Supplementary Material

Hyperspectral Reflectance and Chemical Composition of Pre- and Post-Fire Soils from Three 2021 Western USA Megafires

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Fire Name	Sample Type	Sampling and WDPT			* ACA Analysis	* TG FT-ICR MS Analysis	** Soil Composition (% of Dry Soil Mass)			
		0 Month	6 Months	1 Year			Sand	Silt	Clay	SOM
Dixie	Ash	×	×	×	×	×	-	-	-	-
	Burned soil	×	×	×	×	×	-	-	-	-
	Unburned soil	×	×	×	×	×	66	19	15	1.5
Beckwourth Complex	Ash	×	×	×	×	×	-	-	-	-
	Burned soil	×	×	×	×	×	-	-	-	-
	Unburned soil	×	×	×	×	×	42	38	20	2
Caldor	Ash	×	×	×	×	×	-	-	-	-
	Burned soil	×	×	×	×	×	-	-	-	-
	Unburned soil	×	×	×	×	×	84	11	5	5
Mosquito	Ash	×	-	-	×	-	-	-	-	-
	Burned soil	×	-	-	×	-	-	-	-	-
	Unburned soil	×	-	-	×	-	45	45	10	6

Table S1. Summary of the collected samples; * only zero-month samples (samples collected shortly after the fire) were analyzed; ** Soil classification is according to USDA-NRCS using the NRCS Web Soil Survey; SOM—soil organic matter.

Figure S1. Map with red fire perimeter lines of the Dixie, Beckwourth Complex, Caldor, and Mosquito fires as well as the locations of the respective sampling sites; sample site locations are indicated by yellow triangles [1] © Copyright 2023 by Vera Samburova.

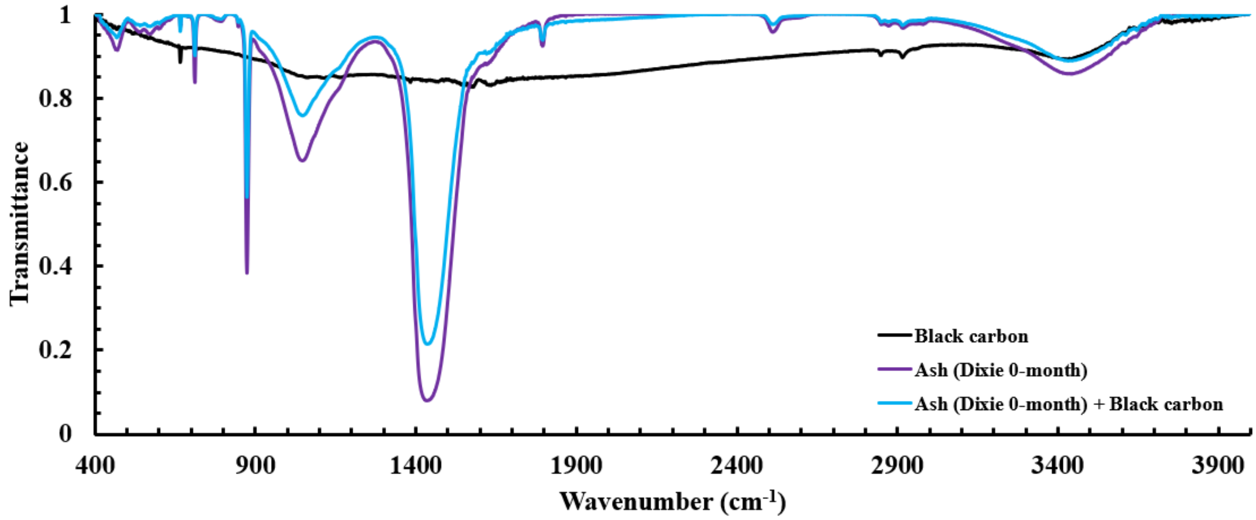

Figure S2. FTIR transmittance spectra for ash, and black carbon samples prepared with KBr pellets for Dixie 0-month ash sample.

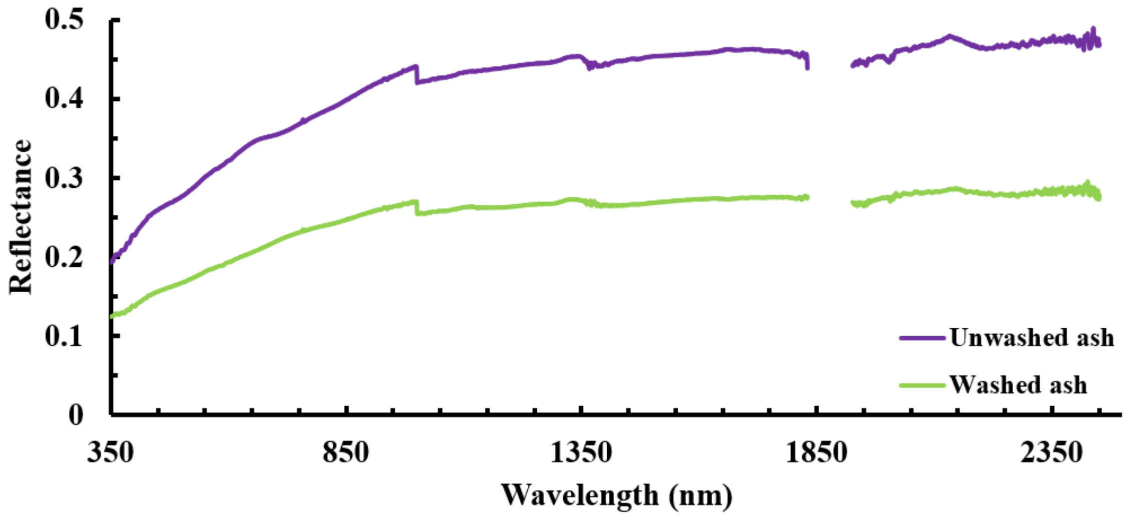

Figure S3. Reflectance spectra for unwashed and washed laboratory generated ash samples.

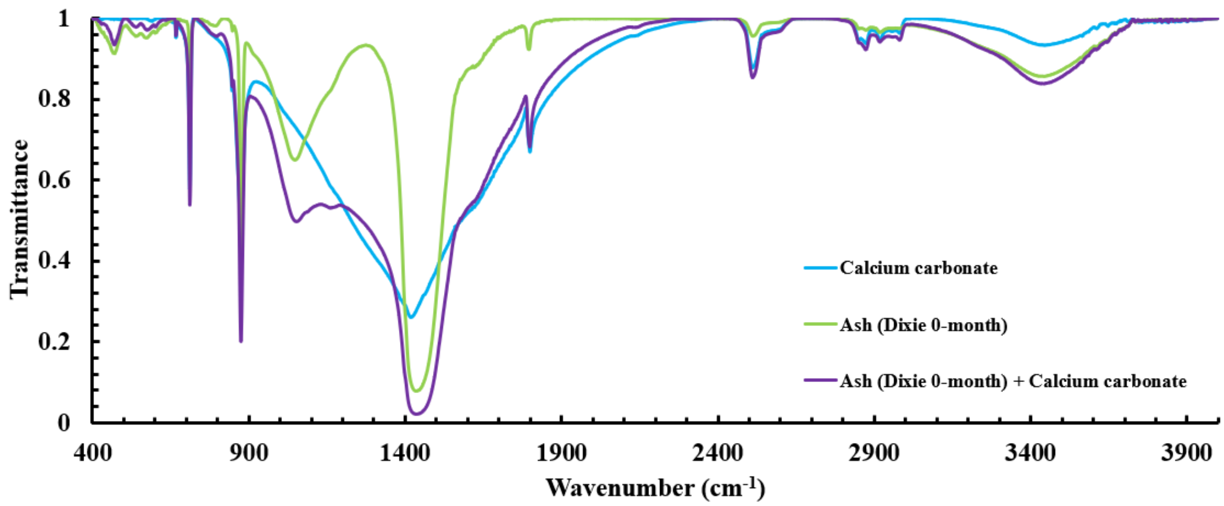

Figure S4. FTIR transmittance spectra for ash, and calcium carbonate samples prepared with KBr pellets for Dixie 0-month ash sample.

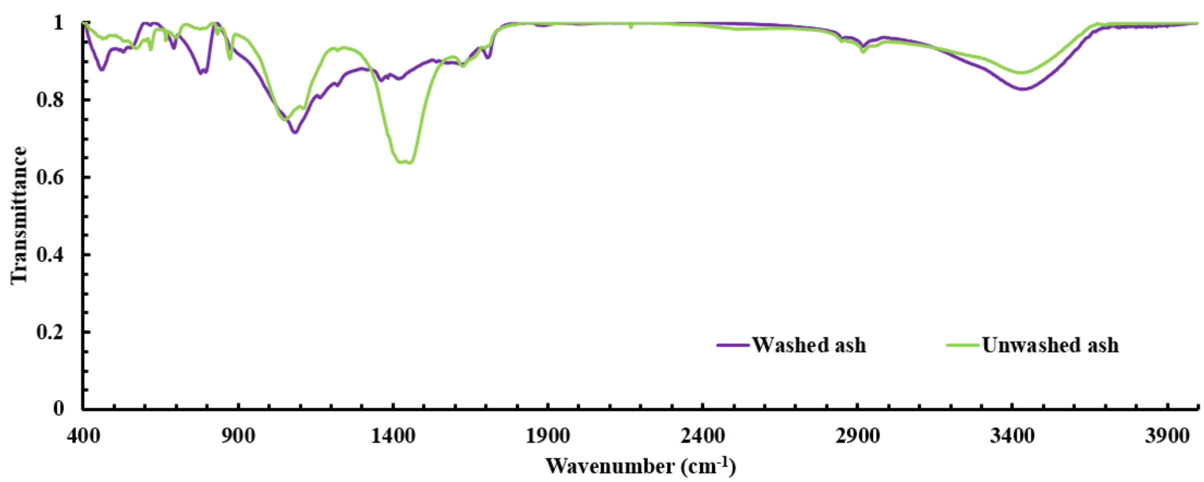

Figure S5. FTIR transmittance spectra for ash samples prepared with KBr pellets for laboratory generated ash samples before and after wash.

Experimental process:

For validating the presence of carbonate peak in the FTIR transmittance spectra, and for confirming our hypothesis; the reduction in carbonate concentration by precipitation over time, we performed FTIR measurements for 0-month Dixie and two different laboratory generated ash samples. Figure S2 shows that the signal for calcium carbonate around 1440.6 cm-1 wavenumber. After adding ~0.0005 g calcium carbonate to ~0.0005 g of Dixie 0-month ash sample, the carbonate signal gets stronger comparing to the ash KBr pellet that does not contain calcium carbonate. In figure S3, ~0.0005 g of black carbon was added to the 0-month ash samples which was ~0.0005 g as well. It is seen that the carbonate signal gets weaker when the black carbon is added which again proves that the decrease in carbonate concentration leads to lower reflectance values of ash samples in this research. For confirming this hypothesis, a wash experiment was performed on laboratory generated ash samples. ~2g of the ash that was collected after combustion experiment with sagebrush, was sonicated (Branson Ultrasonics, Connecticut, USA) for 2 hours, and then washed 4 times using centrifuge (Southwest science, Roebling, New Jersey, USA). The washed ash was then dried at room temperature of 22-24 °C for 24 hours before conducting the FTIR measurements. Two KBr pellets were prepared using these two washed and unwashed sagebrush ash samples. Each pellet contained ~0.002 g of KBr and ~0.0005 g of each of the ash samples. Figure S4 shows that the sagebrush washed ash has weaker carbonate signal around 1440.6 cm^{-1} than unwashed ash sample. The same wash process was performed on ~2g of the ash samples collected after combustion experiments with pine needles. Overall, six KBr pellets for both washed and unwashed with two replicates for each of these samples were created for further analysis. Each pellet contained ~0.002 g of KBr and ~0.0005 g of each of the ash samples. Figures S4 and S5 show the transmittance spectra for both unwashed and washed pine needle ash samples. As observed, unwashed ash samples show deep and strong carbonate signals (Figure S5) comparing to the washed samples (Figure S6). This again proves our hypothesis that washed off carbonate in the ash samples cause the decrease in the carbonate peak signal. Figure S7 shows the reflectance spectra that were recorded for washed and unwashed pine needle samples. As expected, the reflectance is lower for the washed ash sample and this again proves our hypothesis that the whitish materials; carbonate get washed out over time and this cause this decrease in the reflectance spectra.

References

1. Samburova, V.; Schneider, E.; Ruger, C.P.; Inouye, S.; Sion, B.; Axelrod, K.; Bahdanovich, P.; Friederici, L.; Raeofy, Y.; Berli, M., et al. Modification of Soil Hydroscopic and Chemical Properties Caused by Four Recent California, USA Megafires. *Fire-Switzerland* **2023**, *6*, 25, doi:10.3390/fire6050186.