



Composition of Petroleum Hydrocarbons and Technical Additives in Drilling Waste buried in Permafrost Soils

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From the 1960s to the early 2000s, subarctic Canada was subject to extensive onshore and offshore gas exploration activities. For onshore drilling, it was common practice to bury the generated drilling waste in open pits on site [1]. Once the drilling waste was frozen, these constructed *drilling mud sumps* were covered with a dense cap of fine-grained substrate, leaving the waste encapsulated solely in the perennially frozen permafrost soils. Although the drilling fluids used were primarily freshwater-based, the levels of organic contaminants are often enhanced in the sump cap material. These contaminants likely originate from petroleum hydrocarbons present in recovered formation water, oil and grease, as well as technical additives in spent drilling fluids. The often inherent salinity of both formation water and drilling fluids buried in drilling mud sumps may cause the surrounding permafrost to thaw. This entails the risk of contaminant mobilization and their discharge to surface soils and waters.

For this study, the sump cap material covering the buried drilling waste was analyzed for organic contaminants above and below the permafrost table. Their composition and concentrations were compared to the local background. Soil extraction using acetone and *n*-hexane was enhanced through ultrasonication and dispersion. The extract was separated into six fractions by subsequent elution with solvents of increasing polarity. This step improved the quality of the chromatograms generated by gas chromatography coupled with single-quadrupole mass spectrometry (GC-MS). A comprehensive non-target screening was performed using the Xcalibur™ Software linked to the NIST library.

This investigation is part of a multidisciplinary study with the overarching goal of understanding the impact of drilling mud sumps on permafrost environments. Identifying the local signatures of petroleum hydrocarbons and tracing other organic contaminants deep in the sump cap will enable source determination of contaminants found in surrounding soils and larger waterbodies. The results will further feed into assessments of the effects on soil microbial communities, vegetation and hydrology.

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References

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