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Organochlorine compounds in ice melt water from Italian Alpine rivers

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Abstract

Organochlorine chemicals (OCs) (dichlorodiphenyltrichloroethanes, hexachlorocyclohexanes, and hexachlorobenzene) were measured in ice melt water from five glaciers in the Italian Alps. Even though the data collected may not be sufficient for a precise description of persistent organic pollutant release patterns from glacier melting, they have, however, highlighted the potential for surface water contamination. Concentrations were of the same order of magnitude in all glacial streams, indicating comparable contamination levels in different glaciers of the alpine region. OC levels in nonglacial springs sampled in the same areas are usually lower. Even if differences during the melting season (from spring to autumn) have been identified, a regular seasonal pattern in OC concentrations was not observed. Risk for the aquatic environment is excluded through direct water exposure, but it is likely to occur through biomagnification and secondary poisoning exposure.

Keywords: POPs; Glaciers; Surface water; Mountain environment; DDT; HCB; HCH; Alps; Risk assessment

1. Introduction

Persistent organic pollutants (POPs) are known to concentrate in cold environments as a result of progressive volatilization from warm regions and condensation in colder areas. In addition to polar regions, high mountains areas are under probable stress from POPs.

Mountain glaciers, covering part of these areas, play an important role in the fate of these chemicals. The role of snow as an effective scavenger for organic chemicals is well known (Franz and Eisenreich, 1998; Wania et al., 1999), Therefore, glaciers may act as temporary sinks for atmospherically transported POPs, trapping them until final ice melt. Ice layers, deposited in the 1960s and 1970s and characterized by high concentration of POPs, could represent potential sources of these contaminants to surface water.

The release of the accumulated substances into aquatic ecosystems represents an important threat to the surrounding ecosystem and to the quality of water flowing downstream. These molecules can produce adverse effects at very low concentration, acting either as endocrine-disrupting chemicals (Asplund et al., 1999) or as carcinogens (Ahlborg et al., 1995).

Despite this evidence, very few studies have focused on high-altitude water samples (Vilanova et al., 2001; Carrera et al., 2001; Blais et al., 2001a, b).

The present work is a preliminary attempt to investigate concentrations of organochlorine compounds (OCs) in glacial streams in the Italian Alps to highlight the role of glaciers as contributors of POPs to surface waters. In particular, dichlorodiphenyltrichloroethanes (DDTs), hexachlorocyclohexanes (HCHs), and hexachlorobenzene (HCB) levels were measured in water from glaciers with different characteristics, such

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as debris covering, to evaluate their influence on contamination levels. The presence of these chemicals in the ice of alpine glaciers was confirmed by previous studies on ice cores (Villa et al., 2003).

Finally, the present work highlights the role of glaciers as contributors of POP to surface waters, comparing contamination data from water with different origins. By analyzing and interpreting data, this can better help us to understand the origin and dynamics of the contamination and the potential risk for freshwater ecosystems.

2. Materials and methods

2.1. Sampling

Five glacial streams were sampled in the Italian Alps (Fig. 1): Lys stream (Lys glacier, Monte Rosa massif, Western Alps), Frodolfo stream (Forni glacier, Ortles-Cevedale group, Central Alps), Dora di Veny stream (Miage glacier, Monte Bianco massif, Western Alp), and Careser stream and Noce Bianco stream (Careser glacier and Col De La Mare glacier, respectively, both in the Ortles-Cevedale group, Central Alps). Lys and Frodolfo streams were sampled in 2000, 2001, and 2002. In 2002 Dora di Veny, Careser, and Noce Bianco were added. Sampled streams can be divided into two groups: those originating from debris-covered glaciers (Lys and Miage) and those stemming from non-debris-covered glaciers (glaciers of the Cevedale group). In principle, a different melting behavior can be hypothesised in the different glaciers. The scheme of the sampling dates is reported in Table 1.

To collect ice melting water that was not modified by dilution and environmental processes, each stream was sampled on a sampling station very close to the lobe of the glacier, during the snow-free season (generally from May to October). To avoid rain dilution artifacts, sampling was carried out only if preceded by at least 48 h of dry weather. In the Lys and Frodolfo valleys, water samples were also collected from non-glacial springs.

Samples were collected in aluminium cans (5 and 2.5 L) prerinsed with acetone and hexane. The total volume of each sample was about 20 L. A few hours after collection, samples were stored frozen, at −20 °C, until extraction.

2.2. Samples extraction and analysis

Analyzed chemicals were: DDT isomers and metabolites (DDT, DDE, and DDD, *p,p′*- and *o,p′*- isomers), *α*-, *β*-, *γ*- and *δ*-HCH, and HCB.

All OC pesticide standards were purchased from Dr. Ehrenstofer (Augsburg, Germany) to prepare

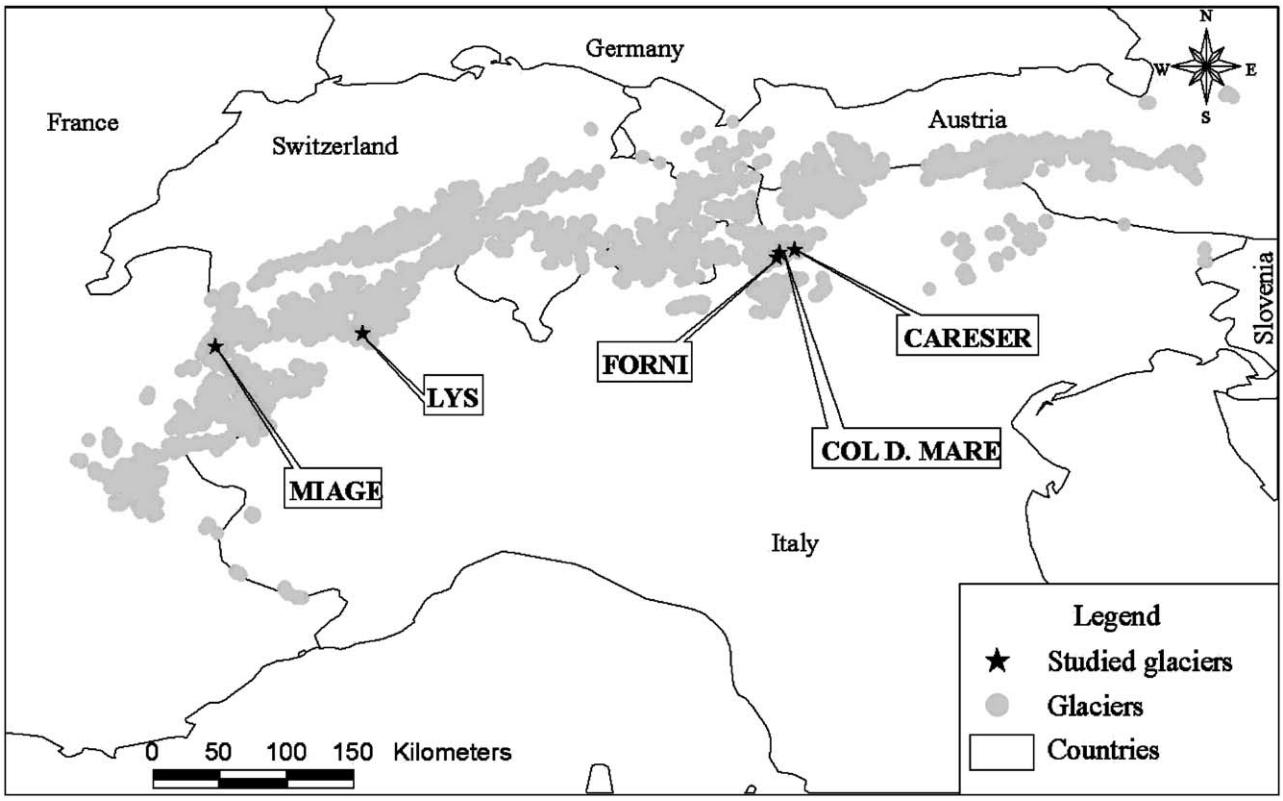

Fig. 1. Location of the sampling sites.