CHAPTER V

CONCLUSION

Six pure compounds were isolated from the stem bark of *Goniothalamus tenuifolius*, collected from Kaengkrachan in Phetchaburi province. Amoung these compounds, four of them are aristolactams, namely aristolactam BII or cepharanone B (GT-B), taliscanine (GT-C), velutinam (GT-D) and aristolactam AII (GT-F). The remainder are the 4,5-dioxoaporphine alkaloid norcepharadione B (GT-E) and the ethyl ester of 2,4-dihydroxy-6-methylbenzoic acid (GT-A). The unambiguous ^{13}C assignments of taliscanine and aristolactam AII were obtained for the first time in this study. With regard to the antimalarial activity of the aristolactam and dioxoaporphine alkaloids, each showed appreciable activity against *Plasmodium falciparum* with approximately equal potency. Their structures can be used as a starting point for further drug development. Structure modification of these compounds may provide more active and clinically useful analogues. In addition, synergistic activity of these compounds with currently used drugs, such as chloroquine or quinine, should also be examined.

It should be noted that this investigation is the first report on the antimalarial activity of phenanthrene lactam alkaloids. The study exemplifies an attempt to search for antimalarial compounds from natural sources. It also provides useful information on the phytochemistry and chemotaxonomy of the plant *G. tenuifolius*.

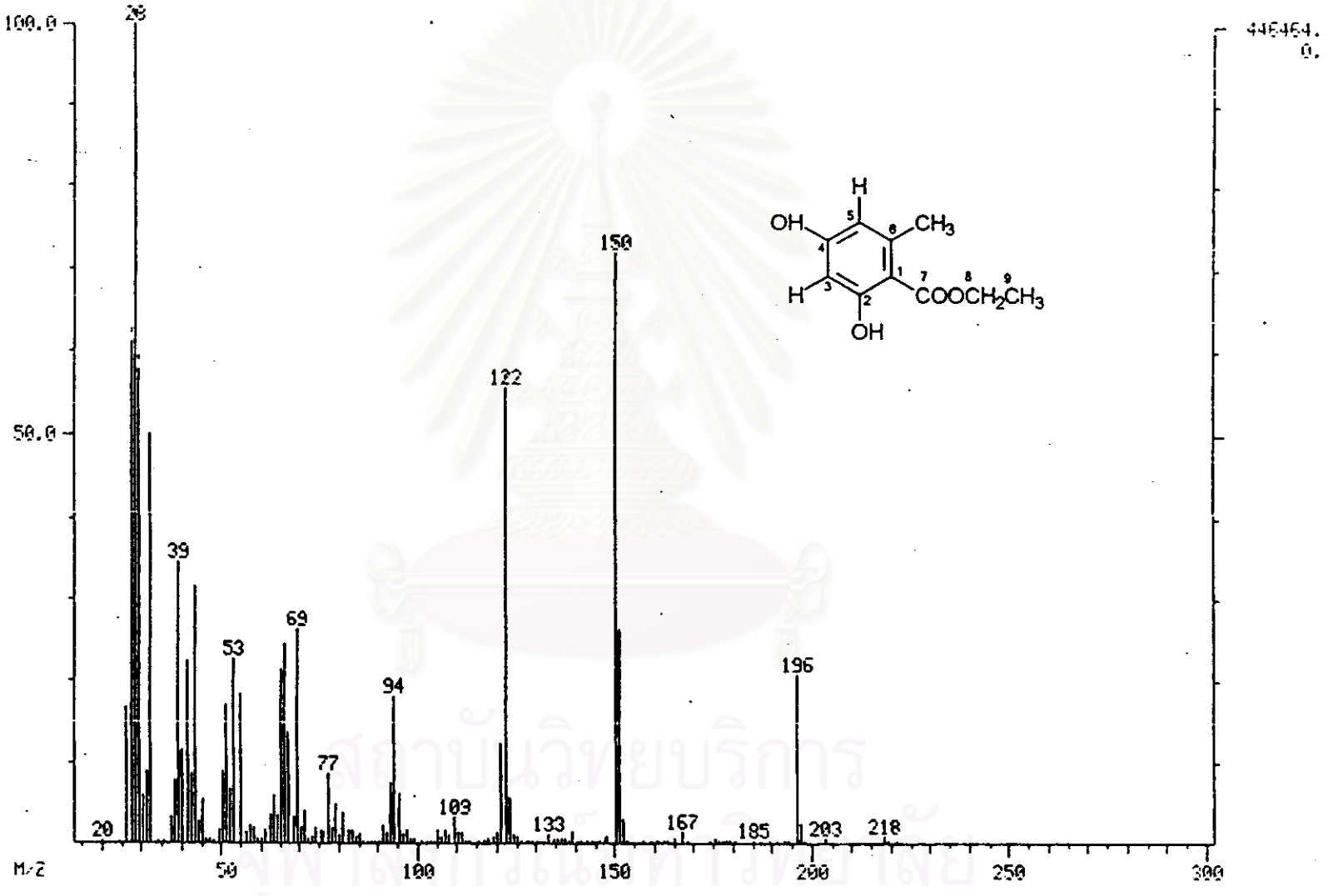


Figure 2 EI mass spectrum of compound GT-A

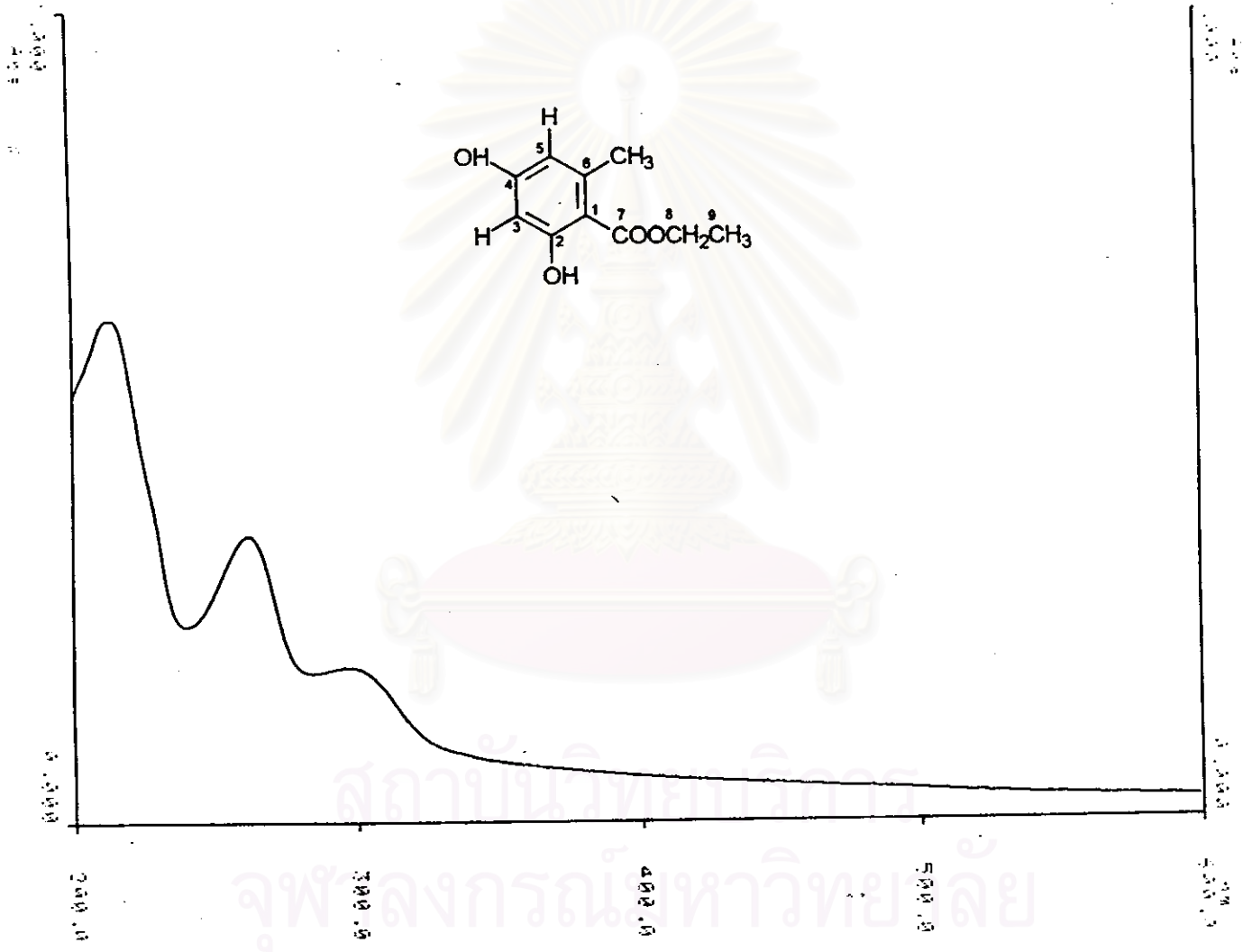


Figure 3 UV spectrum of compound GT-A (in methanol)

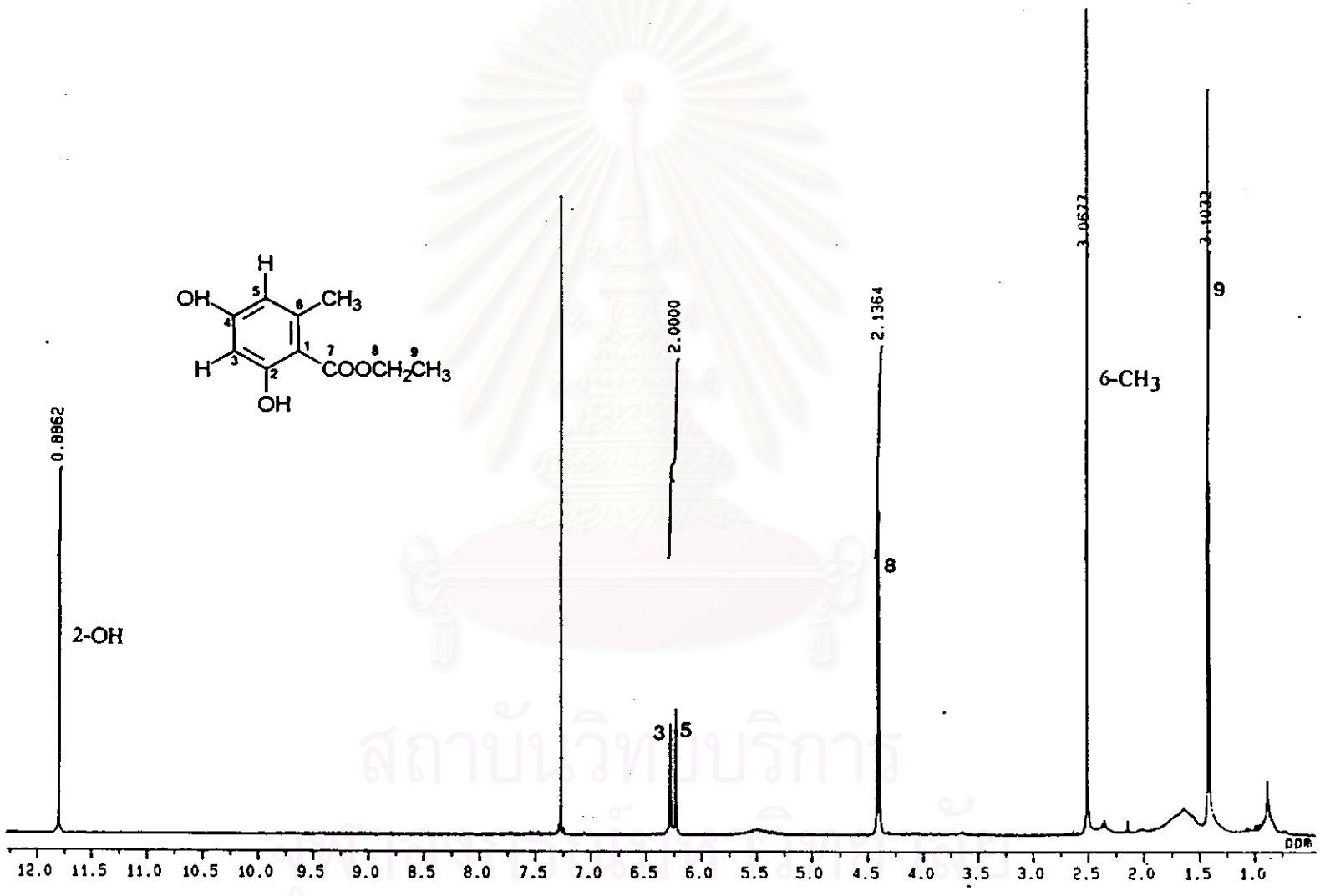


Figure 4a 500 MHz ^{1}H NMR spectrum of compound GT-A (in chloroform-*d*)

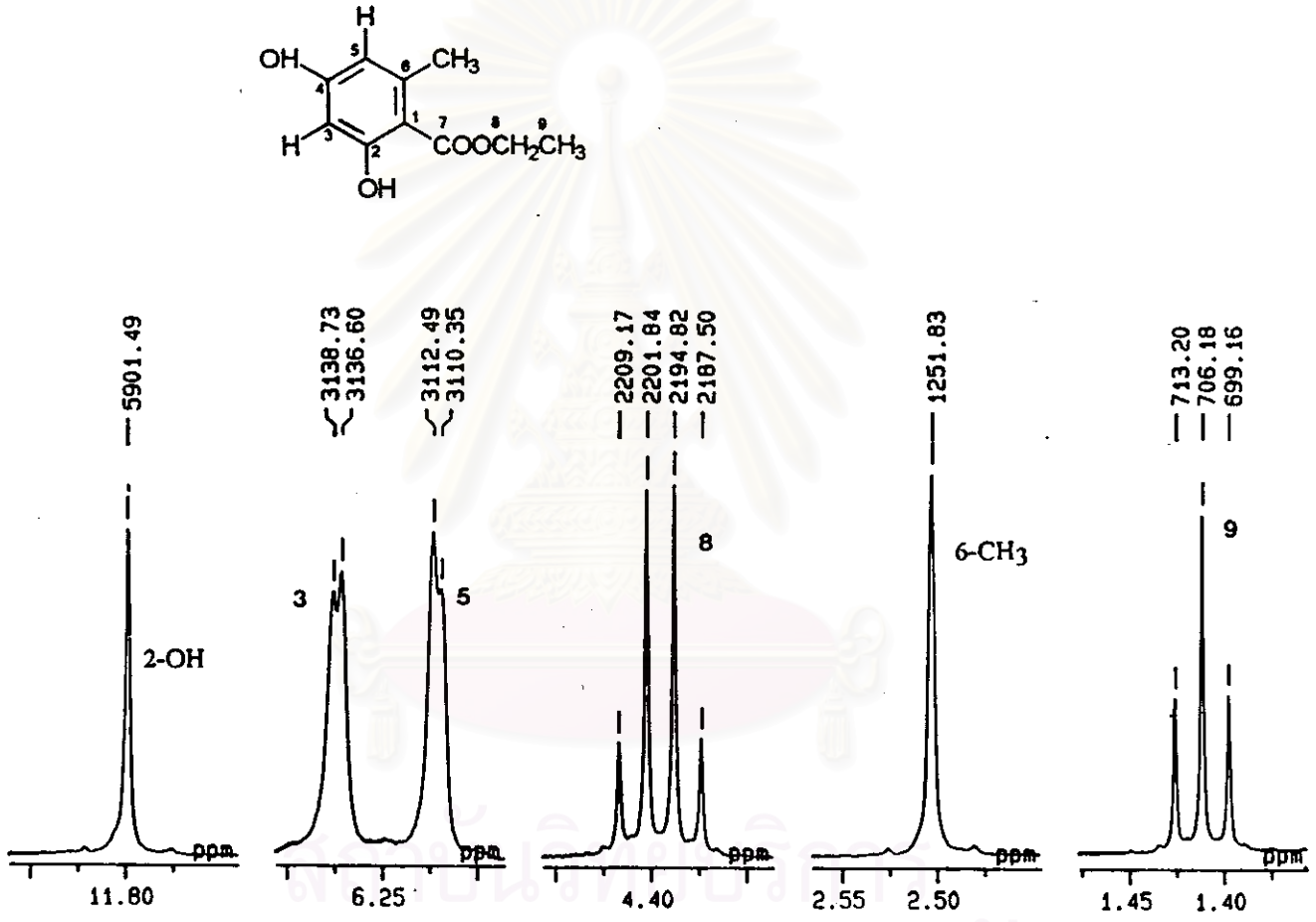


Figure 4b 500 MHz ^{1}H NMR spectrum of compound GT-A (in chloroform-*d*) (expansion from 1.35-11.80 ppm)

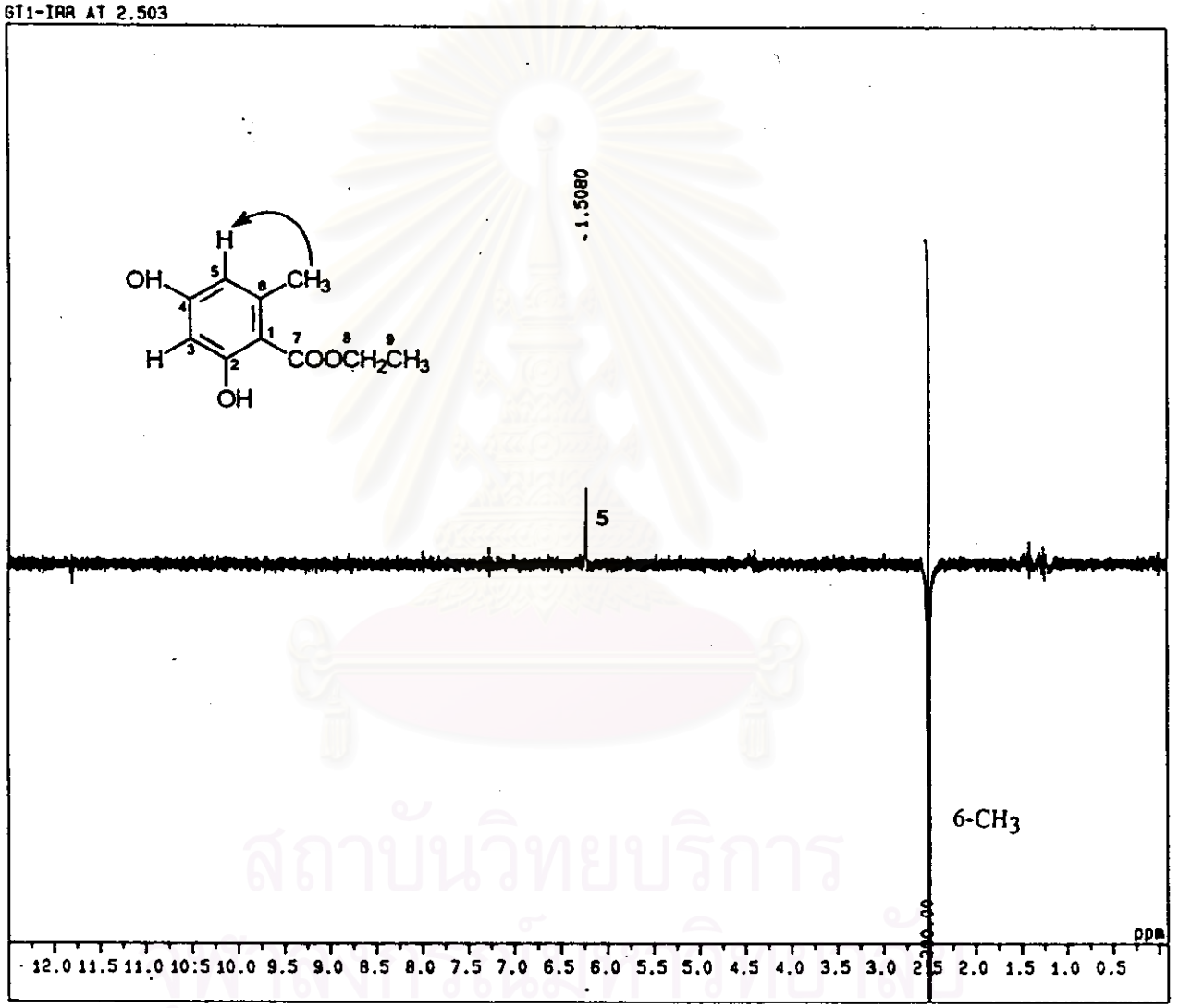


Figure 5a NOE difference spectrum of compound GT-A (in chloroform-*d*) (irradiate at 2.50 ppm)

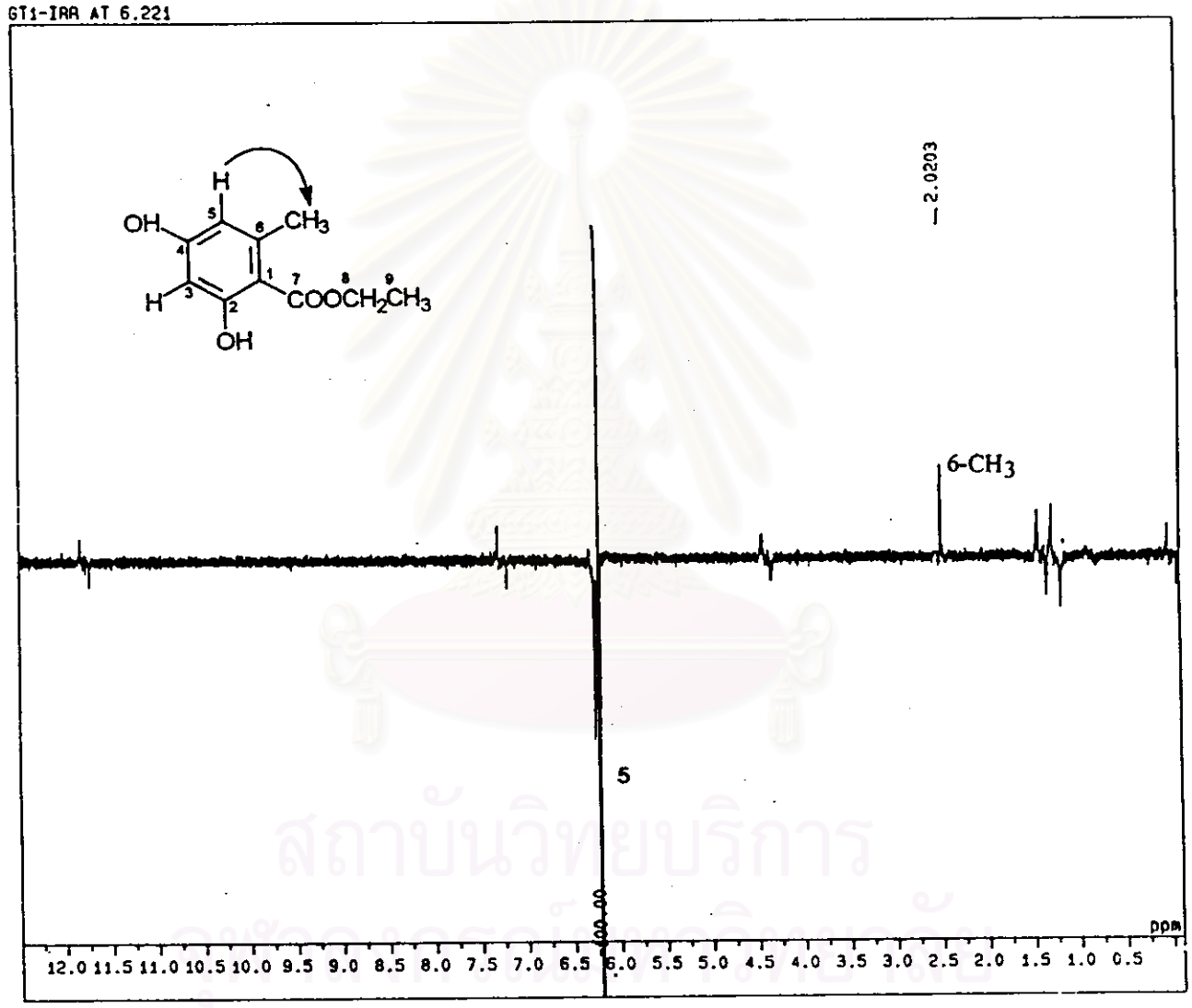


Figure 5b NOE difference spectrum of compound GT-A (in chloroform-*d*) (irradiate at 6.22 ppm)

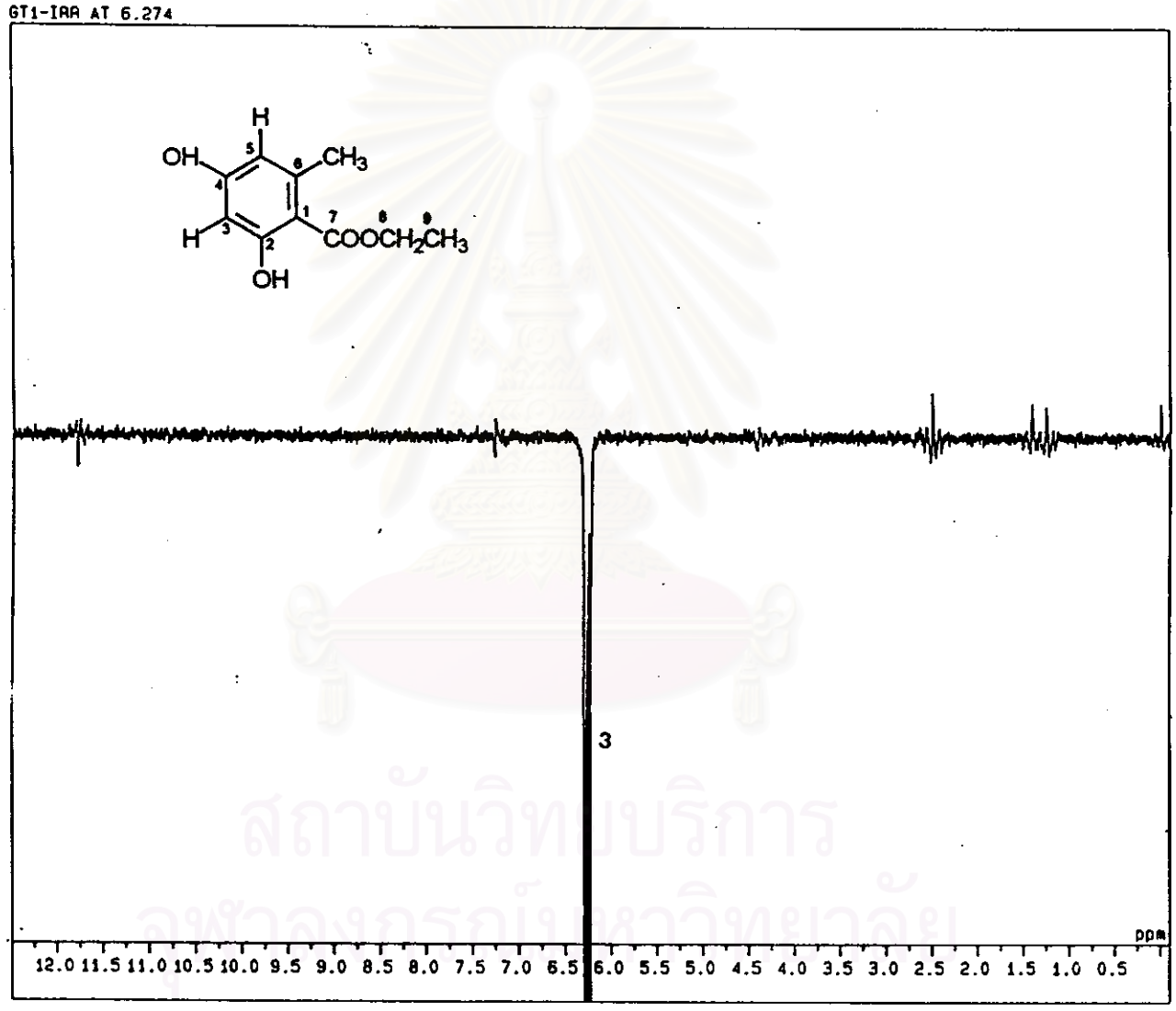


Figure 5c NOE difference spectrum of compound GT-A (in chloroform-*d*) (irradiate at 6.27 ppm)

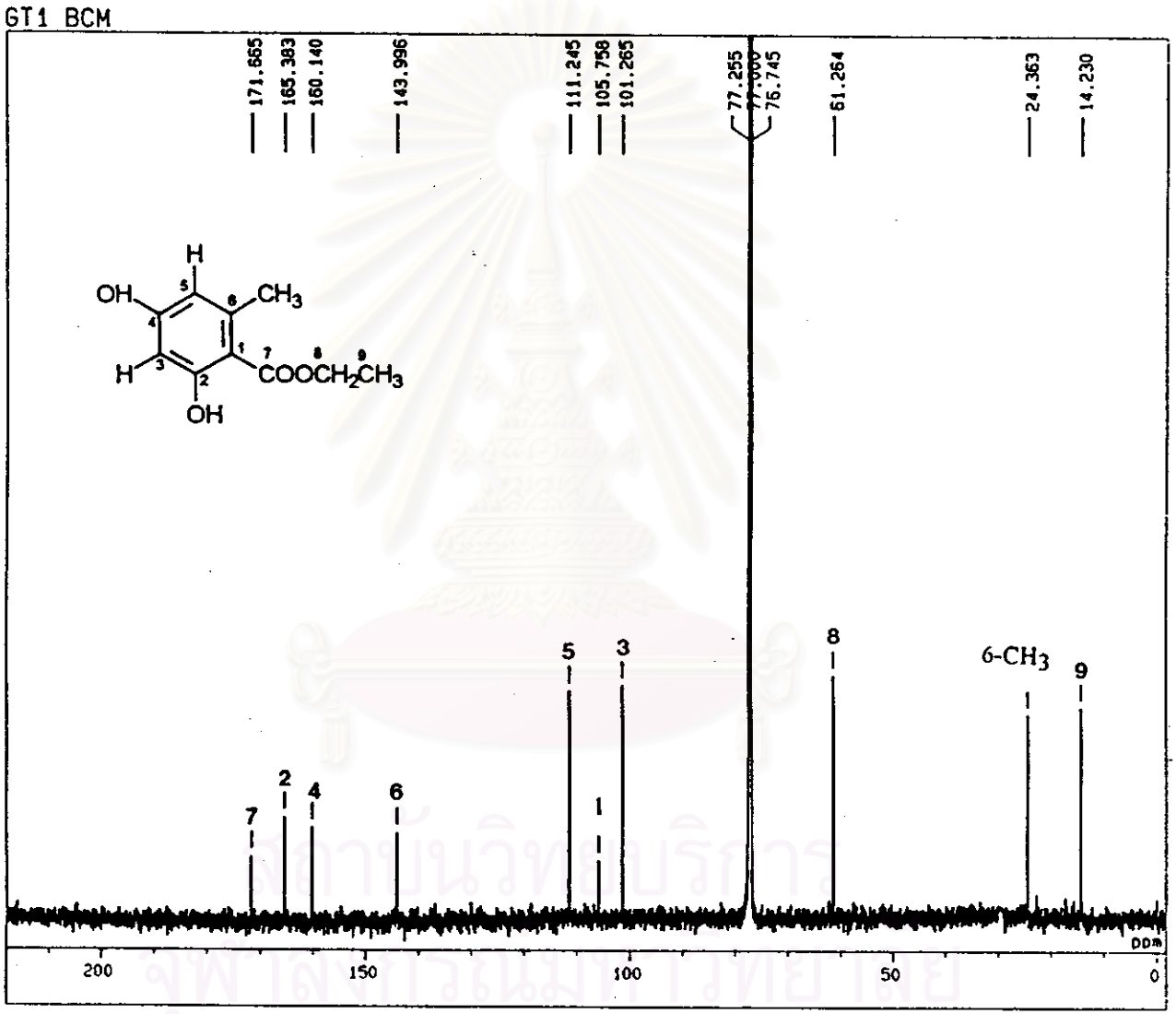


Figure 6 125 MHz ^{13}C NMR spectrum of compound GT-A (in chloroform-*d*)

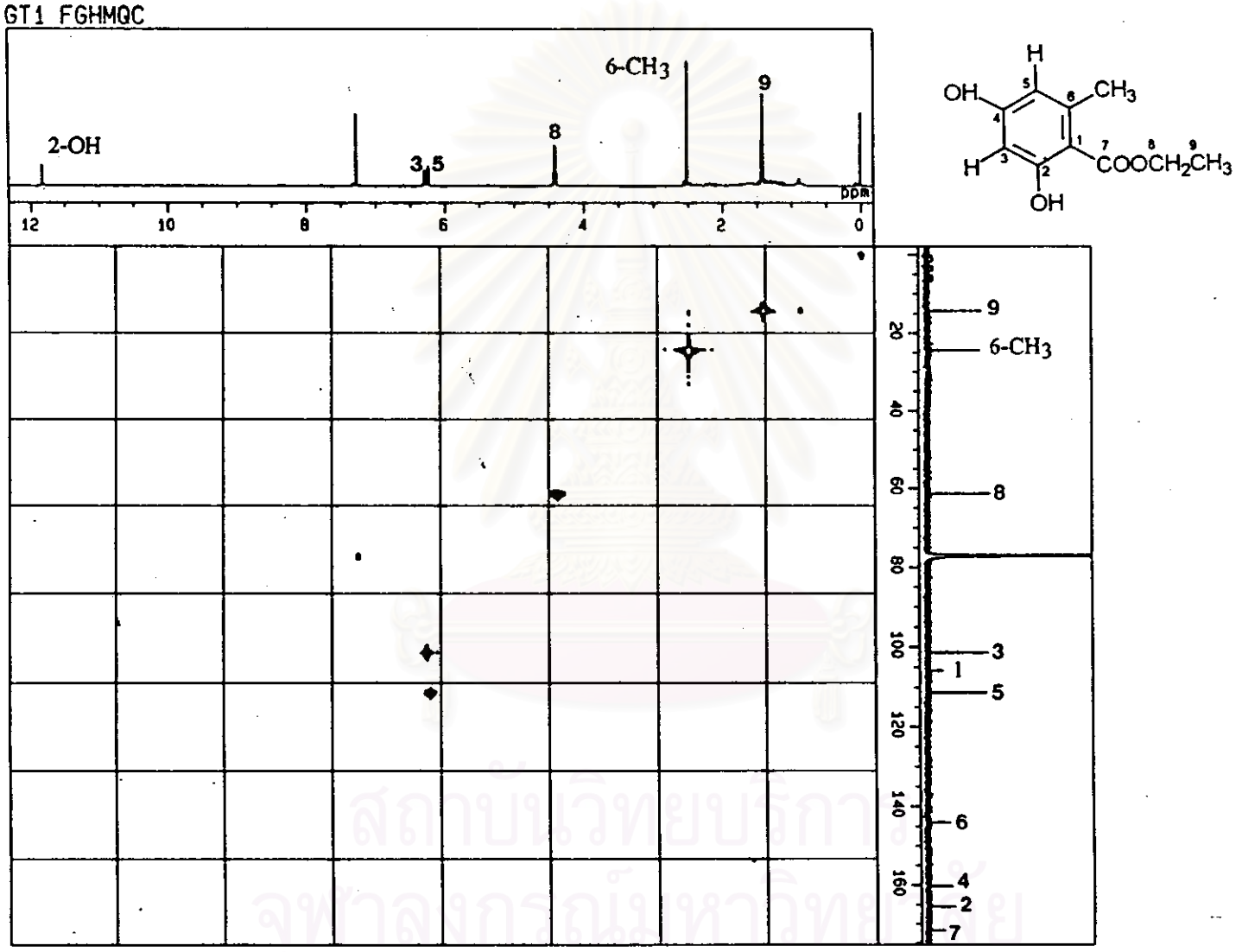


Figure 7 HMQC spectrum of compound GT-A (in chloroform-*d*) [δ_H 0-12 ppm, δ_C 0-175 ppm]

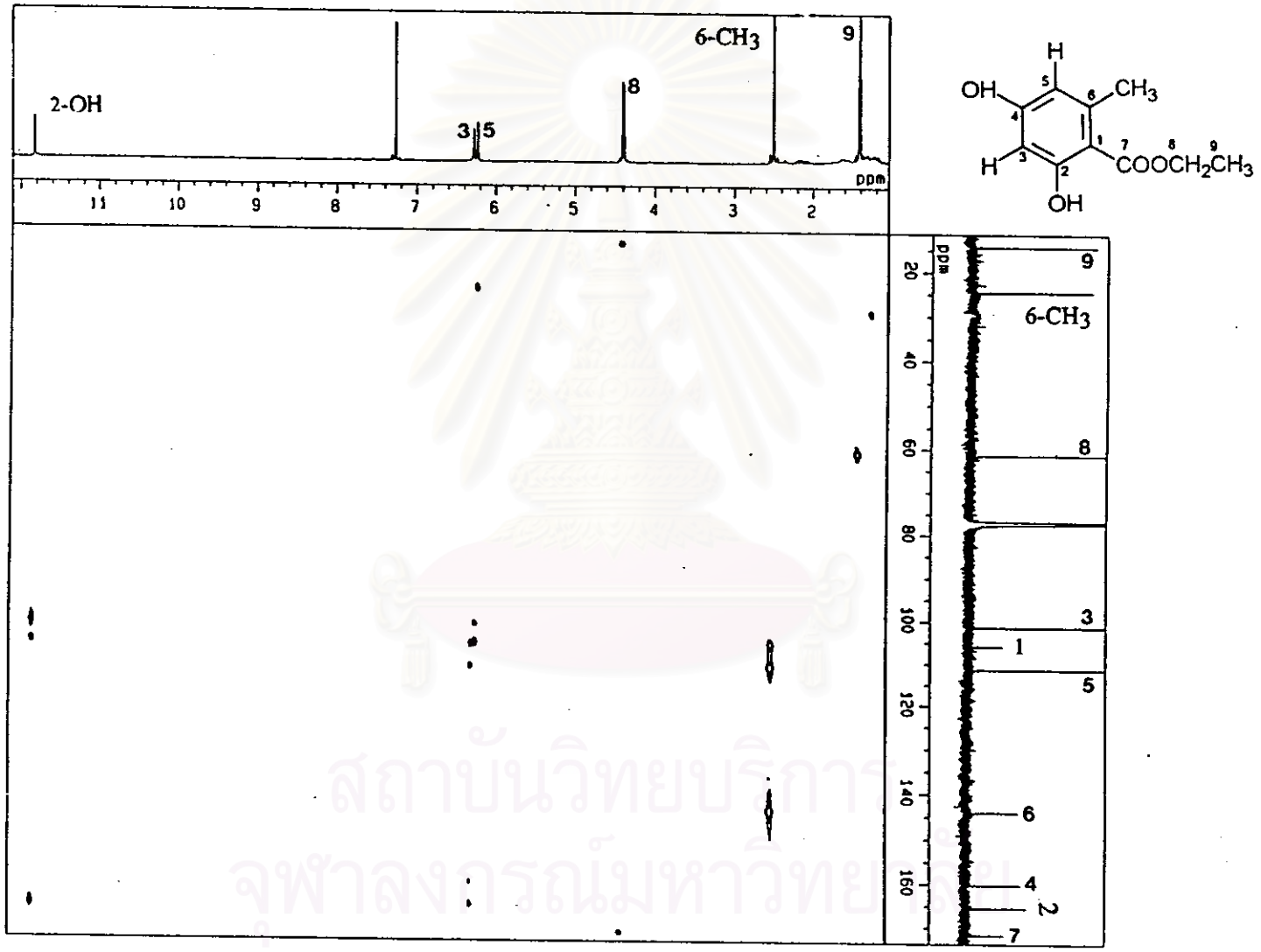


Figure 8a HMBC spectrum of compound GT-A (in chloroform-*d*) [δ_H 0-12 ppm, δ_C 10-171.67 ppm]

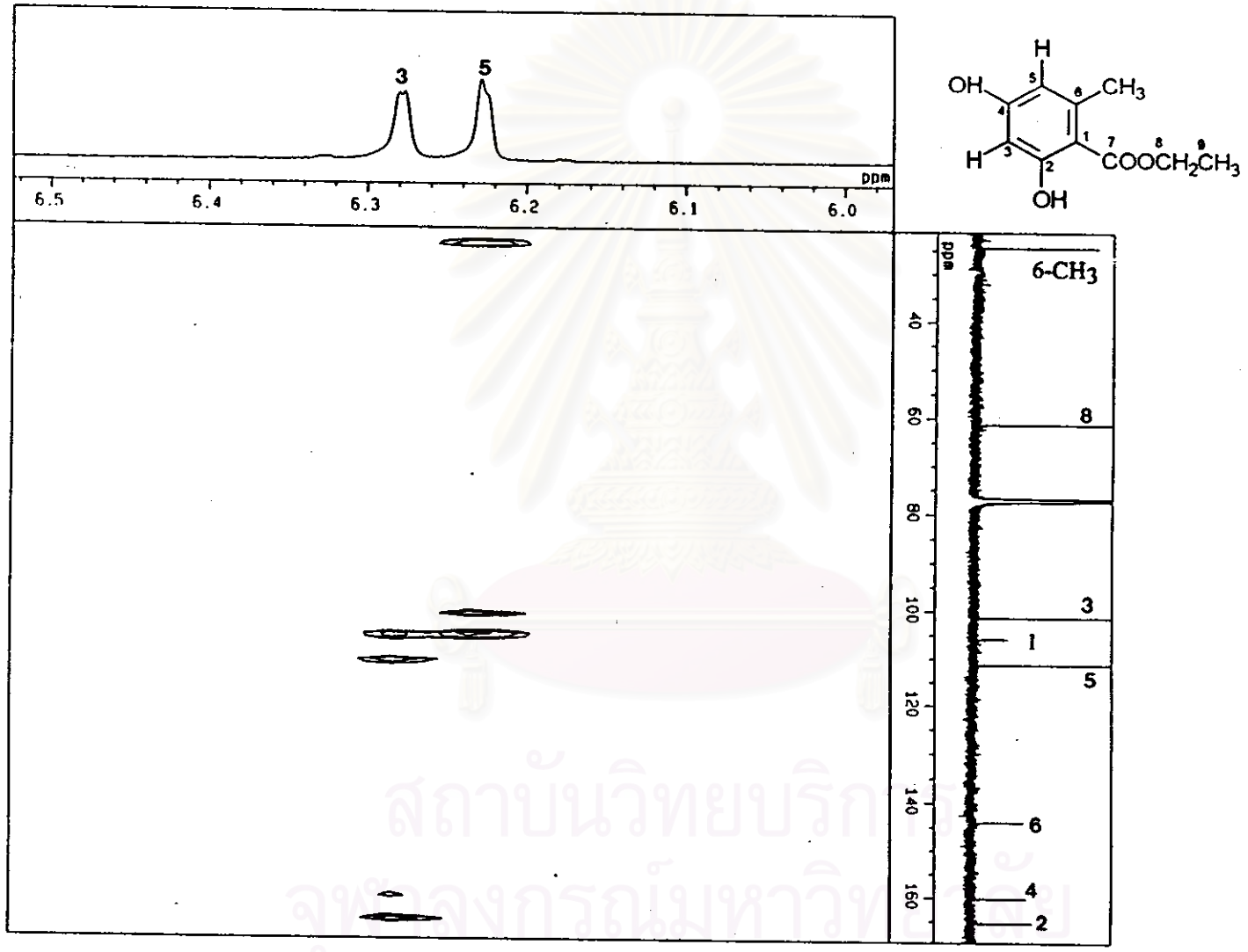


Figure 8b HMBC spectrum of compound GT-A (in chloroform-*d*) [δ_H 6-6.5 ppm, δ_C 24-167 ppm]

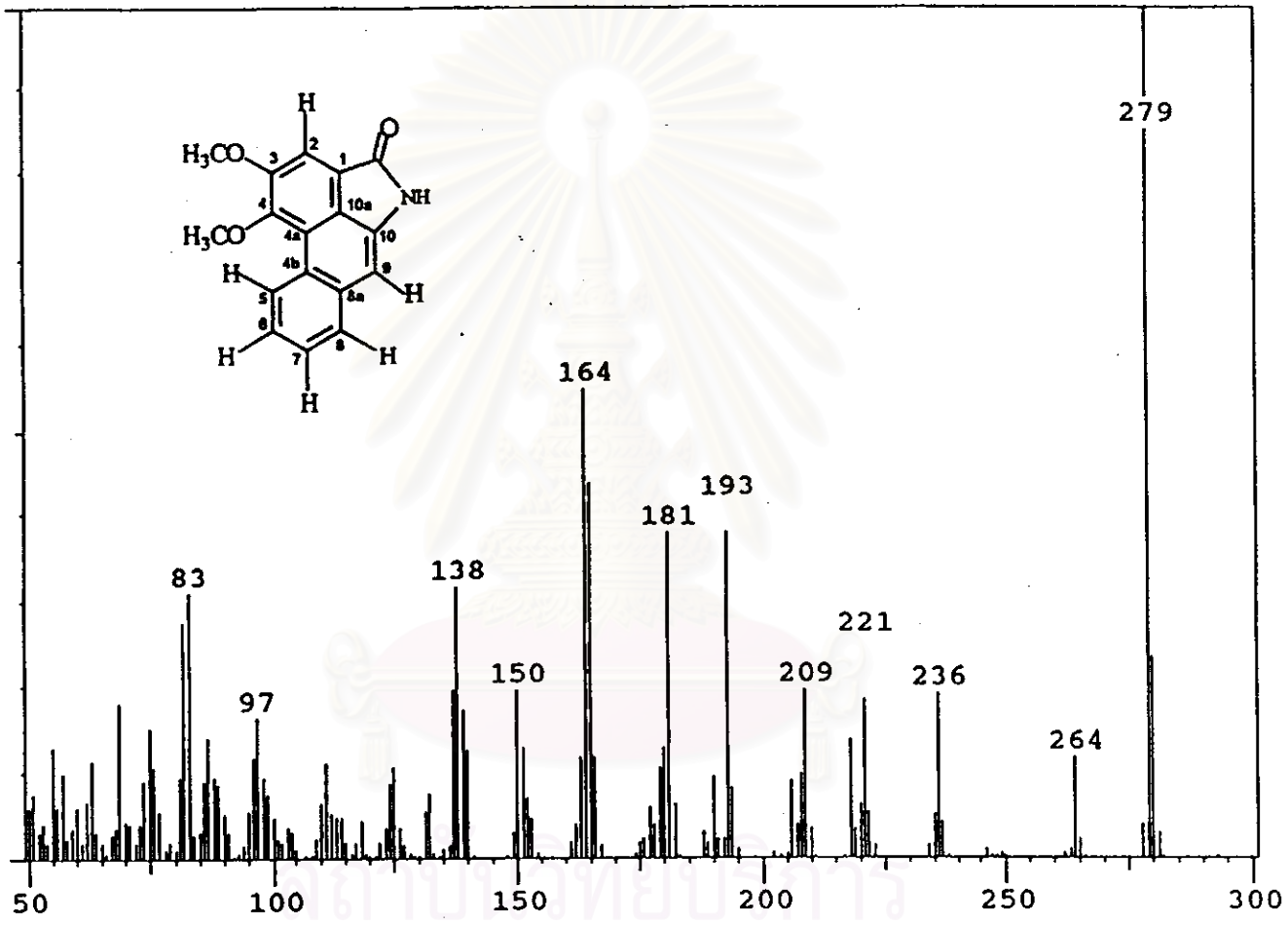


Figure 9 EI mass spectrum of compound GT-B

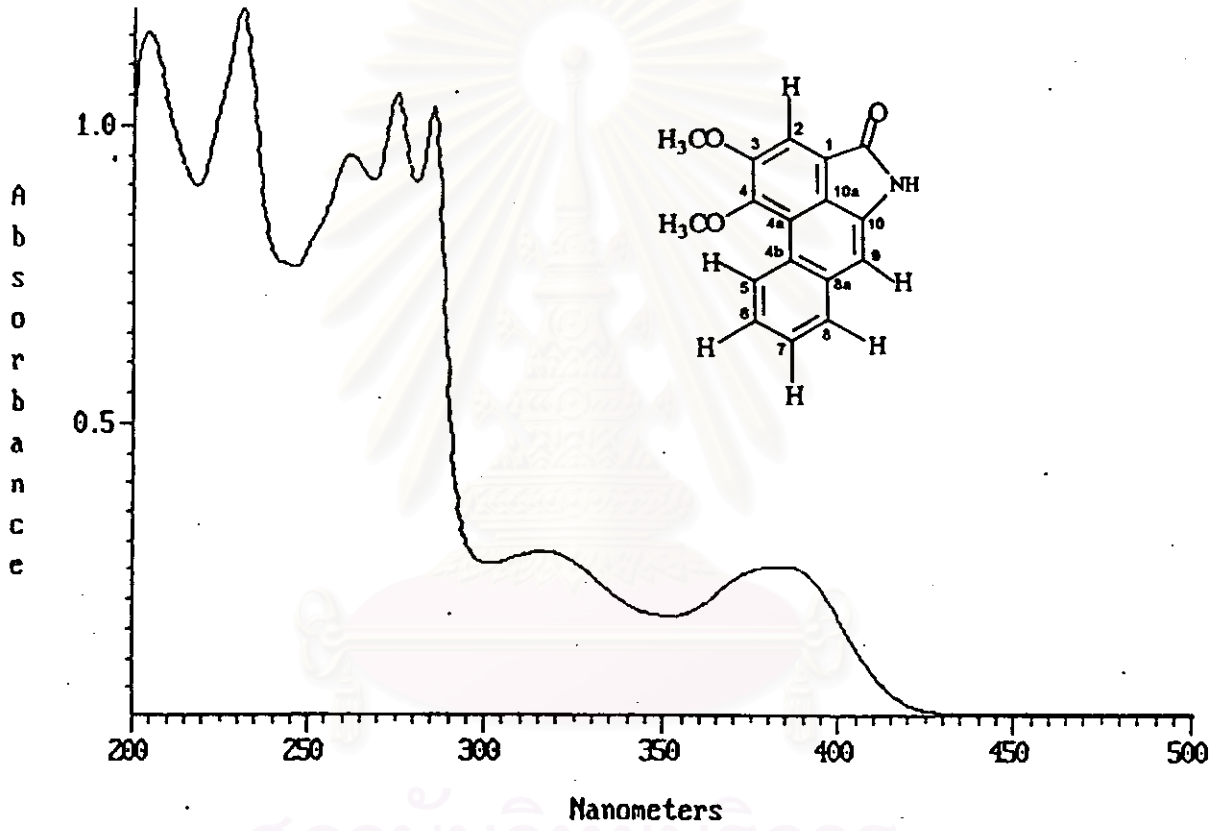


Figure 10 UV spectrum of compound GT-B (in methanol)

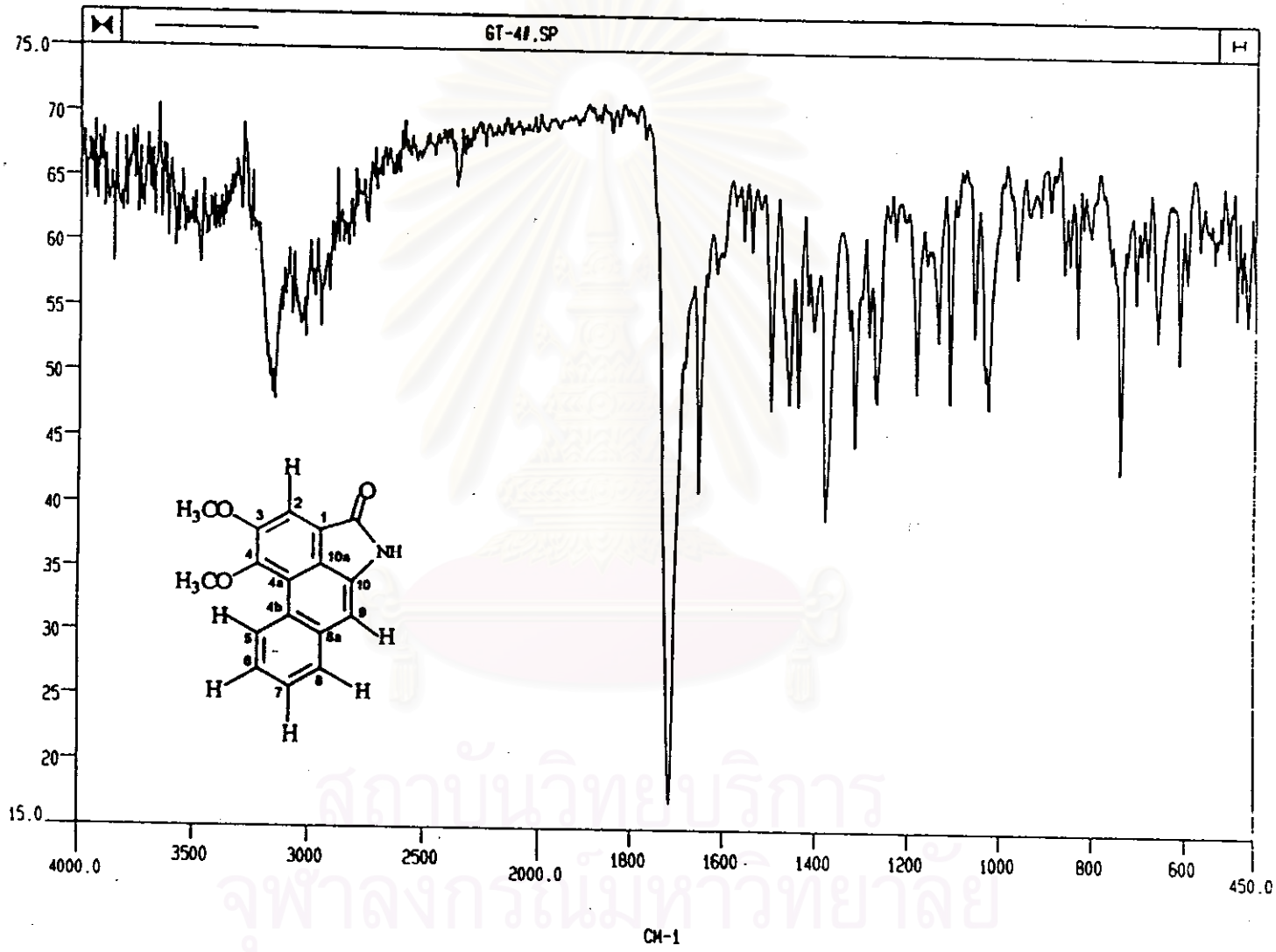


Figure 11 IR spectrum of compound GT-B (KBr disc)

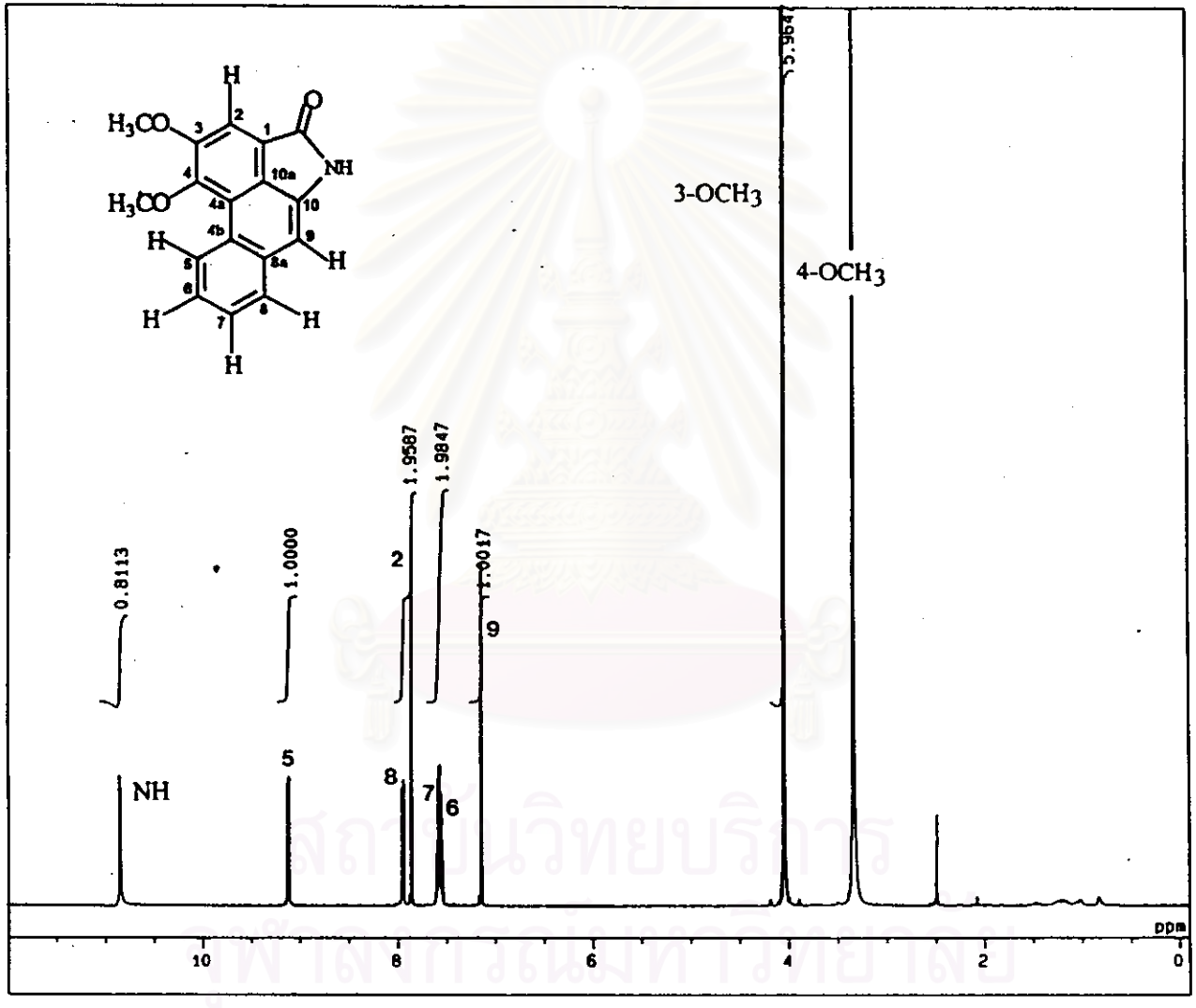


Figure 12a 500 MHz ^{1}H NMR spectrum of compound GT-B (in DMSO-d_6)

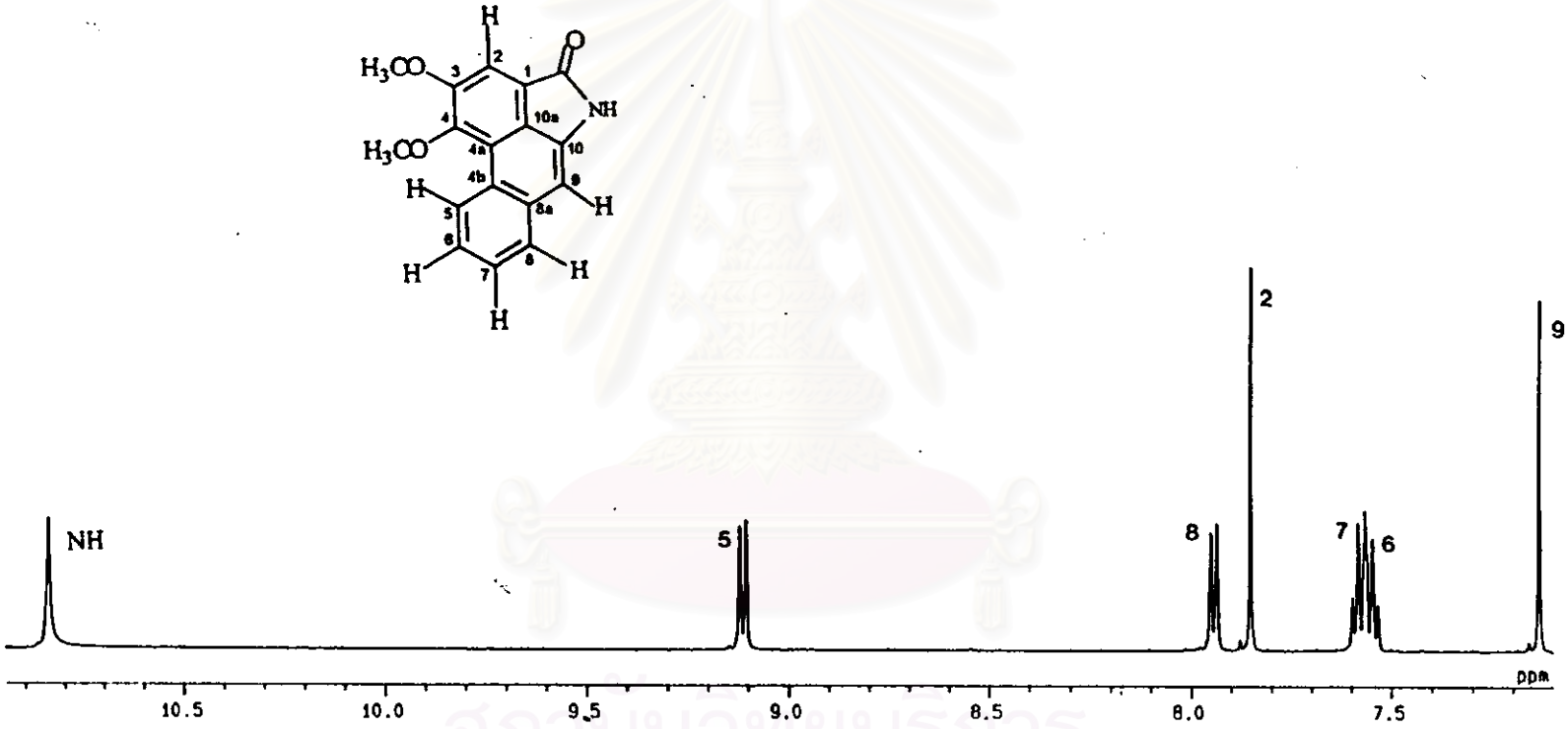


Figure 12b 500 MHz ^{1}H NMR spectrum of compound GT-B (in DMSO-d_6) (expansion from 7.1-10.9 ppm)

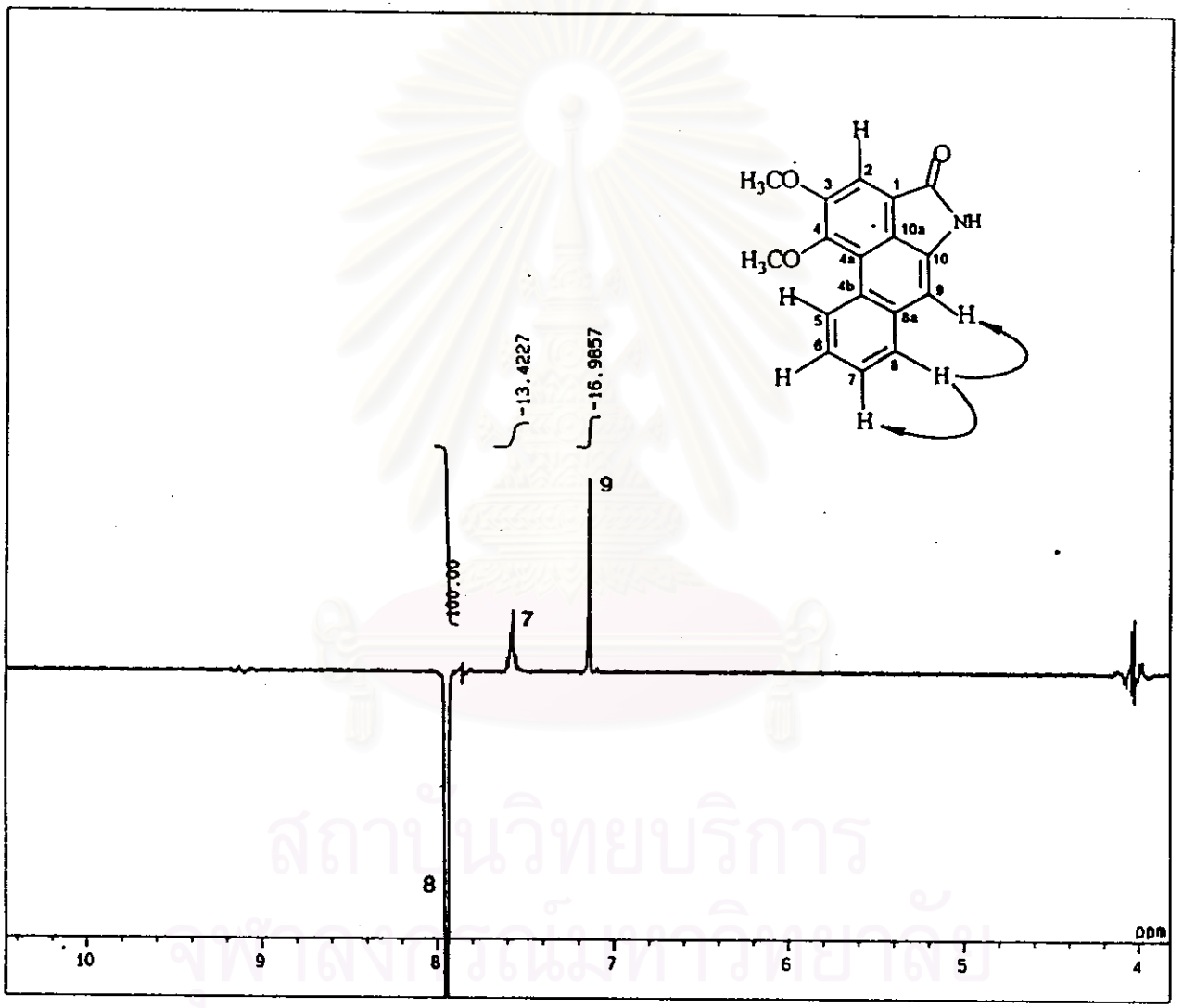


Figure 13a NOE difference spectrum of compound GT-B (in DMSO-d_6) (irradiate at 7.94 ppm)

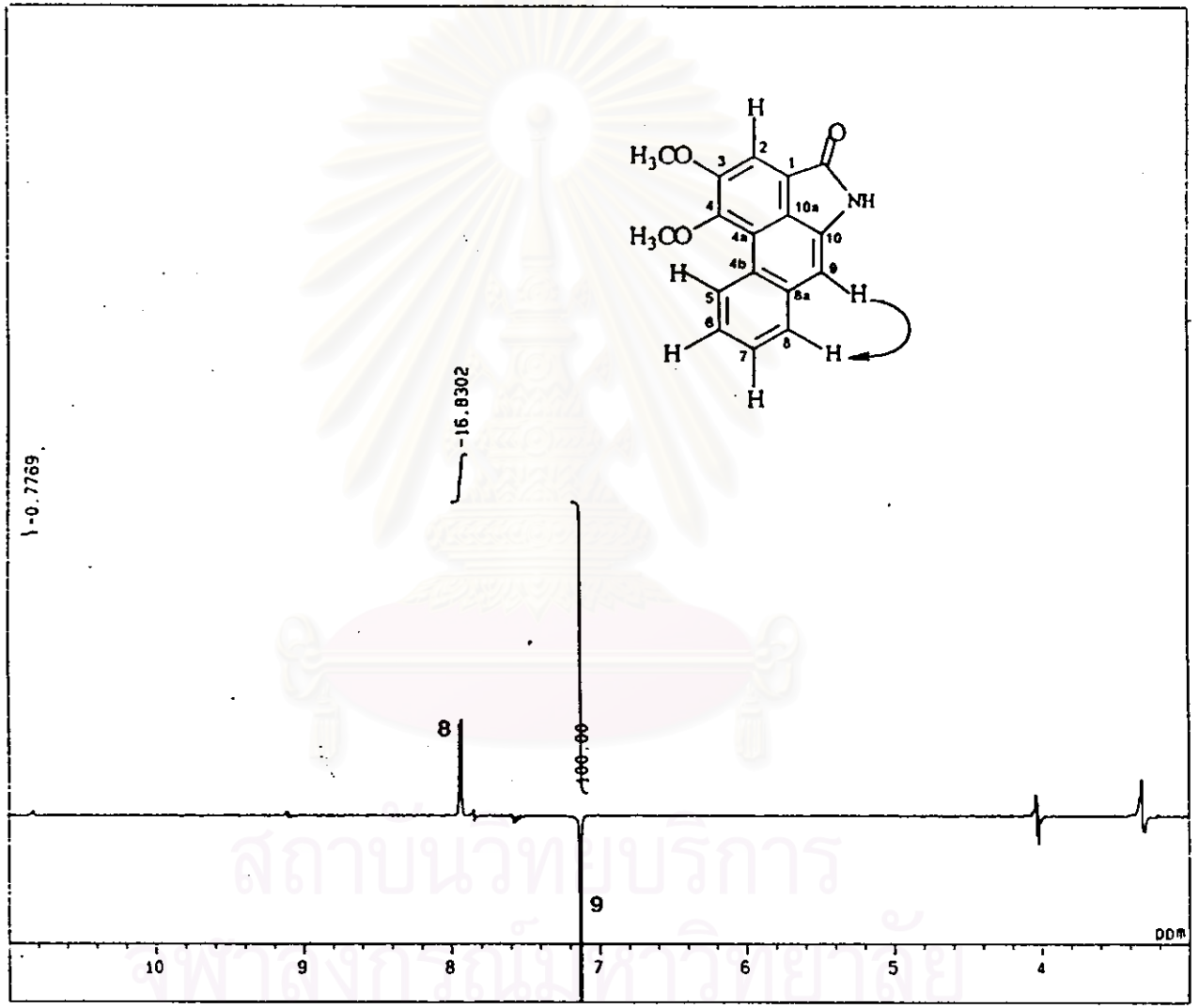


Figure 13b NOE difference spectrum of compound GT-B (in DMSO-d_6) (irradiate at 7.13 ppm)

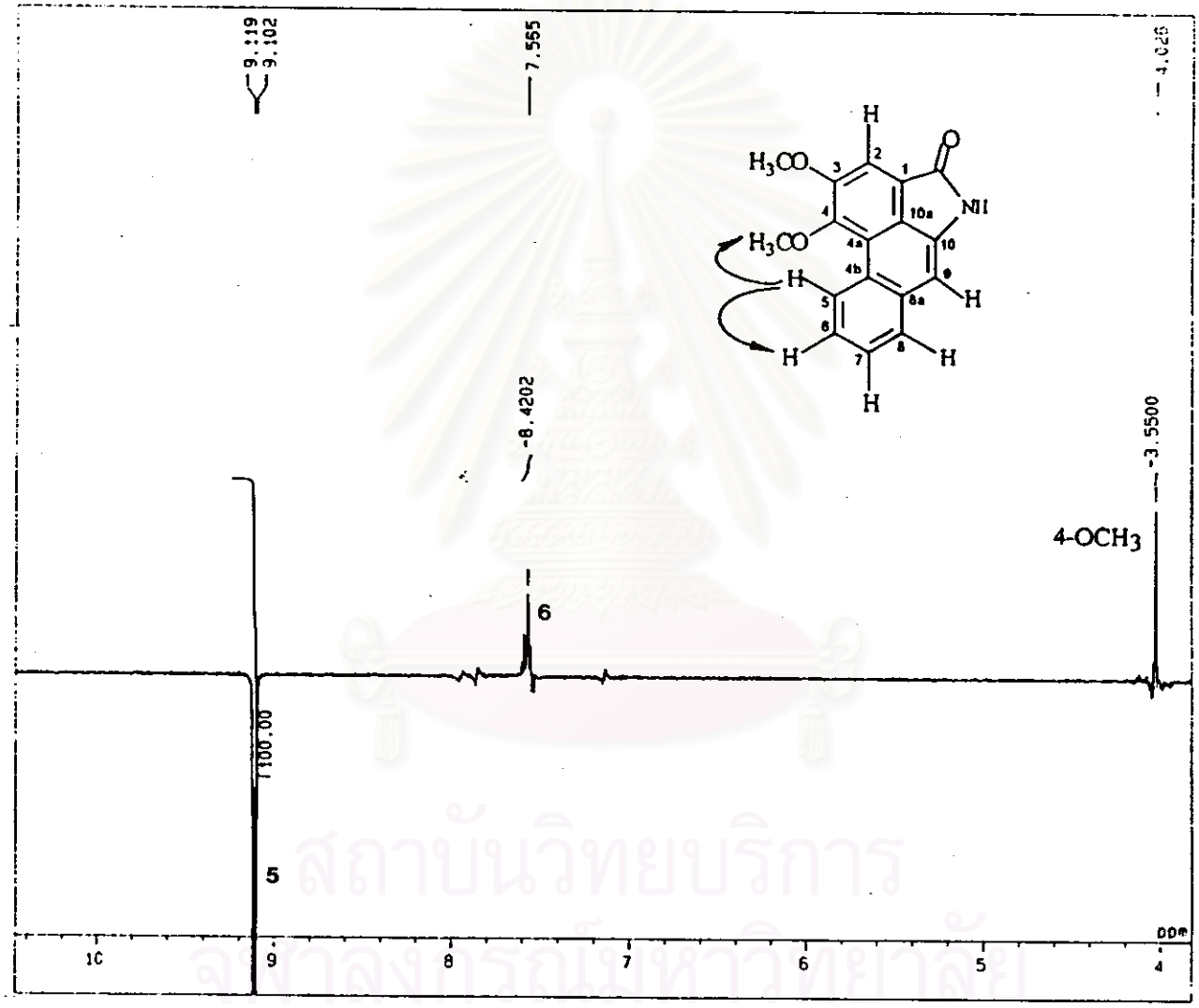


Figure 13c NOE difference spectrum of compound GT-B (in DMSO-d_6) (irradiate at 9.11 ppm)

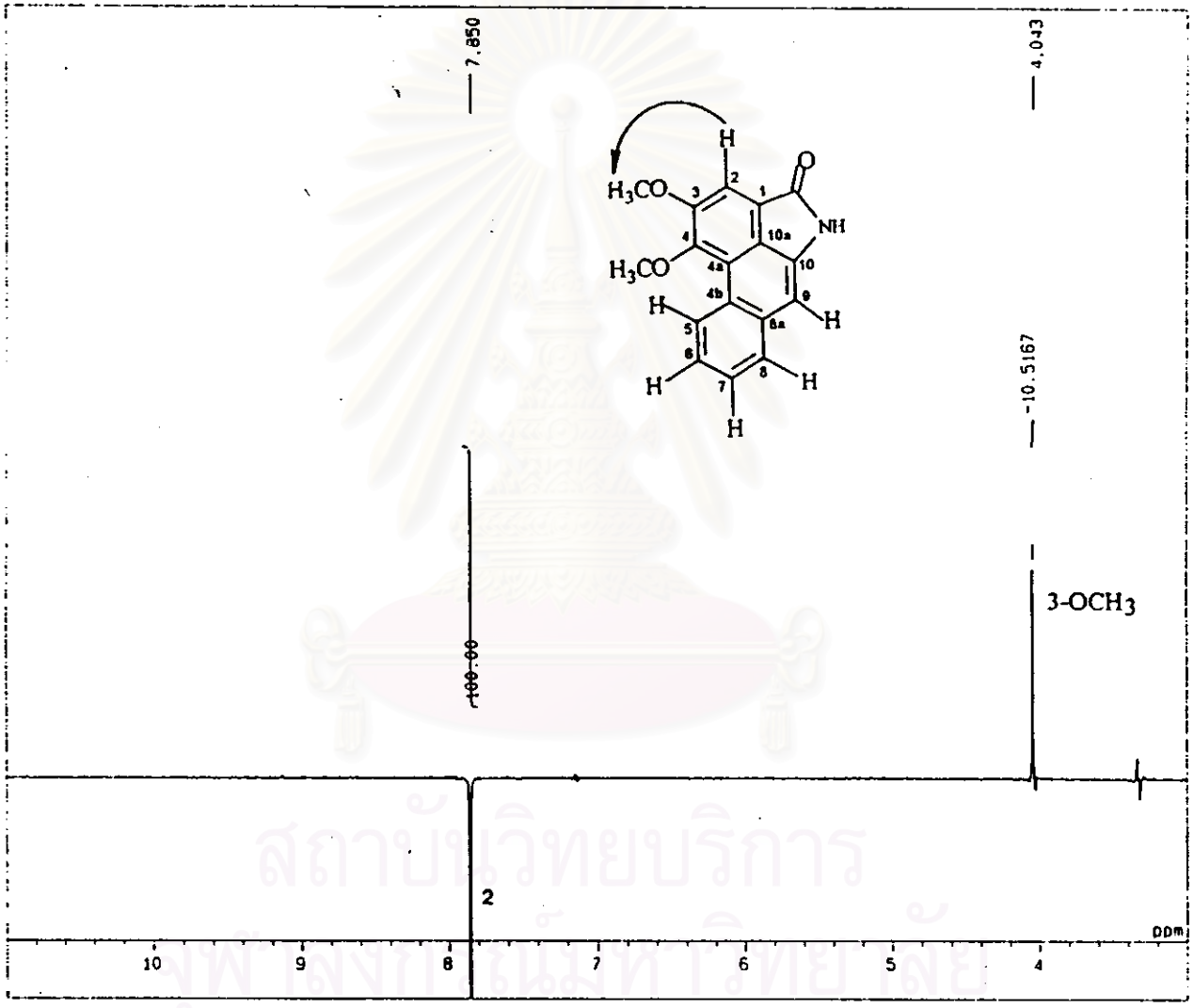


Figure 13d NOE difference spectrum of compound GT-B (in DMSO-d_6) (irradiate at 7.85 ppm)

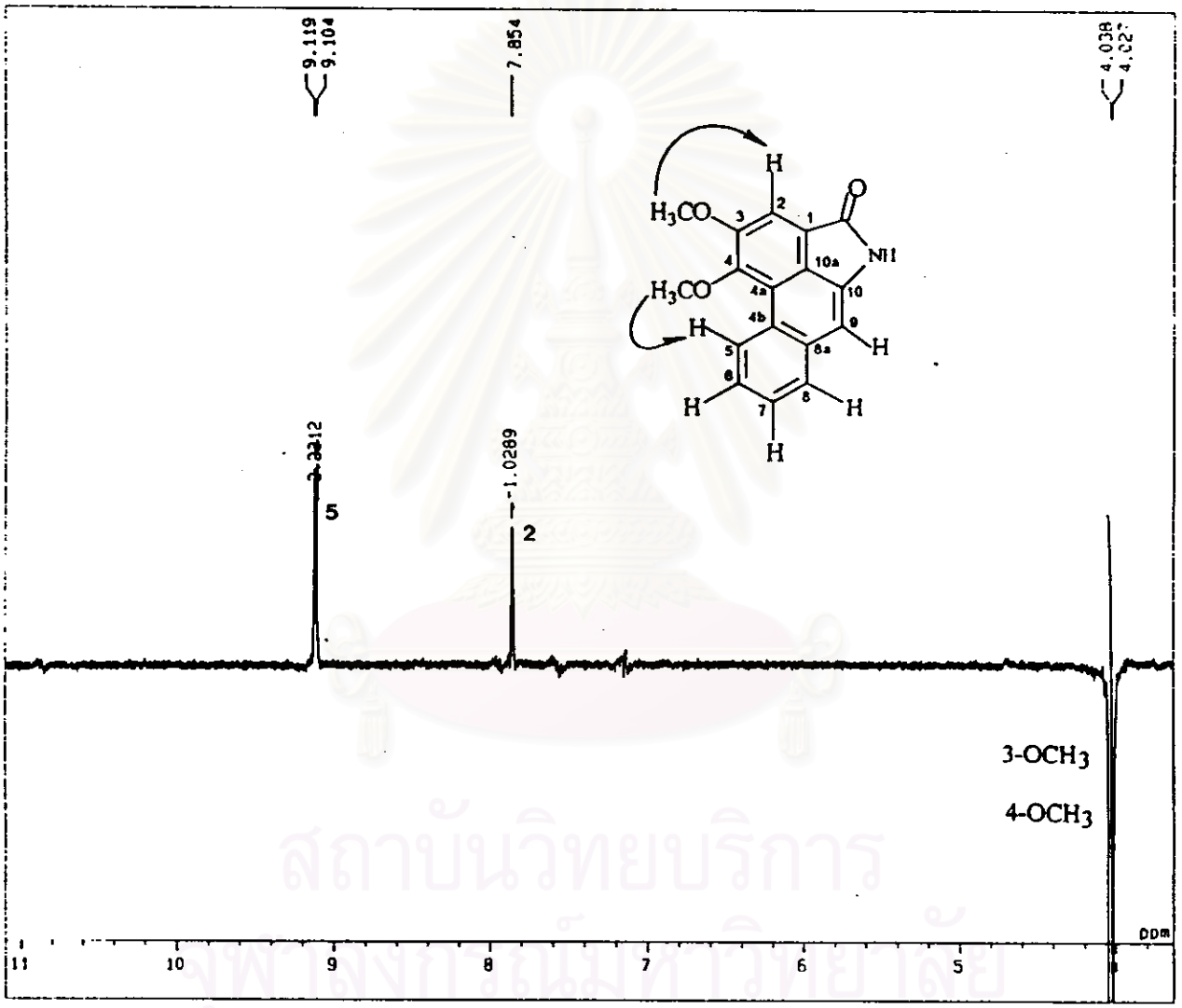


Figure 13e NOE difference spectrum of compound GT-B (in DMSO-d_6) (irradiate at 4.03 ppm)

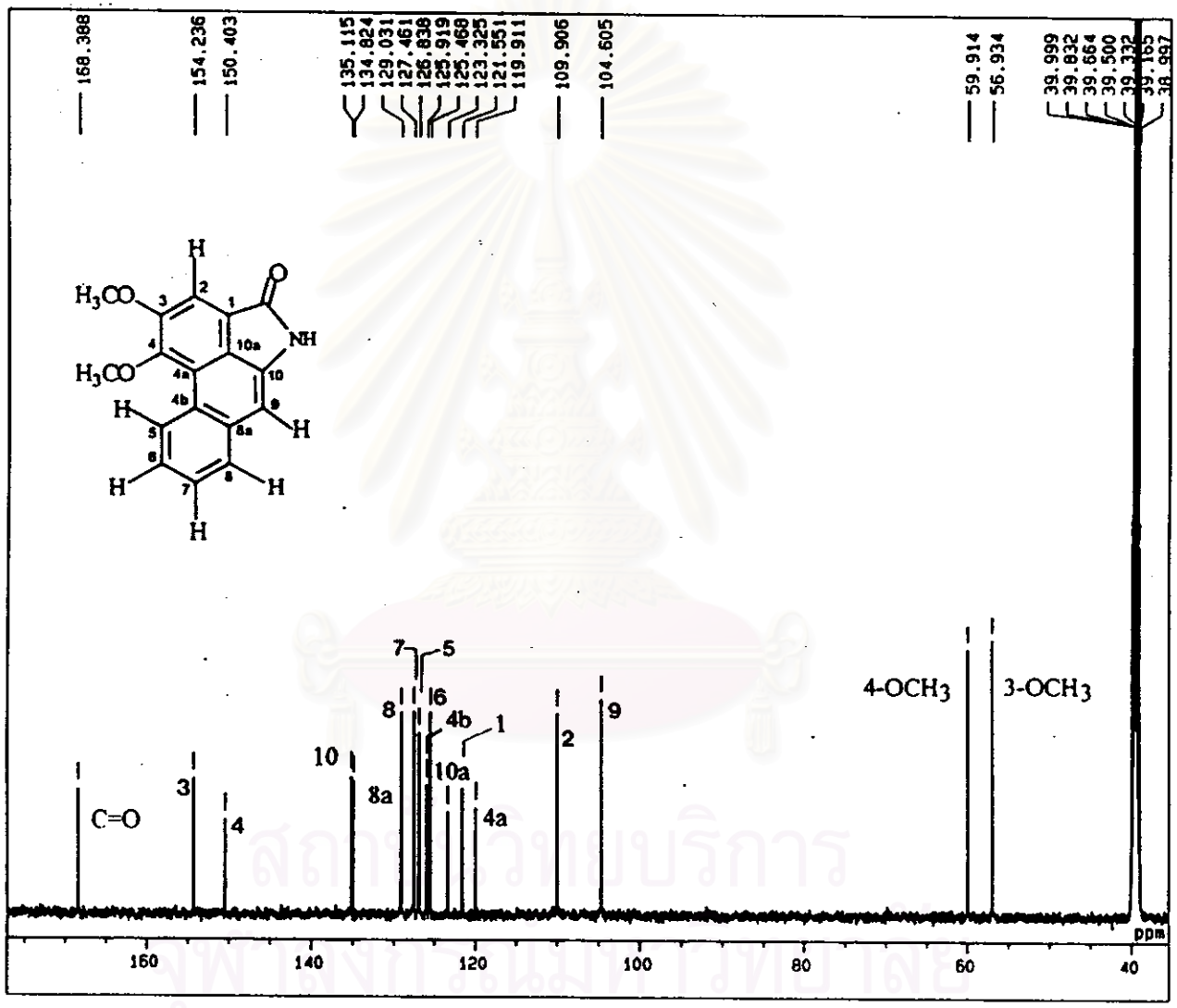


Figure 14 125 MHz ^{13}C NMR spectrum of compound GT-B (in DMSO-d_6)

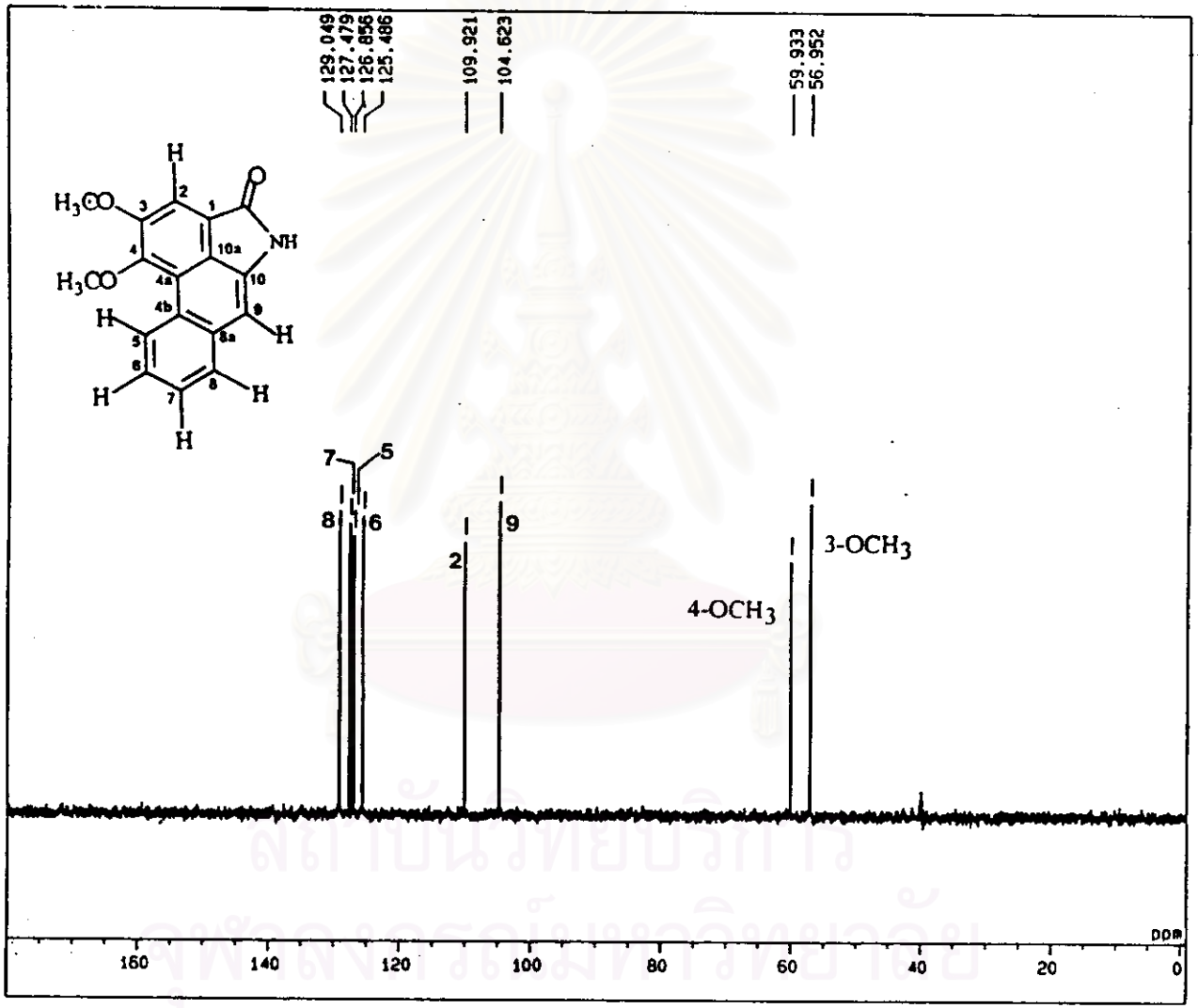
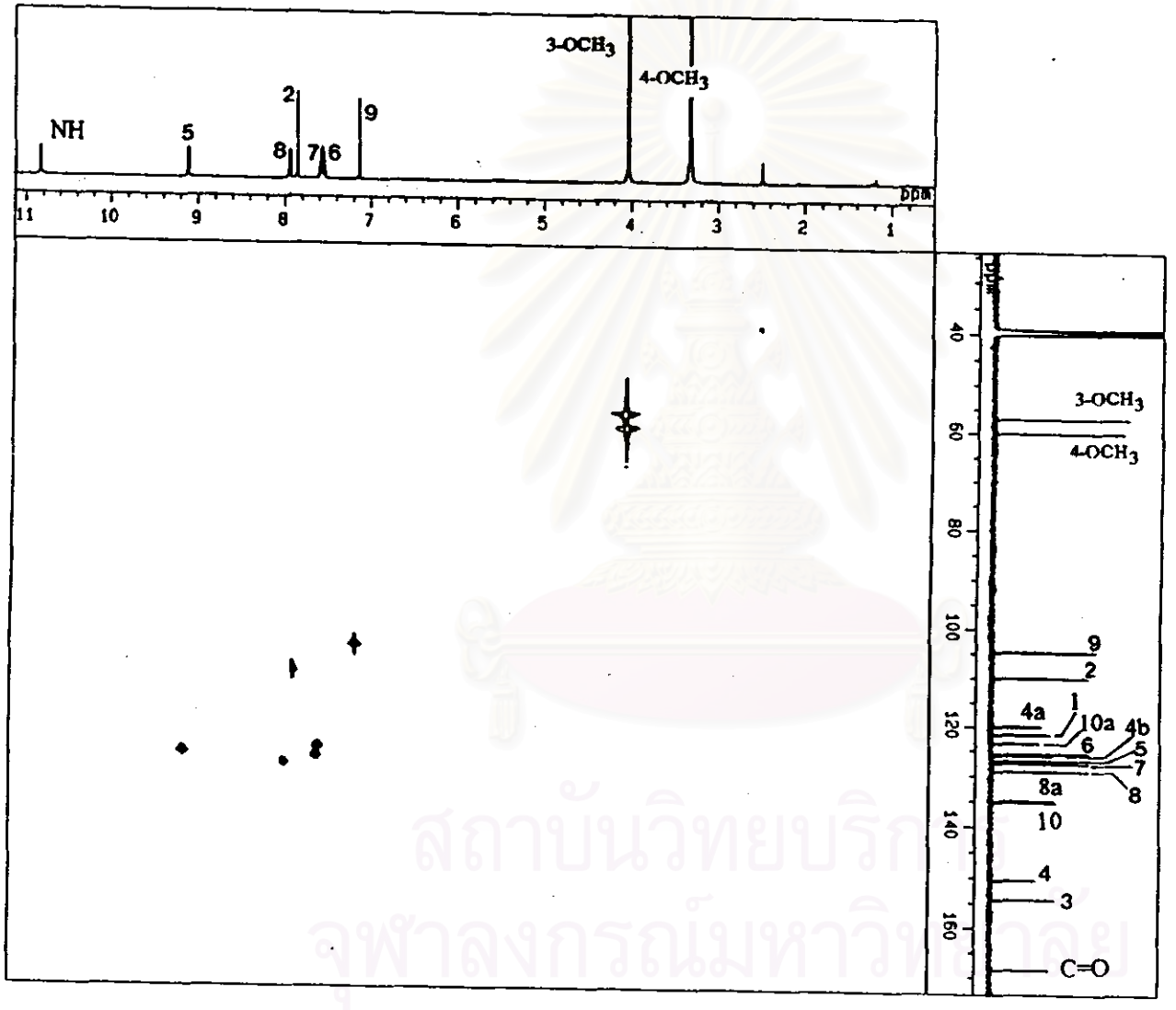


Figure 15 DEPT 135 spectrum of compound GT-B (in DMSO-d_6)



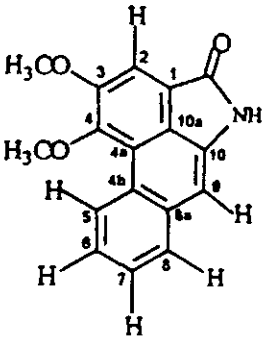


Figure 16a HMQC spectrum of compound GT-B (in DMSO-d_6) [δ_H 7.0-9.7 ppm, δ_C 102-130 ppm]

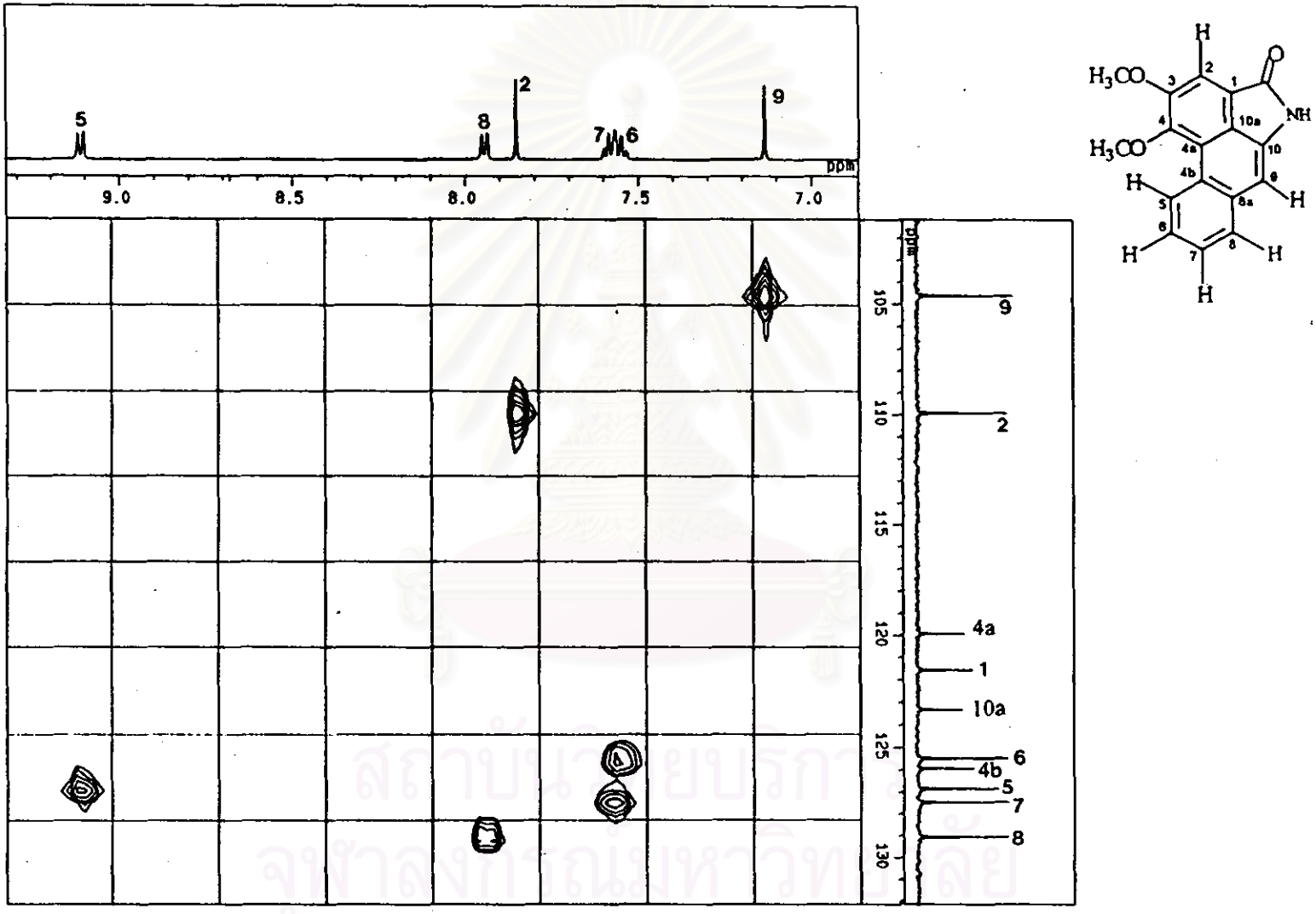
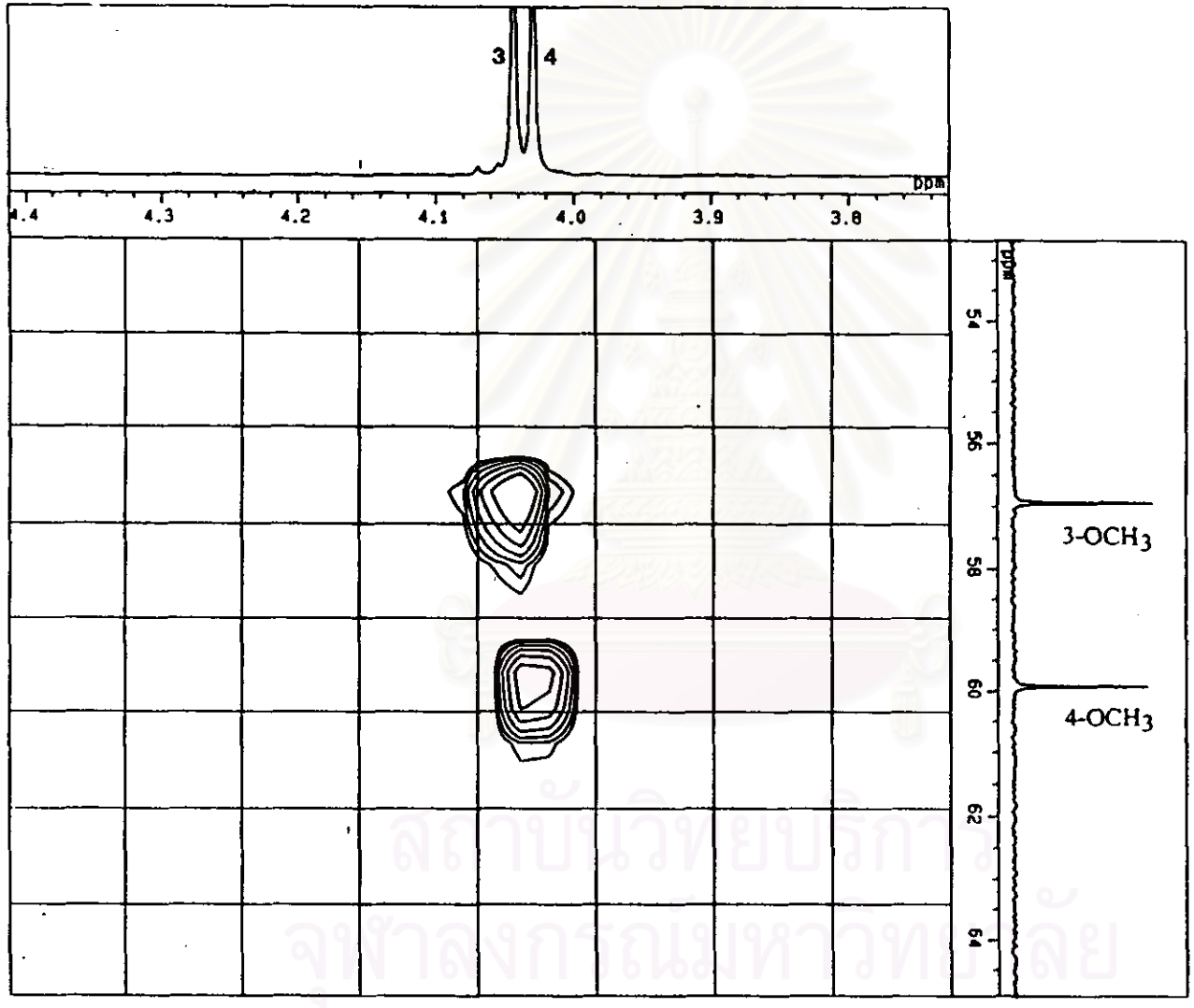


Figure 16b HMQC spectrum of compound GT-B (in DMSO-d_6) [δ_H 3.8-4.4 ppm, δ_C 54-64 ppm]



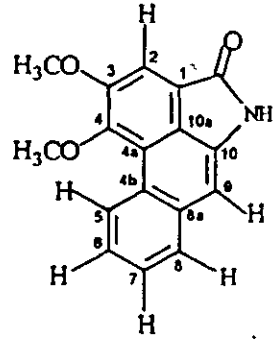


Figure 16c HMQC spectrum of compound GT-B (in DMSO-d_6) [δ_H 1-11 ppm, δ_C 30-170 ppm]

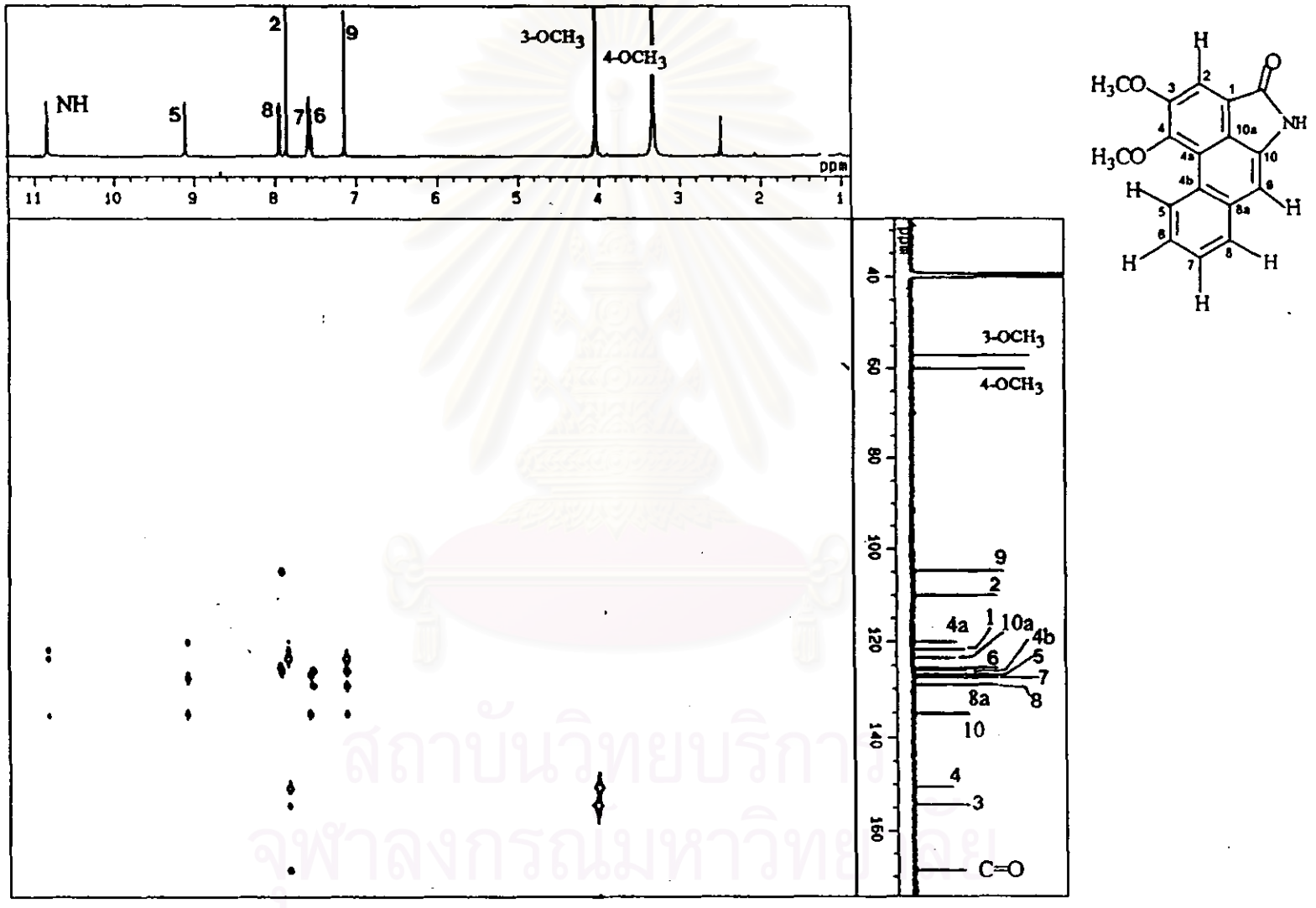
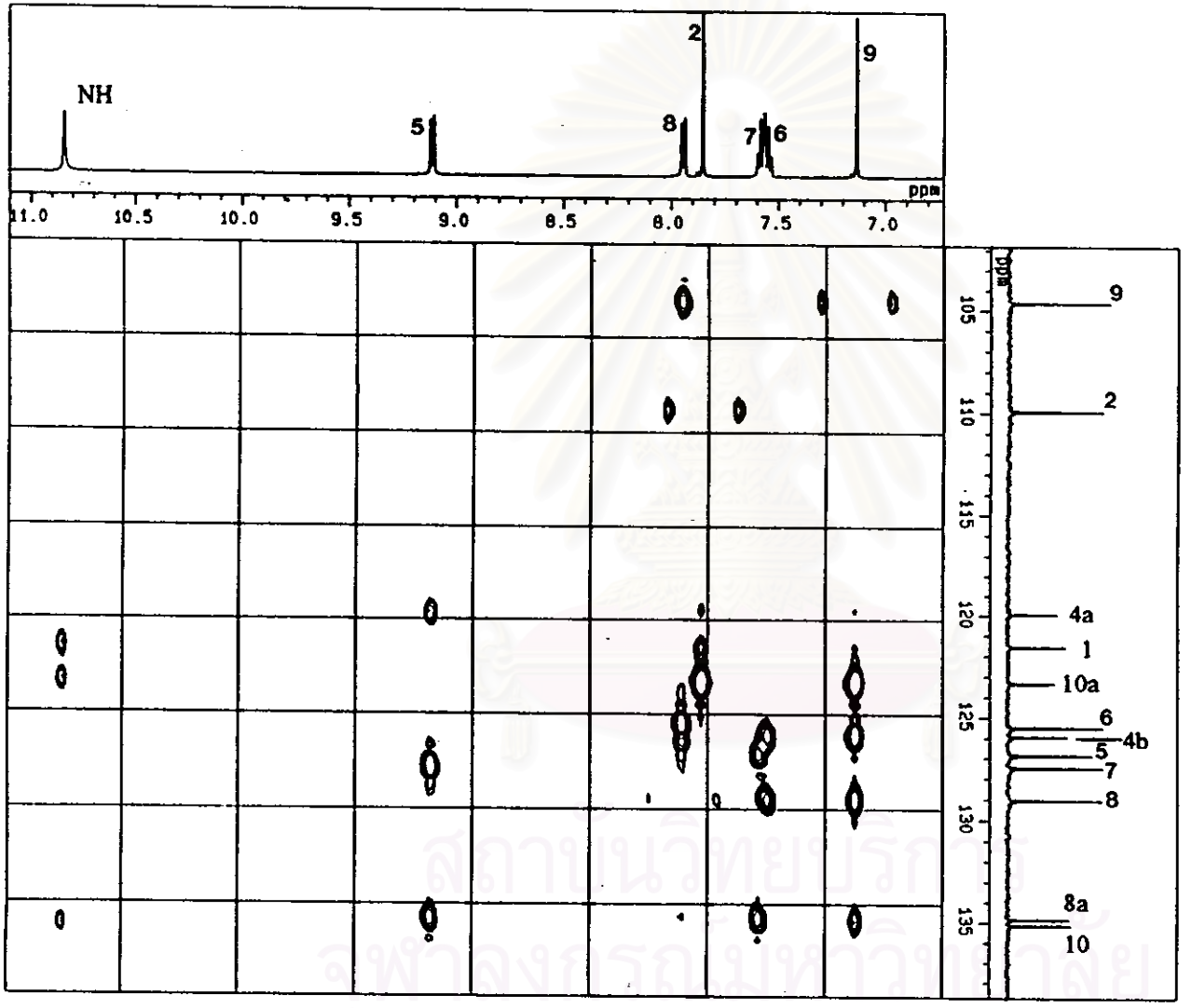


Figure 17a HMBC spectrum of compound GT-B (in DMSO-d_6) [δ_H 1-11 ppm, δ_C 40-170 ppm]



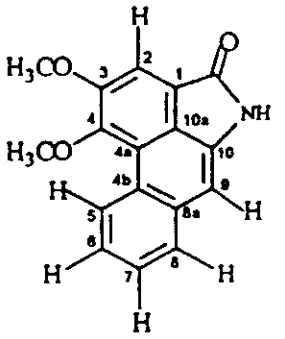
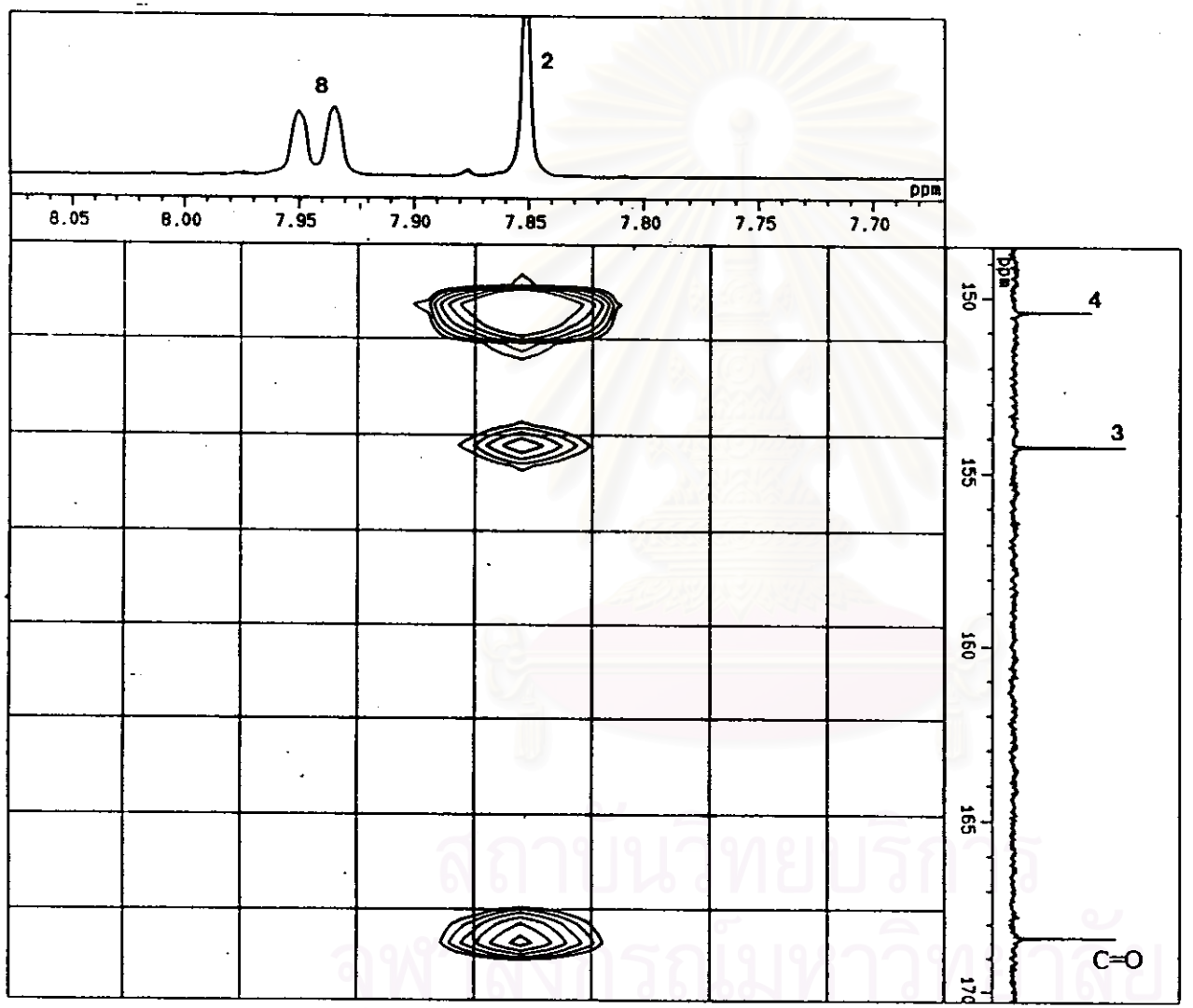


Figure 17b HMBC spectrum of compound GT-B (in DMSO-d_6) [δ_H 7-11 ppm, δ_C 103-138 ppm]



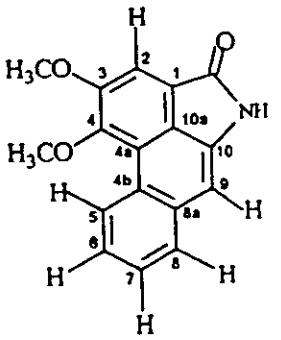
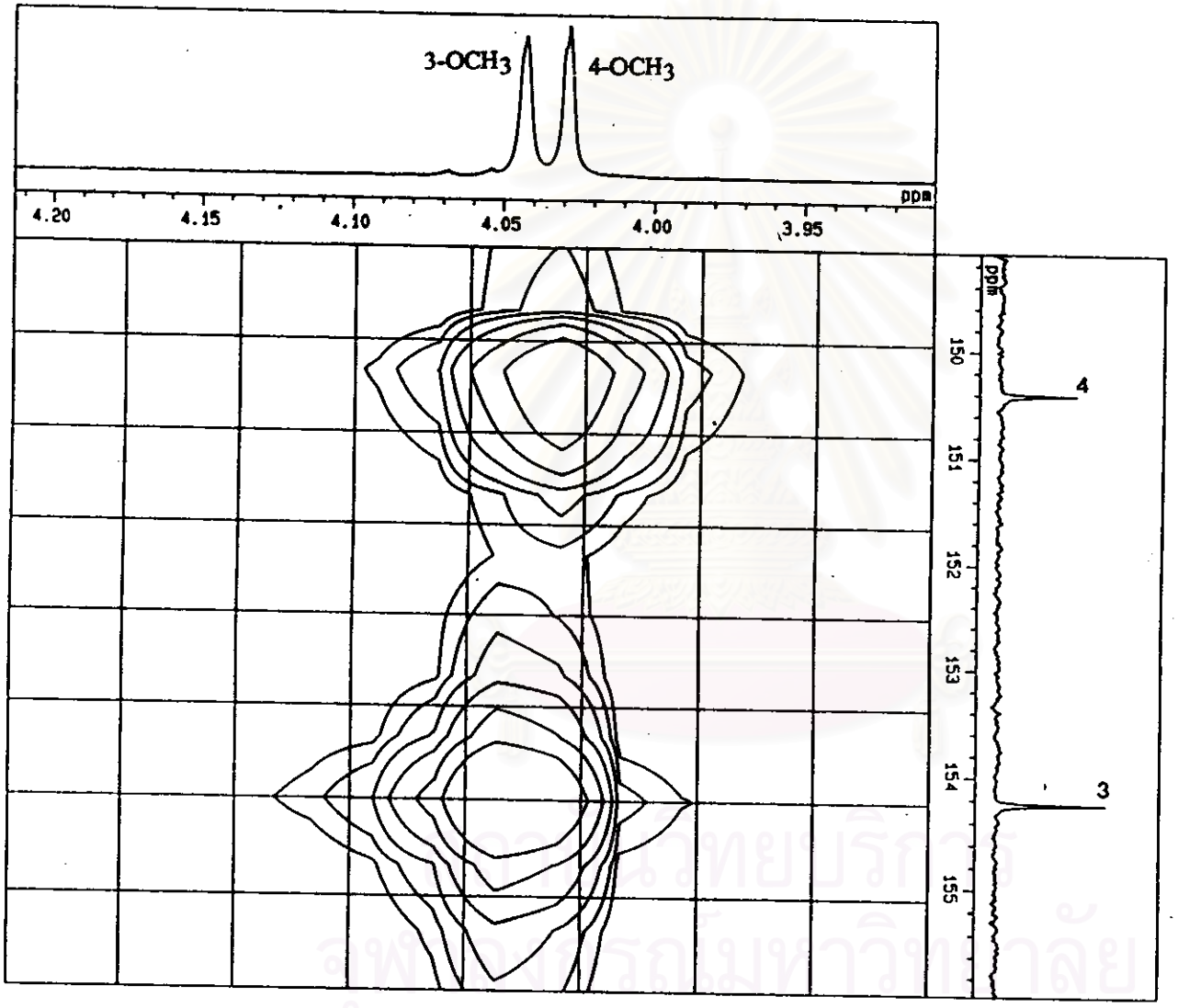


Figure 17c HMBC spectrum of compound GT-B (in DMSO-d_6) [δ_H 7.70-8.05 ppm, δ_C 150-170 ppm]



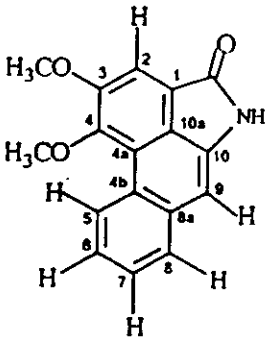


Figure 17d HMBC spectrum of compound GT-B (in DMSO-d_6) [δ_H 3.95-4.20 ppm, δ_C 150-155 ppm]

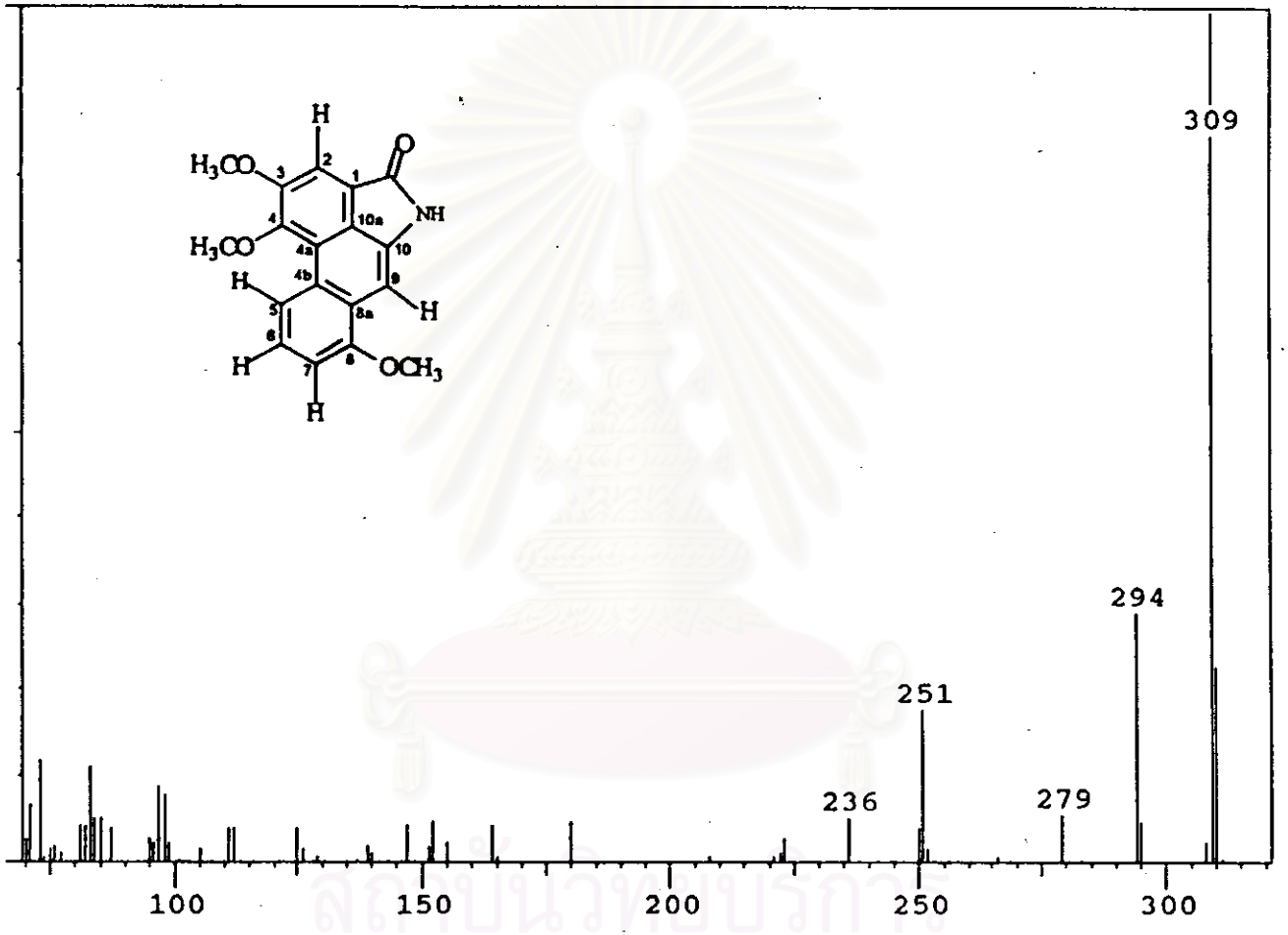


Figure 18 EI mass spectrum of compound GT-C

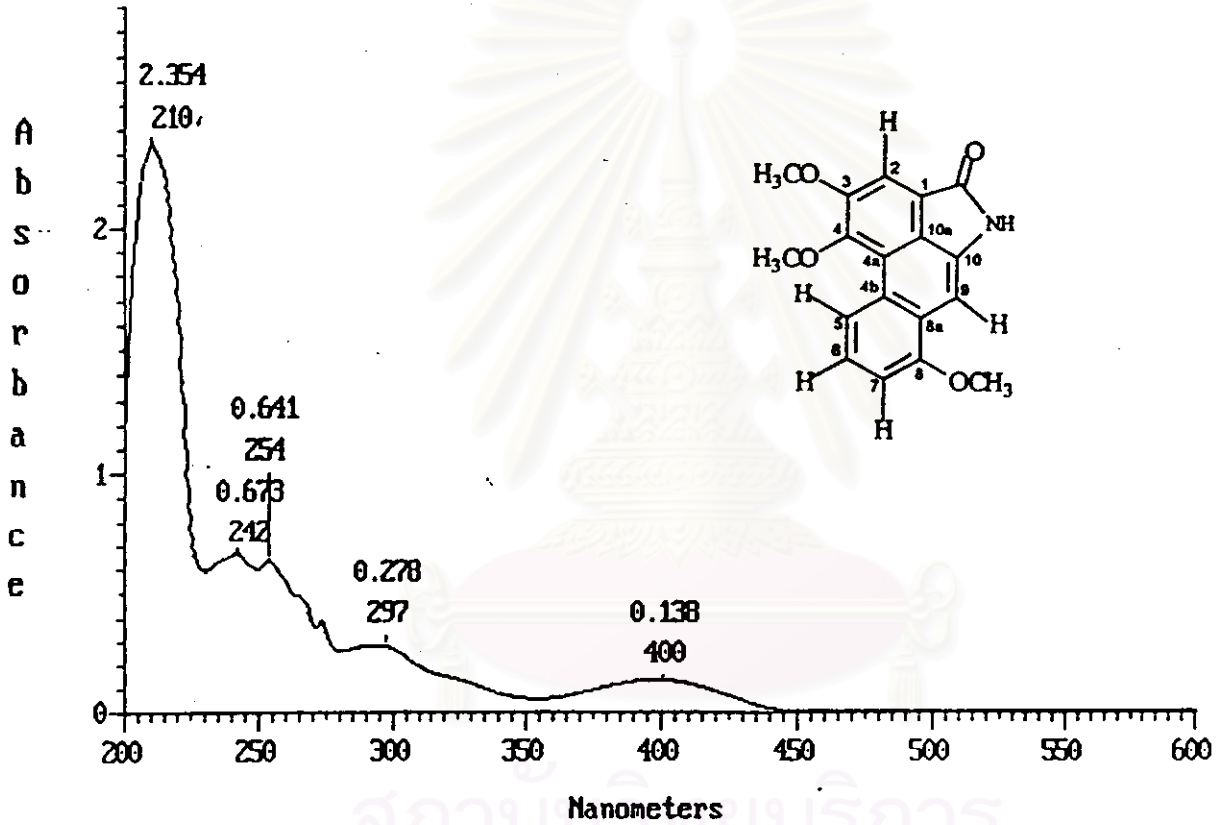


Figure 19 UV spectrum of compound GT-C (in methanol)

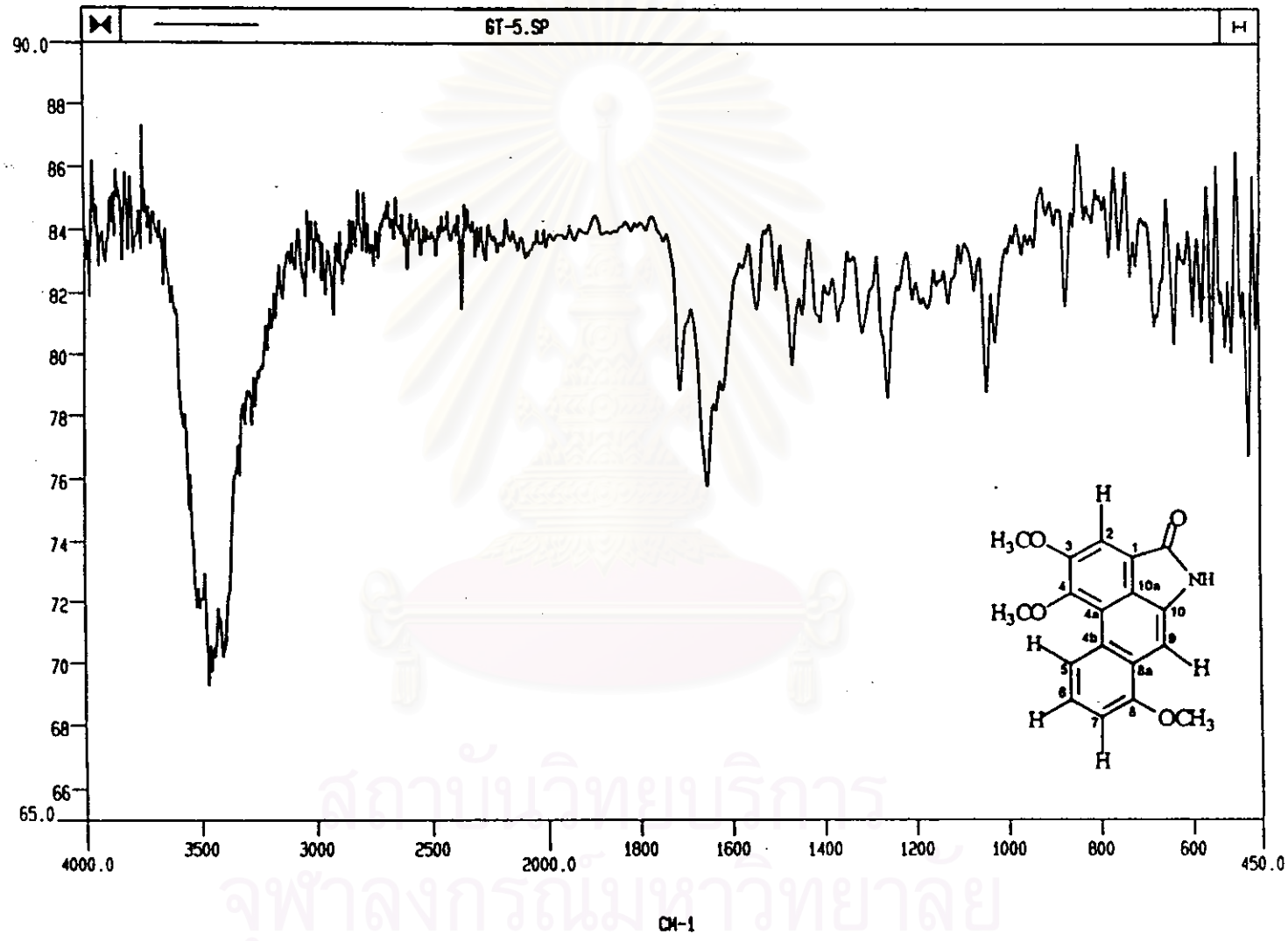


Figure 20 IR spectrum of compound GT-C (KBr disc)

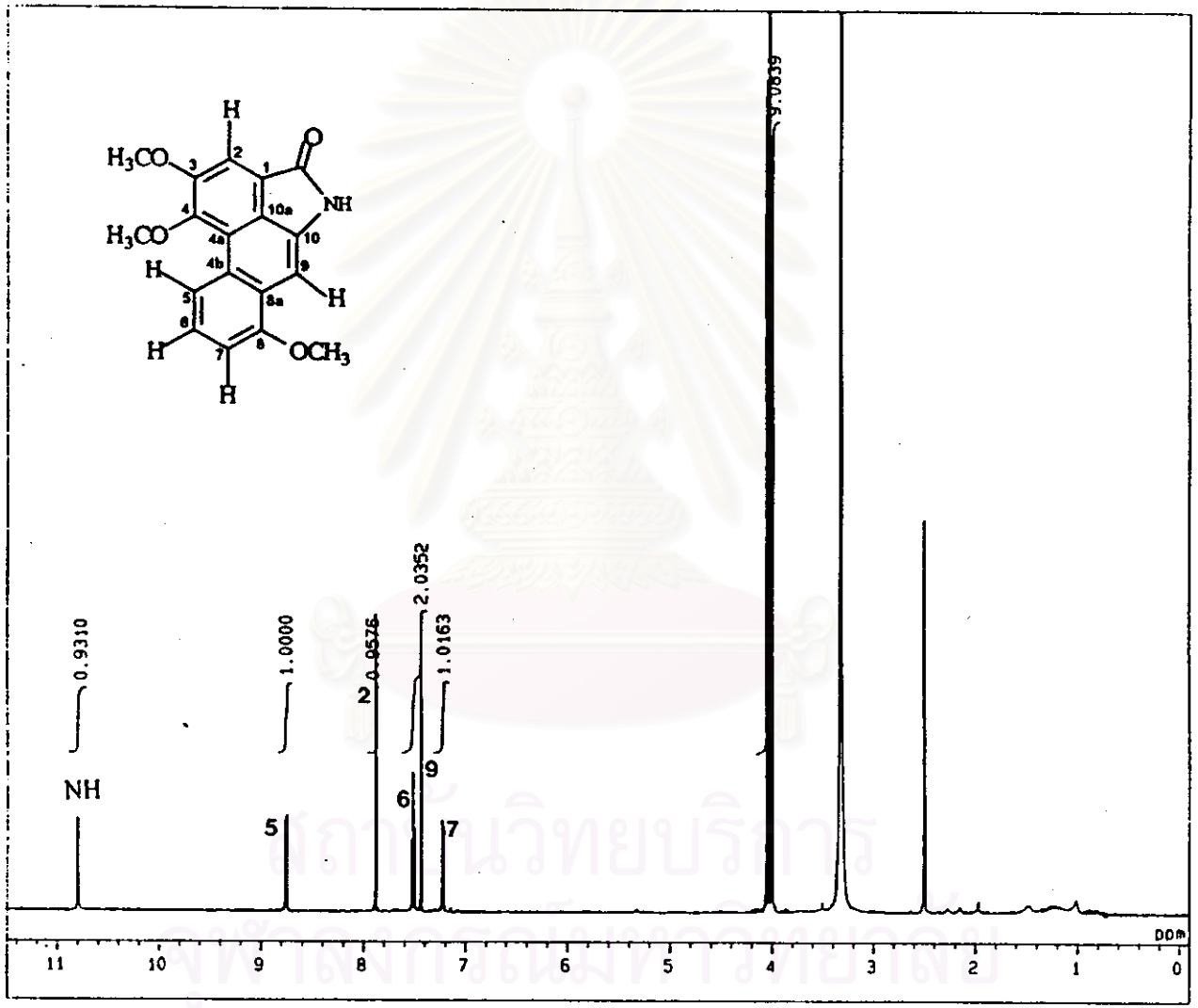


Figure 21a 500 MHz ^{1}H NMR spectrum of compound GT-C (in DMSO-d_6)

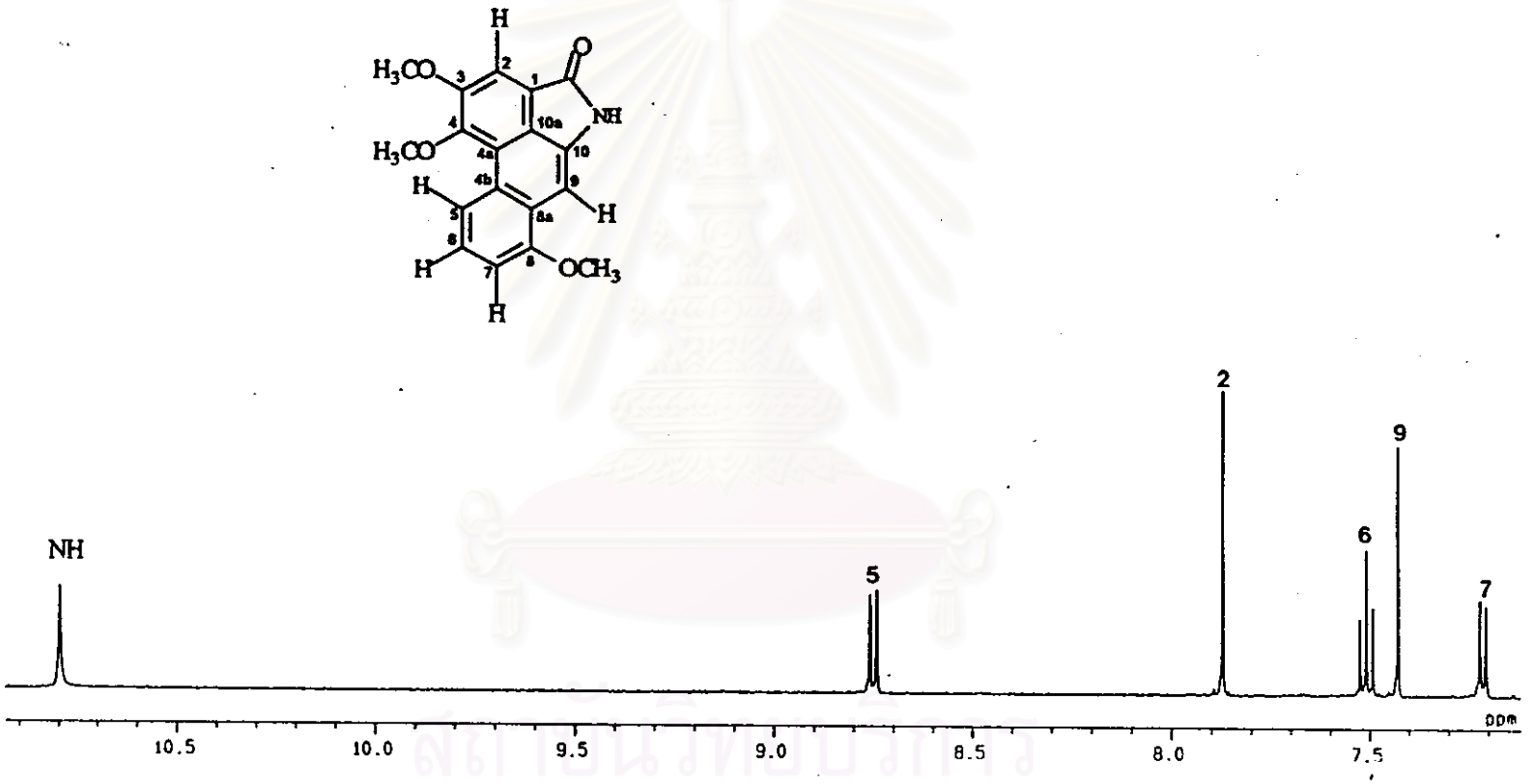
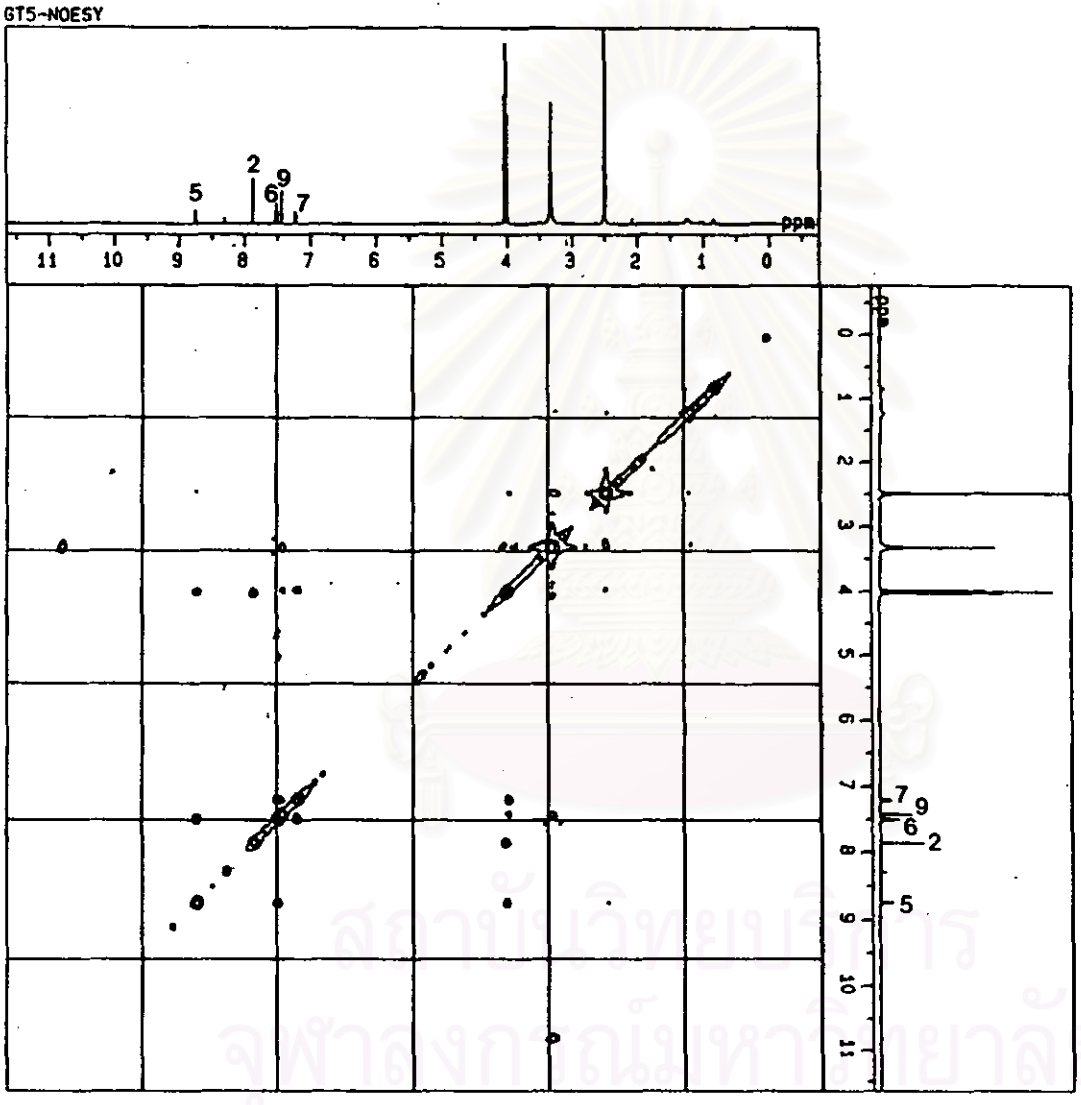


Figure 21b 500 MHz ^{1}H NMR spectrum of compound GT-C (in DMSO-d_6) (expansion from 7.2-10.9 ppm)



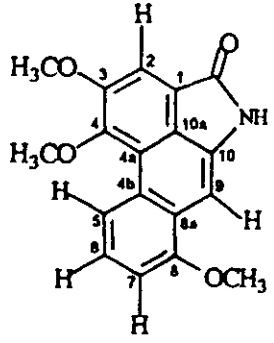


Figure 22a NOESY spectrum of compound GT-C (in DMSO-d_6) [δ_H 0-11 ppm, δ_C 0-11 ppm]

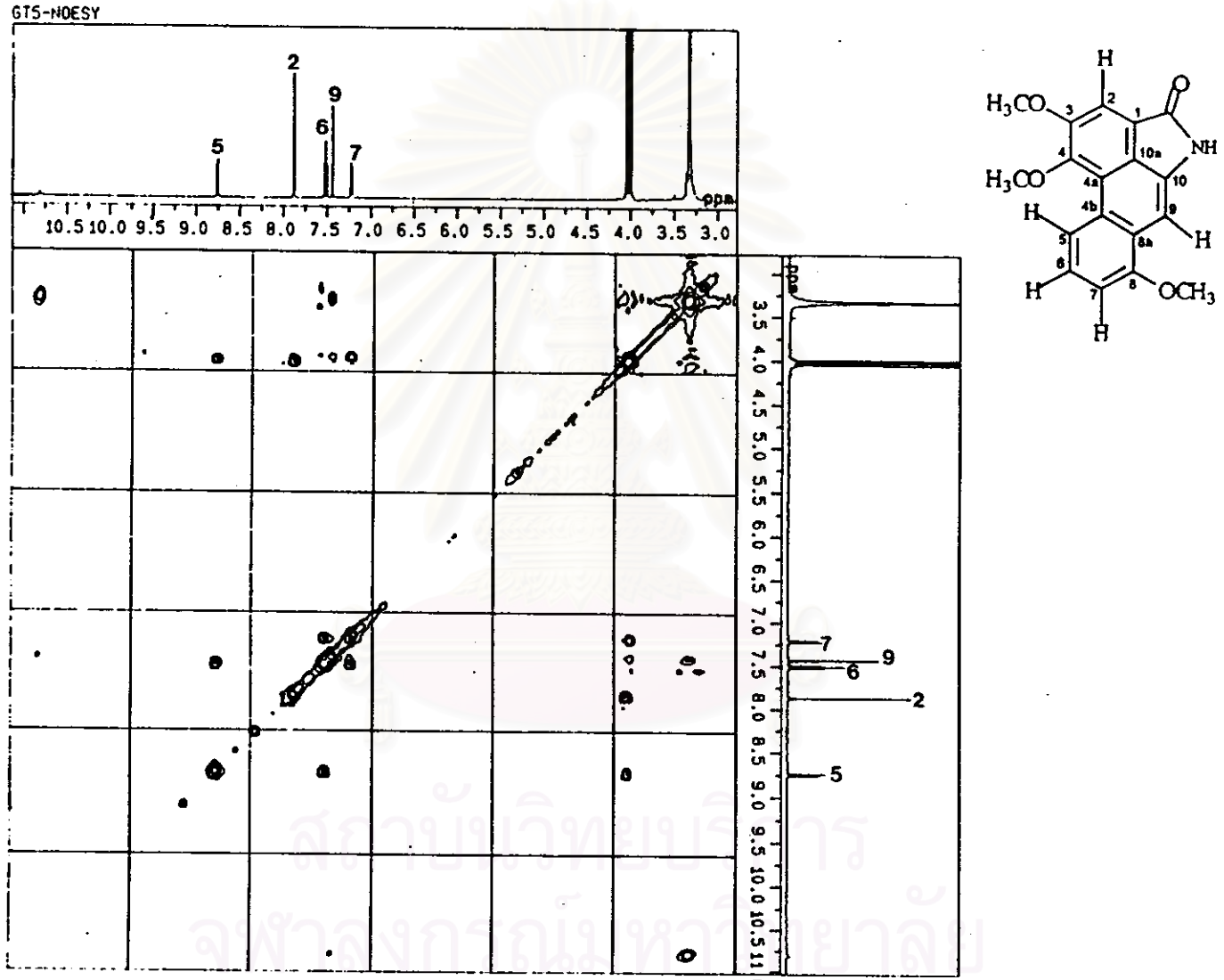


Figure 22b NOESY spectrum of compound GT-C (in DMSO-d_6) [δ_H 3-11 ppm, δ_C 3-11 ppm]

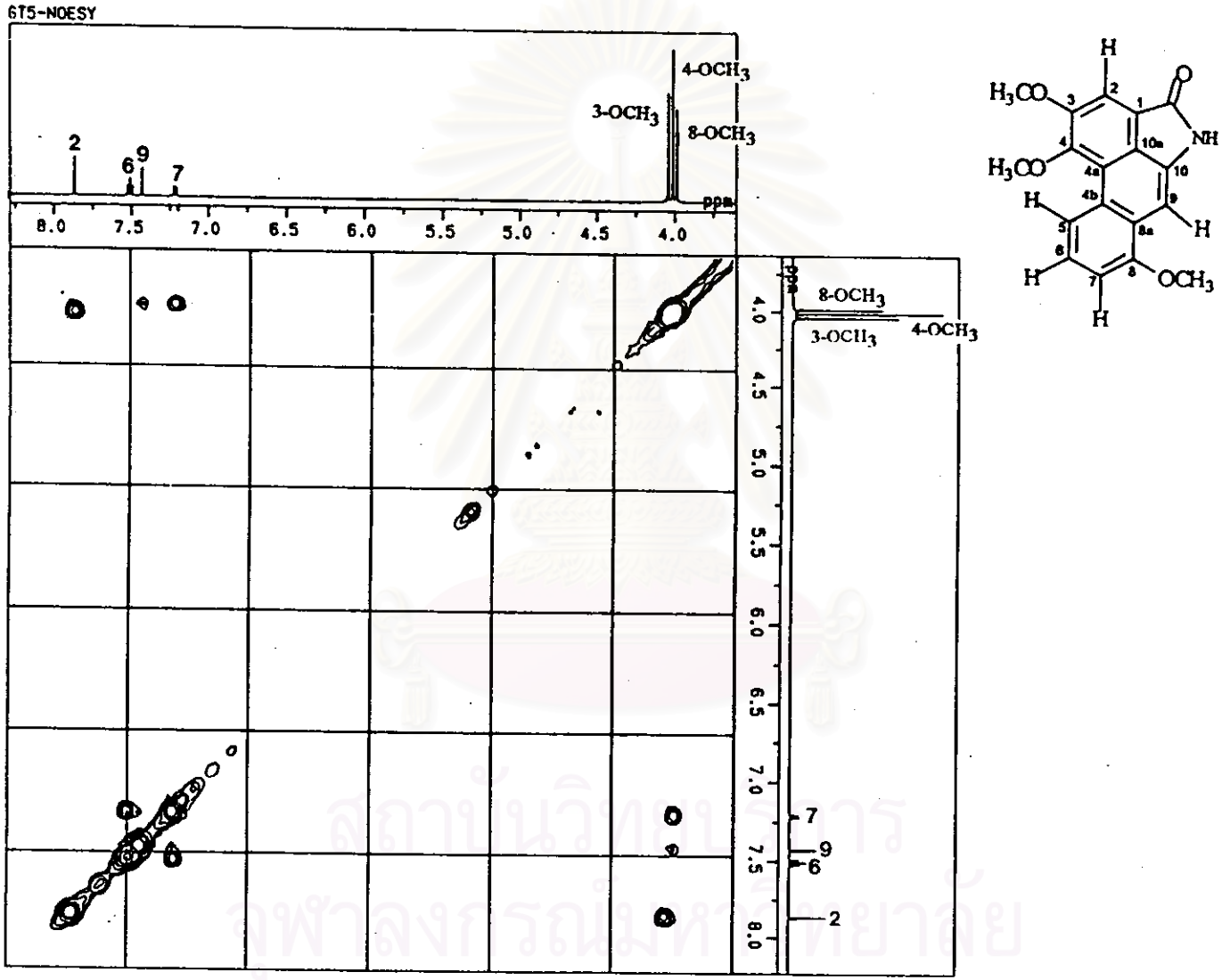
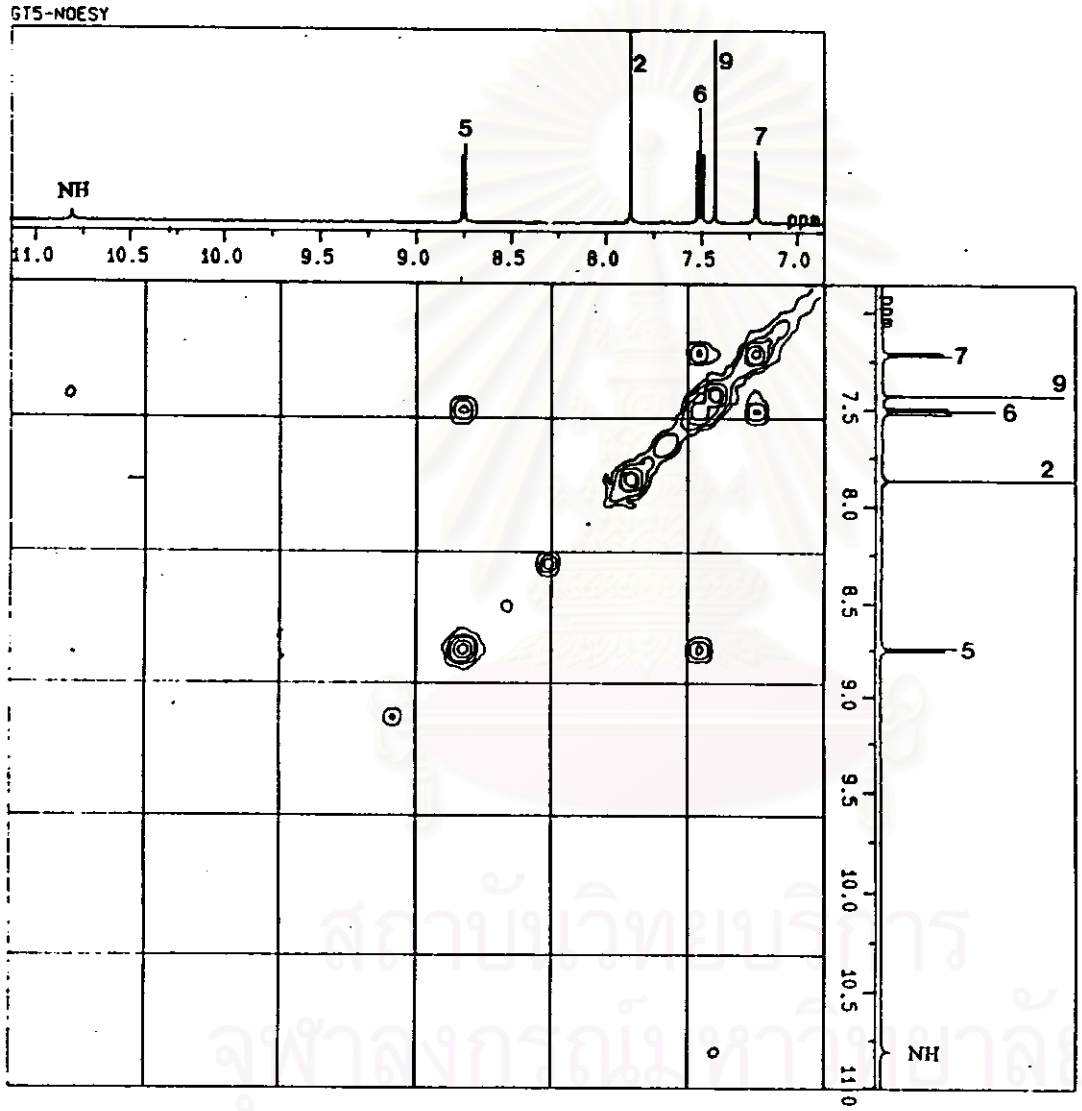


Figure 22c NOESY spectrum of compound GT-C (in DMSO-d_6) [δ_H 4-8 ppm, δ_C 4-8 ppm]



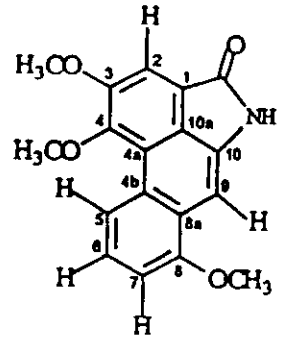


Figure 22d NOESY spectrum of compound GṪ-C (in DMSO-d_6) [δ_H 7-11 ppm, δ_C 7-11 ppm]

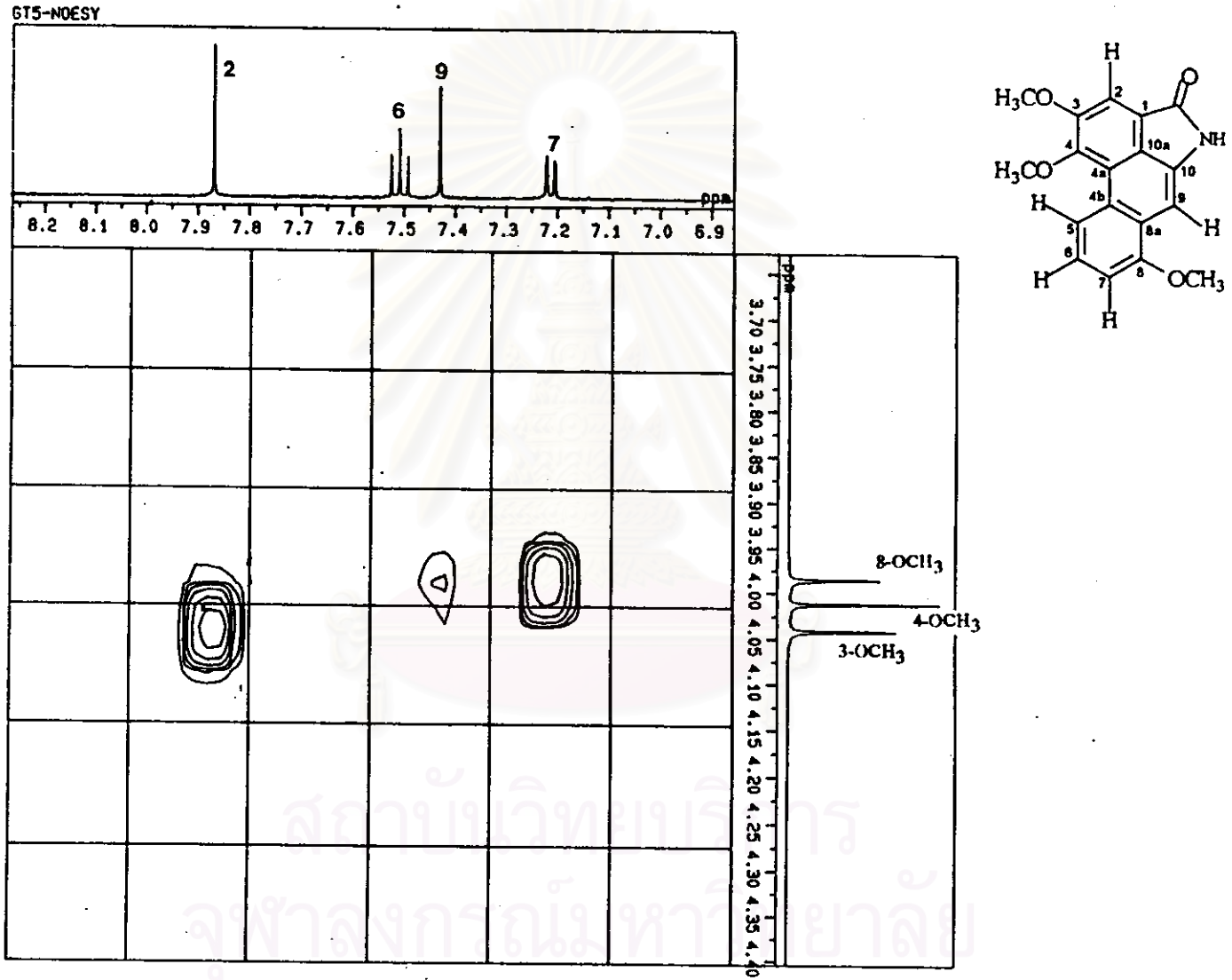


Figure 22e NOESY spectrum of compound GT-C (in DMSO-d_6) [δ_H 6.9-8.2 ppm, δ_C 3.7-4.4 ppm]

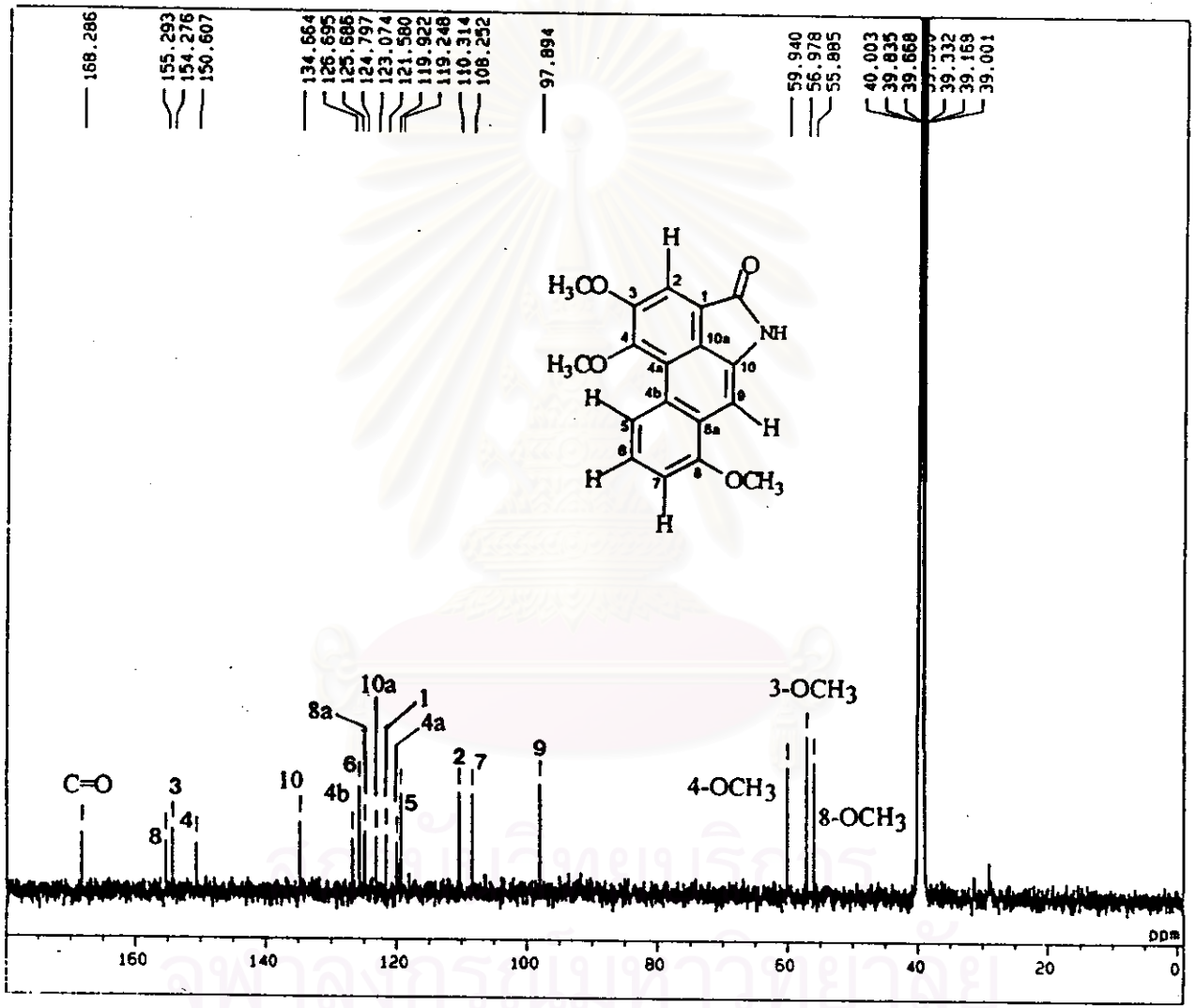


Figure 23 125 MHz ^{13}C NMR spectrum of compound GT-C (in DMSO-d_6)

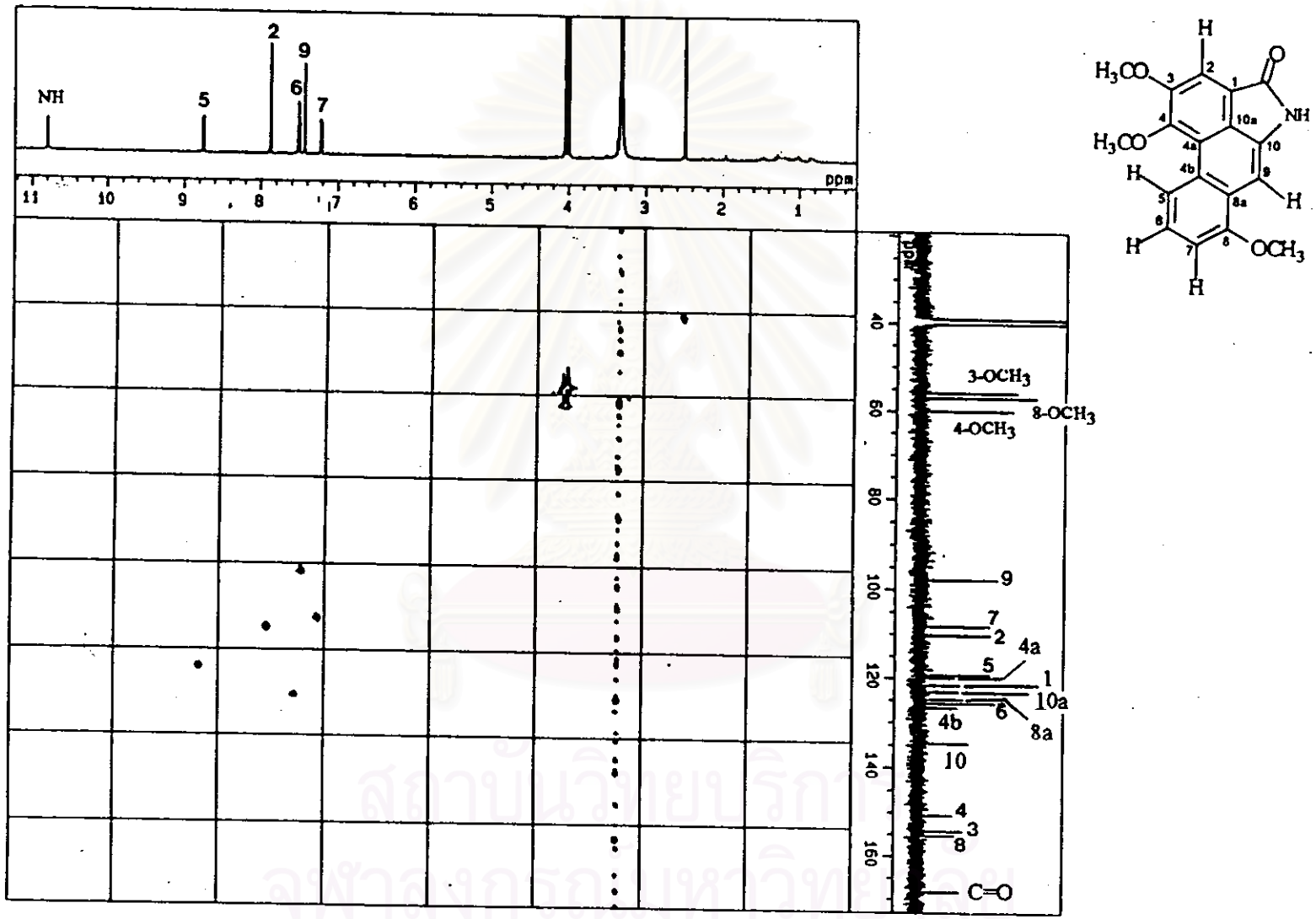
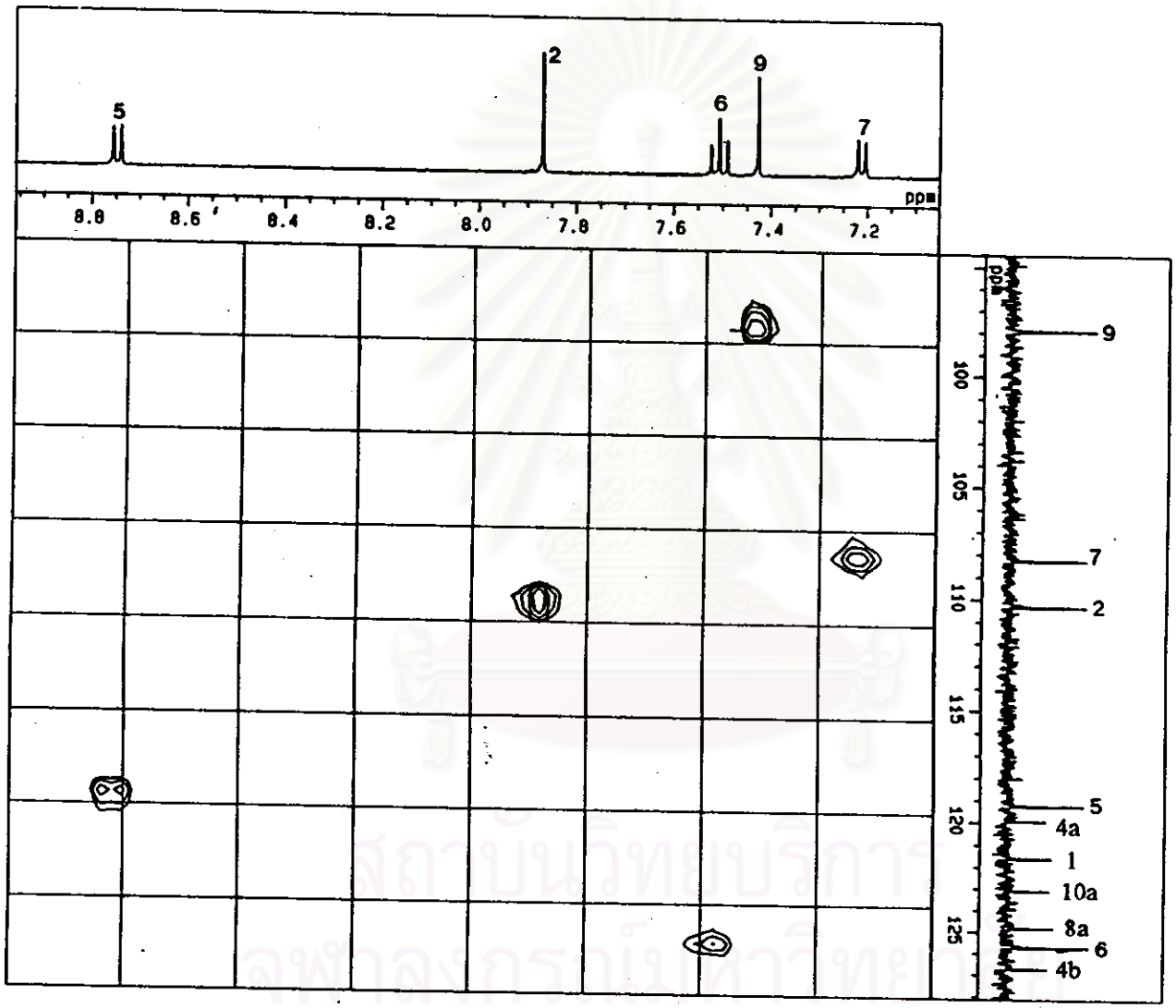


Figure 24a HMQC spectrum of compound GT-C (in DMSO-d_6) [δ_H 1-11 ppm, δ_C 20-170 ppm]



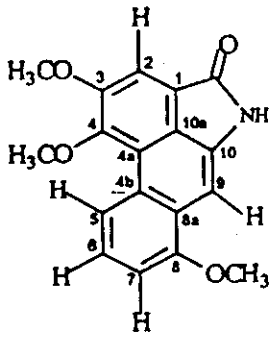
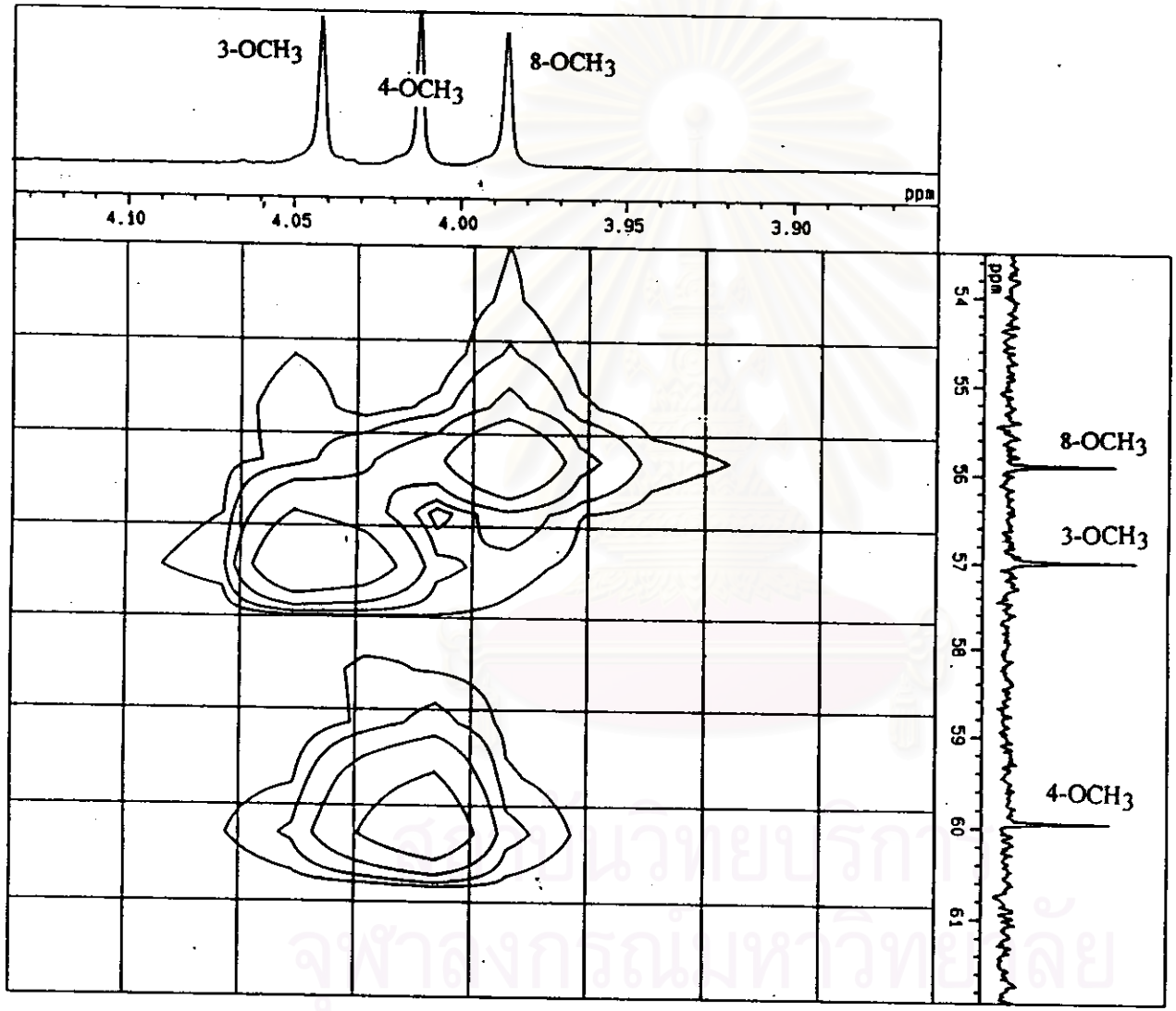


Figure 24b HMQC spectrum of compound GT-C (in DMSO-d_6) [δ_H 7.2-8.8 ppm, δ_C 95-128 ppm]



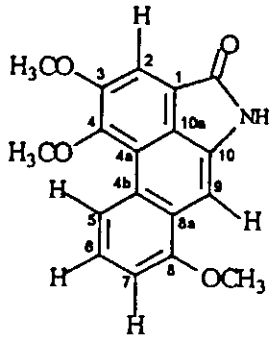


Figure 24c HMQC spectrum of compound GT-C (in DMSO-d_6) [δ_H 3.9-4.1 ppm, δ_C 54-61 ppm]

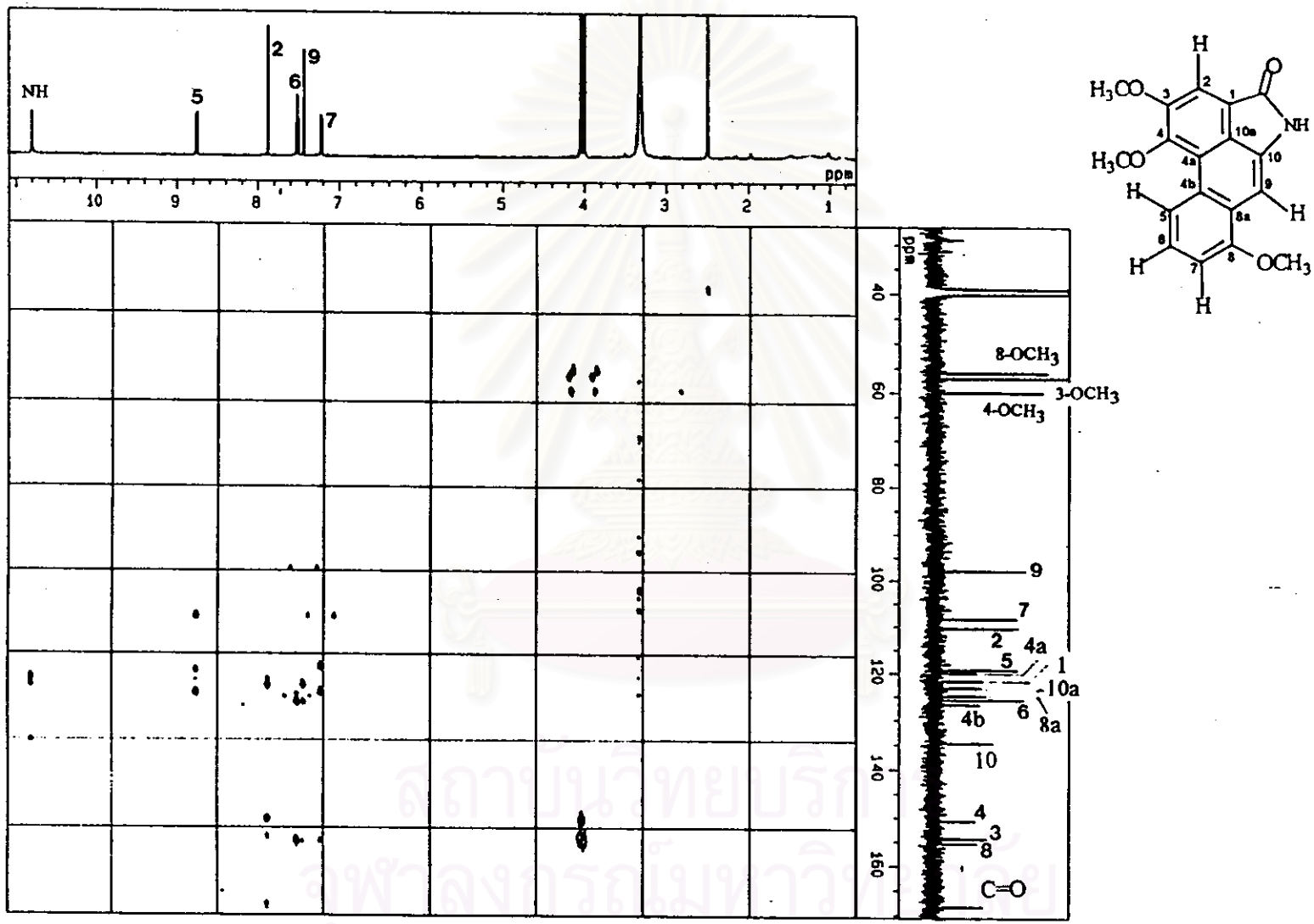
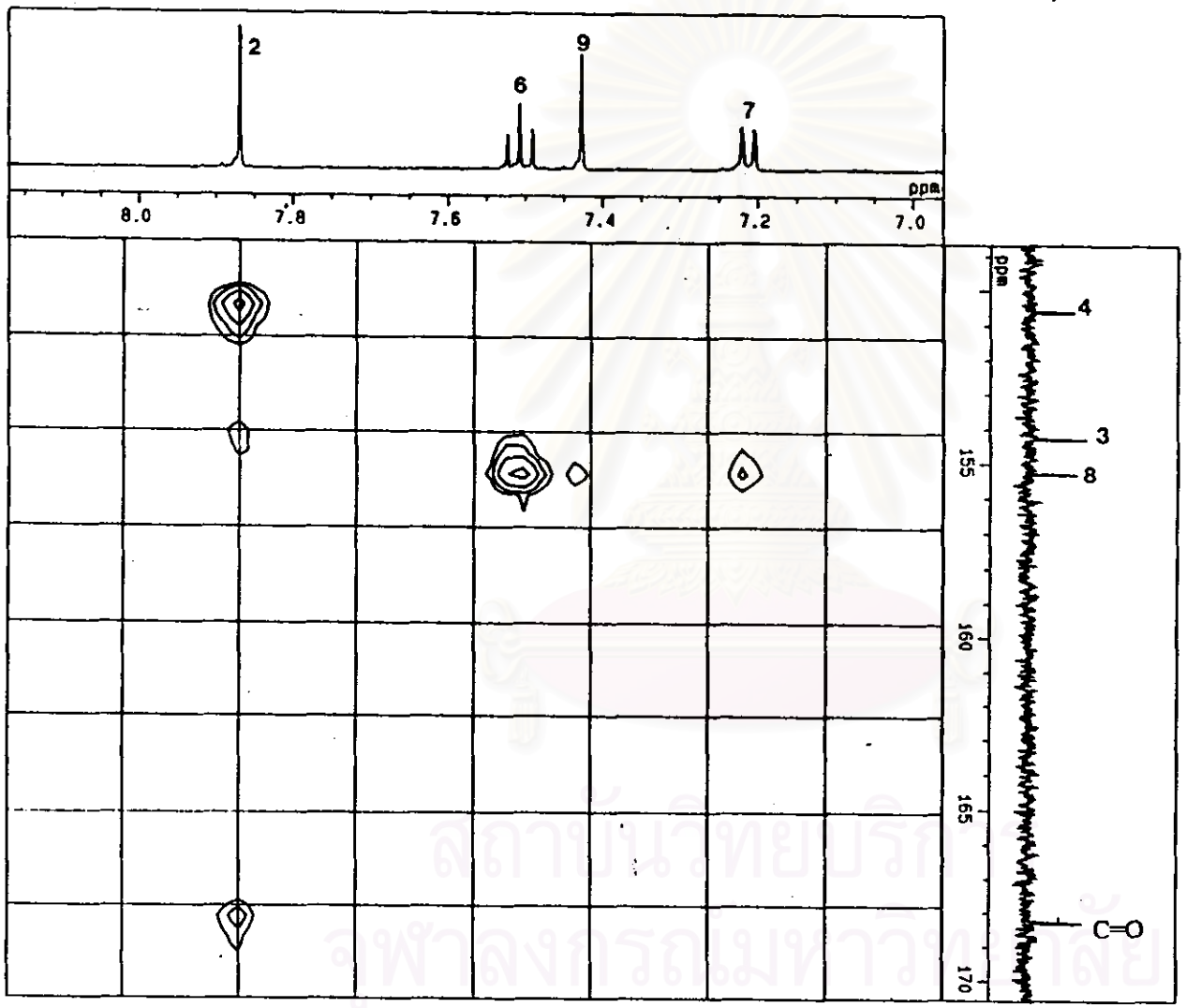


Figure 25a HMBC spectrum of compound GT-C (in DMSO-d_6) [δ_H 1-11 ppm, δ_C 30-170 ppm]



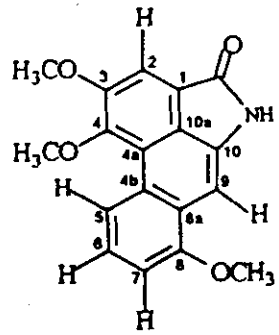


Figure 25b HMBC spectrum of compound GT-C (in DMSO-d_6) [δ_H 7-8 ppm, δ_C 150-170 ppm]

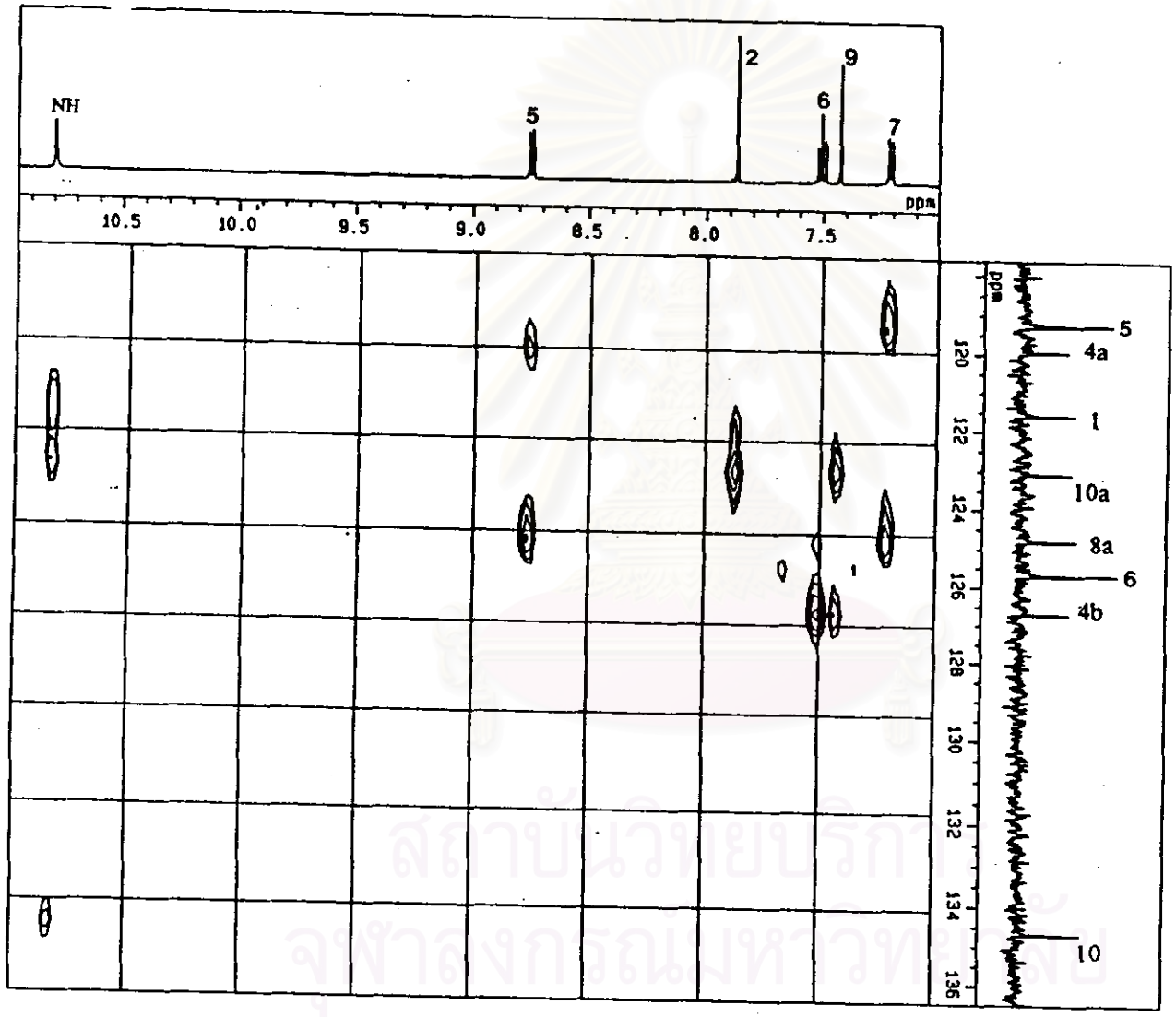


Figure 25c HMBC spectrum of compound GT-C (in DMSO-d_6) [δ_H 7.1-10.9 ppm, δ_C 118-136 ppm]

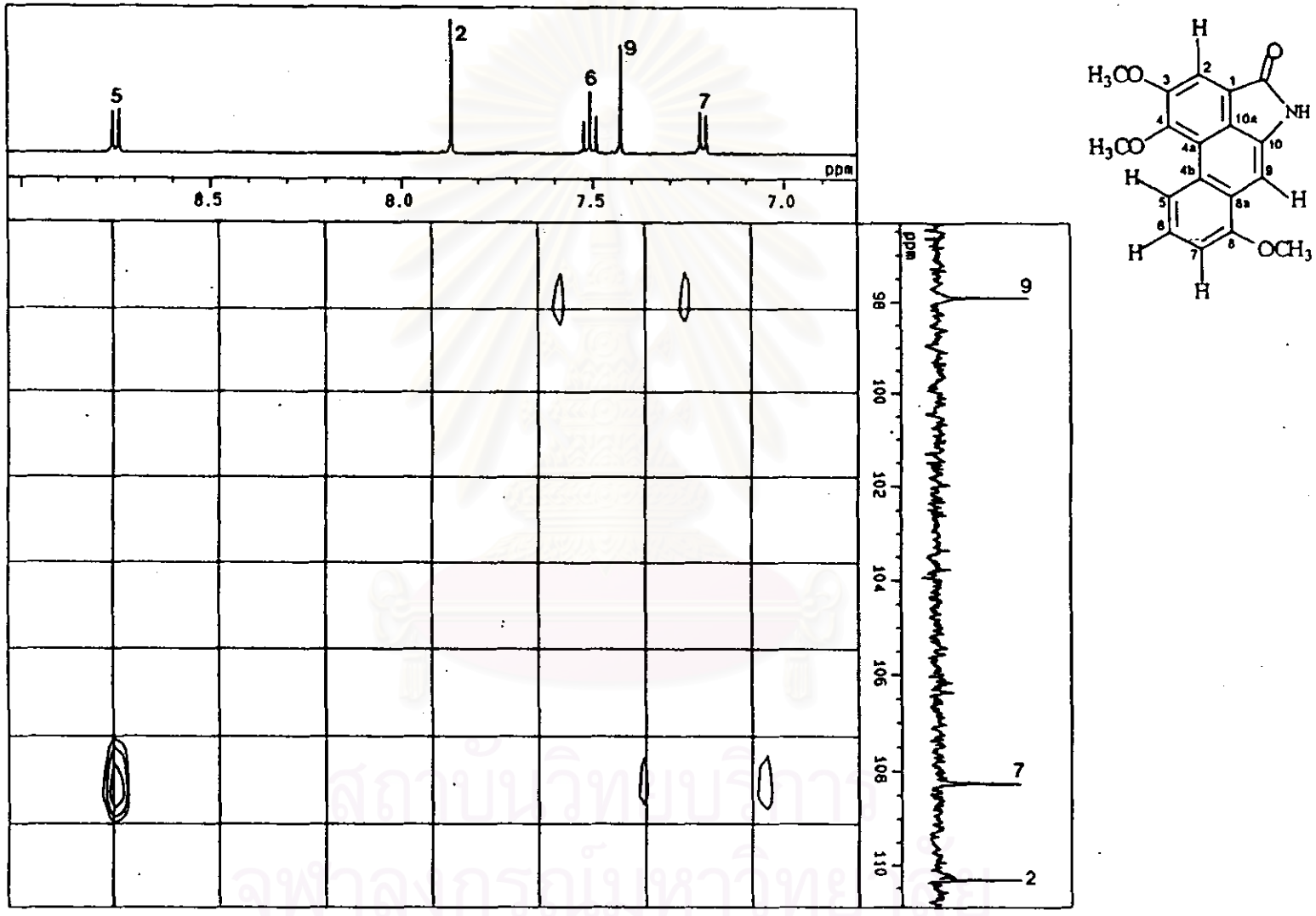


Figure 25d HMBC spectrum of compound GT-C (in DMSO-d_6) [δ_H 7-9 ppm, δ_C 97-111 ppm]

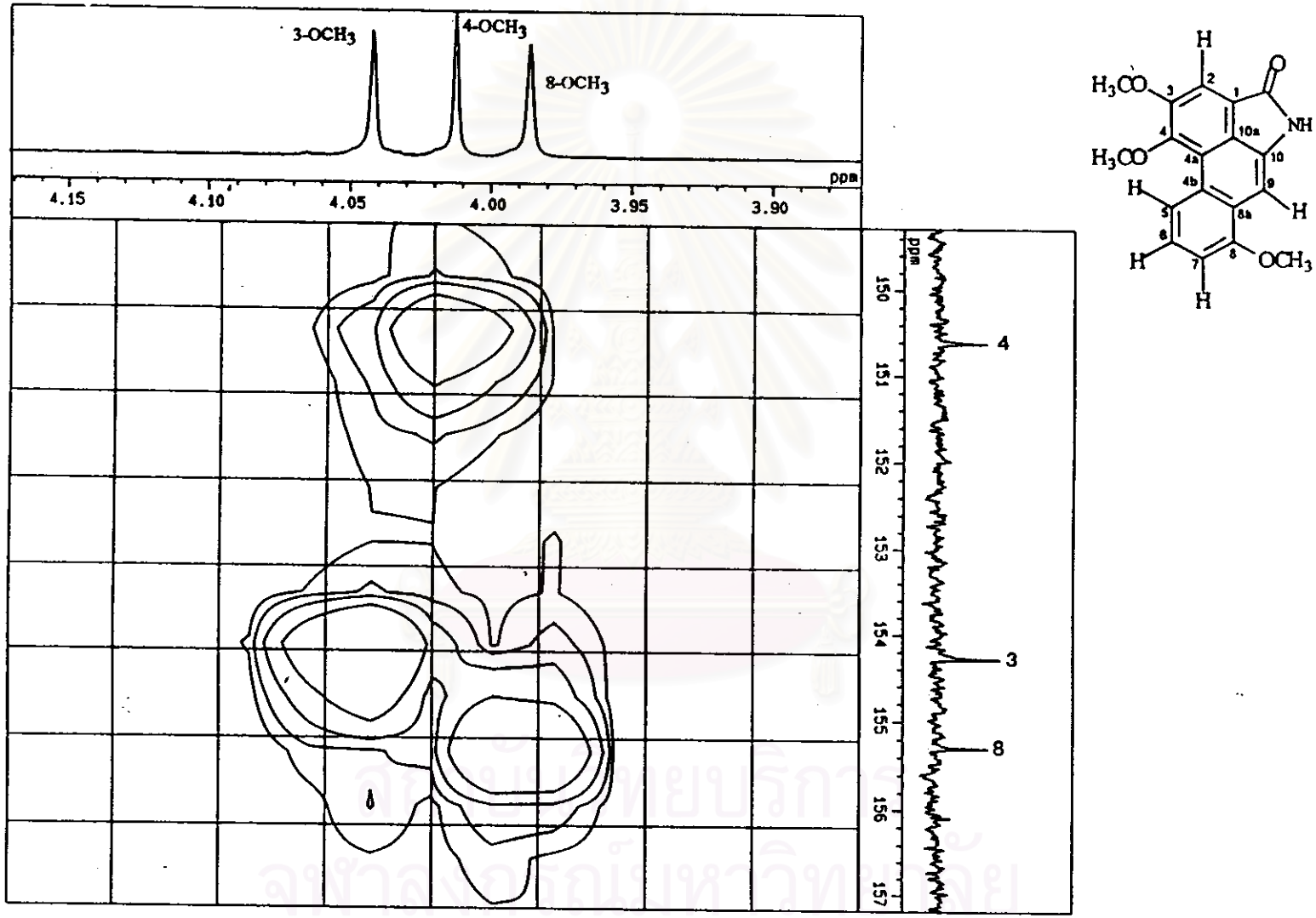


Figure 25e HMBC spectrum of compound GT-C (in DMSO-d_6) [δ_H 3.90-4.15 ppm, δ_C 150-157 ppm]

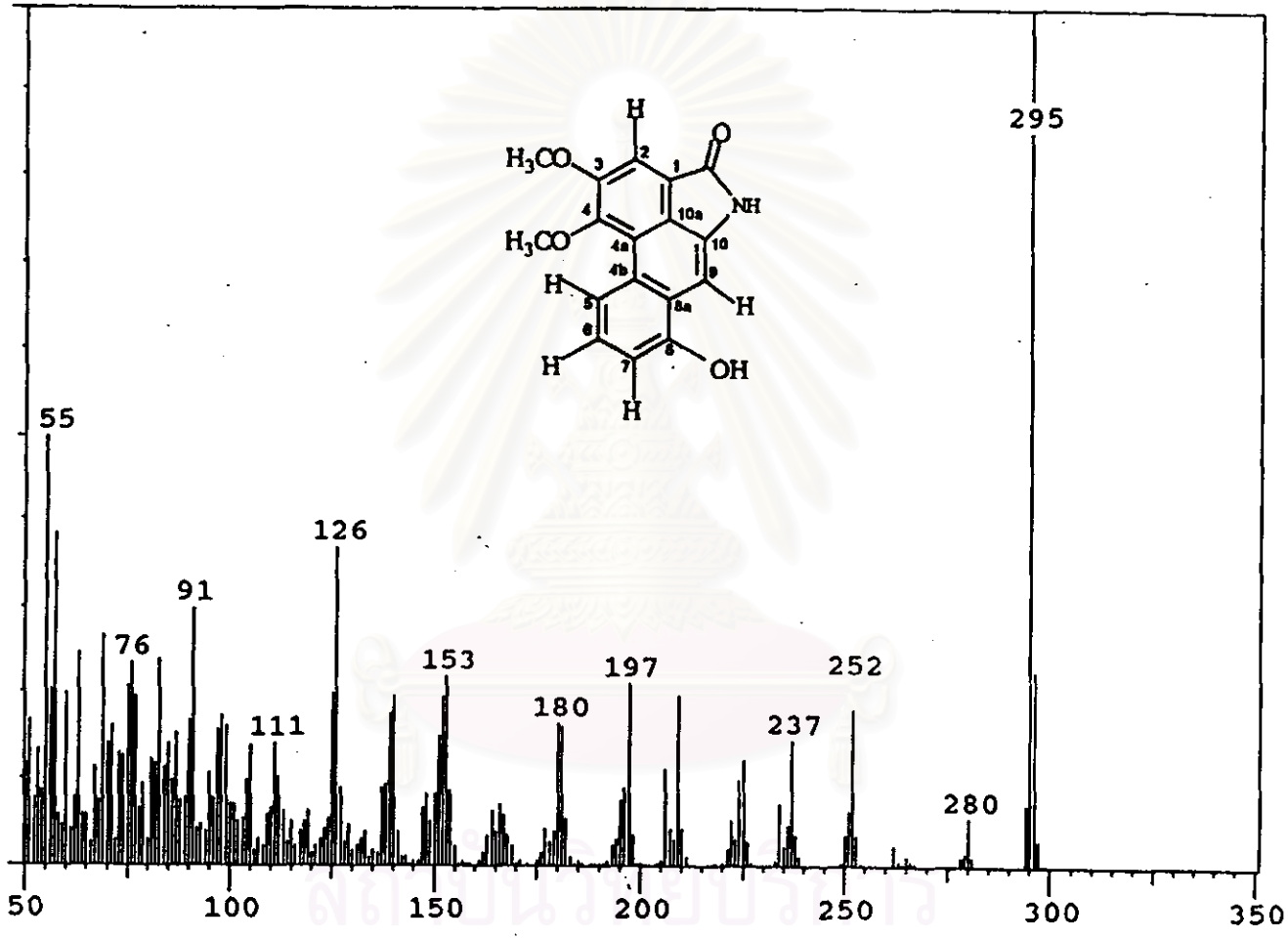


Figure 26 EI mass spectrum of compound GT-D

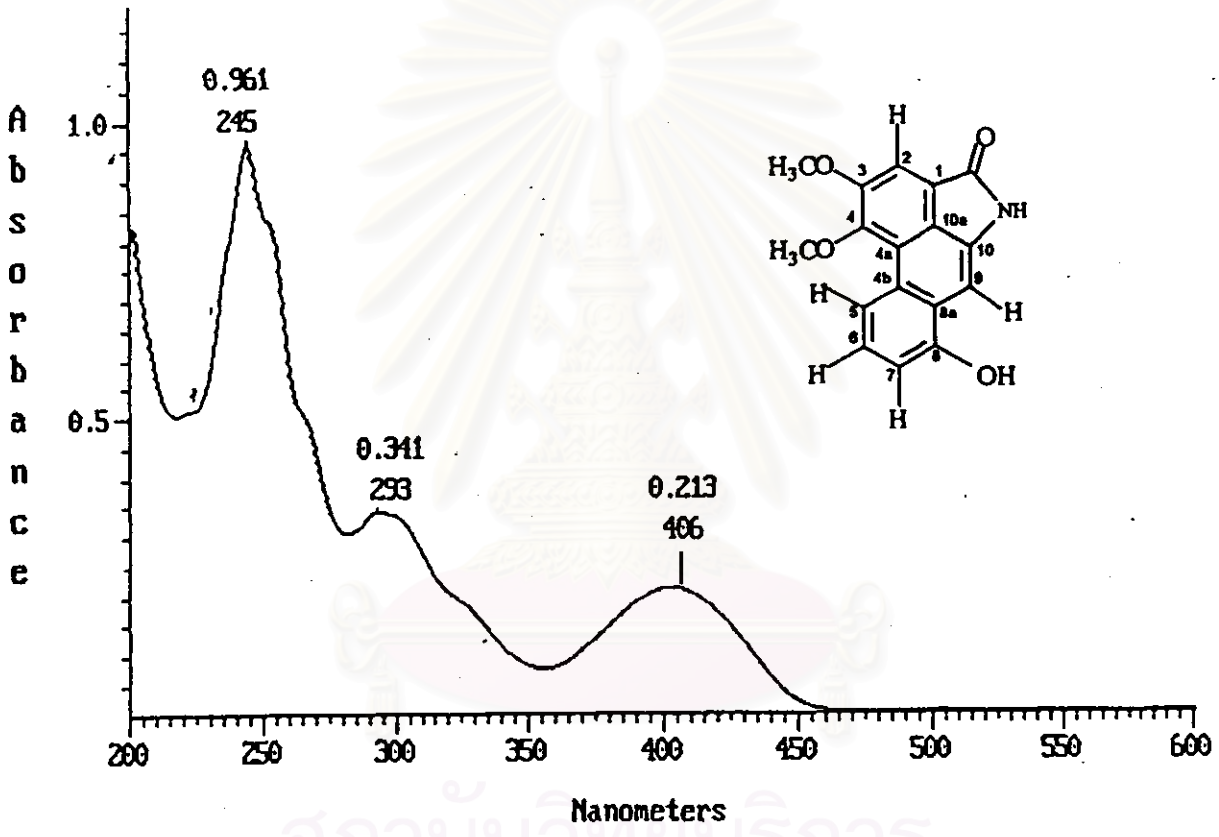


Figure 27 UV spectrum of compound GT-D (in methanol)

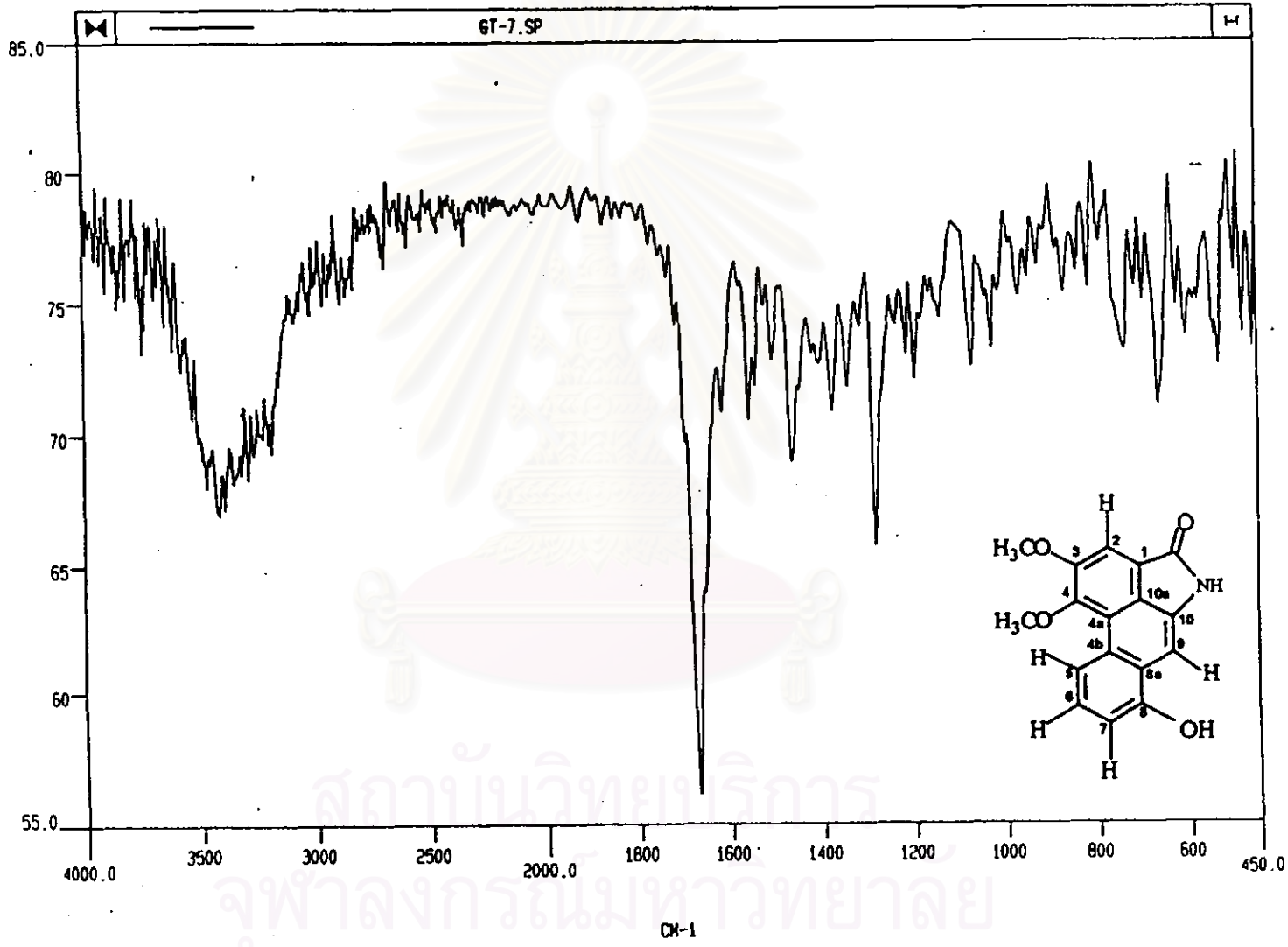


Figure 28 IR spectrum of compound GT-D (KBr disc)

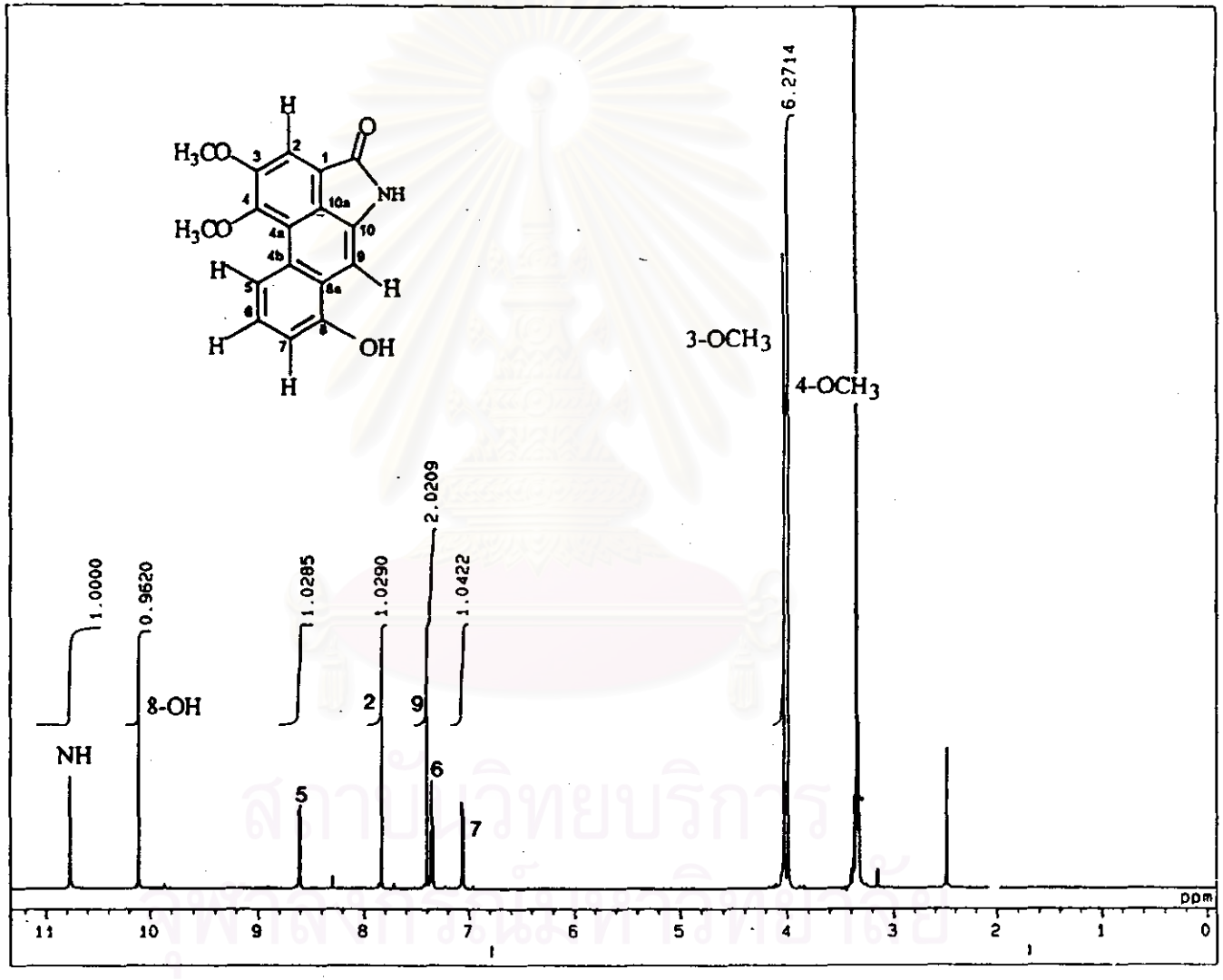


Figure 29a 500 MHz ^{1}H NMR spectrum of compound GT-D (in DMSO-d_6)

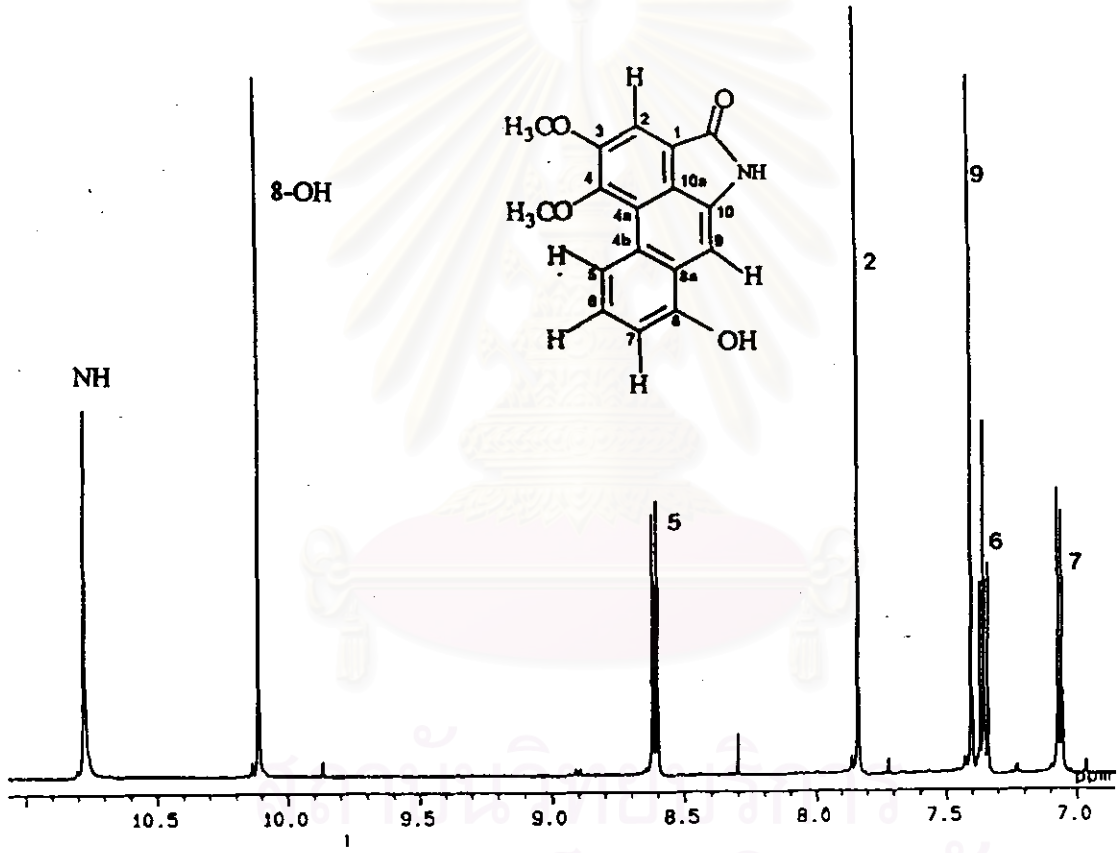


Figure 29b 500 MHz ^{1}H NMR spectrum of compound GT-D (in DMSO-d_6) (expansion from 7.0-10.9 ppm)

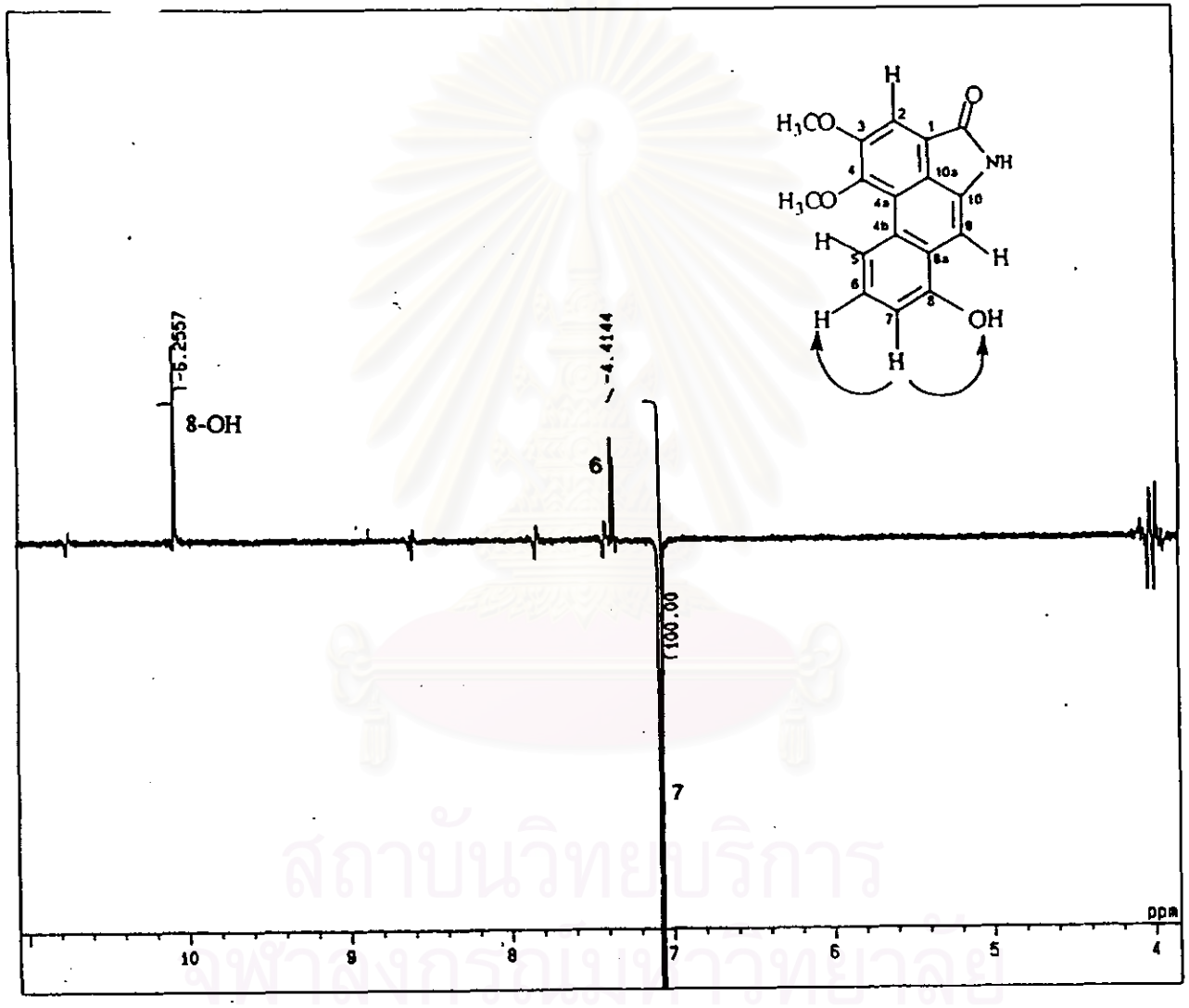


Figure 30a NOE difference spectrum of compound GT-D (in DMSO-d_6) (irradiate at 7.06 ppm)

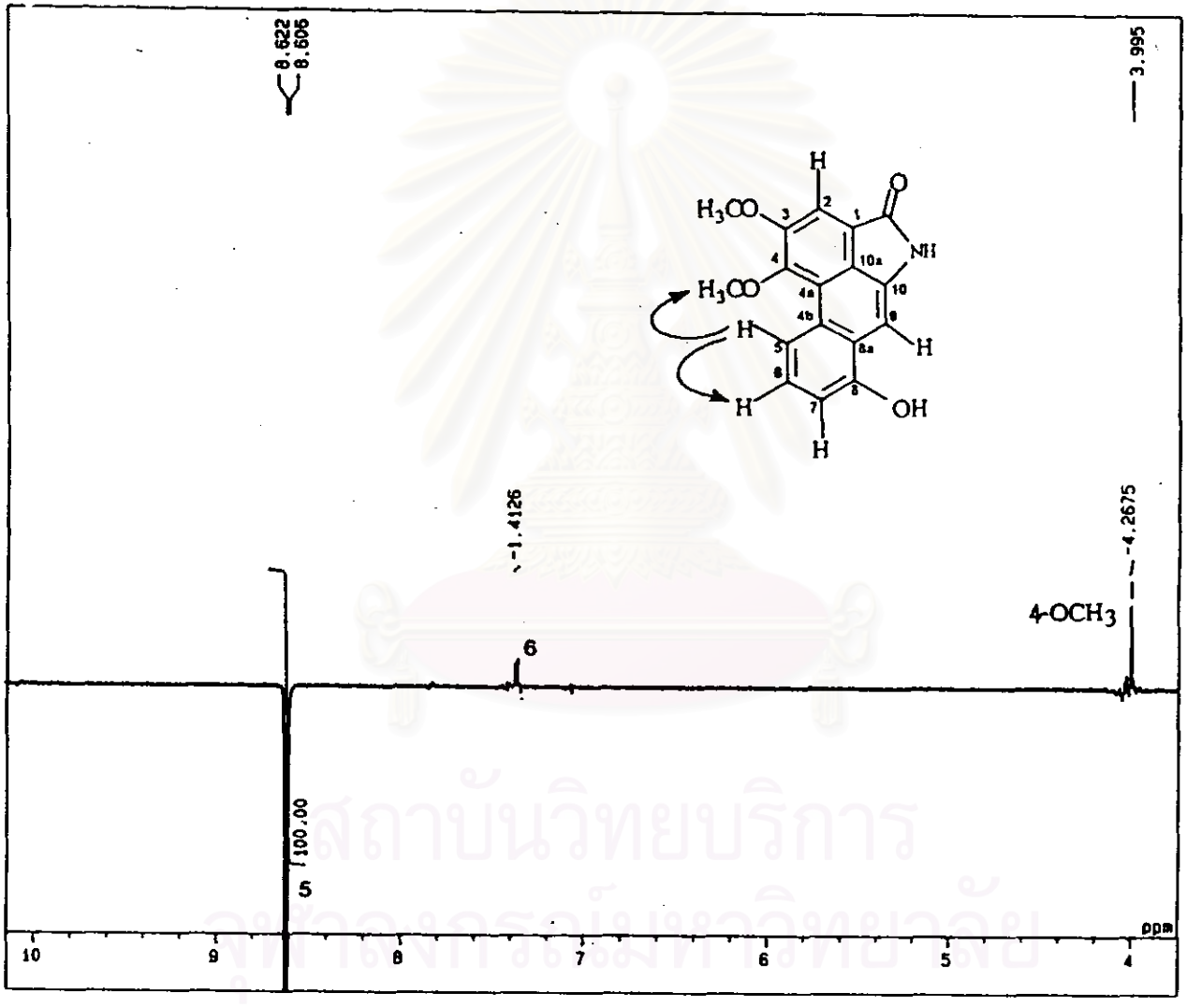


Figure 30b NOE difference spectrum of compound GT-D (in DMSO-d_6) (irradiate at 8.61 ppm)

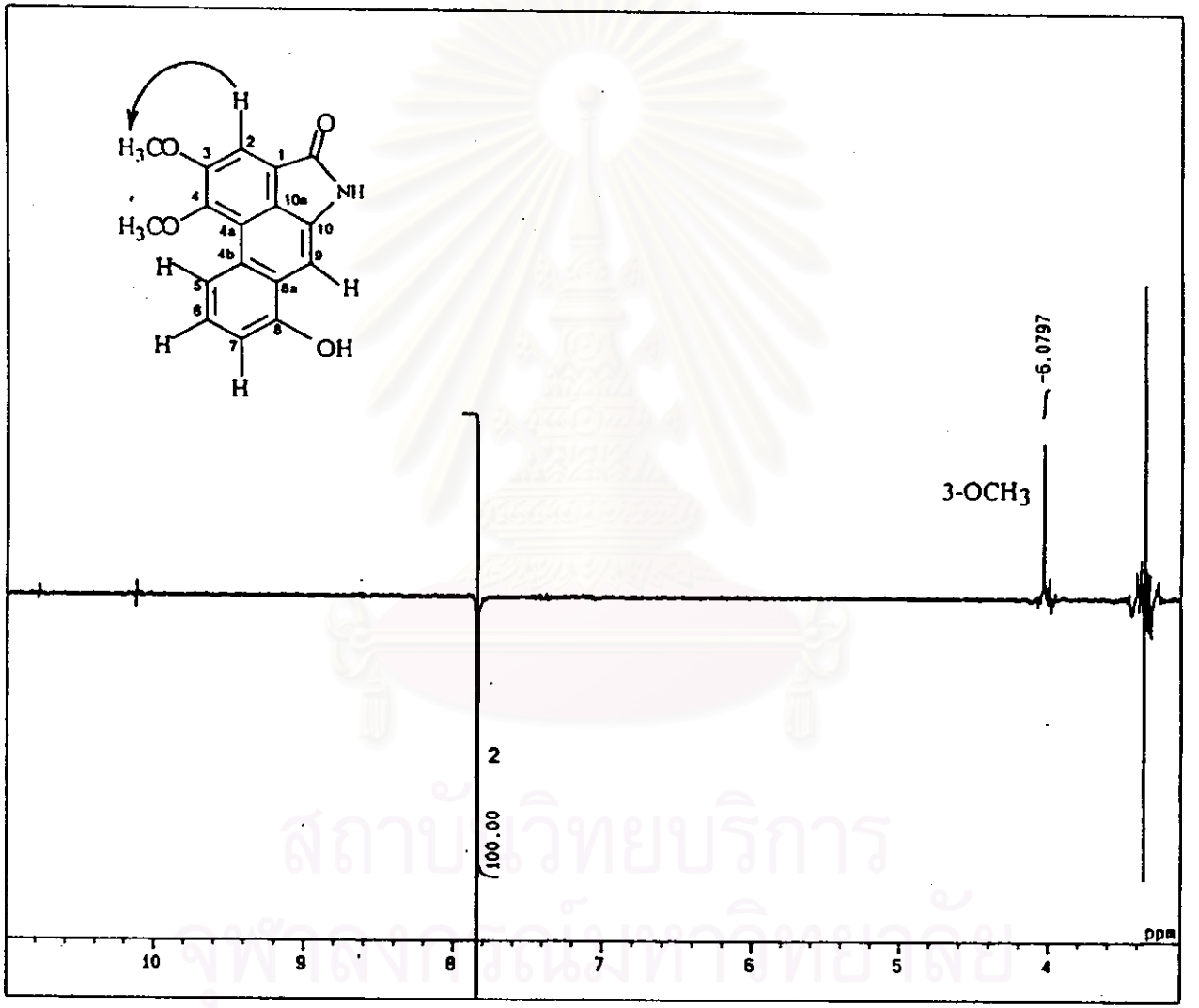


Figure 30c NOE difference spectrum of compound GT-D (in DMSO-d_6) (irradiate at 7.83 ppm)

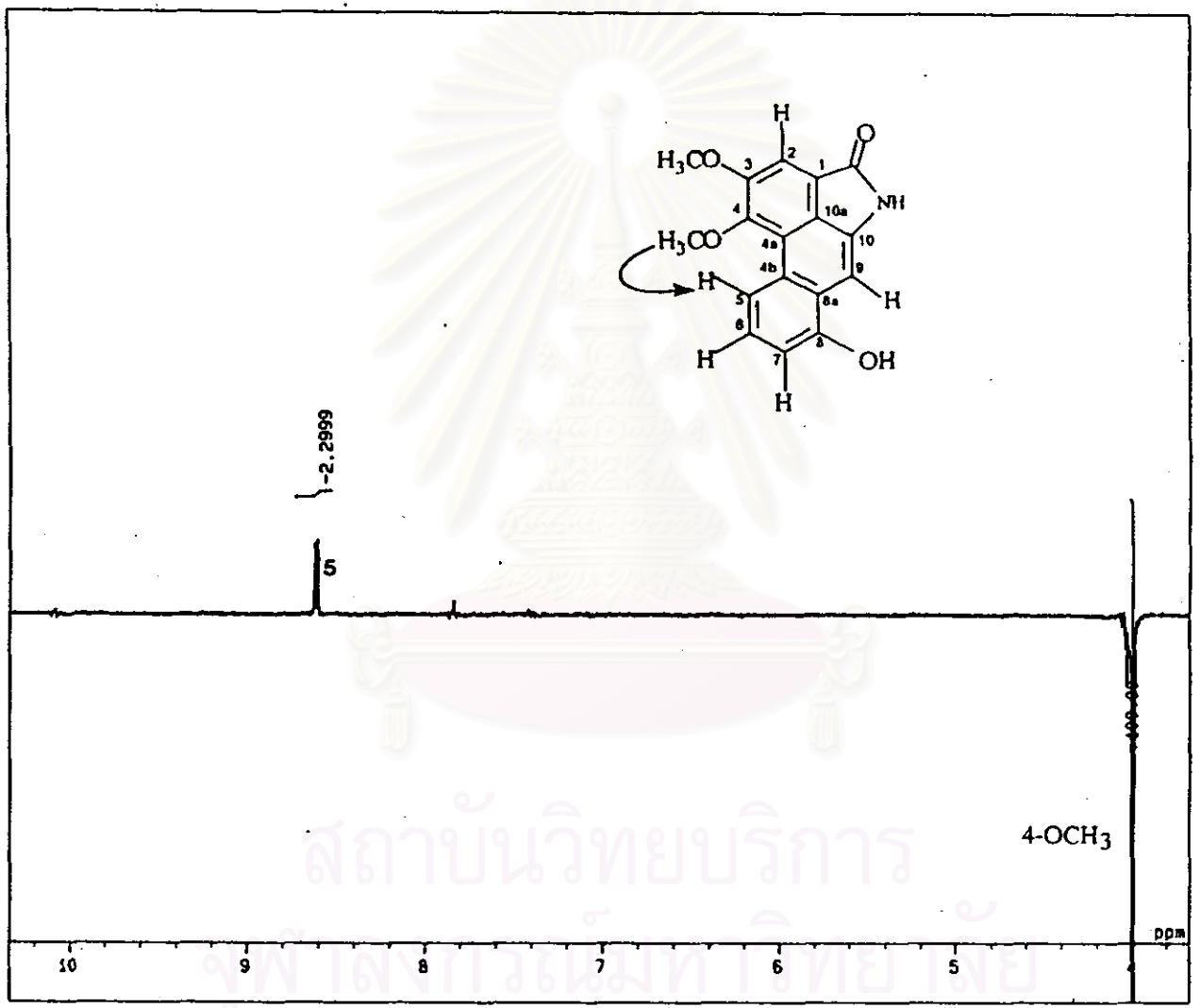


Figure 30d NOE difference spectrum of compound GT-D (in DMSO-d_6) (irradiate at 3.99 ppm)

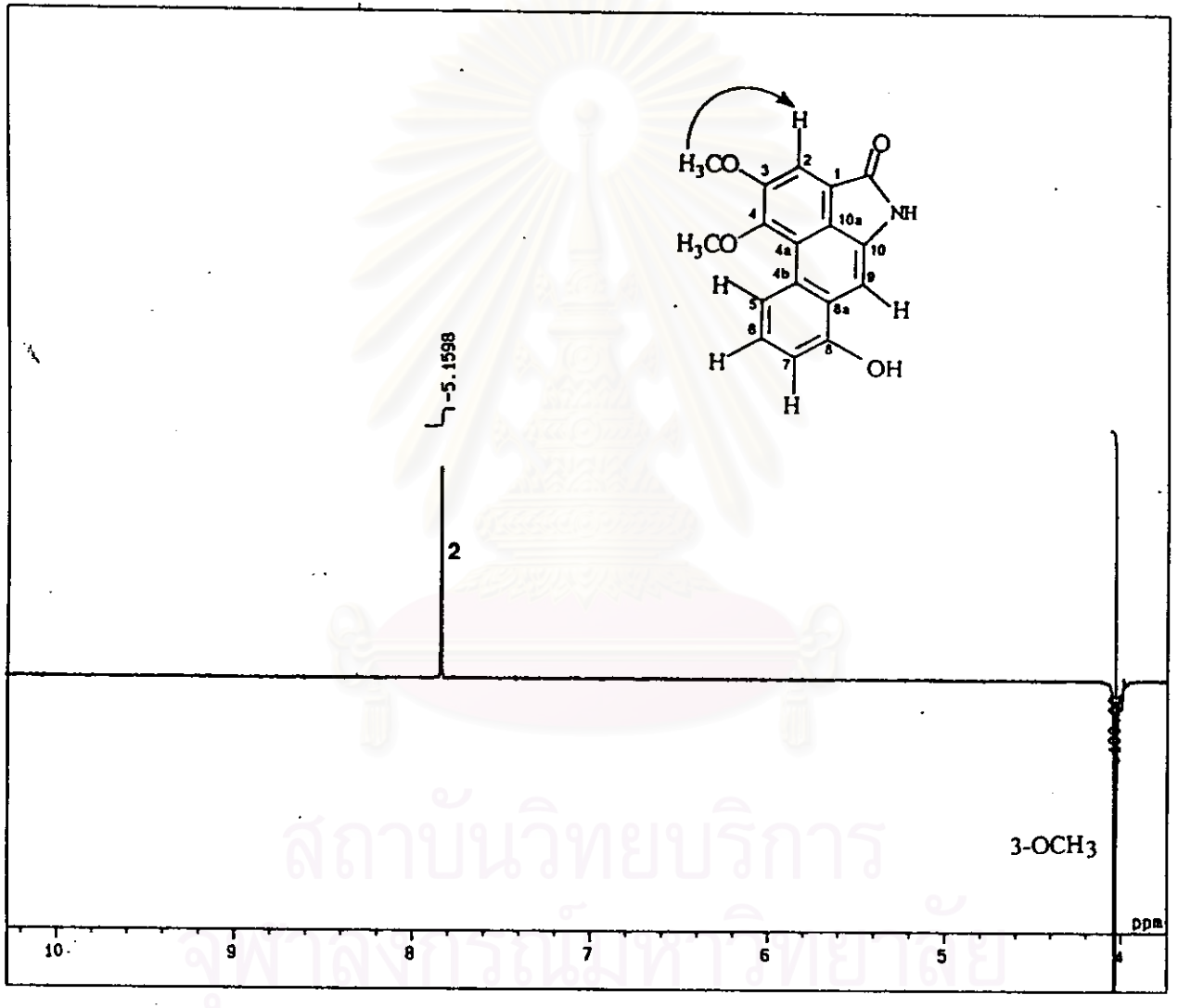


Figure 30e NOE difference spectrum of compound GT-D (in DMSO-d_6) (irradiate at 4.03 ppm)

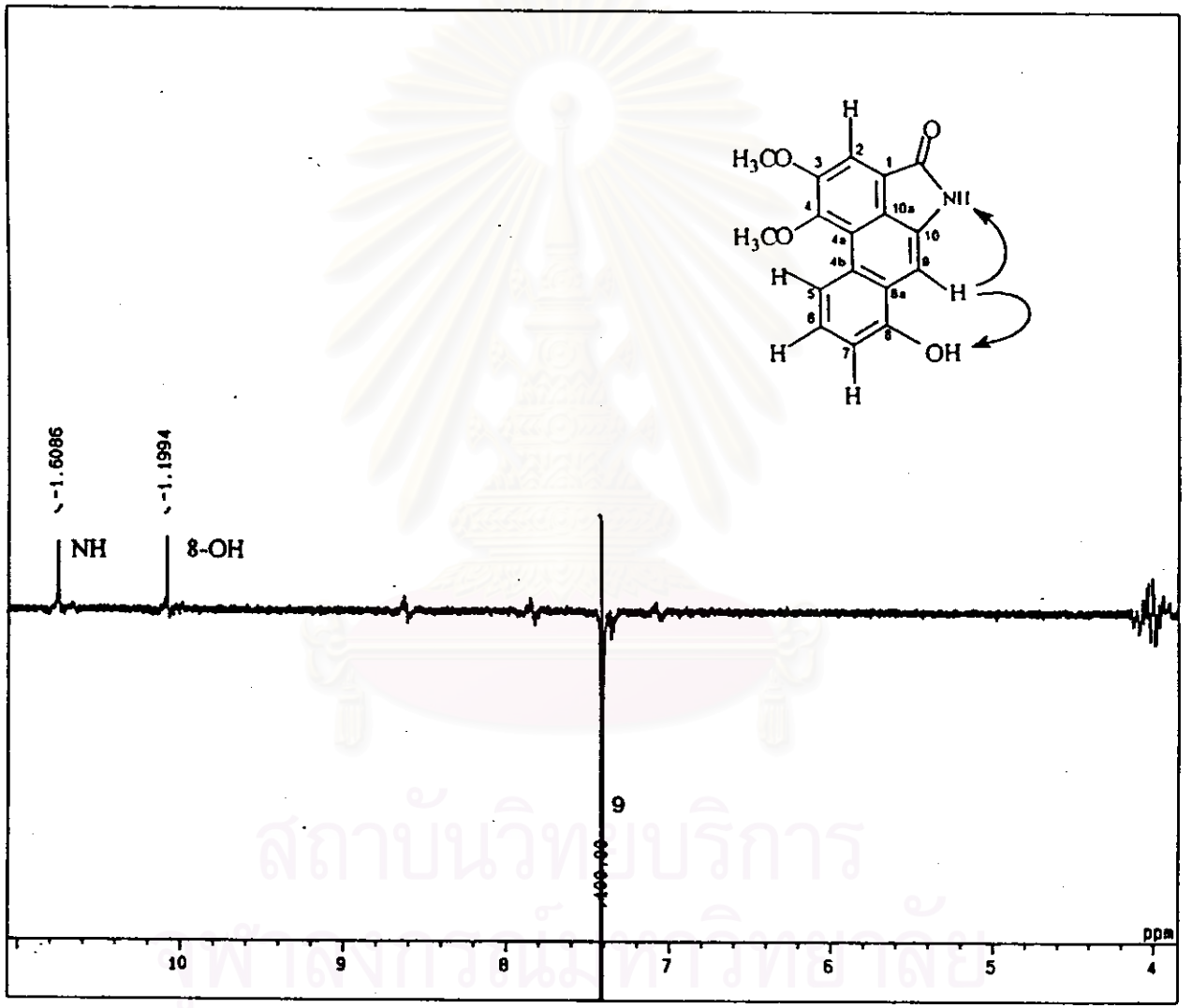


Figure 30f NOE difference spectrum of compound GT-D (in DMSO-d_6) (irradiate at 7.40 ppm)

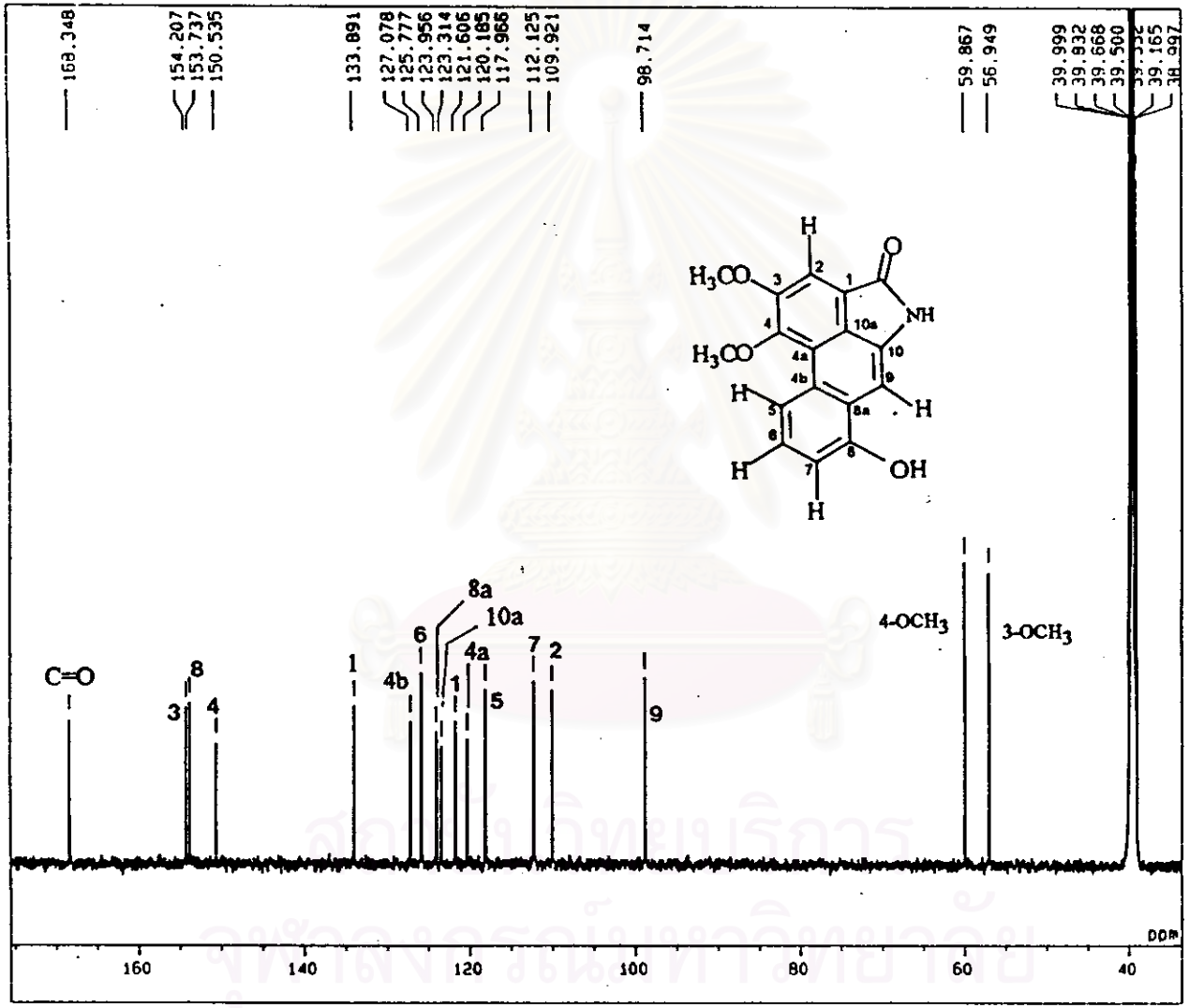


Figure 31 125 MHz ^{13}C NMR spectrum of compound GT-D (in DMSO-d_6)

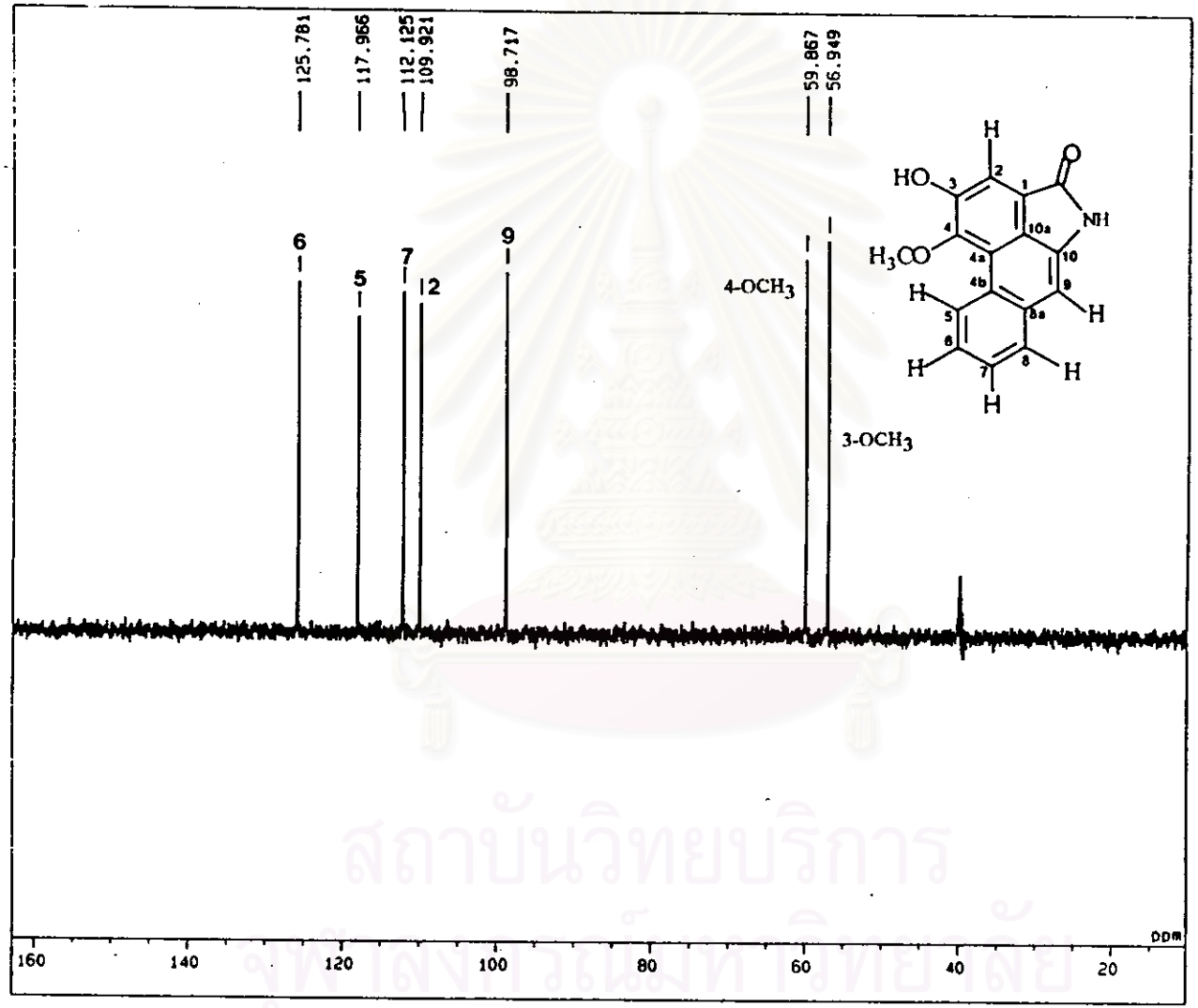
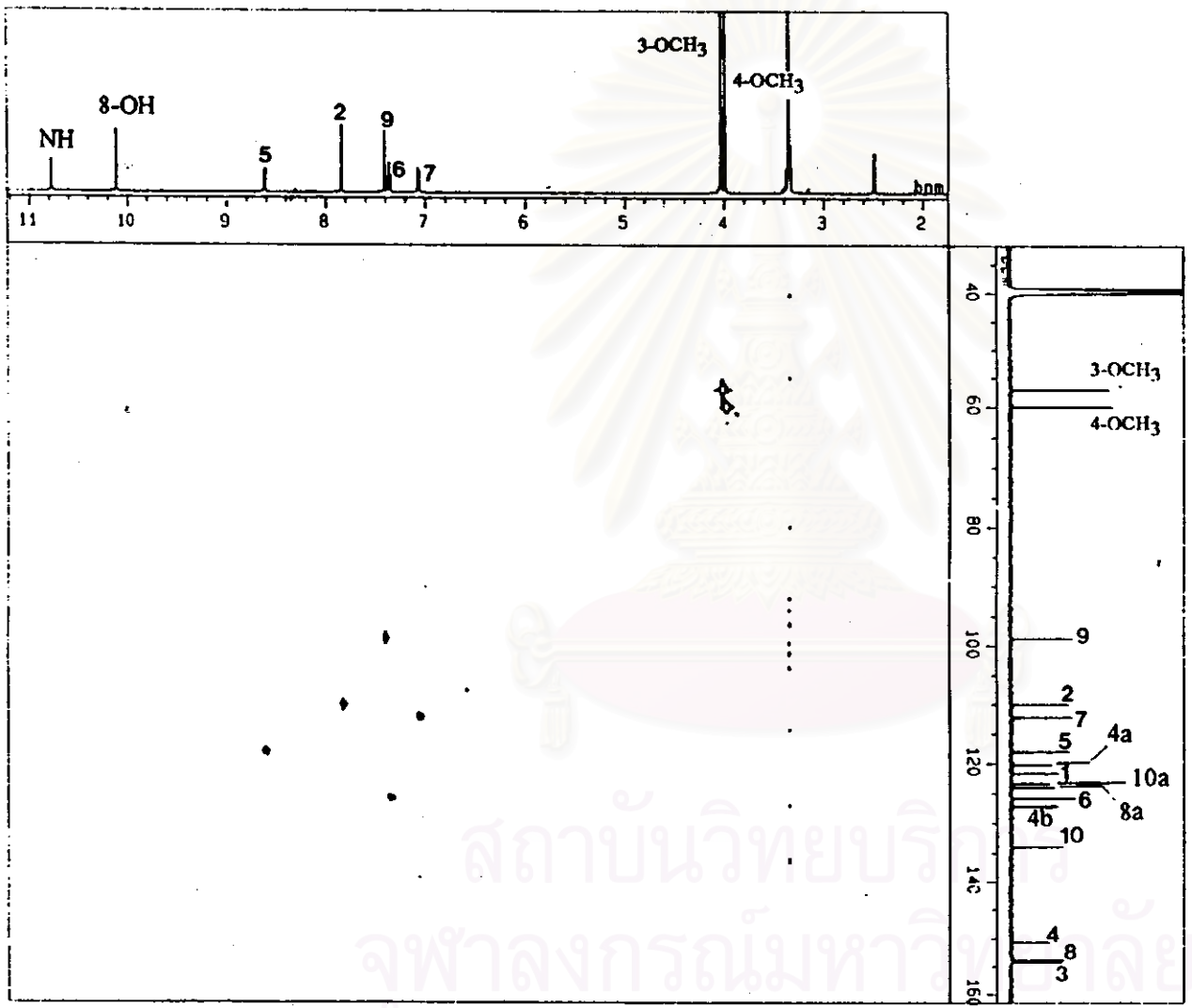


Figure 32 DEPT 135 spectrum of compound GT-D (in DMSO-d_6)



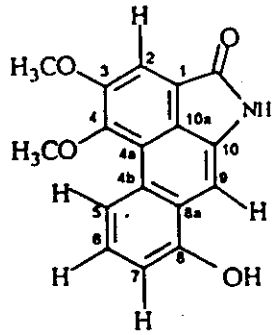
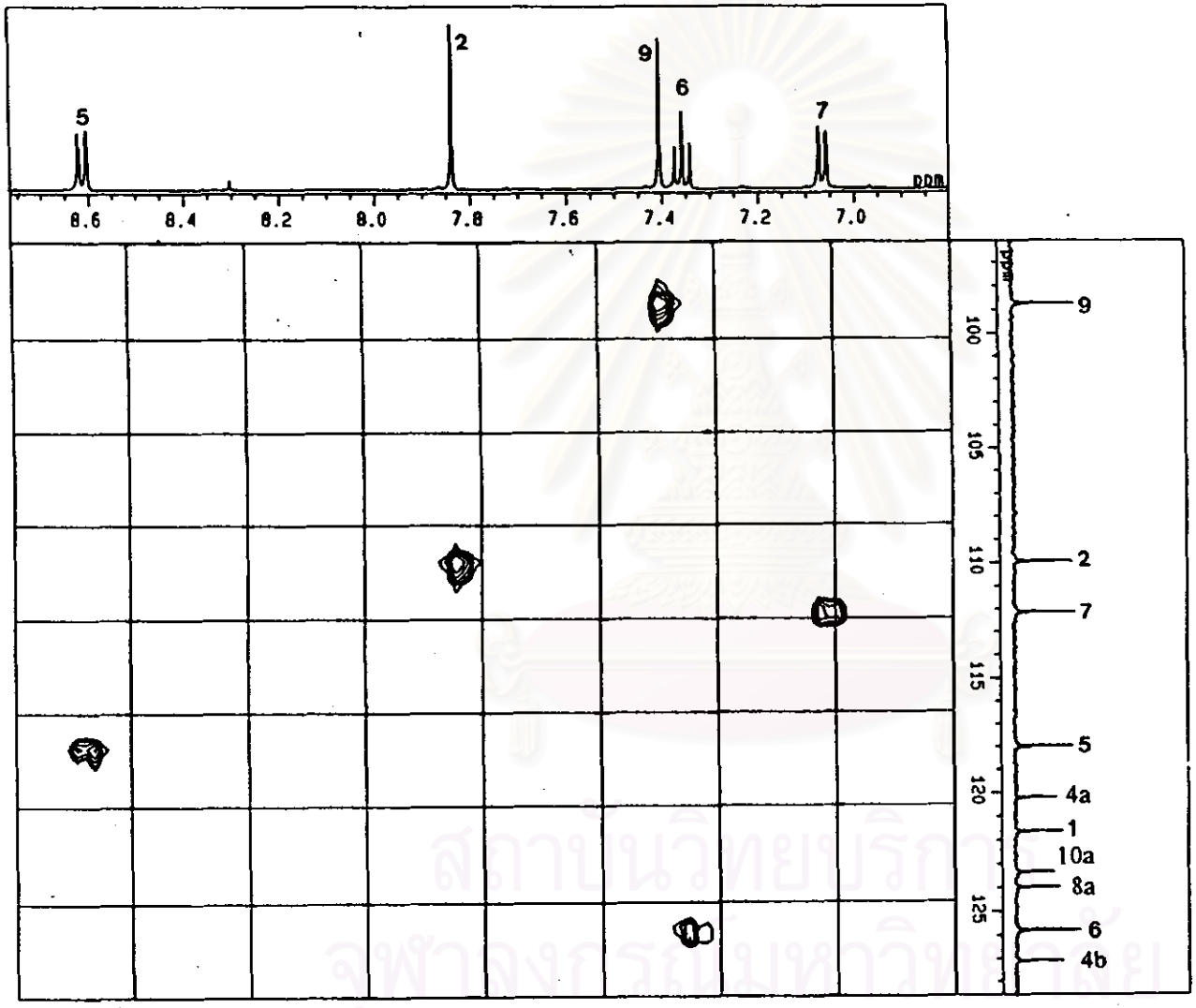


Figure 33a HMQC spectrum of compound GT-D (in DMSO-d_6) [δ_H 2-11 ppm, δ_C 40-160 ppm]



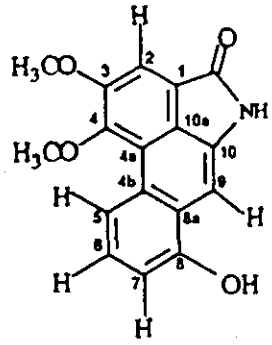
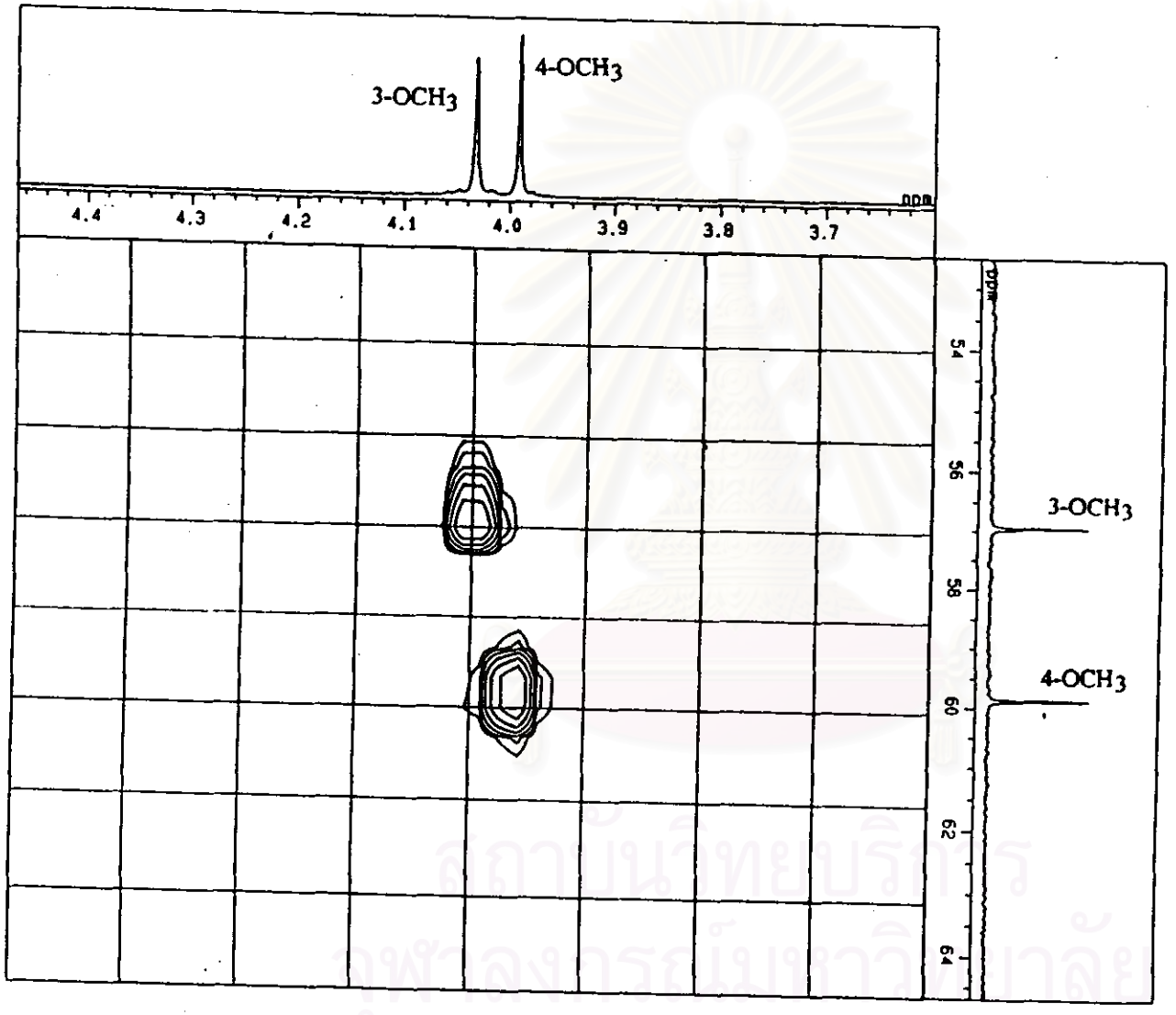


Figure 33b HMQC spectrum of compound GT-D (in DMSO-d_6) [δ_H 7.0-8.7 ppm, δ_C 97-128 ppm]



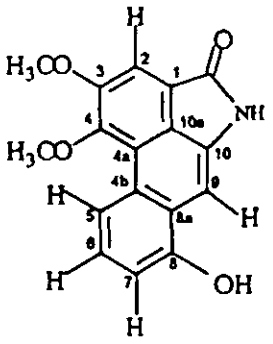


Figure 33c HMQC spectrum of compound GT-D (in DMSO-d_6) [δ_H 3.7-4.4 ppm, δ_C 54-64 ppm]

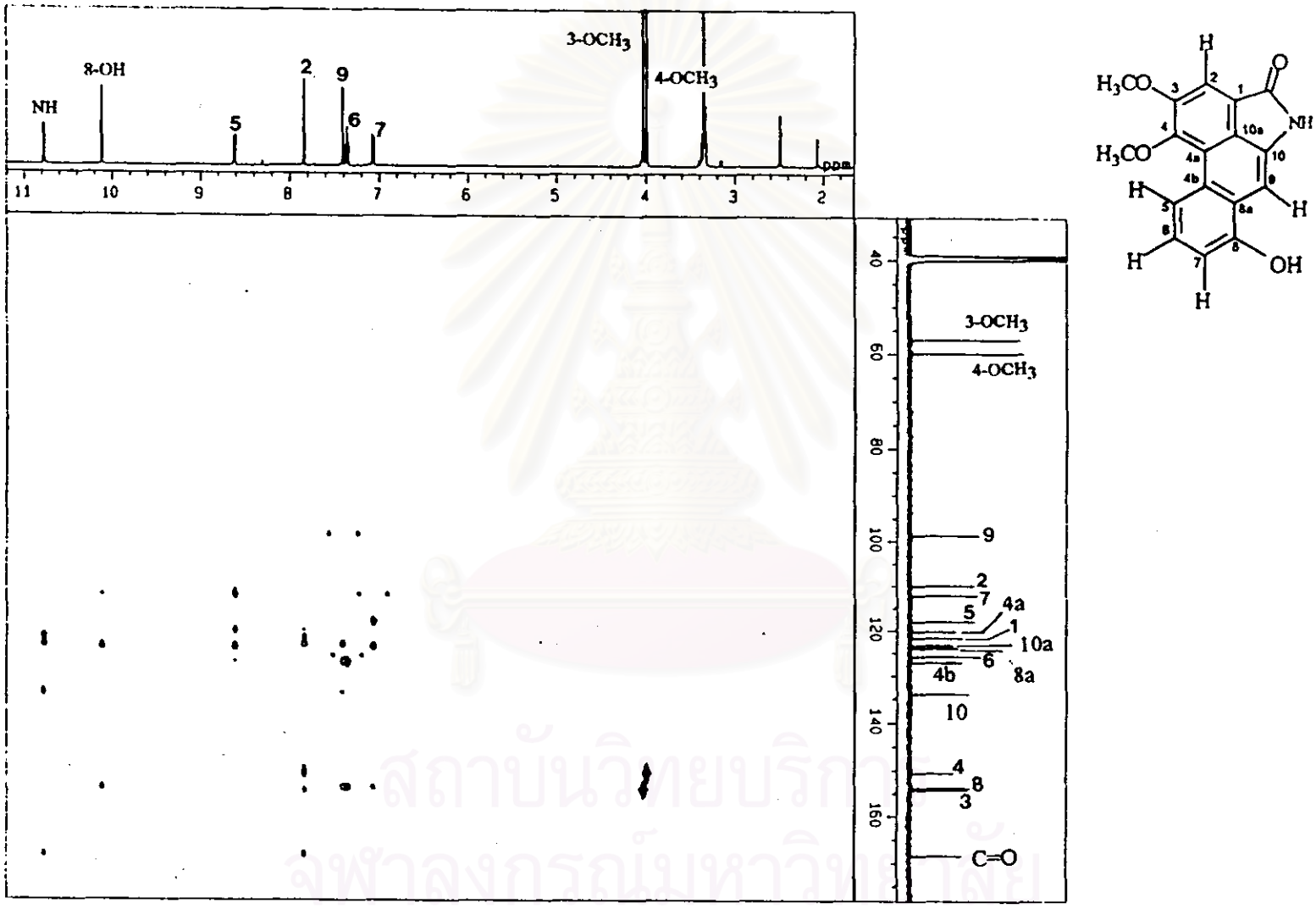


Figure 34a HMBC spectrum of compound GT-D (in DMSO-d_6) [δ_H 2-11 ppm, δ_C 40-170 ppm]

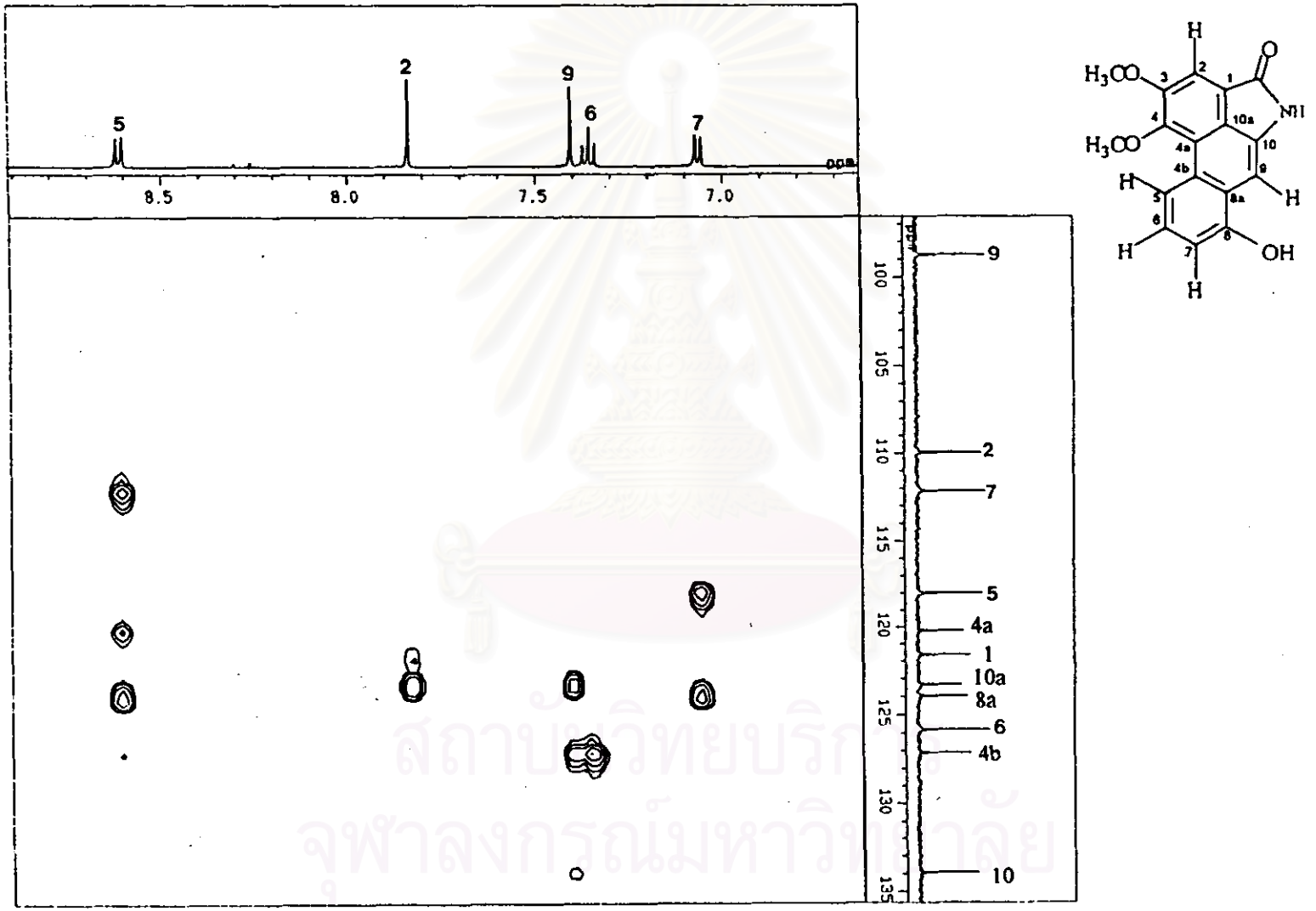
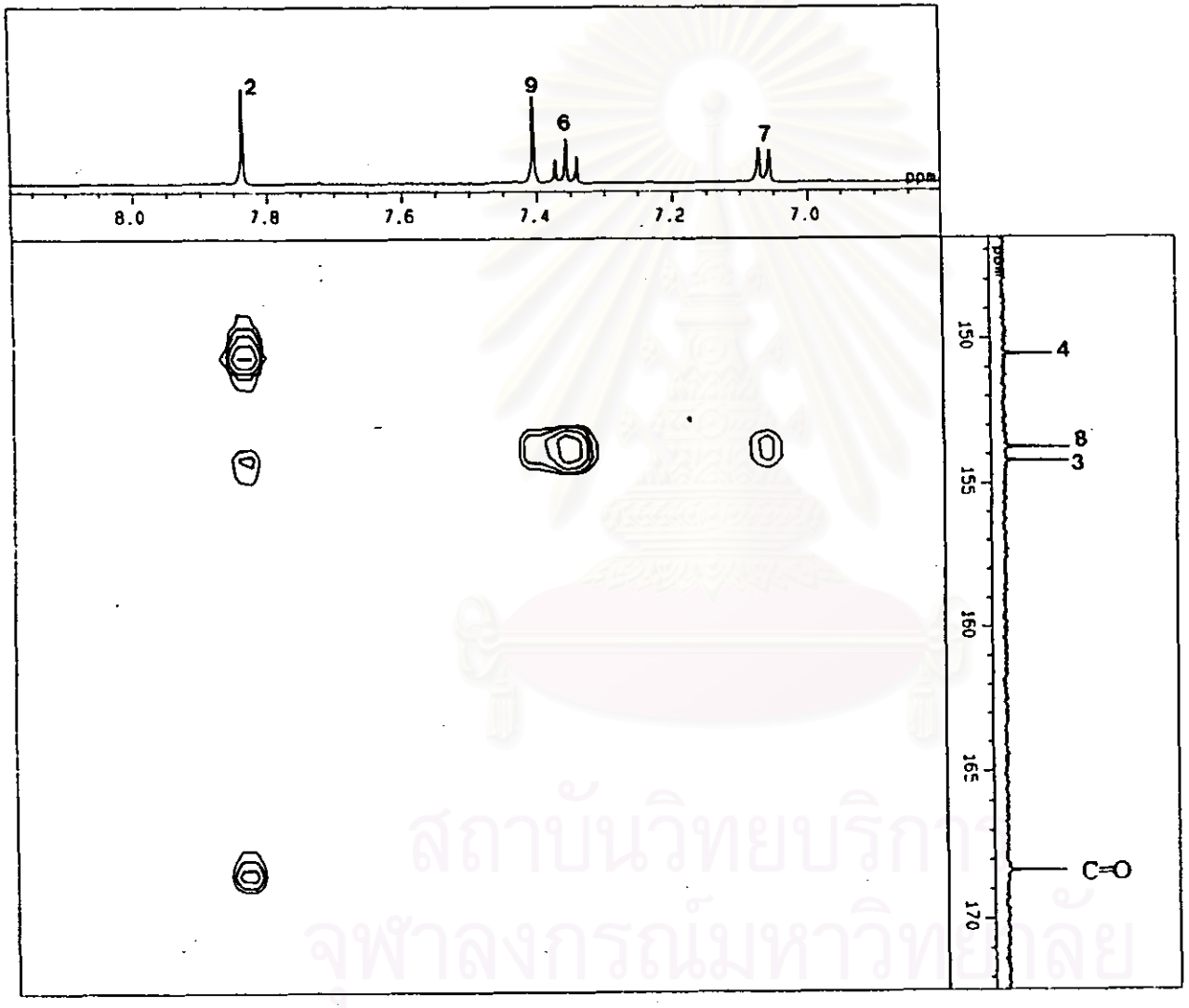


Figure 34b HMBC spectrum of compound GT-D (in DMSO-d_6) [δ_H 6.7-8.8 ppm, δ_C 97-135 ppm]



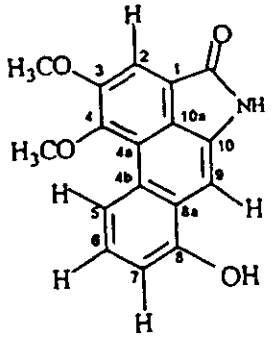


Figure 34c HMBC spectrum of compound GT-D (in DMSO-d_6) [δ_H 7-8 ppm, δ_C 150-170 ppm]

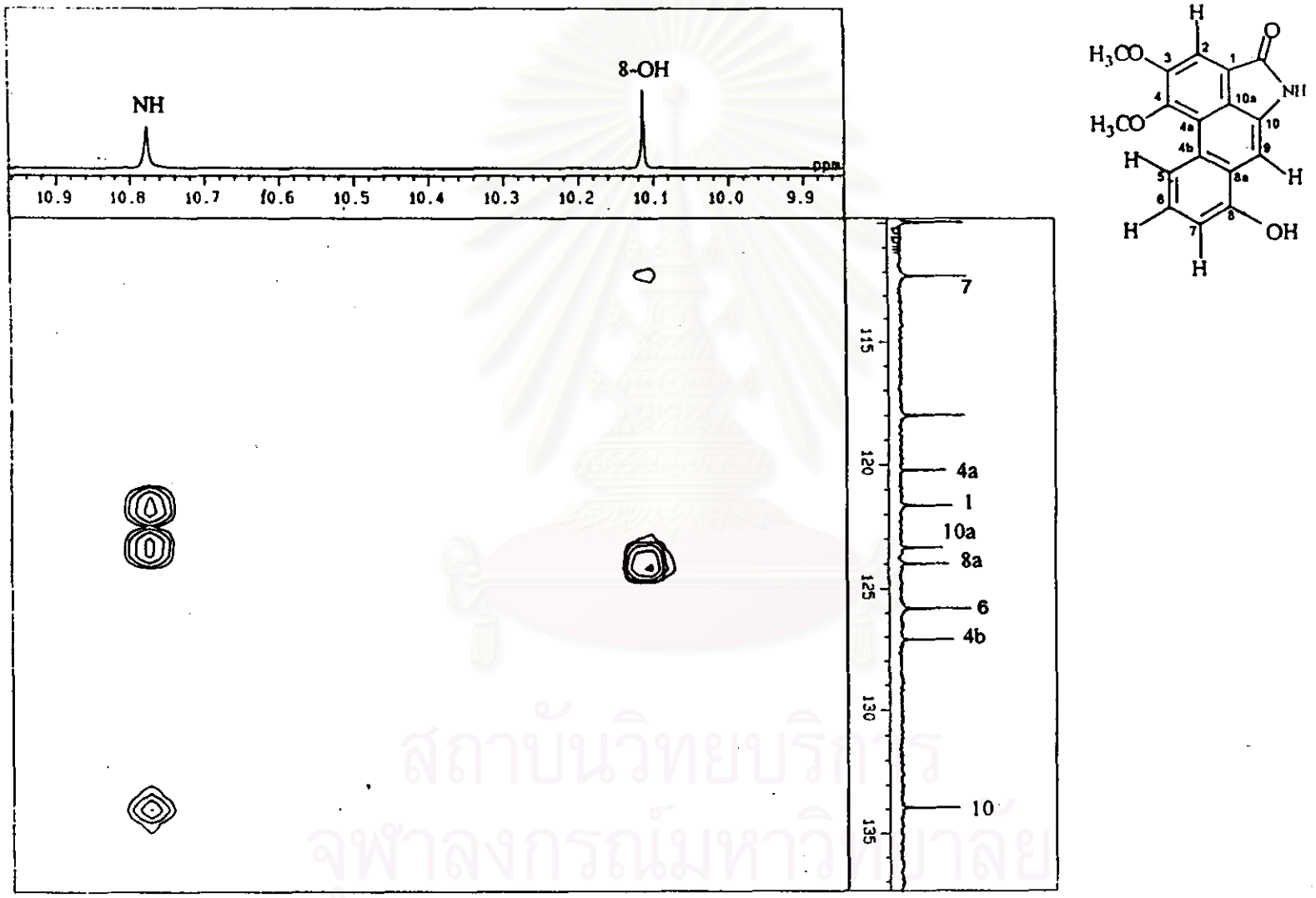


Figure 34d HMBC spectrum of compound GT-D (in DMSO-d_6) [δ_H 9.9-10.9 ppm, δ_C 110-135 ppm]

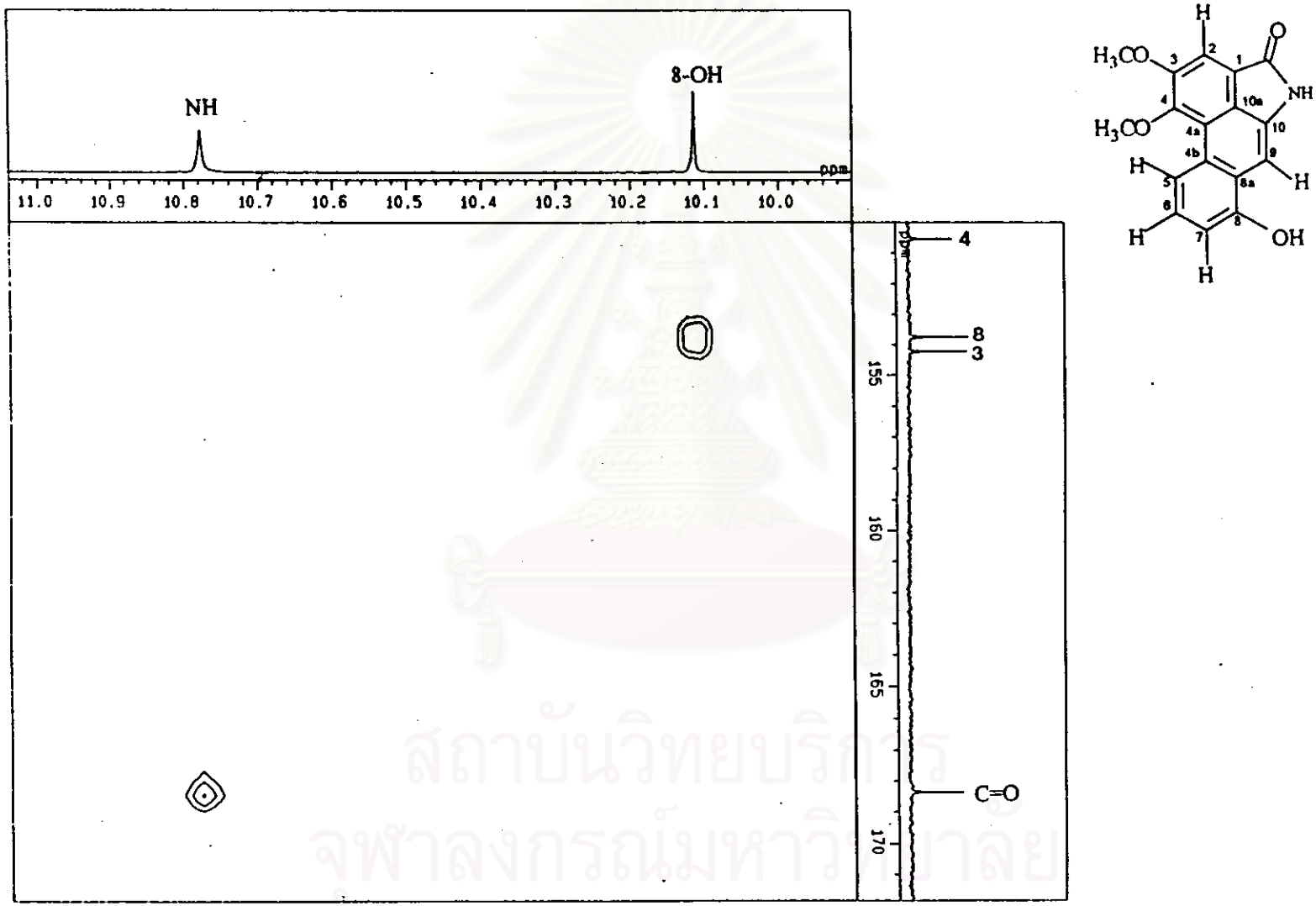


Figure 34e HMBC spectrum of compound GT-D (in DMSO-d_6) [δ_H 10-11 ppm, δ_C 150-170 ppm]

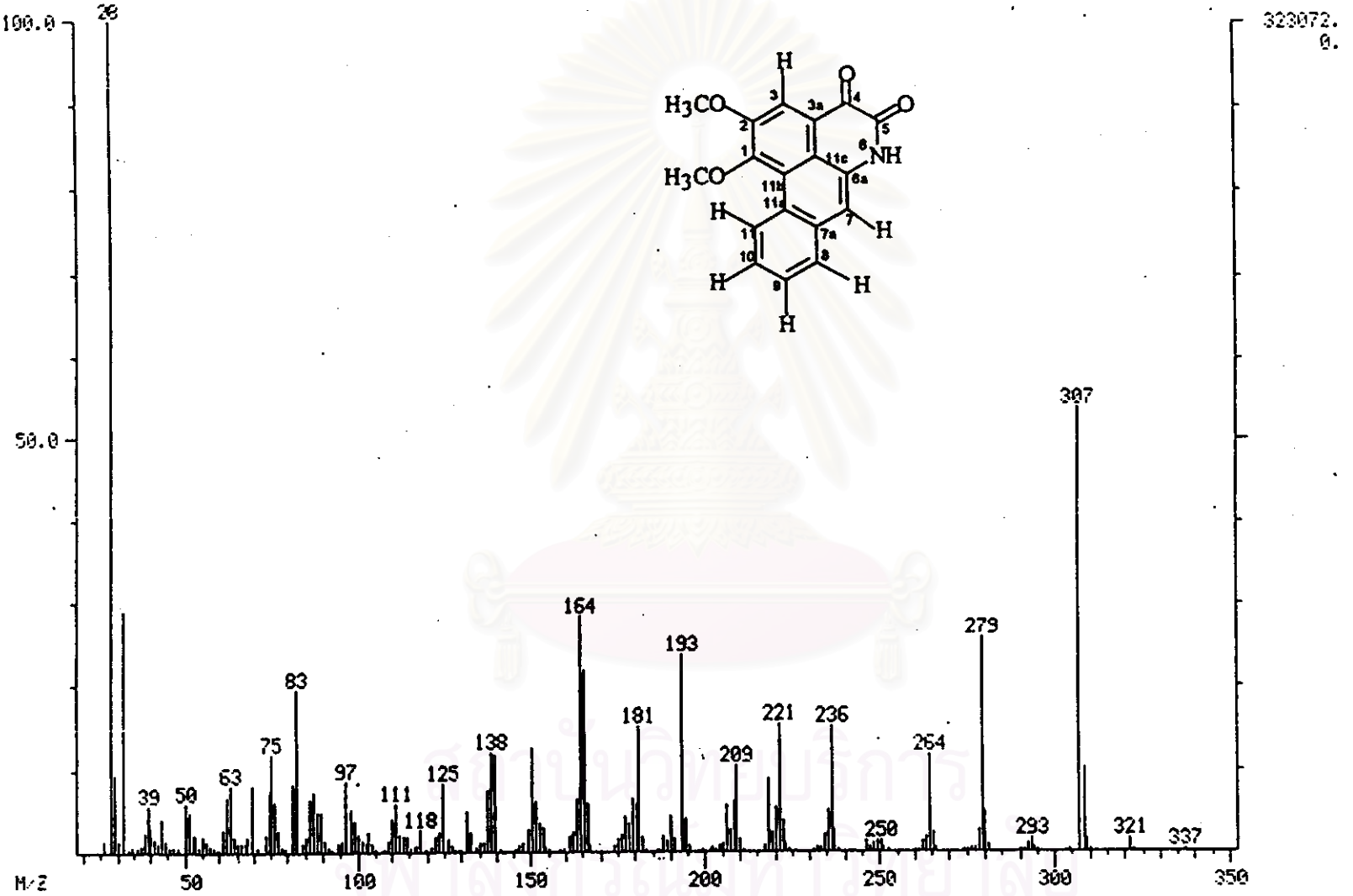


Figure 35 EI mass spectrum of compound GT-E

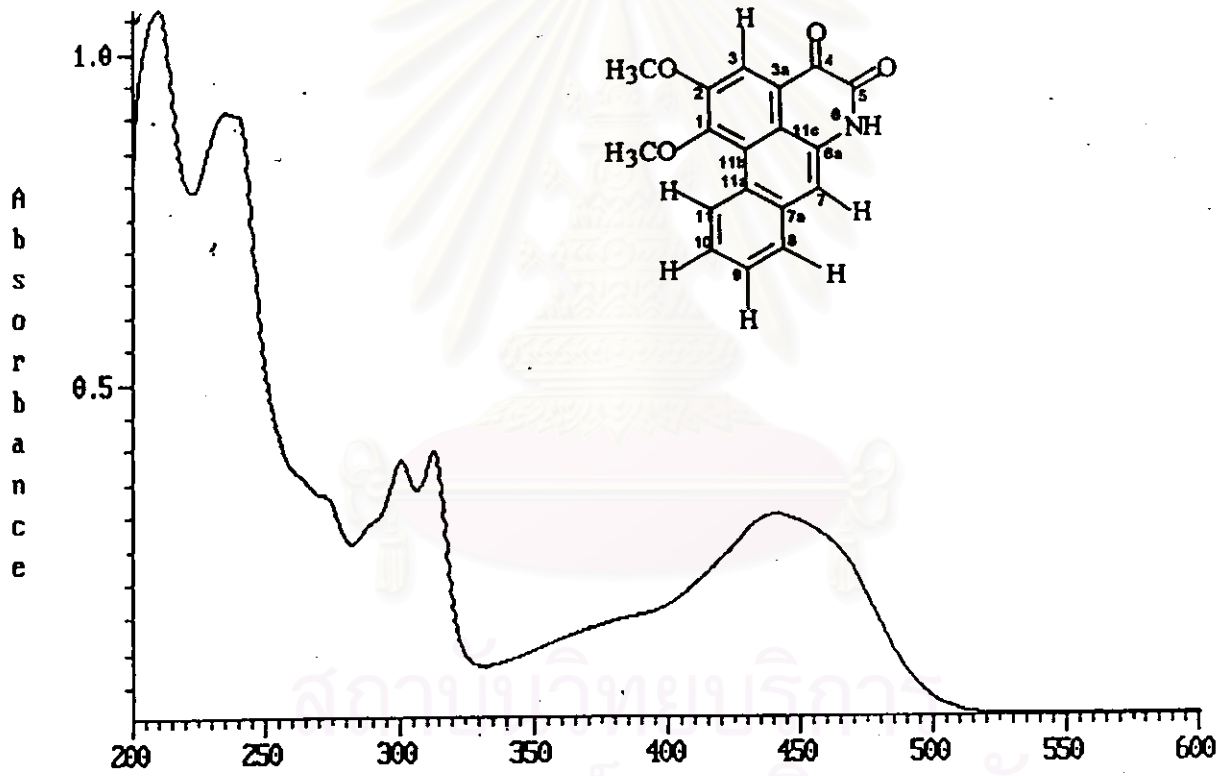


Figure 36 UV spectrum of compound GT-E (in methanol)

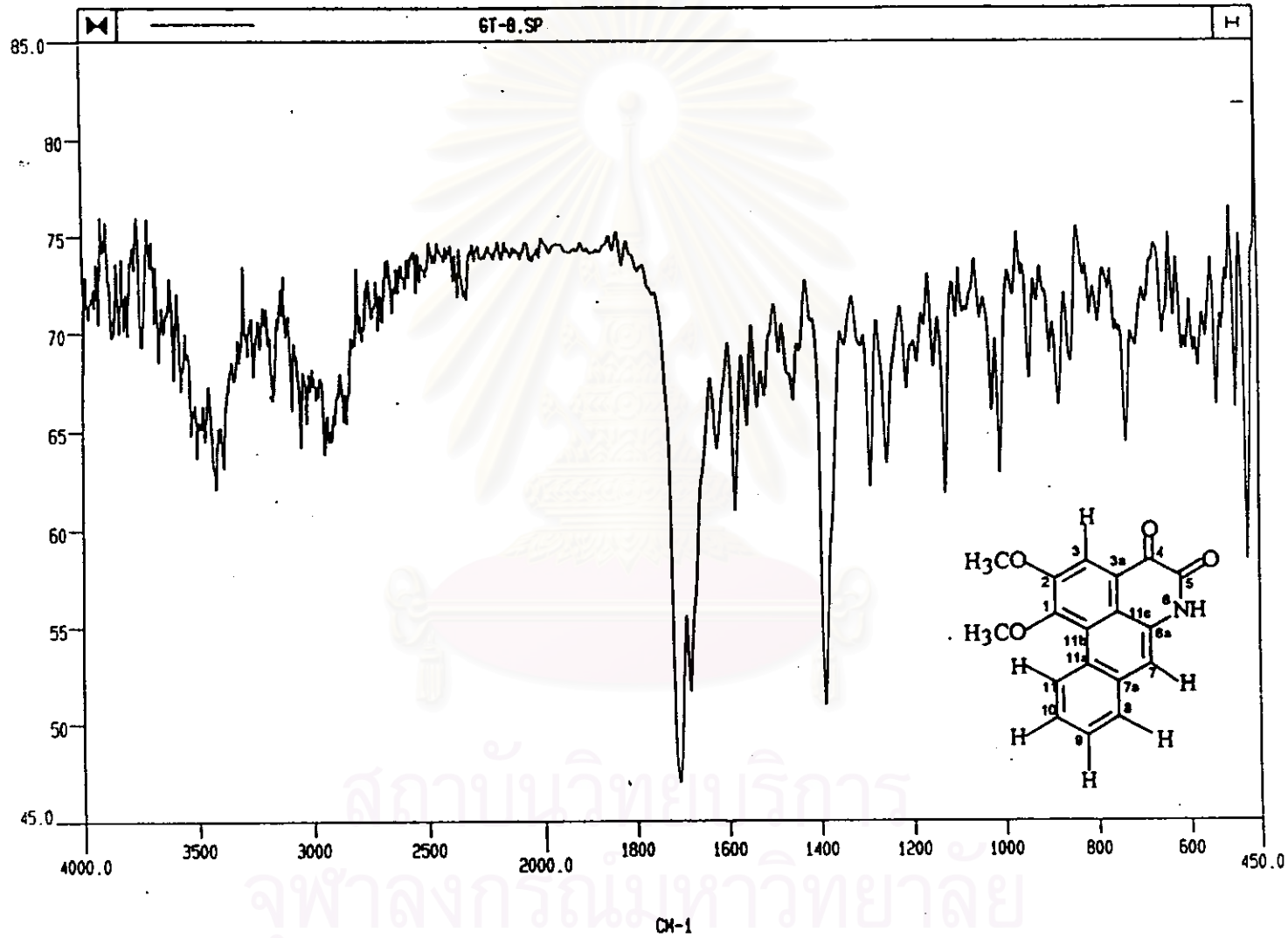


Figure 37 IR spectrum of compound GT-E (KBr disc)

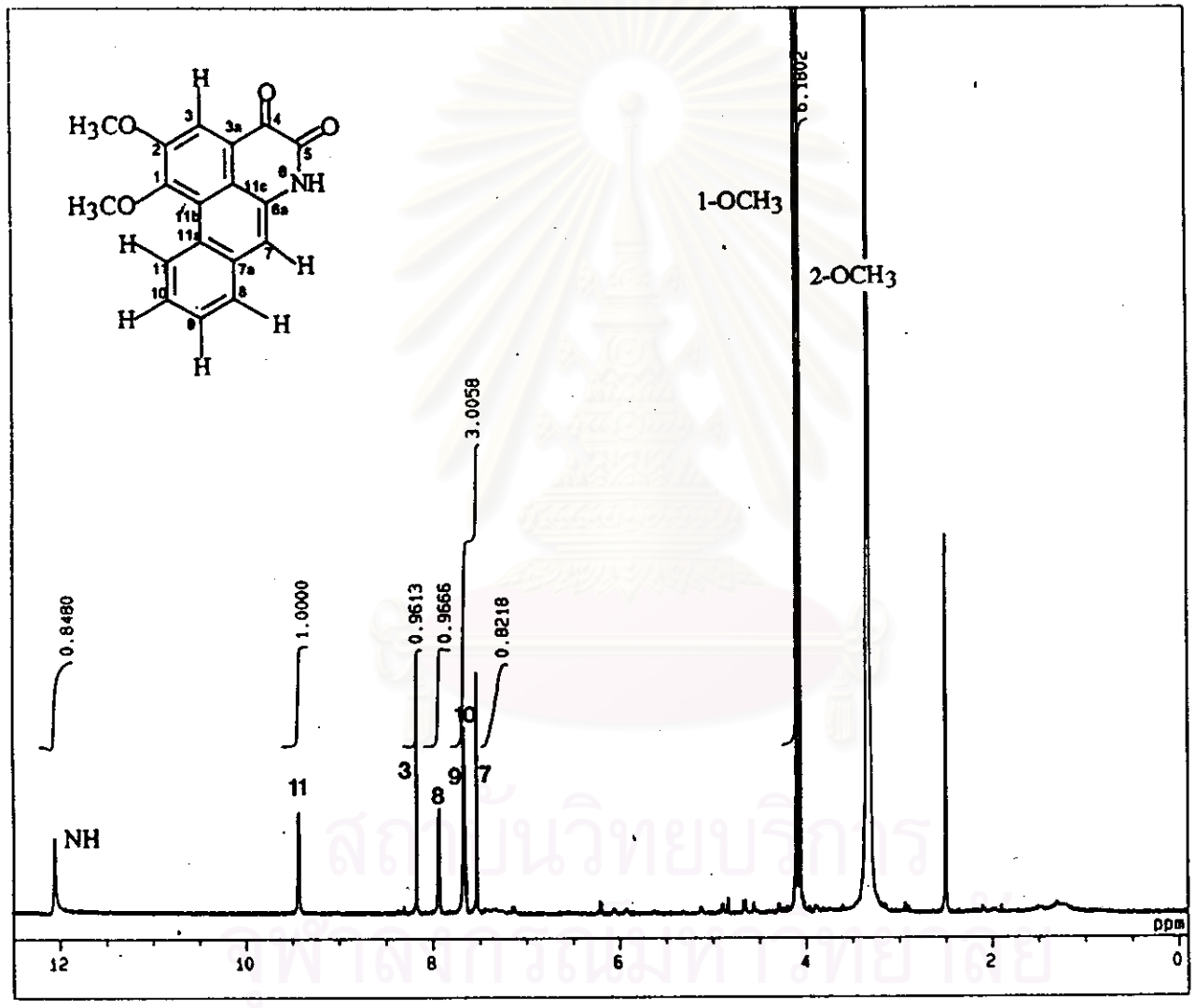


Figure 38a 500 MHz ^{1}H NMR spectrum of compound GT-E (in DMSO-d_6)

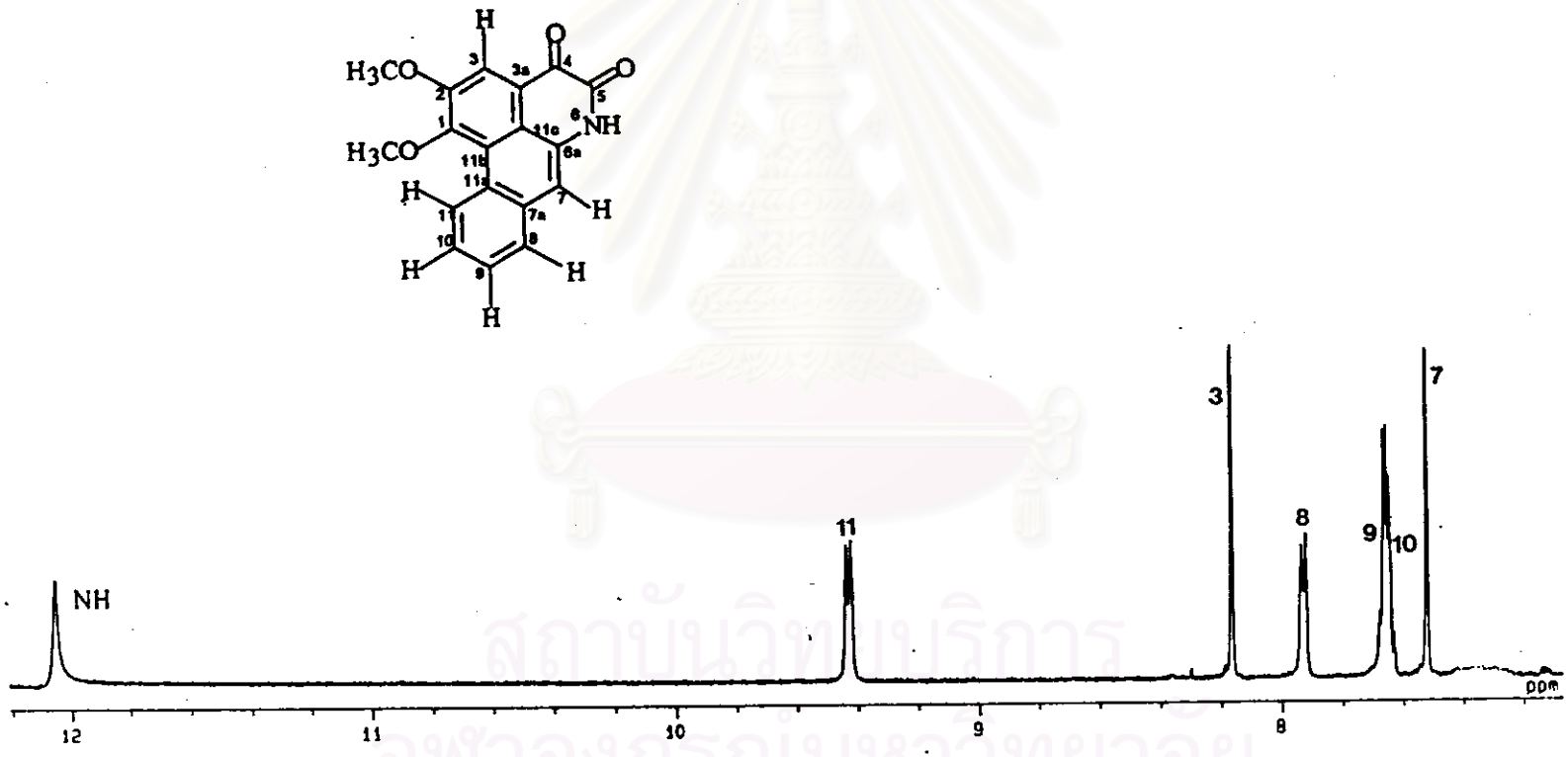


Figure 38b 500 MHz ^{1}H NMR spectrum of compound GT-E (in DMSO-d_6) (expansion from 8.2-12.2 ppm)

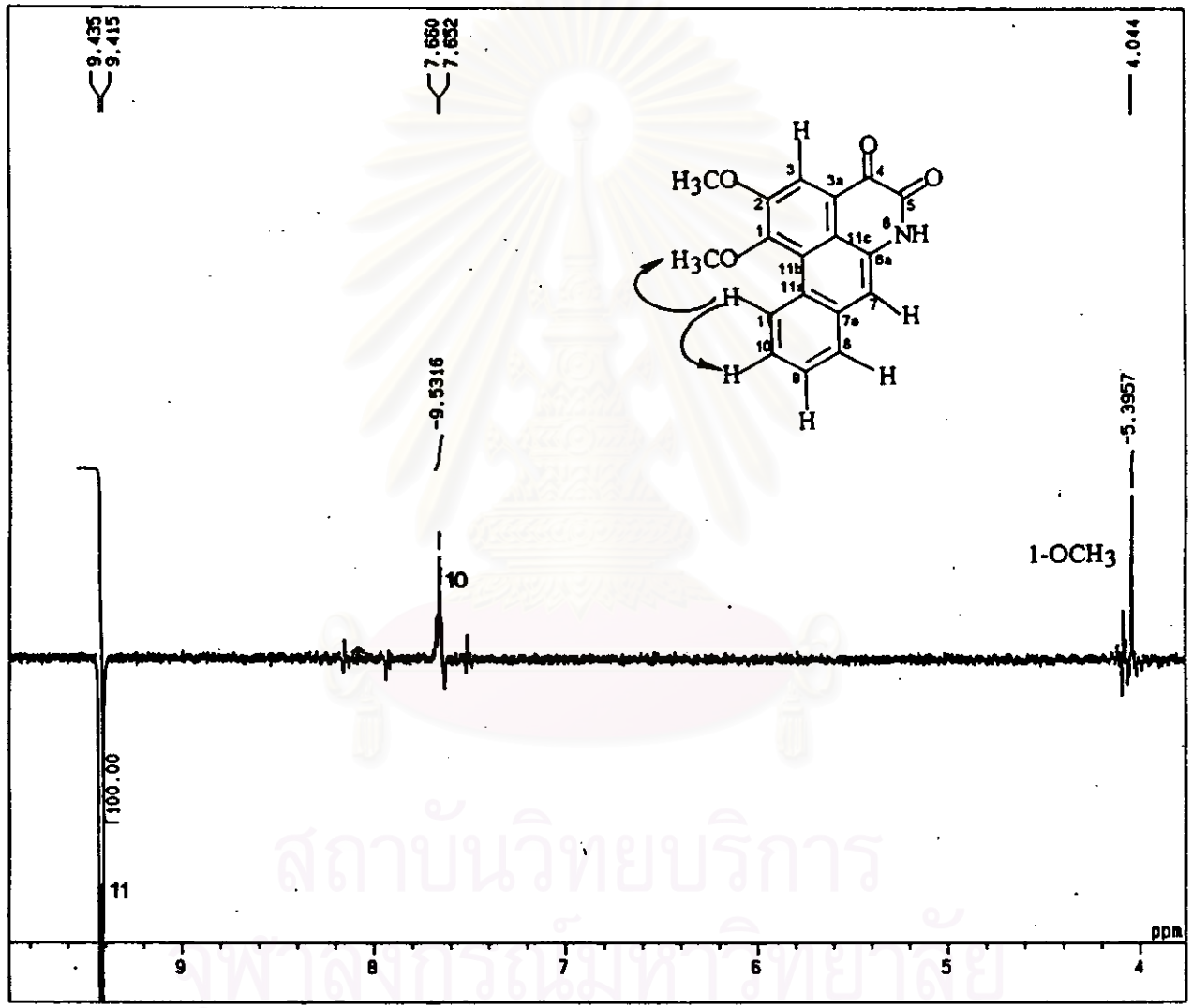


Figure 39a NOE difference spectrum of compound GT-E (in DMSO-d_6) (irradiate at 9.42 ppm)

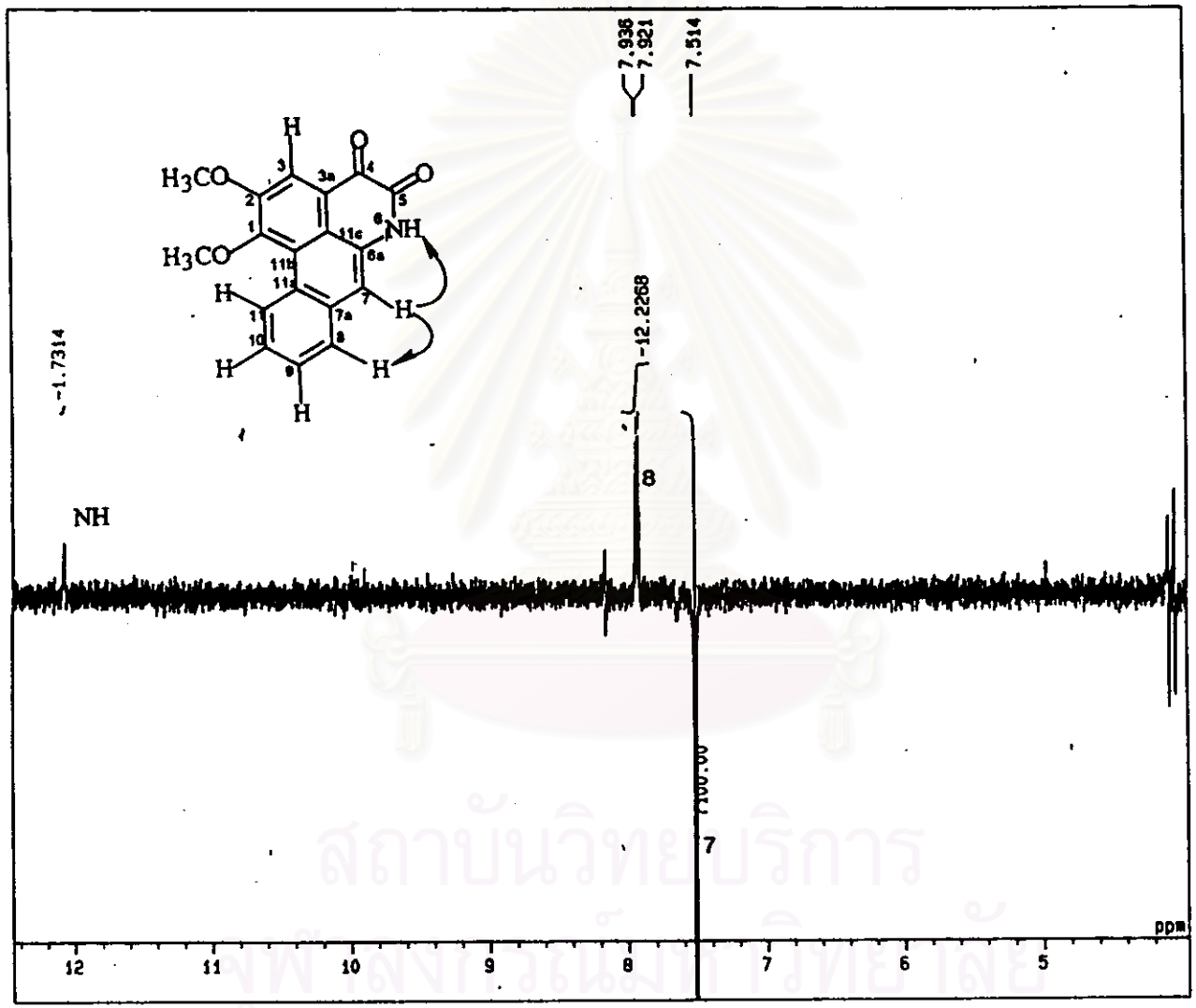


Figure 39b NOE difference spectrum of compound GT-E (in DMSO-d_6) (irradiate at 7.51 ppm)

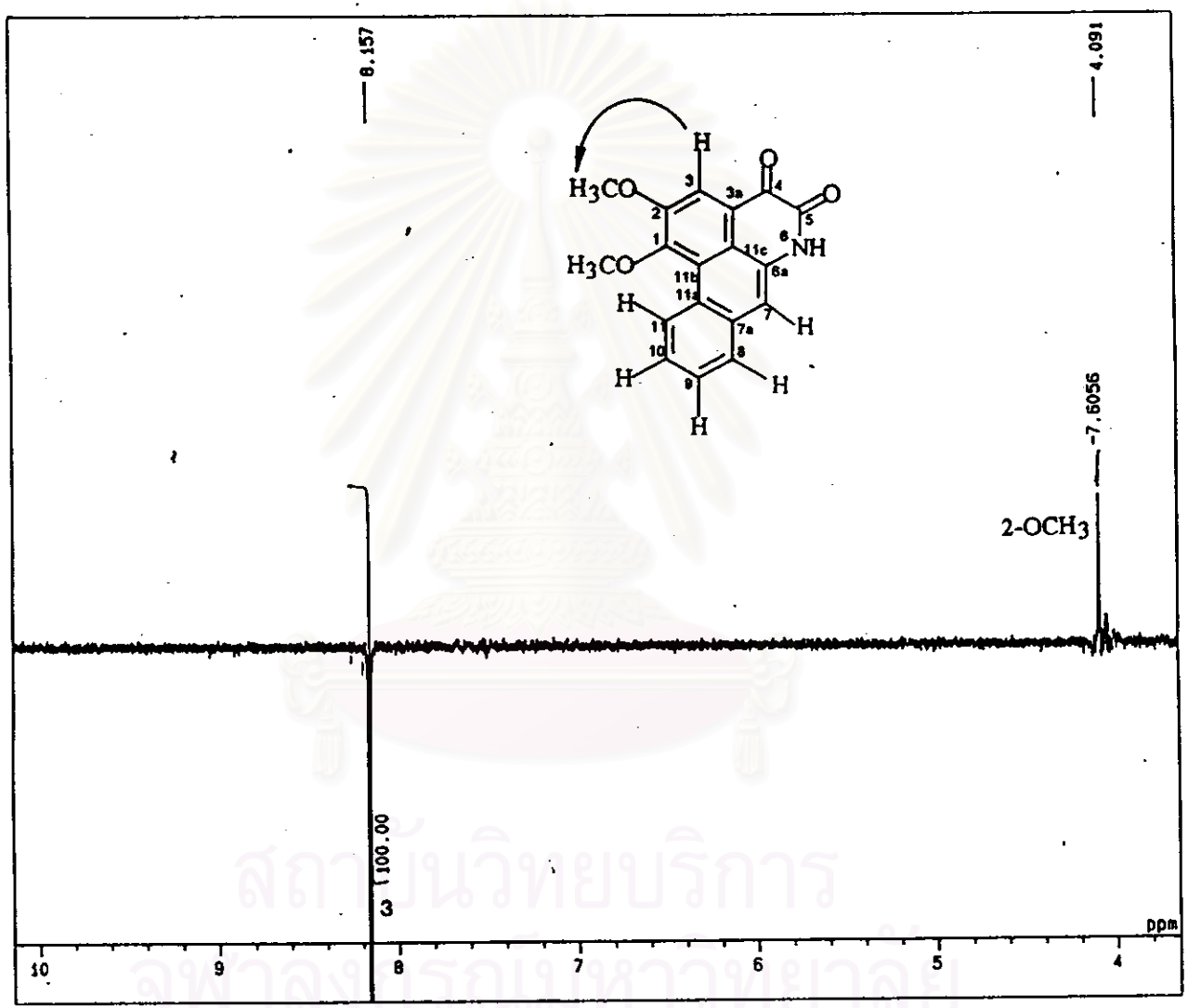


Figure 39c NOE uifference spectrum of compound GT-E (in DMSO-d_6) (irradiate at 8.16 ppm)

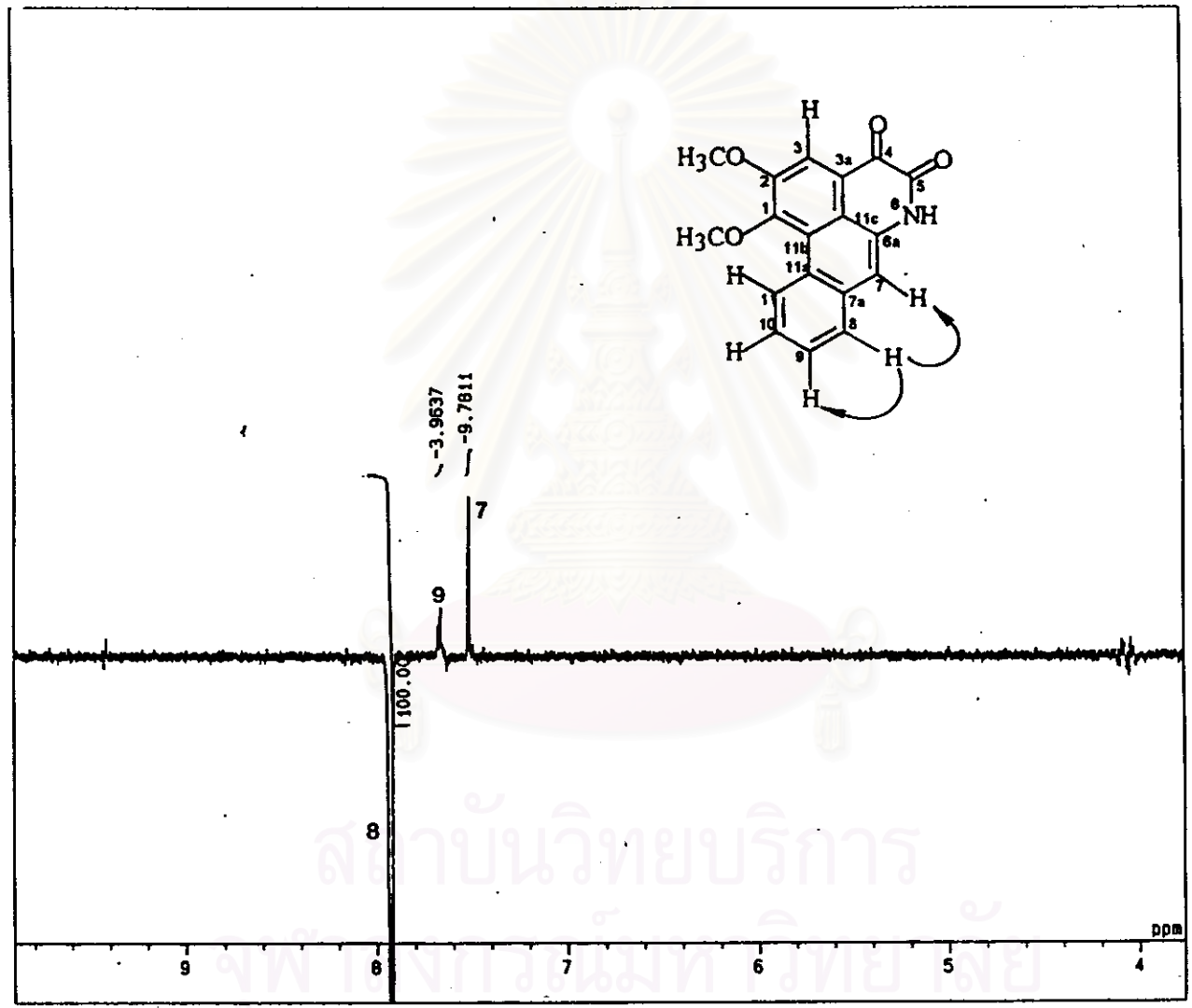


Figure 39d NOE difference spectrum of compound GT-E (in DMSO-d_6) (irradiate at 7.93 ppm)

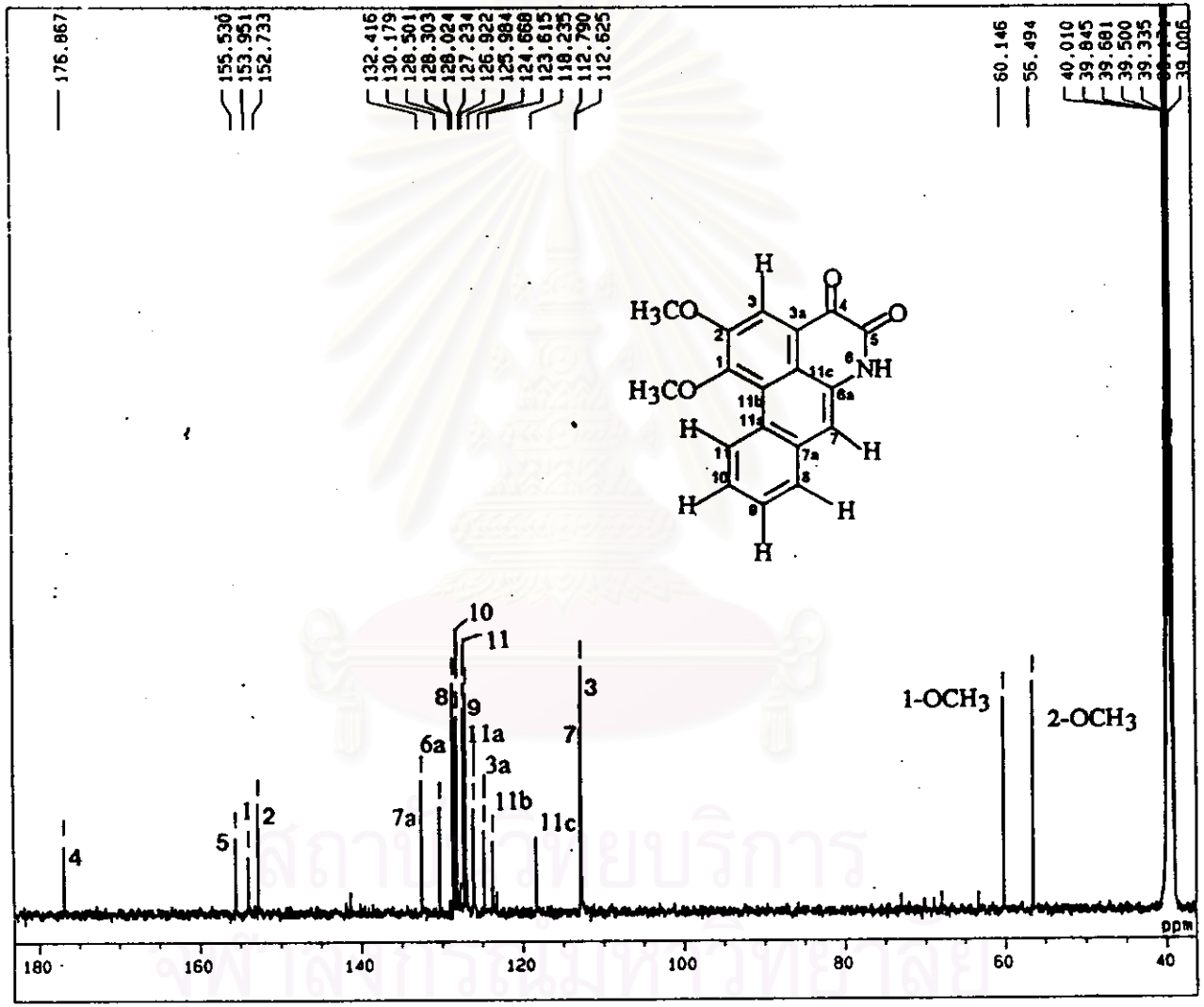


Figure 40a 125 MHz ^{13}C NMR spectrum of compound GT-E (in DMSO-d_6)

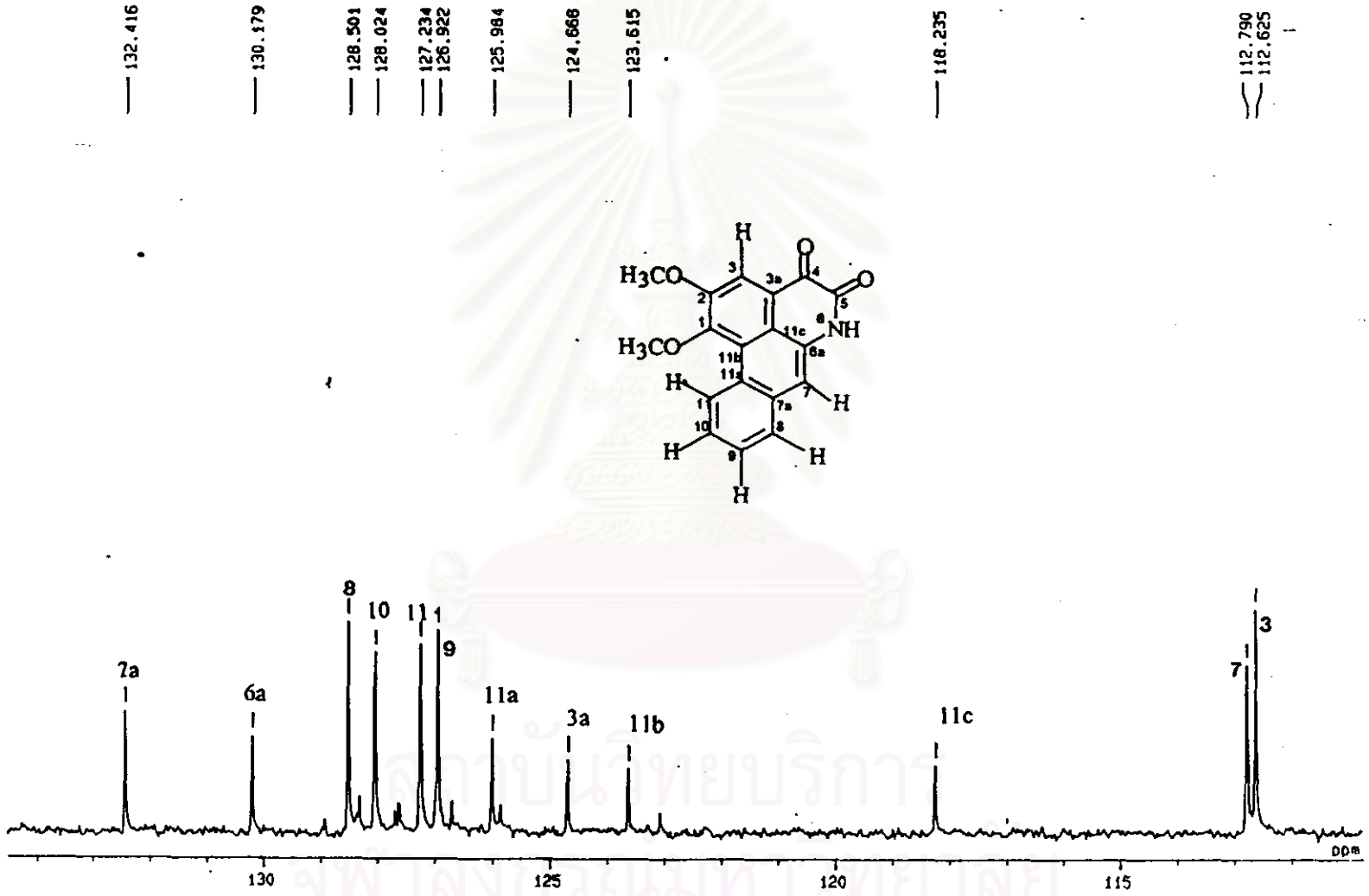


Figure 40b 125 MHz ^{13}C NMR spectrum of compound GT-E (in DMSO-d_6) (expansion from 110-140 ppm)

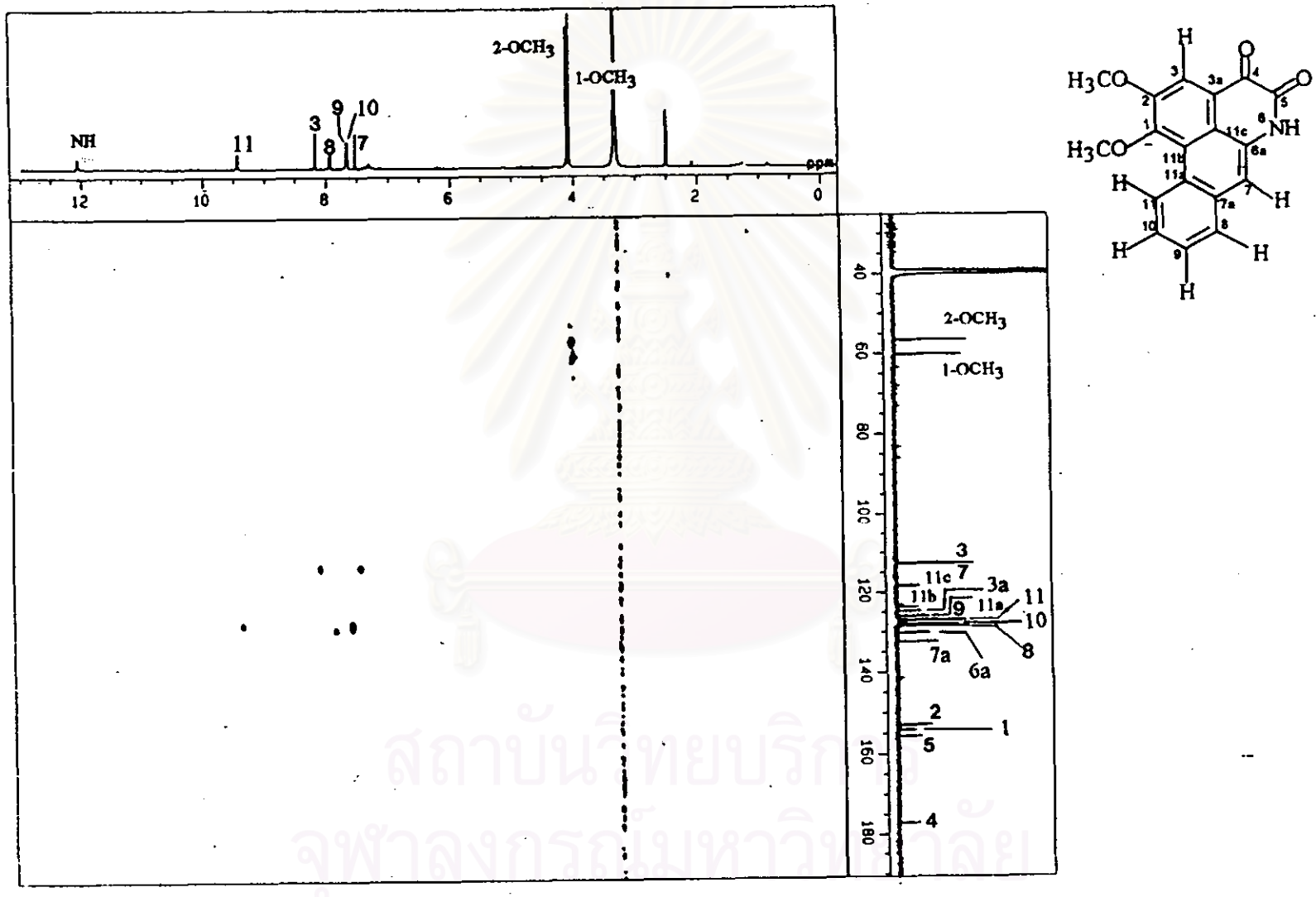
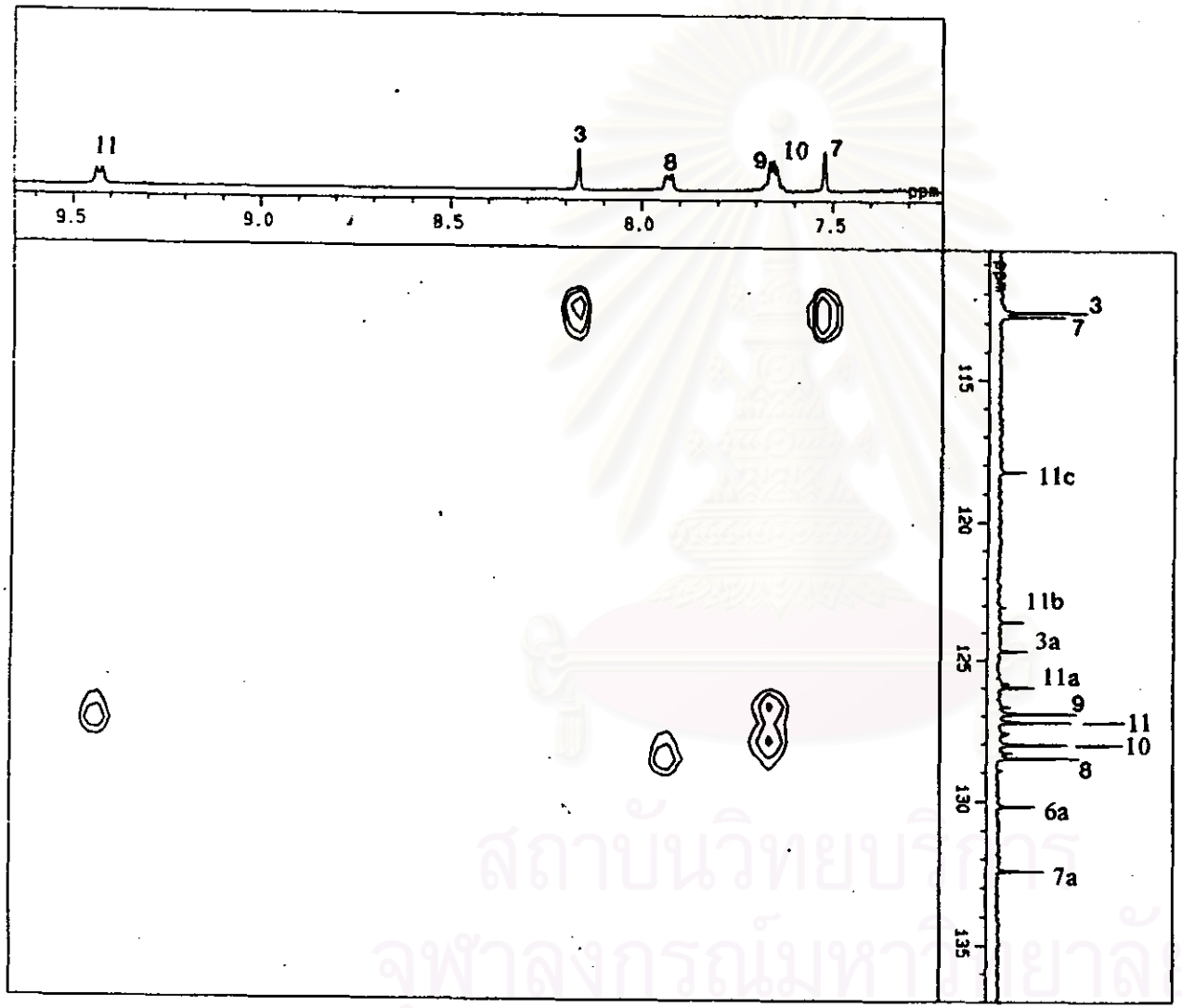


Figure 41a HSQC spectrum of compound GT-E (in DMSO-d_6) [δ_H 0-13 ppm, δ_C 40-190 ppm]



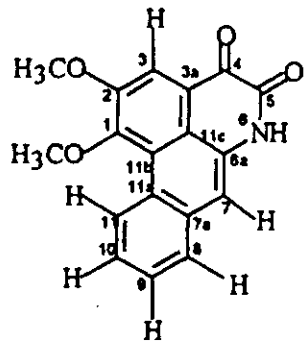


Figure 41b HSQC spectrum of compound GT-E (in DMSO-d_6) [δ_H 7.4-9.5 ppm, δ_C 112-136 ppm]

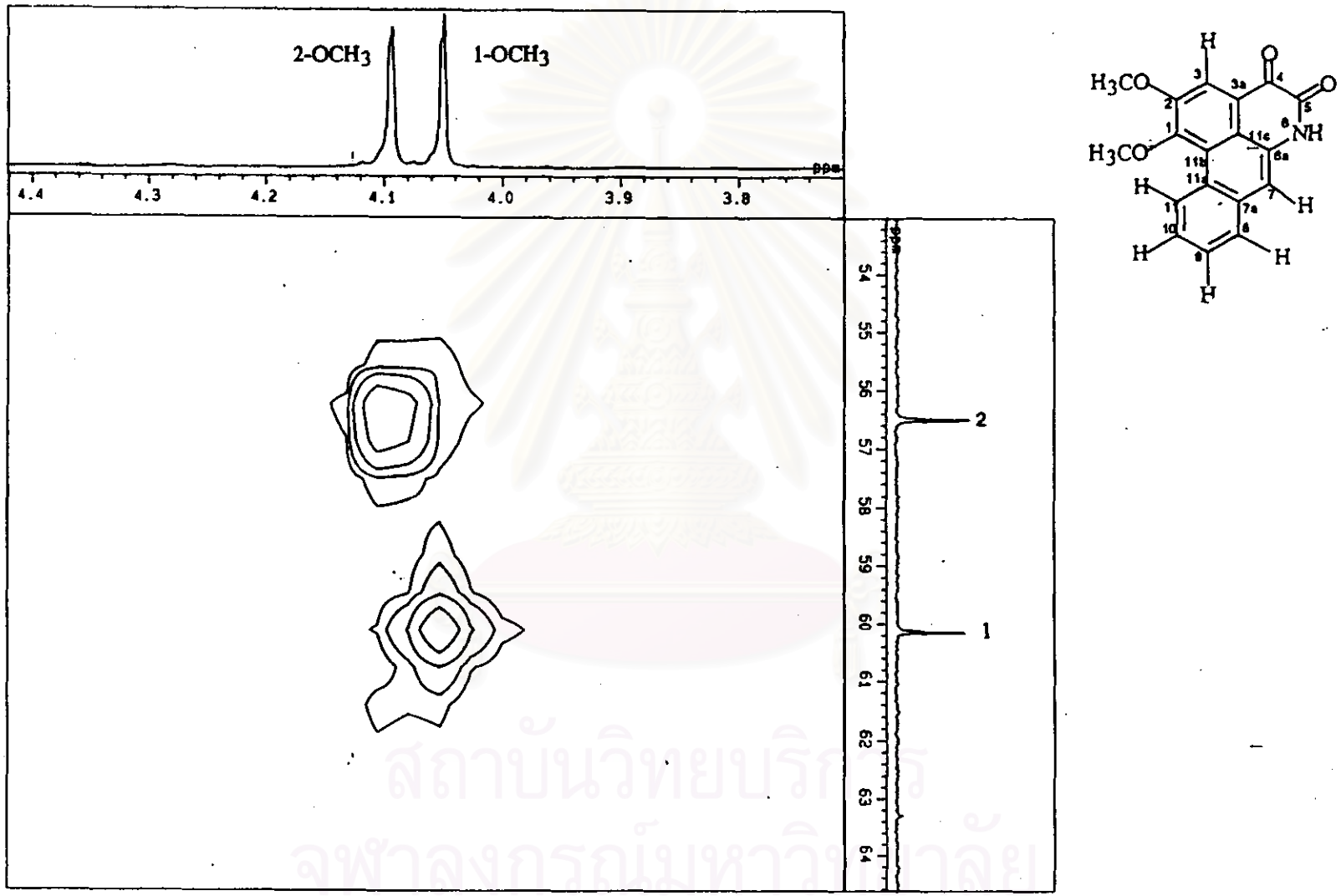
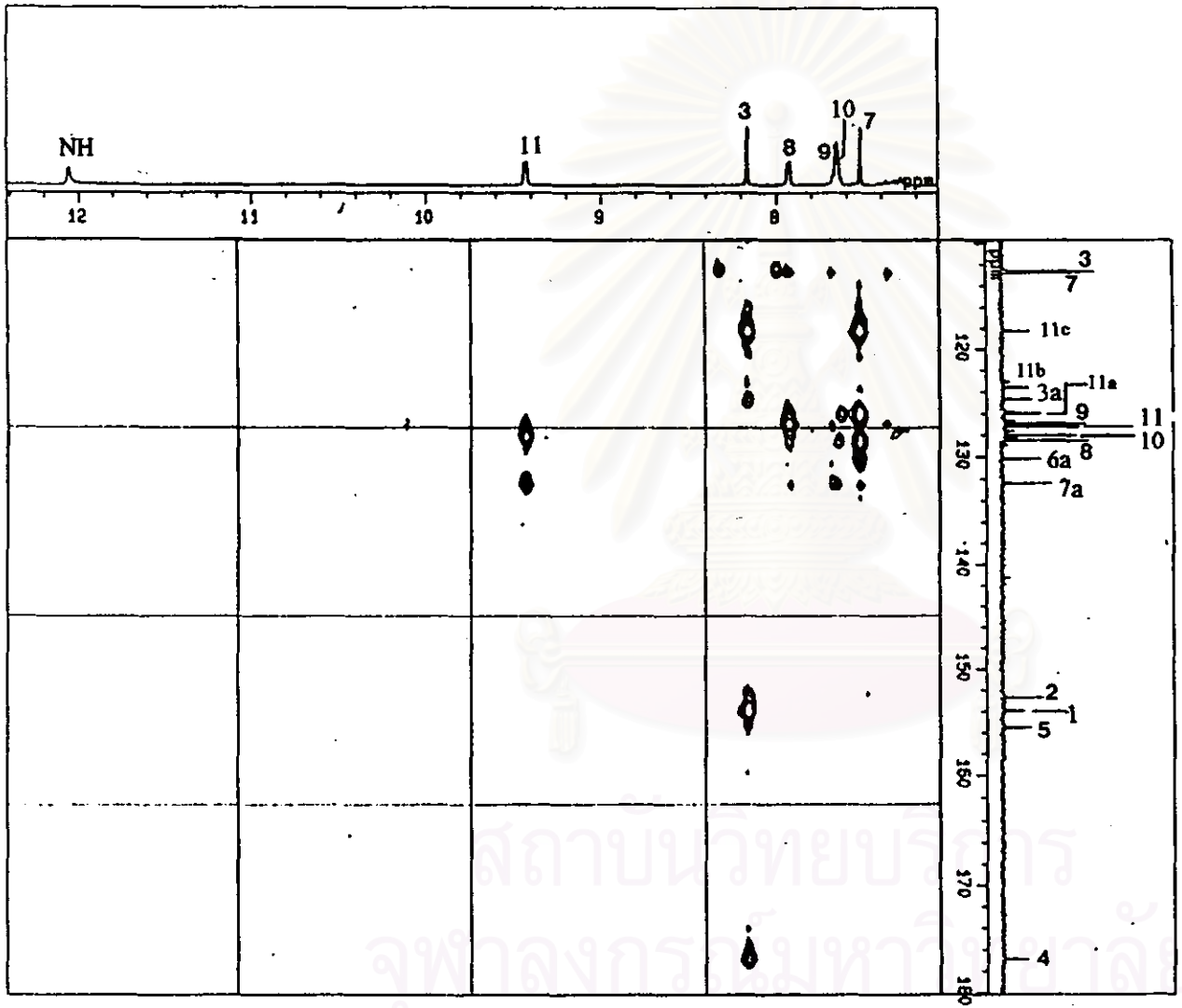


Figure 41c HSQC spectrum of compound GT-E (in DMSO-d_6) [δ_H 3.8-4.4 ppm, δ_C 54-64 ppm]



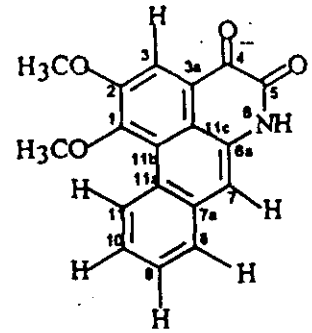
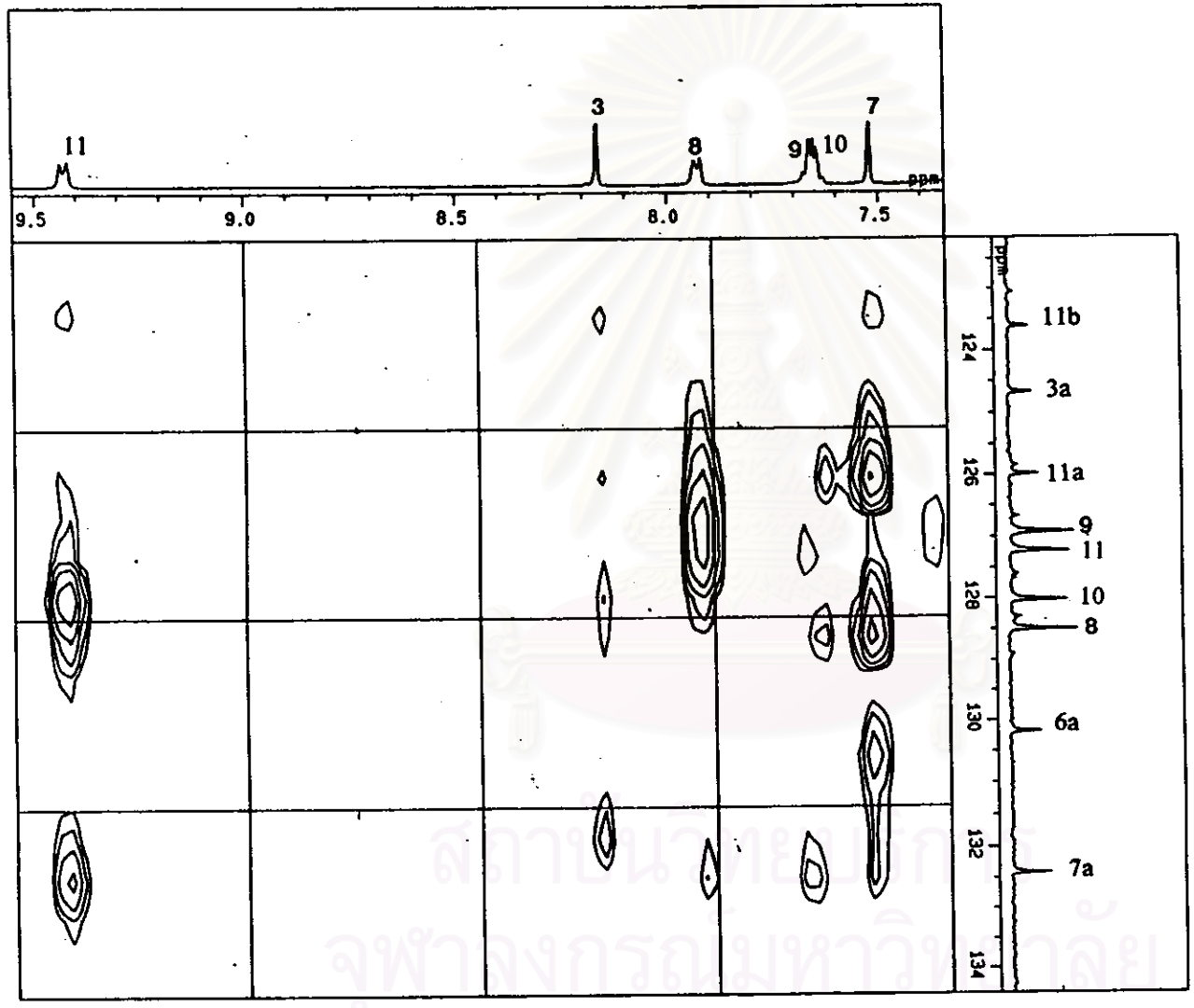


Figure 42a HMBC spectrum of compound GT-E (in DMSO-d_6) [δ_H 7.5-9.5 ppm, δ_C 123-134 ppm]



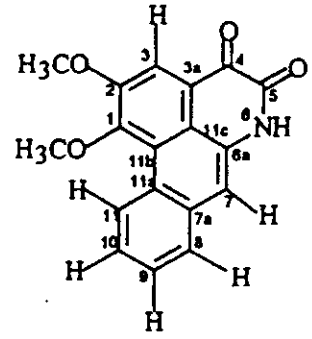


Figure 42b HMBC spectrum of compound GT-E (in DMSO-d_6) [δ_H 7.5-8.0 ppm, δ_C 125-133 ppm]

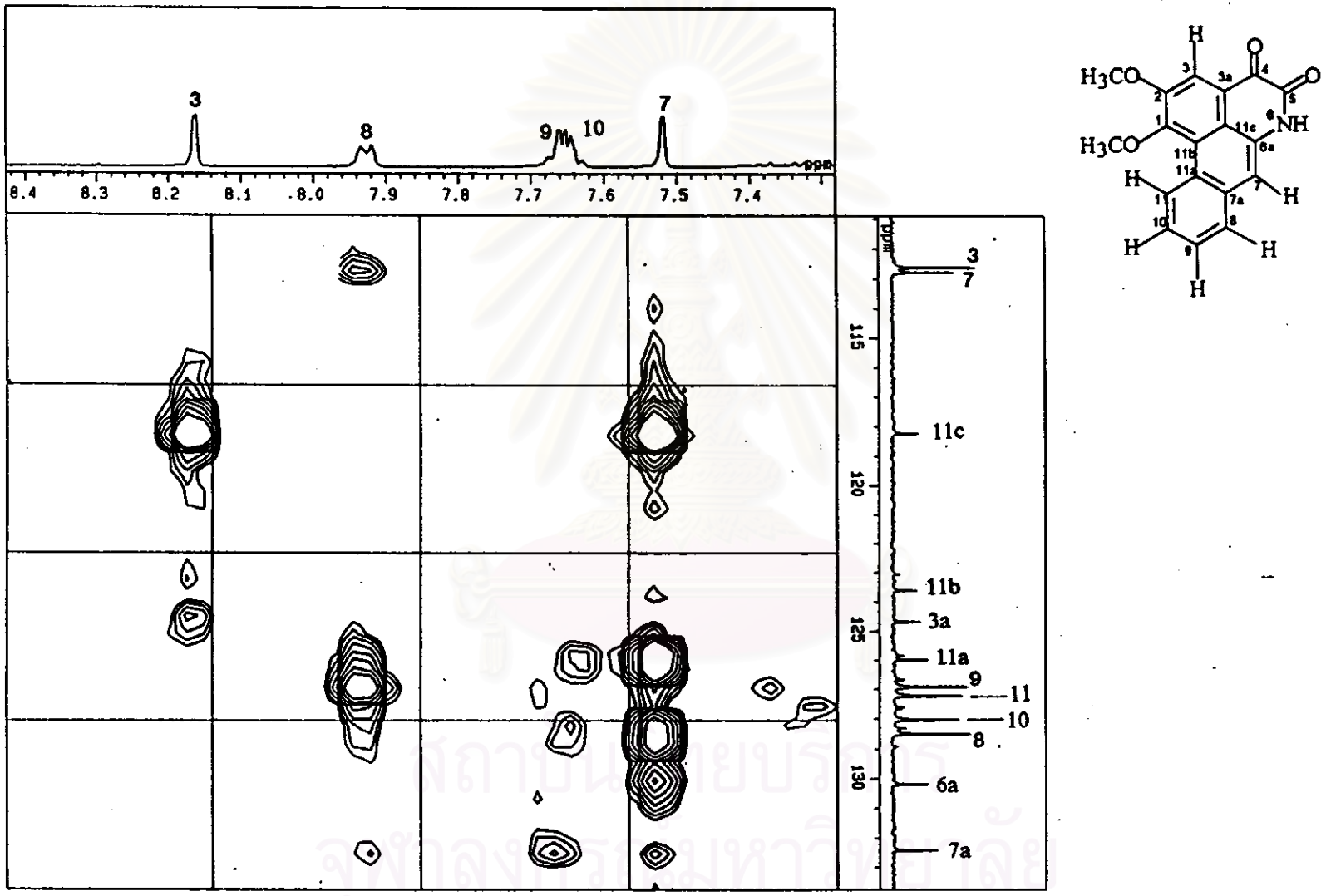


Figure 42c HMBC spectrum of compound GT-E (in DMSO-d_6) [δ_H 7.4-8.4 ppm, δ_C 112-133 ppm]

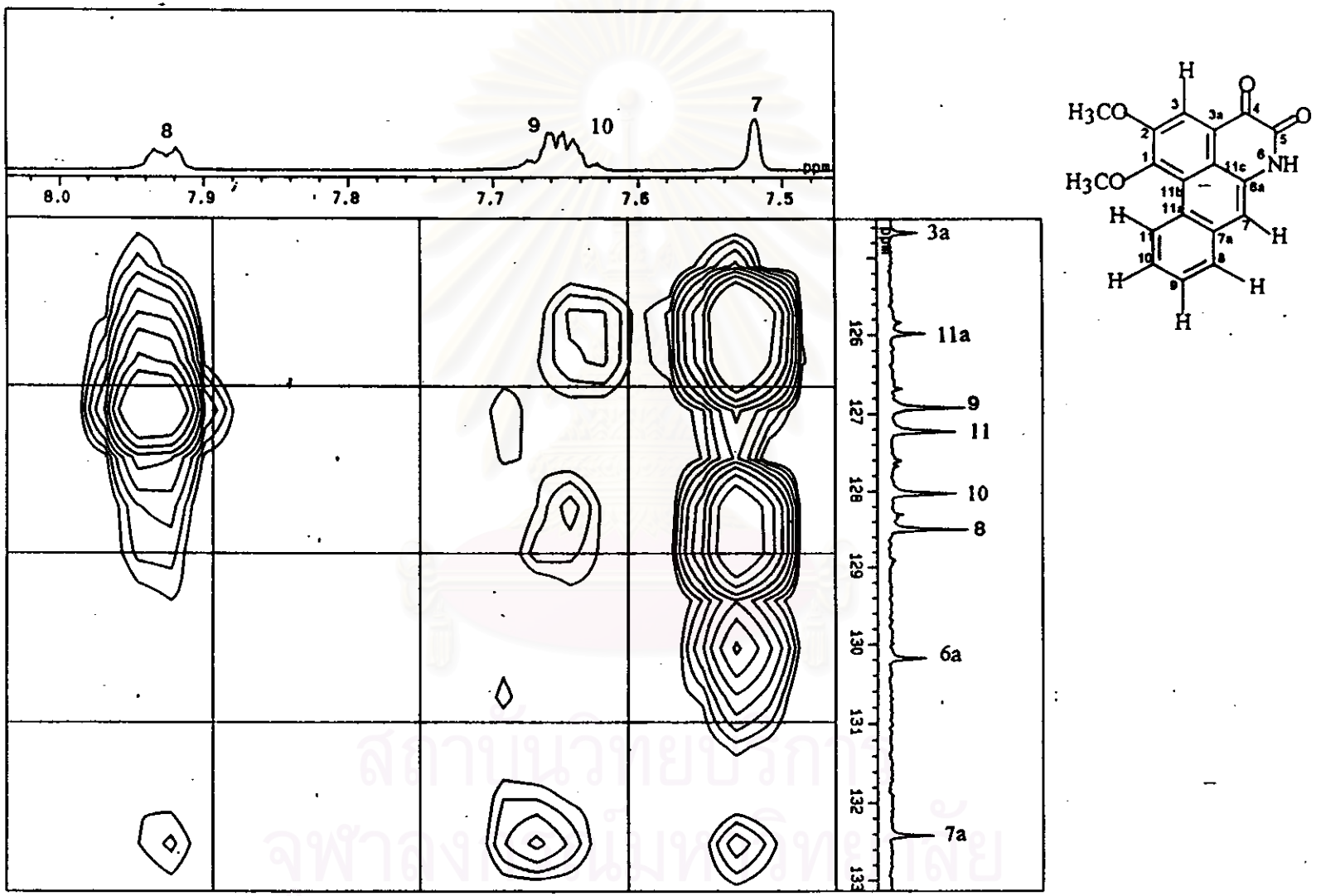


Figure 42d HMBC spectrum of compound GT-E (in DMSO-d_6) [δ_H 7.2-12.4 ppm, δ_C 110-180 ppm]

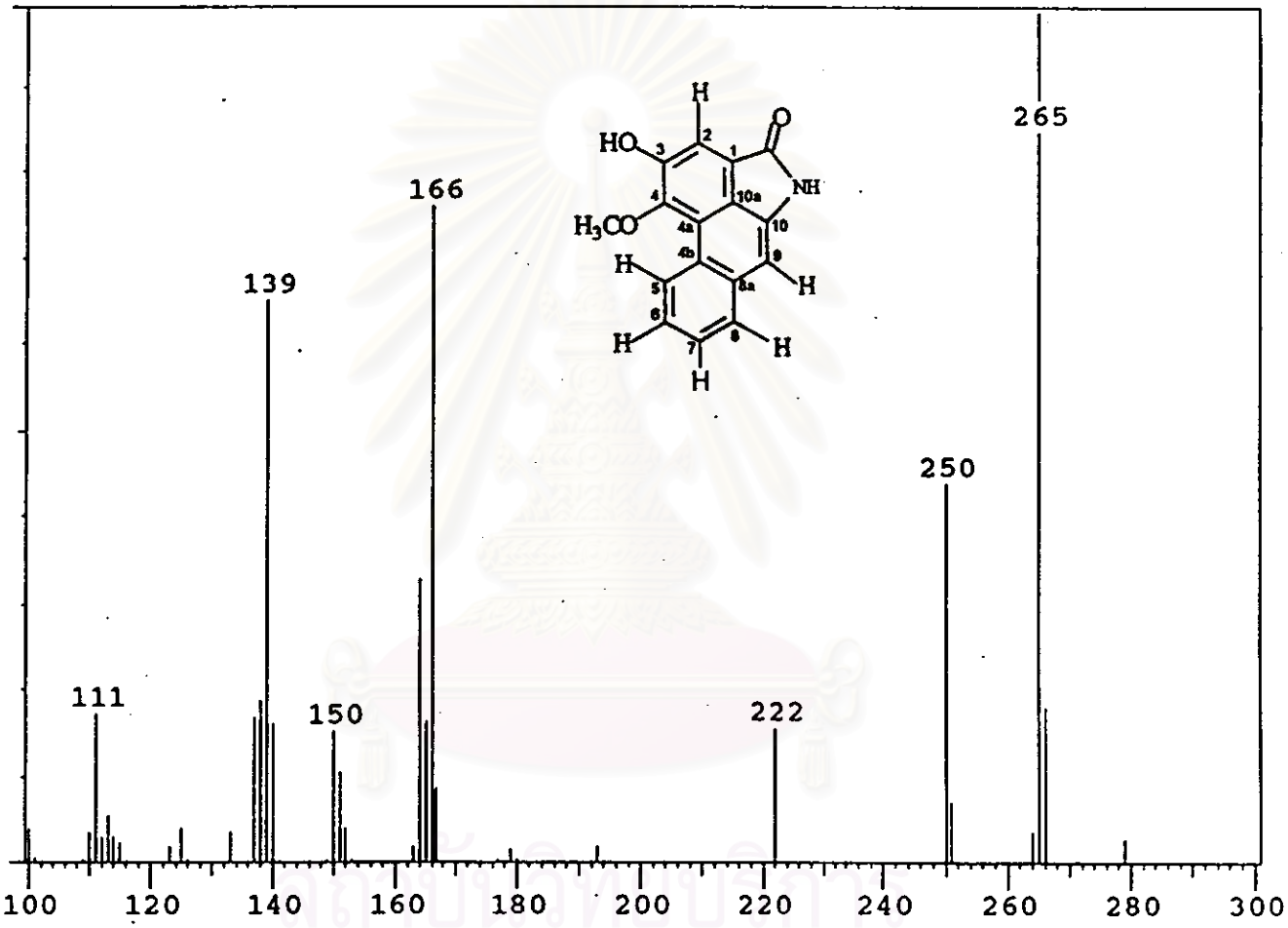


Figure 43 EI mass spectrum of compound GT-F

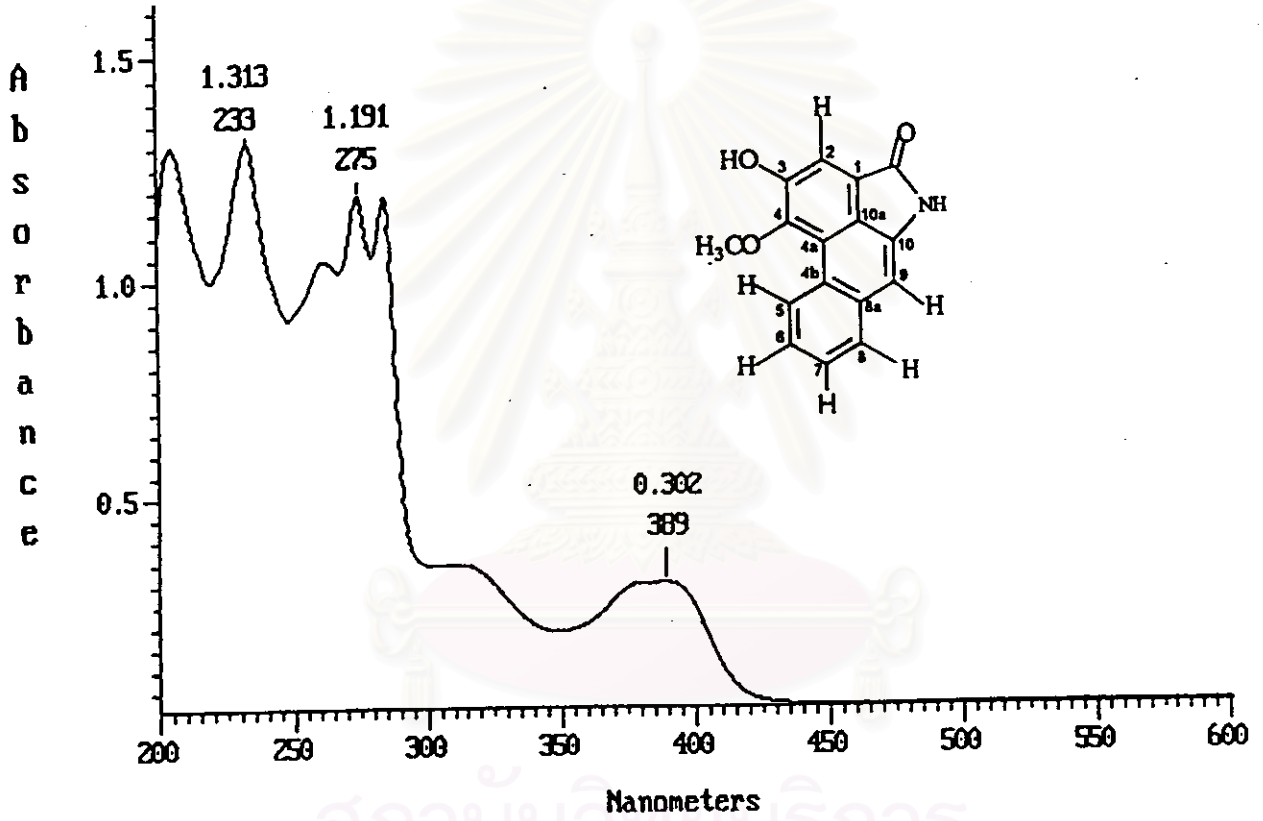


Figure 44 UV spectrum of compound GT-F (in methanol)

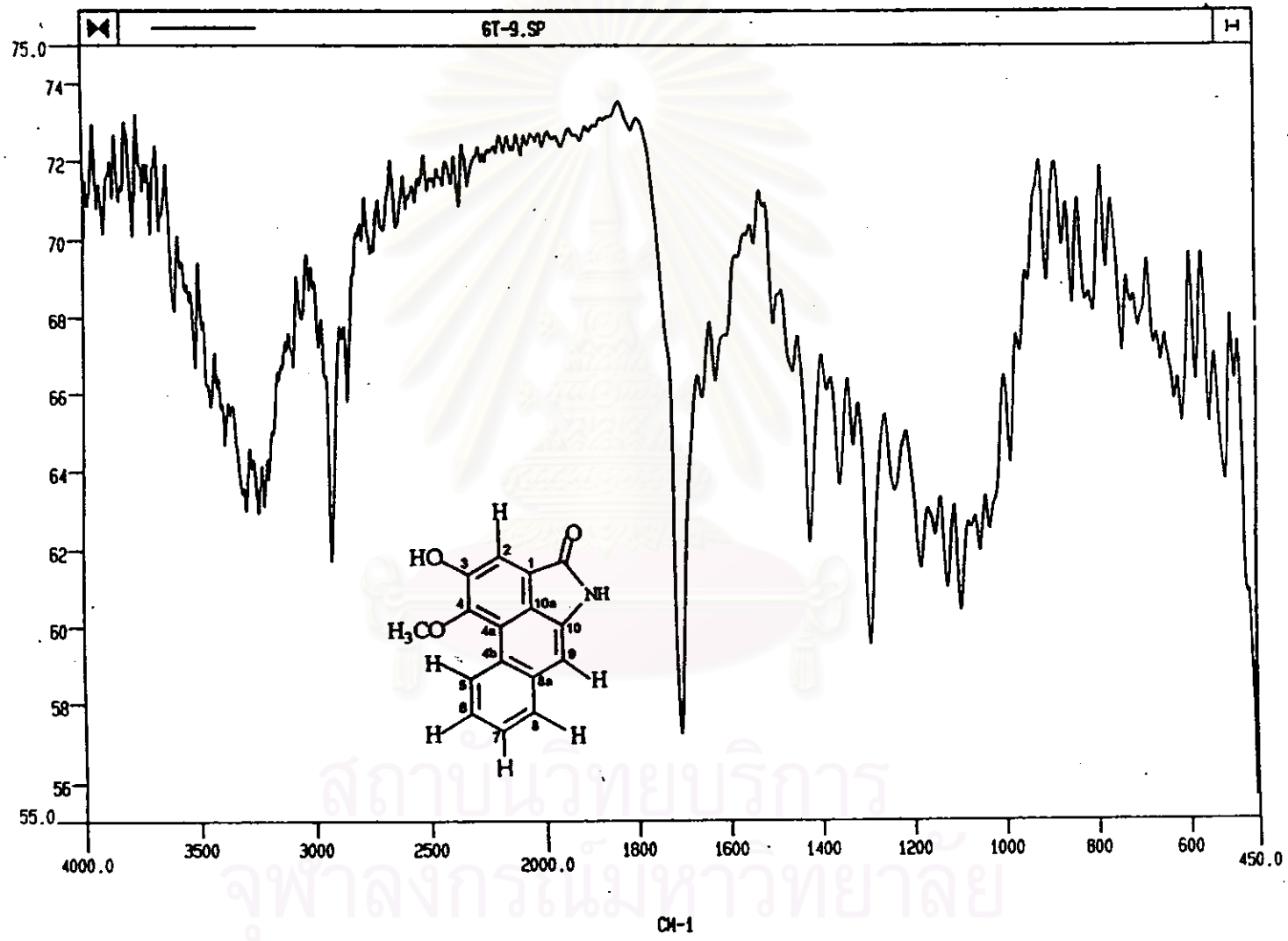


Figure 45 IR spectrum of compound GT-F (KBr disc)

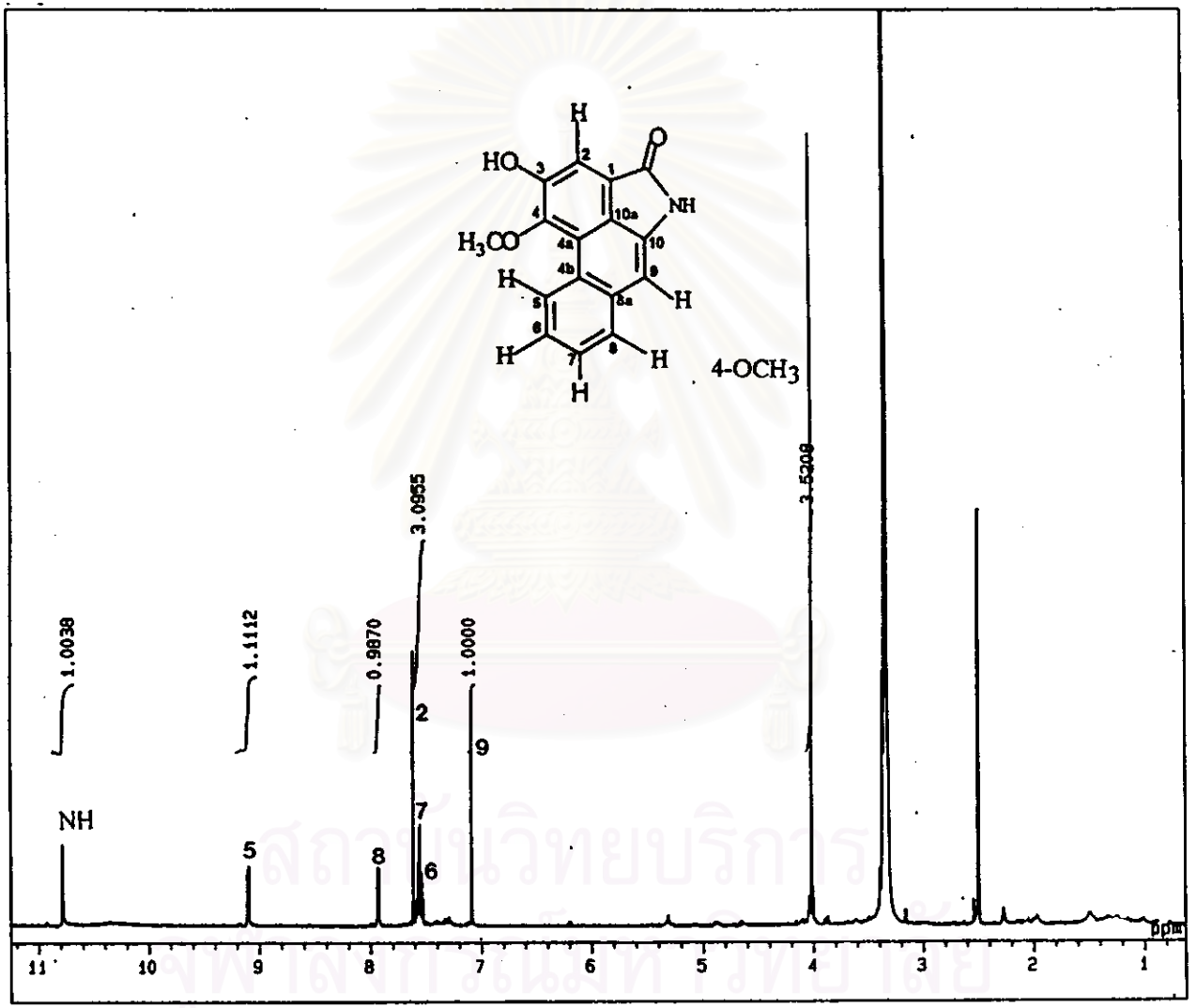


Figure 46a 500 MHz ^{1}H NMR spectrum of compound GT-F (in DMSO-d_6)

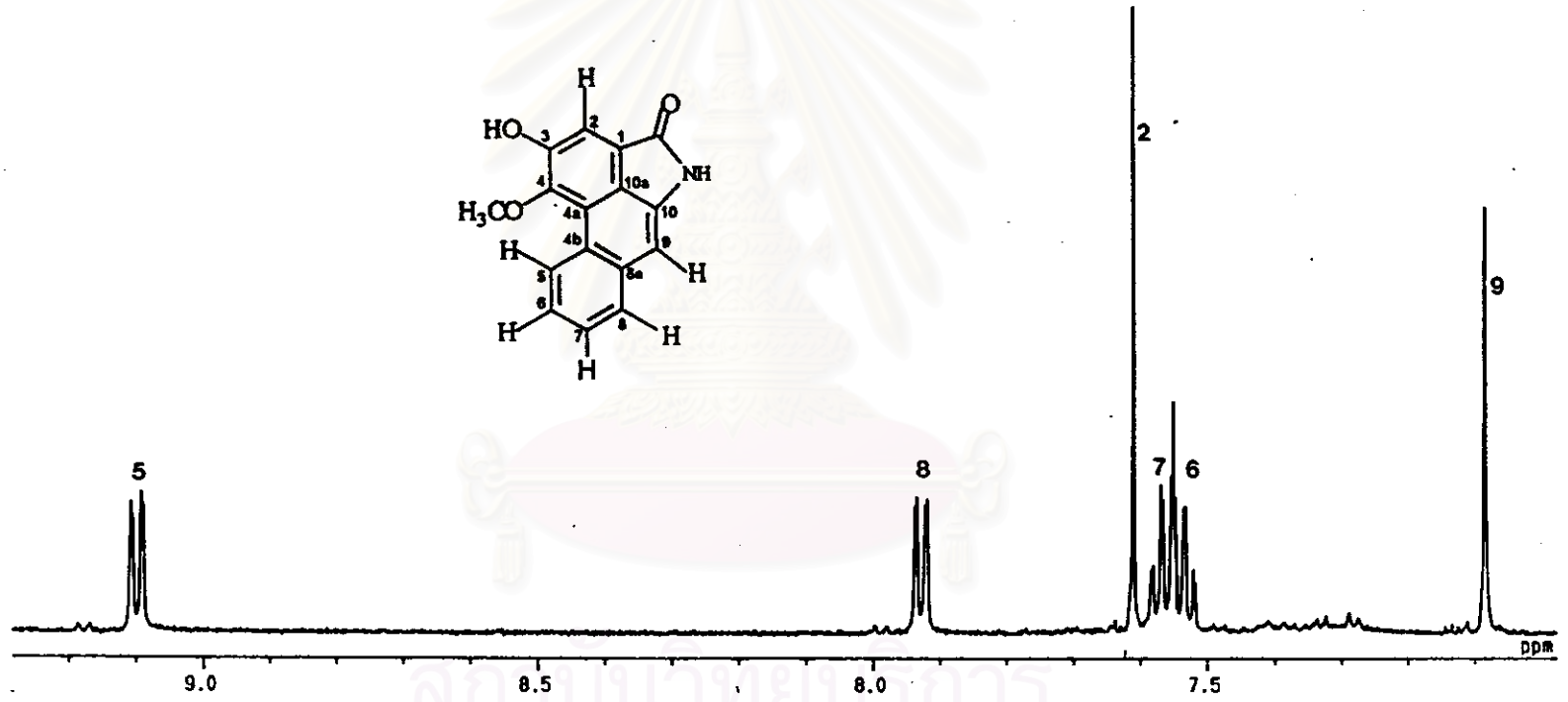


Figure 46b 500 MHz ^{1}H NMR spectrum of compound GT-F (in DMSO-d_6) (expansion from 7.0-9.2 ppm)

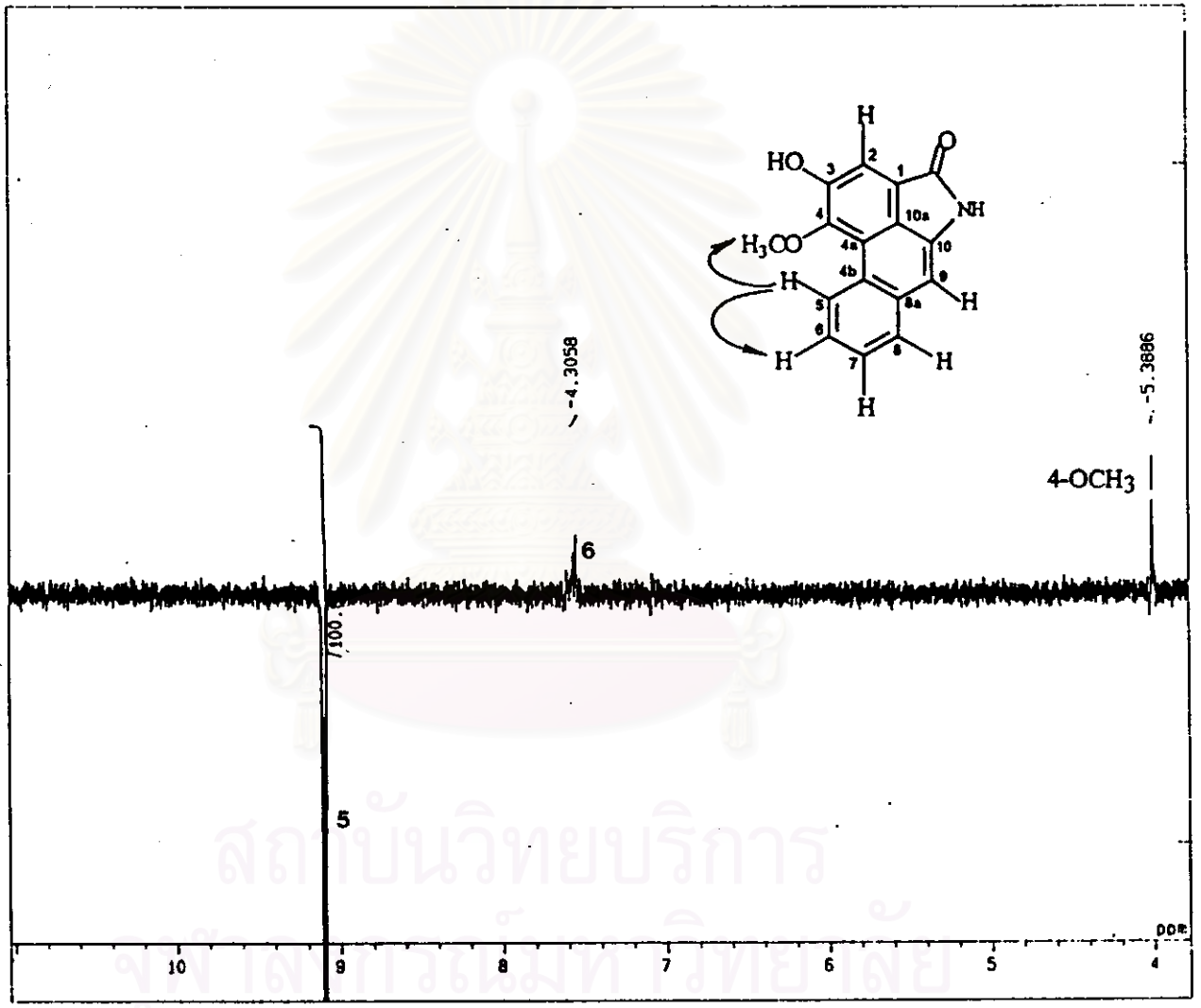


Figure 47a NOE difference spectrum of compound GT-F (in DMSO-d_6) (irradiate at 9.10 ppm)

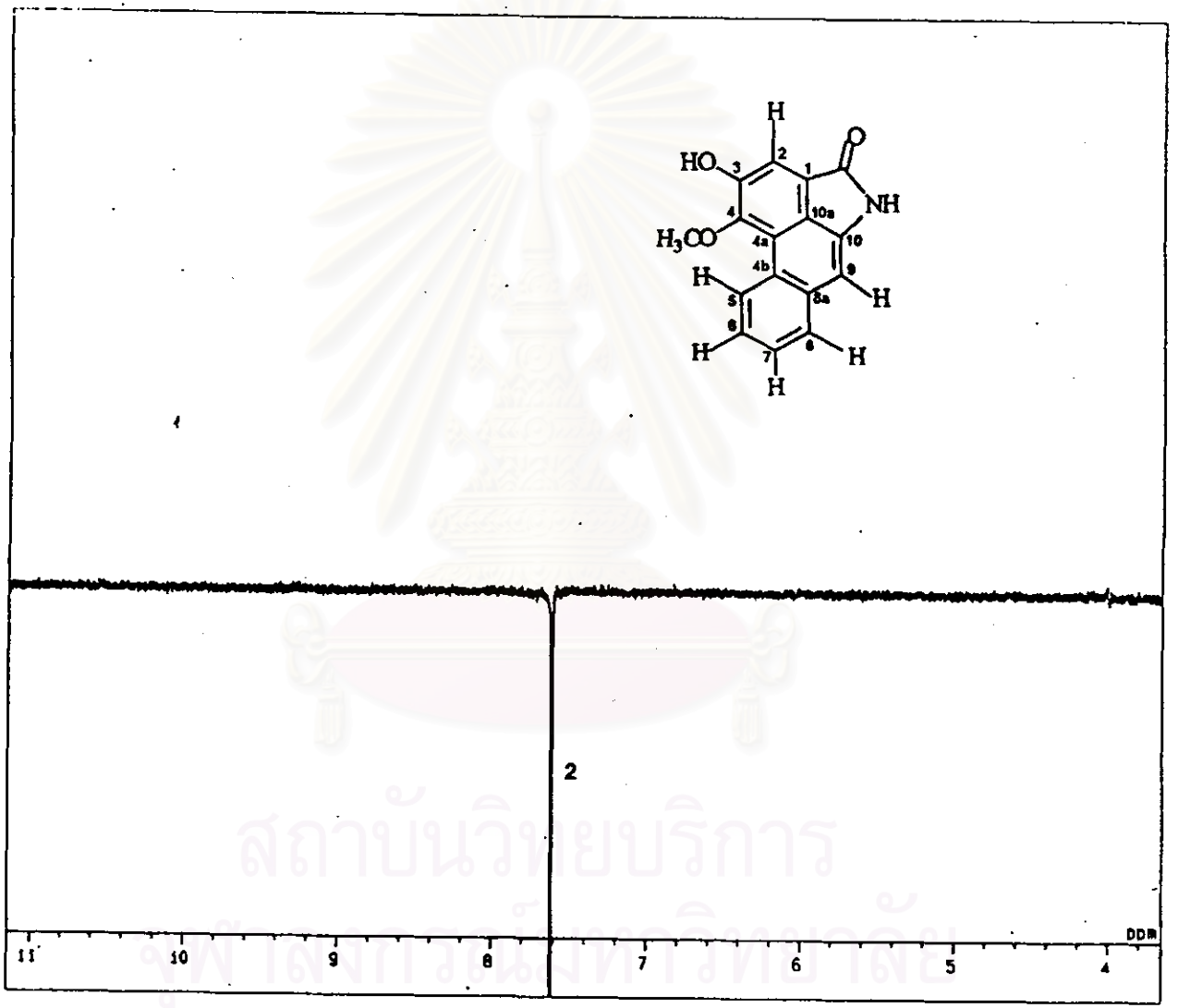


Figure 47b NOE difference spectrum of compound GT-F (in DMSO-d_6) (irradiate at 7.61 ppm)

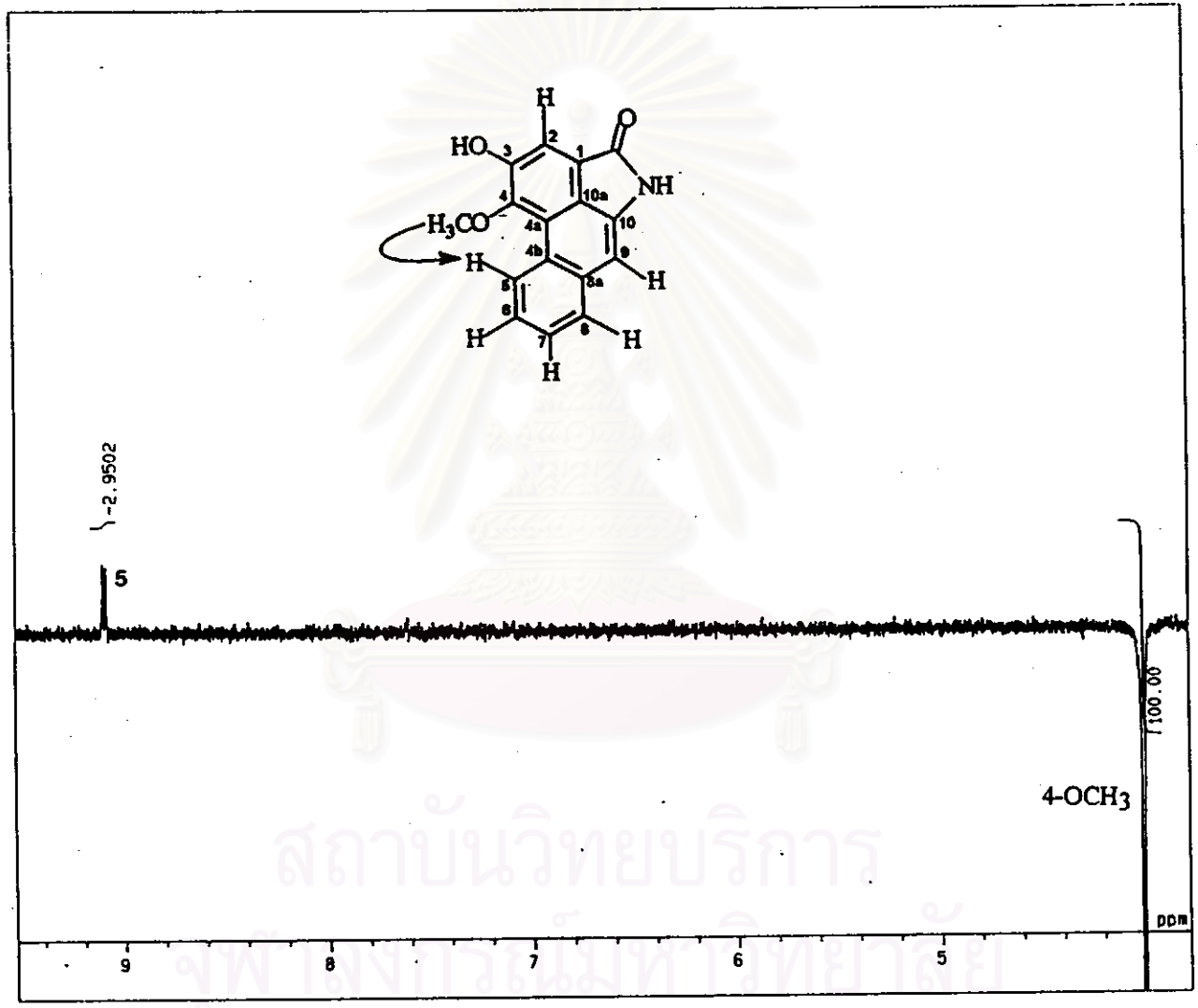


Figure 47c NOE difference spectrum of compound GT-F (in DMSO-d_6) (irradiate at 4.01 ppm)

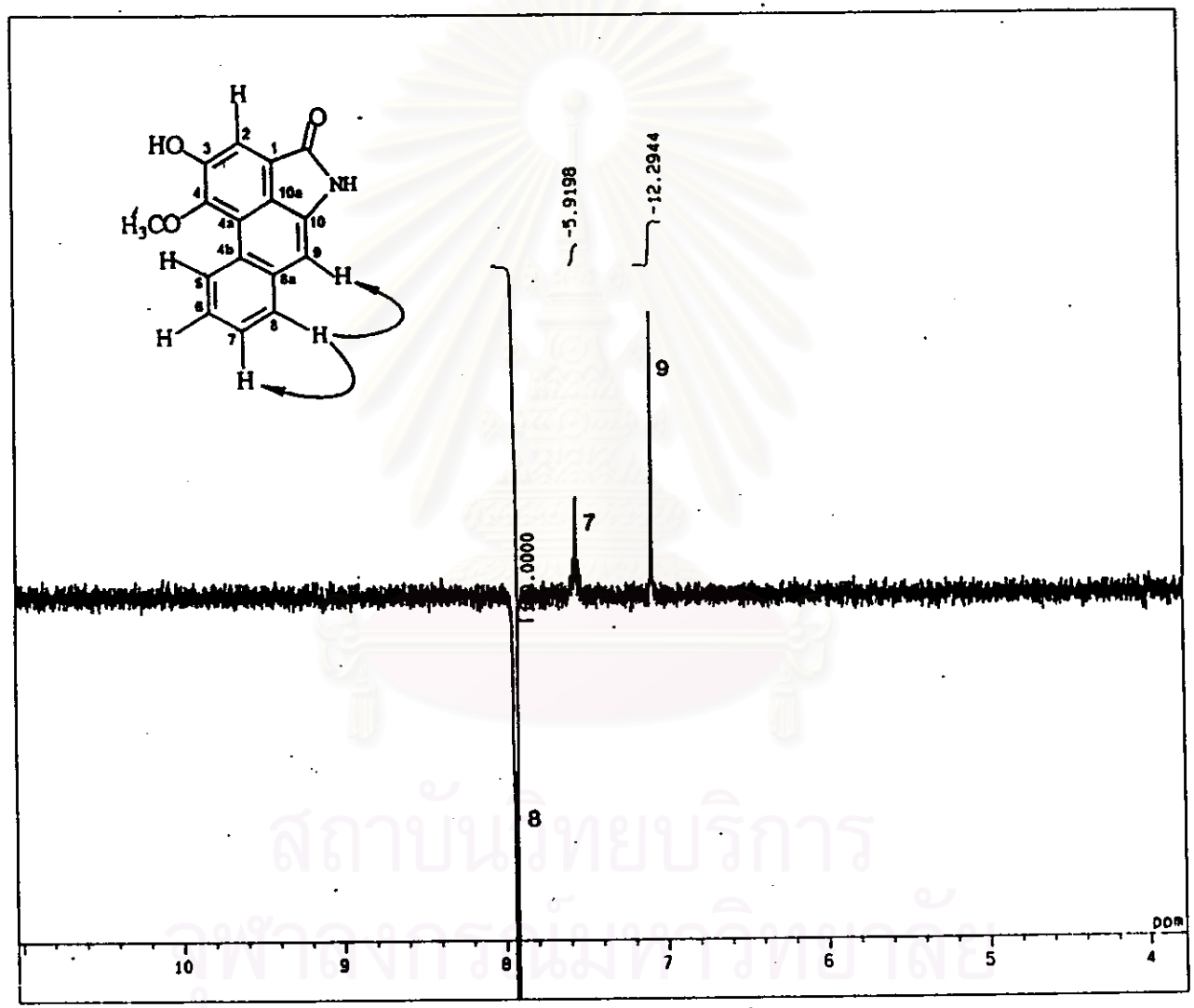


Figure 47d NOE difference spectrum of compound GT-F (in DMSO-d_6) (irradiate at 7.93 ppm)

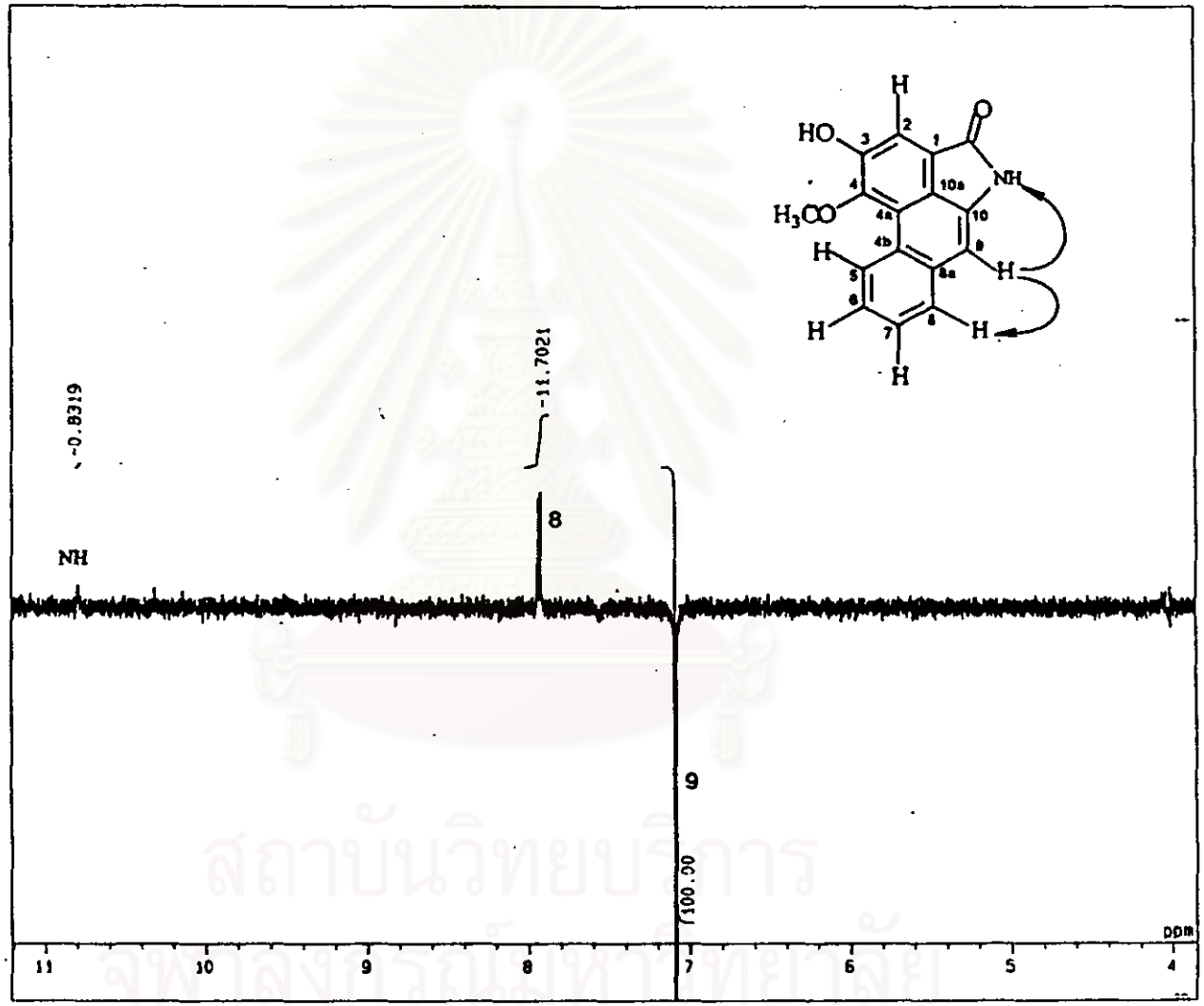


Figure 47e NOE difference spectrum of compound GT-F (in DMSO-d_6) (irradiate at 7.08 ppm)

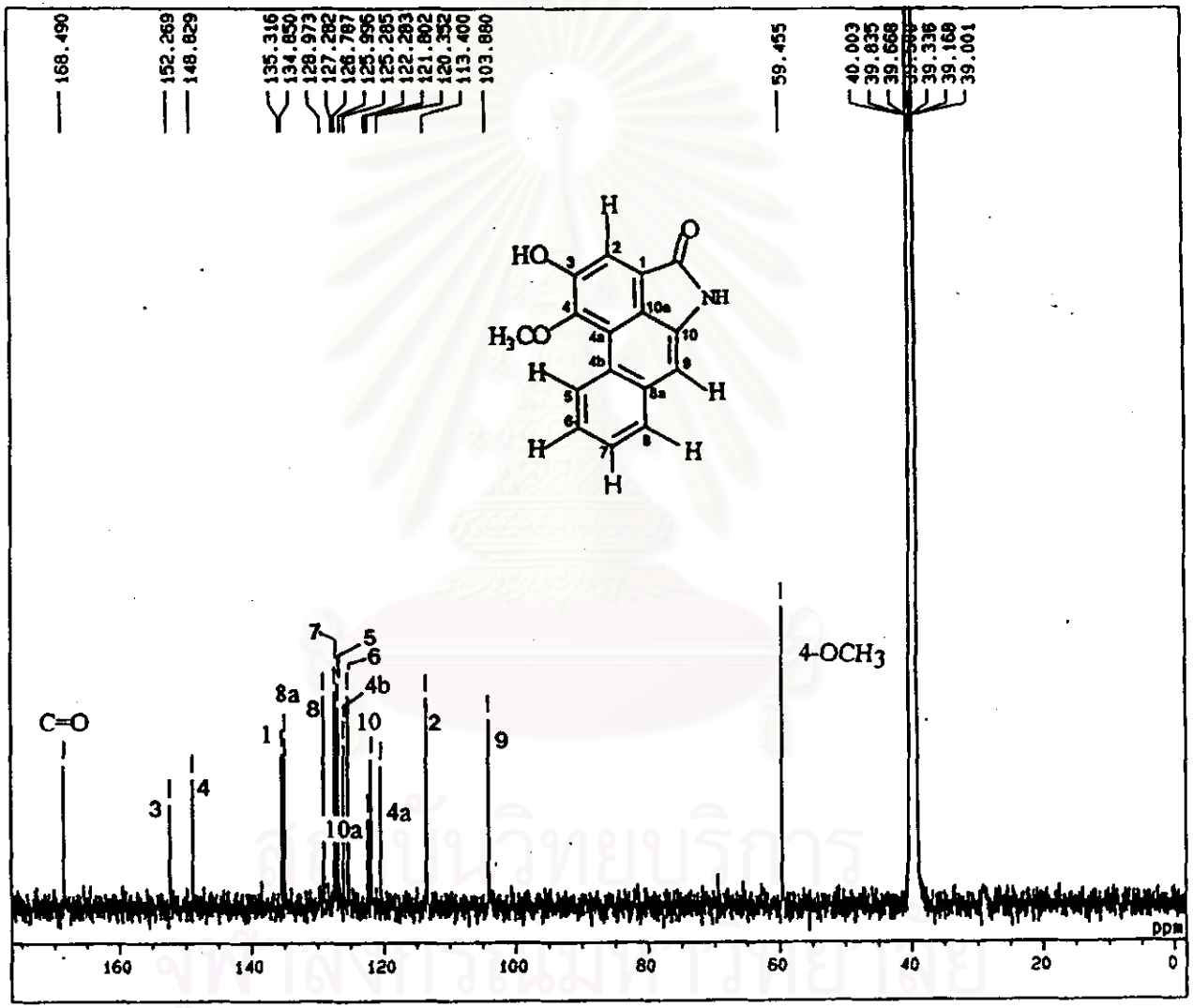


Figure 48a 125 MHz ^{13}C NMR spectrum of compound GT-F (in DMSO-d_6)

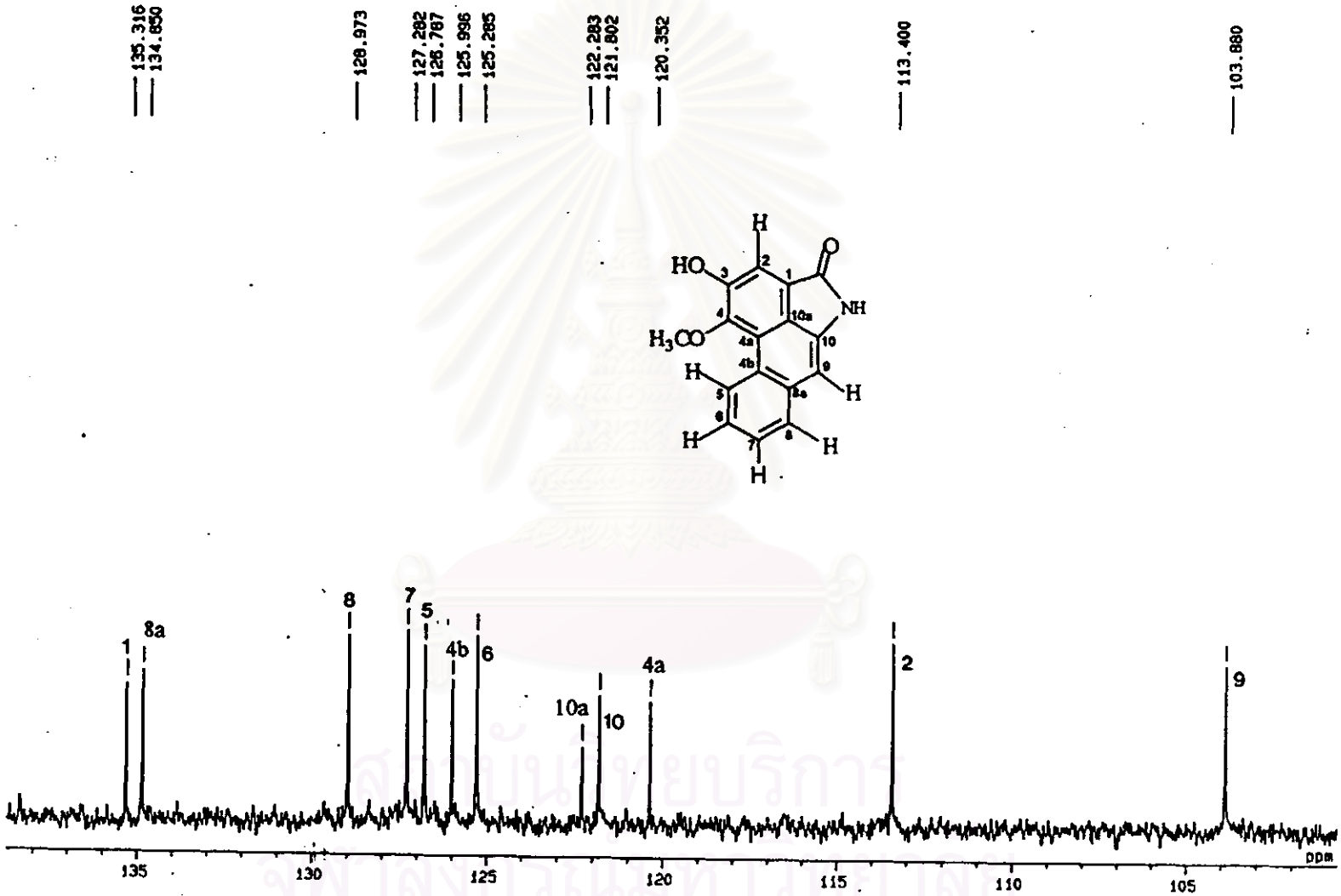


Figure 48b 125 MHz ^{13}C NMR spectrum of compound GT-F (in DMSO-d_6) (expansion from 100-140ppm)

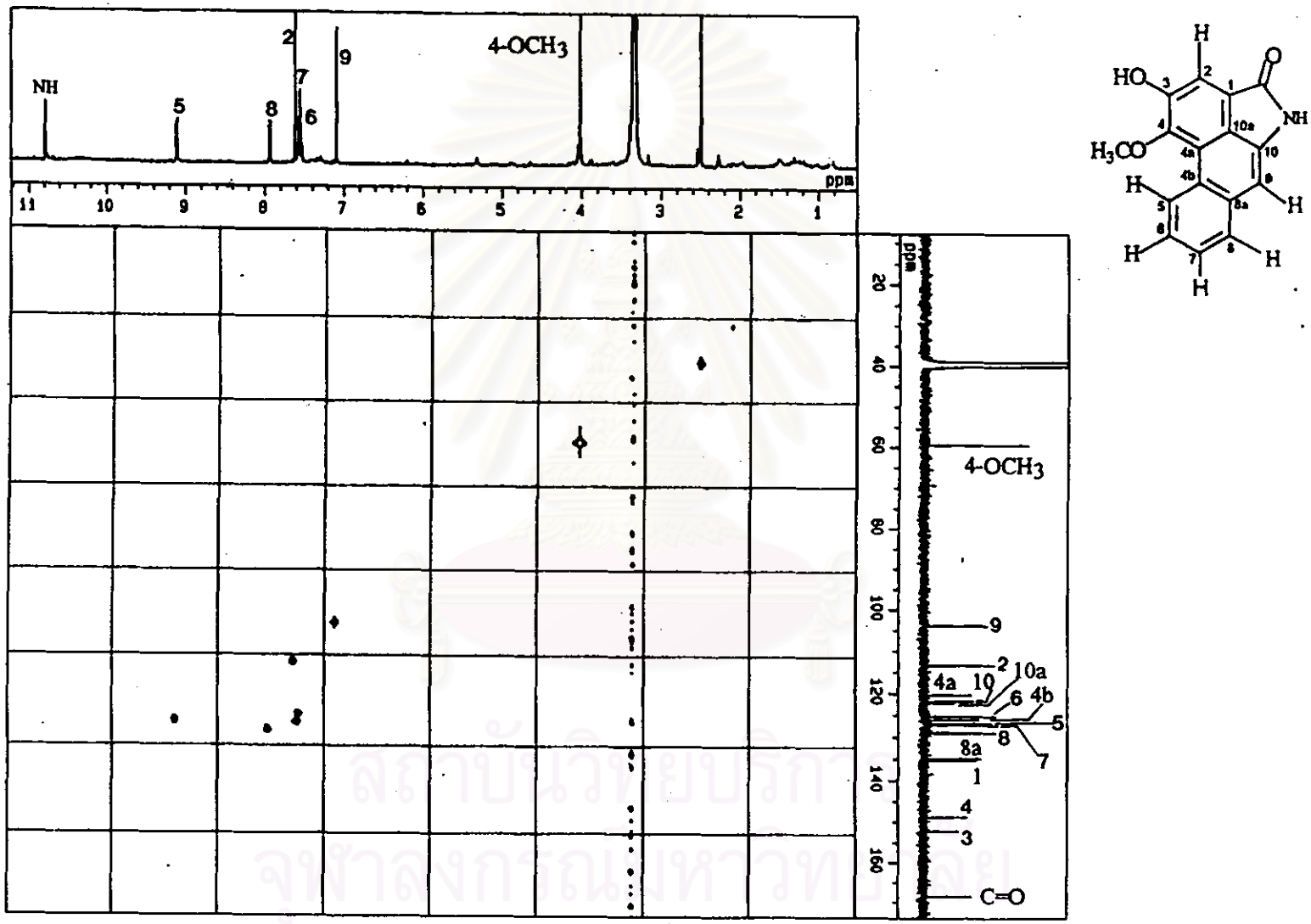


Figure 49a HMQC spectrum of compound GT-F (in DMSO-d_6) [δ_H 7.0-9.2 ppm, δ_C 101-130 ppm]

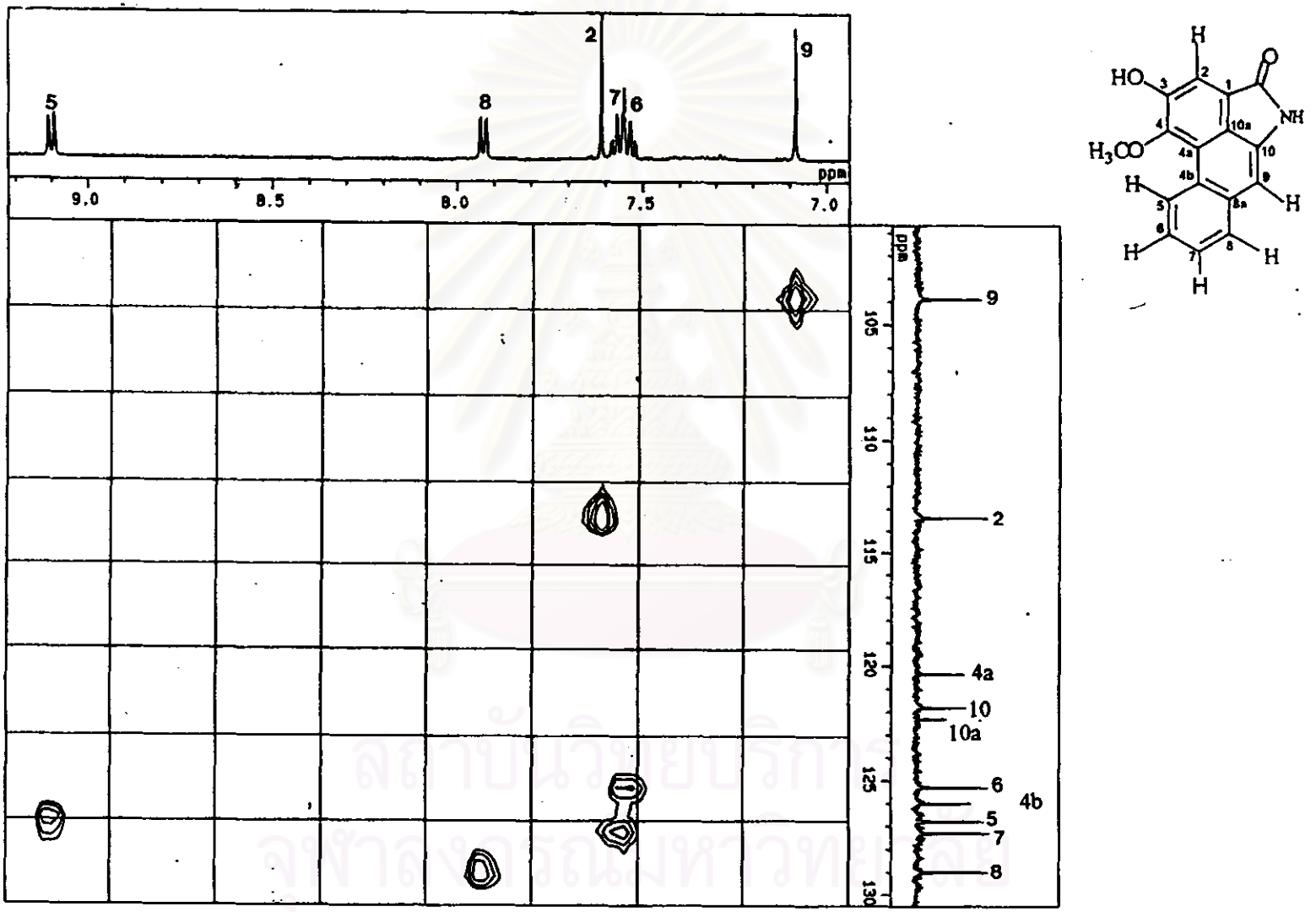
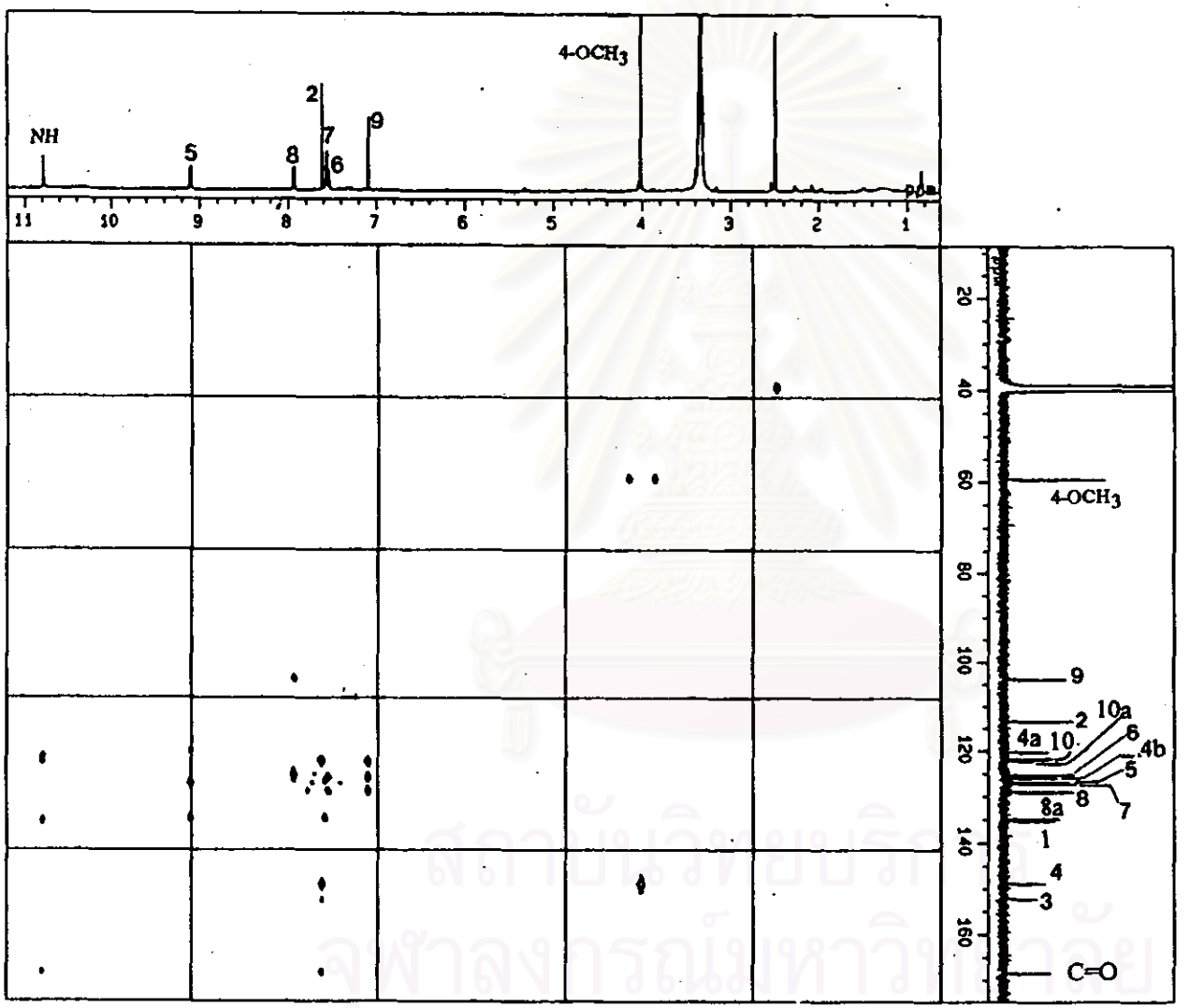


Figure 49b HMQC spectrum of compound GT-F (in DMSO-d_6) [δ_H 1-11 ppm, δ_C 10-170 ppm]



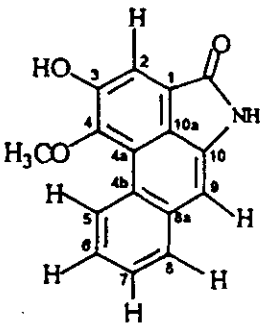
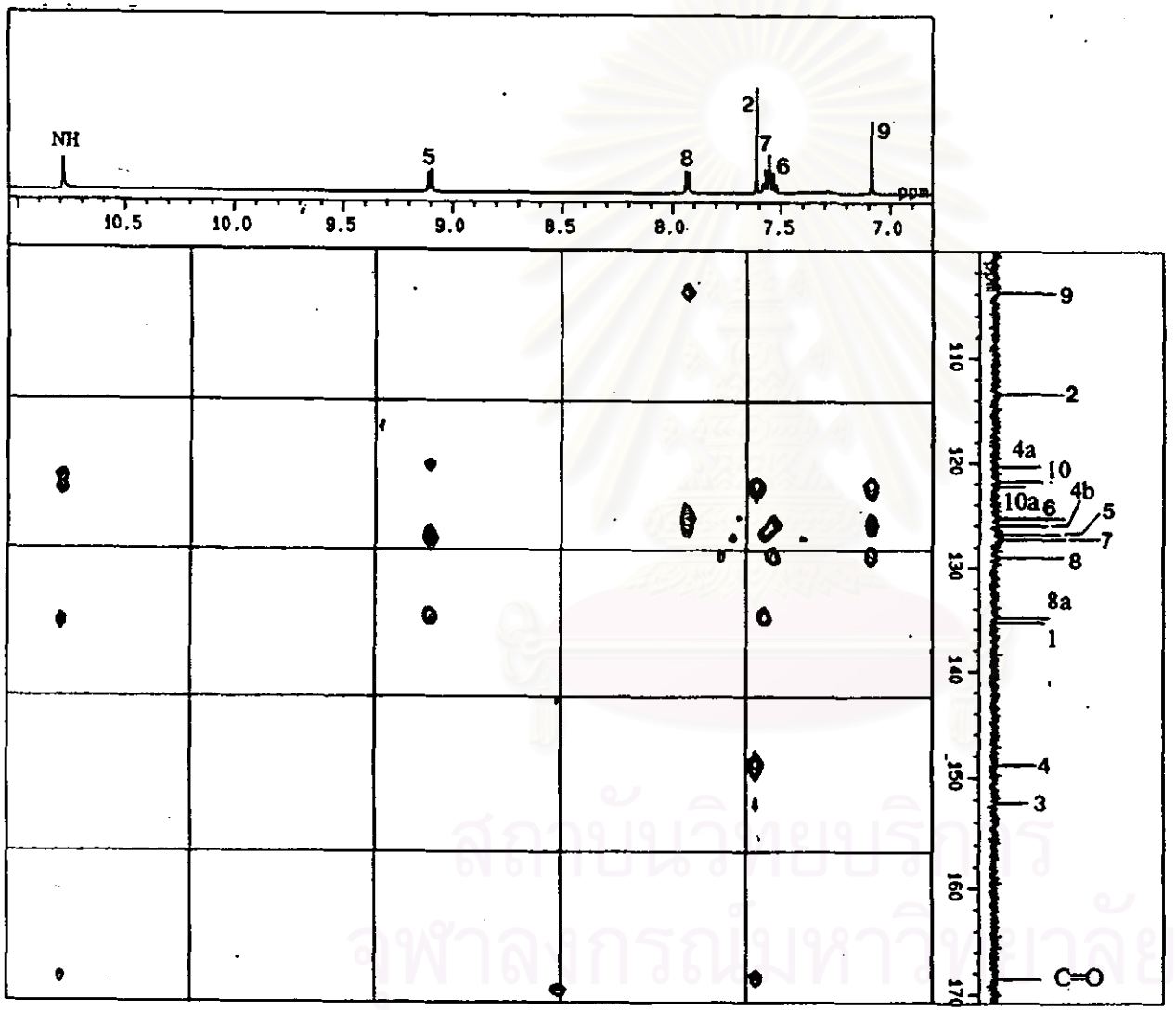


Figure 50a HMBC spectrum of compound GT-F (in DMSO-d_6) [δ_H 1-11 ppm, δ_C 10-170 ppm]



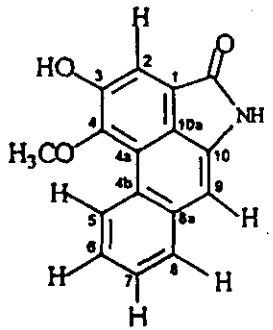
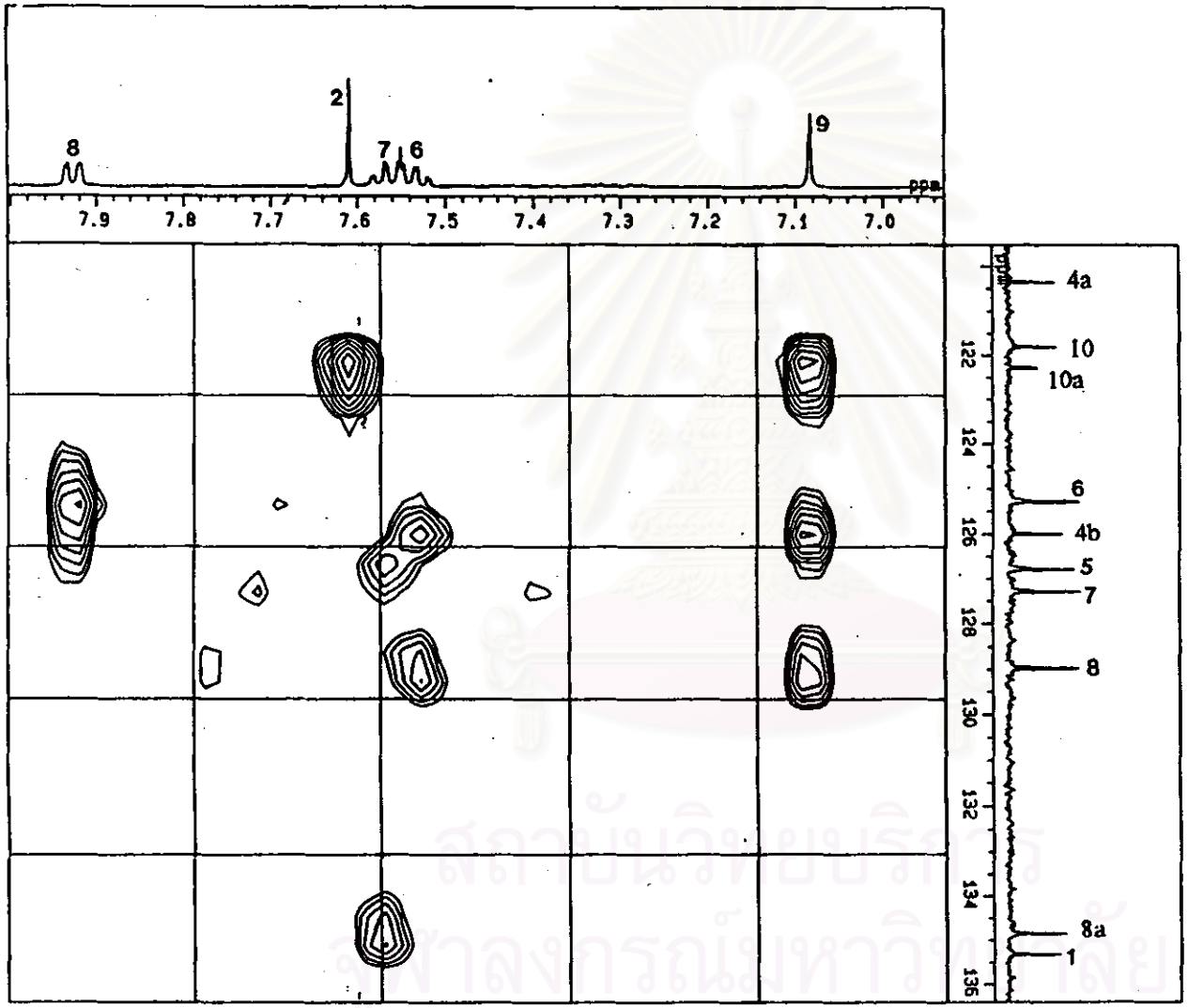


Figure 50b HMBC spectrum of compound GT-F (in DMSO-d_6) [δ_H 9.0-10.9 ppm, δ_C 120-136 ppm]



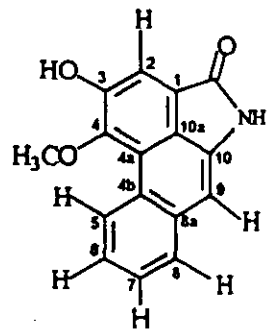


Figure 50c HMBC spectrum of compound GT-F (in DMSO-d_6) [δ_H 7-8 ppm, δ_C 120-136 ppm]

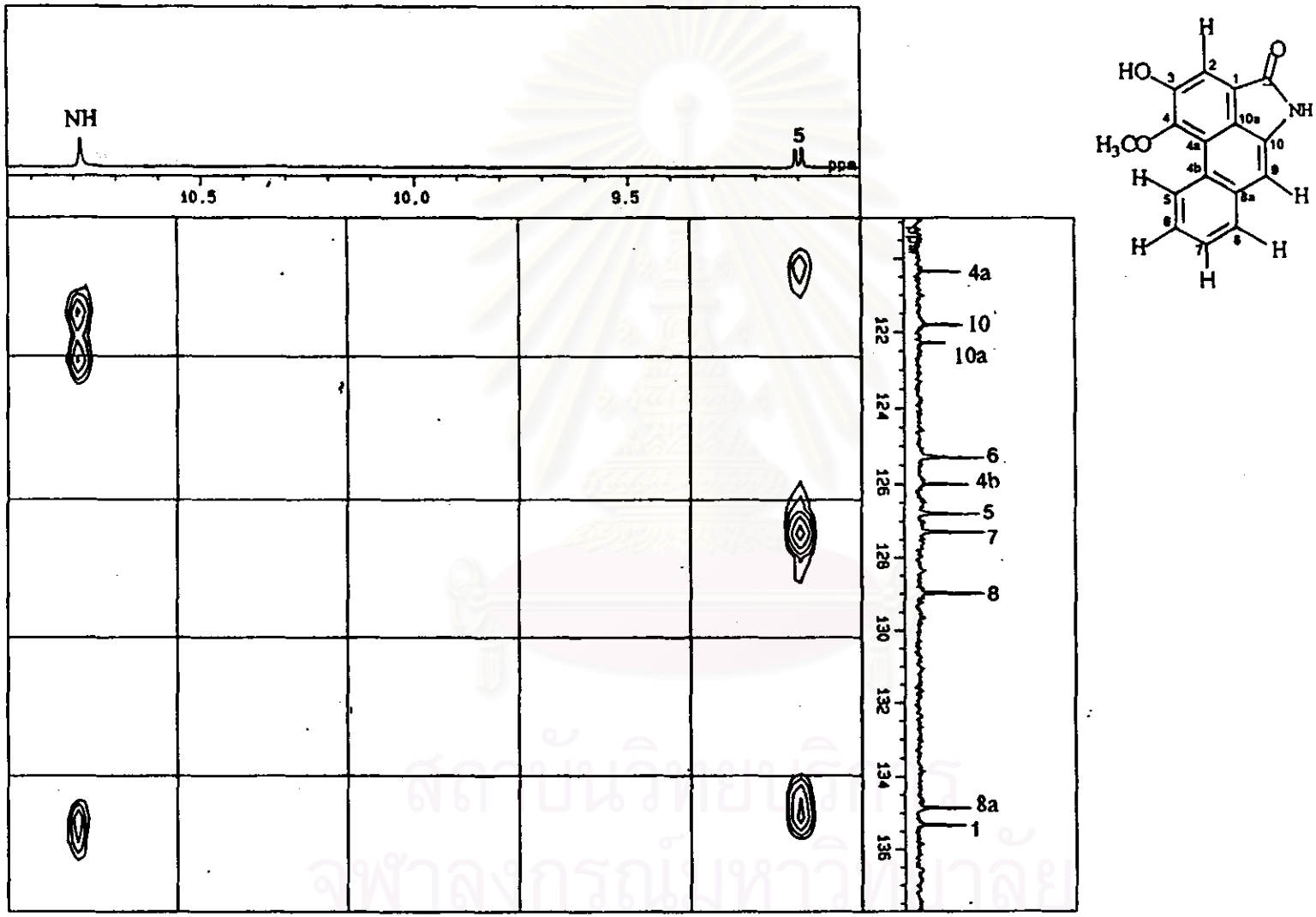
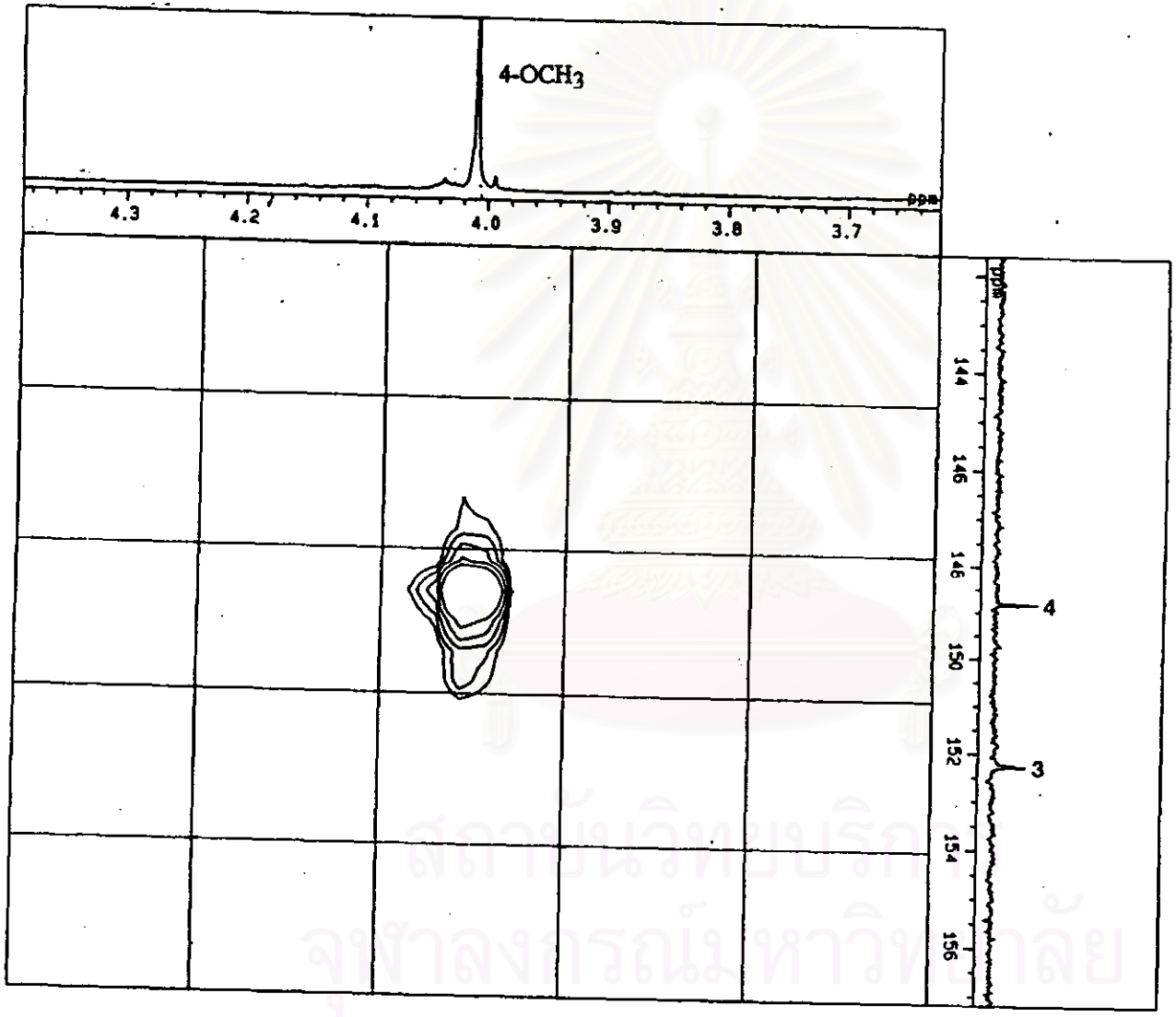


Figure 50d HMBC spectrum of compound GT-F (in DMSO-d_6) [δ_H 7-11 ppm, δ_C 112-170 ppm]



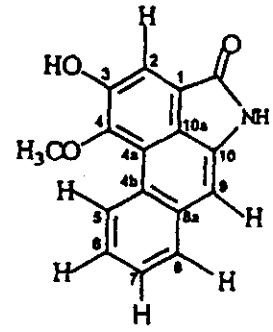


Figure 50e HMBC spectrum of compound GT-F (in DMSO-d_6) [δ_H 3.7-4.3 ppm, δ_C 142-156 ppm]