



Fluctuating water levels accelerate cleanup at petroleum-contaminated sites

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Experimental setup: The stainless-steel soil column setup equipped with moisture, temperature, and redox sensors, along with water and gas samplers. Photo courtesy of Fereidoun Rezanezhad.

Old petroleum spills continue to contaminate soil and groundwater at many industrial and urban sites, making cleanup slow, costly, and difficult to predict. New research suggests that one natural process may play a much larger role than expected: the rise and fall of the water table.

In a 300-day laboratory study, researchers recreated petroleum-contaminated soils under two conditions. Some soils were kept under a stable water table, while others went through repeated cycles of drainage and rewetting, similar to what can happen seasonally in the field. The difference was striking. Soils exposed to fluctuating water levels removed more than 91% of the contamination, compared with about 60% under stable conditions. The main driver was oxygen. When the water table dropped, air entered the soil and supported faster microbial breakdown. A computer model developed with the experiment also reproduced the observed changes, offering a way to test how this process may behave at real sites.

The study clarifies that water table movement is not just background variability at contaminated sites. It can actively control both how quickly petroleum breaks down and what environmental tradeoffs arise during cleanup. These findings point to a more integrated approach to remediation, where contaminant removal, microbial activity, and greenhouse gas impacts are considered together rather than separately.

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Ramezanzadeh, M., Rezanezhad, F., Slowinski, S., Ye, J., Vandergrindt, M., Rudolph, D. L., Thomson, N. R., & Van Cappellen, P. (2026). Effects of water table fluctuations on naphthalene degradation: Soil column experiment and modeling. *Vadose Zone Journal*, 25, e70081. <https://doi.org/10.1002/vzj2.70081>

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