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APPENDIXES

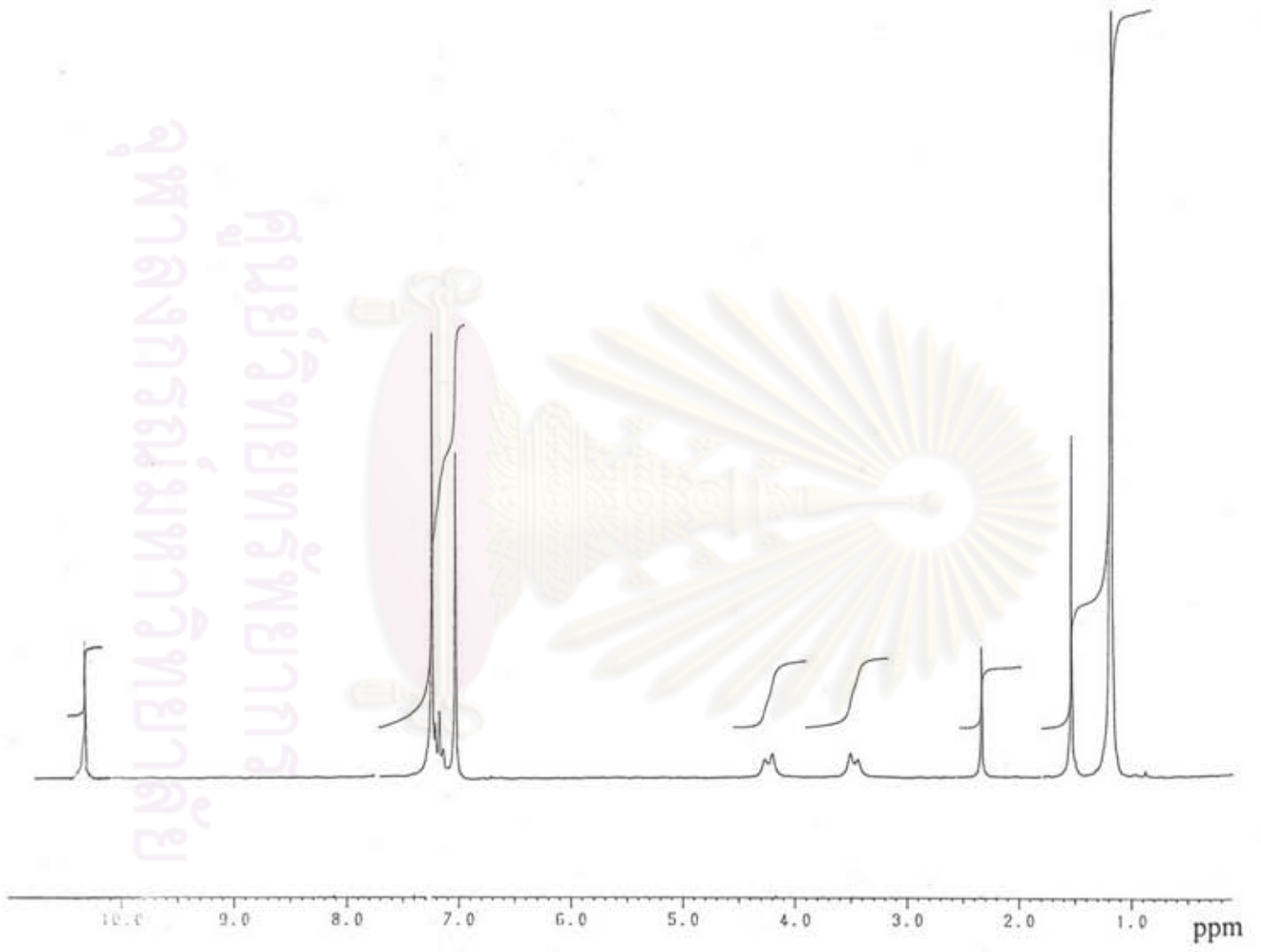


Figure A.1 ^{1}H-NMR ($CDCl_3$) spectrum of *p-tert*-butylcalix[4]arene (1)

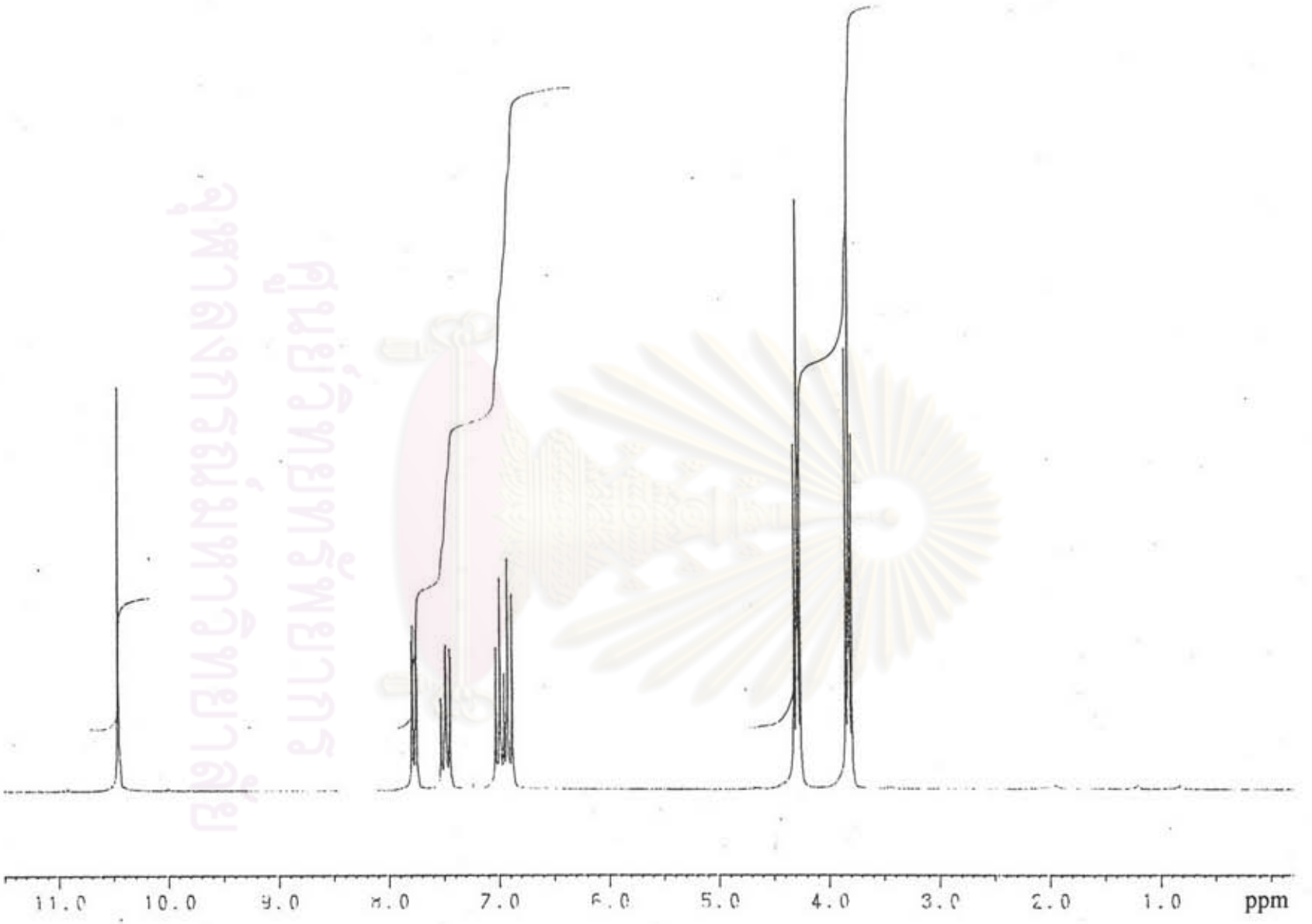


Figure A.2 ^{1}H-NMR ($CDCl_3$) spectrum of 2[(1-formyl-2-phenyl)oxy]ethylbromide (2a)

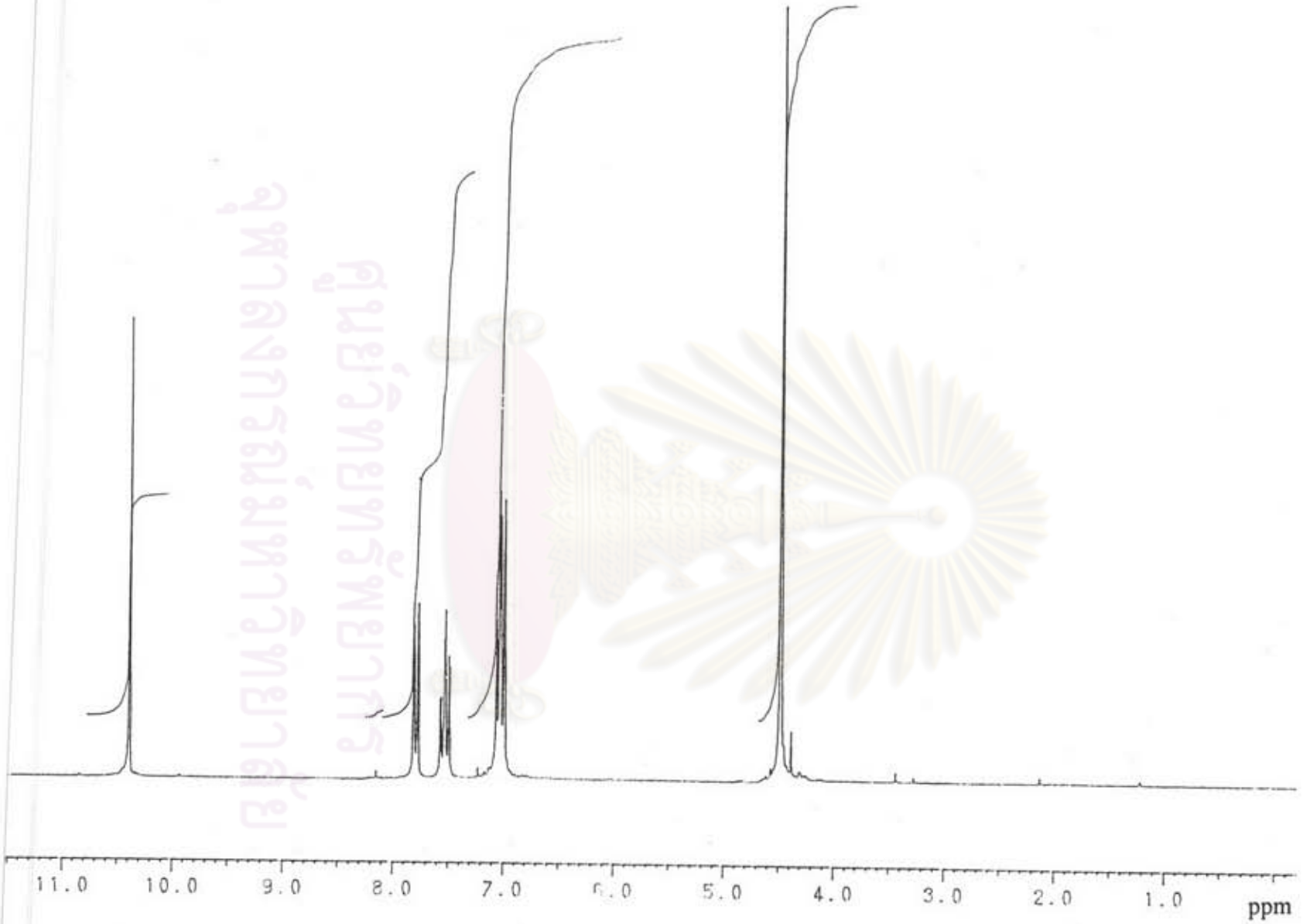


Figure A.3 ^{1}H-NMR ($CDCl_3$) spectrum of 2,2'-(1,1'- dioxyethane)*bis*benzaldehyde (2b)

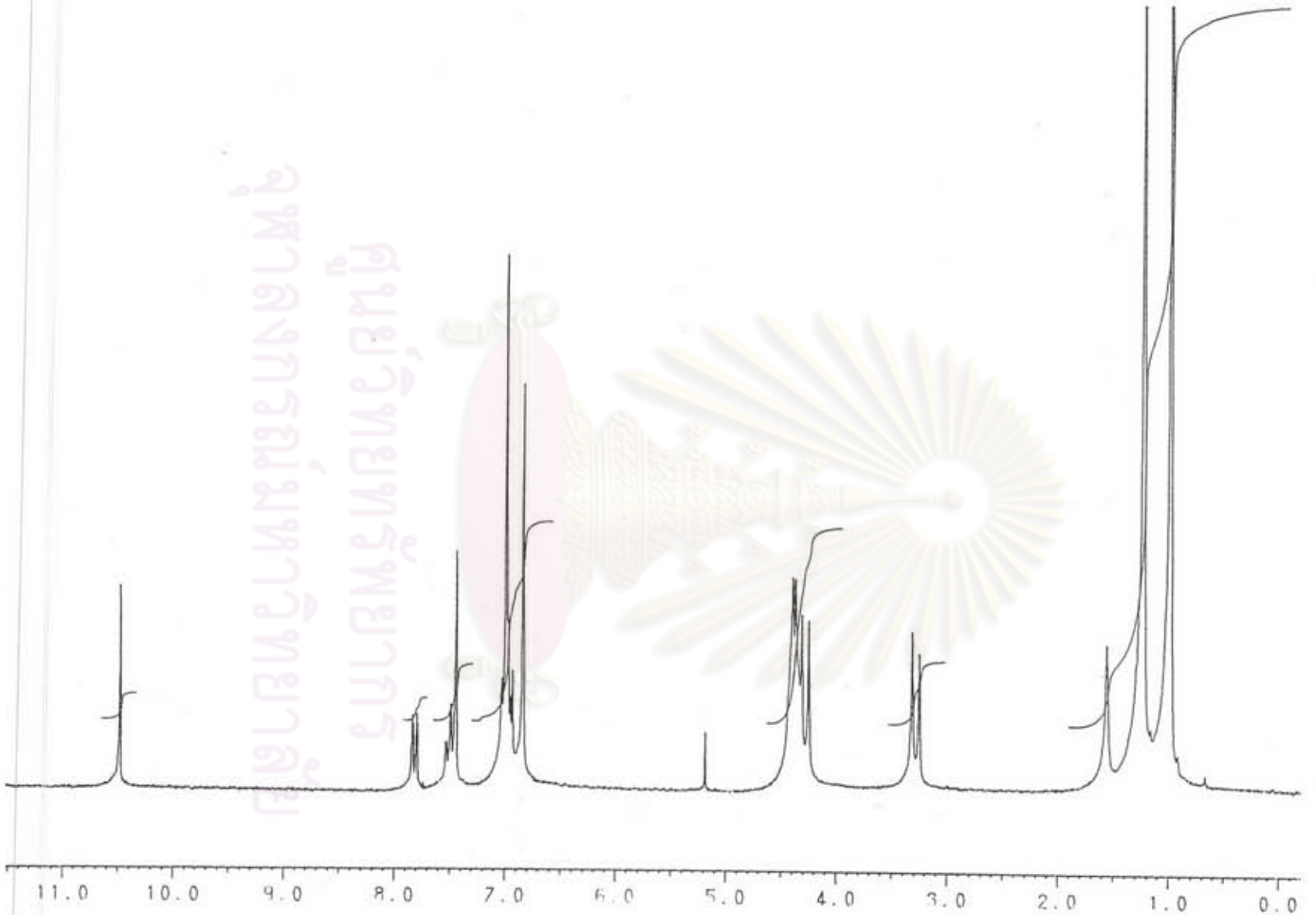


Figure A.4 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-bis[2-[1-formyl-2-phenyl)oxy]ethyl]-*p-tert*-butylcalix[4]arene (3)

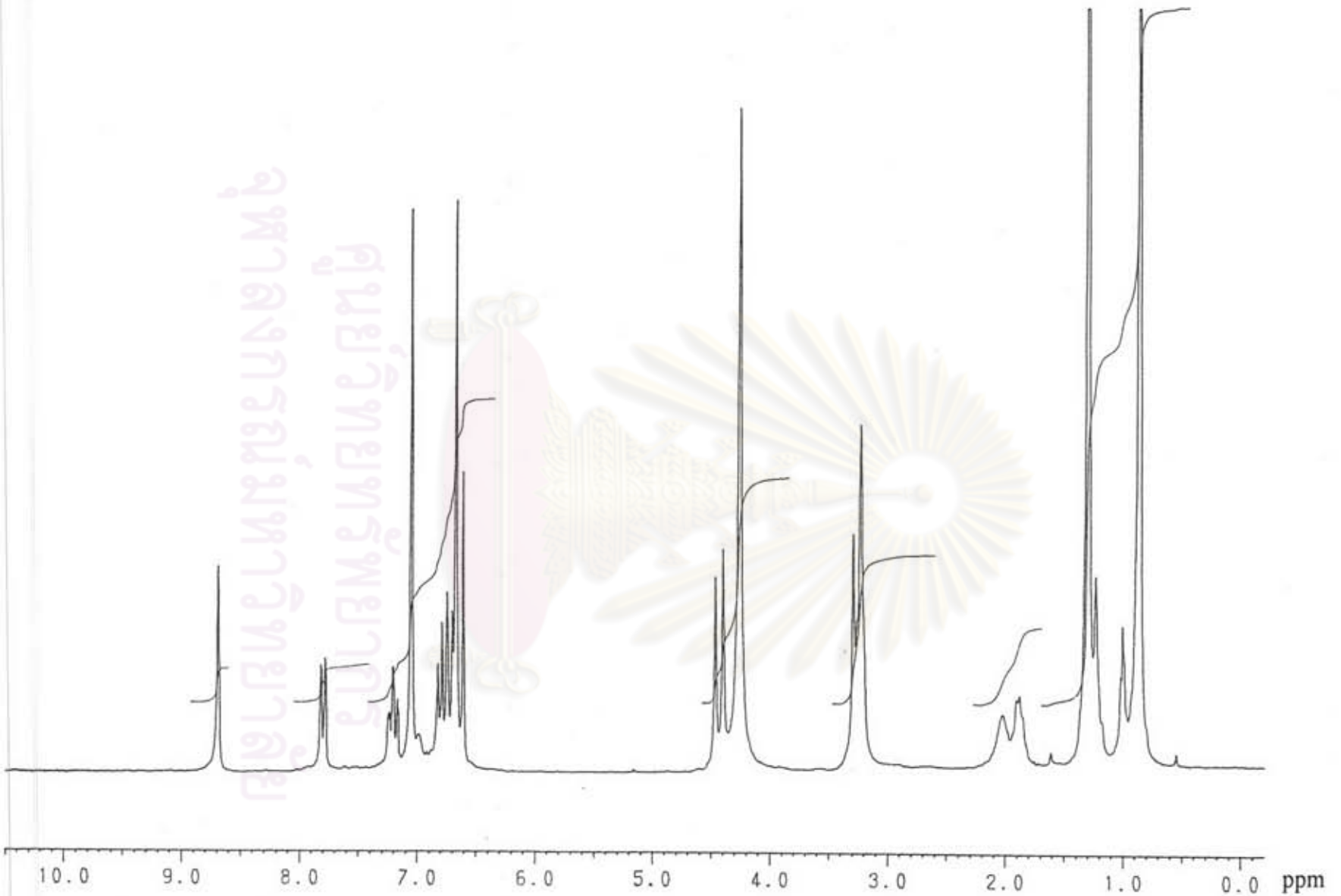


Figure A.5 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[1,1'-(1,3-propylenediimino)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene (4a)

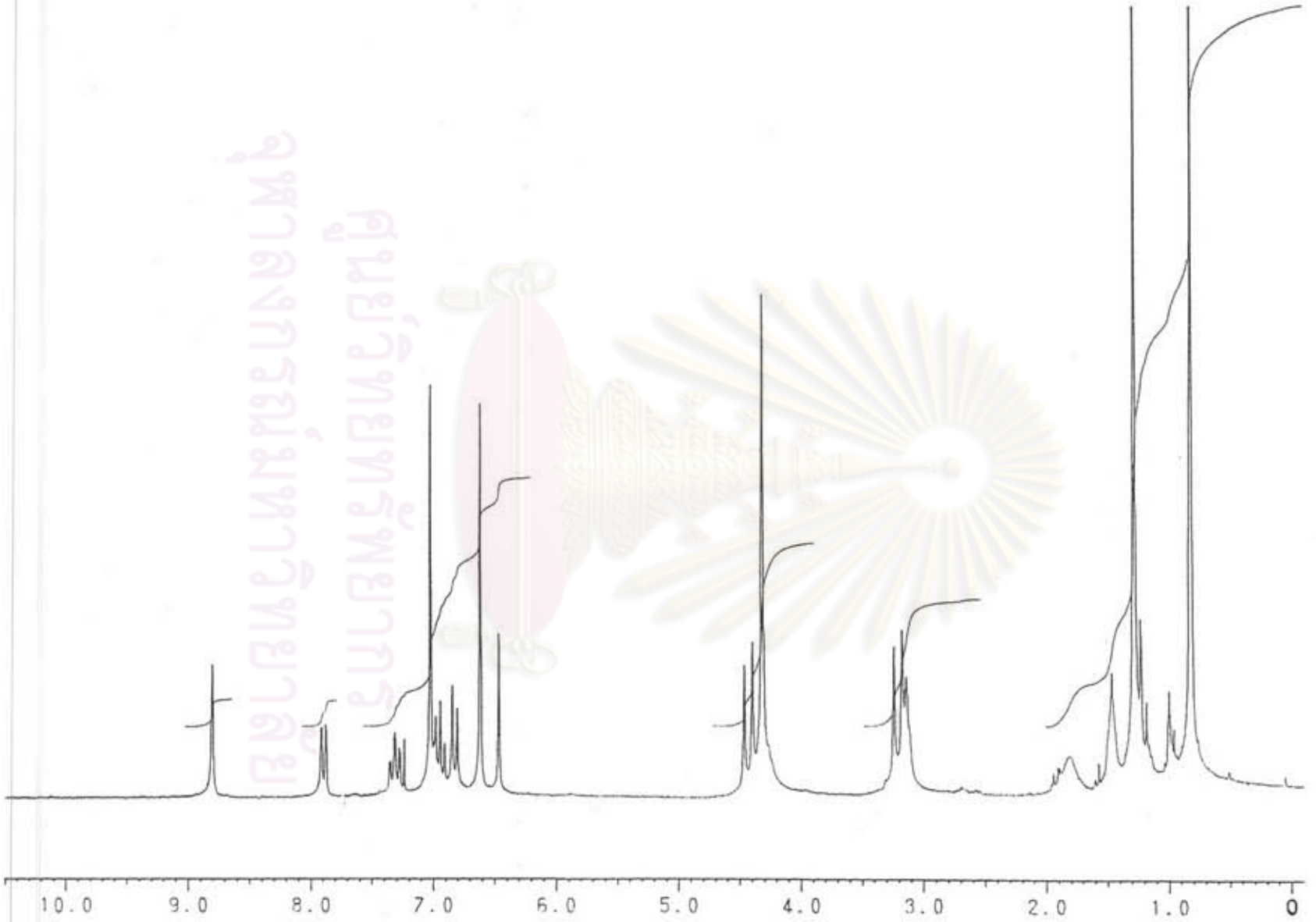


Figure A.6 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[1,1'-(1,4-butylenediimino)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene (4b)

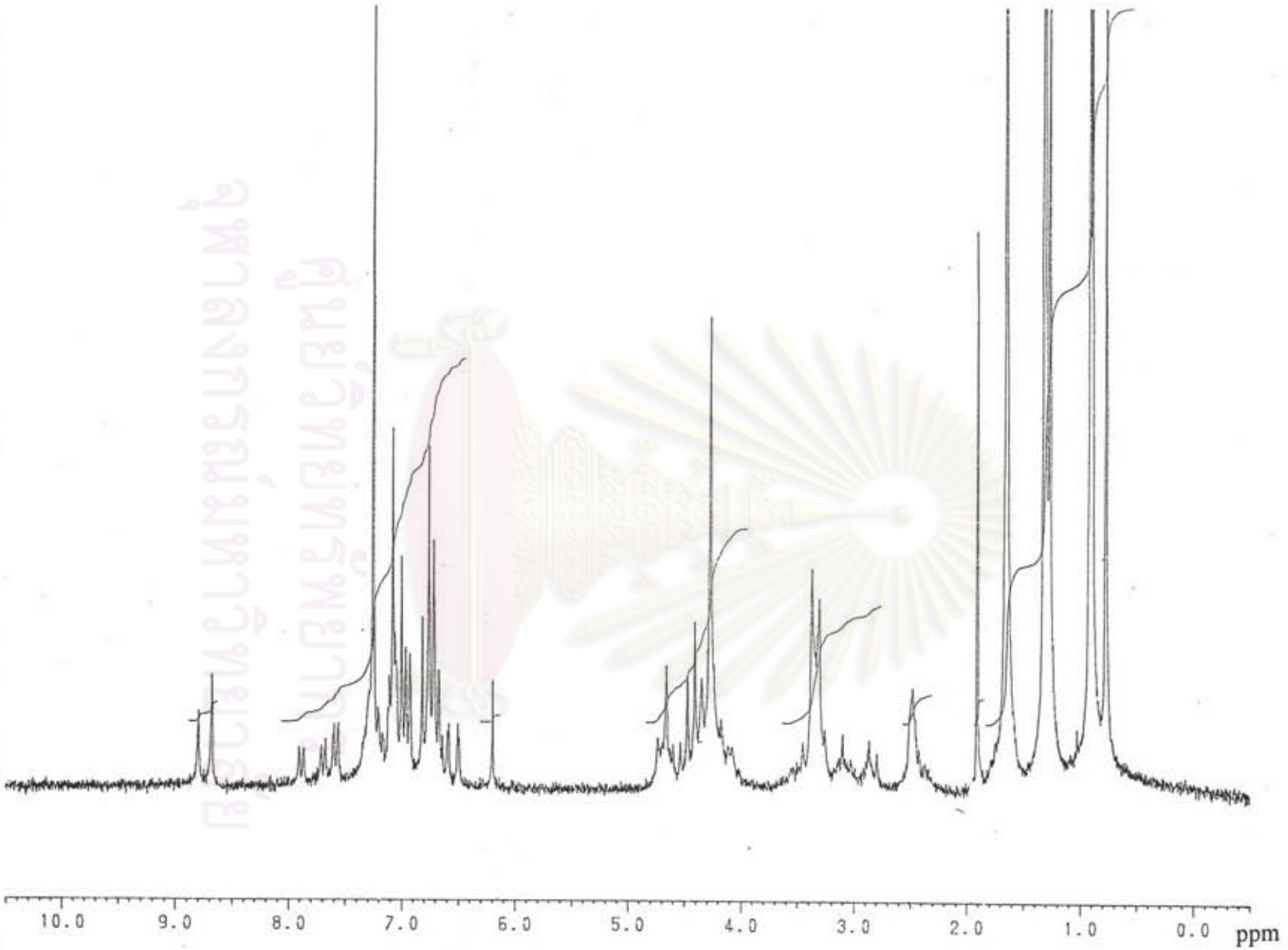


Figure A.7 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,1'-(1,5-(3-aza)pentylene)diimino)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix [4]arene (4c)

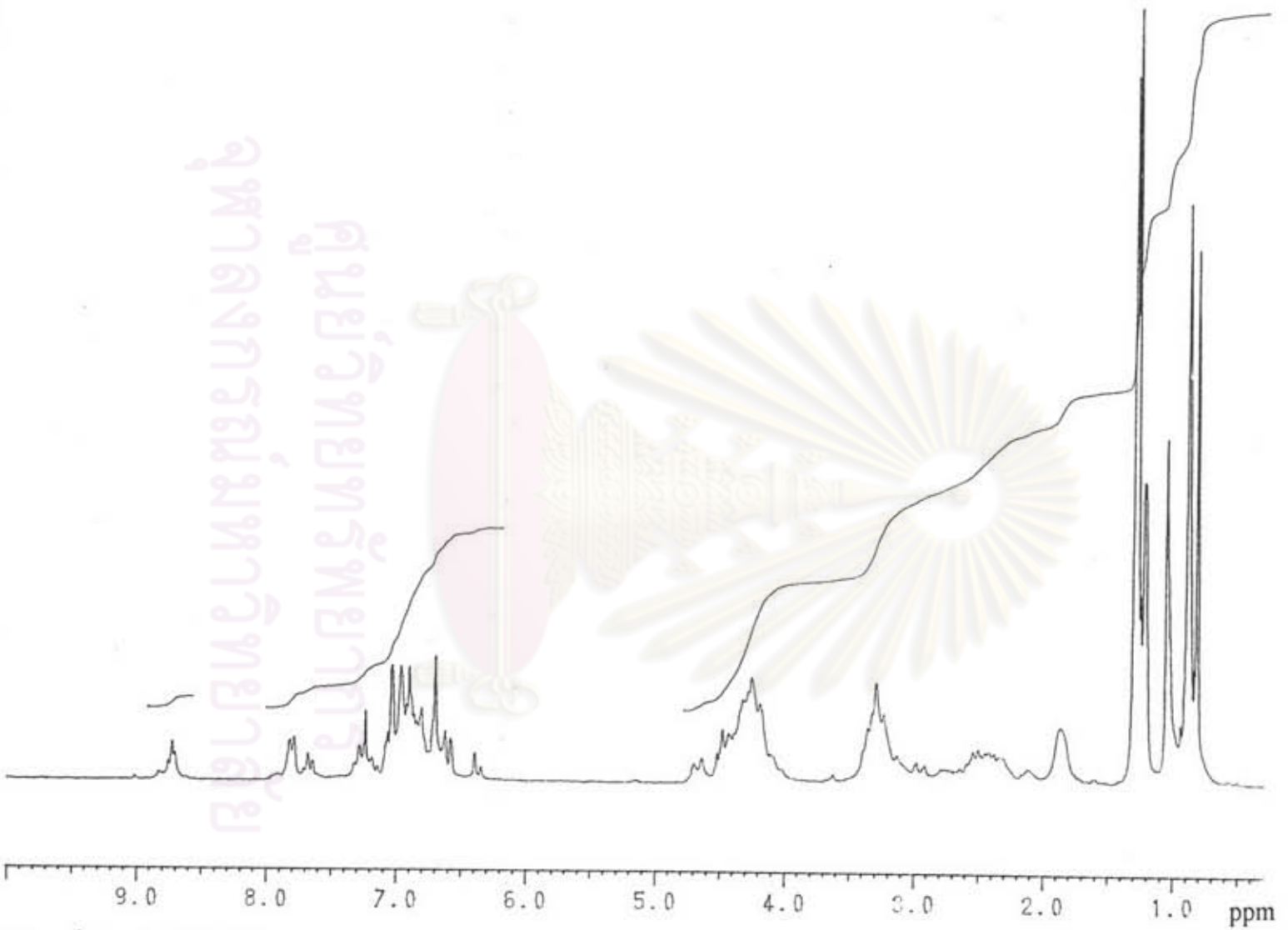


Figure A.8 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,1'-(1,8-(3,6-biaza)octylene)diimino)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene (4d)

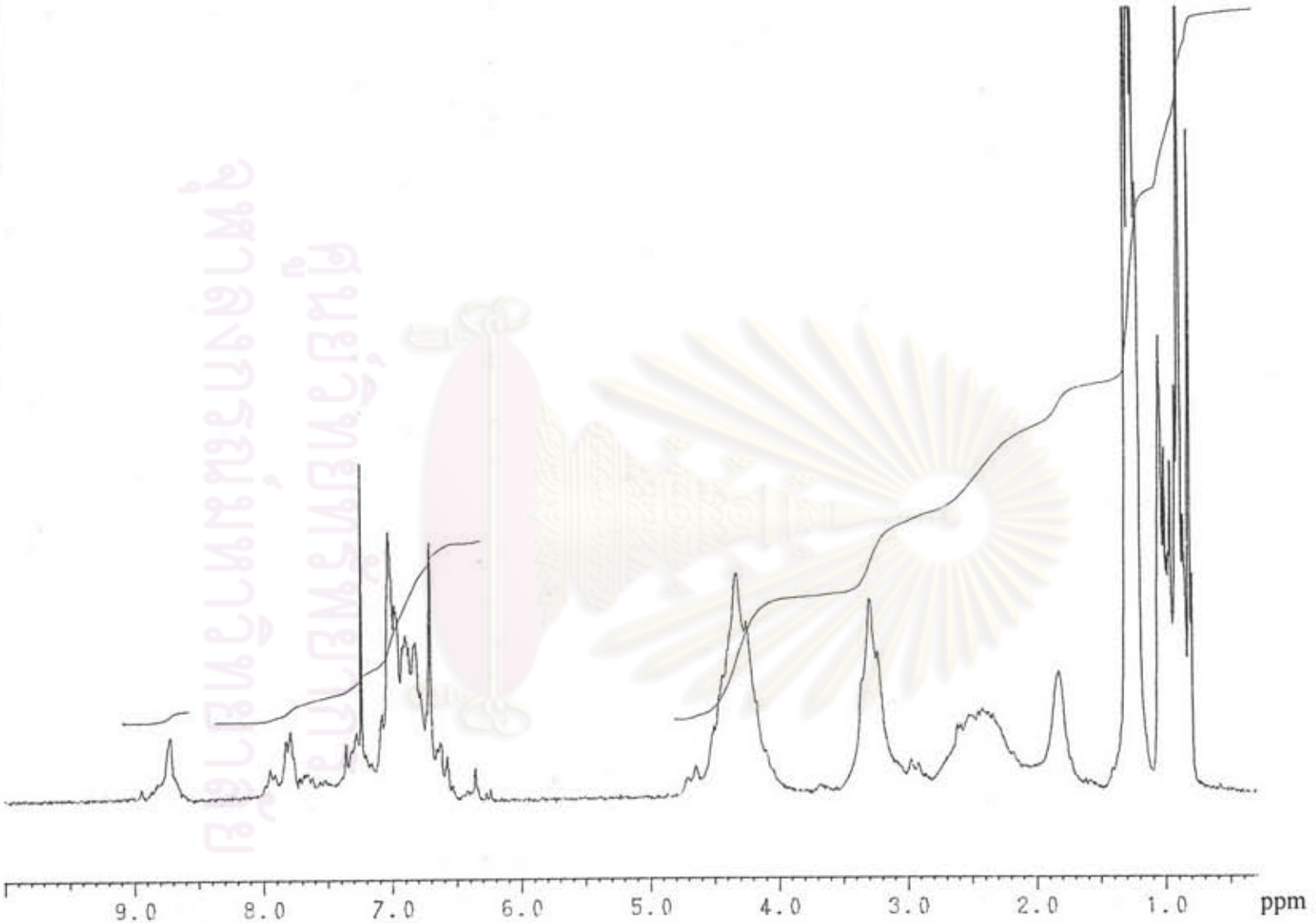


Figure A.9 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,1'-(1,11-(3,6,9-triaza)undecylene)diimino)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene (4e)

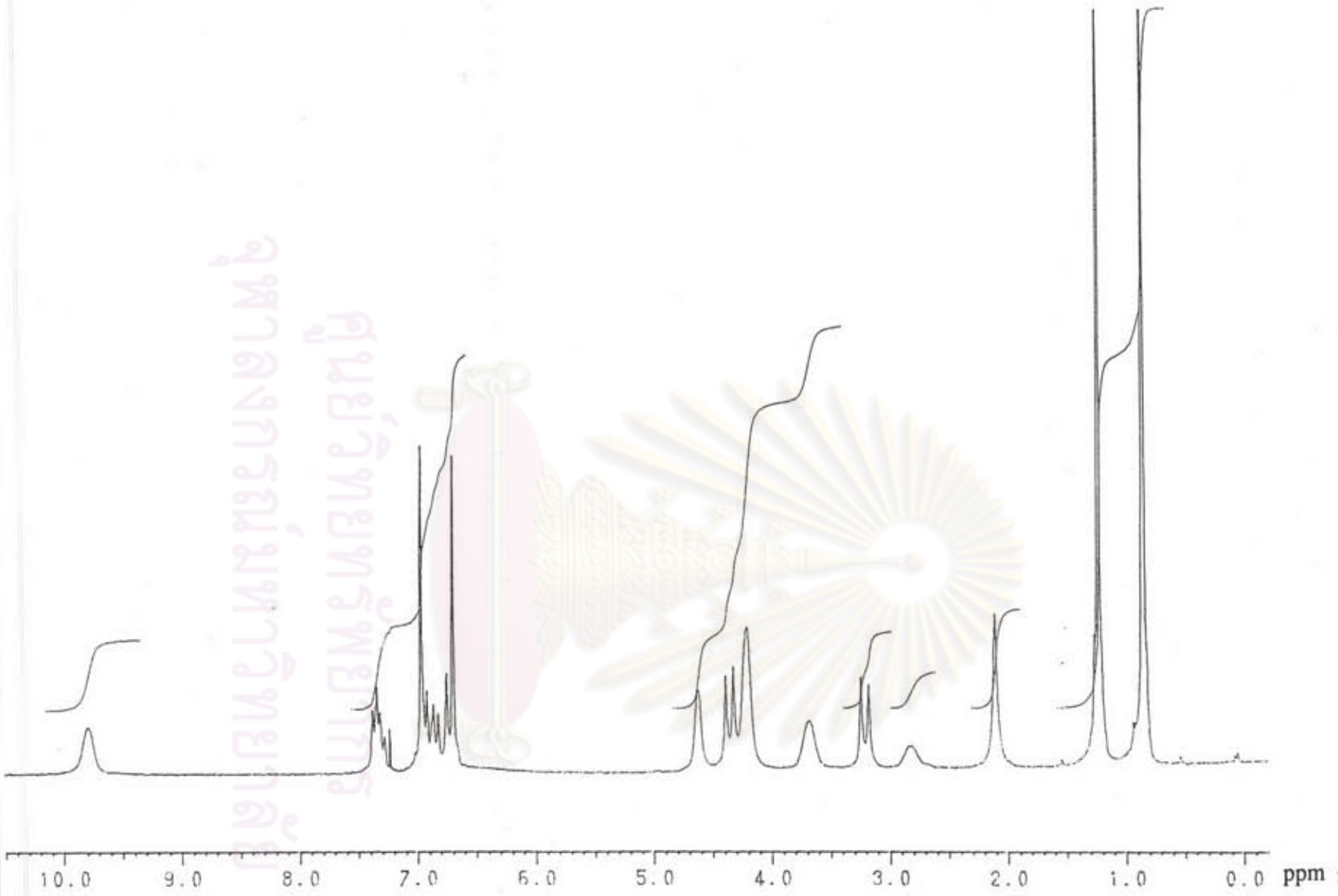


Figure A.10 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,7-(2,6-diammonium)heptylene)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene.dichloride (5a)

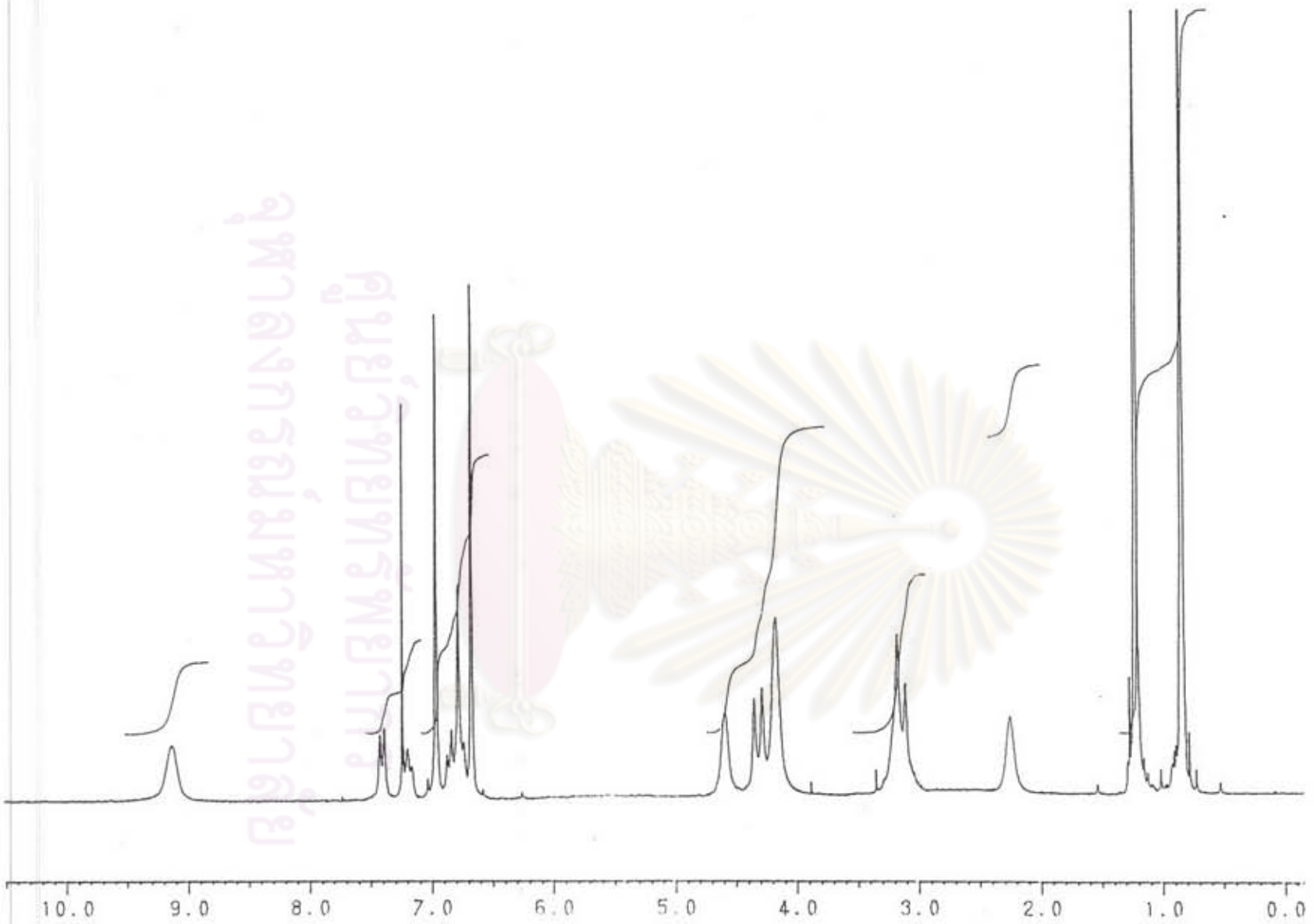


Figure A.11 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,8-(2,7-diammonium)octylene)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene.dichloride (5b)

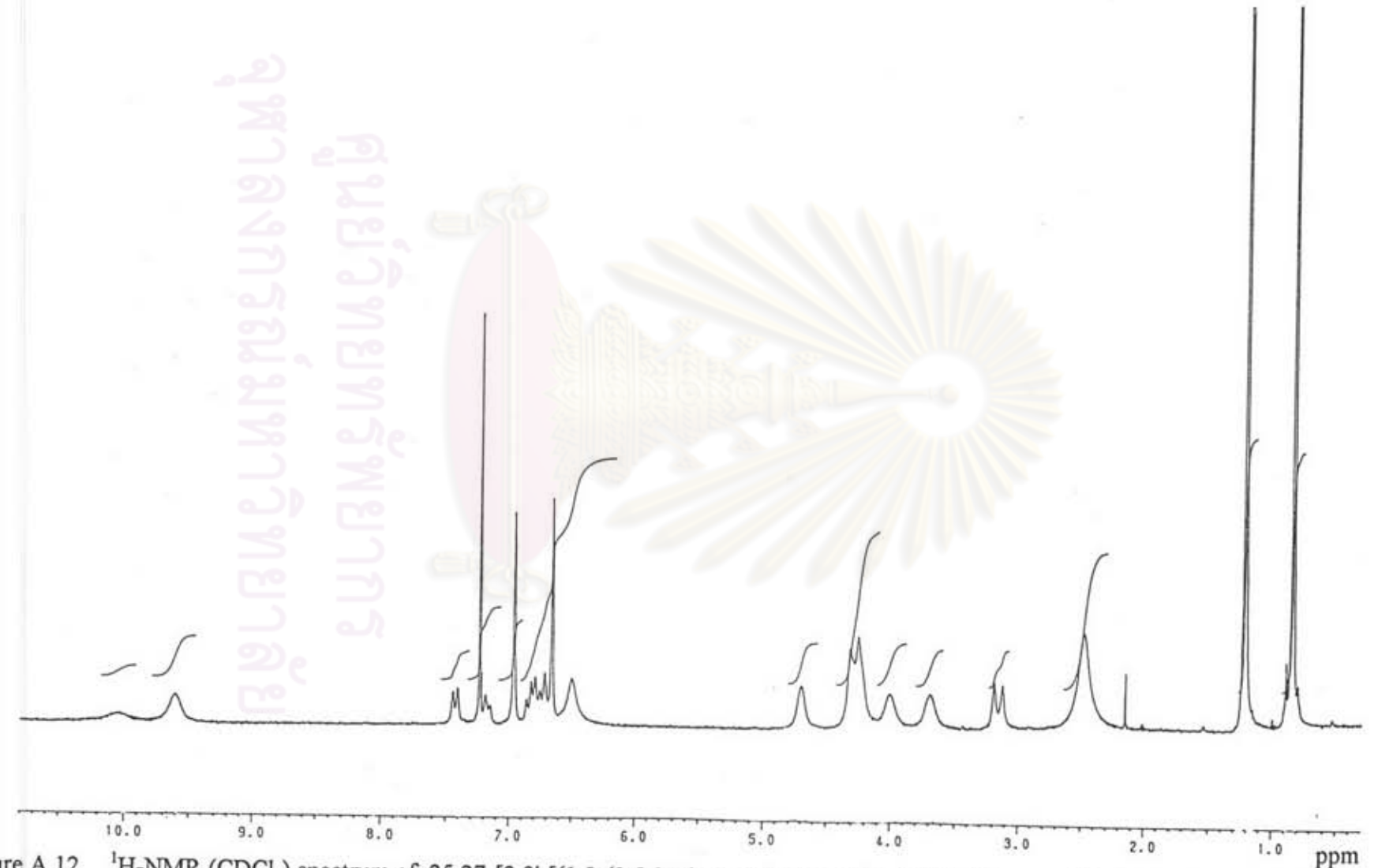


Figure A.12 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,9-(2,5,8-triammonium)nonylene)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix [4]arene.trichloride (5c)

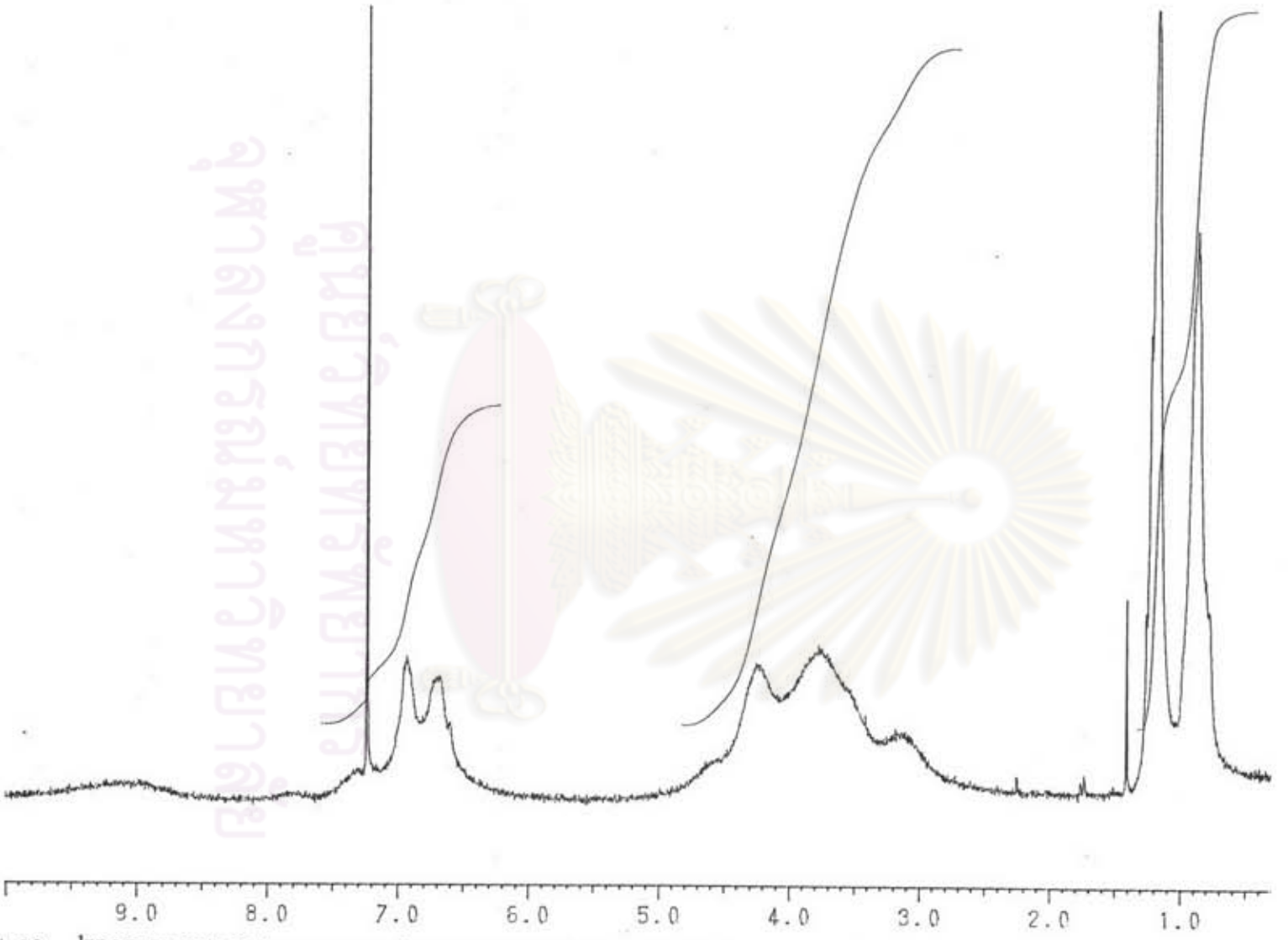


Figure A.13 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,12-(2,5,8,11-tetraammonium)dodecylene)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene.tetrachloride (5d)

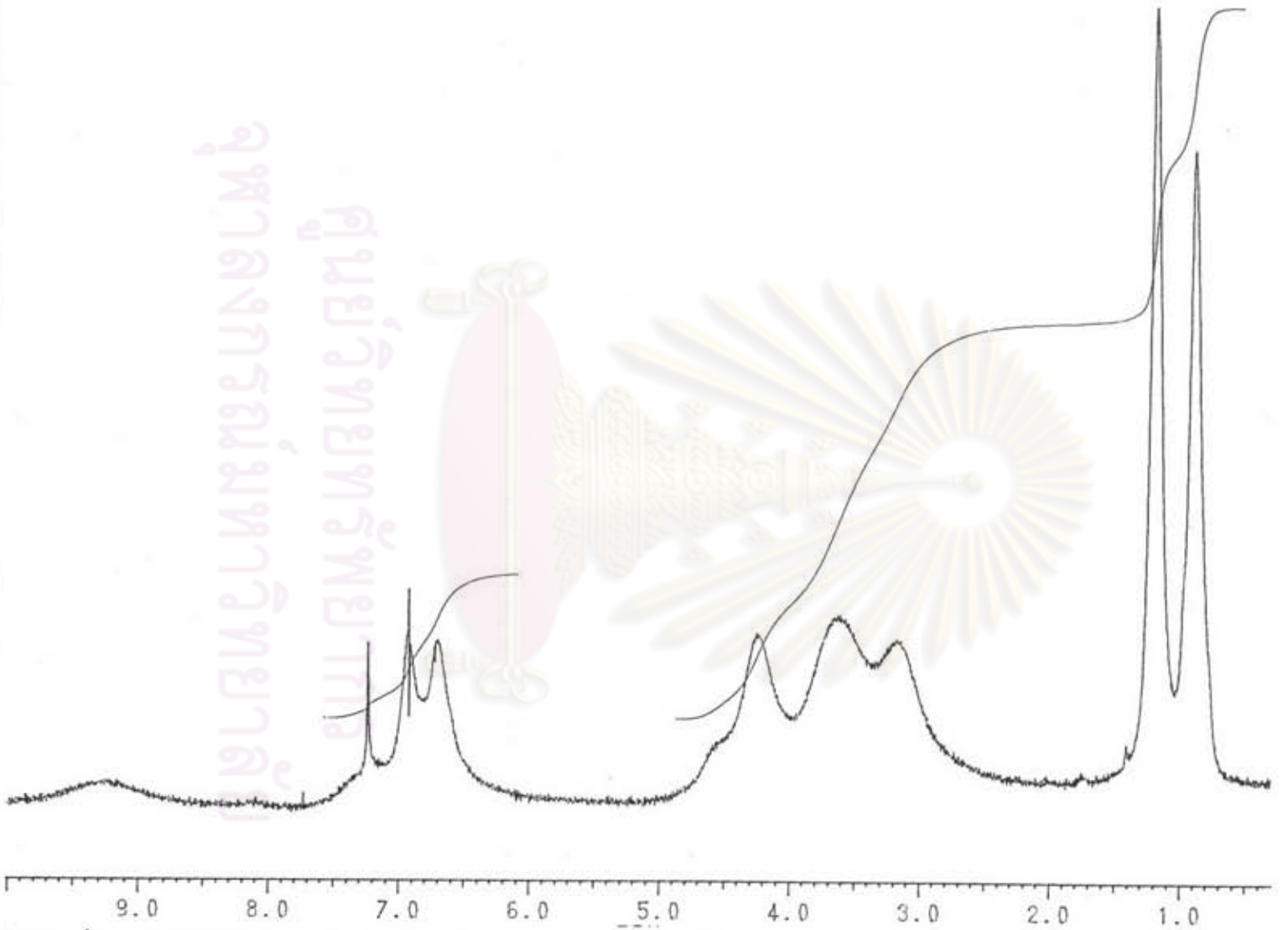
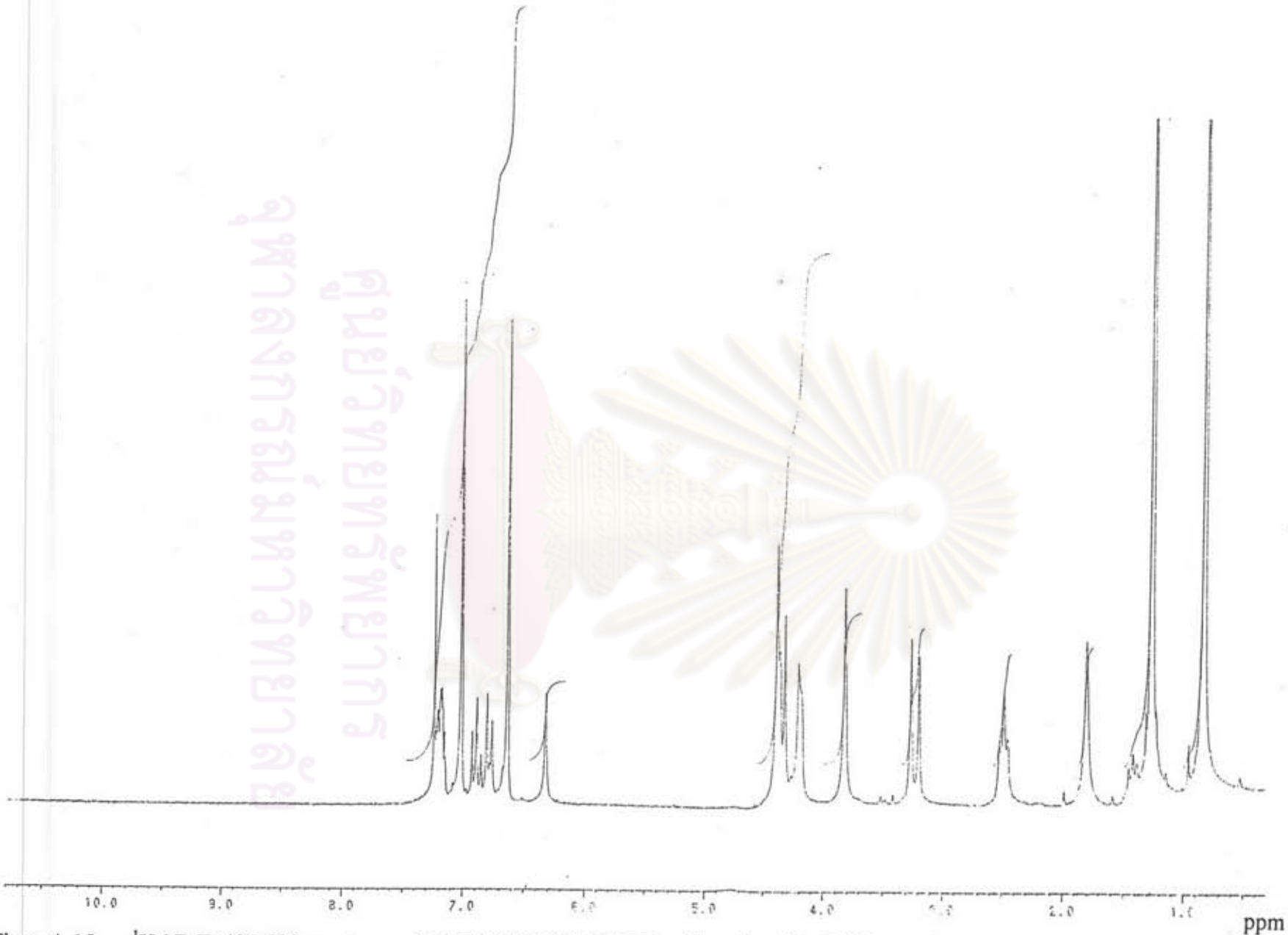


Figure A.14 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,15-(2,5,8,11,14-pentaammonium)pentadecylene)-2,2'-diphenoxy] diethyl]-*p-tert*-butylcalix[4]arene.pentachloride (5e)



Figue A.15 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,7-(2,6-diaza)heptylene)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene (6a)

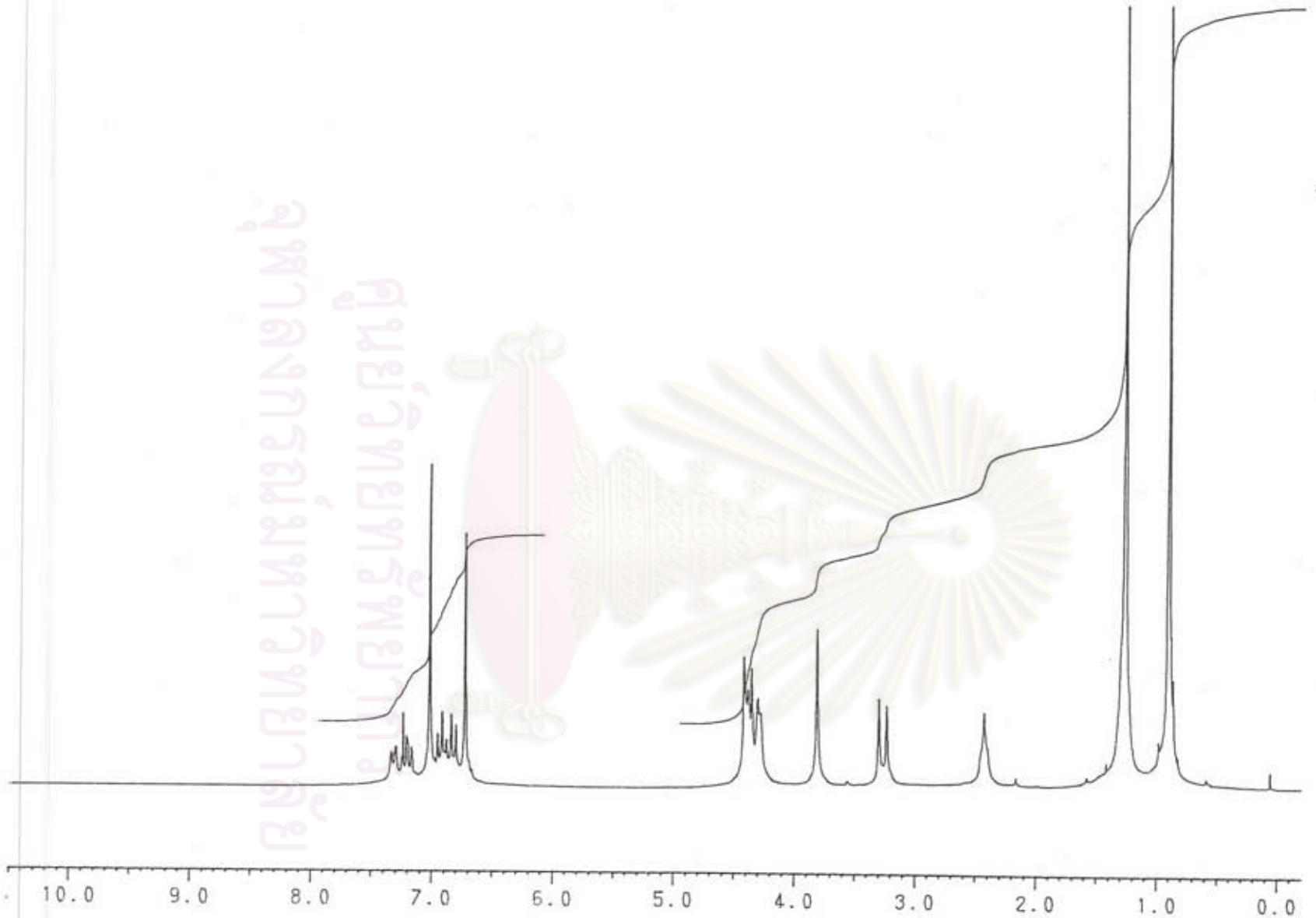


Figure A.16 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,8-(2,7-diaza)octylene)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene (6b)

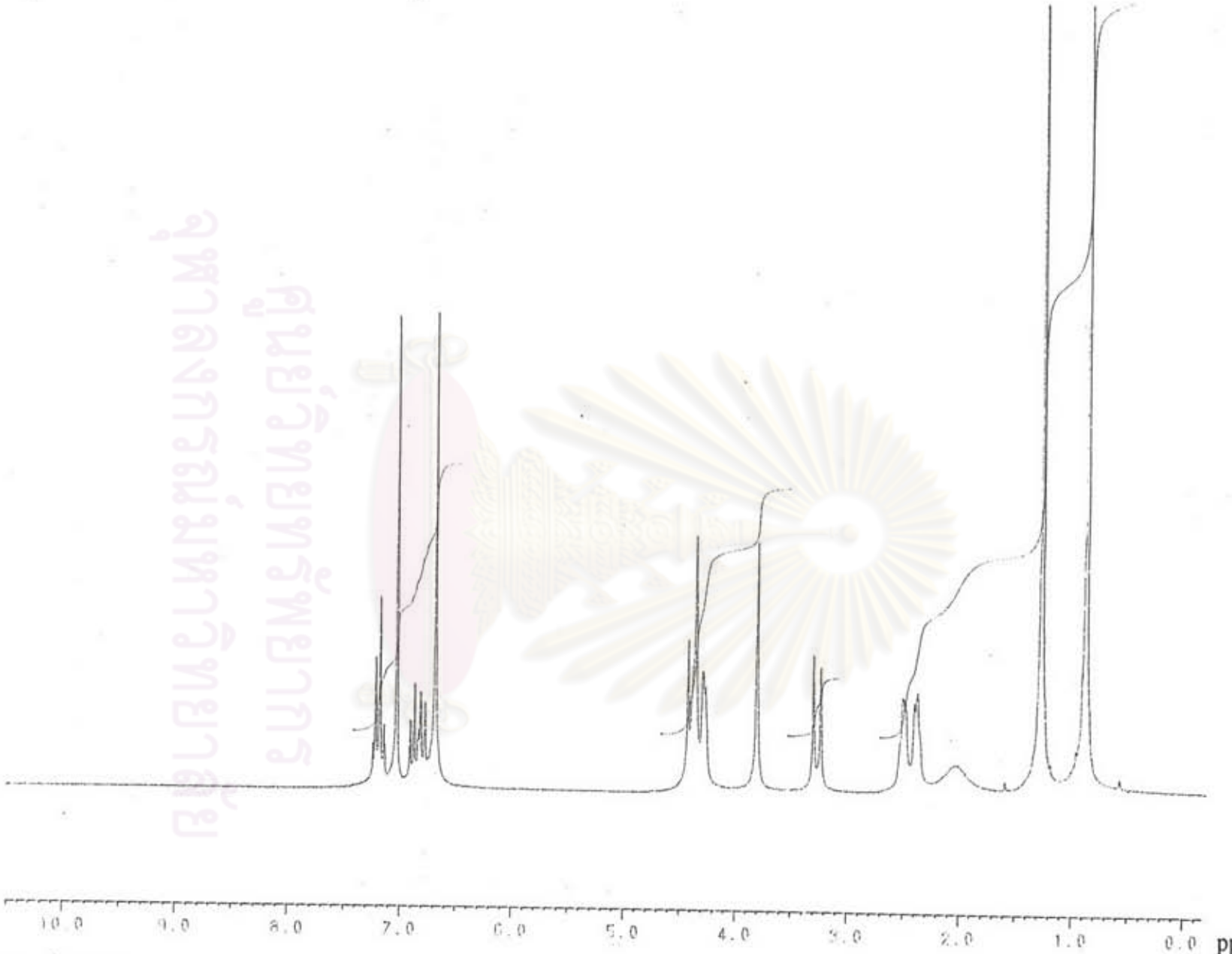


Figure A.17 ^{1}H-NMR ($CDCl_3$) spectrum of 25,27-[2,2'-[(1,9-(2,5,8-triaza)nonylene)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene (6c)

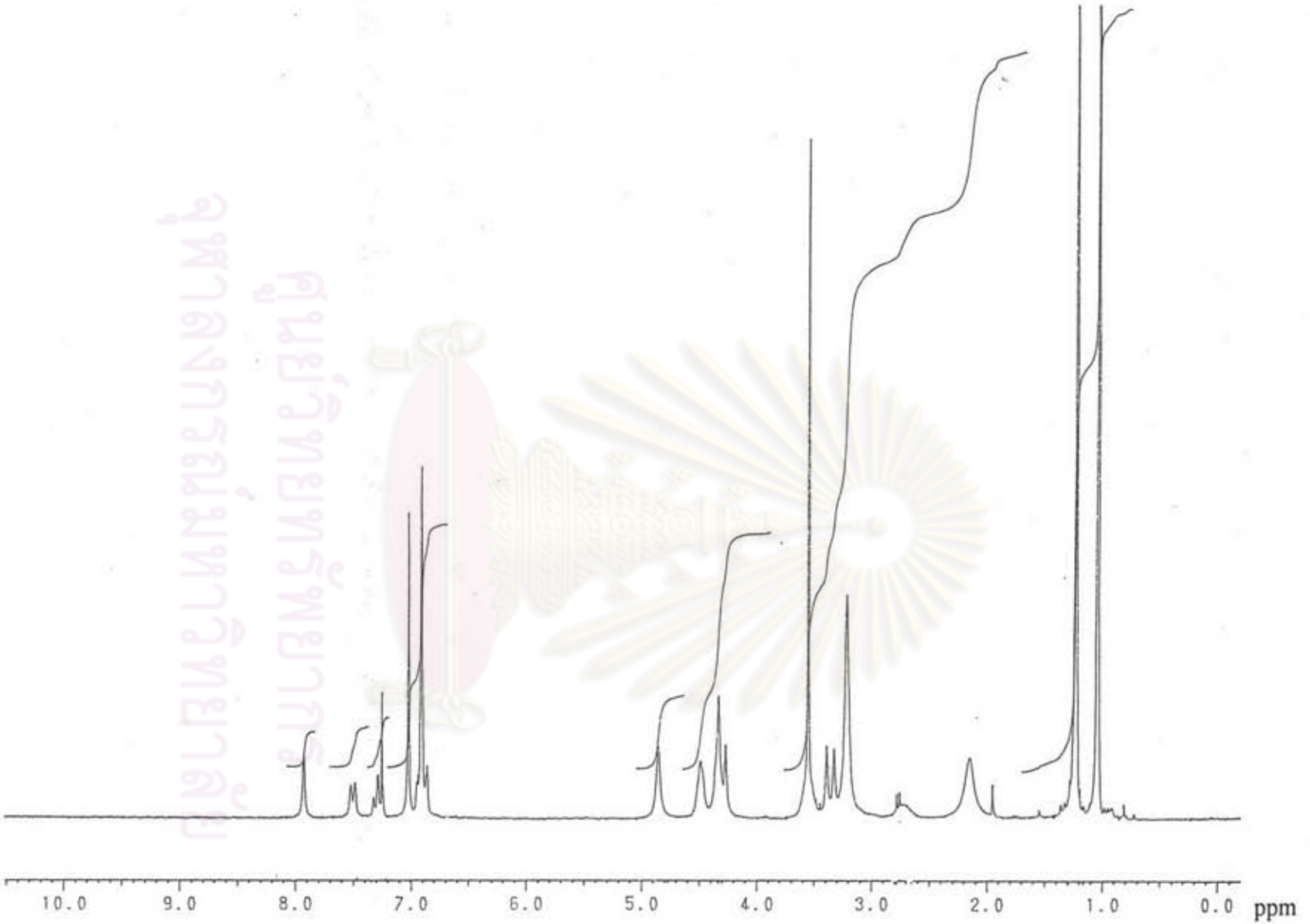


Figure A.18 ^{1}H-NMR ($CDCl_3$) spectrum of 24,26-dimethyl-25,27-[2,2'-[(1,7-(2,6-tetramethylammonium)heptylene)-2,2'-diphenoxy] diethyl]-*p-tert*-butylcalix[4]arene.di(hydrogensulfate) (7a)

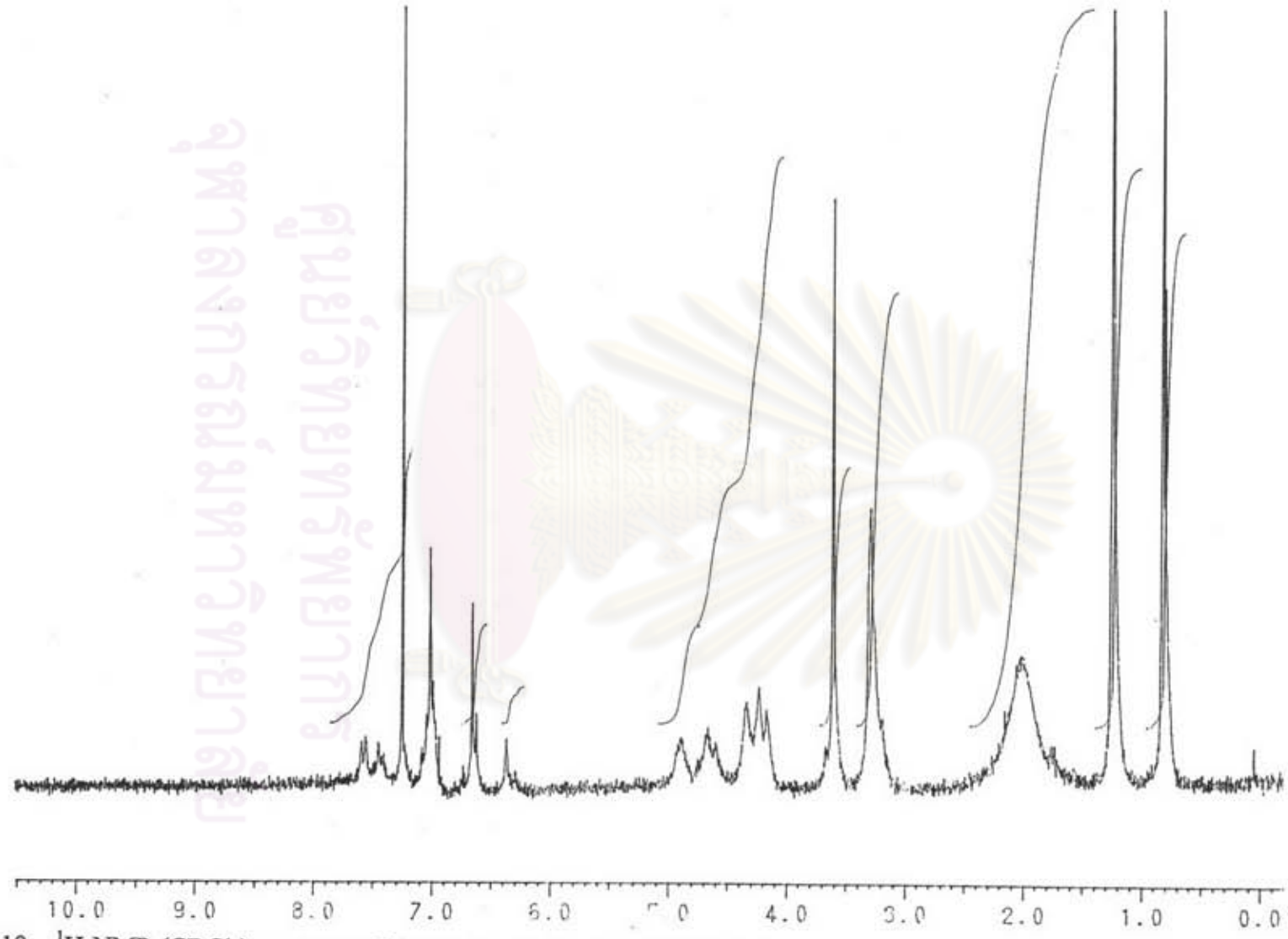


Figure A.19 ^{1}H-NMR ($CDCl_3$) spectrum of 24,26-dimethyl-25,27-[2,2'-[(1,9-(2,5,8-hexamethylammonium)nonylylene)-2,2'-diphenoxy] diethyl]-*p-tert*-butylcalix[4]arene.tri(hydrogensulfate) (7b)

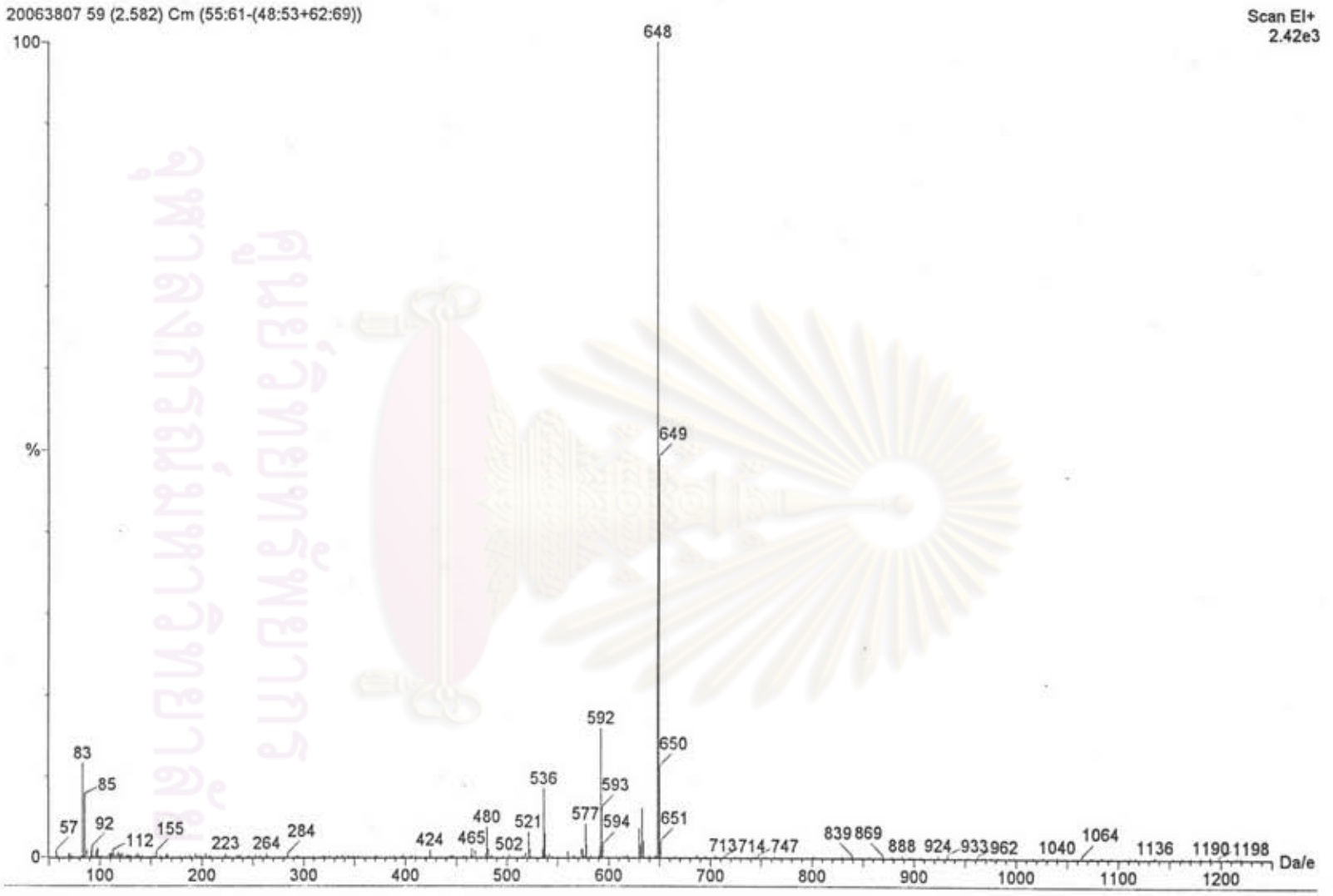


Figure A.20 Mass spectrum (EI^+) of *p-tert*-butylcalix[4]arene (1)

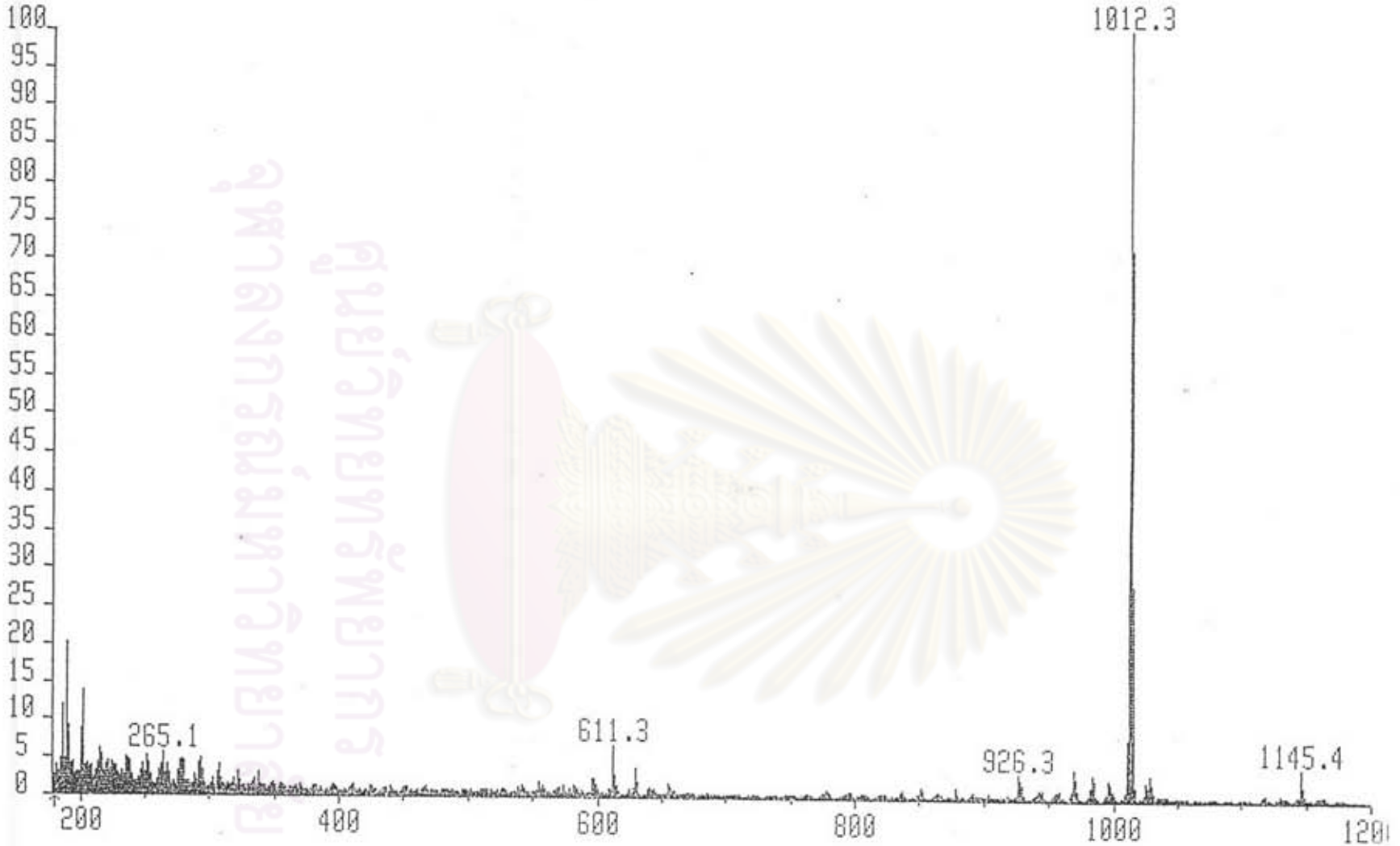


Figure A.21 Mass spectrum (FAB^+) of 25,27-[2,2'-[(1,1'-(1,5-(3-aza)pentylene)diimino)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene (4c)

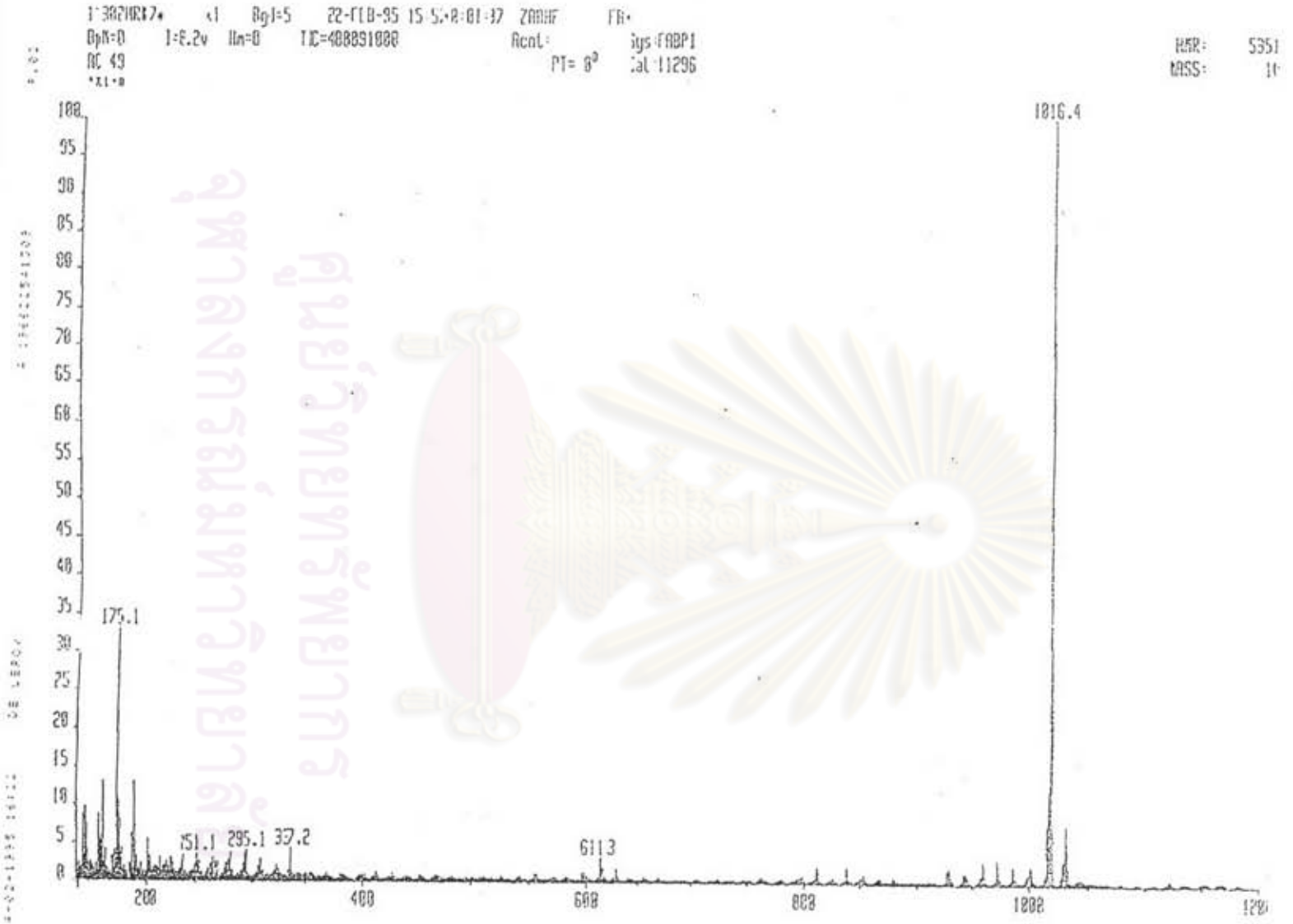


Figure A.22 Mass spectrum (FAB^+) of 25,27-[2,2'-[(1,9-(2,5,8-triammonium)nonylene)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene.trichloride (5c)

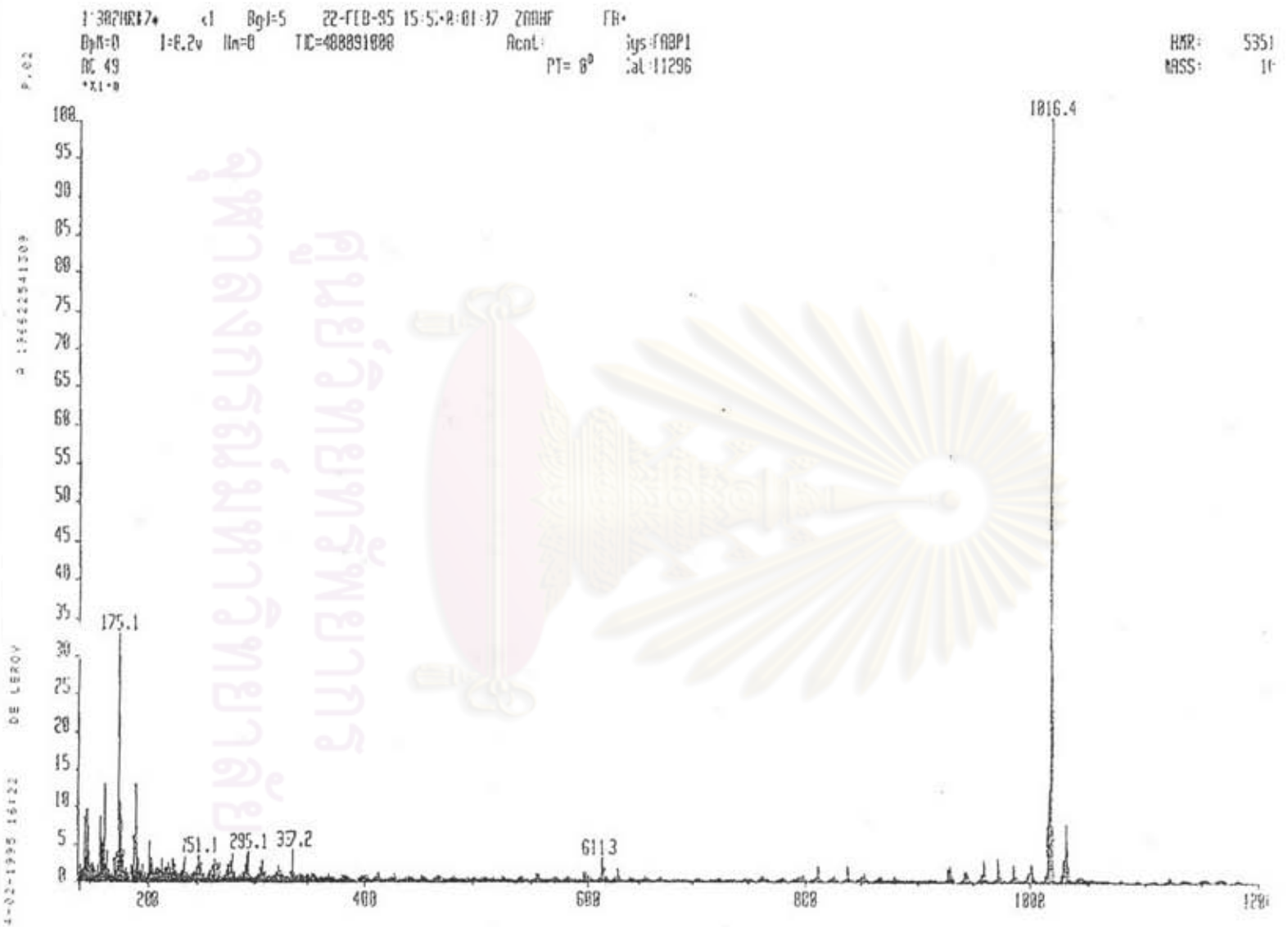


Figure A.23 Mass spectrum (FAB$^+$) of 25,27-[2,2'-[(1,9-(2,5,8-triaza)nonylene)-2,2'-diphenoxy]diethyl]-*p-tert*-butylcalix[4]arene (6c)

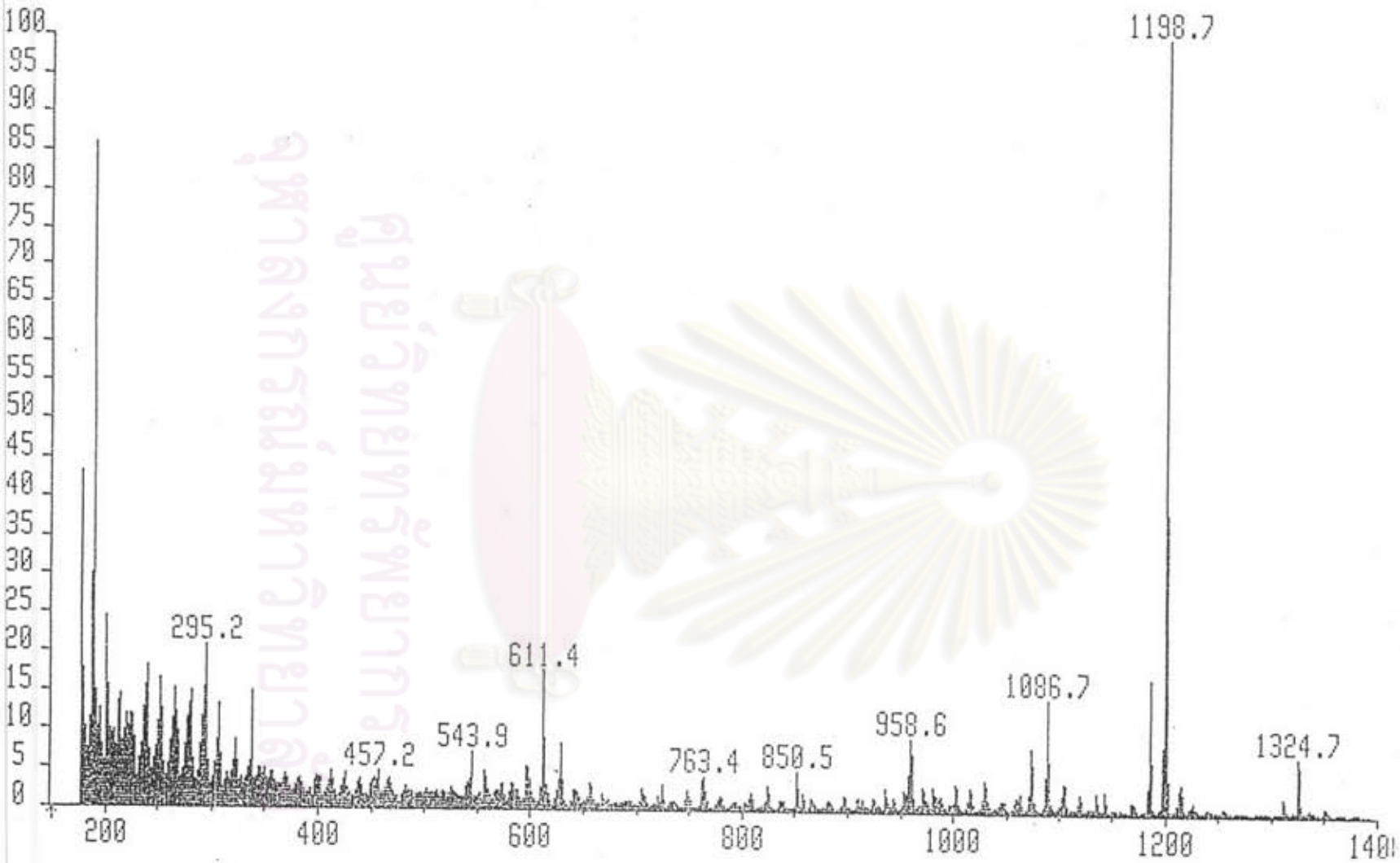


Figure A.24 Mass spectrum (FAB^+) of 24,26-dimethyl-25,27-[2,2'-[(1,9-(2,5,8-hexamethylammonium)nonylene)-2,2'-diphenoxy] diethyl]-*p-tert*-butylcalix[4]arene.tri(hydrogensulfate) (7b)

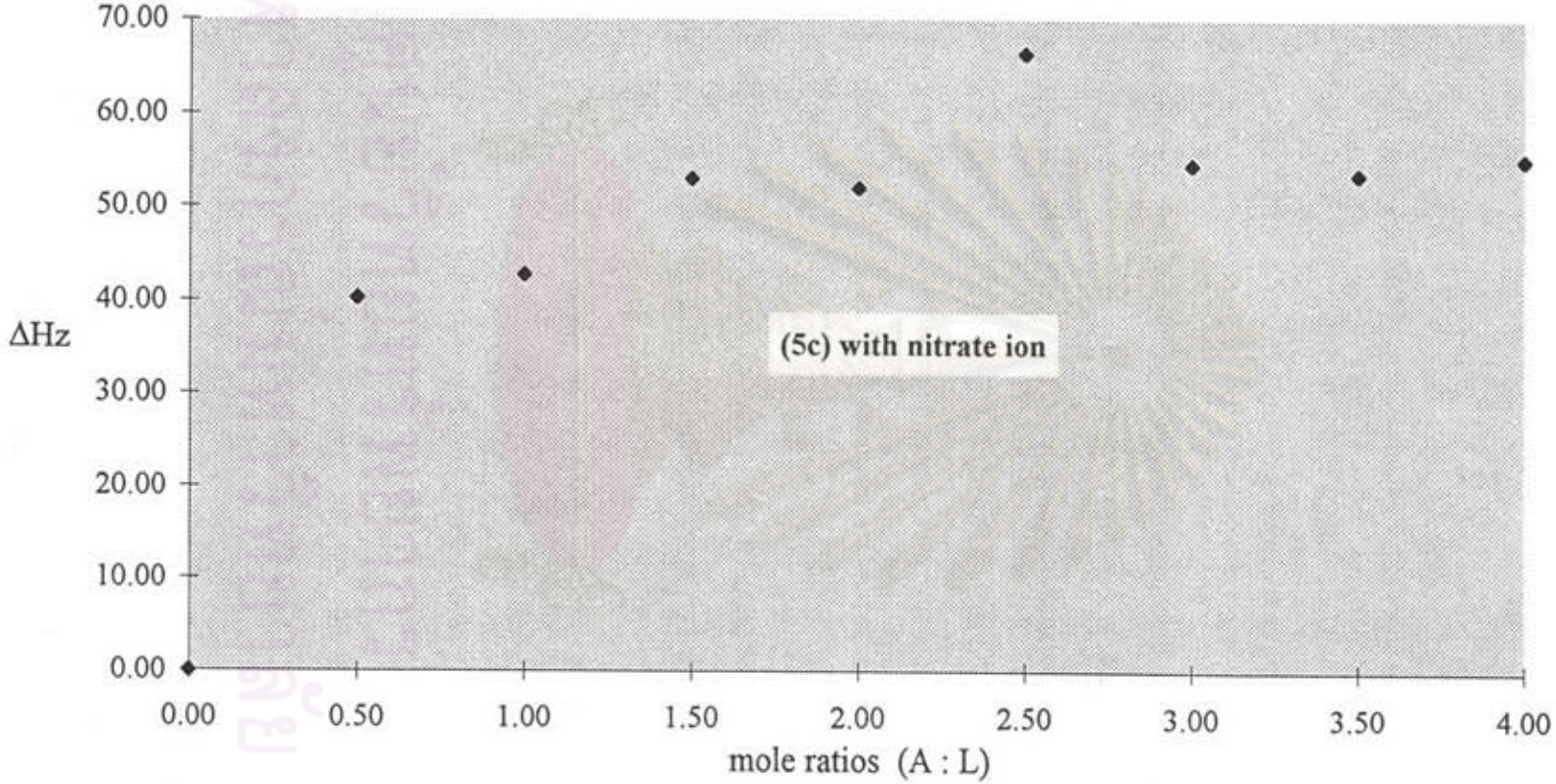


Figure A.25 Plot between mole ratios and ΔHz of CH_2-NH_2^+-CH_2 protons of complexation between ligand (5c) with $NaNO_3$

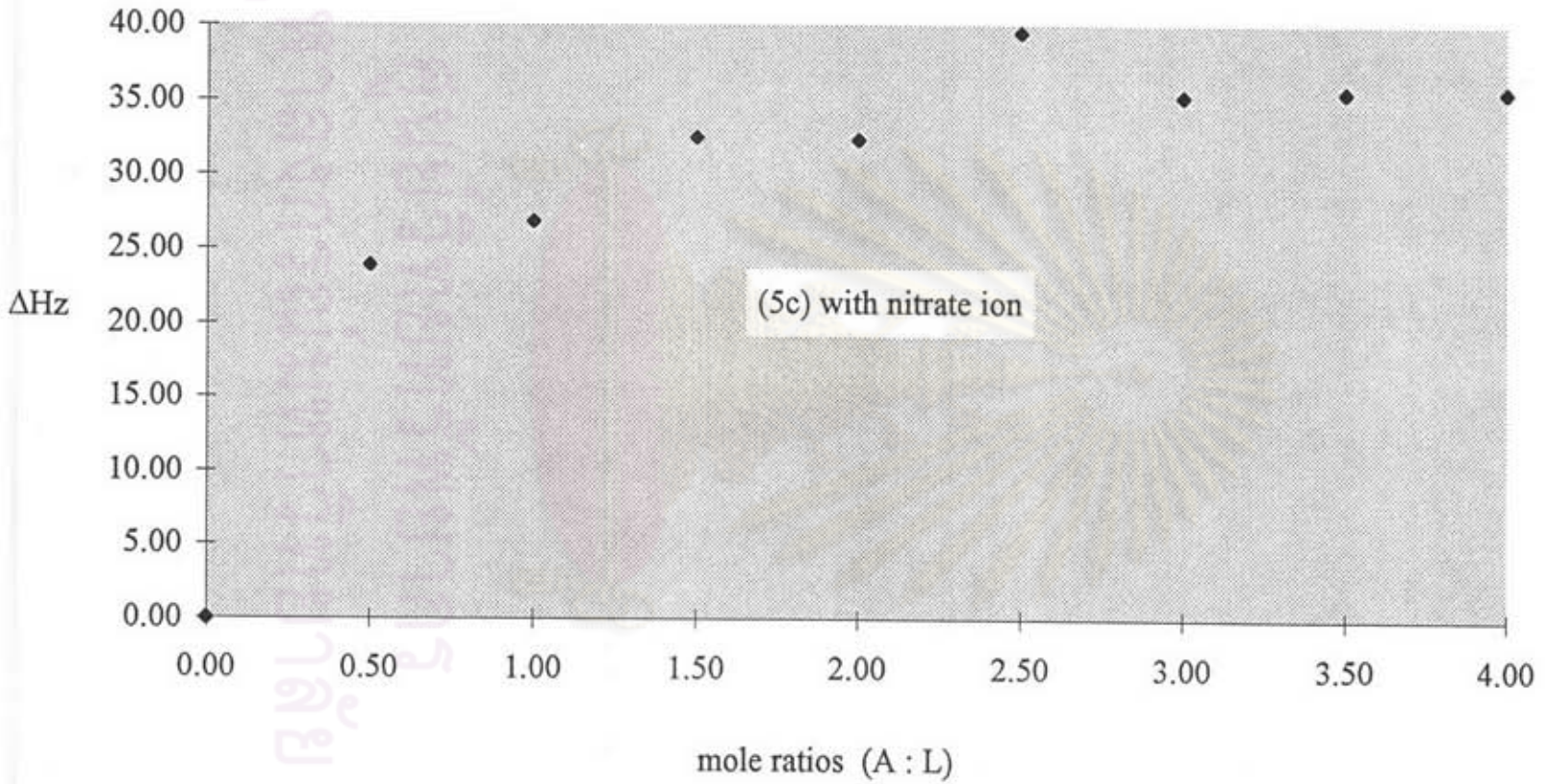


Figure A.26 Plot between mole ratios and ΔHz of Ar-CH_2-NH_2^+-CH_2 protons of complexation between ligand (5c) with $NaNO_3$

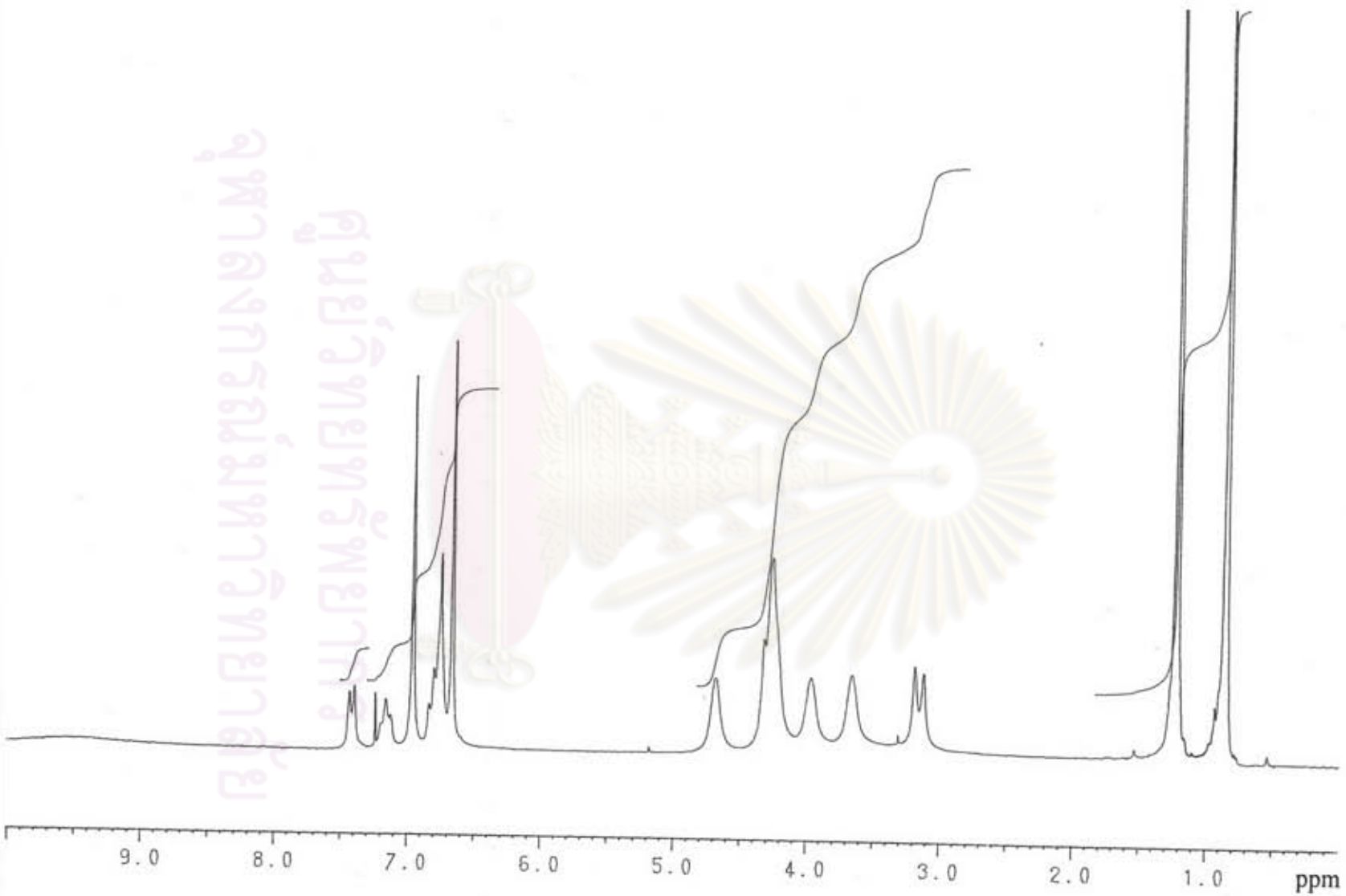


Figure A.27 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium nitrate and ligand (5c) mole ratio (A : L) 0.0 : 1.0

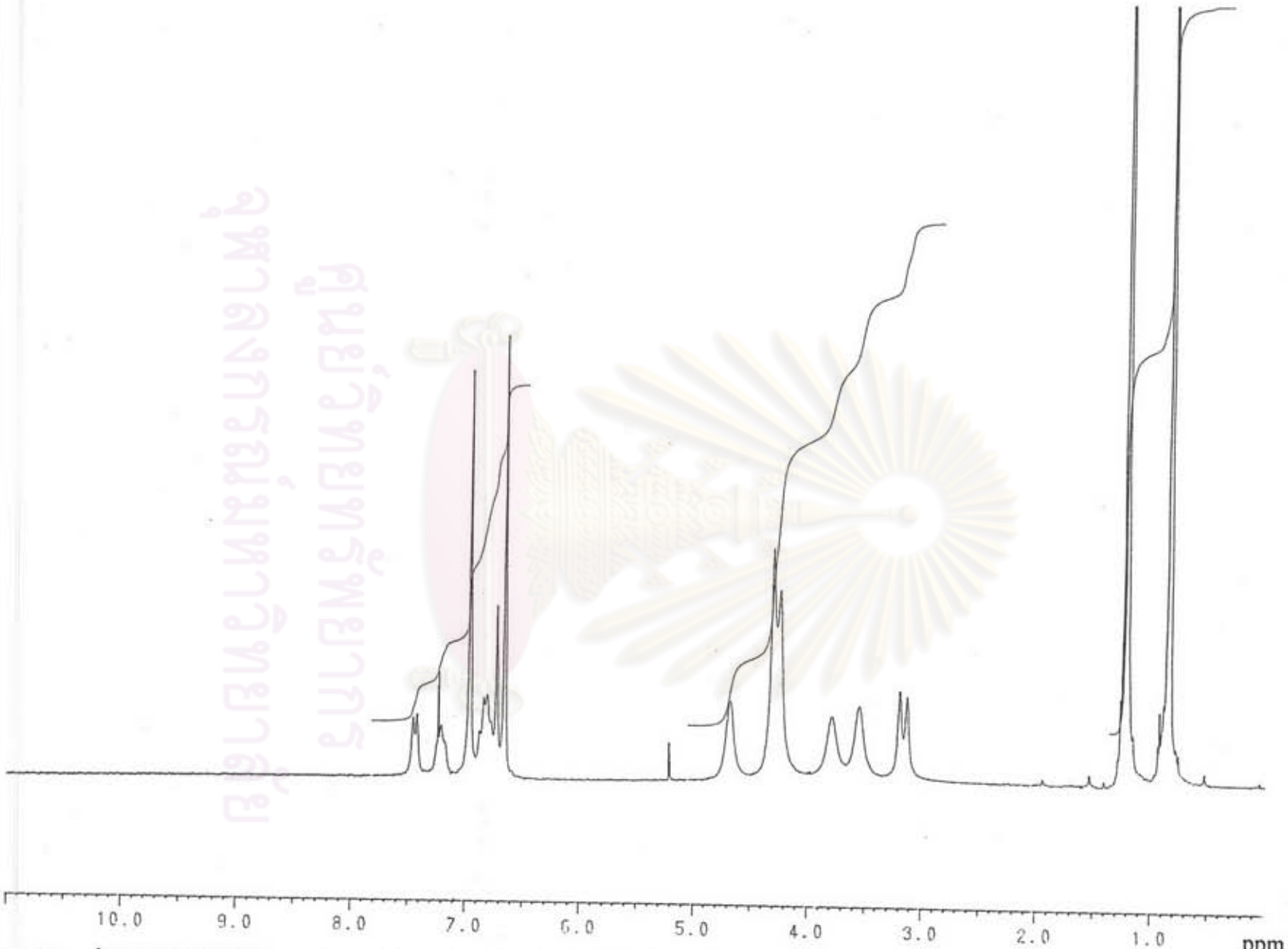


Figure A.28 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium nitrate and ligand (5c) mole ratio (A : L) 0.5 : 1.0

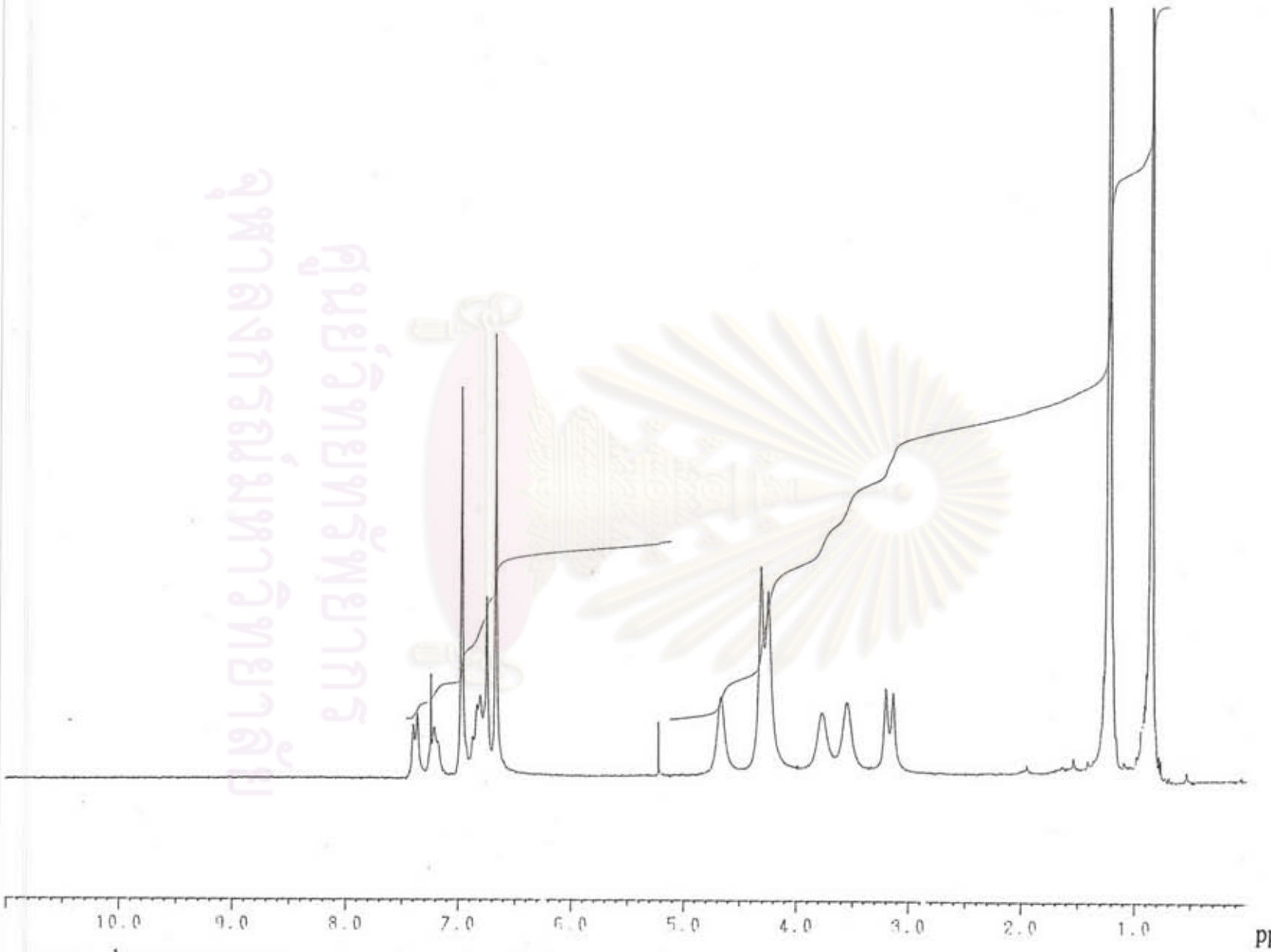


Figure A.29 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium nitrate and ligand (5c) mole ratio (A : L) 1.0 : 1.0

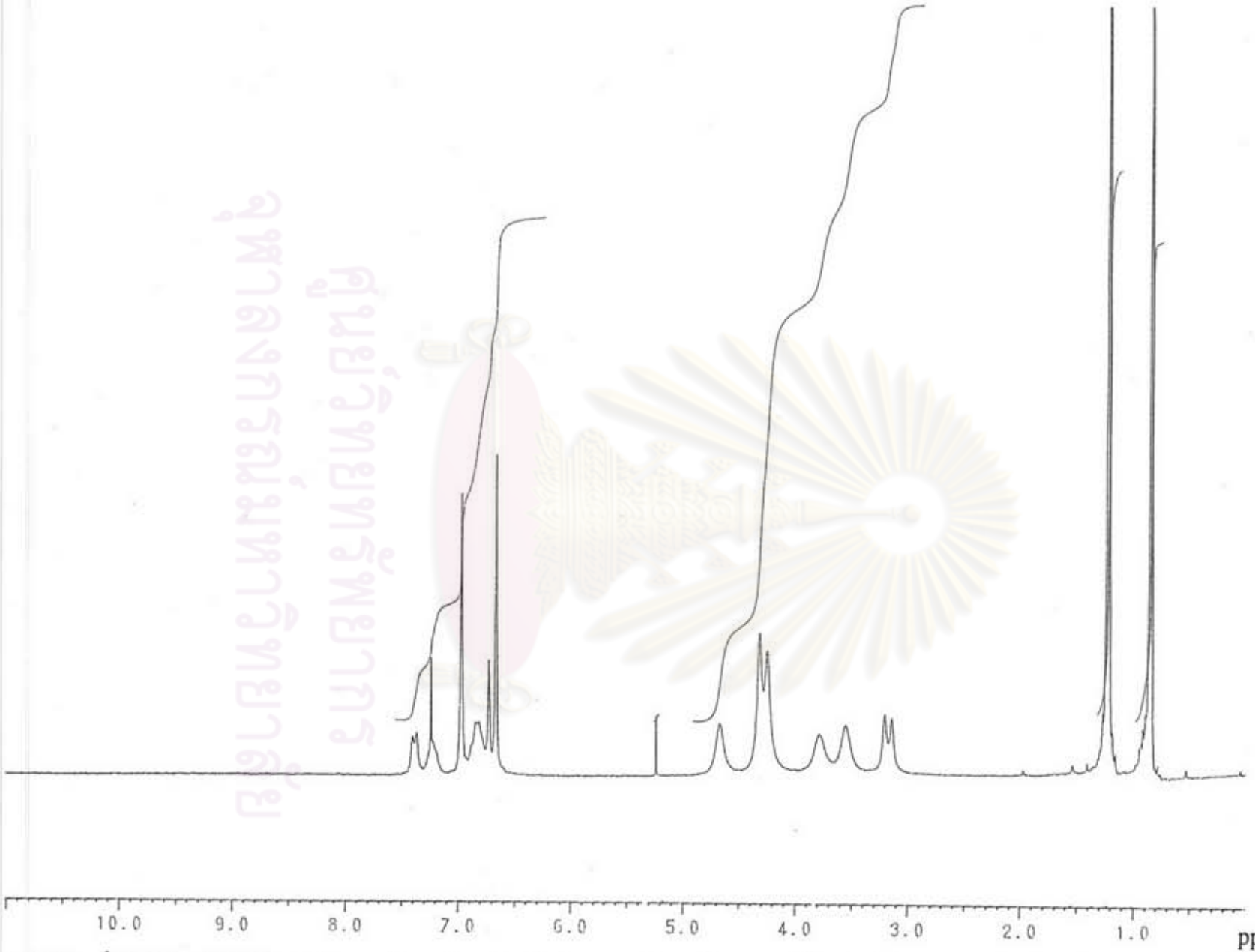


Figure A.30 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium nitrate and ligand (5c) mole ratio (A : L) 1.5 : 1.0

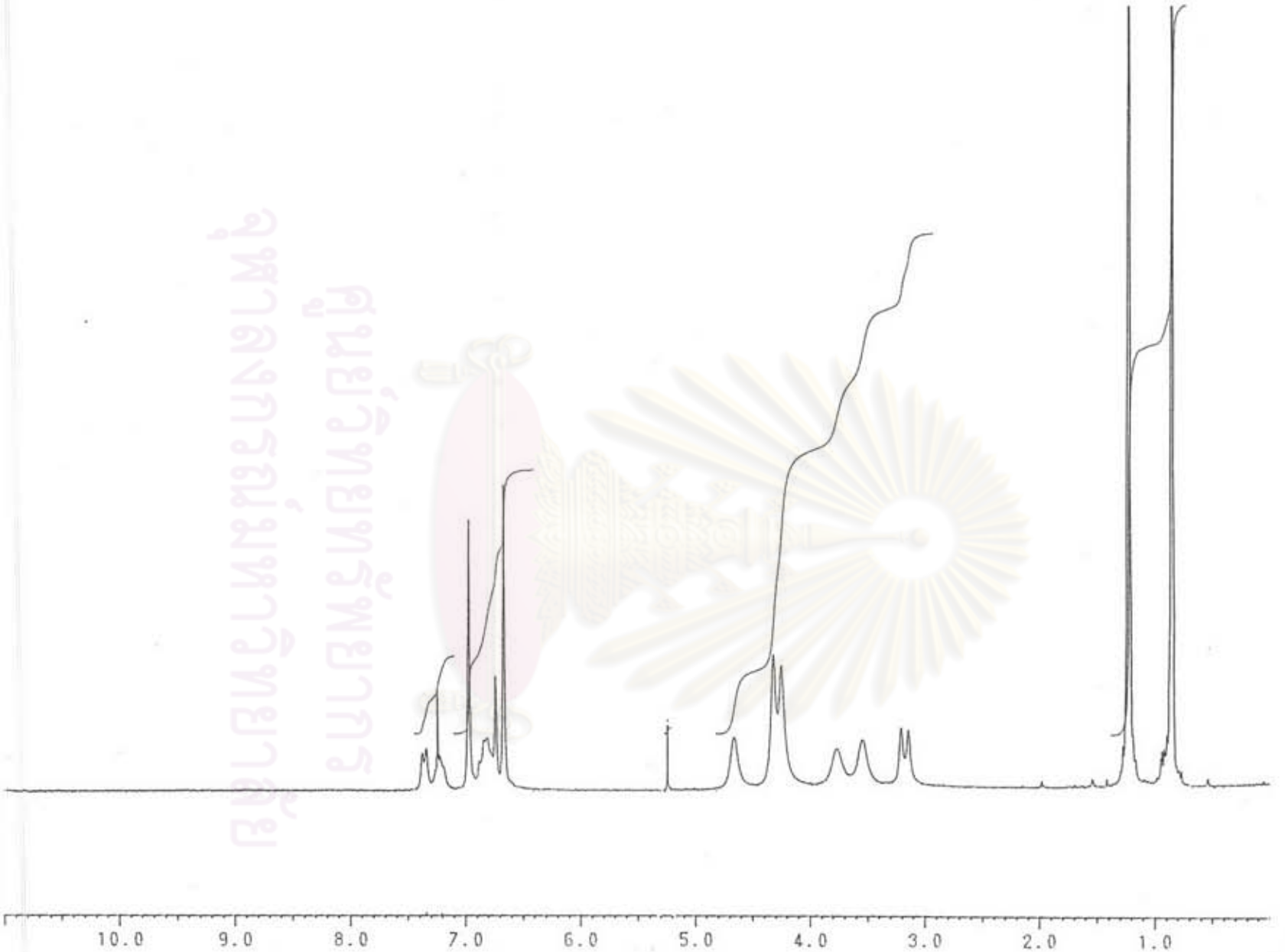


Figure A.31 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium nitrate and ligand (5c) mole ratio (A : L) 2.0 : 1.0

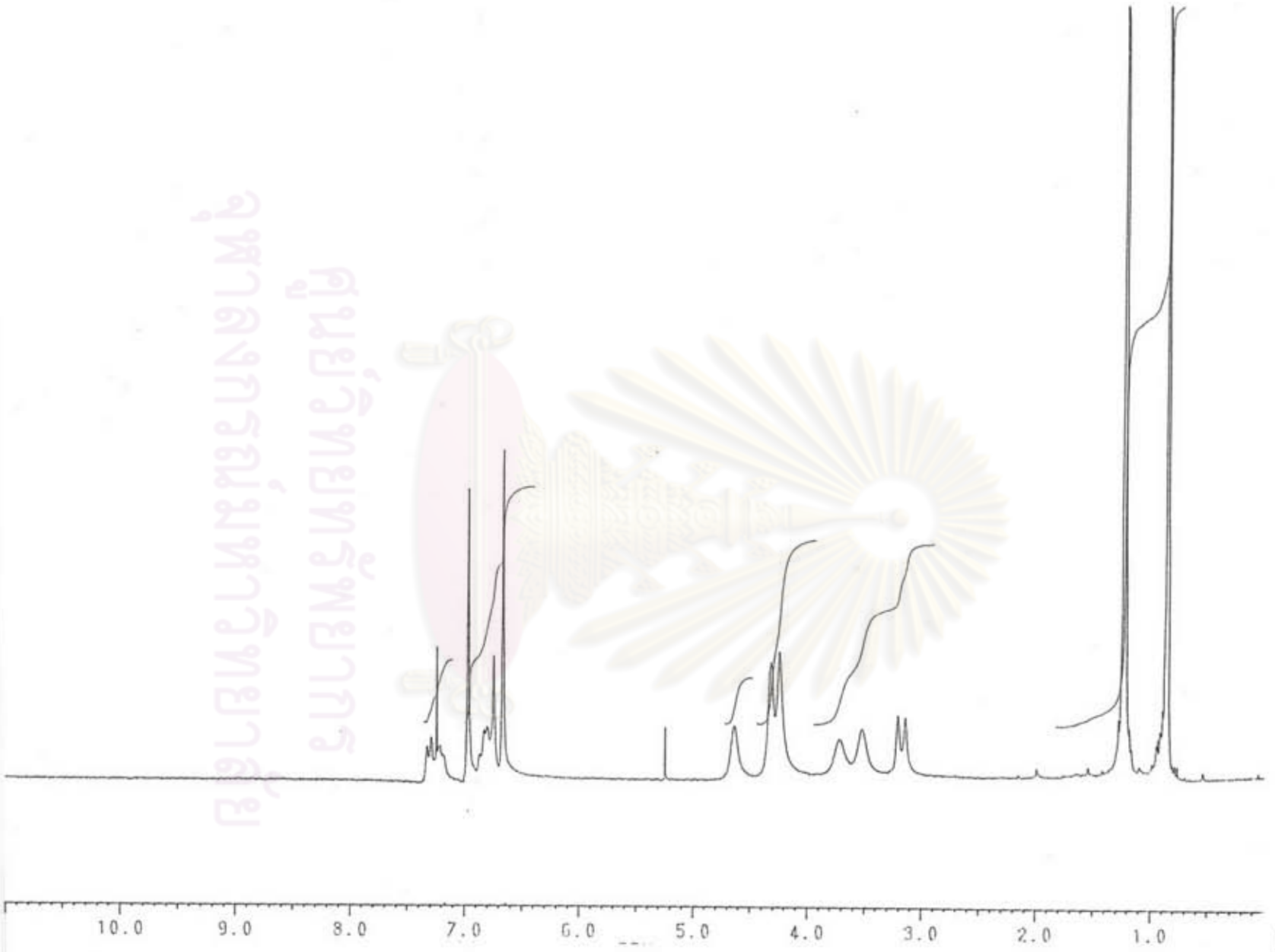


Figure A.32 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium nitrate and ligand (5c) mole ratio (A : L) 2.5 : 1.0

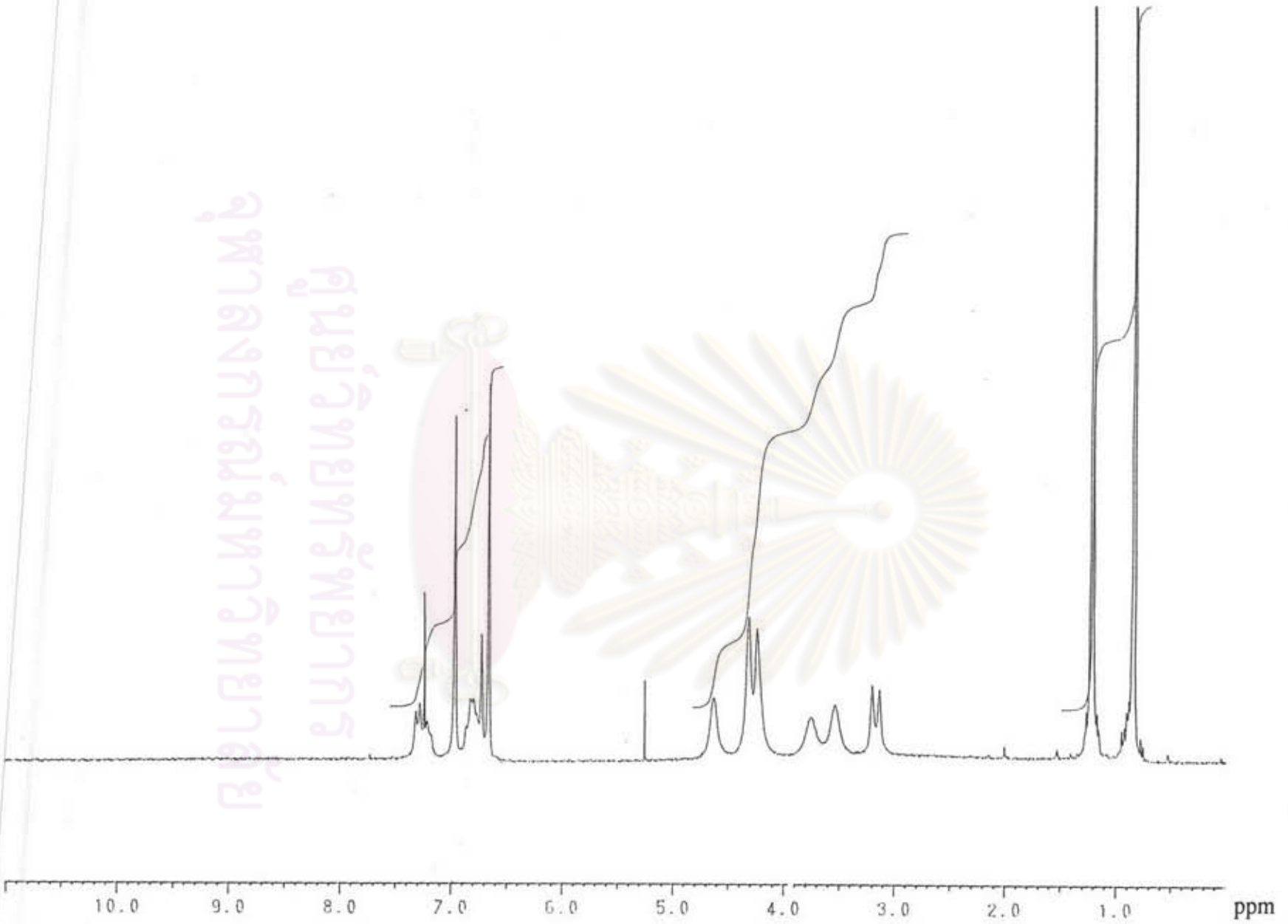


Figure A.33 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium nitrate and ligand (5c) mole ratio (A : L) 3.0 : 1.0

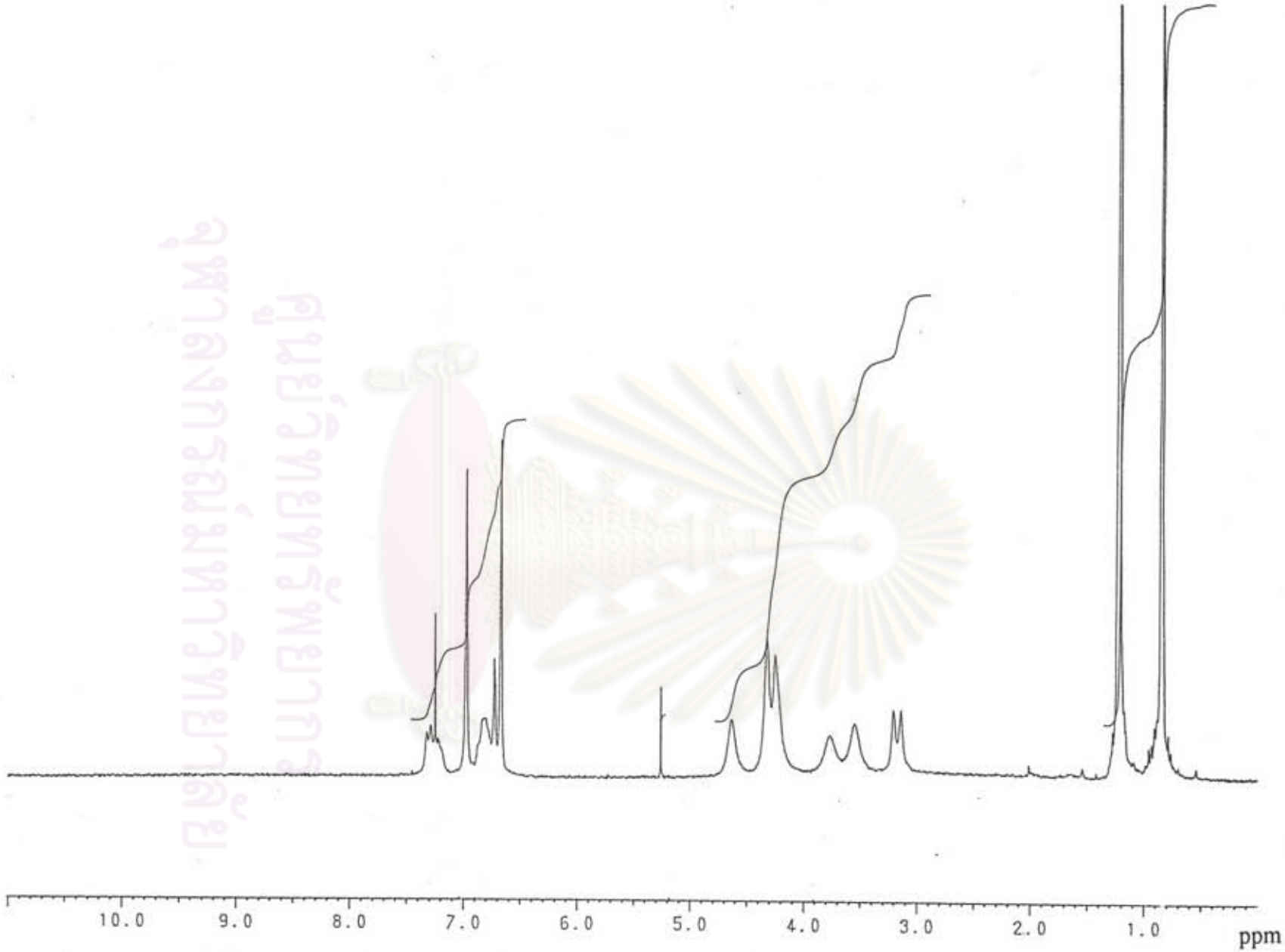


Figure A.34 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium nitrate and ligand (5c) mole ratio (A : L) 3.5 : 1.0

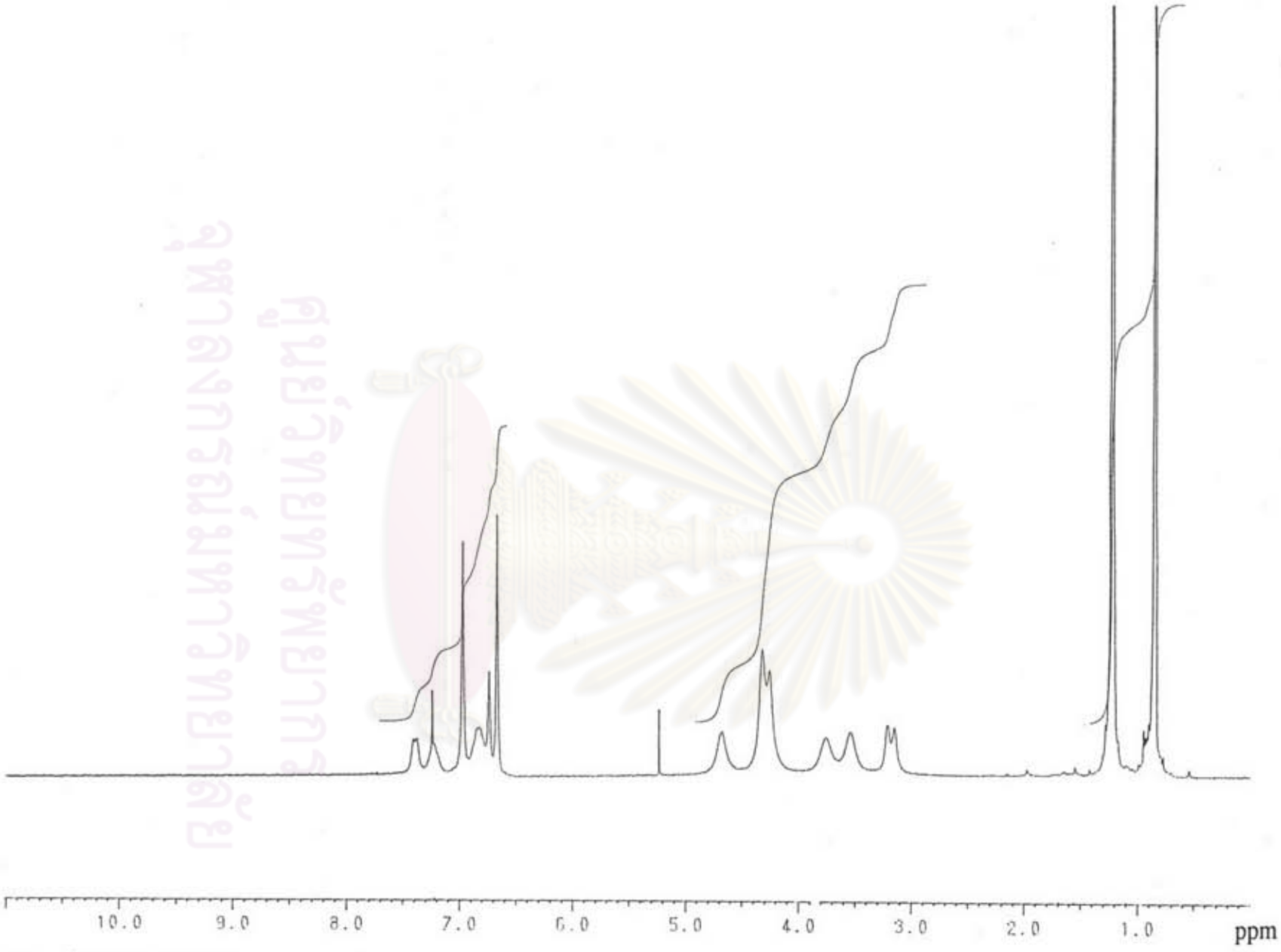


Figure A.35 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium nitrate and ligand (5c) mole ratio (A : L) 4.0 : 1.0

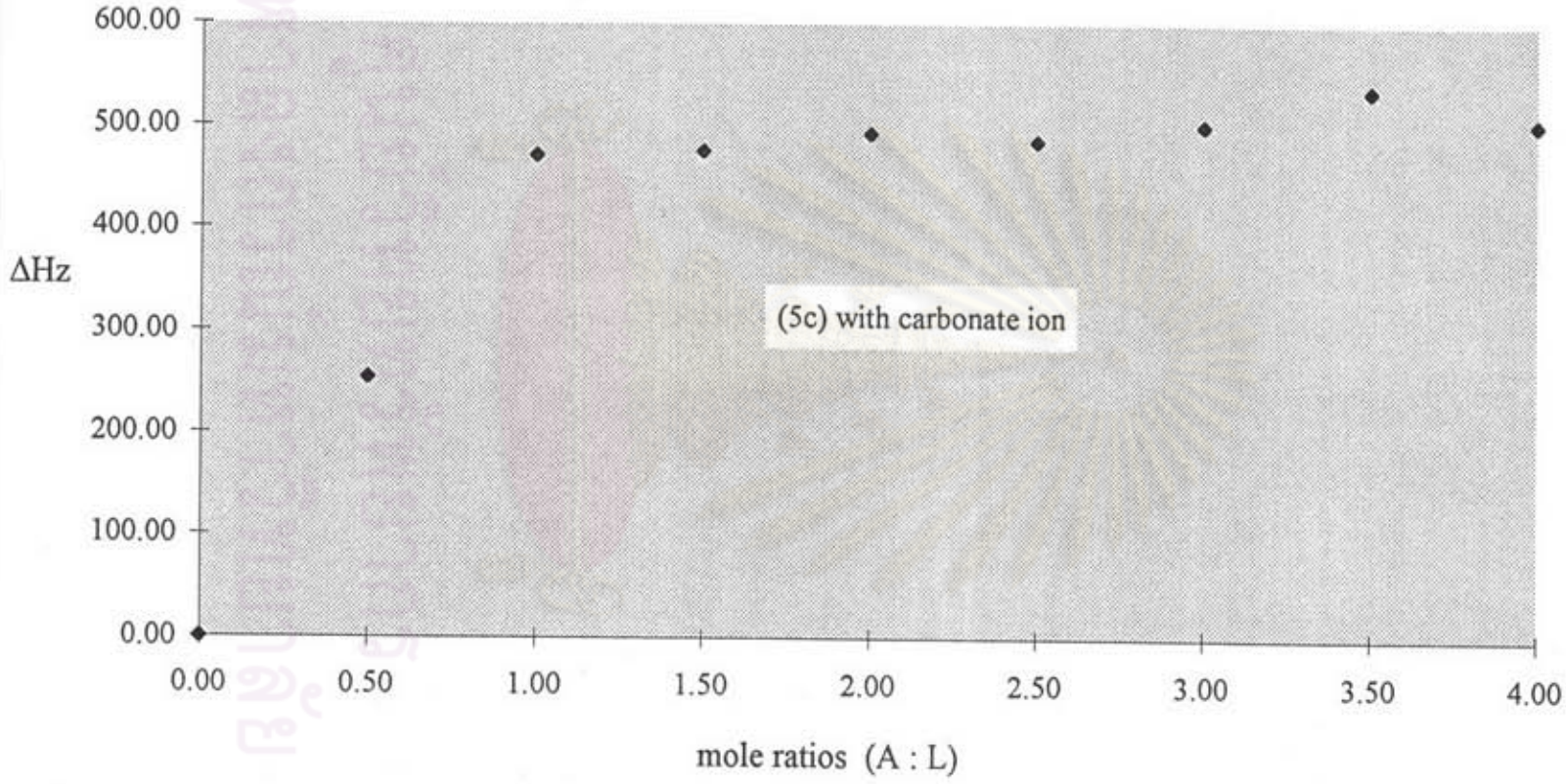


Figure A.36 Plot between mole ratios and ΔHz of CH_2-NH_2^+-CH_2 protons of complexation between ligand (5c) with Na_2CO_3 carbonate

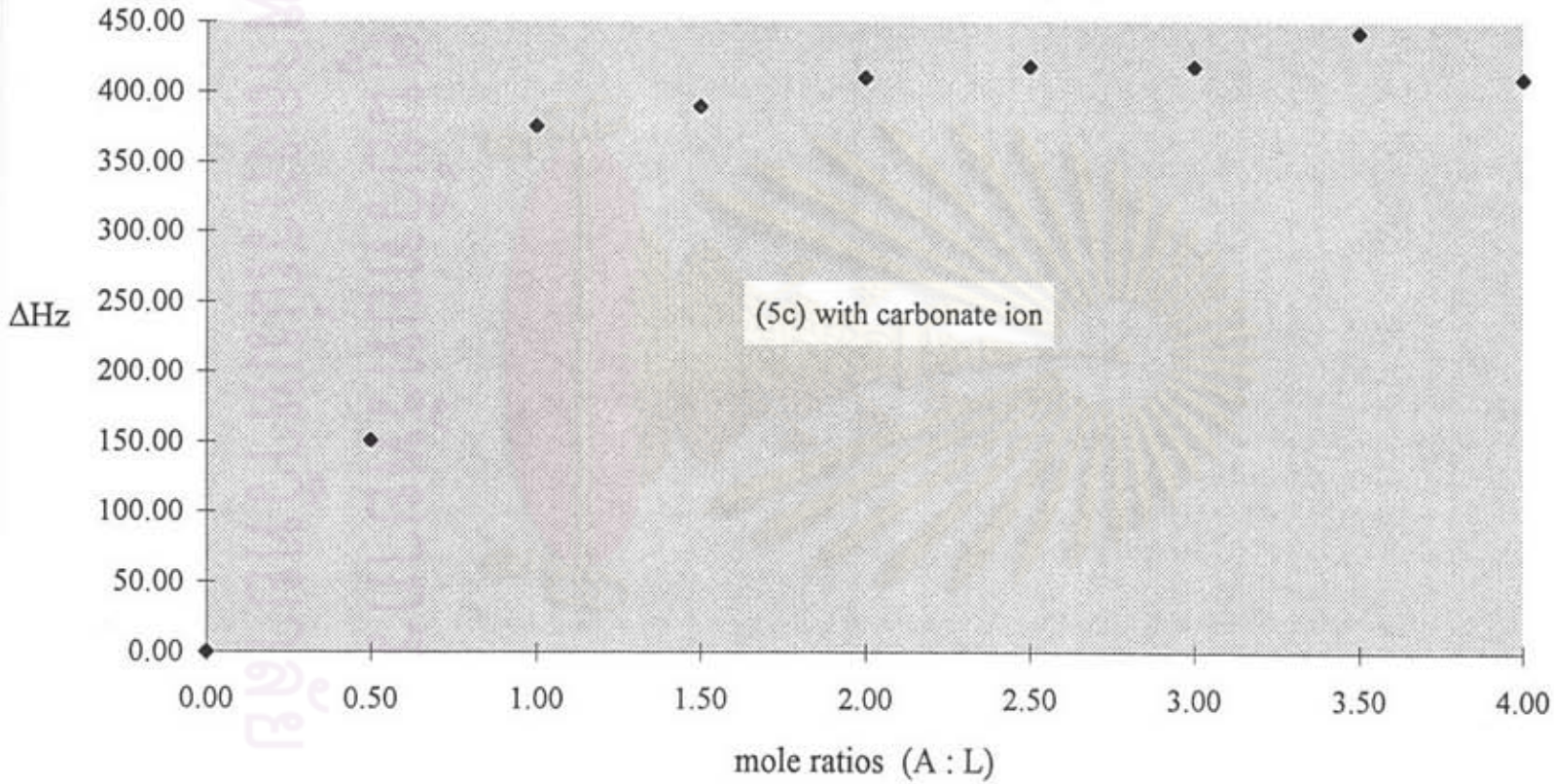


Figure A.37 Plot between mole ratios and ΔHz of Ar-CH_2-NH_2^+-CH_2 protons of complexation between ligand (5c) with Na_2CO_3

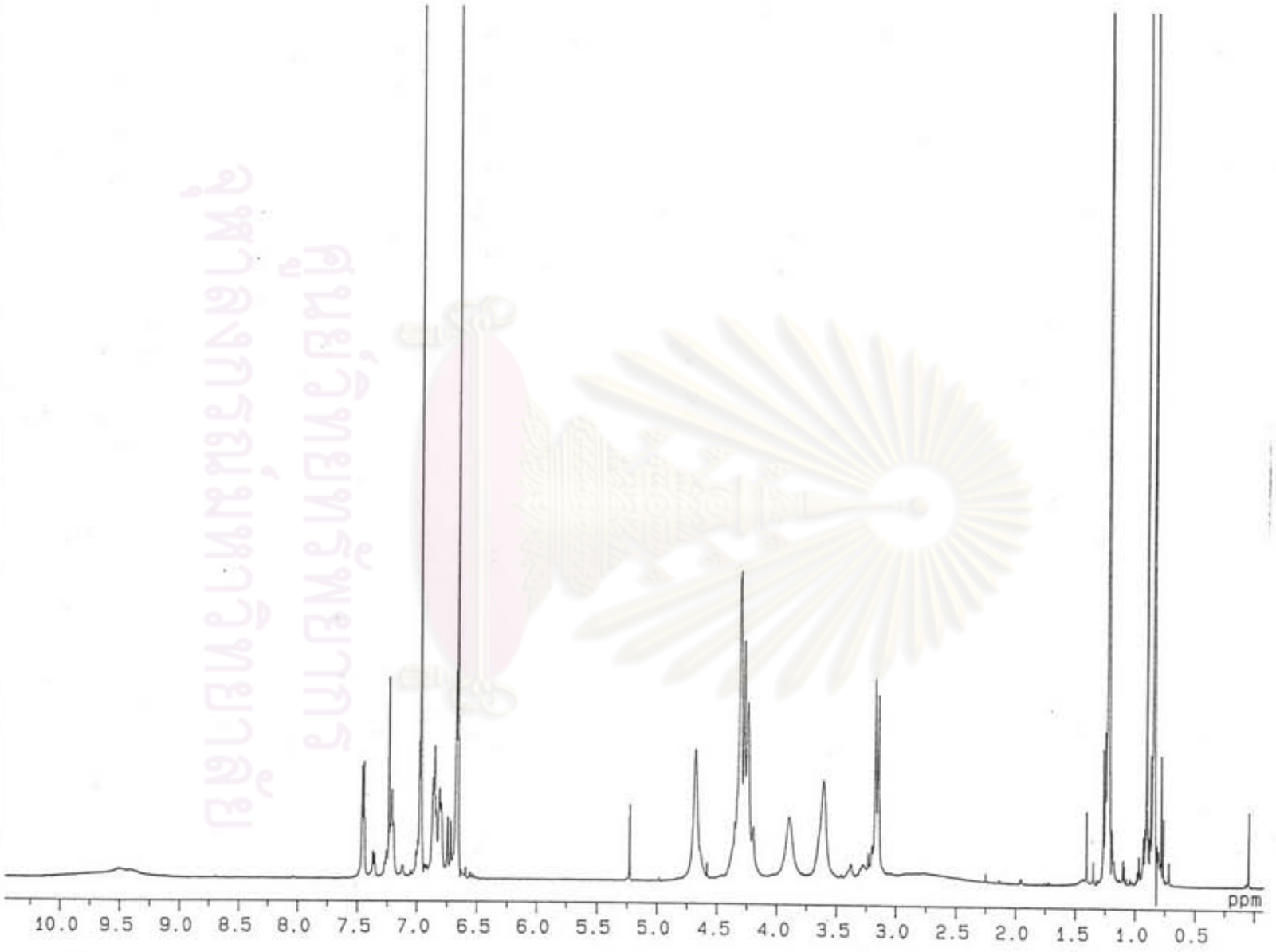


Figure A.38 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium carbonate and ligand (5c) mole ratio (A : L) 0.0 : 1.0

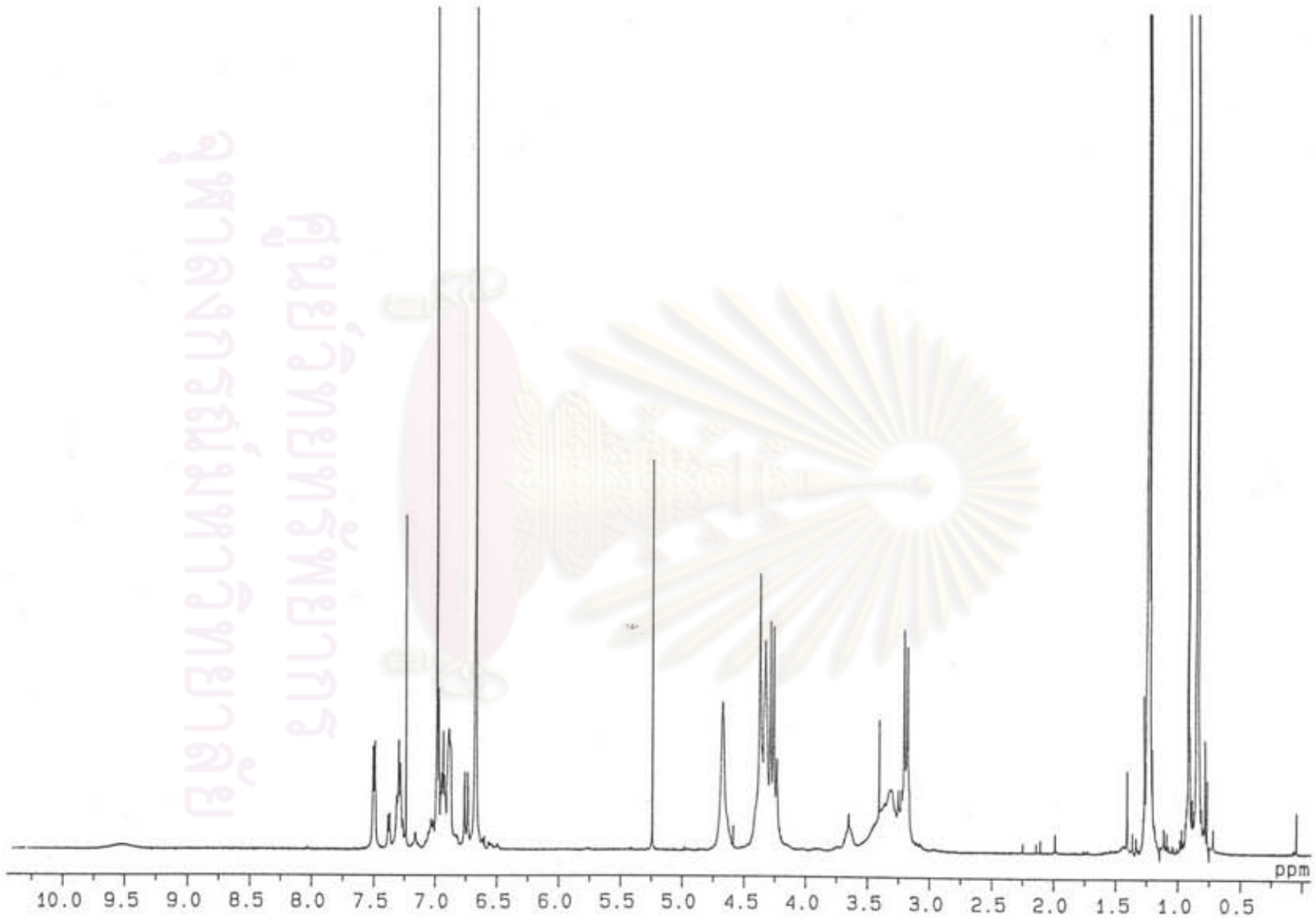


Figure A.39 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium carbonate and ligand (5c) mole ratio (A : L) 0.5 : 1.0

Figure A.40 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium carbonate and ligand (5c) mole ratio (A : L) 1.0 : 1.0

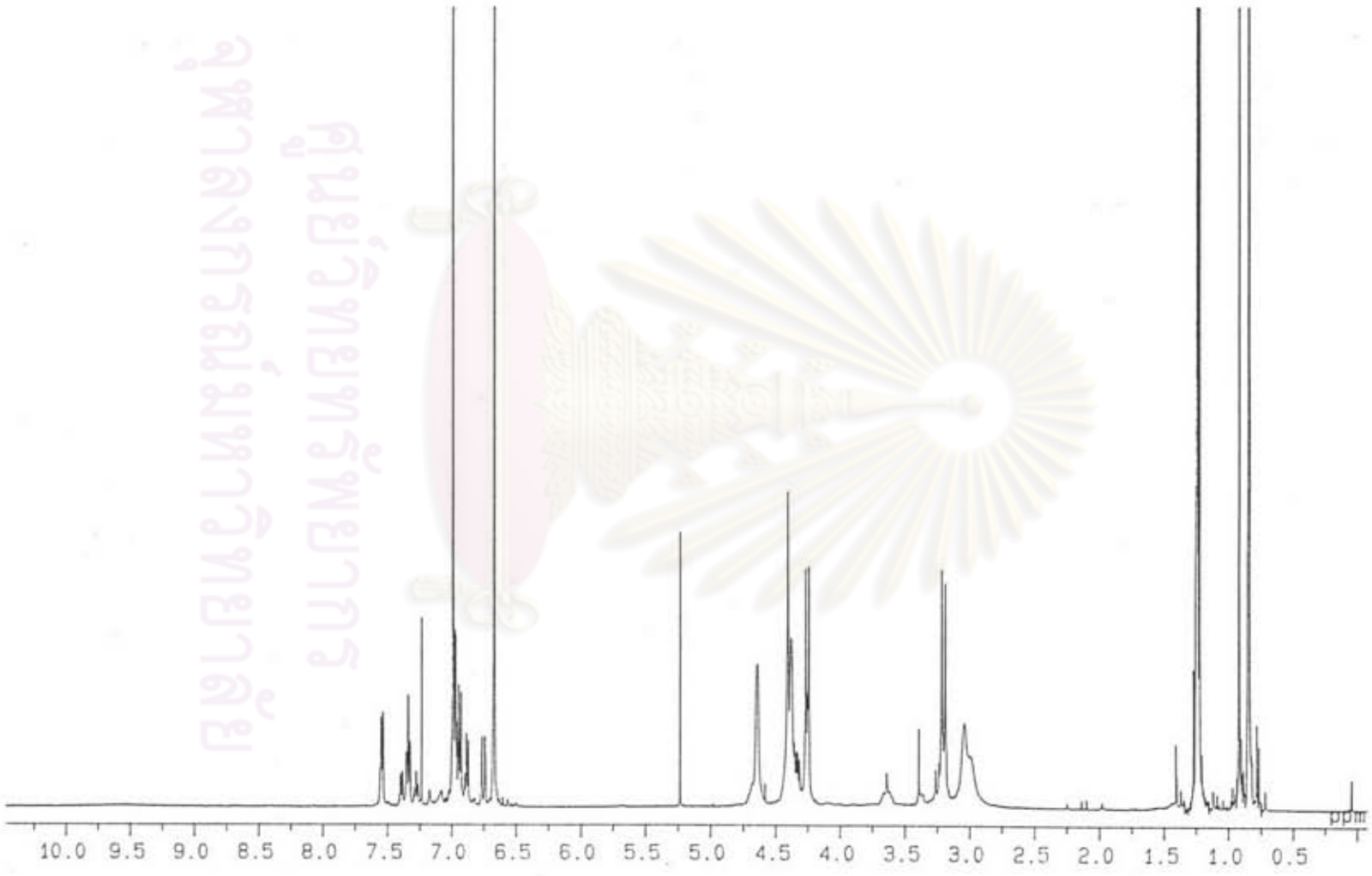


Figure A.41 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium carbonate and ligand (5c) mole ratio (A : L) 1.5 : 1.0

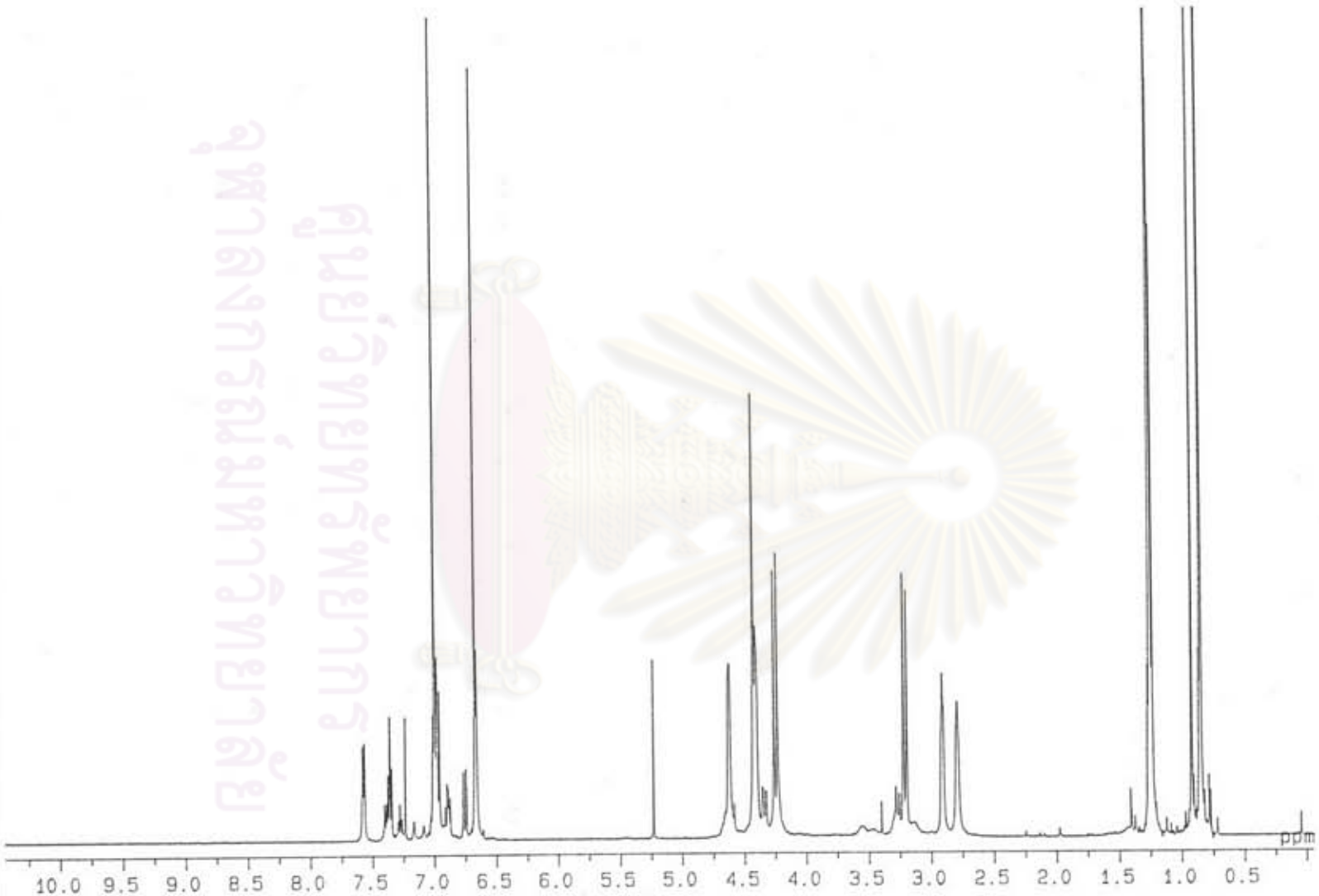


Figure A.42 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium carbonate and ligand (5c) mole ratio (A : L) 2.0 : 1.0

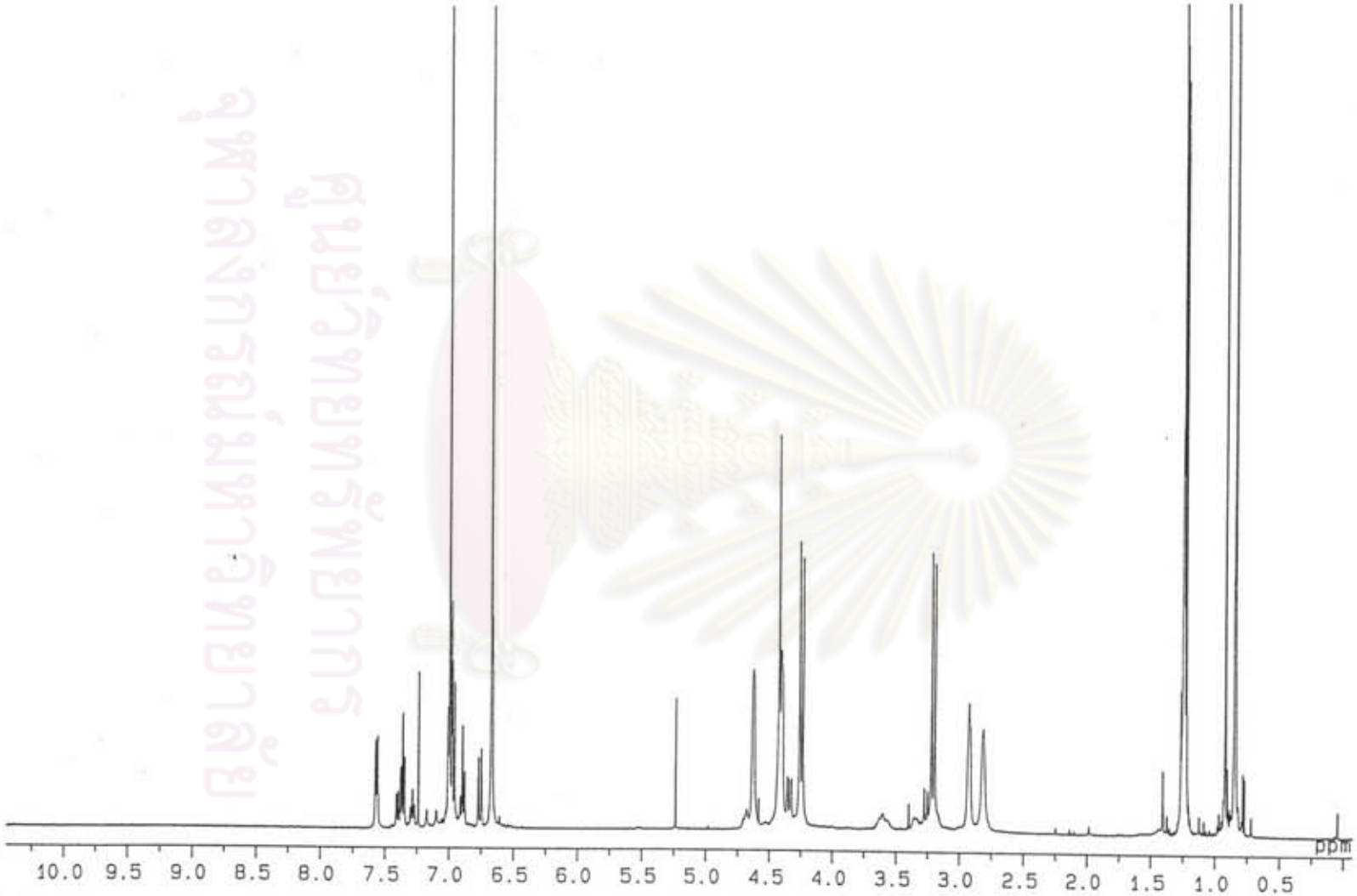


Figure A.43 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium carbonate and ligand (5c) mole ratio (A : L) 2.5 : 1.0

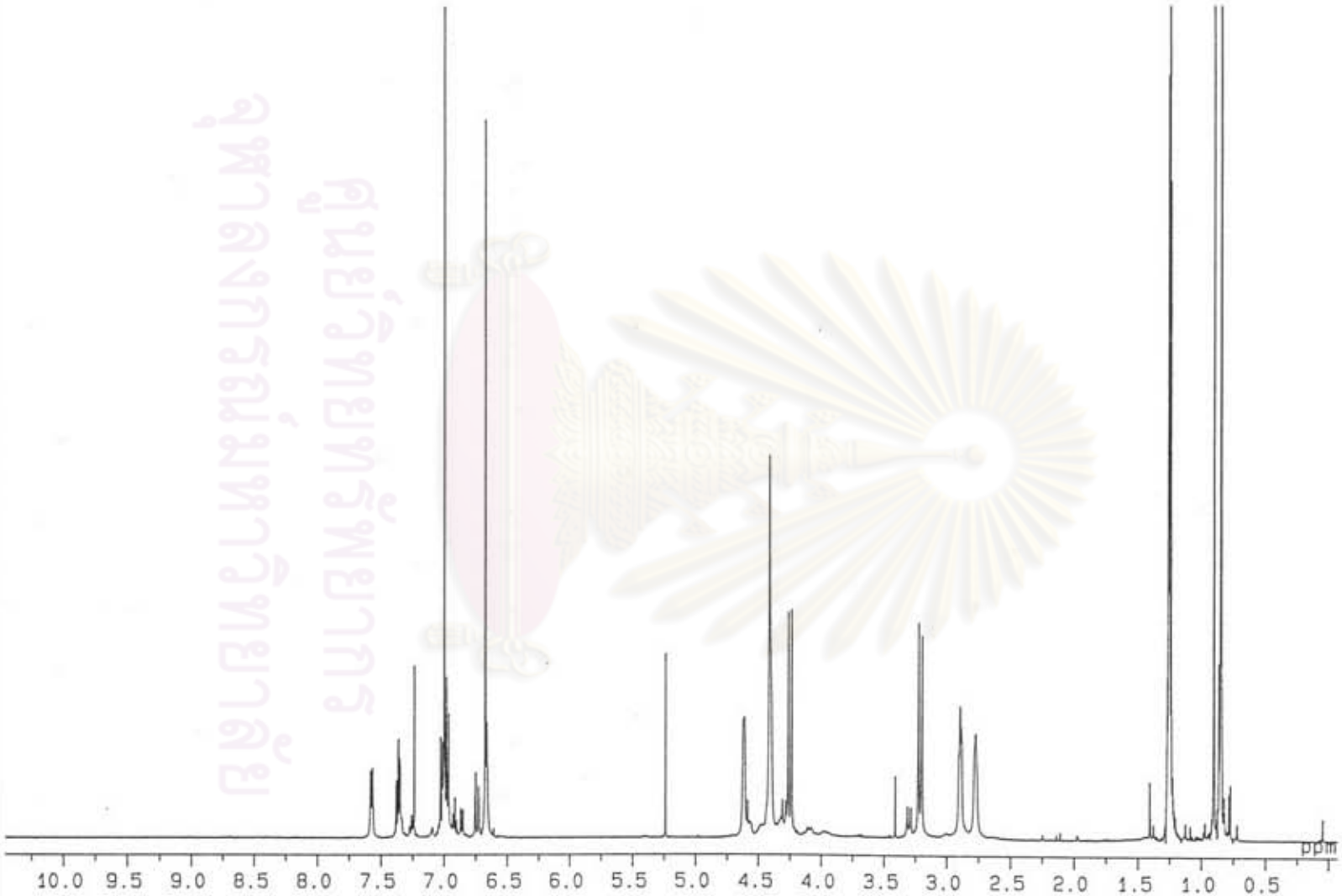


Figure A.44 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium carbonate and ligand (5c) mole ratio (A : L) 3.0 : 1.0

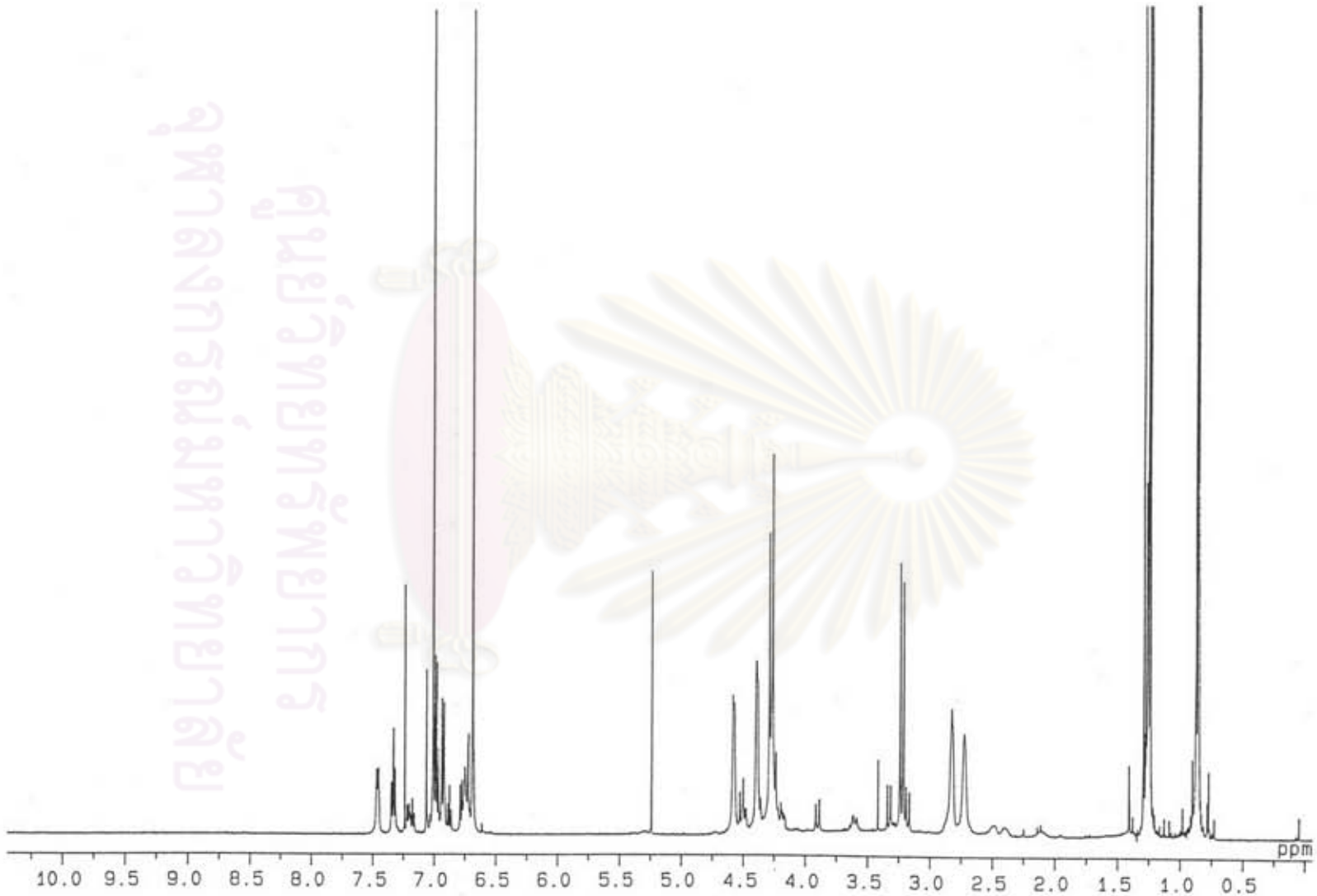


Figure A.45 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium carbonate and ligand (5c) mole ratio (A : L) 3.5 : 1.0

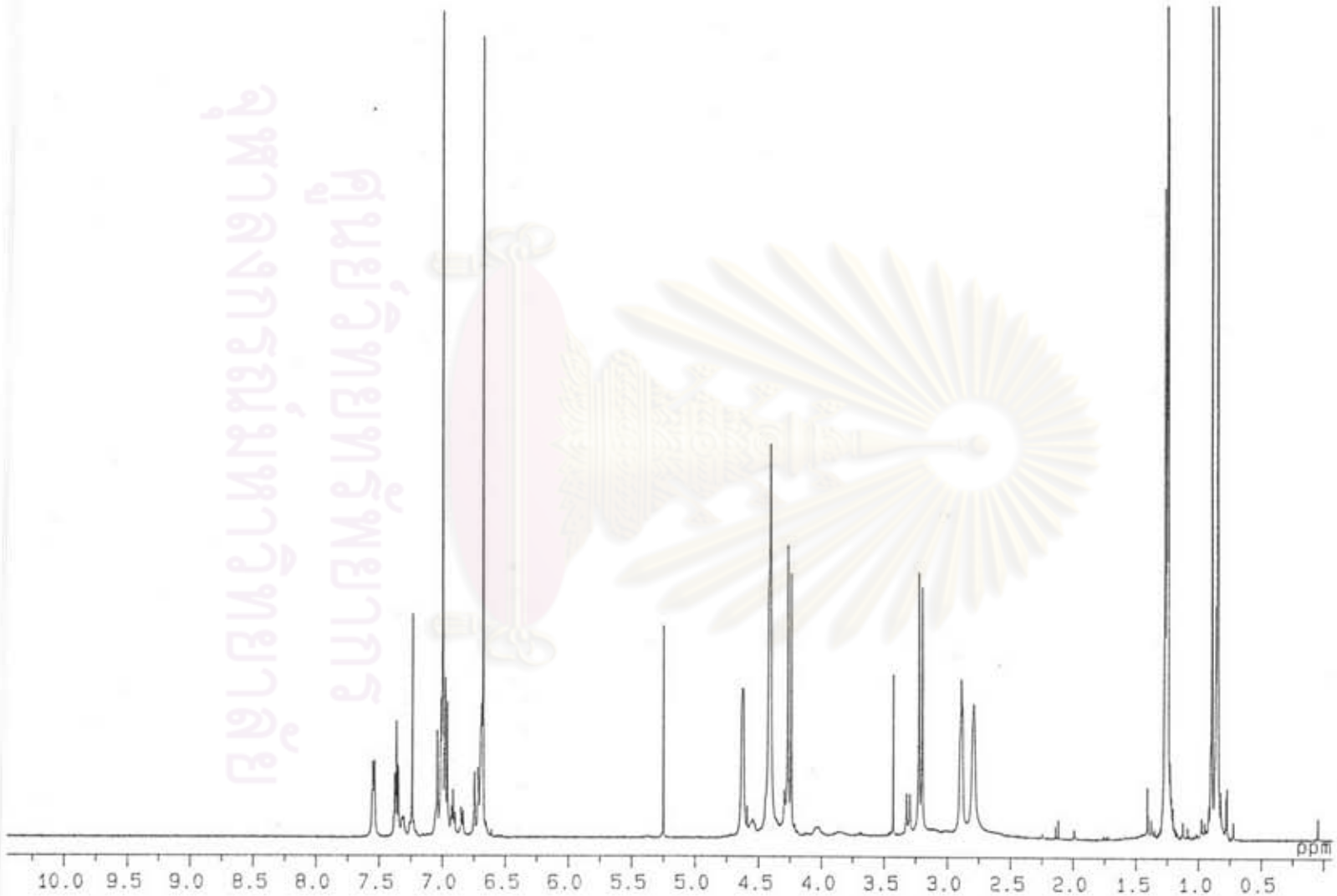


Figure A.46 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium carbonate and ligand (5c) mole ratio (A : L) 4.0 : 1.0

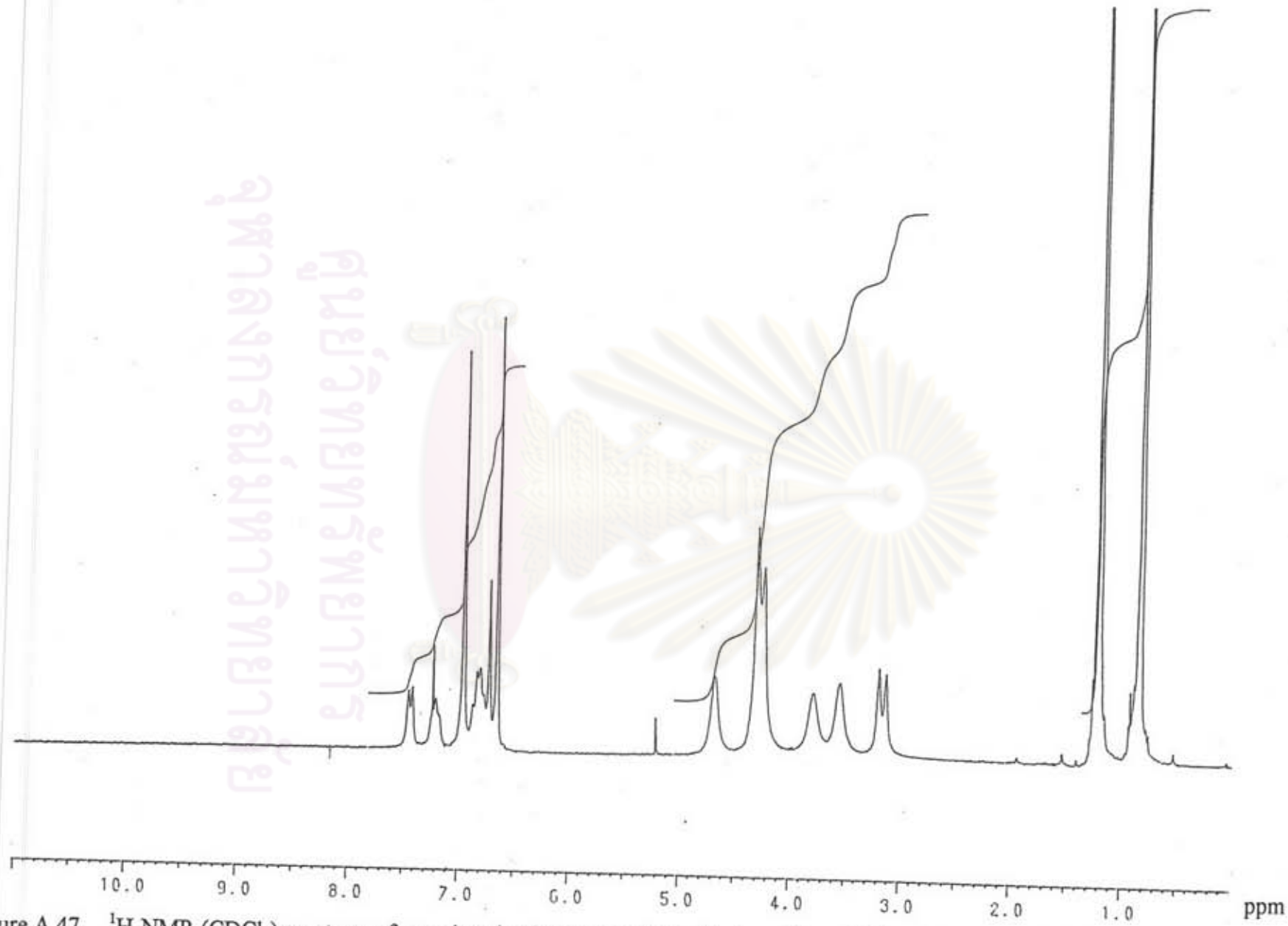


Figure A.47 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between sodium nitrate and ligand (5c) mole ratio (A : L) 1 : 1

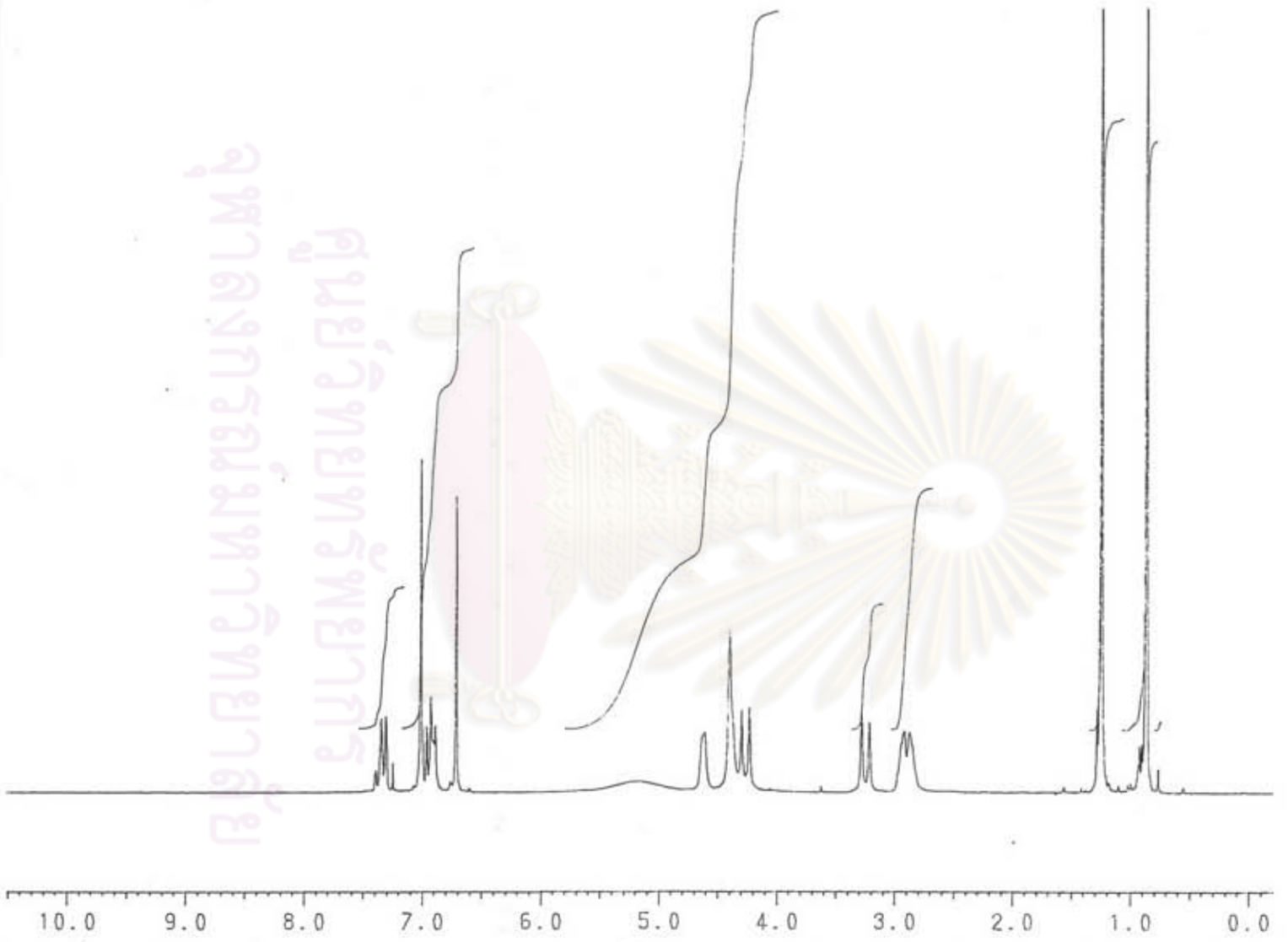


Figure A.48 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between Na_2CO_3 and ligand (5c) - nitrate ion solution (A_2 : L : A_1 = 1 : 1 : 1)

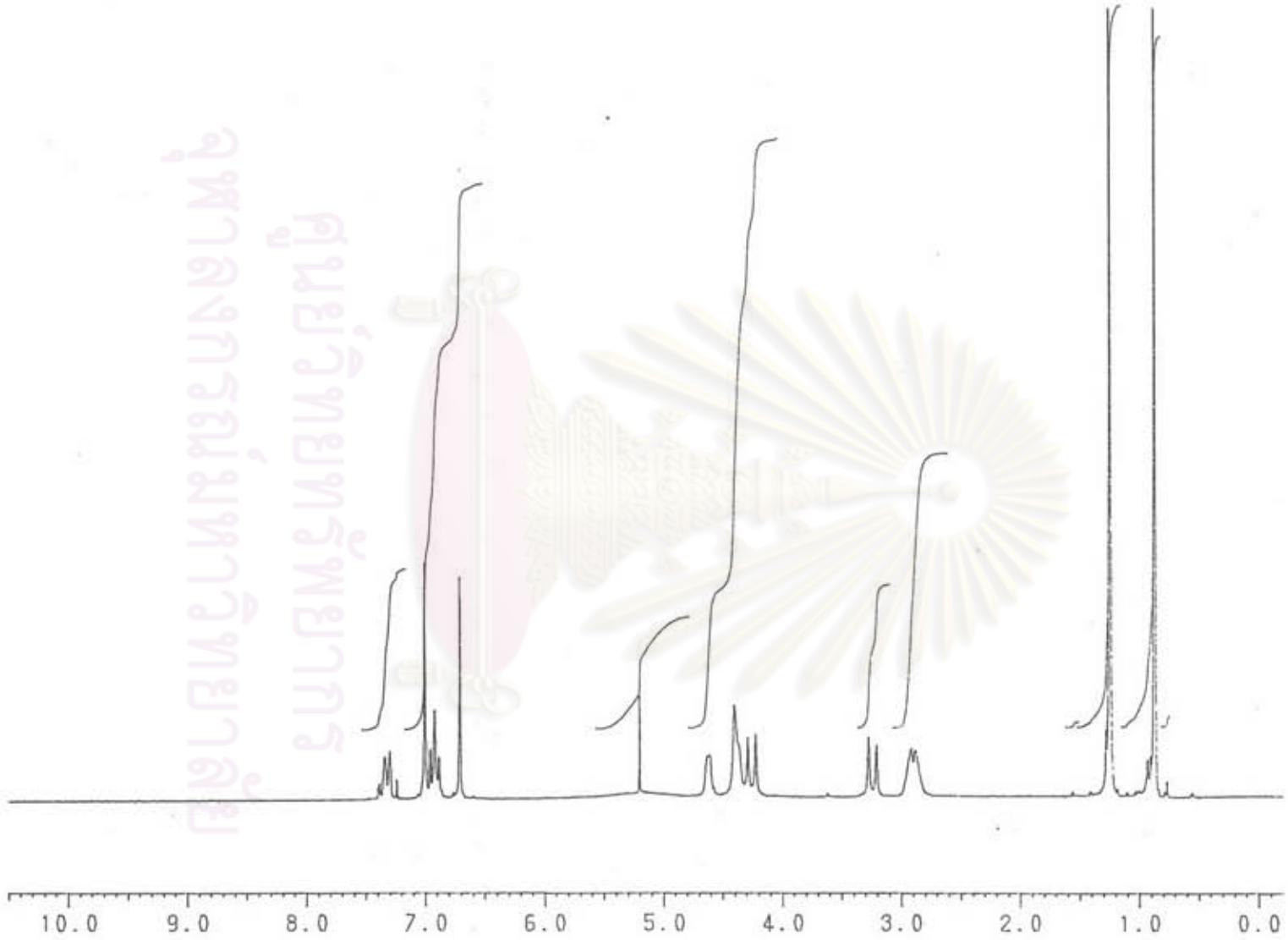


Figure A.49 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between ligand (5c) , $NaNO_3$ and Na_2CO_3 (L : A : A = 1 : 1 : 1)

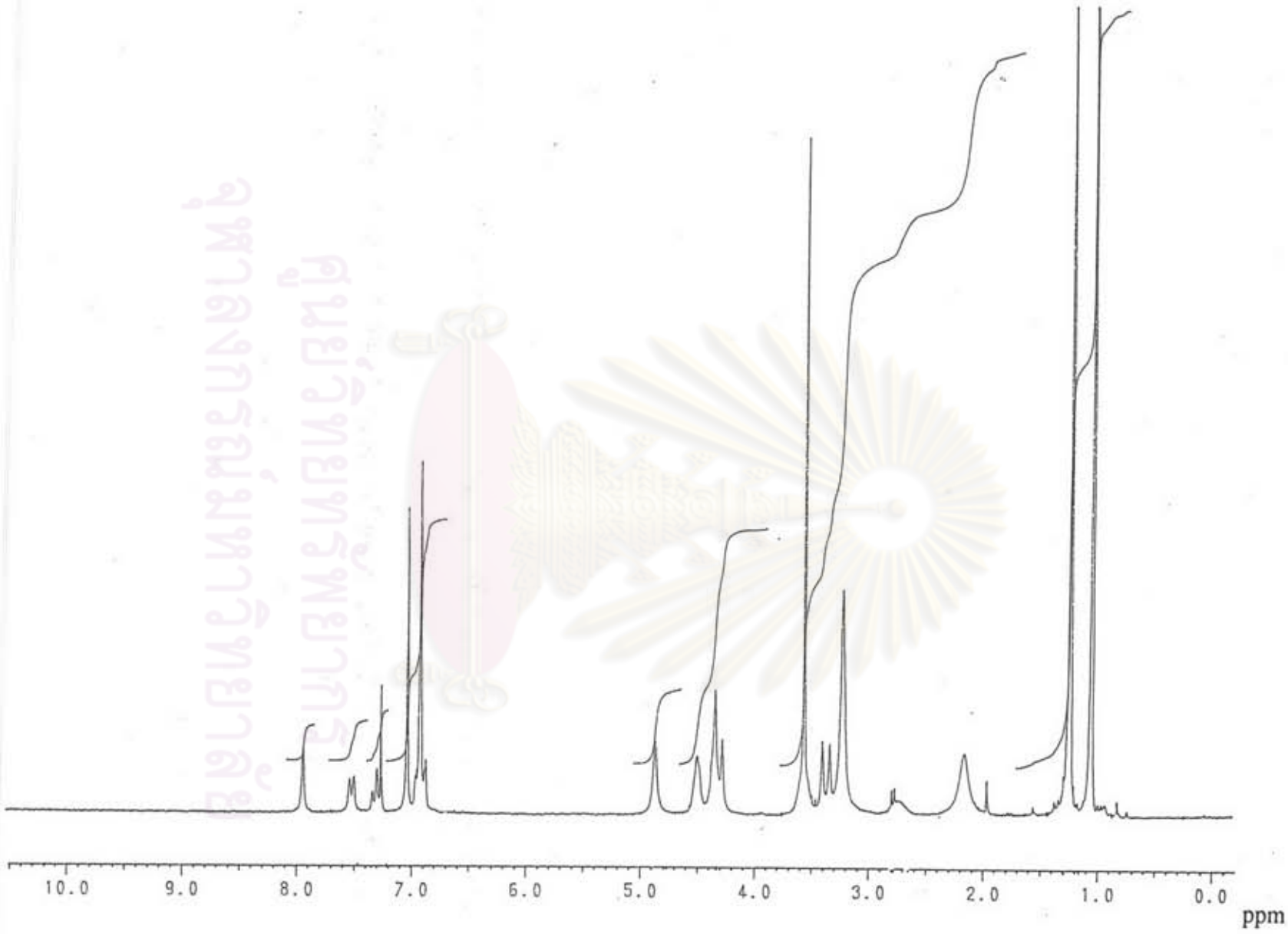


Figure A.50 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between $NaNO_3$ and ligand (7a) mole ratio (A : L) 0 : 1

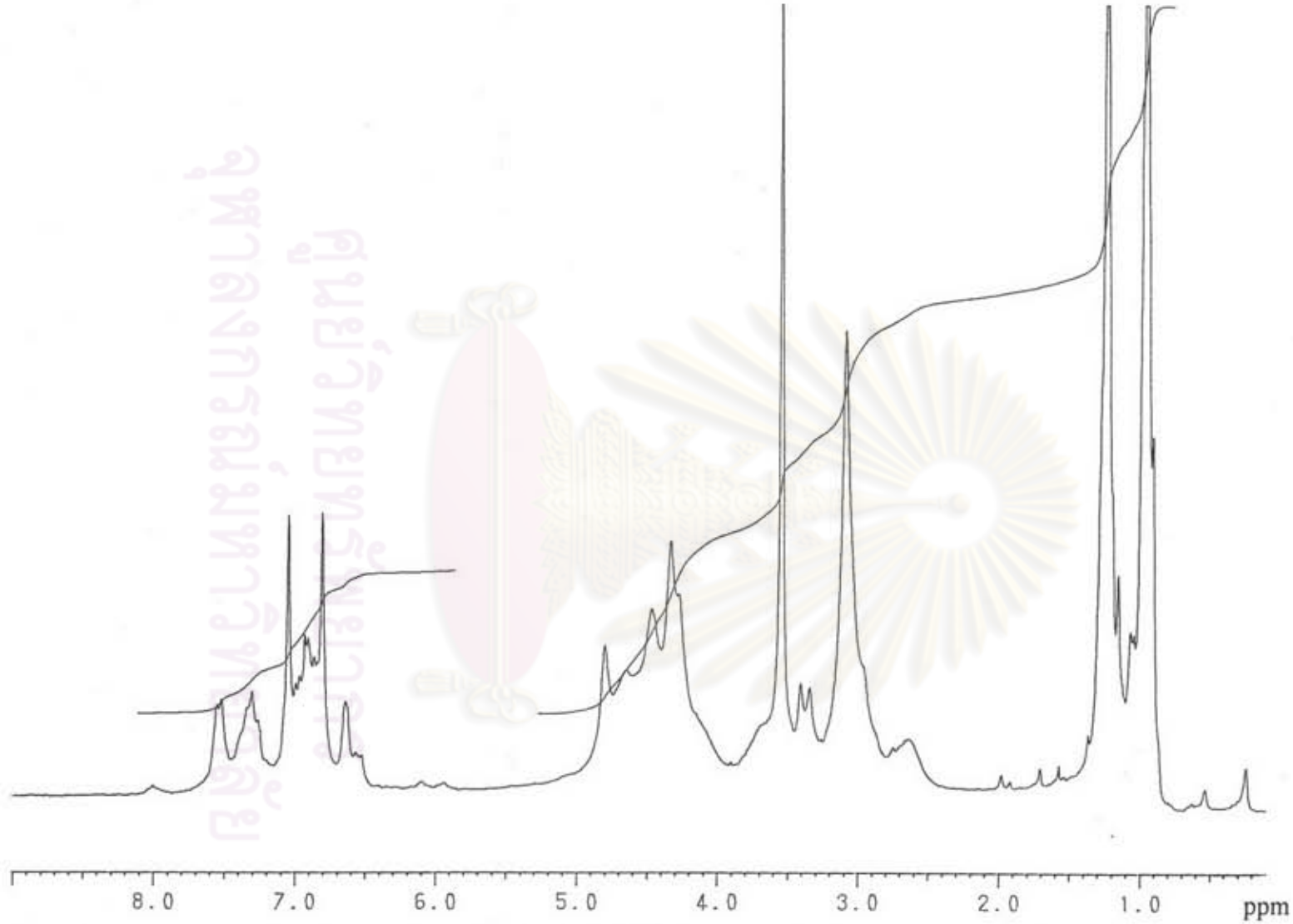


Figure A.51 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between $NaNO_3$ and ligand (7a) mole ratio (A : L) 1 : 1

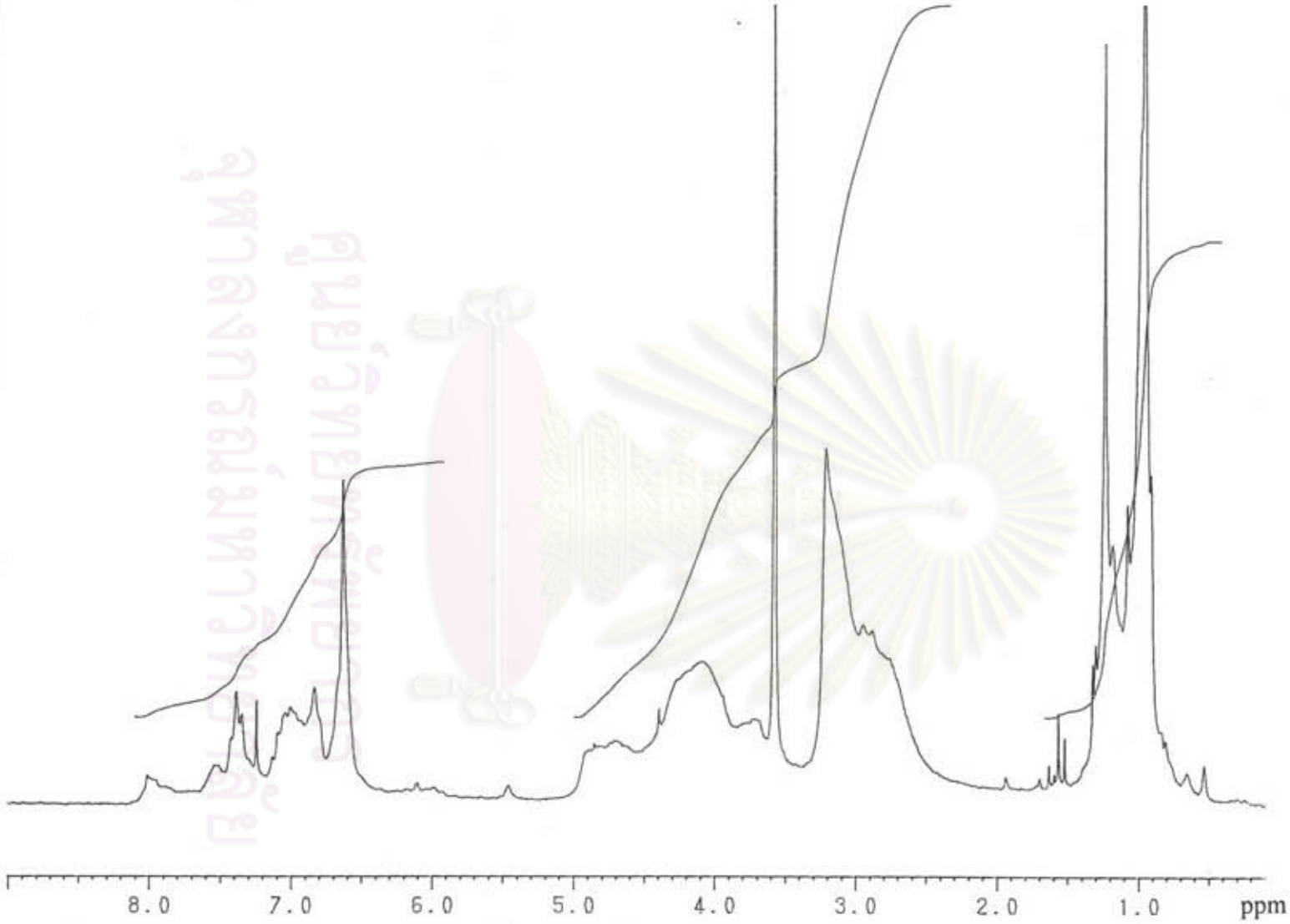


Figure A.52 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between $NaNO_3$ and ligand (7a) mole ratio (A : L) 4 : 1

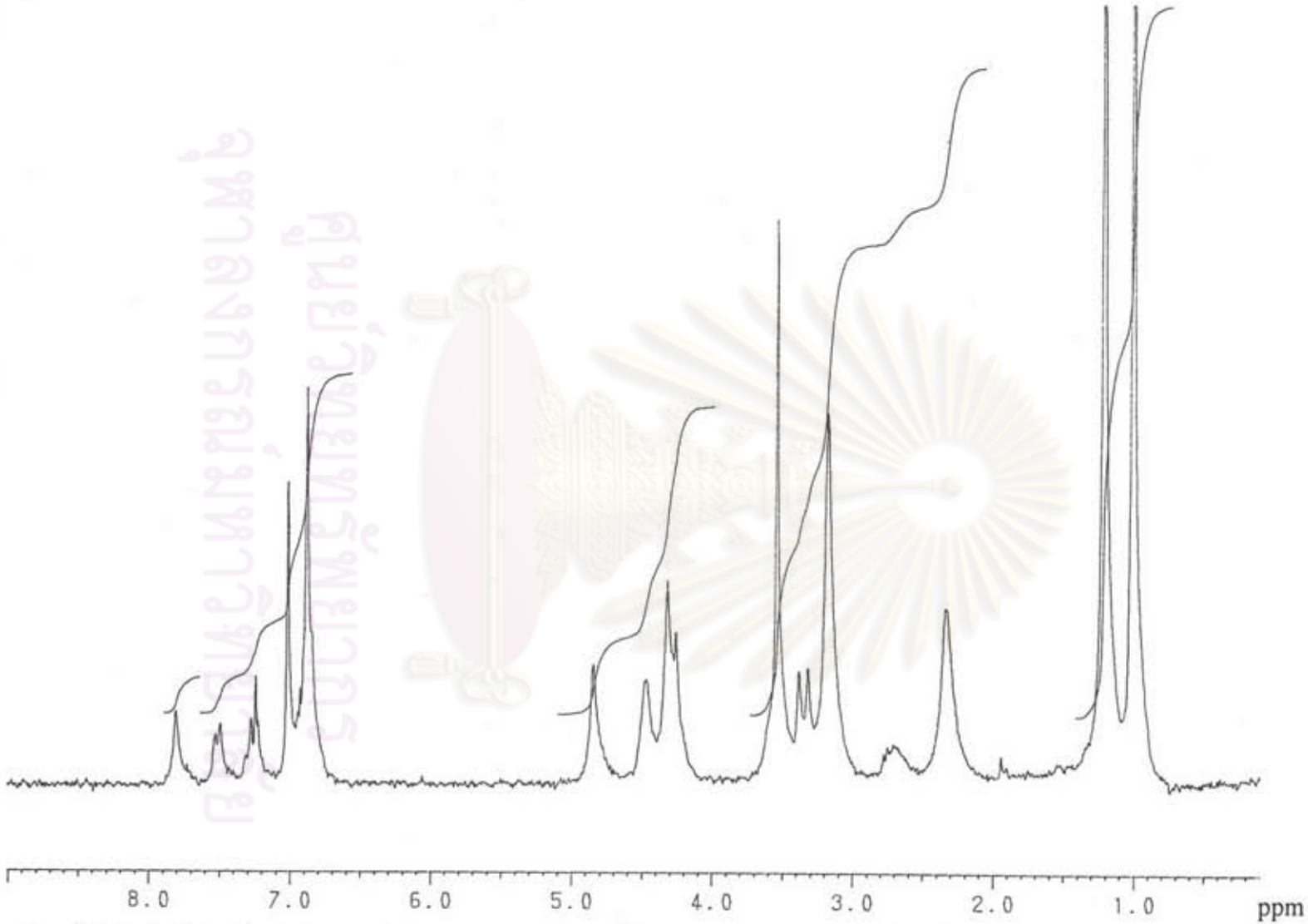


Figure A.53 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between Na_2CO_3 and ligand (7a) mole ratio (A : L) 1 : 1

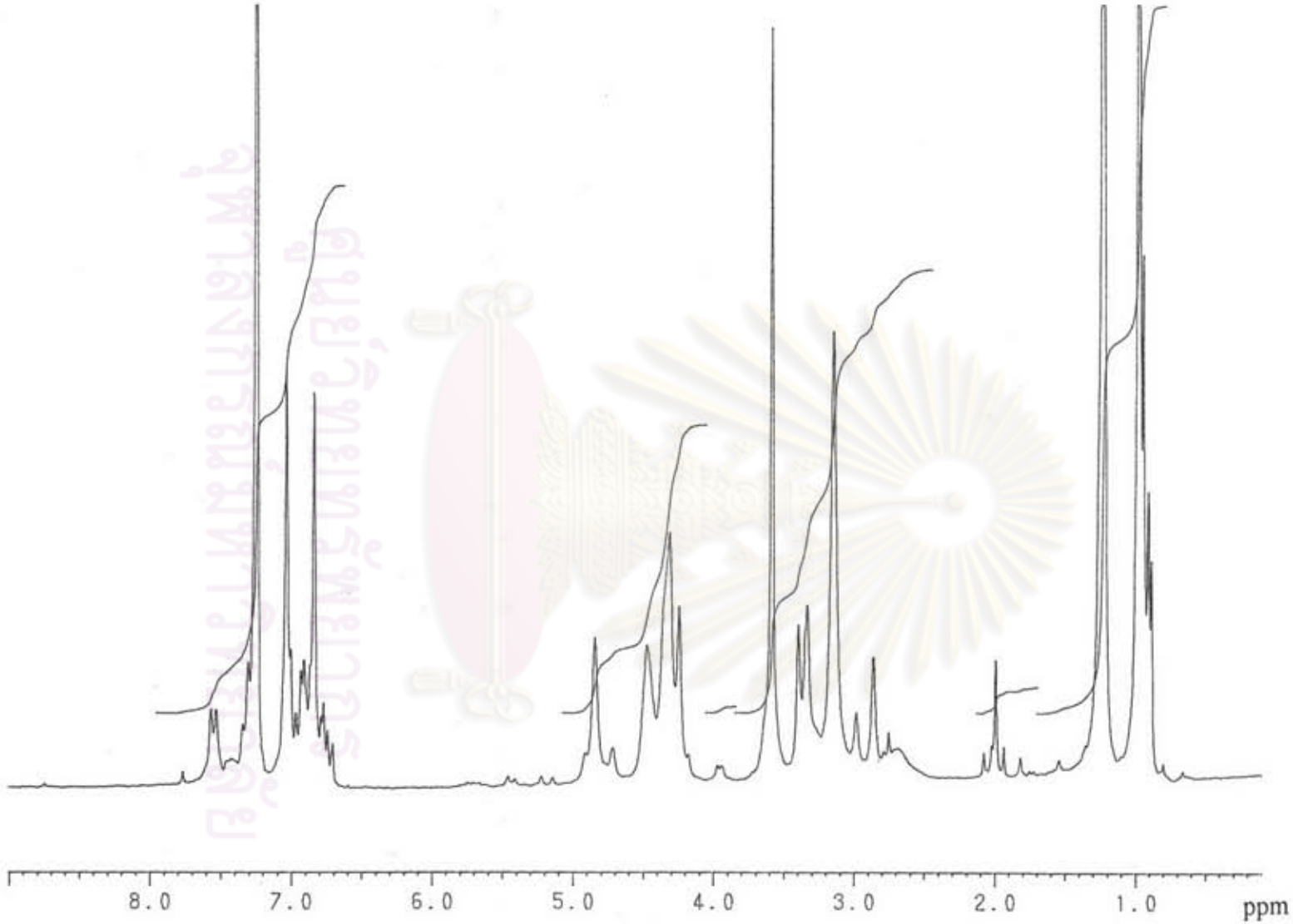


Figure A.54 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between Na_2CO_3 and ligand (7a) mole ratio (A : L) 4 : 1

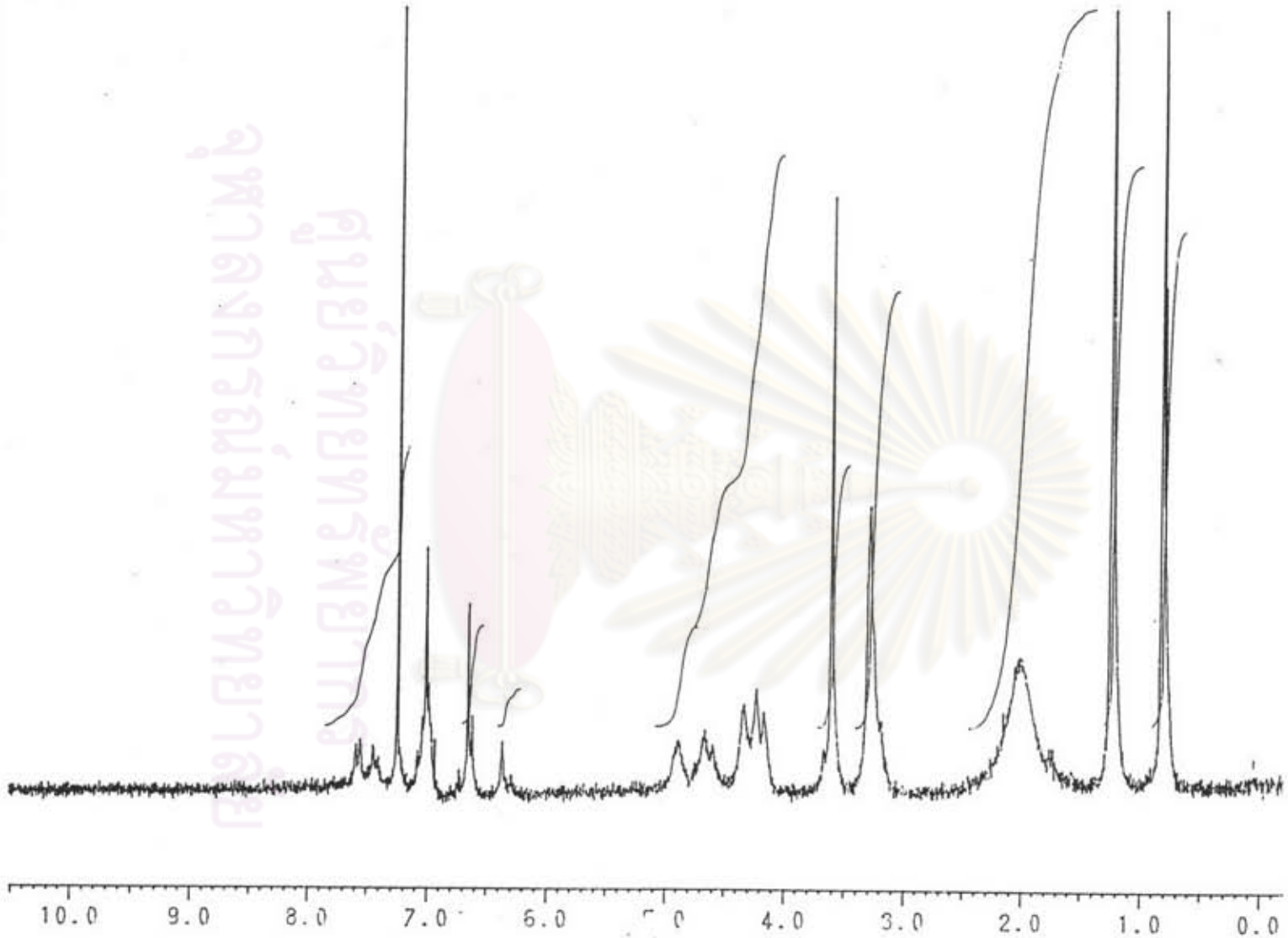


Figure A.55 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between $NaNO_3$ and ligand (7b) mole ratio (A : L) 0 : 1

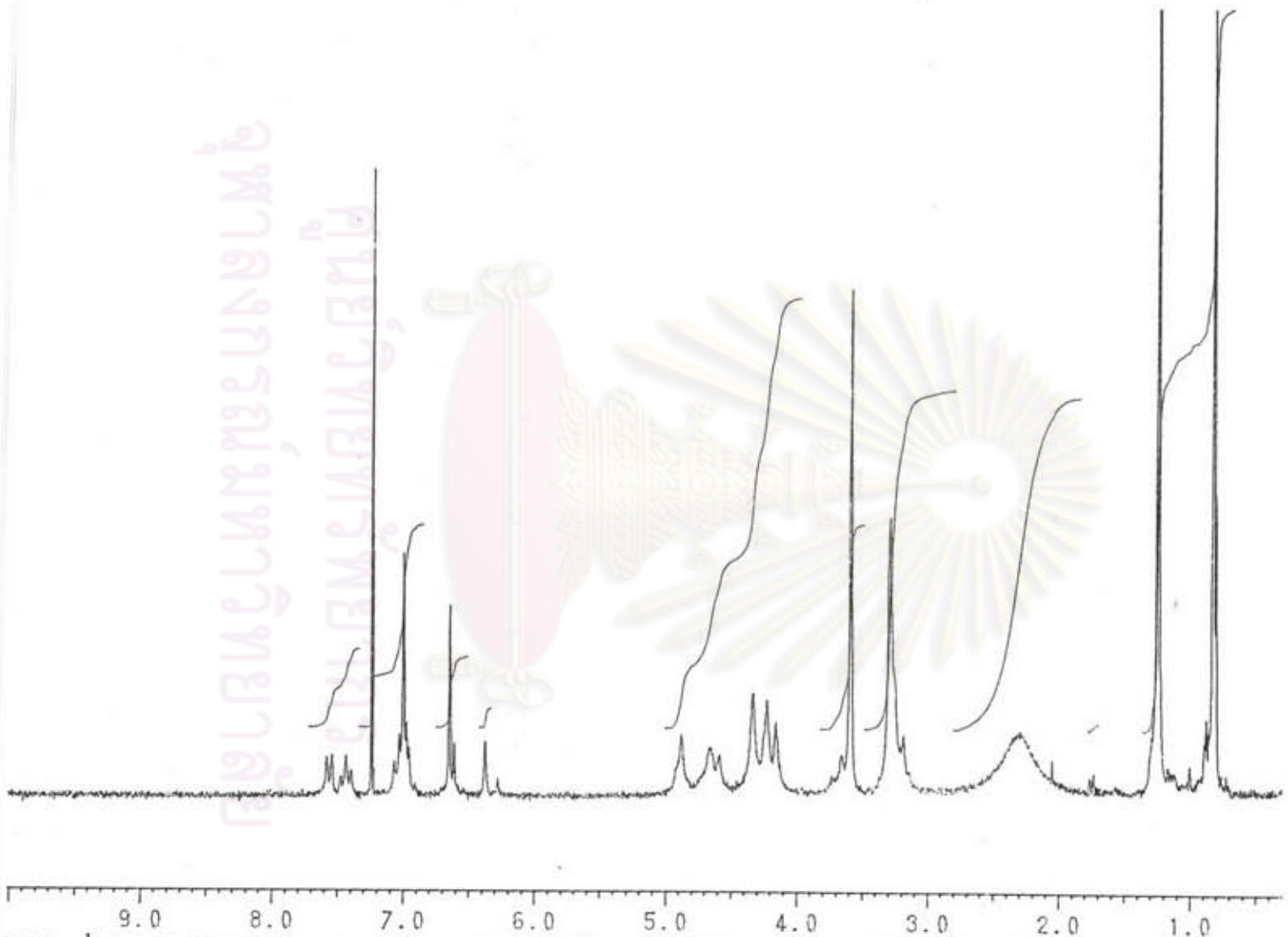


Figure A.56 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between $NaNO_3$ and ligand (7b) mole ratio (A : L) 1 : 1

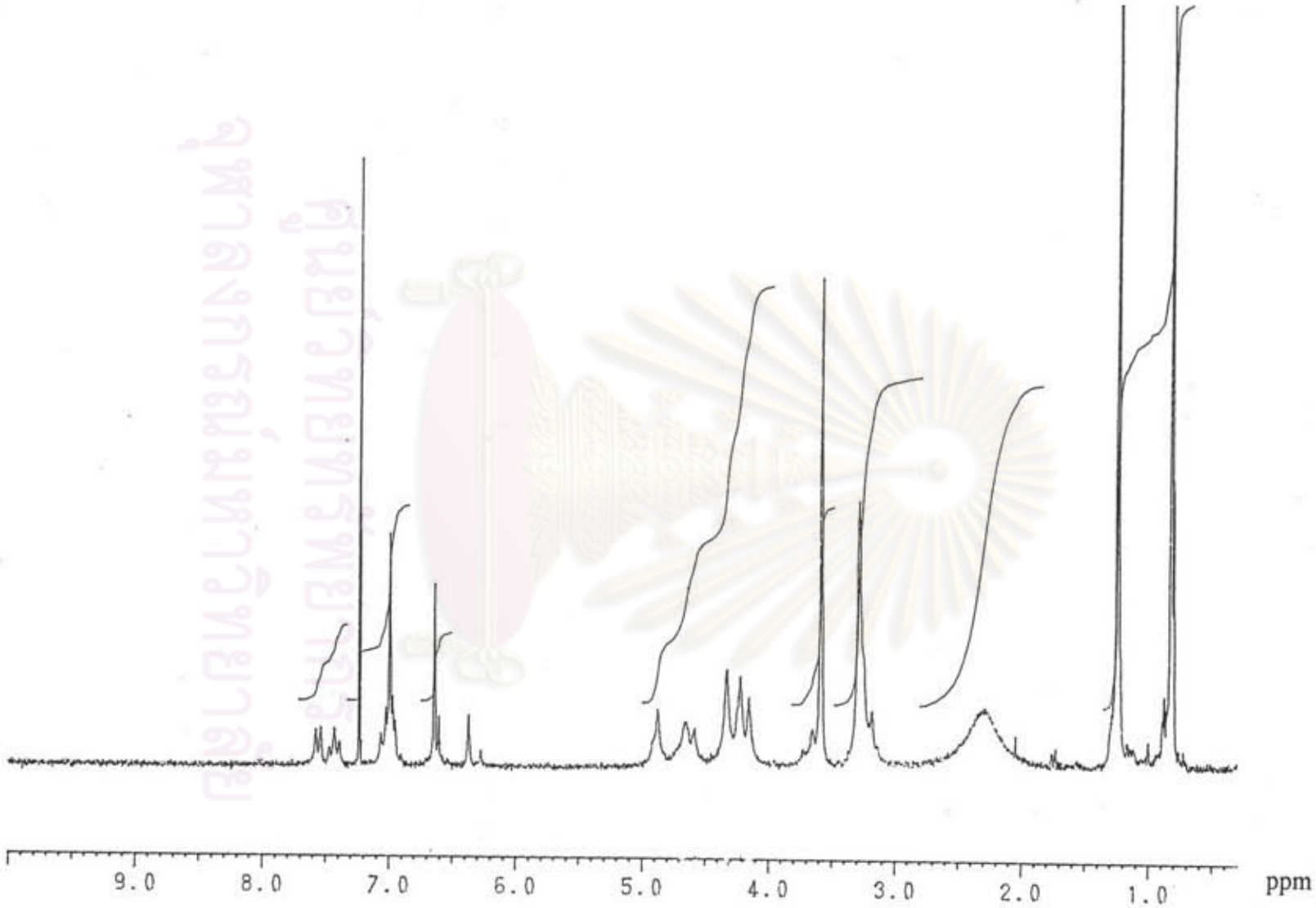


Figure A.57 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between $NaNO_3$ and ligand (7b) mole ratio (A : L) 4 : 1

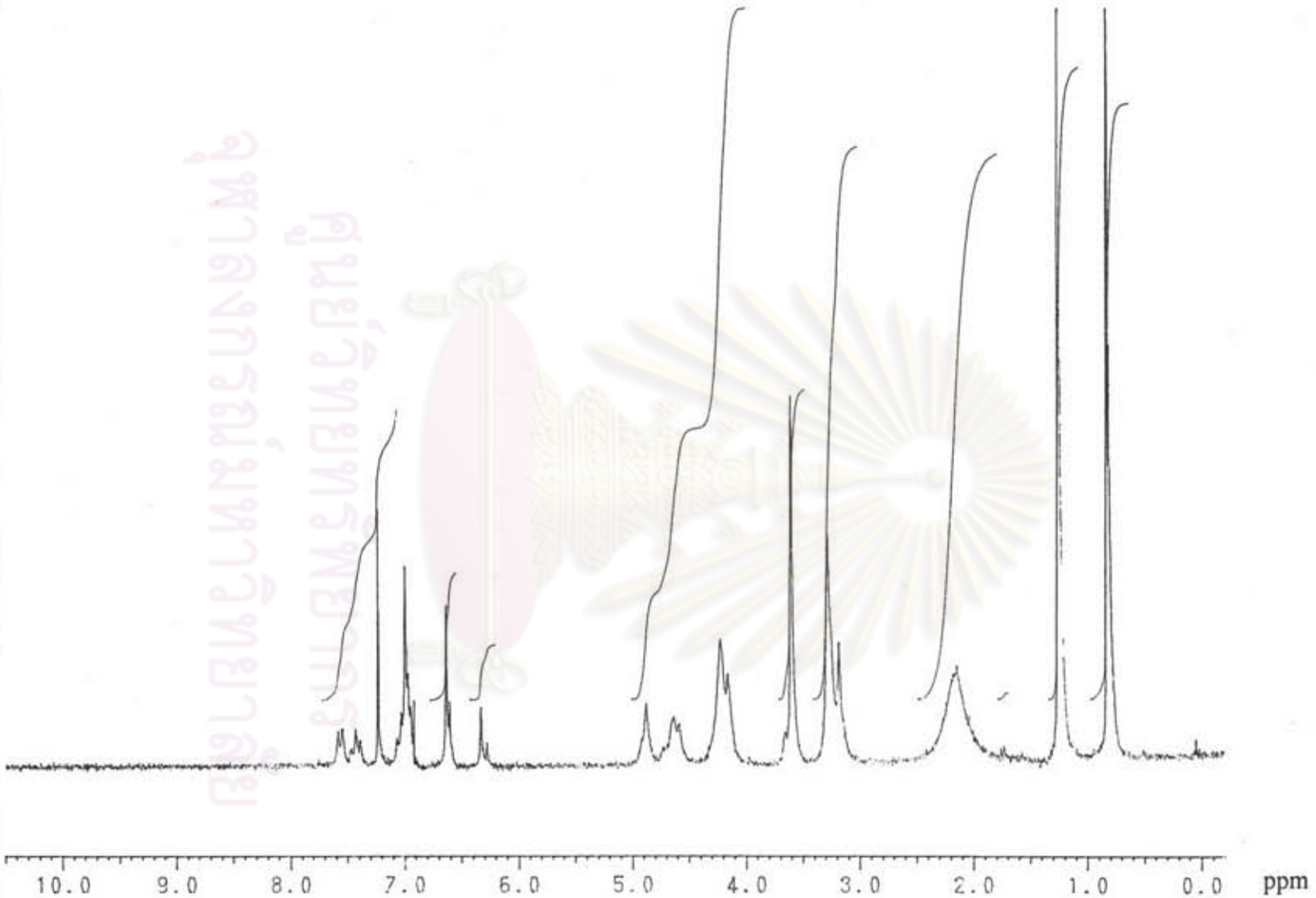


Figure A.58 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between Na_2CO_3 and ligand (7b) mole ratio (A : L) 1 : 1

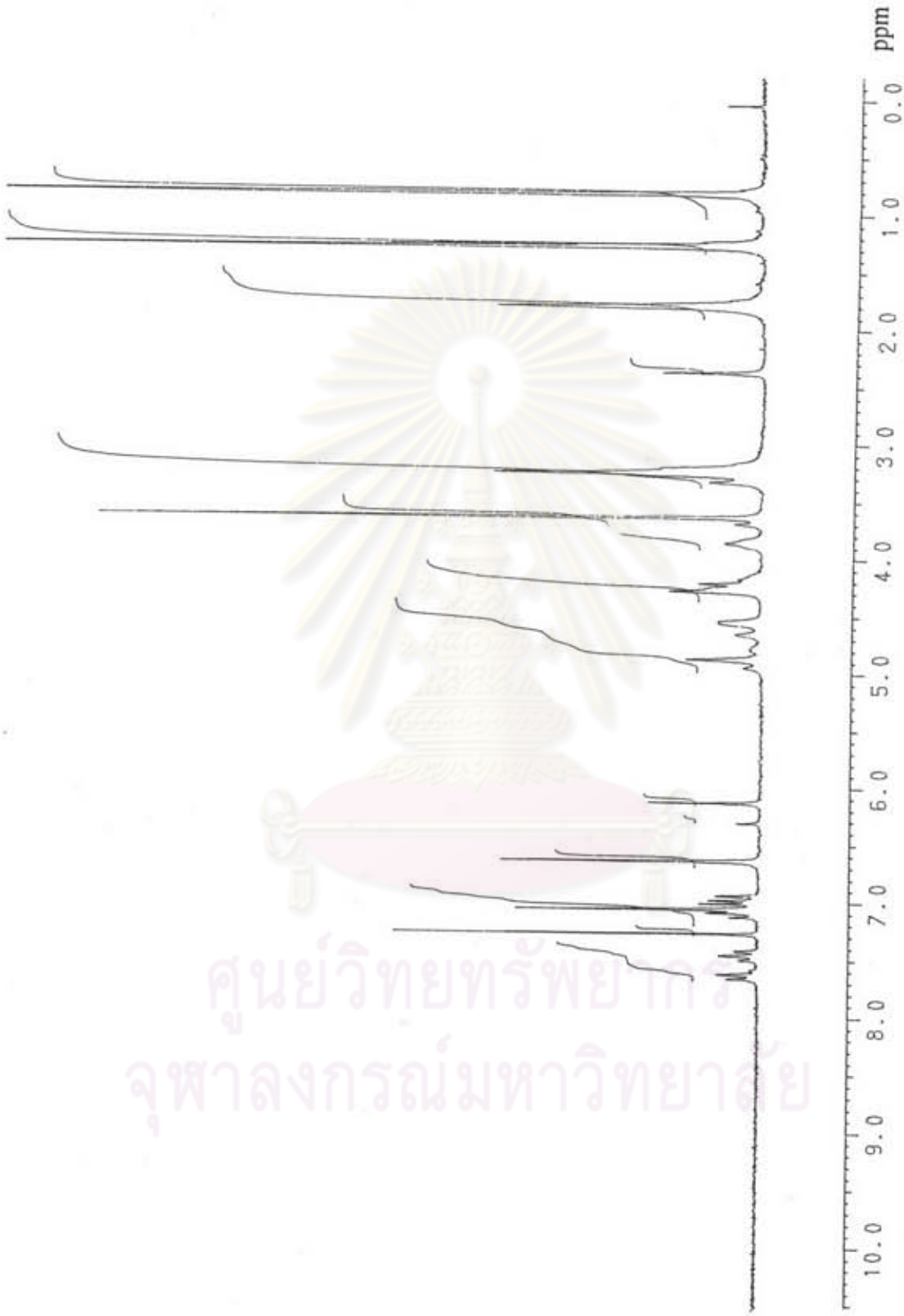


Figure A.59 ^{1}H-NMR ($CDCl_3$) spectrum of complexation between Na_2CO_3 and ligand (7b) mole ratio (A : L) 4 : 1

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Related Work :

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1993-1994	Metallurgy and Material Science Research Institute, Chulalongkorn University - Synthesis of Silicontetrachloride from rice husk
1993-Present	Department of Chemistry, Chulalongkorn University - Teaching Assistant - Research Assistant