SUPPORTING INFORMATION

for

Unexpected catalytic activity of a simple triethylborohydride in hydrosilylation of alkenes

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1. Experimental procedures

1.1. General remarks

All reactions were performed in oven-dried glassware under argon atmosphere. Toluene was purified by MBraun SPS-8400 system and degassed after collection. Other solvents were dried by distillation over calcium hydride.

Gas chromatography was performed on a Bruker Scion 436-GC with a 30 m Agilent VF5-ms 0.53 mm Megabore column and a TCD detector. The temperature program was as follows: 60 °C (3 min), 20 °C/min, 280 °C (20 min). Decane was used as a reference. GC-MS analyses were performed on a Bruker Scion 436-GC with a 30 m Varian DB-5 0.25 mm capillary column and a Scion SQ-MS mass spectrometry detector. The temperature program was as follows: 60 °C (3 min), 10 °C/min, 250 °C (15 min). NMR analyses were performed on a Bruker Fourier 300 spectrometer.

1.2. General procedure of hydrosilylation catalysed by $NaHBEt_3$

1.0 mmol of silane, 2 mL of toluene, 2.0 mmol of alkene, and 0.1 mL of decane were placed in previously evacuated Schlenk bomb flask fitted with a plug valve. A reference sample was taken. Next, 0.1 mL of 1M solution of $NaHBEt_3$ (0.1 mmol) in toluene was added, reaction vessel was closed and heated at 100 °C with stirring.

After specified time, reaction mixture was cooled down to the room temperature and analysed using GC and GC-MS.

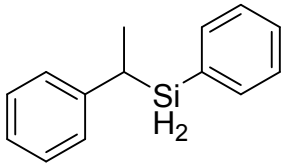
Products of hydrosilylation were isolated by first evaporating toluene on a rotary evaporator, then extraction with 1 mL of hexane followed by column chromatography of concentrated extract (SiO_2, hexane as eluent).

1.3. Yield determination of not isolated products

To determine selectivity, the peak area of desired product was divided by the sum of peak areas of all products obtained in the reaction. Chemical similarity, especially between isomeric products, is often high enough to assume essentially equal ionisation potentials, thus enabling direct comparison of the values. This was proven by cross-check of GC and GC-MS product ratios. So calculated selectivity multiplied by GC-determined conversion of silane is equal to GC-MS yield.

2. Analytical data of isolated products

2.1. Phenyl(1-phenylethyl)silane **3**; colorless oil, yield: 190 mg (91%)



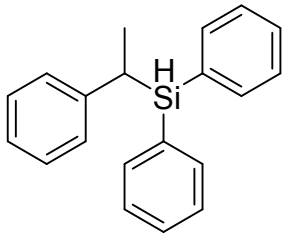
^{1}H NMR (300MHz, $CDCl_3$): δ 7.54-7.11 (m, 10H), 4.41 (d, 2H, *J*= 3.1 Hz), 2.69 (m, 1H), 1.54 (d, 3H, *J*= 7.5)

^{13}C NMR (75 MHz, $CDCl_3$): δ 144.61, 135.72, 131.45, 129.82, 128.44, 127.92, 127.19, 125.09, 25.45, 16.44

*MS (70 eV): m/z (%):*104 (100), 107 (60), 212 (47), 106 (25), 79 (24), 134 (21), 77 (20), 78 (11)

Conforms to the literature analytical data.[1]

2.1. Diphenyl(1-phenylethyl)silane **5**; colorless oil, yield: 256 mg (89%)



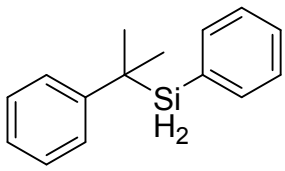
^{1}H NMR (300MHz, $CDCl_3$): δ 7.73-7.09 (m, 15H), 4.96 (d, 1H, *J*= 2.4Hz), 2.94 (qd, 1H, J= 3.3, 7.3 Hz), 1.58 (d, 3H, *J*= 7.4 Hz)

^{13}C NMR (75 MHz, $CDCl_3$): δ 144.45, 135.84, 135.69, 133.14, 129.84 129.71, 128.30, 128.05, 127.84, 125.05, 27.09, 16.63

*MS (70 eV): m/z (%):*183 (100), 105 (20), 184 (16), 181 (16)

HRMS calcd for $C_{20}H_{20}Si$: 288.1334, found:288.1337

2.2. Phenyl(2-phenylpropan-2-yl)silane **6**; colorless oil, yield: 54 mg (24%)



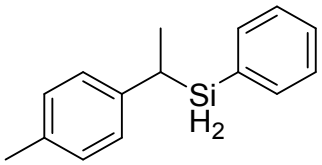
^{1}H NMR (300MHz, $CDCl_3$): δ 7.44-7.30 (m, 6H), 7.26-7.12 (m, 4H), 4.31 (s, 2H), 1,48 (s, 6H)

^{13}C NMR (75 MHz, $CDCl_3$): δ 147.60, 136.00, 131.41, 129.75, 128.14, 127.69, 126.10, 124.87, 26.07, 25.21

MS (70 eV): m/z (%): 119 (100), 91 (70), 118 (51), 105 (21), 77 (17), 226 (16), 107 (14), 79 (14), 103 (12), 78 (11), 53 (10)

HRMS calcd for $C_{15}H_{18}Si$: 226.1178, found: 226.1182

2.3. Phenyl(1-(4-methylphenyl)ethyl)silane **7**, colorless oil, yield: 103 mg (46%)



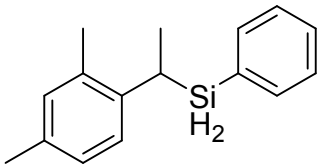
^{1}H NMR (300MHz, $CDCl_3$): δ 7.53-7.23 (m, 5H), 7.14-6.94 (m, 4H), 4.34 (s, 2H), 2.67-2.50 (m, 1H), 2.34 (s, 3H), 1.47 (d, 3H, *J*= 7.4 Hz)

^{13}C NMR (75 MHz, $CDCl_3$) δ 141.47, 135.67, 134.44, 131.62, 129.73, 129.12, 127.87, 127.02, 24.83, 20.99, 16.58

*MS (70 eV): m/z (%):*119 (100), 226 (31), 91 (22), 117 (17), 105 (14), 107 (12), 120 (12)

HRMS calcd for $C_{15}H_{18}Si$: 226.1178, found: 226.1184

2.4. (1-(2,4-dimethylphenyl)ethyl)(phenyl)silane **8**; colorless oil, yield: 93 mg (39%)

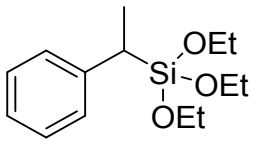


^{1}H NMR (300MHz, $CDCl_3$): δ 7.52-7.31 (m, 5H), 7.09-6.95 (m, 3H), 4.37-4.27 (m, 2H), 2.84-2.70 (m, 1H), 2.32 (s, 3H), 2.23 (s, 3H), 1.47 (d, 3H, *J*= 7.4 Hz)

^{13}C NMR (75 MHz, $CDCl_3$): 139.75, 135.60, 134.69, 134.18, 131.83, 131.04, 129.74, 127.89, 126.93, 126.00, 20.86, 20.32, 19.96, 16.74

MS (70 eV): m/z (%): 138 (100), 105 (23), 240 (18), 116 (13), 91 (12), 134 (11)

2.5. Triethoxy(1-phenylethyl)silane **9**; colorless oil, yield: 195 mg (73%)



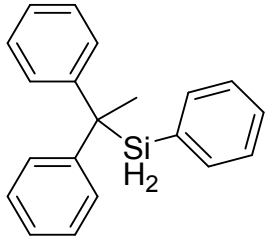
^{1}H NMR (300MHz, $CDCl_3$): δ 7.33-7.26 (m, 3H), 7.19-7.10 (m, 2H), 3.65 (q, 6H, *J*=7.0 Hz), 2.25 (q, 1H, *J*=7.6 Hz), 1.35 (d, 3H, *J*=7.6 Hz), 1.08 (t, 9H, *J*=7.0 Hz)

^{13}C NMR (75 MHz, $CDCl_3$): δ 144.05, 128.04, 127.90, 124.81, 58.80, 26.15, 18.20, 15.58

MS (70 eV): m/z (%): 163 (100), 119 (58), 79 (30), 107 (17), 135 (16), 91 (14), 105 (11), 164 (10), 63 (10)

Conforms to the literature analytical data. [2]

2.6. 1,1-Diphenyl-1-(phenylsilyl)ethane **10**; colorless oil, yield: 187 mg (65%)



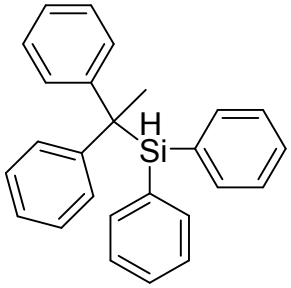
^{1}H NMR (300MHz, $CDCl_3$): δ 7.52-7.28 (m, 7H), 7.27-7.11 (m, 8H), 4.72 (s, 2H), 1.82 (s, 3H)

^{13}C NMR (75 MHz, $CDCl_3$): δ 147.33, 136.36, 130.95, 129.80, 128.28, 127.61, 125.57, 37.61, 25.53

MS (70 eV): m/z (%): 181 (100), 103 (37), 166 (30), 165 (28), 165 (24), 77 (19), 182 (18), 288 (14), 105 (11), 183 (10)

Conforms to the literature analytical data.[1]

2.7. (1,1-Diphenylethyl)diphenylsilane **11**; white solid, yield: 331 mg (91%)



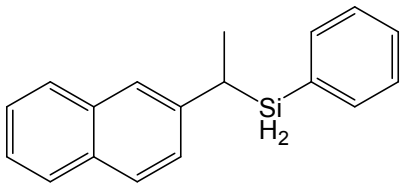
^{1}H NMR (300MHz, $CDCl_3$): δ 7.39-7.31 (m, 2H), 7.27-7.14 (m, 18H), 5.30 (s, 1H), 1.91 (s, 3H)

^{13}C NMR (75 MHz, $CDCl_3$): δ 146.87, 136.38, 133.16, 129.55, 128.82, 128.06, 127.61, 125.53, 39.25, 25.59

MS (70 eV): m/z (%): 183 (100), 105 (20), 181 (19), 184 (18), 103 (11)

HRMS calcd for $C_{26}H_{24}Si$: 364.1647, found: 364.1651

2.8. (1-(Naphthalen-2-yl)ethyl)(phenyl)silane **12**; colorless oil, yield: 218 mg (83%)



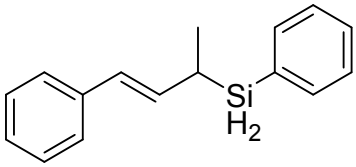
^{1}H NMR (300MHz, $CDCl_3$): δ 7.72-7.60 (m, 3H), 7.45-7.10 (m, 9H), 4.32-4.24 (m, 2H), 2.75-2.62 (m, 1H), 1.45 (d, 3H, *J* = 7.5 Hz)

^{13}C NMR (75 MHz, $CDCl_3$): δ 142.29, 135.73, 133.83, 131.65, 131.33, 129.86, 127.94, 127.85, 127.63, 127.38, 126.75, 125.93, 124.90, 124.58, 25.72, 16.48

MS (70 eV): m/z (%): 155 (100), 262 (25), 153 (21), 156 (17), 128(10)

Conforms to the literature analytical data.[3]

2.9. (E)-phenyl(4-phenylbut-3-en-2-yl)silane **13**; colorless oil, yield: 195 mg (82%)



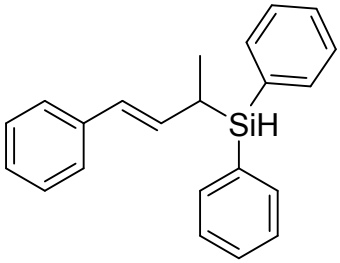
^{1}H NMR (300MHz, $CDCl_3$): δ 7.65-7.57 (m, 2H), 7.45-7.15 (m, 8H), 6.40-6.25 (m, 2H), 4.35-4.28 (m, 2H), 2.35-2.25 (m, 1H), 1.32 (d, 3H, *J* = 7.2 Hz)

^{13}C NMR (75 MHz, $CDCl_3$): δ 138.03, 135.72, 133.06, 131.15, 129.85, 128.51, 128.00, 127.73, 126.61, 125.76, 22.91, 15.11

MS (70 eV): m/z (%): 131 (100), 196 (46), 91 (41), 107 (23), 105 (19), 129 (16), 115 (13), 132 (13), 130 (13), 116 (11), 238 (10)

Conforms to the literature analytical data.[4]

2.10. (E)-diphenyl(4-phenylbut-3-en-2-yl)silane **14**; colorless oil, yield: 175 mg (56%)



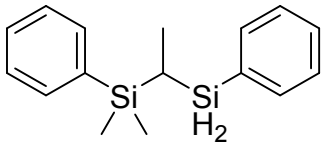
^{1}H NMR (300MHz, $CDCl_3$): δ 7.65-7.60 (m, 4H), 7.50-7.30 (m, 10H), 7.23-7.16 (m, 1H), 6.42-6.22 (m, 2H), 4.83 (d, 2H, *J* = 2.8 Hz), 2.52 (qd, 1H, *J* = 2.7, 7.2 Hz), 1.33 (d, 3H, *J* = 7.2 Hz)

^{13}C NMR (75 MHz, $CDCl_3$): δ 138.23, 135.69, 135.54, 133.02, 129.75, 128.46, 128.01, 127.94, 127.38, 126.49, 125.74, 24.73, 14.76

MS (70 eV): m/z (%): 183, (100), 105 (20), 184 (17), 181 (15), 272 (6), 91 (6)

HRMS calcd for $C_{22}H_{22}Si$: 314.1491, found: 314.1488

2.11. Dimethyl(phenyl)(1-(phenylsilyl)ethyl)silane **15**; colorless oil, yield: 86 mg (32%)

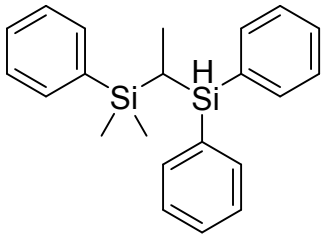


^{1}H NMR (300MHz, $CDCl_3$): δ 7.47-7.38 (m, 4H), 7.31-7.19 (m, 6H), 4.30 (dd, 1H, *J*= 2.1, 5.8 Hz), 4.13 (t, 1H, *J*= 5.6 Hz), 1.06-0.94 (m, 3H), 0.43 (qdd, 1H, *J*= 2.4, 5.4, 7.6 Hz), 0.22 (s, 6H)

^{13}C NMR (75 MHz, $CDCl_3$): δ 136.89, 133.75, 132.15, 131.20, 127.78, 127.26, 126.24, 126.02, 9.11, 0.00, -4.61, -5.74

MS (70 eV): m/z (%): 135 (100), 192 (36), 105 (23), 177 (19), 121 (15), 107 (15), 136 (14), 133 (10)

2.12. (1-(Diphenylsilyl)ethyl)dimethyl(phenyl)silane **16**; colorless wax, yield: 140 mg (41%)



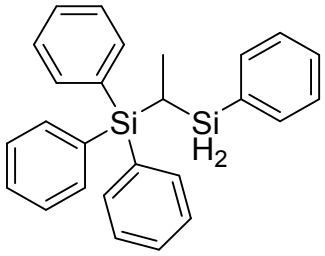
^{1}H NMR (300MHz, $CDCl_3$): δ 7.45-7.10 (m, 15H), 4.69 (d, 1H, *J*= 3.6 Hz), 0.97-0.87 (m, 3H), 0.65 (ddq, 1H, *J*= 3.9, 7.8, 11.4 Hz), 0.01 (d, 6H, *J*= 3.2 Hz)

^{13}C NMR (75 MHz, $CDCl_3$): δ 141.31, 137.89, 137.52, 137.46, 136.85, 136.11, 131.69, 131.67, 131.08, 130.19, 130.15, 129.91, 12.49, 5.34, -0.00, -1.66

MS (70 eV): m/z (%): 135 (100), 190 (71), 105 (50), 183 (35), 182 (29), 210 (28), 181 (24), 197 (23), 107 (18), 253 (17), 121 (16), 191 (15), 136 (13), 175 (12), 132 (11), 148 (11), 268 (11), 259 (10)

HRMS calcd for $C_{22}H_{26}Si_2$: 346.1573, found: 346.1568

2.13. Triphenyl(1-(phenylsilyl)ethyl)silane **17**; colorless solid, yield: 347 mg (88%)



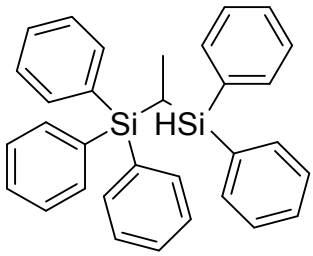
[1]H NMR (300MHz, $CDCl_3$): δ 7.66-7.55 (m, 5H), 7.52-7.29 (m, 15H), 4.48 (d, 1H, *J*= 6.0 Hz), 4.30-4.15 (m, 1H), 1.35-1.25 (m, 4H)

[13]C NMR (75 MHz, $CDCl_3$): δ 135.97, 135.38, 134.59, 132.76, 129.40, 127.92, 127.80, 11.91, -0.90

MS (70 eV): m/z (%): 259 (100), 238 (31), 105 (27), 260 (25), 181 (20), 183 (10)

HRMS calcd for $C_{26}H_{26}Si_2$: 394.1573, found: 394.1570

2.14. (1-(Diphenylsilyl)ethyl)triphenylsilane **18**; colorless solid, yield: 385 mg (82%)



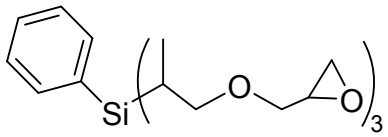
[1]H NMR (300MHz, $CDCl_3$): δ 7.59-7.50 (m, 8H), 7.46-7.19 (m, 17H), 5.03 (d, 1H, *J*= 2.0 Hz), 1.64 (qd, 1H, *J*= 2.2, 7.5 Hz), 1.34 (d, 3H, *J*= 7.5 Hz)

[13]C NMR (75 MHz, $CDCl_3$): δ 136.14, 135.88, 135.21, 135.08, 134.79, 133.70, 129.39, 129.30, 127.94, 127.74, 127.69, 11.5, 0.26

MS (70 eV): m/z (%): 259 (100), 314 (49), 181 (43), 105 (39), 210 (36), 260 (26), 182 (24), 183 (23), 315 (16), 155 (11), 180 (10), 392 (10)

HRMS calcd for $C_{32}H_{30}Si_2$: 470.1886, found: 470.1892

2.15. Tris(1-(glycidyloxy)propan-2-yl)(phenyl)silane **19**;colorless oil, yield: 421 mg (94%)



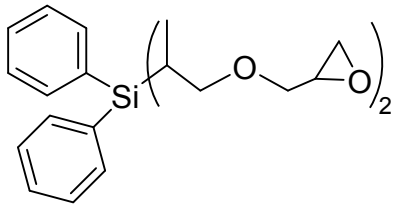
[1]H NMR (300MHz, $CDCl_3$): δ 7.74 (d, 2H, *J*=6.5 Hz), 7.49-7.33 (m, 3H), 5.8 (ddd, 3H, *J*= 5.5, 10.7, 22.5 Hz), 5.21 (dd, 6H, *J*= 13.8, 30.1 Hz), 4.40-4.23 (m, 3H), 3.99 (d, 6H, *J*= 5.4 Hz), 3.52-3.43 (m, 3H), 3.34 (dd, 3H, *J*= 5.7, 9.6 Hz), 1.25 (d, 9H, *J*= 6.2 Hz)

^{13}C NMR (75 MHz, $CDCl_3$): δ 135.06, 135.00, 132.08, 130.08, 127.61, 116.59, 75.61, 72.11, 68.00, 20.61

MS (70 eV): m/z (%): 335 (100), 175 (62), 179 (45), 336 (24), 117 (22), 123 (20), 119 (20), 101 (18), 159 (18), 161 (18), 57 (17), 79 (15), 217 (15), 139 (13), 237 (12), 81 (12), 99 (12), 149 (11)

HRMS (ESI TOF) calcd for $C_{24}H_{38}O_6SiNa$: 473,2336, found: 473,2339

2.16. Bis(1-(glycidyloxy)propan-2-yl)(diphenyl)silane **20**; colorless oil, yield: 358 mg (87%)



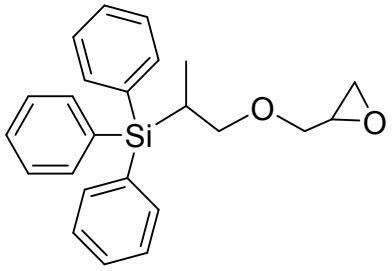
^{1}H NMR (300MHz, $CDCl_3$): δ 7.80-7.72 (m, 4H), 7.48-7.38 (m, 6H), 5.92 (ddd, 2H, *J*= 5.5, 10.7, 22.5 Hz), 5.24 (dd, 4H, *J*= 13.8, 27.1 Hz), 4.36-4.21 (m, 2H), 4.00 (dd, 4H, *J*= 1.1, 5.4 Hz), 3.54 (ddd, 2H, *J*= 2.1, 5.7, 9.6 Hz), 3.40 (dd, 2H, *J*= 5.6, 9.7 Hz), 1.28 (d, 6H, *J*= 6.2 Hz)

^{13}C NMR (75 MHz, $CDCl_3$): δ 135.20, 135.01, 134.00, 133.80, 133.66, 130.10, 127.70, 116.67, 75.73, 72.14, 68.24, 20.75

MS (70 eV): m/z (%): 179 (100), 181 (18), 180 (17), 123 (17), 297 (15), 117 (15), 101 (15), 335 (13), 161 (11)

HRMS (ESI TOF) calcd for $C_{24}H_{32}O_4SiK$: 451,1707, found: 451,1712

2.17. (1-(glycidyloxy)propan-2-yl)(triphenyl)silane **21**; colorless oil, yield: 165 mg (44%)



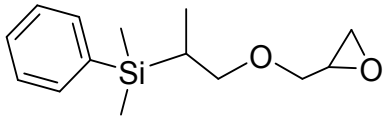
*^{1}H NMR (300MHz, $CDCl_3$):δ*7.79-7.69 (m, 6H), 7,53-7.38 (m, 9H), 5.86 (ddd, 1H, *J*=5.5, 10.7, 22.7 Hz), 5.31-5.13 (m, 2H), 4.31-4.16 (m, 1H), 3.96 (dd, 2H, *J*=6.0, 13.4), 3.53 (dd, 1H, *J*=6.0, 9.7 Hz), 3.42 (dd, 1H, *J*=5.3, 9.7 Hz), 1,27 (d, 3H, *J*=6.2 Hz)

^{13}C NMR (75 MHz, $CDCl_3$): δ 135.61, 134.89, 129.95, 127.82, 116.70, 75.90, 72.12, 68.84, 20.78

MS (70 eV): m/z (%): 259 (100), 179 (60), 297 (35), 181 (31), 260 (24), 199 (19), 180 (16), 105 (11)

HRMS (ESI TOF) calcd for $C_{24}H_{26}O_2SiNa$: 397,1600, found: 397,1606

2.18. (1-(Glycidyloxy)propan-2-yl)(dimethyl)phenylsilane **22**; colorless oil



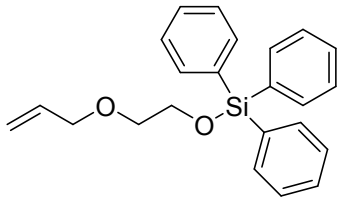
^{1}H NMR (300MHz, $CDCl_3$):δ7.67-7.57 (m, 2H), 7.43-7.34 (m, 3H), 5.88 (ddt, 1H, *J*=5.5, 10.7, 17.1 Hz), 5.26 (ddd, 1H, *J*=1.6, 3.3, 17.3 Hz), 5.17 (dd, 1H, *J*=1.6, 10.4 Hz), 4.10-3.90 (m, 3H), 3.33 (qd, 2H, *J*=5.7, 9.7 Hz), 1.15 (d, 3H, *J*=6.3 Hz), 0.41 (s, 6H)

^{13}C NMR (75 MHz, $CDCl_3$): δ 138.43, 134.90, 133.55, 129.47, 127.74, 116.65, 75.87, 72.15, 67.96, 20.71, 1.02, 1.13

MS (70 eV): m/z (%): 135 (100), 75 (72), 117 (54), 179 (27), 173 (26), 105 (15), 77 (14), 136 (13), 131 (12), 91 (10), 99 (10)

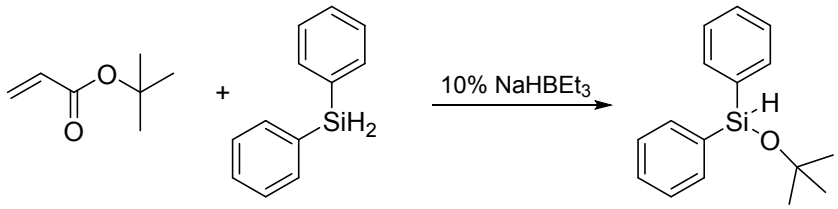
HRMS (ESI TOF) calcd for $C_{14}H_{22}O_2SiK$: 273,1287, found: 273,1289

2.19 (2-(allyloxy)ethoxy)triphenylsilane – identified product of a reaction of triphenylsilane with *O*-THP 2-allyloxyethanol



^{1}H NMR (300MHz, $CDCl_3$):δ7.78-7.60 (m, 6H), 7.50-7.7.30 (m, 9H), 5.87 (ddd, 1H, *J*=5.3, 10.4, 16.2 Hz), 5.24 (d, 1H, *J*=17.2 Hz), 5.15 (d, 1H, *J*=10.4 Hz), 3.98 (d, 2H, *J*=5.9 Hz), 3.94 (d, 2H, *J*=5.4 Hz), 3.60 (t, 2H, *J*=5.3 Hz)

2.20 tert-butoxydiphenylsilane; colorless oil

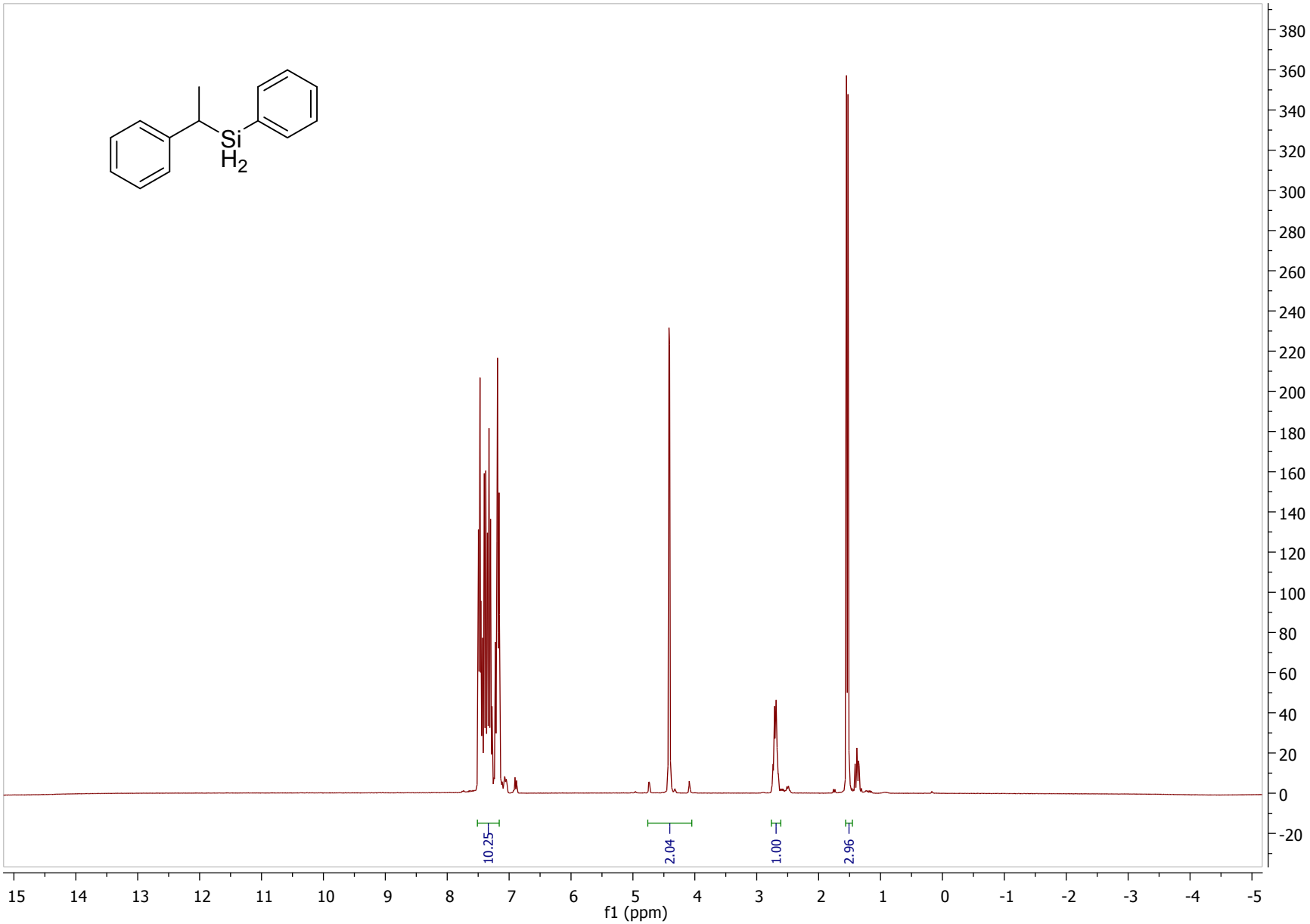


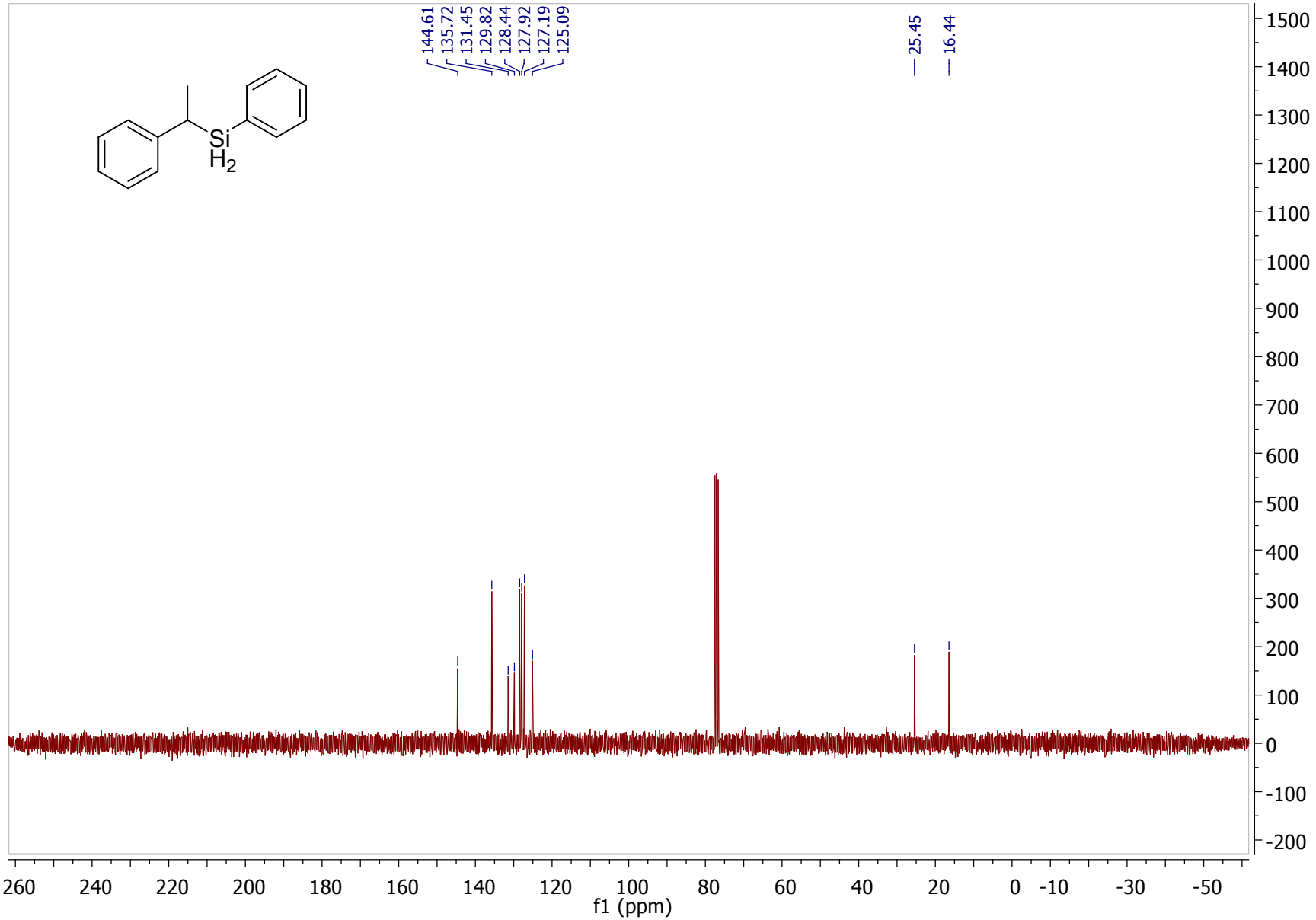
^{1}H NMR (300MHz, $CDCl_3$): 7.67-7.55 (m, 4H), 7.42-7.30 (m, 6H), 5.55 (s, 1H, J=12.63 Hz), 1.33 (s, 9H)

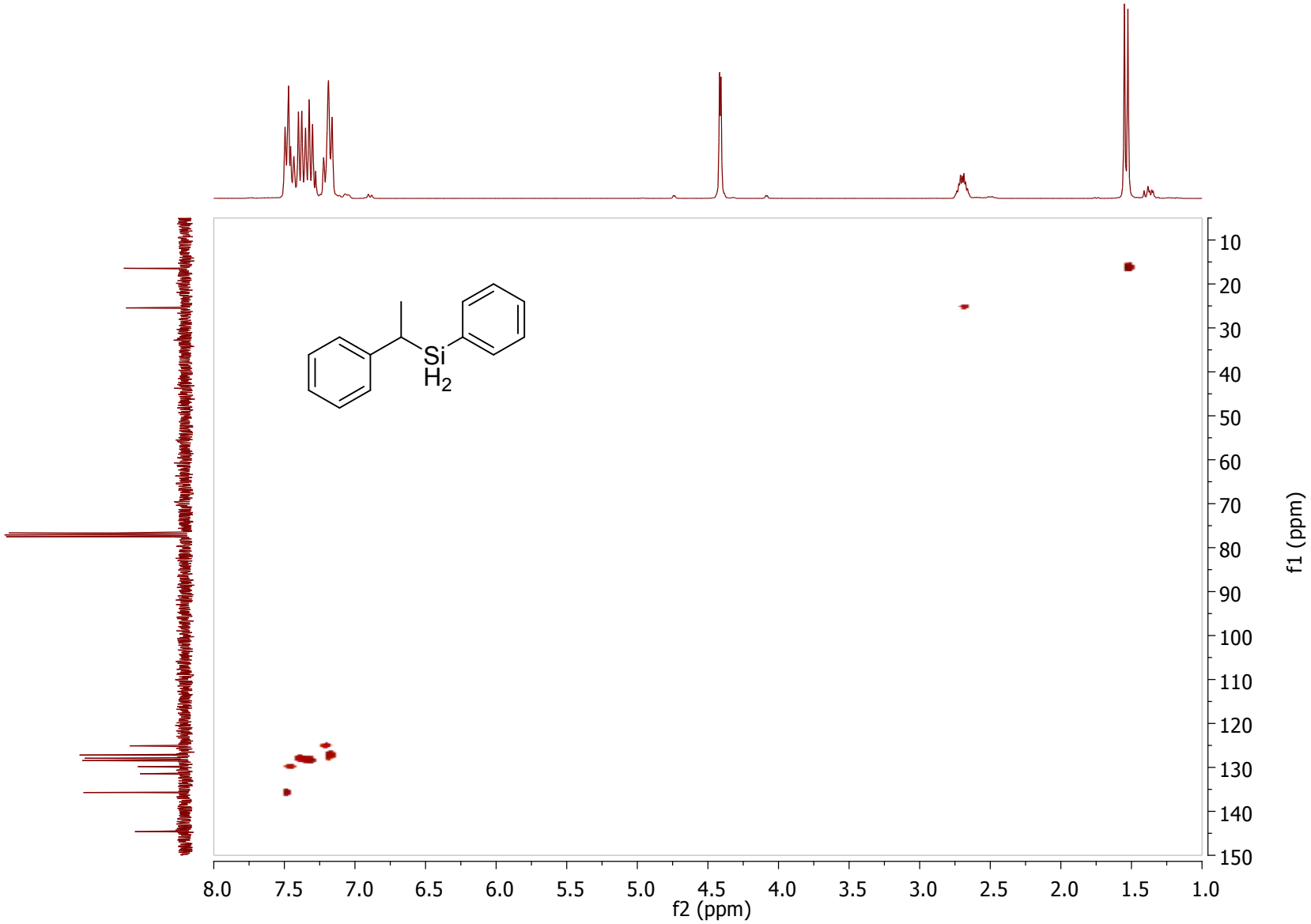
References:

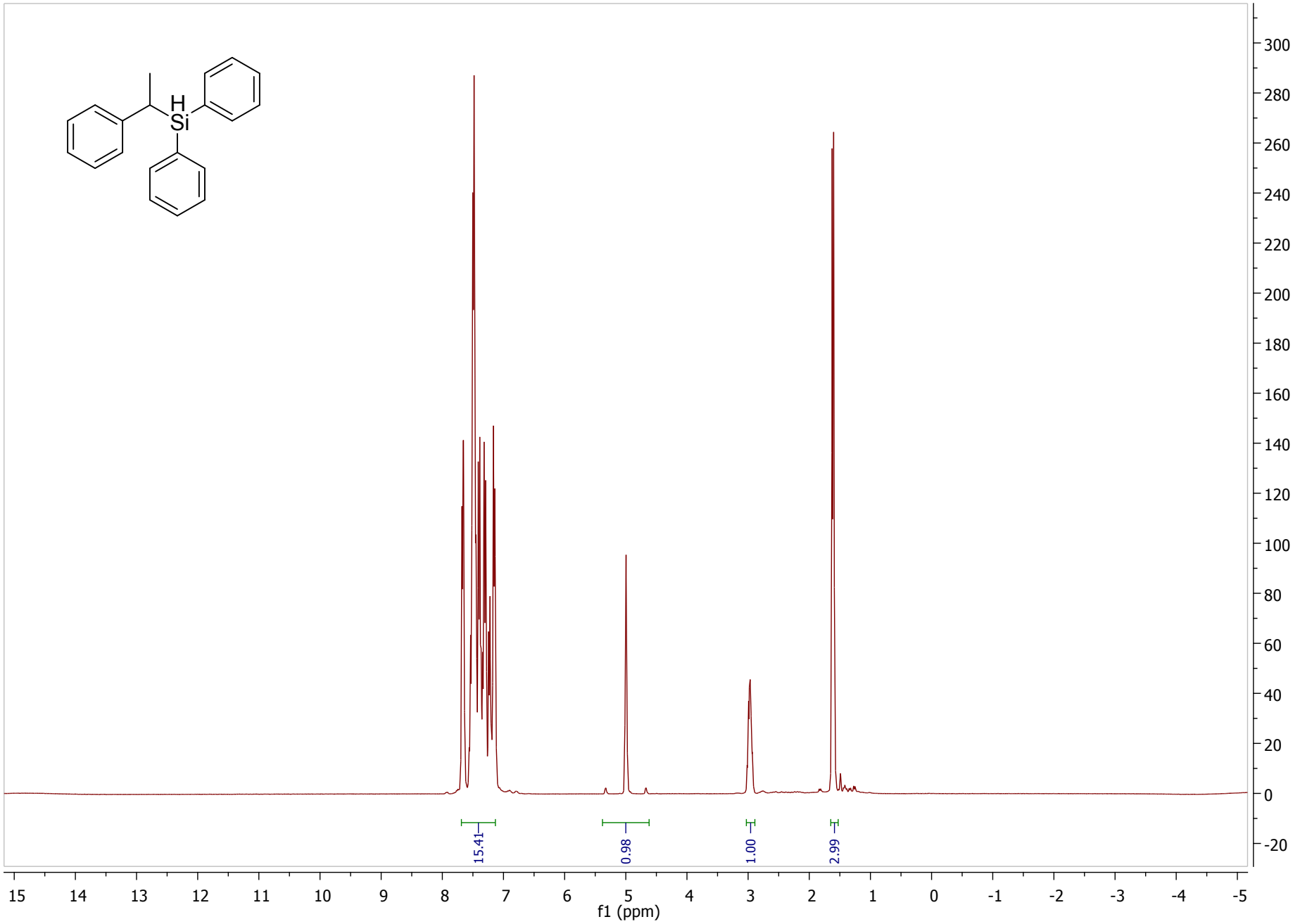
1 R. M. Gauvin, F. Buch, L. Delevoye and S. Harder, *Chem. – Eur. J.*, 2009, **15**, 4382–4393.
2 J. Li, J. Peng, Y. Bai, G. Lai and X. Li, *J. Organomet. Chem.*, 2011, **696**, 2116–2121.
3 P.-F. Fu, L. Brard, Y. Li and T. J. Marks, *J. Am. Chem. Soc.*, 1995, **117**, 7157–7168.
4 M. D. Greenhalgh, D. J. Frank and S. P. Thomas, *Adv. Synth. Catal.*, 2014, **356**, 584–590.

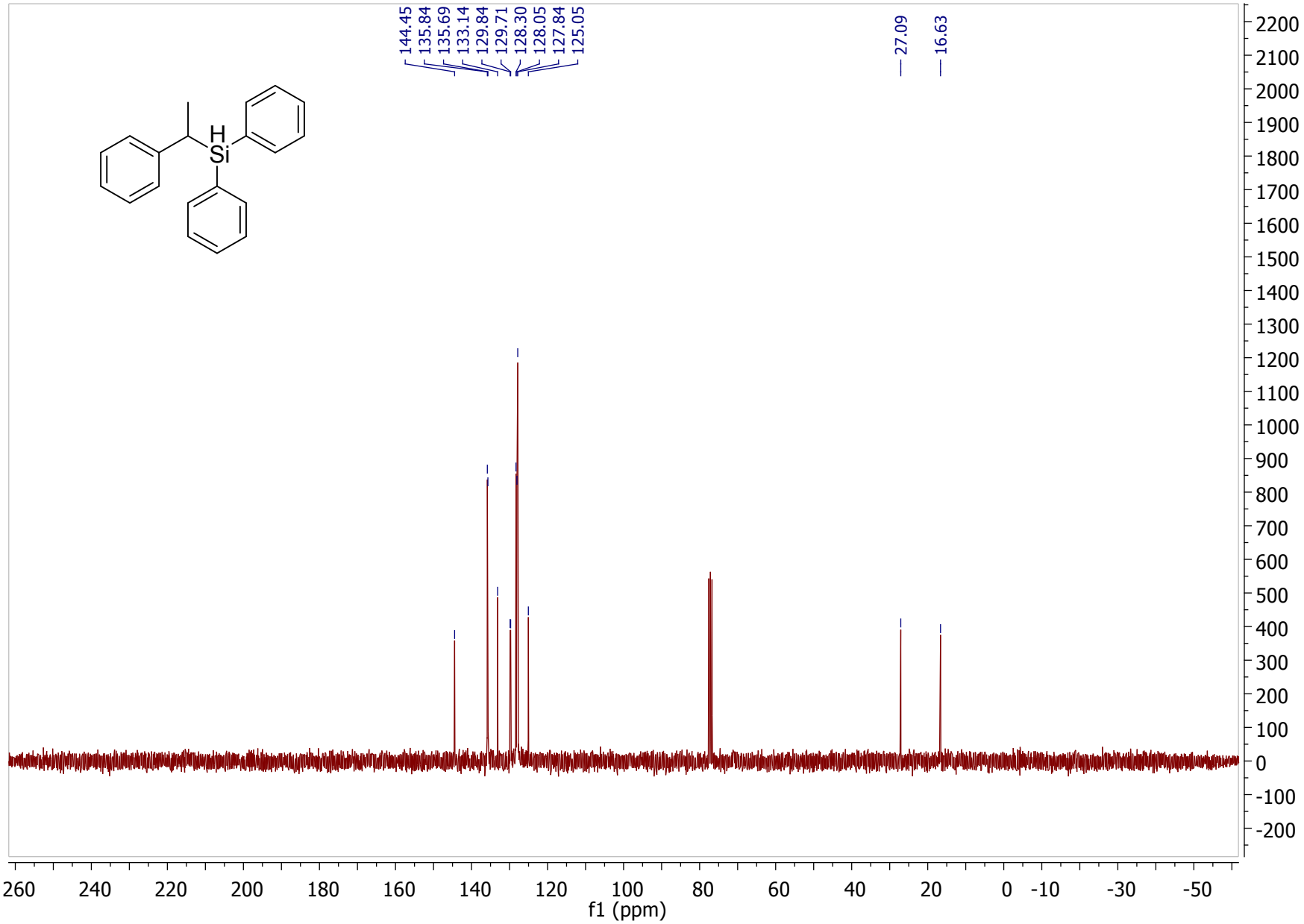
3. **Spectra of products**

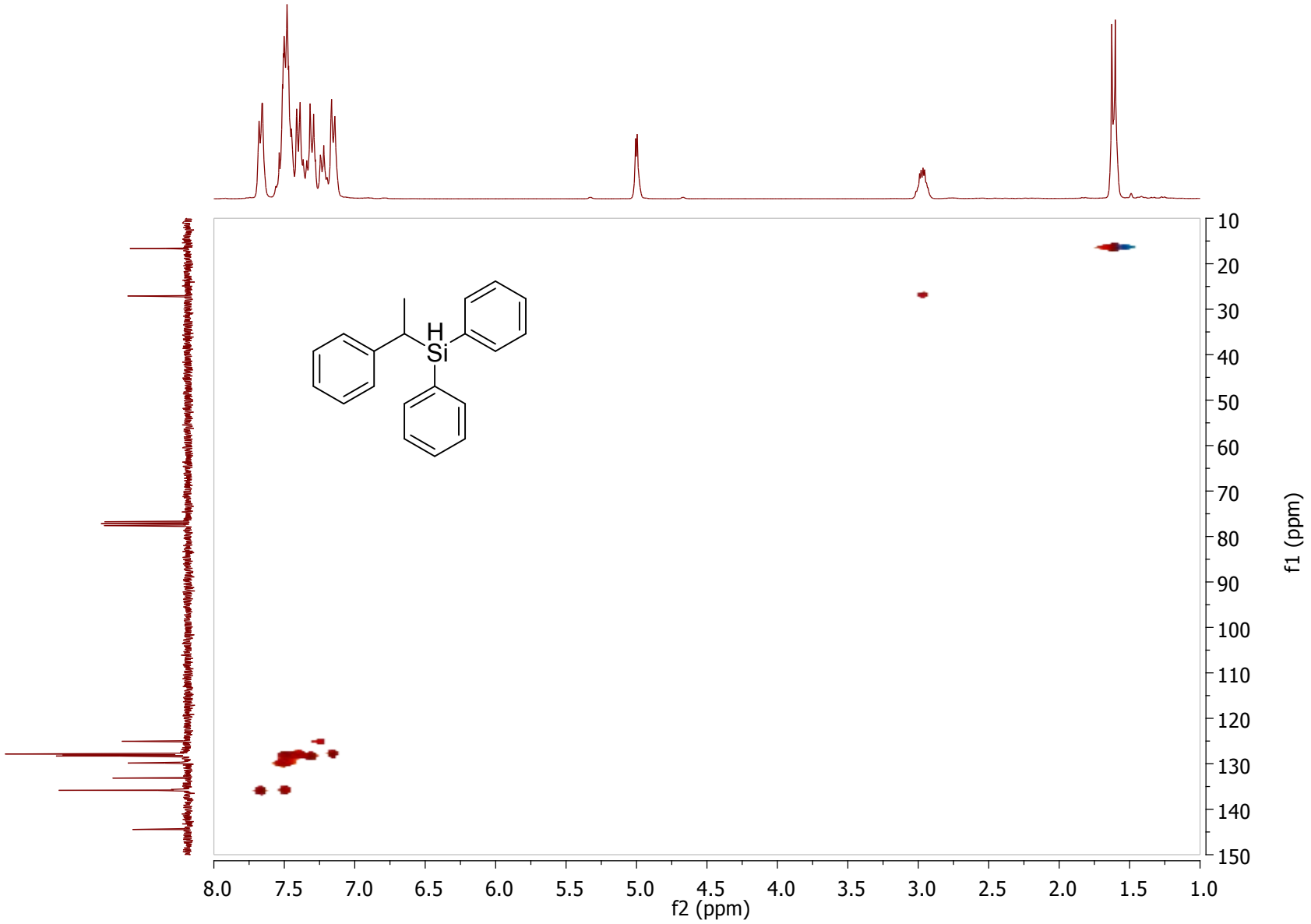


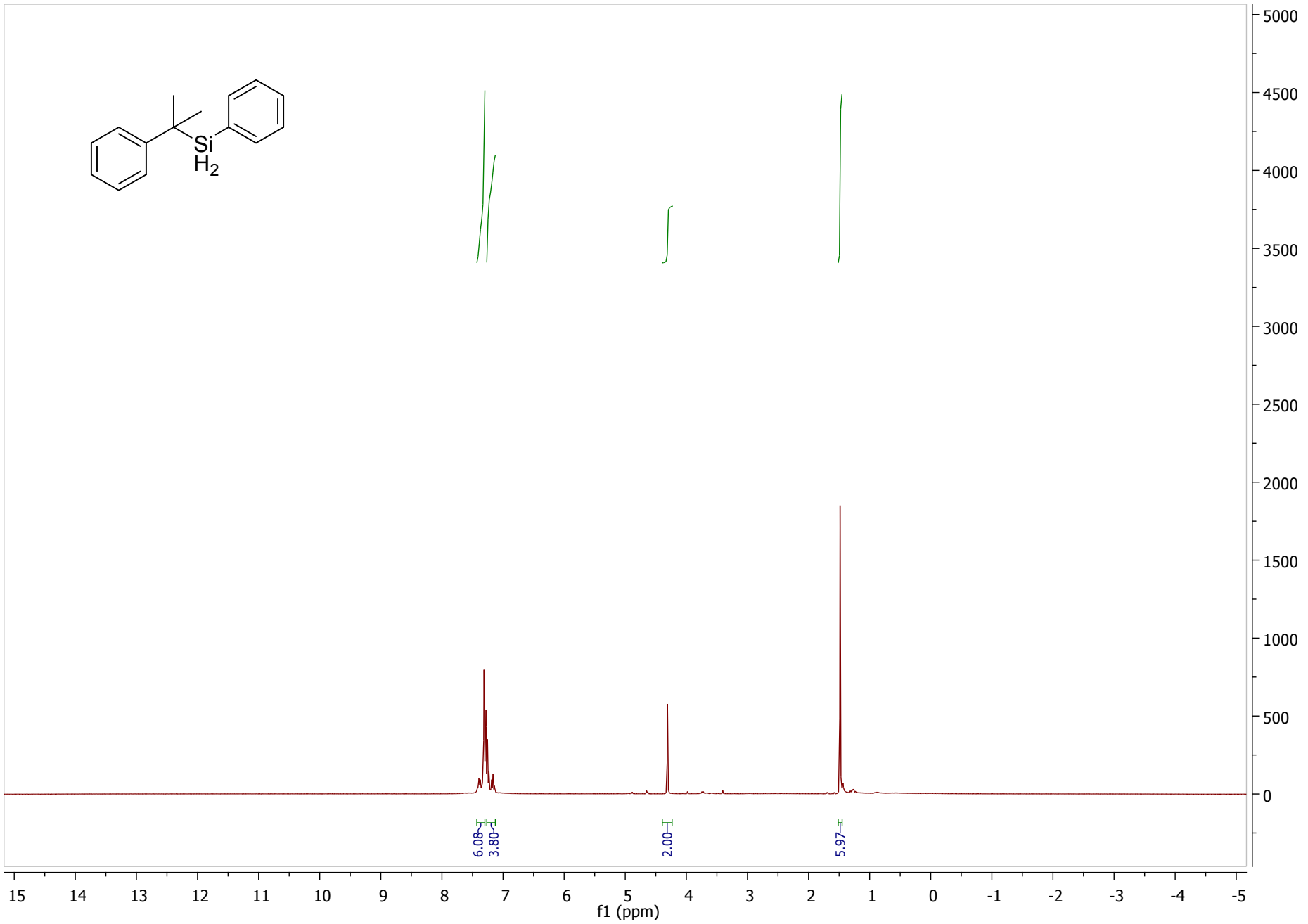

144.61
135.72
131.45
129.82
128.44
127.92
127.19
125.09
25.45
16.44
Si
H2
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

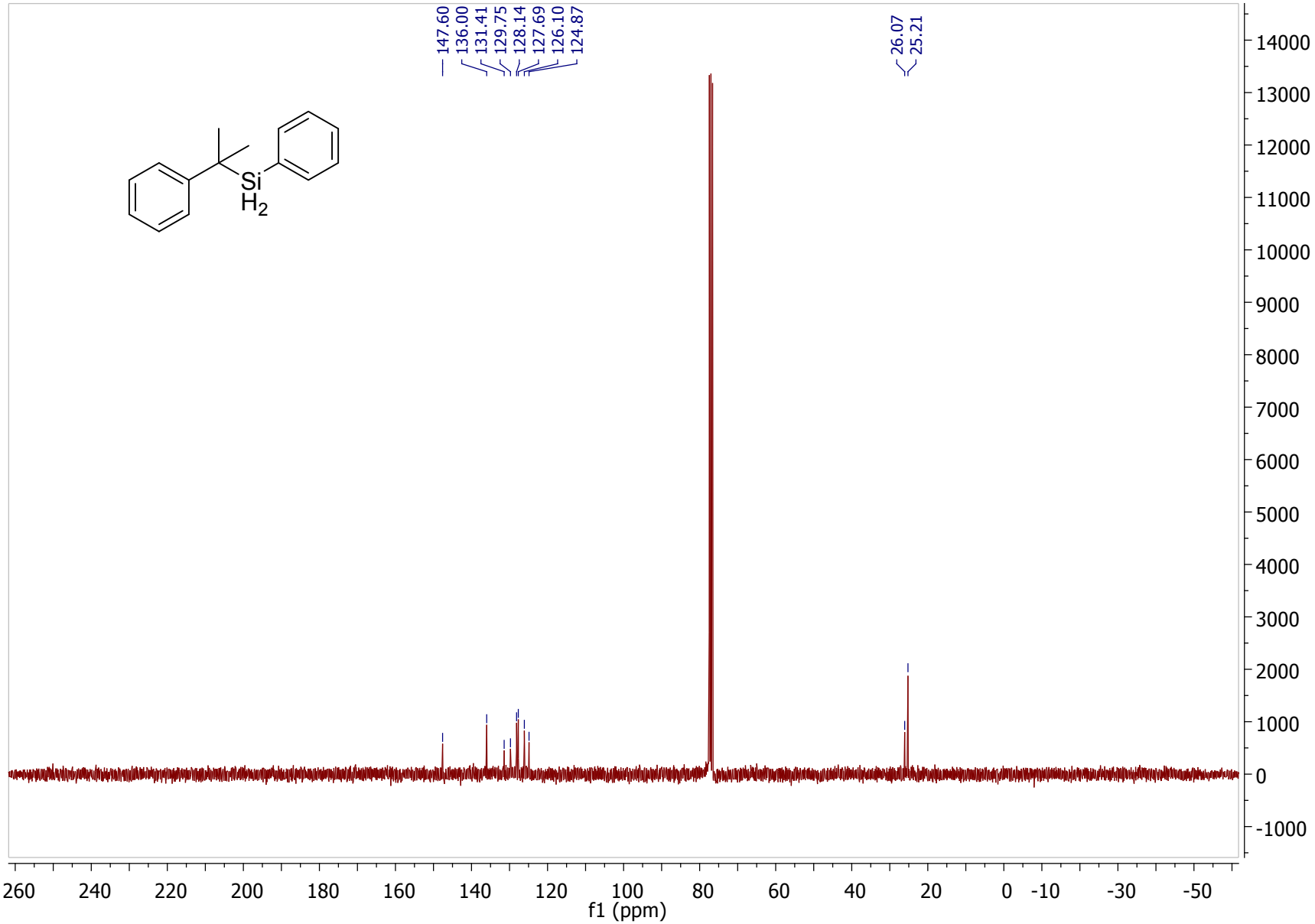

Si
H2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
f2 (ppm)
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
f1 (ppm)

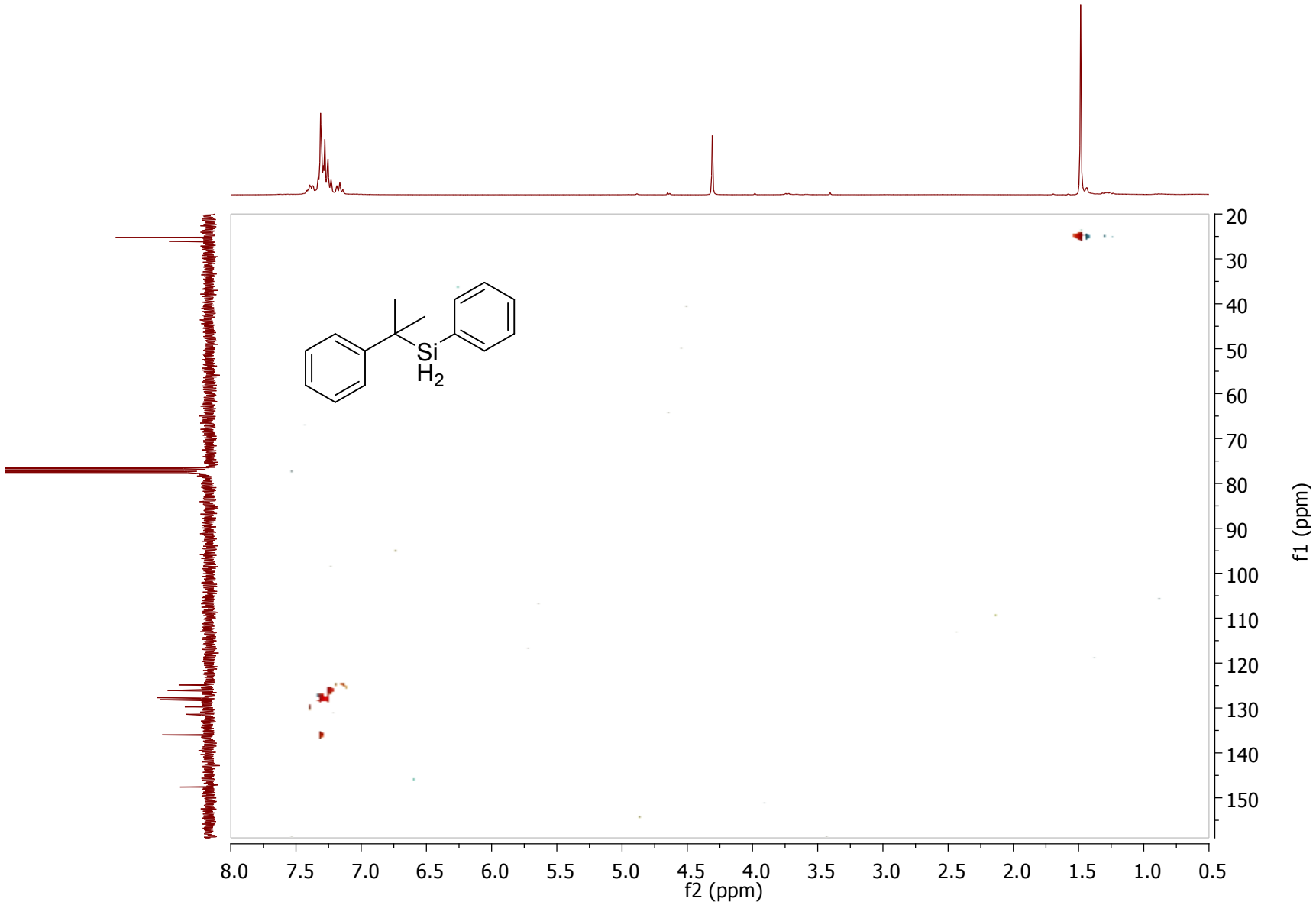

H
Si
15.41
0.98
1.00
2.99
f1 (ppm)

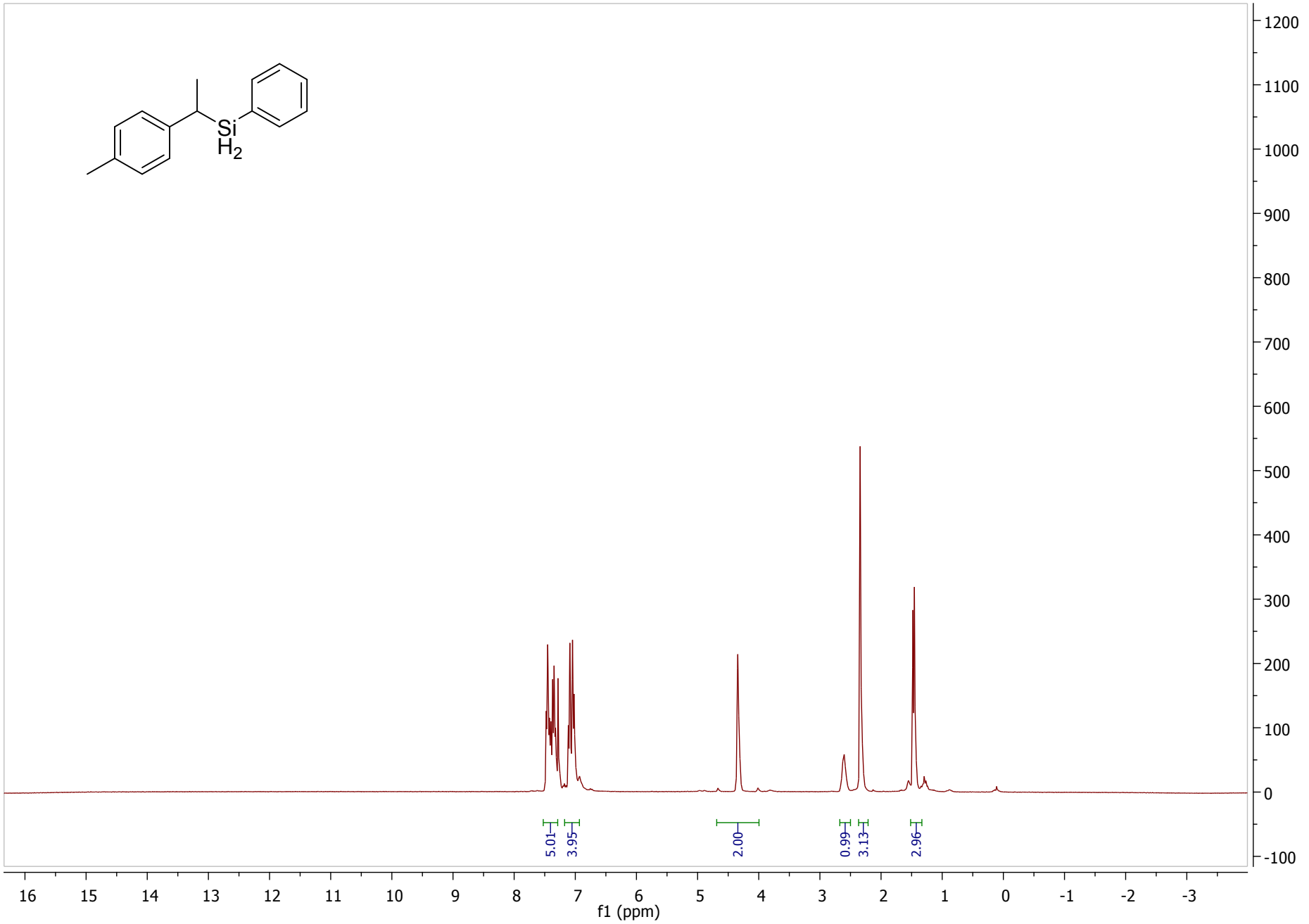

144.45
135.84
135.69
133.14
129.84
129.71
128.30
128.05
127.84
125.05
27.09
16.63
H
Si
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

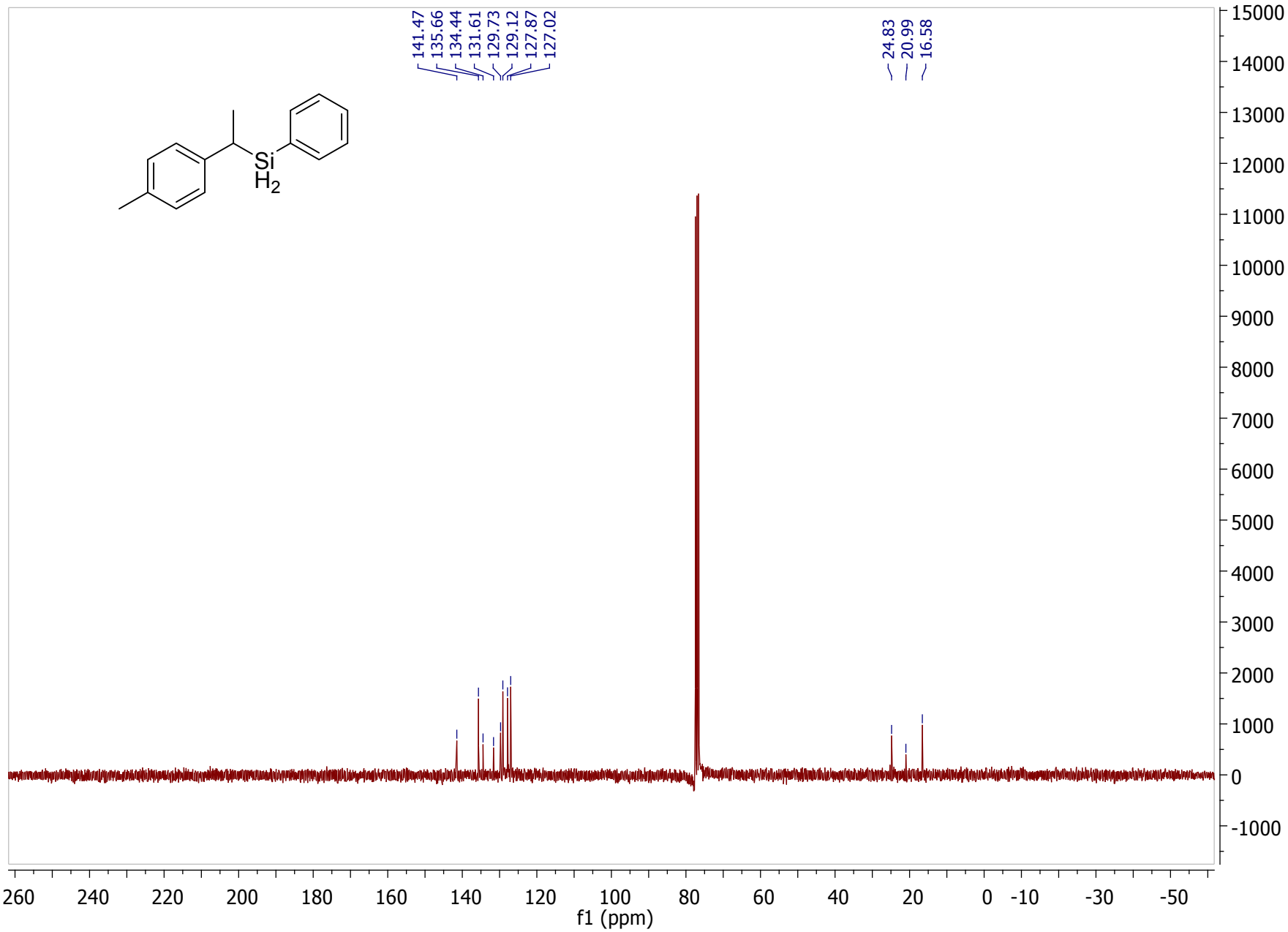

H
Si
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
f2 (ppm)
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
f1 (ppm)

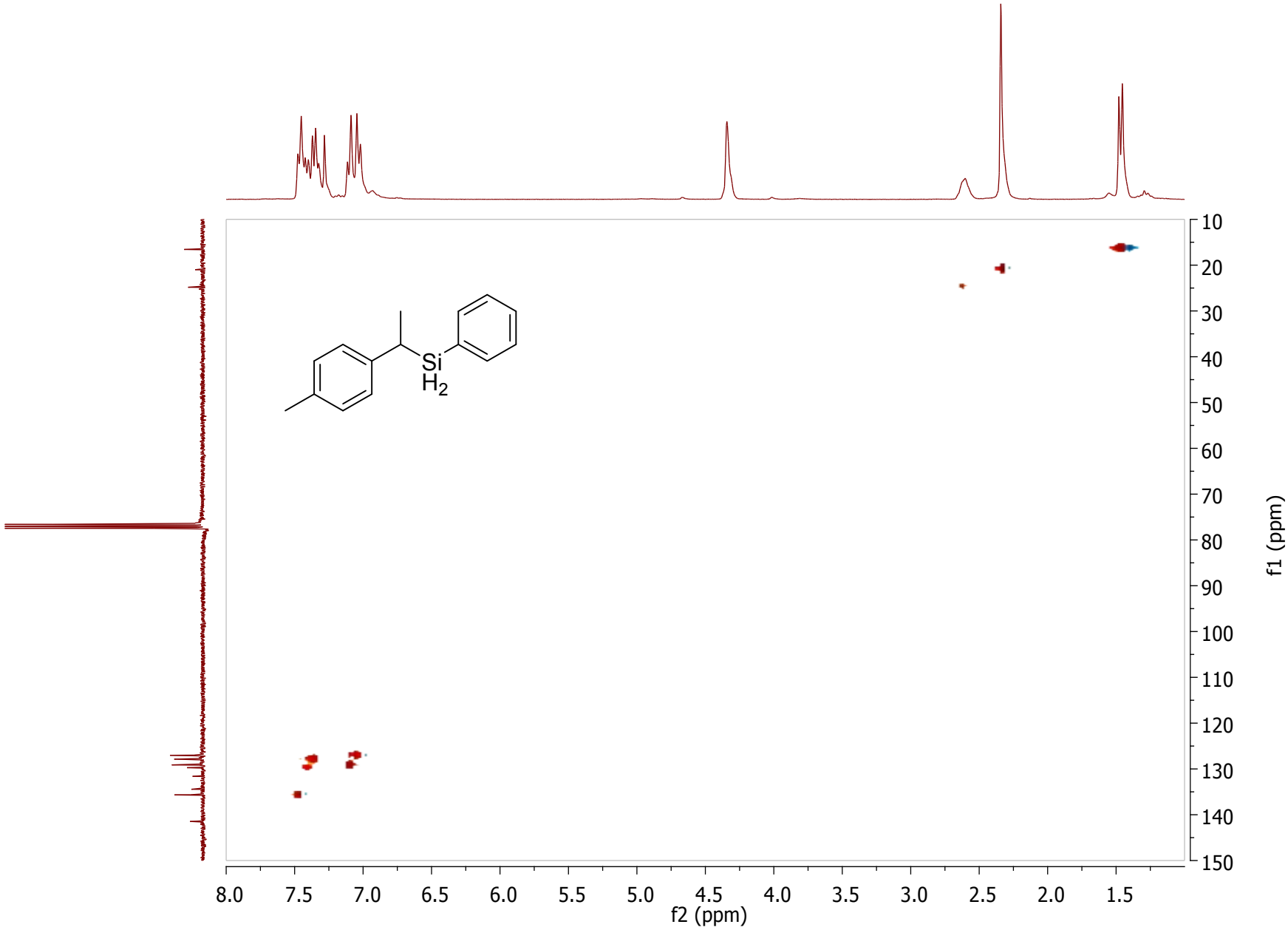

Si
H2
6.08
3.80
2.00
5.97
f1 (ppm)

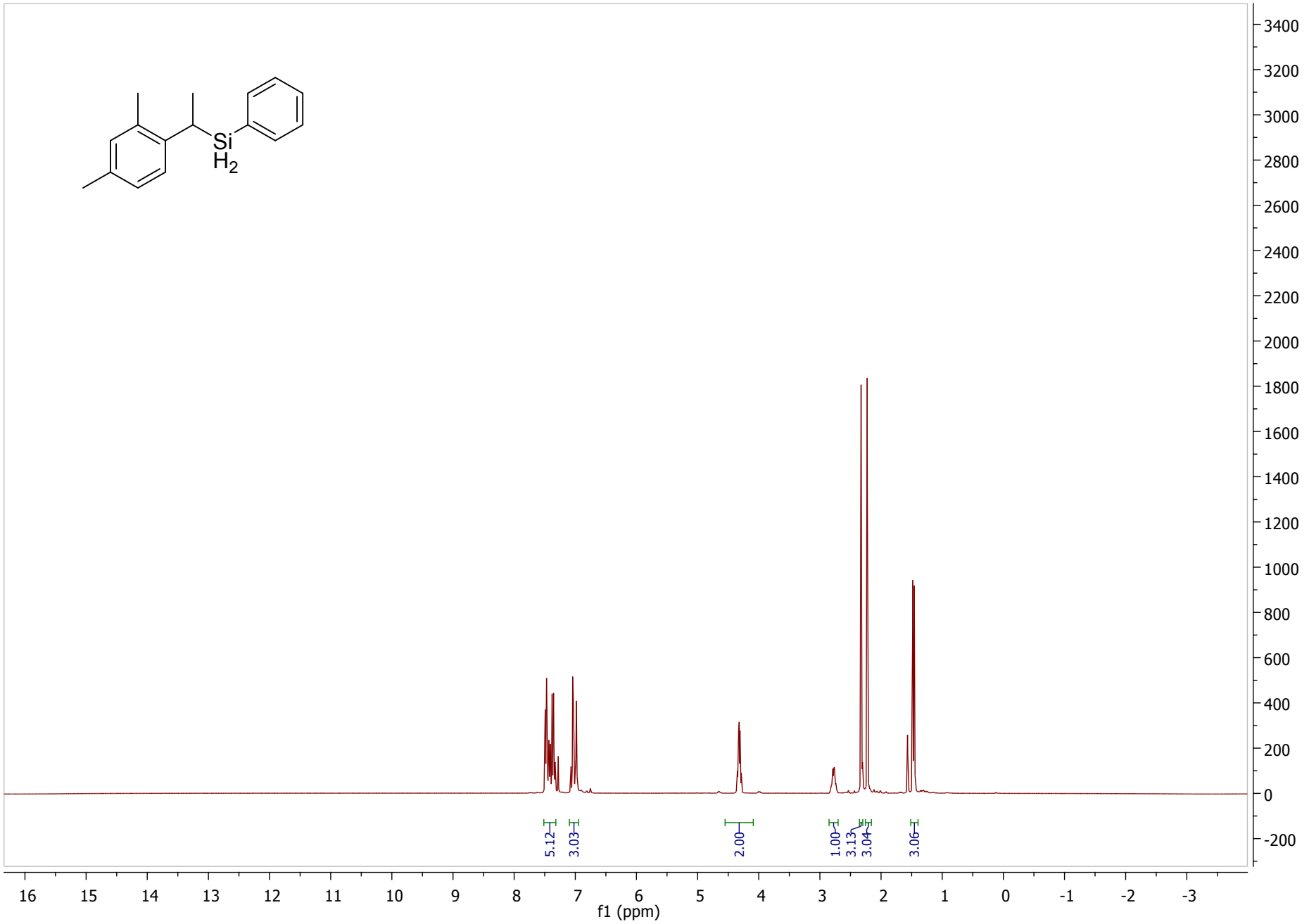

147.60
136.00
131.41
129.75
128.14
127.69
126.10
124.87
26.07
25.21
Si
H2
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

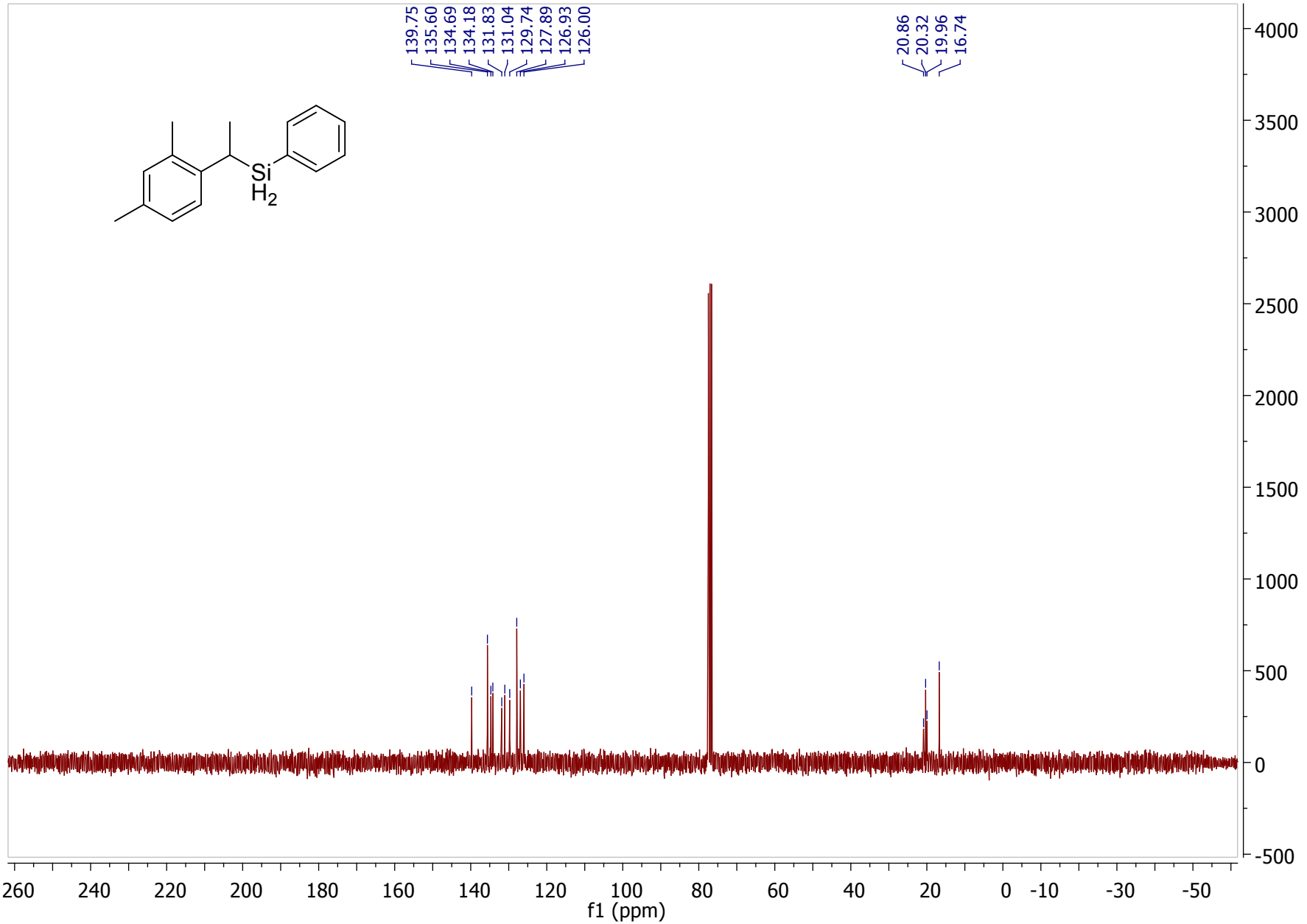

Si
H2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f2 (ppm)
20
30
40
50
60
70
80
90
100
110
120
130
140
150
f1 (ppm)

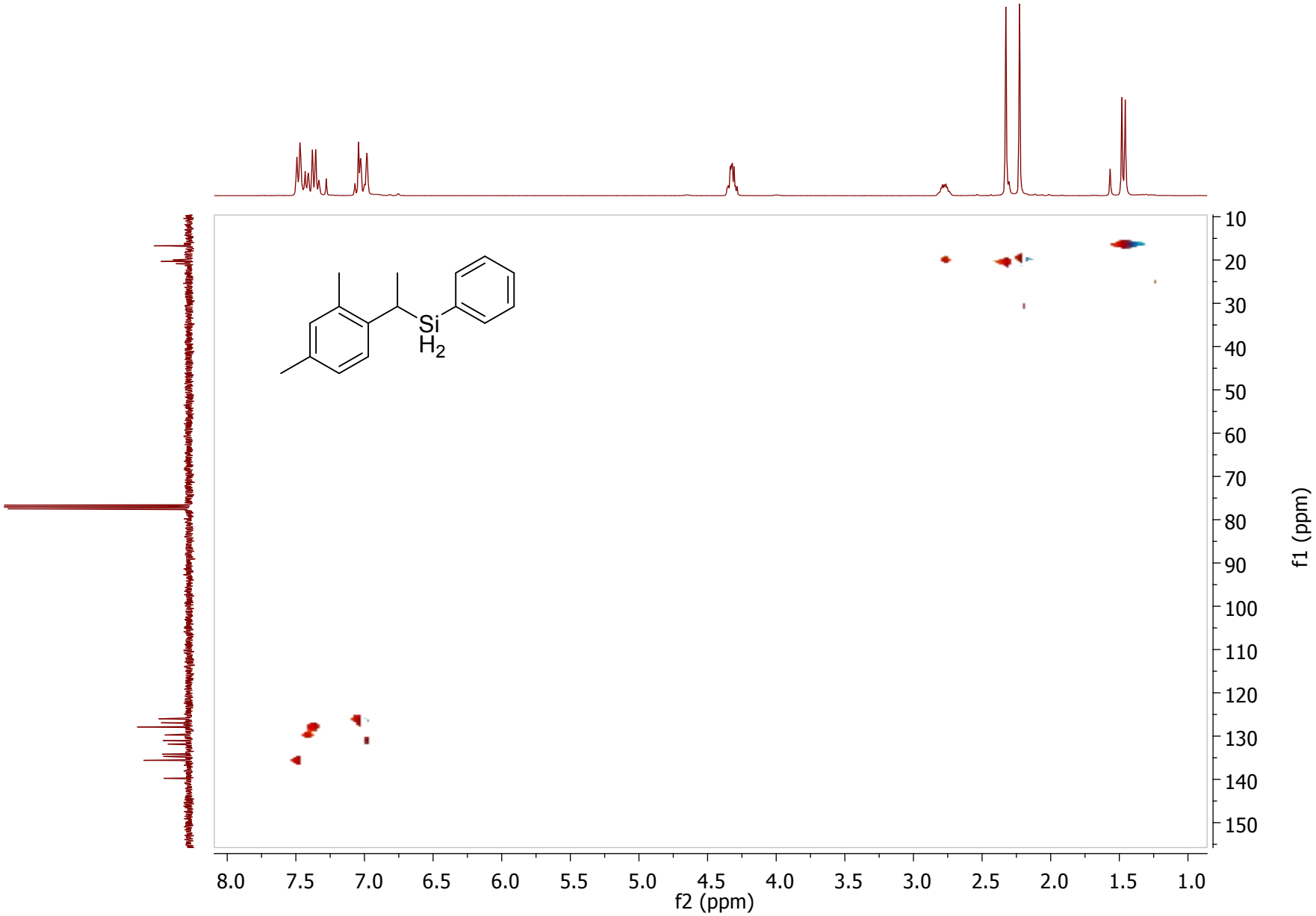

Si
H2
5.01
3.95
2.00
0.99
3.13
2.96
f1 (ppm)

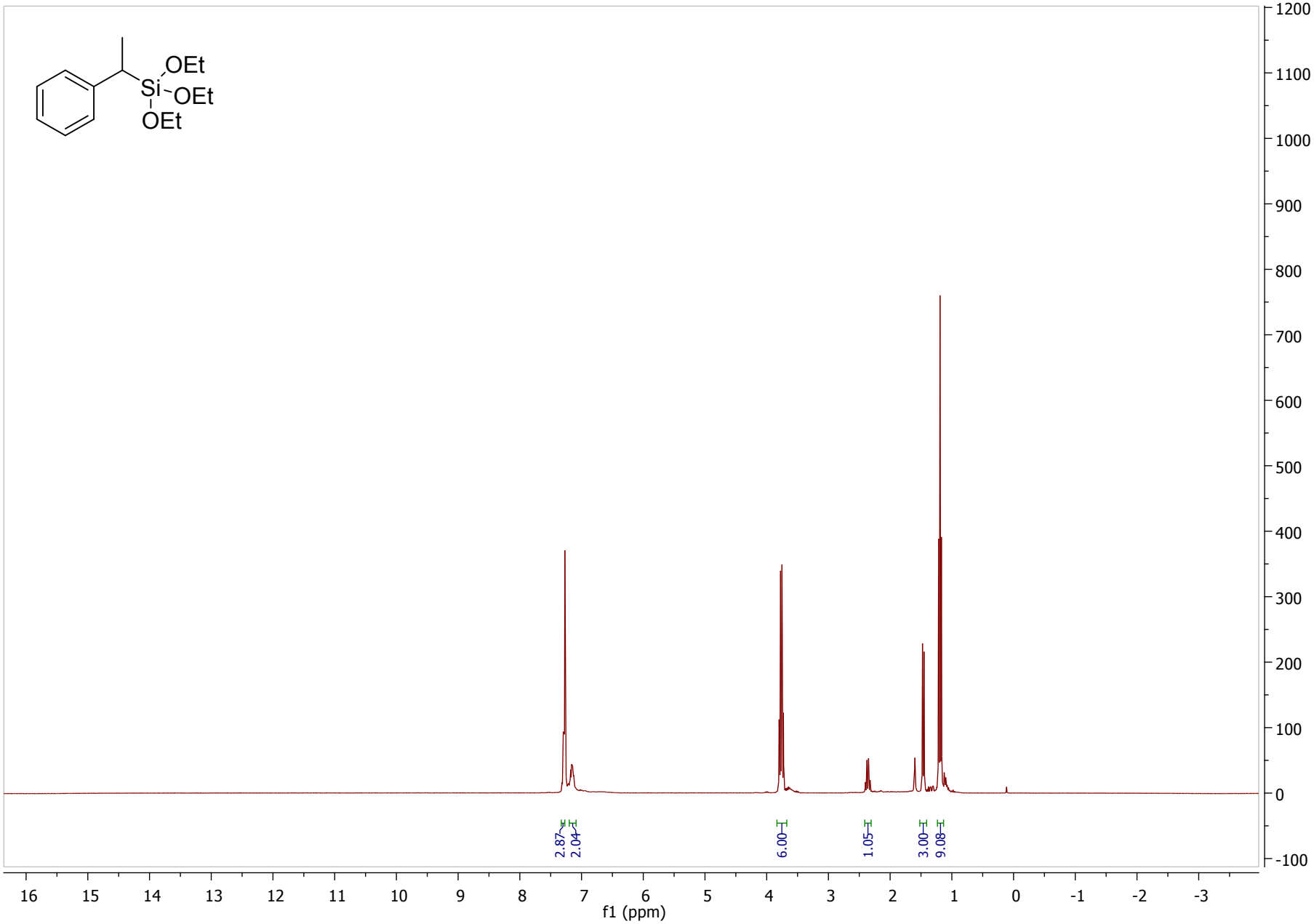

141.47
135.66
134.44
131.61
129.73
129.12
127.87
127.02
24.83
20.99
16.58
Si
H2
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

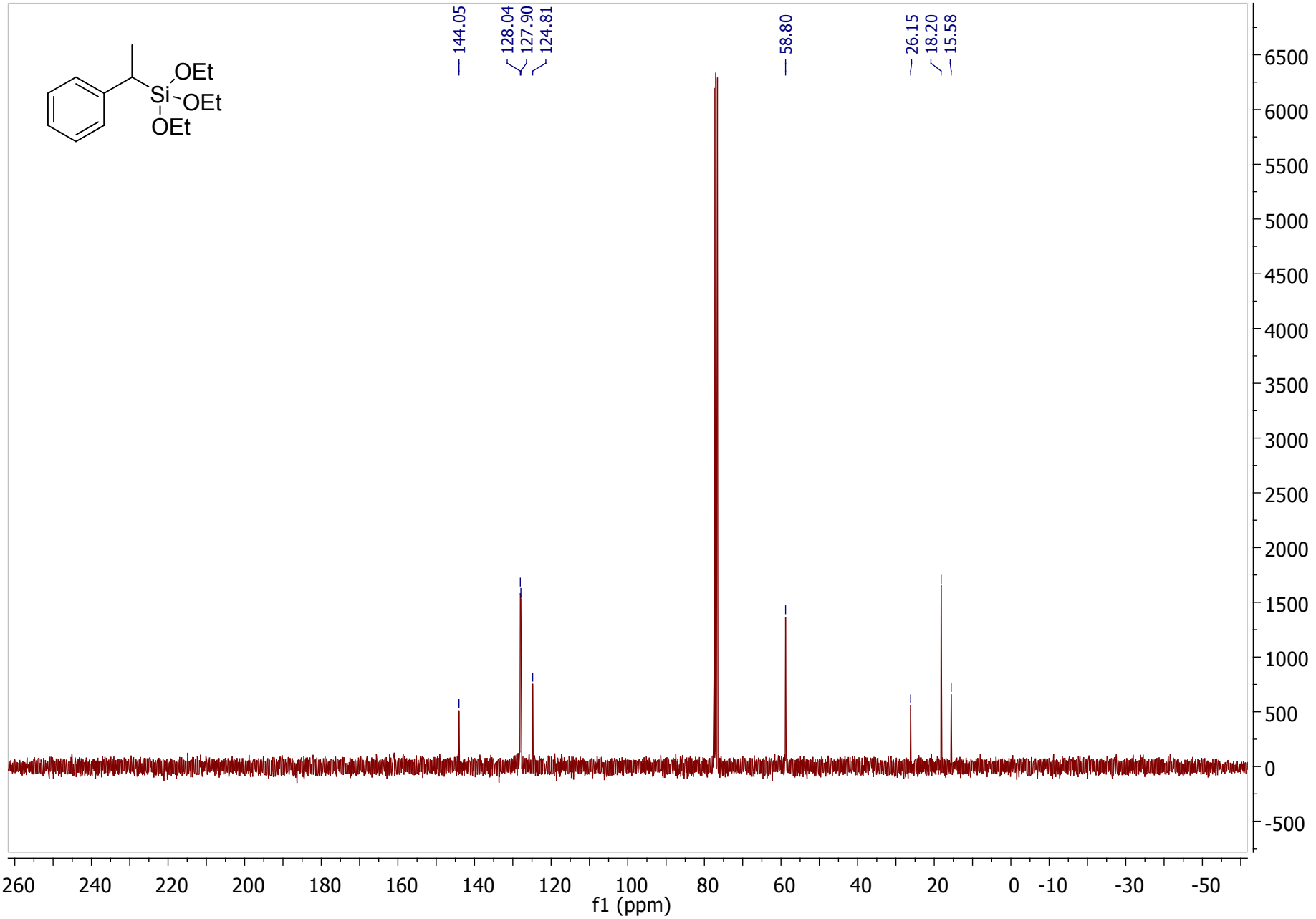

Si
H2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
f2 (ppm)
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
f1 (ppm)

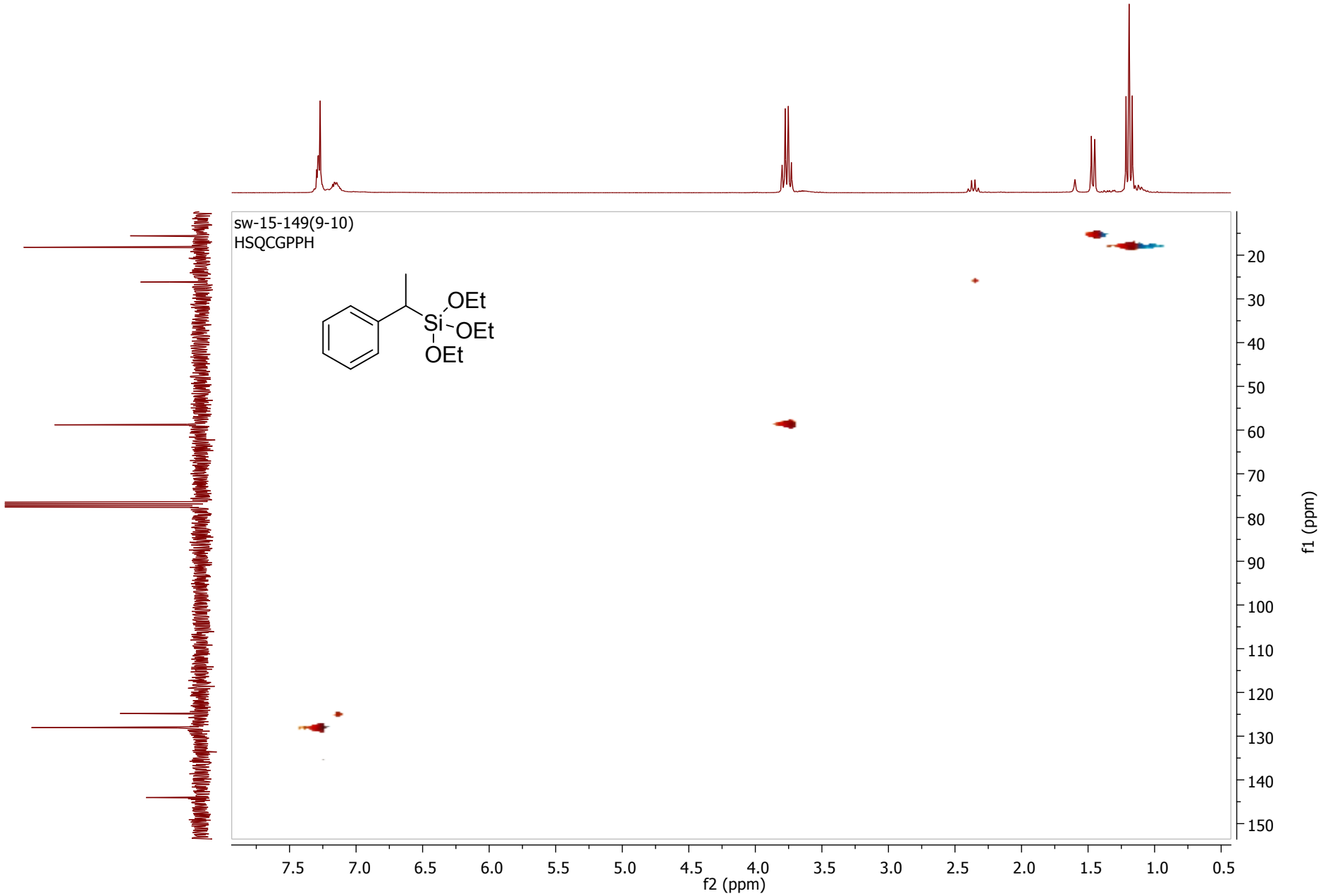

Si
H2
5.12
3.03
2.00
1.00
3.13
3.04
3.06
f1 (ppm)

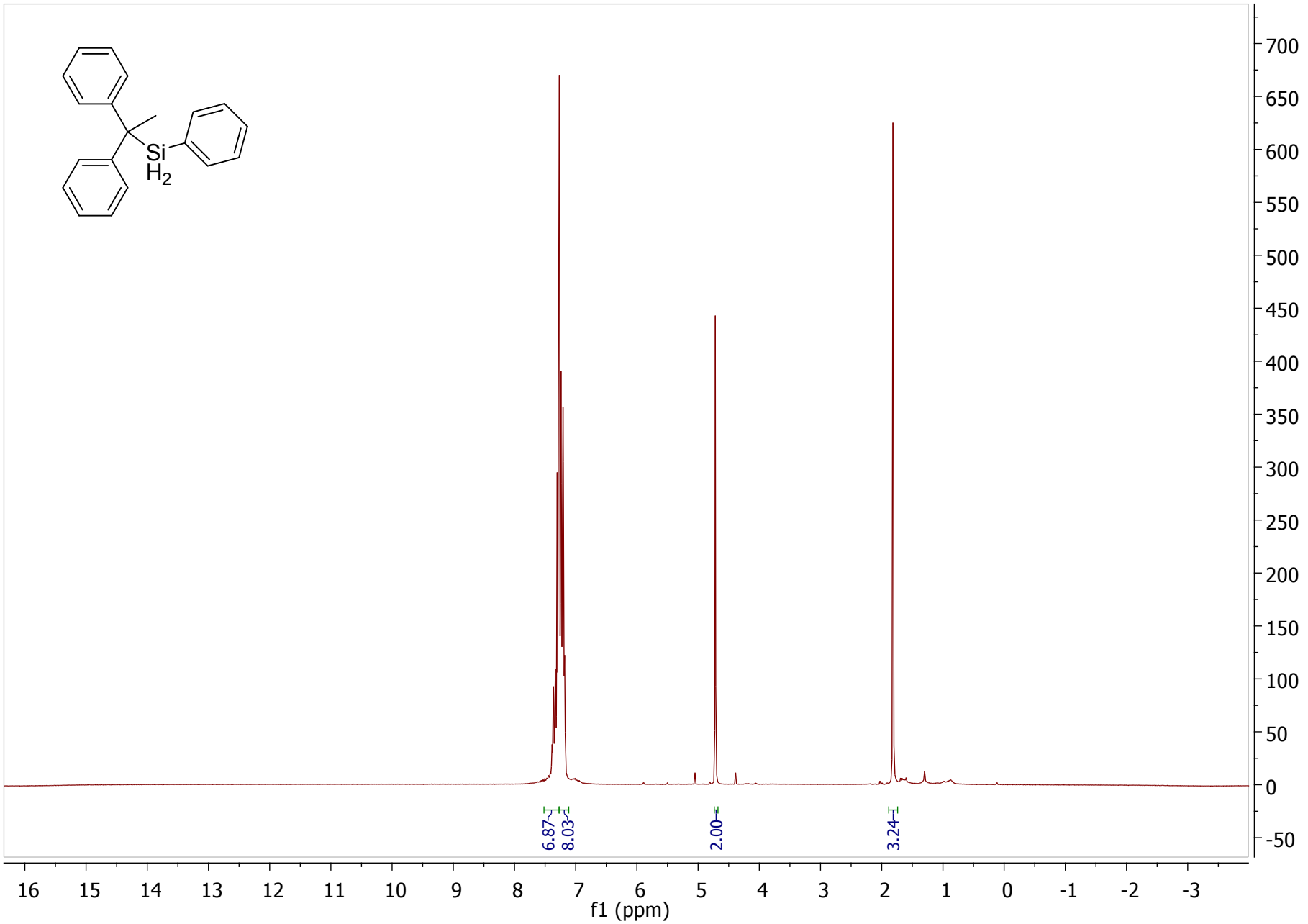

139.75
135.60
134.69
134.18
131.83
131.04
129.74
127.89
126.93
126.00
20.86
20.32
19.96
16.74
Si
H2
4000
3500
3000
2500
2000
1500
1000
500
0
-500
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)


Si
H2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
f2 (ppm)
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
f1 (ppm)


OEt
Si
OEt
OEt
2.87
2.04
6.00
1.05
3.00
9.08
f1 (ppm)


144.05
128.04
127.90
124.81
58.80
26.15
18.20
15.58
OEt
Si
OEt
OEt
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)


sw-15-149(9-10)
HSQCGPPH
OEt
Si
OEt
OEt
f2 (ppm)
f1 (ppm)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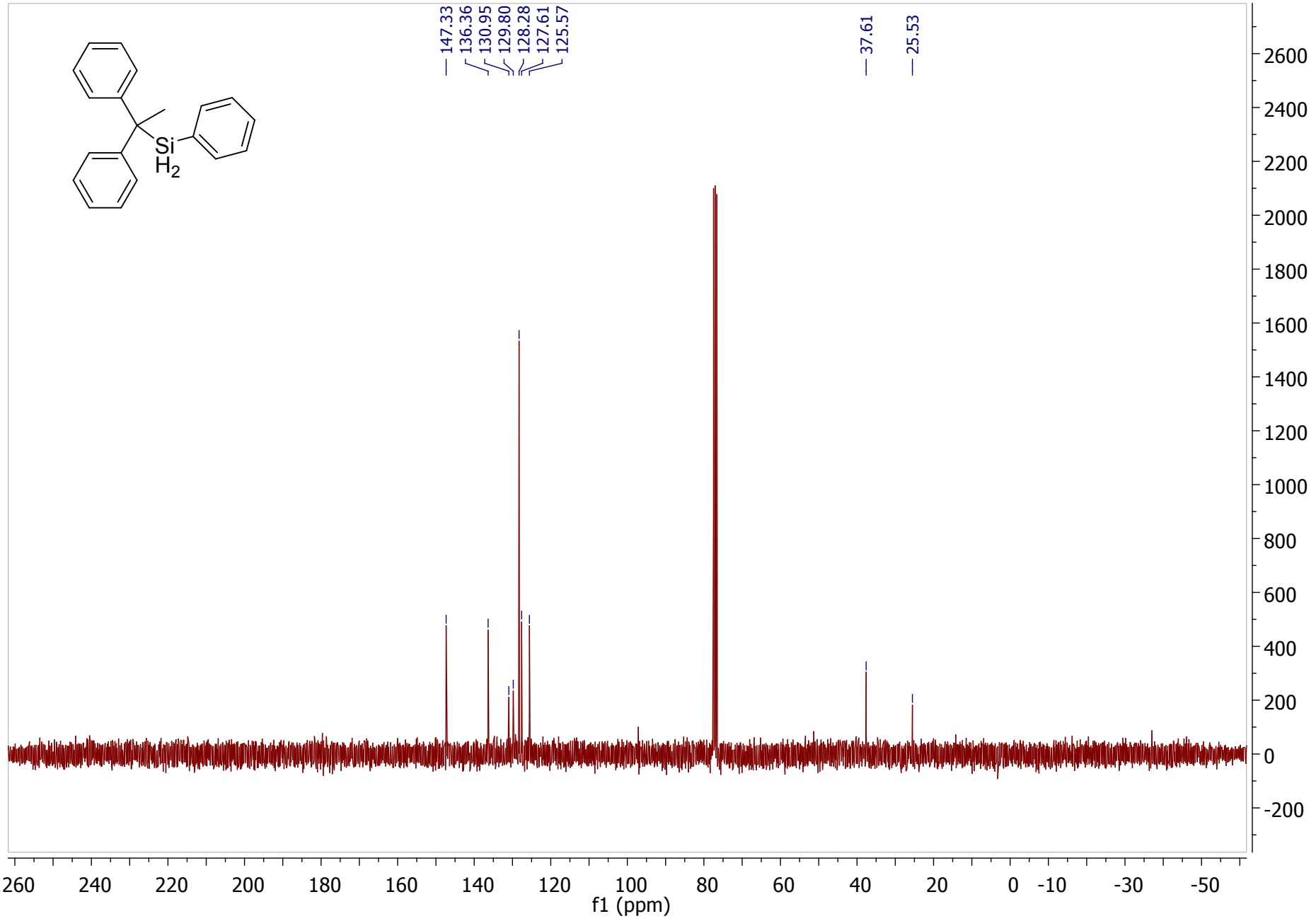
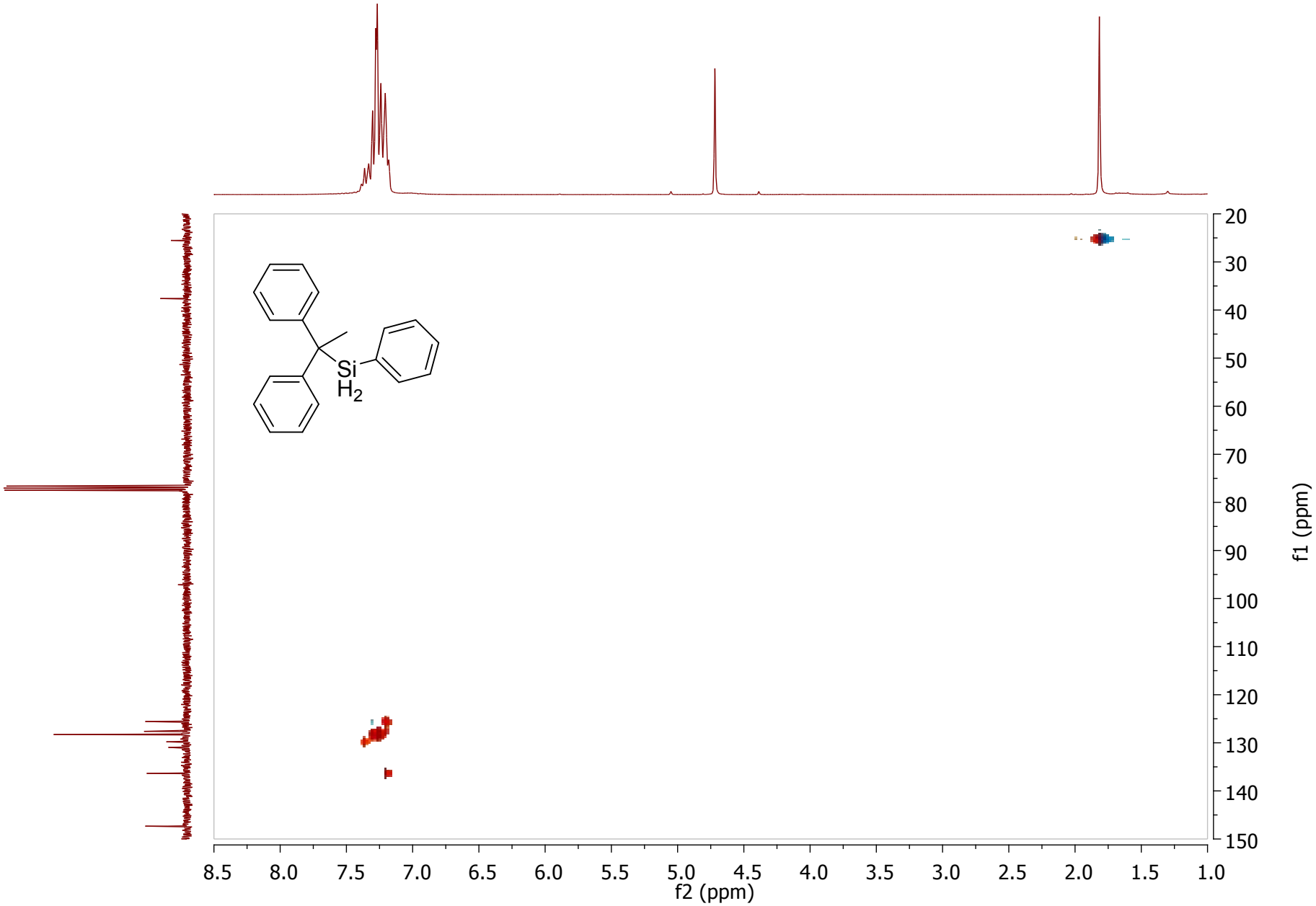
H2
6.87
8.03
2.00
3.24
f1 (ppm)


147.33
136.36
130.95
129.80
128.28
127.61
125.57
37.61
25.53
Si
H2
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)


Si
H2
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8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
f2 (ppm)
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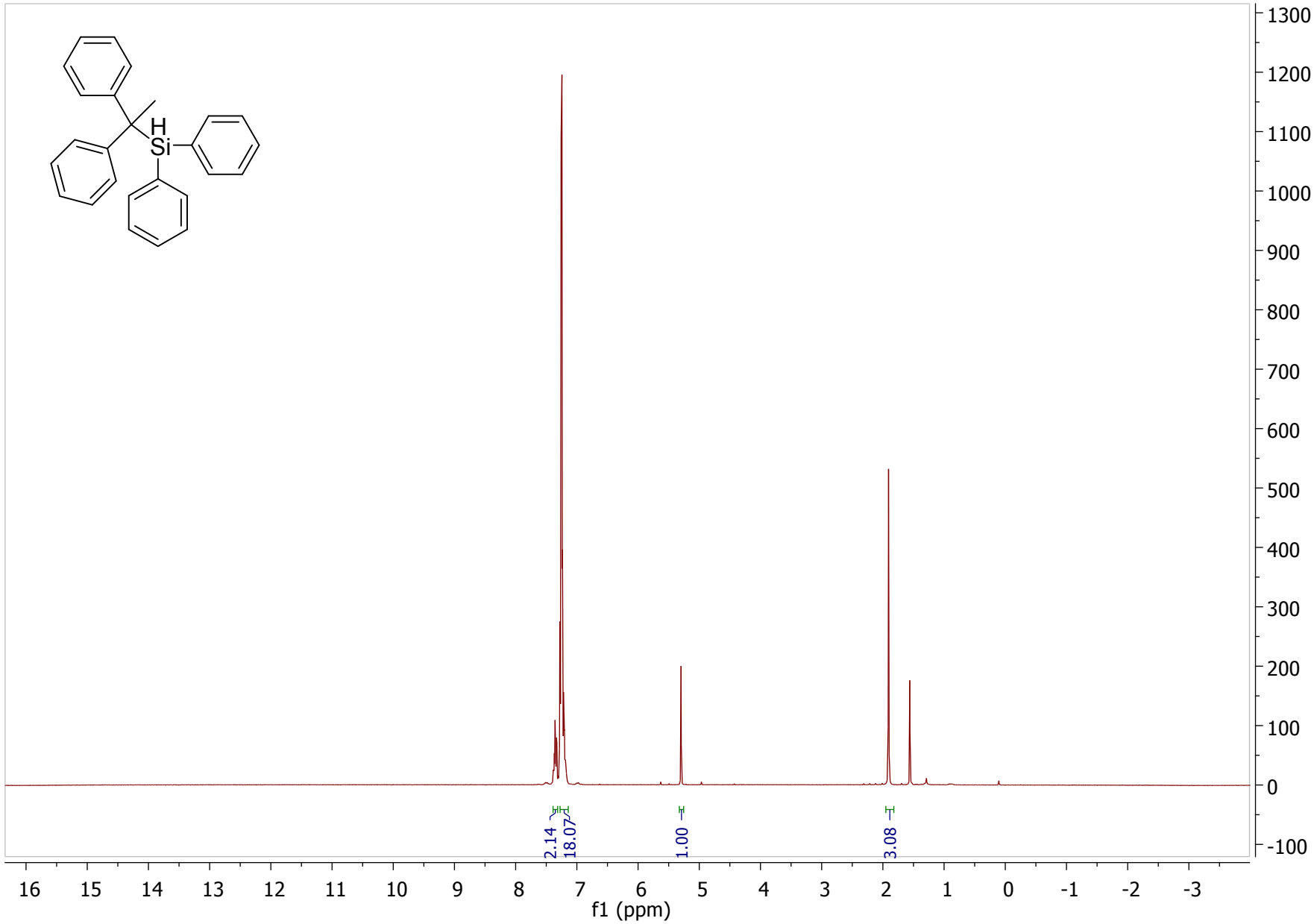
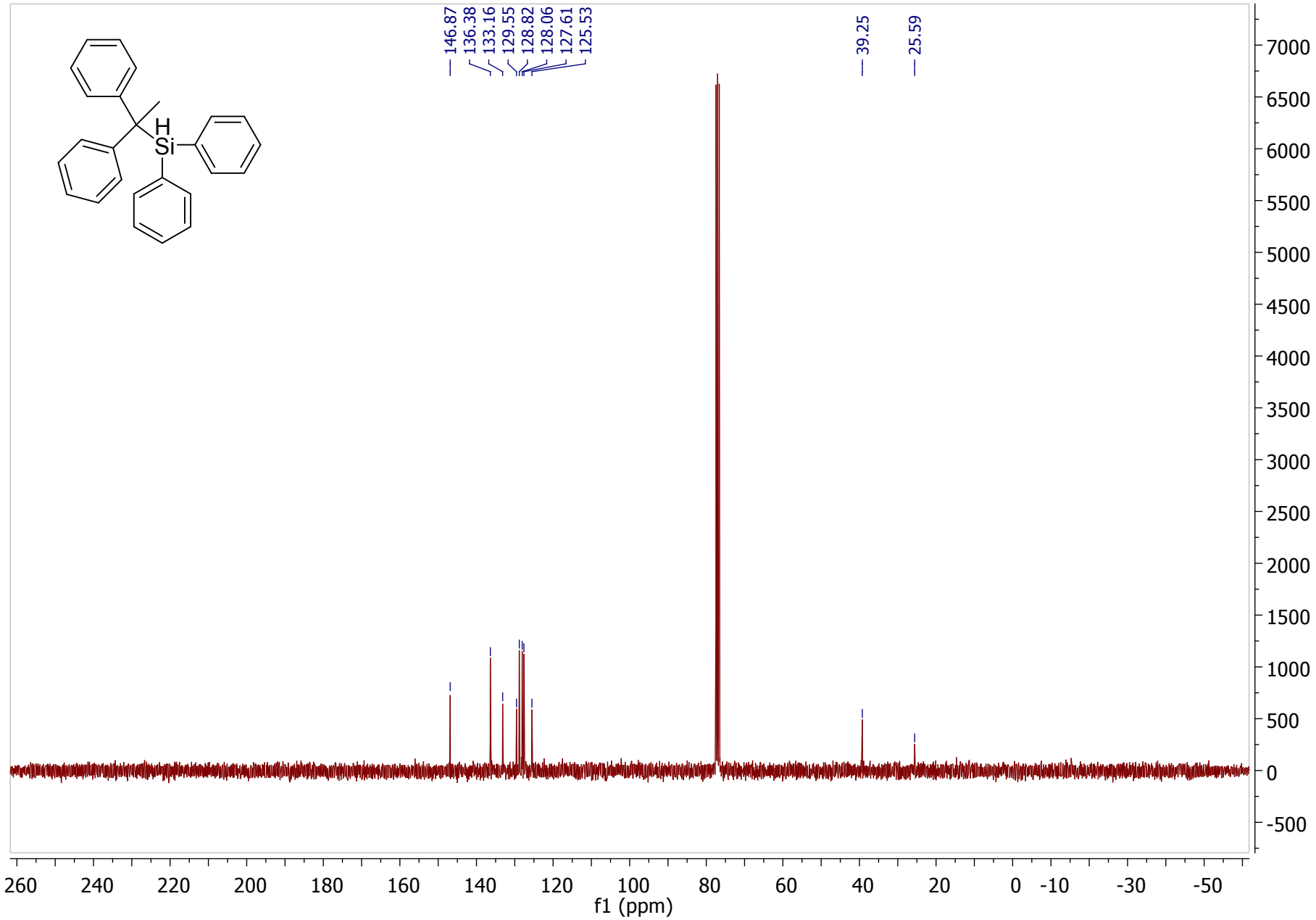
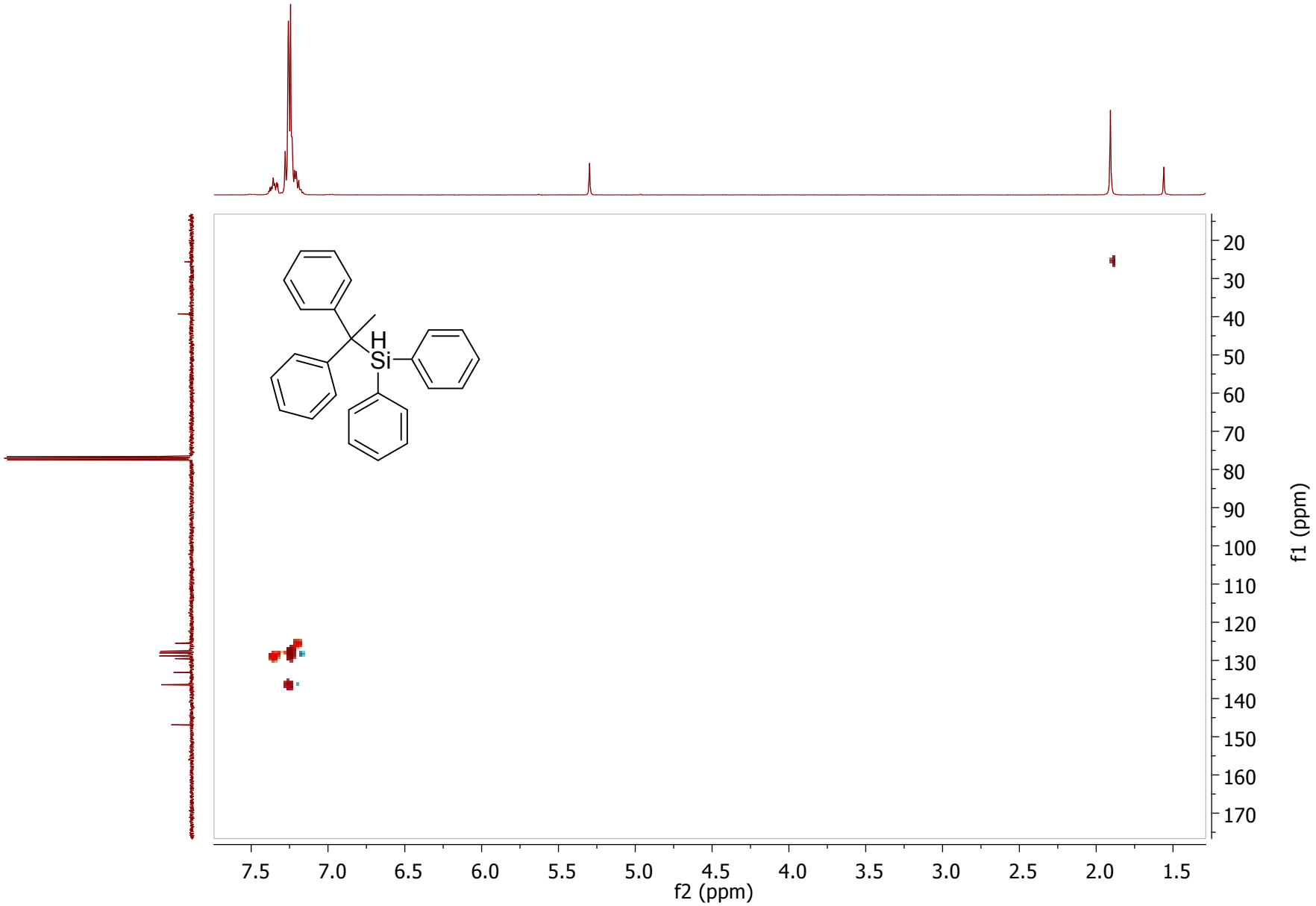
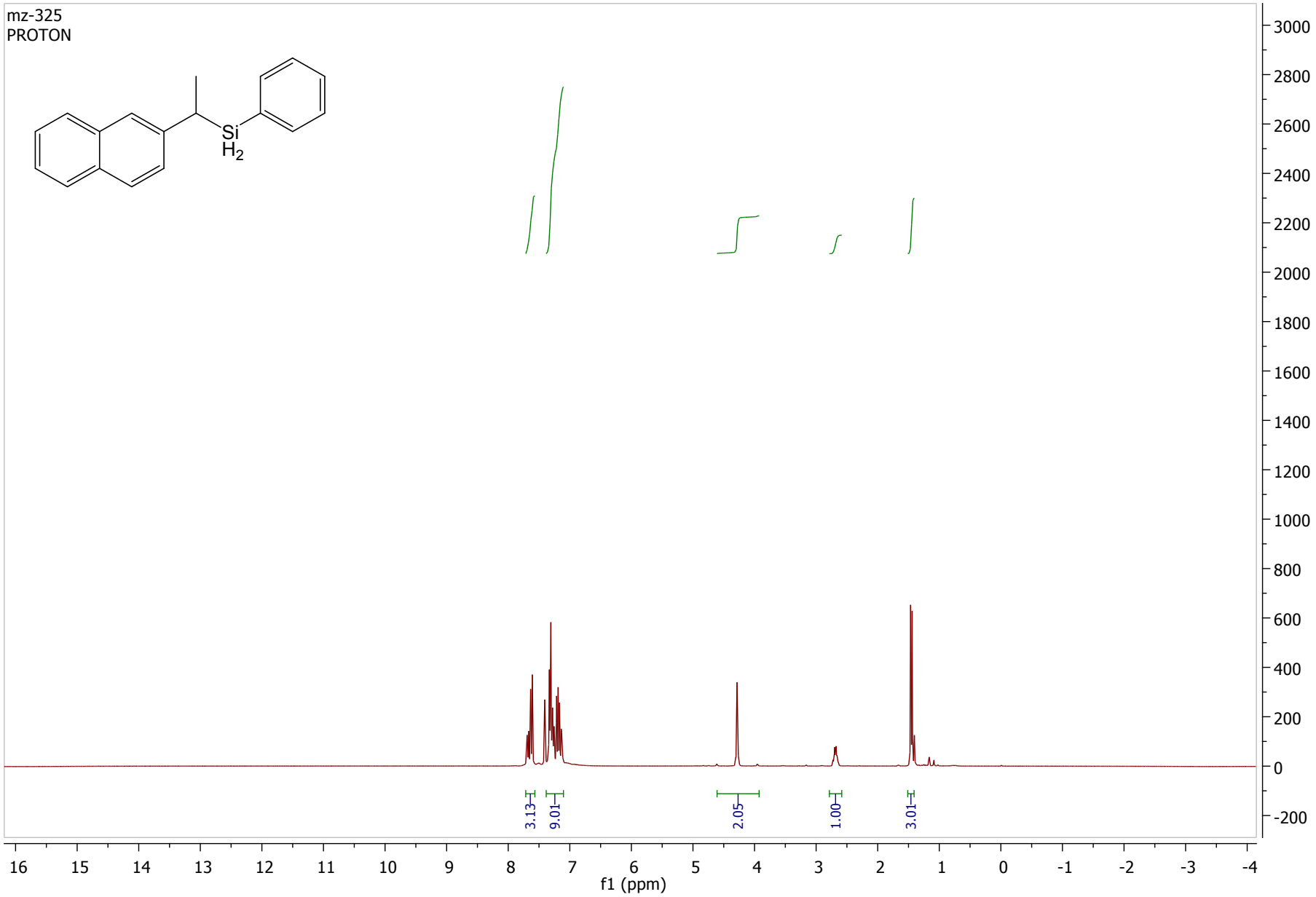
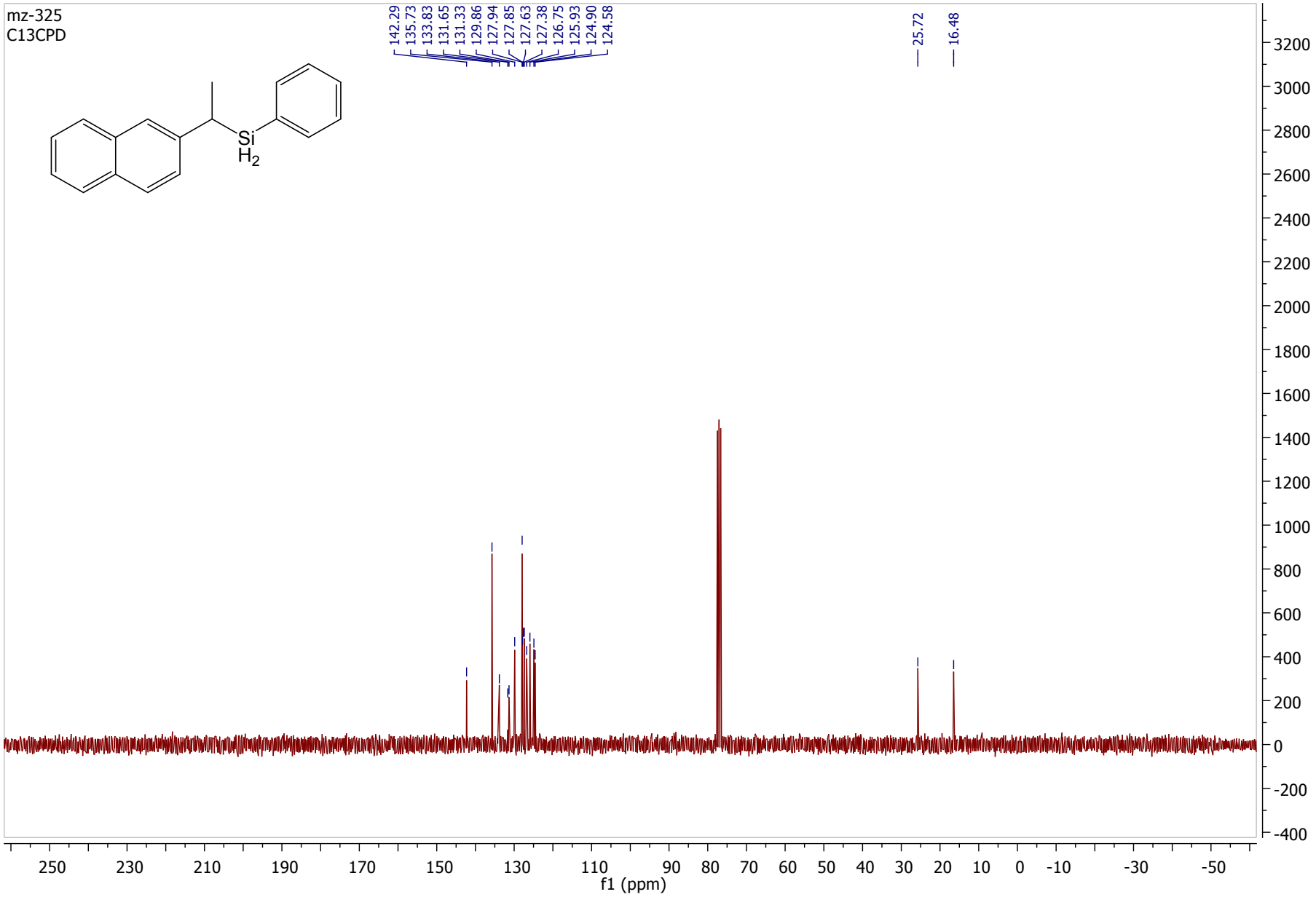
30
40
50
60
70
80
90
100
110
120
130
140
150
f1 (ppm)

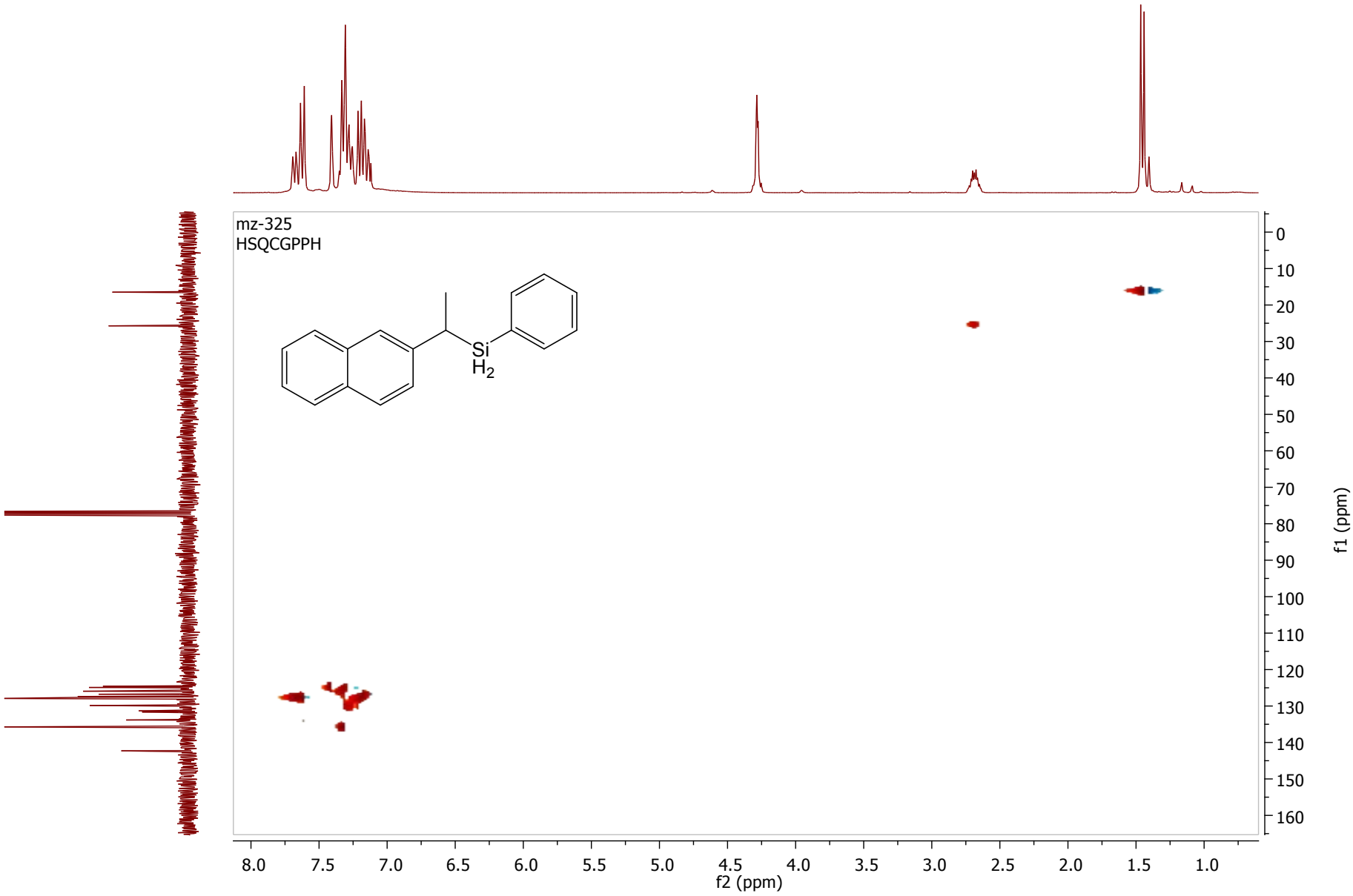

H
Si
2.14
18.07
1.00
3.08
f1 (ppm)

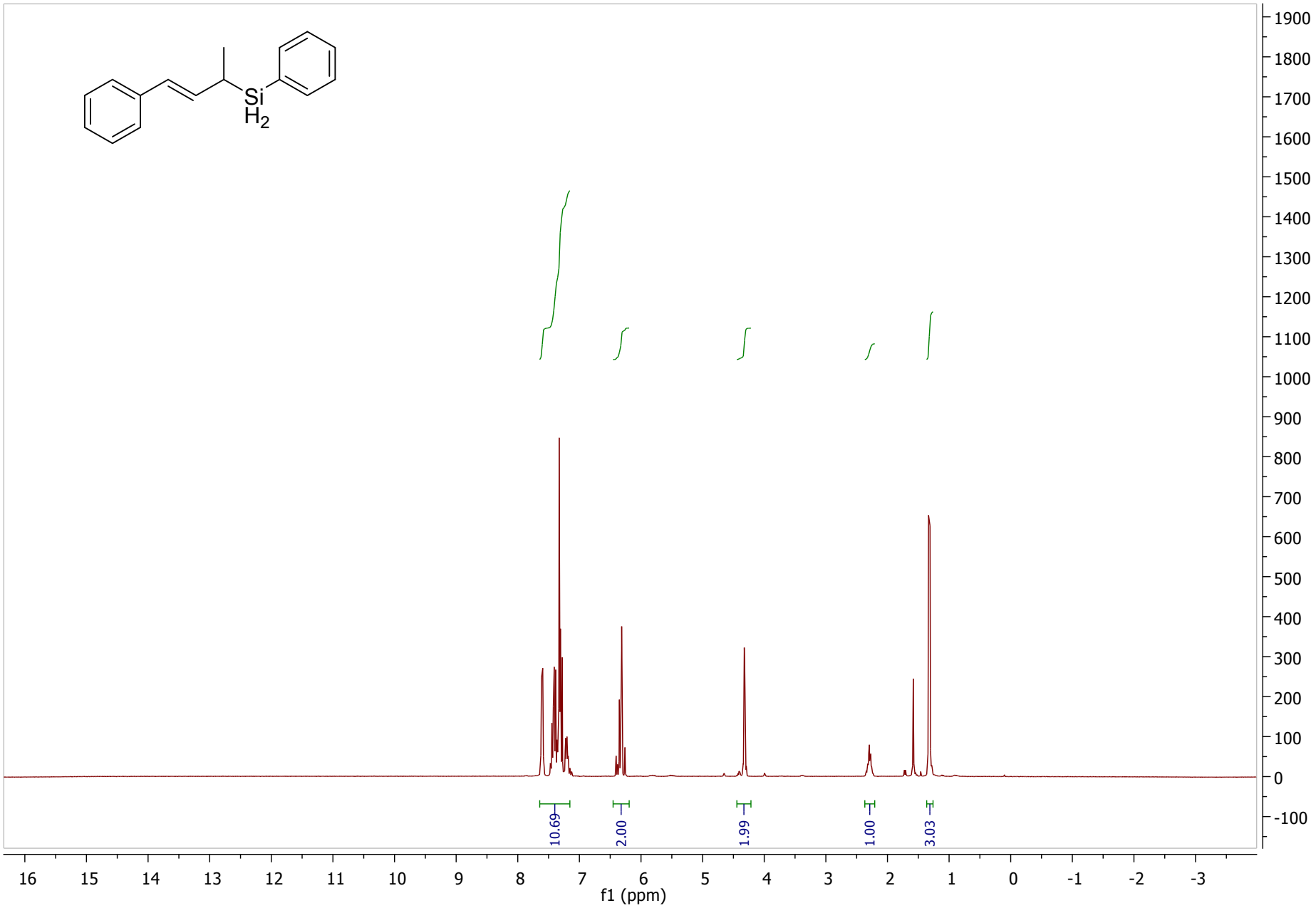

146.87
136.38
133.16
129.55
128.82
128.06
127.61
125.53
39.25
25.59
H
Si
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

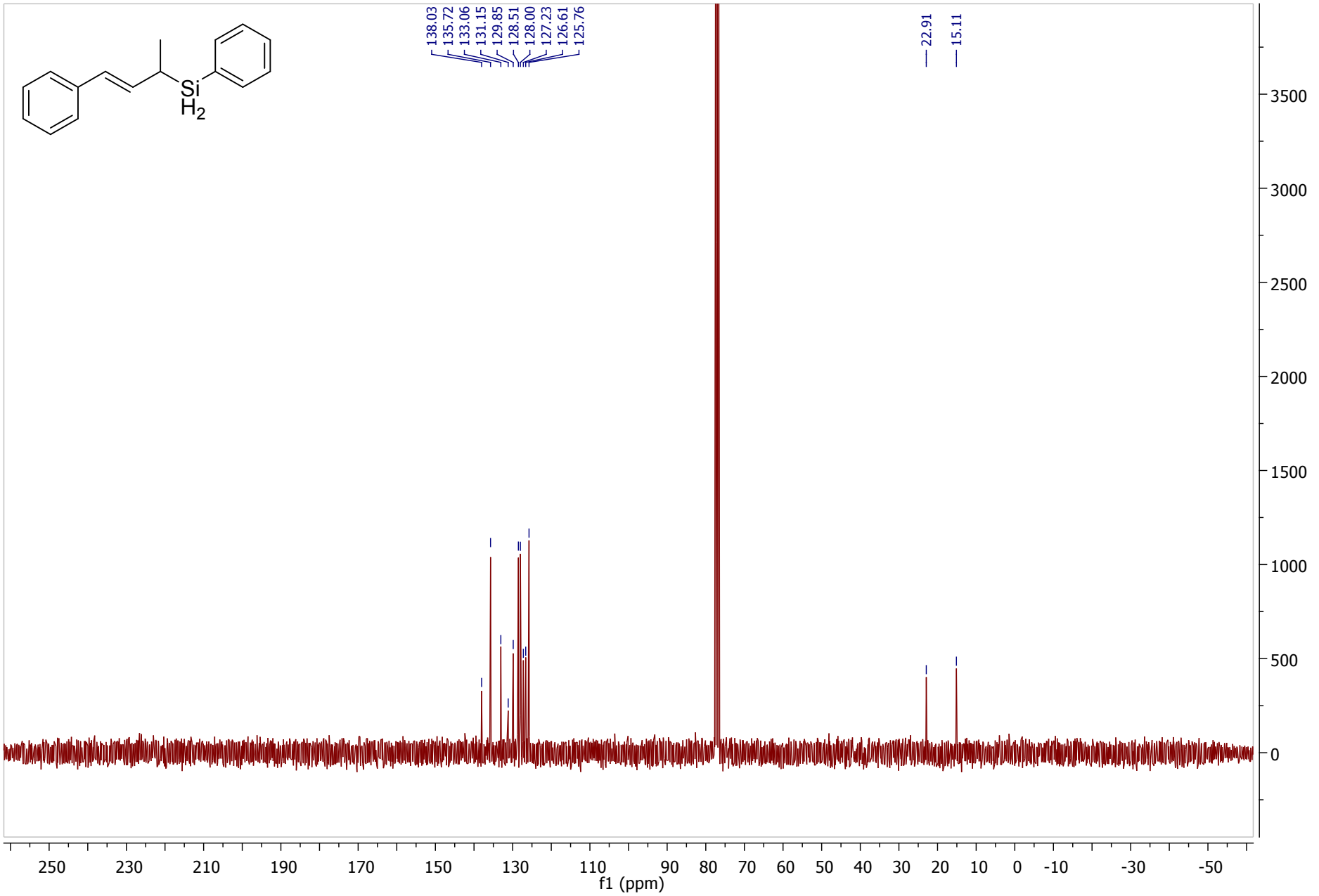

H
Si
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
f2 (ppm)
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
f1 (ppm)

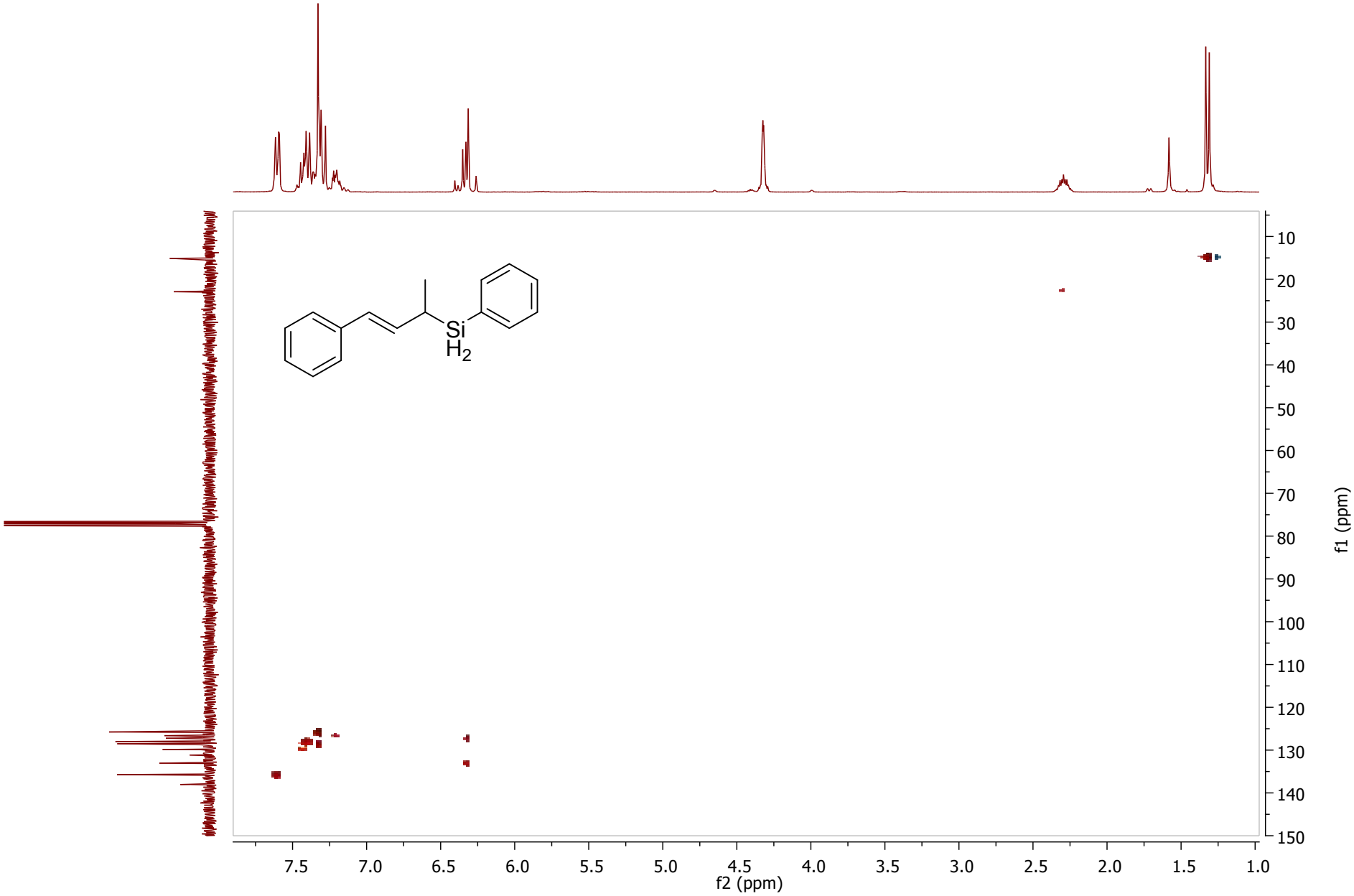

mz-325
PROTON
Si
H2
3.13
9.01
2.05
1.00
3.01
f1 (ppm)

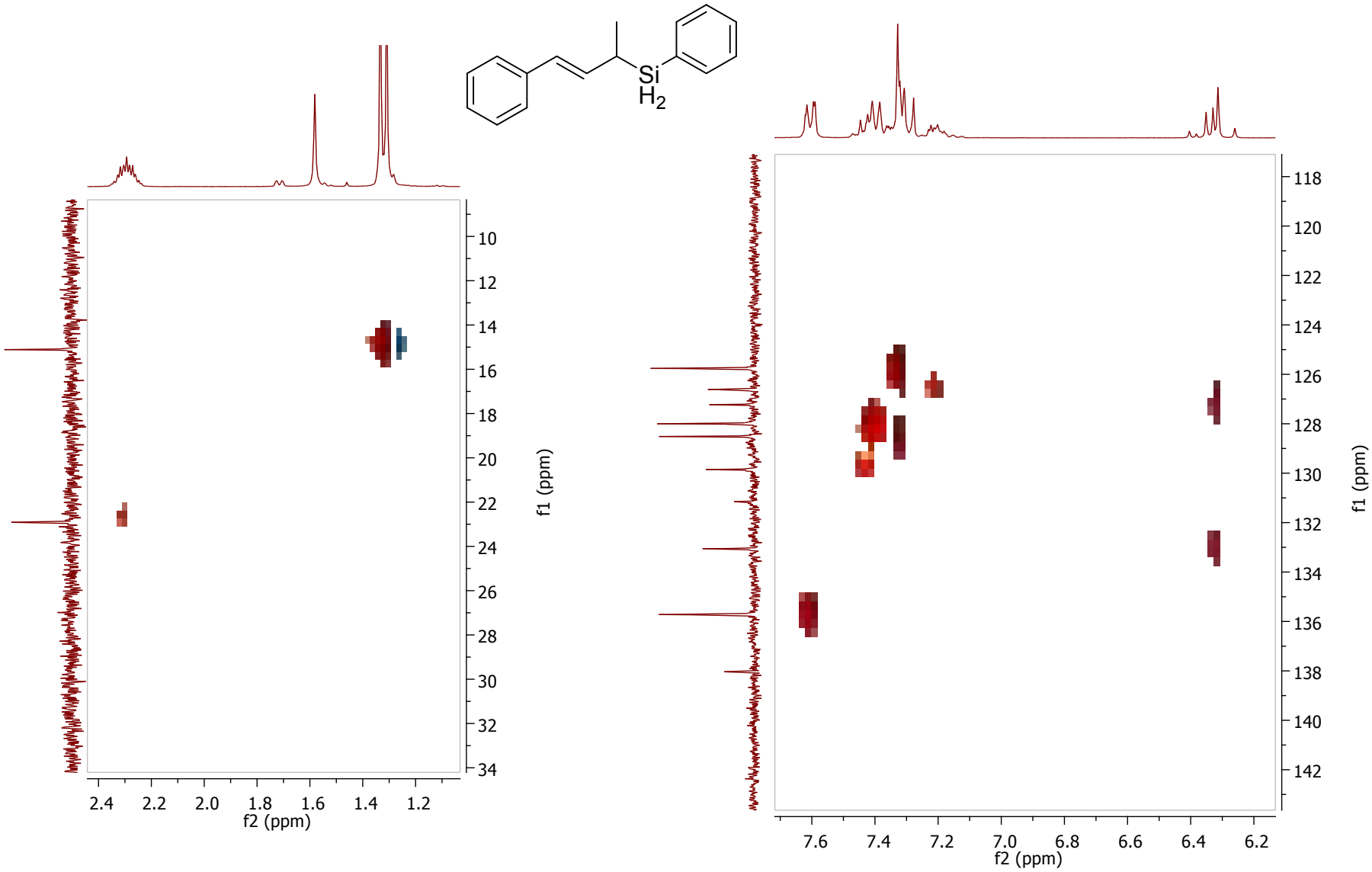

mz-325
C13CPD
142.29
135.73
133.83
131.65
131.33
129.86
127.94
127.85
127.63
127.38
126.75
125.93
124.90
124.58
25.72
16.48
Si
H2
f1 (ppm)

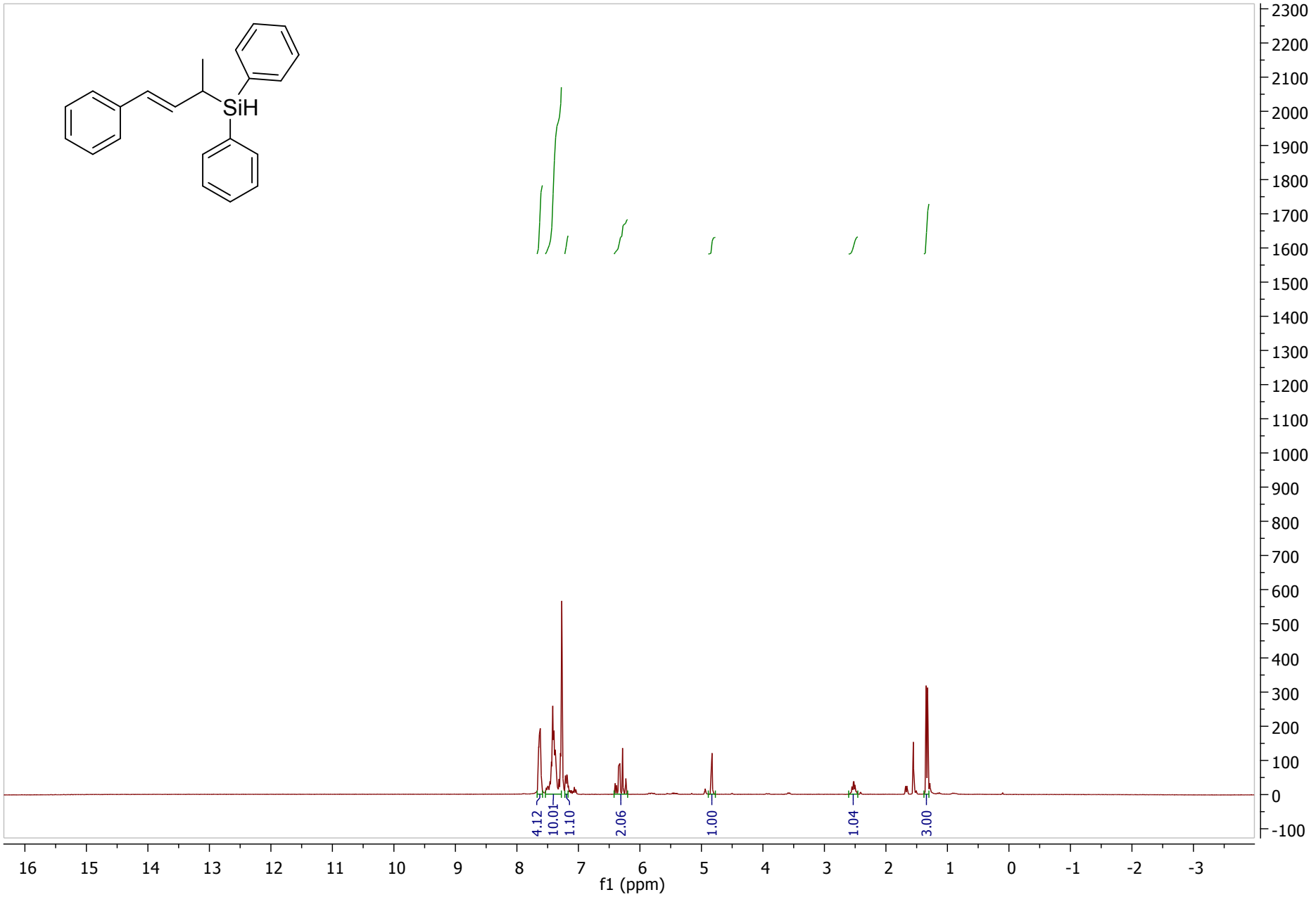

mz-325
HSQCGPPH
Si
H2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
f2 (ppm)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
f1 (ppm)

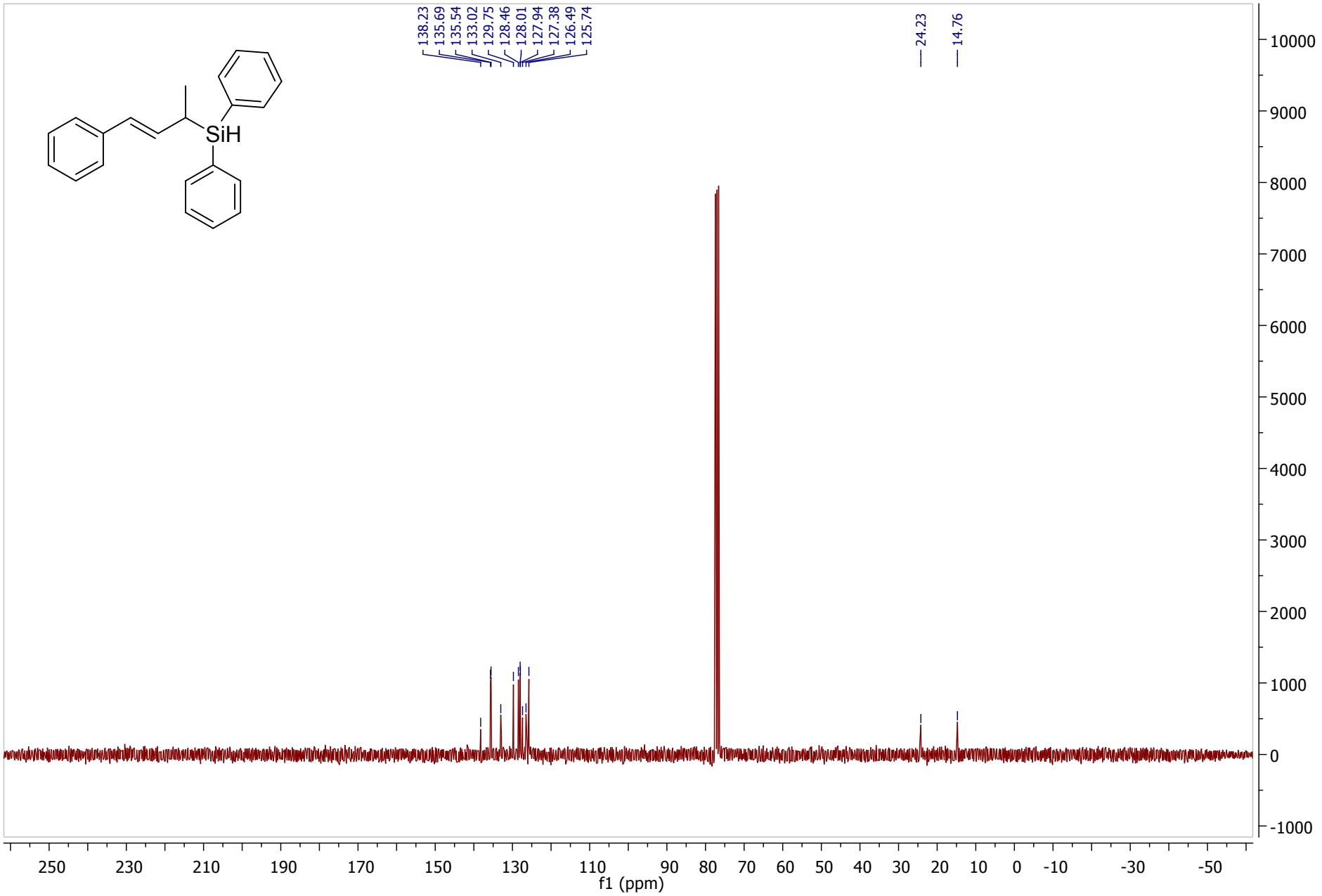

Si
H2
10.69
2.00
1.99
1.00
3.03
f1 (ppm)

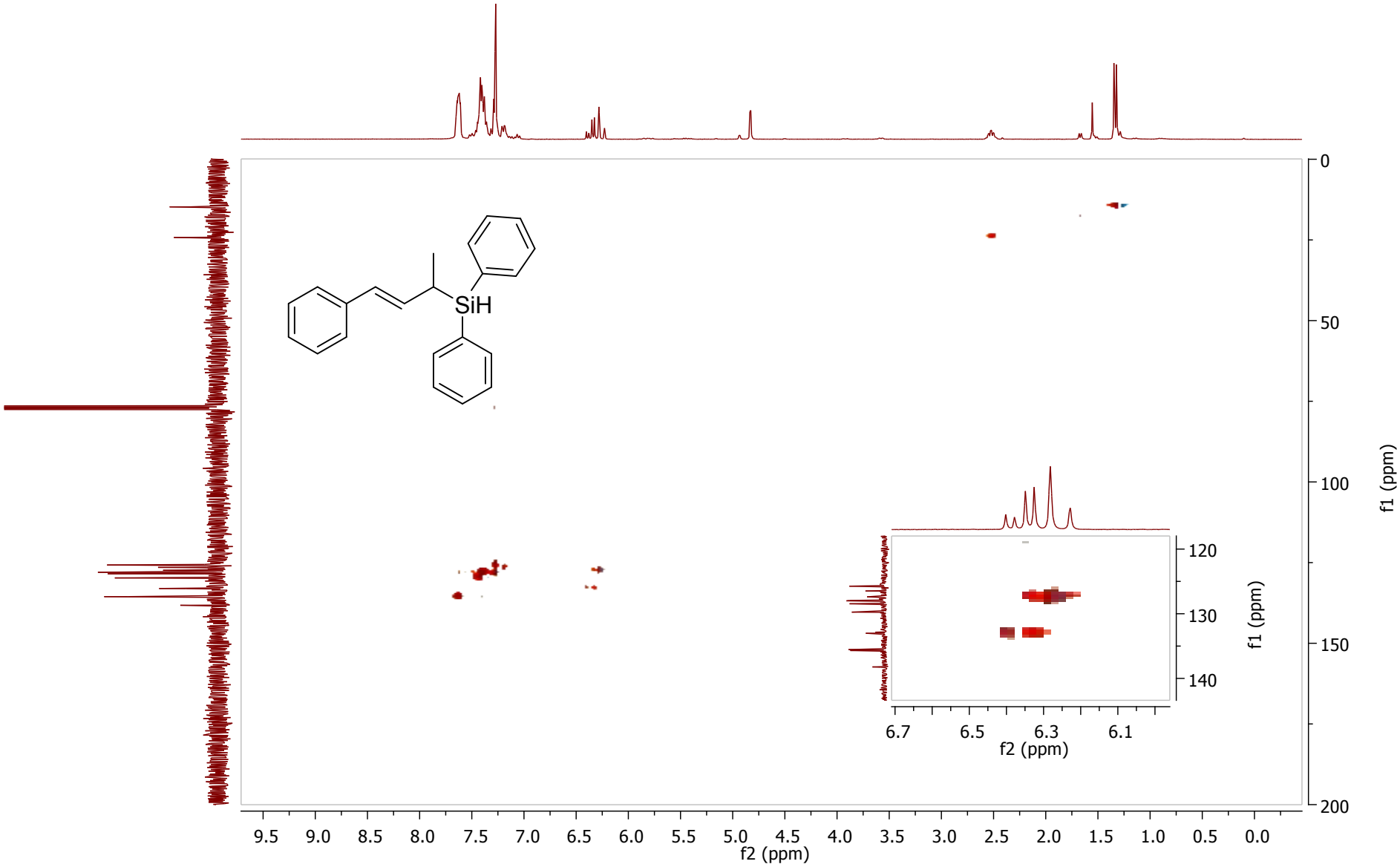

Si
H2
138.03
135.72
133.06
131.15
129.85
128.51
128.00
127.23
126.61
125.76
22.91
15.11
3500
3000
2500
2000
1500
1000
500
0
250
230
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
-30
-50
f1 (ppm)

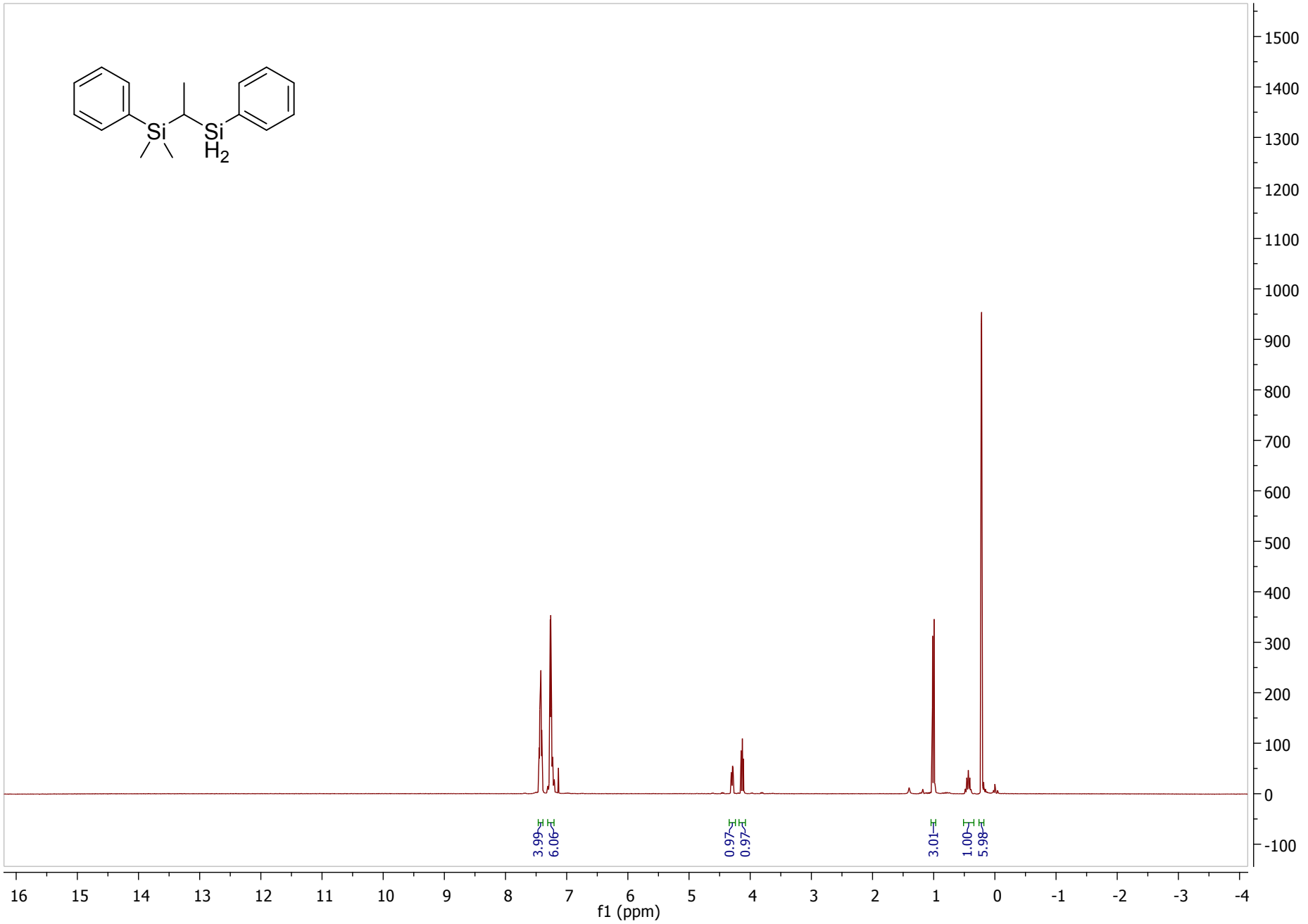

Si
H2
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
f2 (ppm)
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
f1 (ppm)

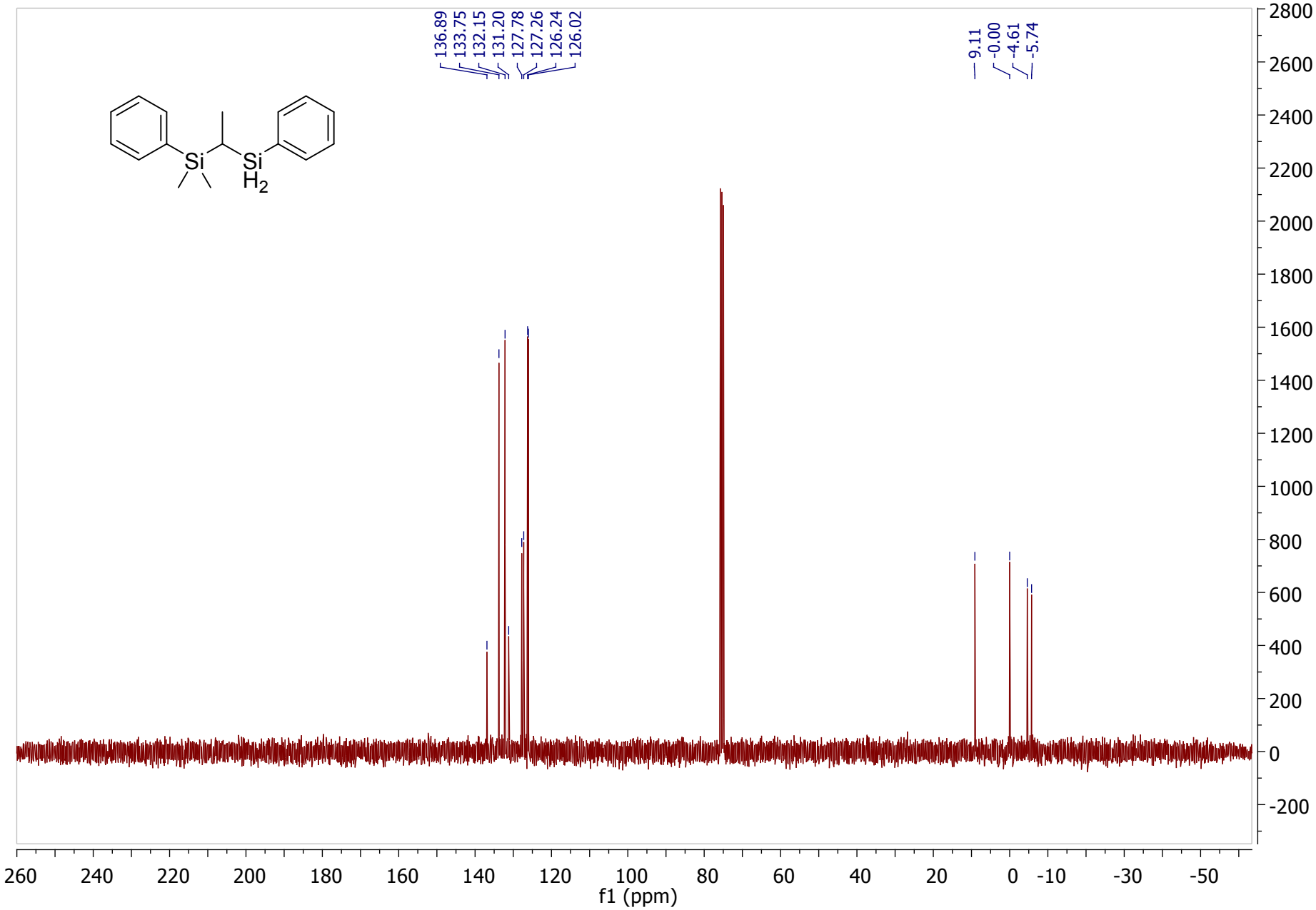

Si
H2
f2 (ppm)
f1 (ppm)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
10
12
14
16
18
20
22
24
26
28
30
32
34
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
118
120
122
124
126
128
130
132
134
136
138
140
142

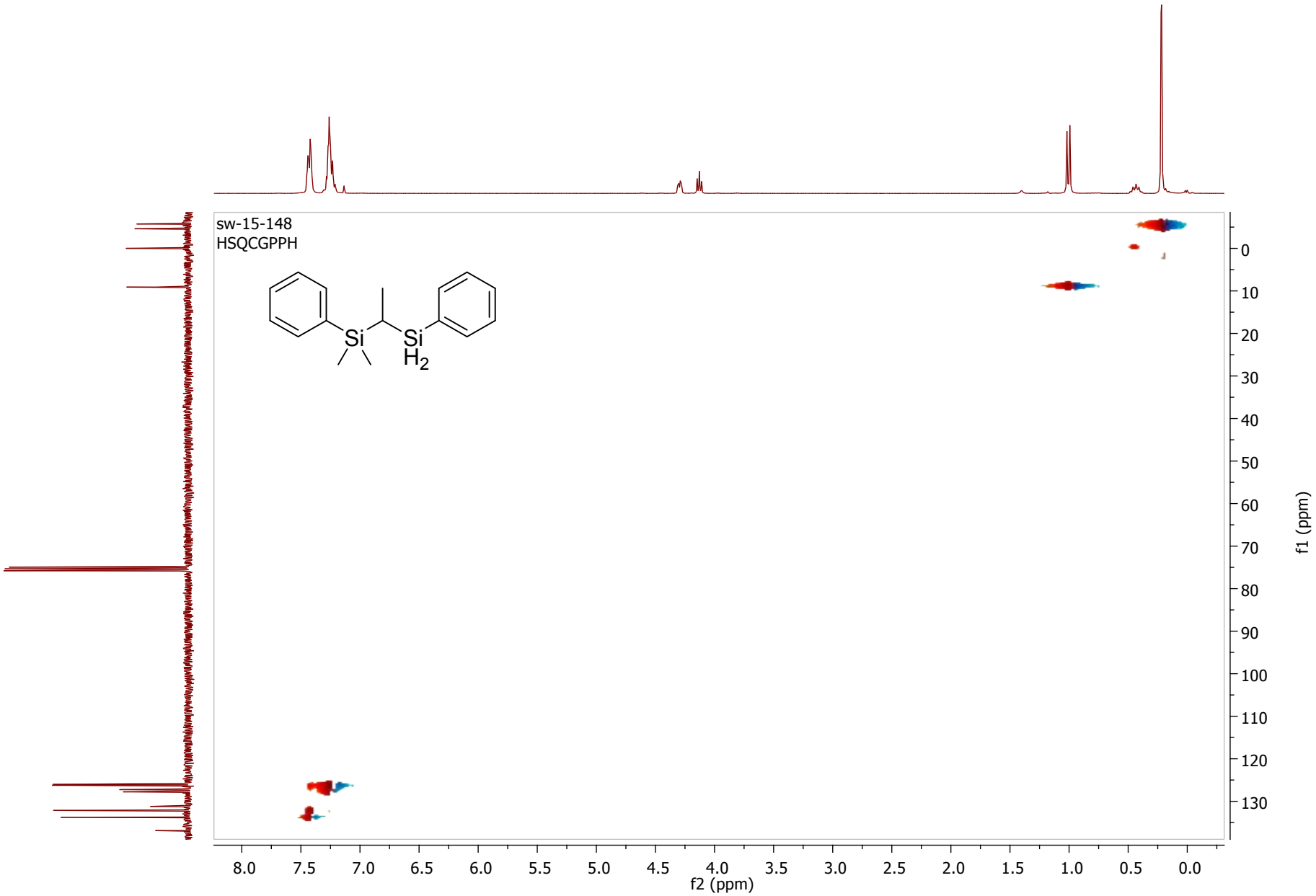

SiH
4.12
10.01
1.10
2.06
1.00
1.04
3.00
f1 (ppm)

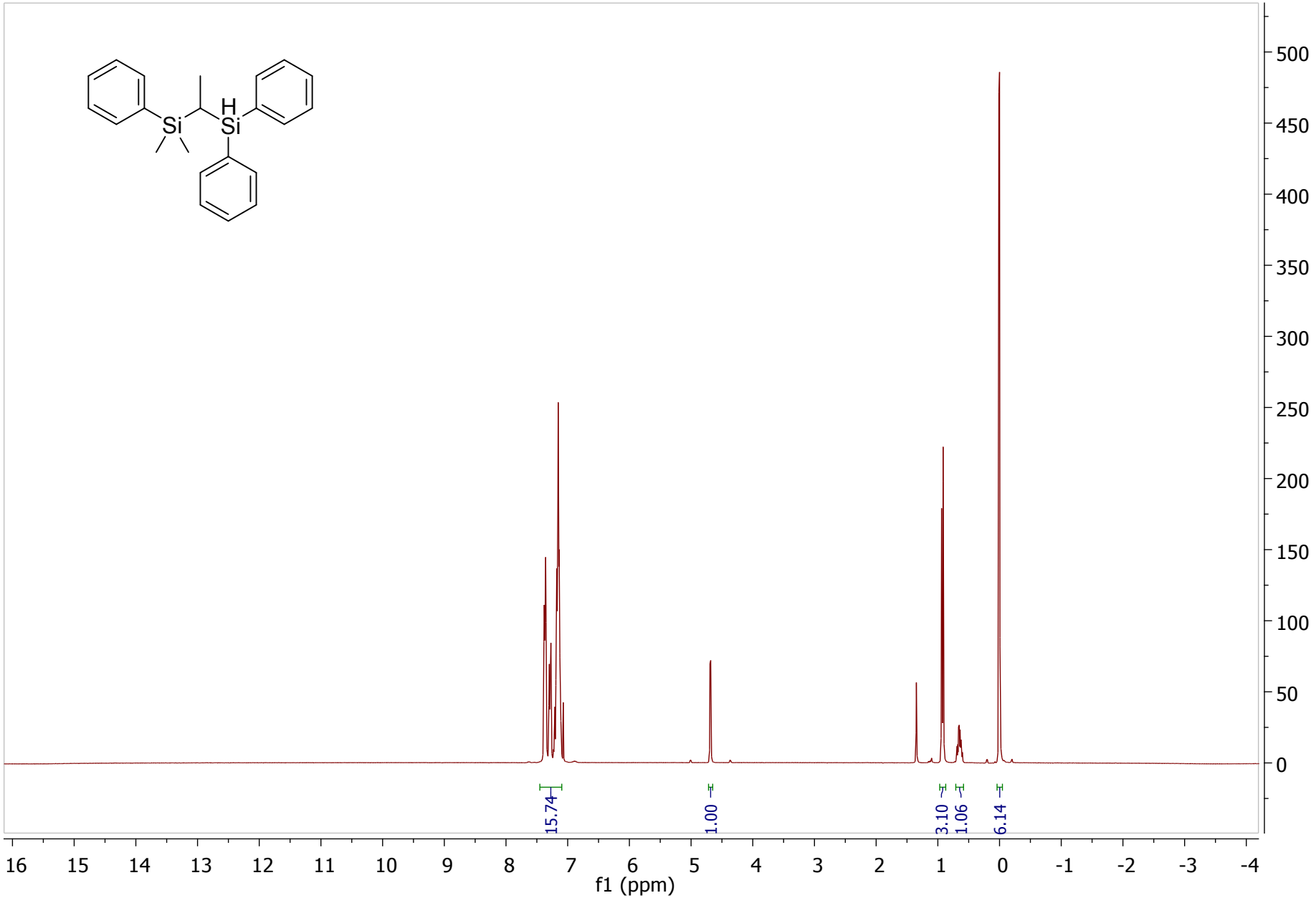

138.23
135.69
135.54
133.02
129.75
128.46
128.01
127.94
127.38
126.49
125.74
24.23
14.76
SiH
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
250
230
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
-30
-50
f1 (ppm)

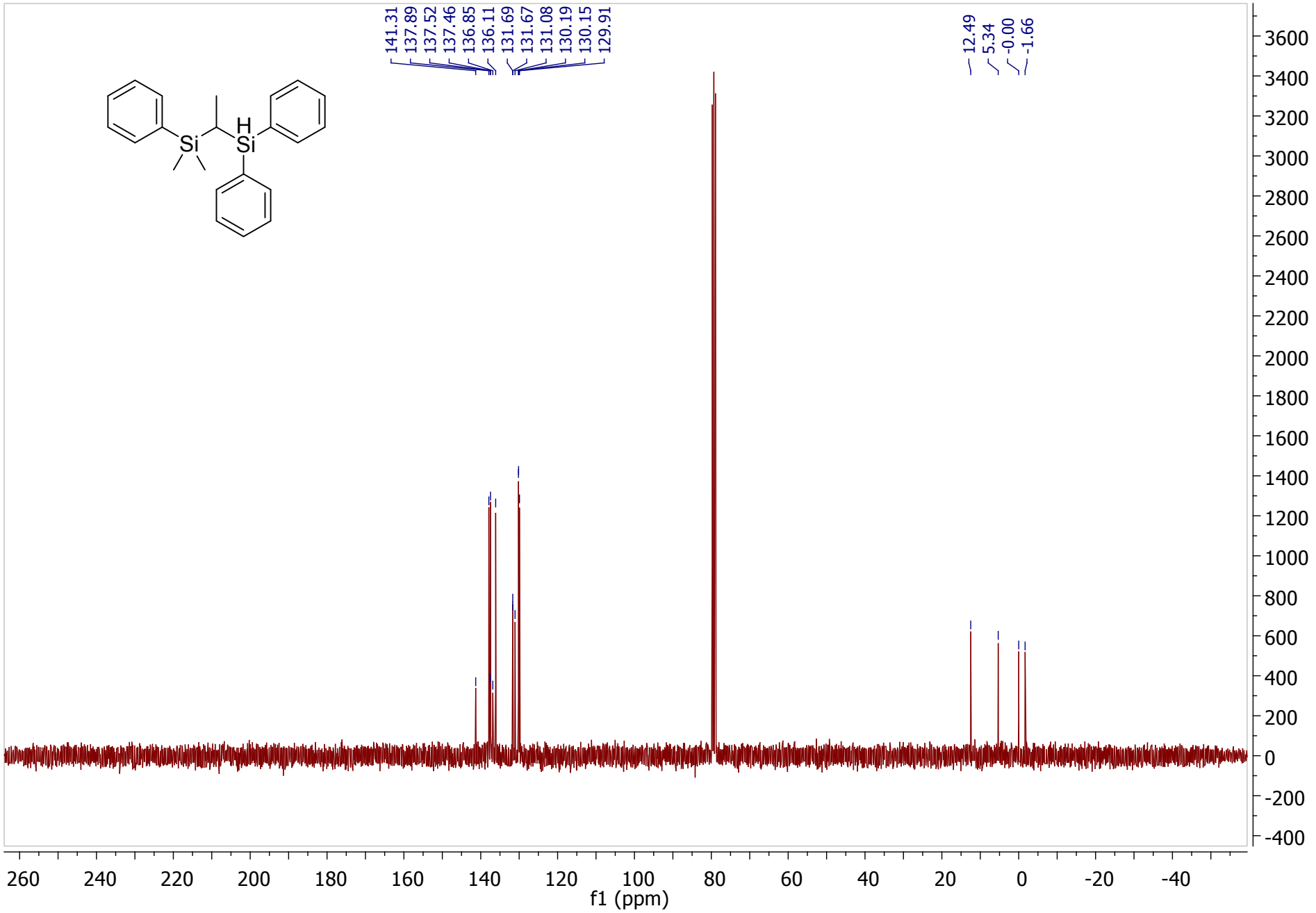

SiH
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f2 (ppm)
0
50
100
150
200
f1 (ppm)
120
130
140
f1 (ppm)
6.7
6.5
6.3
6.1
f2 (ppm)

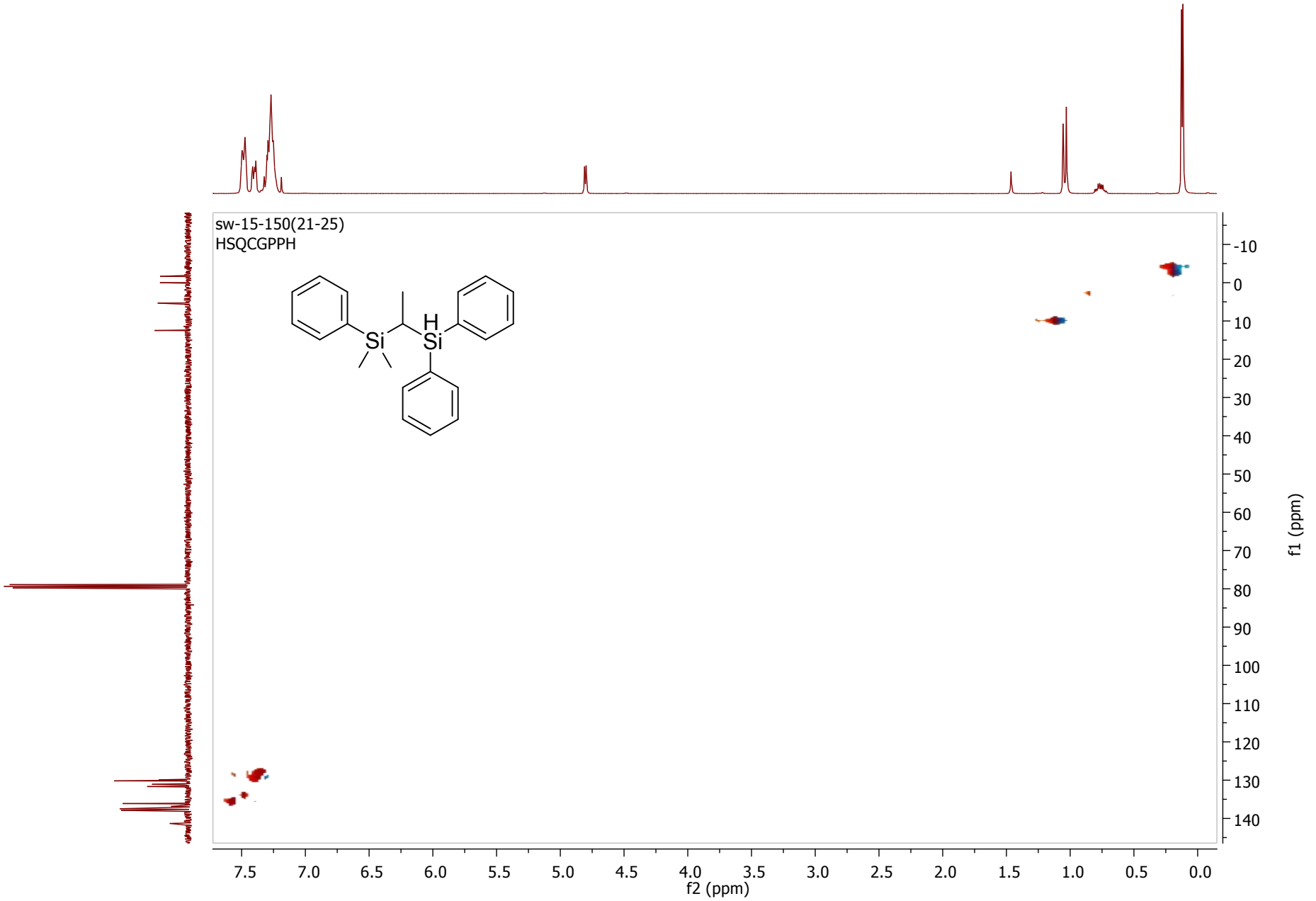

Si
Si
H2
3.99
6.06
0.97
0.97
3.01
1.00
5.98
f1 (ppm)

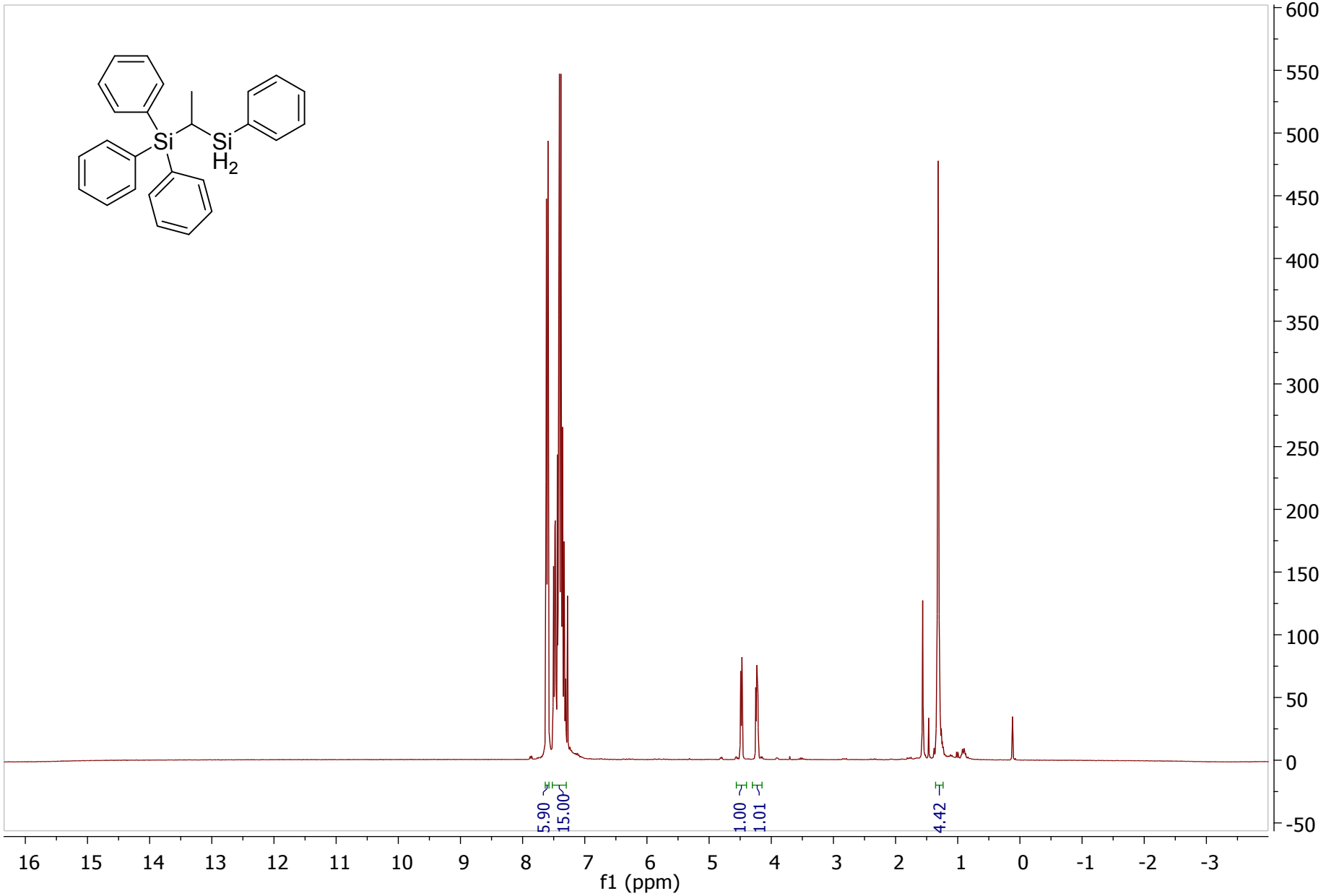

136.89
133.75
132.15
131.20
127.78
127.26
126.24
126.02
9.11
-0.00
-4.61
-5.74
Si
Si
H2
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

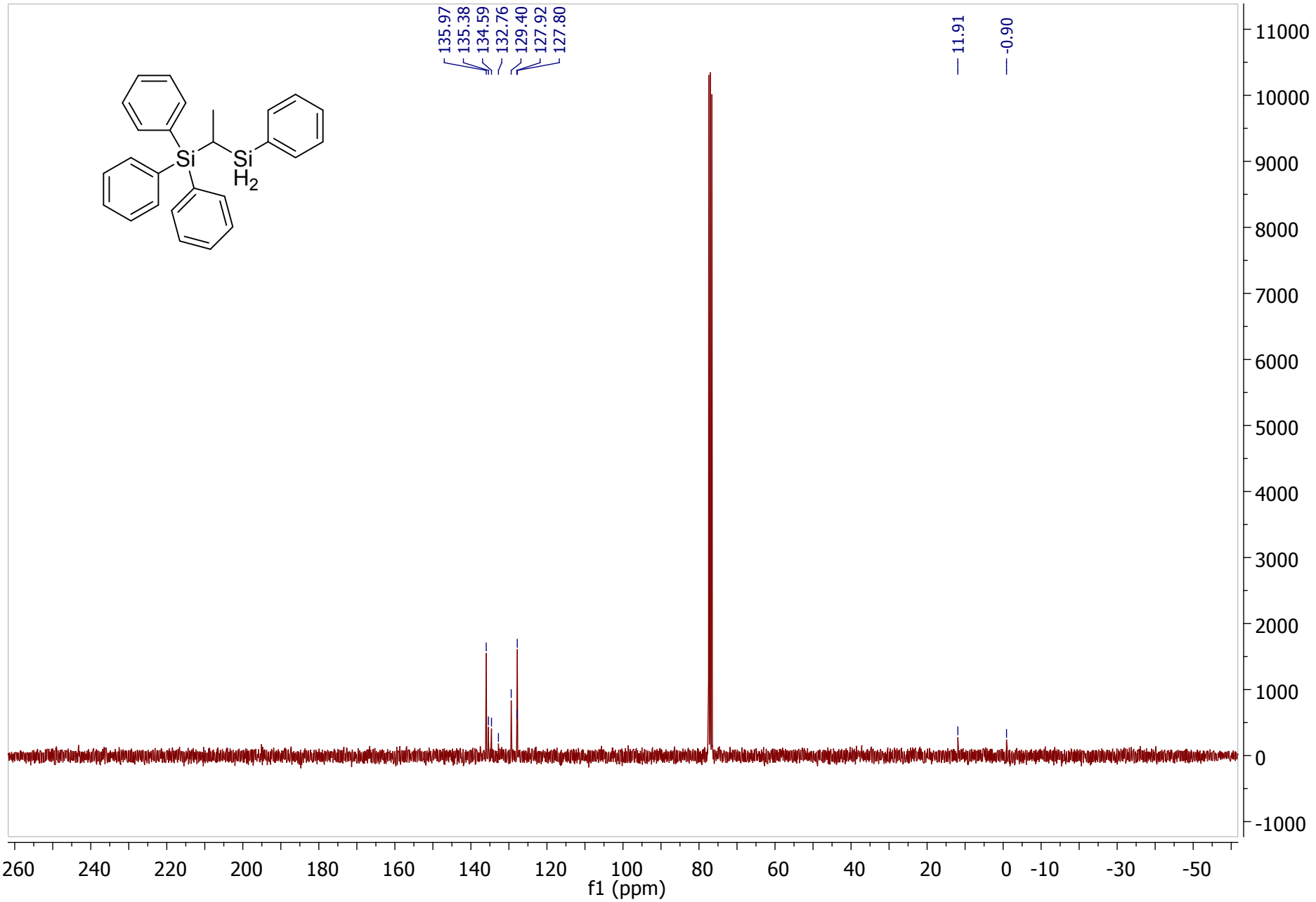

sw-15-148
HSQCGPPH
Si
Si
H2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f2 (ppm)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
f1 (ppm)

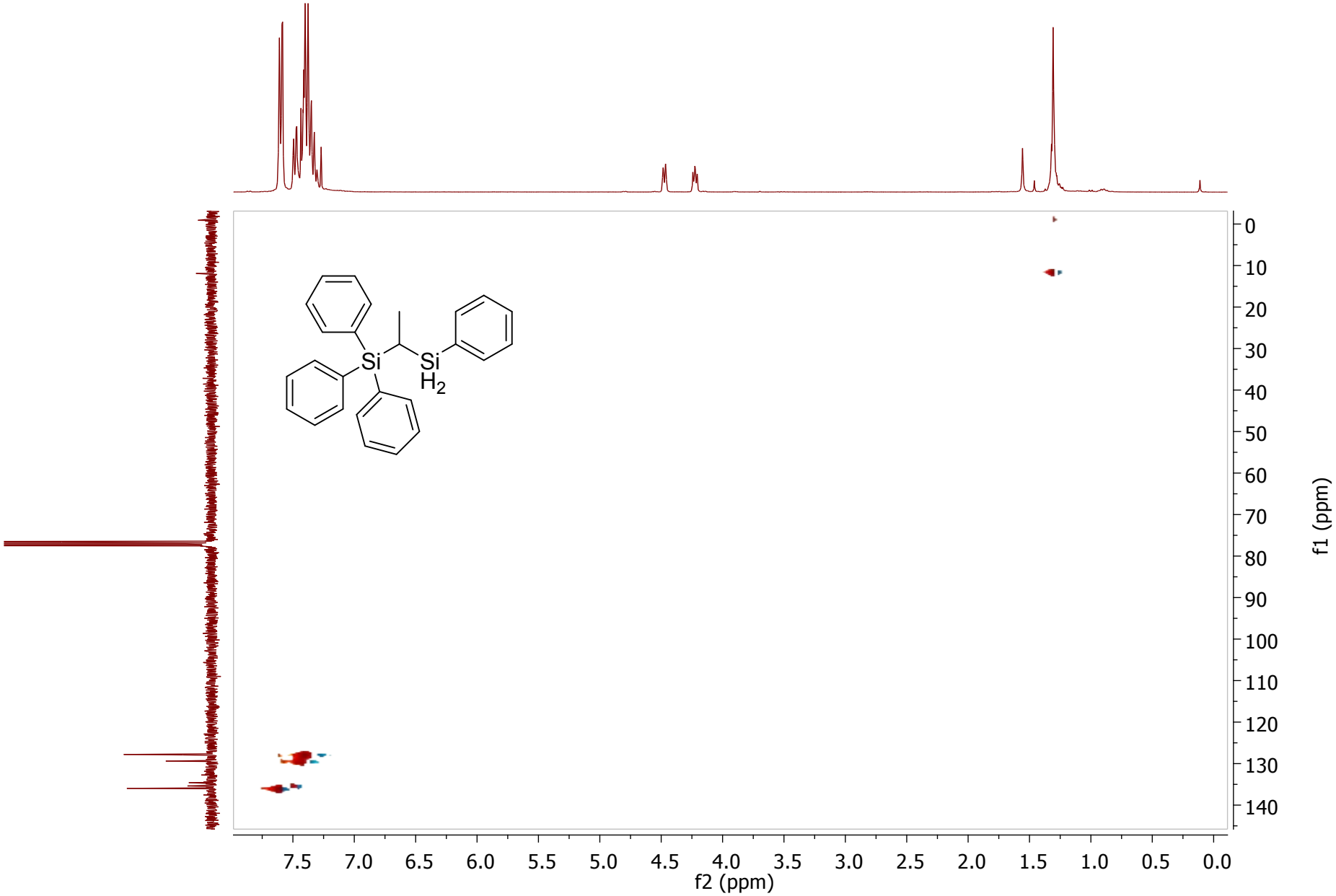

Si
H
Si
15.74
1.00
3.10
1.06
6.14
f1 (ppm)

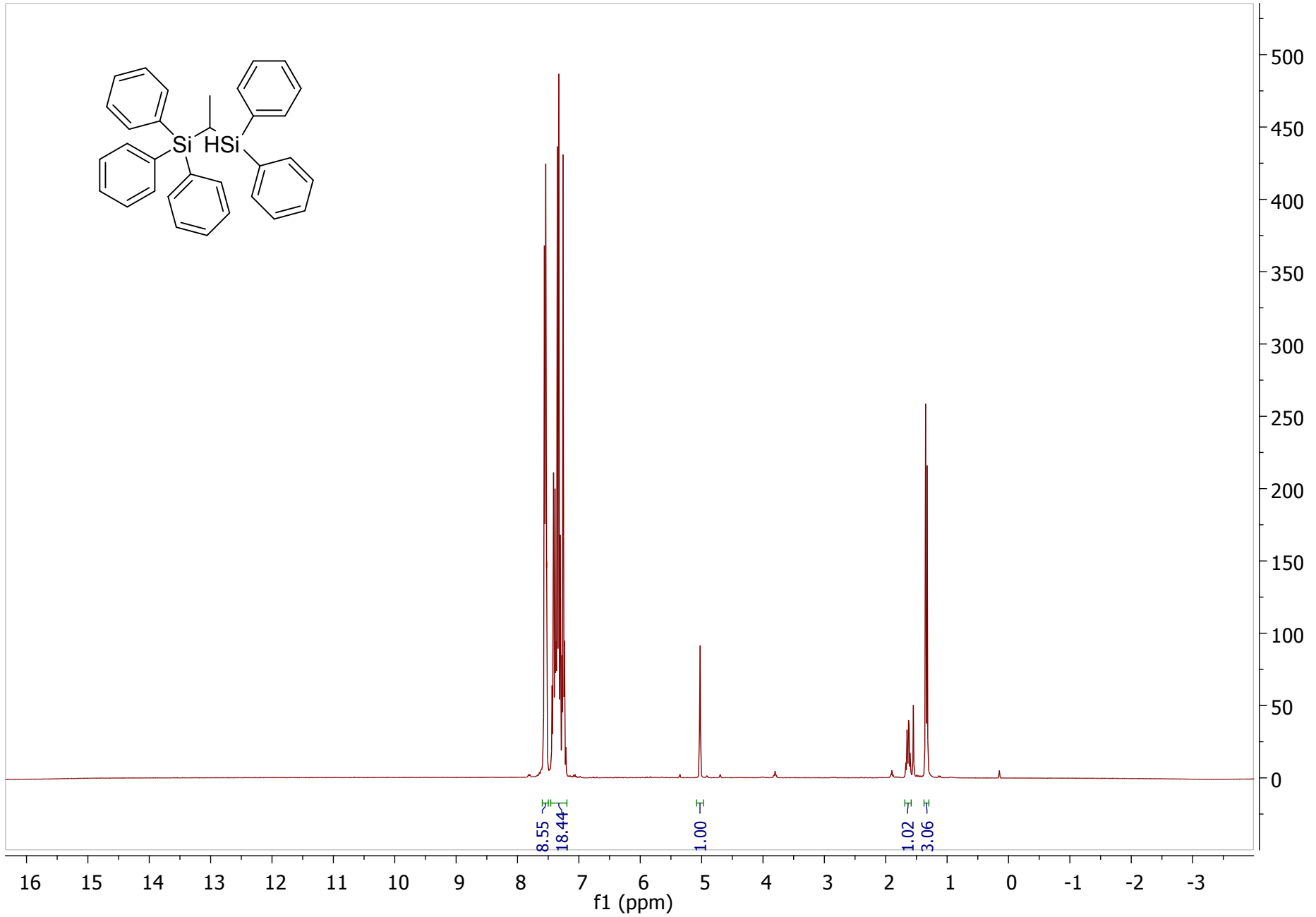

141.31
137.89
137.52
137.46
136.85
136.11
131.69
131.67
131.08
130.19
130.15
129.91
12.49
5.34
-0.00
-1.66
Si
H
Si
f1 (ppm)

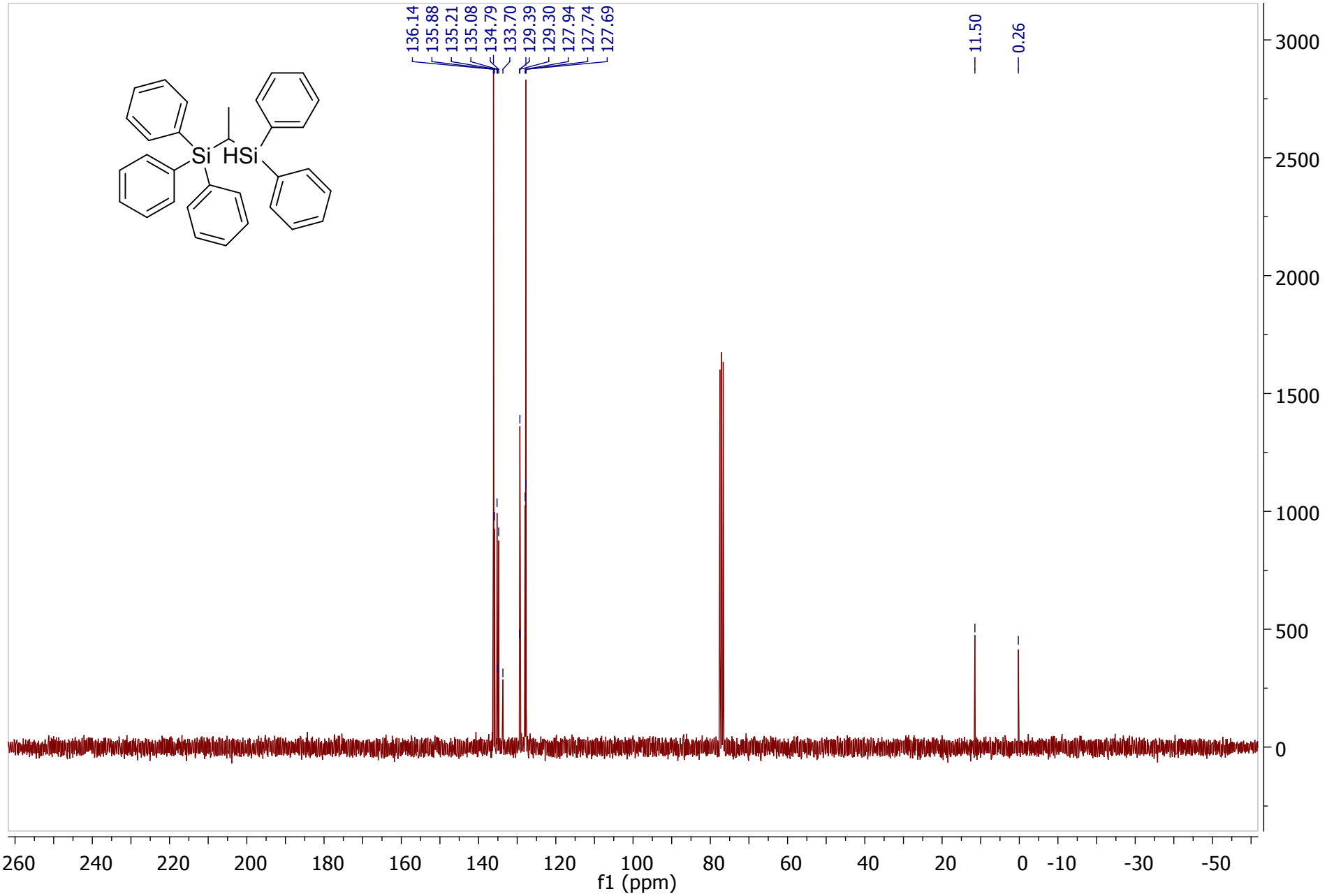

sw-15-150(21-25)
HSQCGPPH
Si
H
Si
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
f1 (ppm)
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f2 (ppm)

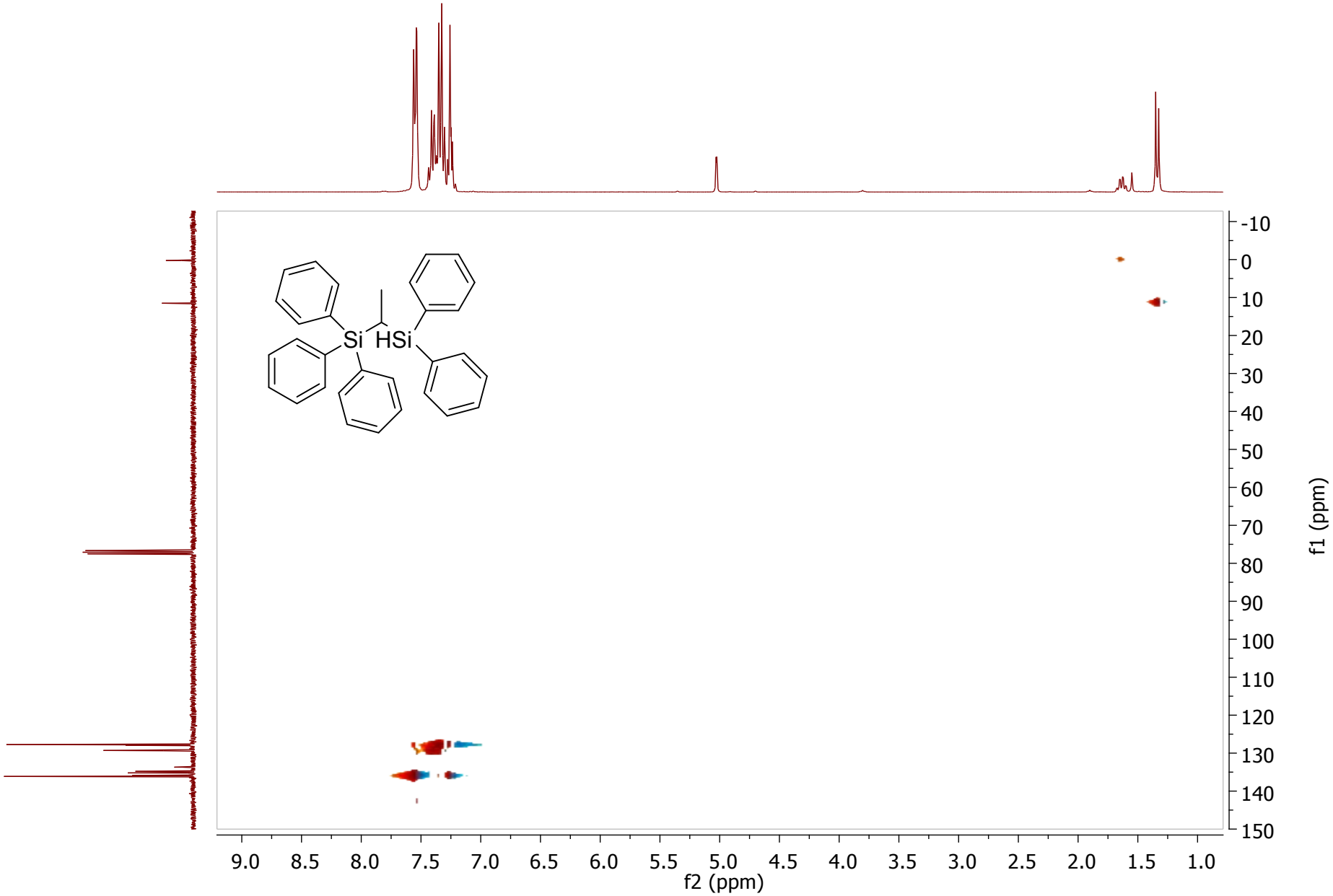

Si
Si
H2
5.90
15.00
1.00
1.01
4.42
f1 (ppm)

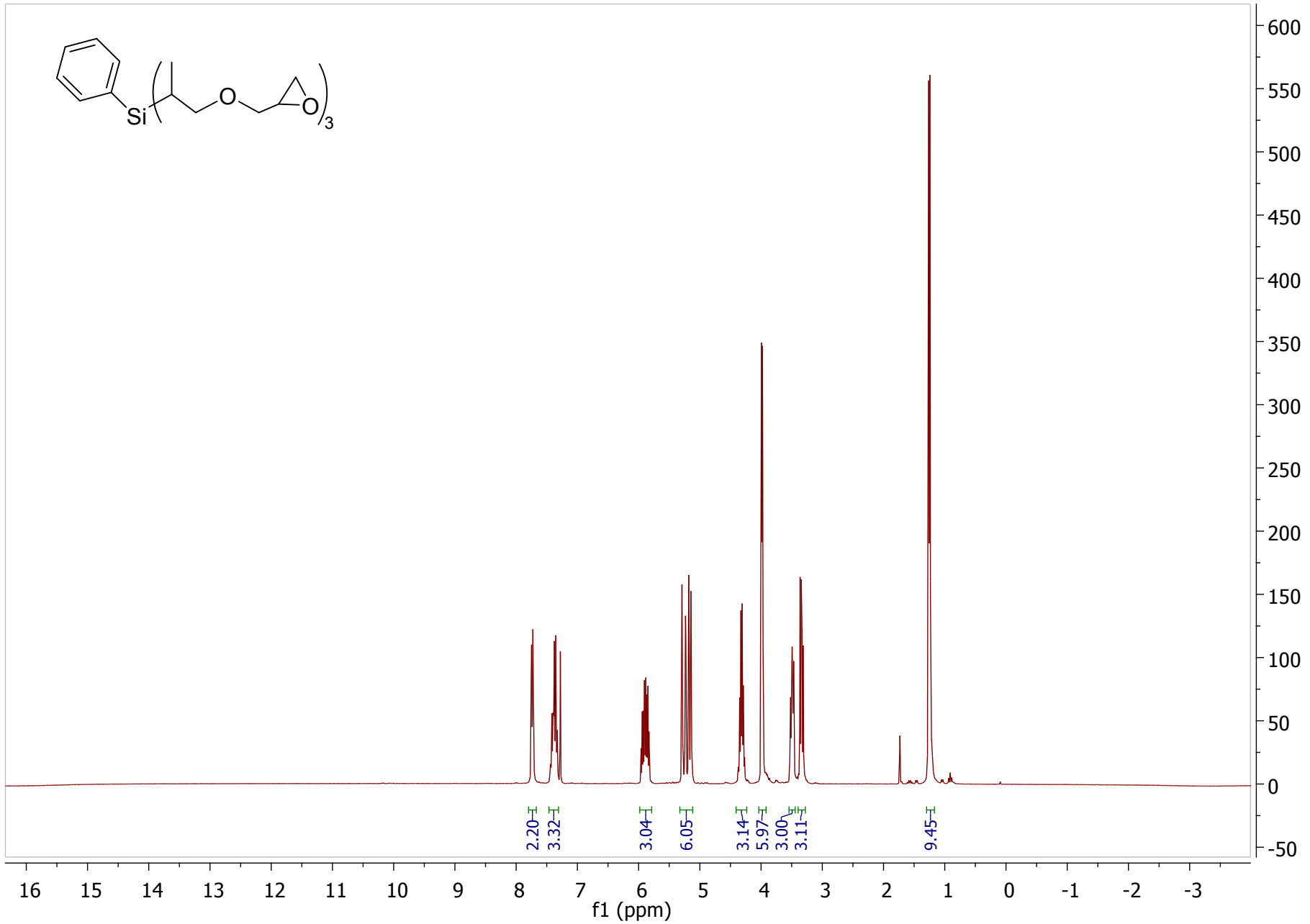

135.97
135.38
134.59
132.76
129.40
127.92
127.80
11.91
-0.90
Si
Si
H2
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

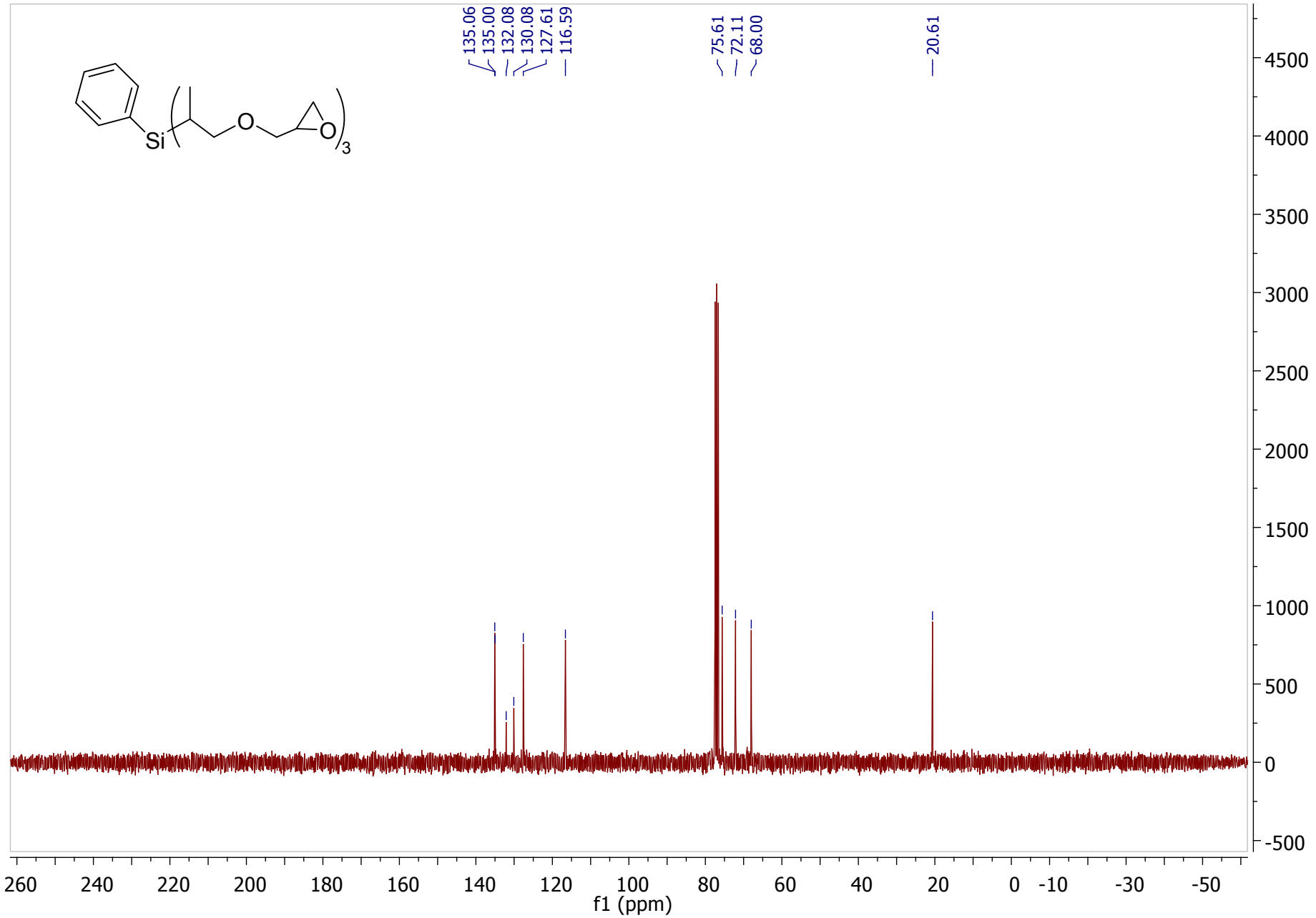

Si
Si
H2
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
f1 (ppm)
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f2 (ppm)

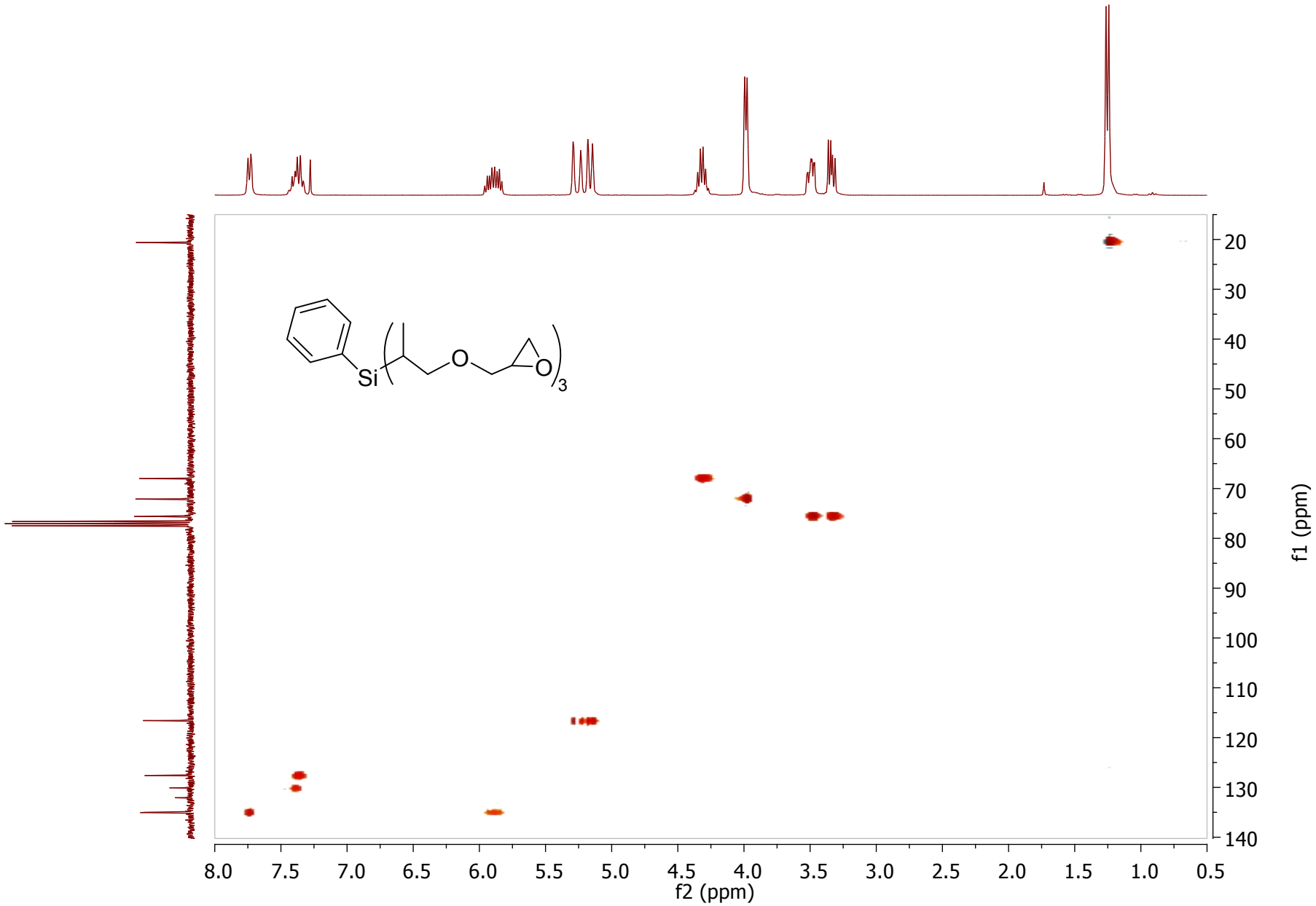

Si
HSi
8.55
18.44
1.00
1.02
3.06
f1 (ppm)

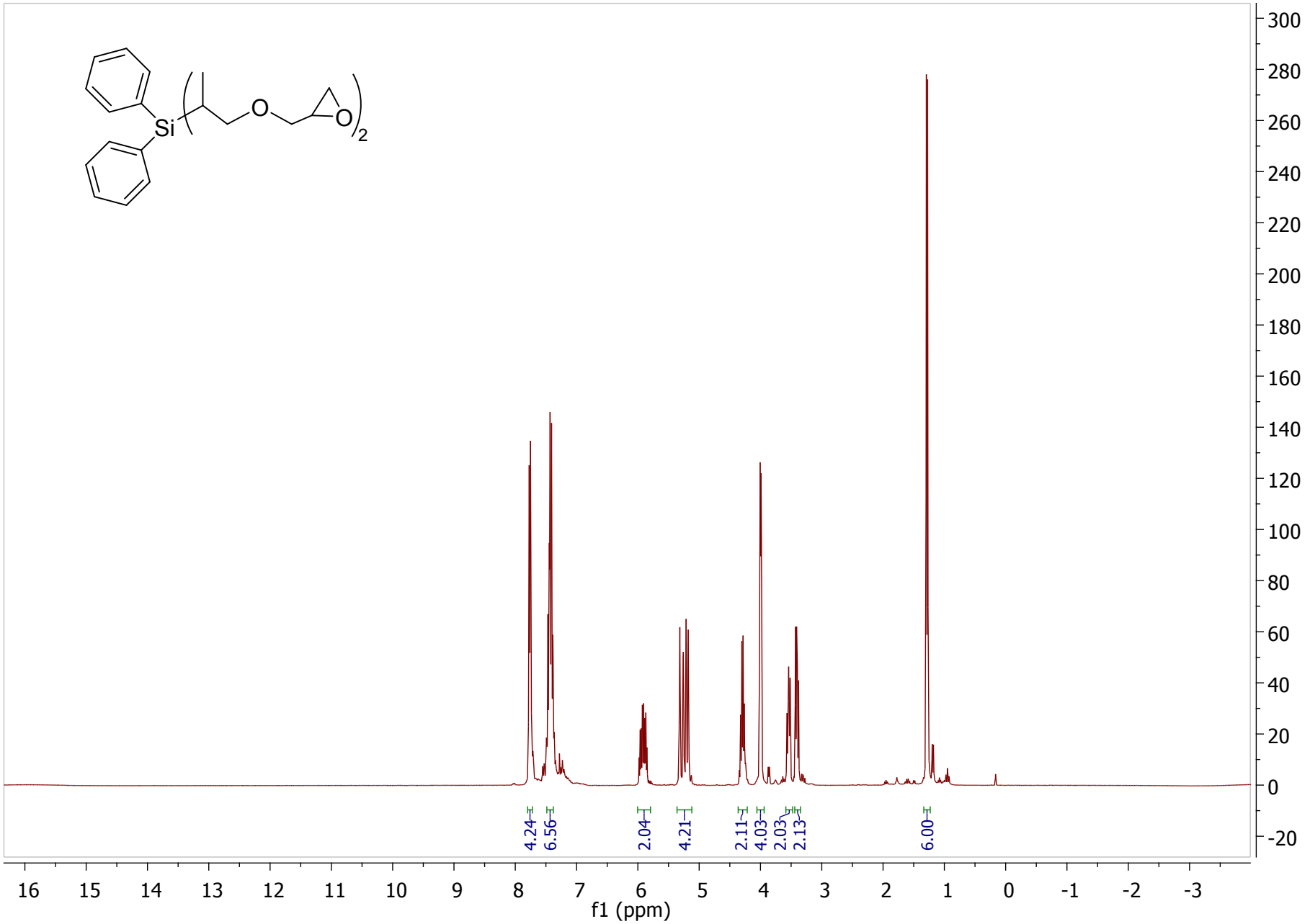

136.14
135.88
135.21
135.08
134.79
133.70
129.39
129.30
127.94
127.74
127.69
11.50
0.26
Si
HSi
3000
2500
2000
1500
1000
500
0
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

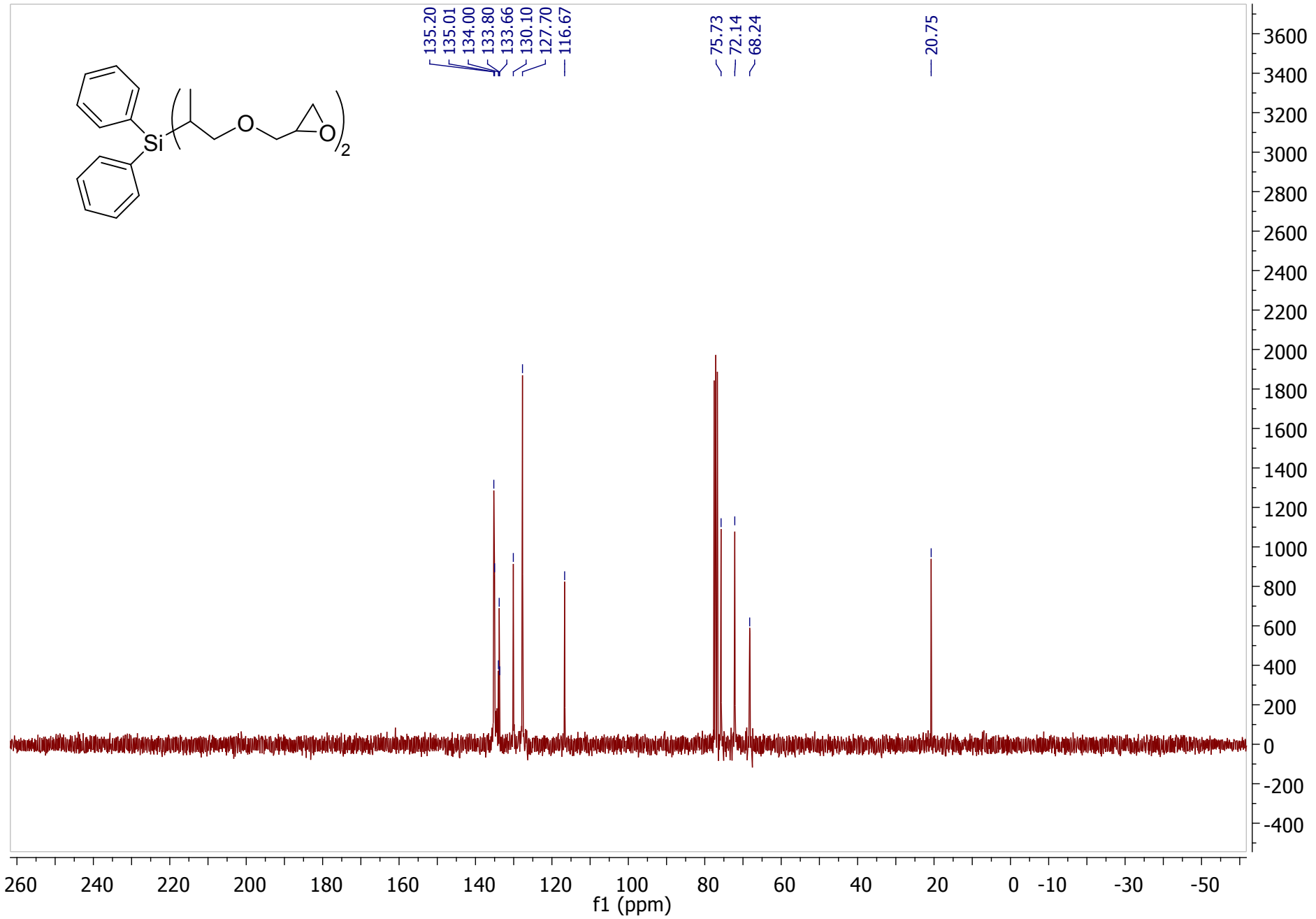

Si
HSi
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
f2 (ppm)
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
f1 (ppm)

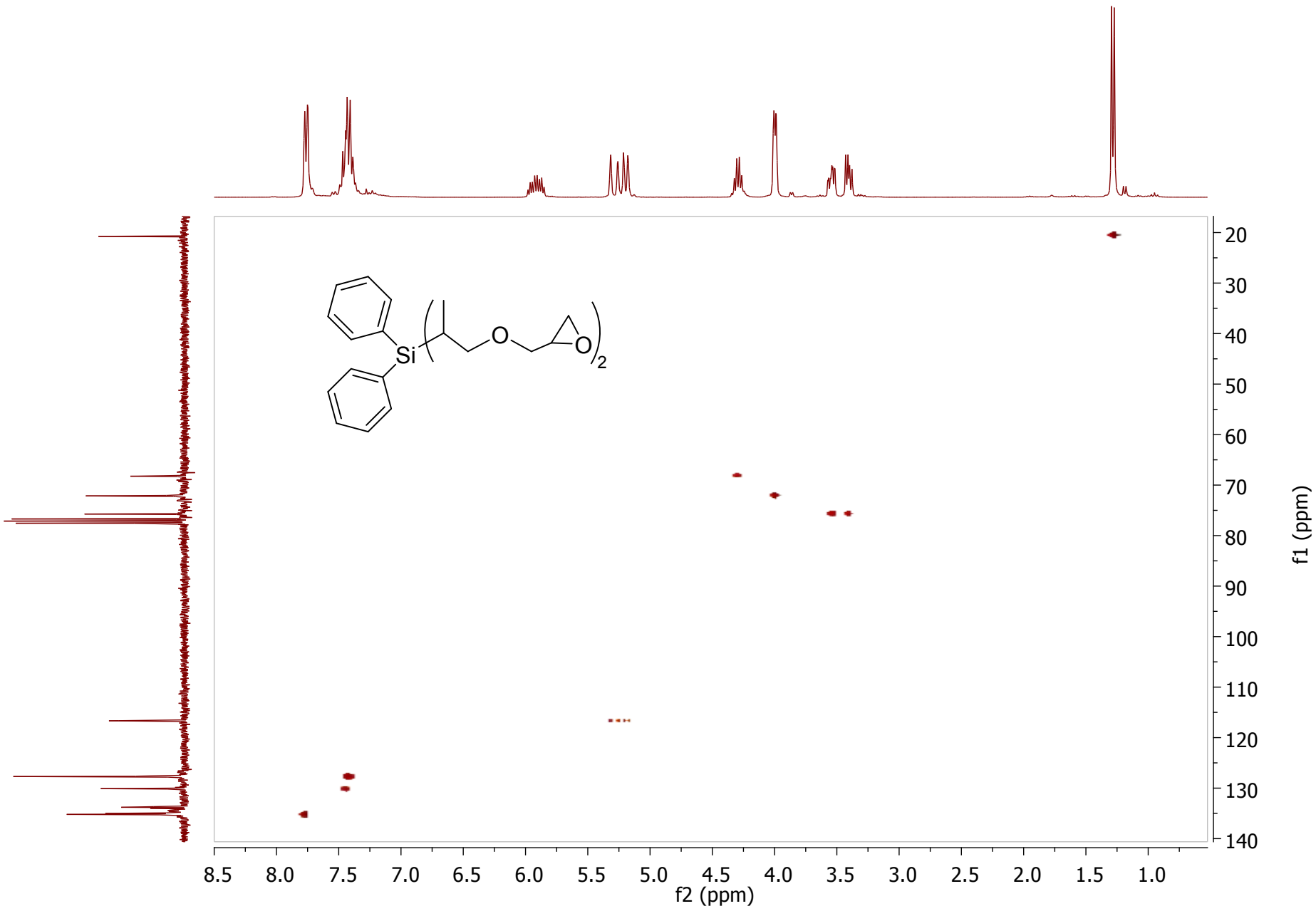

Si
O
O
3
2.20
3.32
3.04
6.05
3.14
5.97
3.00
3.11
9.45
f1 (ppm)

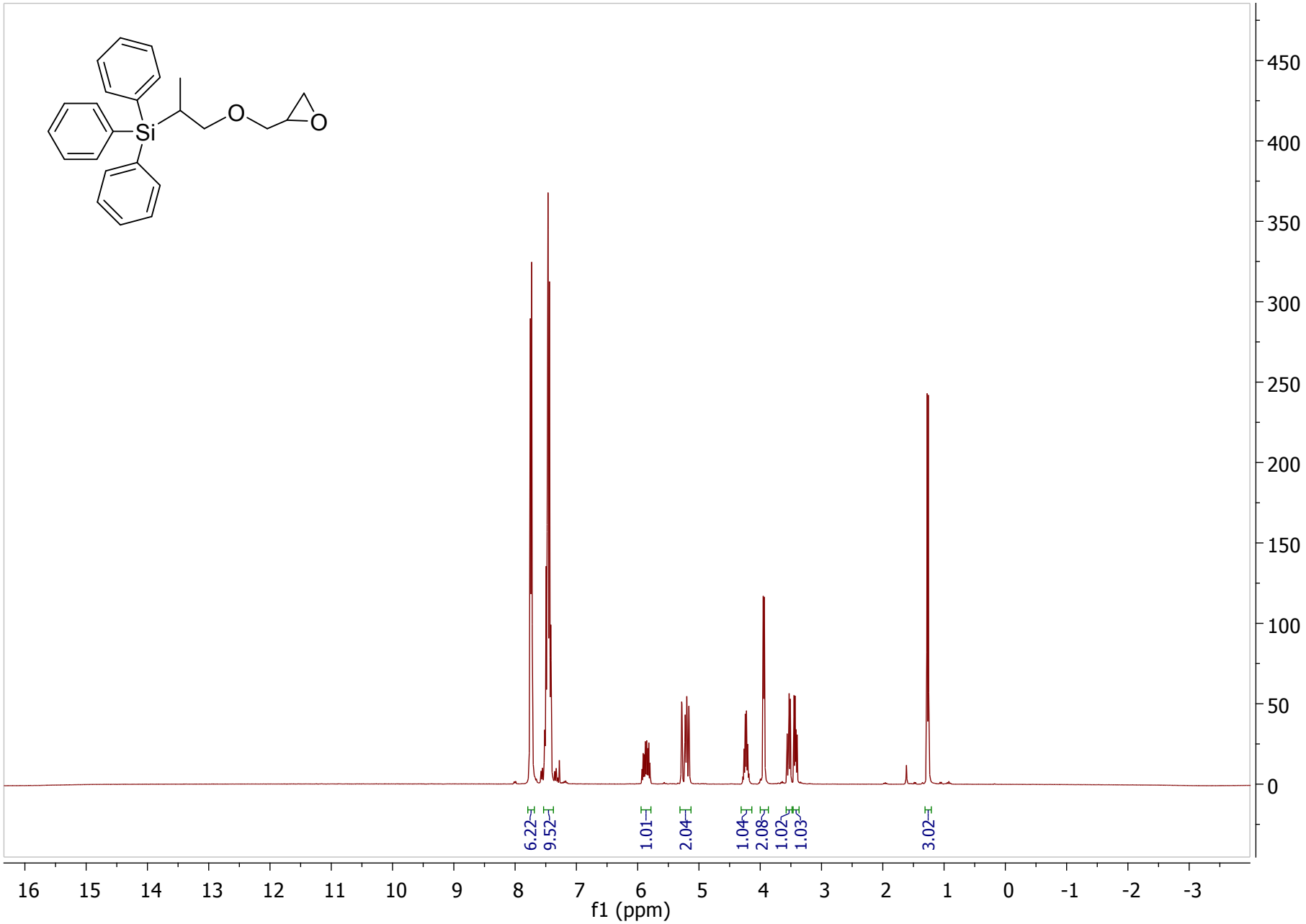

135.06
135.00
132.08
130.08
127.61
116.59
75.61
72.11
68.00
20.61
Si
O
O
3
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

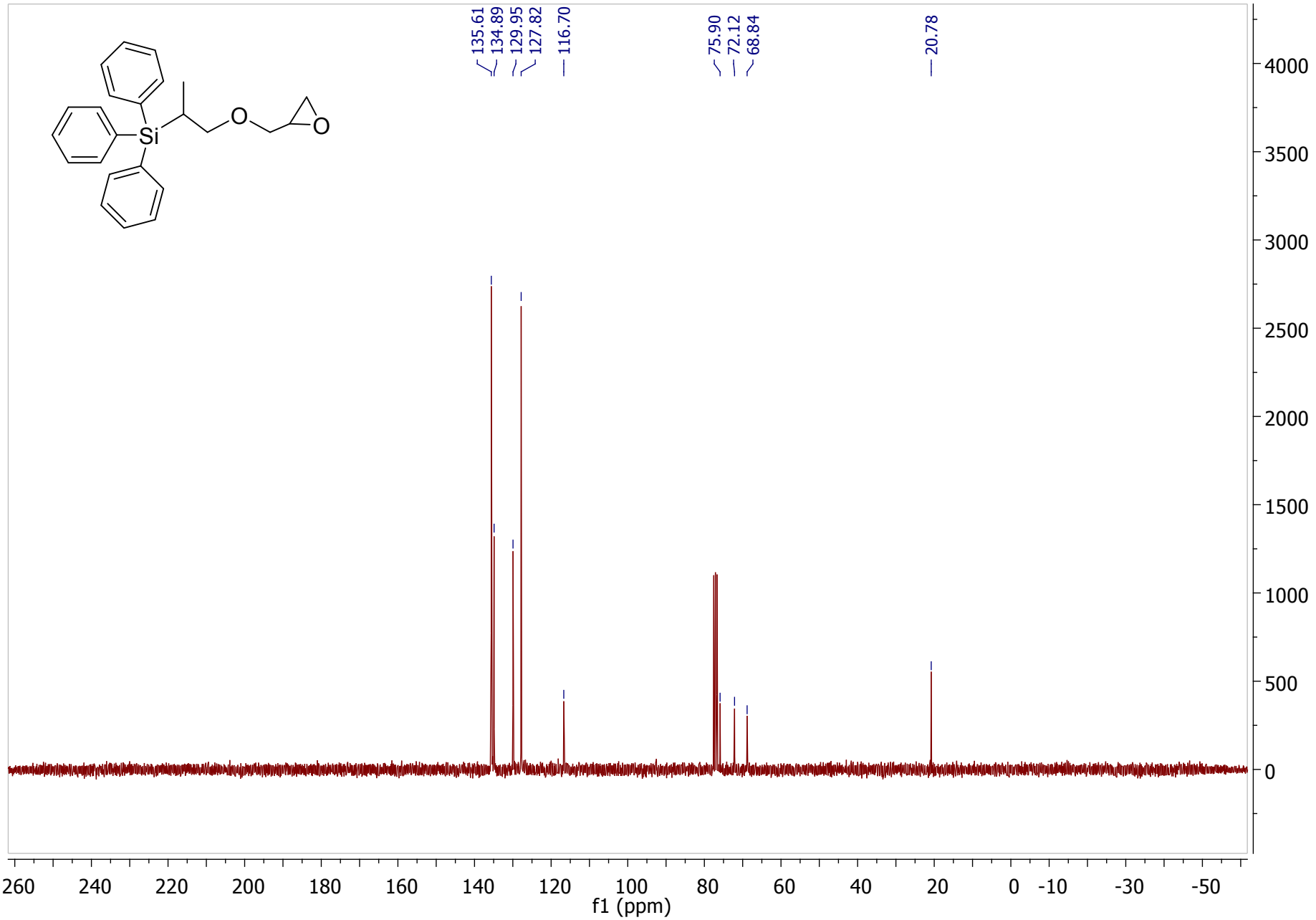

Si
O
O
3
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f2 (ppm)
20
30
40
50
60
70
80
90
100
110
120
130
140
f1 (ppm)

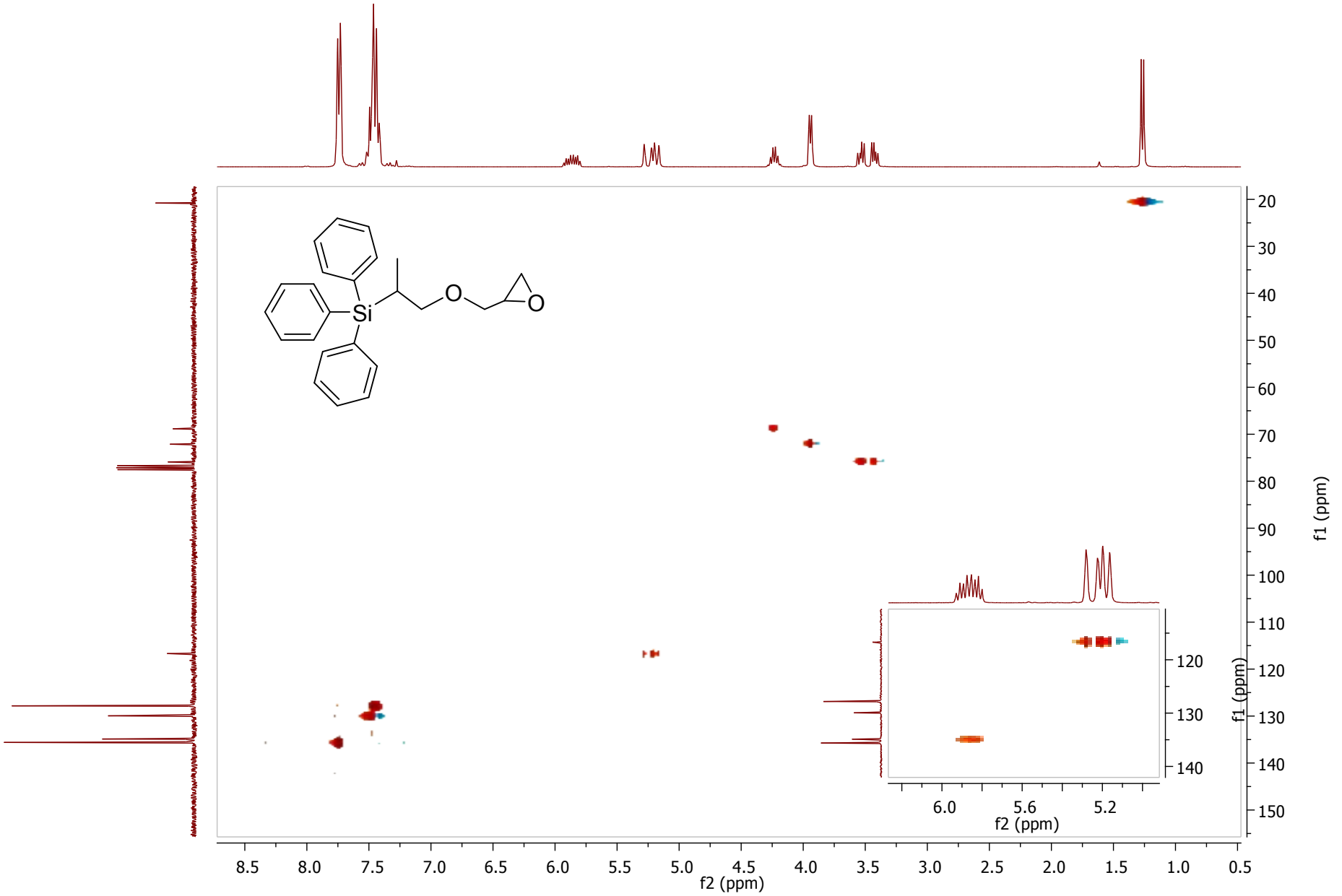

Si
O
O
2
4.24
6.56
2.04
4.21
2.11
4.03
2.03
2.13
6.00
f1 (ppm)

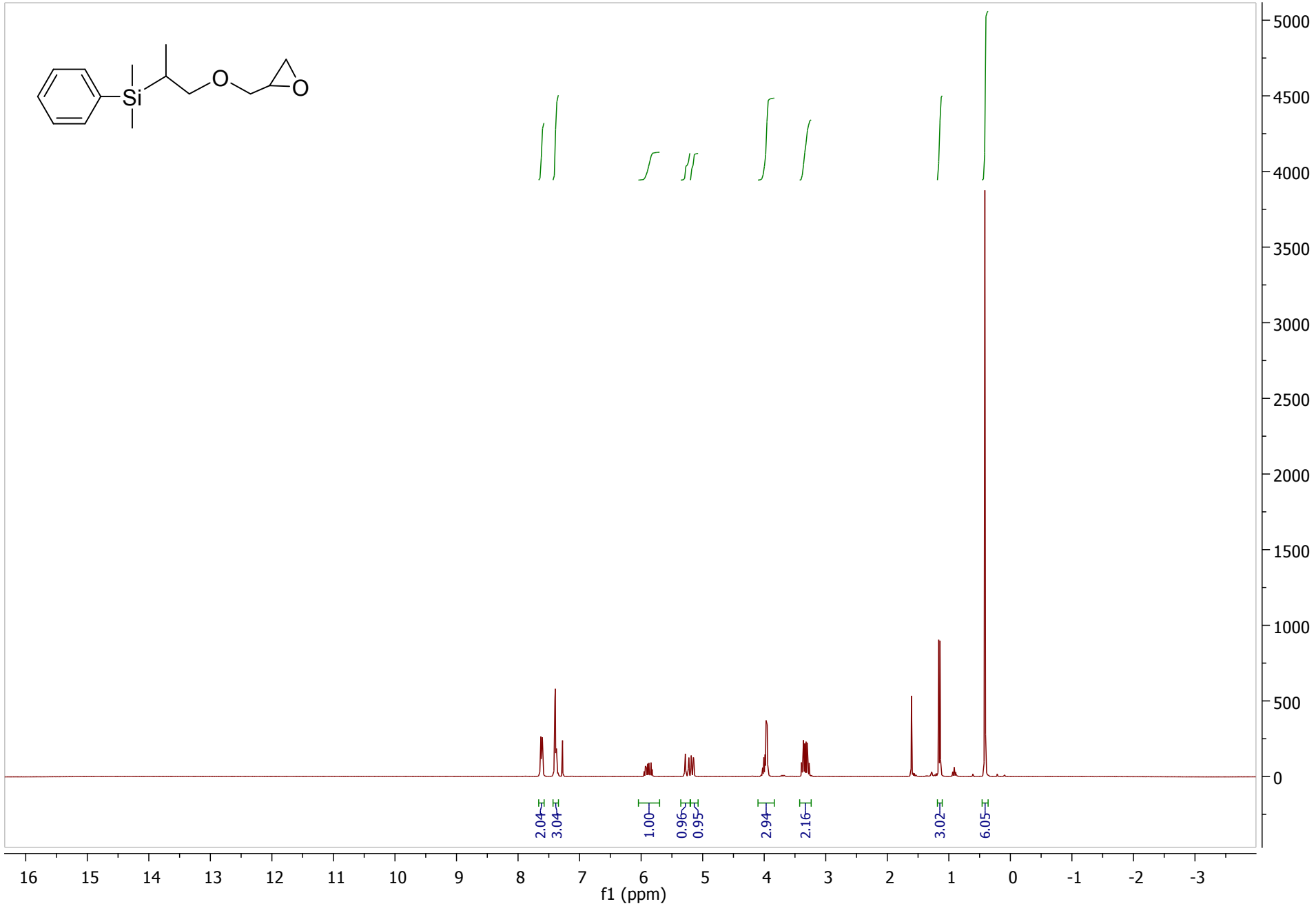

135.20
135.01
134.00
133.80
133.66
130.10
127.70
116.67
75.73
72.14
68.24
20.75
Si
O
O
2
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
-400
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

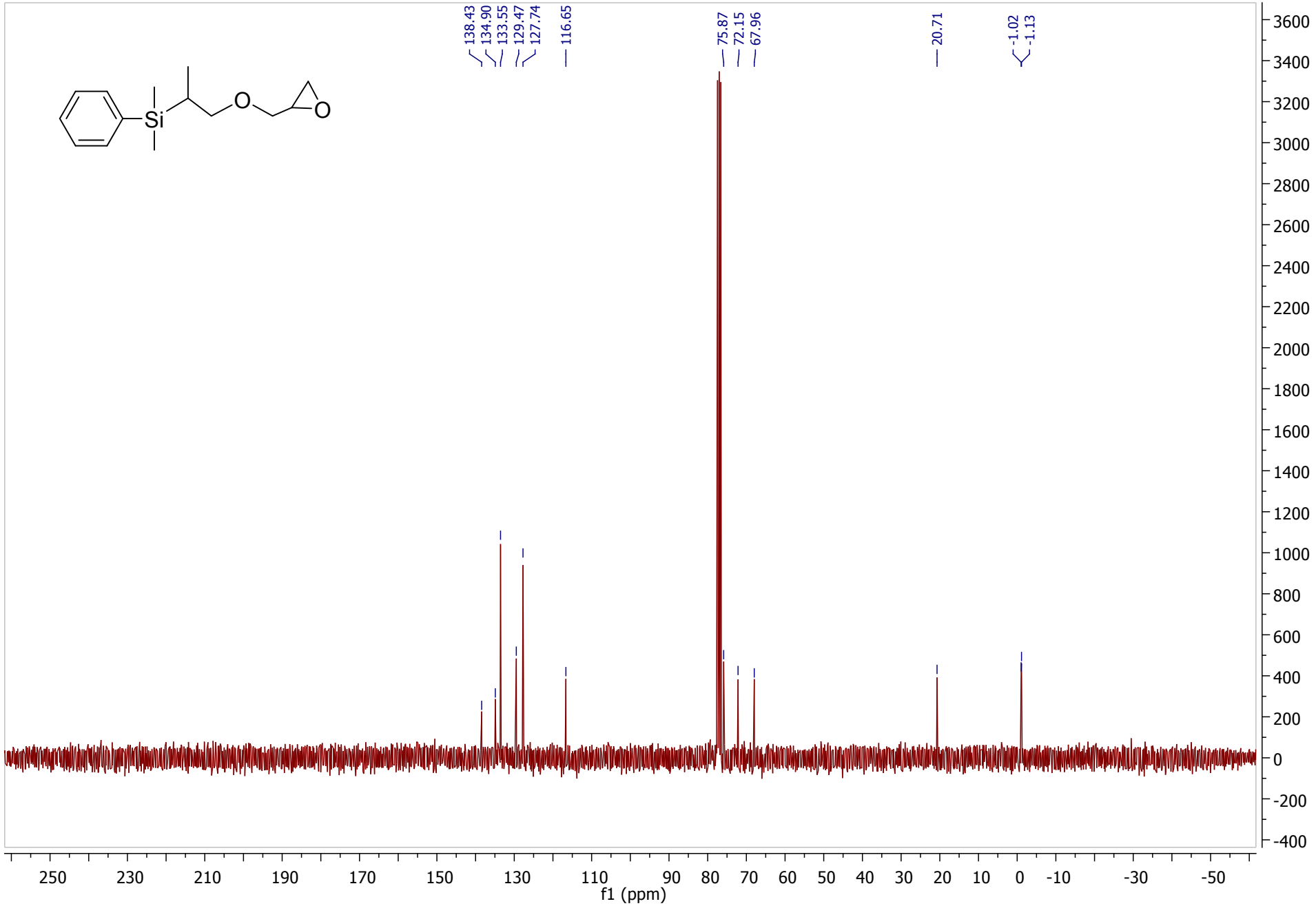

Si
O
O
2
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
f2 (ppm)
20
30
40
50
60
70
80
90
100
110
120
130
140
f1 (ppm)

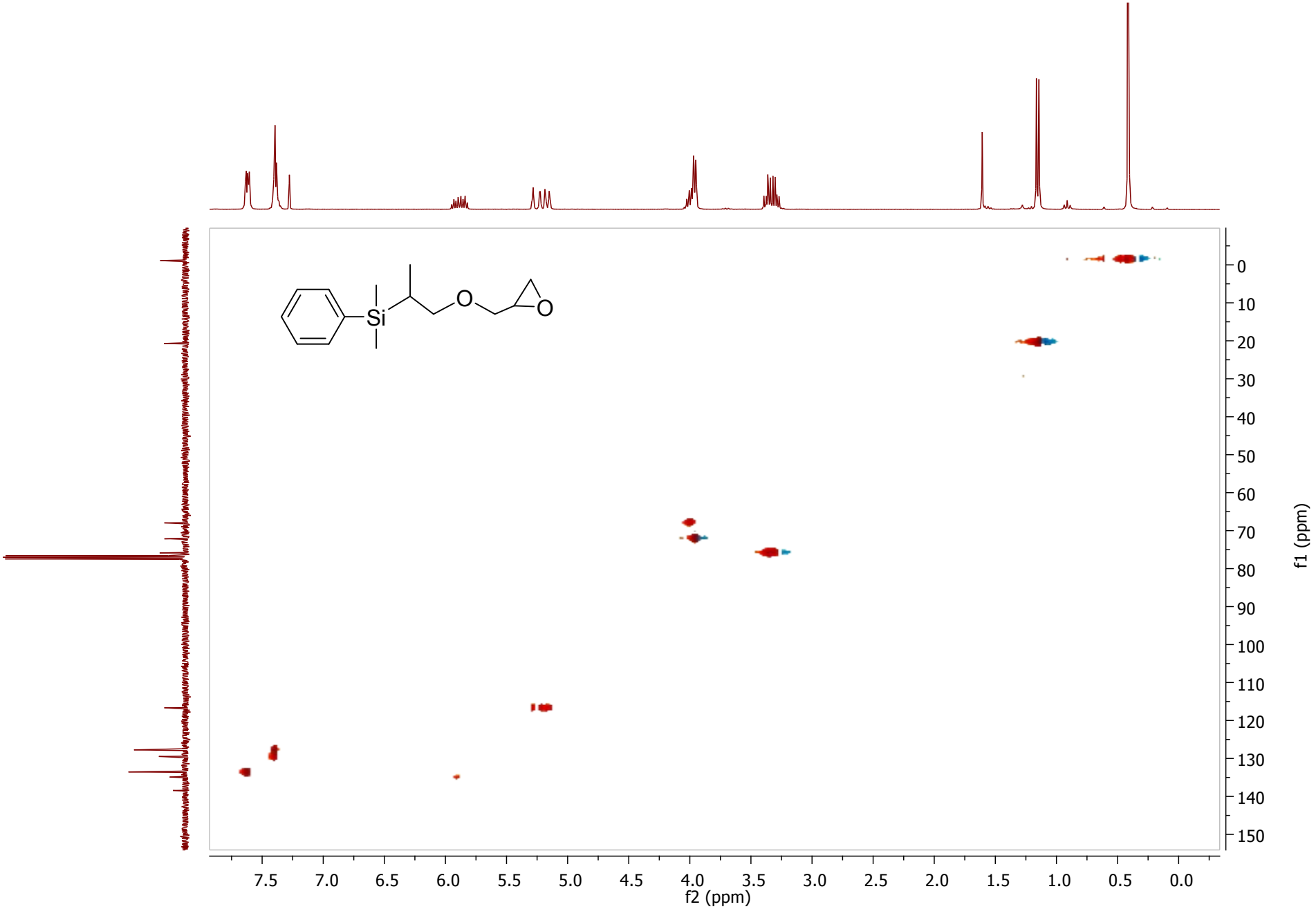

Si
O
O
6.22
9.52
1.01
2.04
1.04
2.08
1.02
1.03
3.02
f1 (ppm)

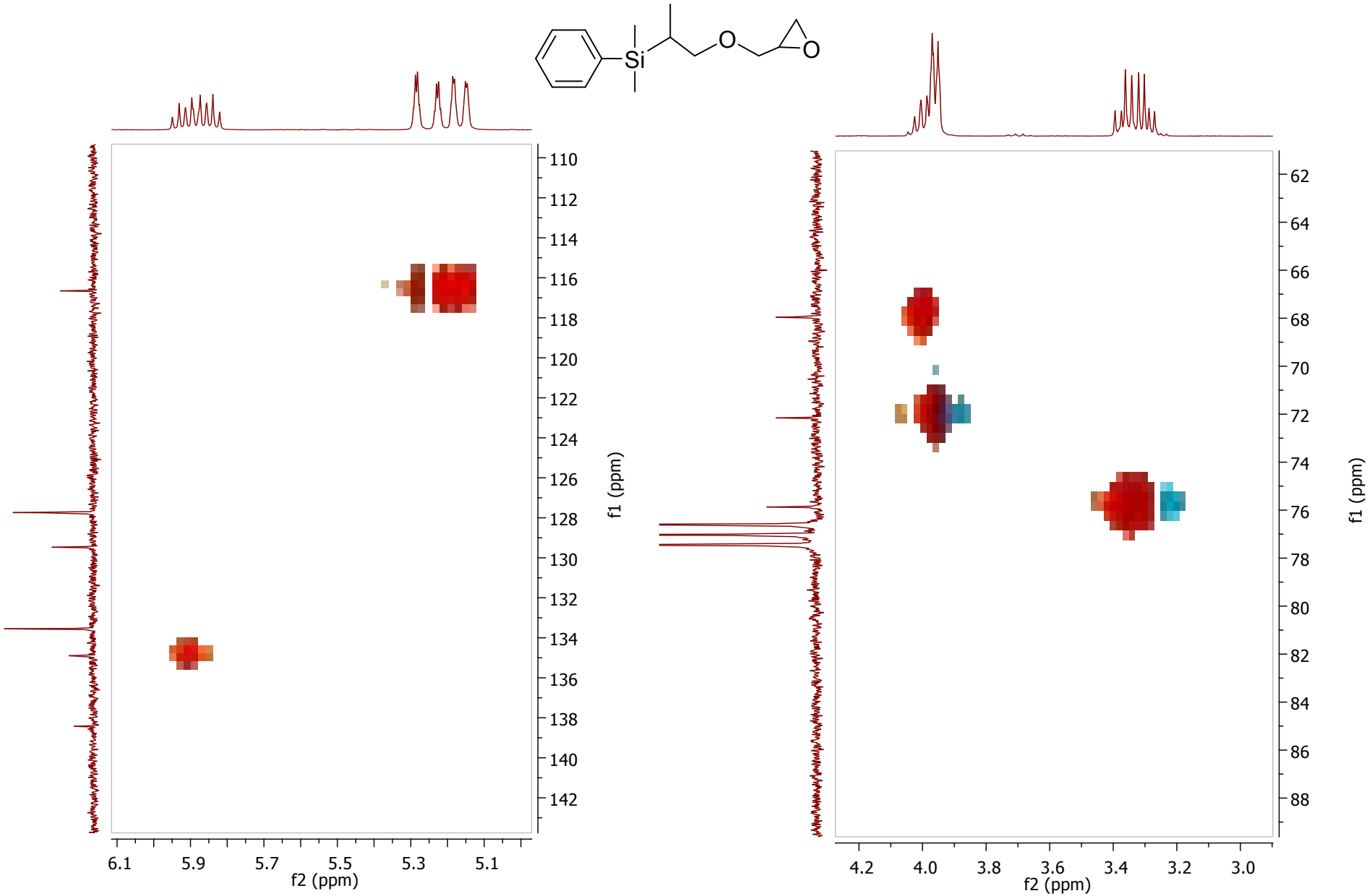

135.61
134.89
129.95
127.82
116.70
75.90
72.12
68.84
20.78
Si
O
O
4000
3500
3000
2500
2000
1500
1000
500
0
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
f1 (ppm)

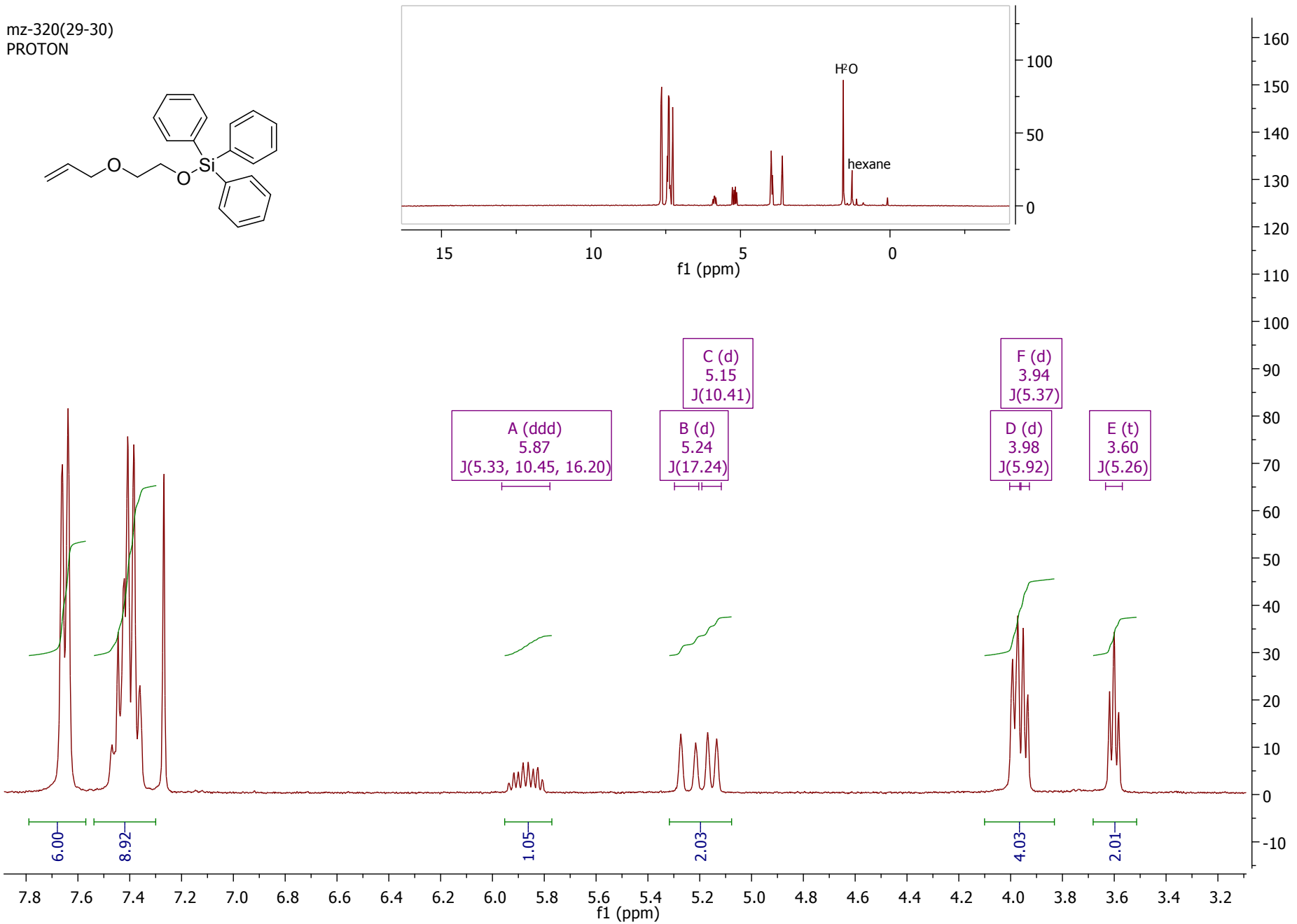

Si
O
O
f2 (ppm)
f1 (ppm)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
20
30
40
50
60
70
80
90
100
110
120
130
140
150
6.0
5.6
5.2

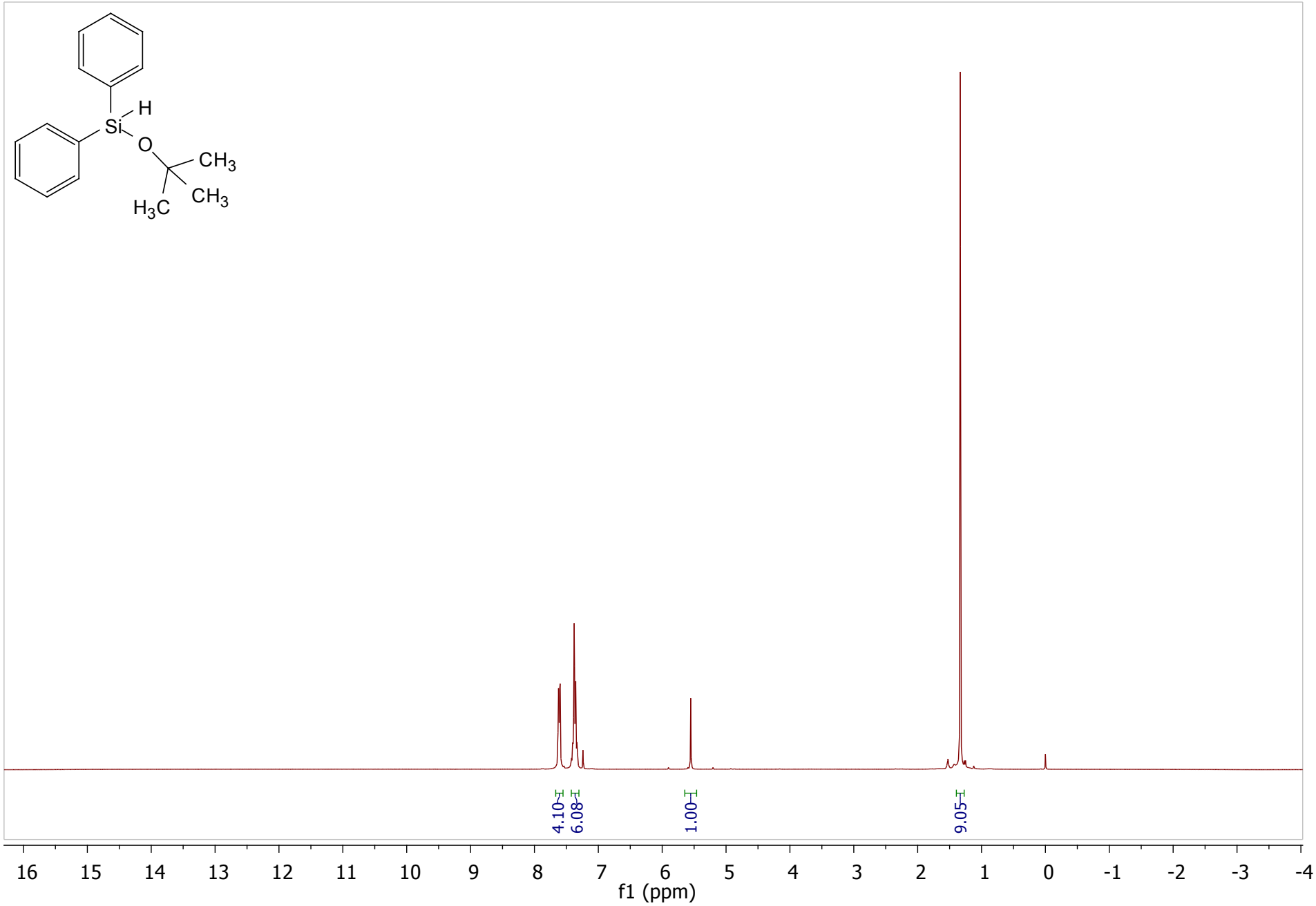

Si
O
O
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
2.04
3.04
1.00
0.96
0.95
2.94
2.16
3.02
6.05
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
f1 (ppm)


138.43
134.90
133.55
129.47
127.74
116.65
75.87
72.15
67.96
20.71
-1.02
-1.13
Si
O
O
f1 (ppm)


Si
O
O
f2 (ppm)
f1 (ppm)


Si
O
O
f1 (ppm)
f2 (ppm)
110
112
114
116
118
120
122
124
126
128
130
132
134
136
138
140
142
6.1
5.9
5.7
5.5
5.3
5.1
62
64
66
68
70
72
74
76
78
80
82
84
86
88
4.2
4.0
3.8
3.6
3.4
3.2
3.0


mz-320(29-30)
PROTON
O
O
Si
H2O
hexane
f1 (ppm)
A (ddd)
5.87
J(5.33, 10.45, 16.20)
B (d)
5.24
J(17.24)
C (d)
5.15
J(10.41)
D (d)
3.98
J(5.92)
E (t)
3.60
J(5.26)
F (d)
3.94
J(5.37)
6.00
8.92
1.05
2.03
4.03
2.01
f1 (ppm)


H
Si
O
CH3
CH3
H3C
4.10
6.08
1.00
9.05
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
f1 (ppm)

4. GC-MS chromatogram of a reaction of 1,1,2,2-tetramethyldisiloxane with styrene and $NaHBEt_3$