Supporting Information

A Simple Protocol for Stereoselective Construction of Novel β-Sulfanyl Vinyl Sulfonyl Flourides

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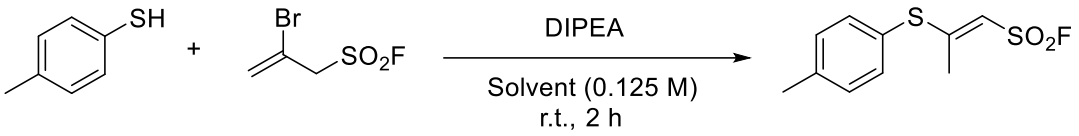
1. General Information

Instrumentation:

The reactions were conducted under ambient air unless otherwise noted. NMR spectra were recorded in $CDCl_3$ or DMSO-d_6 using a spectrometer with frequencies of 500 MHz (for ^{1}H), 471 MHz (for ^{19}F), and 126 MHz (for ^{13}C). (note: $CDCl_3$: δ H = 7.264 ppm, δ C = 77.16 ppm; DMSO-d_6: δ H = 2.500 ppm, δ C = 39.52 ppm). Chemical shifts were reported in ppm relative to TMS (0 ppm for ^{1}H NMR) as the internal standard. HPLC analyses were performed on a Waters e2695 system with a J&K RP-C18 column (5 µm, 4.6 × 150 mm). Product yields were determined using pure compounds as external standards. Coupling constants (J values) were reported in Hertz (Hz). The following abbreviations describe multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, quint = quintet, hept = heptet, m = multiplet, br s = broad singlet, dd = doublet of doublets. The numbering of compounds for assigning NMR spectra is arbitrary and does not follow IUPAC conventions. Chemical structure names were generated using Chemdraw software. High-resolution mass spectrometry (HRMS) was conducted on a TOF-Q EI instrument. Melting points were measured and are uncorrected. All reagents used in the reactions were obtained from commercial sources and used without further purification. Thin layer chromatography (TLC) spots were visualized under UV light (254 nm or 365 nm) and subsequently stained with potassium permanganate or phosphomolybdic acid. The starting thiols were purchased and used without further modification.

2. Optimization of the Reaction Conditions

Table S1 Screening the Solvent.[a]

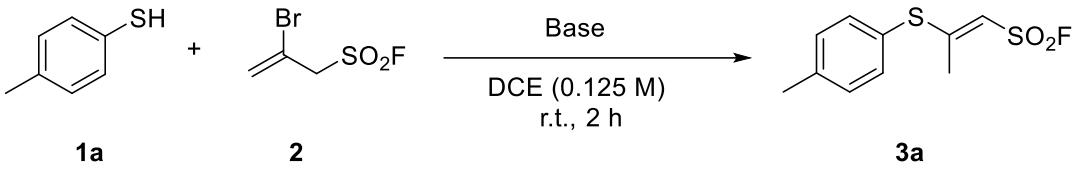


1a **2** **3a**

Entry	Solvent	Yield (**3a**, %)[b]
1	DMSO	66
2	**DCE**	**98**
3	DCM	95
4	Toluene	N.D.
5	MeCN	91
6	THF	91
7	1,4-Dioxane	68
8	DMF	16
9	C_2H_5OH	58
10	NMP	N.D.
11	EtOAc	91
12	Acetone	69

[a]Reaction conditions: a mixture of 4-methylbenzenethiol (**1a**, 25 mg, 0.2 mmol, 1.0 equiv.), BPESF (**2**, 61 mg, 0.3 mmol, 1.5 equiv.) and DIPEA (65 mg, 0.5 mmol, 2.5 equiv.) in solvent (1.6 mL) was stirred at r.t. for 2 h under air. [b]The yield was determined by HPLC using pure **3a** as the external standard (t_R = 5.0 min, λ_{max} = 219.3 nm, water/methanol = 30: 70 (v/v). N.D. = Not detectable.

Table S2 Screening the base.[a]

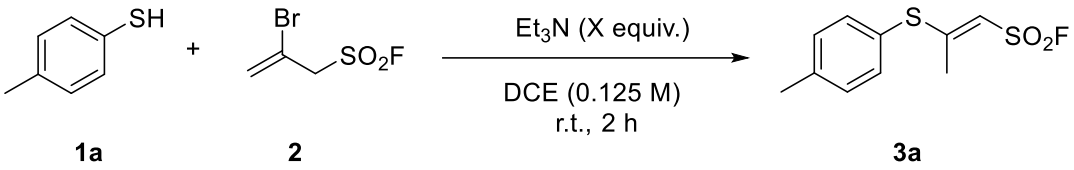


1a **2** **3a**

Entry	Base (2.5 equiv.)	Yield (**3a**, %)[b]
1	DIPEA	98
2	DABCO	75
3	DBU	77
4	CS_2CO_3	6
5	TMEDA	84
6	**Et_3N**	**99**
7	$NaHCO_3$	N.D.
8	K_2CO_3	N.D.
9	Tripopylamine	89
10	Na_2CO_3	2

[a]Reaction conditions: a mixture of 4-methylbenzenethiol (**1a**, 25 mg, 0.2 mmol, 1.0 equiv.), BPESF (**2**, 61 mg, 0.3 mmol, 1.5 equiv.) and base (0.5 mmol, 2.5 equiv.) in DCE (1.6 mL) was stirred at r.t. for 2 h under air. [b]The yield was determined by HPLC using pure **3a** as the external standard (t_R = 5.0 min, λ_{max} = 219.3 nm, water/methanol = 30: 70 (v/v). N.D. = Not detectable.

Table S3 Screening the loading of base.[a]

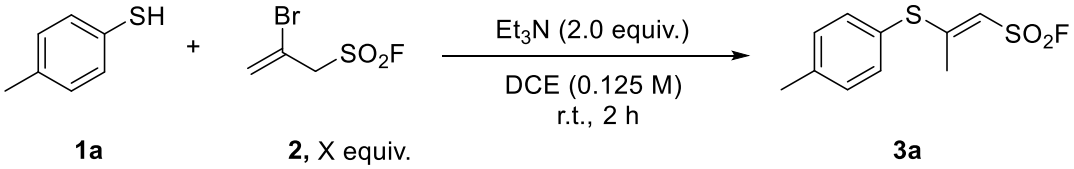


1a **2** **3a**

Entry	Et_3N (x equiv.)	Yield (**3a**, %)[b]
1	1.0	42
2	1.5	56
3	**2.0**	**99**
4	2.5	99

[a]Reaction conditions: a mixture of 4-methylbenzenethiol (**1a**, 25 mg, 0.2 mmol, 1.0 equiv.), BPESF (**2**, 61 mg, 0.3 mmol, 1.5 equiv.) and Et_3N (X equiv.) in DCE (1.6 mL) was stirred at r.t. for 2 h under air. [b]The yield was determined by HPLC using pure **3a** as the external standard (t_R = 5.0 min, λ_{max} = 219.3 nm, water/methanol = 30: 70 (v/v).

Table S4 Screening the loading of BPESF **(2)** [a]



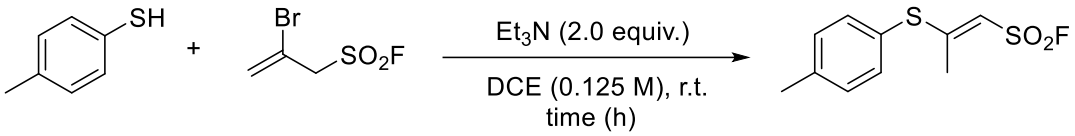
1a **2,** X equiv. **3a**

Entry	X equiv.	Yield (**3a**, %)[b]
1	1.0	93
2	**1.2**	**98**
3	1.5	99
4	2.0	89

[a]Reaction conditions: a mixture of 4-methylbenzenethiol (**1a**, 25 mg, 0.2 mmol, 1.0 equiv.), BPESF (**2**, X equiv.) and Et_3N (40 mg, 0.4 mmol, 2.0 equiv.) in DCE (1.6 mL) was stirred at r.t. for 2 h under

air. [b]The yield was determined by HPLC using pure **3a** as the external standard (t_R = 5.0 min, λ_{max} = 219.3 nm, water/methanol = 30: 70 (v/v).

Table S5 Screening the time of reaction[a]



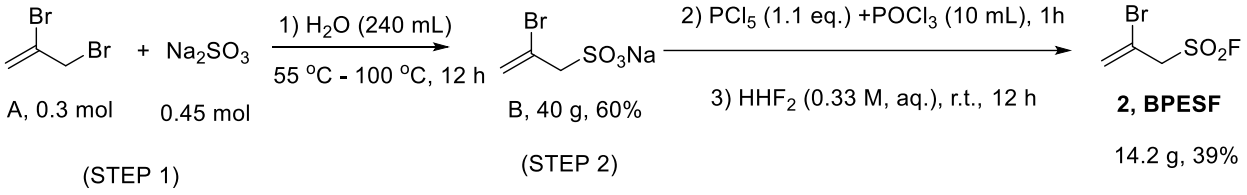
1a **2** **3a**

Entry	Time (h)	Yield (**3a**, %)[b]
1	0.5	90
2	1.0	87
3	**2.0**	**98**

[a]Reaction conditions: a mixture of 4-methylbenzenethiol (**1a**, 25 mg, 0.2 mmol, 1.0 equiv.), BPESF (**2**, 49 mg, 0.24 mmol, 1.2 equiv.) and Et_3N (40 mg, 0.4 mmol, 2.0 equiv.) in DCE (1.6 mL) was stirred at r.t. for X h under air. [b]The yield was determined by HPLC using pure **3a** as the external standard (t_R = 5.0 min, λ_{max} = 219.3 nm, water/methanol = 30: 70 (v/v).

3. Experimental Procedures

3.1 Preparation of 2-chloroprop-2-ene-1-sulfonyl fluoride (BPESF).[1]



A, 0.3 mol 0.45 mol (STEP 1) B, 40 g, 60% (STEP 2) **2, BPESF** 14.2 g, 39%

Step 1: A mixture of 2,3-dibromopropene (60 g, 0.3 mol) and Na_2SO_3 (37.8 g, 0.45 mol, 1.5 equiv.) was added to 240 mL of water and stirred while being heated. The mixture was then refluxed at 100 °C for 12 hours. After the reaction, the solvent was removed under reduced pressure. The resulting residue was dissolved in 300 mL of ethanol, and the mixture was refluxed with stirring at 80 °C for 1 hour. After removing insoluble materials by filtering the hot mixture, the filtrate

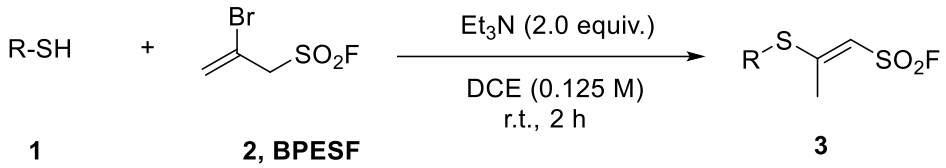
was cooled to -20 °C. The resulting crystalline from of sodium 2-bromoprop-2-ene-1-sulfonate were collected by filtration, yielding 40.0 g (0.179 mol, 60%).

Step 2: A mixture of the sodium salt (40.0 g, 0.179 mol) and PCl_5 (41.0 g, 0.197 mol, 1.1 equiv.) was vigorously stirred until the mixture liquefied, which took about 10 minutes due to the exothermic reaction. Any solids remaining on the bottle walls were rinsed down with 5 mL of $POCl_3$. The mixture was then rapidly heated to 120 °C for 1 hour, cooled to room temperature, and poured onto ice with vigorous stirring. The reaction mixture was maintained at a low temperature (below 20 °C) while being stirred and was extracted with CH_2Cl_2 (3 × 50 mL). The organic phase was washed with ice-cold water (1 × 50 mL) and a 5% $NaHCO_3$ solution (2 × 100 mL), then dried and evaporated under reduced pressure. The resulting 2-bromoprop-2-ene-1-sulfonyl chloride was added dropwise to a solution of KHF_2 (50 g, 0.33 M) while stirring for 12 hours. The reaction mixture was further extracted with CH_2Cl_2 (2 × 50 mL), then dried and evaporated under reduced pressure. The product, 2-bromoprop-2-ene-1-sulfonyl fluoride (BPESF), was distilled at 70 °C under reduced pressure, yielding a colorless oil (14.2 g, 39% yield over 2 steps). For long-term stability, BPESF should be stored at -20 °C.

Note: The vigorous stirring of the sodium salt with PCl_5 generates heat. Prepare ice water to cool the reaction bottle.

2-bromoprop-2-ene-1-sulfonyl fluoride (**2**). Colorless liquid. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 6.18 (d, *J* = 2.6 Hz, 1H), 6.03 (d, *J* = 2.6 Hz, 1H), 4.43 (d, *J* = 3.5 Hz, 2H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 56.3. **^{13}C NMR** (126 MHz, $CDCl_3$) δ 128.5, 114.3, 61.0 (d, *J* = 19.0 Hz). ESI-MS HRMS $[M + Na]^+$ calculated for $C_3H_4BrFNaO_2S$, 224.8992; found, 224.8995.

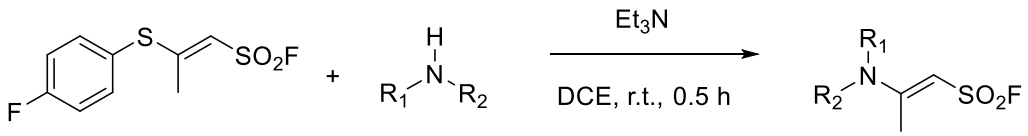
3.2 Procedure for the Synthesis of 3.



1 **2, BPESF** **3**

An oven-dried reaction tube (20 mL) equipped with a magnetic stirring bar was charged with thiols (**1**, 1.0 mmol, 1.0 equiv.), BPESF (**2**, 244 mg, 1.2 mmol, 1.2equiv.) and 8.0 mL DCE. Then, trimethylamine (202 mg, 2.0 mmol, 2.0 equiv.) was added dropwise to the above solution. The mixture was stirred at room temperature for 2 h under an air atmosphere monitored by TLC. After the reaction was completed, 20 mL of water was added to the mixture. The resulting mixture was then extracted with ethyl acetate in three portions of 10 mL each. The combined extracts were dried over anhydrous sodium sulfate (Na_2SO_4) and concentrated under reduced pressure. The residue was then purified by column chromatography on silica gel, using a mixture of petroleum ether and ethyl acetate as the eluent, yielding the desired product **3**.

3.3 Diversification procedure for construction of enaminyl sulfonyl fluorides from 3t.[2]

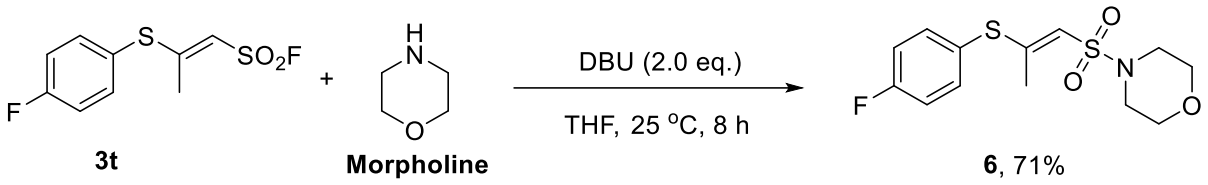


3t **4** **5**

According to a modified procedure from our previous work, an oven-dried reaction tube (20 mL) equipped with a magnetic stirring bar was charged with (E)-2-((4-fluorophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3t**, 0.5 mmol, 125 mg), amines (**4**, 0.5 mmol, 1.0 equiv.), and 4.0 mL DCE. Then, trimethylamine (101 mg, 1.0 mmol, 2.0 equiv.) was added dropwise to the above solution. The mixture was stirred at room temperature for 0.5 h under an air atmosphere monitored by TLC. After the reaction was completed, water (20 mL) was added to the mixture and the reaction mixture was extracted with ethyl acetate (3×10 mL). The extracts were dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by column

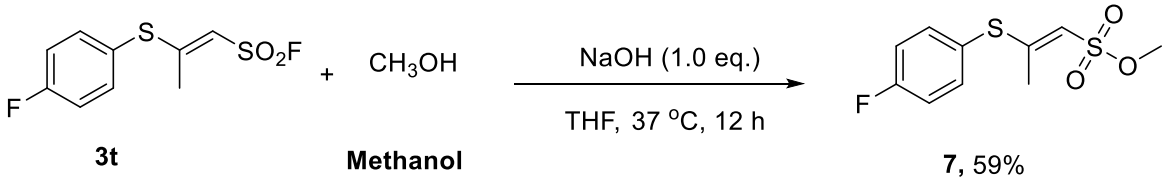
chromatography on silica gel using a mixture of petroleum ether and ethyl acetate as eluents to give the desired product **5.**

3.4 General procedure for synthesis of vinyl sulfonamide from morpholine.[3]



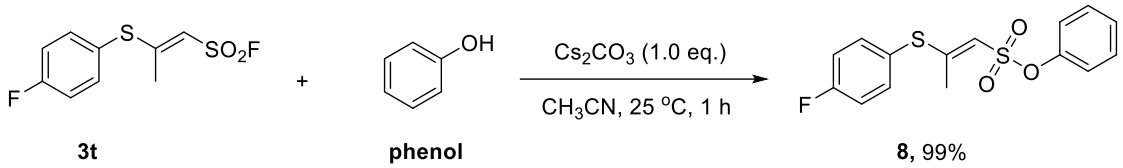
Morpholine (1.0 mmol, 2.0 eq., 87.1 mg) and DBU (1.0 mmol, 2.0 eq., 152.2 mg) were added to a stirred solution of (*E*)-2-((4-fluorophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3t**, 0.5 mmol, 125 mg) dissolved in tetrahydrofuran (2 mL) and the resulting mixture reacted at 25 ℃ for 8 h. The reaction was concentrated to dryness and the residue was further purified by column chromatography on silica gel by gradient elution with petroleum ether/ethyl acetate (5:1 to 3:1, v/v) as eluent to obtain pure vinyl sulfonamide **6** as white solid (114 mg, 71% yield).

3.5 General procedure for synthesis of vinyl sulfonate from methanol.



Methanol (1.0 mmol, 2.0 eq., 32.0 mg) and sodium hydroxide (0.5 mmol, 1.0 equiv, 20.0 mg) were added to a stirred solution of (*E*)-2-((4-fluorophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3t**, 0.5 mmol, 125 mg) dissolved in tetrahydrofuran (2 mL) and the resulting mixture reacted at 37 ℃ for 12 h. The reaction was concentrated to dryness and the residue was further purified by column chromatography on silica gel by gradient elution with petroleum ether/ethyl acetate (5:1 v/v) as eluent to obtain pure vinyl sulfonamide **7** as white solid (77 mg, 59% yield).

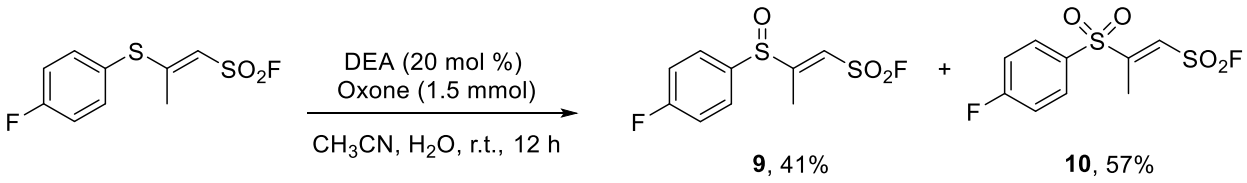
3.6 General procedure for synthesis of vinyl sulfonate from phenol.



3t **phenol** **8**, 99%

(*E*)-2-((4-fluorophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3t**, 0.5 mmol, 125 mg), phenol (0.5 mmol, 1.0 eq., 47mg), cesium carbonate (0.5 mmol, 1.0 eq., 163.4 mg) were added in a solution of acetonitrile (2 mL) and reacted at room temperature in an air atmosphere for 1 h. The reaction mixture was extracted with ethyl acetate (3×20 mL) and the combined organic layers was dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The crude product was further purified by column chromatography on silica gel, using gradient elution with a mixture of petroleum ether and ethyl acetate (10:1, v/v) as the eluent to obtain pure vinyl sulfonate **8** as light yellow solid (160 mg, 99% yield).

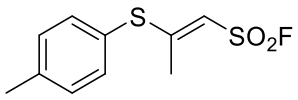
3.7 General procedure of oxidation for synthesis of sulfoxide and sulfone from 3t.[4]



3t **9**, 41% Sulfoxide **10**, 57% Sulfone

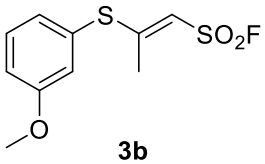
(*E*)-2-((4-fluorophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3t**, 0.5 mmol, 125 mg) and diethylamine (20 mol%) in acetonitrile (2 mL) was added to the solution of Oxone (1.5 mmol) in water (4 mL). The reaction was stirred for 12 h while monitoring by TLC, which indicated the formation of two new oxidation products. Then, the reaction mixture was extracted with ethyl acetate (3×20 mL) and the combined organic layers was dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The crude product was further purified by column chromatography on silica gel by gradient elution with petroleum ether/ethyl acetate (5:1, v/v) as eluent to obtain pure sulfoxide as white solid (55 mg, 41%) and sulfone as colorless oil (81 mg, 57% yield).

4. Characterization



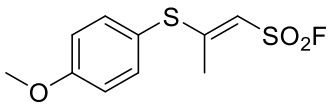
3a

(E)-2-(p-tolylthio)prop-1-ene-1-sulfonyl fluoride (**3a**). Light yellow solid, 222 mg, 90% yield. M.p. 69−70 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 20:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.39 (d, *J* = 8.1 Hz, 2H), 7.30 (d, *J* = 7.9 Hz, 2H), 5.46 (s, 1H), 2.47 (s, 3H), 2.42 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.5 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 167.7 (d, *J* = 1.7 Hz), 142.0, 135.5, 131.4, 123.9, 109.6 (d, *J* = 25.4 Hz), 21.6, 20.0. **HRMS-ESI** (m/z) calcd. for $[C_{10}H_{12}FO_2S_2]^+$ ($[M+H]^+$): 247.0257, found: 247.0257.



3b

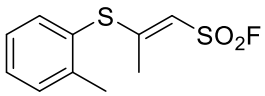
(E)-2-((3-methoxyphenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3b**)**.** Light yellow solid, 262 mg, 100% yield. M.p. 83−84 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent.**^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.41 (t, *J* = 8.0 Hz, 1H), 7.11 – 7.02 (m, 3H), 5.54 (s, 1H), 3.85 (s, 3H), 2.47 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.5 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.8, 161.0, 131.5, 128.2, 127.6, 120.6, 117.3, 110.9 (d, *J* = 25.5 Hz), 55.7, 20.0. **HRMS-ESI** (m/z) calcd. for $[C_{10}H_{12}FO_3S_2]^+$ ($[M+H]^+$): 263.0206, found: 263.0207.



3c

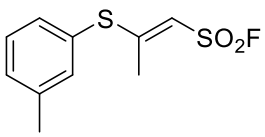
(E)-2-((4-methoxyphenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3c**). Light yellow oil, 257 mg, 98% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 20:1 (v/v) as eluent.**^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.41 (d, *J* = 8.8 Hz, 2H), 7.00 (d, *J* = 8.8 Hz, 2H), 5.44 (s, 1H), 3.87 (s, 3H), 2.45 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.5 (s, 1F). **^{13}C NMR** (126 MHz,

$CDCl_3$) δ 168.3 (d, *J* = 1.7 Hz), 162.1, 137.2, 117.9, 116.2, 109.5 (d, *J* = 25.4 Hz), 55.7, 19.8. **HRMS-ESI** (m/z) calcd. for $[C_{10}H_{12}FO_3S_2]^+$ ($[M+H]^+$): 263.0206, found: 263.0207.



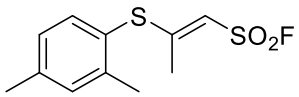
3d

(E)-2-(o-tolylthio)prop-1-ene-1-sulfonyl fluoride (**3d**). Light yellow oil, 246 mg, 100% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.46 (dd, J_1 = 22.6 Hz, J_2 = 7.6 Hz, 2H), 7.40 (d, *J* = 6.1 Hz, 1H), 7.31 (t, *J* = 7.4 Hz, 1H), 5.33 (s, 1H), 2.50 (s, 3H), 2.43 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.6 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 165.8, 142.8, 136.5, 131.8, 131.8, 128.0, 126.6, 109.0 (d, *J* = 25.6 Hz), 20.2, 19.9. **HRMS-ESI** (m/z) calcd. for $[C_{10}H_{12}FO_2S_2]^+$ ($[M+H]^+$): 247.0257, found: 247.0257.



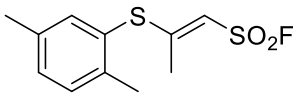
3e

(E)-2-(m-tolylthio)prop-1-ene-1-sulfonyl fluoride (**3e**). Light yellow oil, 236 mg, 96% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 20:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.38 (d, *J* = 7.5 Hz, 1H), 7.36 – 7.29 (m, 3H), 5.49 (s, 1H), 2.47 (s, 3H), 2.41 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.4 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 167.3, 140.8, 136.0, 132.5, 132.2, 130.4, 127.1, 109.8 (d, *J* = 25.5 Hz), 21.3, 20.0. **HRMS-ESI** (m/z) calcd. for $[C_{10}H_{12}FO_2S_2]^+$ ($[M+H]^+$): 247.0257, found: 247.0258.



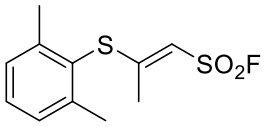
3f

(E)-2-((2,4-dimethylphenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3f**). Light yellow oil, 239 mg, 97% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.35 (d, *J* = 7.8 Hz, 1H), 7.20 (s, 1H), 7.11 (d, *J* = 8.0 Hz, 1H), 5.33 (s, 1H), 2.48 (s, 3H), 2.38 (d, *J* = 3.9 Hz, 6H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.6 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.5, 142.5, 142.5, 136.4, 132.7, 128.9, 123.3, 108.9 (d, *J* = 25.2 Hz), 21.4, 20.2, 19.9. **HRMS-ESI** (m/z) calcd. for $[C_{11}H_{14}FO_2S_2]^+$ ($[M+H]^+$): 261.0414, found: 261.0416.



3g

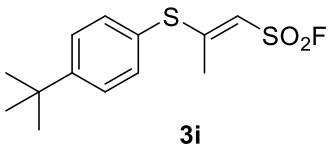
(E)-2-((2,5-dimethylphenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3g**). Light yellow solid, 237 mg, 91% yield. M.p. 40−41 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.28 (s, 1H), 7.26 – 7.20 (m, 2H), 5.33 (s, 1H), 2.47 (s, 3H), 2.34 (d, *J* = 8.5 Hz, 6H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.7 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.1, 139.5, 137.9, 136.8, 132.8, 131.7, 126.3, 109.0 (d, *J* = 25.4 Hz), 20.8, 19.9, 19.7. **HRMS-ESI** (m/z) calcd. for $[C_{11}H_{14}FO_2S_2]^+$ ($[M+H]^+$): 261.0414, found: 261.0415.



3h

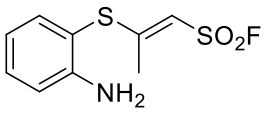
(E)-2-((2,6-dimethylphenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3h**). White solid, 259 mg, 99% yield. M.p. 71−72 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 40:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.24 (d, *J* = 7.6 Hz, 1H), 7.15 (d,

J = 7.6 Hz, 2H), 5.21 (s, 1H), 2.45 (s, 3H), 2.36 (s, 6H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.8 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 165.0, 143.4, 131.5, 129.4, 126.4, 108.0(d, *J* = 25.3 Hz), 21.2, 20.0.



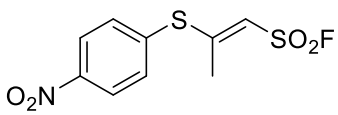
3i

(E)-2-((4-(tert-butyl)phenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3i**). Light yellow solid, 267 mg, 92% yield. M.p. 60−61 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.51 (d, *J* = 8.4 Hz, 2H), 7.43 (d, *J* = 8.4 Hz, 2H), 5.52 (s, 1H), 2.47 (s, 3H), 1.36 (s, 9H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.5 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 167.6, 155.02, 135.2, 127.8, 123.9, 109.6 (d, *J* = 25.1 Hz), 35.2, 31.3, 20.0. **HRMS-ESI** (m/z) calcd. for $[C_{13}H_{18}FO_2S_2]^+$ ($[M+H]^+$): 289.0727, found: 289.0727.



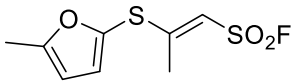
3j

(E)-2-((2-aminophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3j**). Colorless oil, 245 mg, 99% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.31 (t, *J* = 7.4 Hz, 2H), 6.84 – 6.77 (m, 2H), 5.56 (s, 1H), 4.13 (d, *J* = 7.1 Hz, 2H), 2.48 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.5 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 163.9 (d, *J* = 1.8 Hz), 148.7, 137.0, 133.4, 119.6, 116.2, 109.8 (d, *J* = 25.6 Hz), 109.2, 19.7. **HRMS-ESI** (m/z) calcd. for $[C_9H_{11}FNO_2S_2]^+$ ($[M+H]^+$): 248.0210, found: 248.0211.



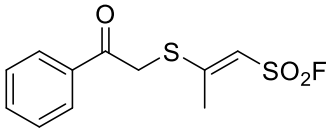
3k

(E)-2-((4-nitrophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3k**). White solid, 136 mg, 67% yield. M.p. 104−105 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.36 (d, *J* = 8.7 Hz, 2H), 7.75 (d, *J* = 8.7 Hz, 2H), 5.56 (s, 1H), 2.51 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.4 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 164.2 (d, *J* = 1.9 Hz), 149.5, 136.5, 135.2, 125.4, 111.8 (d, *J* = 26.7 Hz), 20.2. **HRMS-ESI** (m/z) calcd. for $[C_9H_9FNO_4S_2]^+$ ($[M+H]^+$): 277.9952, found: 277.9953.



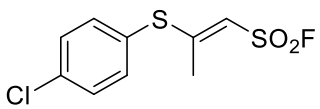
3l

(E)-2-((5-methylfuran-2-yl)thio)prop-1-ene-1-sulfonyl fluoride (**3l**). Light yellow oil, 235 mg, 99% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.43 (d, *J* = 2.0 Hz, 1H), 6.36 (d, *J* = 2.0 Hz, 1H), 5.66 (s, 1H), 2.44 (s, 3H), 2.35 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.5 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 165.7 (d, *J* = 1.8 Hz), 158.5, 142.6, 114.3, 109.9 (d, *J* = 25.9 Hz), 104.4, 19.5, 12.0. **HRMS-ESI** (m/z) calcd. for $[C_8H_{10}FO_3S_2]^+$ ($[M+H]^+$): 237.0050, found: 237.0050.



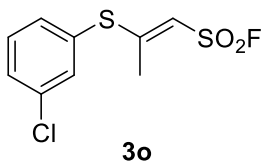
3m

(E)-2-((2-oxo-2-phenylethyl)thio)prop-1-ene-1-sulfonyl fluoride (**3m**). Light yellow solid, 160 mg, 58% yield. M.p. 121−122 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.98 (d, *J* = 7.0 Hz, 2H), 7.67 (t, *J* = 7.4 Hz, 1H), 7.54 (t, *J* = 7.8 Hz, 2H), 6.10 (s, 1H), 4.33 (s, 2H), 2.46 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.5 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 191.3, 163.5, 134.7, 134.6, 129.2, 128.7, 109.6 (d, *J* = 25.8 Hz), 40.0, 20.8. **HRMS-ESI** (m/z) calcd. for $[C_{11}H_{12}FO_3S_2]^+$ ($[M+H]^+$): 275.0206, found: 275.0209.



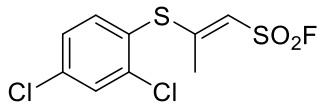
3n

(E)-2-((4-chlorophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3n**). Light yellow solid, 201 mg, 75% yield. M.p. 80−81 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 20:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.47 (q, *J* = 8.6 Hz, 4H), 5.47 (s, 1H), 2.47 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.4 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.3, 138.2, 136.89, 131.0, 125.8, 110.4 (d, *J* = 26.1 Hz), 19.9. **HRMS-ESI** (m/z) calcd. for $[C_9H_9ClFO_2S_2]^+$ ($[M+H]^+$): 266.9711, found: 266.9712.



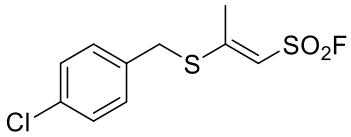
3o

(E)-2-((3-chlorophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3o**). Yellow solid, 169 mg, 63% yield. M.p. 71−72 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.53 (dd, J_1 = 9.2, J_2 = 1.6 Hz, 2H), 7.50 – 7.39 (m, 2H), 5.52 (s, 1H), 2.48 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.5 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 165.7 (d, *J* = 1.9 Hz), 136.3, 135.3, 133.8, 131.7, 131.7, 129.1, 110.8 (d, *J* = 26.2 Hz), 20.0. **HRMS-ESI** (m/z) calcd. for $[C_9H_9ClFO_2S_2]^+$ ($[M+H]^+$): 266.9711, found: 266.9713.



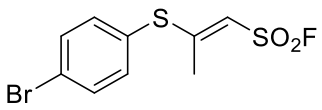
3p

(E)-2-((2,4-dichlorophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3p**). Yellow solid, 171 mg, 57% yield. M.p. 99−100 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.63 (d, *J* = 2.2 Hz, 1H), 7.56 (d, *J* = 8.3 Hz, 1H), 7.39 (dd, J_1 = 8.3 Hz, J_2 = 2.2 Hz, 1H), 5.43 (s, 1H), 2.48 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.6 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 163.3, 140.6, 139.1, 138.4, 131.4, 129.1, 125.1, 110.5 (d, *J* = 26.4 Hz), 19.7. **HRMS-ESI** (m/z) calcd. for $[C_9H_8Cl_2FO_2S_2]^+$ ($[M+H]^+$): 300.9321, found: 300.9322.



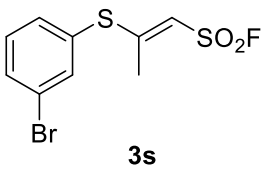
3q

(E)-2-((4-chlorobenzyl)thio)prop-1-ene-1-sulfonyl fluoride (**3q**). Light yellow solid, 250 mg, 89% yield. M.p. 50−51 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.35 (d, *J* = 8.4 Hz, 2H), 7.28 (d, *J* = 8.5 Hz, 2H), 5.94 (s, 1H), 4.01 (s, 2H), 2.42 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.6 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 164.8, 134.5, 131.5, 130.3, 129.5, 108.8 (d, *J* = 25.7 Hz), 36.8, 20.6. **HRMS-ESI** (m/z) calcd. for $[C_{10}H_{11}ClFO_2S_2]^+$ ($[M+H]^+$): 280.9868, found: 280.9868.



3r

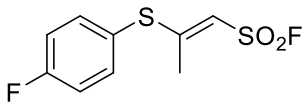
(E)-2-((4-bromophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3r**). Yellow solid, 92 mg, 59% yield. M.p. 76−77°C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.65 (d, *J* = 8.4 Hz, 2H), 7.39 (d, *J* = 8.3 Hz, 2H), 5.49 (s, 1H), 2.47 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.4 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.0 (d, *J* = 1.9 Hz), 137.1, 134.0, 126.5, 126.4, 110.5 (d, *J* = 26.0 Hz), 20.0. **HRMS-ESI** (m/z) calcd. for $[C_9H_9BrFO_2S_2]^+$ ($[M+H]^+$): 310.9206, found: 310.9207.



3s

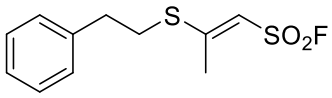
(E)-2-((3-bromophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3s**). Light yellow solid, 262 mg, 84% yield. M.p. 95−96 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.68 (d, *J* = 9.5 Hz, 2H), 7.47 (d, *J* = 8.0 Hz, 1H), 7.40 (t, *J* = 7.8 Hz, 1H), 5.51 (s, 1H), 2.47 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.5

(s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 165.8, 138.1, 134.6, 134.2, 131.9, 129.3, 124.1, 110.7 (d, *J* = 26.0 Hz), 19.9. **HRMS-ESI** (m/z) calcd. for $[C_9H_9BrFO_2S_2]^+$ ($[M+H]^+$): 310.9206, found: 310.9207.



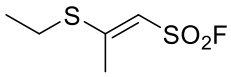
3t

(E)-2-((4-fluorophenyl)thio)prop-1-ene-1-sulfonyl fluoride (**3t**). Light yellow oil, 247 mg, 99% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.52 (t, *J* = 6.1 Hz, 2H), 7.21 (t, *J* = 8.5 Hz, 2H), 5.44 (s, 1H), 2.47 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.4 (s, 1F), -107.3 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.9, 165.5, 163.5, 137.9 (d, *J* = 8.8 Hz), 122.7 (d, *J* = 3.6 Hz), 118.1, 117.9, 110.1 (d, *J* = 26.1 Hz), 19.8. **HRMS-ESI** (m/z) calcd. for $[C_9H_9F_2O_2S_2]^+$ ($[M+H]^+$): 251.0007, found: 251.0008.



3u

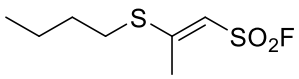
(E)-2-(phenethylthio)prop-1-ene-1-sulfonyl fluoride (**3u**). Light yellow oil, 226 mg, 87% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.35 (t, *J* = 7.3 Hz, 2H), 7.29 (t, *J* = 7.4 Hz, 1H), 7.22 (d, *J* = 6.8 Hz, 2H), 5.88 (s, 1H), 3.07 (t, *J* = 6.8 Hz, 2H), 2.99 (t, *J* = 7.0 Hz, 2H), 2.41 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.6 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 165.5, 138.6, 129.0, 128.5, 127.3, 108.0 (d, *J* = 25.4 Hz), 33.9, 33.3, 20.9. **HRMS-ESI** (m/z) calcd. for $[C_{11}H_{14}FO_2S_2]^+$ ($[M+H]^+$): 261.0414, found: 261.0416.



3v

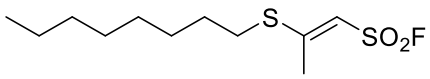
(E)-2-(ethylthio)prop-1-ene-1-sulfonyl fluoride (**3v**). Light yellow oil, 128 mg, 69% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1

(v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 5.86 (s, 1H), 2.83 (q, *J* = 7.4 Hz, 2H), 2.41 (s, 3H), 1.37 (t, *J* = 7.5 Hz, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.5 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 165.9, 107.7 (d, *J* = 25.4 Hz), 26.6, 20.8, 12.1. **HRMS-ESI** (m/z) calcd. for $[C_5H_{10}FO_2S_2]^+$ ($[M+H]^+$): 85.0101, found: 85.0101.



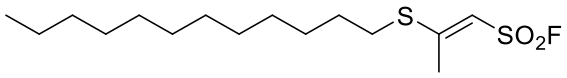
3w

(E)-2-(butylthio)prop-1-ene-1-sulfonyl fluoride (**3v**). Light yellow oil, 152 mg, 72% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 20:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 5.86 (s, 1H), 2.79 (t, *J* = 7.4 Hz, 2H), 2.41 (d, *J* = 1.0 Hz, 3H), 1.68 (p, *J* = 7.4 Hz, 2H), 1.47 (h, *J* = 7.4 Hz, 2H), 0.96 (t, *J* = 7.4 Hz, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.6 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.2, 107.7 (d, *J* = 25.3 Hz), 32.3, 29.0, 22.2, 21.0, 13.6. **HRMS-ESI** (m/z) calcd. for $[C7H14FO2S2]^+$ ($[M+H]^+$): 213.0414, found: 213.0415.



3x

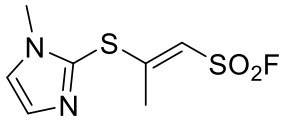
(E)-2-(octylthio)prop-1-ene-1-sulfonyl fluoride (**3x**). Light yellow oil, 210 mg, 78% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 5.85 (s, 1H), 2.78 (t, *J* = 7.4 Hz, 2H), 2.41 (d, *J* = 1.2 Hz, 3H), 1.69 (p, *J* = 7.4 Hz, 2H), 1.42 (q, *J* = 7.4 Hz, 2H), 1.36 – 1.26 (m, 8H), 0.92 – 0.86 (m, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.6 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.2, 107.7 (d, *J* = 25.3 Hz), 32.6, 31.85, 29.2, 29.1, 29.0, 27.0, 22.7, 21.0, 14.2. **HRMS-ESI** (m/z) calcd. for $[C_{11}H_{22}FO_2S_2]^+$ ($[M+H]^+$): 269.1040, found: 269.1040.



3y

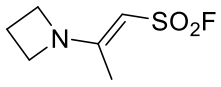
(E)-2-(dodecylthio)prop-1-ene-1-sulfonyl fluoride (**3y**). Yellow oil, 210 mg, 99% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 5.85 (s, 1H), 2.78 (t, *J* = 7.4 Hz, 2H), 2.41 (s, 3H), 1.71 – 1.65 (m, 2H), 1.28 (d, *J* = 10.0 Hz, 18H), 0.89 (d, *J* = 6.6 Hz, 3H). **^{19}F NMR** (471 MHz, CDCl3) δ 67.6 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.01, 107.8 (d, *J* = 25.3 Hz), 32.6, 32.0, 29.73, 29.6, 29.5, 29.5, 29.1, 29.0, 27.0, 22.8, 20.9, 14.2. **HRMS-ESI** (m/z) calcd. for $[C_{15}H_{30}FO_2S_2]$+ ([M+H]+): 325.1666, found: 325.1667.

Note: In the ^{13}C NMR spectrum of **3y**, there are theoretically fifteen peaks expected. However, due to their close proximity, it is difficult to resolve the overlapping peaks clearly.



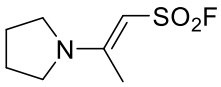
3z

(E)-2-((1-methyl-1H-imidazol-2-yl)thio)prop-1-ene-1-sulfonyl fluoride (**3z**). yellow solid, 209 mg, 88% yield. M.p. 76−77 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 3:1 to 2:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, DMSO-d_6) δ 7.73 (s, 1H), 7.37 (s, 1H), 6.11 (s, 1H), 3.85 (s, 3H), 2.64 (s, 3H). **^{19}F NMR** (471 MHz, DMSO-d_6) δ 68.9 (s, 1F). **^{13}C NMR** (126 MHz, DMSO-d_6) δ 165.6 (d, *J* = 2.4 Hz), 131.6, 130.7 (d, *J* = 8.6 Hz), 126.4 (d, *J* = 9.6 Hz), 110.6 (dd, J_1 = 25.2 Hz, J_2 = 6.2 Hz), 33.6, 18.9.



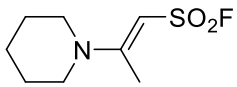
5a

(E)-2-(azetidin-1-yl)prop-1-ene-1-sulfonyl fluoride (**5a**). Colorless oil, 85 mg, 95% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 5:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 4.49 (d, *J* = 2.1 Hz, 1H), 4.17 (t, *J* = 6.7 Hz, 2H), 3.92 (t, *J* = 7.7 Hz, 2H), 2.40 (p, *J* = 7.6 Hz, 2H), 2.12 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 73.0 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.8, 78.8 (d, *J* = 24.2 Hz), 51.4, 51.0, 15.0, 13.8. **HRMS-ESI** (m/z) calcd. for $[C_6H_{11}FNO_2S]^+$ ($[M+H]^+$): 180.0489, found: 180.0489.



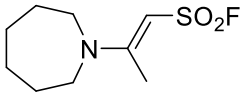
5b

(E)-2-(pyrrolidin-1-yl)prop-1-ene-1-sulfonyl fluoride (**5b**). Colorless oil, 222 mg, 97% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 3:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 4.73 (s, 1H), 3.49 (t, *J* = 5.5 Hz, 2H), 3.19 (t, *J* = 6.7 Hz, 2H), 2.36 (s, 3H), 2.01 (td, J_1 = 12.4 Hz, J_2 = 12.0, 6.6 Hz, 4H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 73.4 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.6, 81.6 (d, *J* = 23.5 Hz), 49.0, 25.4, 25.0, 17.4. **HRMS-ESI** (m/z) calcd. for $[C_7H_{13}FNO_2S]^+$ ($[M+H]^+$): 194.0646, found: 194.0647.



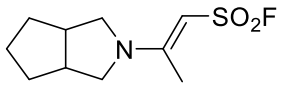
5c

(E)-2-(piperidin-1-yl)prop-1-ene-1-sulfonyl fluoride (**5c**). Yellow oil, 102 mg, 98% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 3:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 5.02 (s, 1H), 3.36 (t, *J* = 5.5 Hz, 4H), 2.33 (s, 3H), 1.67 (dq, J_1 = 27.3 Hz, J_2 = 5.4 Hz, 6H. **^{19}F NMR** (471 MHz, $CDCl_3$) δ 73.4 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.5, 83.6 (d, *J* = 23.7 Hz), 48.3, 25.5, 23.9, 16.6. **HRMS-ESI** (m/z) calcd. for $[C_8H_{15}FNO_2S]^+$ ($[M+H]^+$): 208.0802, found: 208.0804.



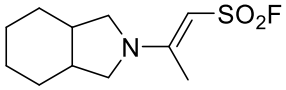
5d

(E)-2-(azepan-1-yl)prop-1-ene-1-sulfonyl fluoride (**5d**). Light yellow oil, 63 mg, 57% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 20:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, DMSO-d_6) δ 5.00 (s, 1H), 3.54 (t, *J* = 6.0 Hz, 2H), 3.41 (t, *J* = 6.2 Hz, 2H), 2.32 (s, 3H), 1.67 (d, *J* = 21.8 Hz, 4H), 1.49 (s, 4H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 73.3 (s, 1F). **^{13}C NMR** (126 MHz, DMSO-d_6) δ 162.6, 79.3 (d, *J* = 21.7 Hz), 50.5, 49.9, 28.3, 26.1, 25.7, 24.54, 15.6. **HRMS-ESI** (m/z) calcd. for $[C_9H_{17}FNO_2S]^+$ ($[M+H]^+$): 222.0959, found: 222.0959.



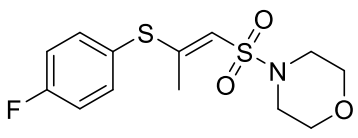
5e

(E)-2-(hexahydrocyclopenta[c]pyrrol-2(1H)-yl)prop-1-ene-1-sulfonyl fluoride (**5e**). White solid, 115 mg, 99% yield. M.p. 42−43 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 3:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 4.71 (s, 1H), 3.70 (s, 1H), 3.41 (s, 1H), 3.28 (d, *J* = 11.3 Hz, 1H), 2.96 (d, *J* = 9.8 Hz, 1H), 2.76 (s, 2H), 2.33 (s, 3H), 1.90 (dq, J_1 = 14.3 Hz, J_2 = 7.5 Hz, 2H), 1.79 (tt, J_1 = 14.3 Hz, J_2 = 7.0 Hz, 1H), 1.73 – 1.64 (m, 1H), 1.56 (s, 2H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 73.3 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 160.5, 82.4 (d, *J* = 23.6 Hz), 55.0, 51.9, 42.8, 42.1, 31.6, 25.3, 17.4. **HRMS-ESI** (m/z) calcd. for $[C_{10}H_{17}FNO_2S]^+$ ($[M+H]^+$): 234.0959, found: 234.0960.



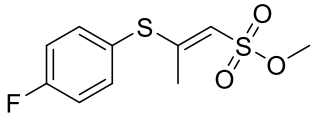
5f

(E)-2-(octahydro-2H-isoindol-2-yl)prop-1-ene-1-sulfonyl fluoride (**5f**). White solid, 117 mg, 95% yield. M.p. 106−107 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 3:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 4.72 (s, 1H), 3.53 – 3.47 (m, 1H), 3.35 (dd, J_1 = 11.6 Hz, J_2 = 6.8 Hz, 1H), 3.21 (dd, J_1 = 10.7 Hz, J_2 = 7.8 Hz, 1H), 3.05 (dd, J_1 = 11.2 Hz, J_2 = 6.1 Hz, 1H), 2.34 (s, 3H), 2.29 (p, *J* = 6.2 Hz, 2H), 1.64 (ddt, J_1 = 12.5 Hz, J_2 = 8.1 Hz, J_3 = 3.6 Hz, 2H), 1.54 – 1.38 (m, 6H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 73.4 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 161.3, 81.3 (d, *J* = 23.5 Hz), 53.0, 52.9, 37.0, 36.6, 25.8, 25.7, 22.7, 22.5, 17.3. **HRMS-ESI** (m/z) calcd. for $[C_{11}H_{19}FNO_2S]^+$ ($[M+H]^+$): 248.1115, found: 248.1116.



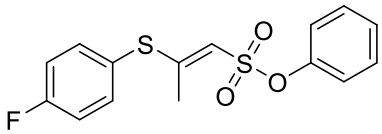
6

(E)-4-((2-((4-fluorophenyl)thio)prop-1-en-1-yl)sulfonyl)morpholine (**6**). White solid, 114 mg, 71% yield. M.p. 100−101 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 5:1to 3:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.54 – 7.47 (m, 2H), 7.17 (t, *J* = 8.3 Hz, 2H), 5.26 (s, 1H), 3.75 – 3.69 (m, 4H), 3.03 – 2.97 (m, 4H), 2.38 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ -108.5 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 165.2, 163.2, 158.4, 138.0 (d, *J* = 8.7 Hz), 124.3 (d, *J* = 3.5 Hz), 117.8, 117.6, 112.8, 66.3, 45.8, 19.3. **HRMS-ESI** (m/z) calcd. for $[C_{13}H_{17}FNO_3S_2]^+$ ($[M+H]^+$): 318.0628, found: 318.0629.



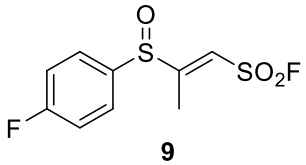
7

methyl (E)-2-((4-fluorophenyl)thio)prop-1-ene-1-sulfonate (**7**). White solid, 77 mg, 59% yield. M.p. 115−116 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 5:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.54 – 7.46 (m, 2H), 7.17 (t, *J* = 8.5 Hz, 2H), 5.38 (s, 1H), 3.74 (s, 3H), 2.39 (d, *J* = 1.0 Hz, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ -108.2 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 165.3, 163.3, 161.0, 137.9 (d, *J* = 8.8 Hz), 123.7 (d, *J* = 3.6 Hz), 117.9, 117.7, 113.1, 55.5, 19.3. **HRMS-ESI** (m/z) calcd. for $[C_{10}H_{12}FO_3S_2]^+$ ($[M+H]^+$): 263.0206, found: 263.0206.



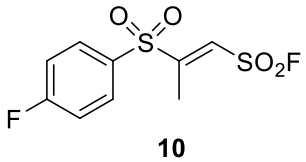
8

phenyl (E)-2-((4-fluorophenyl)thio)prop-1-ene-1-sulfonate (**8**). Light yellow solid, 160 mg, 99% yield. M.p. 89−90 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 10:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.40 (dt, J_1 = 21.0 Hz, J_2 = 8.1 Hz, 4H), 7.31 (d, *J* = 7.4 Hz, 1H), 7.14 (t, *J* = 7.5 Hz, 4H), 5.38 (s, 1H), 2.27 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ -108.0 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 165.3, 163.3, 162.4, 149.6, 137.9 (d, *J* = 8.7 Hz), 129.8, 127.3, 123.4, 122.5, 117.8, 117.6, 113.0, 19.4.



9

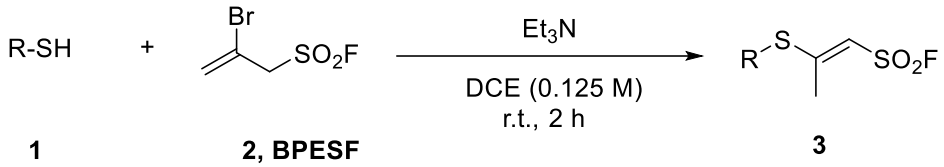
(E)-2-((4-fluorophenyl)sulfinyl)prop-1-ene-1-sulfonyl fluoride (**9**). White solid, 55 mg, 41% yield. M.p. 74−75 °C. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 20:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.67 – 7.60 (m, 2H), 7.27 (d, *J* = 1.5 Hz, 1H), 7.23 – 7.19 (m, 2H), 2.03 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.1 (s, 1F), -103.9 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 166.7, 166.3 (d, *J* = 3.2 Hz), 164.6, 135.5 (d, *J* = 3.4 Hz), 128.8 (d, *J* = 9.4 Hz), 120.8 (d, *J* = 30.3 Hz), 117.8, 117.7, 13.4. **HRMS-ESI** (m/z) calcd. for $[C_9H_9F_2O_3S_2]^+$ ($[M+H]^+$): 266.9956, found: 266.9957.



10

(E)-2-((4-fluorophenyl)sulfonyl)prop-1-ene-1-sulfonyl fluoride (**10**). Colorless oil, 81 mg, 57% yield. Purification by column chromatography on silica gel using petroleum ether / ethyl acetate = 20:1 (v/v) as eluent. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.95 (dd, J_1 = 8.6 Hz, J_2 = 4.9 Hz, 2H), 7.54 – 7.47 (m, 1H), 7.33 (t, *J* = 8.4 Hz, 2H), 2.35 (s, 3H). **^{19}F NMR** (471 MHz, $CDCl_3$) δ 67.2 (s, 1F), -99.8 (s, 1F). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.0, 165.9, 157.7 (d, *J* = 3.6 Hz), 132.3 (d, *J* = 10.0 Hz), 131.8 (d, *J* = 3.2 Hz), 127.8 (d, *J* = 30.9 Hz), 117.8, 117.6, 13.8. **HRMS-ESI** (m/z) calcd. for $[C_9H_9F_2O_4S_2]^+$ ($[M+H]^+$): 282.9905, found: 282.9905.

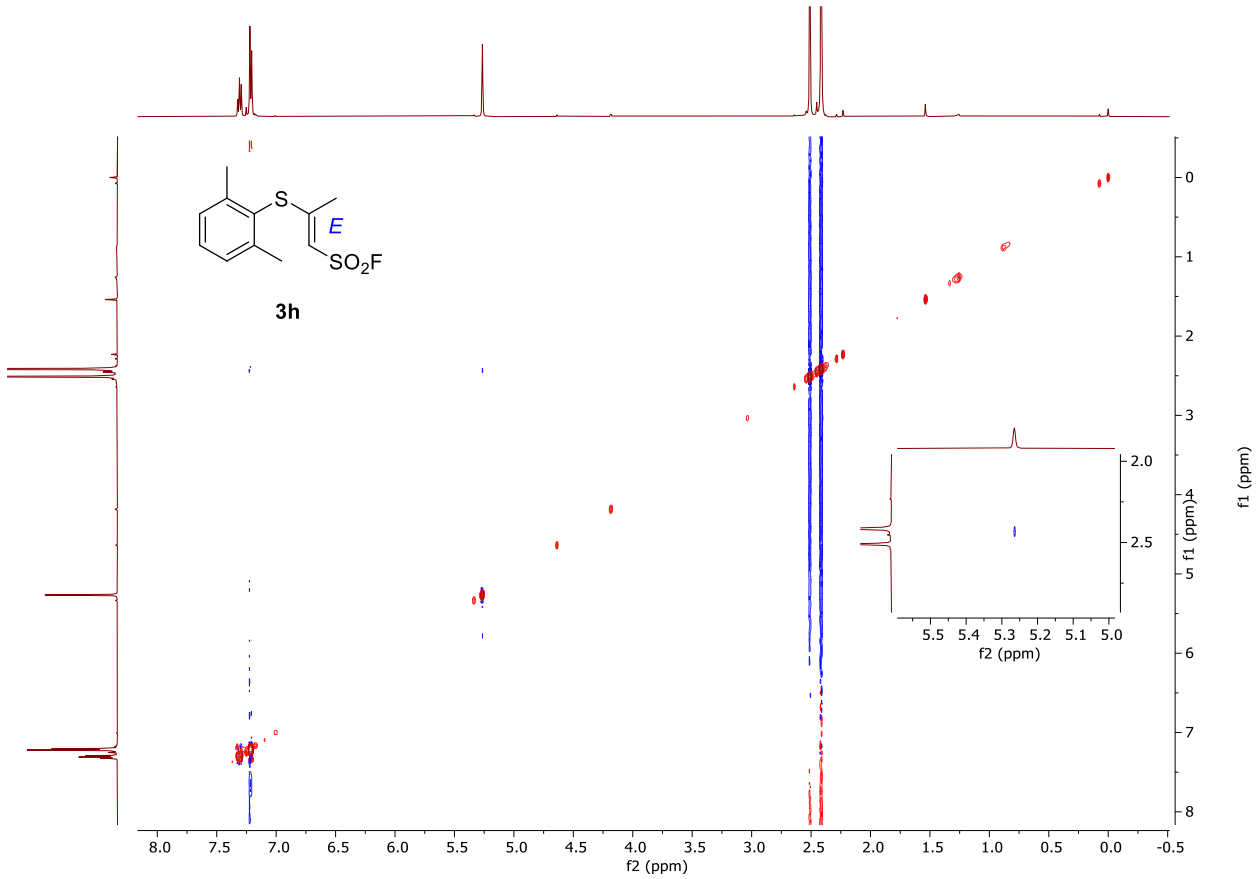
5. Scale-up reaction procedure for (3)



1 **2, BPESF** **3**

An oven-dried reaction tube (250 mL) equipped with a magnetic stirring bar was charged with thiols (**1**, 10.0 mmol, 1.0 equiv.), BPESF (**2**, 2.44 g, 12.0 mmol, 1.2equiv.) and 80.0 mL DCE. Then, trimethylamine (2.02 g, 20.0 mmol, 2.0 equiv.) was added dropwise to the above solution. The mixture was stirred at room temperature for 2 h under an air atmosphere monitored by TLC. After the reaction was completed, 50 mL of water was added to the mixture. The resulting mixture was then extracted with ethyl acetate (3 x 50 mL). The combined extracts were dried over anhydrous sodium sulfate (Na_2SO_4) and concentrated under reduced pressure. The residue was then purified by column chromatography on silica gel, using a mixture of petroleum ether and ethyl acetate as the eluent, yielding the desired product **3**.

6. NOESY of (*E*)-2-((2,6-dimethylphenyl)thio)prop-1-ene-1-sulfonyl fluoride (3h)



7. References

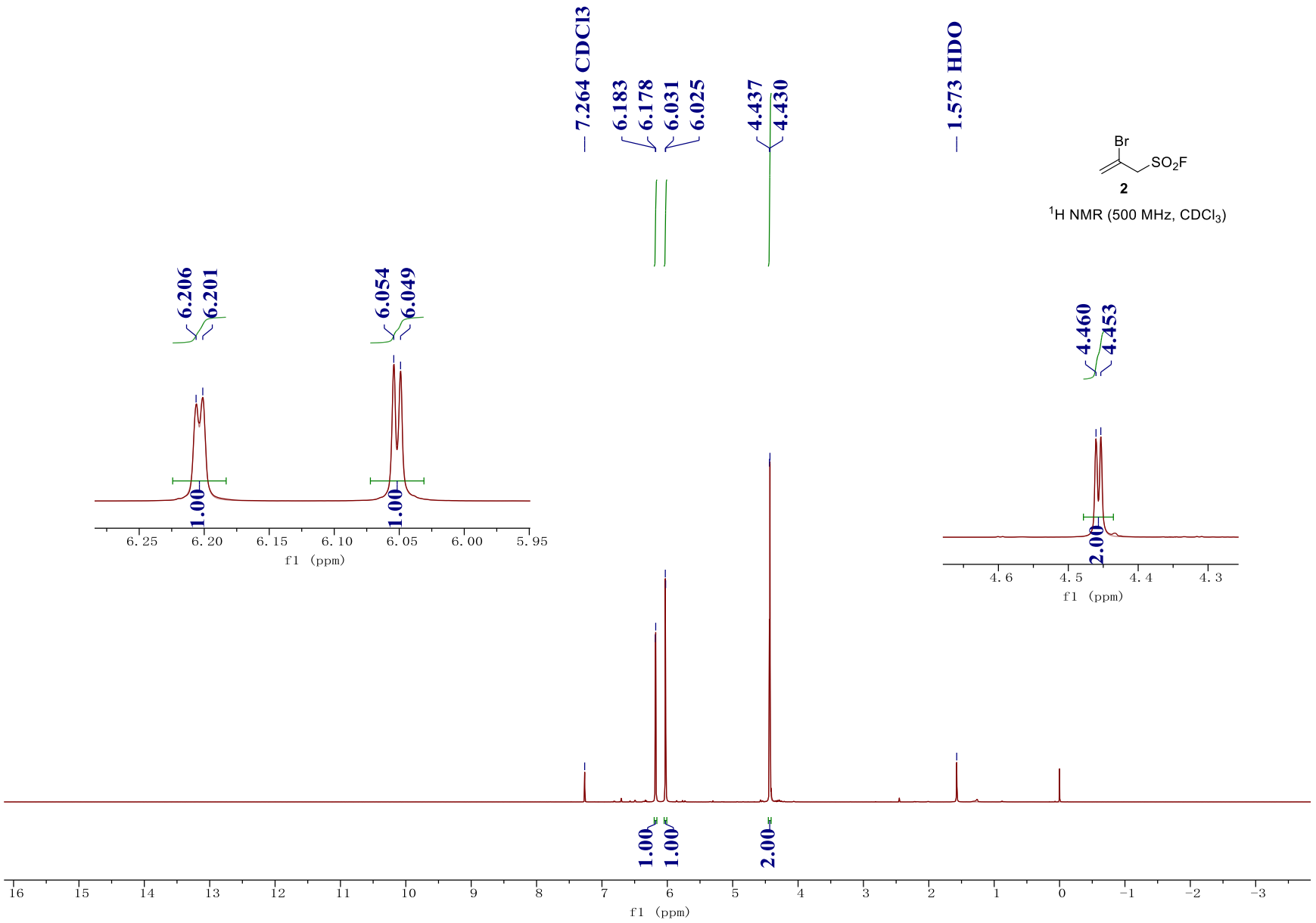
1 X. Zhang and H.-L. Qin, *Org. Lett.*, 2022, **24**, 9311–9315.

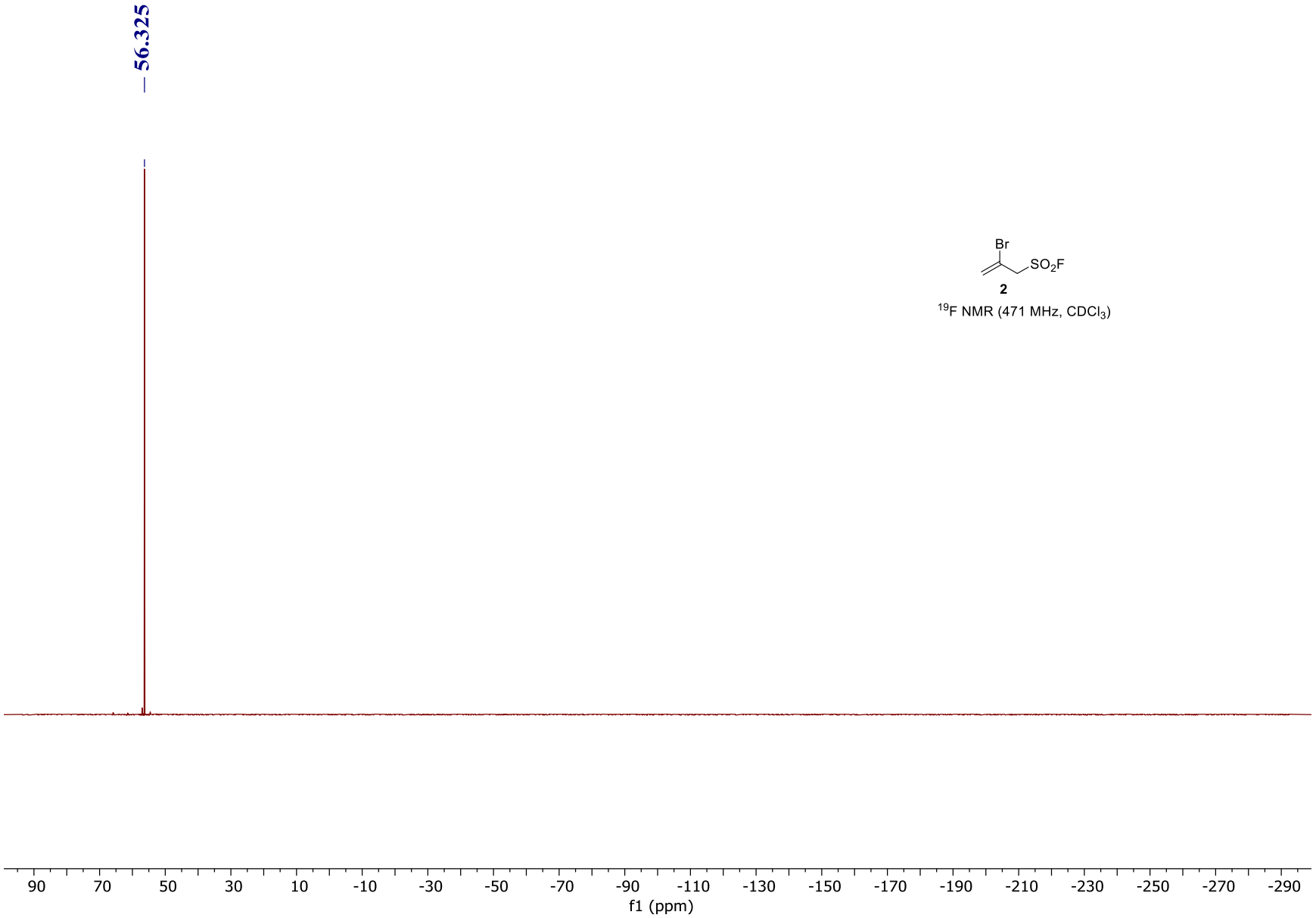
2 M. Liu, W. Tang and H.-L. Qin, *J. Org. Chem.*, 2023, **88**, 1909–1917.

3 X. Zhang, W. Fang, R. Lekkala, W. Tang and H. Qin, *Adv. Synth. Catal.*, 2020, **362**, 3358–3363.

4 R. Kupwade, S. Khot, U. Lad, U. Desai and P. Wadgaonkar, *Res. Chem. Intermed.*, 2017, **43**, 6875–6888.

8. NMR Spectra

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Br
SO2F
2
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
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-150
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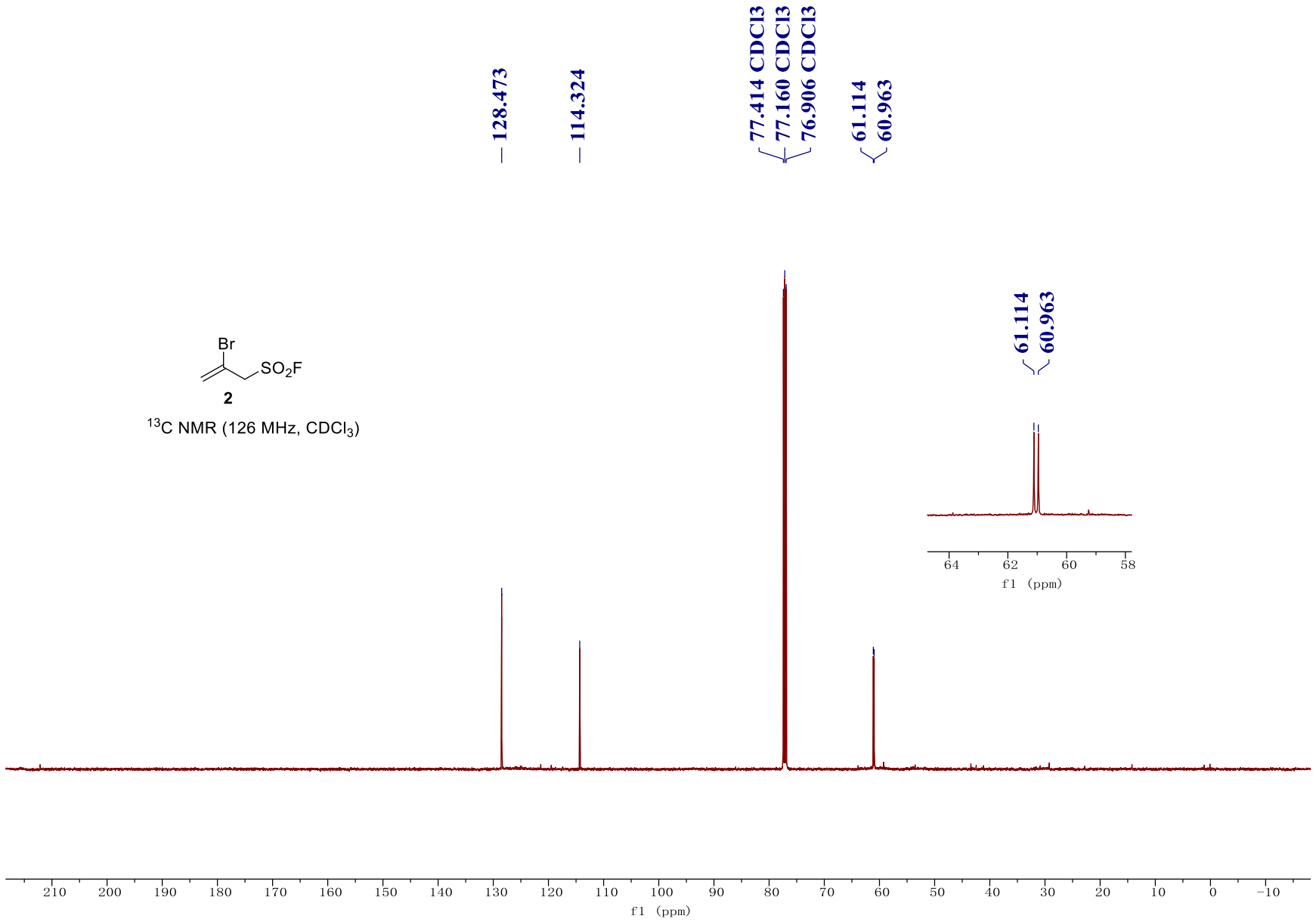
-190
-210
-230
-250
-270
-290
f1 (ppm)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114.324
77.414 CDCl3
77.160 CDCl3
76.906 CDCl3
61.114
60.963
Br
SO2F
2
13C NMR (126 MHz, CDCl3)
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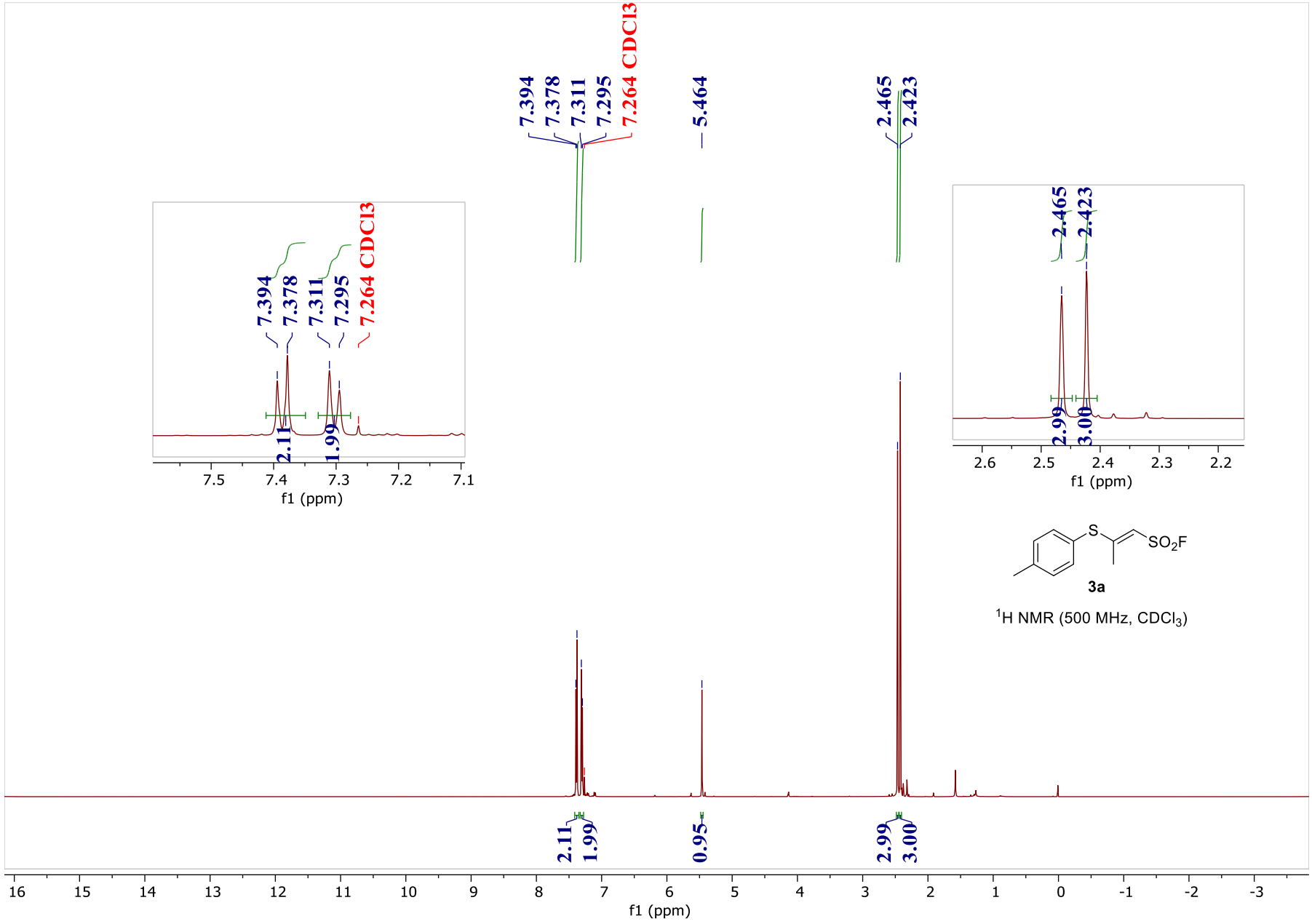
60.963
64
62
60
58
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)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7.311
7.295
7.264 CDCl3
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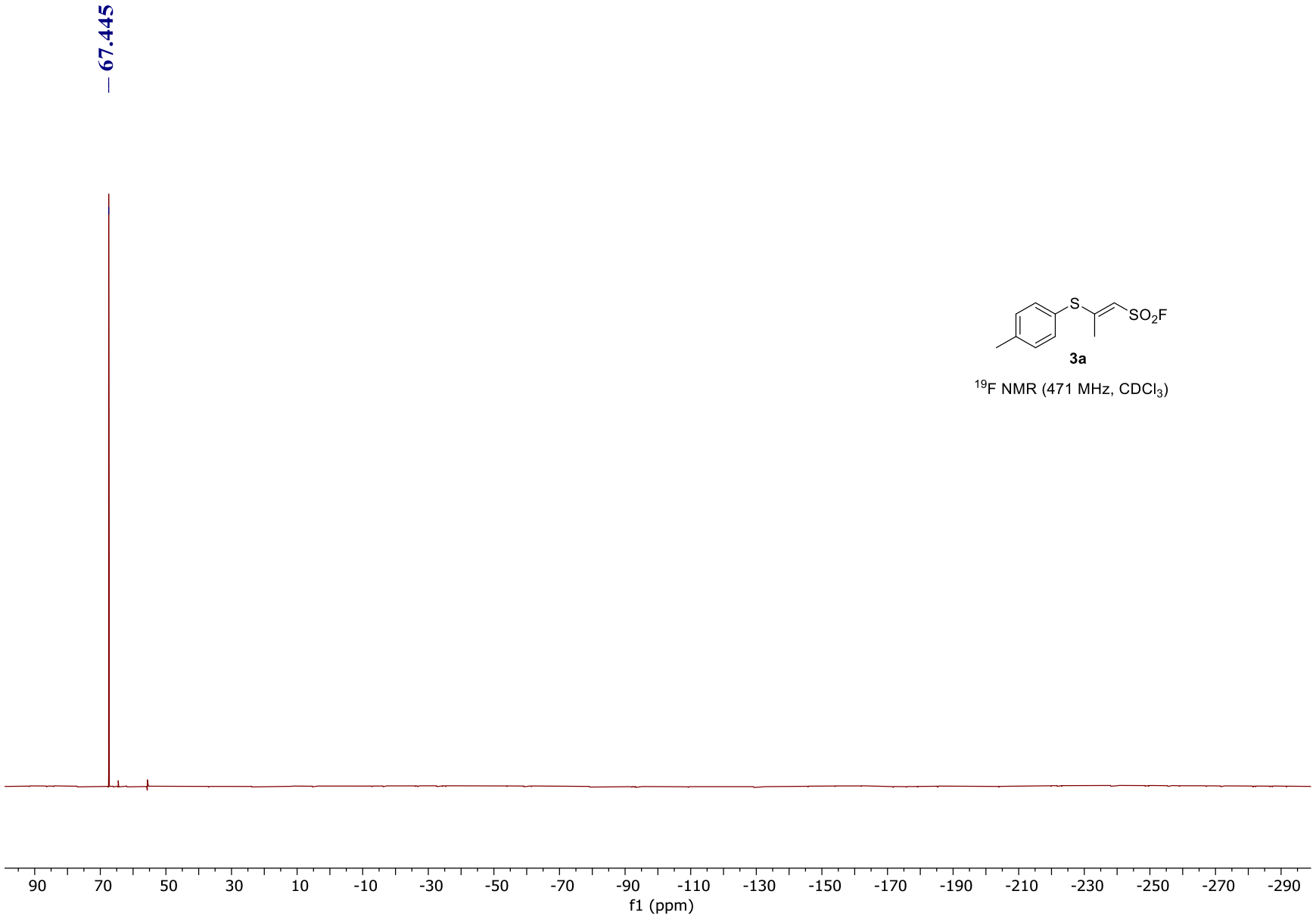
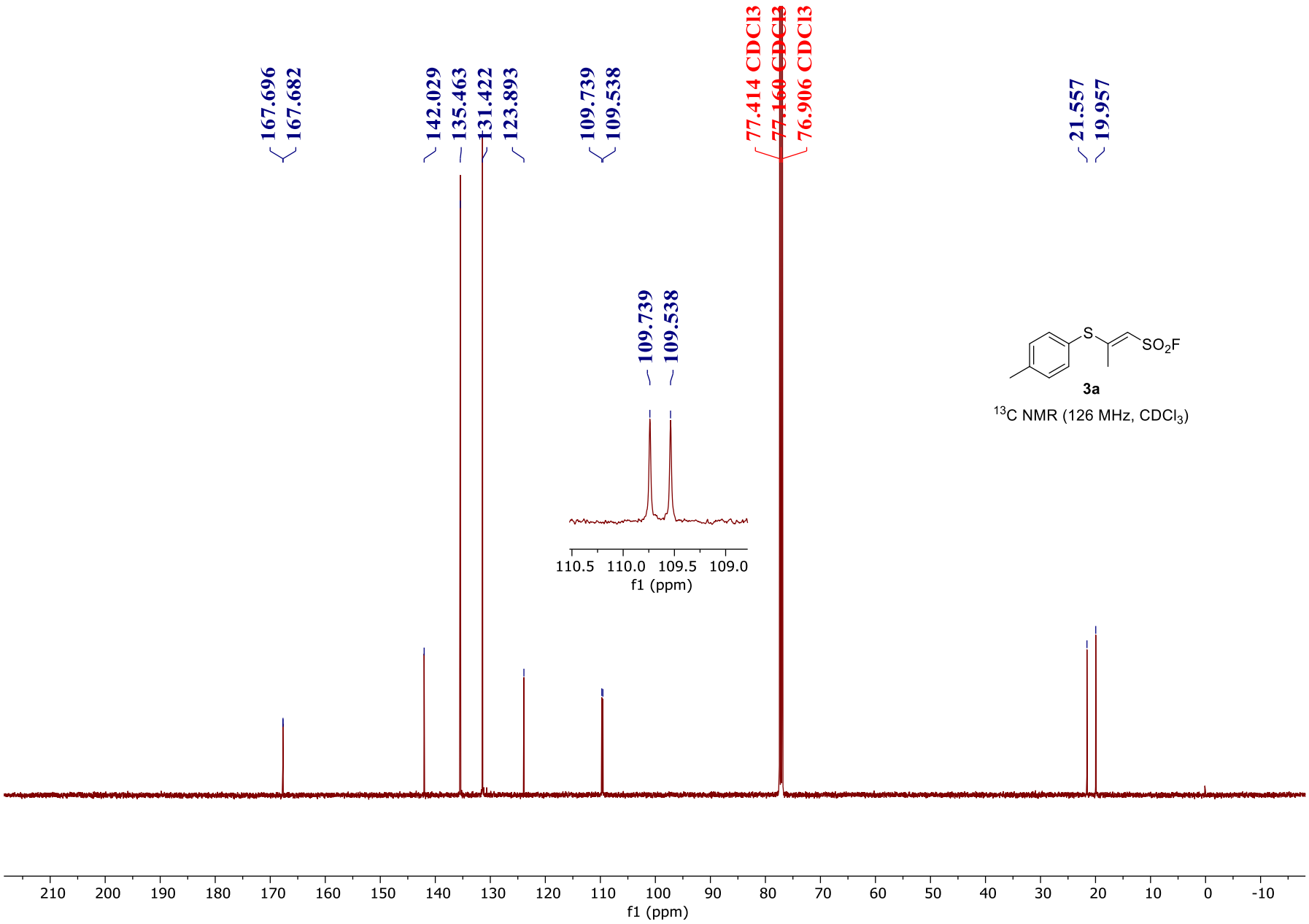
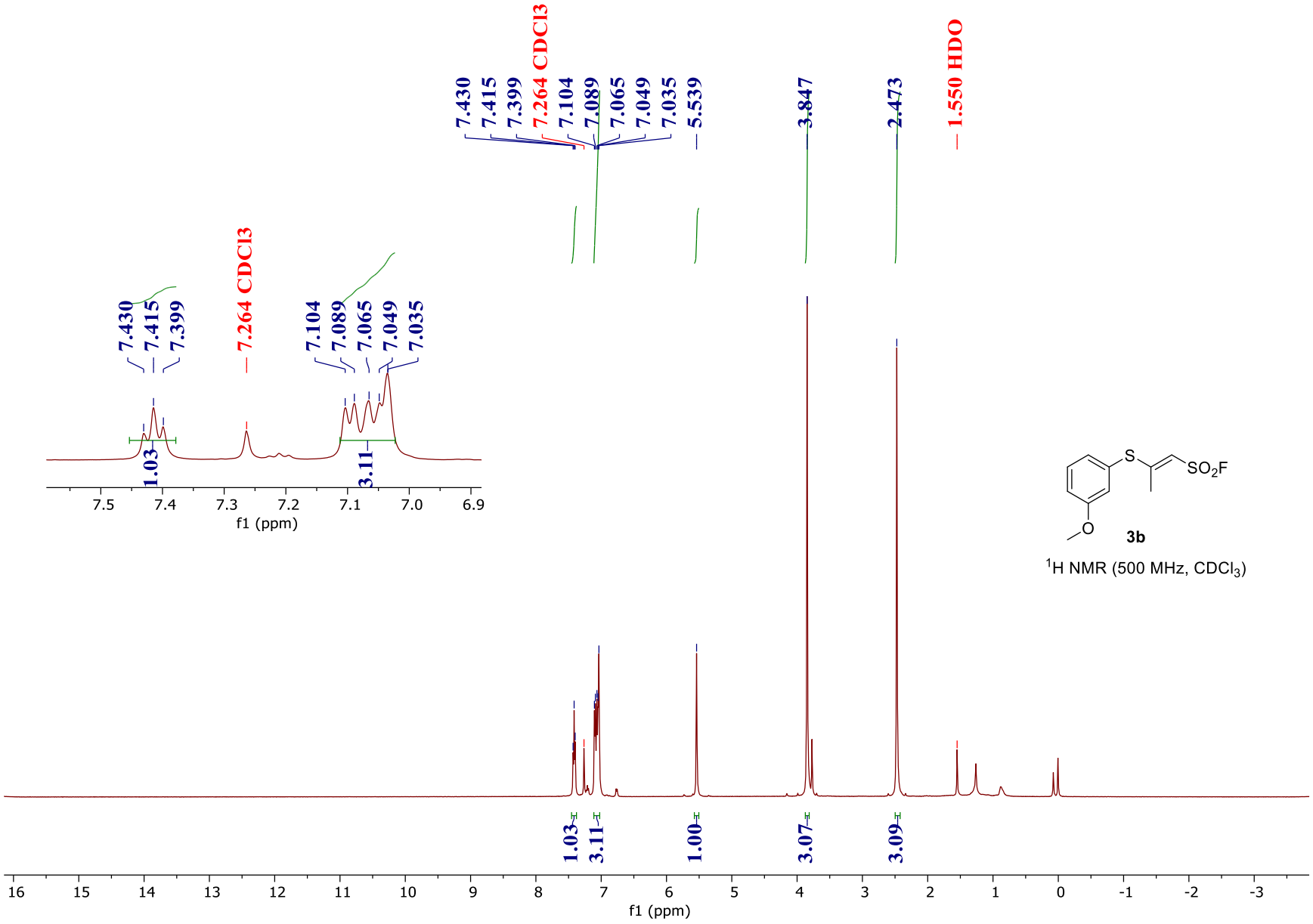
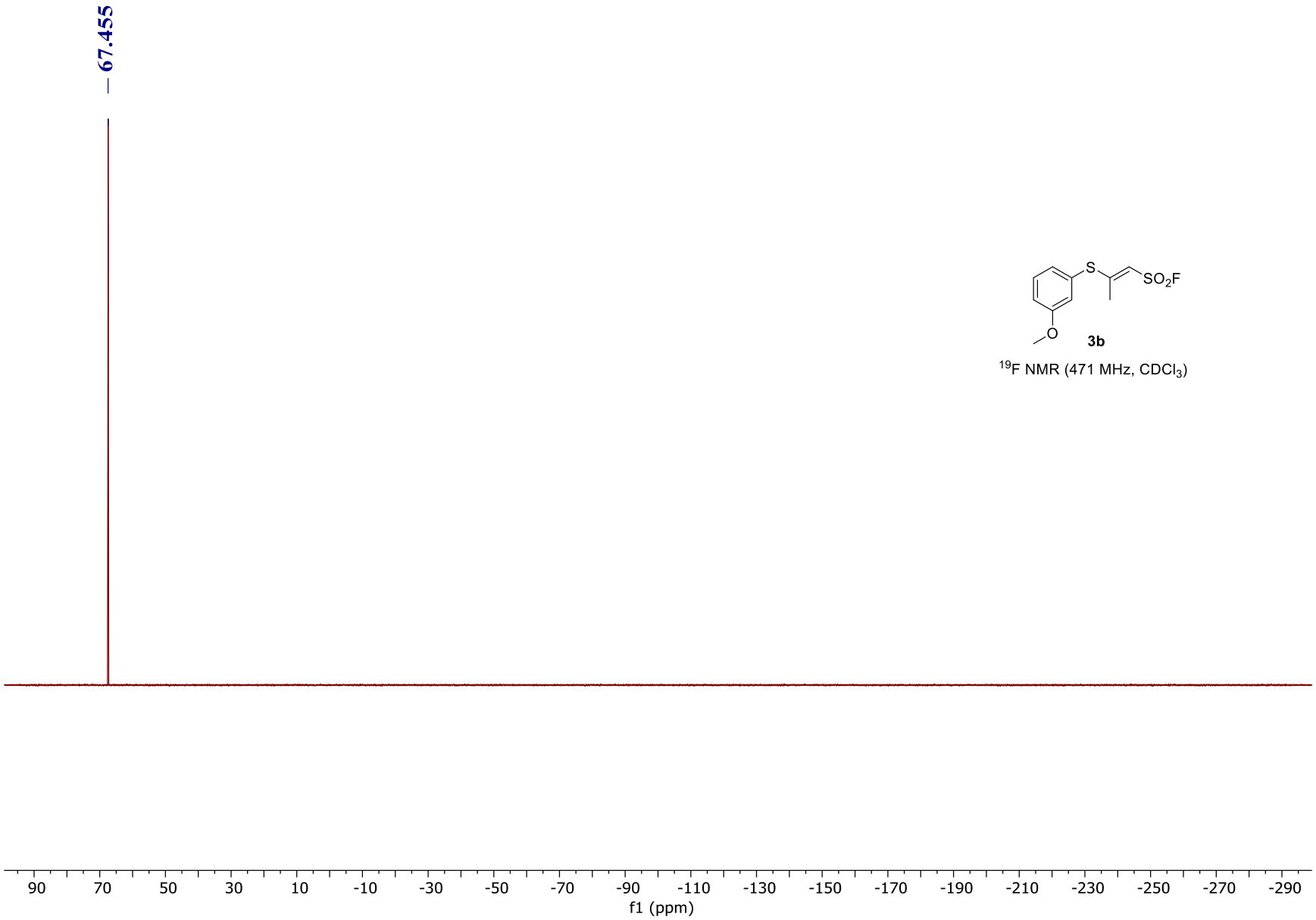
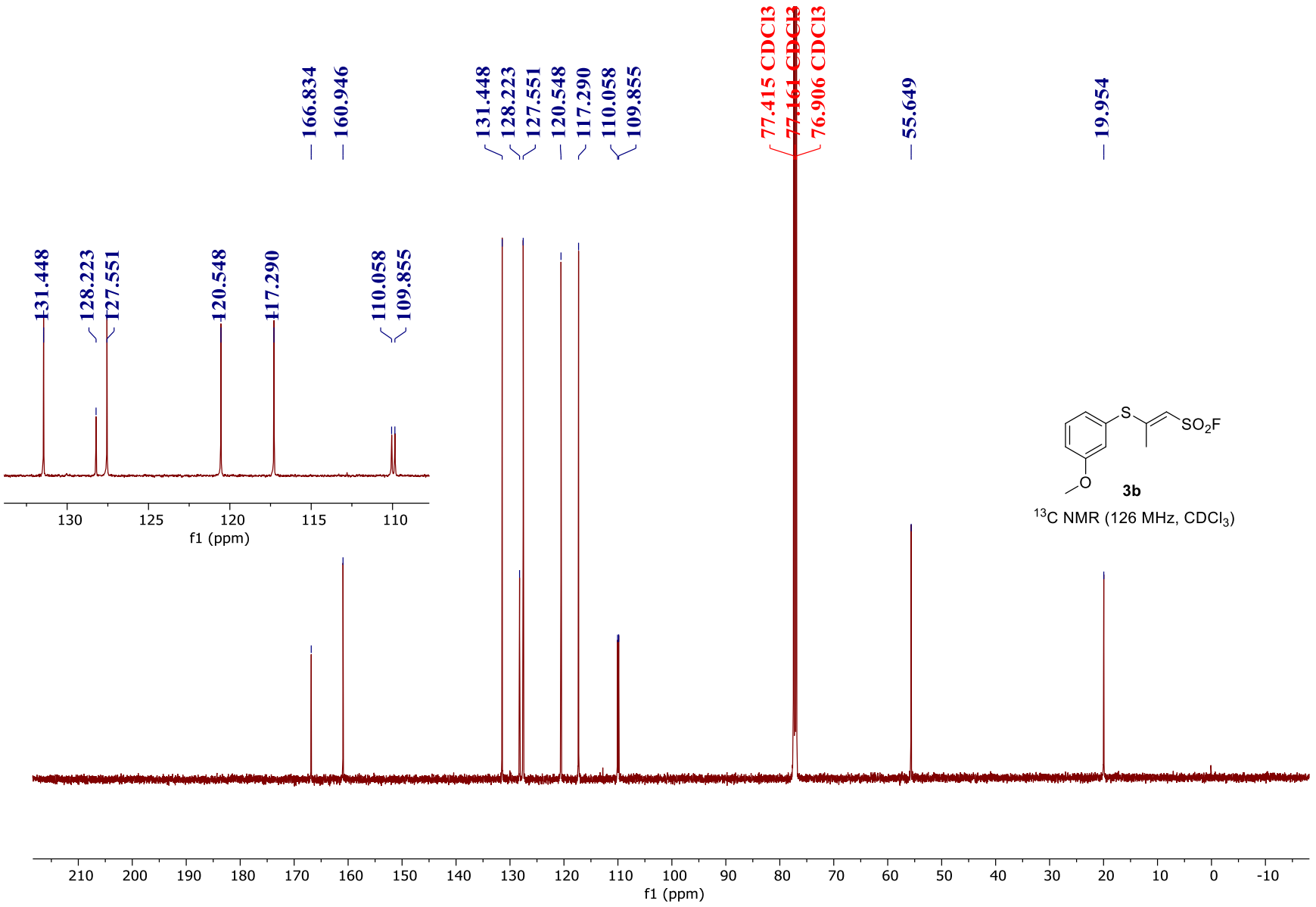
2.465
2.423
2.11
1.99
0.95
2.99
3.00
f1 (ppm)
SO2F
3a
1H NMR (500 MHz, CDCl3)

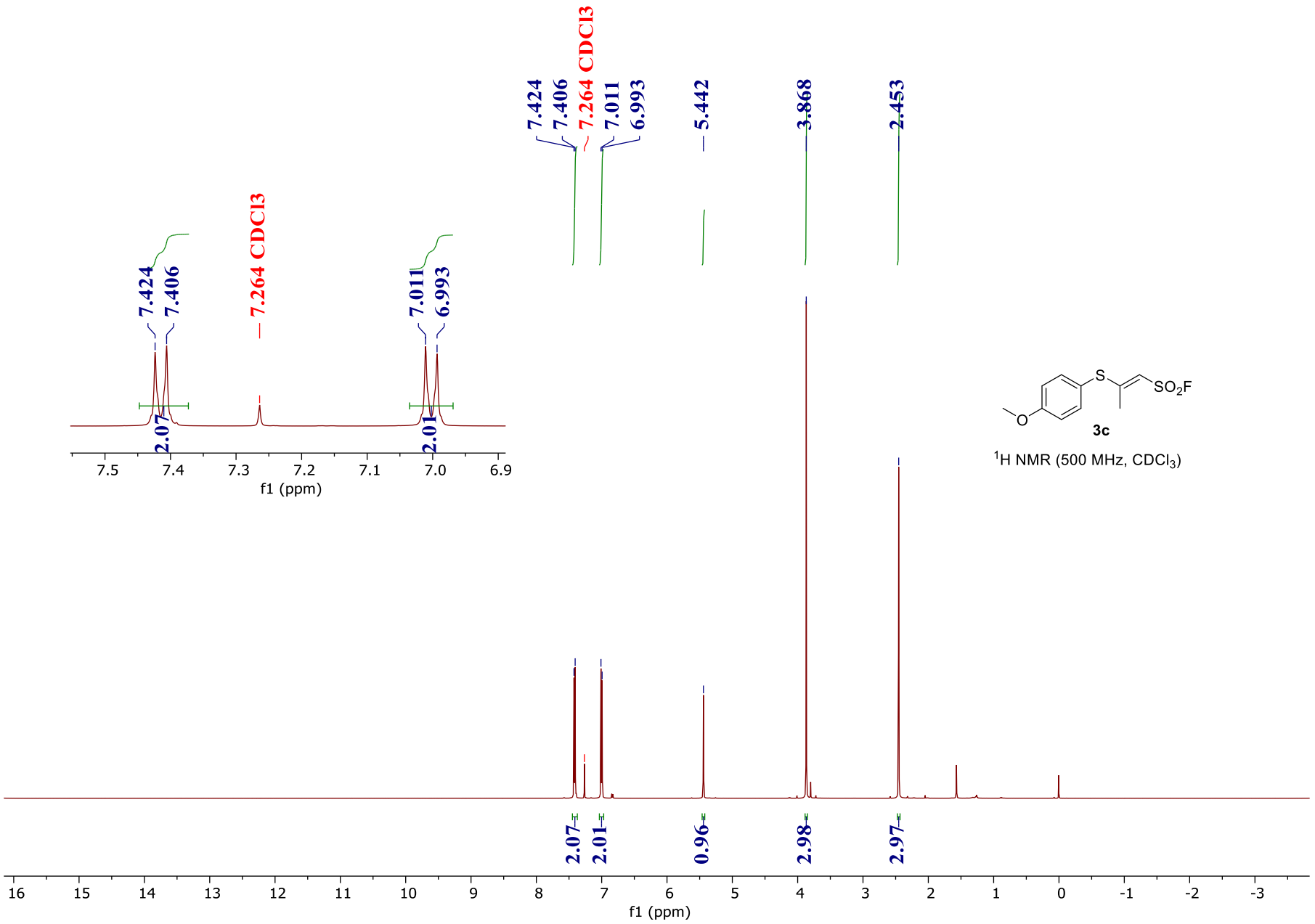

−67.445
S
SO2F
3a
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

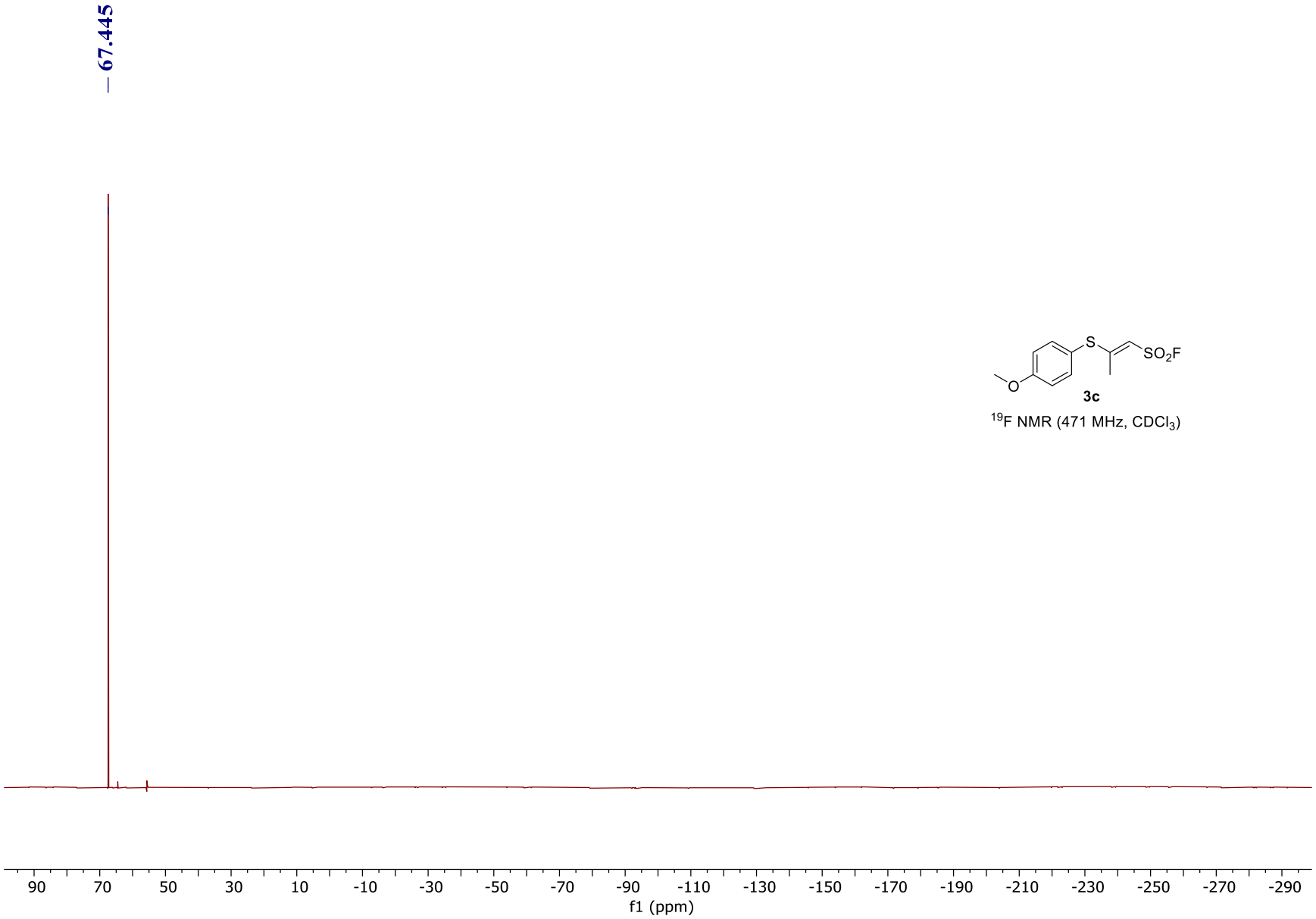

167.696
167.682
142.029
135.463
131.422
123.893
109.739
109.538
77.414 CDCl3
77.160 CDCl3
76.906 CDCl3
21.557
19.957
109.739
109.538
110.5 110.0 109.5 109.0
f1 (ppm)
S
SO2F
3a
13C NMR (126 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

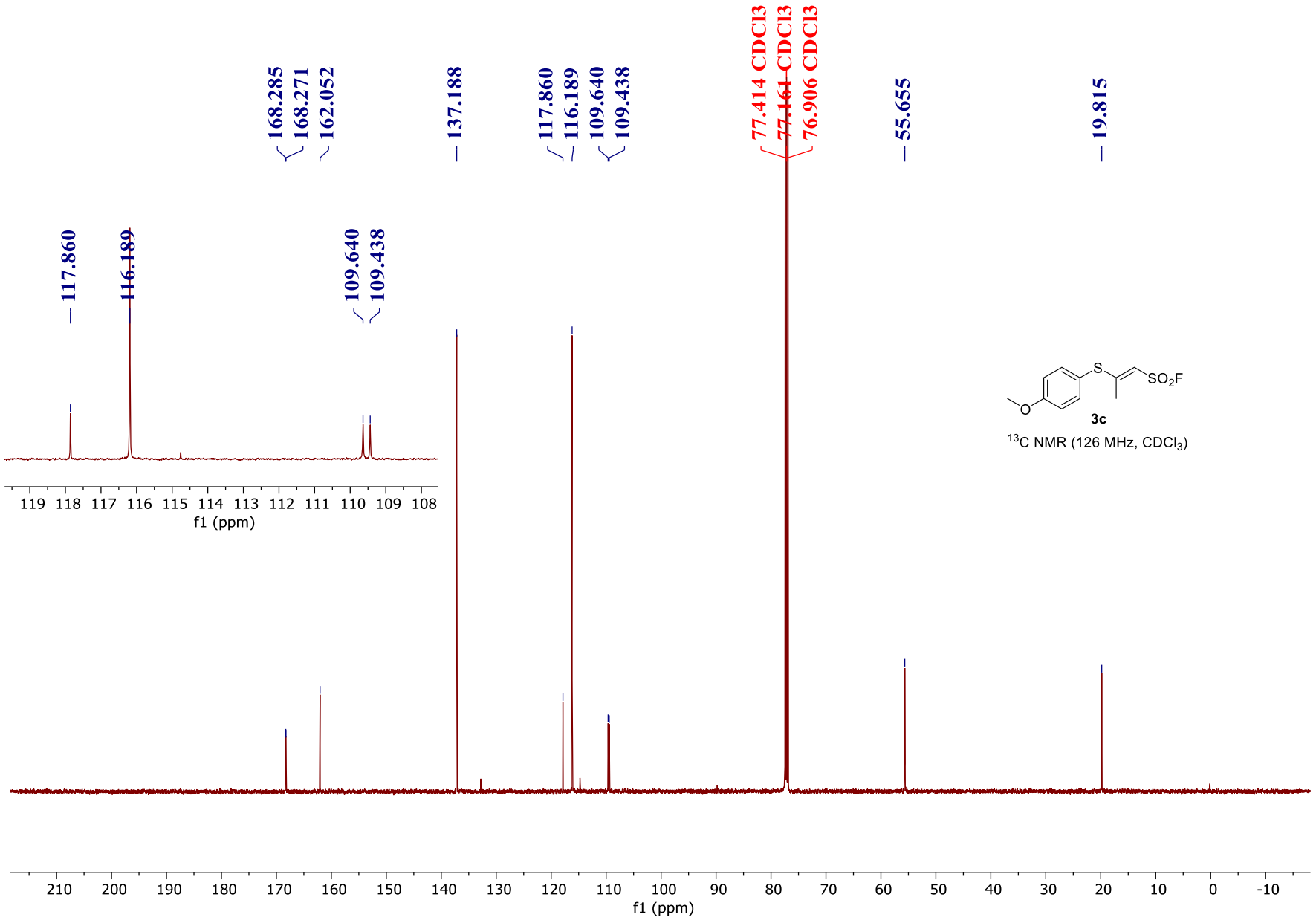

7.430
7.415
7.399
7.264 CDCl3
7.104
7.089
7.065
7.049
7.035
5.539
3.847
2.473
1.550 HDO
1.03
3.11
1.00
3.07
3.09
f1 (ppm)
S
SO2F
O
3b
1H NMR (500 MHz, CDCl3)

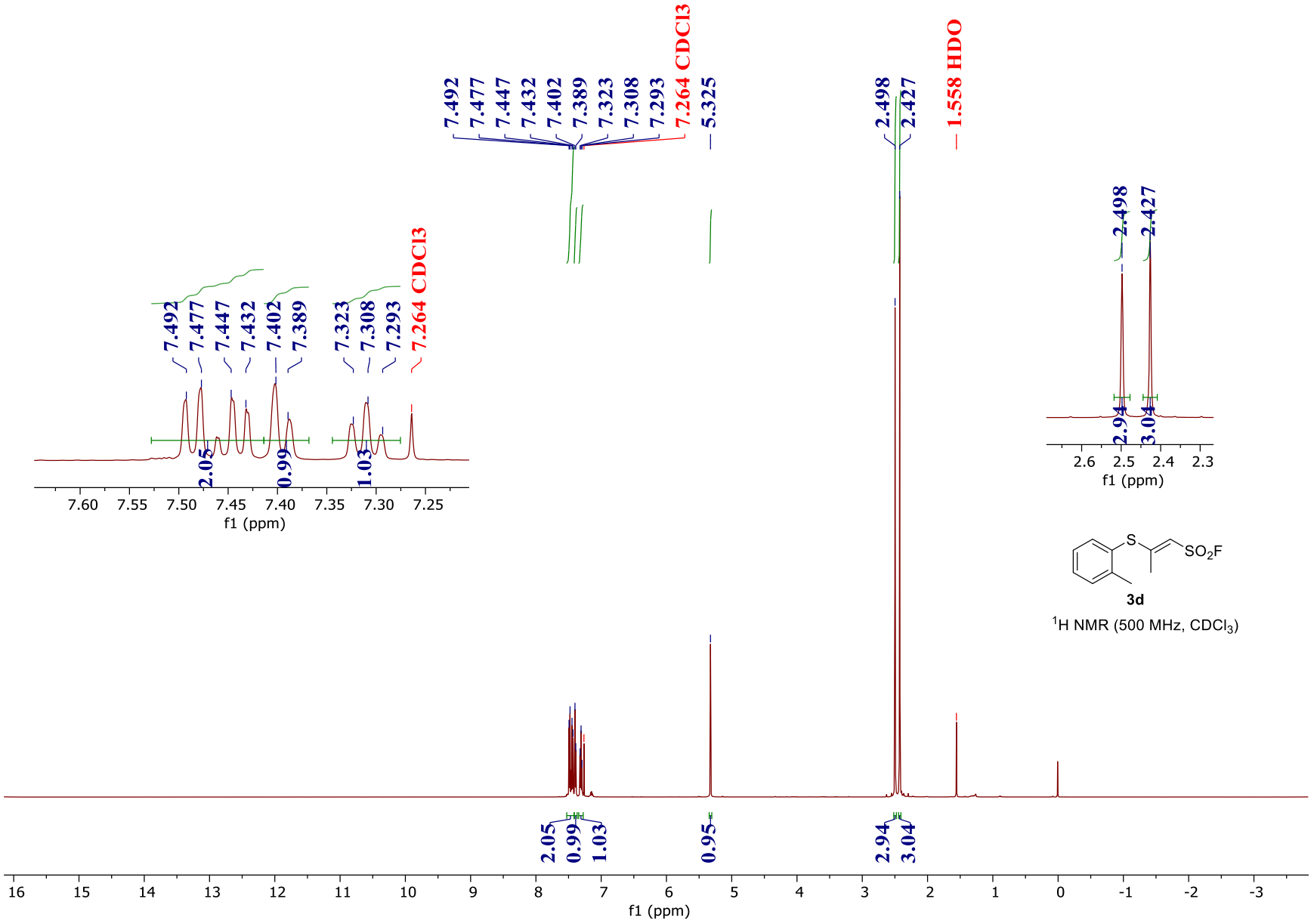

67.455
S
SO2F
O
3b
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

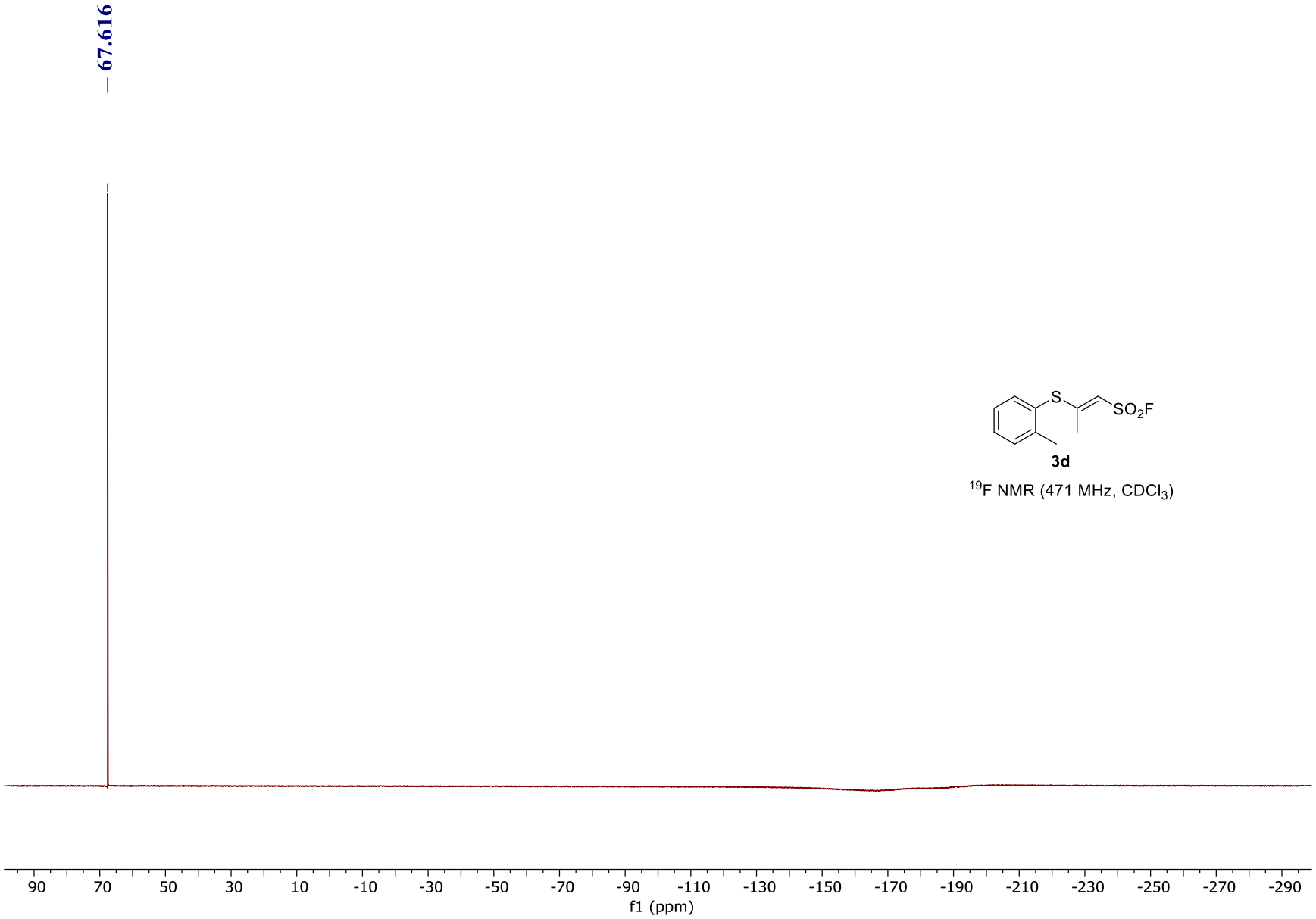

166.834
160.946
131.448
128.223
127.551
120.548
117.290
110.058
109.855
77.415 CDCl3
77.161 CDCl3
76.906 CDCl3
55.649
19.954
f1 (ppm)
S
SO2F
O
3b
13C NMR (126 MHz, CDCl3)

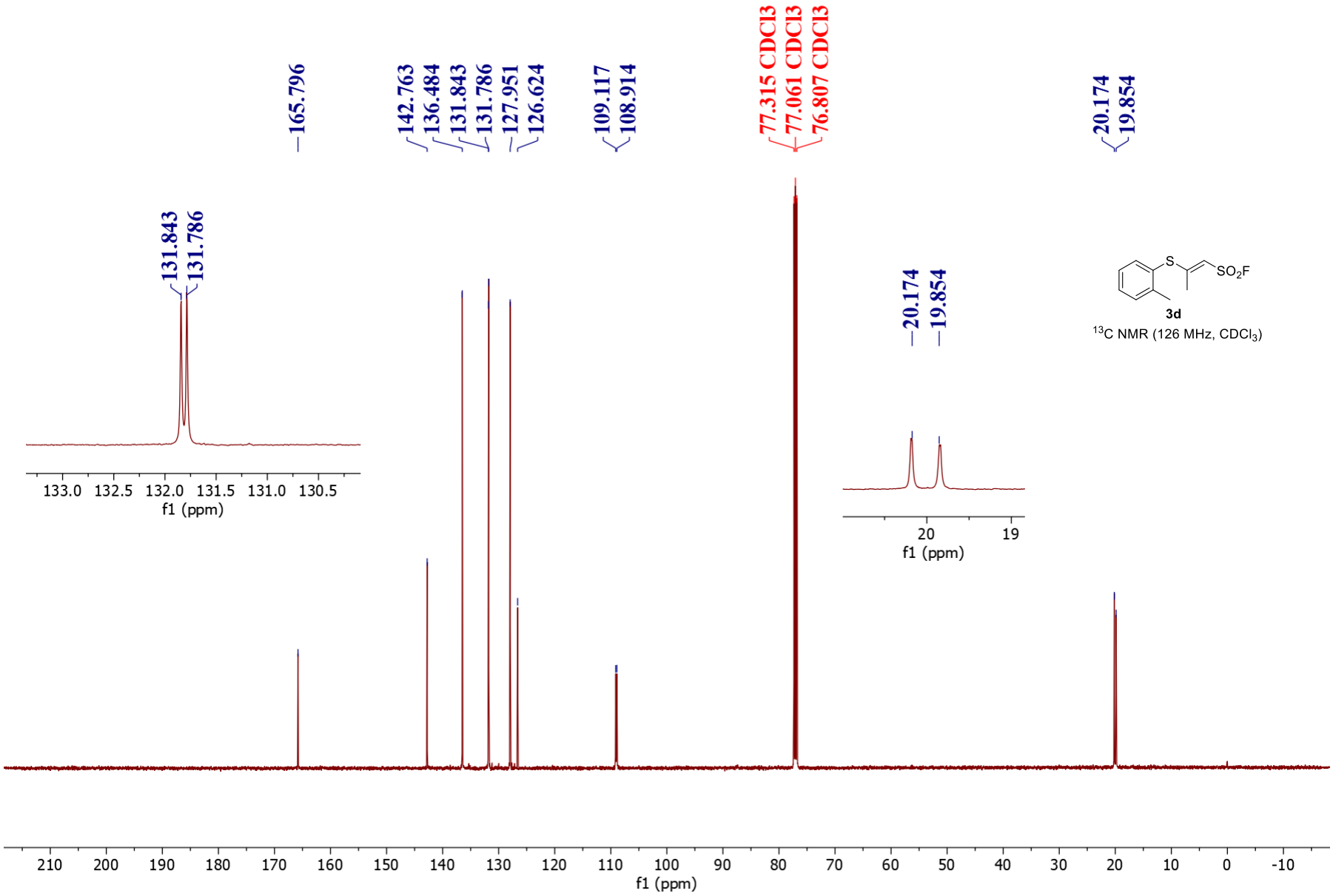

7.424
7.406
7.264 CDCl3
7.011
6.993
5.442
3.868
2.453
2.07
2.01
0.96
2.98
2.97
f1 (ppm)
S
SO2F
O
3c
1H NMR (500 MHz, CDCl3)

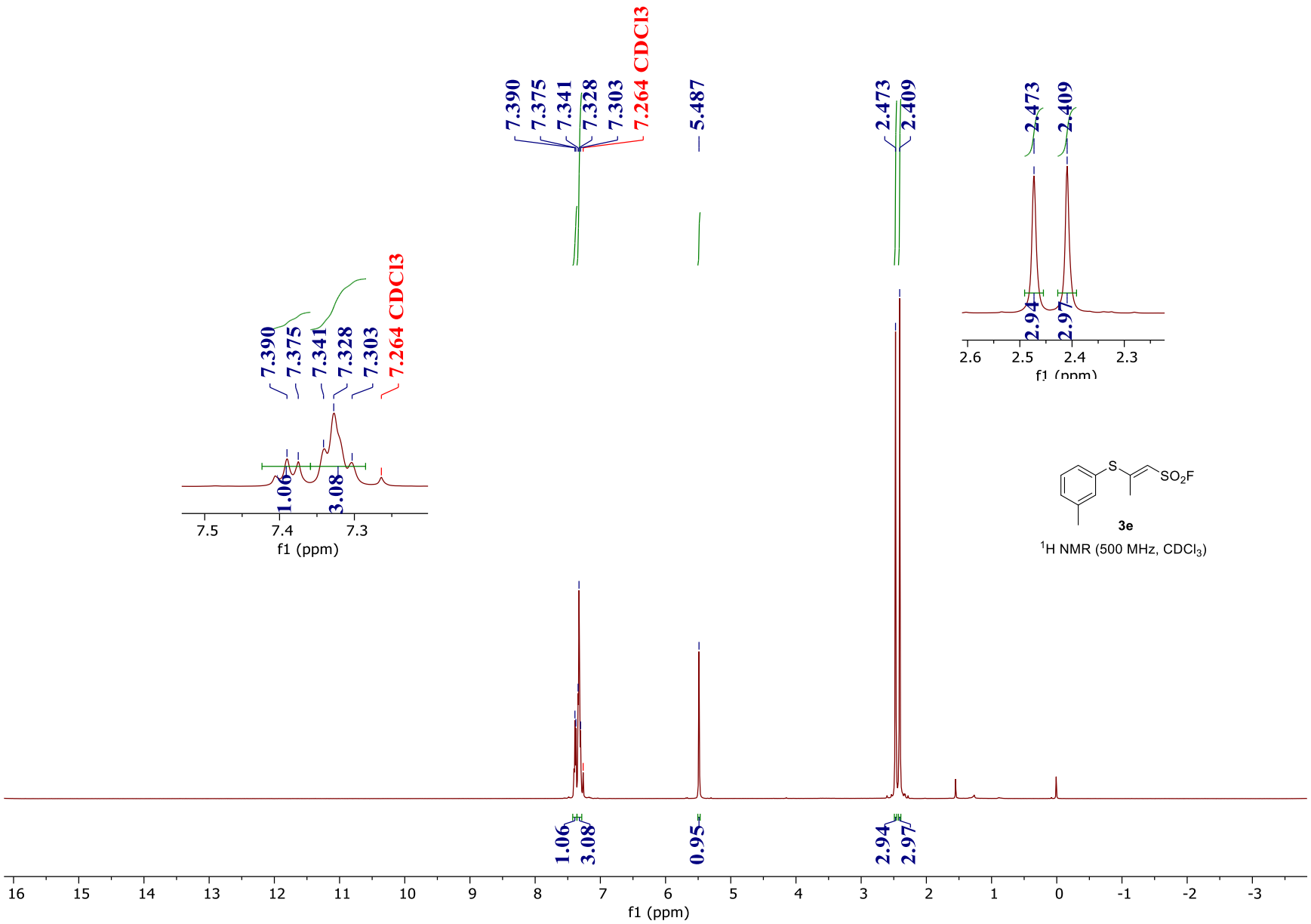

−67.445
S
SO2F
O
3c
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

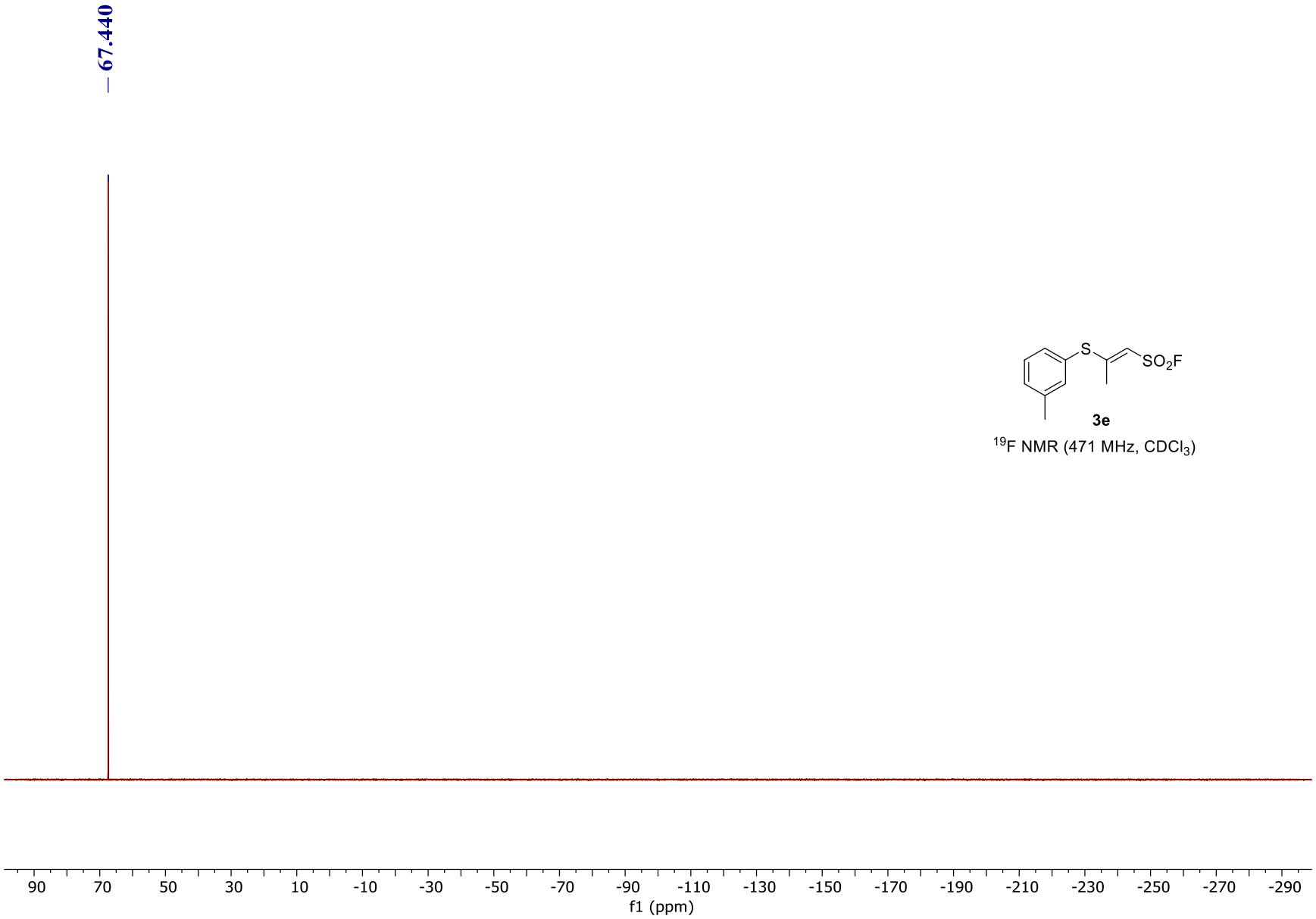

168.285
168.271
162.052
137.188
117.860
116.189
109.640
109.438
77.414 CDCl3
77.161 CDCl3
76.906 CDCl3
55.655
19.815
117.860
116.189
109.640
109.438
119 118 117 116 115 114 113 112 111 110 109 108
f1 (ppm)
S
SO2F
O
3c
13C NMR (126 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.492
7.477
7.447
7.432
7.402
7.389
7.323
7.308
7.293
7.264 CDCl3
5.325
2.498
2.427
1.558 HDO
2.05
0.99
1.03
0.95
2.94
3.04
f1 (ppm)
SO2F
3d
1H NMR (500 MHz, CDCl3)


−67.616
S
SO2F
3d
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

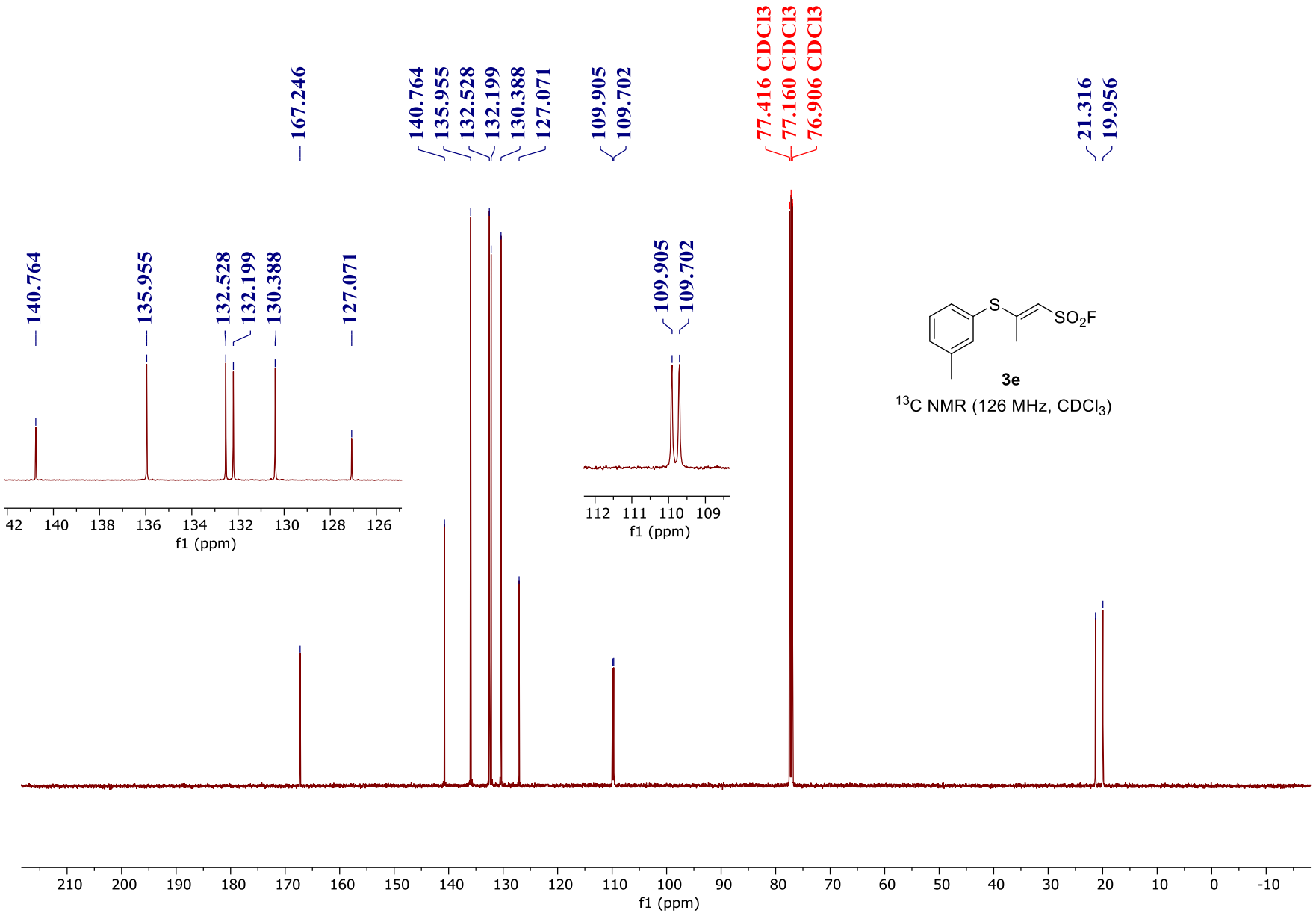

165.796
142.763
136.484
131.843
131.786
127.951
126.624
109.117
108.914
77.315 CDCl3
77.061 CDCl3
76.807 CDCl3
20.174
19.854
131.843
131.786
133.0 132.5 132.0 131.5 131.0 130.5
f1 (ppm)
20.174
19.854
20 19
f1 (ppm)
S
SO2F
3d
13C NMR (126 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

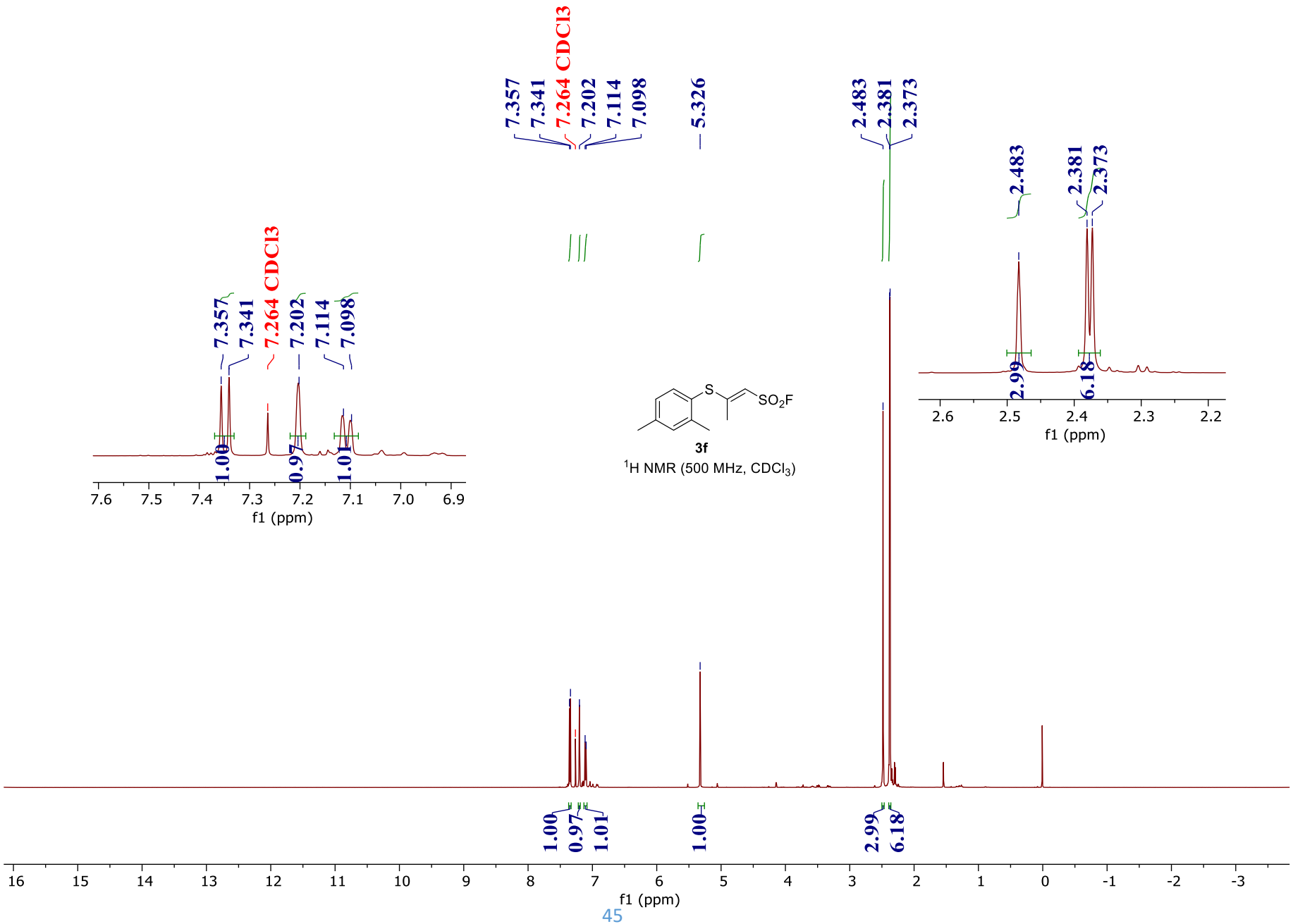

7.390
7.375
7.341
7.328
7.303
7.264 CDCl3
5.487
2.473
2.409
1.06
3.08
0.95
2.94
2.97
f1 (ppm)
2.94
2.97
f1 (ppm)
1.06
3.08
f1 (ppm)
S
SO2F
3e
1H NMR (500 MHz, CDCl3)

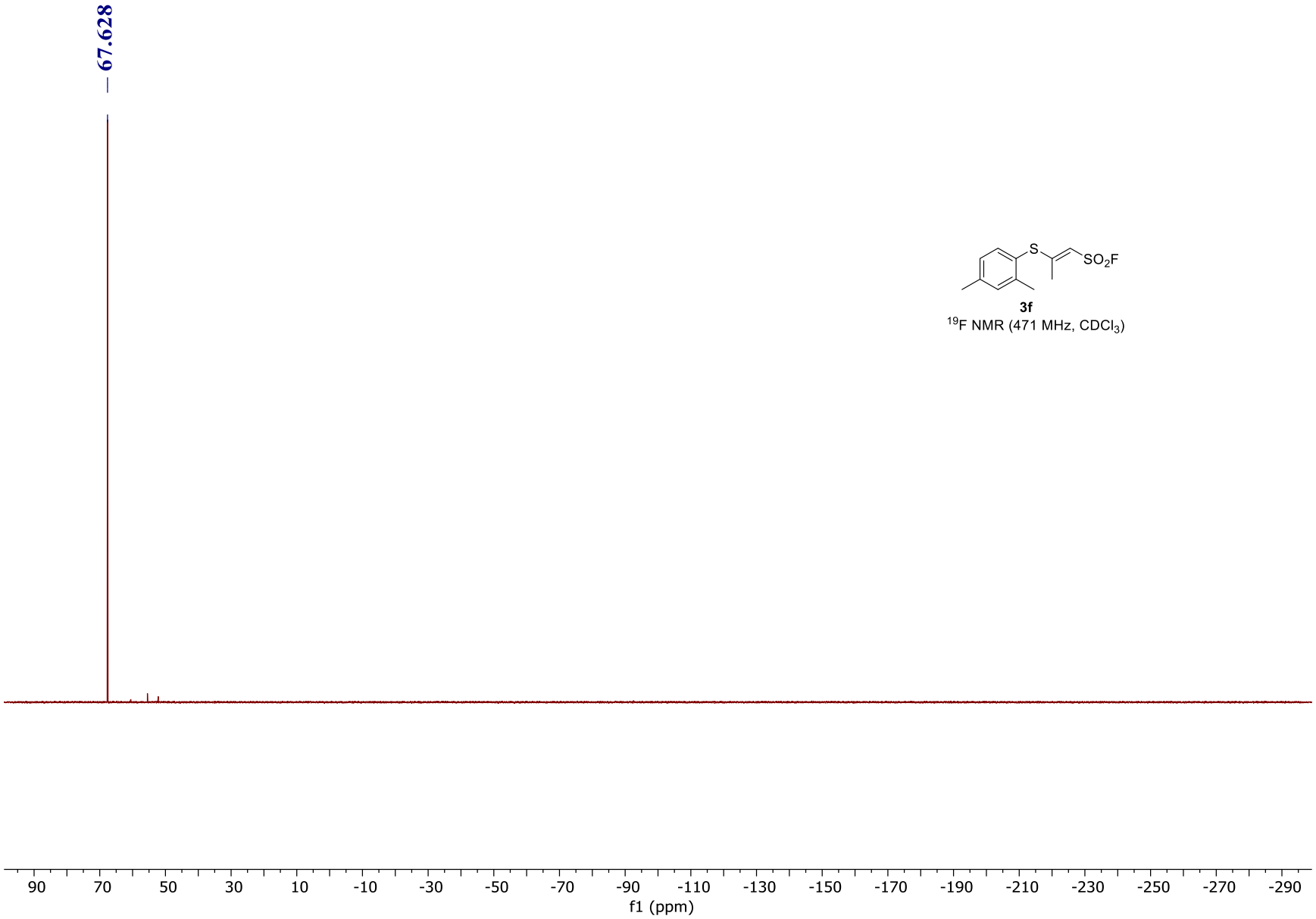


3e

^{19}F NMR (471 MHz, $CDCl_3$)

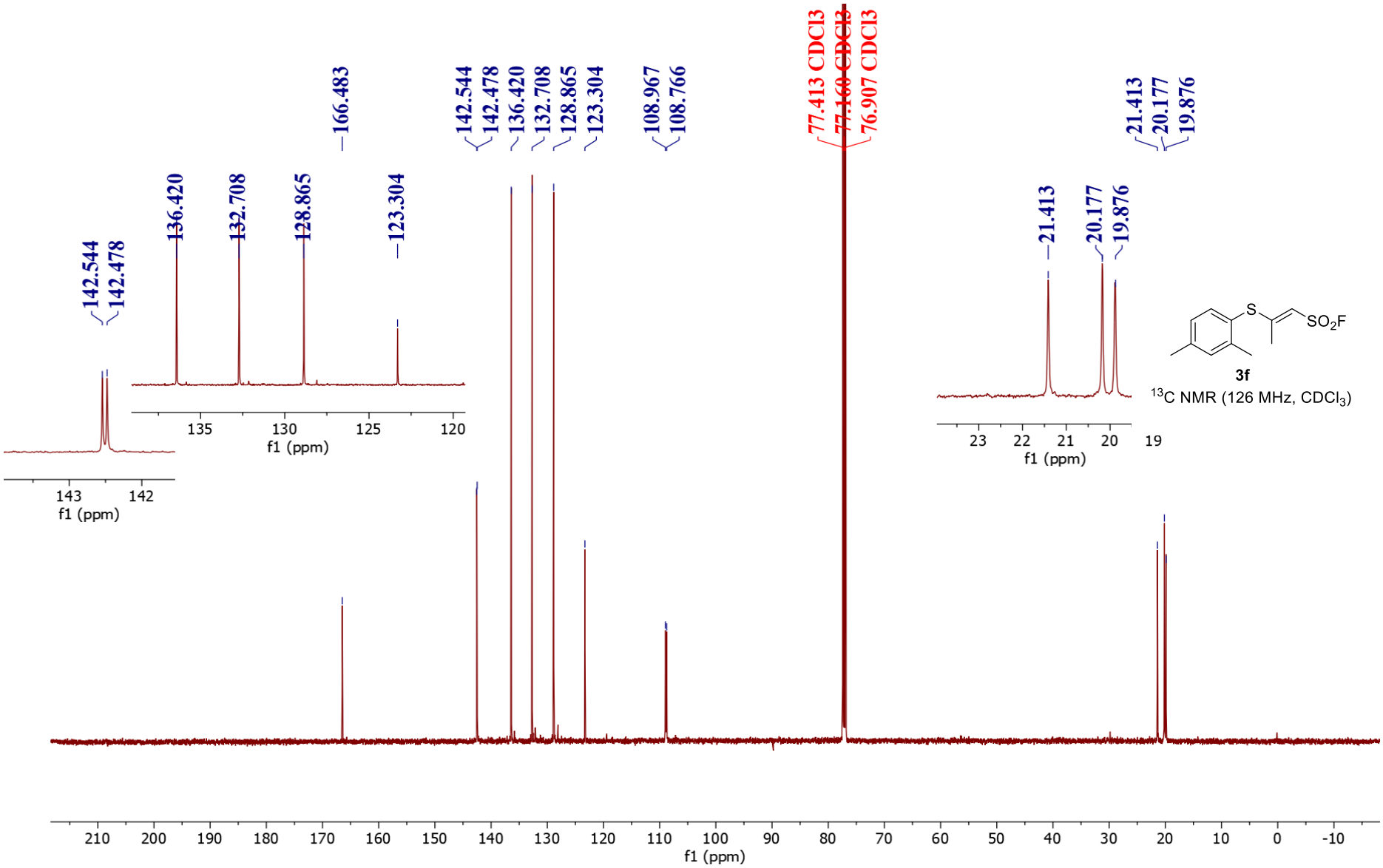

167.246
140.764
135.955
132.528
132.199
130.388
127.071
109.905
109.702
77.416 CDCl3
77.160 CDCl3
76.906 CDCl3
21.316
19.956
f1 (ppm)
S
SO2F
3e
13C NMR (126 MHz, CDCl3)

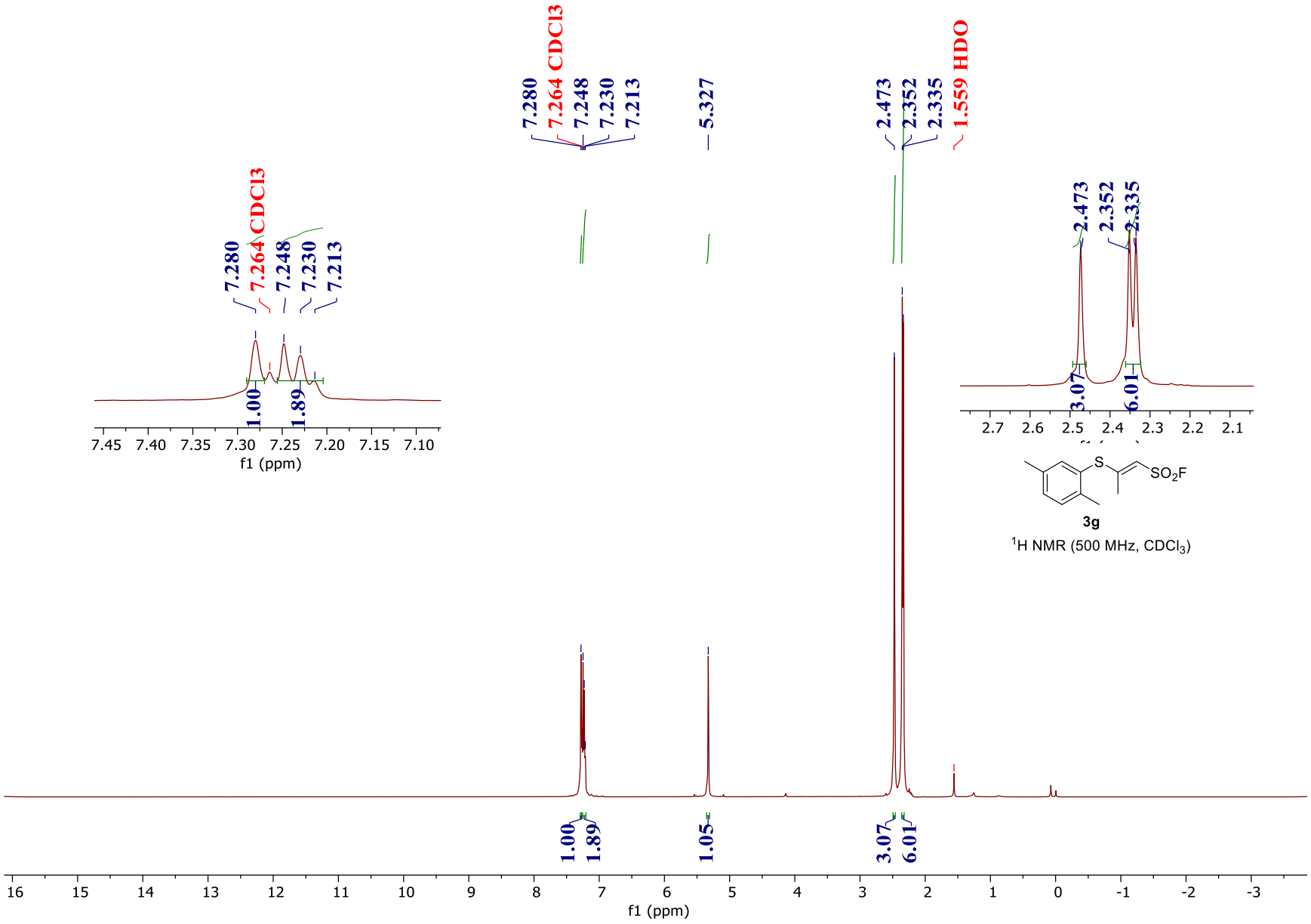

7.357
7.341
7.264 CDCl3
7.202
7.114
7.098
5.326
2.483
2.381
2.373
1.00
0.97
1.01
1.00
2.99
6.18
f1 (ppm)
S
SO2F
3f
1H NMR (500 MHz, CDCl3)

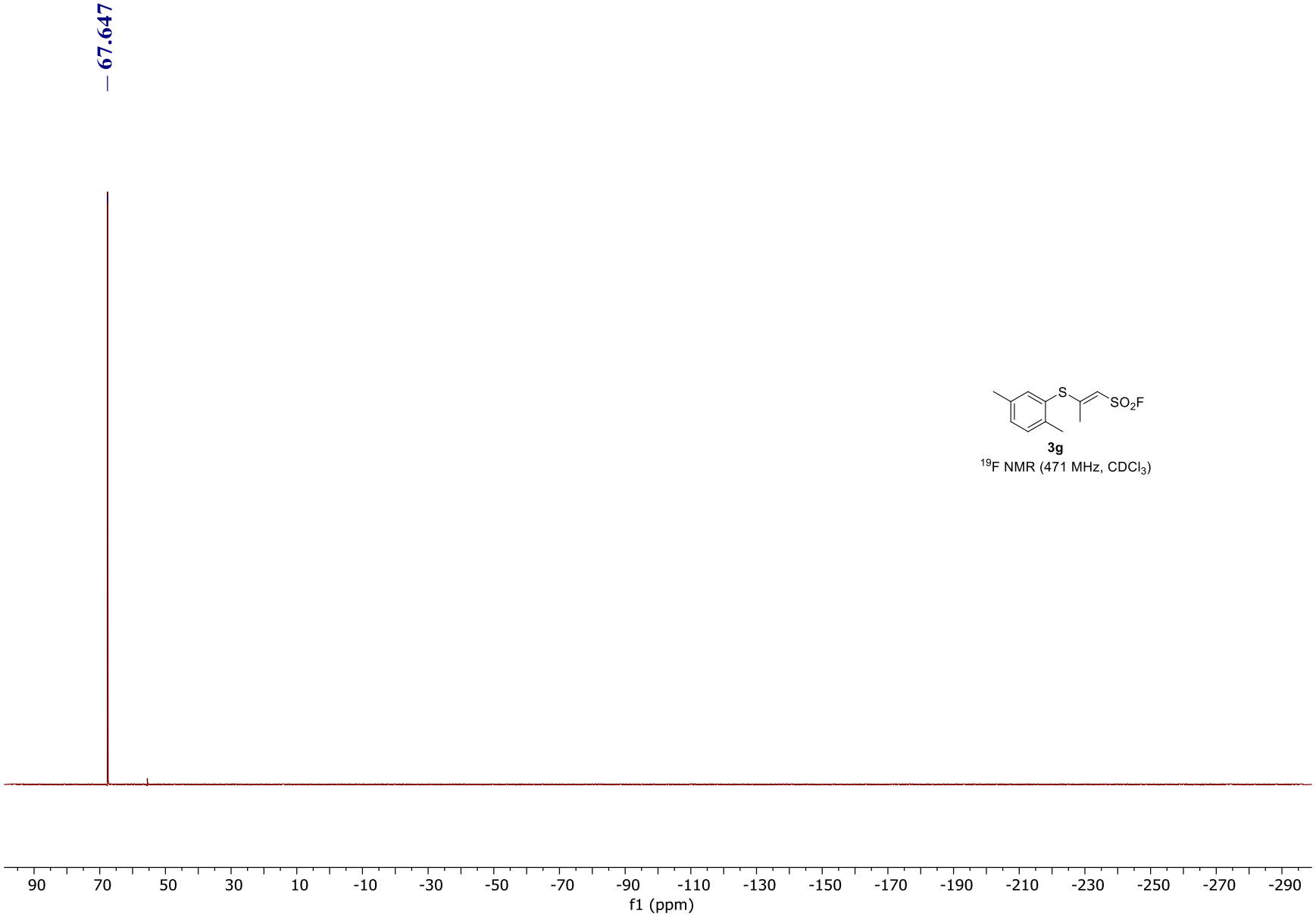


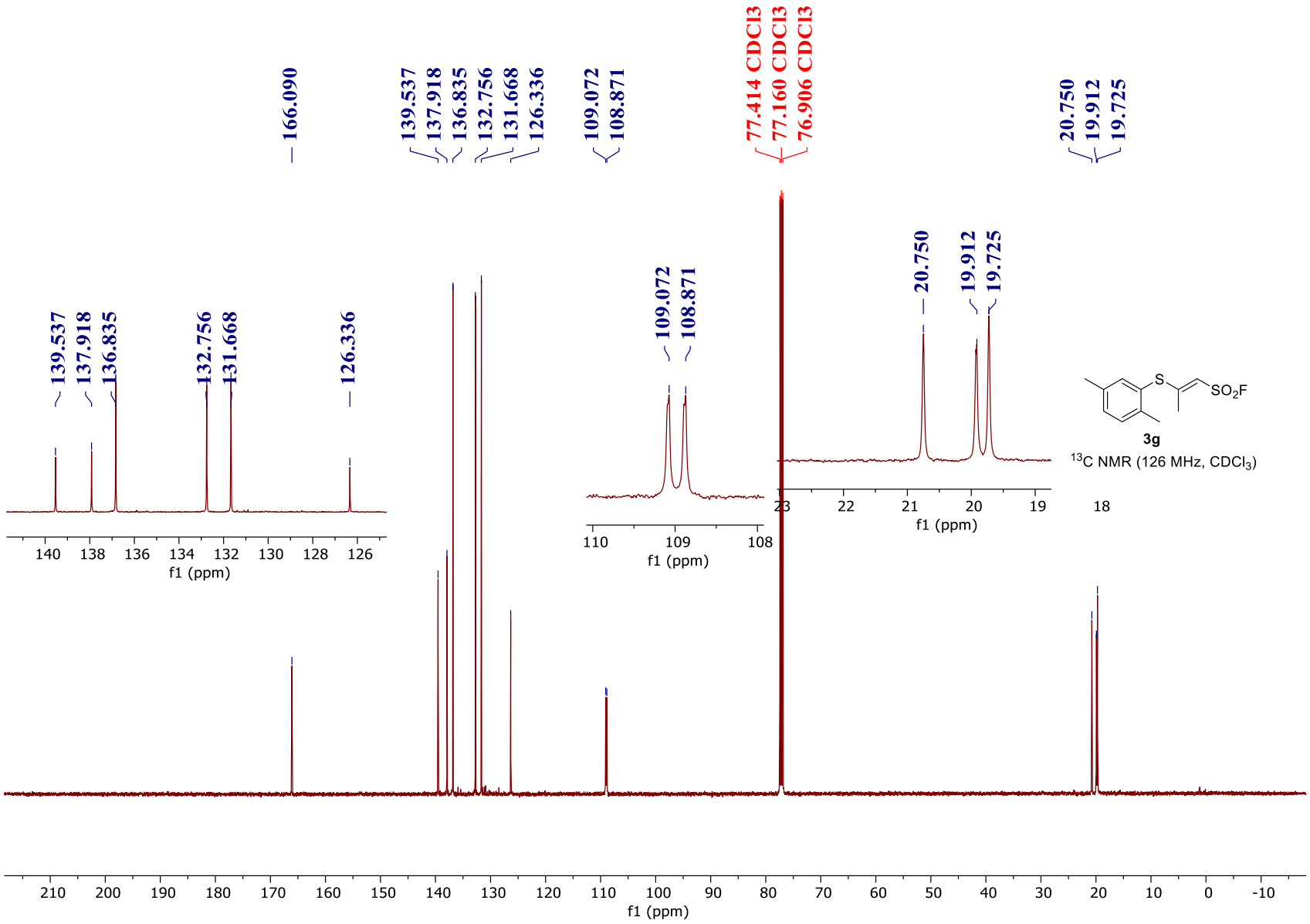
3f

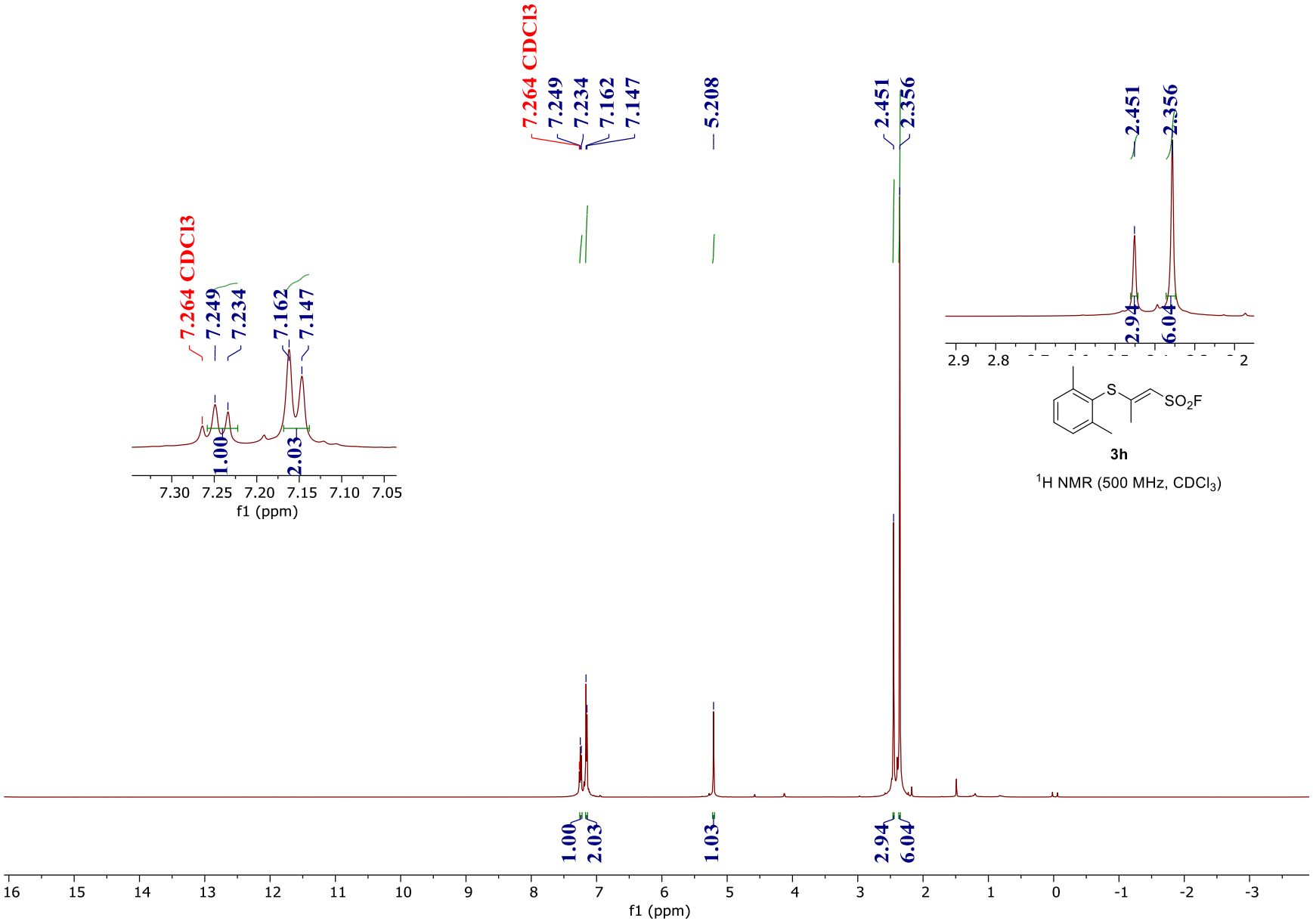
^{19}F NMR (471 MHz, $CDCl_3$)

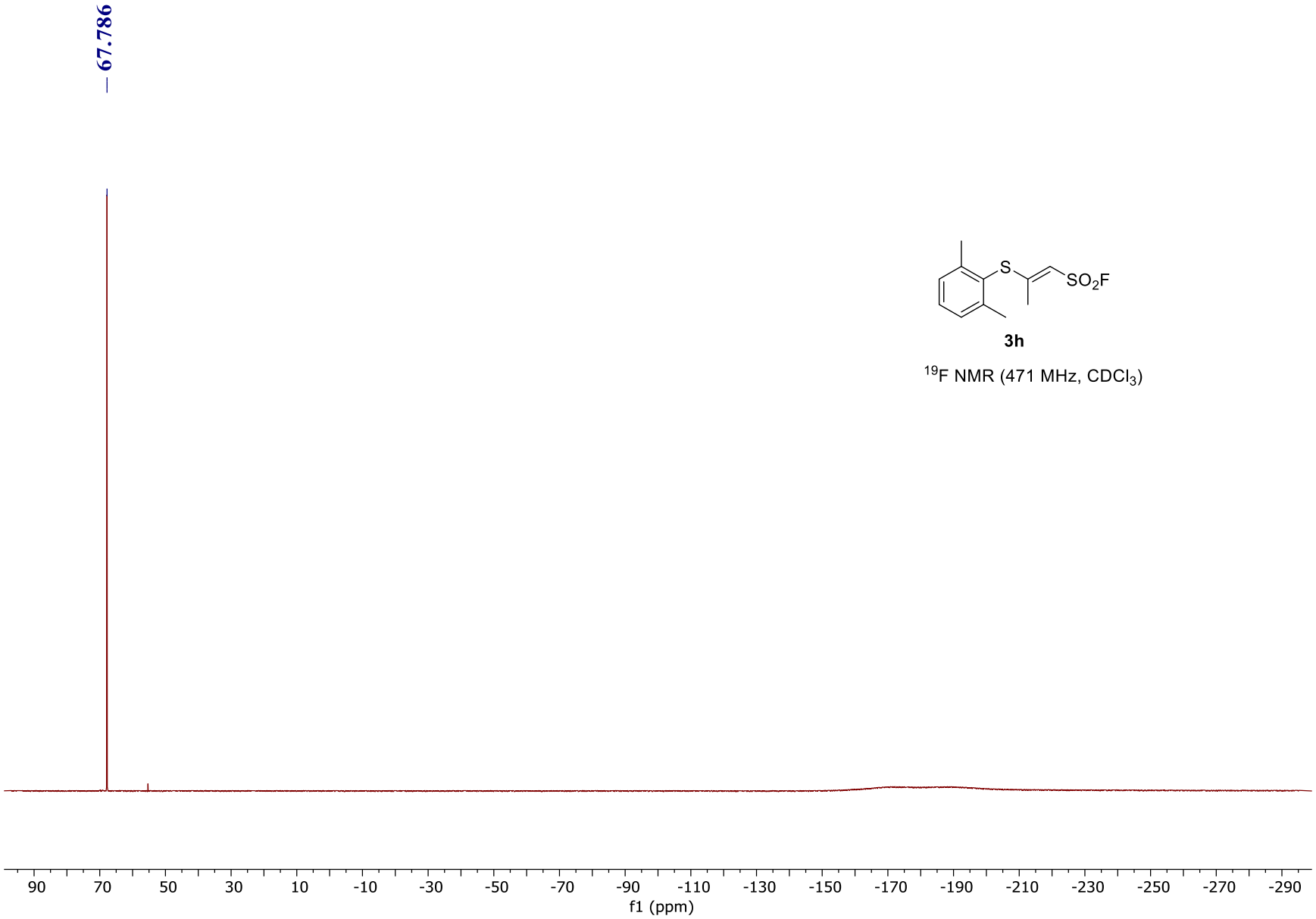

166.483
142.544
142.478
136.420
132.708
128.865
123.304
108.967
108.766
77.413 CDCl3
77.160 CDCl3
76.907 CDCl3
21.413
20.177
19.876
f1 (ppm)
S
SO2F
3f
13C NMR (126 MHz, CDCl3)

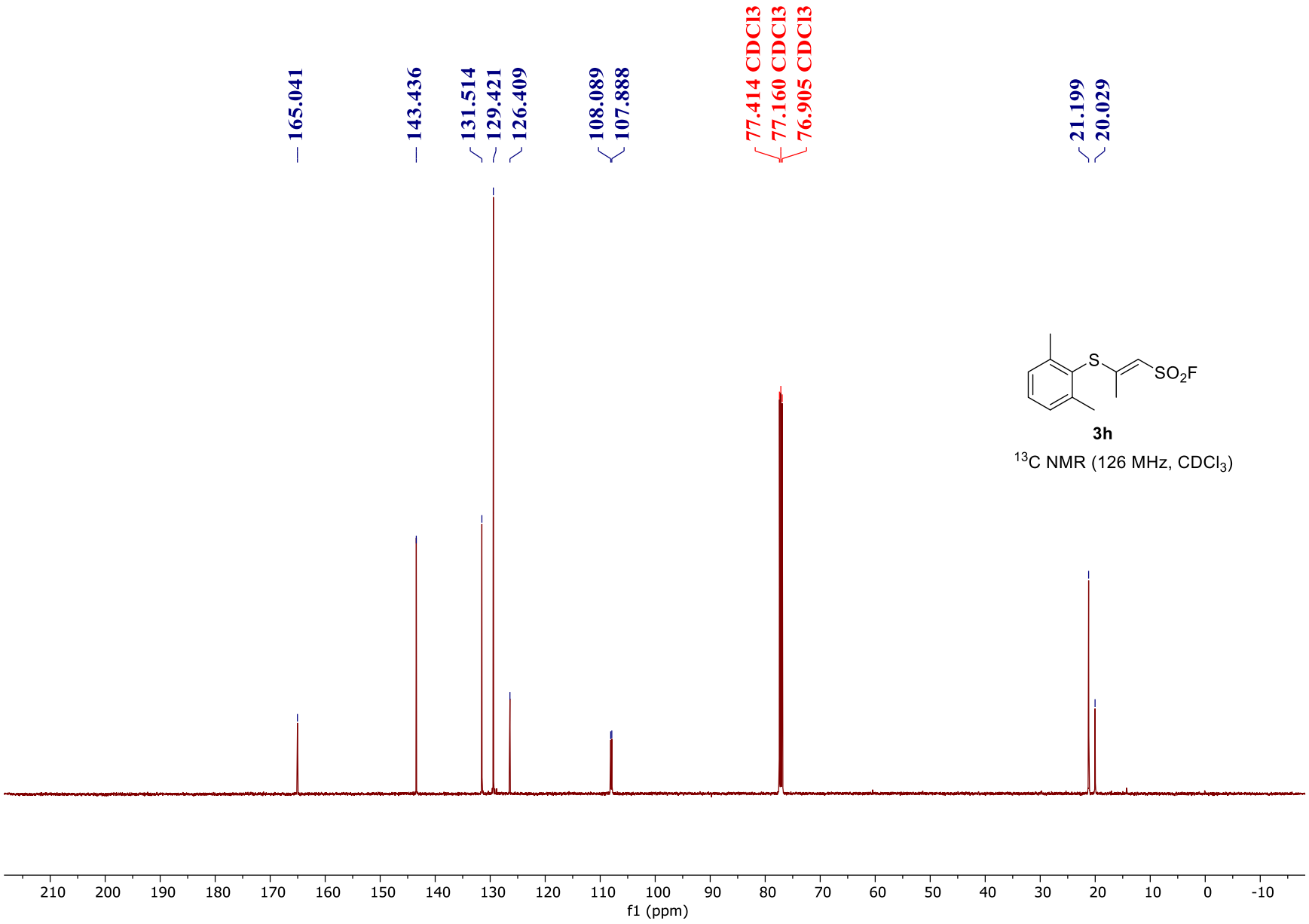

7.280
7.264 CDCl3
7.248
7.230
7.213
5.327
2.473
2.352
2.335
1.559 HDO
1.00
1.89
1.05
3.07
6.01
f1 (ppm)
SO2F
3g
1H NMR (500 MHz, CDCl3)

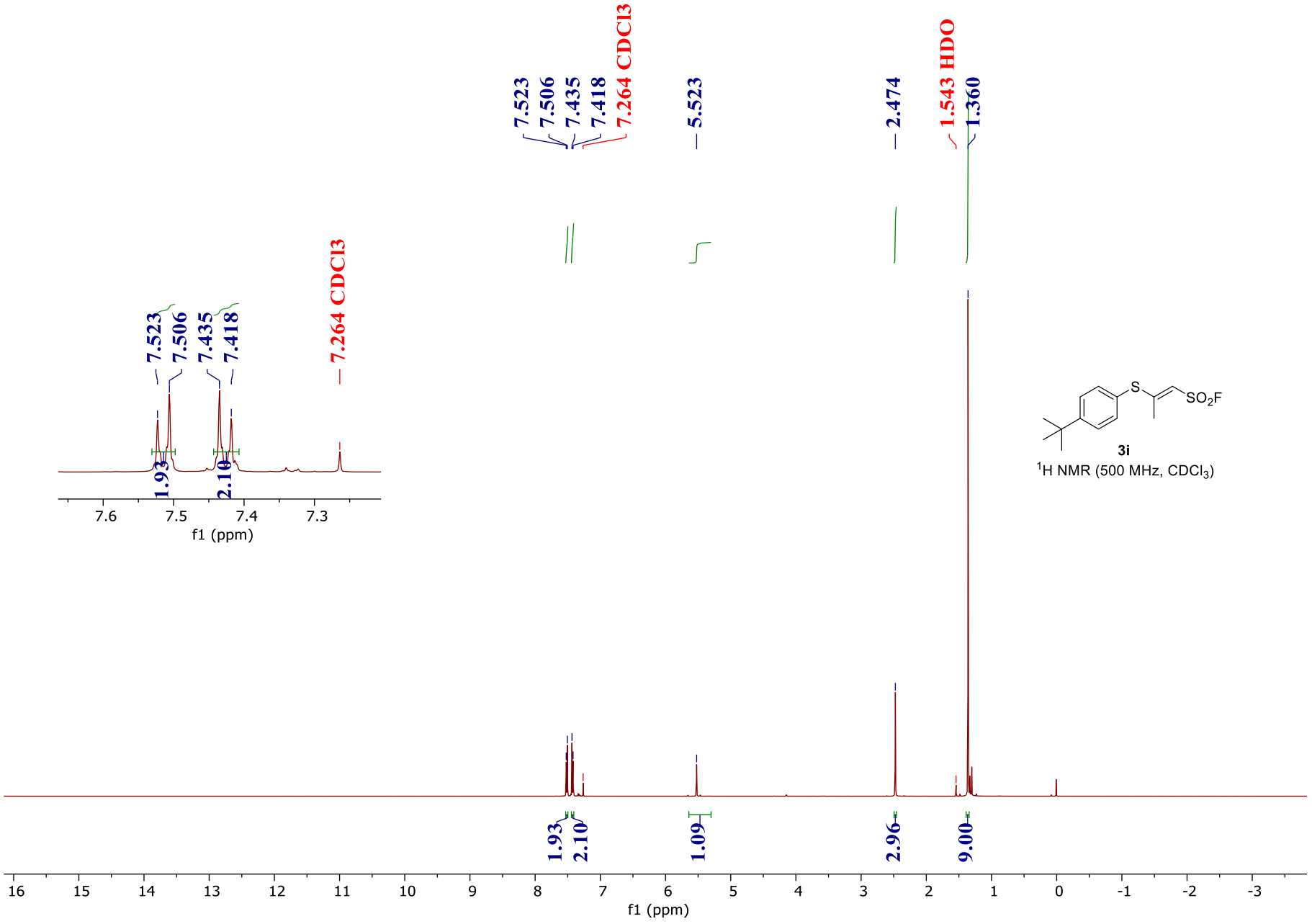

− 67.647
S
SO2F
3g
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

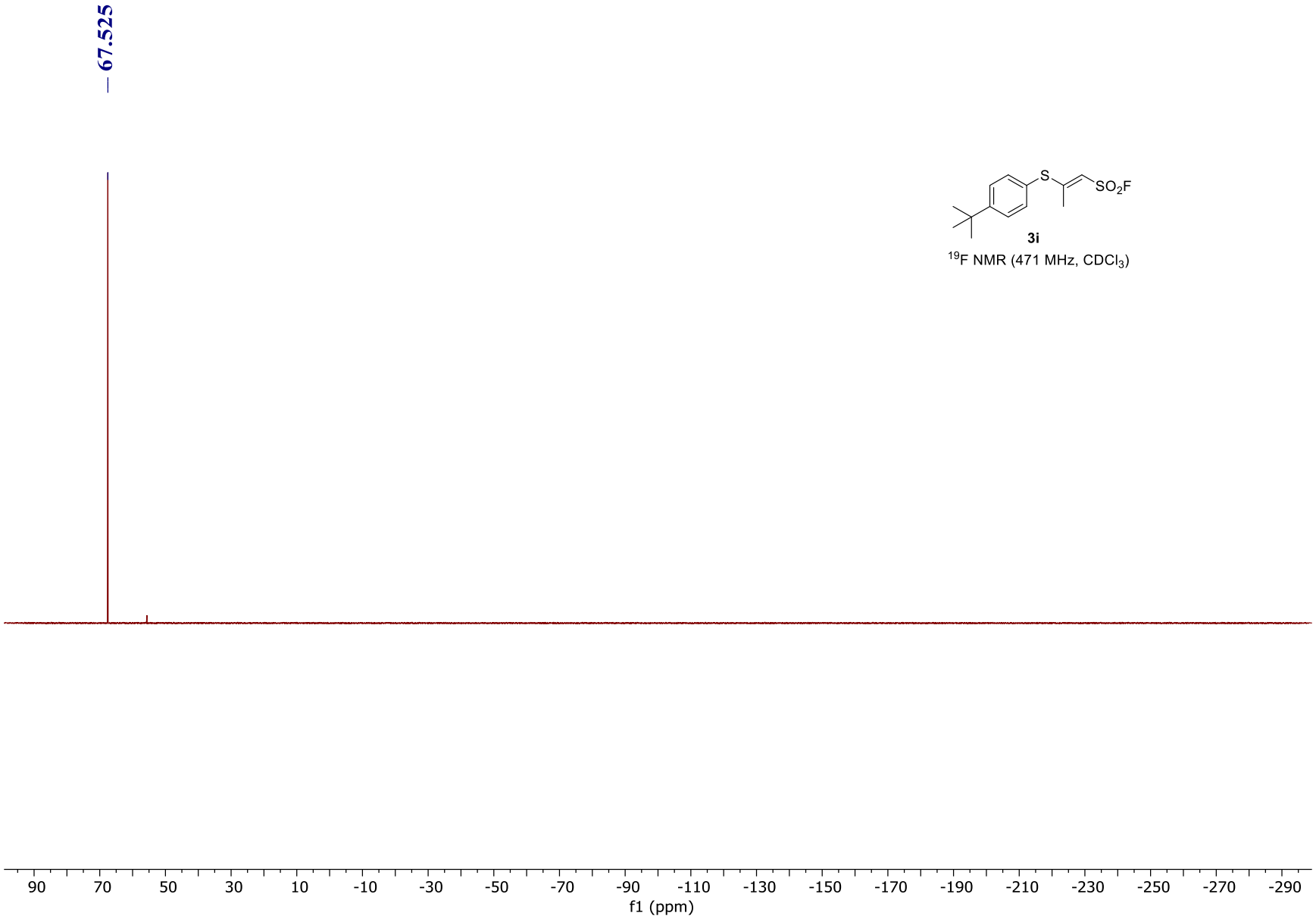

166.090
139.537
137.918
136.835
132.756
131.668
126.336
109.072
108.871
77.414 CDCl3
77.160 CDCl3
76.906 CDCl3
20.750
19.912
19.725
f1 (ppm)
3g
13C NMR (126 MHz, CDCl3)

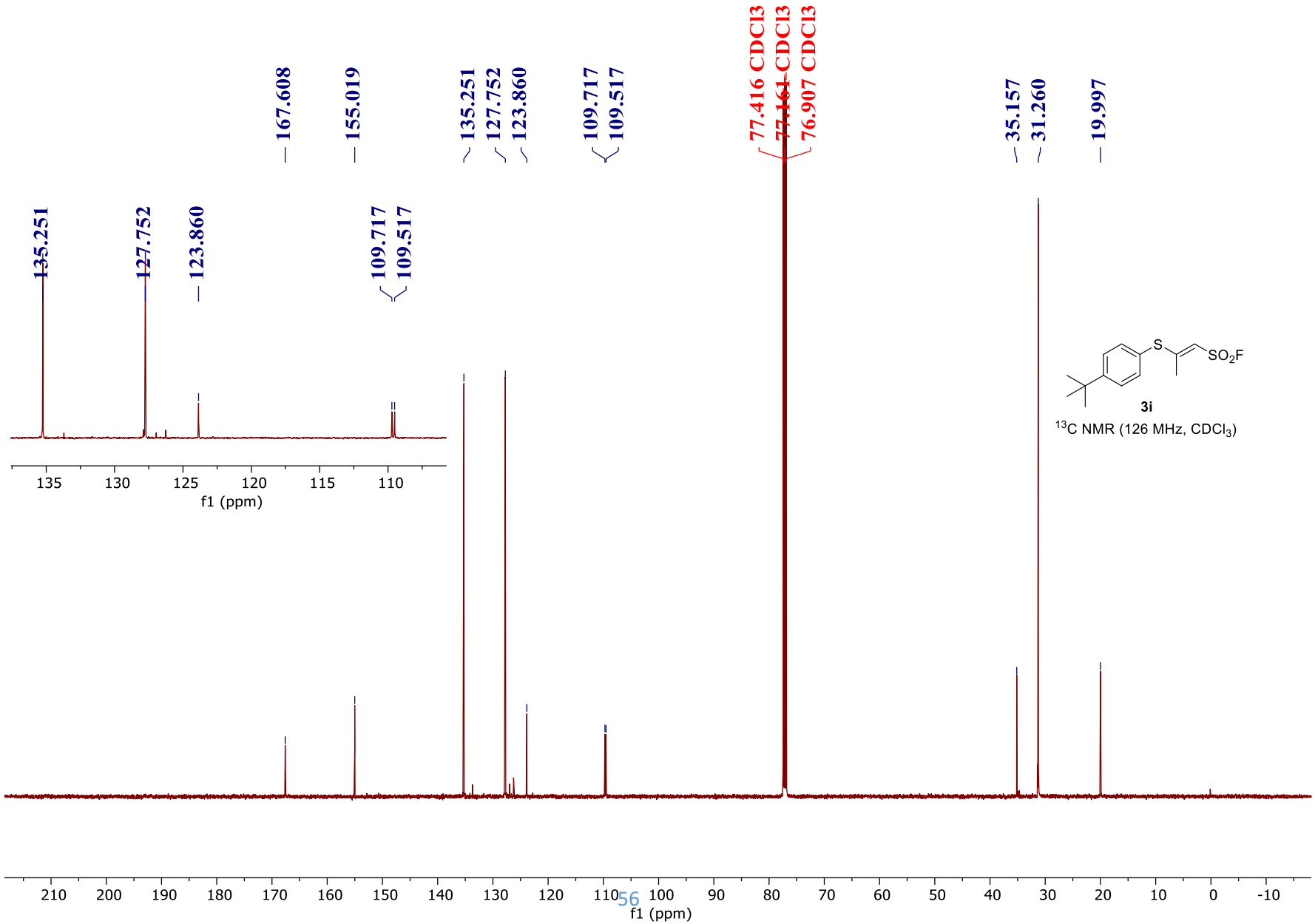

7.264 CDCl3
7.249
7.234
7.162
7.147
5.208
2.451
2.356
1.00
2.03
1.03
2.94
6.04
f1 (ppm)
2.94
6.04
SO2F
3h
1H NMR (500 MHz, CDCl3)

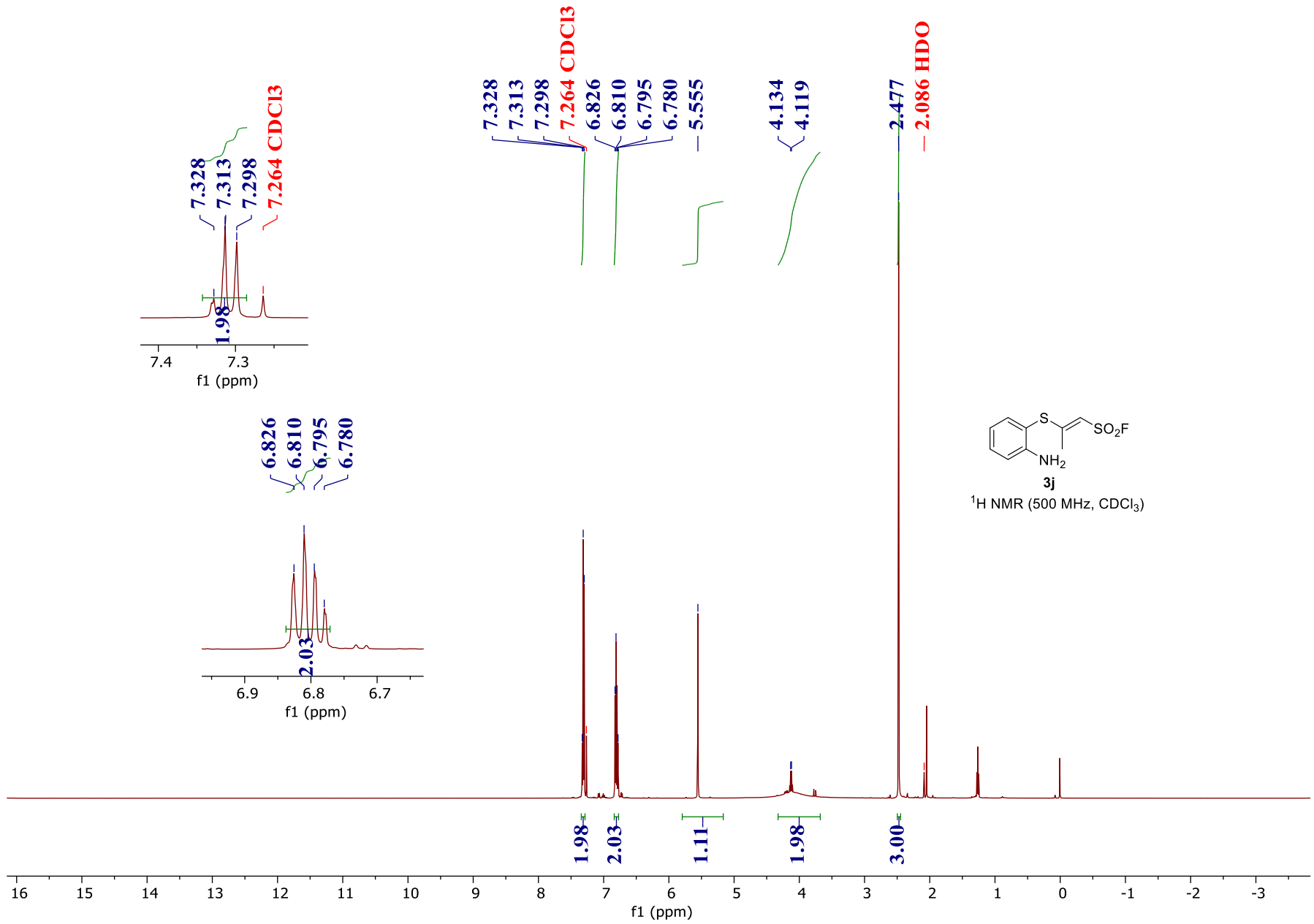

−67.786
S
SO2F
3h
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

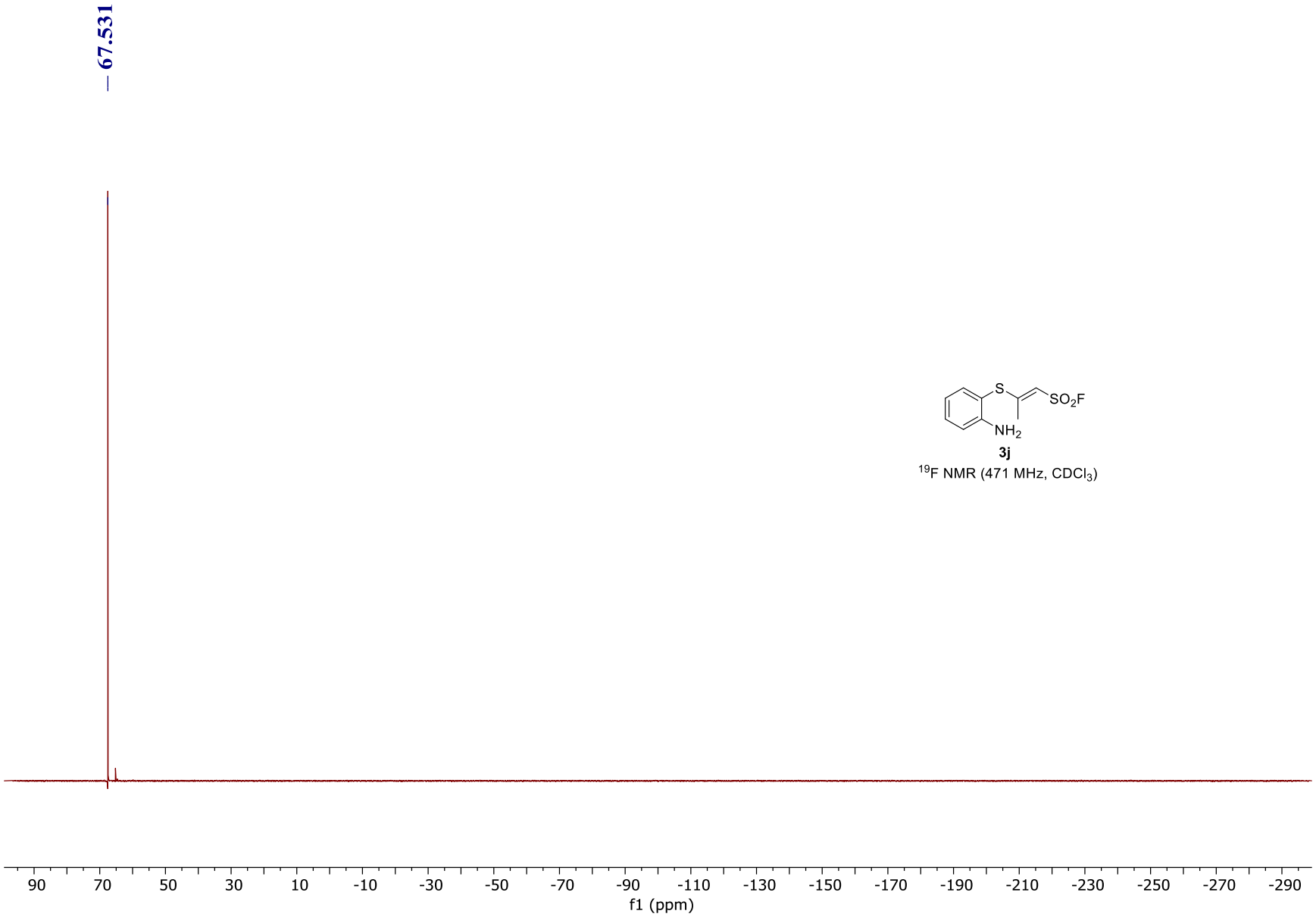

165.041
143.436
131.514
129.421
126.409
108.089
107.888
77.414 CDCl3
77.160 CDCl3
76.905 CDCl3
21.199
20.029
S
SO2F
3h
13C NMR (126 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.523
7.506
7.435
7.418
7.264 CDCl3
5.523
2.474
1.543 HDO
1.360
1.93
2.10
1.09
2.96
9.00
f1 (ppm)
3i
1H NMR (500 MHz, CDCl3)


−67.525
S
SO2F
3i
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

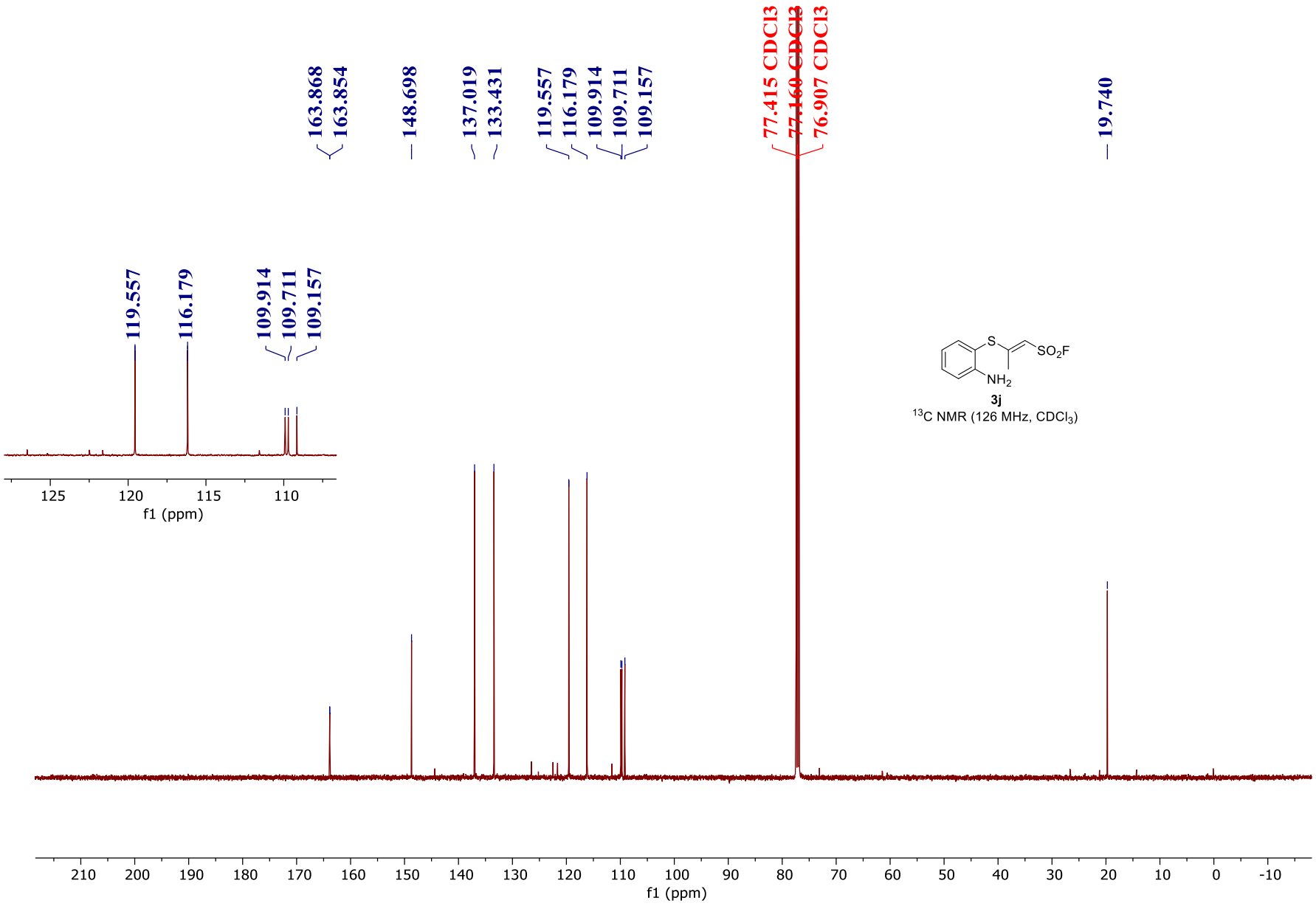

167.608
155.019
135.251
127.752
123.860
109.717
109.517
77.416 CDCl3
77.161 CDCl3
76.907 CDCl3
35.157
31.260
19.997
f1 (ppm)
3i
13C NMR (126 MHz, CDCl3)

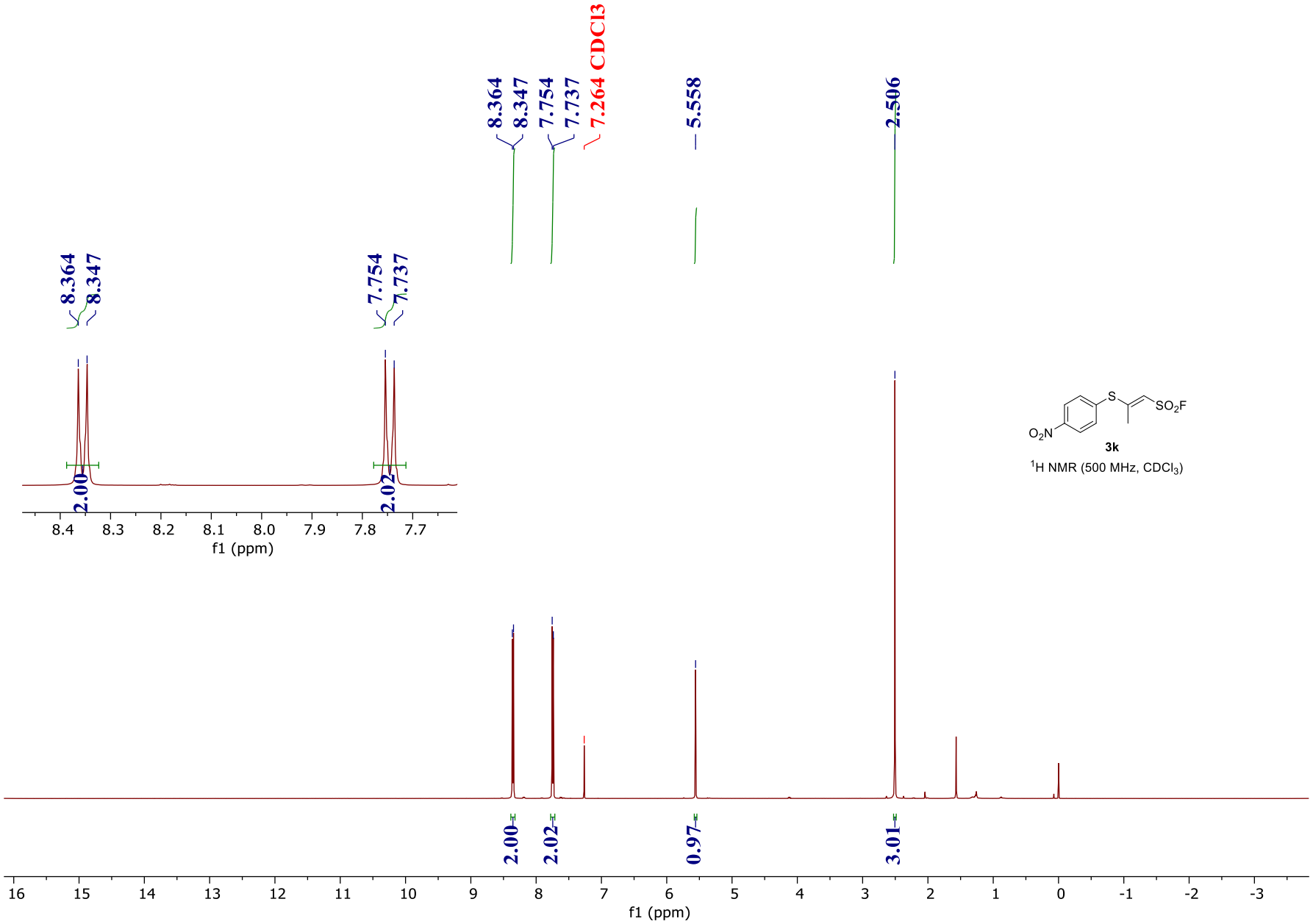

7.328
7.313
7.298
7.264 CDCl3
6.826
6.810
6.795
6.780
5.555
4.134
4.119
2.477
2.086 HDO
1.98
7.4
7.3
f1 (ppm)
2.03
6.9
6.8
6.7
f1 (ppm)
S
SO2F
NH2
3j
1H NMR (500 MHz, CDCl3)
1.98
2.03
1.11
1.98
3.00
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
f1 (ppm)

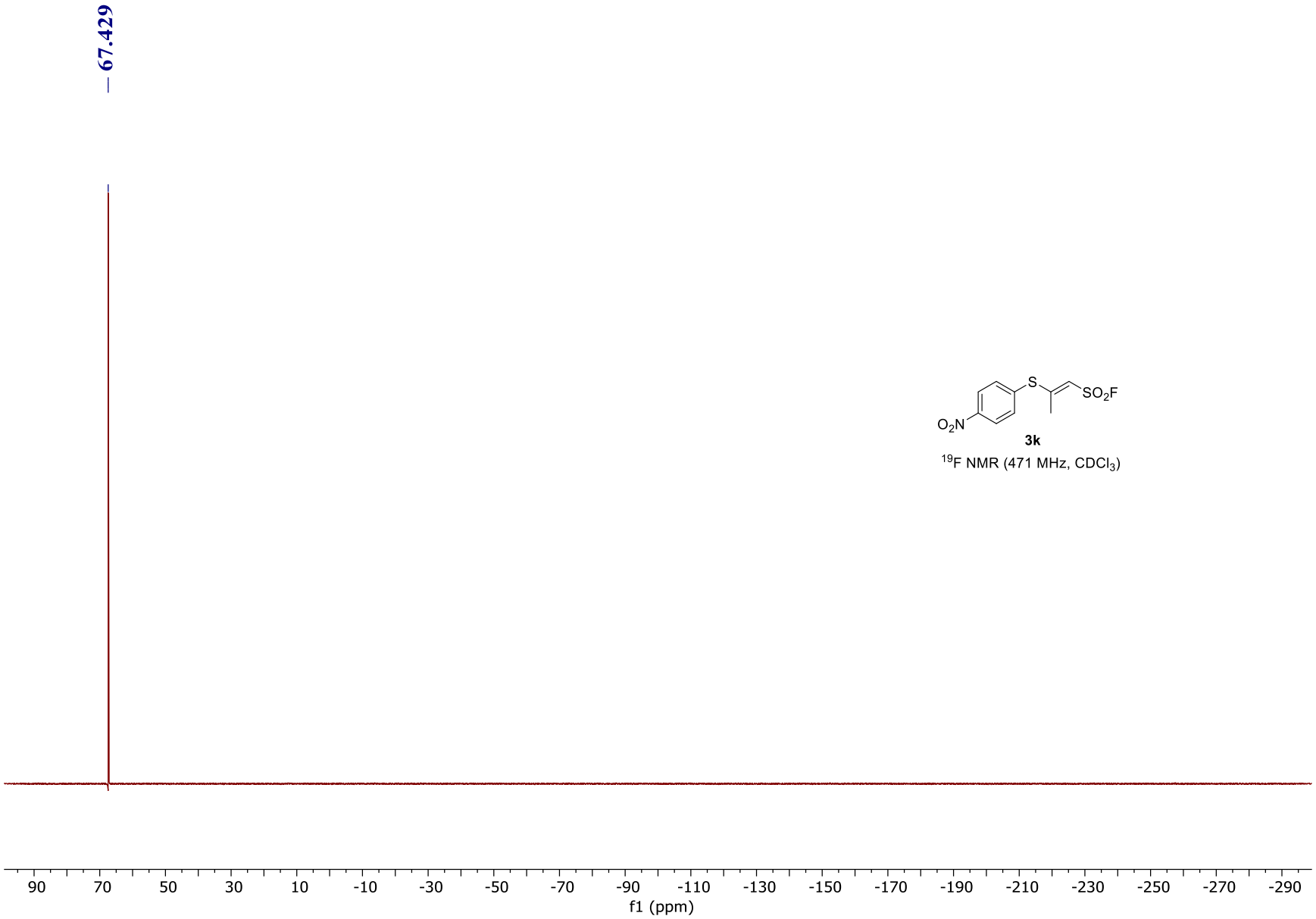


3j

^{19}F NMR (471 MHz, $CDCl_3$)

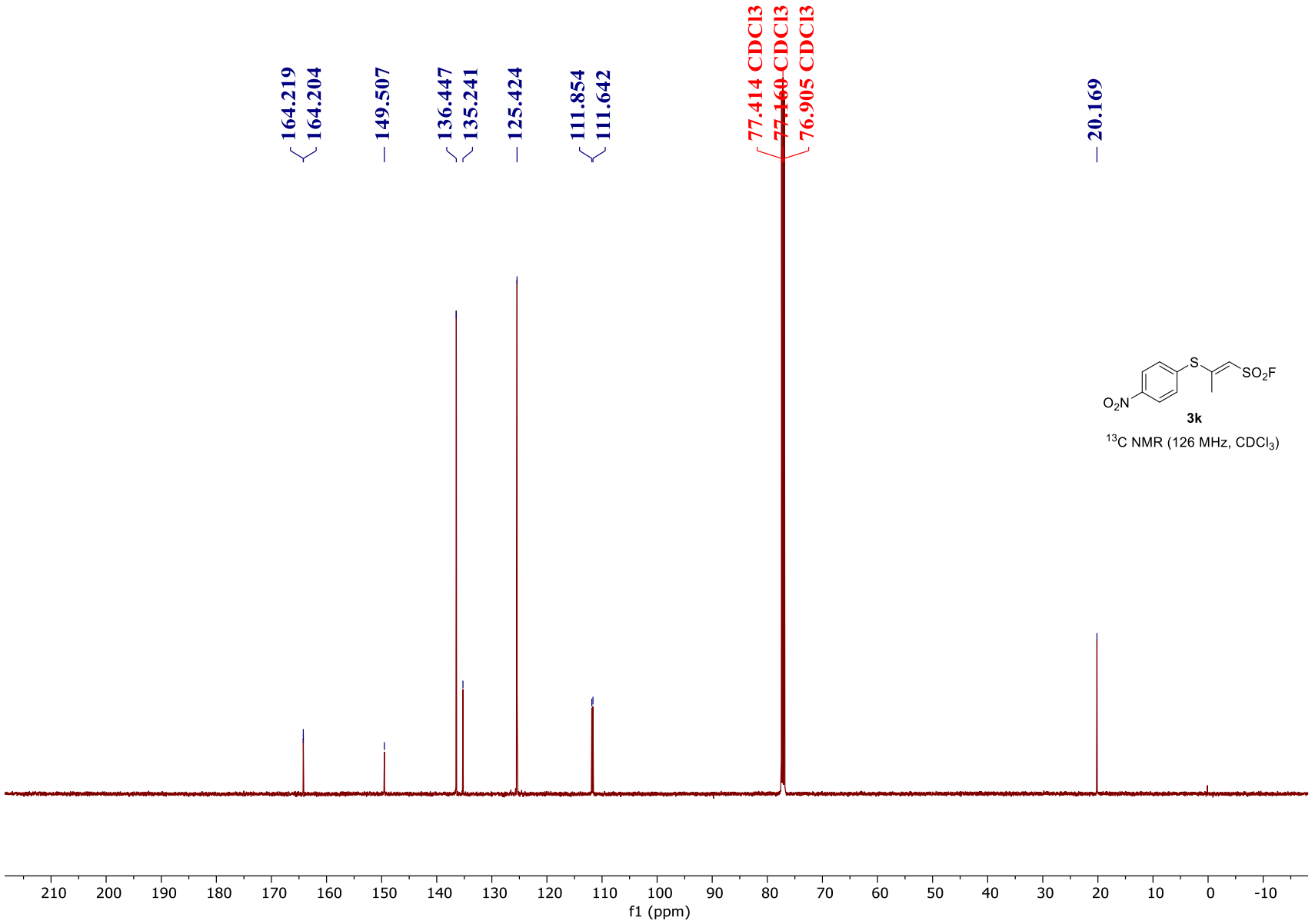

163.868
163.854
148.698
137.019
133.431
119.557
116.179
109.914
109.711
109.157
77.415 CDCl3
77.160 CDCl3
76.907 CDCl3
19.740
S
SO2F
NH2
3j
13C NMR (126 MHz, CDCl3)
f1 (ppm)

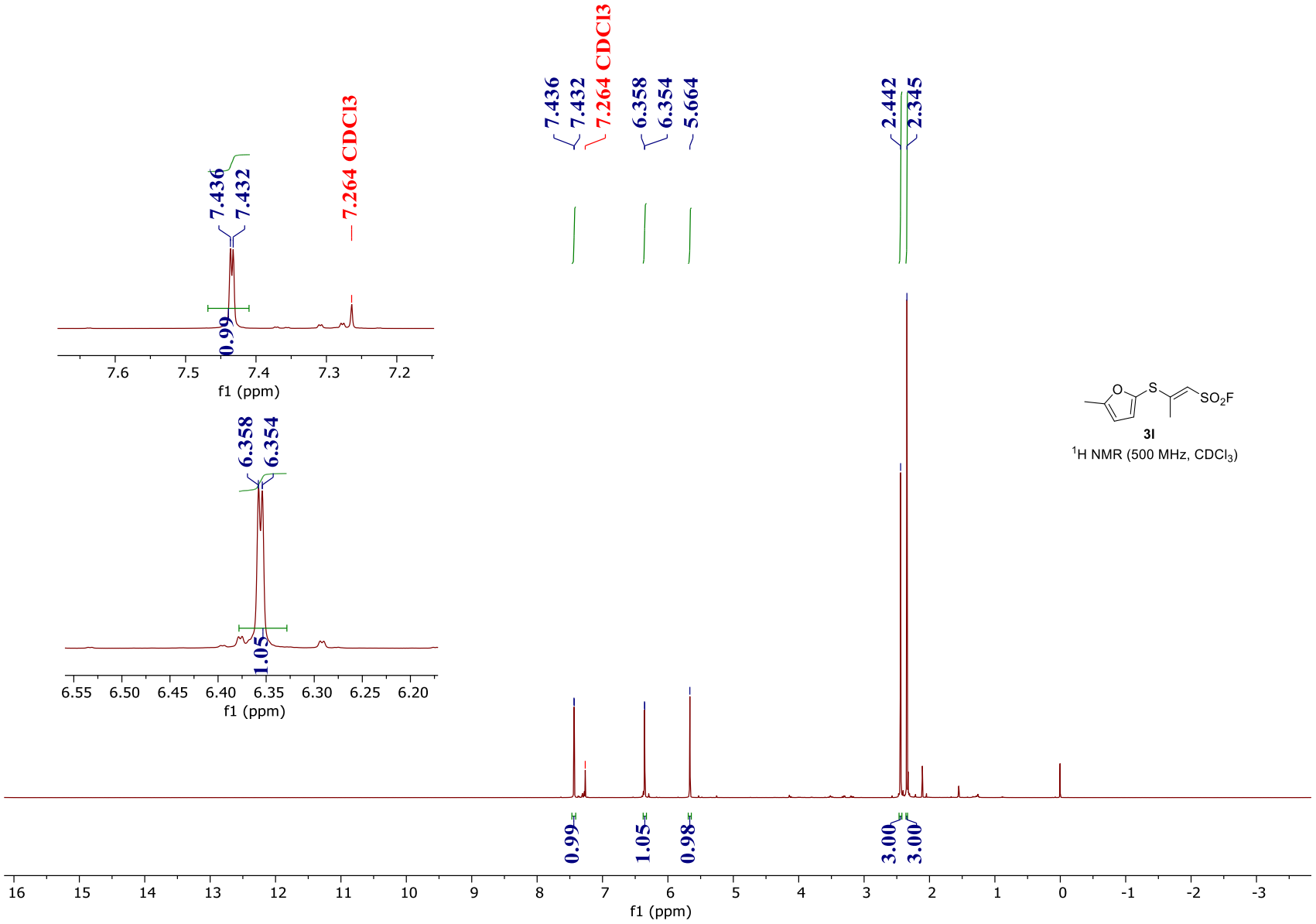

8.364
8.347
7.754
7.737
7.264 CDCl3
5.558
2.506
2.00
2.02
0.97
3.01
f1 (ppm)
O2N
S
SO2F
3k
1H NMR (500 MHz, CDCl3)

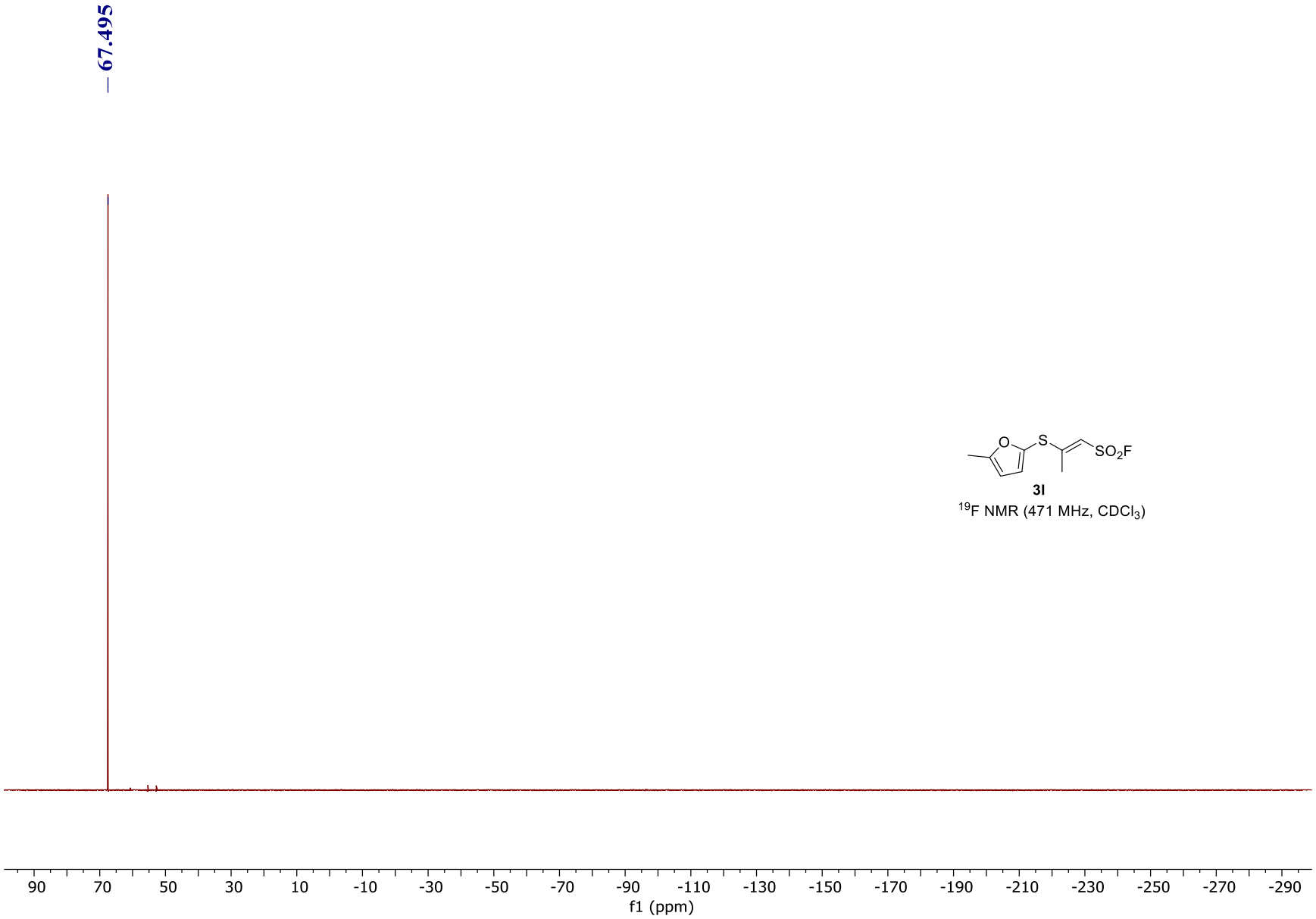


3k

^{19}F NMR (471 MHz, $CDCl_3$)

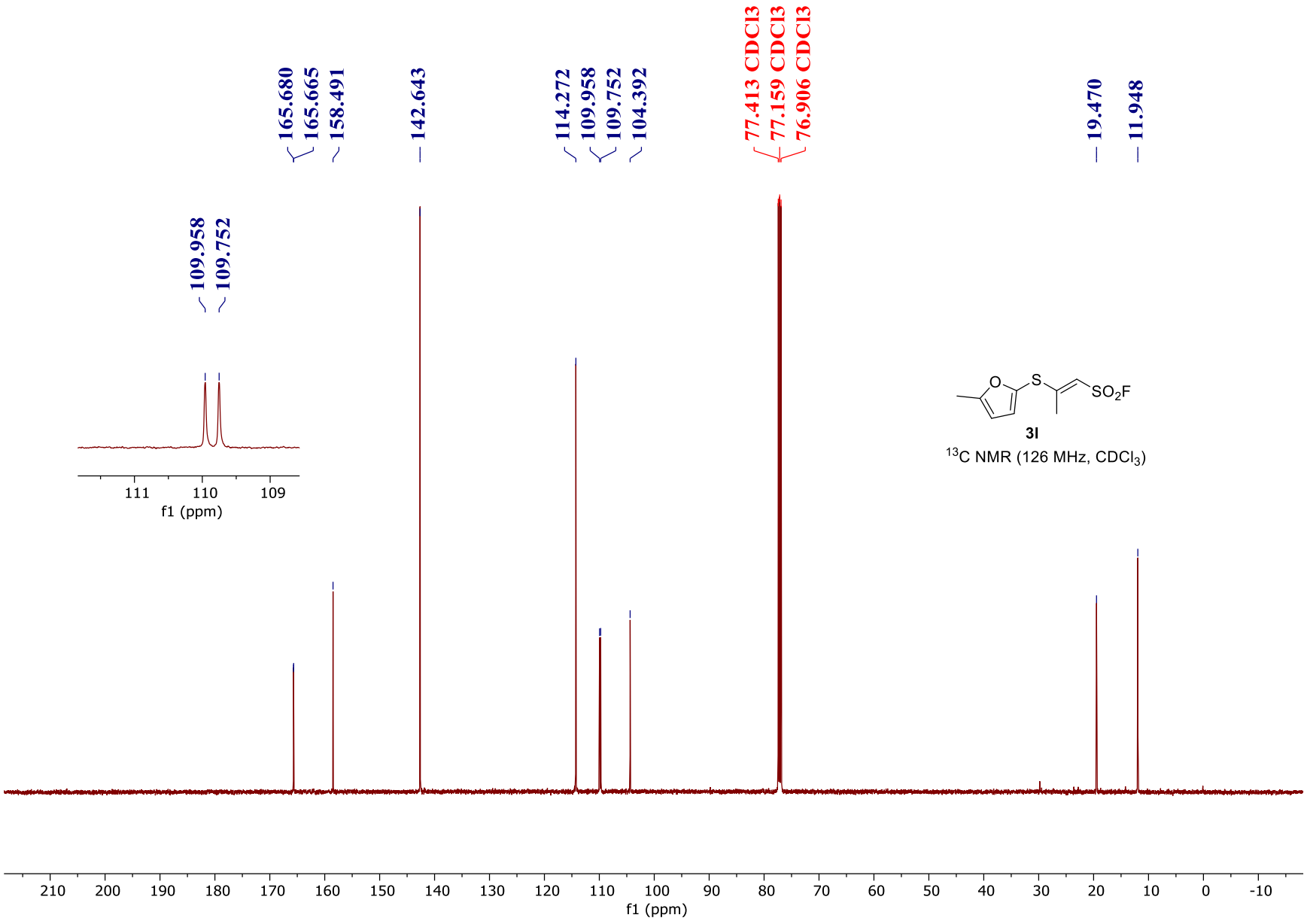

164.219
164.204
149.507
136.447
135.241
125.424
111.854
111.642
77.414 CDCl3
77.160 CDCl3
76.905 CDCl3
20.169
S
SO2F
O2N
3k
13C NMR (126 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

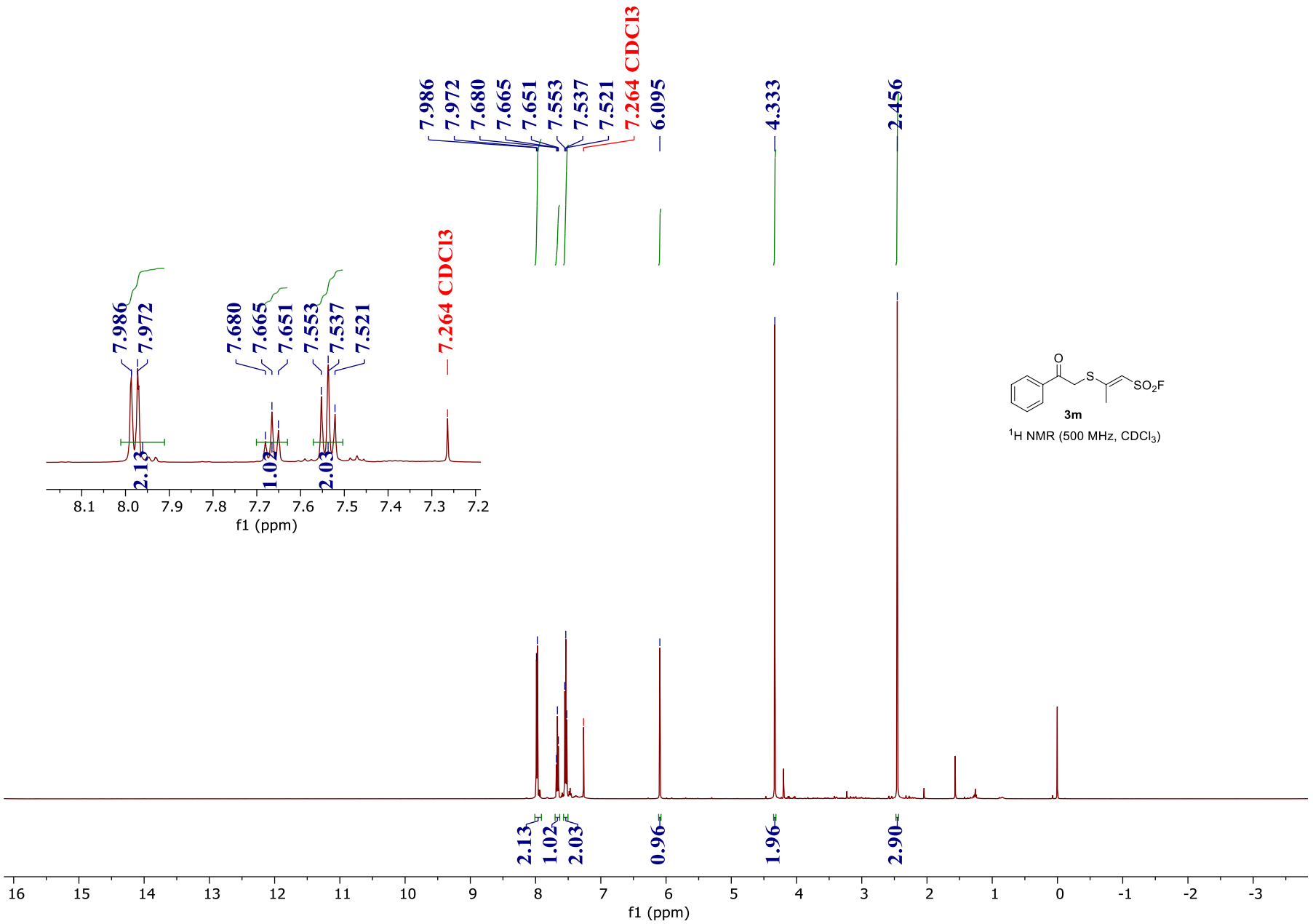

7.436
7.432
7.264 CDCl3
6.358
6.354
5.664
2.442
2.345
0.99
1.05
0.98
3.00
3.00
f1 (ppm)
O
S
SO2F
3l
1H NMR (500 MHz, CDCl3)

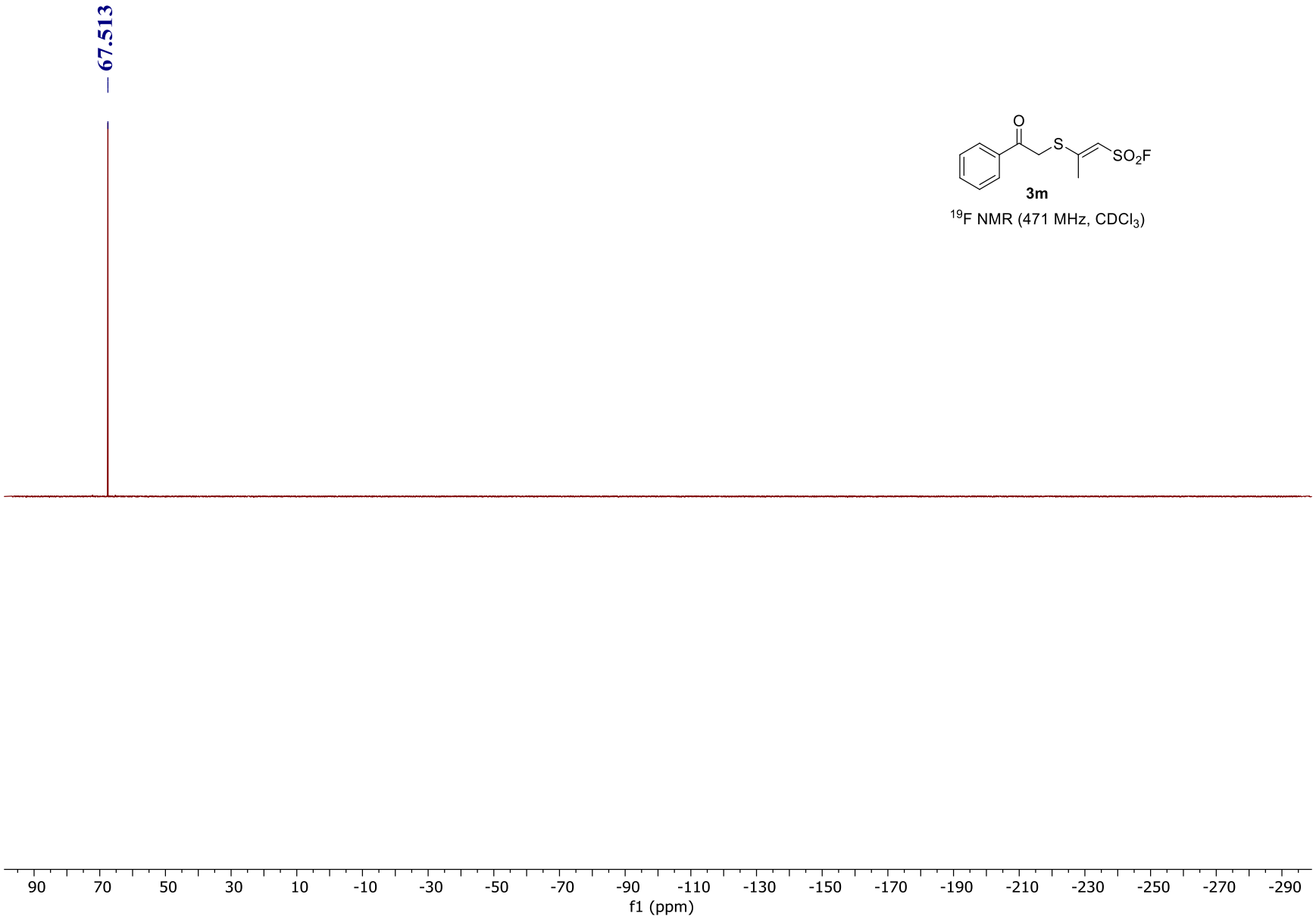


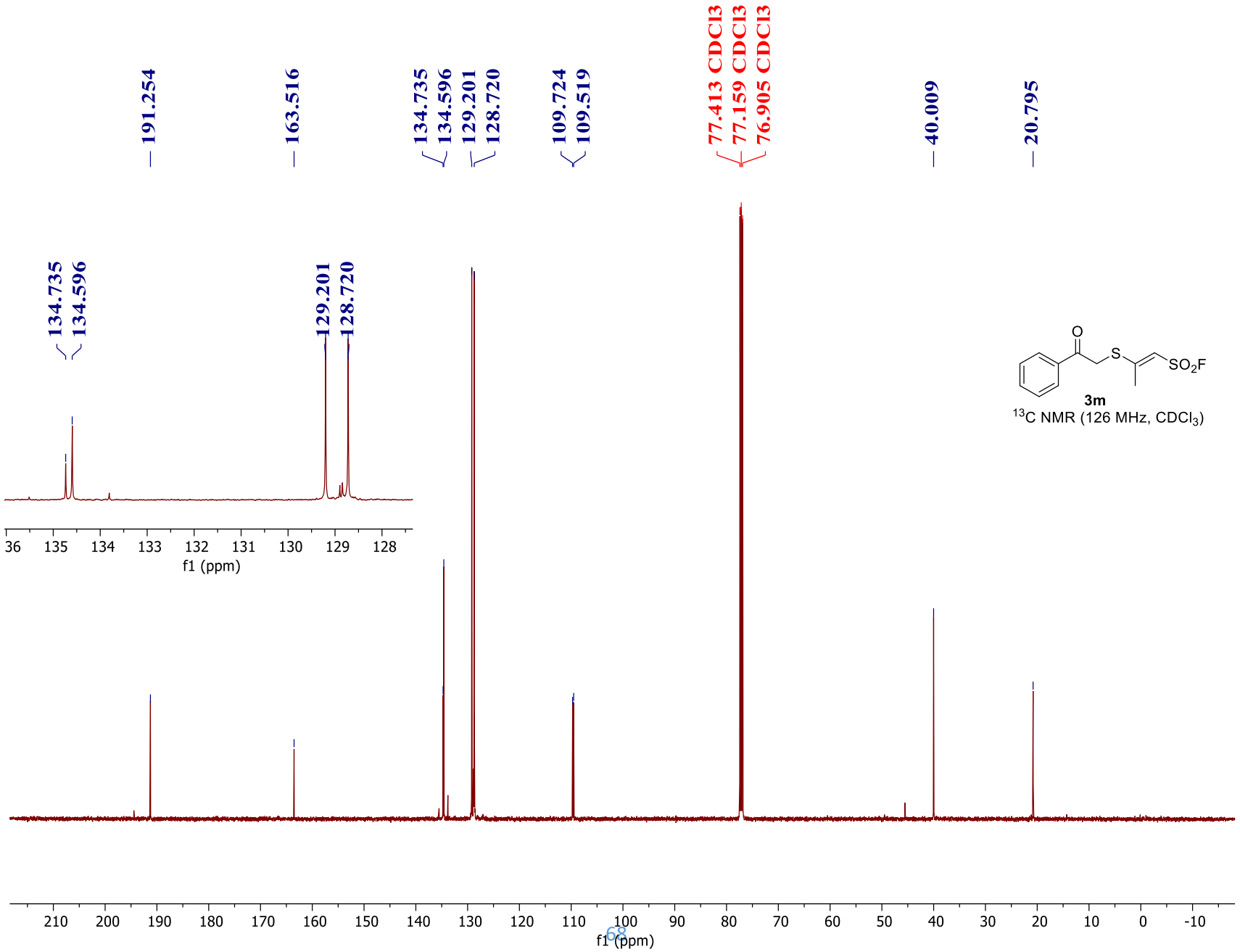
3l

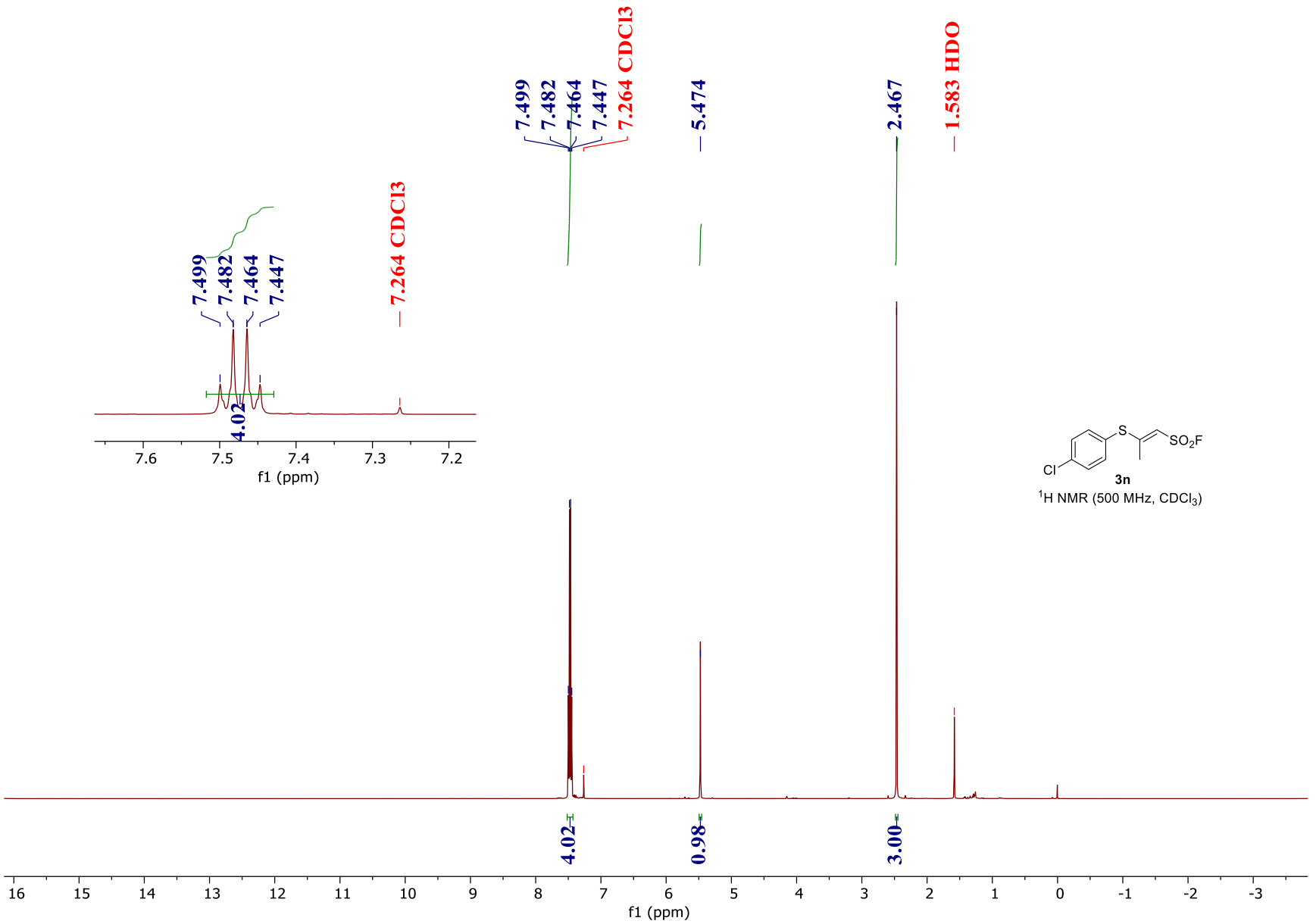
^{19}F NMR (471 MHz, $CDCl_3$)

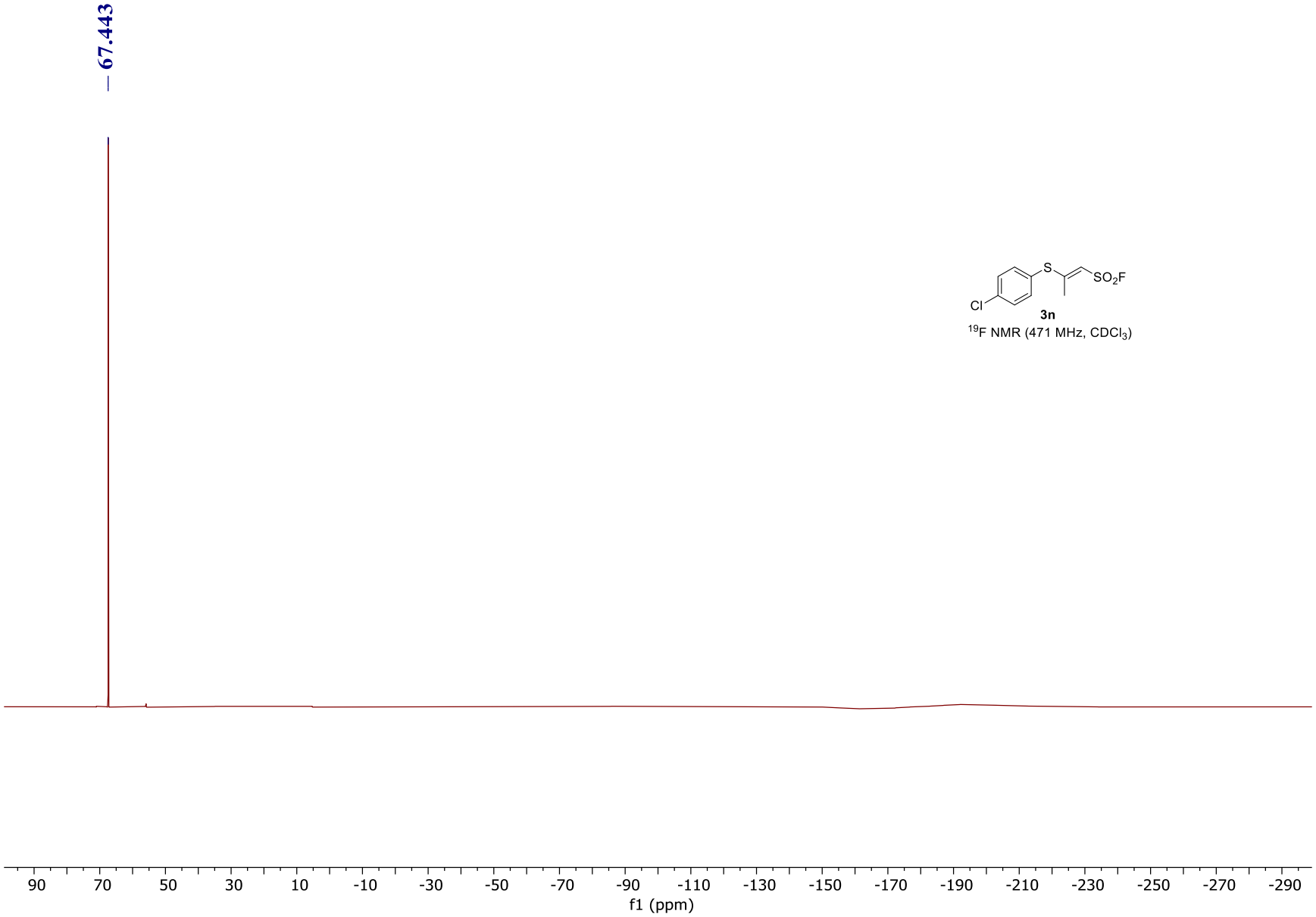

165.680
165.665
158.491
142.643
114.272
109.958
109.752
104.392
77.413 CDCl3
77.159 CDCl3
76.906 CDCl3
19.470
11.948
109.958
109.752
111
110
109
f1 (ppm)
O
S
SO2F
3l
13C NMR (126 MHz, CDCl3)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

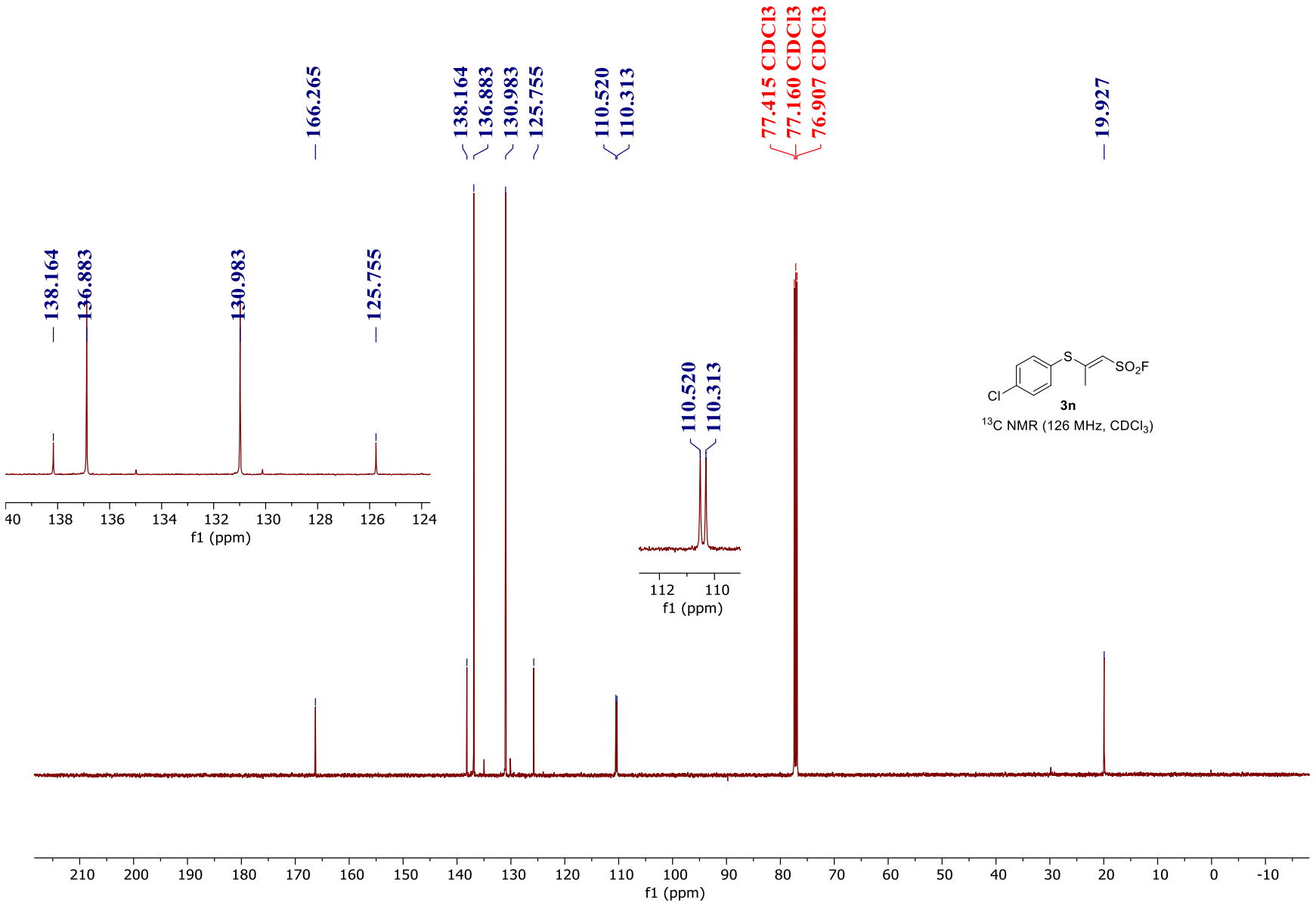

7.986
7.972
7.680
7.665
7.651
7.553
7.537
7.521
7.264 CDCl3
6.095
4.333
2.456
2.13
1.02
2.03
0.96
1.96
2.90
f1 (ppm)
O
S
SO2F
3m
1H NMR (500 MHz, CDCl3)

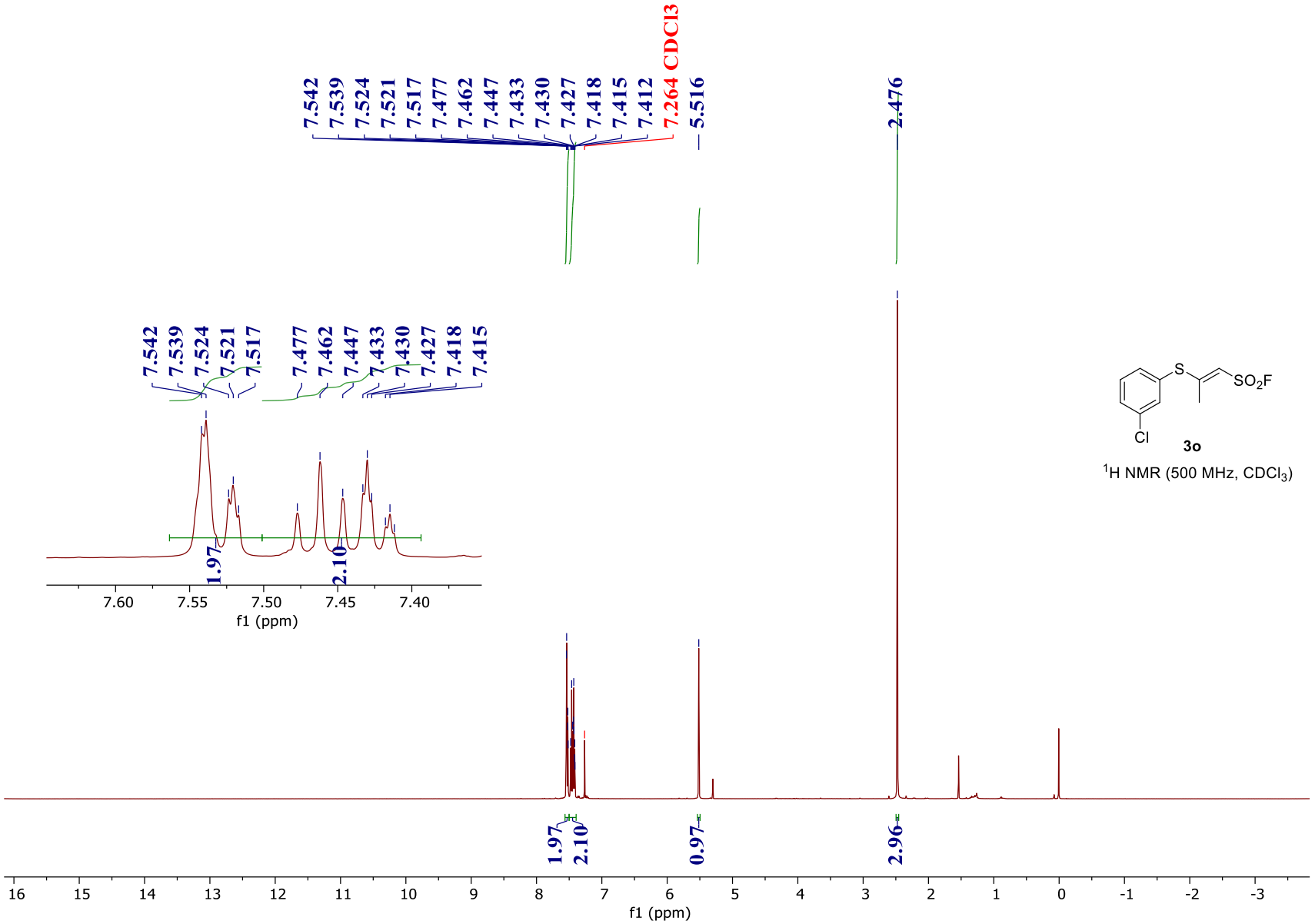

67.513
O
S
SO2F
3m
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

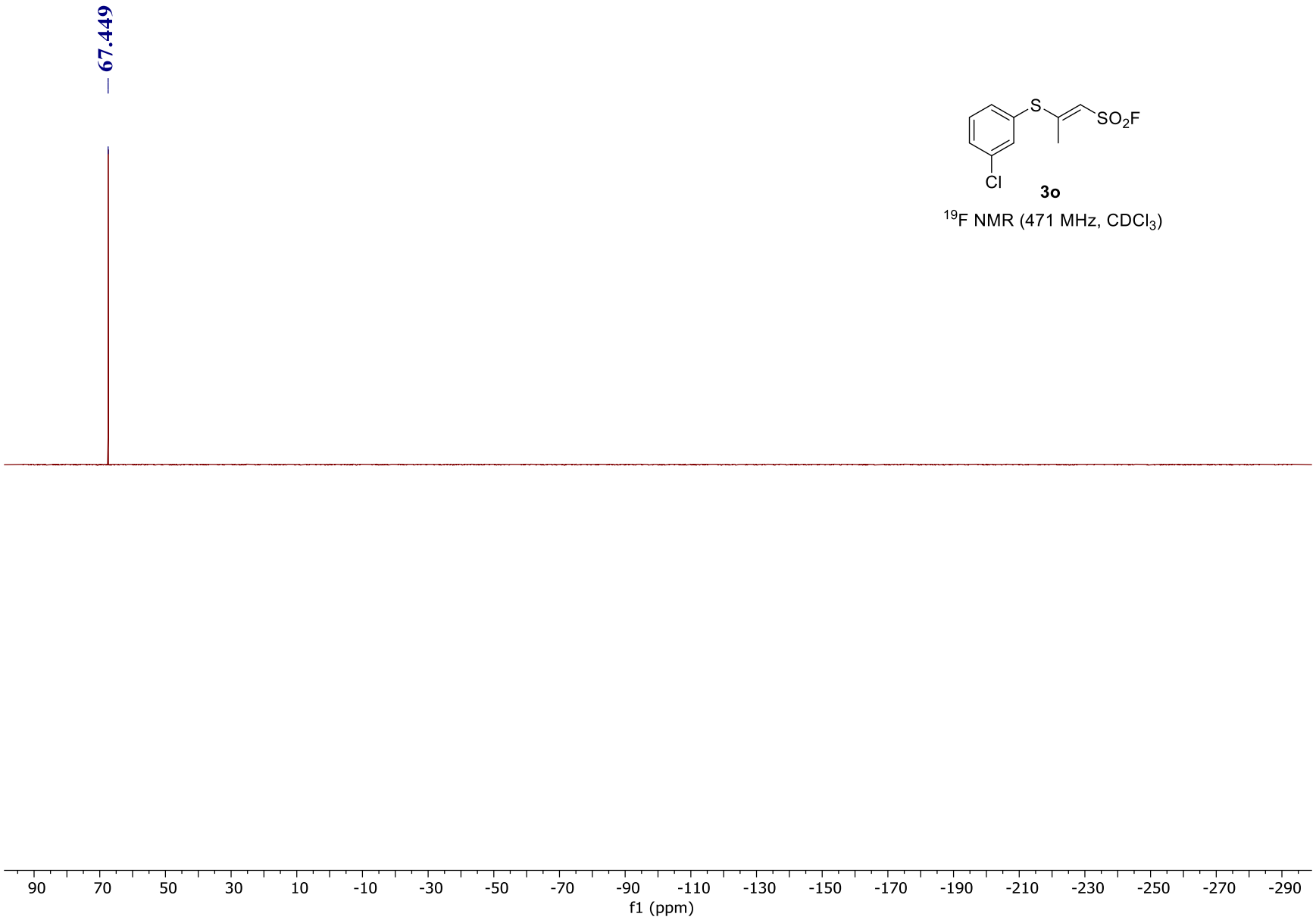

191.254
163.516
134.735
134.596
129.201
128.720
109.724
109.519
77.413 CDCl3
77.159 CDCl3
76.905 CDCl3
40.009
20.795
f1 (ppm)
O
S
SO2F
3m
13C NMR (126 MHz, CDCl3)

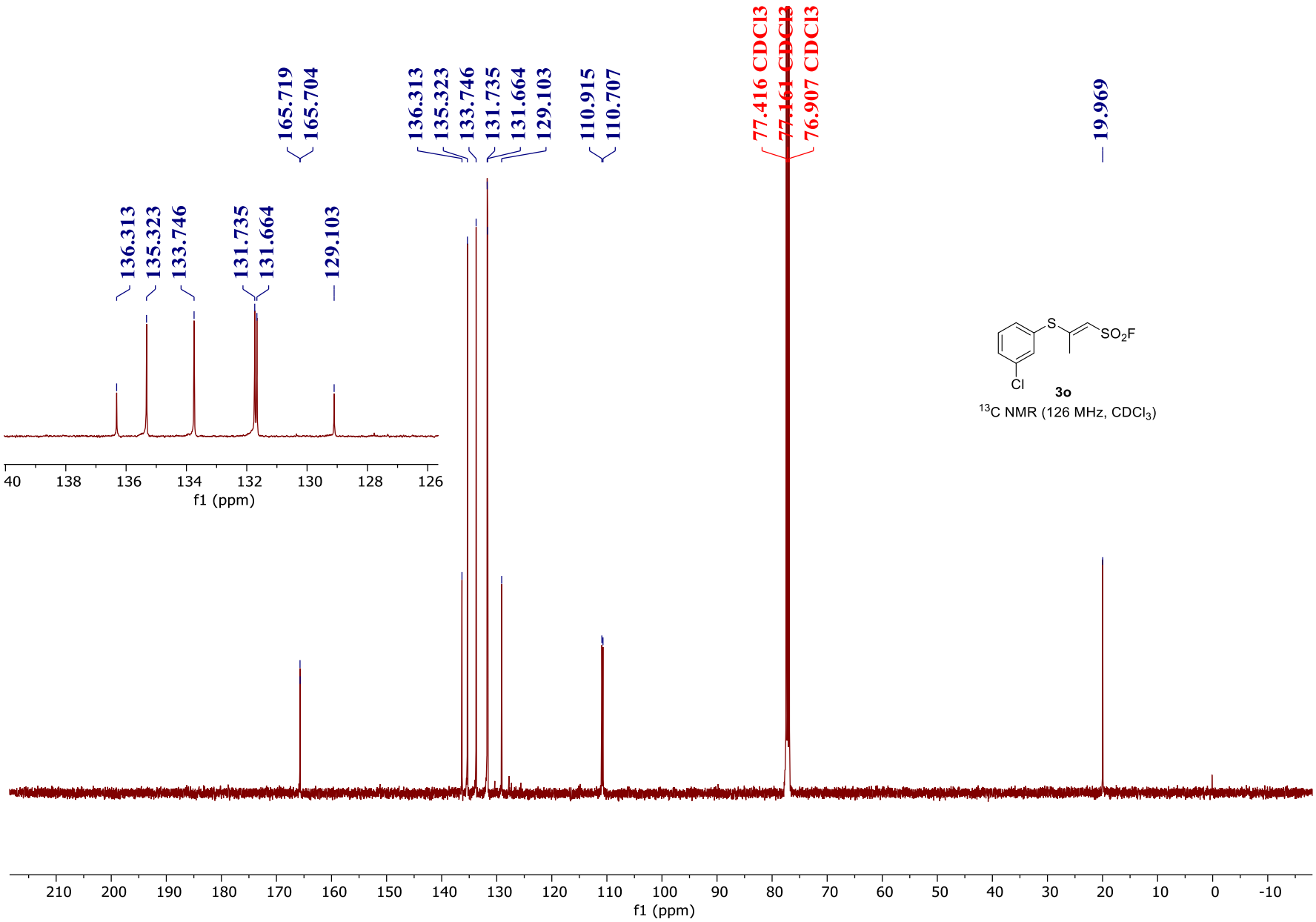

7.499
7.482
7.464
7.447
7.264 CDCl3
5.474
2.467
1.583 HDO
4.02
0.98
3.00
f1 (ppm)
3n
^{1}H NMR (500 MHz, CDCl$_3$)

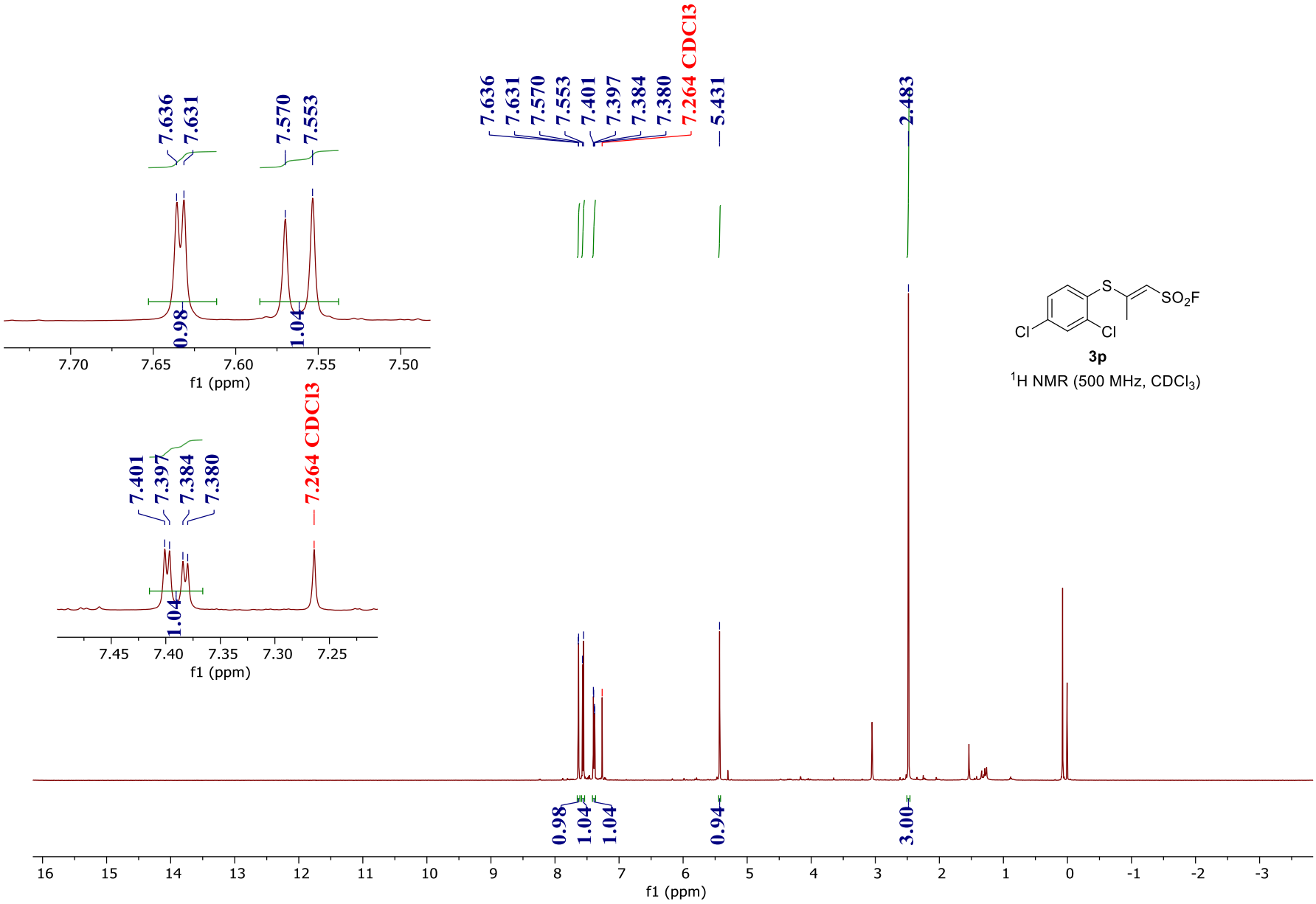

−67.443
S
SO2F
Cl
3n
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

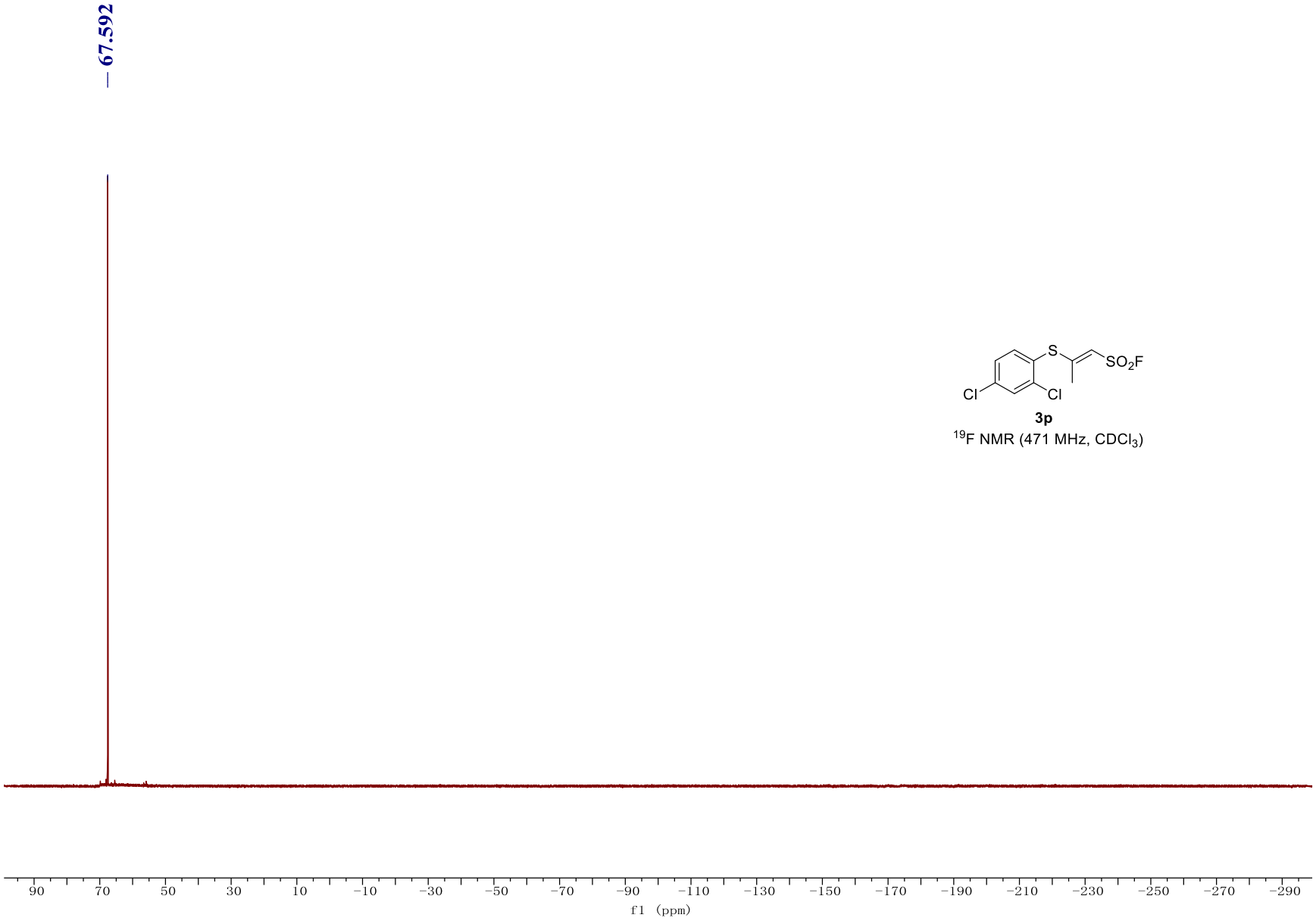

166.265
138.164
136.883
130.983
125.755
110.520
110.313
77.415 CDCl3
77.160 CDCl3
76.907 CDCl3
19.927
f1 (ppm)
S
SO2F
Cl
3n
13C NMR (126 MHz, CDCl3)


7.542
7.539
7.524
7.521
7.517
7.477
7.462
7.447
7.433
7.430
7.427
7.418
7.415
7.412
7.264 CDCl3
5.516
2.476
1.97
2.10
7.60
7.55
7.50
7.45
7.40
f1 (ppm)
0.97
2.96
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
f1 (ppm)
S
SO2F
Cl
3o
1H NMR (500 MHz, CDCl3)


− 67.449
S
SO2F
Cl
3o
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

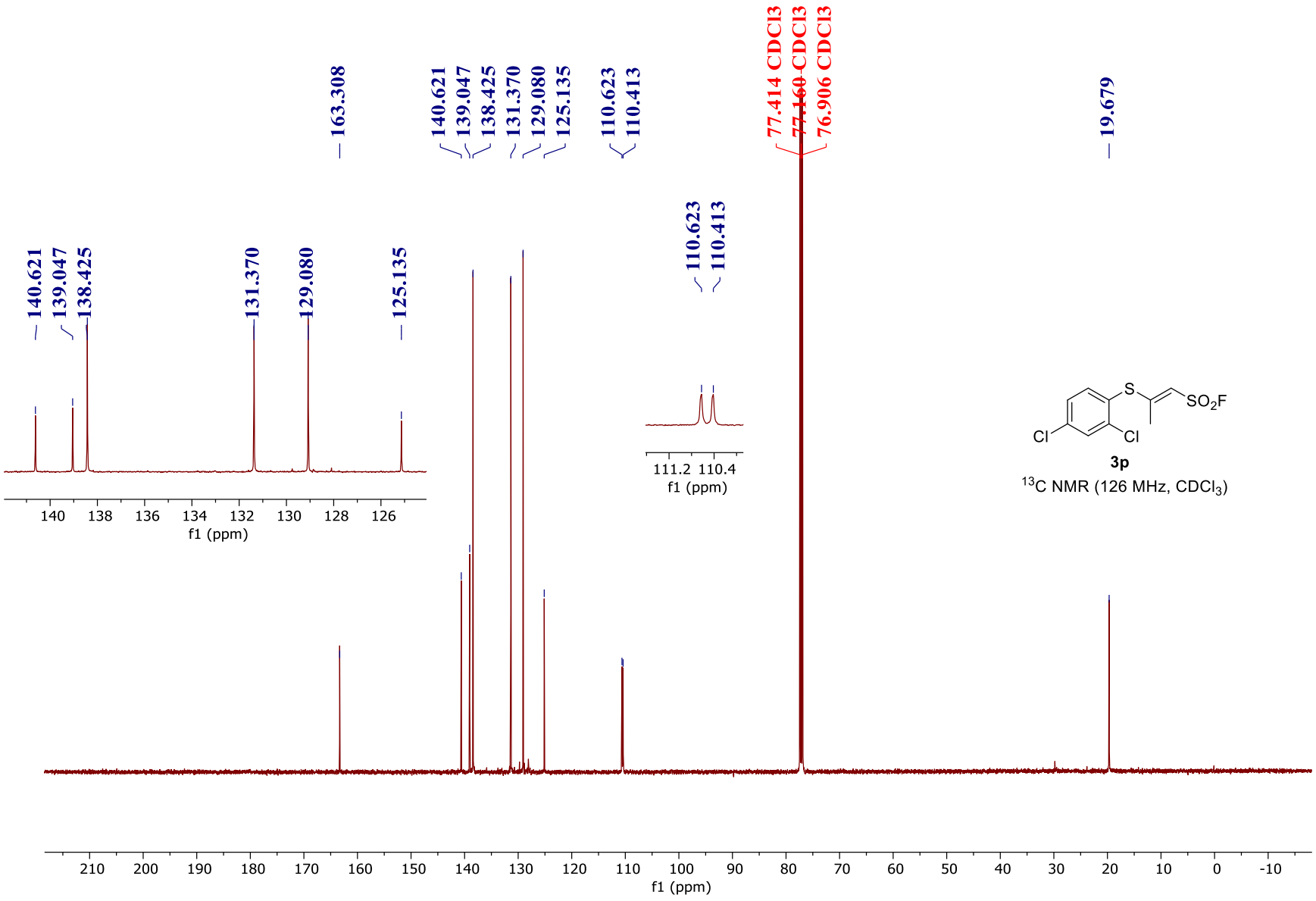

165.719
165.704
136.313
135.323
133.746
131.735
131.664
129.103
110.915
110.707
77.416 CDCl3
77.161 CDCl3
76.907 CDCl3
19.969
f1 (ppm)
S
SO2F
Cl
3o
13C NMR (126 MHz, CDCl3)

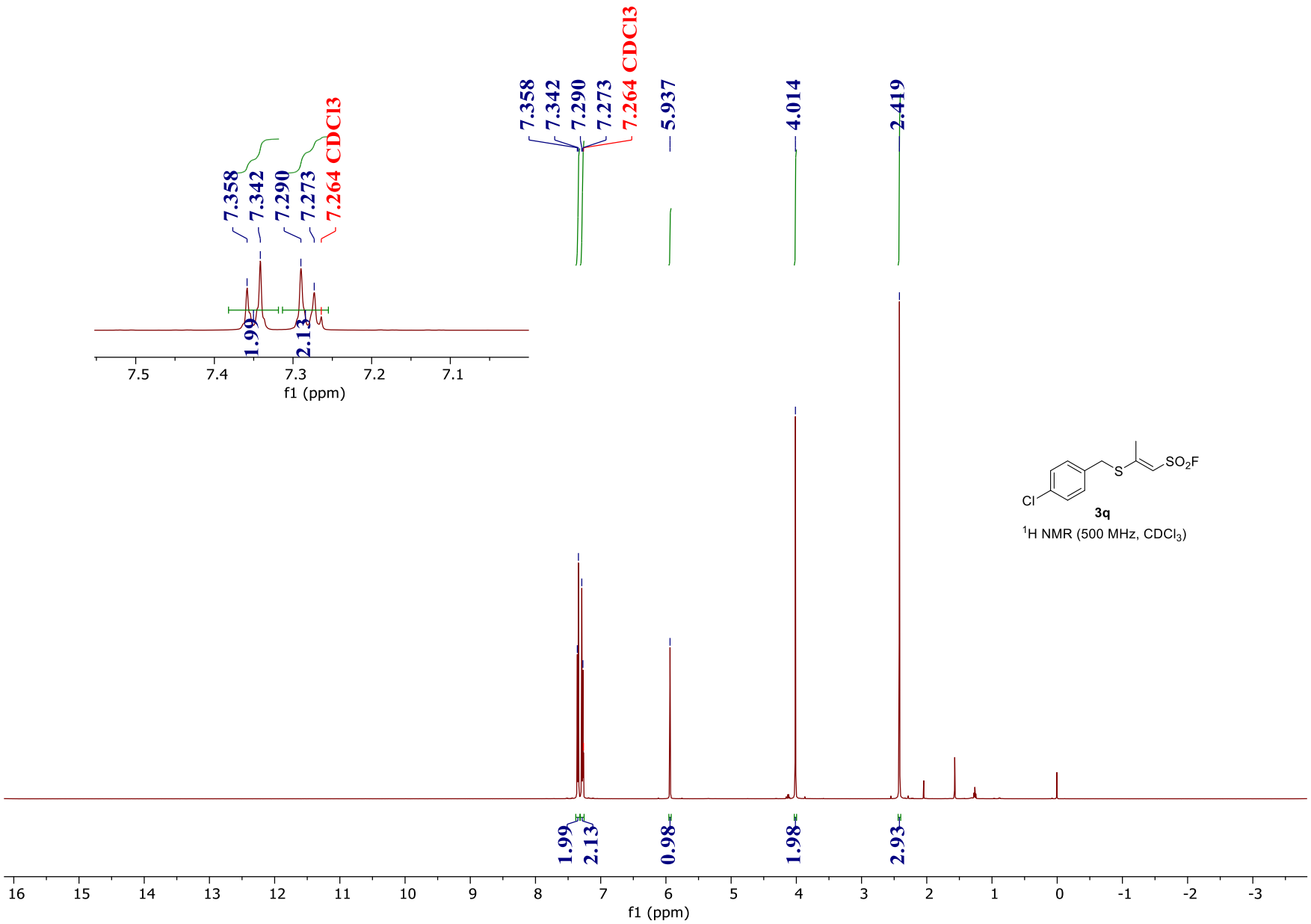

7.636
7.631
7.570
7.553
7.401
7.397
7.384
7.380
7.264 CDCl3
5.431
2.483
0.98
1.04
1.04
0.94
3.00
f1 (ppm)
S
SO2F
Cl
Cl
3p
1H NMR (500 MHz, CDCl3)

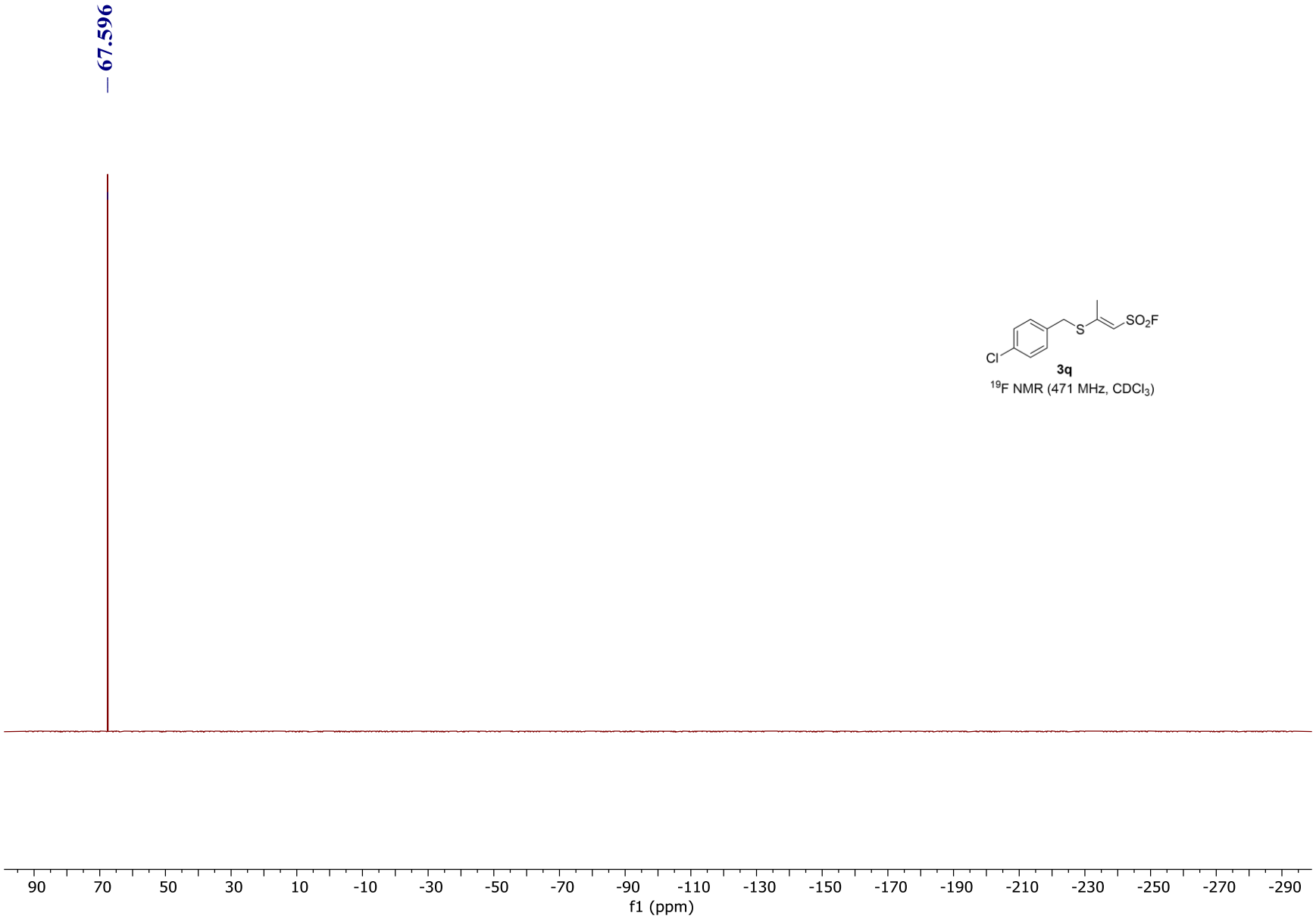


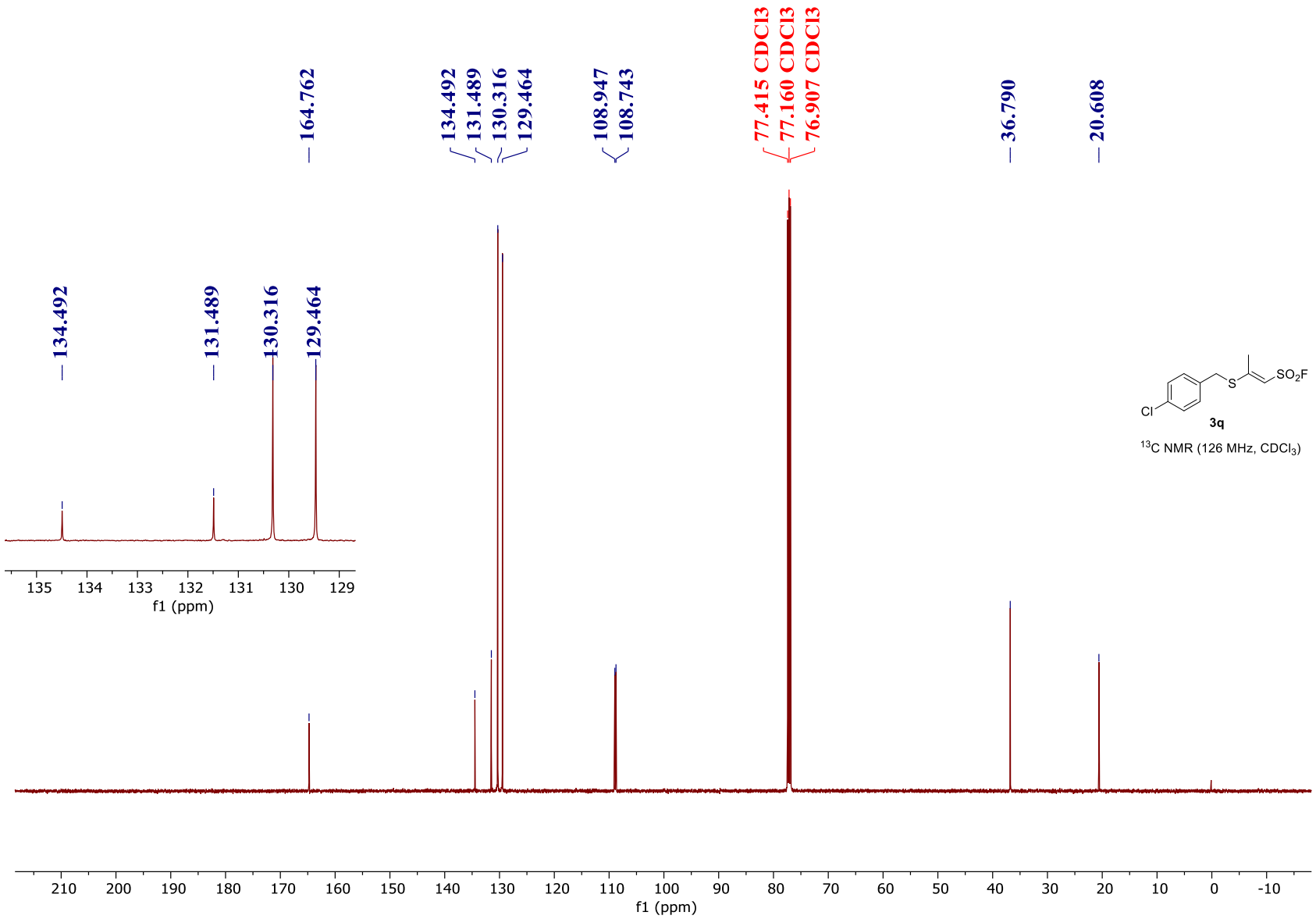
3p

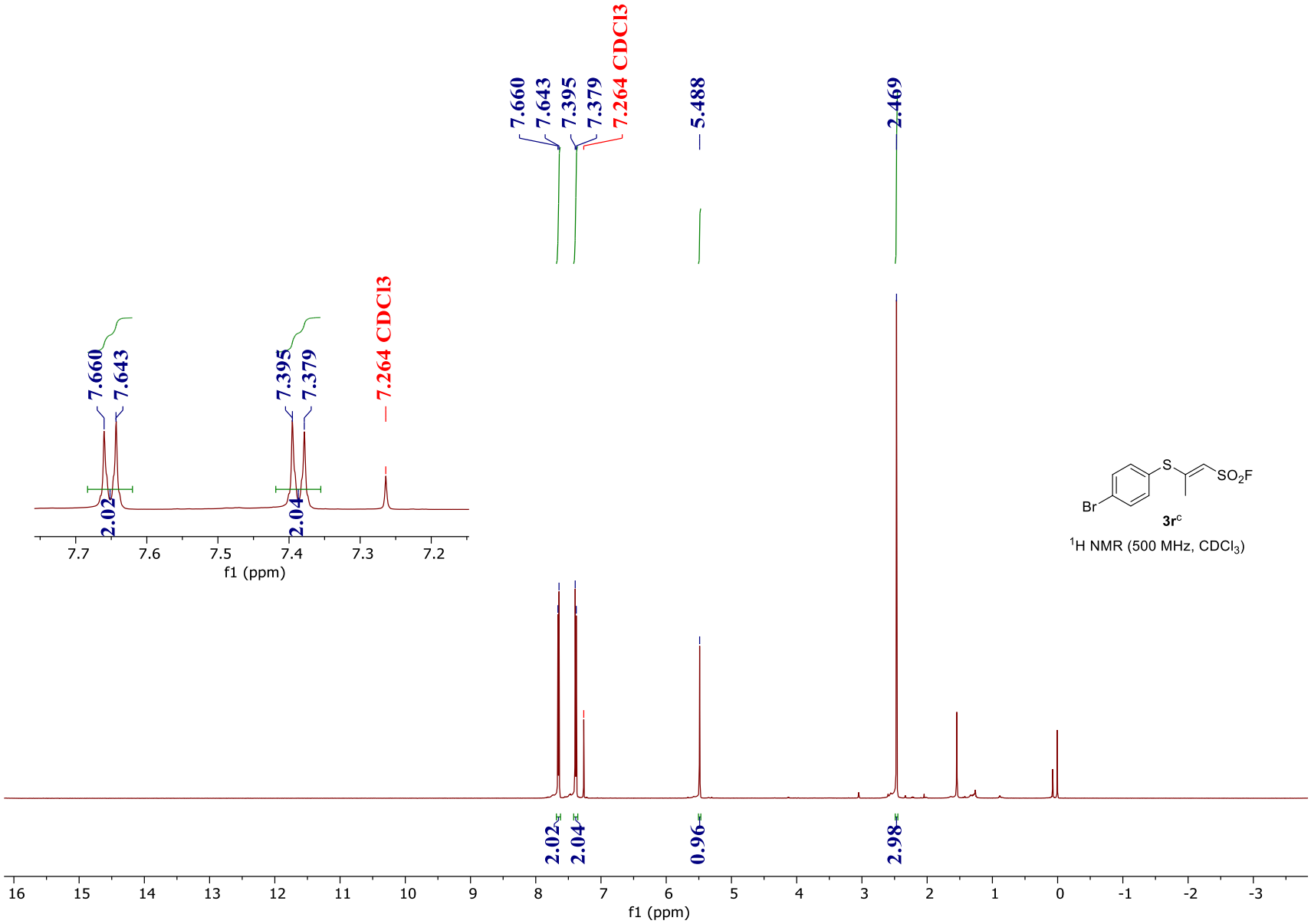
^{19}F NMR (471 MHz, $CDCl_3$)

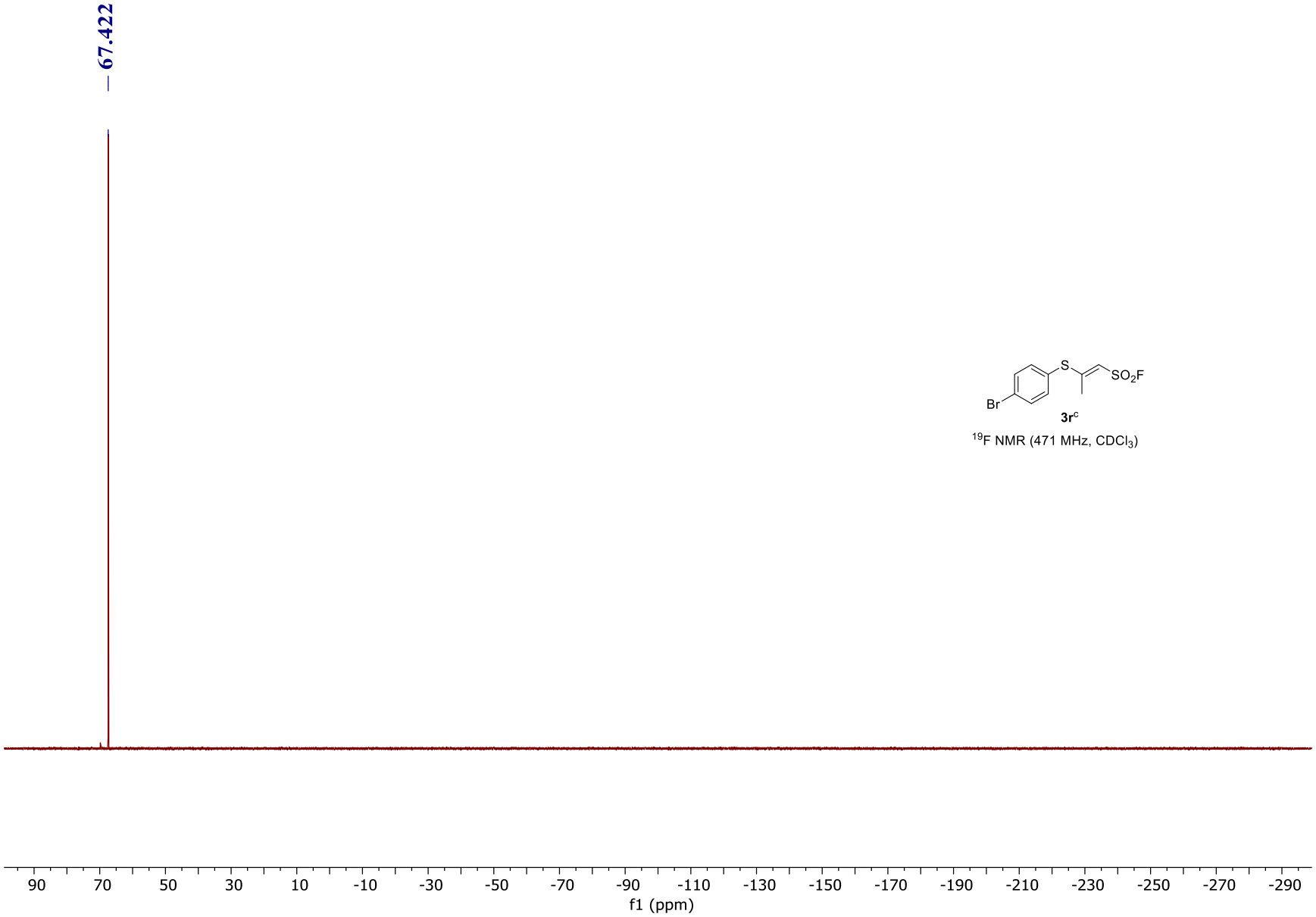

163.308
140.621
139.047
138.425
131.370
129.080
125.135
110.623
110.413
77.414 CDCl3
77.160 CDCl3
76.906 CDCl3
19.679
f1 (ppm)
111.2 110.4
f1 (ppm)
140 138 136 134 132 130 128 126
f1 (ppm)
S
SO2F
Cl
Cl
3p
13C NMR (126 MHz, CDCl3)

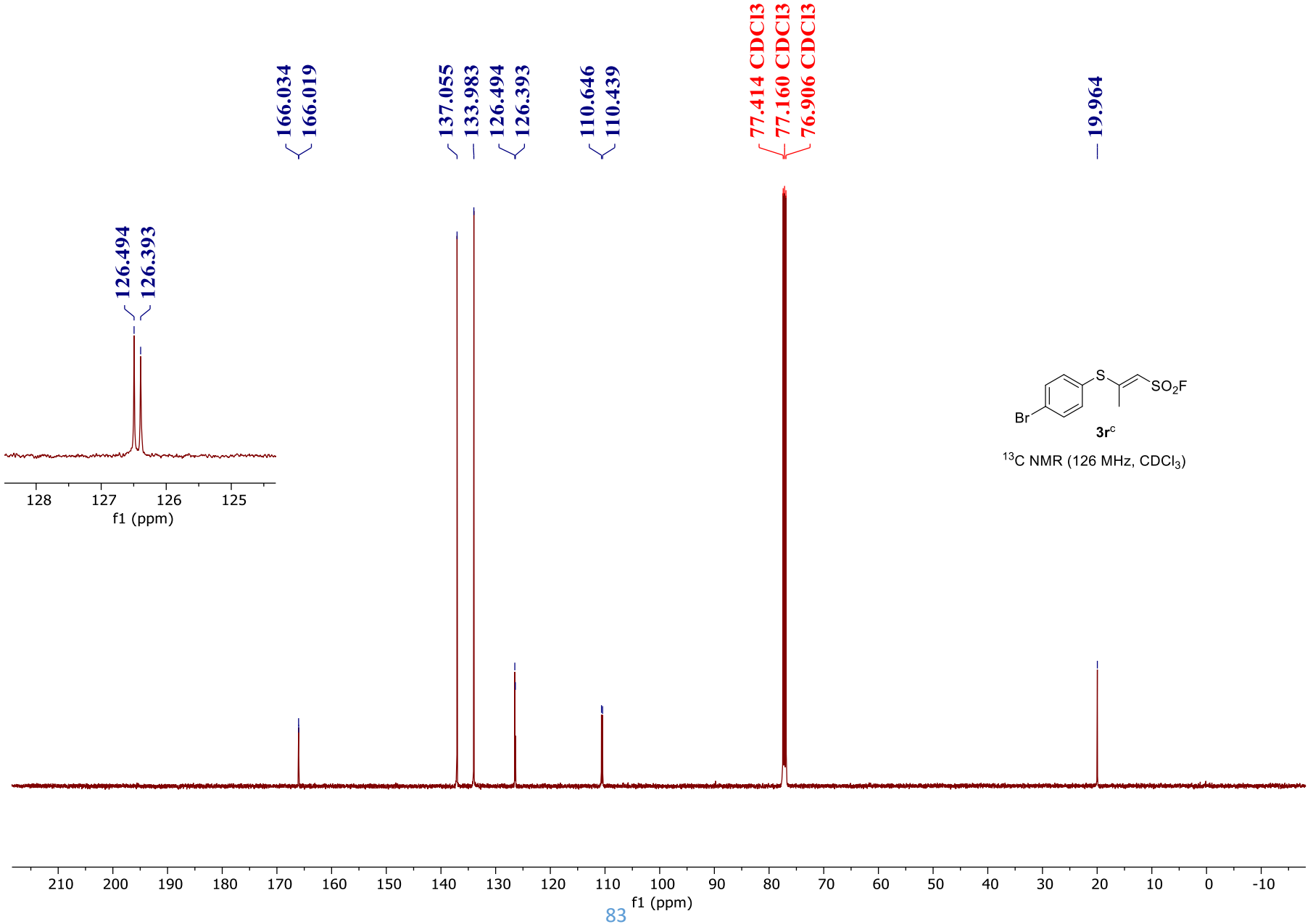

7.358
7.342
7.290
7.273
7.264 CDCl3
5.937
4.014
2.419
1.99
2.13
0.98
1.98
2.93
f1 (ppm)
Cl
S
SO2F
3q
1H NMR (500 MHz, CDCl3)

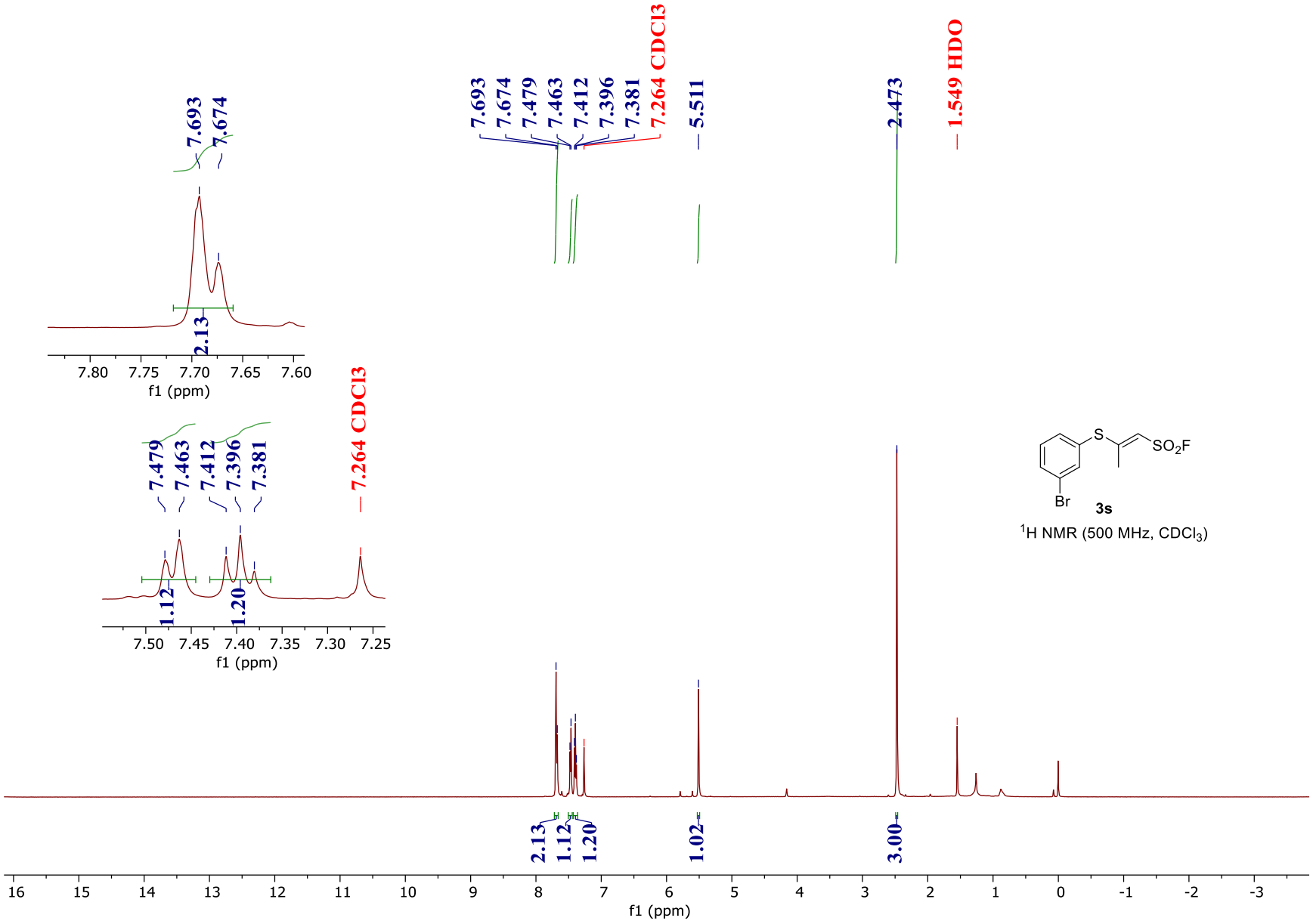

−67.596
Cl
S
SO2F
3q
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

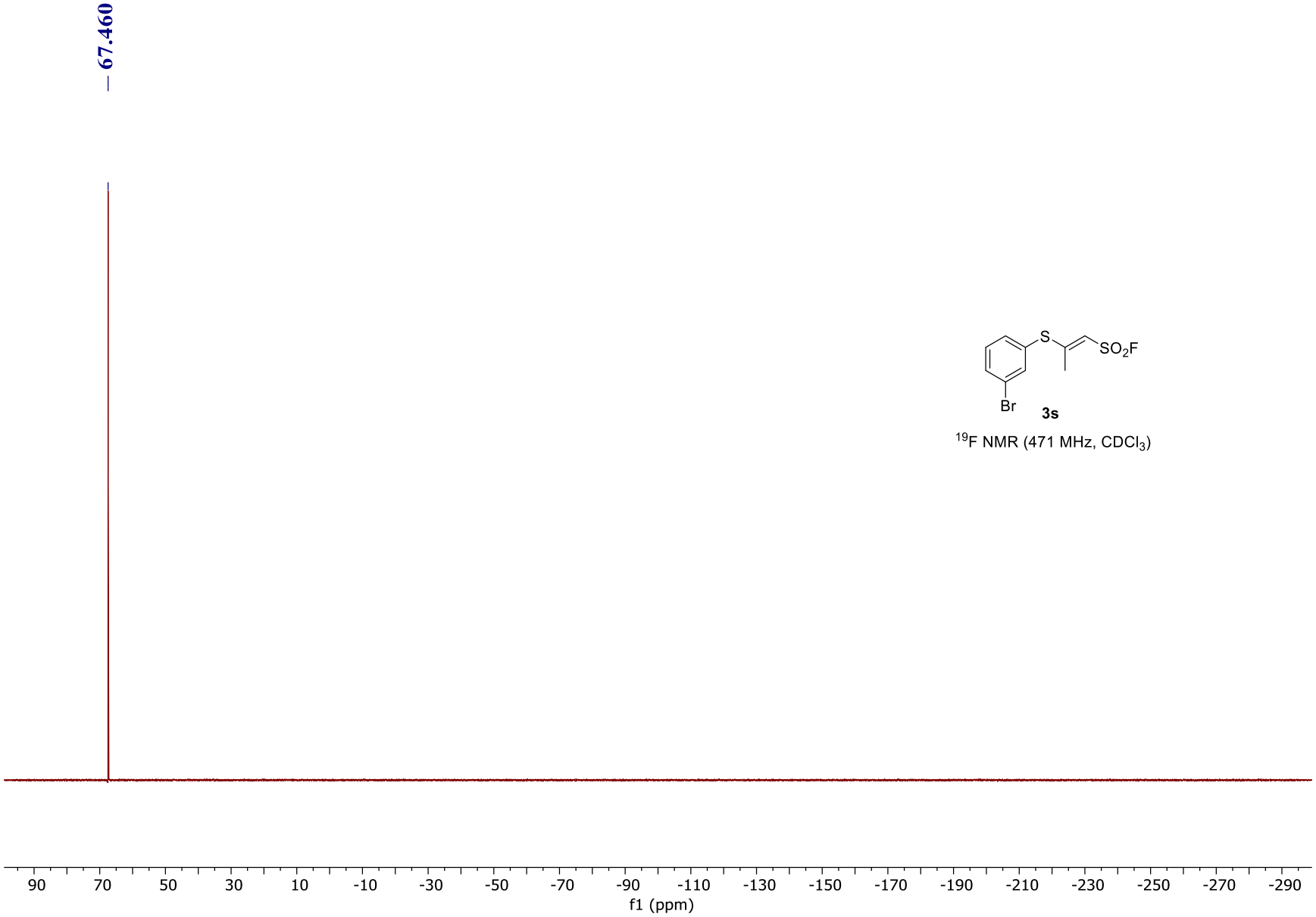

164.762
134.492
131.489
130.316
129.464
108.947
108.743
77.415 CDCl3
77.160 CDCl3
76.907 CDCl3
36.790
20.608
f1 (ppm)
SO2F
Cl
S
3q
13C NMR (126 MHz, CDCl3)

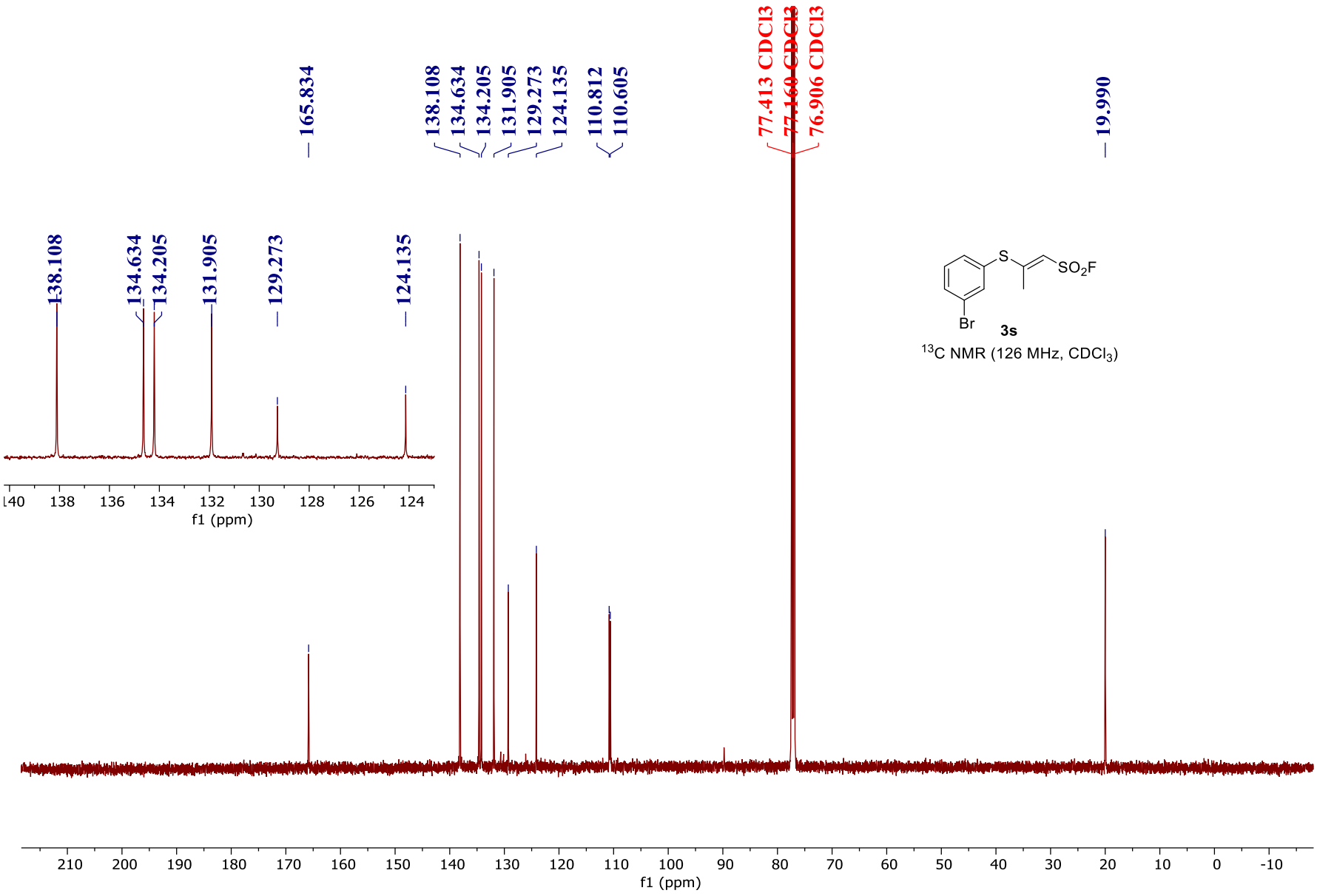

7.660
7.643
7.395
7.379
7.264 CDCl3
5.488
2.469
2.02
2.04
0.96
2.98
f1 (ppm)
Br
S
SO2F
3rc
1H NMR (500 MHz, CDCl3)

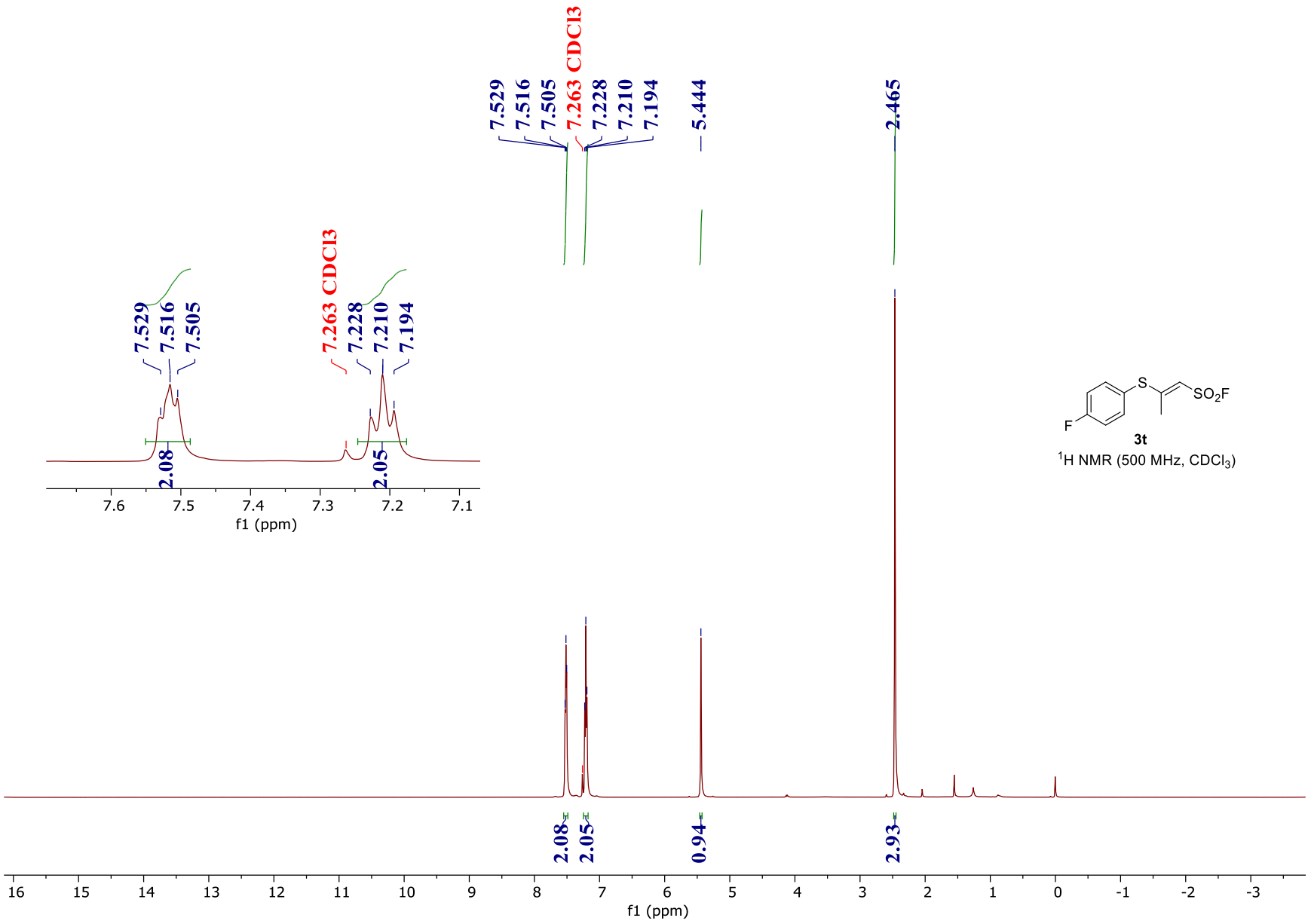

67.422
S
SO2F
Br
3rc
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

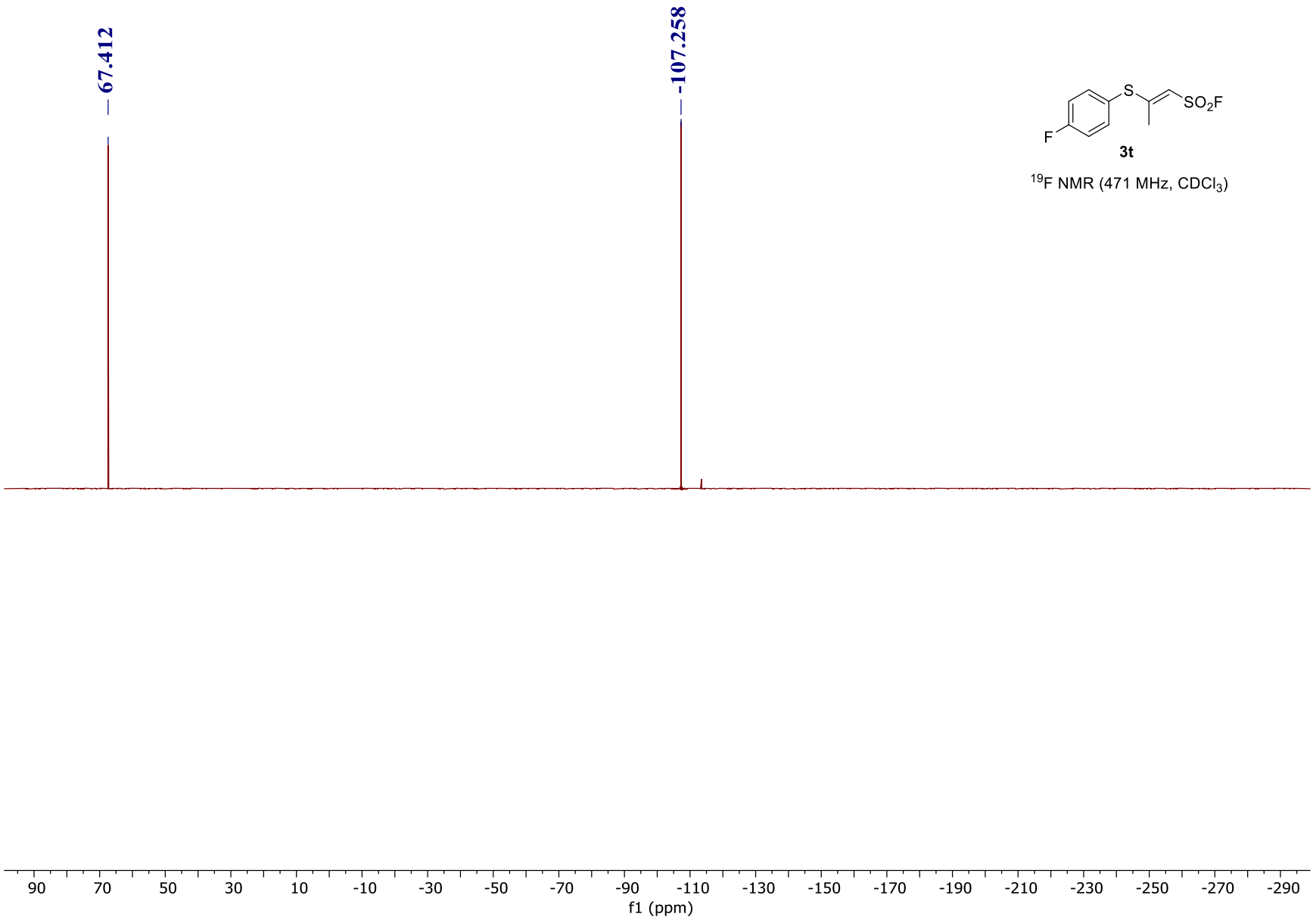

166.034
166.019
137.055
133.983
126.494
126.393
110.646
110.439
77.414 CDCl3
77.160 CDCl3
76.906 CDCl3
19.964
126.494
126.393
128
127
126
125
f1 (ppm)
Br
S
SO2F
3rc
13C NMR (126 MHz, CDCl3)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

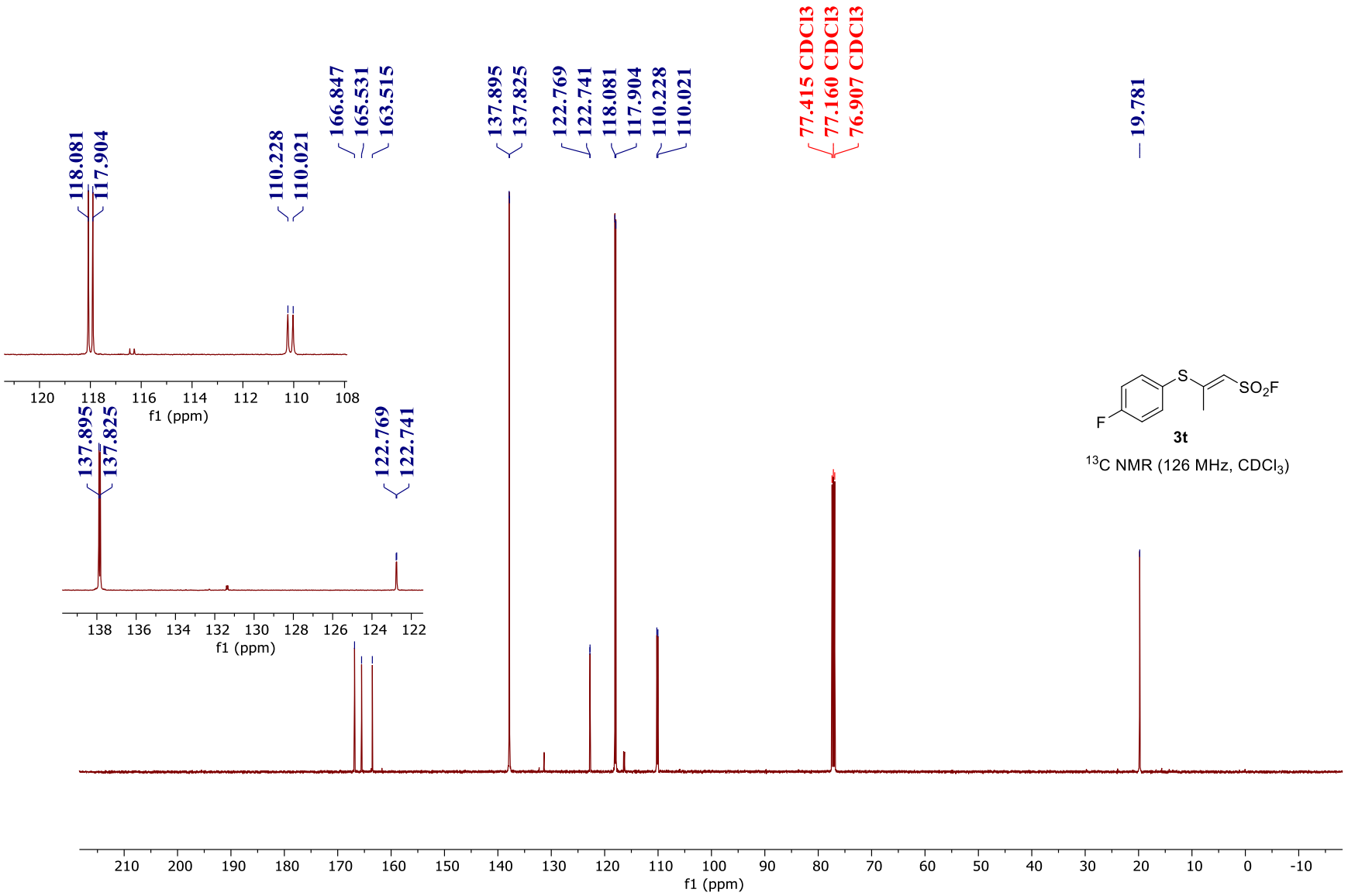

7.693
7.674
7.479
7.463
7.412
7.396
7.381
7.264 CDCl3
5.511
2.473
1.549 HDO
2.13
1.12
1.20
1.02
3.00
f1 (ppm)
SO2F
Br
3s
1H NMR (500 MHz, CDCl3)

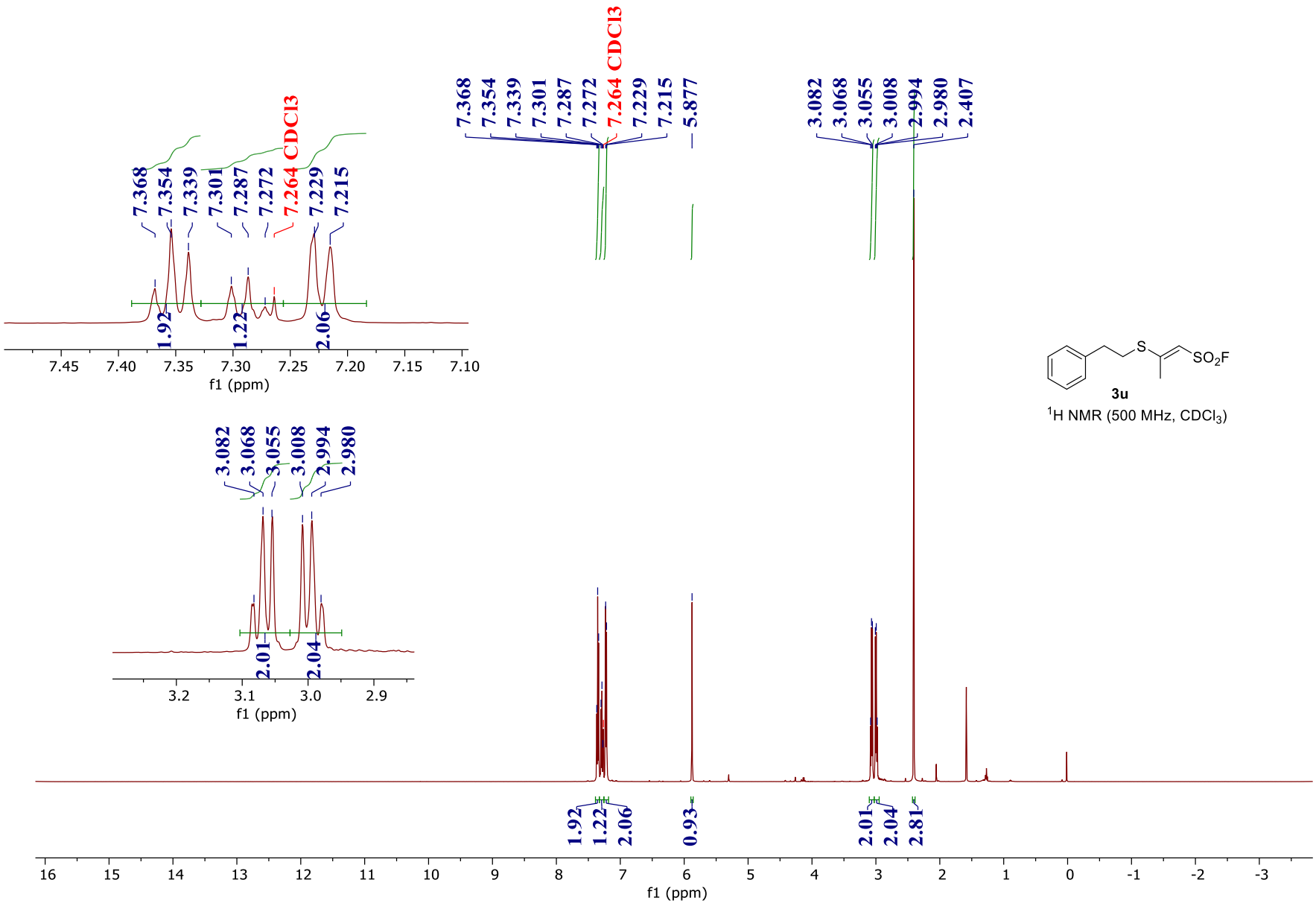

−67.460
S
SO2F
Br
3s
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

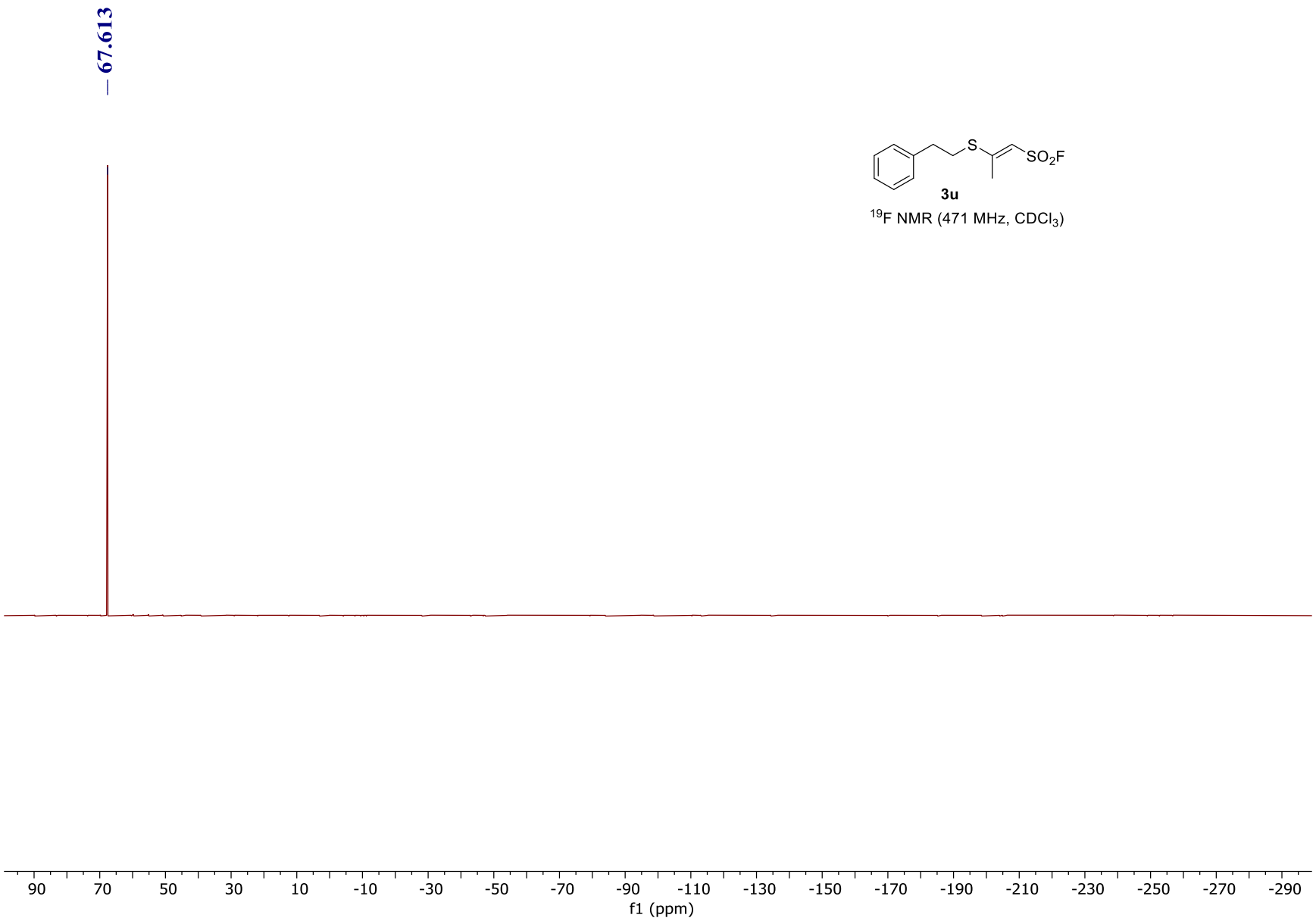

165.834
138.108
134.634
134.205
131.905
129.273
124.135
110.812
110.605
77.413 CDCl3
77.160 CDCl3
76.906 CDCl3
19.990
S
SO2F
Br
3s
13C NMR (126 MHz, CDCl3)
f1 (ppm)

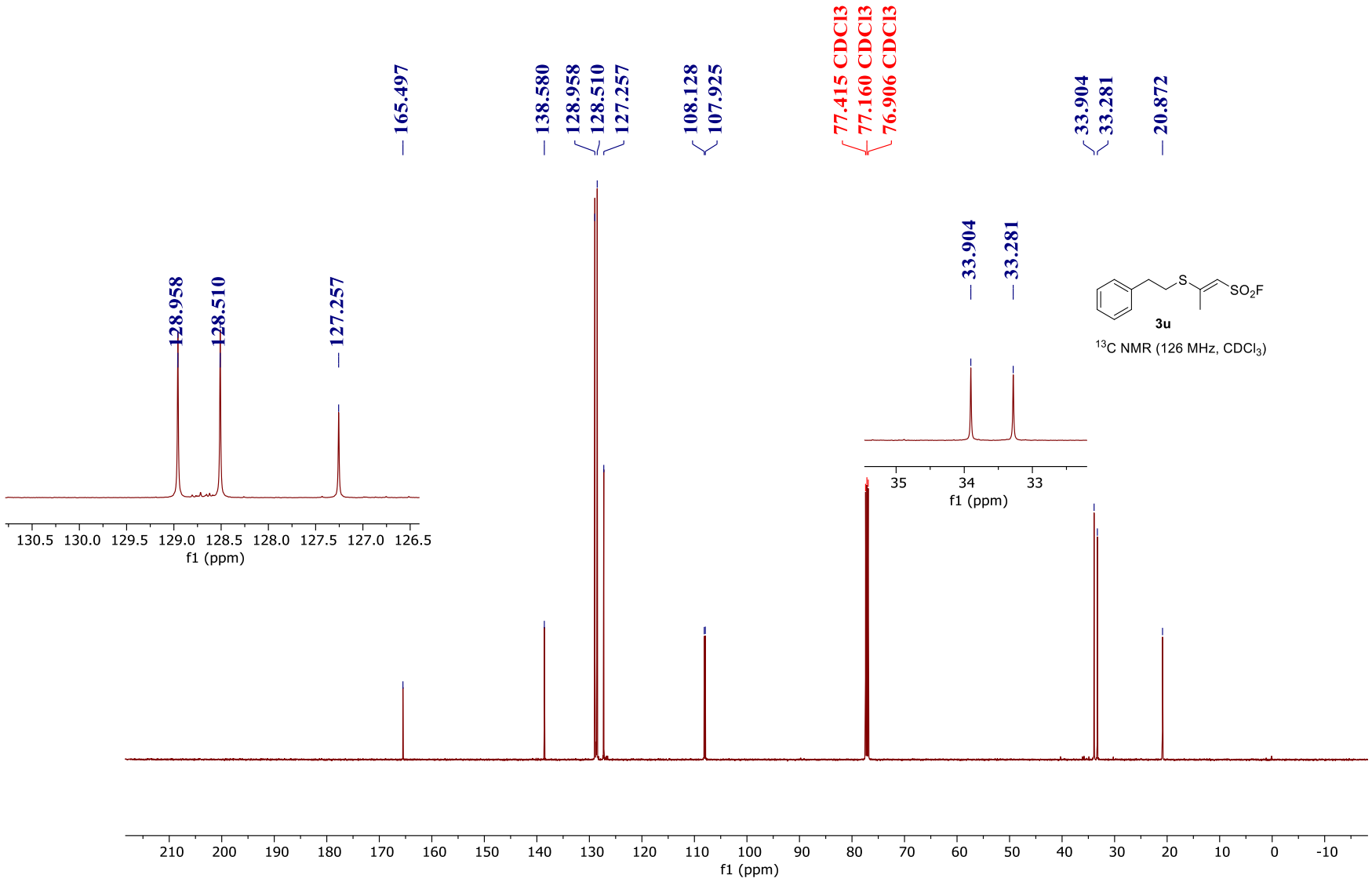

7.529
7.516
7.505
7.263 CDCl3
7.228
7.210
7.194
5.444
2.465
2.08
2.05
0.94
2.93
f1 (ppm)
F
S
SO2F
3t
1H NMR (500 MHz, CDCl3)

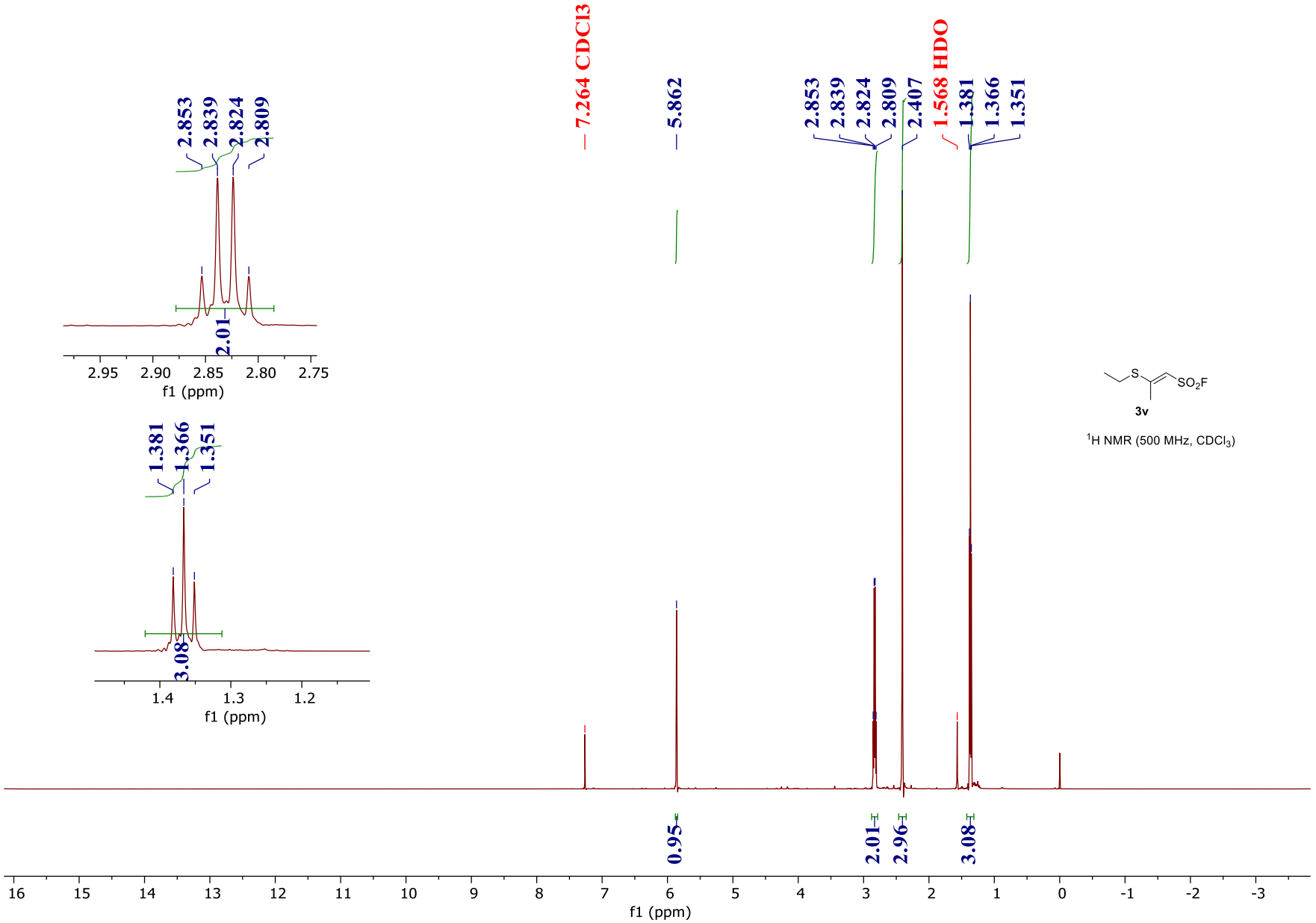

67.412
-107.258
S
SO2F
F
3t
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

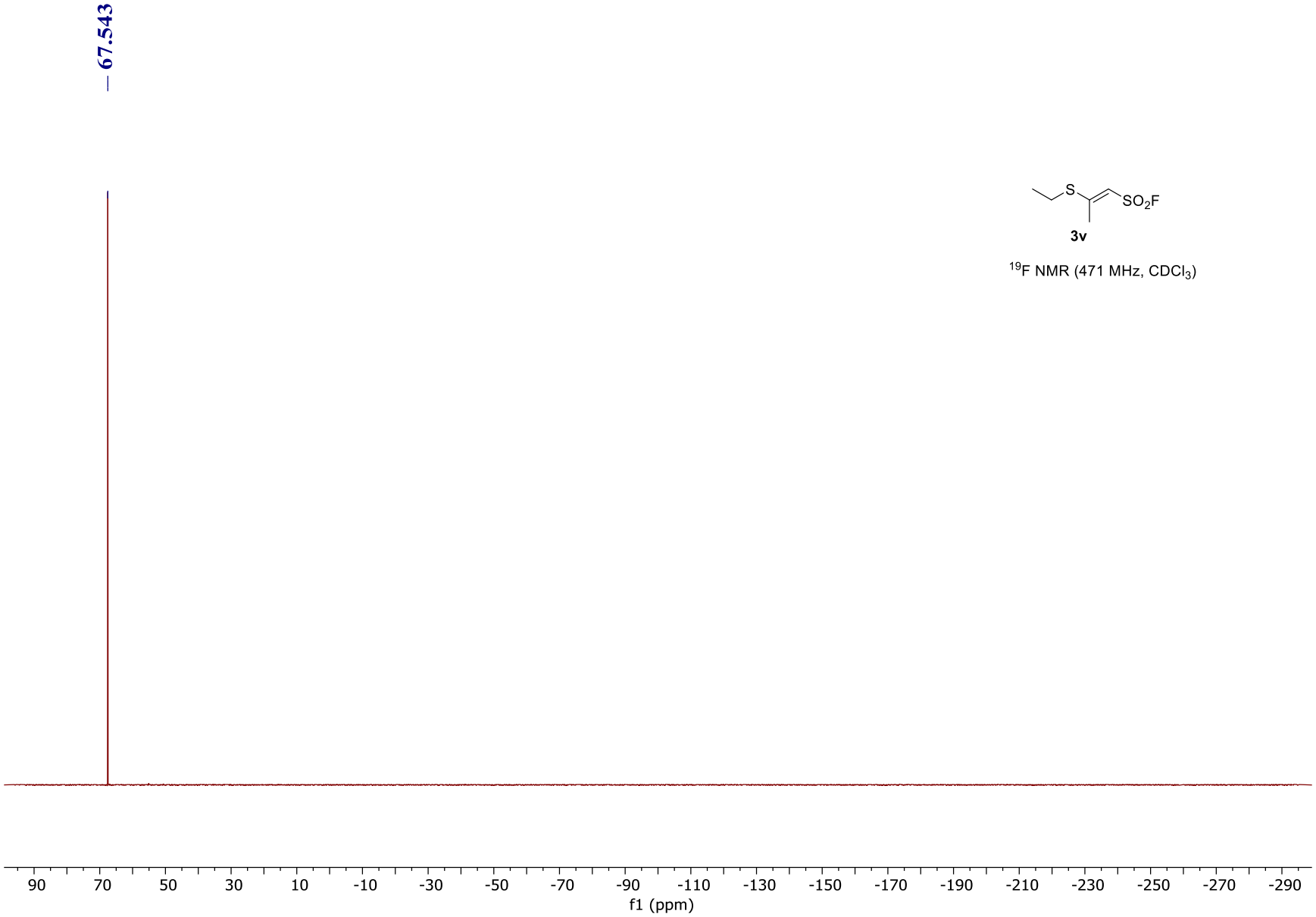

118.081
117.904
110.228
110.021
166.847
165.531
163.515
137.895
137.825
122.769
122.741
118.081
117.904
110.228
110.021
77.415 CDCl3
77.160 CDCl3
76.907 CDCl3
19.781
f1 (ppm)
f1 (ppm)
f1 (ppm)
S
SO2F
F
3t
13C NMR (126 MHz, CDCl3)

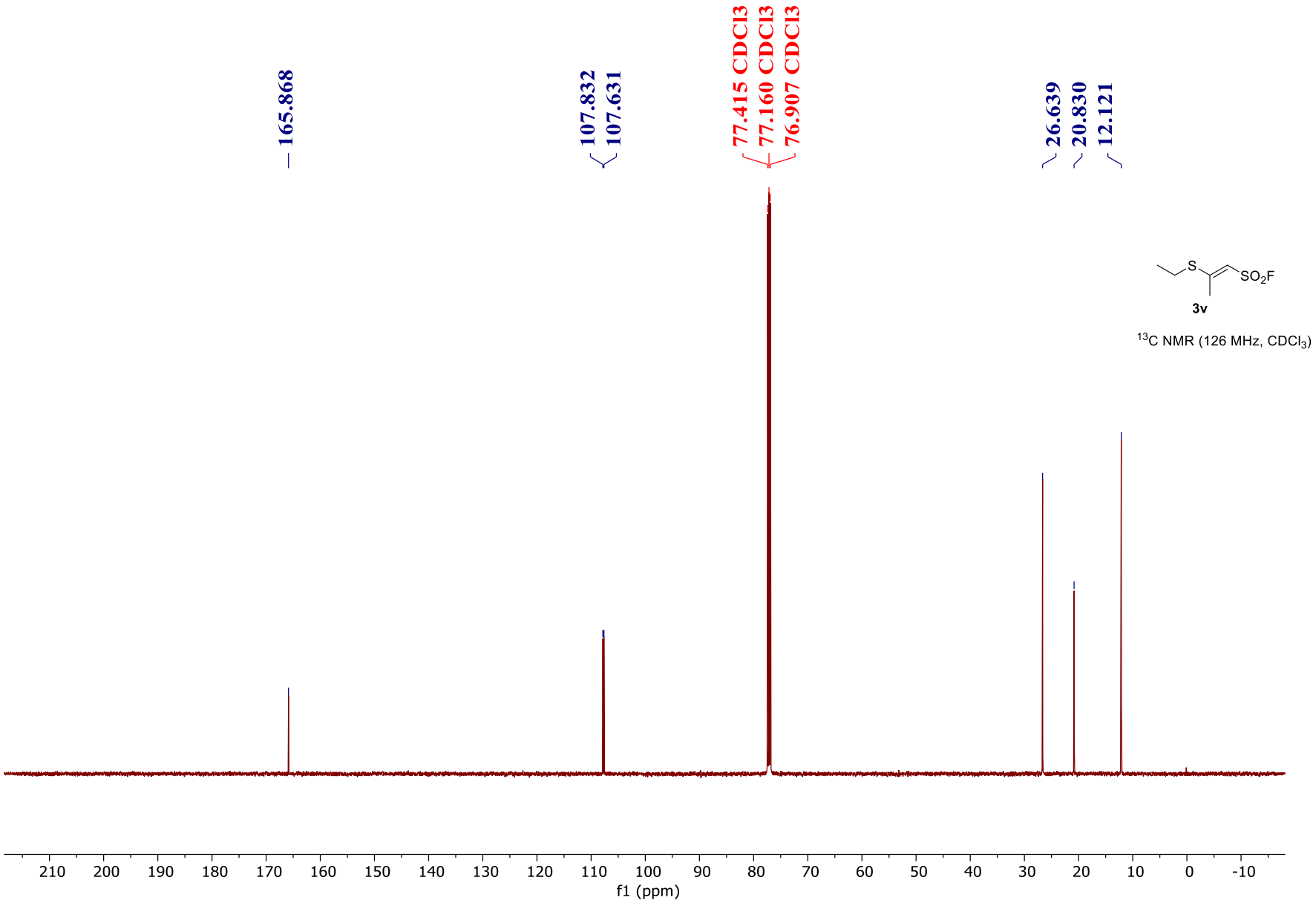

7.368
7.354
7.339
7.301
7.287
7.272
7.264 CDCl3
7.229
7.215
5.877
3.082
3.068
3.055
3.008
2.994
2.980
2.407
1.92
1.22
2.06
0.93
2.01
2.04
2.81
f1 (ppm)
3u
1H NMR (500 MHz, CDCl3)

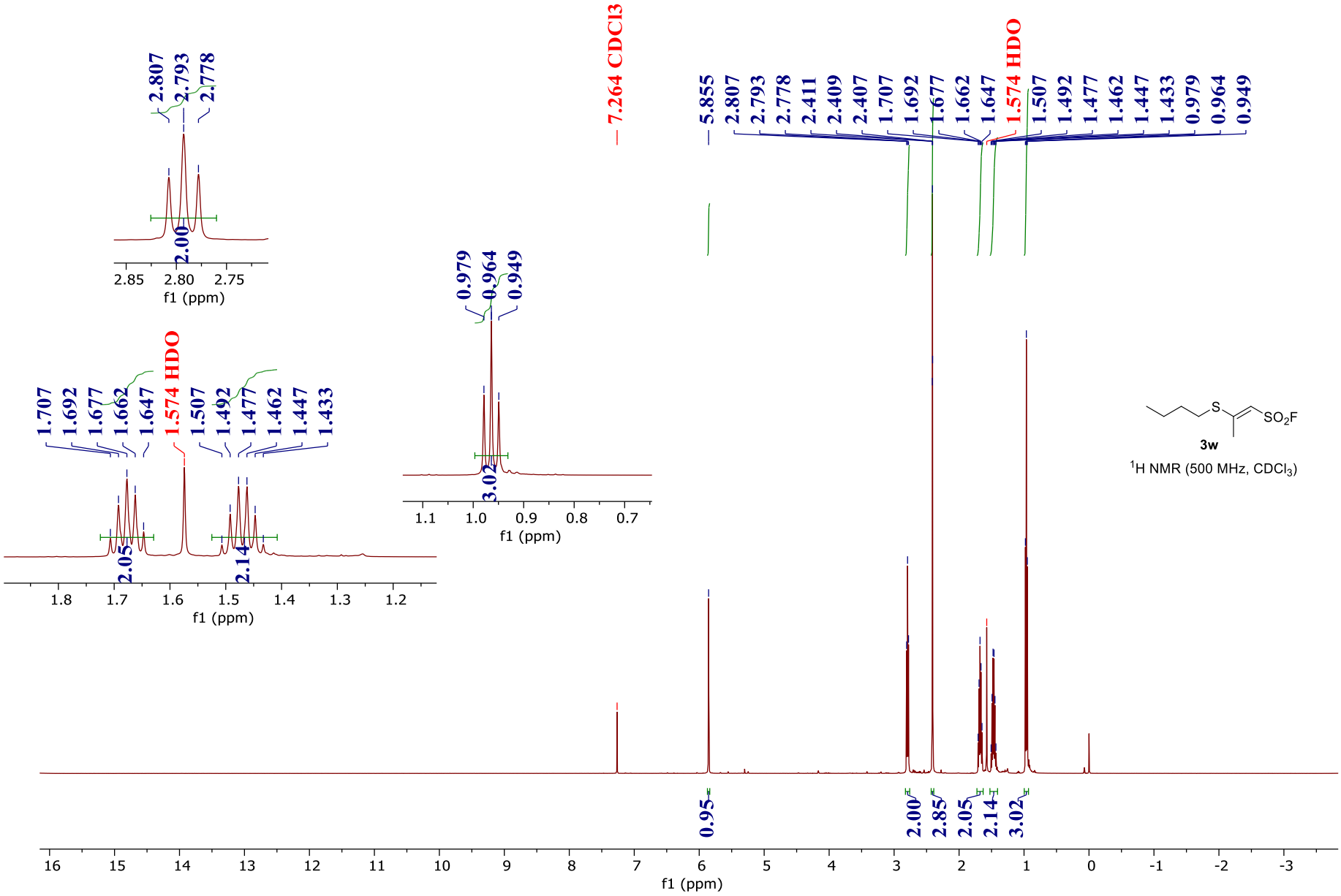

67.613
S
SO2F
3u
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

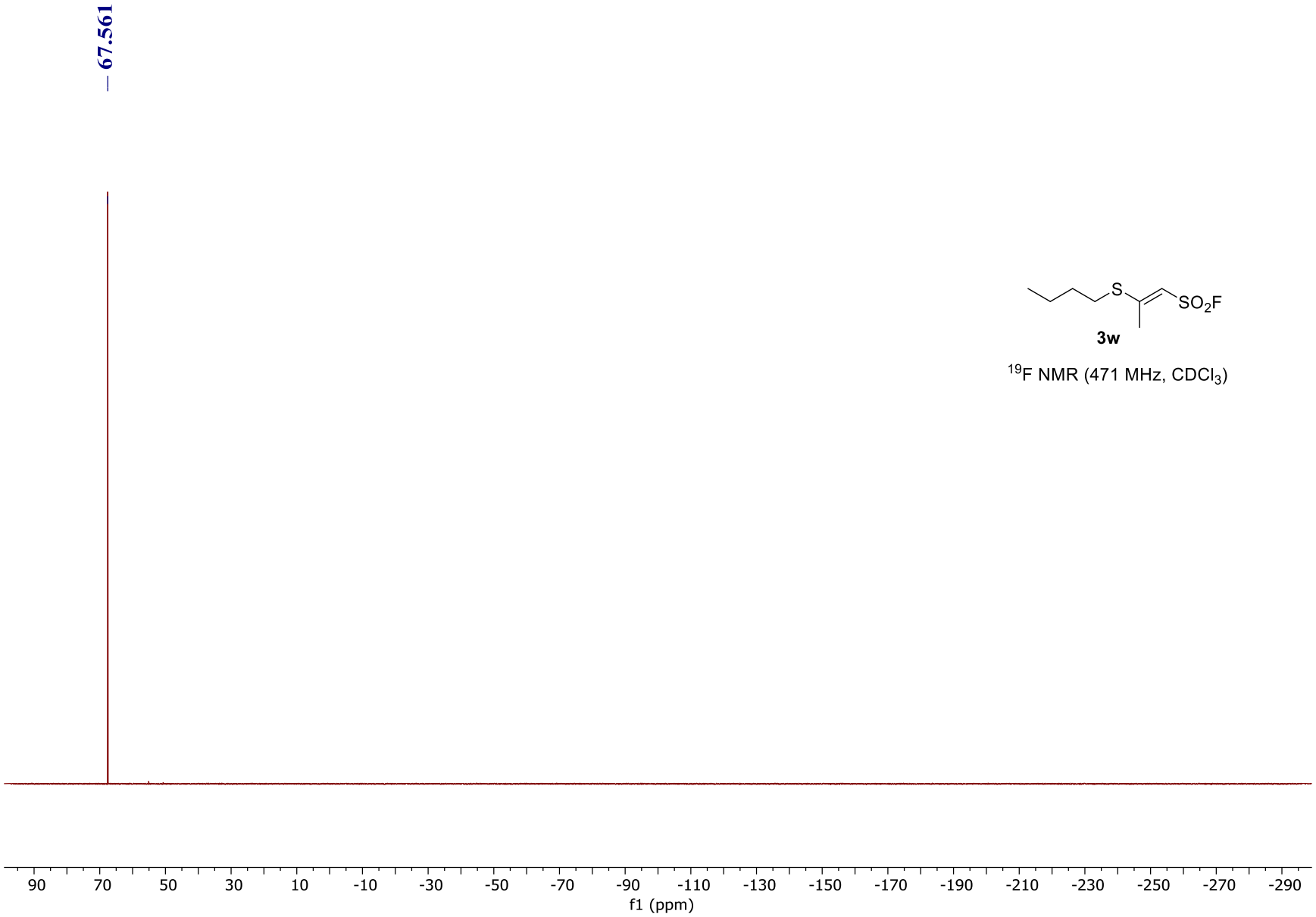

165.497
138.580
128.958
128.510
127.257
108.128
107.925
77.415 CDCl3
77.160 CDCl3
76.906 CDCl3
33.904
33.281
20.872
f1 (ppm)
33.904
33.281
35
34
33
f1 (ppm)
128.958
128.510
127.257
130.5 130.0 129.5 129.0 128.5 128.0 127.5 127.0 126.5
f1 (ppm)
S
SO2F
3u
13C NMR (126 MHz, CDCl3)

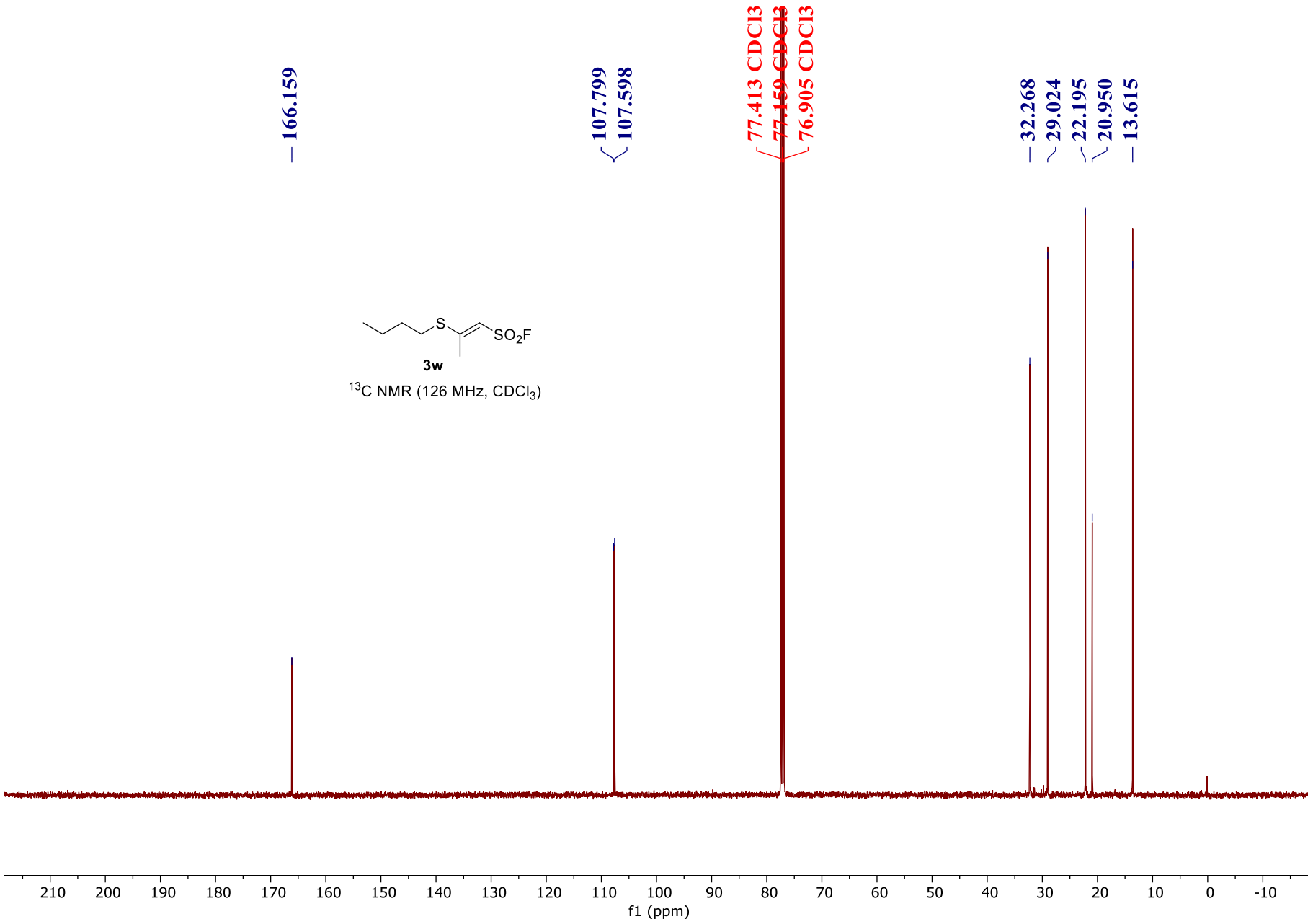

7.264 CDCl3
5.862
2.853
2.839
2.824
2.809
2.407
1.568 HDO
1.381
1.366
1.351
0.95
2.01
2.96
3.08
f1 (ppm)
2.01
3.08
SO2F
3v
1H NMR (500 MHz, CDCl3)

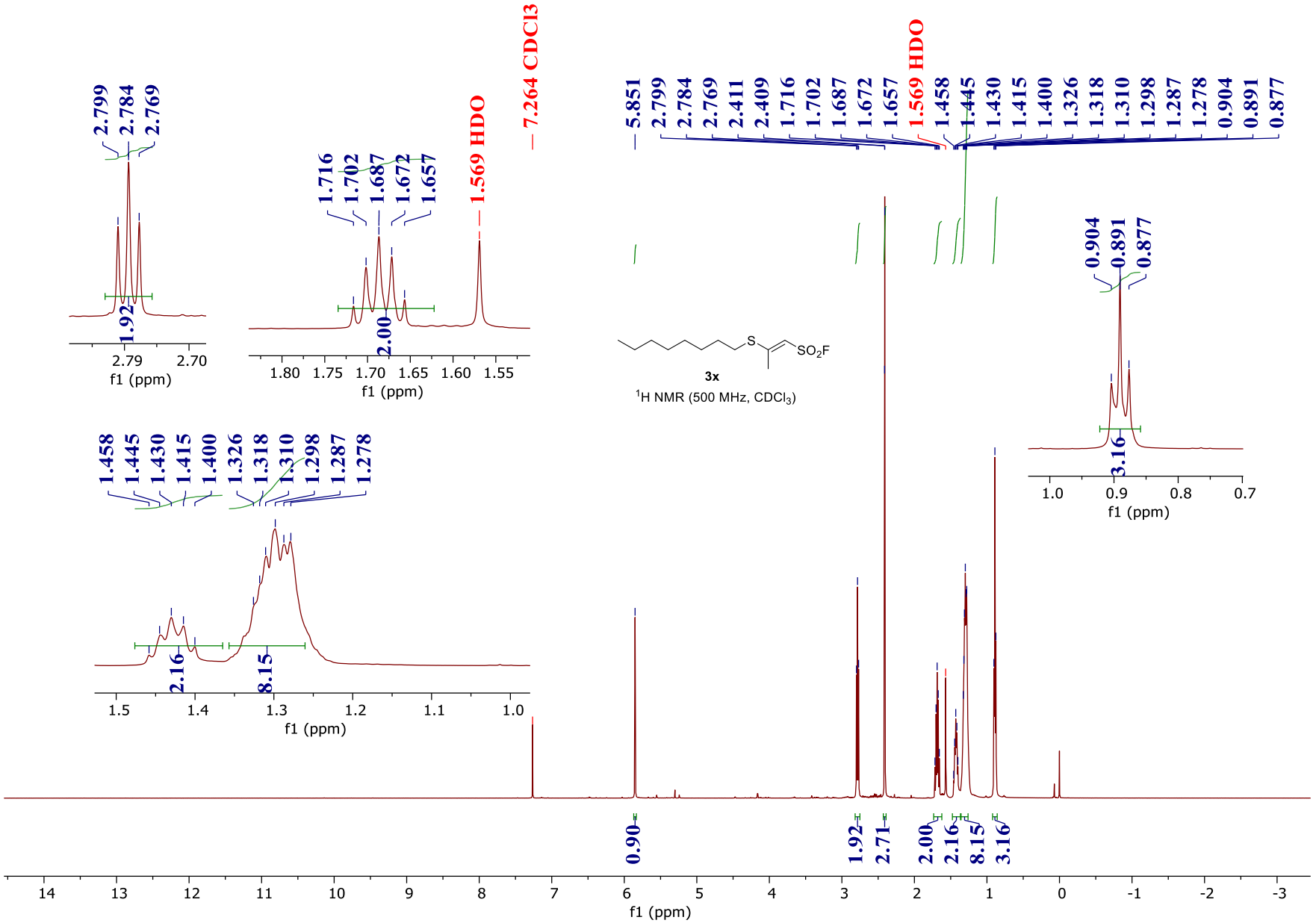

67.543
S
SO2F
3v
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

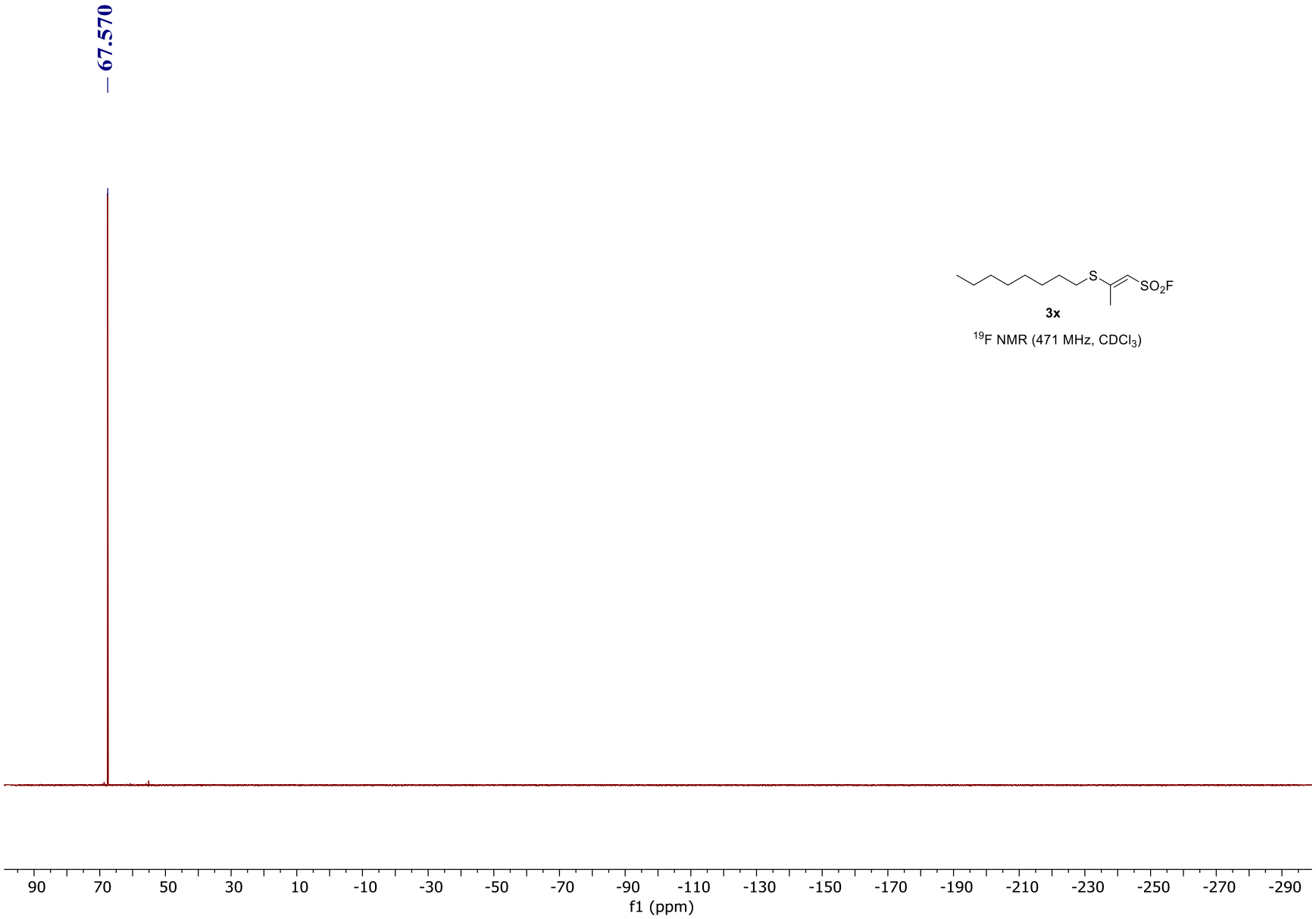

165.868
107.832
107.631
77.415 CDCl3
77.160 CDCl3
76.907 CDCl3
26.639
20.830
12.121
S
SO2F
3v
13C NMR (126 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

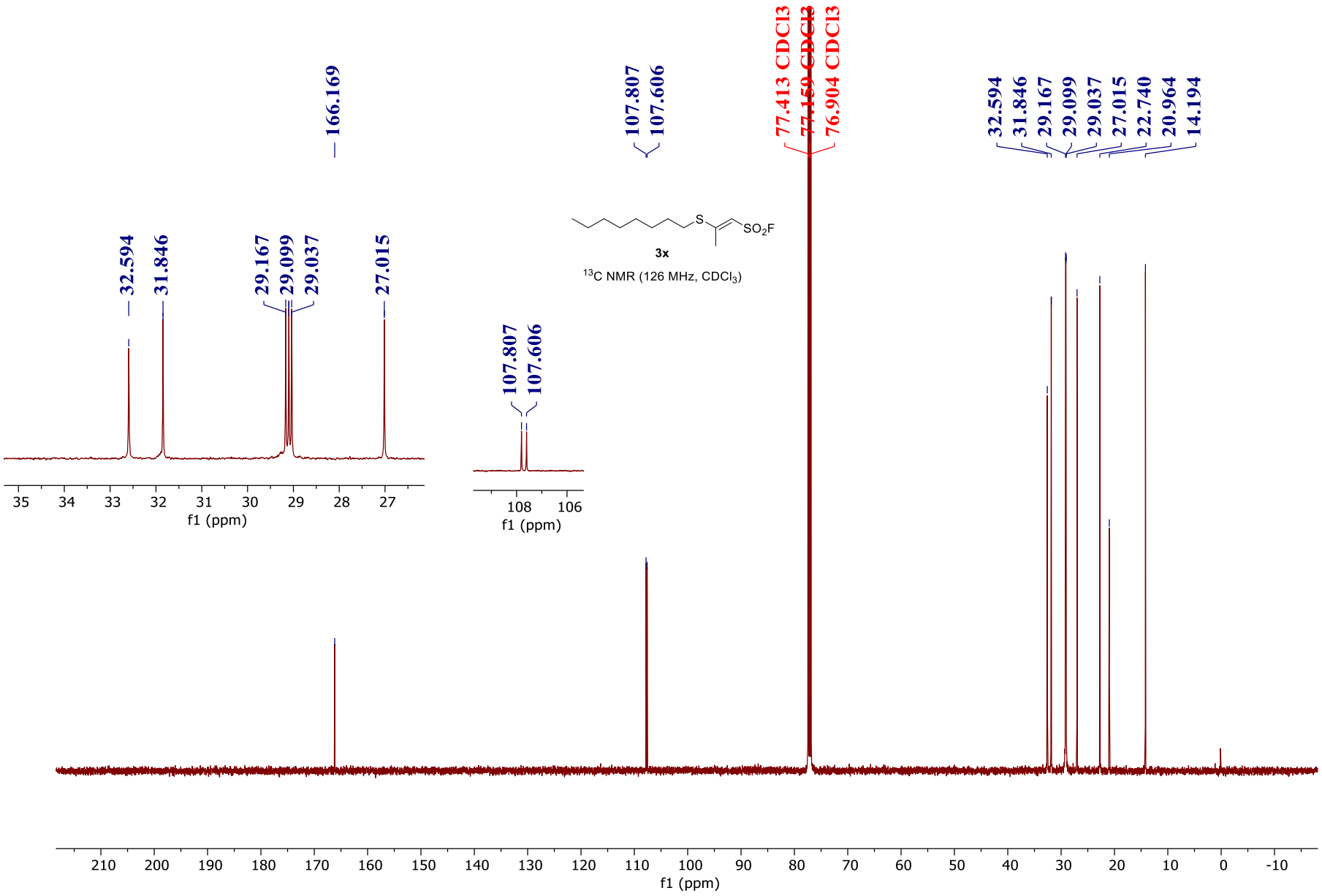

7.264 CDCl3
5.855
2.807
2.793
2.778
2.411
2.409
2.407
1.707
1.692
1.677
1.662
1.647
1.574 HDO
1.507
1.492
1.477
1.462
1.447
1.433
0.979
0.964
0.949
0.95
2.00
2.85
2.05
2.14
3.02
f1 (ppm)
SO2F
3w
1H NMR (500 MHz, CDCl3)

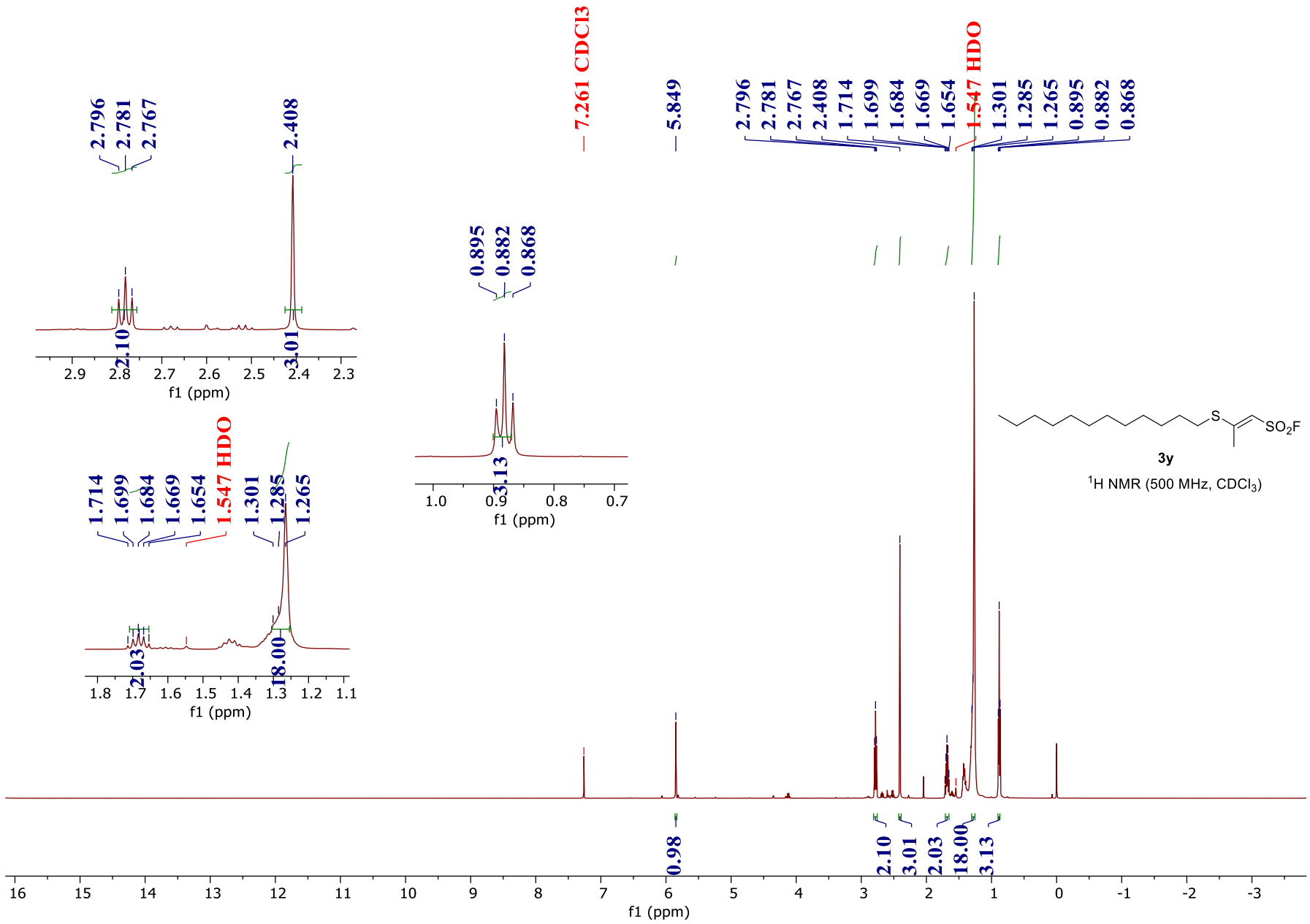

− 67.561
S
SO2F
3w
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

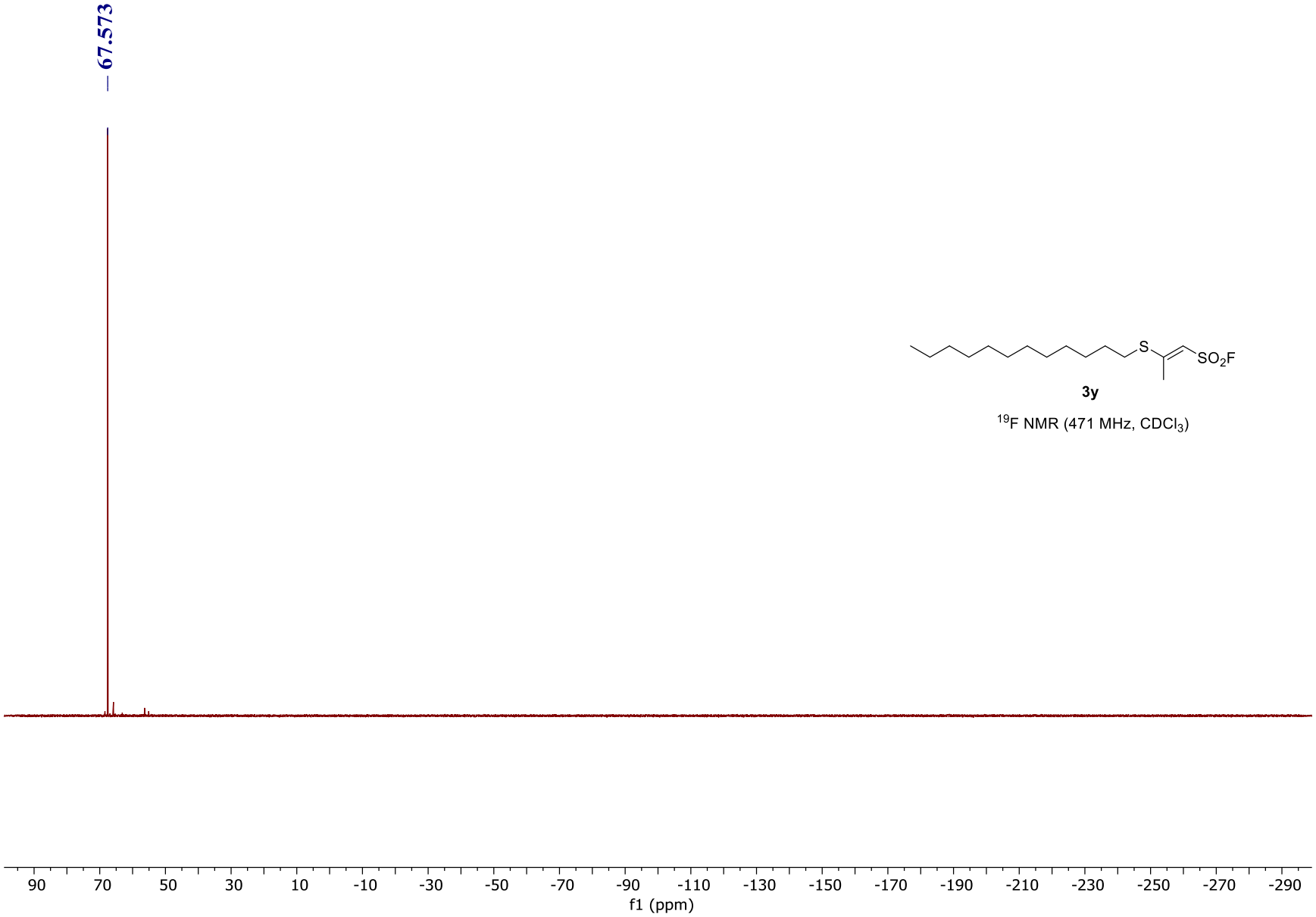

166.159
107.799
107.598
77.413 CDCl3
77.159 CDCl3
76.905 CDCl3
32.268
29.024
22.195
20.950
13.615
S
SO2F
3w
13C NMR (126 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.264 CDCl3
1.569 HDO
5.851
2.799
2.784
2.769
2.411
2.409
1.716
1.702
1.687
1.672
1.657
1.569 HDO
1.458
1.445
1.430
1.415
1.400
1.326
1.318
1.310
1.298
1.287
1.278
0.904
0.891
0.877
SO2F
3x
1H NMR (500 MHz, CDCl3)
1.92
2.00
2.16
8.15
3.16
0.90
1.92
2.71
2.00
2.16
8.15
3.16
f1 (ppm)


−67.570
S
SO2F
3x
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

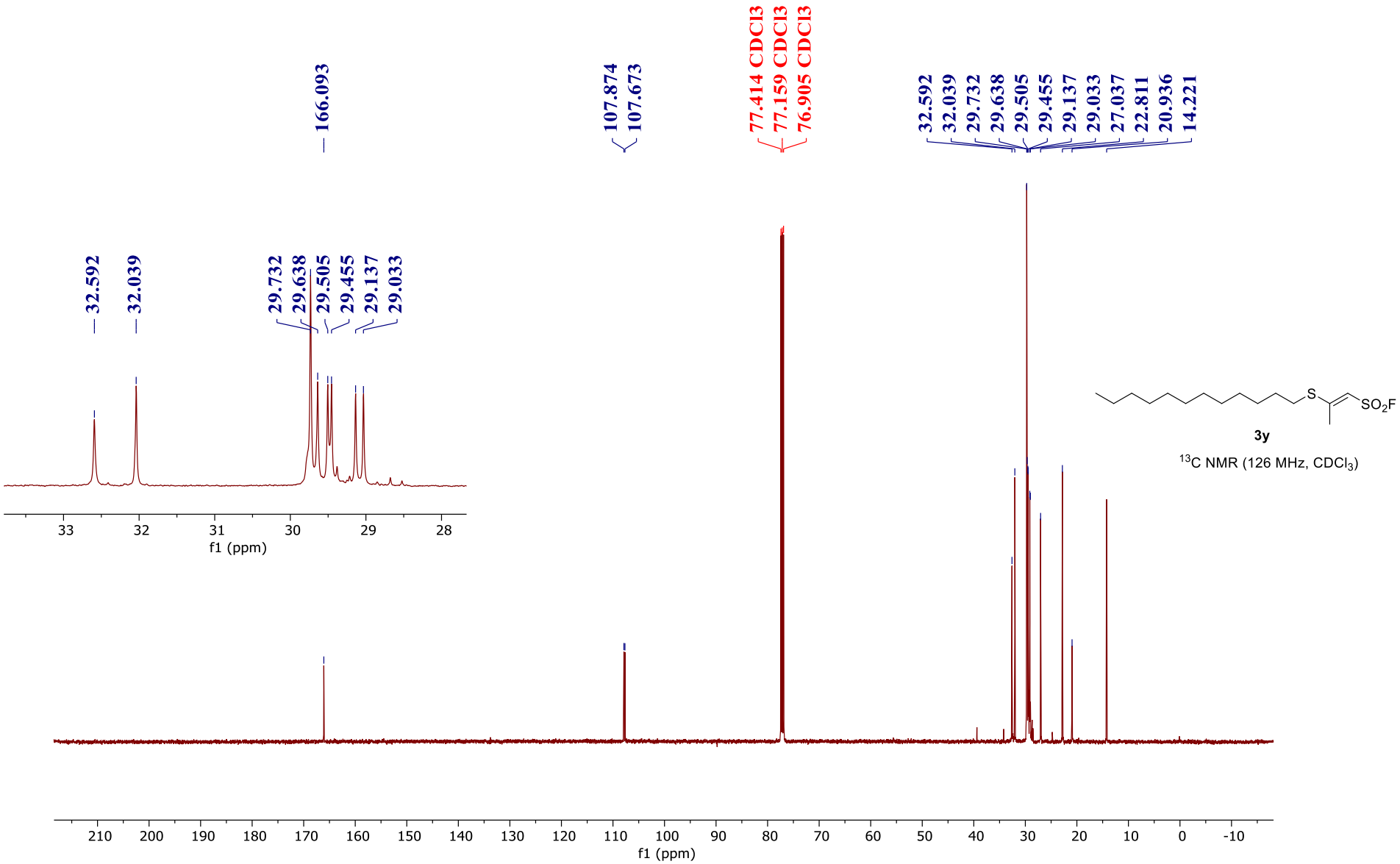

166.169
107.807
107.606
77.413 CDCl3
77.159 CDCl3
76.904 CDCl3
32.594
31.846
29.167
29.099
29.037
27.015
22.740
20.964
14.194
S
SO2F
3x
13C NMR (126 MHz, CDCl3)
f1 (ppm)

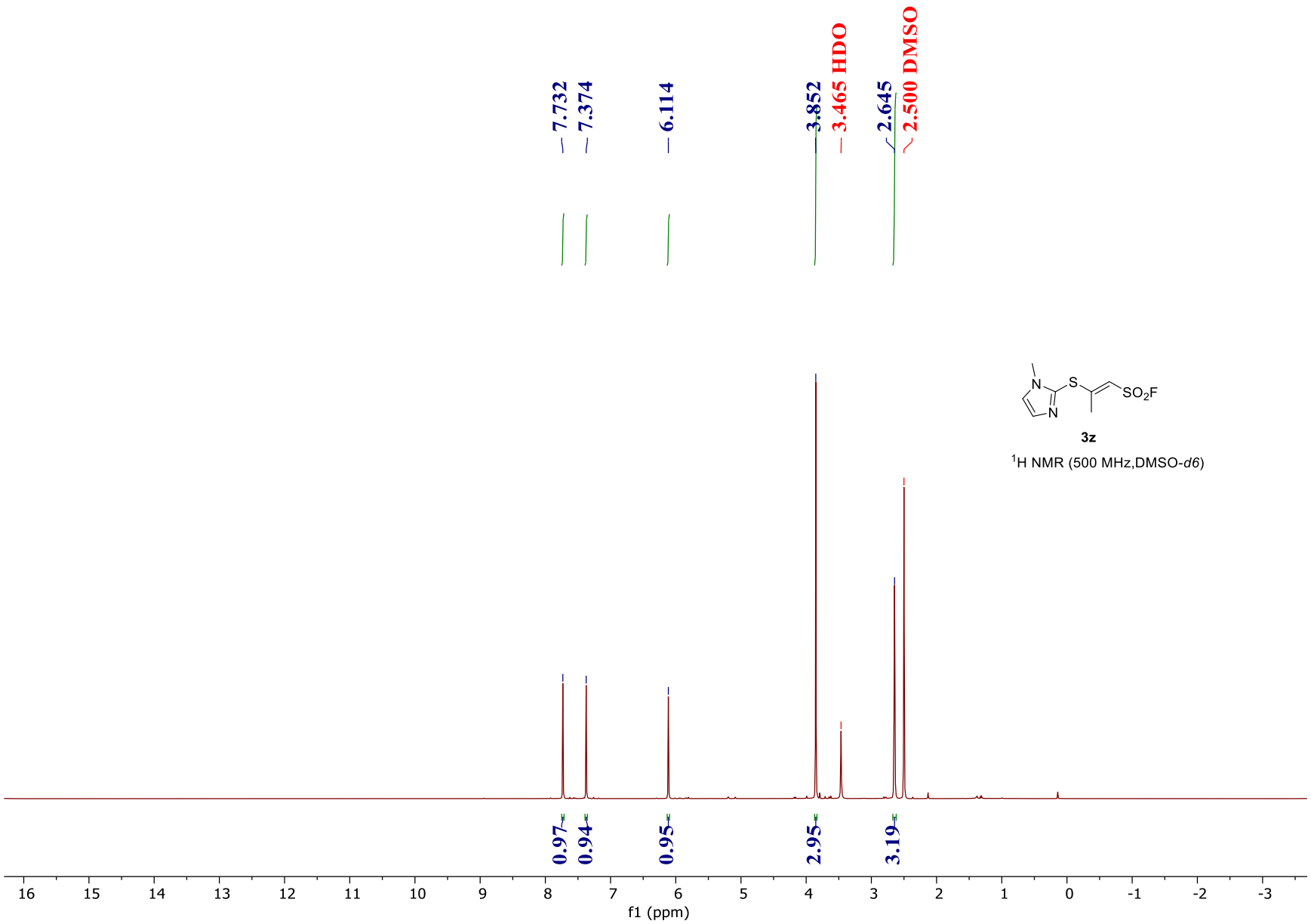

7.261 CDCl3
5.849
2.796
2.781
2.767
2.408
1.714
1.699
1.684
1.669
1.654
1.547 HDO
1.301
1.285
1.265
0.895
0.882
0.868
0.98
2.10
3.01
2.03
18.00
3.13
f1 (ppm)
S
SO2F
3y
1H NMR (500 MHz, CDCl3)

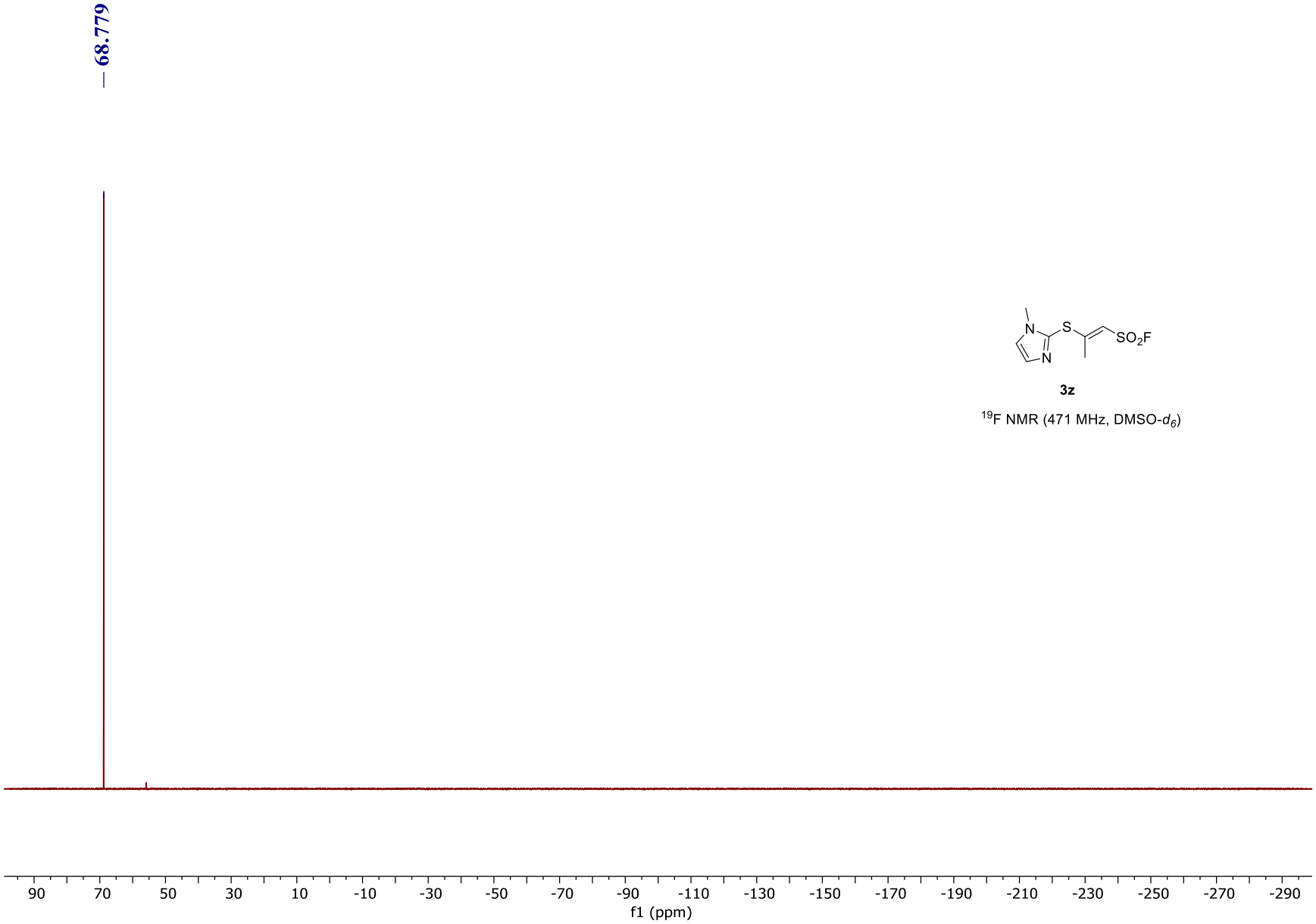


3y

^{19}F NMR (471 MHz, $CDCl_3$)

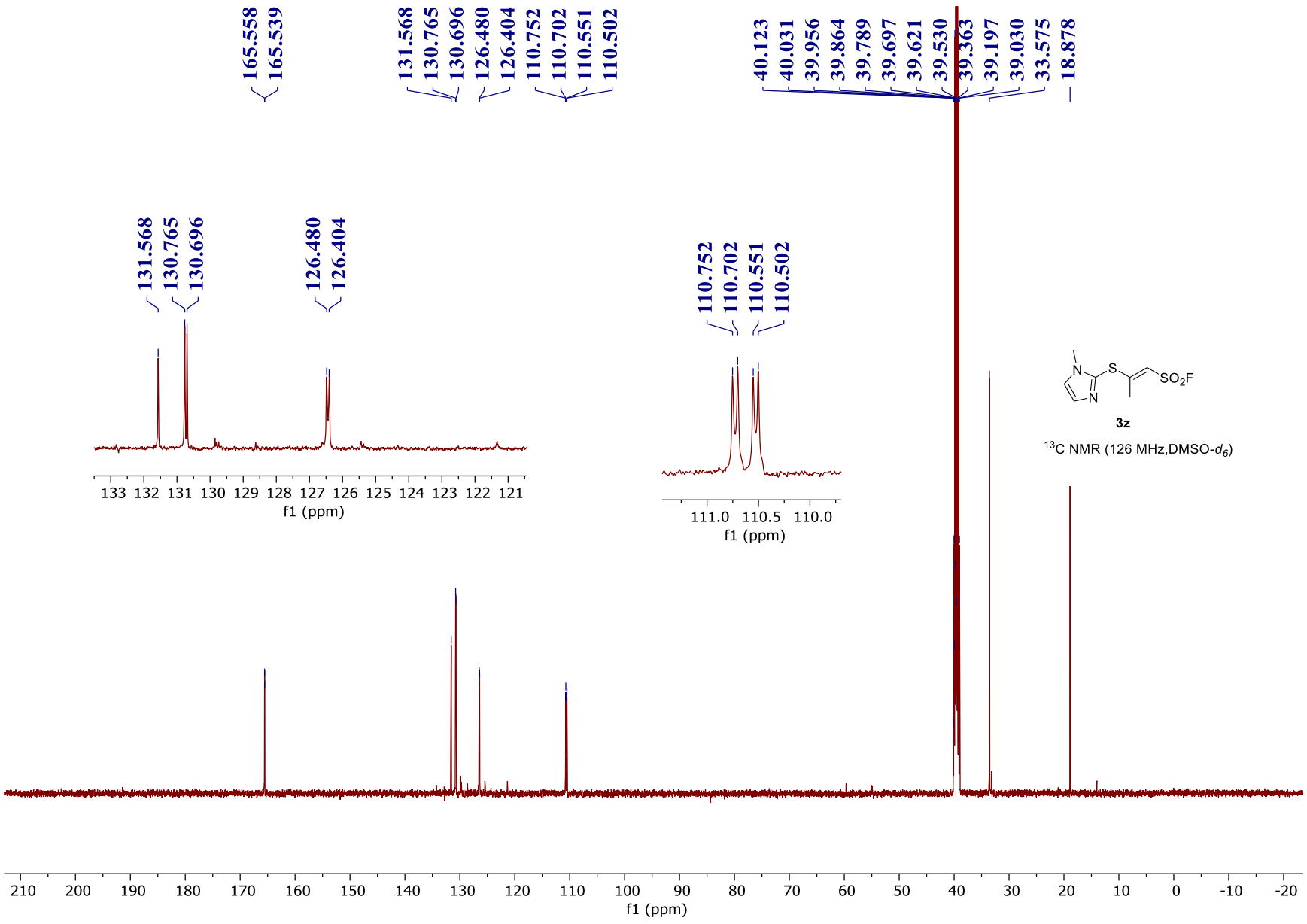

166.093
107.874
107.673
77.414 CDCl3
77.159 CDCl3
76.905 CDCl3
32.592
32.039
29.732
29.638
29.505
29.455
29.137
29.033
27.037
22.811
20.936
14.221
f1 (ppm)
3y
13C NMR (126 MHz, CDCl3)

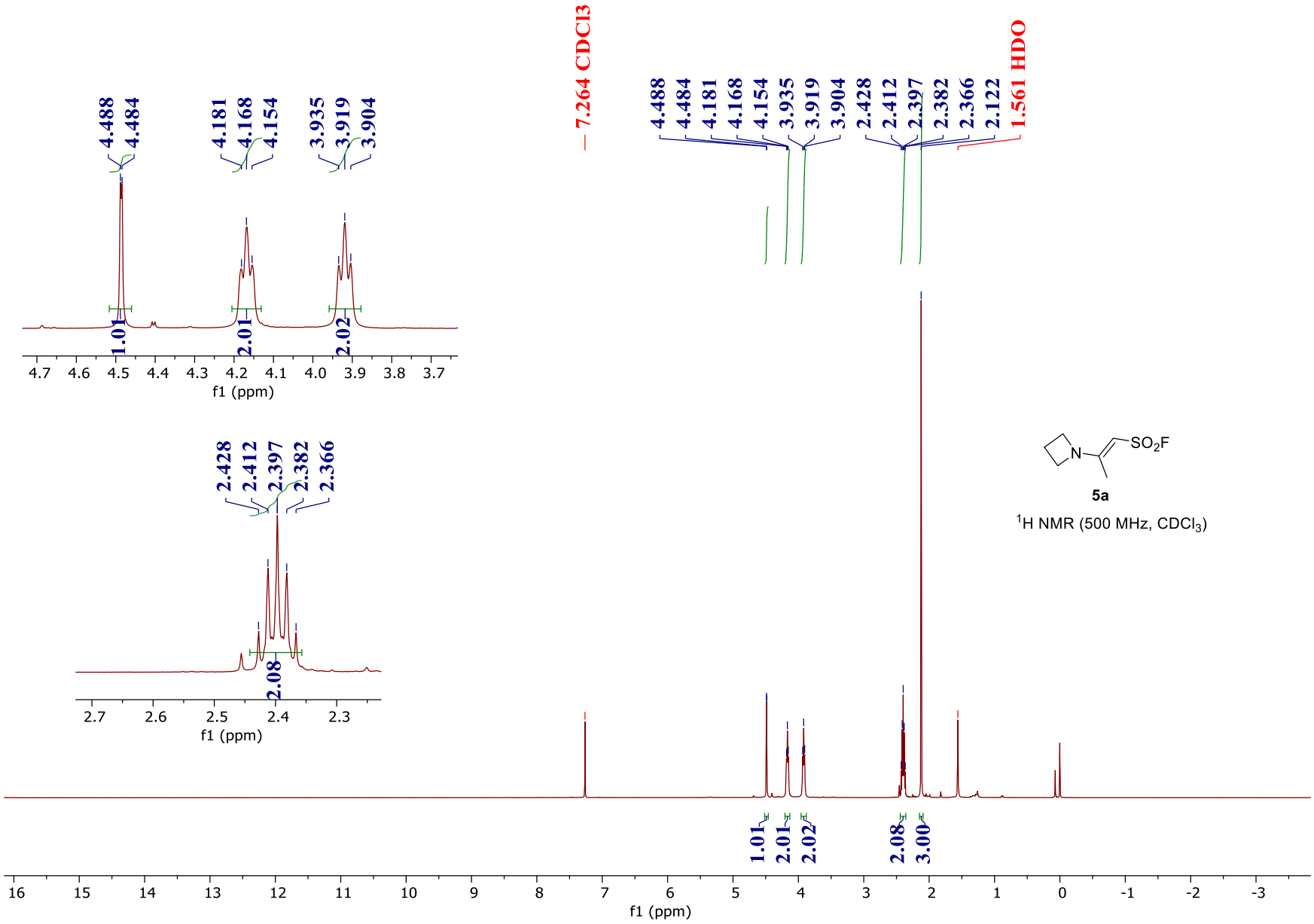

7.732
7.374
6.114
3.852
3.465 HDO
2.645
2.500 DMSO
0.97
0.94
0.95
2.95
3.19
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3
f1 (ppm)
N
S
N
SO2F
3z
1H NMR (500 MHz,DMSO-d6)

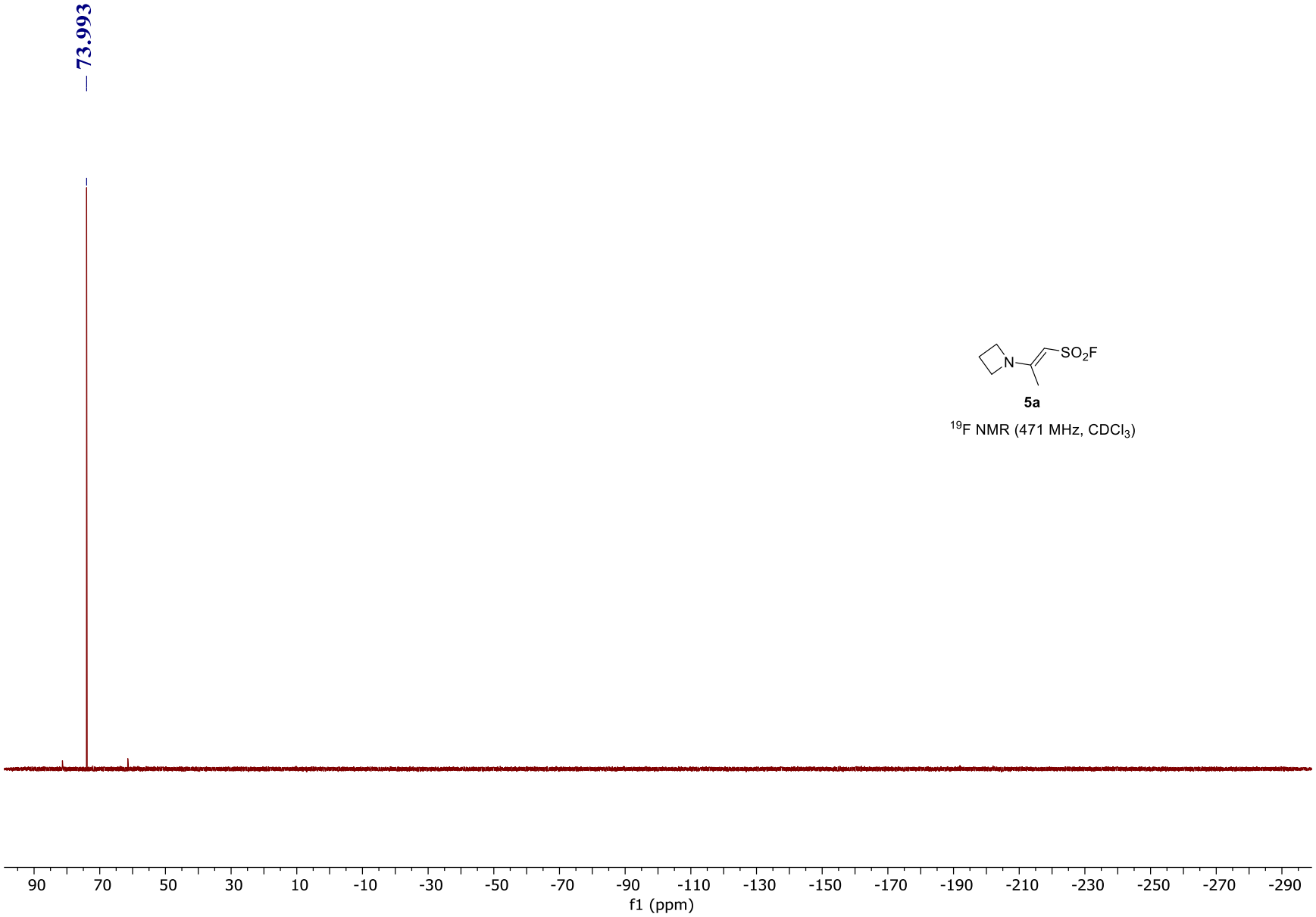


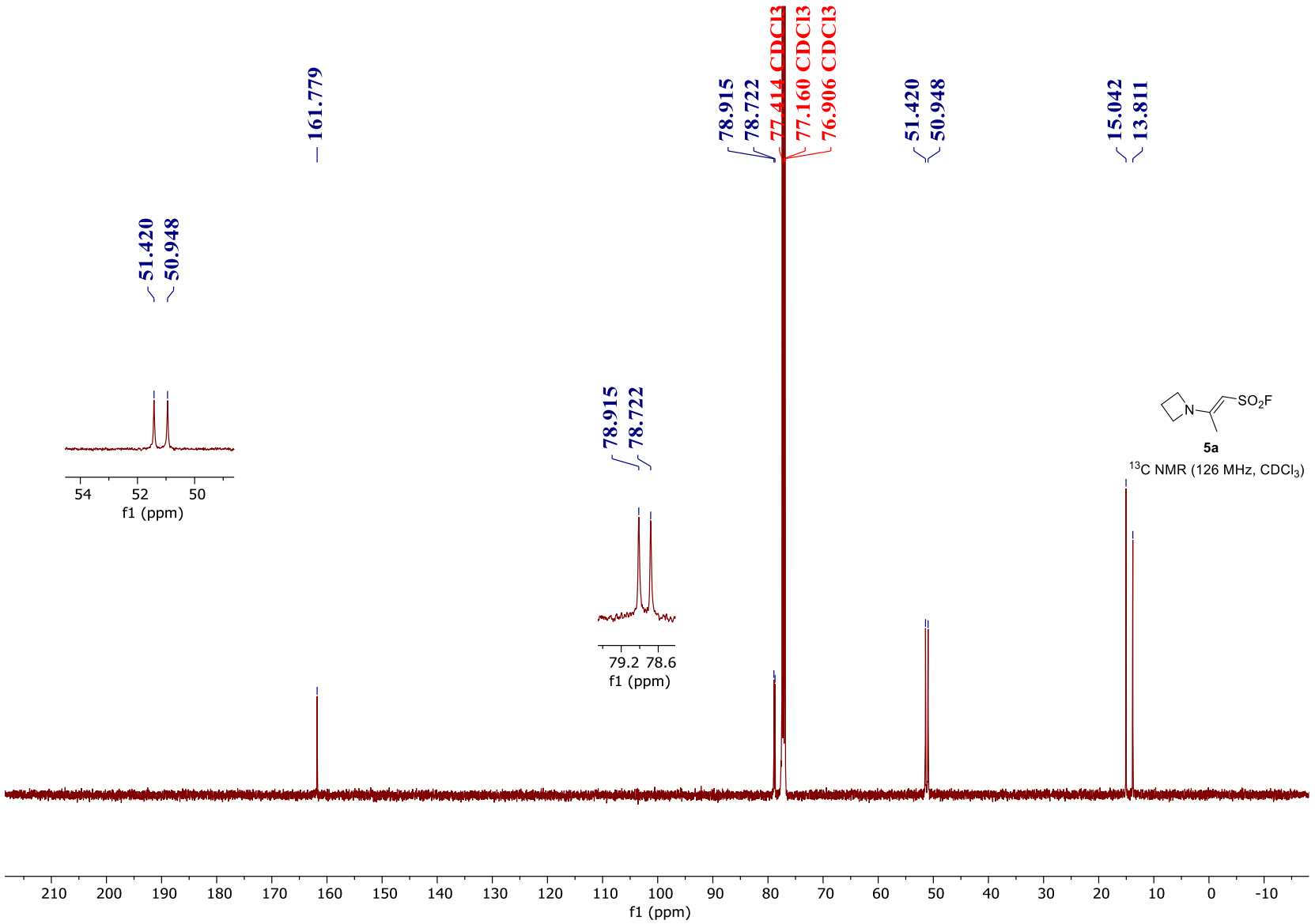
3z

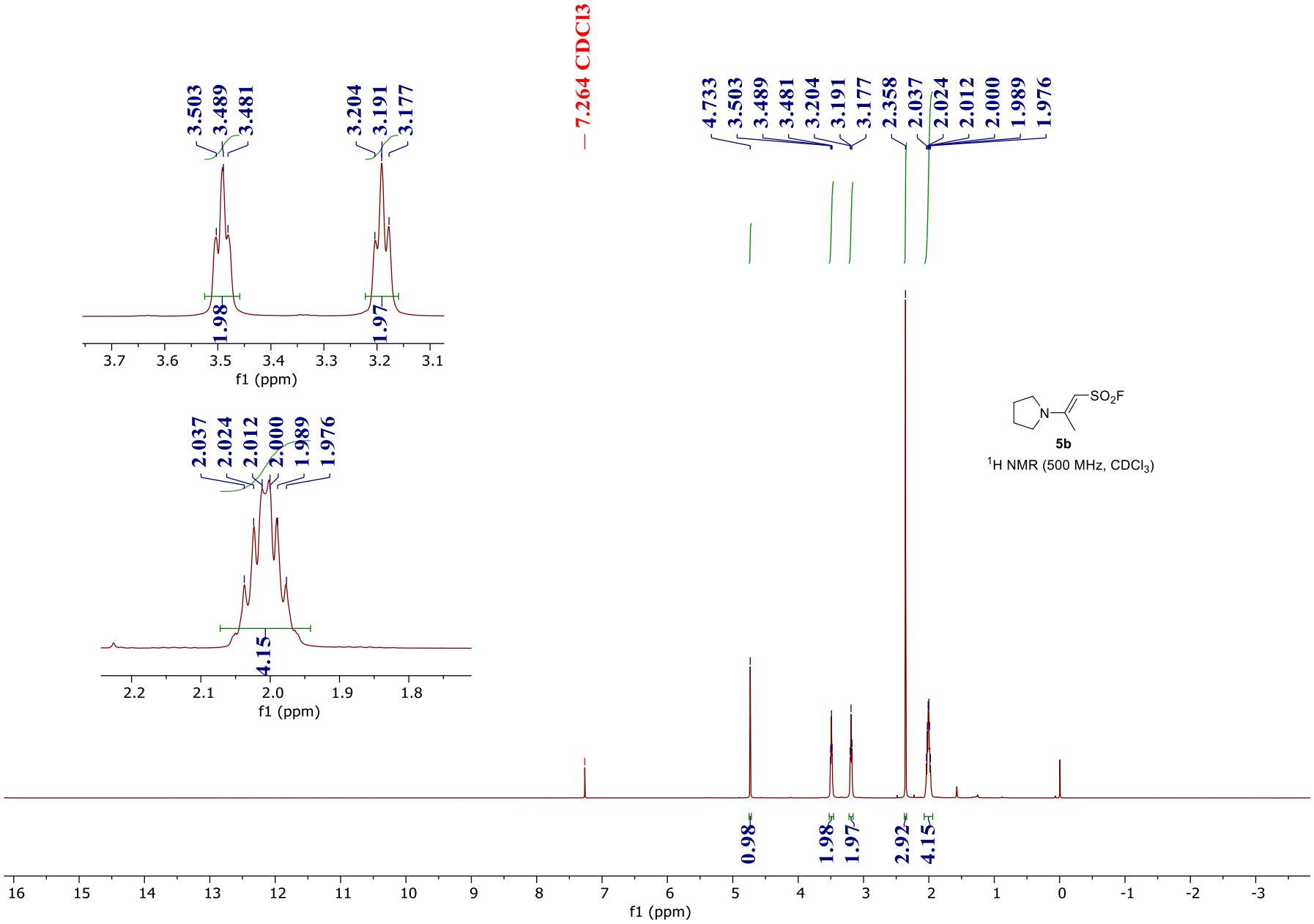
^{19}F NMR (471 MHz, DMSO-d_6)

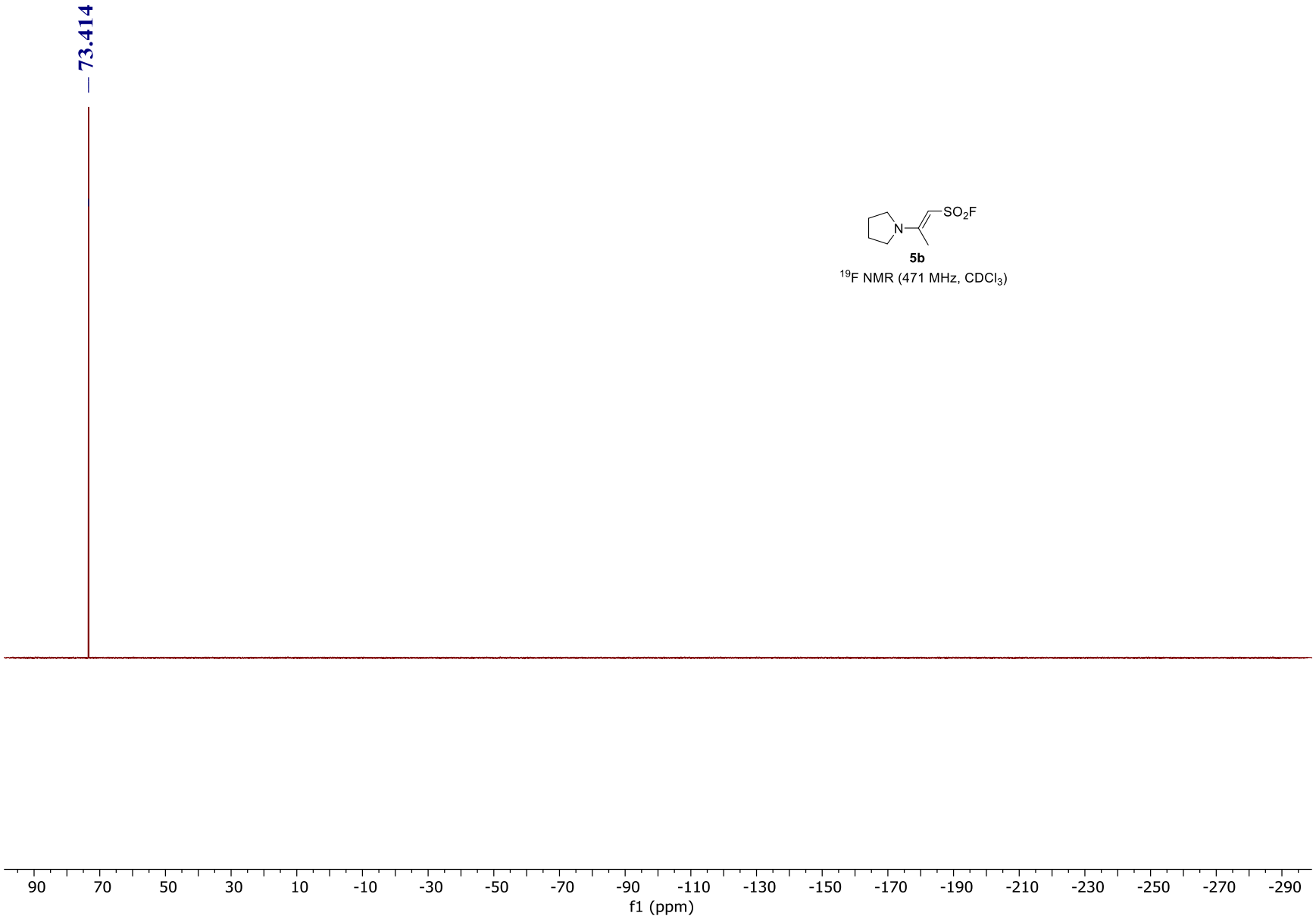

165.558
165.539
131.568
130.765
130.696
126.480
126.404
110.752
110.702
110.551
110.502
40.123
40.031
39.956
39.864
39.789
39.697
39.621
39.530
39.363
39.197
39.030
33.575
18.878
f1 (ppm)
111.0 110.5 110.0
f1 (ppm)
133 132 131 130 129 128 127 126 125 124 123 122 121
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)
SO2F
3z
13C NMR (126 MHz,DMSO-d6)

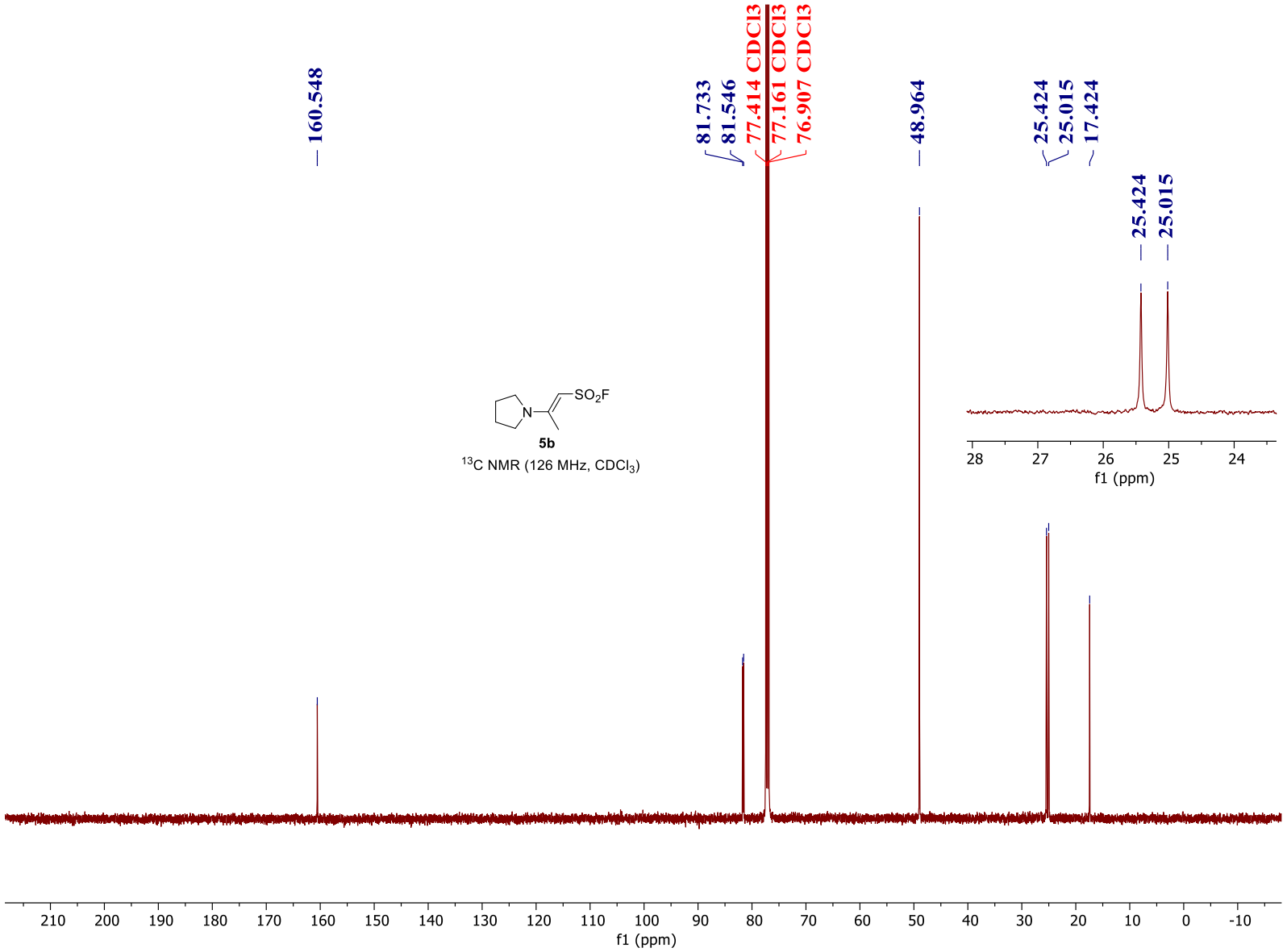

7.264 CDCl3
4.488
4.484
4.181
4.168
4.154
3.935
3.919
3.904
2.428
2.412
2.397
2.382
2.366
2.122
1.561 HDO
1.01
2.01
2.02
2.08
3.00
f1 (ppm)
SO2F
N
5a
1H NMR (500 MHz, CDCl3)

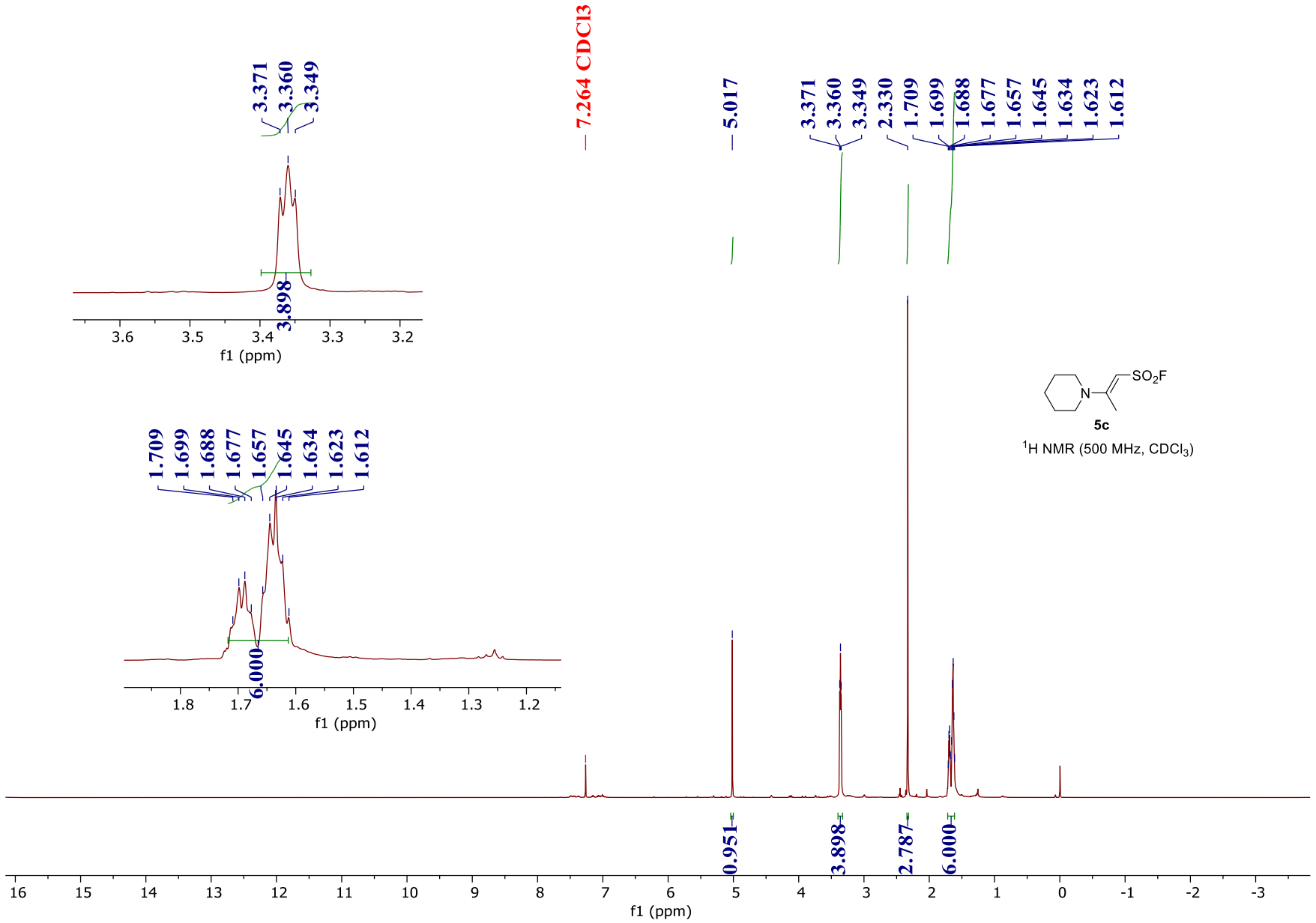

73.993
N
SO2F
5a
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

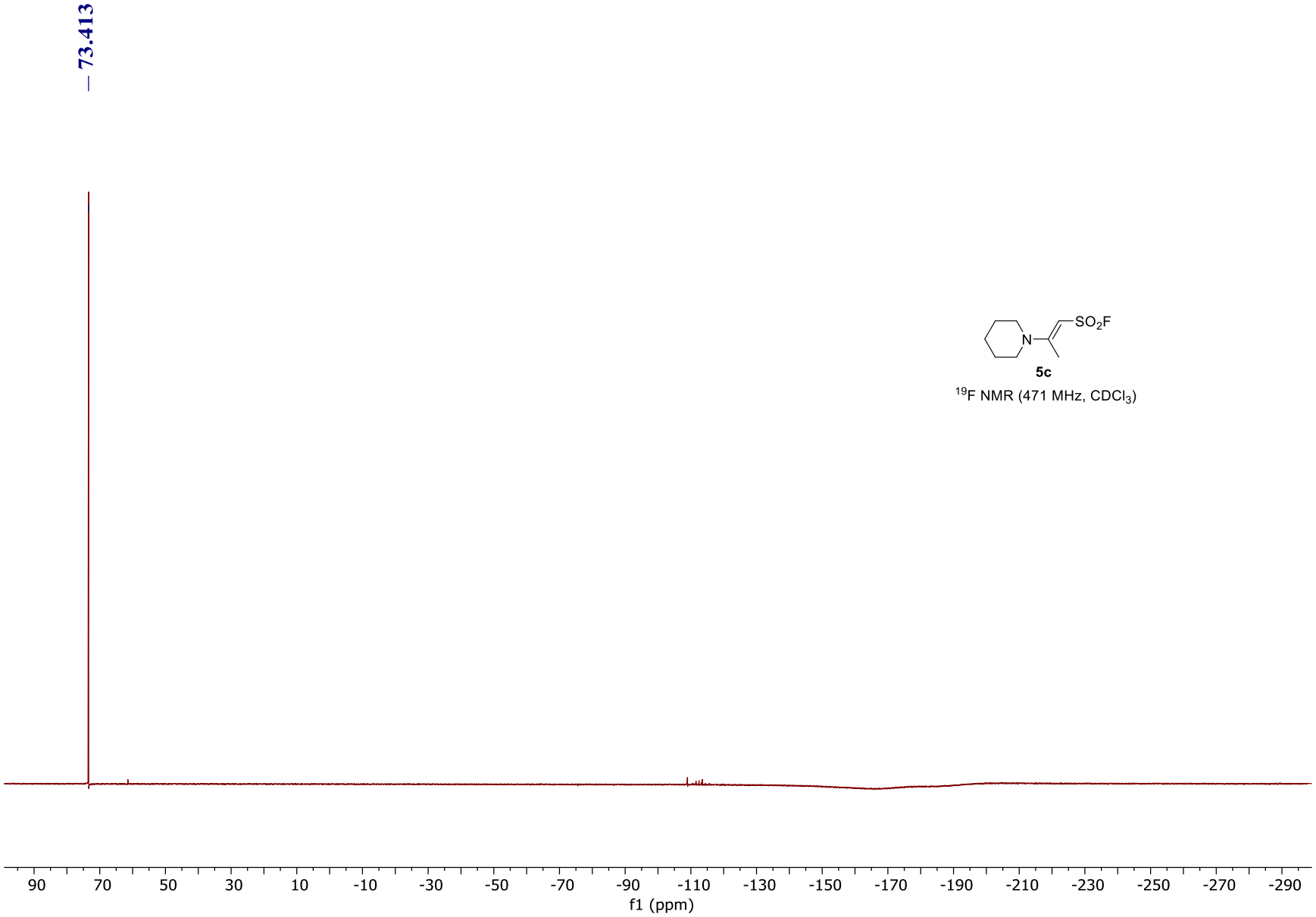

161.779
78.915
78.722
77.414 CDCl3
77.160 CDCl3
76.906 CDCl3
51.420
50.948
15.042
13.811
51.420
50.948
78.915
78.722
54 52 50
f1 (ppm)
79.2 78.6
f1 (ppm)
SO2F
5a
13C NMR (126 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

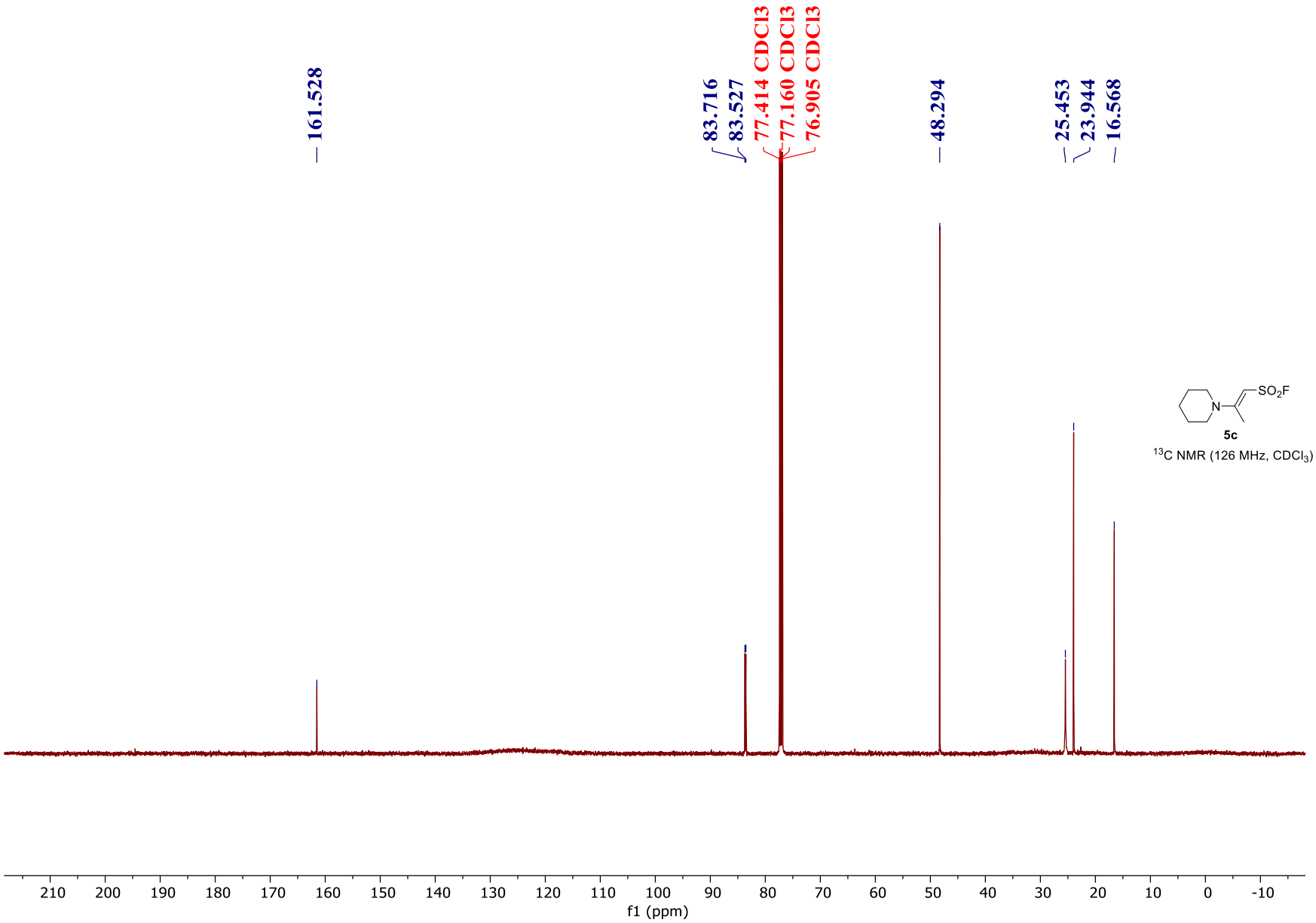

7.264 CDCl3
4.733
3.503
3.489
3.481
3.204
3.191
3.177
2.358
2.037
2.024
2.012
2.000
1.989
1.976
0.98
1.98
1.97
2.92
4.15
f1 (ppm)
1.98
1.97
f1 (ppm)
4.15
f1 (ppm)
SO2F
N
5b
1H NMR (500 MHz, CDCl3)

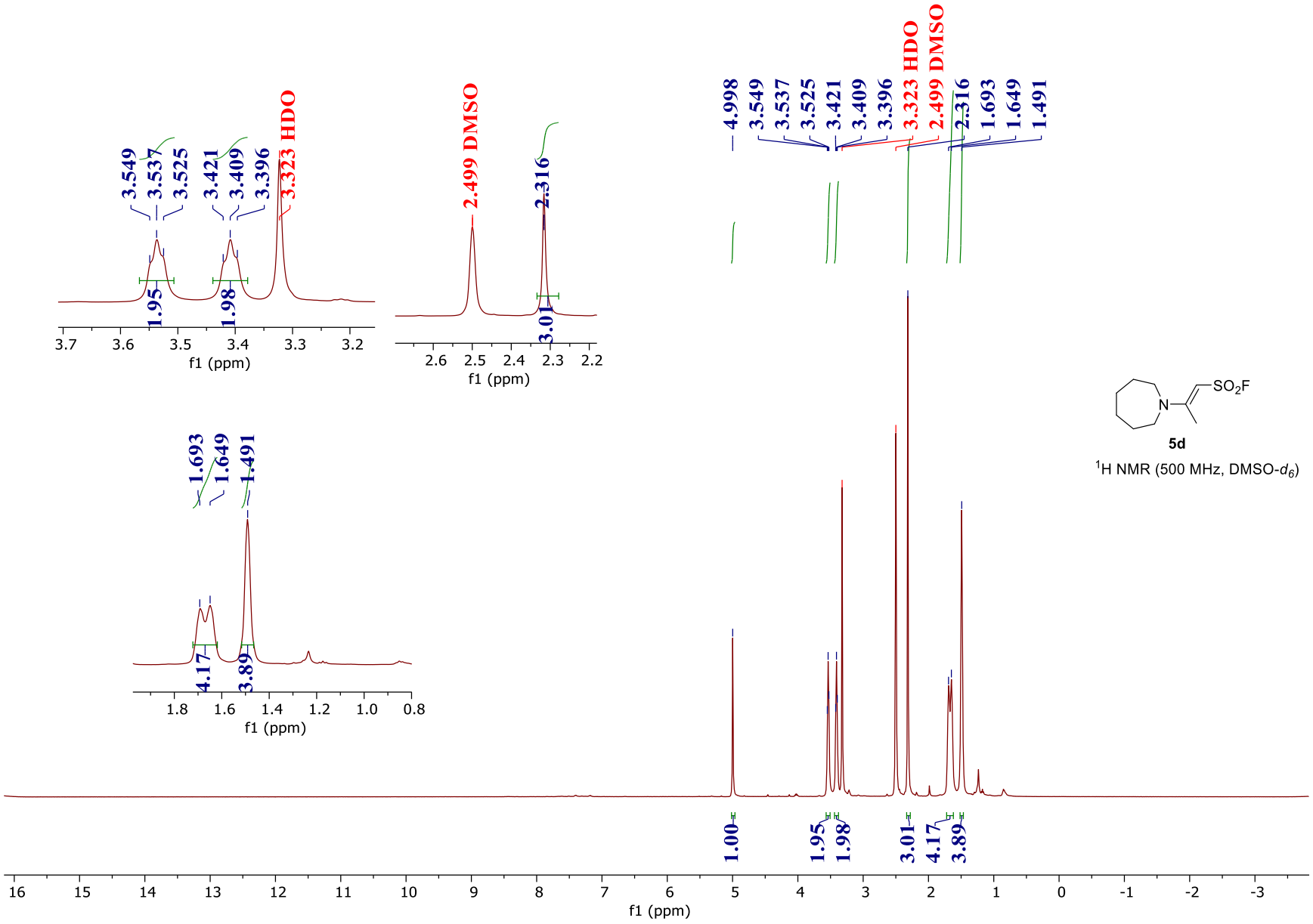

73.414
SO2F
N
5b
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

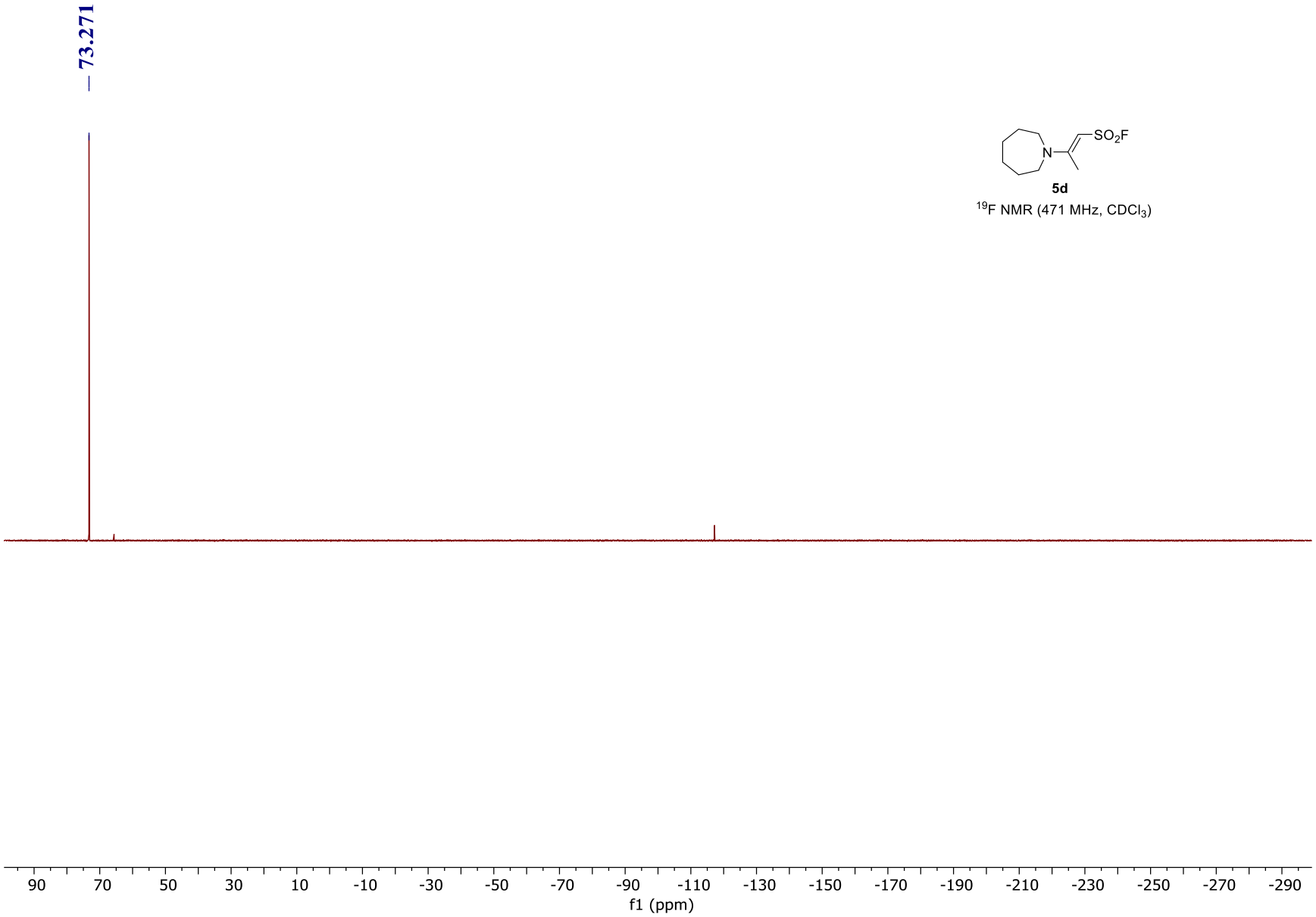

160.548
81.733
81.546
77.414 CDCl3
77.161 CDCl3
76.907 CDCl3
48.964
25.424
25.015
17.424
25.424
25.015
SO2F
N
5b
13C NMR (126 MHz, CDCl3)
28
27
26
25
24
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

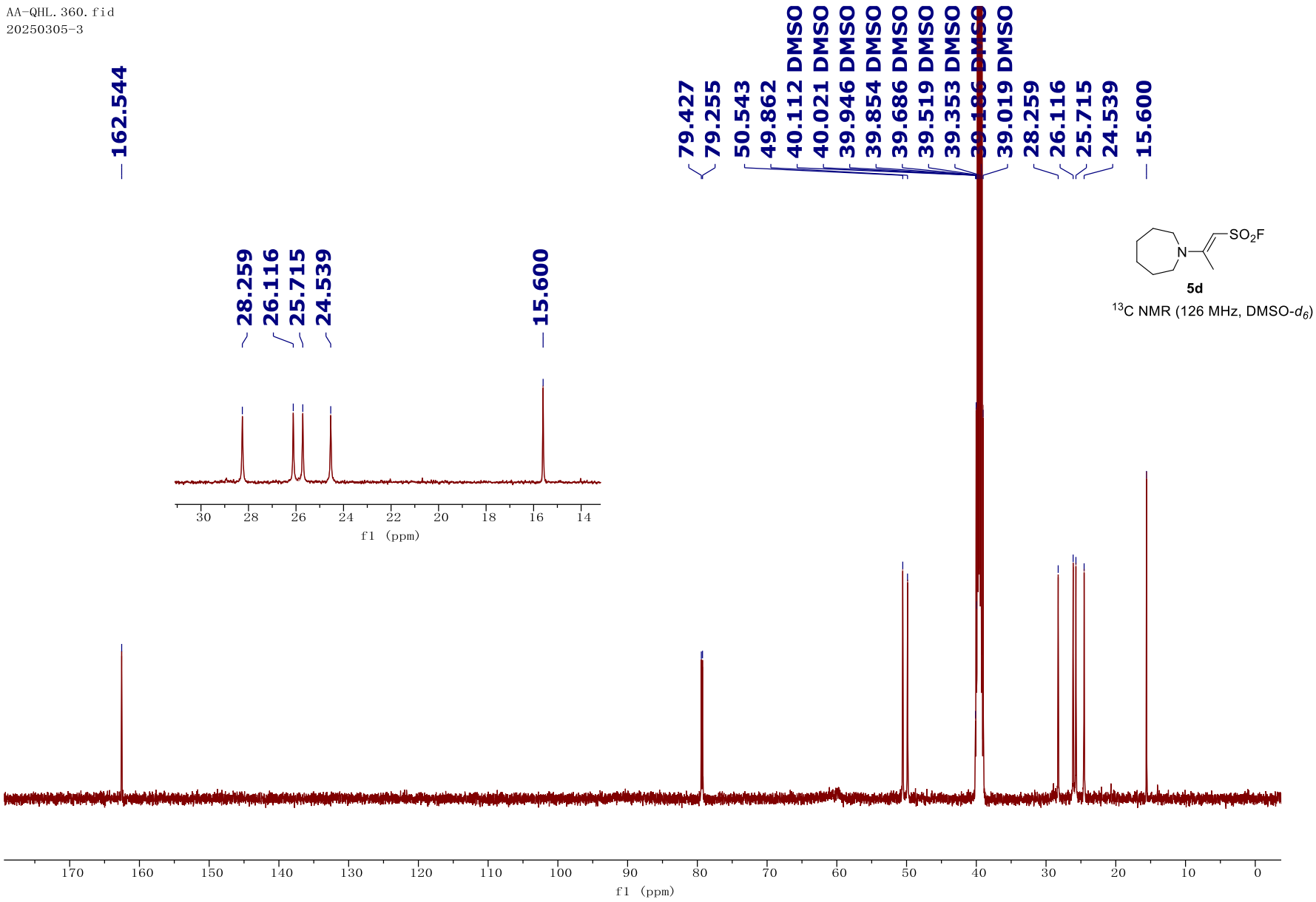

7.264 CDCl3
5.017
3.371
3.360
3.349
2.330
1.709
1.699
1.688
1.677
1.657
1.645
1.634
1.623
1.612
3.898
6.000
0.951
3.898
2.787
6.000
f1 (ppm)
SO2F
N
5c
1H NMR (500 MHz, CDCl3)

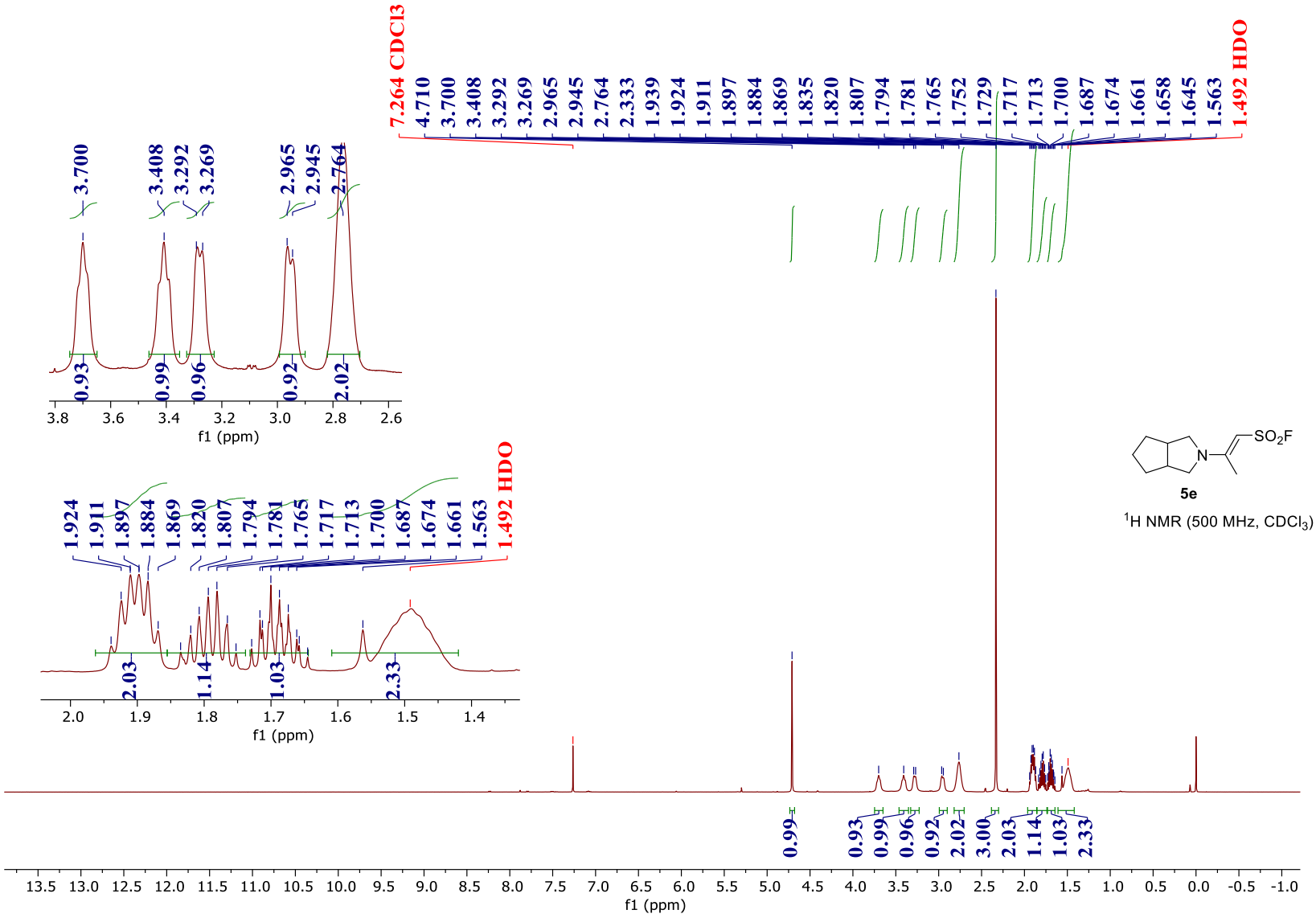

73.413
SO2F
N
5c
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

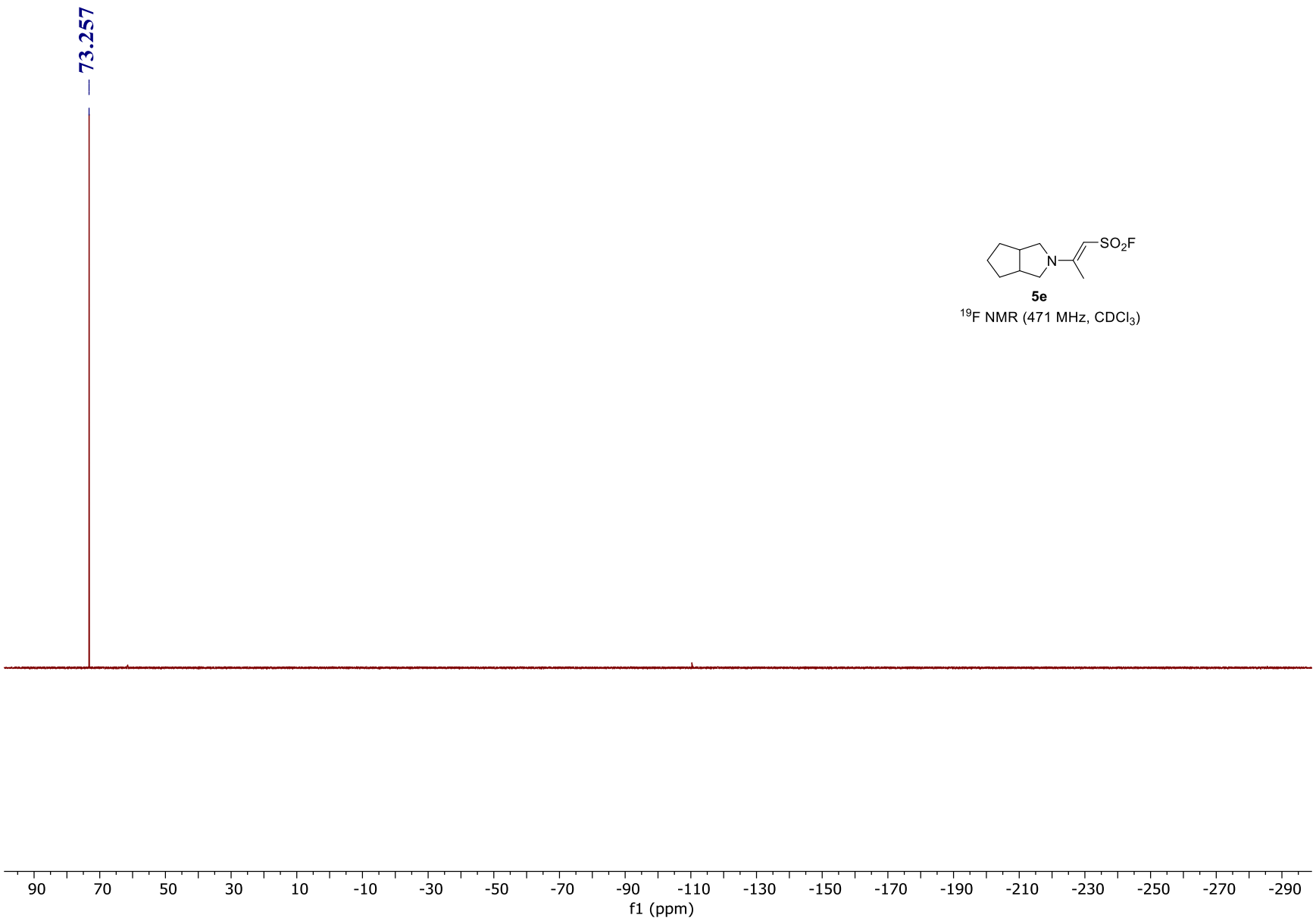

161.528
83.716
83.527
77.414 CDCl3
77.160 CDCl3
76.905 CDCl3
48.294
25.453
23.944
16.568
SO2F
N
5c
13C NMR (126 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


4.998
3.549
3.537
3.525
3.421
3.409
3.396
3.323 HDO
2.499 DMSO
2.316
1.693
1.649
1.491
1.00
1.95
1.98
3.01
4.17
3.89
f1 (ppm)
SO2F
N
5d
1H NMR (500 MHz, DMSO-d6)


73.271
SO2F
N
5d
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)


AA-QHL.360.fid
20250305-3
162.544
79.427
79.255
50.543
49.862
40.112 DMSO
40.021 DMSO
39.946 DMSO
39.854 DMSO
39.686 DMSO
39.519 DMSO
39.353 DMSO
39.196 DMSO
39.019 DMSO
28.259
26.116
25.715
24.539
15.600
SO2F
N
5d
13C NMR (126 MHz, DMSO-d6)
f1 (ppm)


7.264 CDCl3
4.710
3.700
3.408
3.292
3.269
2.965
2.945
2.764
2.333
1.939
1.924
1.911
1.897
1.884
1.869
1.835
1.820
1.807
1.794
1.781
1.765
1.752
1.729
1.717
1.713
1.700
1.687
1.674
1.661
1.658
1.645
1.563
1.492 HDO
0.99
0.93
0.99
0.96
0.92
2.02
3.00
2.03
1.14
1.03
2.33
f1 (ppm)
SO2F
N
5e
1H NMR (500 MHz, CDCl3)


73.257
SO2F
N
5e
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

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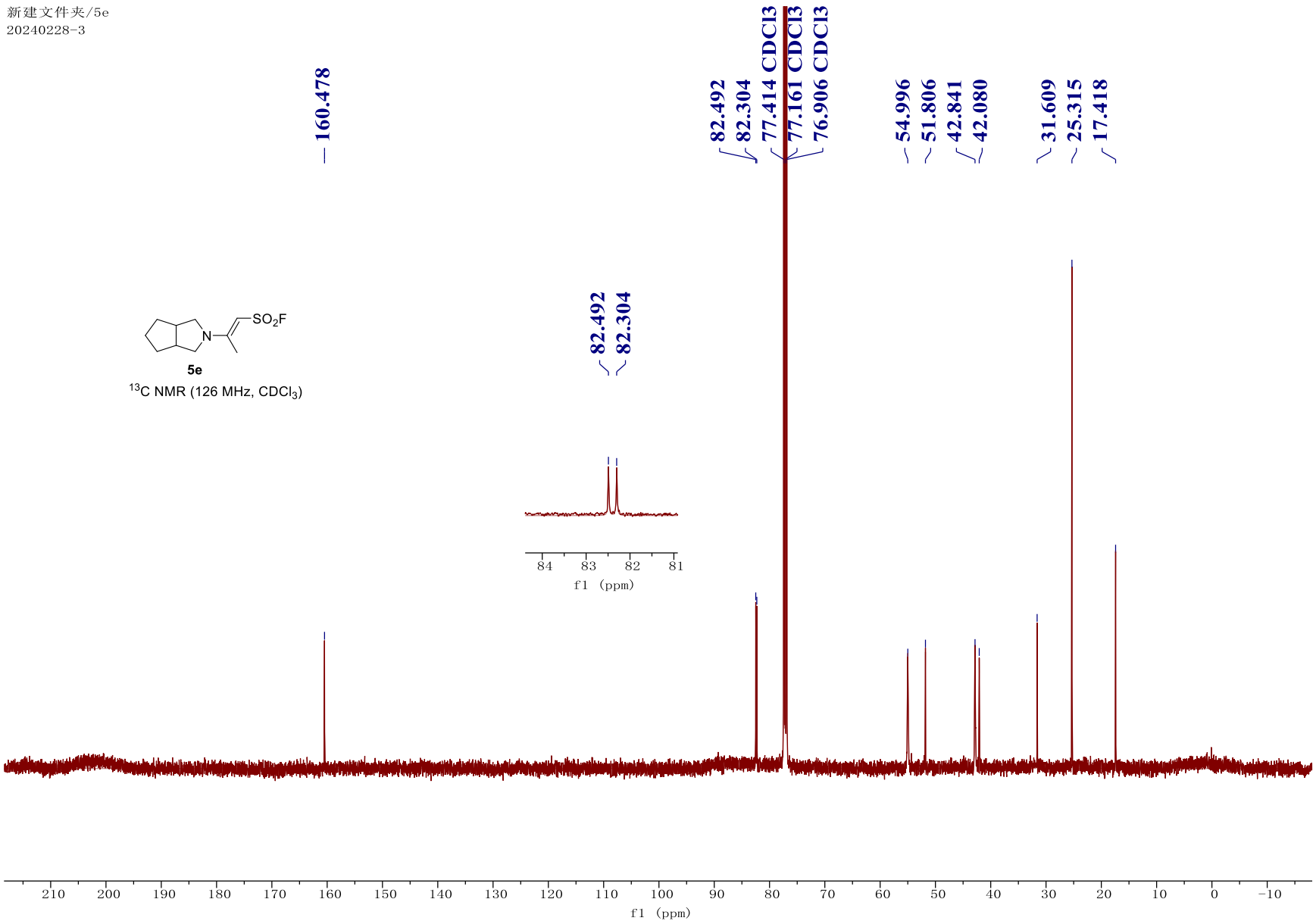
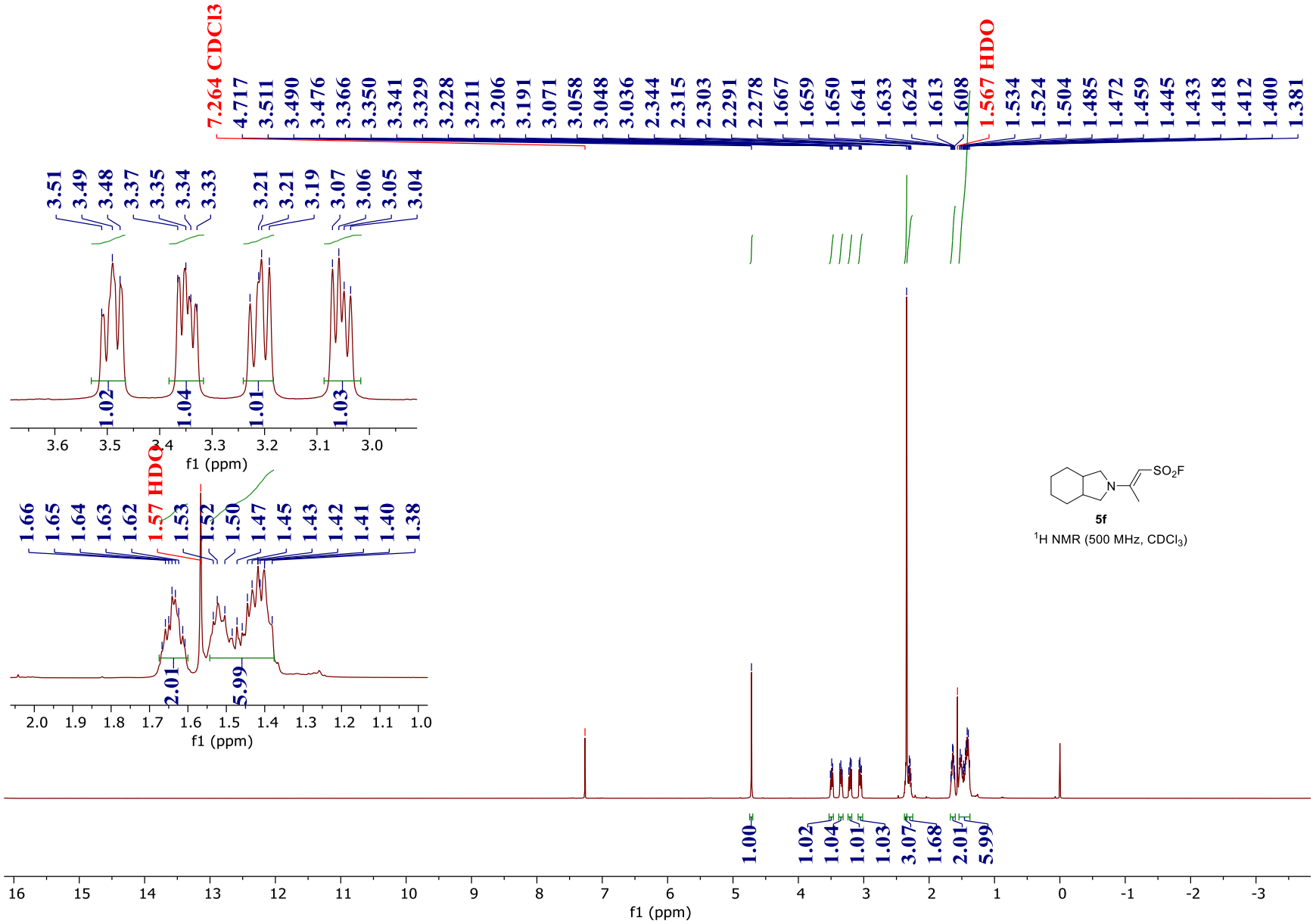
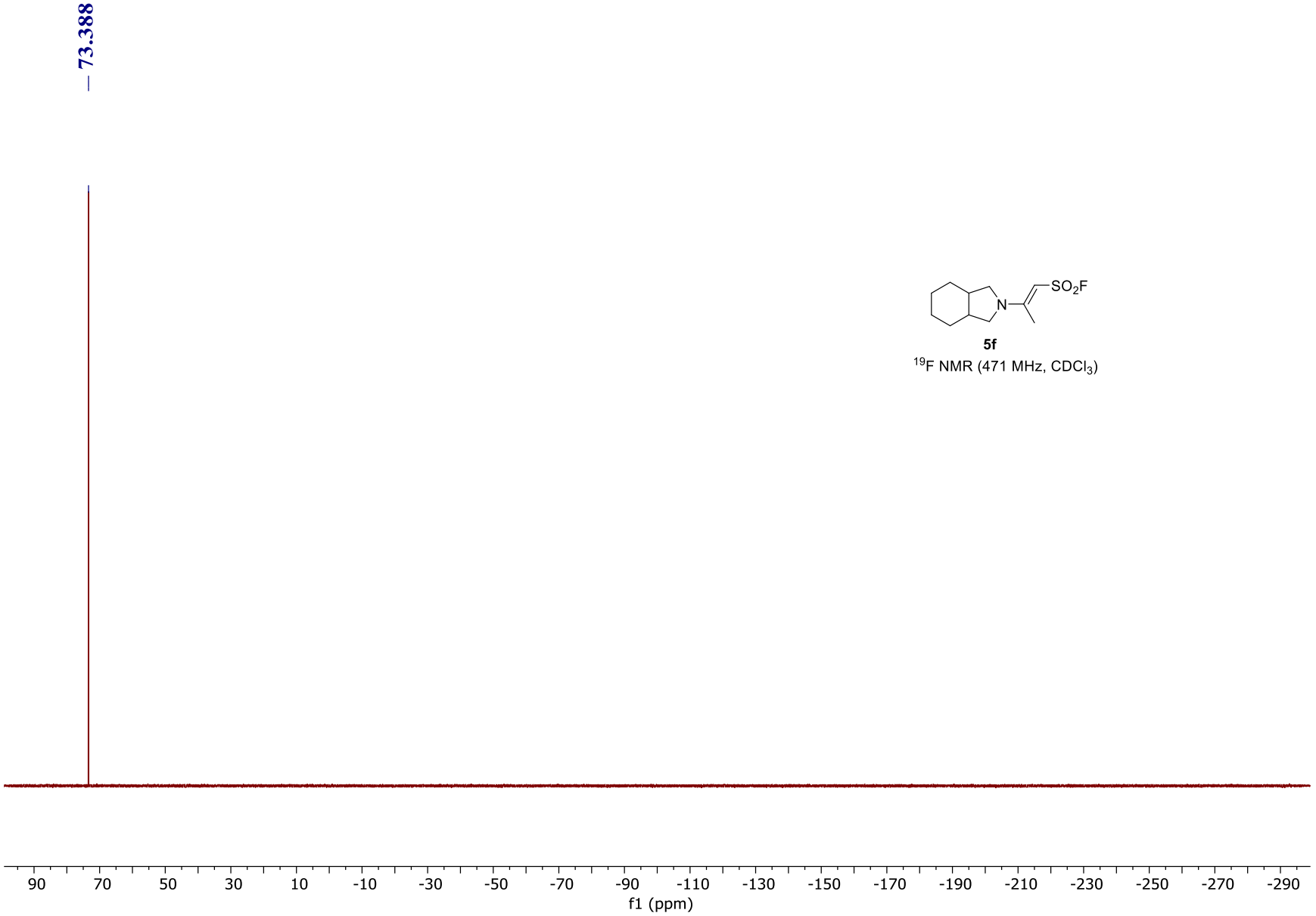
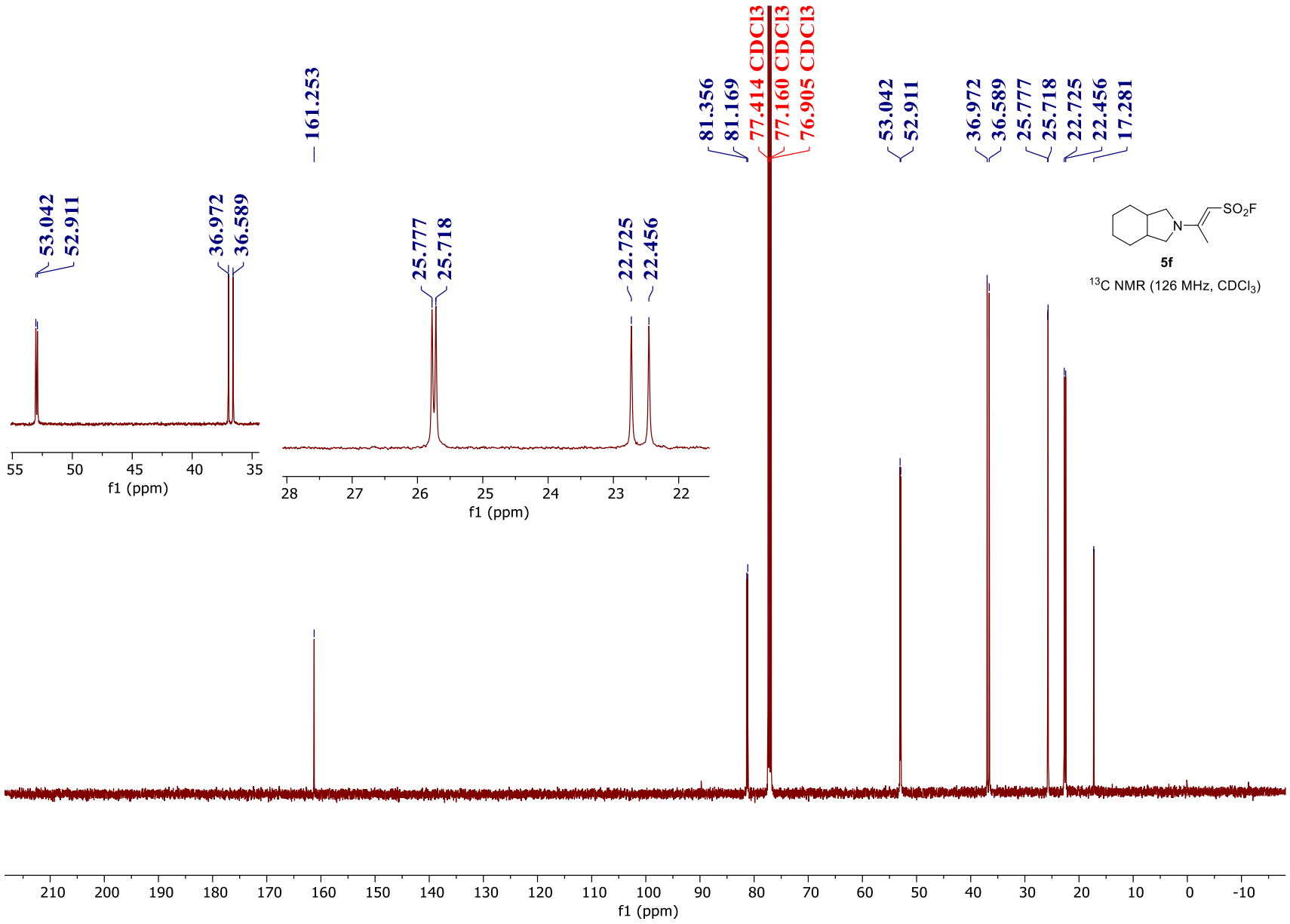
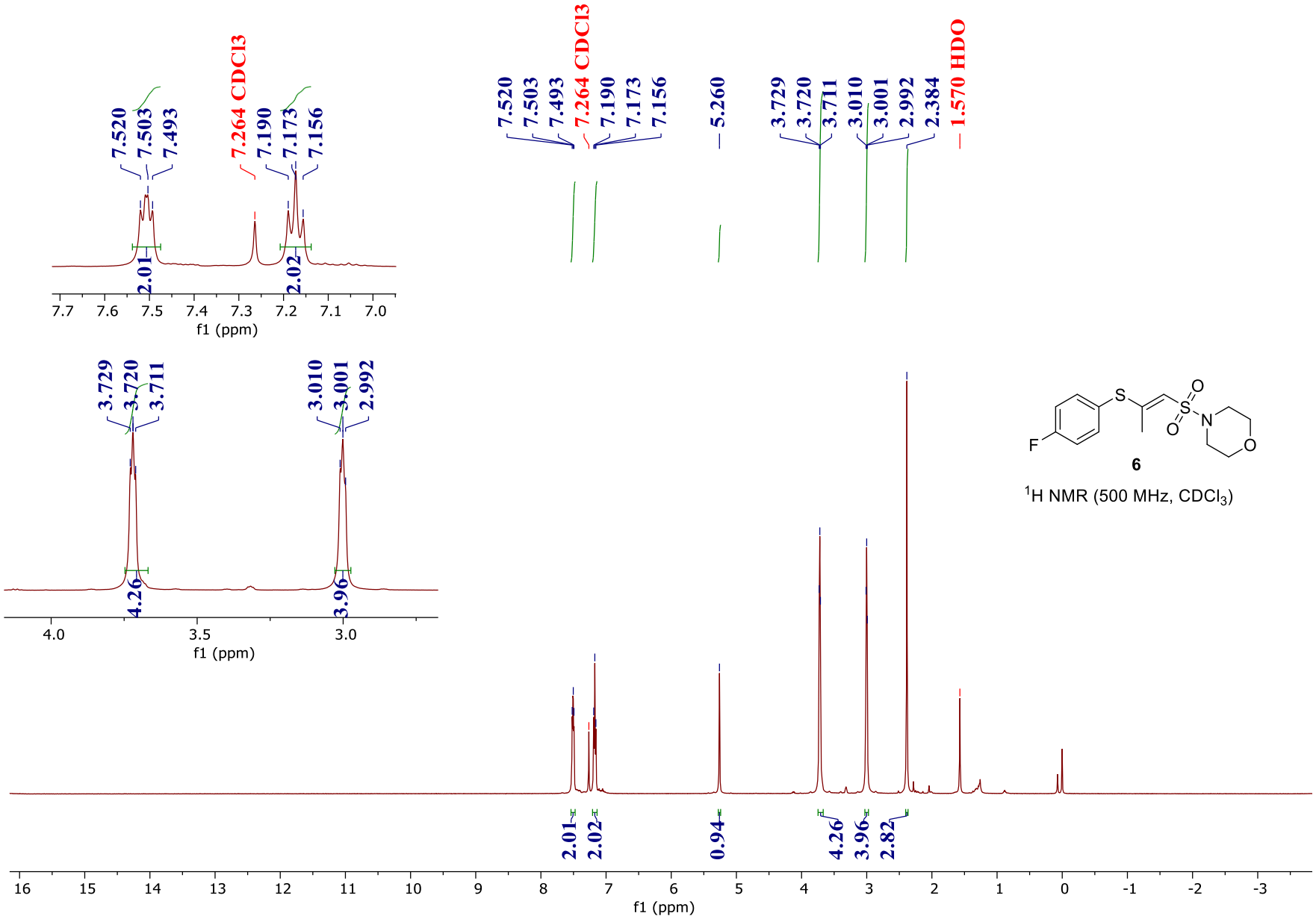
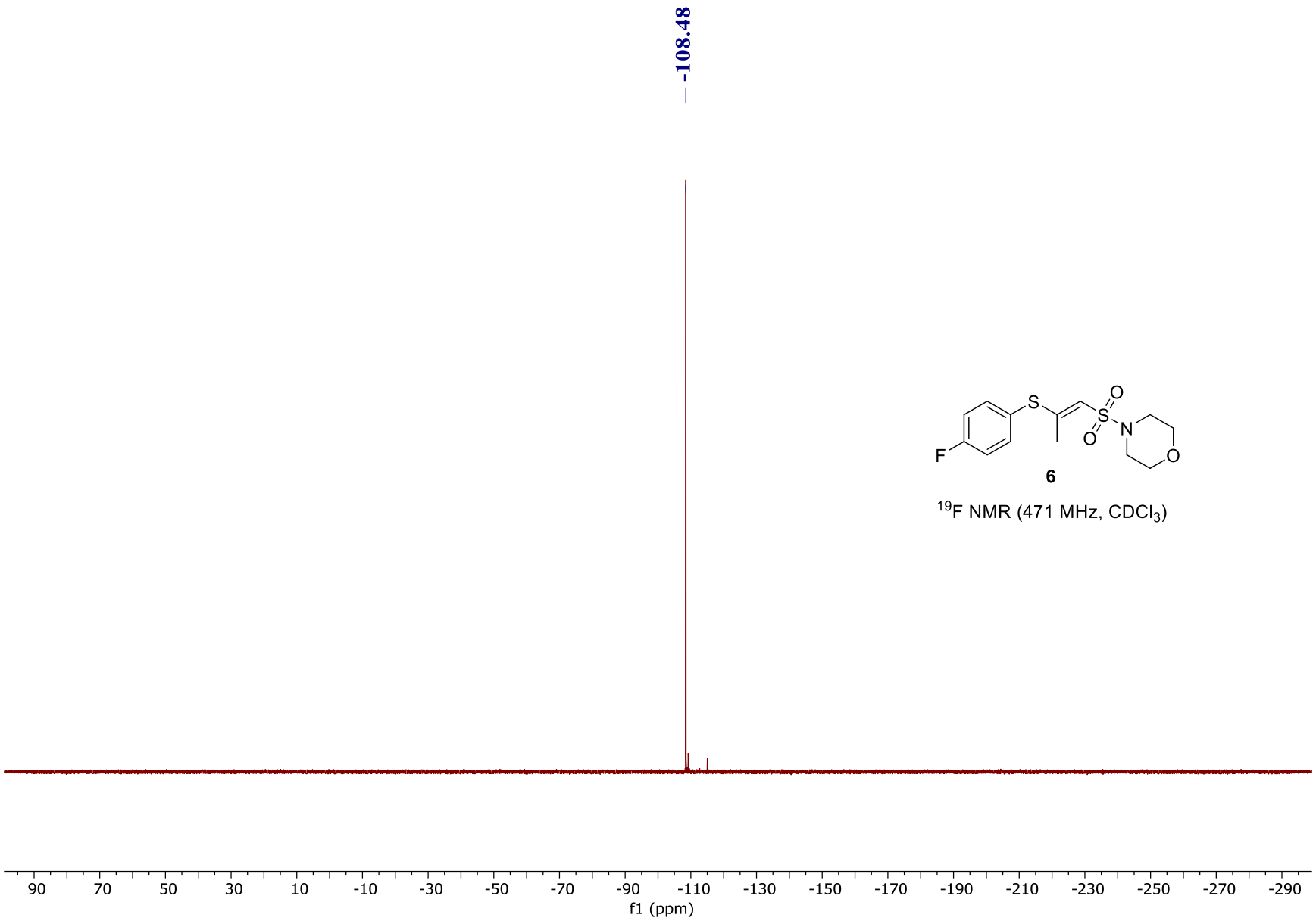


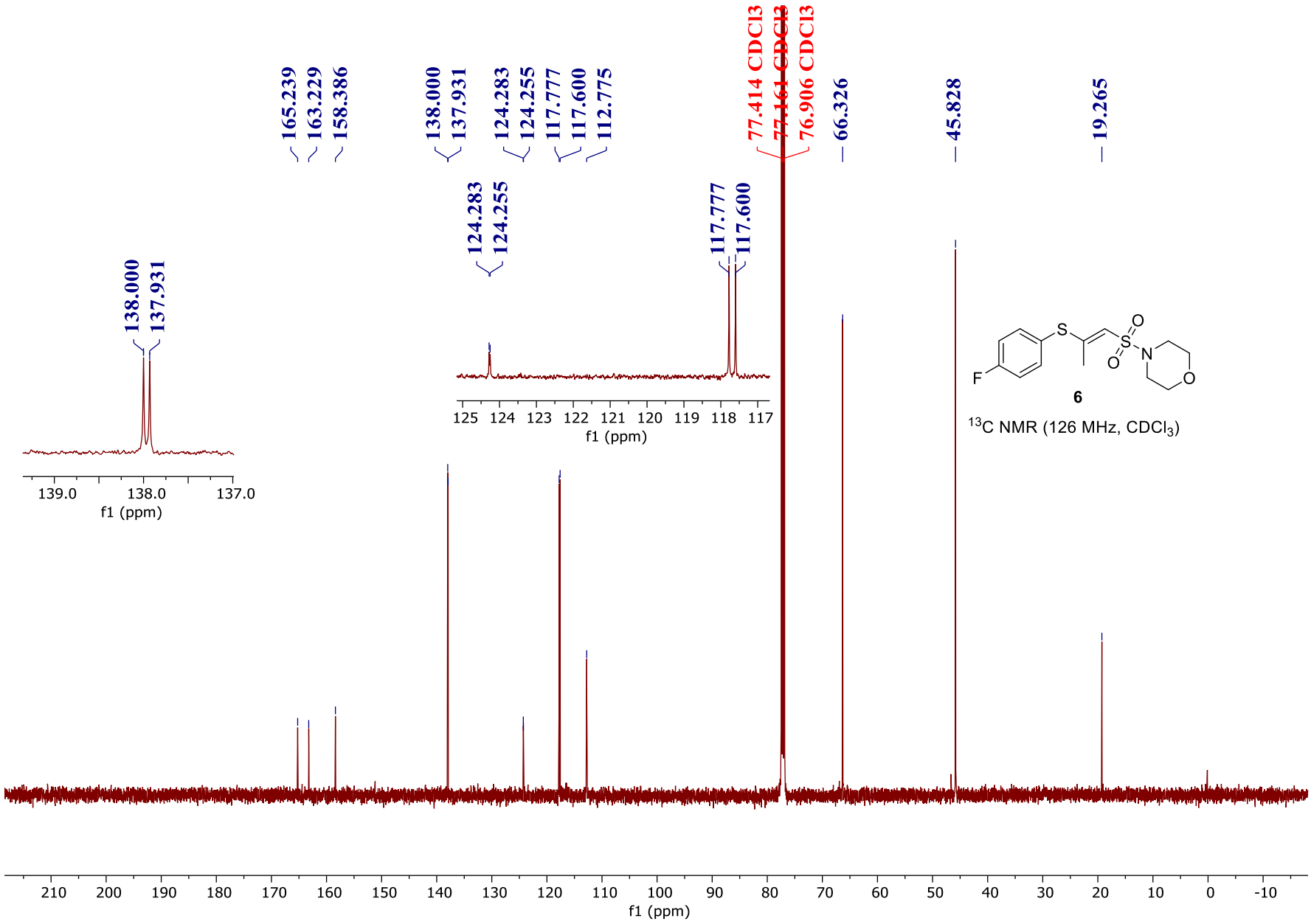

7.264 CDCl3
1.567 HDO
4.717
3.511
3.490
3.476
3.366
3.350
3.341
3.329
3.228
3.211
3.206
3.191
3.071
3.058
3.048
3.036
2.344
2.315
2.303
2.291
2.278
1.667
1.659
1.650
1.641
1.633
1.624
1.613
1.608
1.534
1.524
1.504
1.485
1.472
1.459
1.445
1.433
1.418
1.412
1.400
1.381
3.51
3.49
3.48
3.37
3.35
3.34
3.33
3.21
3.21
3.19
3.07
3.06
3.05
3.04
1.02
1.04
1.01
1.03
f1 (ppm)
1.66
1.65
1.64
1.63
1.62
1.57 HDO
1.53
1.52
1.50
1.47
1.45
1.43
1.42
1.41
1.40
1.38
2.01
5.99
f1 (ppm)
SO2F
N
5f
1H NMR (500 MHz, CDCl3)
1.00
1.02
1.04
1.01
1.03
3.07
1.68
2.01
5.99
f1 (ppm)

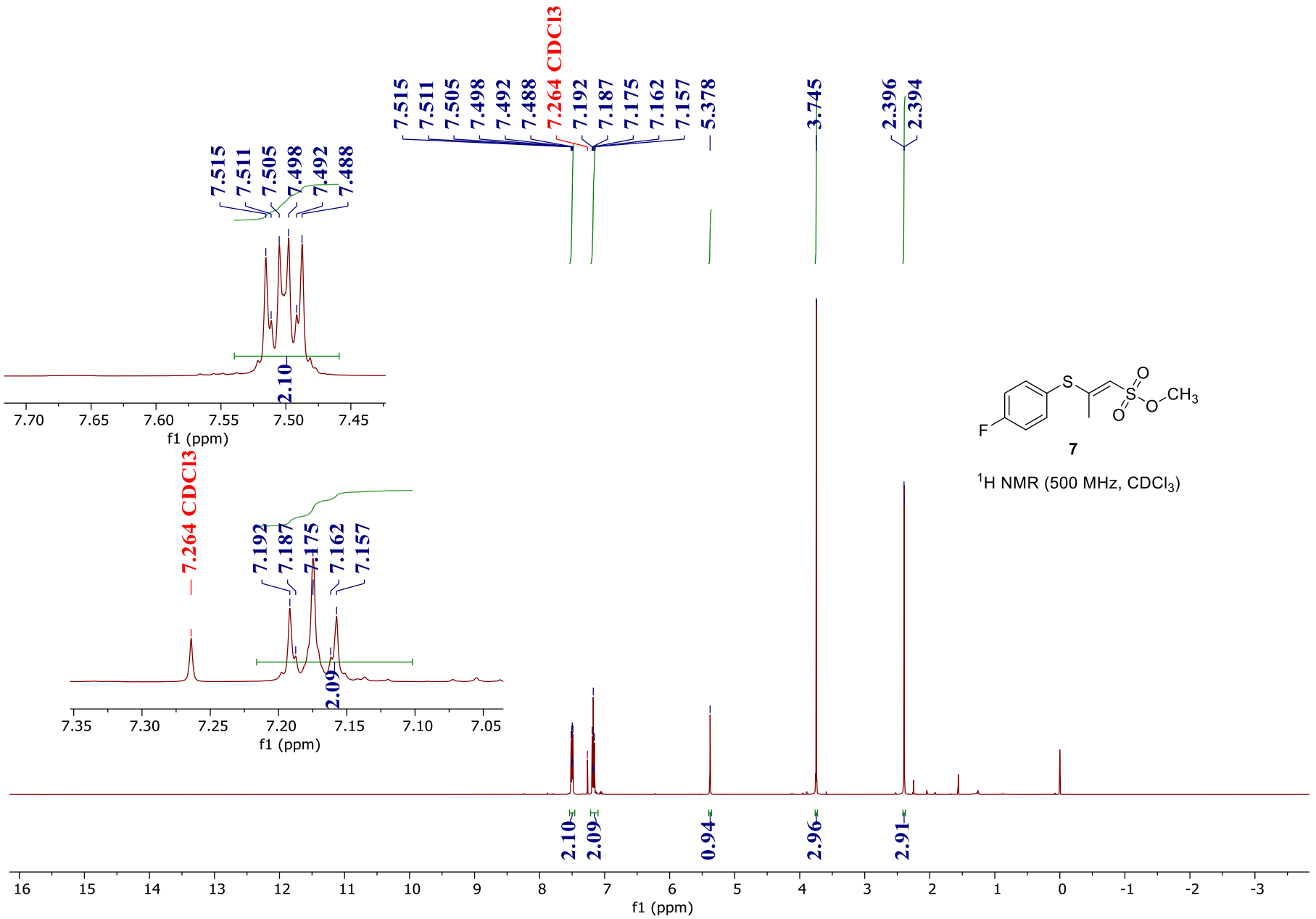

73.388
SO2F
N
5f
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

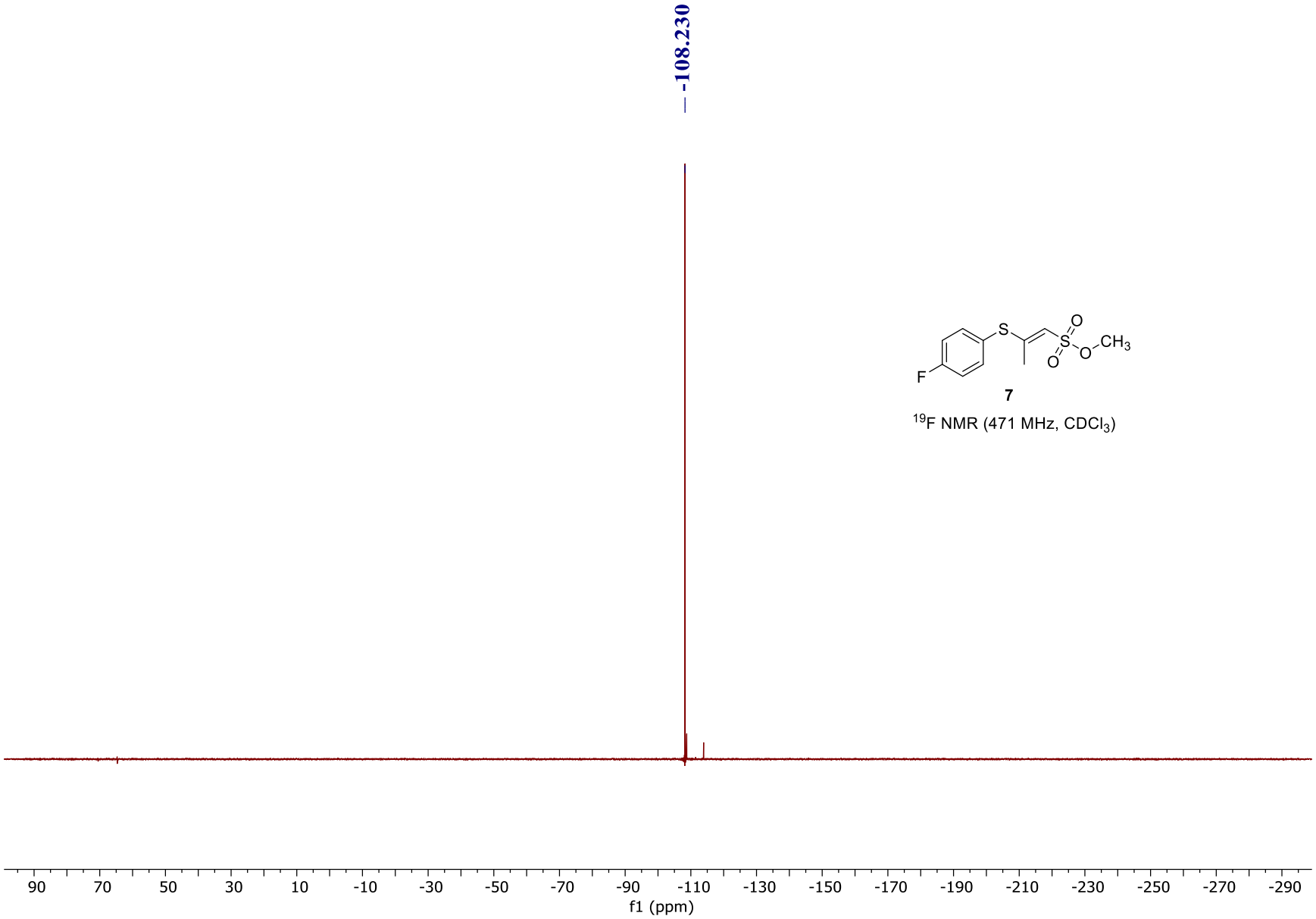

161.253
81.356
81.169
77.414 CDCl3
77.160 CDCl3
76.905 CDCl3
53.042
52.911
36.972
36.589
25.777
25.718
22.725
22.456
17.281
f1 (ppm)
SO2F
N
5f
13C NMR (126 MHz, CDCl3)


7.520
7.503
7.493
7.264 CDCl3
7.190
7.173
7.156
5.260
3.729
3.720
3.711
3.010
3.001
2.992
2.384
1.570 HDO
2.01
2.02
f1 (ppm)
4.26
3.96
F
S
O
S
O
N
O
6
1H NMR (500 MHz, CDCl3)
0.94
2.82


-108.48
F
S
O
S
O
N
O
6
^{19}F NMR (471 MHz, $CDCl_3$)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

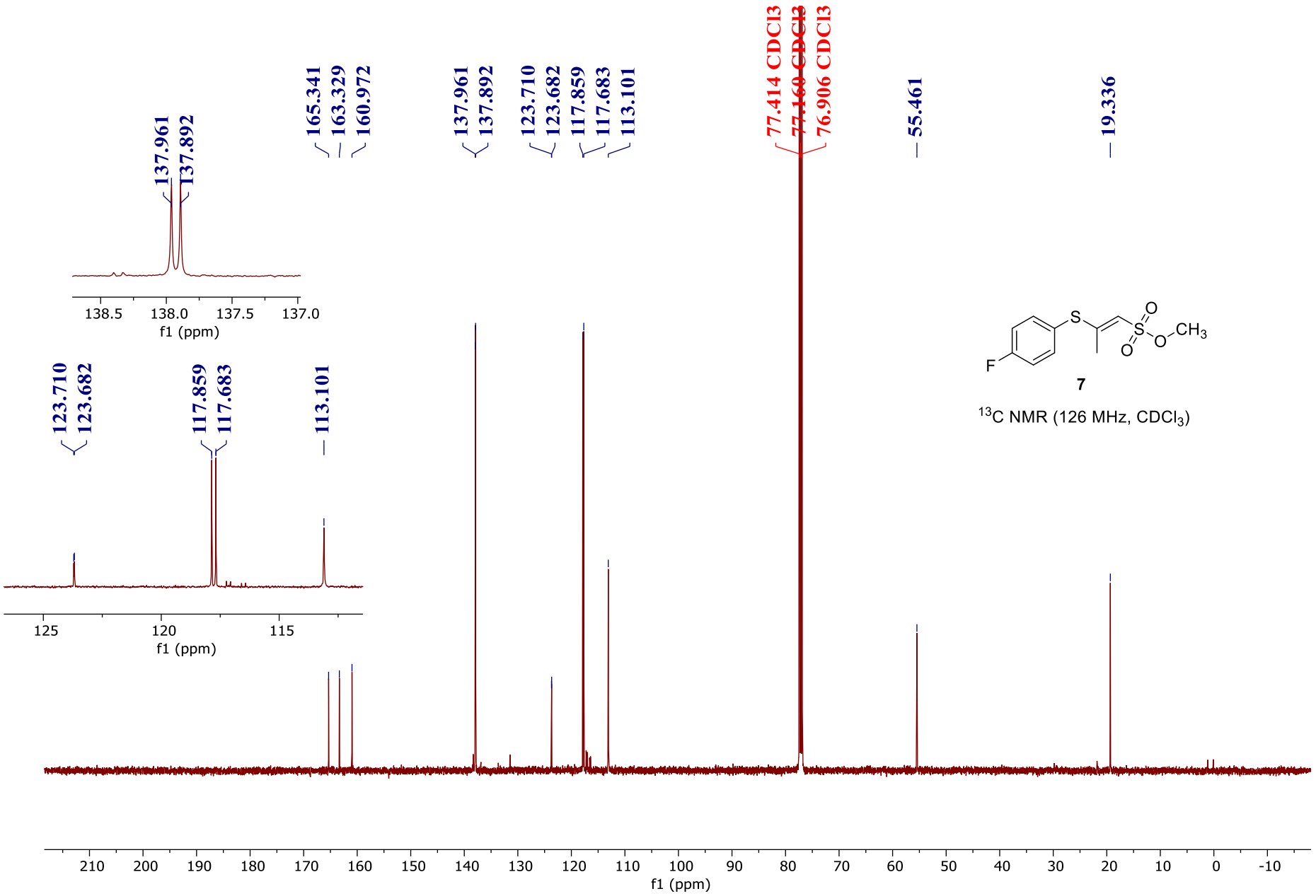

165.239
163.229
158.386
138.000
137.931
124.283
124.255
117.777
117.600
112.775
77.414 CDCl3
77.161 CDCl3
76.906 CDCl3
66.326
45.828
19.265
138.000
137.931
139.0
138.0
137.0
f1 (ppm)
124.283
124.255
117.777
117.600
125 124 123 122 121 120 119 118 117
f1 (ppm)
S
O
S
O
N
O
F
6
13C NMR (126 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

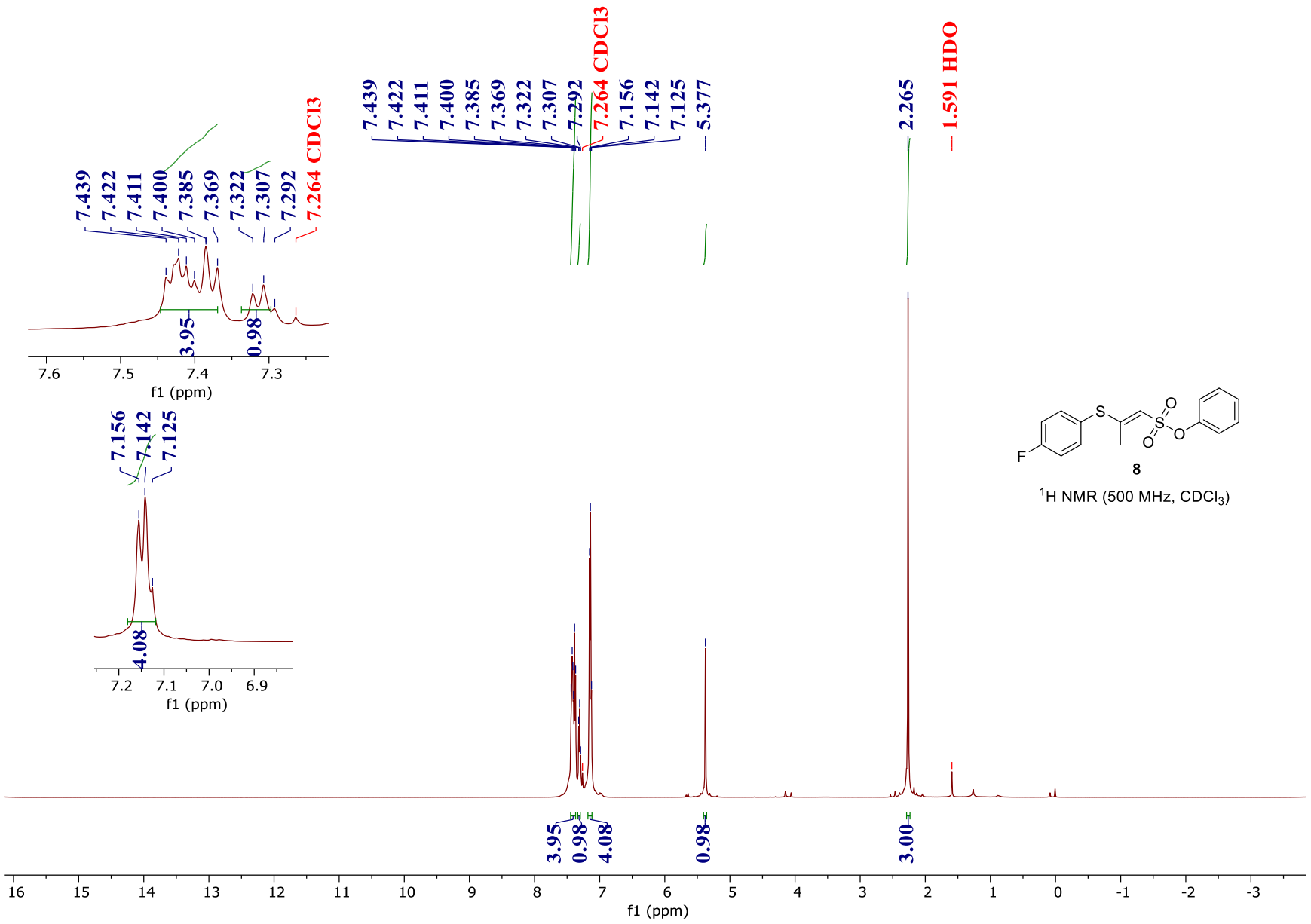

7.515
7.511
7.505
7.498
7.492
7.488
7.264 CDCl3
7.192
7.187
7.175
7.162
7.157
5.378
3.745
2.396
2.394
2.10
2.09
0.94
2.96
2.91
f1 (ppm)
F
S
O
O
O
CH3
7
1H NMR (500 MHz, CDCl3)

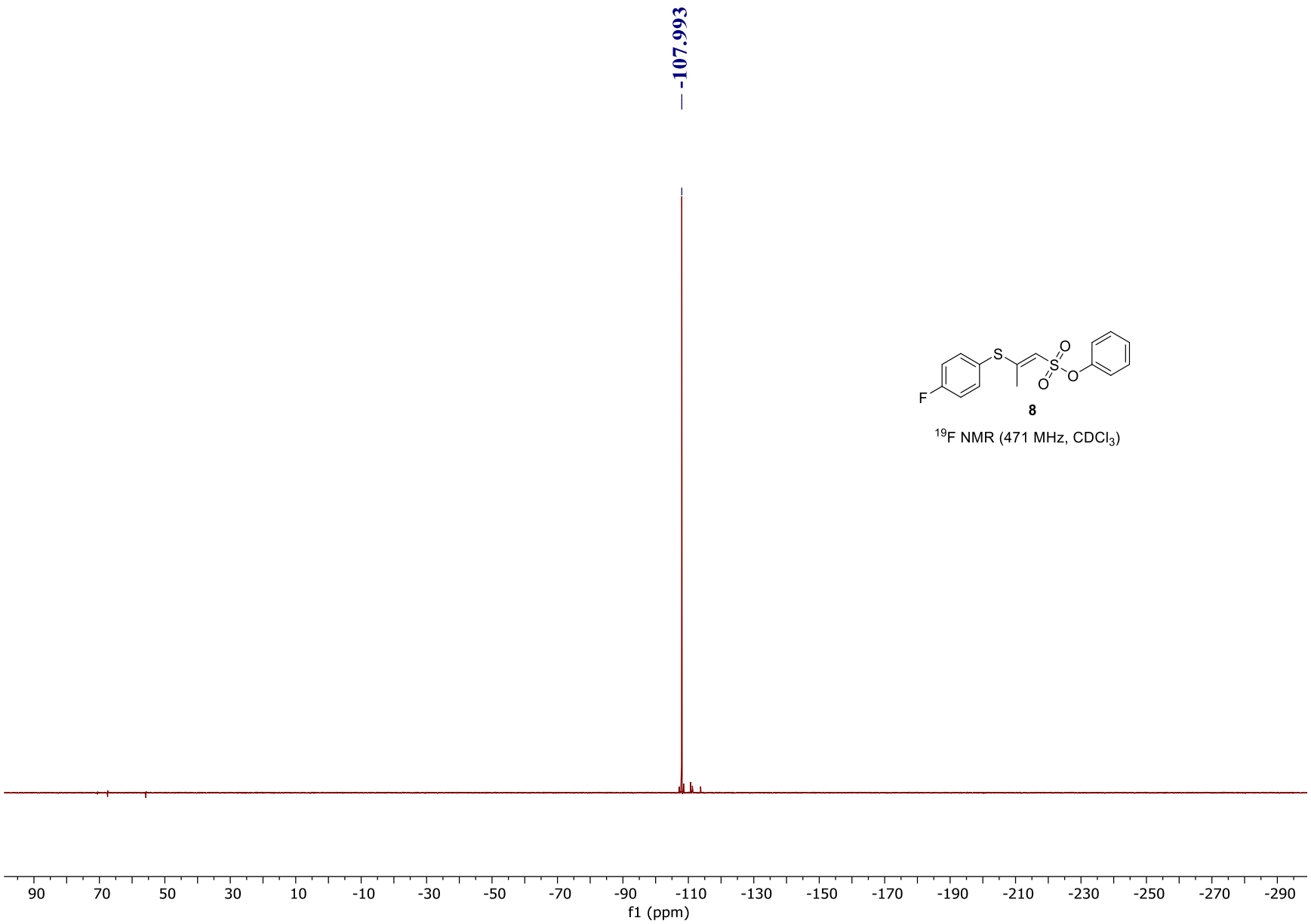


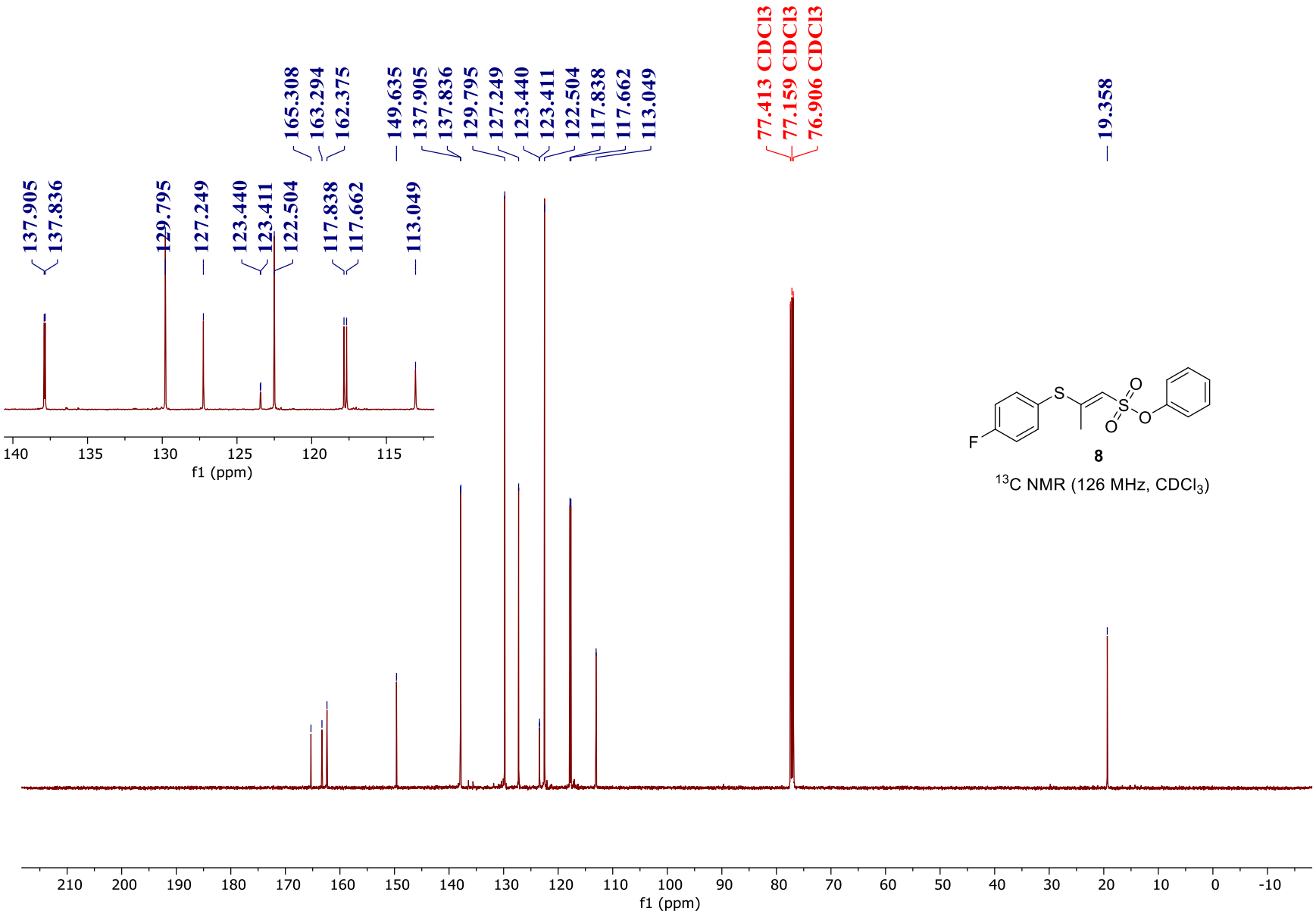
7

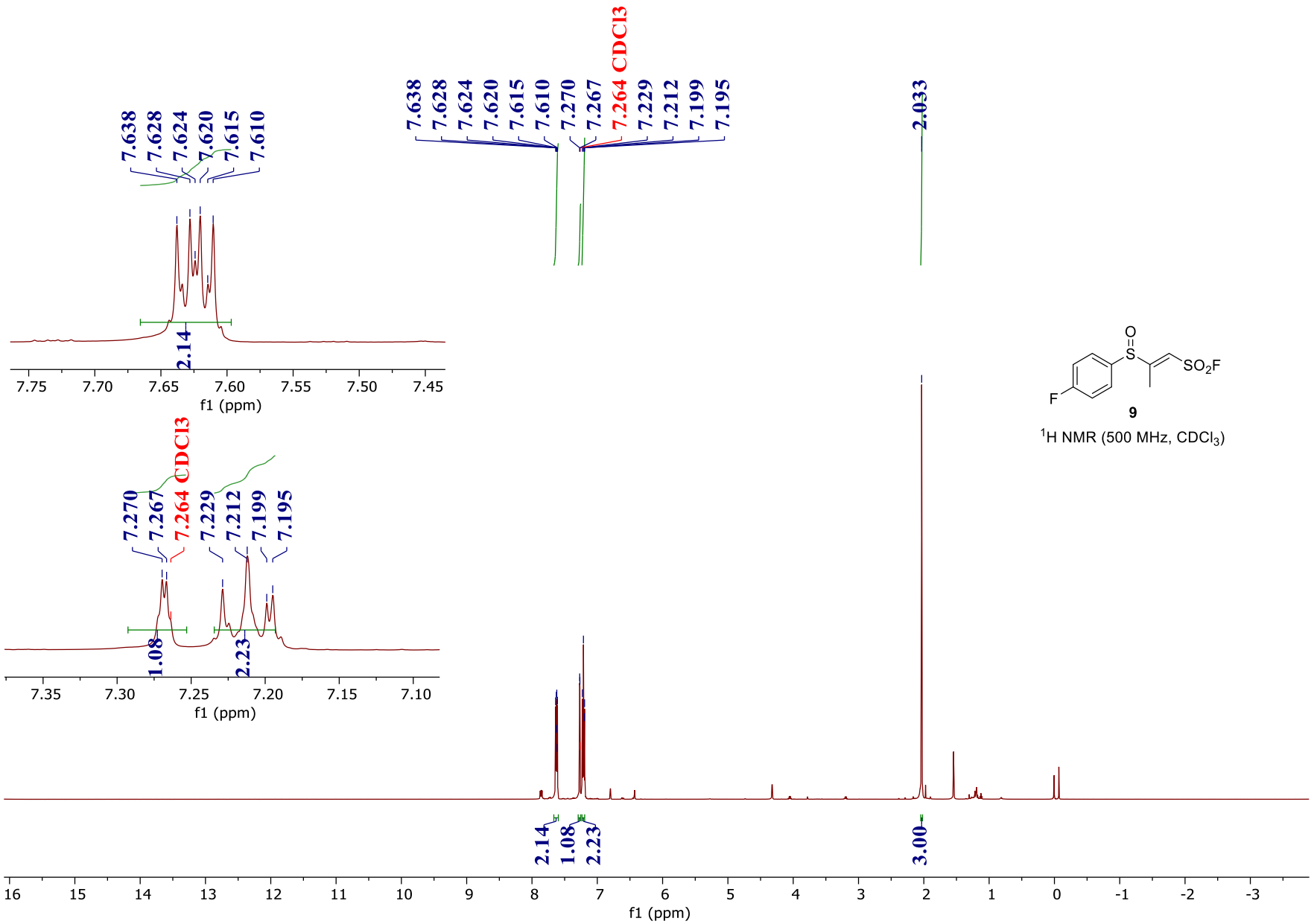
^{19}F NMR (471 MHz, $CDCl_3$)

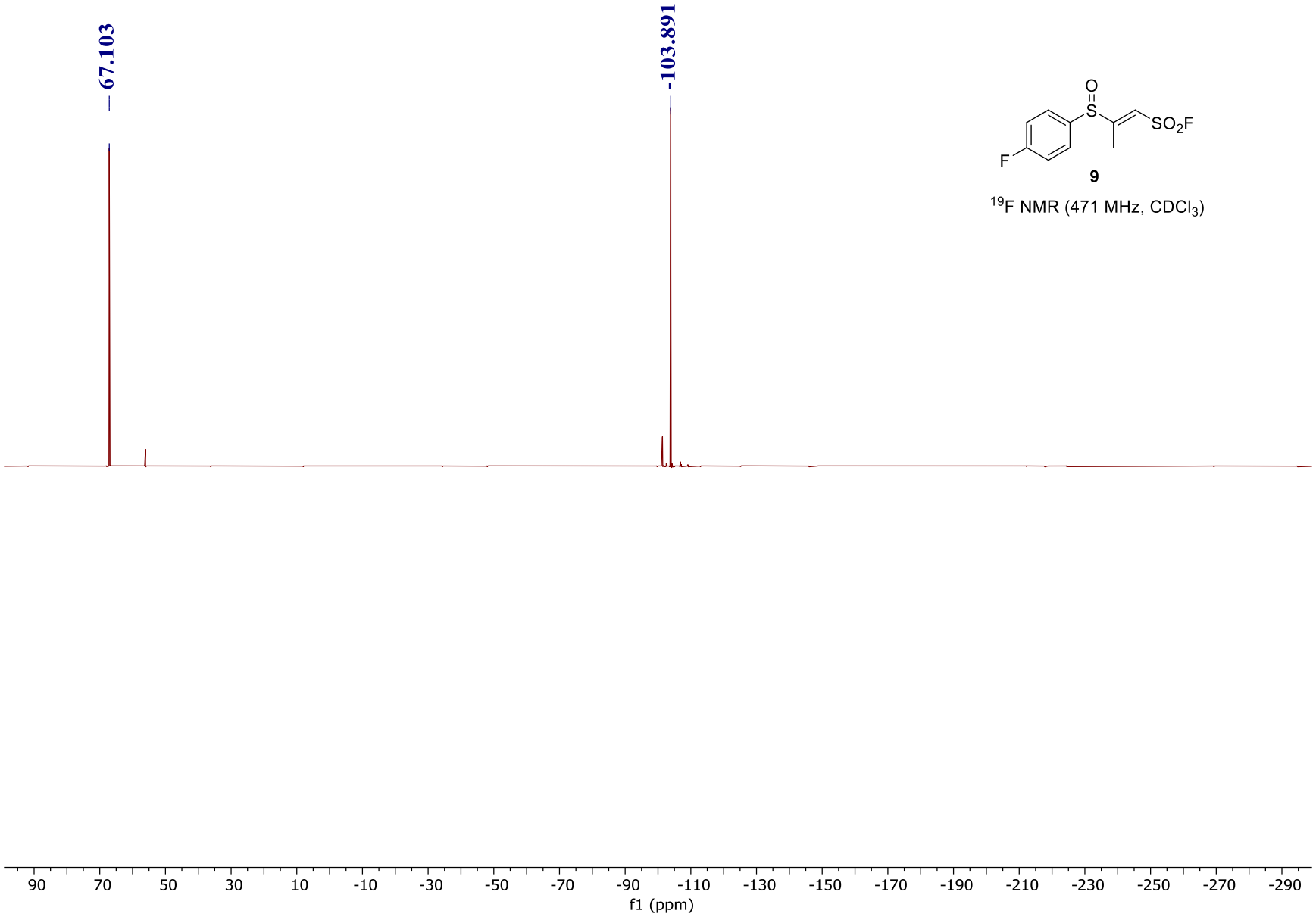

165.341
163.329
160.972
137.961
137.892
123.710
123.682
117.859
117.683
113.101
77.414 CDCl3
77.160 CDCl3
76.906 CDCl3
55.461
19.336
f1 (ppm)
7
13C NMR (126 MHz, CDCl3)


7.439
7.422
7.411
7.400
7.385
7.369
7.322
7.307
7.292
7.264 CDCl3
7.156
7.142
7.125
5.377
2.265
1.591 HDO
3.95
0.98
4.08
0.98
3.00
f1 (ppm)
F
S
O
O
O
8
1H NMR (500 MHz, CDCl3)


-107.993
F
S
O
S
O
O
8
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)

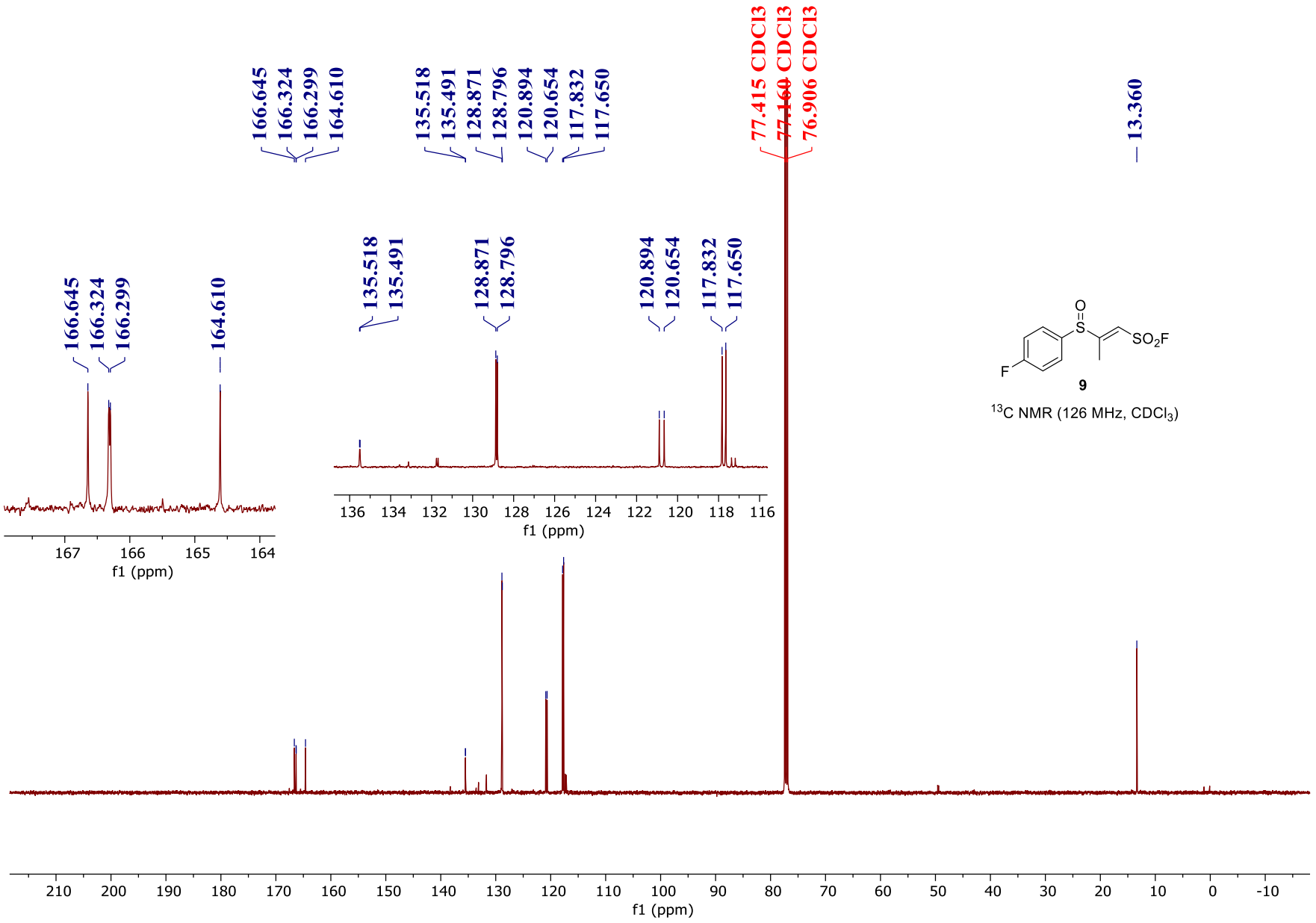

165.308
163.294
162.375
149.635
137.905
137.836
129.795
127.249
123.440
123.411
122.504
117.838
117.662
113.049
77.413 CDCl3
77.159 CDCl3
76.906 CDCl3
19.358
f1 (ppm)
F
S
O
O
O
8
13C NMR (126 MHz, CDCl3)

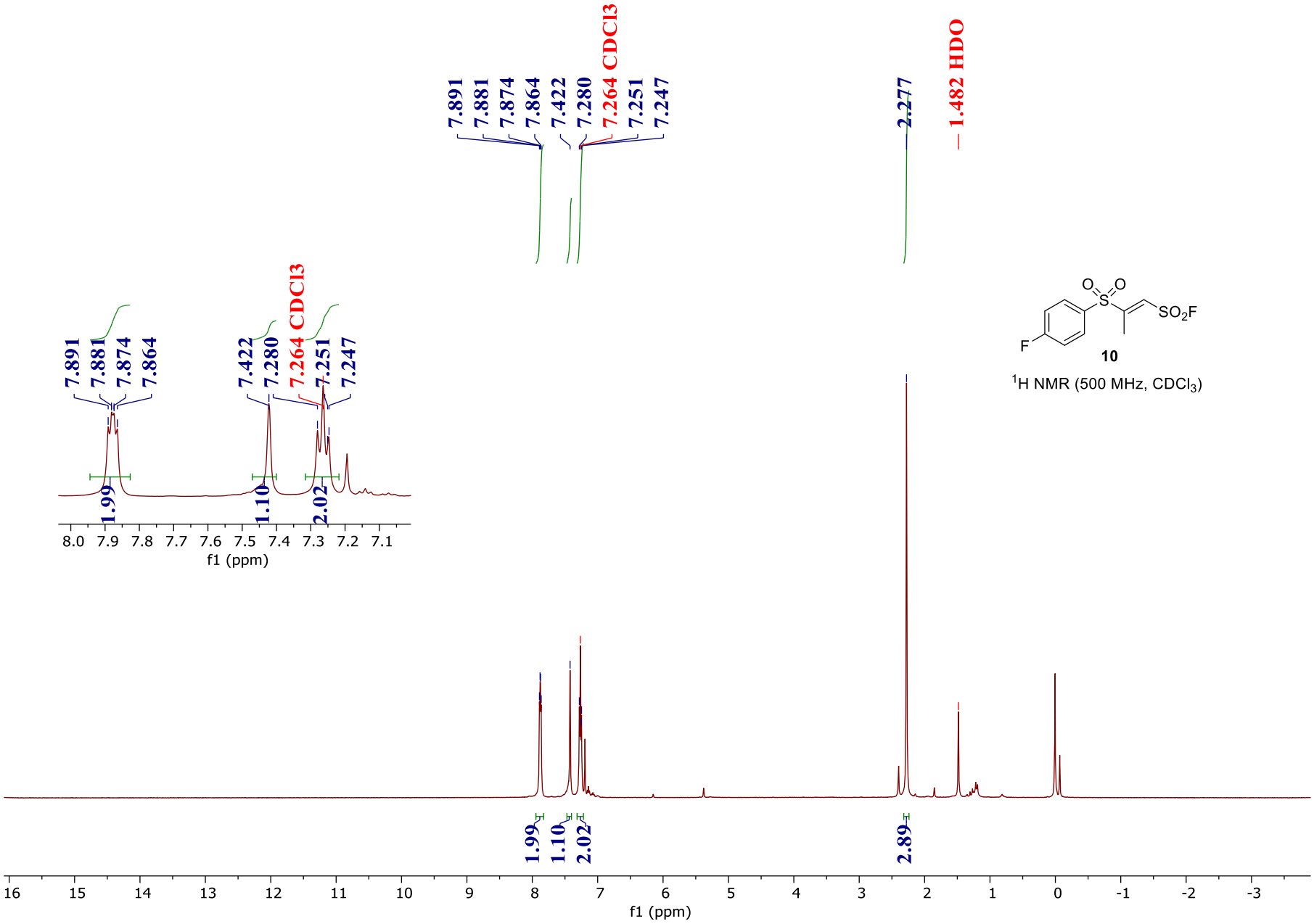

7.638
7.628
7.624
7.620
7.615
7.610
7.270
7.267
7.264 CDCl3
7.229
7.212
7.199
7.195
2.033
2.14
1.08
2.23
3.00
f1 (ppm)
O
S
SO2F
F
9
1H NMR (500 MHz, CDCl3)

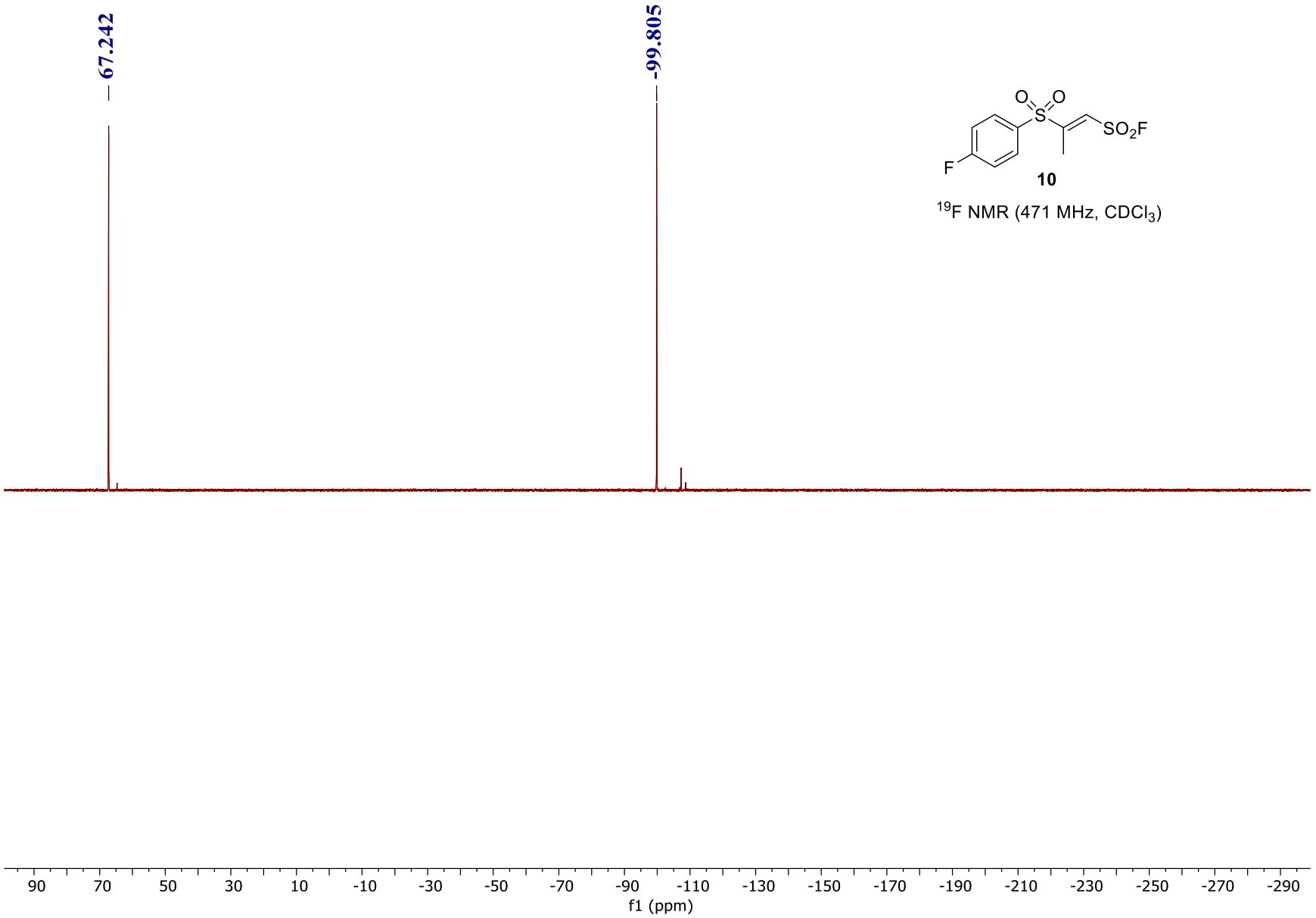


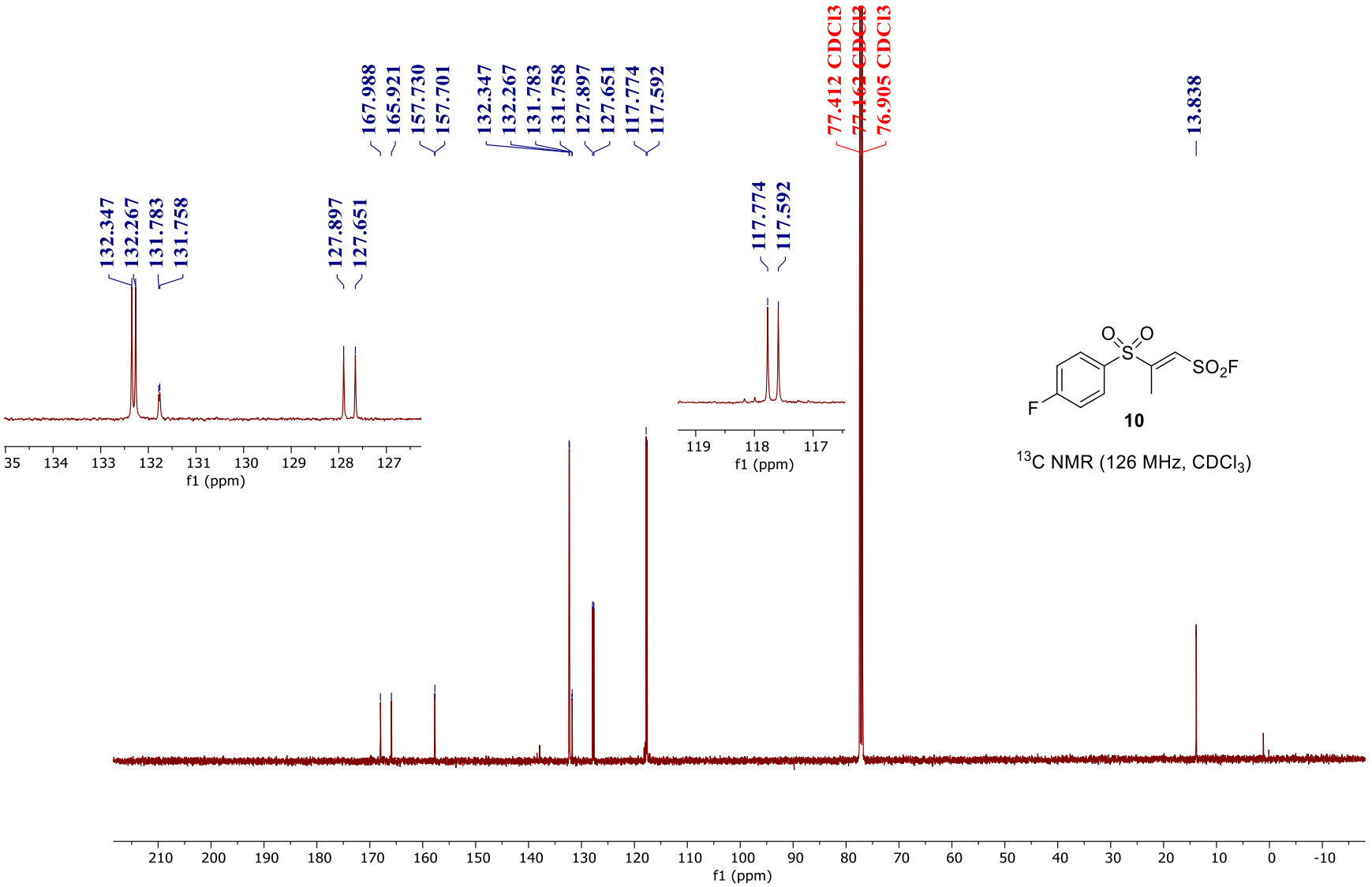
9

^{19}F NMR (471 MHz, $CDCl_3$)


166.645
166.324
166.299
164.610
135.518
135.491
128.871
128.796
120.894
120.654
117.832
117.650
77.415 CDCl3
77.160 CDCl3
76.906 CDCl3
13.360
f1 (ppm)
O
S
SO2F
F
9
13C NMR (126 MHz, CDCl3)


7.891
7.881
7.874
7.864
7.422
7.280
7.264 CDCl3
7.251
7.247
2.277
1.482 HDO
1.99
1.10
2.02
2.89
f1 (ppm)
10
^{1}H NMR (500 MHz, $CDCl_3$)


-67.242
-99.805
O
O
S
SO2F
F
10
19F NMR (471 MHz, CDCl3)
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130
-150
-170
-190
-210
-230
-250
-270
-290
f1 (ppm)


167.988
165.921
157.730
157.701
132.347
132.267
131.783
131.758
127.897
127.651
117.774
117.592
77.412 CDCl3
77.162 CDCl3
76.905 CDCl3
13.838
f1 (ppm)
10
13C NMR (126 MHz, CDCl3)