

Supplementary Data

***O*-Aminoalkyl-*O*-Trimethyl-2,3-Dehydrosilybins: Synthesis and *in vitro* Effects toward Prostate Cancer Cells**

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7-*O*-(*N,N*-Diethylaminopropyl)-3,5,20-*O*-trimethyl-2,3-dehydrosilybin (**10**). 29% yield, yellow solid, m.p. 107-109 °C. IR (film) ν_{\max} : 3419, 3182, 2981, 2844, 1624, 1602 cm^{-1} ; ^1H NMR (300 MHz, CD_3OD): δ 7.59-7.48 (overlapped, 1H, H-15), 7.51 (s, 1H, H-13), 7.03 (s, 1H, H-18), 7.00-6.94 (overlapped, 2H, H-16 and H-22), 6.93 (d, $J = 8.4$ Hz, 1H, H-21), 6.36 (s, 1H, H-8), 6.23 (s, 1H, H-6), 4.89-4.86 (overlapped, 1H, H-11), 4.09-3.92 (overlapped, 3H, H-10 & 7- OCH_2), 3.84 (s, 3H, OCH_3), 3.83 (s, 3H, OCH_3), 3.78 (s, 3H, OCH_3), 3.75 (s, 3H, OCH_3), 3.69 (dd, $J = 12.9, 2.4$ Hz, 1H, H-23), 3.43 (dd, $J = 12.3, 3.9$ Hz, 1H, H-23), 2.74 (t, $J = 7.5$ Hz, 2H, 7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 2.70 (t, $J = 7.2$ Hz, 2H, NCH_2), 2.67 (t, $J = 7.2$ Hz, 2H, NCH_2), 2.02-1.86 (m, 2H, 7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 1.10 (t, $J = 7.2$ Hz, 6H, 2 \times NCH_2CH_3); ^{13}C NMR (75 MHz, CD_3OD): δ 175.5 (C-4), 165.0 (C-7), 161.7 (C-5), 159.7 (C-8a), 153.9 (C-19), 151.1 (C-20), 150.6 (C-16a), 147.2 (C-2), 145.0 (C-12a), 141.9 (C-3), 130.3 (C-17), 124.4 (C-14), 123.0 (C-15), 121.6 (C-22), 118.1 (C-16), 117.9 (C-13), 112.8 (C-21), 112.3 (C-18), 109.6 (C-4a), 97.0 (C-6), 94.1 (C-8), 80.3 (C-10), 77.5 (C-11), 67.9 (7- OCH_2), 61.9 (C-23), 60.2 (OCH_3), 56.6 (OCH_3), 56.5 (OCH_3), 56.4 (OCH_3), 50.3 (NCH_2), 47.9 (7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 26.5 (7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 11.0 (NCH_2CH_3); HRMS-ESI m/z [$\text{M}+\text{H}$] $^+$ calcd for $\text{C}_{35}\text{H}_{42}\text{NO}_{10}$: 636.2808, found: 636.2801.

7-*O*-(*N,N*-Dibutylaminopropyl)-3,5,20-*O*-trimethyl-2,3-dehydrosilybin (**11**). 25% yield, yellow solid, mp. 69-71 °C. IR (film) ν_{\max} : 3404, 2930, 2871, 1625, 1602, 1505 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.75 (d, $J = 1.8$ Hz, 1H, H-13), 7.72 (dd, $J = 8.4, 2.1$ Hz, 1H, H-15), 7.04 (d, $J = 8.4$ Hz, 1H, H-16), 7.03 (dd, $J = 8.1, 1.8$ Hz, 1H, H-22), 6.97 (d, $J = 1.8$ Hz, 1H, H-18), 6.92 (d, $J = 8.4$ Hz, 1H, H-21), 6.46 (d, $J = 2.1$ Hz, 1H, H-8), 6.31 (d, $J = 2.1$ Hz, 1H, H-6), 5.02 (d, $J = 8.4$ Hz, 1H, H-11), 4.13 (dt, $J = 8.1, 2.7$ Hz, 1H, H-10), 4.08 (t, $J = 6.3$ Hz, 2H, 7- OCH_2), 3.94 (s, 3H, OCH_3), 3.92 (s, 3H, OCH_3), 3.91 (s, 3H, OCH_3), 3.88 (s, 3H, OCH_3), 3.84 (dd, $J = 12.6, 2.7$ Hz, 1H, H-23), 3.57 (dd, $J = 12.3, 3.6$ Hz, 1H, H-23), 2.66 (t, $J = 6.3$ Hz, 2H, 7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 2.49 (t, $J = 7.2$ Hz, 4H, 2 \times NCH_2), 1.98 (quin, $J = 6.3$ Hz, 2H, 7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 1.50-1.40 (m, 4H, 2 \times $\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$), 1.36-1.24 (m, 4H, 2 \times $\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$), 0.89 (t, $J = 7.2$ Hz, 6H, 2 \times $\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$); ^{13}C NMR (75 MHz, CDCl_3): δ 174.2 (C-4), 163.4 (C-7), 161.1 (C-5), 158.8 (C-8a), 152.0 (C-19), 149.9 (C-20), 149.6 (C-16a), 145.3 (C-2), 143.8 (C-12a), 141.5 (C-3), 128.5 (C-17), 124.4 (C-14), 122.3 (C-15), 120.3 (C-22), 117.3 (C-16), 117.2 (C-13), 111.5 (C-21), 110.3 (C-18), 109.5 (C-4a), 96.1 (C-6), 93.0 (C-8), 78.8 (C-10), 76.4 (C-11), 66.8 (7- OCH_2), 61.7 (C-23), 60.0 (OCH_3), 56.5 (OCH_3), 56.2 (OCH_3), 56.1 (OCH_3), 53.9 (NCH_2), 50.5 (7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 28.9 ($\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$), 26.7 (7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 20.8 ($\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$), 14.2 ($\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$); HRMS-ESI m/z [$\text{M}+\text{H}$] $^+$ calcd for $\text{C}_{39}\text{H}_{50}\text{NO}_{10}$: 692.3434, found: 692.3431.

7-*O*-Pyrrolidinopropyl-3,5,20-*O*-trimethyl-2,3-dehydrosilybin (**12**). 29% yield, yellow solid, mp. 111-113 °C. IR (film) ν_{\max} : 3415, 2933, 1625, 1605, 1578, 1506 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.74 (d, $J = 1.8$ Hz, 1H, H-13), 7.71 (dd, $J = 8.7, 2.1$ Hz, 1H, H-15), 7.03 (d, $J = 8.7$ Hz, 2H, H-16 & H-22), 6.97 (d, $J = 1.5$ Hz, 1H, H-18), 6.91 (d, $J = 8.1$ Hz, 1H, H-21), 6.46 (d, $J = 2.1$ Hz, 1H, H-8), 6.31 (d, $J = 2.1$ Hz, 1H, H-6), 5.01 (d, $J = 8.1$ Hz, 1H, H-11), 4.16-4.12 (m, 1H, H-10), 4.09 (t, $J = 6.3$ Hz, 2H, 7- OCH_2), 3.94 (s, 3H, OCH_3), 3.92 (s, 3H, OCH_3), 3.90 (s, 3H, OCH_3), 3.88 (s, 3H, OCH_3), 3.84 (dd, $J = 12.9, 2.4$ Hz, 1H, H-23), 3.56 (dd, $J = 12.6, 3.9$ Hz, 1H, H-23), 2.71 (t, $J = 7.2$ Hz, 2H, 7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 2.67-2.57 (m, 4H, 2 \times pyrrolidino- CH_2), 2.07 (quin, $J = 6.0$ Hz, 2H, 7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 1.88-1.79 (m, 4H, 2 \times pyrrolidino- CH_2); ^{13}C NMR (75 MHz, CDCl_3): δ 174.2 (C-4), 163.3 (C-7), 161.0 (C-5), 158.8 (C-8a), 152.1 (C-19), 149.9 (C-20), 149.6 (C-16a), 145.3 (C-2), 143.8 (C-12a), 141.4 (C-3), 128.5 (C-17), 124.3 (C-14), 122.2 (C-15), 120.3 (C-22), 117.3 (C-16), 117.2 (C-13), 111.4 (C-21), 110.2 (C-18), 109.5 (C-4a), 96.1 (C-6), 93.0 (C-8), 78.8 (C-10), 76.4 (C-11), 66.7 (7- OCH_2), 61.7 (C-23), 60.0 (OCH_3), 56.5 (OCH_3), 56.2 (OCH_3), 56.1 (OCH_3), 54.3 (NCH_2), 53.0 (pyrrolidino- CH_2), 28.0 (7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -), 23.6 (pyrrolidino- CH_2); HRMS-ESI m/z [$\text{M}+\text{H}$] $^+$ calcd for $\text{C}_{35}\text{H}_{40}\text{NO}_{10}$: 634.2652, found: 634.2650.

7-*O*-Mopholinopropyl-3,5,20-*O*-trimethyl-2,3-dehydrosilybin (**13**). 19% yield, yellow solid. mp. 132-133 °C. IR (film) ν_{\max} : 3406, 2932, 1625, 1606, 1506, 1464, 1443 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.73 (s, 1H, H-13), 7.72 (d, $J = 10.8$ Hz, 1H, H-15), 7.03 (d, $J = 8.4$ Hz, 2H, H-16 & H-22), 6.97 (s, 1H, H-18), 6.91 (d, $J = 8.1$ Hz, 1H, H-21), 6.44 (s, 1H, H-8), 6.29 (s, 1H, H-6), 5.02 (d, $J = 8.1$ Hz, 1H, H-11), 4.18-4.04 (overlapped, 3H, H-10 & 7- OCH_2), 3.93 (s, 3H, OCH_3), 3.91 (s, 3H, OCH_3), 3.90 (s, 3H, OCH_3), 3.87 (s, 3H, OCH_3), 3.87-3.76 (overlapped, 4H, 2 \times OCH_2 from mopholino), 3.57 (dd, $J = 12.3, 3.3$ Hz, 1H, H-23), 3.06-2.99 (m, 1H, H-23), 2.79-2.57 (overlapped, 6H, 3 \times NCH_2), 2.18-2.05 (overlapped, 2H, 7- $\text{O-CH}_2\text{CH}_2\text{CH}_2$ -); ^{13}C NMR (75 MHz, CDCl_3): δ 174.2 (C-4), 163.2 (C-7), 161.0 (C-

5), 158.8 (C-8a), 152.1 (C-19), 149.9 (C-20), 149.6 (C-16a), 145.3 (C-2), 143.8 (C-12a), 141.4 (C-3), 128.4 (C-17), 124.3 (C-14), 122.2 (C-15), 120.3 (C-22), 117.23 (C-16), 117.17 (C-13), 111.4 (C-21), 110.2 (C-18), 109.5 (C-4a), 96.1 (C-6), 92.9 (C-8), 78.8 (C-10), 76.4 (C-11), 66.4 (7-OCH₂), 66.2 OCH₂ from morpholino), 61.7 (C-23), 60.0 (OCH₃), 56.5 (OCH₃), 56.2 (OCH₃), 56.1 (OCH₃), 55.4 (NCH₂), 53.4 (NCH₂), 42.3 (7-O-CH₂CH₂CH₂-); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₅H₄₀NO₁₁: 650.2601, found: 650.2598.

7-*O*-(4-Methylpiperazin-1-yl)propyl-3,5,20-*O*-trimethyl-2,3-dehydrosilybin (**14**). 10% yield, light yellow solid. Mp. 142-143 °C. IR (film) ν_{\max} : 3406, 2917, 2850, 1625, 1604, 1505 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.77-7.71 (overlapped, 2H, H-13 & H-15), 7.06 (d, *J* = 9.0 Hz, 1H, H-16), 7.04 (dd, *J* = 10.8, 1.5 Hz, 1H, H-22), 6.97 (d, *J* = 1.5 Hz, 1H, H-18), 6.92 (d, *J* = 8.4 Hz, 1H, H-21), 6.44 (d, *J* = 2.1 Hz, 1H, H-8), 6.30 (d, *J* = 1.8 Hz, 1H, H-6), 5.02 (d, *J* = 8.4 Hz, 1H, H-11), 4.17-4.01 (m, 1H, H-10), 4.06 (t, *J* = 6.0 Hz, 2H, 7-OCH₂), 3.94 (s, 3H, OCH₃), 3.92 (s, 3H, OCH₃), 3.91 (s, 3H, OCH₃), 3.89 (s, 3H, OCH₃), 3.85 (dd, *J* = 12.3, 2.1 Hz, 1H, H-23), 3.57 (dd, *J* = 12.6, 3.9 Hz, 1H, H-23), 2.95-2.72 (overlapped, 8H, 4 × NCH₂ from piperazin), 2.67 (t, *J* = 7.2 Hz, 2H, NCH₂), 2.55 (s, 3H, NCH₃), 2.07-2.02 (m, 2H, 7-O-CH₂CH₂CH₂-); ¹³C NMR (75 MHz, CDCl₃): δ 174.2 (C-4), 163.2 (C-7), 161.1 (C-5), 158.8 (C-8a), 152.0 (C-19), 150.0 (C-20), 149.6 (C-16a), 145.3 (C-2), 143.8 (C-12a), 141.5 (C-3), 128.4 (C-17), 124.4 (C-14), 122.4 (C-15), 120.3 (C-22), 117.2 (C-16), 117.2 (C-13), 111.5 (C-21), 110.3 (C-18), 109.6 (C-4a), 96.2 (C-6), 92.8 (C-8), 78.8 (C-10), 76.5 (C-11), 66.3 (7-OCH₂), 61.7 (C-23), 60.1 (OCH₃), 56.6 (OCH₃), 56.2 (OCH₃), 56.1 (OCH₃), 54.3 (NCH₂), 54.0 (NCH₂ from piperazin), 50.9 (NCH₂ from piperazin), 44.5 (NCH₃), 26.1 (7-O-CH₂CH₂CH₂-); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₆H₄₃N₂O₁₀: 663.2917, found: 663.2917.

3-*O*-(4'-Bromo)butyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**18**). 62% Yield, ¹H NMR (300 MHz, CDCl₃): δ 7.71 (s, 1H), 7.69 (dd, *J* = 7.2, 1.5 Hz, 1H), 7.04 (d, *J* = 8.0 Hz, 2H), 6.97 (d, *J* = 1.8 Hz, 1H), 6.92 (d, *J* = 8.1 Hz, 1H), 6.46 (d, *J* = 2.4 Hz, 1H), 6.32 (d, *J* = 2.4 Hz, 1H), 5.03 (d, *J* = 8.1 Hz, 1H), 4.16-4.09 (m, 1H), 4.03 (t, *J* = 6.0 Hz, 2H), 3.93 (s, 3H), 3.91 (s, 3H), 3.90 (s, 3H), 3.86 (s, 3H), 3.81 (dd, *J* = 7.2, 2.4 Hz, 1H), 3.57 (dd, *J* = 12.3, 3.6 Hz, 1H), 3.46 (t, *J* = 6.6 Hz, 2H), 2.09-2.00 (m, 2H), 1.90-1.81 (m, 2H); ¹³C NMR (75 MHz, CDCl₃): δ 174.2, 164.1, 161.1, 158.9, 152.6, 149.9, 149.6, 145.3, 143.8, 140.4, 128.5, 124.4, 122.4, 120.3, 117.3, 117.1, 111.4, 110.3, 109.5, 95.9, 92.5, 78.8, 76.4, 61.7, 56.5, 56.2, 56.1, 55.9, 34.1, 28.8.

3-*O*-(5'-Bromo)pentyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**19**). 77% yield, ¹H NMR (300 MHz, CDCl₃): δ 7.72 (s, 1H), 7.71 (dd, *J* = 7.8, 1.8 Hz, 1H), 7.03 (d, *J* = 8.1 Hz, 2H), 6.97 (d, *J* = 1.5 Hz, 1H), 6.92 (d, *J* = 8.4 Hz, 1H), 6.45 (d, *J* = 2.1 Hz, 1H), 6.31 (d, *J* = 2.1 Hz, 1H), 5.03 (d, *J* = 8.4 Hz, 1H), 4.14-4.11 (m, 1H), 4.02 (t, *J* = 6.3 Hz, 2H), 3.93 (s, 3H), 3.91 (s, 3H), 3.90 (s, 3H), 3.85 (s, 3H), 3.85 (d, *J* = 12.6 Hz, 1H), 3.57 (d, *J* = 11.7 Hz, 1H), 3.34 (t, *J* = 6.9 Hz, 2H), 1.85 (quin, *J* = 7.2 Hz, 2H), 1.74 (quin, *J* = 7.2 Hz, 2H), 1.59-1.49 (m, 2H).

3-*O*-(*N,N*-Dimethylamino)butyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**21**). 86% yield, yellow wax. IR (film) ν_{\max} : 3397, 2938, 1625, 1603, 1505, 1460 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.72 (dd, *J* = 8.7 Hz, 2.1 Hz, 1H, H-15), 7.72 (d, *J* = 1.8 Hz, 1H, H-13), 7.04 (d, *J* = 9.3 Hz, 1H, H-16), 7.03 (dd, *J* = 8.1, 1.8 Hz, 1H, H-22), 6.97 (d, *J* = 1.5 Hz, 1H, H-18), 6.91 (d, *J* = 8.1 Hz, 1H, H-21), 6.45 (d, *J* = 2.1 Hz, 1H, H-8), 6.31 (d, *J* = 2.1 Hz, 1H, H-6), 5.04 (d, *J* = 8.1 Hz, 1H, H-11), 4.13 (dt, *J* = 7.8, 3.3 Hz, 1H, H-10), 4.05-4.01 (m, 2H, 3-OCH₂), 3.93 (s, 3H, OCH₃), 3.91 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.86 (s, 3H, OCH₃), 3.85-3.81 (overlapped, 1H, H-23), 3.57 (dd, *J* = 12.3, 3.9 Hz, 1H, H-23), 2.45 (t, *J* = 7.5 Hz, 2H, NCH₂), 2.29 (s, 6H, 2 × NCH₃), 1.77-1.65 (m, 4H, 3-OCH₂CH₂CH₂-); ¹³C NMR (75 MHz, CDCl₃): δ 174.1 (C-4), 163.9 (C-7), 161.0 (C-5), 158.8 (C-8a), 152.3 (C-16a), 149.7 (C-19), 149.4 (C-20), 145.2 (C-2), 143.6 (C-12a), 140.4 (C-3), 128.5 (C-17), 124.3 (C-14), 122.4 (C-15), 120.2 (C-22), 117.2 (C-13), 117.0 (C-16), 111.3 (C-21), 110.2 (C-18), 109.4 (C-4a), 95.8 (C-6), 92.3 (C-8), 78.7 (C-10), 76.2 (C-11), 71.8 (3-OCH₂), 61.5 (C-23), 59.1 (OCH₃), 56.4 (OCH₃), 56.1 (OCH₃), 56.0 (OCH₃), 55.7 (NCH₂), 44.8 (NCH₃), 27.9 (3-O-CH₂CH₂CH₂-), 23.5 (3-O-CH₂CH₂CH₂-); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₄H₄₀NO₁₀: 622.2652, found: 622.2651.

3-*O*-(*N,N*-Dimethylamino)pentyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**22**). 76% yield, yellow solid, mp. 90-91 °C. IR (film) ν_{max} : 3398, 2919, 1625, 1608, 1509 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.74-7.67 (overlapped, 2H, H-15 & H-13), 7.03 (d, $J = 8.7$ Hz, 2H, H-16 & H-22), 6.98 (d, $J = 1.5$ Hz, 1H, H-18), 6.91 (d, $J = 8.1$ Hz, 1H, H-21), 6.45 (d, $J = 2.1$ Hz, 1H, H-8), 6.31 (d, $J = 2.1$ Hz, 1H, H-6), 5.06 (d, $J = 7.8$ Hz, 1H, H-11), 4.14 (dt, $J = 7.8, 3.3$ Hz, 1H, H-10), 4.03-3.98 (m, 2H, 3-OCH₂), 3.93 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.89 (s, 3H, OCH₃), 3.85 (s, 3H, OCH₃), 3.85-3.81 (overlapped, 1H, H-23), 3.57 (dd, $J = 12.6, 3.9$ Hz, 1H, H-23), 2.42 (t, $J = 7.5$ Hz, 2H, NCH₂), 2.34 (s, 6H, 2 × NCH₃), 1.72 (quin, $J = 6.9$ Hz, 2H, 3-OCH₂CH₂CH₂CH₂CH₂), 1.61-1.51 (m, 2H, 3-OCH₂CH₂CH₂CH₂CH₂), 1.47-1.37 (m, 2H, 3-OCH₂CH₂CH₂CH₂CH₂); ^{13}C NMR (75 MHz, CDCl_3): δ 174.1 (C-4), 163.9 (C-7), 161.0 (C-5), 158.8 (C-8a), 152.3 (C-16a), 149.7 (C-19), 149.4 (C-20), 145.1 (C-2), 143.6 (C-12a), 140.5 (C-3), 128.5 (C-17), 124.3 (C-14), 122.4 (C-15), 120.2 (C-22), 117.2 (C-13), 116.9 (C-16), 111.3 (C-21), 110.2 (C-18), 109.4 (C-4a), 95.8 (C-6), 92.3 (C-8), 78.7 (C-10), 76.1 (C-11), 72.0 (3-OCH₂), 61.5 (C-23), 59.1 (OCH₃), 56.4 (OCH₃), 56.0 (OCH₃), 55.9 (OCH₃), 55.7 (NCH₂), 44.5 (NCH₃), 29.9 (3-OCH₂CH₂CH₂CH₂CH₂), 26.1 (3-OCH₂CH₂CH₂CH₂CH₂), 23.7 (3-OCH₂CH₂CH₂CH₂CH₂); HRMS-ESI m/z [M+H]⁺ calcd for C₃₅H₄₂NO₁₀: 636.2809, found: 636.2807.

3-*O*-(*N,N*-Diethylamino)propyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**23**). 90% yield, yellow wax. IR (film) ν_{max} : 3375, 2936, 2837, 1624, 1604, 1579, 1517, 1505, 1492, 1462 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.81-7.56 (overlapped, 1H, H-15), 7.68 (s, 1H, H-13), 7.06 (d, $J = 9.0$ Hz, 1H, H-16), 7.03 (d, $J = 9.3$ Hz, 1H, H-22), 6.97 (s, 1H, H-18), 6.91 (d, $J = 8.1$ Hz, 1H, H-21), 6.47 (s, 1H, H-8), 6.33 (s, 1H, H-6), 5.03 (d, $J = 7.9$ Hz, 1H, H-11), 4.16-4.13 (m, 1H, H-10), 4.04-4.01 (m, 2H, 3-OCH₂), 3.94 (s, 3H, OCH₃), 3.91 (s, 6H, 2 × OCH₃), 3.86 (s, 3H, OCH₃), 3.88-3.84 (overlapped, 1H, H-23), 3.57 (dd, $J = 12.9, 2.7$ Hz, 1H, H-23), 3.07 (t, $J = 6.9$ Hz, 2H, NCH₂), 2.90-2.83 (m, 4H, 2 × NCH₂CH₃), 2.86-2.78 (m, 2H, 3-OCH₂CH₂), 1.19 (t, $J = 6.9$ Hz, 6H, 2 × NCH₂CH₃); ^{13}C NMR (75 MHz, CDCl_3): δ 174.2 (C-4), 164.2 (C-7), 161.1 (C-5), 159.0 (C-8a), 152.9 (C-16a), 149.9 (C-19), 149.6 (C-20), 145.6 (C-2), 143.9 (C-12a), 140.2 (C-3), 128.5 (C-17), 124.1 (C-14), 122.4 (C-15), 120.4 (C-22), 117.4 (C-13), 117.3 (C-16), 111.5 (C-21), 110.3 (C-18), 109.4 (C-4a), 96.1 (C-6), 92.5 (C-8), 78.9 (C-10), 76.5 (C-11), 70.0 (3-OCH₂), 61.7 (C-23), 56.6 (OCH₃), 56.2 (OCH₃), 56.1 (OCH₃), 55.9 (OCH₃), 49.9 (NCH₂), 46.9 (NCH₂CH₃), 26.4 (3-O-CH₂CH₂CH₂-), 10.1 (NCH₂CH₃); HRMS-ESI m/z [M+H]⁺ calcd for C₃₅H₄₂NO₁₀: 636.2809, found: 636.2806.

3-*O*-(*N,N*-Diethylamino)butyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**24**). 69% yield, yellow solid, mp. 64-65 °C. IR (film) ν_{max} : 3397, 2938, 1625, 1606, 1506, 1463 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.72 (d, $J = 6.3$ Hz, 1H, H-15), 7.71 (s, 1H, H-13), 7.03 (d, $J = 9.0$ Hz, 2H, H-16 & H-22), 6.97 (s, 1H, H-18), 6.91 (d, $J = 8.1$ Hz, 1H, H-21), 6.45 (s, 1H, H-8), 6.31 (s, 1H, H-6), 5.03 (d, $J = 7.8$ Hz, 1H, H-11), 4.15-4.10 (m, 1H, H-10), 4.02-4.98 (m, 2H, 3-OCH₂), 3.95 (s, 3H, OCH₃), 3.93 (s, 6H, 2 × OCH₃), 3.90 (s, 3H, OCH₃), 3.85-3.81 (overlapped, 1H, H-23), 3.56 (dd, $J = 12.3, 3.3$ Hz, 1H, H-23), 2.96 (br.s, 2H, NCH₂), 2.63 (q, $J = 7.2$ Hz, 4H, 2 × NCH₂CH₃), 1.80-1.59 (m, 4H, 3-OCH₂CH₂CH₂), 1.06 (t, $J = 7.2$ Hz, 6H, 2 × NCH₂CH₃); ^{13}C NMR (75 MHz, CDCl_3): δ 174.8 (C-4), 164.5 (C-7), 161.6 (C-5), 159.4 (C-8a), 153.0 (C-16a), 150.3 (C-19), 150.0 (C-20), 145.8 (C-2), 144.2 (C-12a), 141.0 (C-3), 129.1 (C-17), 124.9 (C-14), 123.0 (C-15), 120.8 (C-22), 117.7 (C-13), 117.6 (C-16), 111.9 (C-21), 110.8 (C-18), 110.0 (C-4a), 96.4 (C-6), 92.9 (C-8), 79.3 (C-10), 76.8 (C-11), 72.5 (3-OCH₂), 62.1 (C-23), 57.0 (OCH₃), 56.6 (OCH₃), 56.6 (OCH₃), 56.4 (OCH₃), 52.7 (NCH₂), 47.1 (NCH₂CH₃), 28.7 (3-O-CH₂CH₂CH₂CH₂-), 22.9 (3-O-CH₂CH₂CH₂CH₂-), 11.3 (NCH₂CH₃); HRMS-ESI m/z [M+H]⁺ calcd for C₃₆H₄₄NO₁₀: 650.2966, found 650.2963.

3-*O*-(*N,N*-Diethylamino)pentyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**25**). 33% yield, yellow wax. IR (film) ν_{max} : 3397, 2938, 1624, 1606, 1507, 1459 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.74 (dd, $J = 9.3, 2.1$ Hz, 1H, H-15), 7.74 (d, $J = 2.1$ Hz, 1H, H-13), 7.05 (d, $J = 9.3$ Hz, 1H, H-16), 7.04 (dd, $J = 8.4, 2.1$ Hz, 1H, H-22), 6.98 (d, $J = 1.8$ Hz, 1H, H-18), 6.92 (d, $J = 8.1$ Hz, 1H, H-21), 6.46 (d, $J = 2.1$ Hz, 1H, H-8), 6.32 (d, $J = 2.1$ Hz, 1H, H-6), 5.07 (d, $J = 8.1$ Hz, 1H, H-11), 4.16 (dt, $J = 7.2, 2.4$ Hz, 1H, H-10), 4.05-3.98 (m, 2H, 3-OCH₂), 3.93 (s, 3H, OCH₃), 3.91 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.86 (s, 3H, OCH₃), 3.85 (dd, $J = 12.6, 2.7$ Hz, 1H, H-23), 3.58 (dd, $J = 12.6, 3.9$ Hz, 1H, H-23), 2.75 (q, $J = 7.2$ Hz, 4H, 2 × NCH₂CH₃), 2.63 (t, $J = 8.4$ Hz, 2H, NCH₂), 1.73 (quin, $J = 6.9$ Hz, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.56-1.51 (m, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.46-1.41 (m, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.13 (t, $J = 7.2$ Hz, 6H, 2 ×

NCH₂CH₃); ¹³C NMR (75 MHz, CDCl₃): δ 174.1 (C-4), 163.9 (C-7), 161.0 (C-5), 158.8 (C-8a), 152.5 (C-16a), 149.7 (C-19), 149.4 (C-20), 145.3 (C-2), 143.6 (C-12a), 140.3 (C-3), 128.5 (C-17), 124.2 (C-14), 122.3 (C-15), 120.2 (C-22), 117.2 (C-13), 117.0 (C-16), 111.3 (C-21), 110.2 (C-18), 109.4 (C-4a), 95.8 (C-6), 92.3 (C-8), 78.7 (C-10), 76.1 (C-11), 71.7 (3-OCH₂), 61.5 (C-23), 56.4 (OCH₃), 56.1 (OCH₃), 56.0 (OCH₃), 55.7 (OCH₃), 51.1 (NCH₂), 46.3 (NCH₂CH₃), 29.5 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 23.7 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 9.4 (NCH₂CH₃); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₇H₄₆NO₁₀: 663.3122, found: 664.3116.

3-O-(3-(*N,N*-Dipropyl)propyl)-5,7,20-O-trimethyl-2,3-dehydrosilybin (**26**). 78% yield, yellow wax. IR (film) ν_{\max} : 3338, 3052, 2958, 2934, 2873, 2837, 1624, 1603, 1578, 1517, 1505, 1456 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.70 (d, *J* = 7.7 Hz, 1H, H-15), 7.68 (s, 1H, H-13), 7.05 (d, *J* = 7.9 Hz, 1H, H-16), 7.03 (d, *J* = 6.8 Hz, 1H, H-22), 6.97 (s, 1H, H-18), 6.91 (d, *J* = 8.2 Hz, 1H, H-21), 6.46 (s, 1H, H-8), 6.32 (s, 1H, H-6), 5.03 (d, *J* = 8.0 Hz, 1H, H-11), 4.13 (d, *J* = 7.8 Hz, 1H, H-10), 4.08-4.00 (m, 2H, 3-OCH₂), 3.93 (s, 3H, OCH₃), 3.90 (s, 6H, 2 × OCH₃), 3.85 (s, 3H, OCH₃), 3.85-3.82 (overlapped, 1H, H-23), 3.57 (dd, *J* = 12.4, 3.3 Hz, 1H, H-23), 2.97-2.85 (m, 2H, 3-O-CH₂CH₂CH₂N-), 2.59 (t, *J* = 7.4 Hz, 4H, 2 × NCH₂CH₂CH₃), 2.05-2.00 (m, 2H, 3-O-CH₂CH₂CH₂N-), 1.56 (sextet, *J* = 6.8 Hz, 4H, 2 × NCH₂CH₂CH₃), 0.86 (t, *J* = 7.2 Hz, 6H, 2 × NCH₂CH₂CH₃); ¹³C NMR (75 MHz, CDCl₃): δ 174.2 (C-4), 164.1 (C-7), 161.1 (C-5), 158.9 (C-8a), 152.7 (C-16a), 149.9 (C-19), 149.6 (C-20), 145.5 (C-2), 143.8 (C-12a), 140.3 (C-3), 128.5 (C-17), 124.2 (C-14), 122.5 (C-15), 120.3 (C-22), 117.3 (C-13), 117.2 (C-16), 111.5 (C-21), 110.3 (C-18), 109.5 (C-4a), 96.0 (C-6), 92.5 (C-8), 78.9 (C-10), 76.4 (C-11), 70.3 (3-OCH₂), 61.6 (C-23), 56.5 (OCH₃), 56.2 (OCH₃), 56.1 (OCH₃), 55.9 (OCH₃), 55.4 (3-O-CH₂CH₂CH₂N-), 51.0 (NCH₂CH₂CH₃), 26.7 (3-O-CH₂CH₂CH₂N-), 18.7 (NCH₂CH₂CH₃), 11.8 (NCH₂CH₂CH₃); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₇H₄₆NO₁₀: 664.3122, found: 664.3118.

3-O-(*N,N*-dipropylamino)butyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (**27**). 59% yield, yellow solid, mp. 80-81 °C. IR (film) ν_{\max} : 3415, 2956, 1625, 1607, 1507, 1462, 1433 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.75 (d, *J* = 10.2 Hz, 1H, H-15), 7.73 (s, 1H, H-13), 7.04 (d, *J* = 8.4 Hz, 1H, H-16), 7.03 (d, *J* = 8.4 Hz, 1H, H-22), 6.97 (s, 1H, H-18), 6.92 (d, *J* = 8.1 Hz, 1H, H-21), 6.46 (s, 1H, H-8), 6.32 (s, 1H, H-6), 5.04 (d, *J* = 8.1 Hz, 1H, H-11), 4.15-4.12 (m, 1H, H-10), 4.05-3.99 (m, 2H, 3-OCH₂), 3.94 (s, 3H, OCH₃), 3.91 (s, 6H, 2 × OCH₃), 3.86 (s, 3H, OCH₃), 3.88-3.82 (overlapped, 1H, H-23), 3.57 (dd, *J* = 12.3, 3.3 Hz, 1H, H-23), 2.55 (t, *J* = 5.7 Hz, 2H, 3-O-CH₂CH₂CH₂CH₂N-), 2.44 (t, *J* = 7.5 Hz, 4H, 2 × NCH₂CH₂CH₃), 1.80-1.56 (m, 4H, 2 × NCH₂CH₂CH₃), 1.52-1.43 (m, 4H, 3-O-CH₂CH₂CH₂CH₂N-), 0.85 (t, *J* = 7.2 Hz, 6H, 2 × NCH₂CH₂CH₃); ¹³C NMR (75 MHz, CDCl₃): δ 174.8 (C-4), 164.5 (C-7), 161.6 (C-5), 159.4 (C-8a), 152.9 (C-16a), 150.4 (C-19), 150.0 (C-20), 145.7 (C-2), 144.2 (C-12a), 141.1 (C-3), 129.0 (C-17), 125.0 (C-14), 123.1 (C-15), 120.8 (C-22), 117.7 (C-13), 117.6 (C-16), 111.9 (C-21), 110.7 (C-18), 110.1 (C-4a), 96.4 (C-6), 92.9 (C-8), 79.3 (C-10), 76.9 (C-11), 72.7 (3-OCH₂), 62.2 (C-23), 57.0 (OCH₃), 56.7 (OCH₃), 56.6 (OCH₃), 56.4 (OCH₃), 56.2 (3-O-CH₂CH₂CH₂CH₂N-), 54.1 (NCH₂CH₂CH₃), 28.7 (3-O-CH₂CH₂CH₂CH₂N-), 23.3 (3-O-CH₂CH₂CH₂CH₂N-), 20.1 (NCH₂CH₂CH₃), 12.5 (NCH₂CH₂CH₃); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₈H₄₈NO₁₀: 678.3279, found: 678.3275.

3-O-(*N,N*-Dipropylamino)pentyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (**28**). 60% yield, white solid, mp. 94.0-94.5 °C. IR (film) ν_{\max} : 3388, 2936, 2873, 2838, 1624, 1605, 578, 1490, 1462 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.73 (d, *J* = 7.2 Hz, 1H, H-15), 7.72 (s, 1H, H-13), 7.06 (d, *J* = 9.3 Hz, 2H, H-16 & H-22), 6.99 (s, 1H, H-18), 6.93 (d, *J* = 8.4 Hz, 1H, H-21), 6.47 (s, 1H, H-8), 6.33 (s, 1H, H-6), 5.07 (d, *J* = 7.8 Hz, 1H, H-11), 4.16 (d, *J* = 7.8 Hz, 1H, H-10), 4.03 (t, *J* = 6.0 Hz, 2H, 3-OCH₂), 3.94 (s, 3H, OCH₃), 3.91 (s, 6H, 2 × OCH₃), 3.87 (s, 3H, OCH₃), 3.87-3.83 (overlapped, 1H, H-23), 3.67 (dd, *J* = 12.3, 3.0 Hz, 1H, H-23), 2.68-2.51 (overlapped, 6H, 3-O-CH₂CH₂CH₂CH₂CH₂N- & 2 × NCH₂CH₂CH₃), 1.75 (quin, *J* = 6.9 Hz, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.60-1.50 (m, 6H, 3-O-CH₂CH₂CH₂CH₂CH₂N- & 2 × NCH₂CH₂CH₃), 1.43 (quin, *J* = 6.9 Hz, 2H 3-O-CH₂CH₂CH₂CH₂CH₂N-), 0.90 (t, *J* = 7.5 Hz, 6H, 2 × NCH₂CH₂CH₃); ¹³C NMR (75 MHz, CDCl₃): δ 174.1 (C-4), 163.9 (C-7), 161.0 (C-5), 158.8 (C-8a), 152.3 (C-16a), 149.7 (C-19), 149.4 (C-20), 145.1 (C-2), 143.6 (C-12a), 140.4 (C-3), 128.4 (C-17), 124.4 (C-14), 122.4 (C-15), 120.1 (C-22), 117.2 (C-13), 116.9 (C-16), 111.3 (C-21), 110.2 (C-18), 109.5 (C-4a), 95.8 (C-6), 92.3 (C-8), 78.6 (C-10), 76.2 (C-11), 72.0 (3-OCH₂), 61.5 (C-23), 56.4 (OCH₃), 56.1 (OCH₃), 56.0 (OCH₃), 55.7 (OCH₃), 55.2 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 53.2 (NCH₂CH₂CH₃), 29.7 (3-O-

CH₂CH₂CH₂CH₂CH₂N-), 23.8 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 18.8 (NCH₂CH₂CH₃), 18.7 (3-O-CH₂CH₂CH₂CH₂CH₂N-). 11.7 (NCH₂CH₂CH₃); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₉H₅₀NO₁₀: 692.3435, found: 692.3436.

3-O-(3-(*N,N*-Dibutylamino)propyl)-5,7,20-O-trimethyl-2,3-dehydrosilybin (**29**). 79% yield, yellow wax. IR (film) ν_{\max} : 3352, 2957, 2933, 2872, 2838, 1624, 1604, 1578, 1505, 1491, 1457 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.67 (d, *J* = 7.2 Hz, 1H, H-15), 7.65 (s, 1H, H-13), 7.04 (d, *J* = 8.7 Hz, 1H, H-16), 6.98 (d, *J* = 7.2 Hz, 1H, H-22), 6.96 (s, 1H, H-18), 6.89 (d, *J* = 8.1 Hz, 1H, H-21), 6.45 (s, 1H, H-8), 6.31 (s, 1H, H-6), 5.02 (d, *J* = 8.1 Hz, 1H, H-11), 4.12 (d, *J* = 7.8 Hz, 1H, H-10), 4.05-3.95 (m, 2H, 3-OCH₂), 3.92 (s, 3H, OCH₃), 3.89 (s, 3H, OCH₃), 3.88 (s, 3H, OCH₃), 3.84 (s, 3H, OCH₃), 3.84-3.81 (overlapped, 1H, H-23), 3.55 (dd, *J* = 12.6, 3.3 Hz, 1H, H-23), 3.04 (t, *J* = 6.9 Hz, 2H, 3-O-CH₂CH₂CH₂N-), 2.72 (t, *J* = 7.8 Hz, 4H, 2 × NCH₂CH₂CH₂CH₃), 2.13-2.05 (m, 2H, 3-O-CH₂CH₂CH₂N-), 1.62-1.51 (m, 4H, 2 × NCH₂CH₂CH₂CH₃), 1.30 (quin, *J* = 7.2 Hz, 4H, 2 × NCH₂CH₂CH₂CH₃), 0.89 (t, *J* = 7.5 Hz, 6H, 2 × NCH₂CH₂CH₂CH₃); ¹³C NMR (75 MHz, CDCl₃): δ 174.2 (C-4), 164.2 (C-7), 161.0 (C-5), 158.9 (C-8a), 152.8 (C-16a), 149.9 (C-19), 149.5 (C-20), 145.5 (C-2), 143.9 (C-12a), 140.2 (C-3), 128.5 (C-17), 124.1 (C-14), 122.5 (C-15), 120.3 (C-22), 117.3 (C-13), 117.2 (C-16), 111.4 (C-21), 110.3 (C-18), 109.4 (C-4a), 96.0 (C-6), 92.5 (C-8), 78.9 (C-10), 76.4 (C-11), 70.1 (3-OCH₂), 61.6 (C-23), 56.6 (OCH₃), 56.2 (OCH₃), 56.1 (OCH₃), 55.9 (OCH₃), 53.3 (3-O-CH₂CH₂CH₂N-), 51.1 (NCH₂CH₂CH₂CH₃), 27.1 (NCH₂CH₂CH₂CH₃), 26.5 (3-O-CH₂CH₂CH₂N-), 20.6 (NCH₂CH₂CH₂CH₃), 14.0 (NCH₂CH₂CH₂CH₃); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₉H₅₀NO₁₀: 692.3435, found 692.3427.

3-O-(*N,N*-dibutylamino)butyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (**30**). 74% yield, yellow wax. IR (film) ν_{\max} : 3397, 2931, 2870, 1624, 1605, 1579, 1506, 1460 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.75 (dd, *J* = 9.9, 1.8 Hz, 1H, H-15), 7.73 (s, 1H, H-13), 7.05 (d, *J* = 8.4 Hz, 1H, H-16), 7.03 (d, *J* = 8.1 Hz, 1H, H-22), 6.97 (s, 1H, H-18), 6.92 (d, *J* = 8.1 Hz, 1H, H-21), 6.46 (d, *J* = 1.8 Hz, 1H, H-8), 6.32 (d, *J* = 2.1 Hz, 1H, H-6), 5.05 (d, *J* = 8.1 Hz, 1H, H-11), 4.16-4.12 (m, 1H, H-10), 4.02 (t, *J* = 5.7 Hz, 2H, 3-OCH₂), 3.94 (s, 3H, OCH₃), 3.91 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.86 (s, 3H, OCH₃), 3.86-3.81 (overlapped, 1H, H-23), 3.58 (dd, *J* = 12.6, 3.9 Hz, 1H, H-23), 2.59 (t, *J* = 7.5 Hz, 2H, 3-O-CH₂CH₂CH₂CH₂N-), 2.51 (t, *J* = 7.5 Hz, 4H, 2 × NCH₂CH₂CH₂CH₃), 1.78-1.60 (m, 4H, 2 × NCH₂CH₂CH₂CH₃), 1.50-1.40 (m, 4H, 3-O-CH₂CH₂CH₂CH₂N-), 1.33-1.21 (m, 4H, 2 × NCH₂CH₂CH₂CH₃), 0.89 (t, *J* = 7.2 Hz, 6H, 2 × NCH₂CH₂CH₂CH₃). ¹³C NMR (75 MHz, CDCl₃): δ 174.1 (C-4), 163.9 (C-7), 161.0 (C-5), 158.8 (C-8a), 152.3 (C-16a), 149.7 (C-19), 149.4 (C-20), 145.1 (C-2), 143.6 (C-12a), 140.4 (C-3), 128.4 (C-17), 124.4 (C-14), 122.4 (C-15), 120.2 (C-22), 117.1 (C-13), 117.0 (C-16), 111.3 (C-21), 110.1 (C-18), 109.4 (C-4a), 96.8 (C-6), 92.3 (C-8), 78.6 (C-10), 76.2 (C-11), 72.0 (3-OCH₂), 61.5 (C-23), 56.4 (OCH₃), 56.0 (OCH₃), 55.9 (OCH₃), 55.7 (OCH₃), 53.3 (3-O-CH₂CH₂CH₂CH₂N-), 53.2 (NCH₂CH₂CH₂CH₃), 28.1 (NCH₂CH₂CH₂CH₃), 22.5 (NCH₂CH₂CH₂CH₃), 20.6 (NCH₂CH₂CH₂CH₃), 14.0 (NCH₂CH₂CH₂CH₃); HRMS-ESI *m/z* [M+H]⁺ calcd for C₄₀H₅₂NO₁₀: 706.3592, found: 706.3591.

3-O-(*N,N*-Dibutylamino)pentyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (**31**). 85% yield, yellow wax. IR (film) ν_{\max} : 3398, 2931, 1625, 1606, 1506, 1462 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.72 (dd, *J* = 8.1, 2.1 Hz, 1H, H-15), 7.71 (s, 1H, H-13), 7.04 (d, *J* = 8.1 Hz, 2H, H-16 & H-22), 6.98 (d, *J* = 1.8 Hz, 1H, H-18), 6.91 (d, *J* = 8.1 Hz, 1H, H-21), 6.46 (d, *J* = 2.1 Hz, 1H, H-8), 6.31 (d, *J* = 2.1 Hz, 1H, H-6), 5.06 (d, *J* = 8.1 Hz, 1H, H-11), 4.17-4.13 (m, 1H, H-10), 4.02 (t, *J* = 6.3 Hz, 2H, 3-OCH₂), 3.93 (s, 3H, OCH₃), 3.91 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.86 (s, 3H, OCH₃), 3.86-3.81 (overlapped, 1H, H-11), 3.58 (dd, *J* = 12.3, 3.9 Hz, 1H, H-10), 2.54 (t, *J* = 7.5 Hz, 6H, 3-O-CH₂CH₂CH₂CH₂CH₂N- & 2 × NCH₂CH₂CH₂CH₃), 1.74 (quin, *J* = 7.5 Hz, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.51-1.25 (m, 12H, 3-O-CH₂CH₂CH₂CH₂CH₂N- & 2 × NCH₂CH₂CH₂CH₃), 0.90 (t, *J* = 7.2 Hz, 6H, 2 × NCH₂CH₂CH₂CH₃); ¹³C NMR (75 MHz, CDCl₃): δ 174.8 (C-4), 164.5 (C-7), 161.6 (C-5), 159.4 (C-8a), 153.0 (C-16a), 150.3 (C-19), 150.0 (C-20), 145.8 (C-2), 144.2 (C-12a), 141.1 (C-3), 129.1 (C-17), 124.9 (C-14), 123.0 (C-15), 120.8 (C-22), 117.8 (C-13), 117.6 (C-16), 111.9 (C-21), 110.8 (C-18), 110.0 (C-4a), 96.4 (C-6), 92.9 (C-8), 79.3 (C-10), 76.8 (C-11), 72.7 (3-OCH₂), 62.1 (C-23), 57.0 (OCH₃), 56.7 (OCH₃), 56.6 (OCH₃), 56.4 (OCH₃), 53.9 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 53.8 (NCH₂CH₂CH₂CH₃), 30.5 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 28.3 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 25.7 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 24.5 (NCH₂CH₂CH₂CH₃), 21.2 (NCH₂CH₂CH₂CH₃), 14.6 (NCH₂CH₂CH₂CH₃); HRMS-ESI *m/z* [M+H]⁺ calcd for C₄₁H₅₄NO₁₀: 720.3748, found: 720.3741.

3-*O*-Pyrrolidinopropyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**32**). 84% yield, yellow oil. IR (film) ν_{\max} : 3361, 2935, 2879, 2837, 1668, 1624, 1604, 1578, 1517, 1505, 1459 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.69 (s, 1H, H-13), 7.68 (dd, $J = 7.8, 2.1$ Hz, 1H, H-15), 7.06-7.01 (overlapped, 2H, H-16 & H-22), 6.96 (d, $J = 1.5$ Hz, 1H, H-18), 6.91 (d, $J = 8.4$ Hz, 1H, H-21), 6.45 (d, $J = 2.1$ Hz, 1H, H-8), 6.32 (d, $J = 2.1$ Hz, 1H, H-6), 5.03 (d, $J = 8.4$ Hz, 1H, H-11), 4.13 (dt, $J = 7.8, 3.3$ Hz, 1H, H-10), 4.07-3.96 (m, 2H, 3- OCH_2), 3.93 (s, 3H, OCH_3), 3.91 (s, 3H, OCH_3), 3.90 (s, 3H, OCH_3), 3.85 (s, 3H, OCH_3), 3.85-3.81 (overlapped, 1H, H-23), 3.56 (dd, $J = 12.3, 3.6$ Hz, 1H, H-23), 3.05 (t, $J = 7.8$ Hz, 2H, 3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 2.95-2.83 (m, 4H, 2 \times CH_2 from pyrrolidino), 2.16-2.00 (m, 2H, 3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 1.92 – 1.83 (m, 4H, 2 \times CH_2 from pyrrolidino); ^{13}C NMR (75 MHz, CDCl_3): δ 174.2 (C-4), 164.2 (C-7), 161.1 (C-5), 159.0 (C-8a), 152.8 (C-16a), 149.9 (C-19), 149.6 (C-20), 145.5 (C-2), 143.8 (C-12a), 140.2 (C-3), 128.5 (C-17), 124.2 (C-14), 122.4 (C-15), 120.4 (C-22), 117.3 (C-13), 117.3 (C-16), 111.5 (C-21), 110.4 (C-18), 109.5 (C-4a), 96.0 (C-6), 92.5 (C-8), 78.9 (C-10), 76.4 (C-11), 70.0 (3- OCH_2), 61.6 (C-23), 56.6 (OCH_3), 56.2 (OCH_3), 56.1 (OCH_3), 55.9 (OCH_3), 53.7 (3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 53.3 (CH_2 from pyrrolidino), 28.2 (3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 23.6 (CH_2 from pyrrolidino); HRMS-ESI m/z $[\text{M}+\text{H}]^+$ calcd for $\text{C}_{35}\text{H}_{40}\text{NO}_{10}$: 634.2652, found: 634.2648.

3-*O*-Pyrrolidinobutyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**33**). 69% yield, yellow solid, mp. 109-110 $^\circ\text{C}$. IR (film) ν_{\max} : 3398, 2936, 1625, 1606, 1507, 1458, 1433 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.70 (s, 1H, H-13), 7.69 (d, $J = 5.4$ Hz, 1H, H-15), 7.04 (d, $J = 9.0$ Hz, 1H, H-16), 7.03 (d, $J = 8.4$ Hz, 1H, H-22), 6.97 (s, 1H, H-18), 6.91 (d, $J = 8.1$ Hz, 1H, H-21), 6.45 (s, 1H, H-8), 6.31 (s, 1H, H-6), 5.05 (d, $J = 8.1$ Hz, 1H, H-11), 4.15-4.12 (m, 1H, H-10), 4.00-3.90 (overlapped, 2H, 3- OCH_2), 3.93 (s, 3H, OCH_3), 3.90 (s, 6H, 2 \times OCH_3), 3.85 (s, 3H, OCH_3), 3.85-3.81 (overlapped, 1H, H-23), 3.56 (dd, $J = 12.6, 3.6$ Hz, 1H, H-23), 3.35-3.19 (m, 2H, 3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 2.88-2.71 (m, 4H, 2 \times CH_2 from pyrrolidino), 1.95-1.76 (m, 8H, 3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$ & 2 \times CH_2 from pyrrolidino); ^{13}C NMR (75 MHz, CDCl_3): δ 174.8 (C-4), 164.6 (C-7), 161.5 (C-5), 159.4 (C-8a), 153.2 (C-16a), 150.3 (C-19), 150.0 (C-20), 145.9 (C-2), 144.2 (C-12a), 140.9 (C-3), 129.1 (C-17), 124.8 (C-14), 123.0 (C-15), 120.8 (C-22), 117.74 (C-13), 117.70 (C-16), 111.9 (C-21), 110.8 (C-18), 110.0 (C-4a), 96.4 (C-6), 93.0 (C-8), 79.3 (C-10), 76.8 (C-11), 72.2 (3- OCH_2), 62.0 (C-23), 57.0 (OCH_3), 56.7 (OCH_3), 56.6 (OCH_3), 56.4 (OCH_3), 56.3 (3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 54.2 (2 \times CH_2 from pyrrolidino), 28.4 (3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 24.8 (3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 24.0 (2 \times CH_2 from pyrrolidino); HRMS-ESI m/z $[\text{M}+\text{H}]^+$ calcd for $\text{C}_{36}\text{H}_{42}\text{NO}_{10}$: 648.2809, found: 648.2806.

3-*O*-Pyrrolidinopentyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**34**). 77% yield, reddish wax. IR (film) ν_{\max} : 3348, 2935, 2874, 2838, 2802, 1667, 1623, 1604, 1578, 1517, 1505, 1460 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.70 (s, 1H, H-13), 7.69 (dd, $J = 7.3, 2.0$ Hz, 1H, H-15), 7.03 (d, $J = 9.3$ Hz, 2H, H-16 & H-22), 6.98 (d, $J = 1.3$ Hz, 1H, H-18), 6.90 (d, $J = 8.3$ Hz, 1H, H-21), 6.45 (d, $J = 2.1$ Hz, 1H, H-8), 6.31 (d, $J = 2.1$ Hz, 1H, H-6), 5.06 (d, $J = 7.9$ Hz, 1H, H-11), 4.16-4.13 (m, 1H, H-10), 4.03-3.96 (m, 2H, 3- OCH_2), 3.93 (s, 3H, OCH_3), 3.90 (s, 3H, OCH_3), 3.89 (s, 3H, OCH_3), 3.85 (s, 3H, OCH_3), 3.85-3.81 (overlapped, 1H, H-23), 3.57 (dd, $J = 12.5, 3.8$ Hz, 1H, H-23), 2.74 (t, $J = 6.6$ Hz, 4H, 2 \times CH_2 from pyrrolidino), 2.58 (t, $J = 7.9$ Hz, 2H, 3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 1.90-1.81 (m, 4H, 2 \times CH_2 from pyrrolidino), 1.76-1.55 (m, 4H, 3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 1.42 (quin, $J = 7.8$ Hz, 2H, 3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$); ^{13}C NMR (75 MHz, CDCl_3): δ 174.1 (C-4), 163.9 (C-7), 161.0 (C-5), 158.8 (C-8a), 152.4 (C-16a), 149.7 (C-19), 149.4 (C-20), 145.2 (C-2), 143.5 (C-12a), 140.5 (C-3), 128.6 (C-17), 124.3 (C-14), 122.4 (C-15), 120.1 (C-22), 117.2 (C-13), 116.9 (C-16), 111.3 (C-21), 110.2 (C-18), 109.4 (C-4a), 95.8 (C-6), 92.3 (C-8), 78.7 (C-10), 76.1 (C-11), 72.1 (3- OCH_2), 61.4 (C-23), 56.4 (OCH_3), 56.0 (OCH_3), 55.9 (OCH_3), 55.8 (OCH_3), 55.7 (3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 53.5 (CH_2 from pyrrolidino), 29.8 (3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 27.1 (3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$), 23.9 (CH_2 from pyrrolidino), 23.4 (3- $\text{O-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{N-}$); HRMS-ESI m/z $[\text{M}+\text{H}]^+$ calcd for $\text{C}_{37}\text{H}_{44}\text{NO}_{10}$: 662.2965, found: 662.2970.

3-*O*-Piperidinopropyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**35**). 51% yield, yellow wax. IR (film) ν_{\max} : 3380, 2934, 2853, 1702, 1626, 1606, 1578, 1518, 1506, 1460 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3): δ 7.70 (s, 1H, H-13), 7.69 (d, $J = 7.2$ Hz, 1H, H-15), 7.06 (d, $J = 9.0$ Hz, 1H, H-16), 7.03 (d, $J = 8.0$ Hz, 1H, H-22), 6.97 (s, 1H, H-18), 6.92 (d, $J = 8.2$ Hz, 1H, H-21), 6.46 (d, $J = 1.6$ Hz, 1H, H-8), 6.32 (d, $J = 1.7$ Hz, 1H, H-6), 5.03 (d, $J = 8.1$ Hz, 1H, H-11), 4.14 (dd, $J = 11.2, 3.2$ Hz, 1H, H-10), 4.08-3.97 (m, 2H, 3- OCH_2), 3.94 (s, 3H, OCH_3), 3.92 (s, 3H, OCH_3), 3.91 (s, 3H, OCH_3), 3.86 (s, 3H, OCH_3), 3.86-3.82 (overlapped, 1H, H-23), 3.57 (dd, $J =$

12.5, 3.7 Hz, 1H, H-23), 2.94-2.83 (m, 2H, 3-O-CH₂CH₂CH₂N-), 2.76-2.63 (m, 4H, 2 × NCH₂ from piperidino), 2.12-2.08 (m, 2H, 3-O-CH₂CH₂CH₂N-), 1.79-1.76 (m, 4H, 2 × CH₂ from piperidino), 1.54-1.43 (m, 2H, CH₂ from piperidino); ¹³C NMR (75 MHz, CDCl₃): δ 174.1 (C-4), 164.0 (C-7), 160.9 (C-5), 158.8 (C-8a), 152.6 (C-16a), 149.8 (C-19), 149.4 (C-20), 145.3 (C-2), 143.7 (C-12a), 140.1 (C-3), 128.3 (C-17), 124.0 (C-14), 122.3 (C-15), 120.2 (C-22), 117.2 (C-13), 117.2 (C-16), 111.3 (C-21), 110.2 (C-18), 109.3 (C-4a), 95.9 (C-6), 92.4 (C-8), 78.7 (C-10), 76.3 (C-11), 70.1 (3-OCH₂), 61.5 (C-23), 56.4 (OCH₃), 56.1 (OCH₃), 56.0 (OCH₃), 55.77 (OCH₃), 55.76 (3-O-CH₂CH₂CH₂N-), 53.9 (NCH₂ from piperidino), 26.2 (3-O-CH₂CH₂CH₂N-), 24.3 (CH₂ from piperidino), 23.4 (CH₂ from piperidino); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₆H₄₂NO₁₀: 648.2809, found: 648.2807.

3-O-Piperidinobutyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (36). 78% yield, yellow solid, mp. 91-92 °C. IR (film) ν_{\max} : 3392, 2937, 2837, 1625, 1606, 1506, 1458 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.70-7.65 (overlapped, 2H, H-13 & H-15), 7.02 (d, *J* = 9.0 Hz, 2H, H-16 & H-22), 6.97 (s, 1H, H-18), 6.90 (d, *J* = 8.1 Hz, 1H, H-21), 6.44 (s, 1H, H-8), 6.30 (s, 1H, H-6), 5.03 (d, *J* = 7.8 Hz, 1H, H-11), 4.15-4.10 (m, 1H, H-10), 3.97 (t, *J* = 5.7 Hz, 2H, 3-OCH₂), 3.92 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.89 (s, 3H, OCH₃), 3.84 (s, 3H, OCH₃), 3.84-3.81 (overlapped, 1H, H-23), 3.56 (dd, *J* = 12.3, 3.6 Hz, 1H, H-23), 2.70-2.42 (overlapped, 6H, 3-O-CH₂CH₂CH₂CH₂N- & 2 × NCH₂ from piperidino), 1.74-1.64 (m, 8H, 3-O-CH₂CH₂CH₂CH₂N- & 2 × CH₂ from piperidino), 1.52-1.36 (m, 2H, CH₂ from piperidino); ¹³C NMR (75 MHz, CDCl₃): δ 174.8 (C-4), 164.6 (C-7), 161.5 (C-5), 159.4 (C-8a), 153.0 (C-16a), 150.3 (C-19), 150.0 (C-20), 145.9 (C-2), 144.2 (C-12a), 141.0 (C-3), 129.1 (C-17), 124.8 (C-14), 123.0 (C-15), 120.8 (C-22), 117.71 (C-13), 117.65 (C-16), 111.9 (C-21), 110.8 (C-18), 110.0 (C-4a), 96.4 (C-6), 93.0 (C-8), 79.3 (C-10), 76.8 (C-11), 72.4 (3-OCH₂), 62.0 (C-23), 59.1 (OCH₃), 57.0 (OCH₃), 56.7 (OCH₃), 56.6 (OCH₃), 56.4 (3-O-CH₂CH₂CH₂CH₂N-), 54.5 (NCH₂ from piperidino), 28.6 (3-O-CH₂CH₂CH₂CH₂N-), 25.4 (3-O-CH₂CH₂CH₂CH₂N-), 24.3 (CH₂ from piperidino), 22.9 (CH₂ from piperidino); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₇H₄₄NO₁₀: 662.2966, found: 662.2959.

3.10.18. 3-O-Piperidinopentyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (37). 91% yield, white solid, mp. 89.5-90.0 °C. IR (film) ν_{\max} : 3404, 2935, 2858, 1624, 1605, 1578, 1538, 1517, 1490, 1462 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.71 (s, 1H, H-13), 7.70 (d, *J* = 6.5 Hz, 1H, H-15), 7.03 (d, *J* = 8.2 Hz, 2H, H-16 & H-22), 6.98 (s, 1H, H-18), 6.92 (d, *J* = 8.1 Hz, 1H, H-21), 6.45 (s, 1H, H-8), 6.31 (s, 1H, H-6), 5.06 (d, *J* = 7.9 Hz, 1H, H-11), 4.16-4.13 (m, 1H, H-10), 4.03-3.97 (m, 2H, 3-OCH₂), 3.93 (s, 3H, OCH₃), 3.90 (s, 6H, 2 × OCH₃), 3.85 (s, 3H, OCH₃), 3.85-3.82 (overlapped, 1H, H-23), 3.58 (dd, *J* = 11.8, 2.1 Hz, 1H, H-23), 2.59-2.45 (m, 4H, 2 × NCH₂ from piperidino), 2.41 (t, *J* = 7.1 Hz, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.76-1.62 (m, 6H, 3-O-CH₂CH₂CH₂CH₂CH₂N- & 2 × CH₂ from piperidino), 1.60-1.52 (m, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.51-1.37 (m, 4H, CH₂ from piperidino & 3-O-CH₂CH₂CH₂CH₂CH₂N-); ¹³C NMR (75 MHz, CDCl₃): δ 174.3 (C-4), 164.0 (C-7), 161.1 (C-5), 158.9 (C-8a), 152.5 (C-16a), 149.9 (C-19), 149.6 (C-20), 145.3 (C-2), 143.7 (C-12a), 140.6 (C-3), 128.7 (C-17), 124.5 (C-14), 122.6 (C-15), 120.3 (C-22), 117.4 (C-13), 117.1 (C-16), 111.5 (C-21), 110.3 (C-18), 109.6 (C-4a), 95.9 (C-6), 92.5 (C-8), 78.8 (C-10), 76.3 (C-11), 72.3 (3-OCH₂), 61.6 (C-23), 58.9 (OCH₃), 56.5 (OCH₃), 56.2 (OCH₃), 56.1 (OCH₃), 55.9 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 54.1 (NCH₂ from piperidino), 30.0 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 25.6 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 25.0 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 24.2 (CH₂ from piperidino), 23.9 (CH₂ from piperidino); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₈H₄₆NO₁₀: 676.3122, found: 676.3117.

3-O-Morpholinopropyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (38). 54% yield, yellow wax. IR (film) ν_{\max} : 3379, 2937, 2838, 1625, 1606, 1518, 1506, 1493, 1462 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.69 (s, 1H, H-13), 7.68 (d, *J* = 8.6 Hz, 1H, H-15), 7.07 (d, *J* = 8.9 Hz, 1H, H-16), 7.04 (d, *J* = 10.8 Hz, 1H, H-22), 6.97 (s, 1H, H-18), 6.92 (d, *J* = 8.2 Hz, 1H, H-21), 6.48 (s, 1H, H-8), 6.34 (s, 1H, H-6), 5.03 (d, *J* = 8.3 Hz, 1H, H-11), 4.16-4.14 (m, 1H, H-10), 4.02-3.90 (overlapped, 2H, 3-OCH₂), 3.94 (s, 3H, OCH₃), 3.91 (s, 6H, 2 × OCH₃), 3.87 (s, 3H, OCH₃), 3.94-3.87 (overlapped, 4H, 2 × OCH₂ from morpholino), 3.87-3.83 (overlapped, 1H, H-23), 3.58 (dd, *J* = 12.2, 2.9 Hz, 1H, H-23), 3.24-3.10 (m, 2H, 3-O-CH₂CH₂CH₂N-), 3.03-2.83 (m, 4H, 2 × NCH₂ from morpholino), 2.29-2.13 (m, 2H, 3-O-CH₂CH₂CH₂N-); ¹³C NMR (75 MHz, CDCl₃): δ 174.2 (C-4), 164.3 (C-7), 161.1 (C-5), 159.0 (C-8a), 153.0 (C-16a), 150.0 (C-19), 149.6 (C-20), 145.6 (C-2), 143.9 (C-12a), 140.1 (C-3), 128.4 (C-17), 124.0 (C-14), 122.4 (C-15), 120.4 (C-22), 117.4 (C-13), 117.3 (C-16), 111.5 (C-21), 110.4 (C-18), 109.4 (C-4a), 96.1 (C-6), 92.6 (C-

8), 78.9 (C-10), 76.5 (C-11), 69.6 (3-OCH₂), 65.0 (OCH₂ from morpholino), 61.7 (C-23), 56.6 (OCH₃), 56.2 (OCH₃), 56.2 (OCH₃), 56.1 (OCH₃), 56.0 (3-O-CH₂CH₂CH₂N-), 52.9 (NCH₂ from morpholino), 25.6 (3-O-CH₂CH₂CH₂N-); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₅H₄₀NO₁₁: 650.2601, found: 650.2602.

3-O-Morpholinobutyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (39). 90% yield, yellow wax. IR (film) ν_{\max} : 3415, 2938, 1624, 1605, 1579, 1491 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.73 (d, *J* = 6.9 Hz, 1H, H-15), 7.72 (s, 1H, H-13), 7.02 (d, *J* = 9.0 Hz, 2H, H-16 & H-22), 6.96 (s, 1H, H-18), 6.91 (d, *J* = 8.4 Hz, 1H, H-21), 6.45 (d, *J* = 1.5 Hz, 1H, H-8), 6.31 (s, 1H, H-6), 5.03 (d, *J* = 8.1 Hz, 1H, H-11), 4.13-4.10 (m, 1H, H-10), 4.07-4.01 (m, 2H, 3-OCH₂), 3.93 (s, 3H, OCH₃), 3.91 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.85 (s, 3H, OCH₃), 3.85-3.82 (overlapped, 1H, H-23), 3.68 (t, *J* = 4.5 Hz, 4H, 2 × OCH₂ from morpholino), 3.56 (dd, *J* = 12.3, 3.6 Hz, H-23), 2.42-2.35 (overlapped, 6H, 3-O-CH₂CH₂CH₂CH₂N- & 2 × NCH₂ from morpholino), 1.77-1.62 (m, 4H, 3-O-CH₂CH₂CH₂CH₂N-); ¹³C NMR (75 MHz, CDCl₃): δ 174.8 (C-4), 164.5 (C-7), 161.6 (C-5), 159.4 (C-8a), 152.8 (C-16a), 150.4 (C-19), 150.0 (C-20), 145.8 (C-2), 144.2 (C-12a), 141.1 (C-3), 129.0 (C-17), 125.0 (C-14), 123.0 (C-15), 120.8 (C-22), 117.8 (C-13), 117.6 (C-16), 111.9 (C-21), 110.7 (C-18), 110.0 (C-4a), 96.4 (C-6), 92.9 (C-8), 79.3 (C-10), 76.9 (C-11), 72.6 (3-OCH₂), 67.4 (OCH₂ from morpholino), 62.2 (C-23), 59.3 (OCH₃), 57.0 (OCH₃), 56.7 (OCH₃), 56.6 (OCH₃), 56.4 (3-O-CH₂CH₂CH₂CH₂N-), 54.1 (NCH₂ from morpholino), 28.7 (3-O-CH₂CH₂CH₂CH₂N-), 23.3 (3-O-CH₂CH₂CH₂CH₂N-); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₆H₄₂NO₁₁: 664.2758, found: 664.2757.

3-O-Morpholinopentyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (40). 77% yield, light yellow wax. IR (film) ν_{\max} : 3397, 2936, 1625, 1603, 1505, 1456, 1428 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.72-7.69 (overlapped, 2H, H-15 & H-13), 7.02 (dd, *J* = 8.4, 1.8 Hz, 1H, H-16), 7.01 (d, *J* = 9.3 Hz, 1H, H-22), 6.97 (s, 1H, H-18), 6.90 (d, *J* = 8.1 Hz, 1H, H-21), 6.44 (d, *J* = 2.1 Hz, 1H, H-8), 6.30 (d, *J* = 2.1 Hz, 1H, H-6), 5.03 (d, *J* = 8.1 Hz, 1H, H-11), 4.12 (dt, *J* = 8.1, 4.8 Hz, 1H, H-10), 4.01-3.98 (m, 2H, 3-OCH₂), 3.92 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.89 (s, 3H, OCH₃), 3.84 (s, 3H, OCH₃), 3.84-3.80 (overlapped, 1H, H-23), 3.72 (t, *J* = 4.5 Hz, 4H, 2 × OCH₂ from morpholino), 3.56 (dd, *J* = 12.6, 3.9 Hz, 1H, H-23), 2.47 (br,s, 4H, 2 × NCH₂ from morpholino), 2.35 (t, *J* = 7.2 Hz, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.73 (quin, *J* = 6.9 Hz, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.53-1.23 (m, 4H, 3-O-CH₂CH₂CH₂CH₂CH₂N-). ¹³C NMR (75 MHz, CDCl₃): δ 174.1 (C-4), 163.9 (C-7), 160.9 (C-5), 158.7 (C-8a), 152.2 (C-16a), 149.7 (C-19), 149.4 (C-20), 145.1 (C-2), 143.6 (C-12a), 140.5 (C-3), 128.4 (C-17), 124.4 (C-14), 122.4 (C-15), 120.2 (C-22), 117.1 (C-13), 116.9 (C-16), 111.3 (C-21), 110.2 (C-18), 109.4 (C-4a), 95.7 (C-6), 92.3 (C-8), 78.7 (C-10), 76.2 (C-11), 72.0 (3-OCH₂), 66.5 (OCH₂ from morpholino), 61.5 (C-23), 58.9 (OCH₃), 56.3 (OCH₃), 56.0 (OCH₃), 55.9 (OCH₃), 55.7 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 53.4 (NCH₂ from morpholino), 29.9 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 25.7 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 23.8 (3-O-CH₂CH₂CH₂CH₂CH₂N-); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₇H₄₄NO₁₁: 678.2914, found: 678.2915.

3-O-(Piperazin-1-yl)propyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (41). 74% yield, white solid, mp. 158-159 °C. IR (film) ν_{\max} : 3347, 3207, 2937, 2836, 1623, 1604, 1578, 1517, 1490, 1458 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.67 (s, 1H, H-13), 7.66 (d, *J* = 8.1 Hz, 1H, H-15), 7.02 (d, *J* = 8.1 Hz, 2H, H-16 & H-22), 6.97 (s, 1H, H-18), 6.90 (d, *J* = 8.1 Hz, 1H, H-21), 6.44 (s, 1H, H-8), 6.31 (s, 1H, H-6), 5.73 (br.s, 1H, NH), 5.04 (d, *J* = 7.8 Hz, 1H, H-11), 4.13 (d, *J* = 7.5 Hz, 1H, H-10), 4.04 (t, *J* = 5.4 Hz, 2H, 3-OCH₂), 3.92 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.89 (s, 3H, OCH₃), 3.85 (s, 3H, OCH₃), 3.85-3.82 (overlapped, 1H, H-23), 3.55 (dd, *J* = 12.3, 3.0 Hz, 1H, H-23), 2.97 (br.s, 4H, 2 × NCH₂ from piperazine), 2.49 (br.s., 6H, 3-O-CH₂CH₂CH₂N- & 2 × NCH₂ from piperazine), 1.90-1.79 (m, 2H, 3-O-CH₂CH₂CH₂N-); ¹³C NMR (75 MHz, CDCl₃): δ 174.1 (C-4), 163.9 (C-7), 160.9 (C-5), 158.8 (C-8a), 152.5 (C-16a), 149.7 (C-19), 149.3 (C-20), 145.3 (C-2), 143.5 (C-12a), 140.3 (C-3), 128.5 (C-17), 124.1 (C-14), 122.5 (C-15), 120.2 (C-22), 117.3 (C-13), 116.9 (C-16), 111.3 (C-21), 110.2 (C-18), 109.4 (C-4a), 95.8 (C-6), 92.3 (C-8), 78.7 (C-10), 76.1 (C-11), 70.4 (3-OCH₂), 61.2 (C-23), 56.4 (OCH₃), 56.0 (OCH₃), 55.9 (OCH₃), 55.8 (OCH₃), 55.3 (3-O-CH₂CH₂CH₂N-), 51.7 (NCH₂ from piperazine), 44.2 (NCH₂ from piperazine), 27.2 (3-O-CH₂CH₂CH₂N-); HRMS-ESI *m/z* [M+H]⁺ calcd for C₃₅H₄₁N₂O₁₀: 649.2761, found: 649.2764.

3-O-(Piperazin-1-yl)butyl-5,7,20-O-trimethyl-2,3-dehydrosilybin (42). 68% yield, yellow wax. IR (film) ν_{\max} : 3379, 2934, 1625, 1604, 1505, 1456 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.68 (d, *J* = 7.8 Hz, 1H, H-15), 7.66 (s, 1H, H-13), 7.03 (d, *J* = 7.8 Hz, 2H, H-16 & H-22), 6.99 (s, 1H, H-18), 6.91 (d, *J* = 8.1 Hz, 1H, H-21),

6.45 (s, 1H, H-8), 6.32 (s, 1H, H-6), 5.06 (d, $J = 7.8$ Hz, 1H, H-11), 4.17-4.09 (m, 1H, H-10), 4.09-3.99 (m, 2H, 3-OCH₂), 3.93 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.89 (s, 3H, OCH₃), 3.86 (s, 3H, OCH₃), 3.85-3.79 (overlapped, 1H, H-23), 3.56 (d, $J = 11.1$ Hz, 1H, H-23), 3.11-2.99 (m, 2H, 3-O-CH₂CH₂CH₂CH₂N-), 2.61-2.43 (m, 4H, 2 × NCH₂ from piperazine), 2.39-2.26 (m, 4H, 2 × NCH₂ from piperazine), 1.74-1.47 (m, 4H, 3-O-CH₂CH₂CH₂CH₂N-); ¹³C NMR (75 MHz, CDCl₃): δ 174.8 (C-4), 164.5 (C-7), 161.6 (C-5), 159.4 (C-8a), 153.2 (C-16a), 150.3 (C-19), 150.0 (C-20), 145.8 (C-2), 144.2 (C-12a), 141.0 (C-3), 129.1 (C-17), 124.9 (C-14), 123.3 (C-15), 120.8 (C-22), 117.9 (C-13), 117.5 (C-16), 111.9 (C-21), 110.8 (C-18), 110.0 (C-4a), 96.4 (C-6), 92.9 (C-8), 79.4 (C-10), 76.7 (C-11), 72.7 (3-OCH₂), 61.8 (C-23), 58.6 (OCH₃), 57.0 (OCH₃), 56.7 (OCH₃), 56.6 (OCH₃), 56.4 (3-O-CH₂CH₂CH₂CH₂N-), 52.0 (NCH₂ from piperazine), 44.9 (NCH₂ from piperazine), 28.4 (3-O-CH₂CH₂CH₂CH₂N-), 23.7 (3-O-CH₂CH₂CH₂CH₂N-); HRMS-ESI m/z [M+H]⁺ calcd for C₃₆H₄₃N₂O₁₀: 663.2918, found: 663.2912.

3-*O*-(Piperazin-1-yl)pentyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**43**). 98% yield, light yellow wax. IR (film) ν_{\max} : 3365, 3003, 2937, 2861, 2836, 1667, 1623, 1604, 1578, 1517, 1491, 1459 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.72 (d, $J = 8.1$ Hz, 1H, H-15), 7.67 (s, 1H, H-13), 7.04 (d, $J = 8.1$ Hz, 2H, H-16 & H-22), 6.98 (s, 1H, H-18), 6.91 (d, $J = 8.1$ Hz, 1H, H-21), 6.46 (s, 1H, H-8), 6.32 (s, 1H, H-6), 5.05 (d, $J = 7.8$ Hz, 1H, H-11), 4.12 (d, $J = 7.2$ Hz, 1H, H-10), 4.02 (t, $J = 4.5$ Hz, 2H, 3-OCH₂), 3.93 (s, 6H, 2 × OCH₃), 3.91 (s, 6H, 2 × OCH₃), 3.91-3.83 (overlapped, 1H, H-23), 3.56 (d, $J = 12.3$ Hz, 1H, H-23), 3.28-2.98 (m, 4H, 2 × NCH₂ from piperazine), 2.62-2.50 (m, 4H, 2 × NCH₂ from piperazine), 2.41-2.25 (m, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.78-1.60 (m, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.50-1.33 (m, 4H, 3-O-CH₂CH₂CH₂CH₂CH₂N-); ¹³C NMR (75 MHz, CDCl₃): δ 174.3 (C-4), 164.1 (C-7), 161.1 (C-5), 159.0 (C-8a), 152.7 (C-16a), 149.9 (C-19), 149.6 (C-20), 145.3 (C-2), 143.8 (C-12a), 140.6 (C-3), 128.7 (C-17), 124.5 (C-14), 122.8 (C-15), 120.4 (C-22), 117.3 (C-13), 117.0 (C-16), 111.5 (C-21), 110.4 (C-18), 109.6 (C-4a), 95.9 (C-6), 92.5 (C-8), 79.0 (C-10), 76.4 (C-11), 72.2 (3-OCH₂), 61.3 (C-23), 58.5 (OCH₃), 56.5 (OCH₃), 56.2 (OCH₃), 56.1 (OCH₃), 55.9 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 51.0 (NCH₂ from piperazine), 43.9 (NCH₂ from piperazine), 30.0 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 26.2 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 24.1 (3-O-CH₂CH₂CH₂CH₂CH₂N-); HRMS-ESI m/z [M+H]⁺ calcd for C₃₇H₄₅N₂O₁₀: 677.3074, found: 677.3064.

3-*O*-(4-Methylpiperazin-1-yl)propyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**44**). 75% yield, yellow wax. IR (film) ν_{\max} : 3398, 3002, 2937, 2879, 2836, 2806, 1625, 1606, 1578, 1517, 1506, 1491, 1460 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.70 (s, 1H, H-13), 7.68 (dd, $J = 8.7, 2.1$ Hz, 1H, H-15), 7.03 (d, $J = 8.4$ Hz, 2H, H-16 & H-22), 6.97 (d, $J = 1.5$ Hz, 1H, H-18), 6.91 (d, $J = 8.2$ Hz, 1H, H-21), 6.45 (d, $J = 2.1$ Hz, 1H, H-8), 6.31 (d, $J = 2.1$ Hz, 1H, H-6), 5.04 (d, $J = 8.1$ Hz, 1H, H-11), 4.17-4.12 (m, 1H, H-10), 4.10-4.04 (m, 2H, 3-OCH₂), 3.93 (s, 3H, OCH₃), 3.91 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.86 (s, 3H, OCH₃), 3.85-3.82 (overlapped, 1H, H-23), 3.58 (dd, $J = 12.3, 3.9$ Hz, 1H, H-23), 2.62-2.47 (overlapped, 10H, 4 × NCH₂ from 4-methylpiperazine and 3-O-CH₂CH₂CH₂N-), 2.32 (s, 3H, NCH₃), 1.93 (quin, $J = 6.6$ Hz, 2H, 3-O-CH₂CH₂CH₂N-); ¹³C NMR (75 MHz, CDCl₃): δ 174.0 (C-4), 163.9 (C-7), 161.0 (C-5), 158.8 (C-8a), 152.3 (C-16a), 149.7 (C-19), 149.4 (C-20), 145.2 (C-2), 143.6 (C-12a), 140.3 (C-3), 128.5 (C-17), 124.2 (C-14), 122.4 (C-15), 120.2 (C-22), 117.3 (C-13), 117.0 (C-16), 111.3 (C-21), 110.2 (C-18), 109.4 (C-4a), 95.8 (C-6), 92.3 (C-8), 78.7 (C-10), 76.2 (C-11), 70.4 (3-OCH₂), 61.4 (C-23), 56.4 (OCH₃), 56.1 (OCH₃), 56.0 (OCH₃), 55.7 (OCH₃), 55.2 (3-O-CH₂CH₂CH₂N-), 54.3 (NCH₂ from 4-methylpiperazine), 52.3 (NCH₂ from 4-methylpiperazine), 45.4 (NCH₃), 27.2 (3-O-CH₂CH₂CH₂N-); HRMS-ESI m/z [M+H]⁺ calcd for C₃₆H₄₃N₂O₁₀: 663.2918, found: 663.2914.

3-*O*-(4-Methylpiperazin-1-yl)pentyl-5,7,20-*O*-trimethyl-2,3-dehydrosilybin (**45**). 93% yield, light yellow wax. IR (film) ν_{\max} : 3384, 2941, 2838, 1624, 1606, 1579, 1517, 1506, 1491, 1463 cm⁻¹; ¹H NMR (300 MHz, CDCl₃): δ 7.72 (dd, $J = 7.7, 2.1$ Hz, 1H, H-15), 7.70 (s, 1H, H-13), 7.05-7.01 (overlapped, 2H, H-16 & H-22), 6.98 (d, $J = 1.8$ Hz, 1H, H-18), 6.91 (d, $J = 8.3$ Hz, 1H, H-21), 6.46 (d, $J = 2.2$ Hz, 1H, H-8), 6.31 (d, $J = 2.2$ Hz, 1H, H-6), 5.06 (d, $J = 8.1$ Hz, 1H, H-11), 4.13 (dt, $J = 7.9, 3.1$ Hz, 1H, H-10), 4.02 (t, $J = 6.4$ Hz, 2H, 3-OCH₂), 3.93 (s, 3H, OCH₃), 3.91 (s, 3H, OCH₃), 3.90 (s, 3H, OCH₃), 3.86 (s, 3H, OCH₃), 3.85 (dd, $J = 12.5, 2.6$ Hz, 1H, H-23), 3.56 (dd, $J = 12.5, 3.8$ Hz, 1H, H-23), 2.89-2.70 (overlapped, 4H, 2 × NCH₂ from 4-methylpiperazine), 2.63-2.45 (m, 6H, 2 × NCH₂ from 4-methylpiperazine and 3-O-CH₂CH₂CH₂CH₂CH₂N-), 2.32 (s, 3H, NCH₃), 1.71 (quin, $J = 6.3$ Hz, 2H, 3-O-CH₂CH₂CH₂CH₂CH₂N-), 1.51-1.35 (m, 4H, 3-O-CH₂CH₂CH₂CH₂CH₂N-); ¹³C NMR (75 MHz, CDCl₃): δ 174.1 (C-4), 163.9 (C-7), 161.0 (C-5), 158.8 (C-8a), 152.3 (C-16a), 149.7 (C-19), 149.4 (C-20), 145.1 (C-2),

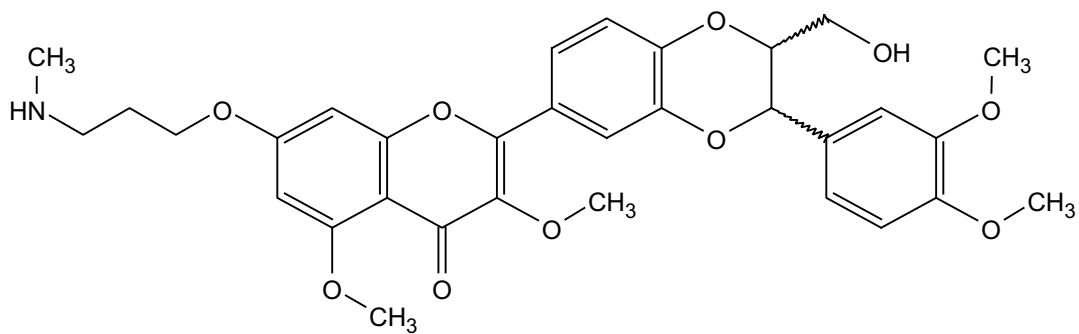
143.6 (C-12a), 140.5 (C-3), 128.5 (C-17), 124.4 (C-14), 122.5 (C-15), 120.2 (C-22), 117.2 (C-13), 116.9 (C-16), 111.3 (C-21), 110.2 (C-18), 109.5 (C-4a), 95.8 (C-6), 92.3 (C-8), 78.7 (C-10), 76.1 (C-11), 72.2 (3-OCH₂), 61.4 (C-23), 58.4 (OCH₃), 56.4 (OCH₃), 56.1 (OCH₃), 56.0 (OCH₃), 55.7 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 54.5 (NCH₂ from 4-methylpiperazine), 52.5 (NCH₂ from 4-methylpiperazine), 45.6 (NCH₃), 29.9 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 26.1 (3-O-CH₂CH₂CH₂CH₂CH₂N-), 23.9 (3-O-CH₂CH₂CH₂CH₂CH₂N-); HRMS-ESI m/z [M+H]⁺ calcd for C₃₈H₄₇N₂O₁₀: 691.3231, found 691.3233.

NMR
SZ-208-4 CDCl₃ 300 MHz

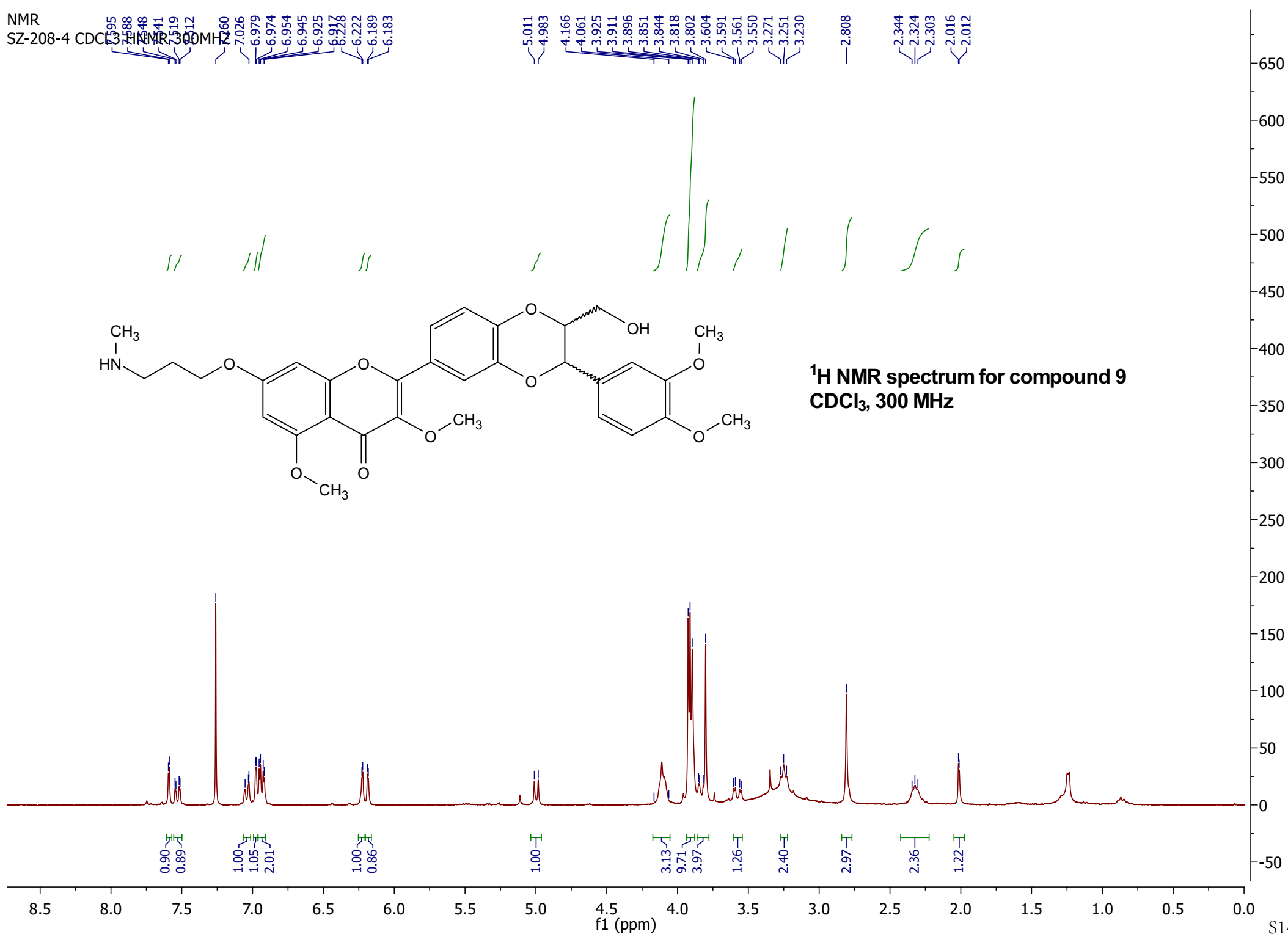
7.995
7.988
7.948
7.941
7.919
7.912
7.660
7.026
6.979
6.974
6.954
6.945
6.925
6.917
6.222
6.189
6.183

5.011
4.983
4.166
4.061
3.925
3.911
3.896
3.851
3.844
3.818
3.802
3.604
3.591
3.561
3.550
3.271
3.251
3.230

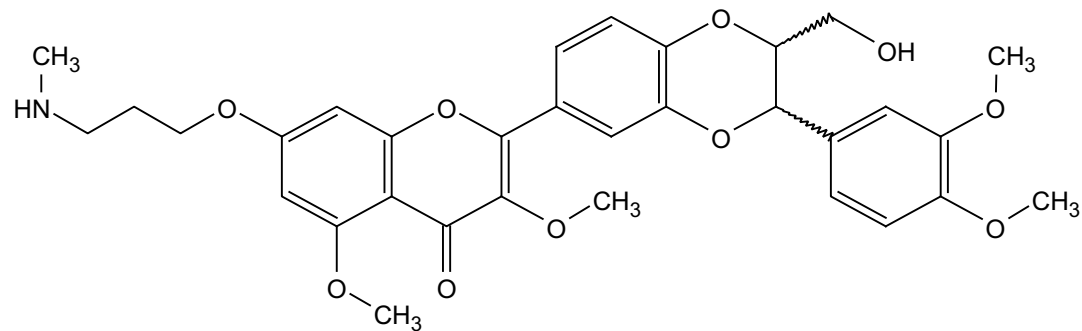
2.808
2.344
2.324
2.303
2.016
2.012



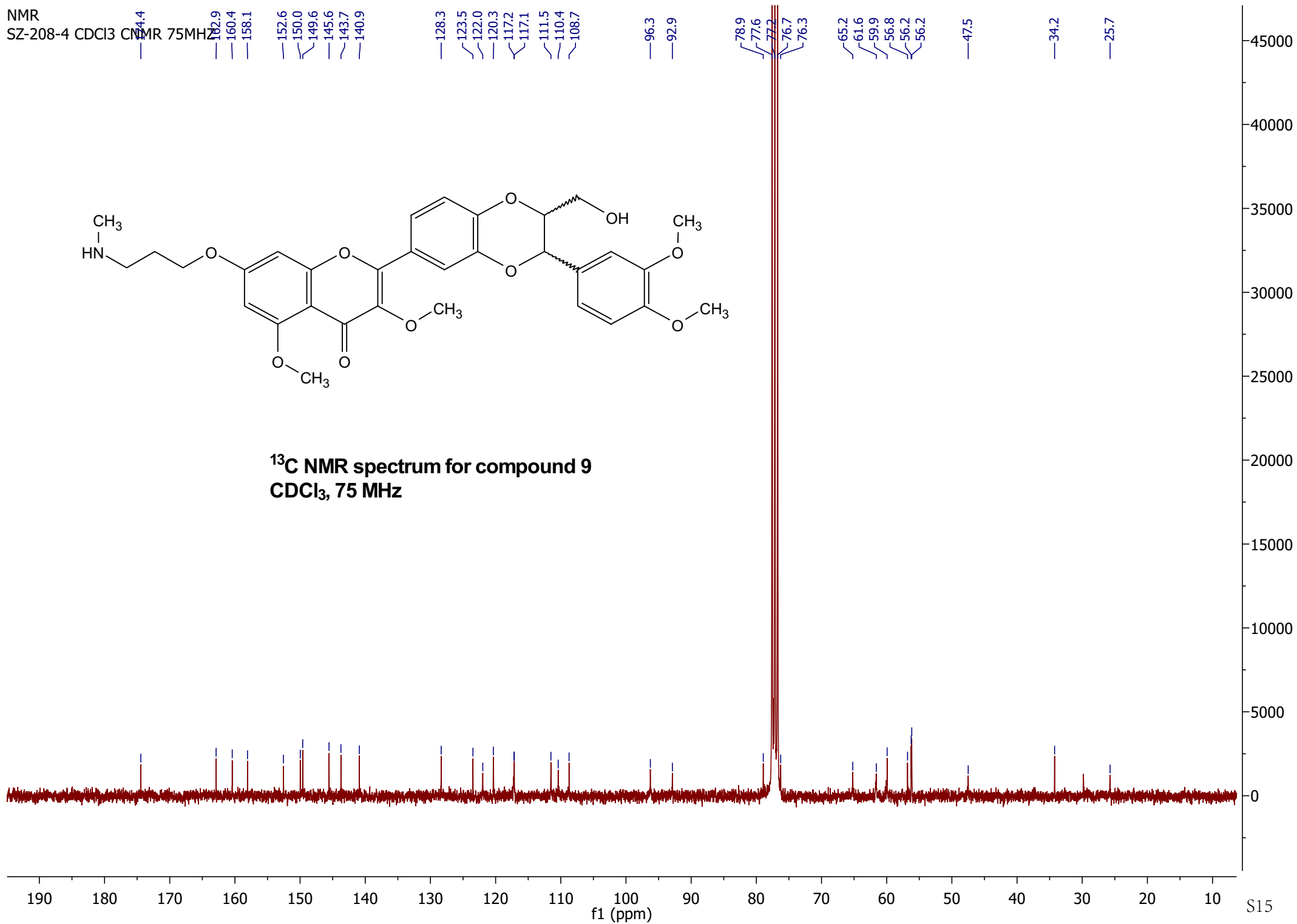
¹H NMR spectrum for compound 9
CDCl₃, 300 MHz



NMR
SZ-208-4 CDCl₃ NMR 75MHz

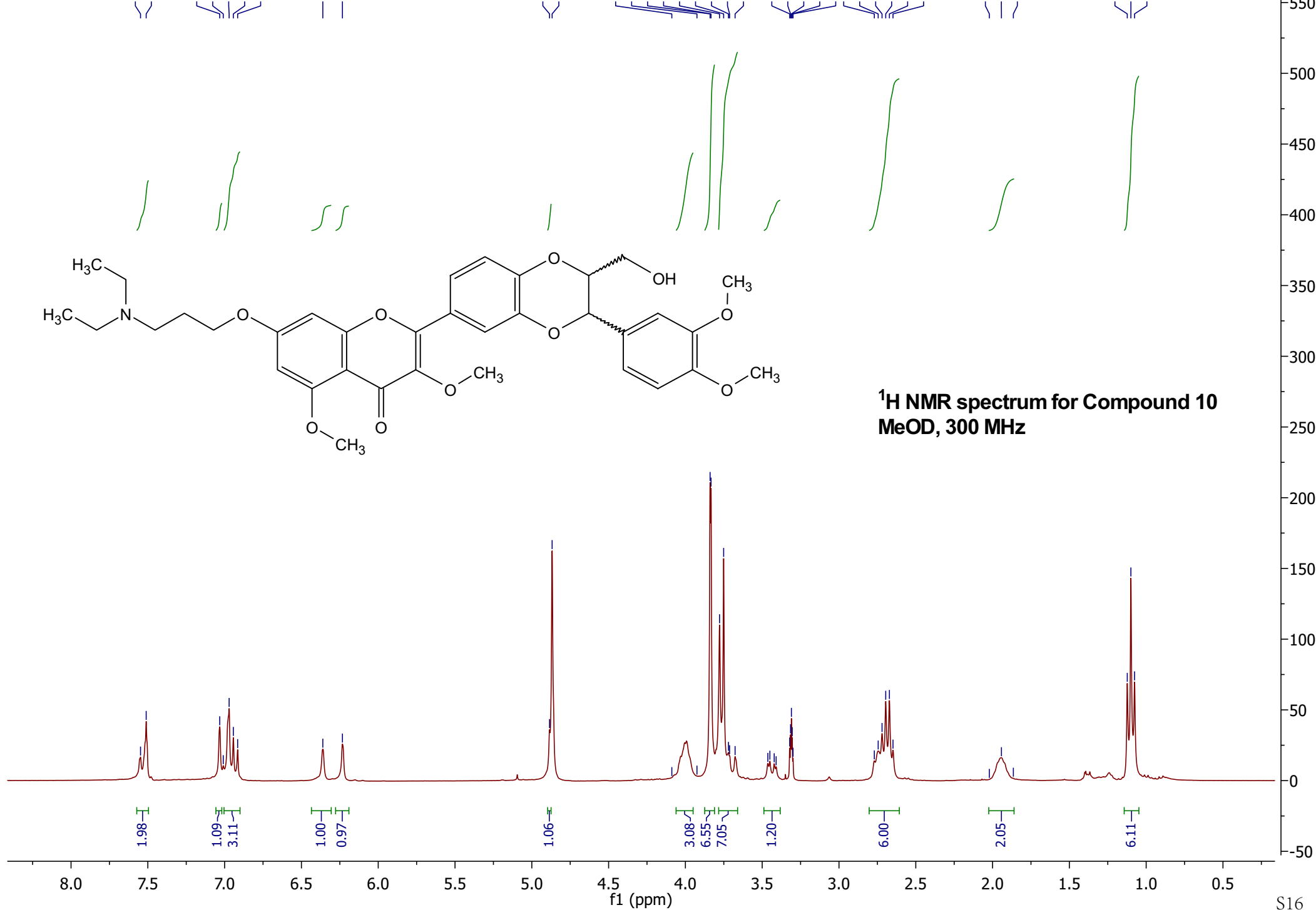


¹³C NMR spectrum for compound 9
CDCl₃, 75 MHz



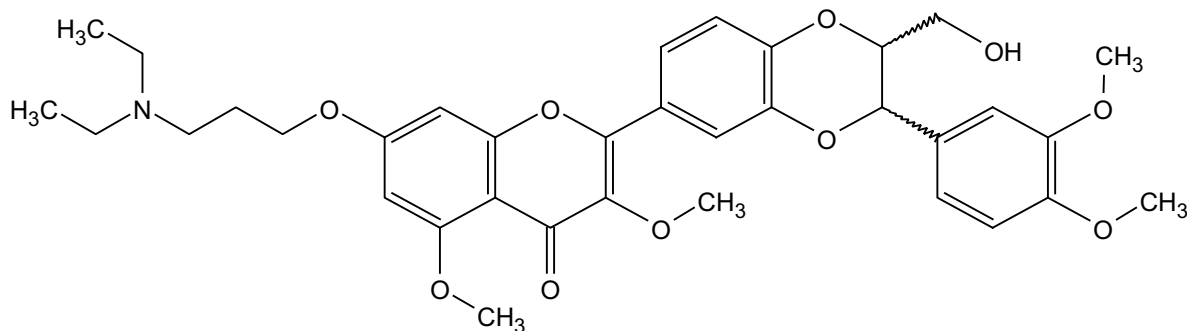
NMR

SZ-19-138 MeOD, 300 MHz

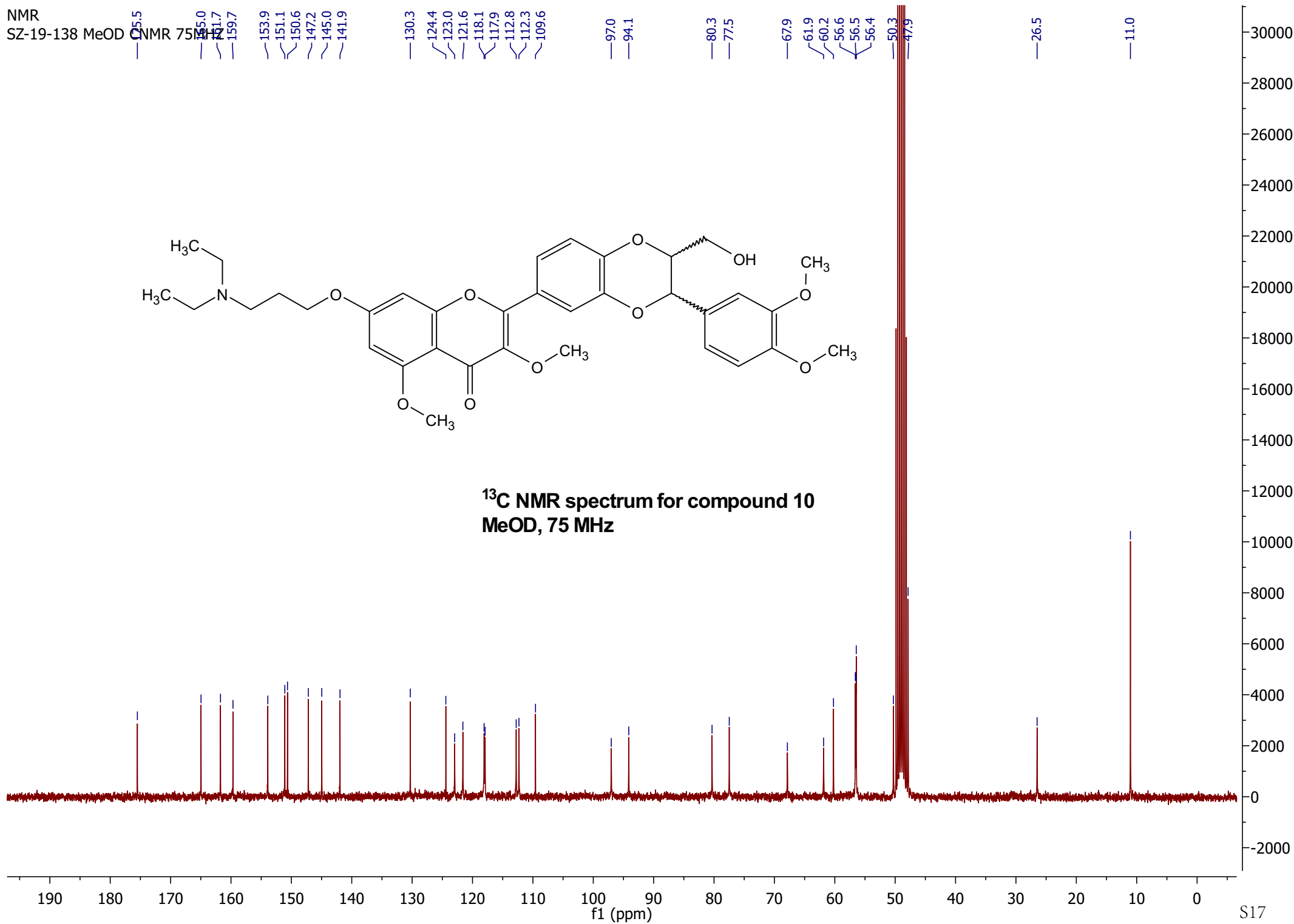


NMR
SZ-19-138 MeOD

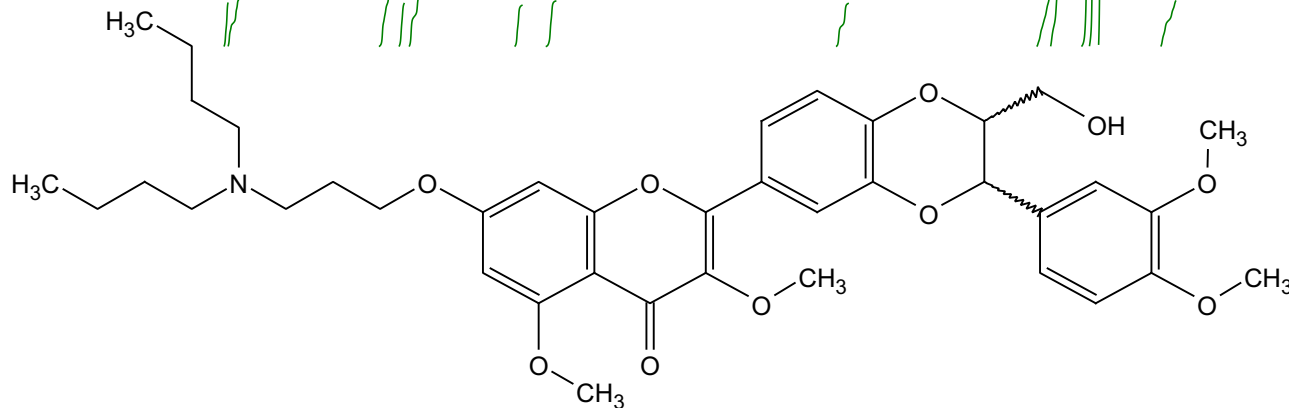
¹³C NMR 75 MHz



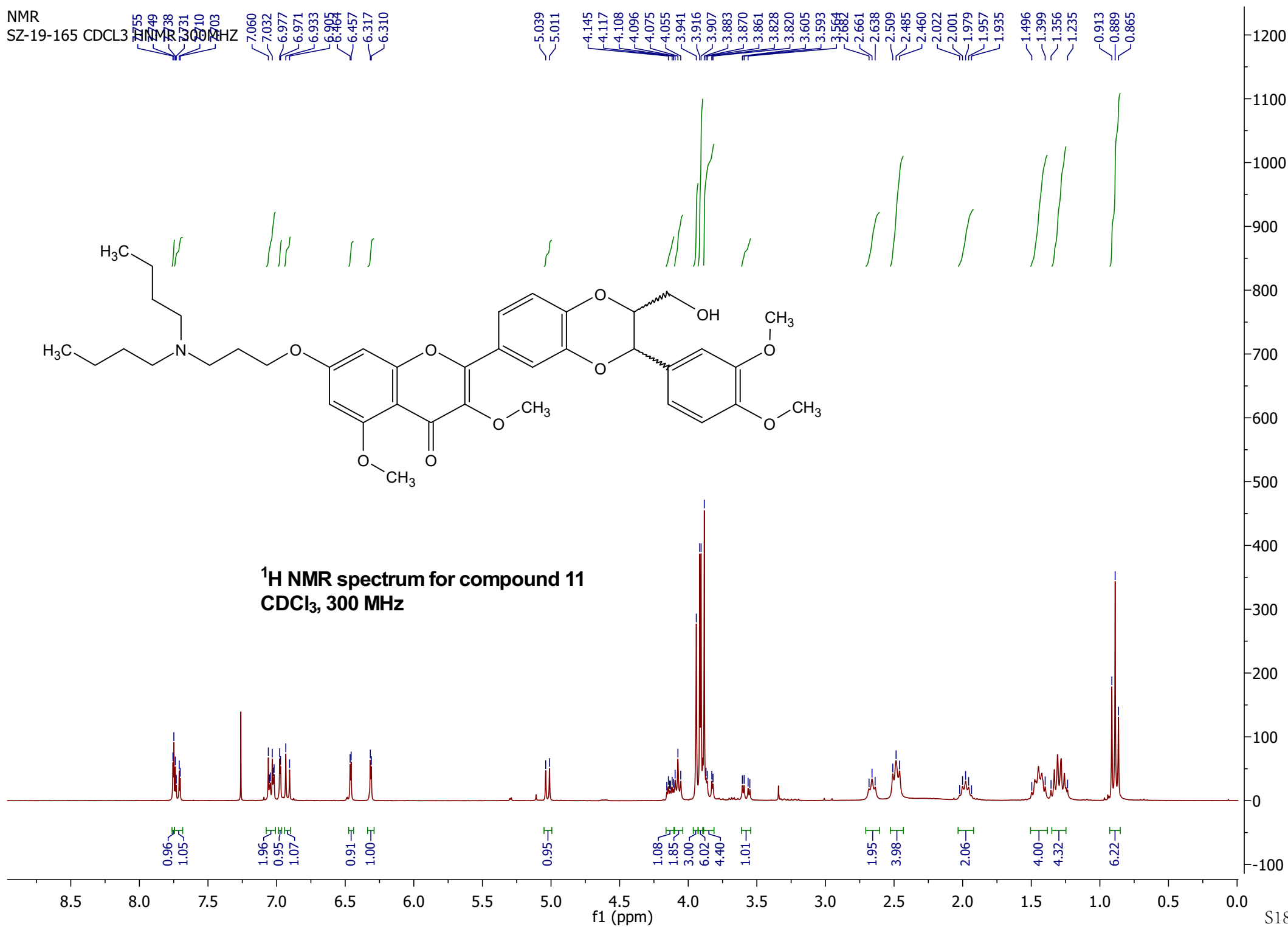
¹³C NMR spectrum for compound 10
MeOD, 75 MHz



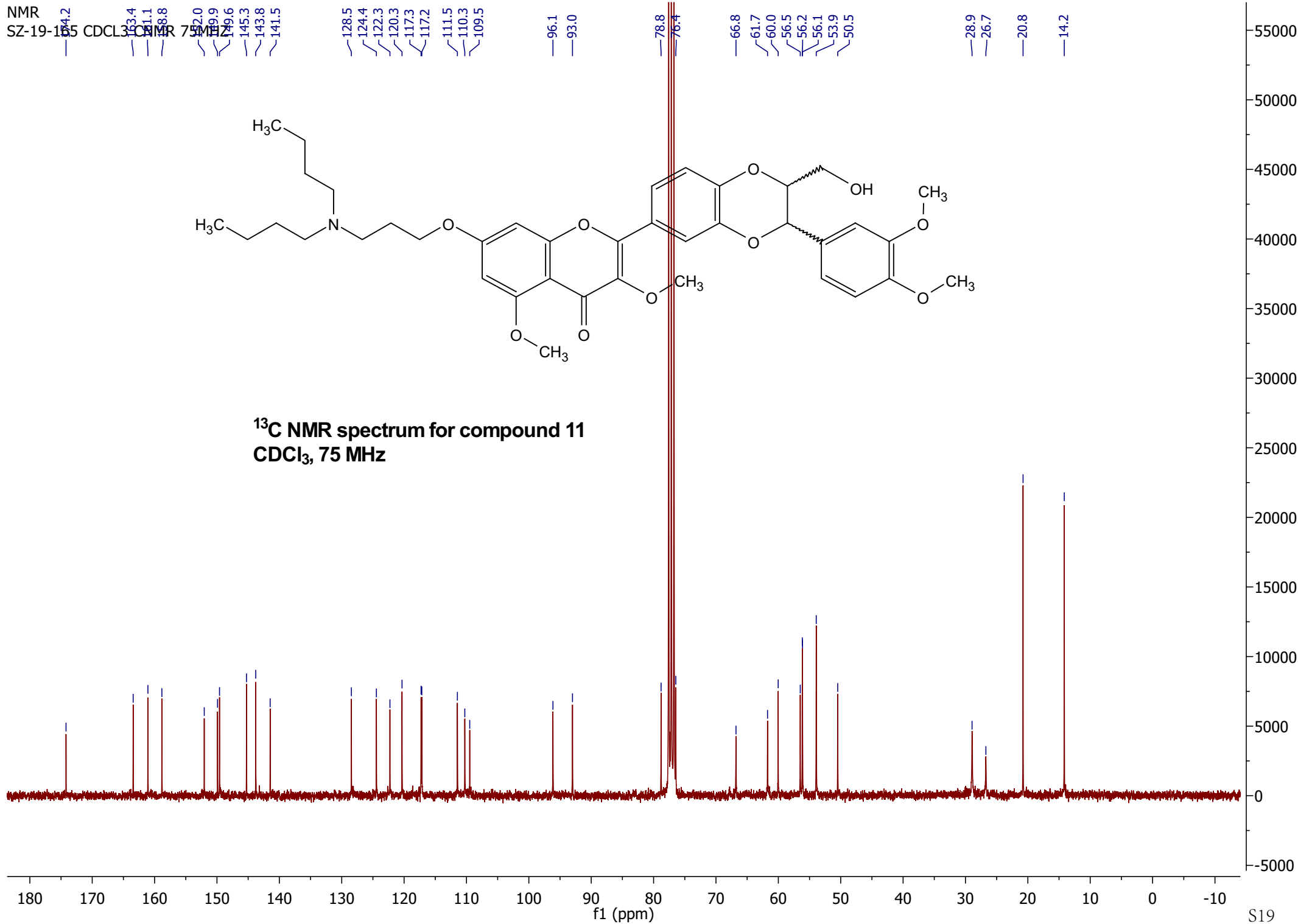
NMR
SZ-19-165 CDCl₃ 300 MHz



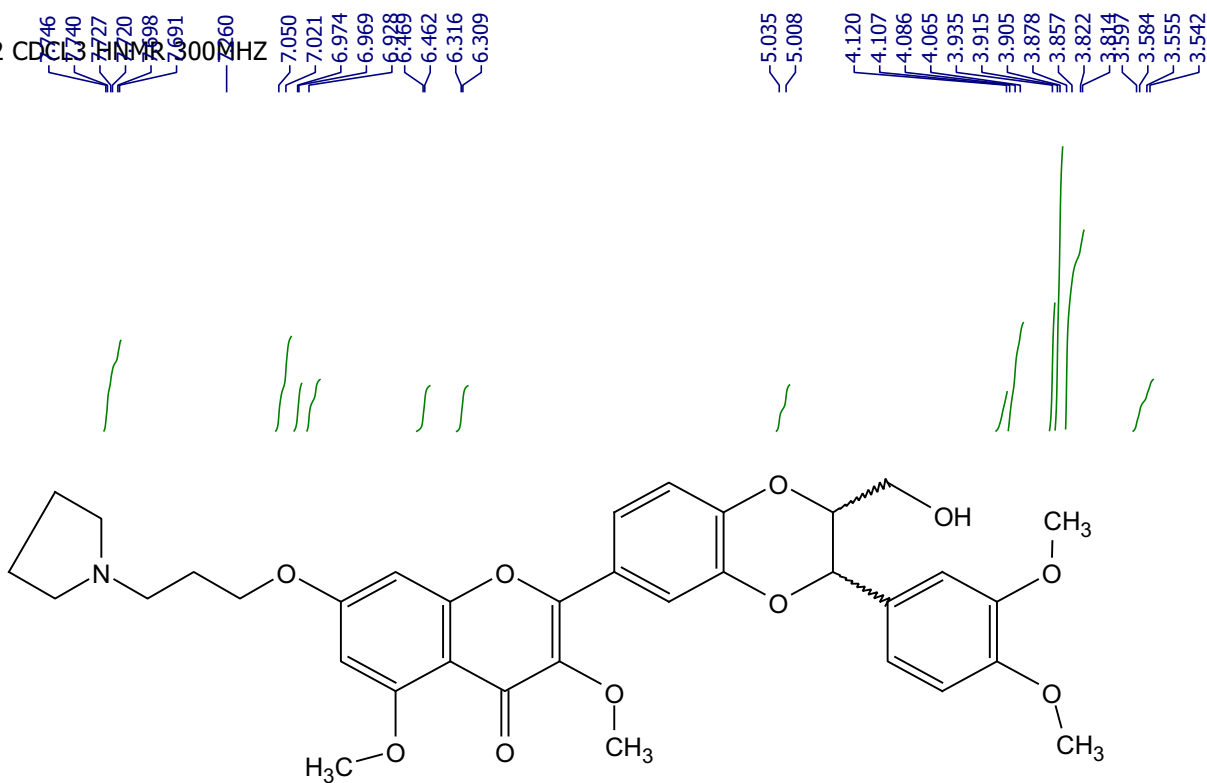
**¹H NMR spectrum for compound 11
CDCl₃, 300 MHz**



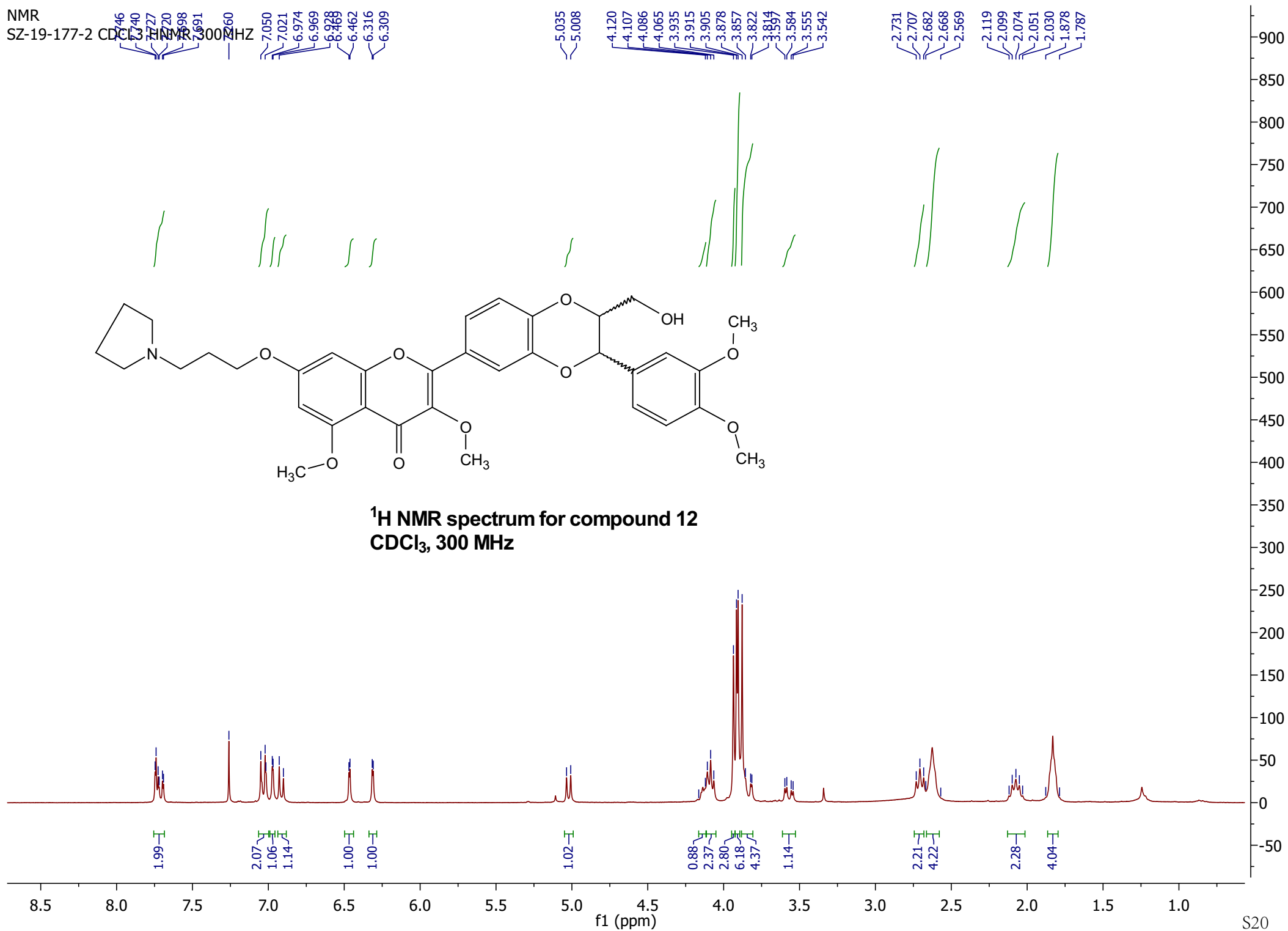
NMR
SZ-19-165 CDCl₃



NMR
SZ-19-177-2 CDCl₃ 300 MHz



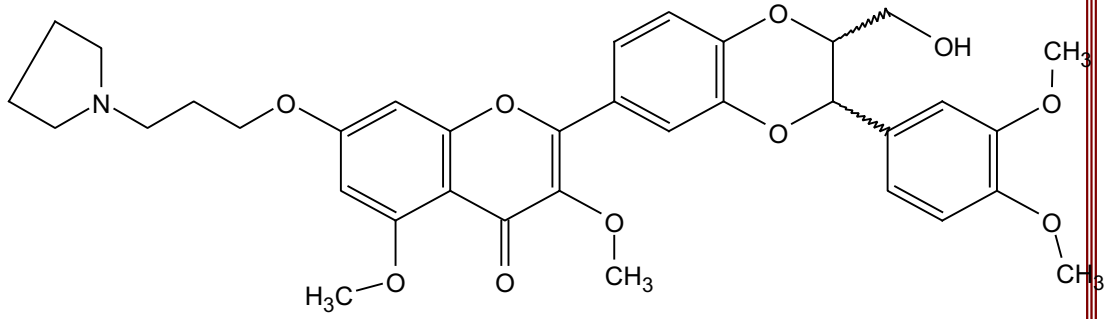
¹H NMR spectrum for compound 12
CDCl₃, 300 MHz



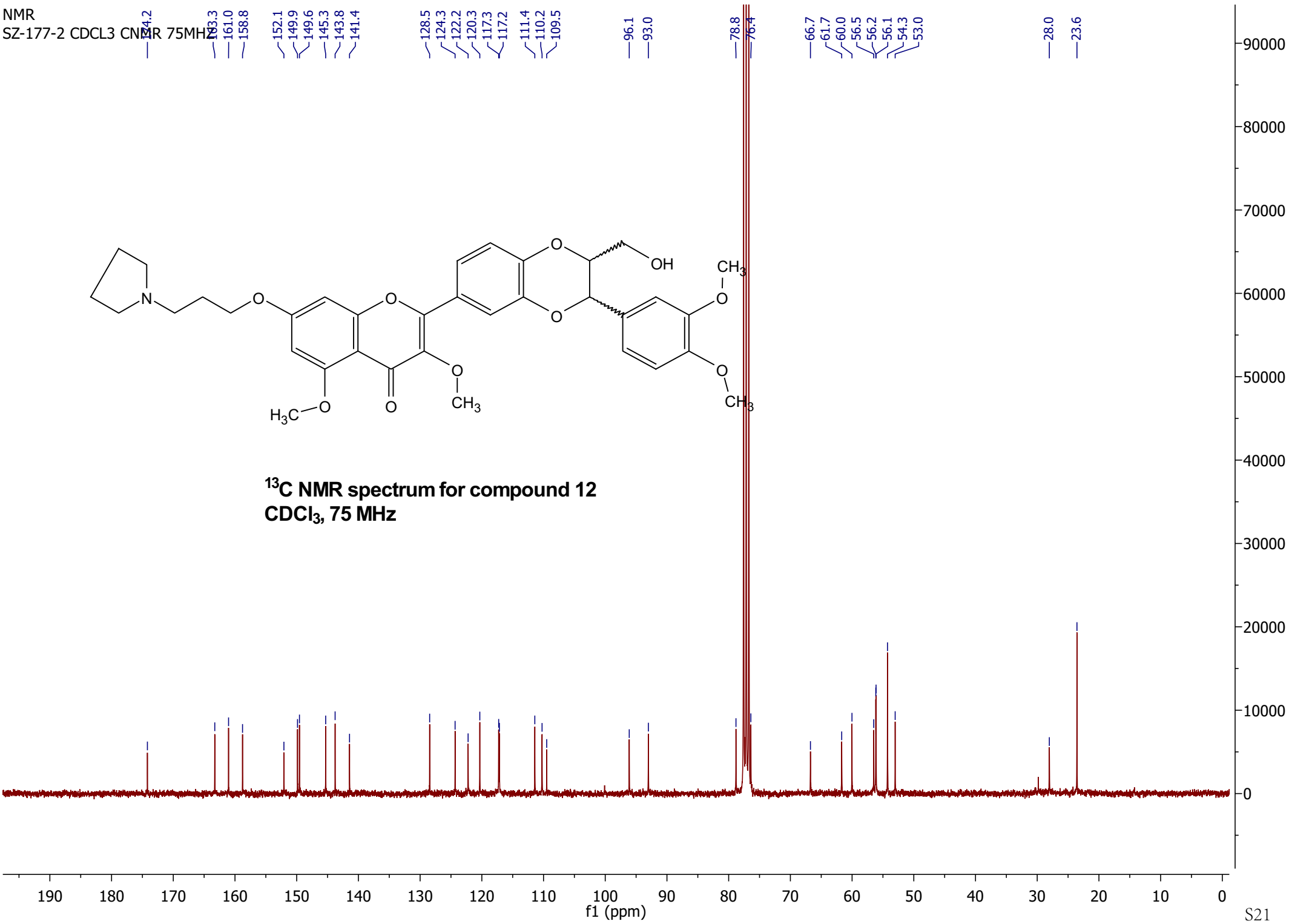
NMR

SZ-177-2 CDCl₃ CNMR 75MHz

174.2 163.3 161.0 158.8 152.1 149.9 149.6 145.3 143.8 141.4 128.5 124.3 122.2 120.3 117.3 117.2 111.4 110.2 109.5 96.1 93.0 78.8 76.4 66.7 61.7 60.0 56.5 56.2 56.1 54.3 53.0 28.0 23.6



¹³C NMR spectrum for compound 12
CDCl₃, 75 MHz



NMR

SZ-19-142 CDCl₃ HNMR 300MHz

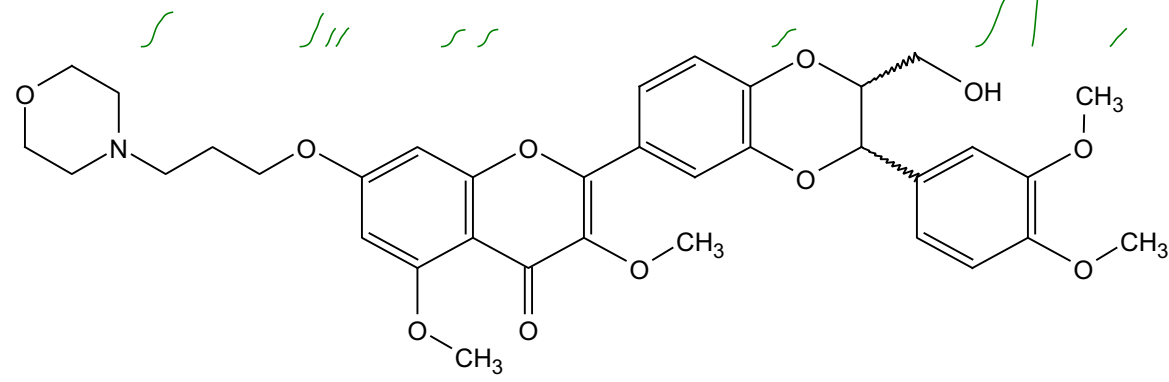
7.31
7.095
7.060
7.048
7.020
6.970
6.931
6.904

6.439
6.293

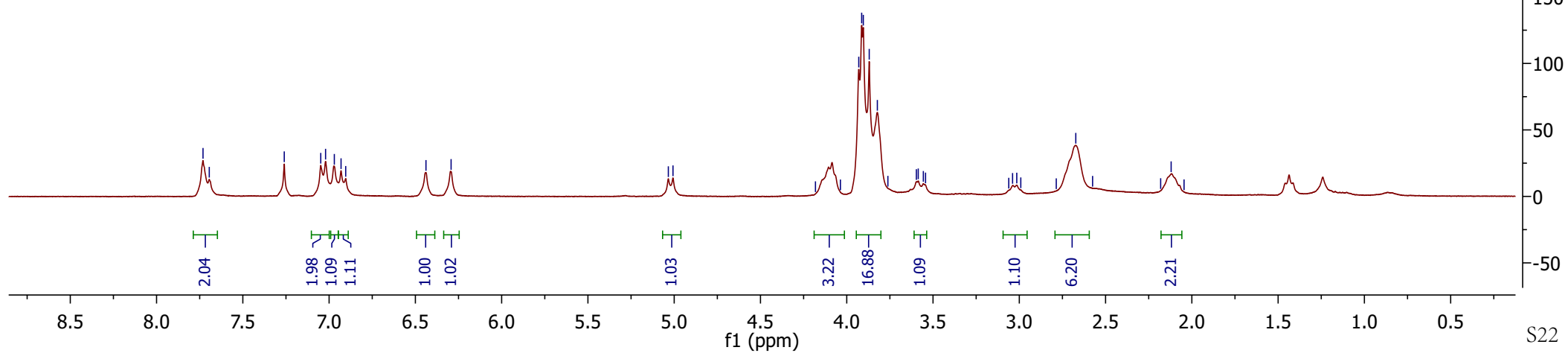
5.034
5.007

4.181
4.037
3.930
3.914
3.904
3.870
3.823
3.762
3.597
3.586
3.556
3.543
3.061
3.039
3.015
2.991
2.786
2.673
2.575

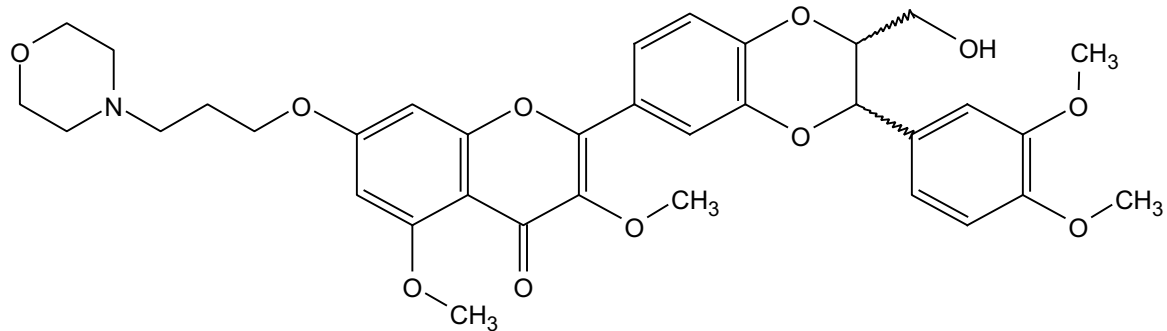
2.181
2.120
2.045



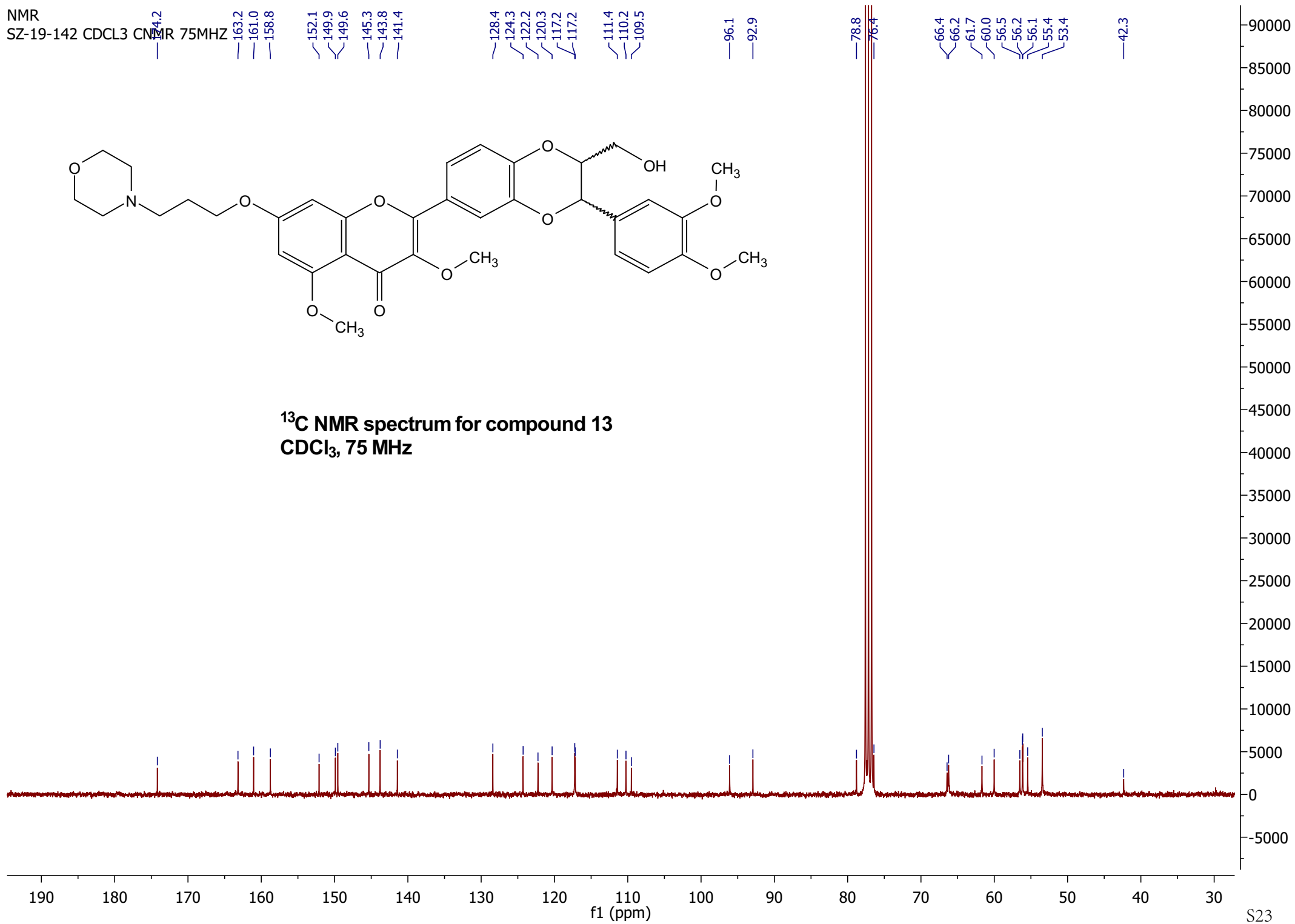
¹H NMR spectrum for compound 13
CDCl₃, 300 MHz

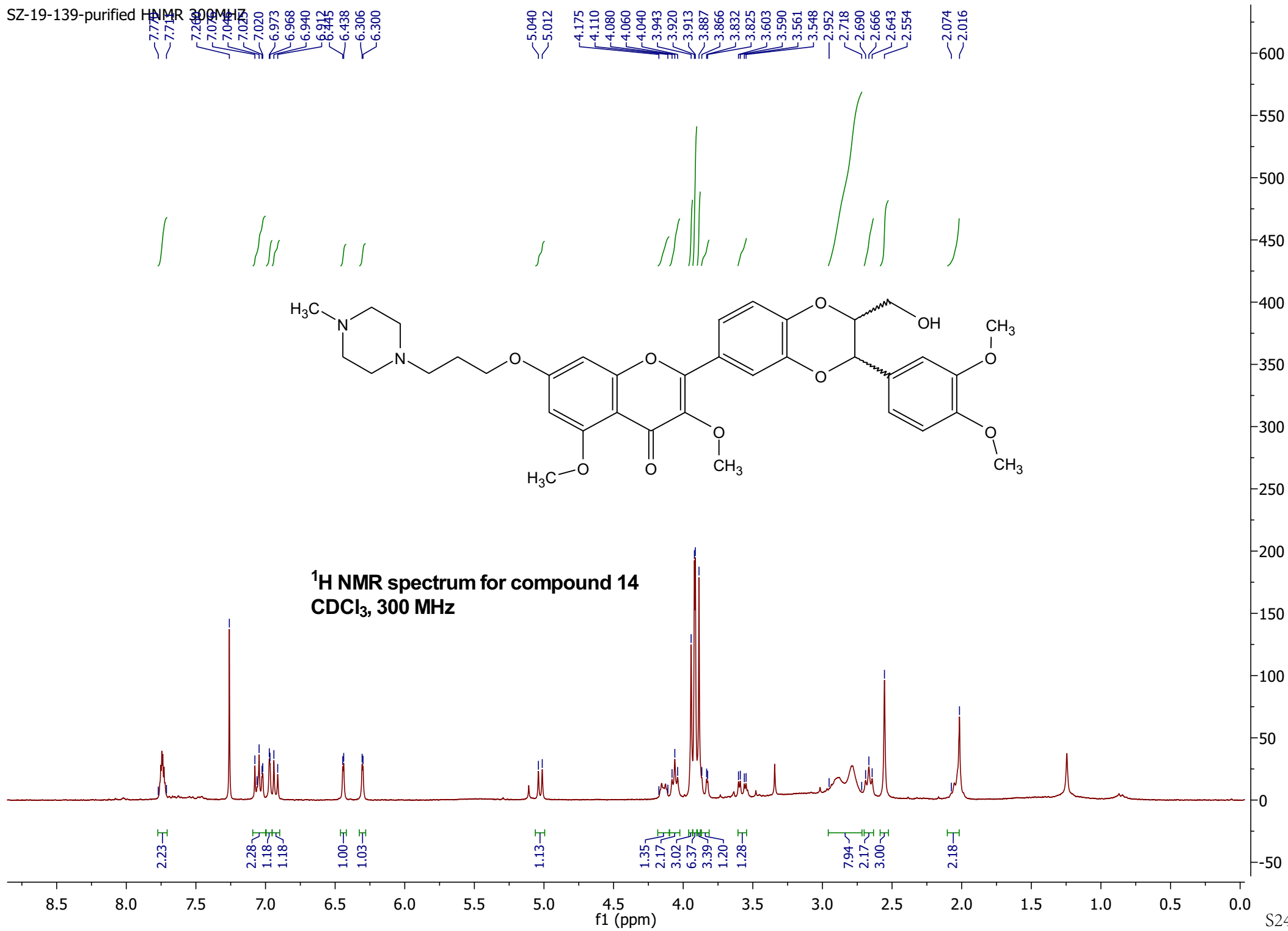


NMR
SZ-19-142 CDCL3 CPMR 75MHZ

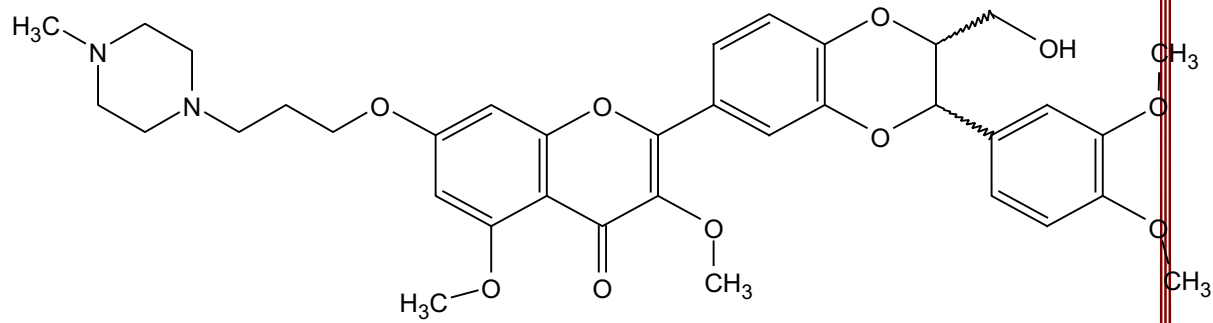


¹³C NMR spectrum for compound 13
CDCl₃, 75 MHz

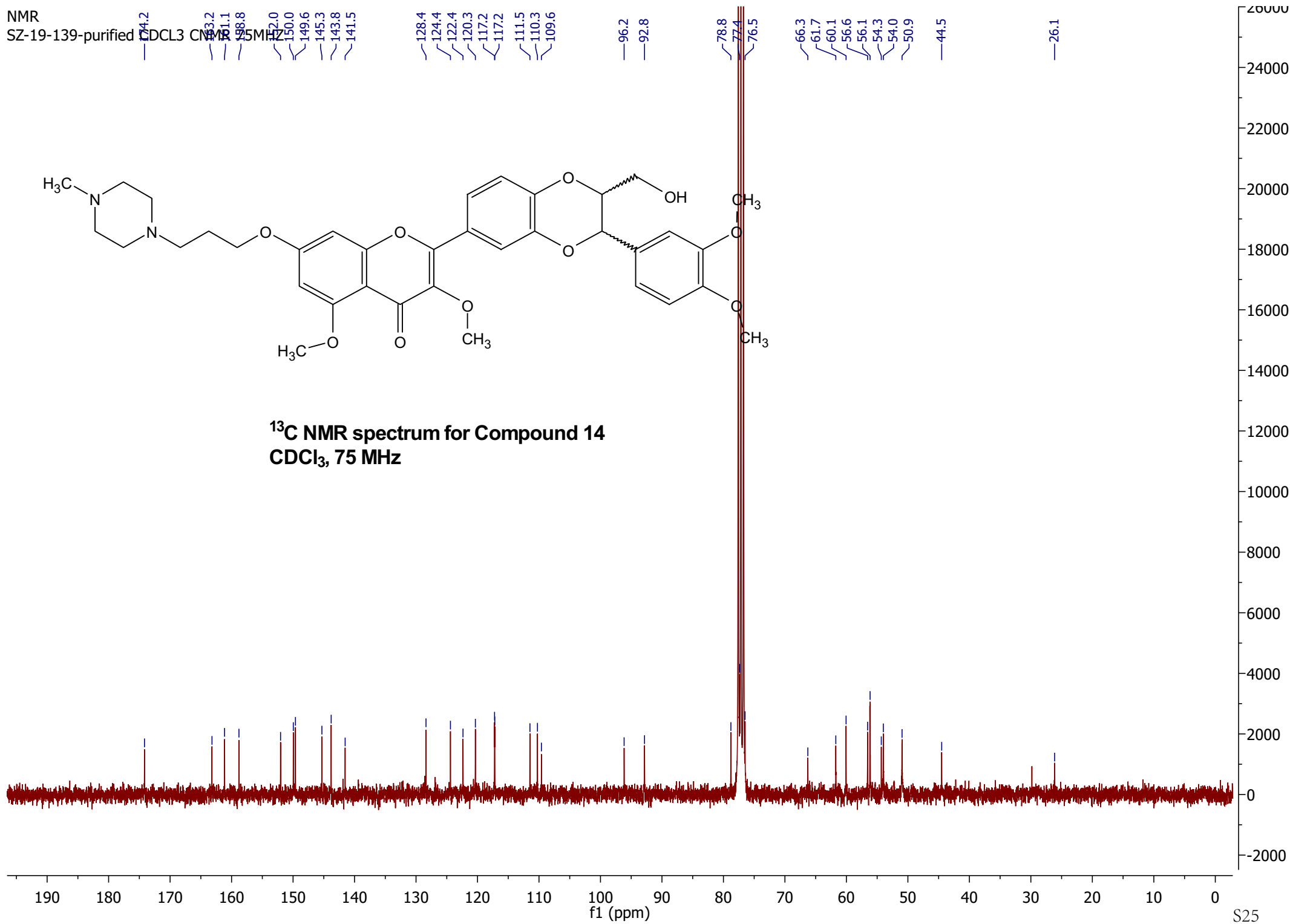




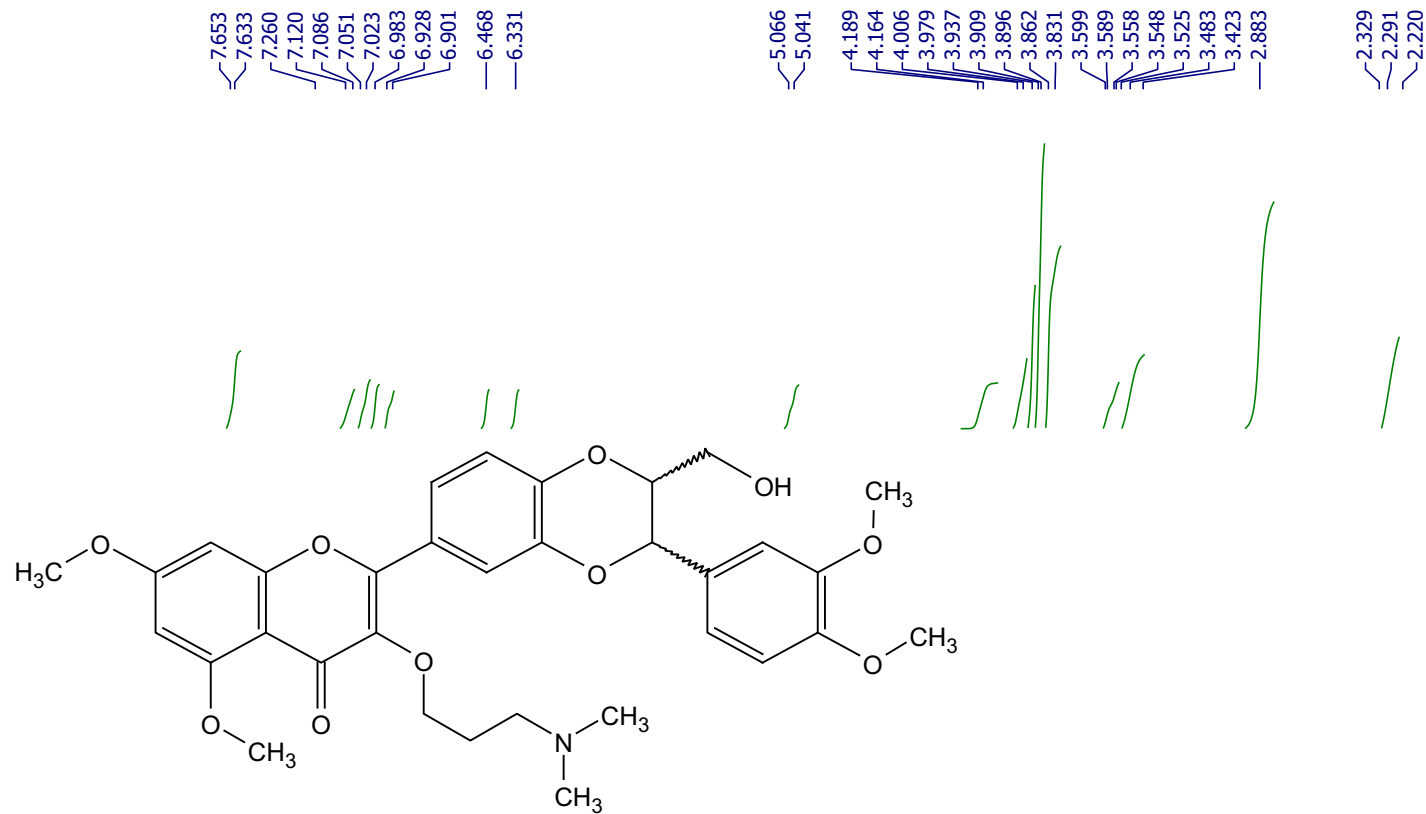
NMR
SZ-19-139-purified CDCl₃ NMR 75 MHz



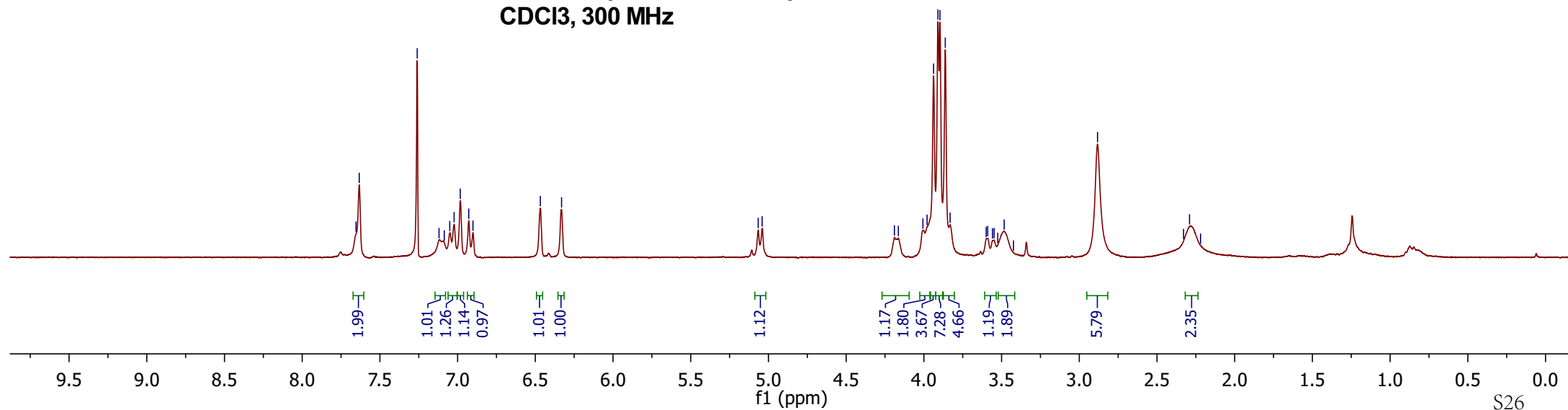
¹³C NMR spectrum for Compound 14
CDCl₃, 75 MHz



E:
BV-48-23-R2-CDCL3



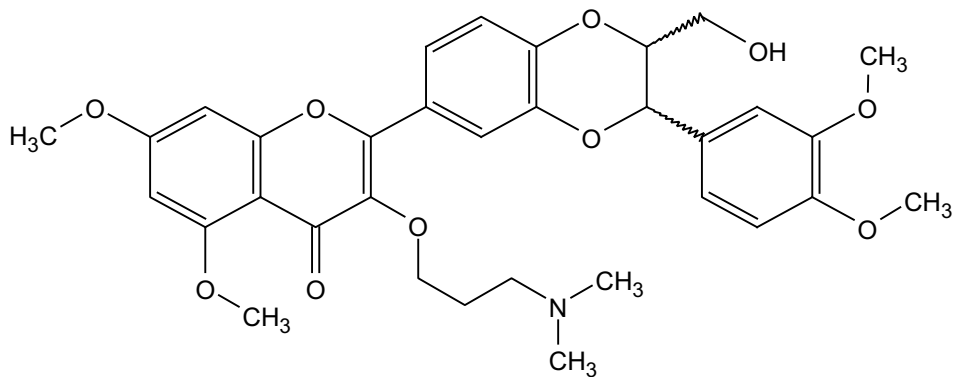
1H NMR spectrum for compound 20
CDCl₃, 300 MHz



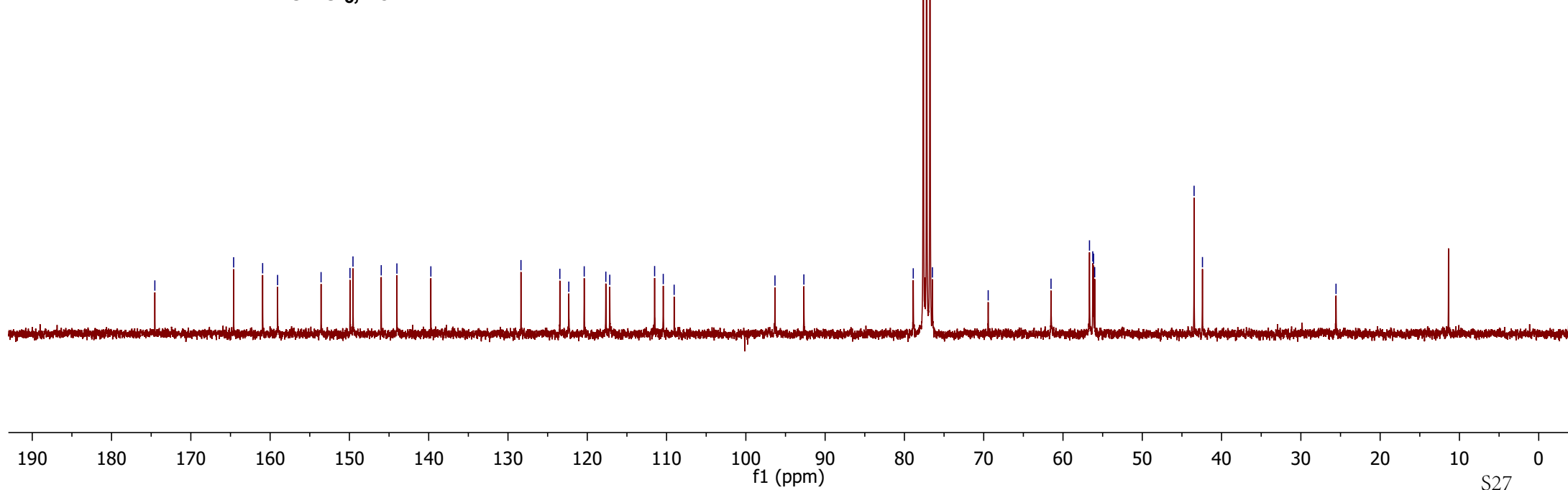
linker nmr

bv-17-23-r2- cdc

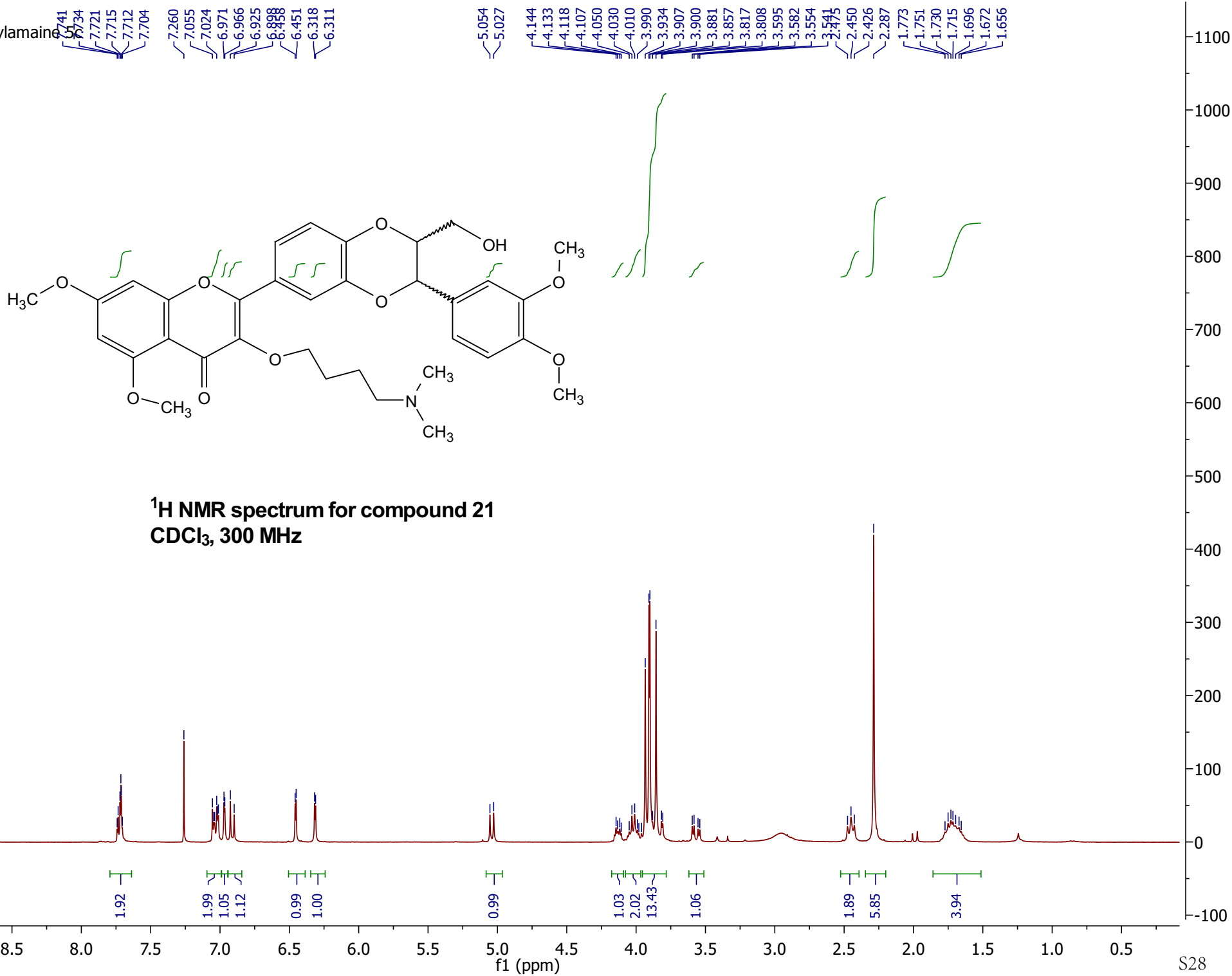
174.54 164.60 160.94 159.06 153.57 149.93 149.55 145.99 144.01 139.73 128.36 123.46 122.33 120.38 117.66 117.16 111.51 110.42 109.04 96.33 92.68 78.89 77.62 77.20 76.78 76.47 69.43 61.51 56.66 56.25 56.14 56.00 43.47 42.41 25.57



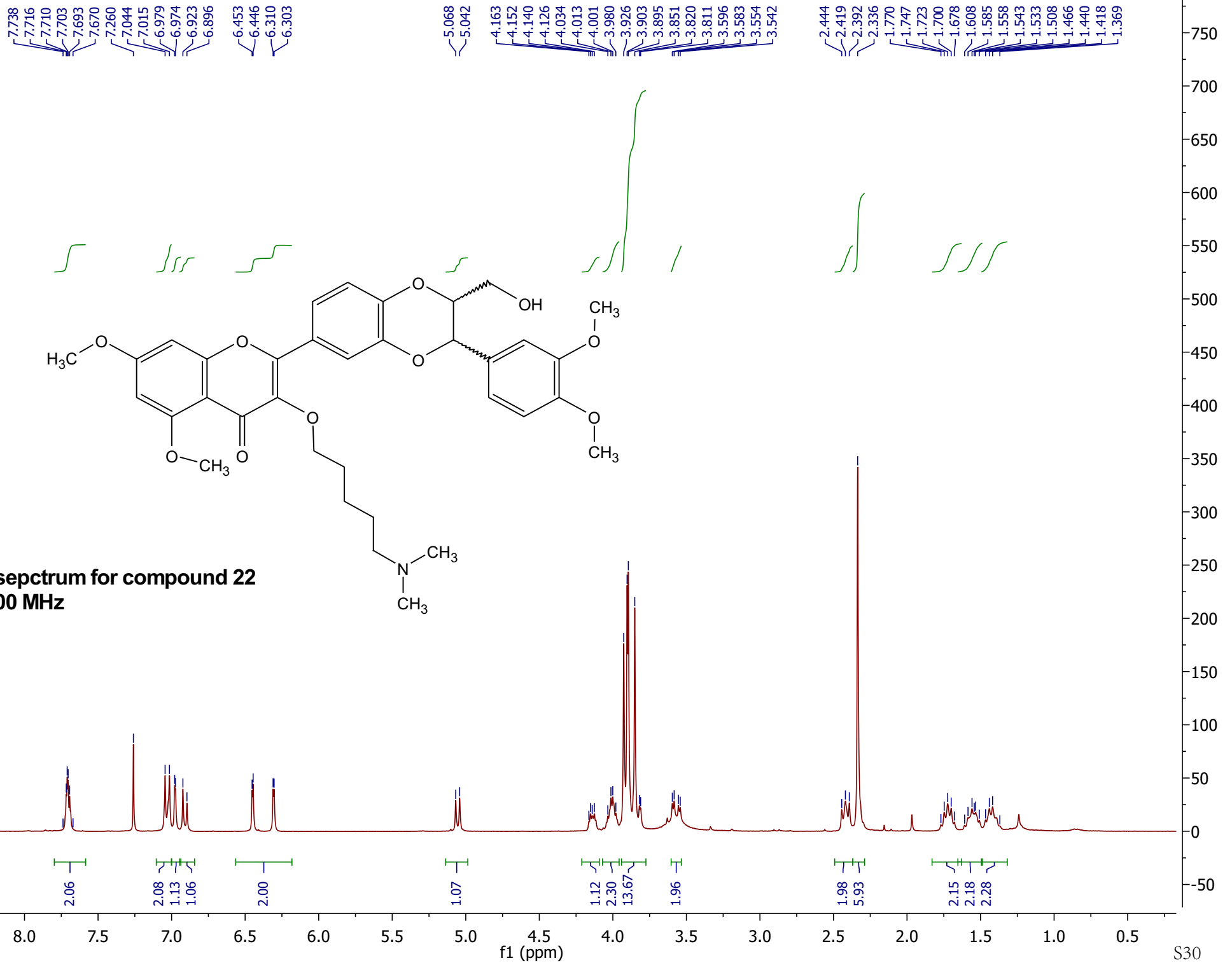
¹³C NMR spectrum for compound 20
CDCl₃, 75 MHz



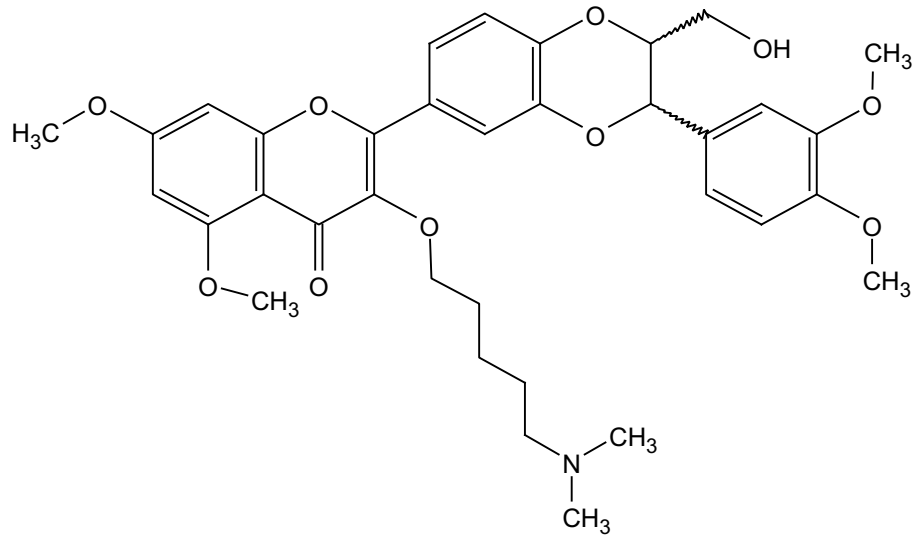
andre vignau
av 39-36 dimethylamine



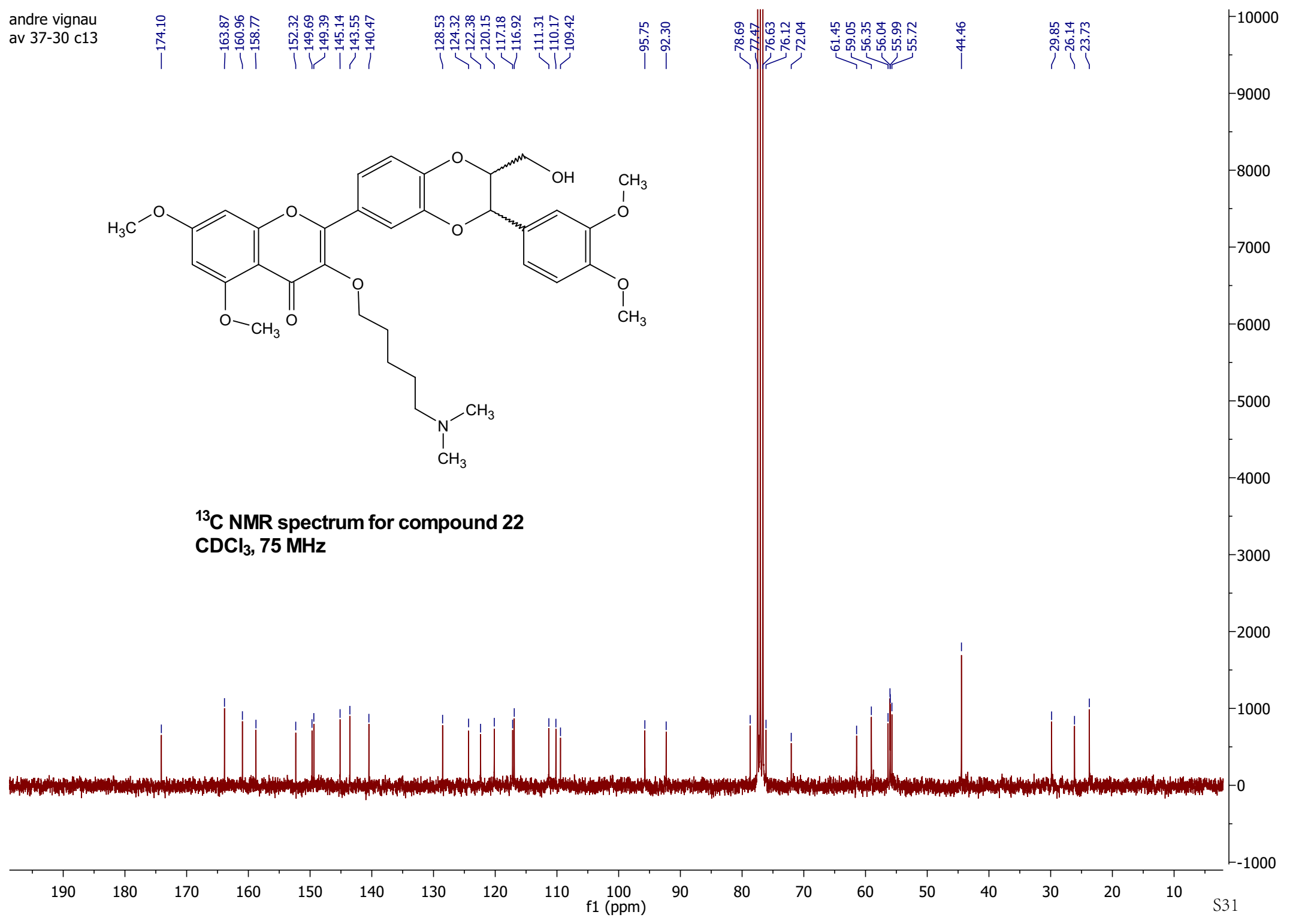
andre vignau
av 37-30



andre vignau
av 37-30 c13

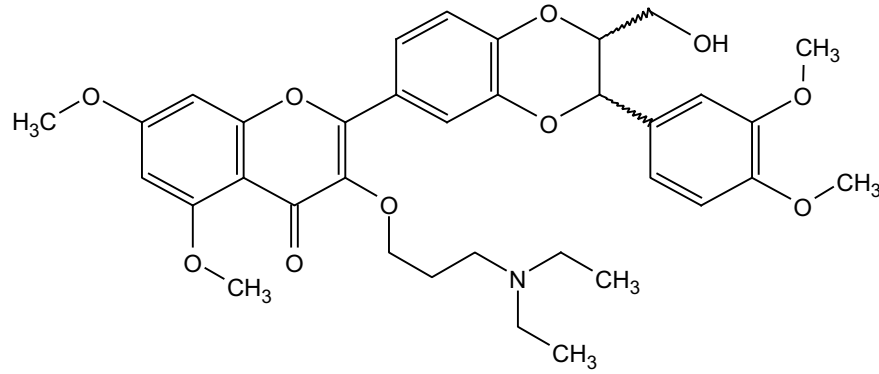


¹³C NMR spectrum for compound 22
CDCl₃, 75 MHz

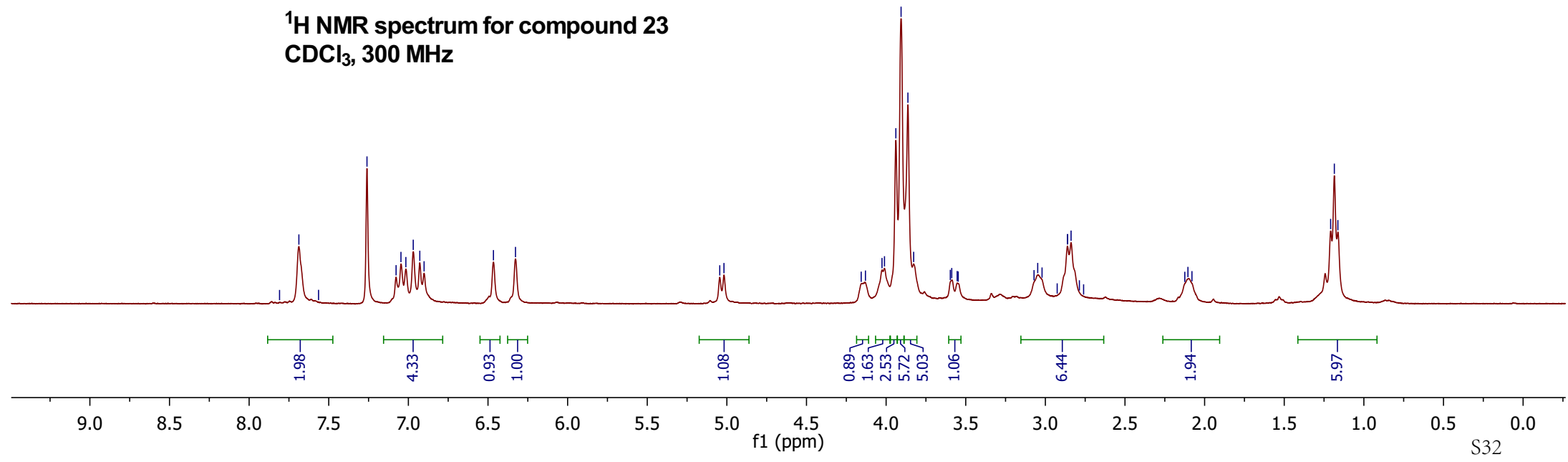


linker nmr
bv-17-232 cdcl3

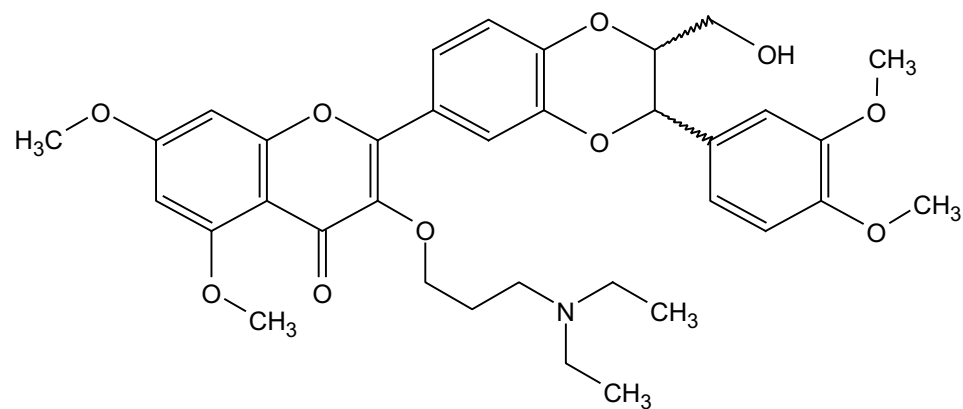
7.809 7.688 7.564 7.260 7.077 7.047 7.016 6.969 6.928 6.901 6.466 6.327 5.045 5.018 4.157 4.130 4.026 4.010 3.939 3.906 3.863 3.827 3.597 3.588 3.554 3.571 3.048 3.021 2.926 2.861 2.861 2.839 2.786 2.760 2.124 2.105 2.080 1.209 1.185 1.163



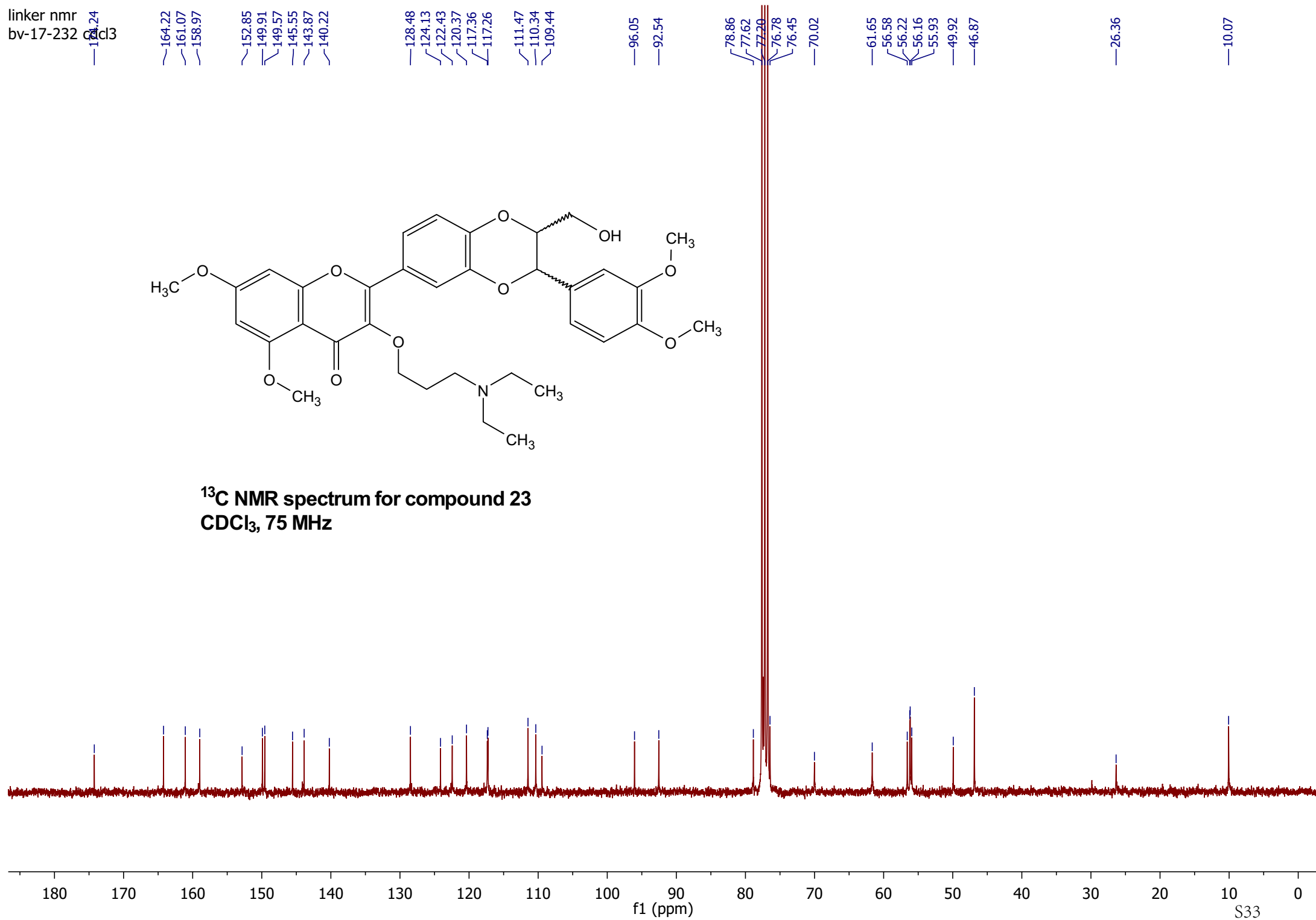
**¹H NMR spectrum for compound 23
CDCl₃, 300 MHz**



linker nmr
bv-17-232
CDCl₃



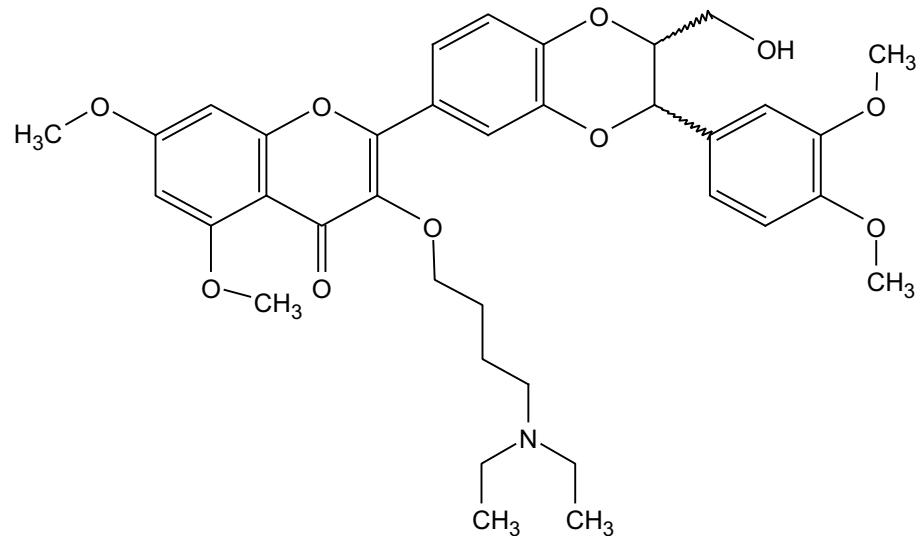
¹³C NMR spectrum for compound 23
CDCl₃, 75 MHz



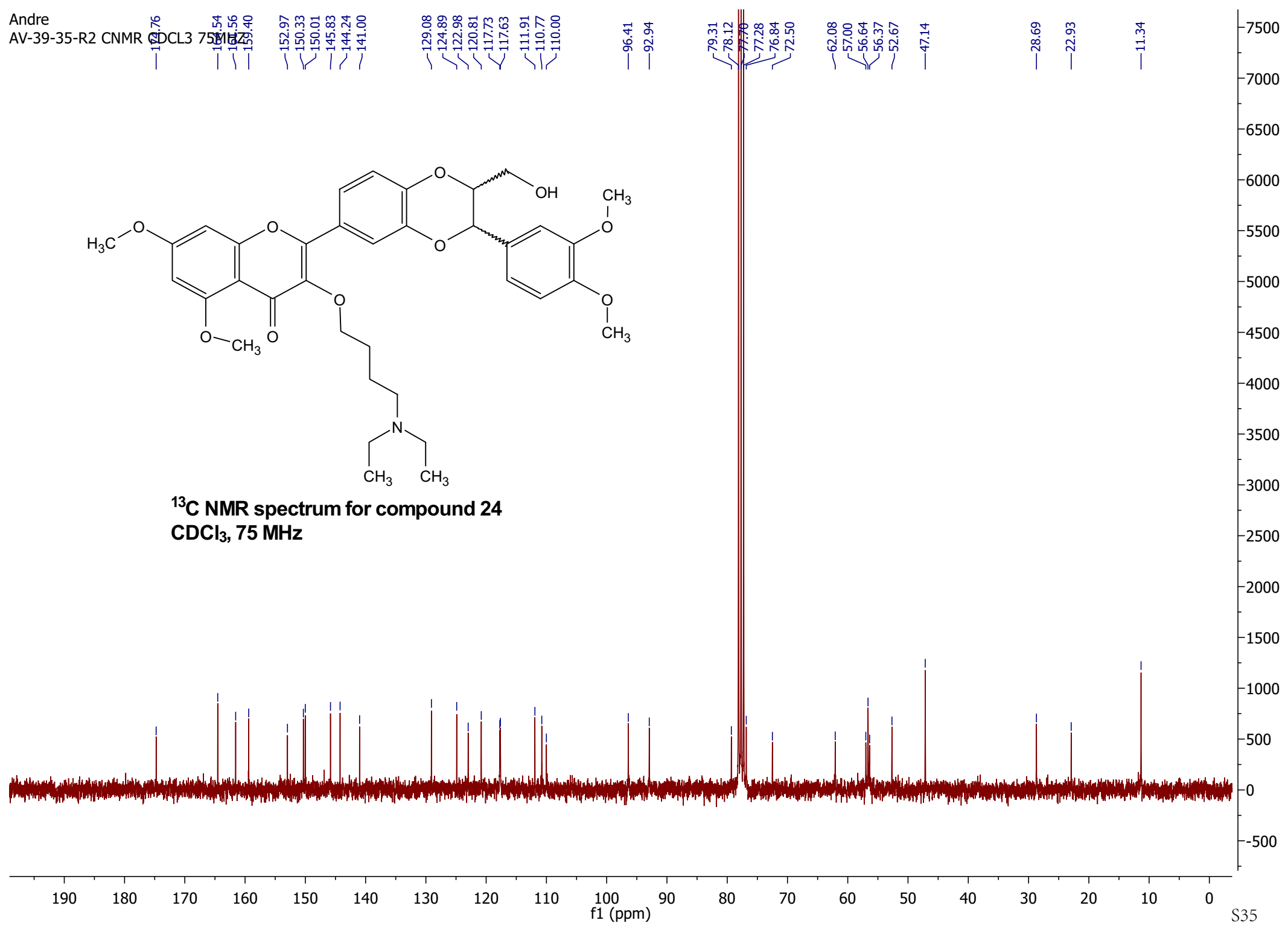
Andre

AV-39-35-R2 CNMR

CDCl₃ 75 MHz
174.76 161.54 161.56 159.40 152.97 150.33 150.01 145.83 144.24 141.00 129.08 124.89 122.98 120.81 117.73 117.63 111.91 110.77 110.00 96.41 92.94 79.31 78.12 77.76 77.28 76.84 72.50 62.08 57.00 56.64 56.37 52.67 47.14 28.69 22.93 11.34



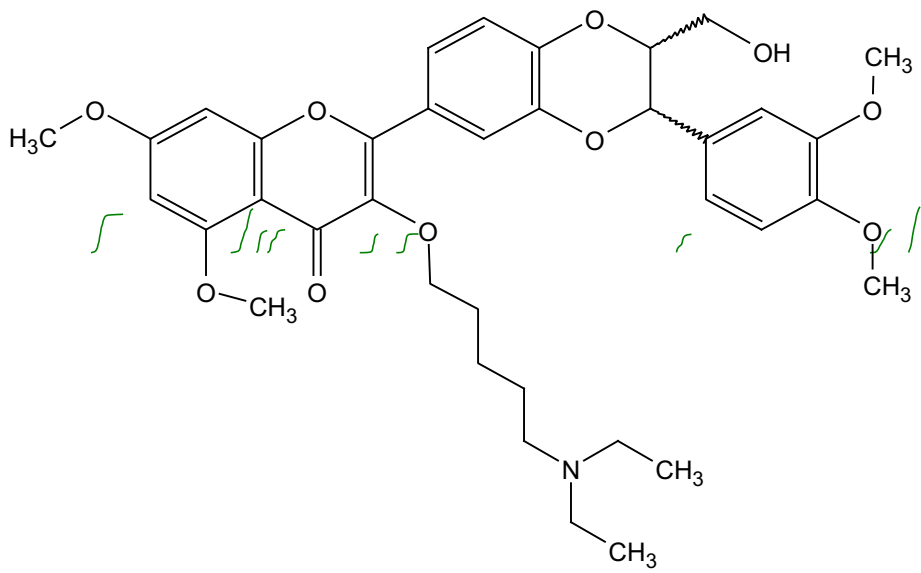
¹³C NMR spectrum for compound 24
CDCl₃, 75 MHz



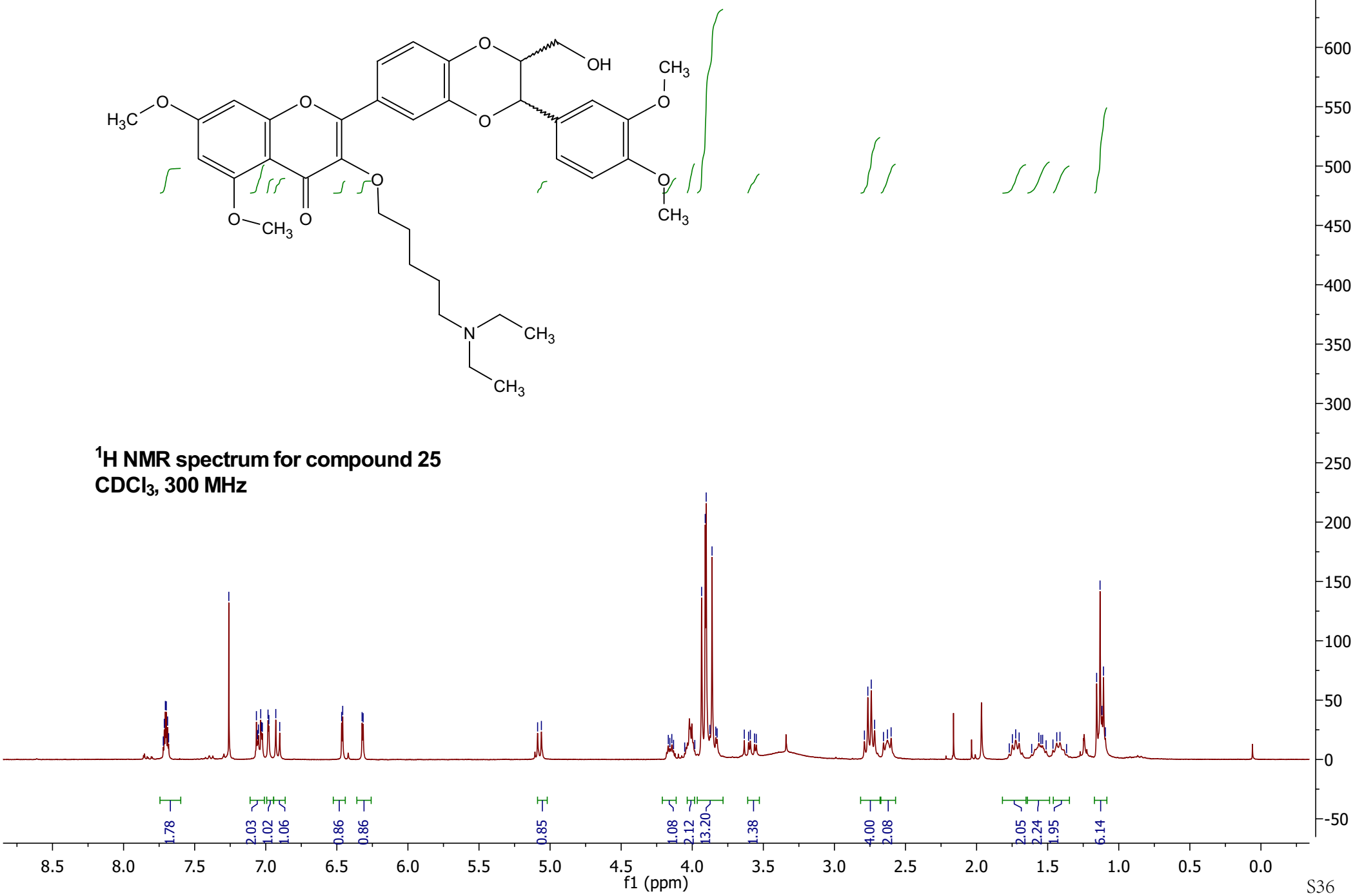
andre vignau
av 37-16 diethylamine

7.721
7.714
7.706
7.699
7.690
7.683
7.260
7.066
7.035
6.984
6.978
6.929
6.886
6.459
6.322
6.315

5.088
5.061
4.168
4.158
4.144
4.132
3.934
3.909
3.902
3.876
3.861
3.834
3.825
3.634
3.604
3.591
3.562
3.589
3.580
2.765
2.741
2.717
2.655
2.627
2.601
1.770
1.748
1.725
1.701
1.612
1.563
1.548
1.536
1.511
1.463
1.436
1.414
1.367
1.156
1.132
1.118
1.107
1.094

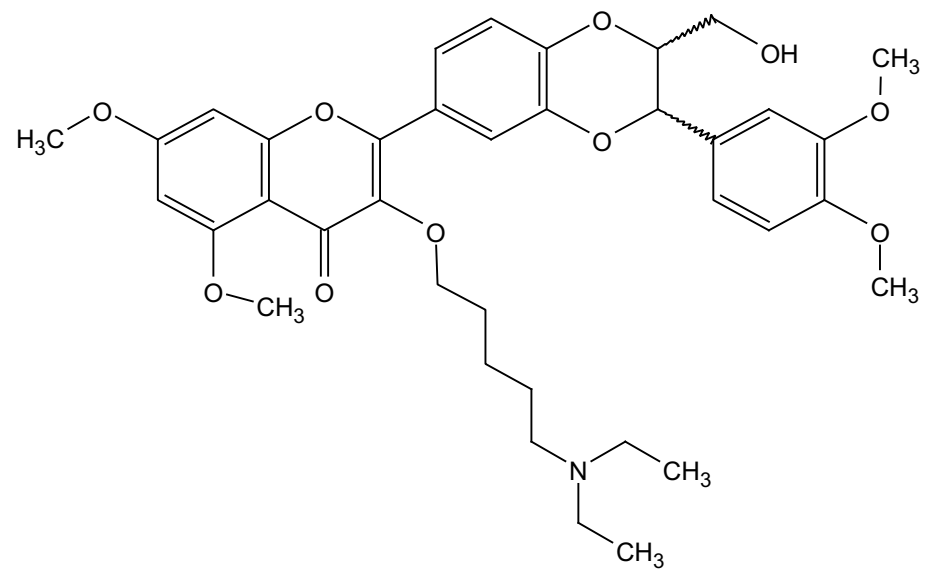


¹H NMR spectrum for compound 25
CDCl₃, 300 MHz

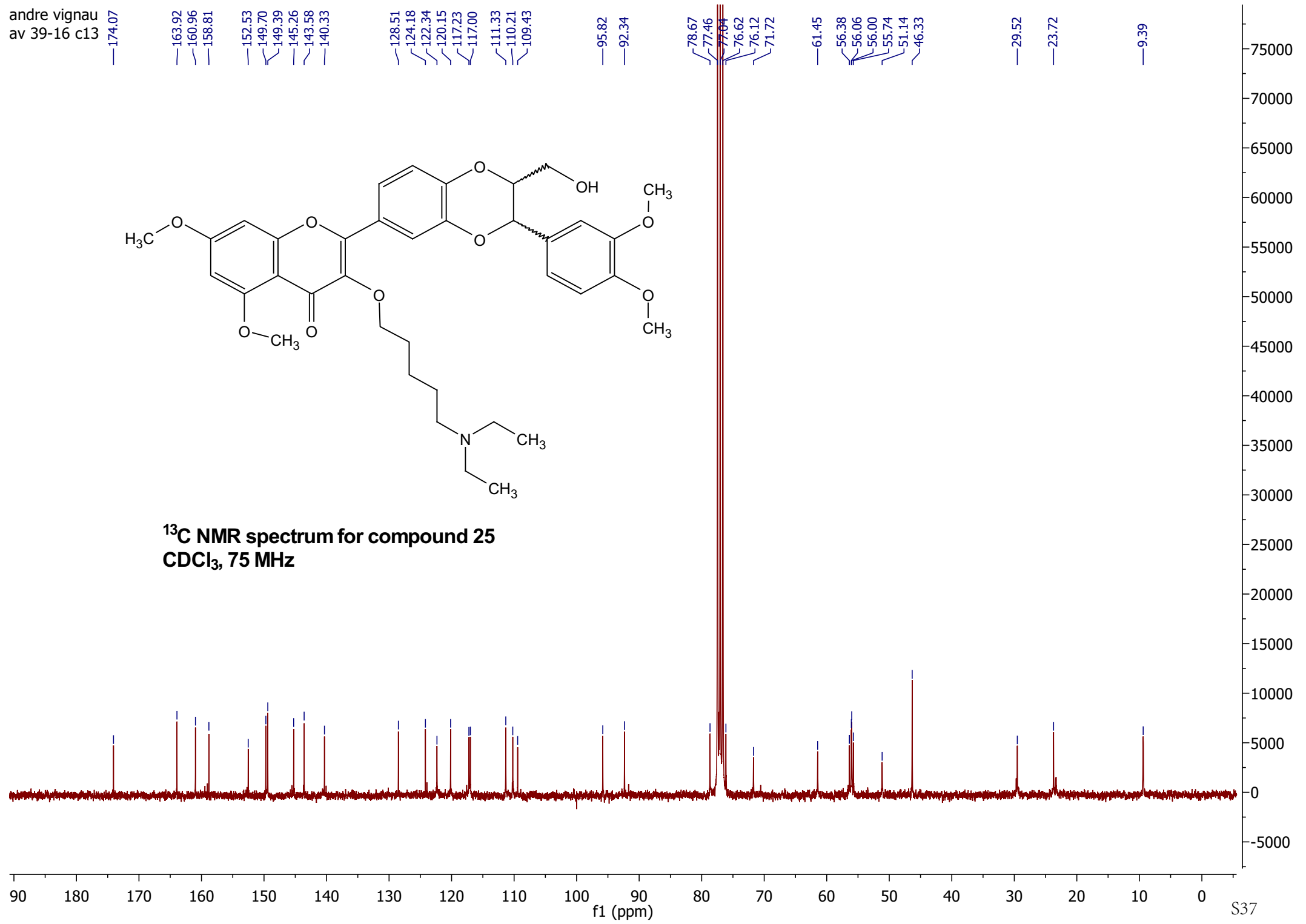


andre vignau
av 39-16 c13

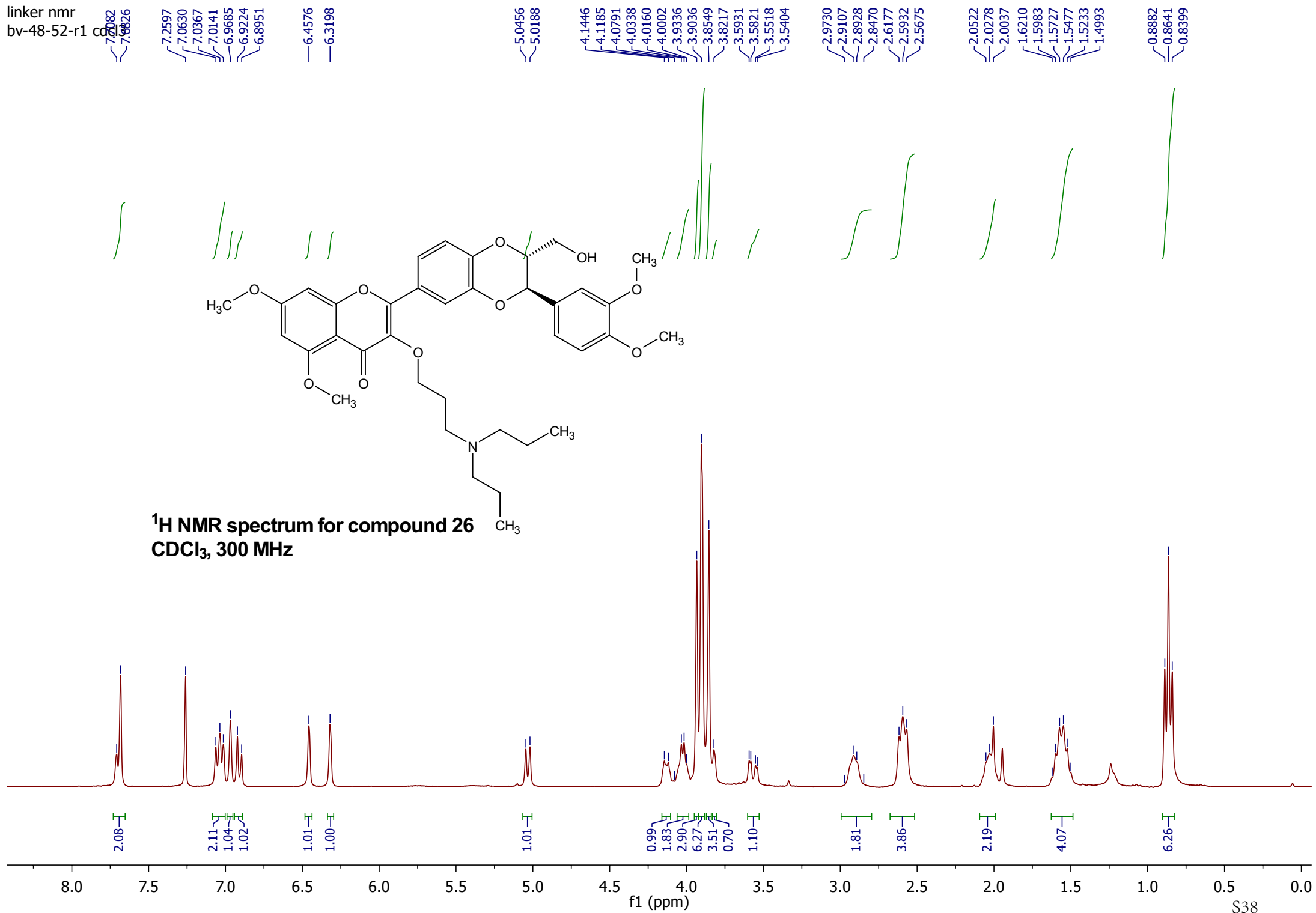
174.07 163.92 160.96 158.81 152.53 149.70 149.39 145.26 143.58 140.33 128.51 124.18 122.34 120.15 117.23 117.00 111.33 110.21 109.43 95.82 92.34 78.67 77.46 77.04 76.62 76.12 71.72 61.45 56.38 56.06 56.00 55.74 51.14 46.33 29.52 23.72 9.39



¹³C NMR spectrum for compound 25
CDCl₃, 75 MHz

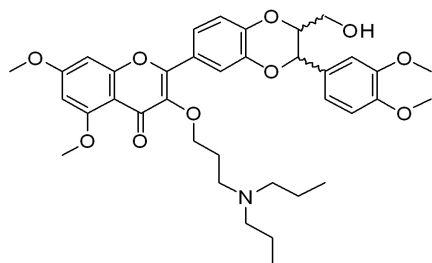


linker nmr
bv-48-52-r1 cd

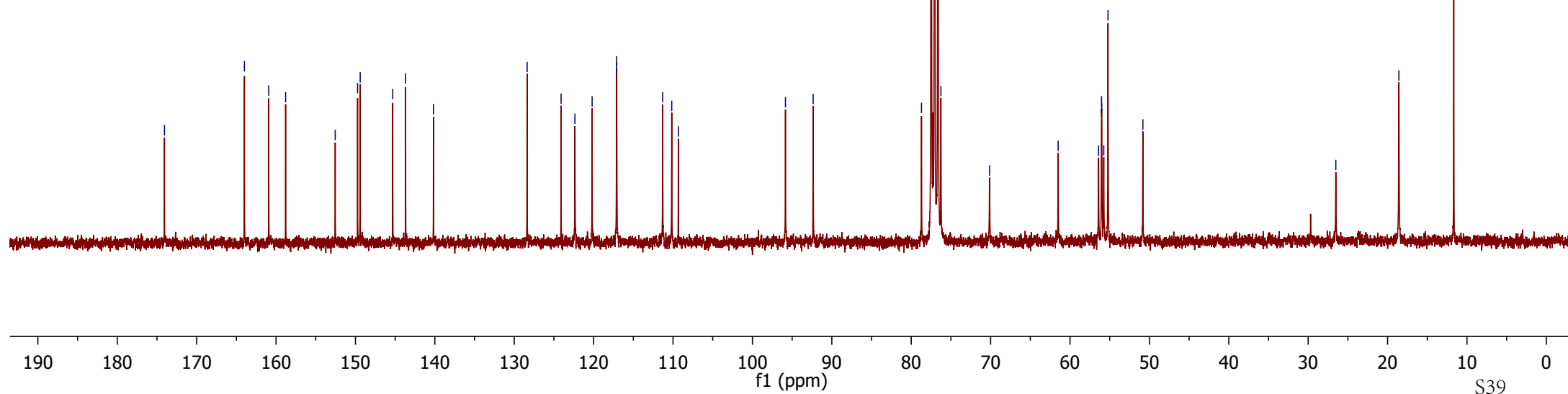


linker nmr
bv-48-52-r1 cdc13

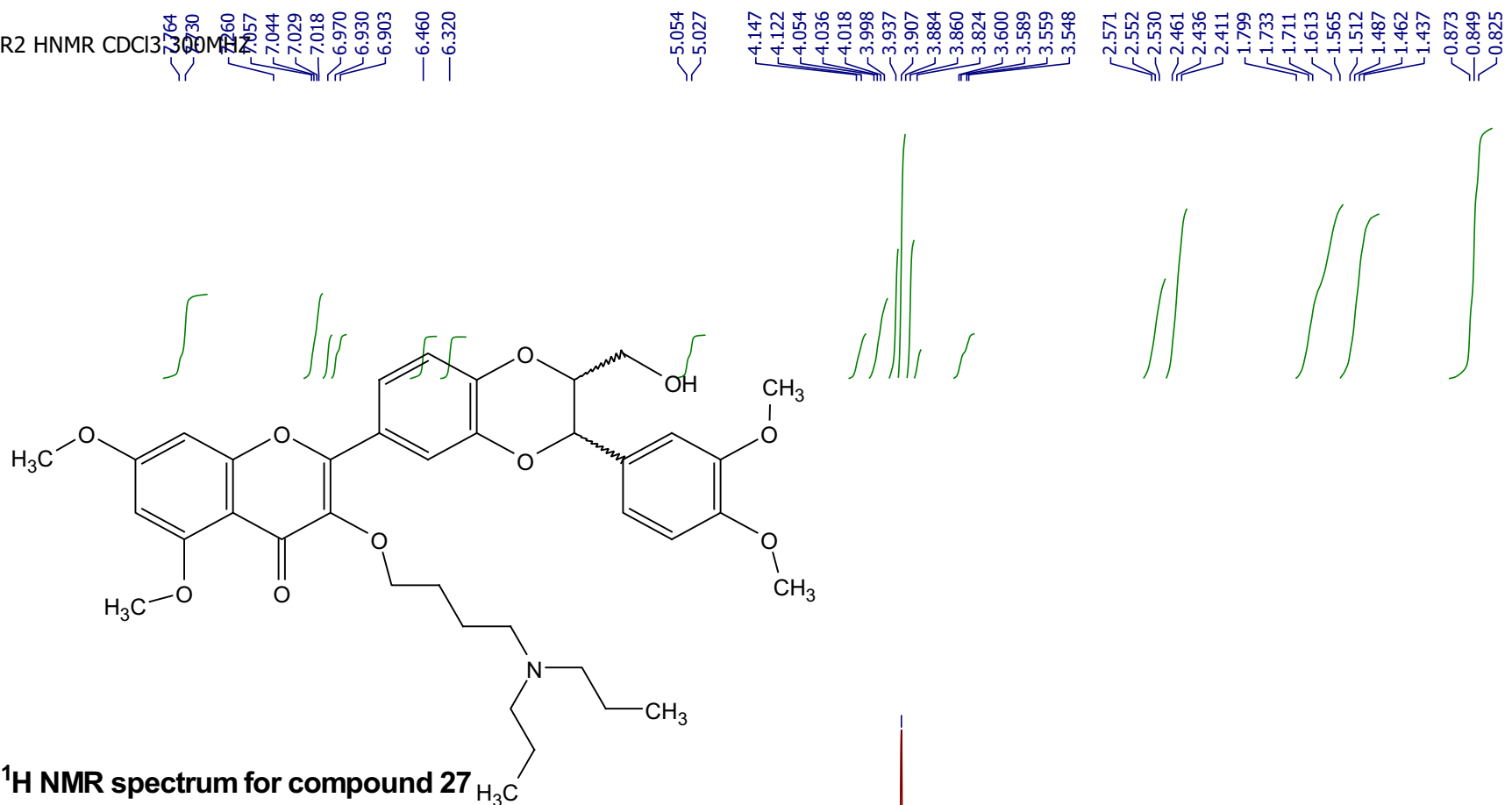
174.06 163.99 160.92 158.80 152.55 149.73 149.40 145.30 143.69 140.17 128.38 124.10 122.36 120.19 117.11 117.09 111.31 110.16 109.33 95.84 92.35 78.71 76.26 70.13 61.49 56.40 56.03 56.00 55.75 55.21 50.82 26.52 18.58 11.66



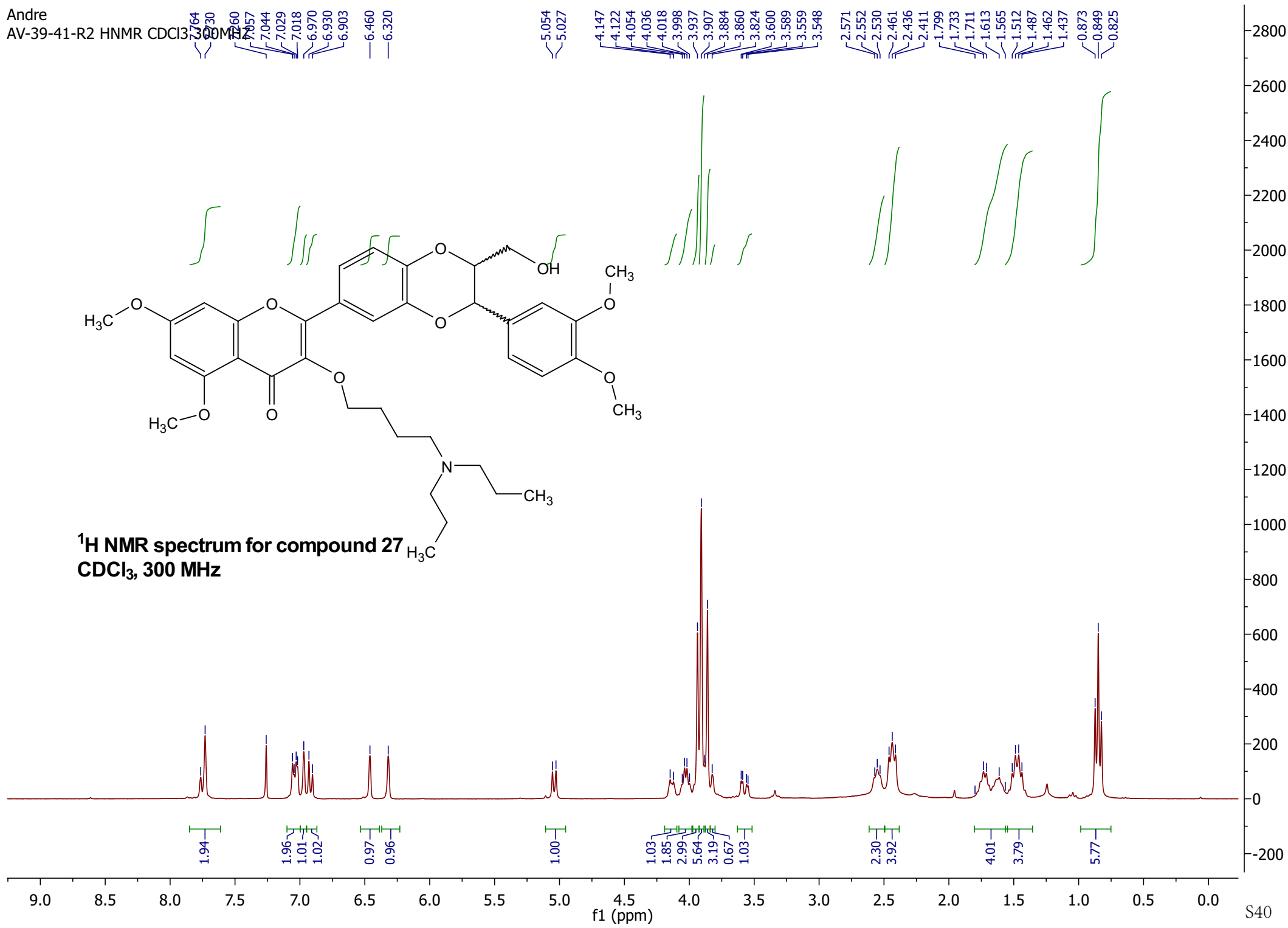
¹³C NMR spectrum for compound 26
CDCl₃, 75 MHz



Andre
AV-39-41-R2 HNMR CDCl₃, 300 MHz



¹H NMR spectrum for compound 27
CDCl₃, 300 MHz



linker nmr
BV-48-36-r1

7.739
7.715

7.260
7.071
7.040
6.992
6.940
6.912

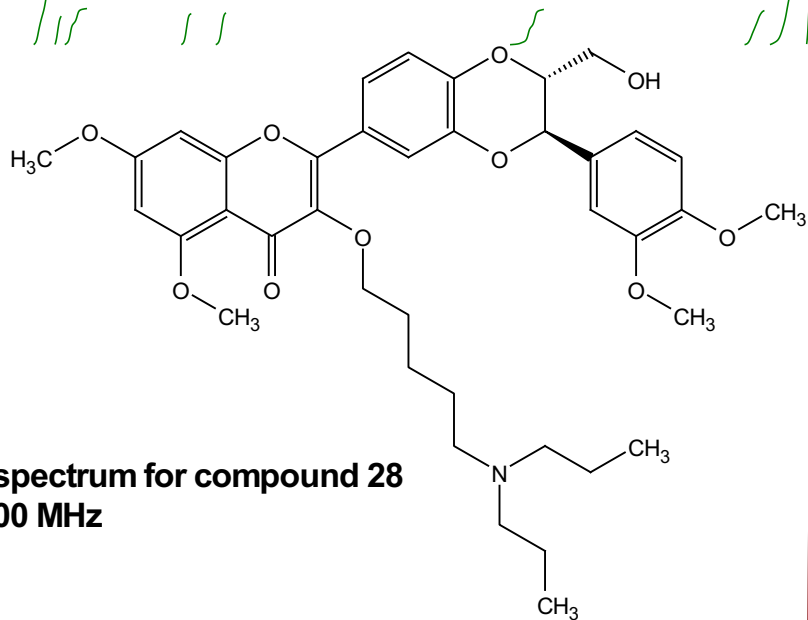
6.470
6.327

5.080
5.054

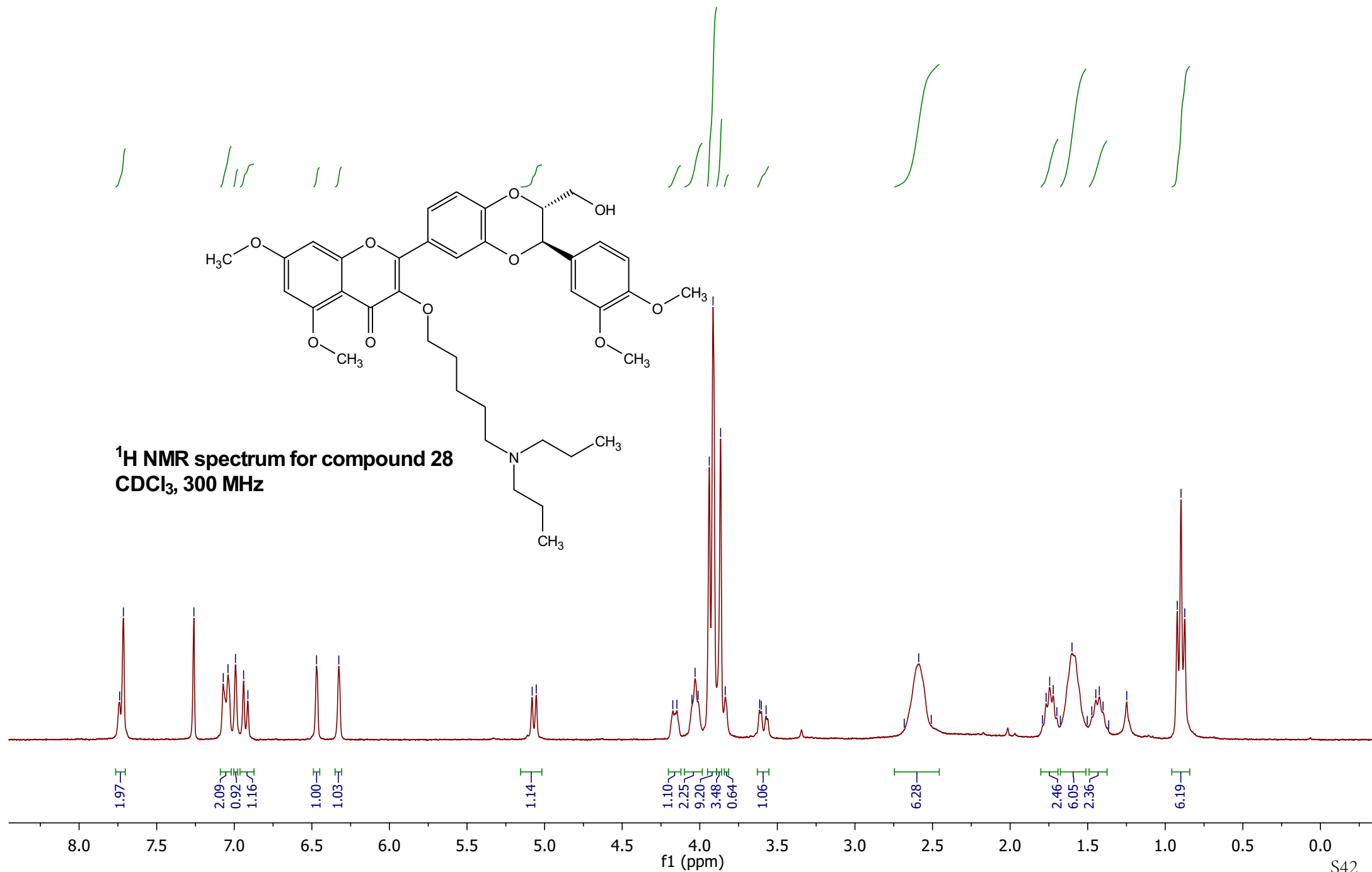
4.174
4.148
4.050
4.030
4.011
3.939
3.914
3.866
3.836
3.614
3.604
3.573

2.682
2.589
2.508

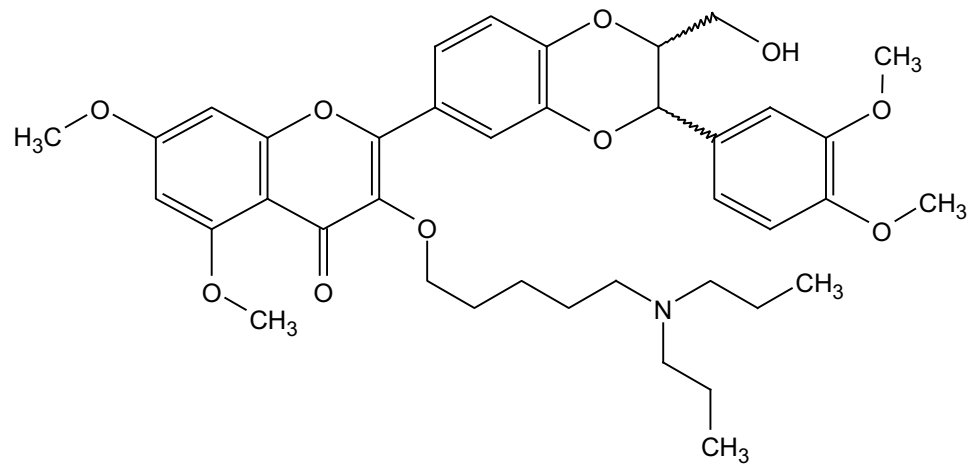
1.791
1.768
1.745
1.722
1.699
1.676
1.601
1.503
1.474
1.448
1.425
1.401
1.248
0.973
0.898
0.874



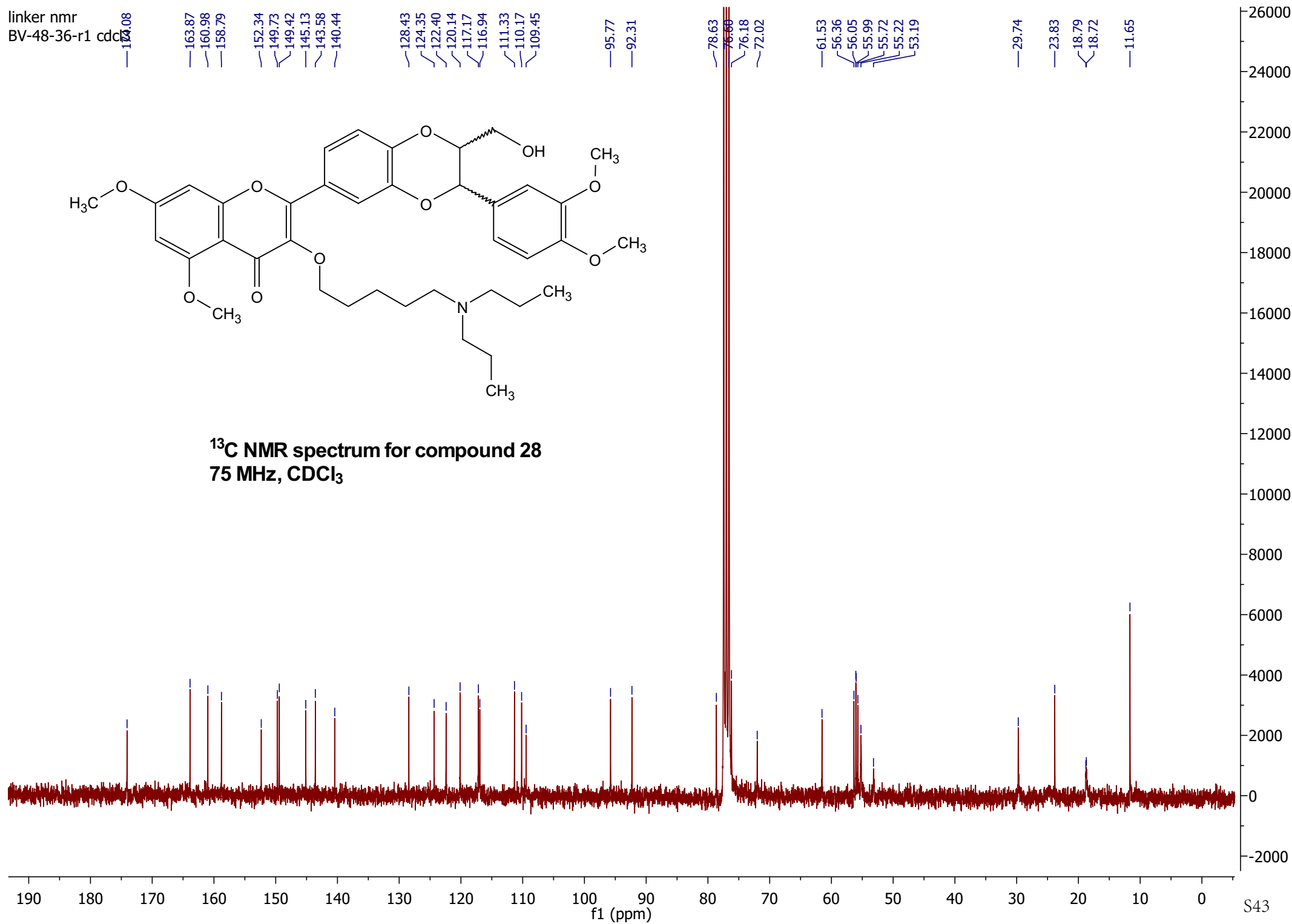
¹H NMR spectrum for compound 28
CDCl₃, 300 MHz



linker nmr
BV-48-36-r1 cdcl3

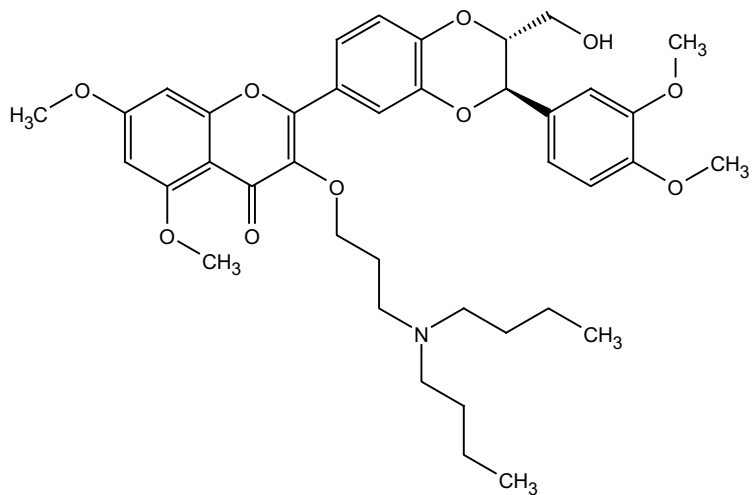


¹³C NMR spectrum for compound 28
75 MHz, CDCl₃

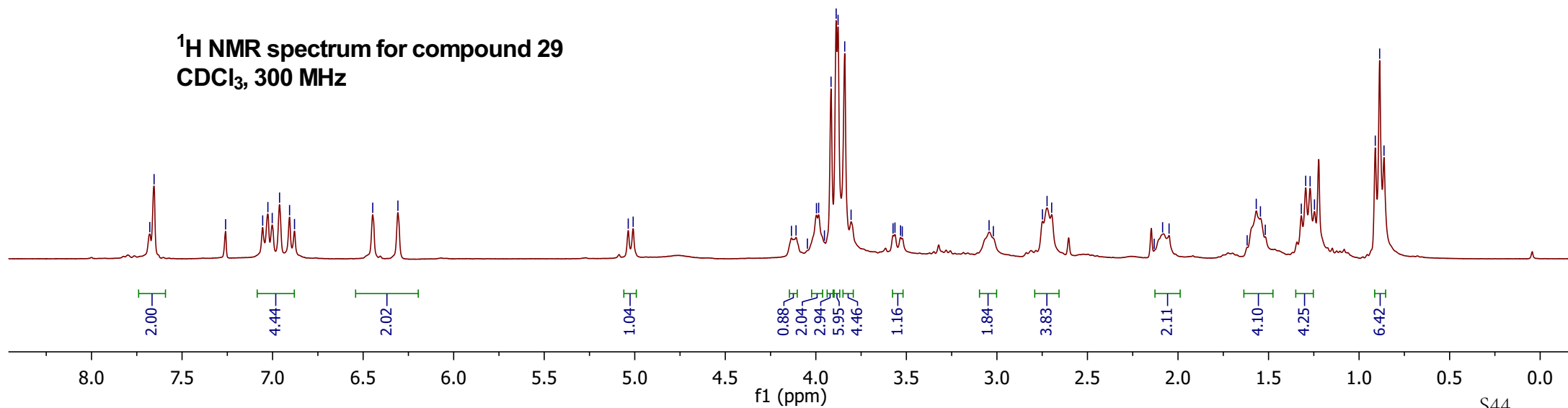


linker nmr
bv-48-13-r2 cdcl3

7.78
7.654
7.260
7.055
7.026
7.002
6.962
6.906
6.879
6.447
6.308
5.036
5.009
4.135
4.109
4.047
3.997
3.984
3.952
3.916
3.888
3.877
3.840
3.805
3.574
3.563
3.532
3.523
3.043
3.020
2.749
2.723
2.698
2.132
2.085
2.049
1.618
1.568
1.545
1.518
1.319
1.295
1.270
1.246
0.911
0.886
0.862

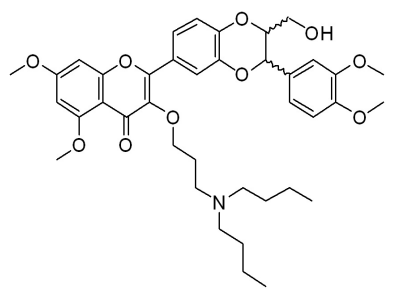


¹H NMR spectrum for compound 29
CDCl₃, 300 MHz

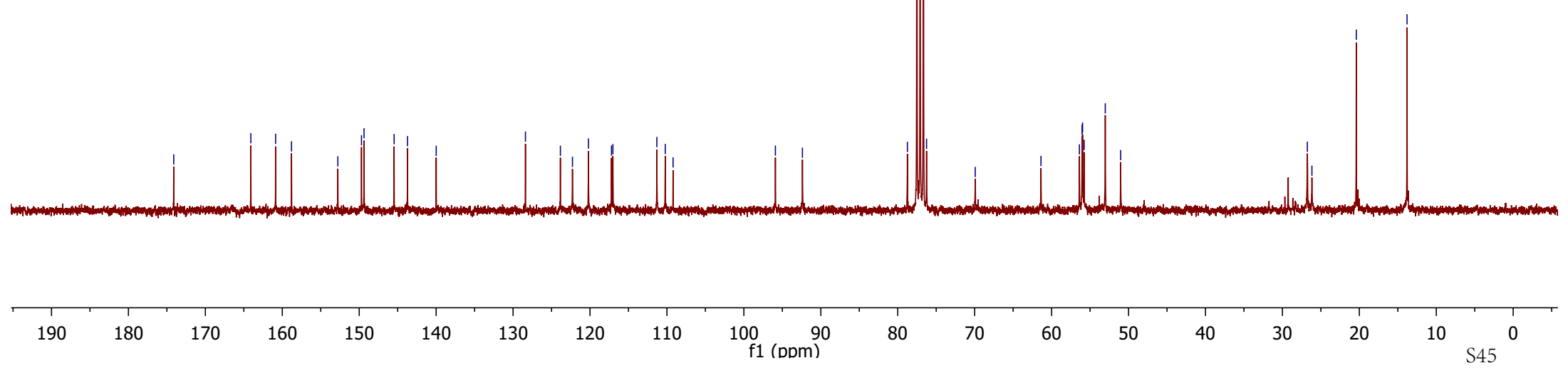


linker nmr
bv-48-13-r2 cdcl3

- 174.11
- 164.09
- 160.87
- 158.80
- 152.78
- 149.71
- 149.37
- 145.46
- 143.72
- 139.99
- 128.39
- 123.85
- 122.28
- 120.20
- 117.21
- 117.03
- 111.31
- 110.22
- 109.20
- 95.90
- 92.39
- 78.74
- 76.25
- 69.93
- 61.38
- 56.39
- 56.04
- 55.98
- 55.77
- 53.02
- 51.03
- 26.76
- 26.16
- 20.40
- 13.80

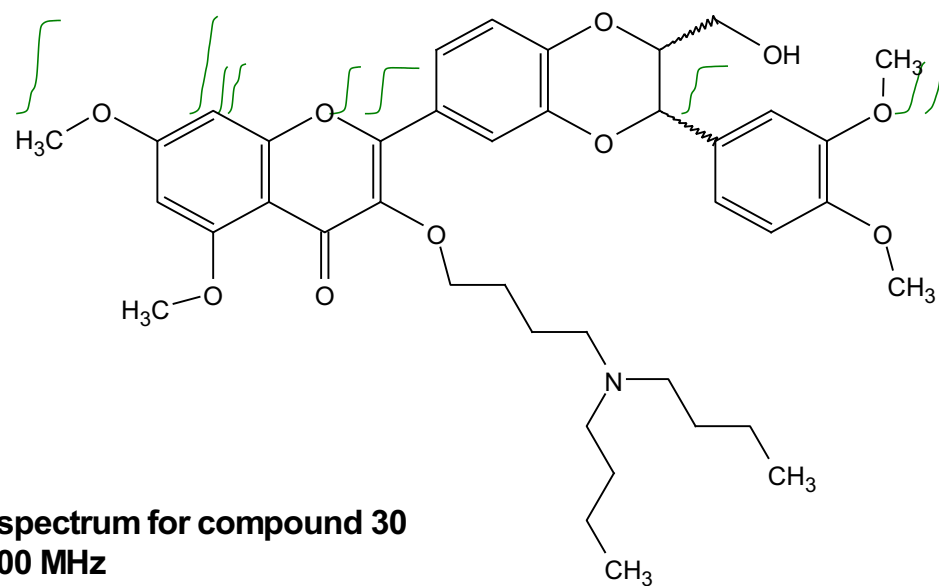


¹³C NMR spectrum for compound 29
CDCl₃, 75 MHz

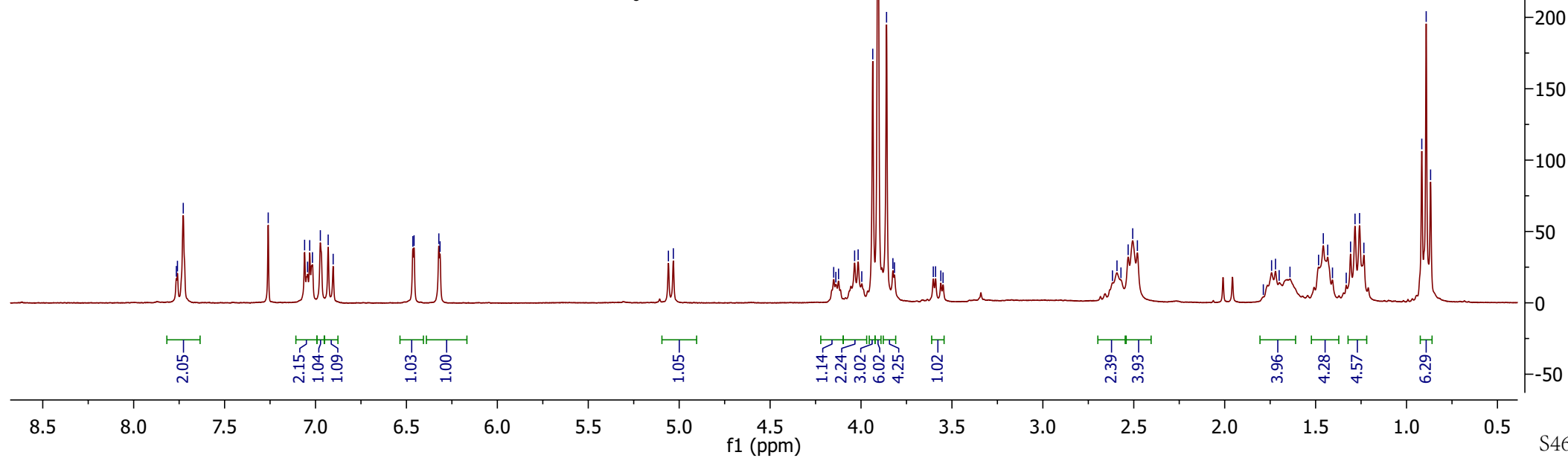


andre vignau
av 39-40-R2

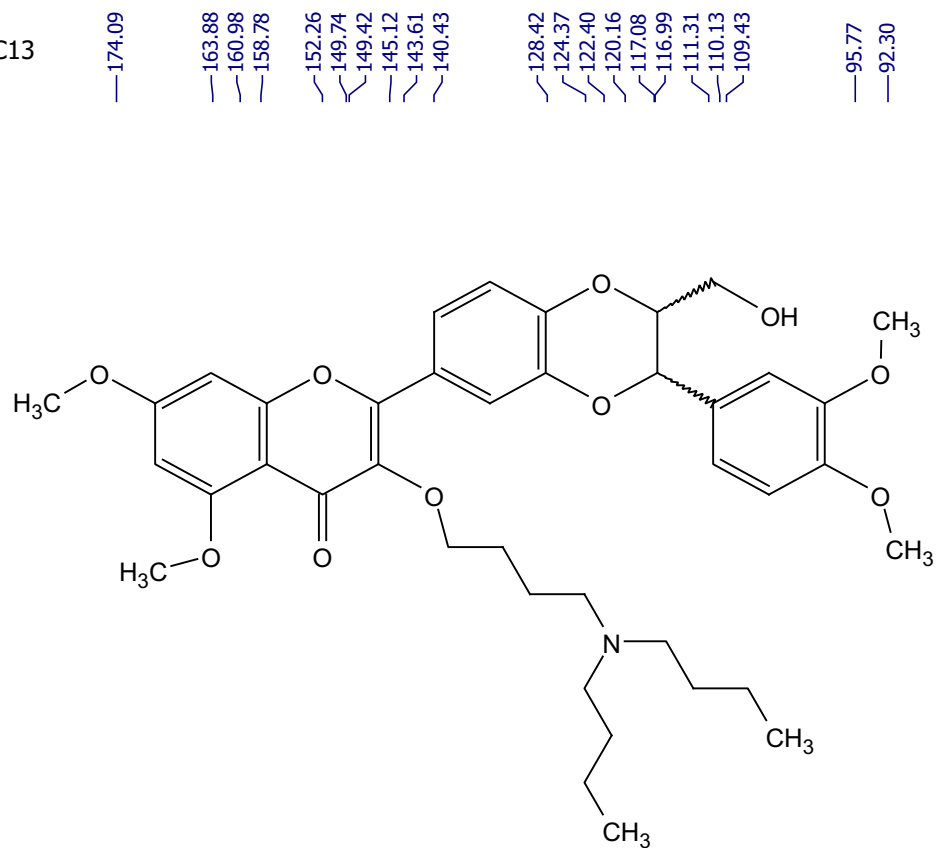
7.765 7.759 7.727 7.260 7.060 7.044 7.032 7.017 6.973 6.930 6.903 6.464 6.458 6.322 6.315 5.059 5.032 4.150 4.124 4.035 4.016 3.996 3.935 3.909 3.904 3.860 3.825 3.816 3.809 3.590 3.561 3.549 2.617 2.592 2.571 2.531 2.506 2.480 1.742 1.721 1.641 1.484 1.458 1.433 1.407 1.308 1.283 1.258 1.235 0.916 0.892 0.868



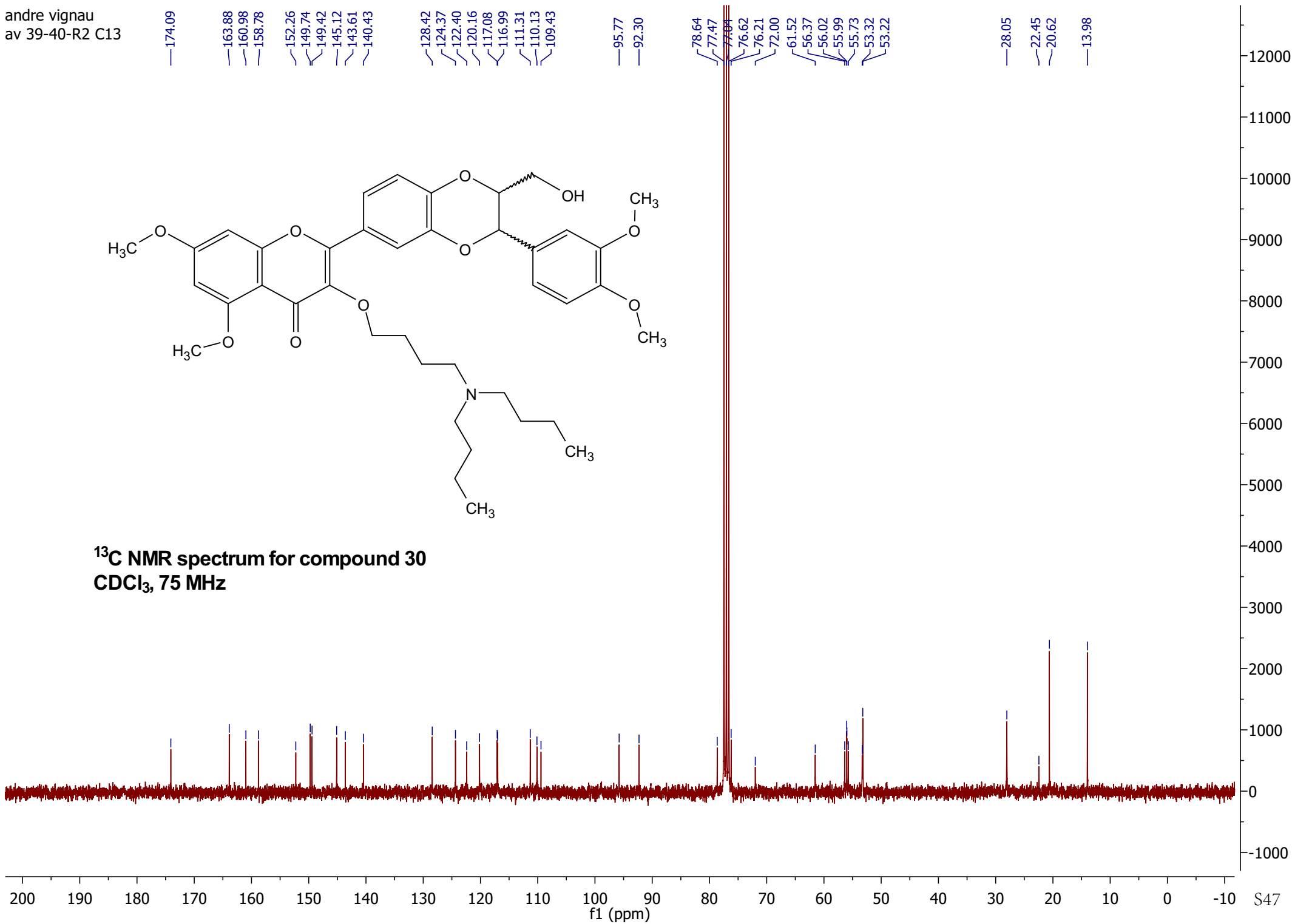
¹H NMR spectrum for compound 30
CDCl₃, 300 MHz



andre vignau
av 39-40-R2 C13



¹³C NMR spectrum for compound 30
CDCl₃, 75 MHz

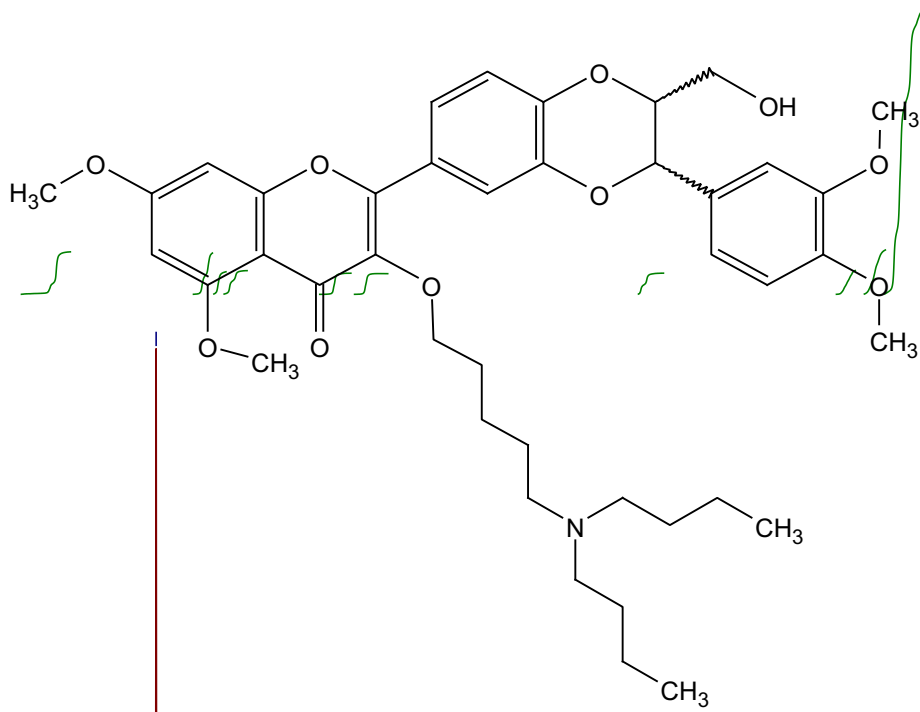


andre vignau
av-39-26

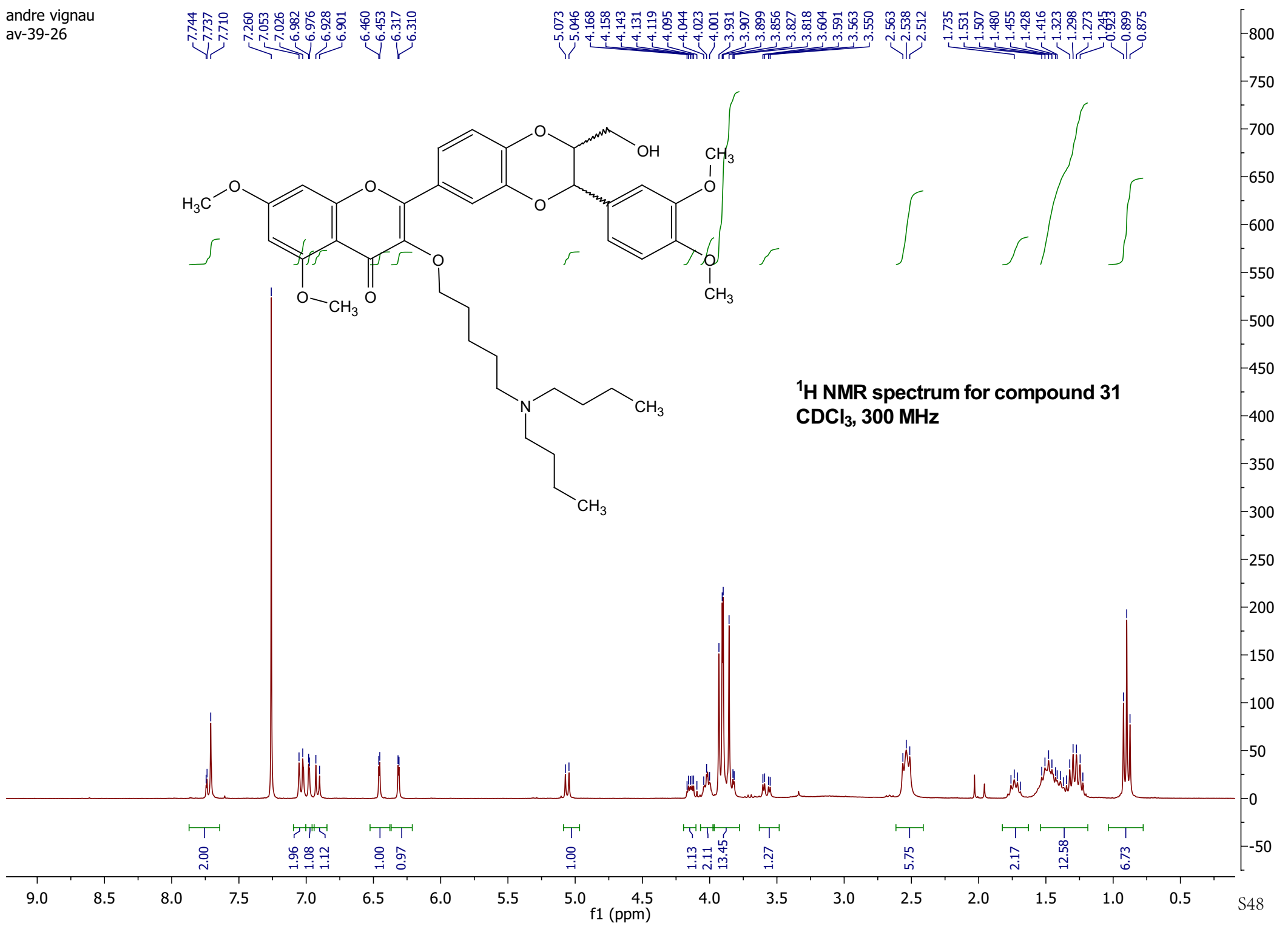
7.744
7.737
7.710
7.260
7.053
7.026
6.982
6.976
6.928
6.901
6.460
6.453
6.317
6.310

5.073
5.046
4.168
4.158
4.143
4.131
4.119
4.095
4.044
4.023
4.001
3.931
3.907
3.899
3.856
3.827
3.818
3.604
3.591
3.563
3.550

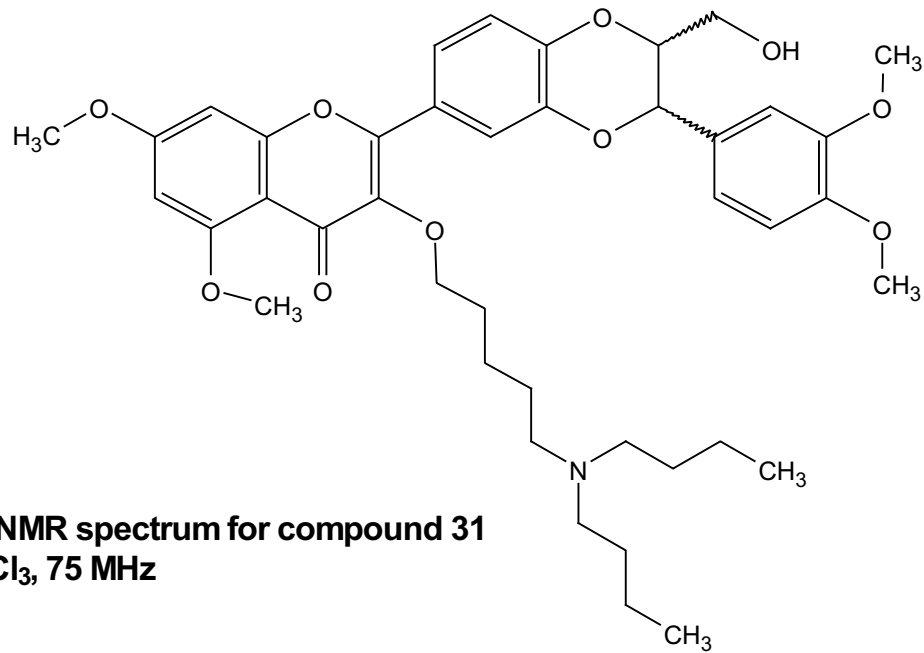
2.563
2.538
2.512
1.735
1.531
1.507
1.480
1.455
1.428
1.416
1.323
1.298
1.273
1.245
0.923
0.899
0.875



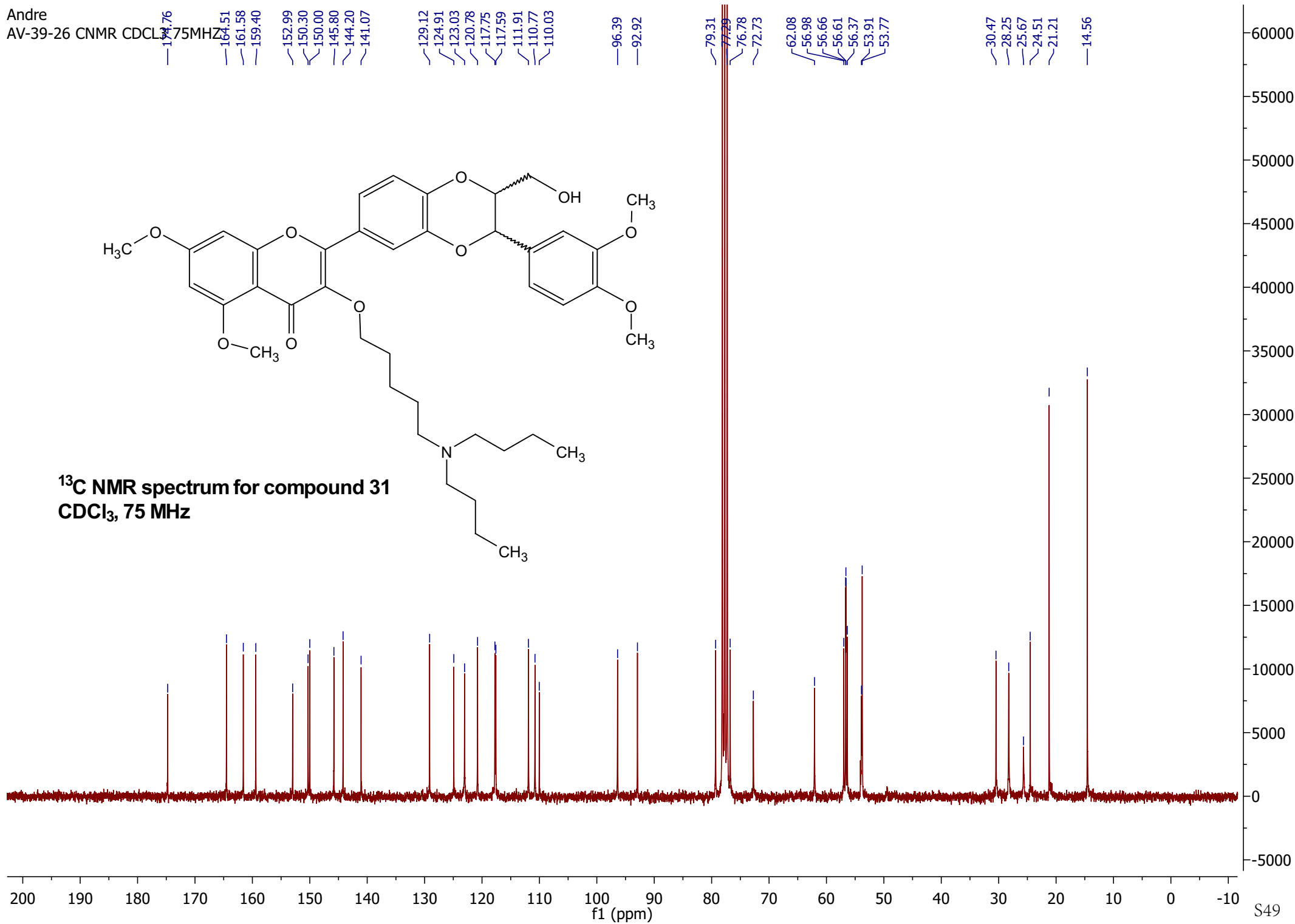
¹H NMR spectrum for compound 31
CDCl₃, 300 MHz



Andre
AV-39-26 CNMR CDCL₃ 75MHz

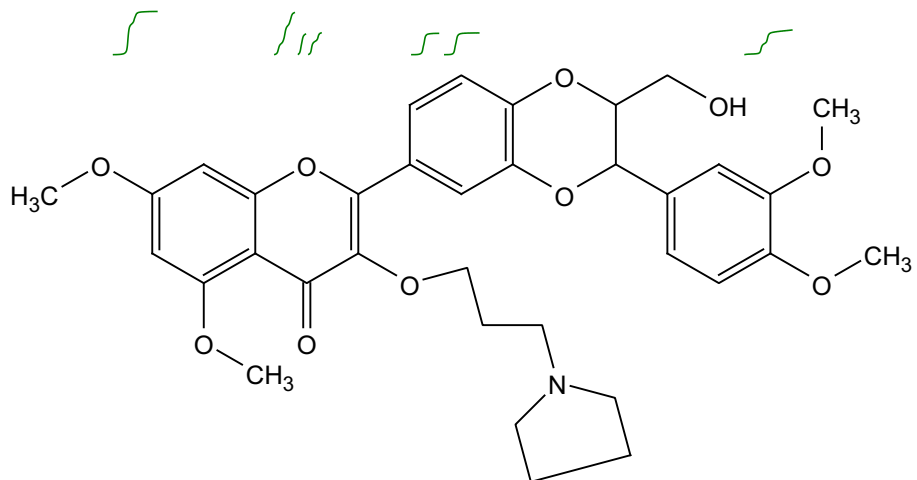


¹³C NMR spectrum for compound 31
CDCl₃, 75 MHz

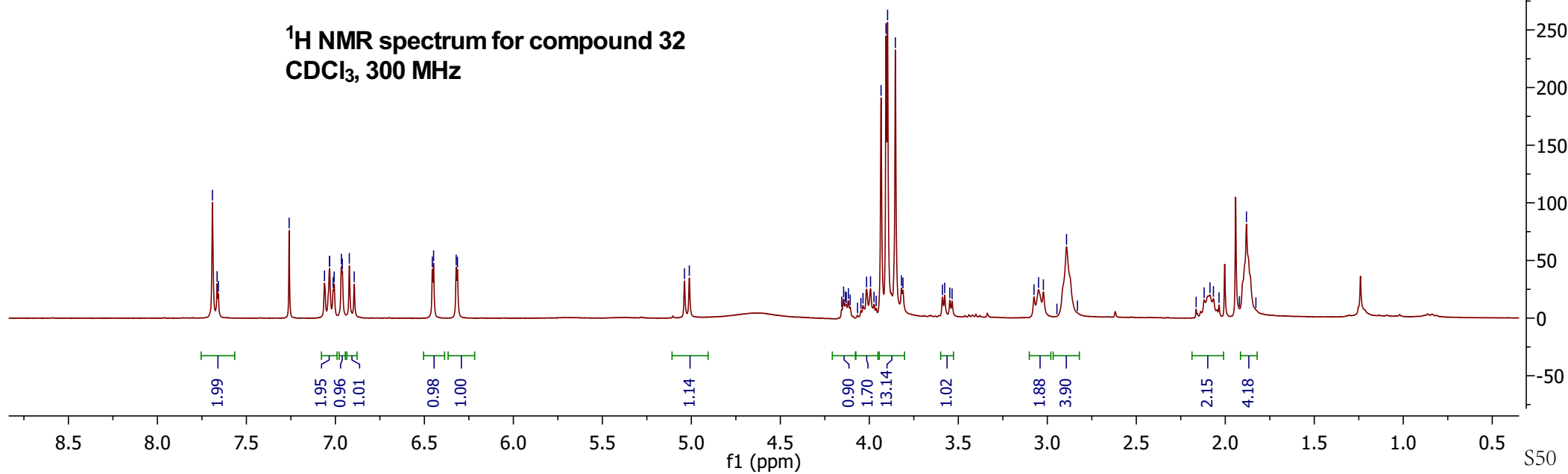


linker nmr
bv-17-37-r1- cdcl3

7.691 7.665 7.658 7.260 7.061 7.033 7.033 6.966 6.961 6.922 6.894 6.855 6.448 6.321 6.314 5.039 5.011 4.144 4.134 4.118 4.016 3.993 3.934 3.906 3.898 3.854 3.819 3.811 3.589 3.577 3.548 3.548 3.049 3.022 2.946 2.892 2.831 2.164 2.119 2.086 2.067 2.035 1.920 1.881 1.828

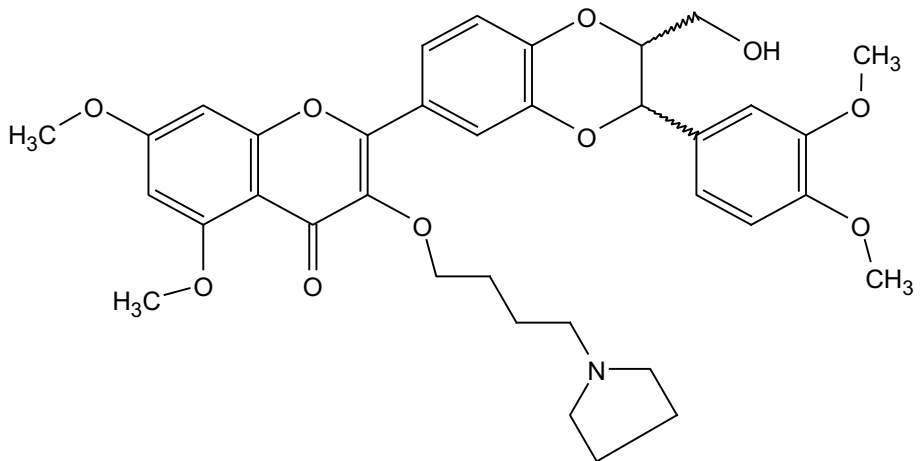


¹H NMR spectrum for compound 32
CDCl₃, 300 MHz

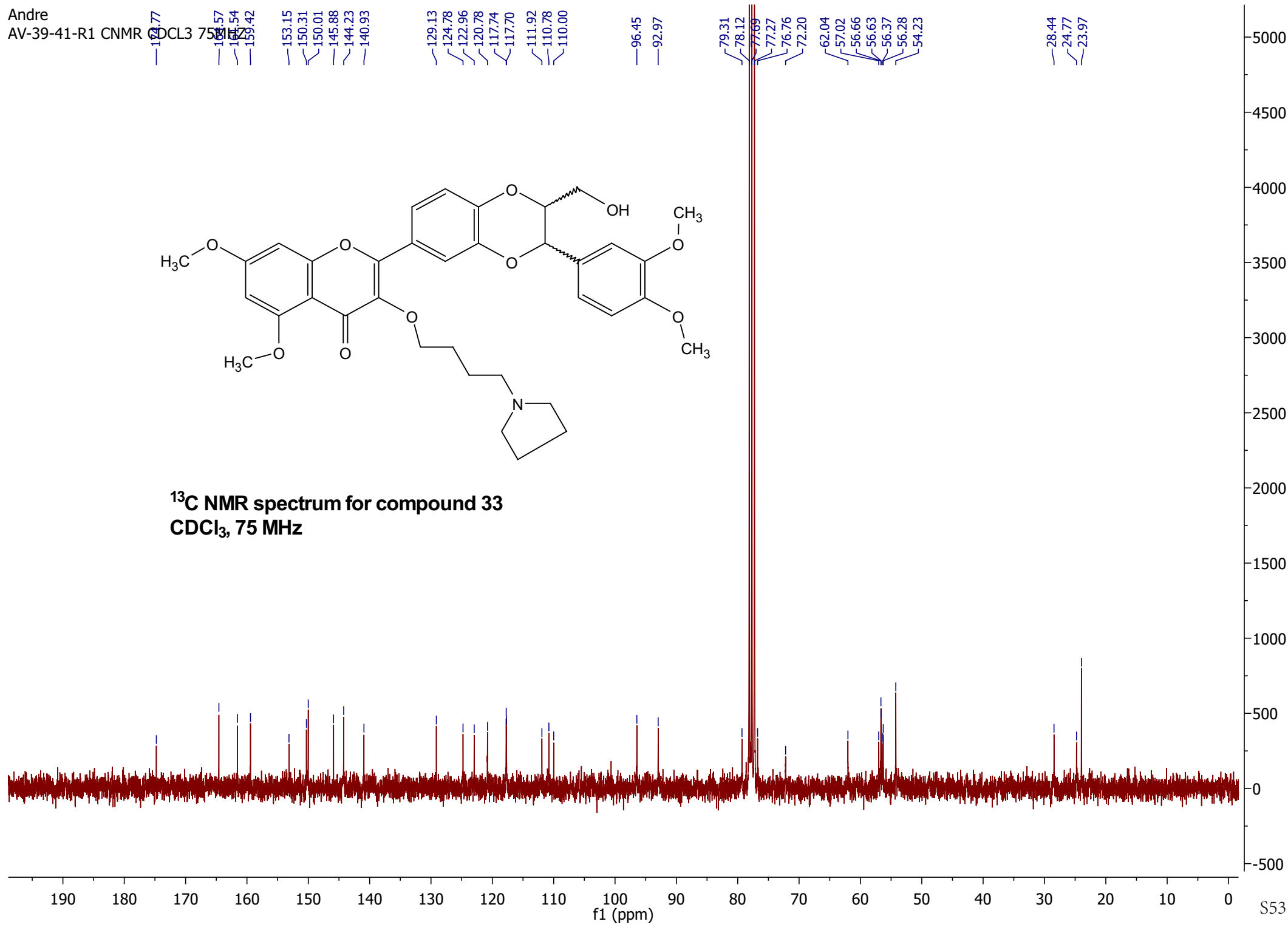


Andre

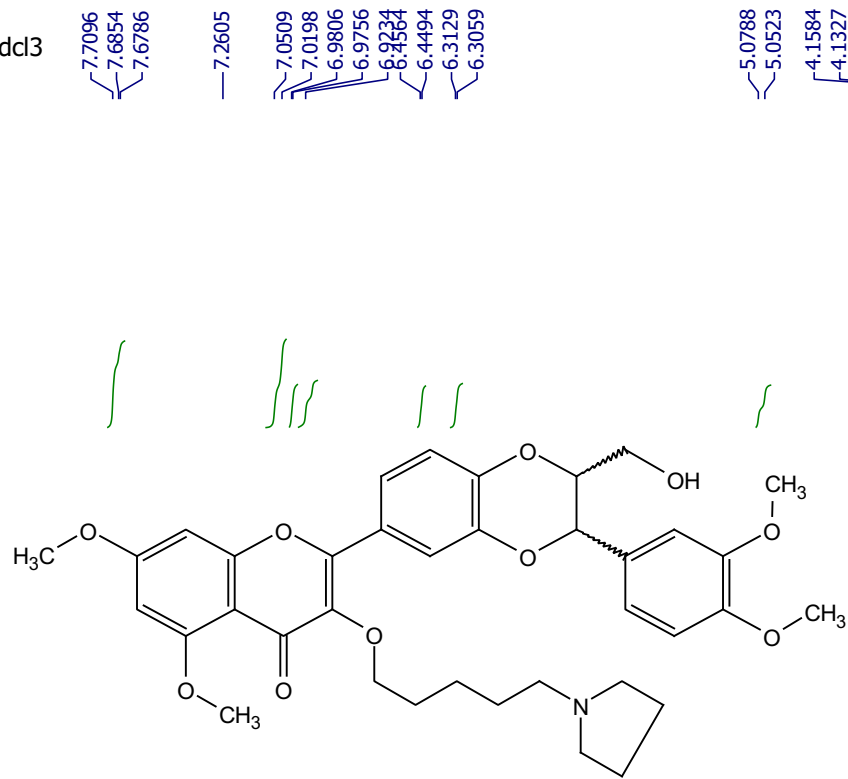
AV-39-41-R1 CNMR CDCl₃ 75 MHz



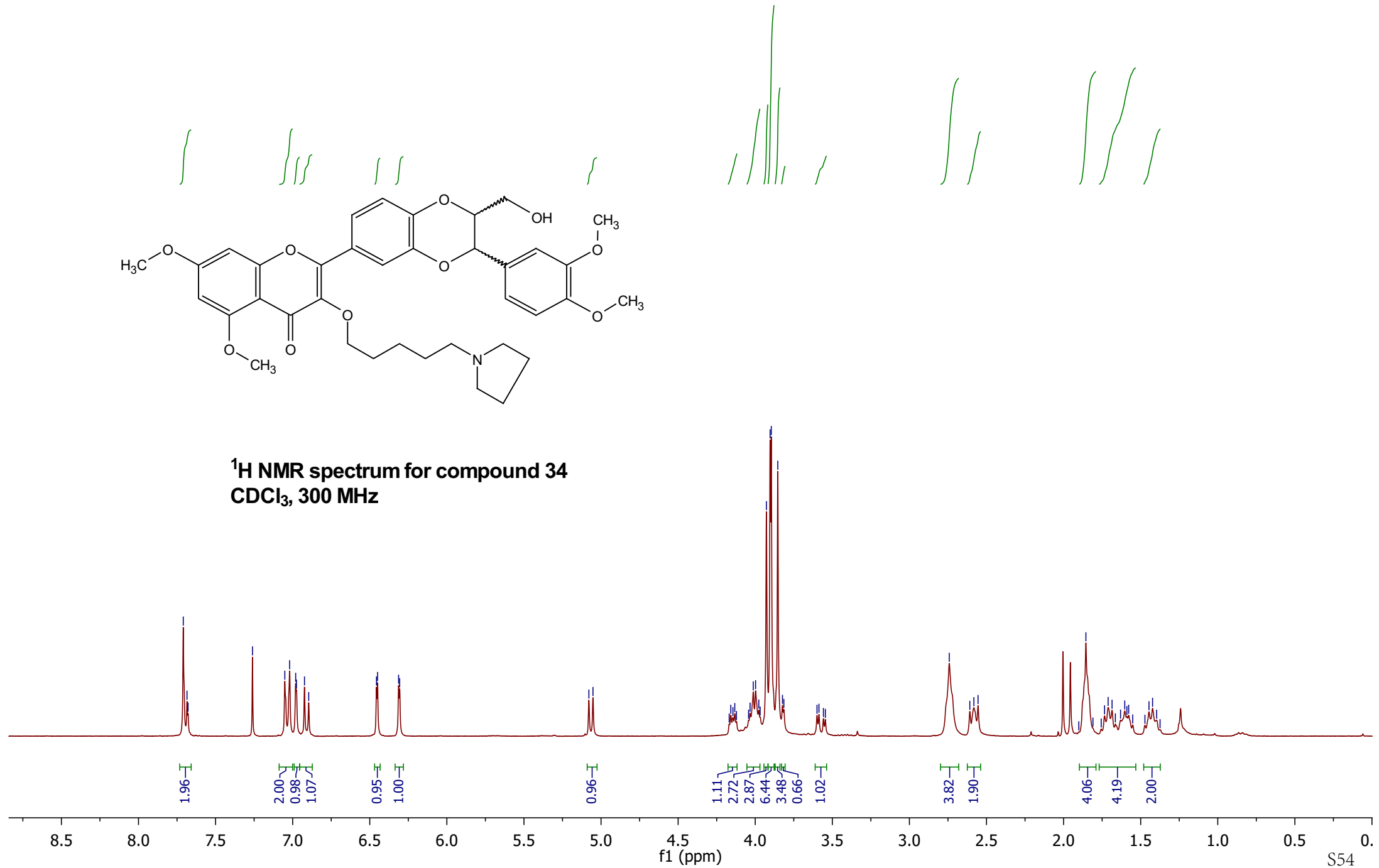
¹³C NMR spectrum for compound 33
CDCl₃, 75 MHz



linker nmr
bv-17-36-r2- cdcl3

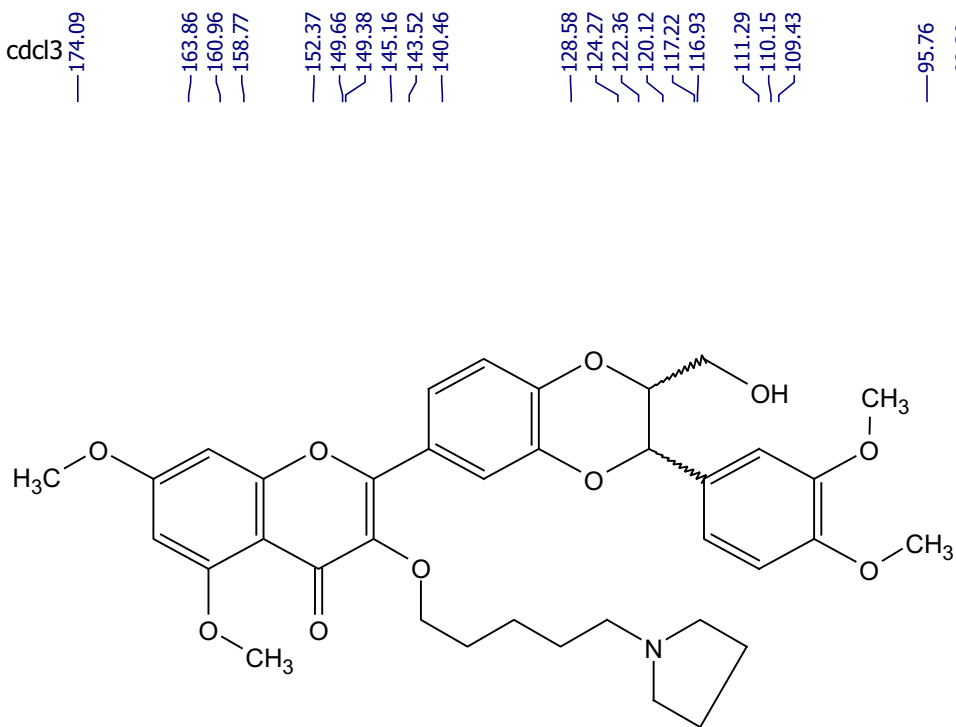


¹H NMR spectrum for compound 34
CDCl₃, 300 MHz

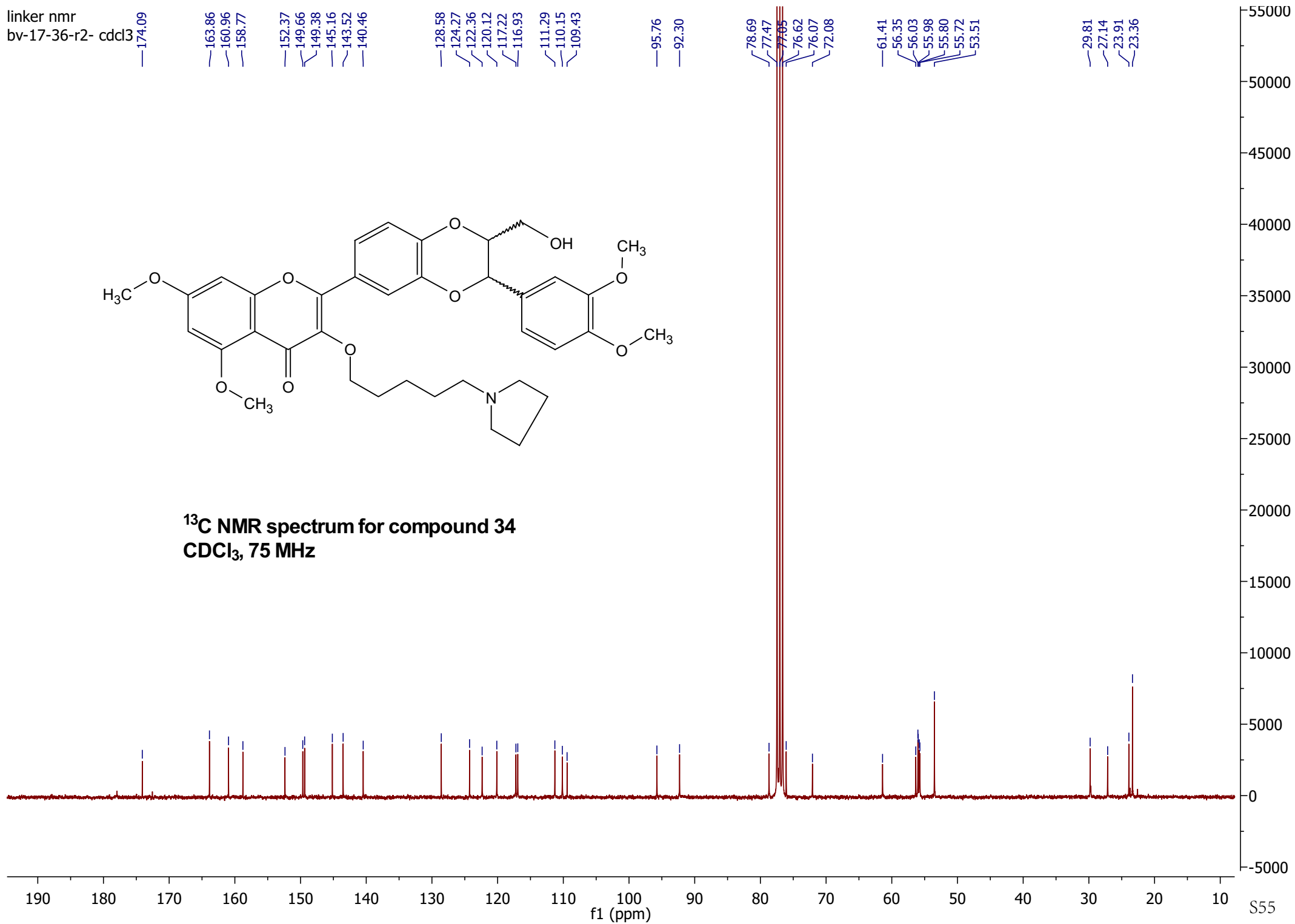


linker nmr

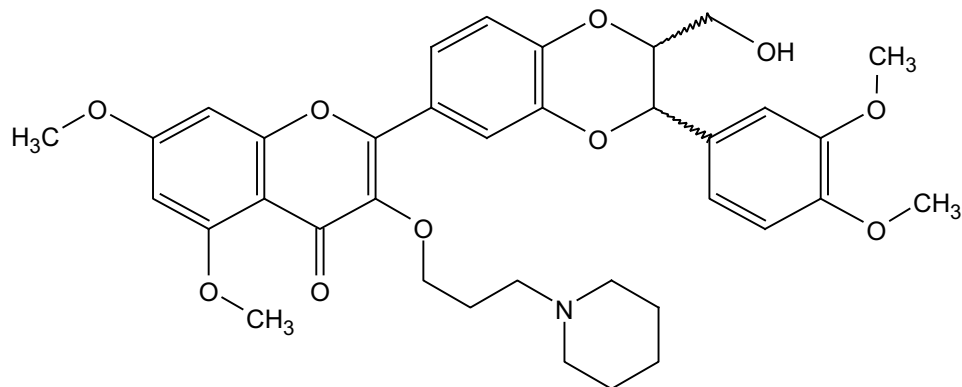
bv-17-36-r2- cdcl3



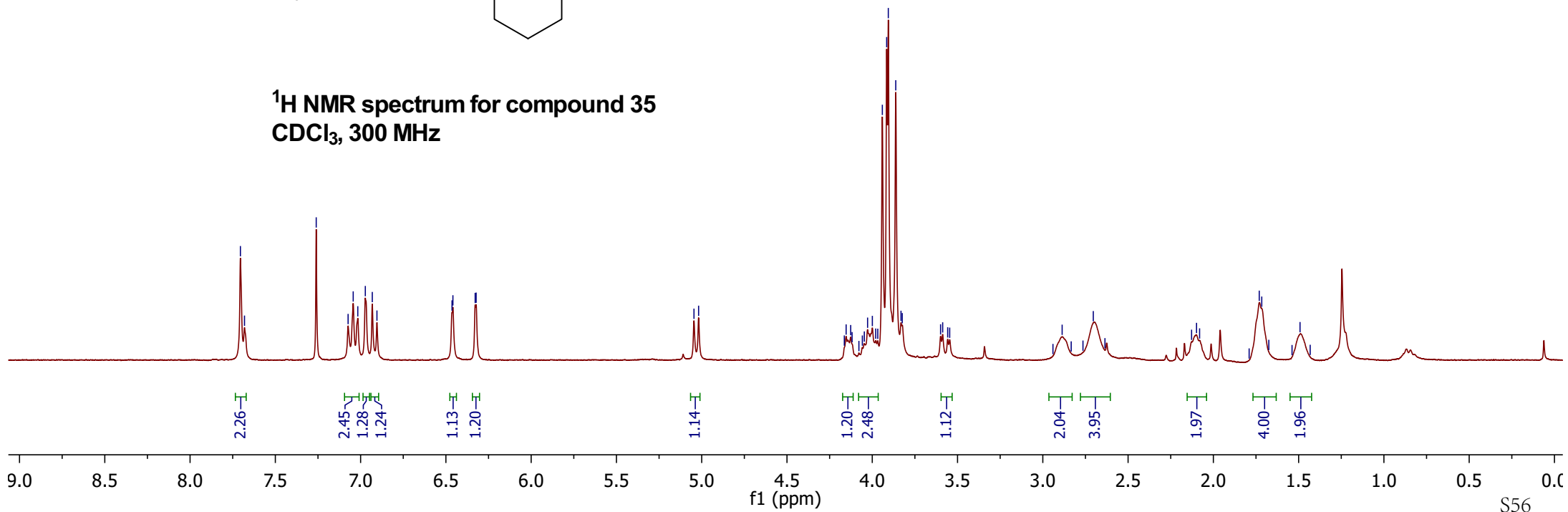
¹³C NMR spectrum for compound 34
CDCl₃, 75 MHz



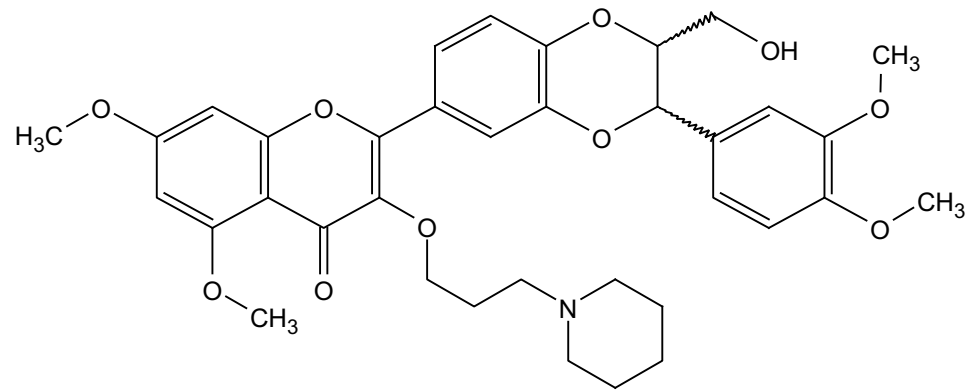
7.7048 7.6808 7.2603 7.0734 7.0434 7.0166 6.9724 6.9316 6.9043 6.4641 6.4588 6.3283 6.3226 5.0453 5.0182 4.1532 4.1264 4.0274 3.9995 3.9798 3.9409 3.9155 3.9059 3.8622 3.8315 3.8242 3.5995 3.5871 3.5577 3.5460 2.9405 2.8866 2.8335 2.7645 2.7040 2.6356 2.1276 2.0986 2.0807 1.7902 1.7310 1.7162 1.6748 1.5387 1.4918 1.4323



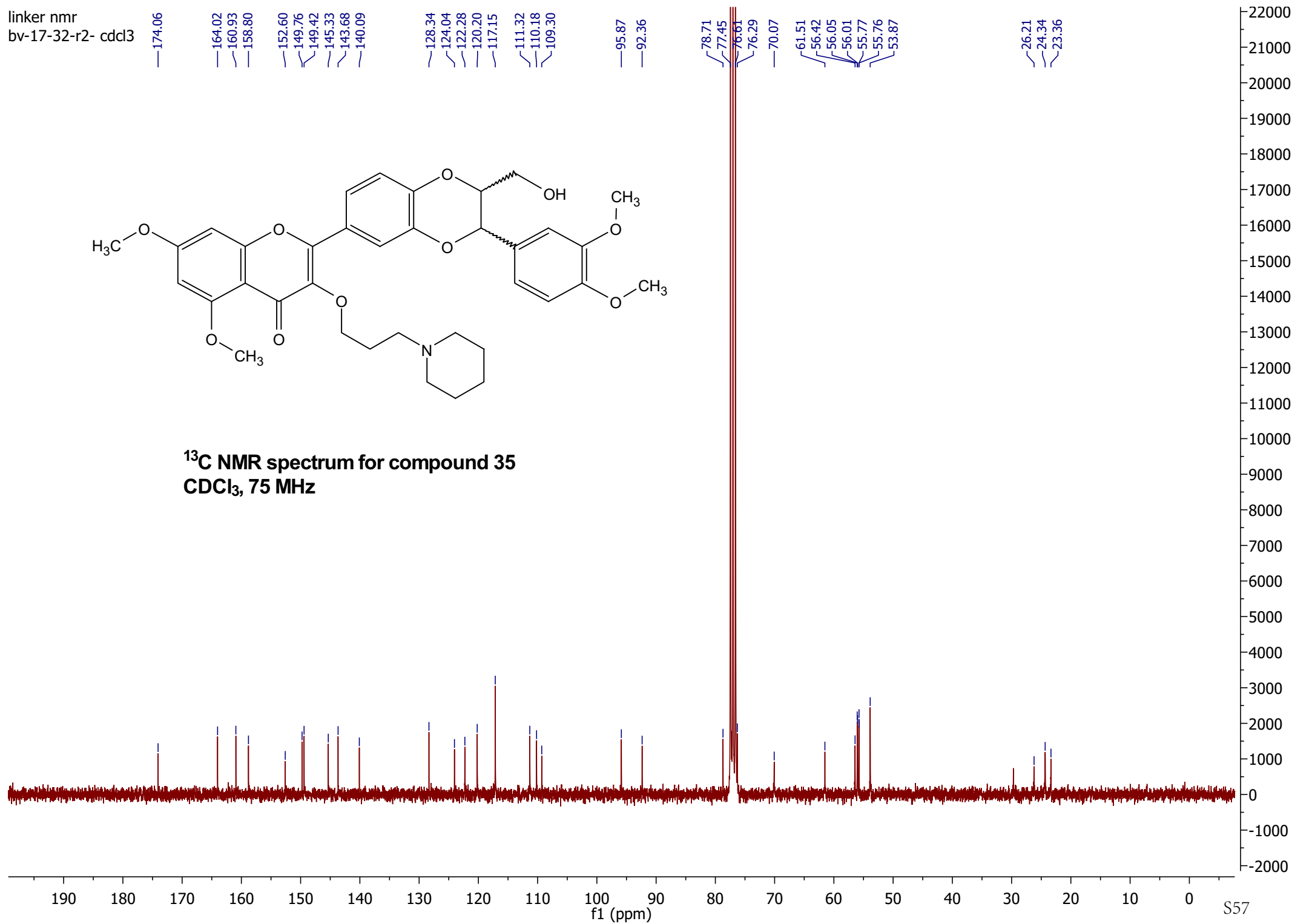
¹H NMR spectrum for compound 35
CDCl₃, 300 MHz



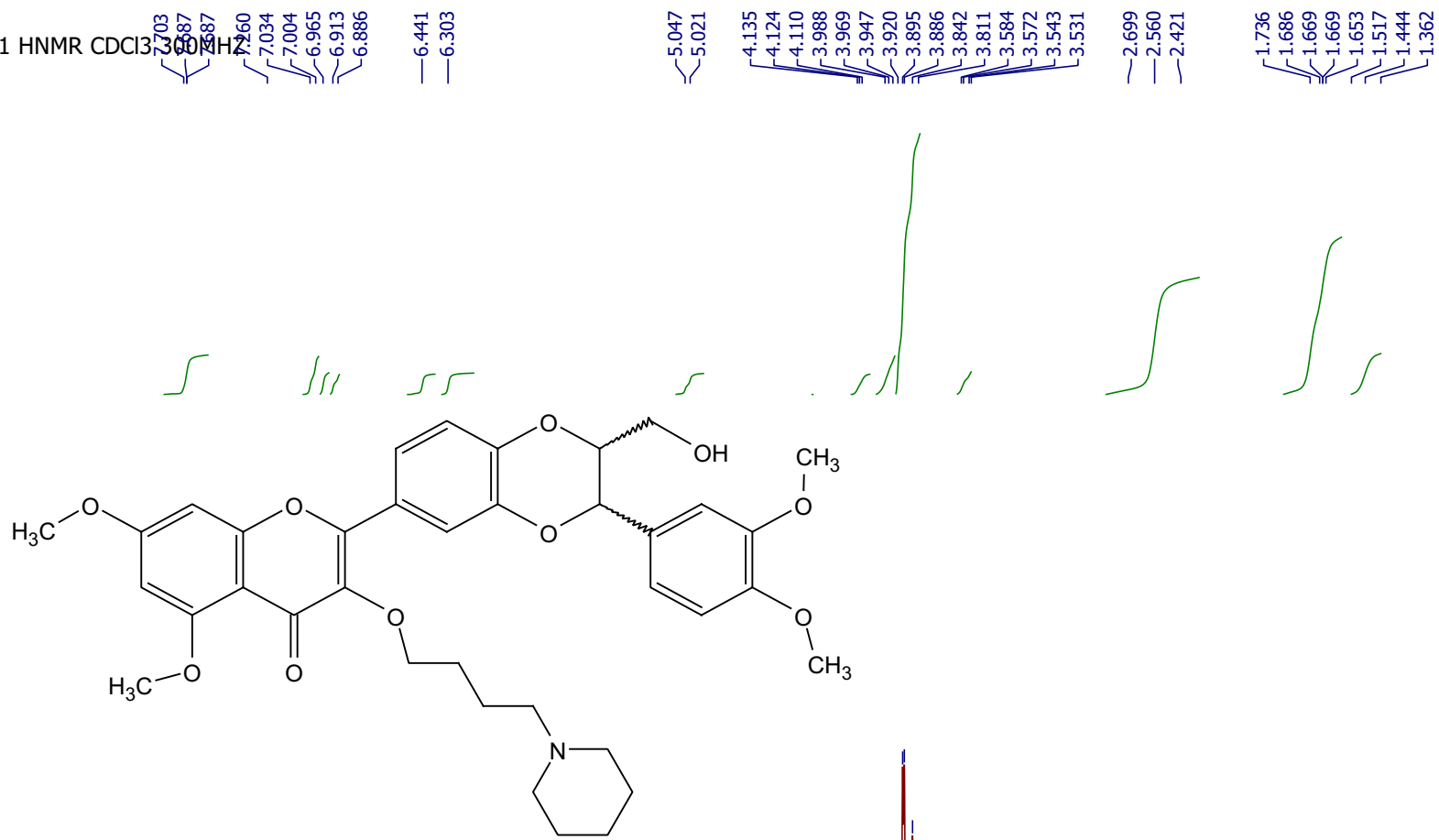
linker nmr
bv-17-32-r2- cdcl3



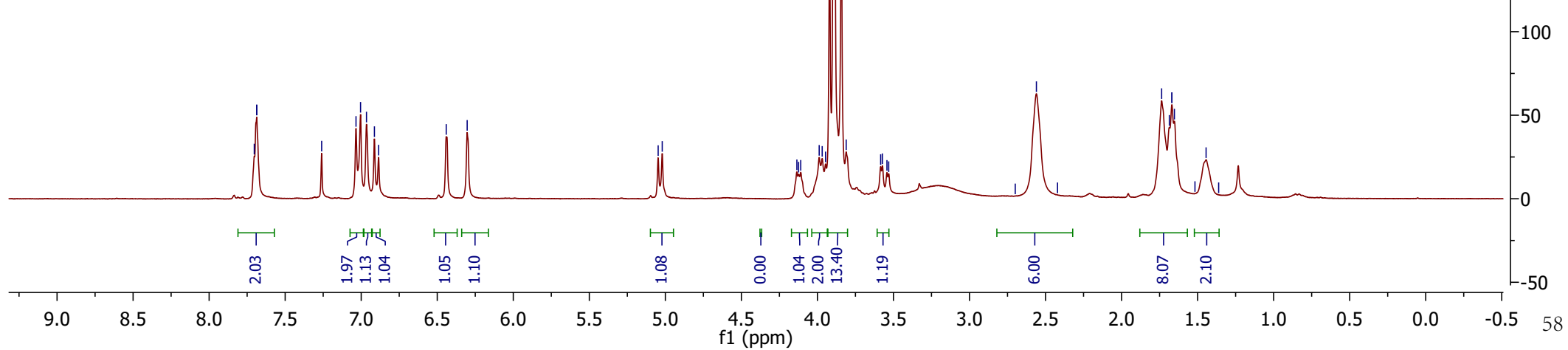
^{13}C NMR spectrum for compound 35
 CDCl_3 , 75 MHz



Andre
AV-39-42-R1 HNMR CDCl₃ 300 MHz

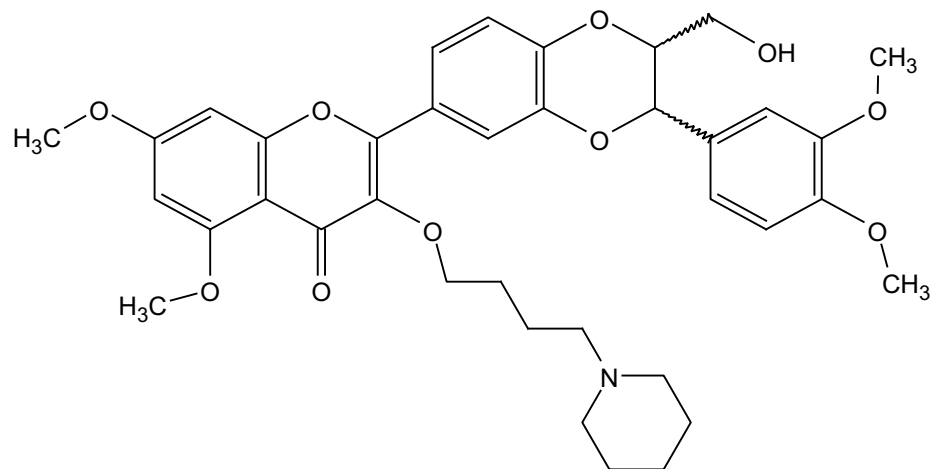


**¹H NMR spectrum for compound 36
CDCl₃, 300 MHz**

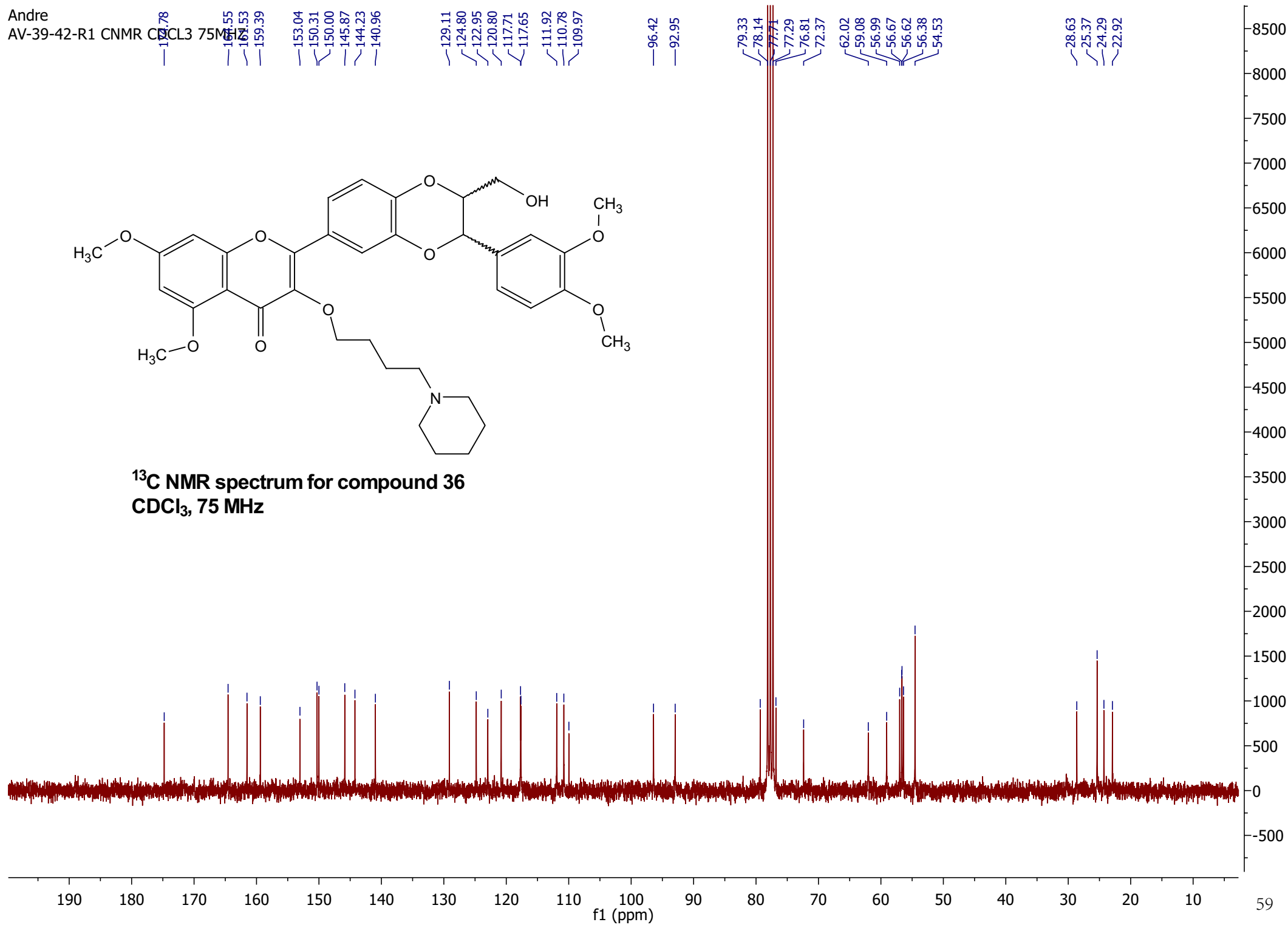


Andre

AV-39-42-R1 CNMR CDCl₃ 75 MHz



¹³C NMR spectrum for compound 36
CDCl₃, 75 MHz



linker nmr
BV-48-37-r2 cdcl3

7.2603
7.0491
7.0219
6.9832
6.9278
6.9009

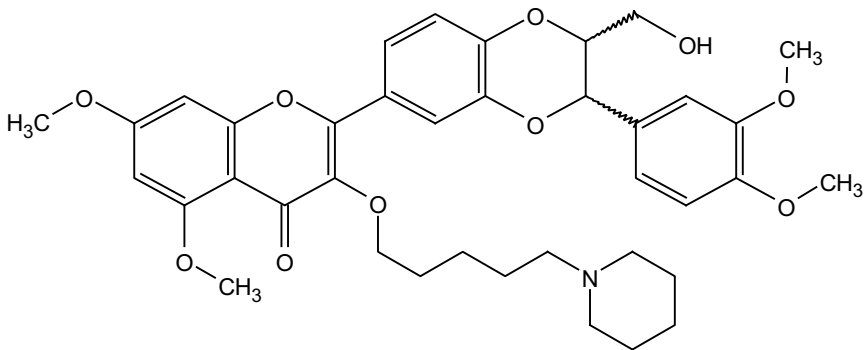
6.4536
6.3108

5.0762
5.0500

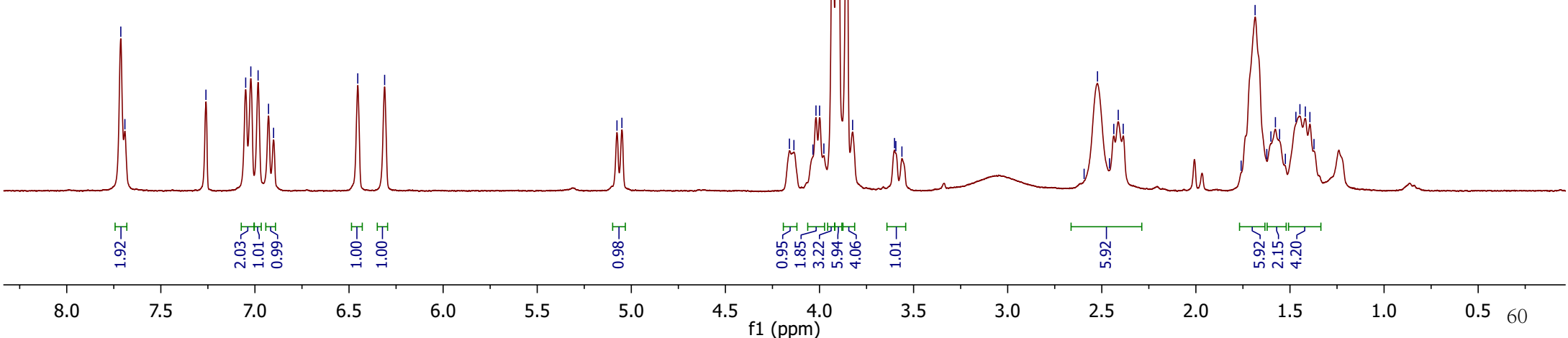
4.1598
4.1359
4.0349
4.0187
3.9995
3.9768
3.9299
3.9039
3.8552
3.8241
3.6014
3.5943
3.5620

2.5939
2.5228
2.4592
2.4363
2.4125
2.3862

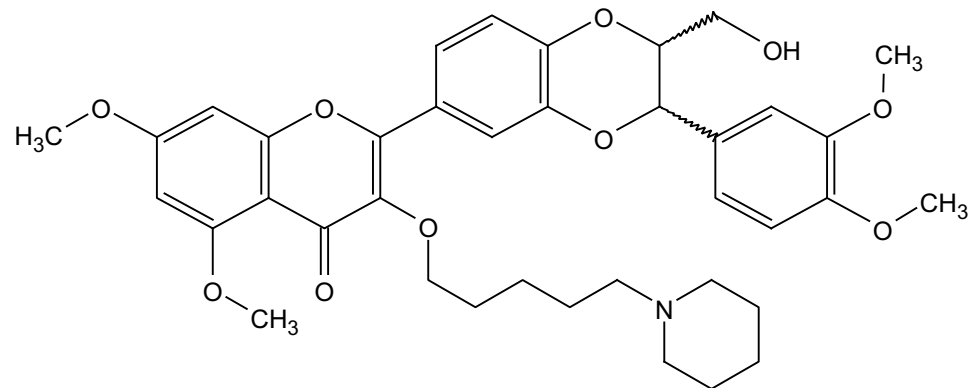
1.7596
1.6853
1.6232
1.6013
1.5774
1.5552
1.5246
1.4686
1.4471
1.4184
1.3941
1.3724



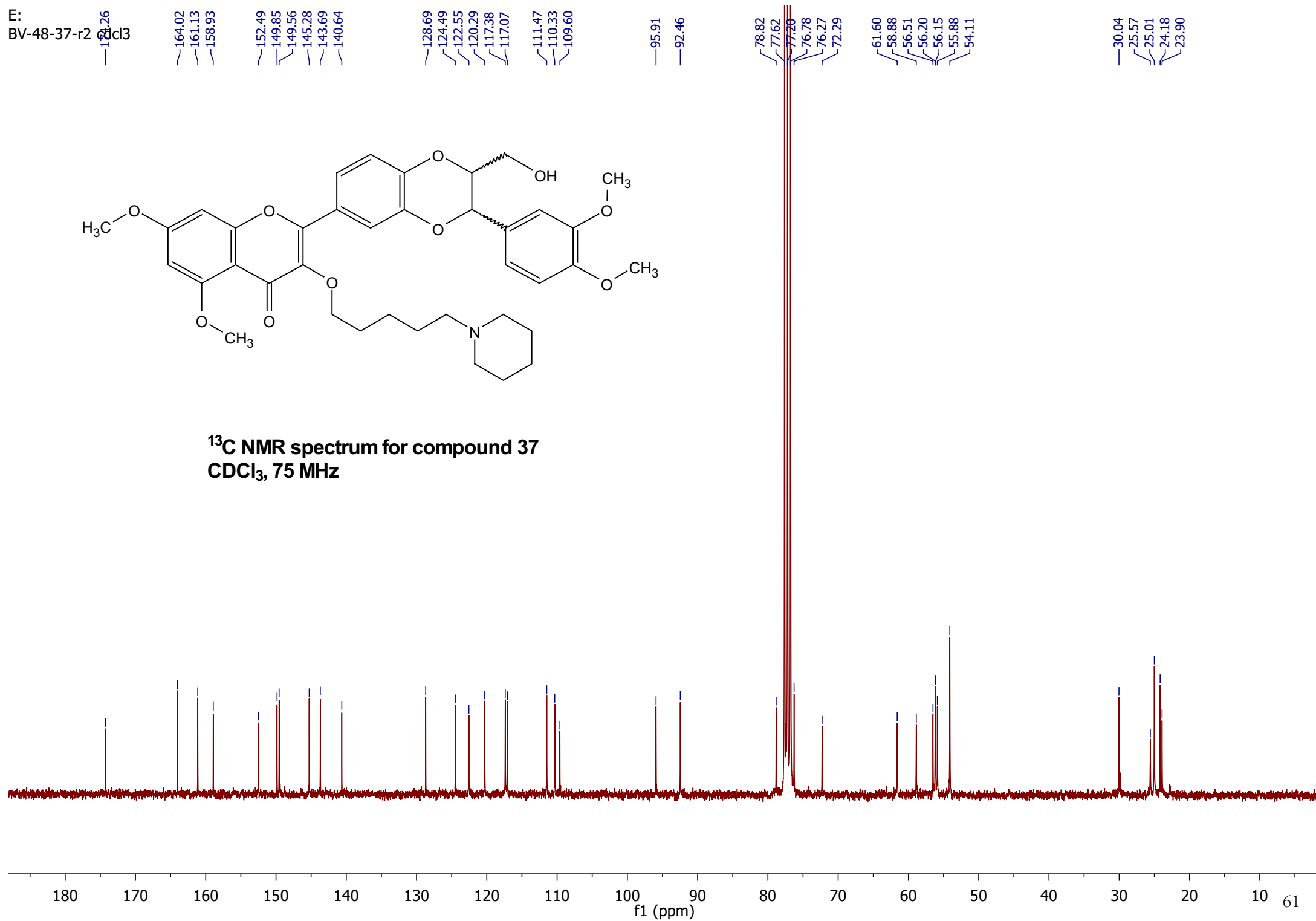
**¹H NMR spectrum for compound 37
CDCl₃, 300 MHz**



E:
BV-48-37-r2
CDCl₃

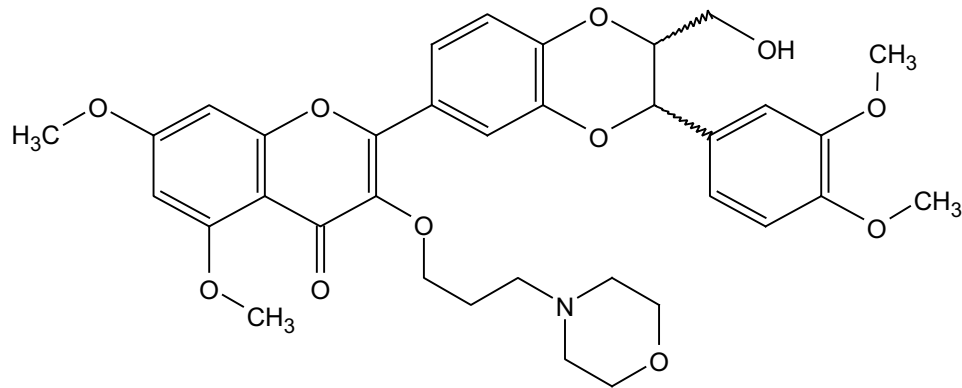


¹³C NMR spectrum for compound 37
CDCl₃, 75 MHz

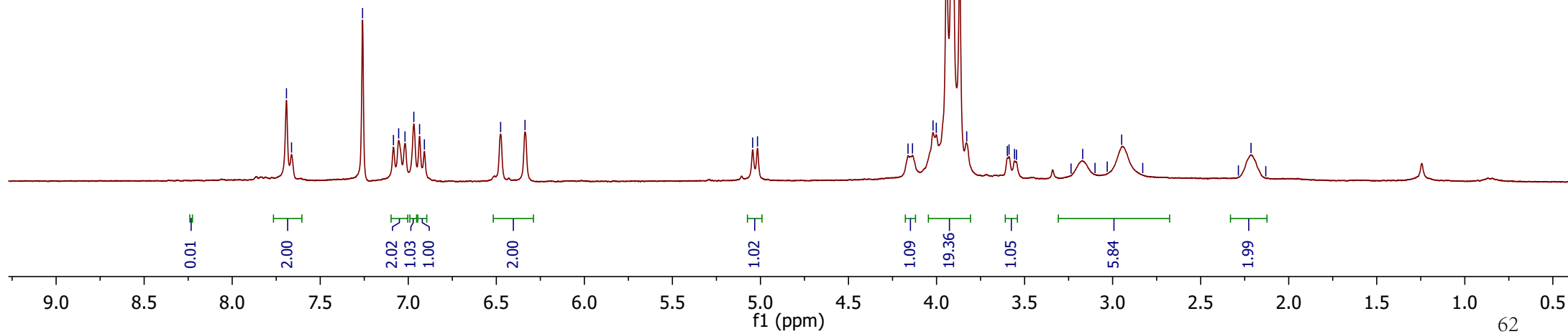


linker nmr
bv-17-243- cdcl3

7.692 7.663 7.260 7.084 7.055 7.019 6.969 6.936 6.909 6.476 6.337 5.044 5.017 4.162 4.137 4.020 4.001 3.943 3.913 3.869 3.829 3.598 3.588 3.557 3.536 3.170 3.100 3.031 2.949 2.829 2.286 2.214 2.130

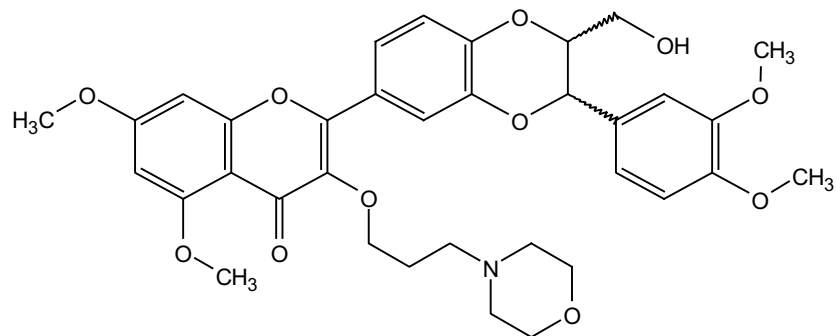


¹H NMR spectrum for compound 38
CDCl₃, 300 MHz

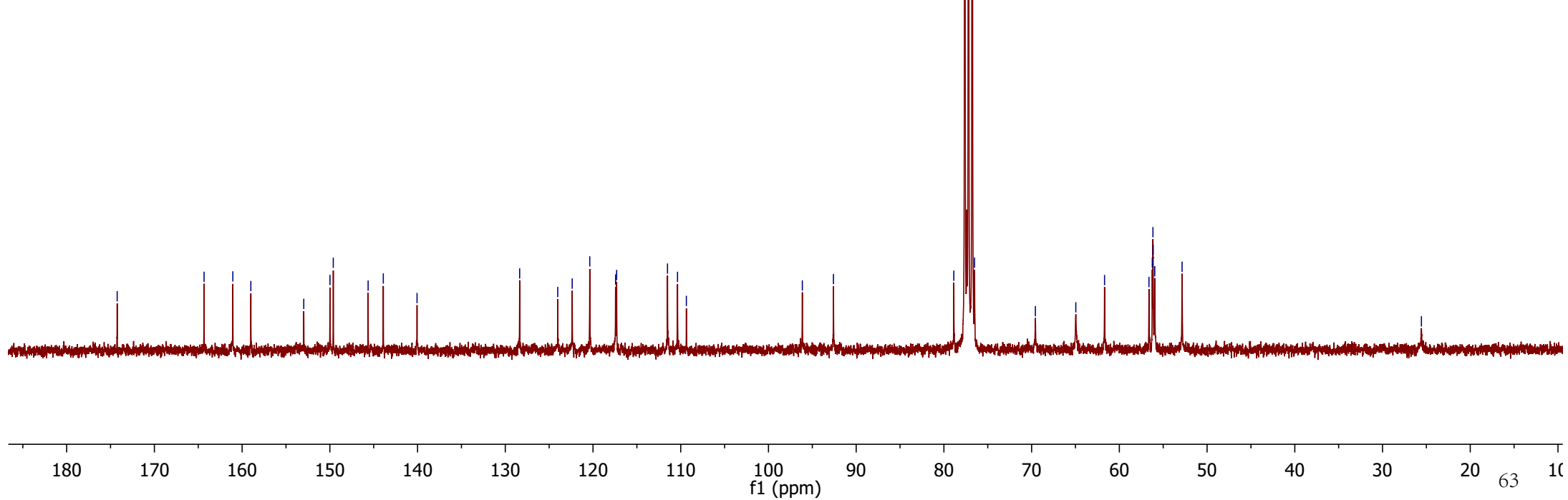


linker nmr
bv-17-243-
CDCl₃

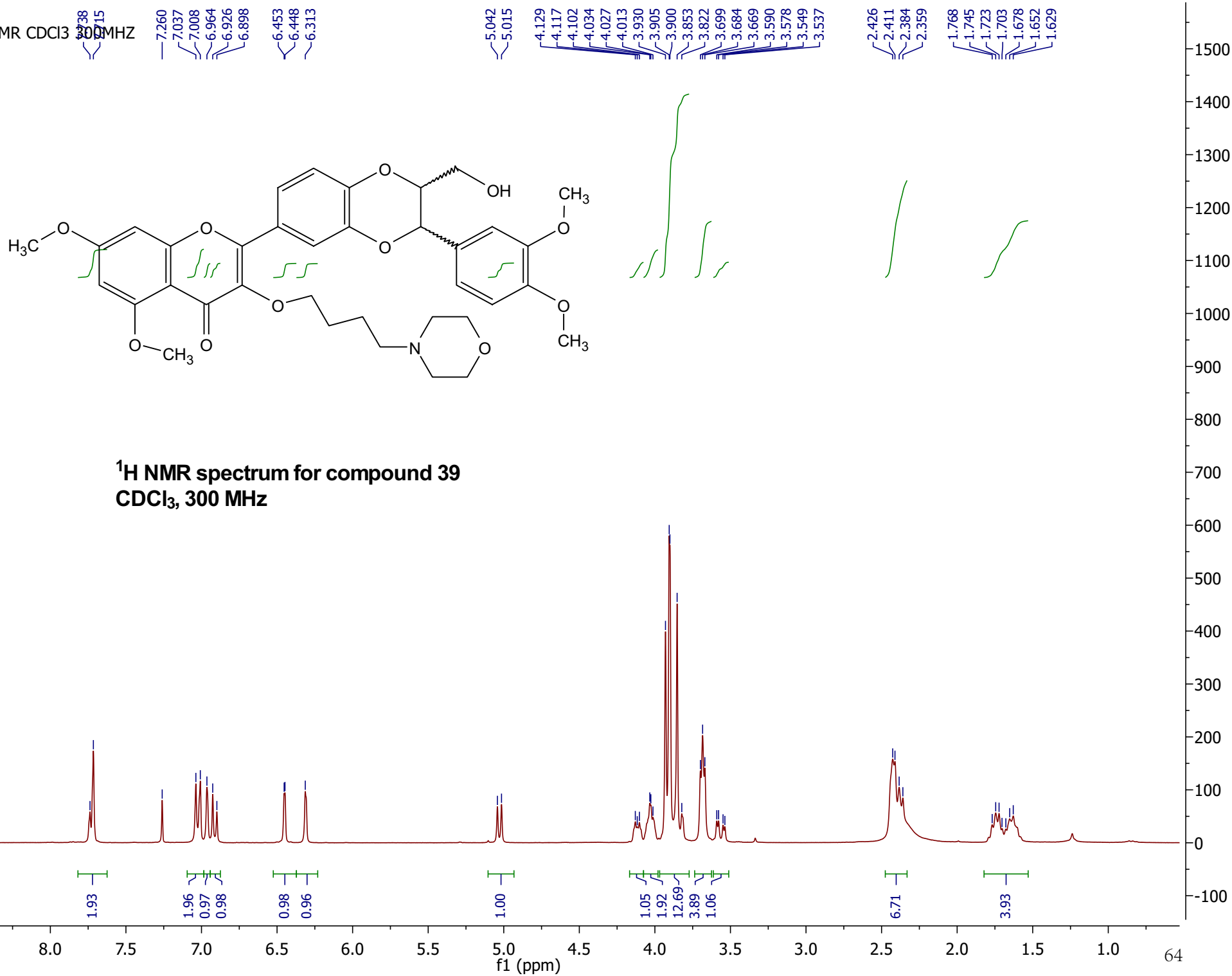
164.34 161.06 159.00 152.97 149.99 149.61 145.64 143.91 140.06 128.36 124.02 122.37 120.37 117.43 117.31 111.51 110.37 109.36 96.14 92.59 78.87 77.62 77.29 76.78 76.51 69.57 64.96 61.69 56.63 56.24 56.17 56.15 55.96 52.85 25.57



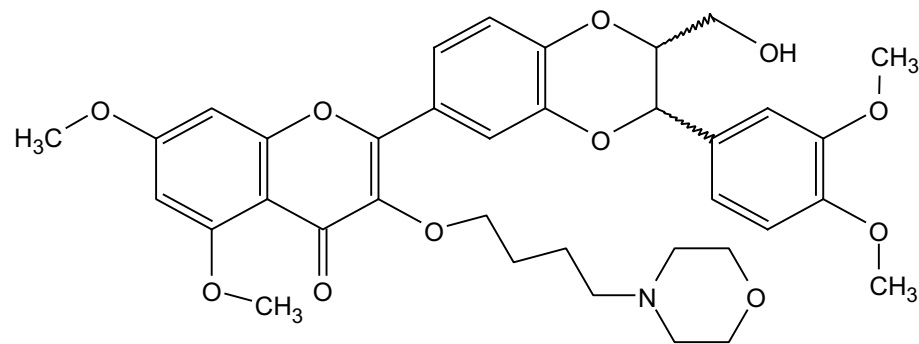
¹³C NMR spectrum for compound 38
CDCl₃, 300 MHz



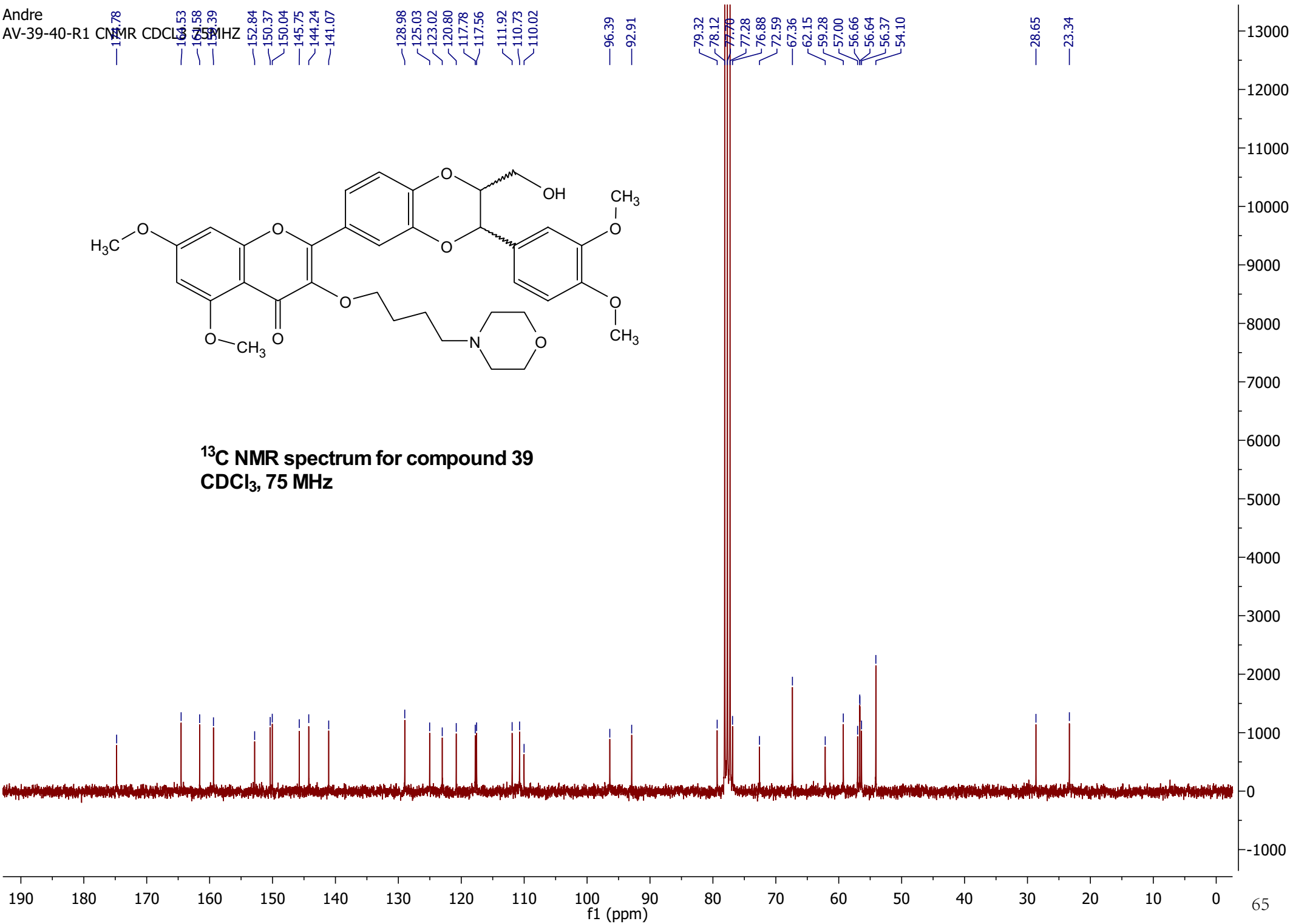
Andre
AV-39-40-R1 HNMR CDCl₃ 300 MHz



Andre
AV-39-40-R1 NMR CDCl₃, 75 MHz



¹³C NMR spectrum for compound 39
CDCl₃, 75 MHz

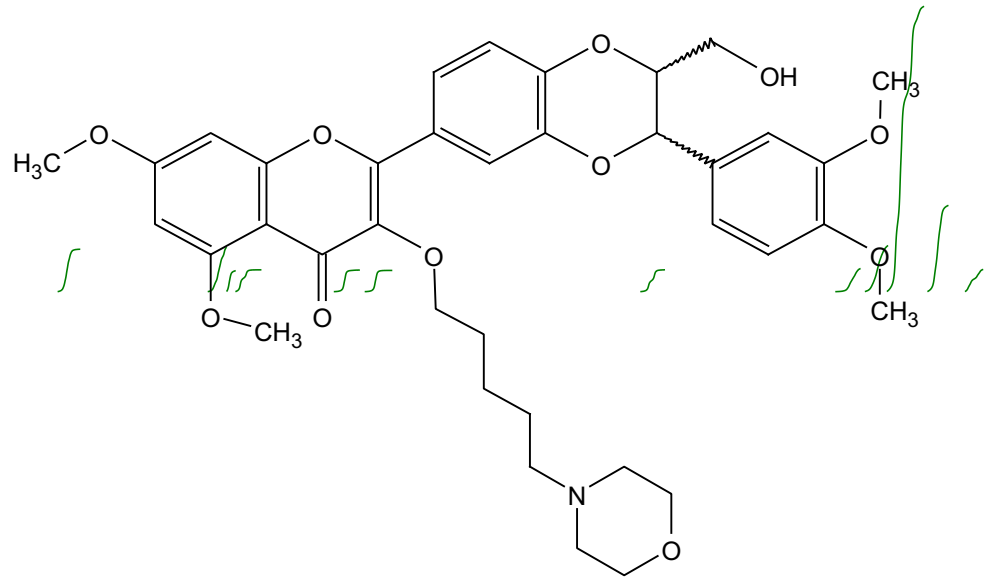


andre vignau
av 37-31

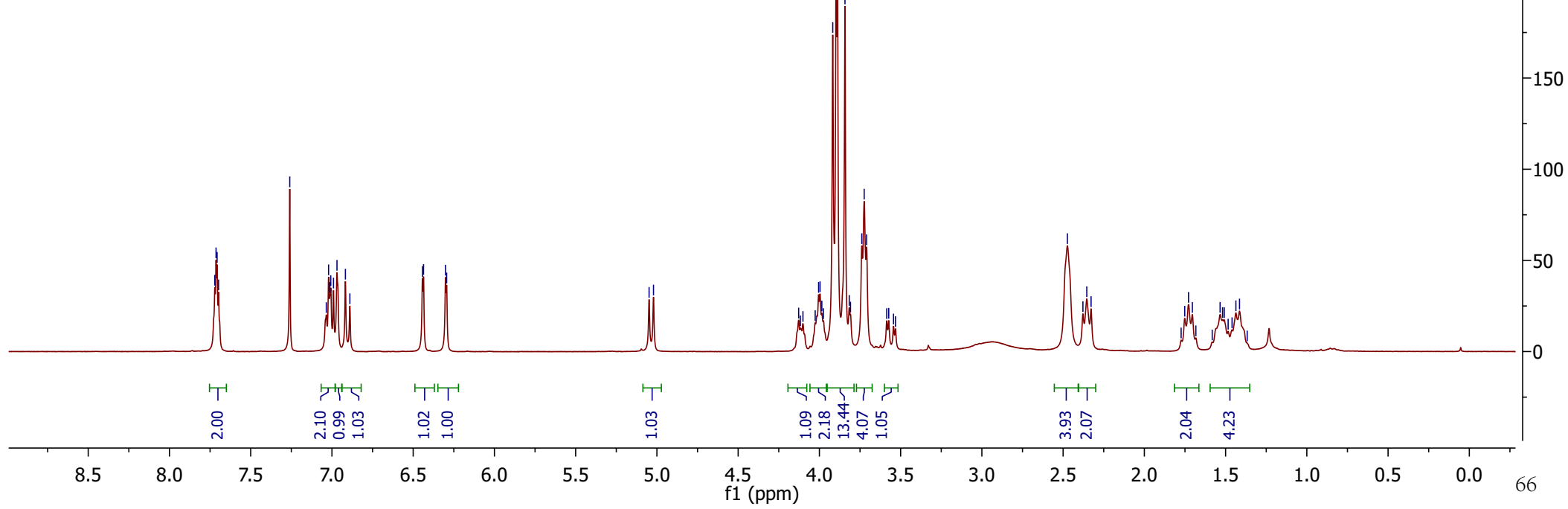
7.721
7.713
7.707
7.698
7.260
7.021
7.013
7.007
6.990
6.969
6.917
6.843
6.436
6.301
6.294

5.048
5.021

4.128
4.101
4.026
4.005
3.996
3.985
3.975
3.918
3.897
3.889
3.842
3.816
3.809
3.739
3.724
3.709
3.586
3.573
3.544
3.474
2.378
2.354
2.328
1.774
1.751
1.728
1.705
1.683
1.582
1.534
1.519
1.508
1.484
1.460
1.437
1.414
1.367

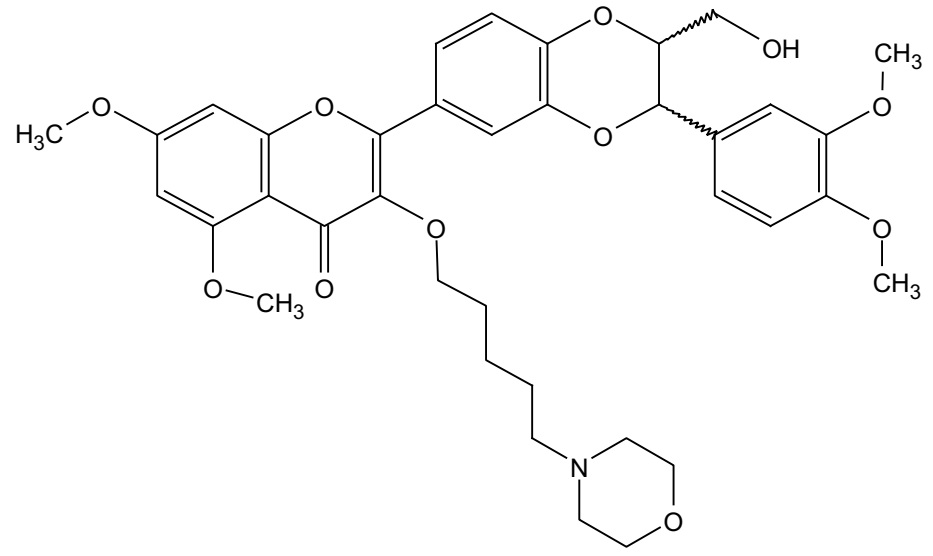


¹H NMR spectrum for compound 40
CDCl₃, 300 MHz

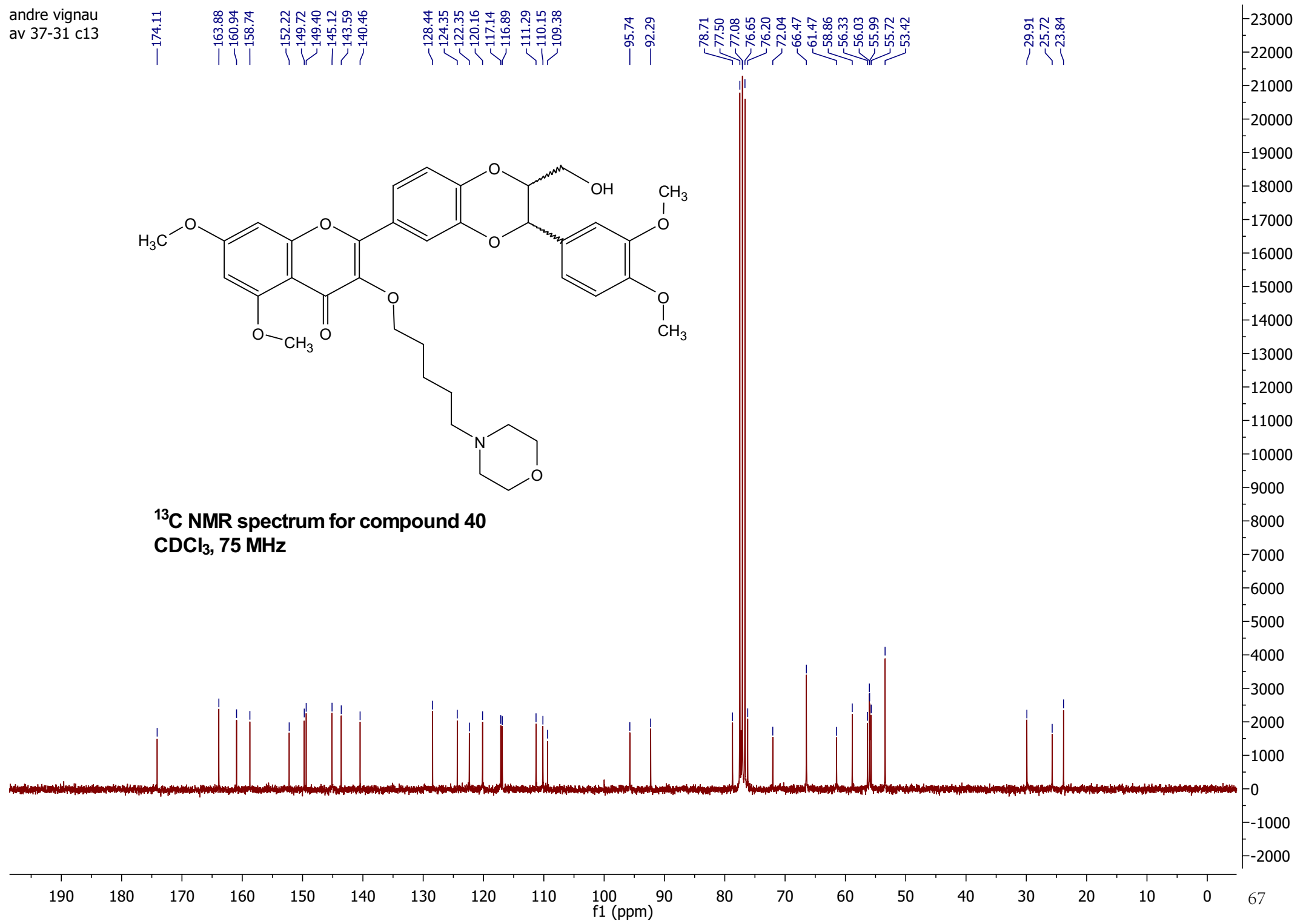


andre vignau
av 37-31 c13

174.11 163.88 160.94 158.74 152.22 149.72 149.40 145.12 143.59 140.46 128.44 124.35 122.35 120.16 117.14 116.89 111.29 110.15 109.38 95.74 92.29 78.71 77.50 77.08 76.65 76.20 72.04 66.47 61.47 58.86 56.33 56.03 55.99 55.72 53.42 29.91 25.72 23.84



¹³C NMR spectrum for compound 40
CDCl₃, 75 MHz



linker nmr
BV-48-52-R2 CDCl₃

7.773
7.746
7.260
7.036
7.009
6.969
6.915
6.888

6.440
6.306

5.731

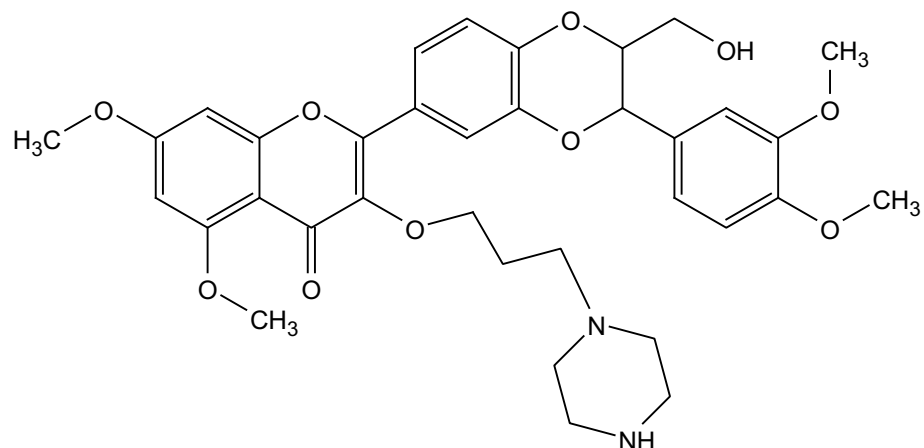
5.057
5.031

4.143
4.118
4.056
4.038
3.922
3.896
3.889
3.847
3.821
3.579
3.569
3.538
3.528

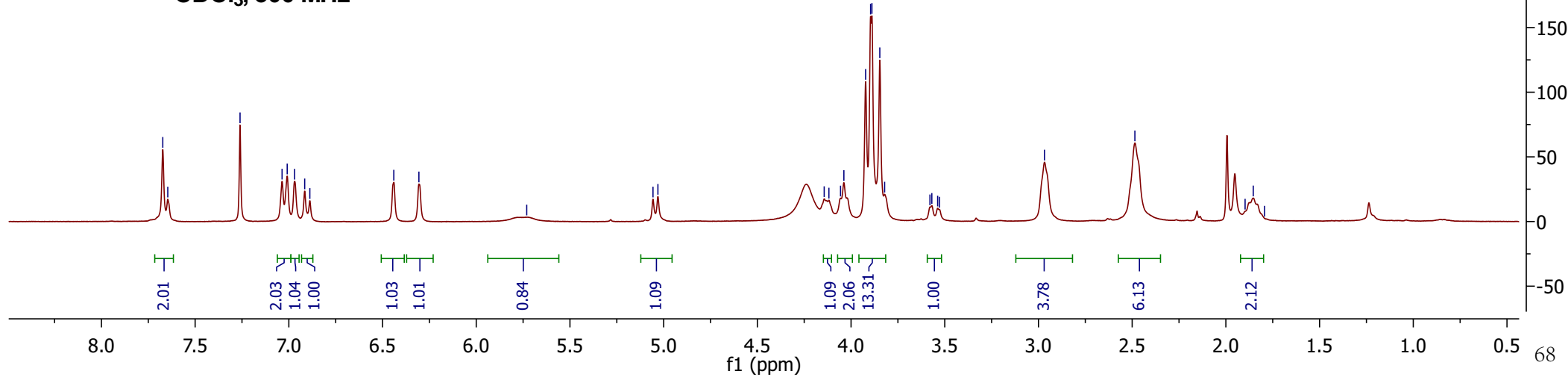
2.968

2.485

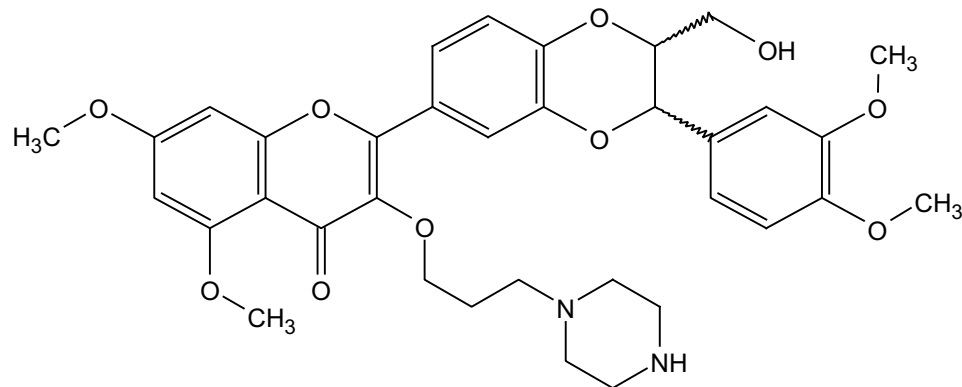
1.897
1.854
1.794



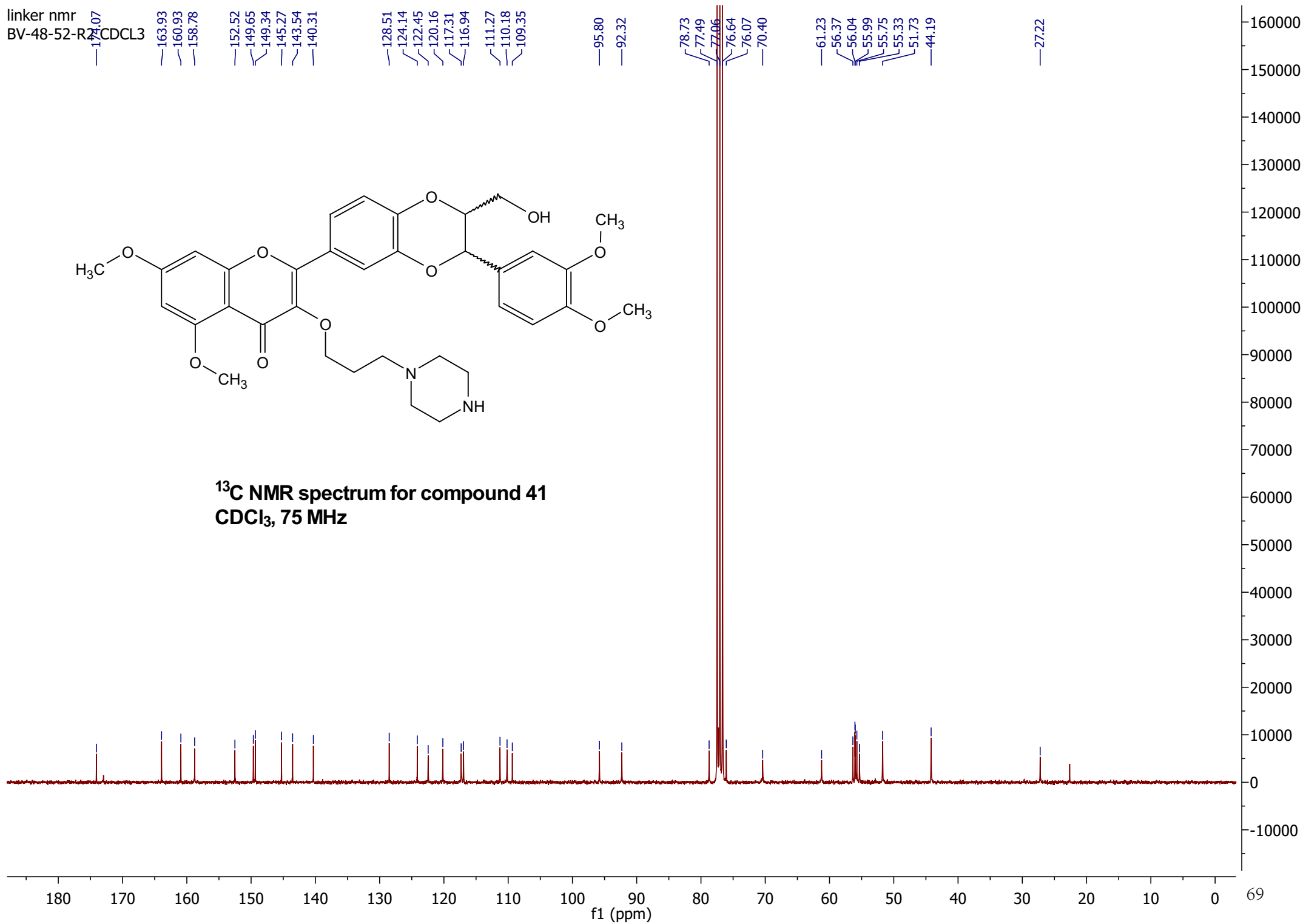
¹H NMR spectrum for compound 41
CDCl₃, 300 MHz



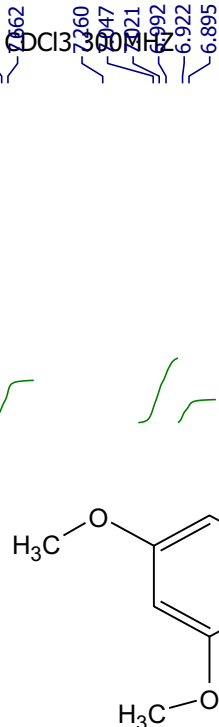
linker nmr
BV-48-52-R2 CDCl3



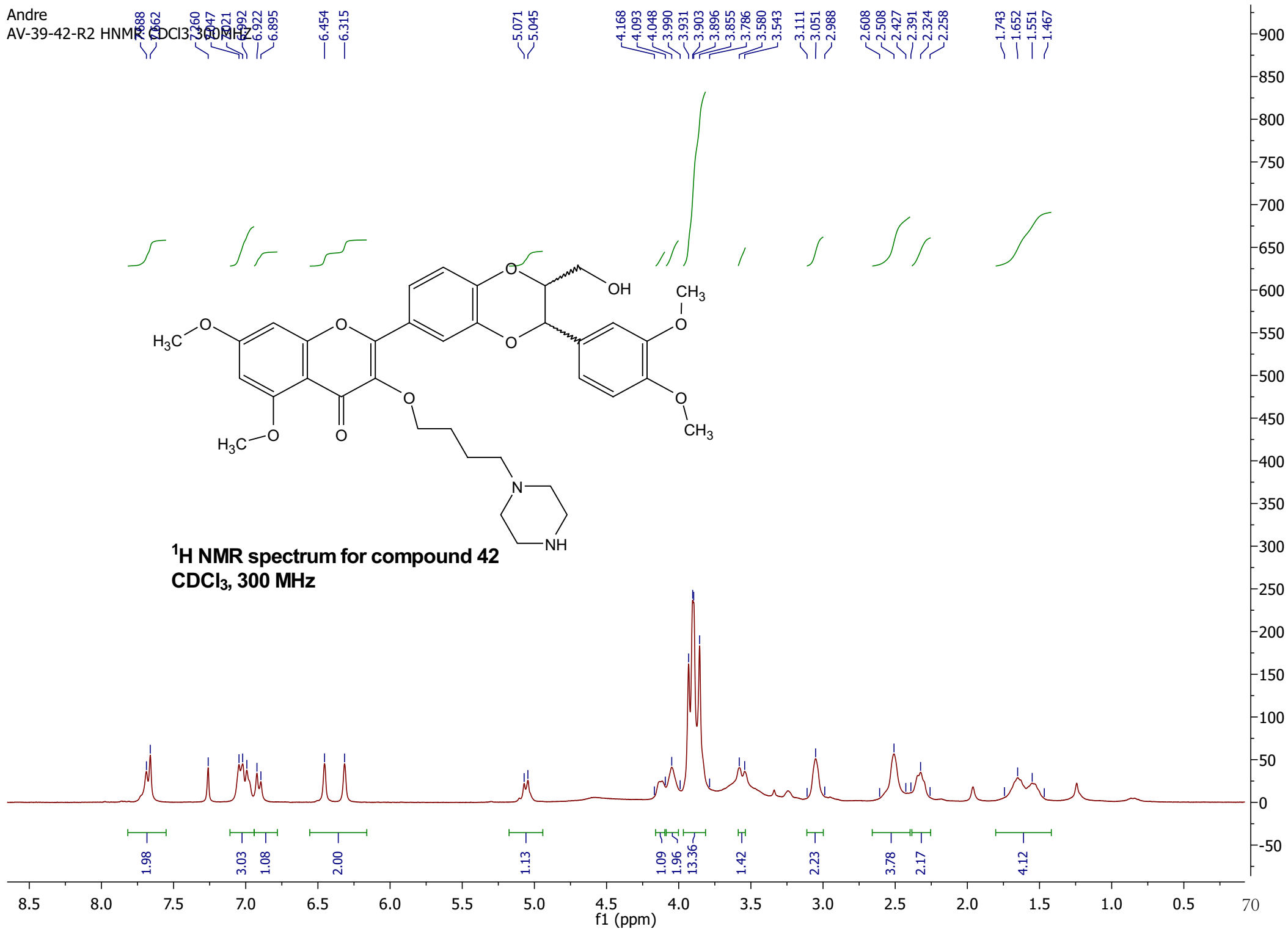
¹³C NMR spectrum for compound 41
CDCl₃, 75 MHz



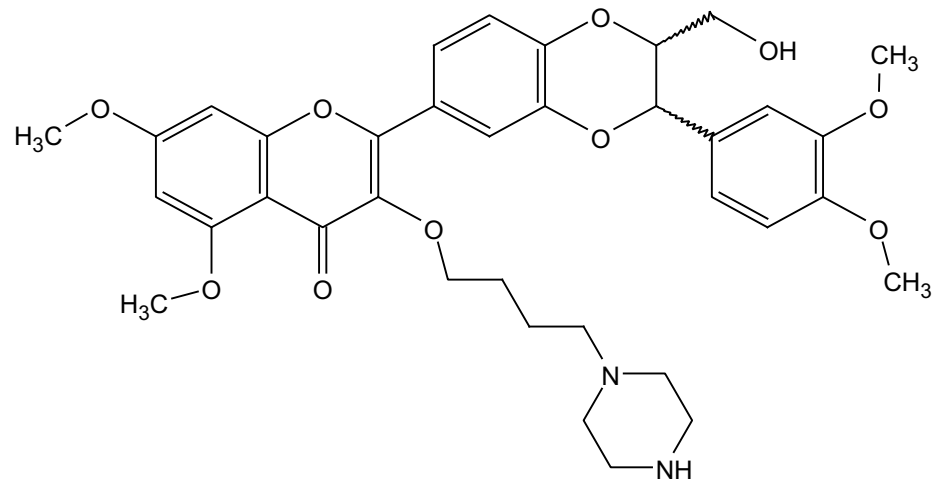
Andre
AV-39-42-R2 HNMR
CDCl₃, 300 MHz



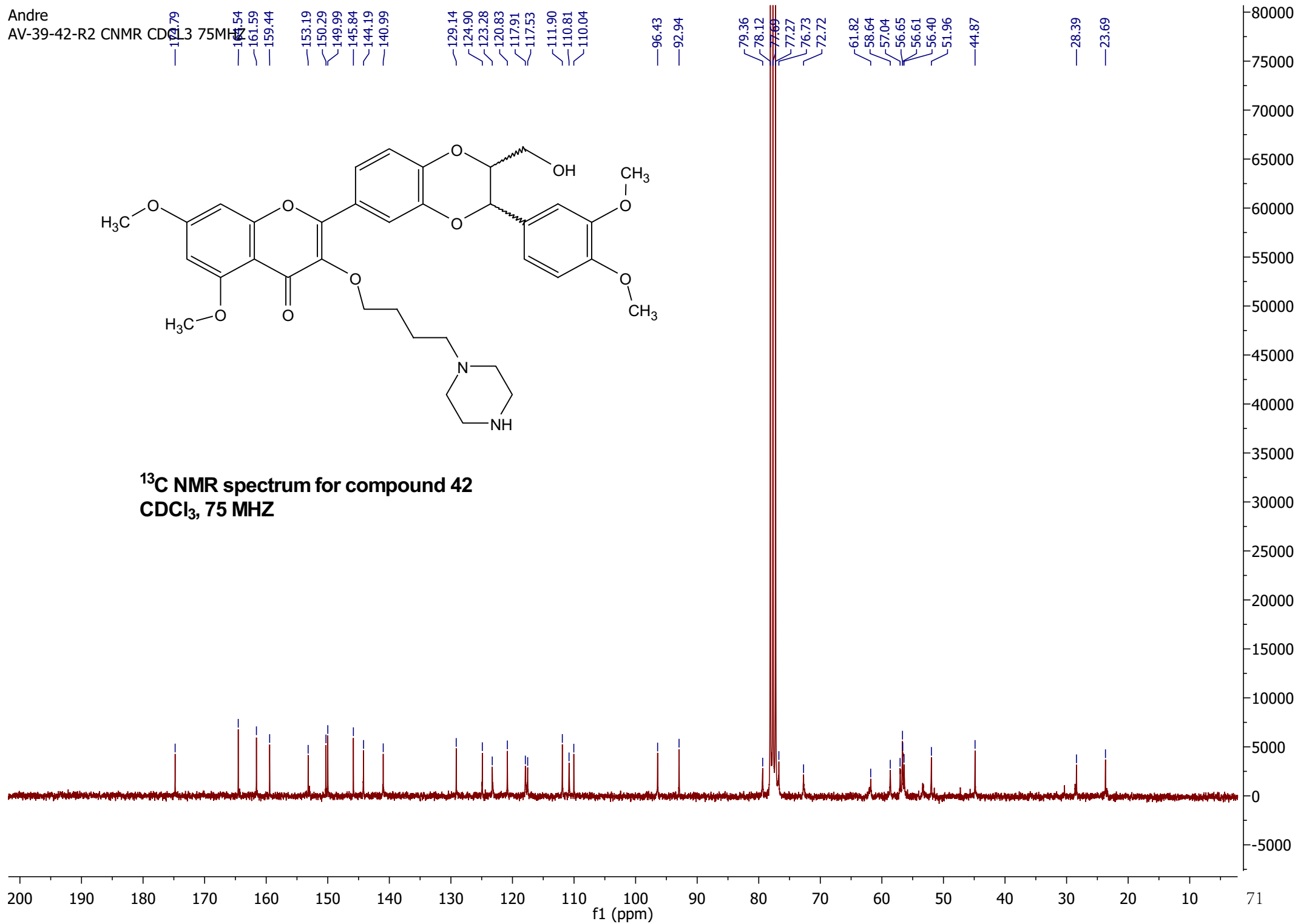
¹H NMR spectrum for compound 42
CDCl₃, 300 MHz



Andre
AV-39-42-R2 CNMR CDCl₃ 75MHZ

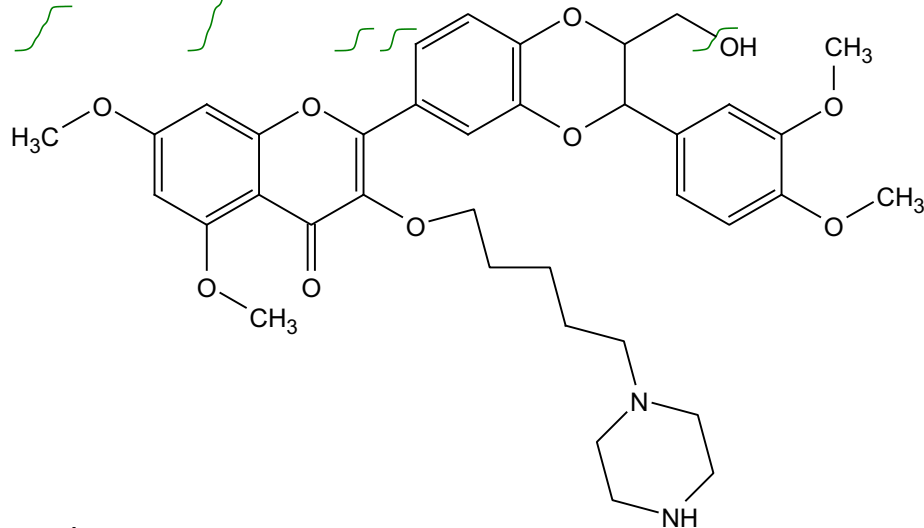


¹³C NMR spectrum for compound 42
CDCl₃, 75 MHZ

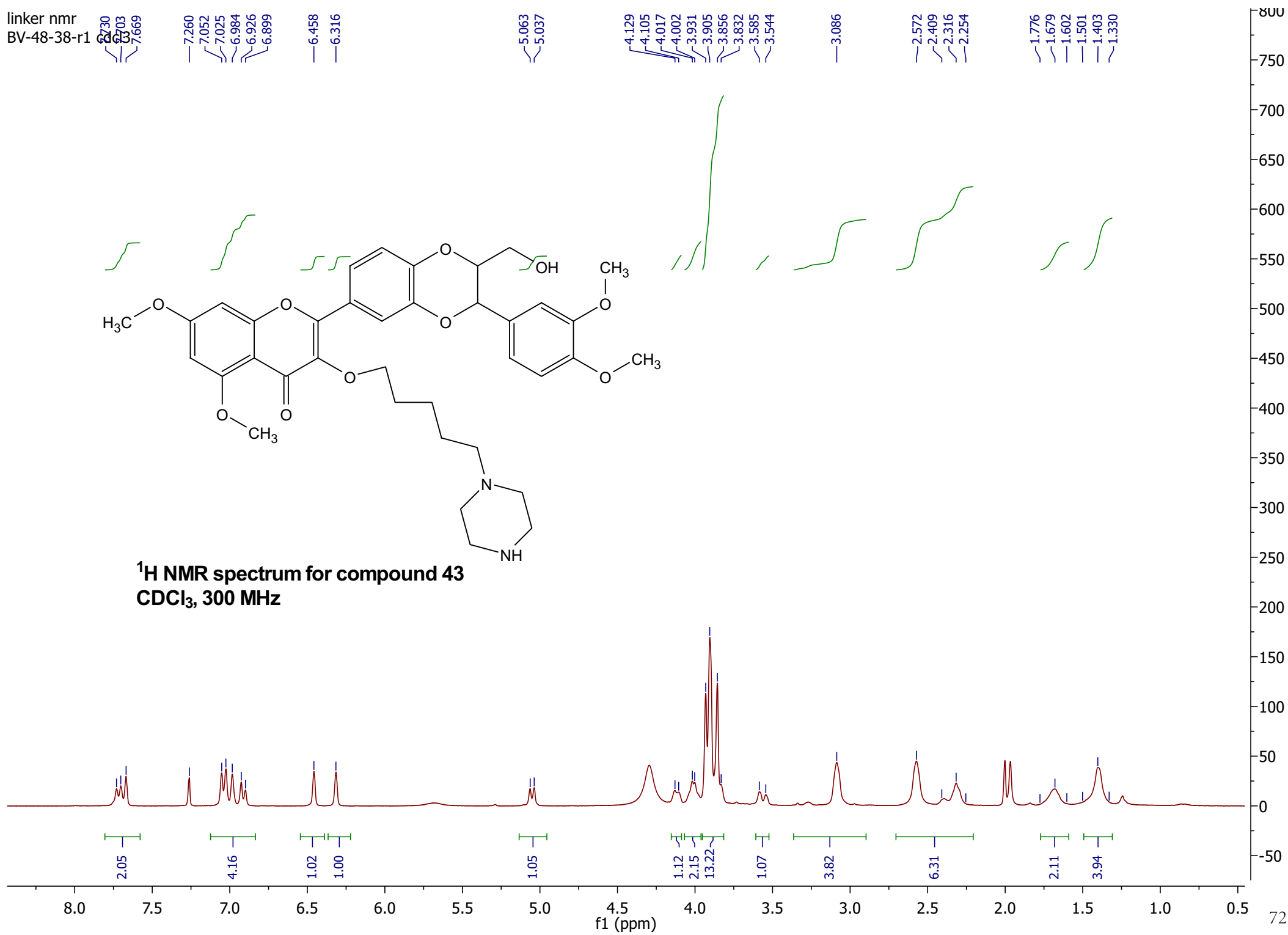


linker nmr
BV-48-38-r1

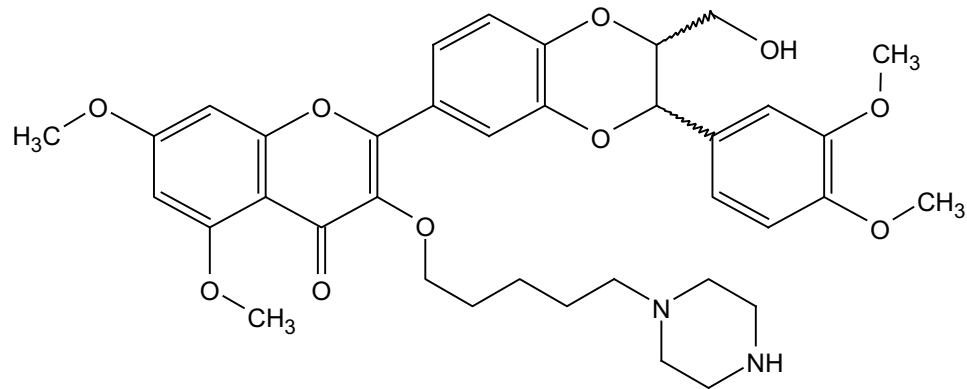
7.730
7.703
7.669
7.260
7.052
7.025
6.984
6.926
6.899
6.458
6.316
5.063
5.037
4.129
4.105
4.017
4.002
3.931
3.905
3.856
3.832
3.585
3.544
3.086
2.572
2.409
2.316
2.254
1.776
1.679
1.602
1.501
1.403
1.330



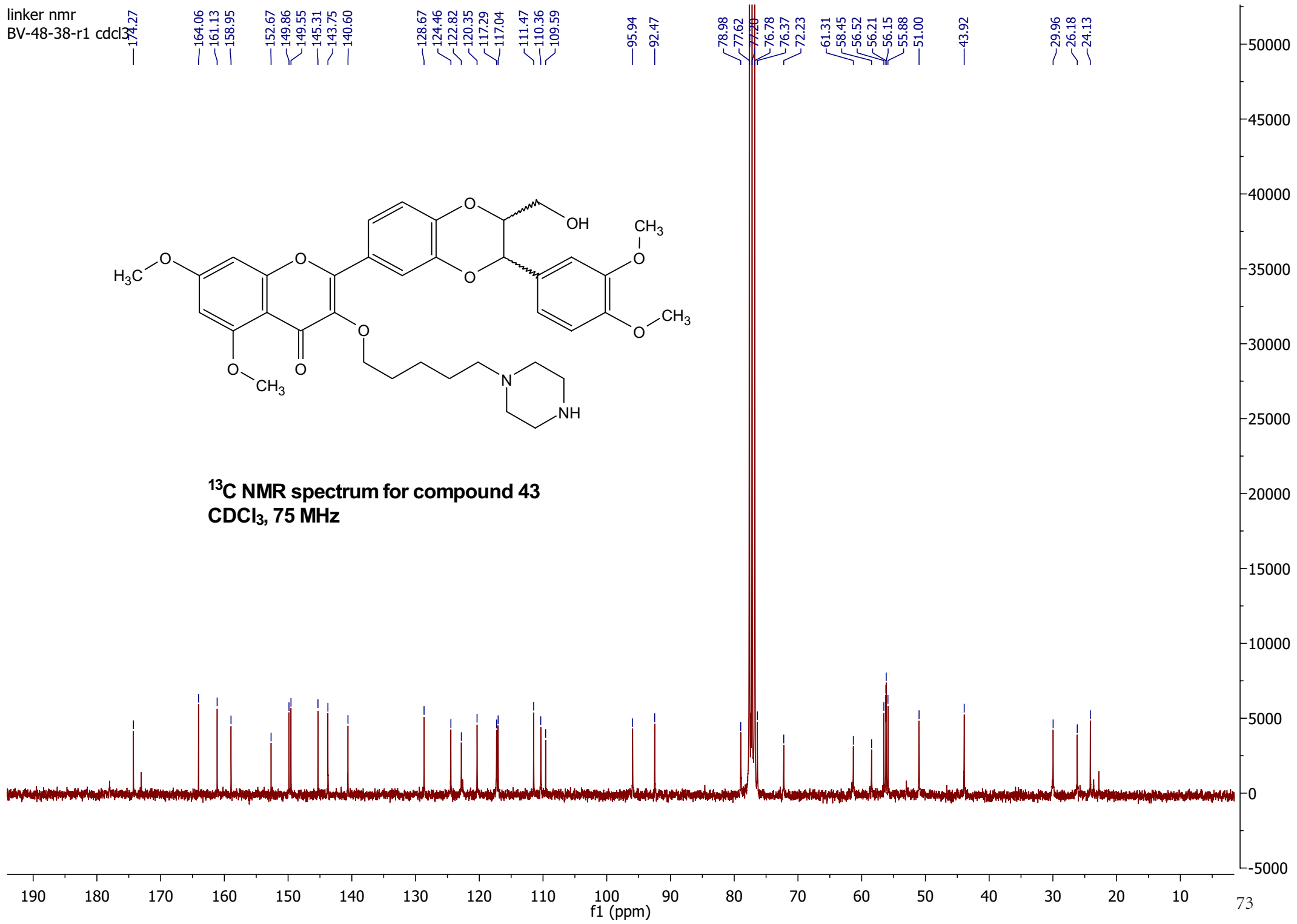
¹H NMR spectrum for compound 43
CDCl₃, 300 MHz



linker nmr
BV-48-38-r1 cdcl3



¹³C NMR spectrum for compound 43
CDCl₃, 75 MHz



linker nmr
BV-48-32-r1

7.702
7.673
7.666

7.260
7.048
7.020
6.973
6.968
6.928
6.900

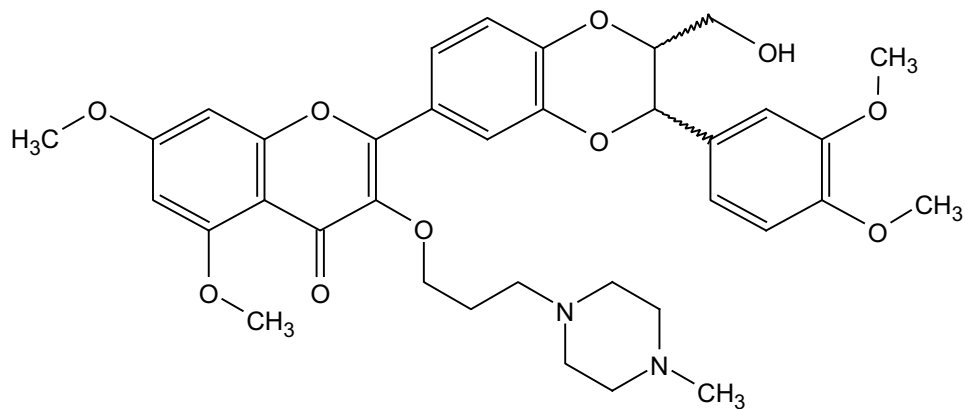
6.453
6.446
6.316
6.309

5.056
5.029

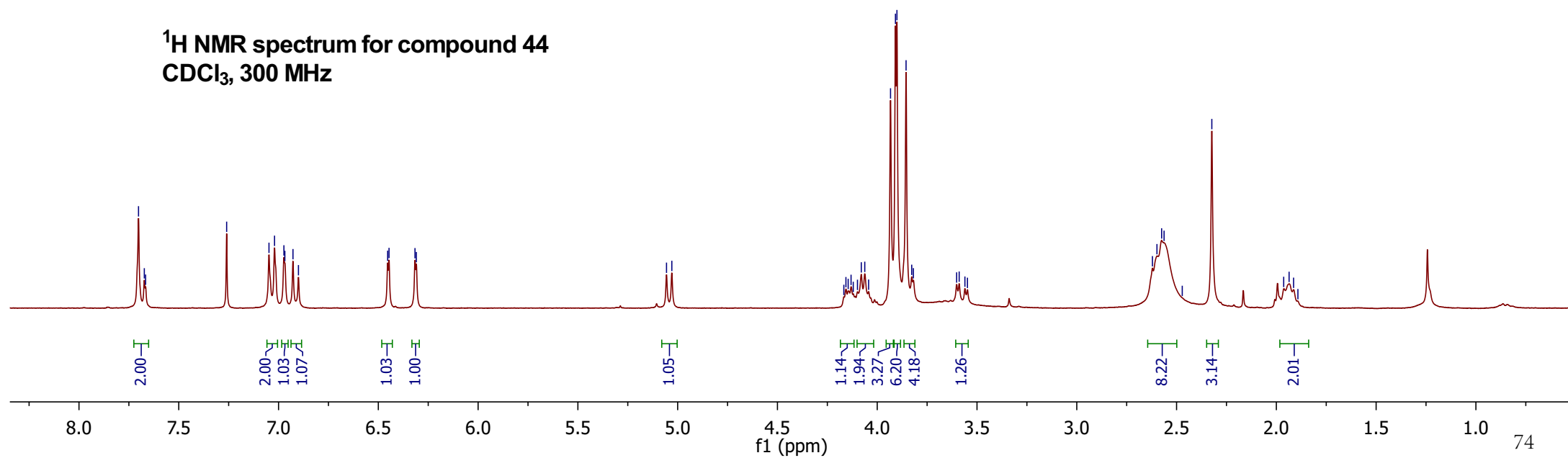
4.157
4.146
4.131
4.099
4.080
4.062
4.043
3.933
3.909
3.901
3.855
3.827
3.819
3.802
3.589
3.561
3.548

2.621
2.598
2.575
2.563
2.471
2.323

1.963
1.936
1.914
1.892

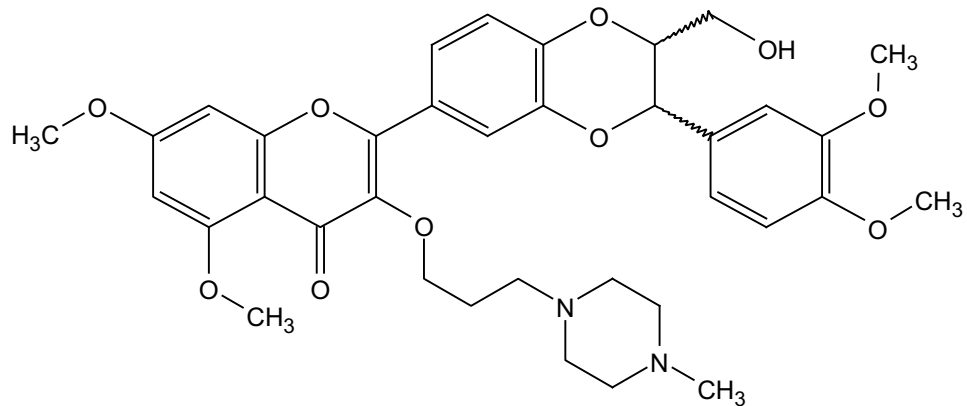


¹H NMR spectrum for compound 44
CDCl₃, 300 MHz

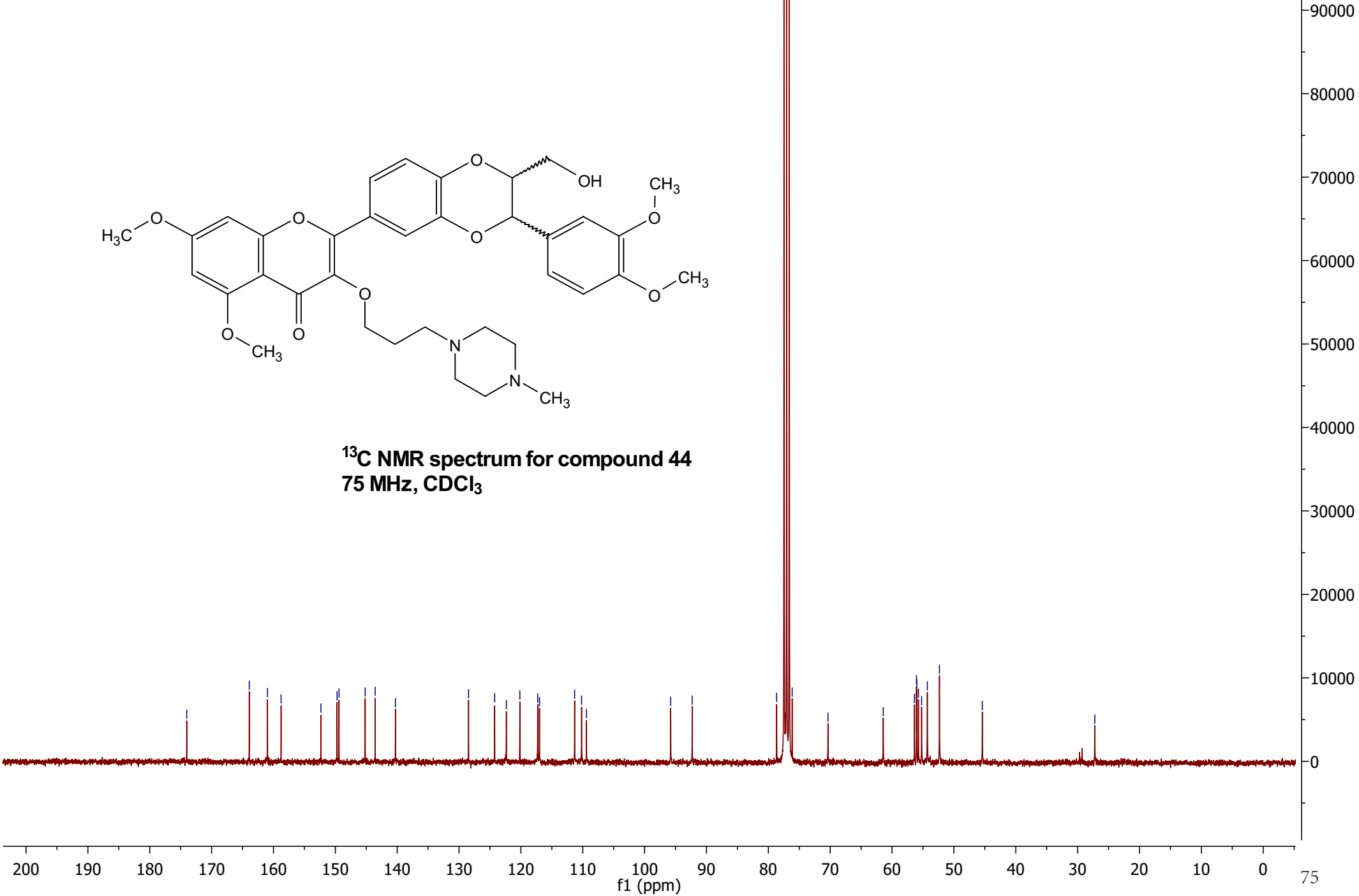


linker nmr
BV-48-32-r1 cdc13

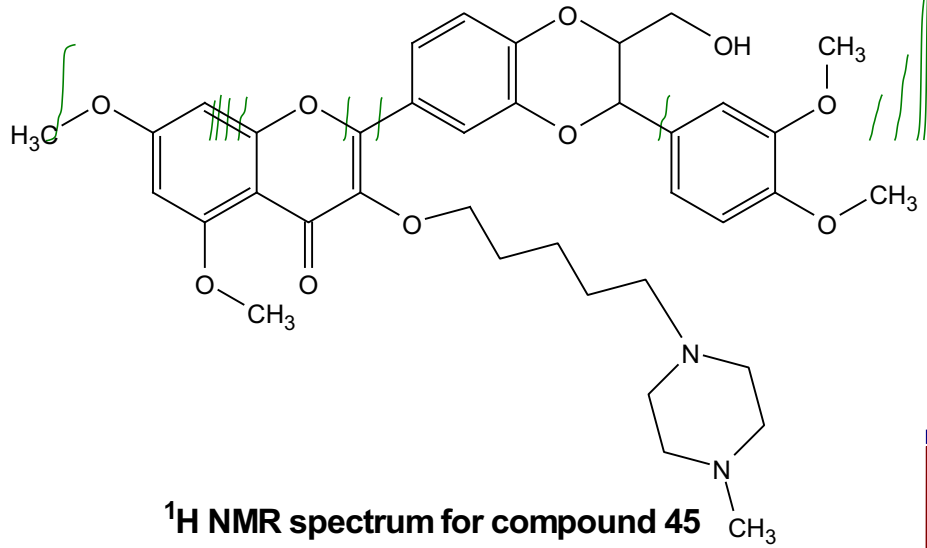
174.02 163.91 160.97 158.77 152.33 149.72 149.40 145.17 143.56 140.28 128.46 124.24 122.35 120.17 117.28 116.99 111.31 110.19 109.40 95.78 92.31 78.66 77.46 77.04 76.62 76.15 70.36 61.42 56.38 56.05 56.00 55.73 55.23 54.30 52.34 45.41 27.23



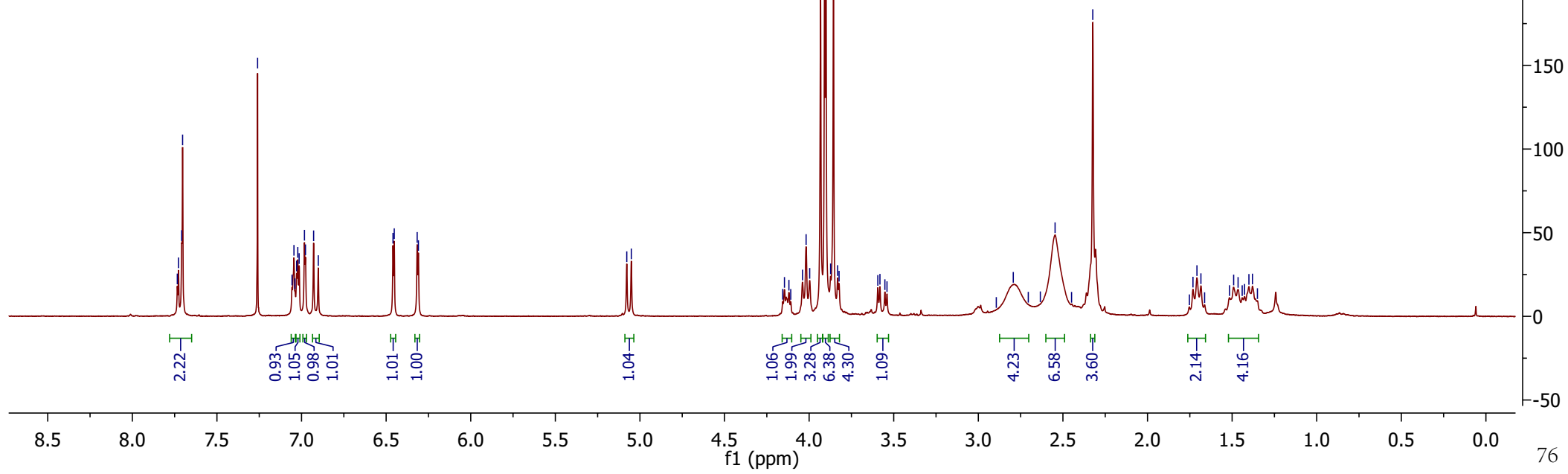
¹³C NMR spectrum for compound 44
75 MHz, CDCl₃



7.7342, 7.7272, 7.7084, 7.7030, 7.2597, 7.0448, 7.0222, 7.0143, 6.9827, 6.9767, 6.9286, 6.4594, 6.4521, 6.3166, 6.3093, 5.0778, 5.0509, 4.1458, 4.0392, 4.0179, 3.9967, 3.9324, 3.9082, 3.9005, 3.8731, 3.8561, 3.8316, 3.8230, 3.5940, 3.5815, 3.5522, 3.5398, 2.8937, 2.7934, 2.7047, 2.6335, 2.5464, 2.4489, 2.3236, 1.7525, 1.7314, 1.7079, 1.6844, 1.6626, 1.5153, 1.4909, 1.4648, 1.4404, 1.4266, 1.4007, 1.3799, 1.3504



¹H NMR spectrum for compound 45
CDCl₃, 300 MHz



bv-48-92

