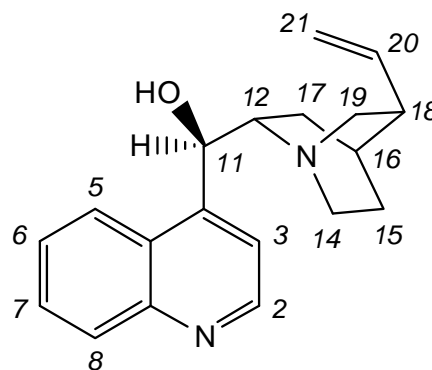


**Discussion Section Exercise:
2-Dimensional NMR Spectroscopy**

^1H , ^{13}C , ^1H - ^1H COSY, and ^1H - ^{13}C HSQC NMR of cinchonidine are shown on the following pages. (HSQC is a technique that is entirely analogous to HMQC, except that it analyzes single [S] quantum correlations rather than multiple [M] ones. HSQC generally yields narrower, better resolved peaks, but is more sensitive to sample and shim quality.)

Assign each of the numbered nuclei in the chart below to a chemical shift in the ^1H or ^{13}C spectra.



Name of hydrogen	δ (ppm)
H2	
H3	
H5	
H6	
H7	
H8	
H11	
H12	
H14a	
H14b	
H15a	

Name of hydrogen	δ (ppm)
H15b	
H16	
H17a	
H17b	
H18	
H19a	
H19b	
H20	
H21a	
H21b	

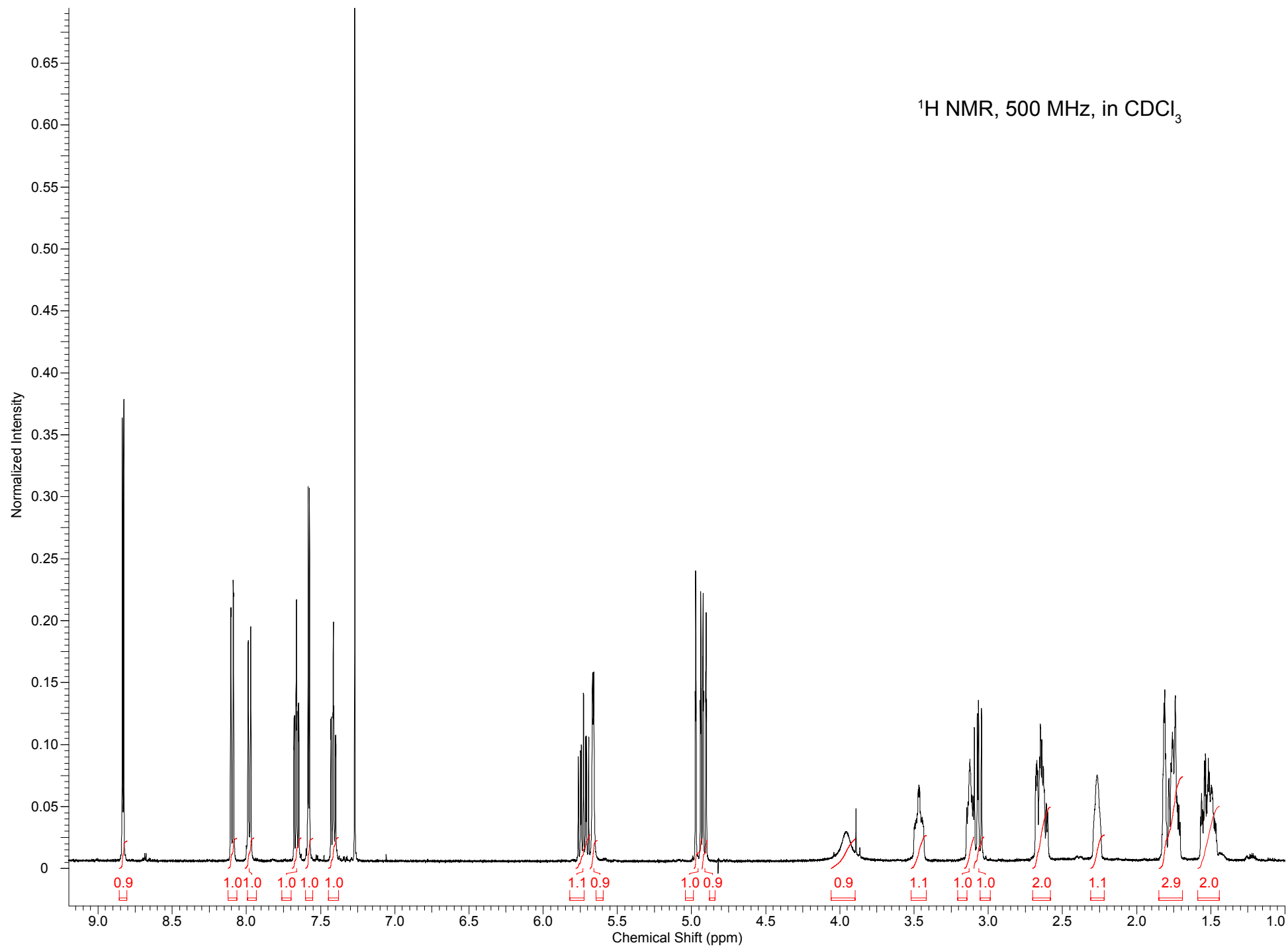
Name of carbon	δ (ppm)
C2	
C3	
C5	
C6	
C7	
C8	
C11	
C12	
C14	
C15	
C16	

Name of carbon	δ (ppm)
C17	
C18	

Name of carbon	δ (ppm)
C19	
C20	

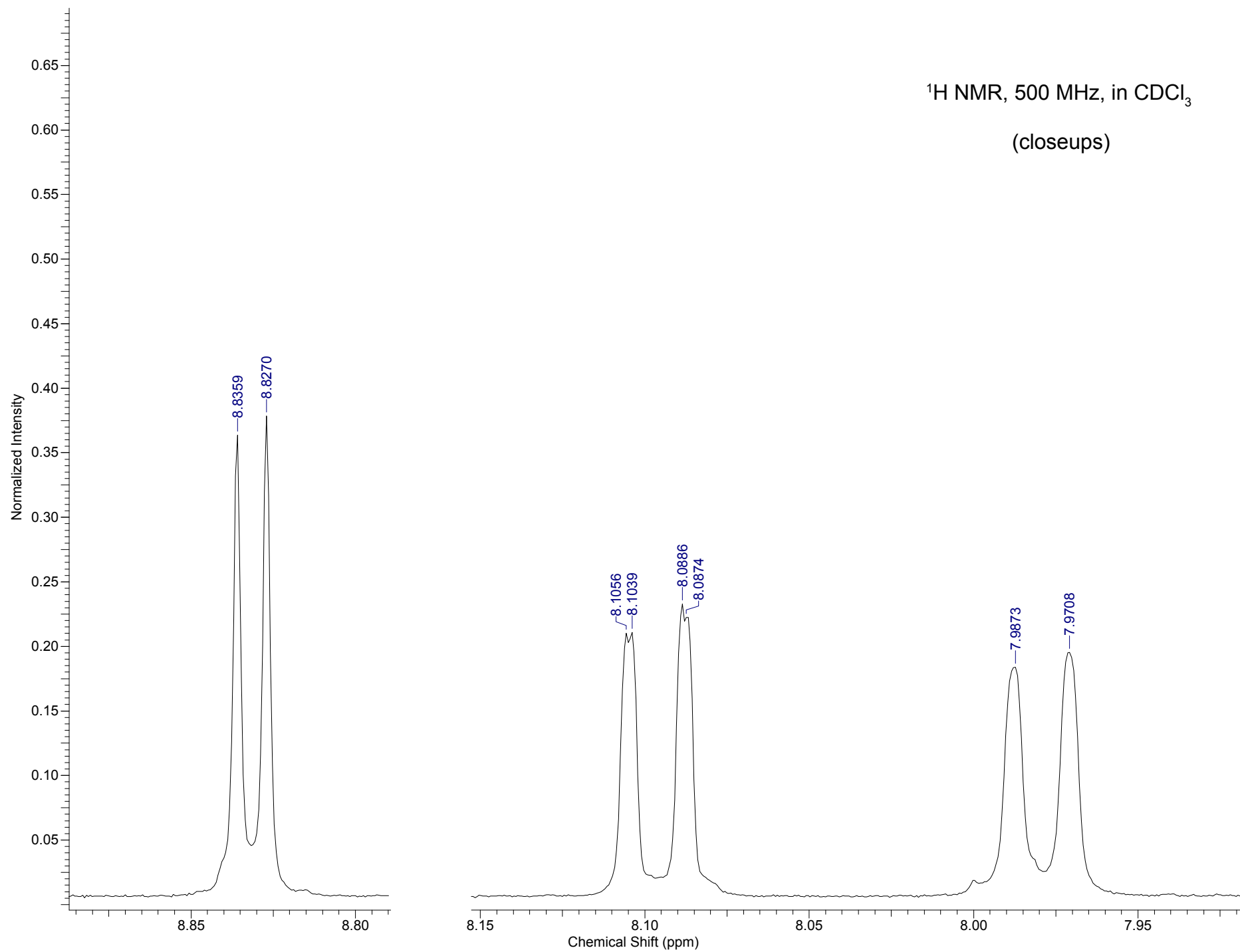
Name of carbon	δ (ppm)
C21	

^1H NMR, 500 MHz, in CDCl_3



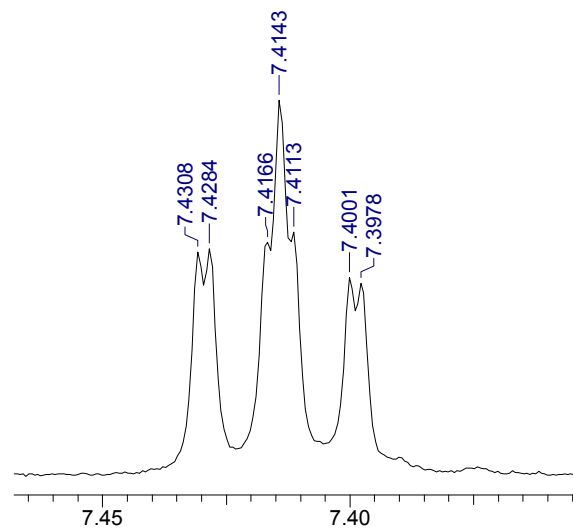
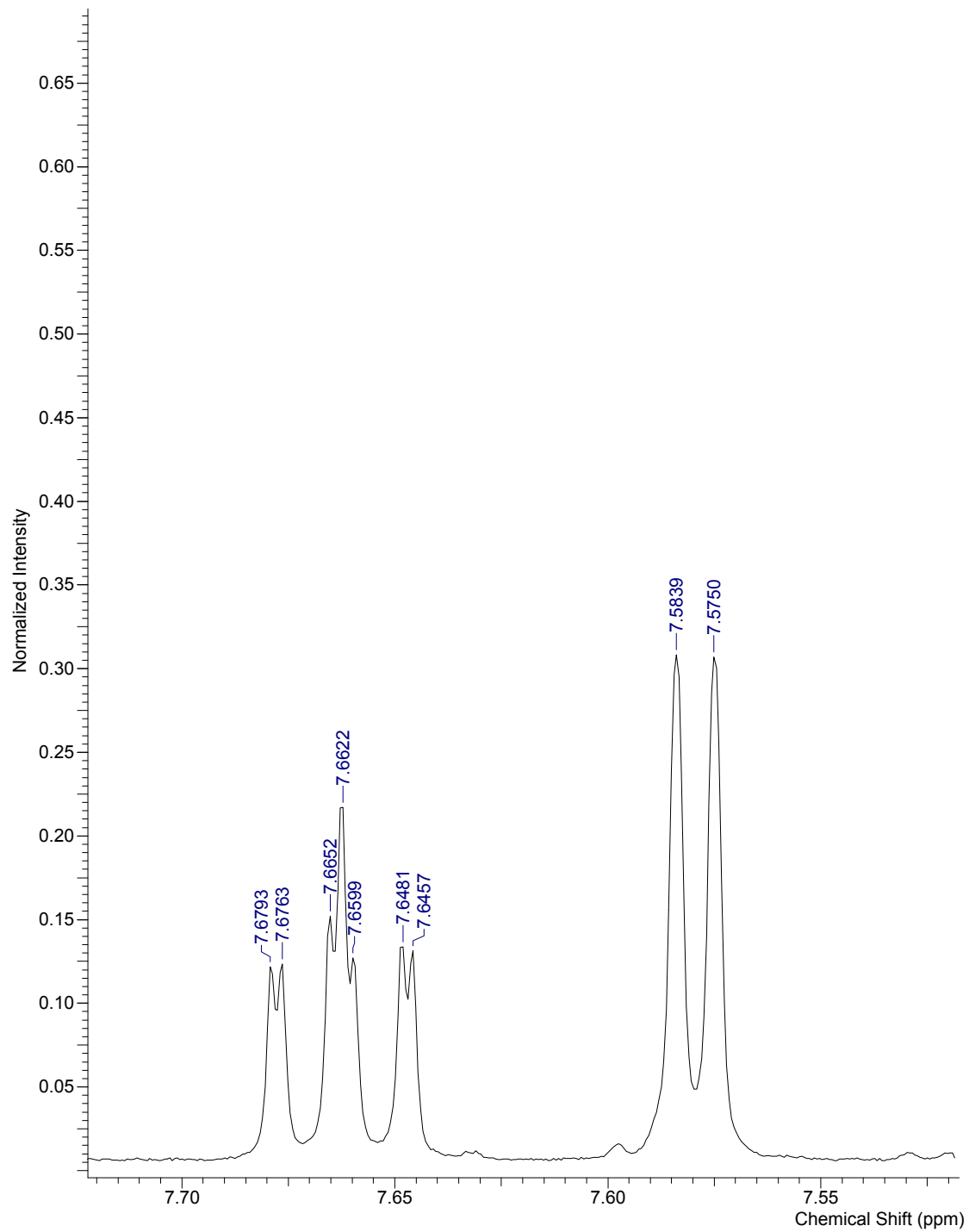
^1H NMR, 500 MHz, in CDCl_3

(closeups)



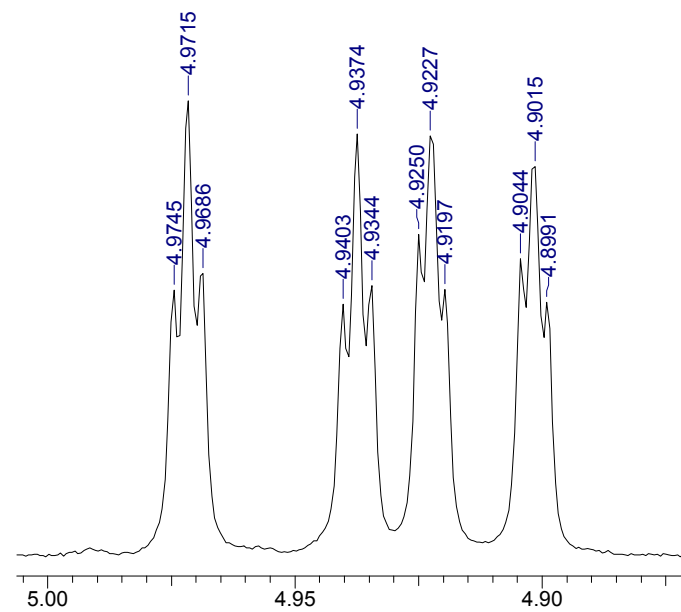
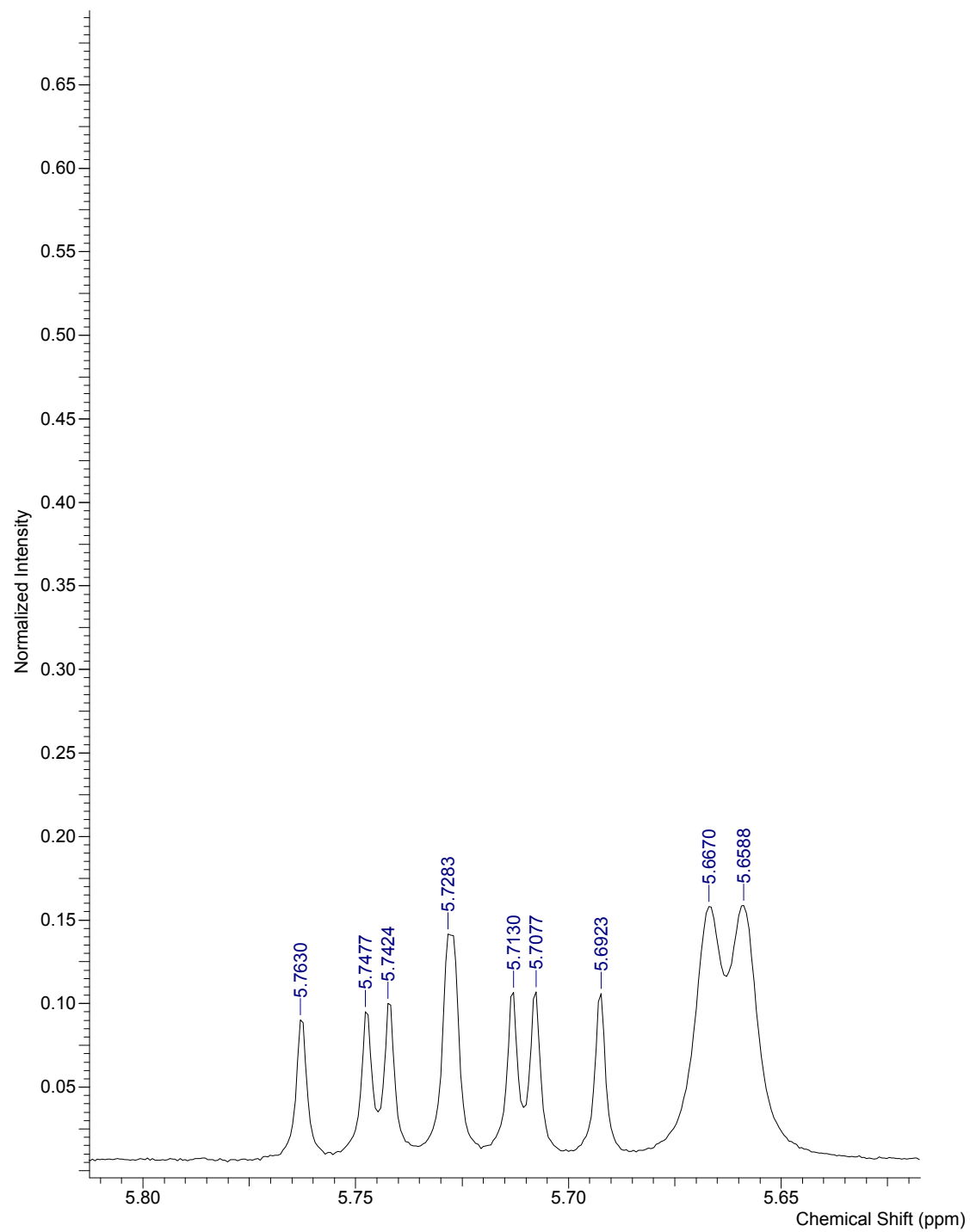
^1H NMR, 500 MHz, in CDCl_3

(closeups)



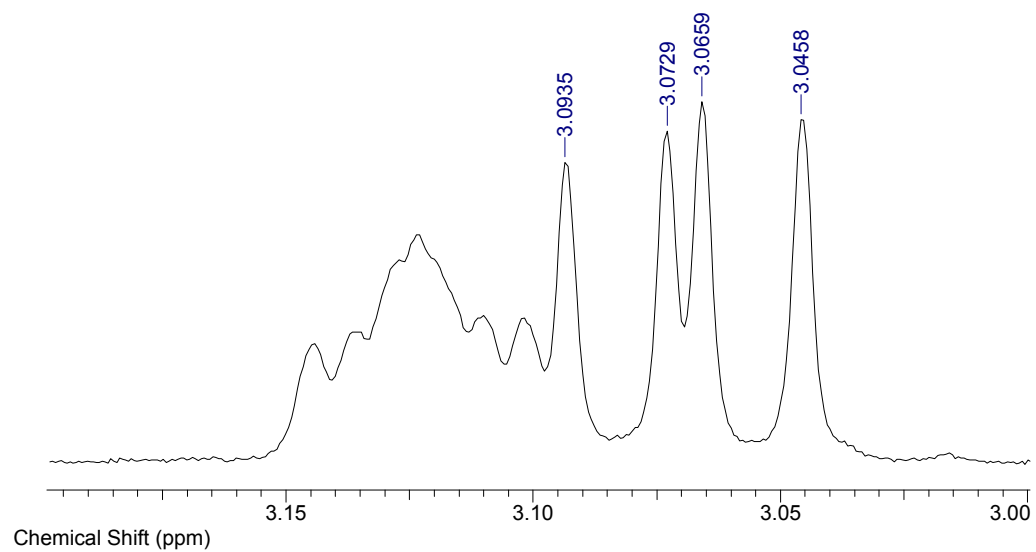
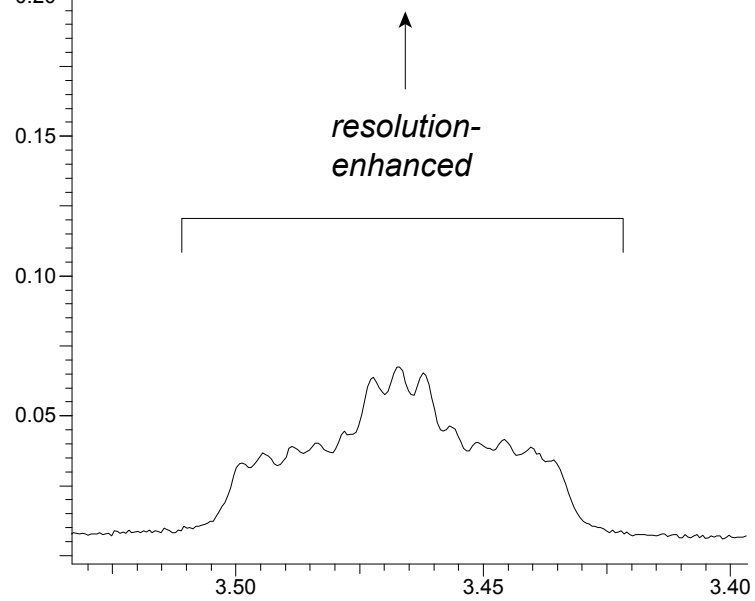
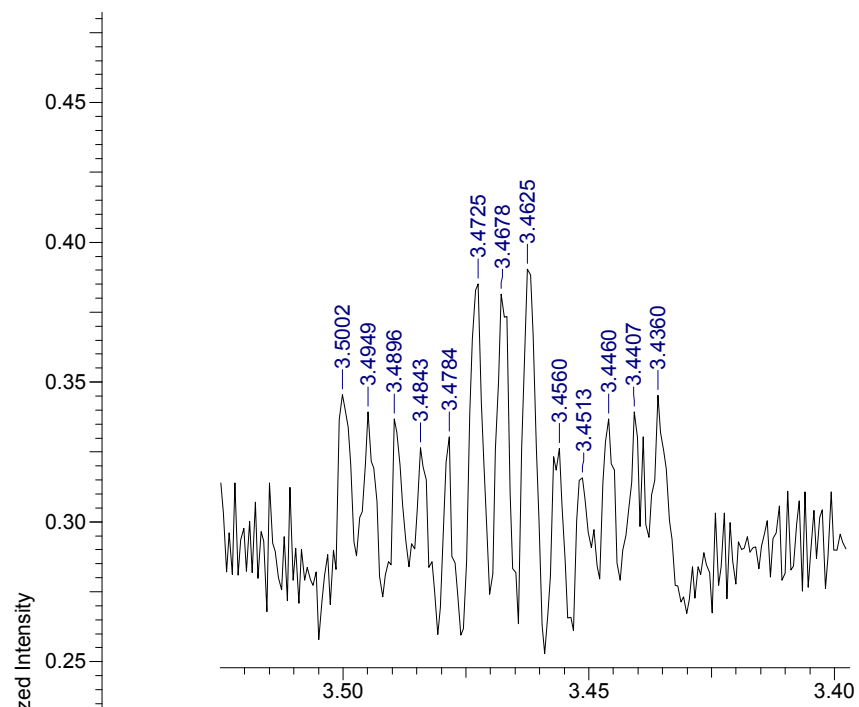
^1H NMR, 500 MHz, in CDCl_3

(closeups)



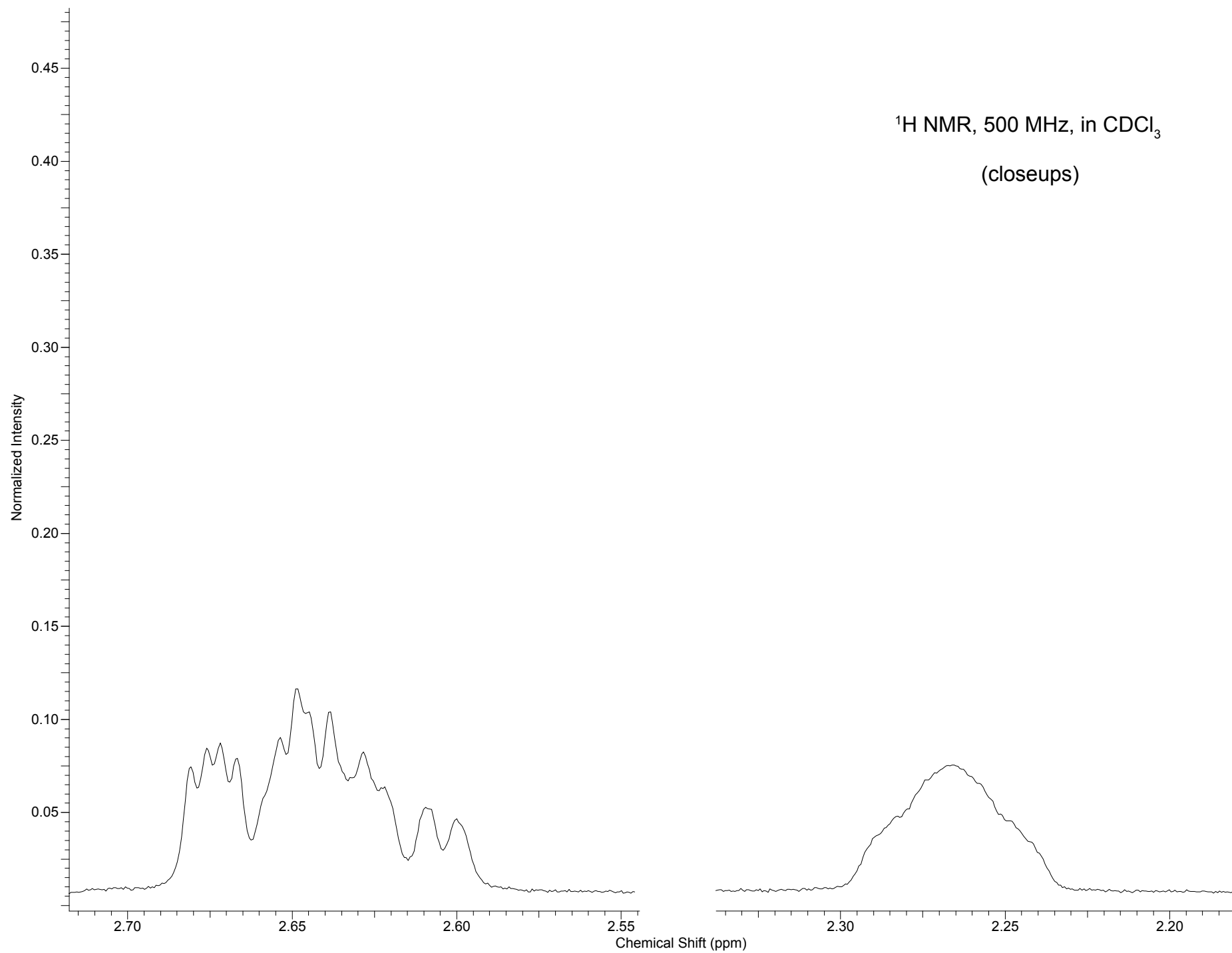
^1H NMR, 500 MHz, in CDCl_3

(closeups)



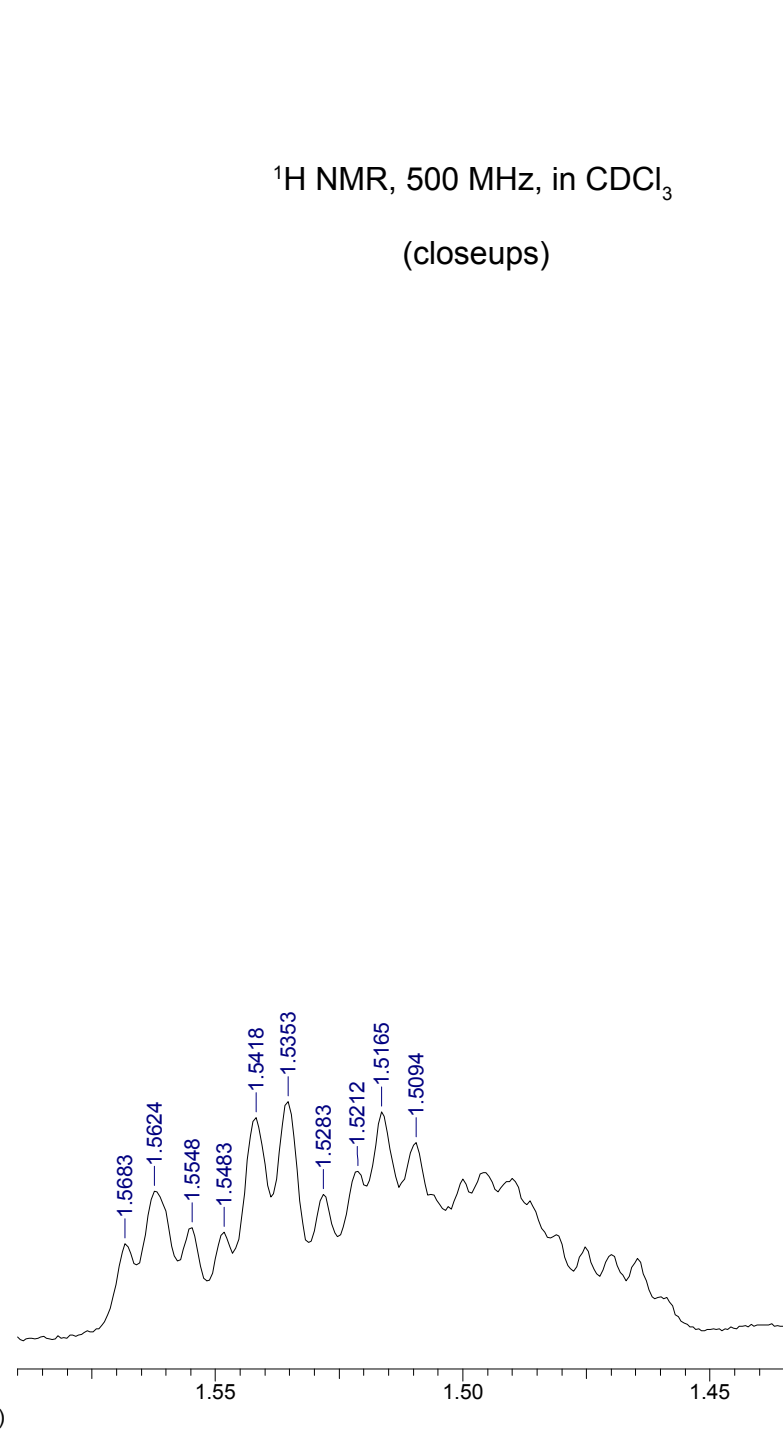
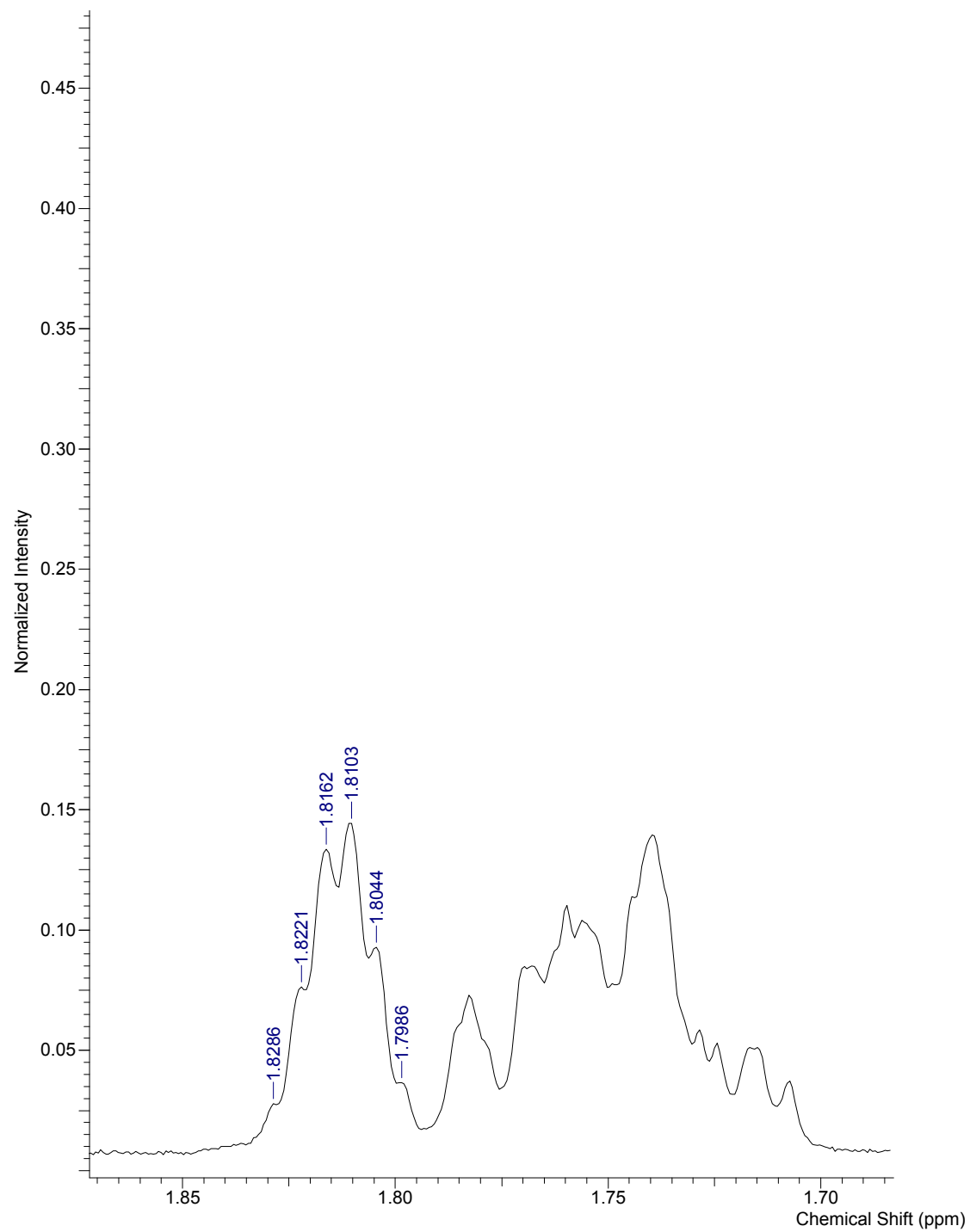
^1H NMR, 500 MHz, in CDCl_3

(closeups)

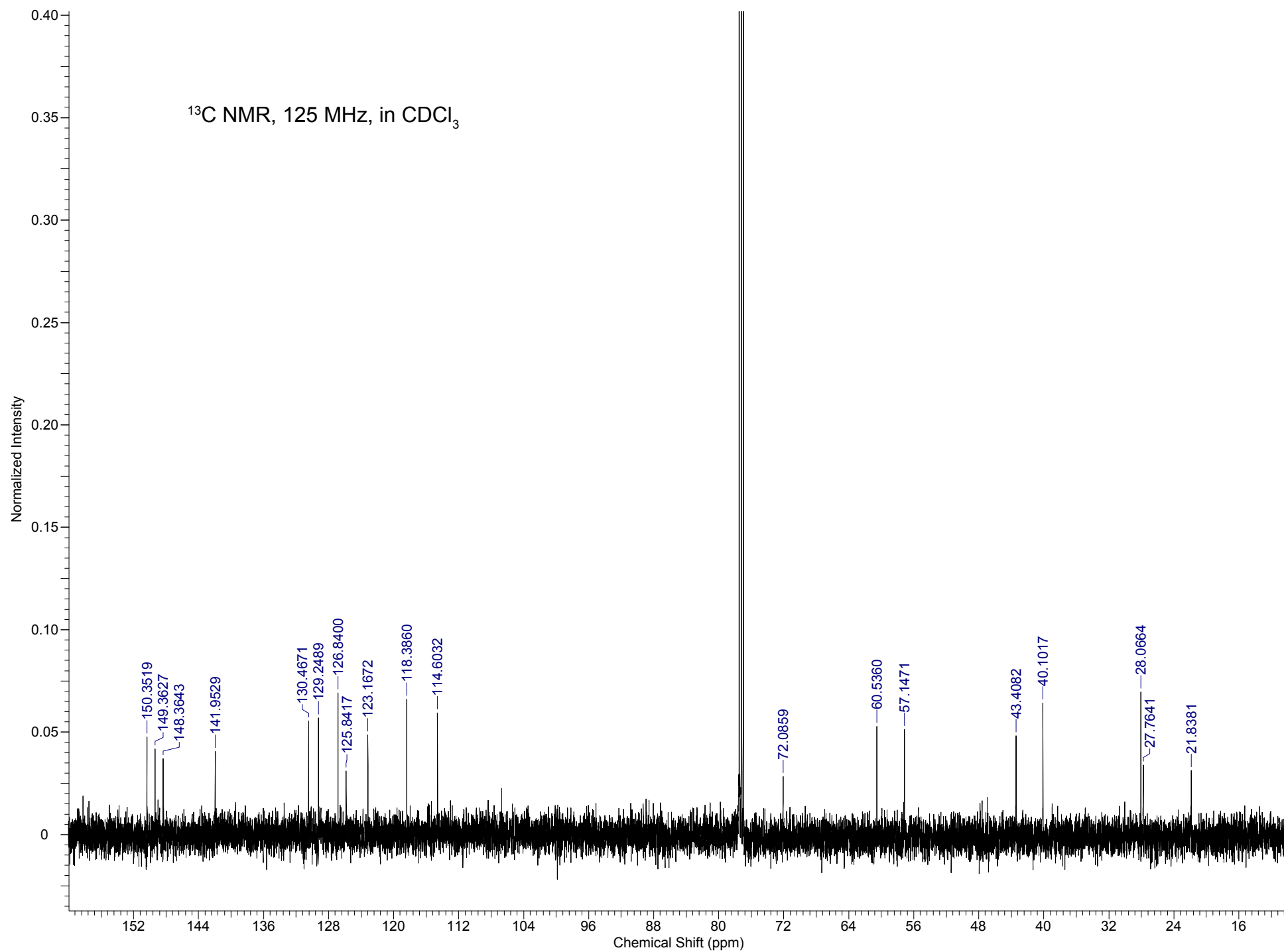


^1H NMR, 500 MHz, in CDCl_3

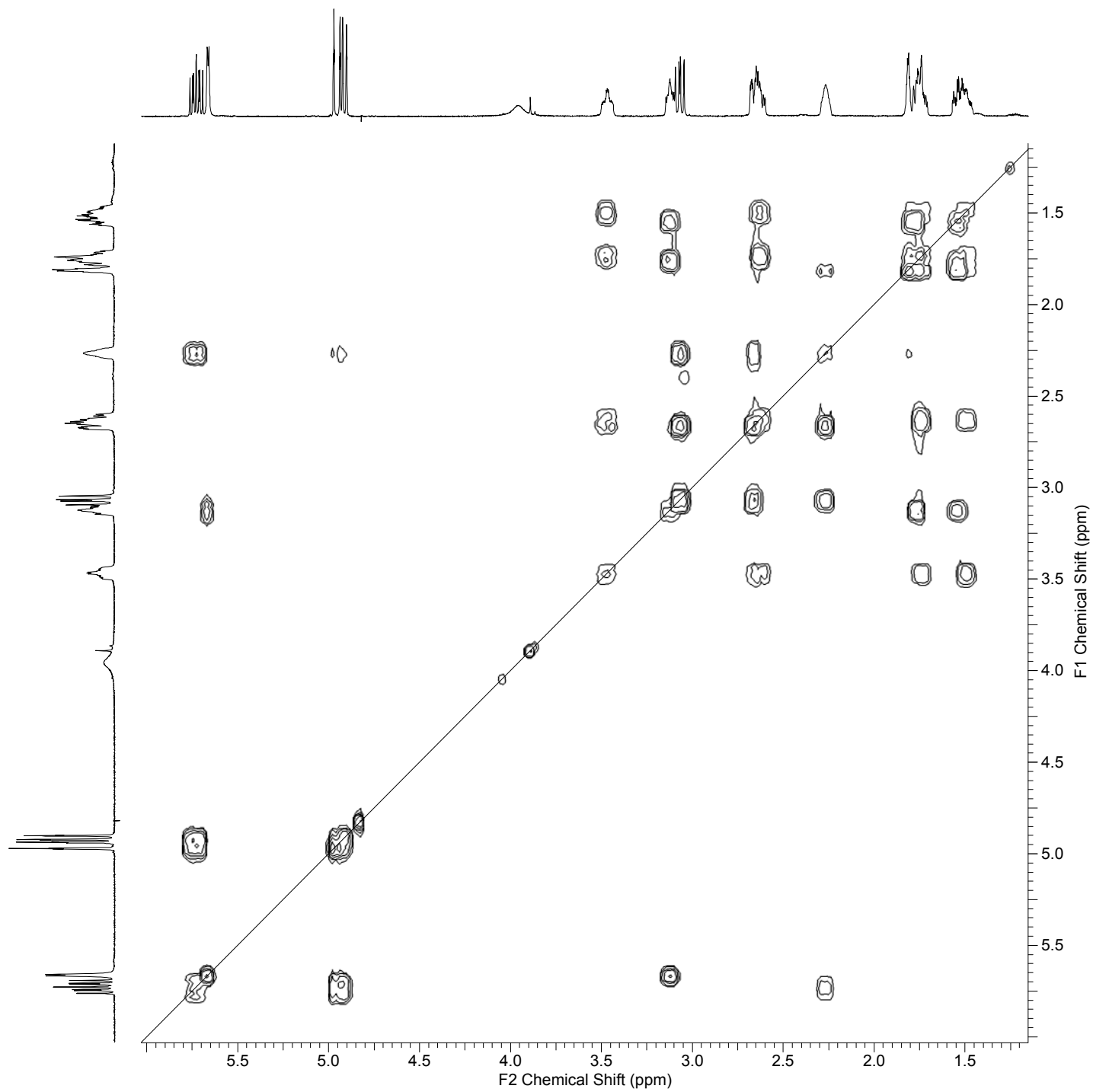
(closeups)



^{13}C NMR, 125 MHz, in CDCl_3



^1H - ^1H COSY, 500 MHz, in CDCl_3
(closeup)



^1H - ^{13}C HSQC, 500/125 MHz, in CDCl_3

