Danube delta holds answers to 'Noah's flood' debate (Video)

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Did a catastrophic flood of biblical proportions drown the shores of the Black Sea 9,500 years ago, wiping out early Neolithic settlements around its perimeter? A geologist with the Woods Hole Oceanographic Institution (WHOI) and two Romanian colleagues report in the January issue of *Quaternary Science Reviews* that, if the flood occurred at all, it was much smaller than previously proposed by other researchers.

Using sediment cores from the delta of the Danube River, which empties into the Black Sea, the researchers determined sea level was approximately 30 meters below present levels—rather than the 80 meters others hypothesized.

"We don't see evidence for a catastrophic flood as others have described," said Liviu Giosan, a geologist in the WHOI Geology and Geophysics Department.
Ten thousand years ago, at the end of the last glacial period, the Black Sea was a lake—cut off from the Sea of Marmara and beyond it the Mediterranean by the Bosphorus sill. Debate in geological and archaeological circles has focused on whether, as glaciers melted and global sea levels began to rise, the Bosphorus sill overflowed gradually or whether a flood broke through the sill, drowning some 70,000 square kilometers and wiping out early Neolithic civilizations in the region. In addition to questions about the rate of the flood, investigators continue to debate the extent of the flood -- a debate centered around what the level of the Black Sea was 9,500 years ago.

In the late 1990s, Columbia University researchers Bill Ryan and Walter Pitman examined the geological evidence and estimated the Black Sea level at the time of the flood was approximately 80 meters lower than present day levels. They suggested that the impact of a Black Sea flood could have forced the movement of early agriculturist groups to central Europe and established the story of Noah and his ark, as well as flood myths among other peoples.

The source of the uncertainty fueling the Black Sea flood debate is the difficulty of finding reliable sea level markers to date the flood. "Sea level is like the Holy Grail," said Giosan. "You can't really talk about a flood if you don't know the exact levels of the sea level in both the Black Sea and outside it in the Mediterranean. And that's what we tried to find."

Scientists examine the geochemistry of sedimentary deposits for evidence of fresh water fauna and the morphology of features on the seafloor, trying to infer drowned beaches or wind-generated dunes, but there are pitfalls associated with these indicators. Sediments are subject to erosion by waves and currents, and sand deposits formed by underwater currents can misleadingly be interpreted as dunes or beaches. "Instead, what we use as indicators of sea level is the level of the Danube River delta plain, an immense landform that cannot be mistaken for something else," Giosan stated.

A delta is formed when a river empties into a body of water. It dumps sediments and builds a flat plain—the delta—that is within a couple of meters of the shore and is, therefore, an indicator of sea level. In 2006, a team led by Liviu Giosan showed that contrary to Soviet-era data suggesting large oscillations of Black Sea level, the development phases of the Danube delta demonstrate that the level was more or less as today in the last 6000 years.

To extend their record back in time beyond 6000 years, in 2007, Giosan and his colleagues drilled a new core to 42 meters depth at the mouth of the Danube River, the largest river emptying into the Black Sea. Their goal was to reconstruct the history of that part of the delta—before and after the flood—through an examination of the sediments. In analyzing the delta sediment from the new core as well as others taken in the region, Giosan's team discovered fresh water deposits of the newly forming delta dating back approximately 10,000 years, subsequently overlaid by fine marine sediments, followed by the modern delta deposits.

"It's amazing," said Giosan. "The early delta was forming in a fresh water lake just a couple of hundred years before the flood. And after the flood you have these marine deposits overlaying the whole delta region."

Using sediment cores to reconstruct the delta with accurate dates is challenging. To attach a date to the layers of a core, scientists use radiocarbon dating on the fossil shells of animals found in the core—for instance, clams or snails. But in energetic areas, waves can erode sediment on the seabed and heave up older shells, depositing them in "younger" sediments. To address these concerns, Giosan and his team used an approach that had not been used before in the Black Sea. They employed high resolution dating performed at WHOI's Accelerator Mass Spectrometer (AMS) facility and only used "articulated" bivalves - those where both sides of the shell were still attached as they are when alive. The shells are held together by an organic substance that degrades easily when they are dead, so the valves usually separate when the animal dies. When bivalves are found intact, it means they were not moved by waves and they are likely to be in situ.

Once the researchers dated and reconstructed the delta plain, they could determine sea level for the Black Sea. They found that the Black Sea level at the time of the flood was around 30 meters below present levels.

Determining how much water poured over the Bosphorus sill remains problematic. There is no direct reconstruction of the sea level for the Marmara, but, according to Giosan, indirect methods put it at approximately 5 to 10 meters above the Black Sea level at the time of the flood.

"So if this is true, it means that the magnitude of the Black Sea flood was 5 or 10 meters but not 50 to 60 meters," said Giosan. "Still, having flooded the Black Sea by 5 meters can have important effects, for example, drowning of the Danube Delta and putting an area of 2,000 square kilometers of prime agricultural land underwater. This has important implications for the archaeology and anthropology of southern Europe, as well as on our understanding of how the unique environment of the Black Sea formed."

Source: Woods Hole Oceanographic Institution