Overview of recent findings regarding the fumarolic ice caves of Erebus volcano, Antarctica

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Fumarolic ice caves and towers on Erebus are the surface expression of flank degassing on the world's southernmost active volcano. The caves act as windows into magmatic processes, host extremophiles, and are analogues for extraterrestrial systems. Over the past four Austral summers, mapping, gas and thermal monitoring conducted under the Erebus Caves Project has elucidated relationships between cave structures, underlying magmatic processes, and surface weather.

A newly compiled database and map of cave locations demonstrates that their locations reflect the underlying magmatic system as imaged by recent seismic tomography and scattering survey, but are also affected by shallow features including lava flow edges and remnant caldera rims.

Heat transport into the caves occurs primarily by advective transport through discrete vents, as revealed by distributed temperature sensing (DTS) campaigns. Long time series of temperature data reveal vent temperatures to be nearly constant over observed periods (up to two years), implying a stable effusive degassing process. Despite constancy on long timescales, vent gas have transient changes, dropping by as much as 15℃ for one to three days, several times a month. These sudden drops in temperature are thought to represent sudden changes in cave geometry, such as the opening of a new entrance or collapse of an ice tower. Small temperature changes (on the order of 1℃) in vent temperature on the scale of hours to days correlate with barometric pressure measured at surface weather stations and reveal barometric pumping of gas from the volcano edifice through the caves. At that scale in temperature and time, relationships between vents on Ice Tower Ridge suggest subsurface gas-permeable pathways connecting the vents.

Vent gases contain up to 3% CO_2 but lack the S, Cl, and F gases that are soluble at lower magma pressure and released at Erebus' convecting lava lake. This suggests that the cave gas exsolves from a deeper source than the degassing that occurs at the crater. FTIR measurements conducted in Warren Cave showed significant absorption in methane bands. This is the first evidence of volcanic gas other than CO_2 in the caves. Results will be presented for analysis of recently collected gas samples using mass spectrometry and gas chromatography.