LA-UR-18-27830
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Title:	Gamma Radiation Emissions Due To Volcano Particulates During Kilauea Eruption
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Intended for:	Report
Issued:	2018-08-16

LANL 2018 – Hawaii Trip #1

Gamma Radiation Emissions Due To Volcano Particulates During Kilauea Eruption

Damien Milazzo – EES-14 – 6/15/2018

LANL 2018 – Hawaii Trip #1

I traveled to the island of Hawaii on May 19th, 2018 to measure gamma emissions from rainfall in the area impacted by recent volcanic eruptions. Kilauea Volcano, which has erupted nearly continuously from the area of Puu Oo Crater since 1983, entered a new eruptive phase on April 30, 2018 with the collapse of the Puu Oo Lava Lake and movement of magma to the east along the east rift zone. Beginning May 3, intrusion of this magma in the lower east rift zone led to eruptions from newly formed fissures that continue today. The eruption has provided geologists an opportunity to examine and document processes that were inaccessible previously on the Hawaiian island. The eruption also provided me an opportunity to gather gamma emissions spectrum from the newly erupted lava and the rainfall that may have incorporated gases and particulate from the erupting fissures. I brought a Light House Detector (LHD) that would be used to measure the gamma emissions, and intended to purchase any additional supplies necessary to complete my surveys. The goal of the trip was to determine if gamma spectrum analysis of rainfall on the leeward side of the erupting fissures could be differentiated from rainfall on the windward side of the fissures, and if the leeward rainfall had any impact on the background radiation for a given sample area.

Surveying began on May 19th in the city of Kona. The first survey sampled the background radiation present in the hotel room. This was done to make sure that the detector was working, and that the testing apparatus that would be used over the next three days did not contribute any statistically significant gamma radiation to the other surveys. The testing apparatus was a five gallon Lowes bucket, with small tin cans to hold the LHD at a given distance from the ground and above the rainfall collected in the bucket. ***Figure 1*** shows the testing apparatus at a rain-free survey site. As rainfall is a necessity for the research, the far northern end of the island, which was not forecast to receive rainfall, was excluded from sampling. However, two surveys were performed at the Kaloko-Honokōhau National Historical Park. The two surveys would act as controls for the other 'dry' surveys that would be performed around the island. If any other 'dry' survey was wildly different from the controls, further analysis at the site would be performed.

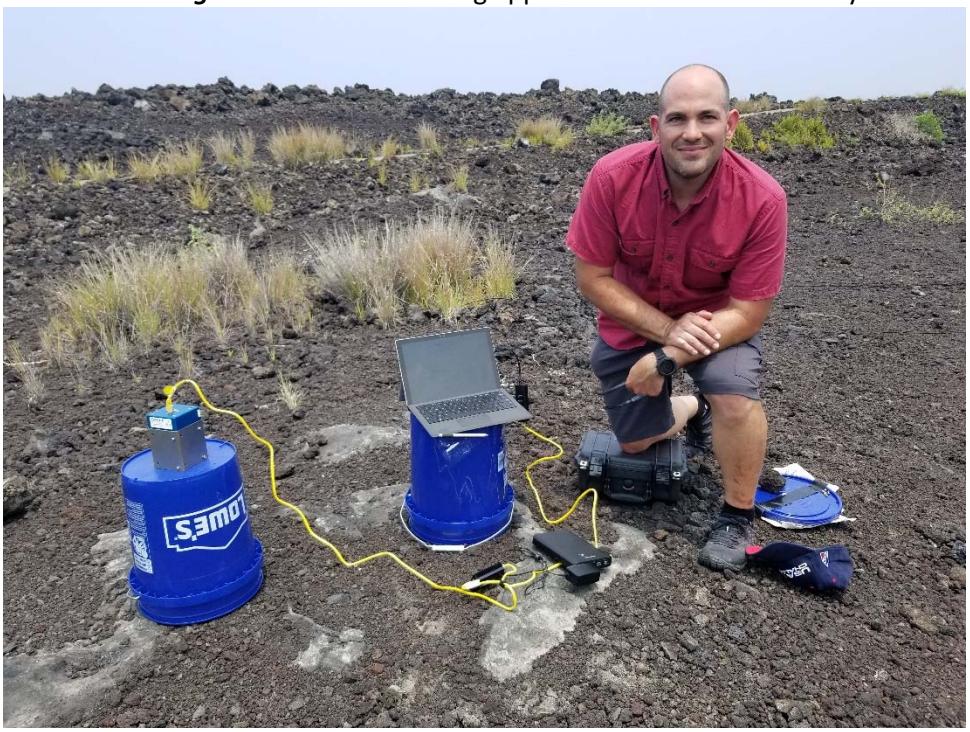

Figure 1 - Dry Site Sampling

The other surveys were performed across the middle of the island along the Saddle Road, continued down the eastern coast, and finished near the most southerly tip of the island. Rainfall that was adequate for collection began near the Ka'Ohe Game Management Area and continued into Hilo. Four stops were made before Hilo, with rainfall collected and surveyed, as well as a 'dry' site surveyed in

Figure 2 - Wet Site Sampling

close proximity to the rainfall collection site. After Hilo, there were five sample sites along the Hawaii Belt Road. The first site was near Keaau, another just before Hawai'i Volcanoes National Park, another in the middle of the park, one near the very end of the park, and the final location just after Ocean View near the southernmost tip of the island. ***Figure 4*** shows the approximate locations of the surveys performed around the island. ***Figures 2 & 3*** show how the testing was performed during rainfall, and also how I washed the rental car for free. The lack of sampling on the southwestern and western portion of the island, with the exception of the single survey near Ocean View, was due to a lack of rainfall, which becomes rarer the farther south and west that you travel on the island.

The results from the 'dry' samples were consistent with data collected from other basaltic lavas, notably the basalt from the Albuquerque Volcanoes, to the west of Albuquerque, and the sites just north of Kona that had not received any rainfall. The results were consistent in that the aggregated gamma counts per second (CPS) were low, at about 20 counts per second, as well as having a very similar gamma emissions spectrum. The lowest aggregate average CPS was 16.9, while the highest CPS was 22.5, with an average of 20%. Results from the rainfall surveys all showed a slight increase in average CPS, ranging from 0.5% to 3% greater, with the exception of the Ocean View site. The Ocean View site had a 'dry' background of 22.5 CPS, while the survey including the rain collected had an 11.7% increase in CPS, or 25.1 CPS. ***Figure 5*** is a plot of the gamma emissions spectrum of the sites. It includes the analysis from the hotel room, which is the light blue line, two surveys performed at the Kaloko-Honokōhau National Historical Park, which were used as control surveys, and four survey sites out of the total nine, showing the 'dry' and wet emissions spectrum from the four chosen sites.

Figure 3 - Wet Site Sampling

The Ocean View site results seems to provide some of the data necessary to draw conclusions about the stated goals of the trip. One, that it is indeed possible to differentiate leeward rainfall from

windward rainfall due to the incorporation of gases and particulate that emit additional gamma radiation, and that the rainfall does indeed impact the overall background radiation, at least for the short period while the survey was performed. However, a single rain event, and a single site are not enough to definitively state that this is fact. The other sites that were surveyed also only showed a very small percentage difference in their average CPS when dry versus wet, which may be caused by something other than the rainfall, such as variability in gamma emissions from the sampled rock during that moment in time. More sampling is necessary, from additional sites and additional rainfall events. In addition, further analysis of the rainfall should be performed; analysis that includes elemental and isotopic analysis of the rainfall.

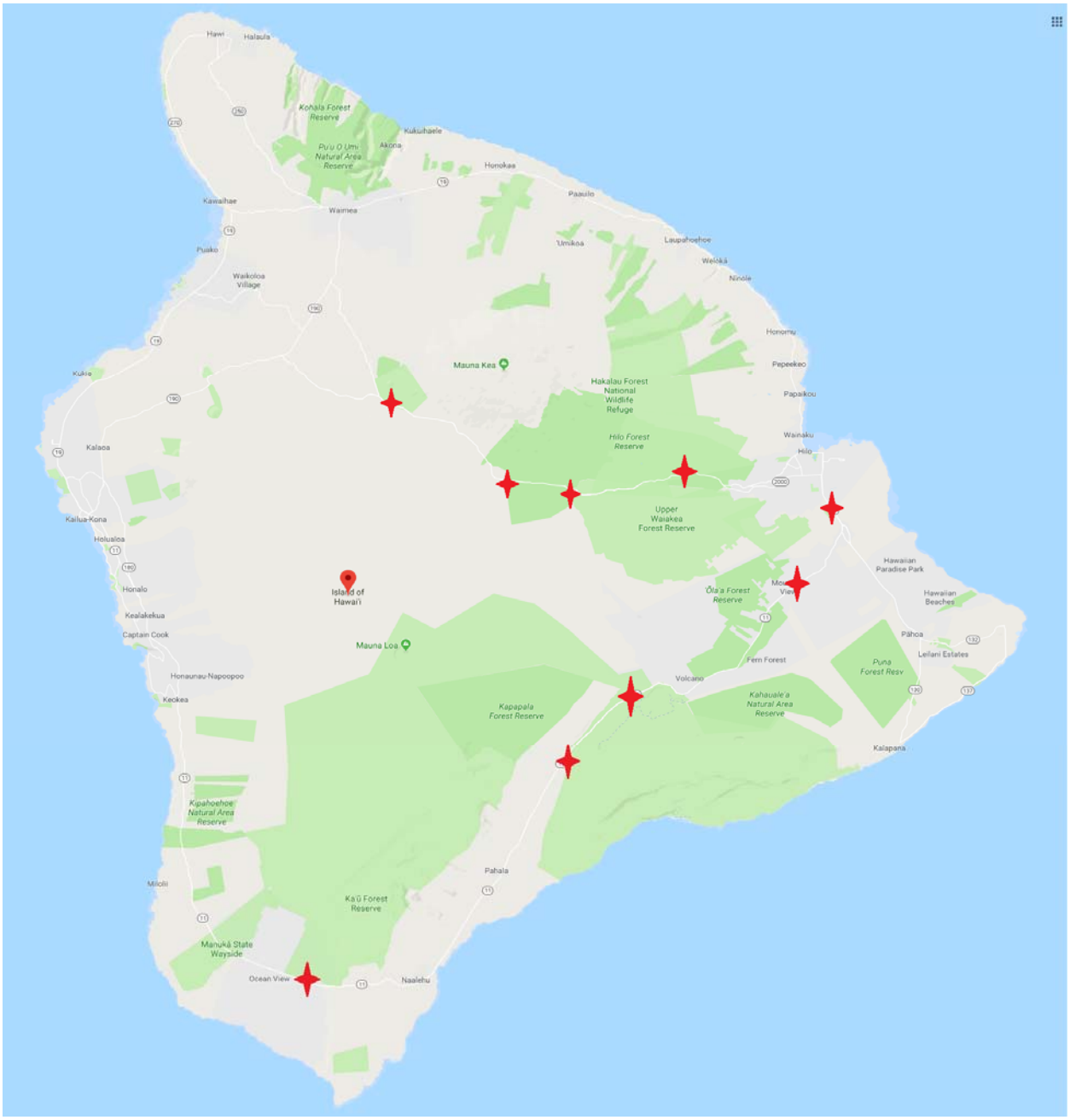

Figure 4 - Gamma Survey Site Approximate Locations

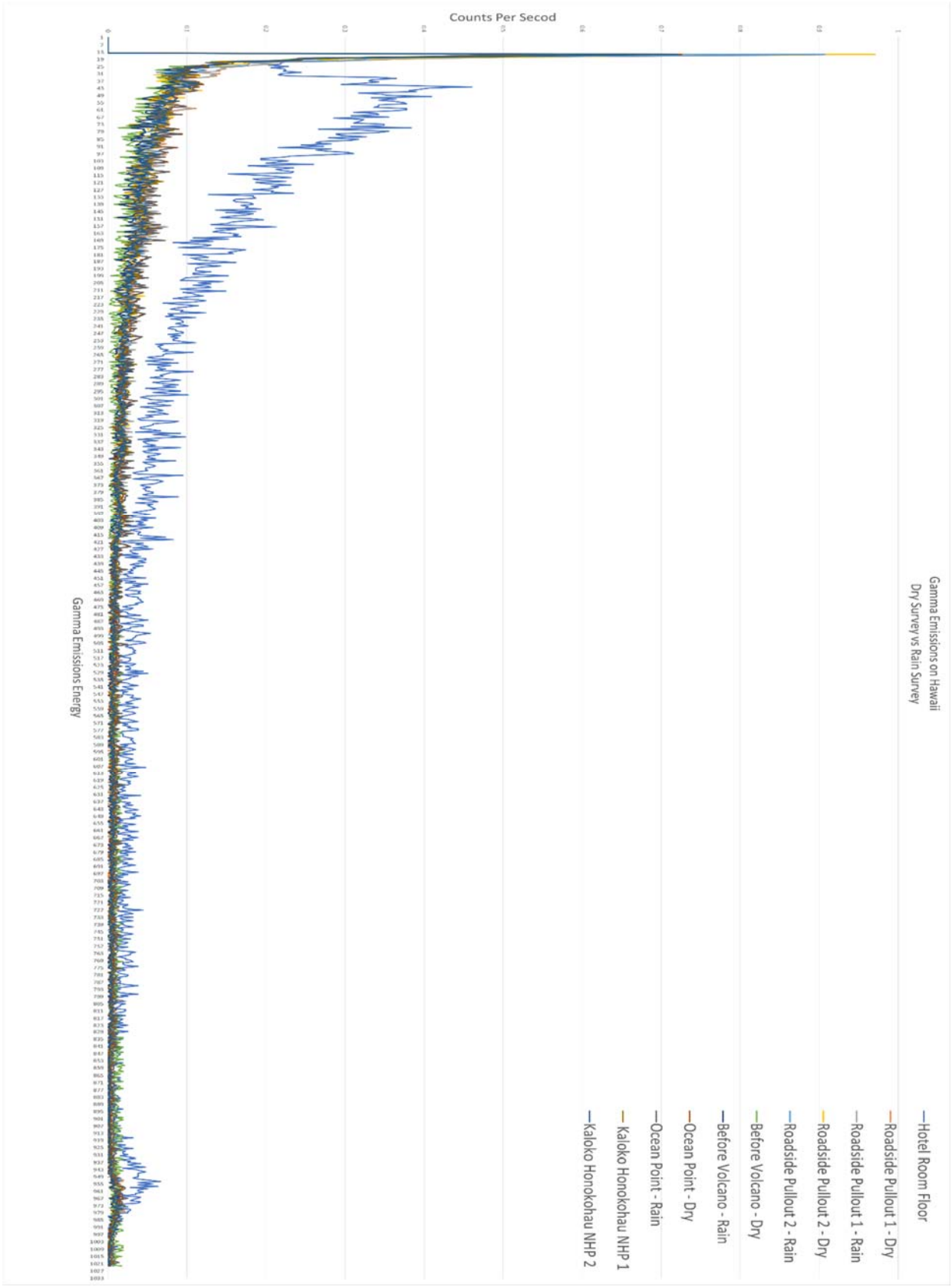

Figure 5 – Gamma Survey Results of Hawaiian Basalt 'Dry' & Hawaiian Basalt with Rainfall