

# Sediments and



# Sedimentary Rocks

# Bottom Line

- Sedimentary rocks form from particles accumulated in sedimentary layers
- Sedimentary layers can be formed by
  - clastic or detrital particles (e.g., sand grains, shells, bones, clay mud, and so on)
  - minerals that have precipitated out of a water-based solution
  - materials erupted from a volcano
- Sedimentary layers contain geohistorical information









# Importance of sed rox

- Forms interface between solid Earth and the biosphere, hydrosphere and atmosphere
- Contains much of the evidence of Earth's biological and climatological history
- Economic interest
  - Building materials (sand, gravel, etc.)
  - Energy resources (oil, gas, coal)
  - Economic minerals: uranium, iron, placer gold, bauxite, et cetera

# History of a sedimentary grain

- Physical or Chemical Weathering
- Dissolution or Erosion: separating the compound or particle from its original source material
- Transportation by wind, water, ice, etc.
- Precipitation or Deposition
- Burial and possible lithification



# Weathering Processes

- Mechanical weathering
- Chemical weathering

# Factors Affecting Chemical Weathering

- Temperature
- Precipitation
- Vegetation
- Industrial pollution upwind

Siliciclastic sediments:  
broken fragments of  
silicate rocks and  
mineral grains



Sediment derived from the weathering of granitic bedrock.

# Common minerals in siliciclastic sediments

- quartz
- clay
- mica
- minor feldspar (weathers easily)
- rock fragments
- dark "ferromagnesian" minerals like amphibole and pyroxene

# The composition of clastic sediment is primarily a function of...

- the composition of the source material
- the distance the sediment has been transported
- greater distance = higher % of quartz or other chemically stable minerals

Carbonate sediments:  
composed primarily of  
the minerals calcite  
(calcium carbonate) or  
dolomite (calcium  
magnesium carbonate)

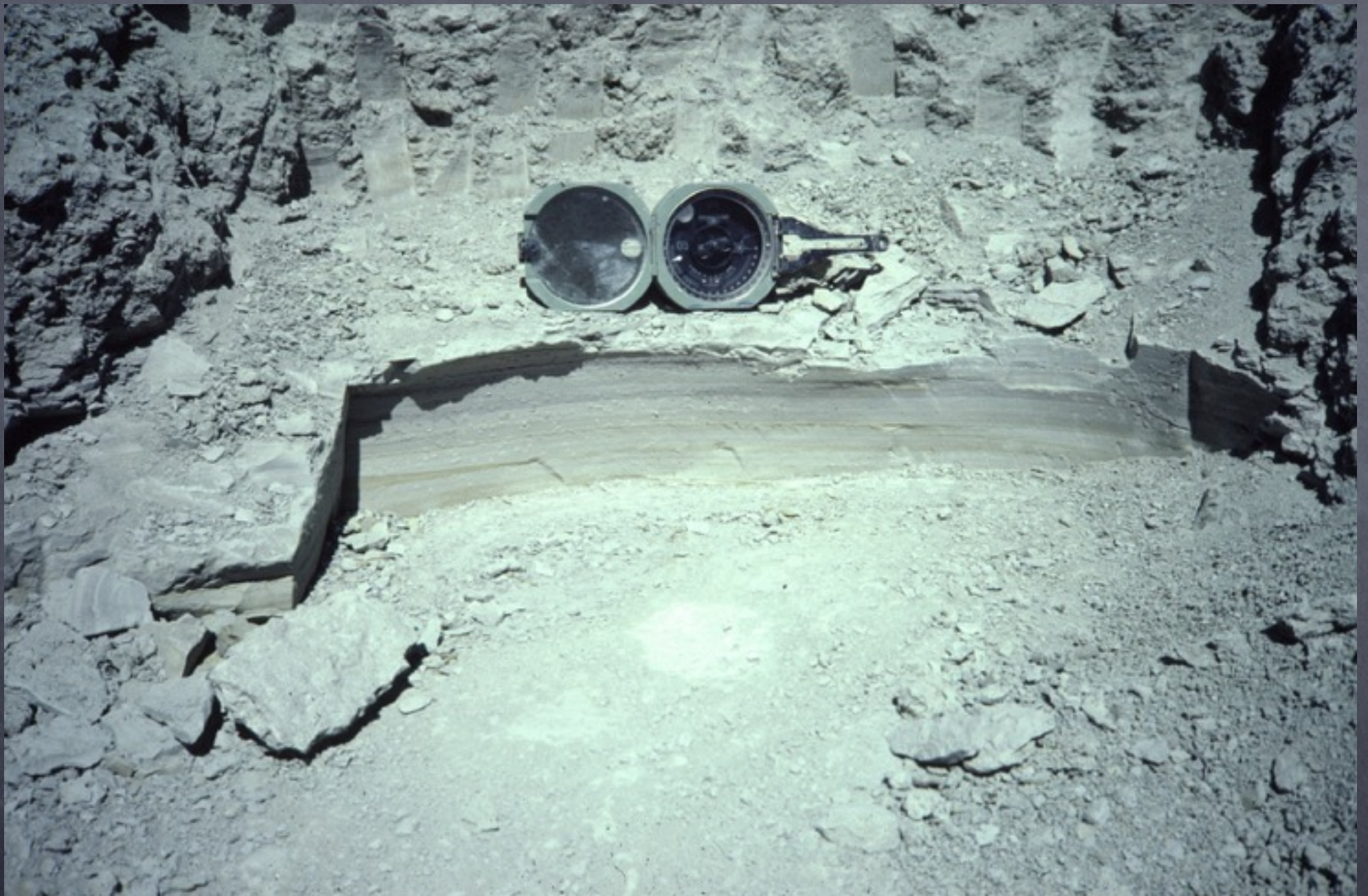
# Common minerals in carbonate sediments

- calcite
- dolomite
- clay
- iron and magnesium oxides



# Grain Size Scale

Particle Name	Grain Diameter	Forms Sed Rock...
clay	$< 1/256$ mm	claystone, shale, mudstone
silt	$1/16$ to $1/256$ mm	siltstone, shale, mudstone
sand	$1/16$ to 2 mm	sandstone
gravel	$> 2$ mm	conglomerate, breccia



Laminated mudstone, Skardu, Himalaya



# Gravel Size Scale

Particle Name	Grain Diameter	Forms Sed Rock...
granule	2 to 4 mm	conglomerate, breccia
pebble	4 to 64 mm	ditto
cobble	64 to 256 mm	ditto
boulder	>256 mm	ditto

# Grain Shape

- Angular grains (sand size and larger) indicate that the grains have not been transported a significant distance compared with rounded grains.
- Grain sphericity is commonly related to composition (spherical, flat, oblate, prolate, et cetera)

Clastic grains from  
source to sink



Angular clasts in talus slope



Angular gravel sediment





Sedimentary breccia, illustrating angular clasts

Ripple marks, dunes,  
cross beds



Rippled sand in a stream channel



Wind-generated ripples, Death Valley.



1.8 billion year old current ripples, Baraboo quartzite, Wisconsin



1.8 billion year old current ripples, Baraboo quartzite, Wisconsin. My wife, on the other hand, is ageless.



Gypsum sand dunes at White Sands National Monument.



Sand blowing over cornice of a sand dune, White Sands  
National Monument, NM





Large sand dunes, Death Valley, California



View of the south side of the Skardu Valley, Baltistan, northern Pakistan



Large sand dunes, Skardu Basin, Kashmir Himalaya



Indus River through Skardu, summer 1981



Indus River through Skardu, Spring 1982



Large sand dunes, Skardu Basin, Kashmir Himalaya

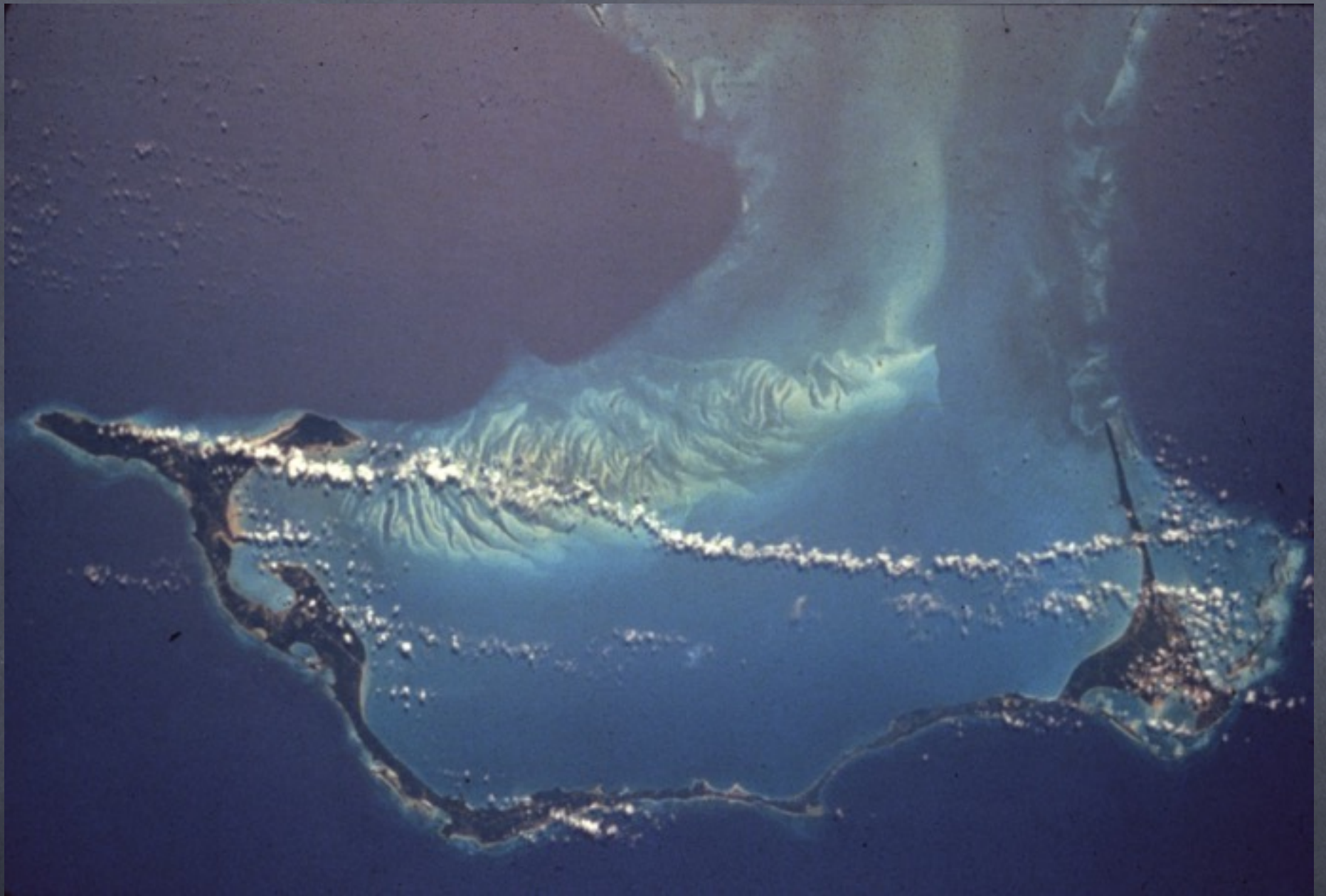


Sand dune impinging on an orchard, Skardu Basin



Cross beds in sandstone





Submarine sand dunes, Bahamas, as observed from a shuttle orbiter



Large cross beds, Zion National Park

# Lithification:

transformation into  
sedimentary rock

- **Compaction** under the weight of overlying sediments
- **Cementation** by precipitation of minerals from ground water

Environmental  
information gleaned  
from analysis of  
sedimentary rock; the  
present is the key to  
interpreting the past



Mud cracks on  
dry lakebed.



Mud desiccation (drying) cracks



Salt rising through  
mud cracks on a  
dry playa lakebed in  
Death Valley,  
California.

Salts carried by  
ground water are  
precipitated as the  
ground water  
evaporates at the  
surface.



Tracks on sand surface





Alluvial fan, Hunza Valley, Hindu Kush Mtns.



Alluvial fan, Death Valley



Evaporite deposits (and my wife) on the floor of a playa lake, Death Valley





Galveston Bay and barrier islands





Carbonate beach near Cancun, Mexico

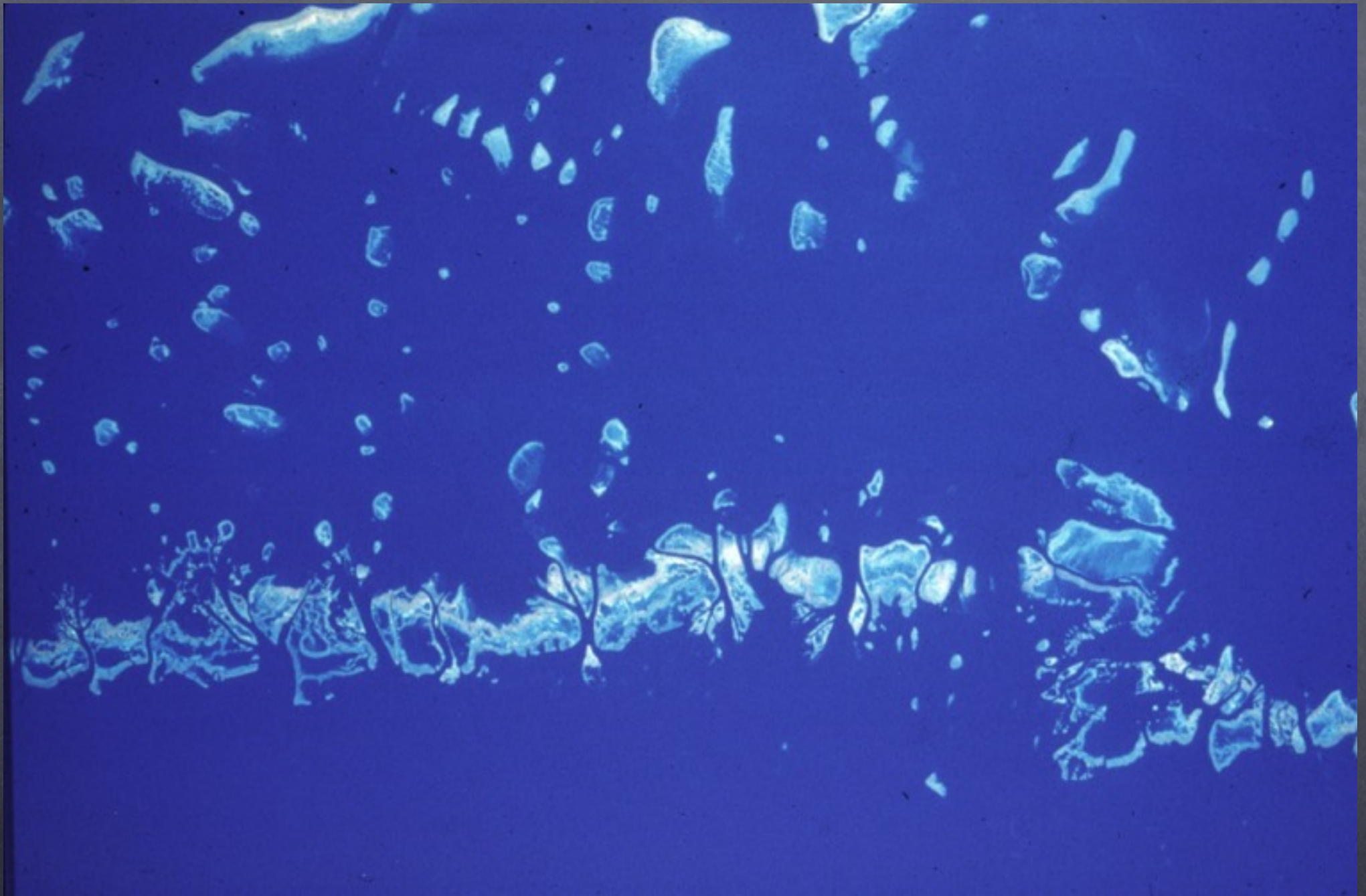


Carbonate-secreting algae and resulting carbonate sediment





Coral reef ("El Garafon"), Isla de las Mujeres,  
Mexico



Great Barrier Reef as observed from a shuttle orbiter



Turbidite layers  
exposed in road  
cut in Illinois.