Death of the NILE?

Lake Tana reveals its secrets

Henry Lamb and his team probed the depths of Lake Tana, the source of the Blue Nile, and revealed that the lake dried up at least once in the last 20,000 years, and could do so again in the not-so-distant future.

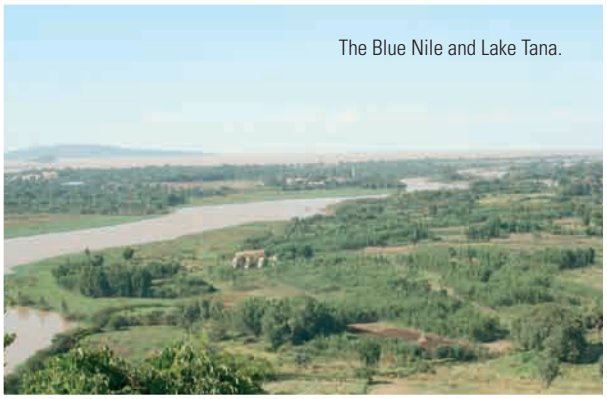
Lake Tana is Ethiopia's largest lake and the source of the Blue Nile, which spills majestically over the Tis Issat Falls into the 600 kilometre-long Blue Nile gorge. It provides most of the water and sediment that reaches Egypt. From the middle of the lake, where we have spent a good deal of time in recent years, you can just see the misty outlines of 2500-metre-high mountains, foothills to the much grander Simiens beyond. Closer to hand, the forest-covered volcanic island of Dega Estephanos rises as a cone, crowned by a round Ethiopian Orthodox church. Twice each day, a bell summons the island monks to climb the steep path to the church, where the mummified remains of forgotten Ethiopian emperors lie haphazardly in the crypt below.

Despite its importance to the Nile, Lake Tana's environmental history has never been investigated, so in 2003 we decided to take sediment cores. We used a low-tech, hand-operated piston corer from a small wooden platform supported by two rubber dinghies. Fortunately the lake's shallow waters, 9m on average, made this task a little easier. We had planned a seismic survey of the lake to visualise the sediment depth and distribution, but first time out, the survey boat's propeller cut the seismic cable, putting paid to survey work that year. So we had no inkling of what lay beneath when we began to core.

The first real surprise came when we pulled up a core segment from 24m below the lake surface. Instead of soft, grey-green lake mud, the core contained a 40cm thick layer of brown peat, very similar to peat from an Irish bog. Clearly, the lake had shrunk to a shallow marsh at some time in the past – but when? Was it 4200 years ago, when the Nile apparently diminished to a trickle, and caused the collapse of the Egyptian Old Kingdom? Or 8200 years ago, when outflow from North American glacial lakes triggered a climatic event that may have been global in extent? Another possibility is that Lake Tana dried 12,700 to 11,500 years ago, when a massive surge of glacial meltwaters into the North Atlantic cooled much of the northern hemisphere and brought widespread drought to Africa.

We now know from radiocarbon dates, pollen and plant fossil evidence, that the peat is the remains of a papyrus swamp that grew in the centre of Lake Tana between 15,700 and 15,100 years

Operating the piston corer on Lake Tana in October 2003.



The Blue Nile and Lake Tana.

The drilling rig in position, January 2007.

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ago. Beneath the peat we found sticky, grey-brown clays that were impossible to penetrate more than a few centimetres with the corer. We had reached what we call the refusal layer. We found the same clays wherever we cored in the lake, but the peat is present only near the central, deepest part of the 70km-wide basin. The clays formed when the lake dried out completely about 17,000 years ago; the papyrus swamp was a transient phase as the lake refilled. Fossil diatoms, the tiny silica shells of aquatic algae, tell the story most eloquently: over 500 years, the lake waters gradually rose to overtop the papyrus, before abruptly spilling into the Blue Nile gorge, 14,700 years ago. The timing of these events is remarkably similar to the refill and overflow of the White Nile's headwater lakes, 1500km to the south. It seems that the entire Nile system was reduced to an ephemeral stream, before the monsoon rains returned and the overflowing lakes filled the Nile once again.

The time of the lake's complete desiccation, around 17,000 years ago, is especially significant. This is when the North American and Scandinavian ice sheets broke apart at their margins, sending a vast armada of icebergs across the North Atlantic. This event, called Heinrich 1, was the most recent of five similar events during the last 60,000 years. The effect on the planet's climate was profound. The ice and meltwater slowed the Atlantic's thermohaline circulation almost to a halt, so that the Gulf Stream's huge heat conveyor ceased to bring tropical waters to European shores. With heat no longer exported from the tropical ocean by the conveyor, the equatorial Atlantic warmed, diminishing the ocean-continent temperature gradient that drives the African monsoon. As a result, the rains failed across northern Africa for many centuries, and the Nile died. It is an ancient warning of what could happen again if global warming causes the collapse of Greenland's ice sheet.

In 2004, and again in 2006, we returned to Lake Tana with seismic gear to survey the three-dimensional architecture of the lake basin and to see what lies beneath the clay layer. Enduring cramped, hot, noisy and often wave-tossed conditions aboard a small fisheries vessel, we traversed 200km of the lake at slightly more than walking speed. The image of the lake's sedimentary infill gradually scrolled across our computer screens, like a slow but fascinating black-and-white movie. Lake Tana's islands, with their ancient monasteries and churches, were revealed as the emergent tops of volcanic pinnacles. The refusal layer now appeared as a continuous layer across the entire lake, marking a sharp boundary between the uppermost 10m of translucent lake muds, and the darker, highly structured, deep sediment body. Beneath this layer, several other prominent lines extend across the seismic images. Their similarity to the refusal layer suggests that they are desiccation surfaces formed at earlier intervals of drought. Could these also be related to Heinrich events?

To find out, we returned to Lake Tana in 2007, to extract a long core of the deep sediments. This required something bigger than our usual hand-operated methods. We teamed up with Addis Geosystems Ltd, an experienced Ethiopian drilling company, who built a steel platform on Tana's northern shore, using skilled local labour and a remarkable set of workshops left from the short-lived Italian occupation of the 1940s. Eight two-tonne concrete blocks anchored the platform to the lake bed, ensuring that Tana's wind and waves didn't shift our drill rig from its spot. They did their job well: two weeks of drilling got us to a depth of 92m.

Those cores are now in the lab at Aberystwyth. They have been analysed at 2mm intervals with an x-ray fluorescence core scanner, yielding many megabytes of information that will ultimately tell Tana's story of droughts, floods and volcanic eruptions, and perhaps provide a backcloth to Ethiopia's ancient human history. But, for a few months more at least, the secrets of Lake Tana's turbid and turbulent past still remain hidden in the mud. ✿

Henry Lamb is a reader in physical geography at the Institute of Geography and Earth Sciences, Aberystwyth University. Email: hfl@aber.ac.uk

This work involved researchers from the Universities of Aberystwyth, Bangor and St Andrews, working closely with colleagues from the Earth Sciences Department at Addis Ababa University. The UK team: Richard Bates, Dei Huws, Mike Marshall, Paul Coombes, Sarah Davies, Harry Toland and Tony Prave. We thank our Ethiopian partners, especially Mohammed Umer, Eshete Dejen and Addis Zeleke.

More information:
www.aber.ac.uk/quaternary/tana