METER
ENVIRONMENT

WILL SAMPLE DISTURBANCE LEAD TO LOWER ACCURACY?

Contributors

Sampling soil for laboratory analysis of water potential is done for two basic reasons. The simplest is to determine the current water potential of the soil. The other is to determine the moisture release curve of the soil. Regardless of the reason for measurement, the question of sample disturbance is important to ensure an accurate result. Here's why:

THE CLOSER WATER IS TO A SURFACE, THE TIGHTER IT WILL BE BOUND

In soil samples, the void spaces (pores) between soil particles can be simplistically thought of as a system of capillary tubes, with a diameter determined by the size of the associated particles and their spatial association. The smaller the size of those tubes, the more tightly water is held because of the surface association.

Clay holds water more tightly than a sand at the same water content because clay contains smaller pores and thus more surface area for the water to bind to. But even sand can eventually dry to a point where there is only a thin film of water on its surfaces and water will be bound tightly. In principle, the closer water is to a surface, the tighter it will be bound.

SAMPLE DISTURBANCE MATTERS…SOMETIMES

Sample disturbance (disturbing soil pores when removing a sample from the ground) becomes an issue depending on the water potential of a sample. Typically, the less negative (wetter) the water potential, the larger impact sample disturbance will have on the measurement. The following calculation shows there are specific pore sizes associated with specific water potentials (see Table 1).

	MPa	pF	Pore Diameter (µm)
	-0.001	1.01	290.08
	-0.01	2.01	29.01
Field Capacity	-0.033	2.53	8.79
	-0.1	3.01	2.90
	-1.0	4.01	0.29
Perm. Wilting Pt.	-1.5	4.18	0.19
	-10	5.01	0.03
Air Dry	-100	6.01	
Oven Dry	-1000	7.01	

Table 1. Water potential units: MPa comparison to pore diameter and pF

If you disturb a sample with low water potential, permanent wilting point (-1.5 MPa) for example, the pores that are still filled with water would be approximately 0.2 µm in diameter, far too small to be broken apart by scooping up a sample. Thus, we could reasonably assume that your water potential readings won't be affected much. But if you disturb soil with higher water potential, say field capacity (-0.033 MPa), it's much more likely that water will be disturbed, as it fills pores to approximately 9 µm.

ARE HYGROMETERS SENSITIVE? IT DEPENDS.

Still, this is only an issue when attempting to measure in a high water potential range. If a chilled mirror hygrometer only measures up to -1000 kPa, sample disturbance will not be an issue because those pores that have broken will likely be larger than the sub-micrometer that are holding water, which is beyond the accuracy of the instrument. However, some hygrometers can now measure to an upper limit of -100 kPa, which approaches the point where sample disturbance will make a difference.

TENSIOMETERS ARE EXCEPTIONALLY SENSITIVE TO SAMPLE DISTURBANCE

If you are sampling to measure with a tensiometer (measures 0 kPa to -80kPa), it's extremely important to keep samples intact because tensiometers cover the emptying range of the largest pores found in soil. A soil collar (sample ring) pounded into the ground will yield the most intact soil core. It's the best method to make sure soil pores remain undisturbed and yield an accurate water potential measurement.

For a more in-depth examination of the magnitude of the effects of sample disturbance, read this chilled-mirror hygrometer app note detailing the subject.

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