

Mineralogical Infrared Analysis of Pele's Hair from Kilauea Fissure 8, 2018 Eruption

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1-16-2020, updated 2-19-2020

Even though the Kilauea lava eruptions have been studied for 150 years, to date, there is no mineralogical analysis of the Pele's hair (glass) extruded in these eruptions that I can locate. Many mineral oxide tallies and atomic absorption composition element tallies have been made, but no mineralogical level analysis using a method of spectroscopy has occurred. An example of Kilauea Fissure 8 Pele's hair is shown below.



Mat of Pele's hair from Fissure 8. The dense accumulations make a basaltic pumice.

X-ray spectroscopy is the standard in mineral studies. It has been used studying the Kilauea lava lake, but has not been used for study of Pele's hair in eruptions. What we get is cliché science with slang like "sideromelane glass", but not a mineral study.

Study of glasses, opals, clays, are almost impossible with X-ray spectroscopy and with poor results, but works fine with infrared spectroscopy. In this study, the author used reflectance infrared spectroscopy to study Fissure 8, 2018 eruption samples, provided by Scott Wiggers who blogged about the 2018 eruption extensively, and hiked and drone surveyed eruptions and flow extents under the title Apau Hawaii Tours.

There are two main populations of lava—continental and oceanic. The continental lava is characterized by two mineral populations, one a silica group such as quartz or

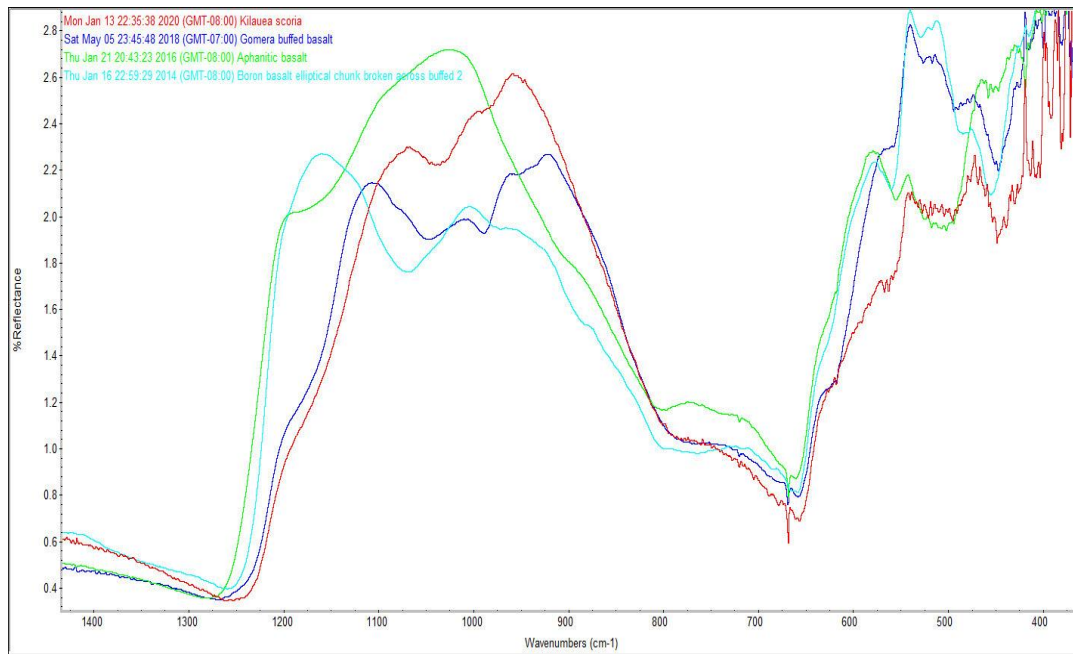
cristobalite, and another group of feldspar. The feldspar is in the labradorite, bytownite, and anorthite groups for basalts. The question for feldspars arises whether the sequence of these plagioclase feldspars (and the rest of the series with albite, oligoclase, and andesine) are just gem names, or have mineral significance. With infrared spectroscopy, the author can clearly link distinct spectra to each of these feldspars, so they are not varieties of the albite-anorthite series, but distinct minerals in their own right.

The oceanic, or tholeiitic basalt is quite different. No silica is shown in infrared spectra and little indication of feldspar. It is dominated by the pyroxene minerals that have various classifications, but center around augite. The silica is in these silica minerals, and not separate by itself. Feldspar is almost impossible to identify with all the spectral dominance of the augite group silicates that includes augite, hedenbergite, pigeonite, diopside, enstatite, and ferrosilite. An example of the Kilauea Fissure 8 A'A scoria is shown below.



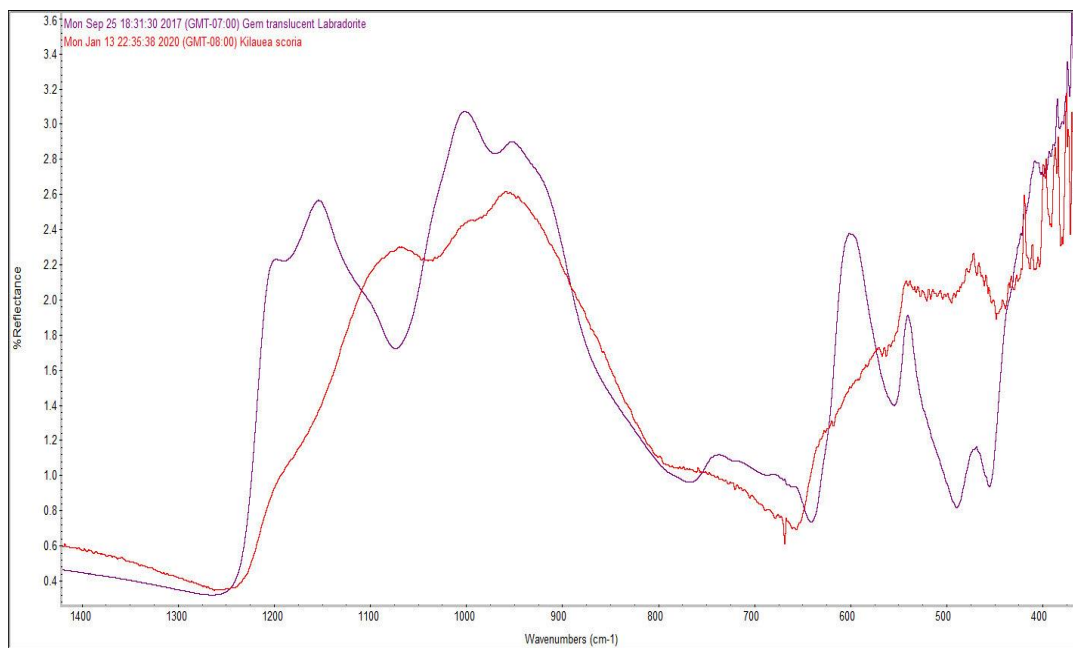
Kilauea Fissure 8 A'A scoria. The top face is glassy.

A spectral graph comparing Kilauea to La Gomera tholeiitic lavas (La Gomera is in the Canary Islands off Morocco), to two western US continental basalts is shown below. The La Gomera samples were collected in the central caldera for the author by Helmut Knoll, a German naturalist. The two tholeiitic lavas are similar.



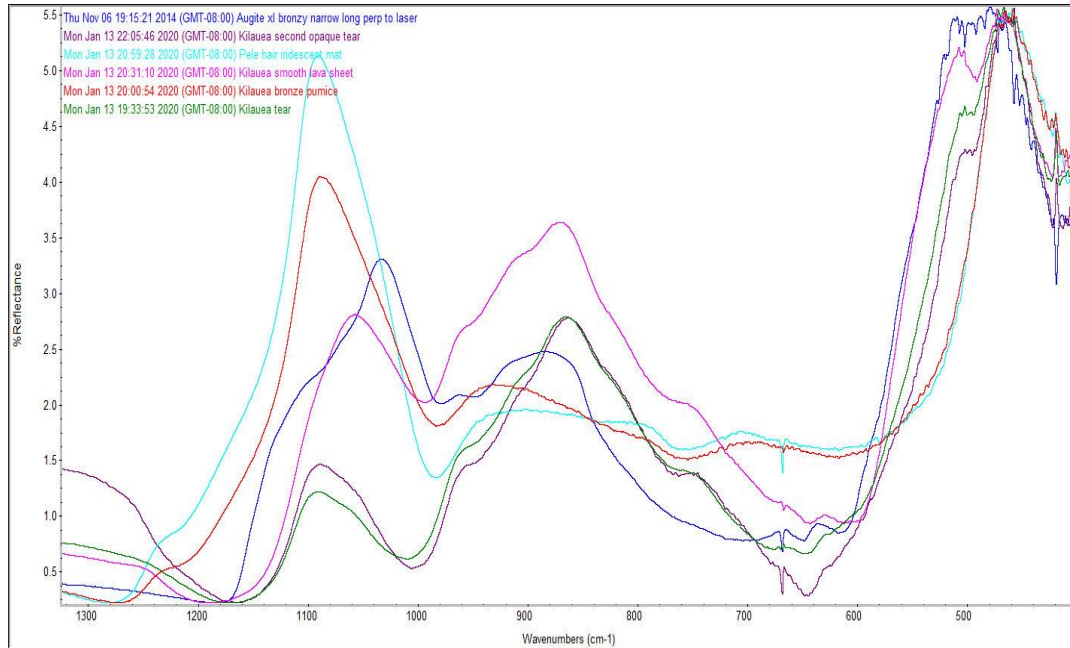
2 continental lavas (green and turquoise spectra), Kilauea Fissure 8 and La Gomera tholeiitic basalts (red and blue spectra, respectively). The continental Boron, CA (Southern California High Desert) basalt is dominated by anorthite in this graph (turquoise spectrum). The continental basalts are graphically shifted left to higher wavenumbers infrared.

There is evidence of labradorite in the scoria from Fissure 8, as shown below.



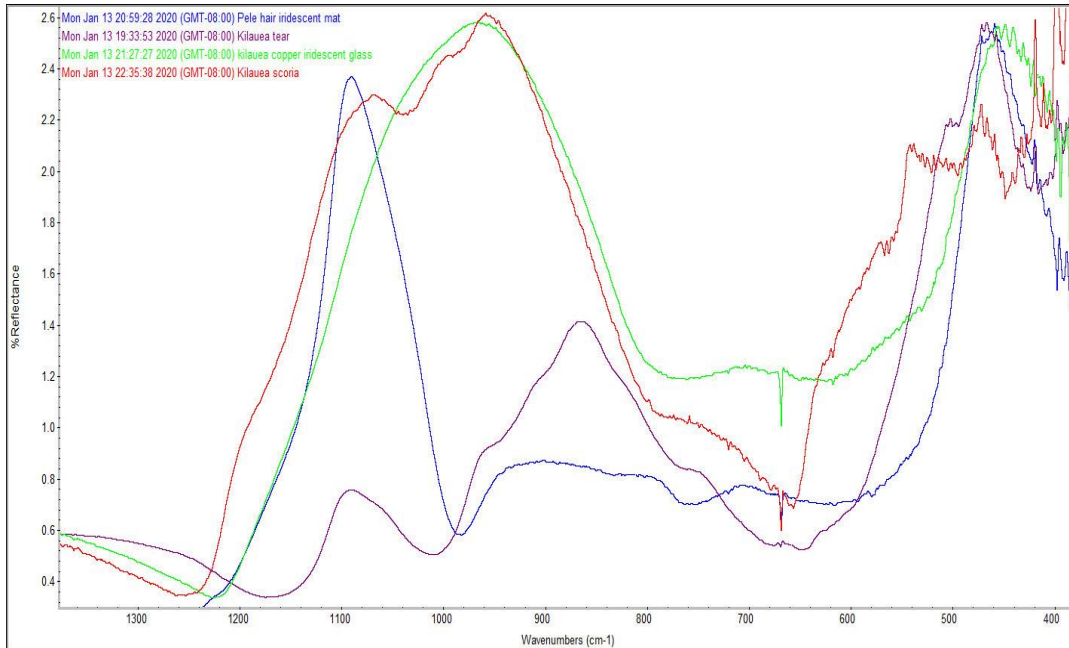
Labradorite reference (violet spectrum) versus Fissure 8 A'A scoria (red spectrum). The glassy nature of all minerals in this rift zone will suppress or mute well-defined mineral peaks and glassier samples will revert to rolling peaks instead of sharp peaks. High porosity of the samples makes the graph noisy on the right in all these spectral graphs.

The Pele's hair, which remains an enigma in the science of volcanology up to this point, graphs as augite, augite decomposition components probably of silica and magnesium oxide, and augite glass. No silica such as quartz or cristobalite is found. What is interesting is that the basaltic pumice around Fissure 8 is actually made of mats of welded Pele's hair that contacted each other and fused or hit the fissure walls upon high velocity, gaseous ejection that makes this structure. However, it is without question not sideromelane, a basaltic glass, it is augite glass, as shown below.



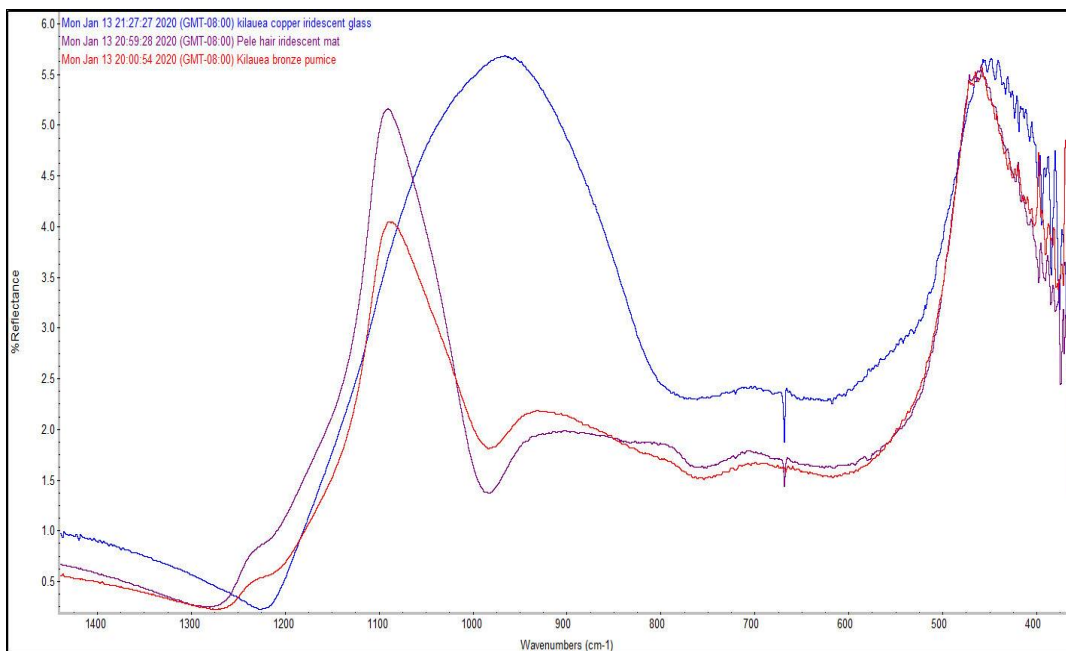
Augite reference (blue spectrum) versus fused basalt (lower violet and green spectra) versus Pele's hair samples (turquoise and red spectra). Pumice in a label means Pele's hair. The glassier Pele red and turquoise spectra have very few peaks and very shallow troughs in the 700-600 cm^{-1} region.

The three population variants of mats of Pele's hair are shown below compared to the duller pahoehoe glass.



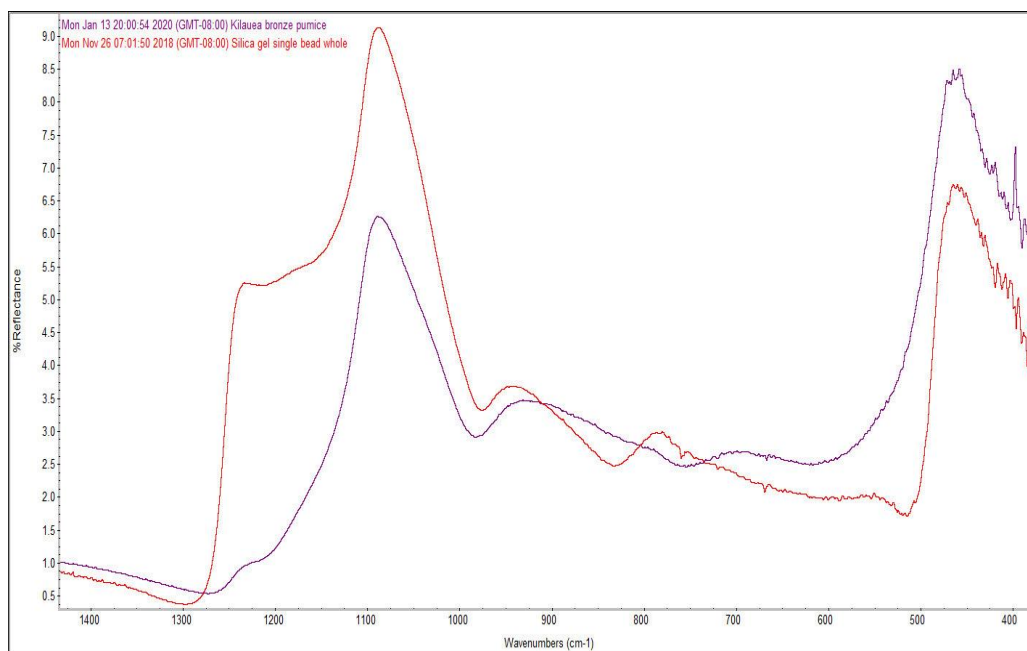
The A'A Fissure 8 vent scoria basalt (red spectrum), lava flowstone (pahoehoe), interpreted as augite glass (green spectrum), the dissociated augite with a silica fraction (blue spectrum) and mixed augite-silica spectrum dominance, more augite (violet spectrum).

The population of 3 samples of iridescent Pele's hair are shown below.



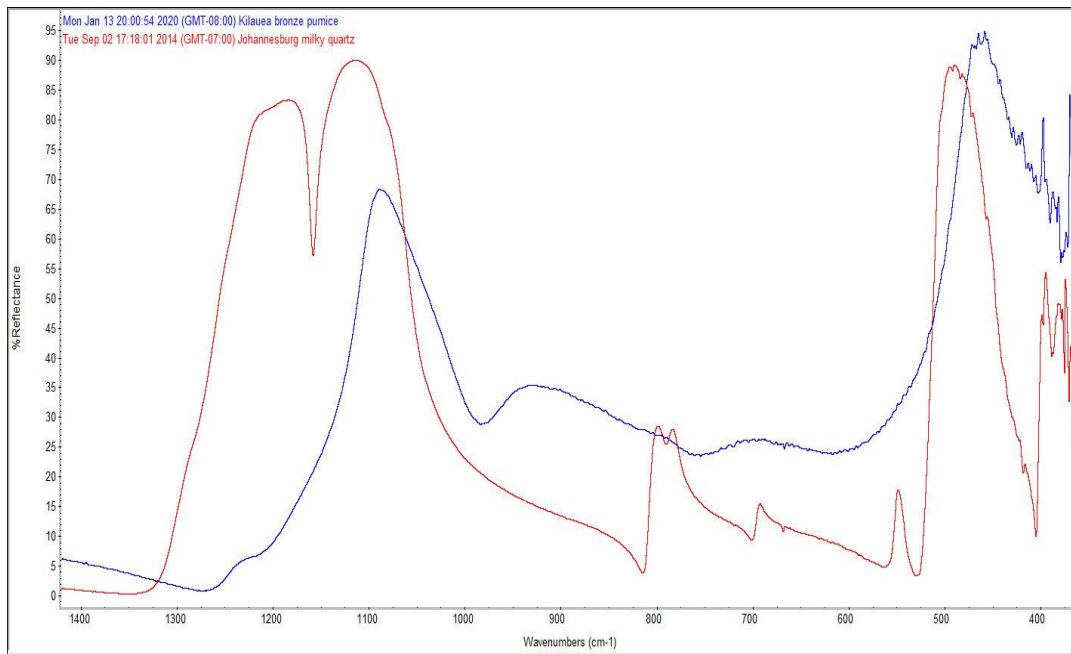
Pele's hair, various iridescent glass scans. The blue spectrum appears how an augite glass could be proposed without science reports on it to compare, and the other spectra are interpreted as decomposed augite products. The left peak at 1086 cm^{-1} is silica.

We can take a look at the group of 1086 cm^{-1} Pele's hair peak spectra and compare that to silica beads. These are beads of silica glass formed at high temperature. The process is around 1500 C . It is done in reaction with steam under pressure. Then we get an excellent match as shown below. For infrared, we cannot match one peak, they must all match, but some can be suppressed as ledges. As such, this match is very good, particularly for the signature peak of quartz at 465 cm^{-1} on the right, and the 1086^{-1} peak and right trough, also for quartz.



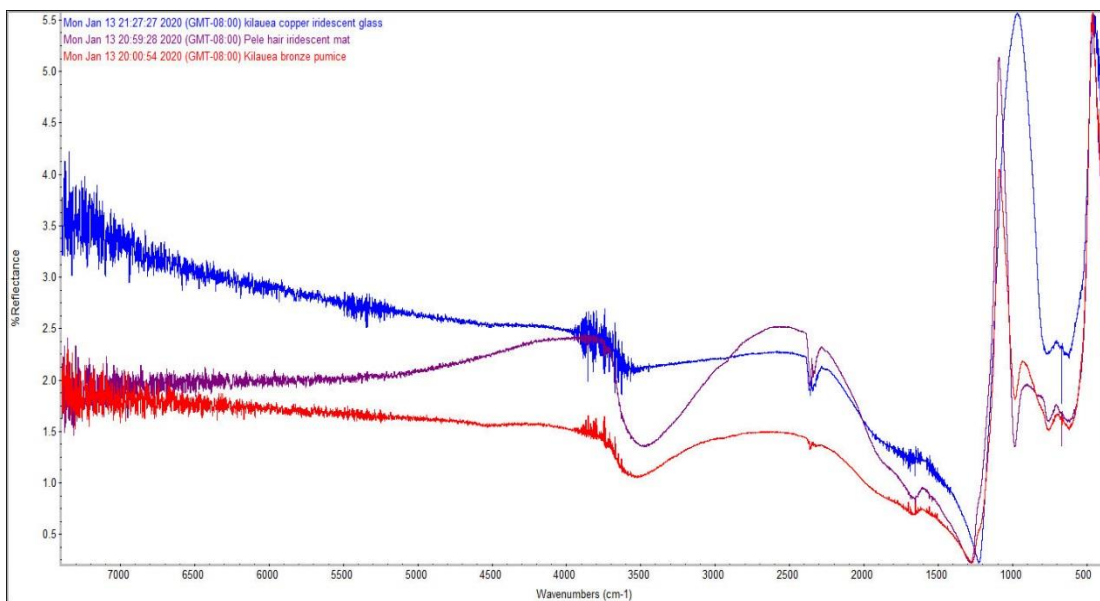
Manufactured silica fume bead (red spectrum) compared to Pele's hair (violet spectrum). The leftmost peak tends to enlarge with high reflectance (glare) in a specimen, meaning how it is prepared and how polished the surface is, affects its height. With that, the Pele's hair is more abraded and less reflective than the silica bead. The silica fume beads are packed into little fiberglass bags for absorbing moisture in medicine bottles and other packing for moisture absorption.

Here is a comparison of Pele's hair silica glass to quartz.



Massive milky quartz (red spectrum), Pele's hair silica glass (blue spectrum). Quartz crystals were not used as the graphs vary by the crystal face.

Longer range scan for the Pele's glass samples shows strong water in the 3500 cm^{-1} region for the silica glass as shown below. This is free water, meaning not mineralogically bound. The type of water response band tells us what kind of water it is.



Pele's hair long range scans showing water at 3500 cm^{-1} for the Pele's hair. The A'A lava and two opaque slick tears have less water, the opaque slick pahoehoe plate below has none. The augite glass has less water than the silica water as seen here. The patches of Mineralogical Infrared Analysis of Pele's Hair from Kilauea Fissure 8, 2018 Eruption, by Donald Kasper

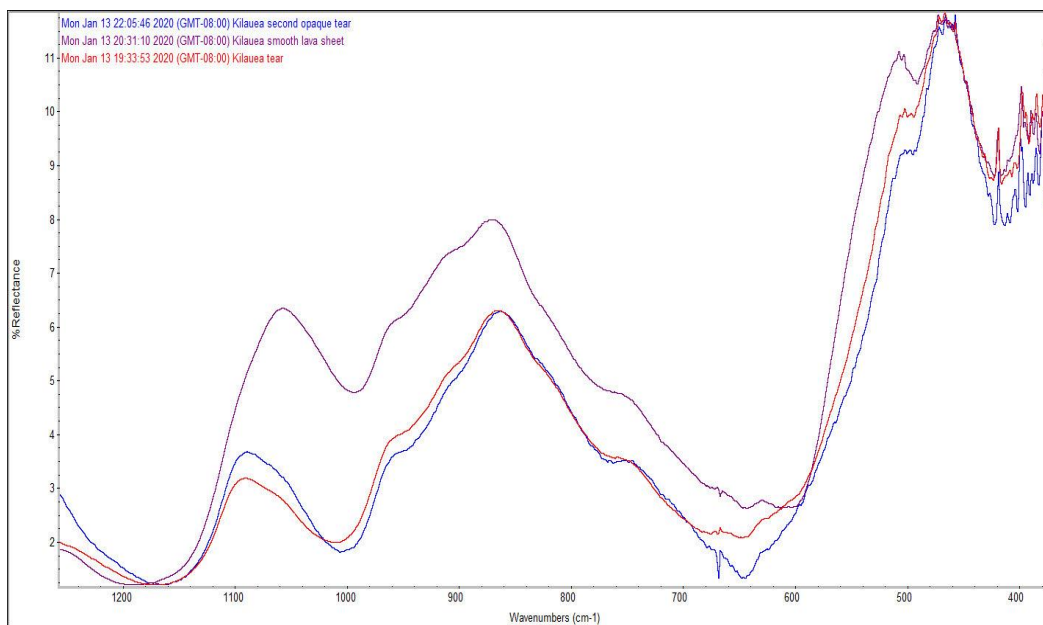
noisy spikes are atmospheric water interference when scanning the sample as the scan is open to the atmosphere.

An example of the pahoehoe from Kilauea Fissure 8 is shown below.



Slick surfaced pahoehoe on scoria base from Kilauea Fissure 8.

The 3 pahoehoe scans including the sheet above and two tears, are shown below.



3 pahoehoe, slick surfaced lava spectra showing two component dissociation of augite, or other augite related mineral not in the author's archives.

Conclusions:

Pele's hair is variably an amorphous silica glass and an augite glass. The duller pahoehoe glass coatings and tears are a mixed augite-silica glass. The A'A scoria is a tholeiitic basalt dominated by pyroxene, most likely augite along with some hint of labradorite. The silica glass only comes out of the melt at the vents at the highest temperature and with high escape velocity for air cooling, perhaps with mixing with groundwater.

The distinction of A'A and pahoehoe may arise from the A'A lava contacting water and organic matter with water causing quenching and augite glass release creating pahoehoe, then as that is all consumed and as the vents degas, the flow continues as A'A lava.