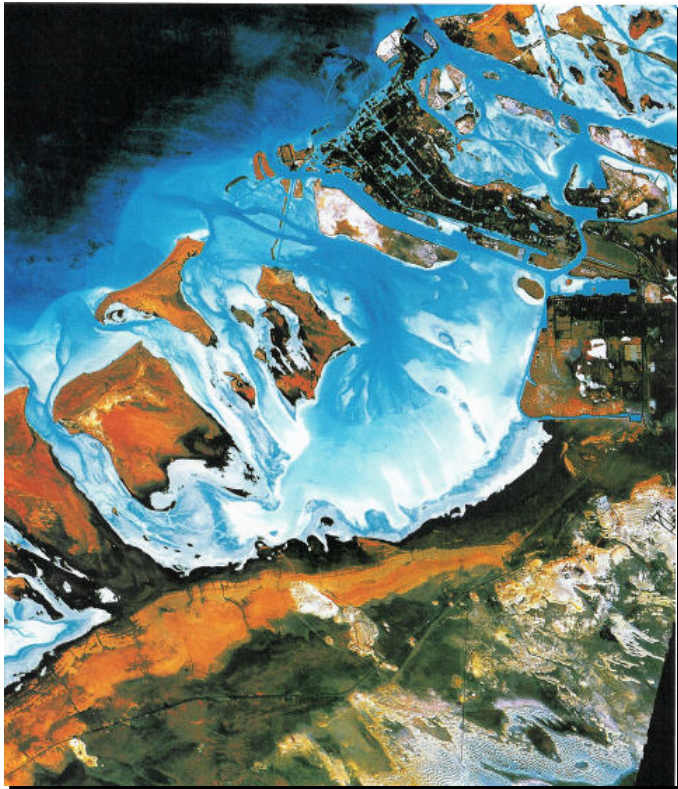


# **CARBONATE DEPOSITIONAL Environments – TIDAL FLATS**

**Major Components**

**Controls over Formation**

**Diagnostic Sedimentary Features**

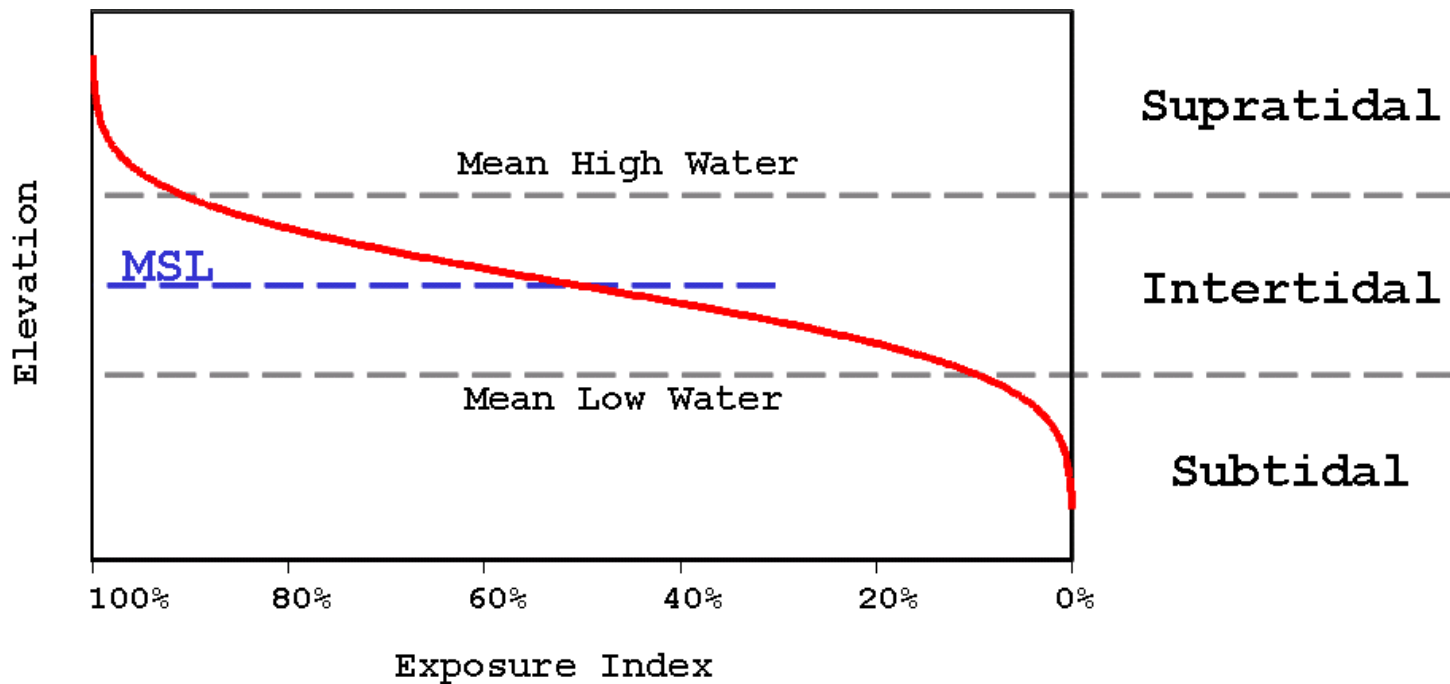
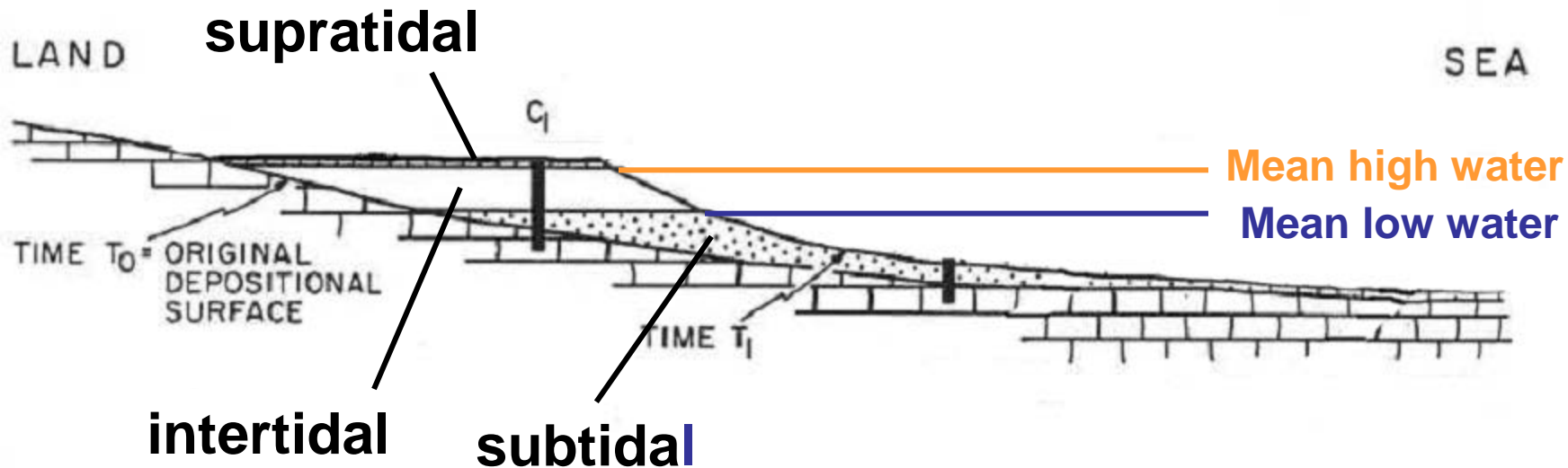


# Controls over Formation

**Q: What are hydrodynamic and bathymetric parameters that lead to tidal flat formation?**

**A: Antecedent topography, wave energy, accumulation mode, *tidal range*, climate**

***Tidal range* – determines basic physiography of tidal flats.**



# Controls over Formation

**Q: What are hydrodynamic and bathymetric parameters that lead to tidal flat formation?**

**A: Antecedent topography, wave energy, accumulation mode, tidal range, climate**

***Antecedent Topography* – Tidal Flats are extremely low-relief shorelines:**

**(i) deposited on low-relief surfaces, seaward of large land-masses, OR**

**(ii) deposited as accretionary wedges in the protected shadow (leeward barrier) of pre-existing paleotopographic barriers, (older islands), or behind coeval topographic barriers (shoals/reefs).**

**Areal extent varies from locally restricted areas (<<100 km sq) to regional features (>500 km sq).**

# Controls over Formation

**Q: What are hydrodynamic and bathymetric parameters that lead to tidal flat formation?**

**A: Antecedent topography, *wave energy*, accumulation mode, tidal range, climate**

***Wave energy* – Tidal flats are protected from open ocean waves, and thus occur in settings:**

- (i) separated from the open ocean by a wide shelf which dampens wave energy;**
- (ii) behind barrier islands which impede open ocean wave energy;**
- (iii) in restricted embayments. Low wave energy allows accumulation of mud-rich sediment.**

# Controls over Formation

**Q: What are hydrodynamic and bathymetric parameters that lead to tidal flat formation?**

**A: Antecedent topography, wave energy, *accumulation mode*, tidal range, climate**

***Mode of accumulation* – Abnormal high tides and storms transport muddy sediment from the offshore “subtidal factory” **ONSHORE** onto tidal flats.**

**Tidal flats can be viewed as a delta system turned “wrong-side out”, with the sea as the ‘river’ supplying sediment to the channelized flats**

# Controls over Formation

**Q: What are hydrodynamic and bathymetric parameters that lead to tidal flat formation?**

**A: Antecedent topography, wave energy, accumulation mode, tidal range, *climate***

## **Climate**

**Arid tidal flats have evaporites associated with the upper intertidal to supratidal zones (displacive intra-sediment growth of gypsum/anhydrite);**

**Humid tidal flats lack evaporites and have a greater density of tidal channels**

# Common Sedimentary Features of Carbonate Tidal Flats

- 1. Algal laminites and stromatolites**
- 2. Mechanically derived stratification**
- 3. Fenestrae (Primary Porosity)**
- 4. Dessication features**
- 5. Intraclasts**
- 6. Channels & fills**

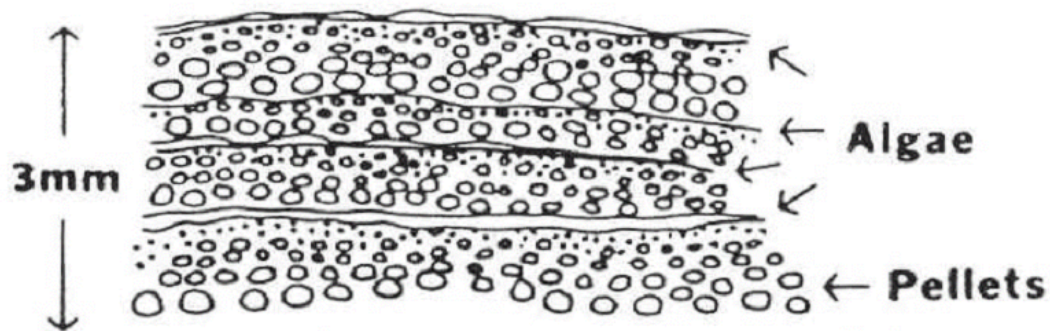
# Algal Laminites & Stromatolites

**Environment of occurrence varies with conditions**

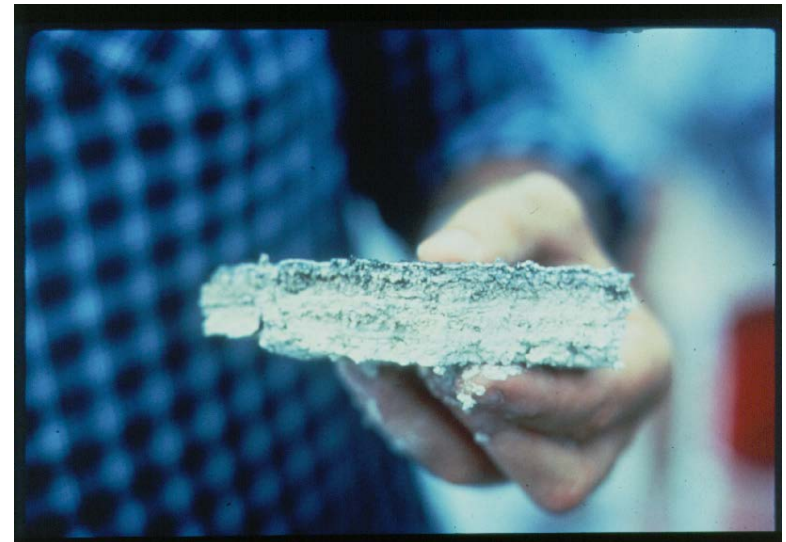
**Humid environments: supratidal**

**Arid environments: intertidal**

**Morphology: controlled by frequency of storm deposition**



**Algal boundstone**



# Stromatolites



*Recent, Australia*



*Proterozoic, Canada*



*Cambrian, Texas*



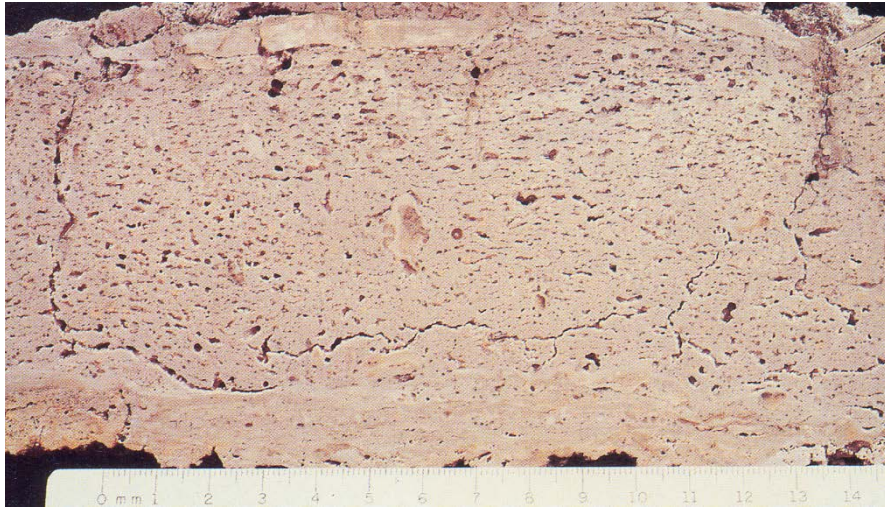
*Permian, Texas*



[Ricci Lucchi, 1995]

# Mechanical stratification

# Fenestrae



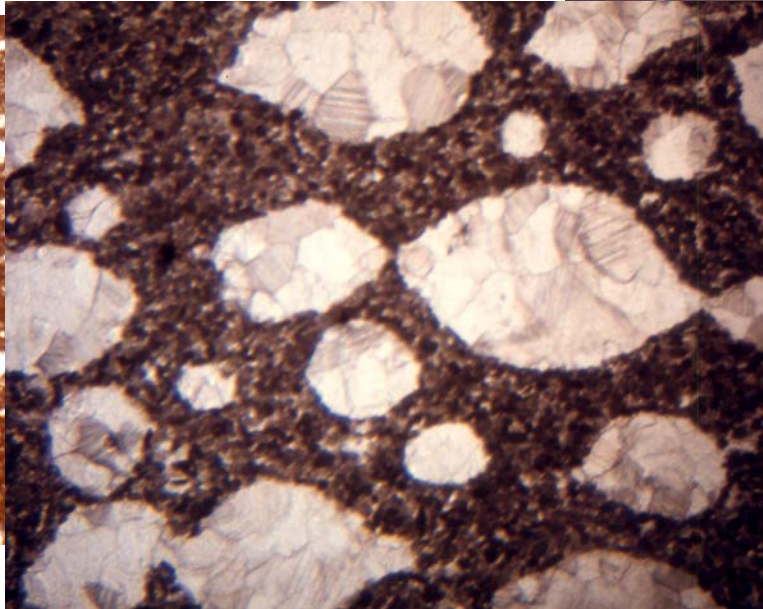
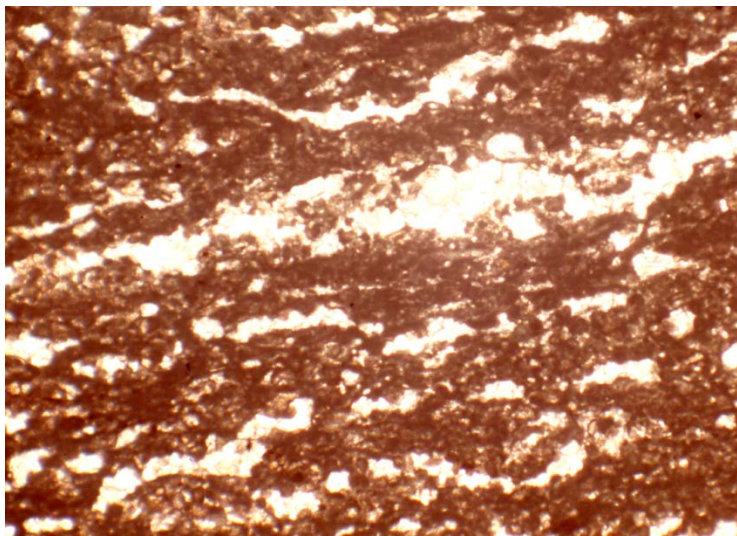
**Laminar**

**Irregular**



**Recent, Florida**

**Circular**



**Mississippian, Texas**

# Desiccation Polygons & Mud cracks

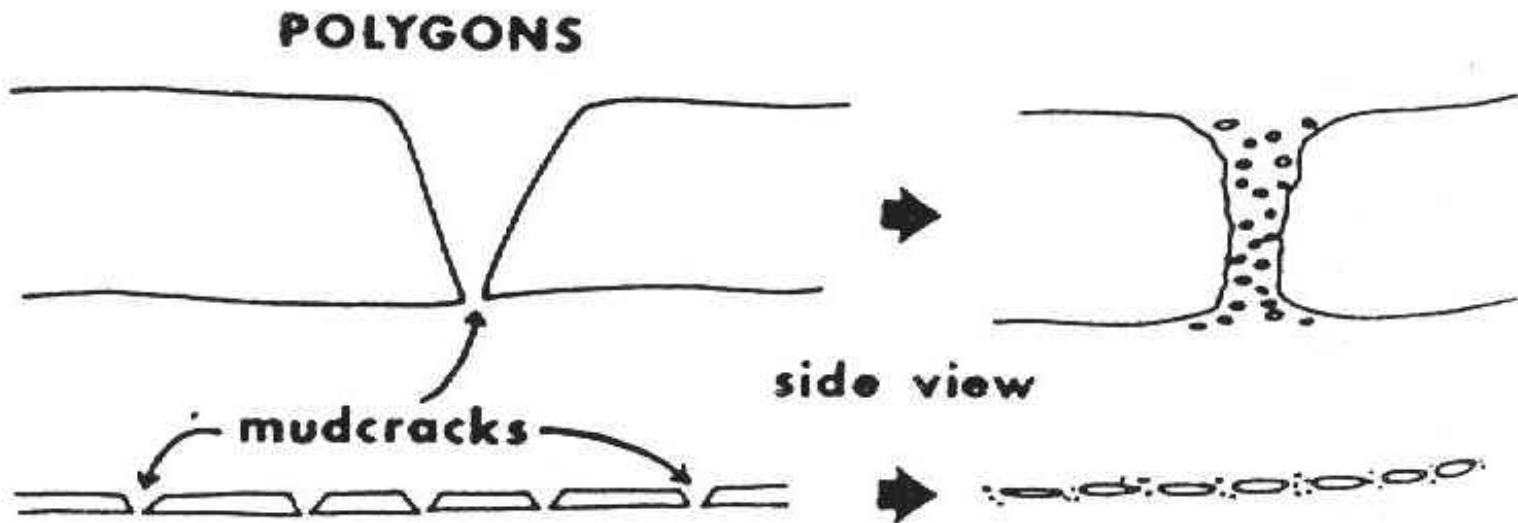
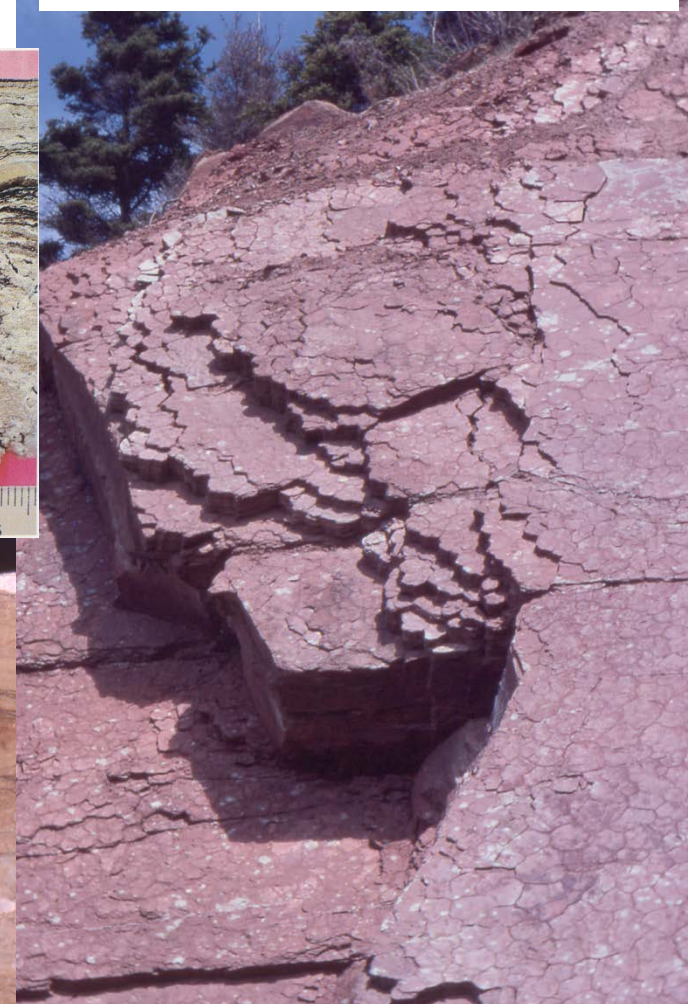
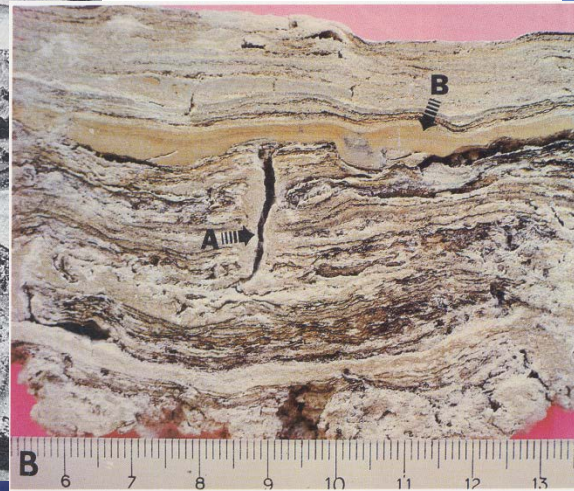
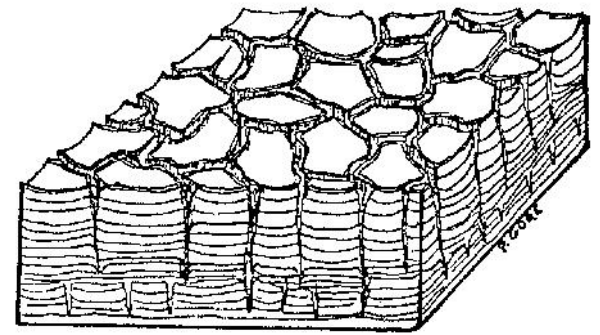
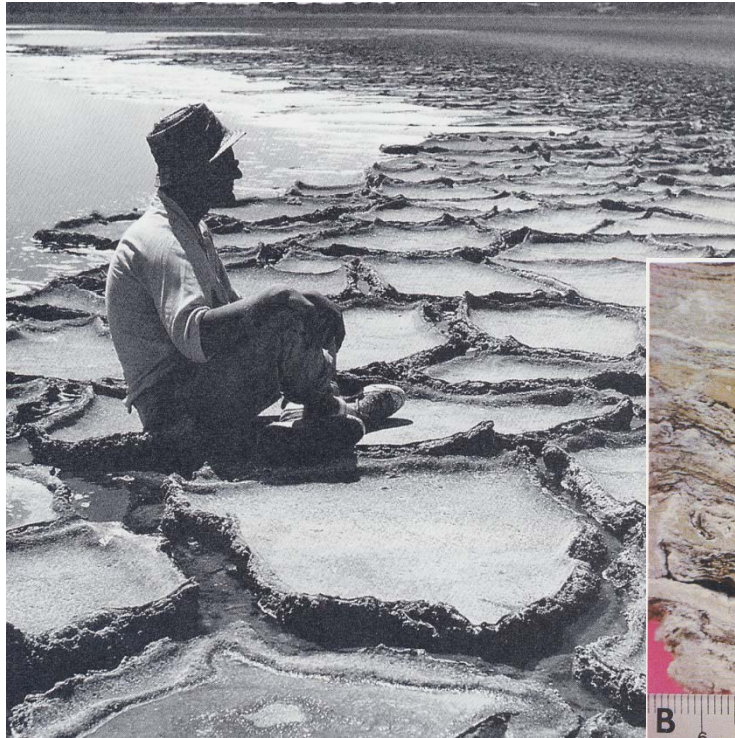


Figure 6.—Evolution of desiccation or mud cracks in thick and thin storm layers. Note that V-shaped cracks evolve into vertical, rounded, sediment-filled cracks.

# Mud cracks, algal mats



**Bahamas**

**Mississippian,  
Texas**



**Silurian, Quebec**

# Intraclasts

**Intraclasts and intra-clastic gravels – During storms, thin layers on the tidal flat are eroded and re-deposited. Hardening and early lithification occurs in supratidal zone.**



# **Tidal Channels & Ponds**

## **Tidal Channels**

**Tidal channels/creeks are more common with humid climate tidal flats.**

**High velocity tidal currents flow thru channels; channels have levees; channels rarely identified in carbonate rocks.**

## **Tidal Ponds**

**slight depressions between creeks are occupied by tidal ponds which fill and partially empty during each tidal cycle.**

**Pond sediments consist of unlayered, un-mud-cracked mudstone-wackestone with a restricted fauna (small gastros)**

