Odd Earth Objects:
Unusual sights and sounds of Earth

A Volcanic Connection

Lake Nyos occupies a crater of a dormant volcano in a failed rift arm that developed during the opening of the Atlantic Ocean.

But…the Lake Nyos volcano has been dormant for 400 years.

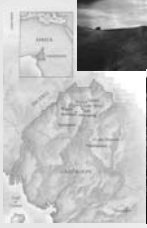
The 1986 disaster was not accompanied by the eruption of any lava or pyroclastic debris.

Strange Happenings: Killer Lakes

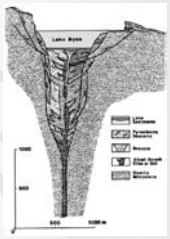
In the middle of the night on August 26, 1986, Some 1,800 people and thousands of animals living in the valley below Lake Nyos, Cameroon mysteriously died in their sleep.

After the disaster, it was noted that Lake Nyos developed a strange orange colour.

How might this strange event be explained ?



Gas Time Bomb



The lake, only about 1 km wide, is exceptionally deep (200 m).

The upper 50 metres is fresh water-below this level, the water is salty (due to emanation of sodium-rich volcanic fluids that from the underlying magma chamber).

Also quietly accumulating at the bottom of the lake are large quantities of carbon dioxide (again fed from an underlying magma chamber).

As long as the lake is undisturbed, the carbon dioxide is confined to the bottom of the lake.

Disturbance and Lake Overturn

Carbon dioxide accumulated to the point that it could no longer be contained at the bottom of the lake, and rapidly escaped to the surface.

The concentrated carbon dioxide, being denser than air, flowed close to the ground as a plume and suffocated victims up to 25 km away from the crater.

Along with the carbon dioxide came lots of lake floor water containing dissolved reduced iron. It was the oxidation of this iron that gave the lake the orange colour.

Mimetoliths

At some point in their lives, most people see familiar shapes in natural geologic features.

A **mimetolith** can be defined as a natural topographic feature, rock outcrop, rock specimen, mineral specimen, or loose stone which contains the likeness of a familiar feature (*e.g.*, face, animal, plant, or manufactured item).

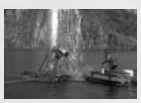
Mimetoliths are popular items of fancy for geologists who have too much time on their hands (these individuals are rare), or are stuck in a camp at night with one tent, one lantern, and no other source of amusement (somewhat more common).

Preventative Measures For the Future

Such outgassings are likely to occur on a fairly regular, though not predicable, basis (on time scales from years to thousands of years).

To prevent future disasters, a lake water piping system has been installed.

This allows for the gradual (small volume) and constant release of carbon dioxide from the lake bottom (thus reducing the rate of carbon dioxide buildup).



Concretions

Concretions-spheroidal masses of mineral matter (usually calcareous) found in various sedimentary rocks (often in black shales and other organic-rich sedimentary rocks)

Concretions are commonly formed in marine sediment with abundant organic matter.

In the process of eating the organic matter (containing carbon), certain bacteria release bicarbonate into the pores of the sediment.

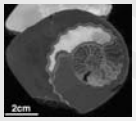
Concretion in Devonian Kettle Point Shale (Kettle Point, Ontario)

Nucleation of Concretions

This bicarbonate combines with dissolved calcium in the pore water, to form crystals of calcite (calcium carbonate), which cement the sediment grains together.

This cementation is often localized around a nucleus, such as a fossil, forming discrete bodies of cemented sediment.

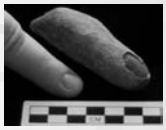
This concretion nucleated around the remains of a fish



This concretion nucleated around an ammonite shell

Strange Concretion Shapes

Due to local differences in the rate of calcite precipitation, sediment type, and other factors, concretions can assume some unusual shapes.



"Fertility figure"
(actually, just a bunch of Small concretions that have grown into one another)

"Fossil finger"
(actually, the weathered rind of this concretion has just partially flaked off)

"Turtle stone"
(calcite has filled in cracks of the concretion)-resembles turtle shell texture.

Differential Erosion

Concretions are more resistant to weathering and erosion than their host sedimentary rocks within which they grew.

When the host rock is eroded away, the concretions appear to be strewn over the eroded surface (even though they may not have moved far from their location of formation).

Delusional people like to think these concretions are fossils or signs from gods or extraterrestrials !

"Fossil pumpkin patch", Argentina
(actually just an erosion surface exposing concretions).

"Cannonball concretion," Central Australia

Bunyan's Burger (North Coyote Buttes, Northern Arizona)

This large concretion (about 3 m wide, 1.5 m high) has been exposed by erosion of the softer sedimentary rock within which it grew.

It has split and has been preferentially eroded along the bedding planes of cemented strata.

Other interesting Mimetoliths…

Mineral Mimetoliths

Gypsum crysanthemum from gypsum cave in Tennessee

Smithsonite ($ZnCO_3$) heart (width - 13mm) from San Antonia El Grande Mine, Chihuahua, Mexico.

Aragonite ("petals") and siderite ("centre") daisy (diameter of "flower" - *ca.* 5 mm). Specimen from Chastriex, Puy de Dôme, France.

A Neat Metamorphic Mimetolith

"The Bride of Frankenstein" natural cameo.

An eroded biotite gneiss cobble found in a back country stream NW side of Mt. Mitchell, North Carolina, U.S.A.

The white "image" is a quartz-rich foliation band. Showing through in patches is an underlying band rich in biotite.

A "Rock Face"

Writing On Stone Provincial Park, southern Alberta

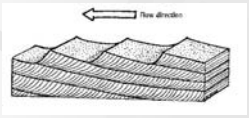
Produced by differential erosion of crossbedded sandstone.

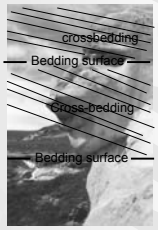
Note the slightly inclined orientation of laminations between bedding surfaces.

Explanation of Cross-bedding

Cross-bedding is a sedimentary structure produced by the migration of bedforms (ripples and dunes) under the influence of a water or wind current.

Sediment particles transported in a current come to rest on the down-current side of the bedforms, forming laminations at a high angle to the main bedding surfaces.





This crossbedded sandstone was deposited in a river during the Cretaceous Period.

Strange Rock Behaviour: Racetrack Basin

Within Death Valley, California is a dry desert lake bed, known as the Racetrack Playa.

Resting on the lakebed are loose dolostone boulders weighing up to 320 kg. Some are associated with long furrows.

Some of the rocks are located hundreds of metres from the edges of the lake, and some have moved *up* slight inclines on the lakebed surface (indicating that gravity is not the sole factor in moving these rocks).

No one has actually seen the rocks move.

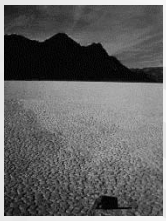
Possible Explanation For Movement of Boulders

The orientation of the furrows indicate that the boulders generally move in a northward direction (this is consistent with the prevailing wind direction).

A plausible explanation for boulder movement:

Brief rainstorms wet the clay-rich lakebed surface.

The wetted clay becomes sufficiently slick that friction is overcome by forces exerted by moderate to high winds (these get up to 70 km/hr in this area). Thus, the large boulders may be moved by wind power!



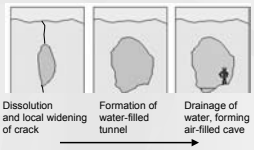
Simulation of boulder movement

Cave Deposits (Speleothems)

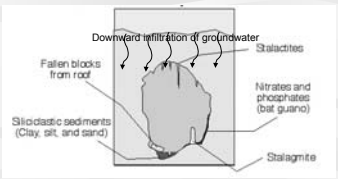
Groundwater can dissolve large quantities carbonate bedrock.

Dissolution is initially focussed along cracks (e.g. joints) and other planes of weakness. Over long periods of time, continued dissolution can produce large underground tunnels.

Tunnels are drained of water if the water table is lowered- this leaves behind an empty, air-filled space that we call a cave.



Air-Filled Cave



Once emptied (at least partially) of water, caves can begin to fill up with sedimentary material: faeces of cave animals, clastic sediment washed in from openings at the surface, and chemical sediment (usually travertine).

Cavern features produced by the minerals precipitated from dripping water are called speleothems (*spelaion* = cave, *them* = put or deposit).

A one of a kind invention: The Stalacpipe Organ

Located in the Luray Caverns of Virginia.

Stalactites covering 1.5 acres of the caverns produce mellow tones when electronically tapped by rubber-tipped mallets.

The instrument was invented in 1954 by Mr. Leland W. Sprinkle, a Virginian mathematician and electronic scientist at the Pentagon (makes one wonder what people do at the Pentagon).

Stalactites and Stalagmites

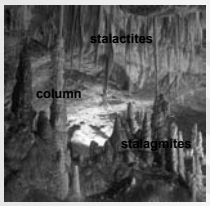
Among the most familiar speleothem features are stalactites and stalagmites.

Over long periods of time, precipitation of calcite from dripping water produces icicle-shaped bodies of travertine called stalactites (stalactos= trickling)

Calcite precipitation from water on the floor of a cave, produces upward-oriented mounds called stalagmites (stalagmos = dropping)

Stalactites and stalagmites can eventually connect, forming columns.

Walls of the cave can also be covered with sheets of travertine (flowstone).



The Stalacpipe Organ

The project took 3 years to complete.

The initial stage involved searching the cavern chambers for stalactites with tones that matched each note of the musical scale. Different tones will be produced by stalactites of different lengths and thicknesses (similar to a pipe organ)--tone may change if stalactite continues to grow. Some stalactites were originally shaved slightly to produce the proper vibration frequency.

Mallets were wired throughout the caverns and connected to a large four-manual console.

When a key on the console is depressed, a tone is produced as the corresponding mallet strikes the stalactite tuned to concert pitch.

Close-up of one of the mallets which strike a stalactite when an organ key is pressed.


END OF LECTURE