**Exploration of lava tubes in the Teide National Park, a martian analog.** A. D. Morse[1], A. Lainez[2] and K.T. Howard[3], [1]Planetary and Space Sciences Research Institute, The Open University, Walton Hall, Milton Keynes, MK7 6AA UK (a.d.morse@open.ac.uk), [2]Department of Mineralogy, The Natural History Museum, Cromwell Road, London, SW7 5BD, UK, [3]Cueva del Viento Centro Visitantes, Icod de los Vinos, Tenerife, Spain.

**Introduction:** Lava tubes and volcanic caves are a potential habitat for Martian life and a target for astrobiological studies[1]. Evidence for the existence of Martian caves such as long lava channels and lines of pits have been identified from orbiting space craft [2] and epithermal neutron maps indicate the presence of water a few metres below the surface [3] which would be accessible to cave life. Inside the caves, any life will have access to water and would be sheltered from the harsh surface conditions of UV radiation and low humidity as well as from the prevailing weather conditions.

The caves in the Teide national park of Tenerife are an ideal terrestrial analogue of Martian caves. They are situated at an altitude of 2500 m in an area of low humidity. Additionally, contamination is reduced as access to the area is limited for conservation reasons. In June 2010, permission was granted by the Parque Nacional del Teide for rock samples to be collected from two caves, Cuevas Negras and Sima de Vicky and the surrounding areas. The aim of this work was to conduct a preliminary study to characterise the microbial (*Bacteria* and *Archaea*) communities that live in volcanic caves and draw parallels with the type of life that may exist on Mars.

**Cuevas Negras:** Cuevas Negras are a series of 6 short horizontal lava tubes close to the surface, typical of volcanic caves. Of particular interest is that one of these caves has a natural rock arch similar to distinctive Martian volcanic features observed from space (see figures in [1] and [2]). This type of cave would be more accessible by robotic (and human) explorers and could provide a habitat for early colonists. One of the caves which faced westwards had ferns growing inside, evidence that the cave environment provides a shelter from the harsh dry surface conditions.

**Sima de Vicky:** Located on Montaña Rajada, Sima de Vicky is a predominately vertical system, 71 m deep, formed by fractures in the rock as magma has risen and caused the overlying rock to dome [4], [5]. This type of volcanic cave allows access to depths greater than that readily achievable by robotic drilling.

Whilst visiting this cave at a depth of -35m to -50m it was noticed that the walls were covered with a delicate white formation on the walls with a solid "icing" on the floor (figure1). The presence of this delicate white formation indicated that the cave had been rarely visited. Below -50m the air became distinctly cooler and the walls were damp. The bottom of the cave was filled with boulders blocking any further progress, although the cold damp draught indicated that the cave was probably a lot deeper.

Figure 1. White formation in Sima de Vicky. Field of view~30cm.

**Study Progress:** Two of the samples from Cuevas Negras were crushed and viewed by optical microscopy to confirm the presence of bacteria. DNA was extracted from these two samples using PowerMax Soil DNA Isolation kit using a technique specifically developed for volcanic rocks[6]. The concentration of DNA was determined by spectrophotometry to verify that the DNA can be extracted from these particular volcanic rocks using this technique. Further work would require sending the DNA for genetic sequencing of the *Bacteria* and *Archaea* probably by 545 pyrosequencing.

The white formation growing on the walls of Sima de Vicky is very unusual and its presence was unexpected. Optical microscopy showed a very low concentration of bacteria; however, the sample that was collected was of the more crystalline material lying on the floor rather than the delicate powdery material on the cave walls, so it is possible that it could have a bacterial origin. A sample has been sent for lipid extraction which will provide further information. A Scanning Electron Microscope (SEM) image showed an unusual texture (figure 2), a smooth surface with holes surrounded by a polygon structure. The SEM analysis indicated that the only elements detected were sodium and oxygen. Analysis by X-Ray Diffraction (XRD) at the British Museum (Natural History) has identified it as thermonitrite ($Na_2CO_3.H_2O$), which is often formed as an evaporate deposit.

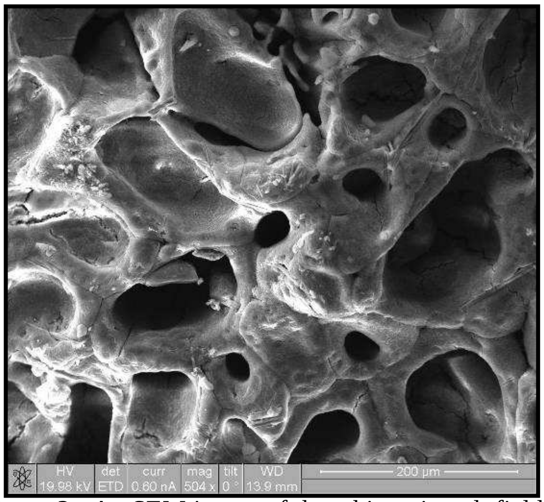

Figure 2. An SEM image of the white mineral, field of view ~500µm.

An understanding on the formation of the white mineral could provide further information about the caves of Montaña Rajada. The circulation of cold moist air indicates that the cave system is much deeper and probably connected to many of the other caves in the area. Further insights could be gained by a detailed survey of the caves. Connections between caves, too small for speleologists could be mapped by monitoring the air circulation e.g. temperature, humidity and carbon dioxide concentration. Thus providing remote access to even greater depths.

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