

HCH AND DDT COMPOUNDS IN THE SEDIMENTS FROM THE ZUB LAKE OF SCHIRMACHER OASIS, ANTARCTICA

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Abstract

Residues of various organochlorine pesticides such as HCH and DDT compounds (pp' -DDT, op' -DDT, pp'-DDE, op' -DDE, op' -DDD) were determined in the sediments from all over the Zub Lake in Schirmacher Oasis, Antarctica, during Dec. 86-Feb. 87. HCH was found to be more or less consistent all over the lake whereas DDT compounds showed a wide variation at different positions of the lake. Among DDT metabolites, pp' -DDT was present relatively in higher concentration than the others. Monthly variation of the pesticide residues in the lake sediments showed a significant variation in total DDT concentration with a sharp increase at two points whereas no significant variation was observed in total HCH concentrations. These variations in total DDT and total HCH concentration might be attributed to the transport of these materials to the lake through the flow of glacial melt water nearby as well as through the atmospheric path.

INTRODUCTION

Most of the studies (Sladen, *et al.*, 1966 ; Risebrough, *et al.*, 1968 ; Peterle, 1969 ; Tanabe *et al.*, 1982 ; 1983) on Antarctic pollution by PCBs and DDT compounds dealt with wild life, snow, lake water, seawater and to some extent atmosphere. These findings indicated the dispersion of these pollutants in Antarctica. However, no data of these pollutants were available in Antarctic lake sediments.

Antarctic continental margins are remarkably known for the diverse group of lakes, ponds and even rivers and streams. These water bodies may chemically range from distilled water of crystal clarity to salt laden brines. Zub lake is one of the largest lakes in Schirmacher Oasis. From geographical point of view, this has drawn our special attention for its location in the oasis. It is surrounded by hills and covered with snow. Obviously, most of the pollutants in the Antarctic lakes are expected to be transported by the atmospheric path only (Goldberg, 1976). This paper deals with the studies on some organochlorine pesticides and their metabolites in Zub lake sediments in

Schirmacher Oasis, Antarctica and was undertaken during the 6th Indian scientific expedition to Antarctica (1986-1987).

MATERIAL AND METHODS

Sediment samples were collected from eight points around the Zub lake (Fig. 1a, b). Immediately after collection, the samples were wrapped in aluminium foil and kept in deep freeze to avoid any further bio-degradation till the analysis is over. Chlorinated pesticides were extracted from the lake sediments according to the methods described earlier (Sarkar and Sen Gupta, 1987) using spectrographic grade three different solvents such as acetone, dichloromethane and n-hexane and ammonium chloride, potassium chloride and sodium chloride as the electrolytes to facilitate the maximum possible extraction. Electrolyte used here acted as the desorbing agent to the materials adsorbed on the sedimentary particles. All the three solvents were gently evaporated almost to dryness and redissolved in double distilled n-hexane and the three combined into a cleaned glass bottle for further purification. All the extracts were purified thoroughly by concentrated sulphuric acid, activated copper powder, 1% sodium bicarbonate solution and anhydrous sodium sulphate (Wheeler and Thomson, 1980; El-Dib and Badway, 1985). The purified extracts were then reduced to a minimum volume of 5 ml and analysed by gas chromatography. A Perkin Elmer (3920B) gas chromatograph equipped with a Ni-63 electron capture detector (temp. 250°C) and a glass column (1/8" i.d. and 16' length) packed with OV-17 and QF-1 on 80/100 chromosorb was used. The column, injector and interface temperature were 200°C, 225°C and 225°C respectively. Argon (95% + 5% methane) was used as a carrier gas at a flow rate of 75 ml/min. Organochlorine pesticides were identified and quantitated with reference to the EPA standard samples (Thomson and Watts, 1980). The accuracy and precision of the analysis was within 0.01 ng/g.

RESULTS AND DISCUSSION

The results of the analysis are reproduced in Table 1, which shows that the organochlorine pesticides detected so far in the Zub lake are Σ HCH ($\alpha + \beta + \gamma$), pp'-DDT, op'-DDT, pp'-DDE, op'-DDE and op'-DDD. Among these compounds, HCH was distributed more or less uniformly throughout the entire lake whereas pp'-DDT could be detected only at five points. Among the DDT compounds pp'-DDE, op'-DDE and op'-DDD were found to be uniform at all the points. The variation of the chlorinated pesticides at different positions over the lake is shown in Fig. 2a, b, which clearly shows a zigzag relationship for almost all the compounds detected. A map showing the average concentration of total HCH and DDT compounds in sediments from the Zub lake of Schirmacher Oasis, Antarctica, for the consecutive three months (Dec. 86-Feb. 87) is given in Fig. 2b. Fig. 3 represents the monthly variation of the residue levels of total DDT as well as total HCH. It clearly distinguishes the fate and persistence

of these compounds in the sediments of the Zub lake. DDT was estimated to be in much higher concentration than HCH. A sharp increase in DDT concentration was observed at G and H points from Dec. 86 to Feb. 87, whereas a sharp decrease in concentration was observed at the points B and A. Moreover, a zigzag variation in concentration of total DDT was observed at the points E and F. But total HCH concentration was found to be almost consistent at all the positions of the lake. Such a significant variation in DDT and HCH concentration might be attributed to the transport of these materials to the lake through human interference and also by the atmospheric path (Snelson, 1977 ; Goldberg, 1976, Risebrough *et. al.*, 1976 ; Norheim *et. al.*, 1982). Biodegradation of DDT to its metabolites could be attributed to the highly oxygenated environment of the Antarctic region. Besides, physico-chemical characteristics of the lake sediments are considered to be highly important towards the degradation of DDT to its metabolites. Apart from these reasons, various kinds of aquatic organisms in the Antarctic lake are expected to play quite an important role towards the bio-degradation. A detailed study on this will enable us to know the detoxication mechanisms of DDT in the Antarctic region. However, the concentration, as of now, are fairly low in the range of picograms only and there is no cause for alarm.

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HCH AND DDT IN LAKE SEDIMENTS

Table 1. Residue levels of organochlorine pesticides and their metabolites in the sediments from the Zub lake of Schirmacher Oasis, Antarctica (pg/g, wet weight).

Posi- tions	Year	Month	ΣHCH	pp'-DDT	op'-DDT	pp'-DDE	op'-DDE	op'-DDD	ΣDDT
A	1986	Dec.	123.3	N.D.	70.0	117.3	175.1	50.9	413.3
	1987	Jan.	70.6	N.D.	78.0	92.9	93.1	88.9	352.9
	1987	Feb.	67.5	N.D.	118.7	48.7	23.4	122.4	313.2
B	1986	Dec.	123.4	N.D.	350.0	124.4	119.4	104.6	698.4
	1987	Jan.	123.0	N.D.	39.2	255.9	204.7	110.0	609.8
	1987	Feb.	88.6	N.D.	45.0	91.4	157.8	137.7	413.9
C	1986	Dec.	104.9	N.D.	80.0	113.7	32.7	101.5	327.9
	1987	Jan.	99.1	N.D.	78.4	93.9	77.3	134.8	384.4
	1987	Feb.	102.1	N.D.	108.4	22.1	141.6	138.9	411.0
D	1986	Dec.	175.0	350.6	89.0	91.1	60.7	125.5	716.9
	1987	Jan.	133.7	408.5	102.2	162.3	111.3	194.1	978.4
	1987	Feb.	129.7	432.2	125.0	129.7	103.7	96.5	887.1
E	1986	Dec.	223.2	205.0	N.D.	65.0	116.0	90.0	476.6
	1987	Jan.	64.0	266.0	N.D.	60.9	31.9	88.2	447.0
	1987	Feb.	116.6	280.0	N.D.	110.5	106.1	158.6	655.2
F	1986	Dec.	128.9	335.3	61.5	48.9	147.6	101.4	694.7
	1987	Jan.	154.3	240.4	75.0	133.7	89.8	123.2	662.1
	1987	Feb.	118.2	225.6	65.0	102.5	131.1	200.7	724.9
G	1986	Dec.	110.3	300.2	24.5	69.5	122.7	117.9	634.8
	1987	Jan.	117.8	250.8	178.6	125.0	112.5	98.8	765.7
	1987	Feb.	137.4	315.2	180.0	119.0	190.5	110.7	918.4
H	1986	Dec.	95.6	186.4	N.D.	33.7	52.2	78.0	350.3
	1987	Jan.	157.8	305.5	N.D.	109.6	184.2	183.6	783.0
	1987	Feb.	167.8	462.9	N.D.	176.4	169.3	92.3	900.9

N.D. indicated, not detected.

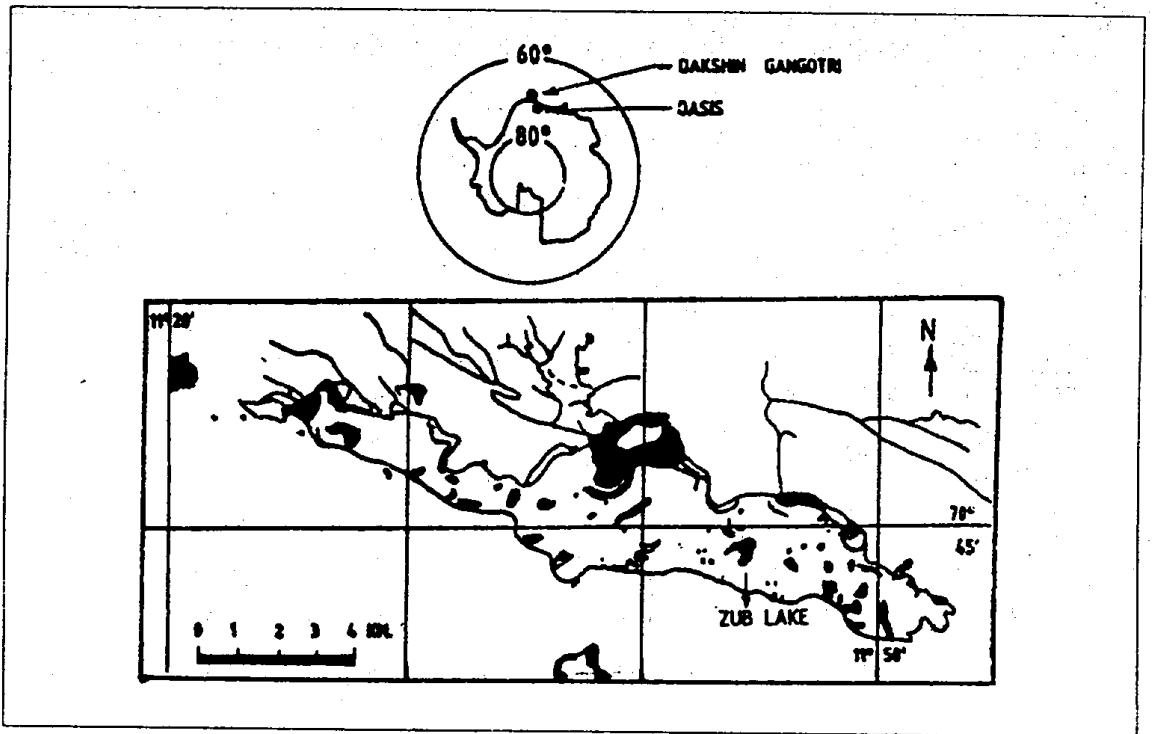


Fig. 1(a). Study area showing the schirmacher oasis, Antarctica

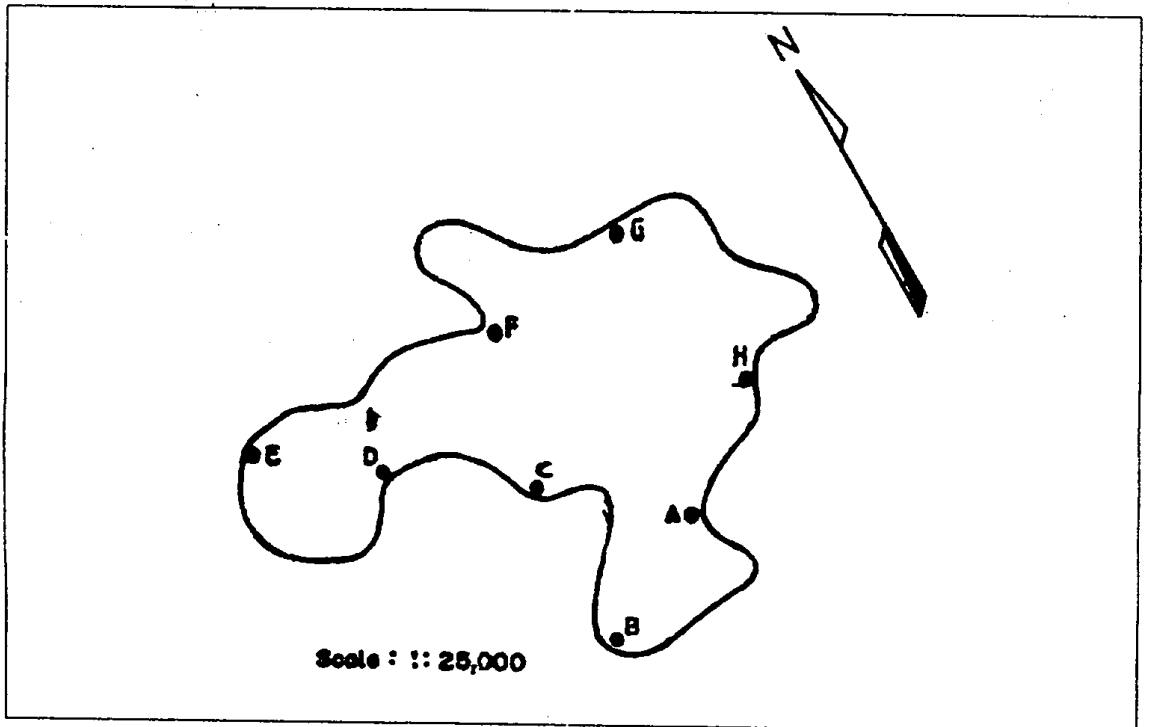


Fig. 1(b). Positions of sample collection in zub lake

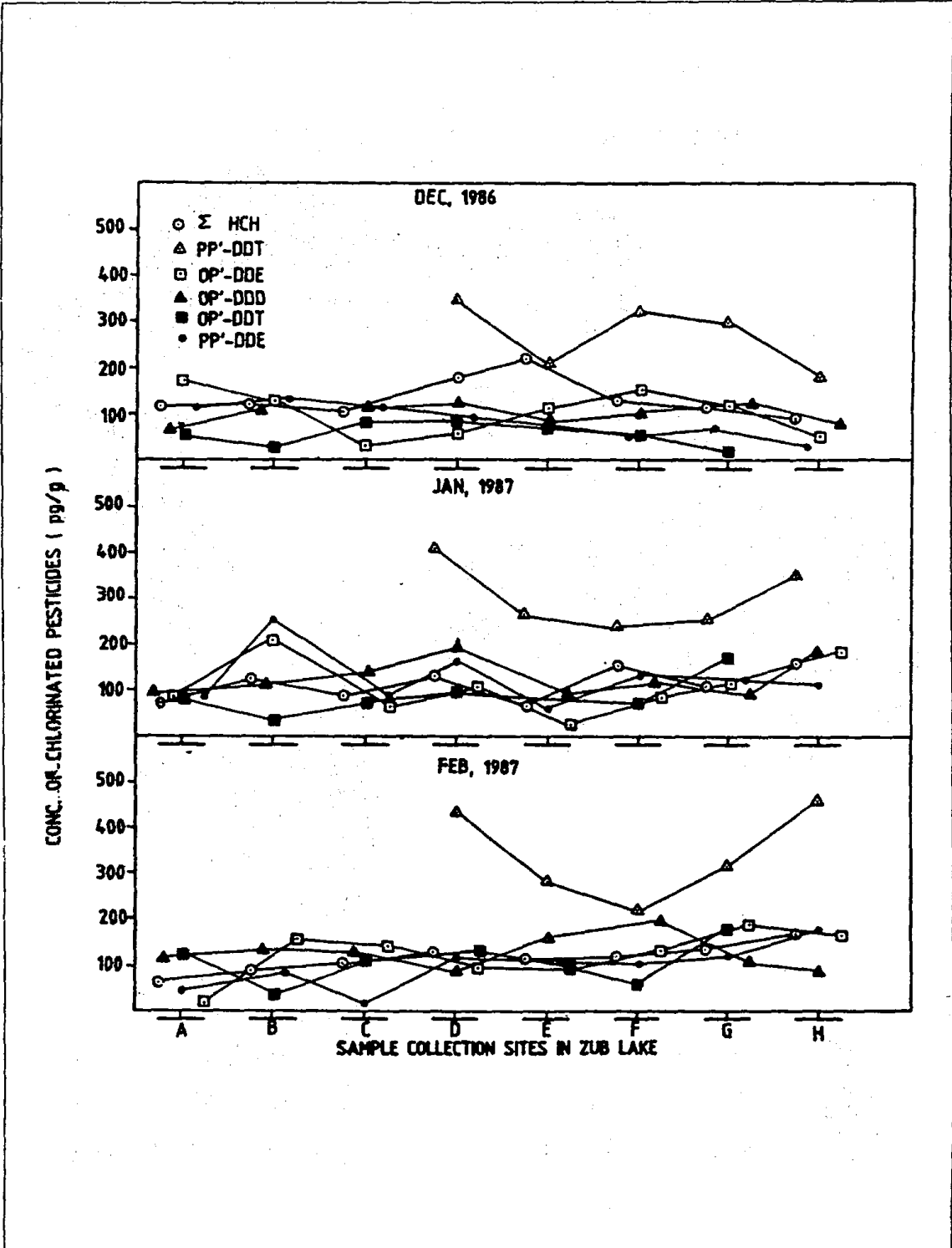
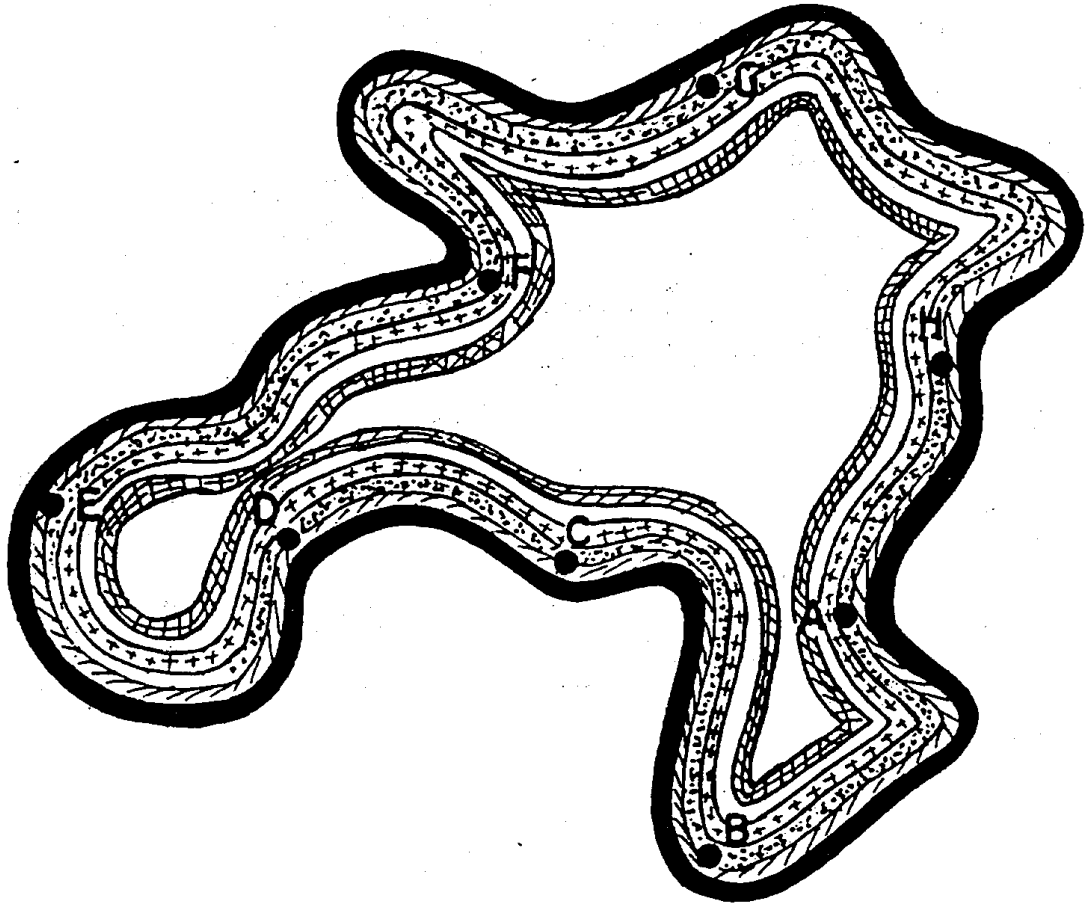


Fig. 2(a). Variation of residue levels of different chlorinated pesticides in sediments from the zub lake of schirmacher oasis, Antarctica.

Zub Lake, Schirmacher Oasis, Antarctica



A - H, indicate the sample collection sites



	pp'-DDT, 250 - 400 pg/g		pp'-DDE, 75 - 125 pg/g
	op'-DDE, 80 - 200 pg/g		op'-DDT 60 - 150 pg/g
	op'-DDD, 80 - 200 pg/g		Σ HCH 80 - 150 pg/g

Fig. 2(b). Average conc. of Σ HCH and Σ DDT compounds in Zub Lake of Schirmacher Oasis, Antarctica for three months (Dec. 86 - Feb. 87).

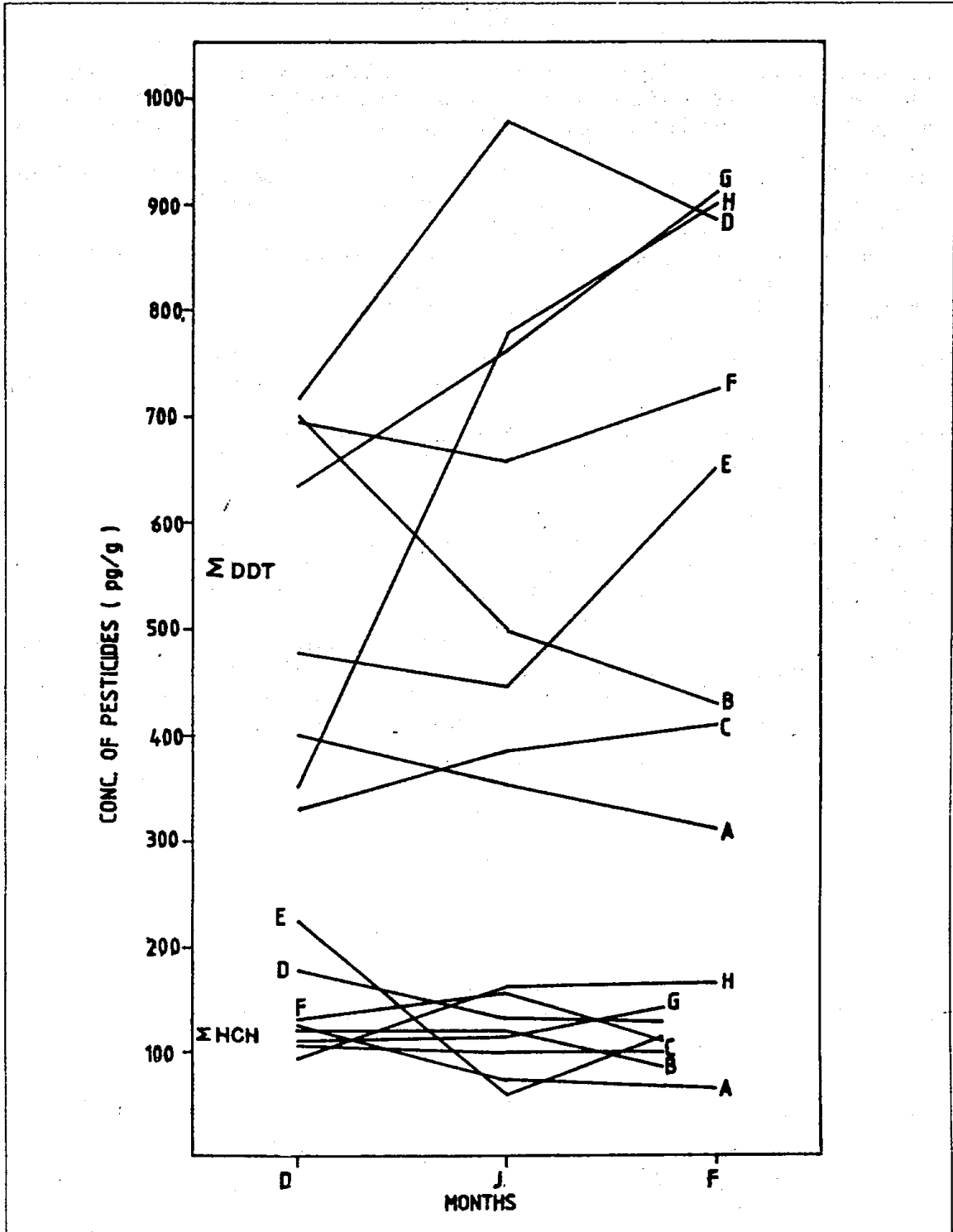


Fig. 3. Monthly variation of residue levels of Σ HCH and Σ DDT in the Sediments from the Zub Lake in Schimacher Oasis Antarctica.

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