

Microclimate and morphology of a fumarolic ice cave on Erebus Volcano, Antarctica

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Flank degassing from Erebus Volcano, Antarctica, occurs largely through fumarolic ice caves (FIC) and fumarolic ice towers. These unusual formations host an internal environment with elevated temperatures (elevated by 30 to 40°C), CO₂ concentrations (elevated by several thousand ppm), and humidity (elevated by 70 to 80% rh). During the last two field seasons the Mount Erebus Volcano Observatory launched an investigation into the microclimates and morphology of the FIC in an effort to determine how the structures form, and how they represent to flank degassing processes on Erebus and other volcanoes worldwide.

Deployment of a fiber-optic distributed temperature sensing system, combined with images from a handheld thermal infrared camera, demonstrated that advective point sources of volcanic gas, as well as point sources of cold air leaking into the cave, are a major control on the FIC air temperature. There is a strong inverse correlation between with barometric pressure outside the cave and vent temperature. We interpret this as “drawing out” of gas from the volcanic edifice by dropping barometric pressure.

Conventional and LiDAR cave surveys were conducted to determine FIC morphology. FIC passages run uphill in an anastomosing pattern linking the volcanic gas vents. Domed chambers are observed above major gas vents. Scallops on cave walls represent airflow direction. FIC locations appear to correspond to geologic zones of structural weakness including the edge of the summit caldera, and a dike collinear with the Main Crater, Side Crater, and Western Crater.