Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

AHW29-10 Room:102A Time:May 23 11:30-11:45

Characteristics and runoff responses of DOM during rainfall events in the Kumaki River in Noto Peninsula, Japan

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Introduction

The management of SATOYAMA is important to sustain material cycle and ecosystem. Recently, SATOYAMA faces to degradation of ecosystem caused by the abandonment of forest and farmland and then influence chemical properties of water in soil and river. Humic substances being high-molecular organic acid is concerned with the coastal biological productivity. The change in SATOYAMA environments caused by deforestation and unmanagement of forests and paddy fields may reduce transport of organic matter from watershed to coastal area. Therefore, we need to elucidate the migration behavior of humic substances on a scale not only local, but also watershed. The purpose of this study was to elucidate the variation of structural properties, concentration and migration behavior of organic matter caused by abandonment of farmland and forest area. We also assess the impact of the abandonment to ecological system in river - coastal environment. This study investigated at the Kumaki River and Nanao Bay, which is located on the Noto Peninsula in Ishikawa Prefecture. The coastal biological productivity is high in the Noto Peninsula, and the abandonment of forest and farmland has been progressing. In this presentation, we report characteristics and runoff responses of humic substances in the Kumaki river waters collected during the rainfall events from 2009 to 2011.

Study sites and Methods

River water samples were collected at Kumaki River during the rainfall events in 13 July 2009, 27-28 July 2009 and 7-8 July 2011. Water samples were filtered through GF/F filters and then filtered samples were kept under freezing until analysis for three-dimensional excitation emission matrix (3D EEM) spectroscopy and high-performance size exclusion chromatography (HPSEC). Precipitation and water level data was provided by Ishikawa Prefecture River Total Information System (Ishikawa Prefecture, Civil Engineering Division).

Results and Discussions

Three rainfall events were different in variation of water level with amount and duration of rainfall. The humic-like materials concentration showed two to three times different values by the rainfall amount and water level. However the concentrations and characteristics of humic-like materials showed similar variations by the rainfall events as follows.

Humic-like peaks were detected at Excitation (Ex.) / Emission (Em.) wavelength of 300-340 / 430-465 nm for 3D EEM spectra in all river water samples. Relative fluorescence intensities (RFI) of humic-like peaks were high values with elevation of water level in the rainfall events, and decreased with downward water level after the rainfall. To understand characteristics of humic-like materials, the river water samples were analyzed by HPSEC with detection wavelength of Ex. / Em. of 320 / 430 nm corresponding to humic fluorescence peak. Three sharp peaks were detected among retention values ranged from 8.4 to 9.7 ml (Peak 1-Peak 3), and Peak 2 was highest peak intensity. Peak intensity of Peak 2 was highest with elevation of water level in rainfall event, and decreased with downward water level after the rainfall. These demonstrate that there is a large contribution of humic-like materials with higher-molecular weight runoff to river.

As compared fluorescence spectra of river water with the normal condition and rainfall events, humic-like peak was detected at higher wavelength in fluorescence spectra at the rainfall events. However in low water level after the rainfall, fluorescence spectra show similar features at normal condition. Moreover, peak height ratio of Peak 2 and 3 detected HPSEC was almost twice higher than that of normal condition. This result shows that runoff of humic-like materials with higher molecular weight occurred by the rainfall events. After the rainfall events, concentrations and molecular weight of humic-like materials decreased to those of the normal condition.

Keywords: Noto Peninsula, DOM, Humic substances, 3-D EEM spectroscopy, HPSEC, Rainfall event