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Wet/dry Repetitions of Centennial Scale Reconstructed by Inorganic Chemistry of the Mid-Holocene Hwayang Wetland in the West Coast of Korea

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Abstract

Inorganic geochemical and mineralogical analyses from the trench sediments of the Hwayang wetland were carried out to verify the wet/dry conditions during 6000 - 5000 yr BP and abnormal event of 6300 yr BP of Korean west coast. Lithostratigraphy, mineralogy and major element concentrations of the sediments of the trench indicate that during 6000 - 5000 yr BP, a wet/dry conditions might be repeated at an interval of 200 years. Carbonate minerals precipitated with the decrease of water depth in the lake or wetland after about 6000 yr BP. On the other hand, the sediments coarser in mean grain size and larger in standard deviation were corresponded with periods of 6300 yr BP and 6230 yr BP. Especially, such a feature of grain size distribution of 6300 yr BP appears in other wetlands situated in the west coast, e.g., Hwangsan wetland and Cheollipo coastal wetland. During the period, the coarse sediments seem to have been delivered by a high energy like storming.

1. Introduction

In general coastal wetland is known as an archive in response to sea level fluctuation and human interference, and drastic coastal environmental changes are well recorded (Dawson et al., 1988; Reed, 1990; Hwang, 1998; Cundy and Croudace, 1995; Daoust et al., 1996). Dry intervals during the mid-Holocene are more possibly asynchronous than synchronous in arid and semi-arid China (An et al., 2006). In order to reconstruct effectively the Holocene climate change of Northeast Asia, it is very important to study the coastal climate changes in Korea and Japan as well as typical continental ones in China.

Hwayang wetland of Pyeongtaek was formed on the old floodplain of the Ansung river on the west coast of Korea (Fig. 1). This study is focused on the reconstruction of wet/dry-environments during 6000 - 5000 yr BP and abnormal event of 6300 yr BP of Korean west coast on the basis of inorganic geochemical information on the trench sediments obtained from the Hwayang wetland.

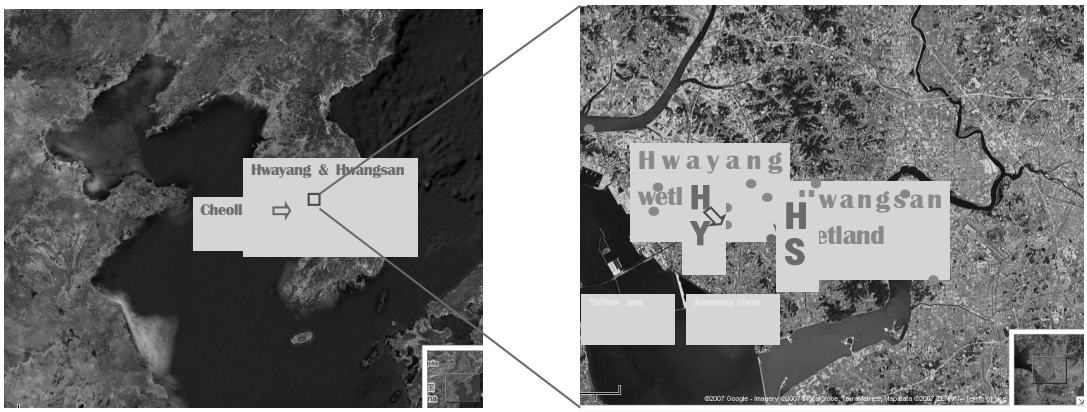

Figure 1. Location map of Hwayang & Hwangsan wetlands of Pyeongtak, Korea.

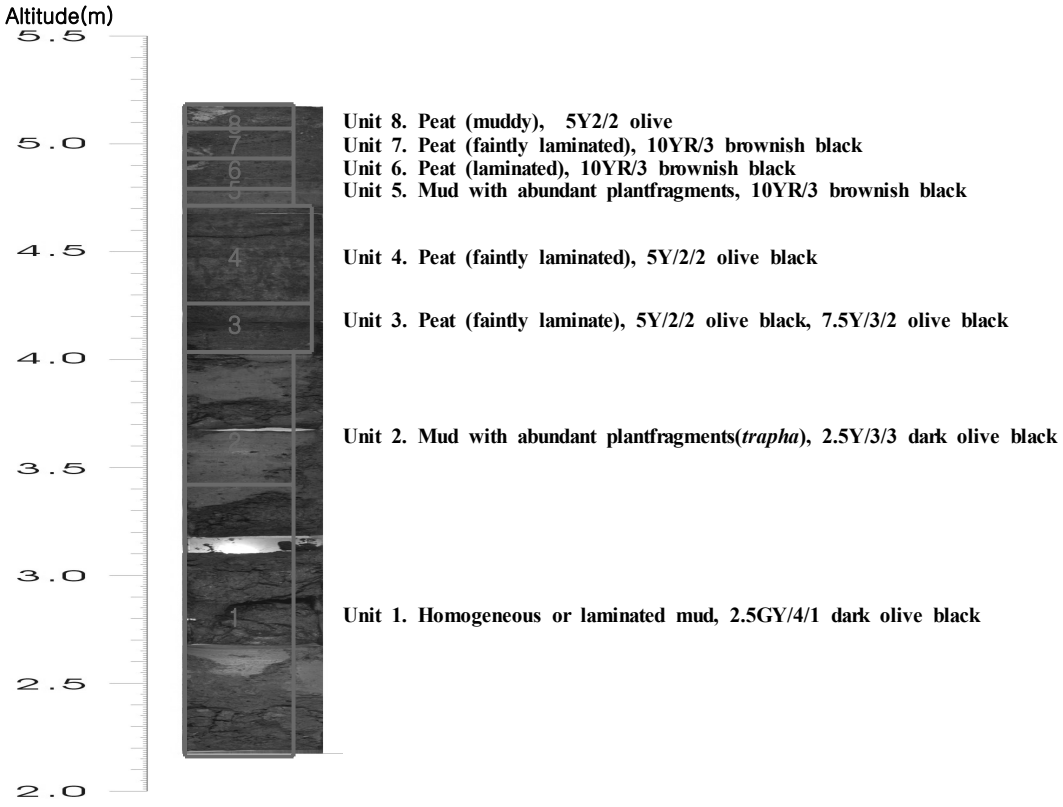

Figure 2. Lithostratigraphy of the sediments at the Hwayang wetland. Elevation means mean sea level (MSL).

2. Study area and methods

Eight sedimentary units from unit 1 (altitude 2.275m) to 8 (altitude 5.175 m) in ascending order are distinguished based on sedimentary textures, grain size distribution and vertical color variation (Fig. 2). A total of 107 samples at 2-10 cm interval depending on lithology were collected from the trench sediments of the Hwayang wetland. The samples were dried at 60℃ for 3 days and homogenized in an agate mortar. The grain-size of bulk sediment samples was analyzed using the laser diffraction method with a Mastersizer 2000 (Malvern Instruments, Ltd., Worcestershire, UK) grain-size analyzer. Subsamples of the <2 mm fraction were pre-treated in (with) 30% hydrogen peroxide solution to remove organic matter, and with sodium carbonate to achieve dispersion.

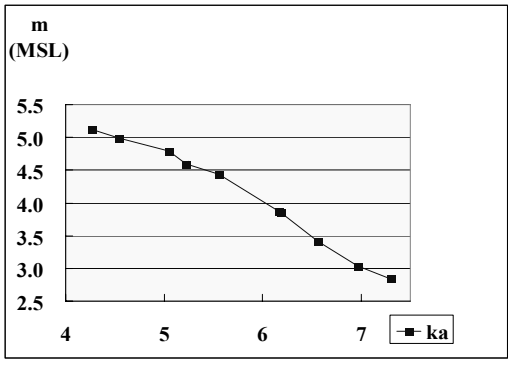

Figure 3. Ten radiocarbon ages were determined by AMS method for the trench sediments containing organic matters.

The ground powder was used for all subsequent geochemical analyses. In order to provide an overview about the geochemical composition of the sediments, the major elements (Si, Al, Fe, Ca, Mg, Mn, K, Na, Ti and P) for 107 samples were analyzed by XRF (Shimazu MXF-2300) using fused borate glass beads. Also ten radiocarbon ages were determined by AMS method for the trench sediments containing organic matters (Fig. 3). The radiocarbon ages were determined by the accelerator mass spectrometer (AMS) method using a 4130-Tandetron AMS/Multi Purpose Beam Line System (MPS) (High Voltage Engineering Europa, Netherlands) at the Seoul National University Radiocarbon Laboratory, Seoul, Korea (http://kiki.snu.ac.kr). All ages used in this study are of uncalibrated ^{14}C ages as ^{14}C yr BP.

3. Results

The analysis of grain size distribution indicates that severe fluctuations of sedimentary environment existed during 6.8 - 5 ka, afterward relative homogenous mud deposited steadily. The sediments deposited between in calm environment and in storming might be different in their grain size distribution and standard deviation, depositional rate and chemical characteristics. We can analogize the possibility of events like storming from two fluctuations of 6230 yr BP and 6300 yr BP in the pattern of grain size distribution and its standard deviation. Especially that of 6300 yr BP can be seen also in two places of Hwangsan wetland and Cheollipo wetland. So there should be a big event like storming at least in west coast of Korea in 6300 yr BP(Fig. 4).

The ratios of Si/Al and Na/Al indicate terrigenous inplux and chemical weathering of detrital fractions, respectively (Roy et al., 2007). The Si/Al was abruptly decreased after 6 ka. Na/Al and Na/Ti values are steadily decreased (Fig. 4).

The Mn/Ti, Fe/Ti, Ca/Ti ratios show somewhat cyclic fluctuation during about 6000-4000 yr BP in response to the formation of peat layer. Especially during 6000 - 5000 yr BP, a wet/dry conditions might be repeated at an interval of about 200 years (Fig. 5). The hydrologic environment in this period seems to be alternated between almost closed limnic environment and wetland. Carbonate minerals precipitated with the decrease of water depth in the lake or wetland after about 6000 yr BP. Eventually, the Hwayang wetland is considered to have reacted more sensitively to wet/dry condition than Cheollipo wetland (Yang, et al., 2007) and Hwangsan wetland situated in the west coast, which resulted in the formation of 5 peat layers in the mid-Holocene.

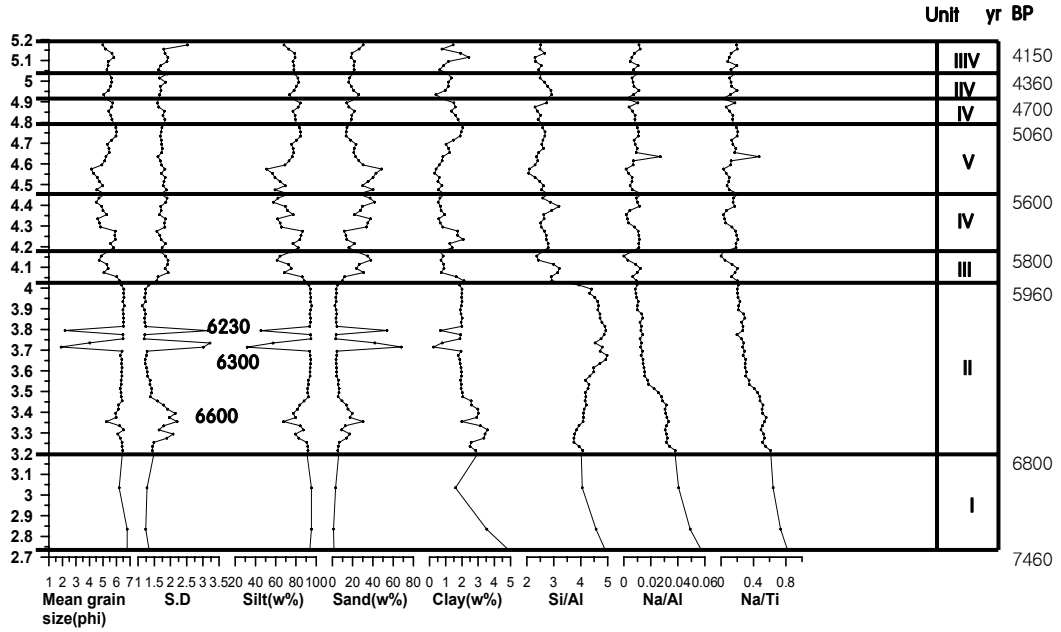

Figure 4. The grain size distribution and the ratios of Si/Al and Na/Al. The value of mean grain size and standard deviation severely fluctuates during 6.8-5 ka, afterward relative homogenous mud deposited steadily.

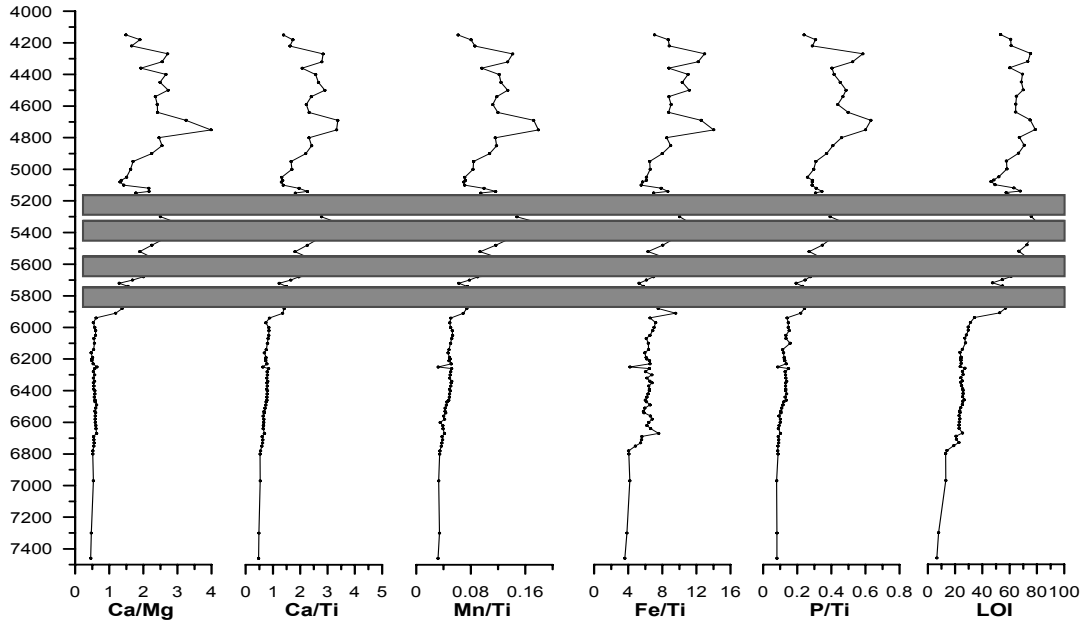

Figure 5. During 6000 - 5000 yr BP, a wet/dry condition might be repeated at an interval of 200 years at the Hwayang wetland in Pyeongtaek.

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