

## Cleopatra Loved the Flood

The Kingdom of Egypt prospered for 3,000 years—in the *desert*. Its success depended on strong leadership, written language, mathematics and engineering... but most importantly, on the flooding of the Nile, which happened each June through September.

Farmers developed an irrigation system that trapped floodwaters in their fields using dams. They let the water recharge the soil for a few months while the organics settled out, providing nutrients to the earth.

They'd then release the water to the receding river and plant their crops. In this way, year after year, the fields could produce enough food to sustain a large population living in the desert.

The floods were the direct result of African monsoons, which fell on the highlands of Ethiopia, the headwaters of the Nile. If the rain didn't fall, the Nile wouldn't flood. And there were some years that it didn't.

Volcanic activity in the region filled the atmosphere with ash and gas, reflecting the sun's heat, reducing evaporation and, therefore, rainfall.

Geologic and historical records now allow us to closely correlate volcanic eruptions with reduced Nile flooding, reduced crop production, reduced tax revenue for the state, and higher incidence of famine and revolt from the populace.

Especially high volcanic activity in the last 300 years of the Egyptian Kingdom contributed to its eventual fall to the Romans.

Yet another example of how connected human civilization has been, and continues to be, to freshwater supply, weather patterns, and the geology of Earth.



The fertile Nile Valley with its bright green vegetation lies in contrast to the desolate desert regions of Egypt. Reliable annual floods of the Nile sustained agriculture over thousands of years, enabling the development of an advanced civilization along its banks.

Credit: NASA Visible Earth



BUREAU OF  
ECONOMIC  
GEOLOGY

# Background: Cleopatra Loved the Flood

**Synopsis:** A series of volcanic eruptions may have helped bring about the downfall of the last Egyptian dynasty 2,000 years ago. By suppressing the monsoons that swelled the Nile River each summer, triggering flooding that supported the region's agriculture, the eruptions probably helped usher in an era of periodic revolts. Such upheaval ultimately doomed the dynasty that ruled Egypt's Ptolemaic Kingdom for nearly 300 years until the death of Cleopatra.

- The great Egyptian dynasties prospered for millennia along the fertile banks of the Nile River. This slim green ribbon snaking through the vast eastern Sahara represents the only significant source of water in the region.
- Annual floods of the Nile brought water, rich nutrients, and silt that enabled and sustained early agriculture, the basis of the developing civilization in the region.
  - Ancient Egyptians believed that the source of the annual flooding was tears of sorrow that the goddess Isis cried for her deceased husband Osiris.
  - We now know that the summer African monsoonal rainfall feeds the Nile headwaters more than 4,000 miles to the south in the mountainous Ethiopian Highlands, which has peaks reaching nearly 15,000 ft high.
    - Water in the Nile would rise from June through September, and then begin declining in October. The timing of the floods was so predictable that Egyptians used them to set their calendar.
    - Flooding from the mountains would reach Aswan at around 45 ft above normal river level; a couple of days later, it would reach Luxor at about 38 ft; and about 5 days later, Cairo at about 25 ft.
- Early on, ancient Egyptians worked crops in the areas that were naturally inundated, but basin-irrigation techniques were soon developed to increase crop yield and reliability.
  - Large fields with dikes and canals were flooded in late summer and closed for about 6 weeks to allow the silt to settle out and the water to saturate the soil.
    - Then, the water was discharged back into the Nile, and seeds were sown in the fields. Crops were harvested about 3–4 months later.
  - The fields were left empty during the dry season when nothing would grow.
  - As long as the floods occurred, people in settlements along the Nile were fed and the region prospered—but occasionally there would be years without floods.
- Civilization flourished along the Nile for the duration of more than 30 Egyptian dynasties. The last of these was the Ptolemaic dynasty.
  - The Macedonian (Greek) Ptolemaic dynasty took over rule of Egypt after the death of Alexander the Great in 323 BCE and ruled for almost three centuries until the death of Cleopatra, 30 years before the birth of Christ.
  - The Ptolemaic rulers took on Egyptian customs and declared themselves pharaohs to gain recognition from the native population.
  - The Egyptian city of Alexandria flourished as a cultural and technological center during Ptolemaic rule, becoming one of the largest Mediterranean cities.
    - Euclid and Archimedes were citizens of Alexandria during this time.
    - Well-dated, detailed records of daily life were kept on papyrus scrolls, which are still preserved, providing a rich window into multiple levels of Ptolemaic civilization that was not available for earlier dynasties.
- Despite its vibrant culture, the Ptolemaic reign was characterized by both internal and external conflict.
  - More than a dozen uprisings occurred during the reign of the Ptolemys.
  - From 274 to 96 BCE, nine wars were fought against the rival Seleucid Empire in the region that is now Syria.

## References: Cleopatra Loved the Flood

Volcanic Suppression of Nile Summer Flooding Triggers Revolt | Nature Communications  
Volcanic Woes May Have Contributed to Ancient Egypt's Fall | Eos  
How Volcanoes Caused Violent Uprisings in Cleopatra's Egypt | National Geographic  
How Volcanoes May Have Ended the Dynasty of Ptolemy and Cleopatra | Science News  
Flooding of the Nile | Wikipedia  
Ptolemaic Kingdom | Wikipedia

Contributors: Juli Hennings, Harry Lynch



BUREAU OF  
ECONOMIC  
GEOLOGY

EarthDate.org  
Fact Sheet:  
Episode **ED 073**

# Background: Cleopatra Loved the Flood

- The end of the Ptolemaic dynasty came when the Roman Empire conquered Egypt and the last recognized pharaoh of Egypt, Cleopatra VII, committed suicide in 30 BCE to avoid capture. Egypt was then annexed as a Roman province.
- Scientists and historians teamed up to better understand the story of strife during the Ptolemaic dynasty.
  - Scientists investigated and modeled the impact of large 20th-century volcanic eruptions on weather patterns associated with the African summer monsoons.
    - Volcanic eruptions impact weather by ejecting sulfur dioxide and particulates high into the stratosphere, forming aerosols that reflect sunlight and cause cooling that decreases evaporation and rainfall for a few years. Decreased rainfall was a major factor in the African summer-monsoonal flow.
    - Their models also showed that normal weather-circulation patterns in other regions shifted to entirely different locations after volcanic events, which did not appear to much affect the Nile headwaters.
  - Scientists then reconstructed hydrological data using a *nilometer* similar to structures used from 622 to 1902 CE to track Nile water levels and predict subsequent harvests.
    - For years following documented volcanic eruptions, nilometer data showed that floodwaters were lower than in years without eruptions; these patterns likely corresponded to patterns in Ptolemaic times.
  - To extrapolate even further back in time, researchers investigated ice cores, which record climatic data seasonally, just like tree rings.
    - Researchers looked back 2,500 years in ice cores from both Greenland and Antarctica for sulfate deposition that would indicate volcanic activity.
      - ◆ They found 16 large global volcanic episodes that occurred during the Ptolemaic reign.
- Scientists then compared the 16 major volcanic events to historical records of socioeconomic events described in the papyri. Using all 16 events, they found some amazing correlations:
  - Internal revolts tended to occur in the second year after eruptions.
    - ◆ The largest of these, the Theban Revolt, started 2 years after a major eruption in 209 BCE and lasted almost 20 years, resulting in destruction of temples and property and significant losses in tax revenues.
  - Priestly decrees reaffirming state control of crisis situations were typically documented in eruption years.
    - ◆ State land auctions reestablished income and taxation after farms were abandoned or seized.
  - The beginning of wars had no correlation with the volcanic events, but cessation of war, allowing leaders to return home to handle uprisings tied to famine, could be correlated with the first 2 years after an eruption.
    - ◆ Ptolemy III returned from war in 245 BCE to import grain at great cost, saving his people.
    - ◆ Following an eruption in 46 BCE, Italy's Mt. Etna erupted explosively the same year Caesar was murdered, in 44 BCE, exacerbating ongoing drought and famine. Cleopatra released state-reserved grain in both years to feed the citizens of the Nile Valley.
- Researchers stress that these major volcanic events didn't topple Egypt's last pharaoh, Cleopatra VII of the House of Ptolemy, on their own, but their dire effects of drought and famine aggravated existing social issues, including high taxation and ethnic tensions, that ultimately led to the end of the Kingdom of Egypt.
  - Ironically, during two centuries of Roman reign over the Nile Valley, only four global eruptions were documented; the first century was entirely eruption-free.

## References: Cleopatra Loved the Flood

Volcanic Suppression of Nile Summer Flooding Triggers Revolt | Nature Communications  
Volcanic Woes May Have Contributed to Ancient Egypt's Fall | Eos  
How Volcanoes Caused Violent Uprisings in Cleopatra's Egypt | National Geographic  
How Volcanoes May Have Ended the Dynasty of Ptolemy and Cleopatra | Science News  
Flooding of the Nile | Wikipedia  
Ptolemaic Kingdom | Wikipedia

Contributors: Juli Hennings, Harry Lynch



BUREAU OF  
ECONOMIC  
GEOLOGY

EarthDate.org  
Fact Sheet:  
Episode **ED 073**

# Background: Cleopatra Loved the Flood

- When the Aswan High Dam was completed in southern Egypt in 1970, the annual floods came to an end; the floodwater stored in the giant Lake Nasser Reservoir is released to the Nile Valley as needed.
  - Each August 15, Egyptians today still observe a 2-week holiday called *Wafaa El-Nil* (“Flooding of the Nile”) to celebrate the life-giving flooding events of the past.
- Researchers warn that today more than 70 percent of the world’s population lives in monsoon-dependent agricultural regions.

## References: Cleopatra Loved the Flood

Volcanic Suppression of Nile Summer Flooding Triggers Revolt | Nature Communications  
Volcanic Woes May Have Contributed to Ancient Egypt’s Fall | Eos  
How Volcanoes Caused Violent Uprisings in Cleopatra’s Egypt | National Geographic  
How Volcanoes May Have Ended the Dynasty of Ptolemy and Cleopatra | Science News  
Flooding of the Nile | Wikipedia  
Ptolemaic Kingdom | Wikipedia

Contributors: Juli Hennings, Harry Lynch



BUREAU OF  
ECONOMIC  
GEOLOGY

EarthDate.org  
Fact Sheet:  
Episode **ED 073**