# Adverse Effects On Erosion and Biogeochemical Fluxes Post-Fire

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## Background

Soil is a simple substrate that we walk on. We typically do not think about its composition and importance in our environment. It is simply the stuff that grows trees, grass, and shrubs. However, soil plays a vital role in various ecosystems and our environment. Soil consists of organic and inorganic matter that are equally essential. They both help maintain the structure and provide homeostasis in the soil's biochemical cycling of nutrients. Therefore, when intense wildfires transfer high levels of thermal energy through various soil layers, they change the soil composition, biochemical balance, and mechanical properties.

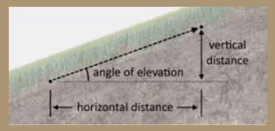
Soils are classified by their mineral particle size distributed into three sizes:

- sand (0.05 – 2.0 mm diameter)
- silt (0.002 – 0.05 mm diameter)
- clay (< 0.002 mm diameter)


Florida's state soil, Myakka

- contains mostly sand making a poorly drained, acidic soil [5].
- It is characterized as a spodosol soil type. Spodosols most often develop in coarse-textured parent material (sands and loamy sands) under coniferous vegetation in humid regions of the world [4].
- Loamy soil combines all three types of soil particles in relatively equal amounts [2].

Slope or elevation grade is the steepness or the inclination of an area of land. Slope affects fire spread by altering the heat transfer processes [3].




## Experiment

Florida State University's Coastal and Marine Laboratory located in St. Teresa, FL. The burn area is located north of Coastal Highway 98 in a small open field.

Extraction site for sample soil. Topsoil was manually removed to decrease the amount of organic matter from the sample.

Stable frame to support our rain simulator positioned above our slope burn table and sample collection system.

### Experimental procedure:

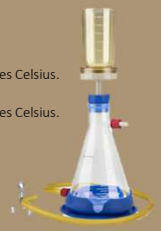
1. Adjust top end of slope burn table to specific slope degree.
2. Prepare and apply soil to burn table to 1-meter squared area and 7.6 cm in depth.
3. Apply evenly 0.5 kg of pine straw.
4. If burn experiment, burn fuel on top of sample plot.
5. Turn on water pump and run rainfall simulator for 10 minutes.
6. Collect sample runoff and label container.
7. Repeat steps for each experiment trial.

## Total Suspended Solids

A total suspended solids (TSS) test measures the amount of large (> 2 microns) sediment collected in the runoff. TSS measures the amount of suspended solids greater than two microns in a sample. Smaller sediment is considered dissolved solids.

### TSS procedure:

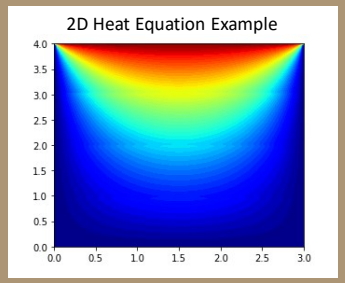
1. Shake sample thoroughly.
2. Weigh each 10-micron filter and record weight.
3. Filter sample through vacuum filtration apparatus.
4. Dry sample and filters in furnace for one hour at 103-105 degrees Celsius.
5. Set aside in desiccator to cool for 30 minutes.
6. Dry sample and filters in furnace for one hour at 103-105 degrees Celsius.
7. Weigh each dried filter and record weight.
8. Calculate TSS amount using weights and sample volume.



## Future Work

During a wildfire the soil surface can generate a large amount of heat within a short period of time and the heat transports downward to cooler regions in the soil [3].

- Our goal is to develop an experiment to study the transport of heat, heat of combustion, and soil thermal conductivity based on fuel load.
- The results will be compared with soil data from Dr. Amy McKenna and should mimic a visualization of the 2D heat equation below.
- The experiment will be based on G. Campbell's 1995 paper "Soil Temperature and Water Content Beneath a Surface Fire".




## Water Chemical Composition

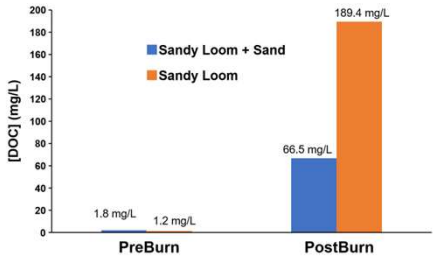
Total Suspended Solids

| Unburned Plot | Loamy Sand | Sand |
|---|---|---|
| Low slope – 7.42 deg | 52.8 mg/L | 150.1 mg/L |
| High slope – 11.1 deg | 154.4 mg/L | 207.7 mg/L |

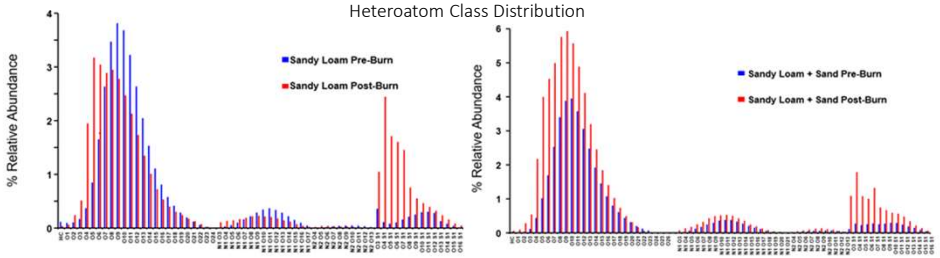
| Burned Plot | Loamy Sand | Sand |
|---|---|---|
| Low slope – 7.42 deg | 104.8 mg/L* | 323.1 mg/L* |
| High slope – 11.1 deg | 134.8 mg/L | 212.8 mg/L |

* Part of sample volume sent to Dr. Amy McKenna, Analytical Chemist at the National High Magnetic Laboratory

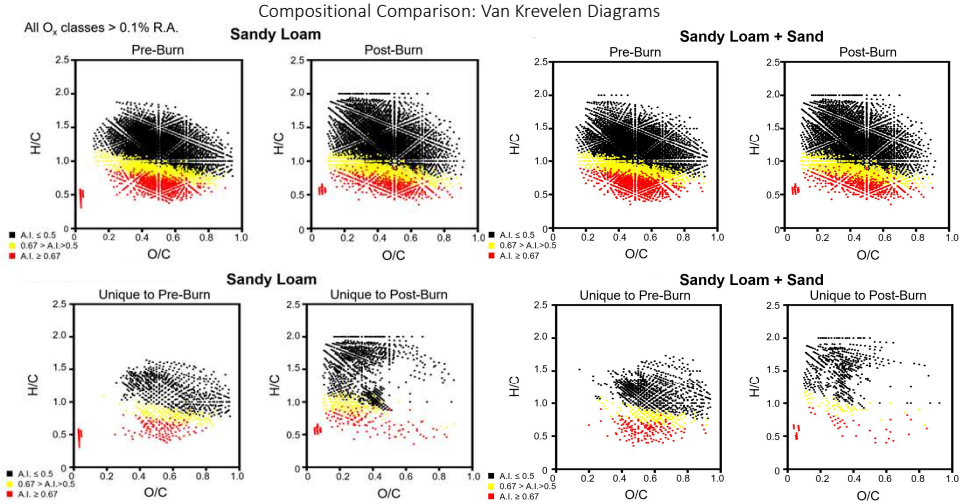
Dissolved Organic Carbon (DOC)




Heteroatom Class Distribution




Compositional Comparison: Van Krevelen Diagrams




## References

[1] ENH1218/EP479: Soil Characteristics and Management Practices for Urban Residential Landscapes. University of Florida IFAS.
[2] What is loam? Indiana Yard and Garden - Purdue Consumer Horticulture.
[3] Ting Bao, Si Liu, Yinghong Qin, and Zhen Liu. 3d modeling of coupled soil heat and moisture transport beneath a surface fire. International Journal of Heat and Mass Transfer, 2020.
[4] M. A. Finney, S. S. McAllister, T. P. Grumstrup, and J. M. Forthofer. Wildland Fire Behaviour: Dynamics, Principles, Processes. CSIRO Publishing, 2021.
[5] W. Harris, G. Hochmuth, and R. Mylavarapu. SL441/SS655: Agricultural Soils of Florida. University of Florida IFAS, September 2019.
[6] Soil Science Society of America. Myakka: Florida state soil.