

Answer Key for "Sediment Sleuths: Exploring Alaska's Glacial History"

1. How could you use the photographs to estimate the amount of glacial ice that has melted from Gulkana Glacier between 1967 and 2016?

By comparing the extent of the glacier in the 1967 and 2016 photographs, you can measure the distance the glacier has retreated.

2. What information do you need to more accurately estimate ice loss than you can get from the photographs alone?

Additional information such as glacier thickness changes, volumetric estimates, precise GPS mapping, and satellite imagery could provide a more accurate estimate of ice loss over time.

3. Can you spot any glacial moraines?

Students should identify distinct, curved ridges beyond the current glacier terminus, often shaped like lobes and following valley contours. Note that some moraines might be dissected by meltwater streams. Recent (Little Ice Age moraines) will be unvegetated, while older moraines may have vegetation cover. An example is marked by the yellow pin in the map.

4. Can you spot any glacier-fed lakes? Name three lakes near glaciers that you think are glacier-fed. What clues helped you make this identification?

Students may identify and name any of the glacial fed lakes visited by the research team. These are marked by the blue pins on the map. Milky or turquoise color (caused by suspended glacial flour) and proximity to glaciers are two clues that students can use to make this identification.

5. Where do you think the oldest sediments are located in the sediment core shown in Figure 5, and why?

The oldest sediments are located at the base of the core because sediment accumulates from the bottom up, with the youngest layers deposited on top.

6. Which layers represent a time when the glacier was large?

Units 1 and 4. Sediment layers with high bulk density and low organic matter content (OM and BSi) represent times when the glacier was large and eroding the bedrock beneath it.

7. Which layers represent a time when the glacier was small or melted away completely?

Unit 3. Sediment layers with low bulk density and high organic matter content (OM and BSi) indicate periods when the glacier was small or absent with limited erosive capacity.

8. What caused changes in glacier size during the Holocene? How does this compare to the rapid glacier retreat observed over the last ~100 years? What does this suggest about the role of human activity in recent glacier change?

Holocene changes in glacier size were driven by natural variations in Earth's orbital parameters (Milankovitch cycles), leading to gradual shifts in solar insolation and climate. In contrast, the rapid retreat of glaciers observed in the last century is driven by human-driven climate change from increased greenhouse gas emissions, which far exceed the rate of natural variations. This suggests that current glacier loss due to human-caused climate change and that recent warming is melting away glaciers that have existed for thousands of years.