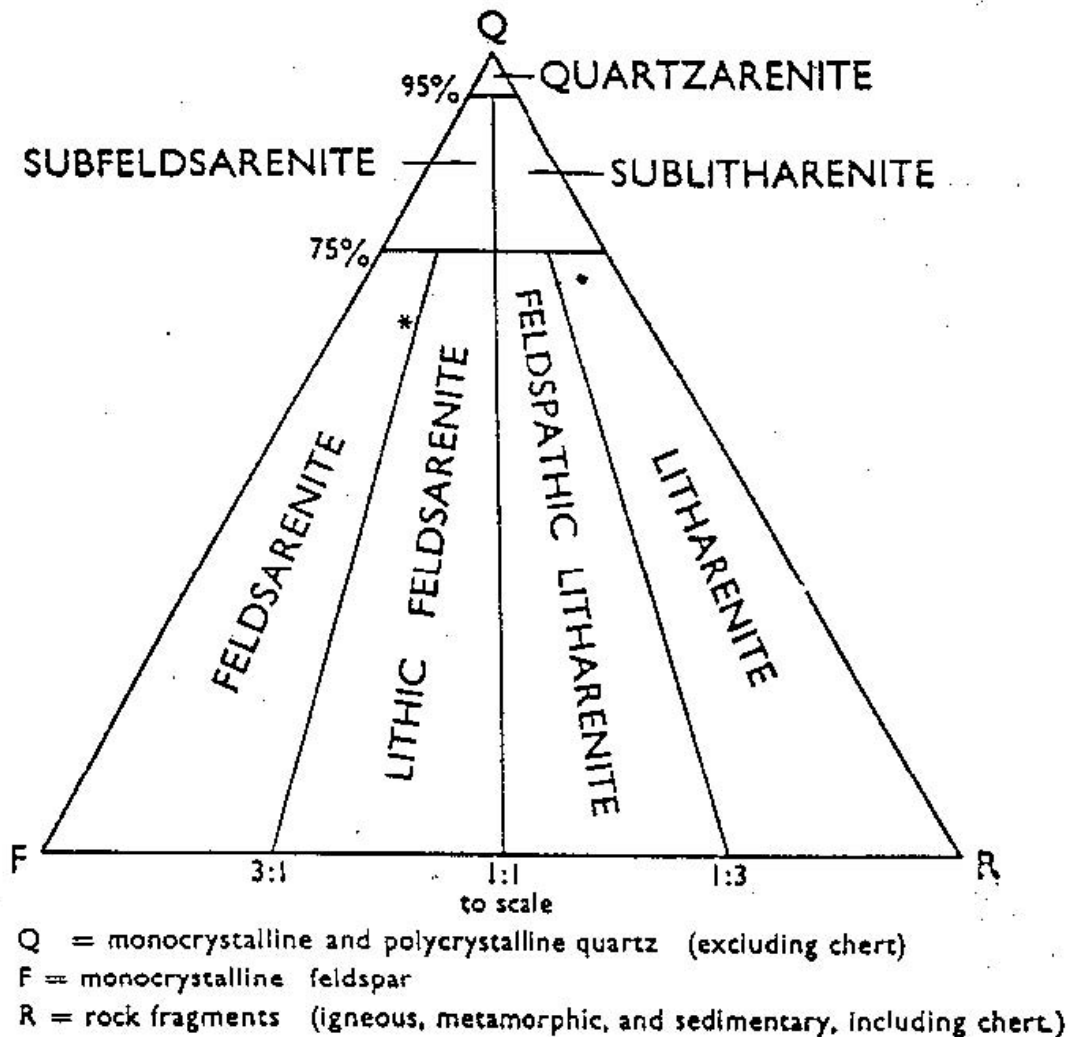


Figure 4

Lithology of Limestone

Limestone is a rock whose origin is much less obvious than sandstone, mudstone and conglomerate (for those of us who live in temperate latitudes)! The most common, particulate, sand-sized, calcareous sediment forms in shallow, warm, tropical, marine waters in the absence of terrigenous sand, mud, and gravel. The most common **Carbonate Allochemical Sediment** types consists of **(1) Fossil Fragments**, although there are other common carbonate allochems in carbonate depositional environments:

(2) Pellets (mostly fecal particles), **(3) Ooids** (concretionary carbonate like hail stones), and particles of lithified carbonate called **(4) Lithoclasts**.

The equivalent of "mud" in the world of carbonate sediments is "carbonate mud" or **Micrite**, very fine-grained **microcrystallites** of carbonate formed by some algae, through abrasion of allochems, and rarely through direct precipitation. The presence of "carbonate mud" indicates low current energy in the warm shallow, marine waters in which the carbonate sediment accumulates.

The ratio of mud to grains is the main criteria for the **Dunham Limestone Classification Scheme** (Figure 5). Additional considerations in naming limestones includes: original organic binding (like reefs), or complete absence of primary depositional textures. Dunham limestone names should include a principle allochem grain type, such as "fossiliferous packstone or "pelletal wackestone".

Depositional texture recognizable										Depositional texture not recognizable
Original components not bound together during deposition					Original components organically bound during deposition					
Contains mud (clay and fine silt-size carbonate)		Grain-supported	Lacks mud and is grain-supported	> 10% grains > 2mm		Boundstone	Bafflestone	Bindstone	Framestone	Crystalline
Mud-supported				Matrix-supported	Supported by > 2mm component					
Less than 10% grains	More than 10% grains									
Mudstone	Wackestone	Packstone	Grainstone	Floatstone	Rudstone	Boundstone	Bafflestone	Bindstone	Framestone	Crystalline

Figure 5

The composition of allochemical grains and the texture are used in another limestone classification scheme formulated by Folk.

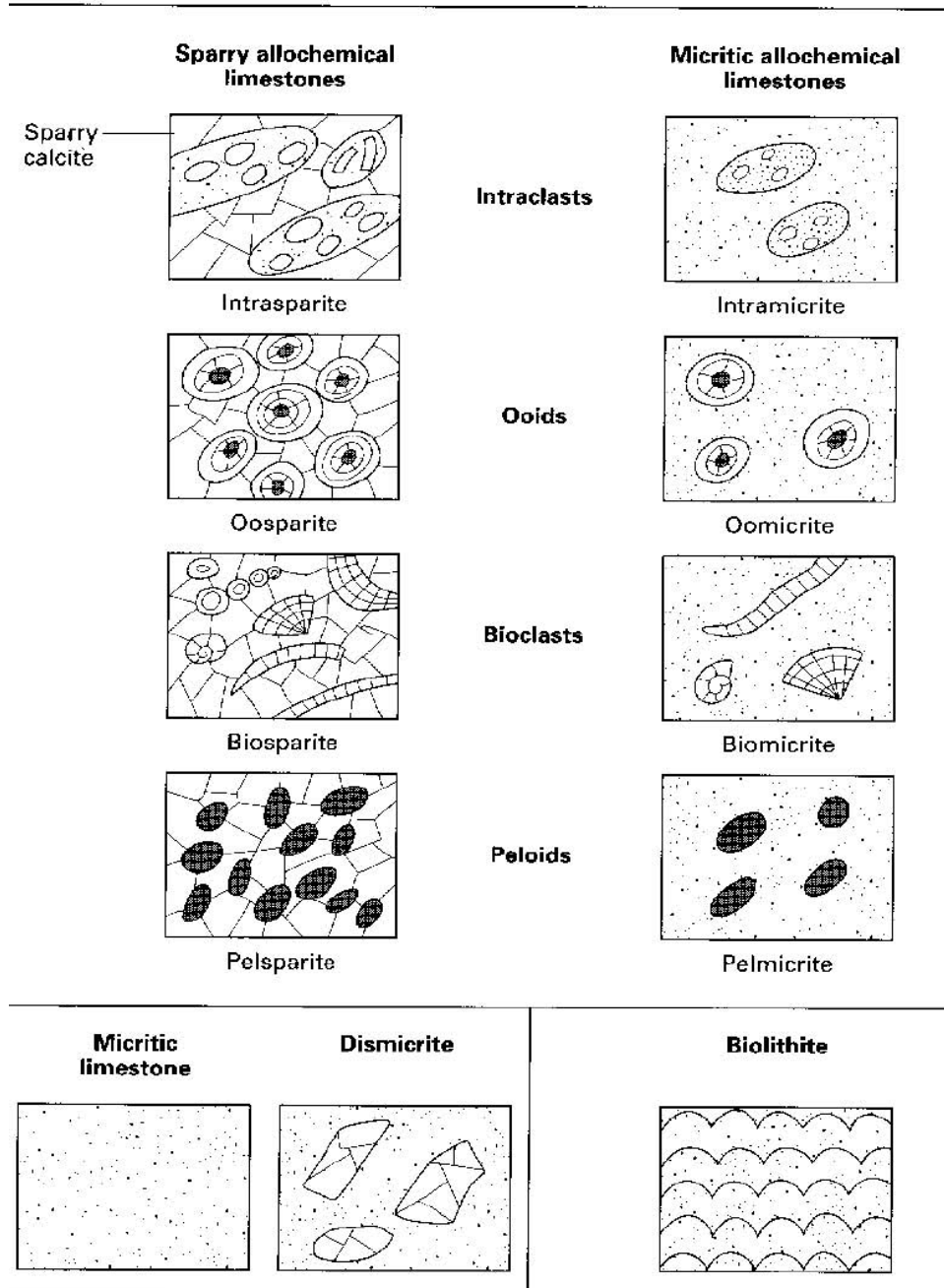


Figure 6: Folk Limestone Classification

Chemical Sediments; Evaporate Deposits

IONS IN SEA WATER (in ppm)

Note that most of the dissolved material consists of Na and Cl i.e. - "salt"

Cl-	18,980	K+	380
Na+	10,556	HCO ₃ ⁻	140
SO ₄ ⁼	2,649	Br	65
Mg ⁺⁺	1,272	H ₃ BO ₃ ⁻	26
Ca ⁺⁺	400	Sr ⁺⁺	8

USIGLIO'S EXPERIMENT

An experiment where by sea water was evaporated in order to determine the sequence of salts precipitated. The sequence of precipitation is as follows.

1. CaCO₃
2. CaSO₄ 2H₂O - CaSO₄
3. NaCl
4. MgSO₄
5. MgCl₂
6. K-Mg Salts

SOME EVAPORITE MINERALS

Marine

Gypsum-anhydrite

Halite

Polyhalite

Carnallite

Terrestrial

Soda

Trona

Glauber Salt

Borax

MAJOR EVAPORITE AREAS AND GEOLOGIC PERIODS

Michigan, Ohio, New York - Silurian

Michigan - Mississippian Permian Basin

Texas - Permian

Zechstein Germany - Permian

Paradox Basin, Utah - Pennsylvanian

Williston Basin, N. Dakota - Devonian

Gulf Coast US (Salt Domes) - Mesozoic

East Coast US - Triassic Rift Basin