

Portable gas analyser proves invaluable for research into carbon dioxide in caves



Little is known about how and why carbon dioxide builds up in caves. However, a university project is aiming to find some answers, and a portable Servomex 5200 Multi Purpose gas analyser has played a key role in the research.

Hannah Sargent, an undergraduate geographer at the University of Sussex, has been studying carbon dioxide in caves in the Mendip Hills, Somerset. In particular, she has been investigating what effect visitors to caves have as a result of the carbon dioxide they exhale, both in large 'tourist' caves and in the less accessible networks of caves enjoyed by cavers.

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Carbon dioxide is naturally present in the atmosphere at a concentration of approximately 0.03 per cent. Humans can survive levels as high as 4 per cent, though various symptoms are likely to be exhibited. Higher concentrations, however, can be dangerous, and rapid death occurs at levels above 10 per cent. Due to the risks to health, the caves in the Mendip Hills are closed when carbon dioxide exceeds 4 per cent, and this has happened on many occasions in the last five years. The highest level recorded by the Servomex analyser during the project was 3.5 per cent.

Some caves are renowned for having high carbon dioxide levels, and in such cases cavers carry personal gas monitors. However, these monitors are designed for use in 'confined space' applications, such as entry to storage tanks for maintenance and typically have an alarm threshold of 1 per cent, so caves with a higher-than-average carbon dioxide concentration tend to trigger frequent 'nuisance' alarms.

It is known that water entering caves gives up carbon dioxide to the atmosphere, as a result of the different partial pressure of carbon dioxide. But it is not clear why the concentration of carbon dioxide in the cave atmosphere sometimes increases dramatically. One theory is that the weather has an influence, with high pressure causing the concentration to rise; another theory is that mild winters hinder the natural dispersion of the carbon dioxide. However, the cause of the phenomenon remains unclear, and research in this area has so far been limited.

Apart from having implications for visitor safety, high levels of carbon dioxide in calcium carbonate caves can adversely influence the formation of stalactites and stalagmites, as carbon dioxide can react with water to form carbonic acid, which dissolves the calcium carbonate.

When she started her project, Hannah Sargent had hoped to be able to use the existing gas analyser owned by the university. However, there was heavy demand for this from within the department, so she started to look elsewhere. Fortunately Servomex was able to loan her a 5200 Multi Purpose equipped with an infrared 0-10% carbon dioxide sensor and a paramagnetic 0-100% oxygen sensor. This new battery-powered instrument, which could also be linked to Ms Sargent's laptop computer, proved to be ideal for the project due to its excellent performance and accuracy, when compared to standard gas monitors.

The instrument was available to Ms Sargent for approximately two months and, in this time, was utterly reliable. One of the advantages of the instrument was its fast response time (less than 10 seconds for carbon dioxide), which meant that she was able to move the instrument around the caves to gather a large number of readings in a short time. The instrument could also be strategically positioned in a cave and linked to a laptop computer, allowing carbon dioxide and oxygen readings to be taken every 20 seconds for a period of five hours, with the data logged directly onto the PC.

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Weighing less than 4kg, and housed in a sturdy casing with integral feet, the Servomex 5200 Multi Purpose gas analyser is truly portable. With a little extra protection - in the form of nothing more sophisticated than bubble wrap - the instrument could even be taken into the tunnels and caves visited by cavers. A similar and even more rugged unit, called the 5200HD, is due for release early next year.

Indeed, the cavers were very excited by the instrument, as carbon dioxide is a serious concern to them, and the personal gas monitors on the market have their limitations in caving. One aspect of the instrument that the cavers particularly liked was the user-settable audible alarm and the wide measurement range. In some caves there are gas analysers permanently installed, and the cavers felt that the infrared sensor of the Servomex instrument offered significant advantages over the chemical tube-type sensors traditionally used.

Ms Sargent comments: "The Servomex 5200 Multi Purpose was so easy to use that I did not need any training as such, and it was certainly portable enough to take almost anywhere in the caves. I was easily able to read the white LCD display and it was useful to have a clear indication of the battery level. Compared with the alternatives, the speed of response was much faster - which enabled me to collect data almost as soon as I positioned the instrument - and the accuracy was also better [$\pm 2\%$ FSR]."

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More information about the Servomex gas analysers and sample systems, all of which are available and fully supported worldwide, can be obtained from Servomex Group by calling 01892 652181, faxing 01892 662253, emailing info@servomex.com or visiting the website at www.servomex.com

Editors: Please Contact Joanna Watchman or Rosie Davey at IMS Marketing Communications Group plc for any editorial questions or for additional images: Joanna and Rosie can be contacted on +44 (0) 117929 3041 or at joanna.watchman@implc.com