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The SPLASH Action Group – Towards standardized sampling strategies in permafrost science

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The Action Group called 'Standardized methods across Permafrost Landscapes: from Arctic Soils to Hydrosystems' (SPLASH) is a community-driven effort aiming to provide a suite of standardized field strategies for sampling mineral and organic components in soils, sediments, and water across permafrost landscapes. This unified approach will allow data from different landscape interfaces, field locations and seasons to be shared and compared, thus improving our understanding of the processes occurring during lateral transport in circumpolar Arctic watersheds.

1 Context of the SPLASH project

The ongoing warming and thawing across the northern permafrost region are driving changes in Arctic hydrology and the mobilization of mineral and organic materials, including nutrients, contaminants, and microorganisms, from formerly frozen soils to terrestrial ecosystems and surface water bodies, and ultimately to Arctic continental shelves and the atmosphere. Mineral and organic components interact along the 'lateral continuum' (from soils to aquatic systems), affecting biogeochemical cycles. Some elements, such as mercury, are potentially harmful for humans and other life forms while others, such as nitrogen and phosphorous, contribute to plant and plankton productivity. Other elements, such as carbon, have high potential for impacting our global climate system via CO_2 and CH_4 production and emissions to the atmosphere through microbial activity. There is an urgent need for a set of unified protocols to capture changes in the lateral transport of both mineral and organic matter across Arctic permafrost landscapes.

The circumpolar Arctic region is characterized by high spatial heterogeneity related to local climate, geology, topography, vegetation, and ground-ice content, among other factors. In addition, large interannual and seasonal

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variations in physical, chemical, and biological processes affect the behaviour of mineral and organic components in soils and water bodies. These spatial and temporal challenges add another layer of complexity to our understanding of mineral-organic interactions in permafrost-dominated systems. Standardized sampling strategies, applied uniformly in different seasons and locations, could help to overcome these challenges.

SPLASH is a new international, transdisciplinary initiative (2020–2022) funded by the International Permafrost Association (IPA) as a targeted Action Group (https://ipa.arcticportal.org/activities/action-groups). It is led by a Coordinating Committee exclusively composed of early-career researchers (ECRs), in collaboration with more than 30 other members from 11 countries (both ECRs and senior experts, referred to as the SPLASH team). The idea is not to 'reinvent the wheel', but rather to coordinate with existing broad-scale research initiatives and networks, such as T-MOSAiC, H2020 Nunataryuk, IPaC, or the Permafrost Carbon Network. This will contribute to the ongoing effort on standardizing sampling strategies, improving data comparison, synthesis, and upscaling of results.

2 Disentangling mineral-organic complexities

To summarise the task, we visualise the mineral and organic permafrost pools as balls of wool (Figure 1). Upon permafrost thaw, a portion of this pool is unraveled across the landscape as solid, dissolved, and gaseous fractions represented as threads. These threads are intertwined via mineral-organic interactions during transport. At key interfaces, we picture these interactions as hypothetical knots where exchanges between solid, dissolved, and gaseous fractions can be sampled and their interactions can be detected. SPLASH aims at sharing and

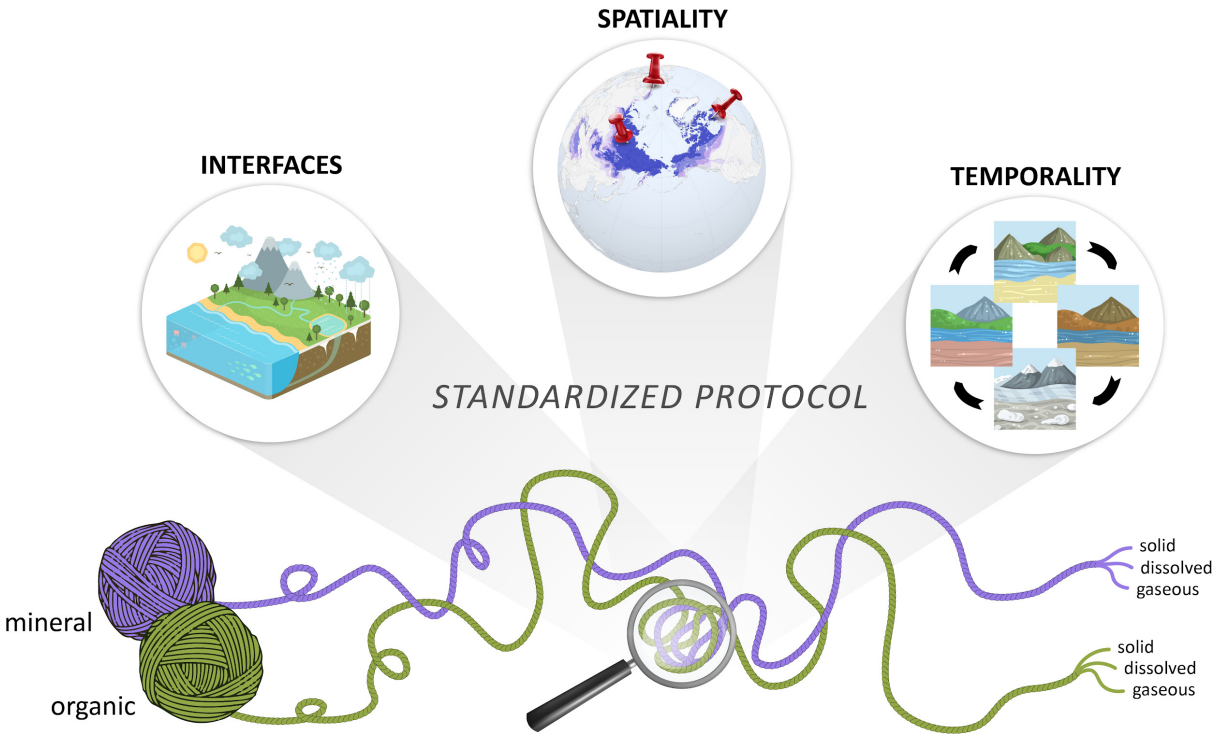

Figure 1 The mineral and organic permafrost pools.

standardizing field strategies for mineral and organic sampling in order to understand – and thus unravel – these knots in the landscape.

This unified approach will allow us to overcome the following challenges: (1) identifying interfaces where detectable changes in mineral and organic components occur; (2) allowing spatial comparison of these detectable changes; (3) capturing temporal (inter-/intra-annual) variations at these interfaces.

3 We need your help

To help us gather important information and design standardized approaches for this Action Group, we prepared a brief online survey to collect input from researchers who sample along the soil-to-hydrosystem continuum (click here to access the survey).

The survey asks about the 'WHAT, WHERE, and WHEN' of field sampling across permafrost landscapes,

and will be greatly helpful in identifying important interfaces, as well as approaches, to tackle spatial and temporal heterogeneities (i.e., adopting a 'critical places and times' approach).

Understanding ongoing changes across the circumpolar Arctic and finding adaptation strategies are paramount challenges for scientists and societies. We will build on the combined experience of our permafrost community to develop a unified set of field methods that can be applied across permafrost landscapes. There is a great need to share sampling location strategies and sampling protocols within the community in order to standardize field sampling efforts, and ultimately allow for comparison of data and interpretations across the soil-to-hydrosystem continuum. This community-driven effort will provide a fantastic networking opportunity for ECRs and will actively promote the sharing of fieldwork strategies and data between permafrost scientists focusing on different disciplines.

Please get in contact with the SPLASH team at splash@biogeochimie.fr and contribute to the online survey (here). Let's grow this large group even larger.

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Note: Queries and discussions on this article should be made by E-mail directly with the corresponding author.