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On the organic compounds in water of Mochou Lake and Heart Lake in Larsemann Hills, Antarctica*

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Abstract Information on the organic compounds in water of Mochou Lake and Heart Lake, Antarctica is given in this paper. 93 organic compounds were identified from 121 chemical constituents in lake water, including n-alkanes, lipidal isopentadienes, aromatic hydrocarbons, polycyclic aromatics, alcohols, aldehydes, ketones, esters, monocarboxylic acids and phthalic esters in the range of 0.027-4.79 μg/L. Organic compounds of global occurrence like BHC, DDT and PCBs were detected in the water, at the concentration of 0.012-0.356 μg/L.

Key words Larsemann Hills, Mochou Lake, Heart Lake, organic compounds, global pollutants.

1 Introduction

Mochou Lake and Heart Lake are located in Mirror Peninsula of Larsemann Hills in the vicinity of Zhongshan Station of China and of Progress-I Station of Russia, respectively, and both serve as source of drinking water.

Many organic substances encountered in natural water are the products of biosynthesis and biodegradation, and are present in minute concentration. Compounds from hydrocarbons to complex multi-radicle compounds are present, of which many are difficult to isolate and identify directly. The Antarctica is not only the sole "pure land" without indigenous people and undeveloped, but also a natural laboratory in itself. But at present the range under the influence of technological development and energy consumption is expanding day by day, and some problems are global in nature, a number of researches have already taken notice of the effect of human activities on polar regions, and also the effect of long-distance transfer of organic pollutants (Peterle 1969; Tatton *et al.* 1967; Yao *et al.* 1992). The present paper is to study the organic compounds in lake water of Larsemann Hills, and tries to determine the share which the natural organic compounds bear and the share which the synthetic organic compounds bear in the lake water.

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2 Methods and experimental conditions

Experimentation consists of 5 steps: sampling, concentrating, isolating, qualitative analysis and quantitative analysis. In accordance with the existing conditions the following technical process was taken:

Water sample→Concentrating by macroporous resin network→CH_2Cl_2 elution
→ ⎡CGC isolation→MS qualitative analysis and quantitative analysis
   ⎣CGC, GC isolation→FID, ECD qualitive analysis and quantitative analysis.

Concrete conditions and parameters are listed below:

(1) Water samples were collected discretely from Mochou Lake and Heart Lake from February 13 to February 26, 1992, for 4 times and at the volume of 100 L every lake. Water samples were transported back to the laboratory at the Research Building of Zhongshan Station for treatment the same day.

(2) Concentrating by means of macromolecular net-like resin XAD-2 and XAD-4, 60–80 meshes, 0.5 g of each was mixed at the ratio of 1∶1, to be loaded into glass column of 1.0 cm internal diameter and 10 cm in length. The rate of flow was controlled at 30–50 ml/min through the regulation of hydraulic pressure. 30–50 L of water sample passed through each column.

(3) Adsorption column was eluted with pre-purified CH_2Cl_2, three times 10–20 ml each time. The eluted fluid was evaporated automatically at the local room temperature to 0.3–0.5 ml. The overall concentration ratio was 20×10^4–30×10^4 time, and then preserved at 2–4℃ for use.

(4) Purification of the resin and the reagents. All the reagents used were of analytically pure grade. XAD-2 and XAD-4 were eluted with 10N H_2SO_4 and 10N NaOH, backflow purified by acetone and methyl alcohol in Soxhlet extractor, and preserved in methyl alcohol, to be filled into the column on the spot. Likewise, CH_2Cl_2 was eluted with acid (5N H_2SO_4) and base(5N NaOH), redistilled, and purified through fractional distillation before use. Other reagents (acetone, methyl alcohol) were also subject to purification treatment before use.

(5) Gas chromatographic conditions:

①Capillary chromatograph. HP-5890A (USA) gas chromatography, FID detector, elastic quartz capillary chromatographic column No. 1: DB-5(SE-54), length of column 30 m, internal diameter 0.32 mm (J & W Science Co., USA). Column NO. 2: OV1701, length of column 32 m, internal diameter 0.28 mm (Wuhan University). The diversionless mode of sample feeding was adopted, vaporizing temperature 250℃, FID temperature 280℃. Column temperature: 50℃(2 min), 4℃/min →130℃(1 min), 7℃/min→280℃ (5 min). The entire course of isolation took 56 min. Carrier gas: N_2, 2 ml/min. Tail blowdown: N_2, 40 ml/min; H_2, 40 ml/min; air, 600 ml/min.

②Filling column chromatograph. Simadzn GC-9A gas chromatograph, ECD detector, chormatograph: OV-17(2%)+QF-l(2.5%), length of column 1.6 m, internal diameter 3.2 mm glass column, column temperature 210℃, ECD and vaporizing temperature 260℃. Carrier gas: N_2, 50 ml/min.

(6) Gas Chromatography/mass spectrometer, VG 7070E-HF(UK) median-resolution regular-positioned bifocal magnetic mass spectrometer coupled with

KYKY GC/MS/DS2 Data System. The EI mode was used, with ionization energy of 70 eV, ion source temperature 200℃, accelerating voltage 6 kV, resolution power 1000, temperature at GC-MS interface 250℃.

Chromatograph: HP-5790A (USA) gas chromatograph. Mode of sample feeding, chromatographic column (DB-5), column temperature (programmed temperature) and vaporizing temperature all the same as in chromatographic analysis. Carrier gas :He, average linear velocity 15–20 cm/s (2.0 ml/min).

Qualitative test: Contrast the mass spectrogram obtained from computer minus the background level with the standard chromatogram and relevant literature (Finnigan *et al.* 1979; Glger *et al.* 1978; Heller *et al.* 1978,1980), and combined with the retrieved data from computer, identify the structure of the chemical constituent. For constituents with standard samples, check up the characteristic ionic peaks fragments of the molecular, and integrate with the chromatographic retention to ascertain the correctness of the identification, as in the cases with n-alkanes and phthalic esters.

Qualification: Area normalization method and area external standard method were used. For the former, on the basis of precise determination of the total quantity of organic substances in 100 L of like water, the samples were quantified by making use of the percentage composition of the area obtained form chromatograms and mass spectrograms. External standard method was employed for organic constituents of which standard samples were not available; quantification was done by making use of the corresponding FID response values of compounds having similar structure or having the same carbon.

For organochlorine compounds, chromatographic filling columns and external standard method were used to perform qualitative and quantitative analysis, as in the cases of DDT, BHC and PCBs.

3 Results and discussion

By employing the methods described above, 51 and 42 organic compounds were detected from lake water of Mochou Lake and Heart Lake, respectively, of which typical chromatogram and total ion current mass chromatogram are shown in Fig. 1 and Fig. 2.

Fig. 1 and Fig. 2 show that using elastic quartz capillary columns of the same type(DB-5), chromatogram and total ion current mass chromatogram of water sample from Mochou Lake presented 105 peaks and 77 peaks, respectively, demonstrating the difference in sensitivity of the two analytical methods(GC and GC/MS). Similar results were obtained in the tests of water sample from Heart Lake, revealing 69 and 45 peaks respectively. Besides, it can be seen from the two kinds of graphic presentation that many peaks could not be identified qualitatively because of too low concentration or poor segregation, hence the constituents already disclosed are merely a part of the total organic constituents in the lake water.

From Table 1 and Table 2,it can be seen that among the 93 kinds of organic matter identified, there are 51 kinds in Mochou Lake water, and 42 kinds in Heart Lake water; many of the constituents are common to both lakes, and the numbers of constituents are fairly comparable. With repect to the total contents of organic com-

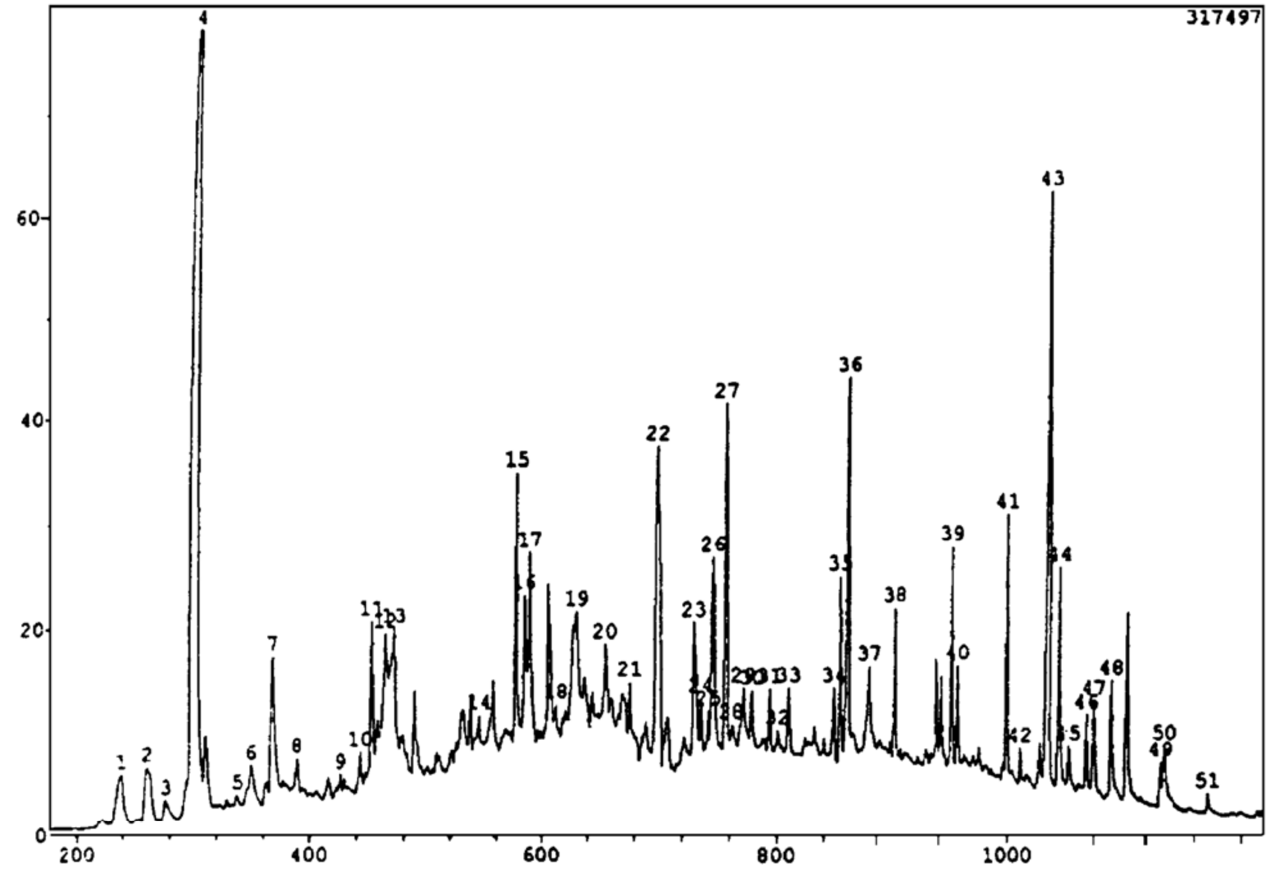

Fig. 1. Total ion current mass chromatogram of organic matter in Mochou Lake water, Antarctica.

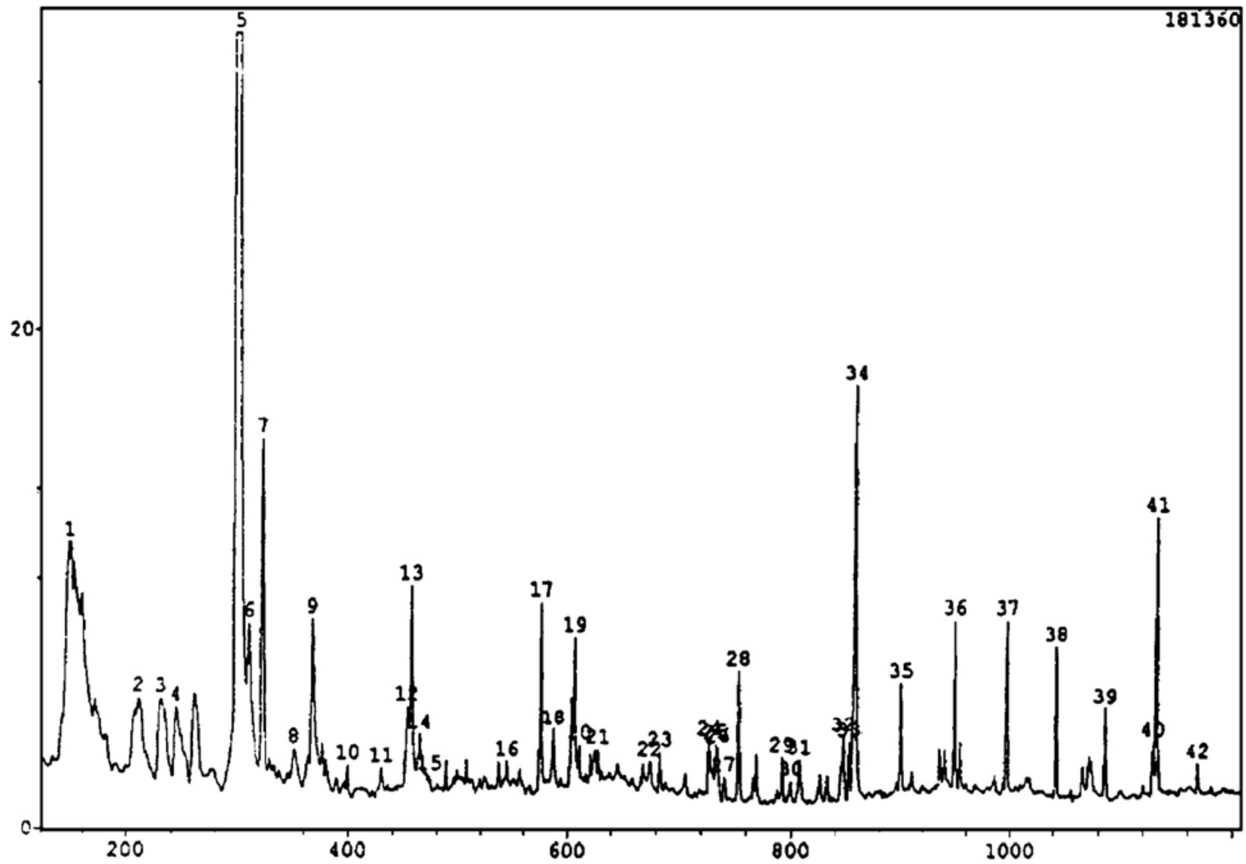

Fig. 2. Total ion current mass chromatogram of organic matter in Heart Lake water, Antarctica.

pounds in lake water 1.65 mg/100 L and 1.45 mg/100 L respectively, the difference is likewise not much. Similar results were obtained with TOC content 4.12 mg/L in Mochou Lake and 3.72 mg/L in Heart Lake, a difference of mere 0.4 mg/L.

Table 1. Analysis of trace organic compounds contained in Mochou Lake water, Antarctica

Peak No.	Number of scanning	Molecular weight	Compound	Content /$\mu g \cdot L^{-1}$
1	239	146	1,3-Dichlorobenzene	0.104
2	262	130	2,2,4-Trimethyl-1-pentanol	0.067
3	277	120	1,3,5-Trimethylbenzene	0.034
4	303	136	Benzoic acid methyl ester	3.277
5	338	152	1,7,7-Trimetylbicyclo[2,2,1]-heptan-2-one	0.107
6	350	134	1,2-Diethylbenzene	0.107
7	368	128	Naphthalene	0.315
8	389	128	Azulene	0.064
9	426	148	1-(4-Ethylphenyl)-ethanone	0.031
10	443	140	5-Undecen-4-one	0.061
11	452	164	3,5-Dimethylbenzoic acid methyl ester	0.282
12	464	164	4-Ethylbenzoic acid methyl ester	0.366
13	471	200	Dodecanoic acid	0.634
14	545	198	Tetradecane	0.031
15	577	220	2,6-Bis(1,1-dimethylethyl)-2,5-cyclohexadiene-1,4-dione	0.327
16	584	221	3-(2,2-Dimethyl-1-oxopropyl) amino benzoic acid	0.168
17	589	172	4,8-Dimethyl-1-nonanol	0.165
18	612	212	Pentadecane	0.044
19	630	190	2,4-Dichlorobenzoic acid	0.496
20	655	168	3-Ethyl-3-nonen-2-one	0.130
21	676	226	Hexadecane	0.058
22	699	266	Tributyl phosphoric acid	0.823
23	730	198	Ethylphenoxybenzene	0.251
24	736	240	Heptadecane	0.067
25	740	268	Pristane	0.048
26	746	249	2-Chloroethyl phosphate(3:1)	0.460
27	757	234	2,6-Bis(1,1-dimethylethyl)-4-ethylphenol	0.478
28	762	178	Phenanthrene	0.076
29	772	228	Tetradecanoic acid	0.156
30	779	198	1,6-Dimethyl-4-(1-methylethyl) naphthalene	0.083
31	794	254	Octadecane	0.058
32	801	282	Phytane	0.043
33	810	278	1,2-Benzenedicarboxylic acid bis(2-methylethyl) ester	0.092
34	849	268	Nonadecane	0.091
35	854	270	Hexadecanoic acid methyl ester	0.163
36	861	278	1,2-benzenedicarboxylic acid dibutyl ester	0.597
37	879	256	Hexadecanoic acid	0.191
38	901	282	Eicosane	0.136
39	951	296	Heneicosane	0.195
40	956	298	Octadecanoic acid methyl ester	0.084
41	999	310	Docosane	0.284
42	1011	129	N-Ethylpentanamide	0.045
43	1036	428	1,3-Dichloro-2-propanol phosphate(3:1)	1.077
44	1045	324	Tricosane	0.265
45	1053	428	Dichloro-2-propanol phosphate(3:1)	0.071
46	1068	302	2,4-Dimethyl-7-(1-methylethyl) Azulenylphenyl methanone	0.083
47	1074	302	1,4-Dimethyl-7-(1-methylethyl)-2-Azulenylphenyl ethanone	0.138
48	1089	338	Tetracosane	0.178
49	1131	352	Pentacosane	0.041
50	1134	390	1,2-Benzenedicarboxylic acid bis (2-ethylhexyl) ester	0.148
51	1171	366	Hexacosane	0.029

Table 1 and Table 2 show that there are various kinds of organic matter in lake water, comprising n-alkanes, lipidal isopentadienes, aromatic hydrocarbons, polycyclic aromatics, alcohols, aldehydes, ketones, esters, phthalic esters, monocarboxylic acids BHC, DDT and PCBs, altogether 13 categories. The composition of organic matter in water of the two lakes is not identical, e.g., the organic constituents in Heart Lake water do not include monocarboxylic acid, camphor, tributyl phosphoric acid, N-ethylpentanamide, etc., but contain four more n-alkane constituents than in Mochou Lake, i.e., C_{10}–C_{13} n-alkanes. As to the distribution of organic matter, although benzoic acid methyl ester forms the main peaks in both lakes, yet the share it partakes is quite different, being 19.86% (3.28 μg/L) in Mochou Lake and 33.04% (4.79 μg/L) in Heart Lake.

Table 2. Analysis of trace organic compounds contained in Heart Lake water, Antarctica

Peak No.	Number of scanning	Molecular weight	Compound	Content /$\mu g \cdot L^{-1}$
1	146	106	Dimethylbenzene	2.461
2	210	120	1-methylethylbenzene	0.112
3	230	120	1,3,5-rimethylbenzene	0.109
4	244	142	Decane	0.098
5	301	136	Benzoic acid methyl ester	4.791
6	310	142	Nonanal	0.393
7	322	156	Undecane	0.473
8	351	134	2,3-Dihydro-2-methylbenzofuran	0.086
9	367	128	Naphthalene	0.483
10	399	170	Dodecane	0.058
11	429	168	9-Methyl-5-undecane	0.046
12	452	164	3,5-Dimethylbenzoic acid methyl ester	0.123
13	456	142	2-Methylnaphthalene	0.145
14	464	164	4-Ethylbenzoic acid methyl ester	0.122
15	473	184	Tridecane	0.035
16	544	198	Tetradecane	0.033
17	575	220	2,6-Bis(1,1-dimethylethyl)-2, 5-cyclohexadiene-1,4-dione	0.159
18	587	212	Pentadecane	0.076
19	606	206	2,6-Bis(1,1-dimethylethyl)-phenol	0.760
20	611	212	Pentadecane	0.076
21	628	196	2-Butyl-5-(2-methylpropyl)-thiophene	0.062
22	674	226	Hexadecane	0.084
23	683	220	2,6-Bis(1,1-dimethylethyl)-4-methylphenol	0.036
24	727	198	Ethylphenoxybenzene	0.091
25	733	240	Heptadecane	0.103
26	735	268	Pristane	0.041
27	740	242	Tetradecanoic acid methyl ester	0.036
28	753	234	2,6-Bis(1,1-dimethylethyl)-4-ethylphenol	0.134
29	792	254	Octadecane	0.033
30	800	282	Phytane	0.027
31	807	278	1,2-benzenedicarboxylic acid bis(2-methylpropyl) ester	0.073
32	847	268	Nonadecane	0.084
33	852	270	Hexadecanoic acid methyl ester	0.073
34	857	278	1,2-benzenedicarboxylic acid dibutyl ester	0.501
35	899	282	Eicosane	0.095
36	949	296	Heneicosane	0.135
37	997	310	Docosane	0.154
38	1042	324	Tridecane	0.146
39	1086	338	Tetradecane	0.081
40	1129	352	Pentadecane	0.037
41	1132	390	1,2-benzenedicarboxylic acid bis(2-ethylhexyl) ester	0.322
42	1169	366	Hexacosane	0.029

3. 1 *n-alkanes*

Here we put isopentadienes and n-alkanes together for discussing the situation in bath lakes. In order to ascertain the constituents of n-alkanes in lake water, apart form the data of organic matter obtained from GC and GC/MS full-range scanning, we reconstructed mass chromatograms by integrating the characteristic ion peaks of n-alkanes m/z 57,71 and 85. Fig. 3 and Fig. 4 characterize clearly the distribution of carbon numbers of n-alkanes in both lakes, ranging from C_{14}–C_{26} in Mochou Lake and from C_{10}–C_{20} in Heart Lake. Isopentadienes are mainly represented by Pristane (Pr), Phytane (Ph), and other compounds of the same series.

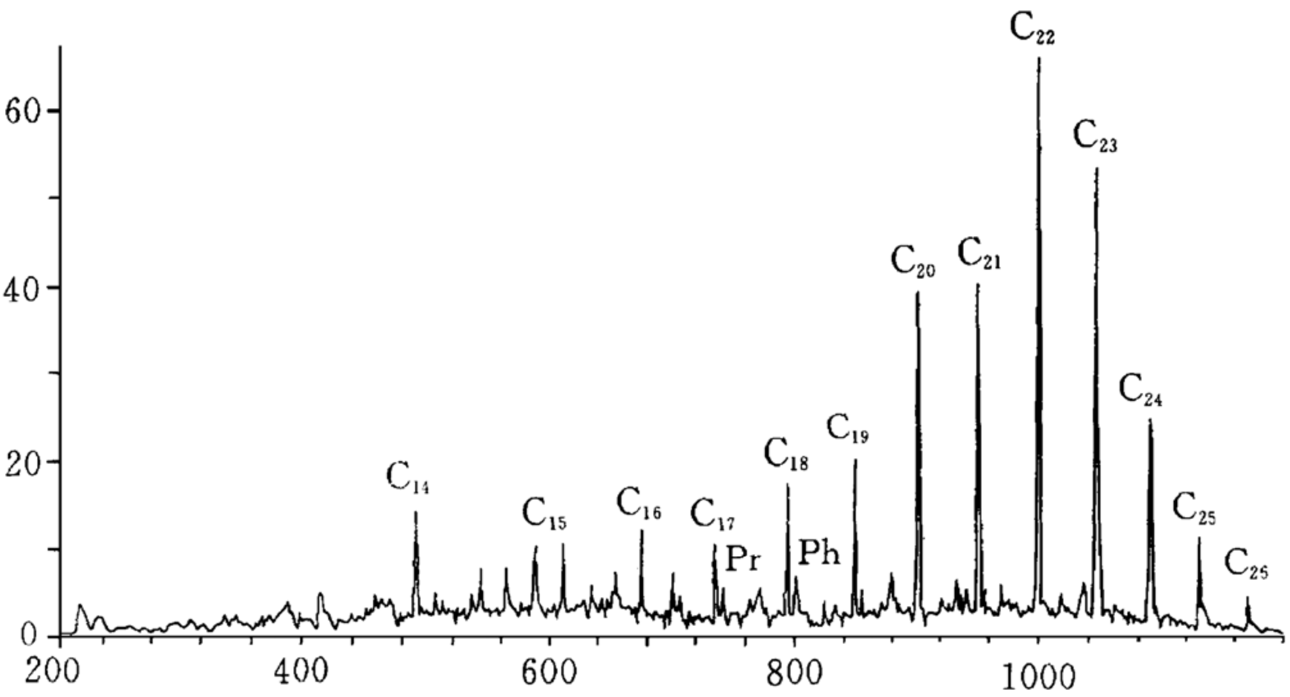

Fig. 3. The m/z 85 mass chromatogram of organic matter in Mochou Lake water, Antarctica.

Distributionally, the carbon numbers of n-alkanes in water of the two lakes are not identical. Main peaks of carbon number in Mochou Lake are represented by C_{22} (0. 28 μg/L) and C_{23}(0. 26 μg/L), whereas those in Hart Lake, by C_{11}(0. 47 μg/L) and C_{22}(0. 15 μg/L). Besides, although conspicuous dominance of odd number carbon and even number carbon occurs in n-alkanes the following situation was found in both lakes: relatively high peak values occurred in even number carbons C_{20}–C_{24}. As is known to all, in the combustion products of coal and petroleum, the contents of odd number carbon alkanes and even number carbon alkanes exhibit no difference, whereas in the compounds liberated from plants, there is marked difference, the ratio of contents being generally over 5 (Zhao *et al*. 1985). N-alkanes formed from insects and terrestrial plants are rich in odd number carbons such as C_{27}, C_{29} and C_{31}, whereas aquatic (marine) organisms give rise to alkanes of low molecule weights, such as C_{13}, C_{15}, C_{17} and C_{19}(Gillan *et al*. 1981). The odd: even carbon ratio in the alkanes of Mochou Lake and Heart Lake is 1. 21 and 1. 41, respectively.

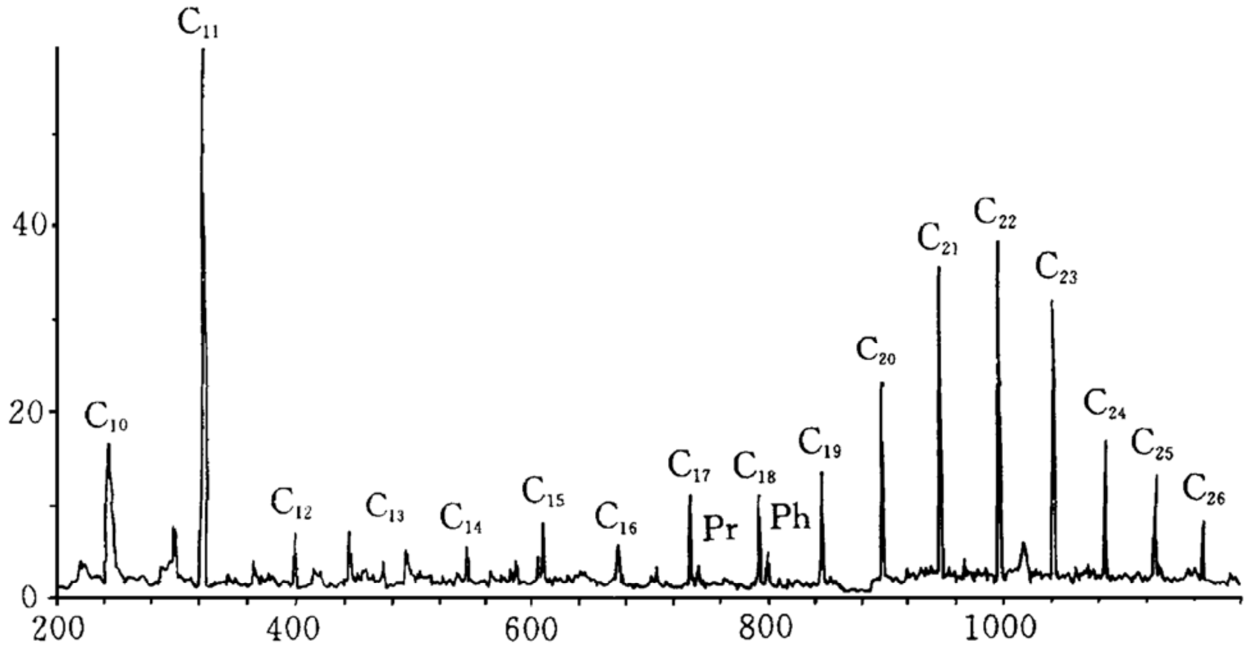

Fig. 4. The m/z 85 mass chromatogram of organic matter in Heart Lake water ,Antarctica.

Pristane (2,6,10,14-tetramethyl pentadecane) and Phytane (2,6,10,14-tetramethyl hexadecane) are the derivatives of Phytol (originated from chlorophyll) formed under different Ph conditions; Pr is formed in comparatively aerobic environment, while Ph is formed in reducing environment through hydrogenation and dehydration. Therefore, their relative contents can be taken as an index of the aquatic environment, especially in the sedimentary deposit. The Pr/Ph ratio in Mochou Lake and Heart Lake is 1.25 and 1.33, respectively, or larger than unity, indicating a fairly high degree of oxidation in the aquatic environment.

3.2 Carboxylic acids

Table 1 shows that the distribution of carbon number *s* in the ortho saturated monocarboxylic acids covers C_{12}, C_{14} and C_{16} in Mochou Lake, with peak at C_{12}(lauric acid, concentration in lake water being 0.634 μg/L, constituting 3.84% of the total content of organic compounds. Corresponding methyl esters of carboxylic acids are C_{14}, C_{16}(Heart Lake) and C_{16}, C_{18}(Mochou Lake), in both lakes the main peaks appear at C_{16}(methyl ester of palmitic acid), its content in water being 0.073 μg/L and 0.163 μg/L, respectively, with a difference of more than double.

MS characteristics of saturated monocarboxylic acids: base peak m/z 73, fragment ions in both lakes 60 and 129. Molecular ion peaks of nC_{12}, nC_{14} and nC_{16} occur at 200, 228 and 256, respectively. The base peak of the methyl exter of carboxylic acid m/z is 74, fragment ions increasing to 87 and 143, molecular ion peaks of C_{14}, C_{16} and C_{18} occurring at 242, 270 and 298, respectively.

Carboxylic acids are the products from algae, but the acids synthesized are not the same. For instance, diatoms synthesize $C_{14}:0$, $C_{16}:0$ and $C_{16}:1\Delta9$. whereas C_{18}

acids come from green algae (Gillan *et al.* 1981; Thompsom *et al.* 1990). Besides, carbon chains longer than C_{24}, being saturated carboxylic acids, are constituents of cork and cutin derived from vascular higher plants and are poorly utilizable to microorganisms, accordingly one can estimate the amount of such plants incorporating into the sediment on the basis of the abundance of C_{28} acids (Perry *et al.* 1979; Tang *et al.* 1985). From this we can infer that the dominant algal species in the lakes of Larsemann Hills would possibly have been diatoms and green algae, and the low carbon chain carboxylic acids could be an indicator of the aboriginal lakes.

3.3 *Phthalic esters*

Among the identified organic matter in Mochou Lake and Heart Lake, in addition to compounds like benzoic acid methyl ester and tributyl phosphoric acid, phthalic esters are also an important group. From Tables 1 and 2, one can see that out of the 7 phthalic esters commonly encountered in environment, 3 have been found in both lakes, with identical chemical structures. They are 1,2-Benzenxdicarboxylic acid bis(2-methylethtyl) ester (DMPP), 1,2-Benzenedicarboxylic acid dibutyl ester (DBP) and 1,2-Benzenedicarboxylic acid bis(2-ethylhexyl) ester (DEHP); their concentrations in water ranged 0.071–0.597 μg/L, the concentration of DBP being the highest in both lakes —0.597 μg/L in Mochou Lake and 0.501 μg/L in Heart Lake.

MS characteristics of phthalic esters: base peak m/z 149, fragment ions m/z 167, 205, 223, 279. Compounds of this category have already become an important group of environmental organic compounds because of their mass production and extensive application. Researches of their environmental behavior and biological effects have continuously received people's attention (Ye 1993). The occurrence of compounds of this category in freshwaters of the Antarctica needs further studies.

3.4 *Aromatic hydrocarbons and ketones*

Tables 1 and 2 give the result of identification of these compounds in Mochou Lake and Heart Lake, respectively. For Mochou Lake, there are 4 kinds of monocycluc aromatic hydrocarbons, i.e., Ethylphenoxybenzene, 1,3,5-Trimethylbenzene, 1,3-Dichlorobenzene and 1,2-Diehtylbenzene. There are also 4 kinds of polycyclic aromatics, with constituents of Naphthalene, Azulene, Phenanthrene and 1,6-Dimethyl-4-(1-methlethyl)naphthalene, at the concentrations 0.067–0.315 μg/L. For Heart Lake, there are 5 kinds of aromatics, of which 3 kinds are monocyclic, 2 are polycyclic; constituents include 1,3-Dimethylbenzene, 1-Methyle thylbenzene, 1,3,5-Trimethylbenzene, Naphthalene, and 2-Methlynaphthalene; content in water 0.145–2.46 μg/L, almost ten times of the concentration in Mochou Lake water.

For ketones, there is wide difference between the two lakes; only a single kind —2,5-cyclohexadiene-1,4-dione was found in Heart Lake, with content of only 0.076 μg/L, while 8 ketones were detected in Mochou Lake: 1-(4-Ethylphenyl) ethanone, 5-Undecen-4-one, 3-Ethyl-3-nonen-2-one, 2,6-Bis (1,1-dimethyl)-2,5-cyclohexadiene-1, 4-dione, 2, 4-Dimethyl-7-(1-methylethyl) Azulenylphenyl methanone, 1, 4-Dimethyl-7-(1-methlyethyl)-2 Azulenylphenyl methanone, and camphor, with concentrations of 0.003–0.032 μg/L.

3.5 *Phenolic compounds*

Table 1 and Table 2 show that there are two types of phenolic compounds: phenol and thiophene, and like the case with ketones, their contents in the two lakes vary considerably. The only constituent found in Mochou Lake is 2,6-Bis(1,1-dimethylethyl)-phenol, with a concentration of 0.478 μg/L, whereas 4 constituents have been found in Heart Lake, i.e., 2,6-Bis(1,1-dimethylethyl)- 4-phenol, 2,6-Bis(1,1-dimethylethyl)-4-methylphenol, 2,6-Bis (1,1-dimethylethyl)-4-ethylphenol, and 2-Butyl-5-(2-methylpropyl)-thiophene, with concentrations of 0.036–0.760 μg/L.

3.6 *Global organic pollutants*

PCBs and organochlorine pesticides BHC, DDT and DDE are worldly recognized global pollutants, with very extensive scope of environmental contamination. Hammond and others have disclosed PCBs and DDT in seals (Hammond 1972) and bionts within the Arctic circle, respectively, PCBs and DDT have been found in fish bodies in Antarctica (Mao *et al*. 1986). Yao *et al*. (1992) reported the presence of DDT and BHC in sea water, sediments, and bionts in the vicinity of Great Wall Station, Antarctica. In order to understand the situation of these compound in freshwater ecosystem of the Antarctica, the present research analyzed the water samples from Mochou Lake and Heart Lake by gas chromatographic method and discovered their tracks.

Information of organochlorine compounds in lake water through GC-ECD analysis is presented in Table 3. It is shown in the Table that Mochou Lake water contains all α-BHC, γ-BHC, p.p′-DDD, p.p′-DDT and PCBs, while Heart Lake water contains α-BHC, γ-BHC and p.p′-DDT, these concentrations are not to be neglected. According to relevant literature, the amount of the gain and loss of atmospheric air over the Antarctica in two consecutive months reached 1.5×10^{8} t (Shinsuka *et al*. 1983). In the course of such large-scale atmospheric exchange, the above-mentioned stable compounds in the atmosphere of other regions would invade the upper air of Antarctica continuously through the medium of atmosphere, then fall onto the Antarctic Continent and into the surrounding marine environment through atmospheric subsidence and precipitation. Therefore, the chief path of intrusion of organic chlorine compounds into the lakes on the Antarctic Continent may be considered to be atmospheric transmission.

Table 3. Concentrations of organochlorine compounds in water of Mochou Lake and Heart Lake

Compounds /$\mu g \cdot L^{-1}$	α-BHC	γ-BHC	p.p′-DDD	p.p′-DDT	PCBs
Mochou Lake	0.034	0.058	0.062	0.048	0.356
Heart Lake	0.058	0.048	-		-

4 Conclusions

(1) In Mochou Lake, the carbon number of n-alkanes in water is C_{14}–C_{26} distributionally, with main peak at C_{22}(0.284 μg/L), while in Heart Lake, it is C_{10}–C_{26}, with main peak at C_{11}(0.473 μg/L). The concentrations of n-alkanes in water range from 0.024 μg/L to 0.473 μg/L. Main constituents of lipidal isopentadienes are Pristane (Pr) and Phytane (Ph); the ratio Pr/Ph is 1.25 in Mochou lake and 1.33 in Heart Lake, indicating a relatively high degree of oxygenation in both lakes.

(2) The carbon number in monocarboxylic acids is C_{12}, C_{14}, C_{16} distributionally in Mochou Lake, with a main peak at C_{12}:0 (0.634 μg/L), whereas in methyl esters of carboxylic acids it is C_{14}, C_{16}, C_{18} with main peak at C_{16}(the same in Heart Lake), and their contents being 0.163 mg/L and 0.073 μg/L, respectively; all the detected constituents are even-number carbon carboxylic acids, indicating that they were derived from hydrobionts, hence such constituents may serve as an index of the freshwaters in the local district.

(3) Water in Mochou Lake and Heart Lake contains aromatic constituents of various type and to various extent, with concentrations ranging between 0.145 μg/L and 2.46 μg/L. The difference in the content of aromatics is substantial, especially the content of 1,3-Dimethylbenzene in water of Heart Lake (2.46 μg/L), constituting 16.97% of the total content of organic matter.

(4) The result of analysis indicates the wide difference in the distribution of organic constituents in water of Mochou Lake and Heart Lake, particularly with reference to carboxylic acids, ketones and phenols.

(5) Phthalic esters in Mochou Lake and Heart Lake are not only identical in constituents but also similar in content. Benzoic acid methyl ester forms the main peak of organic matter in both lakes; its content accounts for 19.86% and 33.04% of the total organic compounds respectively.

(6) The content of organochlorine compounds in water of both lakes is very low indeed; the degree of contamination is very slight in comparison with lakes of other continents; nevertheless it souled attract the attention of international society, and prudent attitude souled be taken particularly in view of the extension and application of various organic chemicals which are industrially synthesized in huge quantity.

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