Impact of burning severity on soil structure and water repellency in the Neo-volcanic Axis Range (central Mexico)

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Contact American Geophysical Union and contribute to soil research.

Methodology

The degree of fire-induced WR depends mainly on temperatures reached during burning. It is known that WR changes shape at soil temperatures below 175 °C, increases considerably between 175 and 200 °C, and is destroyed when temperatures above 280 °C are reached but these thresholds can vary depending on time of residence of temperatures and also on soil properties.

Soil WR has been previously related to different soil fractions, both coarse and fine fractions. In addition, aggregate stability is generally enhanced by WR, since the aggregate wetting is retarded by repellency and hydrophobic coatings act as cementing agents. Thus, soil WR plays a key role in the hydrology of WR and the establishment of vegetation in fire-affected areas making necessary the study of the influence of soil type and conditions.

The objective of this research was to study the effects of burning intensity on the occurrence and degree of WR and aggregate stability in burnt volcanic samples and to find links in central Mexico. Thus, three low intensity and two high intensity burnt sites of different fire-affected areas were selected for this experiment and compared with two unburnt control sites. The effects of different intensity burning on soil WR, aggregate stability, and the distribution of soil WR in aggregate swollen fractions were studied.

Conclusions

1. Volcanic soils under pines and firs in the study area show a natural WR background, comparable to observations from other studied acidic soils under coniferous species. The degree of soil WR after low severity fire was similar to that observed in control long-unburned sites, although the repellency was retained in a higher proportion of samples.

2. High severity burning produced different responses after severe burning, different interactions occurred, and the time of residence of high temperatures can improve the repellency on soil WR. Suspected relatively low temperature peaks or times of residence of high temperatures at severely burnt site 4 did not induce significant changes in repellency, while it was destroyed after partial destruction of soil organic matter at site 3, probably due to high fire intensity.

3. Finer sieve fractions showed a higher degree of repellency in some cases. The degree of repellency of coarse soils can be related with the WR of original surface samples from burnt sites. Nevertheless, finer sieve fractions showed a range of WR more comparable to the original samples. Therefore, it is suggested that destruction of organic matter influenced WR, and it was not related with the WDPT of original surface samples from burnt sites. Nevertheless, finer sieve fractions showed a range of WR more comparable to the original samples. Therefore, it is suggested that destruction of organic matter influenced WR, and it was not related with the WDPT of original surface samples from burnt sites.

4. High aggregate stability could be explained as a consequence of a high degree of WR.