

# Study on transport and characteristics of organic matters in river waters with different watershed conditions

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## Abstract:

$^{14}\text{C}$  and  $\delta^{13}\text{C}$  were used to study transport behavior of particulate organic carbon in major rivers in Hokkaido at spring-summer season. Water samples for the Ishikari River were collected from April to September in 2004. The Tokachi, the Teshio, and the Kushiro River water samples were collected at snow-melting period in 2004. There are positive correlations in POC contents and carbon isotopic values except for the spring sample of the Ishikari. The spring POM sample is different sources and transportation. However, there is a positive correlation between POC content and  $^{14}\text{C}$  values at snow-melting period for the four river POM samples. The four rivers show similar transportation of POM at high water discharge although the river systems have different watershed environment.

## 1. Introduction

River systems play an important role in pathway of organic carbon transportation from terrestrial to coastal area. For better understanding the transport of organic materials, it is important to study the discharge patterns and sources of riverine organic materials through a year. However the transport of POM is not clearly understanding because of spatial and temporal variations in the characteristics. Natural radiocarbon is a useful tool for studying the dynamics of organic carbon in terrestrial environments<sup>1,2</sup>. This study reports the transport behavior of particulate organic carbon in major rivers in Hokkaido at spring-summer season using  $^{14}\text{C}$  and  $\delta^{13}\text{C}$  values.

## 2. Materials and methods

### 2.1 Sampling

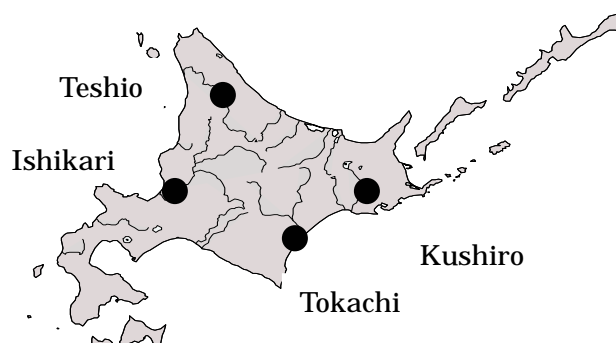


Fig.1 Sampling locations

The Ishikari River has a watershed area of 14330 km<sup>2</sup>. Watershed area of the Tokachi, the

Teshio, and the Kushiro River is 9010, 5590, and 2510 km<sup>2</sup>, respectively. Sampling locations are shown in Fig. 1. Water samples for the Ishikari River were collected at a fixed station (Iwamizawa-Ōhashi) once a month from April to September in 2004. The water samples for the other three rivers were collected at snow-melting period in 2004. Each sampling site is placed at water-flow observatory. Particulate suspended matters were isolated from 30~100 l of water samples by the continuous centrifugation and were dried at 60 °C in an oven.

## 2.2 Analytical methods

Inorganic carbons were removed from the powdered solids using 1M HCl. POC contents were determined by total organic carbon analyzer. <sup>14</sup>C and <sup>13</sup>C measurements were performed by accelerator mass spectrometry. <sup>14</sup>C and δ<sup>13</sup>C defined as the deviations in parts per thousands (‰) from the modern standard.

$$\delta^{13}\text{C}(\text{‰}) = (A_{\text{Sample}}/A_{\text{Standard}} - 1) \times 1000$$

A = Ratio of <sup>12</sup>C to <sup>13</sup>C

Standard = PDB

$$^{14}\text{C}(\text{‰}) = [A_{\text{SN}} e^{\lambda(y-1950)} / 0.7459 A_{\text{ON}} - 1] \times 1000$$

A<sub>SN</sub> = Ratio of <sup>12</sup>C to <sup>14</sup>C of normalized sample

A<sub>ON</sub> = Ratio of <sup>12</sup>C to <sup>14</sup>C in normalized oxalic acid standard

λ = Decay constant

Y = Measurement year.

## 3. Results and discussion:

POC contents and <sup>14</sup>C values for the Ishikari samples increased from April to June and decreased from July to September (Fig. 2 and 3).

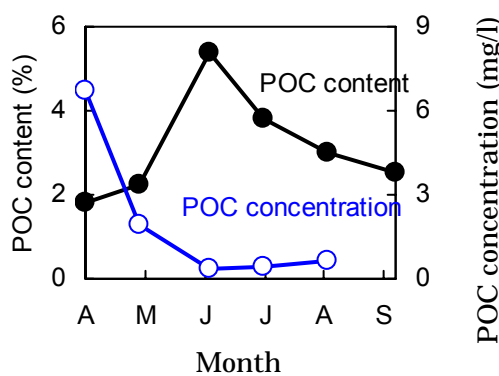


Fig.2 Variation in POC content and concentrations for the Ishikari POM at spring –summer season.

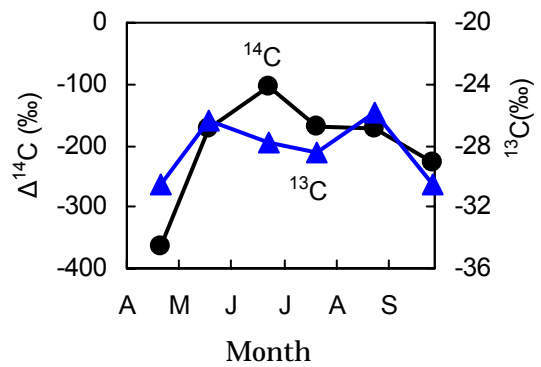


Fig.3 Variation in carbon isotopic values of POM.

The δ<sup>13</sup>C has maxima in May and August and slightly different variation. Based on the results of POC contents and concentrations, it is obvious that transportation of POM varied with sources and

watershed conditions. This is primary information on sources and its variation of organic carbons. POM consists of a mixture of various organic materials with various sources. To understand the discharge patterns of POM,  $^{14}\text{C}$  values were plotted as functions of POC contents and  $\delta^{13}\text{C}$  values (Fig.4 and 5). There are positive correlations in POC contents and carbon isotopic ratios except for the spring samples. The spring POM sample consisted of organic materials with older carbons (apparent  $^{14}\text{C}$  age :3637 year B.P.).

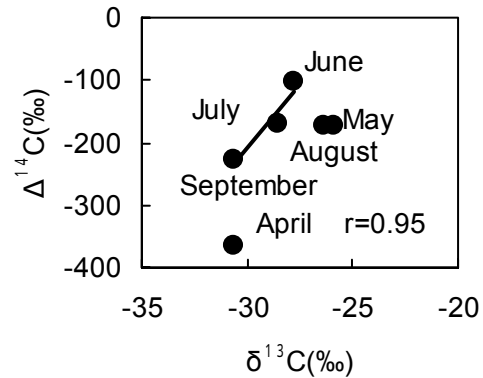
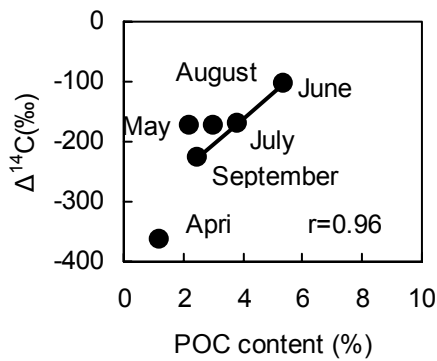


Fig. 4 Correlation in POC contents and  $^{14}\text{C}$  values. Fig. 5 Correlation carbon isotopic values of the Ishikari POM.

The origin of spring sample was different sources and transportation. On the other hand the POM of summer season might be a mixture of old and newly formed organic matters. At spring-summer season variations in water discharge variations and level are observed at the sampling sites. Therefore it appears that water discharge may be one of factors controlling the characteristics of POM at spring- summer season.

At snow-melting period POC,  $^{14}\text{C}$ , and  $\delta^{13}\text{C}$  values for the four river systems were different from each other (Fig. 6 and 7). The Ishikari samples was the lowest  $^{14}\text{C}$  and POC content, but the highest values were observed for the Kushiro sample. Increased water level was 4.65 m for the Ishikari, 1.07 m for the Tokachi, 1.69 m for the Teshio, and 0.73 m for the Kushiro Rivers.

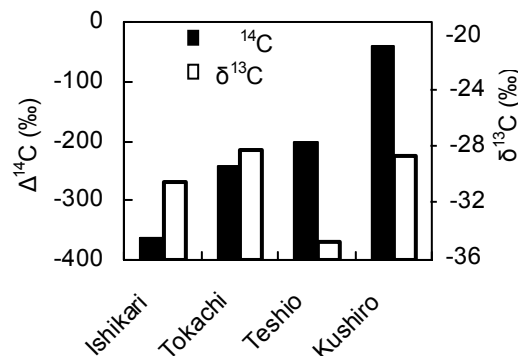
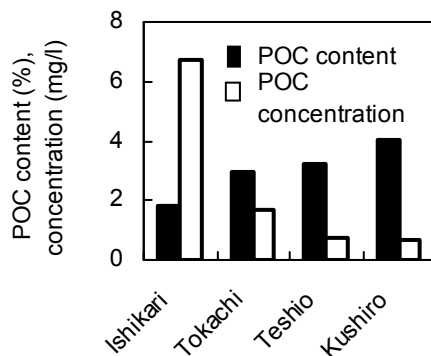


Fig.6 Variation in POC contents of POM. Fig.7 Variation of carbon isotopic values of POM at snow-melting.

Therefore, differences in POC and carbon isotopes depend on water discharge and load of suspended solids of each river. As shown in Fig.8 and 9, there is a positive correlation between POC content and  $^{14}\text{C}$  values but no correlation in  $\delta^{13}\text{C}$  values due to different sources. These results suggest that POM for all locations were the mixture of organic materials with two end members such as old and newly formed organic carbons, though watershed conditions are different from each other.

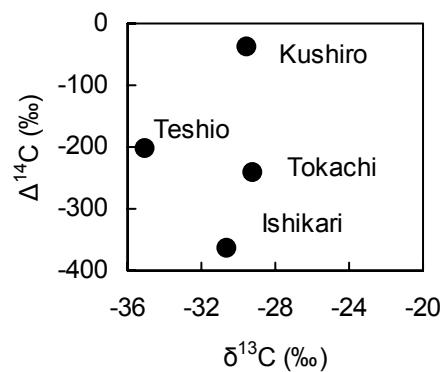
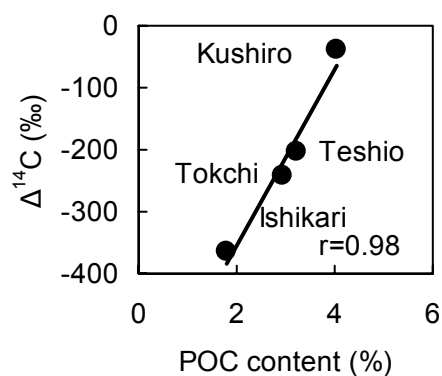


Fig.8 Correlation of POC content and  $^{14}\text{C}$  values      Fig.9 Correlation in carbon isotopic values of POM at snow-melting

Higher water discharge at snow-melting may be one of factors controlling the transportation behavior of POM at the period.

#### 4. Conclusion:

We used  $^{14}\text{C}$  and  $\delta^{13}\text{C}$  values for studying the transportation behavior of riverine POM for major rivers in Hokkaido at spring-summer season. The  $^{14}\text{C}$  values of POM ranged from -364 to -39‰. There are some relationships among  $^{14}\text{C}$ , POC content, and  $\delta^{13}\text{C}$ . These results indicate that organic composition of POM varies with season and their variations appear to be related to the water discharge.

#### References

- (1)P. A. Raymond, J. E. Bauer, 2001. Use of  $^{14}\text{C}$  and  $^{13}\text{C}$  natural abundances for evaluating riverine, estuarine, and coastal DOC and POC sources and cycling: a review and synthesis. *Organic Geochemistry* 32, 469-485.
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