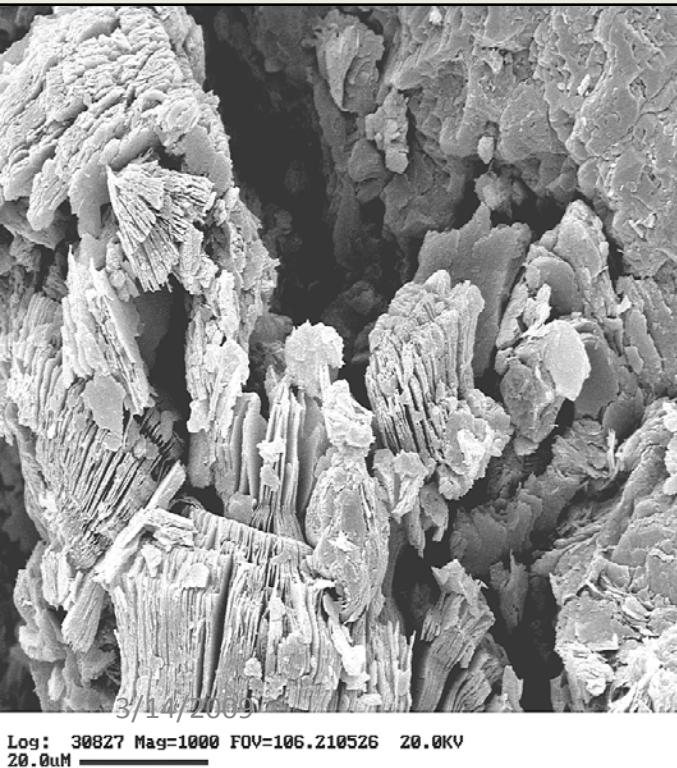


Clays and Damage – not necessarily related

- Will clay create a problem? Depends on clay type, form, location, what fluids are flowing and how flowed?



Migrating Fines

- Sources
 - kaolinite - not really that likely unless weathered!
 - Smectite - very likely, but clay is rare as authogenic deposit
 - zeolites - common in younger sands, GOM area
 - weathered feldspar - older sands
 - micas, silts, drilling additives

Reactivity of Clays

Mineral	Typical Area (M ² /g)	Cation Exchange Capacity (Meq/100 g)
Sand (up to 60 microns)	0.000015	0.6
Kaolinite	22	3 - 15
Chlorite	60	10 - 40
Illite	113	10 - 40
Smectite	82	80 - 150

Size ranges for clays depend on deposit configuration.

Kaolinite

- Detrital - no problem in most cases
- Authogenic - depends on location and attachment
- Worst form - highly “weathered” or decomposed
- Worst problem - loose attachment to host grain.

Smectite

- Detrital - depends on liquid contact area
- Authogenic - swelling clay, sheds particles from swollen structure
- Worst form – authogenic (pore lining)
- Worst problem - swelling and particle generation

Illite

- Detrital - little problem, watch smectite mixtures
- Authogenic - trap for particles
- Worst form - authogenic “hairy” deposit
- Worst problem - particle trap, microporosity

Chlorite

- Detrital - little problem
- Authogenic - little problem, some worry about acid
- Worst form - chlorite rims (free standing and unstable) - rare deposit (Louisiana)
- Worst problem - iron content (but usually only slowly acid soluble)

Migrating Clay Catalysts

- water salinity changes
- surfactants and mutual solvents
- overburden increases
- wettability changes

Other “Migrators”

- The following are dwarfs compared to the problems with smectite.
 - Zeolites - (common in young marine sands) - clintoptolite
 - “Weathered” or altered feldspars
 - one very rare form of chlorite
 - a few loosely attached kaolinite bundles
 - broken illites (and mixed layers)
 - silt and other grains (<5 microns)

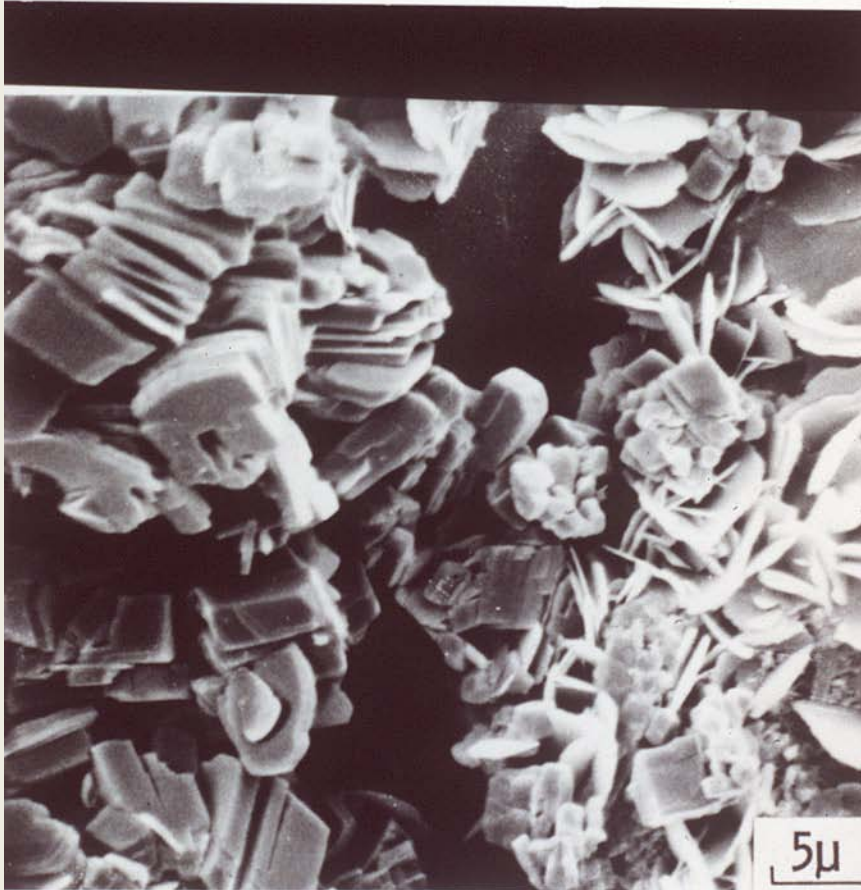
Is Clay a Problem?

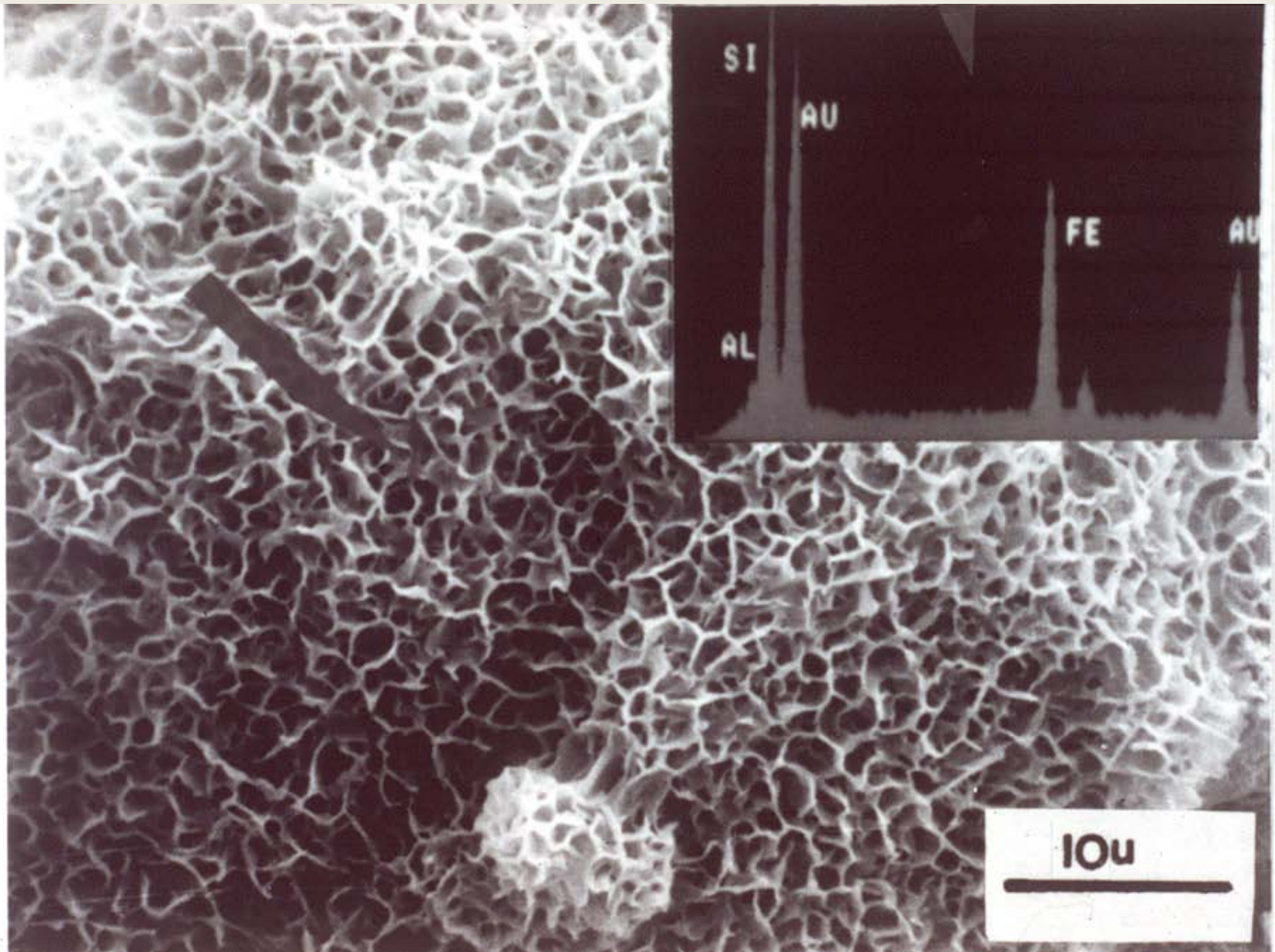
- Usually not.
- Very few formations are water sensitive to a degree that will affect production.
- Clay is a problem when it is in contact with a reactive fluid and the effects or the reaction significantly lower permeability (30% or more?).

Microporosity

- Refers to the very small (non flowable?) volume between clay platelets that can trap and hold water.
- May explain non recovery or slow recovery of load fluids
- May explain errors in log calculations involving high S_w prediction and subsequent dry hydrocarbon flows.

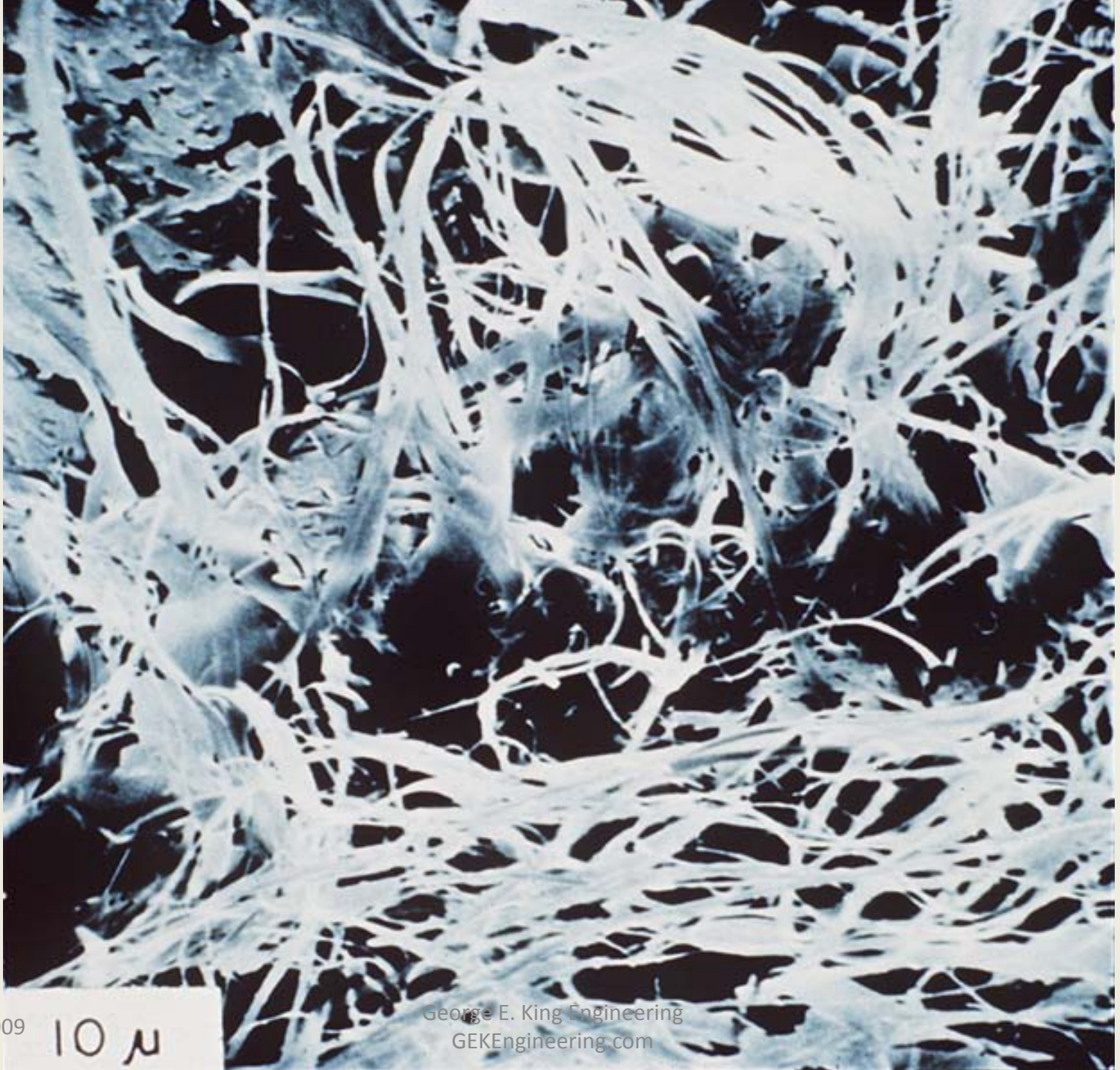
Kaolinite on the left and chlorite on the right.





Migrating???

- Because fines are there means nothing
- What turns the fines loose?
 - Velocity - unlikely
 - salinity change in fluids - very common
 - wetting change
 - cleaning agents
 - solvents (and mutual solvents)
 - shock loads (perforating for example)



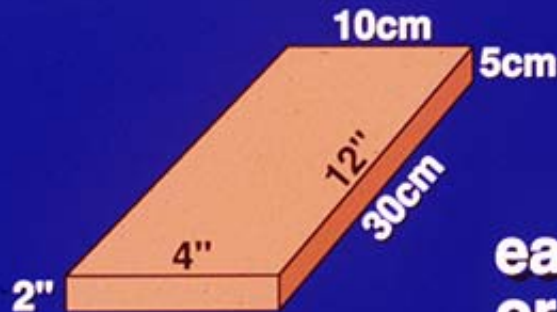
3/14/2009

10 μ

George E. King Engineering
GEKEngineering.com

Surface Area \Rightarrow Reactivity (?)

EXAMPLE: Two types of wood



each is 2.5 lb
or 1100 grams

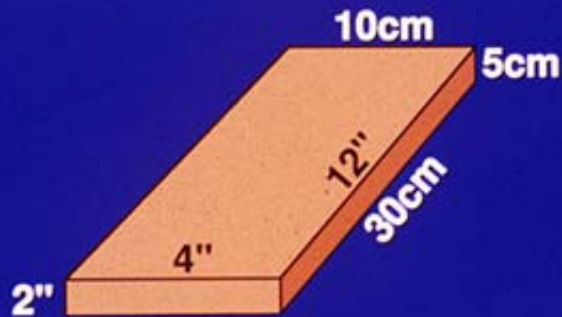


Surface area
1.11 ft² or
1000 cm²

Surface area
about 1000 ft²
or almost
1,000,000 cm²

Surface Area \Rightarrow Reactivity !

EXAMPLE: Two types of wood

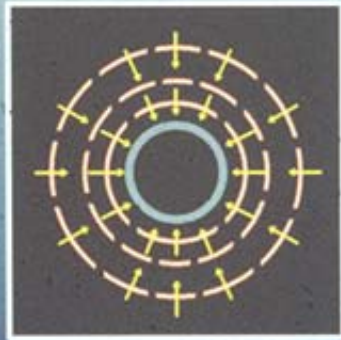


NOW, which is more reactive?



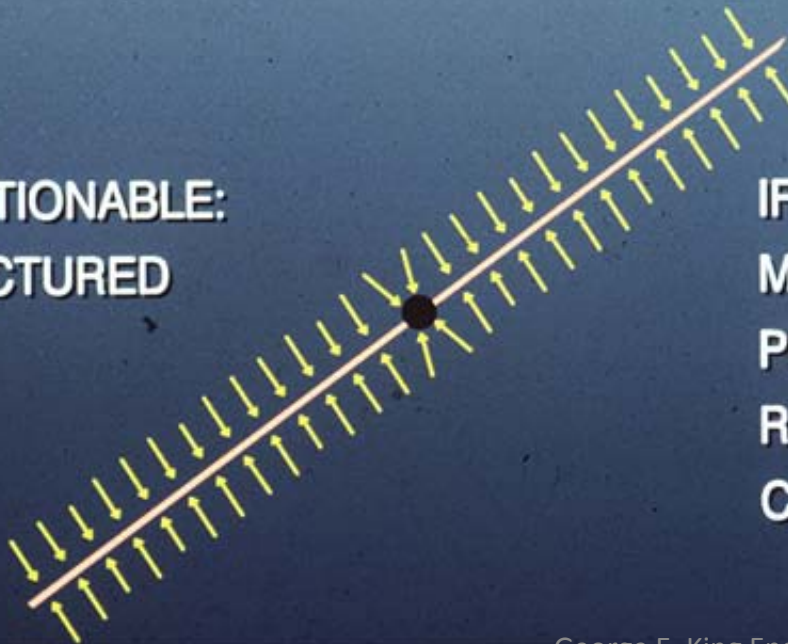
FINES MIGRATION CONTROL

**BEST USE:
NON FRACTURED**



**WHERE INCREASING VELOCITY FROM
CONVERGING RADIAL FLOW IS RIPPING
FINES LOOSE IN THE NEAR WELLBORE
AREA.**

**QUESTIONABLE:
FRACTURED**



**IF LINEAR OR NEAR LINEAR FLOW IS
MOVING FINES, THEN THEY ARE
PROBABLY MOVING ALL OVER THE
RESERVOIR - NOT A TREATABLE
CONDITION.**

Control Shales/Clays - inhibition

- 2 to 8% KCl (Smectites require high end of range)
- 2 to 4% NH₄Cl (watch emulsions with some oils - testing with live and spent crudes suggested)
- sodium chlorides to 10 lb/gal - balance with calcium?
- Calcium chlorides to 11.4 lb/gal - watch plugging and scale formation
- Avoid “liquid KCl” and KCl substitutes, especially in sensitive formations