

## Carbon dioxide stories

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### The Dog's Cave (*Grotta del Cane*)

Carbon dioxide can be formed deep inside the Earth when certain types of rock react with one another in a liquid state. During eruptions, active volcanoes are capable of releasing large quantities of the gas and even in areas with long-extinguished volcanoes, carbon dioxide can be released from fissures in the rock. Perhaps the most famous carbon dioxide source of this kind is the Dog's Cave (*Grotta del Cane*), near Naples, Italy.

Naples is a city surrounded by volcanic areas. In the southeast is Mount Vesuvius, one of the most dangerous volcanoes on Earth, which in 79 AD buried the Roman towns of Pompeii and Herculaneum under magma and ash. In the northwest are the Phlegraean Fields, an area of old, extinguished volcanoes – and the site of The Dog's Cave.

How did the The Dog's Cave get its name? From deep down in the Earth, carbon dioxide enters the cave. Since it is heavier than air, the gas lies in a layer about 1 m above the ground. In past centuries, when people entered the cave with a dog, the dog suffocated, while nothing happened to its owner whose head was well above the layer of carbon dioxide. Today measures are taken to warn dog owners of this danger, although if a dog does somehow enter the cave and falls unconscious, it can be revived quickly by lifting it into the overlying layer of fresh air.

**Source:** [www.unibas.ch/schulen](http://www.unibas.ch/schulen)

### Old wells and liquid manure

Carbon dioxide is often produced in pits of liquid manure or old well shafts. The lack of warning given by a gas that does not smell has meant that time after time, people have fallen unconscious and died on entering such places. On many occasions, rescuers of the unconscious have also fallen victim to the carbon dioxide, because they did not know what the problem was.

### Old wine cellars

Carbon dioxide is produced during the process of fermentation. Before good ventilation systems were installed in wine cellars, vintners used their knowledge of carbon dioxide to ensure their safety. In some old wine cellars you can find small masoned ledges at a height of about 1 m, where vintners would have put slowly burning candles before the wine cellar was locked at night. If the candles had gone out when the vintner opened the upper cellar door the next day, he knew that carbon dioxide had collected and that the cellar needed airing before he could climb down.

## The disaster at Lake Nyos

On 12 August 1986, the same story was in the news everywhere: all 1700 inhabitants of the four villages around Lake Nyos in Cameroon, Africa, had died the night before. Also dead were the villagers' livestock and wild animals and birds. People who came to the villages that morning were baffled over how such a disaster could have happened: none of the bodies showed any injuries, there were no signs of a fight and most lay peacefully in their beds as if they were still asleep. Many held a mysterious poison or disease responsible, although there was no sign of either poison or pathogen. Others from the indigenous population believed that a legendary witch, the *Wrath*, had climbed out of the lake and carried out the killings.

For the scientists who investigated the catastrophe, the answer was soon clear: humans and animals had been suffocated by carbon dioxide, and the only cause could be the lake. Lake Nyos formed in the crater of an extinguished volcano and has a depth of over 200 m and a surface area of about 1.5 km<sup>2</sup>. The scientists found that at the bottom of the lake, a continuous stream of carbon dioxide was being released into the water. Carbon dioxide dissolves particularly well under the high-pressure and low-temperature conditions prevalent here and so remained in solution. Over many decades, an enormous amount of carbon dioxide-rich water had accumulated on the lake bed.

Somehow, possibly due to a small volcanic eruption at the bottom of the lake, during the night of August 11, the water from the bottom of the lake reached the surface. Much like a champagne bottle that is shaken and then quickly opened, an estimated 1.2 km<sup>3</sup> of carbon dioxide were suddenly released from the water, due to the significantly lower pressure at the lake surface. It must have been a spectacular yet terrible sight to have seen the lake's water, driven by the immense surge of gas, explode into the air. Few first-hand reports exist because witnesses, like those who were sleeping, suffocated to death.

To stop such a disaster from repeating itself, in 2002, a system of tubes was passed down from a platform in the centre of the lake to a depth of 200 m. Initially, the carbon dioxide-rich water was pumped up through the tubes, but after a while the pump was turned off because the formation of a steady stream of rising carbon dioxide bubbles in the tube (due to the lower pressure at the surface) performed the job of driving the water to the top. Today, a fountain of water and carbon dioxide flows from the platform, preventing carbon dioxide from accumulating at the bottom of the lake. The amount of carbon dioxide released into the air in this way is entirely harmless.