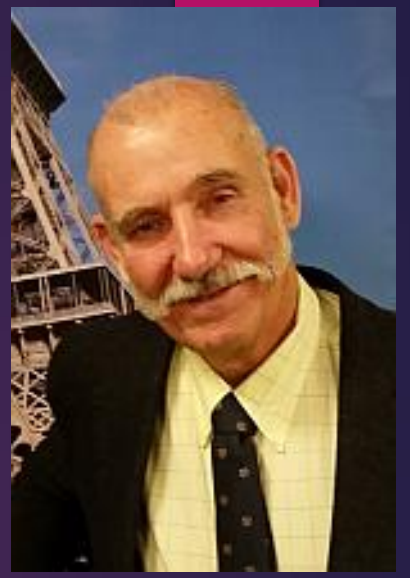


Physical Geology Lab 10B: Deserts

DR. GREGG WILKERSON

MICHAEL OLDERSHAW

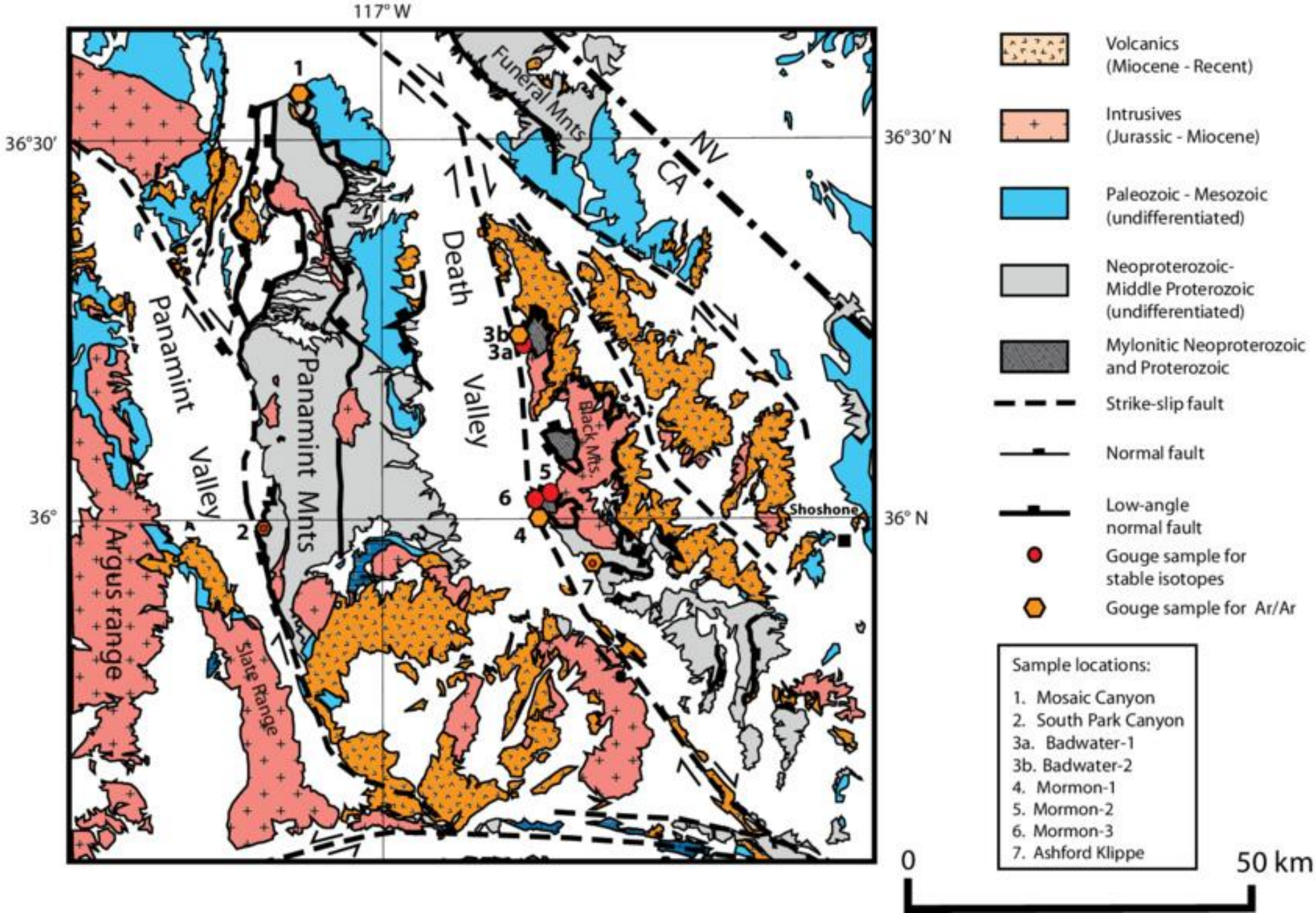
SOLUTIONS ARE IN RED

DOWNLOADS AND LINKS

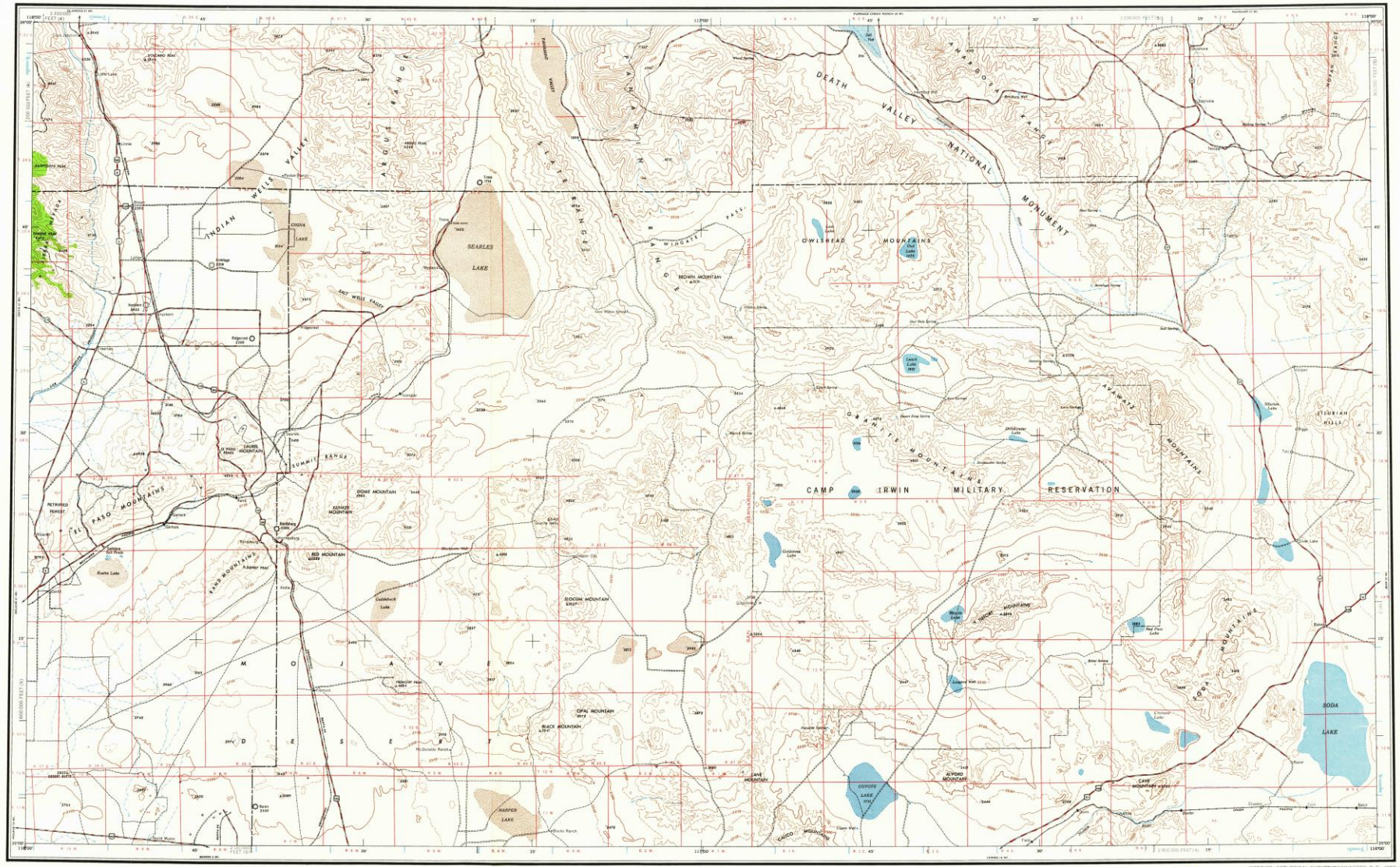
- 1. Download and view the “10B Deserts Lab Solutions”
- 2. Download and view the Lecture “Deserts”
- 3. Download and view the following topographic maps
- a-“Death Valley National Monument and Vicinity
- b-“Badwater, California
- c-“Trona, California”

DOWNLOADS AND LINKS

- **4. Open the maps in PhotoShop or some other imaging program**
- **5. Learn to pan around the map**
- **6. Learn to zoom in and out**


117° W
36°30′
36°30′ N
36°
36° N
Funeral Mts
NV
CA
Death
Valley
Panamint
Valley
Panamint Mts
Black Mts
Shoshone
Argus range
Slate Range
1
2
3b
3a
4
5
6
7
Volcanics
(Miocene - Recent)
Intrusives
(Jurassic - Miocene)
Paleozoic - Mesozoic
(undifferentiated)
Neoproterozoic-
Middle Proterozoic
(undifferentiated)
Mylonitic Neoproterozoic
and Proterozoic
Strike-slip fault
Normal fault
Low-angle
normal fault
Gouge sample for
stable isotopes
Gouge sample for Ar/Ar
Sample locations:
1. Mosaic Canyon
2. South Park Canyon
3a. Badwater-1
3b. Badwater-2
4. Mormon-1
5. Mormon-2
6. Mormon-3
7. Ashford Klippe
0
50 km

TRONA



Prepared under the direction of the Chief of Engineers by the Army Map Service (AMS), Corps of Engineers, Department of the Army, Washington, D.C. Compiled in 1947 from United States Quadrangles 1:62,500 and 1:250,000 Corps of Engineers and U.S. Geological Survey, 1915-1941; County Highway Maps, 1937-1941; Statistical Data to 1946. Woodland partially revised from aerial photography dated 1942-1945. Aerial photography by U.S. Air Force. Road classifications verified by State Highway Department, 1947. Control by U.S. Coast and Geodetic Survey. UTM grid values revised by AMS, 1953.

LEGEND
ROAD DATA 1947

POPULATED PLACES
Small; Large built-up area
500,000 or over — LOS ANGELES
100,000 to 500,000 — OMAHA
25,000 to 100,000 — GALVESTON
5,000 to 25,000 — Laramie
1,000 to 5,000 — Grand Coulee
1,000 or less — Sun Valley

RAILROADS
Standard gauge — Single track; Multiple track
Narrow gauge

BOUNDARIES
International
State
County
Park and reservation
Horizontal control point
Spot elevation in feet

Principal navigation light
Military airfield
Municipal or commercial airfield
Auxiliary airfield
Seaplane base
Seaplane anchorage

Hard surface, heavy duty road, more than two lanes wide
Hard surface, heavy duty road, two lanes wide
Hard surface, medium duty road, more than two lanes wide
Hard surface, medium duty road, two lanes wide
Loose surface, graded and drained road
Dirt road; Trail
Route markers: Federal; State

Woodland
Mine

Falls; Rapids
Intermittent stream
Flowchare marsh; Swamp, marsh
Reef; Limit of danger line
Rocks; awash; Wharf, pier
Flowchare flats

TOWNSHIP OR RANGE LINE
LAND GRANT BOUNDARY

SECTIONIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO BOUNDARIES

California Counties
1. San Bernardino
2. Kern
3. Inyo
4. Tulare

Scale 1:250,000

CONTOUR INTERVAL 500 FEET WITH AUXILIARY CONTOURS AT 250 FEET
DATUM IS MEAN SEA LEVEL

TRANSVERSE MERCATOR PROJECTION
1927 NORTH AMERICAN DATUM

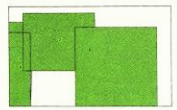
1947 MAGNETIC DECLINATION FOR THIS SHEET VARIED FROM 17°54' EASTERLY FOR THE CENTER OF THE WEST EDGE TO 18°54' EASTERLY FOR THE CENTER OF THE EAST EDGE. MEAN ANNUAL CHANGE IS 0°10' WESTERLY.

FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER 25, COLORADO OR WASHINGTON 25, D. C.

100,000-foot grids based on California coordinate system, zones 4 and 5
10,000-foot Universal Transverse Mercator grid ticks, zone 11, shown in blue

LOCATION DIAGRAM FOR NI 11-2

COVERAGE DIAGRAM



COMPILATION METHODS

Photogrammetric
Photomechanical
Map

A. Large-scale topographic maps, 1945, retaining good B. Medium-scale topographic maps, 1915-35, retaining for aerial photography 1940-41, 1942.

Areas for which additional information is available

INTERIOR - GEOLOGICAL SURVEY, WASHINGTON, D. C.—1960
M-4109

USGS
Historical File
Topographic Division

U.S.G.S.
FILE COPY
TOPOGRAPHIC DIVISION

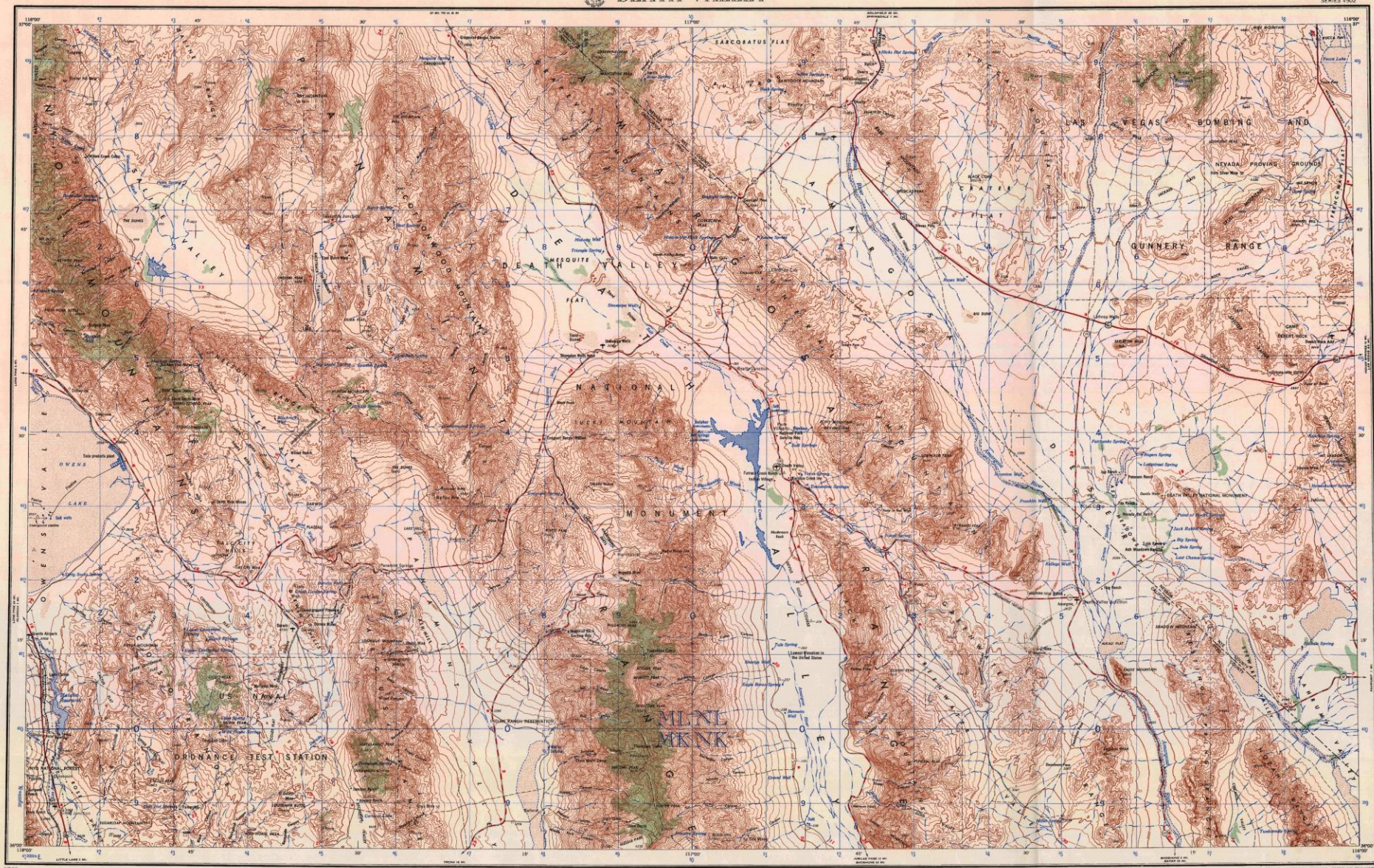
TRONA, CALIFORNIA

WESTERN UNITED STATES 1:250,000

DEATH VALLEY

EDITION 4-AMS

NJ 11-11
SERIES V502



V502
Edition 4-AMS

Prepared by the Army Map Service (CGPM), Corps of Engineers, U.S. Army, Washington, D.C. Compiled in 1956 by the U.S. Coast and Geodetic Survey by photogrammetric methods and from United States coastmapping 1:50,000 and 1:62,500, USGS and USCE, 1951-1954. Planimetric detail revised by photo-planimetric methods. Photography flown prior to 1954. Map partially revised in 1961 by the U.S. Geological Survey from USGS quadrangles, 1:62,500, 1950 - 58; USC&GS Sectional Aeronautical Chart, 1:500,000 Mt. Whitney, 1960; and California and Nevada Department of Highways maps, 1961. Horizontal and vertical control by USGS, USC&GS, USCE, and City of Los Angeles. Map not field checked.

LEGEND
ROAD DATA 1961
Figures in red denote approximate distances in miles between stars

POPULATED PLACES
Over 500,000 — LOS ANGELES
100,000 to 500,000 — OMAHA
25,000 to 100,000 — GALVESTON
5,000 to 25,000 — Laramie
1,000 to 5,000 — Grand Coulee
Less than 1,000 — Sun Valley

RAILROADS
Standard gauge
Narrow gauge

BOUNDARIES
International
State
County
Park or reservation

ROADS
Hard surface, heavy duty
More than two lanes wide — 4 LANES OR LARGER
Two lanes wide, Federal route marker — 2 LANES OR LARGER
Hard surface, medium duty
More than two lanes wide
Two lanes wide, State route marker
Improved light duty
Unimproved dirt
Trail

Landmarks: School; Church; Other
Landplane airport
Landing area
Dry lake
Orchard
Woods-brushwood

Horizontal control point
Spot elevation in feet
Marsh or swamp
Intermittent or dry stream
Power line

Scale 1:250,000

5 0 5 10 15 20 Statute Miles
5 0 5 10 15 20 25 30 Kilometers
5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS

TRANSVERSE MERCATOR PROJECTION

BLUE NUMBERED LINES INDICATE THE 10,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 11

1960 MAGNETIC DECLINATION FROM TRUE NORTH FOR THIS SHEET VARIES FROM 16° 1/2 DEG WEST EASTERLY FOR THE CENTER OF THE WEST EDGE TO 16° 1/2 DEG WEST EASTERLY FOR THE CENTER OF THE EAST EDGE.

REFER CORRECTIONS TO THIS MAP TO COMMANDING OFFICER, ARMY MAP SERVICE, WASHINGTON, D.C.

LOCATION DIAGRAM FOR NJ 11-11

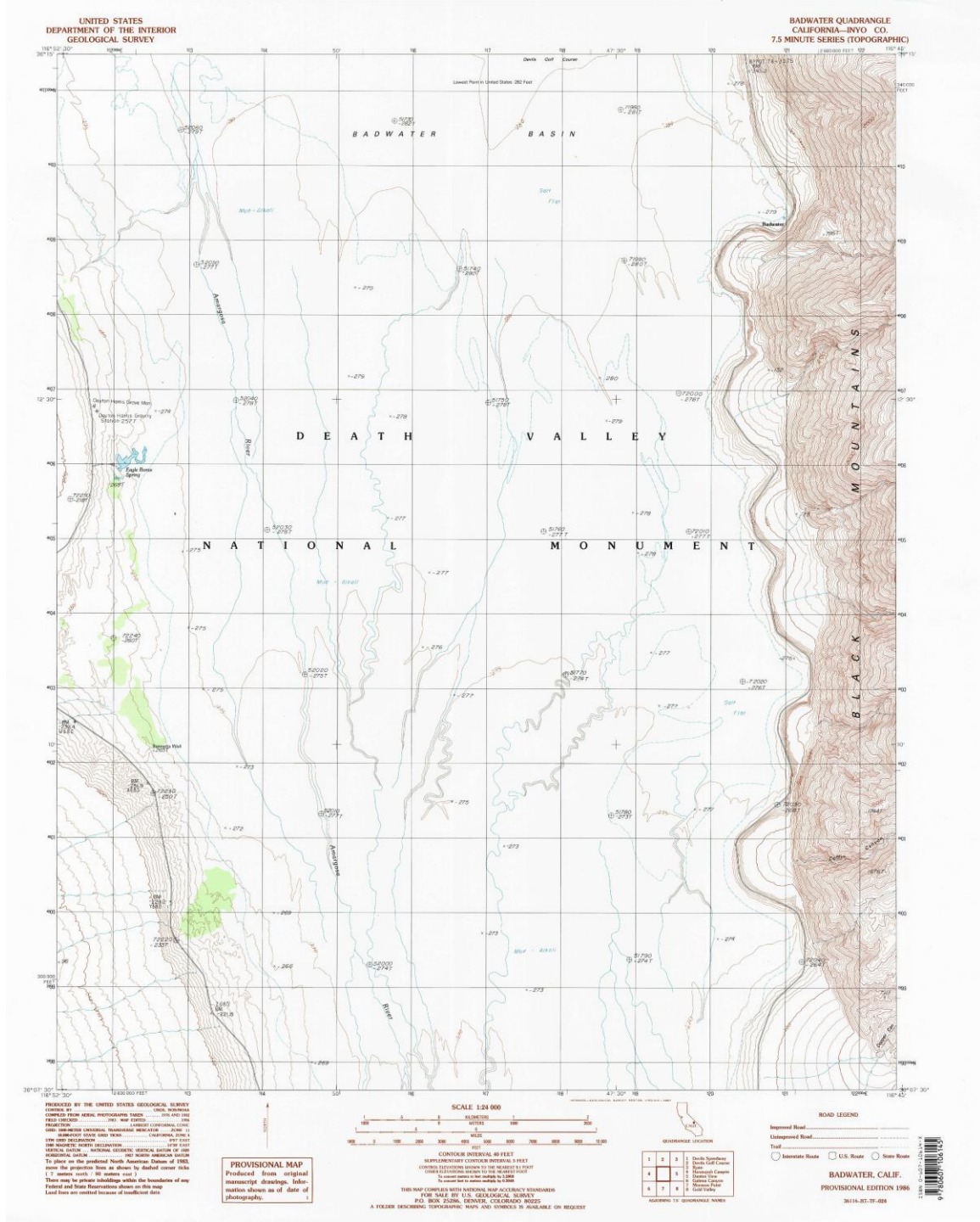
RELIABILITY DIAGRAM

SX 1-65 PRINTED BY ARMY MAP SERVICE, CORPS OF ENGINEERS, WASHINGTON, D.C.

U.S. GEOLOGICAL SURVEY
APR-7 1965
LIBRARY

STOCK NO. V502XNJ1111

DEATH VALLEY, CALIFORNIA-NEVADA
United States. Topo: 1:250,000.
Sheet Death Valley, 1965. cop.1.

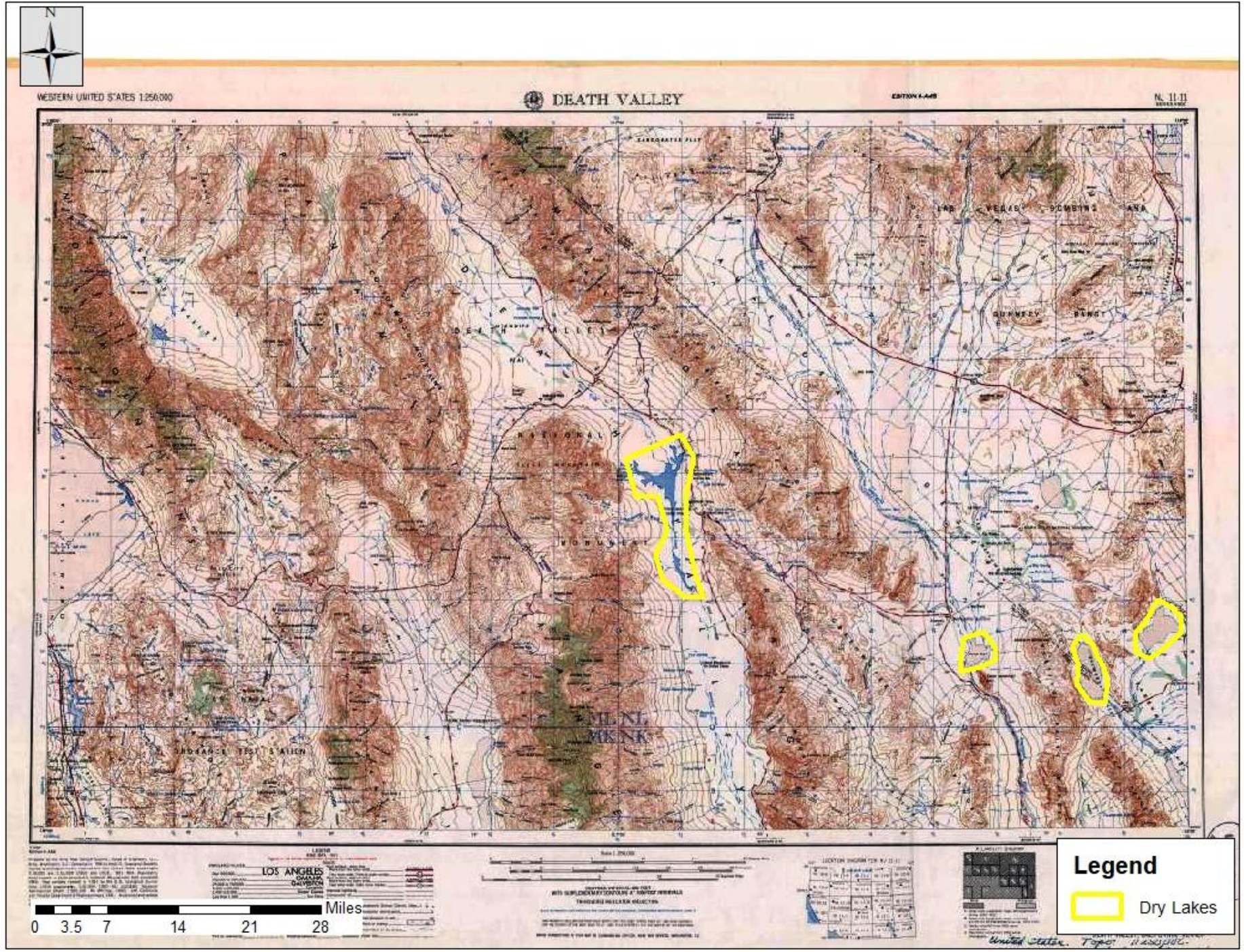

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
BADWATER QUADRANGLE
CALIFORNIA—INYO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
BADWATER BASIN
DEATH VALLEY
NATIONAL MONUMENT
BLACK MOUNTAINS
Amargosa River
Badwater
Salt Flat
Mud - Alkali
Eagle Borax Spring
Dayton Harris Grove Mon
Dayton Harris Gravity Station 2527
Devils Golf Course
Lowest Point in United States 282 Feet
SCALE 1:24 000
CONTOUR INTERVAL 40 FEET
SUPPLEMENTARY CONTOUR INTERVAL 5 FEET
PROVISIONAL MAP
Produced from original manuscript drawings. Information shown as of date of photography.
THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY
P.O. BOX 25286, DENVER, COLORADO 80225
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST
QUADRANGLE LOCATION
ROAD LEGEND
BADWATER, CALIF.
PROVISIONAL EDITION 1986

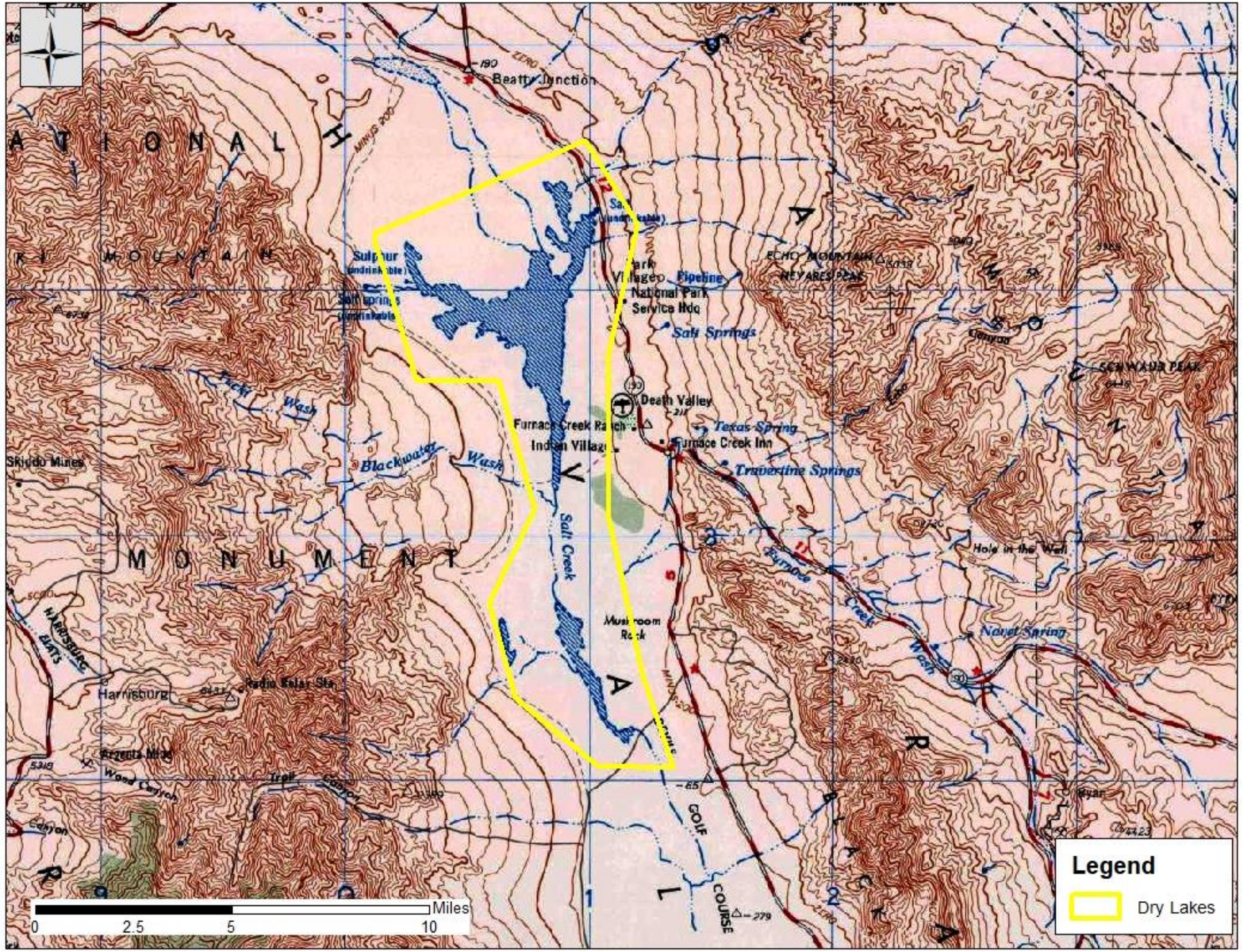
EXERCISE A. Death Valley National Monument and Vicinity

- **1-What are the dry lake beds on this map?**
- **2-Give the location (by name) of an aeolian depositional feature.**
- **3-What is the depositional feature formed along the SW flank of the Amargosa Mountains (hint, look at the contour lines just east of Beatty Junction).**
- **4-What type of fault separates Death Valley from the Amargosa Mountains?**
- **5-Why are playas light colored (hint, think where the water goes once it gets into the Badwater Basin)?**

EXERCISE A-1. Death Valley National Monument and Vicinity

- **1-What are the dry lake beds on this map?**


WESTERN UNITED STATES 1:250,000
DEATH VALLEY
Miles
0 3.5 7 14 21 28
Legend
Dry Lakes

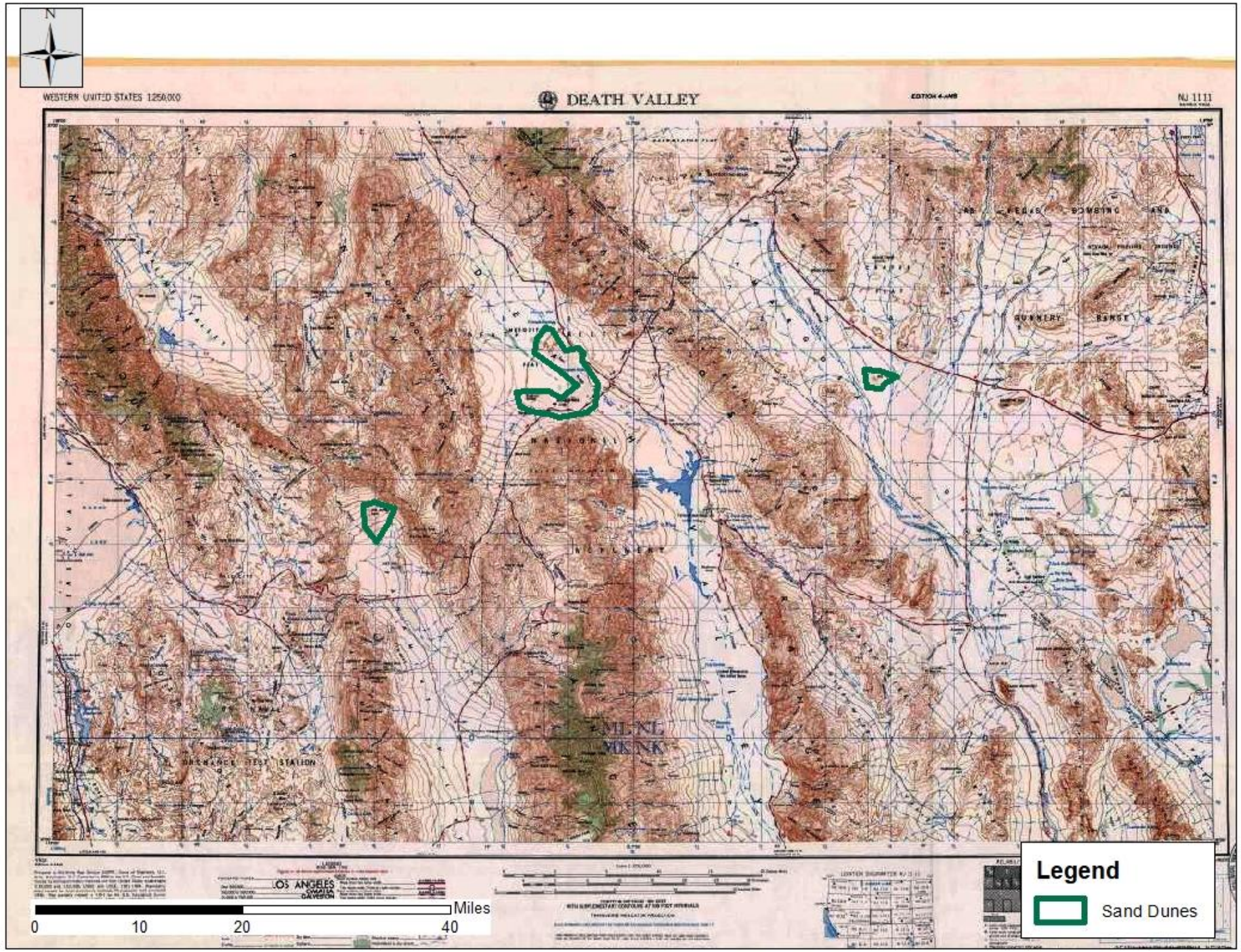

Beatty Junction
Sulphur
Salt Springs
Pipeline
National Park Service Hdq
Salt Springs
Death Valley
Texas Spring
Furnace Creek Inn
Travertine Springs
Furnace Creek Ranch
Indian Village
Blackwater Wash
Salt Creek
Skiddo Mines
Harrisburg
Radio Relay Sta
Mushroom Rock
Furnace Creek Wash
Navel Spring
Hole in the Wall
Ryan
GOLF COURSE
Legend
Dry Lakes
Miles
0
2.5
5
10

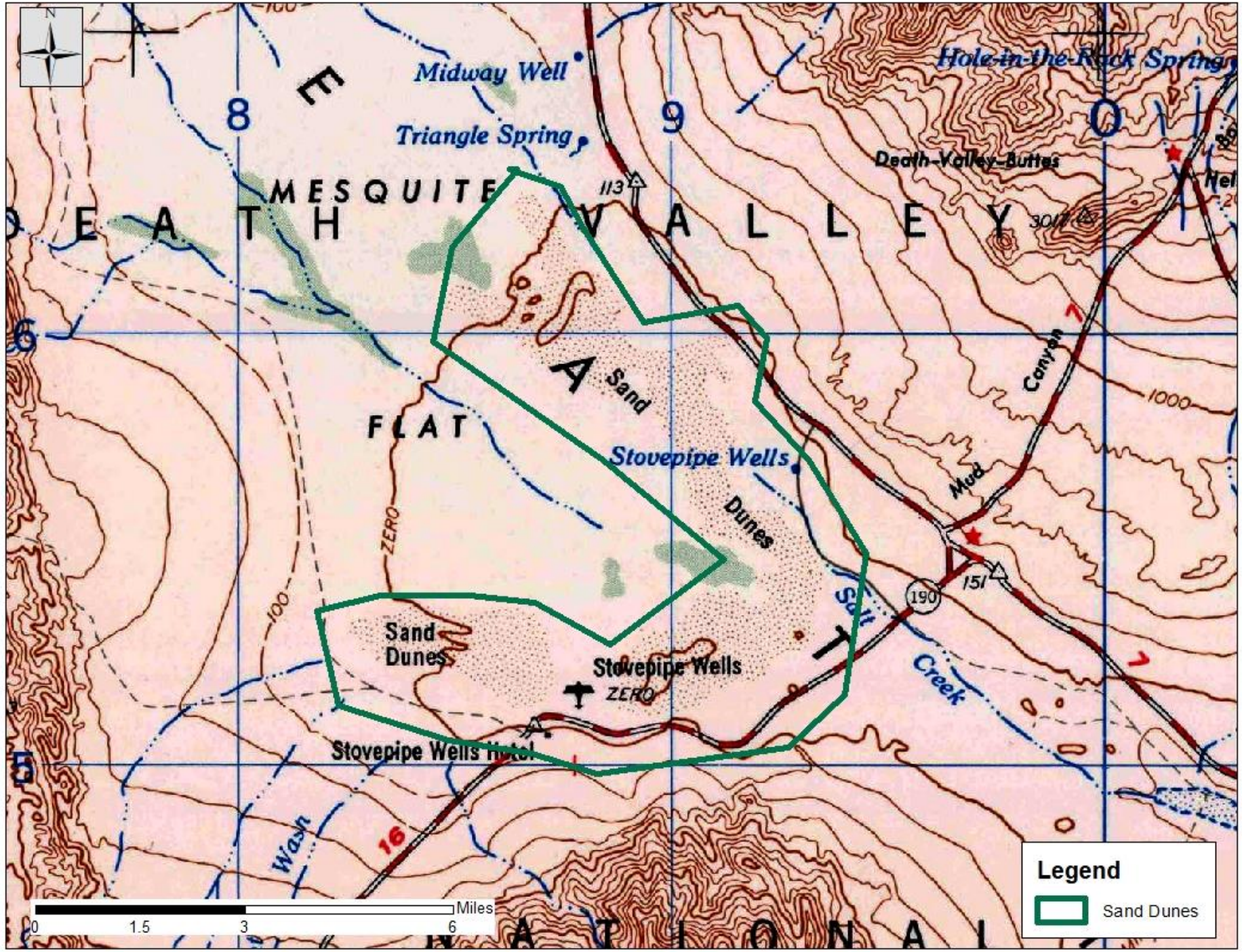
EXERCISE A-1. Death Valley National Monument and Vicinity SOLUTION

- **1-What are the dry lake beds on this map?**
- **A2. Playas**

EXERCISE A-2. Death Valley National Monument and Vicinity

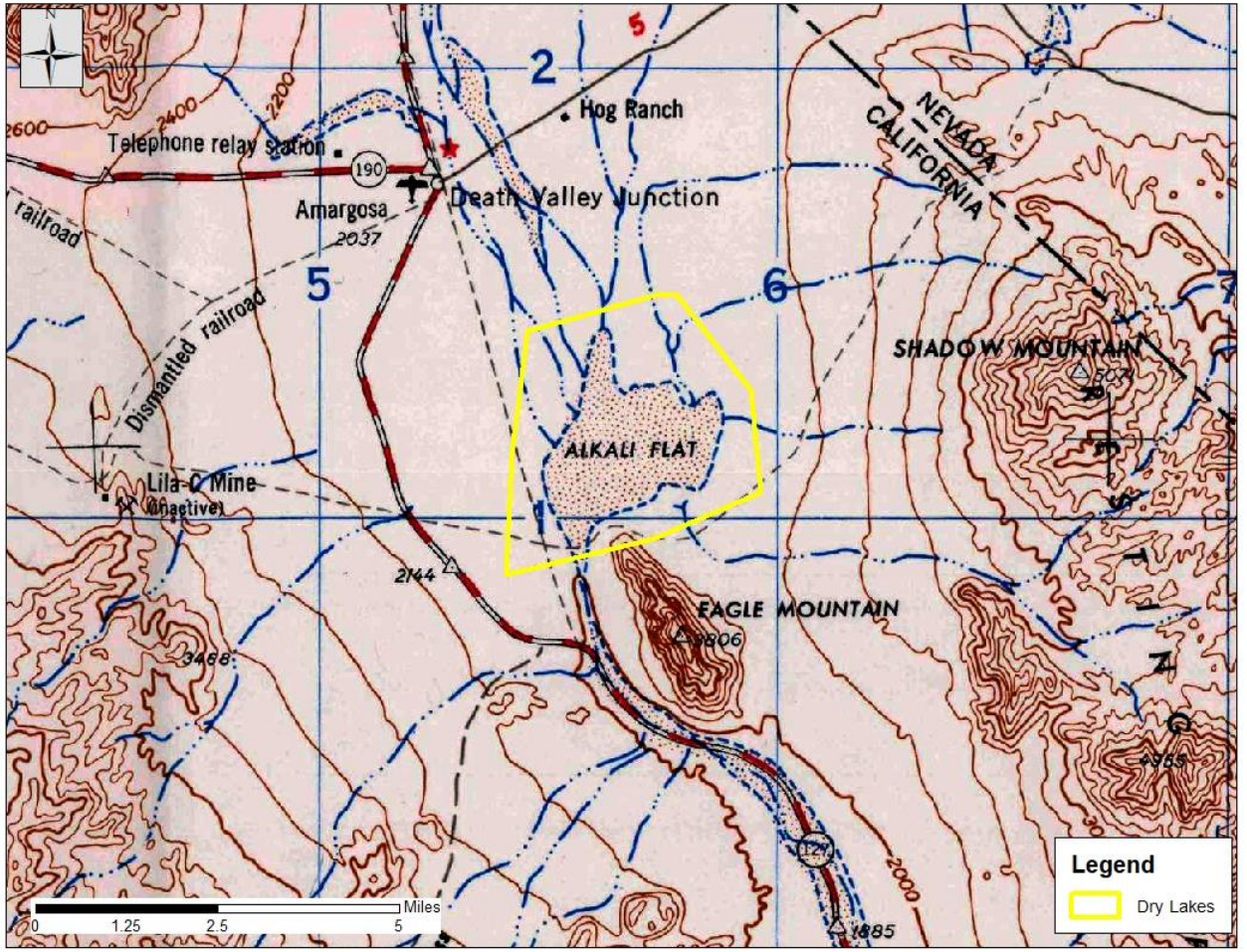
- **2-Give the location (by name) of an aeolian depositional feature.**


N
WESTERN UNITED STATES 1:250,000
DEATH VALLEY
NJ 1111
Miles
0
10
20
40
Legend
Sand Dunes


Midway Well
Triangle Spring
Hole-in-the-Rock Spring
Death Valley Buttes
MESQUITE
DEATH VALLEY
FLAT
Sand
Dunes
Stovepipe Wells
ZERO
Stovepipe Wells Hotel
Mud Canyon
Salt Creek
Wash
113
151
190
Legend
Sand Dunes
Miles
0
1.5
3
6

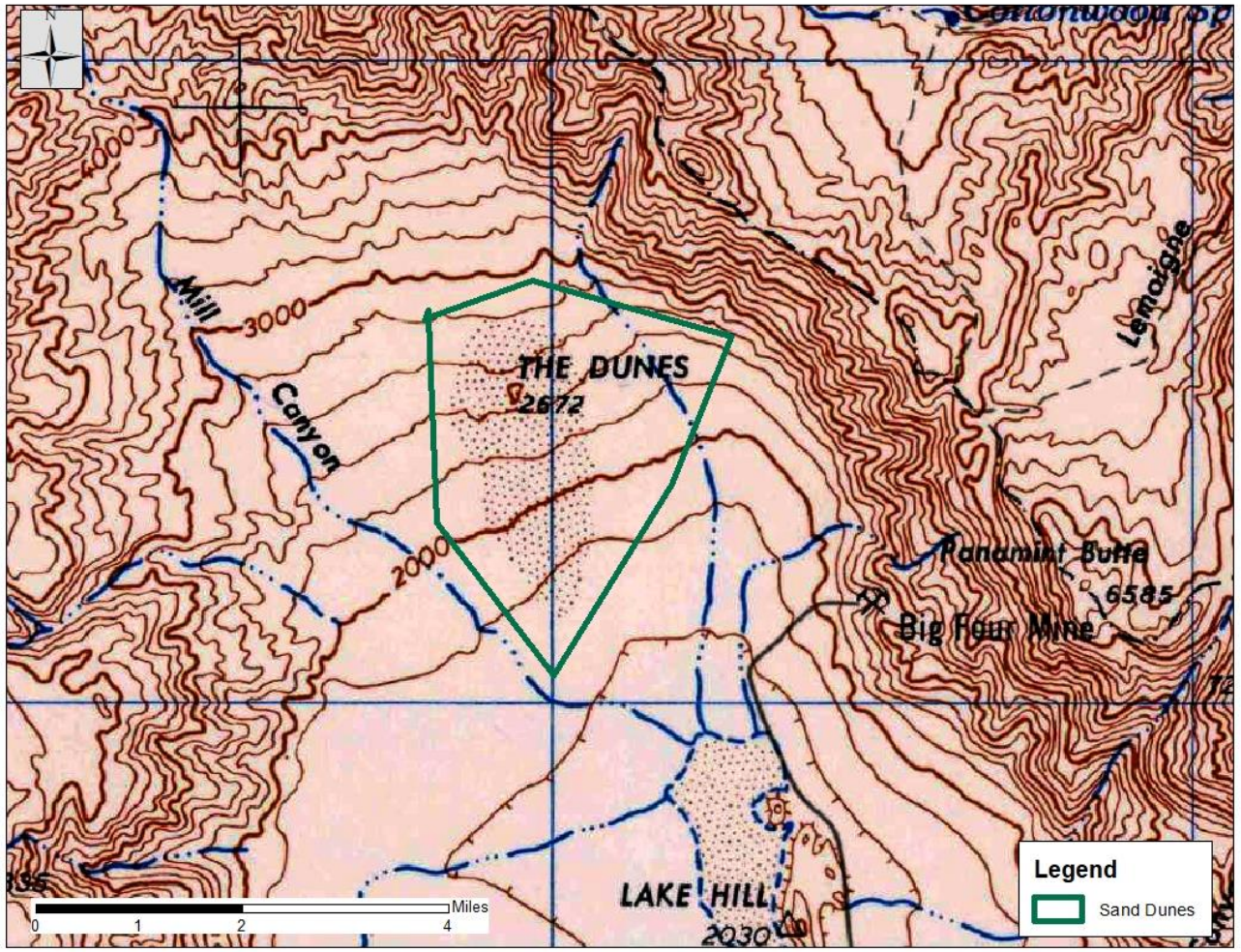
EXERCISE A-2. Death Valley National Monument and Vicinity SOLUTION

- **2-Give the location (by name) of an aeolian depositional feature.**
- **A2. Alkali Flat**



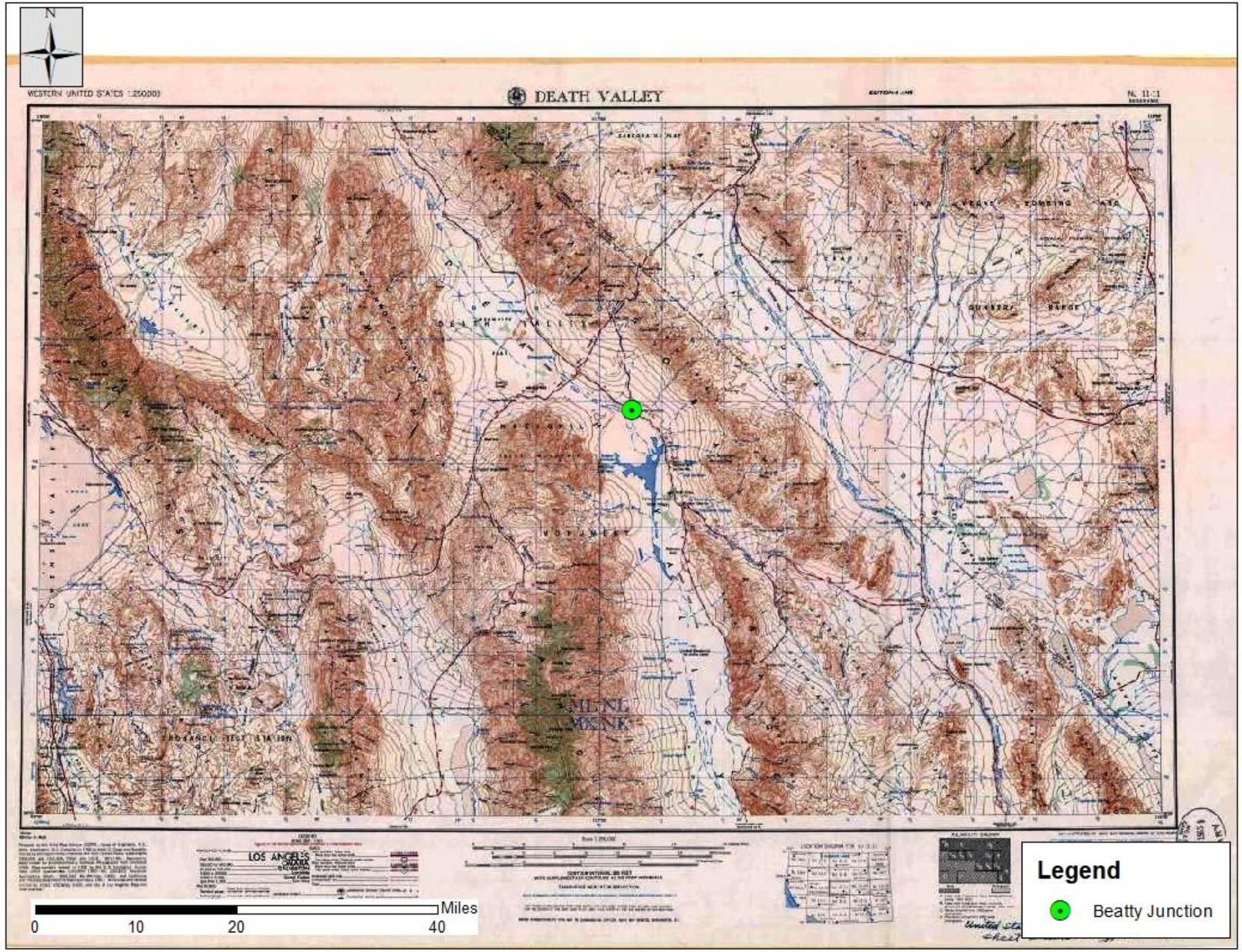
EXERCISE A-2. Death Valley National Monument and Vicinity SOLUTION

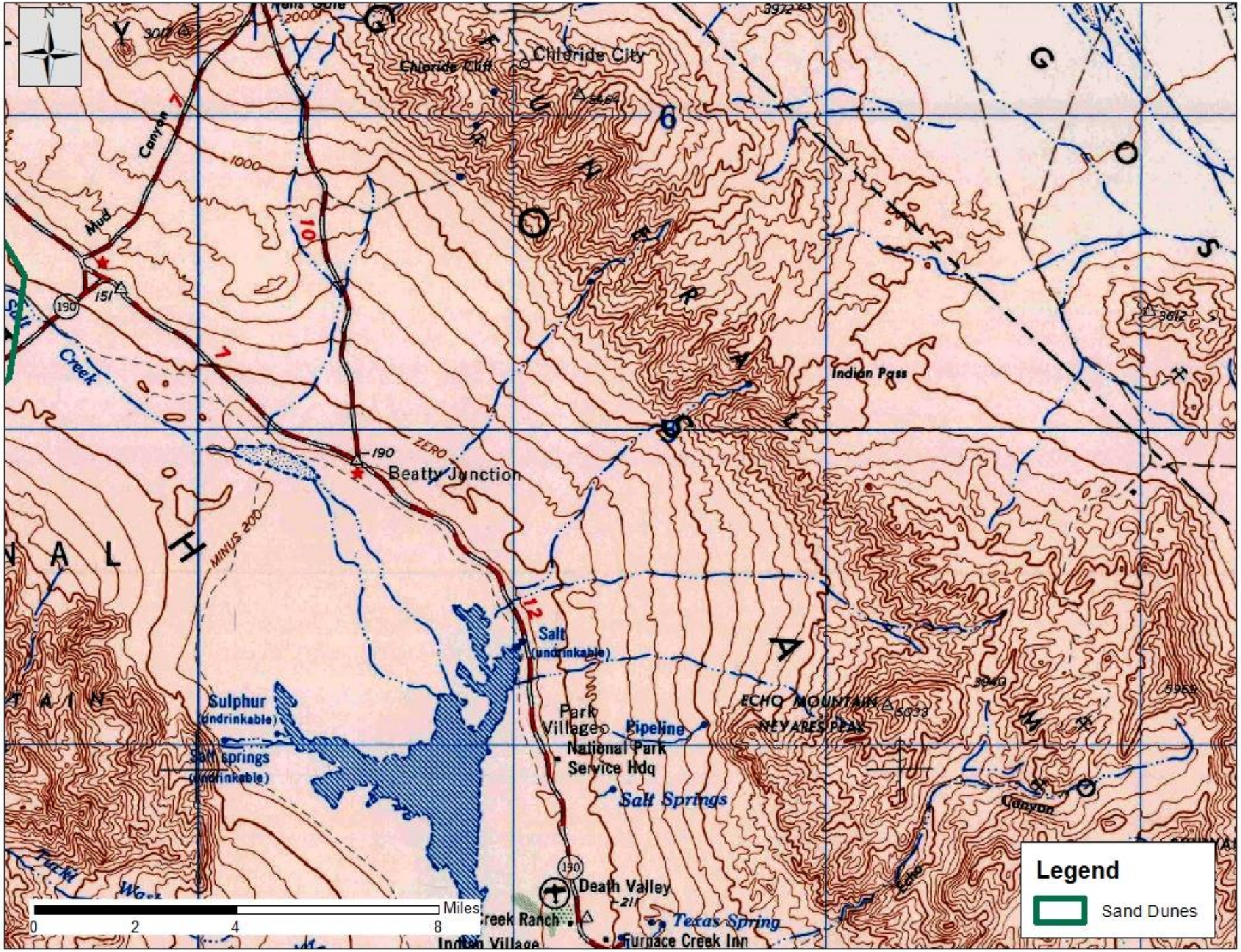
- **2-Give the location (by name) of an aeolian depositional feature.**
- **A2. The Dunes**

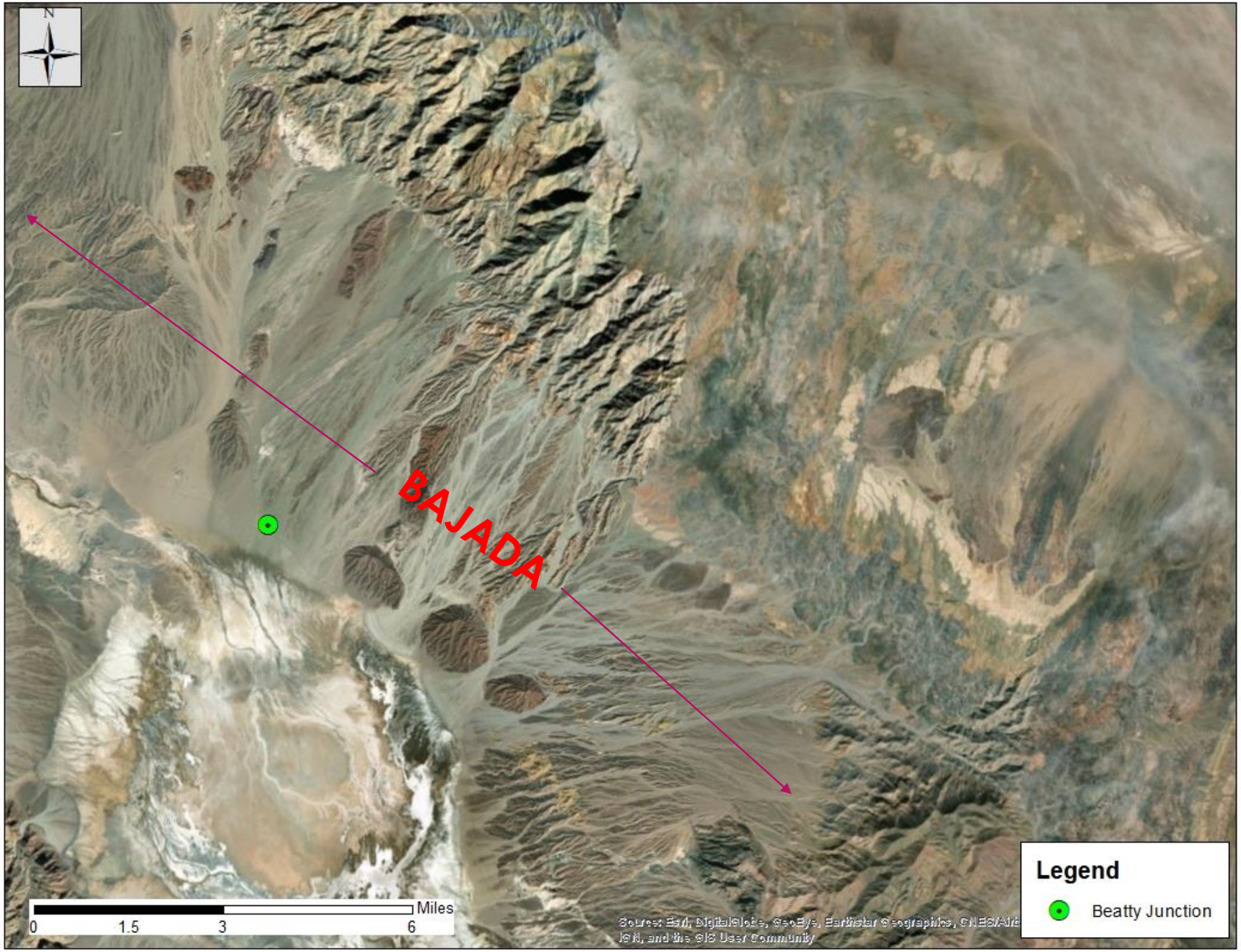


EXERCISE A-3. Death Valley National Monument and Vicinity

- **3-What is the depositional feature formed along the SW flank of the Amargosa Mountains (hint, look at the contour lines just east of Beatty Junction).**

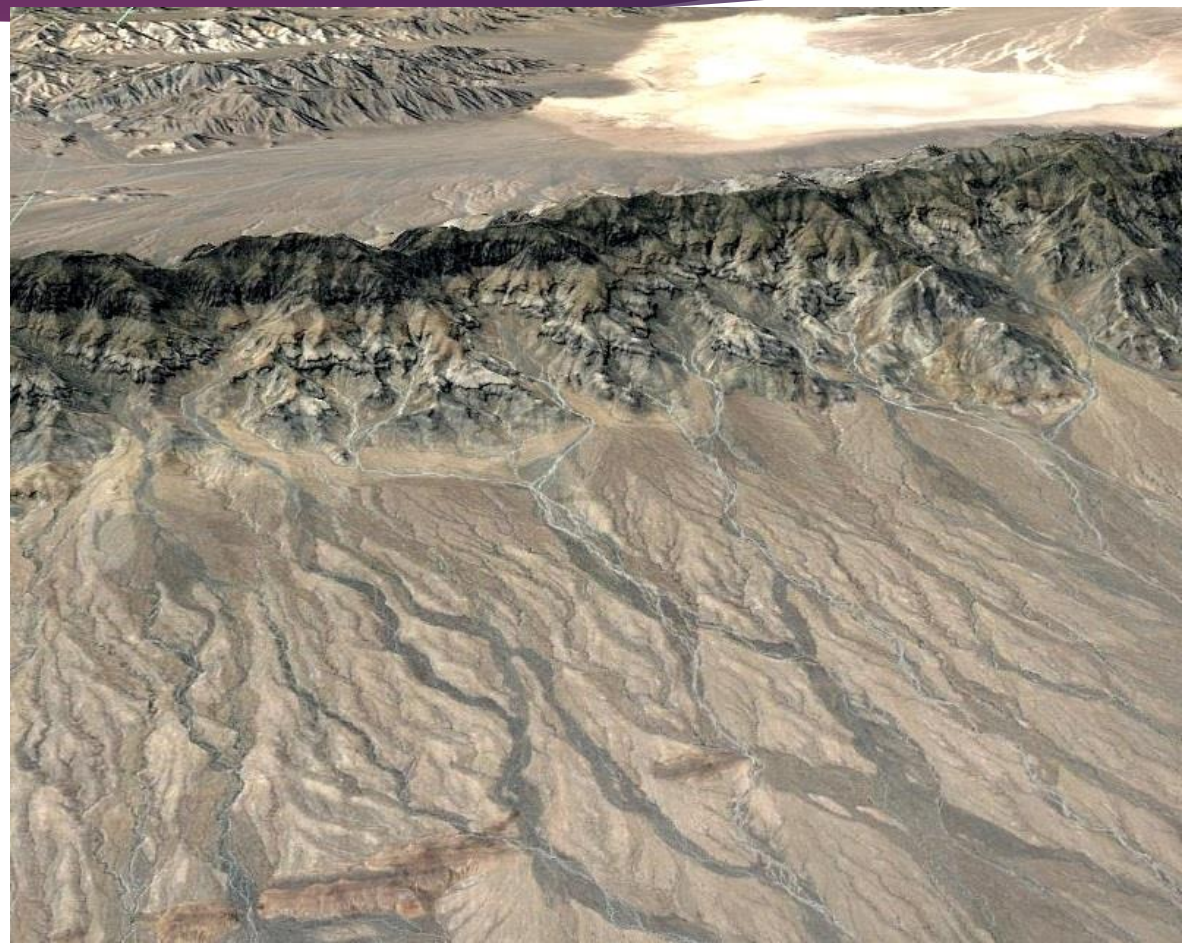

N
WESTERN UNITED STATES 1:250000
DEATH VALLEY
Miles
0
10
20
40
Legend
Beatty Junction


Chloride City
Chloride Cliff
Mud Canyon
Indian Pass
Beatty Junction
ZERO
MINUS 200
Salt
(undrinkable)
Sulphur
(undrinkable)
Salt springs
(undrinkable)
Park Village
Pipeline
National Park Service Hdq
Salt Springs
ECHO MOUNTAIN
NEVARES PEAK
Death Valley
Furnace Creek Inn
Texas Spring
Miles
0
2
4
8
Legend
Sand Dunes


N
BAJADA
Miles
0
1.5
3
6
Legend
Beatty Junction

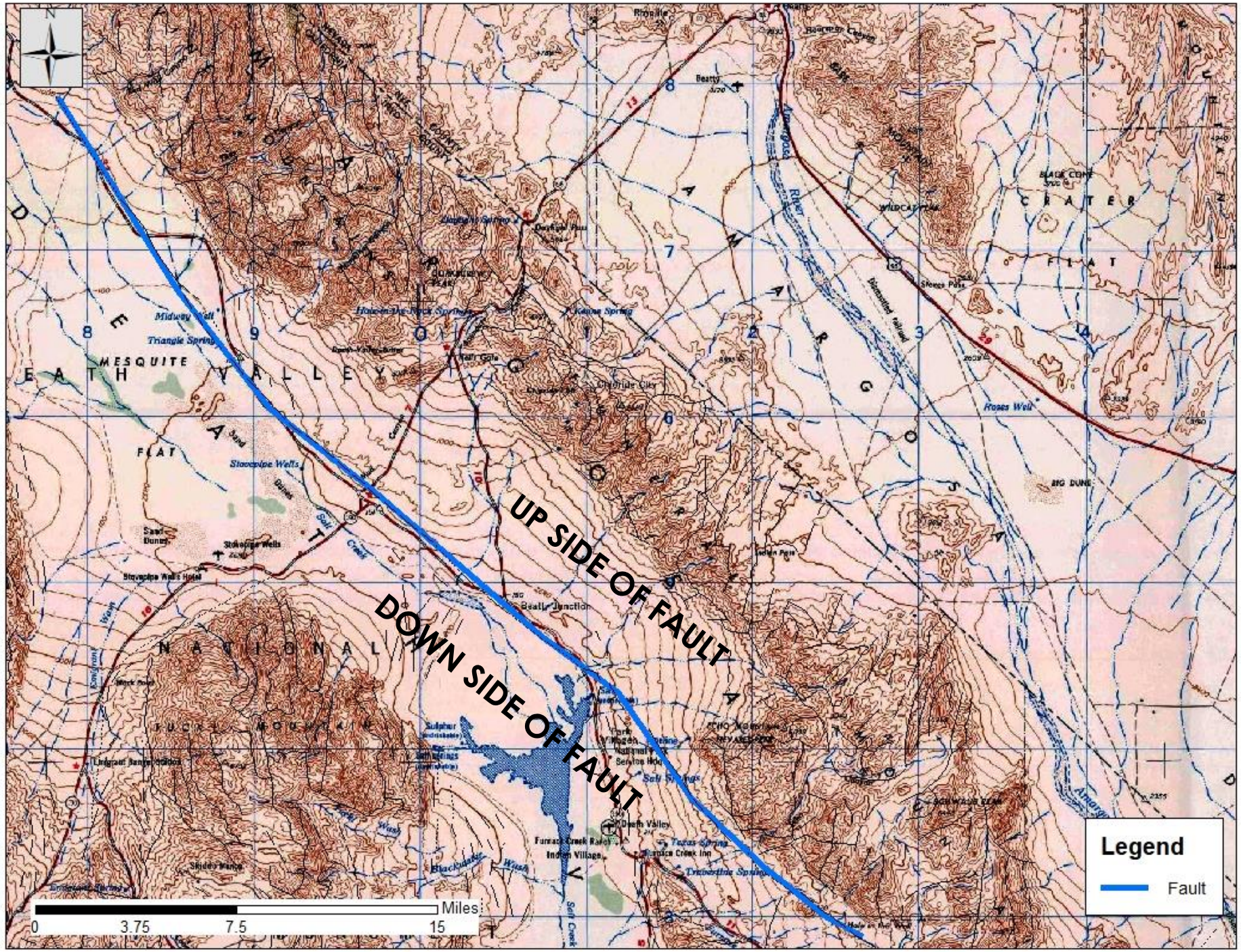
EXERCISE A-3. Death Valley National Monument and Vicinity SOLUTION

- **3-What is the depositional feature formed along the SW flank of the Amargosa Mountains (hint, look at the contour lines just east of Beatty Junction).**
- **3A. Bajada (coalescence of alluvial fans)**



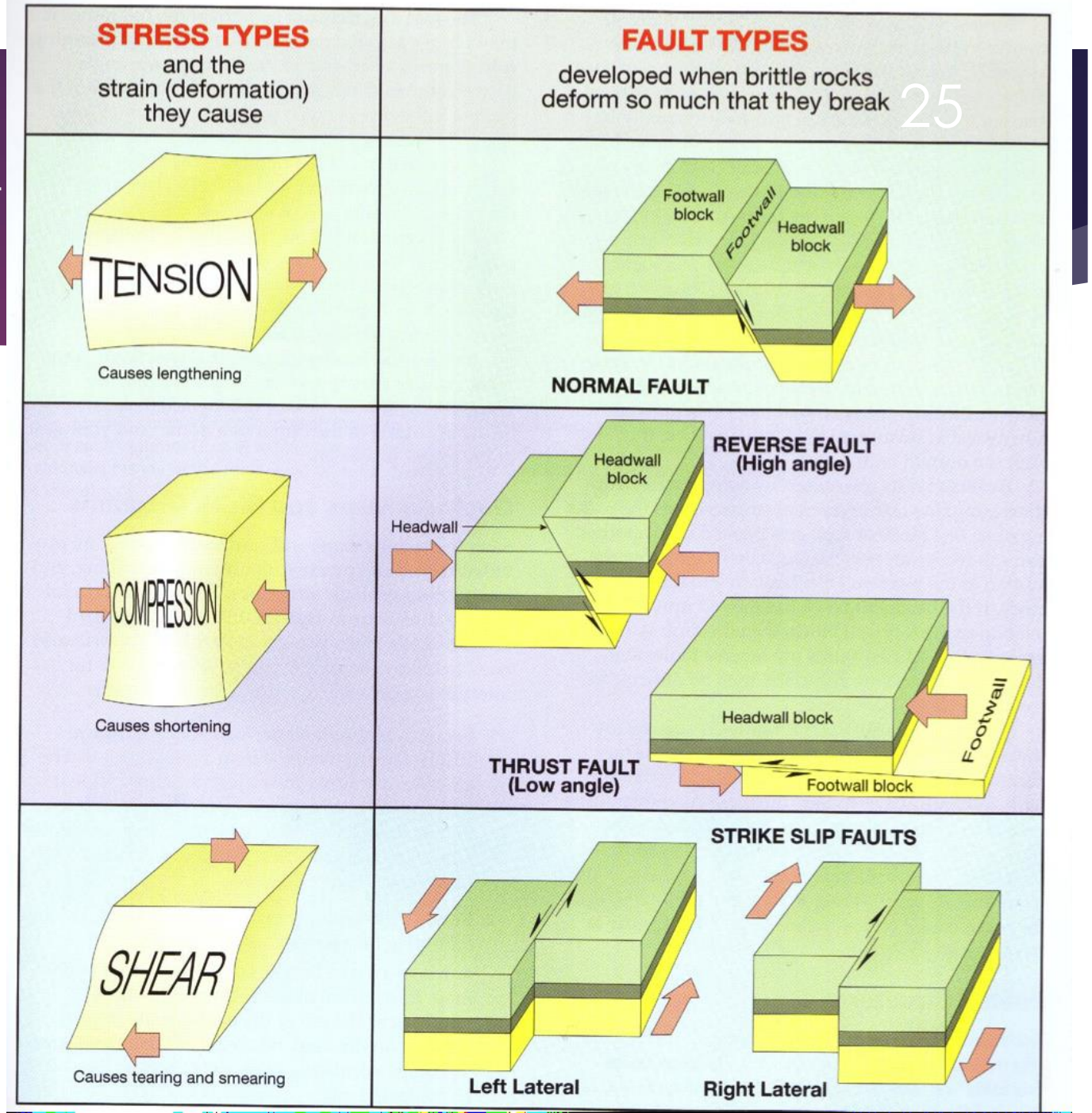
EXERCISE A-4. Death Valley National Monument and Vicinity

- **4-What type of fault separates Death Valley from the Amargosa Mountains?**


UP SIDE OF FAULT
DOWN SIDE OF FAULT
Legend
Fault
Miles
0
3.75
7.5
15
DEATH VALLEY
NATIONAL
MESQUITE
FLAT
SAND DUNES
Stovepipe Wells
Beatty Junction
Furnace Creek Ranch
Indian Village
Death Valley
Salt Creek
Amargosa River
Panamint Range
Funeral Mountains
Black Mountains
Grapevine Mountains
Owlshead Mountains
Nevada
California

EXERCISE A-4. Death Valley National Monument and Vicinity SOLUTION

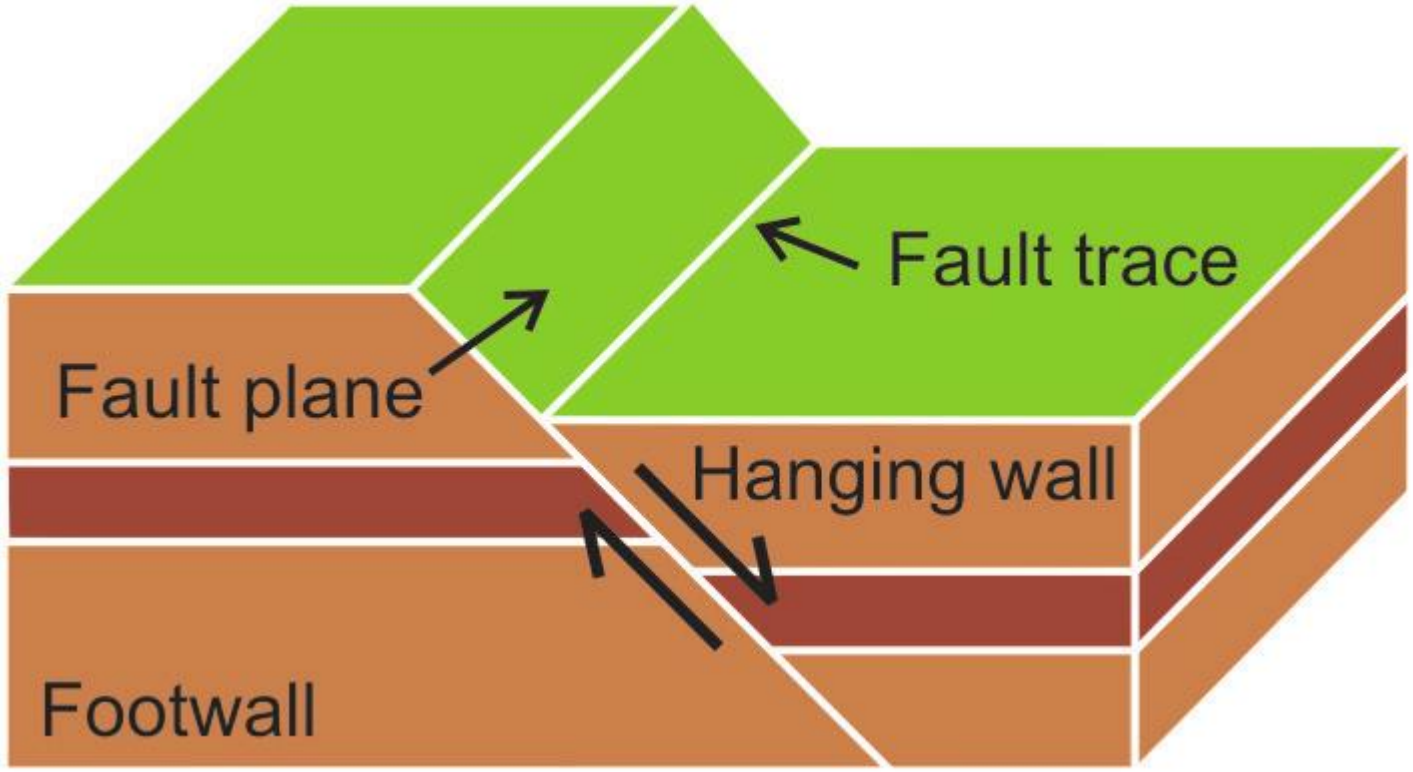
- **4-What type of fault separates Death Valley from the Amargosa Mountains?**

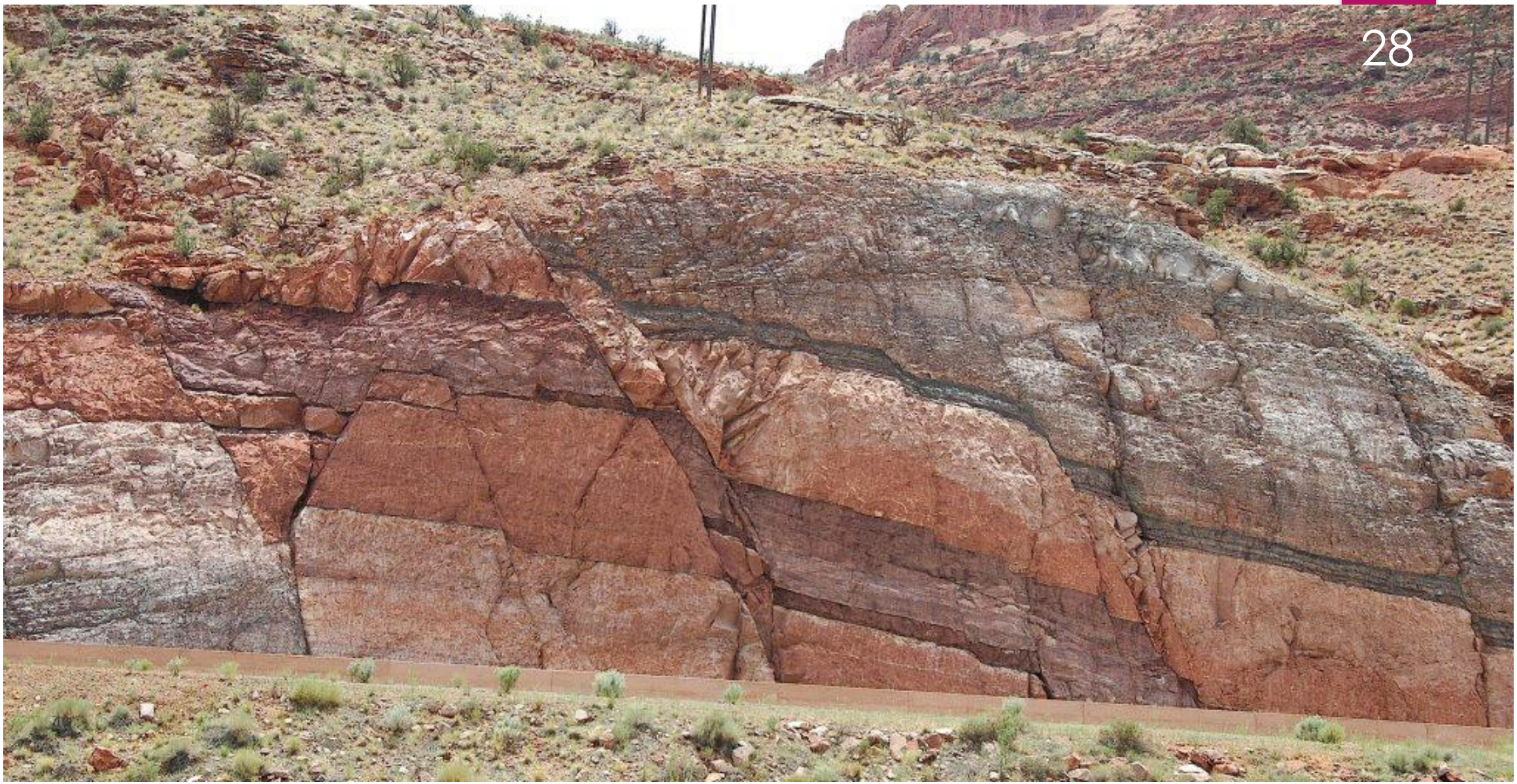


N
Legend
Fault
Miles
0
3.75
7.5
15
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

EXERCISE A-4. Death Valley National Monument and Vicinity SOLUTION

- **4-What type of fault separates Death Valley from the Amargosa Mountains?**
- **A4. A Normal Fault**





EXERCISE A-5. Death Valley National Monument and Vicinity

- **5-Why are playas light colored (hint, think where the water goes once it gets into the Badwater Basin)?**

N
Legend
Playa
0
1.75
3.5
7
Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

EXERCISE A-5. Death Valley National Monument and Vicinity SOLUTION

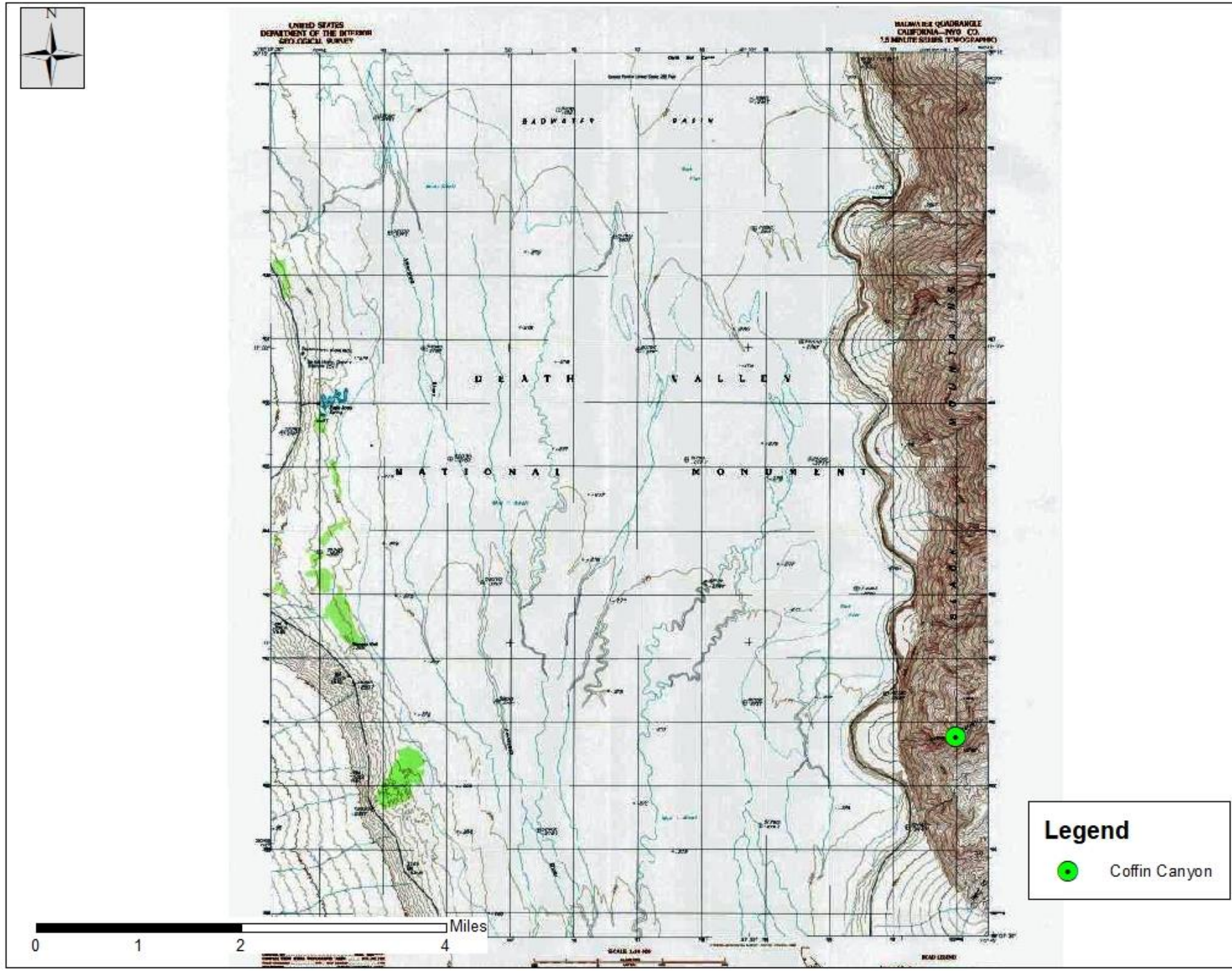
- **5-Why are playas light colored (hint, think where the water goes once it gets into the Badwater Basin)?**
- **A5. Light-colored evaporite minerals**

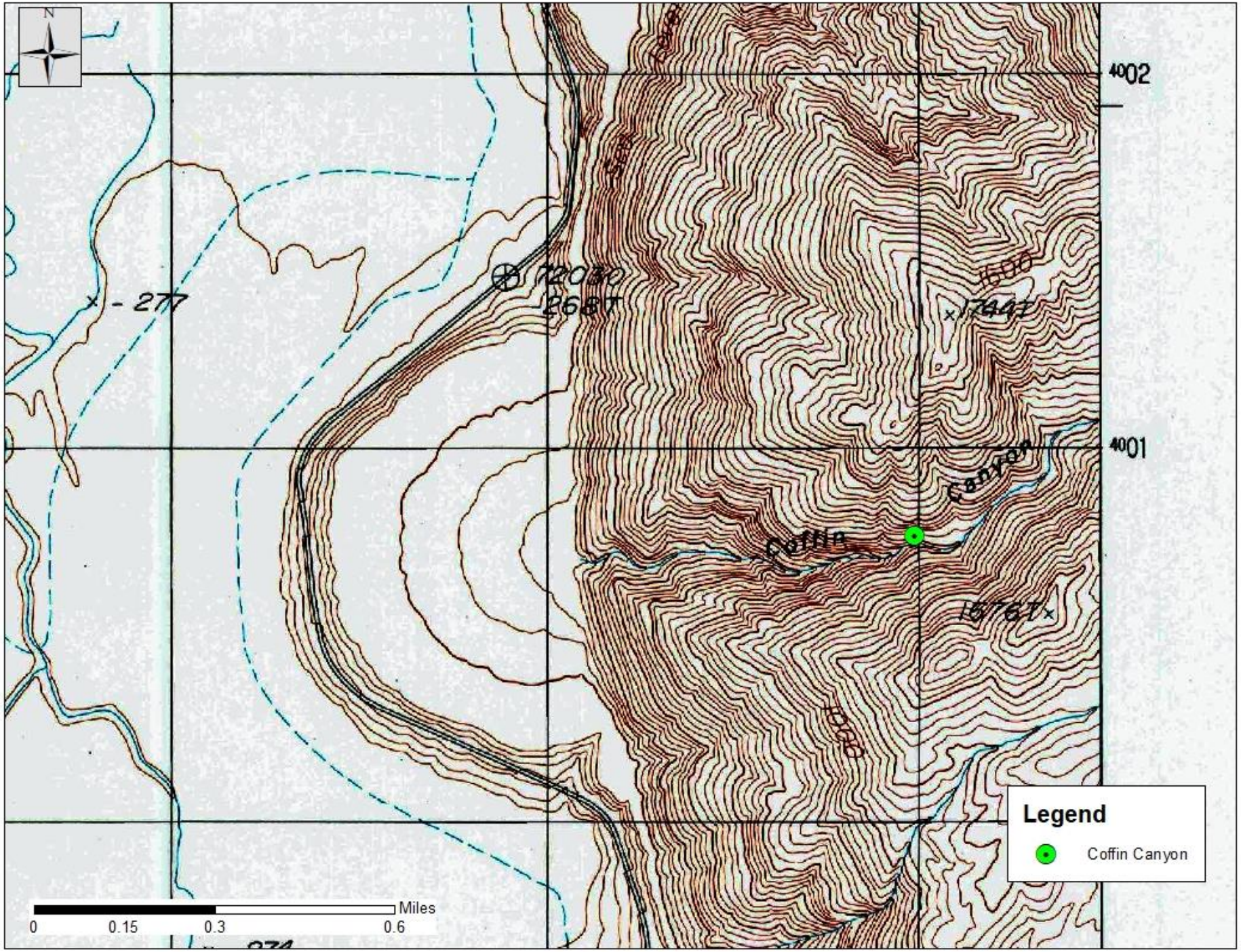
EXERCISE B. Badwater, California 7.5' Quadrangle Map

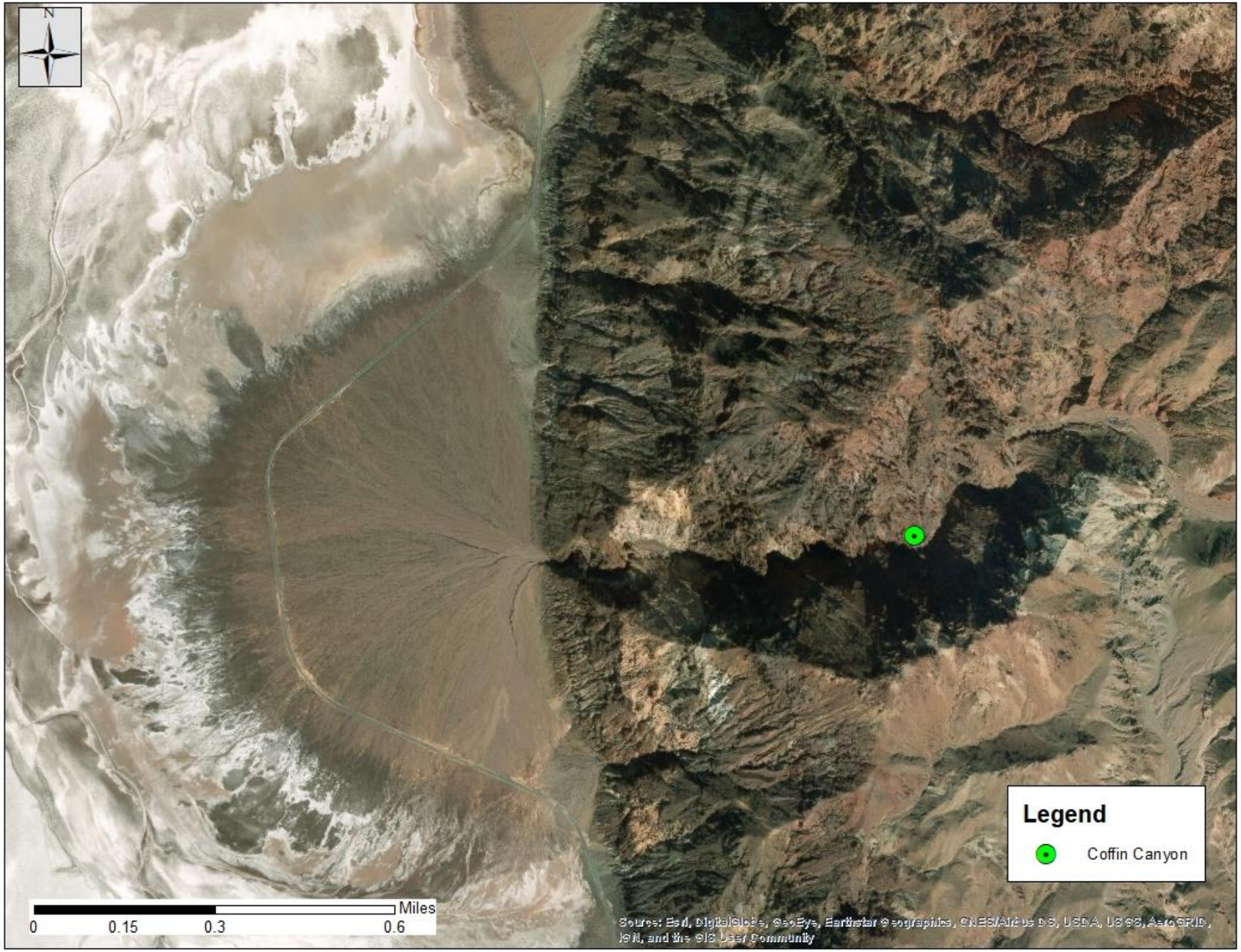
- **1-What feature has formed to the west of Coffin Canyon?**
- **2-Where are coarsest and finest grains on this feature?**
- **3-What has formed west of the Black Mountains?**
- **4-What is the relief of this map in feet (show your work)?**
- **5-Which direction does the Amargosa River flow?**

EXERCISE B-1. Badwater, California 7.5' Quadrangle Map

- **1-What feature has formed to the west of Coffin Canyon?**


N
BADWATER BASIN
DEATH VALLEY
NATIONAL MONUMENT
Legend
Coffin Canyon
Miles
0
1
2
4


N
4002
4001
Coffin
Legend
Coffin Canyon
Miles
0
0.15
0.3
0.6

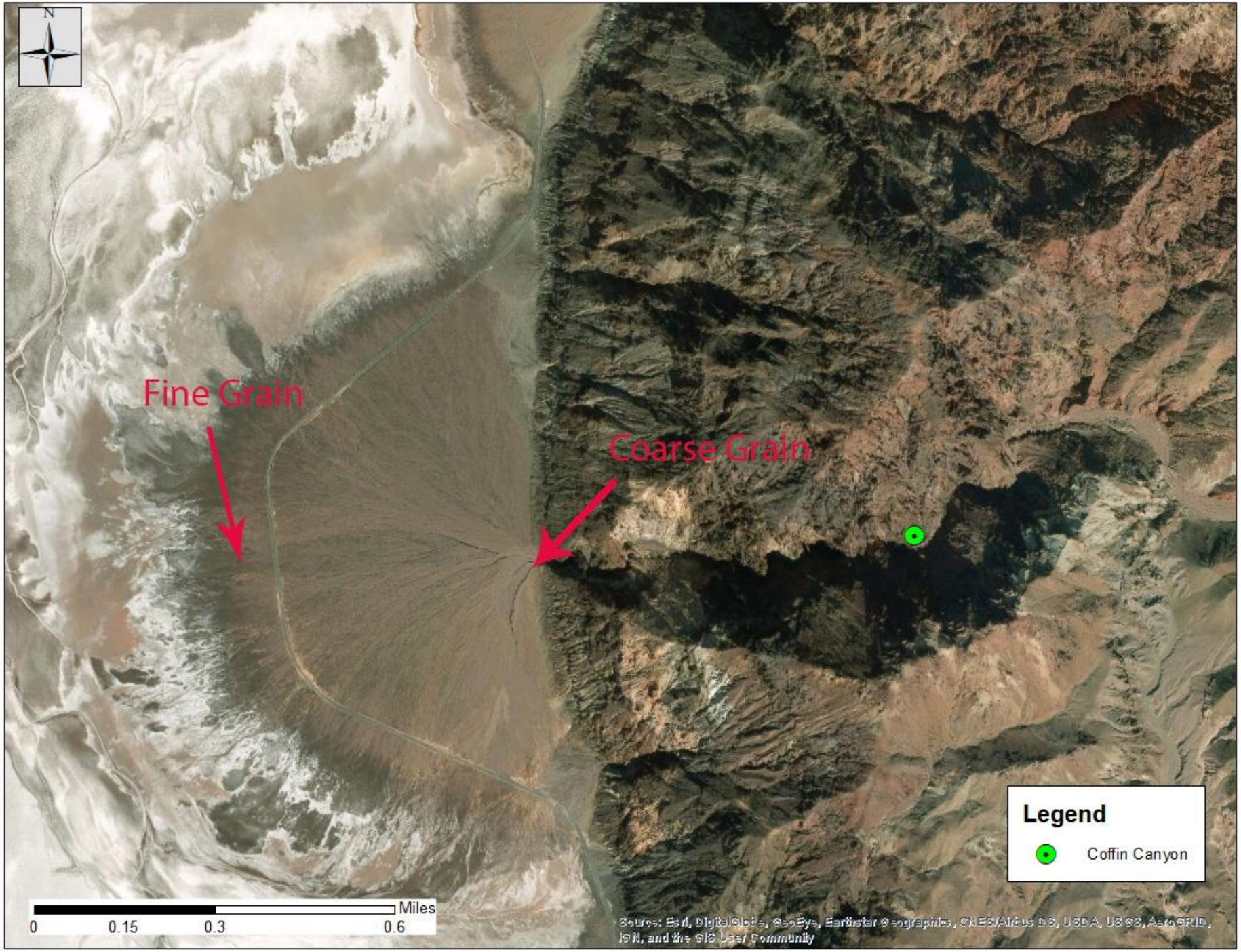

N
Legend
Coffin Canyon
Miles
0
0.15
0.3
0.6
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

EXERCISE B-1. Badwater, California 7.5' Quadrangle Map SOLUTION

- **1-What feature has formed to the west of Coffin Canyon?**
- **B1. Alluvial Fan**

EXERCISE B-2. Badwater, California 7.5' Quadrangle Map

- **2-Where are coarsest and finest grains on this feature?**

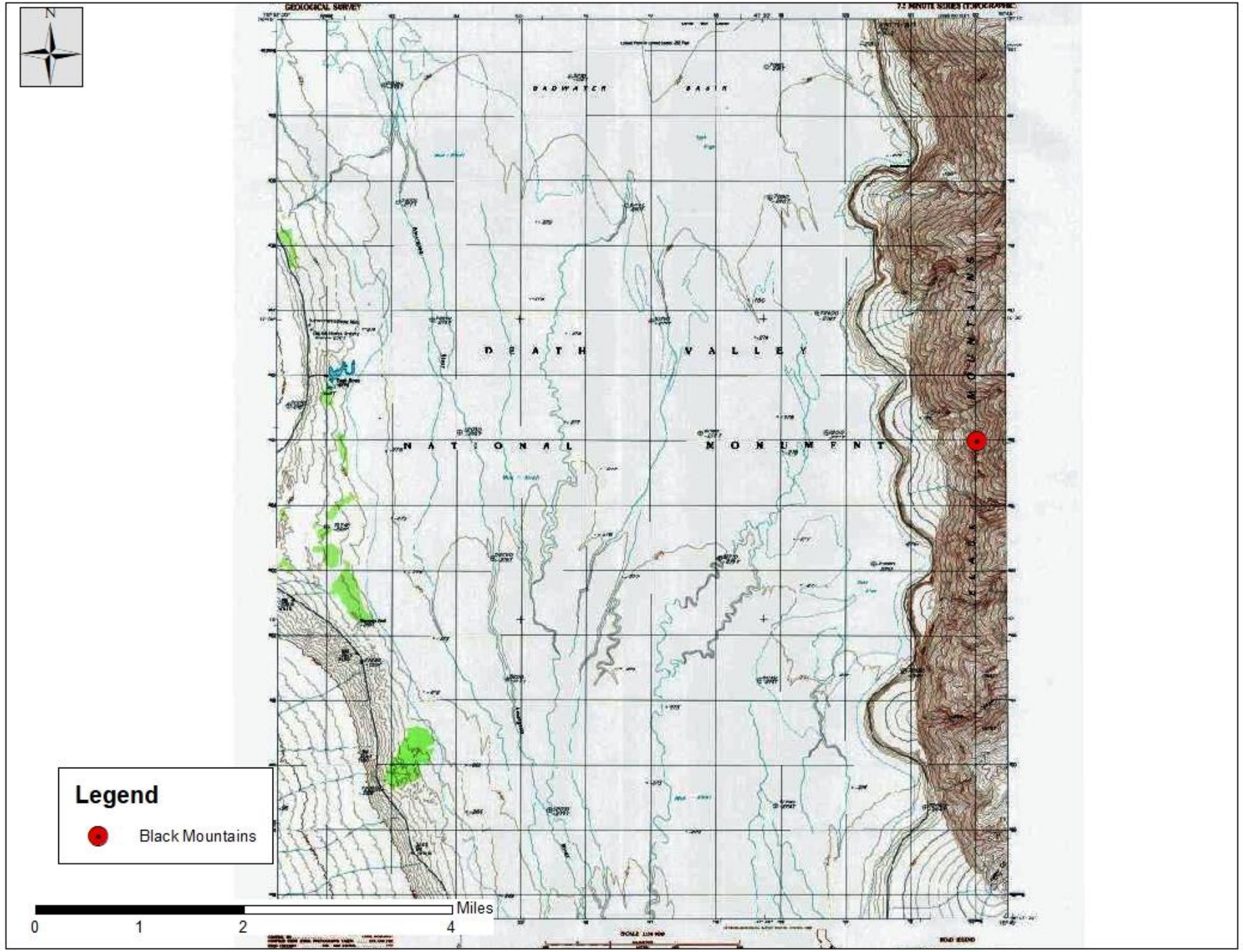

N
Fine Grain
Coarse Grain
Legend
Coffin Canyon
Miles
0
0.15
0.3
0.6
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

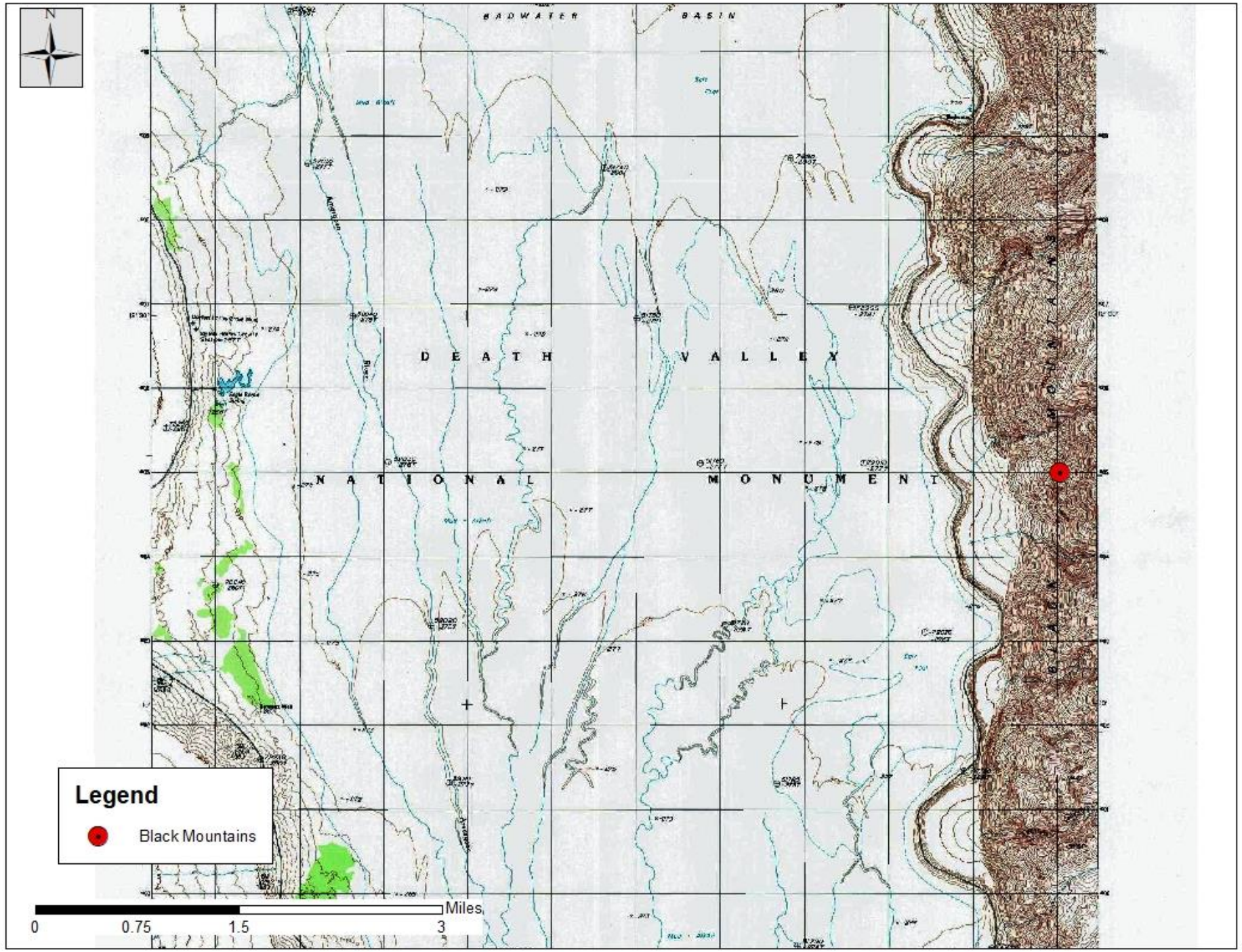
EXERCISE B-2. Badwater, California 7.5' Quadrangle Map SOLUTION

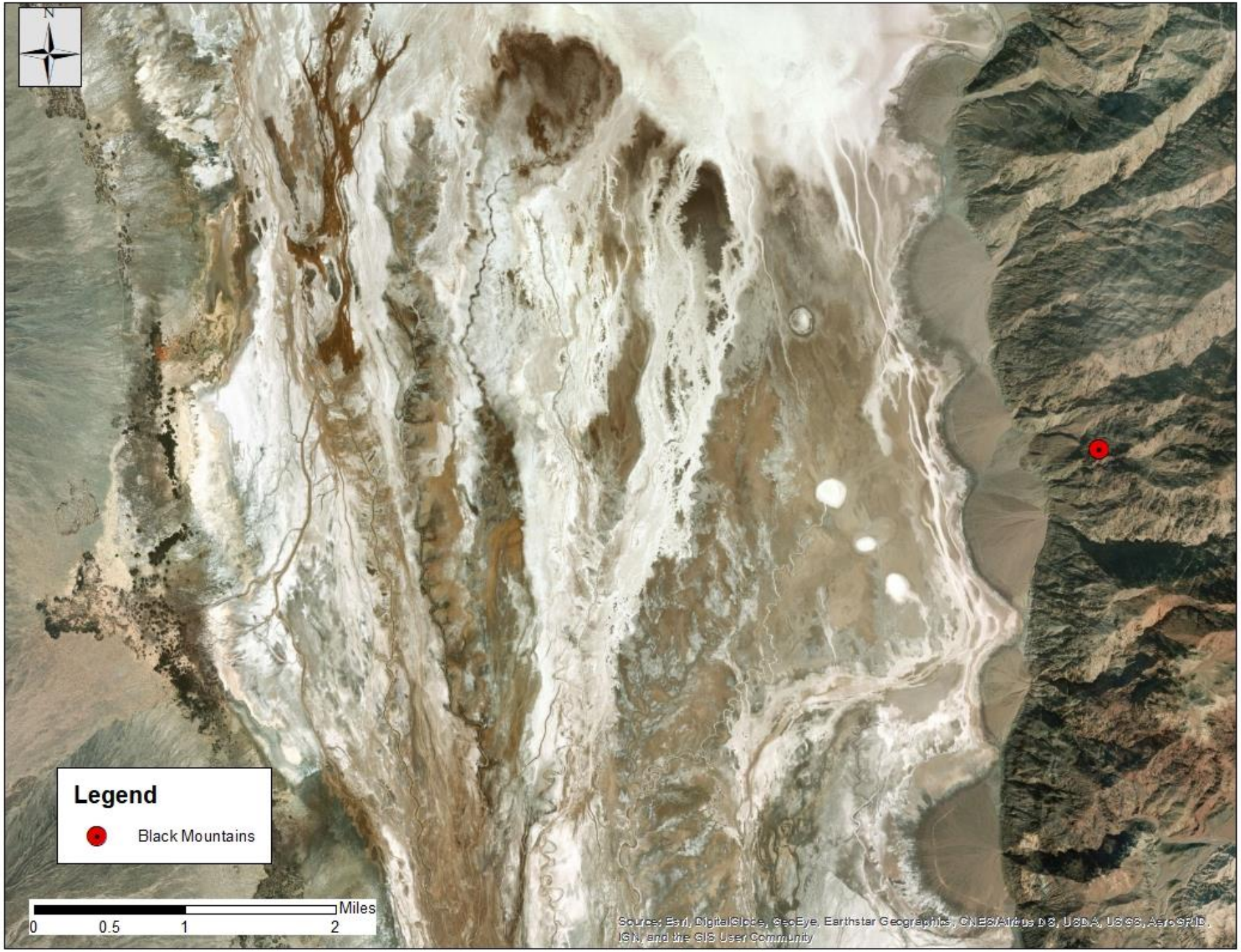
- **2-Where are coarsest and finest grains on this feature?**
- **B2. Coarsest grains (clasts) are near the mouth of Coffin Canyon**

EXERCISE B-3. Badwater, California 7.5' Quadrangle Map

- **3-What has formed west of the Black Mountains?**

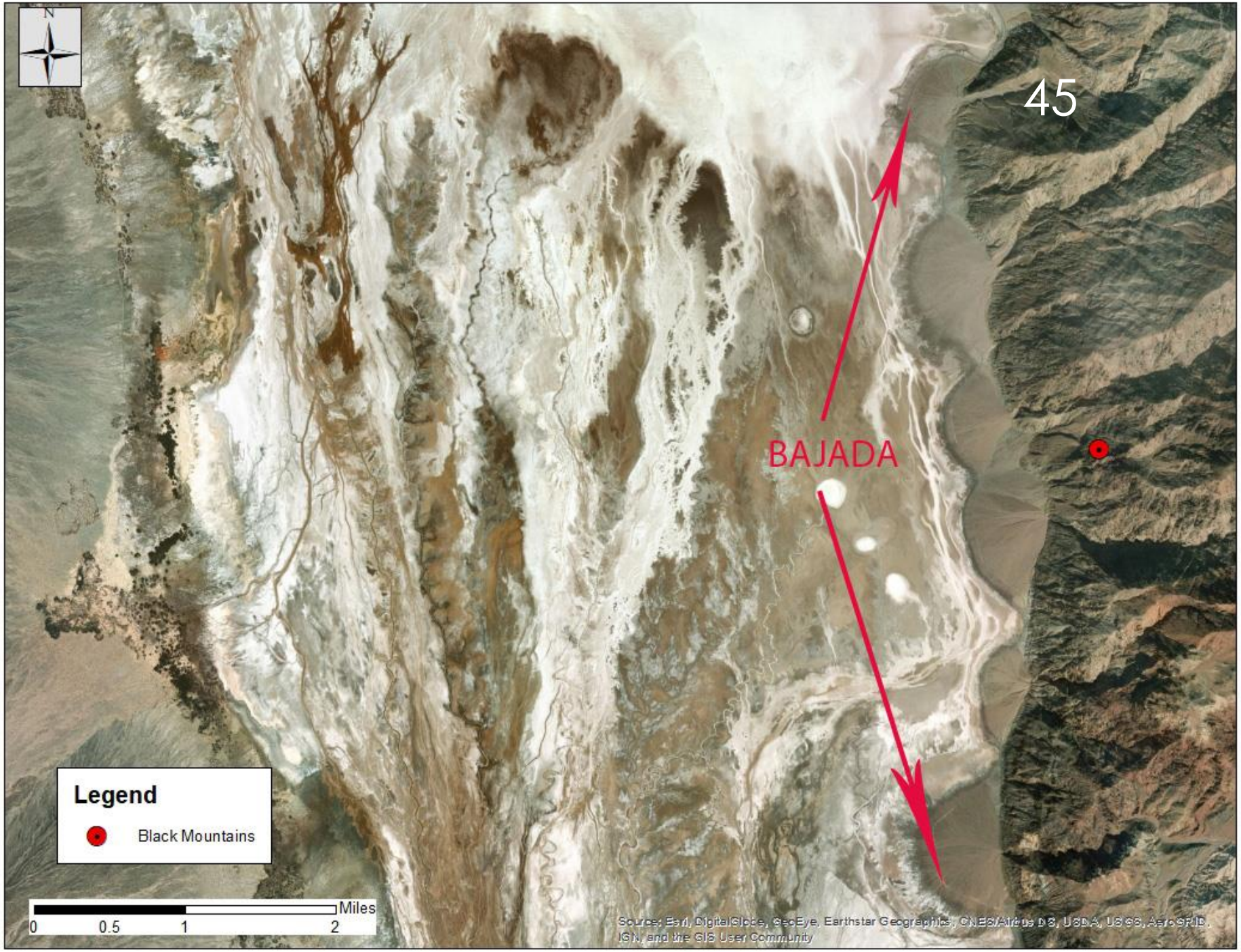

N
BADWATER
BASIN
DEATH VALLEY
NATIONAL MONUMENT
Legend
Black Mountains
Miles
0
1
2
4


BADWATER BASIN
DEATH VALLEY
NATIONAL MONUMENT
Legend
Black Mountains
Miles
0
0.75
1.5
3


N
Legend
Black Mountains
Miles
0
0.5
1
2
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

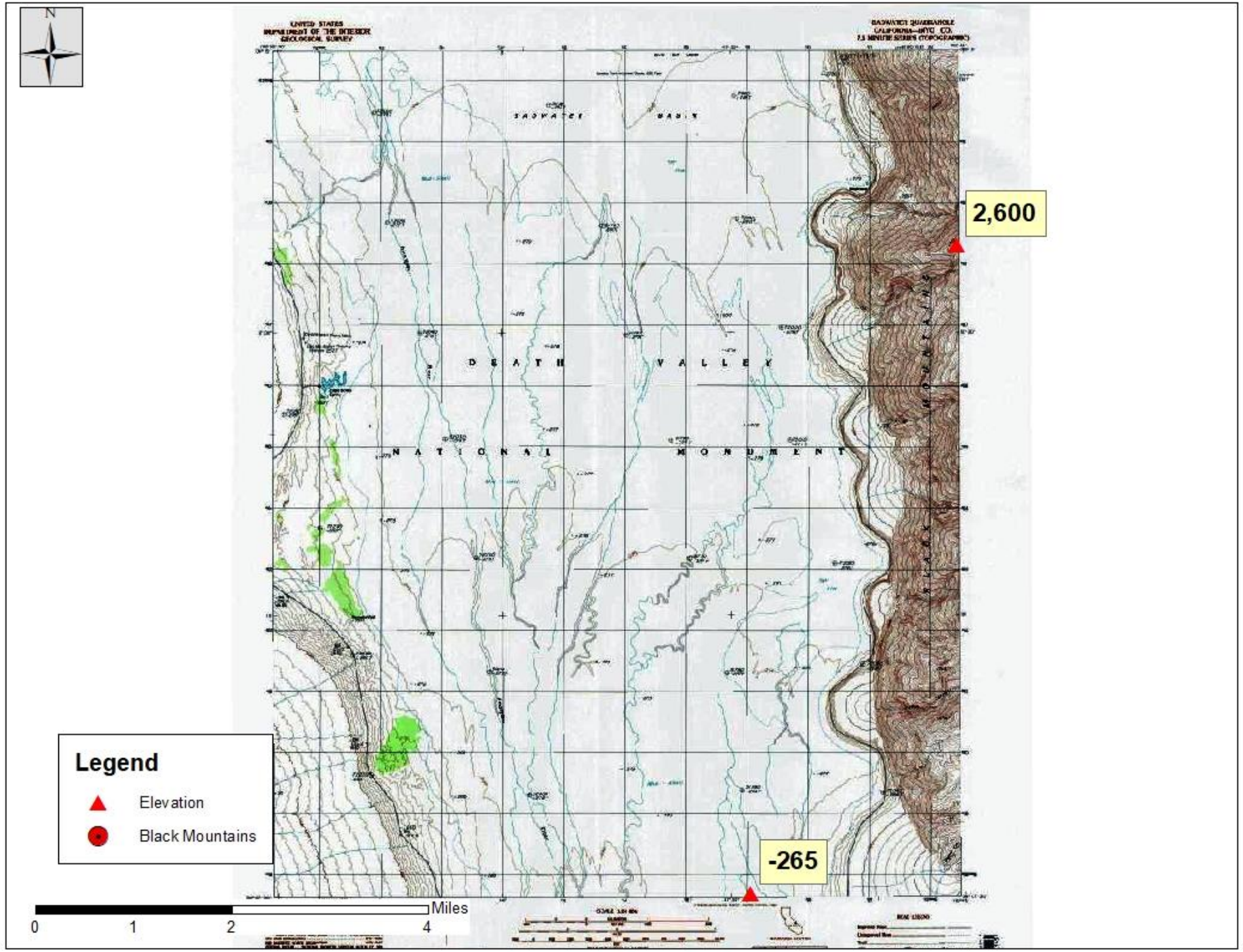
EXERCISE B-3. Badwater, California 7.5' Quadrangle Map SOLUTION

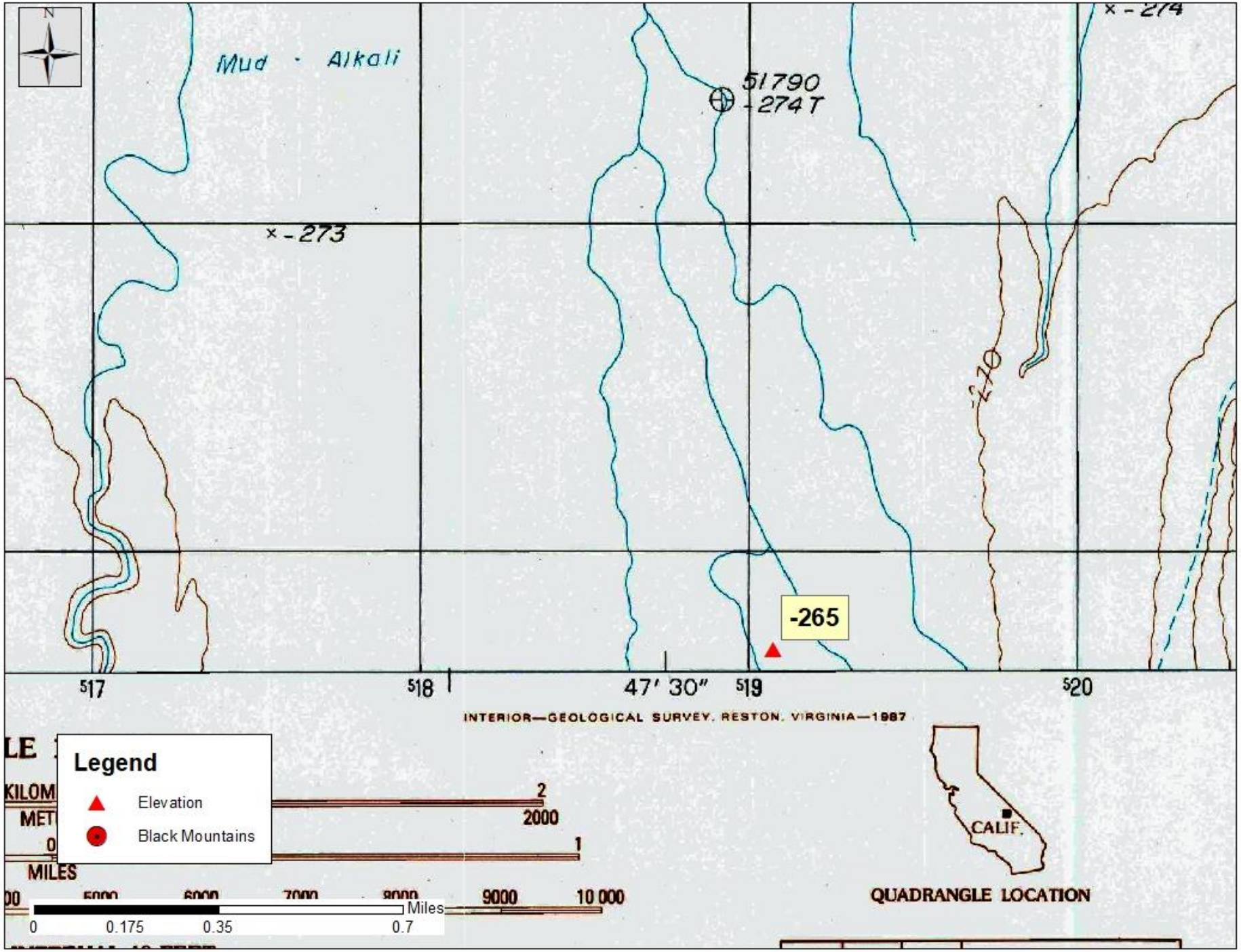
- **3-What has formed west of the Black Mountains?**
- **A3. Bajada (coalescence of alluvial fans)**

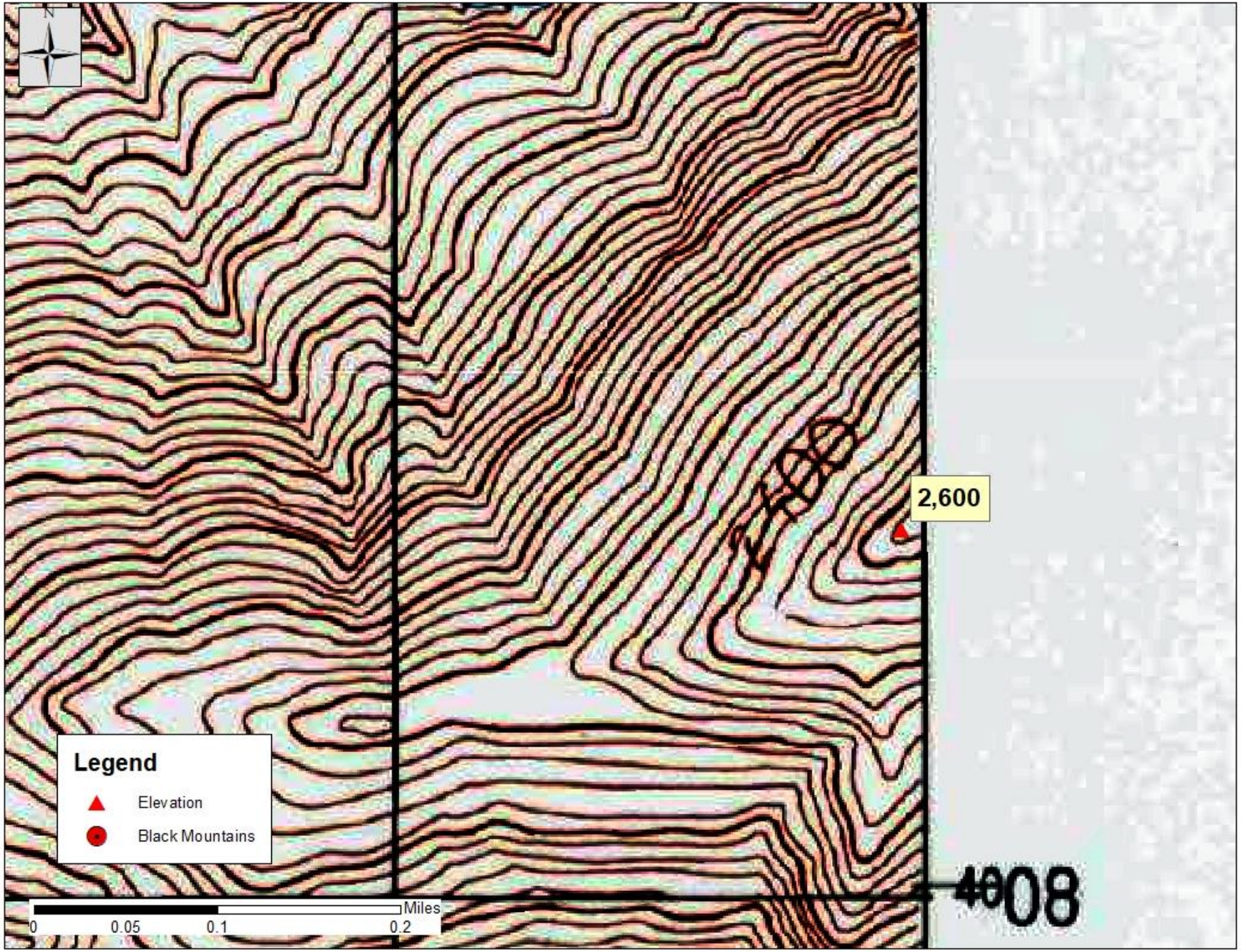


EXERCISE B-4. Badwater, California 7.5' Quadrangle Map

- **4-What is the relief of this map in feet (show your work)?**


N
2,600
-265
Legend
Elevation
Black Mountains
Miles
0
1
2
4


Mud - Alkali
51790
-274T
x - 273
x - 274
-265
517
518
47' 30"
519
520
INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1987
Legend
Elevation
Black Mountains
KILOM
MET
MILES
2
2000
1
9000
10 000
Miles
0
0.175
0.35
0.7
CALIF.
QUADRANGLE LOCATION

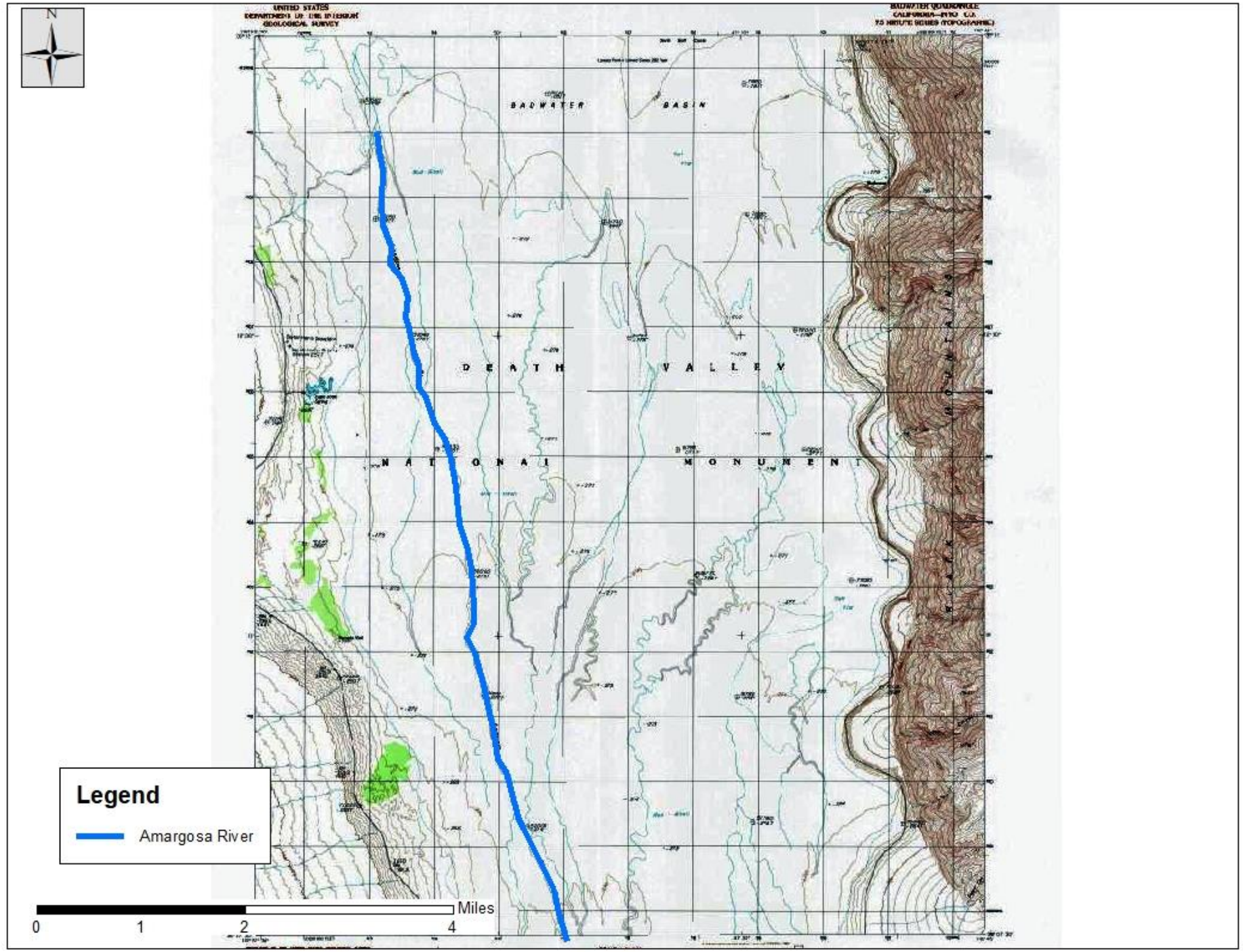

2,600
4008
Legend
Elevation
Black Mountains
Miles
0
0.05
0.1
0.2

EXERCISE B-4. Badwater, California 7.5' Quadrangle Map SOLUTION

- **4-What is the relief of this map in feet (show your work)?**
- **A4. Lowest point is -282**
- **Highest point is 2,600**
- **Relief is 2600 + 282 = 2,882 ft**

EXERCISE B-5. Badwater, California 7.5' Quadrangle Map

- **5-Which direction does the Amargosa River flow?**


N
BADWATER
BASIN
DEATH
VALLEY
NATIONAL
MONUMENT
Legend
Amargosa River
Miles
0
1
2
4

EXERCISE B-5. Badwater, California 7.5' Quadrangle Map SOLUTION

- **5-Which direction does the Amargosa River flow?**
- **A5. The Amargosa River on the Badwater Map flows from south to north**

EXERCISE C. Trona, California Topographic 250K Quadrangle

- 1-Prior to ten thousand years ago there was enough water in this area to make lakes in a series of basins that are now quite dry and covered in salt. Looking at the contour lines surrounding the basin, determine the maximum lake level for the following ancient lakes.
- a-Lake Manley (Death Valley)
- b-Searles Lake
- c-Panamint Lake
- d-Silver Lake
- 2-Did Silver Lake Drain into or out of Lake Manley?
- 3-What was the source of all this water?
- 4-Where did the salt come from?
- 5-What causes this area so dry now (compare to Santa Barbara and to Bakersfield)?

EXERCISE C-1. Trona, California Topographic 250K Quadrangle

- **1-Prior to ten thousand years ago there was enough water in this area to make lakes in a series of basins that are now quite dry and covered in salt. Looking at the contour lines surrounding the basin, determine the maximum lake level for the following ancient lakes.**
- **a-Lake Manley (Death Valley)**
- **b-Searles Lake**
- **c-Panamint Lake**
- **d-Silver Lake**

Pluvial Lakes of the Owens and Amargosa River systems

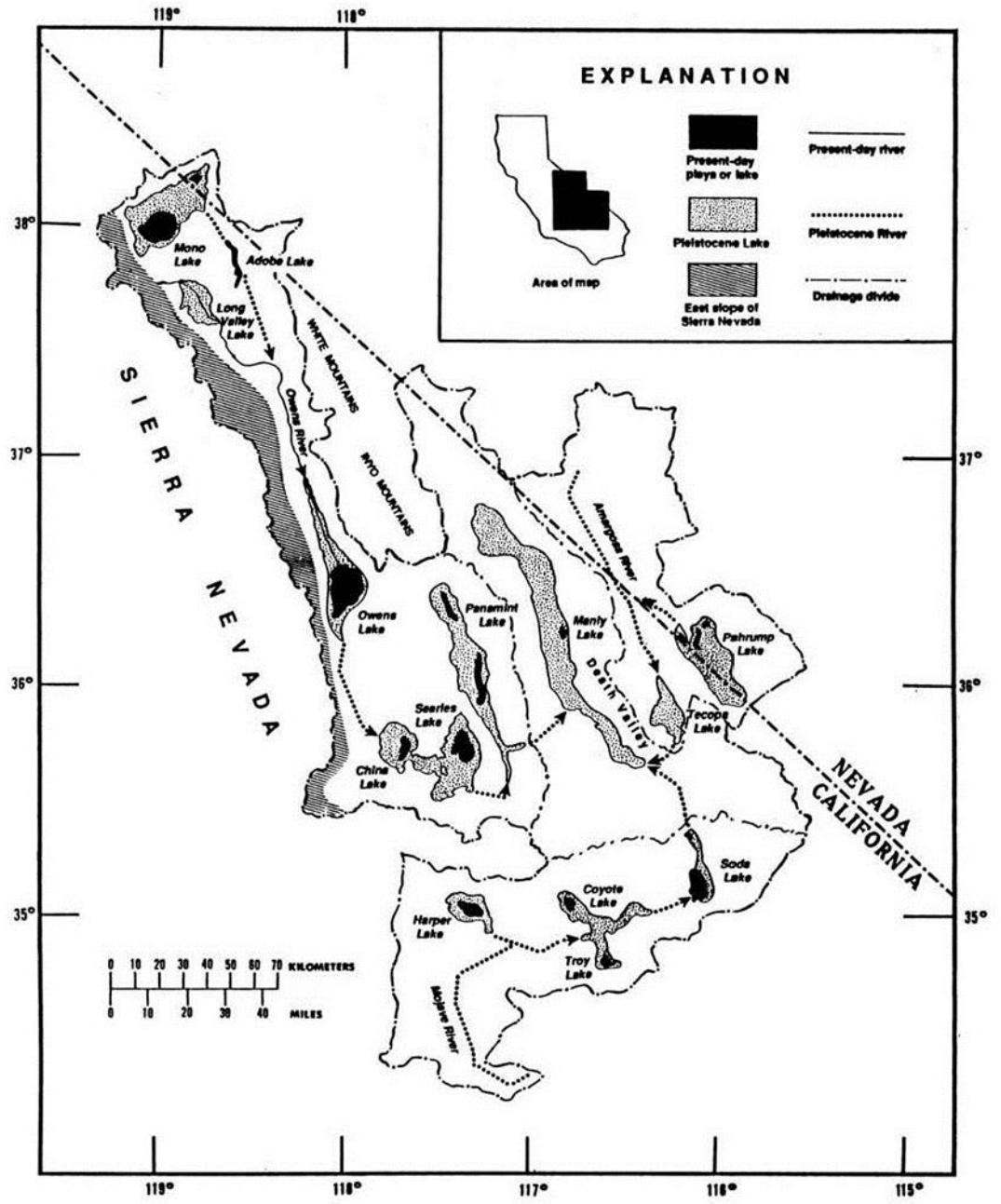
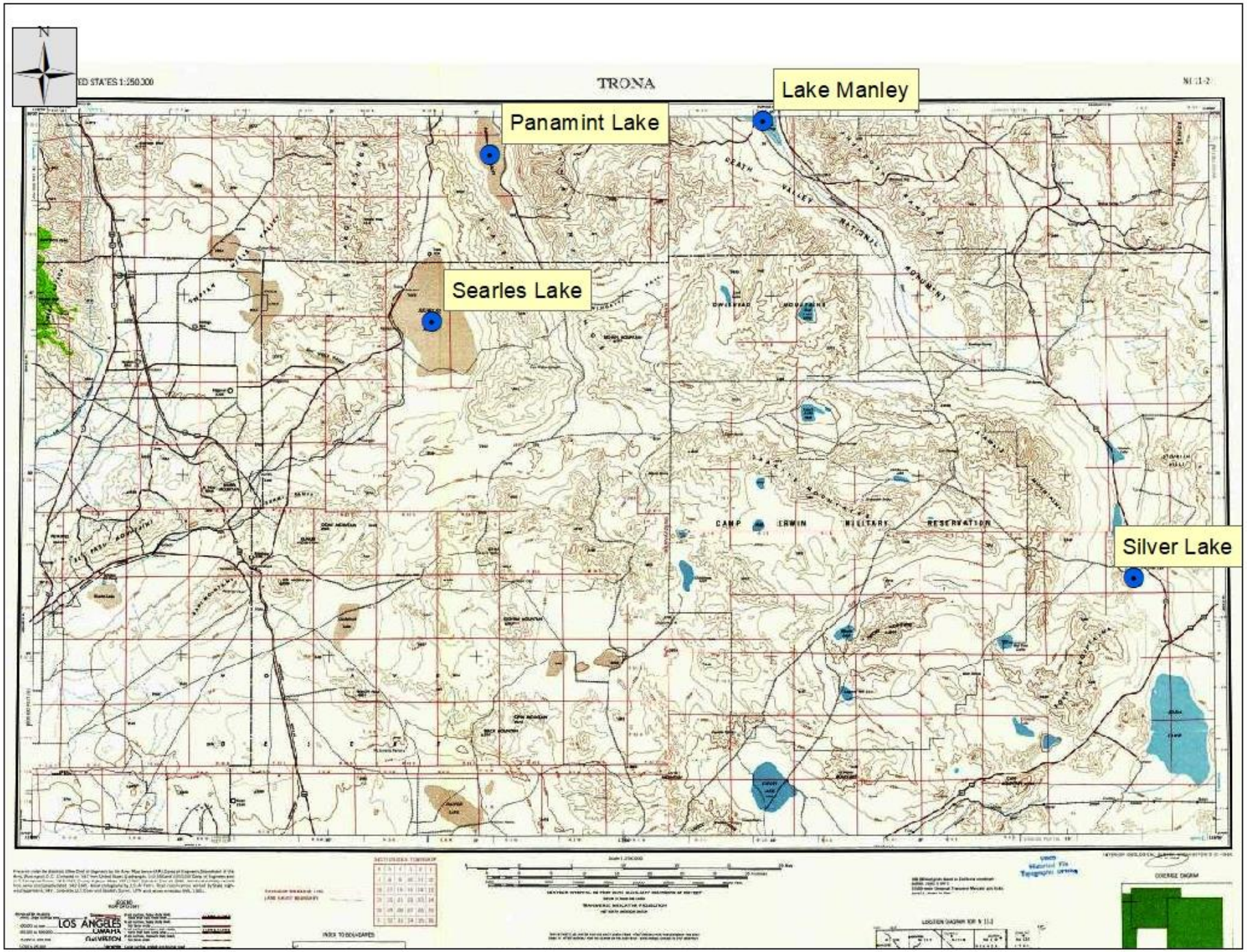
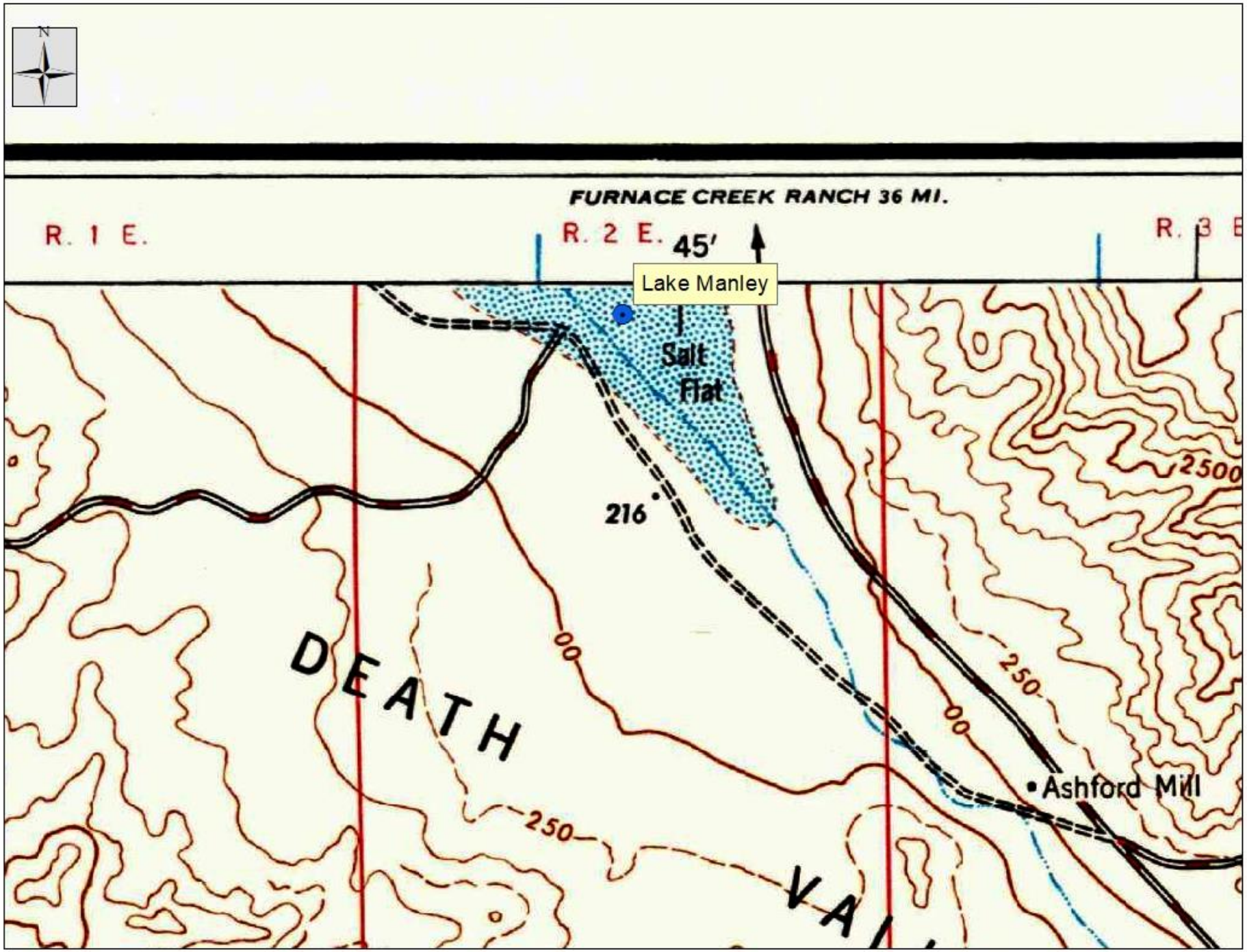
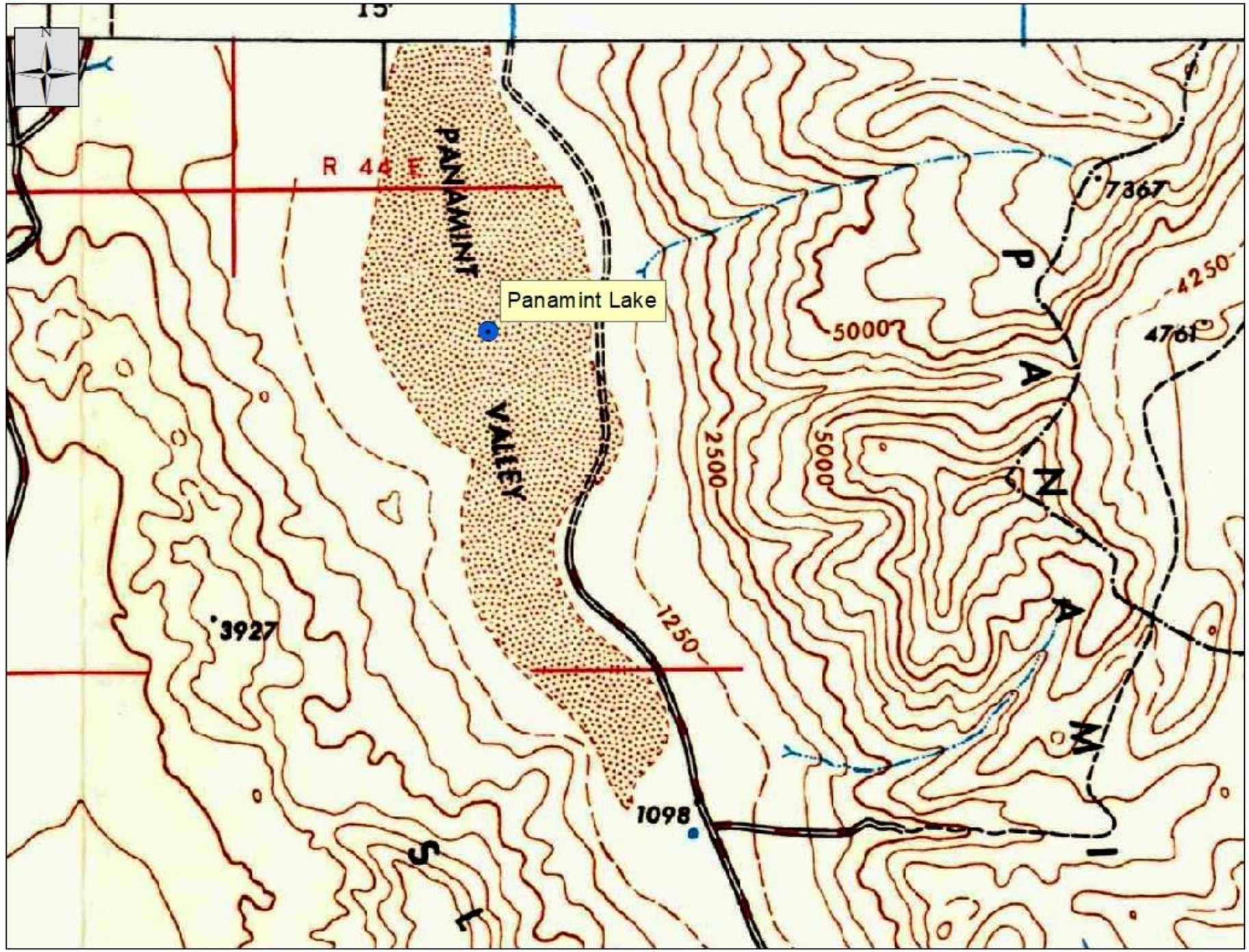
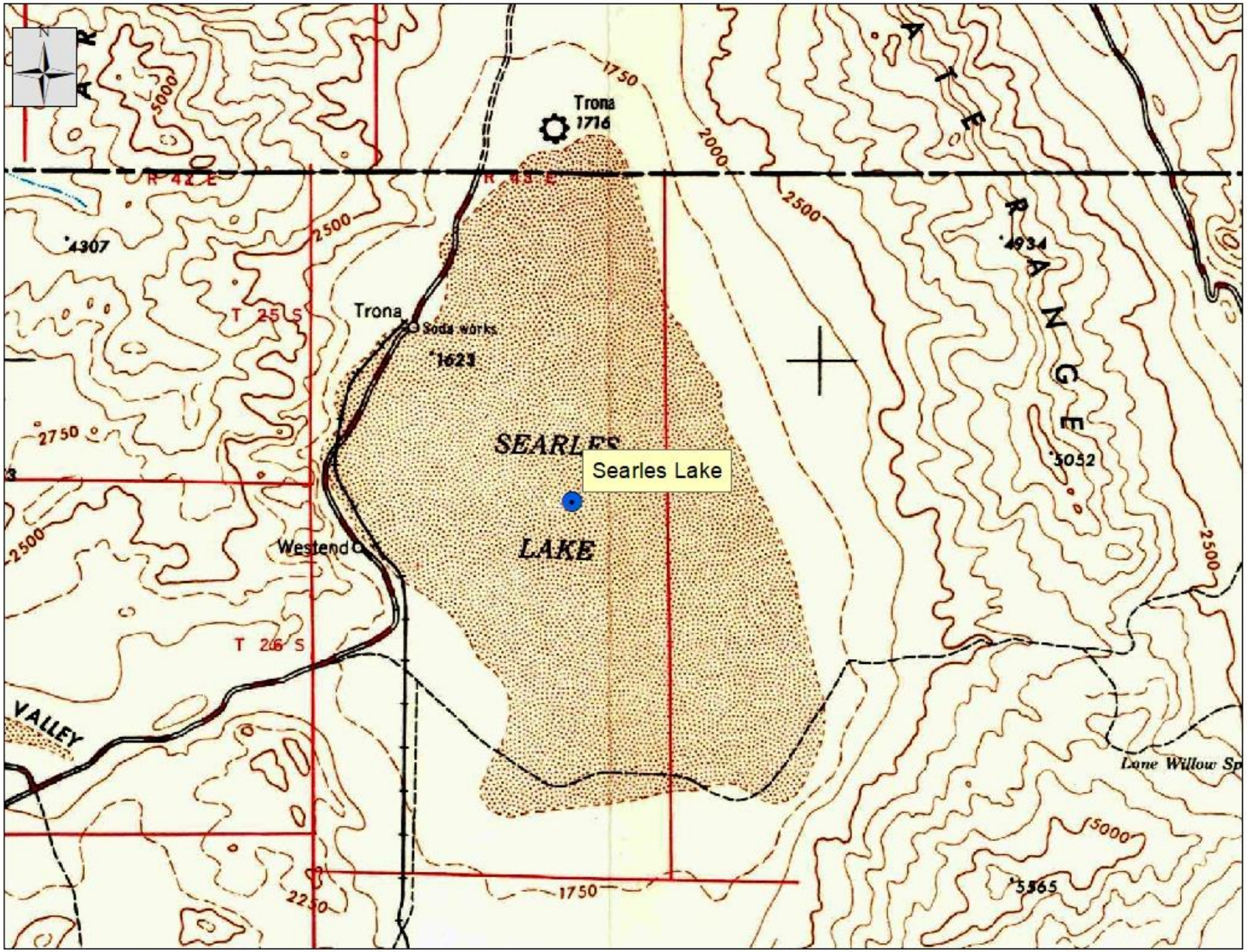


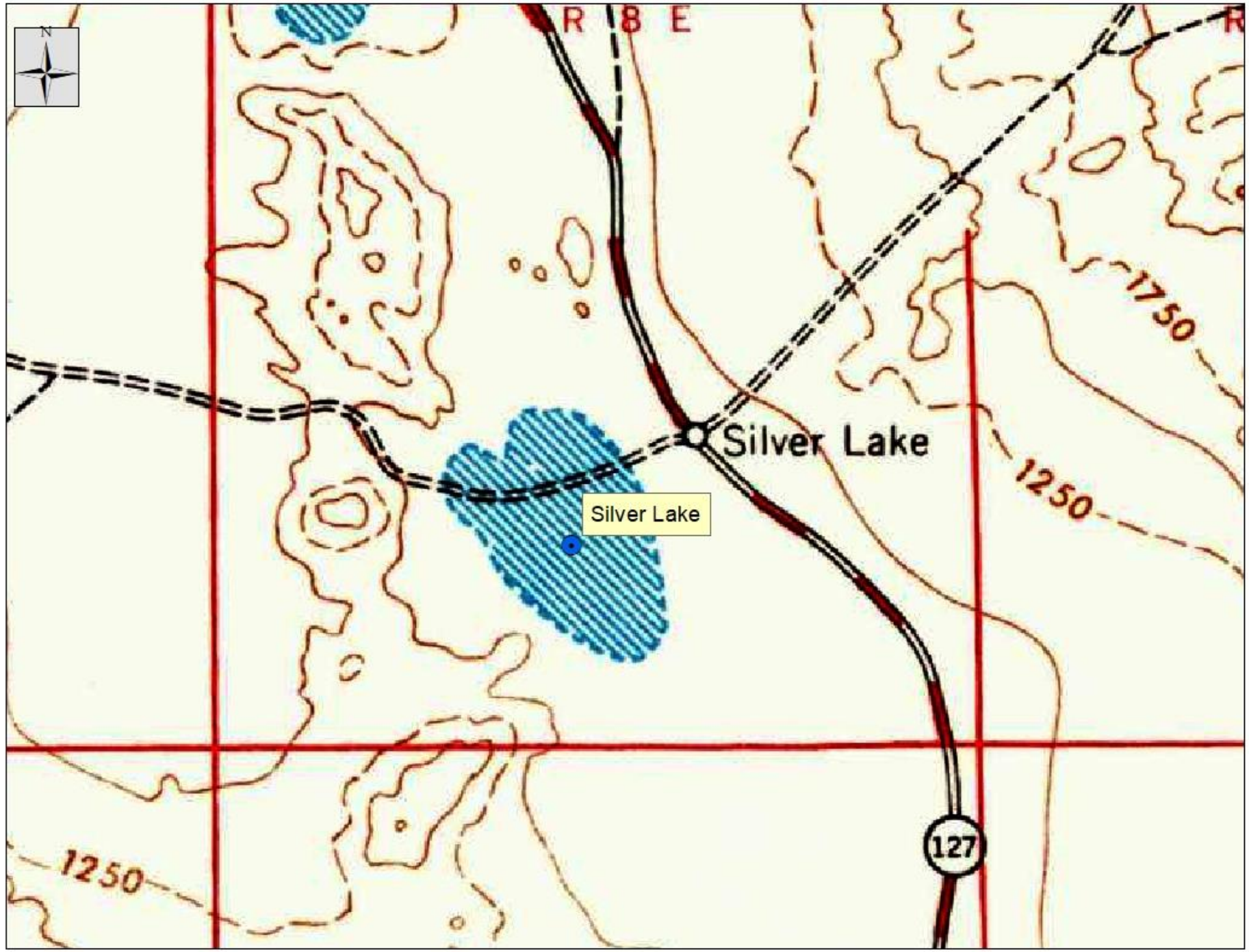
Figure 1. Extent of drainage basins connected with Death Valley during the late Pleistocene (from Jannik et al., 1991). This chapter deals mainly with the drainages between Mono Basin and Death Valley.


TRONA
Lake Manley
Panamint Lake
Searles Lake
Silver Lake
CAMP IRWIN MILITARY RESERVATION
DEATH VALLEY NATIONAL MONUMENT


FURNACE CREEK RANCH 36 MI.
R. 1 E.
R. 2 E.
45'
R. 3 E
Lake Manley
Salt Flat
216
2500
250
250
DEATH
Ashford Mill


15'
R 44 E
PANAMINT
VALLEY
Panamint Lake
7367
4250
4761
5000
2500
5000
1250
3927
1098
P
A
N
A
M
I
S
L


Trona
1716
R 42 E
R 43 E
T 25 S
T 26 S
Trona
Soda works
1623
SEARLES
LAKE
Searles Lake
Westend
VALLEY
Lone Willow Sp
4307
4934
5052
5565
1750
2000
2500
2750
2250
5000

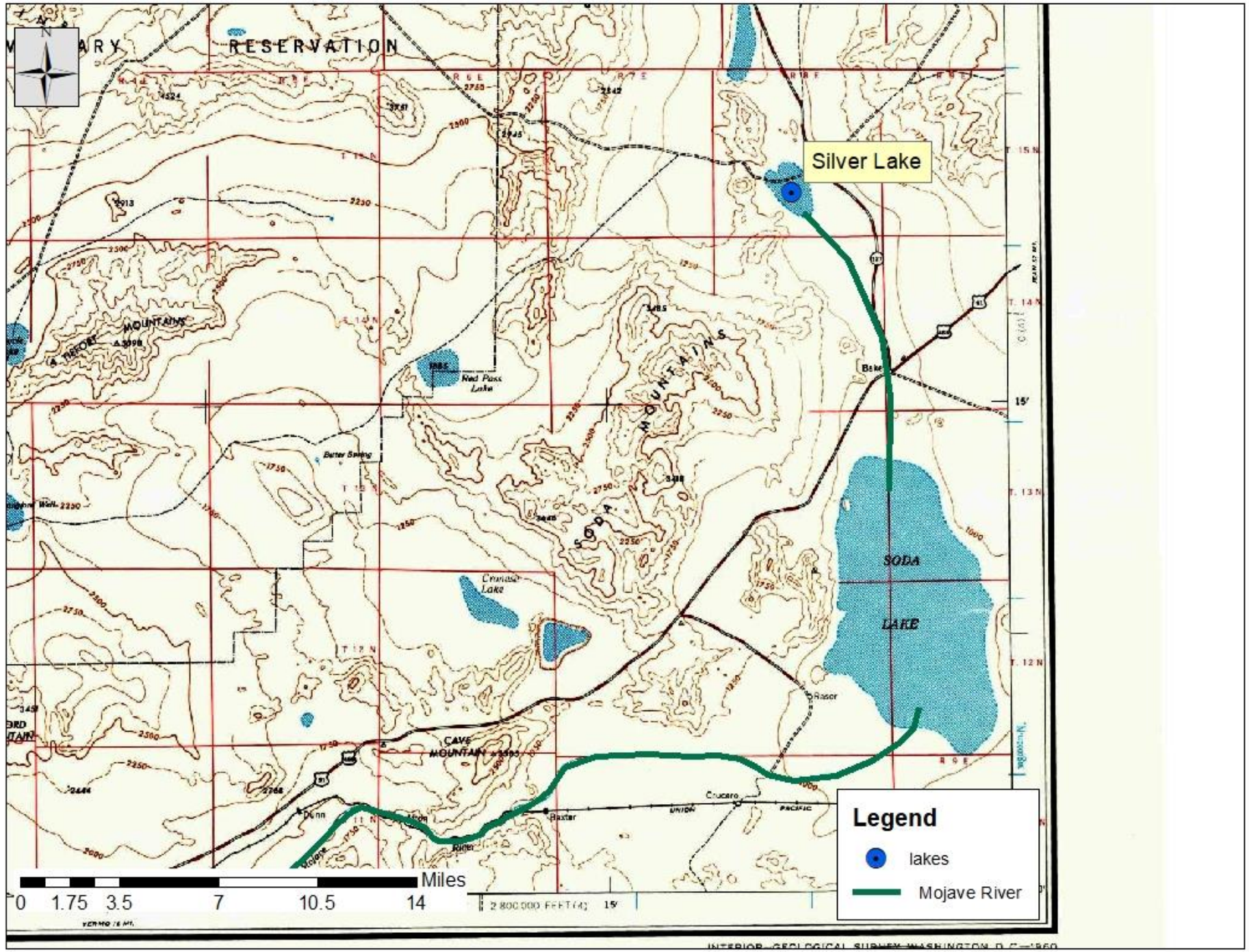

R 8 E
Silver Lake
Silver Lake
1750
1250
1250
127

EXERCISE C-1. Trona, California Topographic 250K Quadrangle SOLUTION

- 1 -Prior to ten thousand years ago there was enough water in this area to make lakes in a series of basins that are now quite dry and covered in salt. Looking at the contour lines surrounding the basin, determine the maximum lake level for the following ancient lakes.
- a-Lake Manley (Death Valley): 0 ft
- b-Searles Lake 1,725 ft
- c-Panamint Lake 1,200 ft
- d-Silver Lake 1,100 ft

EXERCISE C-2. Trona, California Topographic 250K Quadrangle

- **2-Did Silver Lake Drain into or out of Lake Manley?**

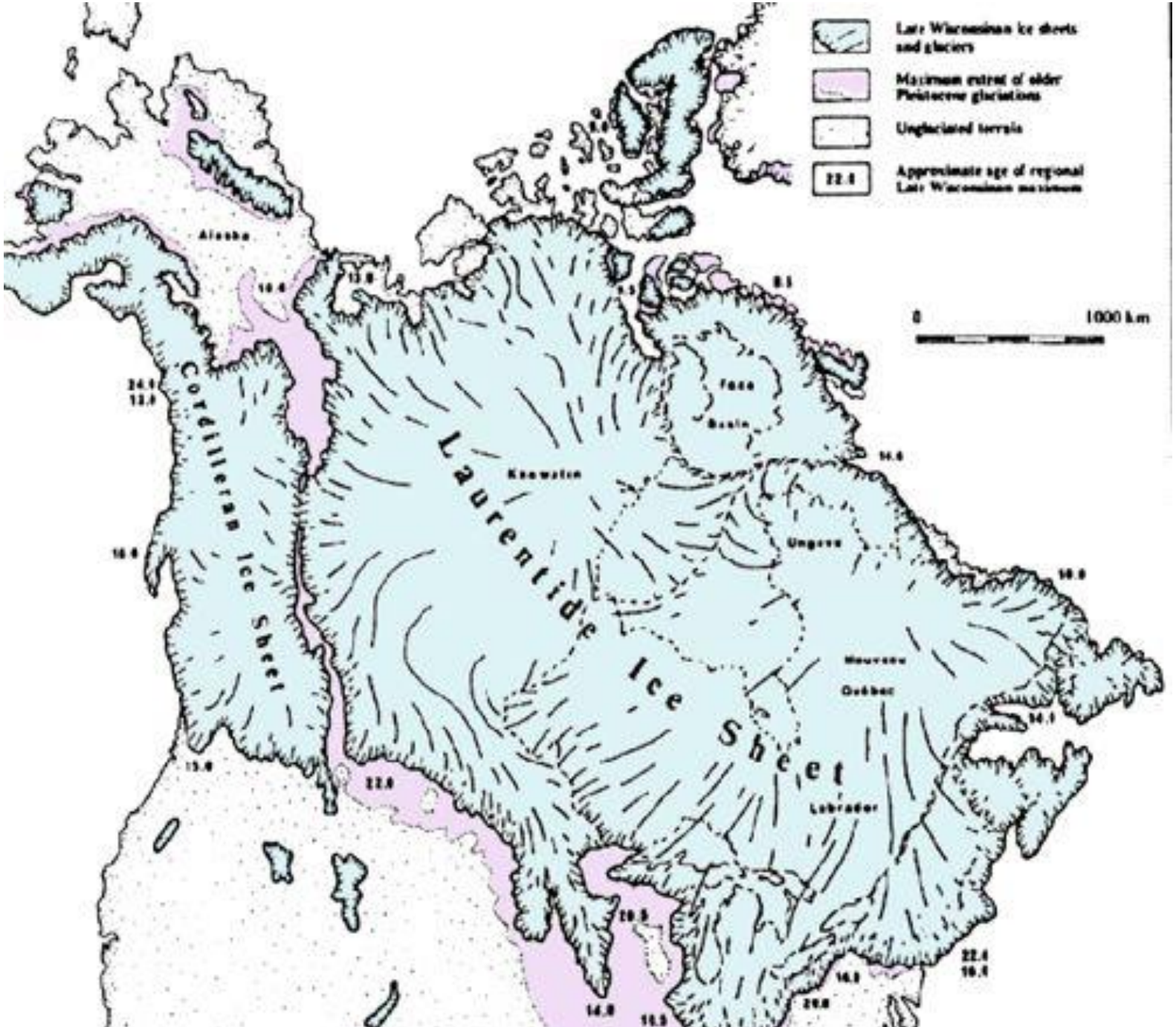

RESERVATION
Silver Lake
SODA MOUNTAINS
SODA LAKE
CAVE MOUNTAIN
Red Pass Lake
Baxter
Daggett
Barstow
Legend
lakes
Mojave River
Miles
0 1.75 3.5 7 10.5 14

EXERCISE C-2. Trona, California Topographic 250K Quadrangle SOLUTION

- **2-Did Silver Lake Drain into or out of Lake Manley?**
- **A2. Neither. Silver Lake Drained to the Mojave River**

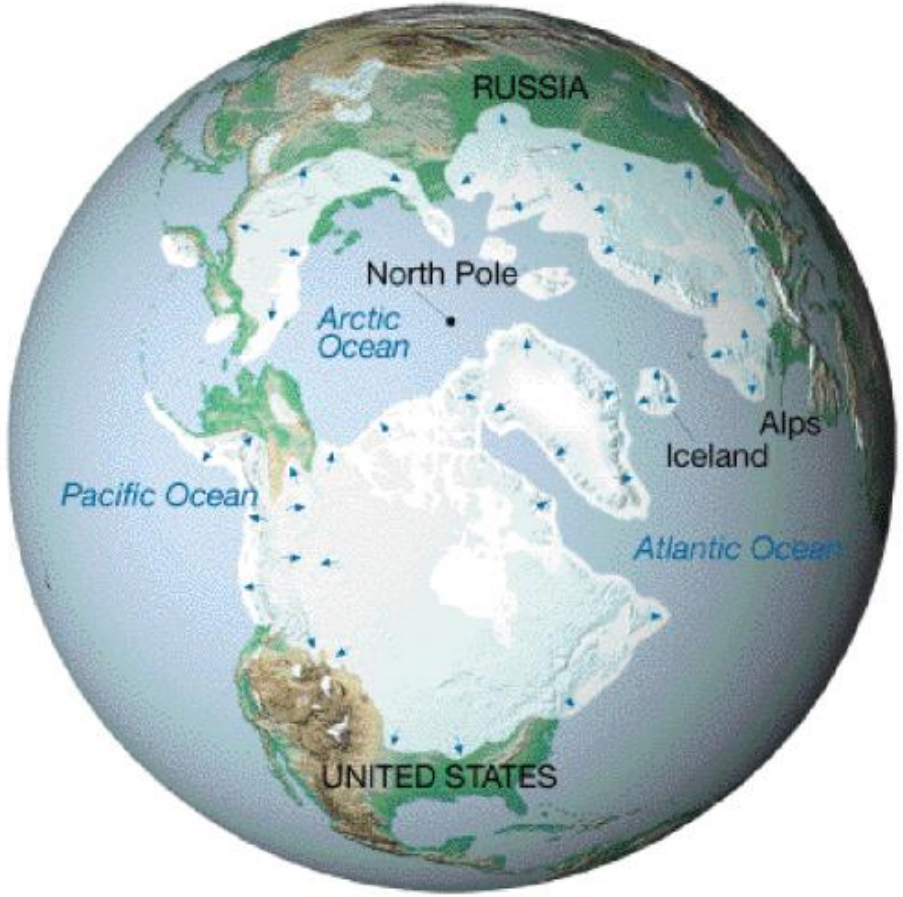
EXERCISE C-3. Trona, California Topographic 250K Quadrangle

- **3-What was the source of all this water?**


Late Wisconsinan ice sheets and glaciers
Maximum extent of older Pleistocene glaciations
Unglaciated terrain
Approximate age of regional Late Wisconsinan maximum
0
1000 km
Alaska
Cordilleran Ice Sheet
Laurentide Ice Sheet
Keewatin
Labrador

EXERCISE C-3. Trona, California Topographic 250K Quadrangle. SOLUTION

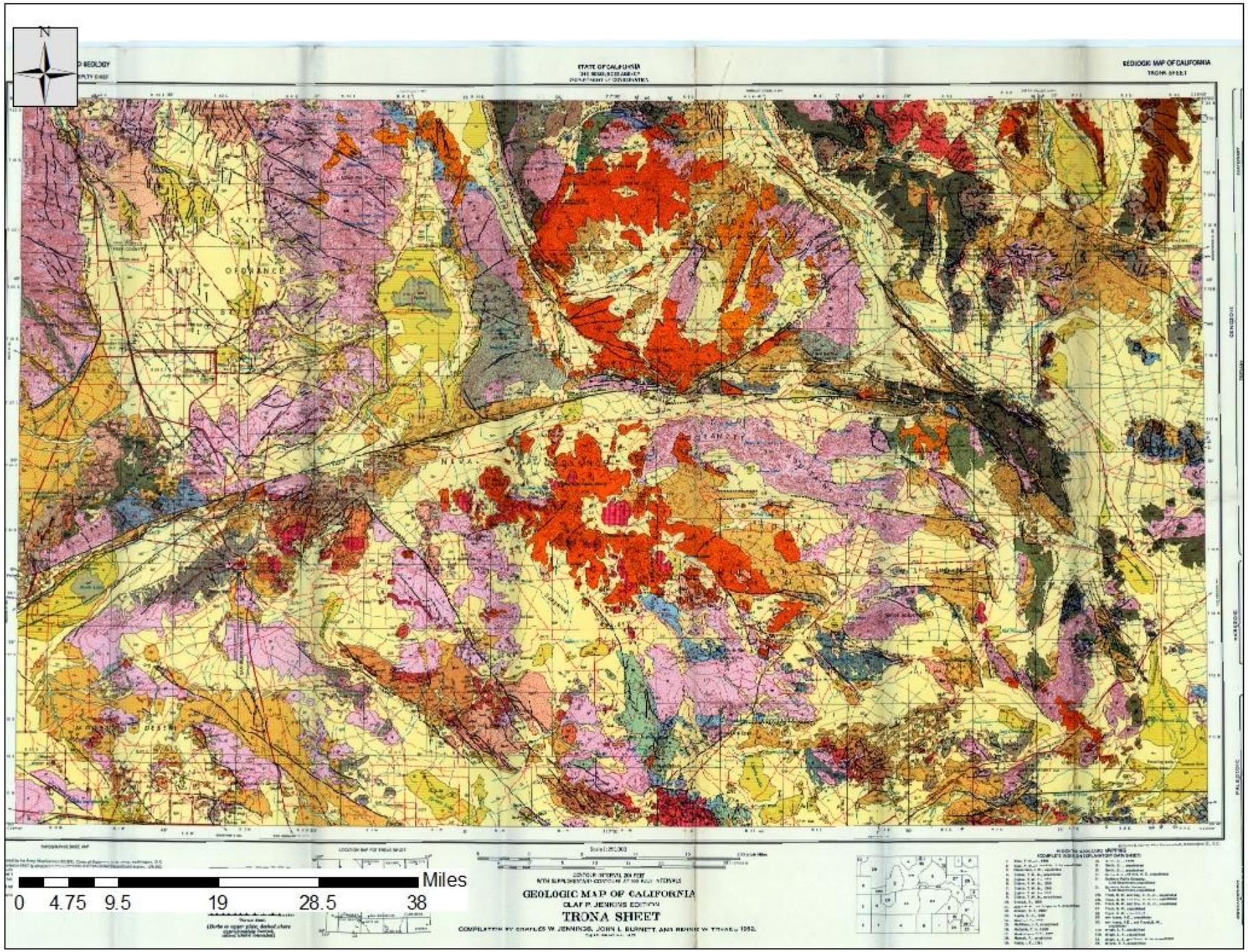
- **3-What was the source of all this water?**
- **A3. Melting of the continental ice sheets of the Pleistocene glaciation**



EXERCISE C-4. Trona, California Topographic 250K Quadrangle

- **4-Where did the salt come from?**

Trona Sheet 250K Geologic Map

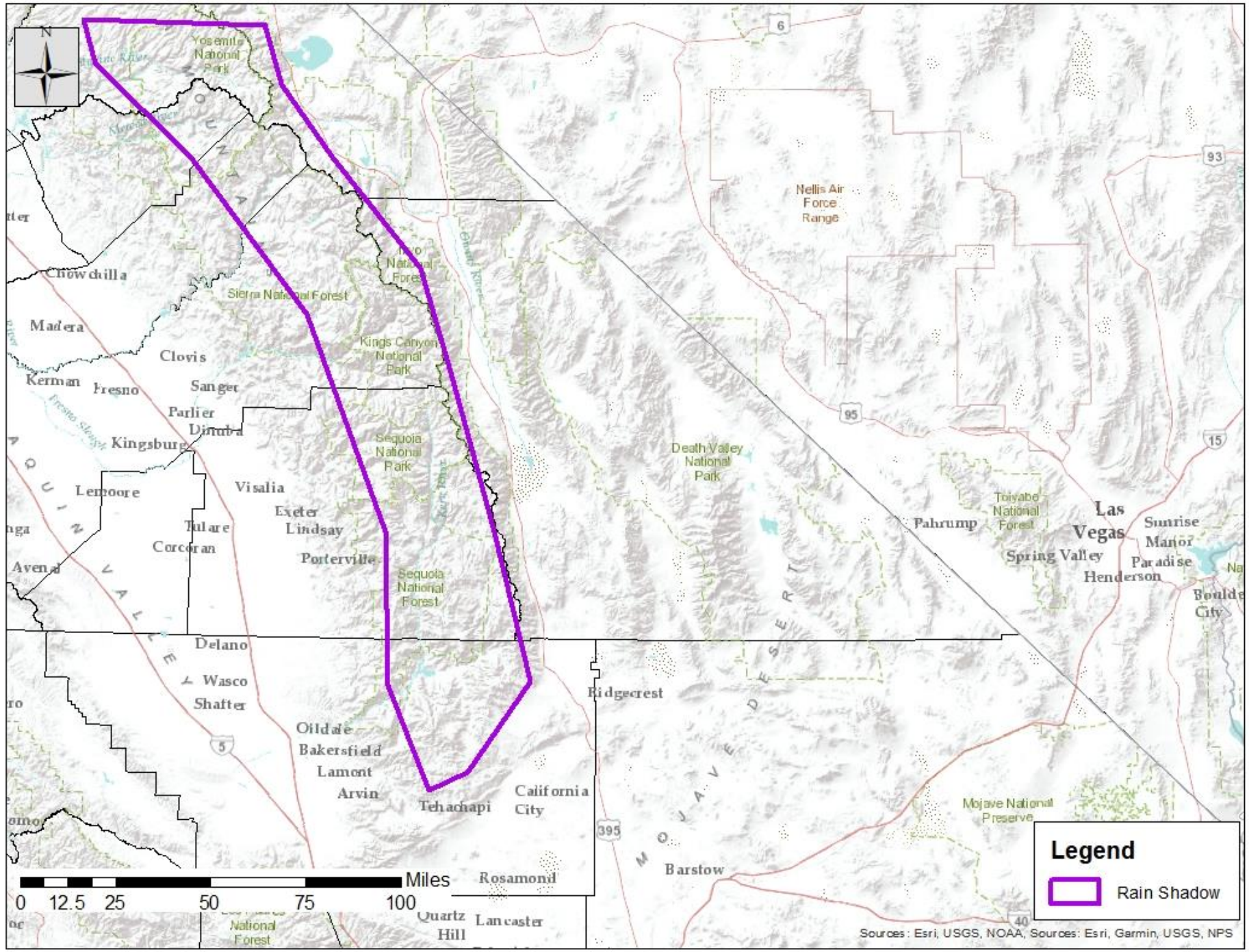


EXERCISE C-4. Trona, California Topographic 250K Quadrangle SOLUTION

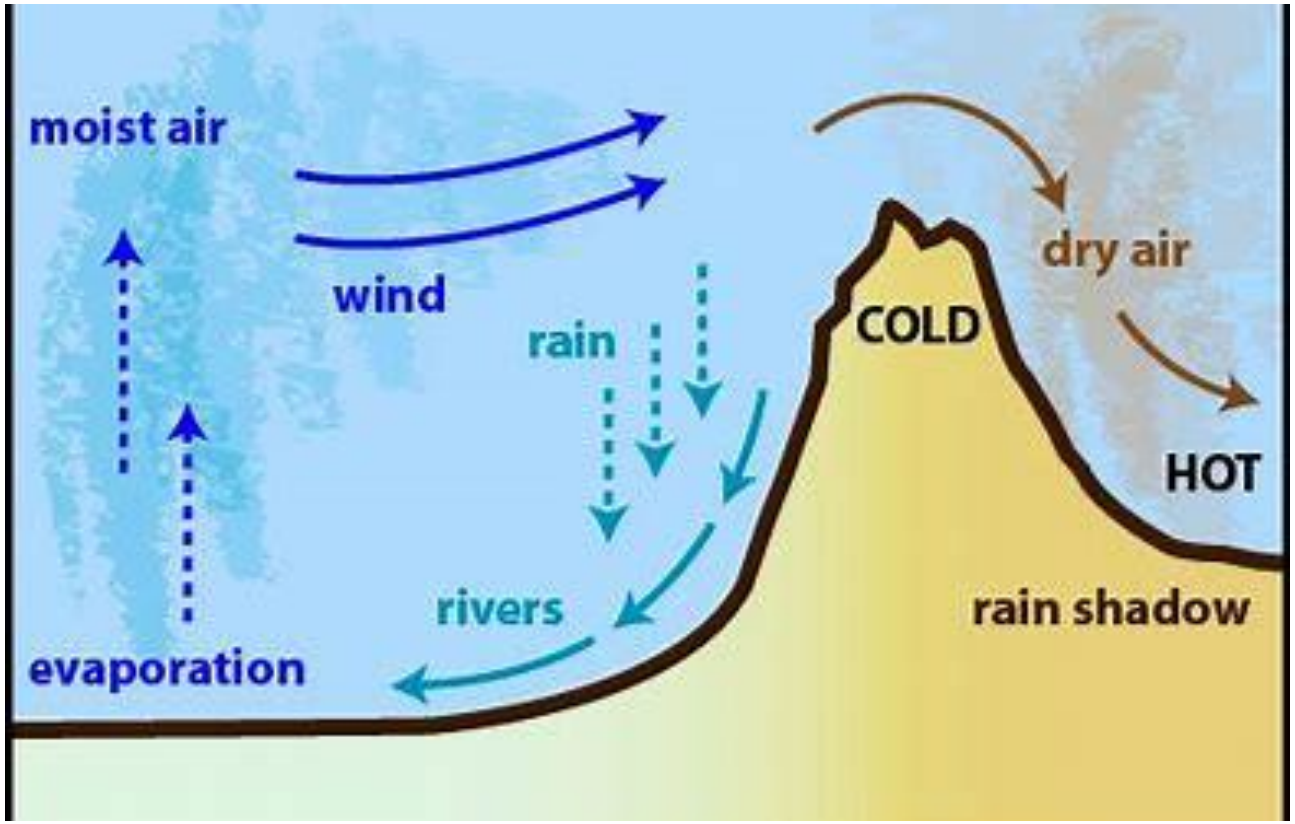
- **4 -Where did the salt come from?**
- **A4. Erosion and weathering of Na-rich rocks**

EXERCISE C-5. Trona, California Topographic 250K Quadrangle

- **5-What causes this area to be so dry now (compare to Santa Barbara and to Bakersfield)?**


N
Yosemite National Park
Chowchilla
Madera
Clovis
Kerman
Fresno
Sanger
Parlier
Dinuba
Kingsburg
Lemoore
Visalia
Exeter
Lindsay
Tulare
Corcoran
Porterville
Avenal
Delano
Wasco
Shafter
Oildale
Bakersfield
Lamont
Arvin
Tehachapi
California City
Ridgecrest
Rosamond
Quartz Hill
Lancaster
Barstow
Sierra National Forest
Kings Canyon National Park
Sequoia National Forest
Sequoia National Forest
Nellis Air Force Range
Death Valley National Park
Pahrump
Toiyabe National Forest
Las Vegas
Sunrise Manor
Spring Valley
Paradise
Henderson
Boulder City
Mojave National Preserve
SAN JOAQUIN VALLEY
MOJAVE DESERT
6
93
95
15
5
395
40
Miles
0 12.5 25 50 75 100
Legend
Rain Shadow
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS

EXERCISE C-5. Trona, California Topographic 250K Quadrangle

- 5-What causes this area to be so dry now (compare to Santa Barbara and to Bakersfield)?

- **A5. The rain shadow of the Sierra Nevada mountains makes the Mojave Desert Dry**