Analysis of long-chain alkenones in sediment cores from continental saline lake, Dabusu Lake, northeastern China

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The distribution of long-chain (37-39 carbon number; C37-C39) alkyl ketones (alkenones) in marine sediment has been well documented to record paleo-sea surface temperatures, as reviewed by Brassell (1993). The alkenones were derived from marine Haptophycean microalgae, especially Gephyrocapsaceae and Isocrysidaceae. The unsaturation ratios (the ratio of the numbers of double bonds) of alkenones vary largely depending on ambient temperature, and are well preserved after sedimentation. Recently, the long-chain alkenones were found in sediments of terrestrial saline lakes (Thiel et al., 1997; Li et al., 1996; Zink et al., 2001). Therefore, the alkenone thermometry can potentially apply to reconstruction of lacustrine paleo-water temperature, which reflects the terrestrial climates around the lake. However, there have been few studies that go beyond the mere quantitative level for assessing systematically the water temperature by alkenone thermometry in terrestrial lake. The source(s) of lacustrine alkenones were still unknown, and the relationship between alkenone unsaturation ratio and water temperature of lake has not been established yet. In this study, the alkenones were firstly identified in the lacustrine sediments of saline lake (Dabusu Lake) in northeastern China. It is reported that the alkenone thermometry in the saline lake was preliminarily examined.

Two cores (DB-A and DB-B cores) collected during January of 2004 in Dabusu lake were analyzed. Extraction and separation of lipids were performed based on Sawada et al.(1996) and Sawada & Handa(1998). After extraction, the lipids separated by silica gel column. Long-chain alkenones were analyzed by gas chromatography (GC) and gas chromatography / mass spectrometer (GC/ MS - EI).

C37-C40 alkenones were identified in samples of DB-A and DB-B. Also, the relative ratios of 4-unsaturated (4 numbers of double bonds) alkenones in C37 and C38 homologues were clearly higher than those of Emiliania huxleyi and marine sediments reported previously (Brassell, 1993).

The unsaturation ratios of C37 alkenones are calculated by using both equations in which the concentration of a C37:4 alkenone is contained as the parameter (Uk37) and not contained (Uk'37), as following,

Uk37 = ([37:2]-[37:4]) / ([37:2]+[37:3]+[37:4])

Uk'37= [37:2] / ([37:2]+[37:3]).

Water temperatures were calculated by using the equations which established in lacustrine sediments of Chinese lakes (Chu et al., 2005). The alkenone temperatures varied by depth in both DB-B and DB-A cores in Dabusu Lake. It is found that there are the lowest peaks (temp. deferences are about 8C) of the temperatures in these cores. These results indicate that water temperatures of Dubusu Lake were remarkably lower (i.e. the climate in the northeastern China were remarkably colder) in the ages, or these are underestimated by alkenone thermometer.

In addition, we evaluated the paleosalinity of Dubusu lake from the relative abundances of C37:4 alkenones to total alkenones (C37:4/K37).

The C37:4/K37 values varied by depth of both DB-B and DB-A cores. These variations were well correlated to Uk37 and Uk'37, which indicated that paleosalinity was changes associated with the changes of water temperatures in Dubusu Lake. We suggest that the C37:4/K37 is useful proxy for reconstructing paleosalinity in continental lake.