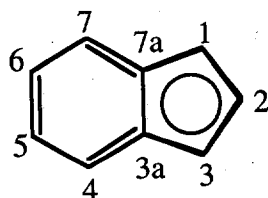


NMR Spectroscopic Data for Compounds 5-7a-c and 9a-c

Abbreviations used: s, singlet; br, broad; d, doublet; dd, doublet of doublets; t, triplet; vt, virtual triplet; m, multiplet.

The numbering for the indenyl skeleton is as follows:



Compound 5a: $^{31}\text{P}\{^1\text{H}\}$ (C_6D_6) δ = 52.64 and 52.99 (d, $^2J_{\text{PP}}$ = 30.2 Hz) ppm. ^1H (C_6D_6) δ = 0.83 and 1.12 (s, 3H each, CH_3), 0.85-2.31 (m, 17H, CH_2 and CH), 4.70 (br, 2H, H-1 and H-3), 5.53 (vt, 1H, J_{HH} = 2.3 Hz, $=\text{CHCH}_2$), 5.79 (br, 1H, H-2), 5.85 (s, 1H, $=\text{CHC}=\text{O}$), 6.41 and 6.69 (m, 2H each, H-4, H-5, H-6 and H-7), 6.94-7.51 (m, 30H, Ph) ppm. $^{13}\text{C}\{^1\text{H}\}$ (C_6D_6) δ = 16.90 and 16.98 (s, CH_3), 21.44, 31.63, 32.21, 32.81, 34.37, 35.75 and 35.80 (s, CH_2), 34.80, 54.57 and 56.00 (s, CH), 38.70 and 48.22 (s, C), 75.09 (s, C-1 and C-3), 95.52 (s, C-2), 109.29 (s, C_β), 109.50 (s, C-3a and C-7a), 113.61 (vt, $^2J_{\text{CP}}$ = 24.9 Hz, Ru- C_α), 123.08, 123.23, 123.50, 124.49, 126.00 and 126.13 (s, C-4, C-5, C-6, C-7, $=\text{CHCH}_2$ and $=\text{CHC}=\text{O}$), 127.34-138.95 (m, Ph), 143.64 (s, C_γ), 169.19 (s, $=\text{C}$), 197.38 (s, $\text{C}=\text{O}$) ppm; $\Delta\delta(\text{C-3a,7a})$ = -21.20.

Compound 5b: $^{31}\text{P}\{^1\text{H}\}$ (C_6D_6) δ = 52.59 and 52.97 (d, $^2J_{\text{PP}}$ = 29.9 Hz) ppm. ^1H (C_6D_6) δ = 0.81-2.78 (m, 13H, CH_2 and CH), 1.14 (s, 3H, CH_3), 4.15 (br, 1H, OH), 4.71 (br, 2H, H-1 and H-3), 5.53 (vt, 1H, J_{HH} = 2.2 Hz, $=\text{CHCH}_2$), 5.79 (br, 1H, H-2), 6.38-6.72 (m, 7H, H-4, H-5, H-6, H-7 and $\text{C}_6\text{H}_3\text{OH}$), 6.94-7.78 (m, 30H, Ph) ppm. $^{13}\text{C}\{^1\text{H}\}$ (C_6D_6) δ = 16.93 (s, CH_3), 27.50, 28.34, 30.01, 31.46 and 36.08 (s, CH_2), 38.44, 45.09 and 55.97 (s, CH), 49.35 (s, CCH_3), 75.03 (s, C-1 and C-3), 95.54 (s, C-2), 109.93, 110.17 and 110.41 (s, C_β , C-3a and C-7a), 113.83 (vt, $^2J_{\text{CP}}$ = 24.7 Hz, Ru- C_α), 113.68 and 116.38 (s, CH of $\text{C}_6\text{H}_3\text{OH}$), 123.73, 123.94, 124.34, 126.60, 126.75 and 127.28 (s, C-4, C-5, C-6, C-7, $=\text{CHCH}_2$ and CH of $\text{C}_6\text{H}_3\text{OH}$), 127.96-139.75 (m, Ph), 133.86 and

138.92 (s, C of C₆H₃OH), 144.61 (s, C_γ), 154.98 (s, COH) ppm; *ca.* Δδ(C-3a,7a) = -20.53.

Compound 5c: ³¹P{¹H} (C₆D₆) δ = 52.41 and 52.87 (d, ²J_{PP} = 29.5 Hz) ppm. ¹H (C₆D₆) δ = 1.16 (s, 3H, CH₃), 1.39-2.86 (m, 13H, CH₂ and CH), 3.44 (s, 3H, OCH₃), 4.69 (br, 2H, H-1 and H-3), 5.49 (vt, 1H, J_{HH} = 2.6 Hz, =CHCH₂), 5.77 (br, 1H, H-2), 6.37-7.55 (m, 37H, Ph, H-4, H-5, H-6, H-7 and C₆H₃OCH₃) ppm. ¹³C{¹H} (C₆D₆) δ = 17.66 (s, CH₃), 28.21, 29.09, 30.91, 32.15 and 36.81 (s, CH₂), 39.15, 45.82 and 56.66 (s, CH), 49.35 (s, CCH₃), 55.50 (s, OCH₃), 75.79 (s, C-1 and C-3), 96.15 (s, C-2), 109.92, 110.10 and 110.40 (s, C_β, C-3a and C-7a), 112.57 and 114.91 (s, CH of C₆H₃OCH₃), 113.68 (vt, ²J_{CP} = 24.9 Hz, Ru-C_α), 123.74, 123.91, 124.20, 126.62, 126.74 and 127.22 (s, C-4, C-5, C-6, C-7, =CHCH₂ and CH of C₆H₃OCH₃), 127.99-139.75 (m, Ph), 134.23 and 138.81 (s, C of C₆H₃OCH₃), 144.64 (s, C_γ), 158.87 (s, COCH₃) ppm; *ca.* Δδ(C-3a,7a) = -20.54.

Compound 6a: ³¹P{¹H} (CD₂Cl₂) δ = 38.56 and 41.24 (d, ²J_{PP} = 24.5 Hz) ppm. ¹H (CD₂Cl₂) δ = 0.71 and 1.14 (s, 3H each, CH₃), 1.68 (s, 3H, Ru=C=CCH₃), 1.10-2.41 (m, 17H, CH₂ and CH), 5.12 and 5.32 (br, 1H each, H-1 and H-3), 5.47-5.75 (m, 4H, H-2, =CHCH₂ and H-4, H-5, H-6 or H-7), 6.00 (s, 1H, =CHC=O), 6.52-7.50 (m, 32H, Ph and H-4, H-5, H-6 or H-7) ppm. ¹³C{¹H} (CD₂Cl₂) δ = 10.56 (s, Ru=C=CCH₃), 17.12 and 17.39 (s, CH₃), 20.95, 32.10, 32.25, 33.01, 33.98, 34.31 and 35.98 (s, CH₂), 34.35, 54.42 and 57.57 (s, CH), 38.97 and 48.08 (s, C), 79.82 (d, ²J_{CP} = 2.3 Hz, C-1 or C-3), 82.21 (d, ²J_{CP} = 2.5 Hz, C-1 or C-3), 99.98 (s, C-2), 115.46 and 118.69 (s, C-3a and C-7a), 120.44 (s, C_β), 123.01, 124.13, 124.42, 129.89, 130.98 and 131.95 (s, C-4, C-5, C-6, C-7, =CHCH₂ and =CHC=O), 128.65-134.82 (m, Ph), 142.46 (s, C_γ), 171.11 (s, =C), 199.19 (s, C=O), 352.26 (dd, ²J_{CP} = 20.5 and 14.3 Hz, Ru=C_α) ppm; Δδ(C-3a,7a) = -13.62.

Compound 6b: ³¹P{¹H} (CD₂Cl₂) δ = 38.66 and 41.42 (d, ²J_{PP} = 24.1 Hz) ppm. ¹H (CD₂Cl₂) δ = 0.47-2.81 (m, 13H, CH₂ and CH), 0.70 (s, 3H, CH₃), 1.72 (s, 3H, Ru=C=CCH₃), 4.35 (br, 1H, OH), 5.15-6.01 (m, 9H, H-1, H-2, H-3, C₆H₃OH, =CHCH₂ and H-4, H-5, H-6 or H-7), 6.56-7.51 (m, 32H, Ph and H-4, H-5, H-6 or H-7) ppm.

$^{13}\text{C}\{^1\text{H}\}$ (CD_2Cl_2) δ = 10.75 (s, $\text{Ru}=\text{C}=\text{CCH}_3$), 17.33 (s, CH_3), 26.71, 28.18, 29.81, 31.99 and 34.30 (s, CH_2), 37.70, 44.49 and 57.45 (s, CH), 48.57 (s, CCH_3), 79.77 (d, $^2J_{\text{CP}} = 7.2$ Hz, C-1 or C-3), 82.34 (d, $^2J_{\text{CP}} = 7.7$ Hz, C-1 or C-3), 100.03 (s, C-2), 113.24 and 115.76 (s, CH of $\text{C}_6\text{H}_3\text{OH}$), 115.40 and 118.61 (s, C-3a and C-7a), 120.56 (s, C_β), 123.02, 124.44, 126.10, 129.89, 130.56 and 131.37 (s, C-4, C-5, C-6, C-7, $=\text{CHCH}_2$ and CH of $\text{C}_6\text{H}_3\text{OH}$), 128.67-134.61 (m, Ph), 133.76 and 138.05 (s, C of $\text{C}_6\text{H}_3\text{OH}$), 142.71 (s, C_γ), 155.15 (s, COH), 352.24 (dd, $^2J_{\text{CP}} = 21.0$ and 14.4 Hz, $\text{Ru}=\text{C}_\alpha$) ppm; $\Delta\delta(\text{C-3a,7a}) = -13.69$.

Compound 6c: $^{31}\text{P}\{^1\text{H}\}$ (CDCl_3) δ = 38.49 and 41.28 (d, $^2J_{\text{PP}} = 24.2$ Hz) ppm. ^1H (CDCl_3) δ = 0.67 (s, 3H, CH_3), 1.19-2.86 (m, 13H, CH_2 and CH), 1.69 (s, 3H, $\text{Ru}=\text{C}=\text{CCH}_3$), 3.75 (s, 3H, OCH_3), 5.10 and 5.32 (br, 1H each, H-1 and H-3), 5.47 (vt, 1H, $J_{\text{HH}} = 2.3$ Hz, $=\text{CHCH}_2$), 5.73 (m, 2H, H-4, H-5, H-6 or H-7), 6.04 (br, 1H, H-2), 6.53-7.48 (m, 37H, Ph, $\text{C}_6\text{H}_3\text{OCH}_3$ and H-4, H-5, H-6 or H-7) ppm. $^{13}\text{C}\{^1\text{H}\}$ (CDCl_3) δ = 10.34 (s, $\text{Ru}=\text{C}=\text{CCH}_3$), 16.83 (s, CH_3), 26.15, 27.62, 29.47, 31.55 and 33.73 (s, CH_2), 37.04, 43.96 and 56.86 (s, CH), 48.04 (s, CCH_3), 55.15 (s, OCH_3), 79.23 (d, $^2J_{\text{CP}} = 7.2$ Hz, C-1 or C-3), 81.84 (d, $^2J_{\text{CP}} = 7.6$ Hz, C-1 or C-3), 99.62 (s, C-2), 111.39 and 113.73 (s, CH of $\text{C}_6\text{H}_3\text{OCH}_3$), 114.88 and 118.15 (s, C-3a and C-7a), 119.84 (s, C_β), 122.46, 123.93, 125.84, 127.24, 129.46 and 130.94 (s, C-4, C-5, C-6, C-7, $=\text{CHCH}_2$ and CH of $\text{C}_6\text{H}_3\text{OCH}_3$), 128.18-134.04 (m, Ph), 134.27 and 137.67 (s, C of $\text{C}_6\text{H}_3\text{OCH}_3$), 142.08 (s, C_γ), 157.41 (s, COCH_3), 351.61 (dd, $^2J_{\text{CP}} = 21.0$ and 13.8 Hz, $\text{Ru}=\text{C}_\alpha$) ppm; $\Delta\delta(\text{C-3a,7a}) = -14.18$.

Compound 7a: ^1H (C_6D_6) δ = 0.46-2.22 (m, 17H, CH_2 and CH), 0.68 and 0.79 (s, 3H each, CH_3), 2.90 (s, 1H, $\equiv\text{CH}$), 5.78 (s, 1H, $=\text{CHC}=\text{O}$), 6.02 (vt, 1H, $J_{\text{HH}} = 3.1$ Hz, $=\text{CHCH}_2$) ppm. $^{13}\text{C}\{^1\text{H}\}$ (C_6D_6) δ = 16.24 and 16.75 (s, CH_3), 20.83, 31.73, 31.97, 32.45, 34.23, 34.53 and 35.56 (s, CH_2), 34.13, 53.94 and 55.50 (s, CH), 38.41 and 47.91 (s, CCH_3), 79.57 (s, $\equiv\text{C}$), 81.38 (s, $\equiv\text{CH}$), 124.55 and 137.38 (s, $=\text{CH}$), 136.85 (s, $\text{C}\equiv\text{C}$), 168.33 (s, $\text{C}=\text{CHC}=\text{O}$), 197.12 (s, $\text{C}=\text{O}$) ppm.

Compound 7b: ^1H (C_6D_6) δ = 0.83 (s, 3H, CH_3), 1.10-2.66 (m, 13H, CH_2 and CH), 2.84 (s, 1H, $\equiv\text{CH}$), 3.95 (s, 1H, OH), 6.02 (br, 1H, $\equiv\text{CH}$), 6.34 (d, 1H, J_{HH} = 1.7 Hz, CH of $\text{C}_6\text{H}_3\text{OH}$), 6.46 (dd, 1H, J_{HH} = 8.5 and 1.7 Hz, CH of $\text{C}_6\text{H}_3\text{OH}$), 6.98 (d, 1H, J_{HH} = 8.5 Hz, CH of $\text{C}_6\text{H}_3\text{OH}$) ppm. $^{13}\text{C}\{^1\text{H}\}$ (C_6D_6) δ = 16.31 (s, CH_3), 26.78, 27.98, 29.73, 31.84 and 34.86 (s, CH_2), 37.70, 44.52 and 55.47 (s, CH), 48.37 (s, CCH_3), 79.75 (s, $\equiv\text{C}$), 81.17 (s, $\equiv\text{CH}$), 112.98, 115.54, 126.51 and 137.41 (s, CH of $\text{C}_6\text{H}_3\text{OH}$), 132.54, 137.17 and 137.89 (s, C of $\text{C}_6\text{H}_3\text{OH}$ and $\equiv\text{C}$), 154.19 (s, COH) ppm.

Compound 7c: ^1H (C_6D_6) δ = 0.85 (s, 3H, CH_3), 1.11-2.70 (m, 13H, CH_2 and CH), 2.85 (s, 1H, $\equiv\text{CH}$), 3.40 (s, 3H, OCH_3), 6.03 (dd, 1H, J_{HH} = 3.2 and 2.5 Hz, $\equiv\text{CH}$), 6.69 (d, 1H, J_{HH} = 2.9 Hz, CH of $\text{C}_6\text{H}_3\text{OCH}_3$), 6.77 (dd, 1H, J_{HH} = 8.6 and 2.9 Hz, CH of $\text{C}_6\text{H}_3\text{OCH}_3$), 7.09 (d, 1H, J_{HH} = 8.6 Hz, CH of $\text{C}_6\text{H}_3\text{OCH}_3$) ppm. $^{13}\text{C}\{^1\text{H}\}$ (C_6D_6) δ = 16.34 (s, CH_3), 26.80, 28.06, 29.96, 31.85 and 34.88 (s, CH_2), 37.74, 44.58 and 54.75 (s, CH), 48.40 (s, CCH_3), 55.50 (s, OCH_3), 79.75 (s, $\equiv\text{C}$), 81.19 (s, $\equiv\text{CH}$), 111.87, 114.19, 126.50 and 137.42 (s, CH of $\text{C}_6\text{H}_3\text{OCH}_3$ and $\equiv\text{CH}$), 132.76, 137.18 and 137.74 (s, C of $\text{C}_6\text{H}_3\text{OCH}_3$ and $\equiv\text{C}$), 158.26 (s, COCH_3) ppm.

Compound 9a: Major diastereoisomer: $^{31}\text{P}\{^1\text{H}\}$ ($(\text{CD}_3)_2\text{CO}$) δ = 27.38 (vt, $^5J_{\text{PP}}$ = 3.8 Hz, PMe_2Ph), 52.12 and 54.16 (dd, $^2J_{\text{PP}}$ = 32.9 Hz, $^5J_{\text{PP}}$ = 3.8 Hz, PPh_3) ppm. ^1H ($(\text{CD}_3)_2\text{CO}$) δ = 0.40-2.92 (m, 19H, CH_2 and CH), 0.96 and 1.13 (s, 3H each, CH_3), 2.42 (d, 3H, $^2J_{\text{HP}}$ = 12.5 Hz, PCH_3), 2.59 (d, 3H, $^2J_{\text{HP}}$ = 12.8 Hz, PCH_3), 4.63 and 4.74 (br, 1H each, H-1 and H-3), 5.26 (br, 1H, H-2), 5.53 (s, 1H, $\equiv\text{CHC}=\text{O}$), 6.34 (m, 2H, H-4, H-5, H-6 or H-7), 6.95-8.24 (m, 37H, Ph and H-4, H-5, H-6 or H-7) ppm. $^{13}\text{C}\{^1\text{H}\}$ ($(\text{CD}_3)_2\text{CO}$) δ = 6.63 (d, J_{CP} = 56.6 Hz, PCH_3), 10.40 (d, J_{CP} = 62.3 Hz, PCH_3), 17.61 (d, $^3J_{\text{CP}}$ = 10.2 Hz, CH_3), 17.68 (s, CH_3), 21.56, 25.15, 34.50, 34.53, 35.70, 36.13 and 36.60 (s, CH_2), 33.04 (d, $^2J_{\text{CP}}$ = 5.1 Hz, CH_2), 37.07, 51.09 and 54.14 (s, CH), 39.26 and 51.76 (s, C), 54.35 (d, J_{CP} = 47.0 Hz, C_γ), 73.43 (s, C-1 and C-3), 95.70 (s, C-2), 106.41 (d, $^2J_{\text{CP}}$ = 5.7 Hz, C_β), 111.02 (s, C-3a and C-7a), 113.48 (m, Ru- C_α), 124.32, 124.81, 127.42, 127.82 and 130.45 (s, C-4, C-5, C-6, C-7 and $\equiv\text{CHC}=\text{O}$), 128.36-139.48 (m, Ph), 170.71 (s, $\equiv\text{C}$), 198.23 (s, $\text{C}=\text{O}$) ppm; $\Delta\delta(\text{C-3a,7a}) = -19.68$. **Minor diastereoisomer:** $^{31}\text{P}\{^1\text{H}\}$ ($(\text{CD}_3)_2\text{CO}$) δ = 27.21 (vt, $^5J_{\text{PP}}$ = 3.8 Hz, PMe_2Ph), 52.76 (m, PPh_3) ppm. ^1H

$((\text{CD}_3)_2\text{CO}) \delta = 0.40\text{--}2.92$ (m, 19H, CH_2 and CH), 0.54 and 1.11 (s, 3H each, CH_3), 2.33 (d, 3H, $^2J_{\text{HP}} = 15.1$ Hz, PCH_3), 2.50 (d, 3H, $^2J_{\text{HP}} = 13.3$ Hz, PCH_3), 4.67 (br, 2H, H-1 and H-3), 5.29 (br, 1H, H-2), 5.63 (s, 1H, $=\text{CHC}=\text{O}$), 6.34 (m, 2H, H-4, H-5, H-6 or H-7), 6.95–8.24 (m, 37H, Ph and H-4, H-5, H-6 or H-7) ppm. $^{13}\text{C}\{^1\text{H}\} ((\text{CD}_3)_2\text{CO}) \delta = 8.45$ (d, $J_{\text{CP}} = 59.1$ Hz, PCH_3), 10.13 (d, $J_{\text{CP}} = 65.5$ Hz, PCH_3), 17.68 (s, CH_3), 18.81 (d, $^3J_{\text{CP}} = 8.3$ Hz, CH_3), 21.68, 25.27, 34.34, 34.38, 35.51, 36.02 and 36.56 (s, CH_2), 32.81 (d, $^2J_{\text{CP}} = 5.7$ Hz, CH_2), 37.07, 52.39 and 53.62 (s, CH), 39.14 and 51.76 (s, C), 57.22 (d, $J_{\text{CP}} = 42.6$ Hz, C_γ), 73.07 (s, C-1 and C-3), 96.09 (s, C-2), 105.65 (d, $^2J_{\text{CP}} = 5.1$ Hz, C_β), 110.86 and 111.63 (s, C-3a and C-7a), 114.72 (m, Ru- C_α), 124.37, 124.75, 127.63, 127.98 and 130.80 (s, C-4, C-5, C-6, C-7 and $=\text{CHC}=\text{O}$), 128.36–139.48 (m, Ph), 170.42 (s, $=\text{C}$), 198.23 (s, $\text{C}=\text{O}$) ppm; $\Delta\delta(\text{C-3a,7a}) = -19.45$.

Compound 9b: Major diastereoisomer: $^{31}\text{P}\{^1\text{H}\} ((\text{CD}_3)_2\text{CO}) \delta = 27.44$ (vt, $^5J_{\text{PP}} = 3.8$ Hz, PMe_2Ph), 52.15 and 54.04 (dd, $^2J_{\text{PP}} = 32.5$ Hz, $^5J_{\text{PP}} = 3.8$ Hz, PPh_3) ppm. $^1\text{H} ((\text{CD}_3)_2\text{CO}) \delta = 0.96$ (s, 3H, CH_3), 1.11–2.92 (m, 14H, CH_2 and CH), 2.42 (d, 3H, $^2J_{\text{HP}} = 12.5$ Hz, PCH_3), 2.67 (d, 3H, $^2J_{\text{HP}} = 13.1$ Hz, PCH_3), 4.48 (br, 1H, OH), 4.67 and 4.74 (br, 1H each, H-1 and H-3), 5.28 (br, 1H, H-2), 6.21–8.28 (m, 42H, Ph, $\text{C}_6\text{H}_3\text{OH}$, H-4, H-5, H-6 and H-7) ppm. $^{13}\text{C}\{^1\text{H}\} ((\text{CD}_3)_2\text{CO}) \delta = 6.57$ (d, $J_{\text{CP}} = 57.1$ Hz, PCH_3), 10.52 (d, $J_{\text{CP}} = 62.3$ Hz, PCH_3), 17.76 (d, $^3J_{\text{CP}} = 4.7$ Hz, CH_3), 24.91, 27.14, 28.51, 29.88, 35.54 and 36.24 (s, CH_2), 39.60, 43.90 and 50.31 (s, CH), 52.20 (d, $^2J_{\text{CP}} = 3.5$ Hz, CCH_3), 54.62 (d, $J_{\text{CP}} = 47.1$ Hz, C_γ), 72.98 and 73.56 (s, C-1 and C-3), 96.16 (s, C-2), 106.69 (d, $^2J_{\text{CP}} = 5.2$ Hz, C_β), 110.43 and 112.06 (s, C-3a and C-7a), 113.73 and 115.97 (s, CH of $\text{C}_6\text{H}_3\text{OH}$), 114.51 (m, Ru- C_α), 123.85–139.27 (m, Ph, CH of $\text{C}_6\text{H}_3\text{OH}$, C of $\text{C}_6\text{H}_3\text{OH}$, C-4, C-5, C-6 and C-7), 156.05 (s, COH) ppm; $\Delta\delta(\text{C-3a,7a}) = -19.45$. **Minor diastereoisomer:** $^{31}\text{P}\{^1\text{H}\} ((\text{CD}_3)_2\text{CO}) \delta = 26.95$ (vt, $^5J_{\text{PP}} = 3.4$ Hz, PMe_2Ph), 51.87 and 53.50 (dd, $^2J_{\text{PP}} = 33.9$ Hz, $^5J_{\text{PP}} = 3.4$ Hz, PPh_3) ppm. $^1\text{H} ((\text{CD}_3)_2\text{CO}) \delta = 0.91$ (s, 3H, CH_3), 1.11–2.92 (m, 14H, CH_2 and CH), 2.41 (d, 3H, $^2J_{\text{HP}} = 12.8$ Hz, PCH_3), 2.53 (d, 3H, $^2J_{\text{HP}} = 13.1$ Hz, PCH_3), 4.48 (br, 1H, OH), 4.58 and 4.84 (br, 1H each, H-1 and H-3), 5.35 (br, 1H, H-2), 6.21–8.28 (m, 42H, Ph, $\text{C}_6\text{H}_3\text{OH}$, H-4, H-5, H-6 and H-7) ppm. $^{13}\text{C}\{^1\text{H}\} ((\text{CD}_3)_2\text{CO}) \delta = 8.55$ (d, $J_{\text{CP}} = 58.8$ Hz, PCH_3), 10.11 (d, $J_{\text{CP}} = 64.6$ Hz, PCH_3), 18.90 (d, $^3J_{\text{CP}} = 8.6$ Hz, CH_3), 25.01, 27.21, 28.81, 30.27 and 36.30 (s, CH_2),

34.75 (d, $^2J_{CP} = 4.1$ Hz, CH_2), 40.49, 45.55 and 50.31 (s, CH), 51.69 (d, $^2J_{CP} = 9.3$ Hz, CCH_3), 57.42 (d, $J_{CP} = 42.5$ Hz, C_γ), 73.56 and 74.06 (s, C-1 and C-3), 95.60 (s, C-2), 105.66 (d, $^2J_{CP} = 5.2$ Hz, C_β), 110.92 and 110.97 (s, C-3a and C-7a), 113.63 and 115.91 (s, CH of C_6H_3OH), 114.51 (m, Ru- C_α), 123.85-139.27 (m, Ph, CH of C_6H_3OH , C of C_6H_3OH , C-4, C-5, C-6 and C-7), 156.05 (s, COH) ppm; $\Delta\delta(C-3a,7a) = -19.75$.

Compound 9c: Major diastereoisomer: $^{31}P\{^1H\}$ ($(CD_3)_2CO$) $\delta = 27.42$ (vt, $^5J_{PP} = 4.1$ Hz, PMe_2Ph), 52.23 and 54.07 (dd, $^2J_{PP} = 32.5$ Hz, $^5J_{PP} = 4.1$ Hz, PPh_3) ppm. 1H ($(CD_3)_2CO$) $\delta = 0.95$ (s, 3H, CH_3), 1.10-2.93 (m, 14H, CH_2 and CH), 2.37 (d, 3H, $^2J_{HP} = 12.5$ Hz, PCH_3), 2.63 (d, 3H, $^2J_{HP} = 12.8$ Hz, PCH_3), 3.71 (s, 3H, OCH_3), 4.65 and 4.71 (br, 1H each, H-1 and H-3), 5.25 (br, 1H, H-2), 6.30-8.26 (m, 42H, Ph, $C_6H_3OCH_3$, H-4, H-5, H-6 and H-7) ppm. $^{13}C\{^1H\}$ ($(CD_3)_2CO$) $\delta = 8.55$ (d, $J_{CP} = 58.8$ Hz, PCH_3), 10.07 (d, $J_{CP} = 65.2$ Hz, PCH_3), 18.93 (d, $^3J_{CP} = 8.1$ Hz, CH_3), 24.95, 27.13, 28.51, 30.07, 35.55 and 36.23 (s, CH_2), 40.44, 43.94 and 50.46 (s, CH), 52.17 (d, $^2J_{CP} = 6.4$ Hz, CCH_3), 55.43 (OCH_3), 57.37 (d, $J_{CP} = 43.1$ Hz, C_γ), 73.56 and 74.08 (s, C-1 and C-3), 95.59 (s, C-2), 105.68 (d, $^2J_{CP} = 5.3$ Hz, C_β), 110.92 (s, C-3a and C-7a), 112.37 and 114.43 (s, CH of $C_6H_3OCH_3$), 113.69 (m, Ru- C_α), 123.95-139.17 (m, Ph, CH of $C_6H_3OCH_3$, C of $C_6H_3OCH_3$, C-4, C-5, C-6 and C-7), 158.60 (s, $COCH_3$) ppm; $\Delta\delta(C-3a,7a) = -19.78$. **Minor diastereoisomer:** $^{31}P\{^1H\}$ ($(CD_3)_2CO$) $\delta = 26.91$ (vt, $^5J_{PP} = 3.8$ Hz, PMe_2Ph), 51.94 and 53.48 (dd, $^2J_{PP} = 32.1$ Hz, $^5J_{PP} = 3.8$ Hz, PPh_3) ppm. 1H ($(CD_3)_2CO$) $\delta = 0.52$ (s, 3H, CH_3), 1.10-2.93 (m, 14H, CH_2 and CH), 2.13 (d, 3H, $^2J_{HP} = 11.7$ Hz, PCH_3), 2.44 (d, 3H, $^2J_{HP} = 12.3$ Hz, PCH_3), 3.71 (s, 3H, OCH_3), 4.56 and 4.68 (br, 1H each, H-1 and H-3), 5.31 (br, 1H, H-2), 6.30-8.26 (m, 42H, Ph, $C_6H_3OCH_3$, H-4, H-5, H-6 and H-7) ppm. $^{13}C\{^1H\}$ ($(CD_3)_2CO$) $\delta = 6.58$ (d, $J_{CP} = 57.1$ Hz, PCH_3), 10.48 (d, $J_{CP} = 62.3$ Hz, PCH_3), 17.80 (d, $^3J_{CP} = 4.7$ Hz, CH_3), 26.23, 27.13, 28.81, 31.01, 34.71 and 36.23 (s, CH_2), 39.51, 43.94 and 51.62 (s, CH), 51.69 (d, $^2J_{CP} = 9.9$ Hz, CCH_3), 54.56 (d, $J_{CP} = 47.1$ Hz, C_γ), 55.06 (OCH_3), 73.04 and 75.25 (s, C-1 and C-3), 96.13 (s, C-2), 106.65 (d, $^2J_{CP} = 5.2$ Hz, C_β), 110.38 and 112.03 (s, C-3a and C-7a), 112.49 and 114.50 (s, CH of $C_6H_3OCH_3$), 113.69 (m, Ru- C_α), 123.95-139.17 (m, Ph, CH of $C_6H_3OCH_3$, C of $C_6H_3OCH_3$, C-4, C-5, C-6 and C-7), 158.60 (s, $COCH_3$) ppm; $\Delta\delta(C-3a,7a) = -19.49$.

Bruker

*** Current Data Parameters ***

NAME : cn121781
EXPNO : 1

*** Acquisition Parameters ***

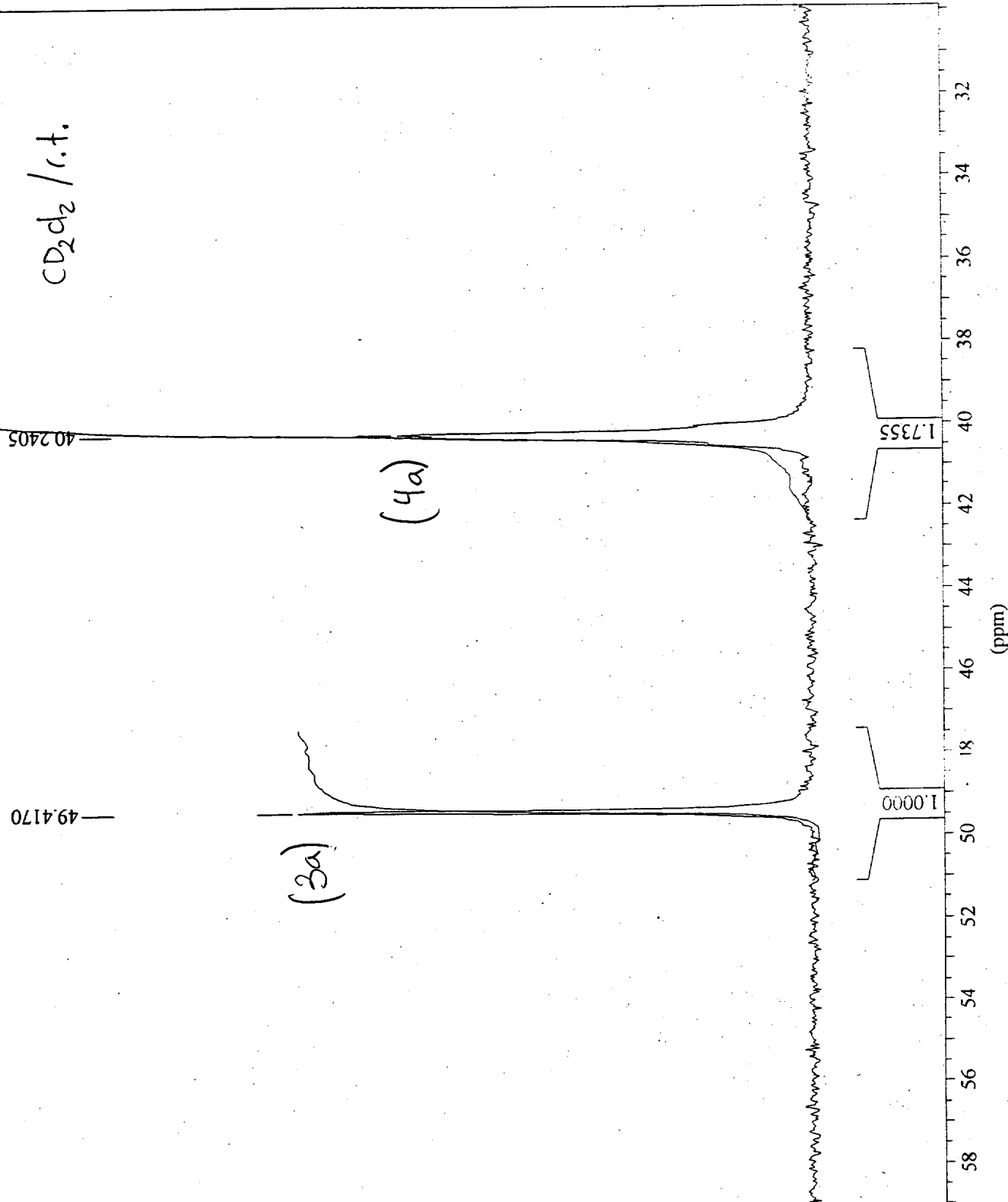
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BF1 : 121.4900021 MHz
BF2 : 0.0000000 MHz
FW : 41700.00 Hz
NS : 116
OI : 20020.35 Hz
O2 : 4700.00 Hz
RO : 20 Hz
SFO1 : 121.5100225 MHz
SW : 274.3634 ppm
SW_h : 33333.333 Hz
TD : 16384

*** Processing Parameters ***

LB : 2.00 Hz
SF : 121.4963972 MHz
SI : 8192
SW_p : 33333.333330

*** 1D NMR Plot Parameters ***

SR : 6395.10 Hz
ppm_cm : 1.45
Hz_cm : 175.74
AQ_time : 0.2457260 sec
*** Aspect 3000 Parameters ***
PHOC : 0





*** Current Data Parameters ***

NAME : en121781
EXPNO : 2

*** Acquisition Parameters ***

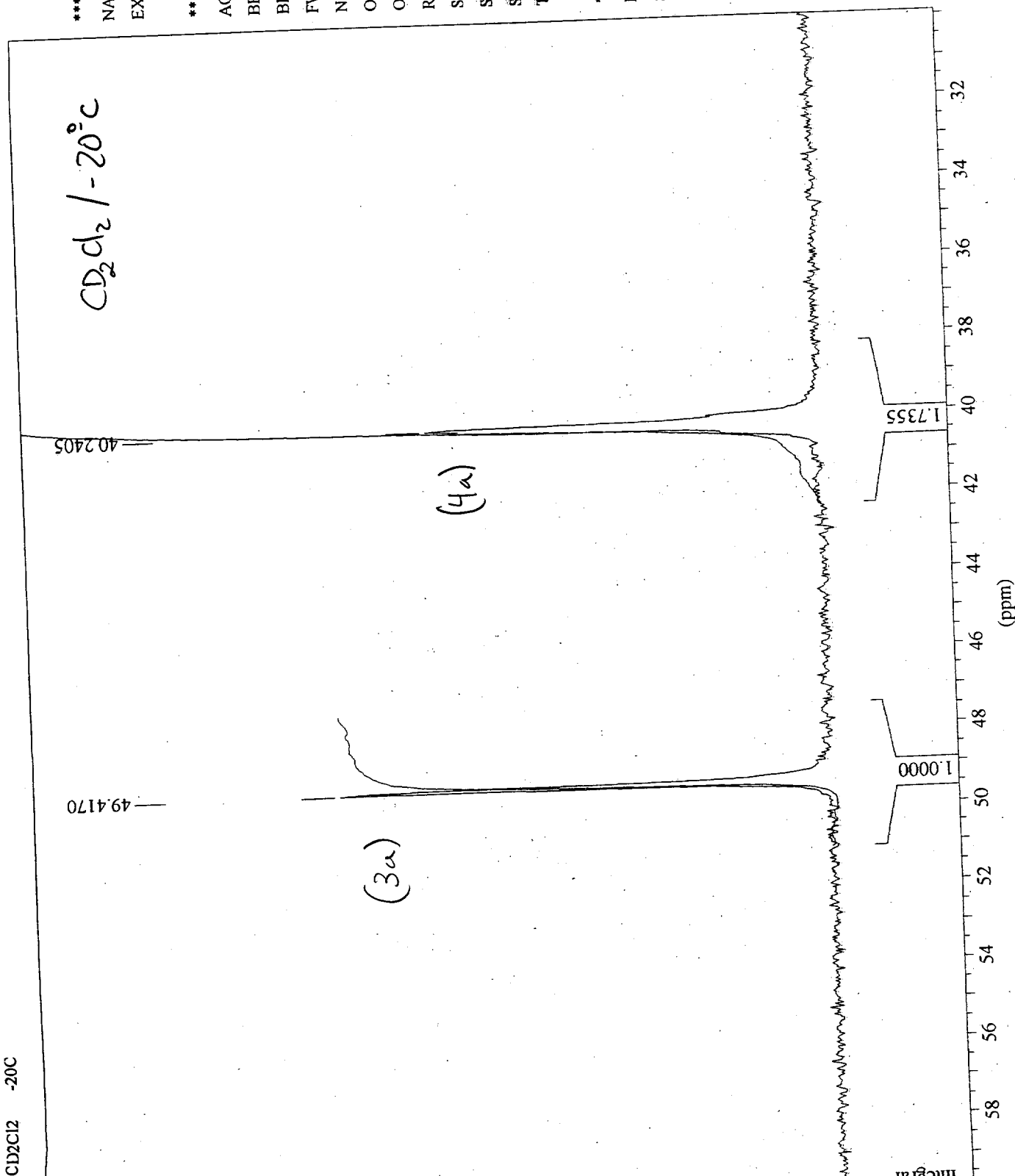
AQ_mod : qseq
BF1 : 121.4900021 MHz
BF2 : 0.0000000 MHz
FW : 41700.00 Hz
NS : 116
O1 : 20020.35 Hz
O2 : 4700.00 Hz
RO : 20 Hz
SFO1 : 121.5100225 MHz
SW : 274.3634 ppm
SW_h : 33333.333 Hz
TD : 16384

*** Processing Parameters ***

LB : 2.00 Hz
SF : 121.4963972 MHz
SI : 8192
SW_p : 33333.333330

*** 1D NMR Plot Parameters ***

SR : 6395.10 Hz
ppm_cm : 1.45
Hz_cm : 175.74
AQ_time : 0.2457260 sec
*** Aspect 3000 Parameters ***
PHOC : 0





*** Current Data Parameters ***

NAME : en121781
EXPNO : 3

*** Acquisition Parameters ***

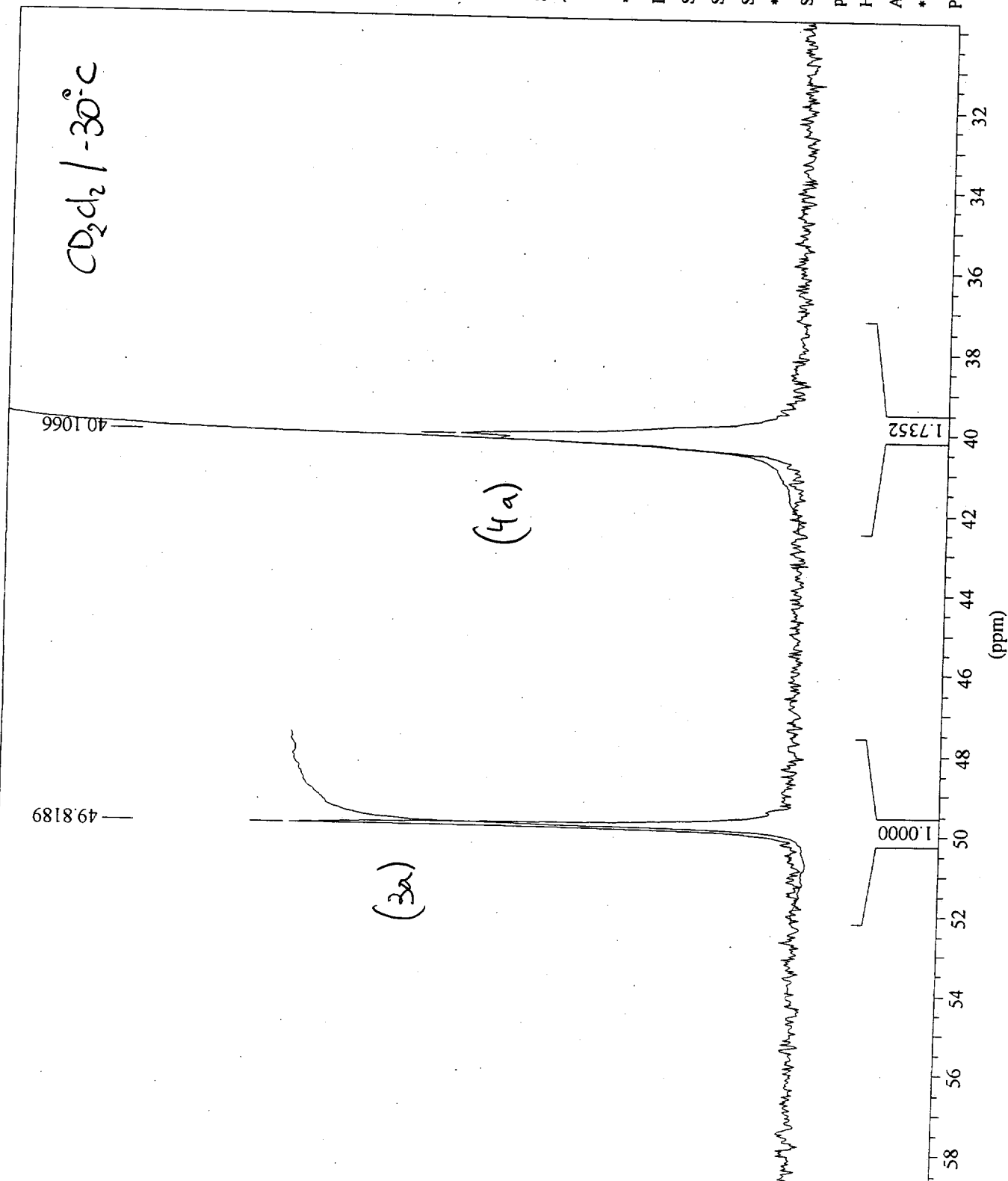
AQ_mod : qseq
BF1 : 121.4900021 MHz
BF2 : 0.0000000 MHz
FW : 41700.00 Hz
NS : 103
OI : 20020.35 Hz
O2 : 4700.00 Hz
RO : 20 Hz
SFO1 : 121.5100225 MHz
SW : 274.3634 ppm
SW_h : 3333.333 Hz
TD : 16384

*** Processing Parameters ***

LB : 2.00 Hz
SF : 121.4963972 MHz
SI : 8192

*** ID NMR Plot Parameters ***

SR : 6395.10 Hz
ppm_cm : 1.44
Hz_cm : 174.97
AQ_time : 0.2457260 sec
*** Aspect 3000 Parameters ***
PHOC : 0





*** Current Data Parameters ***

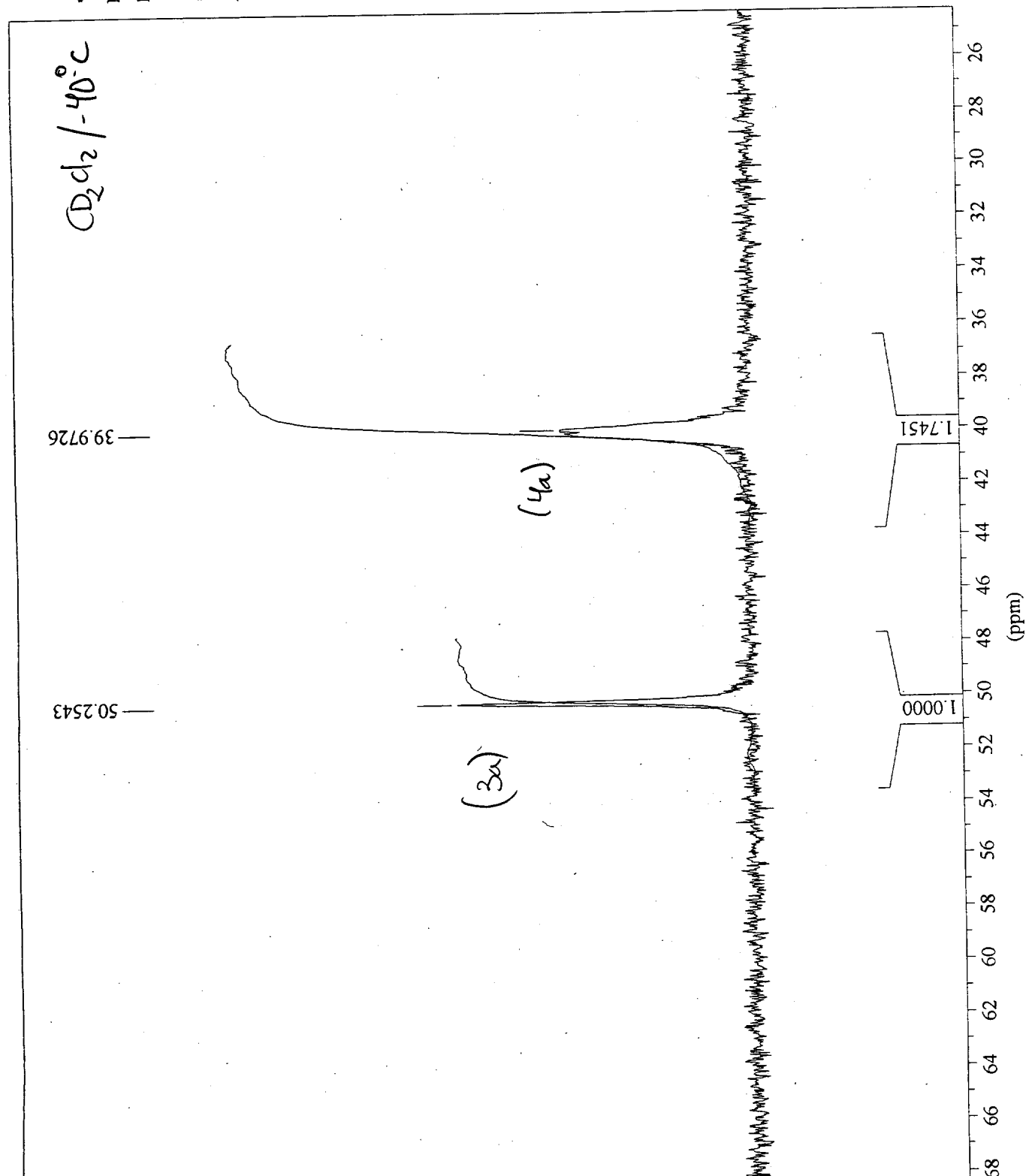
NAME : en121781
EXPNO : 4

*** Acquisition Parameters ***

AQ_mod : qseq
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BF2 : 0.0000000 MHz
FW : 41700.00 Hz
NS : 153
OI : 20020.35 Hz
O2 : 4700.00 Hz
RO : 20 Hz
SFO1 : 121.5100225 MHz
SW : 274.3634 ppm
SW_h : 33333.333 Hz
TD : 16384

*** Processing Parameters ***

LB : 0.00 Hz
SF : 121.4963972 MHz
SI : 8192
SW_p : 33333.333330
*** 1D NMR Plot Parameters ***
SR : 6395.10 Hz
ppm_cm : 2.19
Hz_cm : 266.04
AQ_time : 0.2457260 sec
*** Aspect 3000 Parameters ***
PHOC : 0





*** Current Data Parameters ***

NAME : en121781
EXPNO : 5

*** Acquisition Parameters ***

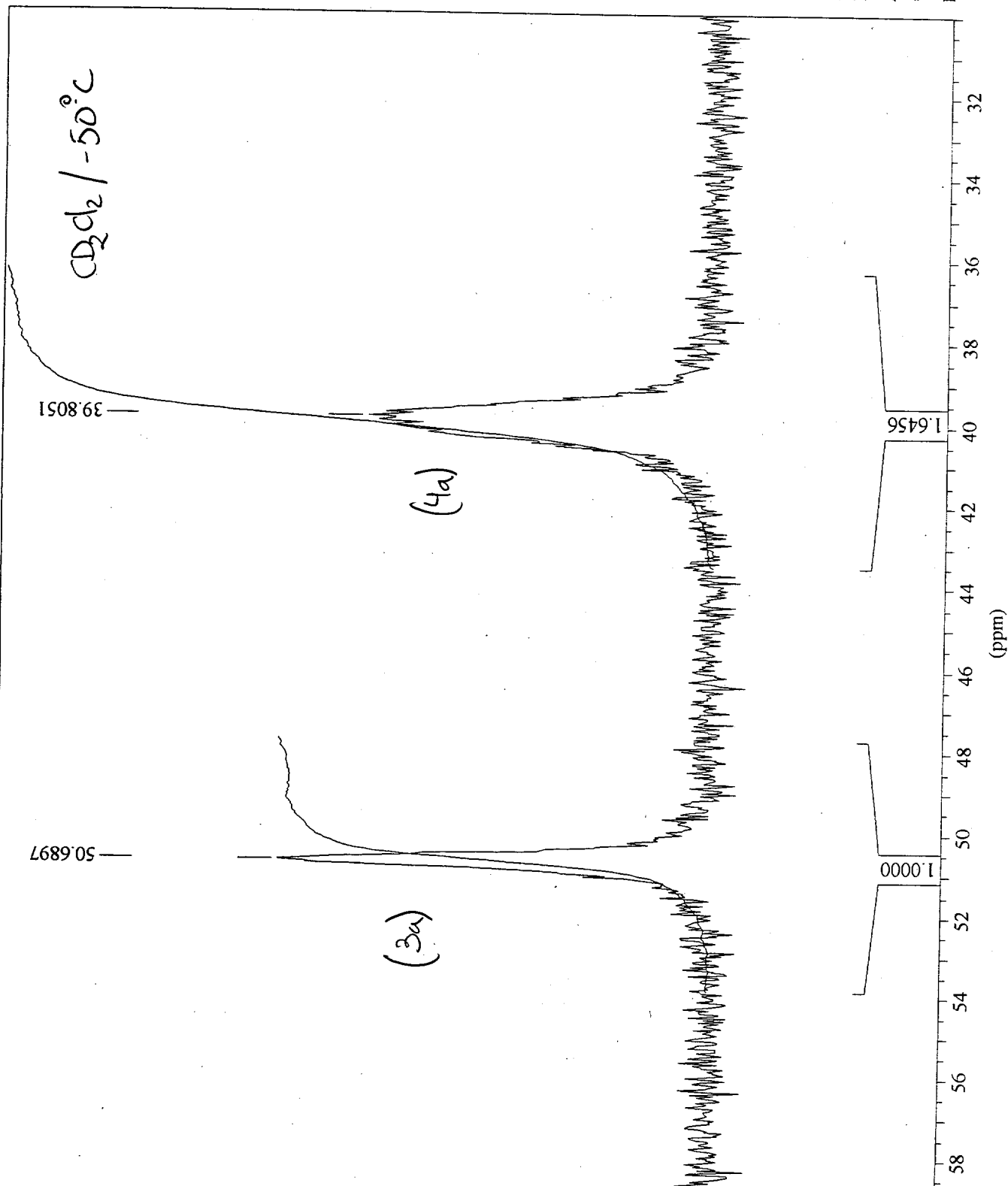
AQ_mod : qseq
BF1 : 121.490021 MHz
BF2 : 0.000000 MHz
FW : 41700.00 Hz
NS : 170
O1 : 20020.35 Hz
O2 : 4700.00 Hz
RO : 20 Hz
SFO1 : 121.5100225 MHz
SW : 274.3634 ppm
SW_h : 33333.333 Hz
TD : 16384

*** Processing Parameters ***

LB : 0.00 Hz
SF : 121.4963972 MHz
SI : 8192
SW_p : 33333.333330

*** 1D NMR Plot Parameters ***

SR : 6395.10 Hz
ppm_cm : 1.43
Hz_cm : 173.42
AQ_time : 0.2457260 sec
*** Aspect 3000 Parameters ***
PH0C : 0





*** Current Data Parameters ***

NAME : cn121781
EXPNO : 6

*** Acquisition Parameters ***

AQ_mod : qseq
BF1 : 121.4900021 MHz
BF2 : 0.0000000 MHz
FW : 41700.00 Hz
NS : 202
O1 : 20020.35 Hz
O2 : 4700.00 Hz
RO : 20 Hz
SFO1 : 121.5100225 MHz
SW : 274.3634 ppm
SW_h : 3333.333 Hz
TD : 16384

*** Processing Parameters ***

LB : 0.00 Hz
SF : 121.4963972 MHz
SI : 8192
SW_p : 33333.333330
*** 1D NMR Plot Parameters ***
SR : 6395.10 Hz
ppm_cm : 1.45
Hz_cm : 175.74
AQ_time : 0.2457260 sec
*** Aspect 3000 Parameters ***
PHOC : 0

$CD_2Cl_2 / -60^\circ C$

— 39.5707

— 51.1585

(4a)

(3a)

1.6291

1.0000

(ppm)