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Studies inside Newly Formed Glacier & Firn Caves in the Crater of Mount Saint Helens (Washington, USA)

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Mount Saint Helens, probably the most famous volcano in the Cascade Volcanic Arc, is located in the southwestern part of Washington State, USA. Characterized by a 2 x 3.5 km horseshoe-shaped and north-facing crater, Mount Saint Helens hosts one of the last expanding glaciers in the Cascade Volcanic Arc. Primarily caused by geothermal activity, an extensive system of firn & glacier caves has developed around the 2004-2008 Lava Dome. These cave systems offer a rare view into the internal workings of a glacier and can lead to a better understanding of how glaciers and active volcanoes interact. Due to cave studies over the last six years it was possible to observe noticeable morphological changes in some cave systems caused by changes of the geothermal system, by extensive glacier movement, and rapid glacier growth. In contrast to studies done inside the former firn caves in proximity of the 1980-1986 Lava Dome around 20 years ago, it is difficult to say if the newly formed system is in balance with the present geothermal heat release.

Between 2014 and 2019 we surveyed 10 caves in detail, with a total length exceeding more than 2 km and the largest system having a surveyed length of almost 540 m. We also calculated cave volumes of more than 145 000 m^3. Most of these caves are located above numerous fumaroles which lead to extremely large-scale systems with a vertical extent of up to 73 m. Fumarole temperatures fluctuate during the year, but usually do not exceed temperatures above 90°C. It seems like cave systems can only exist above low-temperature fumaroles. High-temperature fumaroles, like they might appear outside the caves on and around the 2004-2008 Lava Dome, would lead to a complete melting of passages. It also appears that the volcano´s geothermal system is greatly influenced by exogenous factors in terms of rainfall and snowmelt. Compared to constant fumarole temperatures on Mount Rainier, we here can observe continuous changes. But different than the cave systems on Mount Hood, the crater and firn caves on Saint Helens do not show any signs of glacial flooding. Since the caves show diverse characteristics, it is interesting to study the reasons for it and to continue and expand climatologic research during the next years.

Besides climatologic studies, we also plan to focus on fumarole sampling in summer 2020 to obtain representative chemical and isotopic data. Furthermore, different snow and tephra layers which can be seen in almost all caves shall be investigated. In order to get information about environmental impacts we can study pathways from glacial snow and ice to drinking water, or the existence of major and trace elements. It might be also interesting to see in which extent permanent fumarolic activity influences the glacier and in which way former activity is preserved inside the Crater Firn & Glacier Caves of Mount Saint Helens.

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