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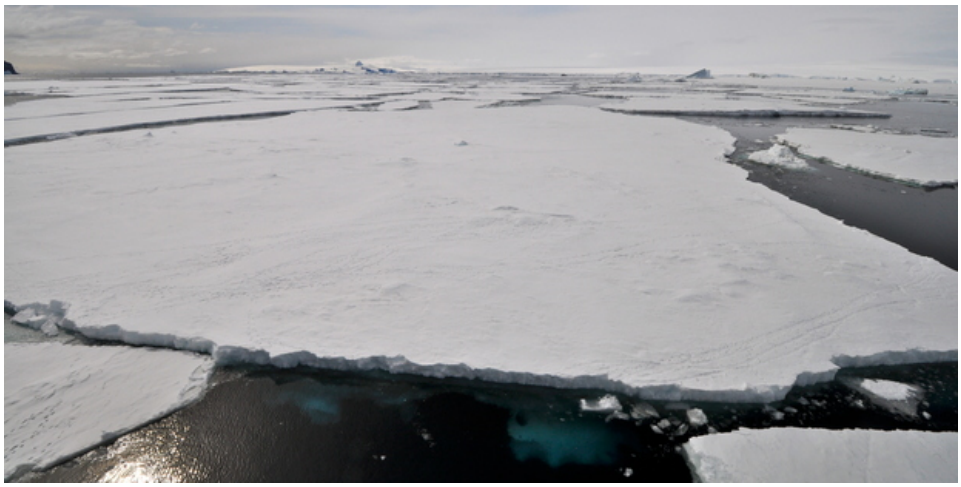
What causes ancient oceans to rise?



Ancient sea levels were pushed up following a dramatic ice sheet collapse that also triggered widespread climate changes. File photo / NZ Herald

A long-standing mystery over why the world's sea level was dramatically higher 135,000 years ago than it is today is closer to being solved by scientists.

In a major study, published today in the leading journal Nature, an international team of researchers found the ancient sea levels were pushed up following a dramatic ice sheet collapse that also triggered widespread climate changes.

The change, which took place amid a chain of major events following the end of the ice age before last, holds lessons for scientists today trying to understand the complex processes that control large transformations in the Earth's climate.

The team had set out to answer why the sea level had overshot its present levels during the last interglacial period, when Earth's temperature was only slightly warmer than it is today.

They found that while ice age cycles may superficially look similar to one another, there were important differences in the relationships between melting of continental ice sheets and global climate changes.

While it had been known that at the end of an ice age, continental ice sheets, ocean, and atmosphere change rapidly, scientists had until now only been able to reconstruct those changes at the end of the most recent ice age, around 20,000 to 10,000 years ago.

To analyse the sequence of changes, the team used precisely-dated cave records and marine sediments from the Mediterranean region.

"We have compared the fluctuations at the end of an earlier ice age, and we found that the patterns were different," said co-author Professor Eelco Rohling, from the Australian National University and the University of Southampton.

"At the end of the older ice age, 135,000 years ago, we found that a dramatic collapse of the Northern Hemisphere ice sheets into the North Atlantic Ocean suppressed the ocean

circulation and caused cooling in the North Atlantic."

"North Atlantic cooling was counterbalanced by Southern Ocean warming that then destabilised Antarctic land ice, causing a continuation of melting that eventually drove sea level rise to several meters above the present."

Study co-author Dr Gianluca Marino explained this was very different from the end of the last ice age.

"The northern hemisphere ice-sheet collapse and climate change did not occur at the same time, and that caused much less warming in Antarctica," he said.

Professor Tim Naish, director of Victoria University's Antarctic Research Centre, said it was known that the Northern Hemisphere ice sheet melted between 135-130,000 years ago as the region experienced strong warming, due to Earth's orbital changes.

But what this latest study goes on to argue, he noted, was this warming ultimately led to the shut-down of the Atlantic Ocean overturning circulation, due to meltwater input which caused a cooling in the Northern Hemisphere at about 132,000 years ago.

This then resulted in a reorganisation of heat transport from the equator - called the "bipolar see-saw" - which favoured the warming of Antarctica for several thousand years, contributing the extra metres of sea-level rise required to push sea level to between six to nine metres above present day.

"If most of the meltwater that produced the six-to-nine metre sea level rise came from Antarctica, then New Zealand would have experienced higher sea levels than present, but not quite as high as the six to nine metre global average."

Ultimately, Professor Naish said, the study suggested that the Antarctic ice sheet - especially its marine-based parts - was very sensitive to ocean and atmosphere warming of the scale that Earth was currently experiencing, and will experience in the future.

GNS Science senior scientist Nancy Bertler said the paper made the argument that Antarctic warming was the engine behind the "surprisingly high" ice loss and sea level increase during the last interglacial period, considering the amount of CO2 in the atmosphere was only at 280 parts per million - the level stands at around 400 parts per million today.

"This adds to the significant challenge to model future sea level rise," she said.
"Constraining such models with empirical data of past reconstructions can help to test and improve projections. This publication added a neat data set to assist with that."

- NZME.