

Solutions Manual to Accompany

Historical Geology
Interpretations and Applications
Sixth Edition

Rock Cycle and Sedimentary Rocks

EXERCISES

Exercise 1-1 CONTINENTAL SEDIMENTARY ENVIRONMENTS, UTAH

Location 1. Shale and siltstone, finely laminated, sandy layers quite common, some fragments of shale with raindrop imprints on the surface.

Laminations are indicative of nonburrowed lake sediments; raindrop imprints could be found only on land.

Location 2. Shale and siltstone, finely laminated, some pebbles, some pollen grains found with a microscope.

Laminations; pollen from land plants.

Location 3. Shale, blocky, red, some nodules of gypsum, a few lenses of very finely cross-bedded sandstone with asymmetrical ripple marks.

Red color from oxidation on land; gypsum from evaporating water; asymmetrical ripple marks from water or wind current.

Location 4. Siltstone, some shale and sand, a few thin beds of conglomerate with fragments of dinosaur bones, clams, and tortoise shell.

Dinosaur bone

Location 5. Sandstone, well-sorted, fine-grained, evidence of large-scale cross-bedding, frosted sand grains, a few thin layers of shale.

Large-scale cross beds and frosted sand grains are associated with dunes.

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Location 6. Claystone, dark gray, platy, a few fragments of large leaves.

Leaf fragments from land plants

Location 7. Sandstone, well-sorted, fine-grained, a few pieces of petrified wood present.

Petrified wood from land plants permineralized by groundwater

Location 8. Siltstone and shale, gray, a few snails, bivalves, and ammonite fragments.

Ammonites (Figs. 4.25, 4.26) were marine creatures; probably not a continental deposit.

Location 9. Coarse sandstone, well-defined cross bedding, crocodile bone fragments.

Crocodile bones fragments could be freshwater, estuarine or nearshore marine.

Exercise 1-2 PALEOGEOGRAPHIC MAP

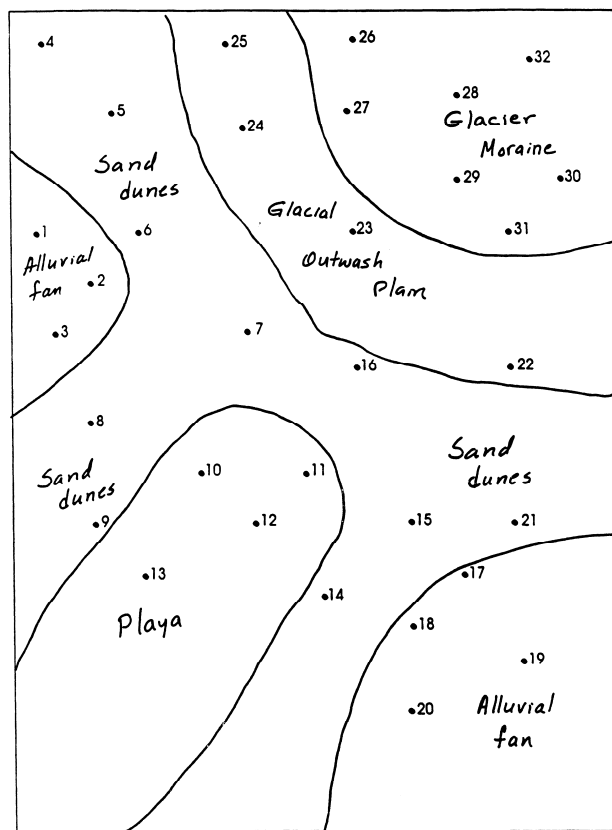


Figure 1.24 Paleogeographic map of sedimentary environments

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Exercise 1-3 PALEOGEOGRAPHIC MAP OF CHINLE FORMATION, UTAH

NORTH

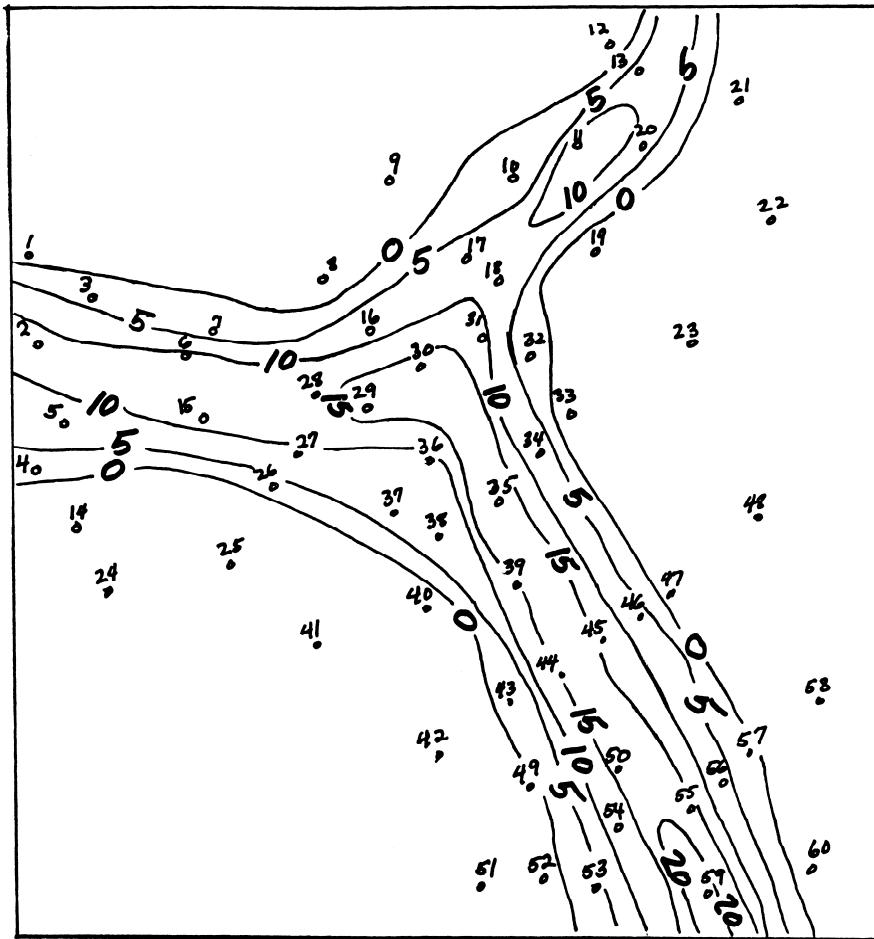


Figure 1.25 Location map for Chinle Formation Database

Questions

1. Describe the depositional nature of the Chinle sandstone as developed by the isopach map.

Main channel runs from west to southeast with a subsidiary channel coming from the northeast. The sand thickens in the channel from the confluence of the two streams southward.

2. What kind of surface exists between the Chinle and Moenkopi formations? Cite evidence for your conclusion.

There is a significant change in depositional environment at the unconformity. Also there is erosional

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down cutting into the uppermost “horizontal” Moenkopi units.

3. Draw an arrow on your map showing the direction of the stream flow as derived from the contouring.

(Arrow should go from west to southeast; see Fig. 1.25.)

Exercise 1-4 CARLSBAD CAVERNS, NEW MEXICO

Questions

- a. On the location map, Fig. 1.28, construct a lithofacies map of this region. Label the fore reef, reef, and back-reef areas.

(See the Permian Reef cross-section, Fig. 1.27.)

- b. In which direction was the shoreline (land) during this interval of the Permian?

Shoreline was northeast, toward the back reef area.

- c. Contrast the water conditions that probably existed in the northwest corner of the map area with those in the southeastern corner.

Northwest: Back reef, restricted circulation, evaporites

Southeast: Reef talus, deep marine shale

- d. Where would you make your speculative land purchase? (Show the location on the lithofacies map.)

What were your reasons for choosing this area?

Purchase would be northeast of the cavern opening. High porosity would indicate the possibility of caverns.

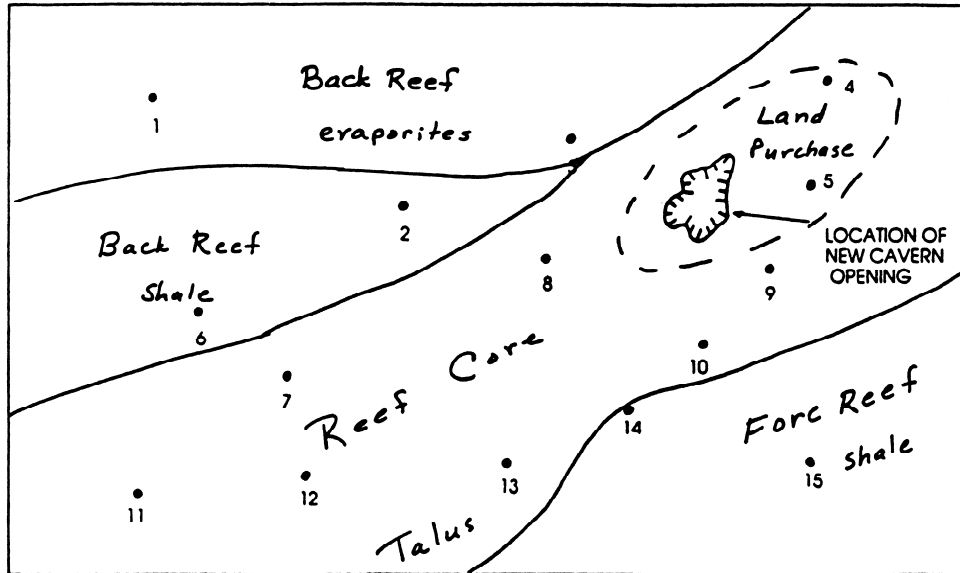


Figure 1.28 Location of sample data

Exercise 1-5 ENVIRONMENTAL ANALYSIS, MISSISSIPPI RIVER DELTA

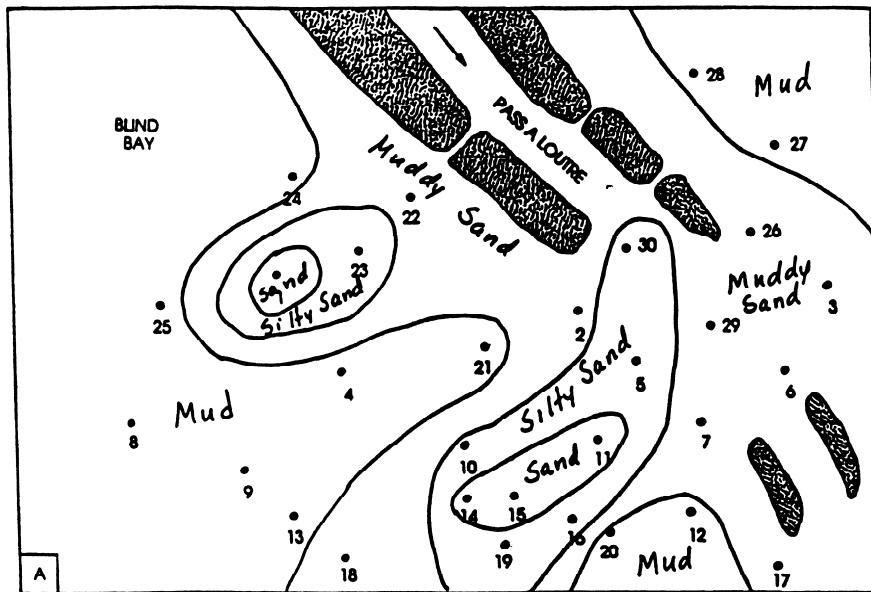


Figure 1.30 Sample location map

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Questions

1. Using Fig. 1.30 as a base map, draw a sediment distribution map showing clean sand, silty sand, muddy sand, and mud. (See Fig. 3.7, Construction of Lithofacies Maps.)

2. Outline with a red pencil the approximate boundary of the potential oyster bed. Describe its bottom sediments.

Clean, well-sorted, fine-grained sand

3. Starfish are a natural predator of oysters. Suggest how a starfish could kill and eat such a bivalve.

Starfish will cover both valves and apply enough outward pressure on the oyster until it barely opens.

Once slightly opened, the starfish begins to “eat” the soft parts of the oyster or clam.

4. What gives the muddy samples the dark gray to black coloration?

Finely disseminated organic material

5. Why is sand concentrated at the mouth of Pass a Loutre, Southeast Pass, and South Pass?

Mixtures of sand and mud move down the distributaries, but wave and current energy winnow the fine particles from the sand.

6. Why is the sand concentrated on the southern side of the passes? (Note the spit development at South Pass, area B on the U.S. Geological Survey map, Fig. 1.29.)

Sand is carried south by the prevailing long-shore current.

7. Pass a Loutre is one of the principal distributaries on the Mississippi Delta. How does such a distributary network differ from a normal dendritic stream drainage pattern?

The distributaries deposit sediment supplied by the main stream. Normal stream tributaries collect water and sediment and carry it into the main stream.

Exercise 1-6 MODERN COASTAL SEDIMENTS, NORTH CAROLINA

EXERCISES

1. Construct maps showing the distribution of each of the sediment components. See Table 6.

a. Draw a lithofacies map showing the distribution of sand. (Use a piece of tracing paper to overlay the location map, then transfer the values from the preceding table onto the tracing paper.) Contour the data using a contour interval of 10 percent.

b. Draw a lithofacies map showing the distribution of silt. Use a contour interval of 5 percent.

c. Draw a lithofacies map showing the distribution of clay. Use a contour interval of 5 percent.

See Fig. 1.31 a, b, and c

2. Compile a general lithofacies map showing the distribution of the sand-silt-clay sediment fractions, using boundaries defined by the following percentages:

a. Sand: greater than 60 percent sand = color in yellow.

b. Silt: greater than 15 percent silt = color in green.

c. Clay: greater than 5 percent clay = color in brown.

See Fig. 1.31d

3. Where is the general source for the sediments in the Pamlico River? Does this agree with your first impression?

Why or why not?

Derived from higher land adjacent to the river

4. If gold were associated with the coarsest sediment fraction, where would you recommend dredging? (Give two areas in order of preference.)

Banks of river or barrier island

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5. Oysters cannot tolerate clay concentration greater than 8 to 10 percent of total sediment. If a company wished to experiment with starfish in a closed pen, where would you recommend that it set up its experiment so as to not interfere with the oyster business? (Starfish are voracious predators of oysters.) Show the location on the lithofacies map in question 2 with a red pencil.

Anywhere with 80% sand or less

6. Would you expect nearby high mountains to the west to be the sediment source for the estuary of the Pamlico River? Explain your reasoning.

No, the sediments are too fine. No coarse conglomerates are present.

7. Following are water depths in feet at the various sample locations. On an overlay, draw a bathymetric map of the river and the bay. Use a contour interval of 5 feet.

See Fig. 1.31e

8. What seems to be the relationship between the depth of water and each of the three sediment facies (sand, silt, and clay) in the bay? Explain in your own terms what you consider to be the primary reasons for these relationships.

Shallow waters have sandy bottom due to wave and current energy winnowing out fine sediments.

9. Describe the topography of the river and sound.

Shallow water lagoon behind a barrier island and inlet; river channel leads from mainland to sound.

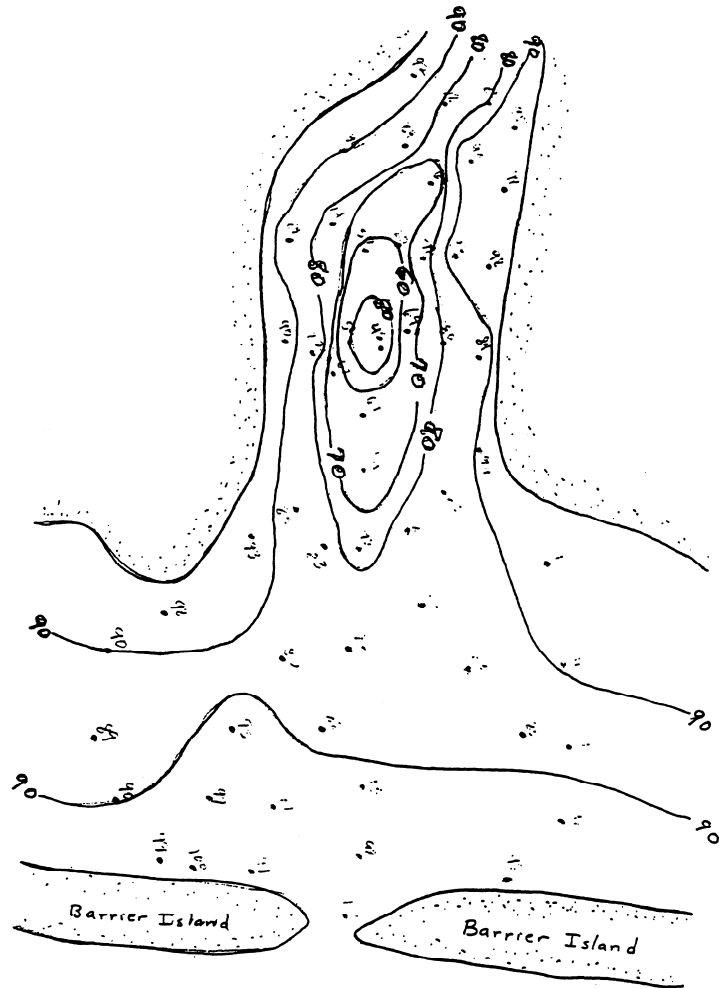


Figure 1.31 a. Distribution of sand