Fri. Apr. 27, 2018

- Today:
  - Possible GIS Geological Map Demo
  - Review of Death Valley (Ch. 14) using different R.S. techniques
- Final Exam: Friday May 11 1:15-3:15
  - Open book and open notes (from this class material only)
  - Review outline also available online
    - Look at midterm review outline also

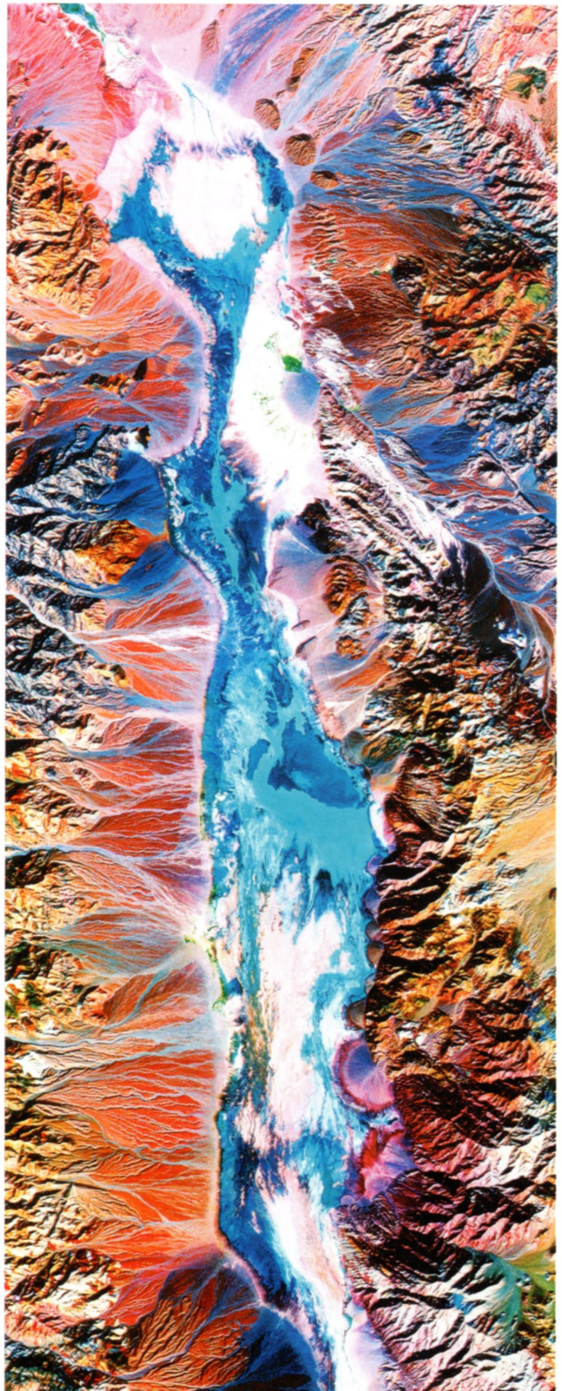
B. Large-format-camera photograph (0.5 to 0.7 μm).

Death Valley

- Common test site for many remote sensing systems
  - Near Edwards AFB / NASA Dryden Center
  - Surface very well mapped
  - Variety of surface types:
    - Variety of exposed bedrock
    - Alluvial fans
    - Sediments (including evaporites)
    - Limited (but at least some) vegetation
- This is picture from Large Format Camera system on shuttle, often used during Radar missions
  - 5-m pixels – highest of images here
    - good for studying topography, drainages, etc.
    - can also acquire stereo pairs
  - "Minus-blue panchromatic photograph"

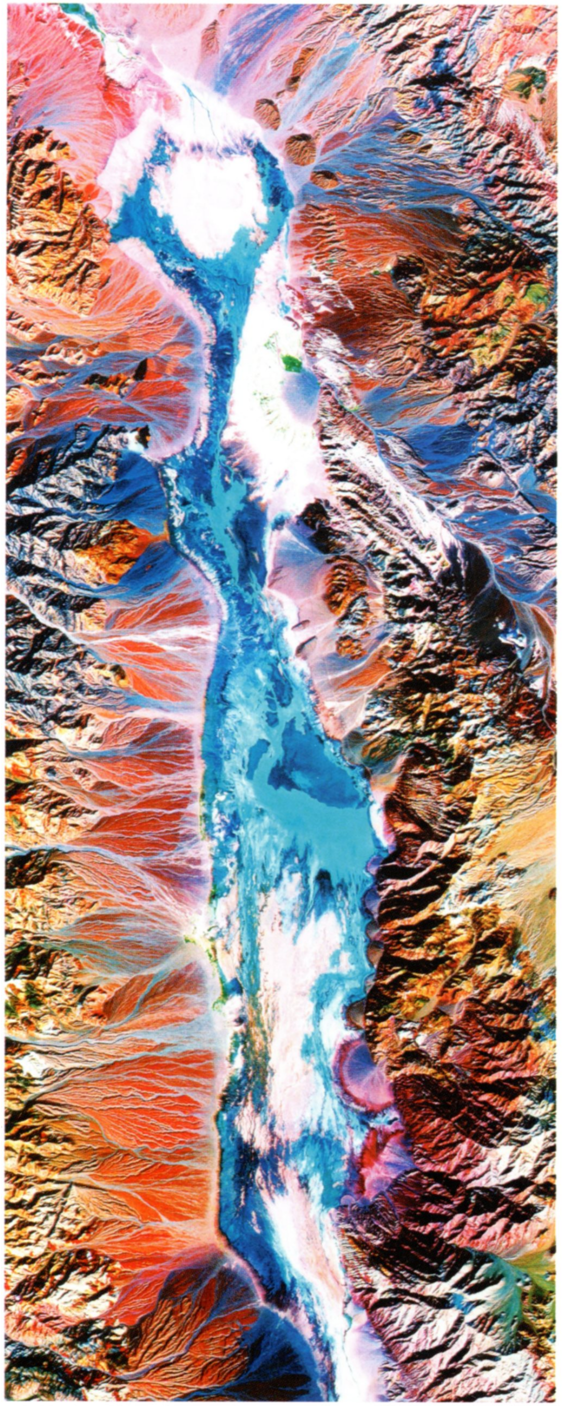
  Panchromatic – film sensitive to all "visible" colors

  Minus-blue: Filter to subtract blue (i.e. green) used to suppress scattered light


A. Landsat TM 2-4-7 image.

Death Valley Landsat TM 2-4-7

- Landsat TM RGB = Bands 7 4 2 (Green, 0.83 µm, 2.22 µm)
    - 30-m resolution pixels
- Enhanced using
    - Contrast stretch
    - IHS (Intensity, Hue, Saturation) enhancement
        - so saturation "increased"
    - Non-directional edge-enhancement
- Color interpretation?
    - Band 2-4-7 commonly used for arid lands work
        - Vegetation does show as green since bright at 0.83 µm
        - Many "reddish" rocks show as shades of G+R, depending on their OH content depressing band 7.
        - Evaporites can be white or blue (after S stretch)



A. Landsat TM 2-4-7 image.

Death Valley Structure?

- Exposed bedrock in mountains on either side
  - Variety of colors/rock types in bedrock
    - Note redder rocks in near bottom right
- Alluvial fans boarder mountains
  - Note some variation in color between fans and in active channels on fans

Asymmetry in valley

Fans broad on western side, narrow on east

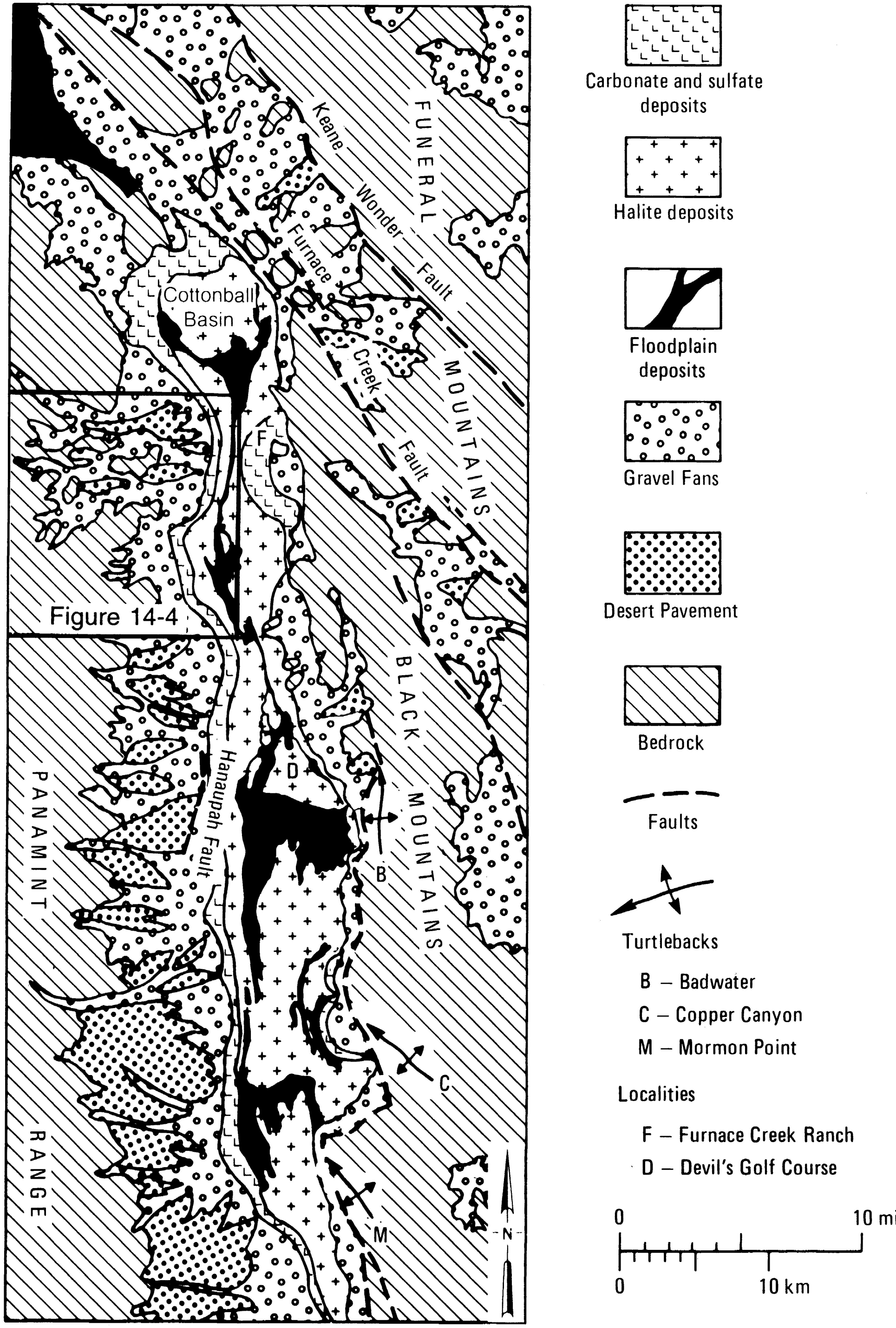
Streams/sediments also offset to east side

Valley floor still sinking on east –

Fans rapidly buried by more recent sediments

Look for active faults on other images

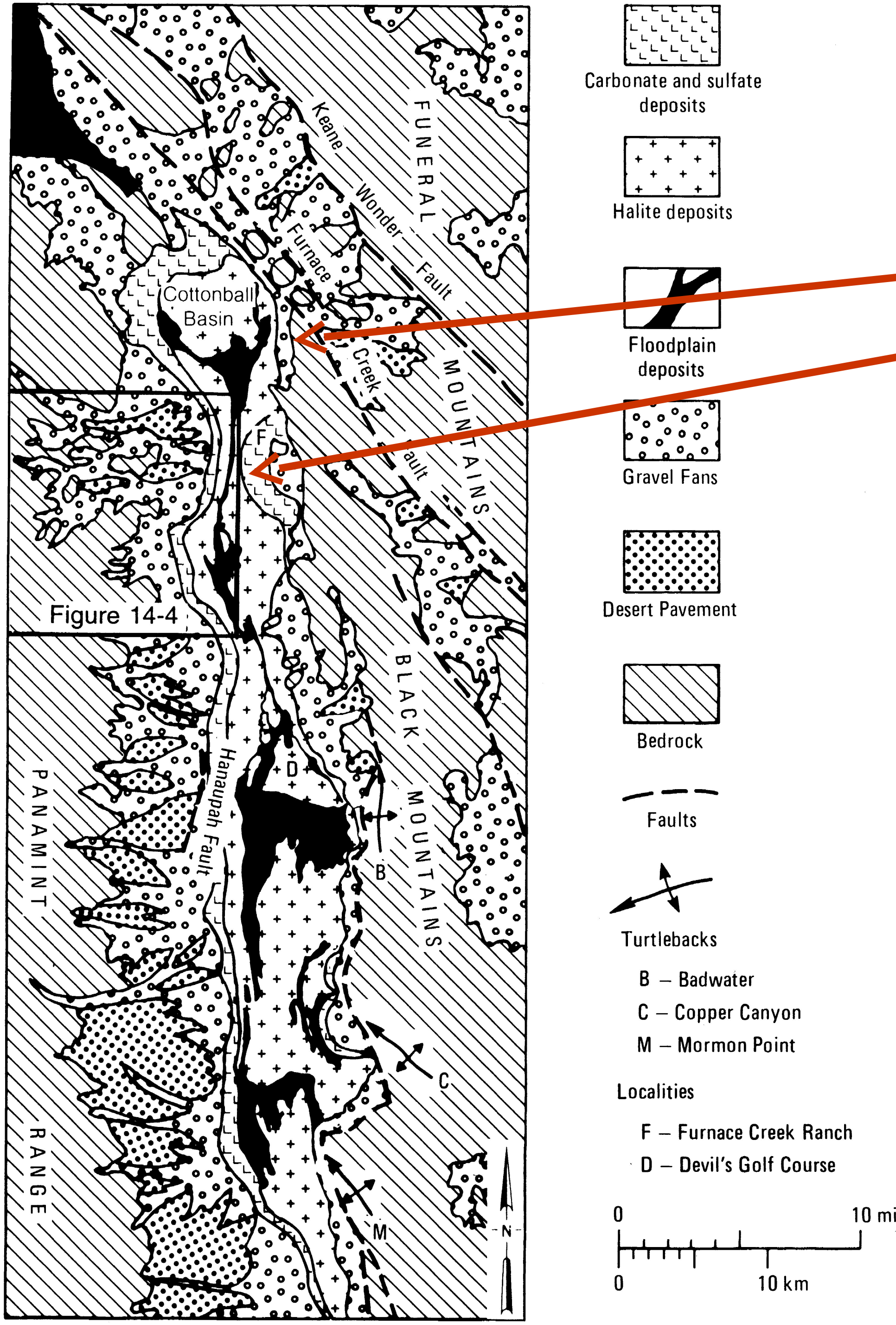
- Several types of sediments visible along axis of valley
- Small bright green areas are vegetation
  - Furnace Creek resort towards upper right of valley



Death Valley Map

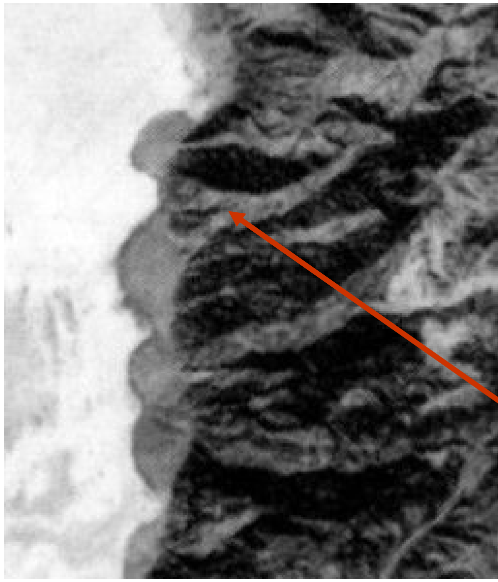
- Panamint range on west, shedding extensive fans
- Funeral and Black Mountains on E
  - Rising relative to floor
  - See faults
  - Also “Turtleback” anticlines
    - Anticlines with bedrock recently excavated from under volcanic cover
- Two types of alluvium along edges
  - Gravel fans
  - Desert Pavement
- Also have floodplain deposits along stream
- Several types of chemical sediments
  - Halite deposits
  - Carbonate and sulfate deposits

Death Valley Map



- Detailed studies of two regions
  - Cottonball Basin
  - Square marked as Figure 14-4

Enlargements from LFC photo Sabins 14-2B



Tectonics

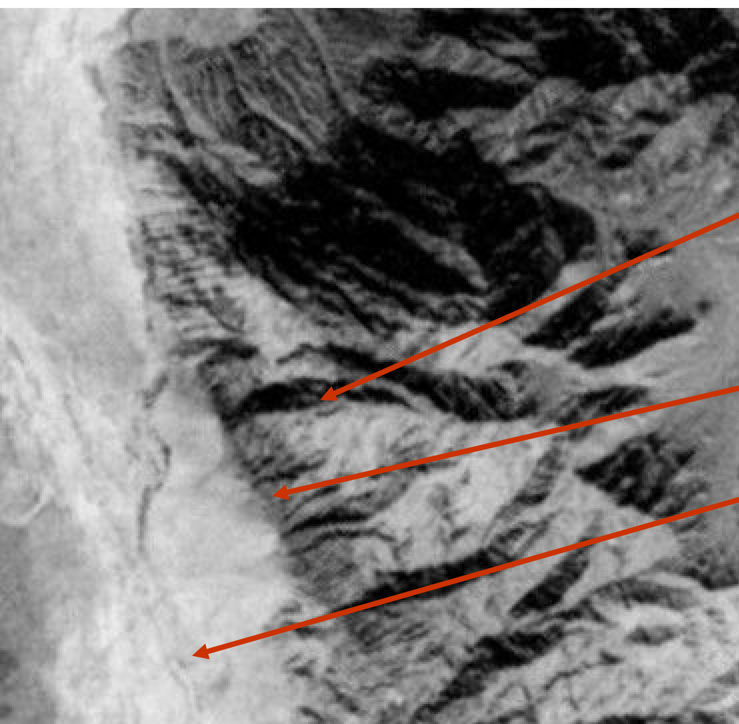
•Asymmetric nature of alluvial fans and valley floor deposits

•Linear nature of whole valley

•Sabin reports other indications of active movement on east side
(Not all obvious in images provided)

•Small exposures of uneroded fault surfaces on basement rock
(triangular facets, mostly buried by debris)

•Wineglass shaped canyons along west face of Black Mountains
(Continued dropping of base level keeps lower canyon narrow and also produces straight edge to mountains)



? •Fault scarps cutting recent gravel deposits

•Older tectonics

•"Turtleback" anticlines

Triangular Fault Scarp Facets

•Recently active faults south of Provo UT along Interstate 15. (R. Howell)

Enlargements from Landsat TM Plate 27A

Tectonics

•Asymmetric nature of alluvial fans and valley floor deposits

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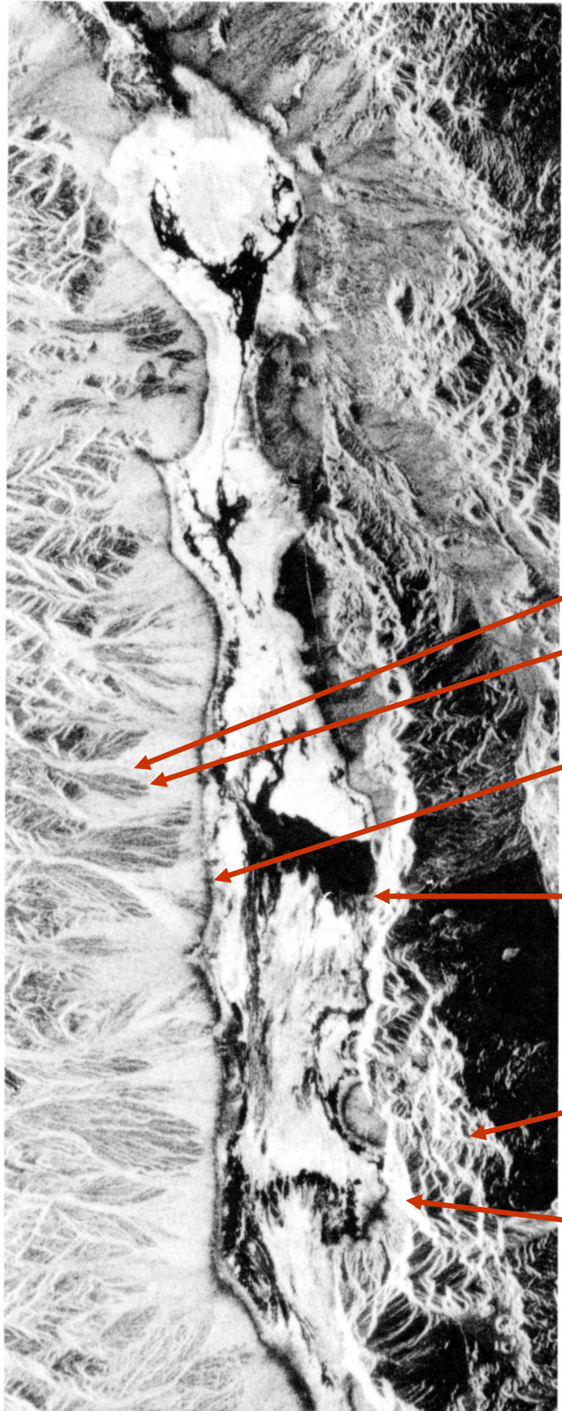
•Older tectonics

- •“Turtleback” anticlines


A. Seasat L-band radar image (23.5 cm).

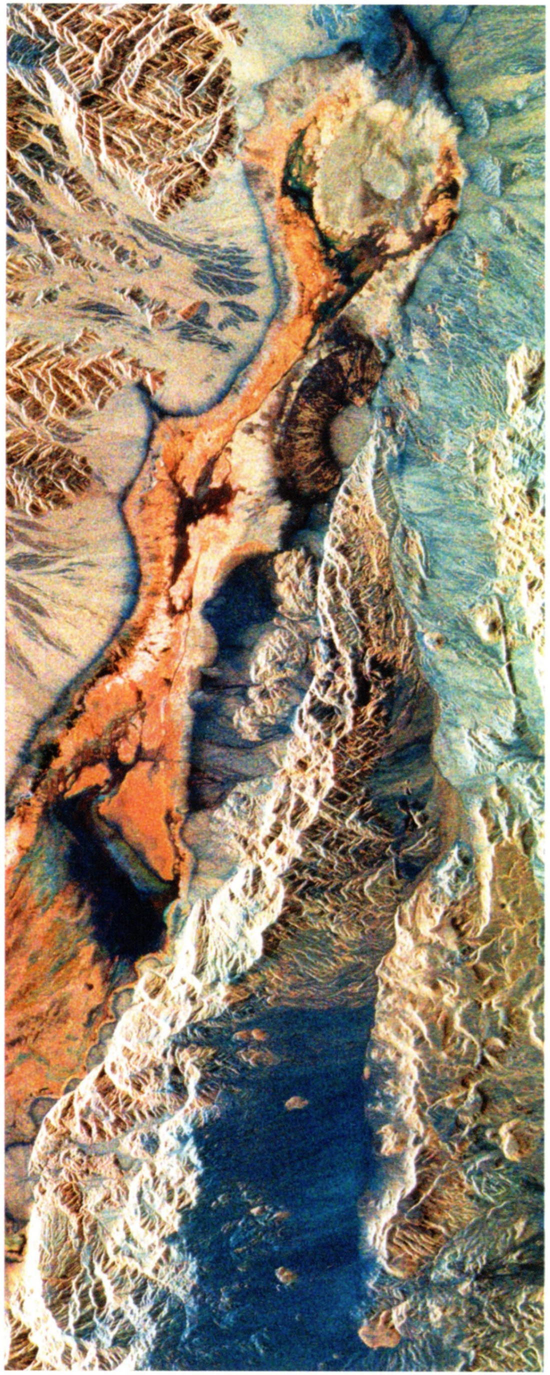
Radar: Seasat L-band (23.5 cm)

- Roughness criteria for 23 cm   Scale of h in cm?

  Smooth   1.60   Intermediate   9.11   Rough

- Two types of material in fans on W side
  - Radar bright along water courses: Coarse gravel
  - Radar dark on rest of fan: Desert Pavement
- Smooth band of sand and small gravel lines western edge of valley
- Variety of surfaces in sediments/evaporites
- Bad layover problems caused by near-vertical view (steep depression angle = 70^{o})
- Faults here show well because of look angle

Sabins Fig. 14-2A pg. 454



B. Color composite of SIR-C images (VV polarization).
Blue = X band, green = C band, red = L band.

Multi-wavelength SIR-C

- All VV polarization

- Blue = X band (3 cm)
- Green = C band (6 cm)
- Red = L band (23 cm)

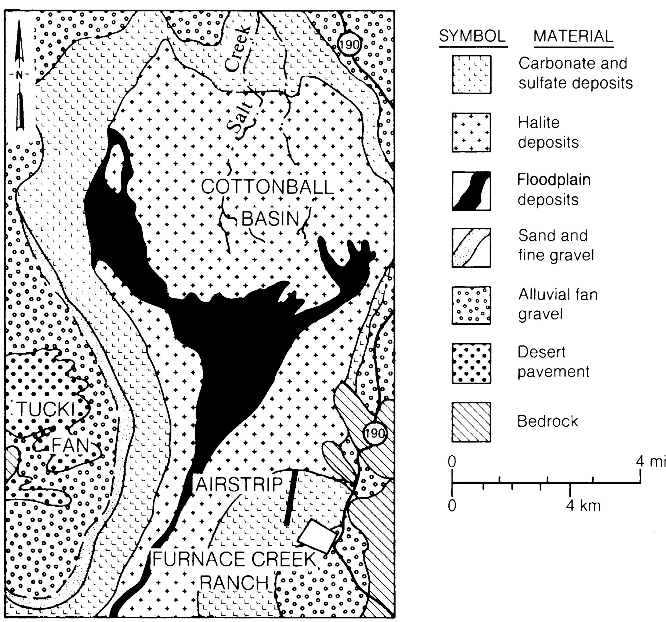
X	Smooth	0.21	Intermediate	1.19	Rough
C	Smooth	0.42	Intermediate	2.38	Rough
L	Smooth	1.60	Intermediate	9.11	Rough

- Two types of material in fans on W side
  - Radar bright along water courses: Coarse gravel
  - Radar dark on rest of fan: Desert Pavement
- Smooth band of sand and small gravel lines western edge of valley
- Variety of surfaces in sediments/evaporites

- Layover problem less: Depression angle only 40^{o}

Sabins Plate 27B

C. TIMS classification image, Cottonball Basin.



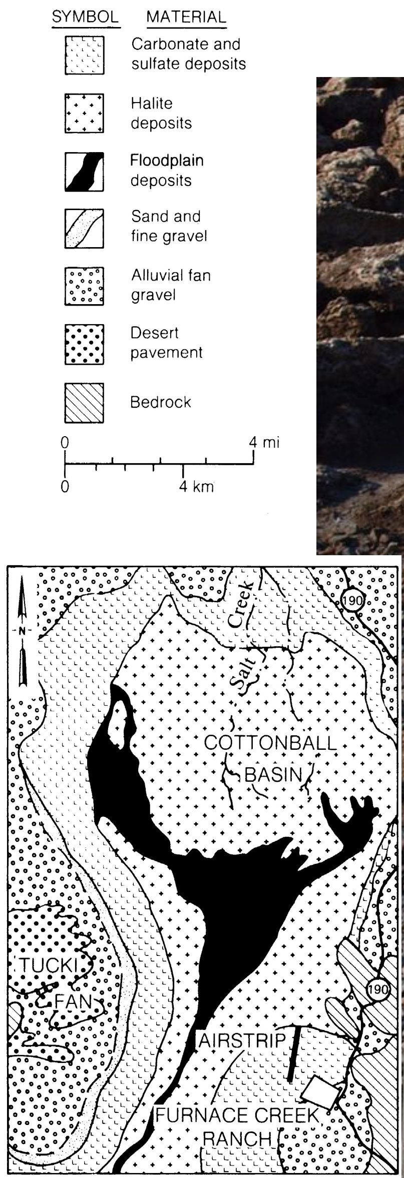
G. Map and legend.

Multi-polarization SIR-C

- All L band (23 cm)
- Blue = VV Green = HV Red = HH
- Changes in roughness of halite evaporites cause most of the variations
- Roughness on scale larger than wavelength causes “multiple scattering” and depolarization
- Most of vegetation at Furnace Creek Ranch is golf course, so does not cause multiple scattering. Do get some multiple scattering from buildings and perhaps palm trees.

Sabins Plate 27C (I think labels for C and D are reversed.)

Devil's Golf Course, Death Valley



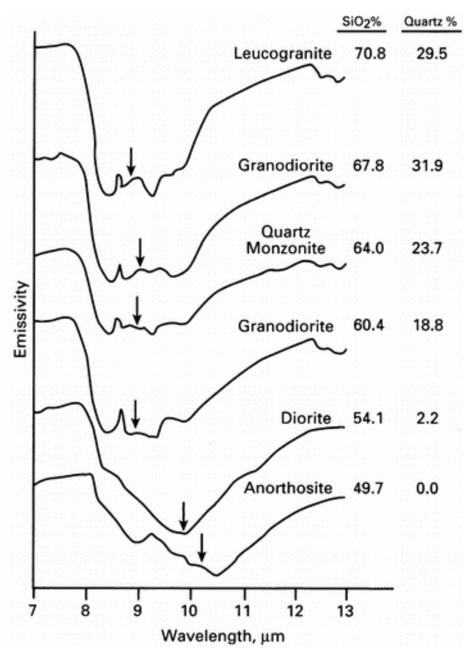
G. Map and legend.

Thermal IR Observations

- Lower image BGR = 8.4, 9.2, 10.7 microns
- Sensitive to different positions of 10 micron thermal emissivity band,, due to varying SiO_2 content
- Note how alluvium matches composition of source regions

B. TM 2-4-7 image, western margin of Death Valley.

A. TIMS image, western margin of Death Valley.



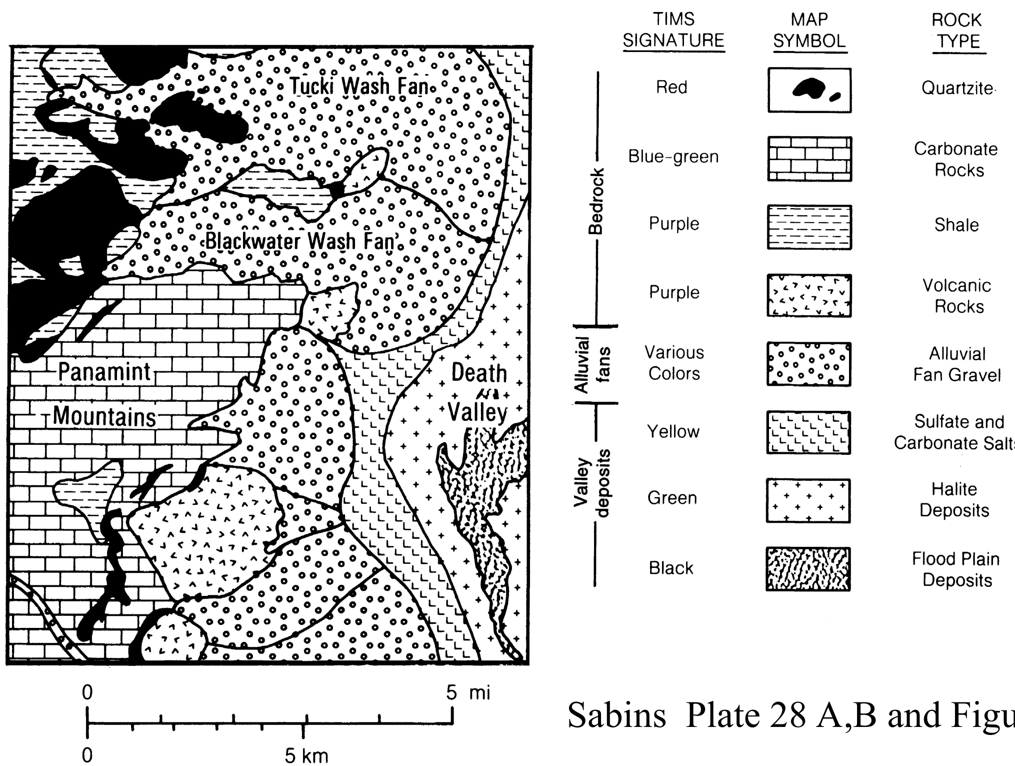
Sabins Plate 28 A,B and Figure 5-35

Thermal IR Observations

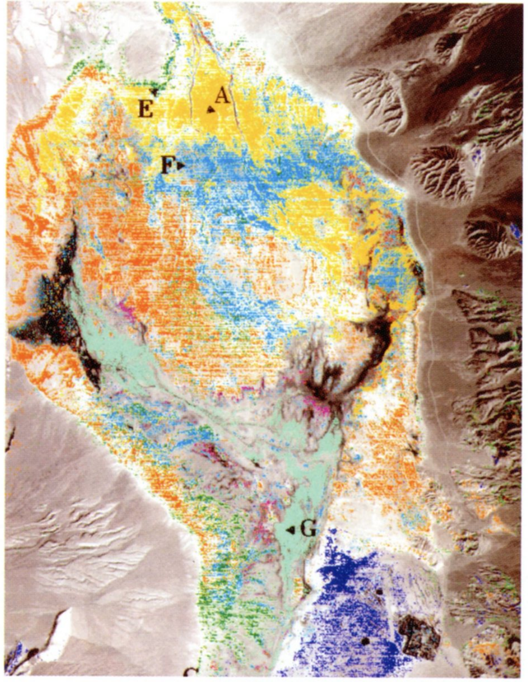
- •Lower image BGR = 8.4, 9.2, 10.7 microns
- •Sensitive to different positions of 10 micron thermal emissivity band,, due to varying SiO_2 content
- •Note how alluvium matches composition of source regions

B. TM 2-4-7 image, western margin of Death Valley.

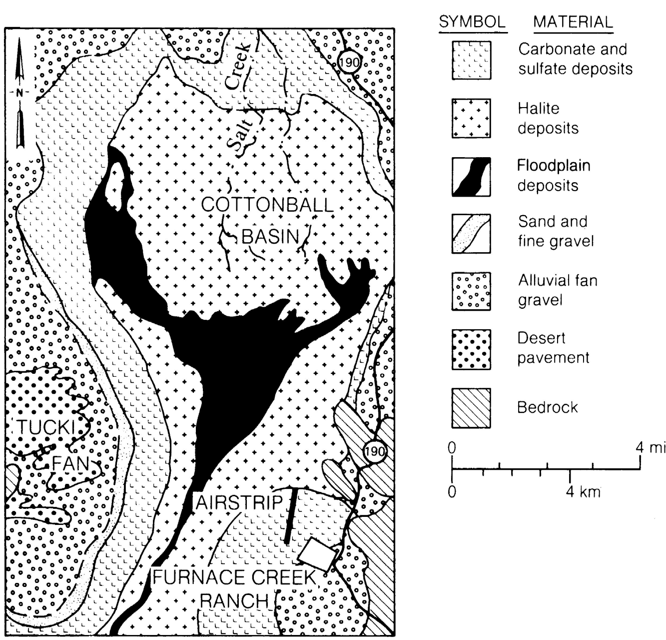
A. TIMS image, western margin of Death Valley.



Sabins Plate 28 A,B and Figure 14-4



D. SIR-C multipolarization image (L-band), Cottonball Basin.
Blue = VV, green = HV, red = HH.



G. Map and legend.

Thermal IR Observations

- •TIMS unsupervised classification image shown in color
  background gray is simple thermal image
- • --Field spectra and samples used to identify classes

•Red	Gypsum
•Orange	Silty halite and carbonate deposits
•Yellow	Thenardite (sodium sulfate)
•Green	Quartz-rich gravel and floodplain deposits
•Light green	Mixed silicate and evaporite minerals
•Cyan	Massive halite and silty halite
•Dark blue	Clay (illite and muscovite) and alluvial deposits

Sabins Plate 28 D (I think labels for C and D are reversed)

D. Landsat TM band 6 image (10.40 to 12.50 µm).

Thermal IR Observations

•Large image is daytime TM Band 7 (TIR)

•Aspect (to sun) controls mountain heating

•On western alluvial fans

Desert pavement has dark coating ⇒hot

Coarse gravel is lighter ⇒cooler

•On valley floor

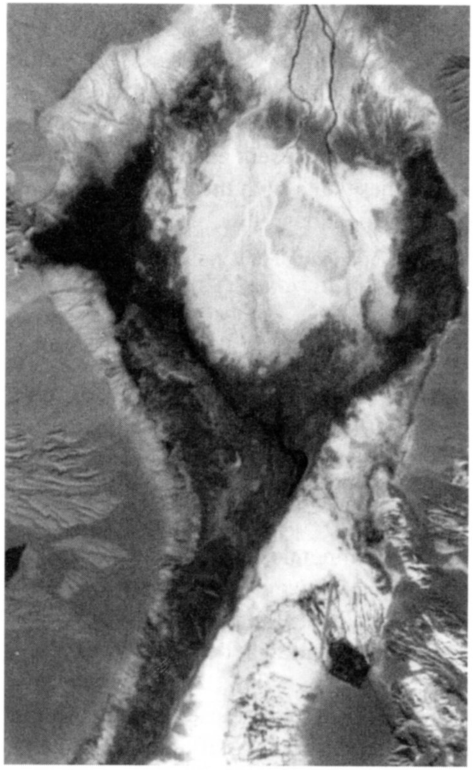
Floodplain deposits show evaporative cooling

Carbonate and sulfate deposits around valley margin are dry and fluffy

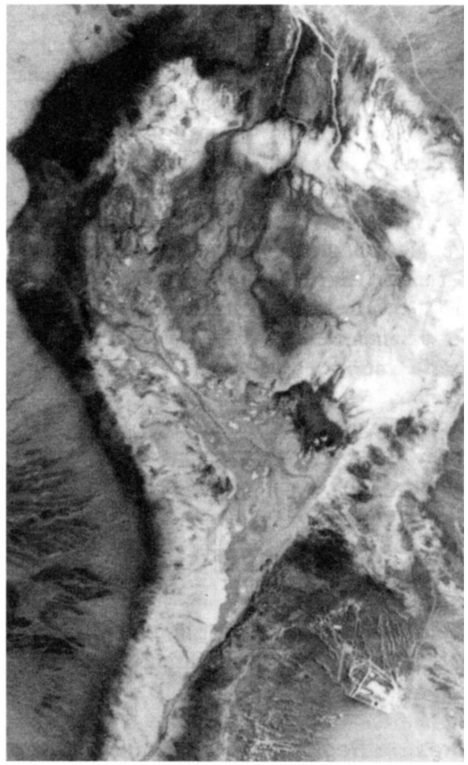
⇒ low thermal inertia ⇒heats quickly

•Evaporative cooling at Furnace Creek Ranch and in some floodplain silt/mud

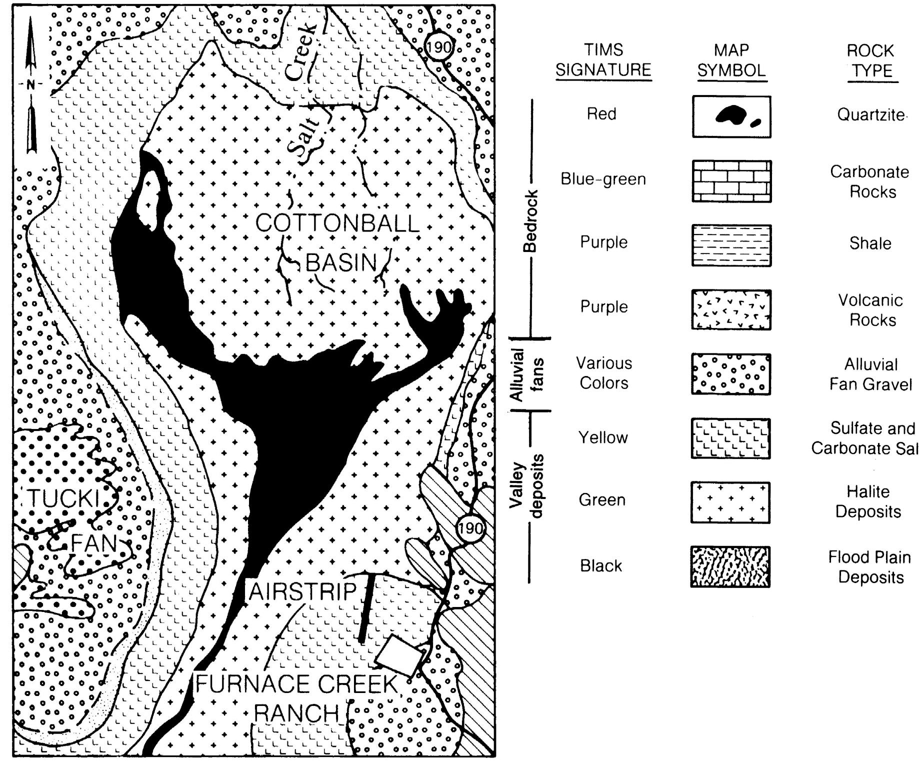
Daytime TM vs. Nighttime TIMS



F. Landsat TM band 7.



D. Aircraft nighttime thermal IR.



G. Map and legend.

- As discussed in last image, daytime heating is controlled by albedo, evaporative cooling, and perhaps thermal inertia effects
- In nighttime image thermal inertia effects are more important.
  - Roads and buildings at Furnace Creek (lower right) stay warm
  - Fine sand border at edge of fan cools quickly as do fluffy carbonates/sulfates
  - Some more dense halite sections cool relatively little.
- Notice how night image separates parts of quartzite from adjacent halite