Supporting Information

Synthesis of Azasilacyclopentenes and Silanols via Huisgen Cycloaddition-Initiated C-H Bond Insertion Cascades

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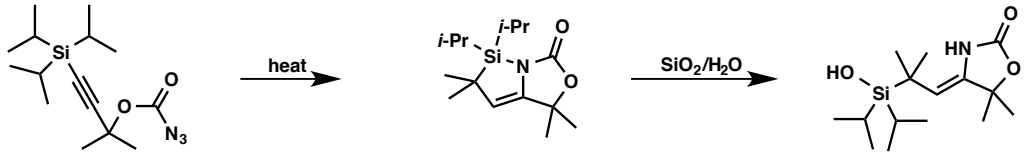
General Considerations

All reactions were carried out in flame or oven-dried glassware. Hexanes, THF, toluene, dichloroethane, and CH_2Cl_2 were purged with argon and dried over activated alumina columns. Isopropyl acetate was dried over Na_2SO_4 before usage. Flash chromatography was performed on 60 Å silica gel (Sorbent Technologies). Analytical thin layer chromatography was performed on EMD silica gel/TLC plates with fluorescent indicator 254 nm. The ^1H and ^{13}C NMR spectra were recorded on a JEOL ECA-500 or ECX-400P spectrometer using the residual solvent peak as an internal reference ($CDCl_3$: 7.24 ppm for ^1H NMR and 77.0 ppm for ^{13}C NMR). NMR yields were determined by addition of 0.5 equivalents of methyl (4-nitrophenyl) carboxylate as an internal standard to the crude reaction mixture. IR spectra were obtained using a ThermoNicolet Avatar 370 FT-IR instrument. GCMS analyses were performed on a Shimadzu GCMS-QP2010S chromatographer equipped with a Shimadzu column (SHRXI-5MS, 0.25 mm x 0.25 u x 30 M). HRMS analyses were performed under contract by UT Austin's mass spectrometric facility via positive mode ESI or CI methods on a US10252005 instrument. Commercially available compounds were purchased from Aldrich Chemical Co., Acros Organics, Alfa Aesar or TCI America and were used without further purification.

Reaction Optimization

A 2 dram vial was charged with a magnetic spin bar, carbonazidate **20a** (30.9 mg, 0.1 mmol, 1 equiv), additive, and dry solvent (0.1M, 1 mL). The reaction vessel was sealed and heated in an oil bath at 90 °C (or 100 °C). **(Warning: Pressure buildup may occur during the reaction.)** The progress of the reaction was monitored by TLC. After the reaction was finished, the reaction vessel was cooled to room temperature and the mixture was concentrated under reduced pressure. To the crude product was added methyl-4-nitro-benzoate (9.1 mg, 0.05 mmol, 0.5 equiv) and $CDCl_3$ (0.7 mL). The yield of the azasilacyclopentene was calculated based on ^1H NMR peak integration relative to the methyl group of methyl-4-nitro-benzoate. NMR data was collected using a relaxation delay of 30 sec. (The experiments were conducted to show that RD = 30 sec was required to achieve quantitative information.) The crude product was purified by column chromatography on silica gel to give silanol **69a**.



Entry	Solvent	Additive	T, °C	Rxn time	c, M	NMR yield% of ***21a*** (isolated of ***69a***)
1	*i*-PrOAc	-	90	18	0.1	48 (48)
2	PhMe	-	90	18	0.1	31
3	hexanes	-	90	18	0.1	53 (50)
4	MeCN	-	90	18	0.1	5
5	THF	-	90	18	0.1	48
6	CH_2Cl_2	1 mol% $Rh_2(esp)_2$	R.T.	48	0.1	-
7	hexanes	silica gel	100	6	0.1	-
8	hexanes	-	100	6	0.05	49
9	hexanes	-	100	6	0.2	47
10	acetone	-	90	12	0.1	18
11	hexanes	1 mol% $Rh_2(oct)_4$	90	12	0.1	29
12	hexanes	1 mol% $Rh_2(esp)_2$	90	18	0.1	43
13	hexanes	2 mol% Cp*RuCl(cod)	90	18	0.1	19
14	hexanes	0.5 equiv K_2CO_3	90	18	0.1	38
15	heptane	-	90	18	0.1	31
16	cyclohexane	-	90	18	0.1	31

Figure 1. Optimization Table.

The Identification of the Azasilacyclopentene

Carbonazidate **20b** was synthesized from alcohol **SI-13** and $Na^{15}N_3$ using General Procedure C. Azasilacyclopentene **21b** was synthesized from carbonazidate **20b** using General Procedure D1(**Figure 2**). The NMR signals of **21a** (the vinyl proton: 4.36 ppm; enamine carbons: 108.3, 150.2 ppm) matched those of oxasilacyclopentenes (**22** to **22b**)

In addition, the ^{15}N NMR analysis of ^{15}N enriched azasilacyclopentene **21b** (110.5 ppm, no signals from 305 to 375 ppm) suggested the nitrogen was involved in an enamine motif, which confirmed the assignment from ^{1}H and ^{13}C NMR.

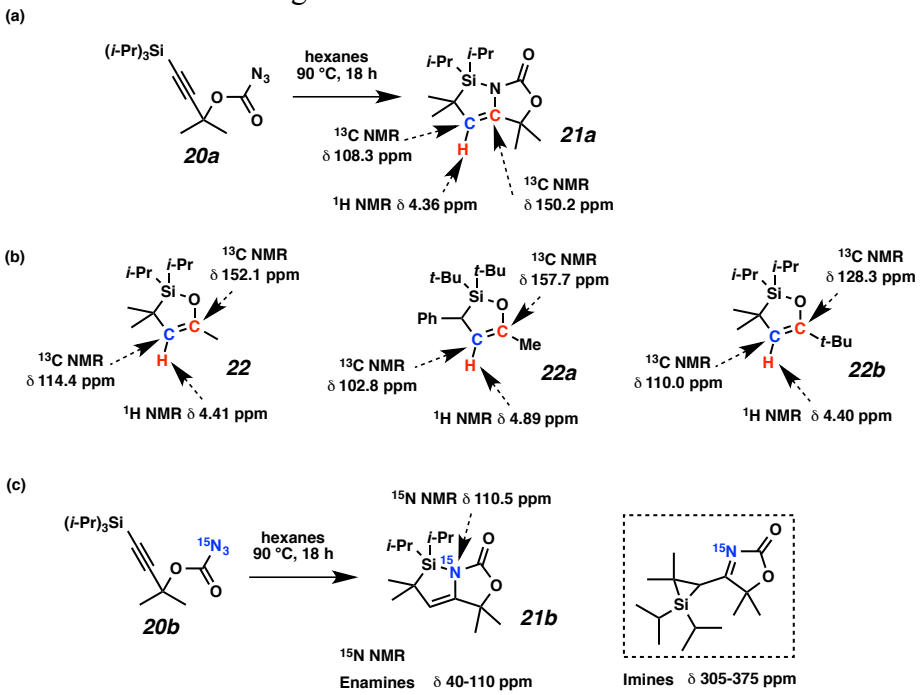
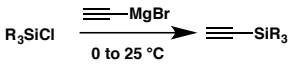


Figure 2. The Identification of the Azasilacyclopentene.

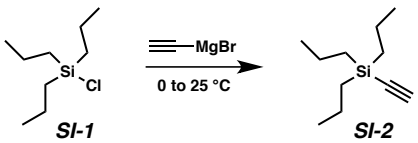
Synthesis of Compounds

Synthesis of Alkynylsilanes

General Procedure A

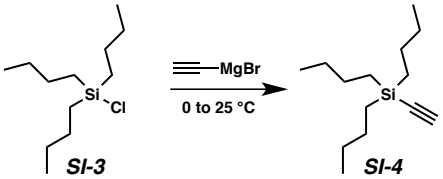


A flame-dried round-bottom flask was charged ethynylmagnesium bromide (1.2 equiv, 0.5 M) under an argon atmosphere. The reaction was cooled to 0 °C in an ice bath. The chlorosilane (1.0 equiv) was then added dropwise into the reaction, and the reaction mixture was allowed to warm up to 25 °C and stirred for 12 hours. Afterwards, the reaction was quenched with H_2O and saturated $NH_4Cl_{(aq)}$, and the mixture was extracted with hexanes (3x). The organic phases were combined and washed with brine, dried over anhydrous $MgSO_4$, filtered through a short plug of silica gel and concentrated under reduced pressure to yield the product. No further purification was necessary.

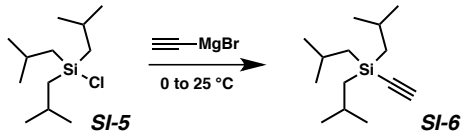


ethynyltri-*n*-propylsilane (SI-2) was synthesized from tri-*n*-propylsilyl chloride (2 mL, 1.764 g, 9.15 mmol) using General Procedure A. The product was obtained as a colorless

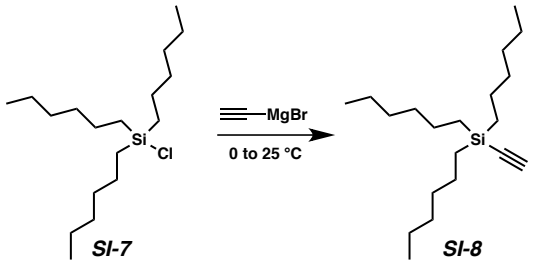
oil. (1.5221 g, 91% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 2.35 (s, 1H), 1.49–1.33 (m, 6H), 0.96 (t, J = 7.3 Hz, 9H), 0.65–0.55 (m, 6H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 94.0, 88.3, 18.2, 17.4, 15.8. **IR(neat)** 3294, 2955, 2926, 2869, 2033, 1455, 1408, 1333, 1066, 1005, 710, 669 cm^{-1}. **HRMS** (CI) *m/z*: 182.1485 [$(M)^+$; calculated for $C_{11}H_{22}Si$: 182.1491]. **R_F**: 0.79 in 5% EtOAc/Hex.



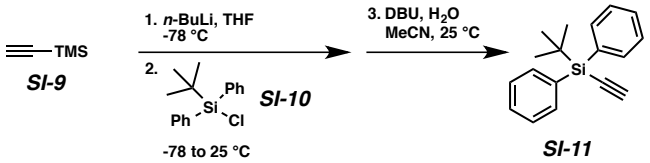
tri-*n*-butyl(ethynyl)silane (SI-4) was synthesized from tri-*n*-butylsilyl chloride (2 mL, 1.766 g, 7.52 mmol) using General Procedure A. The product was obtained as a colorless oil. (1.6663 g, 99% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 2.35 (s, 1H), 1.41–1.26 (m, 12H), 0.94-0.80 (m, 9H), 0.67–0.54 (m, 6H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 94.0, 88.3, 26.4, 26.0, 13.8, 12.8. **IR(neat)** 3294, 2956, 2921, 2872, 2857, 2033, 1464, 1408, 1377, 1192, 1081, 1028, 1000, 963, 885, 787, 758, 711, 669 cm^{-1}. **HRMS** (CI) *m/z*: 224.1957 [$(M)^+$; calculated for $C_{14}H_{28}Si$: 224.1960]. **R_F**: 0.79 in 5% EtOAc/Hex.



ethynyltriisobutylsilane (SI-6) was synthesized from triisobutylsilyl chloride (0.8 mL, 0.7096 g, 3 mmol) using General Procedure A. The product was obtained as a colorless oil. (0.651 g, 90% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 2.39 (s, 1H), 1.92–1.79 (m, 3H), 0.96 (d, J = 6.8 Hz, 18H), 0.63 (d, J = 6.9 Hz, 6H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 94.6, 89.5, 26.2, 25.0, 24.7. **IR(neat)** 3284, 2952, 2896, 2867, 2033, 1464, 1400, 1381, 1364, 1328, 1217, 1163, 1093, 1039, 950, 830, 762, 669 cm^{-1}. **HRMS** (CI) *m/z*: 223.1882 [$(M-H)^+$; calculated for $C_{14}H_{27}Si$: 223.1882]. **R_F**: 0.8 in 5% EtOAc/Hex.



ethynyltri-*n*-hexylsilane (SI-8) was synthesized from tri-*n*-hexylsilyl chloride (2 mL, 1.7420 g, 5,3 mmol) using General Procedure A. The product was obtained as a colorless oil. (1.6460 g, 99% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 2.34 (s, 1H), 1.40–1.18 (m, 24H), 0.92-0.81 (m, 9H), 0.67–0.53 (m, 6H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 94.0, 88.4, 33.1, 31.5, 23.7, 22.6, 14.1, 13.0. **IR(neat)** 3294, 2956, 2920, 2872, 2854, 2033, 1466, 1408, 1377, 1340, 1182, 1101, 995, 961, 889, 846, 764, 710, 669 cm^{-1}. **HRMS** (CI) *m/z*: 308.2888 [$(M)^+$; calculated for $C_{20}H_{40}Si$: 308.2899]. **R_F**: 0.8 in 5% EtOAc/Hex.

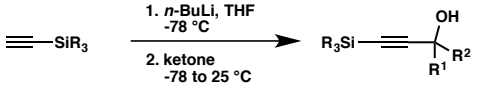


***tert*-butyl(ethynyl)diphenylsilane (SI-11)**

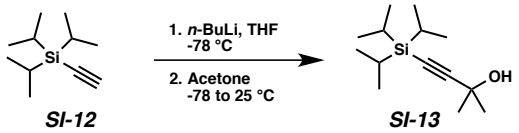
A flame-dried round-bottom flask was charged with *n*-BuLi (2.5 M, 1.3 equiv, 39 mmol, 15.6 mL) under an argon atmosphere. Anhydrous THF (0.5 M, 50 mL) was added, and the mixture was cooled to -78 °C in a dry ice/acetone bath. Trimethylsilylacetylene (1.3 equiv, 39 mmol, 5.6 mL) was then added dropwise. After the reaction was stirring for 15 minutes at -78 °C, *tert*-butyl(chloro)diphenylsilane (7.8 mL, 30 mmol) was added dropwise. The reaction mixture was allowed to warm up to 25 °C and stirred for 2 hours. After completion, saturated NH_4Cl solution was added. The mixture was extracted with Et_2O (3x), and the organic phases were combined and washed with brine, dried over anhydrous $MgSO_4$, filtered, and concentrated to yield crude product. The crude product was subjected to the next step without further purification. The crude product was dissolved in MeCN (0.5 M, 60 mL) and water (10.0 M, 3 mL). Diazobicycloundecene (DBU, 1.0 equiv, 4.5 mL, 30 mmol) was added into the reaction. The progress of the reaction was monitored by TLC. After completion (5 h), the reaction was concentrated to yield crude product, and purification was done by column chromatography on silica gel using a gradient of 0 to 1 % EtOAc in hexanes as eluents. The product was obtained as a white solid. (4.4788 g, 56.5% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.83–7.78 (m, 4H), 7.45–7.33 (m, 6H), 2.71 (s, 1H), 1.11 (s, 9H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 135.5, 132.6, 129.6, 127.8, 97.2, 85.4, 26.9, 18.4. **IR(neat)** 3266, 3065, 2959, 2946, 2857, 2035, 1485, 1468, 1426, 1390, 1372, 1361, 1259, 1105, 1007, 820, 742, 691, 660 cm^{-1}. **HRMS** (CI) *m/z*: 264.1333 [$(M)^+$; calculated for $C_{18}H_{20}Si$: 264.1334]. **R_F**: 0.5 in 2% EtOAc/Hex. **MP**: 66-68 °C.

Synthesis of Propargyl Alcohols

General Procedure B

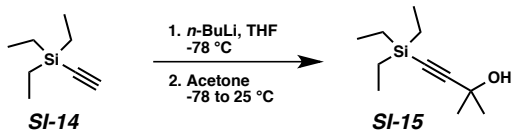


A flame-dried round-bottom flask was charged with *n*-BuLi (2.5 M, 1.2 equiv, 4.8 mmol) under Argon atmosphere. Anhydrous THF (0.5 M, 8 mL) was added, and the reaction was cooled to -78 °C in a dry ice/acetone bath. The silyl acetylene (1.3 equiv, 5.2 mmol) was then added dropwise. The reaction was allowed to stir for 20 minutes at -78 °C. Then, ketone (1 equiv, 4 mmol) was added dropwise. The reaction mixture was allowed to warm to 25 °C and stirred for 2 hours. After completion, saturated NH_4Cl solution was added to quench the reaction. The mixture was extracted with Et_2O three times, and the organic phases were combined and washed with brine, dried over anhydrous $MgSO_4$, filtered through a celite pad, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel.



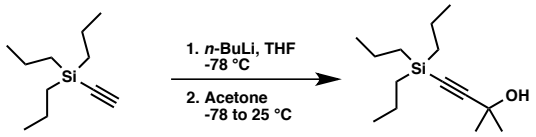
SI-12 *SI-13*

2-methyl-4-(triisopropylsilyl)but-3-yn-2-ol (SI-13) was synthesized from triisopropylsilylacetylene and acetone using General Procedure B. The crude product was purified by column chromatography on silica gel using 10% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.777 g, 88% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 1.92 (s, 1H), 1.51 (s, 6H), 1.08–0.99 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 112.7, 82.1, 65.5, 31.6, 18.6, 11.1. **IR(neat)** 3343, 2942, 2892, 2865, 2167, 2032, 1463, 1364, 1220, 1164, 996, 968, 912, 881, 786, 674, 658 cm^{-1}. **HRMS** (CI) *m/z*: 240.1906 [$(M)^+$; calculated for $C_{14}H_{28}OSi$: 240.1909]. **R_F**: 0.27 in 10% EtOAc/Hex.



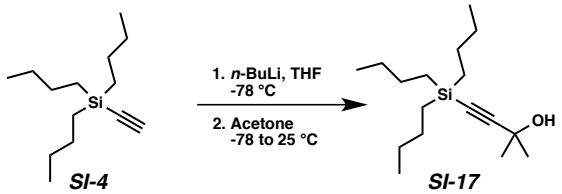
SI-14 *SI-15*

2-methyl-4-(triethylsilyl)but-3-yn-2-ol (SI-15) was synthesized from triethylsilylacetylene and acetone using General Procedure B. The crude product was purified by column chromatography on silica gel using 10% Et_2O in pentane as an eluent. The product was obtained as a colorless oil. (0.7801 g, 98% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.92 (s, 1H), 1.50 (s, 6H), 0.96 (t, *J* = 8.0 Hz, 9H), 0.56 (q, *J* = 8.0 Hz, 6H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 111.9, 83.2, 65.5, 31.5, 7.4, 4.3. **IR(neat)** 3340, 2955, 2912, 2875, 2168, 1457, 1362, 1220, 1164, 1005, 912, 789, 722, 701 cm^{-1}. **HRMS** (CI) *m/z*: 198.1441 [$(M)^+$; calculated for $C_{11}H_{22}OSi$: 198.1440]. **R_F**: 0.15 in 10% Et_2O/pentane.

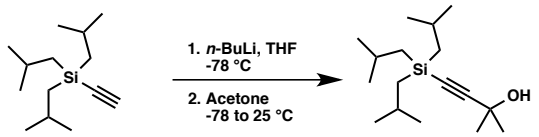


SI-2 *SI-16*

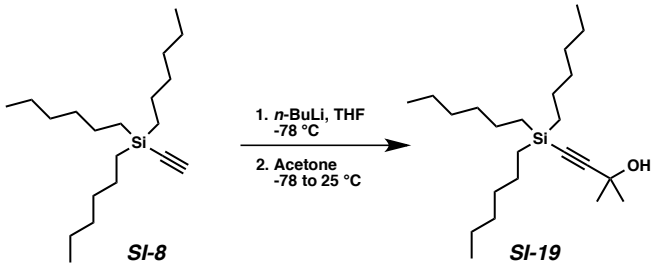
2-methyl-4-(tripropylsilyl)but-3-yn-2-ol (SI-16) was synthesized from tri-*n*-propylsilylacetylene and acetone using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 5% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.9908 g, 98% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 1.89 (s, 1H), 1.49 (s, 6H), 1.43–1.31 (m, 6H), 0.95 (t, *J* = 7.2 Hz, 9H), 0.61–0.51 (m, 6H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 111.8, 84.1, 65.5, 31.4, 18.2, 17.4, 16.0. **IR(neat)** 3344, 2954, 2926, 2868, 2168, 1455, 1408, 1374, 1362, 1333, 1217, 1164, 1065, 1031, 1004, 912, 786, 814, 739, 699 cm^{-1}. **HRMS** (CI) *m/z*: 240.1905 [$(M)^+$; calculated for $C_{14}H_{28}OSi$: 240.1909]. **R_F**: 0.36 in 10% EtOAc/Hex.



2-methyl-4-(tributylsilyl)but-3-yn-2-ol (SI-17) was synthesized from tri-*n*-butylsilylacetylene and acetone using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 5% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (1.0730 g, 95% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.88 (s, 1H), 1.49 (s, 6H), 1.40–1.19 (m, 12H), 0.94–0.77 (m, 9H), 0.66–0.47 (m, 6H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 111.7, 84.1, 76.9, 65.5, 31.4, 26.4, 26.1, 13.8, 12.9. **IR(neat)** 3295, 2951, 2895, 2867, 2168, 2033, 1463, 1400, 1380, 1163, 1093, 912, 793, 670 cm^{-1}. **HRMS** (CI) *m/z*: 282.2374 [$(M)^+$; calculated for $C_{17}H_{34}OSi$: 282.2379]. **R_F**: 0.42 in 10% EtOAc/Hex.

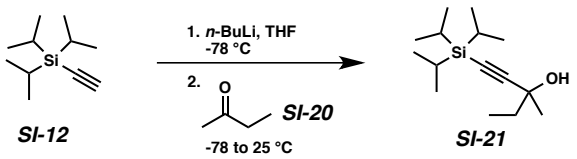


2-methyl-4-(triisobutylsilyl)but-3-yn-2-ol (SI-18) was synthesized from triisobutylsilylacetylene and acetone using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 5% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (1.0730 g, 95% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.90–1.72 (m, 3H), 1.48 (s, 6H), 0.95 (d, J = 6.5 Hz, 18H), 0.59 (d, J = 6.9 Hz, 6H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 112.0, 9.5, 65.4, 31.2, 26.2, 25.0, 24.9. **IR(neat)** 3347, 2951, 2895, 2867, 2168, 1463, 1400, 1379, 1364, 1217, 1163, 1092, 912, 829, 793, 768 cm^{-1}. **HRMS** (CI) *m/z*: 282.2374 [$(M)^+$; calculated for $C_{17}H_{34}OSi$: 282.2379]. **R_F**: 0.42 in 10% EtOAc/Hex.

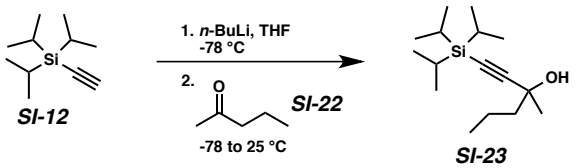


2-methyl-4-(trihexylsilyl)but-3-yn-2-ol (SI-19) was synthesized from tri-*n*-hexylsilylacetylene and acetone using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 5% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (1.3544 g, 92% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.49 (s, 6H), 1.37–1.17 (m, 24H), 0.95–0.80 (m, 9H), 0.64–0.48 (m, 6H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 111.7, 84.2, 65.4, 33.1, 31.5, 31.4, 23.8, 22.6, 14.2, 13.2. **IR(neat)** 3345, 2956, 2920, 2872, 2854, 2167 1457, 1408, 1362, 1219,

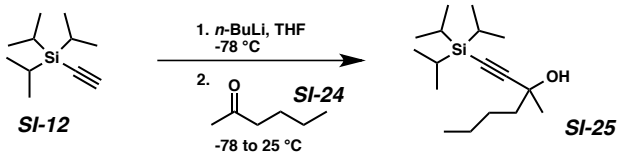
1165 968, 913, 846, 791, 700 cm^{-1}. **HRMS** (CI) *m/z*: 367.3386 $[(M+H)^+$; calculated for $C_{23}H_{47}OSi$: 367.3396]. $\mathbf{R_F}$: 0.45 in 10% EtOAc/Hex.



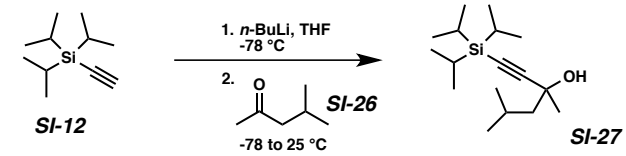
3-methyl-1-(triisopropylsilyl)pent-1-yn-3-ol (SI-21) was synthesized from triisopropylsilylacetylene and 2-butanone using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 5% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.813 g, 89% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.89 (s, 1H), 1.77–1.56 (m, 2H), 1.46 (s, 3H), 1.08–0.96 (m, 24H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 111.4, 83.4, 69.1, 36.6, 29.5, 18.6, 11.1, 9.1. **IR(neat)** 3360, 2941, 2891, 2865, 2165, 1462, 1382, 1366, 1323, 1288, 1157, 1126, 1073, 1053, 1034, 1012, 995, 930, 909, 881, 793, 766, 674, 658 cm^{-1}. **HRMS** (CI) *m/z*: 254.2065 $[(M)^+$; calculated for $C_{15}H_{30}OSi$: 254.2066]. $\mathbf{R_F}$: 0.42 in 10% EtOAc/Hex.



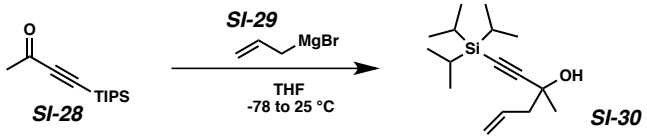
3-methyl-1-(triisopropylsilyl)hex-1-yn-3-ol (SI-23) was synthesized from triisopropylsilylacetylene and 2-pentanone using General Procedure B. The crude product was purified by column chromatography on silica gel using 5% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.902 g, 84% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.89 (s, 1H), 1.70–1.48 (m, 4H), 1.46 (s, 3H), 1.13–0.97 (m, 21H), 0.94 (t, J = 7.2 Hz, 3H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 111.7, 83.2, 68.6, 46.0, 30.0, 18.6, 18.1, 14.3, 11.1. **IR(neat)** 3373, 2958, 2941, 2892, 2865, 2165, 1463, 1366, 1382, 1284, 1253, 1159, 1131, 1073, 1051, 1017, 995, 934, 904, 882, 794, 674, 659 cm^{-1}. **HRMS** (CI) m/z: 268.2229 $[(M)^+$; calculated for $C_{16}H_{32}OSi$: 268.2222]. $\mathbf{R_F}$: 0.4 in 10% EtOAc/Hex.



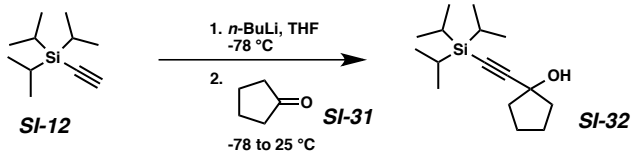
3-methyl-1-(triisopropylsilyl)hept-1-yn-3-ol (SI-25) was synthesized from triisopropylsilylacetylene and 2-hexanone using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 5% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (904 mg, 80% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.88 (s, 1H), 1.67–1.45 (m, 4H), 1.46 (s, 3H), 1.41–1.26 (m, 2H), 1.11-0.97 (m, 21H), 0.90 (t, J = 7.3 Hz, 3H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 111.8, 83.3, 68.6, 43.4, 29.9, 27.0, 22.8, 18.6, 14.1, 11.1. **IR(neat)** 3374, 2941, 2864, 2164, 1463, 1129, 1087, 949, 909, 675, 659 cm^{-1}. **HRMS** (CI) *m/z*: 282.2386 $[(M)^+$; calculated for $C_{17}H_{34}OSi$: 282.2379]. $\mathbf{R_F}$: 0.3 in 5% EtOAc/Hex.



3,5-dimethyl-1-(triisopropylsilyl)hex-1-yn-3-ol (SI-27) was synthesized from triisopropylsilylacetylene and methyl isobutyl ketone using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 5% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (1.1075 g, 98% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 2.04–1.88 (m, 1H), 1.85 (s, 1H), 1.57 (d, *J* = 6.2 Hz, 2H), 1.48 (s, 3H), 1.09–0.95 (m, 27H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 112.0, 94.7, 8.6, 68.5, 51.7, 31.3, 25.3, 24.3, 24.1, 18.5, 11.1. **IR(neat)** 3440, 2943, 2865, 2164, 2032, 1463, 1383, 1073, 1045, 1017, 944, 919, 881, 673, 660 cm^{-1}. **HRMS** (CI) m/z: 282.2381 [$(M)^+$; calculated for $C_{17}H_{34}OSi$: 282.2379]. **R_F**: 0.42 in 10% EtOAc/Hex.

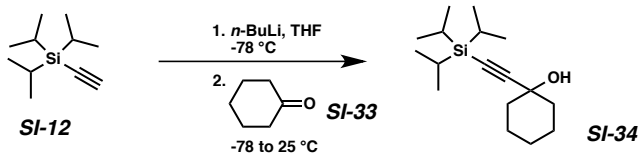


3-methyl-1-(triisopropylsilyl)hex-5-en-1-yn-3-ol (SI-30)
To a flame-dried round-bottom flask was added ynone **SI-28** (1.12 g, 5 mmol, 1 equiv) and THF (6 mL). The reaction was cooled to -78 °C. After stirring for 10 min at -78 °C, allylmagnesium bromide (1 M in Et_2O, 6 mL, 6 mmol, 1.2 equiv) was added to the reaction. The reaction was allowed to warm to 25 °C. After completion, saturated NH_4Cl solution was added to quench the reaction. The mixture was extracted with Et_2O three times, and the organic phases were combined and washed with brine, dried over anhydrous $MgSO_4$, filtered through a celite pad, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel with a gradient of 1 to 2% ethyl acetate in hexanes as eluents. The product was obtained as colorless oil. (1 g, 75% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 6.02–5.91 (m, 1H), 5.24–5.11 (m, 2H), 2.47 (dd, *J* = 13.4, 6.5 Hz, 1H), 2.36 (dd, *J* = 13.5, 8.1 Hz, 1H), 1.48 (s, 3H), 1.10–0.98 (m, 21H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 133.4, 119.5, 111.1, 83.7, 67.3, 48.3, 29.5, 18.6, 11.1. **IR(neat)** 3373, 2942, 2892, 2865, 2166, 1642, 1463, 1382, 1367, 1260, 1110, 1073, 995, 942, 916, 882, 799, 675 cm^{-1}. **HRMS** (ESI) *m/z*: 289.1962 [$(M+Na)^+$; calculated for $C_{16}H_{30}OSi$: 289.1958]. **R_F**: 0.21 in 5% EtOAc/Hex.

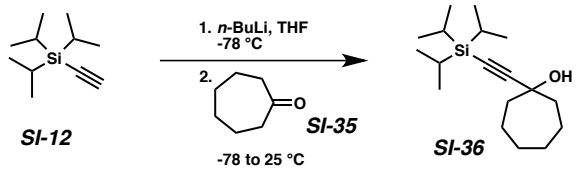


1-((triisopropylsilyl)ethynyl)cyclopentan-1-ol (SI-32) was synthesized from triisopropylsilylacetylene and cyclopentanone using General Procedure B. The crude product was purified by column chromatography on silica gel using 5% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.9167 g, 86% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 2.06–1.62 (m, 8H), 1.09–0.98 (m, 21H). **^{13}C NMR**

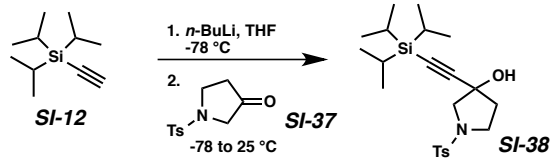
(125.77 MHz, $CDCl_3$) δ 111.9, 83.1, 74.9, 42.7, 23.5, 18.6, 11.1. **IR(neat)** 3334, 2942, 2891, 2864, 2161, 1462, 1382, 1366, 1314, 1208, 1073, 994, 944, 918, 672 cm^{-1}. **HRMS** (CI) *m/z*: 266.2066 [$(M)^+$; calculated for $C_{16}H_{30}OSi$: 266.2066]. $\mathbf{R_F}$: 0.18 in 5% EtOAc/Hex.



1-((triisopropylsilyl)ethynyl)cyclohexan-1-ol (SI-34) was synthesized from triisopropylsilylacetylene and cyclohexanone using General Procedure B. The crude product was purified by column chromatography on silica gel using 5% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.9875 g, 88% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 2.18 (s, 1H), 1.96–1.83 (m, 2H), 1.72–1.62 (m, 2H), 1.60–1.45 (m, 6H), 1.11–0.92 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 111.5, 84.5, 69.2, 40.1, 25.2, 23.5, 18.6, 11.1. **IR(neat)** 3339, 2934, 2891, 2863, 2163, 1446, 1462, 1382, 1366, 1281, 1257, 1132, 1032, 995, 918, 881, 760, 658 cm^{-1}. **HRMS** (CI) *m/z*: 280.2217 [$(M)^+$; calculated for $C_{17}H_{32}OSi$: 280.2222]. $\mathbf{R_F}$: 0.2 in 5% EtOAc/Hex.

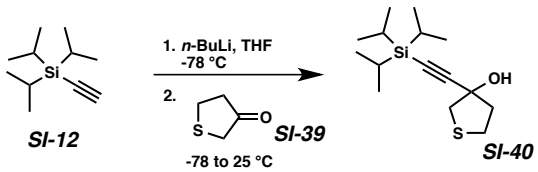


1-((triisopropylsilyl)ethynyl)cycloheptan-1-ol (SI-36) was synthesized from triisopropylsilylacetylene and cycloheptanone using General Procedure B. The crude product was purified by column chromatography on silica gel using 5% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (1.1546 g, 98% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 2.06–1.89 (m, 2H), 1.86–1.72 (m, 2H), 1.72–1.46 (m, 8H), 1.12–0.87 (m, 21H).**^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 112.5, 83.8, 72.3, 43.2, 27.7, 22.3, 18.6, 11.1. **IR(neat)** 2939, 2863, 2163, 2031, 1461, 1383, 1366, 1242, 1200, 1058, 1018, 995, 920, 882, 795, 750, 723, 673 cm^{-1}. **HRMS** (CI) *m/z*: 294.2369 [$(M)^+$; calculated for $C_{18}H_{34}OSi$: 294.2379]. $\mathbf{R_F}$: 0.36 in 10% EtOAc/Hex.

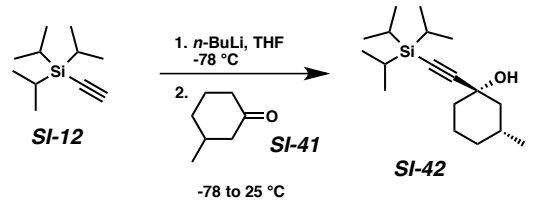


1-tosyl-3-((triisopropylsilyl)ethynyl)pyrrolidin-3-ol (SI-38) synthesized from triisopropylsilylacetylene and 1-tosylpyrrolidin-3-one using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of 15 to 20% EtOAc in hexanes as eluents. The product was obtained as a white solid. (1.2800 g, 76% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.70 (d, J = 8.4 Hz, 2H), 7.29 (d, J = 8.0 Hz, 2H), 3.58–3.42 (m, 3H), 3.41–3.31 (m, 1H), 2.40 (s, 3H), 2.16–2.03 (m, 2H), 1.86 (s, 1H), 1.07–0.90 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 143.5, 133.9, 129.6,

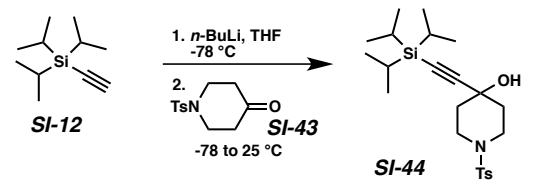
127.5, 106.2, 86.7, 72.0, 61.1, 46.5, 40.9, 21.5, 18.5, 10.9. **IR(neat)** 3455, 2942, 2891, 2864, 2167, 1597, 1462, 1383, 1323, 1304, 1290, 1242, 1153, 1110, 1037, 1017, 997, 925, 881, 804, 756, 699 cm^{-1}. **HRMS** (ESI) *m/z*: 444.2004 $[(M+Na)^+$; calculated for $C_{22}H_{35}NO_3SSiNa$: 444.1999]. $\mathbf{R_F}$: 0.3 in 20% EtOAc/Hex. **MP**: 86-87 °C.



3-((triisopropylsilyl)ethynyl)tetrahydrothiophen-3-ol (SI-40) was synthesized from triisopropylsilylacetylene and dihydrothiophen-3(2*H*)-one using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 5% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.455 g, 40% yield). ^{1}**H NMR** (500 MHz, $CDCl_3$) δ 3.18 (d, *J* = 11.5 Hz, 1H), 3.06–2.86 (m, 3H), 2.40–2.29 (m, 1H), 2.27 (s, 1H), 2.21–2.09 (m, 1H), 1.15–0.88 (m, 21H). ^{13}**C NMR** (125.77 MHz, $CDCl_3$) δ 107.4, 85.6, 75.6, 44.8, 44.5, 28.7, 18.5, 11.0. **IR(neat)** 3382, 2941, 2890, 2864, 2163, 1462, 1428, 1382, 1366, 1270, 1233, 1209, 1061, 1029, 950, 918, 881, 831, 781, 751, 671 cm^{-1}. **HRMS** (CI) *m/z*: 284.1629 $[(M)^+$; calculated for $C_{15}H_{28}OSSi$: 284.1630]. $\mathbf{R_F}$: 0.36 in 10% EtOAc/Hex.

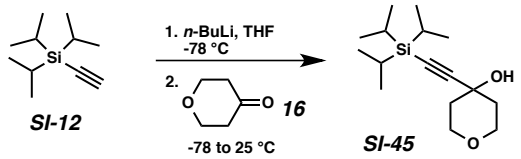


(1*S*,3*R*)-3-methyl-1-((triisopropylsilyl)ethynyl)cyclohexan-1-ol (SI-42) was synthesized from triisopropylsilylacetylene and 3-methylcyclohexanone using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of 1 to 2% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.685 g, 56% yield). ^{1}**H NMR** (500 MHz, $CDCl_3$) δ 2.12 (s, 1H), 1.98–1.87 (m, 2H), 1.79–1.50 (m, 4H), 1.42–1.29 (m, 1H), 1.20–0.95 (m, 22H), 0.90 (d, *J* = 6.8 Hz, 3H), 0.84–0.69 (m, 1H). ^{13}**C NMR** (125.77 MHz, $CDCl_3$) δ 111.3, 84.9, 69.9, 48.7, 39.9, 34.0, 30.6, 23.7, 22.1, 18.6, 11.1. **IR(neat)** 3349, 2927, 2892, 2864, 2159, 1460, 1366, 1327, 1073, 1051, 1001, 953, 942, 918, 882, 854, 813, 762, 675 cm^{-1}. **HRMS** (CI) *m/z*: 294.2371 $[(M)^+$; calculated for $C_{18}H_{34}OSi$: 294.2379]. $\mathbf{R_F}$: 0.2 in 5% EtOAc/Hex.

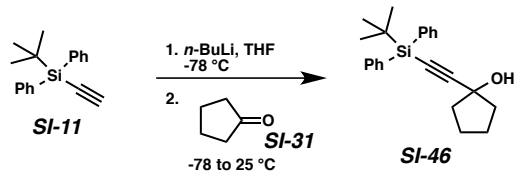


1-tosyl-4-((triisopropylsilyl)ethynyl)piperidin-4-ol (SI-44) synthesized from triisopropylsilylacetylene and 1-tosylpiperdin-4-one using General Procedure B. The crude product was purified by column chromatography on silica gel using a gradient of

15 to 20% EtOAc in hexanes as eluents. The product was obtained as a white solid. (1.436 g, 72% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.62 (d, *J* = 8.4 Hz, 2H), 7.29 (d, *J* = 8.1 Hz, 2H), 3.63–3.40 (m, 2H), 2.83–2.64 (m, 2H), 2.42 (s, 3H), 2.08–1.80 (m, 5H), 0.99–0.84 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 143.5, 132.7, 129.6, 127.6, 108.6, 86.9, 66.6, 43.7, 38.6, 21.5, 18.5, 10.9. **IR(neat)** 3493, 2940, 2864, 2170, 1743, 1597, 1494, 1379, 1351, 1319, 1190, 1169, 1158, 1141, 1047, 1002, 955, 801, 766, 730, 706 cm^{-1}. **HRMS** (ESI) *m/z*: 458.2158 [$(M+Na)^+$; calculated for $C_{23}H_{37}NO_3SSiNa$: 458.2156]. **R_F**: 0.24 in 20% EtOAc/Hex. **MP**: 153-154 °C.



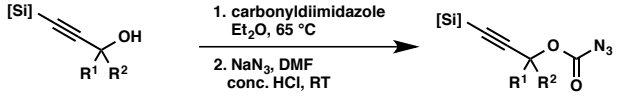
4-((triisopropylsilyl)ethynyl)tetrahydro-2*H*-pyran-4-ol (SI-45) was synthesized from triisopropylsilylacetylene and tetrahydro-*4H*-pyran-4-one using General Procedure B. The crude product was purified by column chromatography on silica gel using 10% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (1.0396 g, 92% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 3.99–3.82 (m, 2H), 3.73–3.55 (m, 2H), 2.28 (s, 1H), 1.98–1.84 (m, 2H), 1.84–1.74 (m, 2H), 1.13–0.88 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 109.9, 85.9, 66.4, 65.2, 40.2, 18.6, 11.1. **IR(neat)** 3416, 2942, 2891, 2864, 2162, 1463, 1425, 1384, 1366, 1335, 1300, 1275, 1233, 1160, 1134, 1011, 987, 958, 882, 842, 768, 674 cm^{-1}. **HRMS** (CI) *m/z*: 282.2021 [$(M)^+$; calculated for $C_{16}H_{30}O_2Si$: 282.2015]. **R_F**: 0.3 in 20% EtOAc/Hex.



1-((*tert*-butyldiphenylsilyl)ethynyl)cyclopentan-1-ol (SI-46) was synthesized from *tert*-butyl(ethynyl)diphenylsilane and cyclopentanone using General Procedure B. The crude product was purified by column chromatography on silica gel using 5% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.976 g, 70% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.81–7.72 (m, 4H), 7.44–7.29 (m, 6H), 2.18–1.95 (m, 4H), 1.95–1.69 (m, 4H), 1.06 (s, 9H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 135.5, 133.2, 129.5, 127.7, 114.0, 82.4, 75.0, 42.6, 27.0, 23.5, 18.5. **IR(neat)** 3343, 3070, 2957, 2929, 2856, 2162, 1471, 1428, 1389, 1361, 1258, 1208, 1106, 997, 941, 914, 883, 819, 740 cm^{-1}. **HRMS** (CI) *m/z*: 348.1905 [$(M)^+$; calculated for $C_{23}H_{28}OSi$: 348.1909]. **R_F**: 0.3 in 10% EtOAc/Hex.

Synthesis of Carbonazidates

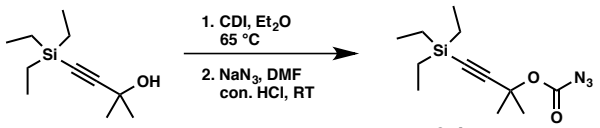
General Procedure C



A flame-dried heavy wall pressure vessel was charged with the propargyl alcohol (1.0 equiv, 3 mmol), carbonyldiimidazole (CDI, 2.0 equiv, 6 mmol, 973 mg), and anhydrous Et_2O (0.5 M, 6 mL) under an argon atmosphere. The reaction vessel was sealed and heated to reflux in an oil bath (65 °C). **(Warning: Pressure buildup may occur during the reaction.)** The progress of the reaction was monitored by TLC. (The reaction vessel should only be opened when cooled to room temperature!) After the reaction was done, the reaction vessel was cooled to room temperature, and the solvent was evaporated under a stream of nitrogen gas. The residue was then dissolved in DMF (0.5 M, 6 mL), and NaN_3 (5.0 equiv, 15 mmol, 975 mg) was added in one portion. The reaction mixture was acidified with concentrated HCl until pH ~ 6 (monitored by pH paper). The progress of the reaction was monitored by TLC. After the reaction was finished, deionized water was added and the mixture was extracted with Et_2O three times. The organic phases were combined and washed with brine, dried over anhydrous $MgSO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel. No decomposition of the carbonazidates was observed at room temperature after more than a month, but it is recommended to keep them at -20 °C for long-term storage.

SI-13 ***20a***

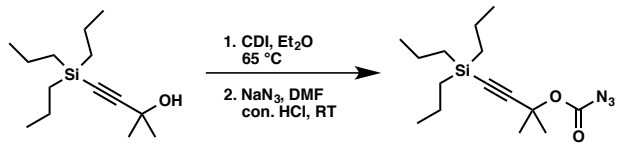
2-methyl-4-(triisopropylsilyl)but-3-yn-2-yl carbonazidate (20a) was synthesized from alcohol **SI-13** using General Procedure C. The crude product was purified by column chromatography on silica gel using a gradient of 0.5 to 1% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.680 g, 73% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 1.70 (s, 6H), 1.09–0.94 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.8, 106.5, 86.6, 76.3, 28.9, 18.5, 11.0. **IR(neat)** 2942, 2866, 2174, 2129, 1735, 1463, 1383, 1366, 1231, 1193, 1120, 1072, 996, 947, 919, 878, 796, 775, 676 cm^{-1}. **HRMS** (ESI) *m/z*: 332.1764 [$(M+Na)^+$; calculated for $C_{15}H_{27}N_3O_2SiNa$: 332.1765]. **R_F1** = 0.24 in 10% EtOAc/Hex. **R_F2** = 0.42 in 5% EtOAc/Hex.



SI-15 ***67b***

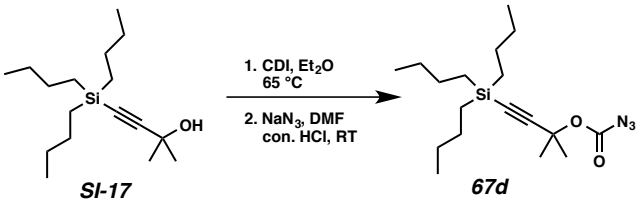
2-methyl-4-(triethylsilyl)but-3-yn-2-yl carbonazidate (67b) was synthesized from alcohol **SI-15** using General Procedure C. The crude product was purified by column

chromatography on silica gel using a gradient of 0.5 to 1% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.625 g, 78% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 1.69 (s, 6H), 0.96 (t, *J* = 7.9 Hz, 9H), 0.57 (q, *J* = 8.0 Hz, 6H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.9, 105.8, 87.6, 76.3, 28.8, 7.36, 4.2. **IR(neat)** 2956, 2913, 2876, 2174, 2129, 1735, 1458, 1415, 1383, 1366, 1229, 1192, 1119, 1015, 947, 875, 775, 724 cm^{-1}. **HRMS** (CI) *m/z*: 268.1476 [$(M+H)^+$; calculated for $C_{12}H_{22}N_3O_2Si$: 268.1481]. **R_F1** = 0.24 in 10% EtOAc/Hex. **R_F2** = 0.5 in 5% EtOAc/Hex.



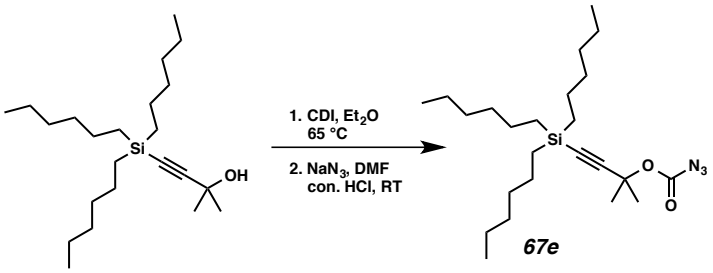
SI-16 ***67c***

2-methyl-4-(tripropylsilyl)but-3-yn-2-yl carbonazidate (67c) was synthesized from alcohol **SI-16** using General Procedure C. The crude product was purified by column chromatography on silica gel using 0.5% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.750 g, 80% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 1.68 (s, 6H), 1.44–1.29 (m, 6H), 0.95 (t, *J* = 7.4 Hz, 9H), 0.62–0.53 (m, 6H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.9, 105.7, 88.4, 76.4, 28.8, 18.1, 17.4, 15.8. **IR(neat)** 2955, 2926, 2869, 2174, 2129, 1760, 1736, 1462, 1365, 1231, 1193, 1119, 1065, 1005, 947, 875, 801, 749 cm^{-1}. **HRMS** (CI) *m/z*: 310.1947 [$(M+H)^+$; calculated for $C_{15}H_{28}N_3O_2Si$: 310.1951]. **R_F1** = 0.24 in 10% EtOAc/Hex. **R_F2** = 0.54 in 2% EtOAc/Hex.



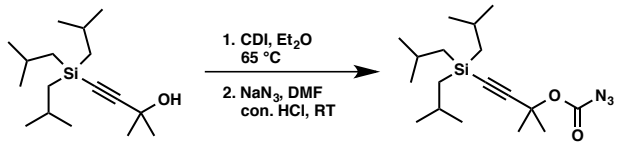
SI-17 ***67d***

2-methyl-4-(tributylsilyl)but-3-yn-2-yl carbonazidate (67d) was synthesized from alcohol **SI-17** using General Procedure C. The crude product was purified by column chromatography on silica gel using 0.5% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.824 g, 78% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 1.69 (s, 6H), 1.38–1.22 (m, 12H), 0.93–0.80 (m, 9H), 0.65–0.50 (m, 6H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.9, 105.6, 88.5, 76.4, 28.8, 26.3, 26.0, 13.8, 12.7. **IR(neat)** 2956, 2922, 2872, 2174, 2129, 1736, 1465, 1408, 1378, 1365, 1232, 1192, 1120, 1081, 1028, 999, 947, 876, 799, 749 cm^{-1}. **HRMS** (CI) *m/z*: 352.2422 [$(M+H)^+$; calculated for $C_{18}H_{34}N_3O_2Si$: 352.2420]. **R_F1** = 0.24 in 10% EtOAc/Hex. **R_F2** = 0.6 in 5% EtOAc/Hex.



67e

2-methyl-4-(trihexylsilyl)but-3-yn-2-yl carbonazidate (67e) was synthesized from alcohol **SI-19** using General Procedure C. The crude product was purified by column chromatography on silica gel using a gradient of 0 to 2% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (1.0995 g, 84% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 1.68 (s, 6H), 1.38–1.15 (m, 24H), 0.92–0.81 (m, 9H), 0.63–0.51 (m, 6H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.9, 105.6, 88.5, 76.3, 33.0, 31.5, 28.8, 23.8, 22.6, 14.1, 13.0. **IR(neat)** 2956, 2921, 285, 2175, 2129, 1737, 1466, 1381, 1365, 1232, 1192, 1121, 975, 875, 799, 749, 721 cm^{-1}. **HRMS** (CI) *m/z*: 436.3347 [$(M+H)^+$; calculated for $C_{24}H_{46}N_3O_2Si$: 436.3359]. **R_F1** = 0.3 in 10% EtOAc/Hex. **R_F2** = 0.45 in 2% EtOAc/Hex.



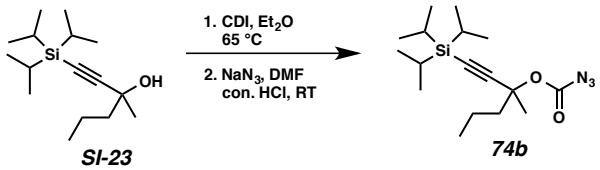
SI-18 *67f*

2-methyl-4-(triisobutylsilyl)but-3-yn-2-yl carbonazidate (67f) was synthesized from alcohol **SI-18** using General Procedure C. The crude product was purified by column chromatography on silica gel using 0.5% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.990 g, 94% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 1.89–1.74 (m, 3H), 1.67 (s, 6H), 1.00–0.90 (m, 18H), 0.60 (d, *J* = 7.0 Hz, 6H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.9, 105.9, 89.8, 76.4, 28.5, 26.2, 25.0, 24.7. **IR(neat)** 2952, 2895, 2867, 2174, 2130, 2070, 1737, 1531, 1464, 1233, 1193, 1163, 1120, 1093, 1039, 974, 947, 875, 829, 800, 749 cm^{-1}. **HRMS** (ESI) *m/z*: 374.2240 [$(M+Na)^+$; calculated for $C_{18}H_{33}N_3O_2SiNa$: 374.2234]. **R_F1** = 0.24 in 10% EtOAc/Hex. **R_F2** = 0.6 in 5% EtOAc/Hex.

SI-21 *74a*

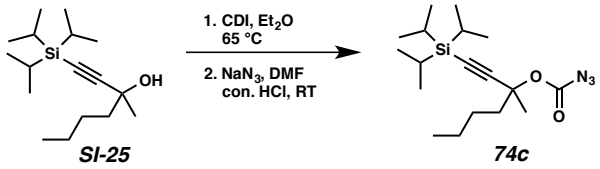
3-methyl-1-(triisopropylsilyl)pent-1-yn-3-yl carbonazidate (74a) was synthesized from alcohol **SI-21** using General Procedure C. The crude product was purified by column chromatography on silica gel using a gradient of 0.5 to 1% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.789 g, 81% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 2.06–1.93 (m, 1H), 1.89–1.77 (m, 1H), 1.69 (s, 3H), 1.09–0.98 (m, 24H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.7, 105.3, 87.8, 80.2, 34.5, 26.0, 18.5, 11.0, 8.7.

IR(neat) 2942, 2865, 2180, 2129, 1741, 1463, 1382, 1299, 1227, 1185, 1152, 1120, 1056, 1032, 997, 951, 881, 786, 748, 676 cm^{-1}. **HRMS** (ESI) *m/z*: 346.1920 $[(M+Na)^+$; calculated for $C_{16}H_{29}N_3O_2SiNa$: 346.1921]. $\mathbf{R_F1}$ = 0.24 in 5% EtOAc/Hex. $\mathbf{R_F2}$ = 0.63 in 5% EtOAc/Hex.



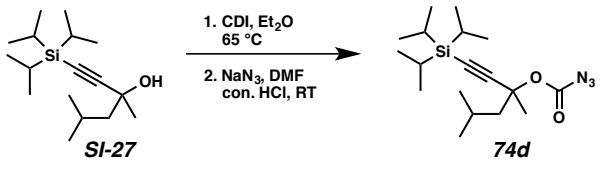
SI-23 *74b*

3-methyl-1-(triisopropylsilyl)hex-1-yn-3-yl carbonazidate (74b) was synthesized from alcohol **SI-23** using General Procedure C. The crude product was purified by column chromatography on silica gel using a gradient of 0.5 to 2% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.737 g, 73% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.94 (ddd, *J* = 13.4, 10.8, 5.6 Hz, 1H), 1.78 (ddd, *J* = 13.6, 10.6, 5.9 Hz, 1H), 1.70 (s, 3H), 1.59–1.43 (m, 2H), 1.14–0.98 (m, 21H), 0.93 (t, *J* = 7.4 Hz, 3H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 154.7, 105.6, 87.6, 79.7, 43.4, 26.5, 18.5, 17.6, 14.0, 11.0. **IR(neat)** 2942, 2866, 2182, 2131, 1736, 1463, 1375, 1225, 1181, 1151, 1111, 1078, 1048, 1018, 996, 967, 916, 881, 800, 773, 749, 676 cm^{-1}. **HRMS** (ESI) *m/z*: 360.2075 $[(M+Na)^+$; calculated for $C_{17}H_{31}N_3O_2SiNa$: 360.2078]. $\mathbf{R_F1}$ = 0.3 in 10% EtOAc/Hex. $\mathbf{R_F2}$ = 0.45 in 5% EtOAc/Hex.



SI-25 *74c*

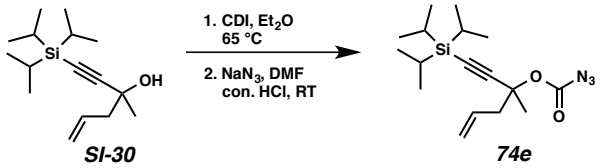
3-methyl-1-(triisopropylsilyl)hept-1-yn-3-yl carbonazidate (74c) was synthesized from alcohol **SI-25** using General Procedure C. The crude product was purified by column chromatography on silica gel using 0.5% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.739 g, 70% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 1.96 (ddd, *J* = 13.7, 11.1, 5.3 Hz, 1H), 1.79 (ddd, *J* = 13.6, 11.1, 5.7 Hz, 1H), 1.70 (s, 3H), 1.52–1.39 (m, 2H), 1.39–1.26 (m, 2H), 1.11–0.97 (m, 21H), 0.89 (t, *J* = 7.3 Hz, 3H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.7, 105.6, 87.7, 79.8, 41.0, 26.4, 26.4, 22.6, 18.5, 14.0, 11.0. **IR(neat)** 2942, 2865, 2182, 2129, 1737, 1463, 1375, 1223, 1129, 1114, 1151, 1082, 1043, 996, 920, 881, 806, 774, 749, 676, 660 cm^{-1}. **HRMS** (ESI) *m/z*: 374.2232 $[(M+Na)^+$; calculated for $C_{18}H_{33}N_3O_2SiNa$: 374.2234]. $\mathbf{R_F1}$ = 0.2 in 5% EtOAc/Hex. $\mathbf{R_F2}$ = 0.6 in 5% EtOAc/Hex.



SI-27 *74d*

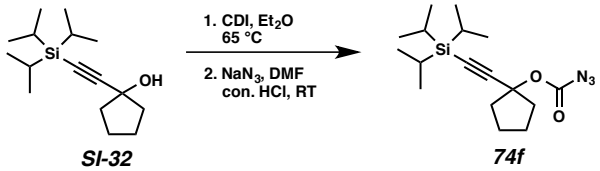
3,5-dimethyl-1-(triisopropylsilyl)hex-1-yn-3-yl carbonazidate (74d) was synthesized from alcohol **SI-27** using General Procedure C. The crude product was purified by column chromatography on silica gel using 0.5% EtOAc in hexanes as an eluent. The

product was obtained as a colorless oil. (0.526 g, 50% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 2.05–1.92 (m, 1H), 1.92–1.85 (m, 1H), 1.77–1.65 (m, 4H), 1.13–1.00 (m, 21H), 1.00–0.91 (m, 6H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 154.6, 105.6, 88.0, 79.8, 49.3, 27.3, 25.0, 24.1, 23.6, 18.5, 11.0. **IR(neat)** 2942, 2866, 2182, 2129, 1736, 1463, 1367, 1274, 1225, 1127, 1040, 996, 953, 903, 881, 802, 749, 676, 660 cm^{-1}. **HRMS** (CI) *m/z*: 352.2426 [$(M+H)^+$; calculated for $C_{18}H_{34}N_3O_2Si$: 352.2420]. **R_F1** = 0.2 in 5% EtOAc/Hex. **R_F2** = 0.75 in 5% EtOAc/Hex.



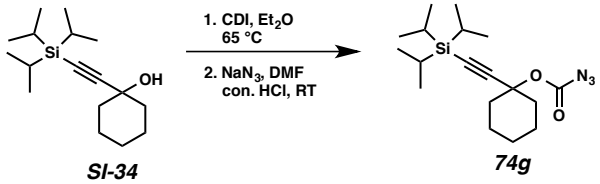
SI-30 *74e*

3-methyl-1-(triisopropylsilyl)hex-5-en-1-yn-3-yl carbonazidate (74e) was synthesized from alcohol **SI-30** using General Procedure C. The crude product was purified by column chromatography on silica gel using a gradient of 0 to 0.5% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.5940 g, 59% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 5.88–5.80 (m, 1H), 5.19–5.16 (m, 1H), 5.18–5.10 (m, 1H), 2.74 (dd, *J* = 13.8, 6.9 Hz, 1H), 2.62 (dd, *J* = 13.8, 7.5 Hz, 1H), 1.68 (s, 3H), 1.04 (s, 21H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 154.64, 131.66, 119.61, 105.20, 88.21, 78.44, 45.45, 26.17, 18.51, 11.02. **IR(neat)** 2943, 2865, 2183, 2130, 1737, 1463, 1224, 1143, 1089, 1061, 995, 920, 902, 881, 773, 749 cm^{-1}. **HRMS** (ESI) *m/z*: 358.1924 [$(M+Na)^+$; calculated for $C_{17}H_{29}N_3O_2Si$: 358.1921]. **R_F1** = 0.3 in 10% EtOAc/Hex. **R_F2** = 0.6 in 5% EtOAc/Hex.



SI-32 *74f*

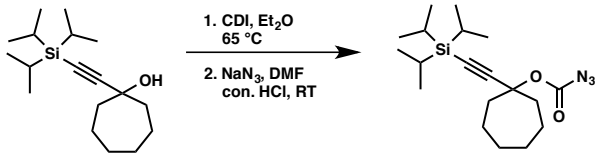
1-((triisopropylsilyl)ethynyl)cyclopentyl carbonazidate (74f) was synthesized from alcohol **SI-32** using General Procedure C. The crude product was purified by column chromatography on silica gel using 0.5% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.804 g, 80% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 2.34–2.20 (m, 2H), 2.20–2.08 (m, 2H), 1.81–1.65 (m, 4H), 1.12–0.88 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 155.2, 105.9, 87.3, 84.8, 40.4, 23.2, 18.5, 11.0. **IR(neat)** 2943, 2865, 2173, 2128, 1737, 1463, 1383, 1329, 1228, 1170, 1071, 995, 919, 881, 749, 675 cm^{-1}. **HRMS** (ESI) *m/z*: 358.1921 [$(M+Na)^+$; calculated for $C_{17}H_{29}N_3O_2SiNa$: 358.1921]. **R_F1** = 0.24 in 20% EtOAc/Hex. **R_F2** = 0.6 in 20% EtOAc/Hex.



SI-34 *74g*

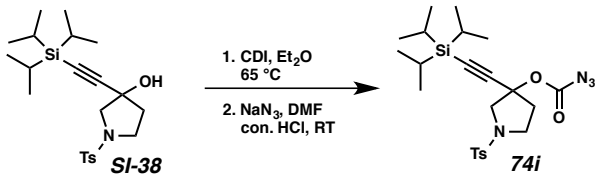
1-((triisopropylsilyl)ethynyl)cyclohexyl carbonazidate (74g) was synthesized from alcohol **SI-34** using General Procedure C. The crude product was purified by column

chromatography on silica gel using a gradient of 0.5 to 1% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.785 g, 75% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 2.20 (dt, *J* = 11.5, 4.4 Hz, 2H), 1.79 (dt, *J* = 11.8, 3.8 Hz, 2H), 1.72–1.50 (m, 4H), 1.14–0.90 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.5, 105.2, 88.9, 80.2, 37.0, 25.0, 22.9, 18.5, 11.1. **IR(neat)** 2939, 2864, 2183, 2135, 1739, 1463, 1383, 1366, 1296, 1262, 1205, 1170, 1140, 1119, 1071, 941, 918, 881, 852, 839, 676 cm^{-1}. **HRMS** (ESI) *m/z*: 372.2069 [(M+Na)$^+$; calculated for $C_{18}H_{31}N_3O_2SiNa$: 372.2078]. **R_F1** = 0.27 in 10% EtOAc/Hex. **R_F2** = 0.7 in 10% EtOAc/Hex.



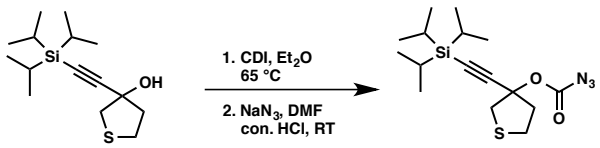
SI-36 ***74h***

1-((triisopropylsilyl)ethynyl)cycloheptyl carbonazidate (74h) was synthesized from alcohol **SI-36** using General Procedure C. The crude product was purified by column chromatography on silica gel using a gradient of 0.5 to 1% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.816 g, 75% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 2.28 (ddd, *J* = 14.0, 7.4, 3.1 Hz, 2H), 2.06 (ddd, *J* = 14.3, 8.8, 3.1 Hz, 2H), 1.72–1.50 (m, 8H), 1.14–0.91 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.6, 106.2, 88.3, 83.6, 40.0, 27.9, 22.2, 18.5, 11.1. **IR(neat)** 2940, 2864, 2181, 2130, 2069, 1735, 1527, 1462, 1367, 1286, 1223, 1192, 1176, 1065, 996, 881, 802, 749, 676 cm^{-1}. **HRMS** (ESI) *m/z*: 386.2234 [(M+Na)$^+$; calculated for $C_{19}H_{33}N_3O_2SiNa$: 386.2234]. **R_F1** = 0.3 in 10% EtOAc/Hex. **R_F2** = 0.67 in 10% EtOAc/Hex.



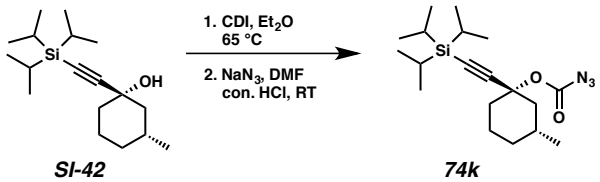
SI-38 ***74i***

1-tosyl-3-((triisopropylsilyl)ethynyl)pyrrolidin-3-yl carbonazidate (74i) was synthesized from alcohol **SI-38** using General Procedure C. The crude product was purified by column chromatography on silica gel using a gradient of 5 to 10% EtOAc in hexanes as eluents. The product was obtained as a white solid. (1.1762 g, 80% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.69 (d, *J* = 8.3 Hz, 2H), 7.33 (d, *J* = 8.2 Hz, 2H), 4.00 (dd, *J* = 12.8, 1.7 Hz, 1H), 3.64 (d, *J* = 12.7 Hz, 1H), 3.54 (ddd, *J* = 9.6, 8.1, 3.1 Hz, 1H), 3.29 (ddd, *J* = 9.8, 9.7, 6.6 Hz, 1H), 2.50–2.34 (m, 4H), 2.26 (ddd, *J* = 13.7, 10.0, 8.2 Hz, 1H), 1.08–0.87 (m, 21H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 154.7, 143.8, 133.3, 129.7, 127.6, 100.4, 90.9, 80.1, 57.8, 46.1, 38.9, 21.5, 18.4, 10.8. **IR(neat)** 2942, 2891, 2865, 2174, 2129, 1731, 1463, 1384, 1222, 1174, 1086, 1029, 1016, 972, 944, 919, 848, 814, 708, 697, 678 cm^{-1}. **HRMS** (ESI) *m/z*: 513.1967 [(M+Na)$^+$; calculated for $C_{23}H_{34}N_4O_4SSiNa$: 513.1962]. **R_F1** = 0.2 in 25% EtOAc/Hex. **R_F2** = 0.6 in 25% EtOAc/Hex. **MP**: 72-74 °C.



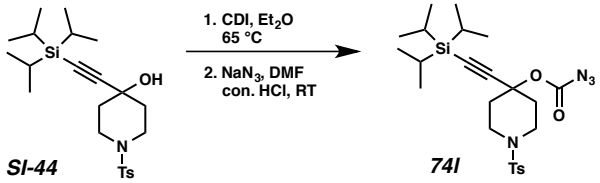
SI-40 *74j*

3-((triisopropylsilyl)ethynyl)tetrahydrothiophen-3-yl carbonazidate (74j) was synthesized from alcohol **SI-40** using General Procedure C. The crude product was purified by column chromatography on silica gel using 2% EtOAc in hexanes as an eluent. The product was obtained as a colorless oil. (0.773 g, 73% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 3.47 (dd, *J* = 12.3, 1.2 Hz, 1H), 3.31 (d, *J* = 12.1 Hz, 1H), 3.05–2.87 (m, 2H), 2.73–2.62 (m, 1H), 2.44–2.24 (m, 1H), 1.12–0.97 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 155.1, 102.1, 89.6, 84.1, 42.9, 41.2, 28.1, 18.5, 11.0. **IR(neat)** 2942, 2891, 2865, 2177, 2132, 1763, 1734, 1463, 1384, 1247, 1228, 1199, 1176, 1072, 1004, 959, 910, 881, 848, 747, 669 cm^{-1}. **HRMS** (CI) *m/z*: 353.1590 [(M)$^+$; calculated for $C_{16}H_{27}N_3O_2SSi$: 353.1593]. **R_F1** = 0.2 in 10% EtOAc/Hex. **R_F2** = 0.48 in 5% EtOAc/Hex.



SI-42 *74k*

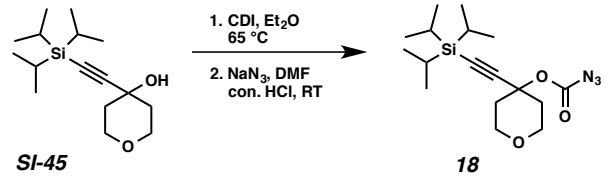
3-methyl-1-((triisopropylsilyl)ethynyl)cyclohexyl carbonazidate (74k) was synthesized from alcohol **SI-42** using General Procedure C. The crude product was purified by column chromatography on silica gel using a gradient of 0.5 to 1% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (1.09 g, 92% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 2.46–2.29 (m, 1H), 1.88–1.57 (m, 4H), 1.53–1.42 (m, 1H), 1.27–1.15 (m, 1H), 1.05 (s, 21H), 0.92 (d, *J* = 6.7 Hz, 3H), 0.89–0.74 (m, 1H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.5, 104.9, 89.5, 81.0, 45.1, 36.8, 33.9, 30.2, 23.1, 21.9, 18.6, 11.1. **IR(neat)** 2940, 2865, 2177, 2133, 1738, 1462, 1383, 1298, 1281, 1229, 1209, 1174, 1052, 1016, 974, 914, 881, 748, 675, 660 cm^{-1}. **HRMS** (ESI) *m/z*: 386.2232 [(M+Na)$^+$; calculated for $C_{19}H_{33}N_3O_2SiNa$: 386.2234]. **R_F1** = 0.3 in 10% EtOAc/Hex. **R_F2** = 0.67 in 10% EtOAc/Hex.



SI-44 *74l*

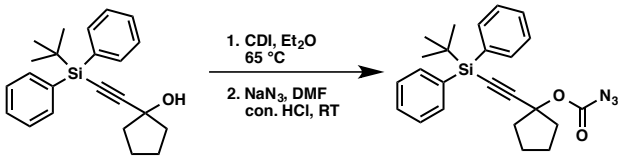
1-tosyl-4-((triisopropylsilyl)ethynyl)piperidin-4-yl carbonazidate (74l) was synthesized from alcohol **SI-44** using General Procedure C. The crude product was purified by column chromatography on silica gel using a gradient of 5 to 10% EtOAc in hexanes as eluents. The product was obtained as a white solid. (1.089 g, 72% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 8.4 Hz, 2H), 7.29 (d, *J* = 8.1 Hz, 2H), 3.57 (ddd, *J* = 12.4, 4.2, 4.2 Hz, 2H), 2.73 (ddd, *J* = 11.4, 11.4, 2.8 Hz, 2H), 2.41 (s, 3H), 2.37–2.25 (m, 2H), 2.04 (ddd, *J* = 12.8, 11.0, 4.0 Hz, 2H), 1.00–0.77 (m, 21H). **^{13}C NMR** (100.52

MHz, $CDCl_3$) δ 154.8, 143.7, 132.4, 129.7, 127.6, 102.5, 91.4, 77.2, 43.3, 35.8, 21.5, 18.4, 10.8. **IR(neat)** 2941, 2864, 2159, 2128, 1736, 1494, 1382, 1302, 1260, 1231, 1211, 1200, 1154, 1109, 1094, 1062, 1032, 960, 800, 767, 746, 729, 709, 679 cm^{-1}. **HRMS** (ESI) *m/z*: 527.2112 $[(M+Na)^+$; calculated for $C_{24}H_{36}N_4O_4SSiNa$: 527.2119]. $\mathbf{R_F1}$ = 0.2 in 25% EtOAc/Hex. $\mathbf{R_F2}$ = 0.6 in 25% EtOAc/Hex. **MP**: 107-108 °C.



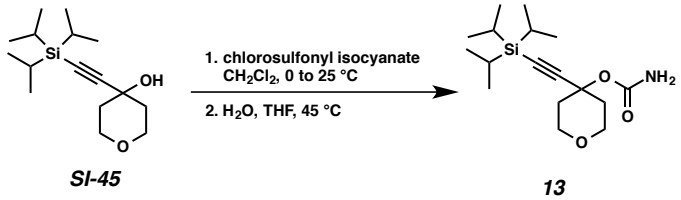
SI-45 *18*

4-((triisopropylsilyl)ethynyl)tetrahydro-2*H*-pyran-4-yl carbonazidate (18) was synthesized from alcohol **SI-45** using General Procedure C. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 5% EtOAc in hexanes as eluents. The product was obtained as a colorless oil. (0.815 g, 77% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 3.89 (ddd, *J* = 12.1, 4.1, 4.1 Hz, 2H), 3.70 (ddd, *J* = 12.6, 10.2, 2.4 Hz, 2H), 2.25 (ddd, *J* = 13.1, 2.2, 2.2 Hz, 2H), 2.00 (ddd, *J* = 13.8, 10.2, 4.2 Hz, 2H), 1.13–0.98 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 154.7, 103.7, 90.3, 76.9, 64.7, 37.5, 18.5, 11.0. **IR(neat)** 2941, 2864, 2184, 2136, 2070, 1738, 1463, 1385, 1267, 1221, 1153, 1098, 988, 935, 881, 849, 748, 660 cm^{-1}. **HRMS** (CI) *m/z*: 352.2045 $[(M+H)^+$; calculated for $C_{17}H_{30}N_3O_3Si$: 352.2056]. $\mathbf{R_F1}$ = 0.24 in 20% EtOAc/Hex. $\mathbf{R_F2}$ = 0.45 in 10% EtOAc/Hex.



SI-46 *23*

1-((*tert*-butyldiphenylsilyl)ethynyl)cyclopentyl carbonazidate (23) was synthesized from alcohol **SI-46** using General Procedure C. The crude product was purified by column chromatography on silica gel using 2% EtOAc in hexanes as an eluent. The product was obtained as a white solid. (0.806 g, 77% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.86–7.75 (m, 4H), 7.46–7.33 (m, 6H), 2.46–2.25 (m, 4H), 1.90–1.77 (m, 4H), 1.10 (s, 9H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 155.4, 135.5, 132.8, 129.5, 127.7, 108.1, 86.4, 84.6, 40.4, 26.9, 23.3, 18.6. **IR(neat)** 3069, 2954, 2931, 2856, 2180, 2129, 1737, 1470, 1444, 1427, 1361, 1329, 1239, 1177, 1107, 998, 964, 950, 899, 819, 701 cm^{-1}. **HRMS** (ESI) *m/z*: 440.1763 $[(M+Na)^+$; calculated for $C_{24}H_{27}N_3O_2SiNa$: 440.1765]. $\mathbf{R_F1}$ = 0.2 in 10% EtOAc/Hex. $\mathbf{R_F2}$ = 0.2 in 2% EtOAc/Hex. **MP**: 44-45 °C.

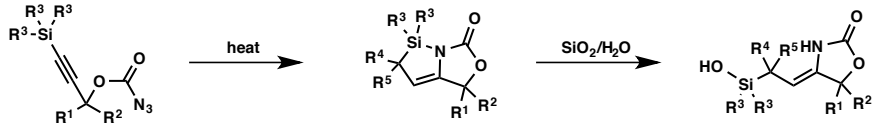


SI-45 *13*

4-((triisopropylsilyl)ethynyl)tetrahydro-2*H*-pyran-4-yl carbamate (13)

A flame-dried round-bottom flask was charged with chlorosulfonyl isocyanate (1.5 equiv) under an argon atmosphere. Anhydrous CH_2Cl_2 (0.1M) was added, and the mixture was cooled to 0 ˚C in an ice/H_2O bath. The propargyl alcohol **SI-45** (0.31 g, 0.26 mmol, 1.0 equiv) dissolved in anhydrous CH_2Cl_2 (0.3M) was then added dropwise. The reaction mixture was allowed to warm to room temperature. After 30 minutes, H_2O (1/10 of the total volume of CH_2Cl_2 added) and THF (1/5 of the total volume) were added. The reaction mixture was refluxed (45 ˚C oil bath) for 30 minutes. Then saturated NaCl solution was added, and the layers were separated. The aqueous layer was extracted with CH_2Cl_2 (2x), and the organic phases were combined, dried over anhydrous $MgSO_4$, filtered and concentrated to yield crude product. The crude product was purified by column chromatography on silica gel using 30% EtOAc in hexanes as an eluent. The product was obtained as a white solid. (0.24 g, 70% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.70 (s, 2H), 3.86 (ddd, *J* = 11.9, 4.1, 4.1 Hz, 2H), 3.71 (ddd, *J* = 12.0, 10.3, 2.5 Hz, 2H), 2.23 (ddd, *J* = 13.4, 4.5, 2.2 Hz, 2H), 1.97 (ddd, *J* = 13.4, 10.3, 4.2 Hz, 2H), 1.16–0.93 (m, 21H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 154.6, 105.8, 88.1, 73.0, 64.7, 38.0, 18.6, 11.1. **IR(neat)** 3429, 3333, 3272, 2941, 2864, 2166, 1723, 1362, 1245, 1204, 1098, 1057, 1025, 972, 906, 845, 819, 780, 718, 680, 663 cm^{-1}. **HRMS** (ESI) *m/z*: 348.1966 [$(M+Na)^+$; calculated for $C_{17}H_{31}NO_3SiNa$: 348.1965]. **R_F**: 0.36 in 30% EtOAc/Hex. **MP**: 82-84 °C.

Synthesis of Azasilacyclopentenes and Silanols



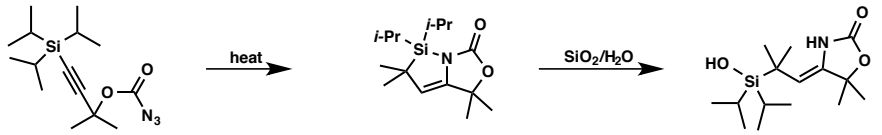
General Procedure D1

A 2 dram vial was charged with a magnetic spin bar, carbonazidate (0.1 mmol), and dry hexanes (0.1 M, 1 mL). The reaction vessel was sealed and heated in an oil bath at 90 °C. **(Warning: Pressure buildup may occur during the reaction.)** The progress of the reaction was monitored by TLC. After the reaction was finished (18 h), the reaction vessel was cooled to room temperature and the mixture was concentrated under reduced pressure. To the crude product was added methyl-4-nitro-benzoate (9.1 mg, 0.05 mmol, 0.5 equiv) and $CDCl_3$ (0.7 mL). The yield of the azasilacyclopentene was calculated based on ^{1}H NMR peak integration relative to the methyl group of methyl-4-nitro-benzoate. NMR data was collected using a relaxation delay of 30 sec. (The experiments were conducted to show that RD = 30 sec was required to achieve quantitative information.) The azasilacyclopentenes were identified by their correspondence to the ^{1}H NMR data of 21a and their mass as determined by GC/MS. The crude product was purified by column chromatography on silica gel to give silanol.

General Procedure D2

A 2 dram vial was charged with a magnetic spin bar, carbonazidate (0.1 mmol), and dry isopropylacetate (0.1 M, 1 mL). The reaction vessel was sealed and heated in an oil bath

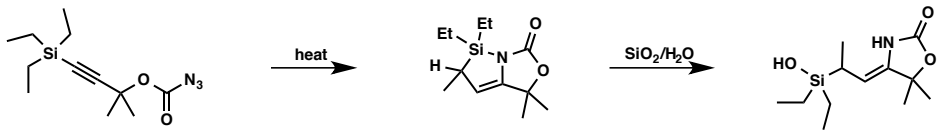
at 100 °C. **(Warning: Pressure buildup may occur during the reaction.)** The progress of the reaction was monitored by TLC. After the reaction was finished (14 h), the reaction vessel was cooled to room temperature and the mixture was concentrated under reduced pressure. To the crude product was added methyl-4-nitro-benzoate (9.1 mg, 0.05 mmol, 0.5 equiv) and $CDCl_3$ (0.7 mL). The yield of the azasilacyclopentene was calculated based on ^{1}H NMR peak integration relative to the methyl group of methyl-4-nitro-benzoate. NMR data was collected using a relaxation delay of 30 sec. (The experiments were conducted to show that RD = 30 sec was required to achieve quantitative information.) The azasilacyclopentenes were identified by their correspondence to the ^{1}H NMR data of 21a and their mass as determined by GC/MS. The crude product was purified by column chromatography on silica gel to give silanol.



20a *21a* *69a*

(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-5,5-dimethyloxazolidin-2-one (69a) was synthesized from carbonazidate **20a** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 10 to 20% EtOAc in hexanes as eluents. The silanol **69a** was obtained as an amorphous yellowish solid. (trial 1: 15.6 mg, 52% yield; trial 2: 15.0 mg, 50% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.21 (s, 1H), 4.52 (s, 1H), 4.22 (s, 1H), 1.44 (s, 6H), 1.13 (s, 6H), 1.10–0.93 (m, 14H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 156.8, 139.4, 107.5, 84.9, 28.1, 25.6, 23.9, 18.4, 18.4, 13.3. **IR(neat)** 3351, 2944, 2866, 1739, 1718, 1690, 1463, 1386, 1207, 1171, 963, 917, 824, 673 cm^{-1}. **HRMS** (ESI) *m/z*: 322.1813 [$(M+Na)^+$; calculated for $C_{15}H_{29}NO_3SiNa$: 322.1809]. **R_F**: 0.2 in 20% EtOAc/Hex.

1,1-diisopropyl-2,2,4,4-tetramethyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (21a) was observed in crude NMR (53% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.36 (s, 1H), 1.45 (s, 6H), 1.20–1.15 (m, 20H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 157.0, 150.2, 108.3, 81.5, 27.7, 26.0, 17.9, 17.5, 11.7. **MS** (EI) *m/z*: 281 [(M^+); calculated for $C_{15}H_{27}NO_2Si$: 281.18]

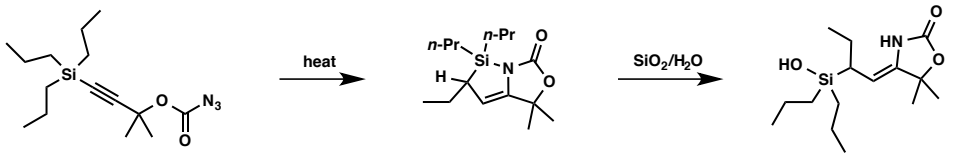


67b *68b* *69b*

(*Z*)-4-(2-(diethyl(hydroxy)silyl)propylidene)-5,5-dimethyloxazolidin-2-one (69b) was synthesized from carbonazidate **67b** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 20 to 25% EtOAc in hexanes as eluents. The silanol **69b** was obtained as an amorphous yellowish solid. (trial 1: 10.0 mg, 39% yield; trial 2: 9.8 mg, 38% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.75 (s, 1H), 4.17 (d, *J* = 9.9 Hz, 1H), 3.00 (s, 1H), 1.66 (dq, *J* = 10.2, 7.4 Hz, 1H), 1.47 (s, 6H), 1.06 (d, *J* = 7.4 Hz, 3H), 1.02–0.90 (m, 6H), 0.68–0.49 (m, 4H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.9, 138.1, 100.9, 85.0, 28.1, 28.0, 20.6, 15.0, 6.8, 6.5, 4.9, 4.3.

IR(neat) 3463, 3231, 2953, 2875, 1723, 1698, 1388, 1369, 1325, 1299, 1204, 1186, 1153, 1017, 912, 888, 850, 770, 715, 669 cm^{-1}. **HRMS** (ESI) *m/z*: 280.1342 [$(M+Na)^+$; calculated for $C_{12}H_{23}NO_3SiNa$: 280.1339]. $\mathbf{R_F}$: 0.2 in 25% EtOAc/Hex.

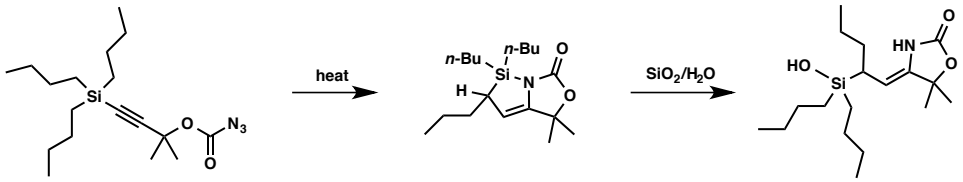
1,1-diethyl-2,4,4-trimethyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (68b) was observed in crude NMR (38% yield).^{1}**H NMR** (400 MHz, $CDCl_3$) δ 4.57 (d, *J* = 3.2 Hz, 1H, vinyl proton), **MS** (EI) *m/z*: 239 [(M^+); calculated for $C_{12}H_{21}NO_2Si$: 239.13]



67c ***68c*** ***69c***

(*Z*)-4-(2-(hydroxydipropylsilyl)butylidene)-5,5-dimethyloxazolidin-2-one (69c) was synthesized from carbonazidate **67c** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 20 to 25% EtOAc in hexanes as eluents. The silanol **69c** was obtained as a yellow oil. (trial 1: 12.5 mg, 42% yield; trial 2: 13.7 mg, 46% yield). ^{1}**H NMR** (500 MHz, $CDCl_3$) δ 8.53 (s, 1H), 4.11 (d, *J* = 10.5 Hz, 1H), 2.64 (s, 1H), 1.68–1.56 (m, 1H), 1.49 (d, *J* = 3.4 Hz, 6H), 1.45–1.17 (m, 5H), 1.03–0.90 (m, 6H), 0.88 (t, *J* = 7.2 Hz, 3H), 0.65–0.50 (m, 4H). ^{13}**C NMR** (125.77 MHz, $CDCl_3$) δ 157.6, 139.7, 98.8, 85.0, 29.9, 28.1, 28.0, 22.7, 18.4, 18.4, 16.7, 16.7, 16.5, 16.2, 14.3. **IR(neat)** 3248, 2954, 2927, 2867, 1744, 1699, 1385, 1305, 1178, 1150, 1130, 1008, 894, 838, 752, 675 cm^{-1}. **HRMS** (CI) *m/z*: 298.1835 [$(M-H)^+$; calculated for $C_{15}H_{28}NO_3Si$:298.1838]. $\mathbf{R_F}$: 0.15 in 20% EtOAc/Hex.

2-ethyl-4,4-dimethyl-1,1-dipropyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (68c) was observed in crude NMR (42% yield). ^{1}**H NMR** (400 MHz, $CDCl_3$) δ 4.65 (d, *J* = 3.2 Hz, 1H, vinyl proton), **MS** (EI) *m/z*: 281 [(M^+); calculated for $C_{15}H_{27}NO_2Si$: 281.18]

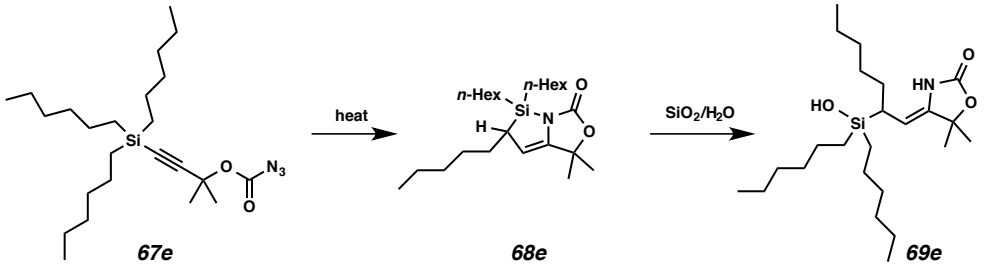


67d ***68d*** ***69d***

(*Z*)-4-(2-(dibutyl(hydroxy)silyl)pentylidene)-5,5-dimethyloxazolidin-2-one (69d) was synthesized from carbonazidate **67d** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 15 to 20% EtOAc in hexanes as eluents. The silanol **69d** was obtained as an amorphous yellowish solid. (trial 1: 14.7 mg, 43% yield; trial 2: 14.3 mg, 42% yield). ^{1}**H NMR** (500 MHz, $CDCl_3$) δ 8.59 (s, 1H), 4.11 (d, *J* = 10.4 Hz, 1H), 2.65 (s, 1H), 1.56 (td, *J* = 11.1, 2.9 Hz, 1H), 1.48 (s, 6H), 1.43–1.07 (m, 12H), 0.93–0.78 (m, 9H), 0.67–0.48 (m, 4H). ^{13}**C NMR** (125.77 MHz, $CDCl_3$) δ 157.6, 139.2, 99.2, 85.0, 31.7, 28.1, 28.0, 27.6, 26.6, 26.6, 25.3, 25.1, 22.6, 13.9, 13.7, 13.7, 13.5, 13.1. **IR(neat)** 3238, 2955, 2923, 2870, 1746, 1699, 1464, 1385, 1307, 1196, 1174, 1132, 1009, 887, 767, 731, 676 cm^{-1}. **HRMS** (ESI) *m/z*:

364.2274 [(M+Na)$^+$; calculated for $C_{18}H_{35}NO_3SiNa$: 364.2278]. $\mathbf{R_F}$: 0.2 in 25% EtOAc/Hex.

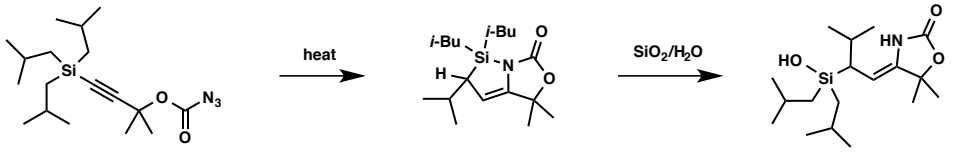
1,1-dibutyl-4,4-dimethyl-2-propyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (68d) was observed in crude NMR (56% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.63 (d, *J* = 2.9 Hz, 1H, vinyl proton), **MS** (EI) *m/z*: 323 [(M+); calculated for $C_{18}H_{33}NO_2Si$: 323.22]



67e *68e* *69e*

(*Z*)-4-(2-(dihexyl(hydroxy)silyl)heptylidene)-5,5-dimethyloxazolidin-2-one (69e) was synthesized from carbonazidate **67e** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 10 to 15% EtOAc in hexanes as eluents. The silanol **69e** was obtained as an amorphous yellowish solid. (trial 1: 18.7 mg, 44% yield; trial 2: 19.1 mg, 45% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.58 (s, 1H), 4.11 (d, *J* = 10.6 Hz, 1H), 2.65 (s, 1H), 1.59–1.42 (m, 8H), 1.42–1.05 (m, 23H), 0.94–0.76 (m, 9H), 0.65–0.46 (m, 4H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.6, 139.2, 99.3, 85.0, 33.4, 33.3, 31.6, 31.5, 31.5, 29.4, 29.2, 28.1, 28.0, 27.8, 23.1, 22.8, 22.6, 22.6, 22.6, 14.1, 14.1, 14.1, 13.9, 13.4. **IR(neat)** 3397, 3096, 2957, 2919, 2871, 2852, 1744, 1704, 1461, 1382, 1366, 1328, 1209, 1167, 1031, 1006, 953, 895, 845, 764, 722, 676 cm^{-1}. **HRMS** (ESI) *m/z*: 448.3221 [(M+Na)$^+$; calculated for $C_{24}H_{47}NO_3SiNa$: 448.3217]. $\mathbf{R_F}$: 0.15 in 10% EtOAc/Hex.

1,1-dihexyl-4,4-dimethyl-2-pentyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (48e) was observed in crude NMR (56% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.63 (d, *J* = 2.9 Hz, 1H, vinyl proton), **MS** (EI) *m/z*: 407 [(M+); calculated for $C_{24}H_{45}NO_2Si$: 407.32]

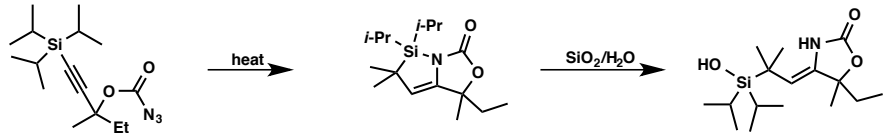


67f *68f* *69f*

(*Z*)-4-(2-(hydroxydiisobutylsilyl)-3-methylbutylidene)-5,5-dimethyloxazolidin-2-one (69f) was synthesized from carbonazidate **67f** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 15 to 20% EtOAc in hexanes as eluents. The silanol **69f** was obtained as an amorphous yellowish solid. (trial 1: 15.0 mg, 44% yield; trial 2: 14.0 mg, 41% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.74 (s, 1H), 4.25 (d, *J* = 11.4 Hz, 1H), 2.04–1.91 (m, 1H), 1.91–1.74 (m, 2H), 1.50 (s, 3H), 1.49 (s, 3H), 1.01–0.82 (m, 19H), 0.67–0.49 (m, 4H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.7, 140.4, 95.7, 85.0, 36.0, 28.4, 28.0, 28.0, 26.6, 26.5, 26.4,

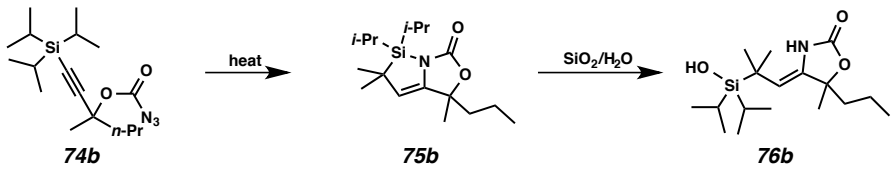
26.3, 26.2, 25.8, 24.3, 24.2, 23.6, 20.4. **IR(neat)** 3241, 2952, 2866, 1743, 1697, 1464, 1384, 1316, 1218, 1184, 1089, 1009, 822, 797, 757, 744, 674 cm^{-1}. **HRMS** (ESI) *m/z*: 364.2282 [$(M+Na)^+$; calculated for $C_{18}H_{35}NO_3SiNa$: 364.2278]. $\mathbf{R_F}$: 0.2 in 25% EtOAc/Hex.

1,1-diisobutyl-2-isopropyl-4,4-dimethyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (68f) was observed in crude NMR (55% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.71 (d, *J* = 3.2 Hz, 1H, vinyl proton), **MS** (EI) *m/z*: 323 [(M^+); calculated for $C_{18}H_{33}NO_2Si$: 323.22]



(*Z*)-5-ethyl-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-5-methyloxazolidin-2-one (76a) was synthesized from carbonazidate **74a** using General Procedure D1. The crude product was purified by column chromatography on silica gel using 10% EtOAc in hexanes as an eluent. The silanol **76a** was obtained as an amorphous yellowish solid. (trial 1: 16.3 mg, 52% yield; trial 2: 15.9 mg, 51% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.19 (s, 1H), 4.28 (s, 1H), 4.17 (s, 1H), 1.76 (dq, *J* = 14.6, 7.3 Hz, 1H), 1.59 (dq, *J* = 14.5, 7.3 Hz, 1H), 1.41 (s, 3H), 1.14 (d, *J* = 6.2 Hz, 6H), 1.11–0.99 (m, 14H), 0.89 (t, *J* = 7.3 Hz, 3H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.6, 137.7, 108.1, 87.7, 33.9, 26.7, 26.0, 25.3, 24.0, 18.4, 18.4, 18.4, 18.3, 13.4, 13.4, 7.3. **IR(neat)** 3350, 2969, 2943, 2866, 1736, 1717, 1687, 1462, 1331, 1281, 1248, 1143, 1099, 1033, 1004, 957, 904, 882, 824, 673 cm^{-1}. **HRMS** (ESI) *m/z*: 336.1970 [$(M+Na)^+$; calculated for $C_{16}H_{31}NO_3SiNa$: 336.1965]. $\mathbf{R_F}$: 0.3 in 20% EtOAc/Hex.

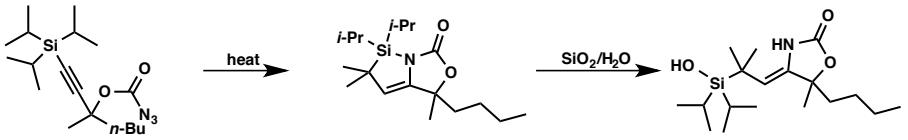
4-ethyl-1,1-diisopropyl-2,2,4-trimethyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (75a) was observed in crude NMR (57% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.33 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 295 [(M^+); calculated for $C_{16}H_{29}NO_2Si$: 295.20]



(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-5-methyl-5-propyloxazolidin-2-one (76b) was synthesized from carbonazidate **74b** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 10 to 15% EtOAc in hexanes as eluents. The silanol **76b** was obtained as an amorphous yellowish solid. (trial 1: 17.3 mg, 53% yield; trial 2: 17.7 mg, 54% yield;). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.17 (s, 1H), 4.31 (s, 1H), 4.17 (s, 1H), 1.77–1.61 (m, 1H), 1.58–1.46 (m, 1H), 1.40 (s, 3H), 1.39–1.29 (m, 2H), 1.13 (d, *J* = 2.4 Hz, 6H), 1.10–1.01 (m, 14H), 0.88 (t, *J* = 7.3 Hz, 3H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.5, 138.1, 108.1, 87.4, 43.3, 26.9, 26.0, 25.3, 24.0, 18.4, 18.4, 18.3, 16.3, 14.0, 13.5. **IR(neat)** 3207, 2941, 2863, 1747, 1687, 1463, 1366, 1332, 1291, 1231, 1146, 1078,

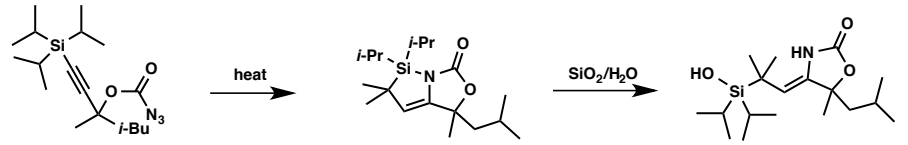
1006, 915, 880, 861, 837, 707, 666 cm^{-1}. **HRMS** (ESI) *m/z*: 350.2126 [$(M+Na)^+$; calculated for $C_{17}H_{33}NO_3SiNa$: 350.2122]. $\mathbf{R_F}$: 0.27 in 20% EtOAc/Hex.

1,1-diisopropyl-2,2,4-trimethyl-4-propyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (75b) was observed in crude NMR (55% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.33 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 309 [(M^+); calculated for $C_{17}H_{31}NO_2Si$: 309.21]



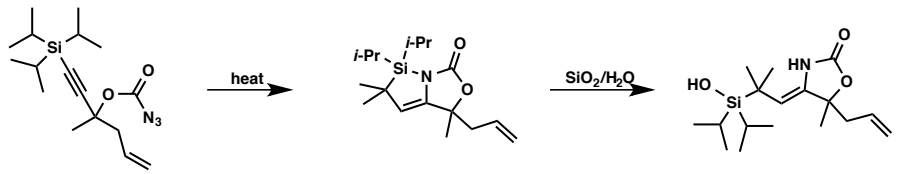
(*Z*)-5-butyl-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-5-methyloxazolidin-2-one (76c) was synthesized from carbonazidate **74c** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 10 to 15% EtOAc in hexanes as eluents. The silanol **76c** was obtained as a yellowish oil. (trial 1: 20.2 mg, 59% yield; trial 2: 20.1 mg, 59 % yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.29 (s, 1H), 4.64 (s, 1H), 4.18 (s, 1H), 1.80–1.65 (m, 1H), 1.59–1.48 (m, 1H), 1.40 (s, 3H), 1.36–1.21 (m, 4H), 1.13 (d, *J* = 3.7 Hz, 6H), 1.09–1.03 (m, 14H), 0.85 (t, *J* = 6.9 Hz, 3H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.7, 138.1, 108.2, 87.7, 40.8, 27.1, 25.9, 25.4, 25.1, 24.0, 22.6, 18.4, 18.4, 18.4, 18.3, 13.9, 13.5, 13.4. **IR(neat)** 3221, 2942, 2865, 1742, 1689, 1464, 1330, 1288, 1144, 1005, 961, 915, 829, 767, 731, 672 cm^{-1}. **HRMS** (ESI) *m/z*: 364.2282 [$(M+Na)^+$; calculated for $C_{18}H_{35}NO_3SiNa$: 364.2278]. $\mathbf{R_F}$: 0.3 in 20% EtOAc/Hex.

4-butyl-1,1-diisopropyl-2,2,4-trimethyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (75c) was observed in crude NMR (60% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.30 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 323 [(M^+); calculated for $C_{18}H_{33}NO_2Si$: 323.23]



(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-5-isobutyl-5-methyloxazolidin-2-one (76d) was synthesized from carbonazidate **74d** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 10 to 15% EtOAc in hexanes as eluents. The silanol **76d** was obtained as a yellowish oil. (trial 1: 14.8 mg, 43% yield; trial 2: 15.4 mg, 45 % yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.25 (s, 1H), 4.46 (s, 1H), 4.16 (s, 1H), 1.85–1.72 (m, *J* = 6.5 Hz, 1H), 1.65 (dd, *J* = 14.7, 6.5 Hz, 1H), 1.52 (dd, *J* = 14.8, 5.6 Hz, 1H), 1.40 (s, 3H), 1.14 (d, *J* = 5.6 Hz, 6H), 1.10–0.98 (m, 14H), 0.91 (t, *J* = 6.6 Hz, 6H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.5, 138.6, 108.3, 87.8, 49.2, 27.7, 26.1, 25.1, 24.3, 24.3, 24.3, 24.0, 24.0, 18.5, 18.4, 18.4, 18.3, 13.4. **IR(neat)** 3221, 2947, 2866, 1742, 1689, 1464, 1376, 1314, 150, 1007, 915, 880, 829, 792, 767, 731, 672 cm^{-1}. **HRMS** (ESI) *m/z*: 364.2282 [$(M+Na)^+$; calculated for $C_{18}H_{35}NO_3SiNa$: 364.2278]. $\mathbf{R_F}$: 0.24 in 20% EtOAc/Hex.

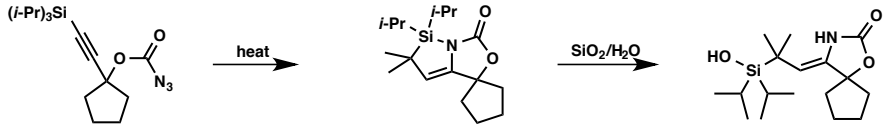
4-isobutyl-1,1-diisopropyl-2,2,4-trimethyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (75d) was observed in crude NMR (49% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.32 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 323 [(M^+); calculated for $C_{18}H_{33}NO_2Si$: 323.23]



74e *75e* *76e*

(*Z*)-5-allyl-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-5-methyloxazolidin-2-one (76e) was synthesized from carbonazidate **74e** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 10 to 15% EtOAc in hexanes as eluents. The silanol **76e** was obtained as a yellowish oil. (trial 1: 16.3 mg, 50% yield; trial 2: 16.1 mg, 49 % yield). **^{1}H NMR** (600 MHz, $CDCl_3$) δ 9.20 (s, 1H), 5.89–5.56 (m, 1H), 5.14–5.12 (m, 1H), 5.11 (d, *J* = 4.4 Hz, 1H), 4.32 (s, 1H), 4.22 (s, 1H), 2.43 (dd, *J* = 14.3, 7.7 Hz, 1H), 2.36 (dd, *J* = 14.2, 6.5 Hz, 1H), 1.42 (s, 3H), 1.13 (s, 6H), 1.10–1.00 (m, 14H). **^{13}C NMR** (151 MHz, $CDCl_3$) δ 157.3, 137.6, 131.1, 119.8, 108.7, 86.3, 45.4, 26.3, 26.0, 25.4, 24.1, 18.4, 18.4, 18.3, 13.4, 13.4. **IR(neat)** 3235, 2944, 2865, 1744, 1690, 1463, 1374, 1329, 1239, 1099, 1046, 1003, 918, 880, 829, 765, 672 cm^{-1}. **HRMS** (ESI) *m/z*: 348.1975 [$(M+Na)^+$; calculated for $C_{17}H_{31}NO_3Si$: 348.1965]. **R_F**: 0.15 in 15% EtOAc/Hex.

4-allyl-1,1-diisopropyl-2,2,4-trimethyl-2,4-dihydro-1*H*,6*H*-[1,2]azasilolo[1,5-*c*]oxazol-6-one (75e) was observed in crude NMR (52% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.35 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 307 [(M^+); calculated for $C_{17}H_{29}NO_2Si$: 307.20]

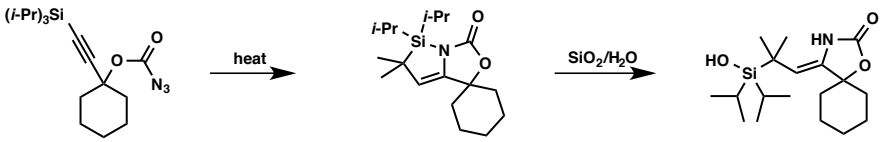


74f *75f* *76f*

(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-1-oxa-3-azaspiro[4.4]nonan-2-one (76f) was synthesized from carbonazidate **74f** using General Procedure D1. The crude product was purified by column chromatography on silica gel using 10% EtOAc in hexanes as an eluent. The silanol **76f** was obtained as an amorphous yellowish solid. (trial 1: 16.6 mg, 51% yield; trial 2: 14.6 mg, 45% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.30 (s, 1H), 4.76 (s, 1H), 4.26 (s, 1H), 2.17–2.03 (m, 2H), 1.92–1.66 (m, 6H), 1.13 (s, 6H), 1.09–1.01 (m, 14H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.4, 137.7, 107.9, 95.1, 41.1, 41.1, 25.6, 25.6, 24.2, 24.2, 24.0, 18.4, 18.4, 18.4, 18.4, 13.4, 13.4. **IR(neat)** 3350, 2941, 2864, 1746, 1692, 1464, 1432, 1340, 1311, 1247, 1080, 991, 880, 791, 765, 674 cm^{-1}. **HRMS** (ESI) *m/z*: 348.1970 [$(M+Na)^+$; calculated for $C_{17}H_{31}NO_3SiNa$: 348.1965]. **R_F**: 0.2 in 20% EtOAc/Hex.

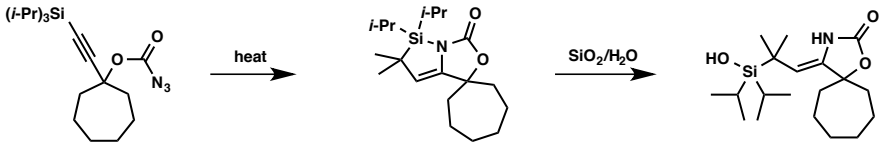
1',1'-diisopropyl-2',2'-dimethyl-1',2'-dihydro-6'*H*-spiro[cyclopentane-1,4'-[1,2]azasilolo[1,5-*c*]oxazol]-6'-one (75f) was observed in crude NMR (52% yield). **^{1}H**

NMR (400 MHz, $CDCl_3$) δ 4.39 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 307 [(M^+); calculated for $C_{17}H_{29}NO_2Si$: 307.20]



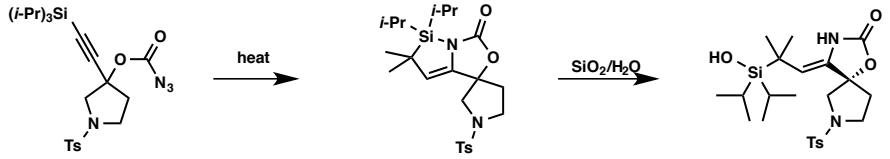
74g *75g* *76g*

(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-1-oxa-3-azaspiro[4.5]decan-2-one (76g) was synthesized from carbonazidate **74g** using General Procedure D1. The crude product was purified by column chromatography on silica gel using 10% EtOAc in hexanes as an eluent. The silanol **76g** was obtained as a yellowish solid. (trial 1: 16.9 mg, 50% yield; trial 2: 16.2 mg, 48% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.15 (s, 1H), 4.44 (s, 1H), 4.20 (s, 1H), 1.94–1.81 (m, 2H), 1.78–1.54 (m, 6H), 1.53–1.33 (m, 2H), 1.12 (s, 6H), 1.09–0.90 (m, 14H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.6, 139.3, 108.3, 86.8, 37.1, 37.1, 25.7, 25.7, 24.7, 23.9, 21.7, 21.7, 18.4, 18.4, 13.4, 13.4. **IR(neat)** 3195, 2931, 2866, 1754, 1690, 1463, 1421, 1306, 1148, 1005, 945, 885, 867, 727, 699, 662 cm^{-1}. **HRMS** (ESI) *m/z*: 362.2127 [$(M+Na)^+$; calculated for $C_{18}H_{33}NO_3SiNa$: 362.2122]. **R_F**: 0.24 in 20% EtOAc/Hex. **MP**: 123-125 °C. **1',1'-diisopropyl-2',2'-dimethyl-1',2'-dihydro-6'*H*-spiro[cyclohexane-1,4'-[1,2]azasilolo[1,5-*c*]oxazol]-6'-one (75g)** was observed in crude NMR (51% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.34 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 321 [(M^+); calculated for $C_{18}H_{31}NO_2Si$: 321.21]



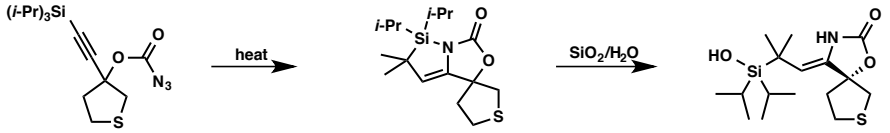
74h *75h* *76h*

(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-1-oxa-3-azaspiro[4.6]undecan-2-one (76h) was synthesized from carbonazidate **74h** using General Procedure D1. The crude product was purified by column chromatography on silica gel using 10% EtOAc in hexanes as an eluent. The silanol **76h** was obtained as an amorphous white solid. (trial 1: 16.5 mg, 47% yield; trial 2: 16.2 mg, 46% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.20 (s, 1H), 4.61 (s, 1H), 4.25 (s, 1H), 2.05–1.92 (m, 2H), 1.83–1.59 (m, 6H), 1.59–1.45 (m, 4H), 1.12 (s, 6H), 1.09–0.89 (m, 14H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.6, 140.9, 108.1, 90.1, 40.8, 28.8, 25.7, 21.9, 18.4, 18.4, 13.5. **IR(neat)** 3282, 2924, 2861, 1740, 1683, 1455, 1444, 1368, 1276, 1143, 1086, 1058, 1003, 952, 869, 849, 821, 786, 663 cm^{-1}. **HRMS** (ESI) *m/z*: 376.2282 [$(M+Na)^+$; calculated for $C_{19}H_{35}NO_3SiNa$: 376.2278]. **R_F**: 0.27 in 20% EtOAc/Hex. **1',1'-diisopropyl-2',2'-dimethyl-1',2'-dihydro-6'*H*-spiro[cycloheptane-1,4'-[1,2]azasilolo[1,5-*c*]oxazol]-6'-one (75h)** was observed in crude NMR (56% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.39 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 335 [(M^+); calculated for $C_{19}H_{33}NO_2Si$: 335.23]



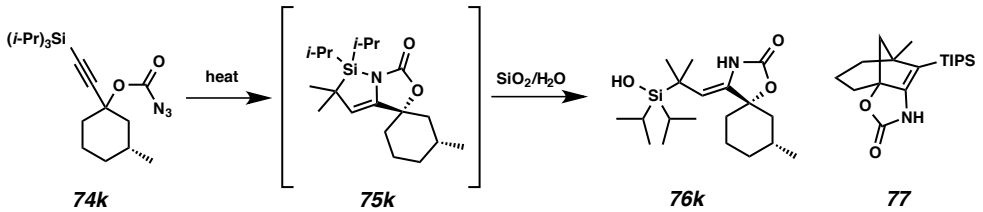
(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-7-tosyl-1-oxa-3,7-diazaspiro[4.4]nonan-2-one (76i) was synthesized from carbonazidate **74i** using General Procedure D2. The crude product was purified by column chromatography on silica gel using 25% EtOAc in hexanes as an eluent. The silanol **76i** was obtained as a white solid. (trial 1: 23.5 mg, 49% yield; trial 2: 23.0 mg, 48% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.00 (s, 1H), 7.69 (d, *J* = 8.4 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 4.31 (s, 1H), 3.74–3.66 (m, 1H), 3.50 (q, *J* = 12.1 Hz, 2H), 3.36 (s, 1H), 3.23 (ddd, *J* = 11.2, 9.6, 6.1 Hz, 1H), 2.42 (s, 3H), 2.16 (dd, *J* = 13.6, 5.9 Hz, 1H), 2.04–1.89 (m, 1H), 1.11 (s, 6H), 1.09–0.86 (m, 14H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 155.6, 144.0, 133.4, 133.3, 129.9, 127.6, 110.3, 90.4, 59.5, 47.2, 39.8, 25.4, 25.2, 24.2, 21.6, 18.4, 18.4, 18.3, 18.3, 13.2, 13.2. **IR(neat)** 2943, 2865, 1747, 1699, 1597, 1494, 1462, 1360, 1342, 1239, 1167, 1149, 1039, 1017, 993, 949, 910, 815, 732, 764, 706, 660 cm^{-1}. **HRMS** (ESI) *m/z*: 503.2011 $[(M+Na)^+$; calculated for $C_{23}H_{36}N_2O_5SSiNa$: 503.2006]. **R_F**: 0.24 in 30% EtOAc/Hex. **MP**: 150-152 °C.

1',1'-diisopropyl-2',2'-dimethyl-1-tosyl-1',2'-dihydro-6'*H*-spiro[pyrrolidine-3,4'-[1,2]azasilolo[1,5-*c*]oxazol]-6'-one (75i) was observed in crude NMR (50% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.41 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 462 [$(M^+$; calculated for $C_{23}H_{34}N_2O_4SSi$: 462.20]



(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-1-oxa-7-thia-3-azaspiro[4.4]nonan-2-one (76j) was synthesized from carbonazidate **74j** using General Procedure D2. The crude product was purified by column chromatography on silica gel using 25% EtOAc in hexanes as an eluent. The silanol **76j** was obtained as an amorphous white solid. (trial 1: 14.5 mg, 42% yield; trial 2: 14.0 mg, 41% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.36 (s, 1H), 4.48 (s, 1H), 4.45 (s, 1H), 3.16 (d, *J* = 12.1 Hz, 1H), 3.13–3.04 (m, 1H), 3.00 (d, *J* = 12.3 Hz, 1H), 2.98–2.92 (m, 1H), 2.44–2.36 (m, 1H), 2.06–1.95 (m, 1H), 1.14 (s, 6H), 1.10–0.99 (m, 14H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 156.6, 133.7, 109.9, 94.3, 43.2, 42.6, 29.3, 25.5, 25.4, 24.3, 18.4, 18.3, 13.3. **IR(neat)** 3391, 2945, 2864, 1749, 1690, 1623, 1462, 1385, 1371, 1334, 1297, 1278, 1246, 1067, 992, 881, 824, 755, 666 cm^{-1}. **HRMS** (ESI) *m/z*: 366.1534 $[(M+Na)^+$; calculated for $C_{16}H_{29}NO_3SSiNa$: 366.1530]. **R_F**: 0.21 in 20% EtOAc/Hex.

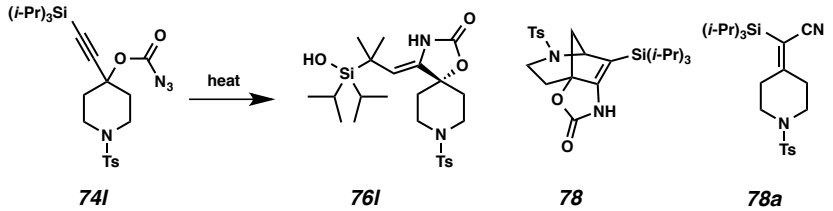
1',1'-diisopropyl-2',2'-dimethyl-1',2',4,5-tetrahydro-2*H*,6'*H*-spiro[thiophene-3,4'-[1,2]azasilolo[1,5-*c*]oxazol]-6'-one (75j) was observed in crude NMR (45% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.58 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 325 [$(M^+$; calculated for $C_{16}H_{27}NO_2SSi$: 325.15]



(5*S*,7*R*,*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-7-methyl-1-oxa-3-azaspiro[4.5]decan-2-one (76k) was synthesized from carbonazidate **74k** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 5 to 10% EtOAc in hexanes as eluents. The silanol **76k** was obtained as an amorphous yellowish solid. (trial 1: 12.4 mg, 35% yield; trial 2: 12.3 mg, 35% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.23 (s, 1H), 4.60 (s, 1H), 4.43 (s, 1H), 2.00–1.41 (m, 9H), 1.14 (s, 6H), 1.05 (s, 14H), 0.98 (d, J = 6.8 Hz, 3H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.4, 139.3, 109.8, 86.7, 43.4, 36.2, 32.0, 28.0, 25.8, 25.7, 24.2, 21.4, 19.8, 18.4, 18.4, 18.4, 18.3, 13.5, 13.5. **IR(neat)** 3088, 2926, 2863, 1745, 1678, 1463, 1367, 1323, 1286, 1250, 1206, 1155, 1134, 1058, 972, 935, 921, 826, 791, 668 cm^{-1}. **HRMS** (ESI) *m/z*: 376.2283 [(M+Na)$^+$; calculated for $C_{19}H_{35}NO_3SiNa$: 376.2278]. **R_F**: 0.18 in 15% EtOAc/Hex.

(1*S*,3*R*)-1',1'-diisopropyl-2',2',3-trimethyl-1',2'-dihydro-6'*H*-spiro[cyclohexane-1,4'-[1,2]azasilolo[1,5-*c*]oxazol]-6'-one (75k) was observed in crude NMR (36% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 4.50 (s, 1H, vinyl proton), **MS** (EI) *m/z*: 335 [(M+); calculated for $C_{19}H_{33}NO_2Si$: 335.23]

(5*S*,8a*S*)-5-methyl-4-(triisopropylsilyl)-5,6,7,8-tetrahydro-5,8a-methanocyclohepta[*d*]oxazol-2(3*H*)-one (77) was synthesized from carbonazidate **74k** using General Procedure D1. The crude product was purified by column chromatography on silica gel using a gradient of 5 to 10% EtOAc in hexanes as eluents. The tricycle **77** was obtained as a white solid. (trial 1: 11.3 mg, 34% yield; trial 2: 11.8 mg, 35% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 6.66 (s, 1H), 2.15–2.01 (m, 1H), 1.86–1.68 (m, 3H), 1.65 (d, J = 9.1 Hz, 1H), 1.62–1.52 (m, 1H), 1.43 (d, 1H), 1.32–1.19 (m, 4H), 1.19–0.94 (m, 21H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 158.9, 152.4, 106.1, 92.7, 57.7, 53.7, 32.6, 28.8, 27.8, 20.8, 19.1, 19.1, 19.1, 19.1, 19.1, 17.7, 12.5, 12.5, 12.2. **IR(neat)** 3230, 2938, 2864, 1756, 1629, 1465, 1321, 1277, 1229, 1008, 976, 944, 881, 846, 745, 712, 665 cm^{-1}. **HRMS** (ESI) *m/z*: 358.2177 [(M+Na)$^+$; calculated for $C_{19}H_{33}NO_2SiNa$: 358.2173]. **R_F**: 0.39 in 15% EtOAc/Hex. **MP** 120-122 °C

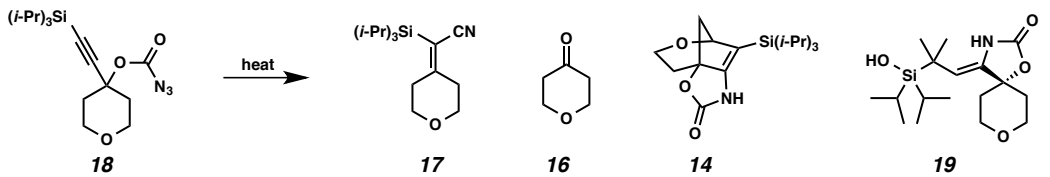


(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-8-tosyl-1-oxa-3,8-diazaspiro[4.5]decan-2-one (76l) was synthesized from carbonazidate **74l** using General Procedure D2. The crude product was purified by column chromatography on silica gel

using a gradient of 10 to 20% EtOAc in hexanes as eluents. The silanol **76l** was obtained as a white solid. (trial 1: 25.7 mg, 52% yield; trial 2: 26.2 mg, 53% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.03 (s, 1H), 7.60 (d, *J* = 8.0 Hz, 2H), 7.30 (d, *J* = 7.9 Hz, 2H), 4.25 (s, 1H), 3.84–3.67 (m, 3H), 3.35 (t, *J* = 6.1 Hz, 1H), 2.59–2.47 (m, 3H), 2.43 (s, 3H), 1.90–1.82 (m, 2H), 1.11 (s, 6H), 1.06–0.92 (m, 14H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 156.4, 143.9, 136.9, 132.7, 129.9, 127.6, 109.6, 82.9, 45.9, 42.34, 40.6, 36.1, 25.4, 24.0, 21.5, 18.4, 13.3. **IR(neat)** 3335, 2946, 2867, 1745, 1698, 1595, 1464, 1376, 1314, 1259, 1180, 1085, 1003, 944, 932, 913, 894, 877, 765, 742, 721, 675 cm^{-1}. **HRMS** (ESI) *m/z*: 517.2167 [$(M+Na)^+$; calculated for $C_{24}H_{38}N_2O_5SSiNa$: 517.2163]. **R_F**: 0.24 in 30% EtOAc/Hex. **MP**: 201-202 °C.

(5*S*,8a*S*)-6-tosyl-4-(triisopropylsilyl)-5,6,7,8-tetrahydro-5,8a-methanooxazolo[4,5-*d*]azepin-2(3*H*)-one (78) was synthesized from carbonazidate **74l** using General Procedure D2. The crude product was purified by column chromatography on silica gel using a gradient of 10 to 20% EtOAc in hexanes as eluents. The tricycle **56** was obtained as a white solid. (trial 1: 9.5 mg, 20% yield; trial 2: 10.0 mg, 21% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.4 Hz, 2H), 7.30 (d, *J* = 8.1 Hz, 2H), 7.16 (s, 1H), 5.07 (d, *J* = 4.0 Hz, 1H), 3.91 (dd, *J* = 14.7, 6.8 Hz, 1H), 3.47 (ddd, *J* = 14.7, 11.9, 5.4 Hz, 1H), 2.42 (s, 3H), 2.09–2.02 (m, 1H), 1.97–1.86 (m, 1H), 1.65 (d, *J* = 9.7 Hz, 1H), 1.62–1.53 (m, 2H), 1.18–0.93 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 158.1, 156.3, 143.6, 137.5, 129.9, 127.1, 100.5, 91.6, 65.3, 48.2, 40.9, 30.8, 21.6, 18.5, 11.5. **IR(neat)** 3206, 2942, 2863, 1770, 1655, 1597, 1459, 1339, 1297, 1223, 1207, 1165, 1153, 1094, 1009, 959, 926, 902, 767, 729, 706, 661 cm^{-1}. **HRMS** (ESI) *m/z*: 499.2060 [$(M+Na)^+$; calculated for $C_{24}H_{36}N_2O_4SSiNa$: 499.2057]. **R_F**: 0.42 in 30% EtOAc/Hex. **MP**: 199-200 °C.

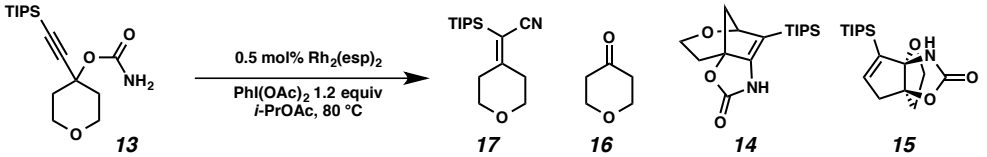
2-(1-tosylpiperidin-4-ylidene)-2-(triisopropylsilyl)acetonitrile (78a) was synthesized from carbonazidate **74l** using General Procedure D2. The crude product was purified by column chromatography on silica gel using a gradient of 10 to 20% EtOAc in hexanes as an eluent. The nitrile **78a** was obtained as a white solid. (trial 1: 4.3 mg, 10% yield; trial 2: 4.8 mg, 11% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.62 (d, *J* = 8.3 Hz, 2H), 7.32 (d, *J* = 8.1 Hz, 2H), 3.15 (t, *J* = 5.9 Hz, 2H), 3.11 (t, *J* = 5.7 Hz, 2H), 2.86 (t, *J* = 5.9 Hz, 2H), 2.51 (t, *J* = 5.9 Hz, 2H), 2.42 (s, 3H), 1.37–1.24 (m, 3H), 1.11–0.90 (m, 18H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 170.4, 144.0, 133.2, 129.8, 127.5, 119.9, 106.3, 46.8, 46.5, 35.9, 34.4, 21.6, 18.5, 12.6. **IR(neat)** 2946, 2863, 2190, 1766, 1656, 1596, 1494, 1357, 1227, 1162, 1101, 1072, 954, 935, 903, 815, 800, 732, 712, 701, 676 cm^{-1}. **HRMS** (ESI) *m/z*: 455.2165 [$(M+Na)^+$; calculated for $C_{23}H_{36}N_2O_2SSiNa$: 455.2159]. **R_F**: 0.6 in 30% EtOAc/Hex. **MP**: 96-98 °C.



2-(tetrahydro-4*H*-pyran-4-ylidene)-2-(triisopropylsilyl)acetonitrile (17) was synthesized from carbonazidate **18** using General Procedure D2. The crude product was purified by column chromatography on silica gel using a gradient of 5 to 20% EtOAc in hexanes as an eluent. The nitrile **17** was obtained as a white solid. (trial 1: 1.4 mg, 5% yield; trial 2: 1.3 mg, 4% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 3.80 (t, *J* = 5.7 Hz, 2H), 3.74 (t, *J* = 5.7 Hz, 2H), 2.82 (t, *J* = 5.7 Hz, 2H), 2.47 (t, *J* = 5.7 Hz, 2H), 1.41–1.31 (m, 3H), 1.11 (m, 18H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 172.4, 120.5, 104.2, 69.0, 68.5, 38.0, 36.6, 18.7, 13.0. **IR(neat)** 2941, 2889, 2863, 2846, 2195, 1756, 1574, 1459, 1430, 1374, 1318, 1288, 1222, 1264, 1172, 1021, 916, 882, 872, 709, 678 cm^{-1}. **HRMS** (CI) *m/z*: 280.2095 [$(M+H)^+$; calculated for $C_{16}H_{30}NOSi$: 280.2097]. **R_F**: 0.51 in 20% EtOAc/Hex. **MP** 53-55 °C.

(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-1,8-dioxa-3-azaspiro[4.5]decan-2-one (19) was synthesized from carbonazidate **18** using General Procedure D2. The crude product was purified by column chromatography on silica gel using a gradient of 5 to 20% EtOAc in hexanes as eluents. The silanol **19** was obtained as a white solid. (trial 1: 15.6 mg, 46% yield; trial 2: 14.0 mg, 41% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.10 (s, 1H), 4.28 (s, 1H), 3.99 (s, 1H), 3.93–3.82 (m, 2H), 3.75 (ddd, *J* = 11.8, 11.9, 2.3 Hz, 2H), 1.91–1.65 (m, 4H), 1.14 (s, 6H), 1.05 (s, 14H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 156.8, 137.8, 109.2, 83.5, 63.8, 37.1, 25.6, 24.0, 18.4, 13.4. **IR(neat)** 3280, 3064, 2951, 2968, 2858, 1748, 1701, 1427, 1385, 1301, 1255, 1244, 1125, 1100, 1021, 1005, 947, 895, 843, 822, 778, 728, 677 cm^{-1}. **HRMS** (ESI) *m/z*: 364.1918 [$(M+Na)^+$; calculated for $C_{17}H_{31}NO_4SiNa$: 364.1915]. **R_F**: 0.18 in 20% EtOAc/Hex. **MP**: 76-78 °C.

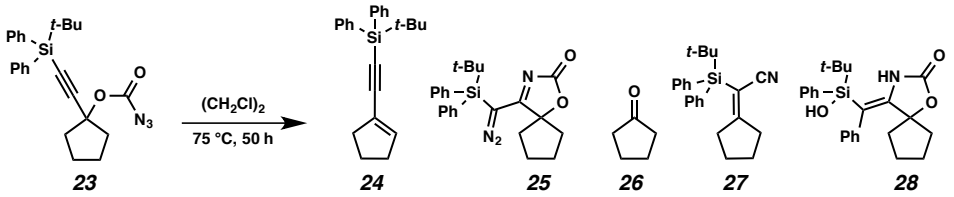
(5*S*,8a*S*)-4-(triisopropylsilyl)-3,5,7,8-tetrahydro-2*H*-5,8a-methanooxepino[4,5-*d*]oxazol-2-one (14) was synthesized from carbonazidate **18** using General Procedure D2. The crude product was purified by column chromatography on silica gel using a gradient of 5 to 20% EtOAc in hexanes as eluents. The tricycle **14** was obtained as a white solid. (trial 1: 9.1 mg, 28% yield; trial 2: 10.1 mg, 31% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.06 (s, 1H), 4.98 (d, *J* = 2.9 Hz, 1H), 4.09–4.01 (m, 1H), 3.88 (dd, *J* = 10.9, 6.9 Hz, 1H), 2.34–2.26 (m, 2H), 2.18 (d, *J* = 9.2 Hz, 1H), 1.69–1.63 (m, 1H), 1.19–1.10 (m, 3H), 1.09–1.04 (m, 18H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 158.6, 156.5, 98.2, 91.9, 84.9, 60.6, 52.3, 32.6, 31.1, 18.8, 18.6, 11.8. **IR(neat)** 3204, 2942, 2864, 1752, 1690, 1651, 1337, 1316, 1248, 1219, 162, 1297, 1100, 1069, 1040, 968, 940, 914, 881, 855, 729, 700 cm^{-1}. **HRMS** (ESI) *m/z*: 346.1814 [$(M+Na)^+$; calculated for $C_{17}H_{29}NO_3SiNa$: 346.1809]. **R_F**: 0.39 in 20% EtOAc/Hex. **MP**: 95-97 °C.



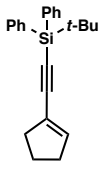
A 2 dram vial was charged with magnetic stir bar, alkynyl carbamate **13** (65 mg, 0.2 mmol, 1.0 equiv), $PhI(OAc)_2$ (77.3 mg, 0.24 mmol, 1.2 equiv) and $Rh_2(esp)_2$ (0.8 mg, 0.0001 mmol, 0.5 mol%). Isopropyl acetate (2 mL, 0.1 M) was added and the vial was sealed. The reaction mixture was heated at 80 ˚C for 21 hours. When cooled to room

temperature, solvents were removed via rotary evaporation and the residue was purified by flash column chromatography on silica gel using a gradient of 5 to 20% EtOAc in hexanes as eluents. **2-(tetrahydro-4*H*-pyran-4-ylidene)-2-(triisopropylsilyl)acetonitrile (17)** was obtained as a white solid. (9 mg, 16% yield). **(5*S*,8a*S*)-4-(triisopropylsilyl)-3,5,7,8-tetrahydro-2*H*-5,8a-methanooxepino[4,5-*d*]oxazol-2-one (14)** was obtained as a white solid. (8 mg, 12% yield).

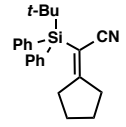
(3a*R*,6a*R*)-6-(triisopropylsilyl)-2,3-dihydro-4*H*-3a,6a-(epoxymethanoimino)cyclopenta[*b*]furan-8-one (15) was obtained as a white solid. (17 mg, 27% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 6.02 (t, *J* = 2.3 Hz, 1H), 5.54 (s, 1H), 4.10–4.05 (m, 1H), 3.98-3.91 (m, 1H), 2.97–2.80 (m, 2H), 2.52–2.45 (m, 1H), 1.98–1.88 (m, 1H), 1.19–1.01 (m, 21H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 157.8, 144.2, 139.8, 112.1, 97.4, 67.4, 45.1, 38.9, 18.8, 18.7, 18.7, 11.4. **IR(neat)** 3258, 2941, 2864, 1745, 1651, 1574, 1462, 1383, 1335, 1274, 1298, 1066, 1144, 999, 985, 959, 937, 922, 880, 818, 766, 710, 679 cm^{-1}. **HRMS** (ESI) *m/z*: 346.1814 [$(M+Na)^+$; calculated for $C_{17}H_{29}NO_3SiNa$: 346.1809]. **R_F**: 0.3 in 20% EtOAc/Hex. **MP**: 95-97 °C.



A 2 dram vial was charged with a magnetic spin bar, carbonazidate **23** (0.3 mmol, 1 equiv), and distilled 1,2-dichloroethane (0.1 M, 3 mL). The reaction vessel was sealed and heated in an oil bath at 75 °C. The progress of the reaction was monitored by TLC. After 50 h, the reaction vessel was cooled to room temperature and the mixture was concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 20% EtOAc in hexanes as eluents.

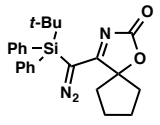


***tert*-butyl(cyclopent-1-en-1-ylethynyl)diphenylsilane (24)** was obtained as a colorless oil. (19.8 mg, 20% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.85-7.75 (m, 4H), 7.44–7.31 (m, 6H), 6.26–6.20 (m, 1H), 2.62–2.51 (m, 2H), 2.50–2.40 (m, 2H), 2.03–1.88 (m, 2H), 1.08 (s, 9H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 139.9, 135.6, 133.6, 129.4, 127.6, 124.7, 106.7, 90.3, 36.4, 33.4, 27.1, 23.3, 18.6. **IR(neat)** 3069, 2956, 2928, 2891, 2855, 2143, 1470, 1427, 1389, 1360, 1259, 1157, 1107, 1008, 998, 875, 819, 741, 724, 697 cm^{-1}. **HRMS** (CI) *m/z*: 330.1800 [$(M)^+$; calculated for $C_{23}H_{26}Si$: 330.1804]. **R_F**: 0.75 in 10% EtOAc/Hex.



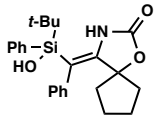
27

2-(*tert*-butyldiphenylsilyl)-2-cyclopentylideneacetonitrile (27) was obtained as a white solid. (15.4 mg, 15% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.72–7.66 (m, 4H), 7.45–7.34 (m, 6H), 2.84 (td, J = 7.4, 1.7 Hz, 2H), 1.70–1.58 (m, 4H), 1.50–1.39 (m, 2H), 1.12 (s, 9H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 189.7, 135.7, 132.4, 129.7, 128.0, 121.3, 98.4, 38.0, 35.9, 27.1, 26.9, 24.9, 18.7. **IR(neat)** 3048, 2955, 2861, 2194, 1751, 1576, 1450, 1427, 1391, 1362, 1336, 1105, 1011, 997, 941, 821, 742, 700, 686 cm^{-1}. **HRMS** (CI) *m/z*: 346.1995 [(M+H)$^+$; calculated for $C_{23}H_{27}NSi$: 346.1991]. **R_F**: 0.51 in 10% EtOAc/Hex. **MP**: 103-105 °C.



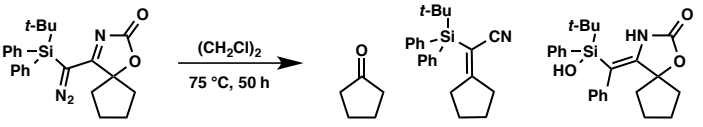
25

4-((*tert*-butyldiphenylsilyl)(diazo)methyl)-1-oxa-3-azaspiro[4.4]non-3-en-2-one (25) was obtained as a yellow solid. (18.8 mg, 15% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.61–7.55 (m, 4H), 7.49–7.41 (m, 2H), 7.41–7.34 (m, 4H), 2.21–2.06 (m, 4H), 2.06–1.90 (m, 2H), 1.89–1.70 (m, 2H), 1.25 (s, 9H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 195.0, 165.6, 136.5, 135.9, 130.9, 130.4, 128.3, 128.1, 96.6, 37.8, 37.0, 29.0, 27.7, 26.0, 23.4, 19.9. **IR(neat)** 3071, 2955, 2856, 2196, 1579, 1427, 1388, 1359, 1258, 1107, 998, 956, 819, 739, 698 cm^{-1}. **HRMS** (ESI) *m/z*: 440.1767 [(M+Na)$^+$; calculated for $C_{24}H_{27}N_3O_2SiNa$: 440.1765]. **R_F**: 0.21 in 10% EtOAc/Hex. **MP**: 108-109 °C.



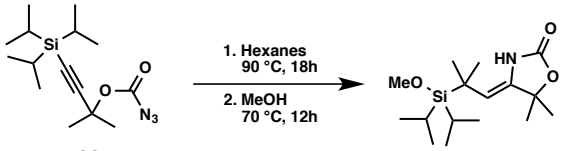
28

(*Z*)-4-((*tert*-butyl(hydroxy)(phenyl)silyl)(phenyl)methylene)-1-oxa-3-azaspiro[4.4]nonan-2-one (28) was obtained as a white solid. (12.3 mg, 10% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.77 (s, 1H), 7.46–7.01 (m, 10H), 5.76 (s, 1H), 2.18–1.98 (m, 2H), 1.83–1.72 (m, 1H), 1.72–1.43 (m, 3H), 1.20–1.07 (m, 1H), 0.95 (s, 10H). **^{13}C NMR** (100.52 MHz, $CDCl_3$) δ 157.1, 149.6, 136.8, 134.7, 134.1, 129.5, 127.5, 127.4, 126.5, 107.1, 97.1, 40.7, 38.7, 26.6, 24.2, 20.7. **IR(neat)** 3074, 2949, 2862, 2196, 1980, 1741, 1579, 1428, 1390, 1363, 1262, 1108, 999, 823, 739, 699 cm^{-1}. **HRMS** (ESI) *m/z*: 430.1813 [(M+Na)$^+$; calculated for $C_{24}H_{29}NO_3SiNa$: 430.1809]. **R_F**: 0.15 in 20% EtOAc/Hex. **MP**: 166-168 °C.



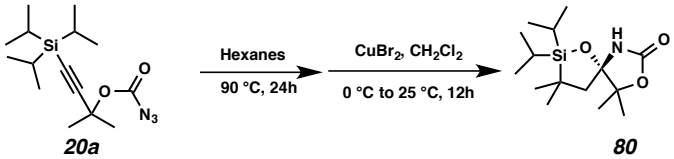
25 *26* *27* *28*

A 2 dram vial was charged with a magnetic spin bar, diazo **25** (62 mg, 0.15 mmol, 1 equiv), and distilled 1,2-dichloroethane (0.1 M, 1.5 mL). The reaction vessel was sealed and heated in an oil bath at 75 °C. The progress of the reaction was monitored by TLC. After 50 h, the reaction vessel was cooled to room temperature and the mixture was concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel using a gradient of 2 to 20% EtOAc in hexanes as eluents. Cyclopentanone **26** was observed on TLC (~30% yield). **Nitrile 27** was obtained as a white solid. (15.1 mg, 30% yield). Silanol **28** was obtained as a white solid. (15.0 mg, 25% yield).



20a *79*

(*Z*)-4-(2-(diisopropyl(methoxy)silyl)-2-methylpropylidene)-5,5-dimethyloxazolidin-2-one (79) A 2 dram vial was charged with a magnetic stir bar, carbonazidate **20a** (0.1 mmol), and dry hexanes (0.1 M, 1 mL). The reaction vessel was sealed and heated in an oil bath at 90 °C. **(Warning: Pressure buildup may occur during the reaction.)** The progress of the reaction was monitored by TLC. After the reaction was finished (18 h), the reaction vessel was cooled to room temperature and the mixture was concentrated under reduced pressure. The crude product was then dissolved in dry methanol (0.1M, 1 mL) in a 2 dram vial. The vial was sealed and the reaction was heated to 70 °C. The progress of the reaction was monitored by TLC. After 12 h, the reaction mixture was cooled and concentrated. The crude product was purified by column chromatography on silica gel using a gradient of 0 to 5% EtOAc in hexanes as eluents. Compound **79** was obtained as a colorless oil. (16.0 mg, 51% yield). **^{1}H NMR** (600 MHz, $CDCl_3$) δ 8.37 (s, 1H), 4.15 (s, 1H), 3.59 (s, 3H), 1.41 (s, 6H), 1.23–0.98 (m, 20H). **^{13}C NMR** (150.91 MHz, $CDCl_3$) δ 156.1, 139.6, 107.0, 84.5, 51.8, 28.0, 25.9, 24.5, 18.6, 18.2, 12.8. **IR(neat)** 2945, 2866, 1757, 1688, 1464, 1384, 1297, 1171, 1104, 1067, 1002, 902, 885, 798, 731, 679 cm^{-1}. **HRMS** (ESI) *m/z*: 336.1969 [$(M+Na)^+$; calculated for $C_{16}H_{21}NO_3SiNa$: 336.1965]. **R_F**: 0.36 in 20% EtOAc/Hex.



20a *80*

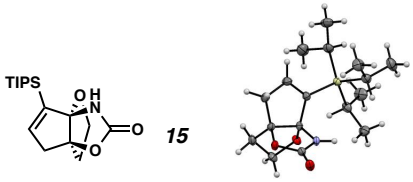
2,2-diisopropyl-3,3,9,9-tetramethyl-1,8-dioxa-6-aza-2-silaspiro[4.4]nonan-7-one (80) A 2 dram vial was charged with a magnetic stir bar, carbonazidate **20a** (0.2 mmol), and dry hexanes (0.1 M, 2 mL). The reaction vessel was sealed and heated in an oil bath at 90

°C. **(Warning: Pressure buildup may occur during the reaction.)** The progress of the reaction was monitored by TLC. After the reaction was finished (24 h), the reaction vessel was cooled to room temperature and the mixture was concentrated under reduced pressure. The crude product was then dissolved in dry dichloromethane (0.1 M, 2 mL). The mixture was cooled to 0 °C and stirred for 10 min. $CuBr_2$ (4.5 mg, 0.02 mmol, 0.1 equiv) was added in one portion. The progress of the reaction was monitored by TLC. After 12 h, the reaction mixture was filtered through a short celite pad and concentrated. The crude product was purified by column chromatography on silica gel using a gradient of 10 to 15% EtOAc in hexanes as eluents. Compound **80** was obtained as a white solid. (trial 1: 29.3 mg, 49% yield; trial 2: 28.7 mg, 48% yield). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 6.14 (s, 1H), 1.85 (d, *J* = 14.0 Hz, 1H), 1.71 (d, *J* = 13.9 Hz, 1H), 1.38 (s, 3H), 1.32 (s, 3H), 1.20 (s, 3H), 1.16 (s, 3H), 1.14–0.92 (m, 14H). **^{13}C NMR** (125.77 MHz, $CDCl_3$) δ 158.3, 95.3, 87.9, 48.8, 26.2, 26.2, 24.1, 23.6, 20.6, 17.9, 17.8, 17.6, 17.6, 13.4, 12.4. **IR(neat)** 3255, 2935, 2863, 1746, 1464, 1386, 1370, 1352, 1191, 1105, 1014, 989, 857, 907, 881, 846, 776, 683 cm^{-1}. **HRMS** (ESI) *m/z*: 322.1813 [$(M+Na)^+$; calculated for $C_{15}H_{29}NO_3SiNa$: 322.1809]. **R_F**: 0.15 in 20% EtOAc/Hex. **MP**: 114-116 °C.

Crystallographic Data

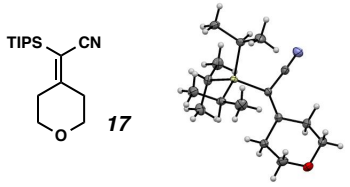
(3a*R*,6a*R*)-6-(triisopropylsilyl)-2,3-dihydro-4*H*-3a,6a-(epoxymethanoimino)cyclopenta[*b*]furan-8-one (15)

The solved structure of **15** has been deposited in The Cambridge Crystallographic Data Centre. CCDC 1477662.



2-(tetrahydro-4*H*-pyran-4-ylidene)-2-(triisopropylsilyl)acetonitrile (17)

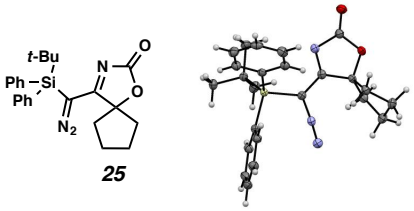
The solved structure of **17** has been deposited in The Cambridge Crystallographic Data Centre. CCDC 1477728.



4-((*tert*-butyldiphenylsilyl)(diazo)methyl)-1-oxa-3-azaspiro[4.4]non-3-en-2-one (25)

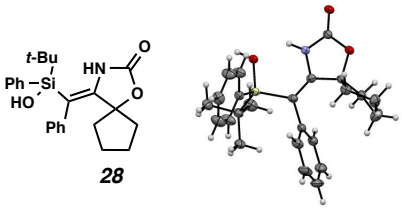
The solved structure of **25** has been deposited in The Cambridge Crystallographic Data

Centre. CCDC 1477664.



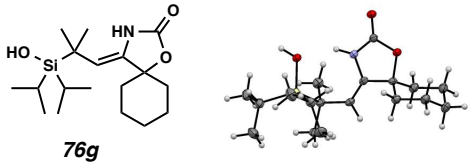
(*Z*)-4-((*tert*-butyl(hydroxy)(phenyl)silyl)(phenyl)methylene)-1-oxa-3-azaspiro[4.4]nonan-2-one (28)

The solved structure of **28** has been deposited in The Cambridge Crystallographic Data Centre. CCDC 1477665.



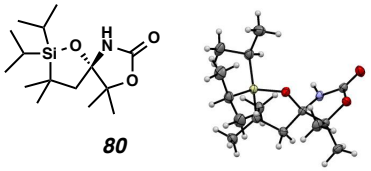
(*Z*)-4-(2-(hydroxydiisopropylsilyl)-2-methylpropylidene)-1-oxa-3-azaspiro[4.5]decan-2-one (76g)

The solved structure of **76g** has been deposited in The Cambridge Crystallographic Data Centre. CCDC 1477663.

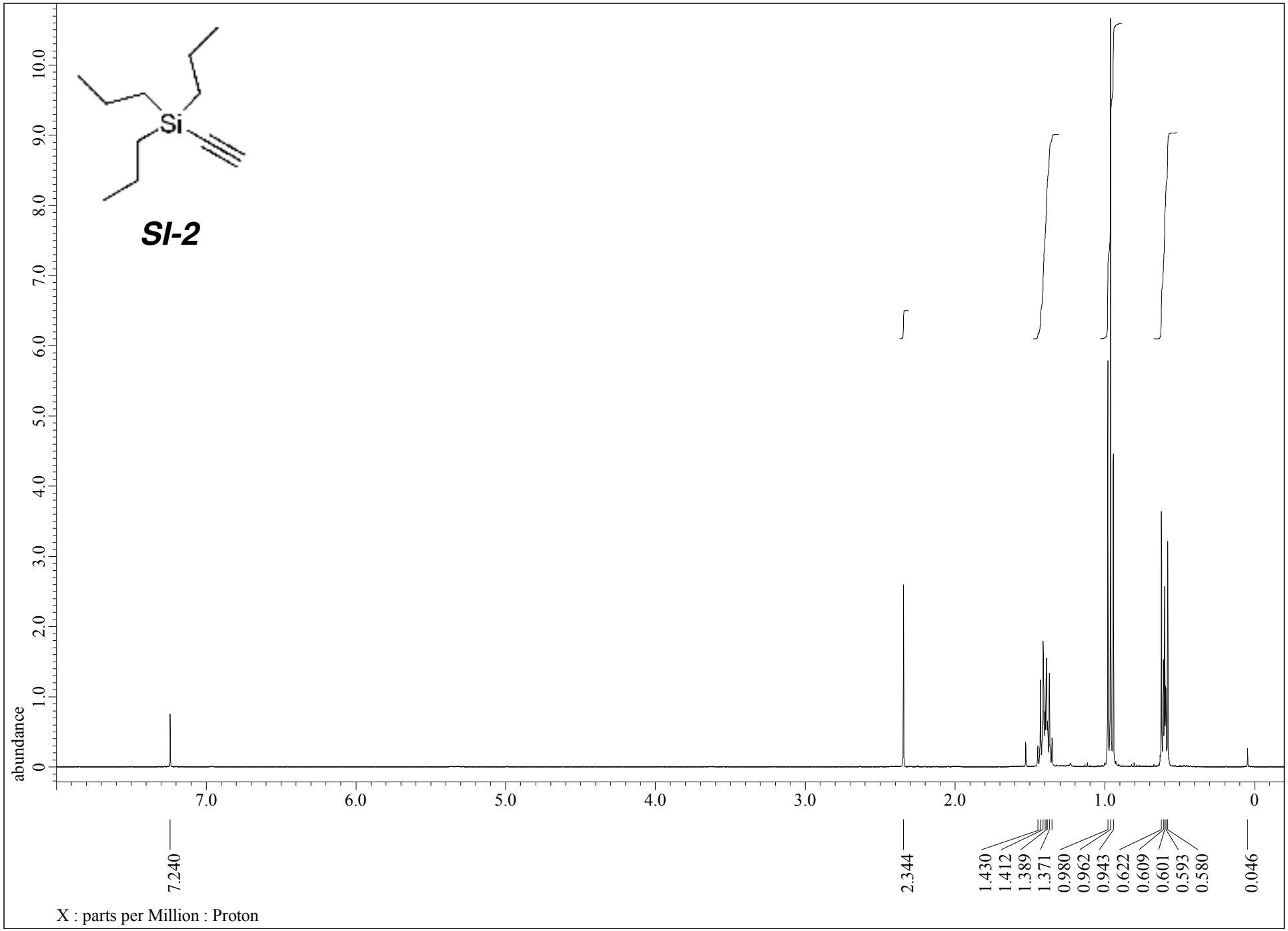


2,2-diisopropyl-3,3,9,9-tetramethyl-1,8-dioxa-6-aza-2-silaspiro[4.4]nonan-7-one (80)

The solved structure of **58** has been deposited in The Cambridge Crystallographic Data Centre. CCDC 1477666.



Spectral Data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3.0
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5.0
6.0
7.0
8.0
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10.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
2.344
1.430
1.412
1.389
1.371
0.980
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0.943
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0.609
0.601
0.593
0.580
0.046
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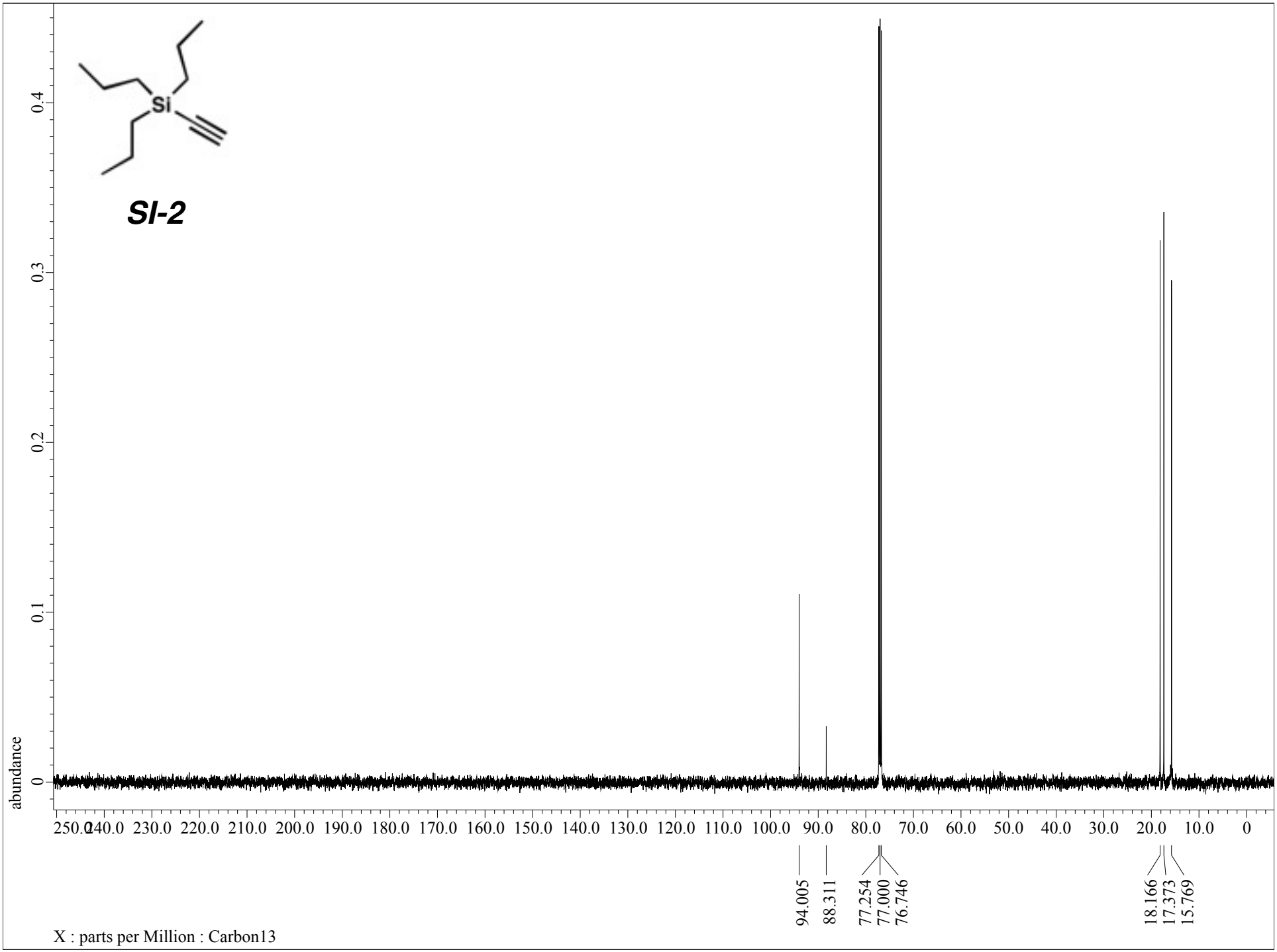
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SI-2
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0.4
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77.000
76.746
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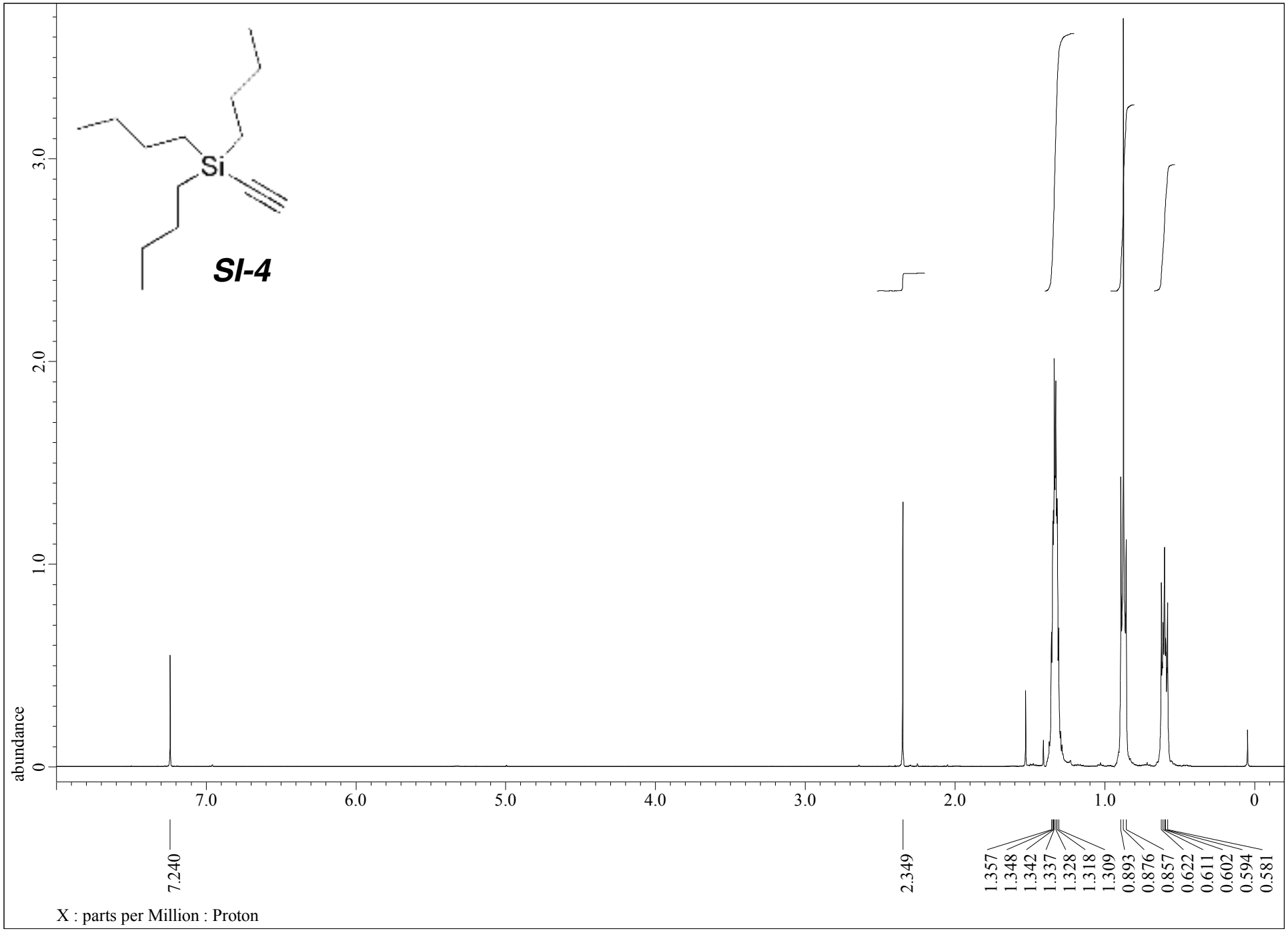
17.373
15.769
X : parts per Million : Carbon13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1.0
0
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2.349
1.357
1.348
1.342
1.337
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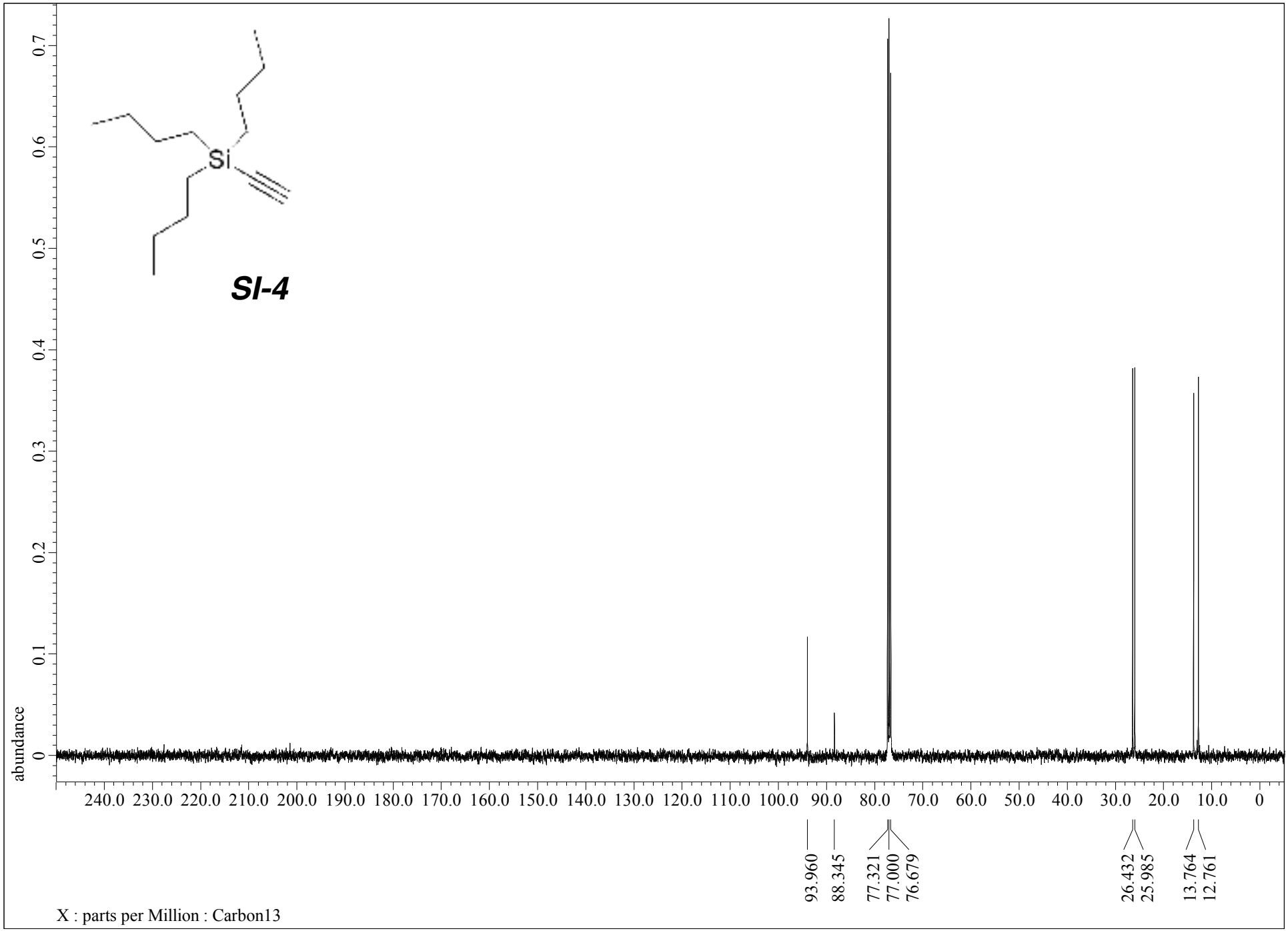
X : parts per Million : Proton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0.4
0.5
0.6
0.7
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77.321
77.000
76.679
26.432
25.985
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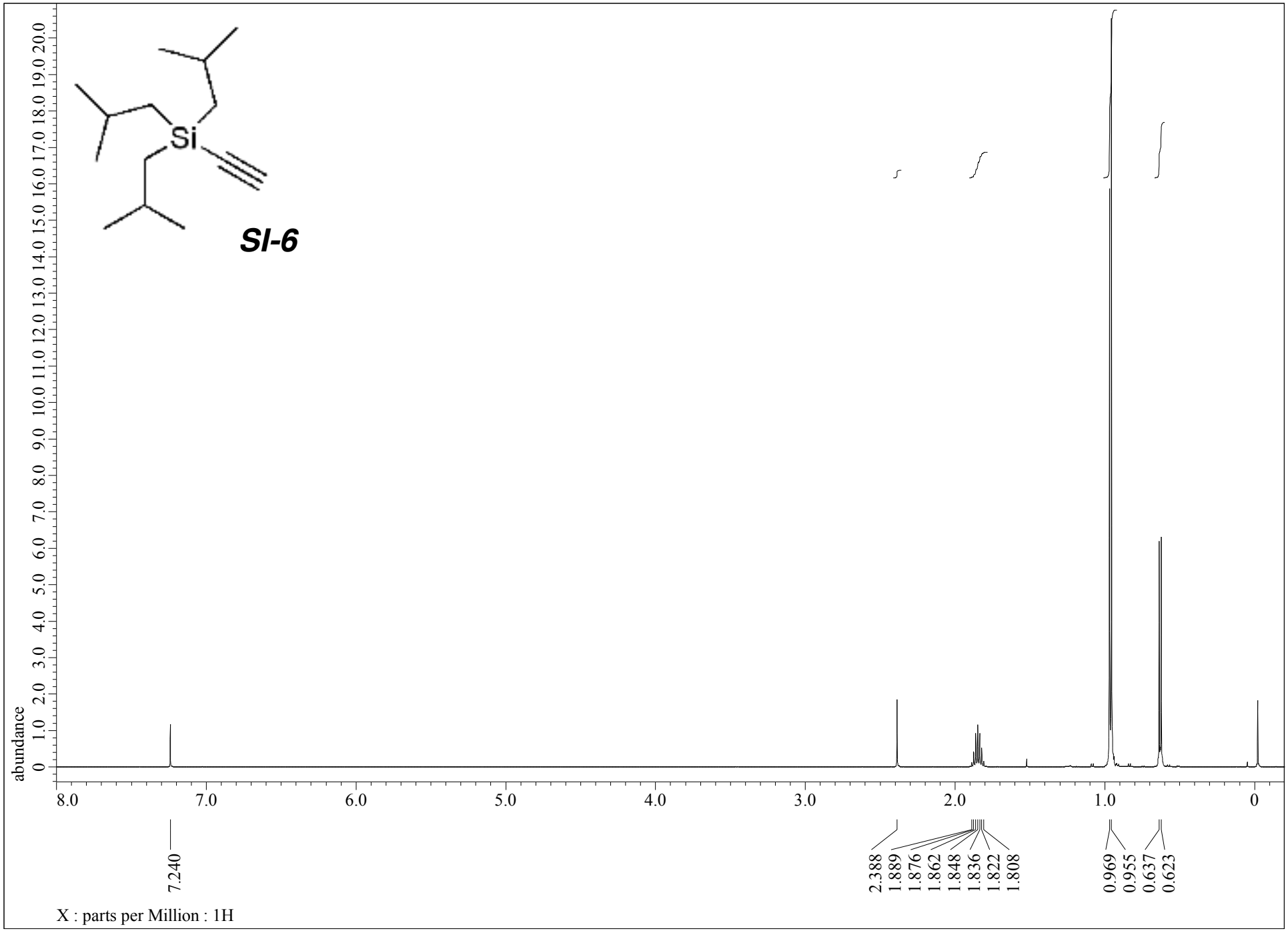
12.761
X : parts per Million : Carbon13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SI-6
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8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0
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0.969 0.955 0.637 0.623
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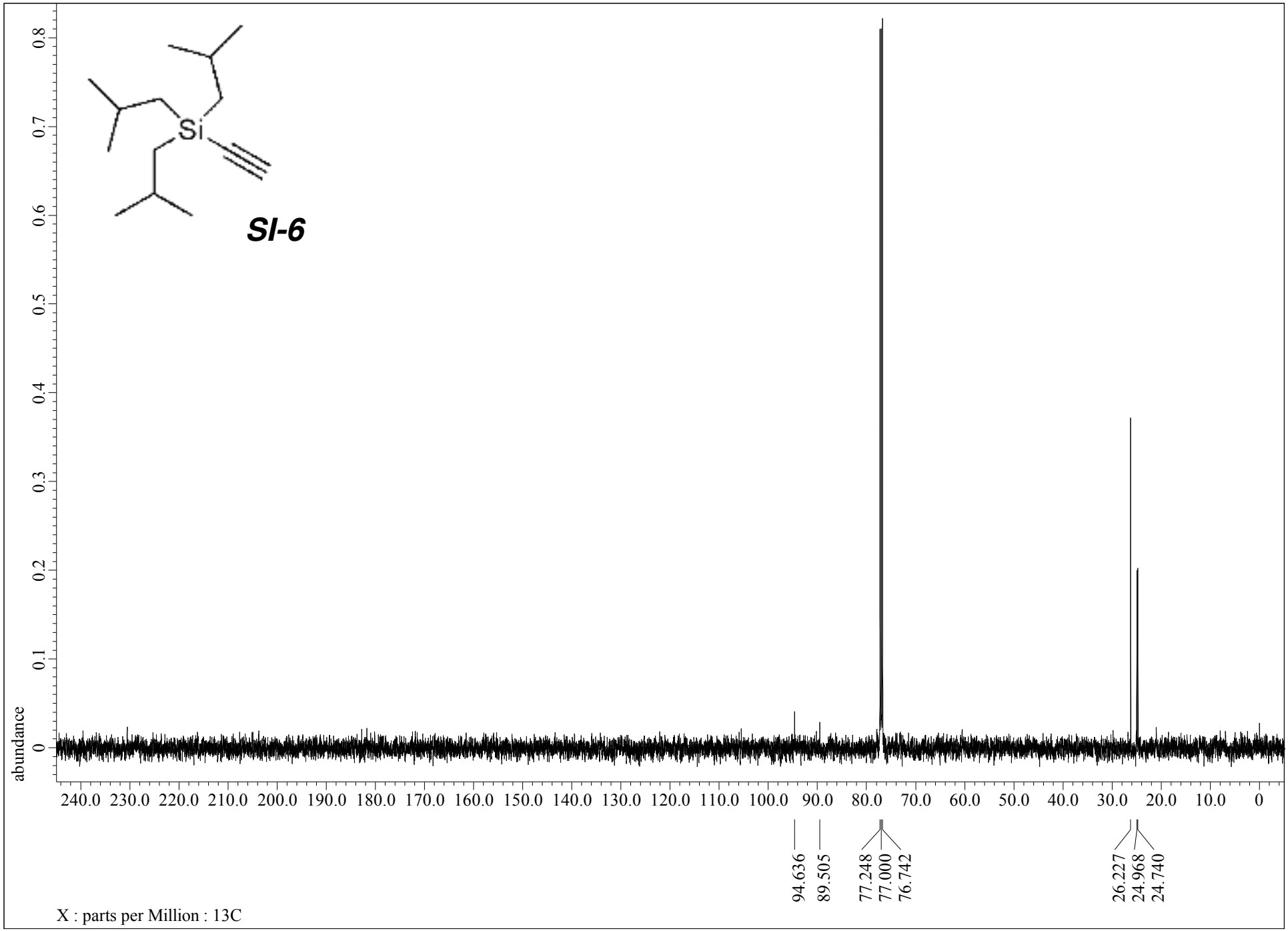
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SI-6
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0.3
0.4
0.5
0.6
0.7
0.8
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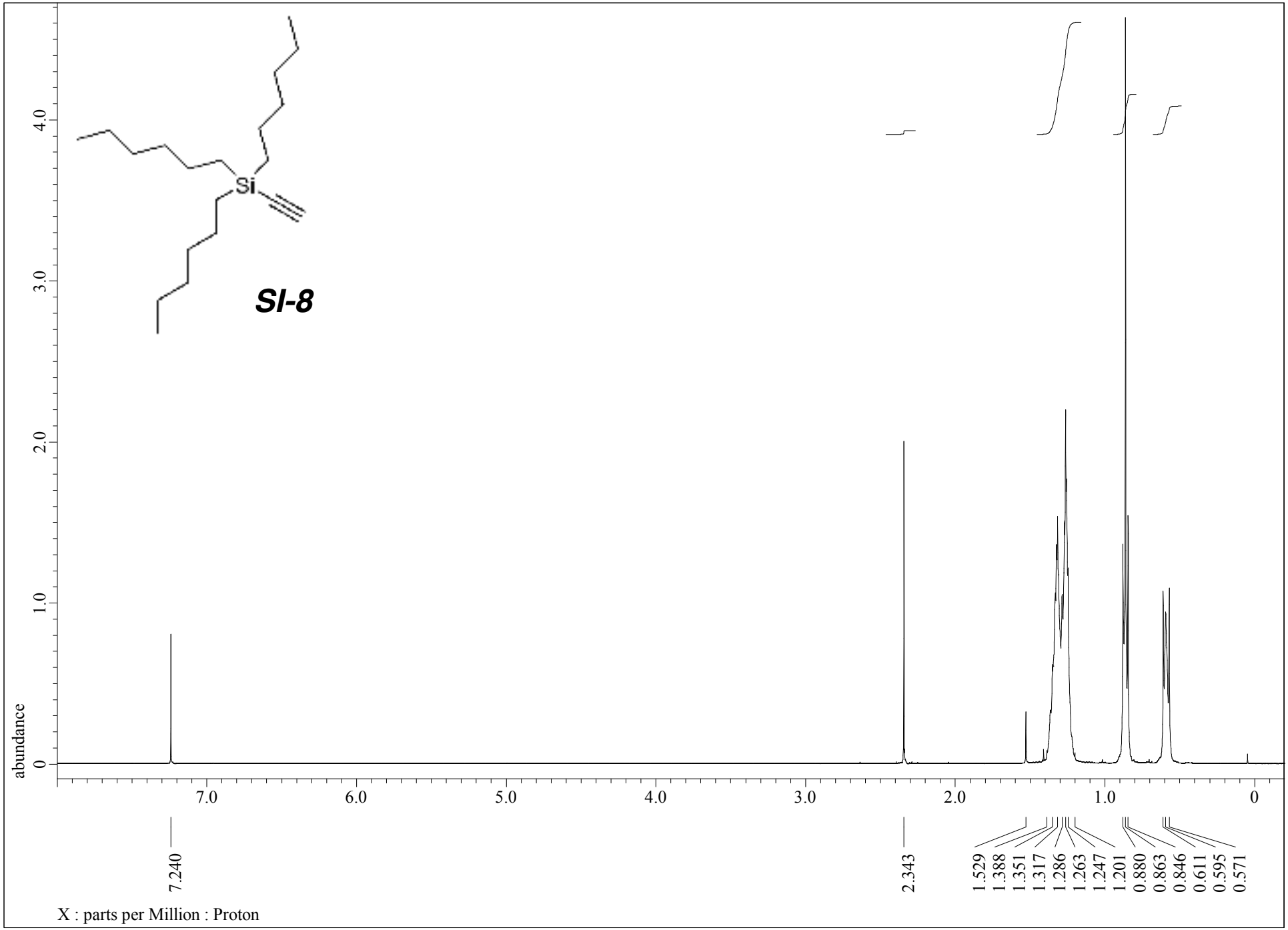
89.505
77.248
77.000
76.742
26.227
24.968
24.740
X : parts per Million : 13C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SI-8
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7.0
6.0
5.0
4.0
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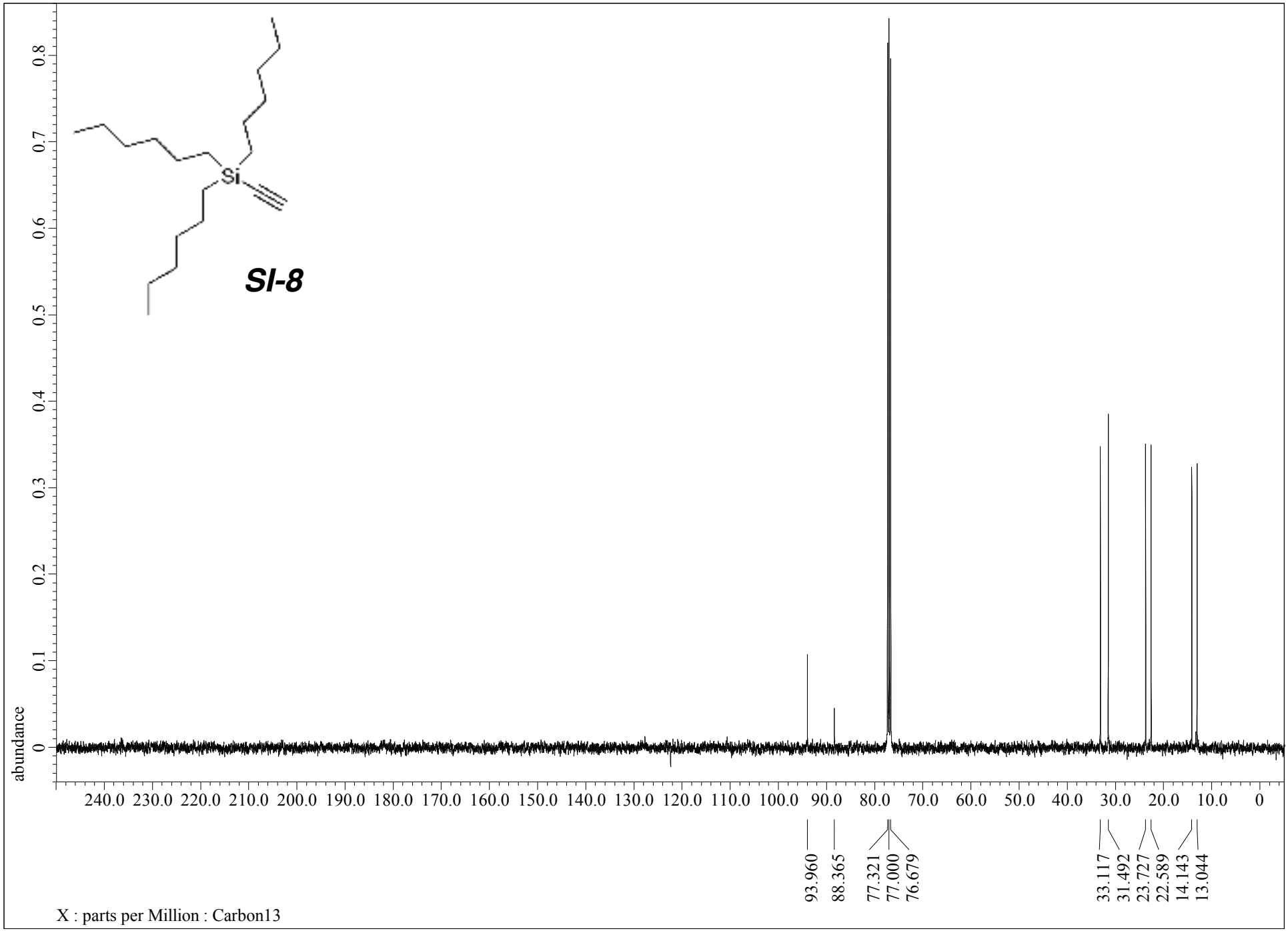
1.0
0
7.240
2.343
1.529
1.388
1.351
1.317
1.286
1.263
1.247
1.201
0.880
0.863
0.846
0.611
0.595
0.571
X : parts per Million : Proton


Si
SI-8
abundance
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0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
93.960
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77.321
77.000
76.679
33.117
31.492
23.727
22.589
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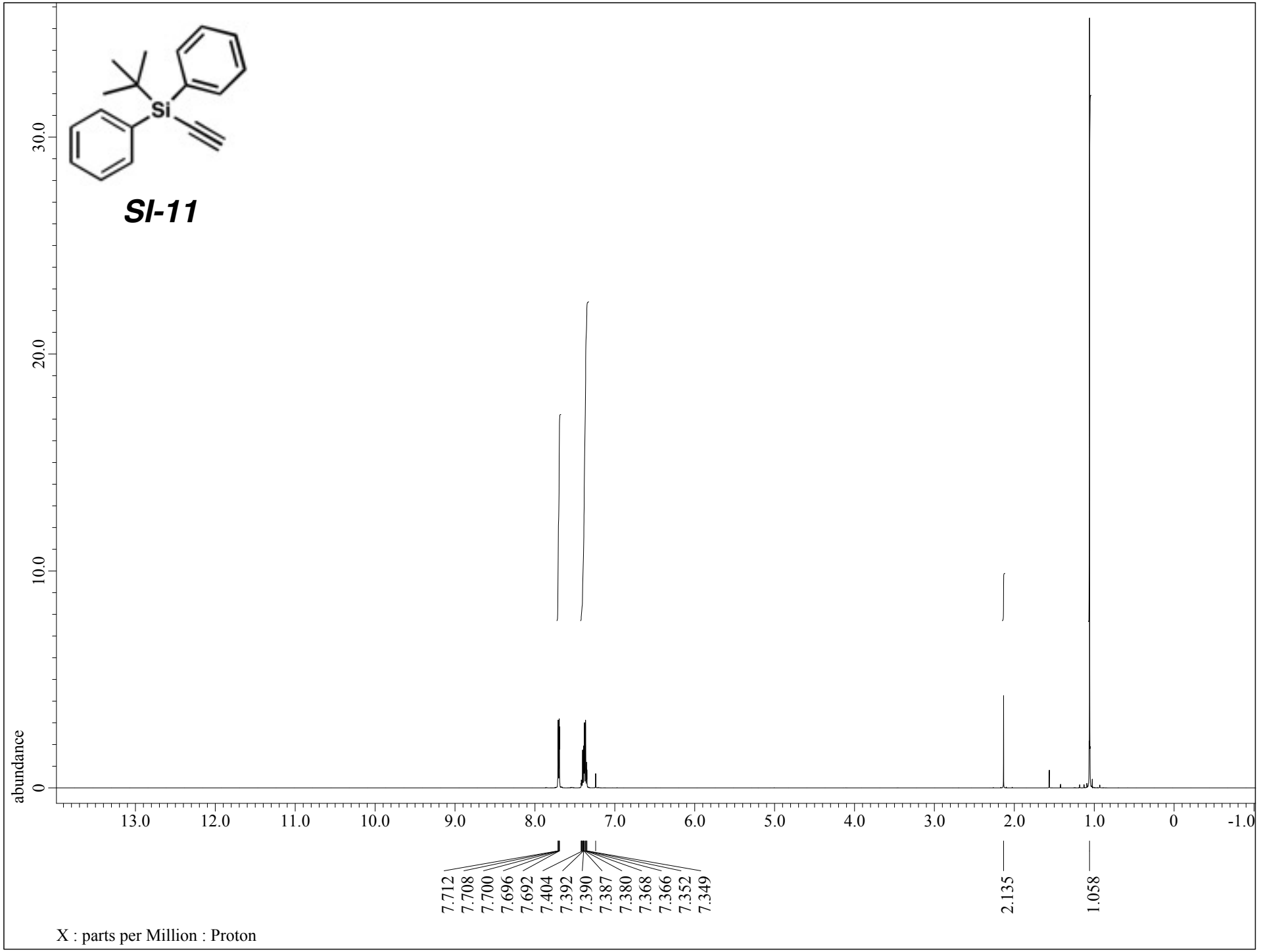
X : parts per Million : Carbon13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SI-11
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abundance
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12.0
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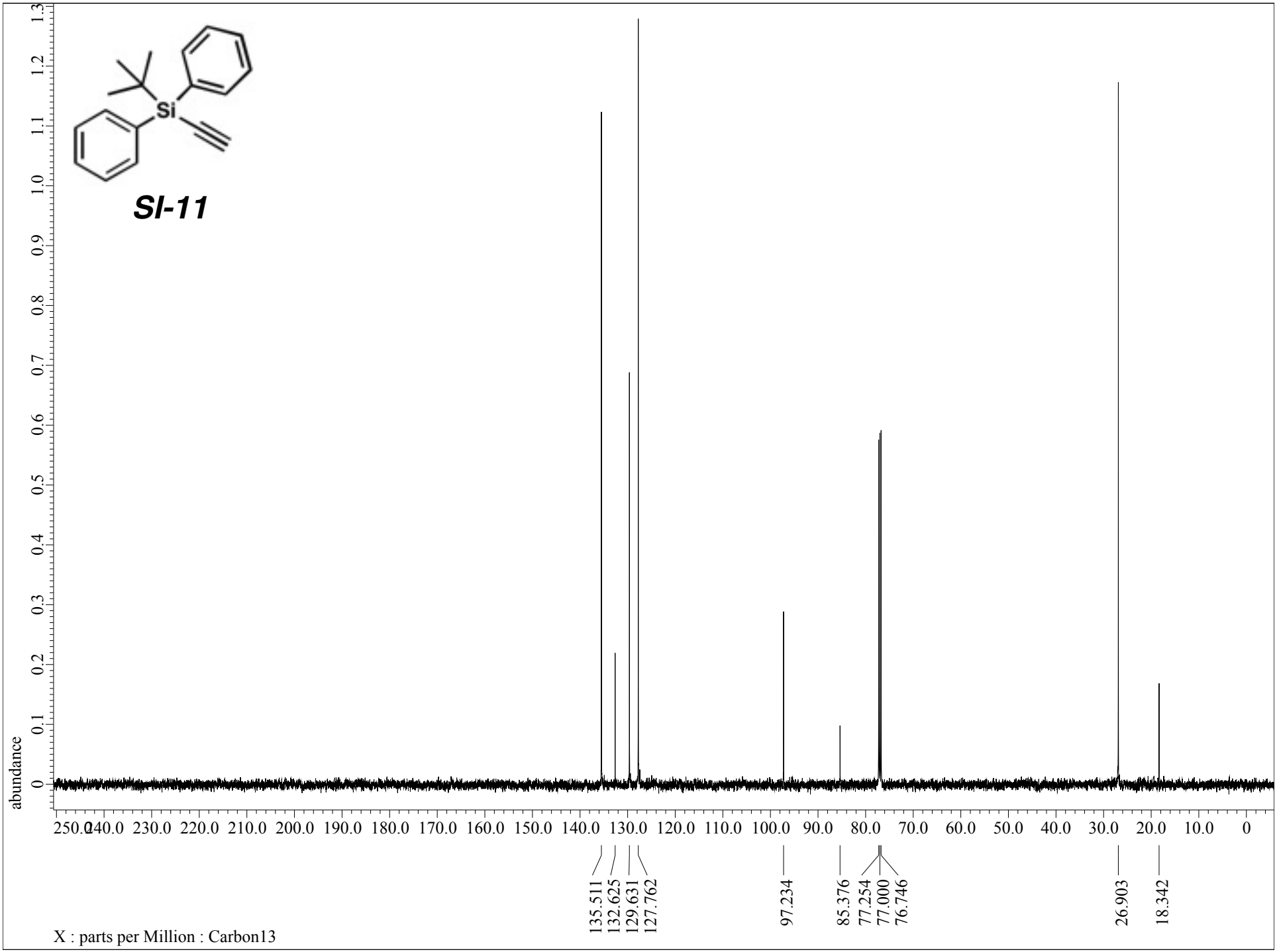
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.712
7.708
7.700
7.696
7.692
7.404
7.392
7.390
7.387
7.380
7.368
7.366
7.352
7.349
2.135
1.058
X : parts per Million : Proton


Si
SI-11
abundance
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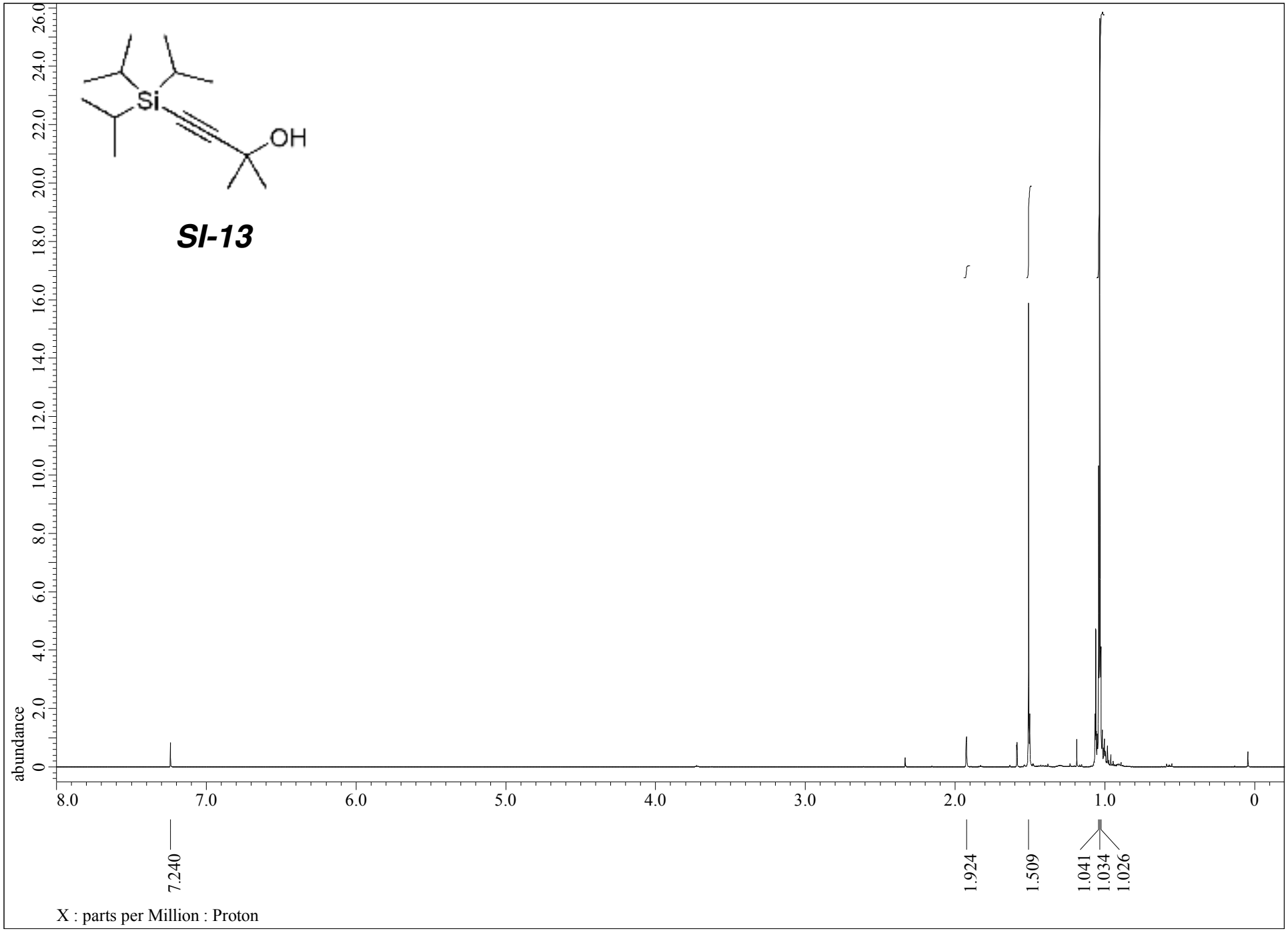
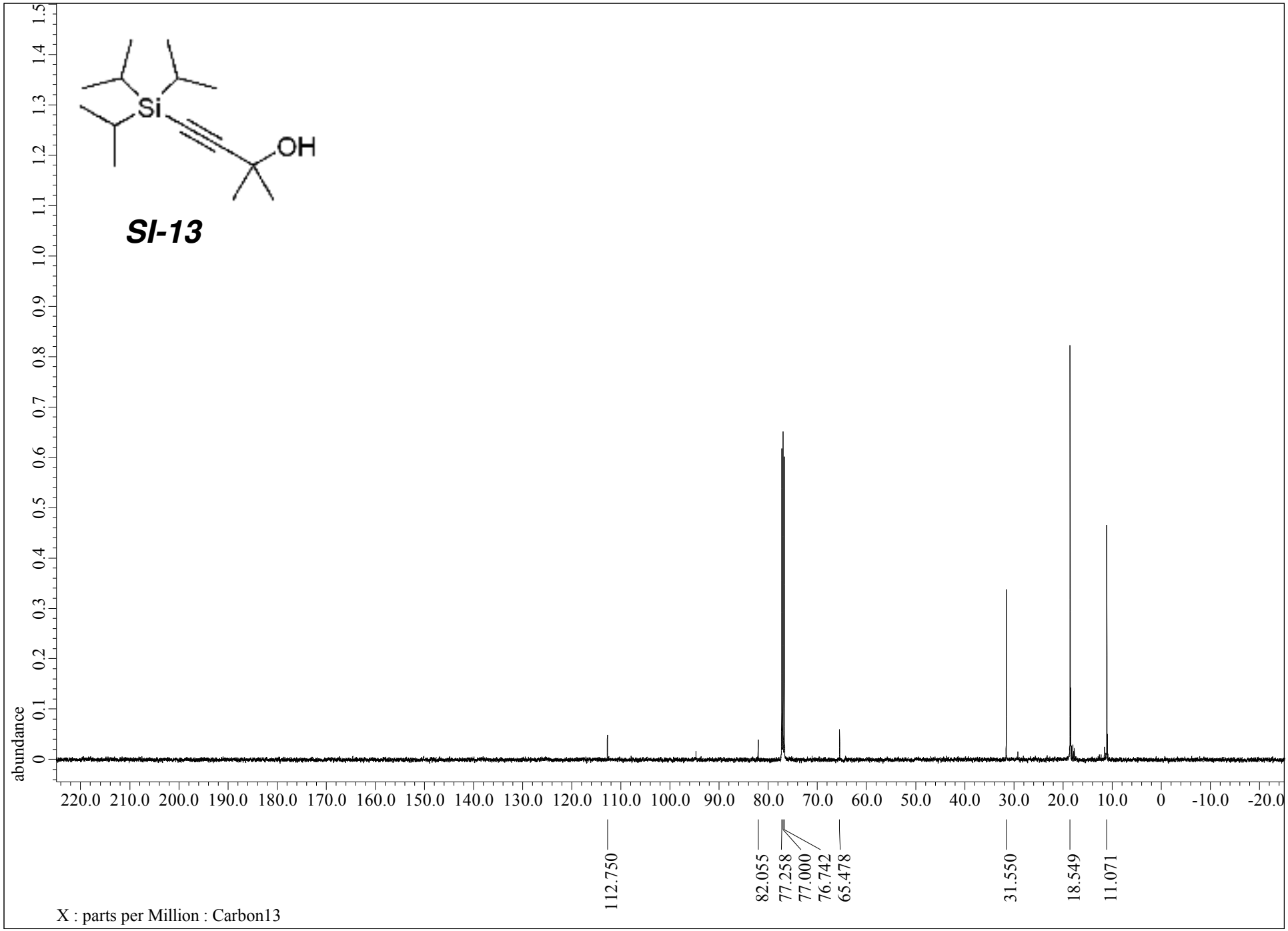
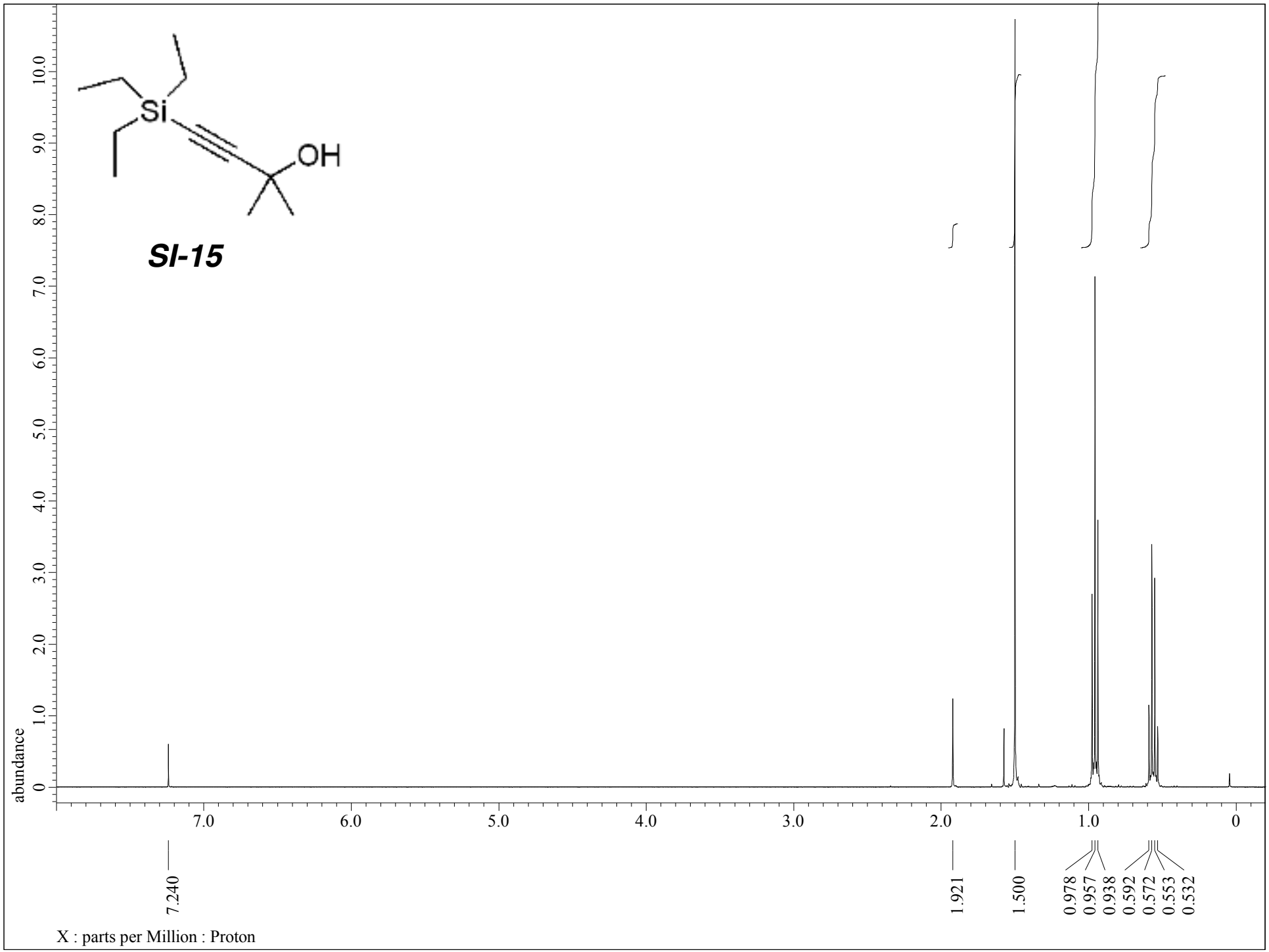
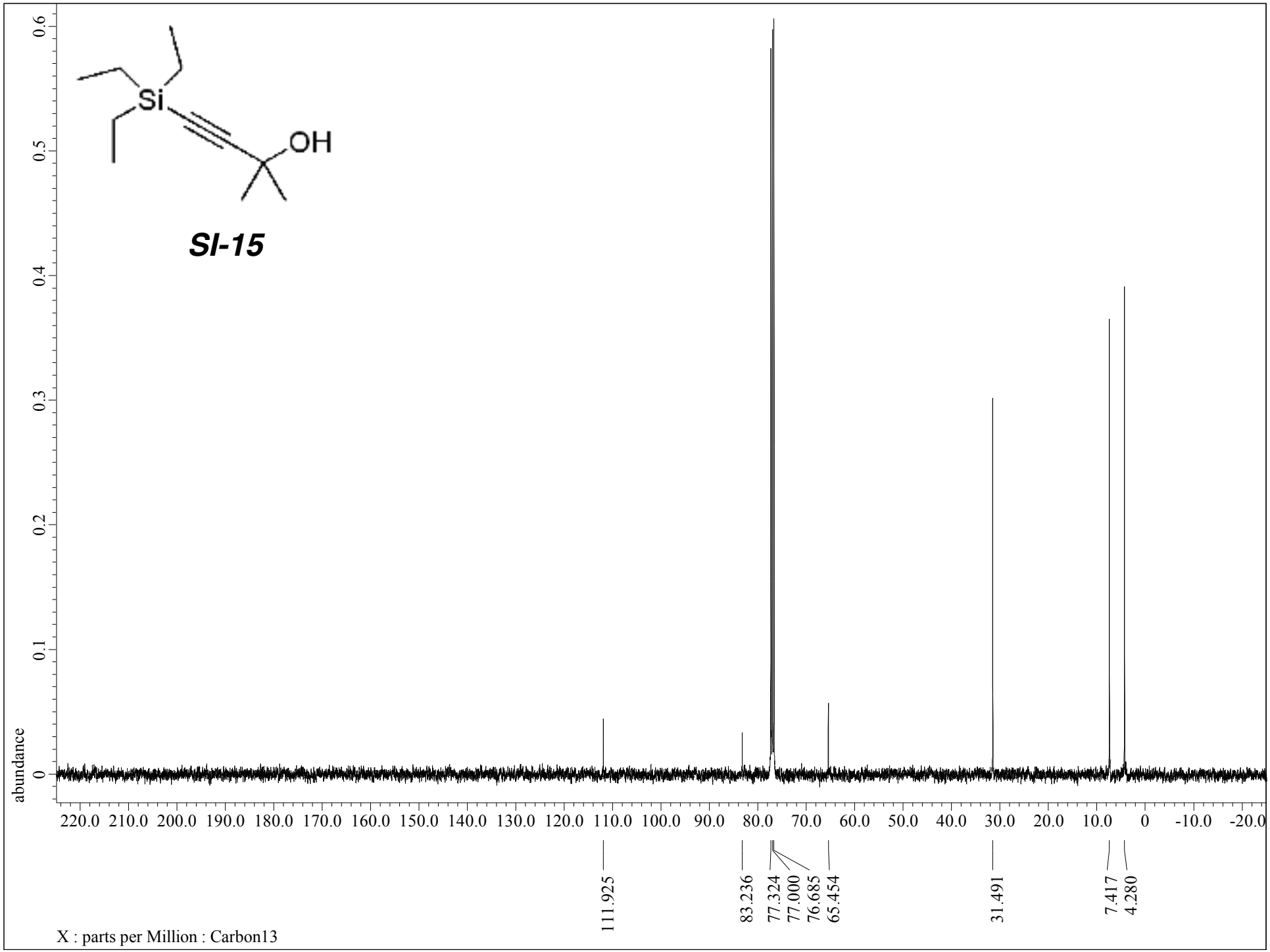
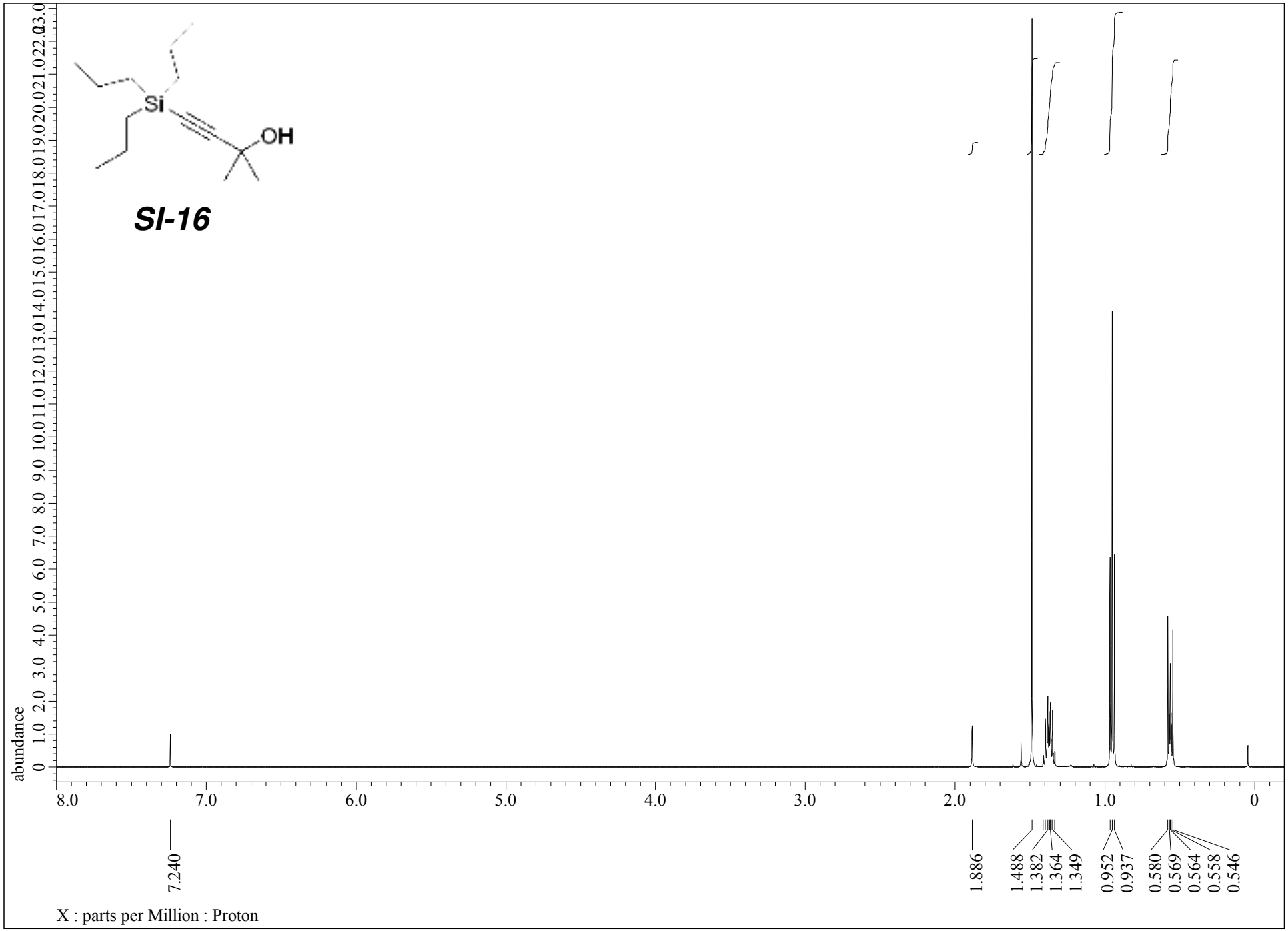
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
250.0
240.0
230.0
220.0
210.0
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
135.511
132.625
129.631
127.762
97.234
85.376
77.254
77.000
76.746
26.903
18.342
X : parts per Million : Carbon13

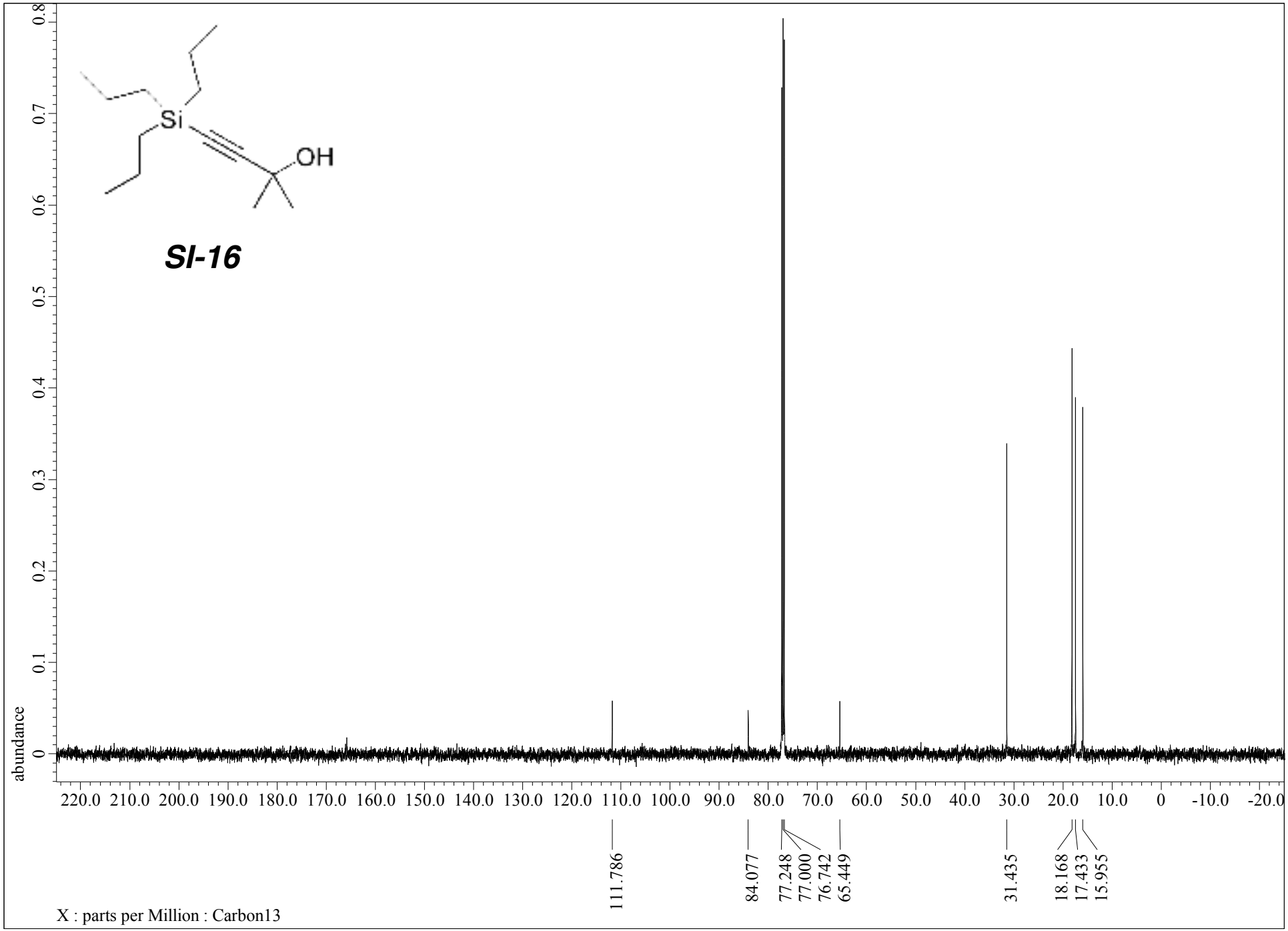

Si
OH
SI-13
abundance
0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
1.924
1.509
1.041
1.034
1.026
X : parts per Million : Proton

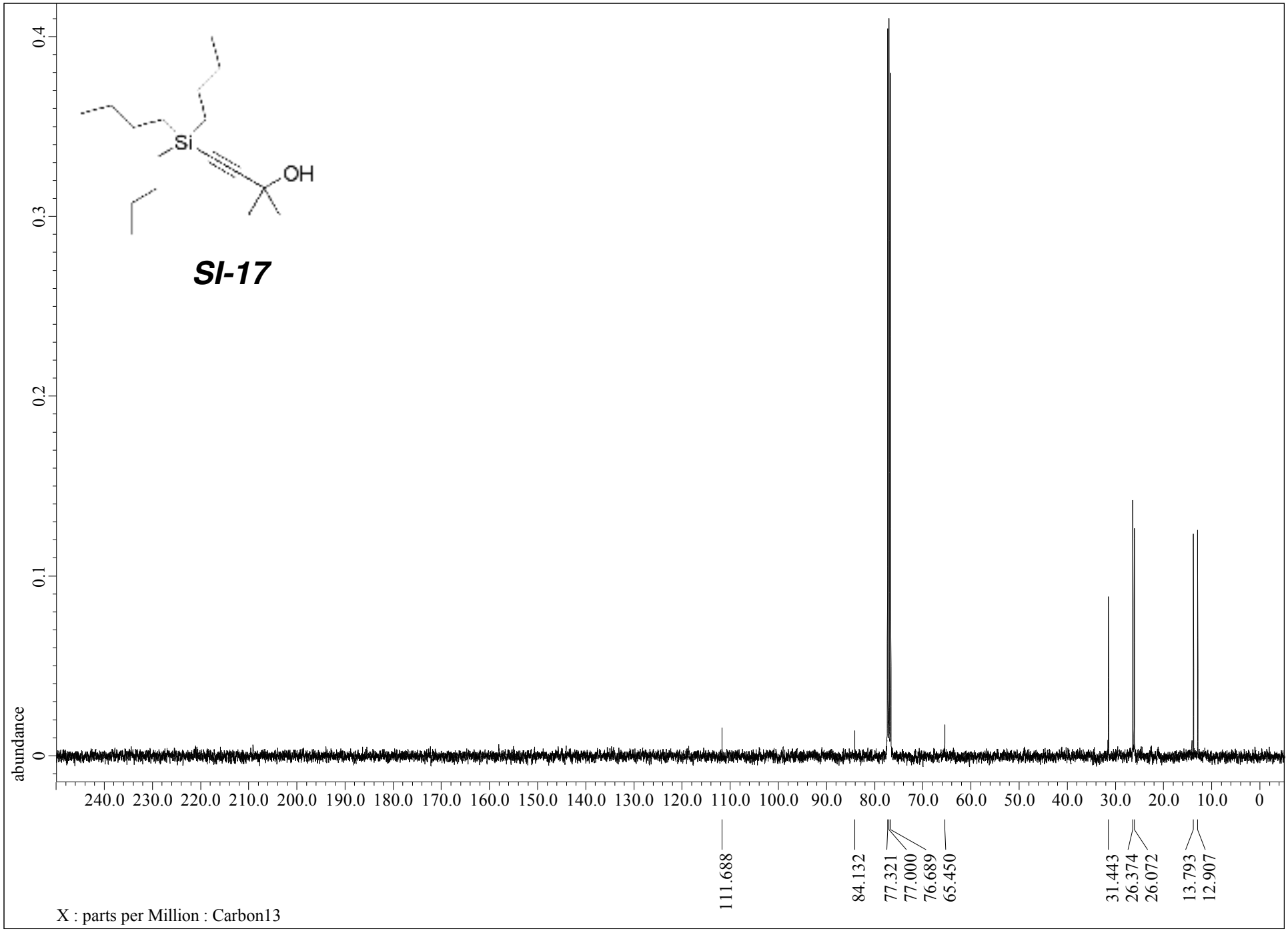

Si
OH
SI-13
abundance
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0 -10.0 -20.0
112.750
82.055
77.258
77.000
76.742
65.478
31.550
18.549
11.071
X : parts per Million : Carbon13

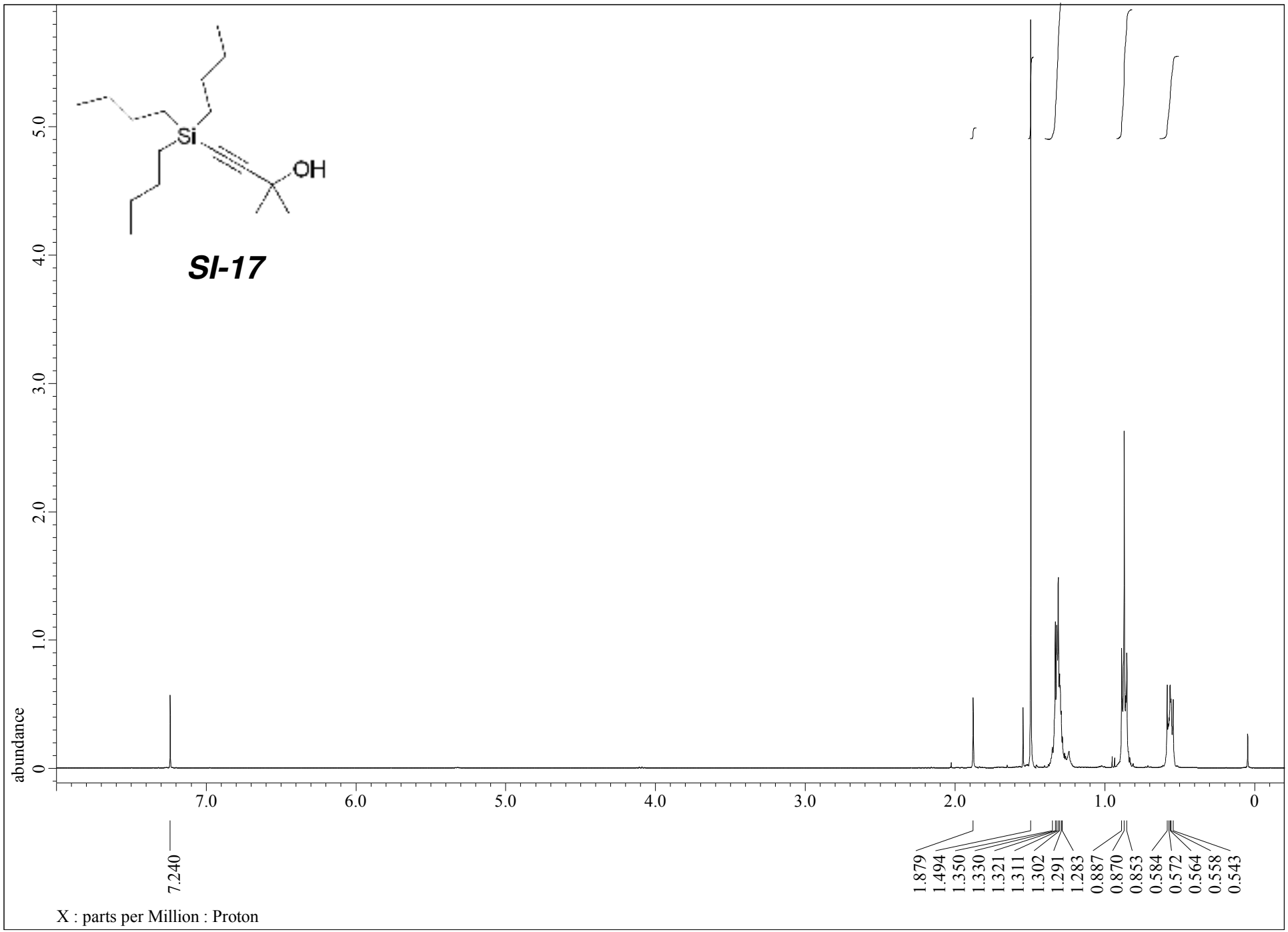

Si
OH
SI-15
abundance
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
1.921
1.500
0.978
0.957
0.938
0.592
0.572
0.553
0.532
X : parts per Million : Proton

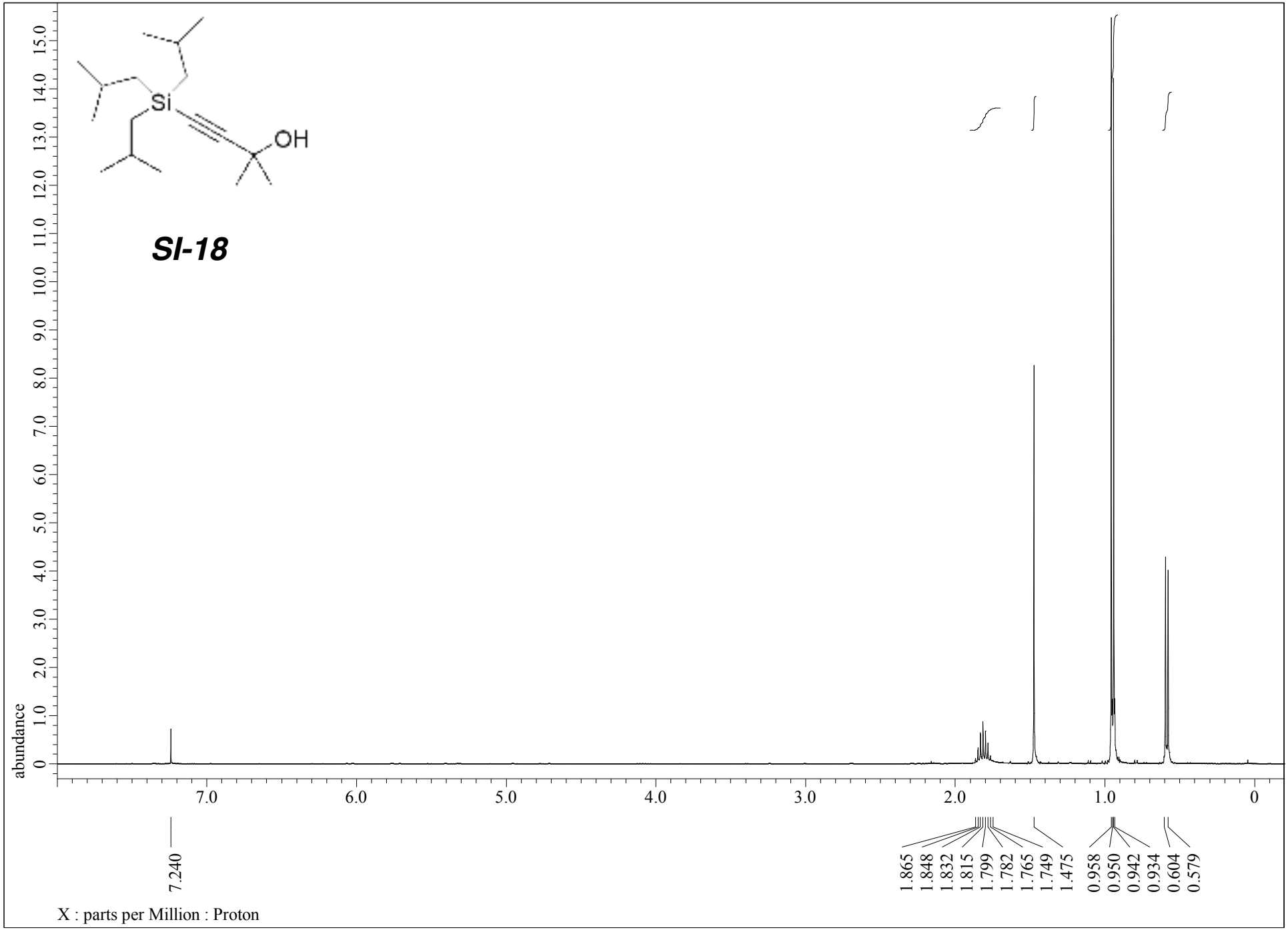

Si
OH
SI-15
abundance
0.6
0.5
0.4
0.3
0.2
0.1
0
220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0 -10.0 -20.0
111.925
83.236
77.324
77.000
76.685
65.454
31.491
7.417
4.280
X : parts per Million : Carbon13

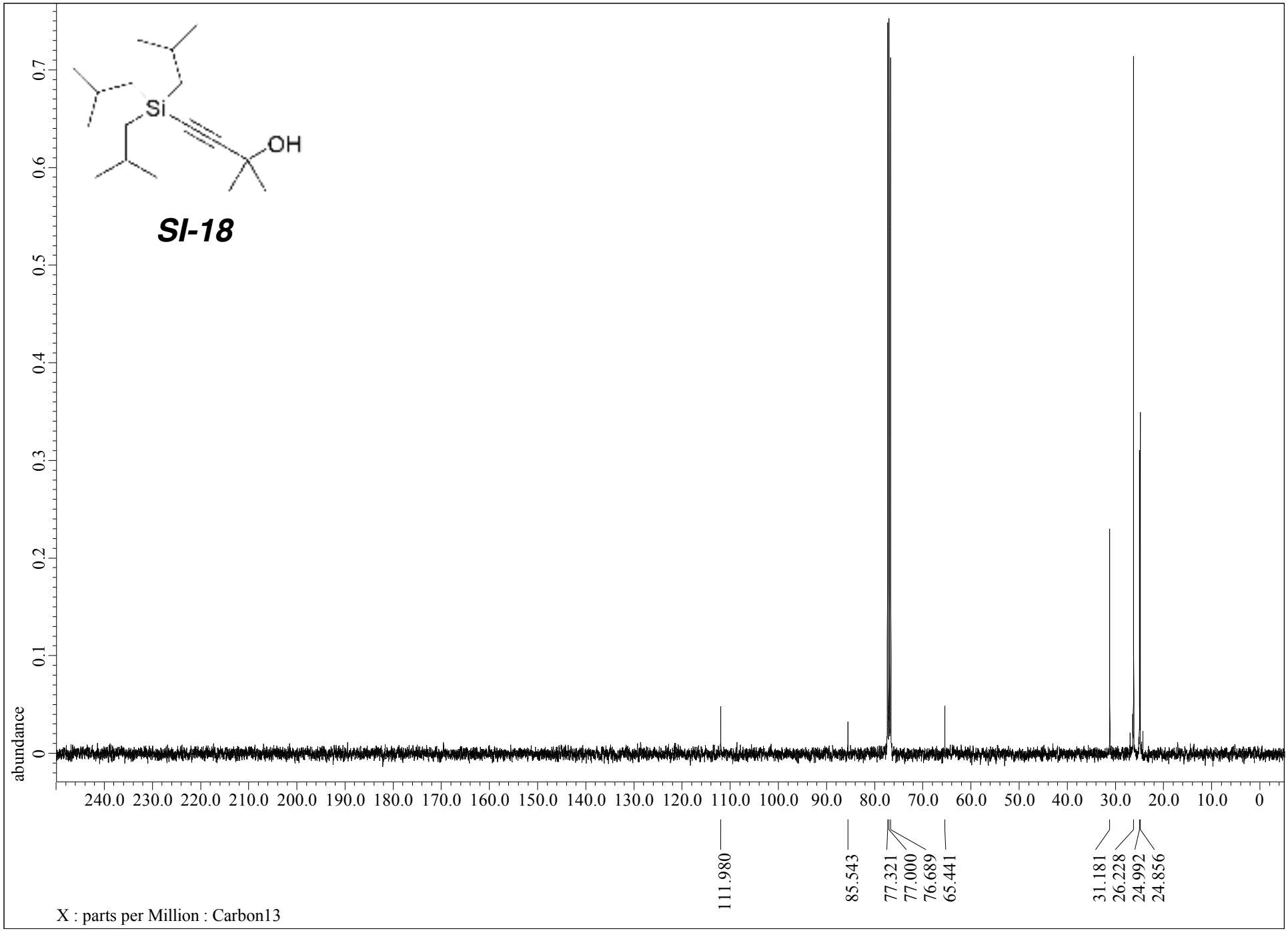

Si
OH
SI-16
abundance
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
1.886
1.488
1.382
1.364
1.349
0.952
0.937
0.580
0.569
0.564
0.558
0.546
X : parts per Million : Proton

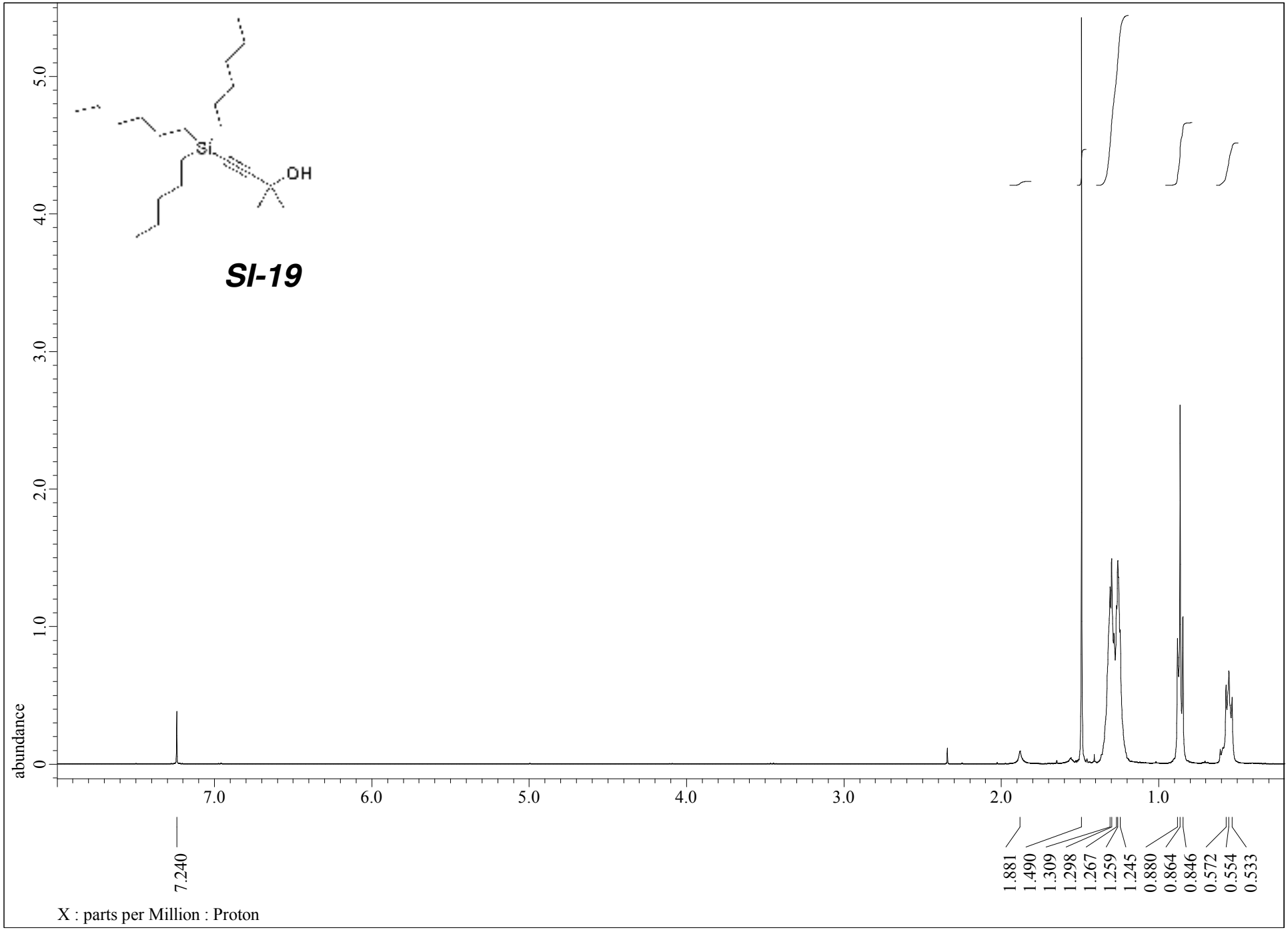

Si
OH
SI-16
abundance
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0 -10.0 -20.0
111.786
84.077
77.248
77.000
76.742
65.449
31.435
18.168
17.433
15.955
X : parts per Million : Carbon13

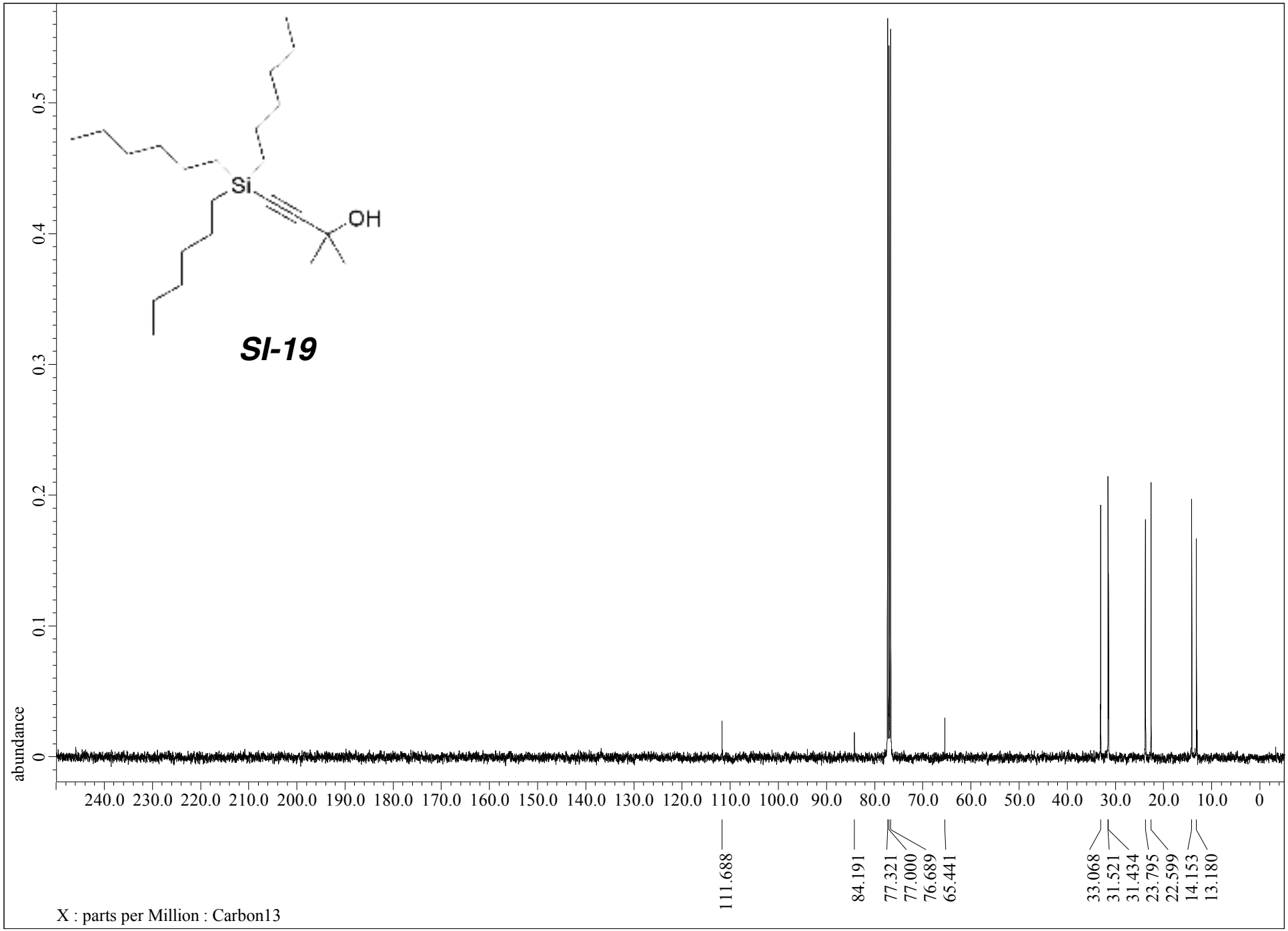

Si
OH
SI-17
abundance
0.4
0.3
0.2
0.1
0
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
111.688
84.132
77.321
77.000
76.689
65.450
31.443
26.374
26.072
13.793
12.907
X : parts per Million : Carbon13

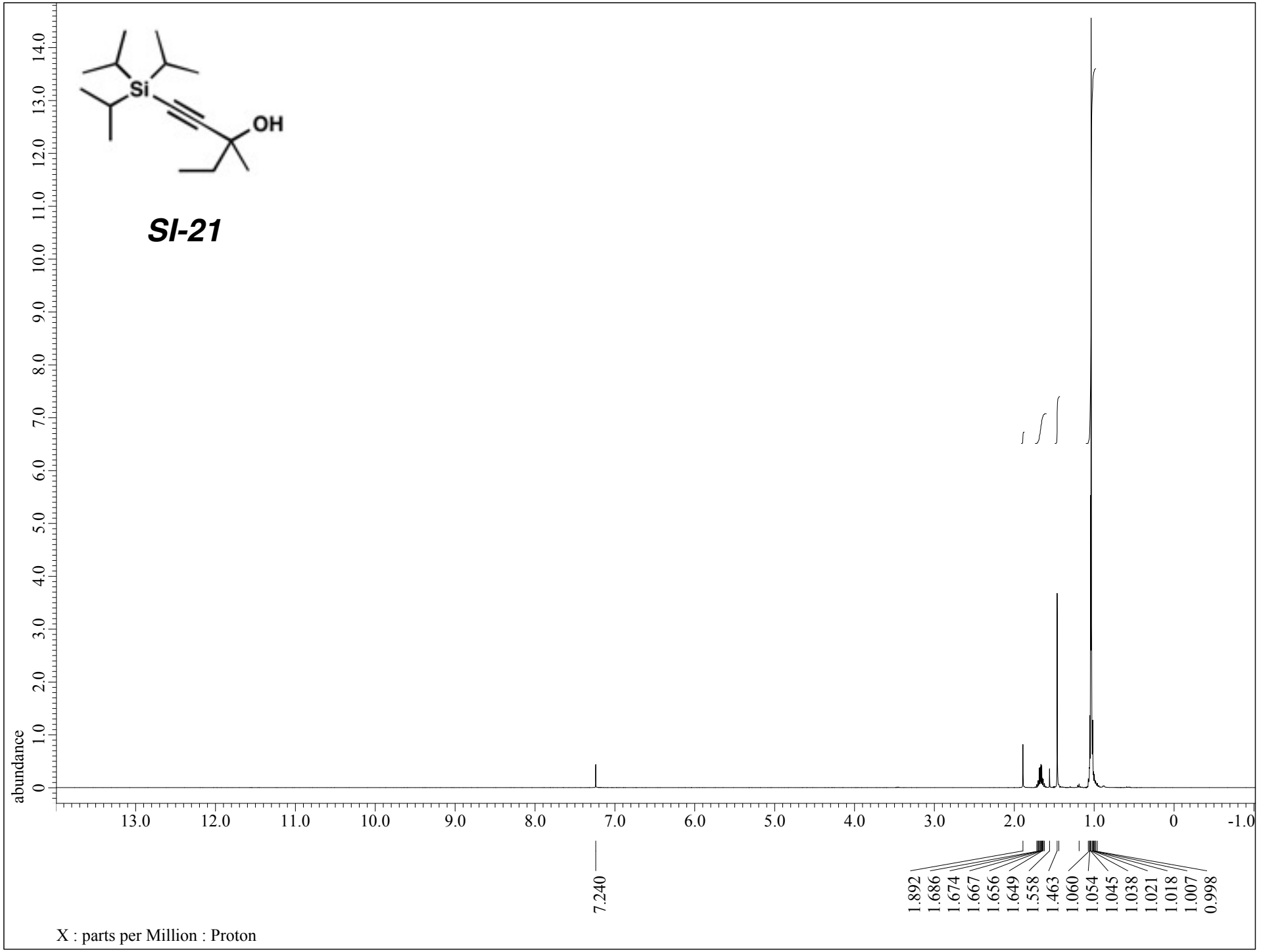

Si
OH
SI-17
abundance
0
1.0
2.0
3.0
4.0
5.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
1.879
1.494
1.350
1.330
1.321
1.311
1.302
1.291
1.283
0.887
0.870
0.853
0.584
0.572
0.564
0.558
0.543
X : parts per Million : Proton

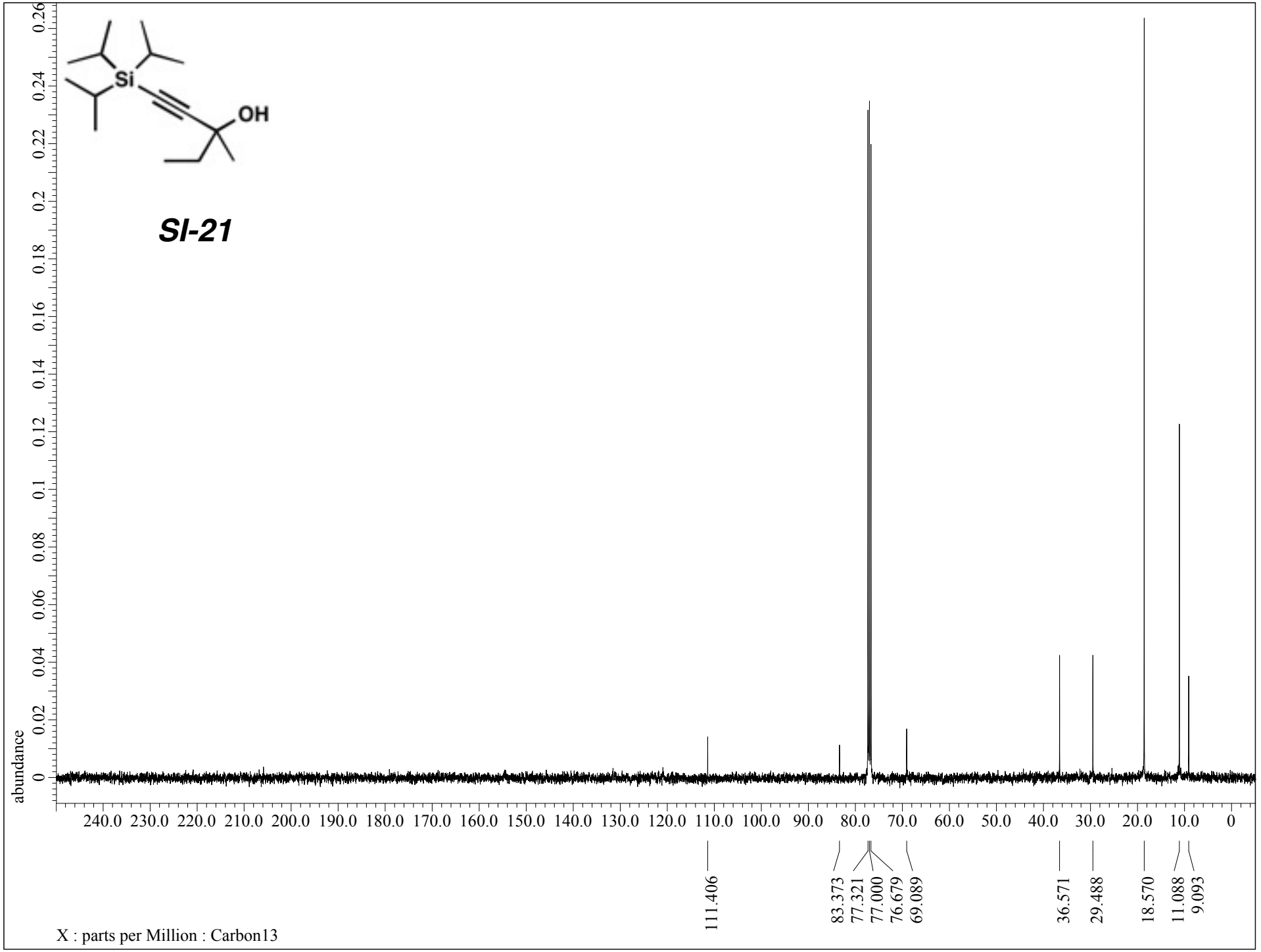

Si
OH
SI-18
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
1.865
1.848
1.832
1.815
1.799
1.782
1.765
1.749
1.475
0.958
0.950
0.942
0.934
0.604
0.579
X : parts per Million : Proton

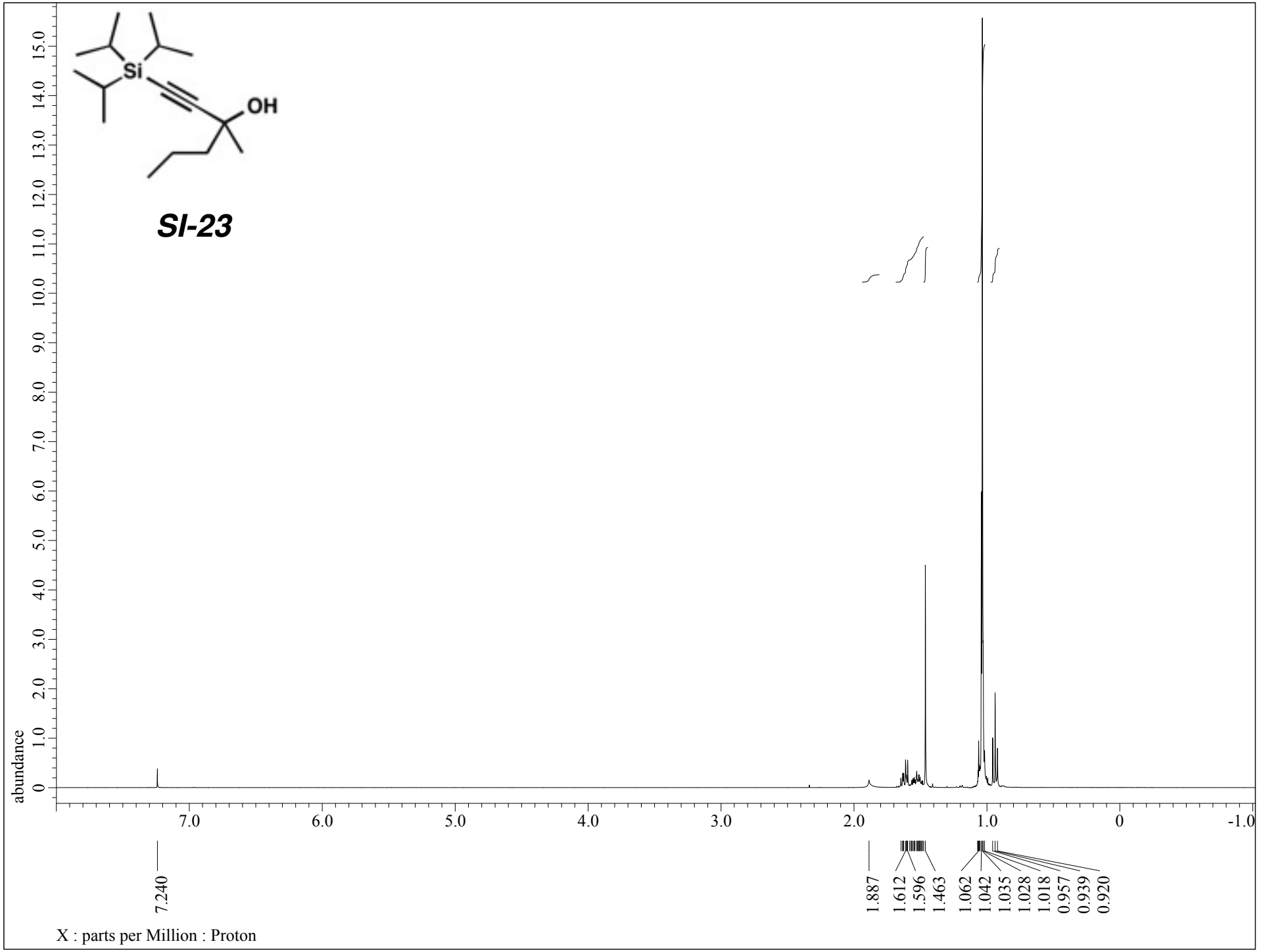

Si
OH
SI-18
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
111.980
85.543
77.321
77.000
76.689
65.441
31.181
26.228
24.992
24.856
X : parts per Million : Carbon13

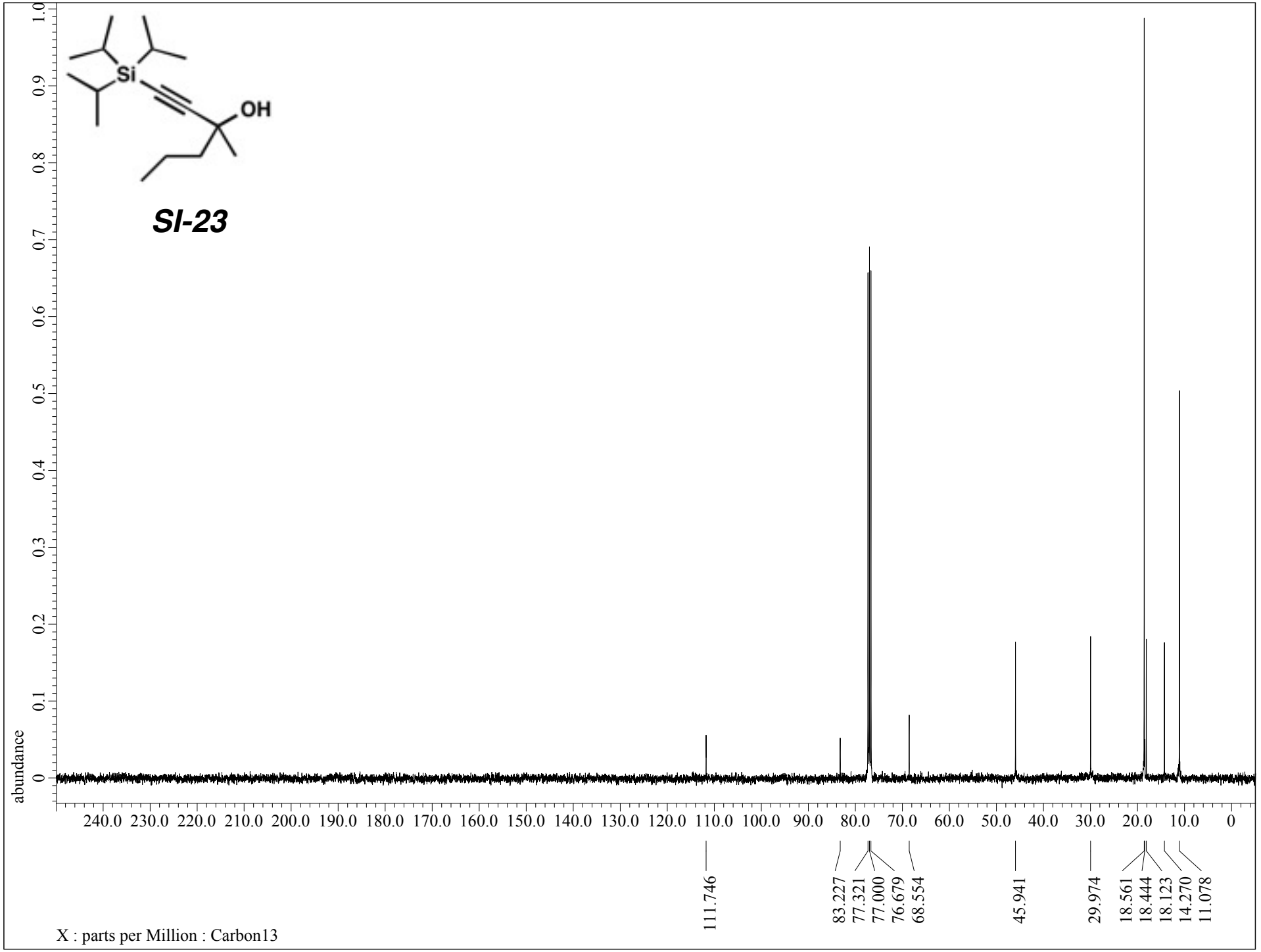

Si
OH
SI-19
abundance
0
1.0
2.0
3.0
4.0
5.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
7.240
1.881
1.490
1.309
1.298
1.267
1.259
1.245
0.880
0.864
0.846
0.572
0.554
0.533
X : parts per Million : Proton

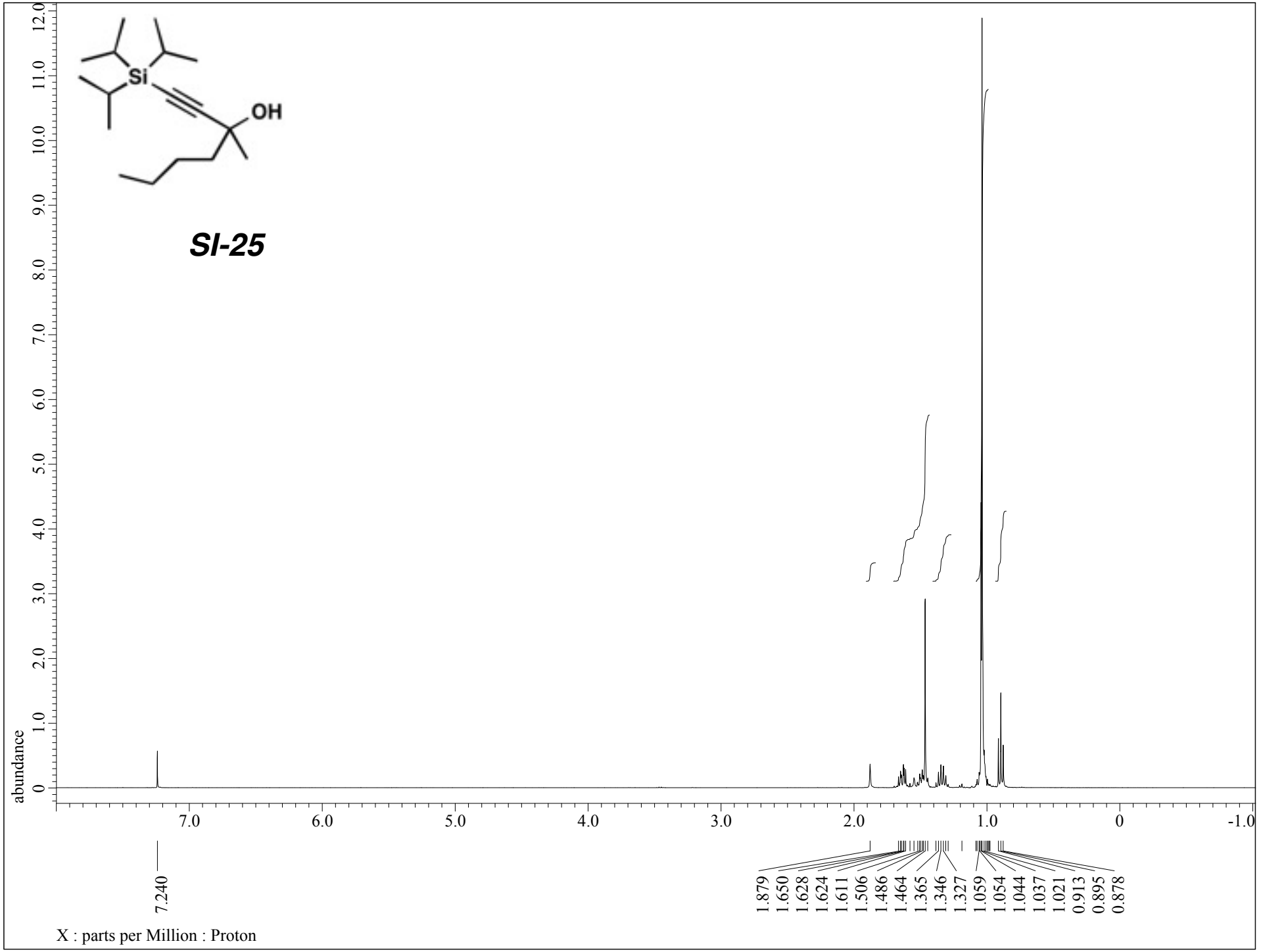

Si
OH
SI-19
abundance
0
0.1
0.2
0.3
0.4
0.5
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
111.688
84.191
77.321
77.000
76.689
65.441
33.068
31.521
31.434
23.795
22.599
14.153
13.180
X : parts per Million : Carbon13

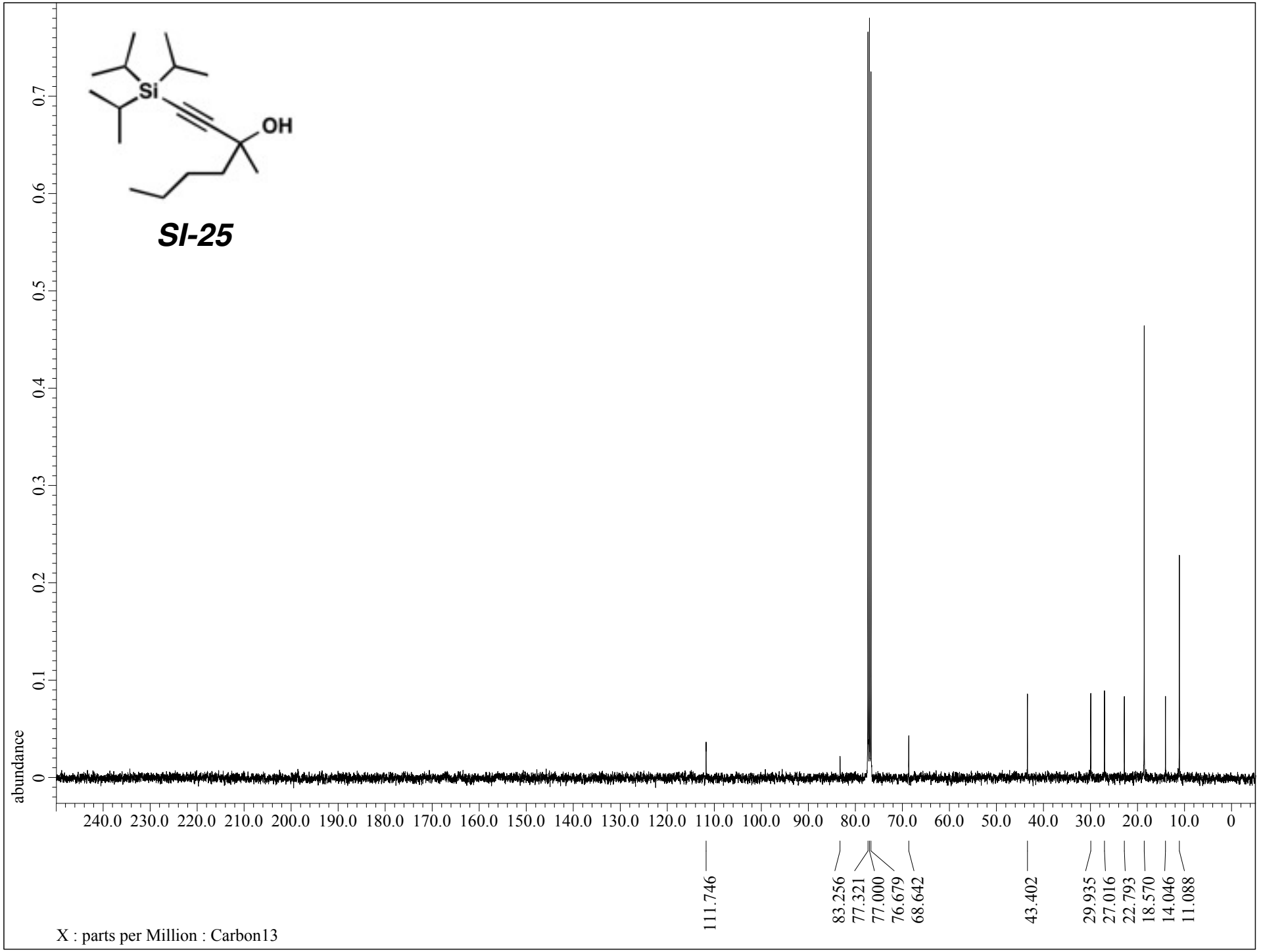

Si
OH
SI-21
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
1.892
1.686
1.674
1.667
1.656
1.649
1.558
1.463
1.060
1.054
1.045
1.038
1.021
1.018
1.007
0.998
X : parts per Million : Proton

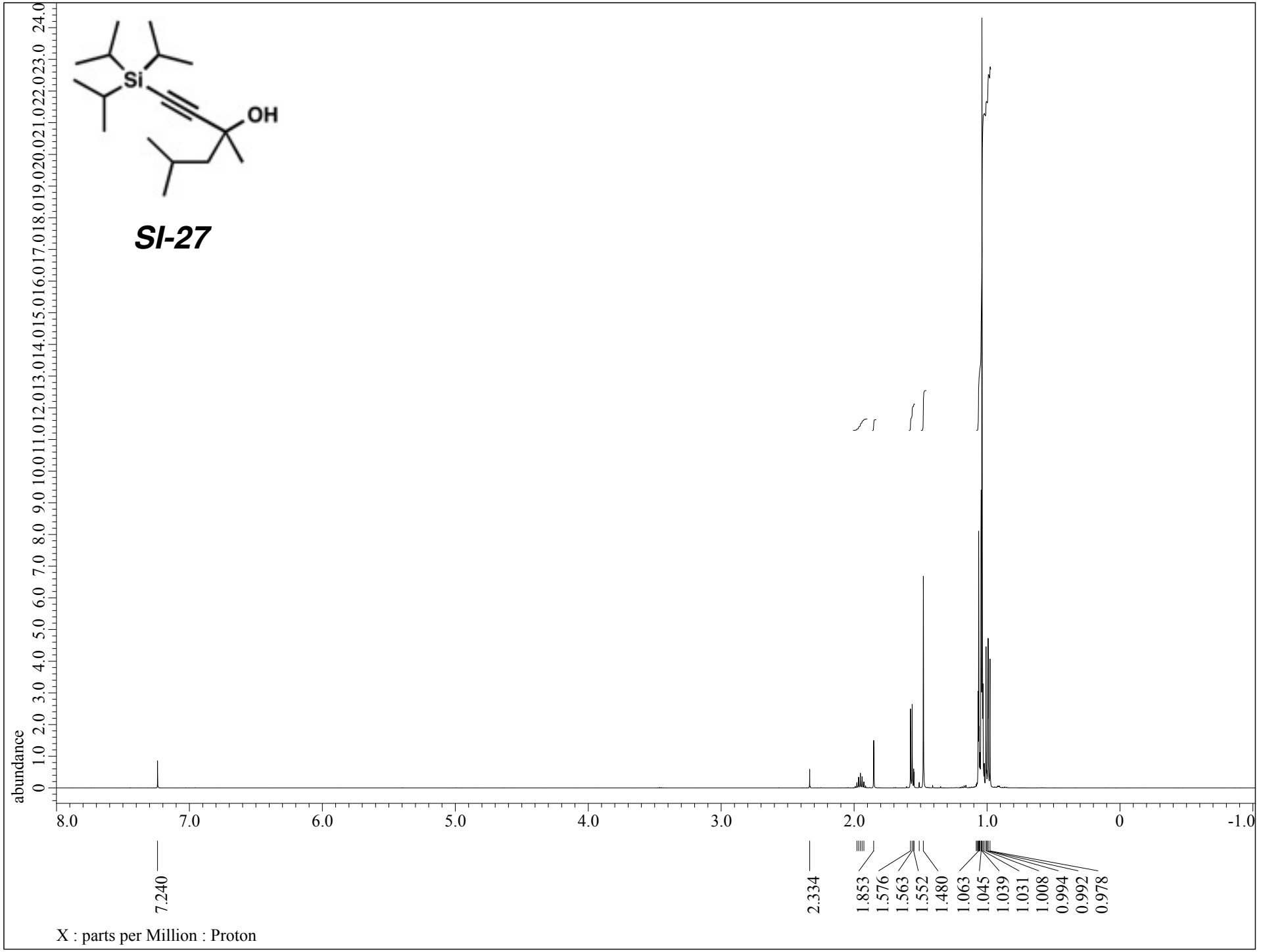

Si
OH
SI-21
abundance
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
0.24
0.26
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
111.406
83.373
77.321
77.000
76.679
69.089
36.571
29.488
18.570
11.088
9.093
X : parts per Million : Carbon13

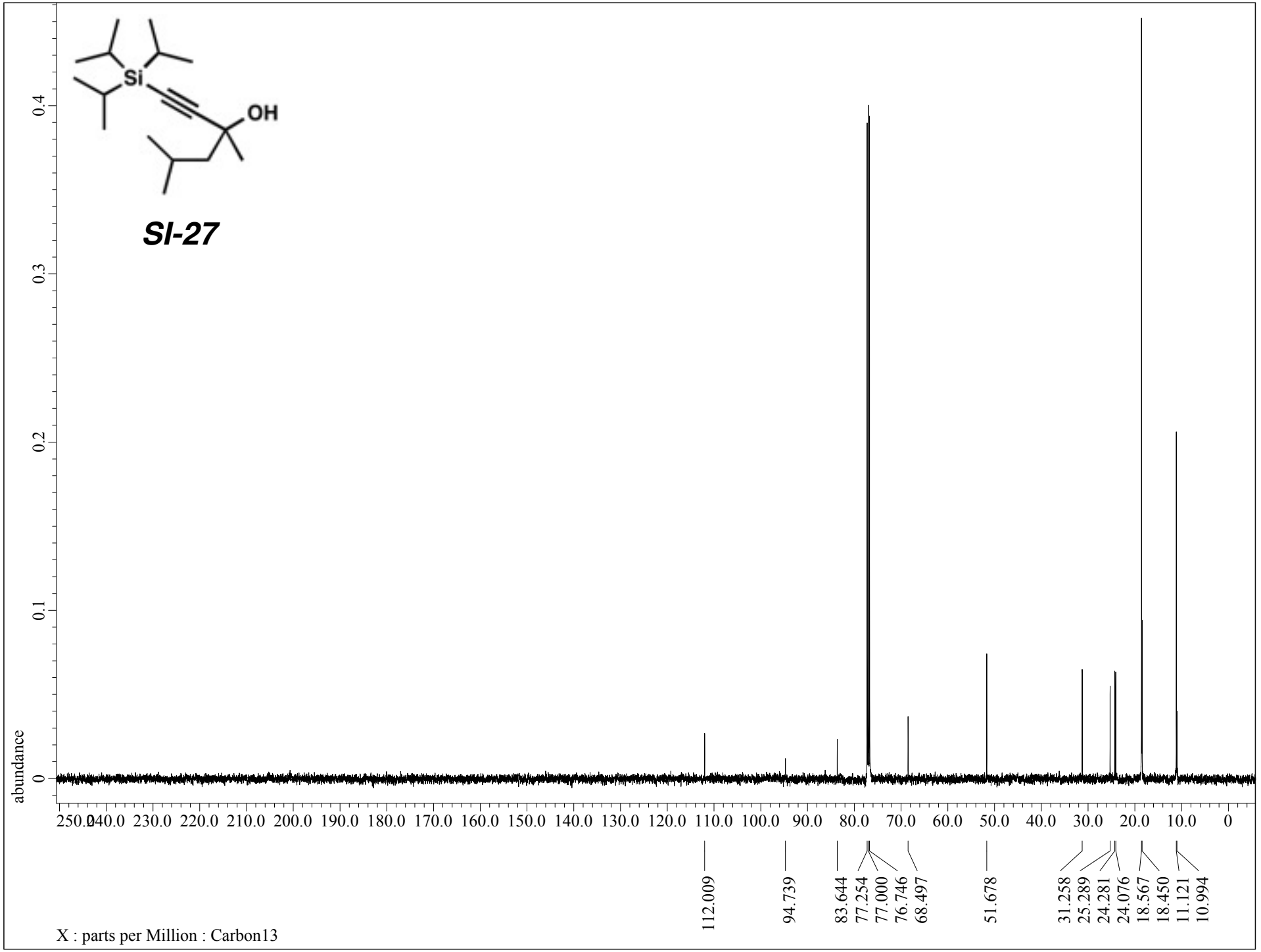

Si
OH
SI-23
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
1.887
1.612
1.596
1.463
1.062
1.042
1.035
1.028
1.018
0.957
0.939
0.920
X : parts per Million : Proton

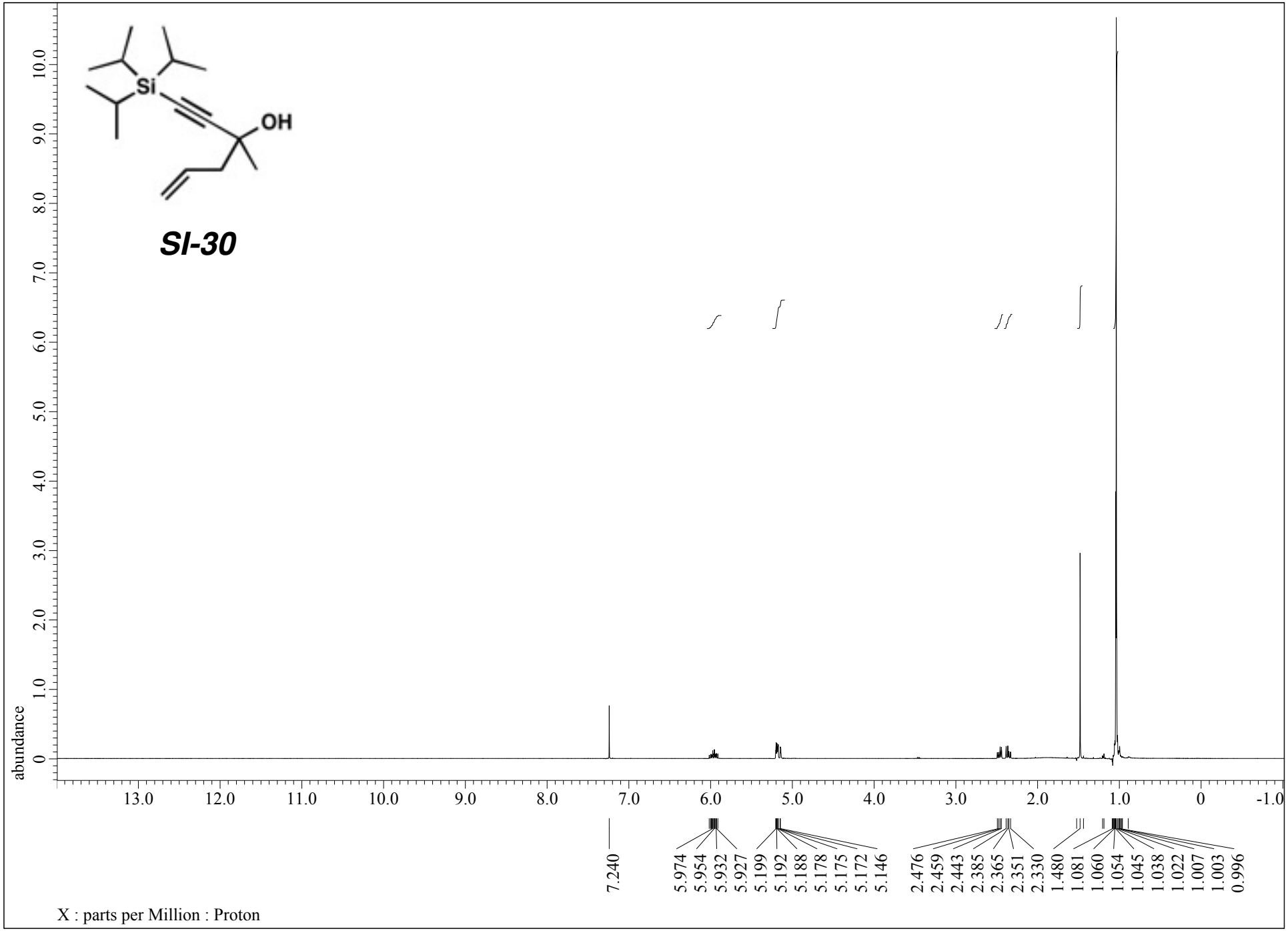

Si
OH
SI-23
abundance
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
111.746
83.227
77.321
77.000
76.679
68.554
45.941
29.974
18.561
18.444
18.123
14.270
11.078
X : parts per Million : Carbon13

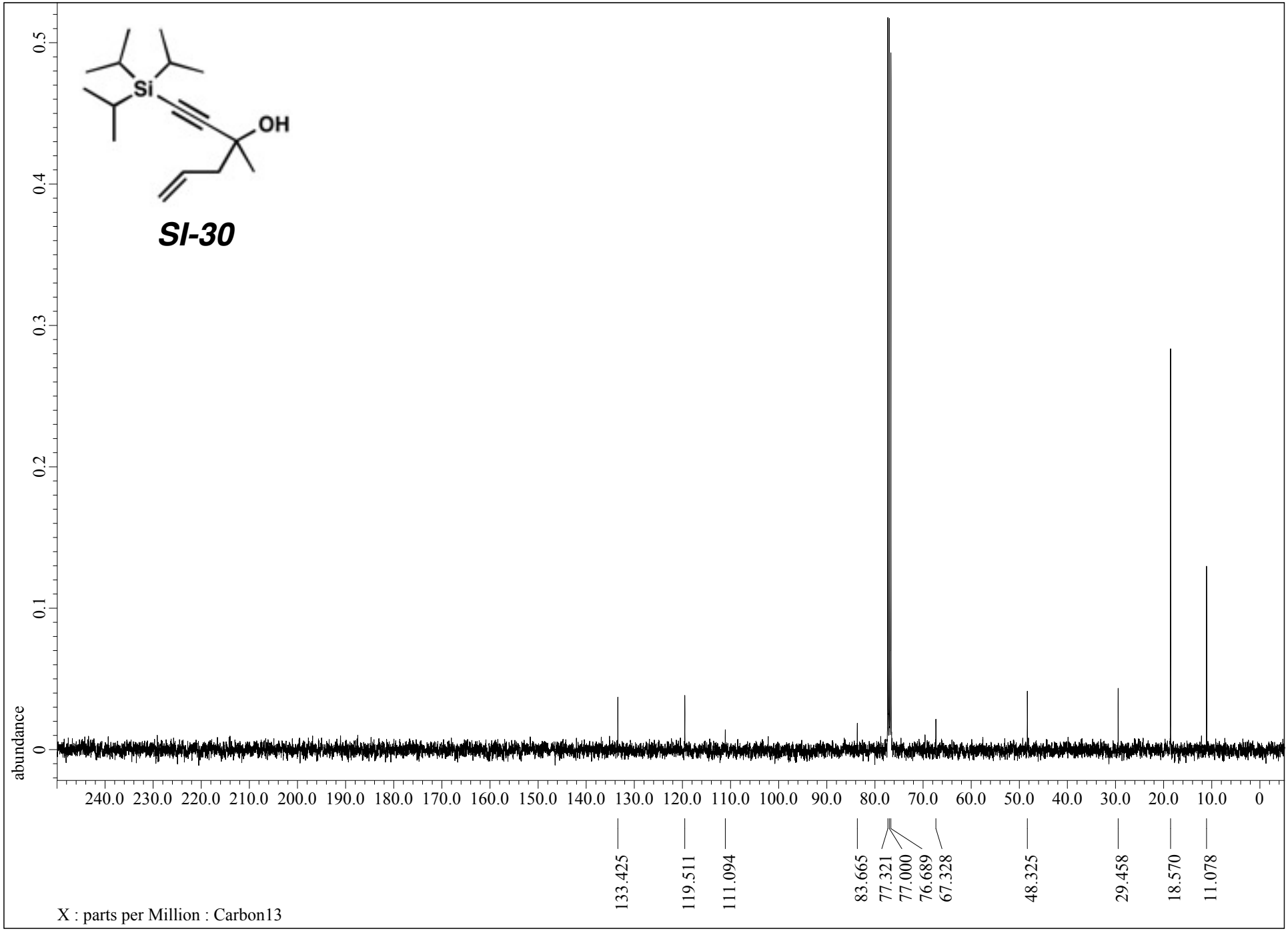

Si
OH
SI-25
abundance
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
1.879
1.650
1.628
1.624
1.611
1.506
1.486
1.464
1.365
1.346
1.327
1.059
1.054
1.044
1.037
1.021
0.913
0.895
0.878
X : parts per Million : Proton

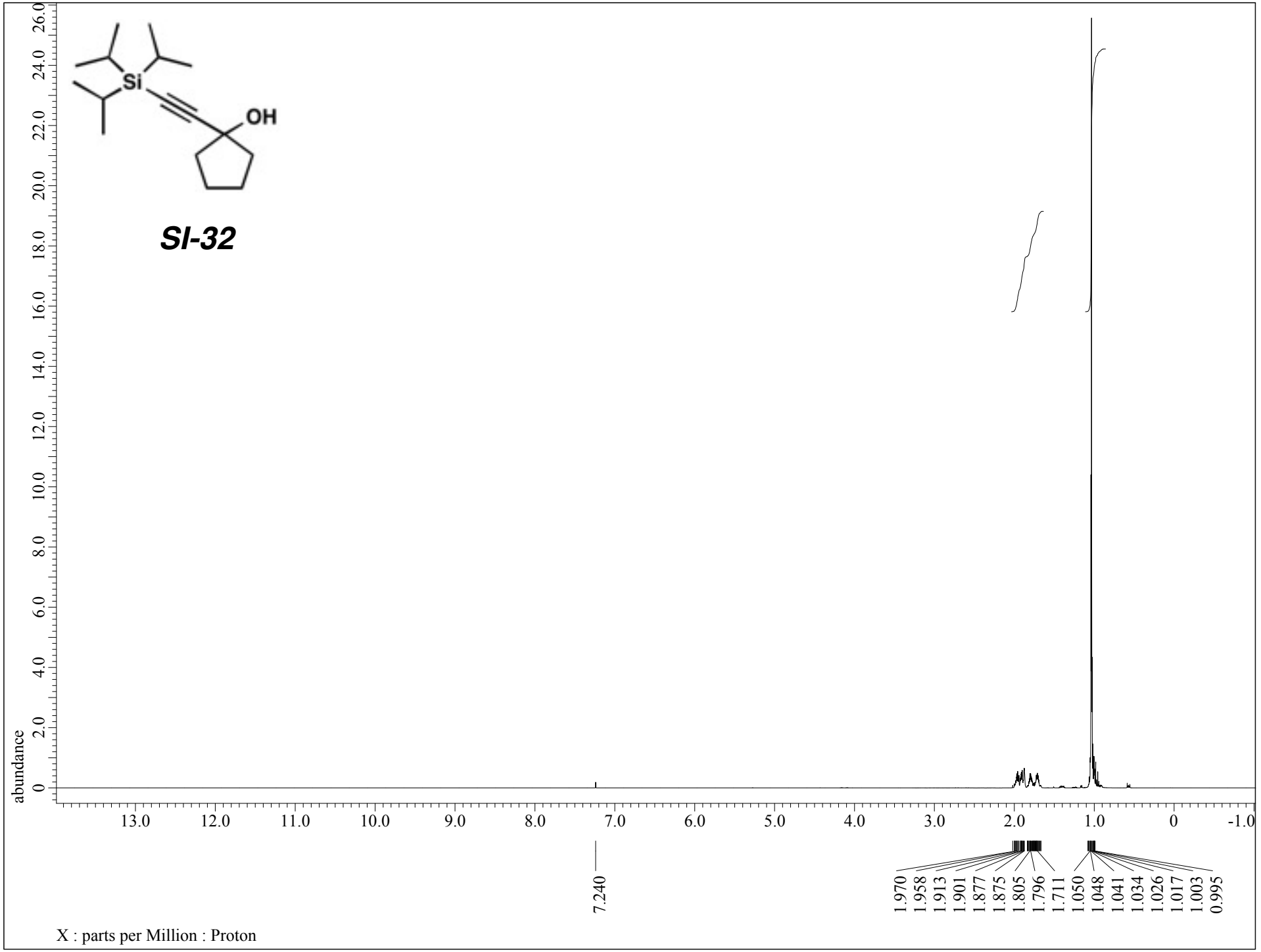

Si
OH
SI-25
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
111.746
83.256
77.321
77.000
76.679
68.642
43.402
29.935
27.016
22.793
18.570
14.046
11.088
X : parts per Million : Carbon13

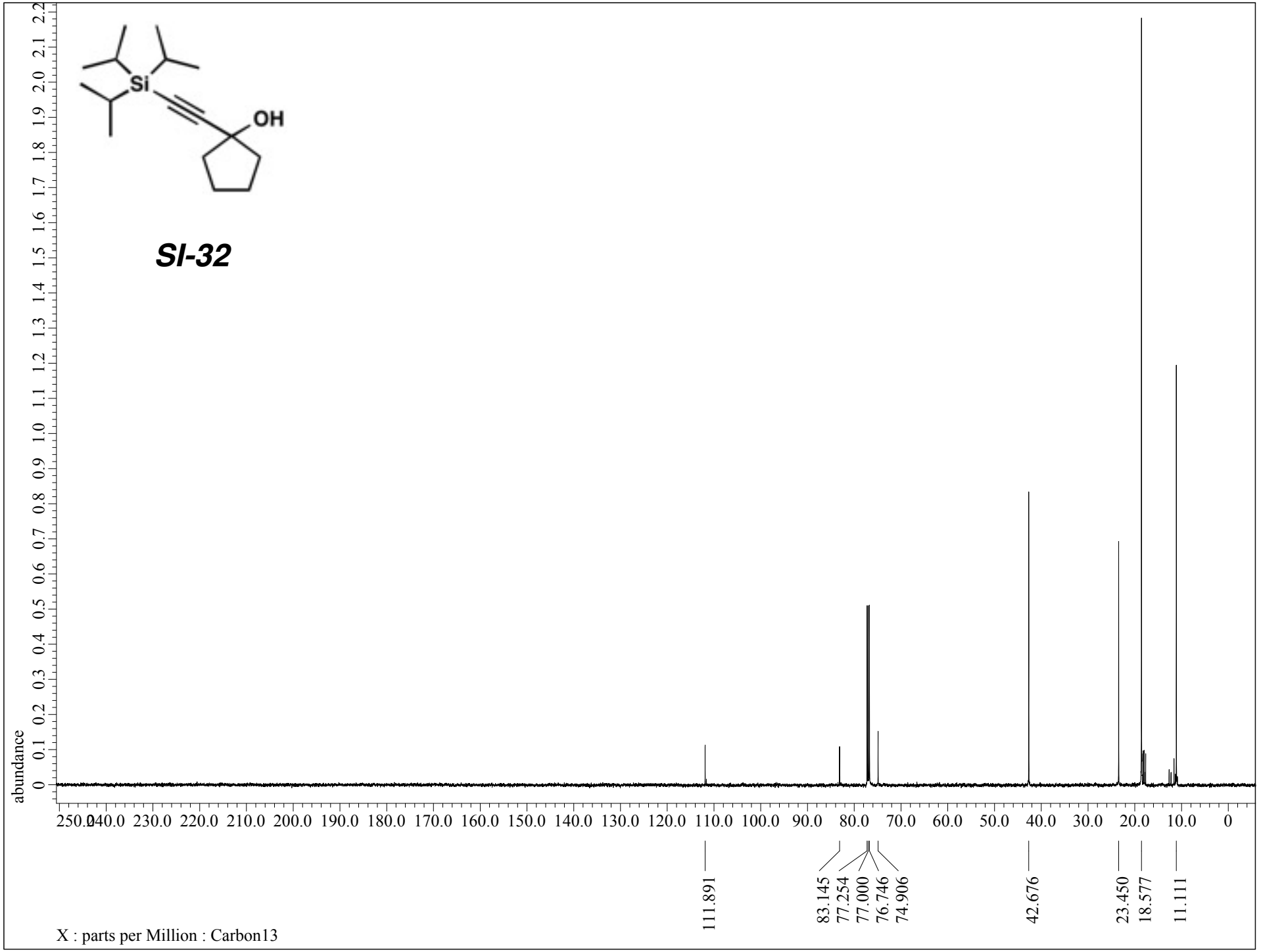

Si
OH
SI-27
abundance
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0
8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0 -1.0
7.240
2.334
1.853
1.576
1.563
1.552
1.480
1.063
1.045
1.039
1.031
1.008
0.994
0.992
0.978
X : parts per Million : Proton

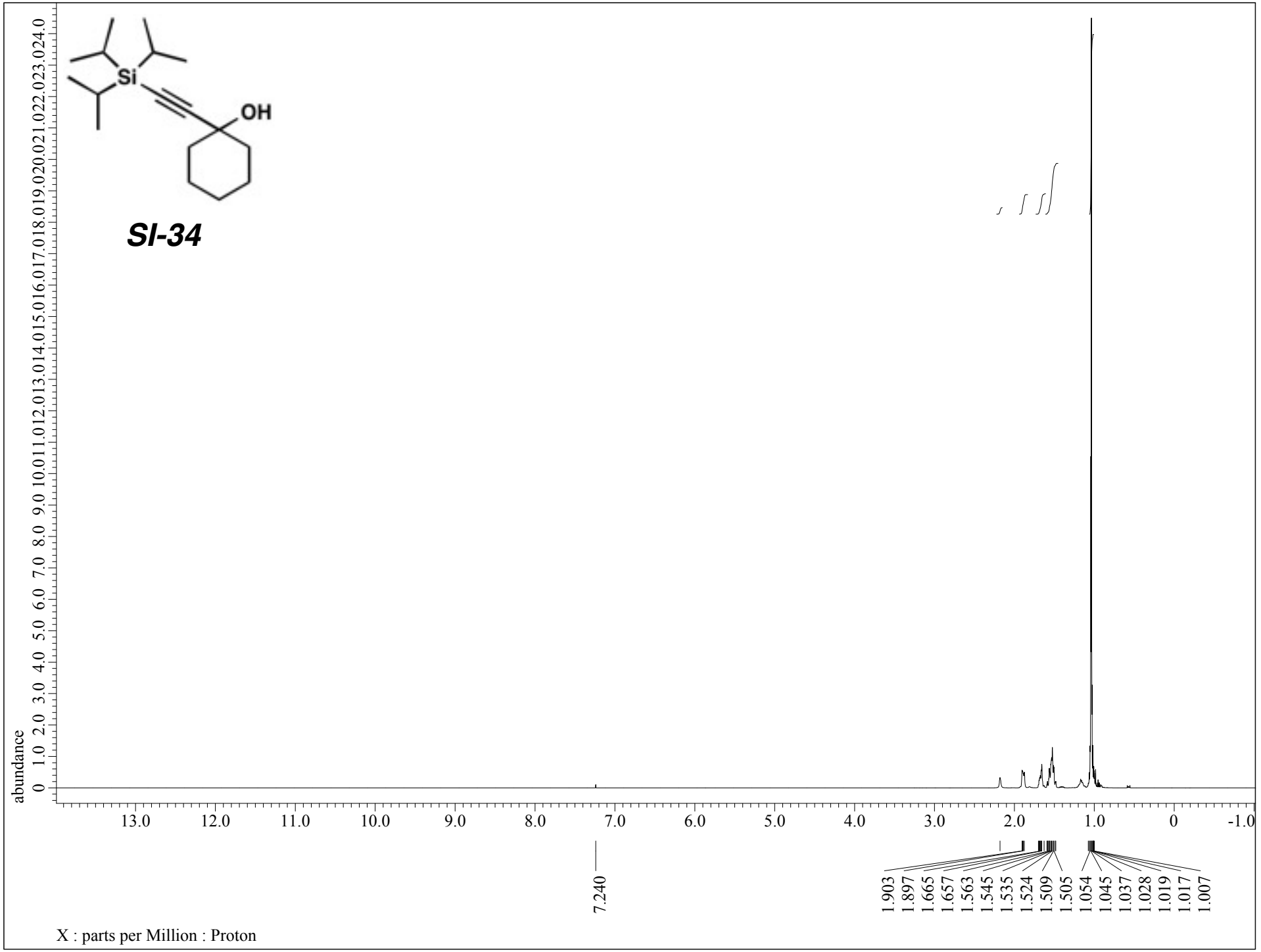

Si
OH
SI-27
abundance
0
0.1
0.2
0.3
0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
112.009
94.739
83.644
77.254
77.000
76.746
68.497
51.678
31.258
25.289
24.281
24.076
18.567
18.450
11.121
10.994
X : parts per Million : Carbon13

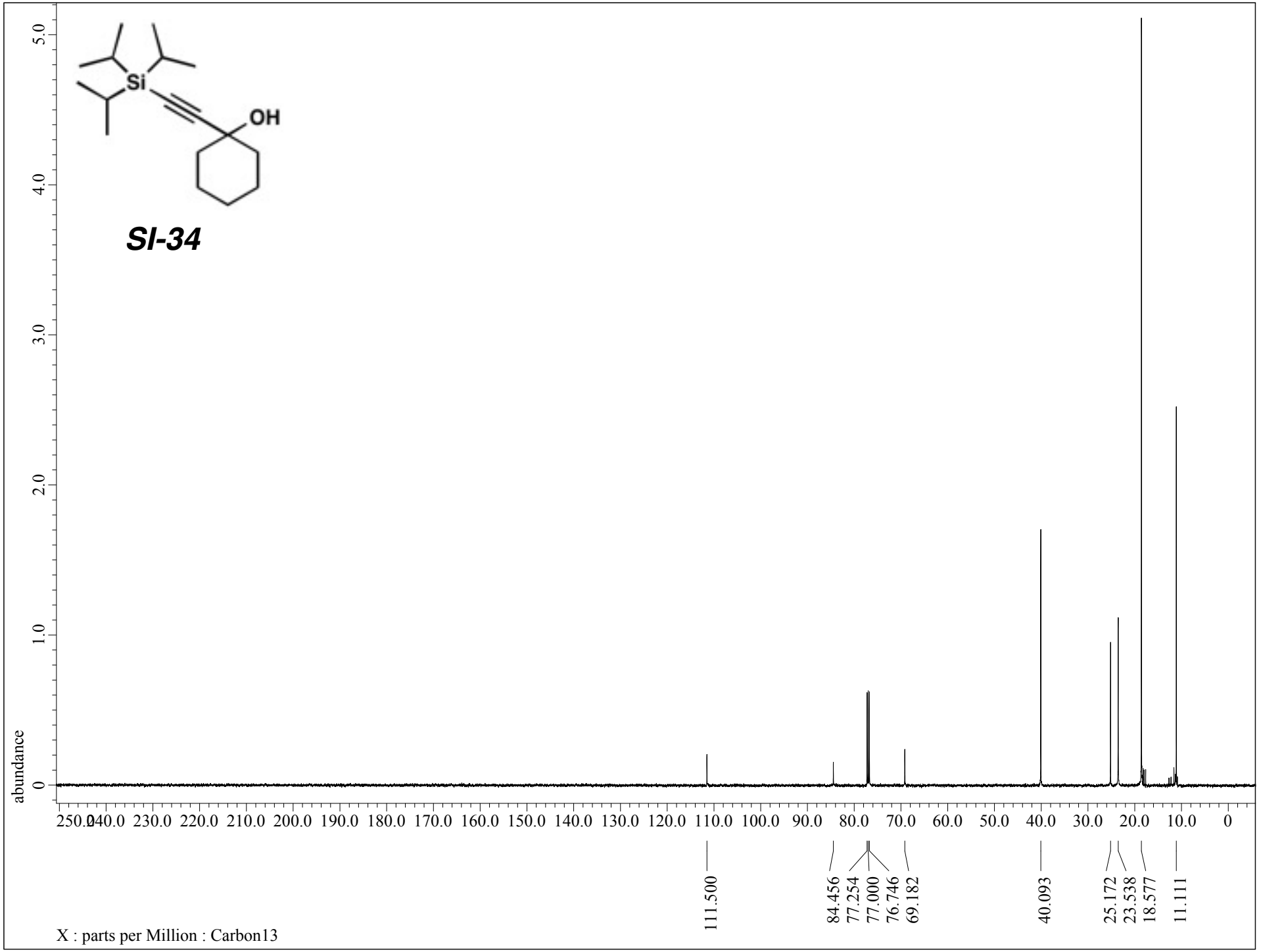

Si
OH
SI-30
abundance
X : parts per Million : Proton
7.240
5.974
5.954
5.932
5.927
5.199
5.192
5.188
5.178
5.175
5.172
5.146
2.476
2.459
2.443
2.385
2.365
2.351
2.330
1.480
1.081
1.060
1.054
1.045
1.038
1.022
1.007
1.003
0.996

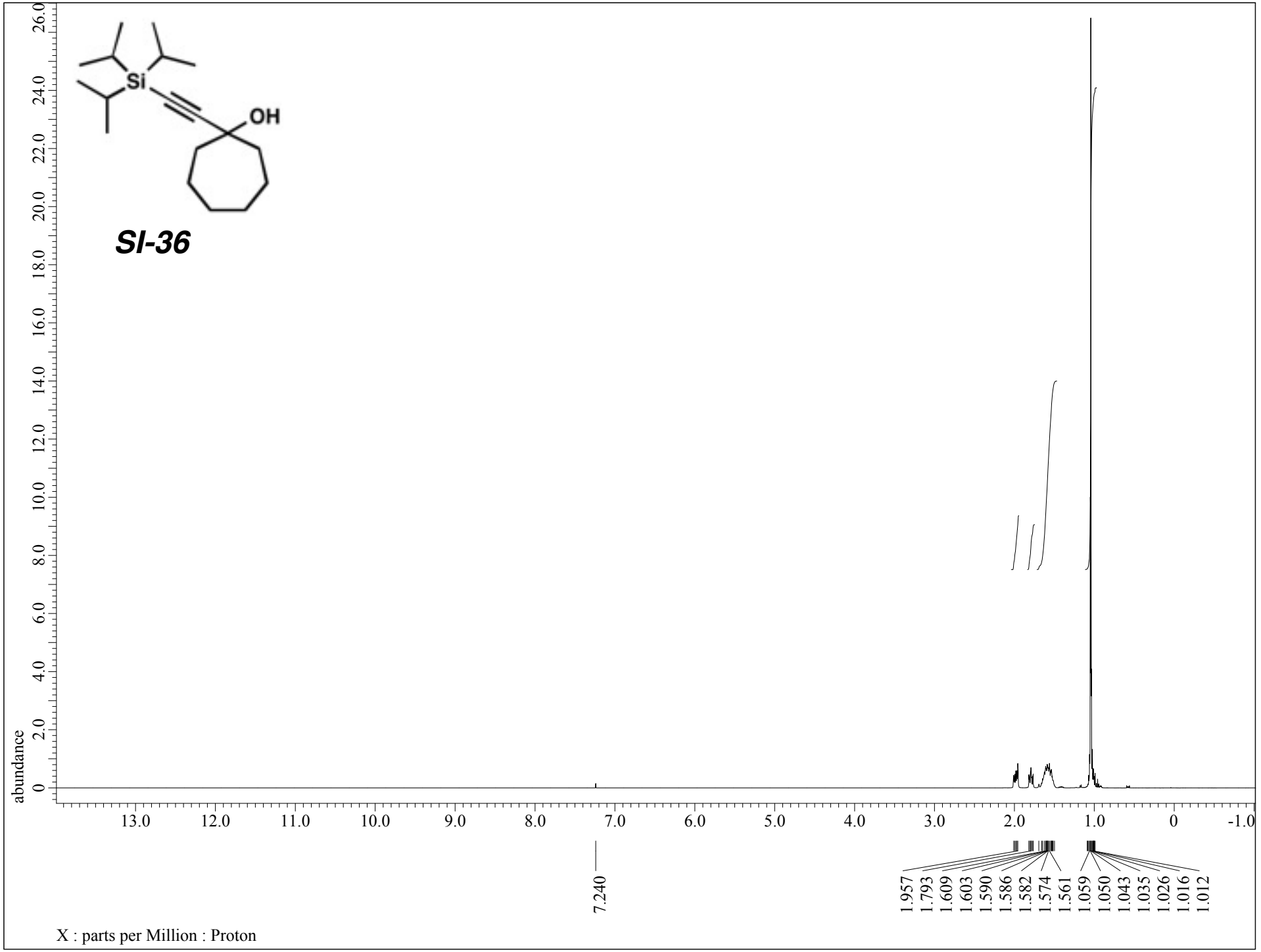

Si
OH
SI-30
abundance
0
0.1
0.2
0.3
0.4
0.5
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
133.425
119.511
111.094
83.665
77.321
77.000
76.689
67.328
48.325
29.458
18.570
11.078
X : parts per Million : Carbon13

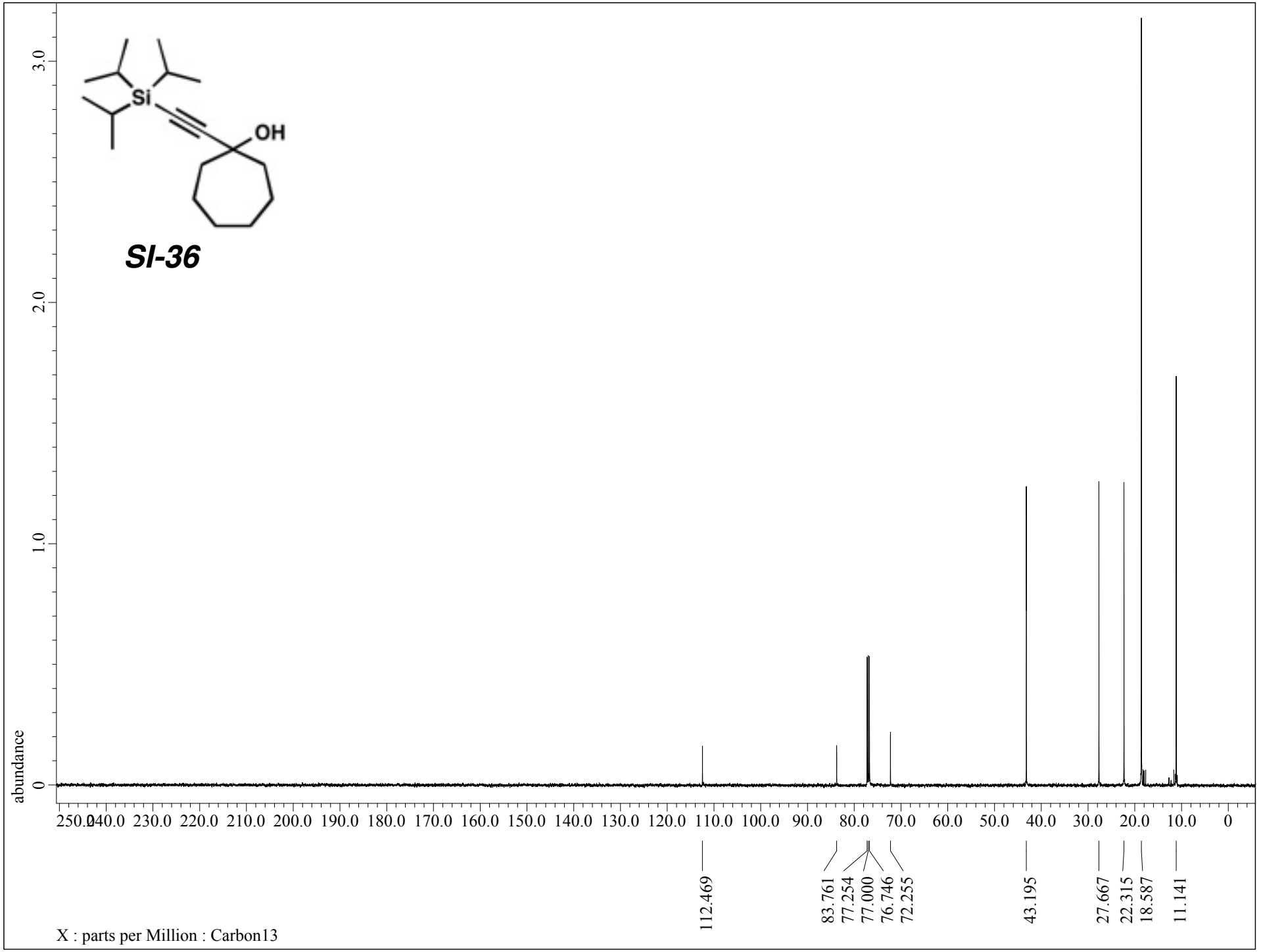

Si
OH
SI-32
abundance
0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
1.970
1.958
1.913
1.901
1.877
1.875
1.805
1.796
1.711
1.050
1.048
1.041
1.034
1.026
1.017
1.003
0.995
X : parts per Million : Proton

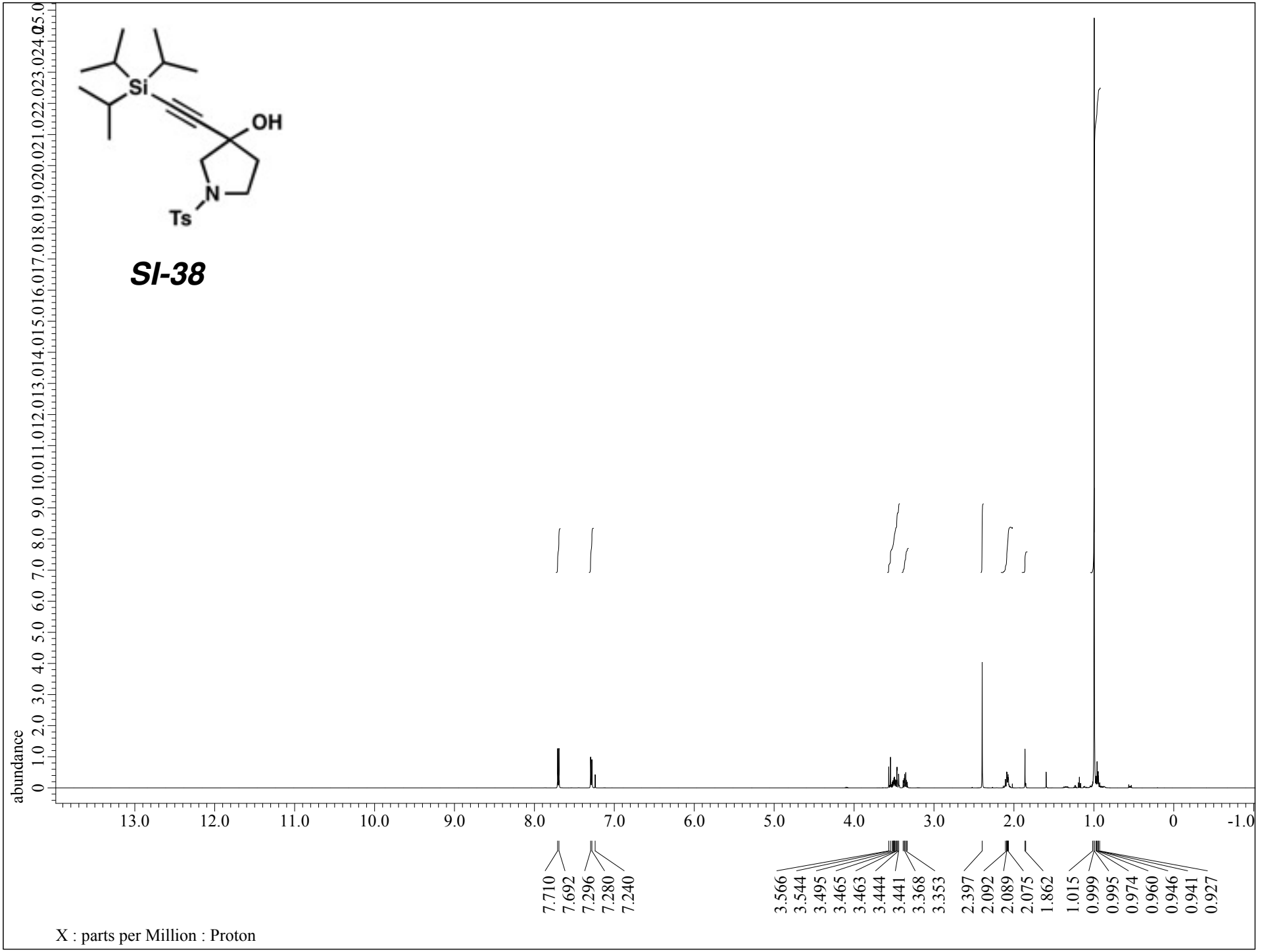

Si
OH
SI-32
abundance
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
111.891
83.145
77.254
77.000
76.746
74.906
42.676
23.450
18.577
11.111
X : parts per Million : Carbon13

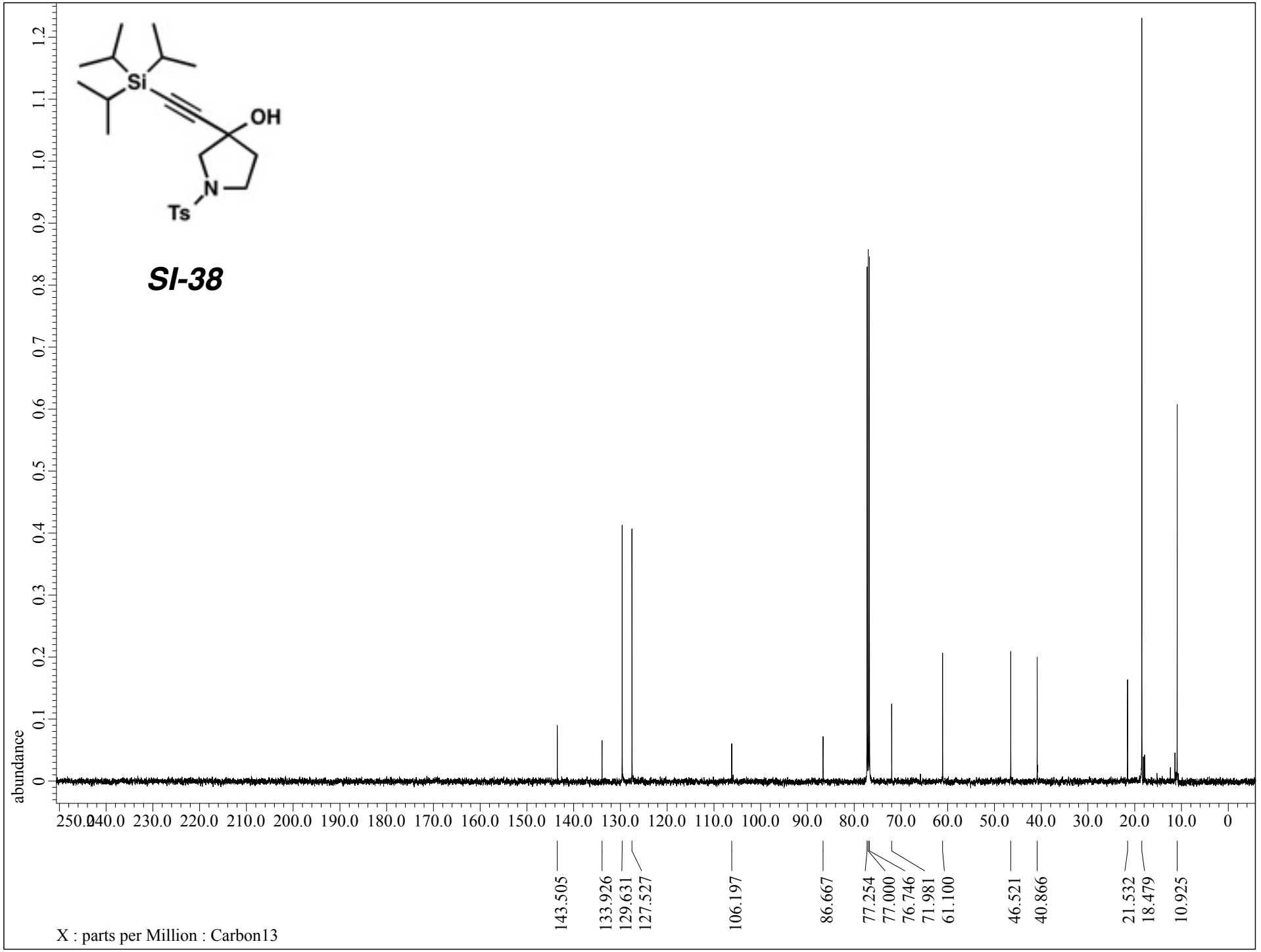

Si
OH
SI-34
abundance
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0
13.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0 -1.0
7.240
1.903 1.897 1.665 1.657 1.563 1.545 1.535 1.524 1.509 1.505 1.054 1.045 1.037 1.028 1.019 1.017 1.007
X : parts per Million : Proton

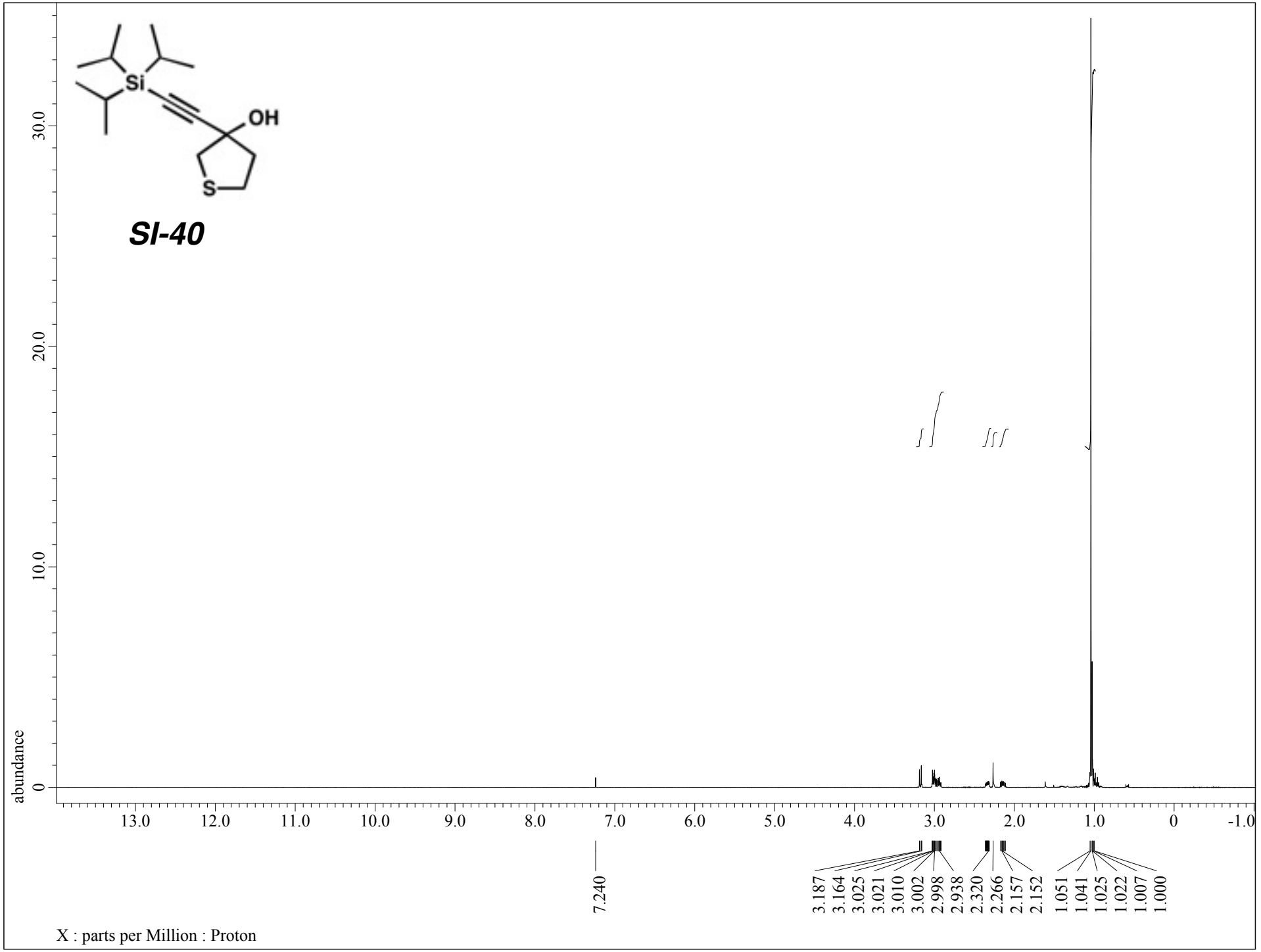

Si
OH
SI-34
abundance
5.0
4.0
3.0
2.0
1.0
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
111.500
84.456
77.254
77.000
76.746
69.182
40.093
25.172
23.538
18.577
11.111
X : parts per Million : Carbon13

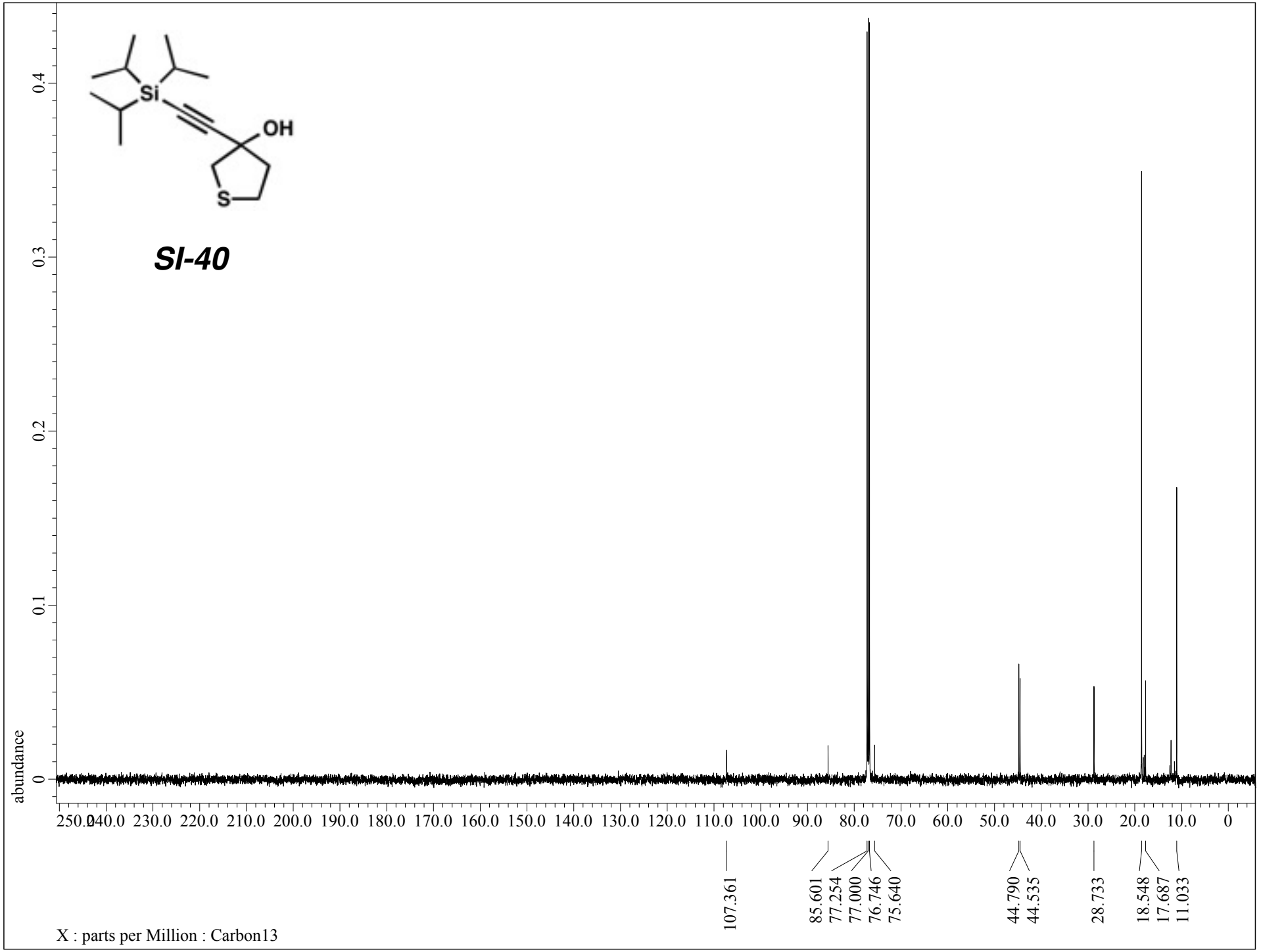

Si
OH
SI-36
abundance
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
1.957
1.793
1.609
1.603
1.590
1.586
1.582
1.574
1.561
1.059
1.050
1.043
1.035
1.026
1.016
1.012
X : parts per Million : Proton

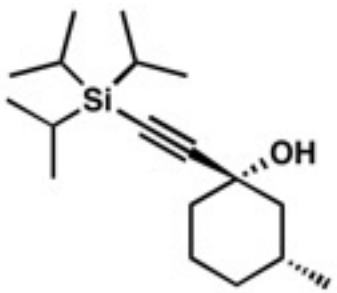

Si
OH
SI-36
abundance
3.0
2.0
1.0
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
112.469
83.761
77.254
77.000
76.746
72.255
43.195
27.667
22.315
18.587
11.141
X : parts per Million : Carbon13


Si
OH
N
Ts
SI-38
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.710
7.692
7.296
7.280
7.240
3.566
3.544
3.495
3.465
3.463
3.444
3.441
3.368
3.353
2.397
2.092
2.089
2.075
1.862
1.015
0.999
0.995
0.974
0.960
0.946
0.941
0.927
X : parts per Million : Proton


Si
OH
N
Ts
SI-38
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
143.505
133.926
129.631
127.527
106.197
86.667
77.254
77.000
76.746
71.981
61.100
46.521
40.866
21.532
18.479
10.925
X : parts per Million : Carbon13

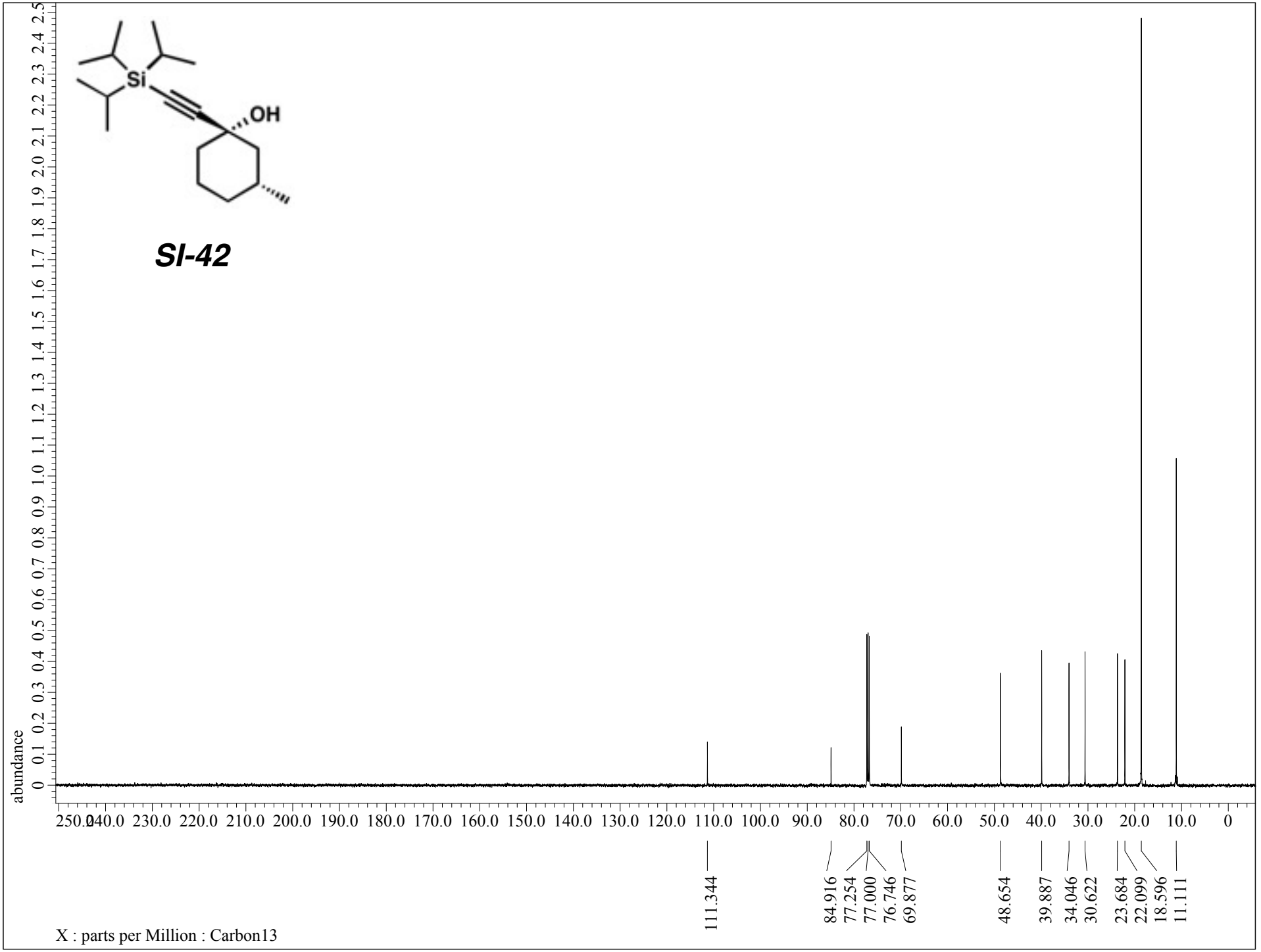

Si
OH
S
SI-40
30.0
20.0
10.0
0
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
3.187
3.164
3.025
3.021
3.010
3.002
2.998
2.938
2.320
2.266
2.157
2.152
1.051
1.041
1.025
1.022
1.007
1.000
X : parts per Million : Proton

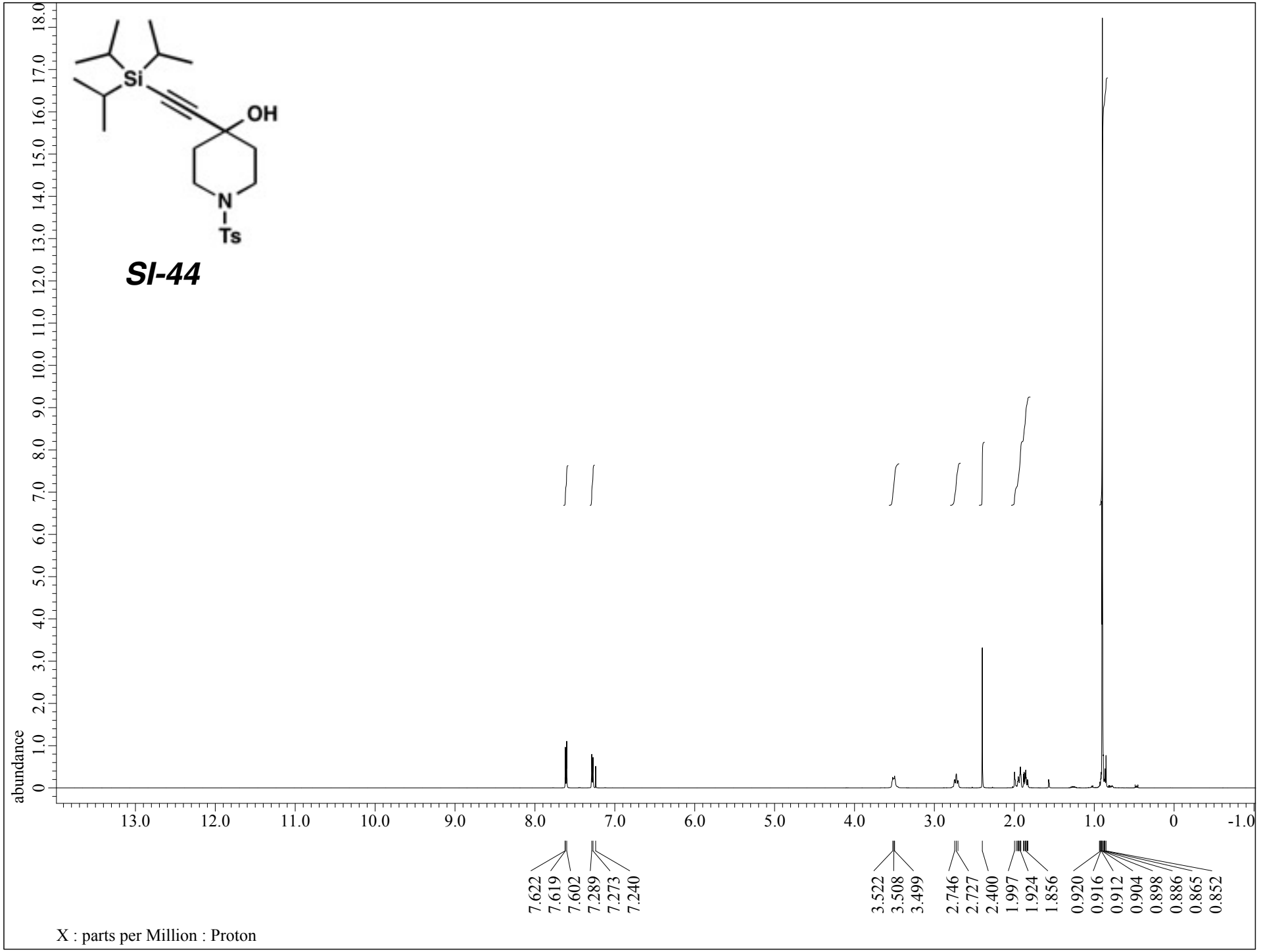

Si
OH
S
SI-40
abundance
0
0.1
0.2
0.3
0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
107.361
85.601
77.254
77.000
76.746
75.640
44.790
44.535
28.733
18.548
17.687
11.033
X : parts per Million : Carbon13

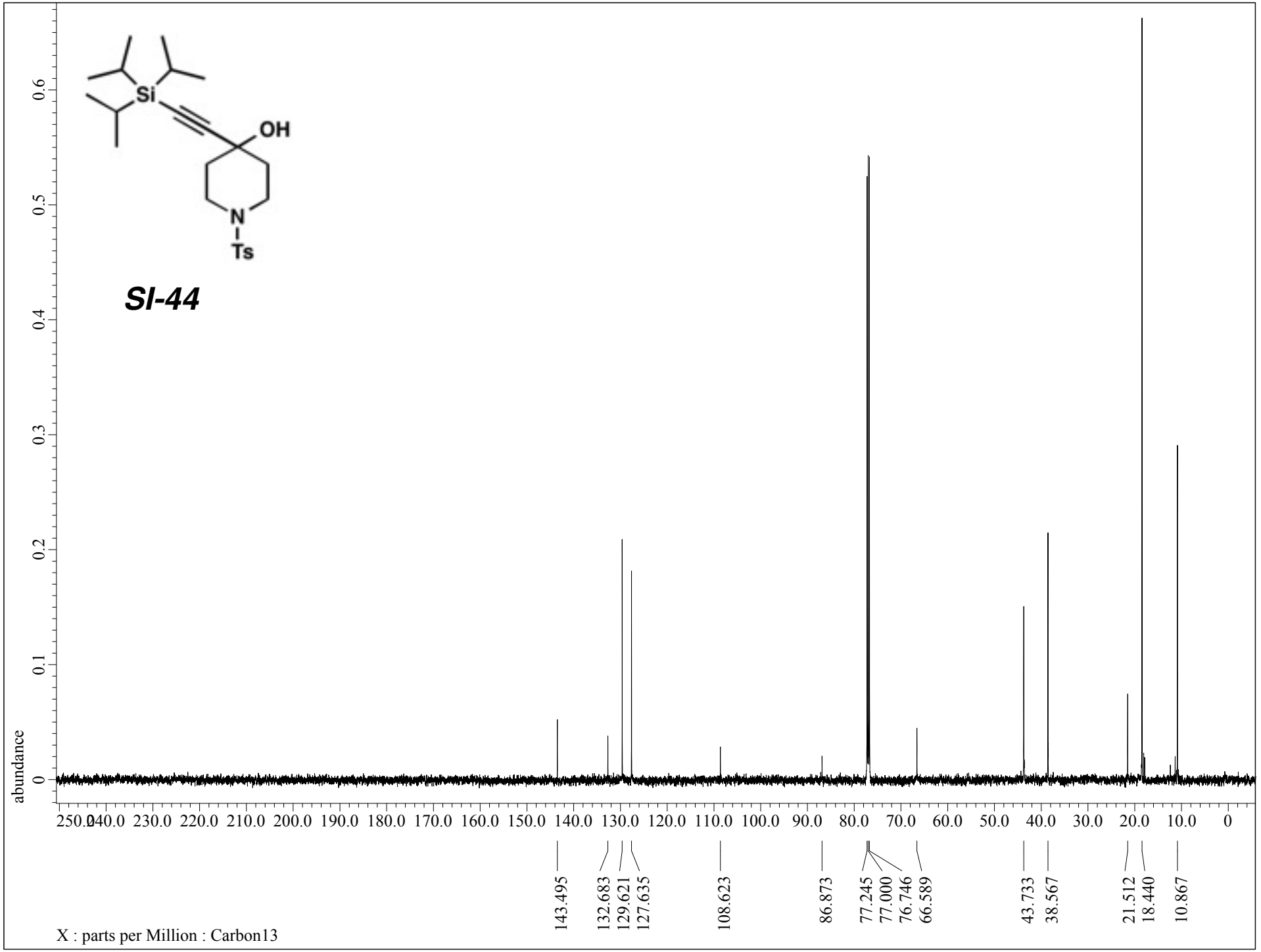

Si
OH

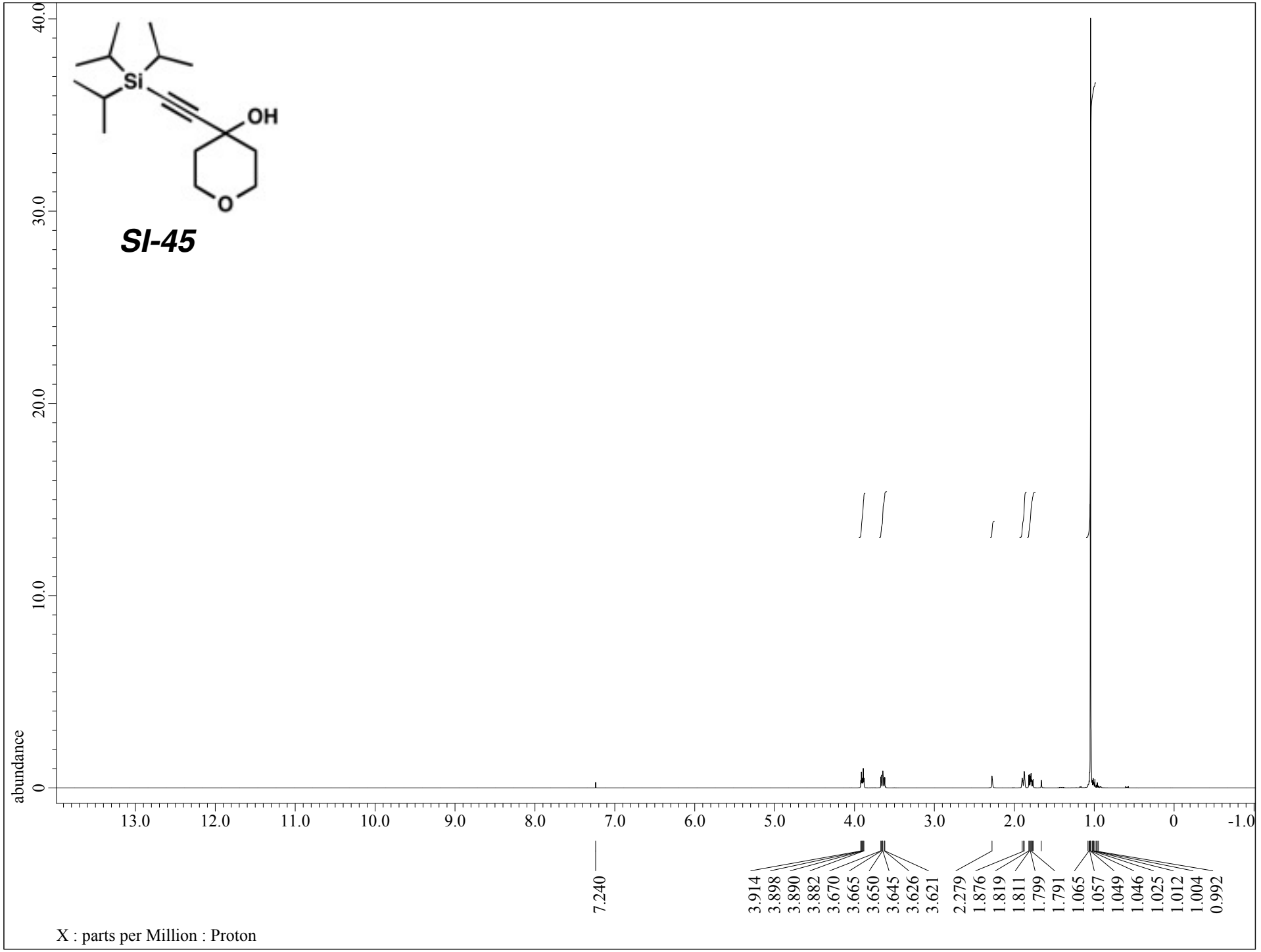
SI-42

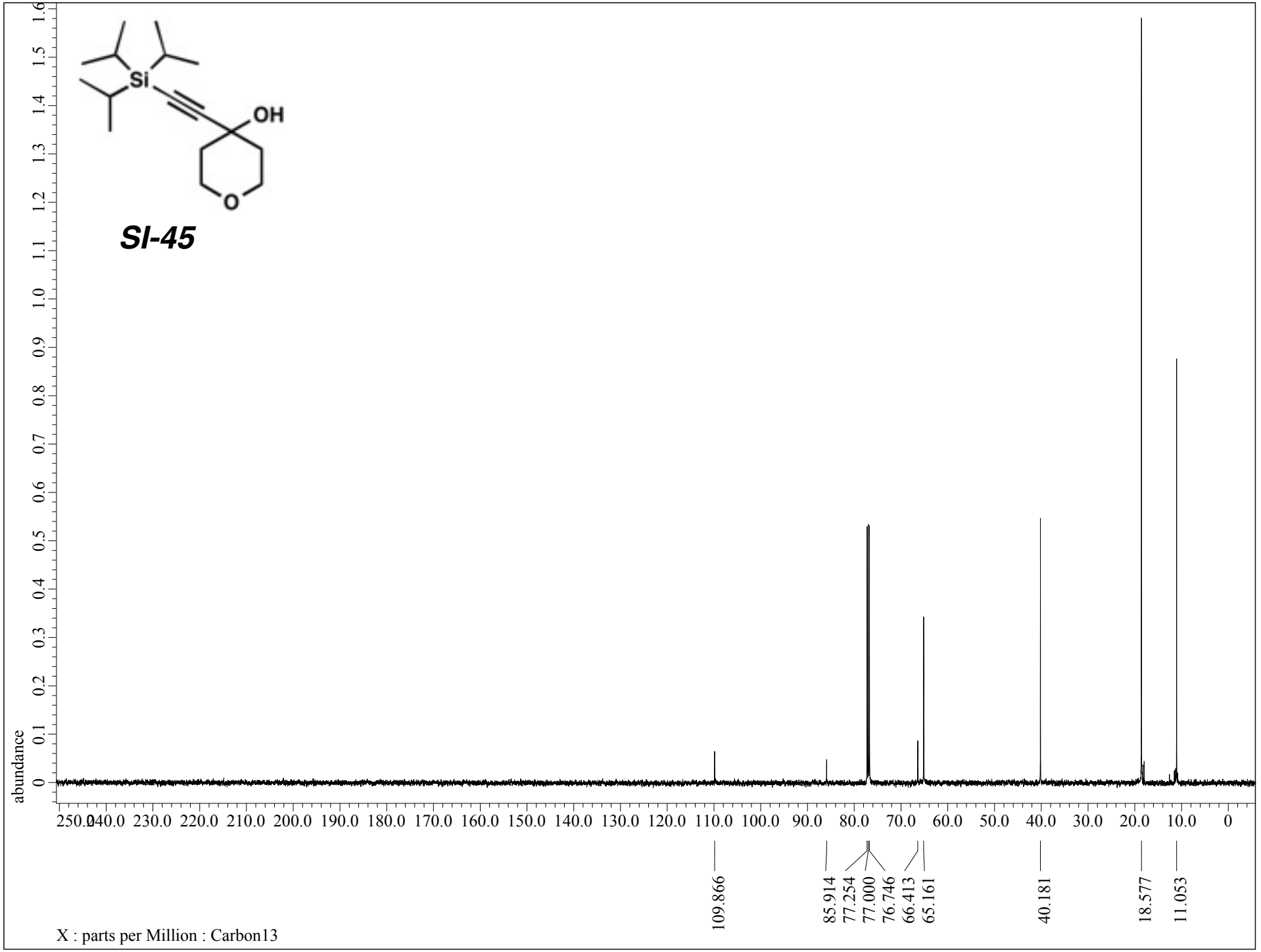
abundance
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0
13.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0 -1.0
7.240
2.116 1.941 1.935 1.922 1.917 1.669 1.606 1.601 1.142 1.118 1.093 1.057 1.054 1.047 1.040 1.025 0.907 0.893
X : parts per Million : Proton

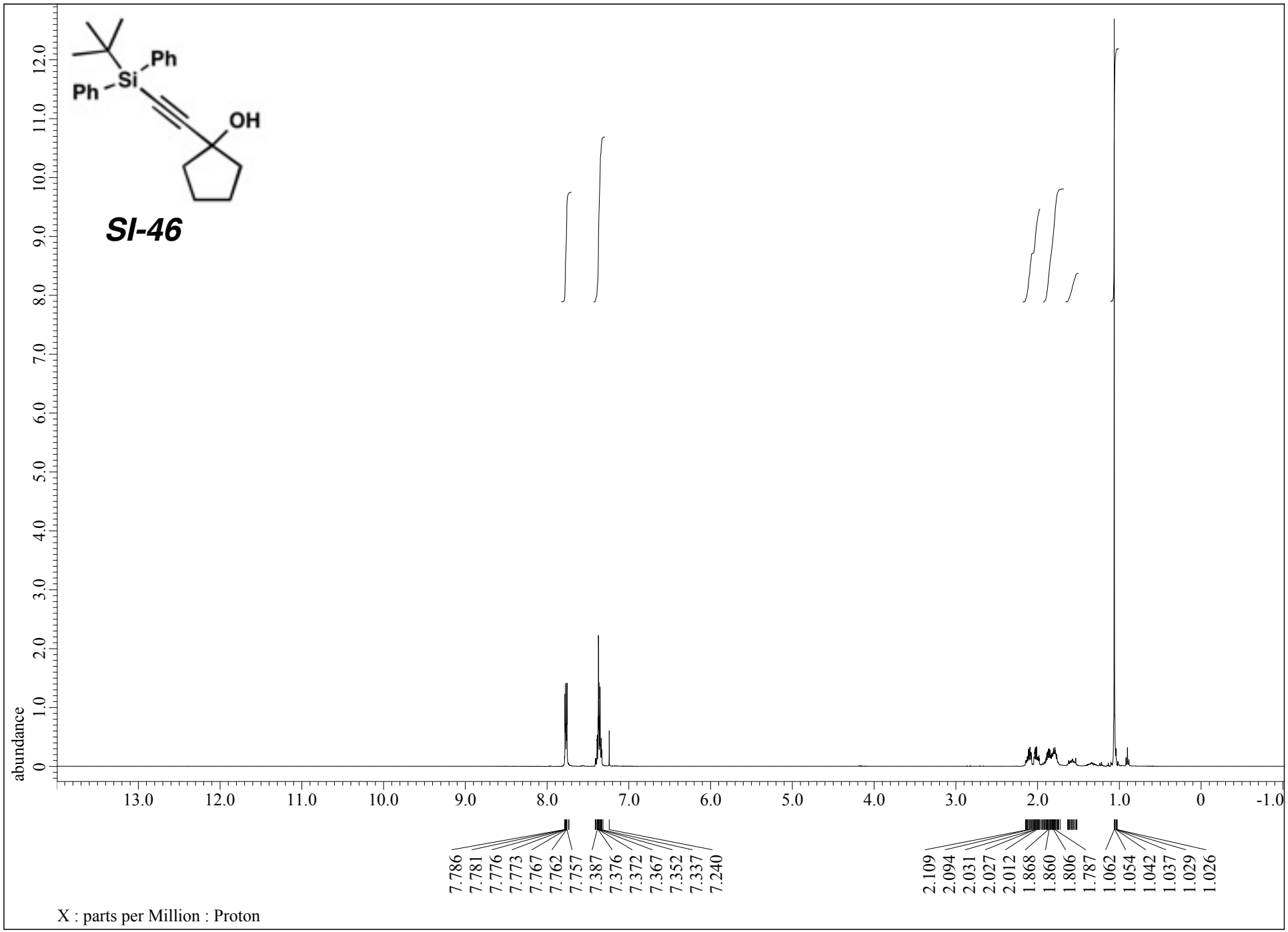

Si
OH
SI-42
abundance
X : parts per Million : Carbon13
111.344
84.916
77.254
77.000
76.746
69.877
48.654
39.887
34.046
30.622
23.684
22.099
18.596
11.111

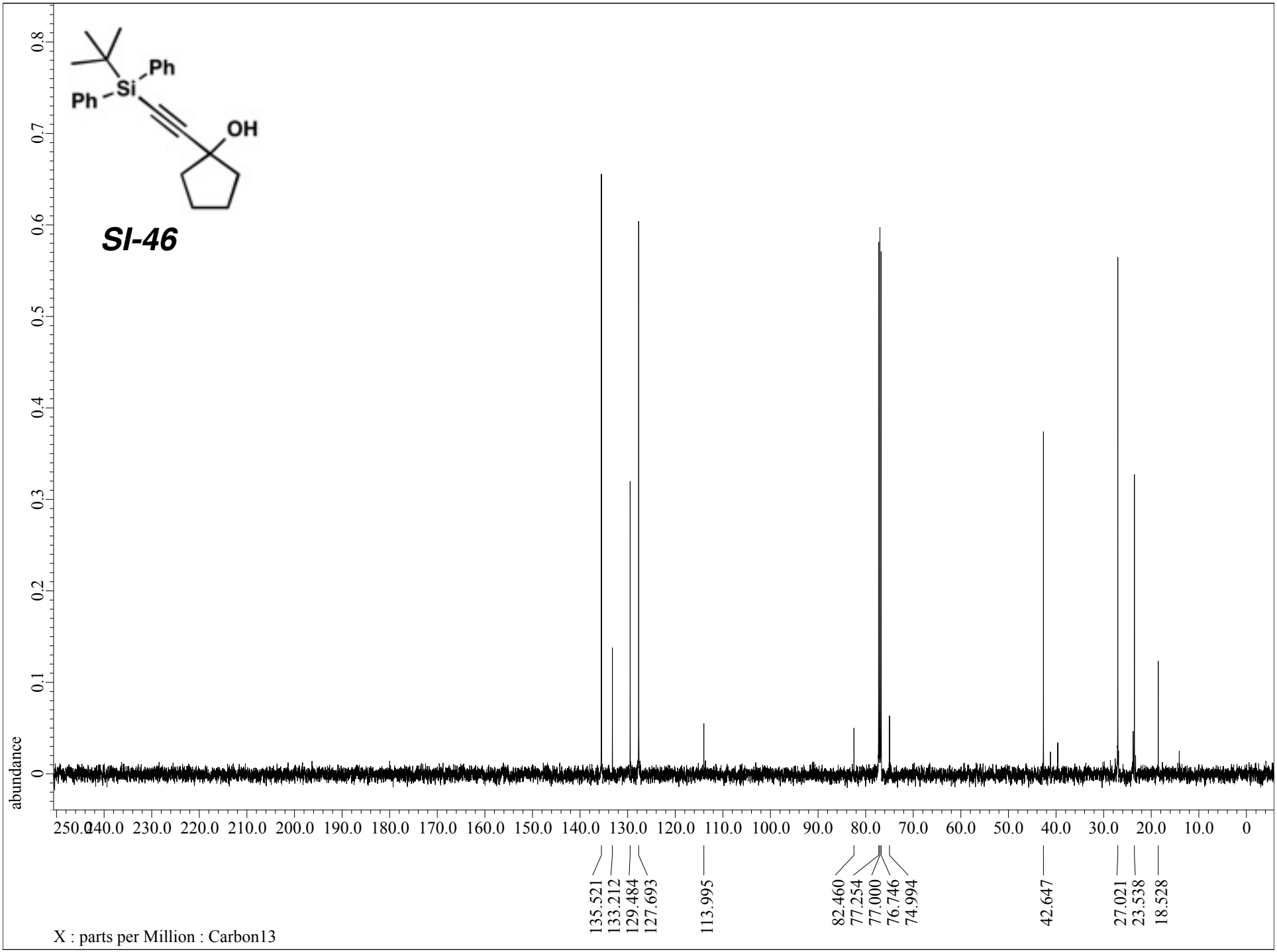

Si
OH
N
Ts
SI-44
abundance
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.622
7.619
7.602
7.289
7.273
7.240
3.522
3.508
3.499
2.746
2.727
2.400
1.997
1.924
1.856
0.920
0.916
0.912
0.904
0.898
0.886
0.865
0.852
X : parts per Million : Proton

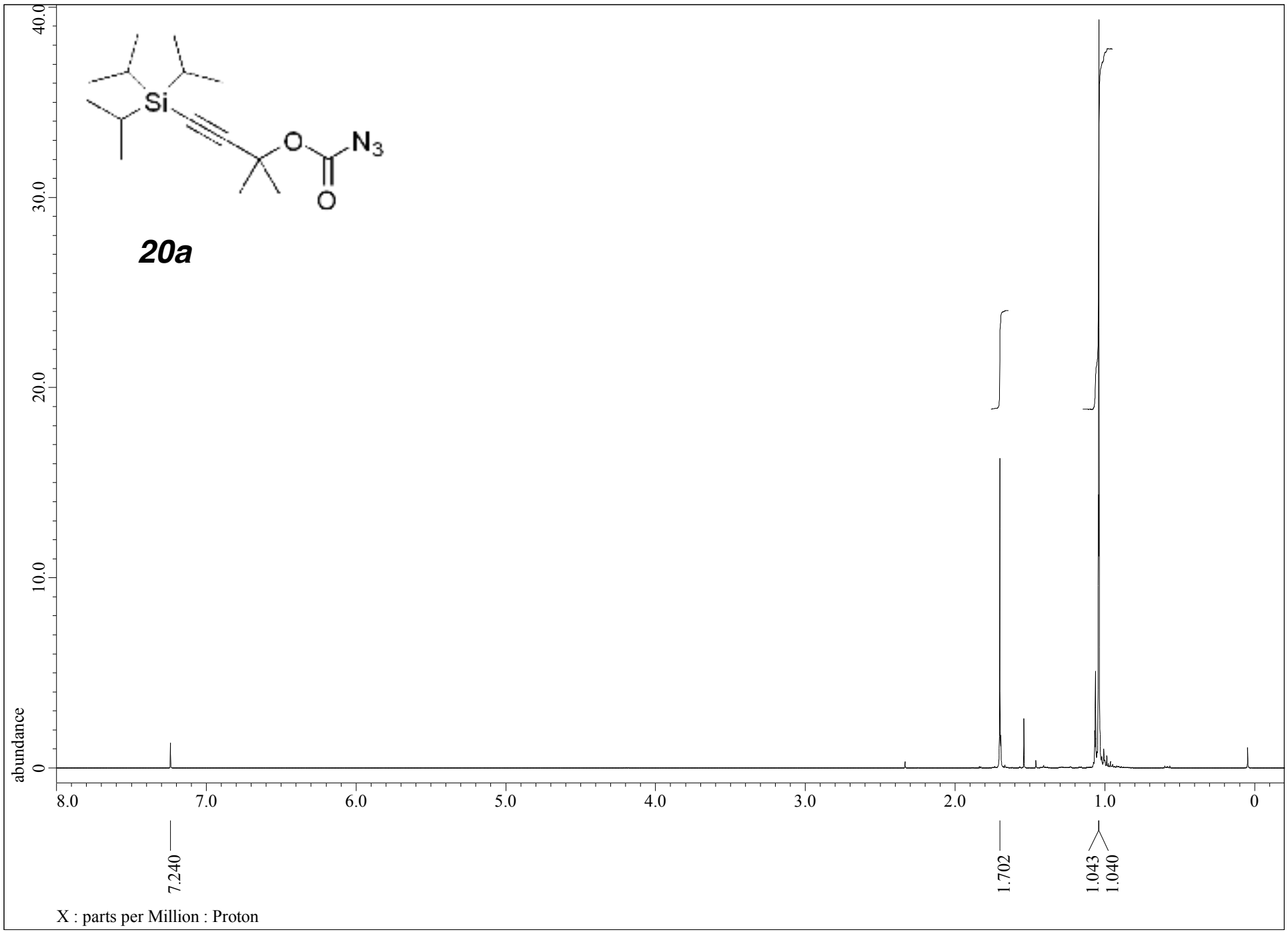

Si
OH
N
Ts
SI-44
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
143.495
132.683
129.621
127.635
108.623
86.873
77.245
77.000
76.746
66.589
43.733
38.567
21.512
18.440
10.867
X : parts per Million : Carbon13

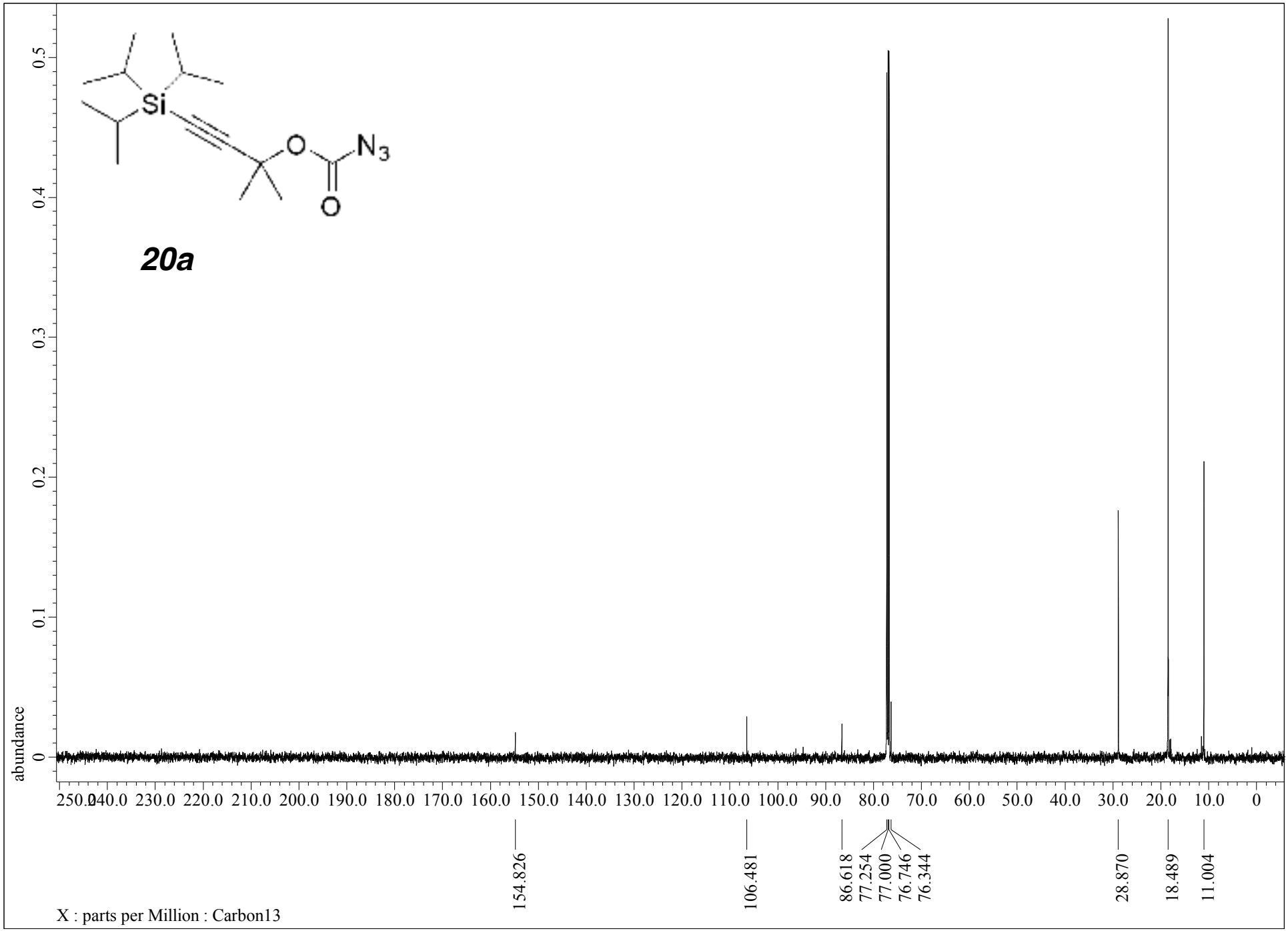

Si
OH
O
SI-45
abundance
40.0
30.0
20.0
10.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
3.914
3.898
3.890
3.882
3.670
3.665
3.650
3.645
3.626
3.621
2.279
1.876
1.819
1.811
1.799
1.791
1.065
1.057
1.049
1.046
1.025
1.012
1.004
0.992
X : parts per Million : Proton

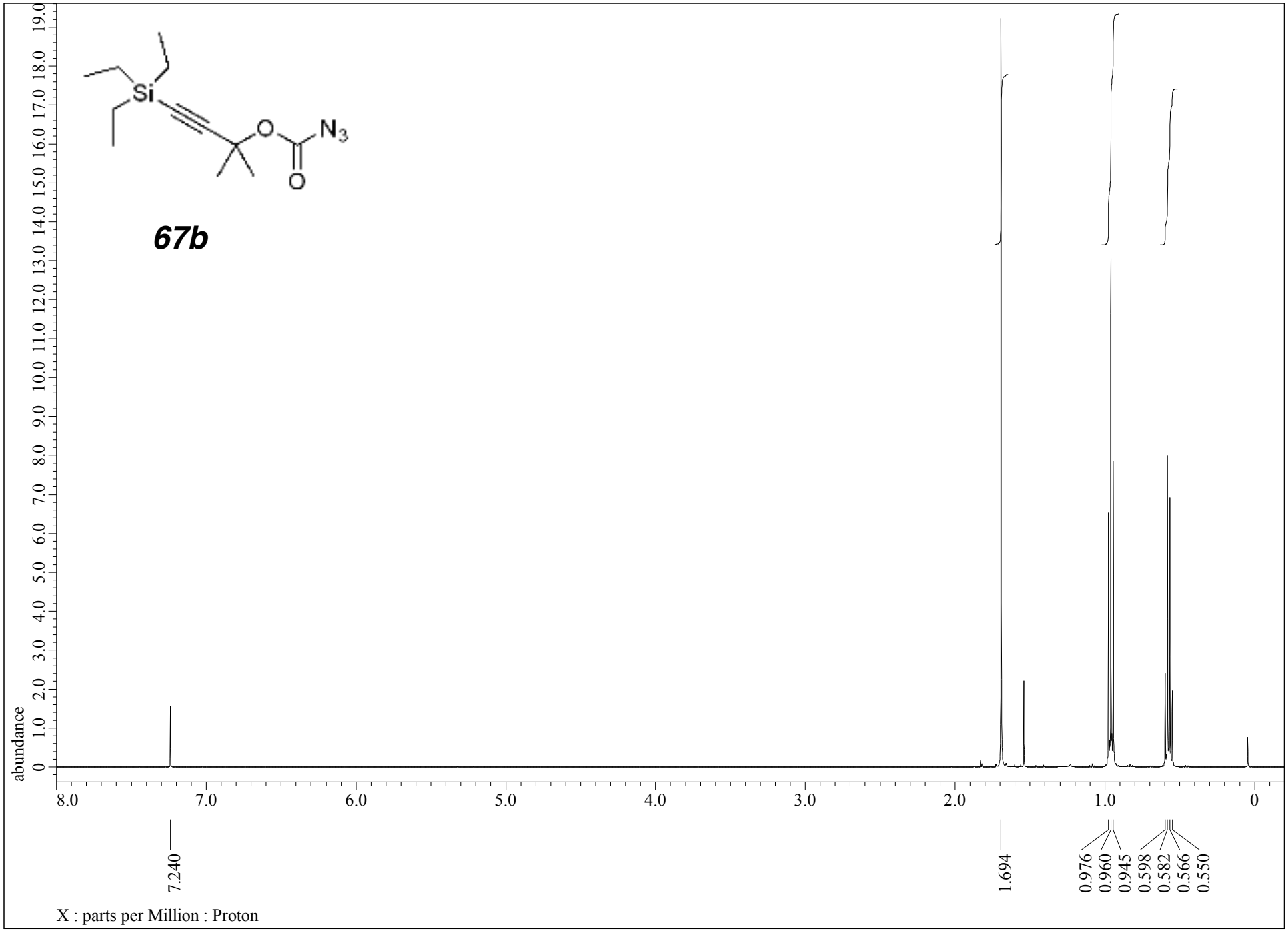

Si
OH
O
SI-45
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
109.866
85.914
77.254
77.000
76.746
66.413
65.161
40.181
18.577
11.053
X : parts per Million : Carbon13

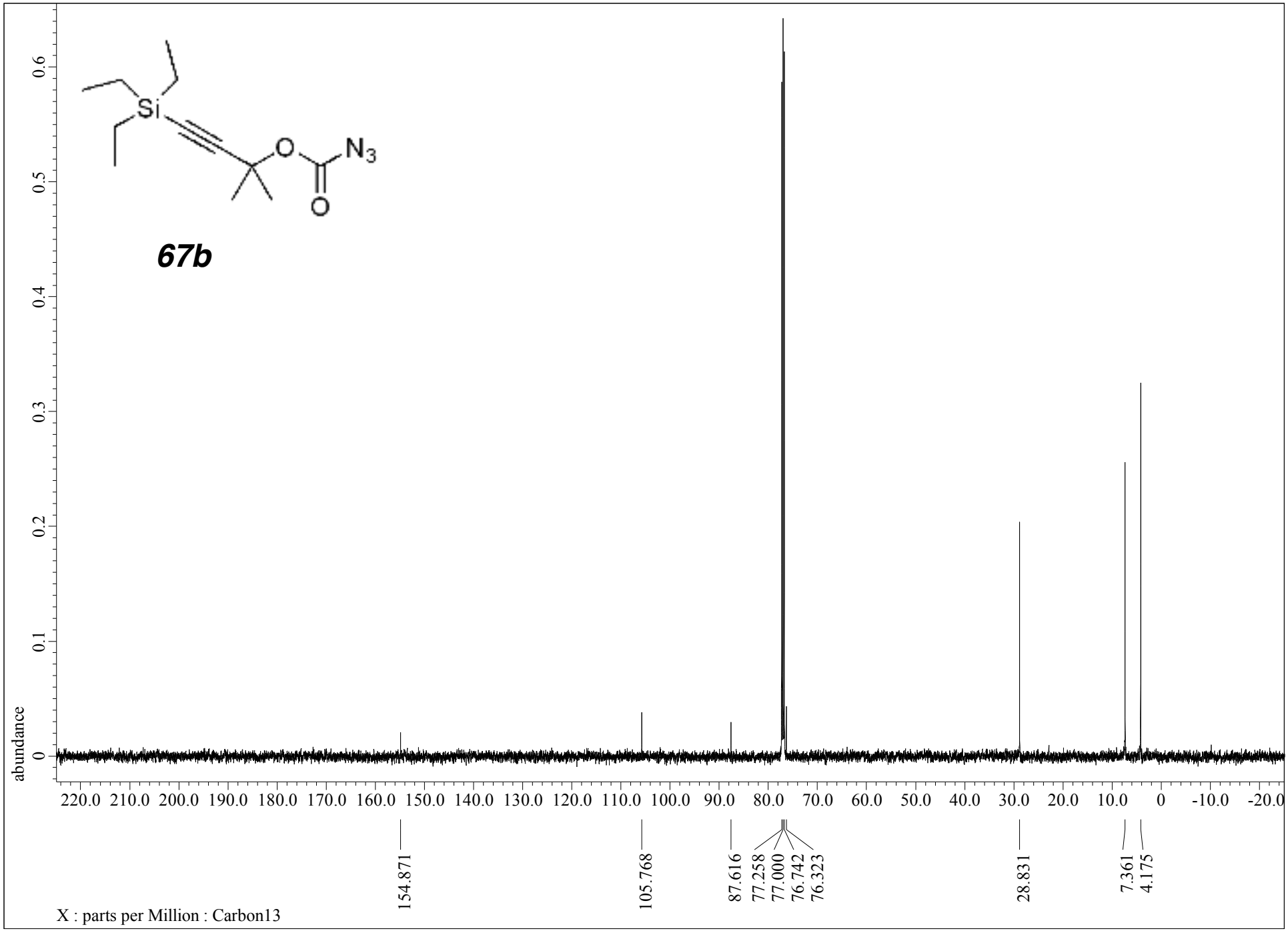

Ph
Si
Ph
OH
SI-46
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.786
7.781
7.776
7.773
7.767
7.762
7.757
7.387
7.376
7.372
7.367
7.352
7.337
7.240
2.109
2.094
2.031
2.027
2.012
1.868
1.860
1.806
1.787
1.062
1.054
1.042
1.037
1.029
1.026
X : parts per Million : Proton

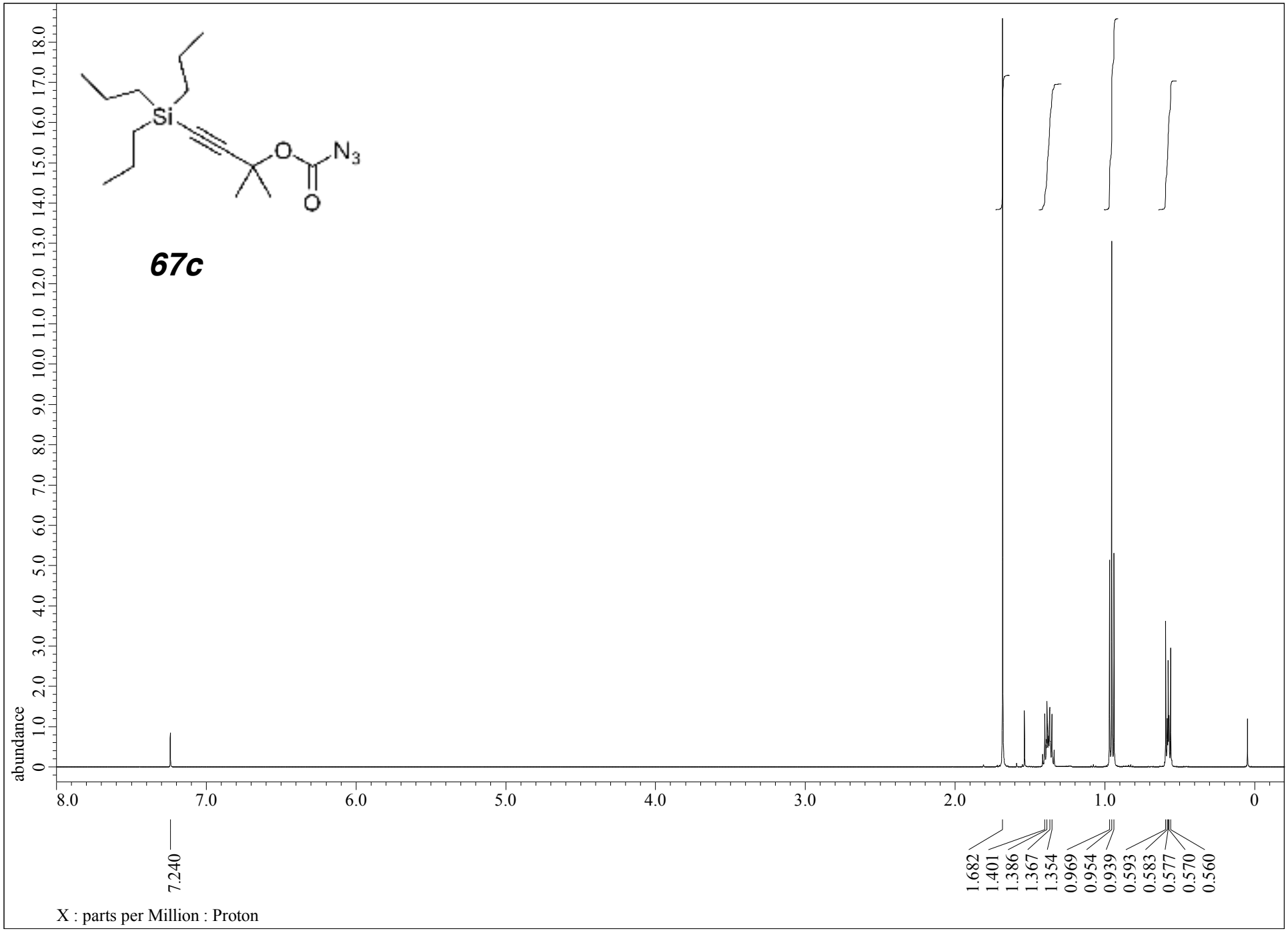

Ph
Si
Ph
OH
SI-46
abundance
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
135.521
133.212
129.484
127.693
113.995
82.460
77.254
77.000
76.746
74.994
42.647
27.021
23.538
18.528
X : parts per Million : Carbon13

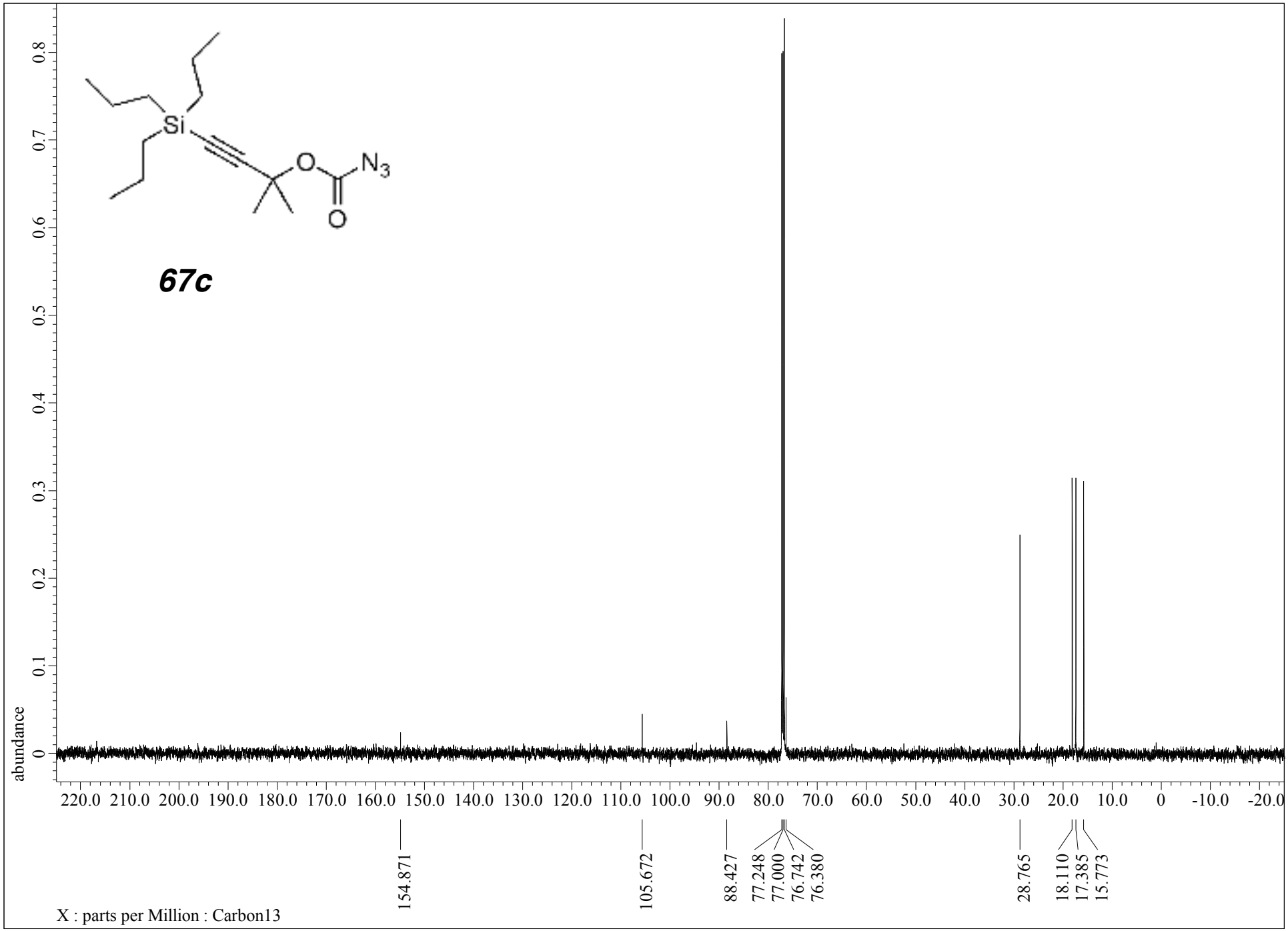

Si
O
N3
O
20a
40.0
30.0
20.0
10.0
0
abundance
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
1.702
1.043
1.040
X : parts per Million : Proton

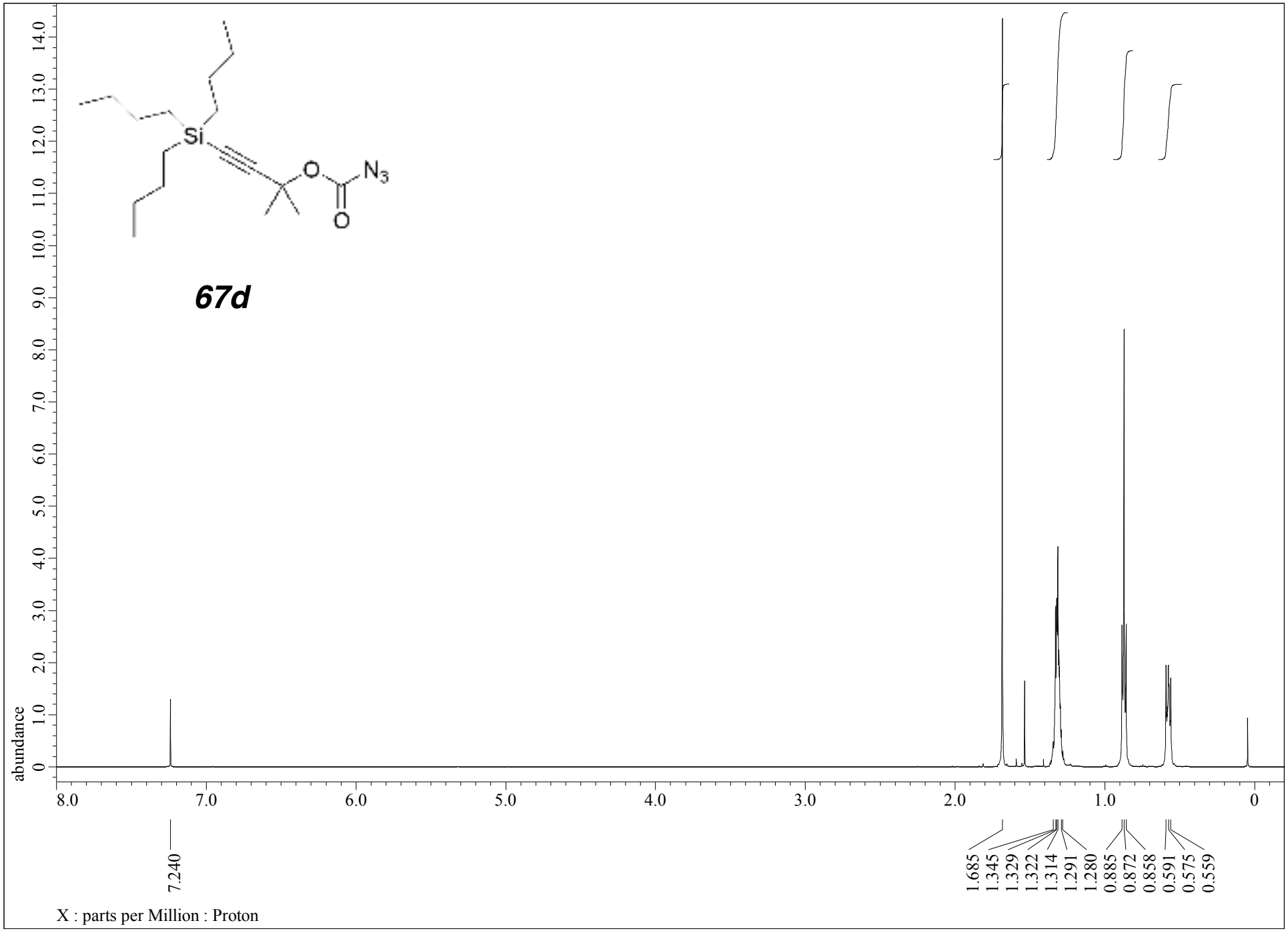

Si
O
O
N3
20a
abundance
0
0.1
0.2
0.3
0.4
0.5
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.826
106.481
86.618
77.254
77.000
76.746
76.344
28.870
18.489
11.004
X : parts per Million : Carbon13

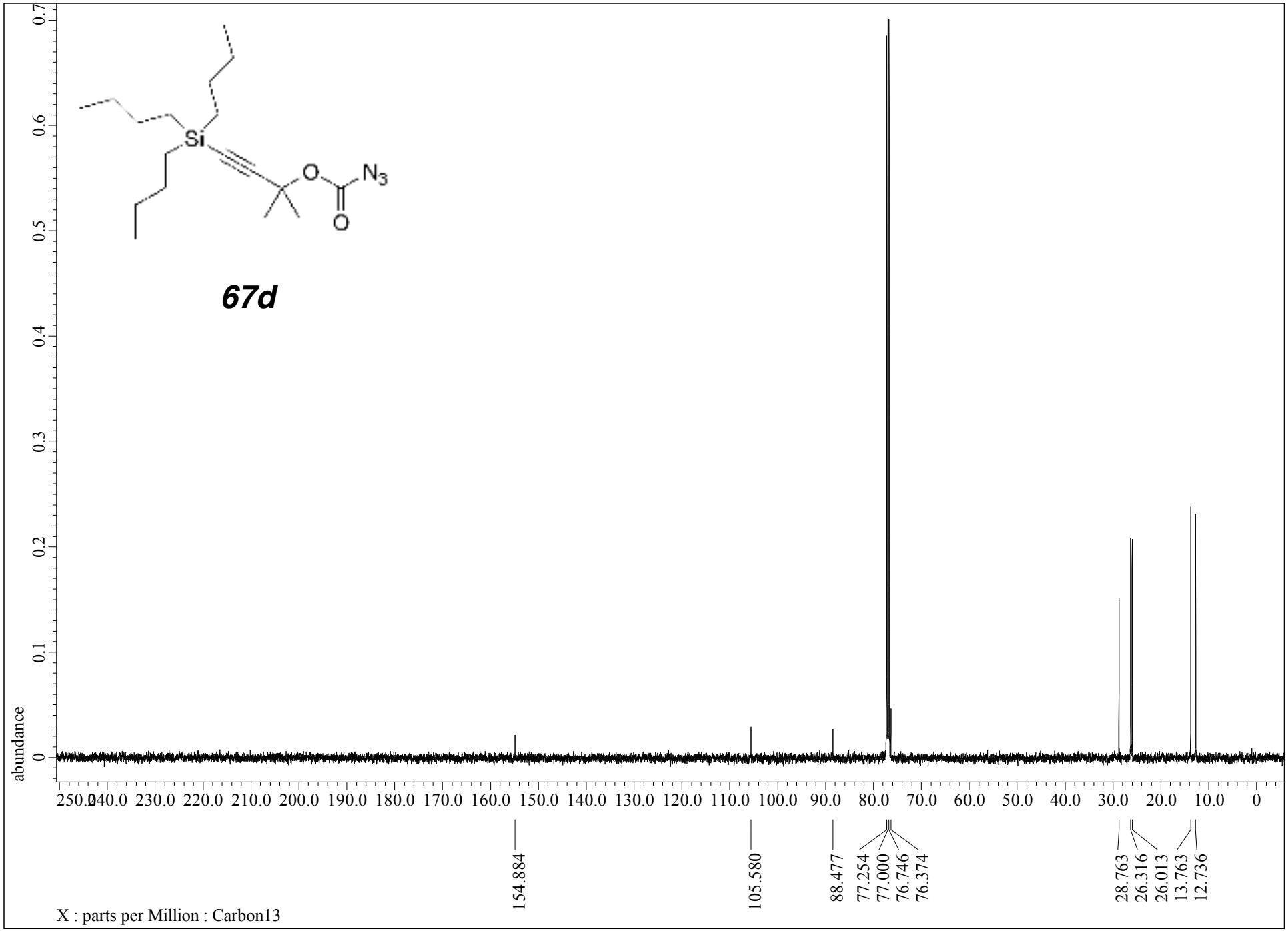

Si
O
N3
O
67b
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
1.694
0.976
0.960
0.945
0.598
0.582
0.566
0.550
X : parts per Million : Proton

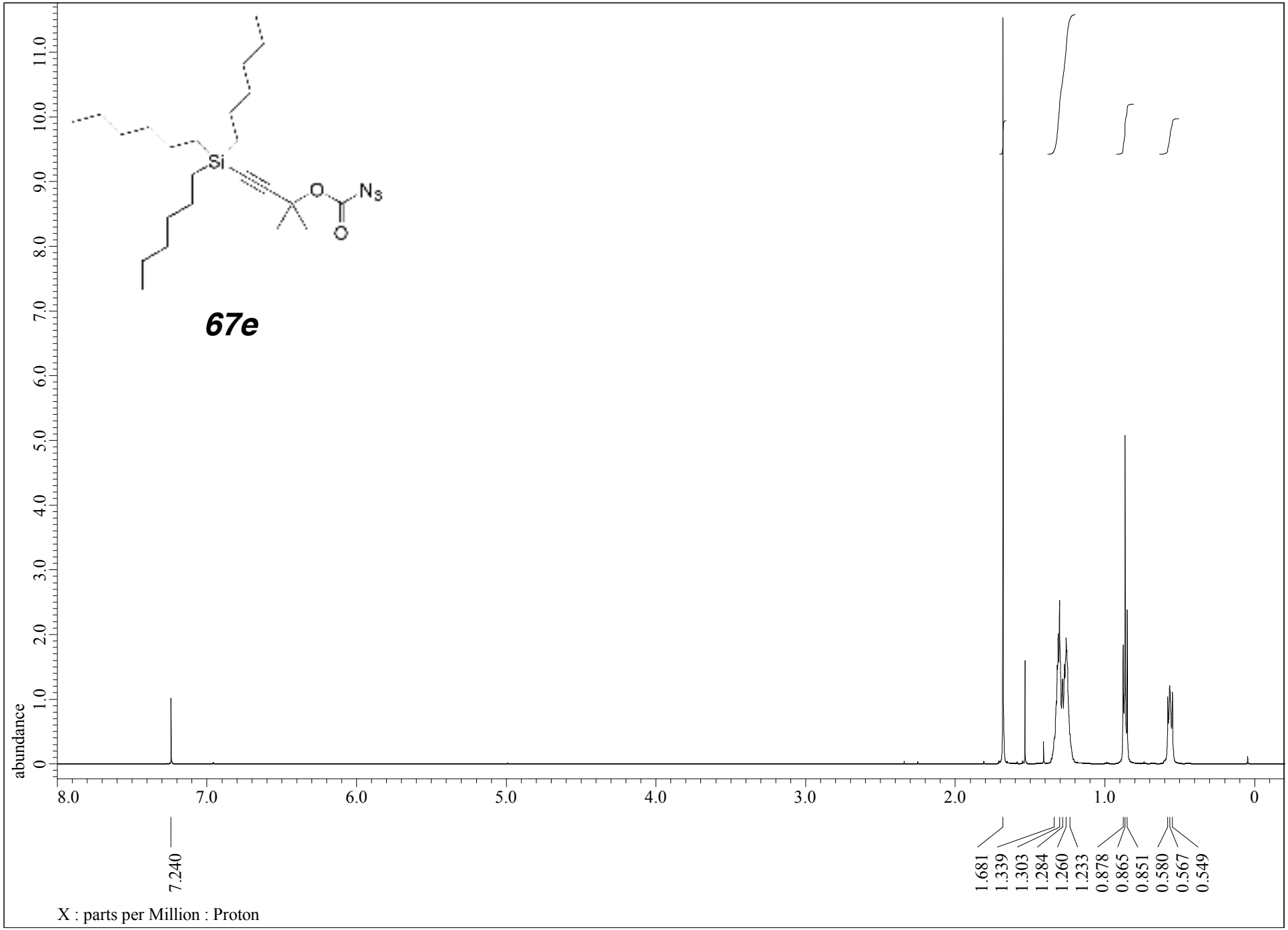

67b
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0 -10.0 -20.0
154.871
105.768
87.616
77.258
77.000
76.742
76.323
28.831
7.361
4.175
X : parts per Million : Carbon13

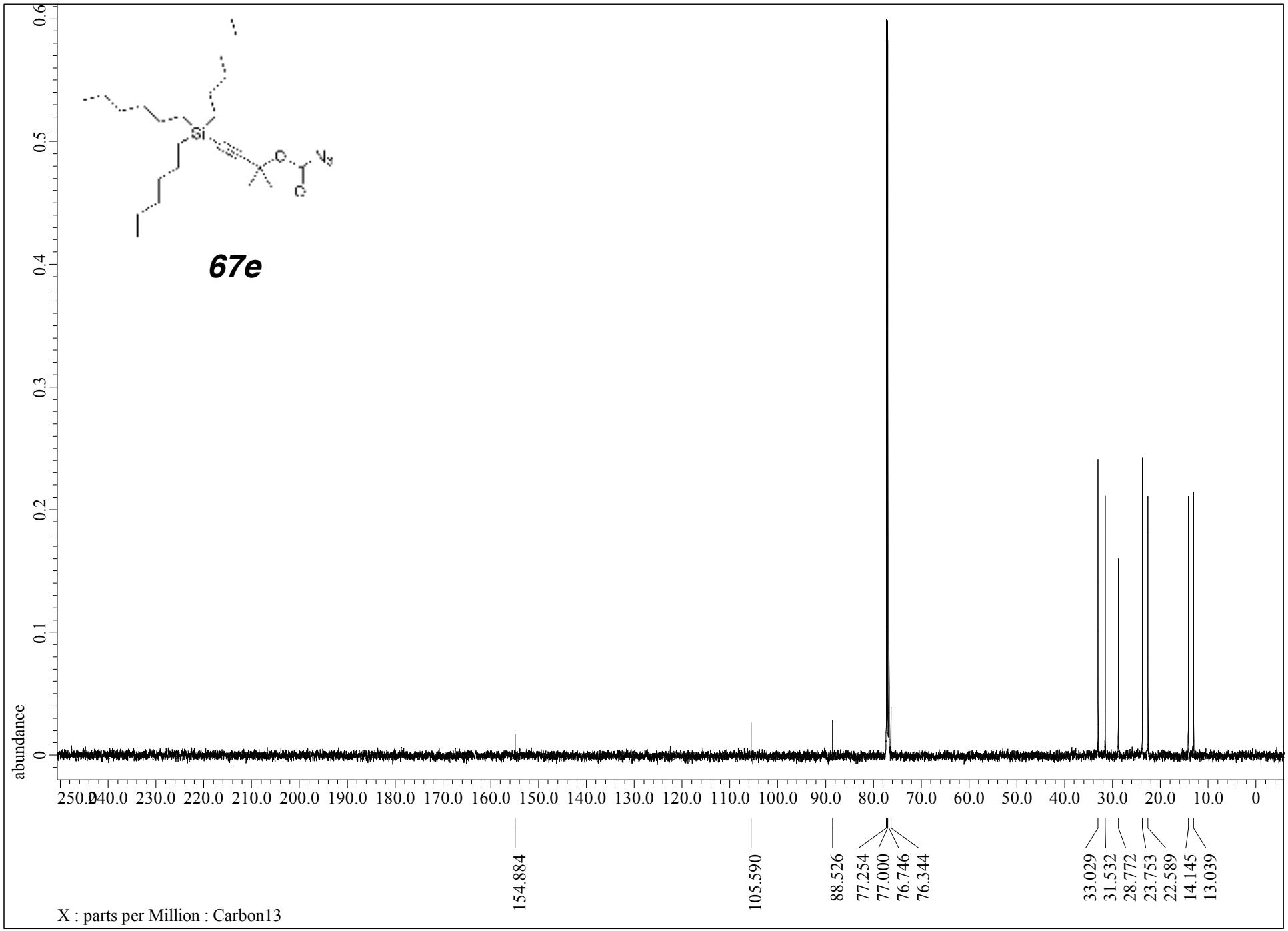

Si
O
O
N3
67c
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
1.682
1.401
1.386
1.367
1.354
0.969
0.954
0.939
0.593
0.583
0.577
0.570
0.560
X : parts per Million : Proton

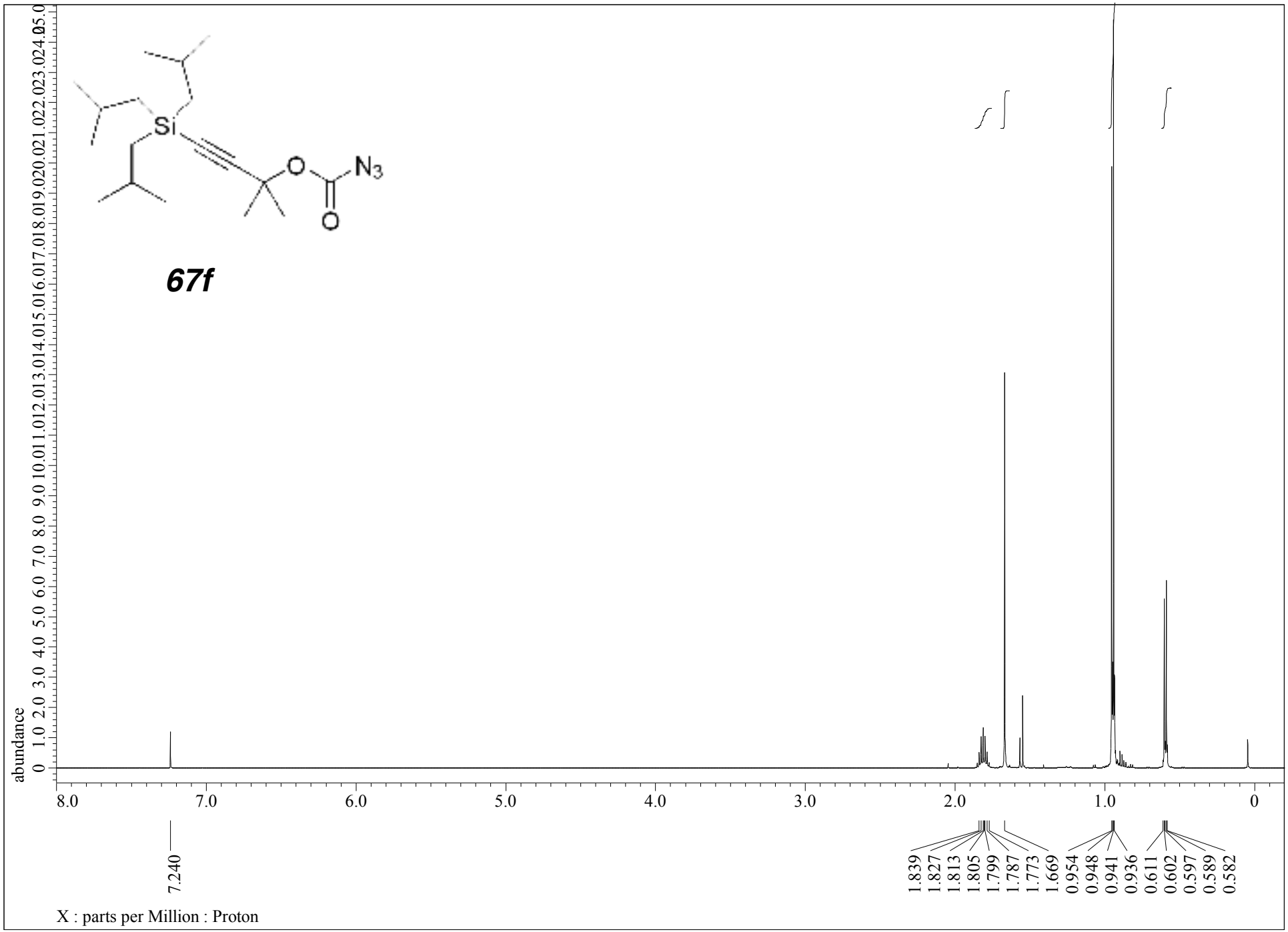

67c
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0 -10.0 -20.0
154.871
105.672
88.427
77.248
77.000
76.742
76.380
28.765
18.110
17.385
15.773
X : parts per Million : Carbon13

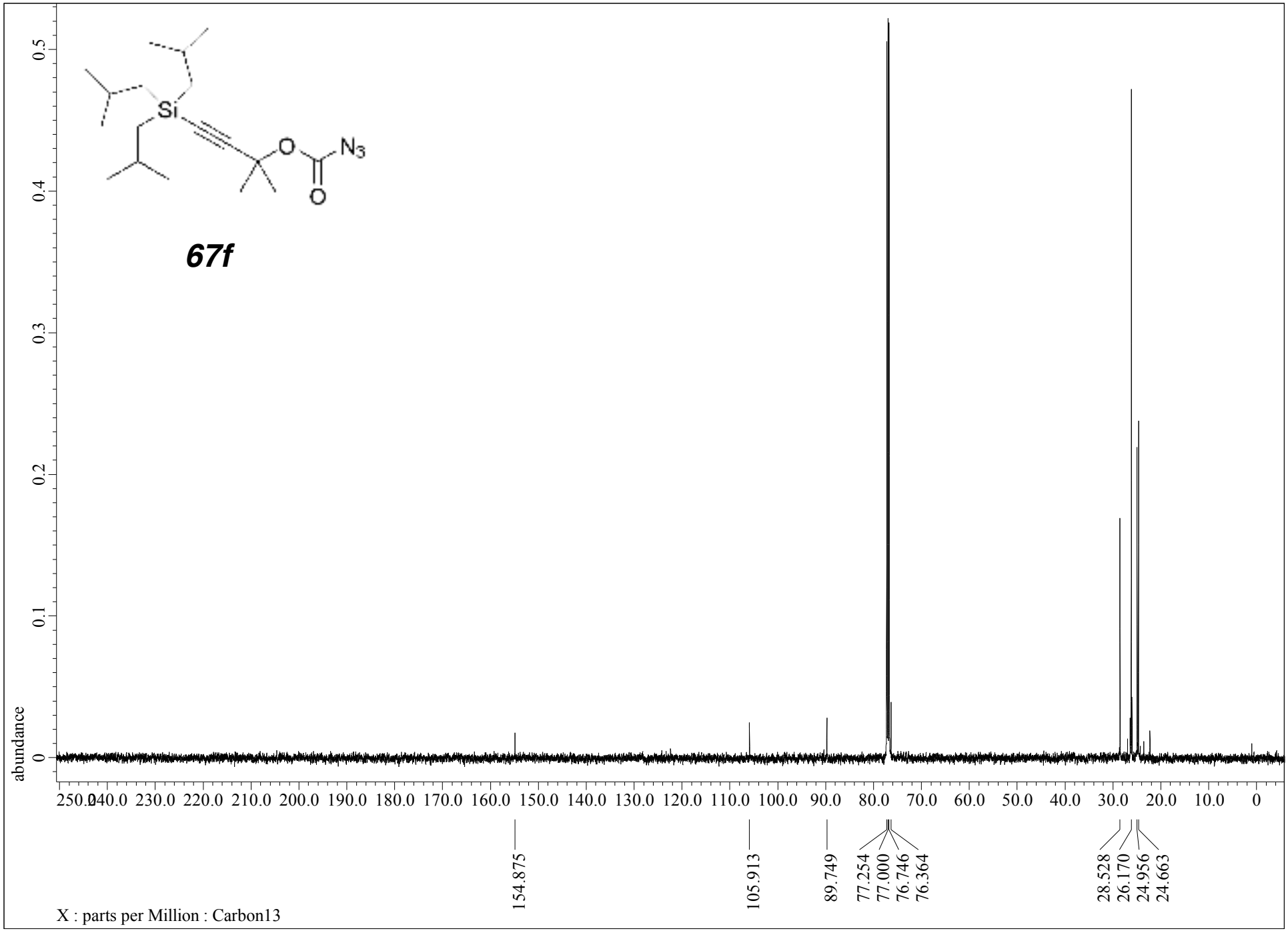

Si
O
O
N3
67d
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
1.685
1.345
1.329
1.322
1.314
1.291
1.280
0.885
0.872
0.858
0.591
0.575
0.559
X : parts per Million : Proton

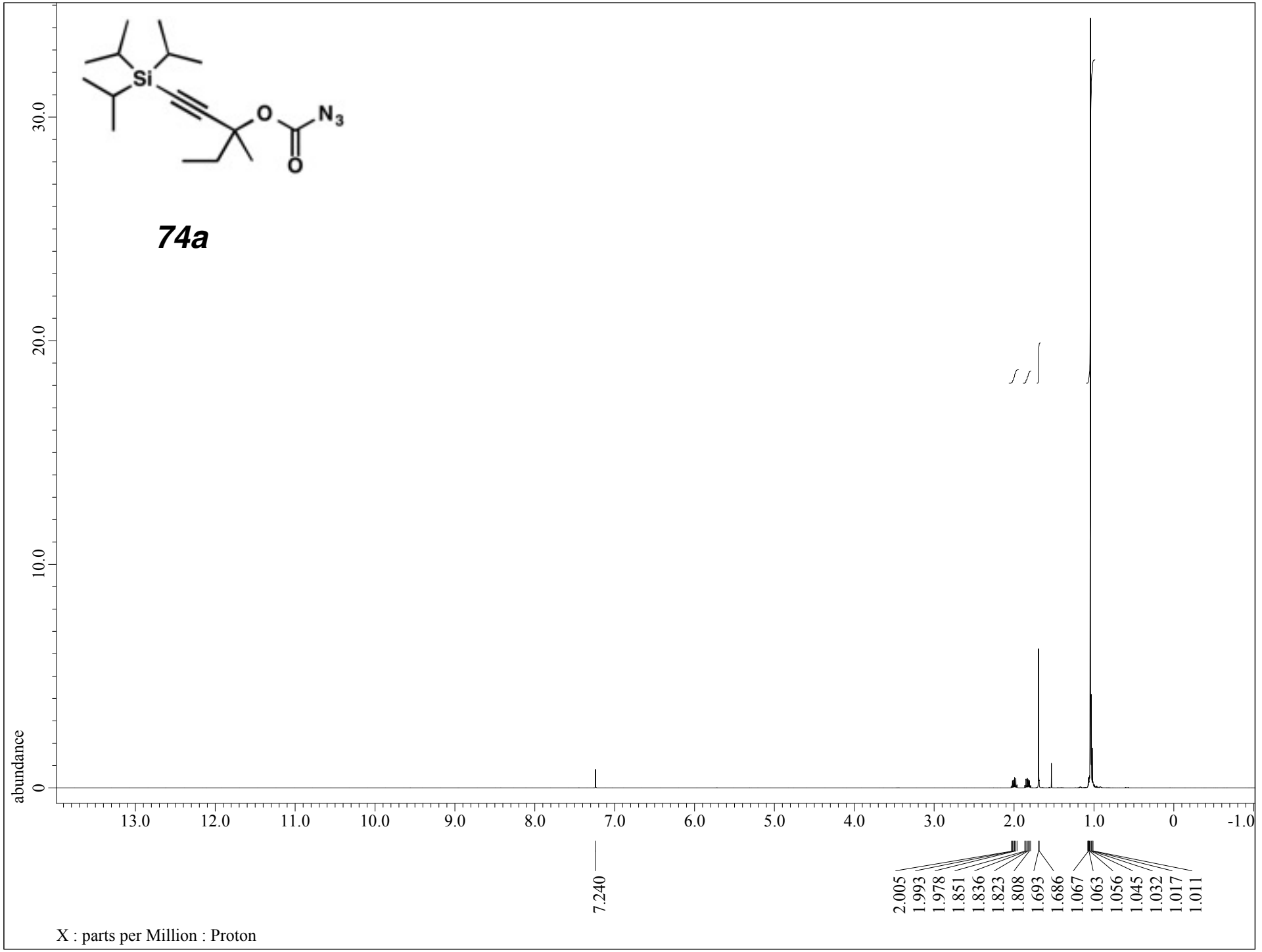

Si
O
O
N3
67d
abundance
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.884
105.580
88.477
77.254
77.000
76.746
76.374
28.763
26.316
26.013
13.763
12.736
X : parts per Million : Carbon13

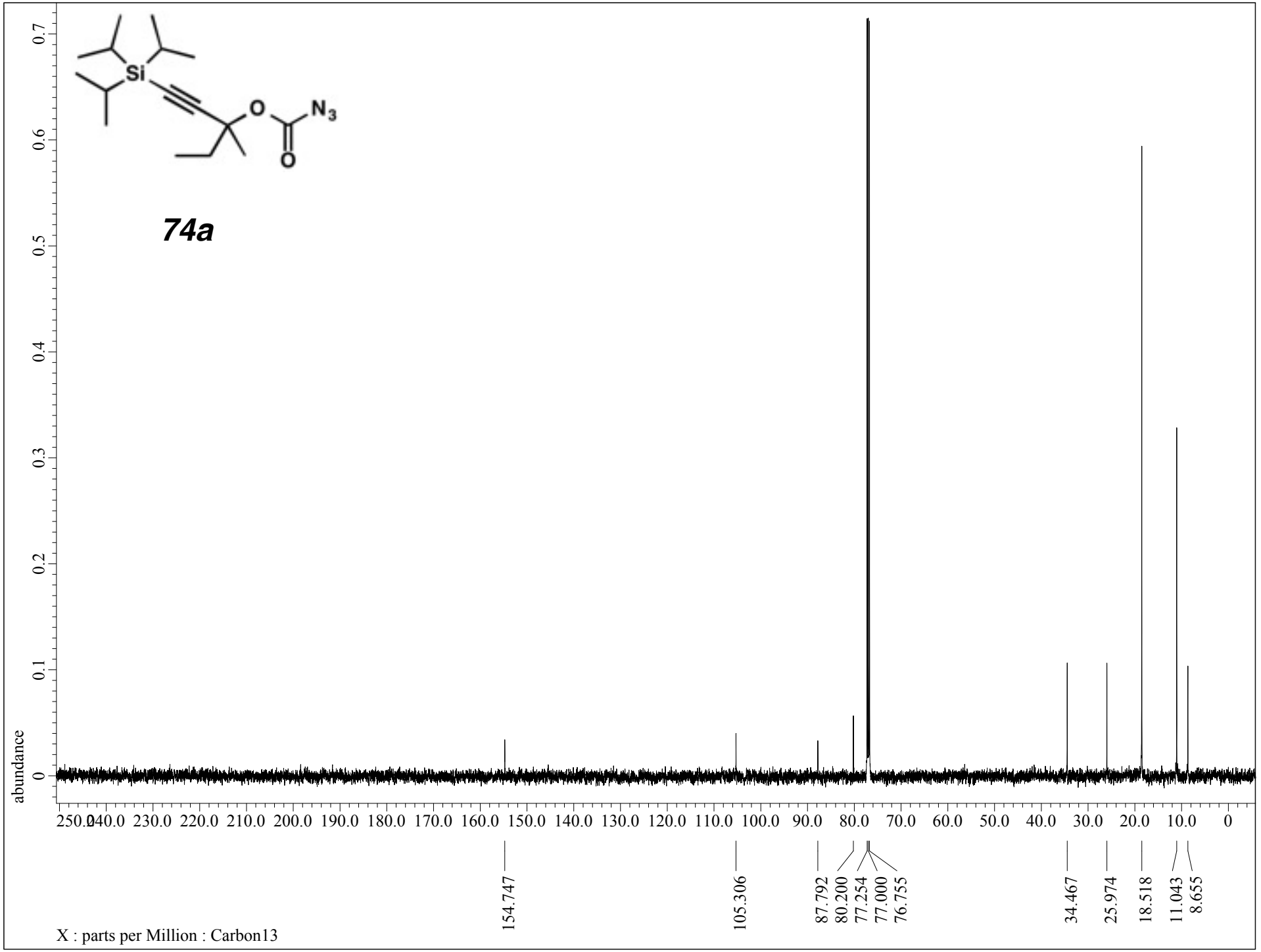

Si
O
O
N3
67e
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
1.681
1.339
1.303
1.284
1.260
1.233
0.878
0.865
0.851
0.580
0.567
0.549
X : parts per Million : Proton

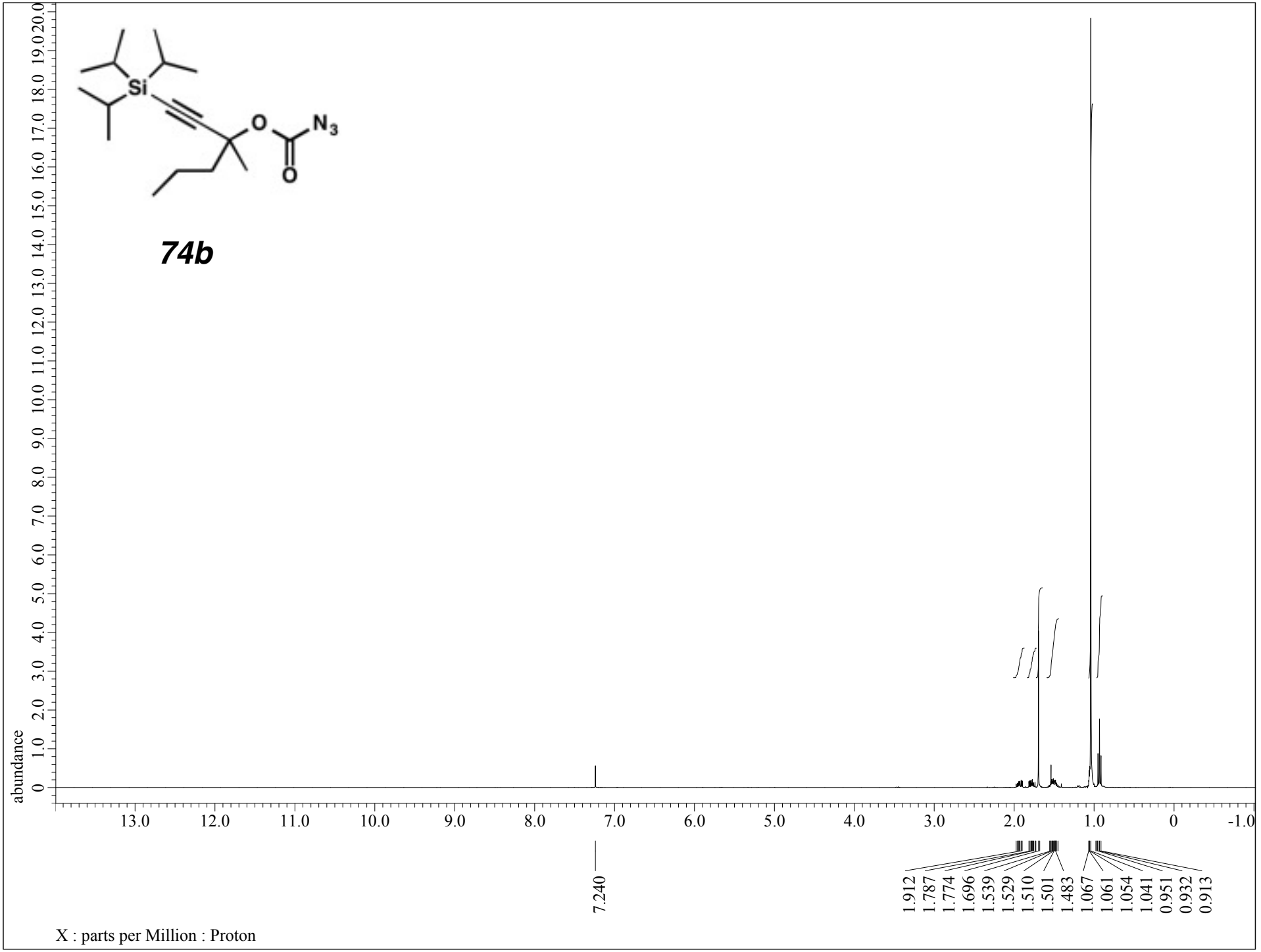

67e
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.884
105.590
88.526
77.254
77.000
76.746
76.344
33.029
31.532
28.772
23.753
22.589
14.145
13.039
X : parts per Million : Carbon13

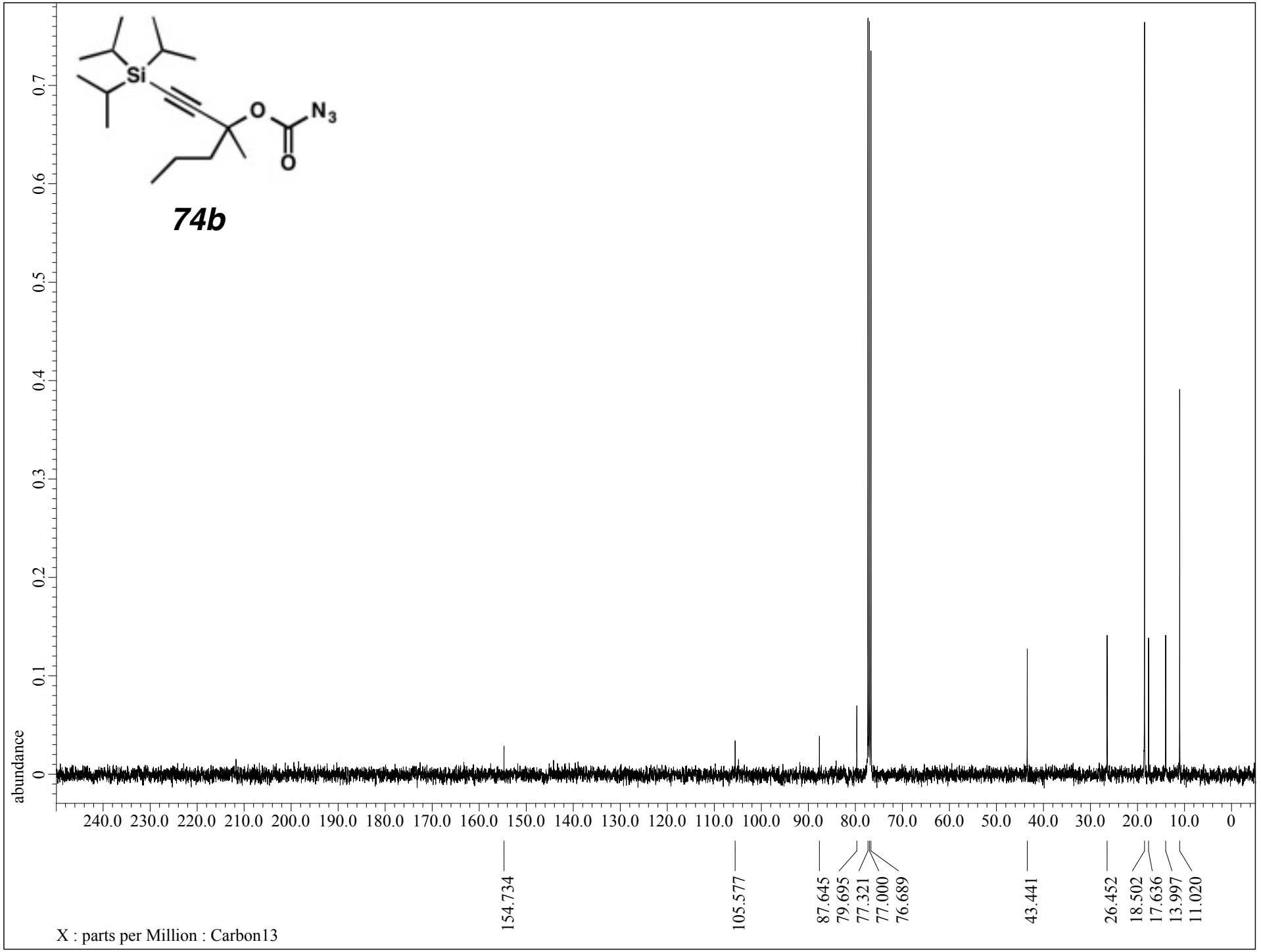

67f
abundance
X : parts per Million : Proton
7.240
1.839
1.827
1.813
1.805
1.799
1.787
1.773
1.669
0.954
0.948
0.941
0.936
0.611
0.602
0.597
0.589
0.582

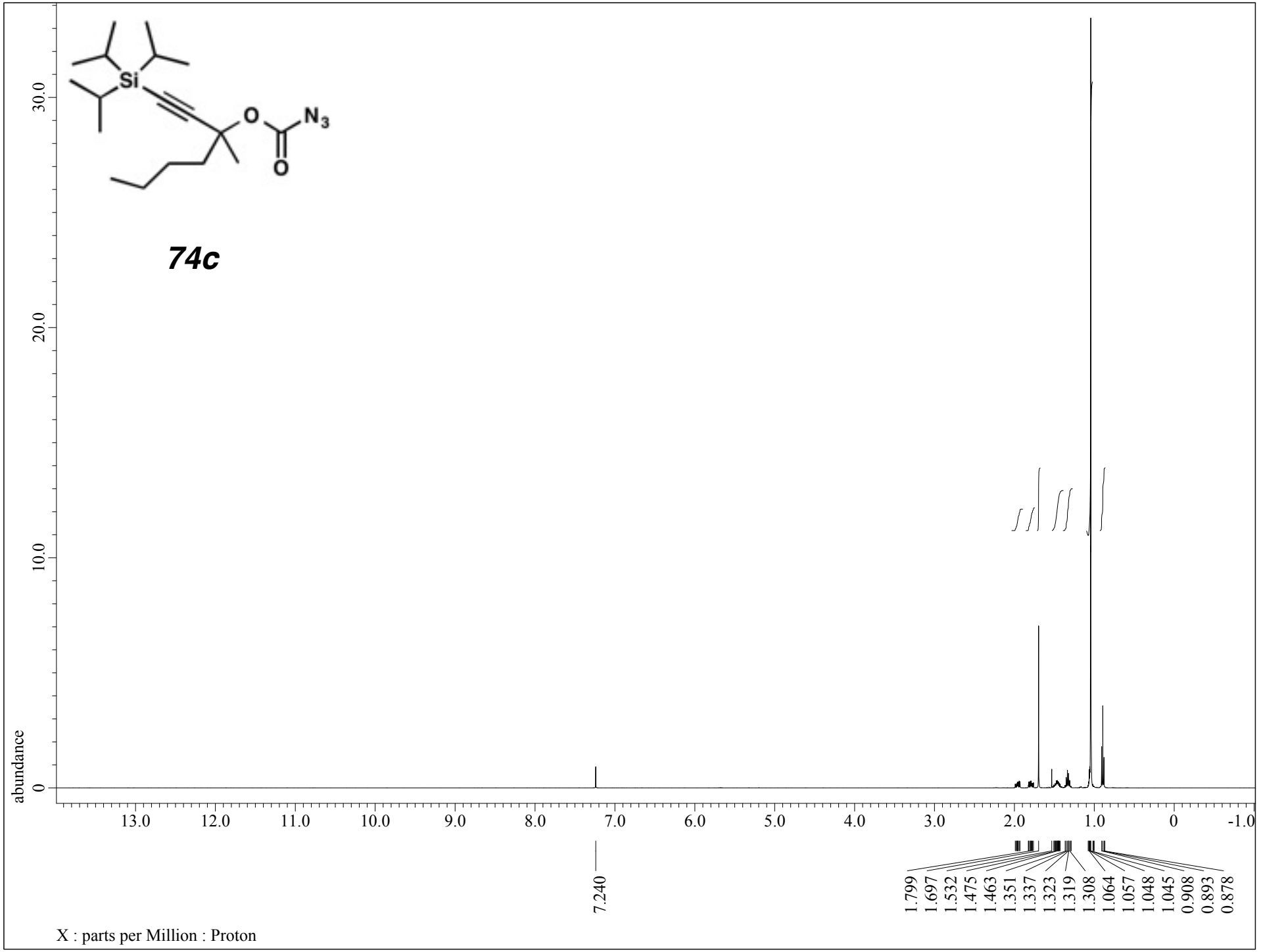

Si
O
N3
O
67f
abundance
0.5
0.4
0.3
0.2
0.1
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.875
105.913
89.749
77.254
77.000
76.746
76.364
28.528
26.170
24.956
24.663
X : parts per Million : Carbon13

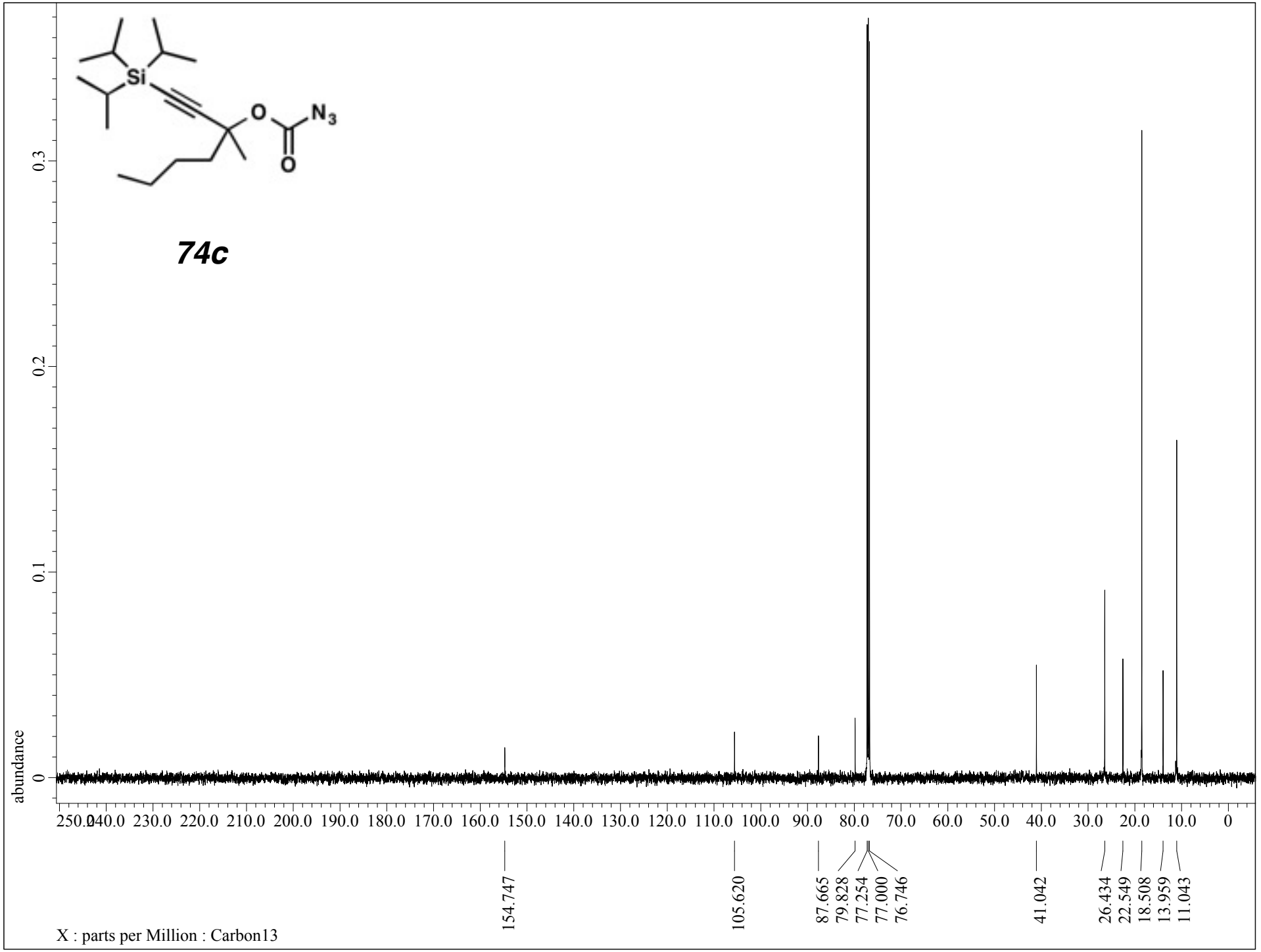

Si
O
O
N3
74a
30.0
20.0
10.0
0
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
2.005
1.993
1.978
1.851
1.836
1.823
1.808
1.693
1.686
1.067
1.063
1.056
1.045
1.032
1.017
1.011
X : parts per Million : Proton

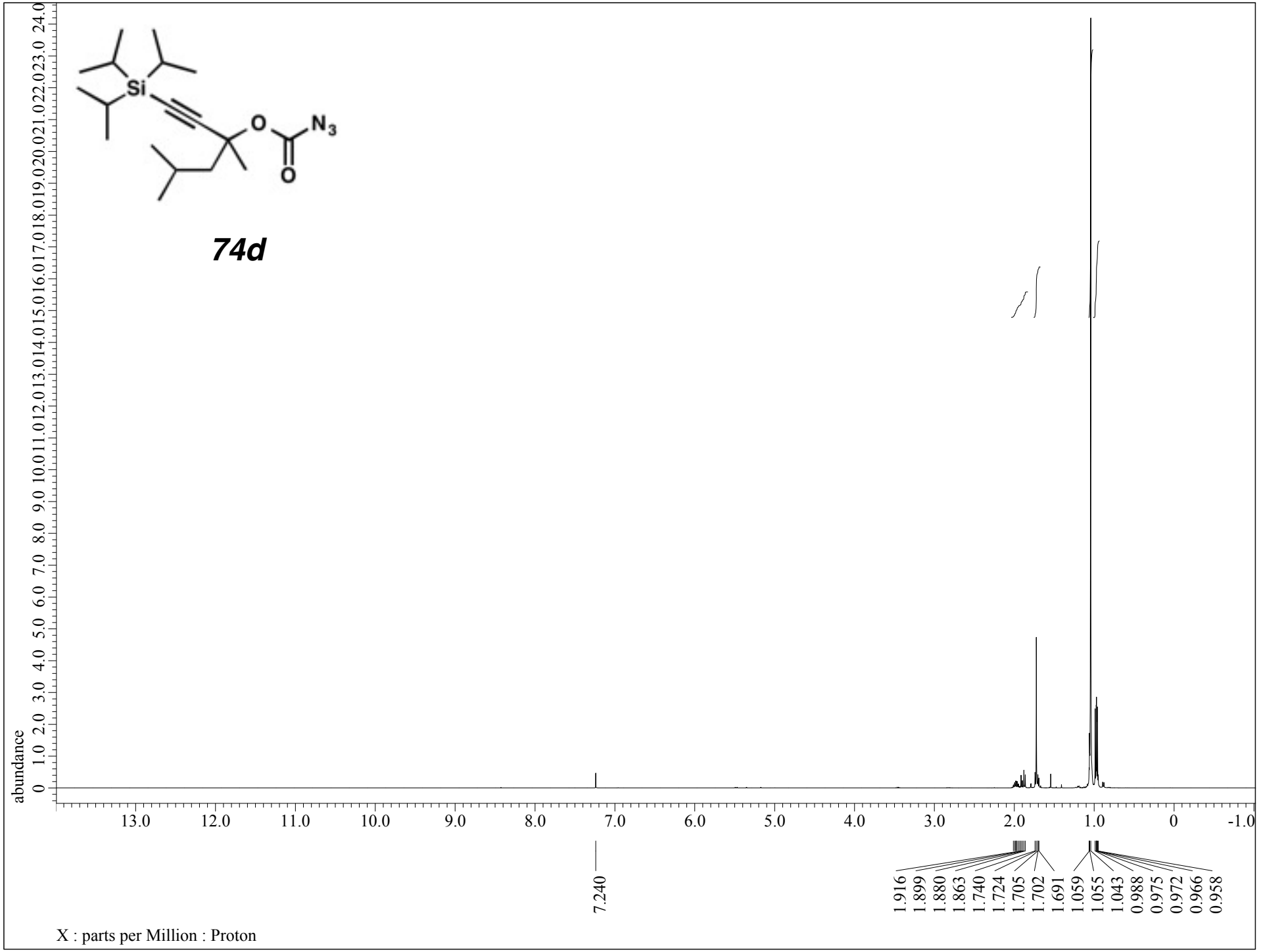

74a
abundance
X : parts per Million : Carbon13
154.747
105.306
87.792
80.200
77.254
77.000
76.755
34.467
25.974
18.518
11.043
8.655

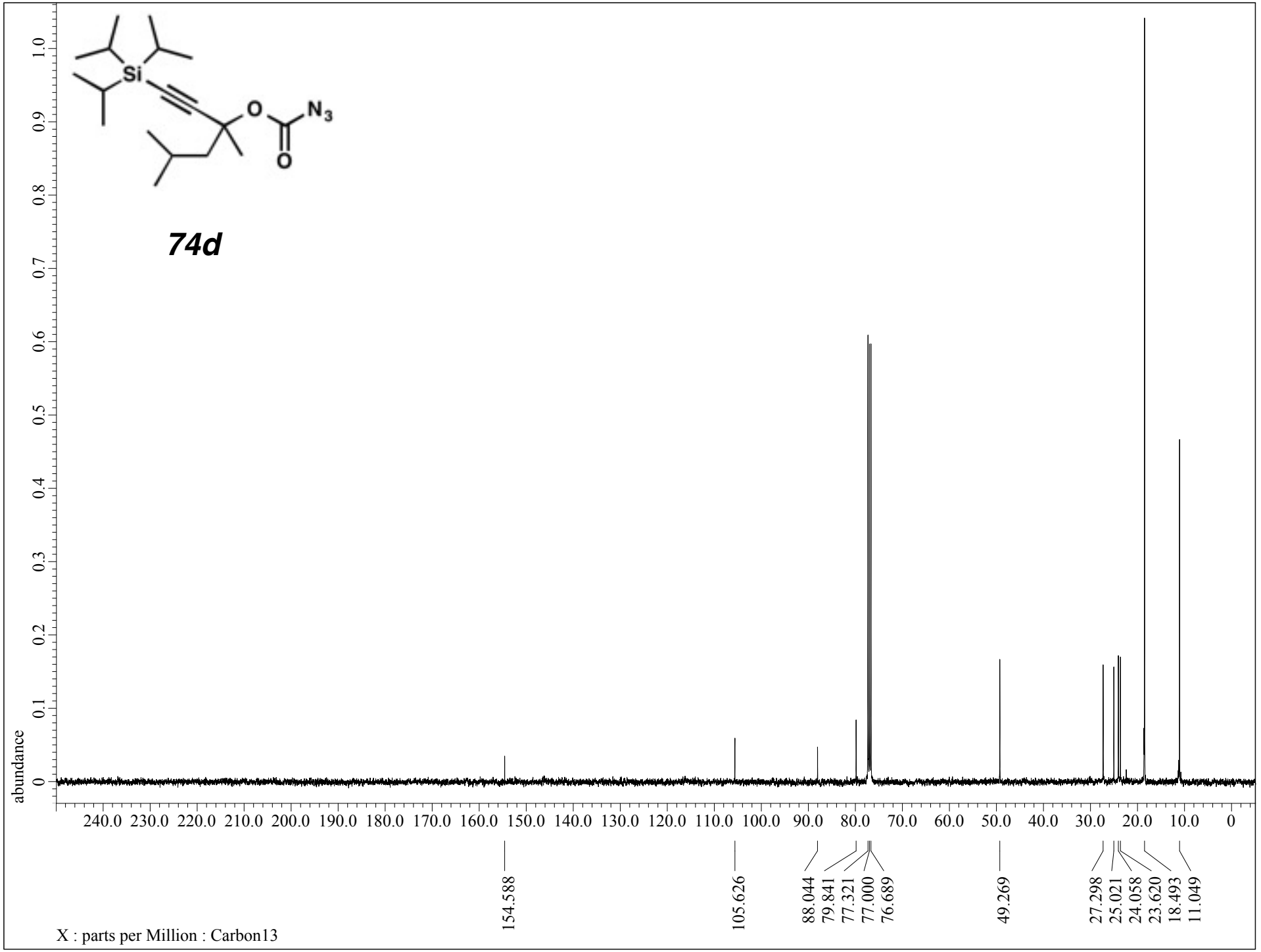

74b
abundance
X : parts per Million : Proton
7.240
1.912
1.787
1.774
1.696
1.539
1.529
1.510
1.501
1.483
1.067
1.061
1.054
1.041
0.951
0.932
0.913

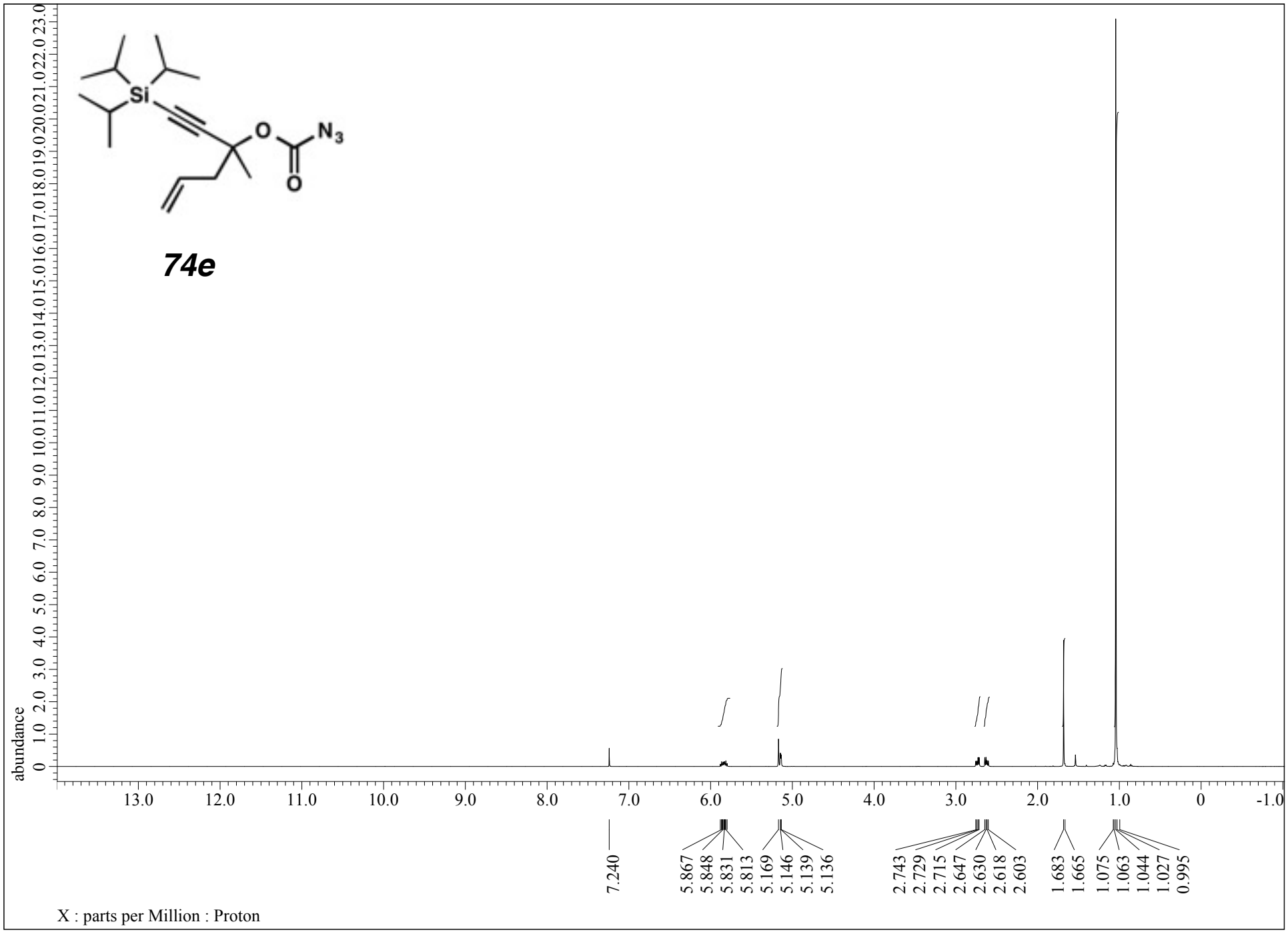

74b
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.734
105.577
87.645
79.695
77.321
77.000
76.689
43.441
26.452
18.502
17.636
13.997
11.020
X : parts per Million : Carbon13

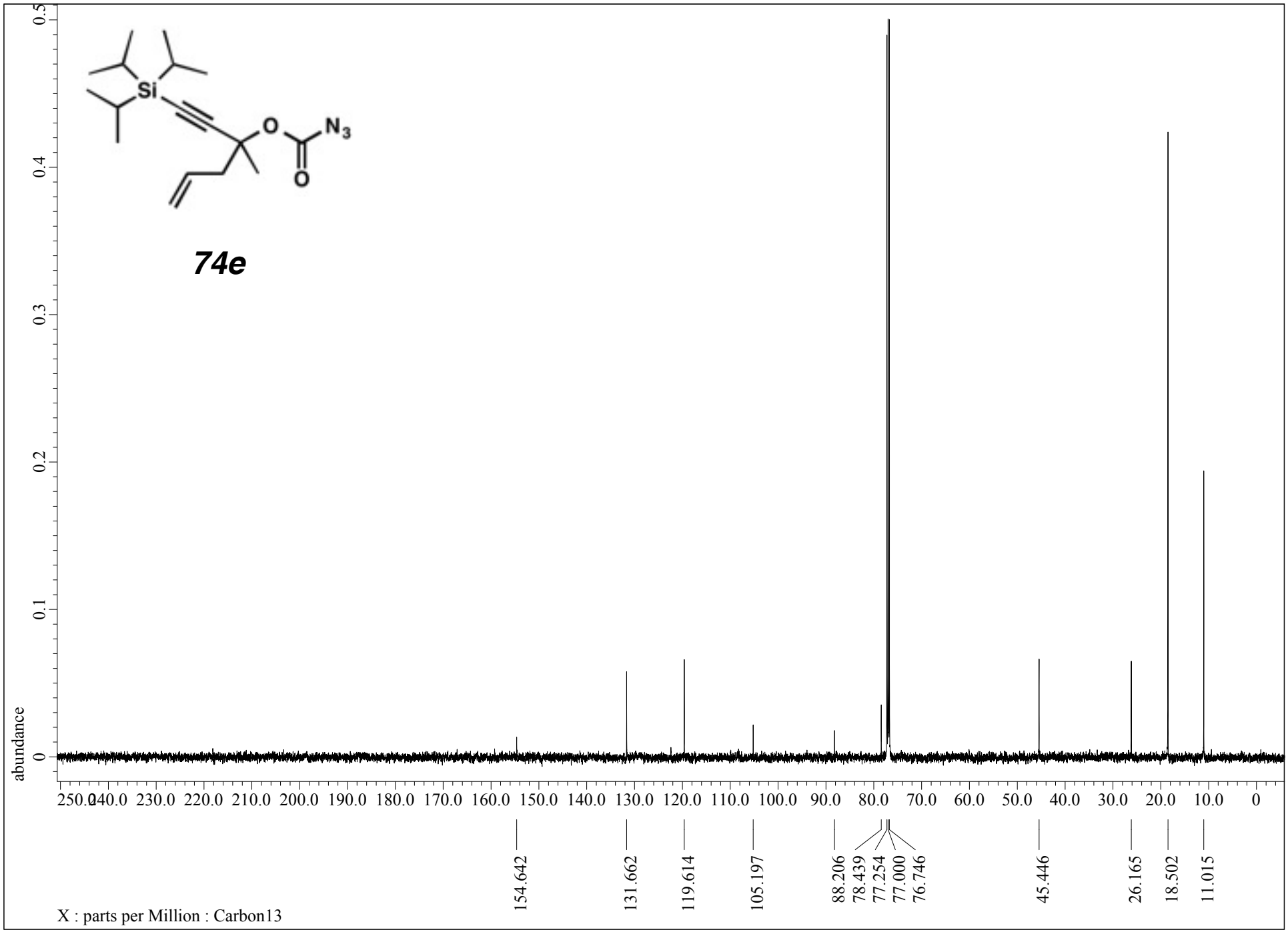

Si
O
O
N3
74c
30.0
20.0
10.0
0
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
1.799
1.697
1.532
1.475
1.463
1.351
1.337
1.323
1.319
1.308
1.064
1.057
1.048
1.045
0.908
0.893
0.878
X : parts per Million : Proton

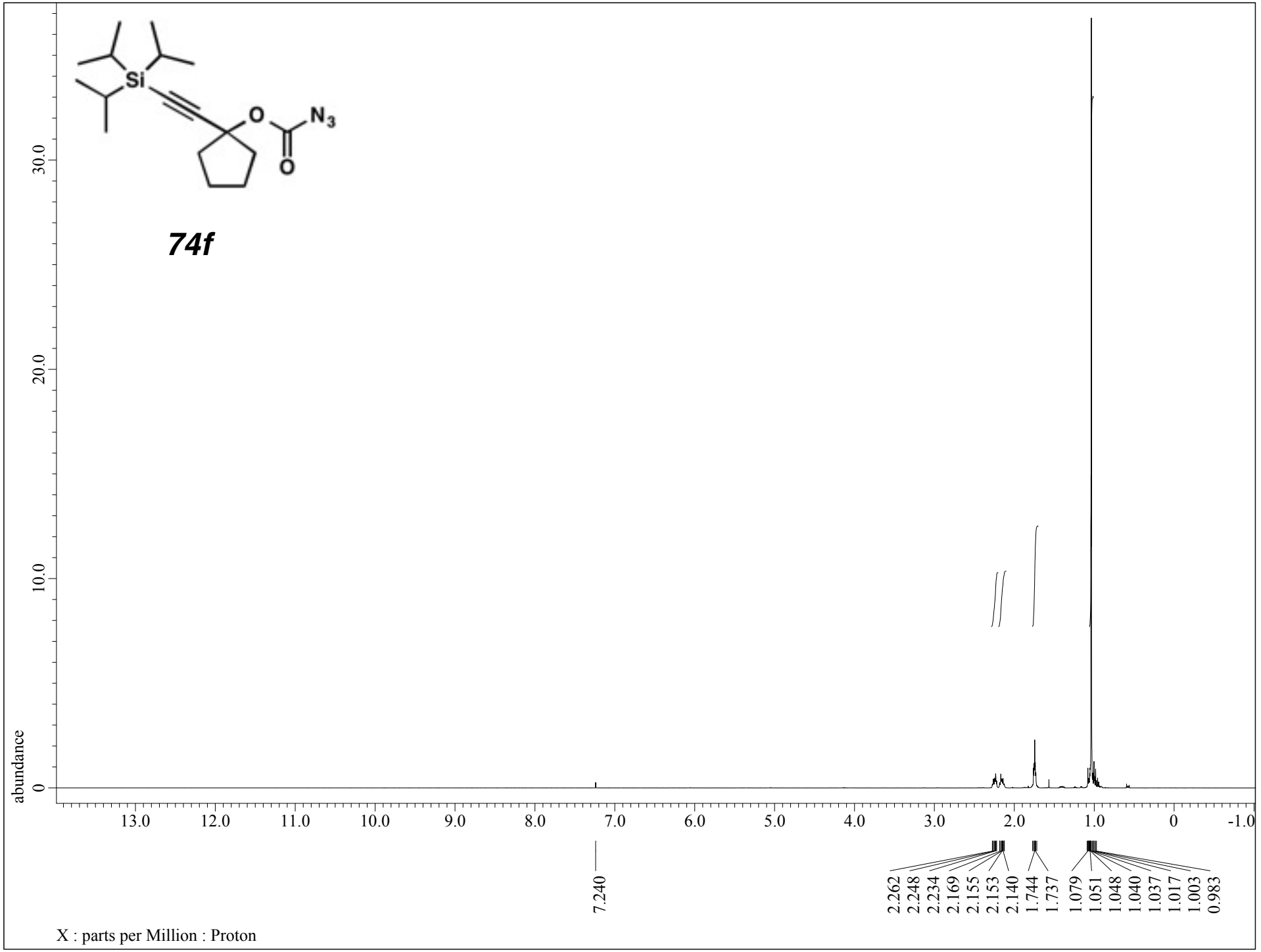

Si
O
N3
O
74c
abundance
0
0.1
0.2
0.3
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.747
105.620
87.665
79.828
77.254
77.000
76.746
41.042
26.434
22.549
18.508
13.959
11.043
X : parts per Million : Carbon13

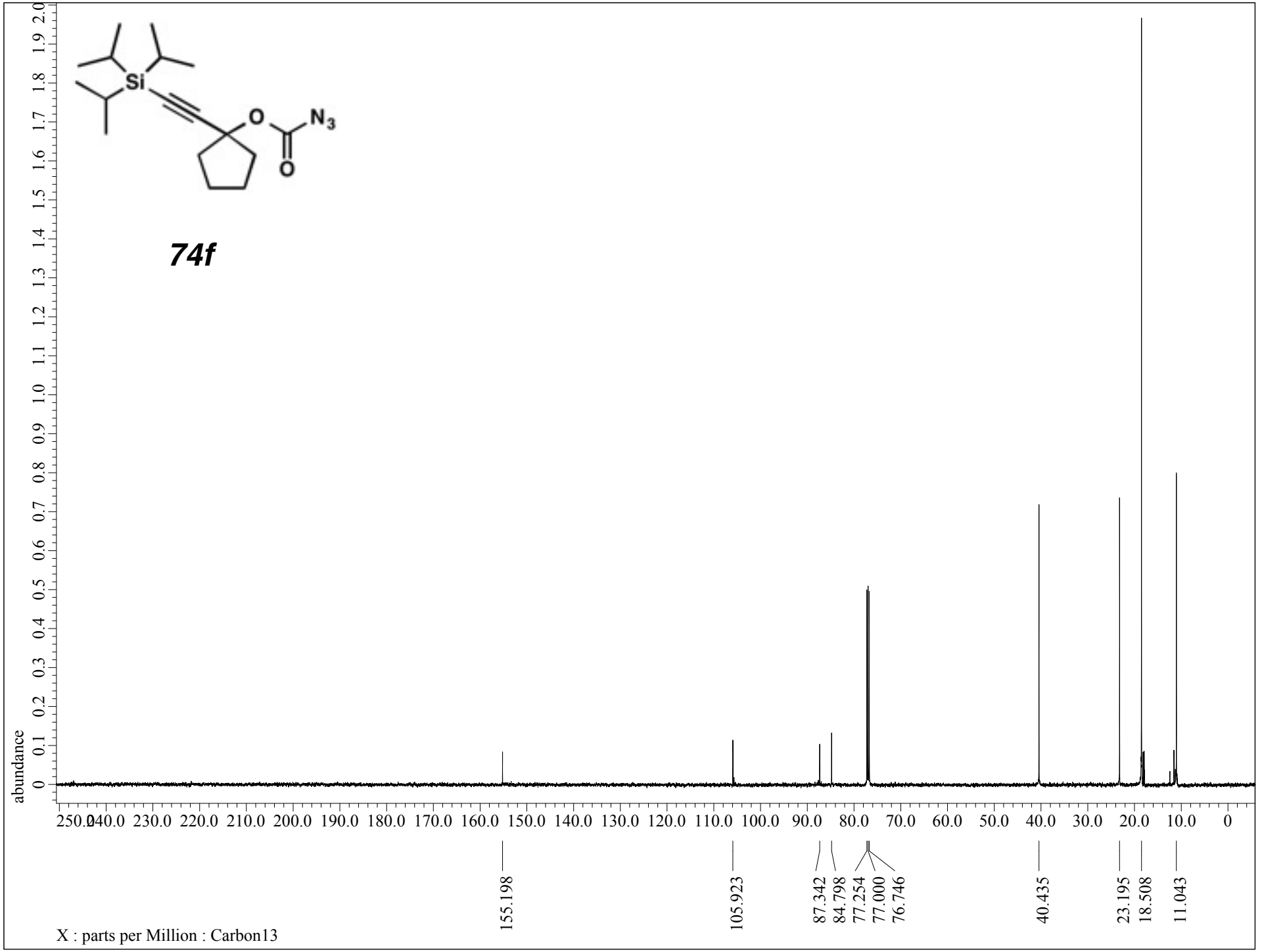

Si
O
O
N3
74d
abundance
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0
13.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0 -1.0
7.240
1.916 1.899 1.880 1.863 1.740 1.724 1.705 1.702 1.691 1.059 1.055 1.043 0.988 0.975 0.972 0.966 0.958
X : parts per Million : Proton

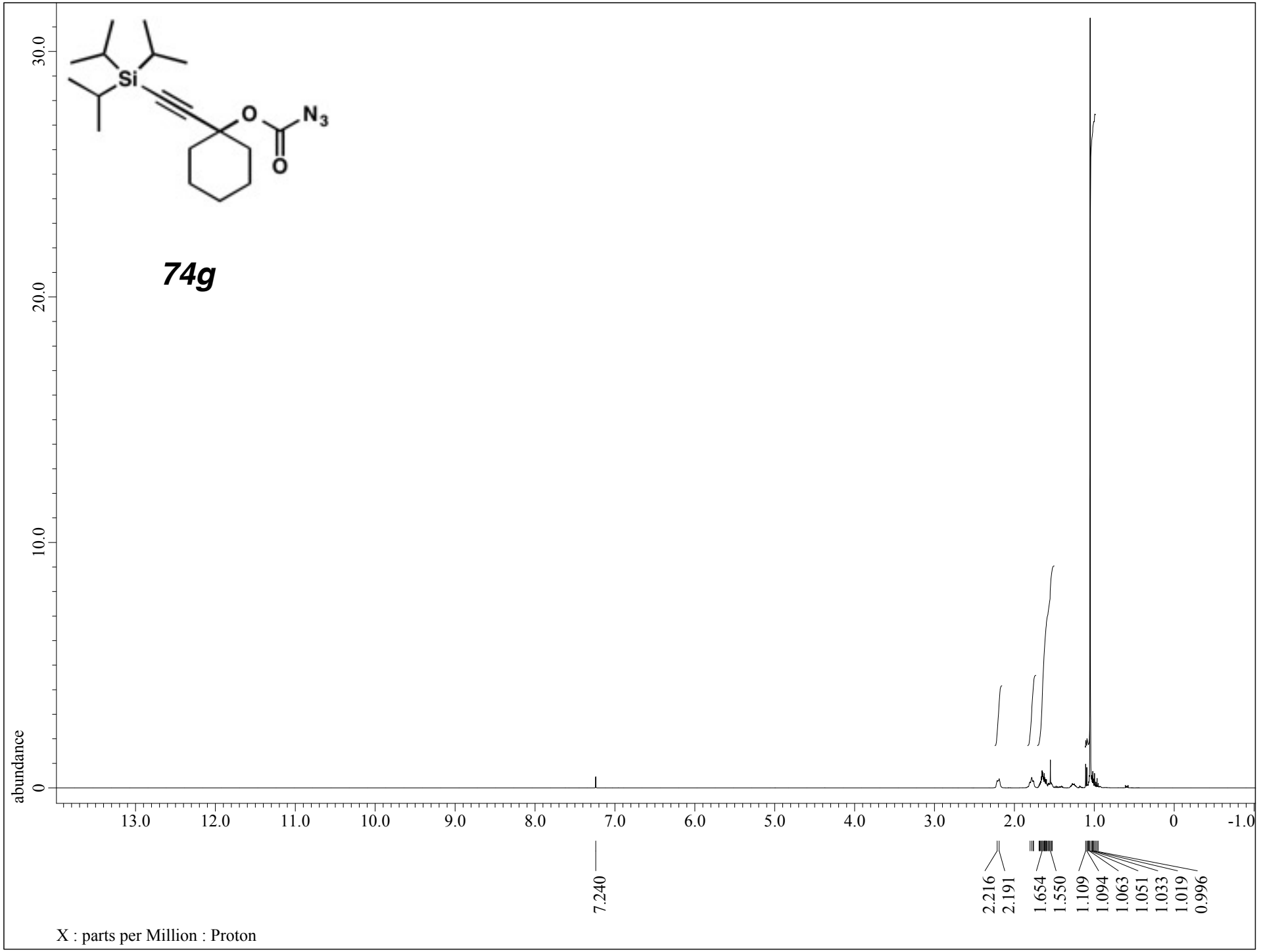

74d
abundance
X : parts per Million : Carbon13
154.588
105.626
88.044
79.841
77.321
77.000
76.689
49.269
27.298
25.021
24.058
23.620
18.493
11.049

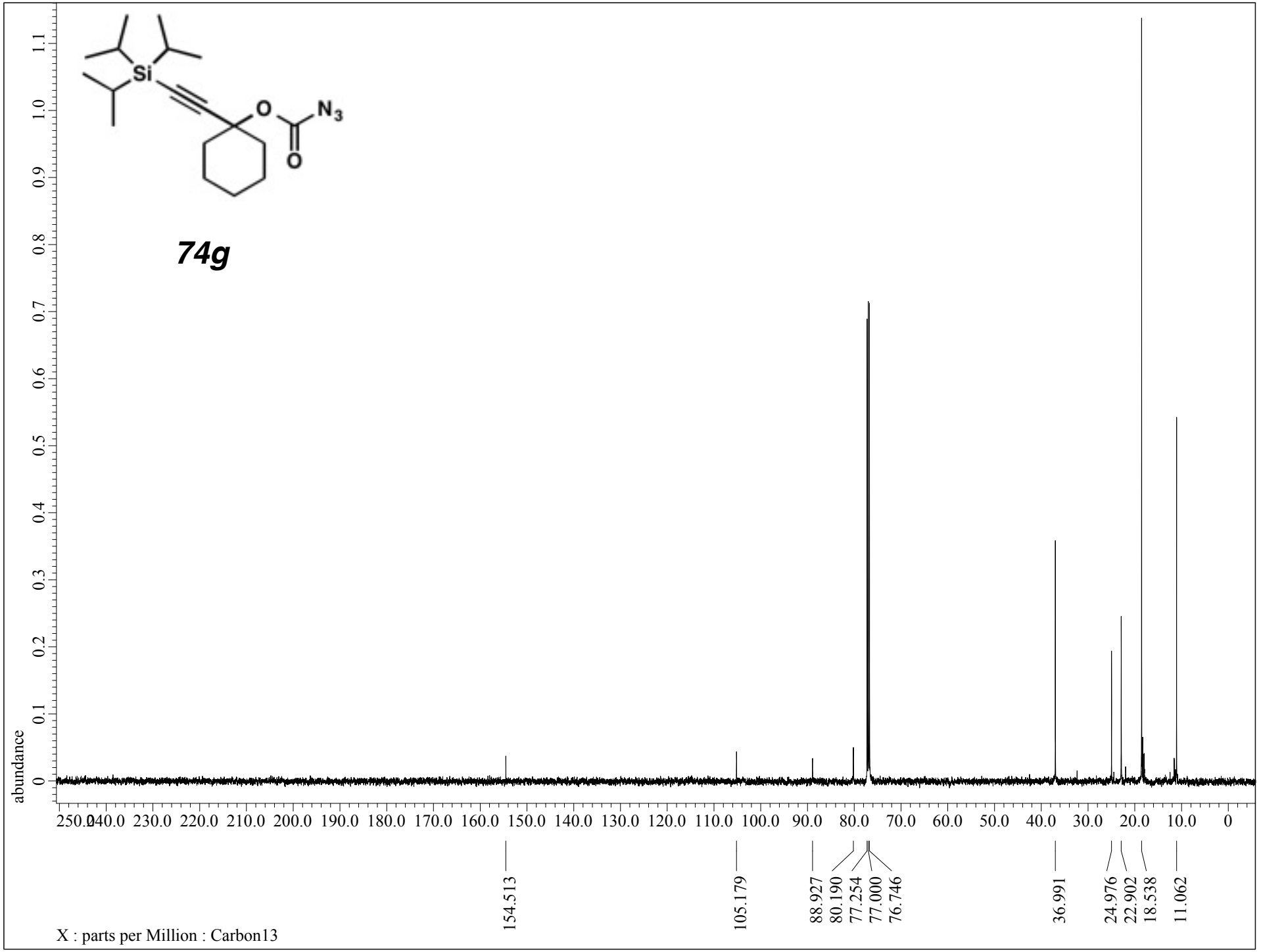

Si
O
O
N3
74e
abundance
X : parts per Million : Proton
7.240
5.867
5.848
5.831
5.813
5.169
5.146
5.139
5.136
2.743
2.729
2.715
2.647
2.630
2.618
2.603
1.683
1.665
1.075
1.063
1.044
1.027
0.995

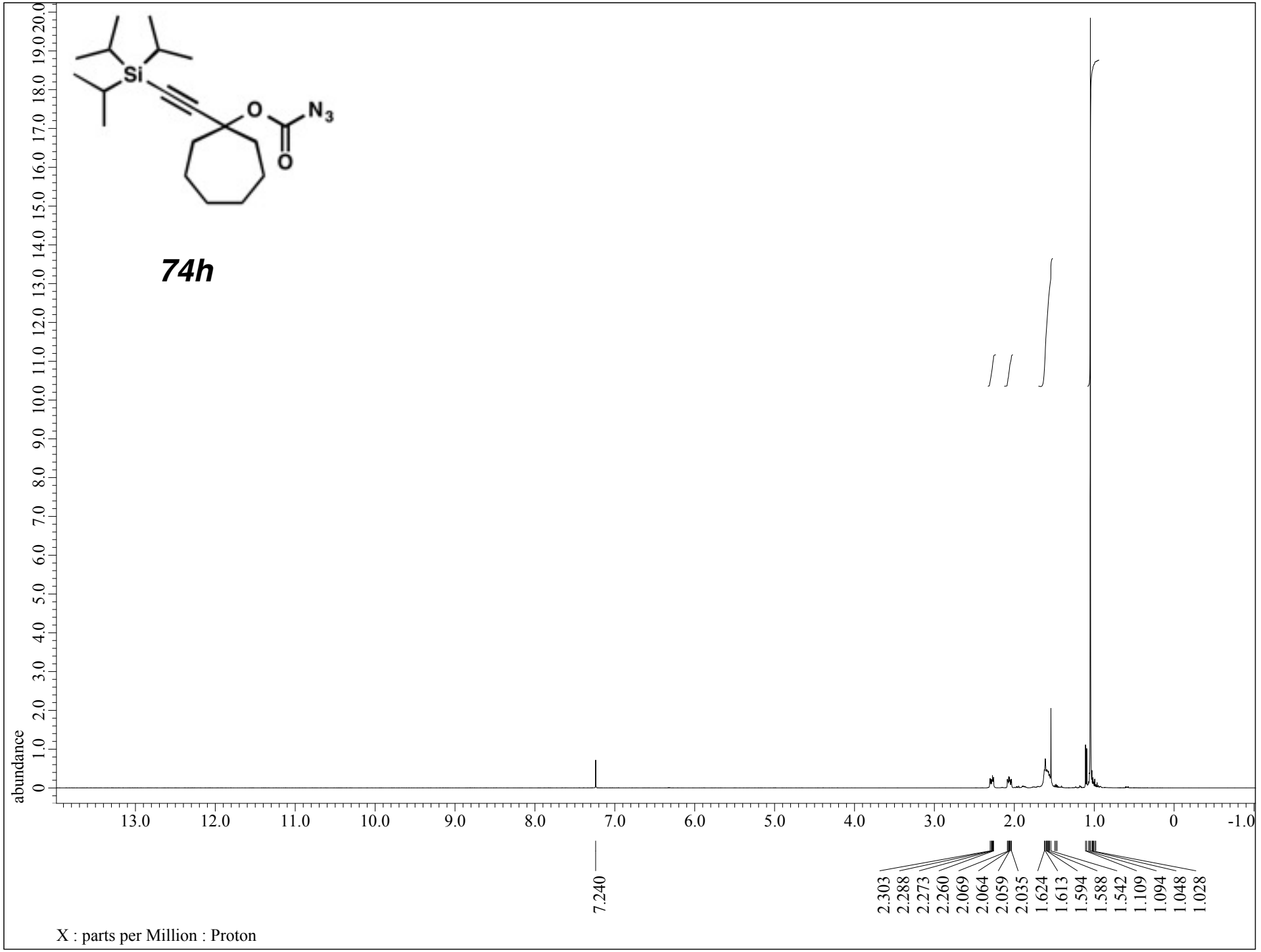

74e
abundance
0.5
0.4
0.3
0.2
0.1
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.642
131.662
119.614
105.197
88.206
78.439
77.254
77.000
76.746
45.446
26.165
18.502
11.015
X : parts per Million : Carbon13

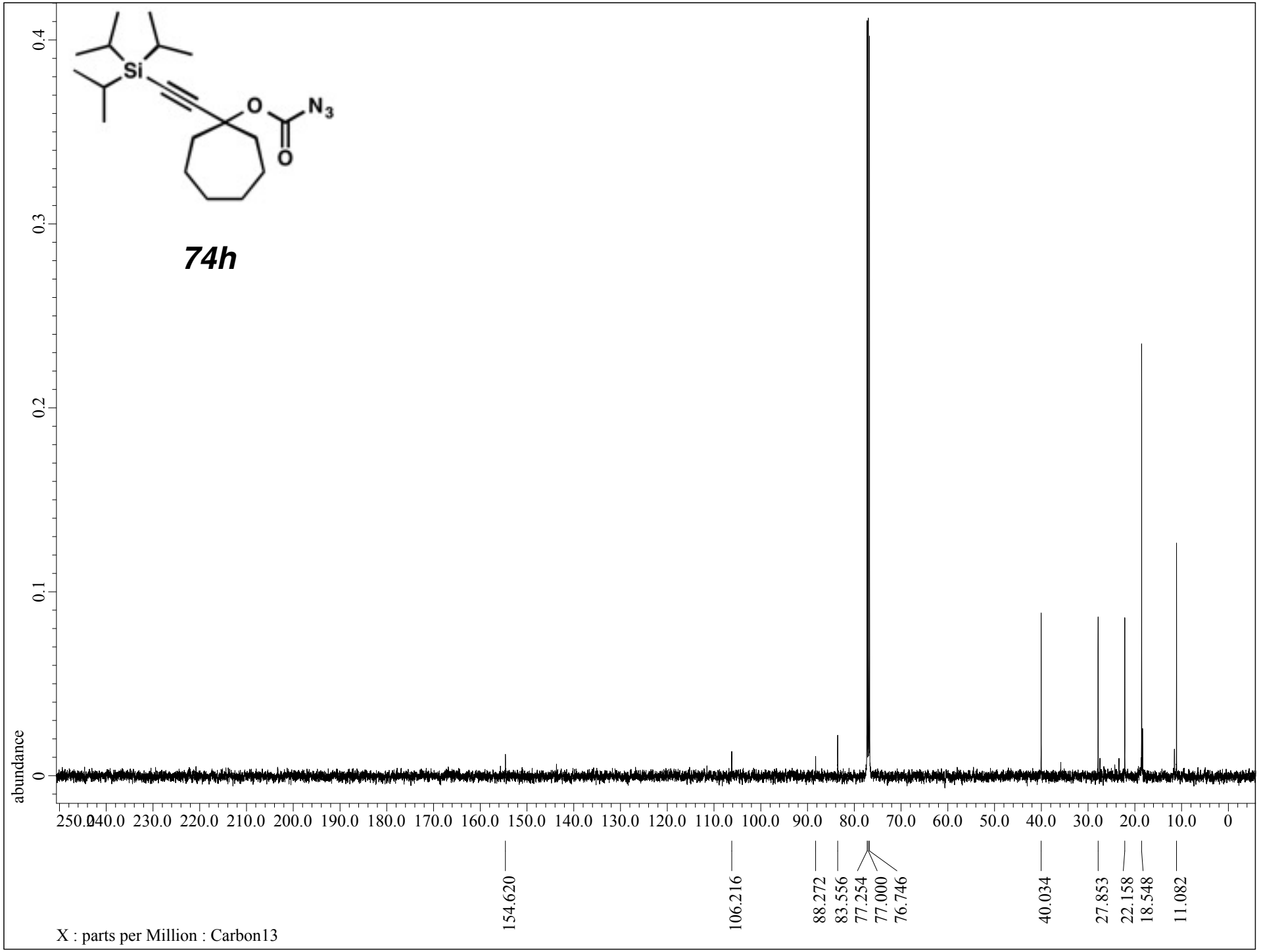

Si
O
N3
O
74f
30.0
20.0
10.0
0
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
2.262
2.248
2.234
2.169
2.155
2.153
2.140
1.744
1.737
1.079
1.051
1.048
1.040
1.037
1.017
1.003
0.983
X : parts per Million : Proton

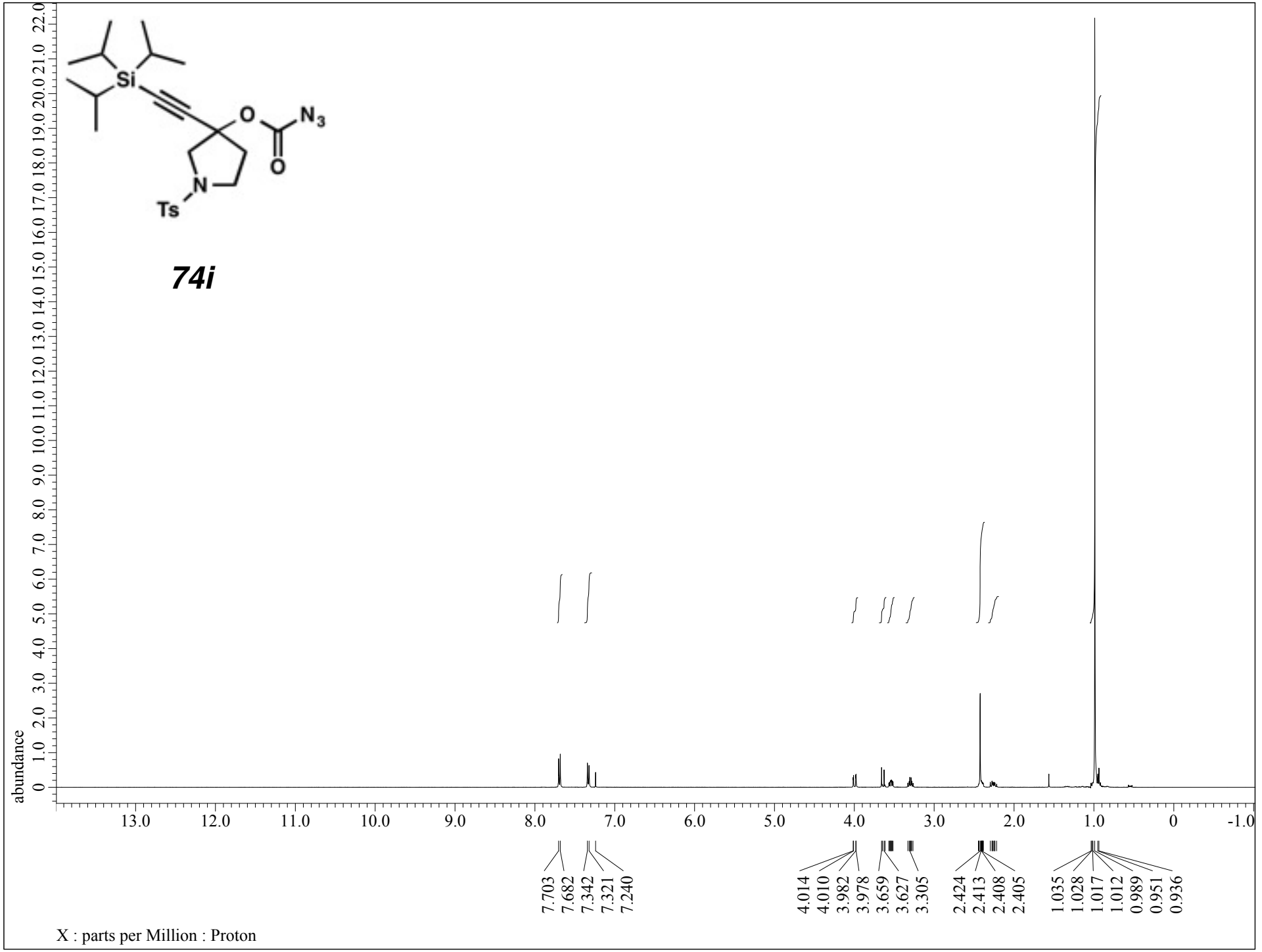

74f
abundance
X : parts per Million : Carbon13
155.198
105.923
87.342
84.798
77.254
77.000
76.746
40.435
23.195
18.508
11.043

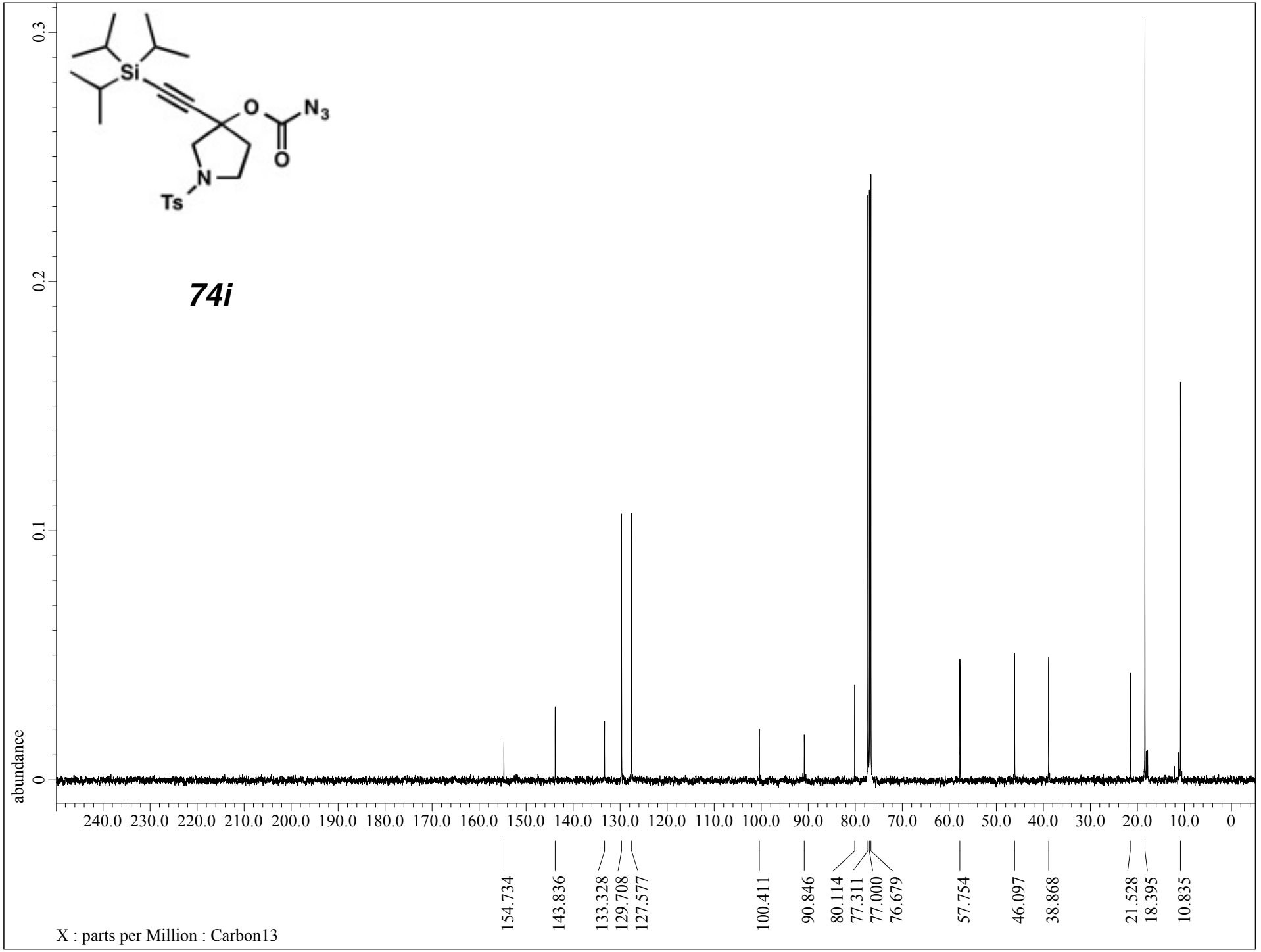

74g
abundance
30.0
20.0
10.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
2.216
2.191
1.654
1.550
1.109
1.094
1.063
1.051
1.033
1.019
0.996
X : parts per Million : Proton

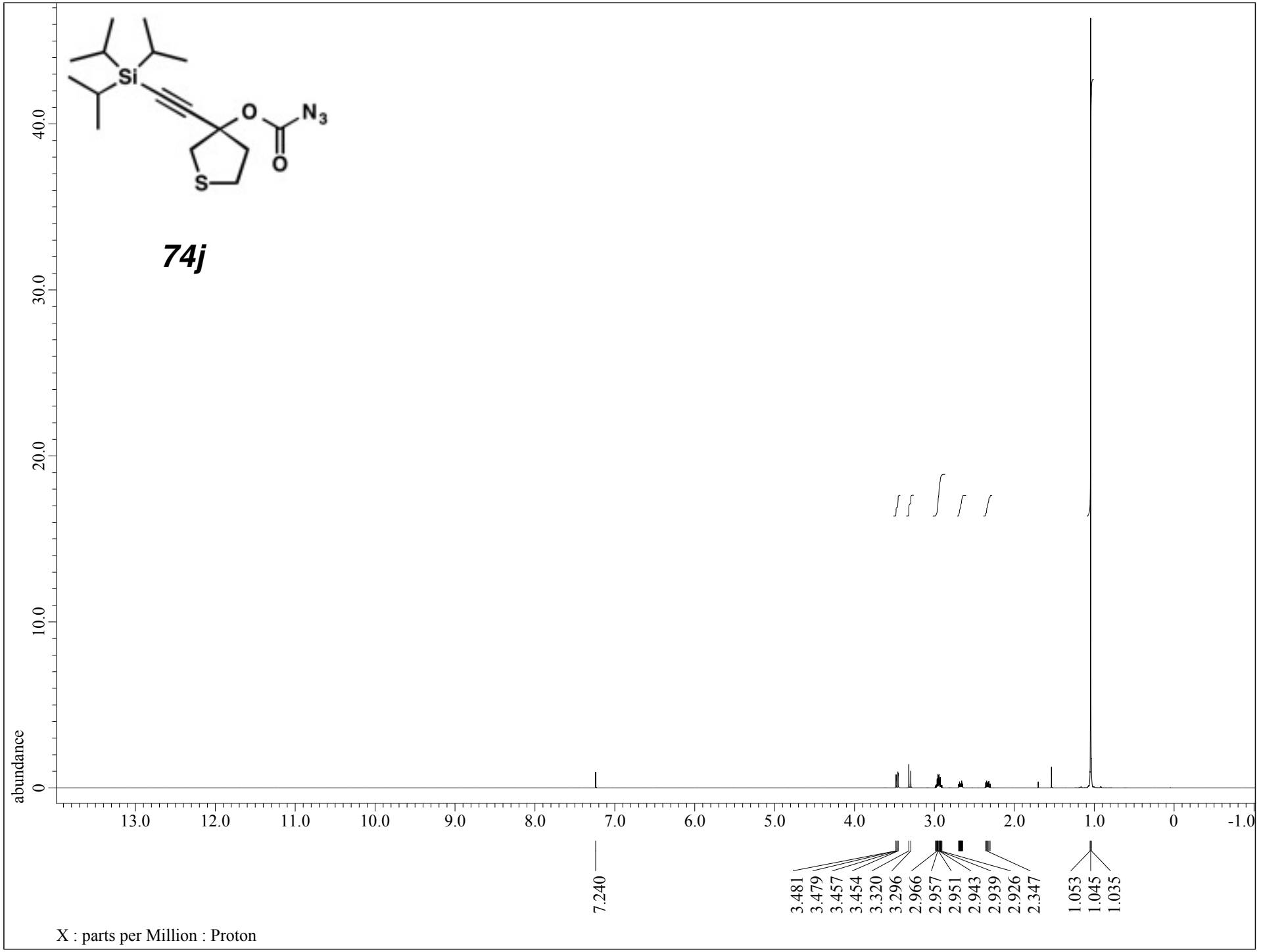

74g
abundance
X : parts per Million : Carbon13
154.513
105.179
88.927
80.190
77.254
77.000
76.746
36.991
24.976
22.902
18.538
11.062

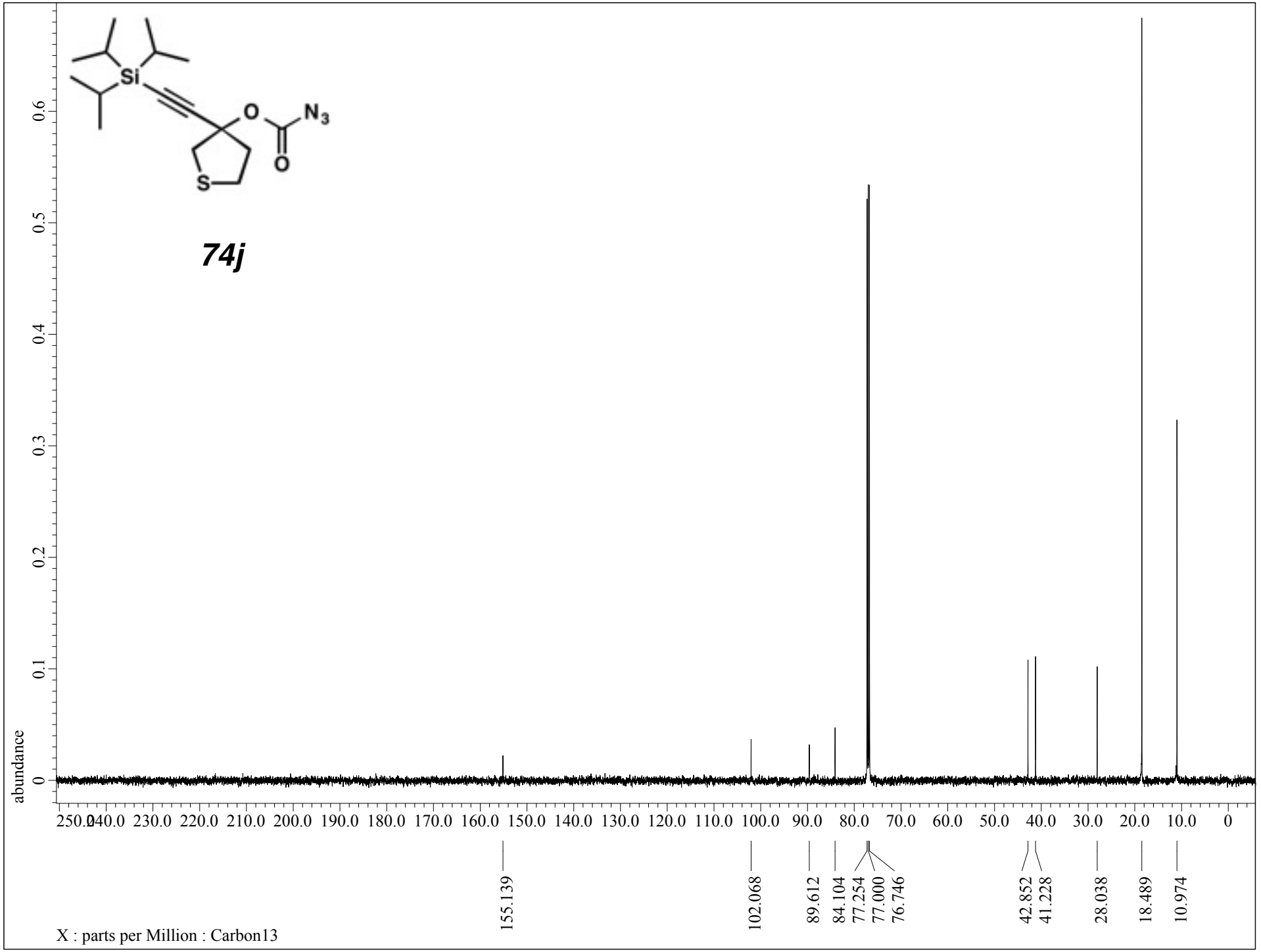

Si
O
O
N3
74h
abundance
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0
13.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0 -1.0
7.240
2.303 2.288 2.273 2.260 2.069 2.064 2.059 2.035 1.624 1.613 1.594 1.588 1.542 1.109 1.094 1.048 1.028
X : parts per Million : Proton

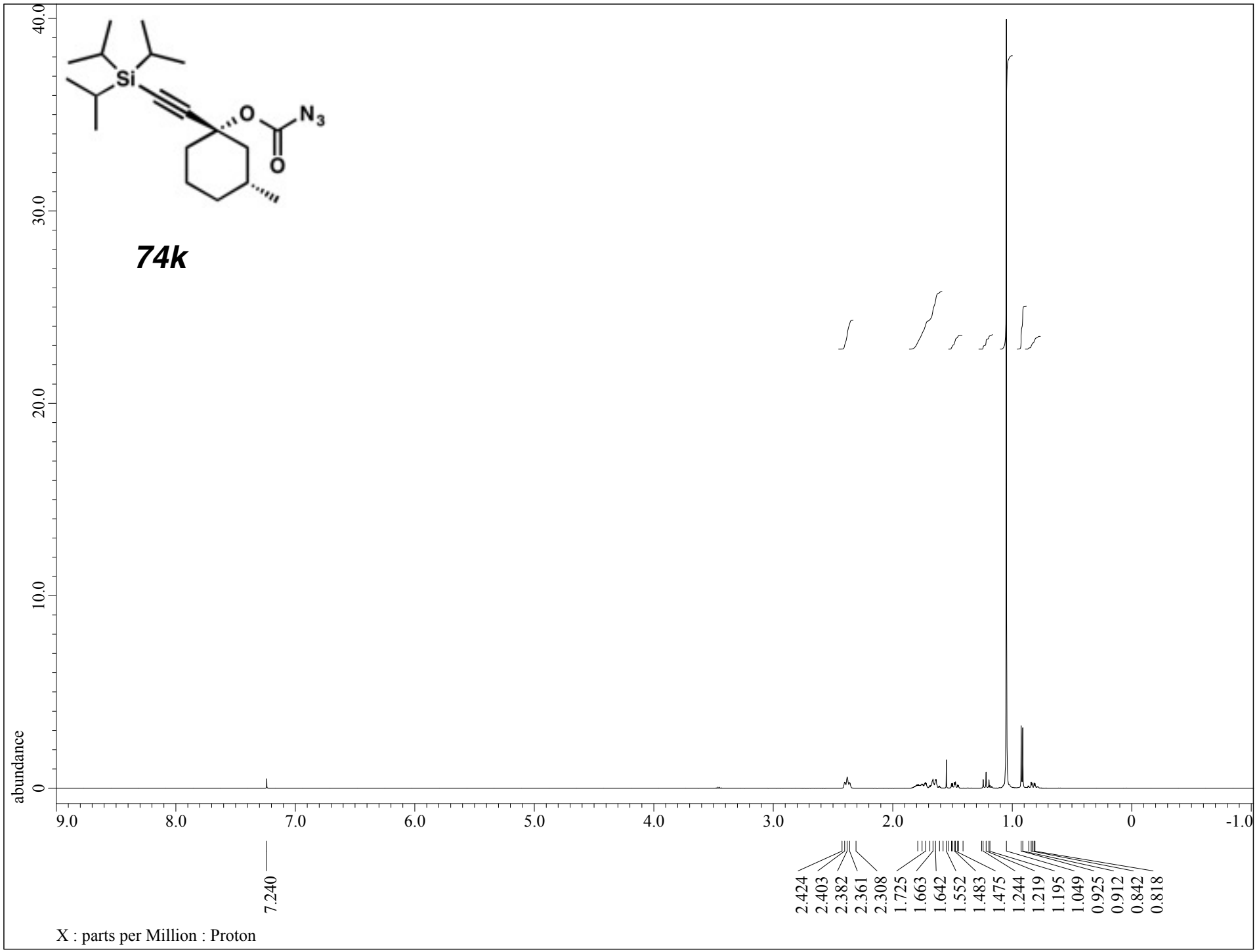

Si
O
O
N3
74h
abundance
0
0.1
0.2
0.3
0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.620
106.216
88.272
83.556
77.254
77.000
76.746
40.034
27.853
22.158
18.548
11.082
X : parts per Million : Carbon13

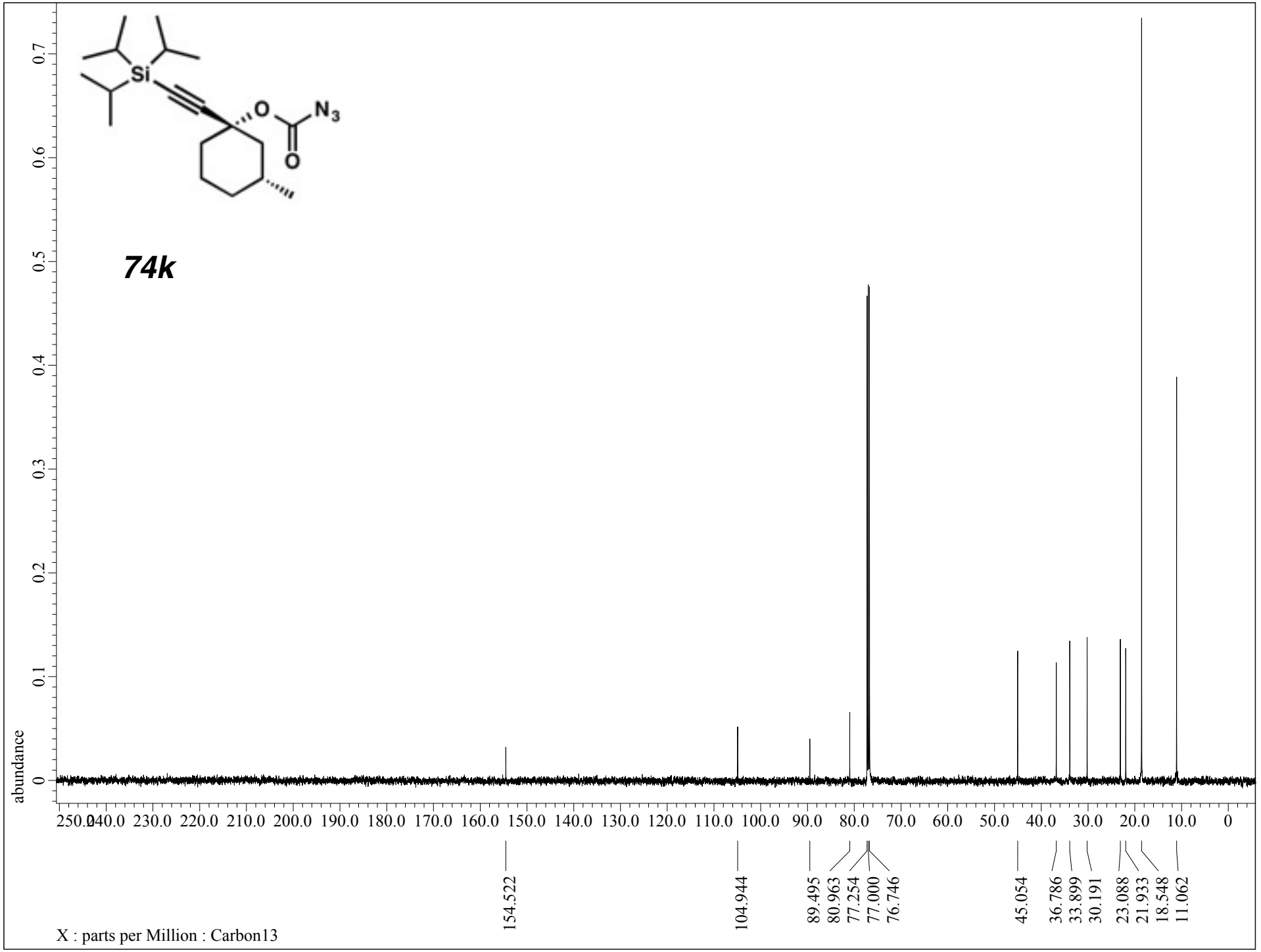

Si
O
N3
O
N
Ts
74i
abundance
X : parts per Million : Proton
7.703
7.682
7.342
7.321
7.240
4.014
4.010
3.982
3.978
3.659
3.627
3.305
2.424
2.413
2.408
2.405
1.035
1.028
1.017
1.012
0.989
0.951
0.936

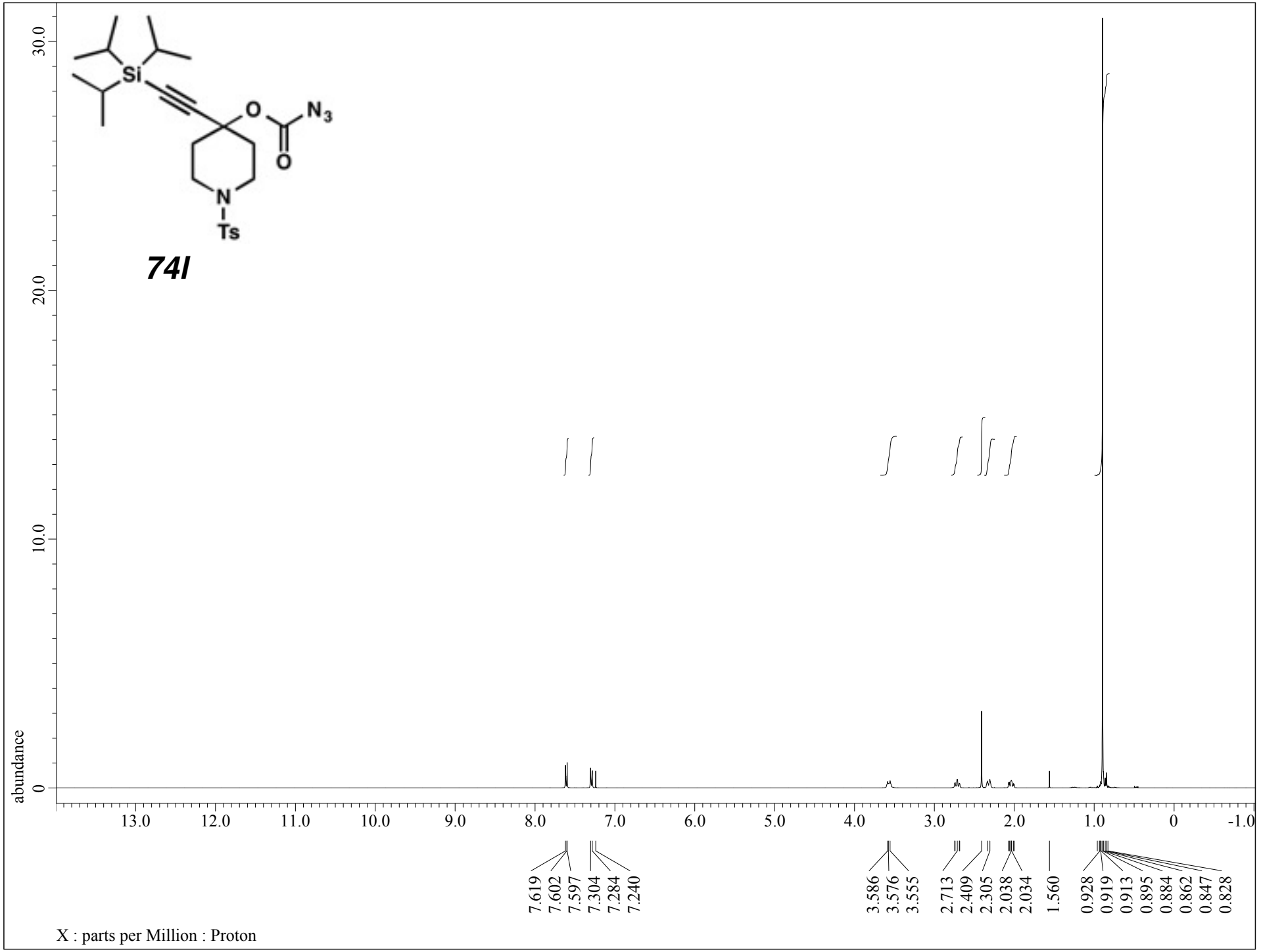

74i
Si
O
N3
O
N
Ts
abundance
0.3
0.2
0.1
0
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.734
143.836
133.328
129.708
127.577
100.411
90.846
80.114
77.311
77.000
76.679
57.754
46.097
38.868
21.528
18.395
10.835
X : parts per Million : Carbon13

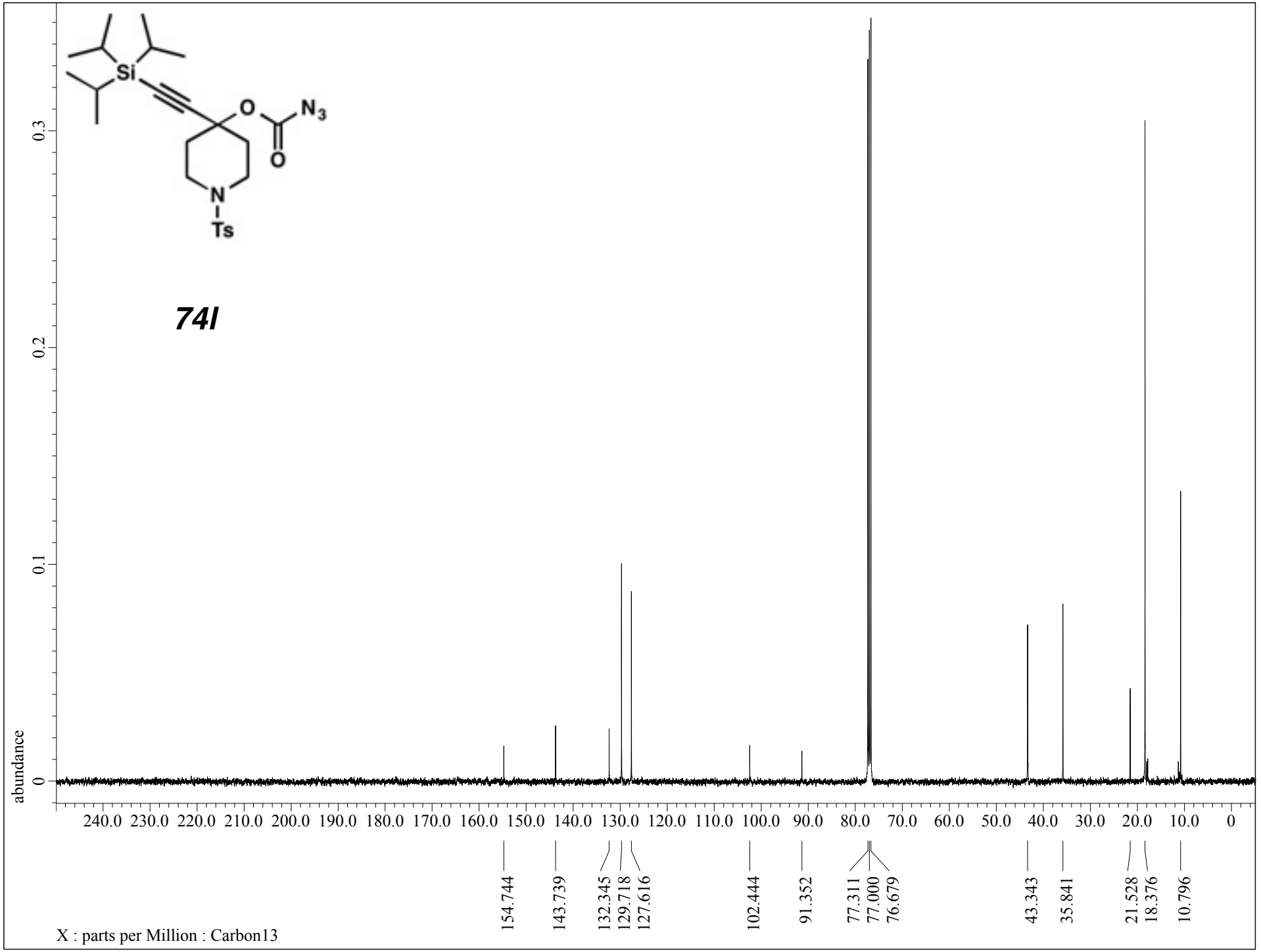

Si
O
N3
O
S
74j
40.0
30.0
20.0
10.0
0
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
3.481
3.479
3.457
3.454
3.320
3.296
2.966
2.957
2.951
2.943
2.939
2.926
2.347
1.053
1.045
1.035
X : parts per Million : Proton

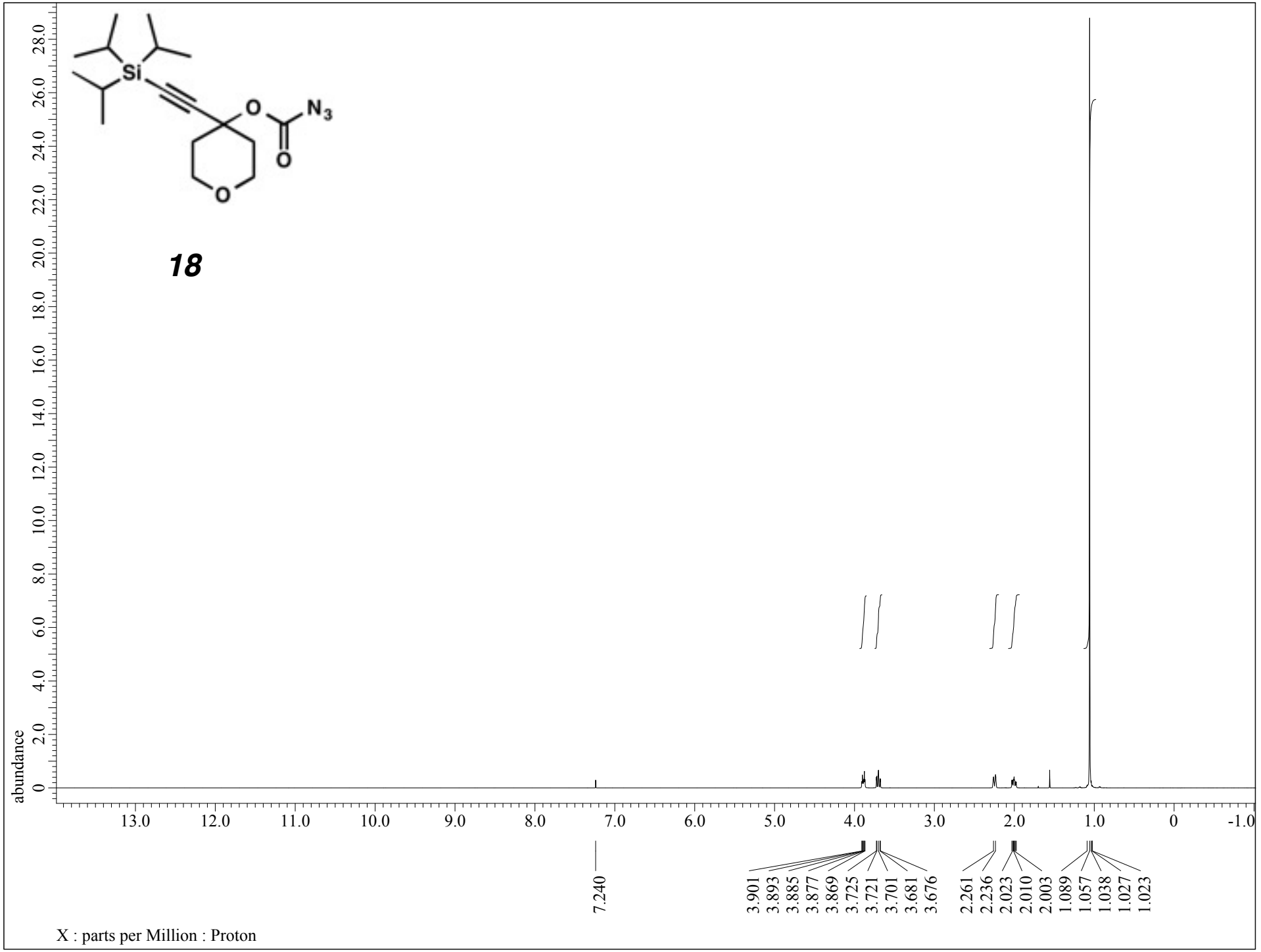

74j
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
155.139
102.068
89.612
84.104
77.254
77.000
76.746
42.852
41.228
28.038
18.489
10.974
X : parts per Million : Carbon13

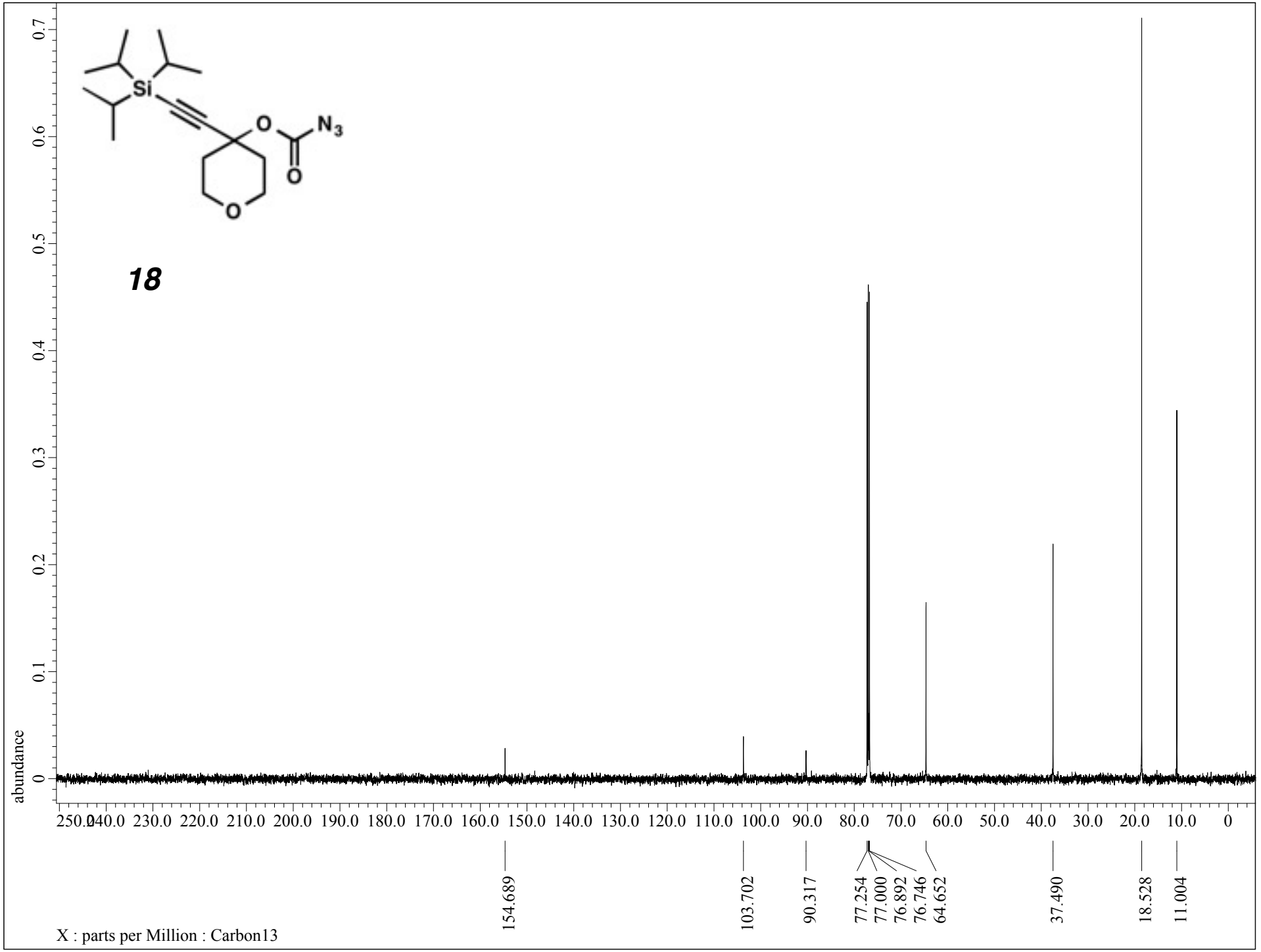

74k
abundance
X : parts per Million : Proton
7.240
2.424
2.403
2.382
2.361
2.308
1.725
1.663
1.642
1.552
1.483
1.475
1.244
1.219
1.195
1.049
0.925
0.912
0.842
0.818

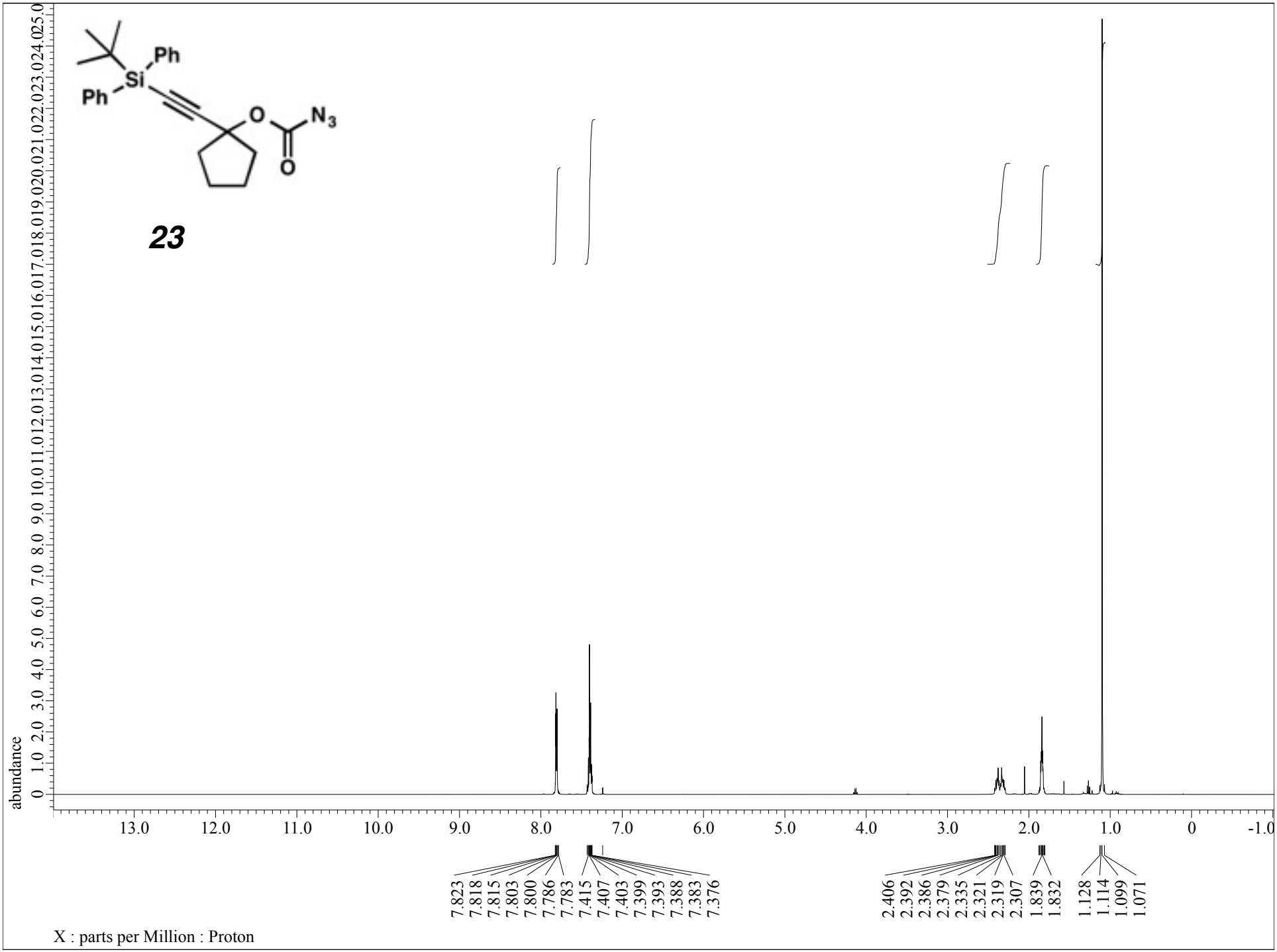

74k
abundance
X : parts per Million : Carbon13
154.522
104.944
89.495
80.963
77.254
77.000
76.746
45.054
36.786
33.899
30.191
23.088
21.933
18.548
11.062

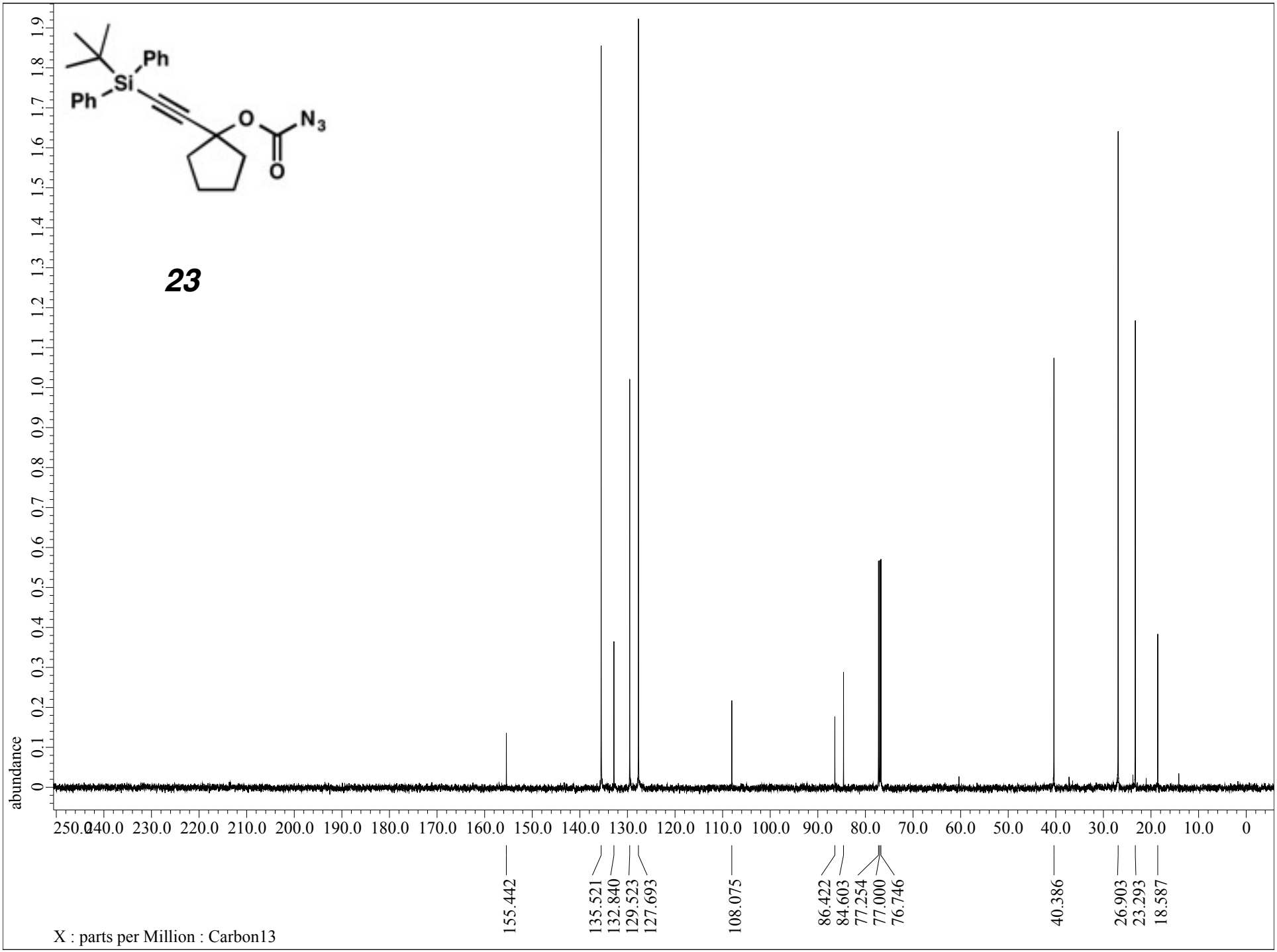

Si
O
N3
O
N
Ts
74l
30.0
20.0
10.0
0
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.619
7.602
7.597
7.304
7.284
7.240
3.586
3.576
3.555
2.713
2.409
2.305
2.038
2.034
1.560
0.928
0.919
0.913
0.895
0.884
0.862
0.847
0.828
X : parts per Million : Proton

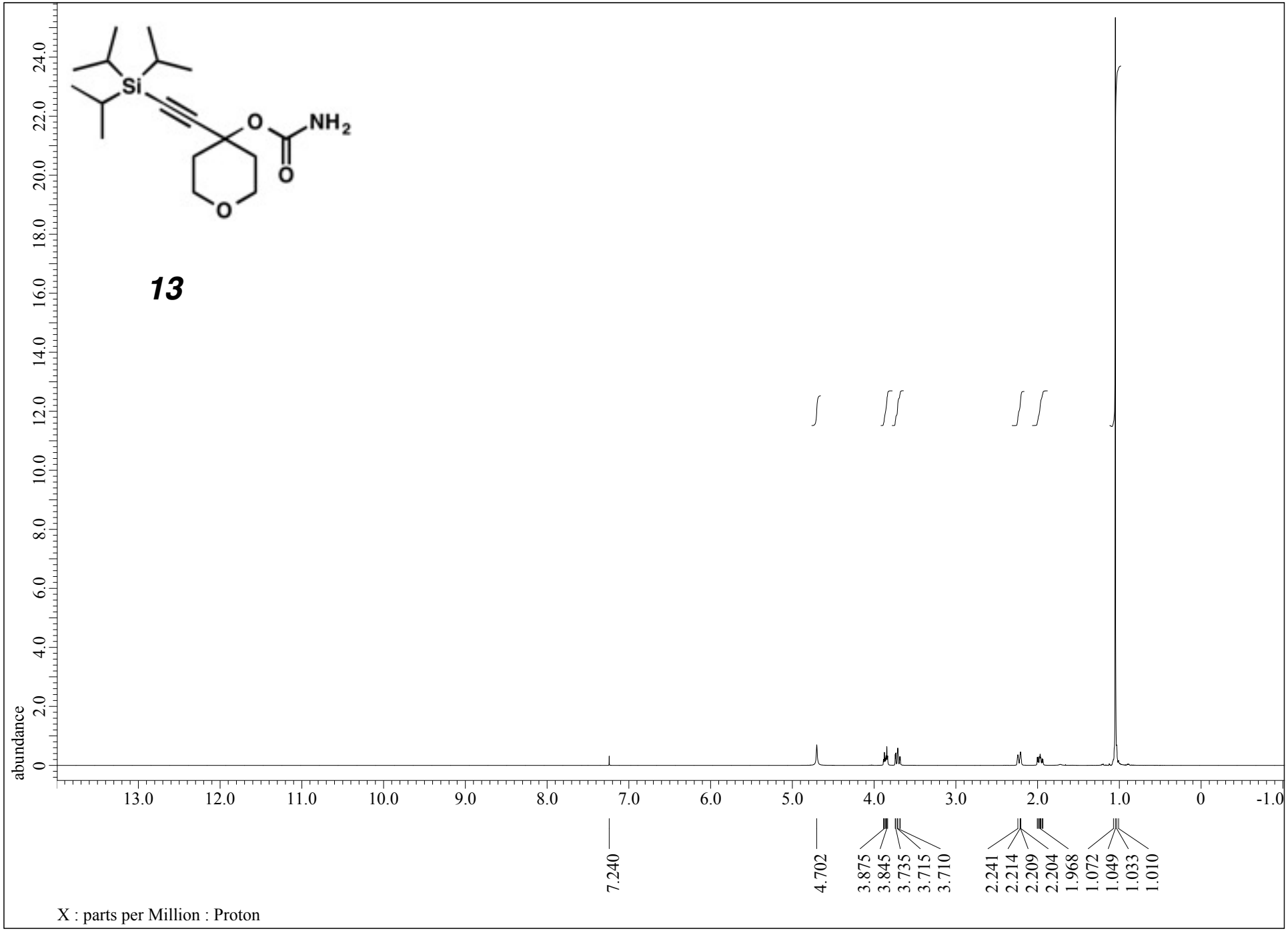

Si
O
N3
O
N
Ts
74l
abundance
0
0.1
0.2
0.3
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.744
143.739
132.345
129.718
127.616
102.444
91.352
77.311
77.000
76.679
43.343
35.841
21.528
18.376
10.796
X : parts per Million : Carbon13

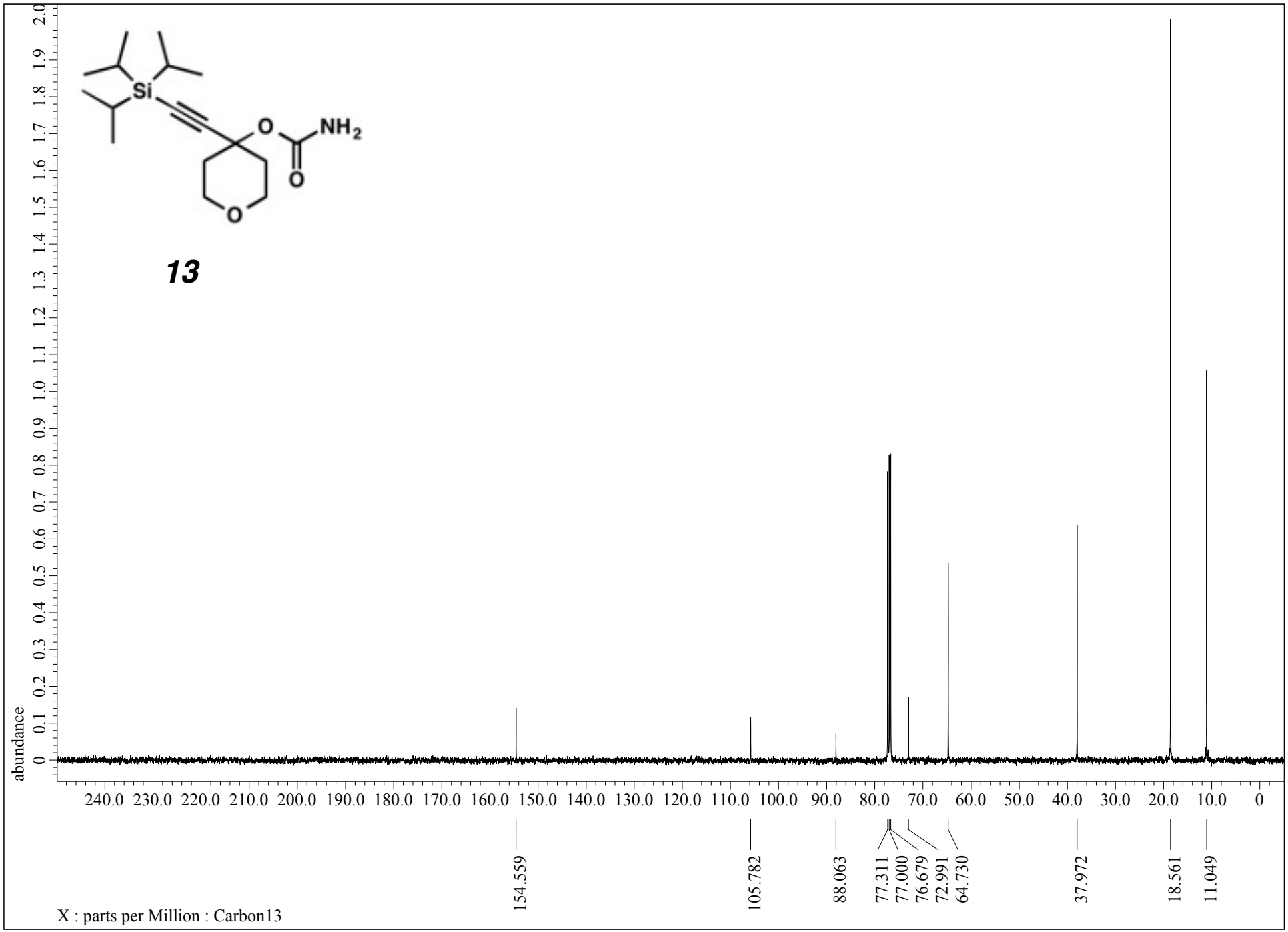

Si
O
O
N3
O
18
abundance
X : parts per Million : Proton
7.240
3.901
3.893
3.885
3.877
3.869
3.725
3.721
3.701
3.681
3.676
2.261
2.236
2.023
2.010
2.003
1.089
1.057
1.038
1.027
1.023

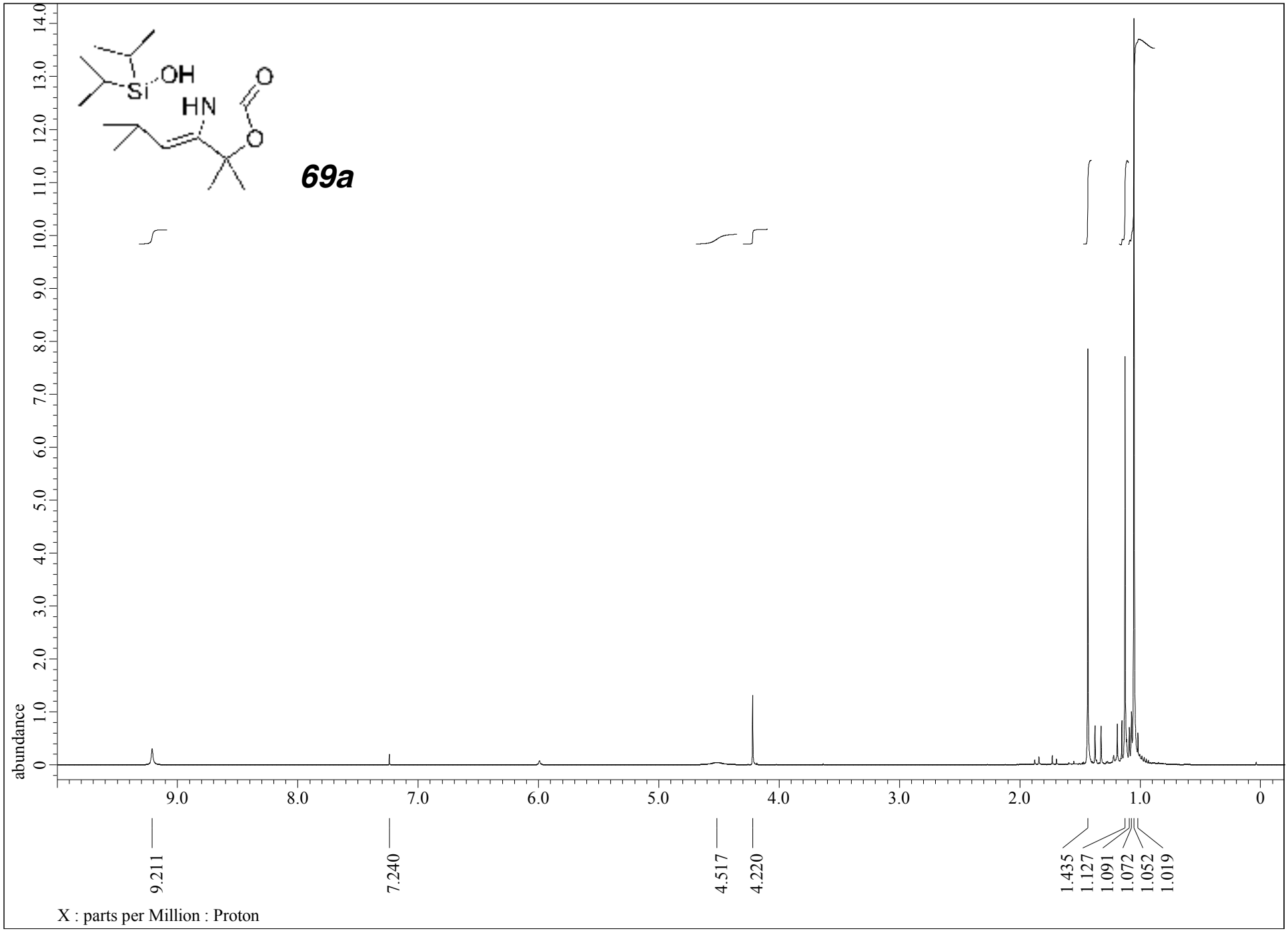

18
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.689
103.702
90.317
77.254
77.000
76.892
76.746
64.652
37.490
18.528
11.004
X : parts per Million : Carbon13

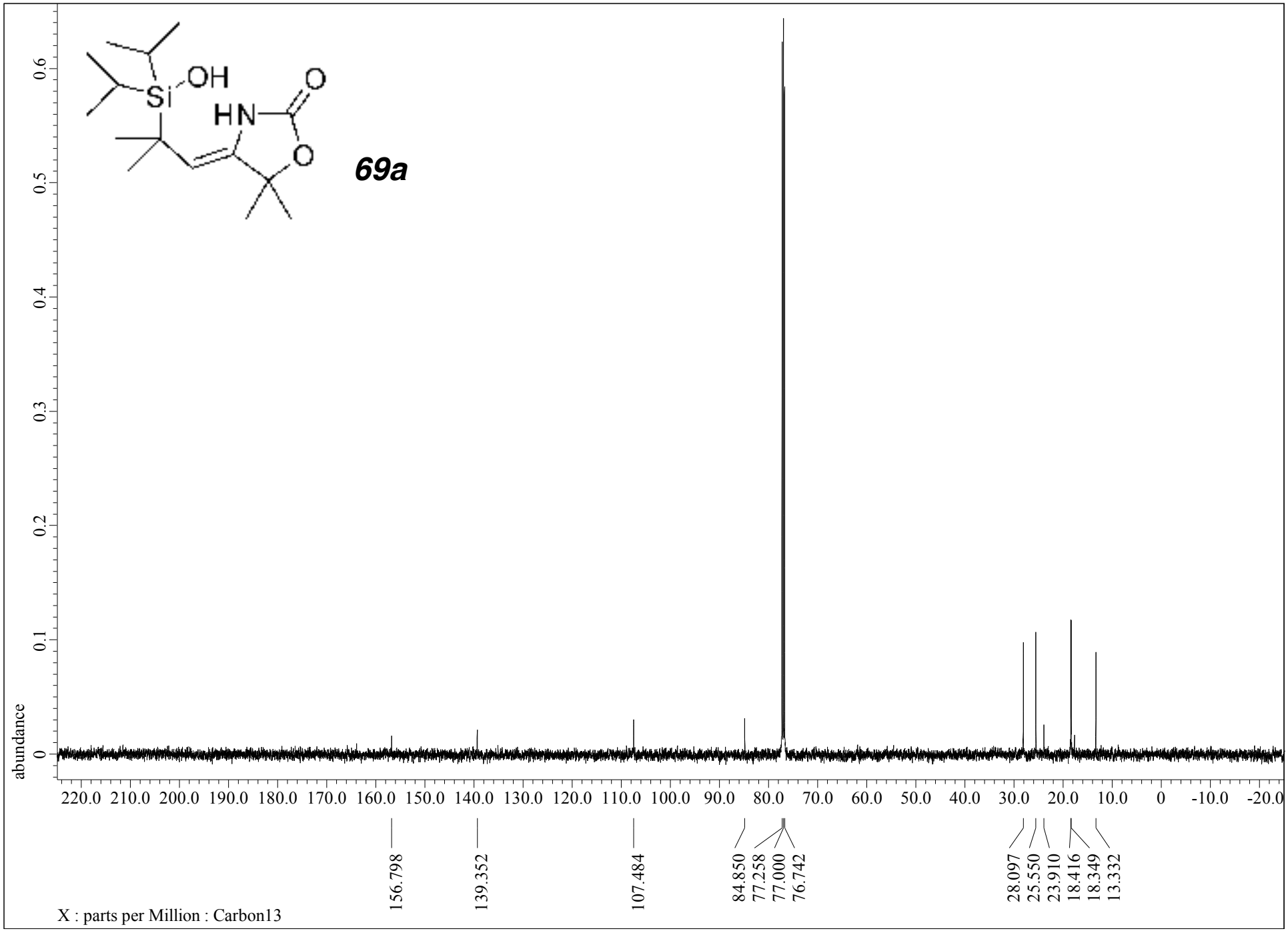

Ph
Si
Ph
O
N3
O
23
abundance
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0
13.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0 -1.0
7.823 7.818 7.815 7.803 7.800 7.786 7.783 7.415 7.407 7.403 7.399 7.393 7.388 7.383 7.376
2.406 2.392 2.386 2.379 2.335 2.321 2.319 2.307 1.839 1.832 1.128 1.114 1.099 1.071
X : parts per Million : Proton

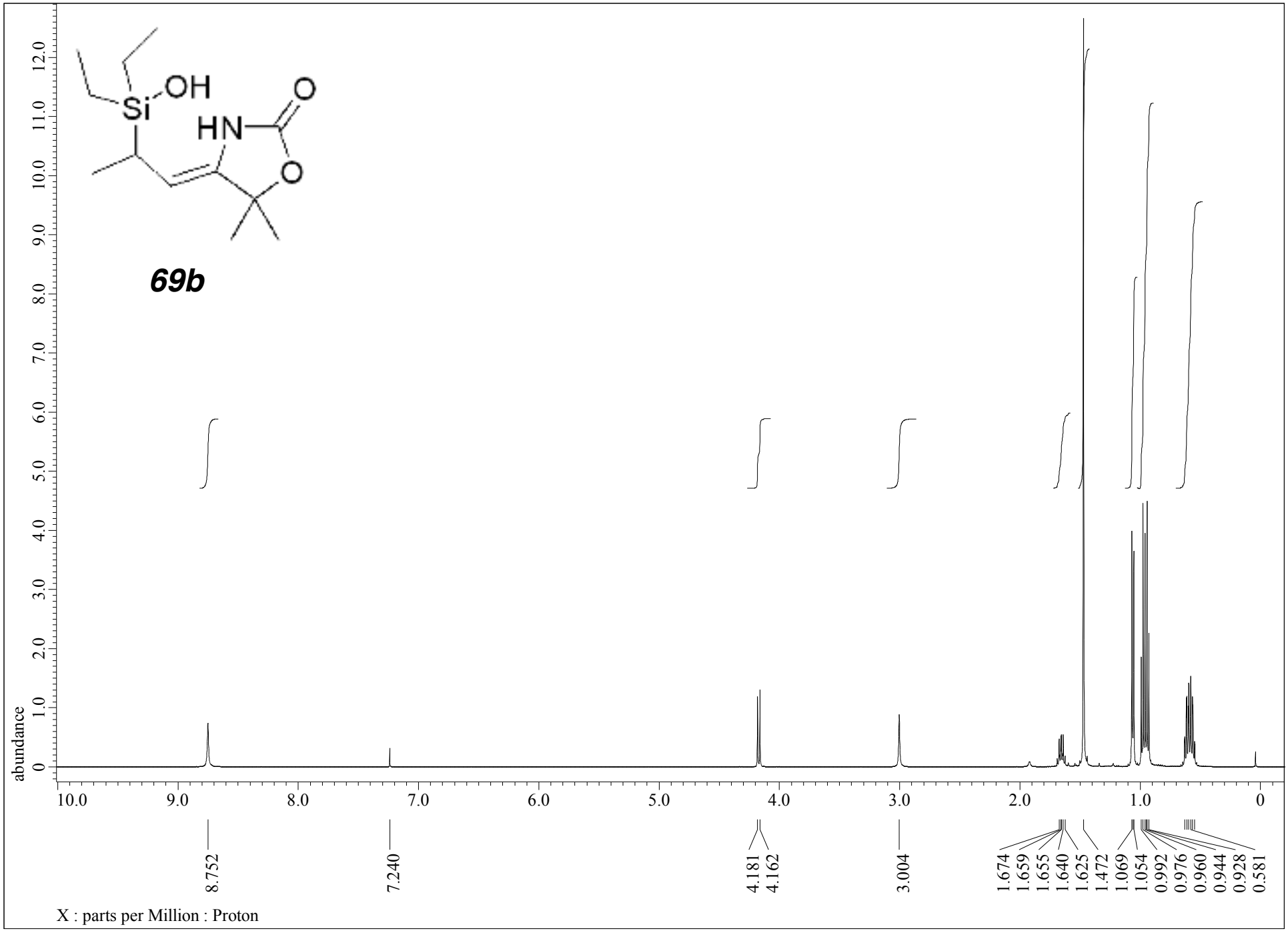

Ph
Si
Ph
O
N3
O
23
abundance
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
155.442
135.521
132.840
129.523
127.693
108.075
86.422
84.603
77.254
77.000
76.746
40.386
26.903
23.293
18.587
X : parts per Million : Carbon13

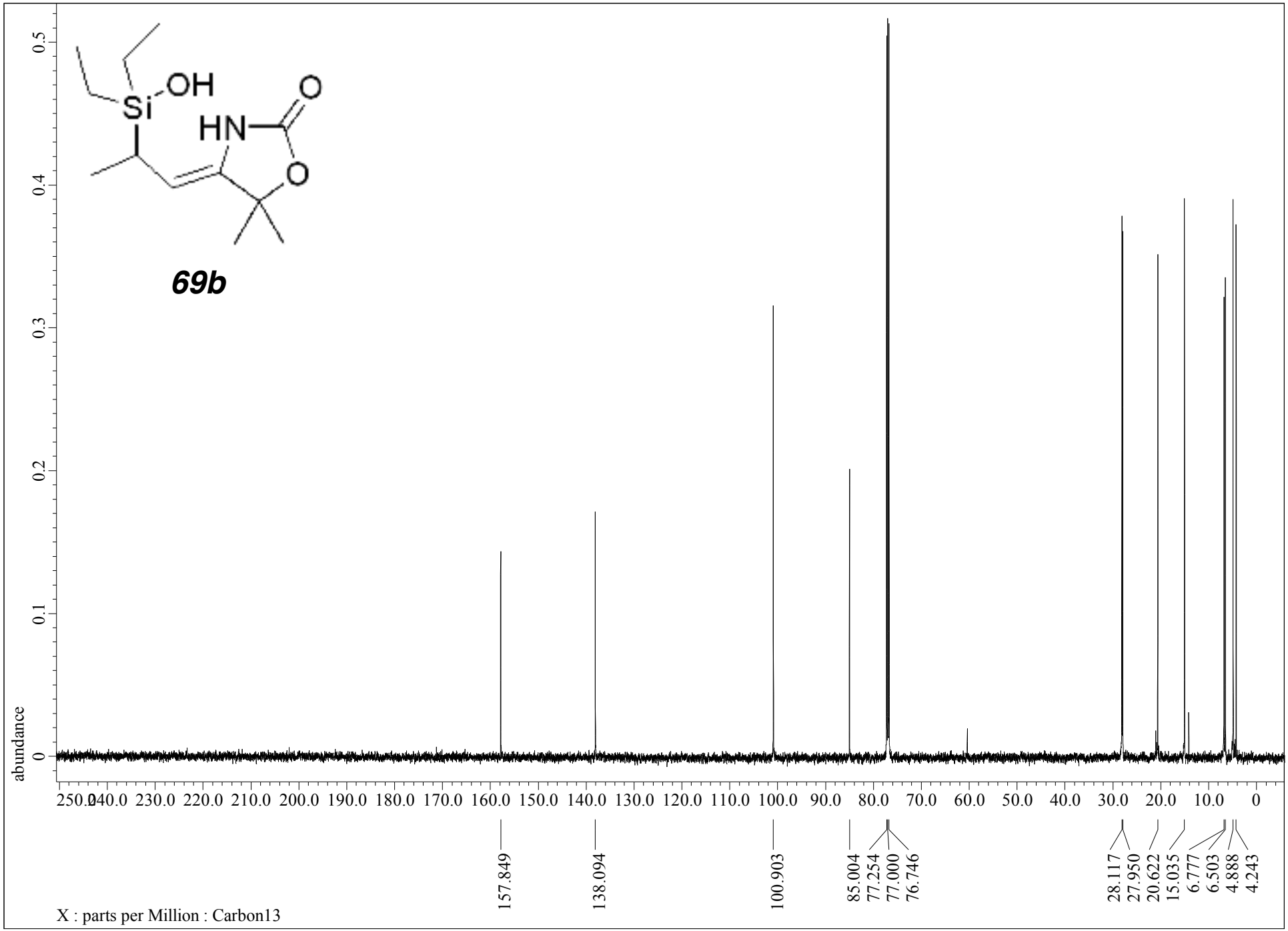

Si
O
NH2
O
O
13
abundance
0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
4.702
3.875
3.845
3.735
3.715
3.710
2.241
2.214
2.209
2.204
1.968
1.072
1.049
1.033
1.010
X : parts per Million : Proton


Si
O
NH2
O
O
13
abundance
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.559
105.782
88.063
77.311
77.000
76.679
72.991
64.730
37.972
18.561
11.049
X : parts per Million : Carbon13

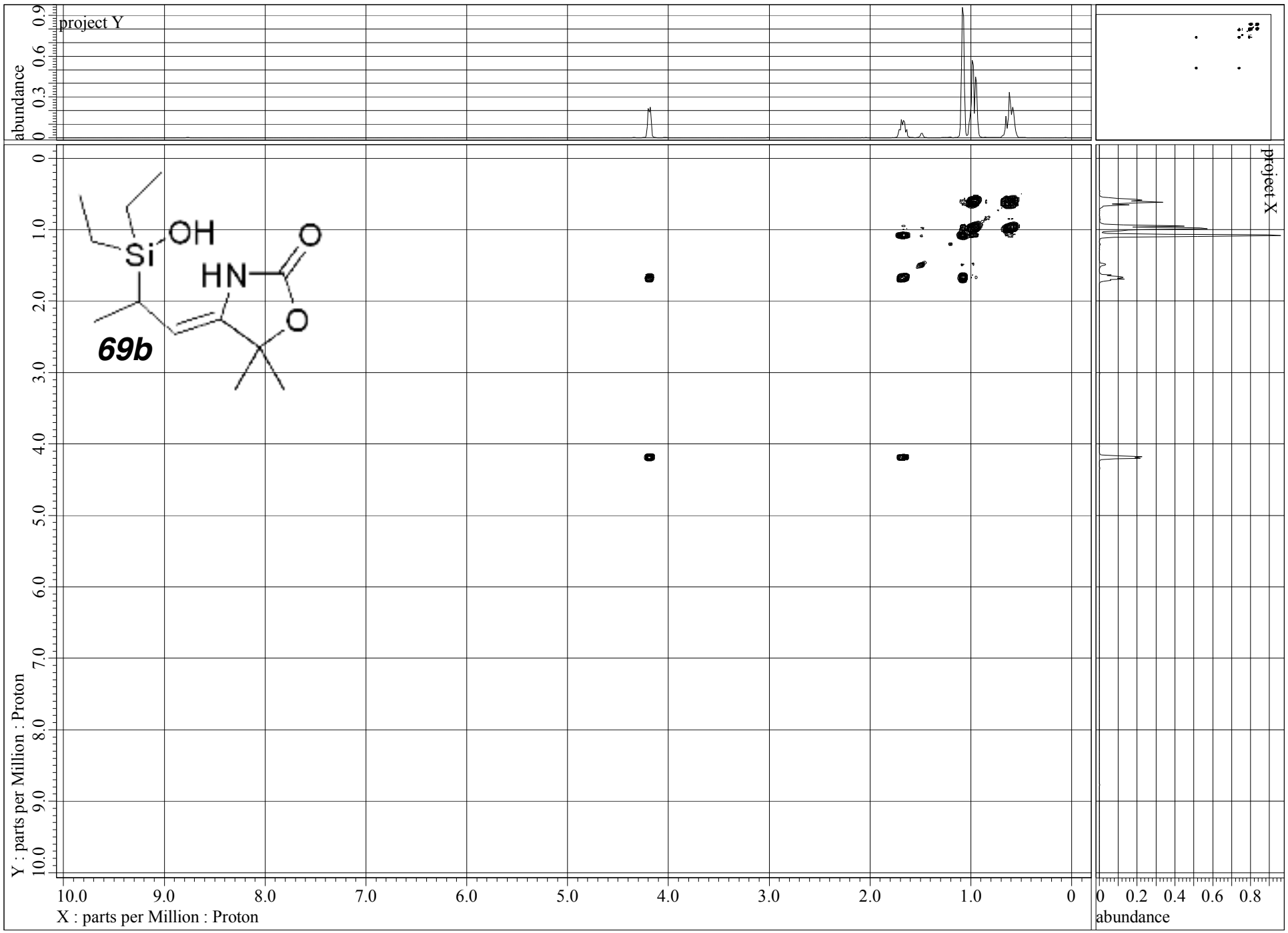

OH
Si
HN
O
O
69a
abundance
9.211
7.240
4.517
4.220
1.435
1.127
1.091
1.072
1.052
1.019
X : parts per Million : Proton


OH
Si
HN
O
O
69a
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0 -10.0 -20.0
156.798
139.352
107.484
84.850
77.258
77.000
76.742
28.097
25.550
23.910
18.416
18.349
13.332
X : parts per Million : Carbon13

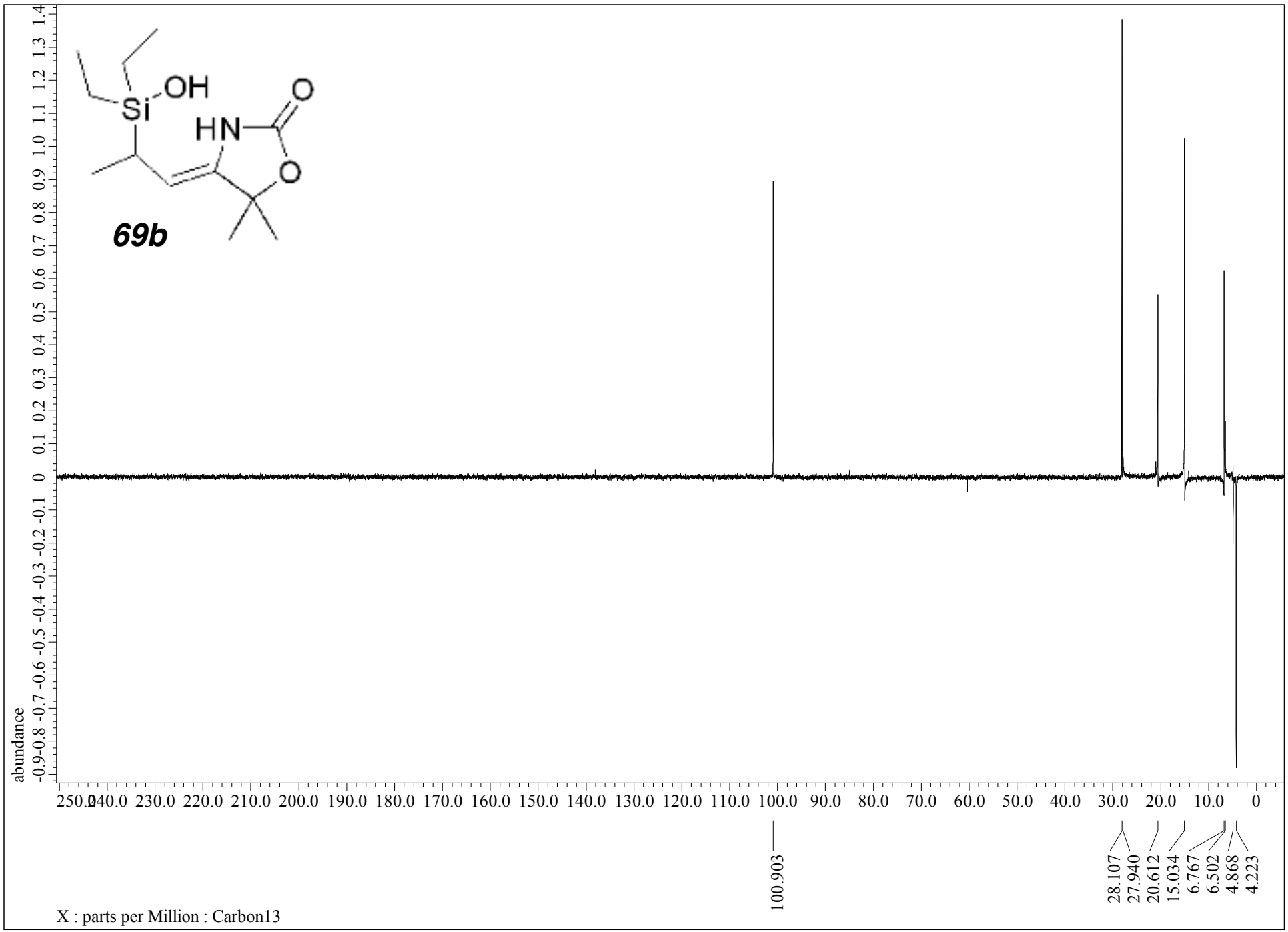

OH
Si
HN
O
O
69b
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
8.752
7.240
4.181
4.162
3.004
1.674
1.659
1.655
1.640
1.625
1.472
1.069
1.054
0.992
0.976
0.960
0.944
0.928
0.581
X : parts per Million : Proton

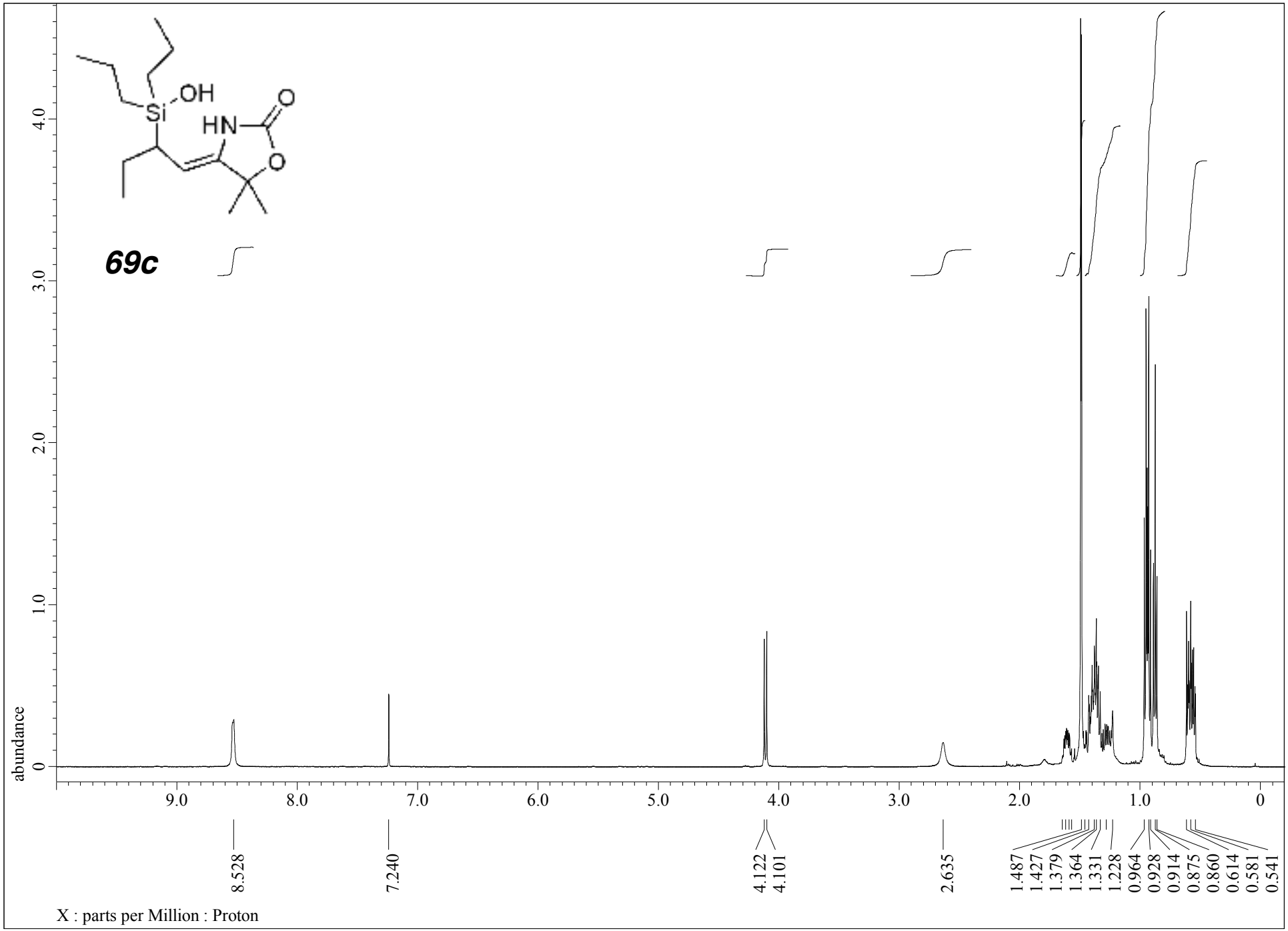

OH
Si
HN
O
O
69b
abundance
0.5
0.4
0.3
0.2
0.1
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.849
138.094
100.903
85.004
77.254
77.000
76.746
28.117
27.950
20.622
15.035
6.777
6.503
4.888
4.243
X : parts per Million : Carbon13

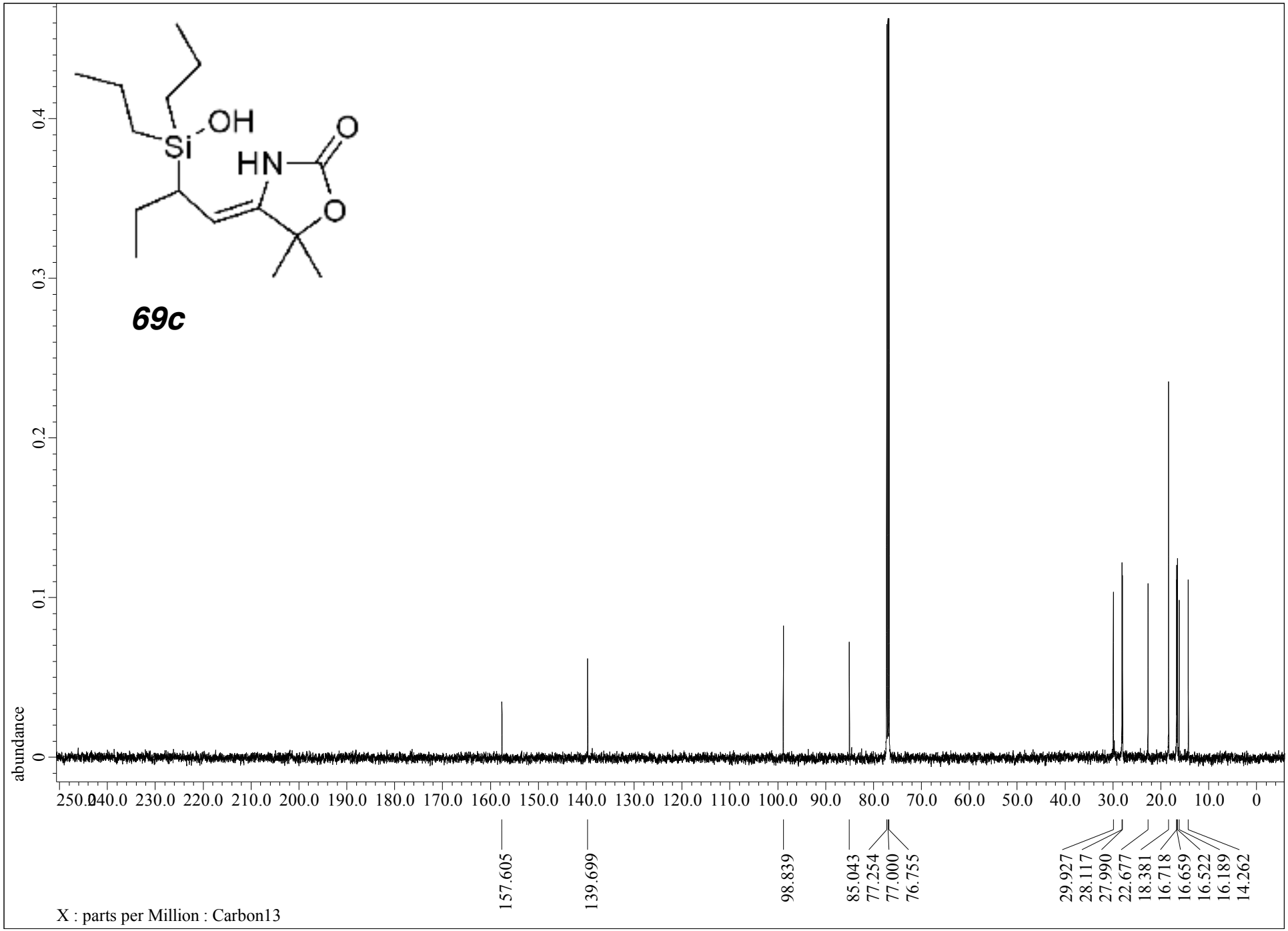
cosy

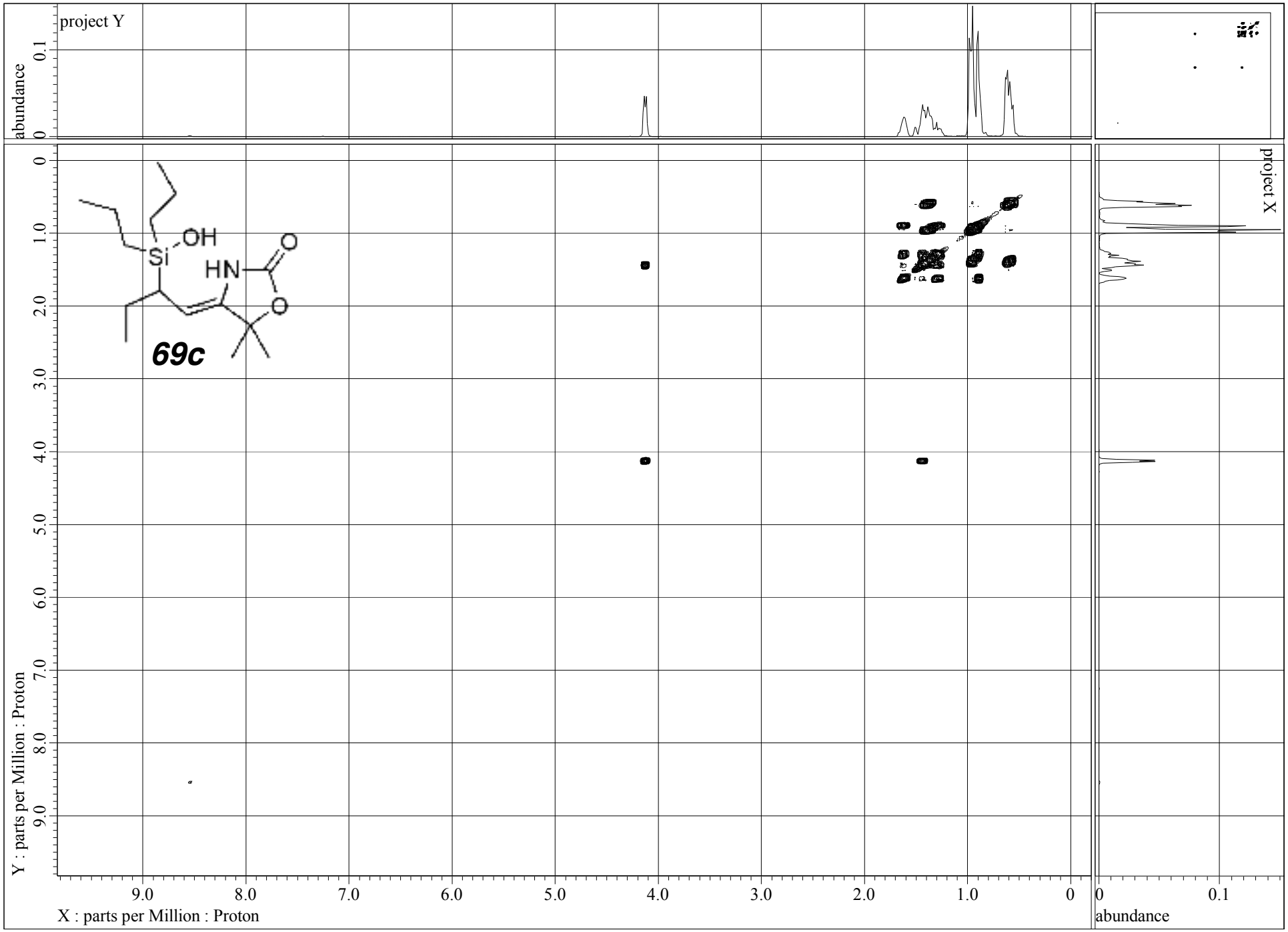

project Y
abundance
0
0.3
0.6
0.9
project X
OH
Si
HN
O
O
69b
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Y : parts per Million : Proton
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
X : parts per Million : Proton
0
0.2
0.4
0.6
0.8
abundance

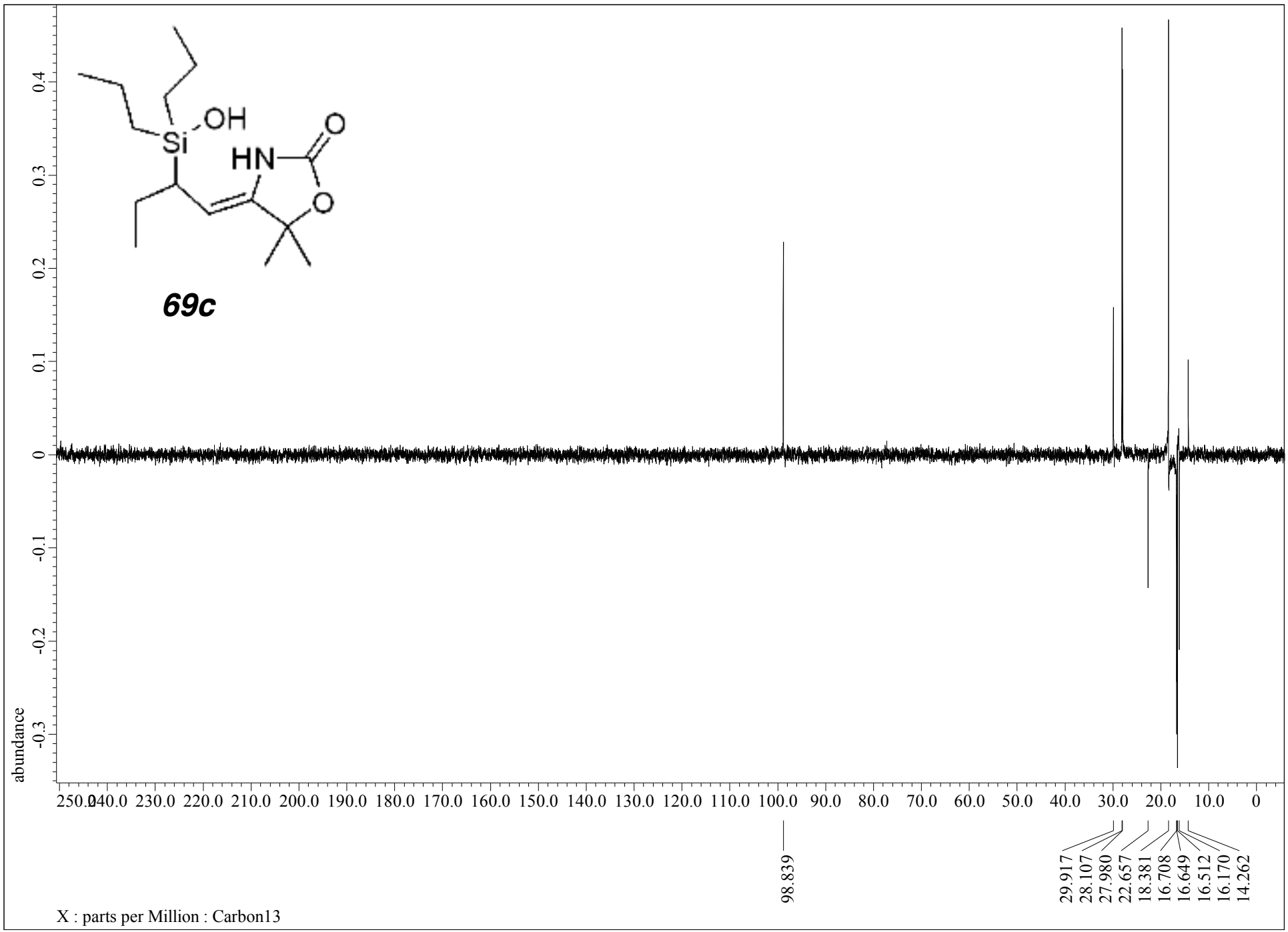
DEPT

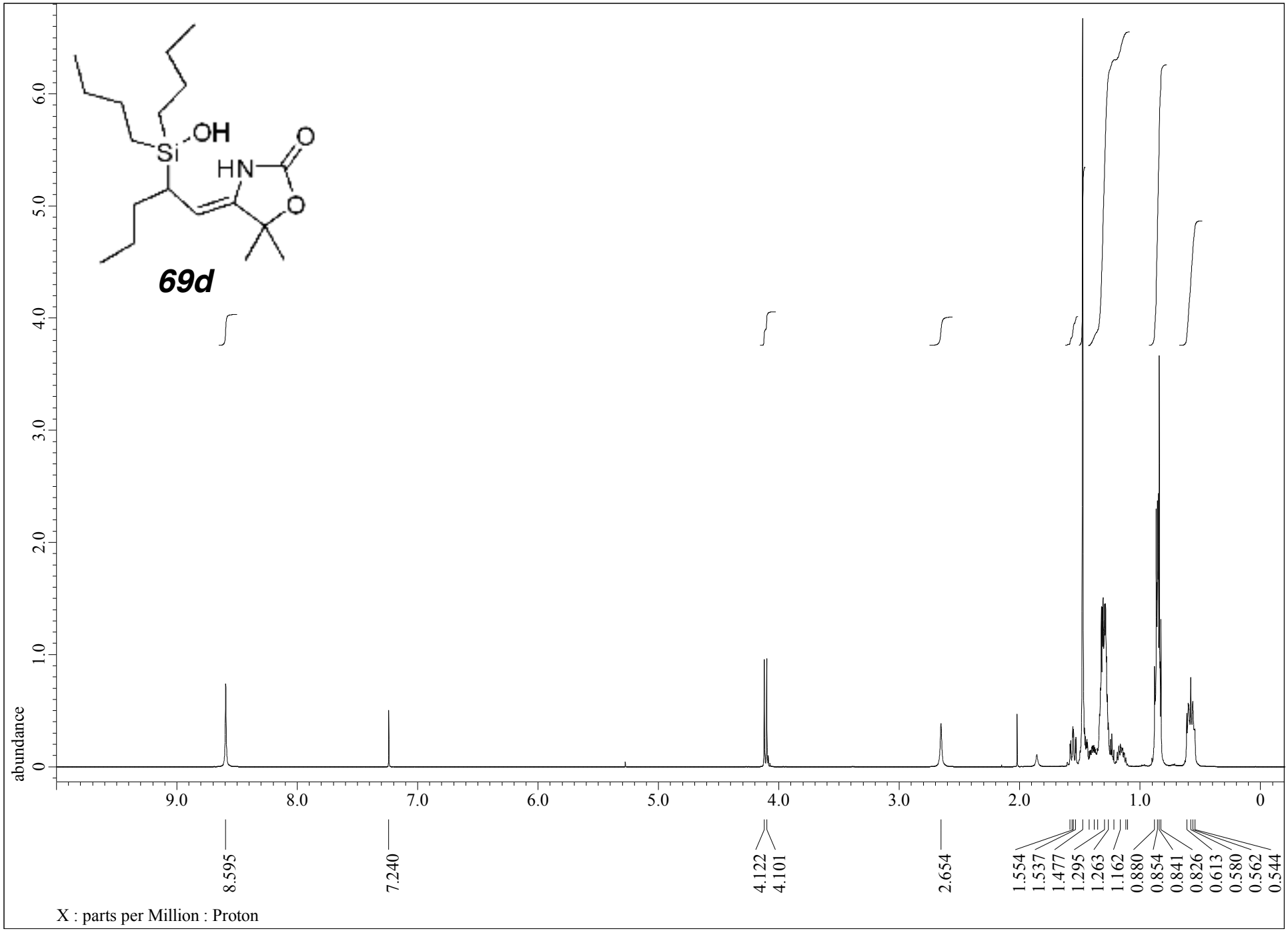

OH
Si
HN
O
O
69b
abundance
X : parts per Million : Carbon13
100.903
28.107
27.940
20.612
15.034
6.767
6.502
4.868
4.223

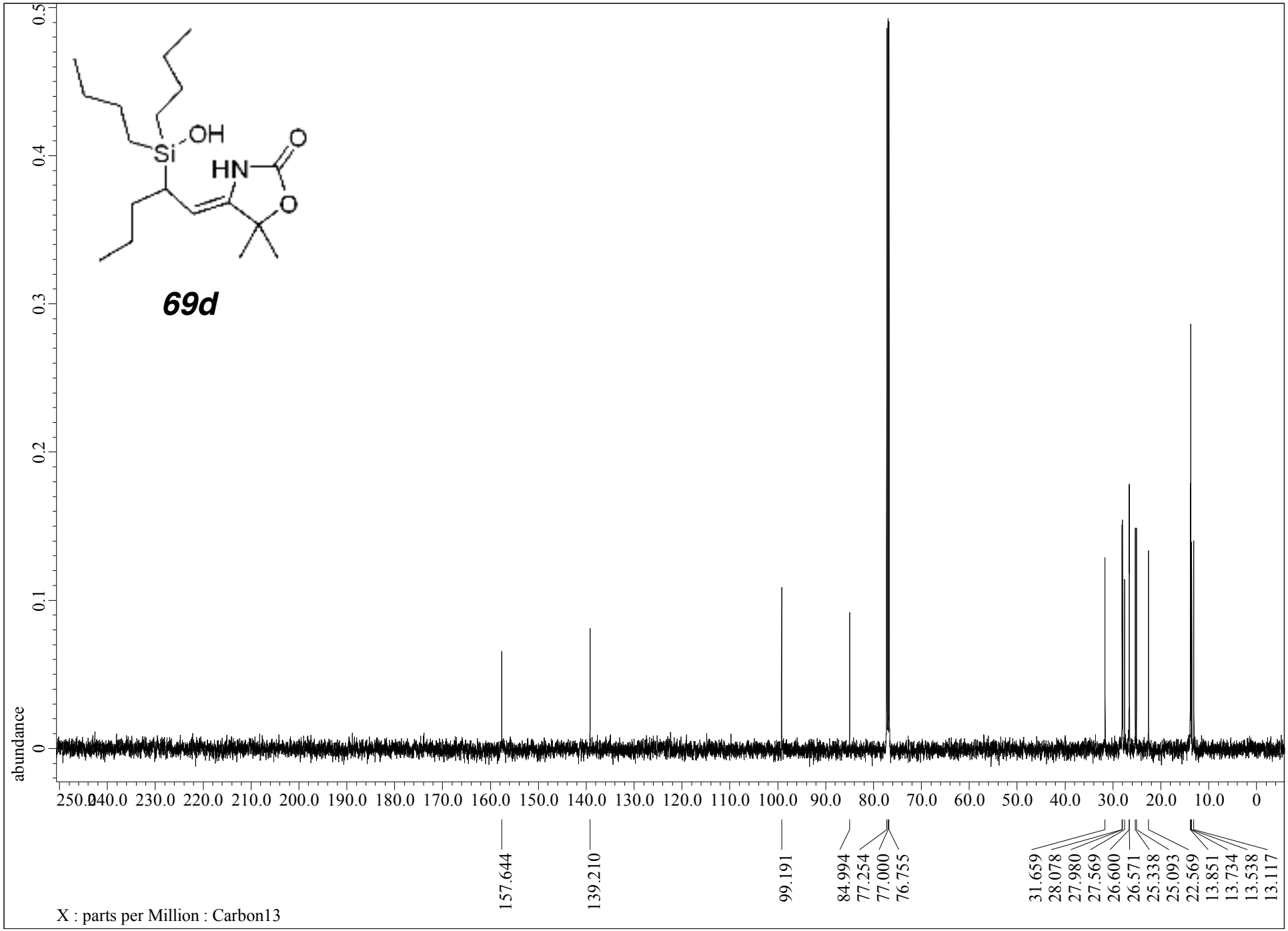

OH
Si
HN
O
O
69c
abundance
4.0
3.0
2.0
1.0
0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
8.528
7.240
4.122
4.101
2.635
1.487
1.427
1.379
1.364
1.331
1.228
0.964
0.928
0.914
0.875
0.860
0.614
0.581
0.541
X : parts per Million : Proton

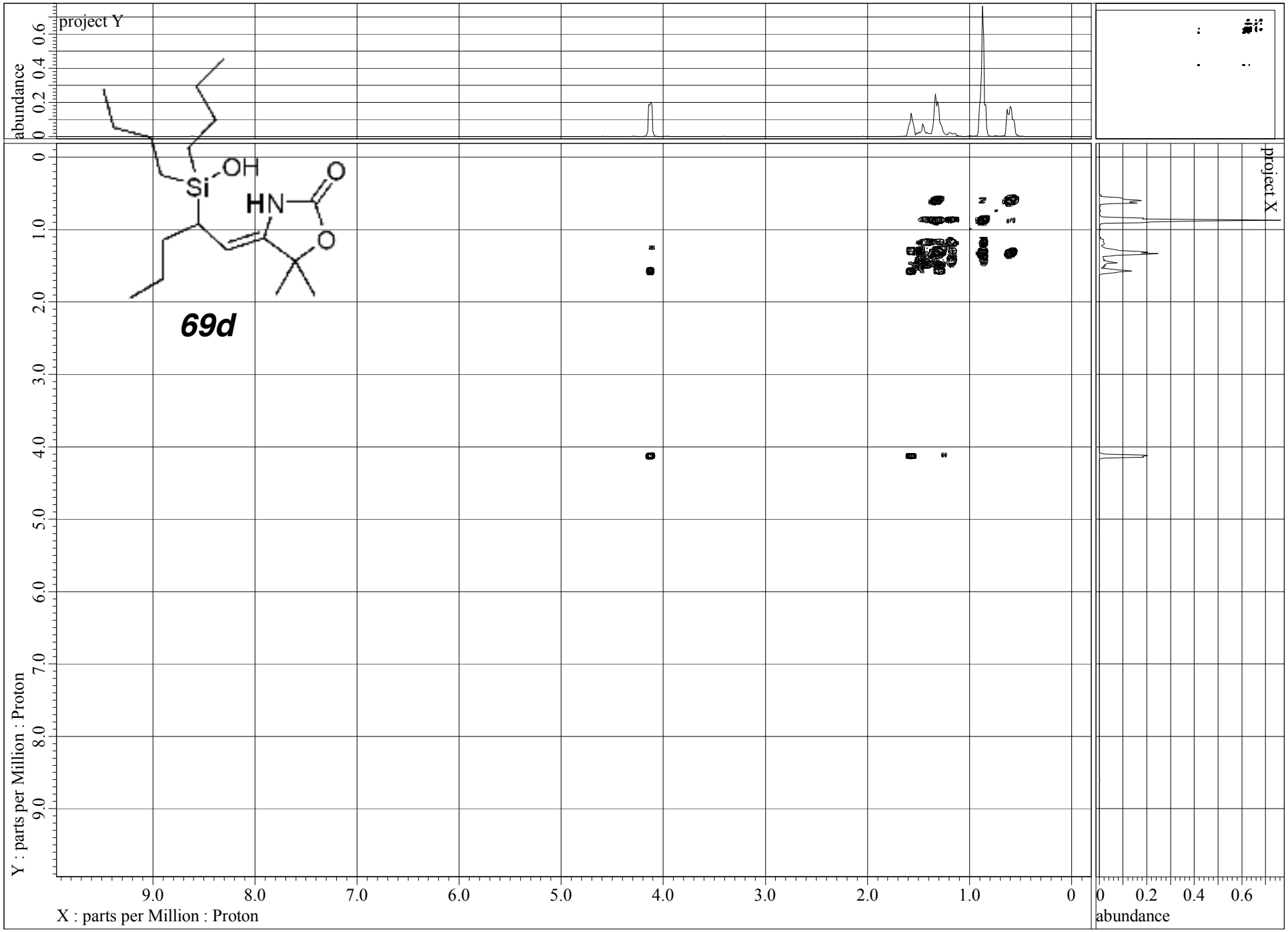

OH
Si
HN
O
O
69c
abundance
0
0.1
0.2
0.3
0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.605
139.699
98.839
85.043
77.254
77.000
76.755
29.927
28.117
27.990
22.677
18.381
16.718
16.659
16.522
16.189
14.262
X : parts per Million : Carbon13

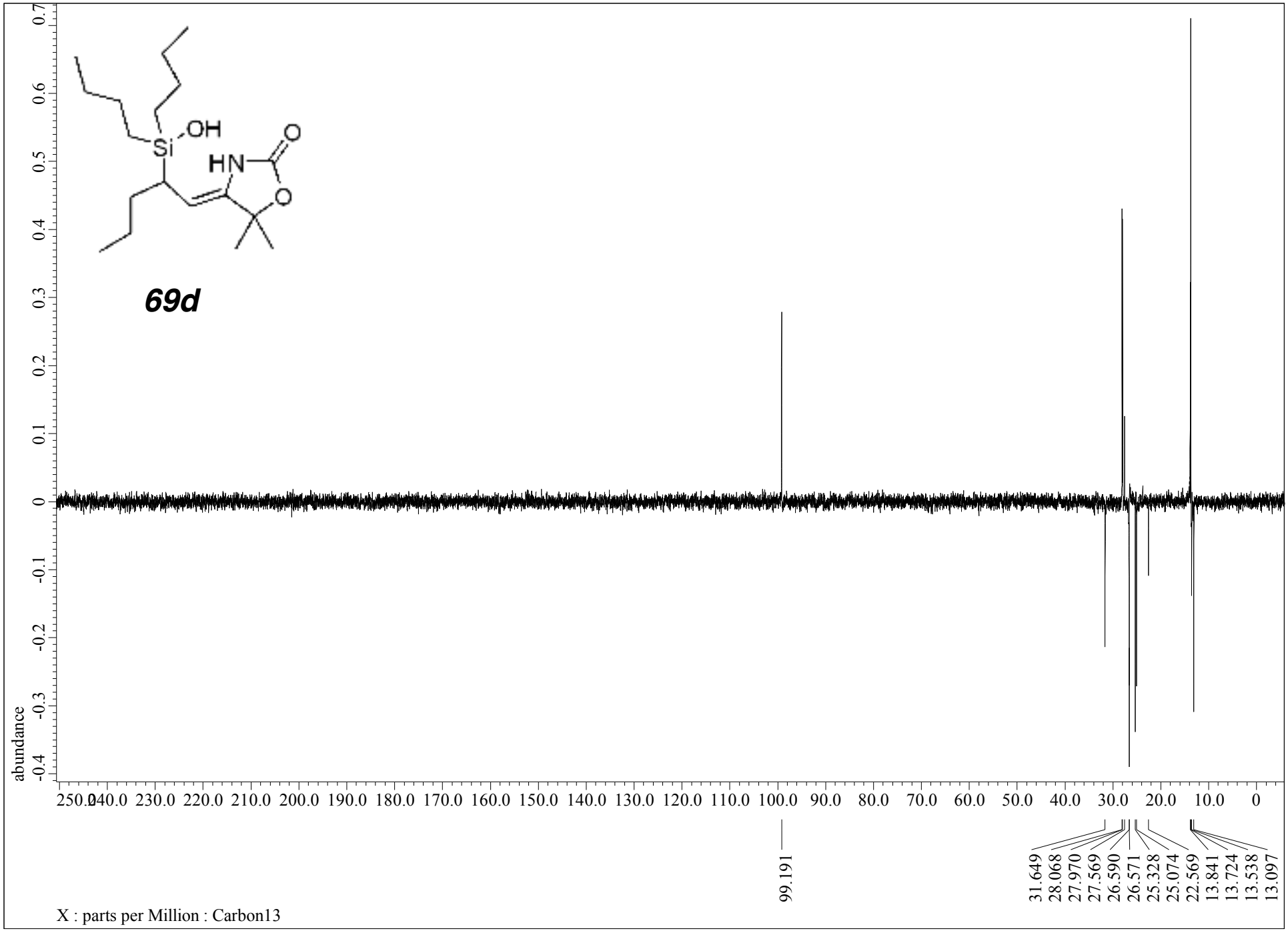

project Y
abundance
0
0.1
project X
OH
Si
HN
O
O
69c
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Y : parts per Million : Proton
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
X : parts per Million : Proton
0
0.1
abundance

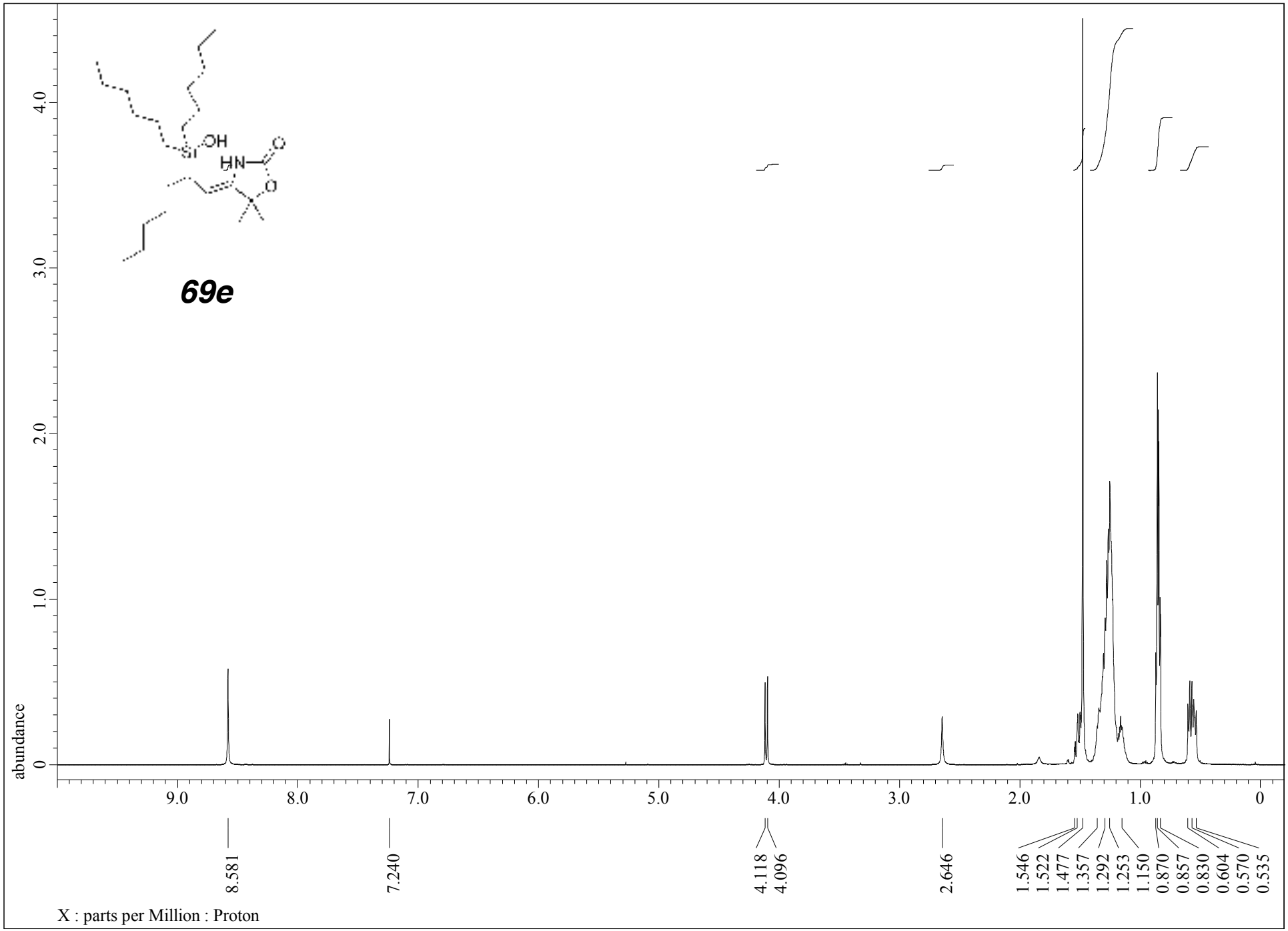

OH
Si
HN
O
O
69c
abundance
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
98.839
29.917
28.107
27.980
22.657
18.381
16.708
16.649
16.512
16.170
14.262
X : parts per Million : Carbon13

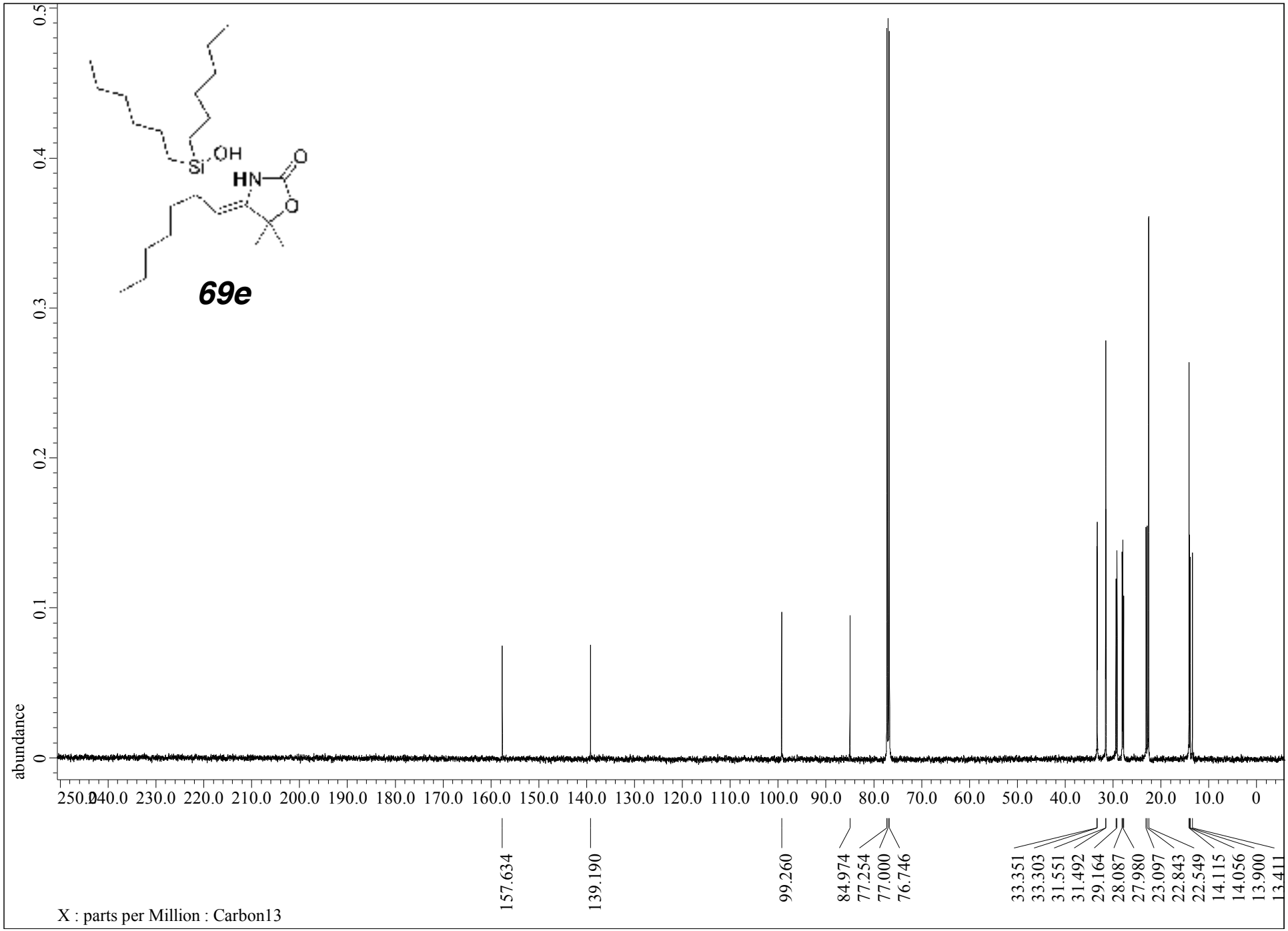

OH
Si
HN
O
O
69d
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
8.595
7.240
4.122
4.101
2.654
1.554
1.537
1.477
1.295
1.263
1.162
0.880
0.854
0.841
0.826
0.613
0.580
0.562
0.544
X : parts per Million : Proton

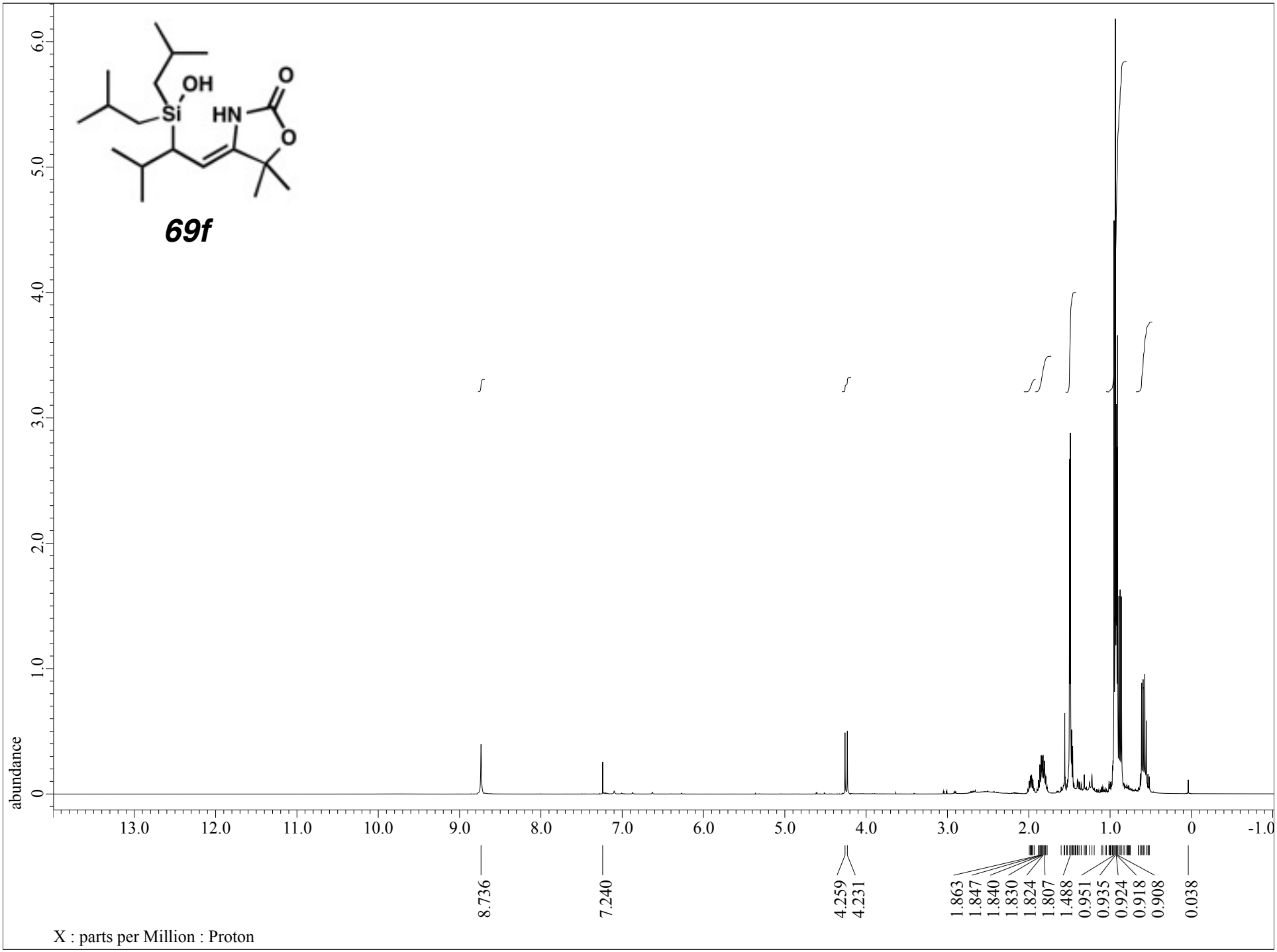

OH
Si
HN
O
O
69d
abundance
0.5
0.4
0.3
0.2
0.1
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.644
139.210
99.191
84.994
77.254
77.000
76.755
31.659
28.078
27.980
27.569
26.600
26.571
25.338
25.093
22.569
13.851
13.734
13.538
13.117
X : parts per Million : Carbon13

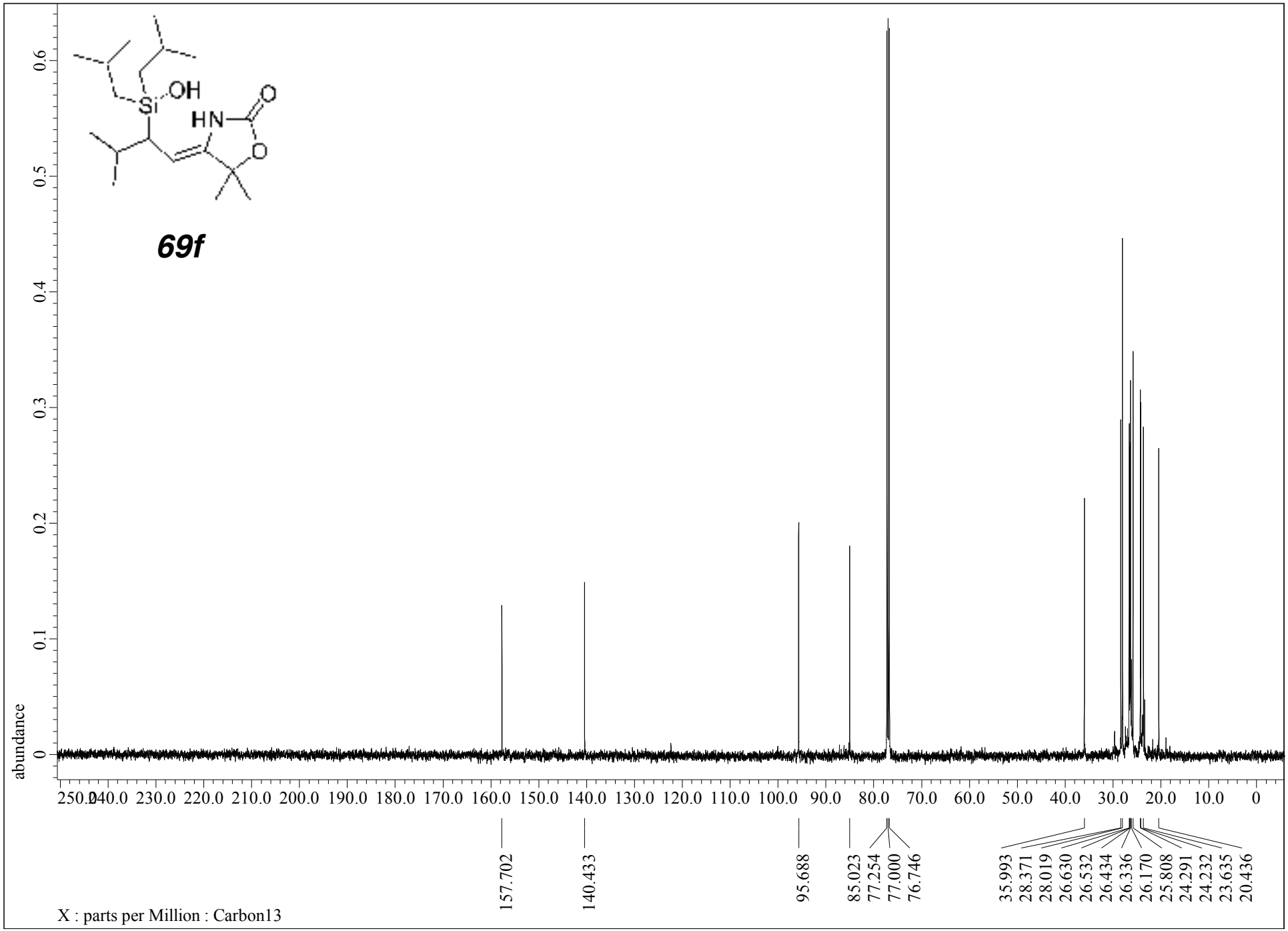

project Y
abundance
0
0.2
0.4
0.6
OH
Si
HN
O
O
69d
project X
Y : parts per Million : Proton
X : parts per Million : Proton
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
abundance

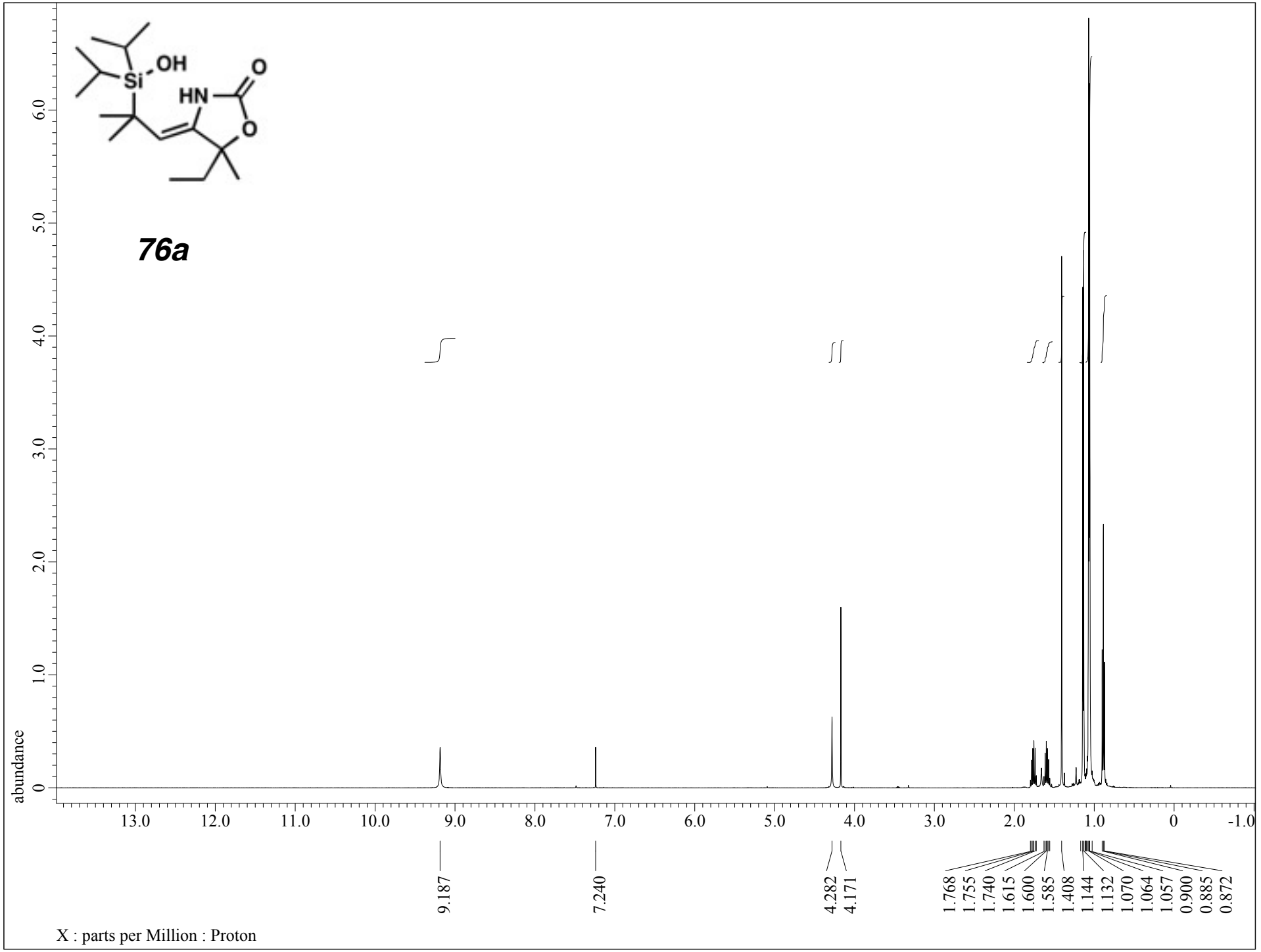

OH
Si
HN
O
O
69d
abundance
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
99.191
31.649
28.068
27.970
27.569
26.590
26.571
25.328
25.074
22.569
13.841
13.724
13.538
13.097
X : parts per Million : Carbon13

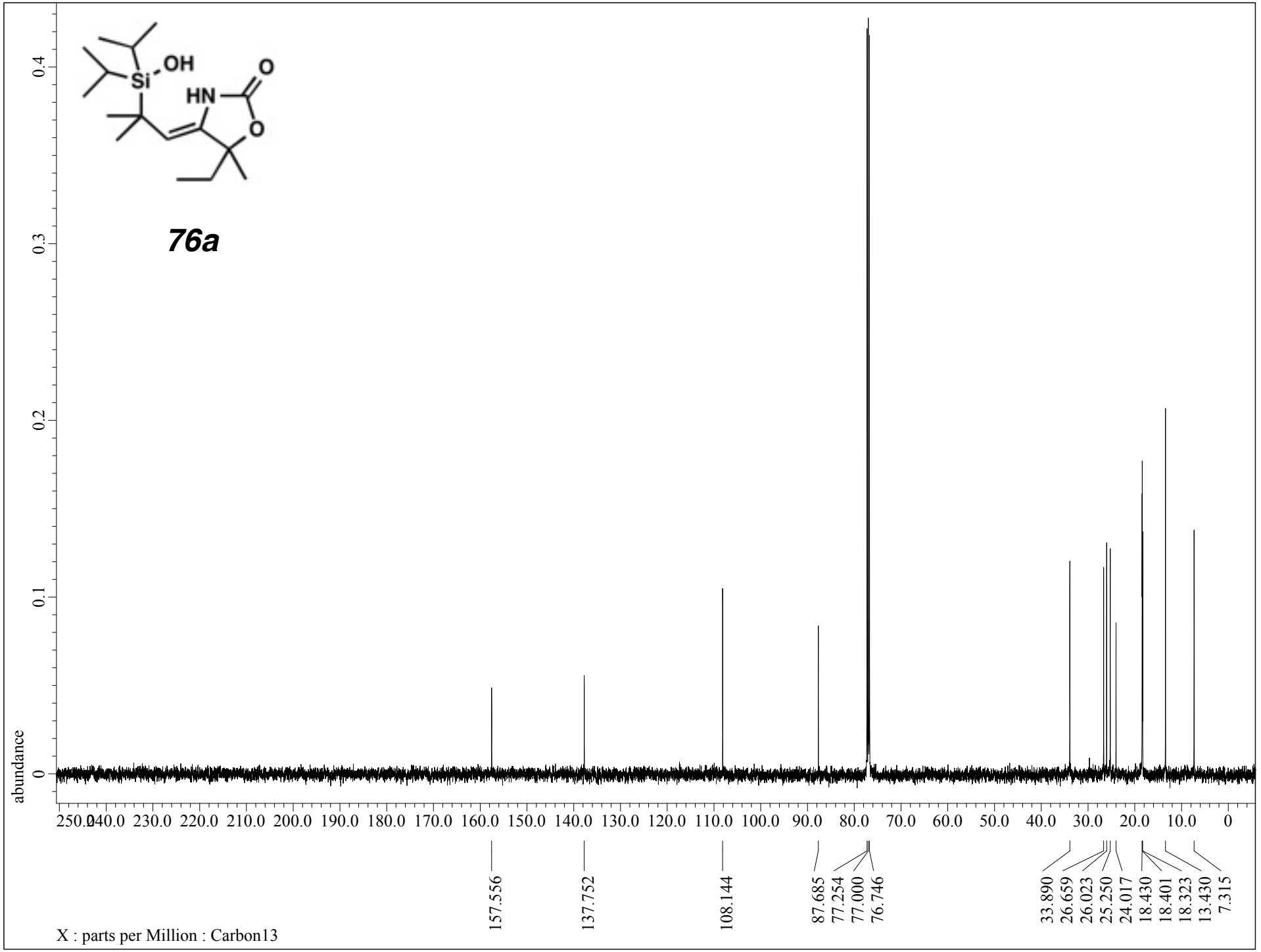

69e
abundance
4.0
3.0
2.0
1.0
0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
8.581
7.240
4.118
4.096
2.646
1.546
1.522
1.477
1.357
1.292
1.253
1.150
0.870
0.857
0.830
0.604
0.570
0.535
X : parts per Million : Proton

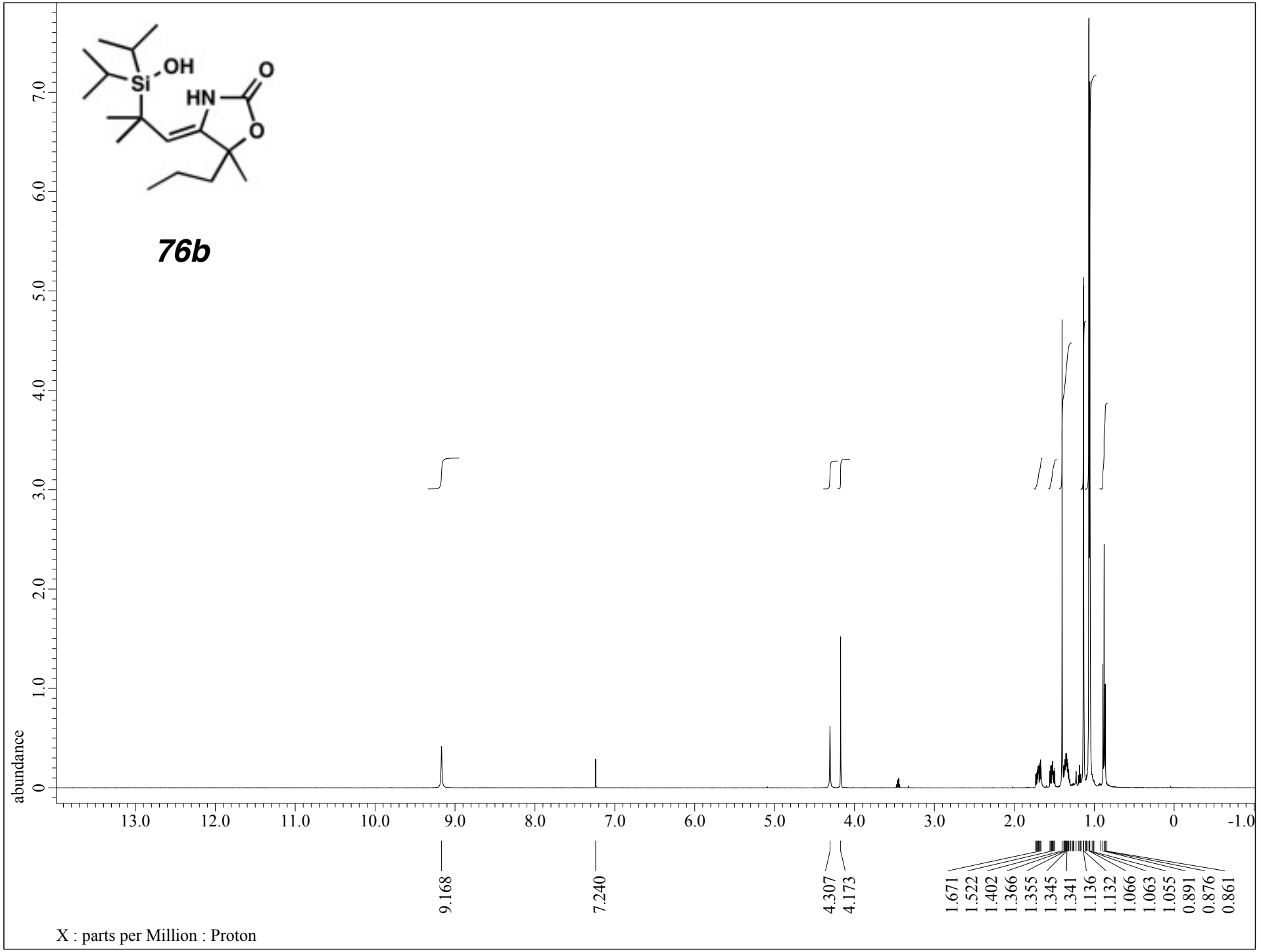

69e
Si
OH
HN
O
O
O
abundance
0.5
0.4
0.3
0.2
0.1
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.634
139.190
99.260
84.974
77.254
77.000
76.746
33.351
33.303
31.551
31.492
29.164
28.087
27.980
23.097
22.843
22.549
14.115
14.056
13.900
13.411
X : parts per Million : Carbon13

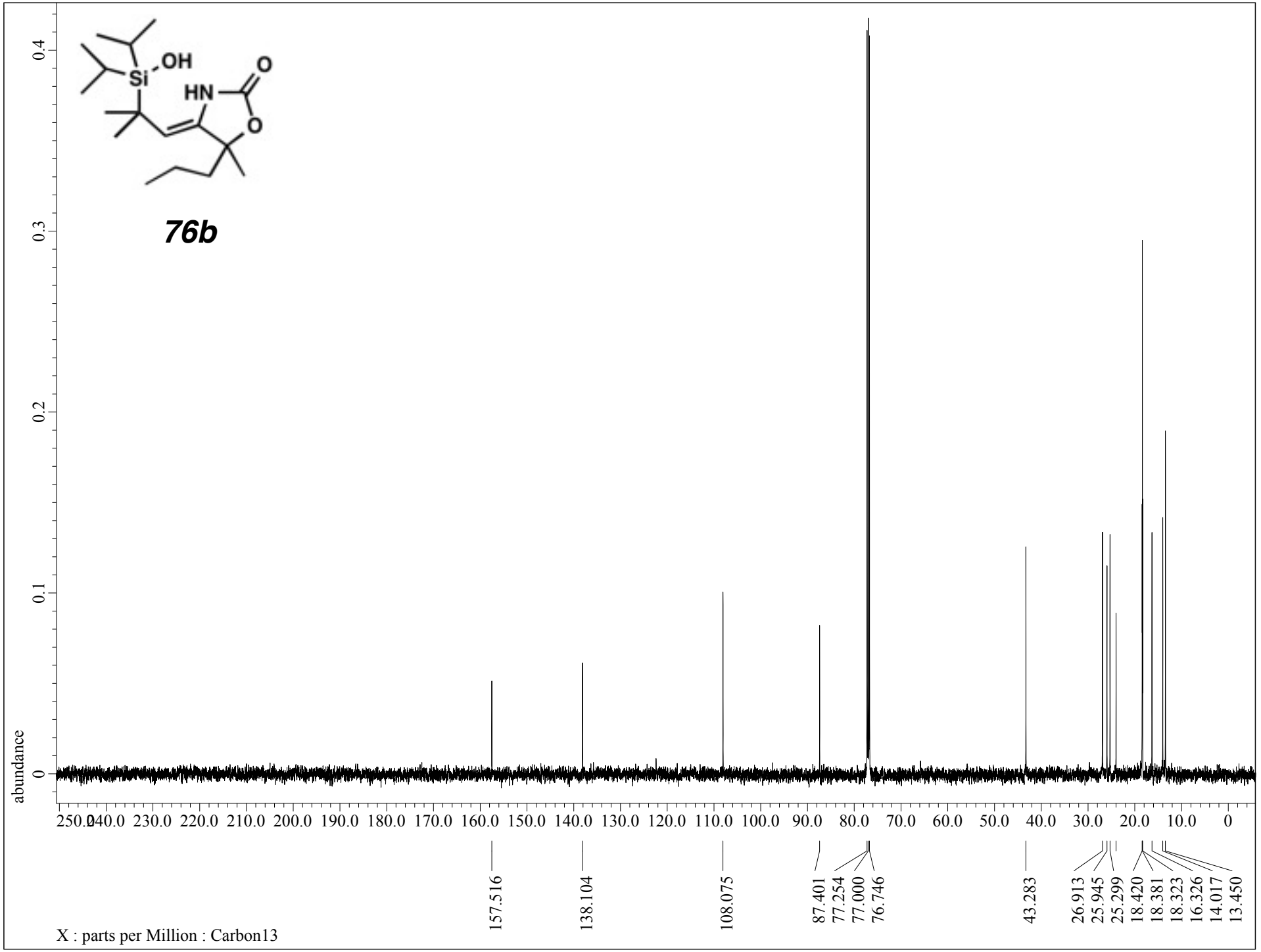

OH
Si
HN
O
O
69f
abundance
6.0
5.0
4.0
3.0
2.0
1.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
8.736
7.240
4.259
4.231
1.863
1.847
1.840
1.830
1.824
1.807
1.488
0.951
0.935
0.924
0.918
0.908
0.038
X : parts per Million : Proton

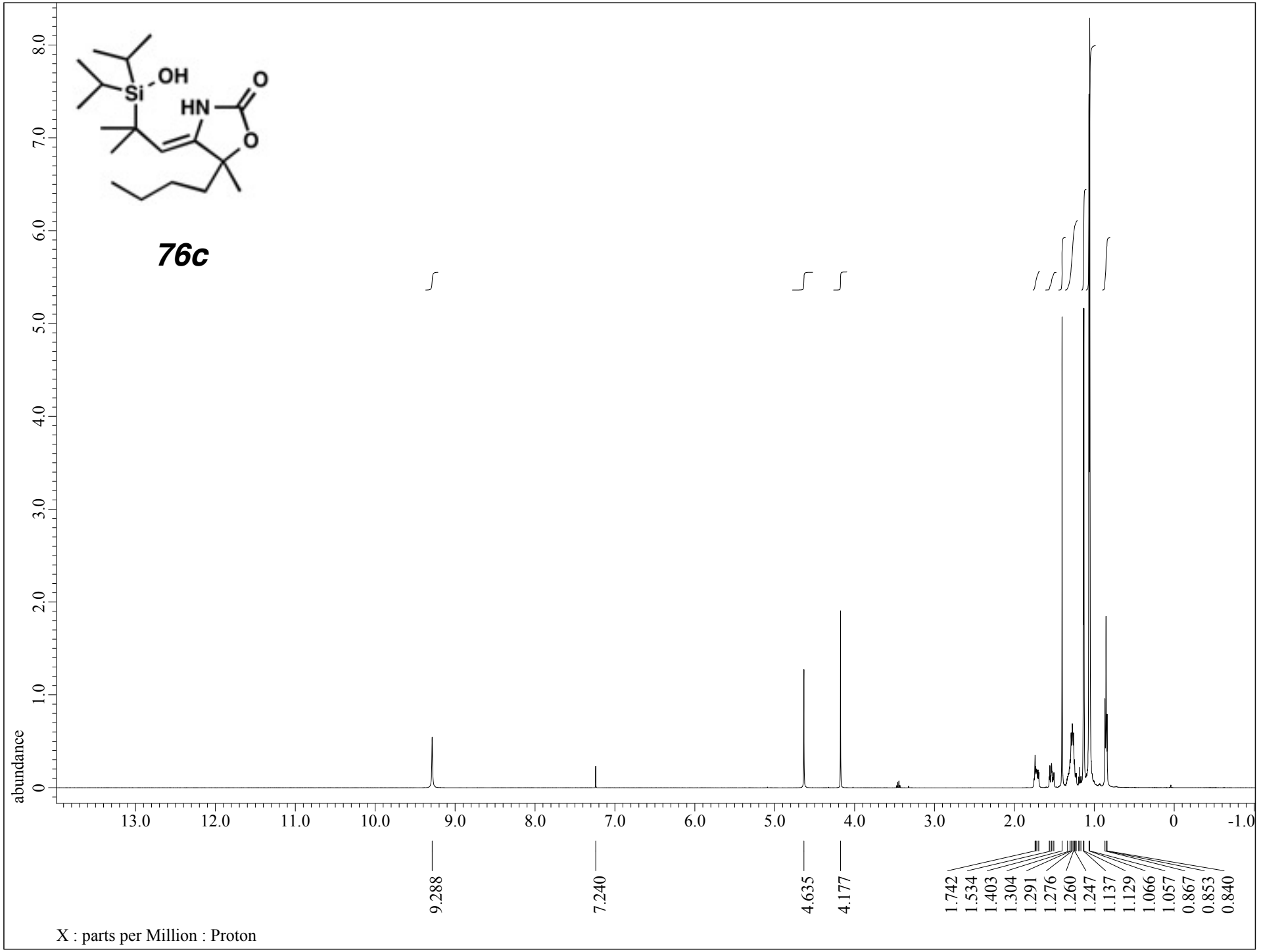

OH
Si
HN
O
O
69f
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.702
140.433
95.688
85.023
77.254
77.000
76.746
35.993
28.371
28.019
26.630
26.532
26.434
26.336
26.170
25.808
24.291
24.232
23.635
20.436
X : parts per Million : Carbon13

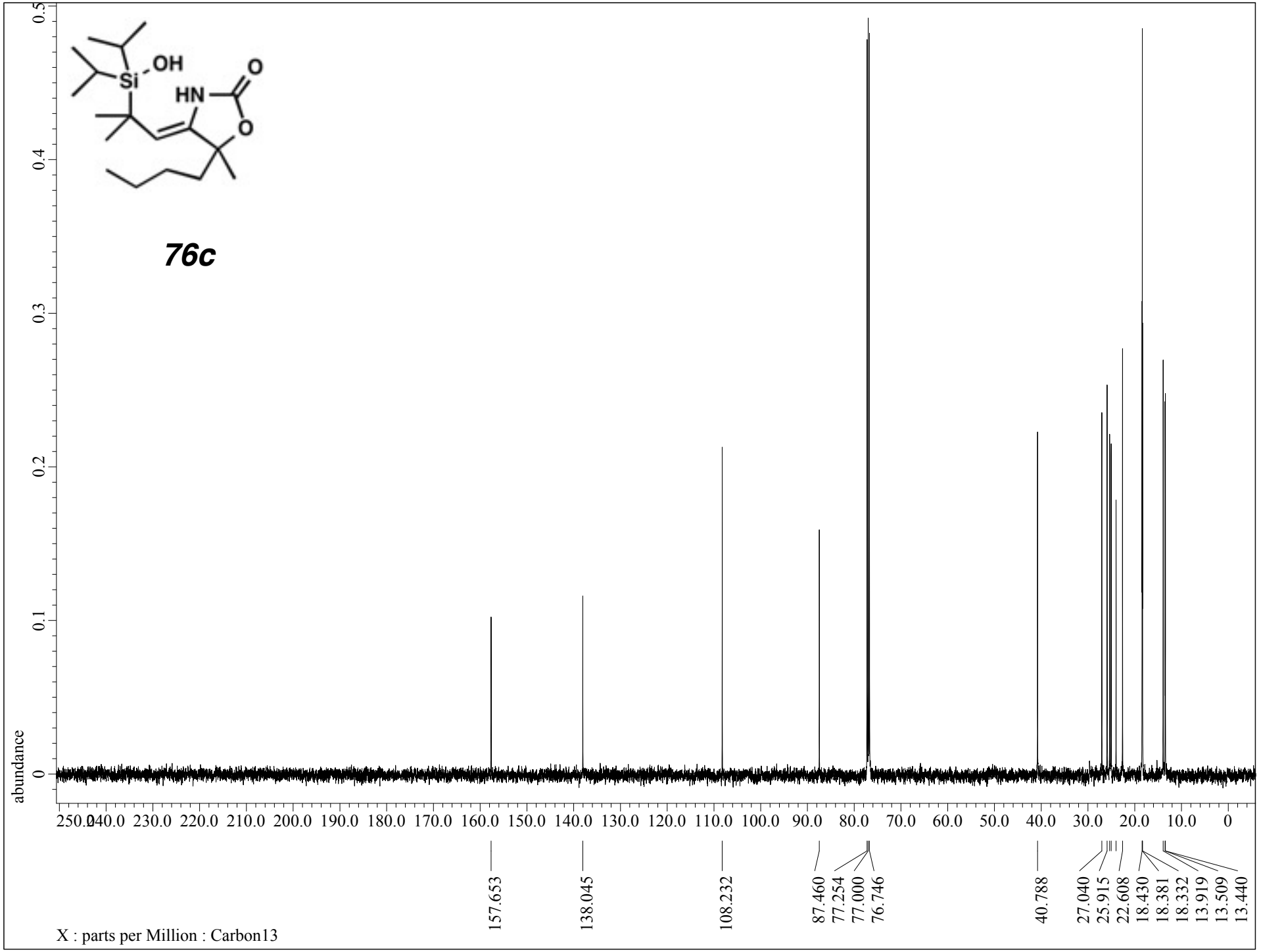

OH
Si
HN
O
O
76a
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
9.187
7.240
4.282
4.171
1.768
1.755
1.740
1.615
1.600
1.585
1.408
1.144
1.132
1.070
1.064
1.057
0.900
0.885
0.872
X : parts per Million : Proton

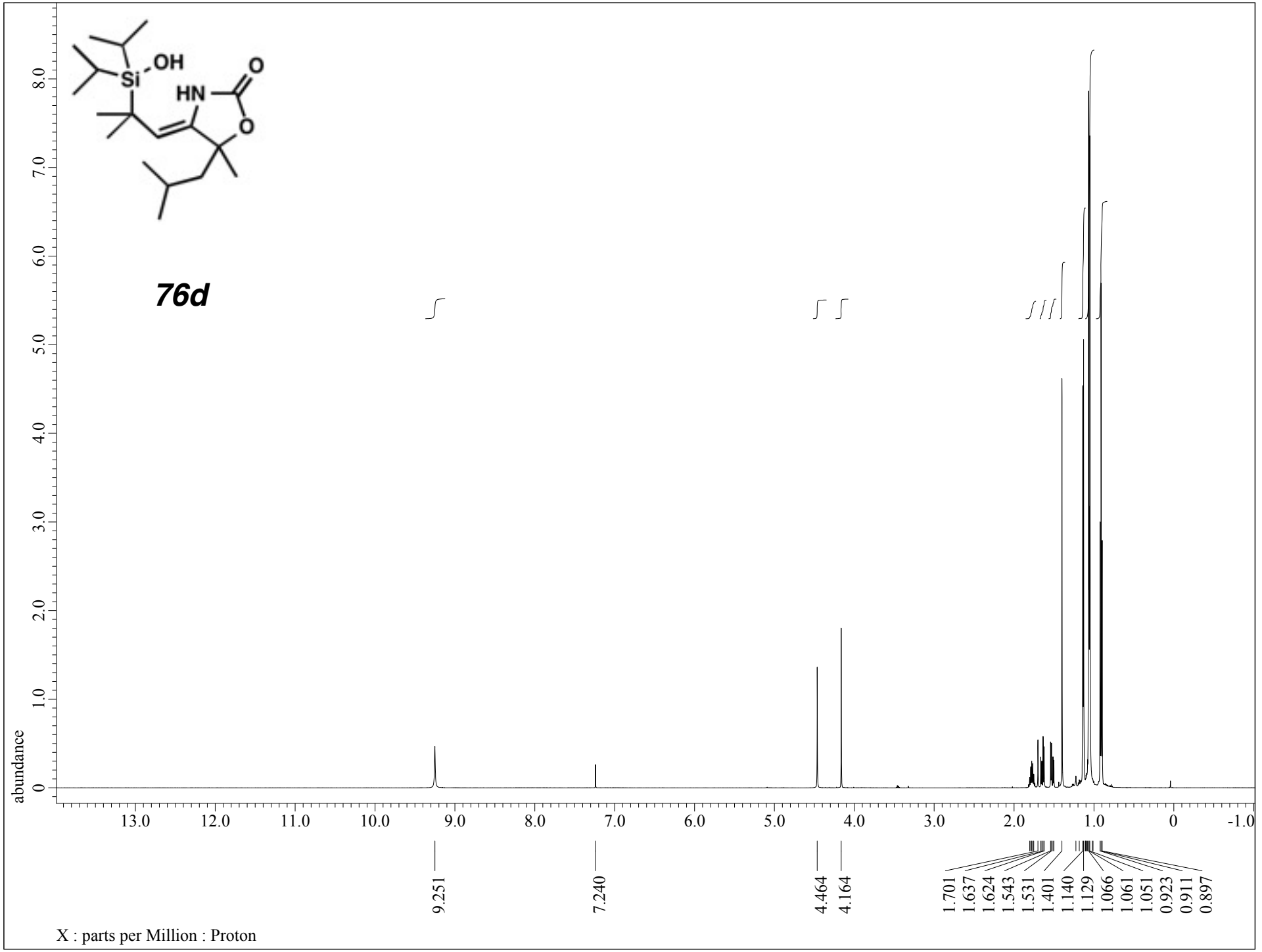

OH
Si
HN
O
O
76a
abundance
0
0.1
0.2
0.3
0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.556
137.752
108.144
87.685
77.254
77.000
76.746
33.890
26.659
26.023
25.250
24.017
18.430
18.401
18.323
13.430
7.315
X : parts per Million : Carbon13

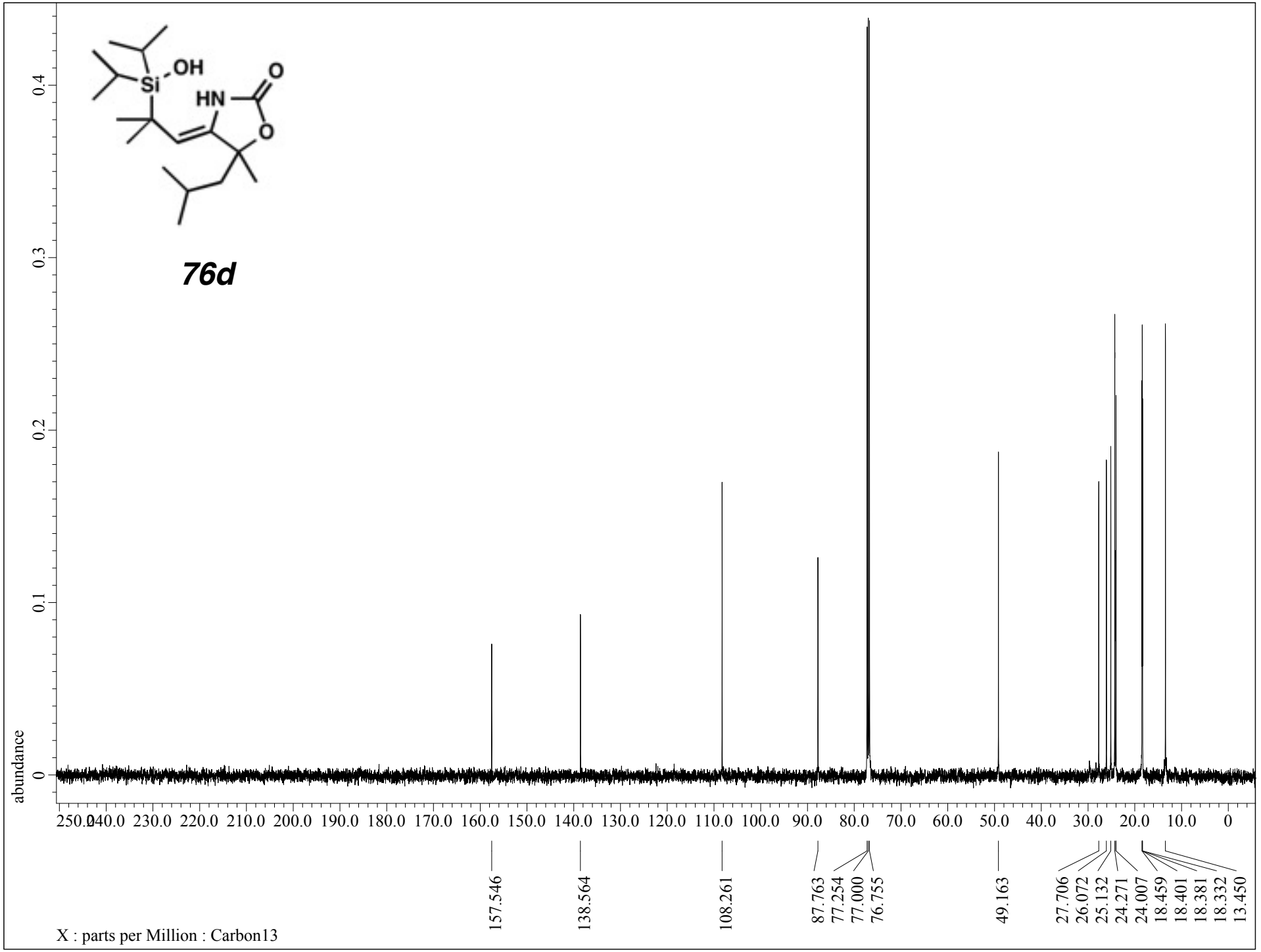

OH
Si
HN
O
O
76b
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
9.168
7.240
4.307
4.173
1.671
1.522
1.402
1.366
1.355
1.345
1.341
1.136
1.132
1.066
1.063
1.055
0.891
0.876
0.861
X : parts per Million : Proton

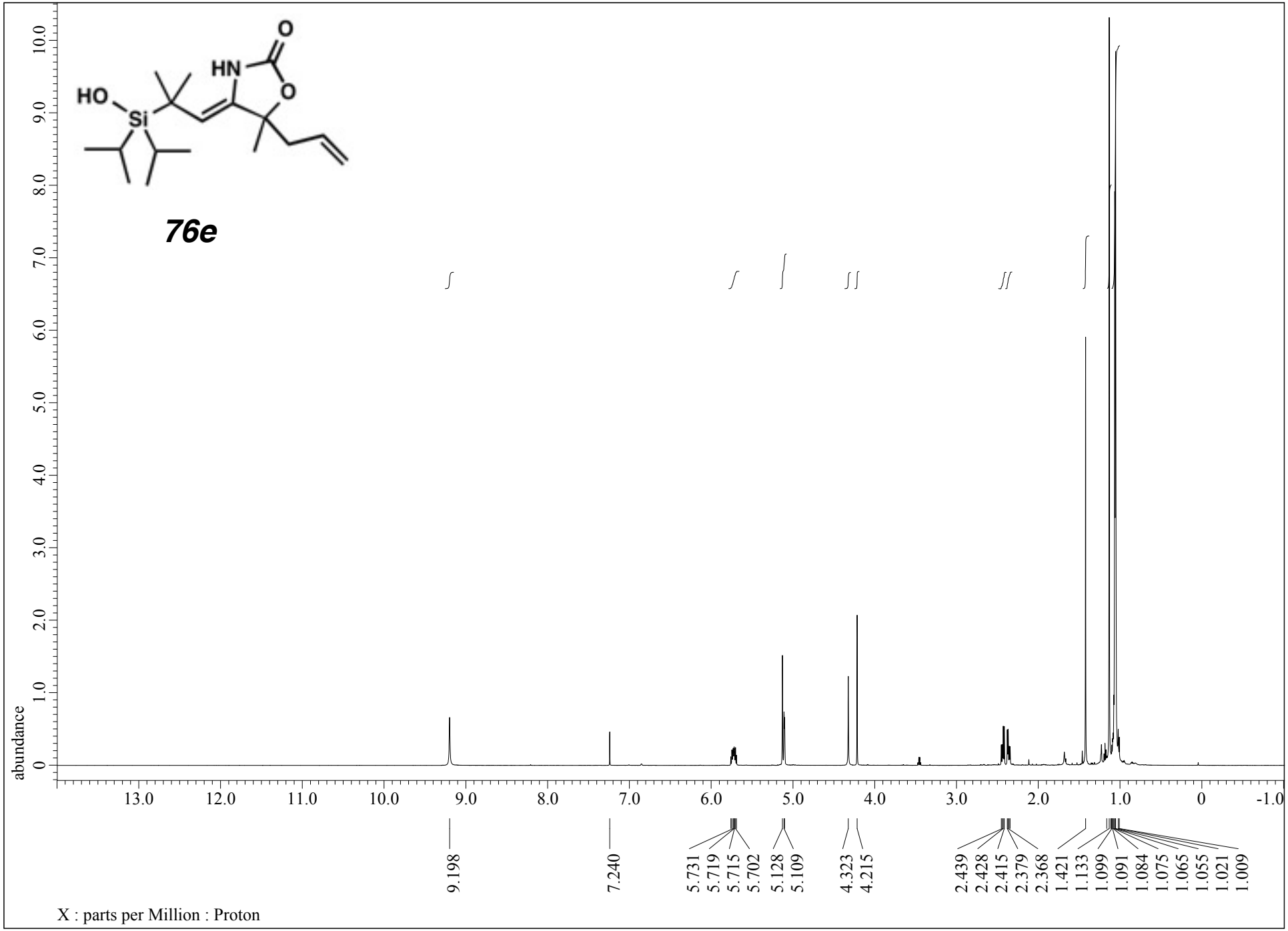

OH
Si
HN
O
O
76b
abundance
0.4
0.3
0.2
0.1
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.516
138.104
108.075
87.401
77.254
77.000
76.746
43.283
26.913
25.945
25.299
18.420
18.381
18.323
16.326
14.017
13.450
X : parts per Million : Carbon13

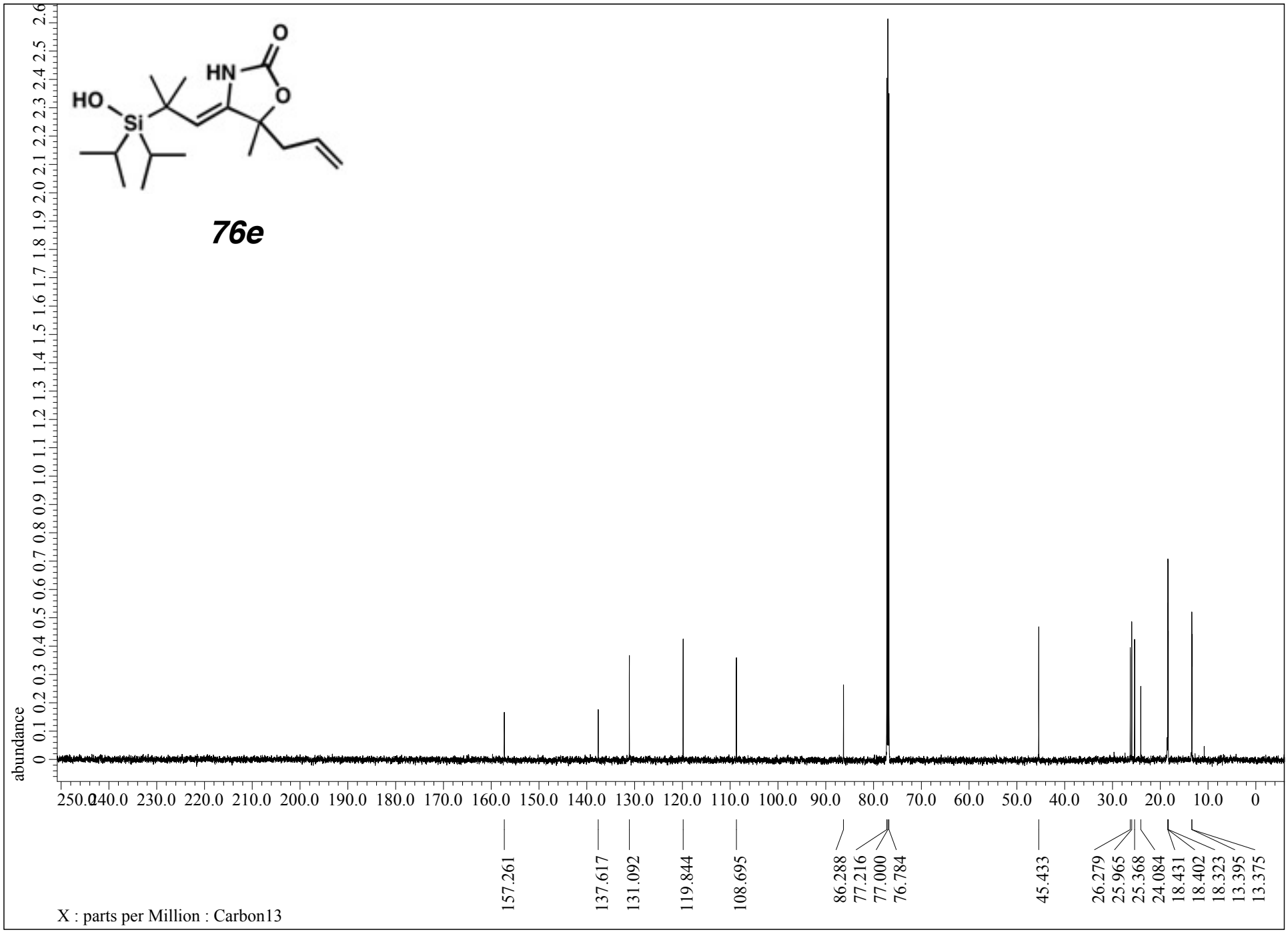

OH
Si
HN
O
O
76c
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
9.288
7.240
4.635
4.177
1.742
1.534
1.403
1.304
1.291
1.276
1.260
1.247
1.137
1.129
1.066
1.057
0.867
0.853
0.840
X : parts per Million : Proton

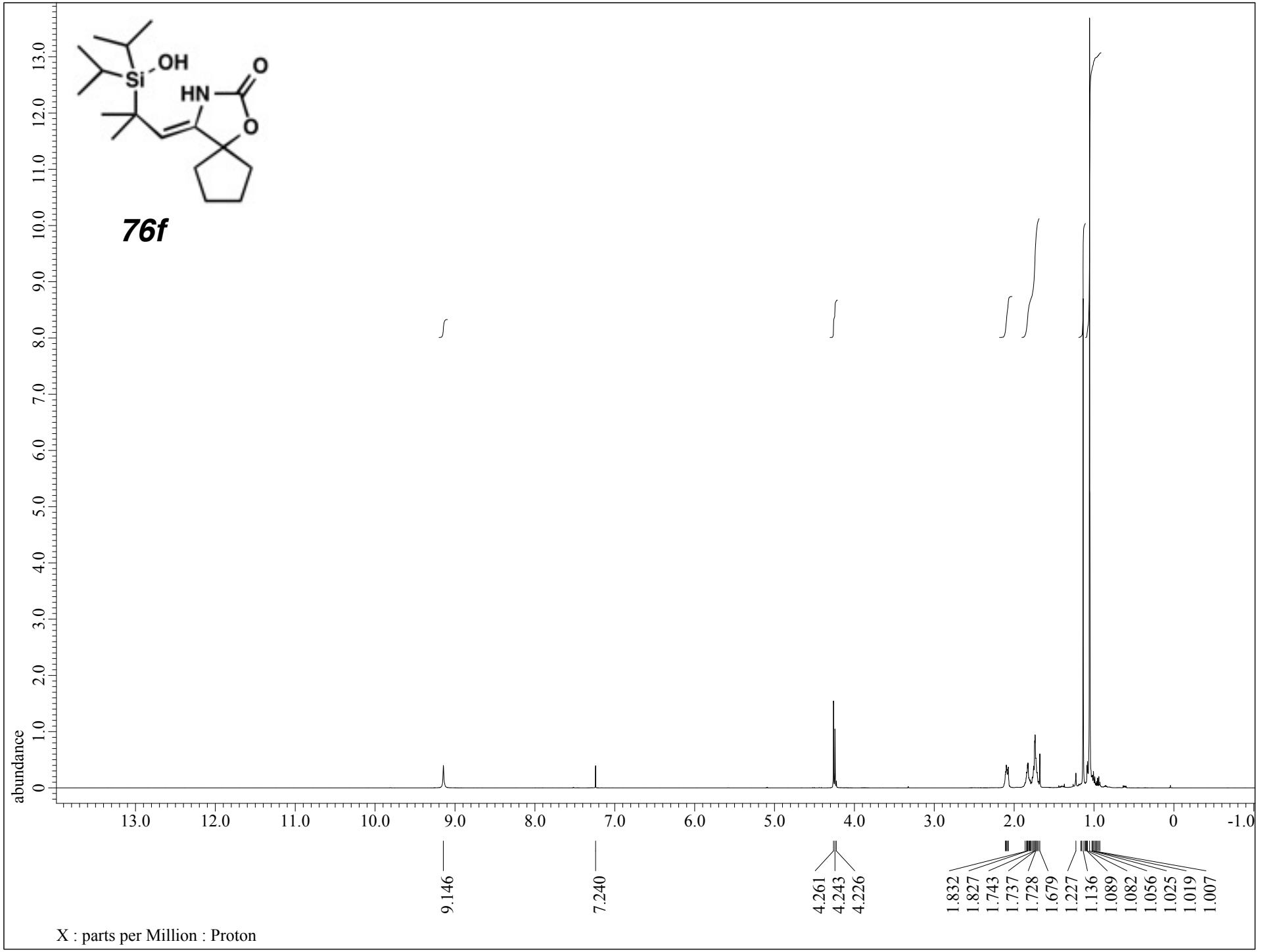

OH
Si
HN
O
O
76c
abundance
0.5
0.4
0.3
0.2
0.1
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.653
138.045
108.232
87.460
77.254
77.000
76.746
40.788
27.040
25.915
22.608
18.430
18.381
18.332
13.919
13.509
13.440
X : parts per Million : Carbon13

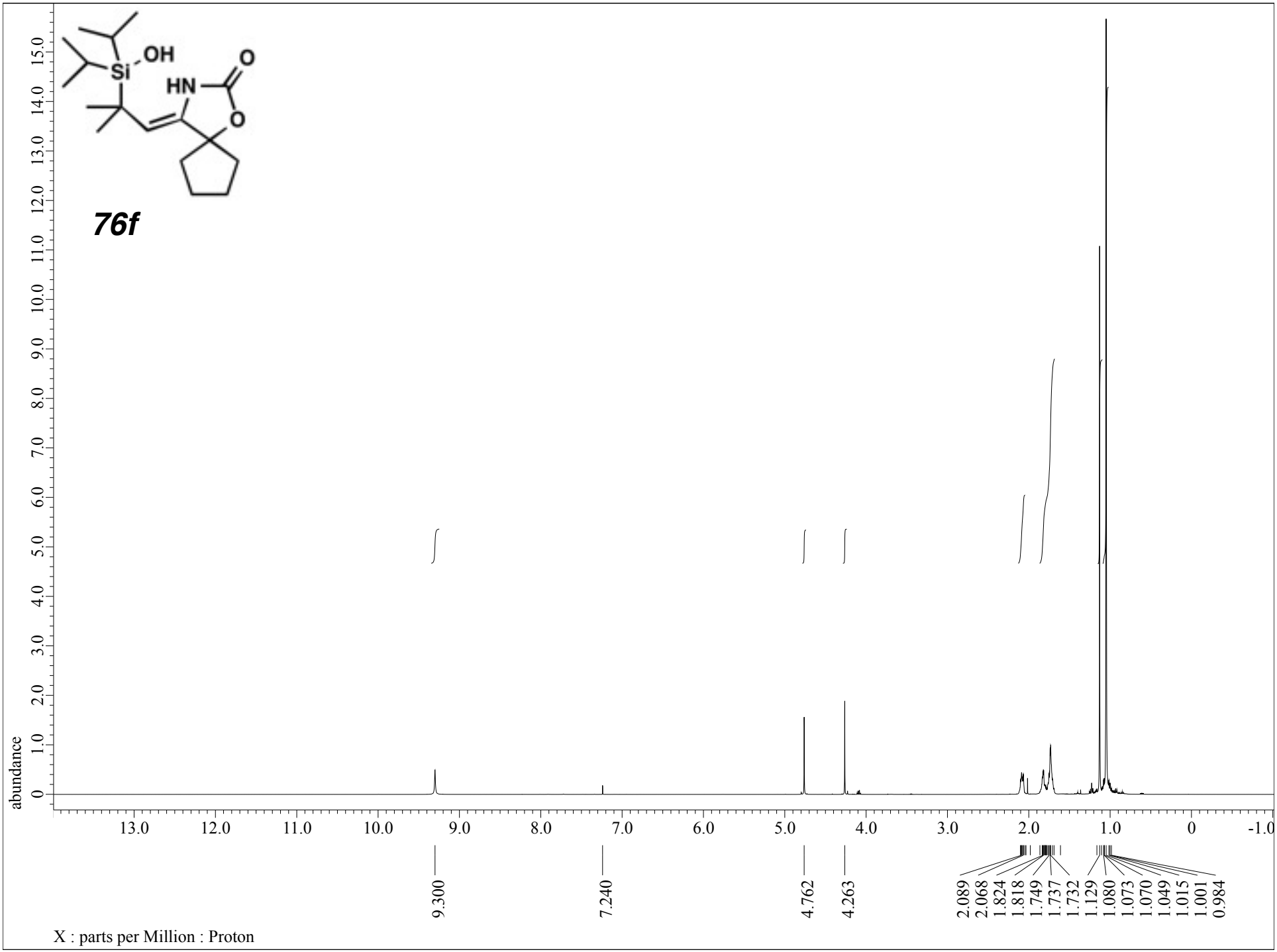

76d
abundance
X : parts per Million : Proton
9.251
7.240
4.464
4.164
1.701
1.637
1.624
1.543
1.531
1.401
1.140
1.129
1.066
1.061
1.051
0.923
0.911
0.897

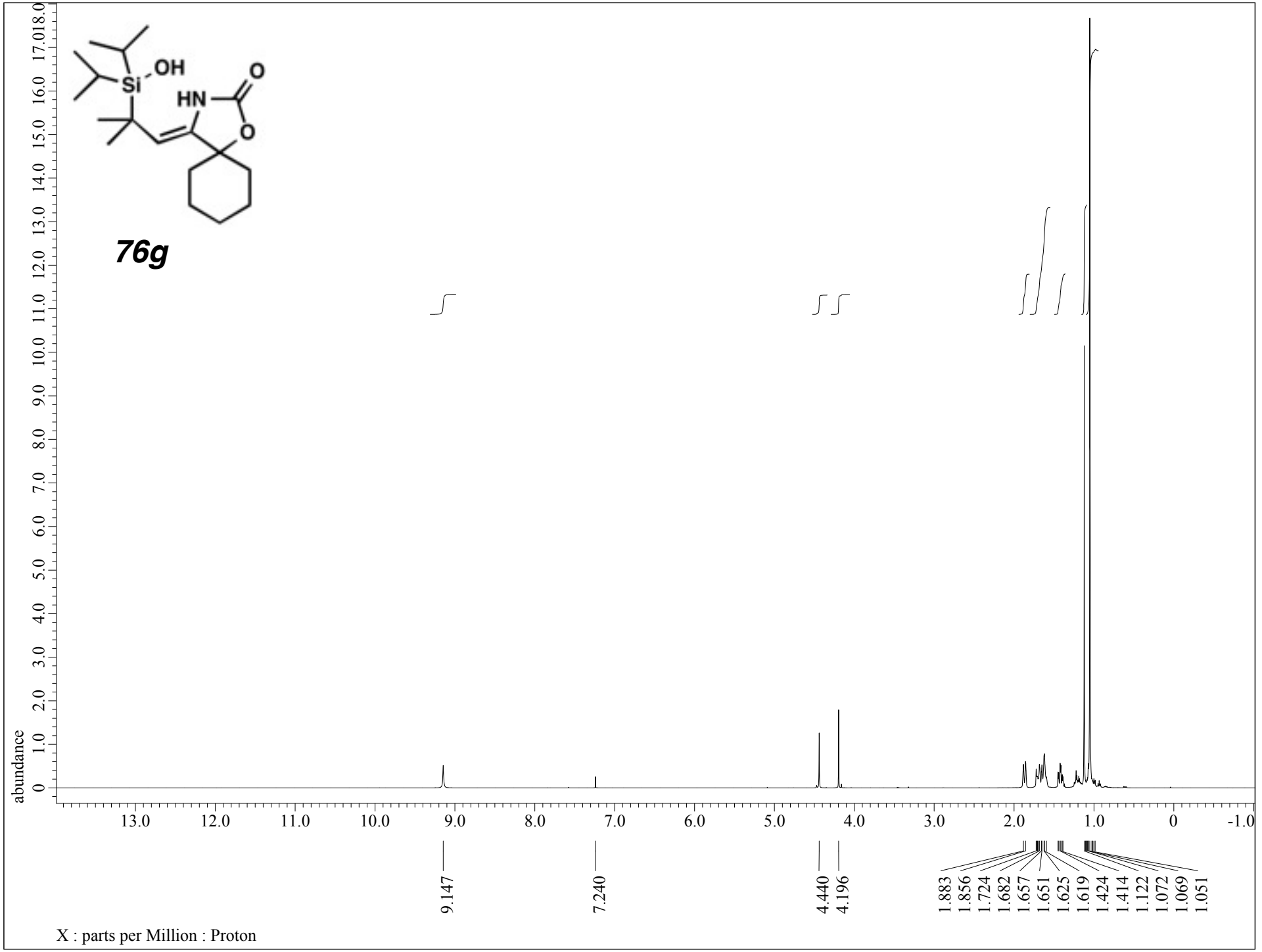

OH
Si
HN
O
O
76d
abundance
0
0.1
0.2
0.3
0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.546
138.564
108.261
87.763
77.254
77.000
76.755
49.163
27.706
26.072
25.132
24.271
24.007
18.459
18.401
18.381
18.332
13.450
X : parts per Million : Carbon13

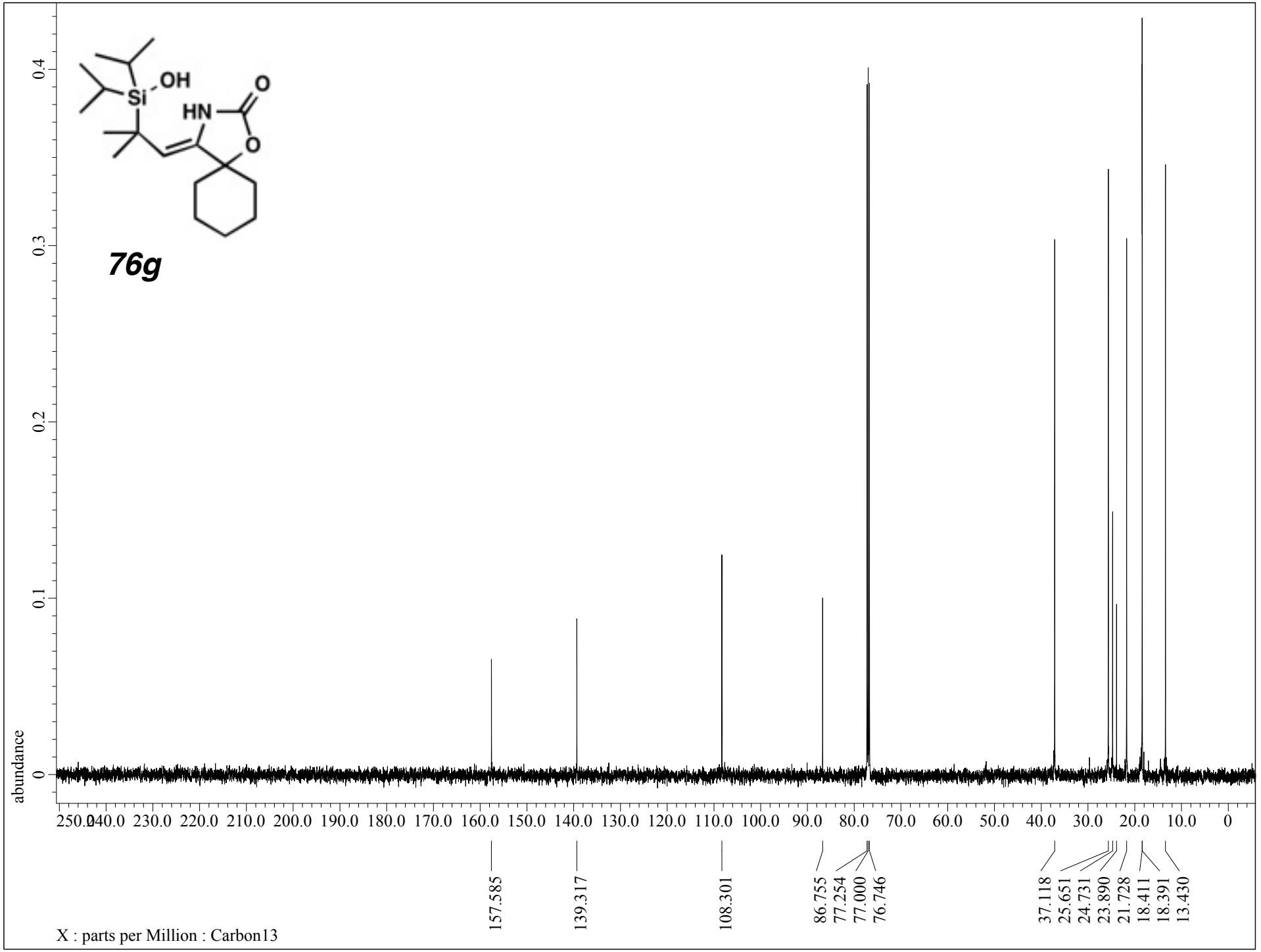

HO
Si
HN
O
O
O
76e
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
9.198
7.240
5.731
5.719
5.715
5.702
5.128
5.109
4.323
4.215
2.439
2.428
2.415
2.379
2.368
1.421
1.133
1.099
1.091
1.084
1.075
1.065
1.055
1.021
1.009
X : parts per Million : Proton

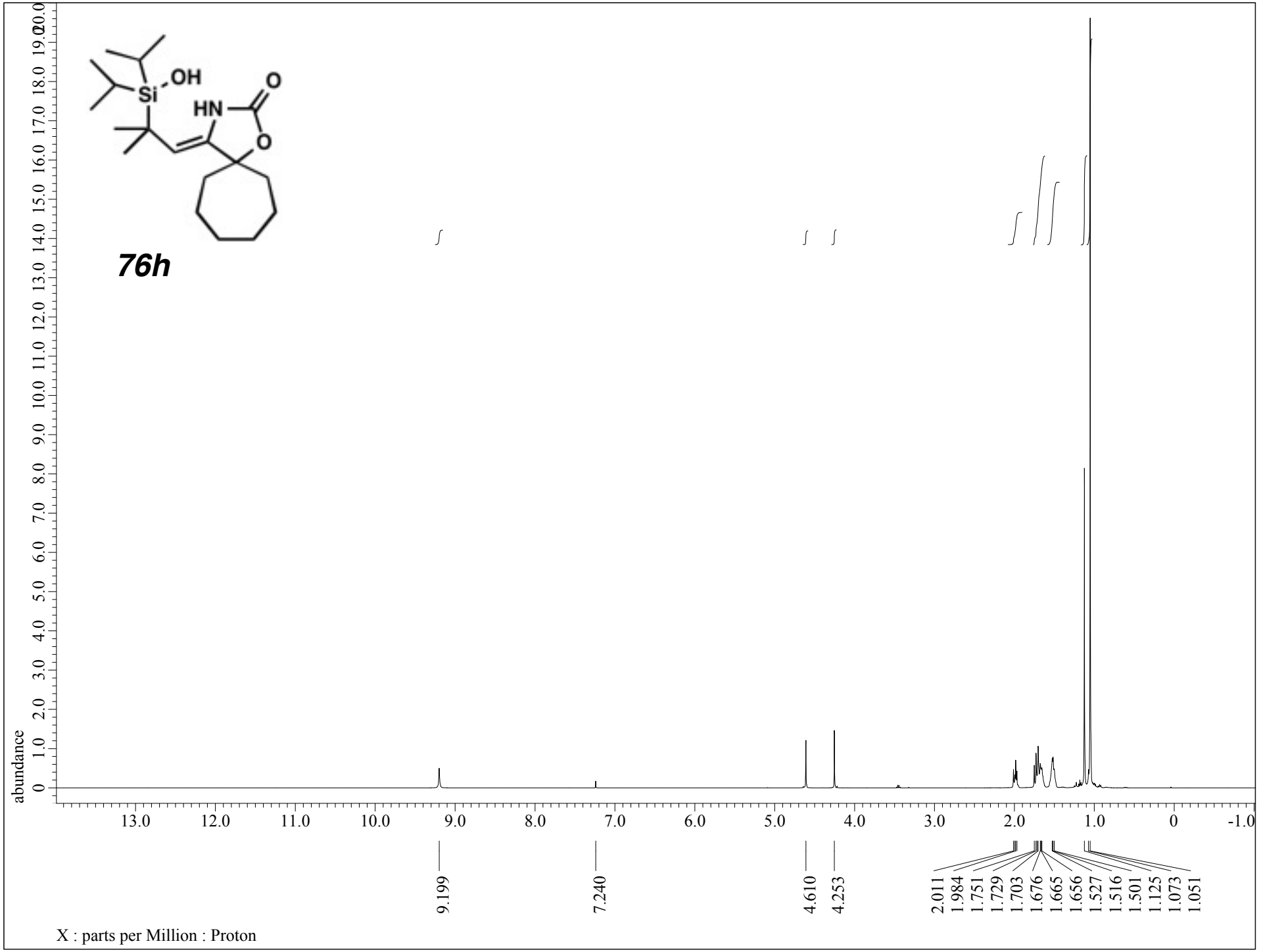

HO
Si
HN
O
O
76e
abundance
X : parts per Million : Carbon13
157.261
137.617
131.092
119.844
108.695
86.288
77.216
77.000
76.784
45.433
26.279
25.965
25.368
24.084
18.431
18.402
18.323
13.395
13.375

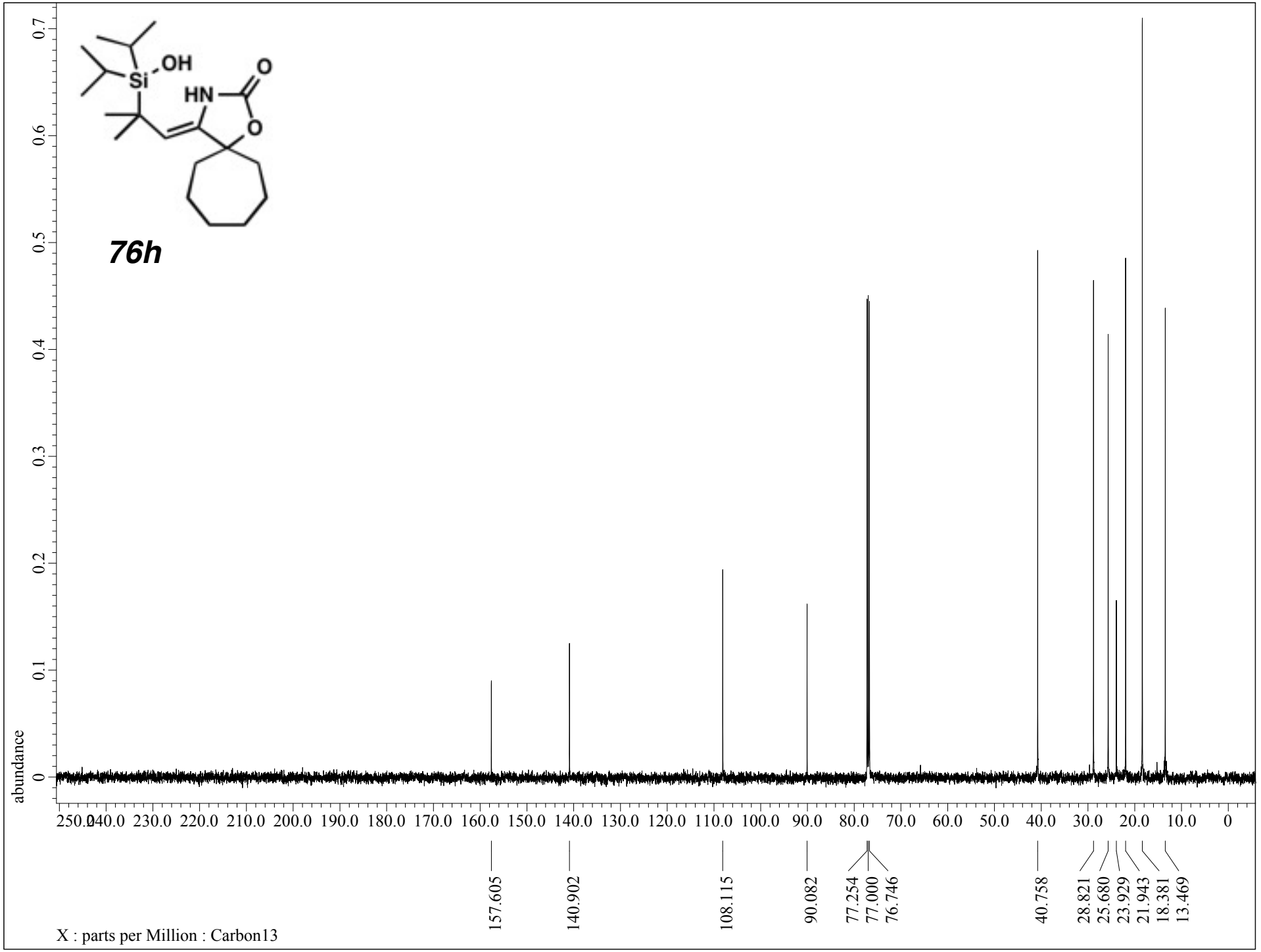

OH
Si
HN
O
O
76f
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
9.146
7.240
4.261
4.243
4.226
1.832
1.827
1.743
1.737
1.728
1.679
1.227
1.136
1.089
1.082
1.056
1.025
1.019
1.007
X : parts per Million : Proton

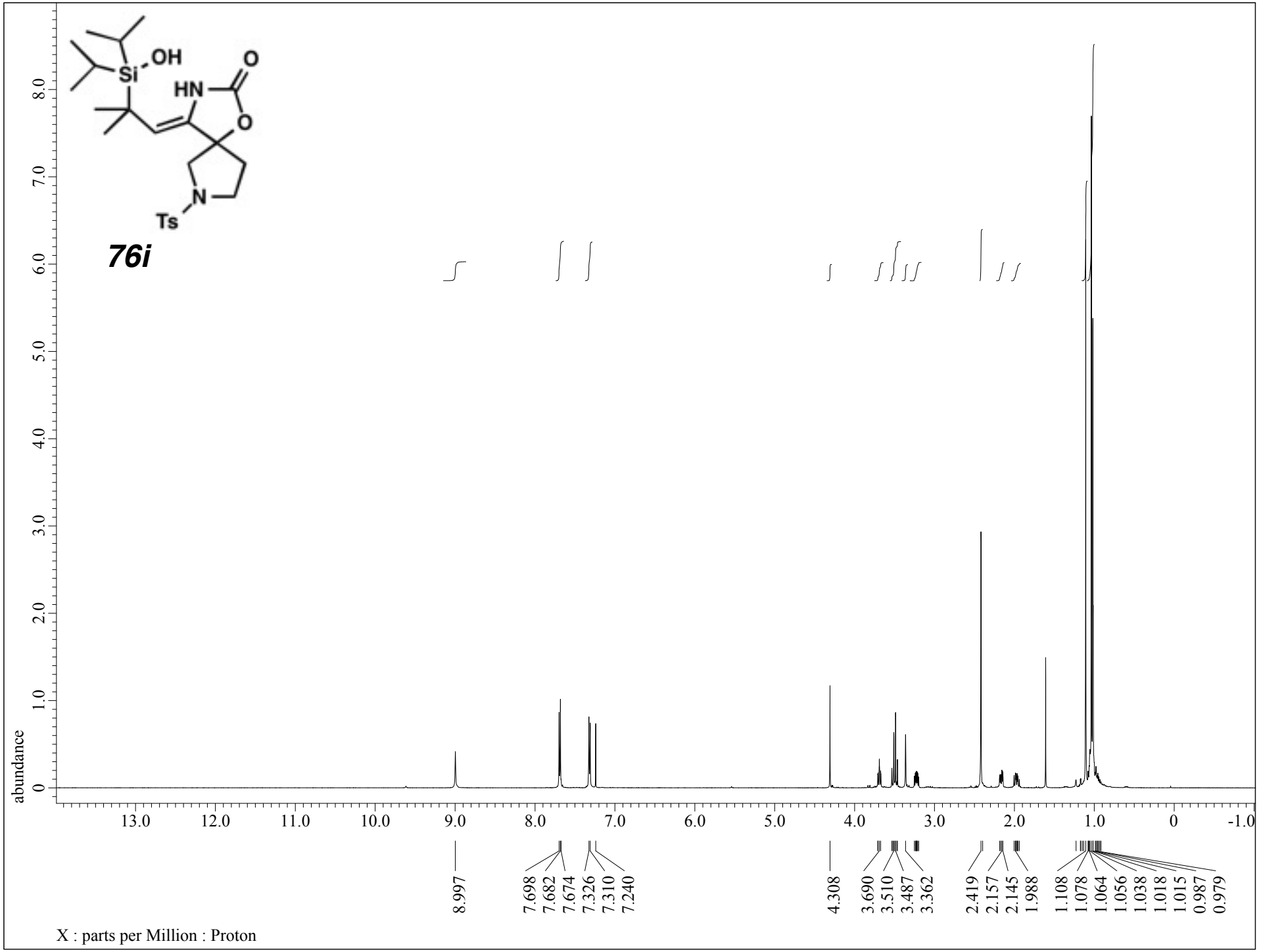

OH
Si
HN
O
O
76f
abundance
X : parts per Million : Proton
9.300
7.240
4.762
4.263
2.089
2.068
1.824
1.818
1.749
1.737
1.732
1.129
1.080
1.073
1.070
1.049
1.015
1.001
0.984

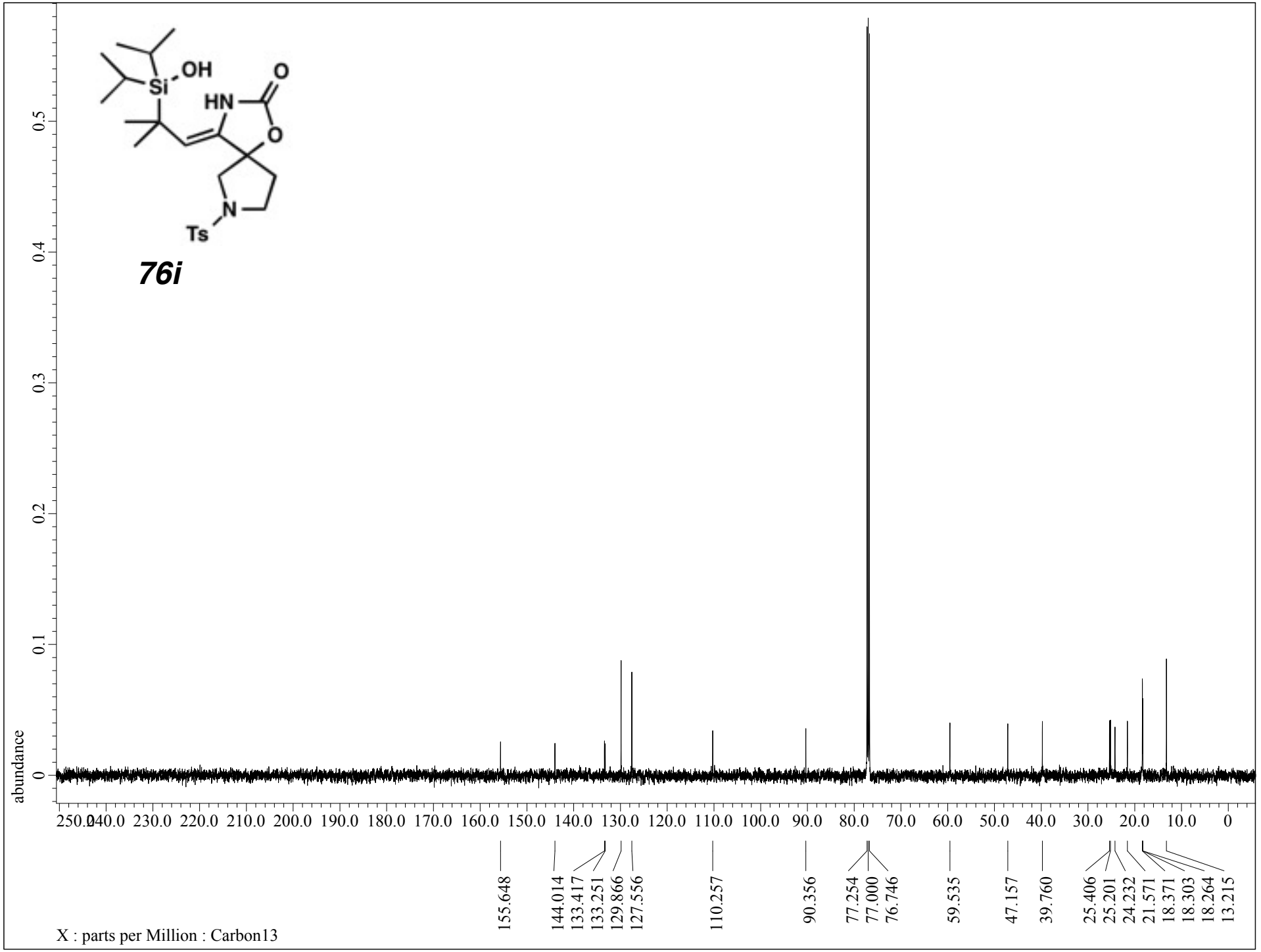

OH
Si
HN
O
O
76g
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
9.147
7.240
4.440
4.196
1.883
1.856
1.724
1.682
1.657
1.651
1.625
1.619
1.424
1.414
1.122
1.072
1.069
1.051
X : parts per Million : Proton

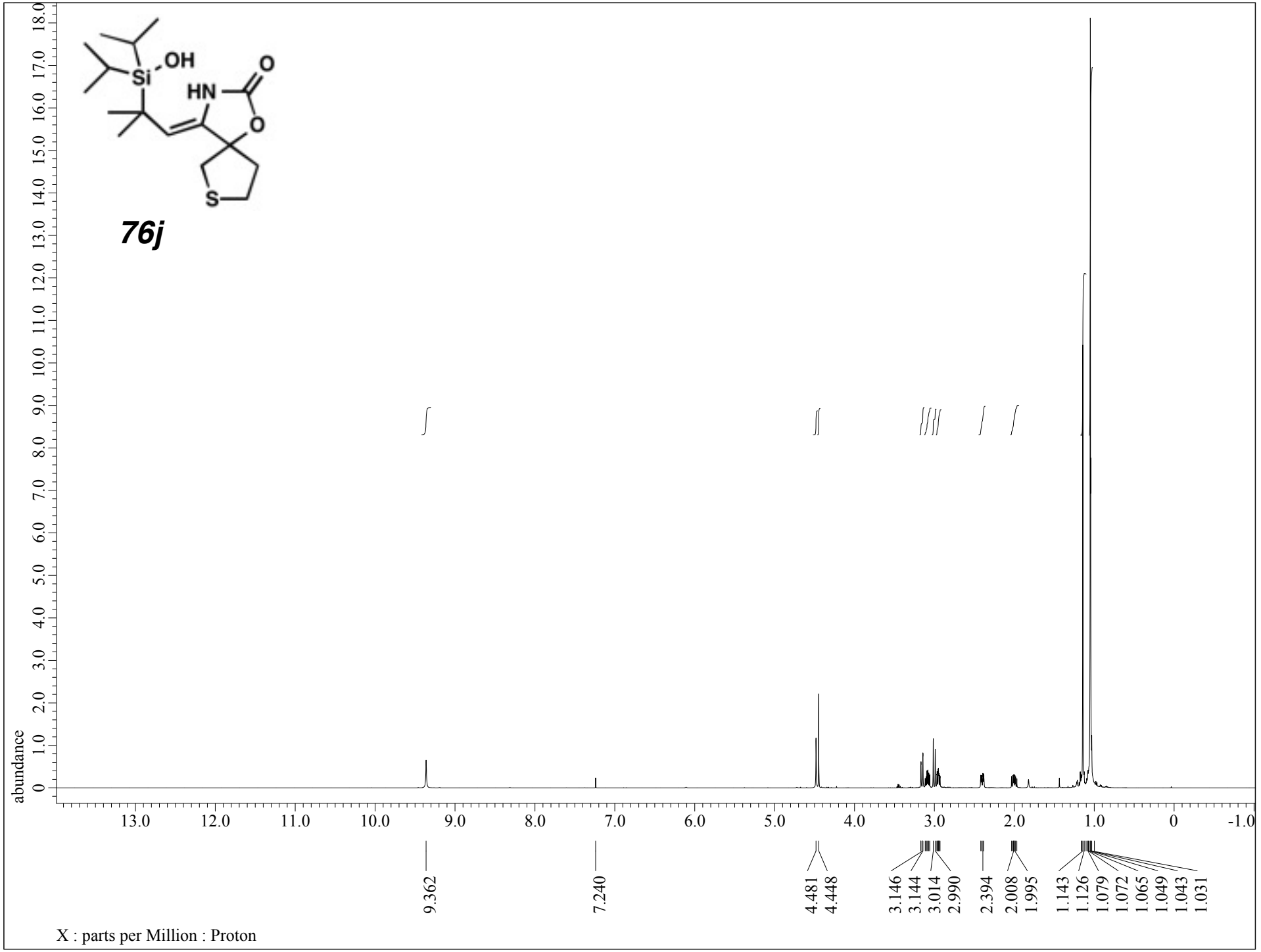

OH
Si
HN
O
O
76g
abundance
0
0.1
0.2
0.3
0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.585
139.317
108.301
86.755
77.254
77.000
76.746
37.118
25.651
24.731
23.890
21.728
18.411
18.391
13.430
X : parts per Million : Carbon13

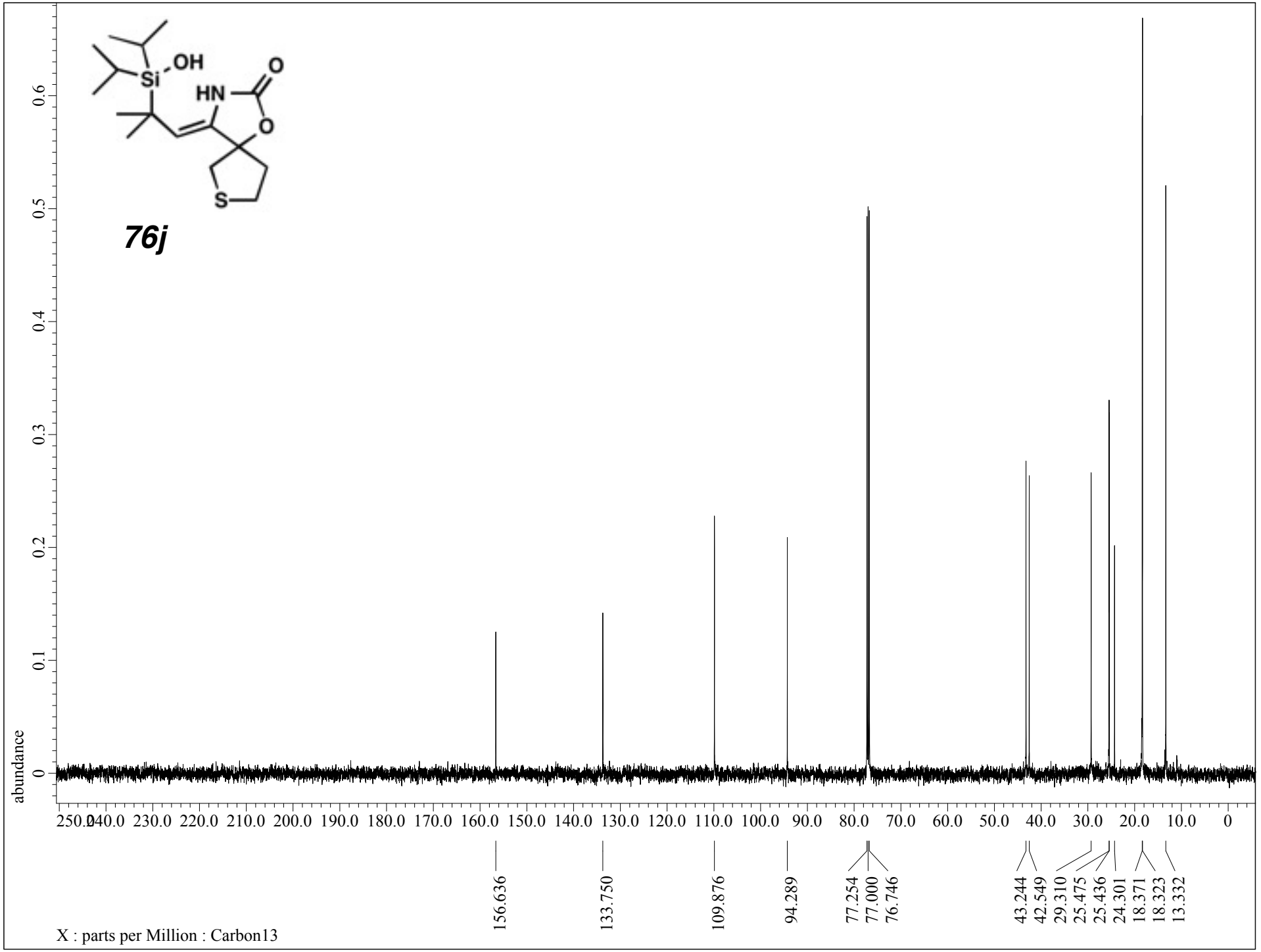

OH
Si
HN
O
O
76h
abundance
X : parts per Million : Proton
9.199
7.240
4.610
4.253
2.011
1.984
1.751
1.729
1.703
1.676
1.665
1.656
1.527
1.516
1.501
1.125
1.073
1.051

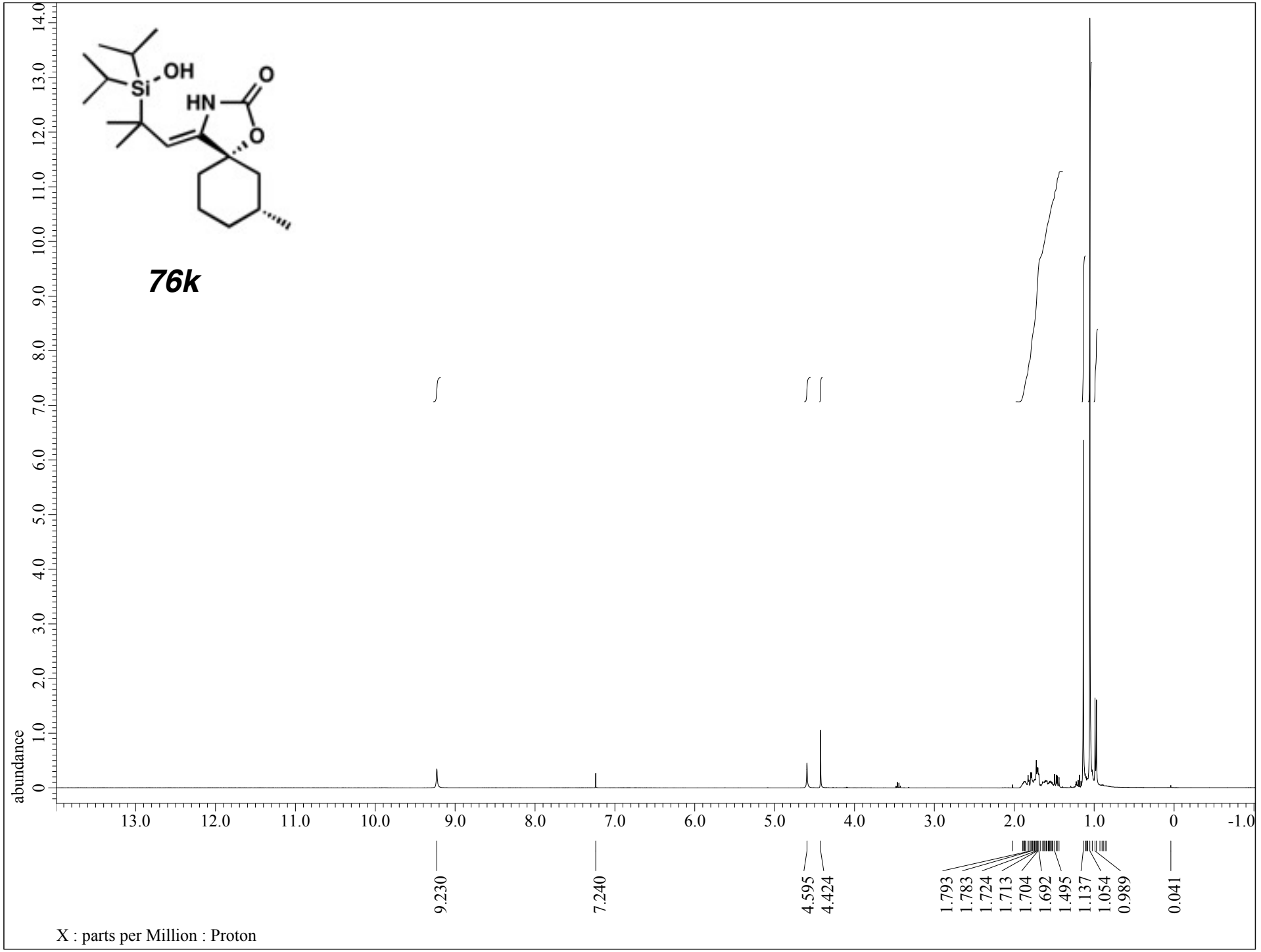

OH
Si
HN
O
O
76h
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.605
140.902
108.115
90.082
77.254
77.000
76.746
40.758
28.821
25.680
23.929
21.943
18.381
13.469
X : parts per Million : Carbon13

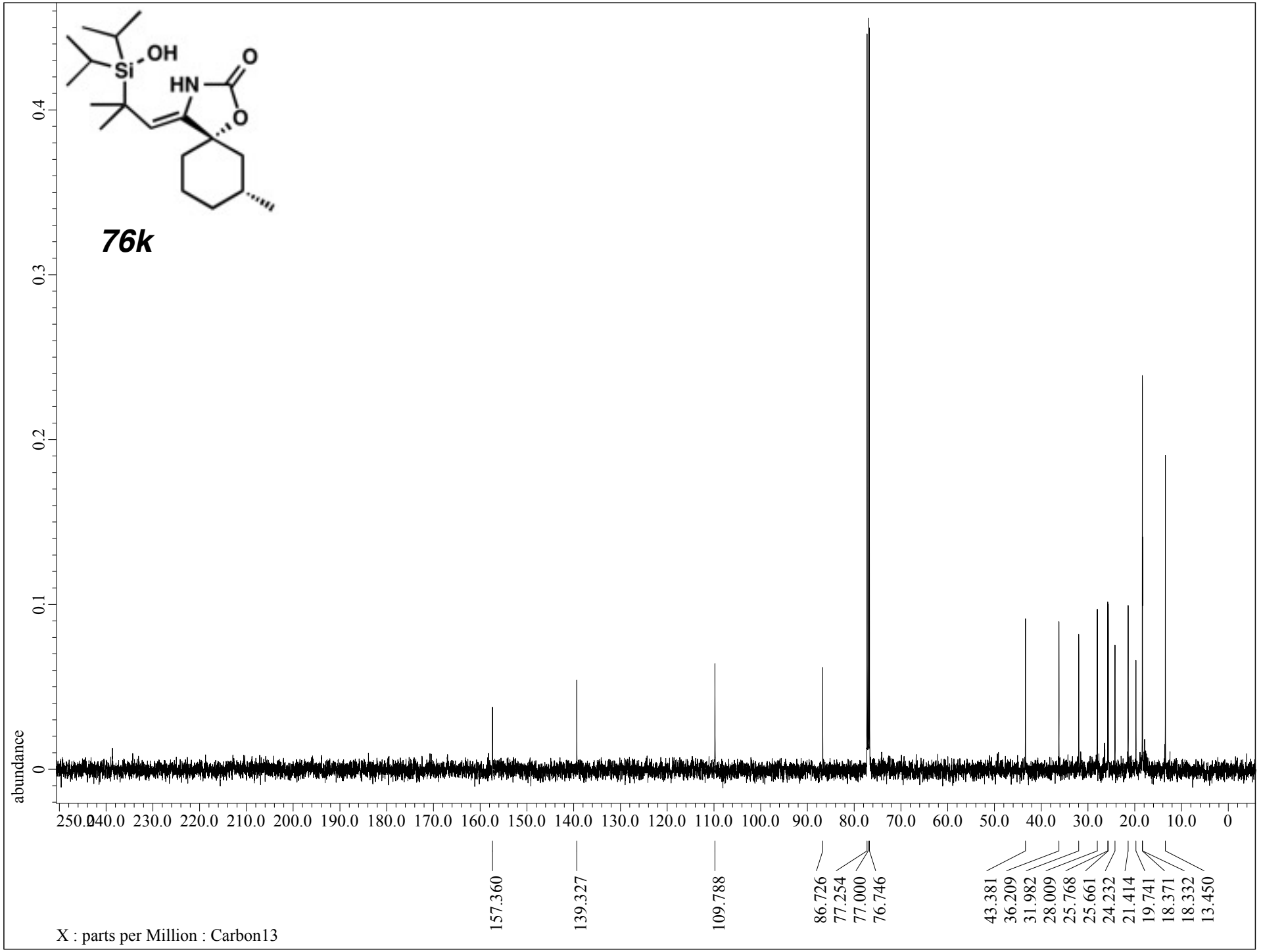

OH
Si
HN
O
O
N
Ts
76i
abundance
X : parts per Million : Proton
8.997
7.698
7.682
7.674
7.326
7.310
7.240
4.308
3.690
3.510
3.487
3.362
2.419
2.157
2.145
1.988
1.108
1.078
1.064
1.056
1.038
1.018
1.015
0.987
0.979

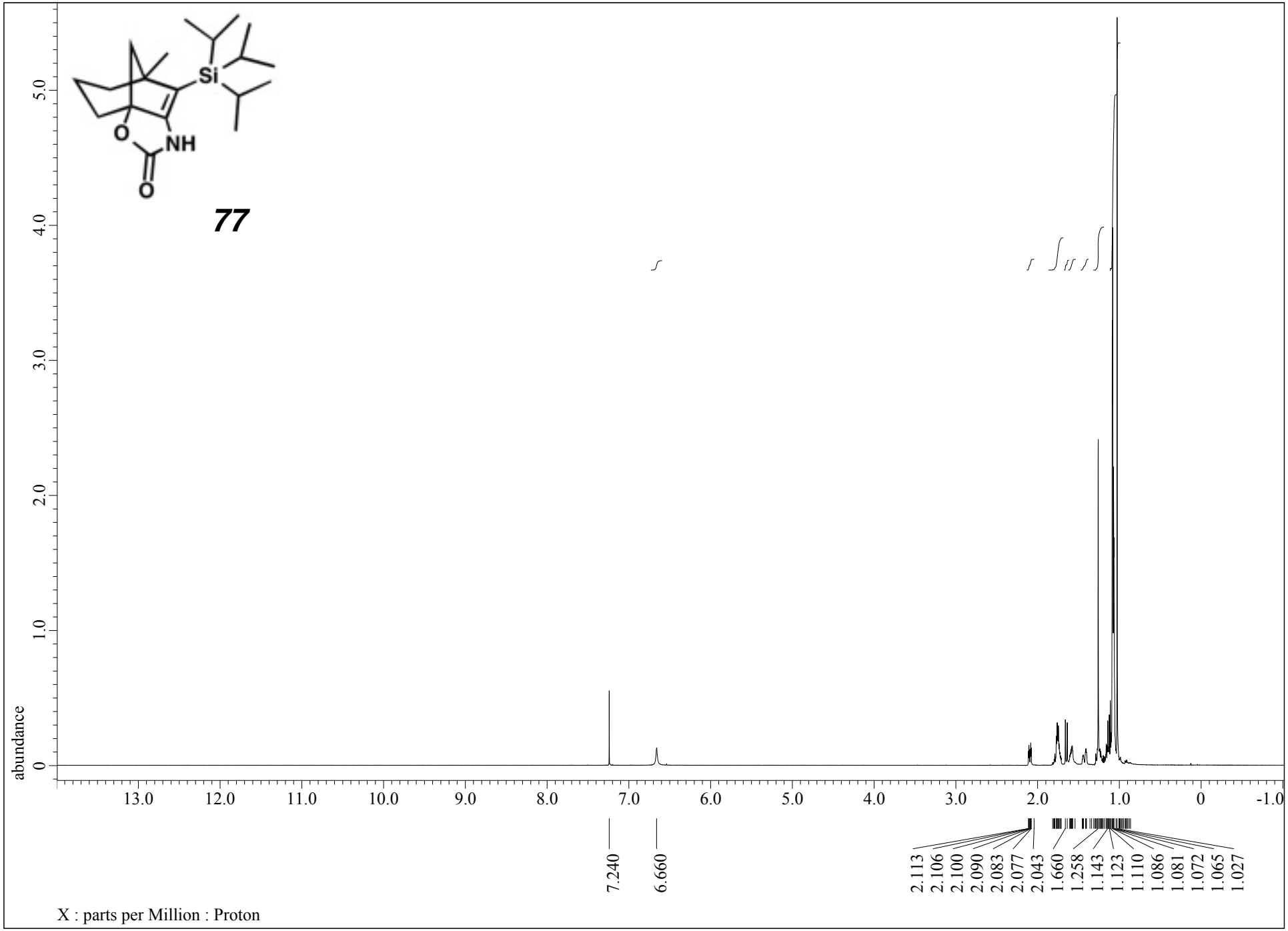

OH
Si
HN
O
O
N
Ts
76i
abundance
0
0.1
0.2
0.3
0.4
0.5
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
155.648
144.014
133.417
133.251
129.866
127.556
110.257
90.356
77.254
77.000
76.746
59.535
47.157
39.760
25.406
25.201
24.232
21.571
18.371
18.303
18.264
13.215
X : parts per Million : Carbon13

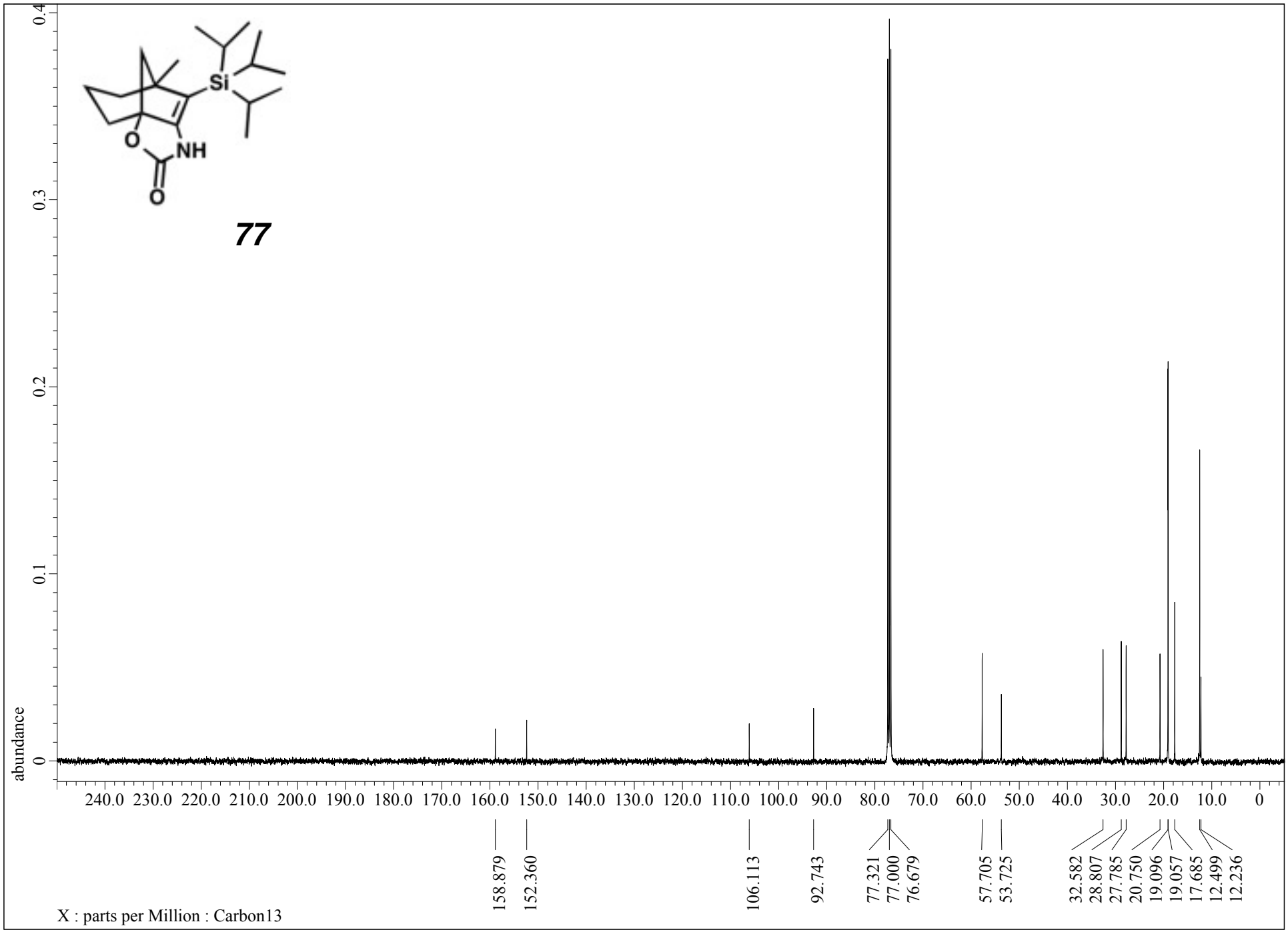

OH
Si
HN
O
O
S
76j
abundance
X : parts per Million : Proton
9.362
7.240
4.481
4.448
3.146
3.144
3.014
2.990
2.394
2.008
1.995
1.143
1.126
1.079
1.072
1.065
1.049
1.043
1.031

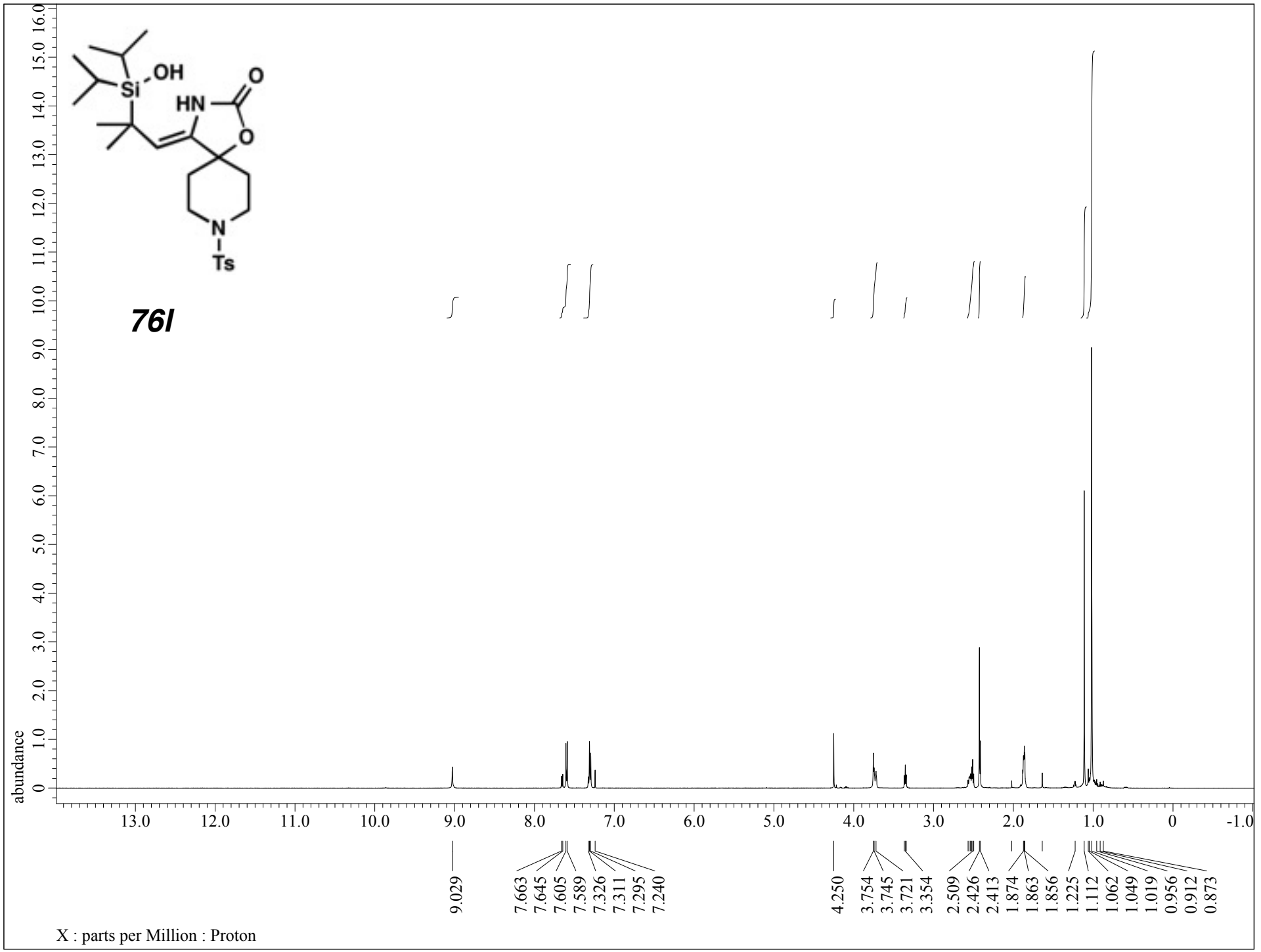

OH
Si
HN
O
O
S
76j
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
156.636
133.750
109.876
94.289
77.254
77.000
76.746
43.244
42.549
29.310
25.475
25.436
24.301
18.371
18.323
13.332
X : parts per Million : Carbon13

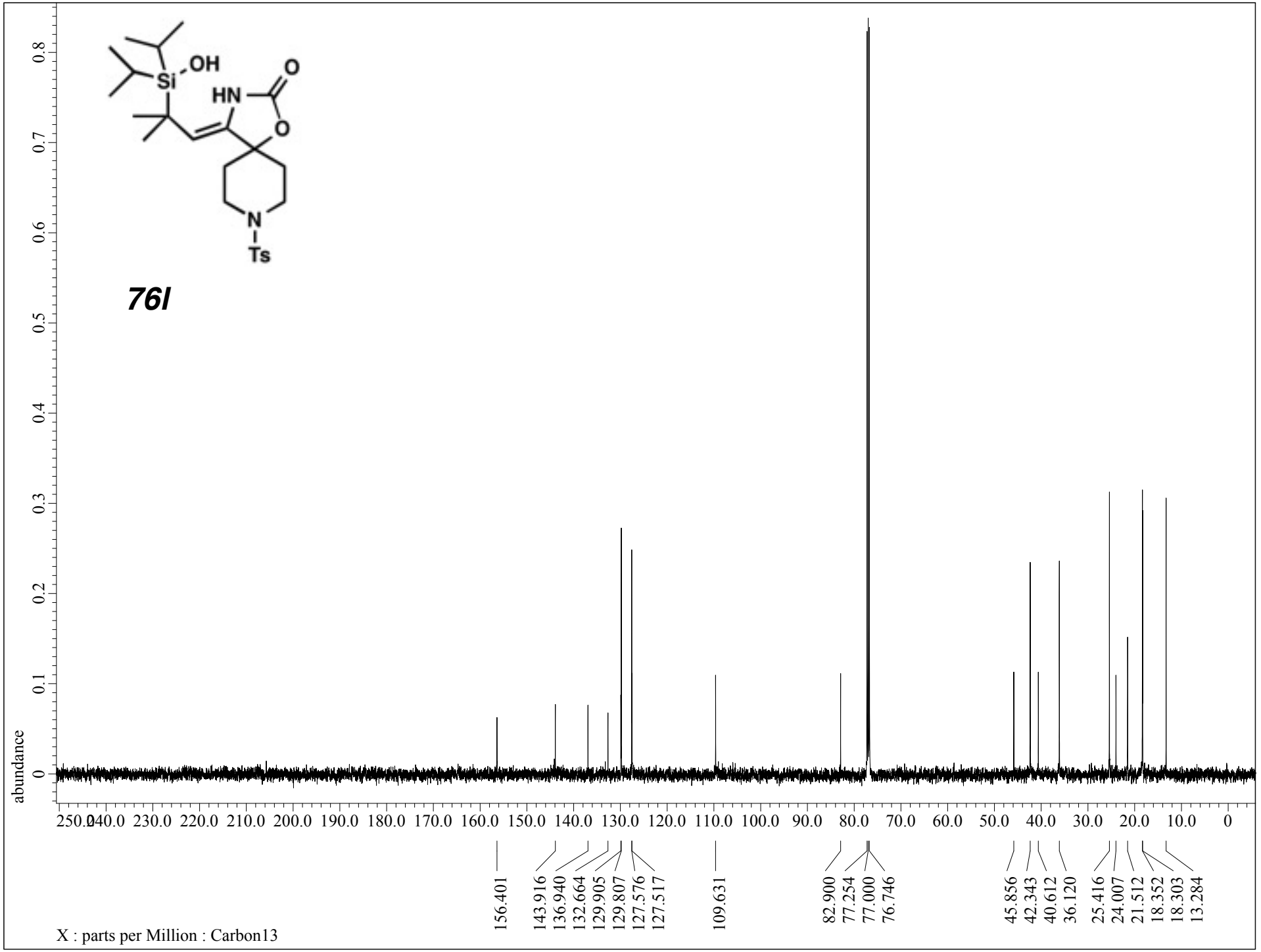

OH
Si
HN
O
O
76k
abundance
X : parts per Million : Proton
9.230
7.240
4.595
4.424
1.793
1.783
1.724
1.713
1.704
1.692
1.495
1.137
1.054
0.989
0.041

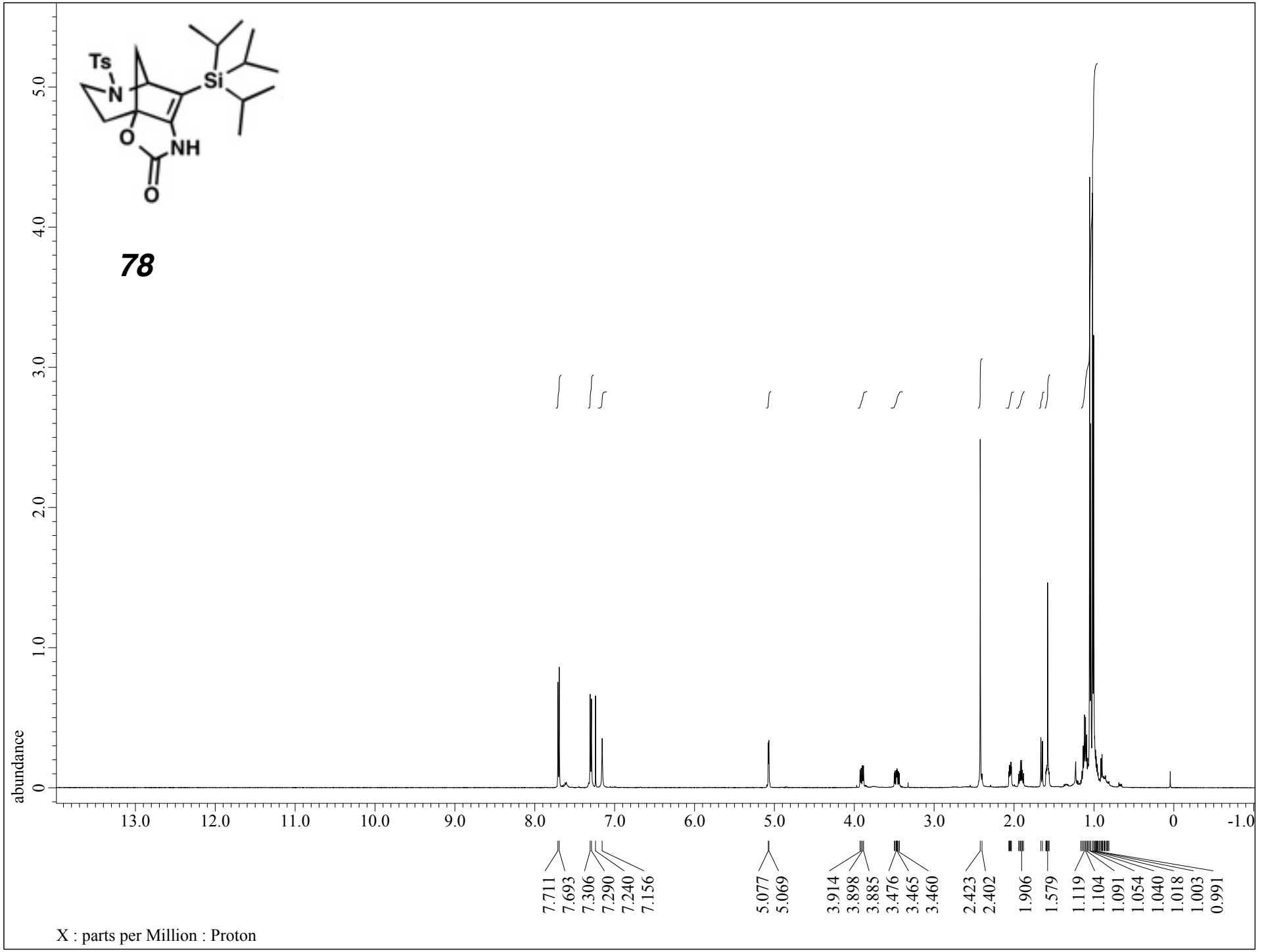

76k
Si
OH
HN
O
O
abundance
0
0.1
0.2
0.3
0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.360
139.327
109.788
86.726
77.254
77.000
76.746
43.381
36.209
31.982
28.009
25.768
25.661
24.232
21.414
19.741
18.371
18.332
13.450
X : parts per Million : Carbon13

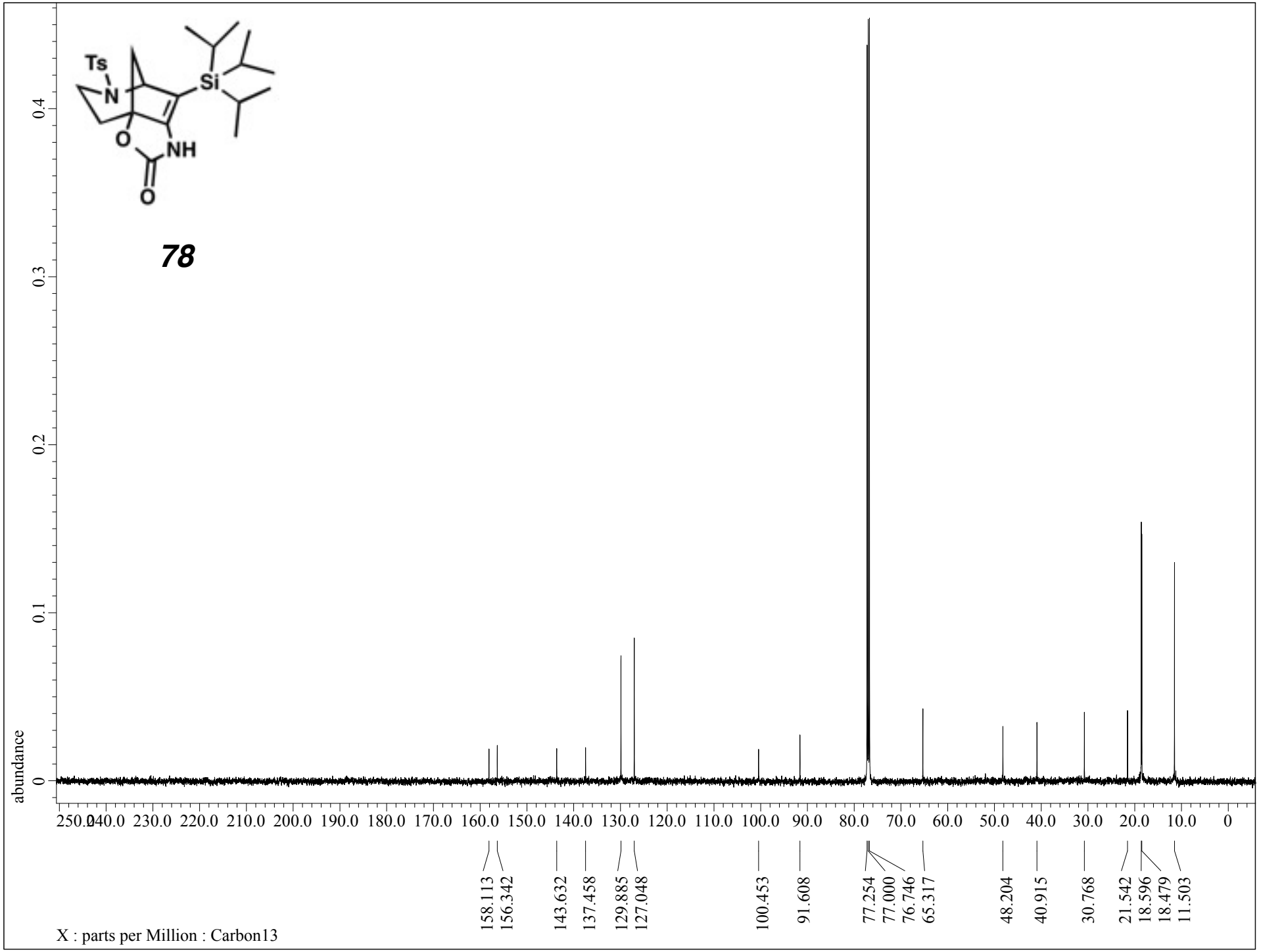

Si
O
NH
O
77
abundance
0
1.0
2.0
3.0
4.0
5.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
6.660
2.113
2.106
2.100
2.090
2.083
2.077
2.043
1.660
1.258
1.143
1.123
1.110
1.086
1.081
1.072
1.065
1.027
X : parts per Million : Proton

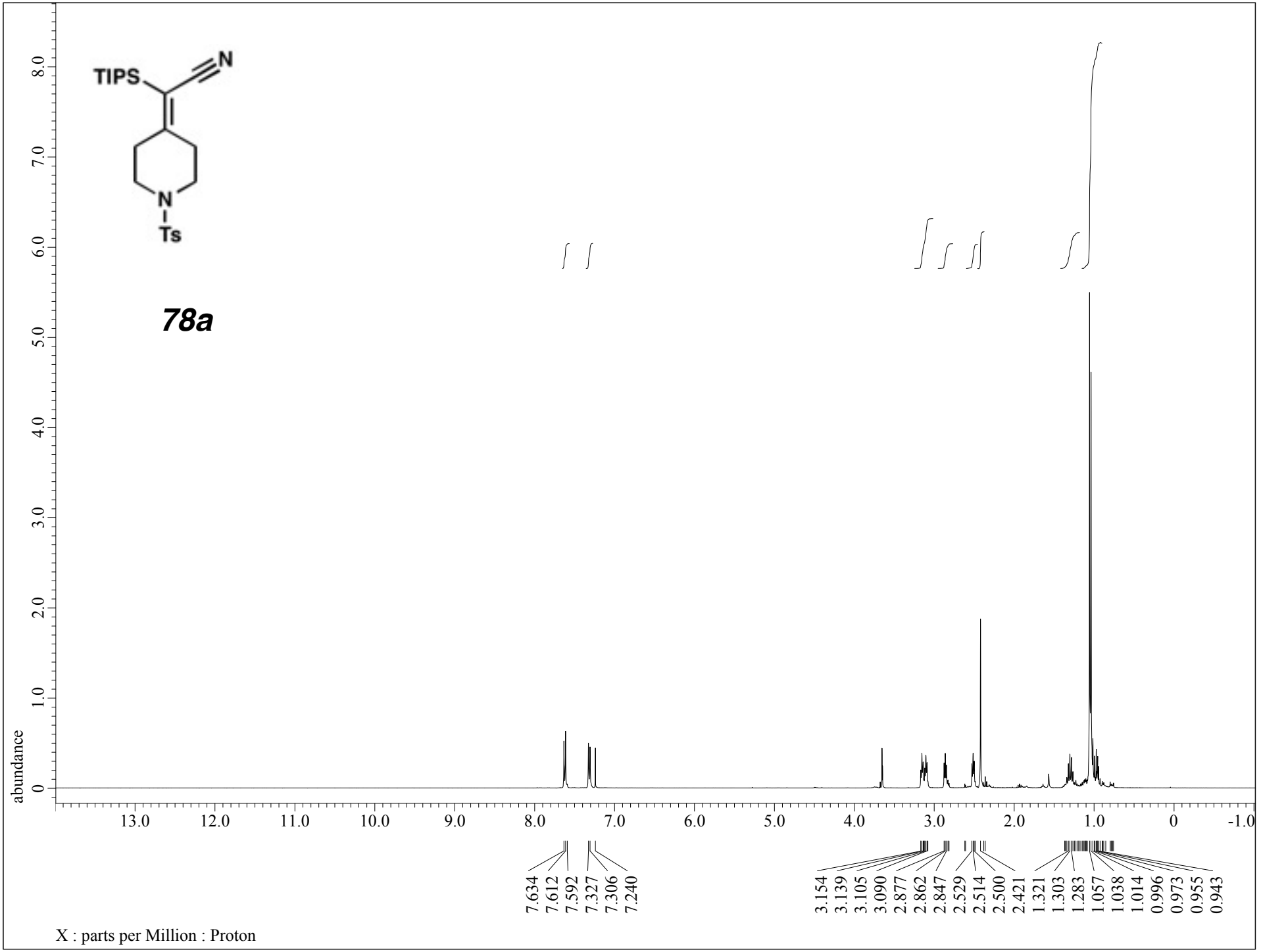

Si
O
NH
O
77
abundance
0.4
0.3
0.2
0.1
0
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
158.879
152.360
106.113
92.743
77.321
77.000
76.679
57.705
53.725
32.582
28.807
27.785
20.750
19.096
19.057
17.685
12.499
12.236
X : parts per Million : Carbon13

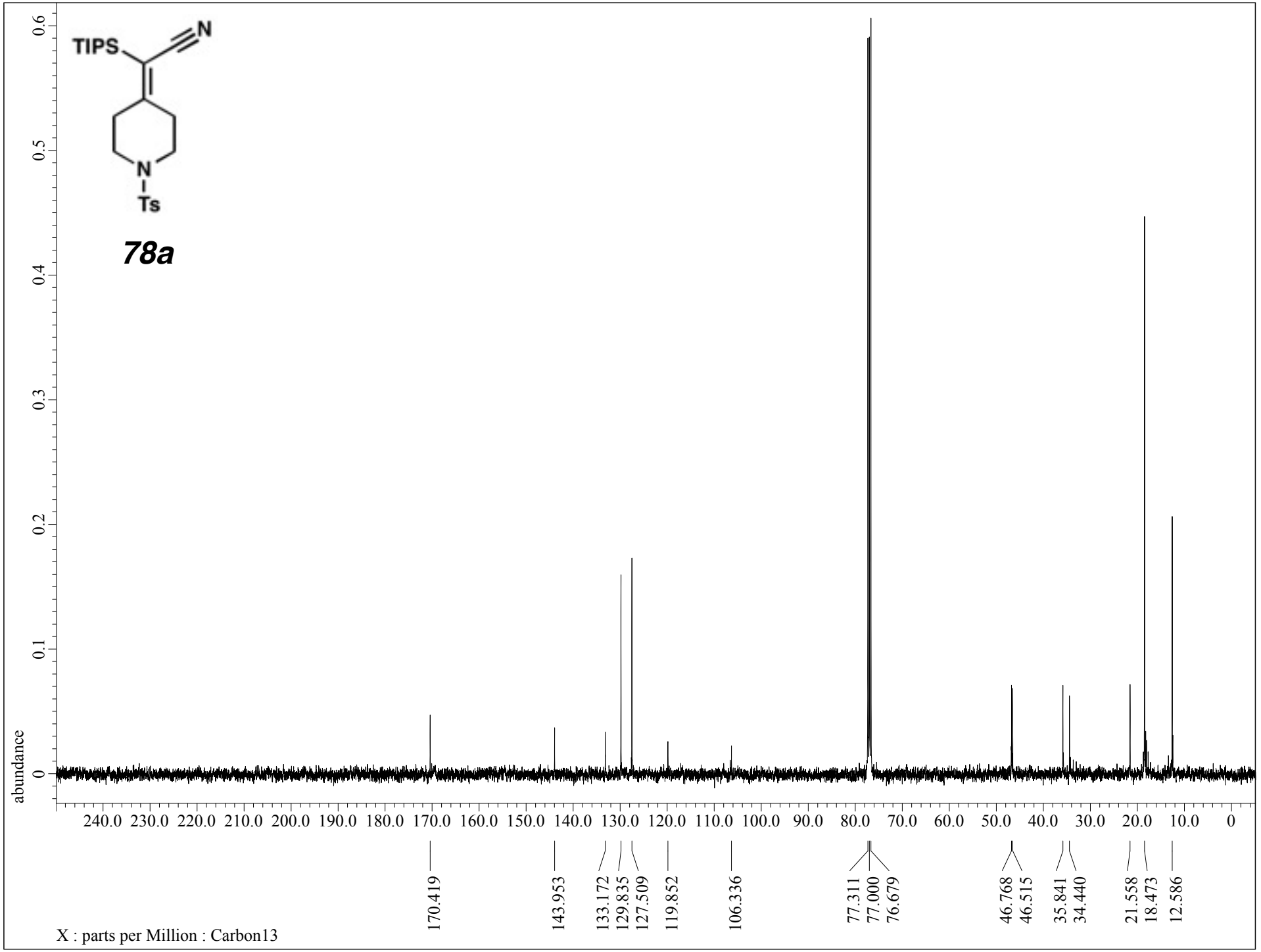

OH
Si
HN
O
O
N
Ts
76l
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
9.029
7.663
7.645
7.605
7.589
7.326
7.311
7.295
7.240
4.250
3.754
3.745
3.721
3.354
2.509
2.426
2.413
1.874
1.863
1.856
1.225
1.112
1.062
1.049
1.019
0.956
0.912
0.873
X : parts per Million : Proton

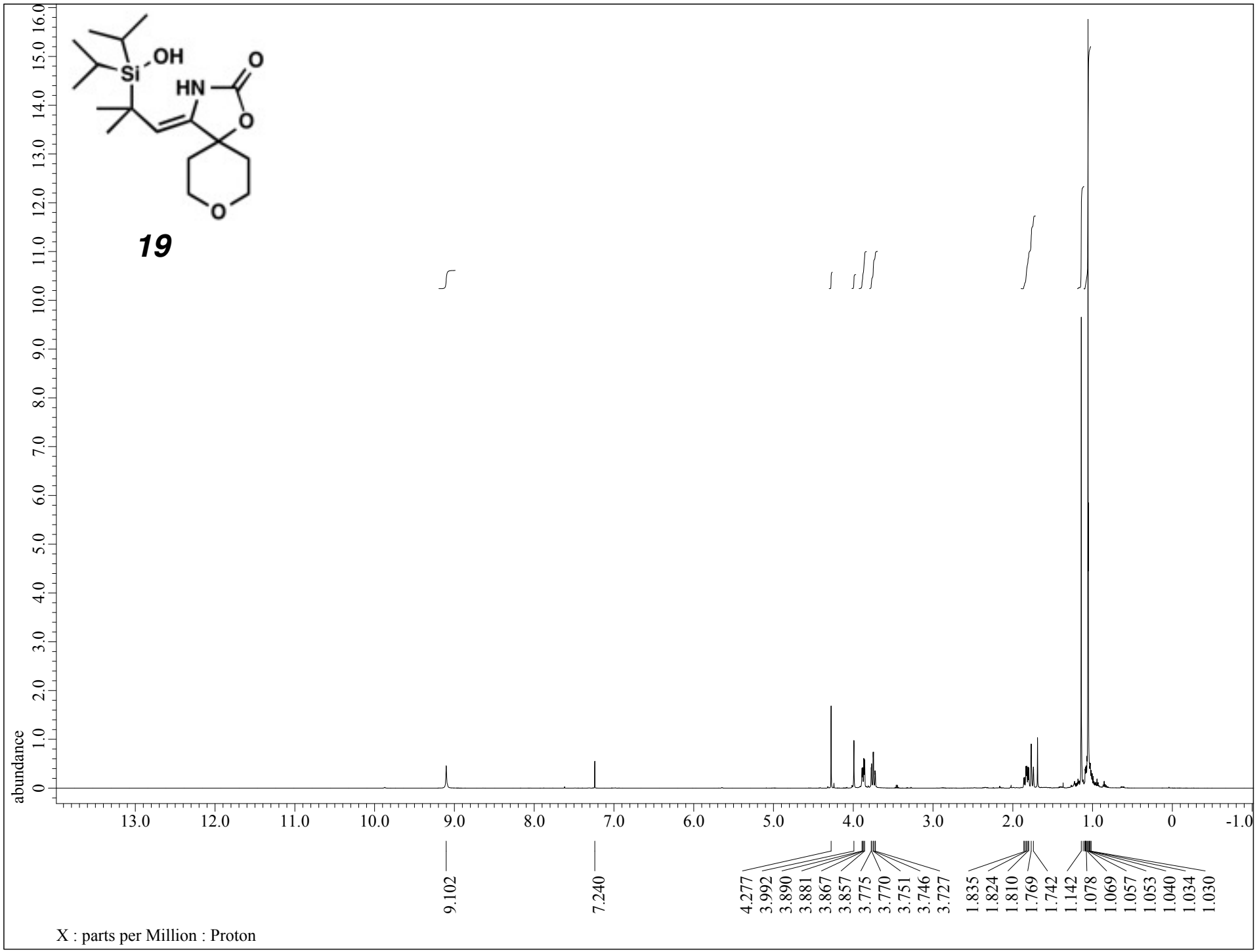

OH
Si
HN
O
O
N
Ts
76l
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
156.401
143.916
136.940
132.664
129.905
129.807
127.576
127.517
109.631
82.900
77.254
77.000
76.746
45.856
42.343
40.612
36.120
25.416
24.007
21.512
18.352
18.303
13.284
X : parts per Million : Carbon13

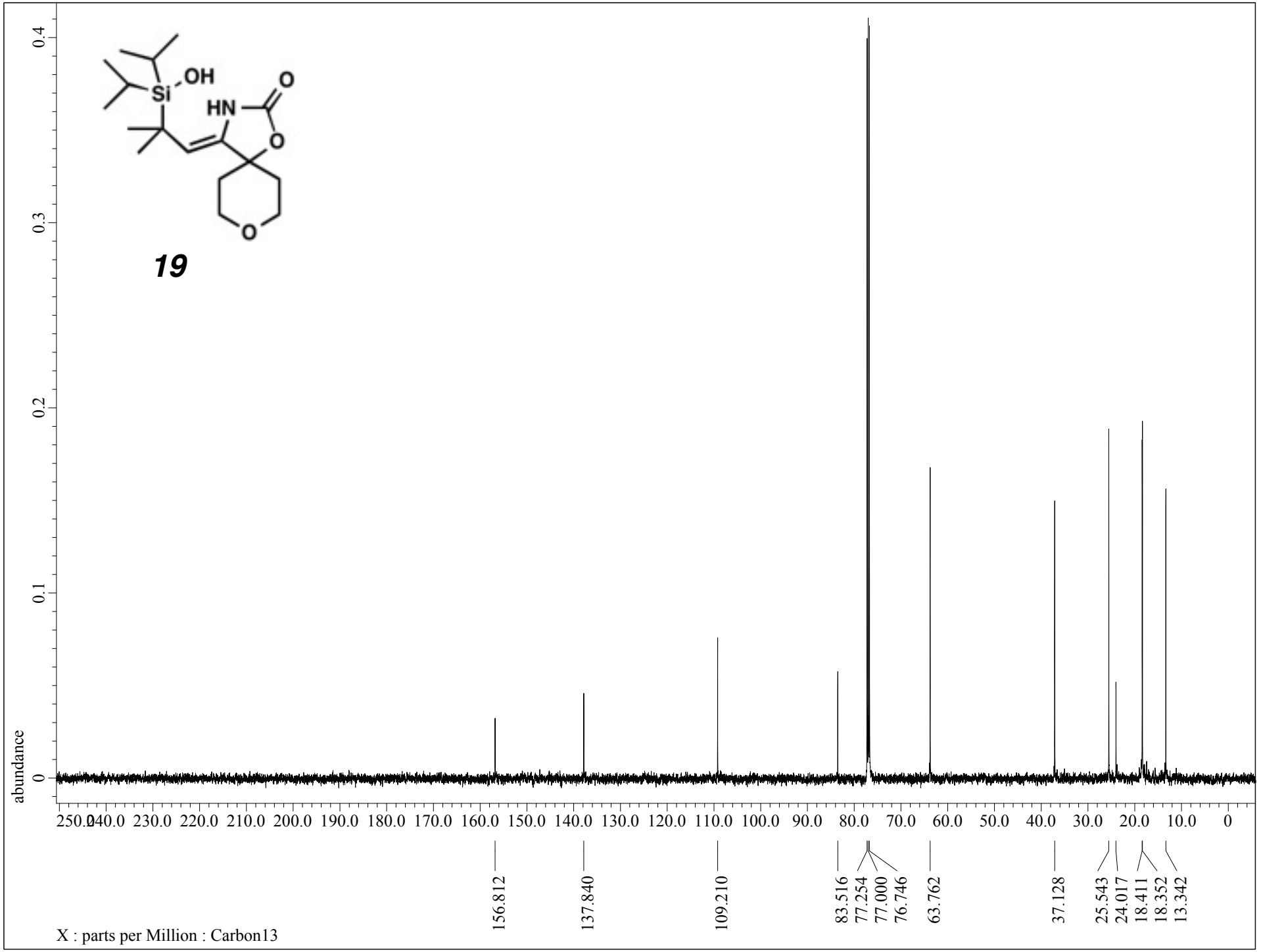

Ts
N
Si
O
NH
O
78
abundance
0
1.0
2.0
3.0
4.0
5.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.711
7.693
7.306
7.290
7.240
7.156
5.077
5.069
3.914
3.898
3.885
3.476
3.465
3.460
2.423
2.402
1.906
1.579
1.119
1.104
1.091
1.054
1.040
1.018
1.003
0.991
X : parts per Million : Proton

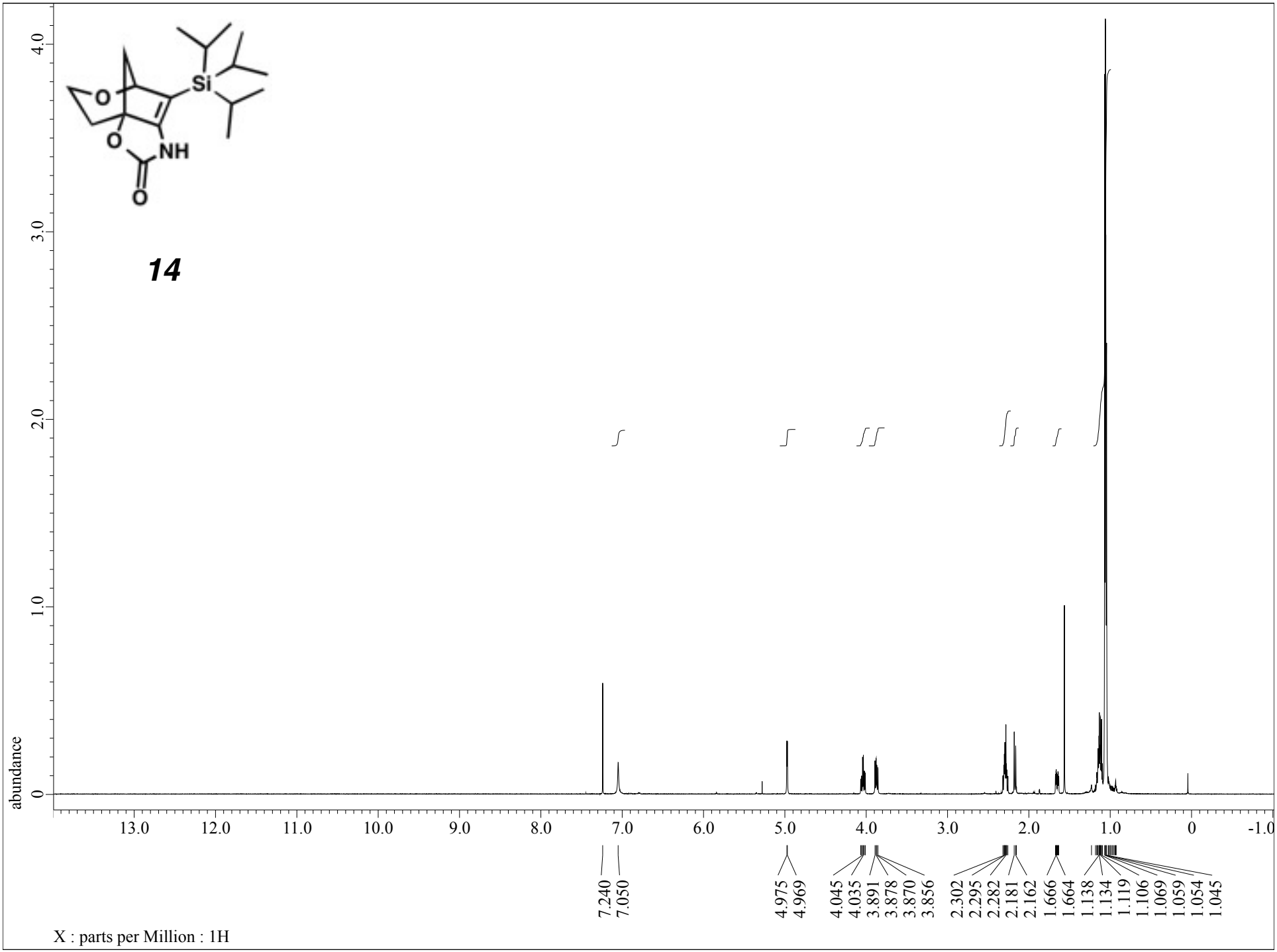

Ts
N
Si
O
NH
O
78
abundance
0
0.1
0.2
0.3
0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
158.113
156.342
143.632
137.458
129.885
127.048
100.453
91.608
77.254
77.000
76.746
65.317
48.204
40.915
30.768
21.542
18.596
18.479
11.503
X : parts per Million : Carbon13

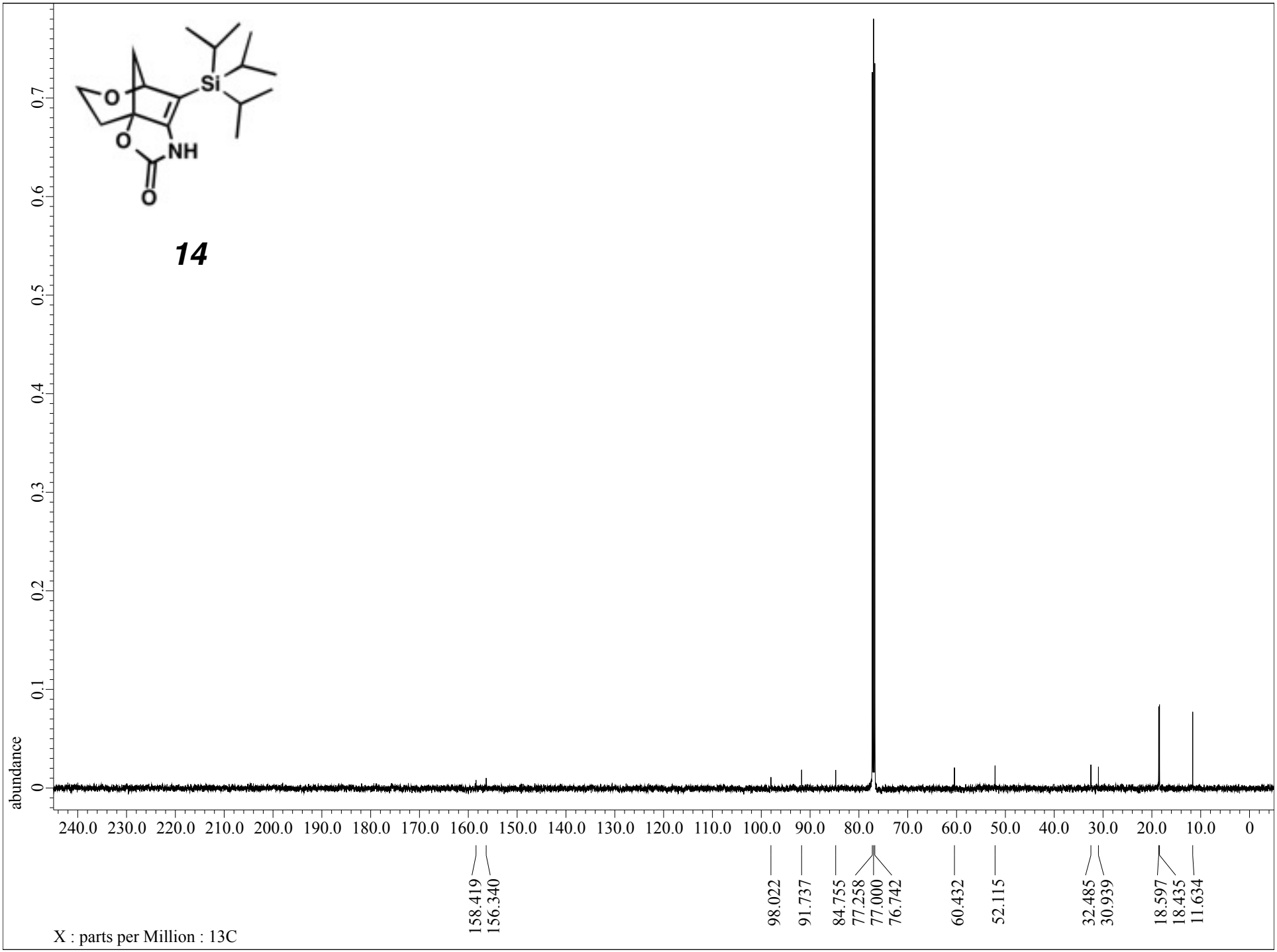

TIPS
N
N
Ts
78a
abundance
X : parts per Million : Proton
7.634
7.612
7.592
7.327
7.306
7.240
3.154
3.139
3.105
3.090
2.877
2.862
2.847
2.529
2.514
2.500
2.421
1.321
1.303
1.283
1.057
1.038
1.014
0.996
0.973
0.955
0.943

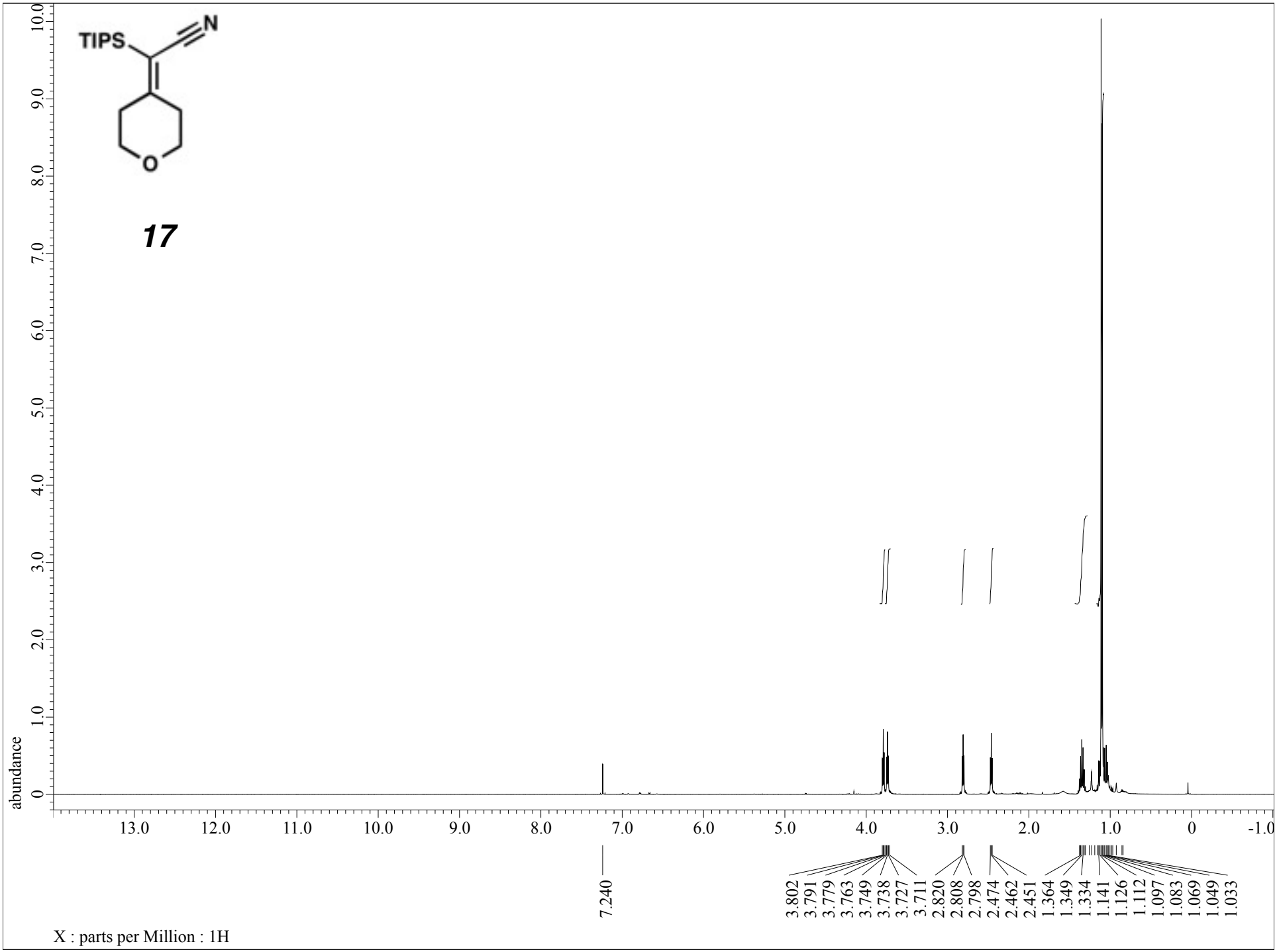

TIPS
N
N
Ts
78a
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
170.419
143.953
133.172
129.835
127.509
119.852
106.336
77.311
77.000
76.679
46.768
46.515
35.841
34.440
21.558
18.473
12.586
X : parts per Million : Carbon13

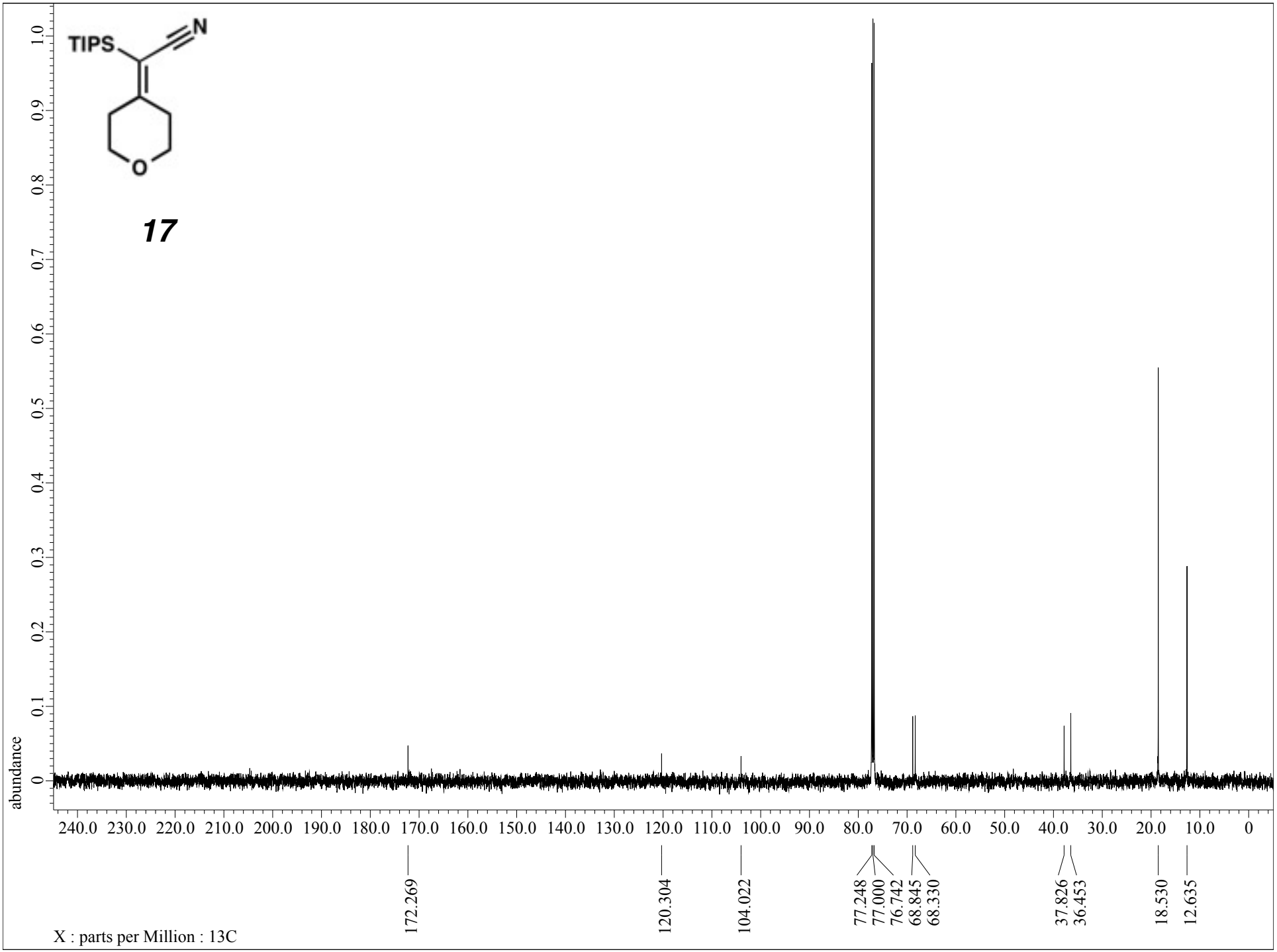

OH
Si
HN
O
O
O
19
abundance
X : parts per Million : Proton
9.102
7.240
4.277
3.992
3.890
3.881
3.867
3.857
3.775
3.770
3.751
3.746
3.727
1.835
1.824
1.810
1.769
1.742
1.142
1.078
1.069
1.057
1.053
1.040
1.034
1.030

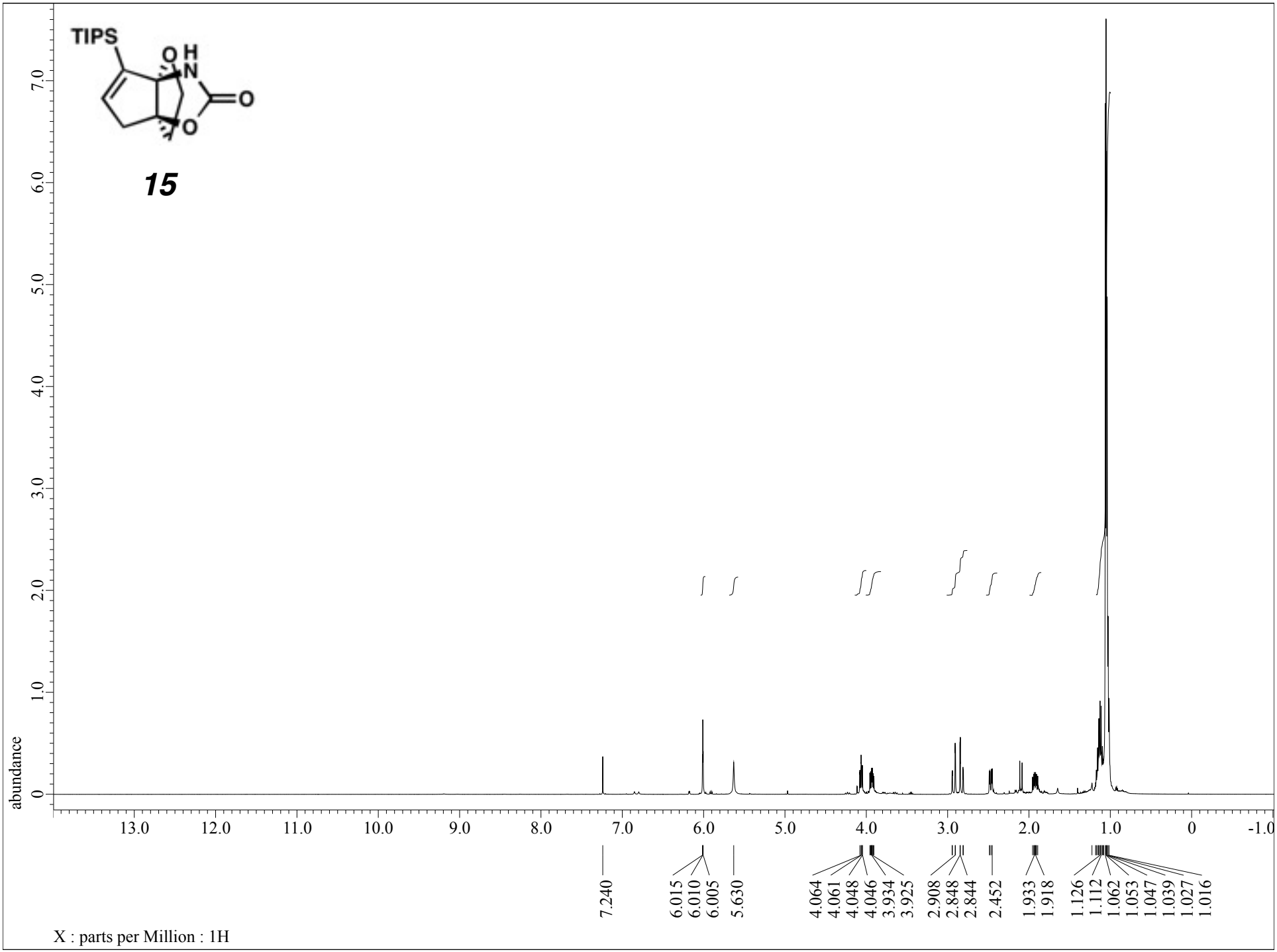

OH
Si
HN
O
O
O
19
abundance
0.4
0.3
0.2
0.1
0
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
156.812
137.840
109.210
83.516
77.254
77.000
76.746
63.762
37.128
25.543
24.017
18.411
18.352
13.342
X : parts per Million : Carbon13

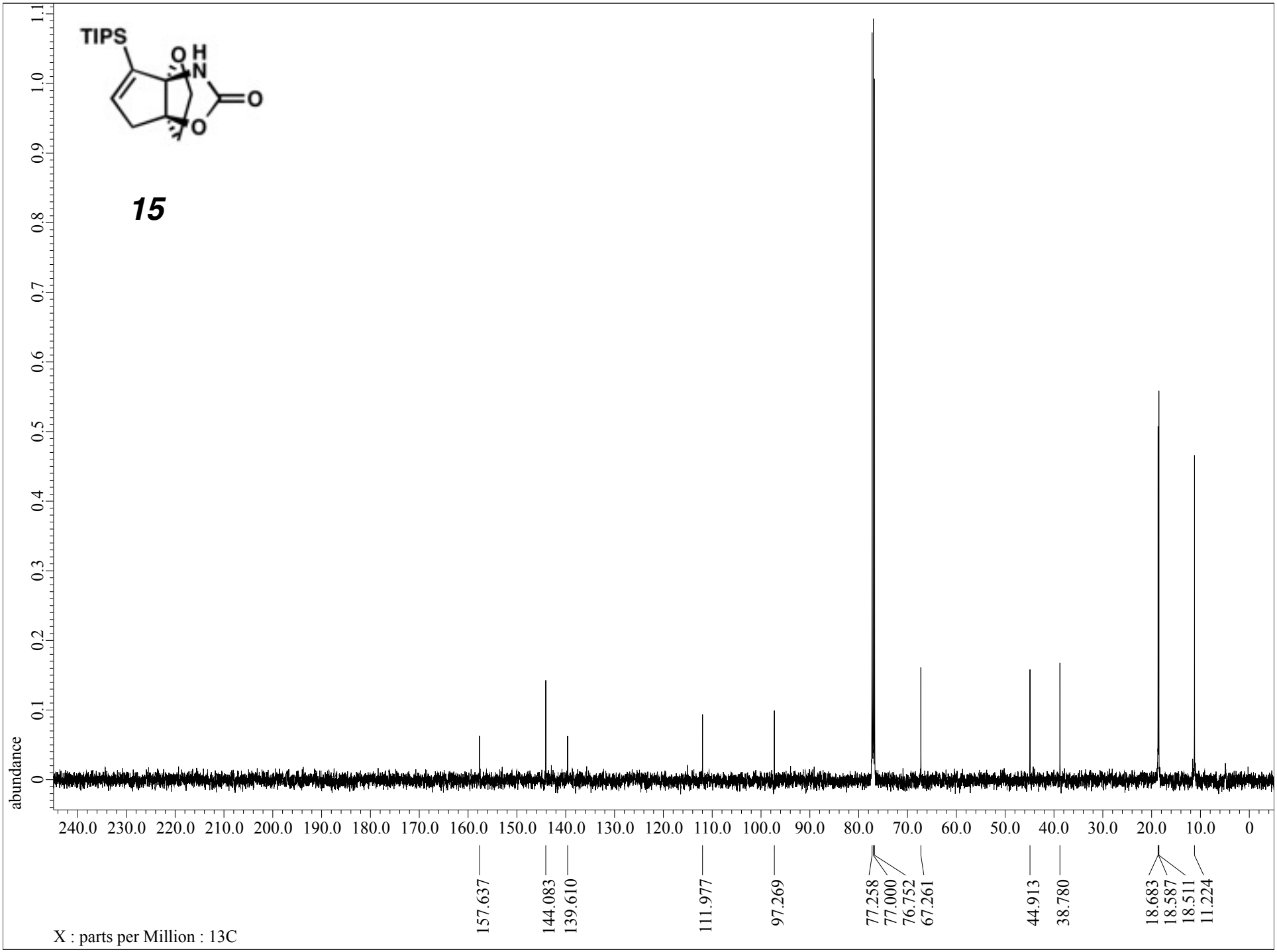

Si
O
O
NH
O
14
abundance
4.0
3.0
2.0
1.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
7.050
4.975
4.969
4.045
4.035
3.891
3.878
3.870
3.856
2.302
2.295
2.282
2.181
2.162
1.666
1.664
1.138
1.134
1.119
1.106
1.069
1.059
1.054
1.045
X : parts per Million : 1H

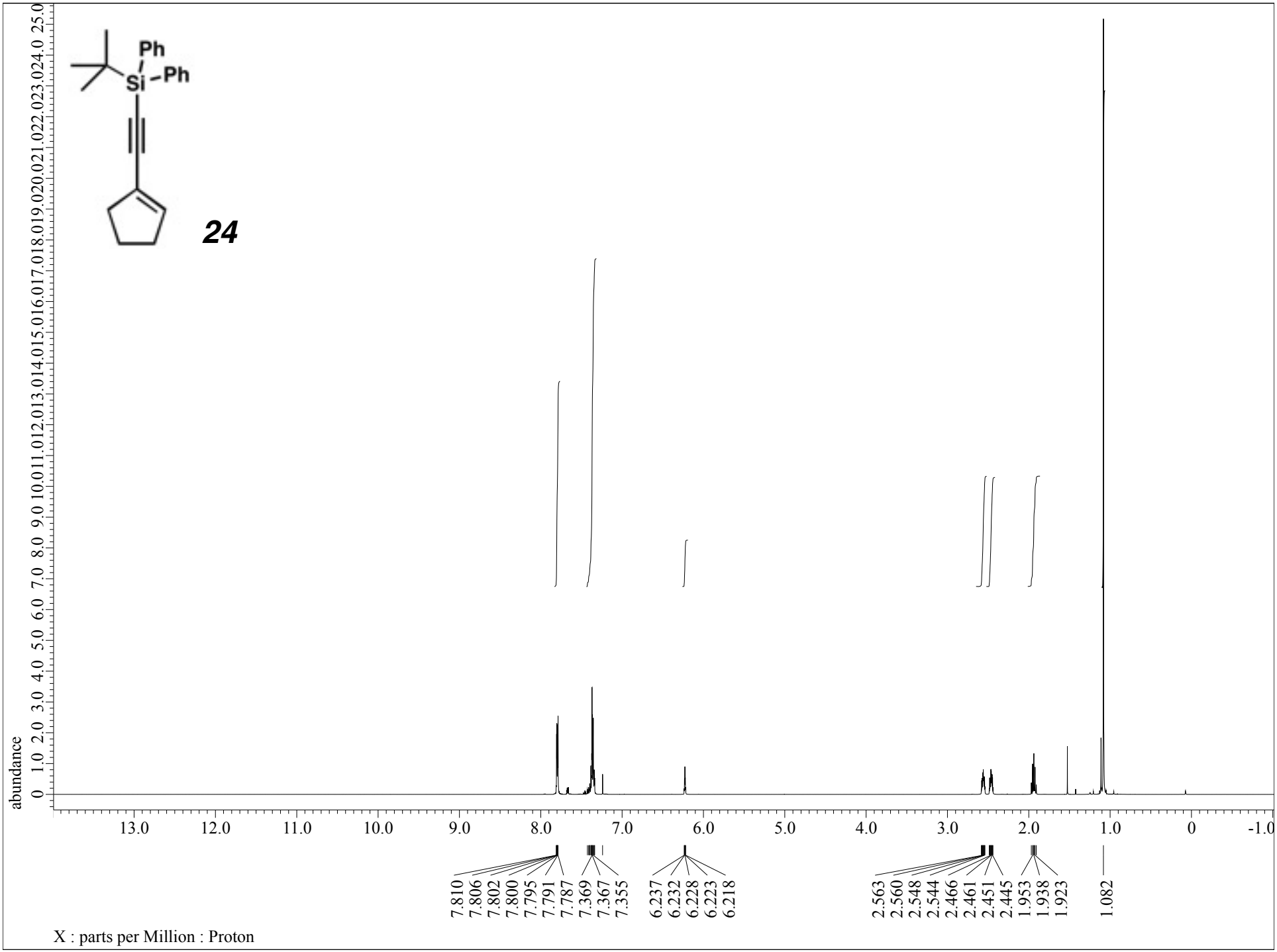

Si
O
O
NH
O
14
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
158.419
156.340
98.022
91.737
84.755
77.258
77.000
76.742
60.432
52.115
32.485
30.939
18.597
18.435
11.634
X : parts per Million : 13C

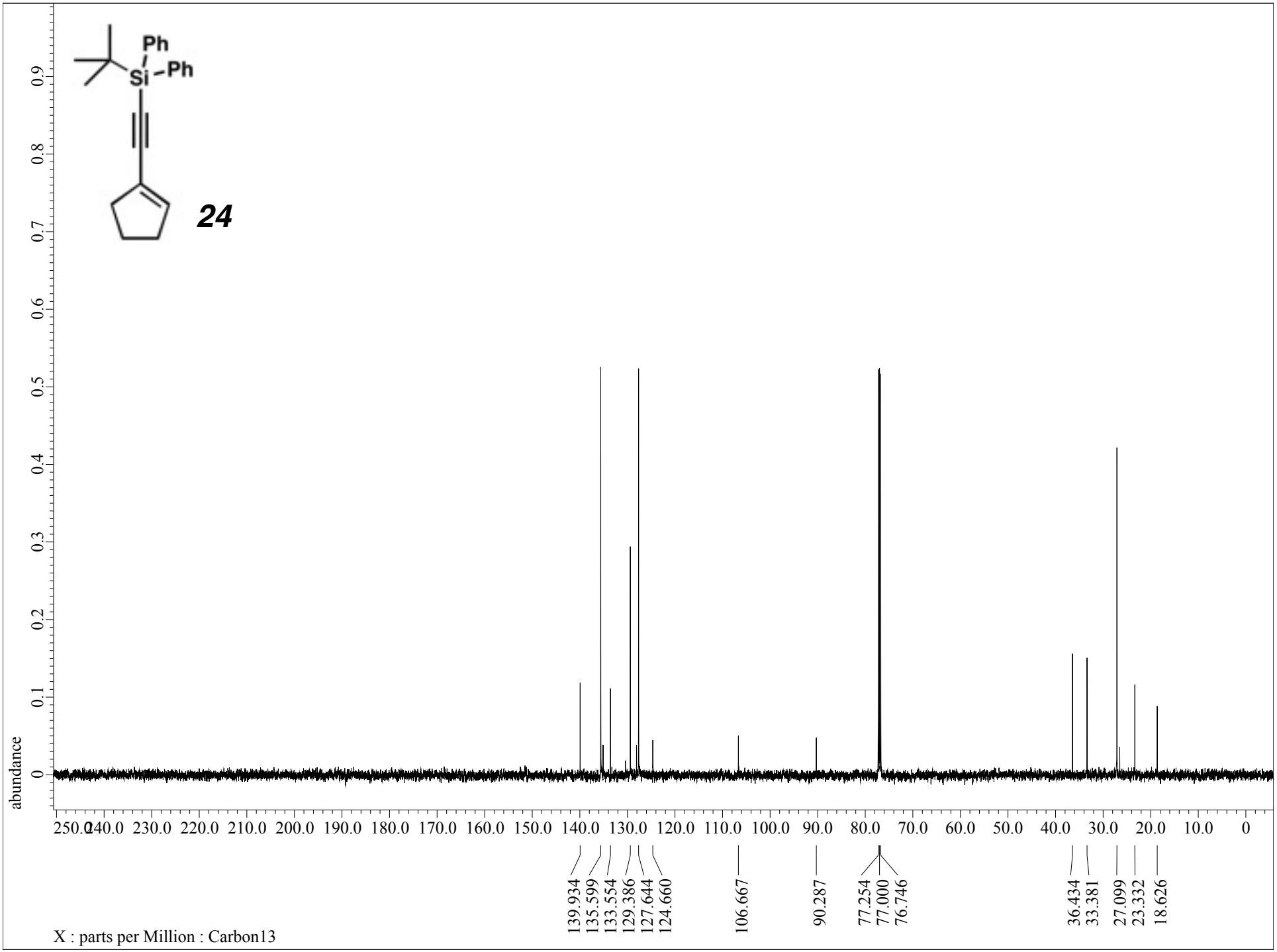

TIPS
N
O
17
abundance
X : parts per Million : 1H
7.240
3.802
3.791
3.779
3.763
3.749
3.738
3.727
3.711
2.820
2.808
2.798
2.474
2.462
2.451
1.364
1.349
1.334
1.141
1.126
1.112
1.097
1.083
1.069
1.049
1.033

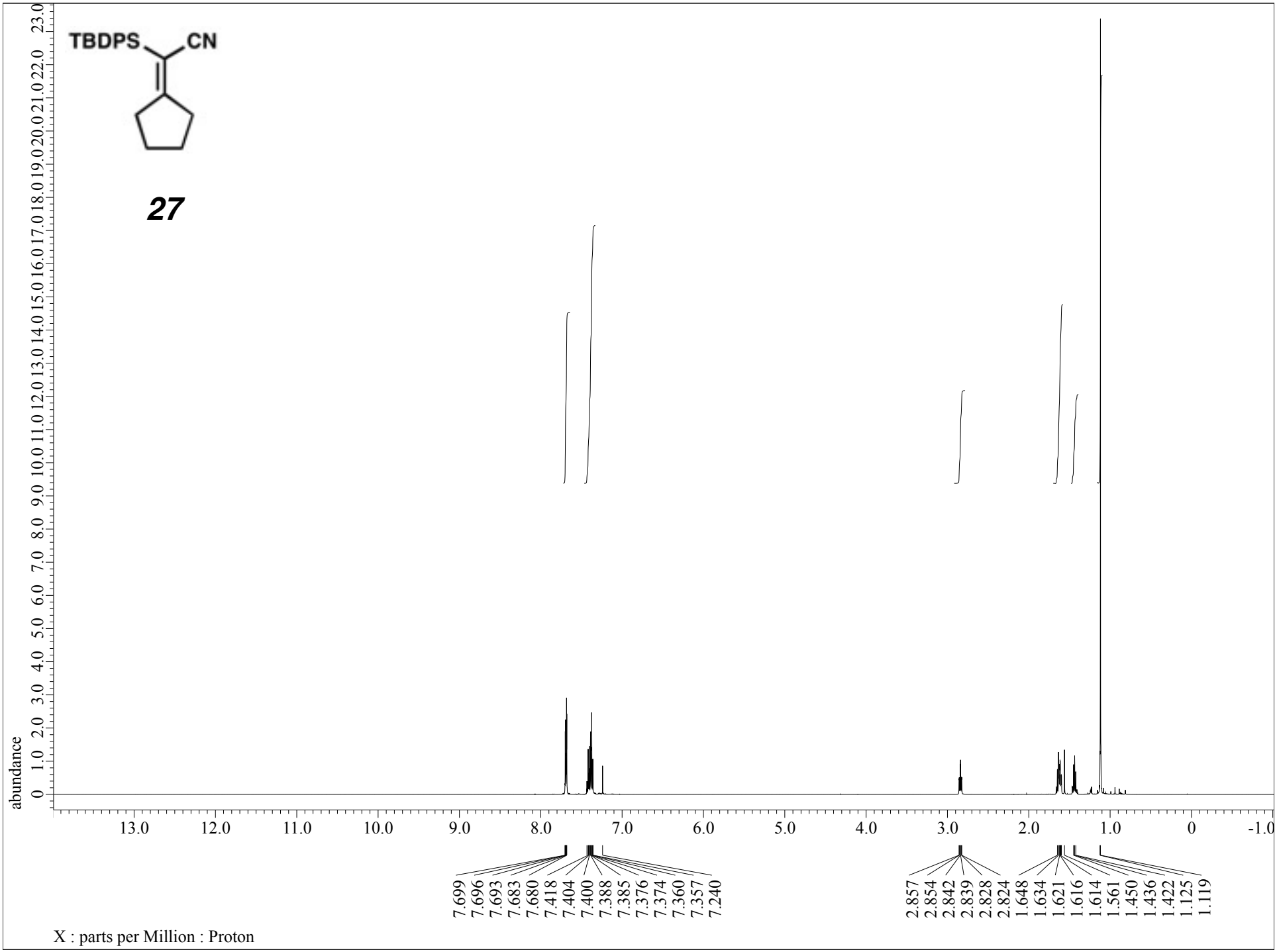

TIPS
N
O
17
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
172.269
120.304
104.022
77.248
77.000
76.742
68.845
68.330
37.826
36.453
18.530
12.635
X : parts per Million : 13C

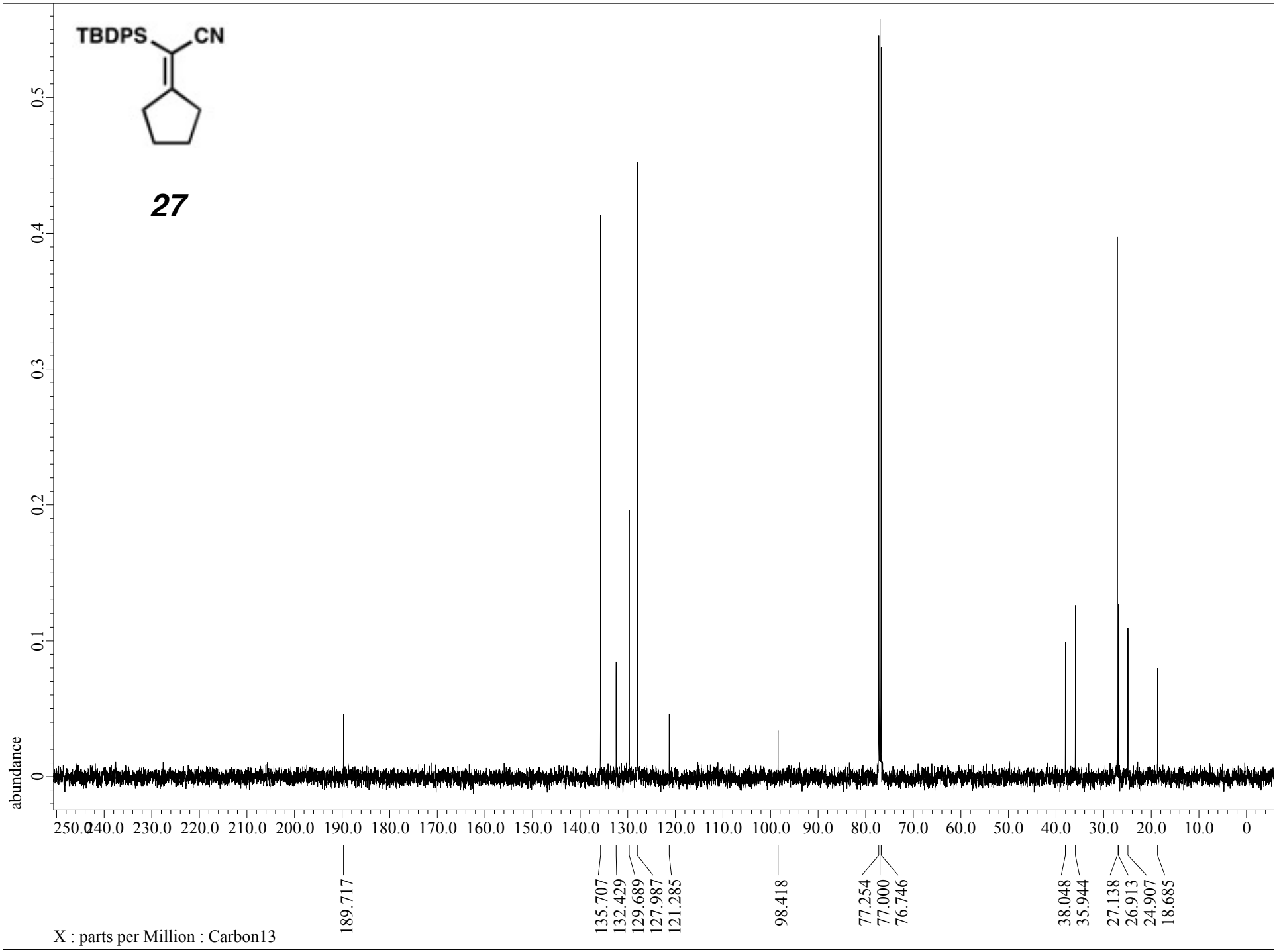

TIPS
O
H
N
O
O
15
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
6.015
6.010
6.005
5.630
4.064
4.061
4.048
4.046
3.934
3.925
2.908
2.848
2.844
2.452
1.933
1.918
1.126
1.112
1.062
1.053
1.047
1.039
1.027
1.016
X : parts per Million : 1H

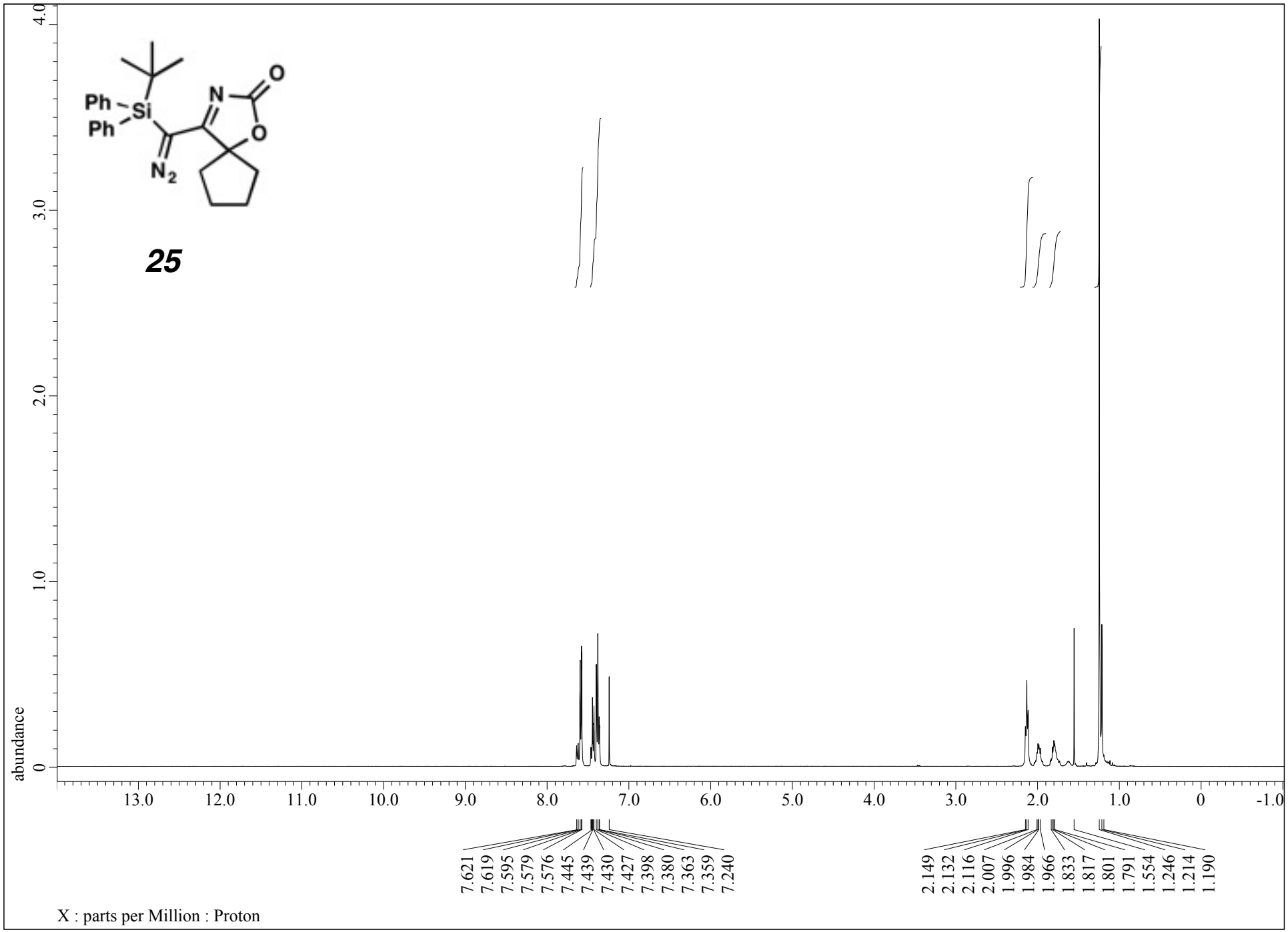

TIPS
O
H
N
O
O
15
abundance
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.637
144.083
139.610
111.977
97.269
77.258
77.000
76.752
67.261
44.913
38.780
18.683
18.587
18.511
11.224
X : parts per Million : 13C

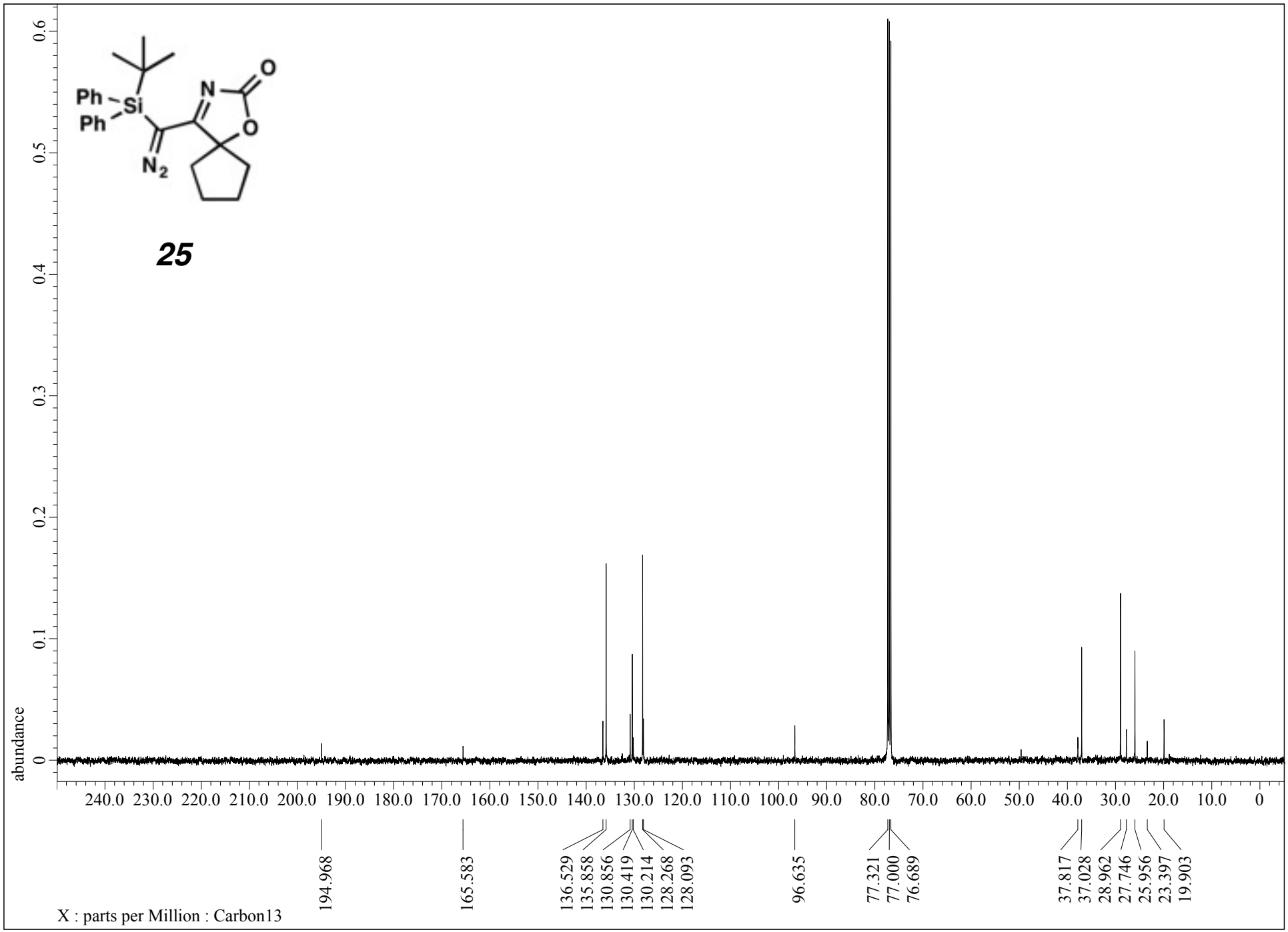

Ph
Si
Ph
24
abundance
X : parts per Million : Proton
7.810
7.806
7.802
7.800
7.795
7.791
7.787
7.369
7.367
7.355
6.237
6.232
6.228
6.223
6.218
2.563
2.560
2.548
2.544
2.466
2.461
2.451
2.445
1.953
1.938
1.923
1.082


Ph
Si
Ph
24
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
139.934
135.599
133.554
129.386
127.644
124.660
106.667
90.287
77.254
77.000
76.746
36.434
33.381
27.099
23.332
18.626
X : parts per Million : Carbon13

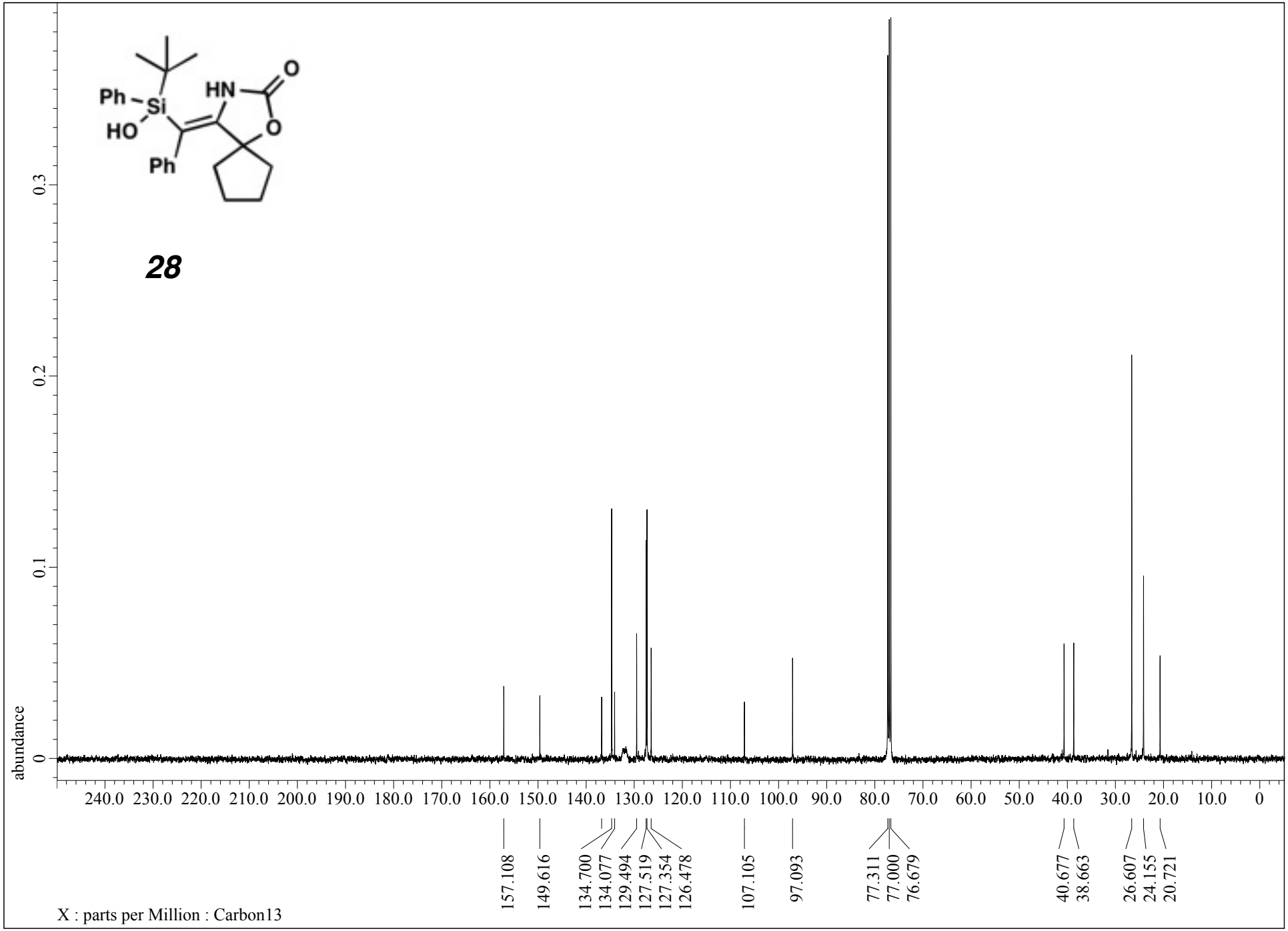

TBDPS
CN
27
abundance
X : parts per Million : Proton
7.699
7.696
7.693
7.683
7.680
7.418
7.404
7.400
7.388
7.385
7.376
7.374
7.360
7.357
7.240
2.857
2.854
2.842
2.839
2.828
2.824
1.648
1.634
1.621
1.616
1.614
1.561
1.450
1.436
1.422
1.125
1.119

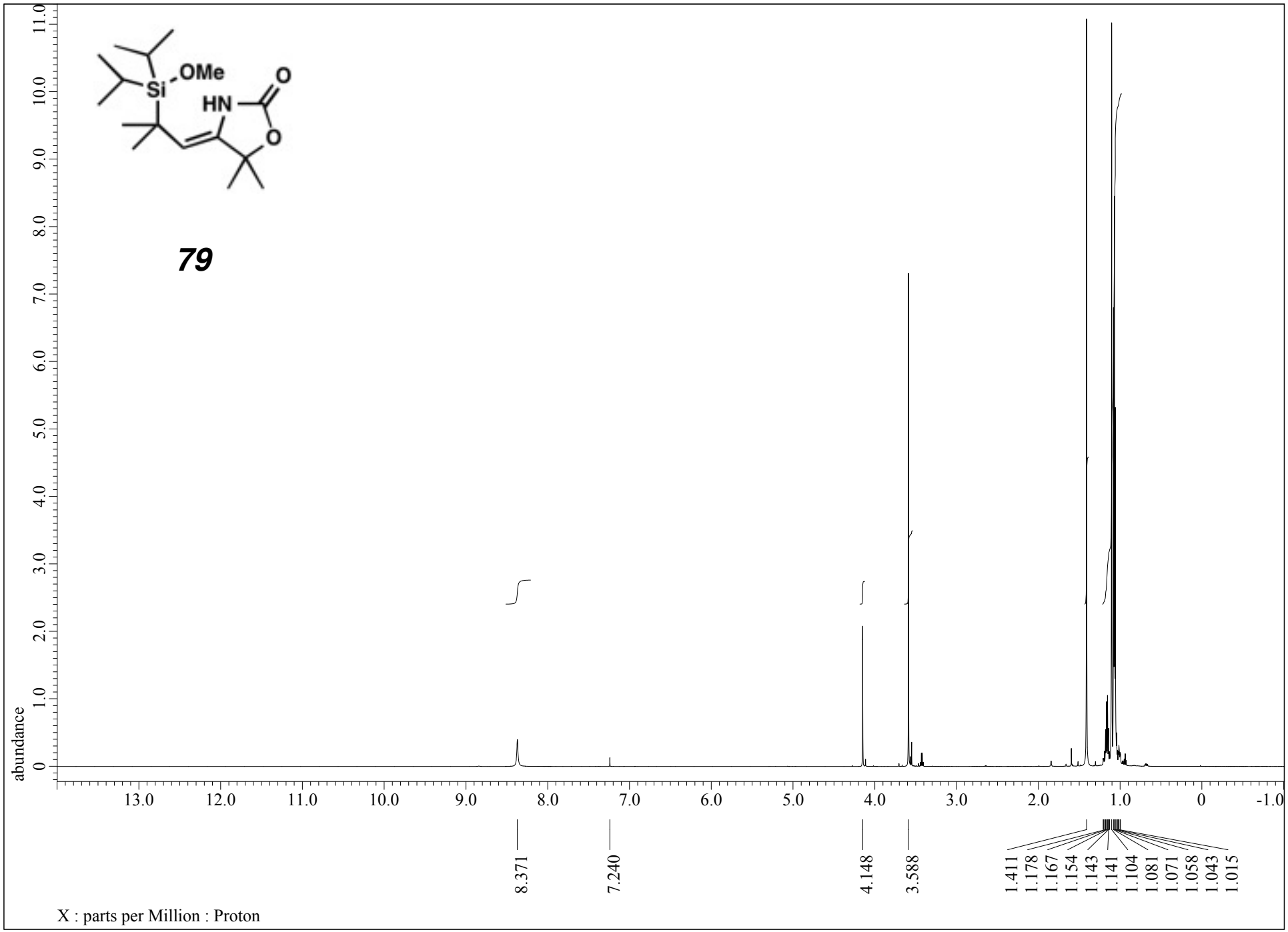

TBDPS
CN
27
abundance
0
0.1
0.2
0.3
0.4
0.5
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
189.717
135.707
132.429
129.689
127.987
121.285
98.418
77.254
77.000
76.746
38.048
35.944
27.138
26.913
24.907
18.685
X : parts per Million : Carbon13

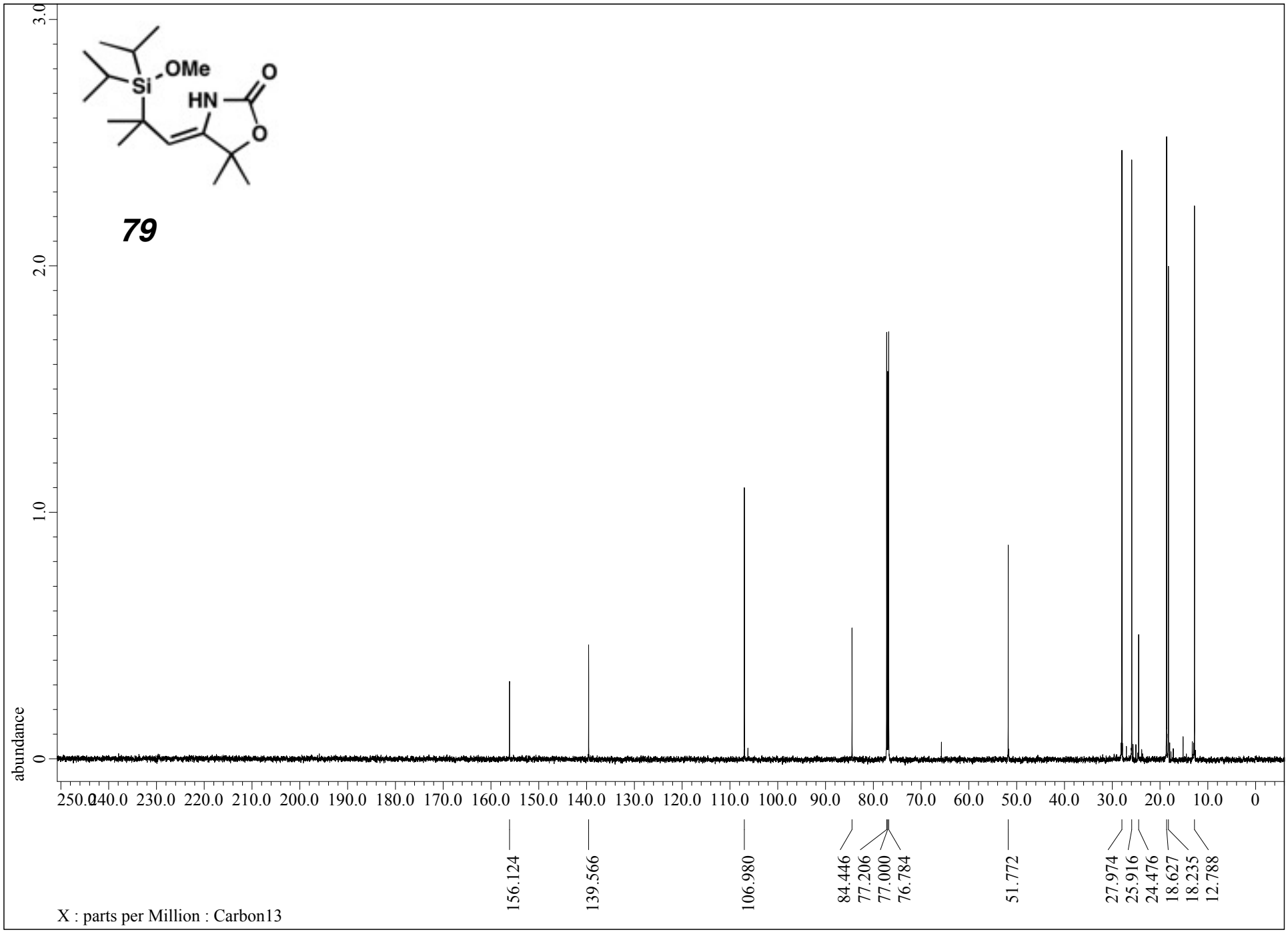

Ph
Si
Ph
N
O
O
N2
25
abundance
4.0
3.0
2.0
1.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.621
7.619
7.595
7.579
7.576
7.445
7.439
7.430
7.427
7.398
7.380
7.363
7.359
7.240
2.149
2.132
2.116
2.007
1.996
1.984
1.966
1.833
1.817
1.801
1.791
1.554
1.246
1.214
1.190
X : parts per Million : Proton

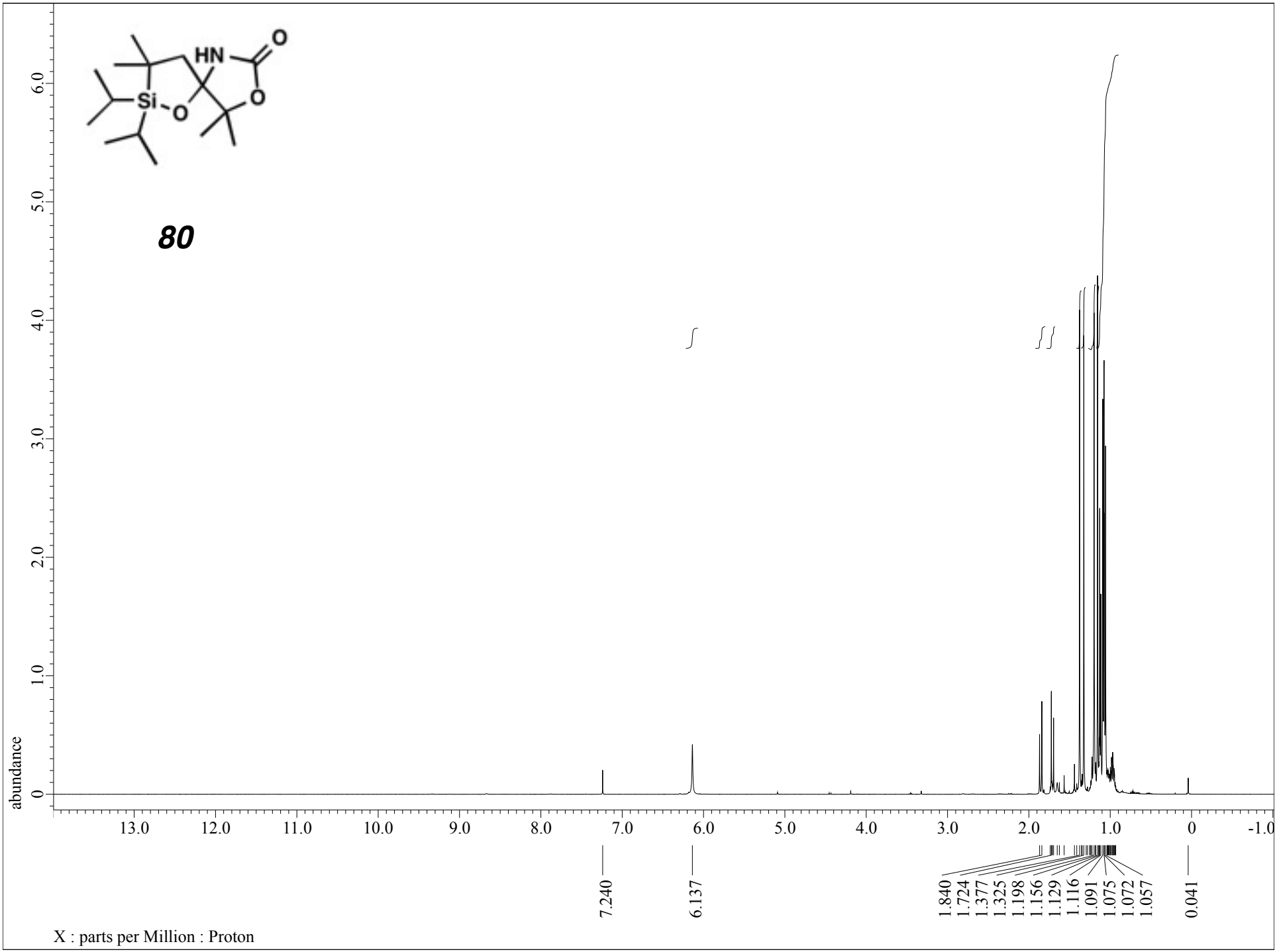

Ph
Si
Ph
N2
N
O
O
25
abundance
0.6
0.5
0.4
0.3
0.2
0.1
0
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
194.968
165.583
136.529
135.858
130.856
130.419
130.214
128.268
128.093
96.635
77.321
77.000
76.689
37.817
37.028
28.962
27.746
25.956
23.397
19.903
X : parts per Million : Carbon13

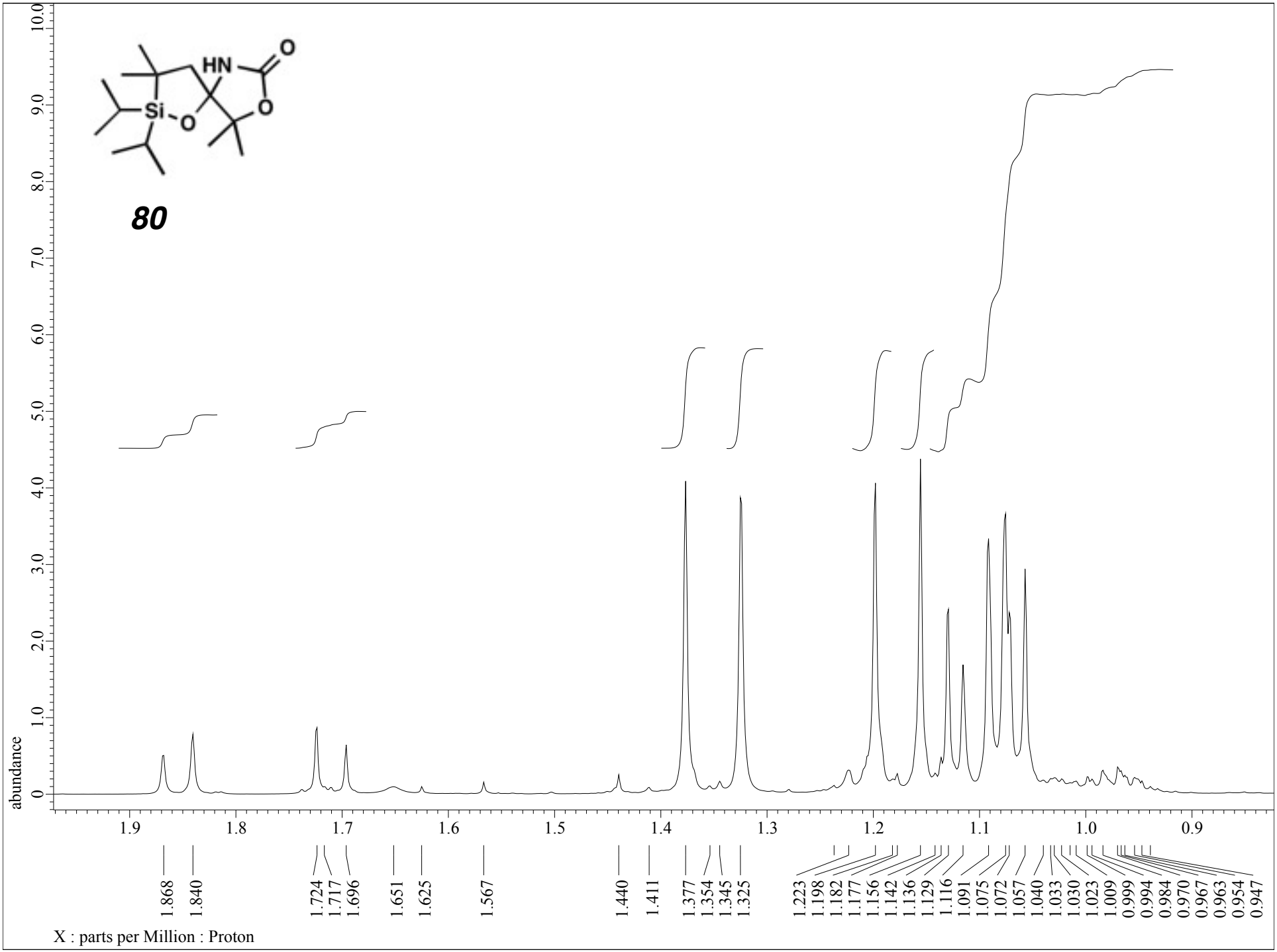

Ph
Si
HO
HN
O
O
Ph
28
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
9.766
7.332
7.312
7.295
7.292
7.250
7.240
7.233
7.215
5.755
2.114
2.099
2.092
2.078
2.066
2.057
2.036
1.683
1.588
1.138
1.030
1.020
1.012
0.996
0.987
0.980
0.948
X : parts per Million : Proton

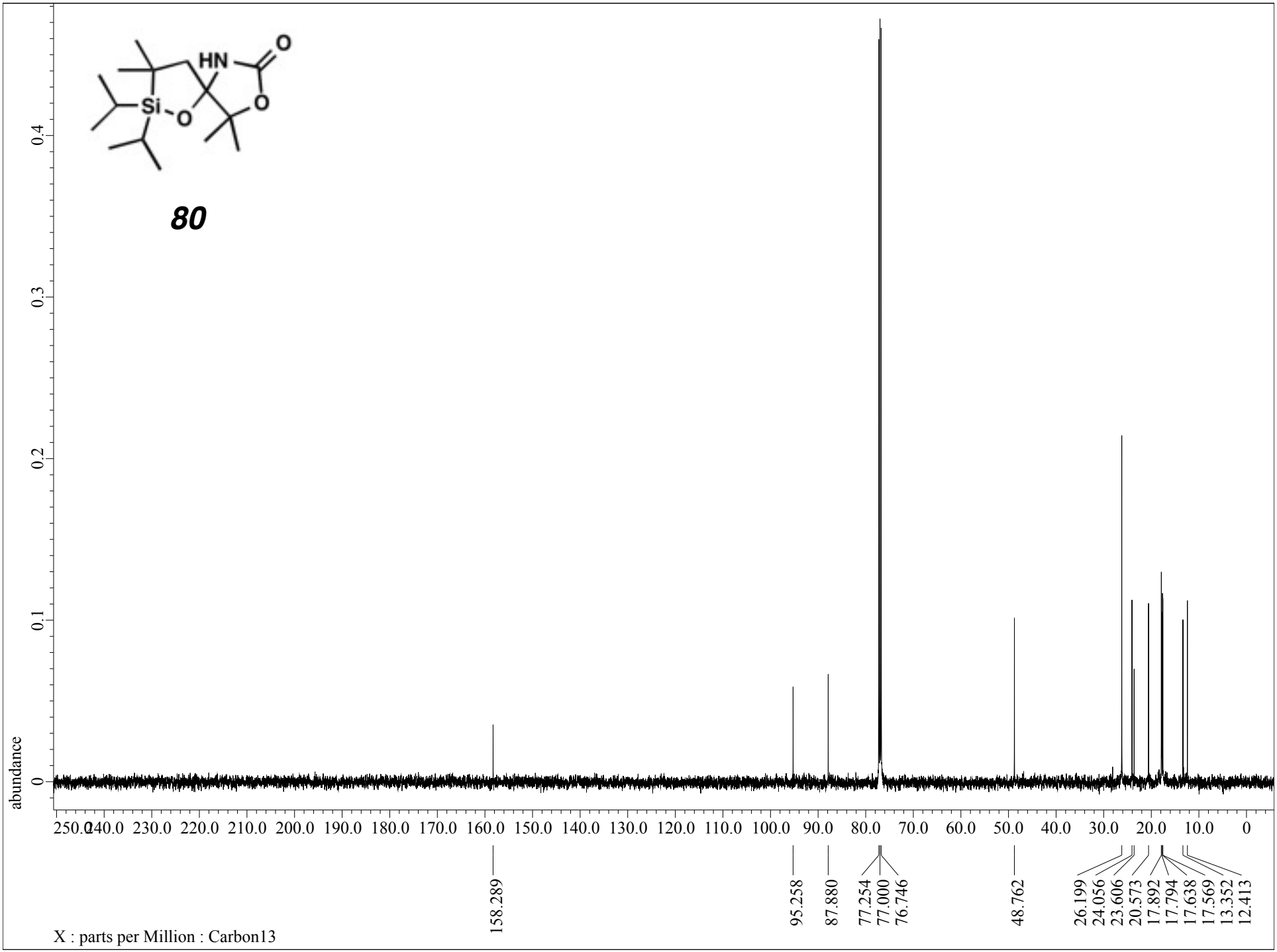

Ph
Si
HO
Ph
HN
O
O
O
28
abundance
0
0.1
0.2
0.3
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
157.108
149.616
134.700
134.077
129.494
127.519
127.354
126.478
107.105
97.093
77.311
77.000
76.679
40.677
38.663
26.607
24.155
20.721
X : parts per Million : Carbon13

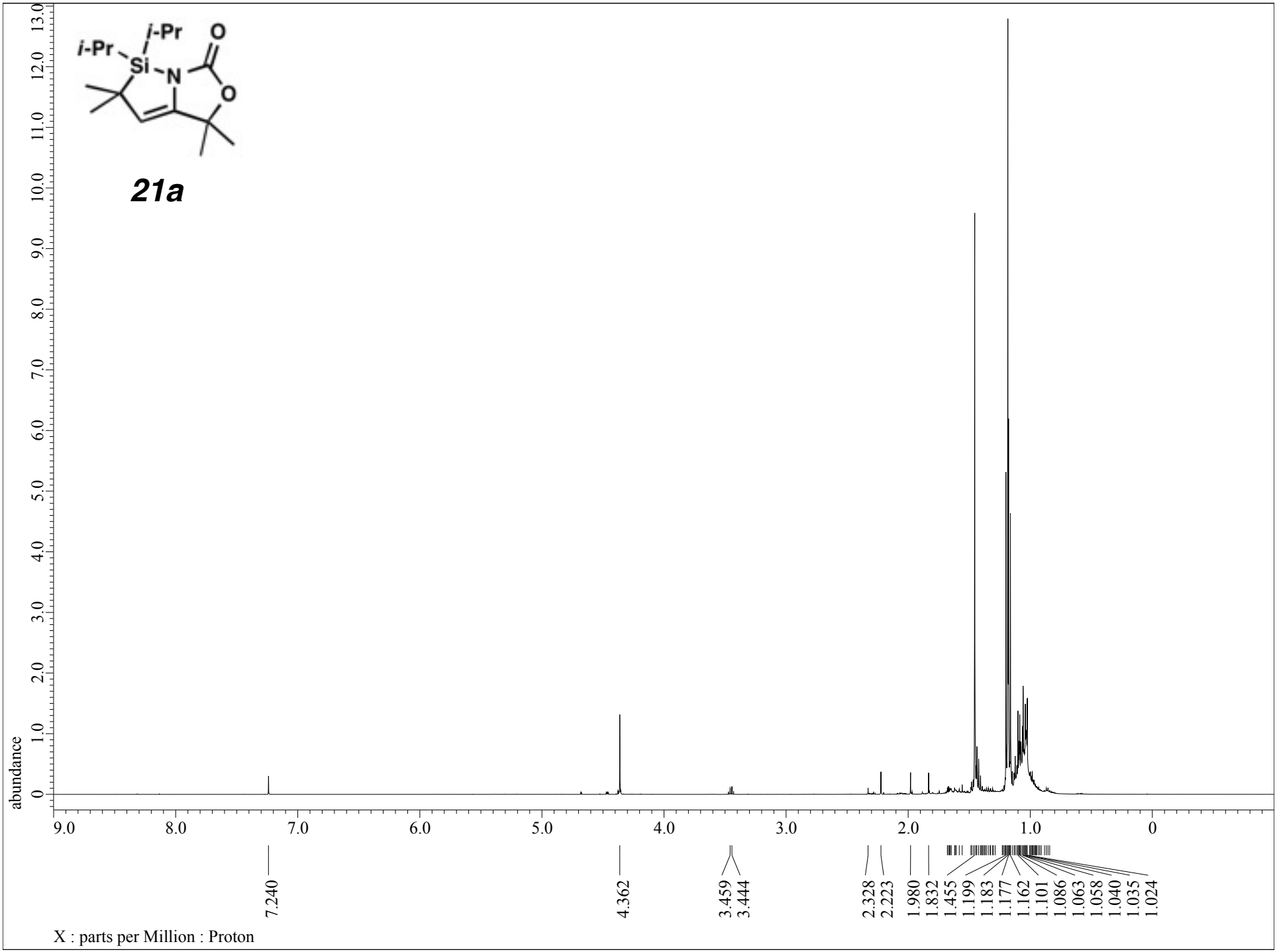

OMe
Si
HN
O
O
79
abundance
X : parts per Million : Proton
8.371
7.240
4.148
3.588
1.411
1.178
1.167
1.154
1.143
1.141
1.104
1.081
1.071
1.058
1.043
1.015

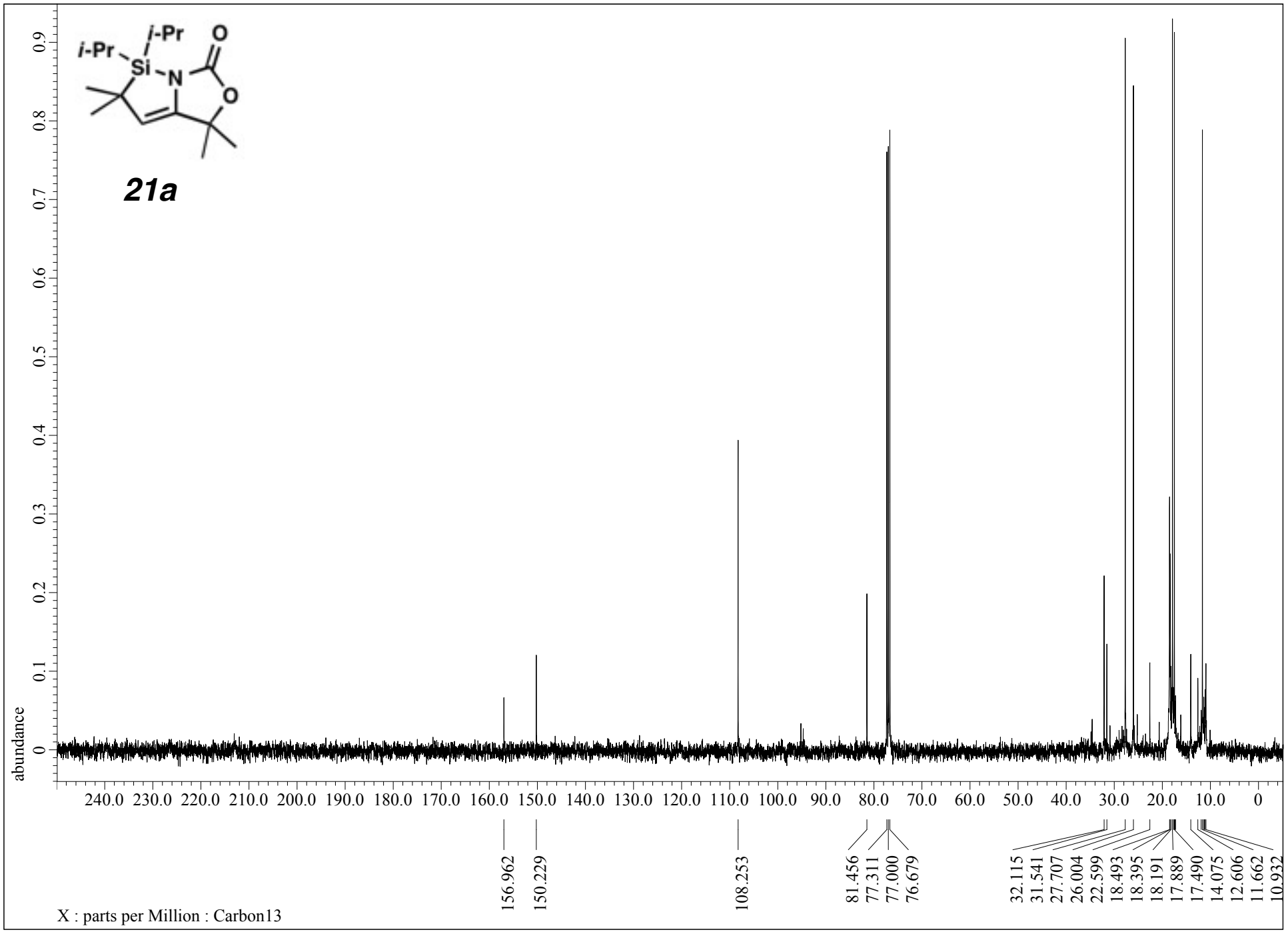

OMe
Si
HN
O
O
79
3.0
2.0
1.0
0
abundance
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
156.124
139.566
106.980
84.446
77.206
77.000
76.784
51.772
27.974
25.916
24.476
18.627
18.235
12.788
X : parts per Million : Carbon13

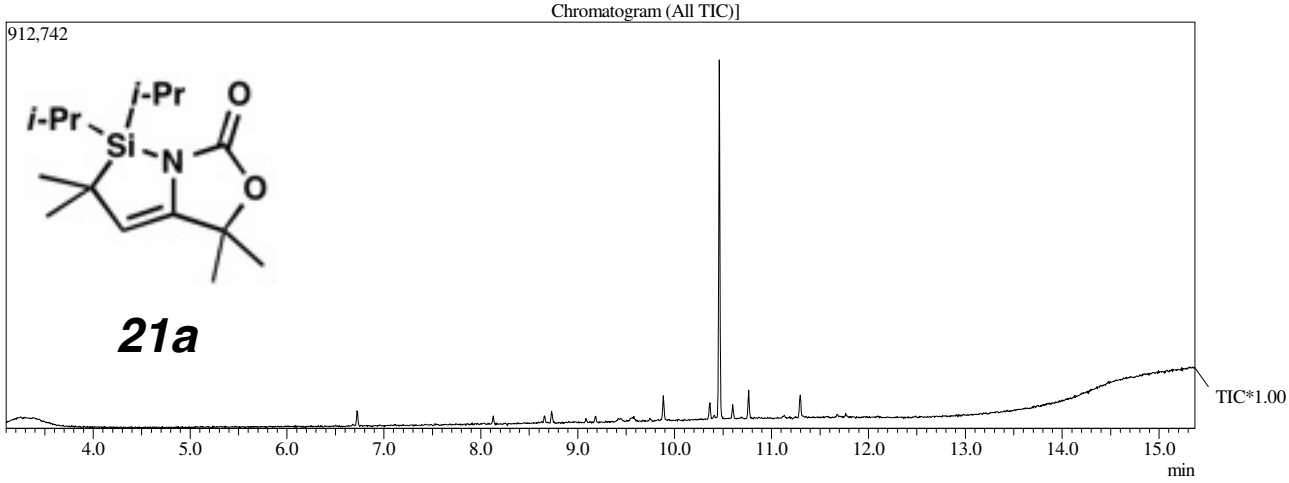

HN
O
Si
O
O
80
abundance
6.0
5.0
4.0
3.0
2.0
1.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
6.137
1.840
1.724
1.377
1.325
1.198
1.156
1.129
1.116
1.091
1.075
1.072
1.057
0.041
X : parts per Million : Proton

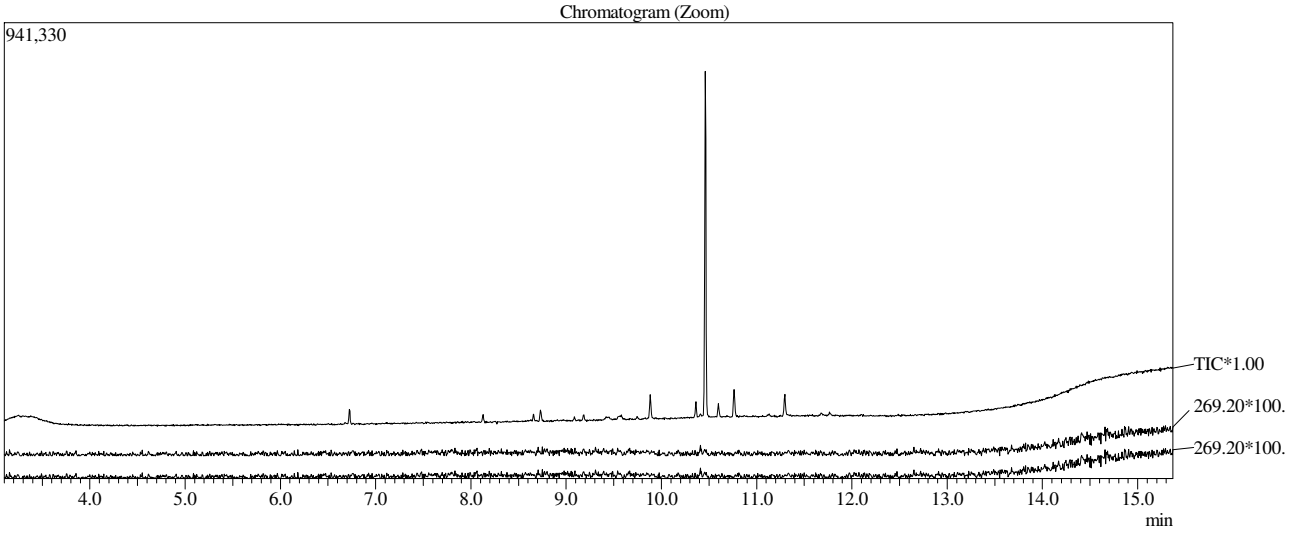

HN
O
O
Si
O
80
abundance
X : parts per Million : Proton
1.868
1.840
1.724
1.717
1.696
1.651
1.625
1.567
1.440
1.411
1.377
1.354
1.345
1.325
1.223
1.198
1.182
1.177
1.156
1.142
1.136
1.129
1.116
1.091
1.075
1.072
1.057
1.040
1.033
1.030
1.023
1.009
0.999
0.994
0.984
0.970
0.967
0.963
0.954
0.947


HN
O
O
Si
O
80
abundance
0
0.1
0.2
0.3
0.4
250.0 240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
158.289
95.258
87.880
77.254
77.000
76.746
48.762
26.199
24.056
23.606
20.573
17.892
17.794
17.638
17.569
13.352
12.413
X : parts per Million : Carbon13


i-Pr
i-Pr
Si
N
O
O
21a
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
4.362
3.459
3.444
2.328
2.223
1.980
1.832
1.455
1.199
1.183
1.177
1.162
1.101
1.086
1.063
1.058
1.040
1.035
1.024
X : parts per Million : Proton

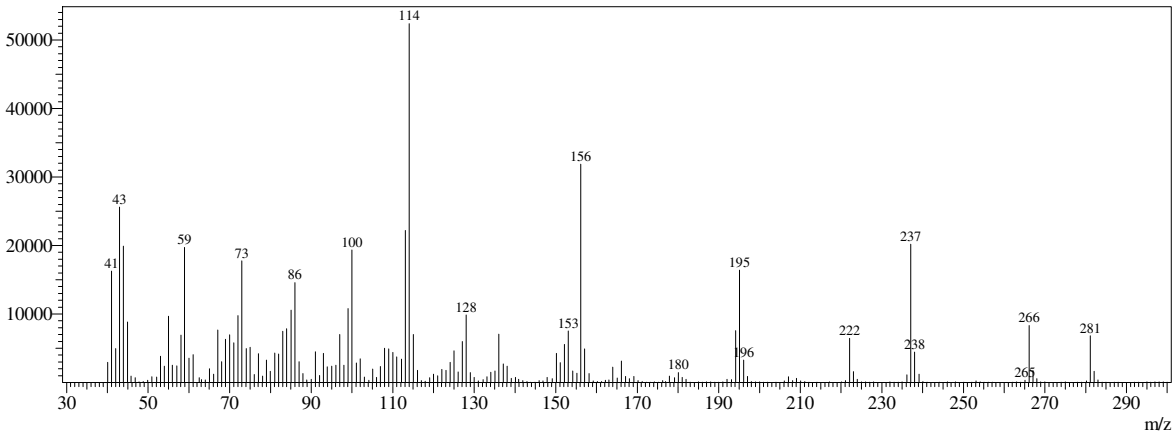

i-Pr
i-Pr
Si
N
O
O
21a
abundance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
156.962
150.229
108.253
81.456
77.311
77.000
76.679
32.115
31.541
27.707
26.004
22.599
18.493
18.395
18.191
17.889
17.490
14.075
12.606
11.662
10.932
X : parts per Million : Carbon13

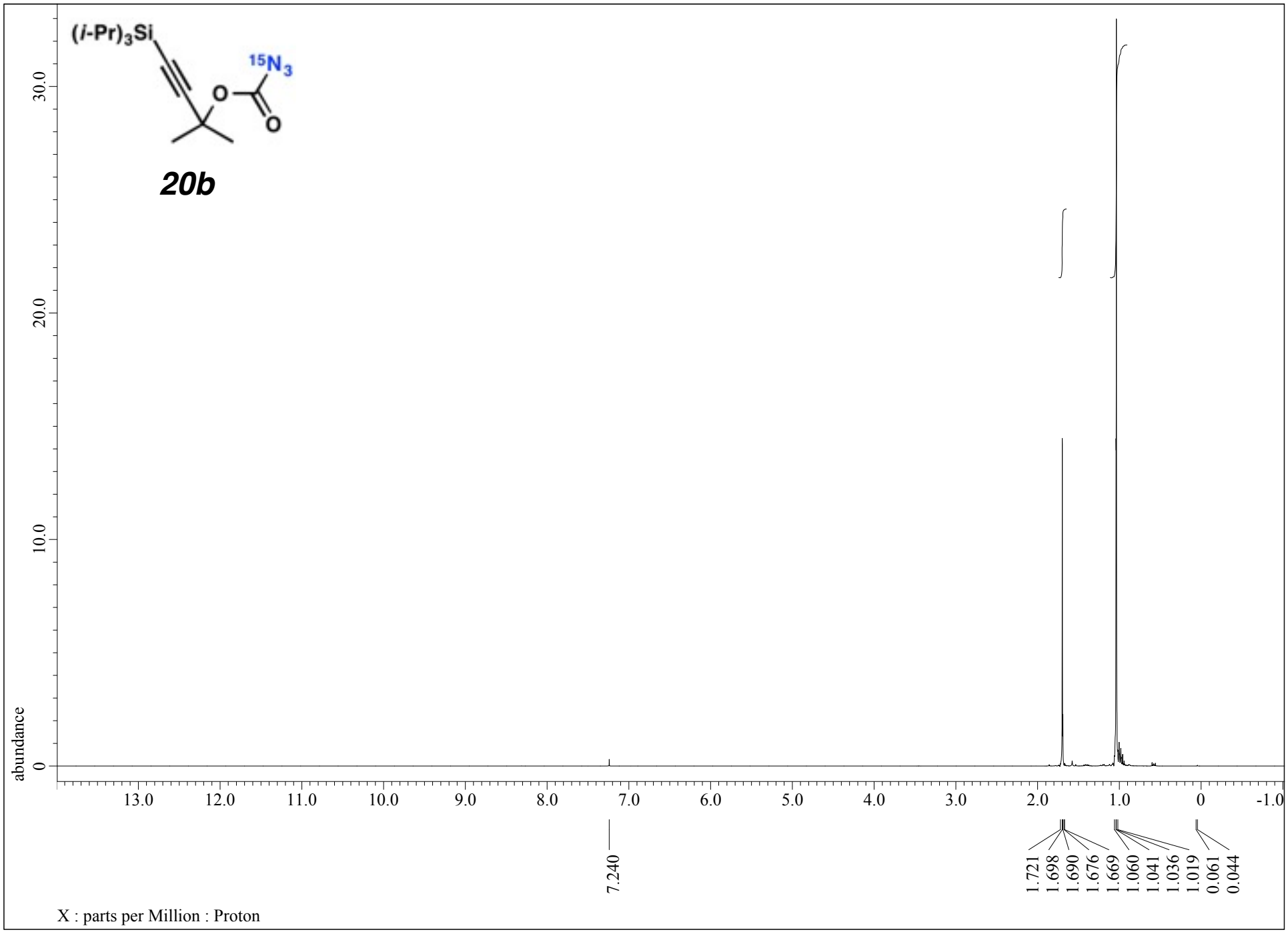


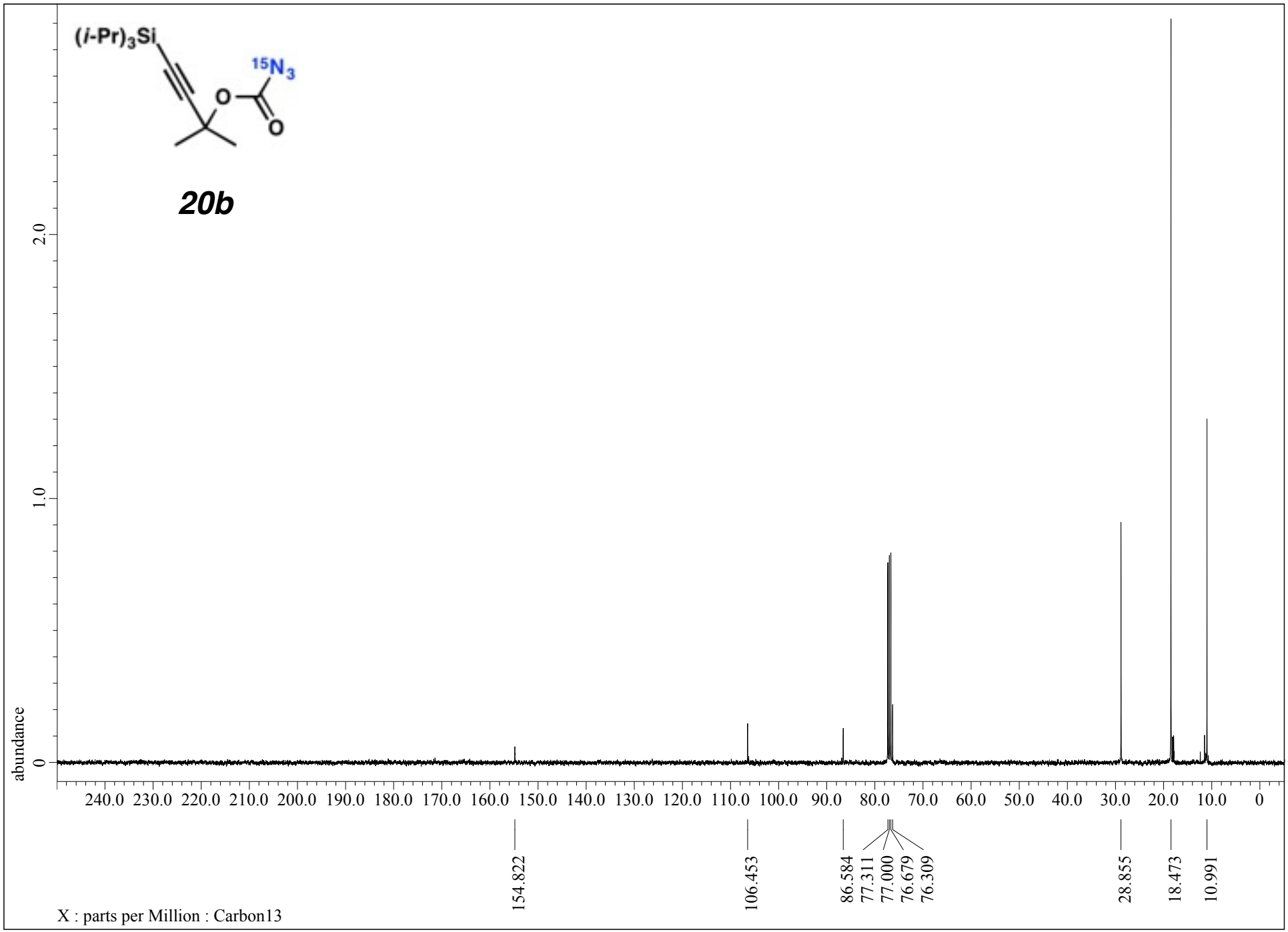


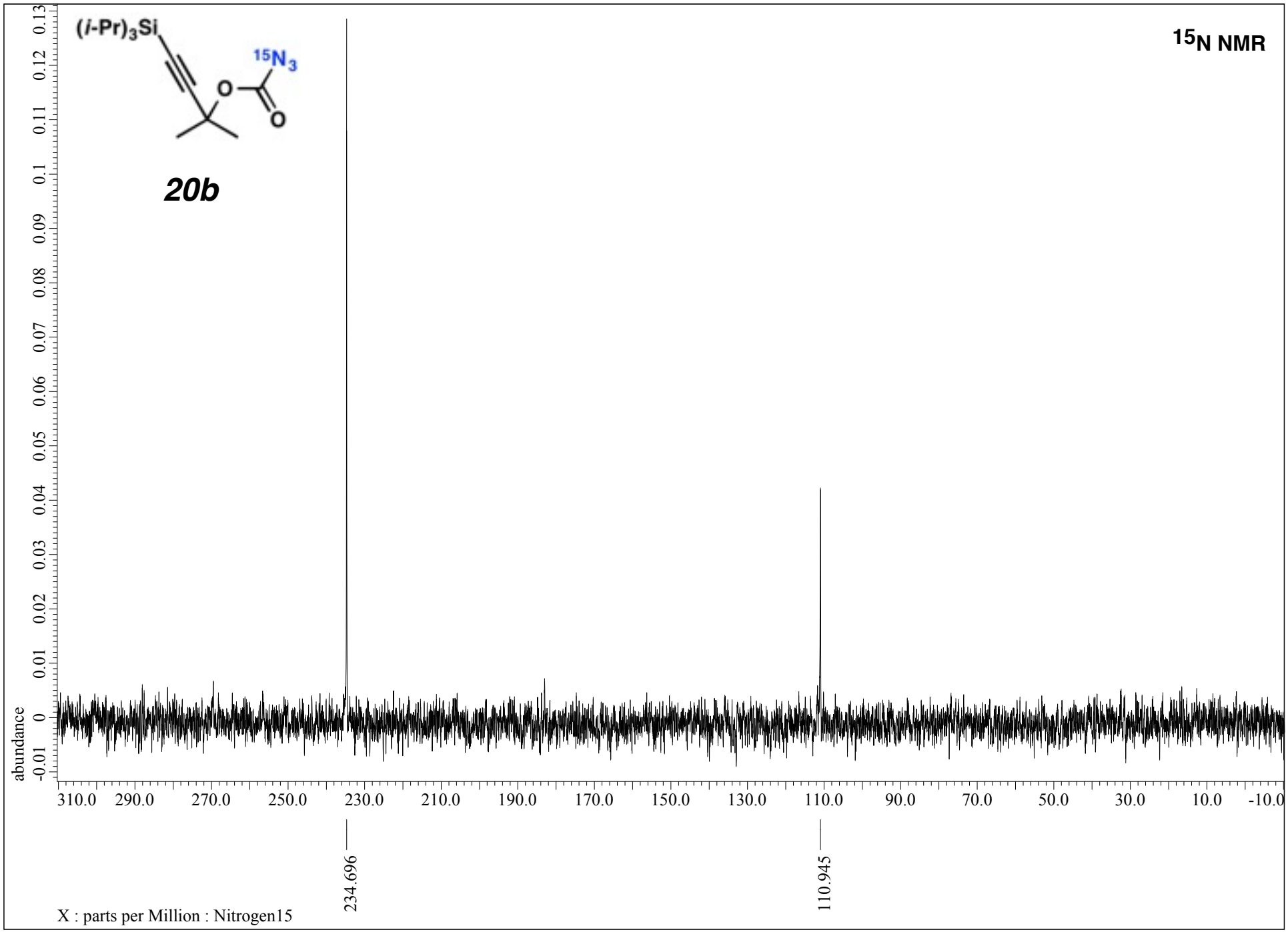
Spectrum

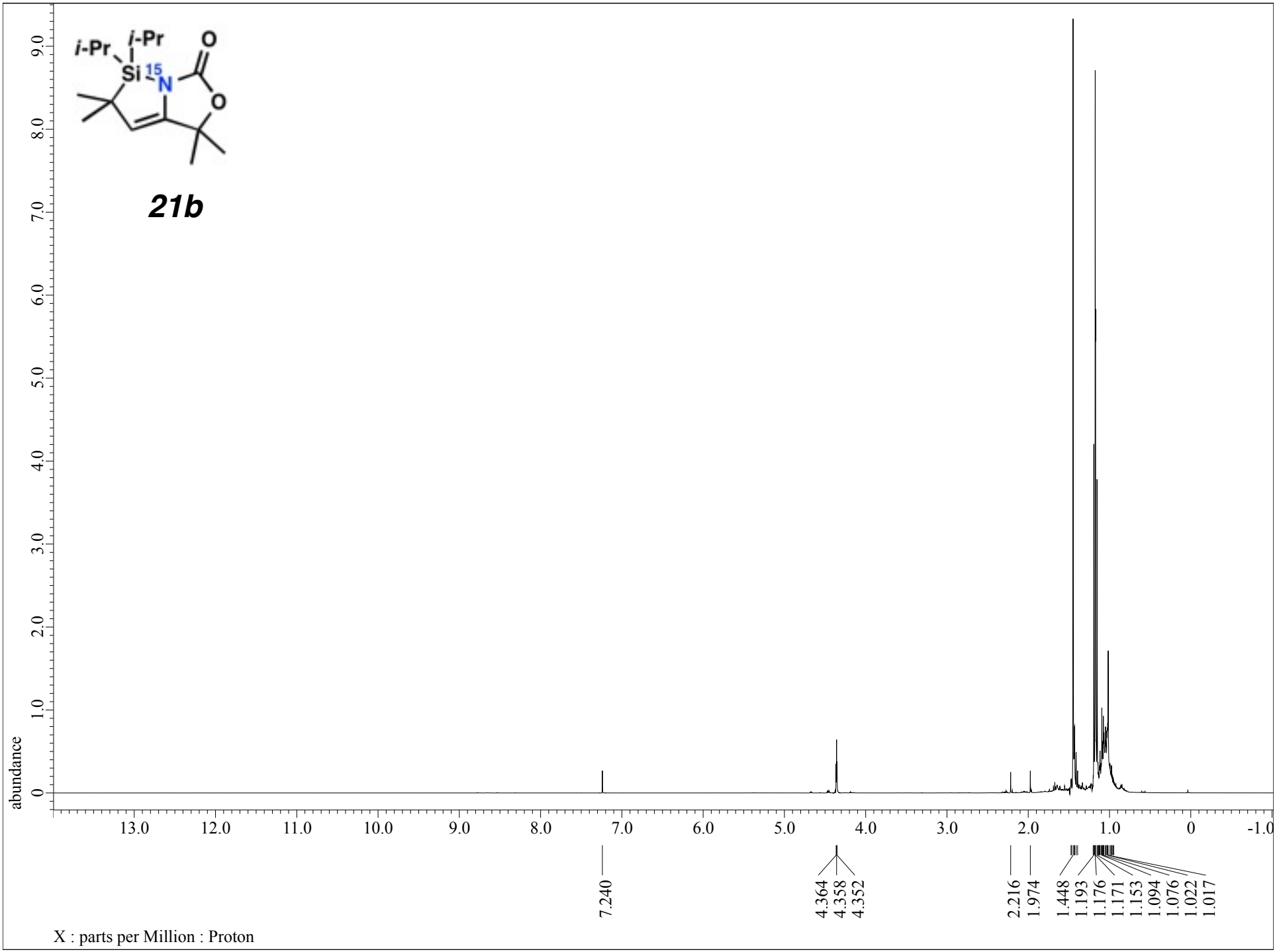
Line#:1 R.Time:10.466(Scan#:1164)
MassPeaks:300
RawMode:Single 10.466(1164) BasePeak:114.05(52381)
BG Mode:None Group 1 - Event 1

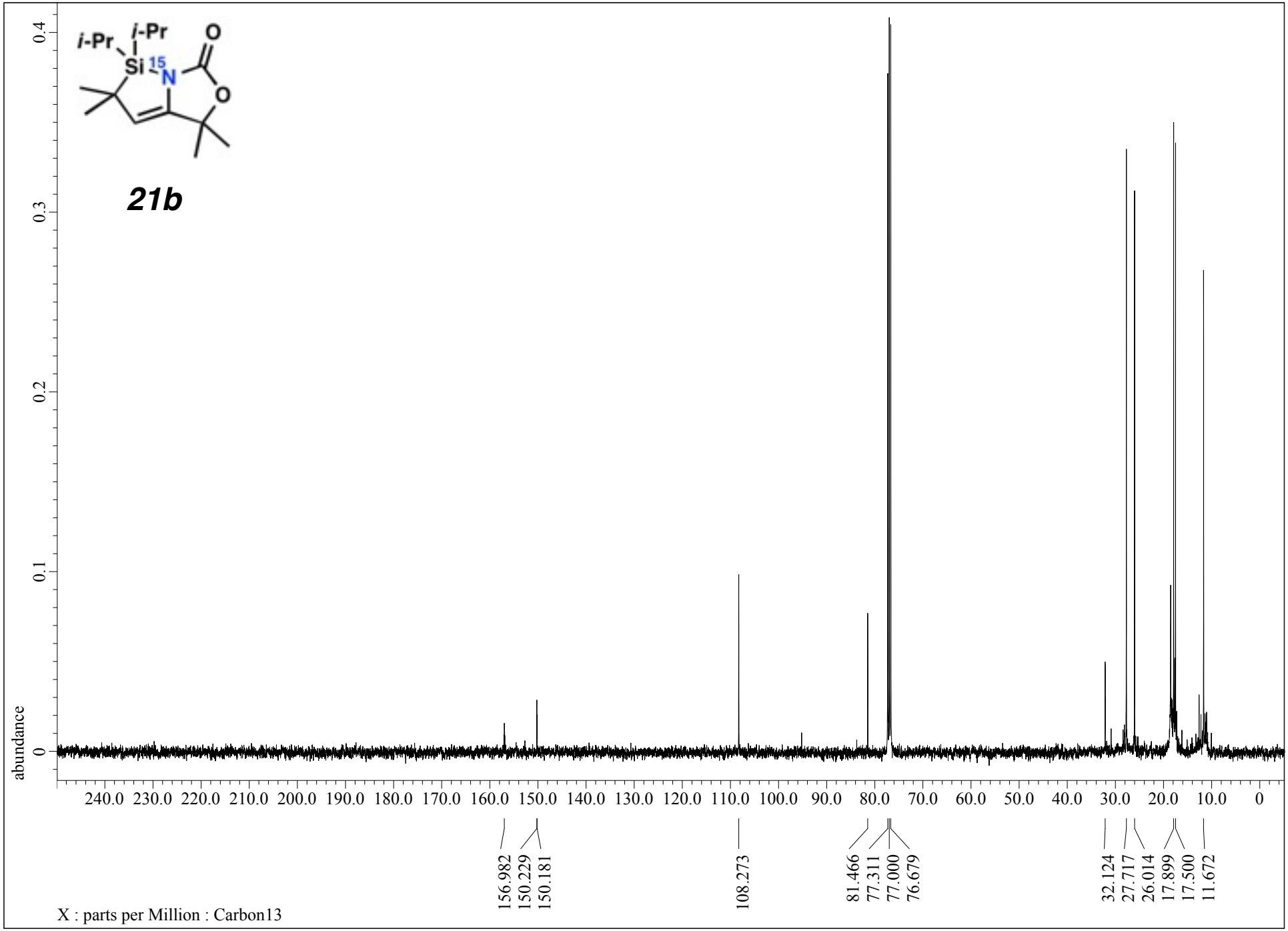


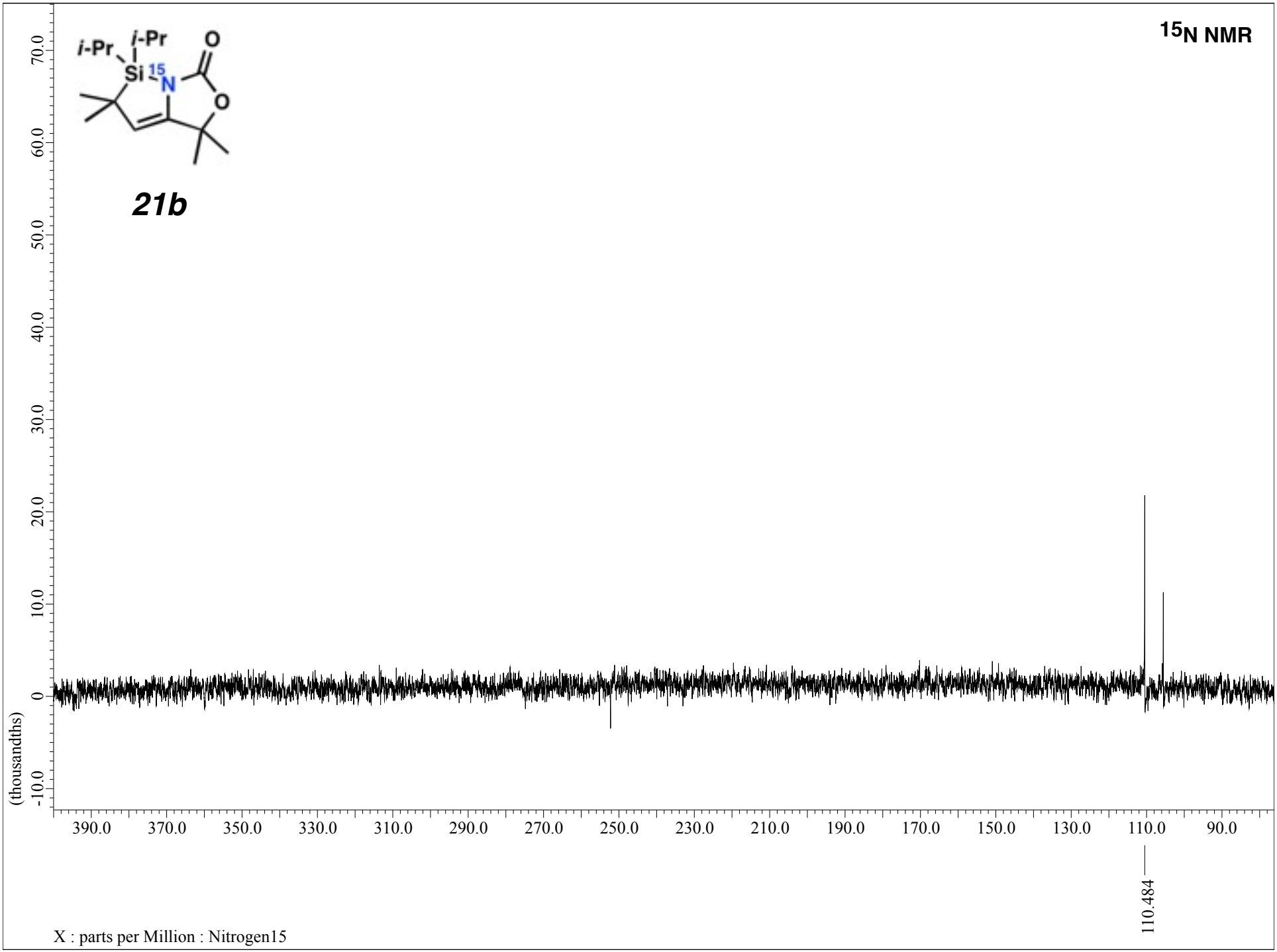

(i-Pr)3Si
15N3
O
O
20b
30.0
20.0
10.0
0
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
1.721
1.698
1.690
1.676
1.669
1.060
1.041
1.036
1.019
0.061
0.044
X : parts per Million : Proton

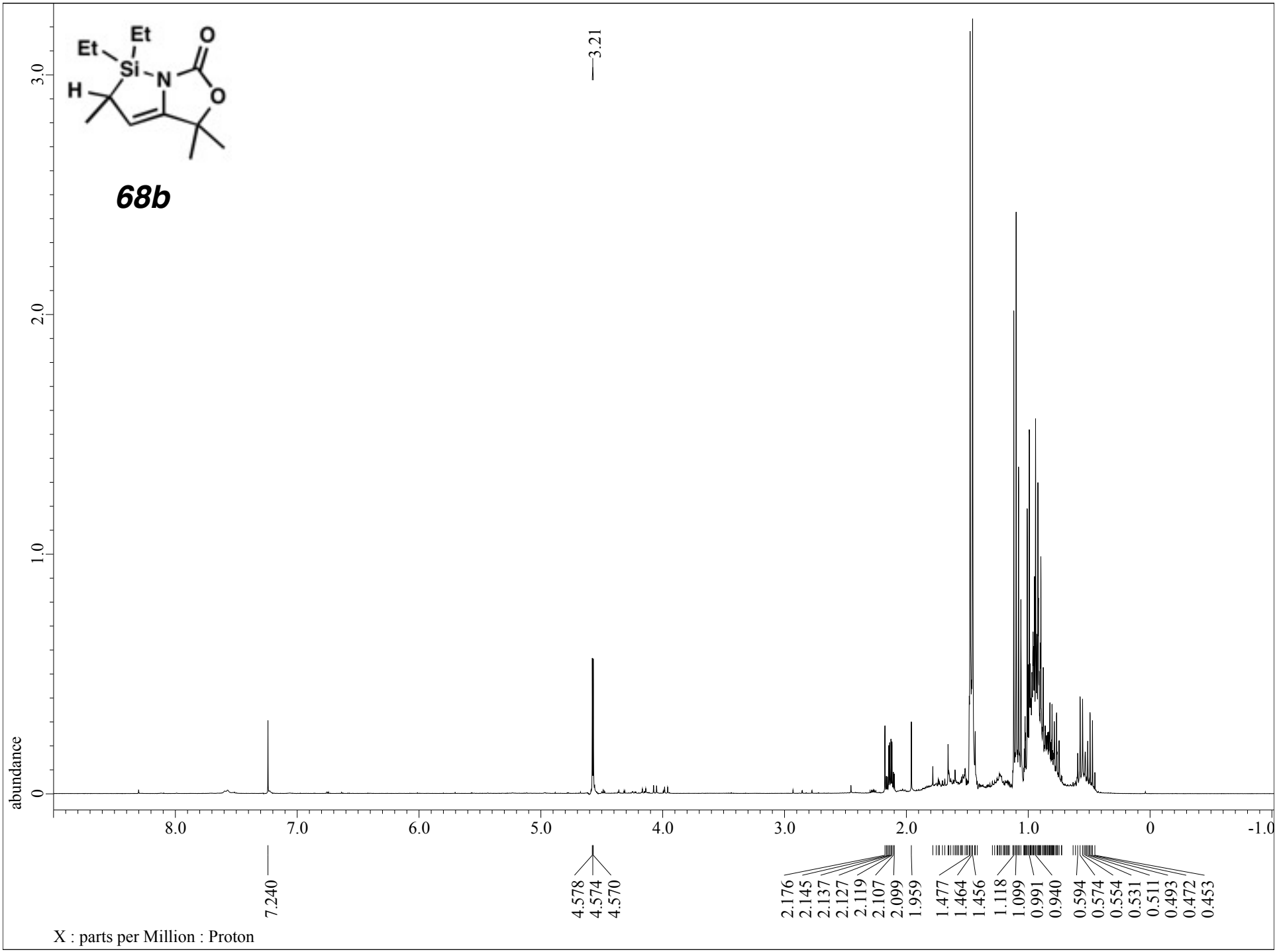

(i-Pr)3Si
15N3
O
O
20b
2.0
1.0
0
abundance
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
154.822
106.453
86.584
77.311
77.000
76.679
76.309
28.855
18.473
10.991
X : parts per Million : Carbon13

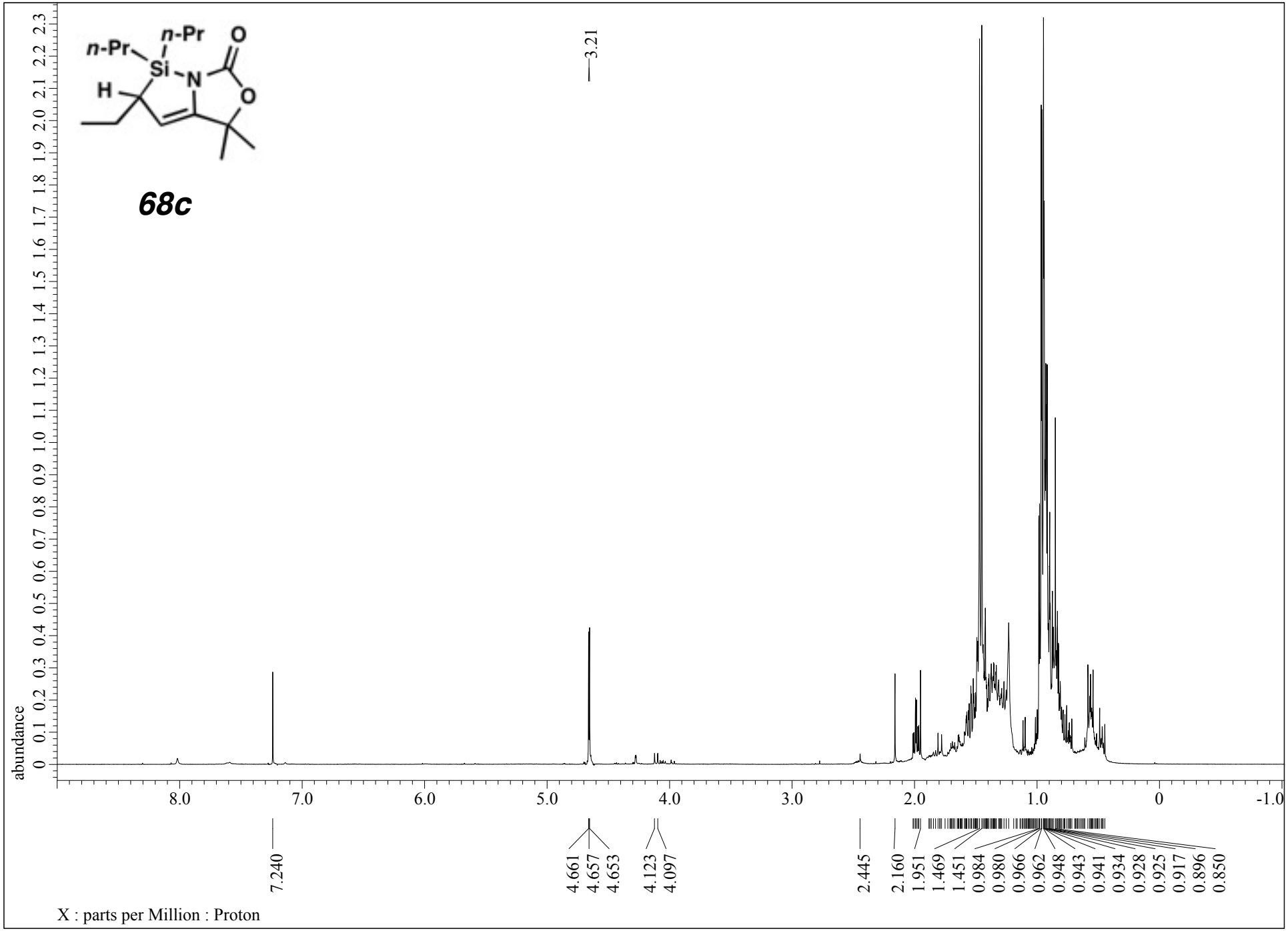

(i-Pr)3Si
15N3
O
O
20b
15N NMR
abundance
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
310.0
290.0
270.0
250.0
230.0
210.0
190.0
170.0
150.0
130.0
110.0
90.0
70.0
50.0
30.0
10.0
-10.0
234.696
110.945
X : parts per Million : Nitrogen15

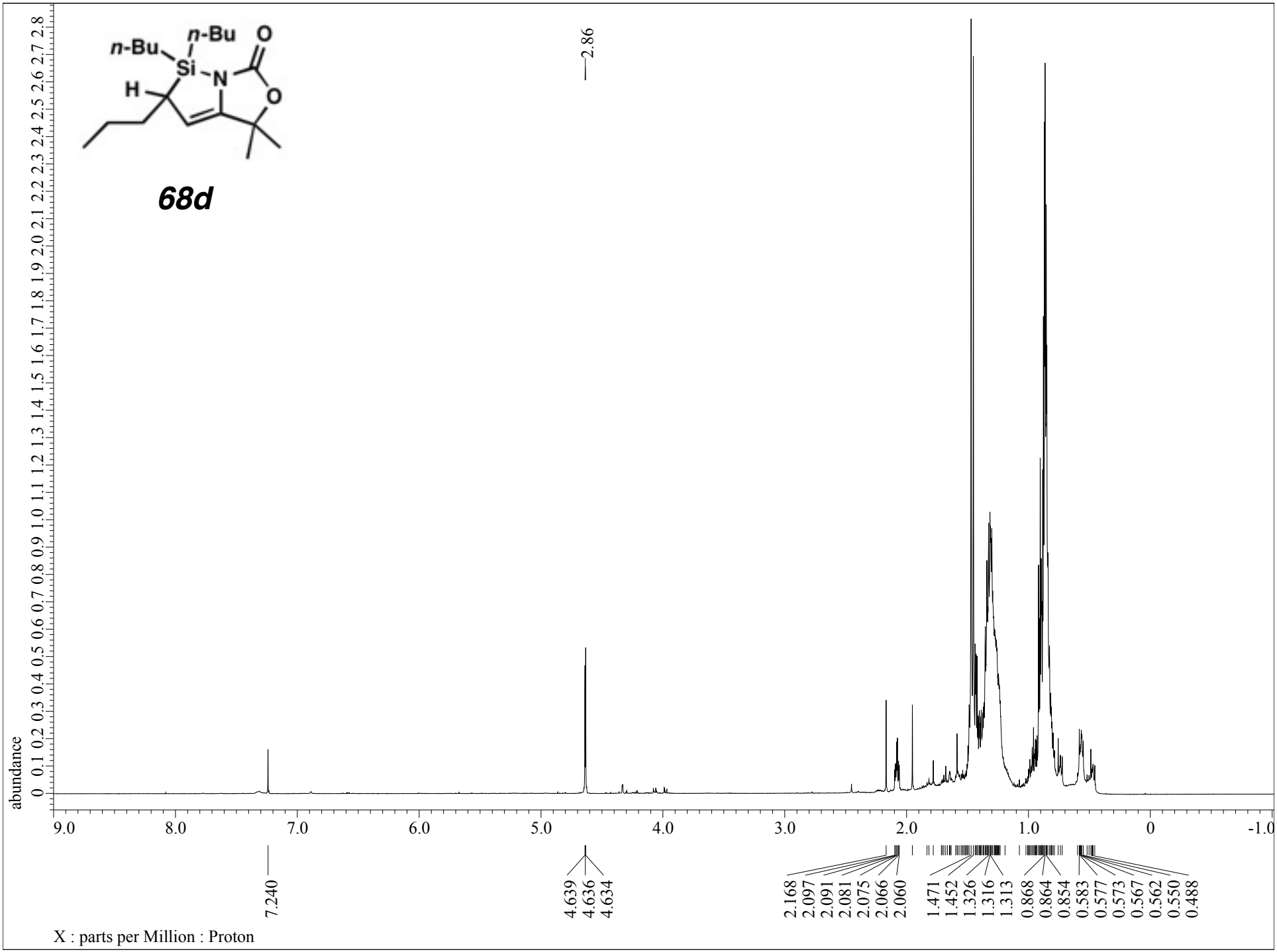

i-Pr
i-Pr
Si
15
N
O
O
21b
abundance
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
4.364
4.358
4.352
2.216
1.974
1.448
1.193
1.176
1.171
1.153
1.094
1.076
1.022
1.017
X : parts per Million : Proton

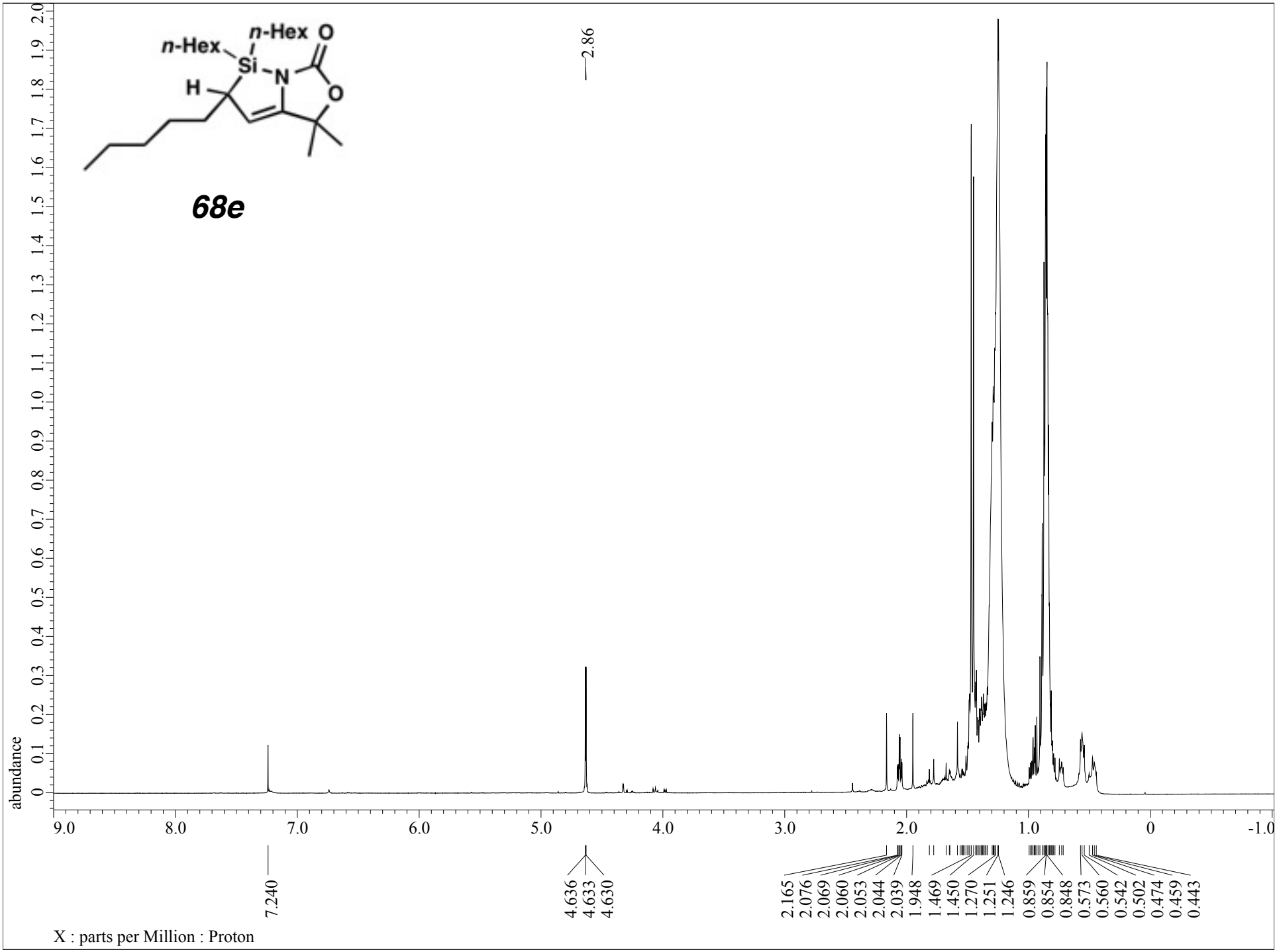

i-Pr
i-Pr
Si
15
N
O
O
21b
abundance
0.4
0.3
0.2
0.1
0
240.0 230.0 220.0 210.0 200.0 190.0 180.0 170.0 160.0 150.0 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0
156.982
150.229
150.181
108.273
81.466
77.311
77.000
76.679
32.124
27.717
26.014
17.899
17.500
11.672
X : parts per Million : Carbon13

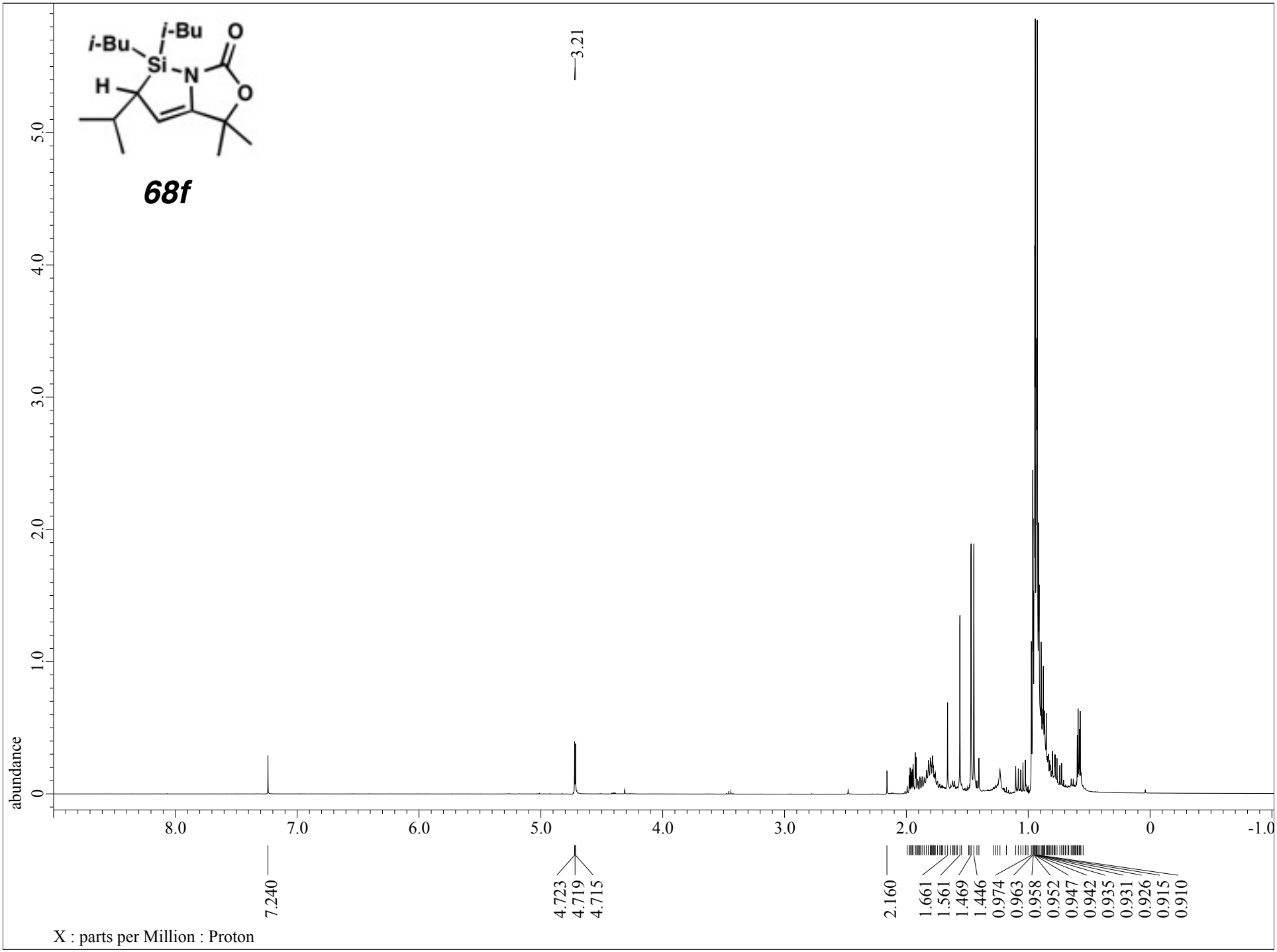

15N NMR
i-Pr
i-Pr
Si
15
N
O
O
21b
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
-10.0
(thousandths)
390.0
370.0
350.0
330.0
310.0
290.0
270.0
250.0
230.0
210.0
190.0
170.0
150.0
130.0
110.0
90.0
110.484
X : parts per Million : Nitrogen15

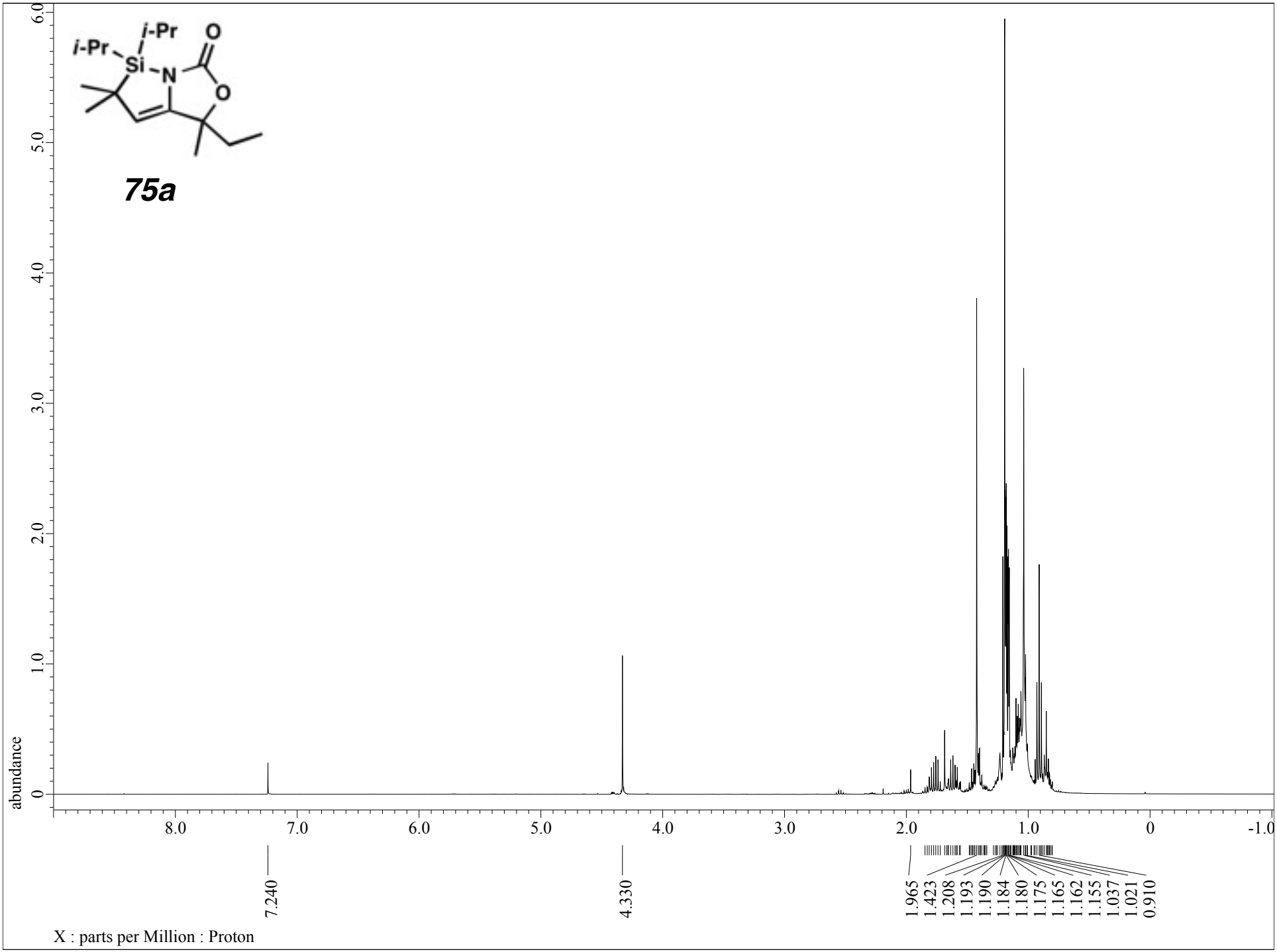

Et
Et
Si
N
O
H
O
68b
3.21
abundance
3.0
2.0
1.0
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
4.578
4.574
4.570
2.176
2.145
2.137
2.127
2.119
2.107
2.099
1.959
1.477
1.464
1.456
1.118
1.099
0.991
0.940
0.594
0.574
0.554
0.531
0.511
0.493
0.472
0.453
X : parts per Million : Proton

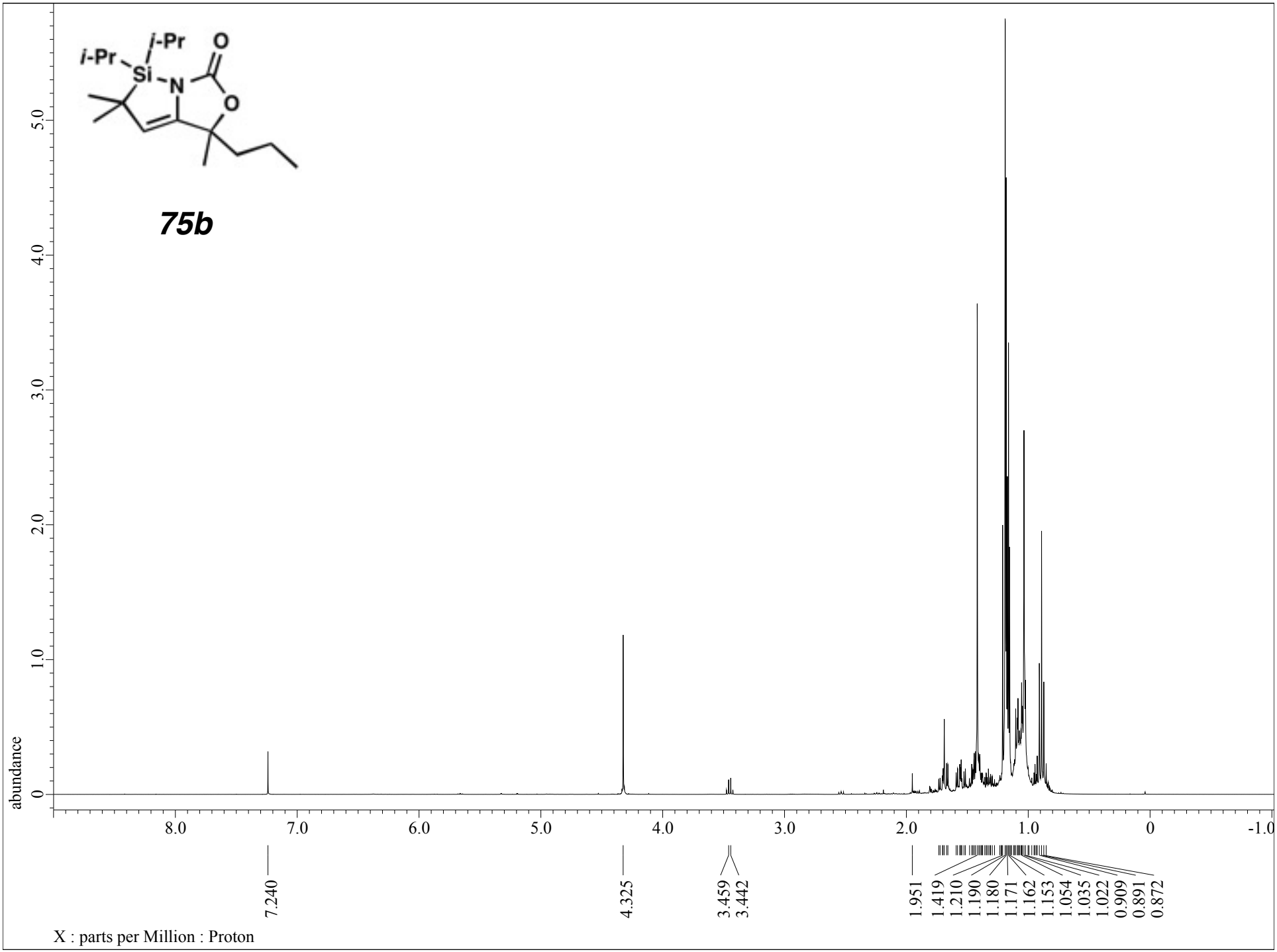

n-Pr
n-Pr
Si
N
O
O
H
68c
3.21
abundance
X : parts per Million : Proton
7.240
4.661
4.657
4.653
4.123
4.097
2.445
2.160
1.951
1.469
1.451
0.984
0.980
0.966
0.962
0.948
0.943
0.941
0.934
0.928
0.925
0.917
0.896
0.850

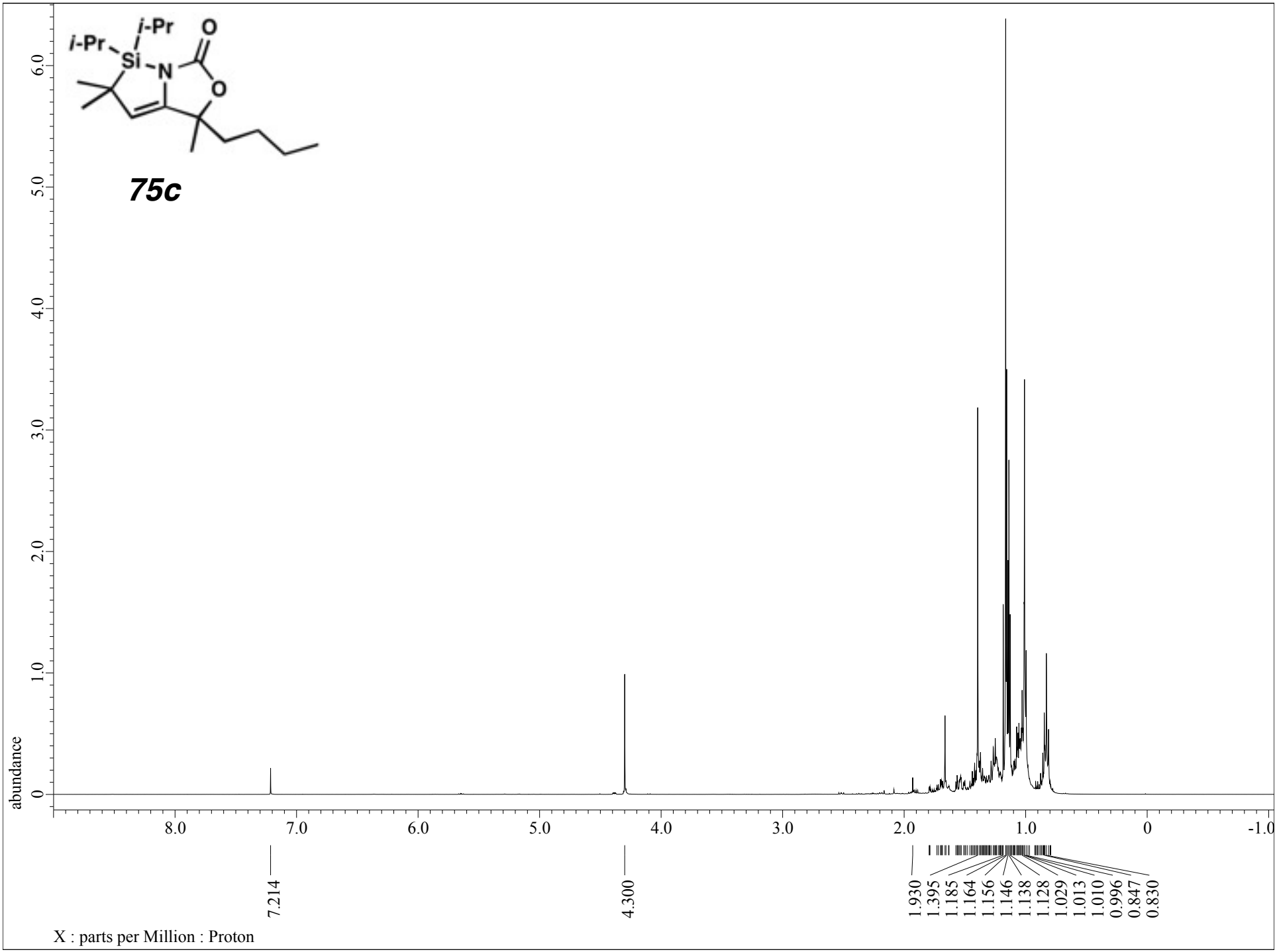

n-Bu
n-Bu
Si
H
N
O
O
68d
2.86
abundance
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
4.639
4.636
4.634
2.168
2.097
2.091
2.081
2.075
2.066
2.060
1.471
1.452
1.326
1.316
1.313
0.868
0.864
0.854
0.583
0.577
0.573
0.567
0.562
0.550
0.488
X : parts per Million : Proton

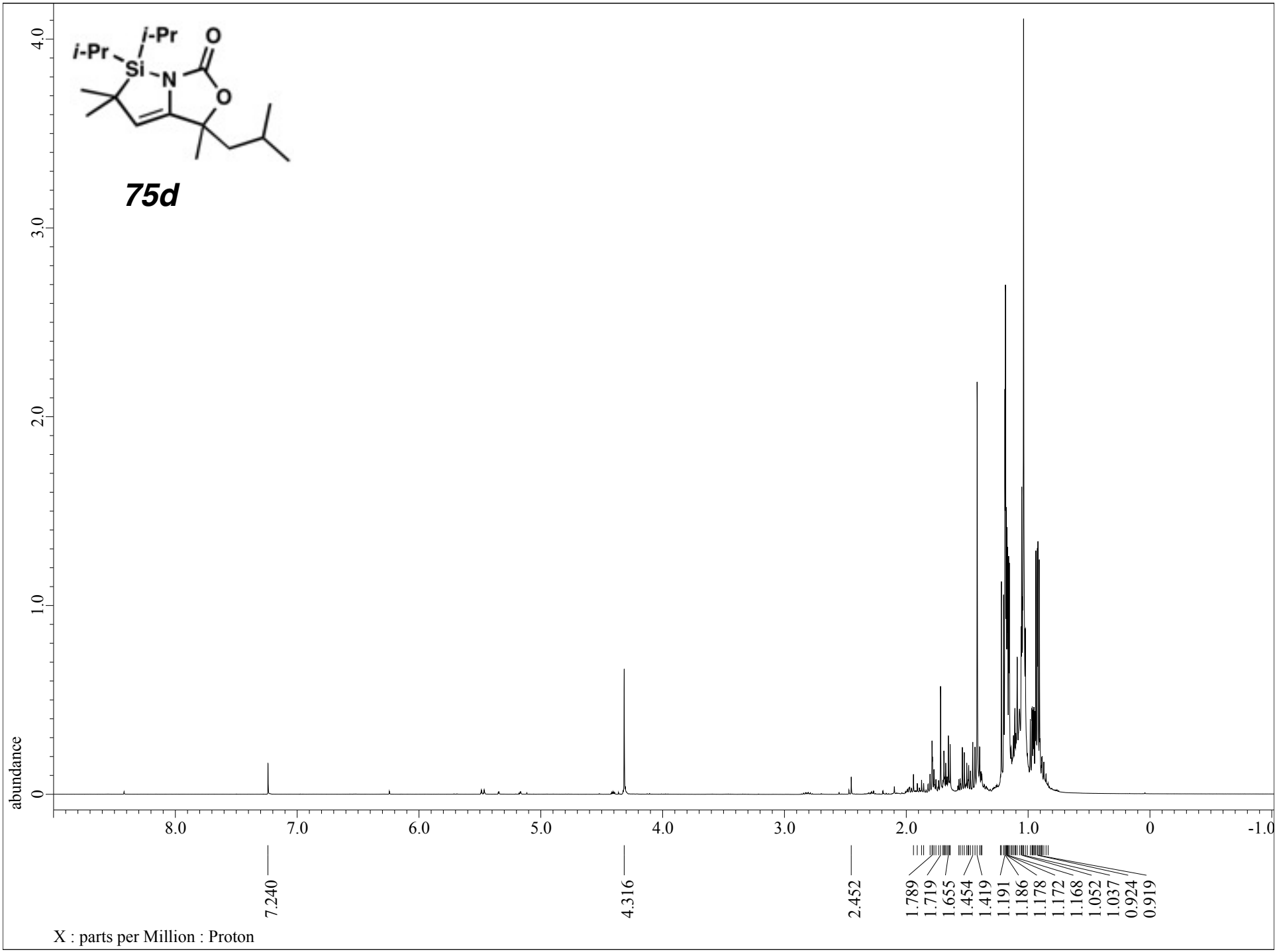

n-Hex
n-Hex
O
Si
N
H
O
68e
2.86
abundance
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
4.636
4.633
4.630
2.165
2.076
2.069
2.060
2.053
2.044
2.039
1.948
1.469
1.450
1.270
1.251
1.246
0.859
0.854
0.848
0.573
0.560
0.542
0.502
0.474
0.459
0.443
X : parts per Million : Proton

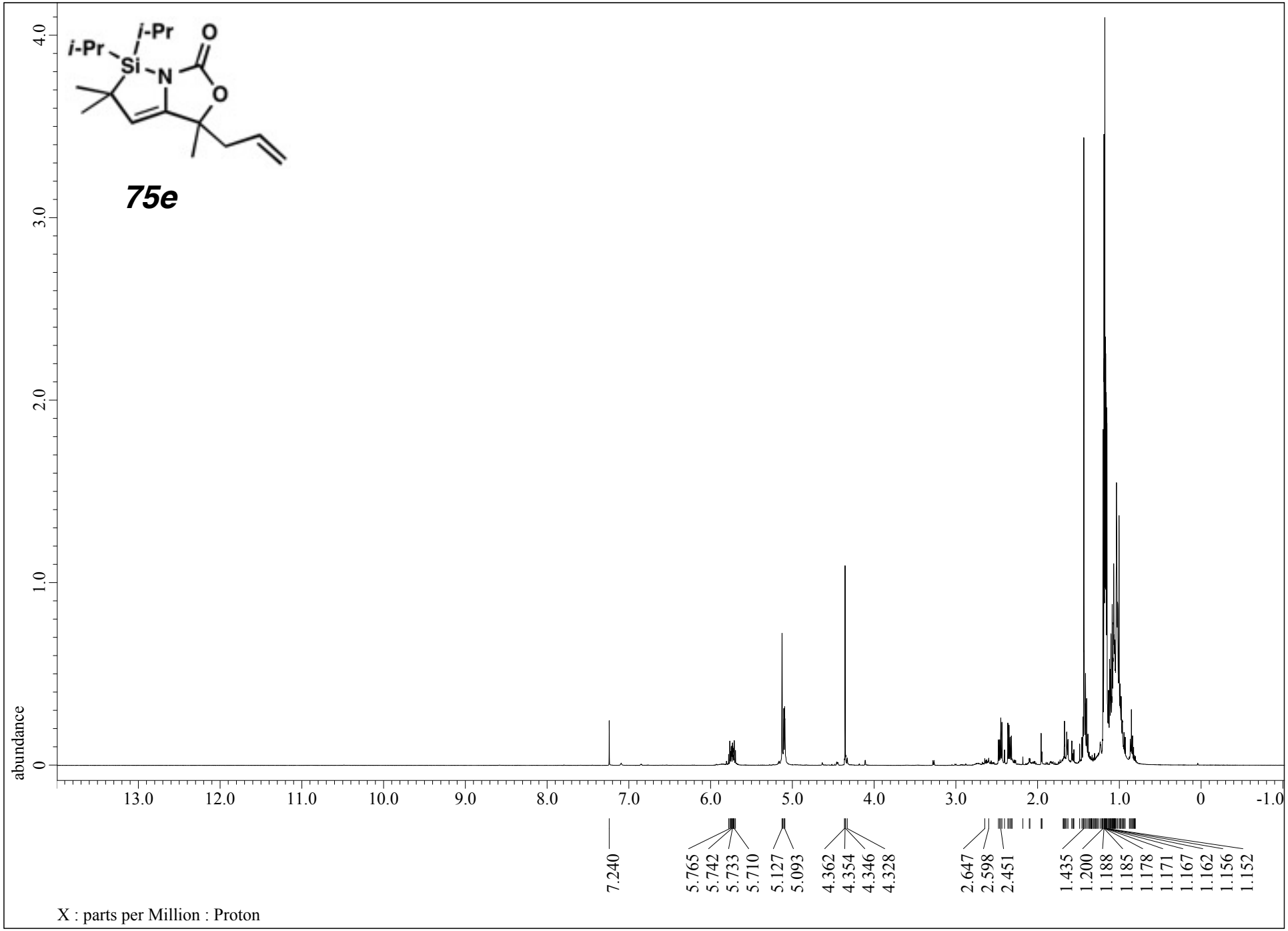

i-Bu
i-Bu
Si
N
O
O
H
68f
3.21
abundance
0
1.0
2.0
3.0
4.0
5.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
4.723
4.719
4.715
2.160
1.661
1.561
1.469
1.446
0.974
0.963
0.958
0.952
0.947
0.942
0.935
0.931
0.926
0.915
0.910
X : parts per Million : Proton

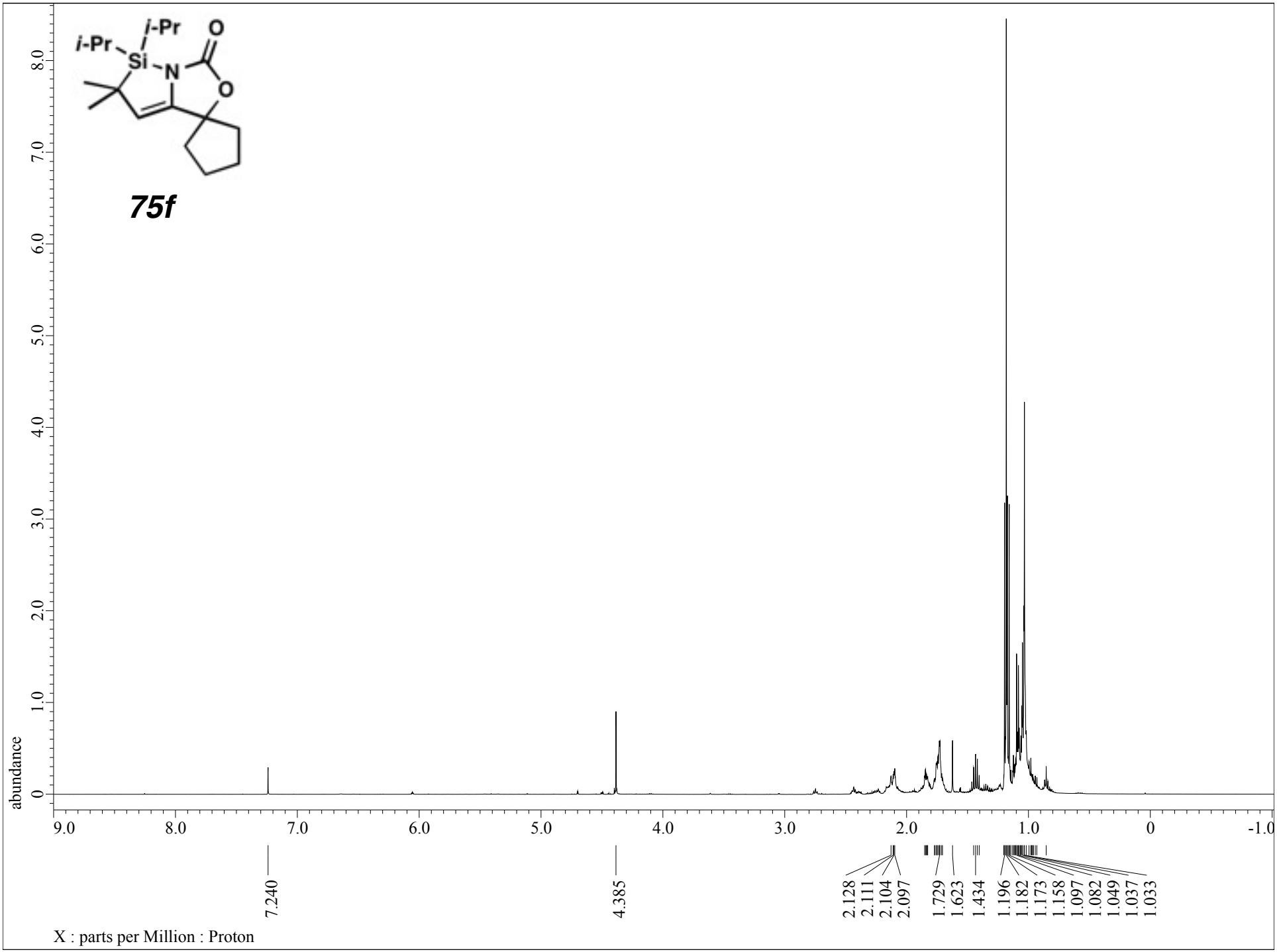

i-Pr
i-Pr
Si
N
O
O
75a
abundance
6.0
5.0
4.0
3.0
2.0
1.0
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
4.330
1.965
1.423
1.208
1.193
1.190
1.184
1.180
1.175
1.165
1.162
1.155
1.037
1.021
0.910
X : parts per Million : Proton

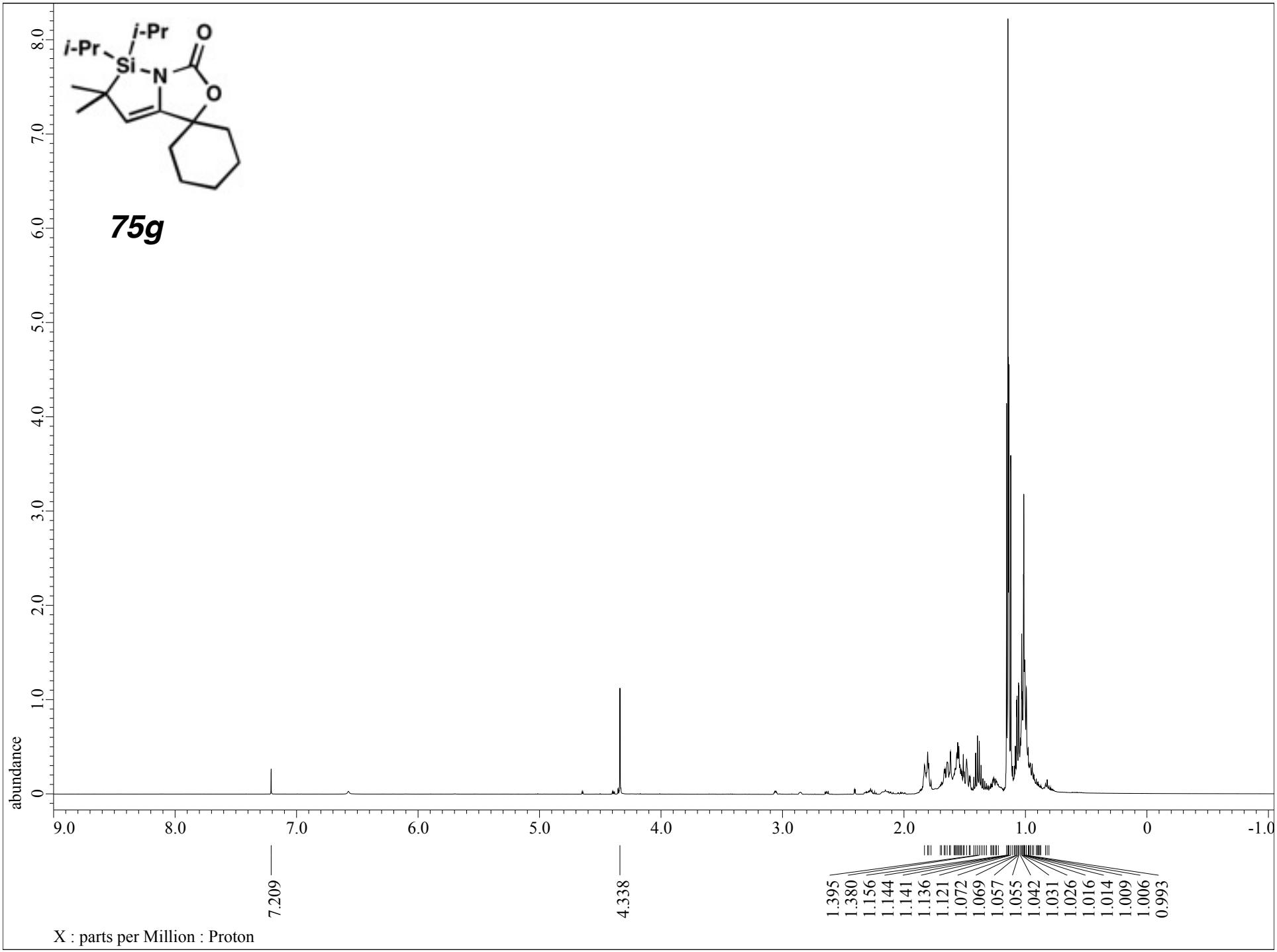

i-Pr
i-Pr
Si
N
O
O
75b
abundance
0
1.0
2.0
3.0
4.0
5.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
4.325
3.459
3.442
1.951
1.419
1.210
1.190
1.180
1.171
1.162
1.153
1.054
1.035
1.022
0.909
0.891
0.872
X : parts per Million : Proton

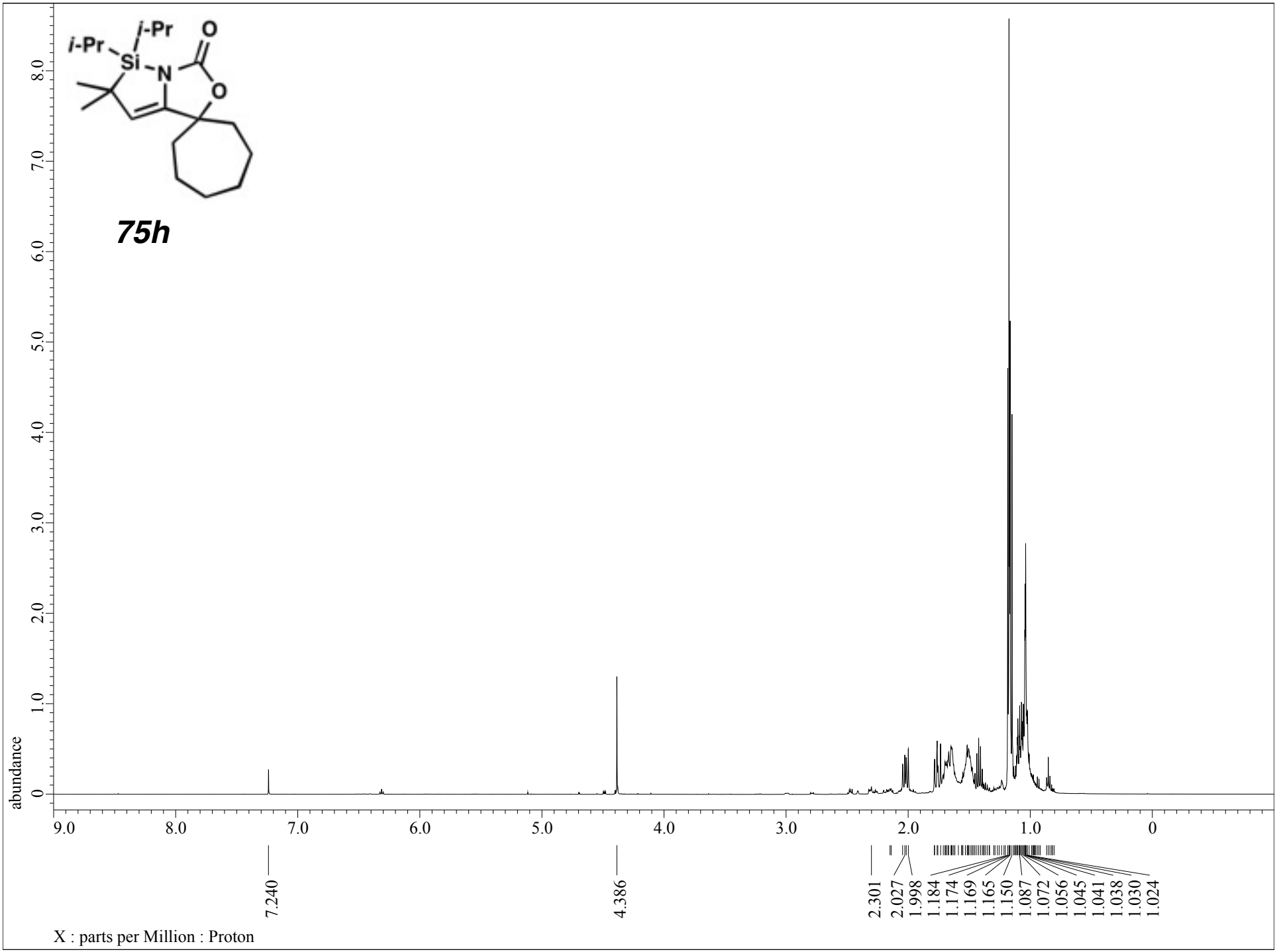

i-Pr
i-Pr
Si
N
O
O
75c
abundance
6.0
5.0
4.0
3.0
2.0
1.0
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.214
4.300
1.930
1.395
1.185
1.164
1.156
1.146
1.138
1.128
1.029
1.013
1.010
0.996
0.847
0.830
X : parts per Million : Proton

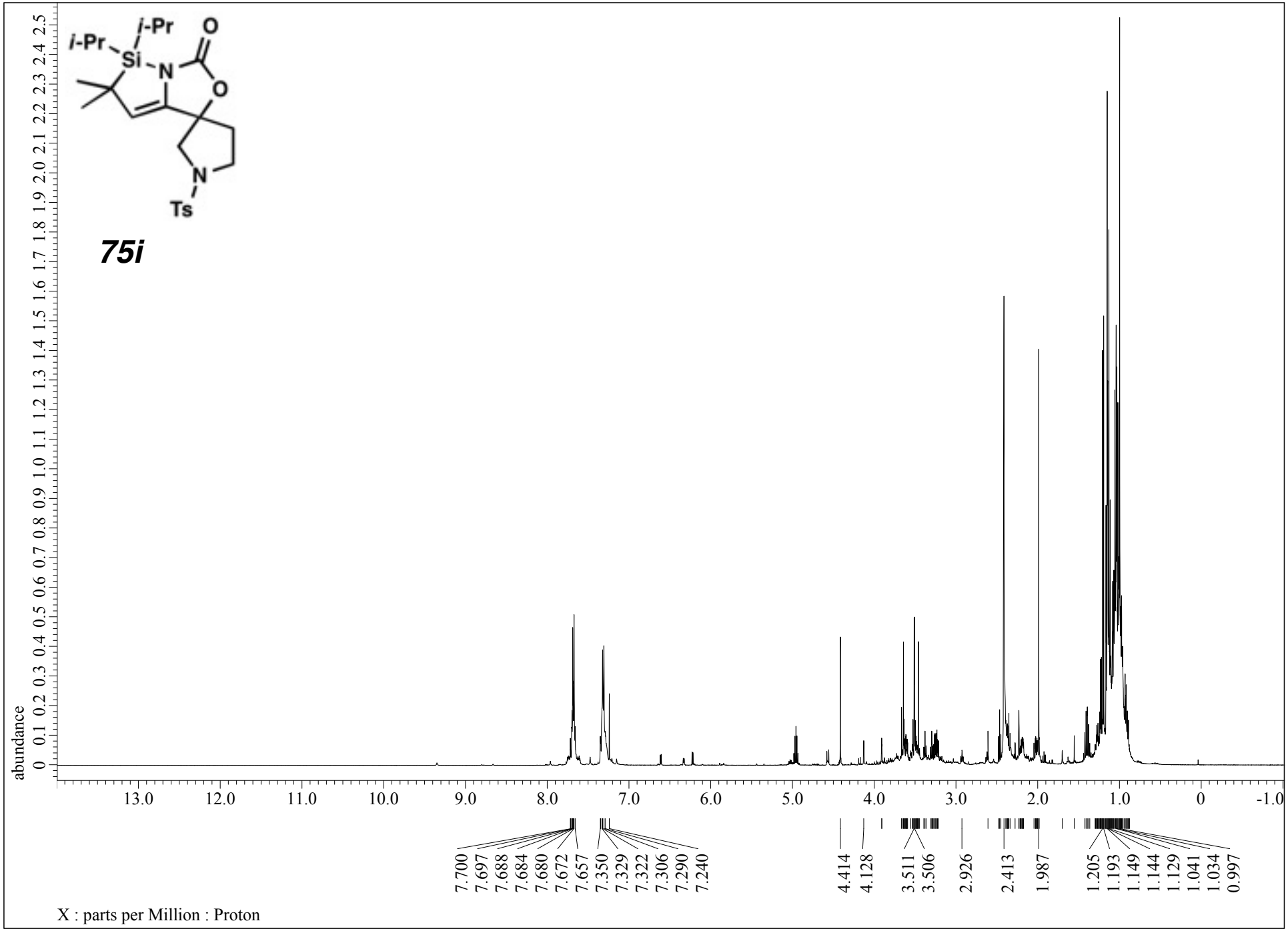

i-Pr
i-Pr
Si
N
O
O
75d
abundance
4.0
3.0
2.0
1.0
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
4.316
2.452
1.789
1.719
1.655
1.454
1.419
1.191
1.186
1.178
1.172
1.168
1.052
1.037
0.924
0.919
X : parts per Million : Proton

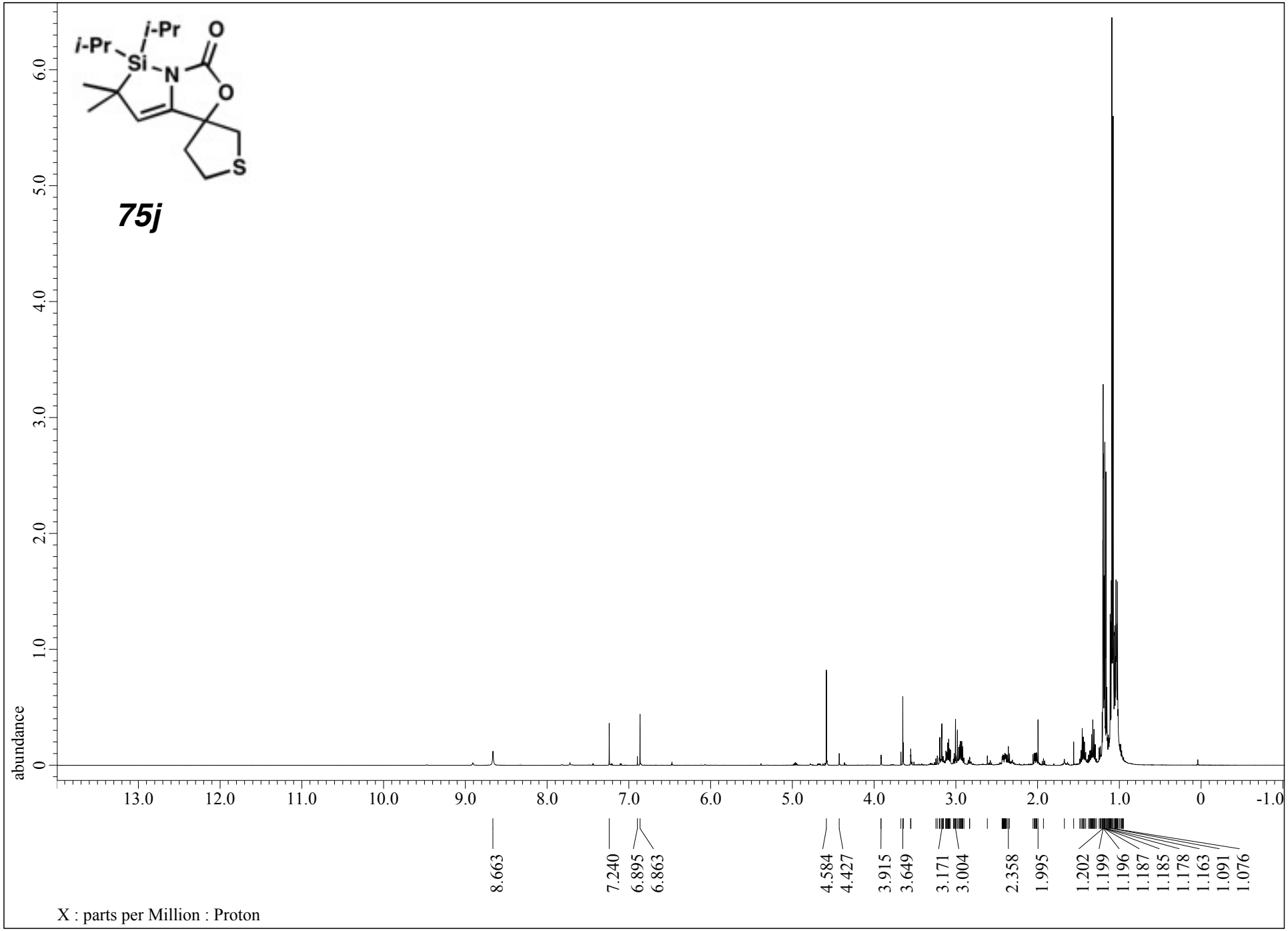

i-Pr
i-Pr
Si
N
O
O
75e
abundance
4.0
3.0
2.0
1.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
5.765
5.742
5.733
5.710
5.127
5.093
4.362
4.354
4.346
4.328
2.647
2.598
2.451
1.435
1.200
1.188
1.185
1.178
1.171
1.167
1.162
1.156
1.152
X : parts per Million : Proton

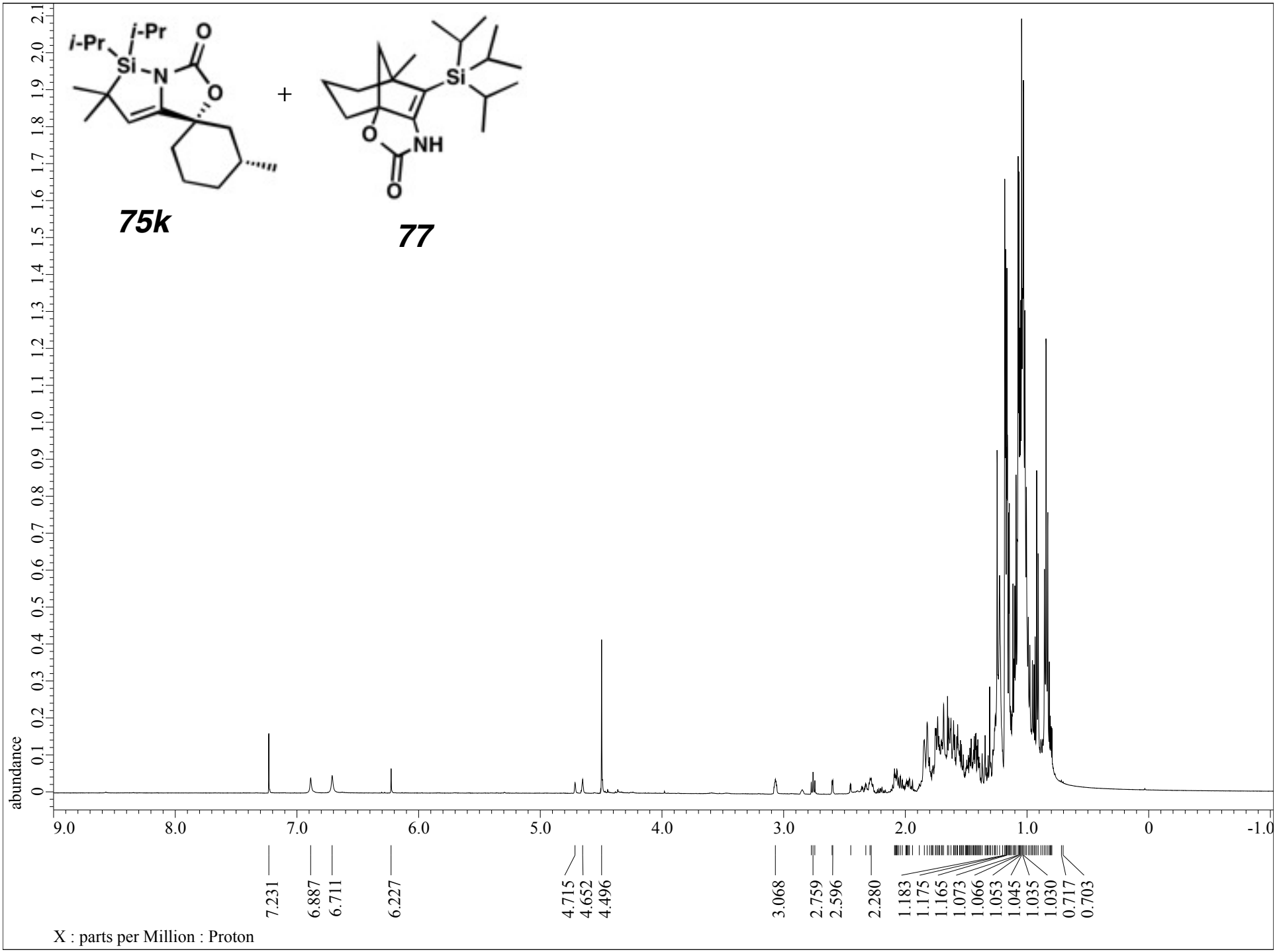

i-Pr
i-Pr
Si
N
O
O
75f
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
4.385
2.128
2.111
2.104
2.097
1.729
1.623
1.434
1.196
1.182
1.173
1.158
1.097
1.082
1.049
1.037
1.033
X : parts per Million : Proton

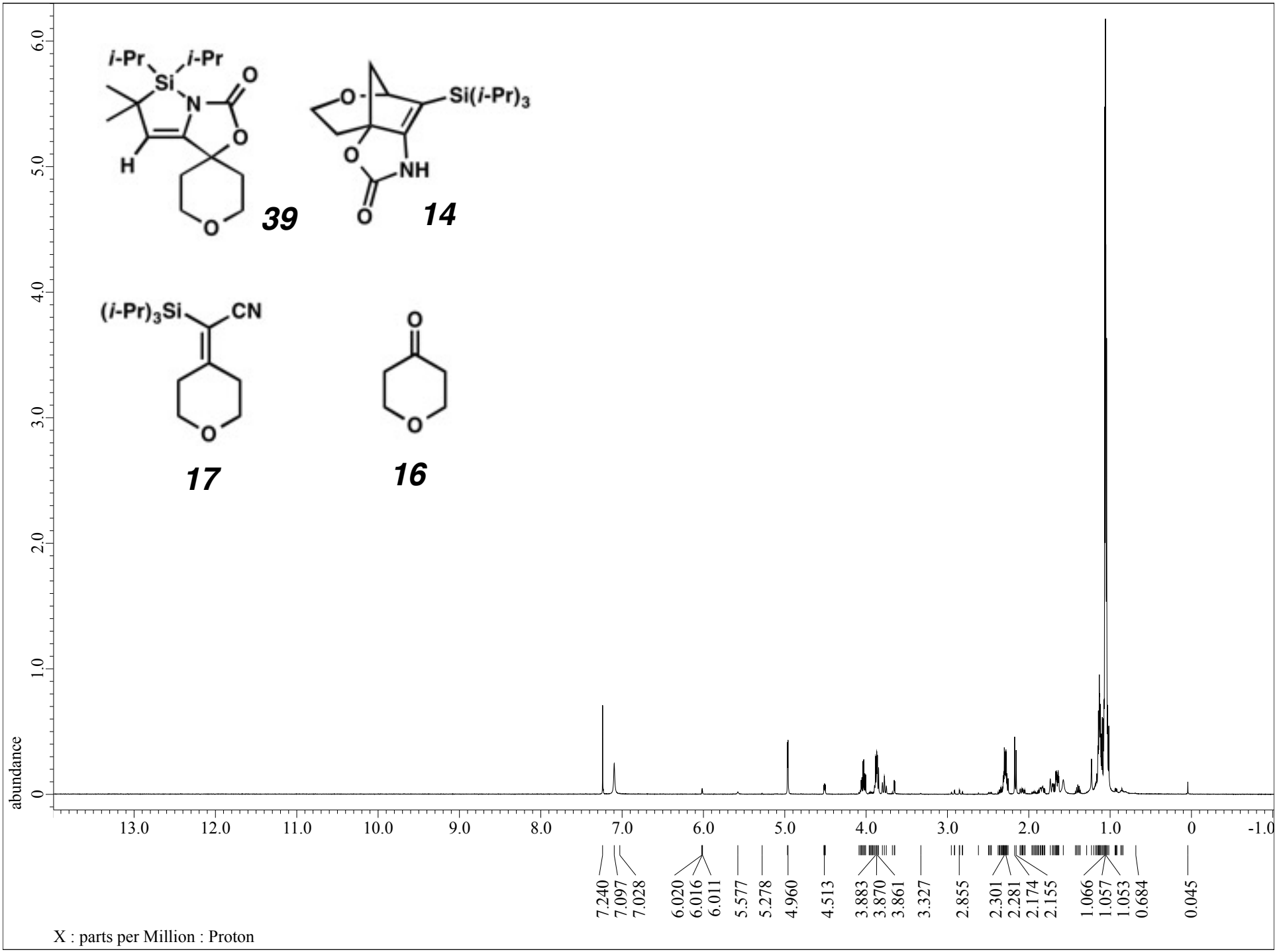

i-Pr
i-Pr
Si
N
O
O
O
75g
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.209
4.338
1.395
1.380
1.156
1.144
1.141
1.136
1.121
1.072
1.069
1.057
1.055
1.042
1.031
1.026
1.016
1.014
1.009
1.006
0.993
X : parts per Million : Proton


i-Pr
i-Pr
Si
N
O
O
75h
abundance
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7.240
4.386
2.301
2.027
1.998
1.184
1.174
1.169
1.165
1.150
1.087
1.072
1.056
1.045
1.041
1.038
1.030
1.024
X : parts per Million : Proton


i-Pr
i-Pr
Si
N
O
O
N
Ts
75i
abundance
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.700
7.697
7.688
7.684
7.680
7.672
7.657
7.350
7.329
7.322
7.306
7.290
7.240
4.414
4.128
3.511
3.506
2.926
2.413
1.987
1.205
1.193
1.149
1.144
1.129
1.041
1.034
0.997
X : parts per Million : Proton


i-Pr
i-Pr
Si
N
O
O
S
75j
abundance
6.0
5.0
4.0
3.0
2.0
1.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
8.663
7.240
6.895
6.863
4.584
4.427
3.915
3.649
3.171
3.004
2.358
1.995
1.202
1.199
1.196
1.187
1.185
1.178
1.163
1.091
1.076
X : parts per Million : Proton


i-Pr
i-Pr
Si
N
O
O
+
Si
O
NH
O
75k
77
abundance
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.231
6.887
6.711
6.227
4.715
4.652
4.496
3.068
2.759
2.596
2.280
1.183
1.175
1.165
1.073
1.066
1.053
1.045
1.035
1.030
0.717
0.703
X : parts per Million : Proton


i-Pr
i-Pr
Si
N
O
O
H
O
39
O
Si(i-Pr)3
O
NH
O
14
(i-Pr)3Si
CN
O
17
O
16
abundance
6.0
5.0
4.0
3.0
2.0
1.0
0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
7.240
7.097
7.028
6.020
6.016
6.011
5.577
5.278
4.960
4.513
3.883
3.870
3.861
3.327
2.855
2.301
2.281
2.174
2.155
1.066
1.057
1.053
0.684
0.045
X : parts per Million : Proton