

Supporting Information

Total Synthesis of (\pm)-Scopadulin

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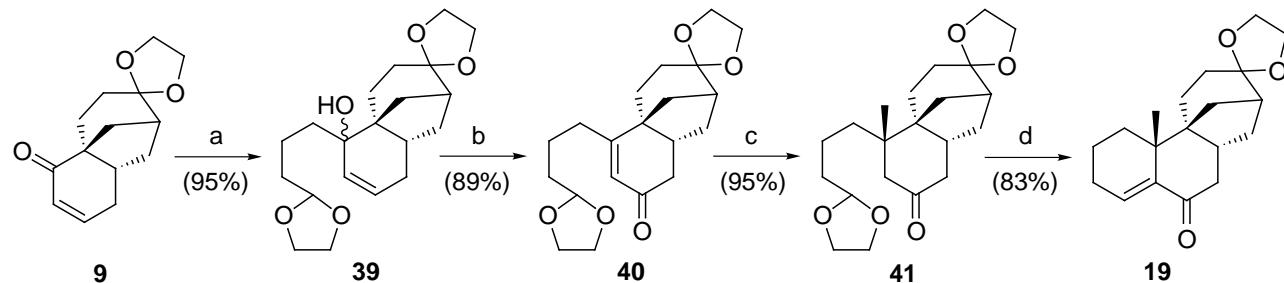
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Preparation of the Enone (19)

As shown in the Scheme S1, the enone **19** was prepared by the similar procedures described in our published literature.¹ However, in some cases better yields of the respective products were observed. Our previous reported data for **19** and the intermediates were precise (recorded by either 200 or 250 MHz) and incomplete (the allylic alcohol **39** was not characterized and none of the compound included ¹³C NMR data). Herein, we present the updated and/or augmented data for the enone **19** and its intermediates (compounds **39**, **40**, and **41**).

1. Tanaka, T.; Okuda, O.; Murakami, K.; Yoshino, H.; Mikamiyama, H.; Kanda, A; Kim, S.-W.; Iwata, C. *Chem. Pharm. Bull.* **1995**, 43, 1407.

Scheme S1



Reaction conditions: (a) Li, 2-(3-chloropropyl)-1,3-dioxolane, THF, ultrasound, rt; (b) PCC, Al₂O₃, CH₂Cl₂, rt; (c) Me₂CuLi, Et₂O, -20 to 0 °C; (d) *p*-TSA, C₆H₆, 75 °C

(\pm)-(1*R*,2*R*,6*R*,8*S*)-2-[3-(1,3-Dioxolan-2-yl)propyl]-2-hydroxytricyclo[6.3.1.0^{1,6}]dodec-3-en-9-one **9,9-Ethylene Acetal and Its (1*S*^{*},2*R*^{*},6*S*^{*},8*R*^{*})-Isomer (39)**. Colorless oil; IR (KBr) cm⁻¹: 3515, 1645, 1133. ¹H-NMR (CDCl₃, 500 MHz) δ: 1.24-1.96 (m, 16H), 2.01-2.07 (m, 1H), 2.13-2.29 (m, 2H), 3.82-3.87 (m, 4H), 3.88-4.01 (m, 4H), 4.86 (t, *J* = 4.5 Hz, 1H), 5.45 (d, *J* = 10.0 Hz, 1H), 5.73 (ddd, *J* = 10.0, 5.0, 2.0 Hz, 1H). ¹³C-NMR (CDCl₃, 75 MHz) δ: 18.6, 25.6, 28.3, 30.5 (2C), 34.5, 34.8, 37.8, 39.7, 43.0, 47.3, 63.9, 64.5, 64.8 (2C), 77.2, 104.6, 111.8, 128.7, 132.9. MS (EI) *m/z* (%): 350 (M⁺, 5.3), 235 (100), 99 (100). HRMS (EI) Calcd for C₂₀H₃₀O₅: 350.2093. Found: 350.2100.

(\pm)-(1*R*,6*S*,8*S*)-2-[3-(1,3-Dioxolan-2-yl)propyl]tricyclo[6.3.1.0^{1,6}]dodec-2-ene-4,9-dione **9,9-Ethylene Acetal (40)**. Colorless oil; IR (KBr) cm⁻¹: 1662, 1602, 1114. ¹H-NMR (CDCl₃, 500

MHz) δ : 1.48-1.72 (m, 9H), 1.81-1.93 (m, 2H), 1.96-2.03 (m, 1H), 2.12 (d, J = 12.0 Hz, 1H), 2.27-2.41 (m, 4H), 2.58-2.68 (m, 1H), 3.82-3.93 (m, 4H), 3.93-4.02 (m, 4H), 4.87 (t, J = 4.5 Hz, 1H), 5.70 (s, 1H). ^{13}C -NMR (CDCl_3 , 125 MHz) δ : 20.9, 29.7, 30.6, 31.7, 32.5, 33.3, 36.9, 39.7, 42.7, 44.7, 46.8, 64.0, 64.7, 64.9 (2C), 104.1, 110.8, 124.6, 172.9, 201.0. MS (EI) m/z (%): 348 (M^+ , 4.1), 99 (29.7), 73 (100). HRMS (EI) Calcd for $\text{C}_{20}\text{H}_{28}\text{O}_5$: 348.1936. Found: 348.1943.

(\pm)-(1*R*,2*R*,6*S*,8*S*)-2-[3-(1,3-Dioxolan-2-yl)propyl]-2-methyltricyclo[6.3.1.0^{1,6}]dodecane-4,9-dione 9,9-Ethylene Acetal (41). Colorless oil; IR (KBr) cm^{-1} : 1706, 1114. ^1H -NMR (CDCl_3 , 500 MHz) δ : 0.96 (s, 3H), 1.25-1.68 (m, 10H), 1.80-1.97 (m, 4H), 2.11 (d, J = 15.5 Hz, 1H), 2.21 (t, J = 6.5 Hz, 1H), 2.33 (d, J = 13.5 Hz, 1H), 2.34-2.40 (m, 1H), 2.35 (d, J = 15.5 Hz, 1H), 2.43 (d, J = 13.5 Hz, 1H), 3.80-4.02 (m, 8H), 4.85 (t, J = 5.0 Hz, 1H). ^{13}C -NMR (CDCl_3 , 125 MHz) δ : 18.8, 20.1, 26.0, 29.7, 29.9, 34.7, 35.4, 39.7, 39.9, 40.2, 42.9, 43.6, 46.2, 51.2, 64.0, 64.6, 64.9 (2C), 104.3, 111.3, 211.3. HRMS (EI) Calcd for $\text{C}_{21}\text{H}_{32}\text{O}_5$ (M^+): 364.2247. Found: 364.2237.

(\pm)-(1*R*,2*S*,10*S*,12*S*)-2-Methyltetracyclo[10.3.1.0^{1,10}.0^{2,7}]hexadec-6-ene-8,13-dione 13,13-Ethylene Acetal (19). Colorless solid: mp 180-181 °C (*n*-hexane-CH₂Cl₂). IR (KBr) cm^{-1} : 1681, 1604, 1111. ^1H -NMR (CDCl_3 , 500 MHz) δ : 1.09 (s, 3H), 1.36-1.40 (m, 2H), 1.50-1.54 (m, 1H), 1.58-1.62 (m, 2H), 1.67-1.86 (m, 6H), 1.96-2.03 (m, 1H), 2.12-2.33 (m, 4H), 2.58-2.65 (m, 1H), 2.67 (d, J = 4.5 Hz, 1H), 3.83-4.02 (m, 4H), 6.72 (dd, J = 4.5, 3.0 Hz, 1H). ^{13}C -NMR (CDCl_3 , 125 MHz) δ : 18.1, 22.5, 25.6, 26.7, 29.8, 30.4, 30.6, 34.3, 36.1, 39.6, 41.7, 43.6, 45.8, 64.0, 64.6, 111.4, 138.0, 143.2, 201.5. MS (EI) m/z (%): 302 (M^+) Anal. Calcd for $\text{C}_{19}\text{H}_{26}\text{NO}_3$: C, 75.46; H, 8.67. Found: C, 75.35; H, 8.88.

Characterization of (29), (30), (32), and (33).

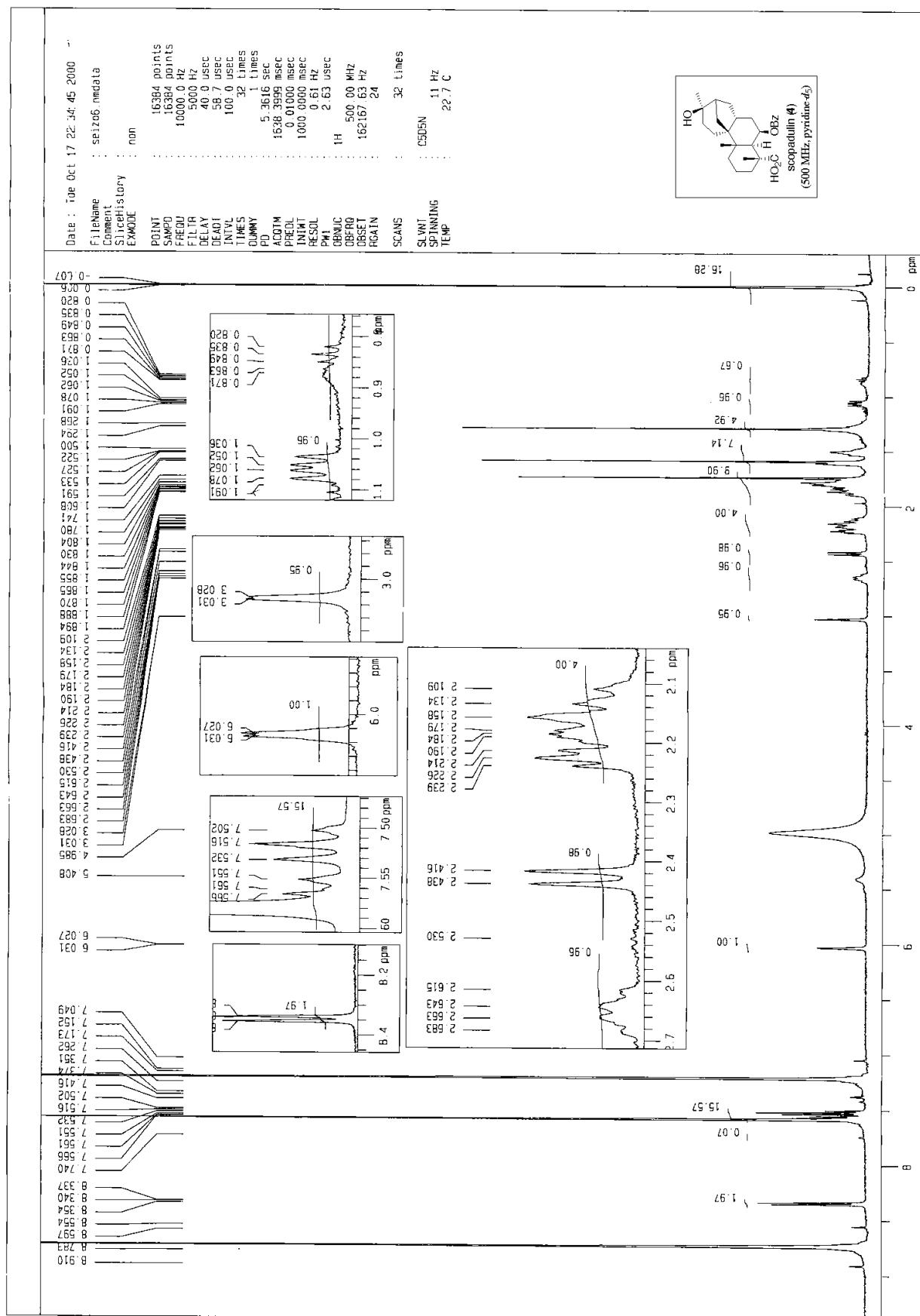
(\pm)-(1*R*,2*R*,6*S*,7*S*,8*S*,10*S*,12*S*)-6-[(Benzylxy)methyl]-2,6-dimethyl-13-[(2-phenylacetyl)oxy]-tetracyclo[10.3.1.0^{1,10}.0^{2,7}]hexadec-13-en-8-yl Benzoate (29). Colorless oil: IR (KBr) cm^{-1} : 1716 (br), 1601, 1273. ^1H -NMR (CDCl_3 , 500 MHz) δ : 0.97 (s, 3H), 1.22-1.42 (m, 8H), 1.58 (s, 3H), 1.68-1.90 (m, 3H), 1.98-2.14 (m, 1H), 2.17 (d, J = 2.5 Hz, 1H), 2.28-2.33 (m, 1H), 2.42 (m, 1H), 2.64-2.75 (m, 2H), 2.93 (d, J = 9.0 Hz, 1H), 3.40 (d, J = 9.0 Hz, 1H), 4.49 (d, J = 12.0 Hz, 1H), 4.58 (d, J = 12.0 Hz, 1H), 5.20 (br s, 1H), 5.65 (d, J = 2.5 Hz, 1H), 7.27-7.36 (m, 5H), 7.42-7.48 (m, 4H), 7.57-7.64 (m, 2H), 8.05-8.09 (m, 4H). MS (FAB) m/z (%): 627 (MNa^+ , 8.5), 105 (100). HRMS (FAB) Calcd for $\text{C}_{40}\text{H}_{44}\text{NaO}_5$ (MNa^+): 627.3086. Found: 627.3086.

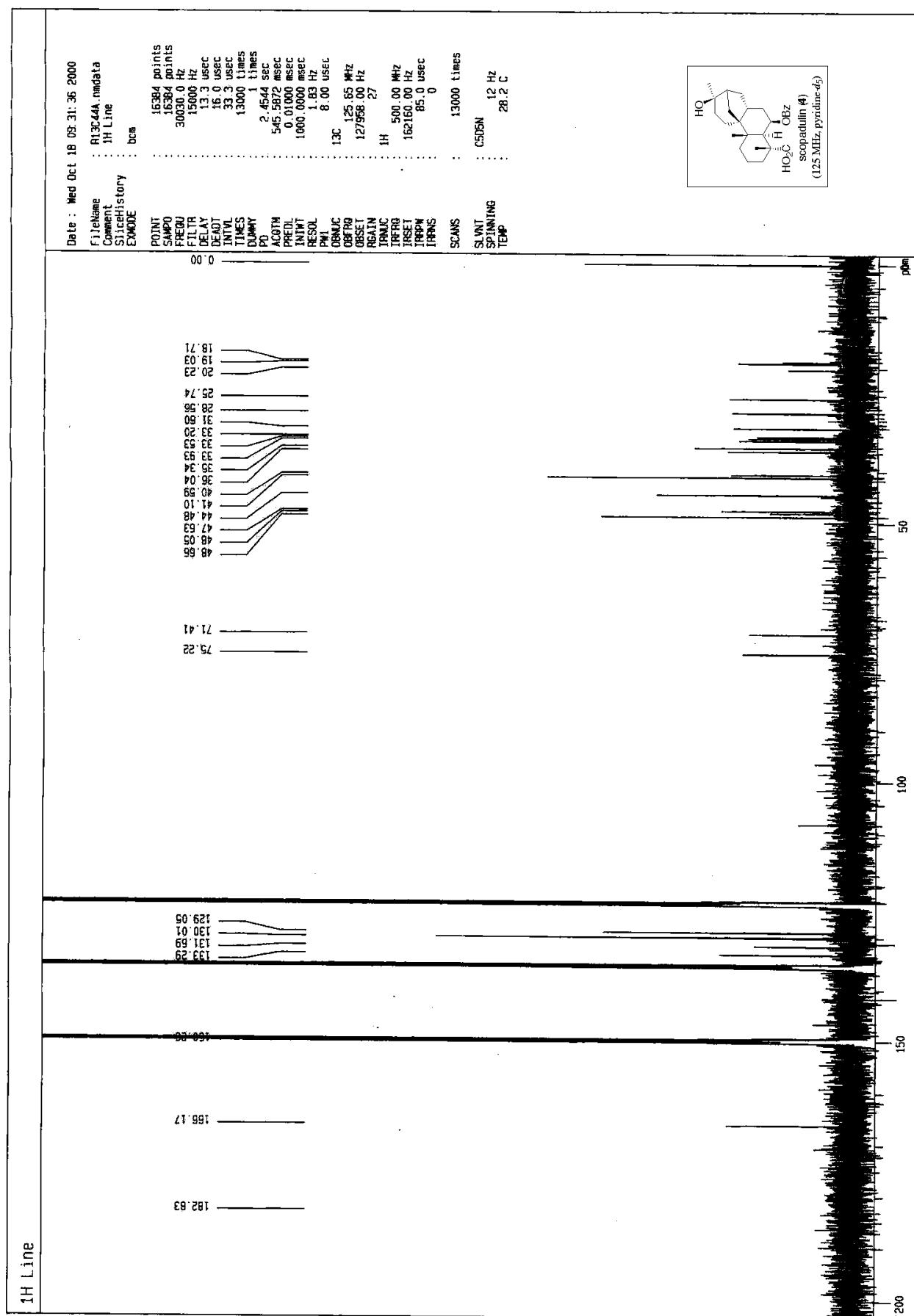
(\pm)-(1*R*,2*R*,6*S*,7*S*,8*S*,10*S*,12*S*)-6-[(Benzylxy)methyl]-2,6-dimethyl-6-[(2-phenylacetyl)oxy]-methyl]-13-[(2-phenylacetyl)oxy]tetracyclo[10.3.1.0^{1,10}.0^{2,7}]hexadec-13-en-8-yl Benzoate (30). Colorless oil: IR (KBr) cm^{-1} : 1724 (br), 1601, 1271. ^1H -NMR (CDCl_3 , 500 MHz) δ : 1.15 (s, 3H), 1.21-1.64 (m, 8H), 1.63 (s, 3H), 1.80-2.00 (m, 2H), 2.08 (d, J = 2.0 Hz, 1H), 2.09-2.16 (m, 1H), 2.30-2.34 (m, 2H), 2.47 (m, 1H), 2.62-2.75 (m, 2H), 4.06 (d, J = 11.5 Hz, 1H), 4.19 (d, J = 11.5 Hz, 1H), 5.20 (br s, 1H), 5.73 (br s, 1H), 7.43-7.49 (m, 6H), 7.56-7.59 (m, 3H), 8.02-8.08 (m, 6H). MS (FAB) m/z (%): 641 (MNa^+ , 22), 176 (100). HRMS (FAB) Calcd for $\text{C}_{40}\text{H}_{42}\text{NaO}_6$ (MNa^+):

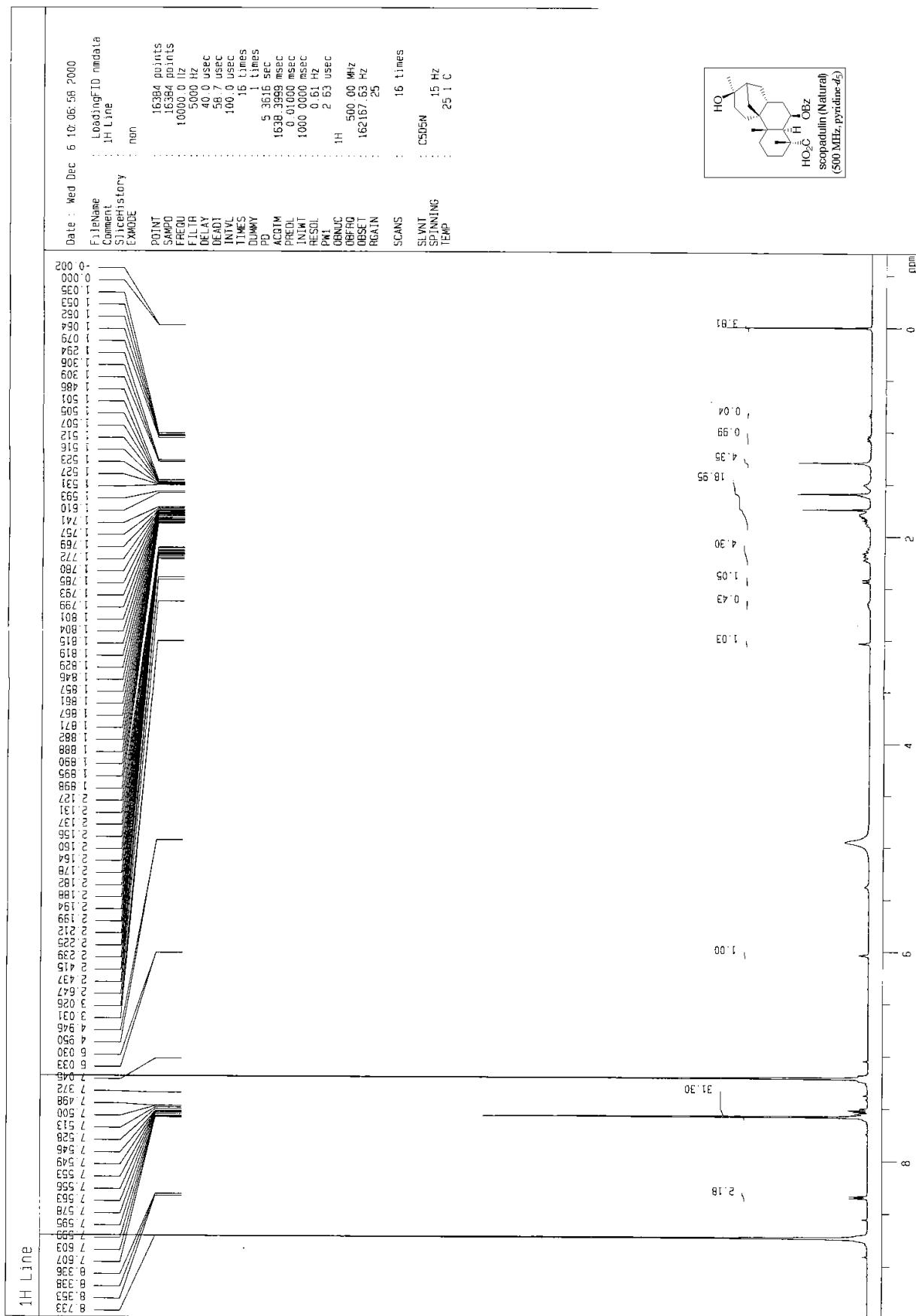
641.2879. Found: 641.2875.

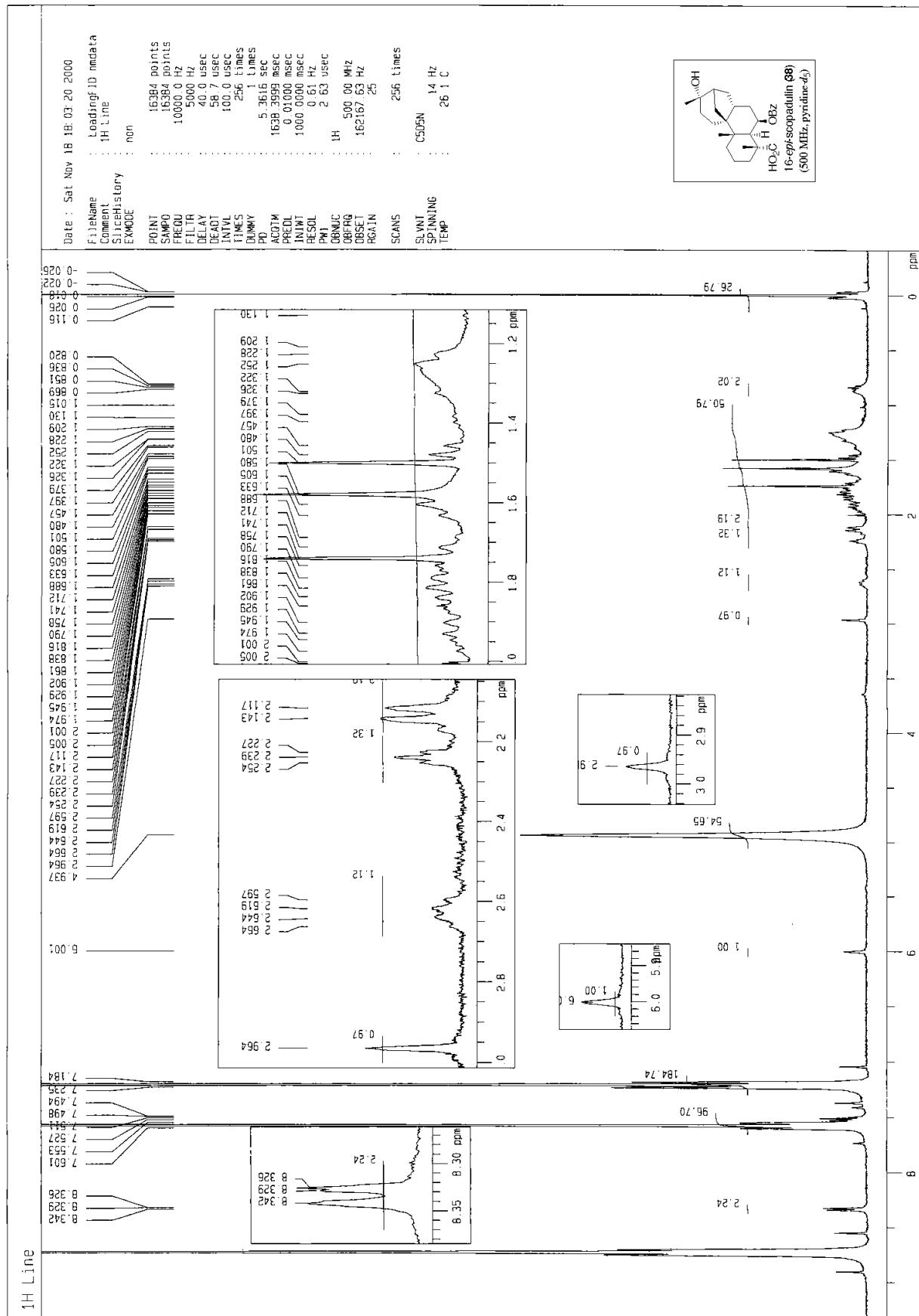
(\pm)-(1*R*,2*R*,6*S*,7*S*,8*S*,10*S*,12*S*)-6-[(Benzylloxy)methyl]-2,6-dimethyl-8-hydroxytetracyclo[10.3.1.0^{1,10}.0^{2,7}]hexadecan-13-one (32). Colorless oil: IR (KBr) cm^{-1} : 3506, 1713, 1603. $^1\text{H-NMR}$ (CDCl_3 , 500 MHz) δ : 1.16-1.28 (m, 4H), 1.23 (s, 3H), 1.34 (s, 3H), 1.43-1.63 (m, 4H), 1.67-1.78 (m, 4H), 1.89-1.98 (m, 3H), 2.09-2.22 (m, 2H), 2.46-2.53 (m, 1H), 2.65-2.73 (m, 2H), 2.99 (d, J = 9.0 Hz, 1H), 3.35 (d, J = 9.0 Hz, 1H), 4.25 (br s, 1H), 4.45 (d, J = 12.0 Hz, 1H), 4.53 (d, J = 12.0 Hz, 1H), 7.27-7.36 (m, 5H). $^{13}\text{C-NMR}$ (CDCl_3 , 125 MHz) δ : 18.6, 18.8, 21.2, 25.3, 29.7, 31.9, 34.4, 35.4, 35.9, 36.2, 36.5, 38.5, 38.8, 40.8, 44.4, 49.2, 68.8, 73.2, 80.5, 127.4 (2C), 127.5, 128.3 (2C), 138.7, 215.3. MS (FAB) m/z (%): 397 (MH^+ , 19), 91 (100). HRMS (FAB) Calcd for $\text{C}_{26}\text{H}_{37}\text{O}_3$ (MH^+): 397.2743. Found: 397.2742.

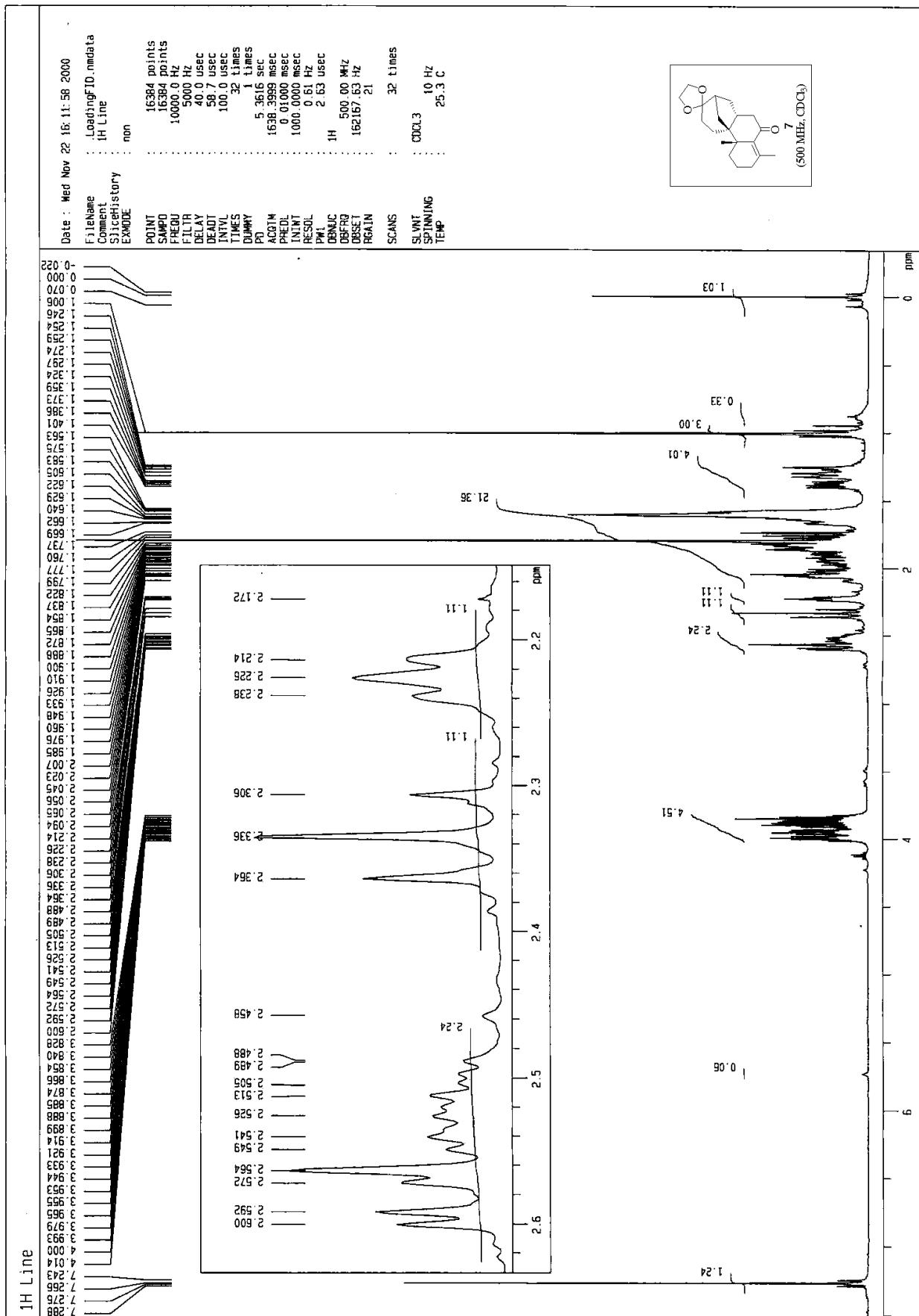
(\pm)-(1*R*,2*R*,6*S*,7*S*,8*S*,10*S*,12*S*)-6-[(Benzylloxy)methyl]-2,6-dimethyl-6-[(2-phenylacetyl)oxy]-methyl}-8-[(2-phenylacetyl)oxy]tetracyclo[10.3.1.0^{1,10}.0^{2,7}]hexadecan-13-one (33). Coarse powder: mp 219-220 °C (*n*-hexane/EtOAc). IR (KBr) cm^{-1} : 1716 (br), 1601. $^1\text{H-NMR}$ (CDCl_3 , 500 MHz) δ : 1.16 (s, 3H), 1.22-1.82 (m, 7H), 1.59 (s, 3H), 1.90-2.15 (m, 8H), 2.23-2.31 (m, 1H), 2.45-2.52 (m, 1H), 2.61-2.71 (m, 2H), 4.04 (d, J = 11.0 Hz, 1H), 4.21 (d, J = 11.0 Hz, 1H), 5.72 (d, J = 2.0 Hz, 1H), 7.44-7.50 (m, 4H), 7.57-7.61 (m, 2H), 8.01 (d, J = 8.5 Hz, 2H), 8.06 (d, J = 7.5 Hz, 2H). $^{13}\text{C-NMR}$ (CDCl_3 , 125 MHz) δ : 18.3, 19.4, 20.2, 24.3, 29.7, 31.3, 32.4, 34.3, 35.7, 36.0, 36.4, 37.9, 38.6, 41.1, 43.5, 48.7, 71.1, 73.0, 128.5 (2C), 128.6 (2C), 129.5 (2C), 129.6 (3C), 130.3, 130.6, 133.1, 165.8, 166.2, 214.3. MS (FAB) m/z (%): 537 (MNa^+ , 22), 176 (100). HRMS (FAB) Calcd for $\text{C}_{33}\text{H}_{38}\text{NaO}_5$ (MNa^+): 537.2617. Found: 537.2615.

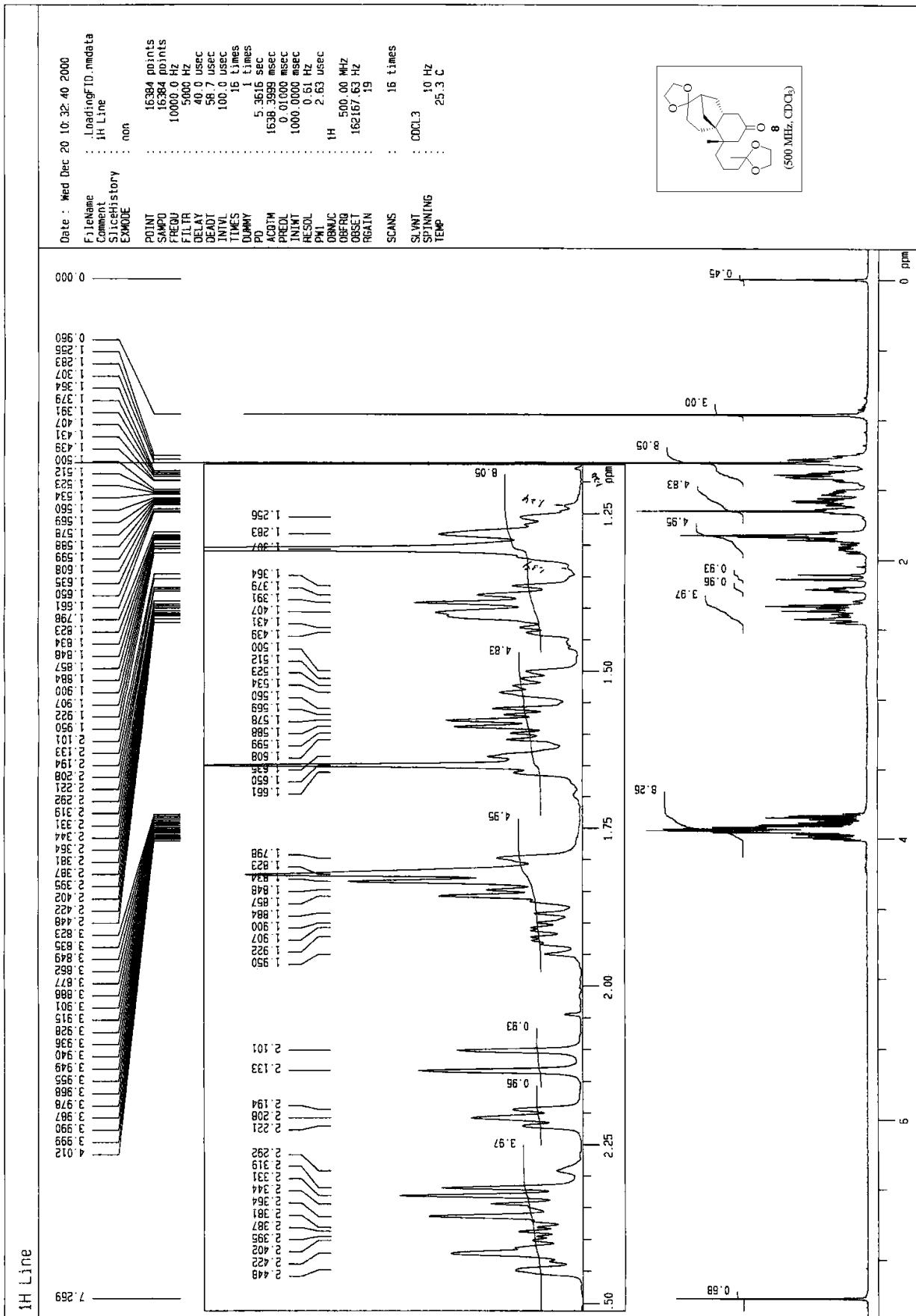


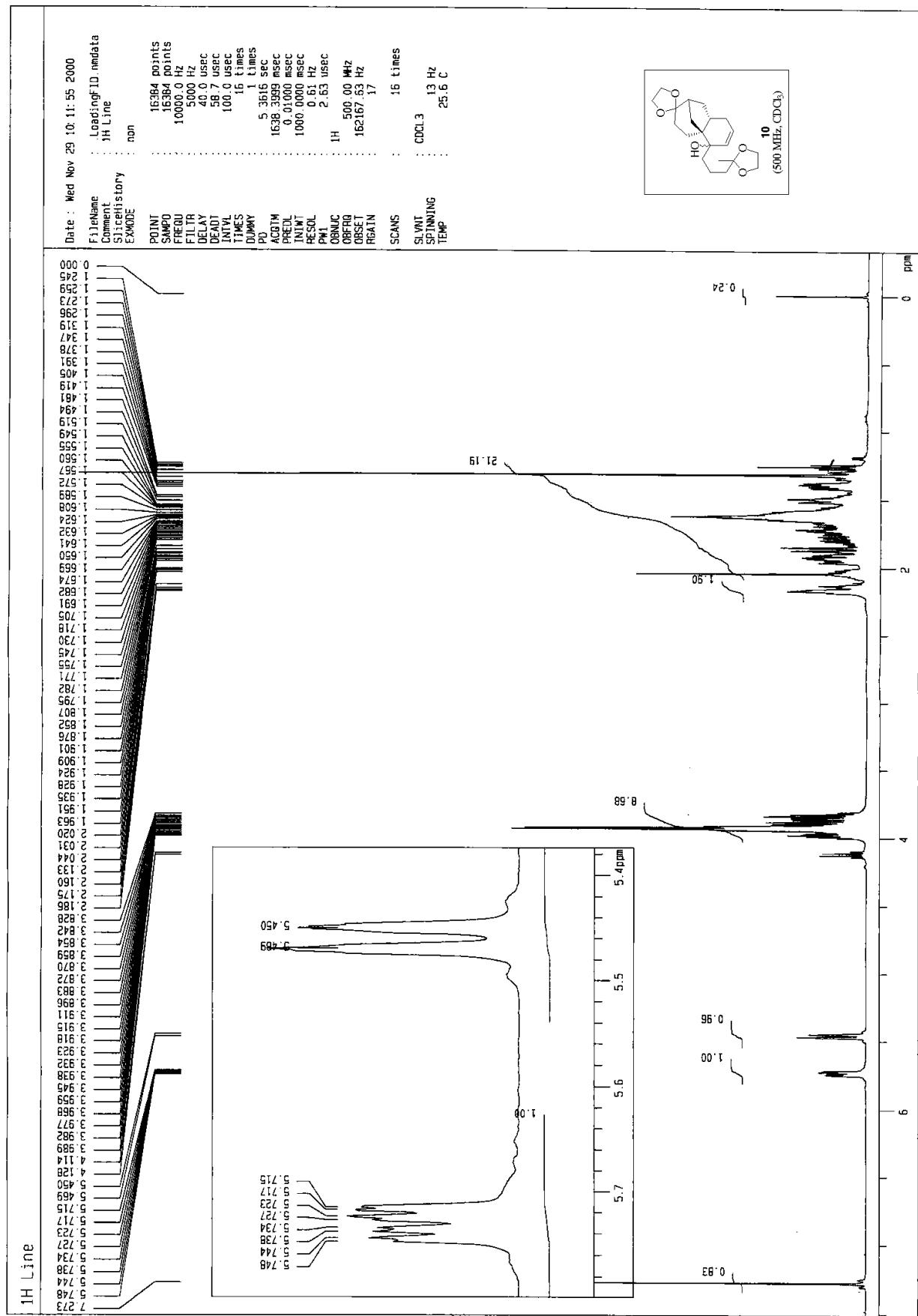


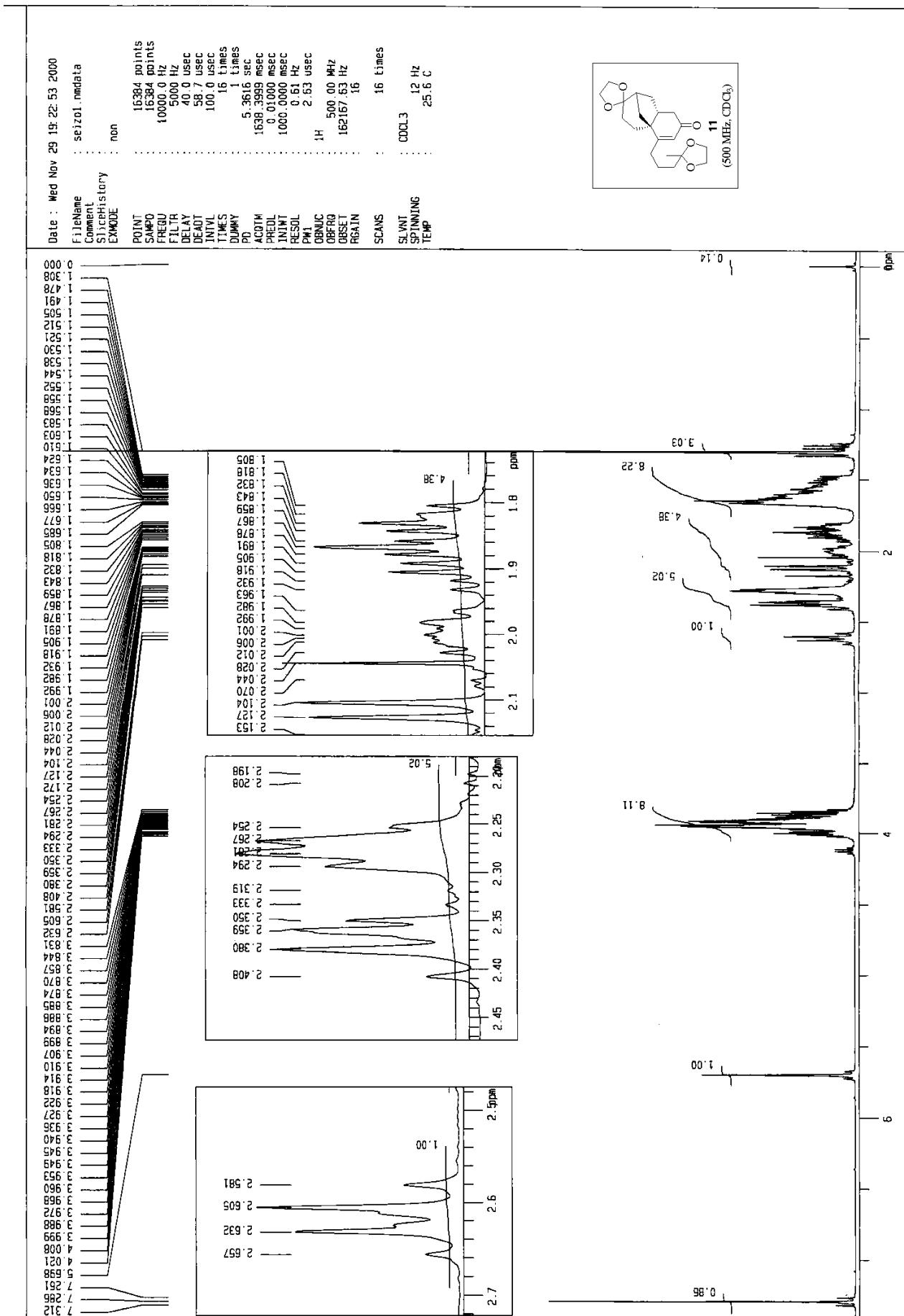




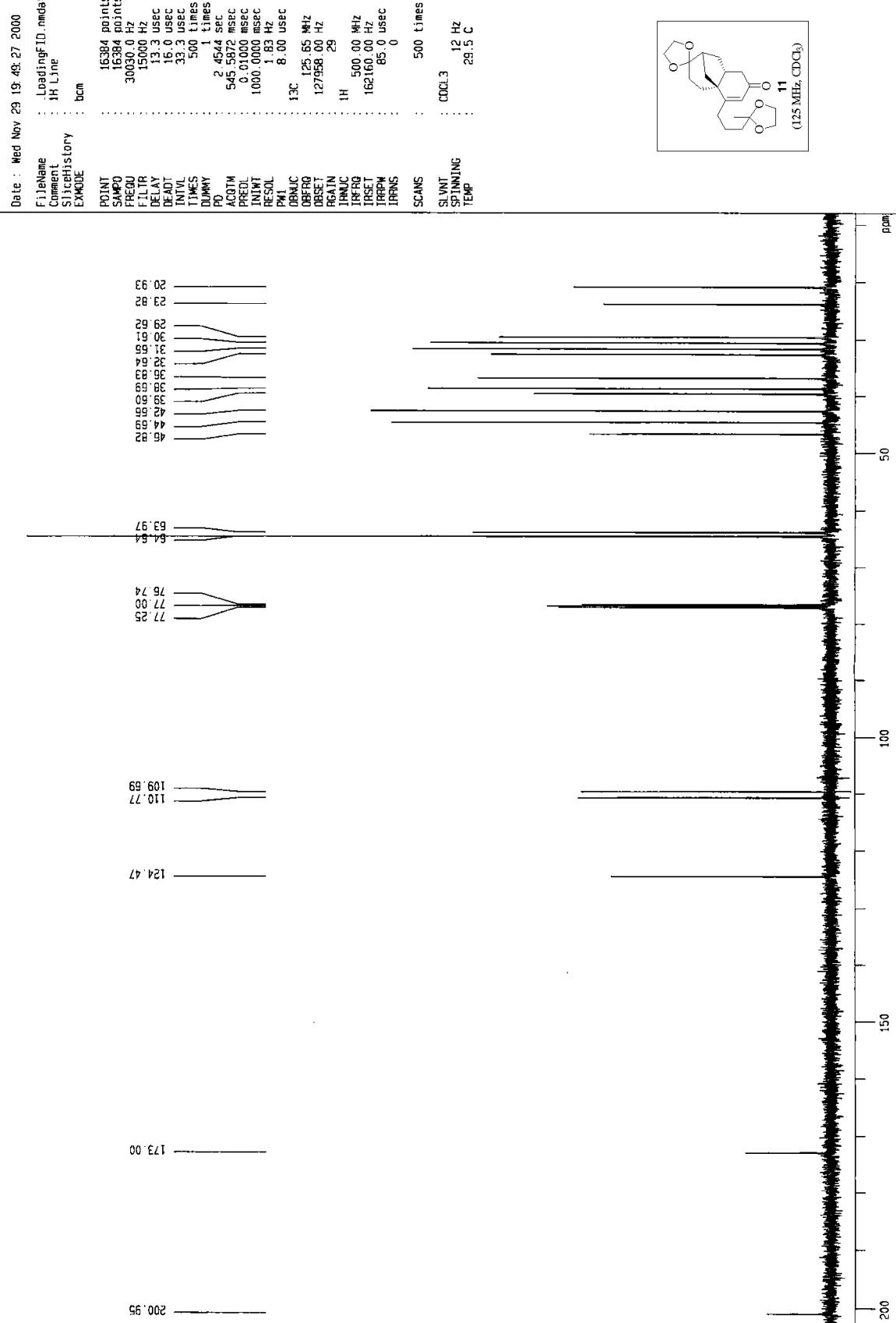


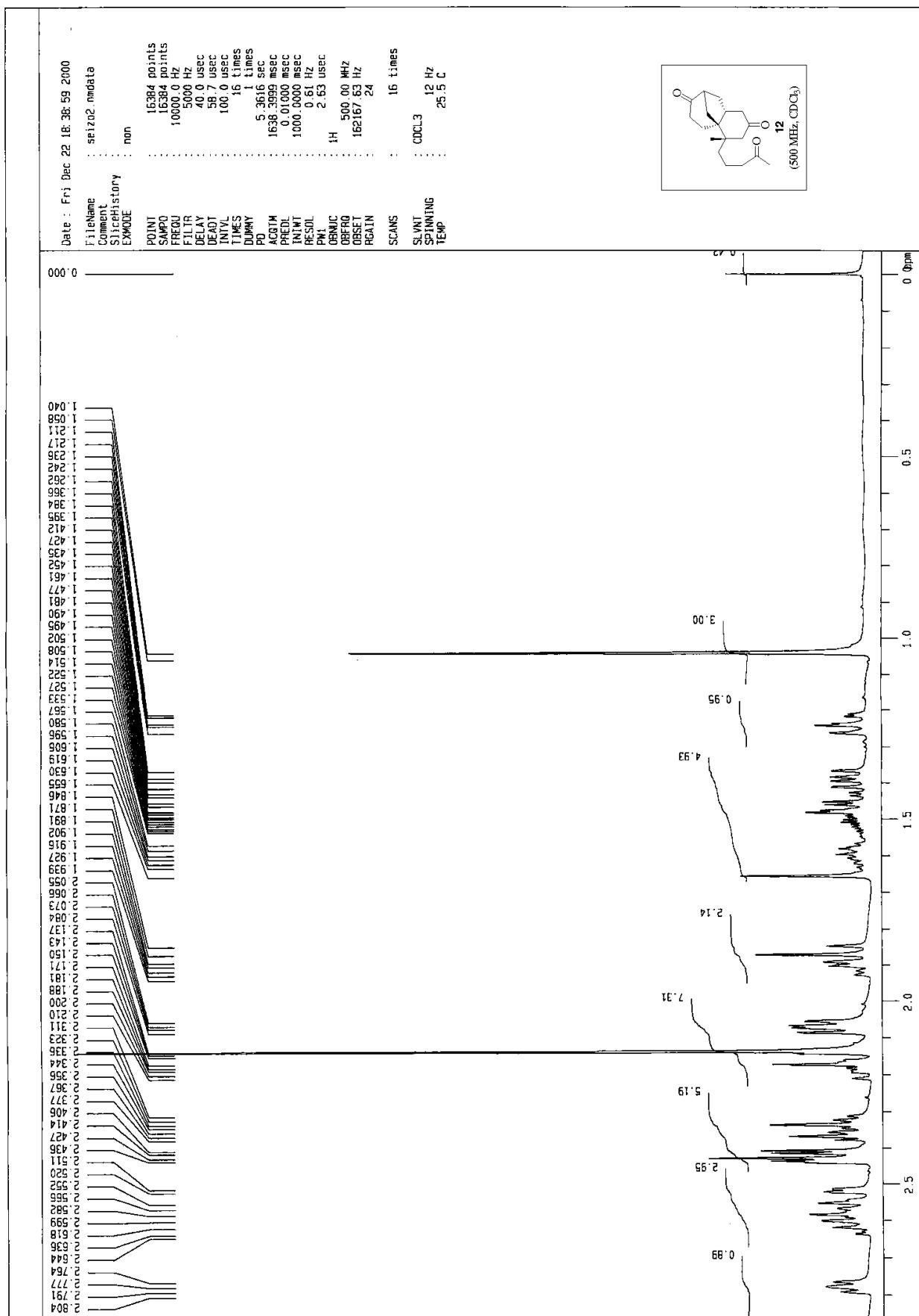


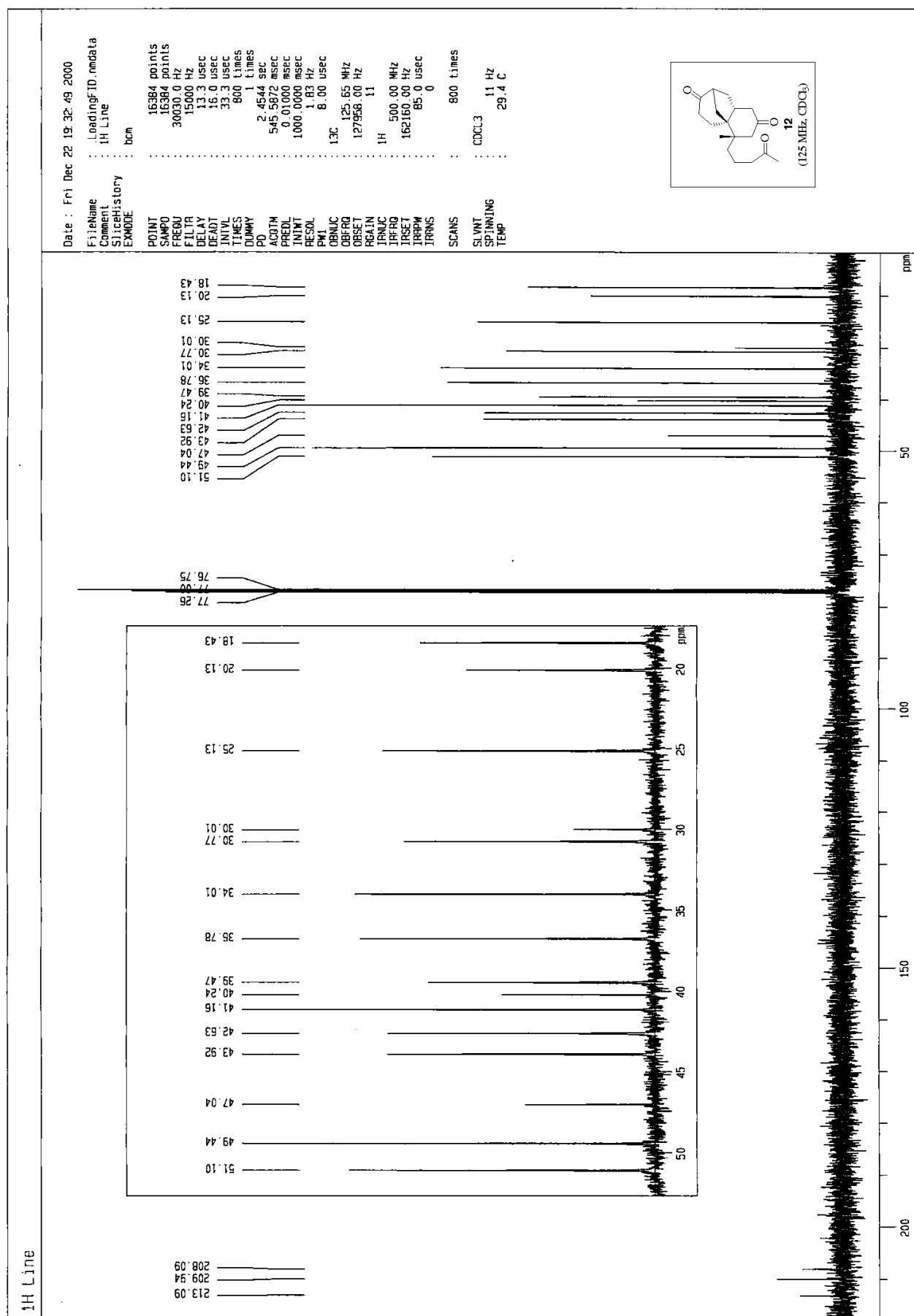


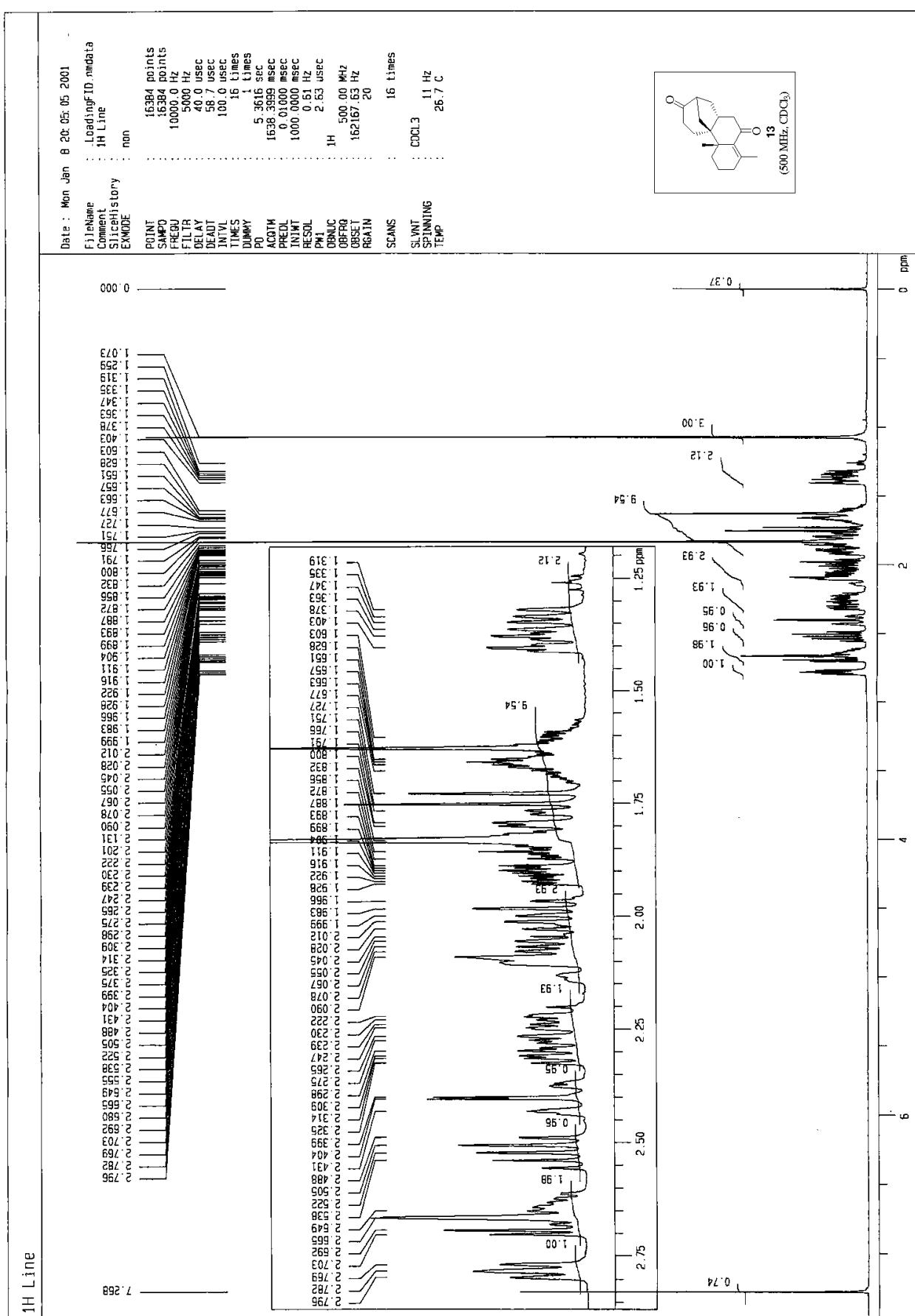


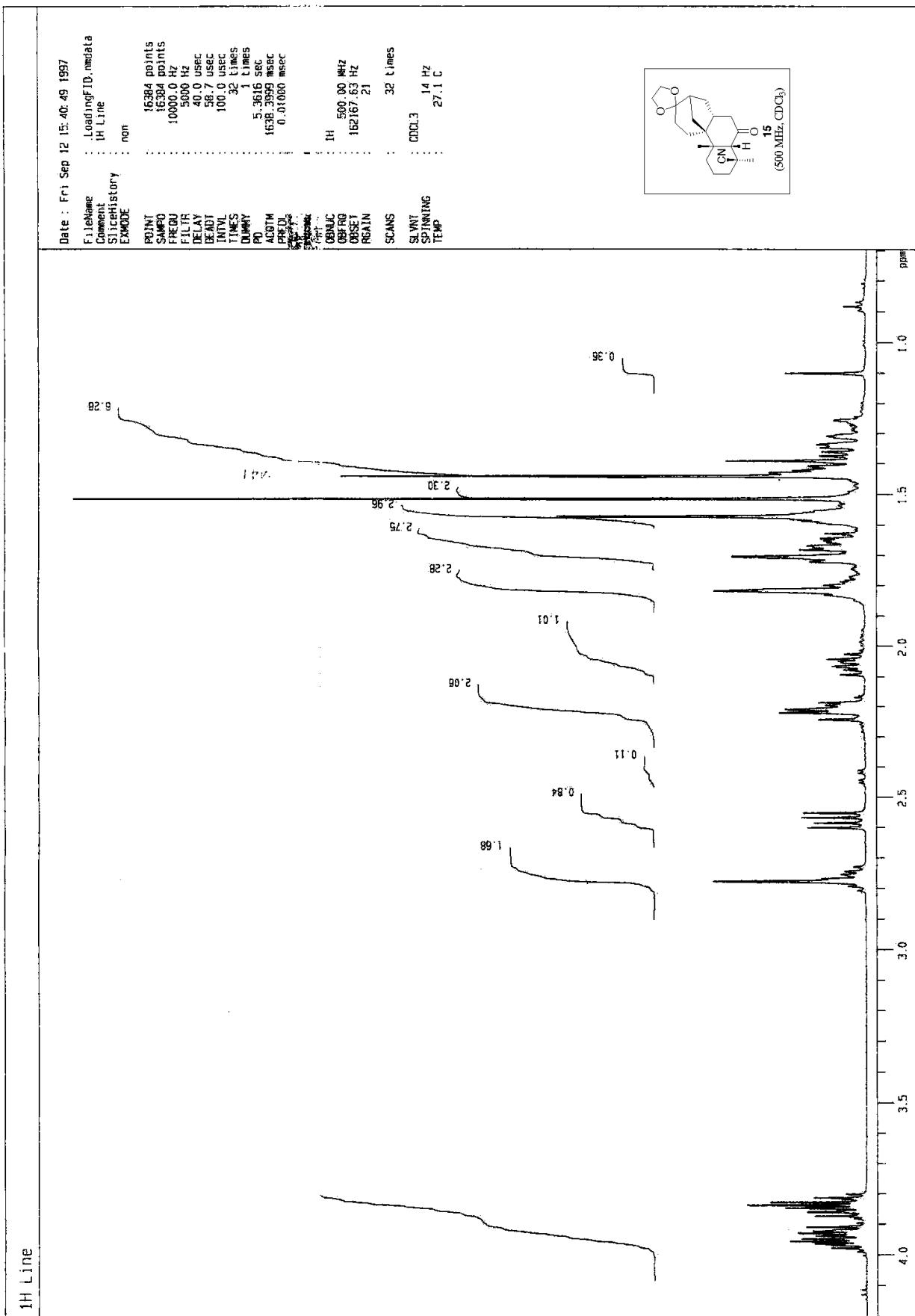
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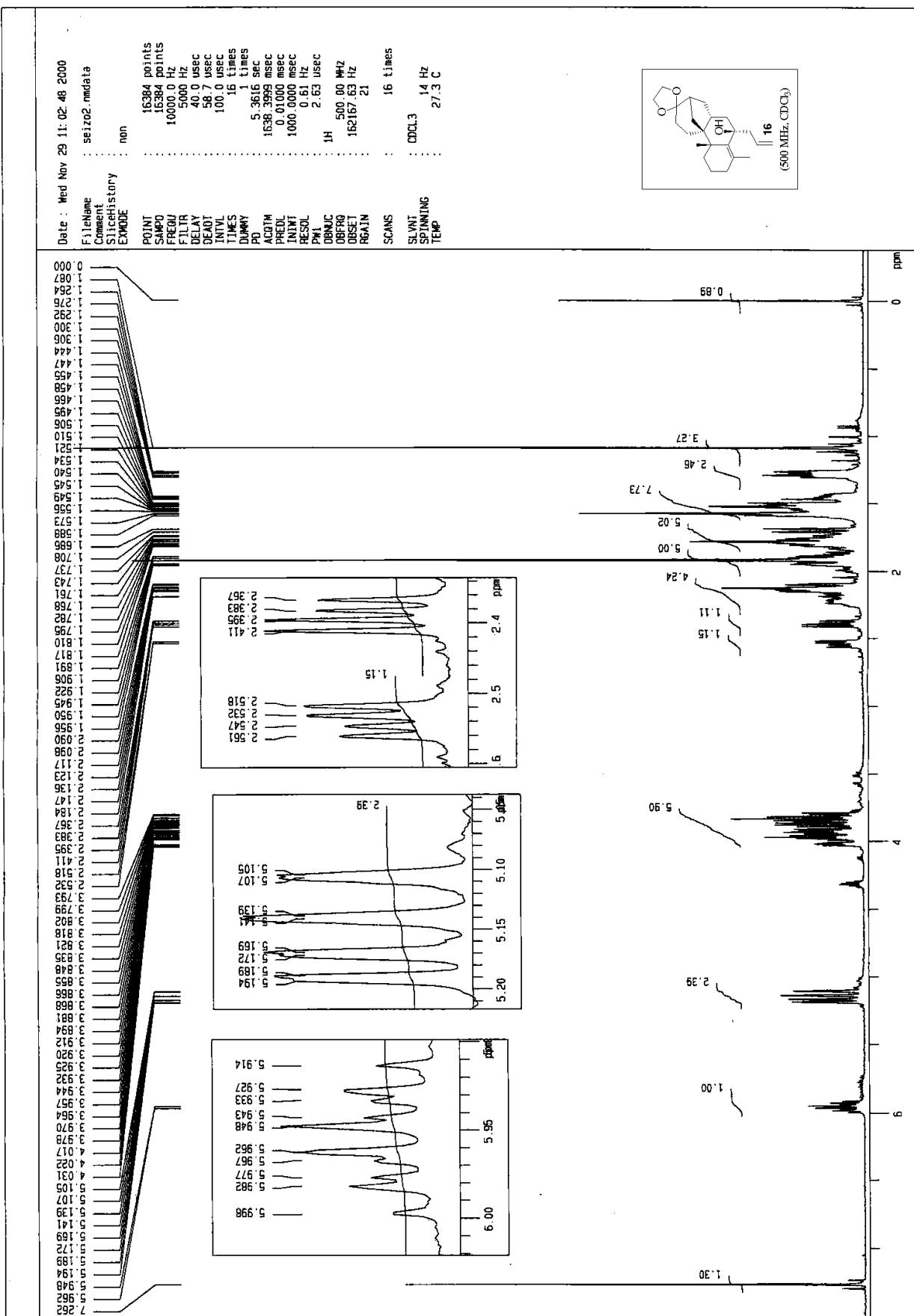


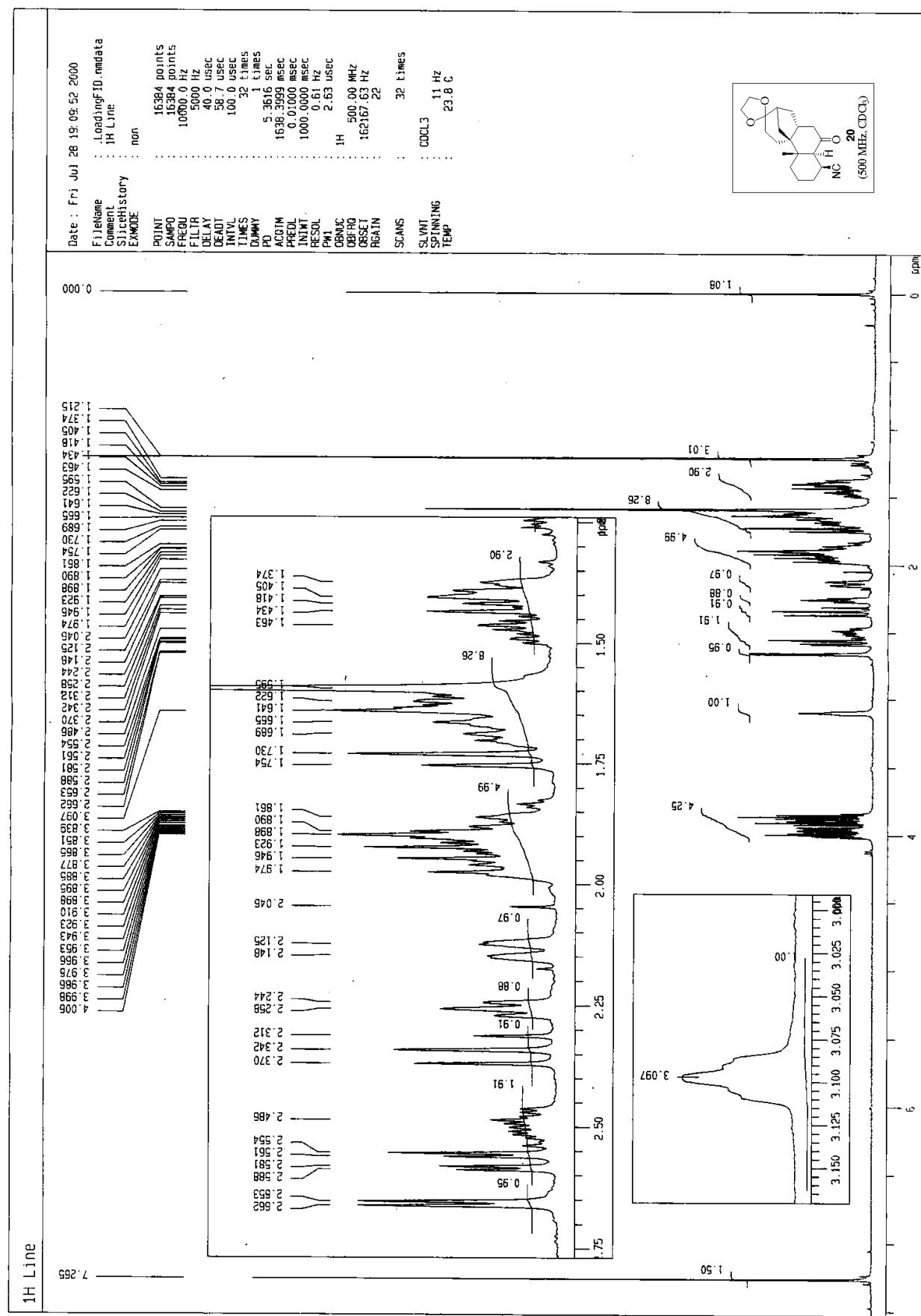


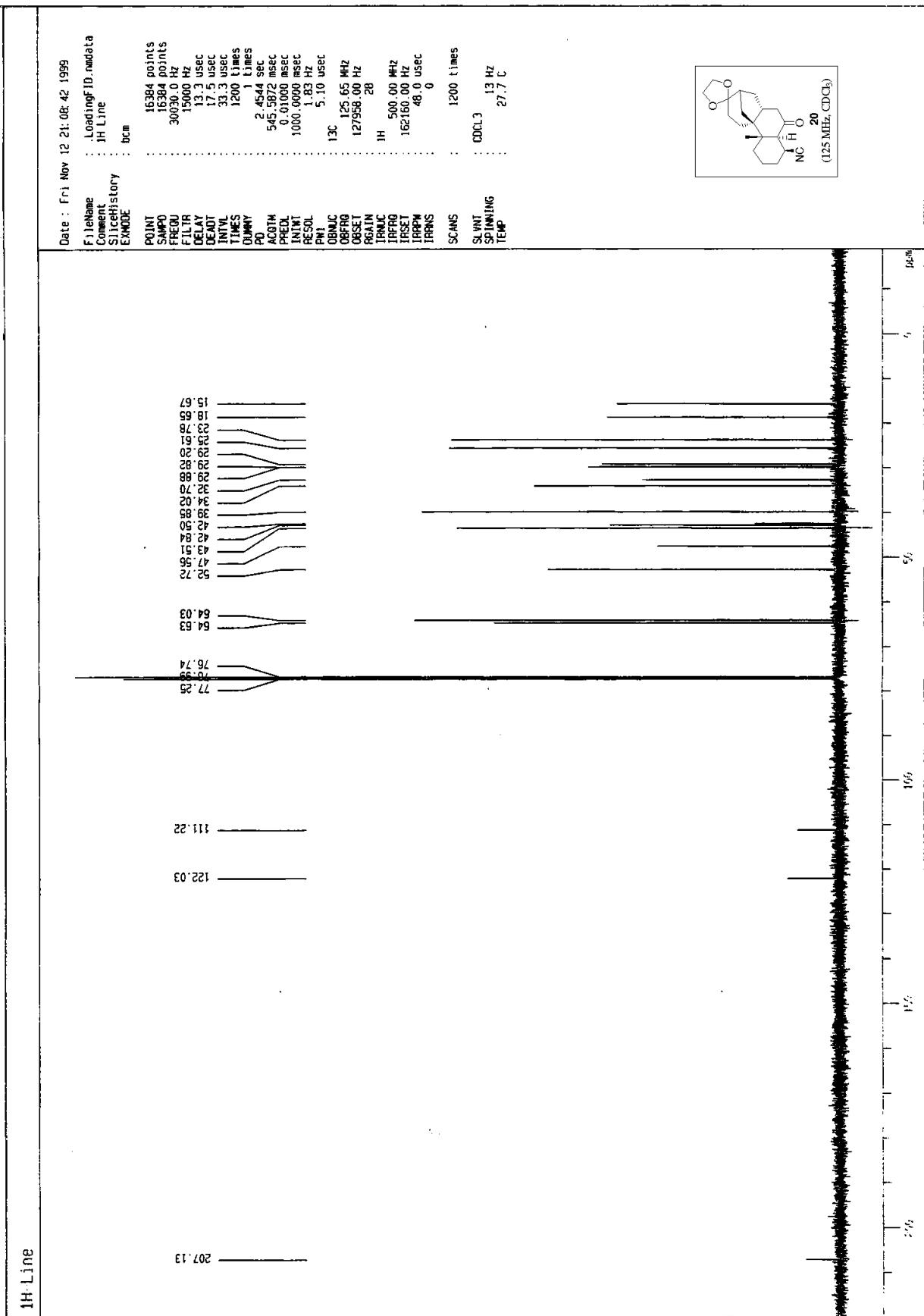


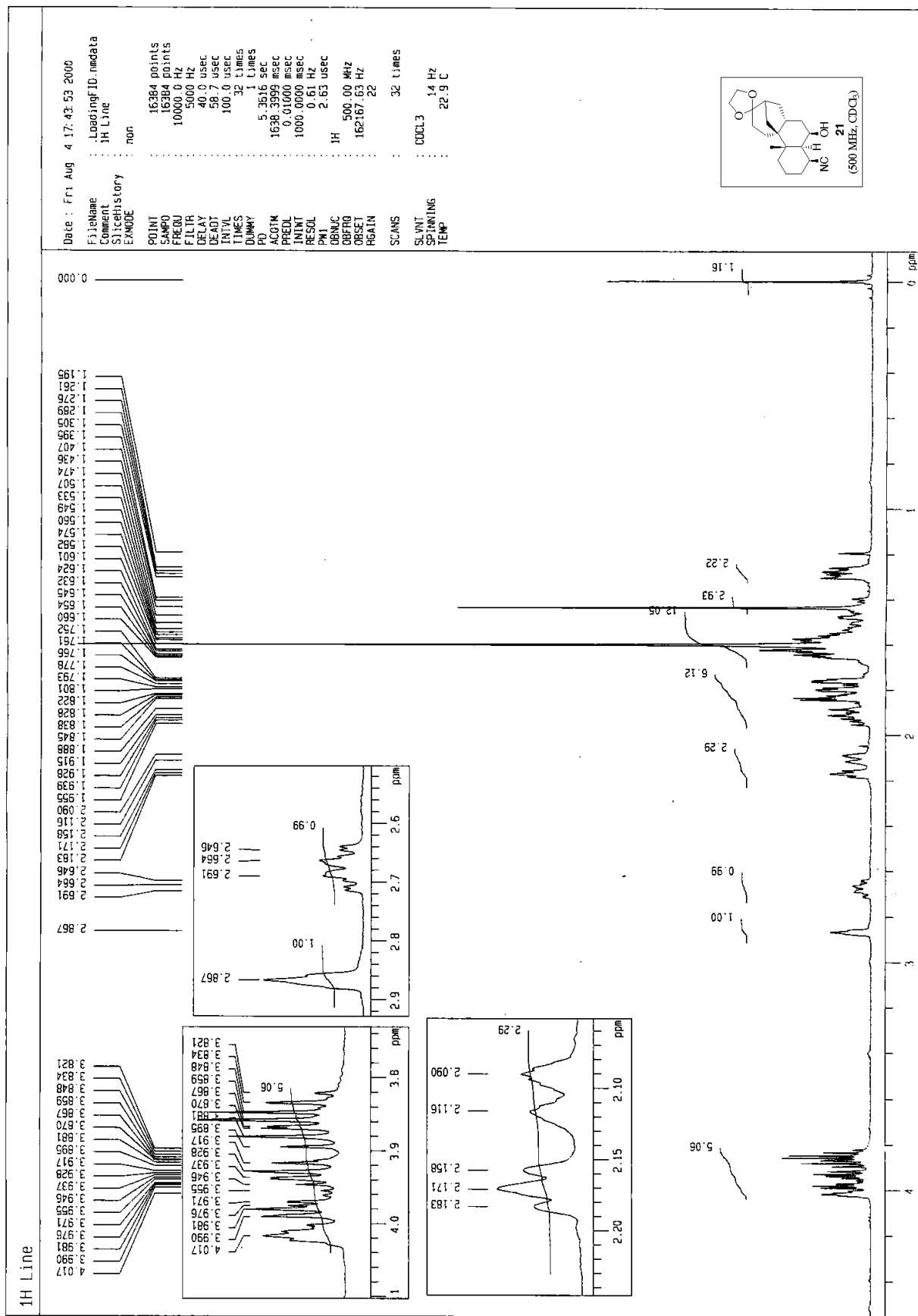


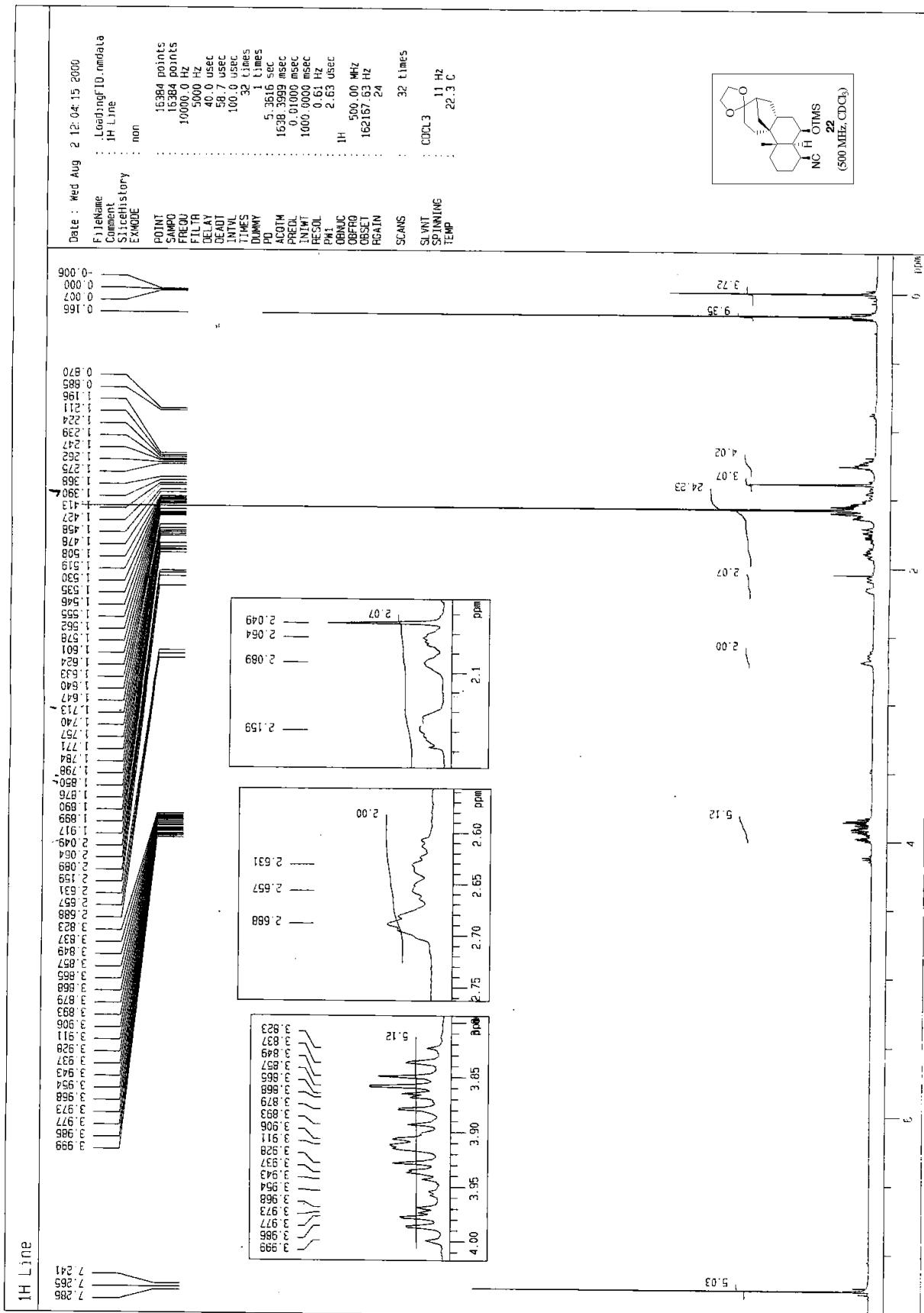


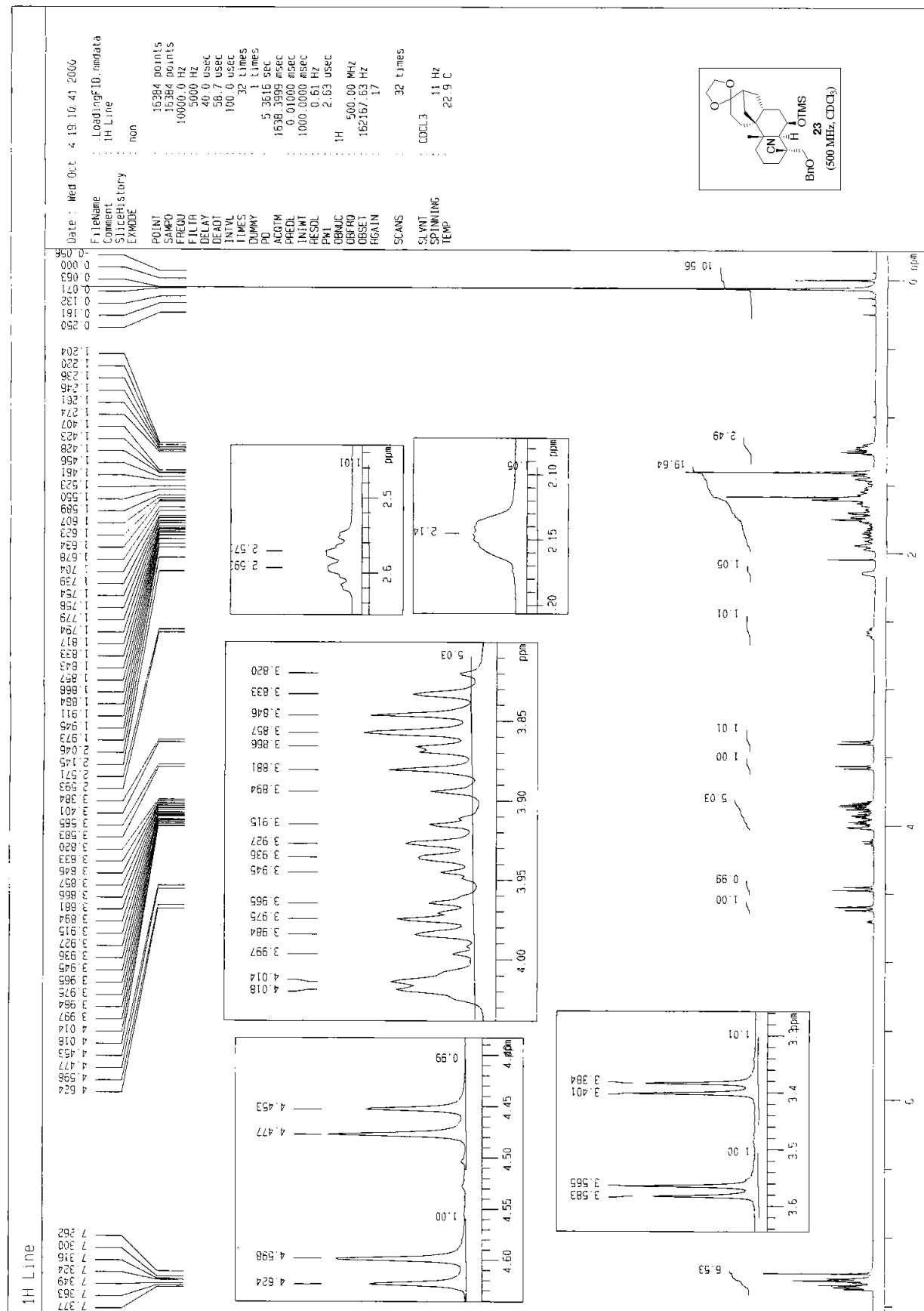




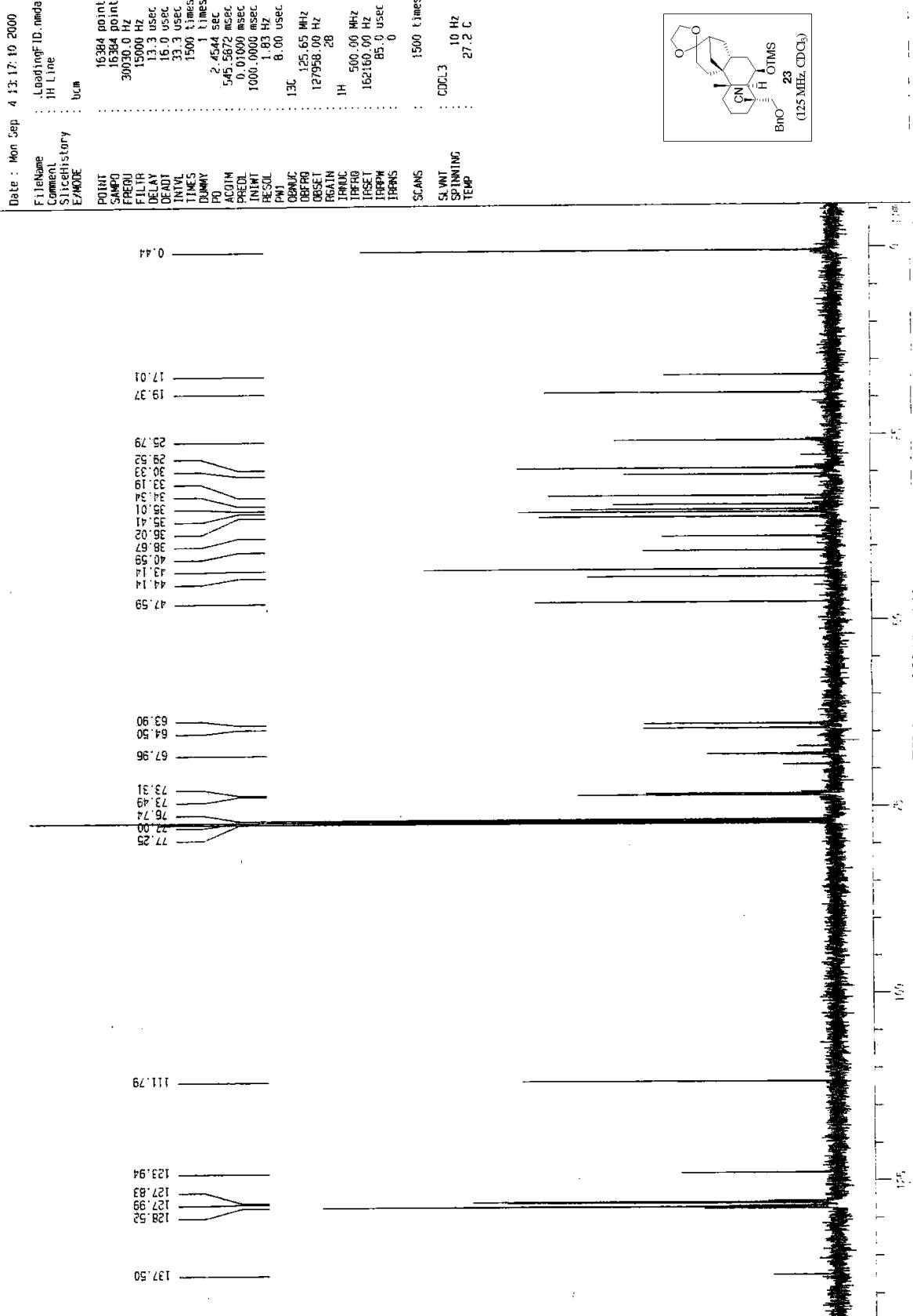




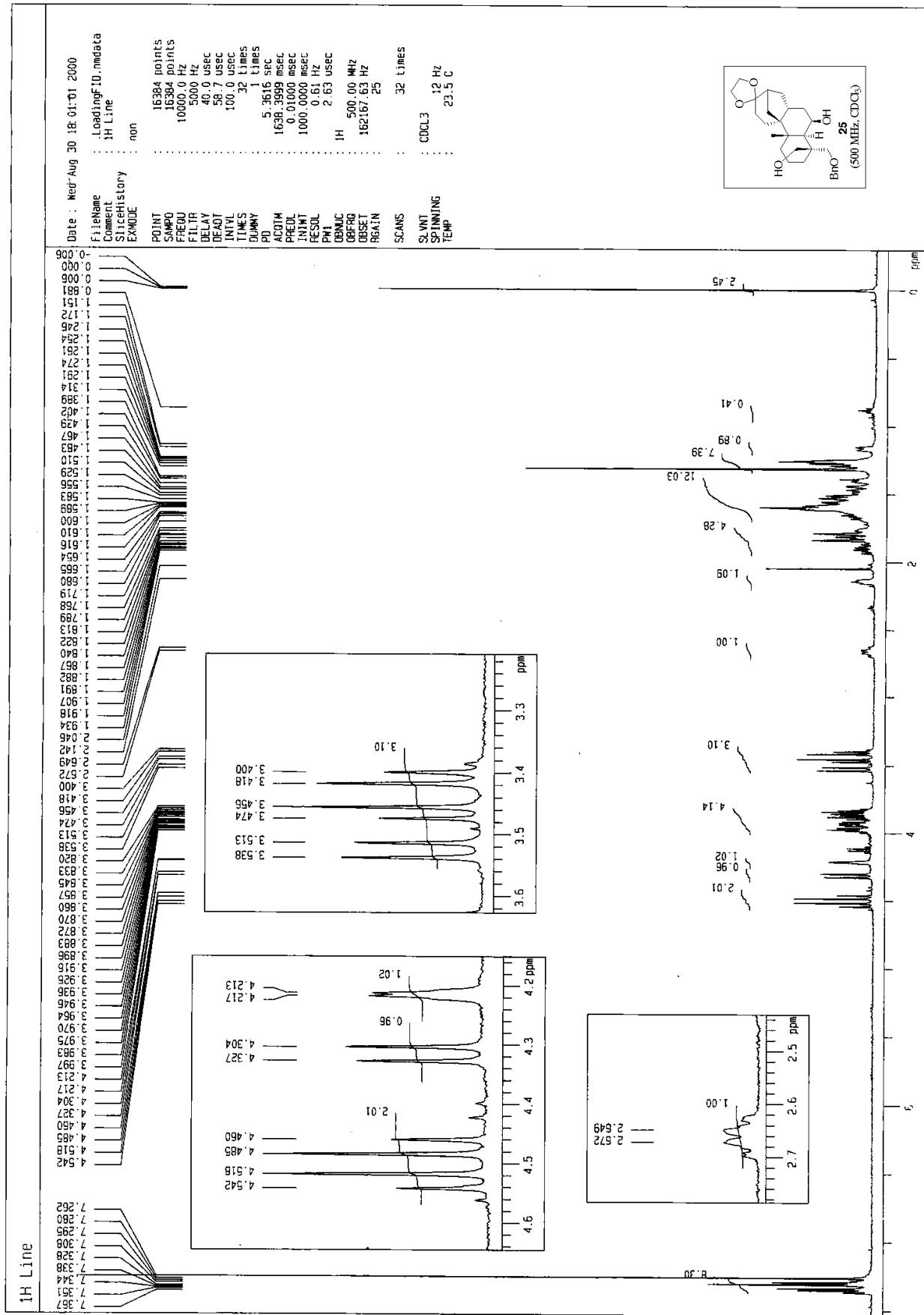




1H Line



1H Line



1H Line

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DEAD1	16.0 usec
INTVL	33.3 usec
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THINNITY	1 times
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