10,000 years of sea-level change in the Thames Estuary

"Is the sea level rising in the Thames Estuary, and if so, by how much?" asks **Dr Chris Vane** who leads a number of projects investigating topics such as sea level change, biogeochemistry and sediment quality (pollution).

Such questions about relative sea-level changes are vital to the protection of housing and infrastructure located on the tidal Thames floodplain and can only be fully answered by comparing present-day measurements from satellites and historical tide gauges to a geological record that stretches back many thousands of years. Geological indications of past sea levels not only provide context for the current observed rates of sea-level rise, but they also validate models used to help forecast future heights.

Fortunate for a team of environmental change and climate scientists at the British Geological Survey (Nottingham) and Rutgers University (New Jersey), the Thames floodplain has seen accumulation of alluvium (silts and clays) and peat formed from salt marshes or freshwater swamps during the current Holocene epoch, which began just over 10,000 years ago. These alluvial deposits contain a comprehensive history of Holocene sea-level movements. However, these sediments do not give up their secrets easily and require knowledge of organic/isotope chemistry and microfossils to unfold the story held within the soft sediments.

Modern-day marsh chemistry

Many of the marsh plants and sediment-dwelling microflora and fauna (diatoms and foraminifera) found in the estuary today are similar to those present during the Holocene. Holocene variations in Thames sea level can be reconstructed by understanding the modern-day relationship between marsh chemistry and microfossils to sea level and by comparing these contemporary assessments to those from sediments that have accumulated throughout the Holocene.

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Determining changes in elevation at Dartford Creek

Detailed analysis of the organic chemistry of soils derived from marsh plants and the abundance of diatoms and foraminifera across salt marsh transects at Dartford Creek, Two Tree Island, Watt Tyler Nature Reserve (Vange Creek), and fen carr vegetation communities at the Ted Ellis Nature Reserve in Norfolk allow scientists to elucidate these relationships.

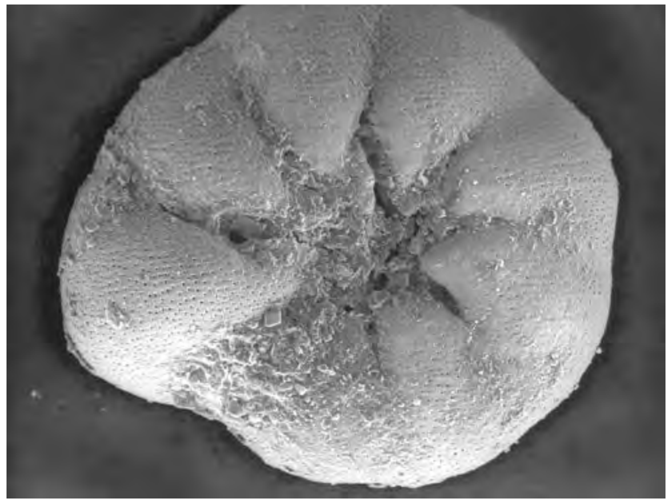
Reaching back in time

Scientists drilled through the entire Holocene sequence to recover sediment cores across a broad reach of the lower Thames at Rainham, Dartford, Swanscombe, Tilbury, Cliffe and Grain. The chemistry and microfossil records were then measured and calibrated against contemporary counterparts, and the age of the sediments were determined by radiocarbon dating, which enabled an accurate estimate of the rates of sea-level change.

This new data combined with previous studies suggests that Thames sea level rose more than 30 metres during the Holocene. The rate was swift at around 5-6 mm/year from 10,000 to 6,000 years ago, due primarily to ice melt from continental ice sheets. The rise of the sea then slowed dramatically to a rate of only 0.3-0.5 mm/year over the past 4,000 years since ice melt had nearly ceased. This rise in Thames sea level was caused primarily by subsidence of land related to waning of the former British Isles and Scandinavian ice sheets (a process known as glacial isostatic adjustment).

Current rates of sea-level rise on the Thames, from the beginning of the 20th century to the present, range from 1.22 mm/year in Southend-on-Sea to 2.14 mm/year at Sheerness. Comparison of contemporary rates of sea-level rise to those from Holocene archives suggests that the Thames is currently subject to rates of rise not seen in thousands of years. Changes on the order of 1 or 2 mm/year can have significant impacts on the frequency of extreme water levels from flood and storm events.

Chemistry of soils under marsh plants



Microfossils define past sea level

Sea Purslane, a typical salt tolerant species

Dr Christopher Vane,
Head of Organic Geochemistry at the British Geological Survey, he currently leads a number of projects on the Thames estuary, spanning topics such as sea level change, biogeochemistry and sediment quality (pollution)

If you would like to know more about the science please contact Chris at: **chv@bgs.ac.uk**