Scientists have Found 18-20 Million Years Old Enamel Proteins

Scientists found 18-20 million-year-old enamel proteins in the Lake Turkana Basin in Kenya, a groundbreaking discovery for a tropical region, offering insights into ancient ecosystems and mammalian evolution. The finding is particularly significant because proteins typically degrade in hot climates, suggesting swift burial in fluviodeltaic sediments helped preserve the fossils. This research, which used mass spectrometry to identify peptide fragments, significantly pushes back the timeline for surviving biomolecules in ancient samples.

Key Highlights

- **Geographical Significance:** The discovery is in the Lake Turkana Basin, a remote area of northern Kenya located in the Eastern Rift Valley.
- **Scientific Breakthrough:** For the first time, well-preserved proteins were found in the enamel of extinct mammals from a hot, tropical climate.
- **Age of Sample:** The proteins are 18-20 million years old, dating back to the Miocene epoch.
- **Preservation Mechanism:** The proteins were preserved due to the rapid burial of fossils within the fluviotidal sediments of the basin, a process that protected them from degradation.
- **Technological Advancement:** The scientists used liquid chromatography tandem mass spectrometry (LC-MS/MS) to detect and analyze the ancient peptide fragments, a cutting-edge proteomics technique.
- **Implications:** This discovery helps in understanding the palaeobiology of extinct species and ancient ecosystems, providing crucial data for evolutionary biology research.
- **Context:** The findings are a significant advance, as the oldest previously published biomolecules were only about 3.5 million years old.
- **Connecting past discoveries:** The new protein analysis complements the existing fossil evidence, offering a more complete picture of the mammalian diversity that existed in the Turkana Basin during the Miocene epoch.

Explanation of Exam Oriented Key Terms

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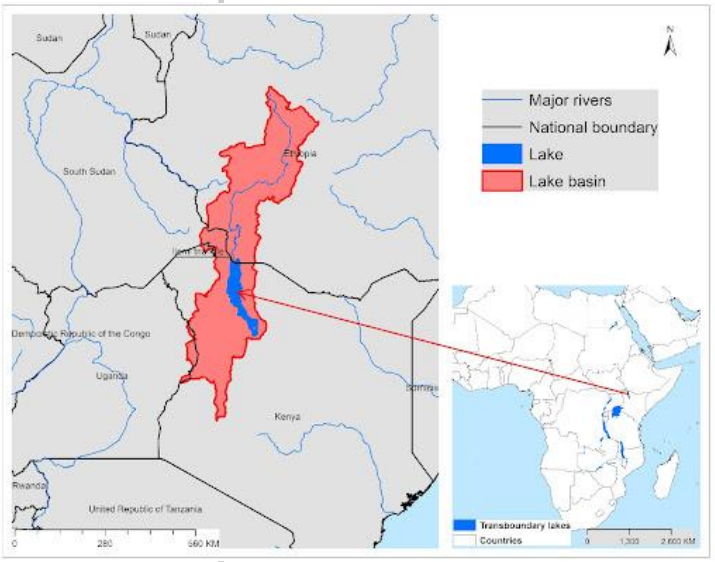
Lake Turkana

Lake Turkana, a UNESCO World Heritage Site in Kenya's northern Rift Valley, is Africa's 4th largest lake and the world's largest permanent desert lake, noted for its high salinity, large population of Nile crocodiles, and the Omo River as its primary perennial inflow. Recent scientific discoveries include 18-20 million-year-old proteins from extinct mammals found in its basin, providing insights into prehistoric ecosystems.

Key Characteristics

- **Location:** Northern Kenya, with its northern tip extending into Ethiopia.
- **Geographic Context:** Situated in the Eastern Rift Valley.
- **Water Body:** An endorheic (closed-basin) lake, meaning it has no outflow, losing water primarily through evaporation.
- **Size & Type:** The fourth-largest lake in Africa and the world's largest permanent desert lake. It's also the world's largest saline lake by volume.



Key Rivers

- **Omo River:** The only perennial (year-round) river, contributing about 90% of the lake's annual water inflow.
- **Other Rivers:** The Turkwel and Kerio rivers also flow into the lake.

Biodiversity

- **Fauna:** Home to a large population of Nile crocodiles and 79 fish species, including 12 endemics.
- **Flora:** Limited to thorn bushes and dry grasslands due to the harsh, arid climate.

Recognition

- **UNESCO World Heritage:** Lake Turkana and its surrounding national parks are recognized as a World Heritage site list in 1997.
- **Recognition criteria:** The site is recognized for its:
  - Geology and fossil records: Provides exceptional insights into Earth's history and paleo-environments, including human evolution, with fossil discoveries at Koobi Fora.
  - Biological diversity: Features diverse habitats, from deserts to grasslands, and is a vital stopover for migratory birds.

Practice Questions:

1. **With reference to the recent discovery of 18-20 million-year-old enamel proteins, consider the following statements:**

   I. The discovered proteins, primarily amelogenins, are the oldest molecular data ever recovered, surpassing the temporal limits of ancient DNA

   II. The preservation of proteins for such an extended period, even in tropical climates like the Turkana Basin in Kenya, is largely attributed to their being embedded within the highly mineralized and durable tooth enamel

   III. This breakthrough is expected to significantly enhance the study of the evolutionary relationships (phylogeny) and palaeobiology of extinct animal species, including ancient human relatives (hominins)

   Which of the statements given above is/are correct?

   a) I and II only

   b) II and III only

   c) I and III only

   d) I, II, and III

Answer: d

Explanation: Statement I is correct: Scientists have recovered protein fragments, including amelogenin and enamelin, from mammal teeth fossils dating back 18-20 million years, with some possibly up to 29 million years old. This is considered the oldest molecular data recovered from the fossil record, as ancient DNA typically degrades within a million years, especially in warmer climates. **Statement II is correct:** The key to this exceptional preservation is the unique structure of enamel, the hardest substance in the body. The proteins essentially "self-fossilised" within the dense, mineral-rich environment of the enamel, which protected them from water access, microbial degradation, and other environmental impacts (diagenesis), even in warm regions like the Turkana Basin in East Africa. **Statement III is correct:** The ability to recover and sequence such ancient proteins opens up new frontiers in palaeobiology and evolutionary studies. It allows researchers to go beyond skeletal morphology and use molecular data to reconstruct the physiological traits and clarify the evolutionary relationships of extinct taxa, including hominins.

Class Discussion Space