Geohazards

Danger of CO_2 release in Cameroon *(August 2000)*

On 21 August 1986 a huge cloud of carbon dioxide gas was released from Lake Nyos located at 300 metres in the Highlands of Yaounde District of Cameroon. Because carbon dioxide is more dense than air it hugged the ground and flowed down valleys. The cloud travelled as far as 15 miles (25 km) from the lake. It was moving fast enough (as much as 80 kph) to flatten vegetation. 1,700 local people died by suffocation, probably unaware of their plight. Two years earlier 37 people died similarly in a gas release from nearby Lake Monoun.

Lake Nyos, Cameroon after 1986 carbon dioxide release. The water is coloured red due to oxidation of dissolved ferrous iron to iron hydroxide when the gas forced reduced bottom water to the surface.

Lake Nyos is in the Oku volcanic field, and is one of several *maars* produced by one-off explosive events in the recent past. Isotopic analyses of gas remaining dissolved in the lake show that the CO_2 is of volcanic origin. The lakes are fed by springs on their beds, which is where the CO_2 enters. Being extremely deep (about 200 metres) and with no surface inlet the lake water is strongly stratified, so that CO_2-rich water builds up at the bottom. The gas release must have involved an overturn of the stratification, so that dissolved gas came out of solution as pressure decreased. What triggered the overturn is hard to establish, but one possibility is that during August (both catastrophes occurred in that month) cold weather cools surface waters so that they sink. Other possibilities are storms, landslides or earthquakes, but there are no records of any of these preceding either event; they came completely unannounced.

Since 1986, gas levels have built up, and now stand at twice their concentration following the disaster, so danger threatens the local people and their livestock once again. An international team, headed by George Kling a geologist at Michigan University, USA, has

devised a means of venting the gas harmlessly. This involves sinking 15 centimetre diameter polyethylene pipes to the lake bed. Once pumping starts, gas bubbles forming as pressure releases will drag the water upwards, as a self-sustaining siphon, similar to the air-lift dredges used in marine archaeology. Four such pipes would rid the lake of its lethal gas content in two years, and even one would reduce the hazard considerably.

Giant tsunamis *(October 2000)*

Various coastal sites around the world show features suggesting massive scouring of low-lying coastal areas in the geologically recent past (less than a million years). Among these are curious crescentic islands and huge boulders far above sea level in the Bahamas, and the bones of whales and other marine mammals stranded well above modern sea levels along the shores of the various firths (estuarine inlets) of eastern Scotland. There are archaeological curiosities too. The renowned Bronze Age site of Scara Brae on Orkney was excavated from beneath sand. Archaeologists found signs of hurried abandonment of the near-perfectly preserved houses, as if it had been overwhelmed by some catastrophe.

On 12 October 2000 the BBC's *Horizon* series presented a 50 minute documentary called *Mega-tsunami*, which examined evidence that tsunamis (often miscalled 'tidal waves') more than ten times the height and power of those produced by earthquakes could be set in motion by coastal landslides. The dramatic centrepiece of the broadcast was an eyewitness account by two Alaskan fisherman who survived such a giant wave triggered by the collapse of a mountain slope in a narrow inlet. Their craft luckily stayed upright and careened over the top of dense forest. The scar left by the wave rose as high as 500 metres above the shore. Dams have been destroyed by landslides forcing water over them, and it is pretty obvious that a large enough fall of rock with sufficient energy could generate huge waves that cross entire oceans if it took place on an ocean shore or on an island.

Tristan Marshall, a researcher for *Horizon*, gives a summary of the evidence for such megatsunamis and the risk posed by unstable slopes in coastal settings, as presented in the programme in *New Scientist* (Marshall, T. 2000. The drowning wave. *New Scientist, 7 October 2000*, 26-30). While the Pacific floor around the Hawaiian island chain is strewn by debris from giant landslips, they are undated and difficult to link to evidence for wave inundations around the Pacific rim. Such a collapse of part of El Hierro in the Canary Islands dates to 120 thousand years ago. This could explain the chevron ridges and the 2000 tonne perched boulders of the Bahamas by the megatsunami resulting from the collapse. Clearly, this possible link poses a frightening threat to any shoreline habitation, for waves capable of the transformation of the Bahamas would rise above the largest skyscrapers of coastal cities; that is, if similar landslips are poised ready to go.

Giant boulders perched on Eleuthera Island, Bahamas. (Credit: Washington Post)

Most volcanic islands show evidence for big slope failures, because they are built rapidly by lavas and ash flows. Worryingly, the active volcano Cumbre Vieja on La Palma in the Canary Islands seems a possible candidate for the future. During its last eruption in 1949 a fault breached surface along the crest of this fissure-type volcano. Should that form the failure surface for a future landslip, a sizeable portion of La Palma falling in the Atlantic would displace a giant wave directed at the western seaboard of the USA. That is made all the more likely by the interior structure of the volcano. Being a fissure volcano, its edifice of volcanic rubble is riven with north-south dykes. These act as dams to groundwater movement, so building up perched water tables that can lubricate potential failure surfaces should they become overloaded or triggered by new eruptions.

For the curious, the evidence for a megatsunami affecting the Scottish coast is dated at around 8000 years ago, during the Mesolithic when humans were first colonising the British Isles and it was probably set in motion by a submarine landslip of glacial debris off the west coast of Norway.