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Comparative study on carbon in surface layer of bottom sediments in different sites of the saline Lake Dagze Co, North-Tibet Plateau, China

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1 Introduction

As the global warming issues become increasingly prominent, a research of carbon sinks, which focused on marine and terrestrial ecosystems, are paid more and more attention. Peatlands, soils and ocean floor are well recognized as sites of organic accumulation and represent important globe carbon sinks (Gorham, 1991; Emerson & Hedges, 1988). The annual burial of organic carbon in lakes exceeds that of ocean sediments (Dean & Gorham, 1998), but the important role, which they play in globe carbon cycle, has not received the attention it deserves (Cole, 2007; Tranvik, 2009), especially the endorheic lakes. In exterior drainage lakes substances may pass through lakes and finally put into ocean, but in the endorheic lakes there is only a river inflow, without output of water. As a result, all substances, which carried by rivers from drainage basins, settle into the recipient lakes.

Tibet is the main area of salt lakes in China, and is also one of the largest salt lake areas in the world. Tibet as the highest altitude salt lake area has the most fragile ecological environment with a small human influence. There are few ecological studies here. Since 2003, we have conducted a series of ecological research on the Tibet salt lakes, especially on Dagze Co and Dangxiong Co.

This report is focused on the surface sediments of Dagze Co in North Tibet. Through the analysis of physical and chemical properties of the surface sediments, we discussed the carbon sedimentary characteristics from the estuary to the open region.

2 Material and methods

Sampling Sediments were sampled in 12 sites from the estuary (Bocangzangbu River inlet) to the open region using a grab sampler (Fig. 1). The characteristics of these sites are presented in Table 1. After retrieval, the sediments were sealed with plastic caps, stored on ice and transported to the lab for immediate analysis.

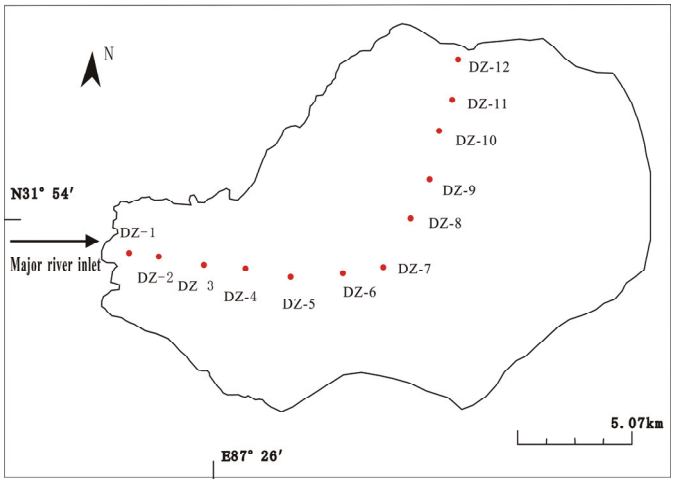

Fig. 1. Sampling sites in Dagze Co

Sediment analysis Water content of the sediment was measured by weighing samples both wet and after freeze drying. Dry bulk density was calculated as the ratio of dry weight and fresh sample volume. Porosity was calculated by water content and volume. The grain size was measured by weighting of sifted dry sediment. Contents of total carbon (TC) and nitrogen (TN) were measured by Elementar vario EL III. Total organic carbon (TOC) was measured by potassium dichromate oxidation. The inorganic carbon (TIC) content was then calculated as the difference between total and inorganic carbon. Microscopic identification was conducted in the stereo microscope.

3 Results and discussions

Physical properties Water content, bulk density, porosity and grain size are all important physical

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Table 1 Characteristics of sampling sites and the overlying water of sediments

Sampling Sites	DZ-1	DZ-2	DZ-3	DZ-4	DZ-5	DZ-6	DZ-7	DZ-8	DZ-9	DZ-10	DZ-11	DZ-12
Water Depth/m	0.5	2.2	4.5	7	9.5	16	22.5	27.5	32	29.5	29	18.5
Transparency/m	0.5	0.45	0.6	1.7	3.8		10.1	6	9	8.3	7.35	7.7
PH	9.6	9.4	9.3	9.7	9.6	10	9.5	9.6	9.7	9.6	9.5	9.8
Salinity/‰	25	25	24.8	25.4	25.4	25.6	25.4	25.6	25.6	25.2	25.4	25.8
Conductivity/μs/cm	14.51	15.87	14.56	16.62	16.63	16.55	16.58	16.74	17.01	16.7	16.82	17.33
Temperature/℃	11	10	10	10.5	10.5	10	12	12	9.5	11	12.4	11.1

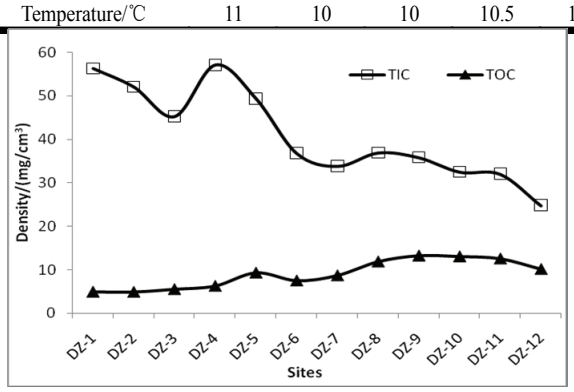

Fig. 2. Spatial distribution of carbon in sediments
(Note: DZ-4 and DZ-5 are influenced by northern seasonal rivers)

characteristics of the sediments, which are closely related to the transport and deposition of particulate matter and other processes, and also have an significant influence on organic content (Willing, 1989). In Lake Dagze Co water content in surface layer of sediment varied from 22.59% to 67.32% with average 46.16%. Comparison of this parameter in different sites shows that in open waters it was higher (average 53.83%). Dry bulk density was between 0.43 and 1.37 g/cm^3, with average value 0.48 g/cm^3; and this parameter decreased with increasing distance from estuary. Porosity in the sediments varied from 40.01% to 88.46%, and it changed as the water content. Mostly grain size are centered in 0.01~ 0.031mm.

Carbon composition The TC ranged from 4.16% to 5.76% with an average value of 5.01%. The TOC was between 4.46 g/kg and 23.64 g/kg with an average value of 12.66 g/kg. From the estuary to open region, the TOC value grew as the water depth increased, then it kept a stable value of 21.64~23.64 g/kg in regions above 29.5 m depth. The content of TIC was between 3.21% and 4.99%, and decreased from the estuary to open region. The inorganic carbon in surface sediment was 14.59~51.35 mg/cm^3 and the organic carbon was 4.88~13.26 mg/cm^3. TOC and TIC had the different trends of spatial changes in the lake (Fig. 2). Changes of TOC and TIC from estuary to the open region reveal that inorganic carbonate mainly dominated in carbon deposition in the lake, and with the increasing of water depth, the role that the organic carbon played became more and more important.

Sediment composition and origin The results from microscopic study shows that in the estuarial area organic matter mainly consisted of *D. tibetana* exoskeletons and fecal pellets with a small amount of plant roots. Analysis of TOC/TN supports this conclusion. The value of TOC/TN can be a good indicator to determine the origin of organic matter in sediment (Meyers, 1994, 1995). The ratio of TOC/TN in surface sediments of Dagze Co ranged from 4.06 to 7.9 that shows that organic matters in sediments are mainly from lake organisms. The conclusion is very different from many literature reported before (Downing, 2010; Kortelainen, 2004).

The mass percentage of CaO is highest in inorganic components in the sediments (all expressed in oxide), and CaO% has a highly significant correlation with TIC ($y=4.363x-0.781$, $R^2=0.949$) that reveals that in the inorganic carbon mainly consist of $CaCO_3$.

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