1. Which rock material was most likely transported to its present location by a glacier?

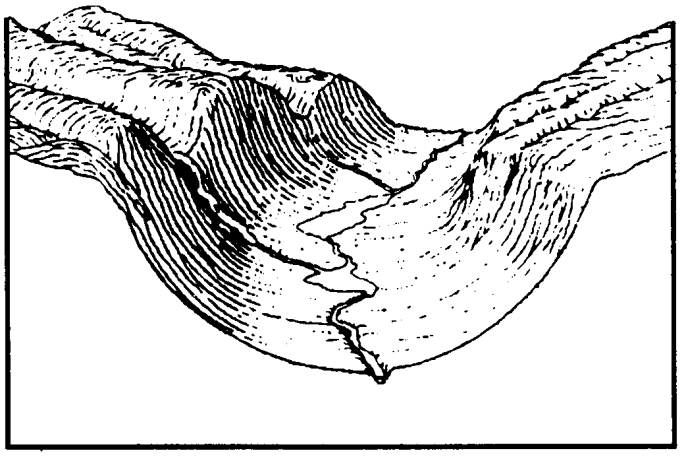
   A) rounded sand grains found in a river delta
   B) rounded grains found in a sand dune
   C) residual soil found on a flat plain
   D) unsorted loose gravel found in hills

2. The photograph below shows a valley.

   Which agent of erosion most likely produced this valley's shape?

   A) wave action  B) moving ice
   C) blowing wind  D) flowing water

3. The diagram below represents the surface topography of a mountain valley.



   Which agent of erosion most likely created the shape of the valley shown in the diagram?

   A) wind  B) glaciers
   C) ocean waves  D) running water

4. Which is the best evidence that more than one glacial advance occurred in a region?

   A) ancient forests covered by glacial deposits
   B) river valleys buried deeply in glacial deposits
   C) scratches in bedrock that is buried by glacial deposits
   D) glacial deposits that overlay soils formed from glacial deposits

5. The photograph below shows a large boulder of metamorphic rock in a field in the Allegheny Plateau region of New York State.

   The boulder was most likely moved to this location by

   A) glacial ice  B) prevailing wind
   C) streamfiow  D) volcanic action

Base your answers to questions **6** through **9** on the reading passage below and on your knowledge of Earth science.

**Roche Moutonée**

A roche moutonée is a glacial landscape feature produced as an advancing glacier slides over a hill of surface bedrock. As the glacier advances up the side of the hill, the surface bedrock is abraded and smoothed by rock fragments carried within the base of the glacial ice, creating a more gentle hillslope. As the glacier advances down the opposite side of the hill, chunks of bedrock are broken off and removed by the ice, a process called glacial quarrying (plucking), making this side of the hill steeper. The resulting hill resembles a drumlin, except it is often smaller and is composed of solid rock.

6. The formation of a roche moutonée by glaciers is best described as an example of

A) chemical weathering
B) physical weathering
C) sediment deposition
D) mass movement

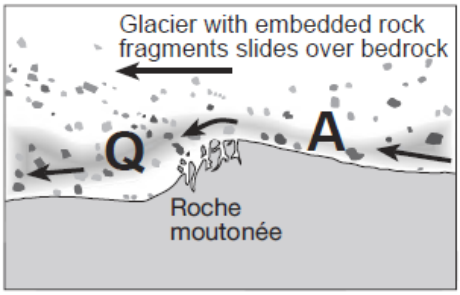
7. A drumlin differs from a roche moutonée because a drumlin is

A) formed by glaciers
B) dome shaped
C) deposited by glacial meltwater
D) composed of loose sediments

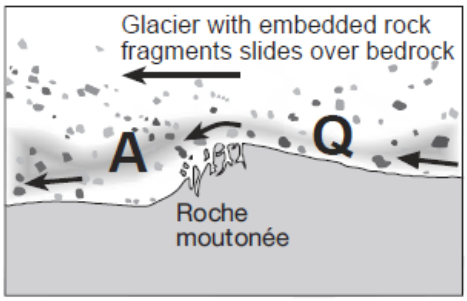
8. Which side-view model best shows the direction of ice movement and the locations of glacial abrasion and glacial quarrying that form a roche moutonée?

| Key | |
|---|---|
| **A** = Glacial abrasion | **Q** = Glacial quarrying |

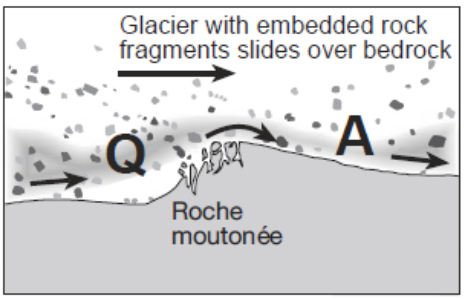
A)



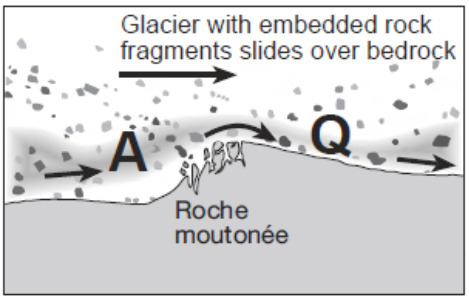

B)




C)




D)



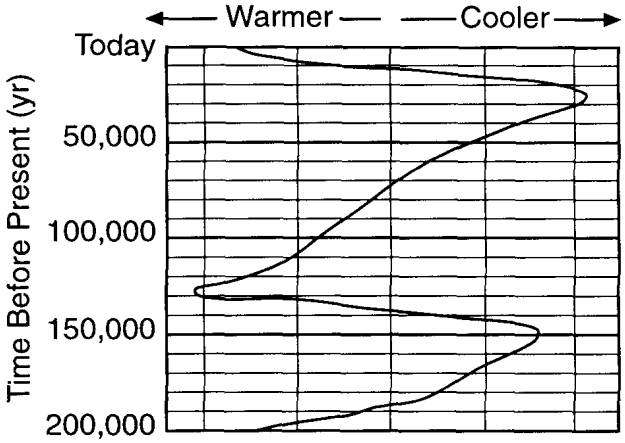

9. The chunks of bedrock removed by glacial quarrying and transported by the glaciers most likely produce

A) terminal outwash plains
B) kettle lake depressions
C) V-shaped valleys
D) parallel scratches in surface bedrock

10. A large, scratched boulder is found in a mixture of unsorted, smaller sediments forming a hill in central New Jersey. Which agent of erosion most likely transported and then deposited this boulder?

A) wind B) a glacier
C) ocean waves D) running water

11. The diagram below shows trends in the temperature of North America during the last 200,000 years, as estimated by scientists.



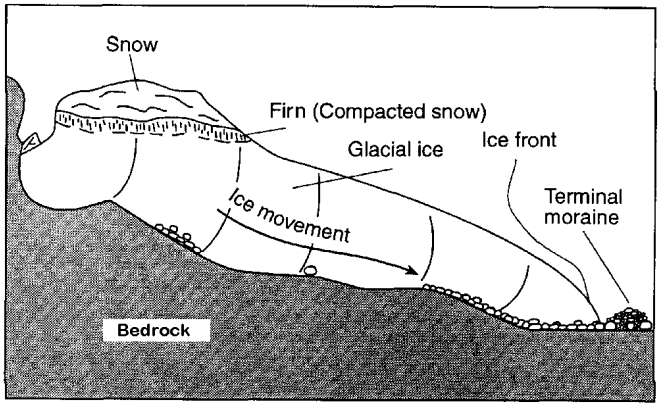

What is the total number of major glacial periods that have occurred in North America in the last 200,000 years?

A) 5 B) 2 C) 3 D) 4

12. Which statement identifies a result of glaciation that has had a positive effect on the economy of Connecticut?

A) Large amounts of oil and natural gas were formed.
B) The number of usable water reservoirs was reduced.
C) Many deposits of sand and gravel were formed.
D) Deposits of fertile soil were removed.

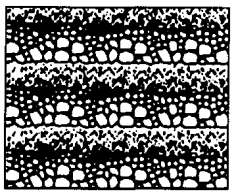
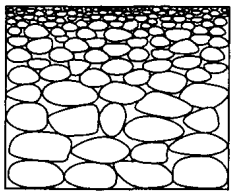
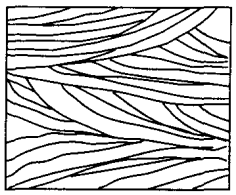
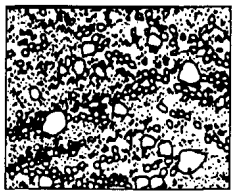
Base your answers to questions **13** through **15** on the diagram which represents a profile of a mountain glacier in the northern United States.




13. Over a period of years, this glacier gains more snow mass than it loses. What will be the most likely result of this gain?

A) The glacier will decrease in size, and the ice front will retreat.
B) The glacier will decrease in size, and the ice front will advance.
C) The glacier will increase in size, and the ice front will retreat.
D) The glacier will increase in size, and the ice front will advance.

14. Which cross section best represents the sediment that was transported and deposited by this glacier?

A) 
B) 
C) 
D) 

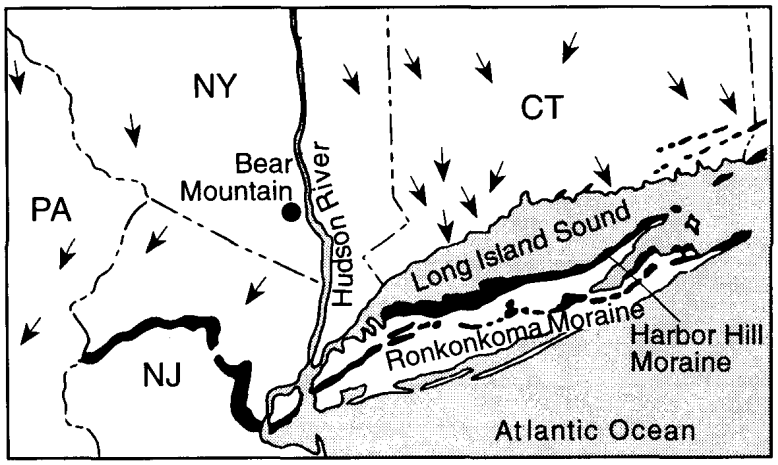
15. The velocity of the ice movement is primarily controlled by the

A) slope of the bedrock surface
B) amount of sediment at the terminal moraine
C) length of the glacier
D) size of the sediment transported by the glacier

16. Which landscape feature was most likely formed by glacial activity?

A) an eroded plateau B) a flat floodplain
C) a U-shaped valley D) a V-shaped valley

Base your answers to questions **17** through **20** on the map below. Arrows on the map show the location and orientation of glacial striations on the surface bedrock. Dark shading shows the location of large moraines (glacial deposits).




17. The striations indicate that the movement of glacial ice was toward the

A) northeast and northwest B) northeast and southwest
C) southeast and northwest D) southeast and southwest

18. The moraines are recognized as glacial deposits because they are composed of rock materials that are

A) uniform in size and layered B) uniform in size and not layered
C) many different sizes and layered D) many different sizes and not layered

19. Observations of which feature would be most useful in determining the thickness of the ice sheet?

A) grooved bedrock near the top of Bear Mountain
B) glacial soils in southern Connecticut
C) glacial boulders at the bottom of Long Island Sound
D) scratches on loose rock at the mouth of the Hudson River

20. How were the striations made?

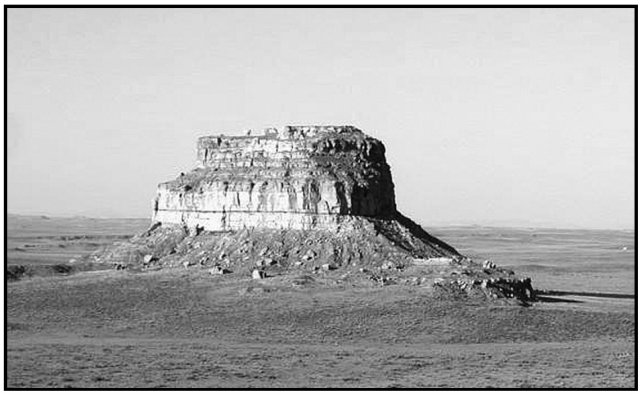
A) Frost action cracked the bedrock during the ice age.
B) Rocks at the bottom of the glaciers were dragged over the bedrock.
C) Particles carried by winds scratched the bedrock during the ice age.
D) Particles carried by glacial meltwater eroded the bedrock.

21. The photograph below shows both erosional and depositional features formed by an agent of erosion.

Which agent of erosion produced the features shown in the photograph?

A) running water
B) glacial ice
C) ocean waves
D) prevailing wind

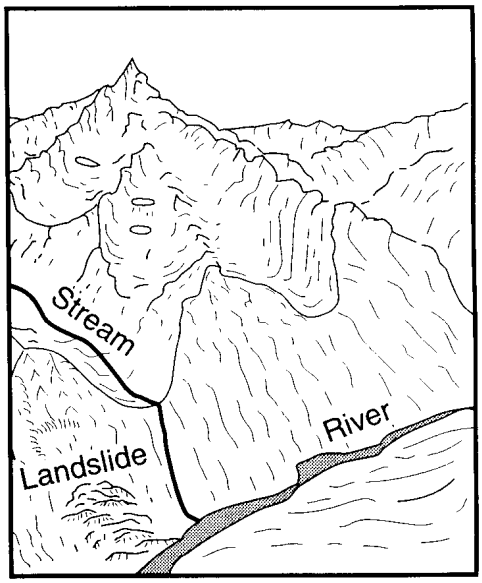
22. The photography below shows a sandstone butte in an arid region.



Which agents of erosion are currently changing the appearance of this butte?

A) glaciers and mass movement
B) wave action and running water
C) wind and mass movement
D) running water and glacier

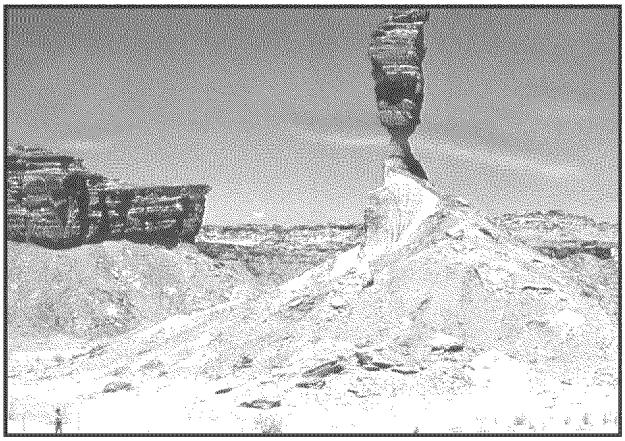
23. The diagram below shows a glacial landscape.




Which evidence suggests that ice created this landscape?

A) U-shaped valleys
B) many stream valleys
C) sorted sediment on the valley floor
D) the landslide near the valley

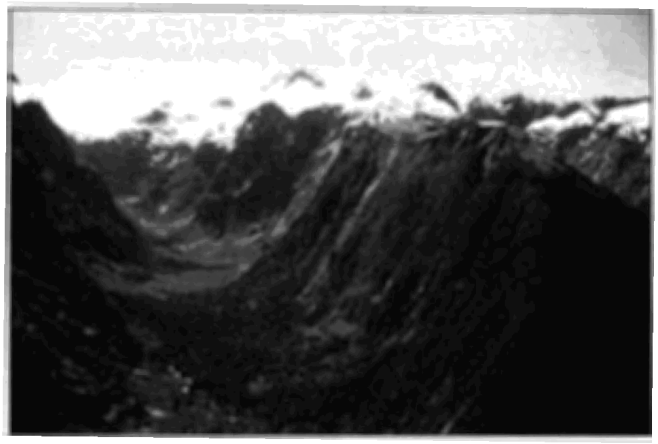
24. The picture below shows a geological feature in the Kalahari Desert of southwestern Africa.



Which process most likely produced the present appearance of this feature?

A) wind erosion
B) volcanic eruption
C) earthquake vibrations
D) plate tectonics

25. The photograph below shows a valley.



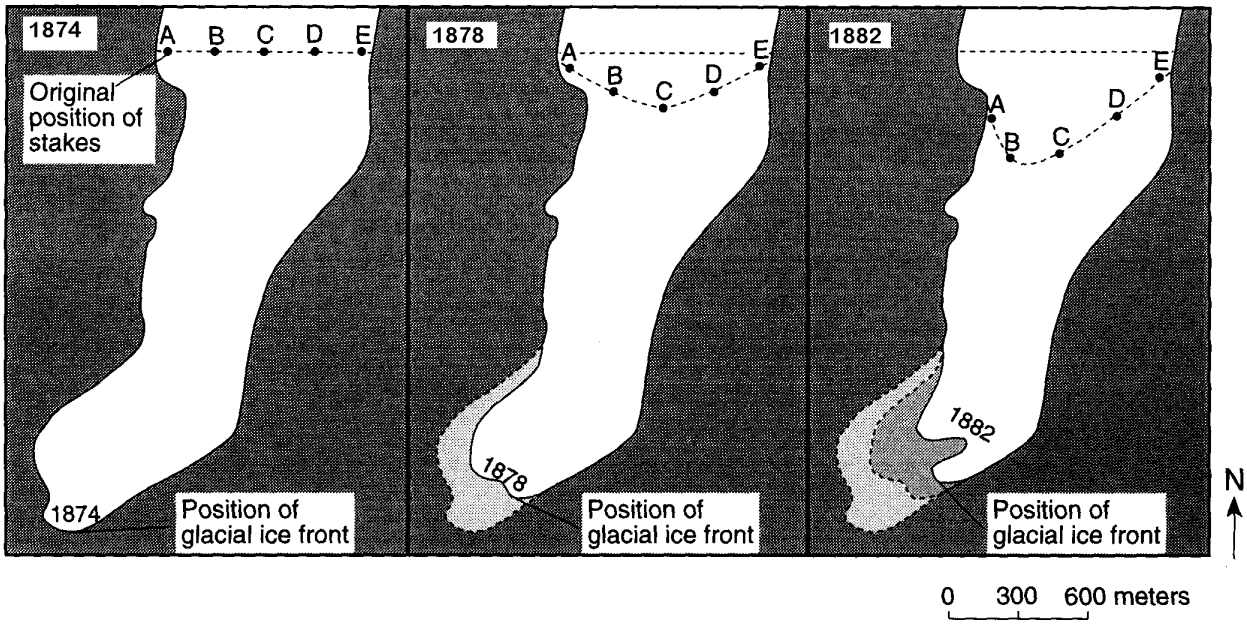
Which agent of erosion most likely produced this valley's shape?

A) blowing wind B) ocean waves
C) moving ice D) running water

26. The particles in a sand dune deposit are small and very well-sorted and have surface pits that give them a frosted appearance. This deposit most likely was transported by

A) ocean currents B) glacial ice
C) gravity D) wind

Base your answers to questions **27** and **28** on the three maps below, which show the ice movement and changes at the ice front of an alpine glacier from the years 1874 to 1882. Points A, B. C, D, and E represent the positions of large markers placed on the glacial ice and left there for a period of eight years.




27. The changing positions of markers A, B. C, D, and E show that the glacial ice is

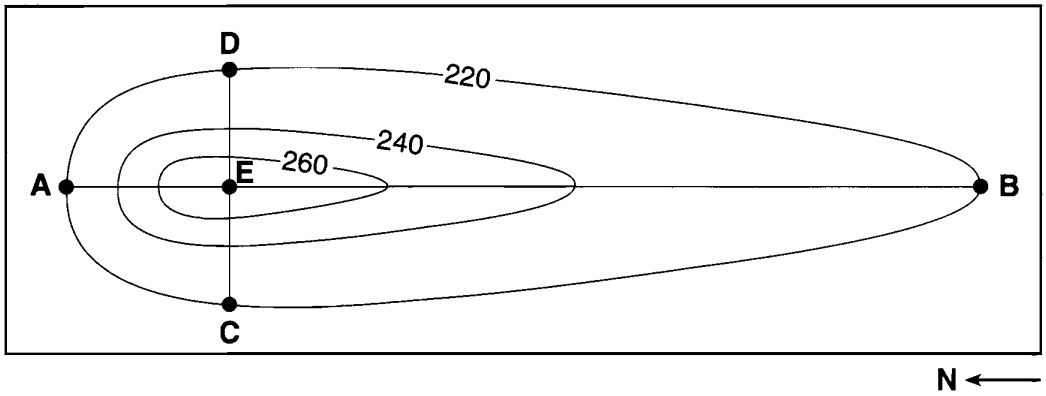
A) slowly becoming thicker
B) forming smaller crystals
C) gradually shifting northward
D) moving fastest near the middle

28. Which statement best describes the changes happening to this glacier between 1874 and 1882?

A) The ice front was advancing, and the ice within the glacier was advancing.
B) The ice front was advancing, and the ice within the glacier was retreating.
C) The ice front was retreating, and the ice within the glacier was advancing.
D) The ice front was retreating, and the ice within the glacier was retreating.

Base your answers to questions **29** and **30** on the contour map below, which shows a hill formed by glacial deposition near Rochester, New York. Letters *A* through *E* are reference points. Elevations are in feet.

**Contour Map**




29. Which set of characteristics most likely describes the sediment in this glacial deposit?

A) sorted and layered
B) sorted and not layered
C) unsorted and not layered
D) unsorted and layered

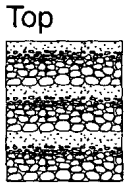
30. This glacial deposit is best identified as

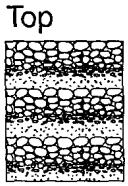
A) a V-shaped valley
B) a sand dune
C) a drumlin
D) an outwash plain

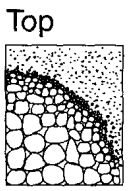
31. How would unsorted piles of angular sediments most likely be transported and deposited?

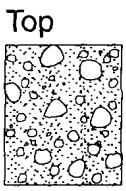
A) wind
B) glaciers
C) ocean waves
D) running water

32. Which diagram best represents a cross section of the sediment deposited directly by a glacier?

A) 


B) 


C) 


D) 

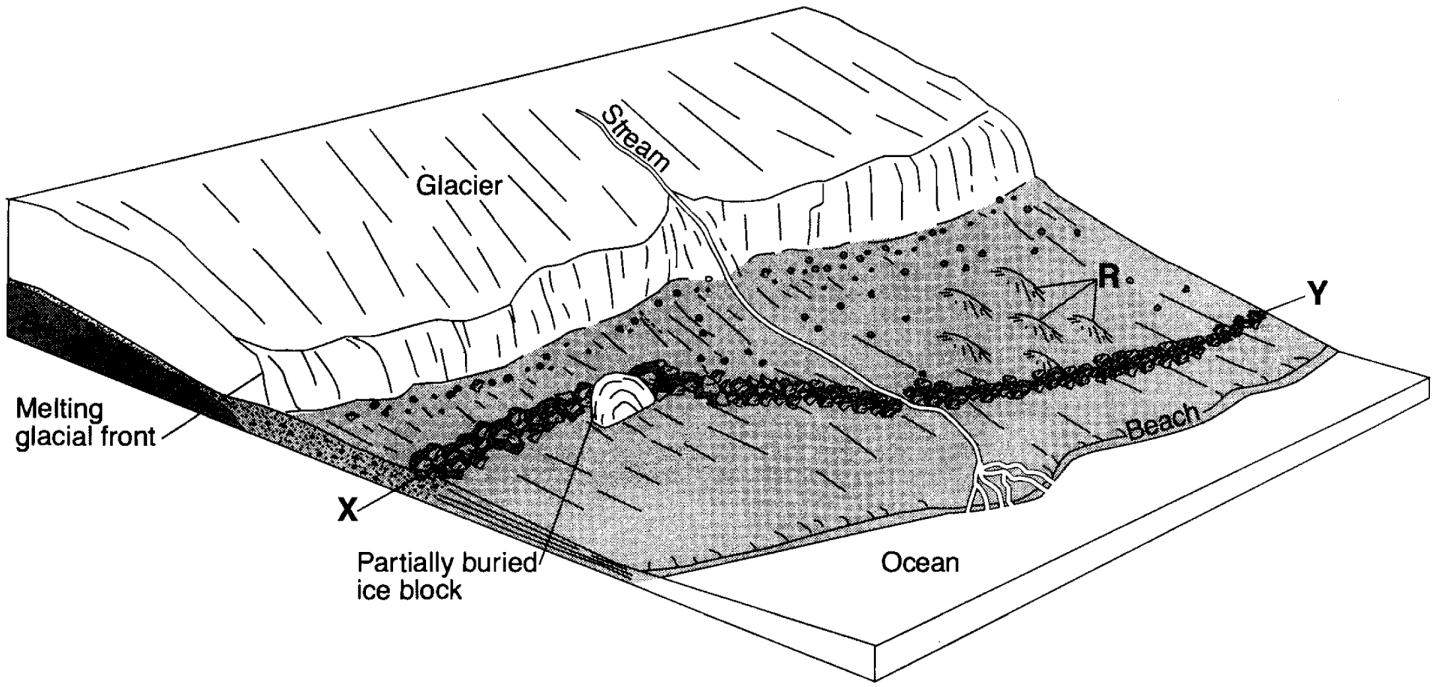

33. The natural sandblasting (abrasion) of surface bedrock in a desert region is the result of

A) wind erosion
B) wave erosion
C) mass movement
D) chemical precipitation

34. Which condition causes glaciers to retreat?

A) They encounter the ocean.
B) The crust beneath them is uplifted.
C) Earth's average temperature decreases.
D) Their rate of melting exceeds their rate of advancing.

Base your answers to questions **35** through **37** on the diagram below, which shows the edge of a continental glacier that is receding. *R* indicates elongated hills. The ridge of sediments from *X* to *Y* represents a landscape feature.




35. The ridge of sediments from *X* to *Y* can best be described as

A) sorted and deposited by ice
B) sorted and deposited by meltwater
C) unsorted and deposited by ice
D) unsorted and deposited by meltwater

36. The elongated hills labeled *R* are most useful in determining the

A) age of the glacier
B) direction the glacier has moved
C) thickness of the glacier
D) rate at which the glacier is melting

37. Which feature will most likely form when the partially buried ice block melts?

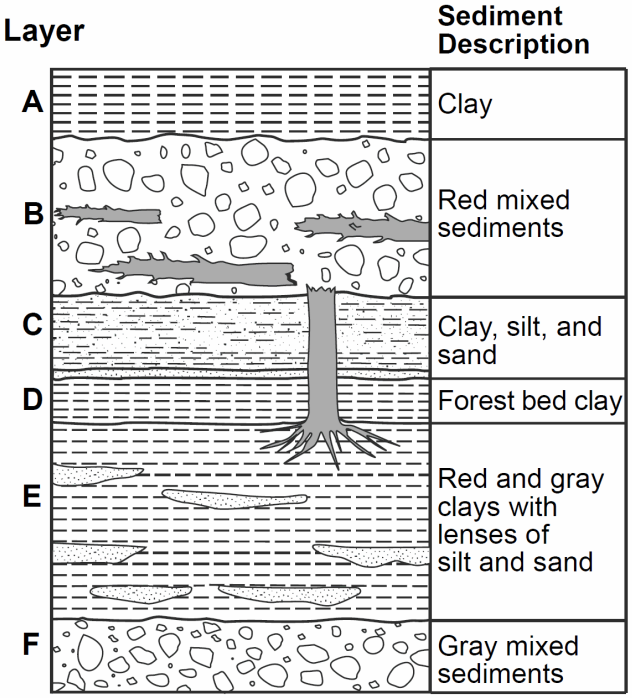
A) drumlin
B) moraine
C) kettle lake
D) finger lake

38. The diagram below shows a hand-sized rock sample with parallel sets of grooves. This rock sample was found in a gravel bank in central Vermont.

The grooves were most likely caused by

A) stream erosion
B) wind erosion
C) a landslide
D) glacial erosion

39. The cross section below shows layers of sediments deposited in a region of Wisconsin that has experienced several periods of glaciation. Descriptions of the sediments in layers *A* through *F* are included.




Source: A. N. Strahler, *The Earth Sciences*, 2nd Edition, 1971 (adapted)

Which two layers of sediments were probably deposited directly by glaciers?

A) *A* and *D*
B) *B* and *F*
C) *C* and *E*
D) *D* and *E*

40. The photograph below shows scratched and polished bedrock produced by weathering and erosion.

Which agent of erosion most likely carried sediment that scratched and polished this bedrock surface?

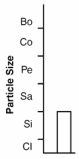
A) a moving glacier B) running water
C) wave action D) wind

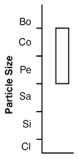
41. Which agent of erosion is mainly responsible for the formation of the depressions occupied by both the kettle lakes and finger lakes found in New York State?

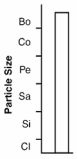
A) wind B) waves
C) streams D) glaciers

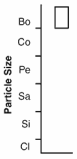
42. Which graph best represents the range of particle sizes that can be carried by a glacier?

| Key | |
|---|---|
| Cl clay | Pe pebbles |
| Si silt | Co cobbles |
| Sa sand | Bo boulders |

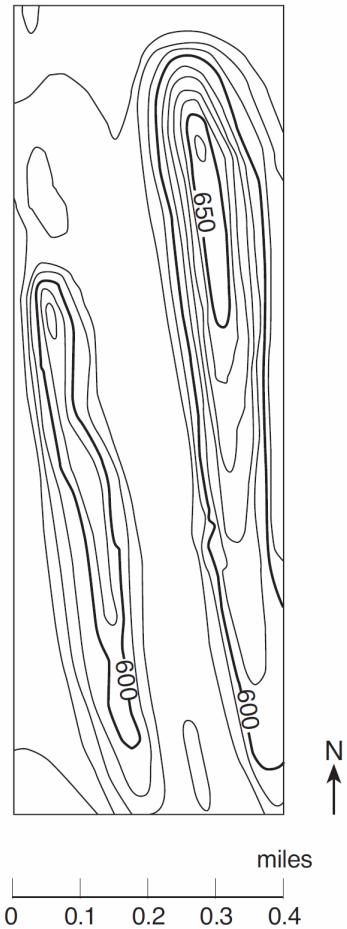
A) 


B) 


C) 


D) 

43. Base your answer to the following question on the topographic map below which shows two hills located in upstate New York.




Which agent of erosion is most responsible for the shape of these hills?

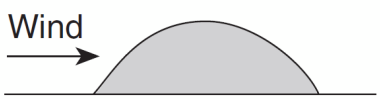
A) wind
B) gravity
C) waves
D) glaciers

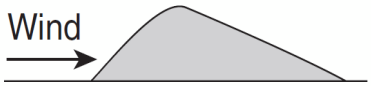
44. Base your answer to the following question on the map below, which shows a portion of a drumlin field. Elevations are in feet.


These drumlins are composed of sediments transported and deposited directly by glacial ice. These sediments are likely to be

A) well-rounded, sand-sized particles
B) well sorted in horizontal layers
C) unsorted and not in layers
D) found underwater, mixed with organic materials

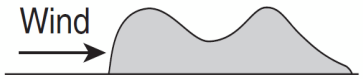
45. Which diagram represents a side view of a sand dune most commonly formed as a result of the prevailing wind direction shown?

A)


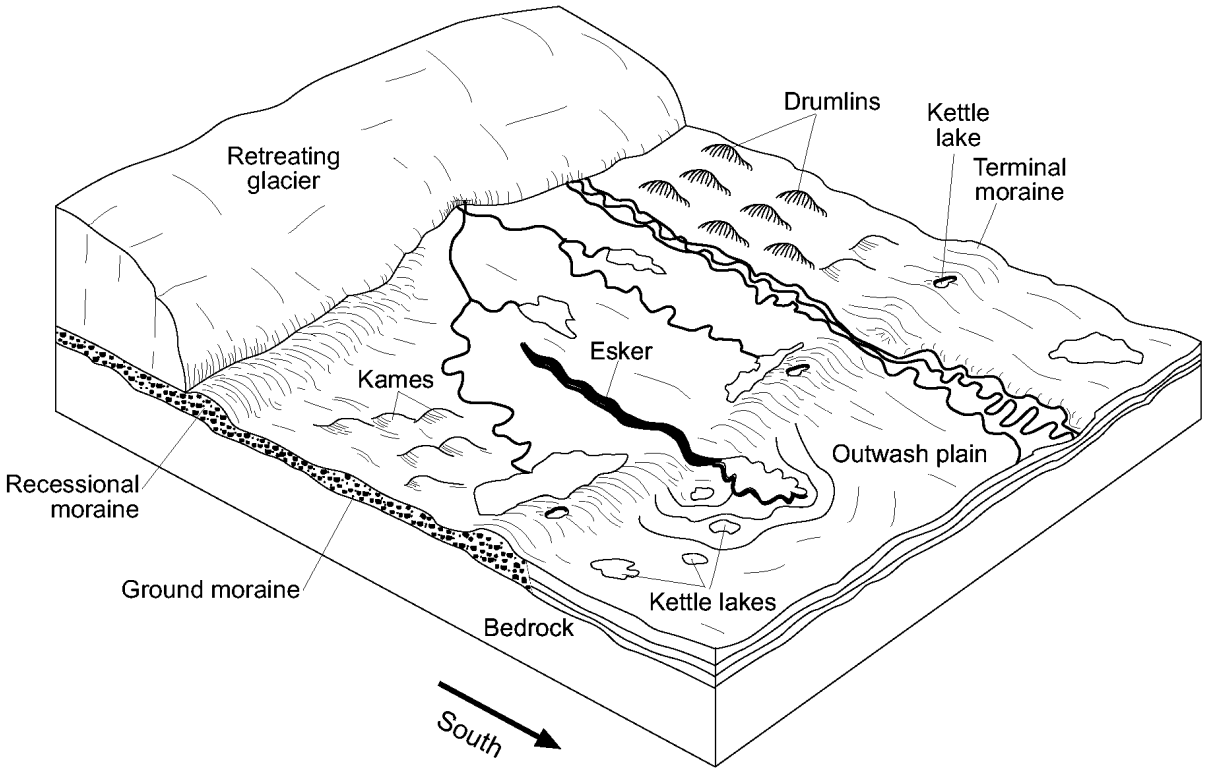

B)



C)



D)


46. Base your answer to the following question on the block diagram below, which shows some of the landscape features formed as the most recent continental glacier melted and retreated across western New York State.



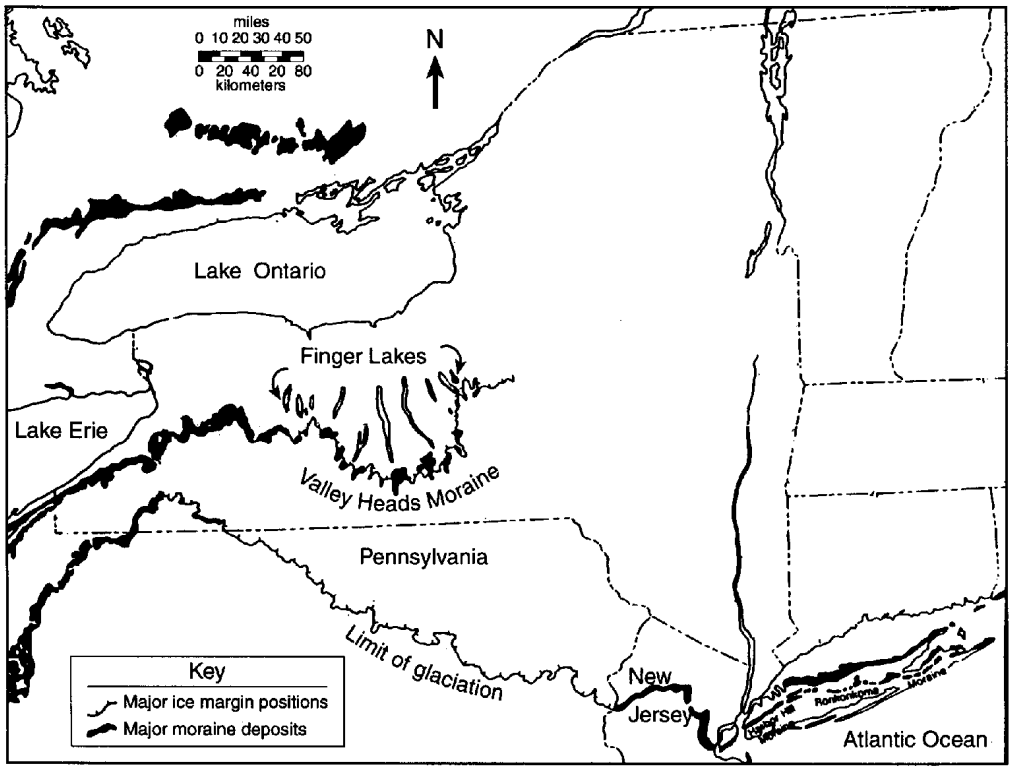

The shape of elongated hills labeled drumlins is most useful in determining the

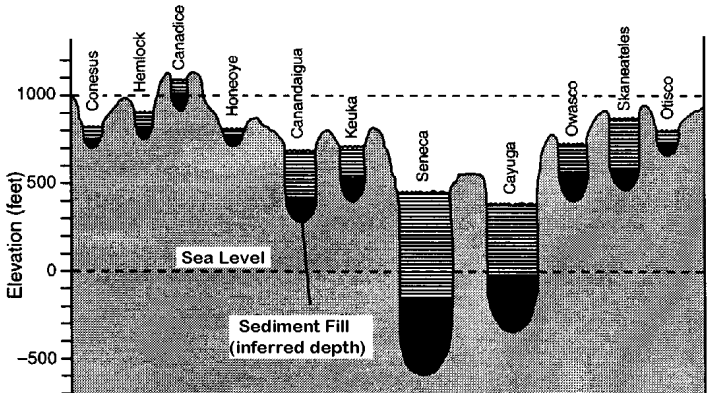
A) age of the glacier
B) direction of glacial movement
C) thickness of the glacial ice
D) rate of glacial movement

47. Which statement provides the best evidence that New York State's Finger Lakes formed as a result of continental glaciation?

A) The lake surfaces are above sea level.
B) The lakes fill long, narrow U-shaped valleys.
C) The lakes are partially filled with sorted beds of sediment.
D) The lakes are surrounded by sharp, jagged peaks and ridges.

Base your answers to questions **48** through **50** on the map and cross section below. The map shows the shapes and locations of New York State's 11 Finger Lakes and the locations of some major glacial deposits (moraines) left behind by the last ice age. The cross section shows surface elevations, valley depths, and water depths of the Finger Lakes.




48. The general shape of the Finger Lakes and the pattern of moraine deposits found across Pennsylvania, New Jersey, and New York are evidence that the continental glacier was advancing from

A) south to north B) north to south C) east to west D) west to east

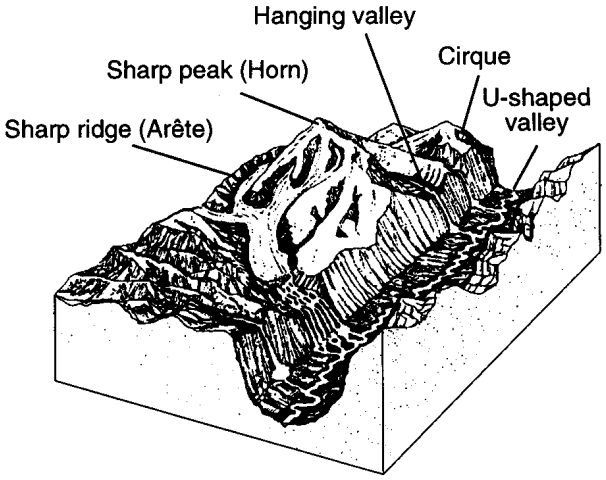
49. In which New York State landscape region are the Finger Lakes located?

A) Hudson-Mohawk Lowlands B) Erie-Ontario Lowlands
C) Allegheny Plateau D) the Catskills

50. Which statement provides the best evidence that New York State's Finger Lakes formed as a result of continental glaciation?

A) The lake surfaces are above sea level.
B) The lakes fill long, narrow, U-shaped valleys.
C) The lakes are partially filled with sorted beds of sediment.
D) The lakes are surrounded by sharp, jagged peaks and ridges.

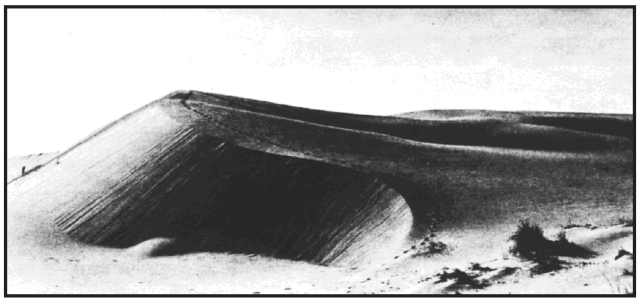
51. The diagram below represents a landscape area.




The labeled surface features of this landscape area resulted mainly from

A) wind erosion B) wave erosion
C) stream erosion D) glacial erosion

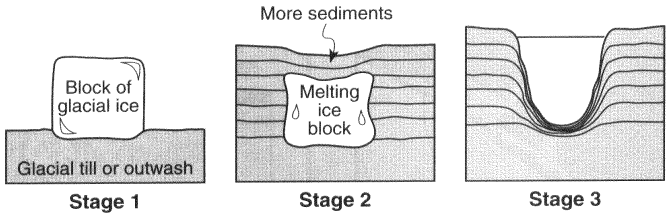
52. The photograph below shows a sand dune that formed in a coastal area.



This sand dune was most likely formed by

A) water flowing from the left
B) water flowing from the right
C) wind blowing from the left
D) wind blowing from the right

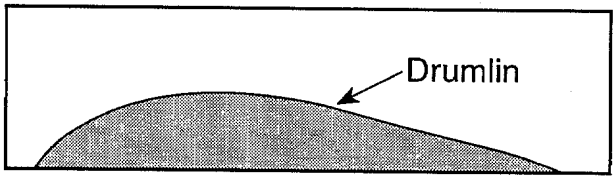
53. The cross sections below show a three-stage sequence in the development of a glacial feature.




Which glacial feature has formed by the end of stage 3?

A) kettle lake B) finger lake
C) drumlin D) parallel scratches

54. The diagram below represents a side view of a hill (drumlin) that was deposited by a glacier on the Atlantic coast.



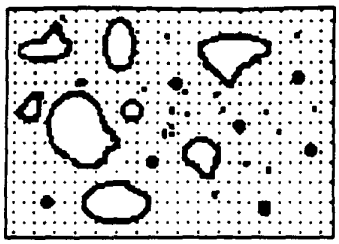

This hill is most likely composed of

A) cemented sediments
B) unsorted sediments
C) vertically layered sediments
D) horizontally layered sediments

55. Which agent of erosion most likely formed the drumlins and finger lakes in New York State?

A) running water B) moving ice
C) wave action D) mass movement

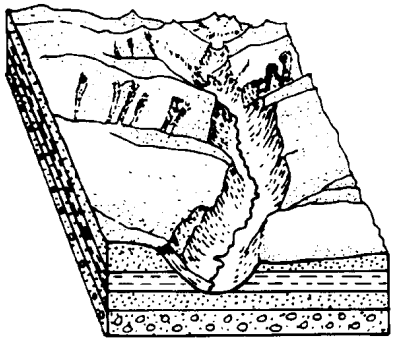
56. The diagram below shows a cross section of soil from the east coast containing pebbles, sand and clay.



The soil was most likely deposited by

A) an ocean current B) the wind
C) a river D) a glacier

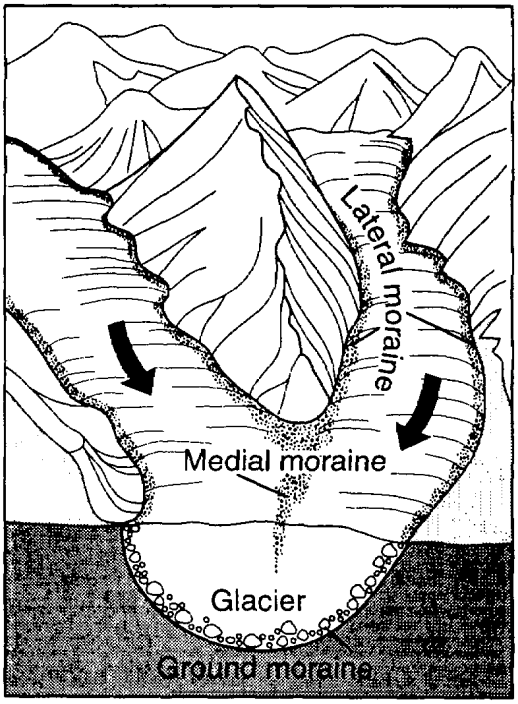
57. The diagram below represents a section of the Earth's crust.



This surface landscape was most likely caused by

A) folding of the crust
B) sinking of rock layers
C) erosion by valley glaciers
D) deposition of stream sediments

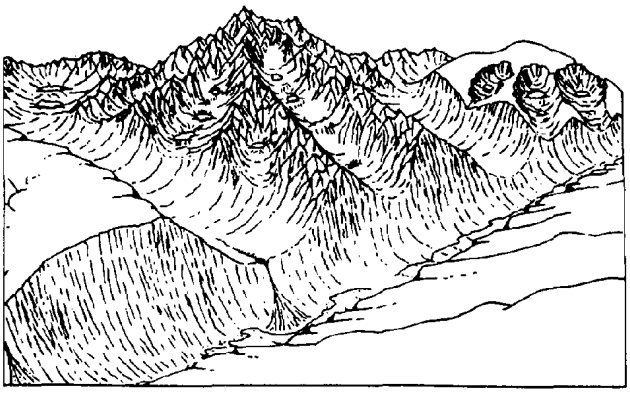
58. The diagram below shows rock material being transported by a mountain glacier.




The moraine deposits left when this glacier melts will generally be

A) sorted by size and layered
B) sorted by size and unlayered
C) unsorted by size and layered
D) unsorted by size and unlayered

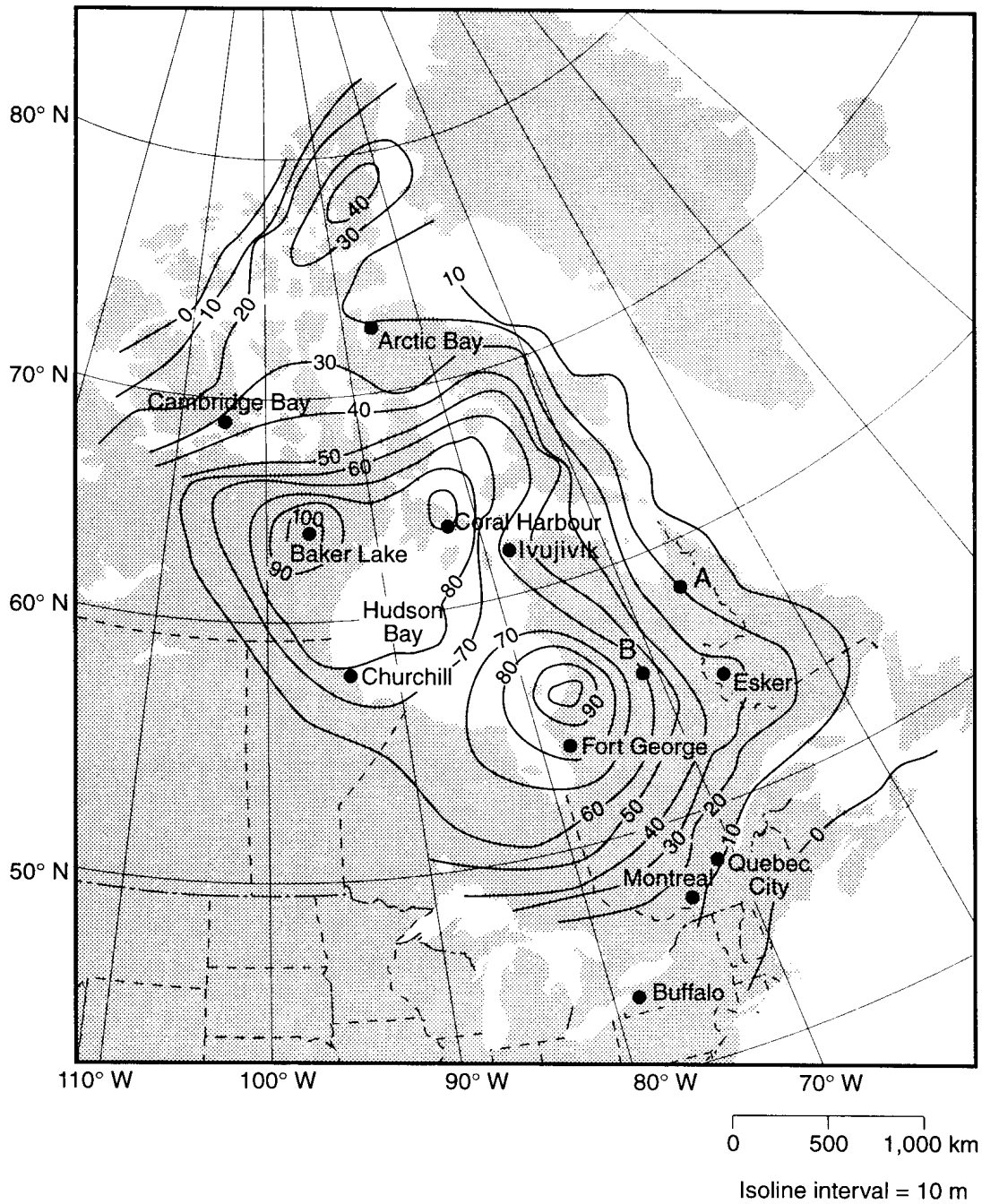
59. The diagram below represents a landscape area.



Which process is primarily responsible for the shape of the surface shown in the diagram?

A) crustal subsidence B) wave action
C) glacial action D) stream erosion

60. Base your answer to the following question on the map below. The isolines on the map show the increases in elevation that have occurred since the end of the ice age in this part of North America. *A* and *B* are two points on isolines. Several towns within the area are indicated.




U-shaped valleys, grooved and polished bedrock, and hills of mixed-sized sediments cover most of this area. These features and the crustal uplift that occurred were most likely caused by the

A) erosion and deposition of stream sediments
B) increase and decrease in the amount of water in Hudson Bay
C) blowing and settling of large amounts of soil across Canada
D) movement and melting of large continental ice sheets

61. The occurrence of parallel scratches on bedrock in a U-shaped valley indicates that the area has most likely been eroded by

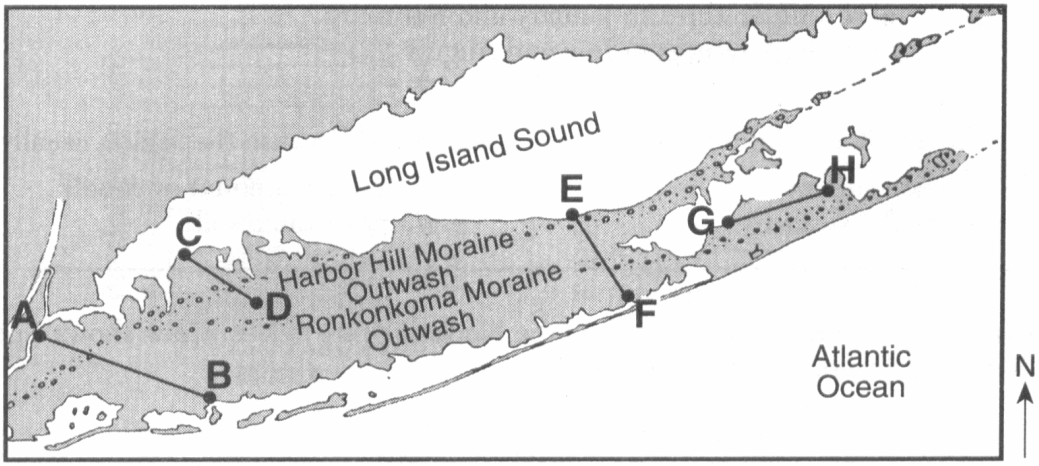
A) a glacier B) a stream
C) waves D) wind

62. Which geologic evidence best supports the inference that a continental ice sheet once covered most of New York State?

A) polished and smooth pebbles; meandering rivers; V-shaped valleys
B) scratched and polished bedrock; unsorted gravel deposits; transported boulders
C) sand and silt beaches; giant swamps; marine fossils found on mountaintops
D) basaltic bedrock; folded, faulted, and tilted rock structures; lava flows

Base your answers to questions **63** through **65** on the map of Long Island, New York. *AB, CD, EF* and *GH* are reference lines on the map.

**Map**




63. The cross section below represents the sediments beneath the land surface along one of the reference lines shown on the map.


Along which reference line was the cross section taken?

A) *AB* B) *CD* C) *EF* D) *GH*

64. Which agent of erosion transported the sediments that formed the moraines shown on the map?

A) water B) wind
C) ice D) mass movement

65. A major difference between sediments in the outwash and sediments in the moraines is that the sediments deposited in the outwash are

A) larger B) sorted C) more angular D) older

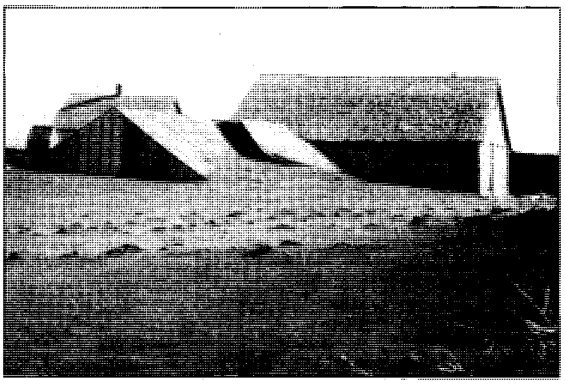
66. Which erosional agent typically deposits hills of unsorted sediments?

A) glaciers B) streams
C) winds D) ocean waves

67. Sharp-edged, irregularly shaped sediment particles found at the base of a rock cliff were probably transported by

A) gravity B) wind
C) ocean waves D) running water

68. The photograph below shows farm buildings partially buried in silt.



Which erosional agent most likely piled the silt against these buildings?

A) glacial ice B) ocean waves
C) wind D) mass movement

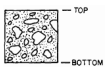
69. Which sediment is most easily picked up and transported by the wind?

A) cobbles B) pebbles
C) sand D) silt

70. Which agent of erosion was primarily responsible for forming the long, narrow, U-shaped valleys in the Finger Lakes region of New York State?

A) wind
B) landslides
C) meandering streams
D) continental glaciers

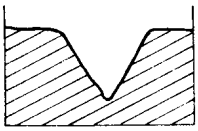
71. The diagram below represents the cross section of a soil deposit from a hill in central New York State.




The deposition was most likely caused by

A) a glacier
B) a wind storm
C) a stream entering a lake
D) wave action along a beach

72. The diagram below represents a stream valley. Which diagram below best shows how this valley might be modified after a glacier has moved through it?



A)  B)  C)  D) 

73. Many elongated hills are found scattered across New Hampshire. These hills contain a mixture of unsorted sediments of all sizes. Erosion and deposition by which agent probably formed these hills?

A) wind B) waves
C) streams D) glaciers

74. Glaciers often form parallel scratches and grooves in bedrock because glaciers

A) deposit sediment in unsorted piles
B) deposit rounded sand in V-shaped valleys
C) continually melt and refreeze
D) drag loose rocks over Earth's surface

75. The photograph below shows scratched and grooved bedrock with boulders on its surface.

Source: www.nr.gov.nl.ca

The scratches and grooves were most likely created when

A) alternating thawing and freezing of water cracked the bedrock
B) flooding from a nearby lake covered the bedrock
C) a glacier dragged rocks over the bedrock
D) rocks from a landslide slid along the bedrock

76. At the present time, glaciers occur mostly in areas of

A) high latitude or high altitude
B) low latitude or low altitude
C) middle latitude and high altitude
D) middle latitude and low altitude

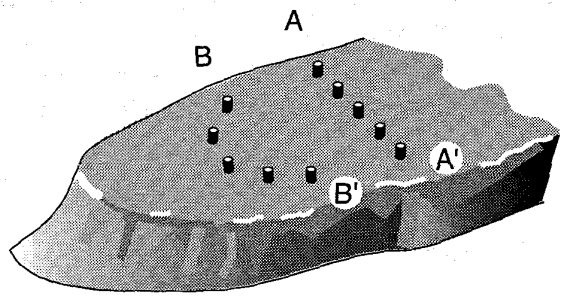
77. Which change is most likely to occur in a landscape if its climate changes from humid to arid?

A) Wind will become a more important agent of erosion.
B) Surface features will become more rounded.
C) Chemical weathering will increase.
D) Vegetation will increase.

78. Which New York State resources are a direct result of the glaciers that once covered most of the State?

A) sand and gravel
B) halite and gypsum
C) magnetite and calcite
D) limestone and marble

79. Wooden stakes were placed on a glacier in a straight line as represented by *A–A′* in the diagram below. The same stakes were observed later in the positions represented by *B–B′*.



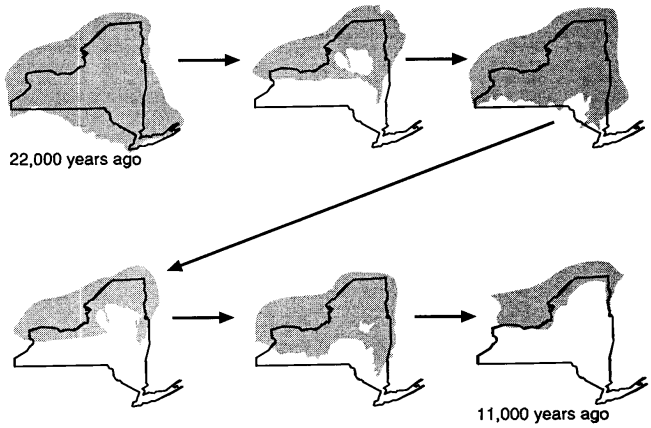

The pattern of movement of the stakes provides evidence that

A) glacial ice does not move
B) glacial ice is melting faster than it accumulates
C) the glacier is moving faster in the center than on the sides
D) friction is less along the sides of the glacier than in the center

80. The bedrock at a certain location is deeply scratched, and in some places is covered by a layer of unsorted sediment. Which erosional agent was probably responsible for these features?

A) ocean waves
B) running water
C) wind
D) glaciers

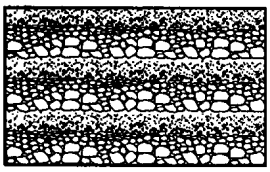
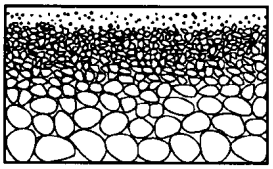
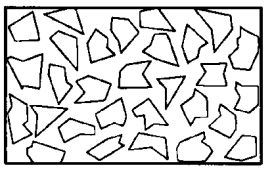
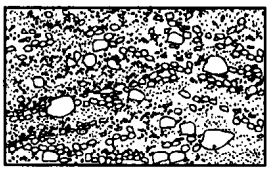
81. Shaded areas on the diagrams below show the part of New York State that was covered by glacial ice during the last ice age.




The best inference that can be made from these diagrams is that this glacial ice

A) was about 1 mile thick at New York City
B) advanced and retreated more than once
C) moved more slowly than the glaciers of earlier ice ages
D) changed the shape of Lake Ontario

82. Which diagram best illustrates a cross section of sediments that were transported and deposited by a glacier?

A) 
B) 
C) 
D) 

83. Many elongated hills, each having a long axis with a mostly north-south direction, are found scattered across New York State. These hills contain unsorted soils, pebbles, and boulders. Which process most likely formed these hills?

A) stream deposition B) wind deposition
C) wave deposition D) glacial deposition