Trends of sediment accretion and carbon sequestration in tidal flat of Liaohe estuary

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Introduction

Carbon sequestration is used to describe both natural and deliberate processes by which CO_2 is either removed from the atmosphere or diverted from emission sources and stored in the ocean, terrestrial environments (vegetation, soils, and sediments), and geologic formations.

Estuary is a main part of coastal zone and main burial area of organic matter, which highlights the important role that estuary plays in maintaining coastal stability and promoting Carbon sequestration potential .

Liaohe estuary coastline has moved in and out frequently and the vegetation biocoenosis are complex and diverse. In recent years, tidal flat of Liaohe estuary has shifted, and the vegetation area has undergone continuous degradation, sediment accretion as well as characteristics of carbon sequestration have been changing.

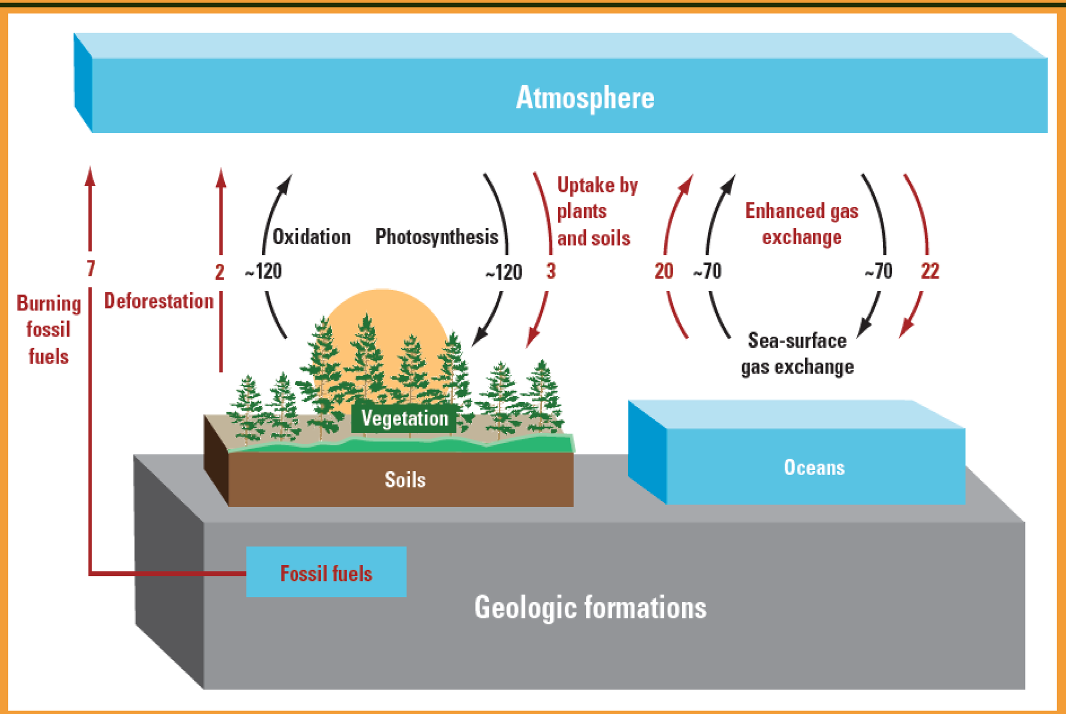

Fig.1 Carbon naturally moves, or cycles, between the atmosphere and vegetation, soils, and the oceans over time scales (CARBON FLUX, IN GIGATONS PER YEAR, Natural:120 Anthropogenic: 20) (USGS Factsheet, 2008)

Objective

(a) Investigating the temporal and spatial trends of sediment accretion rate over last century using $^{210}Pb_{ex}$ and ^{137}Cs chronology methods;

(b) Identifying the main source and variation of sedimentary organic carbon (SOC) based on TOC/TN ratio and isotopic composition of $\delta^{13}C$;

(c) Illustrating the record of carbon sequestration potential changes in sediment and evaluating its responses to sediment accretion and vegetation succession.

Materials & Methods

Two sediment core samples (C1 and C2) were collected from reed marsh and bare beach at different elevations on the west side tidal flat of Liaohe estuary in July 2016.

Samples were collected by hand-held sampler and sectioned into subsamples of 5 cm thickness, sampling depths in bare beach and reed marsh were 200 cm and 100 cm respectively.

Chronology methods of radionuclides $^{210}Pb_{ex}$ and ^{137}Cs were applied, TOC, TN and $\delta^{13}C$ composition were measured and then the temporal and spatial variation of sediment accretion and SOC accumulation characteristics were revealed.

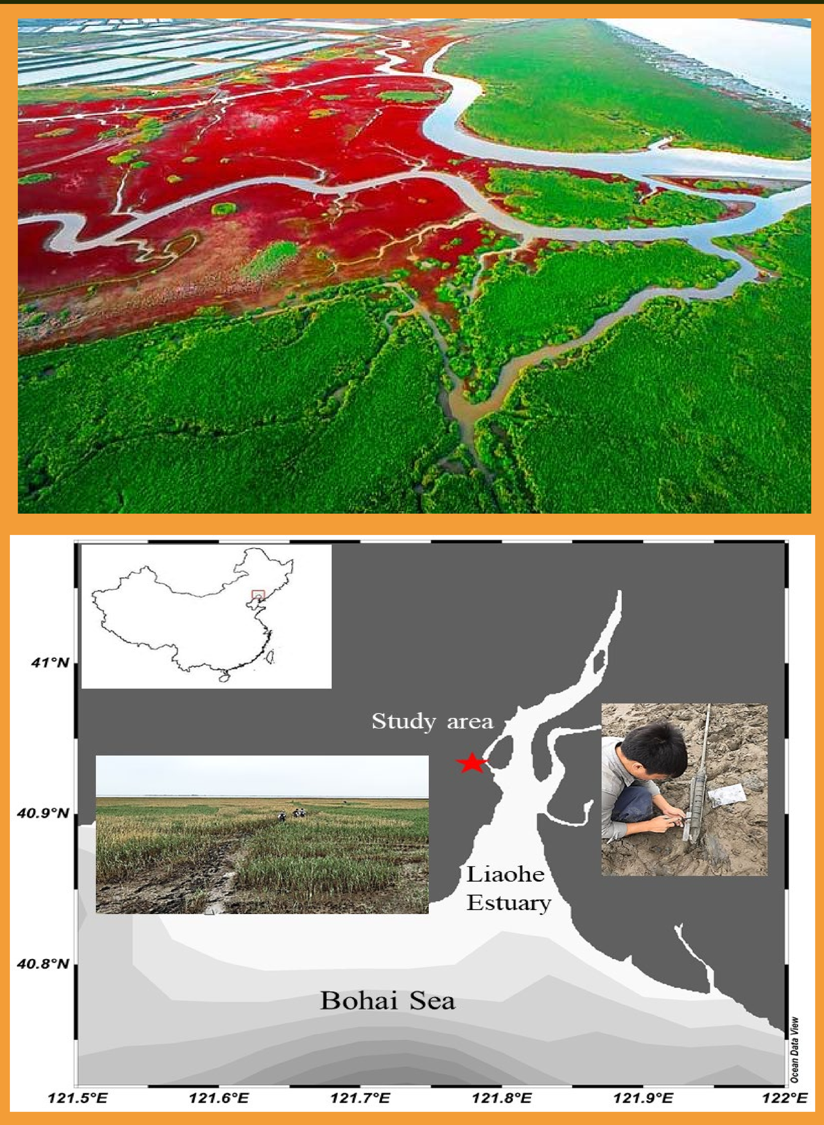

Fig.2 Study area of Liaohe estuary tidal flat and sampling

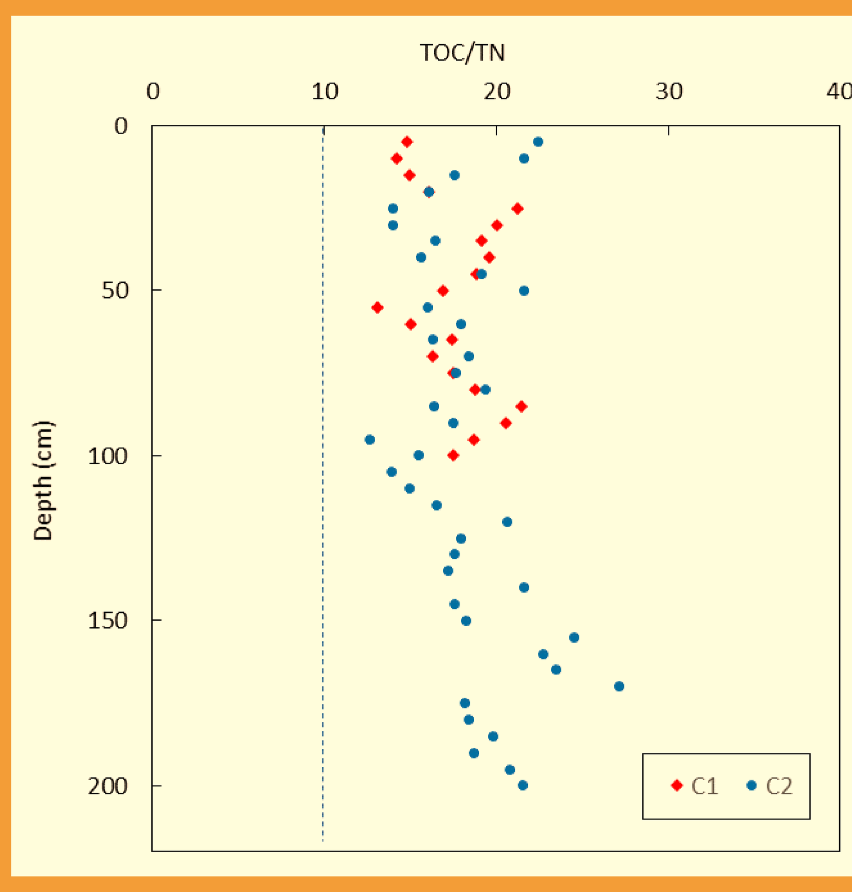

Fig. 4 TOC/TN and $\delta^{13}C$ profiles in sediment: TOC/TN ratios in sediment did not show remarkable change, however, fluctuated dramatically from bottom to top, which were still in the same range of >10, SOC was mainly from terrestrial input; Slight fluctuation of $\delta^{13}C$ values appeared over depth, and all were in the same range of -23~-25 ‰, terrestrial input was the main source of SOC, and $\delta^{13}C$ values from C1 at higher elevation were obvious lower than C2.

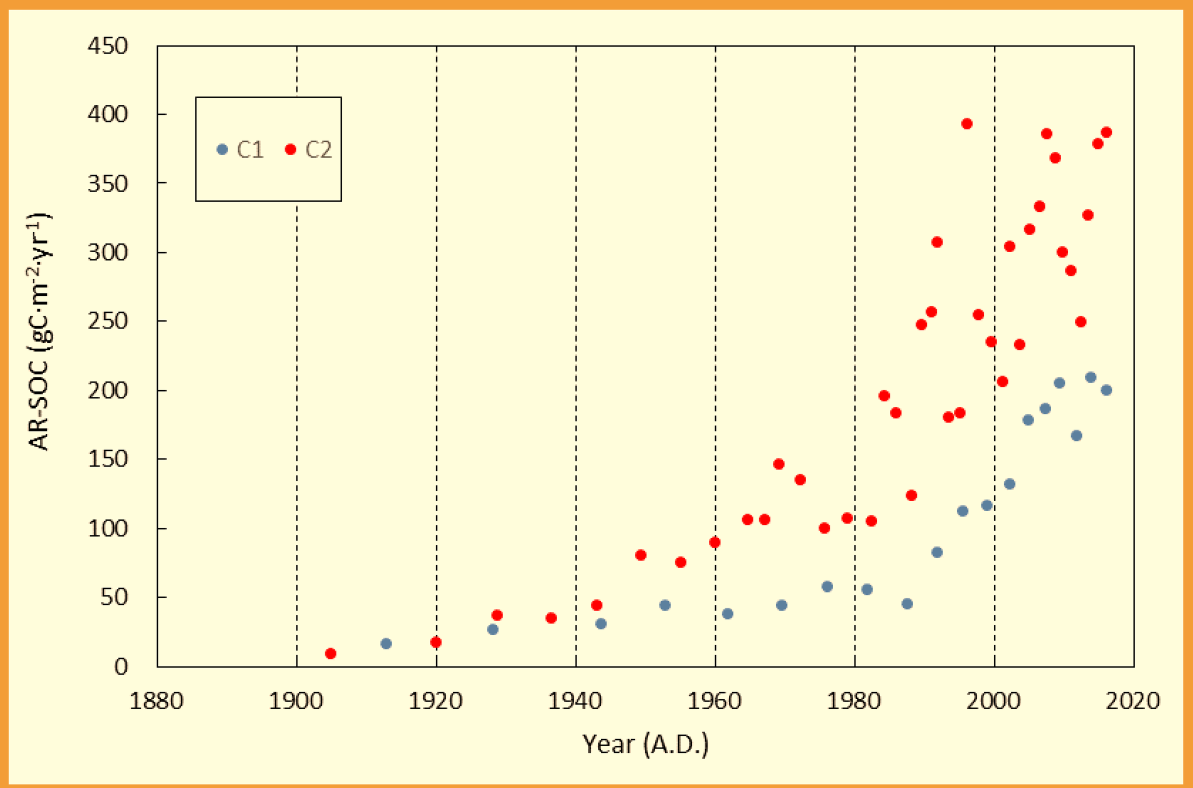

Fig. 5 Variation of SOC Accumulation Rate (AR-SOC) in sediment over time: AR-SOC showed an overall increasing trend over last 100 years at both reed marsh and bare beach, while AR-SOC at bare beach were higher and increased faster than that of reed marsh, especially after the year 1980, which basically coincided with the characteristics of sediment accretion rate.

Results & Discussion

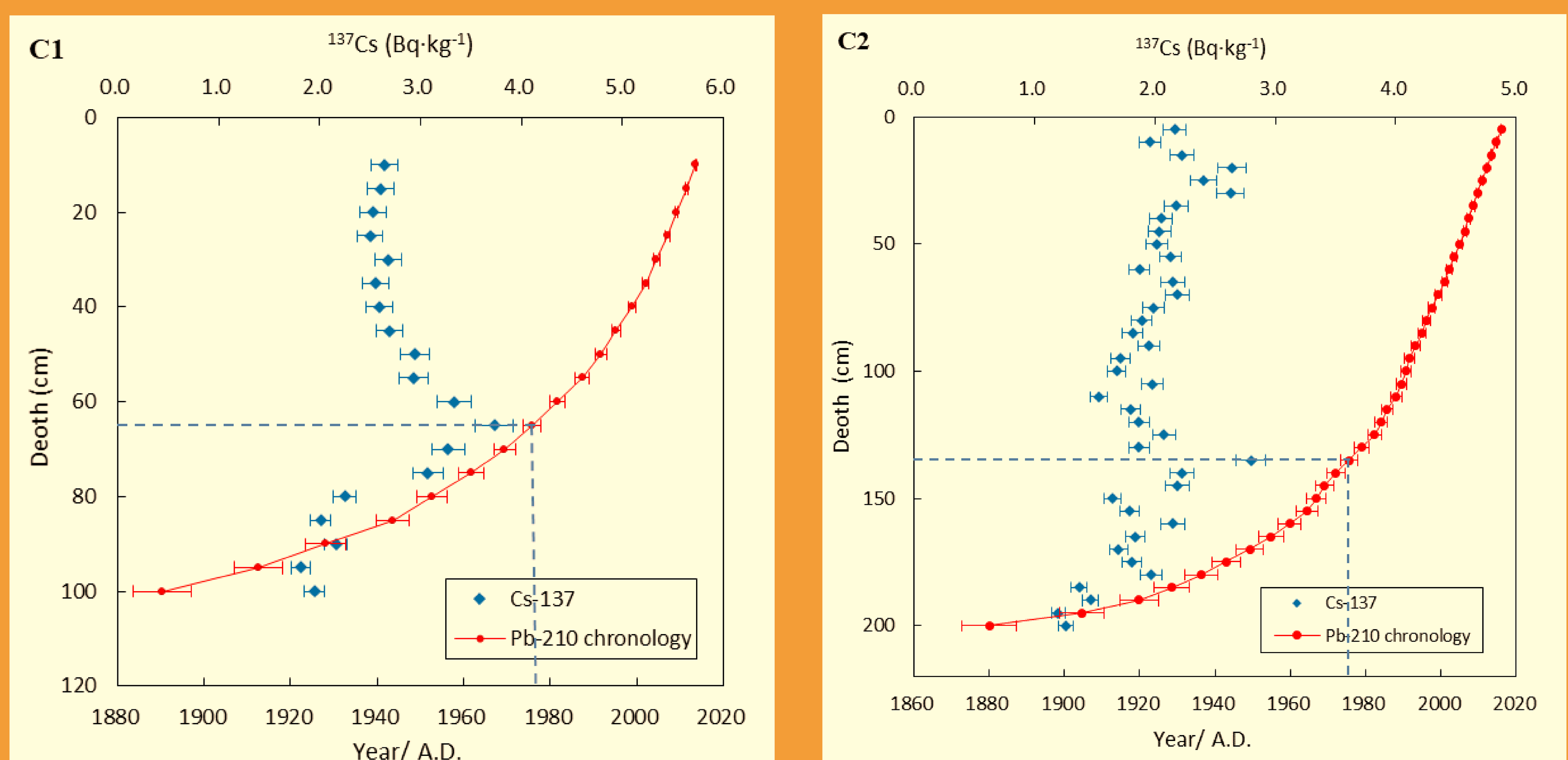

Fig 3. ^{137}Cs profiles and $^{210}Pb_{ex}$ chronology in sediment (Based on the profile of $^{210}Pb_{ex}$ and CRS model, assuming that $^{210}Pb_{ex}$ derived from atmospheric subsidence is constant, the ages of sediment at different layers were calculated, correspondingly plotted with ^{137}Cs profiles)

Table 1. Sediment accretion rates (cm·yr^{-1}) on different timescales (years): SAR of reed marsh and bare beach were obviously different at different time scales, but they both increased over time. Only the first peak from year 1963 was used from ^{137}Cs chronology.

Station	10	20	50		100
	$^{210}Pb_{ex}$	$^{210}Pb_{ex}$	$^{210}Pb_{ex}$	^{137}Cs	$^{210}Pb_{ex}$
C1 (reed marsh)	2.64	2.17	1.38	1.23	0.92
C2 (bare beach)	4.55	4.01	3.05	2.55	1.98

Conclusion

(a) sediment accretion rates of reed marsh and bare beach in study area showed increasing trend over time, and the average value in bare beach was higher than that of reed marsh on the same time scale. Liaohe estuary tidal flat has been exhibiting a trend of siltation over past 100 years.

(b) The main source of SOC at Liaohe estuary tidal flat was dominated by terrestrial input, and the influence from marine input was weakened with elevation increase.

(c) Carbon sequestration potential in Liaohe estuary tidal flat assessing from AR-SOC in sediment showed increasing trend over time, similar with sediment accretion rate, which was more intense after 1980s.

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