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# Characterization of the nature of the suspended particles transported during the low water levels of the Rhône River basin (France)

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## Context

### (1) An increasing frequency and intensity of low water levels

Studies conducted on the Rhône River highlights that in the current context of climate change, the frequency of low-flow situations are likely to increase throughout its basin.

### (2) An increasing production of organic matter at low flow

For these extreme periods, it is expected that the proportion of autochthonous organic matter (OM) contained in suspended particles will increase.

### Towards an increase in the concentration of contaminants ?

The fixation of several contaminants is indeed strongly linked to OM, where its form (and its origin) favors their complexation/adsorption.

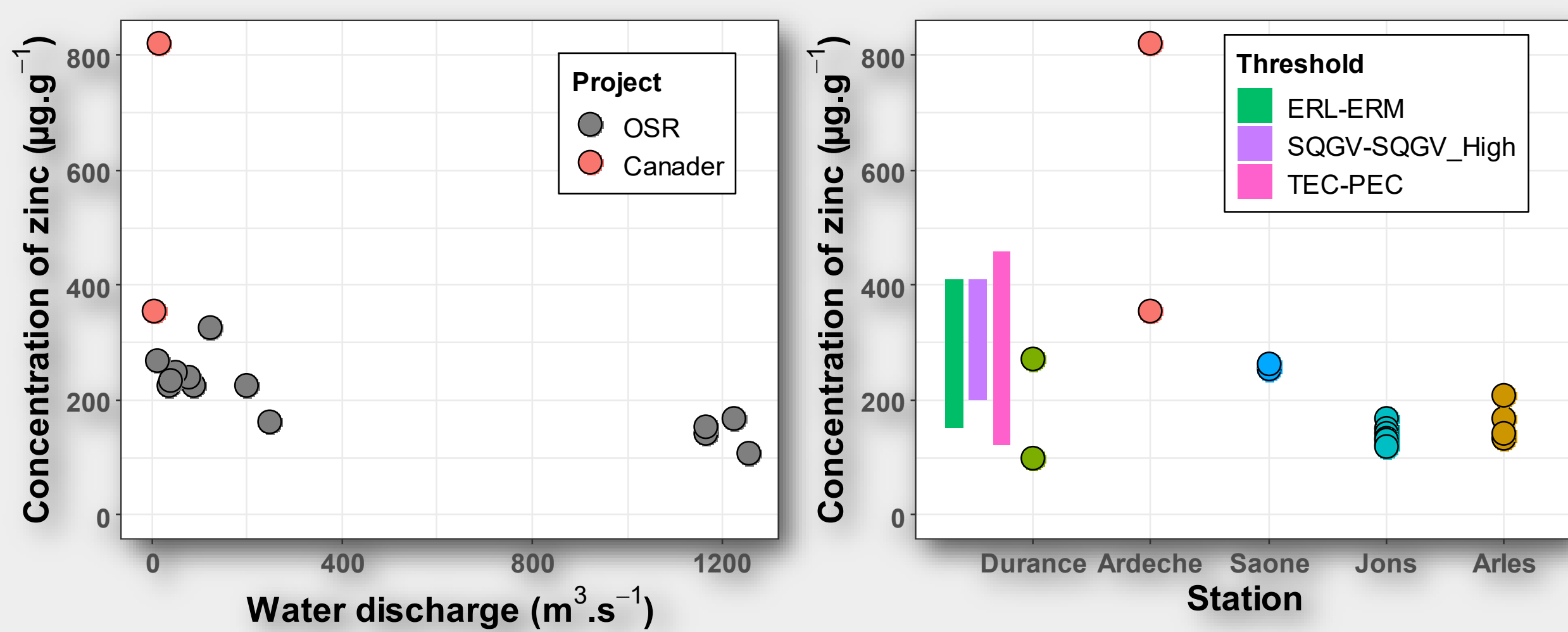
## Outstanding results

### A proven increase of autochthonous organic matter content ...

The **decrease** in the concentration of natural TMEs (from the earth's crust - Co Cs Rb and V) coupled with the **increase** in methylmercury (suggesting a bioaccumulation of concentrations in phytoplankton) shows that a significant proportion of the OM that transits at low water level is autochthonous.

### ... as for anthropogenic contaminant concentrations

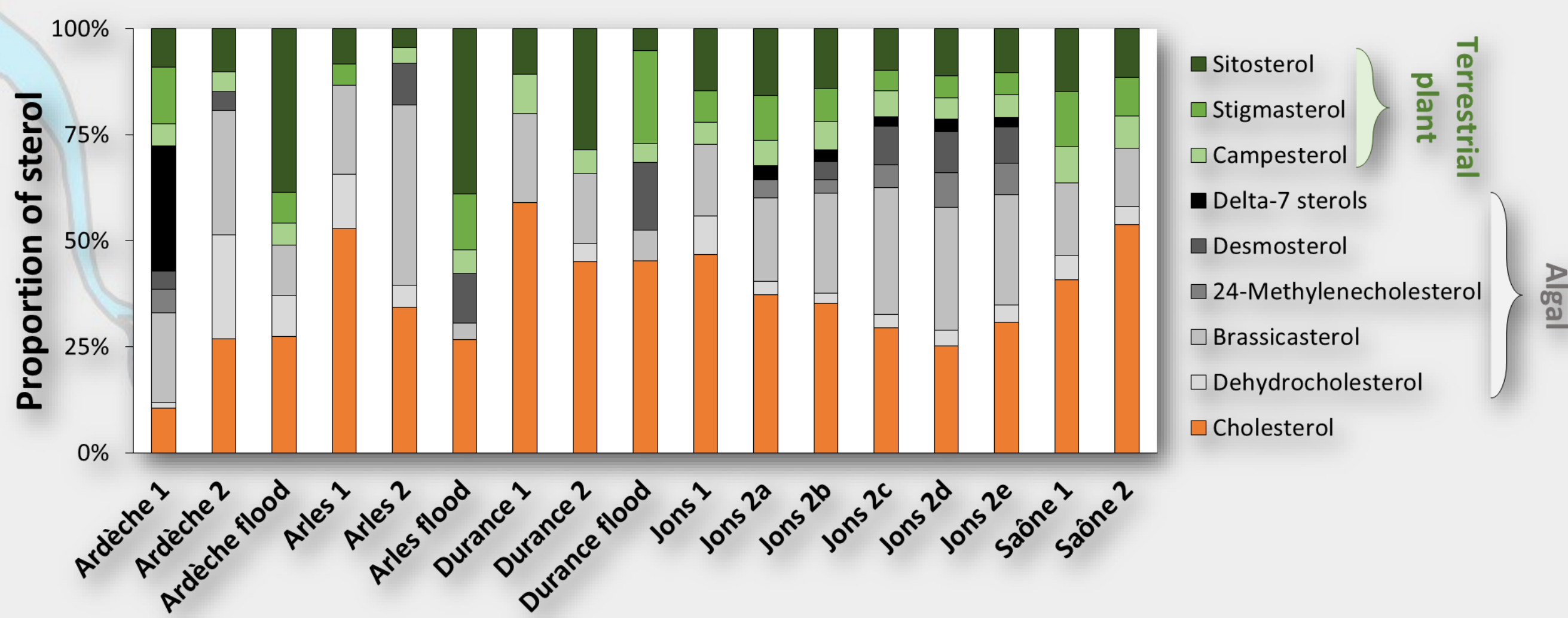
With the exception of radionuclides in the Ardèche River, the concentrations of contaminants in suspended matter tend to increase during low water periods (see the map and the example of zinc in the Ardèche River below). **For some TMEs and Hg, the concentrations can exceed toxicity thresholds (example of zinc below).**



Threshold effect concentration (TEC) and a probable effect concentration (PEC), Effects range low (ERL) and effects range median (ERM), Sediment quality guidelines values (SQGV)

### A contrasted origin of the OM of the Rhône River and its tributaries

The proportion of sterols vary between the stations (see the figure below) but confirm the non-negligible presence of OM from algal origin and terrestrial plant. On the Ardèche River, the presence of green algae (Chlorophyceae - see picture on the bottom right) observed during the sampling in July 2019 (Ardèche 1) results in an important proportion of delta-7-sterols. Cholesterol and its degradation products seem to indicate a greater contribution of animal inputs than human inputs in the Ardèche and Durance rivers.



## To conclude:

- ◆ This work confirms the interest of using sterols as an original tracer of OM and completes the rare information that exists on their content in the Rhône River basin
- ◆ If the organic matter increases at low flow (autochthonous production), there are important contrasts between the Rhône River and its tributaries, either in sterols (different origin) or in the concentrations of the contaminants (increases, decreases or remains stable).
- ◆ At low water level, the concentration of certain pollutants (TME, Hg) can sometimes exceed the toxicity thresholds.
- ◇ However, further work is needed to better understand the role of OM in contaminant transport. Part of this work will be carried out during OSR6 (2021-2024).

## The CANADER project

This project aims to **study the quality of particulate OM** (by measuring the **sterols and their degradation products**) in the Rhône River basin **during periods of low water**, and its link with contaminants (including Trace Metal Element TME, mercury Hg and methylmercury MeHg, and radionuclides).

This project benefited of the work conducted within the Rhône Sediment Observatory (OSR) and in particular its monitoring network of suspended particulate matter and contaminants. Samples were taken at stations shared by the OSR (Rhône River at Arles and Jons, Saône, Ardèche and Durance Rivers) to compare the measurements of contaminants at low flows with those obtained at higher flows.



## Sterols

These are lipids that can be used to determine the nature of organic particles and their origin:

- ◇ **The cholesterol:** input from human (sewage plant) or animal origin
- ◇ **The algal sterols:** contribution of autochthonous OM (produced in the river)
- ◇ **The terrestrial plant sterols:** contribution of terrestrial OM (plant, tree...)

Substance	Rhône River at Jons
Radionuclides	+
Anthropogenic TME Cu Ni Sn Zn	+
Natural TME Co Cs Rb V	+
Hg MeHg	+
Particle size	+
Particulate organic carbon	+

Substance	Saône River
Radionuclides	+
Anthropogenic TME Cu Ni Sn Zn	+
Natural TME Co Cs Rb V	+
Hg MeHg	+
Particle size	+
Particulate organic carbon	+

Substance	Ardèche River
Radionuclides	+
Anthropogenic TME Cu Ni Sn Zn	+
Natural TME Co Cs Rb V	+
Hg MeHg	+
Particle size	+
Particulate organic carbon	+

Substance	Rhône River at Arles
Radionuclides	+
Anthropogenic TME Cu Ni Sn Zn	+
Natural TME Co Cs Rb V	+
Hg MeHg	+
Particle size	+
Particulate organic carbon	+

Substance	Durance River
Radionuclides	+
Anthropogenic TME Cu Ni Sn Zn	+
Natural TME Co Cs Rb V	+
Hg MeHg	+
Particle size	+
Particulate organic carbon	+

Concentrations less than, equal to or greater than 95% of those observed for higher flows



Two samples were collected per station between July and October 2019



The samples were taken by continuous flow centrifugation



From 3 to 5m<sup>3</sup> of centrifuged water for less than 10g of material



Presence of autochthonous organic matter on the Saône



Bloom of chlorophyceae in the Ardèche River in July 2019

