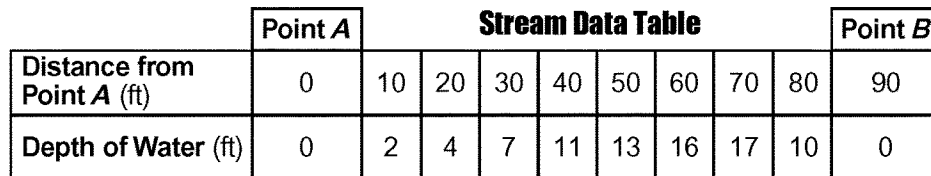


The map below represents a stream flowing into a lake. An arrow shows the direction of streamflow. Points A and B are locations at the edge of the stream. Line AB is a reference line across the stream surface. Line CD is a reference line along the lake bottom from the mouth of the stream into the lake. The data table gives the depth of the water and distance from point A , in feet, along line AB .



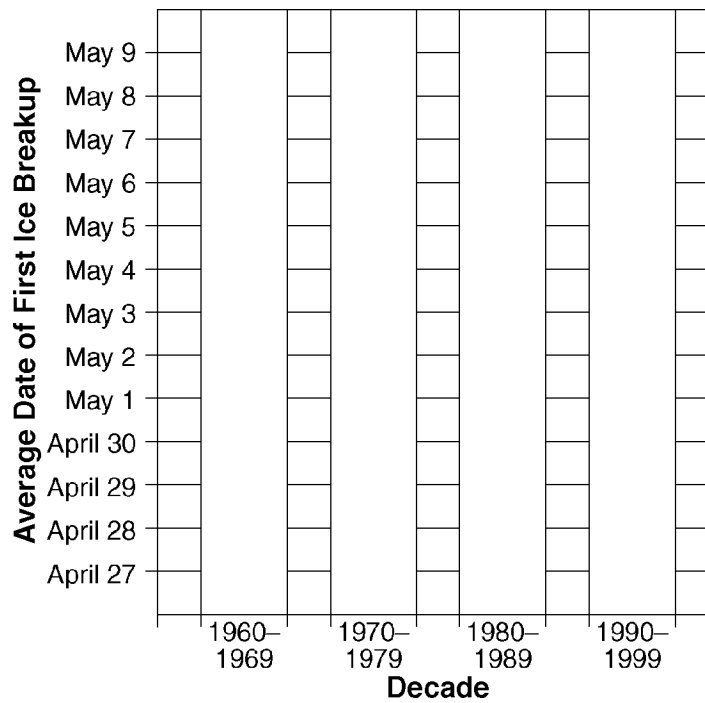
- 1) On the grid provided, construct a profile of the depth of water below line *AB* on the given map, following the directions below.
 - (a) Mark an appropriate numerical scale showing equal intervals on the axis labeled "Depth of Water". The zero (0) on the depth of water axis represents the stream surface.
 - (b) Using the data table, plot with an **X** the depth of water at each distance from point *A* to point *B*. Connect the **Xs** with a smooth, curved line. Points *A* and *B* have already been plotted.
- 2) The sediments being carried by the stream on the given map include clay, pebbles, sand, and silt. List these sediments in the most likely order of deposition from point *C* to point *D*.
- 3) Using the given map and the data table, explain why the depth of water 20 feet from point *A* is different from the depth of water 20 feet from point *B*.

- 4) The data table below shows the average date of the first breakup of ice on the Tanana River at Nenana, Alaska (65° N 149° W). The average date of the first ice breakup is shown for four decades.

DATA TABLE:

Decade	Average Date of First Ice Breakup
1960–1969	May 7
1970–1979	May 5
1980–1989	May 4
1990–1999	April 29

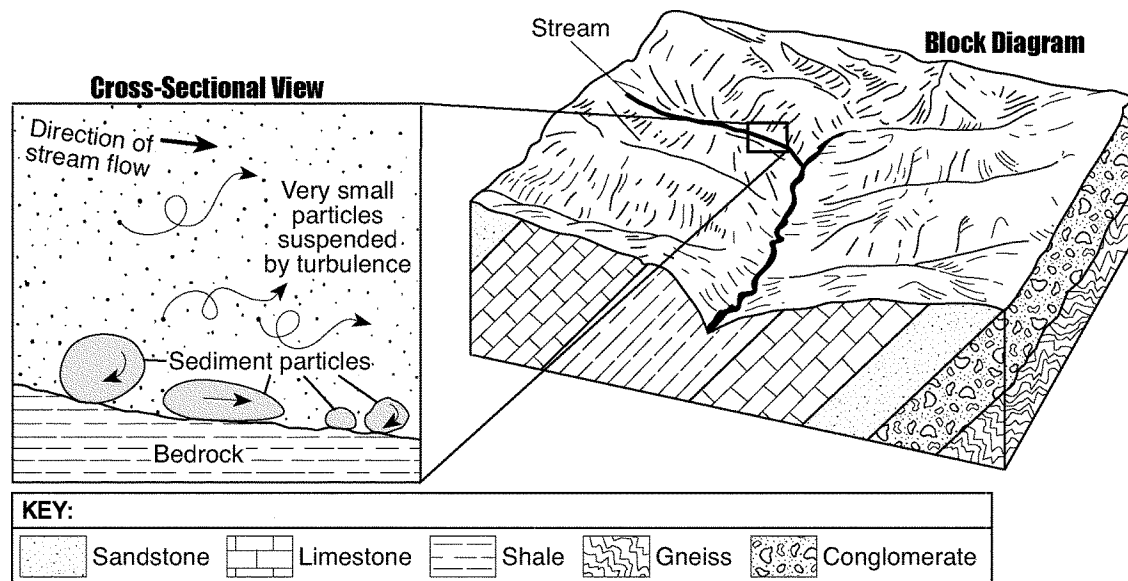
On the grid below, construct a bar graph of the average date of the first ice breakup for *each* decade shown in the data table.



- 5) Describe the arrangement of sediment found in a glacial moraine.

Questions 6 through 9 refer to the following:

The cross section below shows an enlarged view of the stream shown in the block diagram. The sediments in the cross section are drawn to actual size. Arrows show the movement of particles in the stream. The block diagram represents a region of Earth's surface and the bedrock beneath the region.



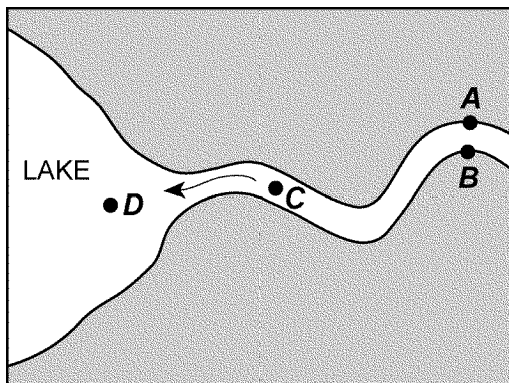
- | | |
|--|---|
| <p>6) How does the shape of a valley eroded by a glacier differ from the shape of the valley shown in the block diagram?</p> | <p>8) Identify the type of rock shown in the block diagram that appears to be the most easily eroded.</p> |
| <p>7) After measuring the actual size, identify the name of the <i>largest</i> particle shown on the stream bottom in the cross section shown.</p> | <p>9) What process is responsible for producing the rounded shape of the particles shown on the stream bottom in the given cross section?</p> |

- 10) Complete the table below by listing three agents of erosion and identifying *one* characteristic surface feature formed by each agent of erosion.

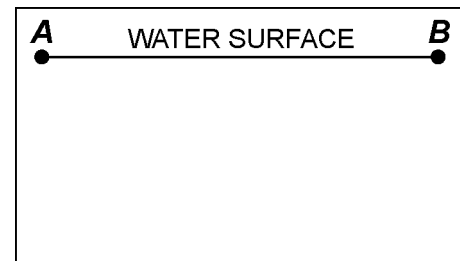
Agent of Erosion	Surface Feature Formed
(1)	
(2)	
(3)	

Questions 11 and 12 refer to the following:

The map below shows a meandering stream as it enters a lake. Points *A* through *D* represent locations in the stream.

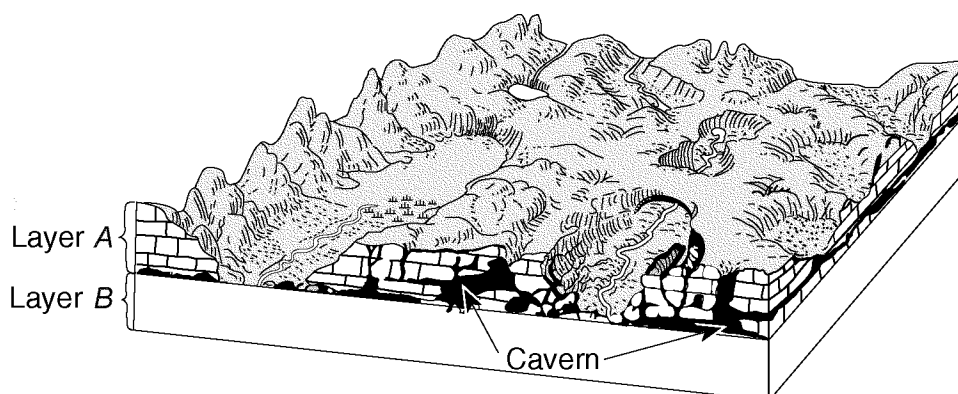


- 11) On the diagram below, draw a cross-sectional view of the general shape of the stream bottom between points *A* and *B* in the given stream map. The water surface line has already been drawn.



- 12) The stream velocity at point *C* in the map shown is 100 centimeters per second and the stream velocity at point *D* is 40 centimeters per second. Identify *one* sediment particle most likely being deposited between points *C* and *D*.

- 13) The block diagram below shows the landscape features of an area of Earth's crust. Two sedimentary rock layers, *A* and *B*, are labeled in the diagram. The rock symbol for layer *B* has been omitted.



Describe how the caverns formed in rock layer *A* of the given block diagram.

- 14) The data table shows the average monthly discharge, in cubic feet per second, for a stream in New York State.

Data Table

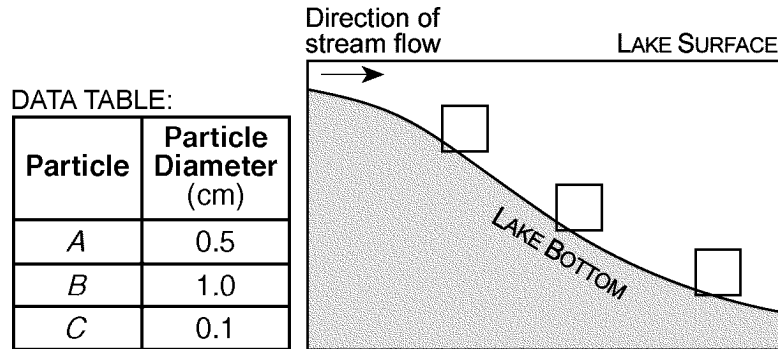
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Discharge (ft ³ /sec)	48	52	59	66	62	70	72	59	55	42	47	53

Based on the data given, state the relationship between this stream's discharge and the amount of suspended sediment that can be carried by this stream.

- | | |
|--|--|
| <p>15) Identify <i>one</i> source of pollution caused by human activity that contributes to precipitation becoming more acidic.</p> <p>16) Describe how the size and shape of <i>most</i> pebbles change when the pebbles are transported in a stream over a great distance.</p> | <p>17) State the relationship between stream velocity and the size of the sediment the stream can carry.</p> <p>18) What <i>two</i> pieces of evidence would a scientist most likely find to indicate that glaciers had once existed in an area?</p> |
|--|--|

Questions 19 and 20 refer to the following:

The data table below shows the diameters of three particles, *A*, *B*, and *C*, made of the same uniform material. These particles were carried by a stream into a lake. The cross-sectional diagram below shows the stream entering the lake.



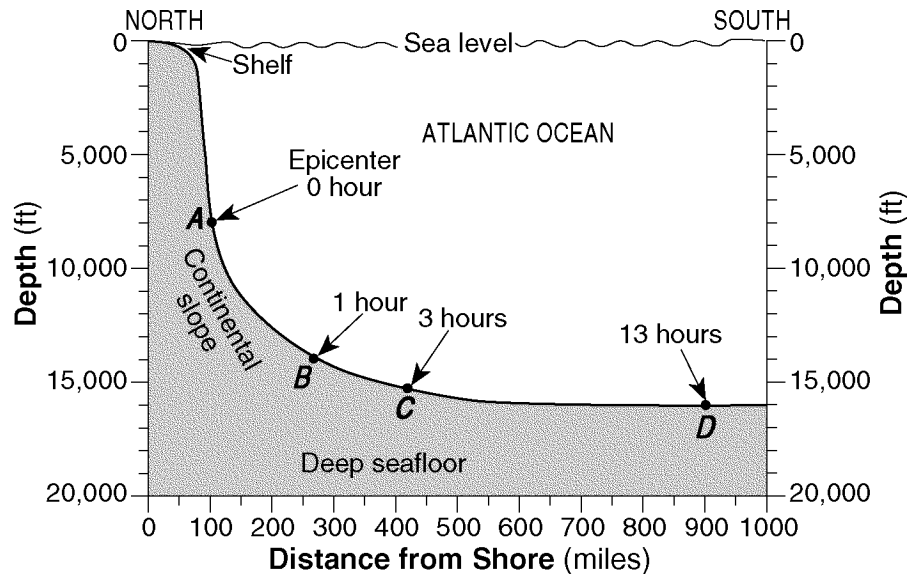
19) Explain why the given particles are deposited after the stream enters the lake.

20) On the diagram provided, indicate the expected pattern of deposition of the three particles by placing the letters *A*, *B*, and *C* in the appropriate boxes along the lake bottom.

21) Explain why acid rain can weather limestone bedrock.

Questions 22 and 23 refer to the following:

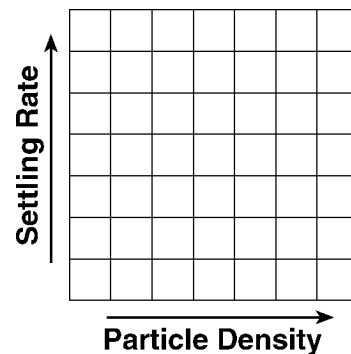
The cross section below represents part of the Atlantic Ocean seafloor. An earthquake occurred on November 18, 1929, triggering an underwater sediment flow. The location of the epicenter is labeled. Letters *A* through *D* indicate locations on the seafloor. Time, in hours, at each lettered location represents the arrival of the sediment flow after the earthquake.



22) Calculate the gradient of the ocean floor between locations *A* and *D* on the cross section shown and label your answer with the correct units.

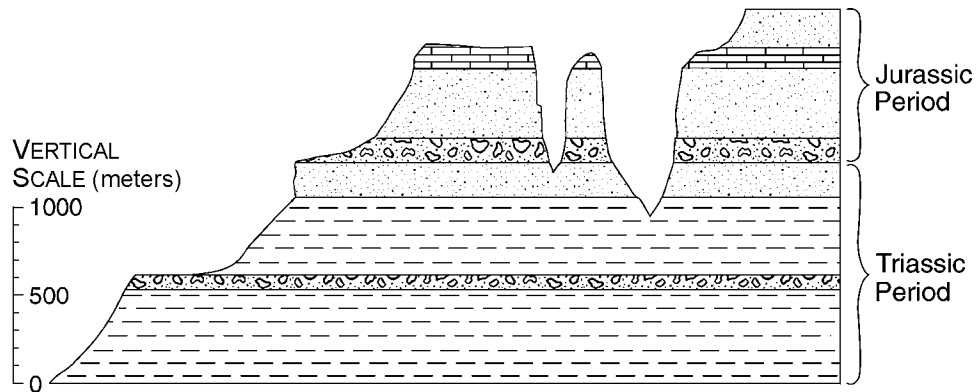
23) Explain why the velocity of the sediment flow created by the earthquake decreased as the sediment moved from location *B* to location *C* on the cross section shown.

24) Deposition is affected by particle density. On the grid below, draw a line to show the relationship between particle density and settling rate.



Questions 25 and 26 refer to the following:

The geologic cross section below shows the surface of a landscape region in the southwestern United States and indicates the age, type, and thickness of the bedrock.

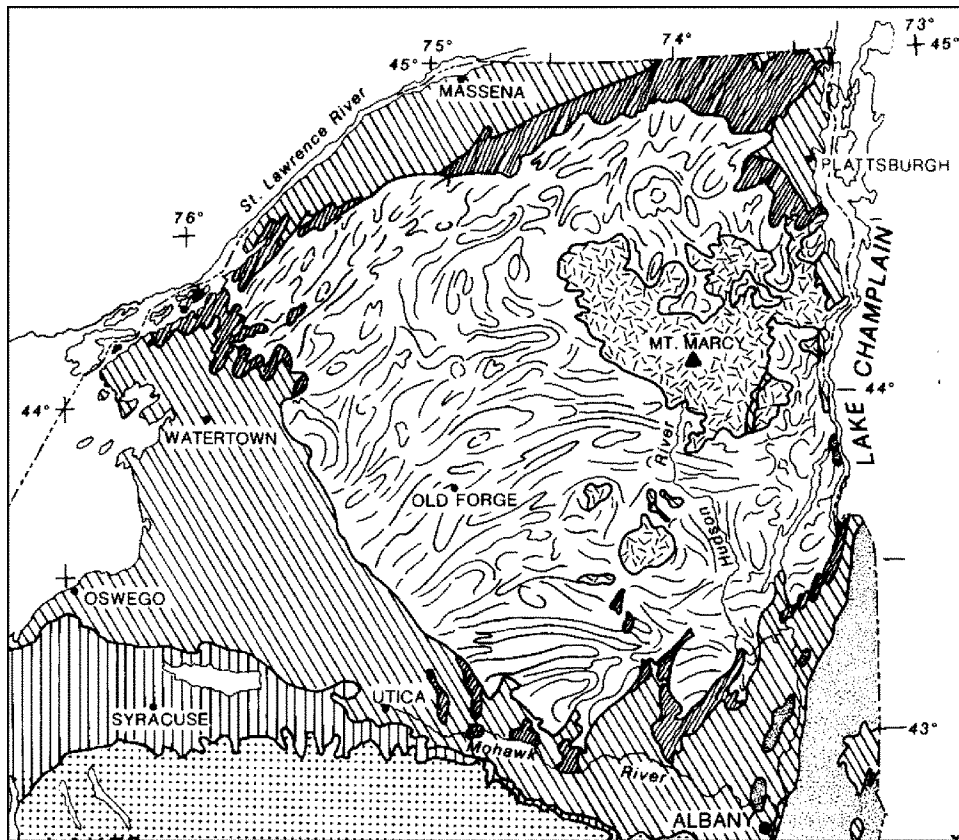


25) Which New York State landscape region has surface bedrock of the same geologic age as the surface bedrock shown in the cross section?

26) State *one* characteristic, other than the horizontal bedrock structure, shown in the cross section that supports the idea that this region is correctly classified as a plateau landscape.

Questions 27 through 29 refer to the following:

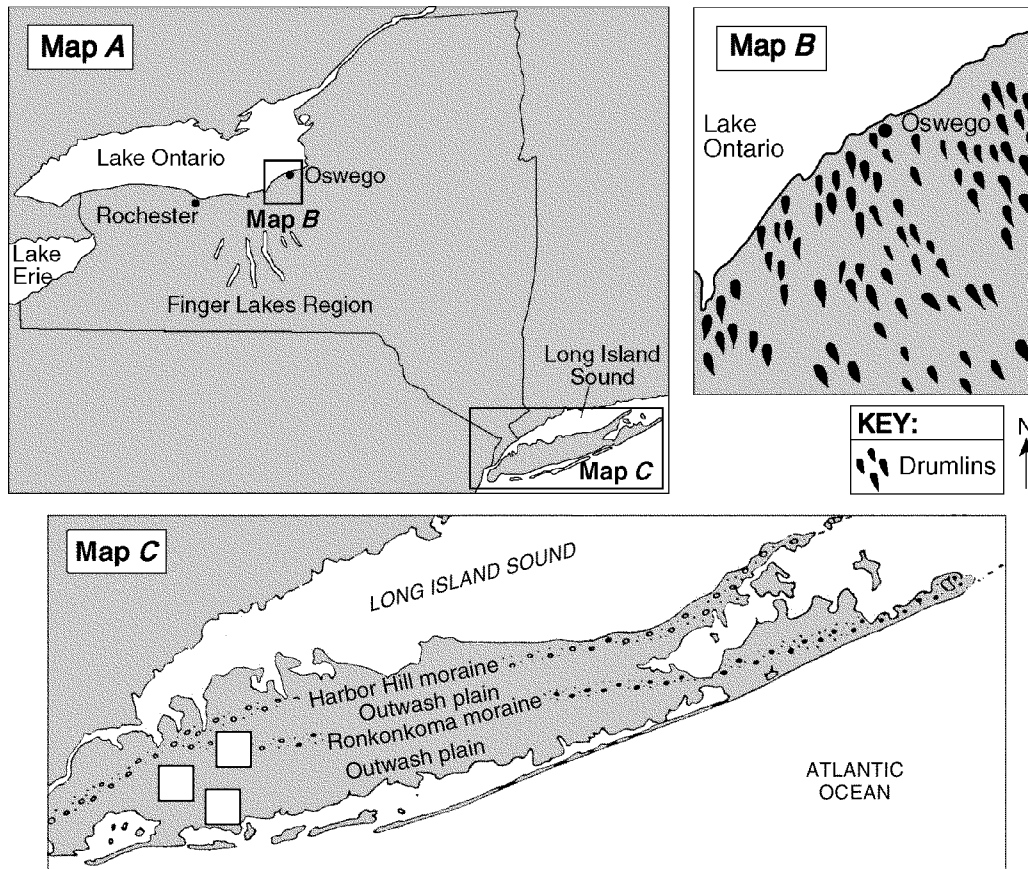
The map below shows the generalized surface bedrock for a portion of New York State.



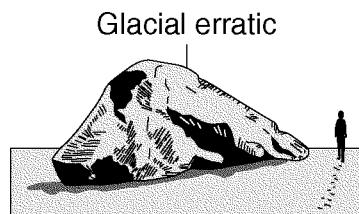
- | | |
|---|--|
| <p>27) Based on the map shown, state the longitude of Mt. Marcy, New York, to the nearest degree. <i>[The units and compass direction must be included in your answer.]</i></p> | <p>28) Based on the map shown, identify the geologic age and name of the surface metamorphic bedrock found at Mt. Marcy.</p> |
| | <p>29) Place an X on the map shown to represent a location in the Tug Hill Plateau landscape region.</p> |

Questions 30 through 33 refer to the following:

Map *A*, map *B*, and map *C* below show evidence that much of New York State was once covered by a glacial ice sheet. Map *A* shows the location of the Finger Lakes Region in New York State. The boxed areas on map *A* were enlarged to create maps *B* and *C*. Map *B* shows a portion of a drumlin field near Oswego, New York. Map *C*, shows the locations of glacial moraines and outwash plains on Long Island, New York.



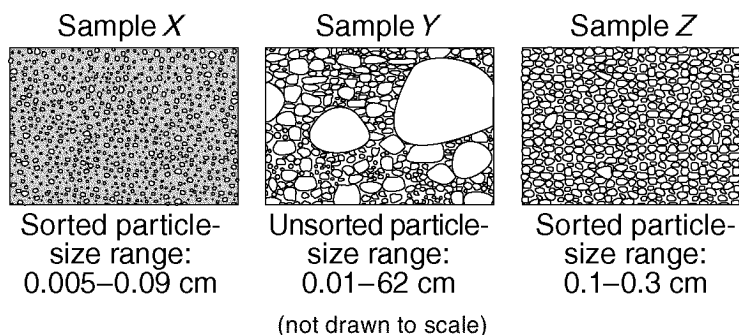
- 30) The drawing below shows a glacial erratic found on the beach of the north shore of Long Island near the Harbor Hill moraine. This boulder is composed of one-billion-year-old gneiss.



Which New York State landscape region has surface bedrock similar in age to this erratic?

- 31) The arrangement of the drumlins on map *B* indicates that a large ice sheet advanced across New York State in which compass direction?

- 32) The diagrams below represent three sediment samples labeled *X*, *Y*, and *Z*. These samples were collected from three locations marked with empty boxes ☐ on map *C*.

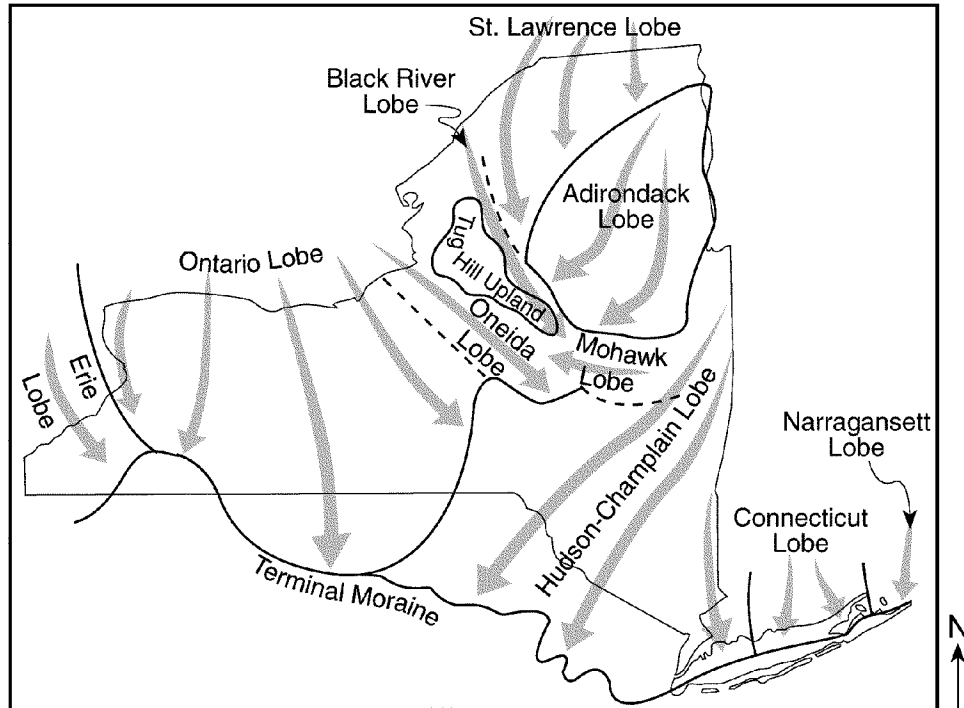


Write the letter of each sample in the correct box on map *C* to indicate the location from which each sample was most likely collected.

- 33) Explain how global warming on present-day continental glaciers could affect New York City and Long Island.

Questions 34 through 36 refer to the following:

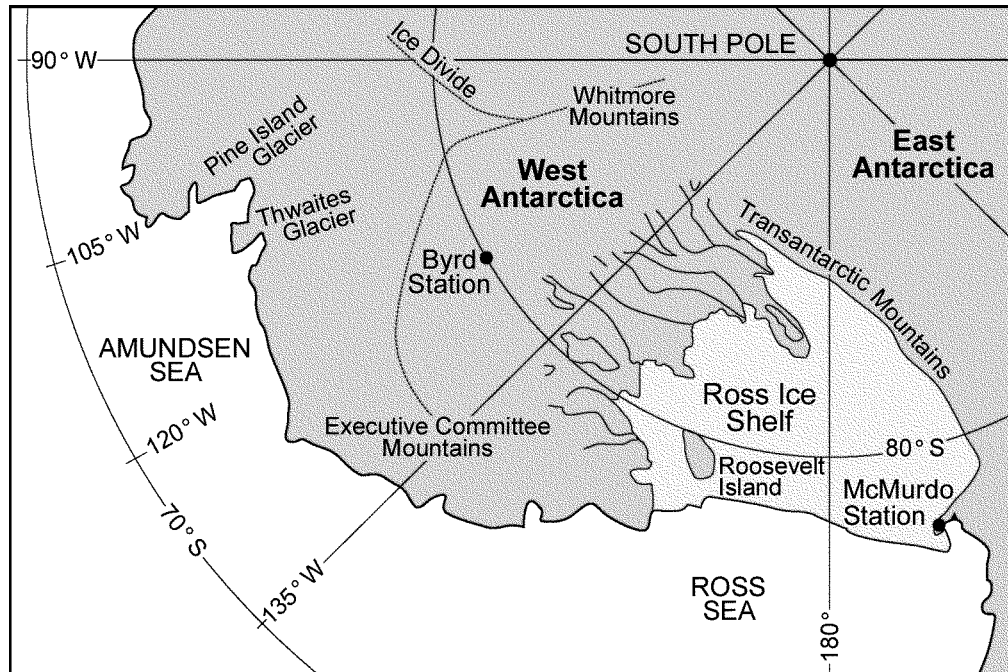
The map below shows the different lobes (sections) of the Laurentide Ice Sheet, the last continental ice sheet that covered most of New York State. The arrows show the direction that the ice lobes flowed. The terminal moraine shows the maximum advance of this ice sheet.



- | | |
|---|---|
| <p>34) Describe the arrangement of rock material in the sediments that were directly deposited by the glacier represented by the map.</p> | <p>36) What evidence might be found on surface bedrock of the Catskills that would indicate the direction of ice flow in the region shown by the map?</p> |
| <p>35) According to the map, toward which compass direction did the ice lobe flow over the Catskills?</p> | |

- 37) The map below shows a portion of the continent of Antarctica. The size and shape of the West Antarctic Ice Sheet depends on many factors, including melting and freezing beneath the glacier, the amount of snowfall, snow removal by wind, iceberg formation, and the rate of ice flow. Glacial moraines are found in the Executive Committee Mountains shown on the map. Moraines are located up to 100 meters in elevation above the present ice sheet surface, which indicates that a thicker ice sheet existed 20,000 years ago.

The world's oceans and climate are influenced by Antarctica's ice. Even a small increase in sea level from melting glaciers would be a disaster for the nearly two billion people who live near coastal areas.



Based on the given information, identify *one* piece of evidence found on the sides of some Antarctic mountains that indicates that an ice sheet, hundreds of meters thicker than the current ice sheet, existed in the past.

Questions 38 through 40 refer to the following:

The passage below describes the geologic history of the Pine Bush region near Albany, New York. The cross section below shows the bedrock and overlying sediment along a southwest to northeast diagonal line through a portion of this area. Location *A* shows an ancient buried stream channel and location *B* shows a large sand dune.

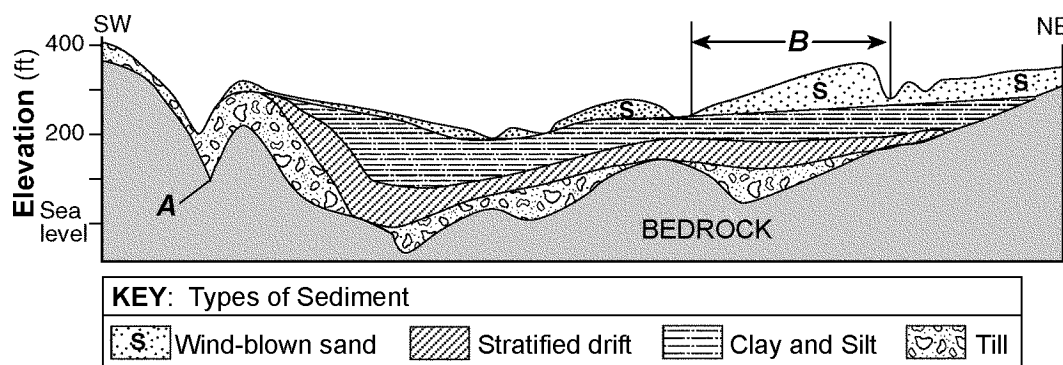
THE PINE BUSH REGION:

The Pine Bush region, just northwest of Albany, New York, is a 40-square mile area of sand dunes and wetlands covered by pitch pine trees and scrub oak bushes. During the Ordovician Period, this area was covered by a large sea. Layers of mud and sand deposited in this sea were compressed into shale and sandstone bedrock.

During most of the Cenozoic Era, running water eroded stream channels into the bedrock. One of these buried channels is shown at location *A* in the cross section. Over the last one million years of the Cenozoic Era, this area was affected by glaciation. During the last major advance of glacial ice, soil and bedrock were eroded and later deposited as till (a mixture of boulders, pebbles, sand, and clay).

About 20,000 years ago, the last glacier in New York State began to melt. The meltwater deposited pebbles and sand, forming the stratified drift. During the 5,000 years it took to melt this glacier, the entire Pine Bush area became submerged under a large 350-foot-deep glacial lake called Lake Albany. Delta deposits of cobbles, pebbles, and sand formed along the lake shorelines, and beds of silt and clay were deposited farther into the lake.

Lake Albany drained about 12,000 years ago, exposing the lake bottom. Wind and erosion created the sand dunes that cover much of the Pine Bush area today.

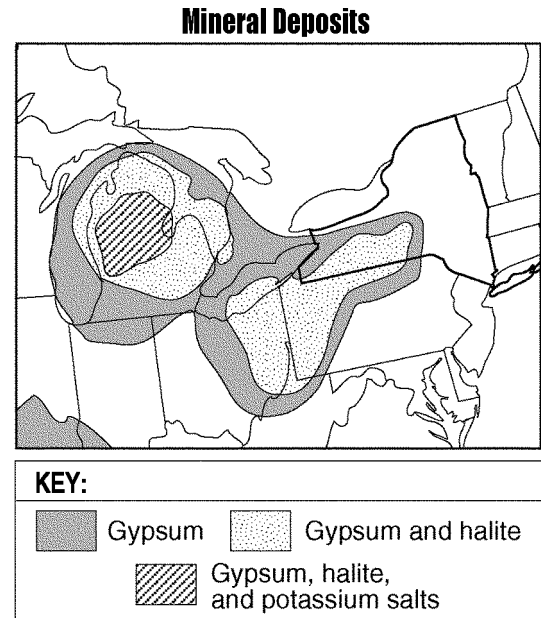


38) Explain why the till layer shown in the cross section is composed of unsorted sediment.

39) How does the shape of the sand dune at location *B* in the diagram provide evidence that the prevailing winds that formed this dune were blowing from the southwest?

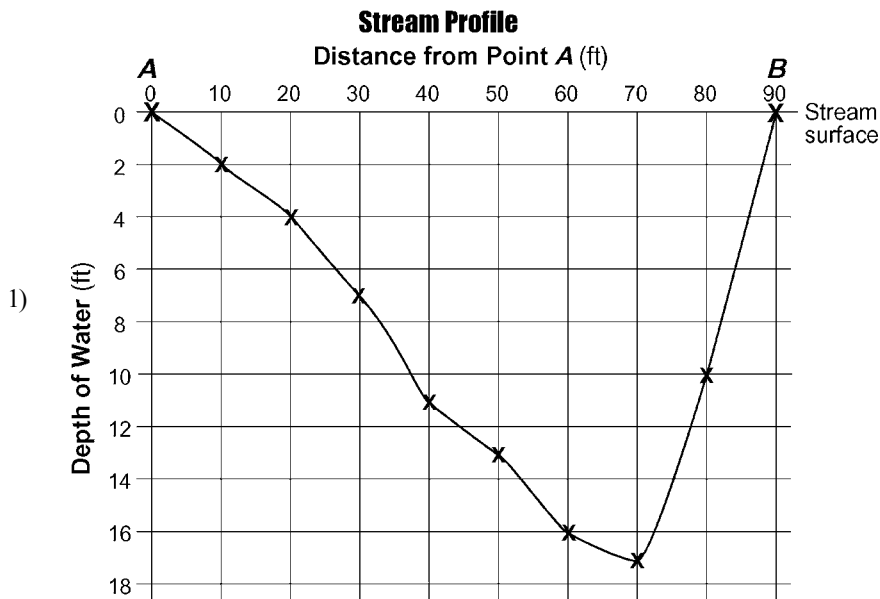
- 40) What evidence shown at location *A* in the given cross section suggests that the channel in the bedrock was eroded by running water?

- 41) The map below shows the approximate area in a portion of North America where some sedimentary rock layers composed of gypsum, halite, and potassium salt minerals are found in Earth's crust.



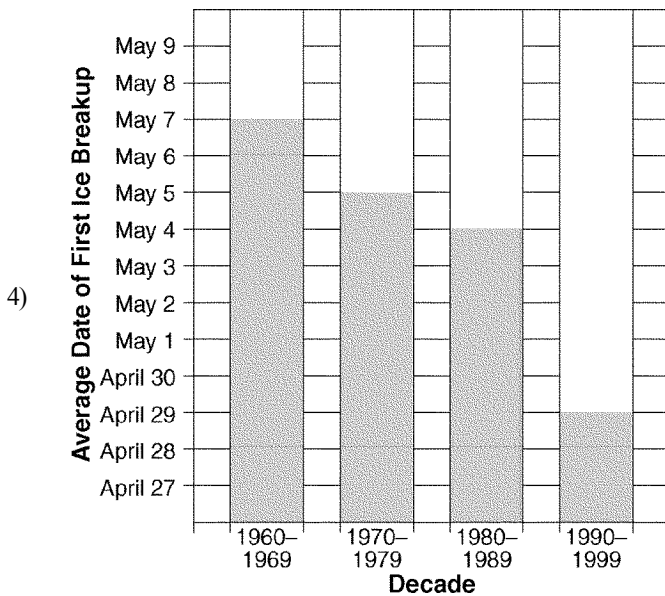
Based on the given map, identify *one* New York State landscape region in which deposits of gypsum and halite are commonly found.

- 42) Part of which generalized New York State landscape region is drained by the Susquehanna River and its tributaries?



2) pebbles → sand → silt → clay
 Point C → Point D

3) SAMPLE ANSWERS: More deposition has occurred on the inside of the meander. OR Stream water moves slower on the inside curve. OR More erosion occurs on the outside of a bend. OR B is located on the outside of a meander.



5) SAMPLE ANSWERS: unsorted OR mixed OR not in layers

6) SAMPLE ANSWERS: A glacier forms a U-shaped valley. OR Glaciers form U-shaped valleys and streams form V-shaped valleys.

7) pebble

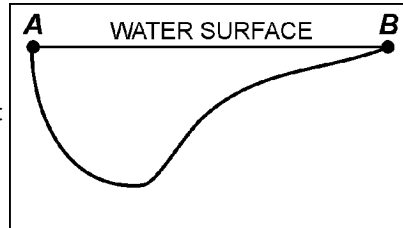
8) shale

9) SAMPLE ANSWERS: abrasion OR weathering OR erosion OR Particles were worn down as they were scraped along the bedrock.

10) SAMPLE ANSWERS:

Agent of Erosion	Surface Feature Formed
Waves	beach, sandbars, barrier islands
Wind	loss of topsoil, dunes
Glacier	U-shaped valley, moraines, drumlins
Running water (streams)	V-shaped valley, deltas, meanders
Mass movement	landslides, slumps

11) SAMPLE ANSWER:



Any drawing that indicates the water is deeper near point A.

12) pebbles or sand

13) SAMPLE ANSWERS: Limestone reacts with acids in groundwater. OR Acids in water cause limestone to dissolve. OR chemical weathering of limestone OR Water flowing through cracks removes limestone.

14) SAMPLE ANSWERS: As stream discharge increases, suspended sediment increases. OR There is a direct relationship between stream discharge and suspended sediment.

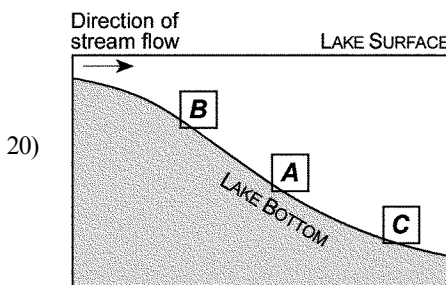
15) SAMPLE ANSWERS: burning fossil fuels OR exhaust emission from automobiles OR smoke from factories

16) SAMPLE ANSWERS: Size: The pebbles become smaller. OR The size of the pebbles decreases.
Shape: The pebbles become rounder. OR The pebbles become more spherical.

17) SAMPLE ANSWERS: a direct relationship OR As the stream velocity increases, the stream can carry bigger sediment.

18) SAMPLE ANSWERS: U-shaped valleys in the area OR parallel scratches in the bedrock OR unsorted sediment deposits OR moraines OR drumlins

19) SAMPLE ANSWERS: The water velocity decreases. OR The particles slow down.

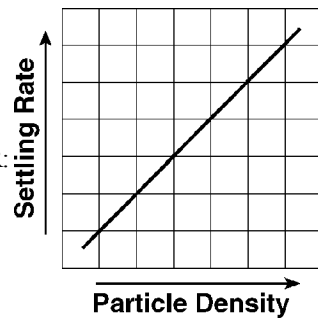


21) SAMPLE ANSWERS: The acid rain dissolves the limestone. OR The calcite in limestone chemically reacts with the acid.

22) Any value from 9.75 to 10.25 with the correct units of ft/mi OR feet/mile OR ft per mile

23) SAMPLE ANSWERS: The slope decreased. OR The gradient decreased from location B to location C. OR The surface was steeper near B and flatter near C.

24) SAMPLE ANSWER:



Any graphed straight or curved line that shows a direct relationship.

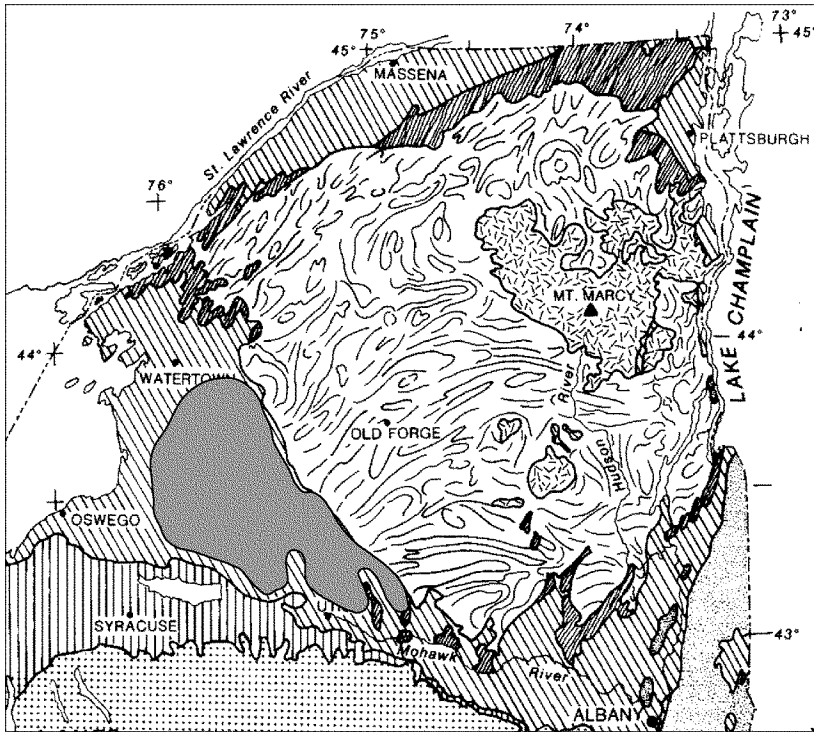
25) Newark Lowlands

26) SAMPLE ANSWERS: The landscape has a high relief. OR There is a large difference in elevation between the top and bottom rocks in the cross section. OR steep slopes OR high elevation

27) 74° W

28) SAMPLE ANSWERS: Geologic age: Proterozoic OR Middle Proterozoic OR Precambrian OR about 1000 million years; Name of bedrock: anorthosite OR anorthositic

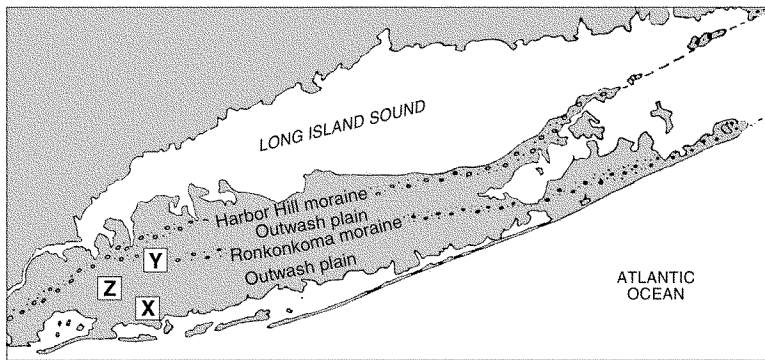
29) Center of the X should be located within the shaded area shown.



30) Hudson Highlands OR Adirondack Mountains

31) SAMPLE ANSWERS: southeastward OR from NW to SE OR south-southeastward OR from N to S

Map C



32)

- 33) SAMPLE ANSWERS: Global warming will cause glaciers to melt, which will raise the sea level. OR New York City and Long Island could be flooded when the sea level rises.
- 34) SAMPLE ANSWERS: Glacial sediment is unsorted. OR piles of mixed sediment sizes
- 35) SAMPLE ANSWERS: southwest (SW) OR south southwest (SSW)
- 36) SAMPLE ANSWERS: parallel scratches OR grooves OR striations OR orientation of glacial features, such as drumlins and lateral moraines
- 37) SAMPLE ANSWERS: moraines OR grooved bedrock OR scratched bedrock OR polished bedrock OR U-shaped valleys
- 38) SAMPLE ANSWERS: Glacial deposits are unsorted. OR Till is a direct ice deposit.
- 39) SAMPLE ANSWERS: The gentle slope of the dune is on the southwest side. OR The windward side has a less steep slope. OR The steeper side is leeward.
- 40) SAMPLE ANSWERS: The channel at A has a V-shape. OR Running water produces V-shaped channels.
- 41) SAMPLE ANSWERS: Allegheny Plateau OR Erie-Ontario Lowlands OR Appalachian Plateau
- 42) SAMPLE ANSWERS: Allegheny Plateau OR Appalachian Plateau (uplands) OR Catskills