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Light Alkanes Have Limited Residence Time in Soils

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Four surveys of 25 closely spaced soil samples each were conducted over one spot in a natural gas line within the Snow Shoe gas field, Centre Co., PA, to determine how stable light alkane concentrations were in soils. The first survey was two days before the leak was repaired. The second survey was conducted six days after the leak was repaired; the third 29 days afterwards and the fourth 97 days afterwards. These samples were analyzed for the light alkanes (i.e., C1, C2, C3, C4 and C5) using the headspace method.

The sample data were compared using one-way analysis of variance (AVOA) to determine if all of the surveys were part of one population, thus representing stable gas concentrations in the soil. The results show that two statistical populations of light alkanes were present. Some bacterial degradation occurs in the soil but the difference is too great to be explained by this process.

The data were compared using Fisher's pairwise comparisons to determine which surveys were part of each population. These comparisons show that the survey before the leak was repaired represents one population while the three surveys after the repair represent a second population with lower gas concentrations.

Graphical presentation of light alkanes from the four surveys versus time shows a rapid decline in concentrations. This suggests that alkanes present as free gas within the soil had a residence time of only a few days. Light alkanes adsorbed on soil particles were more stable, with a residence time of more than three months.

Comparisons of results for the affected species show a difference in behavior, with methane declining the most rapidly. This observation reflects the expected differences in absorption coefficient, increasing (at a common temperature) with molecular weight. Pentane appears to accumulate in the soil during cold weather. Methane appears to adsorb less effectively in the soil than does ethane.

The flux of light alkanes suggests surface anomalies are being fed from a subsurface source and that the shape of these anomalies could change as the flux changes. A suggestion of the short residence time for methane and its less effective adsorption characteristics is that soils containing significant concentrations are probably generating it.