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Persistent organic pollutants analysis in environmental matrices from polar areas

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Persistent organic pollutants (POPs) are organic chemical substances of scientific concern, widely produced in the form of pesticides, industrial chemicals and unintentional by-products. POPs retain particular physicochemical properties and structures such that they have the ability, with a long-range "grasshopper effect" transport, to travel over great distances and reach the polar areas through oceanic and atmospheric pathways. Once discharged into the environment, these contaminants persist for exceptionally long periods of time, and, due to their lipophilic characteristics, have the tendency to bioaccumulate in the biological fatty tissues, with negative impacts and toxic effects on multiple organisms, including humans.

This work moves towards the study of polar areas pollution with two approaches, considering the contamination of remote areas (Antarctica) and the possible remobilisation of past accumulated POPs into the sea because of permafrost thawing (Arctic), one of the most problematic tipping point due to climate change. In order to analyse POPs in different environmental matrices, permafrost active layer and ice samples has been collected in different locations: Ny-Ålesund - Svalbard Islands (permafrost), Yukon Coast - Canada (permafrost) and Dome C - Antarctica (ice core). Samples are treated with different analytical methods in order to detect different groups of POPs, such as polychlorobiphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and polybrominated diphenyl ethers (PBDEs). Prior to handling procedure, samples are spiked with internal isotope-labelled standards. Permafrost samples are firstly freezedried and homogenised. Then, accelerated solvent extraction is performed with a mixture of dichloromethane and hexane, followed by solid phase extraction clean-up. Ice samples treatment starts with melting at a low temperature, followed by a pre-concentration step with Oasis HLB cartridges. Then, samples are eluted with dichloromethane and hexane in order to extract the analytes. Both permafrost and ice eluates are spiked with a recovery standard and finally injected into a 6890A gas chromatographer coupled with a 5975C MSD (Agilent Tech.), that performs the identification and quantification of diverse classes of molecules.

The main outcome is the achievement of a complete and detailed newsworthy POPs dataset, that allows the comparison with other literature studies about POPs contamination in Antarctic and Arctic regions. Moreover, the integration between Canadian and Svalbard data has no precedent for permafrost as environmental matrix for POPs analysis. Finally, this results positively impact on the local societies, that would have new insigths on the thawing permafrost issue, becoming aware about this problem from the organic pollution point of view.