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Interactive comment on "Formation and evolution of newly formed glaciovolcanic caves in the crater of Mount St. Helens, Washington, USA" *by* Linda Sobolewski et al.

Anonymous Referee #2

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This paper purports to describe the formation and evolution of newly formed glaciovolcanic caves in the crater of Mt St Helens. As someone who studies both caves and glaciers, I am unable to see how this manuscript represents even a small research advance in either field and, unfortunately, it even falls short of living up to its title. The manuscript is primarily a collection of cave maps and weather data that is sandwiched between an introduction and discussion section, neither of which explain how these data sets address any specific scientific problem. Explaining how a manuscript addresses a specific research problem is probably the minimum threshold to be considered for publication in any scientific journal. This oversight is underscored by the conclusions section, which is scientifically vague and only links to a handful of caves in

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Discussion paper

the Pacific northwest. From a data analysis perspective, the authors do not go much beyond presenting weather data and cave maps. These can be important data, so I'm not being dismissive of the data, however, there is no meaningful analysis of what is driving air flow in the caves, how that airflow enlarges caves or how the ice responds to enlargement. I'm not suggesting that every paper needs a complicated numerical model in order to be accepted, but I do think that analysis needs to go beyond "Fumarole temperatures do not exceed 60.1C. This is enough heat for cave systems to form." If the paper were truly about the formation and evolution of these caves, there should, at minimum, be some back-of-the-envelope calculations of how air fluxes control cave enlargement rates. I understand and agree that glacier caves are understudied, and I'd be a bit more supportive of publication if this were the first time anyone had described glacier caves on volcanoes. I also don't want to discourage the PhD student who was the lead author on this manuscript, but Ms. Sobolewski and her academic advisers really need to start over and think critically about how their data is useful to the broader fields of speleology or glaciology before submitting to another journal. A few other more specific comments are included below: Lines 101 – Its not clear why conducting the expeditions in May and June mitigate any of these risks. It helps to be specific. The cave maps could use some work. Profile views should be included with each plan view map and the locations of all data loggers should be clearly shown in both plan and profile views (this is especially important because the authors are dealing with temperature driven air flow in some locations. As a side note, I don't see any information about outside air temperature or windspeed, both of which are going to be important in controlling air flow in the caves). Sketches should also clearly indicate different types of geologic substrate. For example, the legends indicate "breakdown" but it is not clear if the block are ice or rock. The symbol being used for ice is more often used for snow (the authors even use the same symbol for snow in their Figure 17). Also, ice isn't a particularly useful category in the context of glacier caves. Is it glacier ice or refrozen meltwater? The authors can use less space for the cave map figures if they present a single, master legend and then remove the legend and other ancillary

information from the cave map figures. Survey groups, etc. are great to include in maps used for presentations at caving clubs, etc. but they take up unnecessary space in scientific journals. Finally – when using DISTOX survey devices, why are the surveyors only making 4 cross-section measurements (L,R,U,D)? The DISTOX, especially when connected to a tablet, allows for rapidly making hundreds of splay shots which can be used to improve the sketches. . ... Finally, in foggy passages, why can't the survey team use fiberglass tape measures for making distance measurements and splay shots (old school compass and inclinometers, not mentioned in the methods, are probably fairly helpful here too). Figure 17 is interesting, and probably right, but the processes shown here are not reflected in any of the data presented in the manuscript. Lines 140-151 – Accuracy and precision of each sensor should be included, as well as the sampling rate. While smoke torches might help the team visualize flow direction while mapping, why not use anemometers for logging direction and speed? Onset makes ones that lightweight and low cost. Line 164 – Are cryospeleothems not just icicles? Line 170 – Table 1 – Presentation of volume requires a detailed explanation of how a 3D surface was put over the cave survey. I'm guessing the team just exported this information from COMPASS, but the volume derived from the cave survey described and COMPASS is very unlikely to be representative of the actual cave volume. Even within COMPASS there will be significant variability in cave volumes based on how the 3D surface is created over the survey points (COMPASS is also not the best tool for creating 3D models of cave surfaces if you use the DISTOX to create hundreds or thousands of survey points to better constrain cave shape and volume – I include this information just in case the authors want to start adopting those strategies moving forward. . ..). Lines 205 – Figure 8 – It might be more effective to show how the caves change by putting both years on the same map. . ... Also, its not clear if the rocky area on the surface is a shallow debris apron or a rocky slope. If it's the latter, is there a georeferencing error? I'm just trying to understand how the cave passages relate to the rocky substrate in the satellite image. . ...

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