

Hazards of the Jamaican Coastline
WILL SEA LEVEL RISE DROWN JAMAICA?

This is the third in a series of articles on Hazards of the Jamaican Coastline contributed by the Marine Geology Unit, Department of Geography and Geology, University of the West Indies, with funding support from the Environmental Foundation of Jamaica.

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In our last article we wrote about large boulders scattered along parts of the Jamaican coastline, and the likelihood that they were deposited by very violent hurricanes or tsunamis. Today we take a look at Jamaica's past, present and probable future in terms of impending sea level rise.

The Past



If you had been sitting at the edge of the sea on the south coast of Jamaica about 18,000 years ago the landscape around you would have been utterly different from that you see at the present day. The beach in front of you is narrow and not well-protected by coral reefs. Behind you a sheer cliff or very steeply rising ground would have reared up some 100 metres or more in height and would have extended out of sight in both directions, many kilometres long. If you have ever visited Lover's Leap in southern St. Elizabeth and looked over the edge, that is what the cliff would have been like, except you would have been sitting at the bottom. The cliff would have been intersected by steep-walled gullies, some with waterfalls cascading directly into the sea. If you had climbed this cliff you would have emerged on to a flat plain, covered with scattered trees, scrub and grassland, and extending almost as far as the eye could see. In the far distance, densely wooded limestone hills, rising abruptly from the plain, would have been visible, stretching back through the haze to the mountains behind. Looking southwards out to sea you would have seen another very large island in the distance, similarly surrounded by steep cliffs, but without any mountains at all.

This, of course, is an imaginary scenario.. The oldest archaeological traces of Early Man in the Caribbean islands date back only to about 4,000 BC. So where is this cliff today? Although we cannot see it, it is still there, some 30 kilometres south of the present coastline of Clarendon parish. It is completely covered by the ocean, and between it and today's coast is a wide flat shelf, over a quarter the size of Jamaica itself,

drowned by a shallow sea, as shown on the first map in this article. The island that was seen to the south is now Pedro Bank. As an island it would have been nearly half the size of Jamaica.

Eighteen thousand years ago vast ice sheets covered much of North America and northern Europe and Asia. They were so huge that they had locked up enough water from the oceans to lower sea level some 120 metres below what it is today. From 18,000 years ago to the present, and into the future, the story we will follow is one of rising sea level as these ice sheets melted.

Initially sea level rise was gradual, about 25 metres over the first 4,000 years, or about 6 millimetres a year. But about 14,000 years ago there was a dramatic increase in the rate of rise to about four and a half centimetres per year, over a period of less than 500 years, raising the ocean surface from about 95 metres below its present level to about 75 metres below present level. This rapid rise, and a similar event 11,500 years ago, have both been attributed to major meltdowns of the great northern ice sheets. By the end of these events the sea surface had risen about 75 metres above its ice age all-time low.

There is evidence that a third catastrophic sea level rise event occurred about 7,500 years ago (about 5,500 BC), bringing sea level up from about 20 metres below its present level to less than 10 metres below the present day. This is thought to have resulted from a partial collapse of the Antarctic ice sheets surrounding the South Pole. During this short-lived event sea level may have risen at a rate some twenty to thirty times faster than today's rate. This would certainly have been noticeable to any human beings that might have been living on the coast at that time. The rise then slowed until, by about four to five thousand years ago (2,000 to 3,000 BC), the oceans reached approximately their present level.

The Present

There is general agreement today that sea level is rising. Tide gauge records all over the world show this trend. The rate of rise varies slightly from place to place due to the differing reactions of the adjacent landmasses, but in this part of the world, it averages about 2 millimetres annually.

Is this rise a continuation of what has gone before or the result of some new impetus, driven by climate change? Global warming appears to be a fact of life, aided by the increased emissions of greenhouse gases, such as carbon dioxide. In addition to causing, perhaps, more violent hurricanes, global warming melts the ice sheets, adding the meltwater to the ocean. It also raises the temperature of the ocean, causing it to expand. Both these effects result in a rise in sea level.

The Future



If global warming continues into the future then sea level will also continue to rise. If all the ice caps on the mountains and on the big island of Greenland melted, sea level would rise about 7 metres. If the huge

Antarctic ice cap also melts the sea would rise to about 70 or 80 metres above its present level. A rise of 7 metres would flood most of Jamaica's coastal communities. In Clarendon, Lionel Town would be on the beach. Portland Cottage, Portmore and both our airports would be drowned. A rise of 70 metres would make Jamaica look like the second map shown in this article. In Kingston the shoreline would extend from Up Park Camp, through the Library on Tom Redcam Drive to the clock tower in Halfway Tree and Calabar College. Upper St. Andrew would become lower St. Andrew.

When will these events happen? This is one of the most heavily debated aspects of the sea level rise scenario. Estimates of total rise between now and the end of the century, published in 2001 by the Intergovernmental Panel on Climate Change ranged from under 20 centimetres as much as 80 centimetres. But recent studies indicate that ice fields are melting faster than previously thought, so the higher figure of 80 centimetres may be more realistic. Are we in for another catastrophic rise in sea level, as has happened three times already in the recent past? In the warm period preceding the last Ice Age, sea level is thought to have been about 6 metres higher than it is today. This has been surmised from evidence such as that provided by ancient raised sea level notches. These are grooves eroded by the sea and marine organisms into cliffs, indicating the positions of former sea levels. As we are presently in a warm period similar to that preceding the last Ice Age, a rise to a similar level is quite possible.



The notch at the base of this ancient cliff at White Bay, Trelawny indicates a former sea level.

When one talks of a catastrophic rise, how catastrophic is it likely to be? Six millimetres a year, or six hundred? Many scientists suggest it may take another 600 years for sea level to rise 7 metres, an average rate of 11 to 12 millimetres a year, well above today's 2 millimetres a year. But there is always the possibility of an unexpected acceleration in the rate of rise. After all, recent reports on accelerated ice melting in both polar regions, such as that by Peter Clark and other scientists in the journal *Science* in October of this year, frequently seem to include phrases such as "startling changes have occurred" or "unexpectedly higher rates were measured", so we may be in for unpleasant surprises. If sea level were to

rise at the same rate as it did 14,000 years ago, it would reach seven metres above today's level in just one hundred and fifty years.

A complete melting of the world's ice is unlikely. At some stage, the climate conditions resulting from global warming may actually start to promote global cooling and a descent into the next ice age. Investigations have shown that ice ages have come and gone repeatedly over the past two million years, and those periods when the climate was as warm as today seldom exceeded a few thousand years. Despite Man's interference with natural processes there is no reason to believe that the warm period in which we live is any different from those that have gone before.

So with sea level rising, what will become of all those homes and businesses on the Jamaican shoreline? We will discuss eroding beaches and appropriate setbacks in the next article on *Hazards of the Jamaican Coastline*.

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