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Supporting Information

A General Amino Acid Synthesis Enabled by Innate Radical Cross-Coupling

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Table of Contents

General Experimental **S13**

Handling of [Ni] Catalysts **S13**

General Procedure for the Synthesis of TCNHPI Redox-Active Esters (General Procedure A) **S14**

Optimization for Amino Acid Synthesis **S16**

General Procedure for Sulfinimine Synthesis (General Procedure B) **S19**

Graphical Supporting Information for Sulfinimine Synthesis (General Procedure B) **S20**

Compound SI-1 ..... S23

Compound SI-2 ..... S26

General Procedure for Decarboxylative Amino Acid Synthesis (General Procedure C) **S28**

Graphical Supporting Information for Decarboxylative Amino Acid Synthesis (General Procedure C) **S29**

General Procedure for One-Pot Activation of Carboxylic Acids in Amino Acid Synthesis (General Procedure D) **S32**

General Procedure when Using Benzyl Bromide for Amino Acid Synthesis (General Procedure E) **S33**

Troubleshooting: Frequently Asked Questions **S34**

Part I. Redox-Active Ester Synthesis S34

Part II. Preparation of Sulfinimine Reagents S34

Part III. Decarboxylative Amino Acid Synthesis S36

Part IV. One-pot Activation of Carboxylic Acids for Decarboxylative Amino Acid Synthesis S38

Experimental Procedures and Characterization Data for Acids **S40**

Compound SI-3 ..... S40

Compound SI-4 ..... S41

Compound SI-5 ..... S41

Experimental Procedures and Characterization Data for Redox-Active Esters S43

Compound SI-6 ..... S43

Compound SI-7 ..... S43

Compound SI-8 ..... S44

Compound SI-9 ..... S45

Compound SI-10 ..... S45

Compound SI-11 ..... S46

Compound SI-12 ..... S47

Compound SI-13 ..... S47

Compound SI-14 ..... S48

Compound SI-15 ..... S49

Compound SI-16 ..... S49

Compound SI-17 ..... S50

Compound SI-18 ..... S51

Compound SI-19 ..... S51

Compound SI-20 ..... S52

Compound SI-21 ..... S53

Compound SI-22 ..... S53

Compound SI-23 ..... S54

Compound SI-24 ..... S55

Compound SI-25 ..... S56

Compound SI-26 ..... S57

Experimental Procedures and Characterization Data for Sulfinimines..... S58

Compound 2 ..... S58

Compound 2b S58

Experimental Procedures and Characterization Data for Amino Acids S60

Compound 3 ..... S60

Compound 8 ..... S61

Compound 9 ..... S61

Compound 10 ..... S62

Compound 11 ..... S63
Compound 12 ..... S63
Compound 13 ..... S64
Compound 14 ..... S65
Compound 15 ..... S66
Compound 16 ..... S66
Compound 17 ..... S67
Compound 18 ..... S68
Compound 19 ..... S69
Compound 20 ..... S69
Compound 21 ..... S70
Compound 22 ..... S71
Compound 23 ..... S71
Compound 24 ..... S72
Compound 25 ..... S73
Compound 26 ..... S74
Compound 27 ..... S75
Compound 28 ..... S75
Compound 29 ..... S76
Compound 30 ..... S77
Compound 31 ..... S78
Compound 32 ..... S79
Compound 33 ..... S80
Compound 34 ..... S80
Compound 35 ..... S81
Compound 36 ..... S82
Compound 37 ..... S83
Compound 38 ..... S84
Compound 39 ..... S84
Compound 40 ..... S85

Compound 41 ..... S86
Compound 42 ..... S87
Compound 43 ..... S87
Compound 44 ..... S88
Compound 45 ..... S89
Compound 46 ..... S90
Compound 47 ..... S91
Compound 48 ..... S91
Compound 49 ..... S92
Compound 50 ..... S93
Compound 51 ..... S94
Compound 52 ..... S95
Compound 53 ..... S96
Compound 54 ..... S97
Compound 56 ..... S99
Compound 58 ..... S101
Compound 59 ..... S103
Compound 60 ..... S104
Compound 61 ..... S104
Compound 62 ..... S105
Compound 63 ..... S106
Compound 63-a S107
Compound 64 ..... S107
Compound 65 ..... S108
Compound 66 ..... S109
Library Synthesis Procedure S110
Amino Ester Data from Library Synthesis..... S112
Compound 68b S112
Compound 69b S113
Compound 70b S113

Compound 71b S114
Compound 72b S115
Compound 74b S116
Compound 75b S117
Compound 76b S118
Compound 77b S119
Compound 78b S120
Compound 79b S121
Compound 80b S122
Compound 82b S122
Compound 84-1 ..... S123
Compound 84b S124
Compound 85b S124
Compound 86b S125
Compound 87b S125
Compound 88b S126
Compound 89b S127
Compound 91b S127
Compound 92b S128
Compound 94b S129
Compound 95b S129
Compound 96b S130
Compound 97b S130
X-Ray Crystallographic Data for Compound 3 ..... S132
X-Ray Crystallographic Data for Compound 50 ..... S137
References S142
Spectra for Redox-Active Esters S145
Compound SI-6 ^{1}H NMR S145
Compound SI-6 ^{13}C NMR S146
Compound SI-7 ^{1}H NMR S147

Compound SI-7 ^{13}C NMR S148
Compound SI-8 ^{1}H NMR S149
Compound SI-8 ^{13}C NMR S150
Compound SI-9 ^{1}H NMR S151
Compound SI-9 ^{13}C NMR S152
Compound SI-10 ^{1}H NMR S153
Compound SI-10 ^{13}C NMR S154
Compound SI-11 ^{1}H NMR S155
Compound SI-11 ^{13}C NMR S156
Compound SI-12 ^{1}H NMR S157
Compound SI-12 ^{13}C NMR S158
Compound SI-13 ^{1}H NMR S159
Compound SI-13 ^{13}C NMR S160
Compound SI-14 ^{1}H NMR S161
Compound SI-14 ^{13}C NMR S162
Compound SI-15 ^{1}H NMR S163
Compound SI-15 ^{13}C NMR S164
Compound SI-16 ^{1}H NMR S165
Compound SI-16 ^{13}C NMR S166
Compound SI-17 ^{1}H NMR S167
Compound SI-17 ^{13}C NMR S168
Compound SI-18 ^{1}H NMR S169
Compound SI-18 ^{13}C NMR S170
Compound SI-18 ^{19}F NMR S171
Compound SI-19 ^{1}H NMR S172
Compound SI-19 ^{13}C NMR S173
Compound SI-20 ^{1}H NMR S174
Compound SI-20 ^{13}C NMR S175
Compound SI-21 ^{1}H NMR S176
Compound SI-21 ^{13}C NMR S177

Compound SI-22 ^{1}H NMR S178
Compound SI-22 ^{13}C NMR S179
Compound SI-23 ^{1}H NMR S180
Compound SI-23 ^{13}C NMR S181
Compound SI-24 ^{1}H NMR S182
Compound SI-24 ^{13}C NMR S183
Compound SI-25 ^{1}H NMR S184
Compound SI-25 ^{13}C NMR S185
Spectra for Sulfinimines S186
Compound 2 ^{1}H NMR S186
Compound 2 ^{13}C NMR S187
Compound 2b ^{1}H NMR S188
Compound 2b ^{13}C NMR S189
Spectra for Decarboxylative Addition Products S190
Compound 3 ^{1}H NMR S190
Compound 3 ^{13}C NMR S191
Compound 8 ^{1}H NMR S192
Compound 8 ^{13}C NMR S193
Compound 9 ^{1}H NMR S194
Compound 9 ^{13}C NMR S195
Compound 10 ^{1}H NMR S196
Compound 10 ^{13}C NMR S197
Compound 11 ^{1}H NMR S198
Compound 11 ^{13}C NMR S199
Compound 12 ^{1}H NMR S200
Compound 12 ^{13}C NMR S201
Compound 13 ^{1}H NMR S202
Compound 13 ^{13}C NMR S203
Compound 14 ^{1}H NMR S204
Compound 14 ^{13}C NMR S205

Compound 15 ^{1}H NMR S206
Compound 15 ^{13}C NMR S207
Compound 16 ^{1}H NMR S208
Compound 16 ^{13}C NMR S209
Compound 17 ^{1}H NMR S210
Compound 17 ^{13}C NMR S211
Compound 18 ^{1}H NMR S212
Compound 18 ^{13}C NMR S213
Compound 19 ^{1}H NMR S214
Compound 19 ^{13}C NMR S215
Compound 20 ^{1}H NMR S216
Compound 20 ^{13}C NMR S217
Compound 21 ^{1}H NMR S218
Compound 21 ^{13}C NMR S219
Compound 22 ^{1}H NMR S220
Compound 22 ^{13}C NMR S221
Compound 23 ^{1}H NMR S222
Compound 23 ^{13}C NMR S223
Compound 24 ^{1}H NMR S224
Compound 24 ^{13}C NMR S225
Compound 24 ^{19}F NMR S226
Compound 25 ^{1}H NMR S227
Compound 25 ^{13}C NMR S228
Compound 26 ^{1}H NMR S229
Compound 26 ^{13}C NMR S230
Compound 27 ^{1}H NMR S231
Compound 27 ^{13}C NMR S232
Compound 28 ^{1}H NMR S233
Compound 28 ^{13}C NMR S234
Compound 29 ^{1}H NMR S235

Compound 29 ^{13}C NMR S236
Compound 30 ^{1}H NMR S237
Compound 30 ^{13}C NMR S238
Compound 31 ^{1}H NMR S239
Compound 31 ^{13}C NMR S240
Compound 32 ^{1}H NMR S241
Compound 32 ^{13}C NMR S242
Compound 33 ^{1}H NMR S243
Compound 33 ^{13}C NMR S244
Compound 34 ^{1}H NMR S245
Compound 34 ^{13}C NMR S246
Compound 35 ^{1}H NMR S247
Compound 35 ^{13}C NMR S248
Compound 36 ^{1}H NMR S249
Compound 36 ^{13}C NMR S250
Compound 37 ^{1}H NMR S251
Compound 37 ^{13}C NMR S252
Compound 38 ^{1}H NMR S253
Compound 38 ^{13}C NMR S254
Compound 39 ^{1}H NMR S255
Compound 39 ^{13}C NMR S256
Compound 39 ^{19}F NMR S257
Compound 40 ^{1}H NMR S258
Compound 40 ^{13}C NMR S259
Compound 41 ^{1}H NMR S260
Compound 41 ^{13}C NMR S261
Compound 42 ^{1}H NMR S262
Compound 42 ^{13}C NMR S263
Compound 43 ^{1}H NMR S264
Compound 43 ^{13}C NMR S265

Compound 44 ^{1}H NMR S266
Compound 44 ^{13}C NMR S267
Compound 45 ^{1}H NMR S268
Compound 45 ^{13}C NMR S269
Compound 46 ^{1}H NMR S270
Compound 46 ^{13}C NMR S271
Compound 47 ^{1}H NMR S272
Compound 47 ^{13}C NMR S273
Compound 48 ^{1}H NMR S274
Compound 48 ^{13}C NMR S275
Compound 49 ^{1}H NMR S276
Compound 49 ^{13}C NMR S277
Compound 50 ^{1}H NMR S278
Compound 51 ^{13}C NMR S279
Compound 51 ^{1}H NMR S280
Compound 51 ^{13}C NMR S281
Compound 51 ^{19}F NMR S282
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Compound 53 ^{1}H NMR S285
Compound 53 ^{13}C NMR S286
Compound 54 ^{1}H NMR S287
Compound 54 ^{13}C NMR S288
Compound 56 ^{1}H NMR S289
Compound 56 ^{13}C NMR S290
Compound 56 ^{19}F NMR S291
Compound 56 HSQC 2D NMR S292
Compound 58 ^{1}H NMR S293
Compound 58 ^{13}C NMR S294
Compound 58 ^{19}F NMR S295

Compound 59 ^{1}H NMR S296
Compound 59 ^{13}C NMR S297
Compound 60 ^{1}H NMR S298
Compound 60 ^{13}C NMR S299
Compound 61 ^{1}H NMR S300
Compound 61 ^{13}C NMR S301
Compound 62 ^{1}H NMR S302
Compound 62 ^{13}C NMR S303
Compound 63 ^{1}H NMR S304
Compound 63 ^{13}C NMR S305
Compound 63-a ^{1}H NMR S306
Compound 63-a ^{13}C NMR S307
Compound 64 ^{1}H NMR S308
Compound 64 ^{13}C NMR S309
Compound 65 ^{1}H NMR S310
Compound 65 ^{13}C NMR S311
Compound 66 ^{1}H NMR S312
Compound 66 ^{13}C NMR S313
Compound 84-1 ^{1}H NMR S314
Compound 84-1 ^{13}C NMR S315

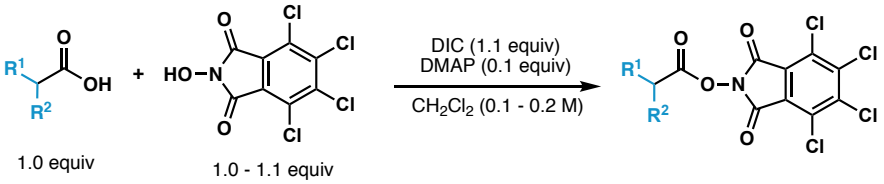
General Experimental

Tetrahydrofuran (THF), *N,N*-dimethylformamide (DMF), and dichloromethane (CH_2Cl_2) were obtained by passing the previously degassed solvents through an activated alumina column. Anhydrous *N*-methyl-2-pyrrolidone (NMP) was purchased from Sigma-Aldrich. DIC (*N,N'*-diisopropylcarbodiimide) and DCC (*N,N'*-dicyclohexylcarbodiimide) were purchased from Chem-Impex. $NiCl_2$•$6H_2O$ was purchased from Sigma-Aldrich (lot # MKBV1320V). All reagents were purchased at the highest commercial quality and used without further purification unless otherwise stated. Yields refer to chromatographically and spectroscopically (^{1}H NMR) homogeneous material, unless otherwise stated. Reactions were monitored by thin layer chromatography (TLC), GC/MS, GC/FID, or LC/MS. TLC was performed using 0.25 mm E. Merck silica plates (60F-254), using short-wave UV light as the visualizing agent, and phosphomolybdic acid, *p*-anisaldehyde, or $KMnO_4$ and heat as developing agents. NMR spectra were recorded on Bruker DRX-600, DRX-500, and AMX-400 instruments and are calibrated using residual undeuterated solvent ($CHCl_3$, CH_2Cl_2, DMSO, MeOH at 7.26, 5.32, 2.50 and 3.31 ppm for ^{1}H NMR, respectively, and 77.16, 53.84, 39.52 and 49.00 ppm for ^{13}C NMR, respectively). The following abbreviations were used to explain multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad. Column chromatography was performed using E. Merck silica gel (60, particle size 0.043–0.063 mm), and preparative TLC was performed on Merck silica plates (60F-254). High-resolution mass spectra (HRMS) were recorded on an Agilent LC/MSD TOF mass spectrometer by electrospray ionization time of flight reflectron experiments. Melting points were recorded on a Fisher-Johns 12-144 melting point apparatus and are uncorrected. Optical rotation data was recorded on an Anton Paar 100 Modular Circular Polarimeter.

Handling of [Ni] Catalysts

All nickel catalysts were handled open to air on the bench top, and the bottles were not stored under inert atmosphere.

General Procedure for the Synthesis of TCNHPI Redox-Active Esters (General Procedure A)



TCNHPI esters were prepared according to the previously reported procedure.[1-3] A round-bottom flask or culture tube was charged with carboxylic acid (1.0 equiv), *N*-hydroxytetrachlorophthalimide (1.0 – 1.1 equiv) and DMAP (0.1 equiv). Dichloromethane was added (0.1 – 0.2 M), and the mixture was stirred vigorously. Carboxylic acid (1.0 equiv) was added via syringe (if liquid). DIC (1.1 equiv) was then added dropwise via syringe, and the mixture was allowed to stir until the acid was consumed (determined by TLC). Typical reaction times were between 0.5 h and 12 h. The mixture was filtered (through a thin pad of Celite®, SiO_2, or frit funnel) and rinsed with additional CH_2Cl_2/Et_2O. The solvent was removed under reduced pressure, and purification of the crude mixture by column chromatography afforded the desired TCNHPI redox-active ester. If necessary, the TCNHPI redox-active ester could be further recrystallized from CH_2Cl_2/MeOH.

We have previously reported the synthesis of the redox-active esters shown below (Figure S1).[1-3] Please see ref. 1-2 for graphical supporting information on the synthesis of TCNHPI redox-active esters (RAEs).

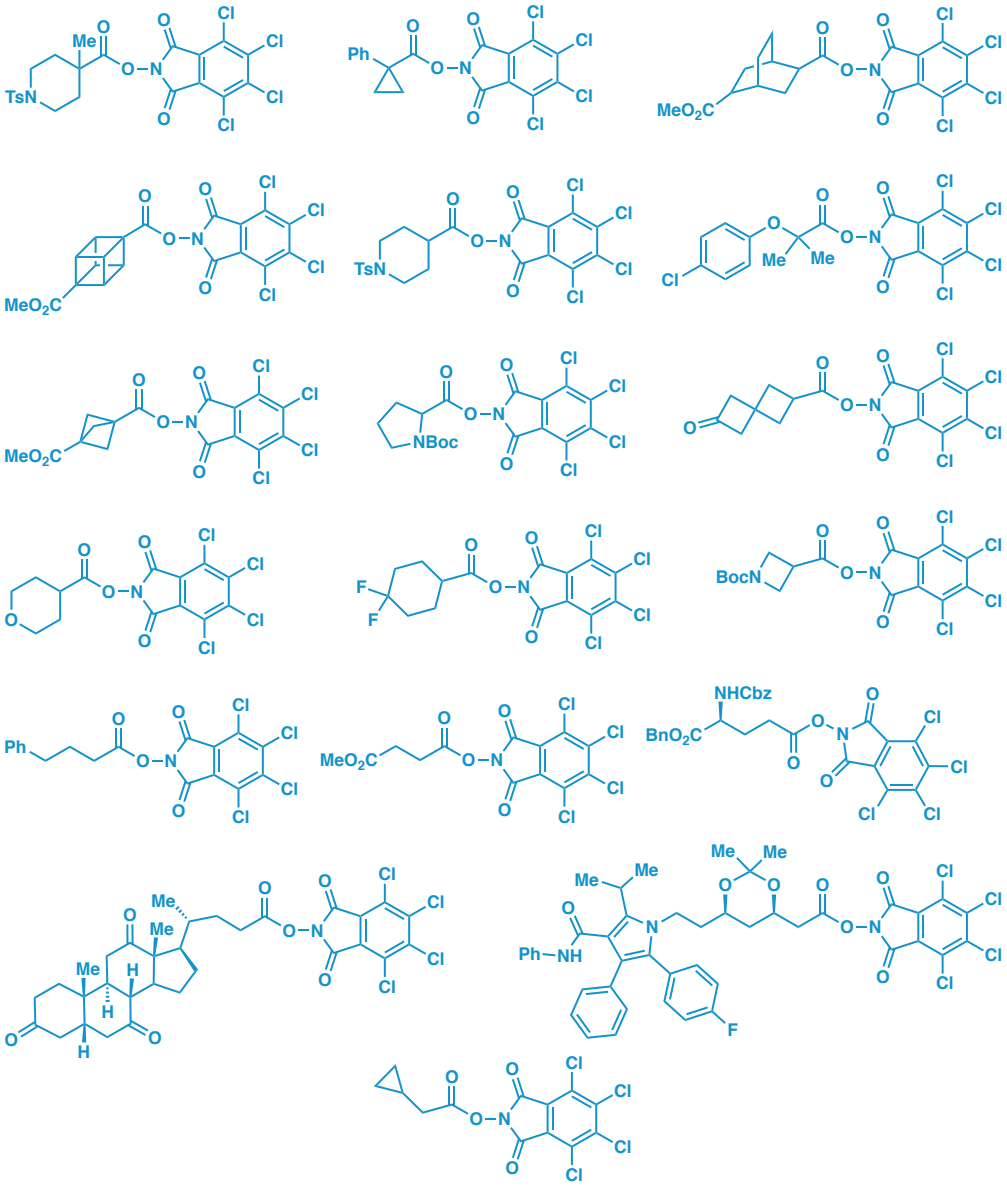
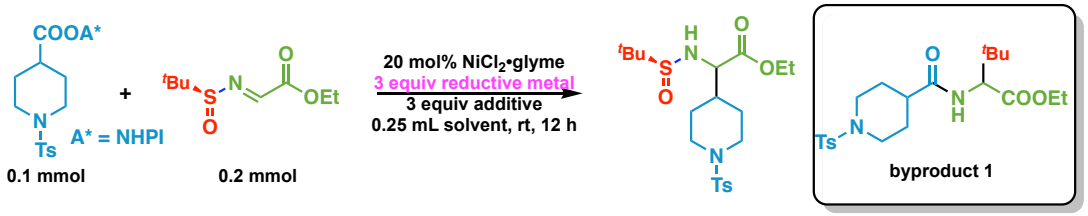


Figure S1: Previously Reported TCNHPI Redox-Active Esters.[1-3]

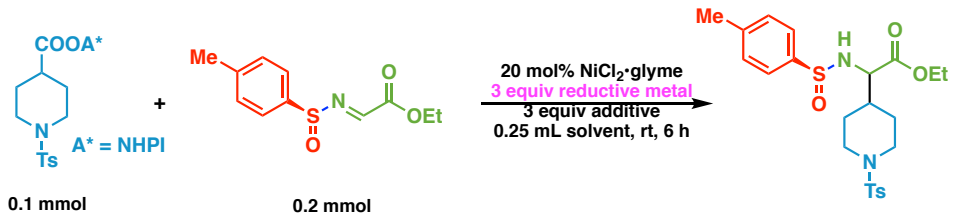
Optimization for Amino Acid Synthesis

Using *tert*-butyl sulfinimine as radical acceptor and NHPI ester as radical precursor



[Ni]	Reductive reagents	Additive	Solvent	Yield (%)
$NiCl_2$•glyme	PMHS		DMA	ND
$NiCl_2$•glyme	PMHS	Et_3N	DMA	ND
$NiCl_2$•glyme	PMHS	$Mg(OAc)_2$•4H2O	MeCN	ND
$NiCl_2$•glyme	PMHS	$Mg(OAc)_2$•4H2O	DMF	ND
$NiCl_2$•glyme	Mn	$Mg(OAc)_2$•4H2O	DMA	< 2%
$NiCl_2$•glyme	PMHS + 0.5 equiv Zn	$Mg(OAc)_2$•4H2O	DMA	ND
$NiCl_2$•glyme	$PhSiH_3$	$Mg(OAc)_2$•4H2O	DMA	ND
$NiCl_2$•glyme	PMHS	Na_2CO_3	DMA	ND
$NiCl_2$•glyme	PMHS	LiCl	DMA	ND
NiI_2	Zn	LiCl	MeCN	< 2%
$NiCl_2$•glyme	Mn		MeCN	ND
NiI_2	Mn	LiCl	MeCN	ND
$NiCl_2$•glyme	B_2Pin_2	LiO^{t}Bu	DMA	ND
$NiCl_2$•glyme	B_2Pin_2	LiO^{t}Bu	DMA	ND
$NiCl_2$•glyme	B_2Pin_2	K_3PO_4	DMA	ND
$Cu(acac)_2$	B_2Pin_2	LiO^{t}Bu	DMA	ND
NiI_2	Zn	LiCl	DMA	< 2%
$Ni(batho)(DMF)_2Cl_2$	Mn		DMA	< 2%
$Ni(acac)_2$	Zn	LiCl	DMA	< 2%
NiI_2 *A*=TCNHPI*	Zn	LiCl	MeCN	< 2%
$CrCl_2$ 4 equiv			DMF	carboxylic acid is the main byproduct> 80%
$Ni(acac)_2$	Zn	LiCl	MeCN	< 2%
NiI_2	Zn		MeCN	< 2%
$Ni(NO_3)_2$•^6H_2O	Zn	LiCl	MeCN	< 2%
$NiBr_2$•$3H_2O$	Zn	LiCl	MeCN	< 2%
$Ni(OAc)_2$	Zn	LiCl	MeCN	< 2%
$Ni(PPh_3)_2Br_2$	Zn	LiCl	MeCN	< 2%
$NiCl_2$•$6H_2O$	Zn	LiCl	MeCN	< 2%
NiI_2	Zn	LiBr	MeCN	ND
NiI_2	Zn	$Mg(OAc)_2$•$4H_2O$	MeCN	ND
NiI_2	Zn	LiCl	MeCN	< 2%

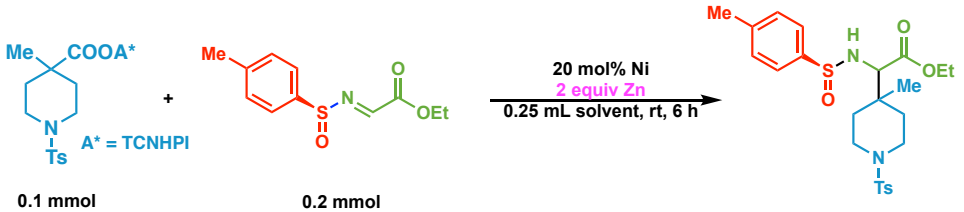
Using *p*-tolyl sulfinimine as radical acceptor and NHPI ester as radical precursor



0.1 mmol 0.2 mmol

[Ni]	Reductive reagents	Additive	Solvent	Yield (%)
NiI_2	Zn	LiCl	MeCN	ND
NiI_2	Zn	LiCl + 1 equiv 2-naphthoic acid	MeCN	ND
$Ni(batho)(DMF)_2Cl_2$	Zn		DMA	ND
$FeBr_2$	Zn		DMA	ND
NiI_2	Mn	LiCl	MeCN	ND
$NiCl_2$·glyme	PMHS	$Mg(OAc)_2$·4H2O	DMA	ND
isonicotinonitrile 2equiv	B_2Pin_2 100 °C	K_3PO_3	toluence	ND
AIBN 2equiv	HE 90 °C		MeCN	ND
NiI_2 + dtbpy A*= TCNHPI	Zn		MeCN	ND
$NiCl_2$·glyme + IPr·HCl	Zn	0.5 equiv $CsCO_3$	DMA	ND
$NiCl_2$·glyme + IPr·HCl	Zn	0.5 equiv $CsCO_3$	MeCN	ND
$Fe(acac)_3$	Zn	LiCl	THF	ND
$Fe(acac)_3$	$PhSiH_3$		THF	ND
$Fe(acac)_3$	$PhSiH_3$		DCM	ND
$Ni(acac)_2$ + dppBz	Zn		DMA	ND
$NiCl_2$·6H2O	Zn	LiCl	THF	ND
$Co(acac)_2$	Zn	LiCl	DMA	ND
$Ni(batho)(DMF)_2Cl_2$	HE+Zn		DMA	ND
$NiCl_2$·$6H_2O$ + PPh_3	Zn		MeCN	ND
$Fe(acac)_3$ + dppBz	Zn		DMA	ND
$NiCl_2$·6H2O	Zn	LiCl	MeCN	ND

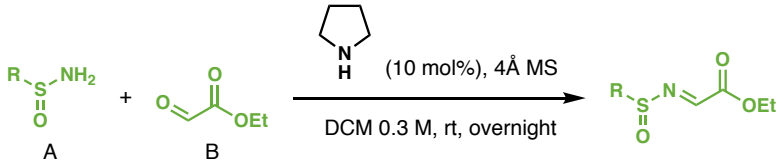
Using *p*-tolyl sulfinimine as radical acceptor and TCNHPI ester as radical precursor



0.1 mmol 0.2 mmol

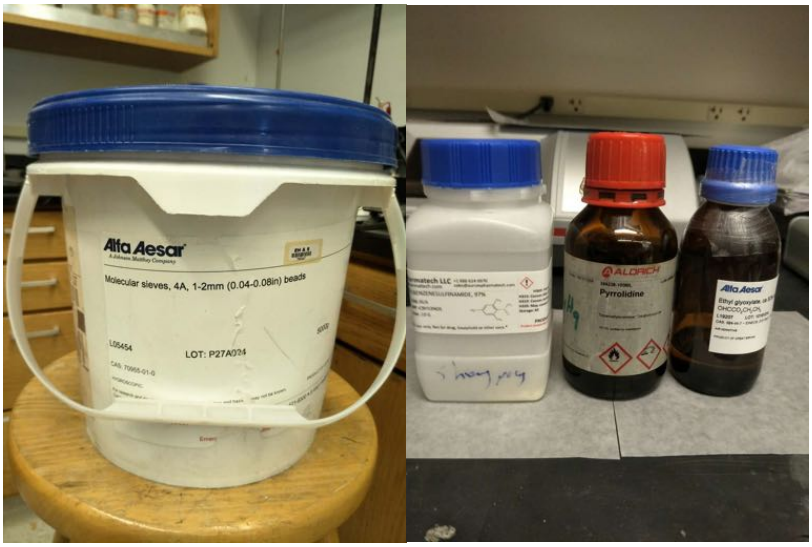
[Ni]	Zn X equiv	Solvent	dr	Yield (%)
20% $NiCl_2 \cdot 6H_2O$	2	DMF	3.3 : 1	23
20% $NiCl_2 \cdot 6H_2O$	2	DMA	3.0 : 1	23
20% $NiCl_2 \cdot 6H_2O$	2	DMPU	7.4 : 1	12
20% $NiCl_2 \cdot 6H_2O$	2	DMI	7.1 : 1	8
20% $NiCl_2 \cdot 6H_2O$	2	NMP	5.5 : 1	44
20% $NiCl_2 \cdot 6H_2O$ 0 *°C*	2	NMP	4.8 : 1	40
20% $NiCl_2 \cdot 6H_2O$ + 1equiv CH_3COOH	2	NMP	3.7 : 1	34
20% $NiCl_2 \cdot 6H_2O$ + 1equiv Et_3N	2	NMP	6.2 : 1	30
20% $NiCl_2 \cdot 6H_2O$ + 1equiv TMSCl	2	NMP	3.1 : 1	33
25% $NiCl_2 \cdot 6H_2O$	2	NMP	6.8 : 1	48
25% $NiCl_2 \cdot 6H_2O$	2	NMP 0.5 mL	6.0 : 1	70
25% $NiCl_2$·glyme	2	NMP 0.5 mL	6.1 : 1	51
25% NiI_2	2	NMP 0.5 mL	5.8 : 1	70
25% $NiBr_2 \cdot 3H_2O$	2	NMP 0.5 mL	6.8 : 1	65
25% $Ni(acac)_2$	2	NMP 0.5 mL	5.8 : 1	65
25% $Ni(ClO_4)_2$	2	NMP 0.5 mL	5.3 : 1	61
25% $Ni(OAc)_2 \cdot 4H_2O$	2	NMP 0.5 mL	6.4 : 1	76
25% $Ni(OAc)_2 \cdot 4H_2O$	3	NMP 0.5 mL	6.8 : 1	80

General Procedure for Sulfinimine Synthesis (General Procedure B)



The sulfinimine was synthesized similar to a reported procedure.[4] A dry round-bottomed flask was charged with sulfinamide **A** (1 equiv) and 4 Å molecular sieves (1g/mmol). The flask was then evacuated and back-filled with argon (three times). Anhydrous CH_2Cl_2 (0.3 M) was added using a syringe followed by addition of aldehyde **B** (1 equiv) and pyrrolidine (10 mol%). The mixture was stirred at rt overnight. The reaction was filtered through a short pad of Celite®. The organic layer was concentrated under reduced pressure (water bath at 30 °C), and purified by flash column chromatography (silica gel) to afford the product.

Graphical Supporting Information for Sulfinimine Synthesis (General Procedure B)



(Above) 4Å molecular sieves (Alfa Aesar), sulfinamide (Pharmatech), pyrrolidine (Sigma-Aldrich), ethyl glyoxylate (Alfa Aesar).

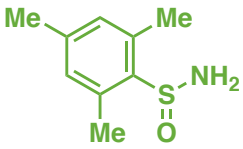
(Left) Activation of molecular sieves by flame-drying. **(Right)** The round-bottomed flask dried under vacuum.

(Left) Molecular sieves. **(Center)** Sulfinamide. **(Right)** After addition of molecular sieves and sulfinamide, flask was placed under Ar atmosphere.

(Left) After addition of CH_2Cl_2 (anhydrous). **(Center)** Ethyl glyoxylate was placed in an oil bath at 50 °C for 1 min. **(Right)** After addition of ethyl glyoxylate and pyrrolidine.

(Left) Filtration through a short pad of Celite®. **(Center)** TLC (CH_2Cl_2, UV) of the crude mixture (stirring at rt overnight), **(Right)** Product (white solid) after short column.

Compound SI-1



2,4,6-trimethylbenzenesulfinamide (SI-1).

Enantiomers (*R*) and (*S*) of compound **SI-1** were provided to us by Bristol-Myers Squibb or directly purchased from Pharmatech.

Both enantiomers were obtained from a racemic mixture using the following SFC conditions:

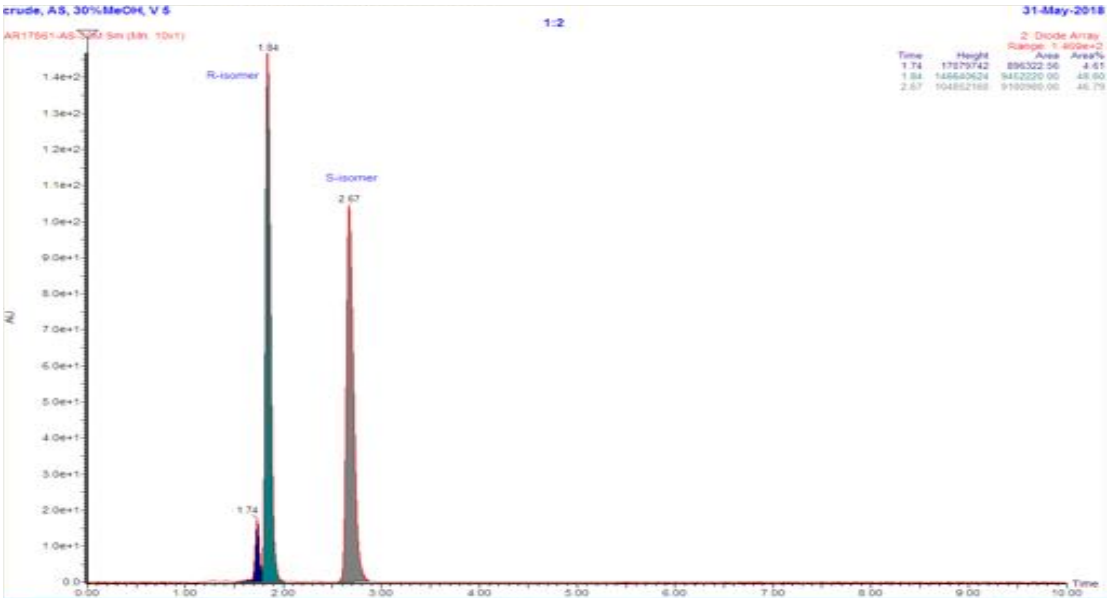
Analytical Conditions:

Analytical column	Chiralpak AS-H (0.46×25 cm, 5 µm)
BPR pressure	100 bars
Temperature	40 °C
Flow rate	3.0 mL/min
Mobile phase	70:30 CO_2:MeOH
Detector wavelength	UV 200-400nm, MS positive ion mode, scan from mv 200-900

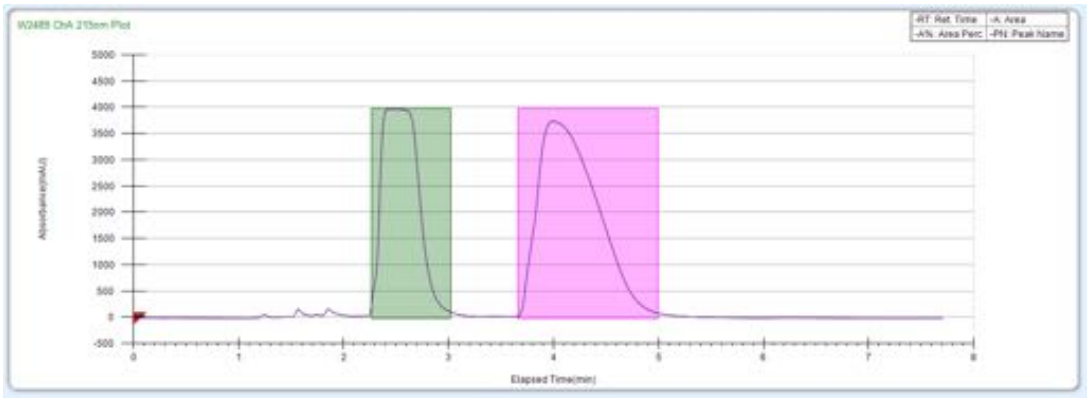
Preparative SFC Conditions:

Preparative column	Chiralpak AS-H (5×25 cm, 5 µm, S/N 602171)
BPR pressure	100 bars
Temperature	40 ºC
Flow rate	270 min/mL
Mobile phase	69:31 CO_2:MeOH
Detector wavelength	219 nm
Separation program	Sequence injection
Injection	2.5 mL with cycle time of 3.38 min
Sample preparation	20 g/30 mL CH_2Cl_2 + 95 mL MeOH, 160.0 mg/mL

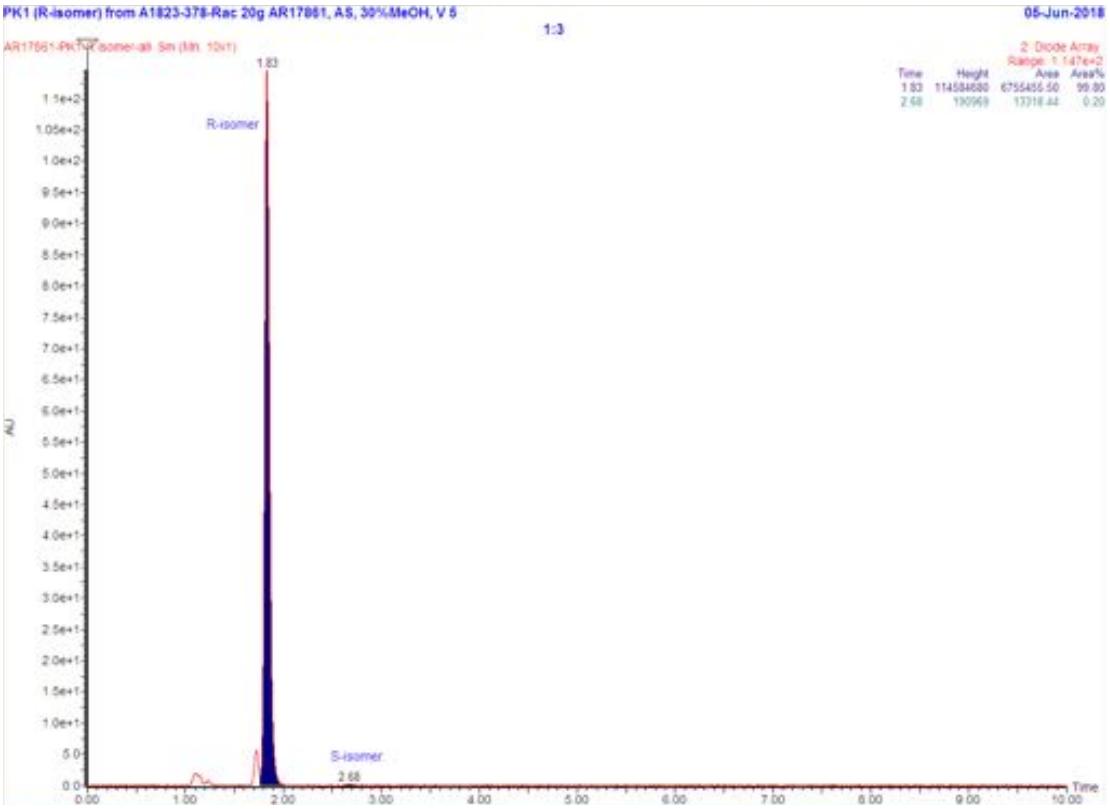
The enantiopurity of sulfinamide **SI-1** was verified through analytical SFC:



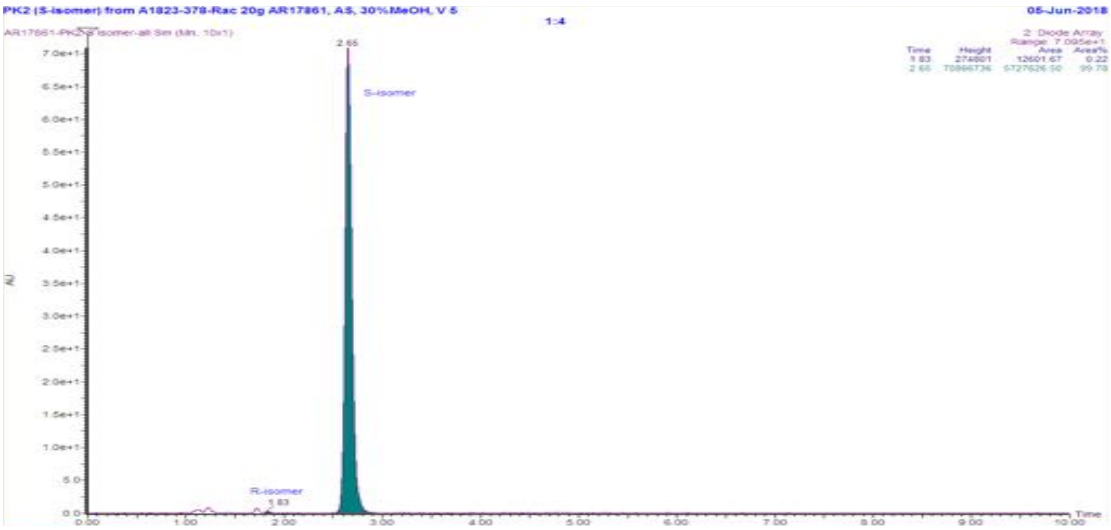
Racemic mixture of **SI-1**



Typical Preparative SFC Chromatogram. (*R*)-enantiomer highlighted in green, (*S*) in pink.

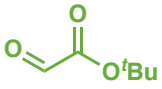


Analytical SFC Chromatogram of isolated (*R*)-enantiomer. *ee* = 99.6%

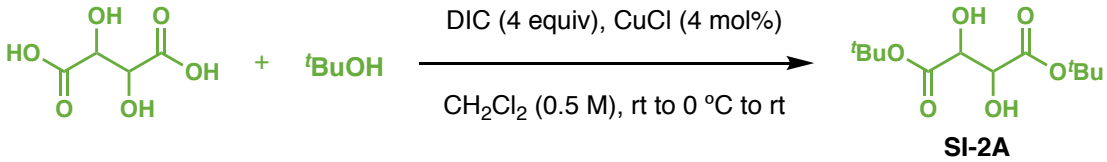


Analytical SFC Chromatogram of isolated (*S*)-enantiomer. *ee* = 99.6%

Compound SI-2

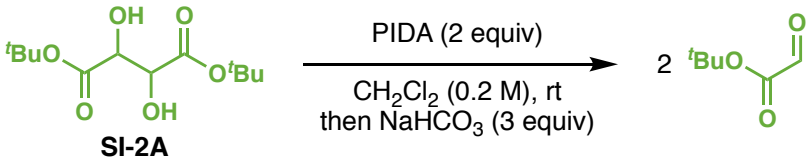


tert-butyl 2-oxoacetate (SI-2)



SI-2A

A dry round-bottomed flask was charged with anhydrous CuCl (39.6 mg, 0.4 mmol, 4 mol%). The flask was then evacuated and back-filled with argon (three times). Anhydrous *tert*-butanol (5.7 mL, 60 mmol, 6 equiv), DIC (6.2 mL, 40 mmol, 4 equiv), and anhydrous CH_2Cl_2 (10 mL) were added through syringe. After stirring the mixture at rt for 13h, a solution of tartaric acid (1.50 g, 10 mmol, 1 equiv) in CH_2Cl_2 (10 mL) was added at 0 ºC. The mixture was allowed to warm up to rt and stirred for an additional 24h. The reaction was concentrated under reduced pressure (water bath at 30 °C), suspended in Et_2O (50 mL) and filtered through a pad of Celite®. The filtrate was concentrated, and purified by flash column chromatography (silica gel, 4:1 hexanes:EtOAc) to afford the intermediate **SI-2A** as a white solid (446 mg, 17% yield).



SI-2A

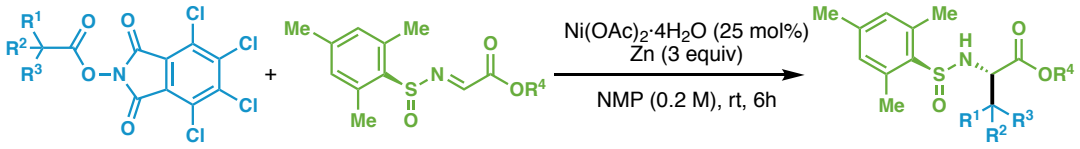
A round-bottomed flash was charged with intermediate **SI-2A** (393.5 mg, 1.5 mmol, 1 equiv), PIDA (966.3 mg, 3.0 mmol, 2 equiv) and CH_2Cl_2 (7.5 mL, 0.2 M). After stirring the resulting solution for 1 h, $NaHCO_3$ (378.0 mg, 4.5 mmol, 3 equiv) was added to the mixture, which was stirred for an additional 30 min. Then, the insoluble salts were filtered off and the filtrate was concentrated under reduced pressure. Flash column chromatography (silica gel, gradient from 9:1 to 1:1 hexanes:EtOAc) afforded 270.1 mg (69%) of the title compound **SI-2**.

Physical State: colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$): δ 9.25 (s, 1H), 1.52 (s, 9H) ppm.

Spectral data is in accordance with previous report.[5]

General Procedure for Decarboxylative Amino Acid Synthesis (General Procedure C)



A B

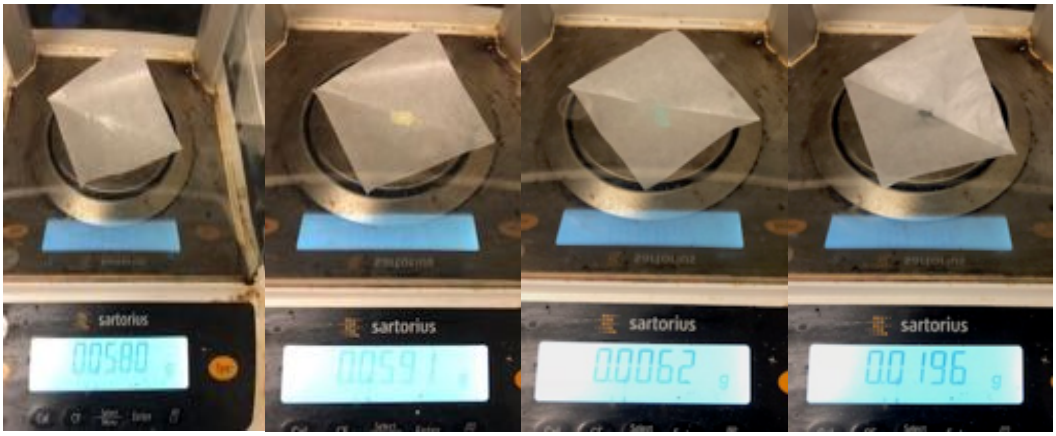
A culture tube was charged with TCNHPI redox-active ester **A** (0.1 mmol, 1 equiv), sulfinimine **B** (0.2 mmol, 2 equiv), $Ni(OAc)_2$•$4H_2O$ (0.025 mmol, 25 mol%) and Zn (0.3 mmol, 3 equiv). The tube was then evacuated and backfilled with argon (three times). Anhydrous NMP (0.5 mL, 0.2 M) was added using a syringe. The mixture was stirred for 6 h at rt. The reaction mixture was diluted with EtOAc, washed with water, brine and dried over $MgSO_4$. Upon filtration, the organic layer was concentrated under reduced pressure (water bath at 30 °C), and purified by flash column chromatography (silica gel) or preparative TLC (pTLC) to provide the product.

Procedure for 1.0 mmol scale:

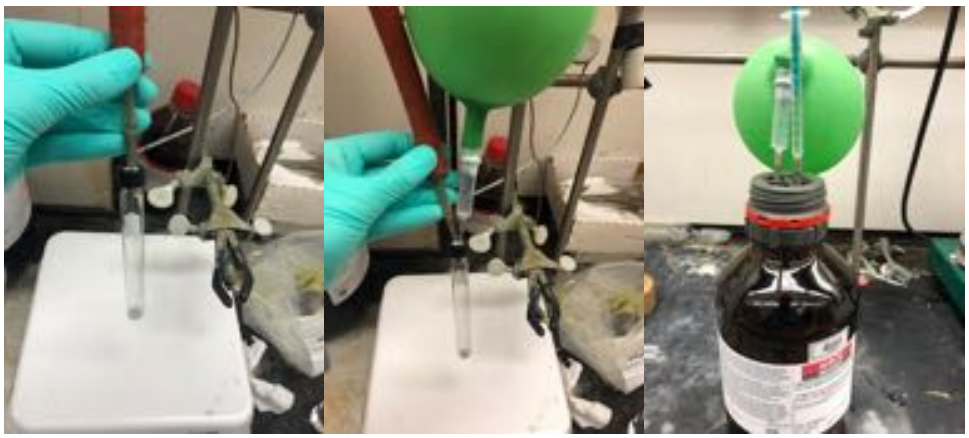
A culture tube was charged with TCNHPI redox-active ester **A** (1.0 mmol), sulfinimine **B** (2.0 mmol), $Ni(OAc)_2$•$4H_2O$ (0.25 mmol, 25 mol%), Zinc (3 mmol, 3 equiv). The tube was then evacuated and backfilled with argon (three times). Anhydrous NMP (5.0 mL, 0.2 M) was added using a syringe. The mixture was stirred overnight at rt. Then, the reaction mixture was diluted with EtOAc, washed with water, brine and dried over $MgSO_4$. Upon filtration, the organic layer was concentrated under reduced pressure (water bath at 30 °C), and purified by flash column chromatography (silica gel) provided the product.

Graphical Supporting Information for Decarboxylative Amino Acid Synthesis (General Procedure C)

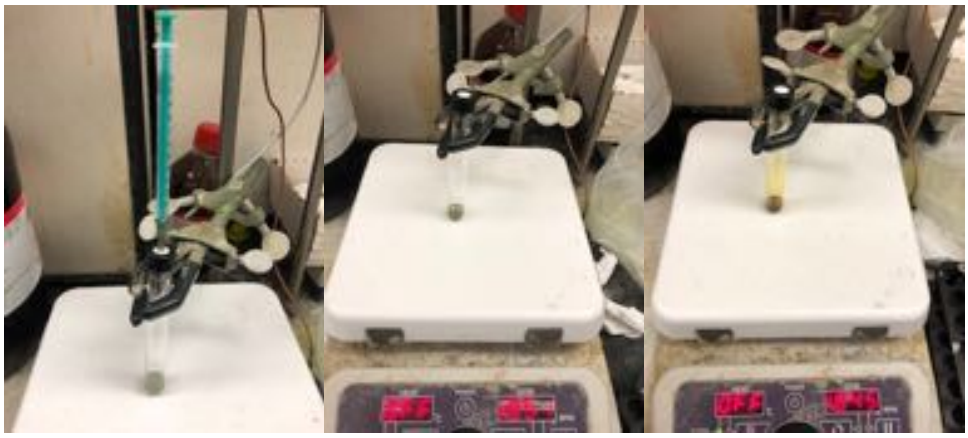
(From left to right) Redox-active ester **1**, sulfinimine **2**, $Ni(OAc)_2 \bullet 4H_2O$, Zn.



(From left to right) Redox-active ester **1**, sulfinimine **2**, $Ni(OAc)_2 \bullet 4H_2O$, Zn.

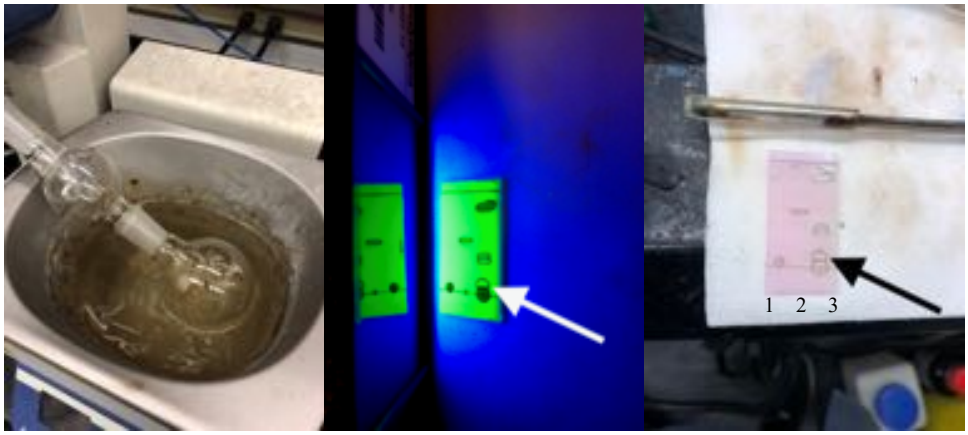


(Left) Culture tube was evacuated. **(Center)** Culture tube backfilled with Ar balloon. **(Right)** NMP (anhydrous).



(Left) After addition of NMP. **(Center)** Crude mixture as reaction started. **(Right)** Crude mixture as reaction ended (6 h).

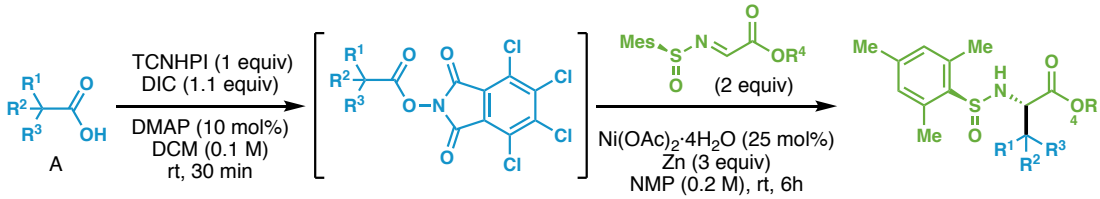
(Left) Crude mixture was diluted with EtOAc and extracted with water and brine. **(Center)** Organic layer was dried over $MgSO_4$. **(Right)** Organic layer was filtered.



(Left) Organic layer was concentrated. **(Center)** TLC (hexanes 4:1 EtOAc, UV). Left lane: redox-active ester. Center lane: sulfinimine. Right lane: crude mixture. The

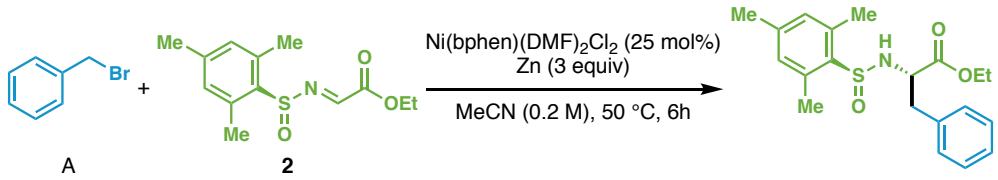
desired product is indicated with the white arrow. **(Right)** Same TLC, after $KMnO_4$ staining. The desired product is indicated with the black arrow. Lane 1: redox-active ester **1**; Lane 2: sulfinimine **2**; Lane 3: crude mixture.

General Procedure for One-Pot Activation of Carboxylic Acids in Amino Acid Synthesis (General Procedure D)



A culture tube was charged with carboxylic acid A (0.1 mmol, 1 equiv), TCNHPI (0.1 mmol, 1 equiv) and DMAP (0.01 mmol, 10 mol%). Then, CH_2Cl_2 (1.0 mL, 0.1 M) and DIC (0.11 mmol, 1.1 equiv) were added. The mixture was stirred at rt and monitored by TLC (typical reaction time was 30 min). After consumption of all starting material, the solvent was removed under reduced pressure (water bath at 30 ºC) and dried on a high-vacuum line for at least 5 minutes to remove residual CH_2Cl_2. The resulting crude RAE was then used in the amino acid synthesis in the same culture tube without further purification or isolation of the RAE (**General Procedure C**).

General Procedure when Using Benzyl Bromide for Amino Acid Synthesis (General Procedure E)



Preparation of [Ni] catalyst:

10g of $NiCl_2$•$6H_2O$ and 14.27g bathophenanthroline were dissolved in DMF (200 mL). The mixture was heated to 75 ºC to dissolve all the reaction components. Then, the solution was filtered while hot. Upon cooling, crystals form. The filtrate was stirred for an additional 3 days, after which it was filtered. The obtained crystals were dried in a vacuum oven at 90 ºC, affording the [Ni] catalyst in 90% yield.

A culture tube was charged with benzyl bromide **A** (0.1 mmol, 1 equiv) (if solid), sulfinimine **2** (0.2 mmol, 2 equiv), Ni(bphen)$(DMF)_2Cl_2$ (0.025 mmol, 25 mol%) and Zn (0.3 mmol, 3 equiv). The tube was then evacuated and backfilled with argon (three times). Anhydrous MeCN (0.5 mL, 0.2 M) and benzyl bromide **A** (0.1 mmol, 1 equiv) (if liquid) were added using a syringe. The mixture was stirred for 6 h at 50 °C. The reaction mixture was diluted with EtOAc, washed with water, brine and dried over $MgSO_4$. Upon filtration, the organic layer was concentrated under reduced pressure (water bath at 30 °C), and purified by flash column chromatography (silica gel) or preparative TLC (pTLC) to afford the product.

Troubleshooting: Frequently Asked Questions

Part I. Redox-Active Ester Synthesis

For questions regarding the synthesis, purification, characterization, stability and storage of redox-active esters, please see our previous papers[1-3] for fully-detailed answers.

Part II. Preparation of Sulfinimine Reagents

Question 1:

How can I monitor my reaction?

Answer:

We monitor the reaction by TLC (and appropriate UV visualization). ^{1}H NMR can also be used by taking an aliquot out of the reaction.

Question 2:

Is it necessary to run the reaction for an overnight period (> 8 hours), or can I stop it sooner?

Answer:

The reaction can be stopped sooner if there is complete consumption of the starting materials (aldehyde and sulfinamide). The best way to determine if the starting material has been completely consumed is by TLC analysis.

Question 3:

Do I need to run this reaction under inert atmosphere?

Answer:

It is not necessary. Atmospheric air does not alter the outcome of the reaction.

However, precautions must be taken to ensure anhydrous conditions in the reaction medium. Flame-drying the flask or storing it in the oven before running the reaction is necessary. Molecular sieves should also be activated with heating-vacuum cycles.

Question 4:

How do I work up the reaction?

Answer:

Aqueous work up is not required. Simple filtration through a short pad of Celite® is enough to remove the molecular sieves.

Question 5:

How do I purify my product?

Answer:

We use flash column chromatography through silica gel, using either CH_2Cl_2 or a 4:1 mixture of hexanes:EtOAc as eluent.

Question 6:

How do I store my product?

Answer:

Sulfinimines are susceptible to hydrolysis. Therefore, we recommend storing them at low temperature (~4 ºC) to avoid decomposition.

Question 7:

What are general ways of making sulfinimines?

Answer:

Sulfinimines are typically prepared through condensation of aldehyde and sulfinamide. The aldehyde is normally activated by a Lewis acid, such as $Ti(OEt)_4$, or by generating an iminium intermediate (pyrrolidine activation). See **General Procedure**

B for more details on the latter approach.

Part III. Decarboxylative Amino Acid Synthesis

Question 1:

How can I monitor the reaction?

Answer:

We monitor the reaction by TLC (and appropriate staining and UV visualization).

Question 2:

It is not convenient for me to stop the reaction after 6 hours. Can I leave it longer?

Answer:

The reaction can be left overnight if needed. In fact, when running larger scale reactions (>1 mmol), we recommend longer reaction times to ensure maximum product formation.

Question 3:

Do I need a glovebox to run the reaction?

Answer:

We do not set up the reaction in a glovebox. The reaction can be set up and run in a glovebox, but this is not necessary as long as you have access to some inert gas (nitrogen or argon) since it is recommended to run the reaction under inert atmosphere.

Question 4:

Are there any indicative color changes during the reaction?

Answer:

We often observe that the reaction mixture changes from dark green to dark red/brown

during the course of the reaction. However, this color change is not necessarily indicative of a successful reaction.

Question 5:

How do I work up the reaction?

Answer:

We dilute the reaction with EtOAc and extract initially with water. If we observe the formation of an emulsion, adding an aqueous salt solution such as 5-10% LiCl, $NaCl_{(sat.)}$ or $NH_4Cl_{(sat.)}$ usually improves phase separation. Upon extraction, the aqueous layer might adopt an oily form. If that is the case, we recommend back-extraction with EtOAc to avoid any product loss through the workup. We then extract the organic layer(s) with brine, dry over $MgSO_4$, filter, and concentrate under reduced pressure. The crude product often contains solids that are phthalimide byproducts, but these are easily removed by column chromatography.

Question 6:

How do I purify my product?

Answer:

We use both silica gel flash column chromatography and PTLC. In the case of column chromatography, we recommend using a gradient with increasing polarity to ensure optimal separation and maximum yield.

Question 7:

How do I store my product?

Answer:

Sulfinamides are generally bench-stable products. No additional precautions are required for product storage.

Question 8:

I think my redox-active ester is unstable. Can I still run the reaction?

Answer:

The *in situ* activation procedure (**General Procedure D**) allows for potentially unstable redox-active esters to be used in the decarboxylative amino acid synthesis and often affords the product in comparable yields to reactions run with the isolated redox-active ester. To test the viability of the coupling partner, we recommend running the reaction using this *in situ* activation protocol. In our experience, there have been no examples where an isolated redox-active ester affords product but *in situ* activation does not result in product.

Question 9:

I obtained the product, but the yield is not satisfactory for my purposes. What do you recommend I try to optimize the reaction?

Answer:

For optimization, we recommend the following:

1. Try adding more equivalents of sulfinimine.
2. Check the purity of your redox-active ester. If you have reason to believe it is not pure, recrystallize with CH_2Cl_2/MeOH.
3. Try using a higher catalyst [$Ni(OAc)_2 \bullet 4H_2O$] loading.
4. Try adding more equivalents of reductant (Zn).
5. Try heating the reaction (40-60 ºC).

Part IV. One-pot Activation of Carboxylic Acids for Decarboxylative Amino Acid Synthesis

Question 1:

Do I have to use DIC? And DMAP?

Answer:

Both DIC and DCC are effective for the transformation, and other coupling reagents such as EDCI should work as well. DMAP accelerates the reaction time, but if your substrate is base-sensitive, it is not strictly necessary for the carboxylic acid activation.

Question 2:

What solvents are best for the one-pot activation procedure?

Answer:

CH_2Cl_2 was found to be the optimal solvent for the one-pot activation procedure.

Question 3:

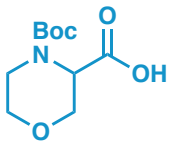
Do I need to remove CH_2Cl_2 before running the decarboxylative amino acid synthesis?

Answer:

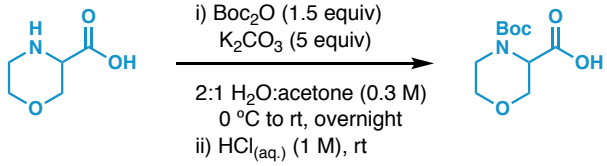
Significant (solvent) quantities of CH_2Cl_2 inhibit product formation in the decarboxylative reaction. The majority of the solvent was removed on a rotary evaporator before conducting the second operation. We did not check for the complete removal of CH_2Cl_2 by ^1H NMR before performing the second operation in the same reaction tube.

Experimental Procedures and Characterization Data for Acids

Compound SI-3



4-(tert-butoxycarbonyl)morpholine-3-carboxylic acid (SI-3)



A scintillation vial was charged with morpholine-3-carboxylic acid (0.5 mmol, 1 equiv) and K_2CO_3 (2.5 mmol, 5 equiv). The solids were dissolved in a 2:1 mixture of water:acetone (1:0.5 mL, 0.3 M), and the resulting solution was cooled to 0 ºC with an ice bath. Then, Boc_2O (0.75 mmol, 1.5 equiv) was added, and the reaction mixture was allowed to warm to rt. After stirring overnight, the reaction was quenched with water (5 mL) and extracted with Et_2O (2x10 mL). The aqueous phase was then treated with HCl (1 M, 20 mL), followed by extraction with CH_2Cl_2 (2x20 mL). The combined organic layers were washed with water and brine, dried over $MgSO_4$ and filtered. Concentration under reduced pressure (water bath at 30 °C) afforded the product **SI-3** (39.1 mg, 34% yield).

Physical State: white solid.

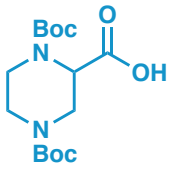
^{1}H NMR (600 MHz, CD_3OD): δ 4.45 (d, *J* = 3.8 Hz, 1H minor rotamer), 4.41 (d, *J* = 3.9 Hz, 1H major rotamer), 4.35 (d, *J* = 11.7 Hz, 1H minor), 4.30 (d, *J* = 11.7 Hz, 1H major), 3.88 (dd, *J* = 11.6, 3.9 Hz, 1H major), 3.81 (dd, *J* = 11.4, 3.8 Hz, 1H minor), 3.66 (td, *J* = 12.2, 3.5 Hz, 4H), 3.51 – 3.41 (m, 2H), 3.17 (td, *J* = 12.8, 4.0 Hz, 1H major), 1.48 (s, 9H minor), 1.44 (s, 9H major) ppm (2 rotamers are reported).

1H from one the minor rotamer was obscured by the residual solvent signal at 3.31 ppm.

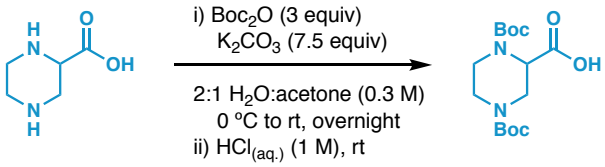
^{13}C NMR (151 MHz, CD_3OD): δ 173.3, 173.2, 157.5, 157.4, 81.9 (2C), 68.8, 68.4, 67.6, 67.4, 56.7, 55.3, 43.1, 41.9, 28.6, 28.5 ppm (2 rotamers are reported).

Spectral data is in accordance with previous reports.[6]

Compound SI-4



1,4-bis(tert-butoxycarbonyl)piperazine-2-carboxylic acid (SI-4)



Similar procedure as that for compound **SI-3** was utilized with the following modifications; Boc_2O (3 equiv) and K_2CO_3 (7.5 equiv), to obtain **SI-4** (115.6 mg, 70% yield).

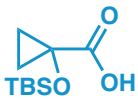
Physical State: white solid.

^{1}H NMR (600 MHz, CD_3OD): δ 4.63 – 4.47 (m, 2H), 3.97 (br s, 1H), 3.79 (t, *J* = 12.4 Hz, 1H), 3.29 – 3.09 (m, 2H), 2.86 (br s, 1H), 1.49 – 1.42 (m, 18H) ppm.

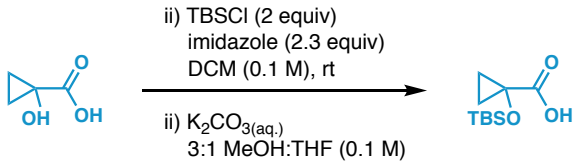
^{13}C NMR (151 MHz, $CDCl_3$): δ 173.4, 173.2, 157.4, 157.2, 156.0 (2C), 82.0, 81.6, 56.3 (2C), 54.9 (2C), 46.1, 45.7, 44.7, 43.5, 42.5 (2C), 41.3 (2C), 28.6, 28.5 ppm (2 rotamers are reported).

Spectral data is in accordance with previous reports.[7]

Compound SI-5



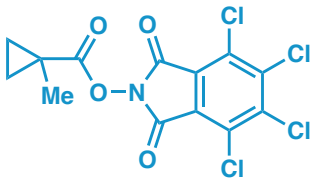
1-((tert-butyldimethylsilyl)oxy)cyclopropane-1-carboxylic acid (SI-5)



A scintillation vial was charged with 1-hydroxycyclopropane-1-carboxylic acid (0.5 mmol, 1 equiv) and imidazole (1.15 mmol, 2.3 equiv). The solids were dissolved in a CH_2Cl_2 (5 mL, 0.1 M), and TBSCl (1.0 mmol, 2 equiv) was added. After stirring overnight, the reaction mixture was concentrated under reduced pressure (water bath at 30 °C). The crude mixture was diluted in a 3:1 mixture of MeOH:THF (3:1 mL, 0.1 M). An aqueous solution of K_2CO_3 (0.72 M, 2 mL) was added and the mixture was stirred for 1 h. After concentrating to remove organic solvents, the crude was diluted with brine (5 mL), and acidified gently with a half-saturated aqueous solution of citric acid (pH~3). The mixture was extracted with Et_2O (2x20 mL). The combined organic layers were washed with brine, dried over $MgSO_4$, filtered and concentrated, affording the title compound **SI-5** (colorless oil, 83.8 mg, 77% yield). The crude acid was used without further purification for the synthesis of RAE **SI-8**.

Experimental Procedures and Characterization Data for Redox-Active Esters

Compound SI-6



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 1-methylcyclopropane-1-carboxylate (SI-6)

Following the **General Procedure A** on 0.20 mmol scale at rt. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 70.0 mg (91%) of the title compound **SI-6**.

Physical State: white solid.

m.p.: 163 – 165 ºC.

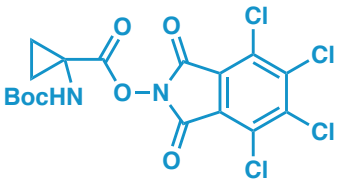
R_f = 0.92 (CH_2Cl_2).

^{1}H NMR (500 MHz, $CDCl_3$): δ 1.57 (dd, *J* = 7.4, 4.5 Hz, 2H), 1.47 (s, 3H), 0.99 (dd, *J* = 7.2, 4.5 Hz, 2H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.7, 157.8, 141.1, 130.5, 124.9, 18.9, 18.9, 17.4 ppm.

The desired mass for HRMS was not observed.

Compound SI-7



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 1-((tert-butoxycarbonyl)amino)cyclopropane-1-carboxylate (SI-7)

Following the **General Procedure A** on 0.20 mmol scale at rt. Purification by column chromatography (silica gel, 20:1 CH_2Cl_2:Et_2O) afforded 75.5 mg (78%) of the title compound **SI-7**.

Physical State: yellow solid.

m.p.: >140 ºC.

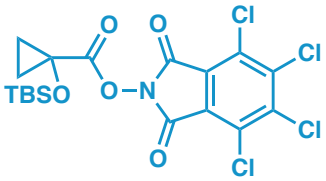
R_f = 0.78 (20:1 CH_2Cl_2:Et_2O).

^{1}H NMR (600 MHz, $CDCl_3$): δ 5.30 (s, 1H), 5.18 (s, 1H), 1.82 (s, 2H), 1.78 (s, 2H), 1.67 (s, 2H), 1.53 (s, 9H), 1.46 (s, 11H) ppm (2 rotamers reported).

^{13}C NMR (151 MHz, $CDCl_3$): δ 169.7 (2C), 157.4 (2C), 155.5 (2C), 141.1 (2C), 130.6 (2C), 124.8 (2C), 81.8, 80.8, 33.9, 33.2, 28.3 (2C), 21.1, 20.0 ppm (2 rotamers reported).

HRMS (ESI-TOF): calc'd for $C_{17}H_{15}Cl_4N_2O_6$ $[M+H]^+$: 482.9679, found: 482.9679.

Compound SI-8



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 1-((tert-butyldimethylsilyl)oxy)cyclopropane-1-carboxylate (SI-8)

Following the **General Procedure A** on 0.20 mmol scale at rt. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 61.9 mg (62%) of the title compound **SI-8**.

Physical State: pale yellow solid.

m.p.: 118 – 119 ºC.

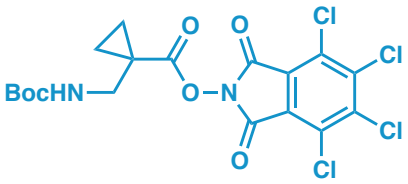
R_f = 0.92 (CH_2Cl_2).

^{1}H NMR (600 MHz, $CDCl_3$): δ 1.62 (dd, J = 8.6, 5.4 Hz, 2H), 1.36 (dd, J = 8.0, 5.3 Hz, 2H), 0.89 (s, 9H), 0.22 (s, 6H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.0, 157.6, 141.2, 130.6, 124.9, 54.6, 25.7, 19.9, 18.0, -4.2 ppm.

The desired mass for HRMS was not observed.

Compound SI-9



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 1-(((tert-butoxycarbonyl)amino)methyl)cyclopropane-1-carboxylate (SI-9)

Following **General Procedure A** on 3.00 mmol scale. Purification by column chromatography (silica gel, gradient from CH_2Cl_2 to 10:1 CH_2Cl_2:Et_2O) afforded 1.07 g (72%) of the title compound **SI-9**.

Physical State: white solid.

m.p.: 149 – 150 °C.

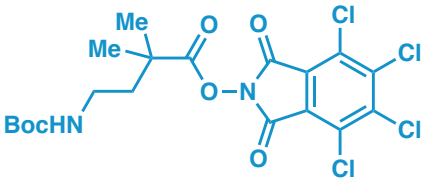
R_f = 0.58 (CH_2Cl_2).

^{1}H NMR (500 MHz, $CDCl_3$): δ 5.17 (t, *J* = 6.5 Hz, 1H), 3.44 (d, *J* = 6.5 Hz, 2H), 1.60 (q, *J* = 4.6 Hz, 2H), 1.45 (s, 9H), 1.31 (q, *J* = 4.6 Hz, 2H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 170.9, 157.7, 156.3, 141.3, 130.6, 124.8, 79.8, 43.5, 28.5, 24.2, 16.7 ppm.

HRMS (ESI-TOF): calc'd for $C_{18}H_{16}Cl_4N_2NaO_6$ $[M+Na]^+$: 518.9655, found: 518.9665.

Compound SI-10



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 4-((tert-butoxycarbonyl)amino)-2,2-dimethylbutanoate (SI-10)

Following **General Procedure A** on 5.00 mmol scale. Purification by column (silica gel, gradient from CH_2Cl_2 to 10:1 CH_2Cl_2:Et_2O) afforded 2.15 g (84%) of the title compound **SI-10**.

Physical State: white solid.

m.p.: 123 – 124 °C.

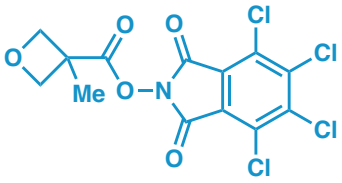
R_f = 0.58 (CH_2Cl_2).

^{1}H NMR (400 MHz, $CDCl_3$): δ 4.89 (br s, 1H), 3.30 (q, *J* = 7.0 Hz, 2H), 1.98 (t, *J* = 7.6 Hz, 2H), 1.42 (s, 15H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 173.1, 157.7, 156.0, 141.1, 130.5, 124.8, 79.3, 40.8, 40.2, 36.8, 28.5, 25.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{19}H_{20}Cl_4N_2NaO_6$ $[M+Na]^+$: 534.9968, found: 534.9973.

Compound SI-11



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 3-methyloxetane-3-carboxylate (SI-11)

Following the **General Procedure A** on 0.80 mmol scale at rt. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 212 mg (66%) of the title compound **SI-11**.

Physical State: white solid.

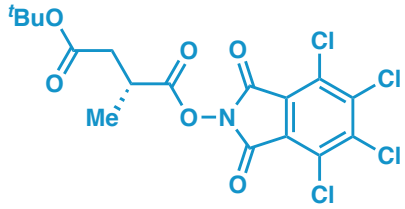
***R*$_f$** = 0.68 (CH_2Cl_2).

^{1}H NMR (400 MHz, $CDCl_3$): δ 5.15 (d, *J* = 6.3 Hz, 2H), 4.55 (d, *J* = 6.3 Hz, 2H), 1.84 (s, 3H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ 170.2, 157.6, 141.4, 130.8, 124.9, 79.0, 43.5, 21.5 ppm.

HRMS (ESI-TOF): calc'd for $C_{13}H_8Cl_4NO_5$ $[M+H]^+$: 397.9151, found: 397.9136.

Compound SI-12



4-(tert-butyl) 1-(4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl) (S)-2-methylsuccinate (SI-12)

Following **General Procedure A** on 3.00 mmol scale. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 1.08 g (77%) of the title compound **SI-12**.

Physical State: white solid.

m.p.: 94 °C.

R_f = 0.81 (CH_2Cl_2).

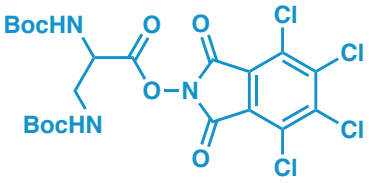
^{1}H NMR (600 MHz, $CDCl_3$): δ 3.27 (h, *J* = 7.2 Hz, 1H), 2.79 (dd, *J* = 16.7, 7.5 Hz, 1H), 2.50 (dd, *J* = 16.8, 6.6 Hz, 1H), 1.47 (s, 9H), 1.42 (d, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.5, 169.7, 157.6, 141.1, 130.6, 124.9, 81.8, 38.6, 34.0, 28.1, 17.0 ppm.

HRMS (ESI-TOF): calc'd for $C_{17}H_{15}Cl_4NNaO_6$ $[M+Na]^+$: 491.9546, found: 491.9548.

$[\alpha]_D^{20}$ = -8.9 (*c* = 1.0, CH_2Cl_2).

Compound SI-13



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl

2,3-bis((tert-butoxycarbonyl)amino)propanoate (SI-13)

Following the **General Procedure A** on 0.20 mmol scale at rt. Purification by column chromatography (silica gel, 20:1 CH_2Cl_2:Et_2O) afforded 68.8 mg (59%) of the title

compound **SI-13**.

Physical State: pale yellow solid.

m.p.: 166 – 170 ºC.

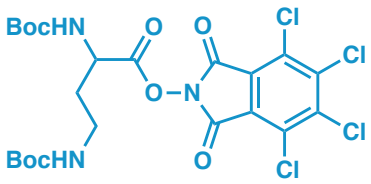
R_f = 0.70 (20:1 CH_2Cl_2:Et_2O).

^{1}H NMR (600 MHz, $CDCl_3$): δ 5.99 (br s, 1H minor rotamer), 5.90 (br s, 1H major rotamer), 5.36 (br s, 1H minor), 5.31 (br s, 1H major), 4.77 (br s, 1H major), 4.55 (br s, 1H minor), 3.82 – 3.80 (m, 1H), 3.69 – 3.60 (m, 1H), 1.48 – 1.44 (m, 18H)) ppm (2 rotamers reported).

^{13}C NMR (151 MHz, $CDCl_3$): δ 167.4 (2C), 157.1 (2C), 157.0 (2C), 155.3 (2C), 141.3 (2C), 130.7 (2C), 124.7 (2C), 80.8, 80.6, 54.0 (2C), 42.4 (2C), 28.4 (2C) ppm (2 rotamers reported).

HRMS (ESI-TOF): calc'd for $C_{21}H_{23}Cl_4N_3NaO_8$ $[M+Na]^+$: 608.0131, found: 608.0136.

Compound SI-14



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 2-cyclobutylacetate (SI-14)

Following the **General Procedure A** on 0.20 mmol scale at rt. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 62.8 mg (79%) of the title compound **SI-14**.

Physical State: orange solid.

m.p.: >200 ºC.

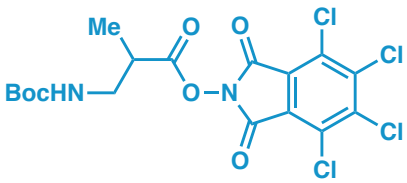
R_f = 0.54 (20:1 CH_2Cl_2:Et_2O).

^{1}H NMR (500 MHz, $CDCl_3$): δ 5.56 – 5.48 (m, 1H), 5.16 (br s, 1H), 4.90 – 4.83 (m, 1H), 3.56 (br s, 1H), 3.18 – 3.13 (m, 1H), 2.25 – 2.18 (m, 1H), 2.16 – 2.08 (m, 1H), 1.47 (s, 9H), 1.42 (s, 9H) ppm.

^{13}C NMR (151 MHz, CD_3OD): δ 174.6, 161.3, 158.4, 158.1, 140.5, 130.3, 127.0, 80.1, 80.1, 52.7, 37.9, 28.8, 28.7, 23.5 ppm.

HRMS (ESI-TOF): calc'd for $C_{22}H_{25}Cl_4N_3NaO_8$ $[M+H]^+$: 622.0288, found: 622.0305.

Compound SI-15



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl

3-((tert-butoxycarbonyl)amino)-2-methylpropanoate (SI-15)

Following the **General Procedure A** on 3.00 mmol scale at rt. Purification by column chromatography (silica gel, 20:1 CH_2Cl_2:Et_2O) afforded 1.12 g (77%) of the title compound **SI-15**.

Physical State: white solid.

m.p.: 135 – 136 ºC.

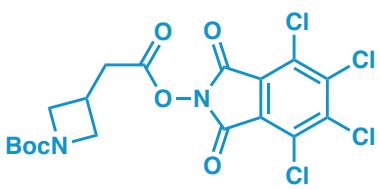
R_f = 0.87 (20:1 CH_2Cl_2:Et_2O).

^{1}H NMR (500 MHz, $CDCl_3$): δ 5.15 (t, *J* = 6.6 Hz, 1H), 3.51 – 3.46 (m, 1H), 3.35 – 3.29 (m, 1H), 3.14 - 3.07 (m, 1H), 1.41 (s, 9H), 1.32 (d, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.3, 157.6, 156.1, 141.1, 130.6, 124.8, 79.8, 43.3, 38.3, 28.4, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{17}H_{17}Cl_4N_2O_6$ $[M+H]^+$: 484.9835, found: 484.9830.

Compound SI-16



tert-butyl

3-(2-oxo-2-((4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl)oxy)ethyl)azetidine-1-carboxylate (SI-16)

Following **General Procedure A** on 5.00 mmol scale. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 2.33 g (93%) of the title compound **SI-16**.

Physical State: white solid.

m.p.: 165 – 166 °C.

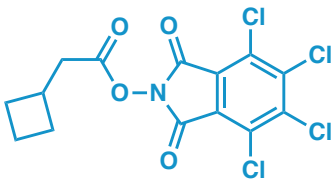
R_f = 0.18 (CH_2Cl_2).

^{1}H NMR (400 MHz, $CDCl_3$): δ 4.21 – 4.11 (m, 2H), 3.71 (dd, *J* = 9.2, 4.6 Hz, 2H), 3.06 – 2.92 (m, 3H), 1.44 (s, 9H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 167.5, 157.5, 156.3, 141.3, 130.7, 124.8, 79.0, 53.8, 35.4, 28.5, 25.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{18}H_{17}Cl_4N_2O_6$ $[M+H]^+$: 496.9835, found: 496.9848.

Compound SI-17



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 2-cyclobutylacetate (SI-17)

Following the **General Procedure A** on 0.20 mmol scale. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 62.8 mg (79%) of the title compound **SI-17**.

Physical State: white solid.

m.p.: 112 – 114 ºC.

R_f = 0.92 (CH_2Cl_2).

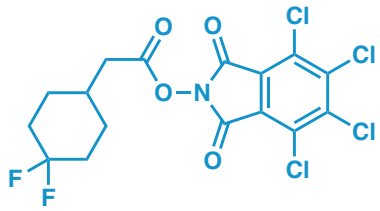
^{1}H NMR (600 MHz, $CDCl_3$): δ 2.86 – 2.72 (m, 3H), 2.29 – 2.18 (m, 2H), 1.99 – 1.80 (m, 4H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 168.1, 157.7, 141.1, 130.6, 124.9, 37.6, 32.1, 28.2,

18.5 ppm.

HRMS (ESI-TOF): calc'd for $C_{14}H_{10}Cl_4NO_4$ $[M+H]^+$: 395.9358, found: 395.9636.

Compound SI-18



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 2-(4,4-difluorocyclohexyl)acetate (SI-18)

Following **General Procedure A** on 5.00 mmol scale. Purification by column (silica gel, CH_2Cl_2) afforded 1.95 g (85%) of the title compound **SI-18**.

Physical State: white solid.

m.p.: 170 – 171 °C.

R_f = 0.92 (CH_2Cl_2).

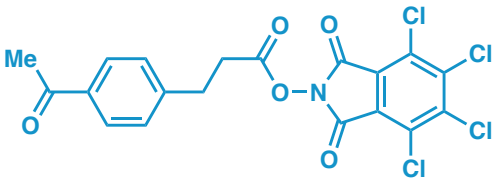
^{1}H NMR (600 MHz, $CDCl_3$): δ 2.61 (d, *J* = 7.2 Hz, 2H), 2.20 – 2.07 (m, 2H), 2.05 – 1.89 (m, 3H), 1.85 – 1.66 (m, 2H), 1.53 – 1.36 (m, 2H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 168.0, 157.6, 141.2, 130.6, 124.8, 123.0 (t, *J* = 241.3 Hz), 37.2, 37.2, 33.3 (t, *J* = 24.4 Hz), 33.2, 28.7, 28.7 ppm.

^{19}F NMR (376 MHz, $CDCl_3$): δ -92.70 (d, *J* = 237.1 Hz), -102.49 (d, *J* = 237.0 Hz) ppm.

The desired mass for HRMS was not observed.

Compound SI-19



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 3-(4-acetylphenyl)propanoate (SI-19)

Following **General Procedure A** on 2.00 mmol scale. Purification by column (silica

gel, CH_2Cl_2) afforded 0.71 g (75%) of the title compound **SI-19**.

Physical State: white solid.

m.p.: 96 – 97 °C.

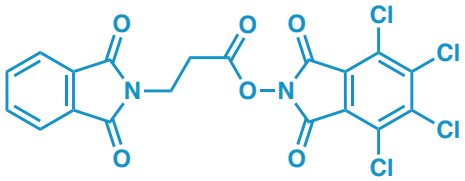
$\mathbf{R_f}$ = 0.27 (CH_2Cl_2).

^{1}H NMR (600 MHz, $CDCl_3$): δ 7.92 (d, *J* = 8.2 Hz, 2H), 7.35 (d, *J* = 8.2 Hz, 2H), 3.15 (t, *J* = 7.7 Hz, 2H), 3.01 (t, *J* = 7.6 Hz, 2H), 2.59 (s, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 197.8, 168.3, 157.5, 144.5, 141.2, 136.0, 130.6, 129.0, 128.7, 124.8, 32.2, 30.5, 26.7 ppm.

The desired mass for HRMS was not observed.

Compound SI-20



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl 3-(1,3-dioxoisoindolin-2-yl)propanoate (SI-20)

Following the **General Procedure A** on 1.48 mmol scale. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 142 mg (19%) of the title compound **SI-20**.

Physical State: white solid.

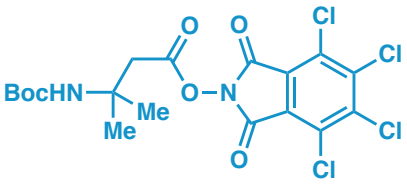
R_f = 0.48 (CH_2Cl_2).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.91 – 7.86 (m, 2H), 7.77 – 7.72 (m, 2H), 4.13 (t, *J* = 7.2 Hz, 2H), 3.17 (t, *J* = 7.2 Hz, 2H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ 167.9, 166.7, 157.3, 141.2, 134.4, 132.1, 130.7, 124.8, 123.7, 33.1, 29.8 ppm.

HRMS (ESI-TOF): calc'd for $C_{19}H_9Cl_4N_2O_6$ $[M+H]^+$: 500.9209, found: 500.9199.

Compound SI-21



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl

3-((tert-butoxycarbonyl)amino)-3-methylbutanoate (SI-21)

Following the **General Procedure A** on 3.00 mmol scale. Purification by column chromatography (silica gel, 20:1 CH_2Cl_2:Et_2O) afforded 1.21 g (81%) of the title compound **SI-21**.

Physical State: pale yellow solid.

m.p.: 162 – 164 ºC.

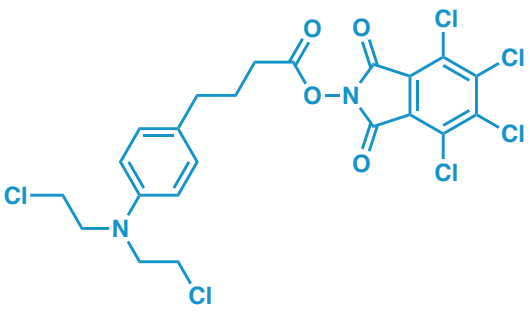
R_f = 0.78 (20:1 CH_2Cl_2:Et_2O).

^{1}H NMR (600 MHz, $CDCl_3$): δ 4.73 (br s, 1H), 3.16 (s, 2H), 1.47 (s, 6H), 1.42 (s, 9H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 166.7, 157.7, 154.6, 141.2, 130.6, 124.8, 79.6, 51.4, 40.3, 28.5, 27.9 ppm.

The desired mass for HRMS was not observed.

Compound SI-22



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl

4-(4-(bis(2-chloroethyl)amino)phenyl)butanoate (SI-22)

Following **General Procedure A** on 5.00 mmol scale. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 2.36 g (81%) of the title compound

SI-22.

Physical State: red solid.

m.p.: 117 – 118 °C

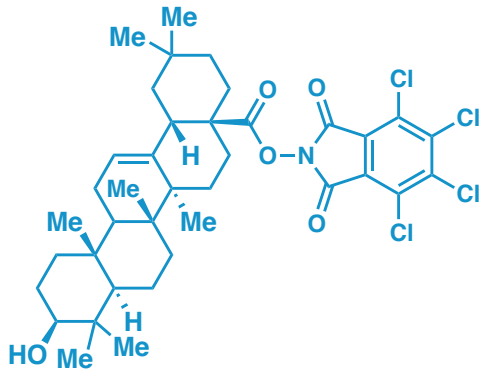
R_f = 0.99 (CH_2Cl_2).

^{1}H NMR (600 MHz, $CDCl_3$): δ 7.10 (d, *J* = 7.7 Hz, 2H), 6.64 (d, *J* = 7.8 Hz, 2H), 3.71 (t, *J* = 7.2 Hz, 4H), 3.63 (t, *J* = 7.2 Hz, 4H), 2.66 (q, *J* = 8.1, 7.6 Hz, 4H), 2.06 (p, *J* = 7.3 Hz, 2H), ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 169.2, 157.7, 144.7, 141.1, 130.6, 129.9, 129.7, 124.8, 112.3, 53.7, 40.6, 33.5, 30.1, 26.6 ppm.

The desired mass for HRMS was not observed.

Compound SI-23



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl (6aS,6bR,8aR,10S,12aR,14bS)-10-hydroxy-2,2,6a,6b,9,9,12a-heptamethyl-1,3,4,5,6,6a,6b,7,8,8a,9,10,11,12,12a,12b,13,14b-octadecahydropicene-4a(2H)-carboxylate (SI-23)

Following **General Procedure A** on 3.00 mmol scale. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 1.9 g (88%) of the title compound **SI-23**.

Physical State: white solid.

m.p.: >200 °C.

R_f = 0.10 (CH_2Cl_2).

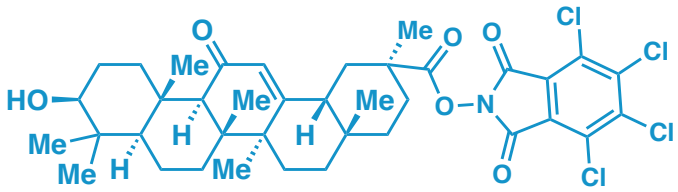
^{1}H NMR (600 MHz, $CDCl_3$): δ 5.32 (t, *J* = 3.6 Hz, 1H), 3.21 (dd, *J* = 11.3, 4.5 Hz, 1H), 2.87 (dd, *J* = 13.6, 3.9 Hz, 1H), 2.18 (td, *J* = 13.8, 3.7 Hz, 1H), 2.01 (td, *J* = 13.8, 4.5 Hz, 1H), 1.97 – 1.82 (m, 5H), 1.71 (t, *J* = 13.7 Hz, 1H), 1.64 – 1.58 (m, 2H), 1.58 – 1.52 (m, 3H), 1.51 – 1.43 (m, 3H), 1.42 – 1.39 (m, 2H), 1.34 – 1.29 (m, 1H), 1.26 (dt, *J* = 14.1, 3.3 Hz, 1H), 1.21 (ddd, *J* = 13.7, 4.8, 2.4 Hz, 1H), 1.18 (s, 3H), 1.00 (s, 3H), 0.98 – 0.96 (m, 1H), 0.94 (s, 3H), 0.93 (s, 3H), 0.92 (s, 3H), 0.83 (s, 3H), 0.78 (s, 3H), 0.74 (d, *J* = 11.4 Hz, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 173.5, 158.0, 142.5, 141.0, 130.5, 125.0, 123.6, 79.2, 55.4, 47.8, 47.5, 45.9, 42.1, 41.7, 39.6, 38.9, 38.7, 37.2, 34.0, 33.1, 32.9, 32.7, 30.7, 28.3, 28.1, 27.4, 25.7, 23.6 (2C), 23.3, 18.5, 17.1, 15.7, 15.6 ppm.

The desired mass for HRMS was not observed.

$[\alpha]_D^{20}$ = +124.0 (*c* = 1.0, CH_2Cl_2).

Compound SI-24



4,5,6,7-tetrachloro-1,3-dioxo-2,3-dihydro-1H-inden-2-yl (2S,4aS,6aS,6bR,8aR,10S,12aS,12bR,14bR)-10-hydroxy-2,4a,6a,6b,9,9,12a-heptamethyl-13-oxo-1,2,3,4,4a,5,6,6a,6b,7,8,8a,9,10,11,12,12a,12b,13,14b-icosahydropicene-2-carboxylate (SI-24)

Following **General Procedure A** on 5.00 mmol scale. Purification by column chromatography (silica gel, CH_2Cl_2) afforded 2.89 g (77%) of the title compound **SI-24**.

Physical State: white solid.

m.p.: >200 °C.

R_f = 0.09 (CH_2Cl_2).

^{1}H NMR (400 MHz, $CDCl_3$): δ 5.73 (s, 1H), 3.21 (dd, *J* = 10.8, 5.5 Hz, 1H), 2.78 (dt,

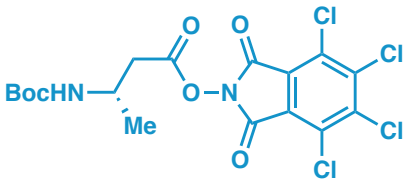
J = 13.5, 3.6 Hz, 1H), 2.38 (dd, J = 13.6, 4.1 Hz, 1H), 2.22 – 1.95 (m, 3H), 1.94 – 1.74 (m, 2H), 1.72 – 1.28 (m, 17H), 1.24 – 1.17 (m, 1H), 1.13 (d, J = 4.8 Hz, 6H), 1.10 – 1.03 (m, 1H), 1.00 (s, 3H), 0.98 – 0.92 (m, 1H), 0.90 (s, 3H), 0.80 (s, 3H), 0.69 (d, J = 11.7 Hz, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 200.2, 172.3, 168.3, 157.8, 141.1, 130.6, 129.1, 124.9, 78.9, 62.0, 55.1, 48.0, 45.5, 44.2, 43.2, 41.2, 39.3, 39.3, 37.4, 37.2, 32.9, 32.0, 31.5, 28.5, 28.2, 28.1, 27.4, 26.6, 26.5, 23.5, 18.8, 17.6, 16.5, 15.7 ppm.

HRMS (ESI-TOF): calc'd for $C_{38}H_{46}Cl_4NO_6$ $[M+H]^+$: 752.2074, found: 752.2075.

$[\alpha]_D^{20}$ = +166.0 (c = 1.0, CH_2Cl_2).

Compound SI-25



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl (S)-3-((tert-butoxycarbonyl)amino)butanoate (SI-25)

Following the **General Procedure A** on 3.00 mmol scale. Purification by column chromatography (silica gel, 20:1 CH_2Cl_2:Et_2O) afforded 1.20 g (82%) of the title compound **SI-25**.

Physical State: white solid.

m.p.: 133 – 135 ºC.

***R*$_f$** = 0.87 (20:1 CH_2Cl_2:Et_2O).

^{1}H NMR (500 MHz, $CDCl_3$): δ 4.83 (br s, 1H), 4.18 (br s, 1H), 2.95 – 2.88 (m, 2H), 1.45 (s, 9H), 1.34 (d, J = 6.9 Hz, 3H) ppm.

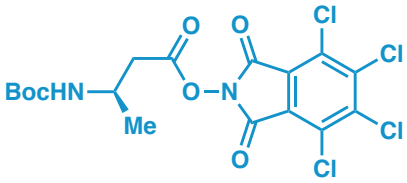
^{13}C NMR (151 MHz, $CDCl_3$): δ 167.1, 157.6, 155.0, 141.2, 130.7, 124.8, 79.9, 43.6, 37.6, 28.5, 19.8 ppm.

HRMS (ESI-TOF): calc'd for $C_{17}H_{16}Cl_4N_2NaO_6$ $[M+Na]^+$: 506.9655, found:

506.9658.

[α]$_D^{20}$ = -61.2 (*c* = 1.0, CH_2Cl_2).

Compound SI-26



4,5,6,7-tetrachloro-1,3-dioxoisoindolin-2-yl

(R)-3-((tert-butoxycarbonyl)amino)butanoate (SI-26)

Following the **General Procedure A** on 1.85 mmol scale. Purification by column chromatography (silica gel, 20:1 CH_2Cl_2:Et_2O) afforded 688.9 mg (77%) of the title compound **SI-26**.

Physical State: white solid.

m.p.: 136 – 137 ºC.

***R**$_f$* = 0.87 (20:1 CH_2Cl_2:Et_2O).

^{1}H NMR (500 MHz, $CDCl_3$): δ 4.88 (br s, 1H), 4.14 (br s, 1H), 2.94 – 2.84 (m, 2H), 1.41 (s, 9H), 1.31 (d, *J* = 6.9 Hz, 3H) ppm.

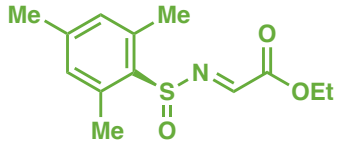
^{13}C NMR (151 MHz, $CDCl_3$): δ 167.0, 157.5, 155.0, 141.1, 130.5, 124.7, 79.7, 43.5, 37.5, 28.4, 19.7 ppm.

HRMS (ESI-TOF): calc'd for $C_{17}H_{17}Cl_4N_2O_6$ $[M+H]^+$: 484.9835, found: 484.9832.

[α]$_D^{20}$ = +65.6 (*c* = 1.0, CH_2Cl_2).

Experimental Procedures and Characterization Data for Sulfinimines

Compound 2



ethyl (S,E)-2-((mesitylsulfinyl)imino)acetate (2)

Following the **General Procedure B** on 10.00 mmol scale at rt. Purification by column chromatography (silica gel, 4:1 hexanes:EtOAc) afforded 2.02 g (75%) of the title compound **2**.

Physical State: white solid.

m.p.: 62 – 63 ºC.

R_f = 0.53 (4:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 8.24 (s, 1H), 6.86 (s, 2H), 4.40 – 4.35 (m, 2H), 2.45 (s, 6H), 2.28 (s, 3H), 1.37 (t, J = 7.1 Hz, 3H) ppm.

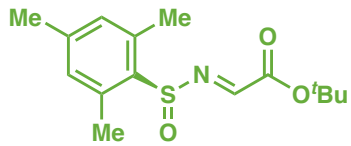
^{13}C NMR (151 MHz, $CDCl_3$): δ 161.5, 154.0, 142.6, 138.9, 133.1, 131.2, 62.8, 21.2, 19.0, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{13}H_{18}NO_3S$ $[M+H]^+$: 268.1002, found: 268.1010.

$[\alpha]_D^{20}$ = +50.0 (c = 2.1, CH_2Cl_2).

For *ent*-2: $[\alpha]_D^{20}$ = -358.3 (c = 1.0, $CHCl_3$).

Compound 2b



tert-butyl (S,E)-2-((mesitylsulfinyl)imino)acetate (2b)

Following the **General Procedure B** on 1.00 mmol scale at rt. Purification by column chromatography (silica gel, 4:1 hexanes:EtOAc) afforded 237.8 mg (80%) of the title compound **2b**.

Physical State: white solid.

m.p.: 67 – 71 ºC.

R_f = 0.64 (4:1 hexanes:EtOAc).

^{1}H NMR (500 MHz, $CDCl_3$): δ 8.15 (s, 1H), 6.86 (s, 2H), 2.45 (s, 6H), 2.28 (s, 3H), 1.55 (s, 9H) ppm.

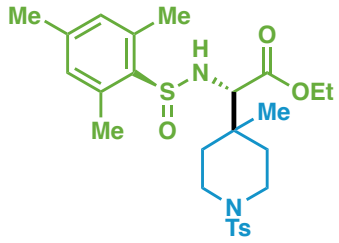
^{13}C NMR (151 MHz, $CDCl_3$): δ 160.6, 155.4, 142.5, 138.9, 133.4, 131.1, 84.2, 28.0, 21.2, 19.0 ppm.

HRMS (ESI-TOF): calc'd for $C_{15}H_{22}NO_3S$ $[M+H]^+$: 296.1315, found: 296.1310.

$[\alpha]_D^{20}$ = +58.3 (*c* = 1.2, CH_2Cl_2).

Experimental Procedures and Characterization Data for Amino Acids

Compound 3



ethyl 2-(((S)-mesitylsulfinyl)amino)-2-(4-methyl-1-tosylpiperidin-4-yl)acetate (3)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 42.2 mg (81%) of the title compound **3**.

Following **General Procedure D** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 38.0 mg (73%) of the title compound **3**.

Physical State: white solid.

m.p.: 128 – 130 ºC.

R_f = 0.30 (2:1 hexanes:EtOAc).

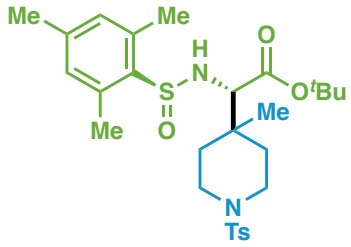
^{1}H NMR (600 MHz, $CDCl_3$): δ 7.67 – 7.61 (m, 2H), 7.35 – 7.31 (m, 2H), 6.86 (s, 2H), 5.00 (d, *J* = 10.0 Hz, 1H), 4.25 – 4.14 (m, 2H), 3.66 (d, *J* = 10.0 Hz, 1H), 3.38 – 3.25 (m, 2H), 2.82 – 2.71 (m, 2H), 2.52 (s, 6H), 2.45 (s, 3H), 2.29 (s, 3H), 1.84 (ddd, *J* = 13.8, 9.7, 4.1 Hz, 1H), 1.73 (ddd, *J* = 13.6, 9.6, 4.1 Hz, 1H), 1.53 – 1.48 (m, 1H), 1.46 – 1.41 (m, 1H), 1.27 (t, *J* = 7.1 Hz, 3H), 0.76 (s, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.9, 143.8, 141.3, 137.7, 136.9, 133.3, 131.0, 129.9, 127.7, 64.3, 61.8, 41.93, 41.90, 35.8, 33.7, 33.5, 21.7, 21.2, 19.4, 19.2, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{26}H_{37}N_2O_5S_2$ $[M+H]^+$: 521.2138, found: 521.2136.

$[\alpha]_D^{20}$ = +76.9 (*c* = 1.0, $CHCl_3$).

Compound 8



tert-butyl 2-(((S)-mesitylsulfinyl)amino)-2-(4-methyl-1-tosylpiperidin-4-yl)acetate (8)

Following **General Procedure C** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 4:1 to 1:1 hexanes:EtOAc) afforded 37.3 mg (68%) of the title compound **8**.

Physical State: white solid.

m.p.: 115 – 116 ºC.

R_f = 0.25 (2:1 hexanes:EtOAc).

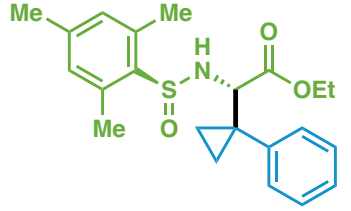
^{1}H NMR (600 MHz, $CDCl_3$): δ 7.63 (d, *J* = 8.2 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 6.86 (s, 2H), 4.97 (d, *J* = 9.9 Hz, 1H), 3.56 (d, *J* = 9.9 Hz, 1H), 3.34 – 3.21 (m, 2H), 2.82 – 2.76 (m, 2H), 2.52 (s, 6H), 2.44 (s, 3H), 2.28 (s, 3H), 1.85 (ddd, *J* = 13.4, 9.5, 3.8 Hz, 1H), 1.72 (ddd, *J* = 13.3, 9.4, 3.9 Hz, 1H), 1.52 – 1.43 (m, 11H), 0.76 (s, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 170.8, 143.8, 141.2, 137.8, 136.8, 133.3, 131.0, 130.0, 127.7, 82.9, 64.6, 41.9, 35.6, 33.9, 33.5, 28.1, 21.7, 21.2, 19.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{28}H_{41}N_2O_5S_2$ $[M+H]^+$: 549.2451, found: 549.2470.

$[\alpha]_D^{20}$ = +69.5 (*c* = 1.0, CH_2Cl_2).

Compound 9



ethyl 2-(((S)-mesitylsulfinyl)amino)-2-(1-phenylcyclopropyl)acetate (9)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 36.3 mg (94%) of the title compound **9**.

Physical State: colorless oil.

R_f = 0.57 (2:1 hexanes:EtOAc).

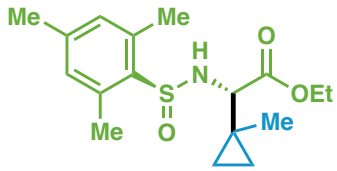
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25 – 7.16 (m, 5H), 6.86 (s, 2H), 5.09 (d, *J* = 7.8 Hz, 1H), 4.20 – 4.09 (m, 2H), 3.77 (d, *J* = 7.8 Hz, 1H), 2.55 (s, 6H), 2.29 (s, 3H), 1.26 – 1.17 (m, 4H), 1.06 – 0.94 (m, 2H), 0.92 – 0.86 (m, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.7, 141.0, 140.8, 137.9, 136.9, 131.0, 130.6, 128.2, 127.4, 64.3, 61.8, 29.6, 21.2, 19.4, 14.2, 11.7, 11.5 ppm.

HRMS (ESI-TOF): calc'd for $C_{22}H_{28}NO_3S$ $[M+H]^+$: 386.1784, found: 386.1790.

$[\alpha]_D^{20}$ = +178.8 (*c* = 1.0, $CHCl_3$).

Compound 10



tert-butyl 2-(((S)-mesitylsulfinyl)amino)-2-(1-methylcyclopropyl)acetate (10)

Following **General Procedure C** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 9:1 to 4:1 hexanes:EtOAc) afforded 28.4 mg (88%) of the title compound **10**.

Physical State: pale yellow solid.

m.p.: >200 ºC.

R_f = 0.45 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 6.87 (s, 2H), 5.19 (d, *J* = 6.7 Hz, 1H), 4.28 – 4.16 (m, 2H), 3.47 (d, *J* = 6.6 Hz, 1H), 2.59 (s, 6H), 2.29 (s, 3H), 1.29 (t, *J* = 7.1 Hz, 3H), 0.99 (s, 3H), 0.80 – 0.76 (m, 1H), 0.70 – 0.66 (m, 1H), 0.46 – 0.39 (m, 2H) ppm.

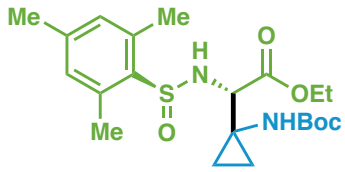
^{13}C NMR (151 MHz, $CDCl_3$): δ 172.2, 140.9, 137.9, 136.9, 130.9, 63.5, 61.7, 21.1, 19.4, 19.21, 19.18, 14.3, 12.3, 11.9 ppm.

HRMS (ESI-TOF): calc'd for $C_{17}H_{26}NO_3S$ $[M+H]^+$: 324.1628, found: 324.1630.

$[\alpha]_D^{20}$ = +164.0 (*c* = 0.1, CH_2Cl_2).

For previous α-amino acid (AA) synthesis, see ref 8.

Compound 11



ethyl

2-(1-((tert-butoxycarbonyl)amino)cyclopropyl)-2-(((S)-mesitylsulfinyl)amino)acetate (11)

Following **General Procedure C** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 9:1 to 4:1 hexanes:EtOAc) afforded 17.6 mg (41%) of the title compound **11**.

Physical State: colorless oil.

$\mathbf{R}_f$ = 0.25 (2:1 hexanes:EtOAc).

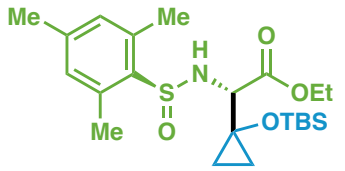
^{1}H NMR (600 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.53 (br s, 1H), 4.98 (br s, 1H), 4.23 – 4.10 (m, 2H), 3.80 (d, *J* = 6.2 Hz, 1H), 2.58 (s, 6H), 2.28 (s, 3H), 1.39 (s, 9H), 1.28 (t, *J* = 7.2 Hz, 3H), 1.11 (br s, 1H), 0.99 (br s, 1H), 0.89 (br s, 1H), 0.83 (br s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.3, 155.6, 141.1, 137.6, 137.0, 131.0, 80.0, 62.0, 61.4, 36.0, 28.4, 21.2, 19.5, 14.2, 13.2, 13.0 ppm.

HRMS (ESI-TOF): calc'd for $C_{21}H_{33}N_2O_5S$ $[M+H]^+$: 425.2105, found: 425.2133.

$[\alpha]_D^{20}$ = +97.2 (*c* = 1.1, CH_2Cl_2).

Compound 12



ethyl

2-(1-((tert-butyldimethylsilyl)oxy)cyclopropyl)-2-(((S)-mesitylsulfinyl)amino)acetate

(12)

Following **General Procedure C** on 0.10 mmol scale. Purification by column chromatography (silica gel, 9:1 hexanes:EtOAc) afforded 30.4 mg (69%) of the title compound **12**.

Physical State: yellow solid.

m.p.: >200 ºC.

$\mathbf{R}_f$ = 0.56 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.36 (d, *J* = 8.2 Hz, 1H), 4.22 (qq, *J* = 11.0, 7.1 Hz, 2H), 3.54 (d, *J* = 8.2 Hz, 1H), 2.60 (s, 6H), 2.28 (s, 3H), 1.29 (t, *J* = 7.2 Hz, 3H), 0.96 – 0.93 (m, 1H), 0.88 – 0.80 (m, 3H), 0.76 (s, 9H), -0.04 (s, 3H), -0.10 (s, 3H) ppm.

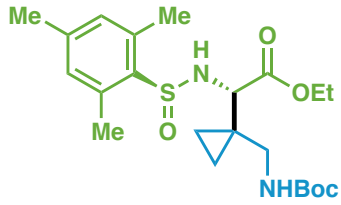
^{13}C NMR (151 MHz, $CDCl_3$): δ 171.3, 140.9, 138.1, 136.6, 130.9, 64.0, 61.8, 60.0, 25.6, 21.2, 19.4, 18.0, 14.3, 12.5, 12.3, -3.5 ppm.

HRMS (ESI-TOF): calc'd for $C_{22}H_{38}NO_4SSi$ $[M+H]^+$: 440.2285, found: 440.2284.

$[\alpha]_D^{20}$ = +231.5 (*c* = 0.1, CH_2Cl_2).

For previous AA synthesis, see ref 9.

Compound 13



ethyl (S)-2-(1-(((tert-butoxycarbonyl)amino)methyl)cyclopropyl)-2-(((S)-mesitylsulfinyl)amino)acetate (13)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 37.3 mg (85%) of the title compound **13**.

Physical State: colorless oil.

$\boldsymbol{R}_f$ = 0.42 (2:1 hexanes:EtOAc).

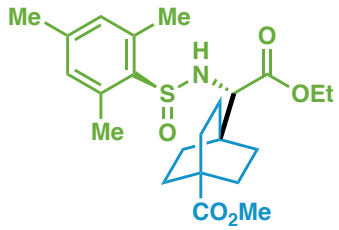
^{1}H NMR (400 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.31 (d, *J* = 6.6 Hz, 1H), 4.81 (br s, 1H), 4.29 – 4.13 (m, 2H), 3.64 (d, *J* = 6.5 Hz, 1H), 3.23 (dd, *J* = 14.4, 6.5 Hz, 1H), 2.97 (dd, *J* = 14.3, 5.5 Hz, 1H), 2.58 (s, 6H), 2.28 (s, 3H), 1.38 (s, 9H), 1.29 (t, *J* = 7.1 Hz, 3H), 0.85 – 0.78 (m, 1H), 0.71 – 0.63 (m, 2H), 0.62 – 0.56 (m, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 172.2, 155.9, 141.2, 137.6, 136.9, 131.0, 79.3, 62.1, 61.0, 45.1, 28.5, 24.0, 21.1, 19.4, 14.2, 10.3, 9.7 ppm.

HRMS (ESI-TOF): calc'd for $C_{22}H_{35}N_2O_5S$ $[M+H]^+$: 439.2261, found: 439.2260.

$[\alpha]_D^{20}$ = +135.4 (*c* = 1.0, $CHCl_3$).

Compound 14



methyl 4-(2-ethoxy-1-(((S)-mesitylsulfinyl)amino)-2-oxoethyl)bicyclo[2.2.2]octane-1-carboxylate (14)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (3: 1 hexanes:EtOAc) afforded 38.4 mg (88%) of the title compound **14**.

Physical State: colorless oil.

***R*$_f$** = 0.48 (2:1 hexanes:EtOAc).

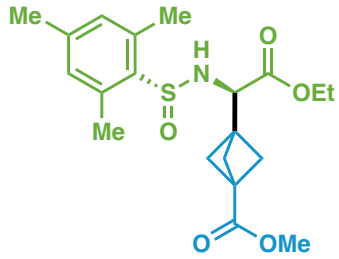
^{1}H NMR (400 MHz, $CDCl_3$): δ 6.87 (s, 2H), 4.92 (d, J = 10.3 Hz, 1H), 4.28 – 4.15 (m, 2H), 3.62 (s, 3H), 3.54 (d, *J* = 10.3 Hz, 1H), 2.56 (s, 6H), 2.29 (s, 3H), 1.84 – 1.68 (m, 6H), 1.67 – 1.58 (m, 3H), 1.47 – 1.37 (m, 3H), 1.30 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 178.1, 172.3, 141.1, 138.0, 136.9, 131.0, 65.2, 61.6, 51.9, 38.9, 35.6, 28.1, 27.2, 21.2, 19.5, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{23}H_{34}NO_5S$ $[M+H]^+$: 436.2152, found: 436.2147.

$[\alpha]_D^{20}$ = +71.4 (*c* = 0.5, $CHCl_3$).

Compound 15



methyl 3-((R)-2-ethoxy-1-(((R)-mesitylsulfinyl)amino)-2-oxoethyl)bicyclo[1.1.1]pentane-1-carboxylate (15)

Following **General Procedure D** on 0.20 mmol scale. Purification by column chromatography (silica gel, gradient from 1:0 to 0:1 heptanes:EtOAc) afforded 43 mg (54%) of the title compound **15**.

Physical State: amorphous material.

$\mathbf{R}_f$ = 0.60 (1:1 heptanes:EtOAc).

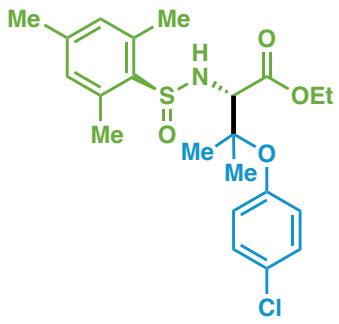
^{1}H NMR (400 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.05 (d, *J* = 8.1 Hz, 1H), 4.32 – 4.13 (m, 2H), 4.06 (d, *J* = 8.2 Hz, 1H), 3.65 (s, 3H), 2.56 (s, 6H), 2.28 (s, 3H), 1.99 (s, 6H), 1.28 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ 170.9, 167.0, 141.2, 137.7, 136.9, 131.0, 62.0, 57.2, 51.8, 50.7, 40.1, 37.7, 21.1, 19.4, 14.4 ppm.

HRMS (ESI-TOF): calc'd for $C_{20}H_{28}NO_5S$ $[M+H]^+$: 394.1683, found: 394.1677.

$[\alpha]_D^{20}$ = -77.8 (*c* = 0.2, MeOH).

Compound 16



ethyl 3-(4-chlorophenoxy)-2-(((S)-mesitylsulfinyl)amino)-3-methylbutanoate (16)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (3: 1 hexanes:EtOAc) afforded 40.3 mg (92%) of the title compound **16**.

Physical State: colorless oil.

R_f = 0.52 (2:1 hexanes:EtOAc).

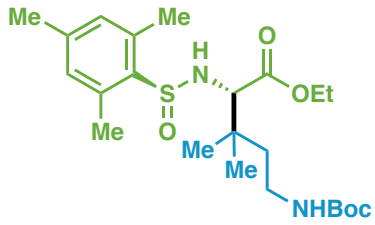
^{1}H NMR (600 MHz, $CDCl_3$): δ 7.20 – 7.18 (m, 2H), 6.89 – 6.85 (m, 4H), 5.33 (d, *J* = 9.9 Hz, 1H), 4.34 – 4.21 (m, 2H), 4.01 (d, *J* = 9.9 Hz, 1H), 2.58 (s, 6H), 2.29 (s, 3H), 1.33 – 1.29 (m, 9H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.4, 153.0, 141.2, 137.9, 137.0, 131.0, 129.4, 129.2, 125.5, 81.9, 65.6, 61.9, 24.3, 23.8, 21.2, 19.5, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{22}H_{29}ClNO_4S$ $[M+H]^+$: 438.1500, found: 438.1500.

$[\alpha]_D^{20}$ = +31.4 (*c* = 1.0, $CHCl_3$).

Compound 17



ethyl (S)-5-((tert-butoxycarbonyl)amino)-2-(((S)-mesitylsulfinyl)amino)-3,3-dimethylpentanoate (17)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2: 1 hexanes:EtOAc) afforded 34.6 mg (76%) of the title compound **17**.

Following **General Procedure C** on 1.0 mmol scale. Purification by column (2:1 hexanes:EtOAc) afforded 327.6 mg (72%) of the title compound **17**.

Physical State: colorless oil.

R_f = 0.40 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.04 (d, *J* = 10.1 Hz, 1H), 4.47 (s, 1H),

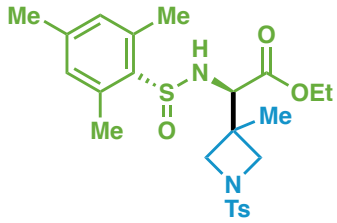
4.28 – 4.16 (m, 2H), 3.66 (d, J = 10.1 Hz, 1H), 3.27 – 3.05 (m, 2H), 2.56 (s, 6H), 2.28 (s, 3H), 1.54 – 1.46 (m, 2H), 1.43 (s, 9H), 1.30 (t, J = 7.2 Hz, 3H), 0.96 (s, 6H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 172.5, 155.9, 141.1, 137.9, 136.9, 131.0, 79.4, 65.5, 61.7, 38.8, 37.1, 36.5, 28.5, 23.9, 23.6, 21.2, 19.4, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{23}H_{39}N_2O_5S$ $[M+H]^+$: 455.2574, found: 455.2569.

$[\alpha]_D^{20}$ = +57.2 (c = 1.0, $CHCl_3$).

Compound 18



ethyl (R)-2-(((R)-mesitylsulfinyl)amino)-2-(3-methyl-1-tosylazetidin-3-yl)acetate (18)

Following **General Procedure D** on 0.20 mmol scale. Purification by column chromatography (silica gel, gradient from 1:0 to 0:1 heptanes:EtOAc) afforded 58 mg (59%) of the title compound **18**.

Physical State: amorphous material.

R_f = 0.45 (1:1 heptanes:EtOAc).

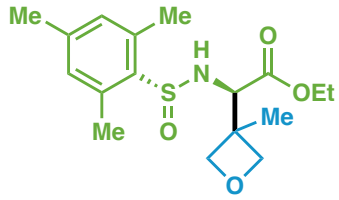
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.74 (d, J = 8.2 Hz, 2H), 7.40 (d, J = 8.0 Hz, 2H), 6.86 (s, 2H), 5.06 (d, J = 8.4 Hz, 1H), 4.24 – 4.07 (m, 2H), 3.92 (d, J = 8.5 Hz, 1H), 3.73 (dd, J = 8.3, 4.5 Hz, 2H), 3.49 (d, J = 8.5 Hz, 1H), 3.42 (d, J = 8.3 Hz, 1H), 2.52 (s, 6H), 2.48 (s, 3H), 2.28 (s, 3H), 1.24 (t, J = 7.1 Hz, 3H), 1.00 (s, 3H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ 170.8, 144.6, 141.5, 137.4, 136.8, 131.4, 131.1, 130.0, 128.4, 62.4, 62.3, 59.7, 59.6, 37.0, 21.8, 21.2, 19.8, 19.4, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{24}H_{33}N_2O_5S_2$ $[M+H]^+$: 493.1825, found: 493.1825.

$[\alpha]_D^{20}$ = -71.7 (c = 0.3, MeOH).

Compound 19



ethyl (R)-2-(((R)-mesitylsulfinyl)amino)-2-(3-methyloxetan-3-yl)acetate (19)

Following **General Procedure D** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 19:1 to 2:3 heptanes:EtOAc) afforded 20.2 mg (60%) of the title compound **19**.

Physical State: white solid.

R$_f$ = 0.3 (7:3 heptanes:EtOAc).

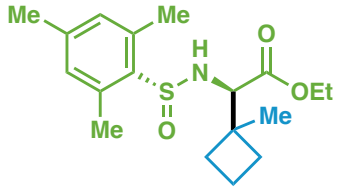
^{1}H NMR (400 MHz, DMSO-*d*$_6$): δ 6.89 (s, 2H), 6.34 (d, *J* = 8.9 Hz, 1H), 4.62 (dd, *J* = 12.9, 6.0 Hz, 2H), 4.23 – 4.13 (m, 3H), 4.02 – 3.89 (m, 2H), 2.52 (s, 6H), 2.25 (s, 3H), 1.24 (s, 3H), 1.10 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (101 MHz, DMSO-*d*$_6$): δ 170.4, 139.9, 136.8, 136.3, 130.5, 78.9, 78.8, 70.0, 60.6, 41.6, 20.4, 19.6, 19.0, 13.8 ppm.

HRMS (ESI-TOF): calc'd for $C_{17}H_{26}NO_4S$ $[M+H]^+$: 340.1577, found: 340.1579.

[α]$_D^{22}$ = -88.8 (*c* = 0.1, MeOH).

Compound 20



ethyl (R)-2-(((R)-mesitylsulfinyl)amino)-2-(1-methylcyclobutyl)acetate (20)

Following **General Procedure D** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 99:1 to 4:1 heptanes:EtOAc) afforded 19 mg (56%) of the title compound **20**.

Physical State: white solid.

R$_f$ = 0.27 (4:1 heptanes:EtOAc).

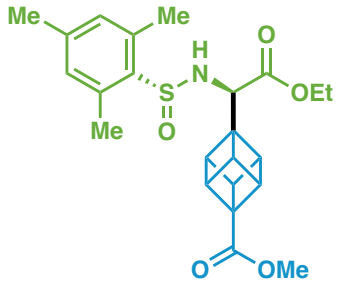
^{1}H NMR (400 MHz, $CDCl_3$): δ 6.87 (s, 2H), 5.13 (d, *J* = 8.6 Hz, 1H), 4.31 – 4.11 (m, 2H), 3.95 (d, *J* = 8.7 Hz, 1H), 2.58 (s, 6H), 2.31 – 2.26 (m, 4H), 2.18 – 2.08 (m, 1H), 2.02 – 1.88 (m, 1H), 1.87 – 1.75 (m, 1H), 1.70 – 1.63 (m, 2H), 1.27 (t, *J* = 7.1 Hz, 3H), 1.03 (s, 3H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ 172.4, 141.0, 138.2, 136.9, 130.9, 65.1, 61.6, 41.9, 31.73, 31.65, 21.6, 21.2, 19.5, 14.9, 14.4 ppm.

HRMS (ESI-TOF): calc'd for $C_{17}H_{26}NO_3S$ $[M+H]^+$: 338.1784, found: 338.1776.

$[\alpha]_D^{20}$ = -50.2 (*c* = 0.6, $CHCl_3$).

Compound 21



methyl 4-((R)-2-ethoxy-1-(((R)-mesitylsulfinyl)amino)-2-oxoethyl)cubane-1-carboxylate (21)

Following **General Procedure D** on 0.20 mmol scale. Purification by column chromatography (silica gel, gradient from 1:0 to 0:1 heptanes:EtOAc) afforded 69 mg (80%) of the title compound **21**.

Physical State: amorphous material.

R_f = 0.62 (1:1 heptanes:EtOAc).

^{1}H NMR (400 MHz, $CDCl_3$): δ 6.87 (s, 2H), 5.10 (d, *J* = 7.1 Hz, 1H), 4.30 (dq, *J* = 10.7, 7.1 Hz, 1H), 4.22 (d, *J* = 7.1 Hz, 1H), 4.19 – 4.07 (m, 4H), 3.97 – 3.91 (m, 3H), 3.68 (s, 3H), 2.57 (s, 6H), 2.28 (s, 3H), 1.25 (t, *J* = 7.1 Hz, 3H) ppm.

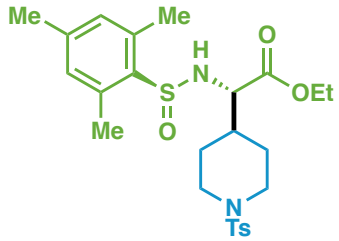
^{13}C NMR (101 MHz, $CDCl_3$): δ 172.4, 170.9, 141.2, 137.8, 137.0, 131.0, 61.9, 58.5, 57.4, 56.4, 51.6, 46.2, 45.2, 21.1, 19.4, 14.4 ppm.

HRMS (ESI-TOF): calc'd for $C_{23}H_{28}NO_5S$ $[M+H]^+$: 430.1683, found: 430.1672.

$[\alpha]_D^{20}$ = -56.5 (*c* = 0.2, MeOH).

For previous AA synthesis, see ref 10.

Compound 22



ethyl 2-(((S)-mesitylsulfinyl)amino)-2-(1-tosylpiperidin-4-yl)acetate (22)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 38.5 mg (76%) of the title compound **22**.

Physical State: colorless oil.

***R*$_f$** = 0.18 (2:1 hexanes:EtOAc).

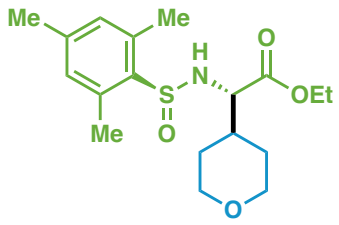
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.66 – 7.55 (m, 2H), 7.34 – 7.27 (m, 2H), 6.87 (s, 2H), 4.99 (d, *J* = 9.1 Hz, 1H), 4.20 (q, *J* = 7.1 Hz, 2H), 3.87 – 3.72 (m, 3H), 2.56 (s, 6H), 2.42 (s, 3H), 2.29 (s, 3H), 2.26 – 2.10 (m, 2H), 1.72 – 1.53 (m, 4H), 1.49 – 1.37 (m, 1H), 1.27 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 172.4, 143.7, 141.3, 137.8, 136.8, 133.2, 131.1, 129.8, 127.8, 62.1, 61.3, 46.11, 46.09, 39.4, 28.2, 26.6, 21.7, 21.2, 19.5, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{25}H_{35}N_2O_5S_2$ $[M+H]^+$: 507.1982, found: 507.1988.

$[\alpha]_D^{20}$ = +162.0 (*c* = 1.0, $CHCl_3$).

Compound 23



ethyl 2-(((S)-mesitylsulfinyl)amino)-2-(tetrahydro-2H-pyran-4-yl)acetate (23)

Following **General Procedure C** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 4:1 to 2:1 hexanes:EtOAc) afforded 23.0 mg (65%) of the title compound **23**.

Physical State: pale yellow oil.

$\mathbf{R}_f$ = 0.11 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 6.87 (s, 2H), 5.04 (d, *J* = 9.2 Hz, 1H), 4.29 – 4.19 (m, 2H), 3.96 (ddd, *J* = 16.7, 11.4, 3.4 Hz, 2H), 3.80 (dd, *J* = 9.2, 5.8 Hz, 1H), 3.39 – 3.27 (m, 2H), 2.58 (s, 6H), 2.29 (s, 3H), 1.97 – 1.91 (m, 1H), 1.60 (qd, *J* = 12.4, 4.6 Hz, 1H), 1.54 – 1.46 (m, 2H), 1.41 (qd, *J* = 13.0, 12.5, 5.6 Hz, 1H), 1.30 (t, *J* = 7.1 Hz, 3H) ppm.

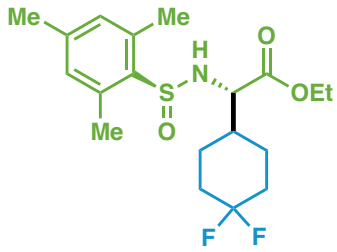
^{13}C NMR (151 MHz, $CDCl_3$): δ 172.7, 141.2, 137.9, 136.8, 131.0, 67.7, 67.6, 62.0, 61.9, 39.2, 29.4, 28.1, 21.2, 19.5, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{18}H_{28}NO_4S$ $[M+H]^+$: 354.1734, found: 354.1733.

$[\alpha]_D^{20}$ = +106.0 (*c* = 1.0, CH_2Cl_2).

For previous AA syntheses, see ref 11.

Compound 24



ethyl (S)-2-(4,4-difluorocyclohexyl)-2-(((S)-mesitylsulfinyl)amino)acetate (24)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 27.2 mg (70%) of the title compound **24**.

Physical State: colorless oil.

$\boldsymbol{R}_f$ = 0.48 (2:1 hexanes:EtOAc).

^{1}H NMR (400 MHz, $CDCl_3$): δ 6.88 (s, 2H), 5.06 (d, *J* = 8.9 Hz, 1H), 4.31 – 4.19 (m, 2H), 3.85 (dd, *J* = 8.9, 5.4 Hz, 1H), 2.58 (s, 6H), 2.29 (s, 3H), 2.20 – 2.01 (m, 2H),

1.83 – 1.56 (m, 6H), 1.49 – 1.36 (m, 1H), 1.31 (t, J = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 172.7, 141.3, 137.9, 136.9, 131.0, 123.0 (t, J = 240.9 Hz), 62.0, 61.10, 61.09, 39.9, 33.3 (q, J = 22.7 Hz), 25.8 (d, J = 9.9 Hz), 24.1 (d, J = 9.9 Hz), 21.2, 19.5, 14.3 ppm.

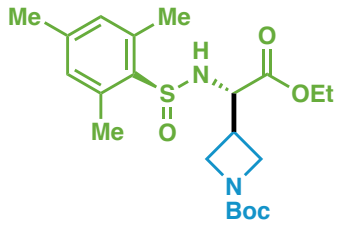
^{19}F NMR (376 MHz, $CDCl_3$): δ -92.32 (d, J = 236.5 Hz), -102.67 (d, J = 236.4 Hz) ppm.

HRMS (ESI-TOF): calc'd for $C_{19}H_{27}F_2NNaO_3S$ $[M+Na]^+$: 410.1572, found: 410.1578.

$[\alpha]_D^{20}$ = +28.0 (c = 1.0, $CHCl_3$).

For previous AA synthesis, see ref 12.

Compound 25



tert-butyl

3-((S)-2-ethoxy-1-(((S)-mesitylsulfinyl)amino)-2-oxoethyl)azetidine-1-carboxylate

(25)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 27.6 mg (65%) of the title compound **25**.

Physical State: colorless oil.

***R*$_f$** = 0.48 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 6.88 (s, 2H), 5.15 (d, J = 8.6 Hz, 1H), 4.28 – 4.17 (m, 2H), 4.09 (t, J = 8.3 Hz, 1H), 3.98 (t, J = 8.6 Hz, 1H), 3.94 – 3.89 (m, 2H), 3.78 (dd, J = 9.0, 5.6 Hz, 1H), 2.85 – 2.77 (m, 1H), 2.59 (s, 6H), 2.29 (s, 3H), 1.41 (s, 9H), 1.28 (t, J = 7.2 Hz, 3H) ppm.

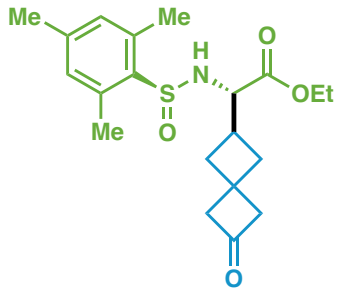
^{13}C NMR (151 MHz, $CDCl_3$): δ 171.9, 156.2, 141.4, 137.6, 136.9, 131.0, 79.8, 62.3, 58.9, 51.7, 50.9, 32.3, 28.4, 21.1, 19.4, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{21}H_{33}N_2O_5S$ $[M+H]^+$: 425.2105, found: 425.2093.

$[\alpha]_D^{20}$ = +23.1 (*c* = 1.0, $CHCl_3$).

For previous AA synthesis, see ref 13.

Compound 26



ethyl (S)-2-(((S)-mesitylsulfinyl)amino)-2-(6-oxospiro[3.3]heptan-2-yl)acetate (26)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 28.4 mg (75%) of the title compound **26**.

Physical State: colorless oil.

R_f = 0.20 (2:1 hexanes:EtOAc).

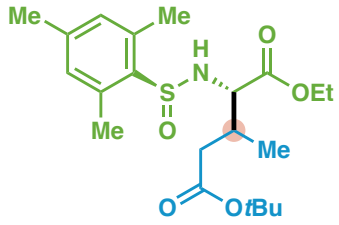
^{1}H NMR (600 MHz, $CDCl_3$): δ 6.88 (s, 2H), 5.09 (d, *J* = 8.6 Hz, 1H), 4.28 – 4.15 (m, 2H), 3.91 (t, *J* = 8.2 Hz, 1H), 3.10 (d, *J* = 5.0 Hz, 2H), 3.00 – 2.95 (m, 2H), 2.65 – 2.58 (m, 7H), 2.35 – 2.30 (m, 1H), 2.29 (s, 3H), 2.27 – 2.13 (m, 3H), 1.28 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 207.0, 172.5, 141.2, 137.9, 136.9, 131.0, 61.9, 60.7, 59.6, 58.6, 36.8, 36.7, 33.8, 29.3, 21.2, 19.5, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{20}H_{27}NNaO_4S$ $[M+Na]^+$: 400.1553, found: 400.1555.

$[\alpha]_D^{20}$ = +154.0 (*c* = 1.0, $CHCl_3$).

Compound 27



5-(tert-butyl) 1-ethyl (2S)-2-(((S)-mesitylsulfinyl)amino)-3-methylpentanedioate (27)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 27.2 mg (62%, β dr 1:1) of the title compound **27**.

Physical State: colorless oil.

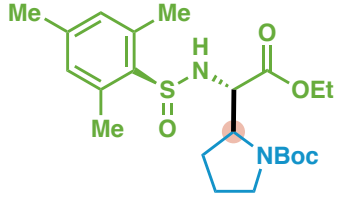
$\mathbf{R}_f$ = 0.67 (2:1 hexanes:EtOAc).

^{1}H NMR (500 MHz, $CDCl_3$): δ 6.88 (s, 2H), 6.87 (s, 2H), 5.10 (d, *J* = 8.7 Hz, 1H), 5.07 (d, *J* = 9.1 Hz, 1H), 4.31 – 4.17 (m, 4H), 4.13 (dd, *J* = 8.7, 3.7 Hz, 1H), 3.85 (dd, *J* = 9.1, 5.8 Hz, 1H), 2.61 (s, 6H), 2.58 (s, 6H), 2.56 – 2.51 (m, 1H), 2.45 – 2.37 (m, 2H), 2.33 (dd, *J* = 15.5, 5.0 Hz, 1H), 2.29 (s, 3H), 2.28 (s, 3H), 2.14 (dd, *J* = 15.8, 6.8 Hz, 1H), 2.06 (dd, *J* = 15.4, 8.6 Hz, 1H), 1.47 (s, 9H), 1.39 (s, 9H), 1.30 (td, *J* = 7.1, 3.6 Hz, 6H), 1.02 (d, *J* = 6.7 Hz, 3H), 0.79 (d, *J* = 6.9 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 172.9, 172.8, 171.6, 171.5, 141.13, 141.11, 138.2, 138.0, 136.9, 136.8, 131.0 (2C), 80.9, 80.8, 62.1, 61.90, 61.89, 60.0, 39.3, 38.6, 34.4, 33.7, 28.2, 28.1, 21.18, 21.16, 19.54, 19.46, 16.8, 14.4, 14.30, 14.26 ppm.

HRMS (ESI-TOF): calc'd for $C_{21}H_{35}N_2O_5S$ $[M+H]^+$: 412.2152, found: 412.2155.

Compound 28



tert-butyl

(2S)-2-(2-ethoxy-1-(((S)-mesitylsulfinyl)amino)-2-oxoethyl)pyrrolidine-1-carboxylat

e (28)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 39.0 mg (89%, β dr 1:1) of the title compound **28**.

Physical State: colorless oil.

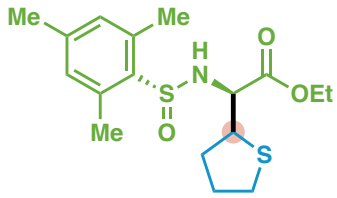
R_f = 0.48 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 6.89 – 6.68 (m, 4H), 5.45 (d, *J* = 8.3 Hz, 1H), 5.36 (d, *J* = 7.6 Hz, 1H), 5.23 (d, *J* = 6.9 Hz, 1H), 5.08 (d, *J* = 8.7 Hz, 1H), 4.80 – 4.74 (m, 1H), 4.71 – 4.61 (m, 1H), 4.35 – 4.27 (m, 1H), 4.26 – 4.11 (m, 4H), 4.10 – 4.04 (m, 2H), 4.00 (br s, 1H), 3.51 – 3.29 (m, 2H), 3.18 (br s, 1H), 3.12 – 3.06 (m, 1H), 2.58 – 2.44 (m, 12H), 2.27 – 2.13 (m, 6H), 1.97 – 1.88 (m, 1H), 1.83 – 1.71 (m, 4H), 1.68 – 1.56 (m, 3H), 1.51 – 1.35 (m, 18H), 1.28 – 1.17 (m, 6H) ppm (2 rotamers for each diastereomer reported).

^{13}C NMR (151 MHz, $CDCl_3$): δ 172.1, 171.9, 171.8, 171.7, 155.2, 154.3, 154.0, 153.8, 140.9, 140.9, 140.7, 140.6, 138.5, 138.2, 137.6, 137.6, 136.8, 136.6, 136.5, 136.4, 130.8, 130.7, 80.3, 80.1, 79.6, 62.0, 61.9, 61.9, 61.5, 60.0, 59.4, 59.3, 59.1, 59.1, 58.6, 57.7, 57.2, 47.5, 47.3, 47.1, 46.6, 28.5, 28.4, 28.3, 27.6, 26.7, 26.0, 24.1, 23.7, 23.6, 22.6, 21.0, 20.9, 19.4, 19.3, 19.2, 19.2, 14.1, 13.9 ppm (2 rotamers for each diastereomer reported).

HRMS (ESI-TOF): calc'd for $C_{22}H_{34}N_2NaO_5S$ $[M+Na]^+$: 461.2081, found: 461.2079.

Compound 29



ethyl (S)-2-(((R)-mesitylsulfinyl)amino)-2-((S)-tetrahydrothiophen-2-yl)acetate (29)

Following **General Procedure D** on 0.10 mmol scale. Purification by column chromatography (silica gel, 20:10:1 heptanes:EtOAc:Et_3N) afforded 24.9 mg (70%, β

dr 1:1) of the title compound **29**.

Physical State: colorless oil.

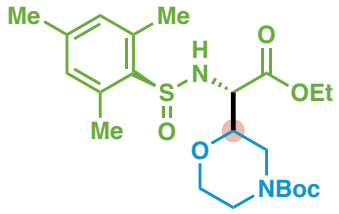
R_f = 0.45 (2:1 heptanes:EtOAc).

^{1}H NMR (400 MHz, CD_2Cl_2): δ 6.88 (s, 4H), 5.20 (d, *J* = 10.2 Hz, 1H), 5.08 (d, *J* = 8.9 Hz, 1H), 4.28 – 4.11 (m, 4H), 3.96 – 3.91 (m, 2H), 3.74 – 3.65 (m, 2H), 2.82 (t, *J* = 6.1 Hz, 2H), 2.79 – 2.73 (m, 2H), 2.57 (s, 6H), 2.56 (s, 6H), 2.29 (s, 6H), 2.16 – 2.06 (m, 2H), 2.06 – 1.95 (m, 2H), 1.95 – 1.82 (m, 4H), 1.28 (q, *J* = 7.0 Hz, 6H) ppm.

^{13}C NMR (101 MHz, CD_2Cl_2): δ 172.5, 172.4, 141.5 (2C), 138.8, 138.6, 137.31, 137.26, 131.3 (2C), 62.5, 62.4, 62.3, 62.2, 52.5, 51.4, 34.5, 33.5, 33.3, 33.2, 31.7, 30.9, 21.3, 19.7, 19.6, 14.5 ppm.

HRMS (ESI-TOF): calc'd for $C_{17}H_{26}NO_3S_2$ $[M+H]^+$: 356.1349, found: 356.1342.

Compound 30



tert-butyl (2R)-2-(2-ethoxy-1-(((S)-mesitylsulfinyl)amino)-2-oxoethyl)morpholine-4-carboxylate (30)

Following **General Procedure D** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 4:1 to 1:1 hexanes:EtOAc) afforded 20.5 mg (45%, β dr 1:1) of the title compound **30**.

Physical State: colorless oil.

R_f = 0.19 (2:1 hexanes:EtOAc).

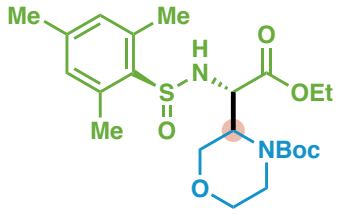
^{1}H NMR (600 MHz, $CDCl_3$): δ 6.86 (s, 2H), 6.85 (s, 2H), 5.24 (d, *J* = 9.2 Hz, 1H), 5.11 (d, *J* = 9.5 Hz, 1H), 4.31 – 4.18 (m, 5H), 4.01 – 3.94 (m, 3H), 3.87 – 3.77 (m, 5H), 3.56 (br s, 1H), 3.45 (t, *J* = 11.4 Hz, 2H), 2.96 (br s, 2H), 2.85 (br s, 2H), 2.60 (s, 6H), 2.57 (s, 6H), 2.28 (s, 6H), 1.46 (s, 9H), 1.43 (s, 9H), 1.31 (t, *J* = 7.2 Hz, 3H),

1.28 (t, J = 7.2 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.2, 170.7, 154.7 (2C), 141.3, 141.2, 137.6 (2C), 137.0, 136.9, 130.98, 130.96, 80.5, 80.4, 75.8 (2C), 67.0, 66.9, 62.3, 62.2, 59.6 (2C), 59.2 (2C), 29.8 (2C), 28.50, 28.45, 21.16, 21.15, 19.6, 19.4, 14.23, 14.21 ppm.

HRMS (ESI-TOF): calc'd for $C_{22}H_{35}N_2O_6S$ $[M+H]^+$: 455.2210, found: 455.2219.

Compound 31



tert-butyl (3R)-3-(2-ethoxy-1-(((S)-mesitylsulfinyl)amino)-2-oxoethyl)morpholine-4-carboxylate (31)

Following **General Procedure D** on 0.10 mmol scale. Purification by column chromatography (silica gel, 4:1 hexanes:EtOAc) afforded 32.8 mg (72%, β dr 1:1) of the title compound **31**.

Physical State: pale yellow oil.

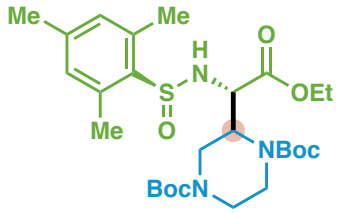
R_f = 0.21 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, CD_3OD): δ 6.93 – 6.92 (m, 4H), 4.47 – 4.35 (m, 2H), 4.30 – 3.92 (m, 8H), 3.88 (t, J = 12.7 Hz, 2H), 3.83 – 3.63 (m, 2H), 3.59 – 3.57 (m, 2H), 3.51 – 3.33 (m, 4H), 3.28 – 2.99 (m, 2H), 2.57 – 2.56 (m, 12H), 2.28 – 2.27 (m, 6H), 1.43 – 1.41 (m, 6H), 1.33 – 1.29 (m, 6H), 1.16 (s, 6H), 1.10 (s, 6H) ppm (2 rotamers for each diastereomer reported).

^{13}C NMR (151 MHz, CD_3OD): δ 173.7, 173.4, 157.6, 156.5, 143.1, 142.9, 142.6, 138.5, 138.4, 138.4, 138.0, 138.0, 132.0, 131.9, 82.0, 81.8, 67.8, 67.4, 67.3, 66.9, 63.2, 63.0, 62.6, 62.5, 58.3, 57.6, 56.5, 56.2, 55.2, 55.0, 53.4, 41.8, 41.7, 40.2, 40.1, 28.6, 28.5, 28.2, 28.1, 21.1, 21.0, 19.7, 19.7, 19.6, 14.3 ppm (2 rotamers for each diastereomer reported).

HRMS (ESI-TOF): calc'd for $C_{22}H_{35}N_2O_6S$ $[M+H]^+$: 455.2210, found: 455.2211.

Compound 32



di-tert-butyl (2S)-2-(2-ethoxy-1-(((S)-mesitylsulfinyl)amino)-2-oxoethyl)piperazine-1,4-dicarboxylate (32)

Following **General Procedure D** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient form 9:1 to 4:1 hexanes:EtOAc) afforded 26.0 mg (47%, β dr 1:1) of the title compound **32**.

Physical State: pale yellow oil.

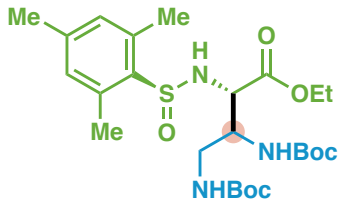
$\mathbf{R_f}$ = 0.31 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, CD_3OD): δ 6.95 – 6.93 (m, 4H), 4.37 – 4.31 (m, 2H), 4.31 – 4.17 (m, 4H), 4.16 – 3.81 (m, 8H), 3.17 – 2.95 (m, 2H), 2.89 – 2.85 (m, 2H), 2.63 – 2.50 (m, 12H), 2.29 – 2.27 (m, 6H), 1.54 – 1.41 (m, 26H), 1.37 – 1.26 (m, 8H), 1.18 (s, 6H), 1.14 (s, 4H) ppm (2 rotamers for each diastereomer reported).

^{13}C NMR (151 MHz, CD_3OD): δ 172.9, 157.6, 156.5, 155.9, 155.6, 143.1, 142.9, 142.8, 138.7, 138.3, 138.1, 138.0, 132.1, 131.8, 82.0, 63.3, 63.0, 62.7, 58.5, 57.8, 55.0, 53.9, 53.2, 44.6, 43.3, 41.3, 41.1, 39.8, 39.7, 30.8, 28.6, 28.2, 21.1, 21.0, 19.9, 19.7, 19.6, 14.4, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{27}H_{44}N_3O_7S$ $[M+H]^+$: 554.2894, found: 554.2898.

Compound 33



ethyl

(3S)-3,4-bis((tert-butoxycarbonyl)amino)-2-(((S)-mesitylsulfinyl)amino)butanoate

(33)

Following **General Procedure D** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 4:1 to 1:1 hexanes:EtOAc) afforded 25.1 mg (48%, β dr 1:1) of the title compound **33**.

Physical State: colorless oil.

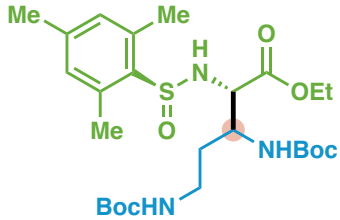
$\mathbf{R}_f$ = 0.23 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 6.87 (s, 2H), 6.85 (s, 2H), 5.58 (d, *J* = 8.9 Hz, 1H), 5.43 – 5.38 (m, 2H), 4.98 – 4.86 (m, 2H), 4.80 (br s, 1H), 4.24 – 4.07 (m, 8H), 3.36 (br s, 1H), 3.28 (br s, 1H), 3.18 (br s, 2H), 2.60 (s, 6H), 2.59 (s, 6H), 2.28 (s, 3H), 2.27 (s, 3H), 1.42 (s, 9H), 1.41 (s, 9H), 1.39 (s, 9H), 1.36 (s, 9H), 1.28 – 1.23 (m, 6H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.2, 170.7, 156.7, 156.4, 155.64, 155.59, 141.4, 141.1, 137.3, 137.2 (2C), 136.8, 131.12, 131.08, 80.1, 80.0, 79.9, 79.8, 62.5, 62.2, 59.1, 57.6, 53.4, 52.6, 42.2, 40.6, 28.4 (2C), 28.3 (2C), 21.2, 21.1, 19.54, 19.51, 14.2, 14.1 ppm.

HRMS (ESI-TOF): calc'd for $C_{25}H_{42}N_3O_7S$ $[M+H]^+$: 528.2738, found: 528.2737.

Compound 34



ethyl

(3S)-3,5-bis((tert-butoxycarbonyl)amino)-2-(((S)-mesitylsulfinyl)amino)pentanoate (34)

Following **General Procedure C** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 4:1 to 1:1 hexanes:EtOAc) afforded 32.6 mg (60%, β dr 1:1) of the title compound **34**.

Physical State: colorless oil.

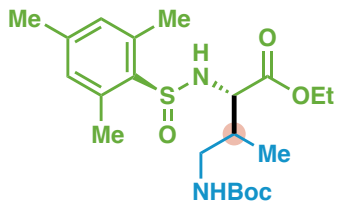
$\mathbf{R}_f$ = 0.19 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 6.88 (s, 2H), 6.86 (s, 2H), 5.36 (d, *J* = 7.8 Hz, 1H), 5.18 (d, *J* = 8.1 Hz, 1H), 5.14 – 5.00 (m, 2H), 4.60 (d, *J* = 8.6 Hz, 1H), 4.29 – 4.13 (m, 7H), 4.12 – 4.05 (m, 2H), 3.41 (m, 2H), 2.87 (m, 2H), 2.58 (s, 12H), 2.29 (s, 3H), 2.28 (s, 3H), 1.79 (br s, 2H), 1.60 (br s, 2H), 1.43 (s, 18H), 1.40 (s, 9H), 1.36 (s, 9H), 1.30 – 1.25 (m, 6H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.4, 171.0, 156.1, 156.0, 155.9, 155.7, 141.5, 141.3, 137.7, 137.1, 136.9 (2C), 131.2, 131.1, 80.1, 80.0, 79.4, 79.2, 62.6, 62.4, 60.6, 59.7, 50.6, 49.7, 37.1, 36.9, 33.4, 30.6, 29.8, 28.6, 28.5, 28.4, 28.3, 21.2, 21.1, 19.5, 14.2, 14.1 ppm.

HRMS (ESI-TOF): calc'd for $C_{26}H_{44}N_3O_7S$ $[M+H]^+$: 542.2894, found: 542.2903.

Compound 35



ethyl

(3S)-4-((tert-butoxycarbonyl)amino)-2-(((S)-mesitylsulfinyl)amino)-3-methylbutanoate (35)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 29.0 mg (68%, β dr 1:1) of the title compound **35**.

For 1.0 mmol scale preparation, **General Procedure C** was followed. Purification by column chromatography (silica gel, 4:1 hexanes:EtOAc) afforded 264.0 mg (62%, β dr 1:1) of the title compound **35**.

Physical State: colorless oil.

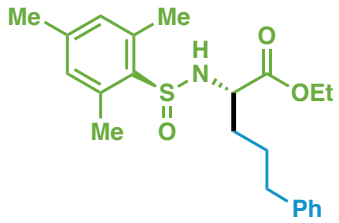
$\mathbf{R}_f$ = 0.24 (2:1 hexanes:EtOAc).

^{1}H NMR (500 MHz, $CDCl_3$): δ 6.86 (s, 4H), 5.30 (d, *J* = 8.7 Hz, 1H), 5.04 (d, *J* = 8.9 Hz, 2H), 4.67 (br s, 1H), 4.26 – 4.15 (m, 4H), 4.07 (dd, *J* = 9.0, 3.7 Hz, 1H), 3.88 (dd, *J* = 8.7, 4.7 Hz, 1H), 3.21 – 3.17 (m, 1H), 3.11 – 3.03 (m, 3H), 2.60 (s, 6H), 2.59 (s, 6H), 2.29 – 2.23 (m, 8H), 1.45 (s, 9H), 1.41 (s, 9H), 1.29 (t, *J* = 7.2 Hz, 3H), 1.23 (t, *J* = 7.1 Hz, 3H), 0.98 (d, *J* = 6.9 Hz, 3H), 0.76 (d, *J* = 6.9 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 173.0, 172.9, 156.07, 156.05, 141.2, 141.1, 137.9, 137.3, 137.1, 136.9, 131.1, 131.0, 79.53, 79.48, 61.9 (2C), 60.1, 57.8, 43.5, 42.5, 37.8, 36.8, 28.5 (2C), 21.2, 21.1, 19.52, 19.45, 15.3, 14.3, 14.2, 12.1 ppm.

HRMS (ESI-TOF): calc'd for $C_{21}H_{35}N_2O_5S$ $[M+H]^+$: 427.2261, found: 427.2267.

Compound 36



ethyl 2-(((S)-mesitylsulfinyl)amino)-5-phenylpentanoate (36)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 26.4 mg (68%) of the title compound **36**.

Physical State: colorless oil.

$\boldsymbol{R}_f$ = 0.52 (2:1 hexanes:EtOAc).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 – 7.22 (m, 2H), 7.21 – 7.11 (m, 3H), 6.87 (s, 2H), 5.05 (d, *J* = 8.4 Hz, 1H), 4.20 (qd, *J* = 7.2, 2.9 Hz, 2H), 4.04 – 3.92 (m, 1H), 2.68 – 2.59 (m, 2H), 2.57 (s, 6H), 2.29 (s, 3H), 1.88 – 1.79 (m, 1H), 1.77 – 1.63 (m, 3H),

1.27 (t, J = 7.1 Hz, 3H) ppm.

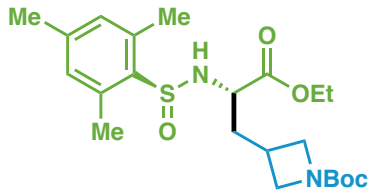
^{13}C NMR (151 MHz, $CDCl_3$): δ 173.6, 141.8, 141.1, 138.0, 136.8, 131.0, 128.5, 128.5, 126.1, 61.8, 57.2, 35.4, 33.6, 27.2, 21.2, 19.5, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{22}H_{30}NO_3S$ $[M+H]^+$: 388.1941, found: 388.1944.

$[\alpha]_D^{20}$ = +105.5 (c = 1.0, $CHCl_3$).

For previous AA syntheses, see ref 14.

Compound 37



tert-butyl 3-((S)-3-ethoxy-2-(((S)-mesitylsulfinyl)amino)-3-oxopropyl)azetidine-1-carboxylate (37)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 23.3 mg (53%) of the title compound **37**.

Following **General Procedure C** on 1.0 mmol scale. Purification by column chromatography (2:1 hexanes:EtOAc) afforded 219.5 mg (50%) of the title compound **37**.

Physical State: colorless oil.

***R*$_f$** = 0.17 (2:1 hexanes:EtOAc).

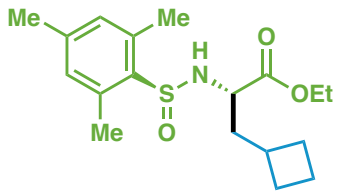
^{1}H NMR (400 MHz, $CDCl_3$): δ 6.84 (s, 2H), 5.04 (d, J = 8.9 Hz, 1H), 4.19 (q, J = 7.2 Hz, 2H), 4.02 – 3.92 (m, 2H), 3.86 (td, J = 8.7, 5.1 Hz, 1H), 3.58 (dd, J = 8.6, 5.7 Hz, 1H), 3.52 (dd, J = 8.6, 5.7 Hz, 1H), 2.73 – 2.61 (m, 1H), 2.55 (s, 6H), 2.26 (s, 3H), 2.10 – 2.01 (m, 1H), 1.95 – 1.85 (m, 1H), 1.40 (s, 9H), 1.27 (t, J = 7.2 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 173.0, 156.3, 141.2, 137.6, 136.7, 131.0, 79.5, 62.0, 56.0, 54.3, 38.5, 28.4, 25.9, 21.1, 19.3, 14.1 ppm.

HRMS (ESI-TOF): calc'd for $C_{22}H_{35}N_2O_5S$ $[M+H]^+$: 439.2261, found: 439.2256.

$[\alpha]_D^{20}$ = +88.4 (*c* = 1.0, $CHCl_3$).

Compound 38



ethyl 3-cyclobutyl-2-(((S)-mesitylsulfinyl)amino)propanoate (38).

Following **General Procedure C** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 9:1 to 4:1 hexanes:EtOAc) afforded 17.9 mg (53%) of the title compound **38**.

Physical State: pale yellow solid.

m.p.: >180 ºC.

R_f = 0.49 (2:1 hexanes:EtOAc).

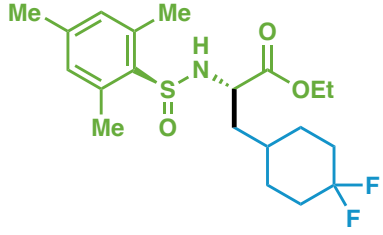
^{1}H NMR (600 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.00 (d, *J* = 8.9 Hz, 1H), 4.19 (q, *J* = 7.1 Hz, 2H), 3.86 (td, *J* = 8.6, 5.1 Hz, 1H), 2.59 (s, 6H), 2.50 – 2.42 (m, 1H), 2.28 (s, 3H), 2.07 – 1.99 (m, 2H), 1.89 – 1.58 (m, 6H), 1.29 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 173.9, 141.0, 138.1, 136.8, 130.9, 61.7, 56.2, 41.2, 32.5, 28.4, 28.2, 21.2, 19.4, 18.6, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{18}H_{28}NO_3S$ $[M+H]^+$: 338.1784, found: 338.1790.

$[\alpha]_D^{20}$ = +97.0 (*c* = 0.1, CH_2Cl_2).

Compound 39



ethyl 3-(4,4-difluorocyclohexyl)-2-(((S)-mesitylsulfinyl)amino)propanoate (39)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 19.3 mg (48%) of the title compound **39**.

Following **General Procedure C** on 1.0 mmol scale. Purification by column chromatography (2:1 hexanes:EtOAc) afforded 216.2 mg (51%) of the title compound **39**.

Physical State: colorless oil.

R_f = 0.50 (2:1 hexanes:EtOAc).

^{1}H NMR (500 MHz, $CDCl_3$): δ 6.88 (s, 2H), 5.02 (d, *J* = 9.2 Hz, 1H), 4.27 – 4.15 (m, 2H), 4.03 – 3.95 (m, 1H), 2.58 (s, 6H), 2.29 (s, 3H), 2.18 – 2.00 (m, 2H), 1.92 – 1.84 (m, 1H), 1.74 – 1.64 (m, 5H), 1.58 – 1.53 (m, 1H), 1.37 – 1.22 (m, 5H) ppm.

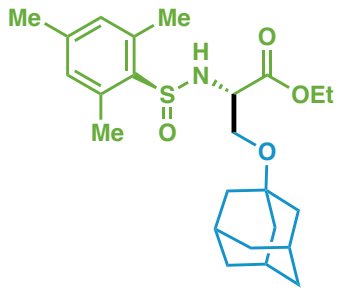
^{13}C NMR (151 MHz, $CDCl_3$): δ 173.9, 141.3, 137.9, 136.8, 131.1, 123.5 (t, *J* = 241.4 Hz), 62.0, 55.6, 39.96, 39.95, 33.5 (m), 32.2, 29.4 (d, *J* = 9.4 Hz), 28.0 (d, *J* = 9.4 Hz), 21.1, 19.4, 14.2 ppm.

^{19}F NMR (376 MHz, $CDCl_3$): δ -92.08 (d, *J* = 235.7 Hz), -102.46 (d, *J* = 234.9 Hz) ppm.

HRMS (ESI-TOF): calc'd for $C_{20}H_{29}F_2NNaO_3S$ $[M+Na]^+$: 424.1728, found: 424.1734.

$[\alpha]_D^{20}$ = +28.0 (*c* = 1.0, $CHCl_3$).

Compound 40



ethyl O-((3R,5R,7R)-adamantan-1-yl)-N-((S)-mesitylsulfinyl)-L-serinate (40)

Following **General Procedure D** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 23.0 mg (53%) of the title compound **40**.

Physical State: pale yellow oil.

R_f = 0.61 (2:1 hexanes:EtOAc).

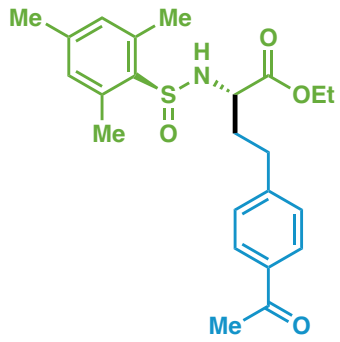
^{1}H NMR (600 MHz, $CDCl_3$): δ 6.84 (s, 2H), 5.19 (d, *J* = 8.0 Hz, 1H), 4.26 – 4.15 (m, 2H), 4.14 – 4.09 (m, 1H), 3.76 (dd, *J* = 9.1, 4.7 Hz, 1H), 3.70 (dd, *J* = 9.1, 4.2 Hz, 1H), 2.59 (s, 6H), 2.27 (s, 3H), 2.11 (s, 3H), 1.68 – 1.54 (m, 12H), 1.27 (t, *J* = 7.2 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 171.6, 140.9, 137.7, 137.1, 130.9, 72.8, 62.1, 61.7, 57.9, 41.4, 36.5, 30.6, 21.1, 19.6, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{24}H_{36}NO_4S$ $[M+H]^+$: 434.2360, found: 439.2364.

$[\alpha]_D^{20}$ = +62.5 (*c* = 1.0, $CHCl_3$).

Compound 41



ethyl (S)-4-(4-acetylphenyl)-2-(((S)-mesitylsulfinyl)amino)butanoate (41)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 23.7 mg (57%) of the title compound **41**.

Physical State: colorless oil.

R_f = 0.26 (2:1 hexanes:EtOAc).

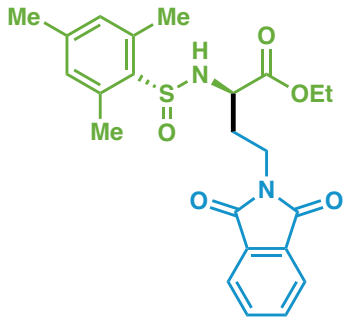
^{1}H NMR (600 MHz, $CDCl_3$): δ 7.91 – 7.86 (m, 2H), 7.28 – 7.23 (m, 2H), 6.89 (s, 2H), 5.14 (d, *J* = 8.4 Hz, 1H), 4.21 (qd, *J* = 7.1, 1.9 Hz, 2H), 3.99 (td, *J* = 8.4, 4.6 Hz, 1H), 2.84 – 2.75 (m, 2H), 2.61 (s, 6H), 2.58 (s, 3H), 2.30 (s, 3H), 2.19 – 2.10 (m, 1H), 2.01 – 1.93 (m, 1H), 1.28 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 197.9, 173.2, 146.6, 141.3, 137.9, 136.9, 135.6, 131.1, 128.83, 128.81, 62.0, 56.7, 35.3, 31.8, 26.7, 21.2, 19.5, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{23}H_{30}NO_4S$ $[M+H]^+$: 416.1890, found: 416.1898.

$[\alpha]_D^{20}$ = +21.6 (*c* = 1.0, $CHCl_3$).

Compound 42



ethyl (R)-4-(1,3-dioxoisoindolin-2-yl)-2-(((R)-mesitylsulfinyl)amino)butanoate (42)

Following **General Procedure C** on 0.10 mmol scale. Purification by column chromatography (silica gel, gradient from 9:1 to 1:1 heptanes:EtOAc) afforded 20 mg (45%) of the title compound **42**.

Physical State: colorless oil.

R_f = 0.3 (7:3 heptanes:EtOAc).

^{1}H NMR (400 MHz, DMSO-*d*$_6$): δ 7.87 – 7.81 (m, 4H), 6.89 (s, 2H), 6.64 (d, *J* = 9.3 Hz, 1H), 3.99 – 3.85 (m, 3H), 3.67 (t, *J* = 6.4 Hz, 2H), 2.24 (s, 3H), 2.12 – 2.05 (m, *J* = 6.7 Hz, 1H), 2.03 – 1.91 (m, 1H), 1.14 – 1.08 (m, 3H) ppm.

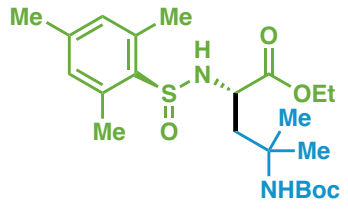
6H were obscured by the residual solvent signal at 2.50 ppm.

^{13}C NMR (101 MHz, DMSO-*d*$_6$): δ 171.9, 167.8, 139.9, 137.3, 136.6, 134.3, 131.6, 130.3, 122.95, 60.6, 55.2, 34.4, 31.3, 20.5, 18.9, 13.8 ppm.

HRMS (ESI-TOF): calc'd for $C_{23}H_{27}N_2O_5S$ $[M+H]^+$: 443.1635, found: 443.1649.

$[\alpha]_D^{22}$ = -54.8 (*c* = 0.1, MeOH).

Compound 43



ethyl

4-((tert-butoxycarbonyl)amino)-2-(((S)-mesitylsulfinyl)amino)-4-methylpentanoate (43)

Following **General Procedure C** on 0.10 mmol scale. Purification by column chromatography (silica gel, 4:1 hexanes:EtOAc) afforded 16.0 mg (36%) of the title compound **43**.

Physical State: colorless oil.

$\mathbf{R_f}$ = 0.35 (2:1 hexanes:EtOAc).

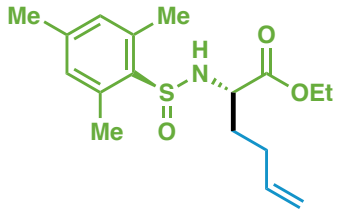
^{1}H NMR (600 MHz, $CDCl_3$): δ 6.85 (s, 2H), 5.06 (d, *J* = 10.4 Hz, 1H), 4.89 (br s, 1H), 4.19 (q, *J* = 7.1 Hz, 2H), 4.08 – 4.00 (m, 1H), 2.59 (s, 6H), 2.27 (s, 3H), 2.10 (dd, *J* = 14.5, 3.8 Hz, 1H), 1.87 (dd, *J* = 14.6, 8.8 Hz, 1H), 1.63 (br s, 1H), 1.38 (s, 11H), 1.34 (s, 3H), 1.28 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 174.0, 154.4, 141.3, 137.6, 137.0, 131.0, 79.1, 61.9, 55.2, 52.3, 43.8, 28.5, 28.2, 21.2, 19.5, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{22}H_{37}N_2O_5S$ $[M+H]^+$: 441.2418, found: 441.2426.

$[\alpha]_D^{20}$ = +64.4 (*c* = 0.5, CH_2Cl_2).

Compound 44



ethyl 2-(((S)-mesitylsulfinyl)amino)hex-5-enoate (44)

Following **General Procedure D** on 0.10 mmol scale. Purification by column chromatogrpahy (silica gel, 20:10:1 heptanes:EtOAc:Et_3N) afforded 20.4 mg (63%) of the title compound **44**.

Cycloproyl opening: Following **General Procedure C** on 0.10 mmol scale. Purification by column chromatogrpahy using gradient from 9:1 to 2:1 hexanes:EtOAc afforded 4.9 mg (15%) of the title compound **44**.

Physical State: colorless oil.

R_f = 0.67 (2:1 hexanes:EtOAc).

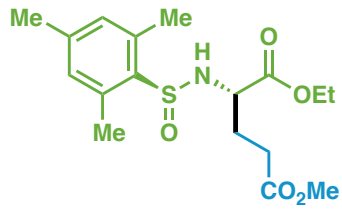
^{1}H NMR (400 MHz, CD_2Cl_2): δ 6.89 (s, 2H), 5.81 (ddt, *J* = 16.9, 10.2, 6.6 Hz, 1H), 5.09 – 4.96 (m, 3H), 4.26 – 4.12 (m, 2H), 3.93 (td, *J* = 8.7, 4.8 Hz, 1H), 2.56 (s, 6H), 2.29 (s, 3H), 2.17 (q, *J* = 7.4 Hz, 2H), 1.93 – 1.84 (m, 1H), 1.76 – 1.67 (m, 1H), 1.28 (t, *J* = 7.2 Hz, 3H) ppm.

^{13}C NMR (101 MHz, CD_2Cl_2): δ 174.0, 141.5, 138.7, 137.8, 137.3, 131.3, 116.1, 62.1, 57.5, 33.8, 30.1, 21.3, 19.6, 14.5 ppm.

HRMS (ESI-TOF): calc'd for $C_{17}H_{26}NO_3S$ $[M+H]^+$: 324.1628, found: 324.1629.

$[\alpha]_D^{20}$ = +37.1 (*c* = 0.5, CH_2Cl_2).

Compound 45



1-ethyl 5-methyl ((S)-mesitylsulfinyl)glutamate (45)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 15.7 mg (44%) of the title compound **45**.

Physical State: colorless oil.

***R*$_f$** = 0.30 (2:1 hexanes:EtOAc).

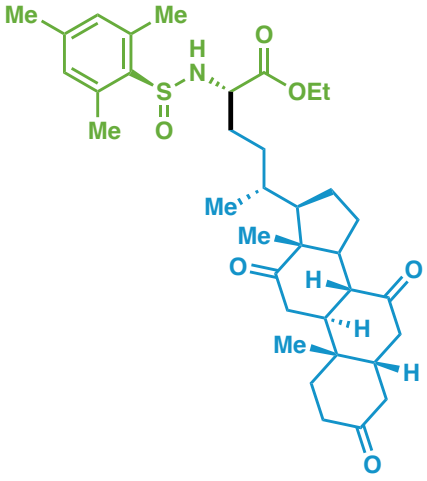
^{1}H NMR (600 MHz, $CDCl_3$): δ 6.87 (s, 2H), 5.07 (d, *J* = 8.6 Hz, 1H), 4.23 (qd, *J* = 7.2, 2.5 Hz, 2H), 4.02 (td, *J* = 8.7, 4.8 Hz, 1H), 3.62 (s, 3H), 2.58 (s, 6H), 2.50 – 2.38 (m, 2H), 2.28 (s, 3H), 2.22 – 2.14 (m, 1H), 1.98 – 1.90 (m, 1H), 1.29 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 173.2, 173.0, 141.2, 137.9, 136.8, 131.0, 62.1, 56.7, 51.9, 30.1, 29.0, 21.2, 19.4, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{17}H_{26}NO_5S$ $[M+H]^+$: 356.1526, found: 356.1531.

$[\alpha]_D^{20}$ = +25.2 (*c* = 1.0, $CHCl_3$).

Compound 46



ethyl (5R)-5-((5S,8R,9S,10S,13R,17R)-10,13-dimethyl-3,7,12-trioxohexadecahydro-1H-cyclopenta[a]phenanthren-17-yl)-2-(((S)-mesitylsulfinyl)amino)hexanoate (46)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 52.0 mg (83%) of the title compound **46**.

Physical State: colorless oil.

R_f = 0.62 (2:1 hexanes:EtOAc).

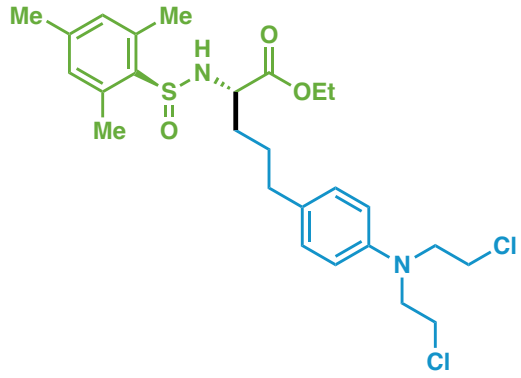
^{1}H NMR (600 MHz, $CDCl_3$): δ 6.90 – 6.82 (s, 2H), 5.04 (d, *J* = 8.1 Hz, 1H), 4.27 – 4.15 (m, 2H), 3.96 – 3.87 (m, 1H), 3.40 – 3.34 (m, 4H), 2.94 – 2.86 (m, 1H), 2.83 (s, 6H), 2.62 – 2.55 (m, 5H), 2.42 – 1.79 (m, 11H), 1.74 (s, 3H), 1.63 – 1.54 (m, 1H), 1.38 (m, 3H), 1.28 (t, *J* = 7.1 Hz, 3H), 1.25 – 1.19 (m, 2H), 1.04 (s, 3H), 0.82 (d, *J* = 6.4 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 212.0, 209.1, 208.9, 173.6, 141.1, 138.0, 137.0, 131.0, 61.8, 57.6, 57.0, 51.9, 49.1, 47.0, 45.74, 45.71, 45.1, 42.9, 38.8, 36.6, 36.2, 36.0, 35.4, 31.2, 31.1, 27.8, 25.3, 22.0, 21.2, 19.5, 19.1, 14.3, 11.9 ppm.

HRMS (ESI-TOF): calc'd for $C_{36}H_{52}NO_6S$ $[M+H]^+$: 626.3510, found: 626.3511.

$[\alpha]_D^{20}$ = +59.0 (*c* = 1.0, $CHCl_3$).

Compound 47



ethyl

5-(4-(bis(2-chloroethyl)amino)phenyl)-2-(((S)-mesitylsulfinyl)amino)pentanoate

(47)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 30.6 mg (58%) of the title compound **47**.

Physical State: yellow oil.

R_f = 0.48 (2:1 hexanes:EtOAc).

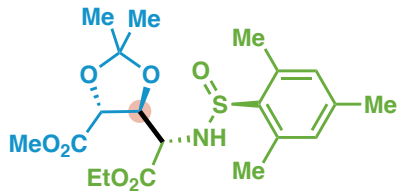
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.07 – 6.99 (m, 2H), 6.87 (s, 2H), 6.65 – 6.55 (m, 2H), 5.04 (d, *J* = 8.5 Hz, 1H), 4.20 (qd, *J* = 7.2, 2.8 Hz, 2H), 4.03 – 3.92 (m, 1H), 3.72 – 3.67 (m, 4H), 3.65 – 3.57 (m, 4H), 2.58 (s, 6H), 2.57 – 2.48 (m, 2H), 2.29 (s, 3H), 1.89 – 1.77 (m, 1H), 1.73 – 1.63 (m, 3H), 1.28 (t, *J* = 7.2 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 173.6, 144.4, 141.1, 138.0, 136.8, 130.98, 130.96, 129.7, 112.3, 61.8, 57.3, 53.7, 40.6, 34.3, 33.7, 27.4, 21.2, 19.5, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{26}H_{37}Cl_2N_2O_3S$ $[M+H]^+$: 527.1896, found: 527.1907.

$[\alpha]_D^{20}$ = +11.2 (*c* = 1.0, $CHCl_3$).

Compound 48



methyl (4R,5S)-5-(2-ethoxy-1-(((S)-mesitylsulfinyl)amino)-2-oxoethyl)-2,2-dimethyl-1,3-dioxolane-4-carboxylate (48)

Following the **General Procedure D** (*in situ*) on 0.10 mmol scale at rt. Purification by pTLC (6:1 CH_2Cl_2:Et_2O) afforded 22.5 mg (53%, β dr 10:1) of the title compound **48**.

Physical State: colorless oil.

R_f = 0.54 (6:1 CH_2Cl_2:Et_2O).

^{1}H NMR (600 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.26 (d, *J* = 9.3 Hz, 1H), 4.60 (d, *J* = 7.6 Hz, 1H), 4.52 (dd, *J* = 7.6, 2.3 Hz, 1H), 4.28 – 4.18 (m, 3H), 3.83 (s, 3H), 2.60 (s, 6H), 2.28 (s, 3H), 1.38 (s, 3H), 1.31 (s, 3H), 1.26 (t, *J* = 7.1 Hz, 3H) ppm.

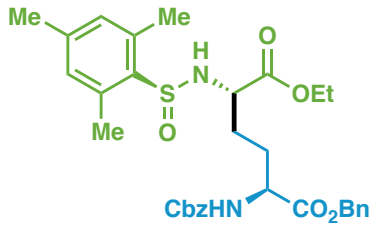
^{13}C NMR (151 MHz, $CDCl_3$): δ 170.8, 170.2, 141.2, 137.3, 137.0, 131.1, 112.1, 79.3, 75.5, 62.4, 57.1, 52.8, 26.6, 25.9, 21.2, 19.5, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{20}H_{29}NNaO_7S^+$ $[M+Na]^+$ 450.1557; found 450.1558.

$[\alpha]_D^{20}$ = +71.0 (*c* = 1.0, $CHCl_3$).

For previous AA syntheses, see ref 15.

Compound 49



1-benzyl 6-ethyl (2S)-2-(((benzyloxy)carbonyl)amino)-5-(((S)-mesitylsulfinyl)amino)hexanedioate 1-benzyl 7-ethyl (49)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 38.2 mg (63%) of the title compound **49**.

Physical State: colorless oil.

R_f = 0.26 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 7.39 – 7.26 (m, 10H), 6.85 (s, 2H), 5.34 (d, *J* = 8.2 Hz, 1H), 5.19 – 5.07 (m, 4H), 4.97 (d, *J* = 8.3 Hz, 1H), 4.53 – 4.37 (m, 1H), 4.18 (q, *J* = 7.1 Hz, 2H), 3.95 – 3.86 (m, 1H), 2.53 (s, 6H), 2.29 (s, 3H), 2.03 – 1.94 (m, 1H), 1.93 – 1.84 (m, 1H), 1.83 – 1.70 (m, 1H), 1.60 – 1.50 (m, 1H), 1.25 (t, *J* = 7.1 Hz, 3H) ppm.

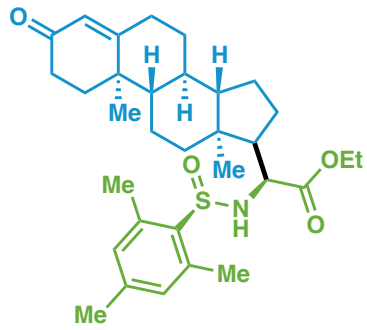
^{13}C NMR (151 MHz, $CDCl_3$): δ 172.9, 171.9, 156.0, 141.2, 137.7, 136.9, 136.2, 135.2, 131.0, 128.8, 128.7, 128.5, 128.4, 128.3, 67.5, 67.2, 62.1, 56.7, 53.6, 29.6, 28.9, 21.2, 19.4, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{32}H_{39}N_2O_7S$ $[M+H]^+$: 595.2472, found: 595.2476.

$[\alpha]_D^{20}$ = +135.4 (*c* = 1.0, $CHCl_3$).

For previous AA synthesis, see ref 16.

Compound 50



ethyl (S)-2-((8S,9S,10R,13S,14S,17R)-10,13-dimethyl-3-oxo-2,3,6,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-1H-cyclopenta[a]phenanthren-17-yl)-2-(((S)-mesitylsulfinyl)amino)acetate (50)

Following **General Procedure D** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 22.8 mg (42%, β dr 16:1) of the title compound **50**.

Physical State: white solid.

m.p.: 132 – 134 ºC.

R_f = 0.30 (2:1 hexanes:EtOAc).

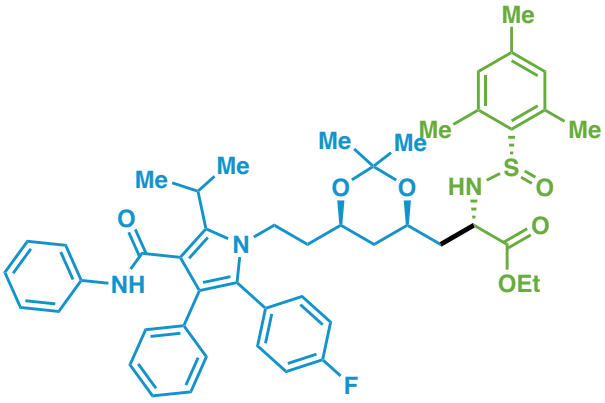
^{1}H NMR (600 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.71 (d, *J* = 1.6 Hz, 1H), 4.91 (d, *J* = 10.2 Hz, 1H), 4.21 (dt, *J* = 7.0, 3.5 Hz, 2H), 4.03 (dd, *J* = 10.2, 3.4 Hz, 1H), 2.56 (s, 6H), 2.47 – 2.30 (m, 3H), 2.27 (s, 3H), 2.24-2.18 (m, 1H), 2.09 – 2.02 (m, 2H), 1.81-1.74 (m, 1H), 1.73-1.69 (m, 2H), 1.67-1.58 (m, 4H), 1.54-1.45 (m, 2H), 1.44-1.37 (m, 1H), 1.36 – 1.31 (m, 1H), 1.28 (t, *J* = 7.1 Hz, 3H), 1.26 – 1.19 (m, 1H), 1.17 (s, 3H), 0.87 – 0.75 (m, 5H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 199.7, 174.1, 171.3, 141.3, 138.1, 136.9, 131.0, 123.9, 61.8, 58.2, 53.8, 51.3, 50.3, 44.0, 38.8, 36.1, 36.0, 34.1, 33.3, 33.0, 32.6, 26.0, 22.5, 21.3, 21.2, 21.1, 19.5, 17.5, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{32}H_{46}NO_4S$ $[M+H]^+$: 540.3142, found: 540.3145.

$[\alpha]_D^{20}$ = +23.3 (*c* = 1.0, $CHCl_3$).

Compound 51



ethyl (S)-3-((4S,6R)-6-(2-(2-(4-fluorophenyl)-5-isopropyl-3-phenyl-4-(phenylcarbamoyl)-1H-pyrrol-1-yl)ethyl)-2,2-dimethyl-1,3-dioxan-4-yl)-2-(((S)-mesitylsulfinyl)amino)propanoate (51)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 43.4 mg (53%) of the title compound **51**.

Physical State: colorless oil.

***R*$_f$** = 0.45 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 7.22 – 7.13 (m, 10H), 7.06 (d, *J* = 8.0 Hz, 2H), 6.99 – 6.94 (m, 2H), 6.86 (s, 2H), 5.14 (d, *J* = 9.6 Hz, 1H), 4.22 – 4.16 (m, 3H), 4.11 – 4.01 (m, 1H), 4.00 – 3.95 (m, 1H), 3.87 – 3.74 (m, 1H), 3.68 – 3.60 (m, 1H), 3.56 (p, *J* = 7.1 Hz, 1H), 2.59 (s, 6H), 2.28 (s, 3H), 1.88 – 1.80 (m, 1H), 1.70 – 1.59 (m, 3H), 1.52 (dd, *J* = 7.2, 2.3 Hz, 6H), 1.36 (s, 3H), 1.34 (s, 3H), 1.29 – 1.24 (m, 4H), 1.16 – 1.10 (m, 1H), 1.04 (q, *J* = 11.6 Hz, 1H) ppm.

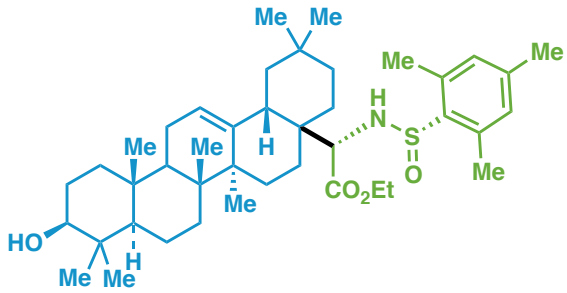
^{13}C NMR (151 MHz, $CDCl_3$): δ 173.9, 164.0 (d, *J* = 257.1 Hz), 161.5, 141.6, 141.1, 138.5, 138.1, 136.8, 134.7, 133.3 (d, *J* = 8.1 Hz), 131.0, 130.6, 128.9, 128.8, 128.5, 128.4 (d, *J* = 3.4 Hz), 126.7, 123.6, 121.9, 119.7, 115.5, 115.4, 98.9, 66.5, 64.8, 61.8, 53.9, 40.9, 40.8, 38.2, 36.4, 30.1, 26.2, 21.9, 21.7, 21.1, 20.0, 19.5, 14.2 ppm.

^{19}F NMR (376 MHz, $CDCl_3$): δ -113.92 ppm.

HRMS (ESI-TOF): calc'd for $C_{48}H_{57}FN_3O_6S$ $[M+H]^+$: 822.3947, found: 822.3962.

$[\alpha]_D^{20}$ = +60.9 (*c* = 1.0, $CHCl_3$).

Compound 52



ethyl (2R)-2-((4aS,6aS,8aR,10S,12aR,14bS)-10-hydroxy-2,2,6a,9,9,12a-hexamethyl-1,3,4,5,6,6a,6b,7,8,8a,9,10,11,12,12a,12b,13,14b-octadecahydropicen-4a(2H)-yl)-2-(((S)-mesitylsulfinyl)amino)acetate (52)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 63.2 mg (93%, β dr >20:1) of the title compound **52**.

Physical State: white solid.

m.p.: 159 – 161 ºC.

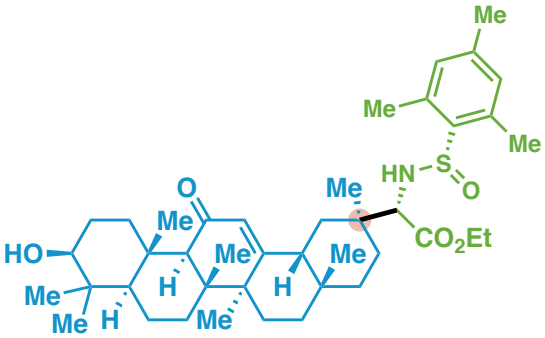
***R*$_f$** = 0.62 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.26 (t, *J* = 3.6 Hz, 1H), 5.09 (d, *J* = 9.1 Hz, 1H), 4.30 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.20 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.09 (d, *J* = 9.2 Hz, 1H), 3.22 (dd, *J* = 11.2, 4.6 Hz, 1H), 2.66 – 2.61 (m, 1H), 2.58 (s, 6H), 2.29 (s, 3H), 2.24 (dd, *J* = 14.0, 4.5 Hz, 1H), 2.09 (td, *J* = 14.3, 4.9 Hz, 1H), 1.97 (ddd, *J* = 18.5, 11.5, 3.2 Hz, 1H), 1.91 – 1.85 (m, 1H), 1.74 (t, *J* = 13.6 Hz, 1H), 1.66 – 1.55 (m, 6H), 1.54 – 1.44 (m, 3H), 1.39 (dt, *J* = 12.4, 2.7 Hz, 1H), 1.30 (t, *J* = 7.1 Hz, 3H), 1.27 – 1.21 (m, 1H), 1.20 (s, 3H), 1.13 (s, 3H), 1.09 (dq, *J* = 13.7, 2.1 Hz, 2H), 1.04 (dq, *J* = 15.4, 2.4 Hz, 2H), 1.01 (s, 3H), 0.97 (s, 3H), 0.91 – 0.86 (m, 1H), 0.86 – 0.82 (m, 4H), 0.81 (s, 3H), 0.76 (dd, *J* = 11.6, 1.8 Hz, 1H), 0.70 (s, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 172.9, 143.5, 140.9, 138.7, 136.9, 130.9, 124.0, 79.2, 61.5, 59.7, 55.4, 47.8, 46.4, 41.47, 41.45, 40.6, 40.0, 38.9, 38.8, 37.1, 33.9, 33.1, 32.4, 30.9, 28.2, 27.4, 26.8, 26.6, 25.5, 23.9, 23.7, 23.4, 21.2, 19.5, 18.5, 17.1, 15.72, 15.69, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{42}H_{66}NO_4S$ $[M+H]^+$: 680.4707, found: 680.4704.

Compound 53



ethyl 2-((2S,4aS,6aS,6bR,8aR,10S,12aS,12bR,14bR)-10-hydroxy-2,4a,6a,6b,9,9,12a-heptamethyl-13-oxo-1,2,3,4,4a,5,6,6a,6b,7,8,8a,9,10,11,12,12a,12b,13,14b-icosahydropicen-2-yl)-2-(((S)-mesitylsulfinyl)amino)acetate (53)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 58.8 mg (85%, β dr 2.5:1) of the title compound **53**.

Physical State: white solid.

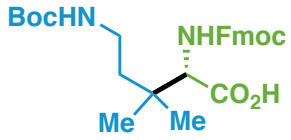
R_f = 0.20 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, CD_3Cl): δ 6.88 – 6.85 (m, 2H), 5.62 (s, 1H minor diastereomer), 5.54 (s, 1H major diastereomer), 5.04 – 4.95 (m, 1H), 4.28 – 4.17 (m, 2H), 3.54 (d, *J* = 10.3 Hz, 1H), 3.26 – 3.18 (m, 1H), 2.82 – 2.74 (m, 1H), 2.63 – 2.53 (m, 6H), 2.32 – 2.26 (m, 5H), 2.13 – 2.06 (m, 1H), 2.05 – 1.92 (m, 2H), 1.89 – 1.72 (m, 1H), 1.69 – 1.66 (m, 1H), 1.64 – 1.58 (m, 3H), 1.53 – 1.32 (m, 10H), 1.28 (t, *J* = 7.2 Hz, 3H), 1.15 – 1.09 (m, 6H), 1.04 – 0.91 (m, 9H), 0.86 – 0.75 (m, 6H), 0.72 – 0.66 (m, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 200.3, 200.0, 172.8, 172.3, 169.6, 169.1, 141.3, 141.2, 137.9, 137.9, 137.1, 136.9, 131.1, 131.0, 128.7, 128.6, 78.9, 78.9, 67.9 (2C), 61.9, 61.6, 61.5, 58.5, 55.1, 55.1, 46.8, 46.7, 45.5, 45.5, 43.5, 43.4, 40.6, 39.4, 39.3, 39.3, 39.2, 39.0, 38.6, 38.2, 37.3, 37.2, 35.6, 35.6, 32.9, 32.9, 32.5 (2C), 32.4, 31.3, 29.1, 28.7, 28.6, 28.2, 27.4 (2C), 27.1, 26.5, 26.5, 26.4, 24.3 (2C), 23.5, 23.5, 21.2, 21.2, 19.7, 19.5, 18.9, 18.8, 18.3 (2C), 17.6, 17.6, 16.5, 16.5, 15.7 (2C), 14.4, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{42}H_{64}NO_5S$ $[M+H]^+$: 694.4500, found: 694.4510.

Compound 54



2-((((9H-fluoren-9-yl)methoxy)carbonyl)amino)-5-((tert-butoxycarbonyl)amino)-3,3-dimethylpentanoic acid (54)

A culture tube was charged with **17** (0.5 mmol, 1.0 equiv). HCl (4.0 equiv) in MeOH (0.3 M) was added via syringe and the resulting mixture was stirred at rt for around 10 min (screened by TLC). After the reaction, LiOH was added until pH was 7 and the solvents were removed under reduced pressure.

LiOH (2 equiv) in MeOH/H_2O (2:1, 0.04 M) was added to the crude mixture. The reaction was stirred at 60 ºC overnight. On completion, HCl in MeOH (0.3 M) was added until pH was 7 and the solvents were removed under reduced pressure.

The crude mixture was dissolved in 9% aqueous Na_2CO_3 (5 mL) and dioxane (2 mL). It was slowly added at 0 ºC to a solution of Fmoc-OSu (1.2 equiv) in dioxane (8 mL). The mixture was stirred at 0 ºC for 1h and then allowed to warm to rt. After 10 h, the reaction mixture was quenched with HCl (0.5 M), reaching pH 3, and then diluted with EtOAc. The aqueous phase was extracted with EtOAc (3 x 15 mL), and the combined organic layers were washed with brine, dried over Na_2SO_4, filtered and the solvent removed under reduced pressure. The crude mixture was then purified by flash column chromatography (silica gel, 2:1 hexanes:EtOAc) to afford the product **54** in 68% overall yield and 95% ee.

Physical State: colorless oil.

$\boldsymbol{R_f}$ = 0.08 (1:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 7.76 (d, *J* = 7.5 Hz, 2H), 7.63 – 7.54 (m, 2H), 7.39 (td, *J* = 7.3, 2.6 Hz, 2H), 7.33 – 7.28 (m, 2H), 5.50 (br s, 1H), 4.68 (br s, 1H), 4.45 – 4.43 (m, 1H), 4.38 – 4.35 (m, 1H), 4.30 (d, *J* = 7.9 Hz, 1H), 4.21 (t, *J* = 6.8 Hz, 1H), 3.27 (br s, 1H), 3.16 (br s, 1H), 1.63 – 1.50 (m, 2H), 1.43 (s, 9H), 1.09 – 0.76 (m, 6H) ppm.

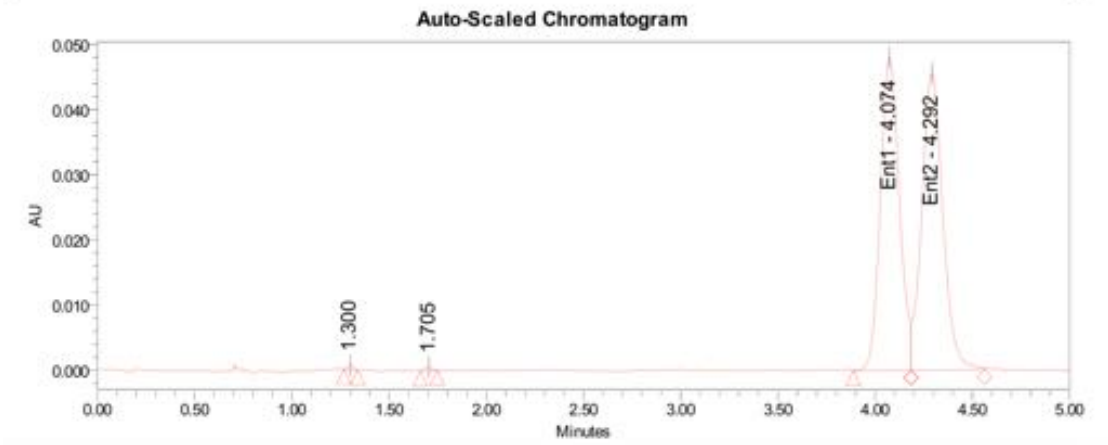
^{13}C NMR (151 MHz, $CDCl_3$): δ 185.8, 174.3, 156.5, 144.0, 143.9, 141.5, 127.9, 127.2, 125.24, 125.21, 120.2, 120.1, 79.8, 67.2, 60.9, 47.4, 39.2, 36.8, 29.9, 28.6, 23.9 ppm.

HRMS (ESI-TOF): calc'd for $C_{27}H_{35}N_2O_6$ $[M+H]^+$: 483.2490, found: 483.2489.

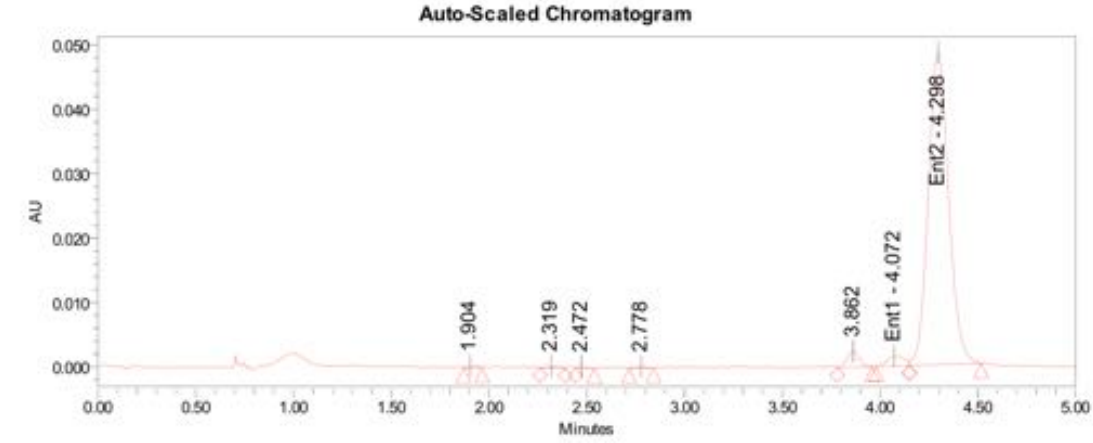
$[\alpha]_D^{20}$ = +4.0 (*c* = 0.4, $CHCl_3$).

The enantiopurity of **54** was determined by chiral SFC on a Daicel IBN column (3 mm, 4.6x250 mm) under isocratic conditions [15% (MeOH containing 0.5% formic acid) / CO_2 (4 mL/min), 1600 psi backpressure] at 30 °C. The enantiomers were detected by UV light (262 nm).

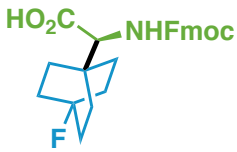
Racemic:



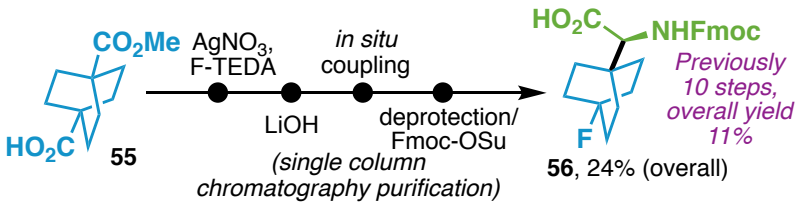
Chiral **54**:



Compound 56



(S)-2-((((9H-fluoren-9-yl)methoxy)carbonyl)amino)-2-(4-fluorobicyclo[2.2.2]octan-1-yl)acetic acid (56)



To a solution of the corresponding acid **55** (0.2 mmol, 1.0 equiv) in deoxygenated H_2O (1.0 mL) was added Selectfluor® (0.36 mmol, 1.8 equiv) and $AgNO_3$ (0.04 mmol, 0.2 equiv), and the mixture was stirred at 55 ºC overnight under an argon atmosphere. Then it was cooled to rt, filtered, and extracted with Et_2O (5 x 5 mL). The organic layers were dried over $MgSO_4$, filtered and solvents removed under reduced pressure to afford the crude product as a colorless oil. The crude mixture was dissolved in MeOH:H_2O (2:1, 3 mL), and LiOH (0.4 mmol) was added. The reaction mixture was heated at 50 ºC and stirred overnight. Afterwards, HCl in MeOH (1.0 M) was added until pH was 2 and the crude mixture was diluted with EtOAc. The aqueous phase was extracted with EtOAc (3 x 15 mL), and the combined organic layers were washed with brine, dried over Na_2SO_4, filtered and the solvents removed under reduced pressure to afford the crude carboxylic acid. The product was carried forward without any further purification.

General Procedure D was followed on 0.2 mmol scale. After 6 h, the mixture was filtered, and extracted with EtOAc (3 ×10 mL). The organic layers were dried over $MgSO_4$, filtered and evaporated to dryness to afford the crude coupling product.

To a culture tube containing the crude mixture, HCl (4.0 equiv) in MeOH (1.0 M) was added via syringe and the resulting mixture was stirred at rt for around 10 min (screened by TLC). After the reaction, LiOH was added until pH was 7 followed by removal of solvents under reduced pressure.

LiOH (2.0 equiv) was added to the crude mixture in MeOH/H_2O (2:1, 0.04 M) and the solution was stirred at 60 ºC overnight. After the reaction, HCl in MeOH (0.3 M) was added until pH was 7 followed by removal of solvents under reduced pressure.

The crude mixture was dissolved in 9% aqueous Na_2CO_3 (5 mL) and dioxane (2 mL). It was slowly added at 0 ºC to a solution of Fmoc-OSu (1.2 equiv) in dioxane (8 mL). The mixture was stirred at 0 ºC for 1h and then allowed to warm to rt. After 10 h, the reaction was quenched with HCl (1.0 M), reaching pH 3, and then diluted with EtOAc. The mixture was extracted with EtOAc (3 x 15 mL), and the combined organic layers

were washed with brine, dried over Na_2SO_4, filtered and the solvents removed under reduced pressure. The crude mixture was then purified by pTLC (10:1 CH_2Cl_2:MeOH) to afford product **56** in 20.4 mg (24%) overall yield.

Physical State: colorless oil.

$\mathbf{R_f}$ = 0.10 (1:1 hexanes:EtOAc).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.77 (d, *J* = 7.5 Hz, 2H), 7.58 (d, *J* = 7.5 Hz, 2H), 7.40 (t, *J* = 7.7 Hz, 2H), 7.36 – 7.27 (m, 2H), 5.22 (d, *J* = 9.7 Hz, 1H), 4.52 – 4.47 (m, 1H), 4.42 – 4.38 (m, 1H), 4.20 (t, *J* = 6.6 Hz, 2H), 4.15 (d, *J* = 9.6 Hz, 1H), 1.80 – 1.70 (m, 11H), 1.45 (br s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 185.8, 175.2, 156.2, 143.9, 143.7, 141.53, 141.50, 127.93, 127.90, 127.2, 125.2, 125.1, 120.20, 120.15, 93.6 (d, *J* = 186.3 Hz), 67.2, 60.1, 47.4, 34.7, 30.8 (d, *J* = 19.3 Hz), 28.9 (d, *J* = 10.3 Hz) ppm.

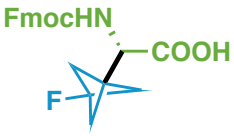
^{19}F NMR (376 MHz, $CDCl_3$): δ -152.53 (s) ppm.

HRMS (ESI-TOF): calc'd for $C_{25}H_{27}FNO_4$ $[M+H]^+$: 424.1924, found: 424.1916.

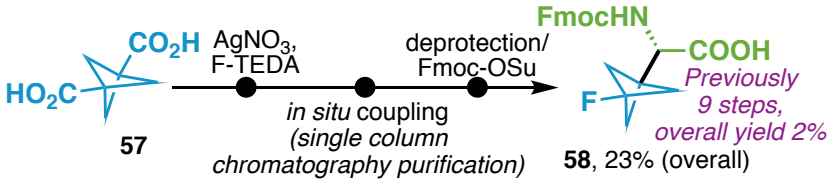
$[\alpha]_D^{20}$ = +15.0 (*c* = 0.5, $CHCl_3$).

For previous AA synthesis, see ref 17.

Compound 58



2-((((9H-fluoren-9-yl)methoxy)carbonyl)amino)-2-(3-fluorobicyclo[1.1.1]pentan-1-yl)acetic acid (58)



To a solution of **57** (0.2 mmol, 1.0 equiv) in deoxygenated H_2O (1.0 mL) was added Selectfluor® (0.36 mmol, 1.8 equiv) and $AgNO_3$ (0.04 mmol, 0.2 equiv), and the

mixture was stirred at 55 ºC overnight under an argon atmosphere. Then it was cooled to rt, filtered, and extracted with Et_2O (5 x 5 mL). The organic layers were dried over $MgSO_4$, filtered and evaporated to dryness to afford the corresponding acid as a white solid.

General Procedure D was followed on 0.20 mmol scale. After 6 h, the mixture was filtered and extracted with EtOAc (3 x 10 mL). The organic layers were dried over $MgSO_4$, filtered and evaporated to dryness to afford the crude coupling product.

To a culture tube containing **t**he crude mixture, HCl (4.0 equiv) in MeOH (1.0 M) was added via syringe and the resulting mixture was stirred at rt for around 10 min (monitored by TLC). After the reaction, LiOH was added until pH was 7 followed by removal of solvents under reduced pressure.

LiOH (2.0 equiv) was added to the crude mixture in MeOH/H_2O (2:1, 0.04 M). The reaction was stirred at 60 ºC overnight. After the reaction, HCl in MeOH (0.3 M) was added until pH was 7. Then, the solvent was removed under reduced pressure.

The crude mixture was dissolved in 9% aqueous Na_2CO_3 (5 mL) and dioxane (2 mL). It was slowly added at 0 ºC to a solution of Fmoc-OSu (1.2 equiv) in dioxane (8 mL). The mixture was stirred at 0 ºC for 1h and then allowed to warm to rt. After 10 h, the reaction was quenched with HCl (1.0 M), reaching pH 3, and then diluted with EtOAc. The aqueous phase was extracted with EtOAc (3 x 15 mL), and the combined organic layers were washed with brine, dried over Na_2SO_4, filtered and the solvent was removed under reduced pressure. The crude mixture was then purified by pTLC (10:1 CH_2Cl_2:MeOH) to afford product **58** in 17.5 mg (23%) overall yield.

Physical State: colorless oil.

$\mathbf{R_f}$ = 0.10 (1:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 7.77 (dd, *J* = 7.6, 2.8 Hz, 2H), 7.57 (d, *J* = 7.5 Hz, 2H), 7.40 (td, *J* = 7.5, 3.9 Hz, 2H), 7.34 – 7.28 (m, 2H), 5.33 (d, *J* = 8.5 Hz, 1H), 4.69 (d, *J* = 8.0 Hz, 1H), 4.54 – 4.44 (m, 1H), 4.43 – 4.37 (m, 1H), 4.24 – 4.15 (m, 1H), 2.09 – 2.01 (m, 6H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 174.0, 173.2, 156.7, 155.9, 143.8, 143.7, 143.6, 143.4, 141.6, 141.5, 128.1 (2C), 128.0 (2C), 127.4 (2C), 127.3 (2C), 125.11 (2C), 125.07 (2C), 124.7, 124.6, 120.2 (2C), 120.2 (2C), 75.2 (d, *J* = 327.6 Hz, 2C), 67.6, 67.3, 55.7 (d, *J* = 22.1 Hz, 2C), 53.1 (d, *J* = 21.2 Hz), 52.4 (d, *J* = 26.0 Hz), 47.3, 47.1, 29.6 (d, *J* = 46.9 Hz, 2C) ppm (2 rotamers reported).

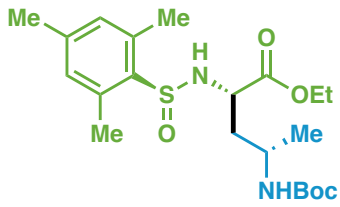
^{19}F NMR (376 MHz, $CDCl_3$): δ -149.98 (s) ppm.

HRMS (ESI-TOF): calc'd for $C_{22}H_{21}FNO_4$ $[M+H]^+$: 382.1455, found: 382.1451.

$[\alpha]_D^{20}$ = +16.0 (*c* = 0.5, $CHCl_3$).

For previous AA synthesis, see ref 18.

Compound 59



ethyl (4S)-4-((tert-butoxycarbonyl)amino)-2-(((S)-mesitylsulfinyl)amino)pentanoate (59)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 20.9 mg (49%) of the title compound **59**.

Physical State: colorless oil.

R_f = 0.20 (2:1 hexanes:EtOAc).

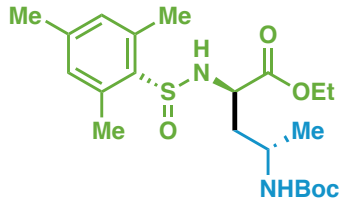
^{1}H NMR (500 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.21 (d, *J* = 8.6 Hz, 1H), 4.53 (d, *J* = 8.9 Hz, 1H), 4.23 (qq, *J* = 7.0, 3.5 Hz, 2H), 4.04 (td, *J* = 10.0, 3.6 Hz, 1H), 3.94 (br s, 1H), 2.62 (s, 6H), 2.27 (s, 3H), 1.86 – 1.78 (m, 1H), 1.77 – 1.68 (m, 1H), 1.43 (s, 9H), 1.30 (t, *J* = 7.2 Hz, 3H), 1.17 (d, *J* = 6.6 Hz, 3H) ppm.

^{13}C NMR (126 MHz, $CDCl_3$): δ 173.6, 155.3, 141.1, 138.0, 137.0, 130.9, 79.4, 61.9, 55.4, 43.6, 41.0, 28.5, 21.7, 21.1, 19.4, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{21}H_{35}N_2O_5S$ $[M+H]^+$: 427.2261, found: 427.2261.

$[\alpha]_D^{20}$ = +27.3 (*c* = 1.0, CH_2Cl_2).

Compound 60



ethyl (2R,4S)-4-((tert-butoxycarbonyl)amino)-2-(((R)-mesitylsulfinyl)amino)pentanoate (60)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 23.4 mg (55%) of the title compound **60**.

Physical State: colorless oil.

$\mathbf{R_f}$ = 0.20 (2:1 hexanes:EtOAc).

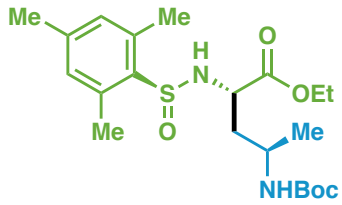
^{1}H NMR (500 MHz, $CDCl_3$): δ 6.84 (s, 2H), 5.27 (d, *J* = 6.7 Hz, 1H), 4.39 (s, 1H), 4.28 – 4.13 (m, 2H), 4.02 (ddd, *J* = 9.0, 7.5, 5.3 Hz, 1H), 3.84 (s, 1H), 2.58 (s, 6H), 2.27 (s, 3H), 1.99 – 1.90 (m, 1H), 1.87 – 1.80 (m, 1H), 1.40 (s, 9H), 1.28 (t, *J* = 7.1 Hz, 3H), 1.18 (d, *J* = 6.6 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 173.1, 155.1, 141.1, 137.7, 136.9, 131.0, 79.5, 61.9, 55.2, 43.5, 40.5, 28.5, 21.1, 20.9, 19.5, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{21}H_{35}N_2O_5S$ $[M+H]^+$: 427.2261, found: 427.2261.

$[\alpha]_D^{20}$ = -127.1 (*c* = 1.0, $CHCl_3$).

Compound 61



ethyl (4R)-4-((tert-butoxycarbonyl)amino)-2-(((S)-mesitylsulfinyl)amino)pentanoate (61)

For 0.1 mmol scale preparation, **General Procedure C** was followed. Purification by

pTLC (silica gel, 2:1 hexanes:EtOAc) afforded 22.6 mg (53%) of the title compound **61**.

For 1.0 mmol scale preparation, **General Procedure C** was followed. Purification by column chromatography (silica gel, 4:1 hexanes:EtOAc) afforded 242.4 mg (56%) of the title compound **61**.

Physical State: colorless oil.

$\mathbf{R}_f$ = 0.22 (2:1 hexanes:EtOAc).

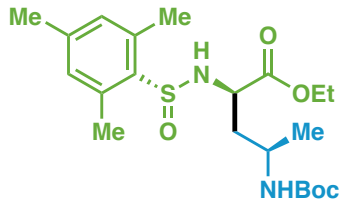
^{1}H NMR (500 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.20 (d, *J* = 9.6 Hz, 1H), 4.52 (d, *J* = 7.5 Hz, 1H), 4.23 (qd, *J* = 7.1, 2.4 Hz, 2H), 4.04 (td, *J* = 10.1, 3.7 Hz, 1H), 3.94 (br s, 1H), 2.62 (s, 6H), 2.28 (s, 3H), 1.86 – 1.78 (m, 1H), 1.77 – 1.68 (m, 1H), 1.43 (s, 9H), 1.30 (t, *J* = 7.2 Hz, 3H), 1.17 (d, *J* = 6.6 Hz, 3H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ 173.5, 155.3, 140.9, 137.9, 136.9, 130.8, 79.2, 61.8, 55.3, 43.4, 40.8, 28.3, 21.6, 21.0, 19.3, 14.1 ppm.

HRMS (ESI-TOF): calc'd for $C_{21}H_{35}N_2O_5S$ $[M+H]^+$: 427.2261, found: 427.2265.

$[\alpha]_D^{20}$ = +20.5 (*c* = 1.0, CH_2Cl_2).

Compound 62



ethyl (2R,4R)-4-((tert-butoxycarbonyl)amino)-2-(((R)-mesitylsulfinyl)amino)pentanoate (62)

Following **General Procedure C** on 0.10 mmol scale. Purification by pTLC (2:1 hexanes:EtOAc) afforded 25.6 mg (60%) of the title compound **62**.

Physical State: colorless oil.

$\mathbf{R}_f$ = 0.20 (2:1 hexanes:EtOAc).

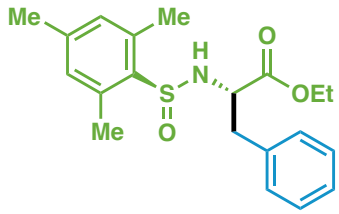
^{1}H NMR (500 MHz, $CDCl_3$): δ 6.86 (s, 2H), 5.20 (d, *J* = 9.5 Hz, 1H), 4.53 (d, *J* = 9.0 Hz, 1H), 4.22 (qd, *J* = 7.2, 2.6 Hz, 2H), 4.03 (td, *J* = 9.9, 3.7 Hz, 1H), 3.93 (s, 1H), 2.62 (s, 6H), 2.27 (s, 3H), 1.87 – 1.78 (m, 1H), 1.76 – 1.66 (m, 1H), 1.42 (s, 9H), 1.29 (t, *J* = 7.1 Hz, 3H), 1.16 (d, *J* = 6.7 Hz, 3H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ 173.6, 155.3, 141.1, 138.1, 137.0, 130.9, 79.4, 62.0, 55.4, 43.6, 41.0, 28.5, 21.8, 21.2, 19.4, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{21}H_{35}N_2O_5S$ $[M+H]^+$: 427.2261, found: 427.2265.

$[\alpha]_D^{20}$ = -151.6 (*c* = 1.0, $CHCl_3$).

Compound 63



ethyl ((S)-mesitylsulfinyl)phenylalaninate (63)

Following **General Procedure E** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 18.3 mg (51%) of the title compound **63**.

Physical State: colorless oil.

R_f = 0.65 (2:1 hexanes:EtOAc).

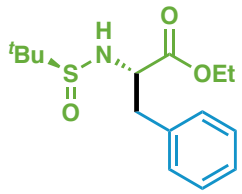
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31 – 7.20 (m, 3H), 7.19 – 7.13 (m, 2H), 6.82 (s, 2H), 5.08 (d, *J* = 8.7 Hz, 1H), 4.29 – 4.10 (m, 3H), 3.15 (dd, *J* = 13.8, 5.2 Hz, 1H), 2.89 (dd, *J* = 13.8, 8.5 Hz, 1H), 2.41 (s, 6H), 2.27 (s, 3H), 1.24 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ 172.9, 141.0, 137.8, 136.9, 136.6, 130.9, 129.6, 128.5, 127.0, 61.9, 58.8, 40.6, 21.2, 19.2, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{20}H_{26}NO_3S$ $[M+H]^+$: 360.1628, found: 360.1633.

$[\alpha]_D^{20}$ = +103.9 (*c* = 1.0, $CHCl_3$).

Compound 63-a



ethyl ((S)-tert-butylsulfinyl)phenylalaninate (63-a).

Following **General Procedure E** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 15.4 mg (52%) of the title compound **63-a**.

Physical State: yellow oil.

$\mathbf{R}_f$ = 0.68 (2:1 hexanes:EtOAc).

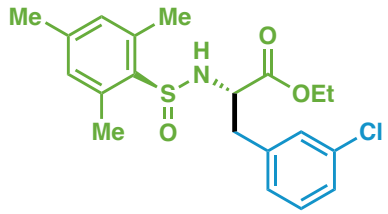
^{1}H NMR (600 MHz, $CDCl_3$): δ 7.39 – 7.29 (m, 5H), 4.47 (d, *J* = 10.1 Hz, 1H), 4.24 – 4.10 (m, 2H), 4.01 – 3.92 (m, 2H), 3.65 (d, *J* = 10.1 Hz, 1H), 1.28 (t, *J* = 7.1 Hz, 3H), 0.98 (s, 9H) ppm.

^{13}C NMR (151 MHz, CDCl3): δ 172.6, 130.5, 129.8, 128.9, 128.4, 63.3, 61.9, 61.3, 34.4, 26.8, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{15}H_{24}NO_3S$ $[M+H]^+$: 298.1477, found: 298.1480.

$[\alpha]_D^{20}$ = +102.2 (*c* = 1.0, $CHCl_3$).

Compound 64



ethyl 3-(3-chlorophenyl)-2-(((S)-mesitylsulfinyl)amino)propanoate (64)

Following **General Procedure E** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 25.6 mg (65%) of the title compound **64**.

Physical State: colorless oil.

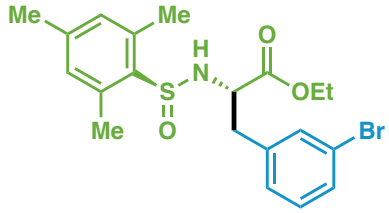
$\mathbf{R}_f$ = 0.62 (2:1 hexanes:EtOAc).

^{1}H NMR (600 MHz, $CDCl_3$): δ 7.23 – 6.90 (m, 4H), 6.83 (s, 2H), 5.11 (d, *J* = 8.5 Hz, 1H), 4.25 – 4.14 (m, 3H), 3.13 (dd, *J* = 13.9, 5.0 Hz, 1H), 2.85 (dd, *J* = 13.9, 8.7 Hz, 1H), 2.43 (s, 6H), 2.27 (s, 3H), 1.26 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 172.6, 141.1, 138.8, 137.7, 136.9, 134.3, 130.9, 129.81, 129.78, 127.7, 127.2, 62.1, 58.5, 40.0, 21.1, 19.2, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{20}H_{24}ClNNaO_3S$ $[M+Na]^+$: 416.1063, found: 416.1057.

Compound 65



ethyl 3-(3-bromophenyl)-2-(((S)-mesitylsulfinyl)amino)propanoate (65)

Following **General Procedure E** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 18.4 mg (42%) of the title compound **65**.

Physical State: colorless oil.

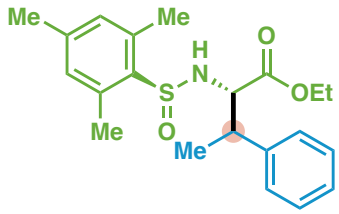
R_f = 0.62 (2:1 hexanes:EtOAc).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 – 7.28 (m, 2H), 7.20 – 7.03 (m, 2H), 6.83 (s, 2H), 5.10 (d, *J* = 8.5 Hz, 1H), 4.29 – 4.12 (m, 3H), 3.12 (dd, *J* = 13.8, 5.0 Hz, 1H), 2.84 (dd, *J* = 13.8, 8.7 Hz, 1H), 2.43 (s, 6H), 2.27 (s, 3H), 1.26 (t, *J* = 7.2 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ 172.6, 141.1, 139.1, 137.7, 136.9, 132.7, 130.9, 130.11, 130.06, 128.2, 122.5, 62.1, 58.5, 40.0, 21.1, 19.2, 14.2 ppm.

HRMS (ESI-TOF): calc'd for $C_{20}H_{24}BrNNaO_3S$ $[M+Na]^+$: 460.0558, found: 460.0553.

Compound 66



ethyl (3R)-2-(((S)-mesitylsulfinyl)amino)-3-phenylbutanoate (66)

Following **General Procedure E** on 0.10 mmol scale. Purification by pTLC (3:1 hexanes:EtOAc) afforded 13.5 mg (36%, dr 1:1:0.1:0.1) of the title compound **66**.

Physical State: colorless oil.

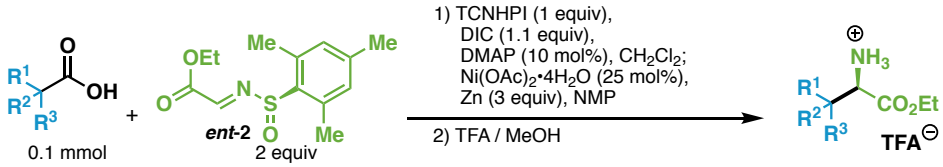
$\mathbf{R_f}$ = 0.58 (3:1 hexanes:EtOAc).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30 – 7.16 (m, 7H), 7.11 – 7.08 (m, 2H), 7.01 – 6.94 (m, 1H), 6.87 – 6.75 (m, 4H), 5.13 (d, *J* = 9.3 Hz, 1H), 4.90 (d, *J* = 9.2 Hz, 1H), 4.25 – 3.93 (m, 6H), 3.31 – 3.00 (m, 2H), 2.52 – 2.18 (m, 18H), 1.47 – 1.00 (m, 12H) ppm (2 major diastereomers reported).

^{13}C NMR (151 MHz, $CDCl_3$): 172.9, 172.6, 142.0, 141.6, 141.0, 140.9, 138.2, 138.0, 137.6, 137.4, 136.9, 130.9, 130.8, 128.5, 128.0, 128.0, 127.1, 127.1, 63.7, 63.1, 61.8, 61.7, 43.5, 43.3, 21.2, 21.2, 19.3, 19.3, 18.5, 15.8, 14.2, 14.0 ppm (2 major diastereomers reported).

HRMS (ESI-TOF): calc'd for $C_{21}H_{28}NO_3S$ $[M+H]^+$: 374.1784, found: 374.1790.

Library Synthesis Procedure



Step 1: Carboxylic acid activation / decarboxylative addition to imine.

Stock solution A: To a dried round bottom flask under nitrogen atmosphere was added TCNHPI (1 equiv. per reaction, 30 mg, 0.10 mmol) and DMAP (10 mol% per reaction, 1.2 mg, 0.010 mmol). The flask was purged with nitrogen for 5 min, then CH_2Cl_2 (0.5 mL per reaction) was added. The resulting mixture was sonicated for 1 min, then stirred rapidly for 10 min to provide an orange suspension (TCNHPI not fully soluble).

Stock solution B: To a dry round bottom flask under nitrogen atmosphere was added imino-ester ***ent*-2** (2 equiv per reaction, 54 mg, 0.20 mmol) and $Ni(OAc)_2•4H_2O$ (0.25 equiv per reaction, 6.2 mg, 0.025 mmol). The flask was purged with nitrogen for 5 min, then NMP (anhydrous) was added (0.5 mL per reaction). The resulting mixture was stirred vigorously to provide a transparent green solution.

Stock solution A was prepared according to the procedure above. A plate of 1-dram vials with septum caps under air atmosphere were each charged with carboxylic acid monomer and stirbar. Using an 18-gauge needle to prevent clogging, stock solution A was added (0.5 mL per vial). Some undissolved TCNHPI was observed remaining in the round bottom flask of stock solution A (not rinsed). The vials were stirred at 23 °C for 5 min, then DIC (1.1 equiv per reaction, 17 μL, 0.11 mmol) was added via syringe. The resulting mixture was stirred at ambient temperature for 3 h, then each vial was concentrated in parallel under a stream of nitrogen. During this time, stock solution B was prepared. Approximately 20 mg of zinc dust (0.3 mmol) was added to each vial (not individually measured; one spatula tip ~20 mg). Using one vacuum line fitted with a 20-gauge needle and one nitrogen line fitted with a 20-gauge needle, each vial was evacuated for ~15 seconds, then backfilled with nitrogen (repeated the purging/backfill sequence once). Stock solution B (0.5 mL per reaction) was added to

each vial and the reactions were stirred at ambient temperature, producing typically green or brown suspensions. After 20 h, the reactions were diluted with 2 mL EtOAc and 2 mL brine. The capped vials were vortexed for ~10 seconds each. The organic phase was removed by pipette and filtered through a prepacked Na_2SO_4 plug into a 1-dram vial. The Na_2SO_4 plugs were rinsed with EtOAc (~2 mL) and the resulting solutions were concentrated in parallel under a stream of nitrogen to provide the crude sulfinamide products.

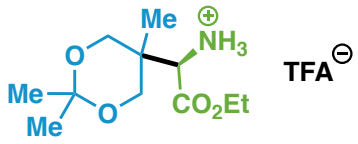
Step 2: Sulfinamide removal.

To the 1-dram vials containing the sulfinamide intermediates was added stir bars and MeOH (1 mL per vial). TFA was added (8 equiv, 61 μL, 0.80 mmol) and the reactions were stirred at 23 °C for 1 h. The reactions were concentrated in parallel under a stream of nitrogen. The resulting crude amino esters were dissolved in 1 mL DMSO and submitted for high-throughput purification (column: Waters Sunfire C18 19x100, 5μ; Mobile phase A: 0.05% TFA in water (v/v); Mobile phase B: 0.05% TFA in acetonitrile (v/v).

The isolated, desired AA products were characterized using LC-MS, which is consistent with other reported library synthesis standard. For a library synthesis data characterization example, see ref 19.

Amino Ester Data from Library Synthesis

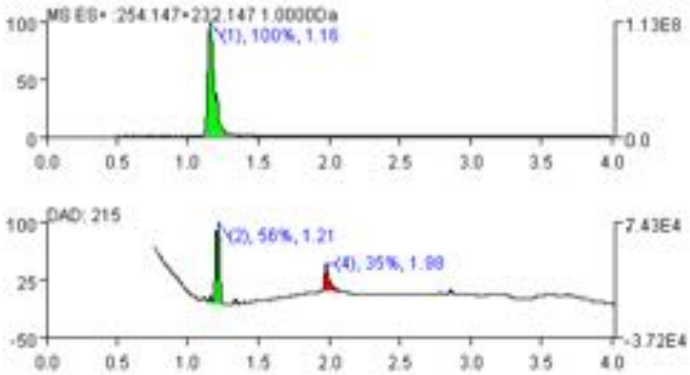
Compound 68b

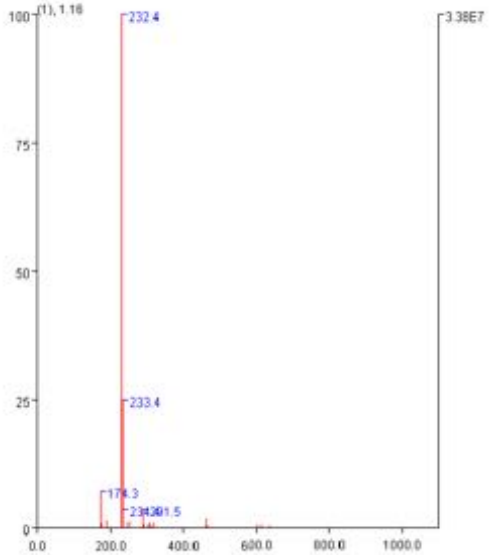


(R)-2-ethoxy-2-oxo-1-(2,2,5-trimethyl-1,3-dioxan-5-yl)ethan-1-aminium (68b)

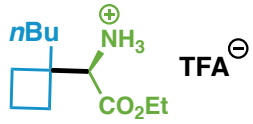
*acetonide partially deprotected in the presence of TFA.

Product obtained as an off-white solid (3.2 mg). LC-MS data – Ret. time 1.16: MS ES+ *m/z* 232 ($[M+H]^+$).



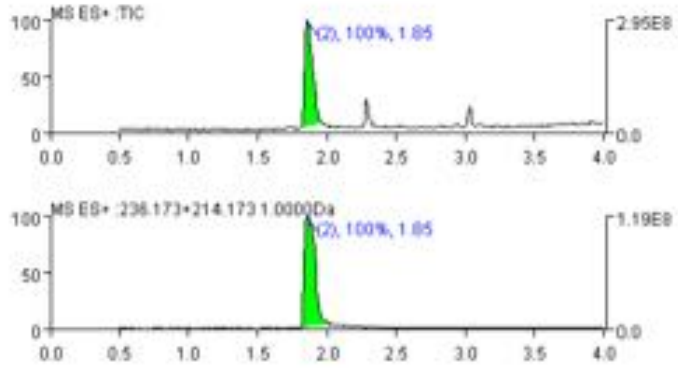


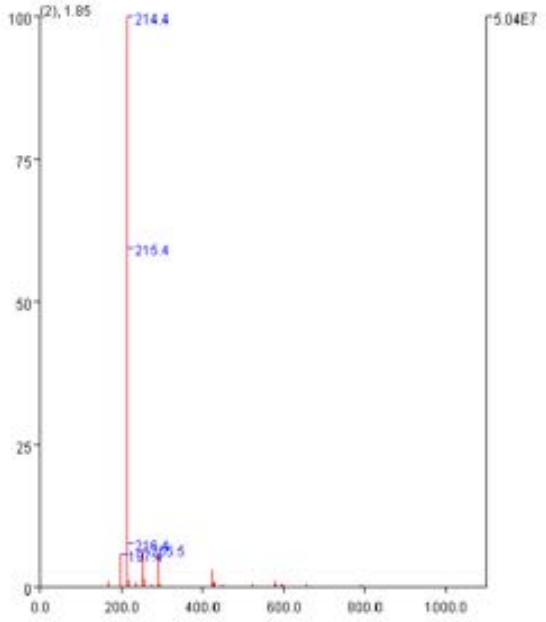
Compound 69b



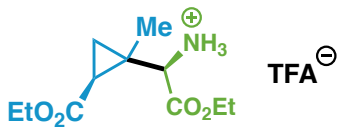
(R)-1-(1-butylcyclobutyl)-2-ethoxy-2-oxoethan-1-aminium (69b)

Product obtained as a white solid (3.1 mg). LC-MS data – Ret. time 1.85: MS ES+ *m/z* 214 ($[M+H]^+$).



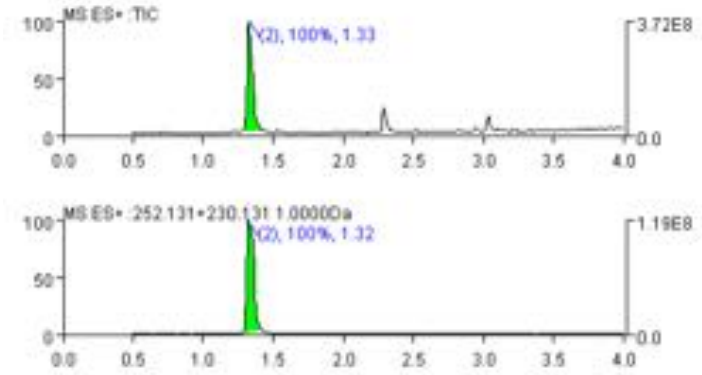


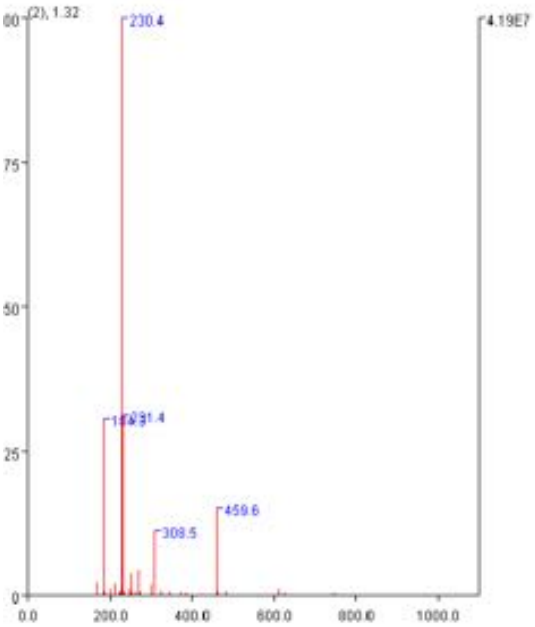
Compound 70b



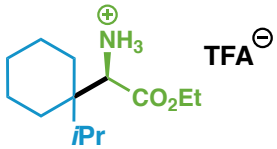
(R)-2-ethoxy-1-((1R,2S)-2-(ethoxycarbonyl)-1-methylcyclopropyl)-2-oxoethan-1-aminium (70b)

Product obtained as an off-white solid (1.8 mg), β stereochemistry unassigned. LC-MS data – Ret. time 1.33: MS ES+ *m/z* 230 ($[M+H]^+$).



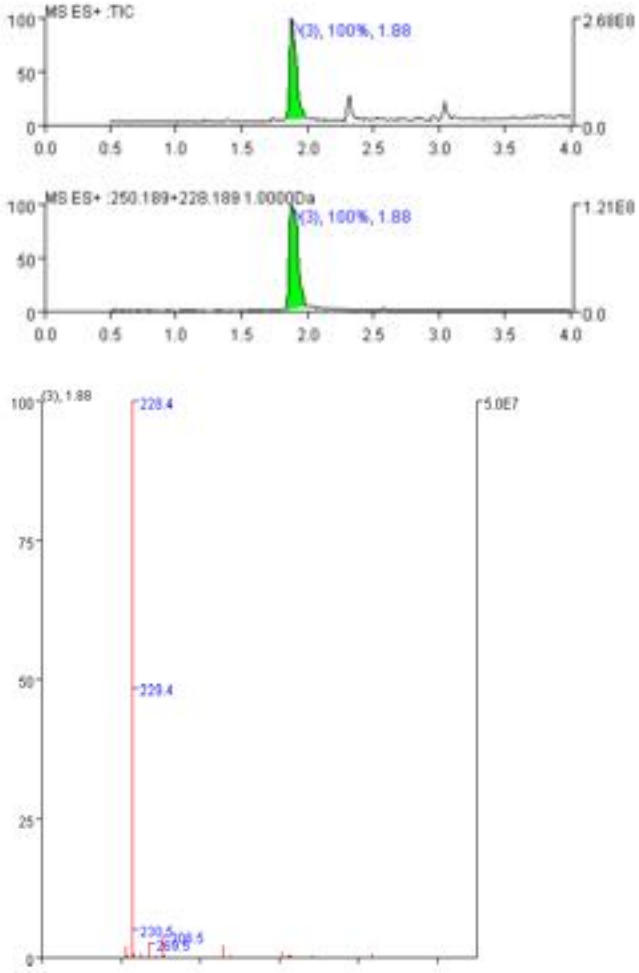


Compound 71b

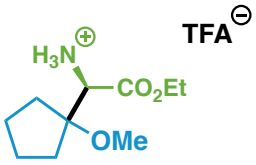


(R)-2-ethoxy-1-(1-isopropylcyclohexyl)-2-oxoethan-1-aminium (71b)

Product obtained as an off-white solid (2.1 mg). LC-MS data – Ret. time 1.88: MS ES+ *m/z* 228 ($[M+H]^+$).

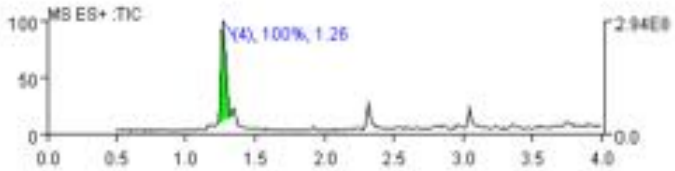


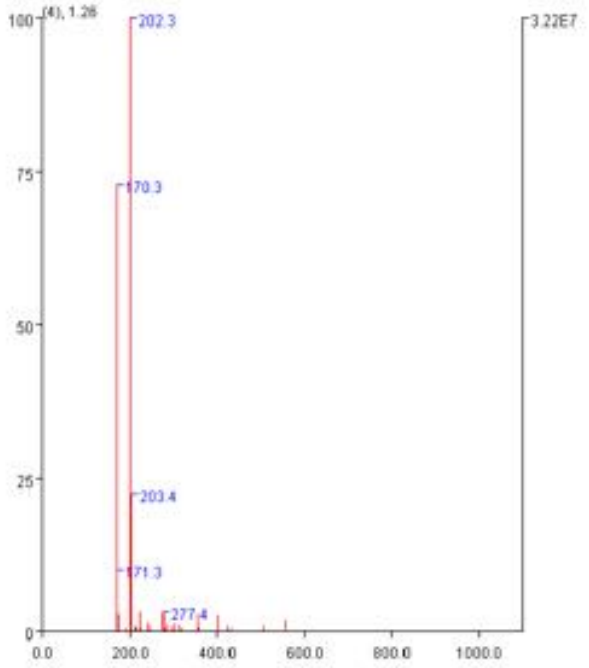
Compound 72b



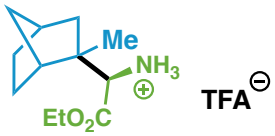
(R)-2-ethoxy-1-(1-methoxycyclopentyl)-2-oxoethan-1-aminium (72b)

Product obtained as an off-white solid (1.6 mg). LC-MS data – Ret. time 1.26: MS ES+ *m/z* 202 ($[M+H]^+$).



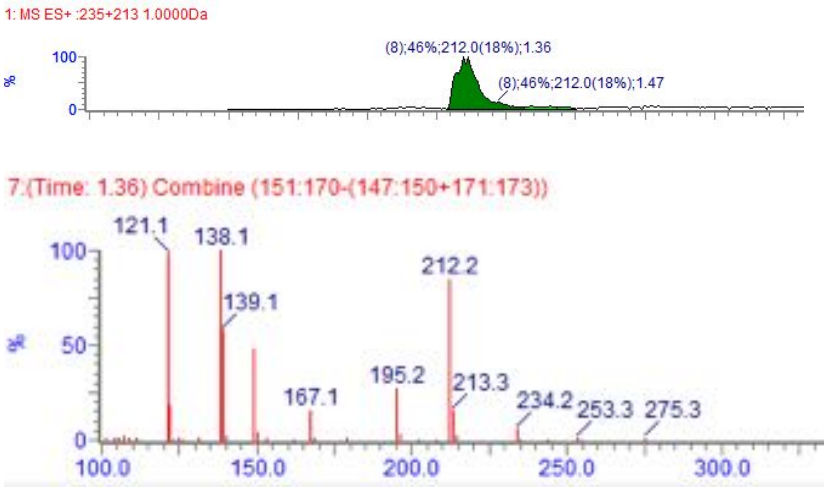


Compound 74b

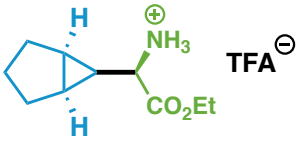


(R)-2-ethoxy-1-((1R,2R,4S)-2-methylbicyclo[2.2.1]heptan-2-yl)-2-oxoethan-1-aminium (74b)

Product obtained as an off-white solid (2.2 mg), β stereochemistry unassigned. LC-MS data – Ret. time 1.36: MS ES+ *m/z* 212 ($[M+H]^+$).

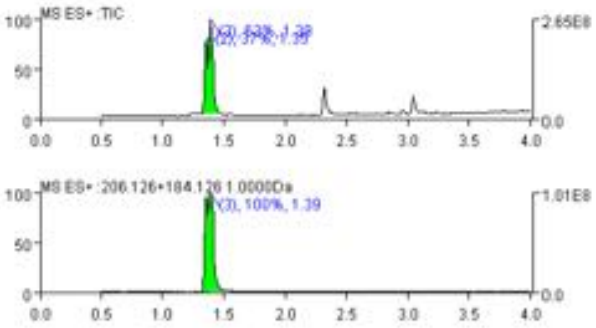


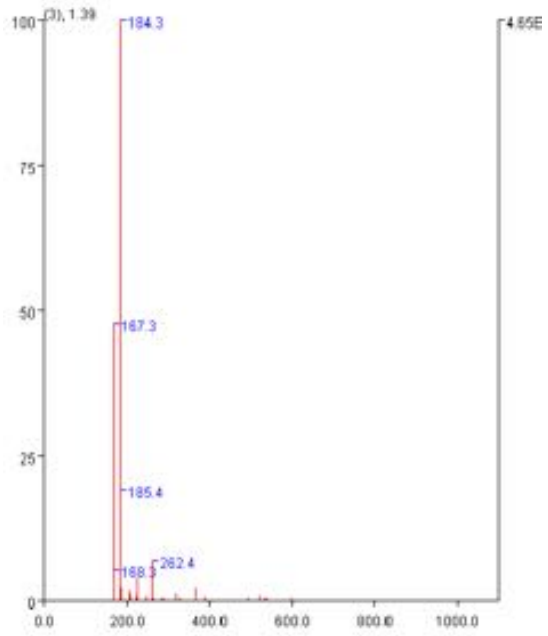
Compound 75b



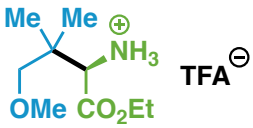
(R)-1-((1R,5S,6s)-bicyclo[3.1.0]hexan-6-yl)-2-ethoxy-2-oxoethan-1-aminium (75b)

Product obtained as an off-white solid (1.0 mg), β stereochemistry unassigned. LC-MS data – Ret. time 1.39: MS ES+ *m/z* 184 ($[M+H]^+$).



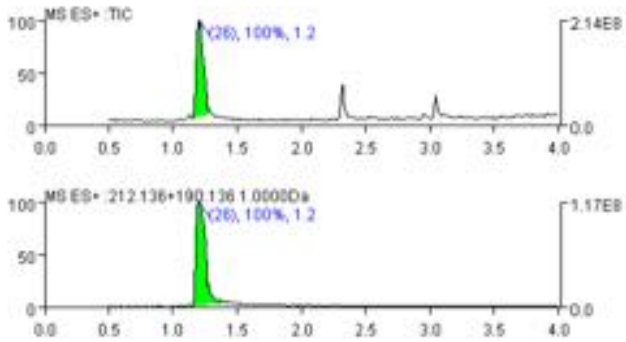


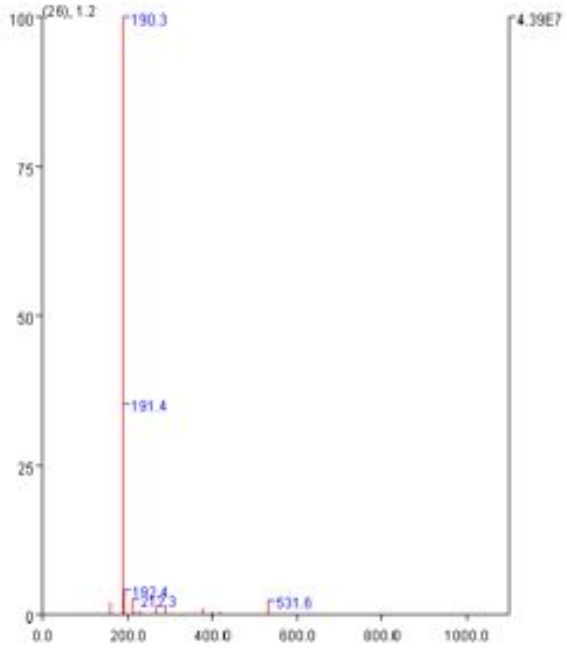
Compound 76b



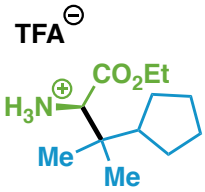
(R)-1-ethoxy-4-methoxy-3,3-dimethyl-1-oxobutan-2-aminium (76b)

Product obtained as a white solid (4.1 mg). LC-MS data – Ret. time 1.99: MS ES+ *m/z* 190 ($[M+H]^+$).



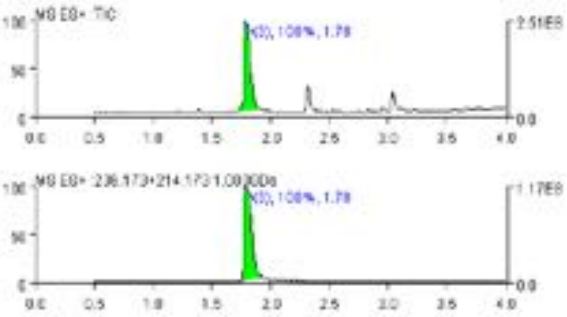


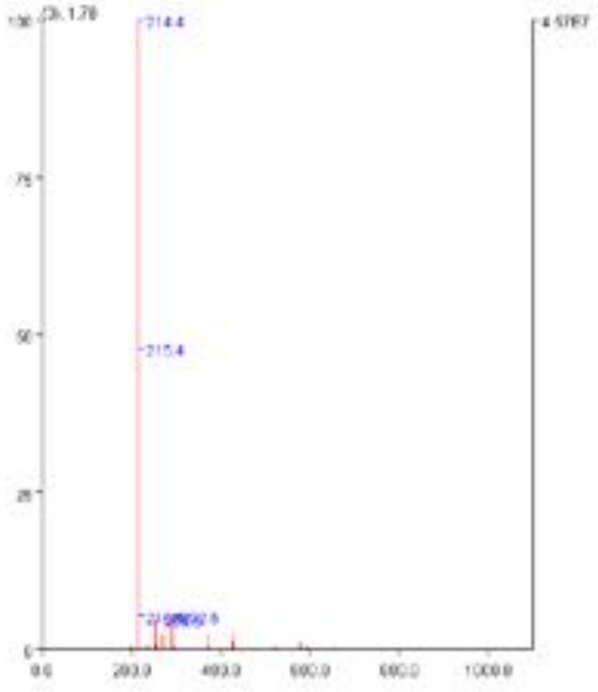
Compound 77b



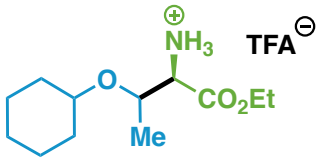
(R)-3-cyclopentyl-1-ethoxy-3-methyl-1-oxobutan-2-aminium (77b)

Product obtained as an off-white solid (2.0 mg). LC-MS data – Ret. time 1.78: MS ES+ *m/z* 214 ($[M+H]^+$).



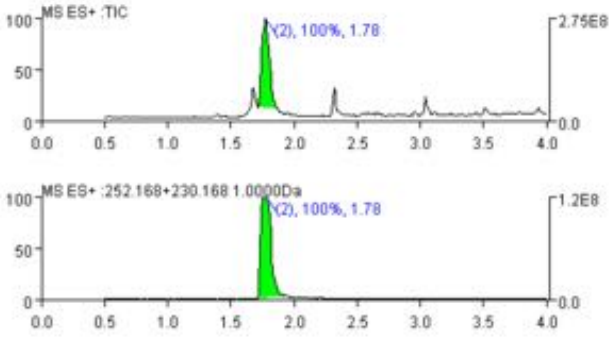


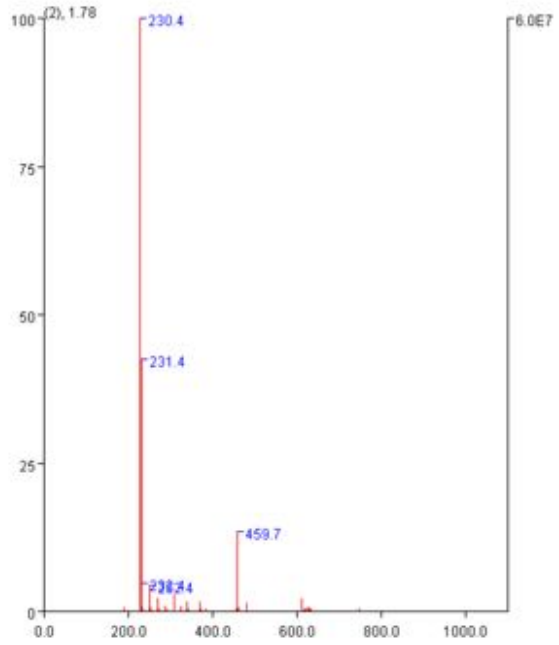
Compound 78b



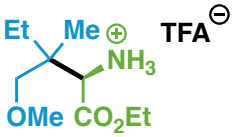
(2R,3R)-3-(cyclohexyloxy)-1-ethoxy-1-oxobutan-2-aminium (78b)

Product obtained as an off-white solid (4.9 mg). LC-MS data – Ret. time 1.78: MS ES+ *m/z* 230 ($[M+H]^+$).



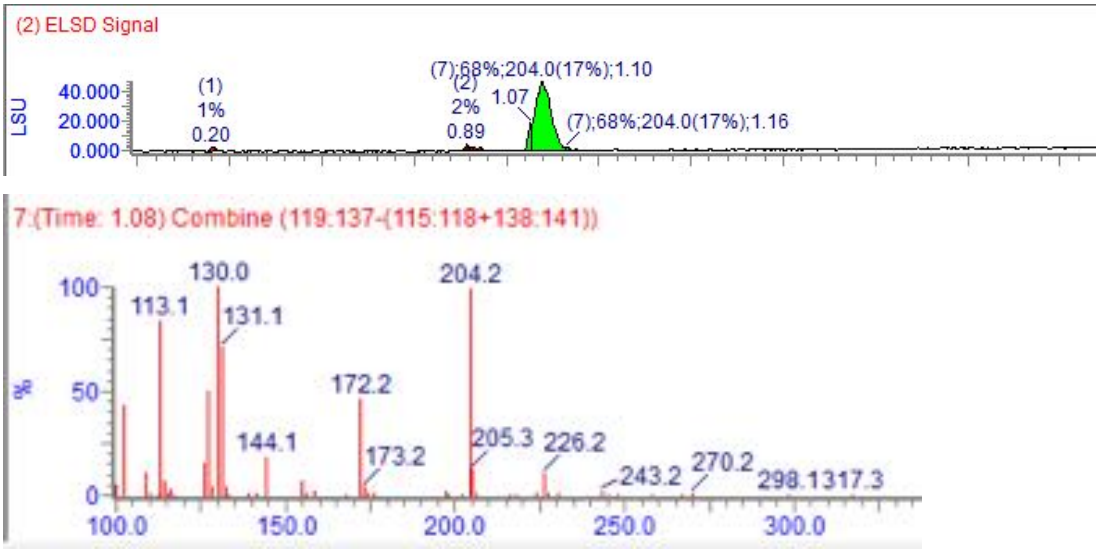


Compound 79b

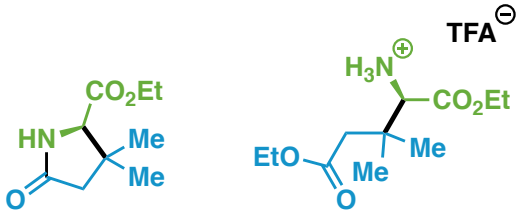


(2R)-1-ethoxy-3-(methoxymethyl)-3-methyl-1-oxopentan-2-aminium (79b)

Product obtained as a white solid (10.5 mg). LC-MS data – Ret. time 1.08: MS ES+ *m/z* 204 ($[M+H]^+$).

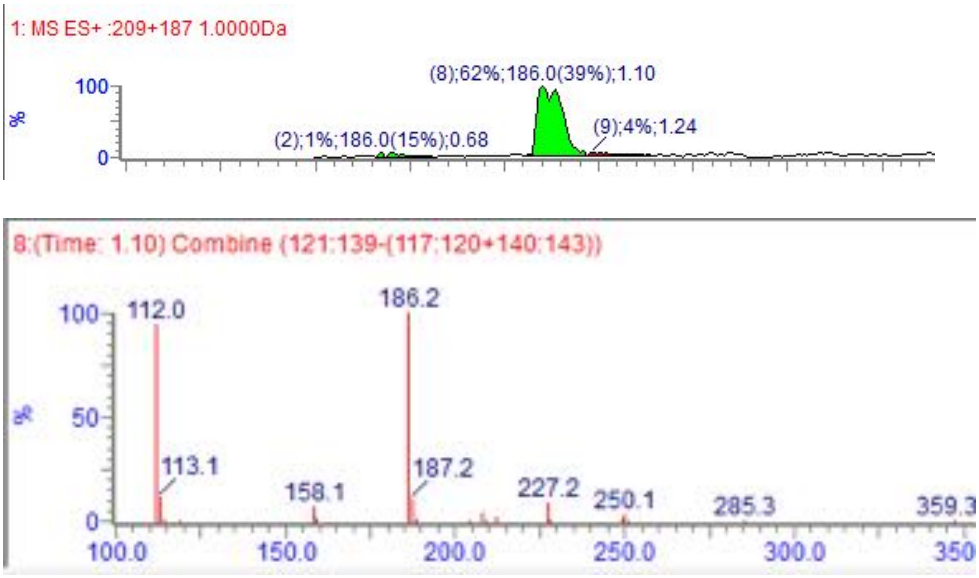


Compound 80b

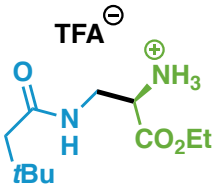


ethyl (R)-3,3-dimethyl-5-oxopyrrolidine-2-carboxylate (80b)

Product obtained as an off-white solid (1.2 mg). LC-MS data – Ret. time 1.10: MS ES+ *m/z* 186 ($[M+H]^+$).

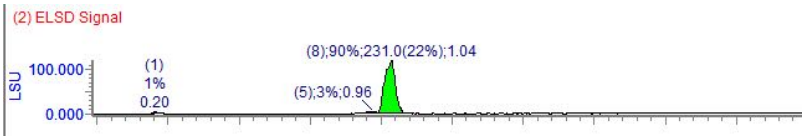


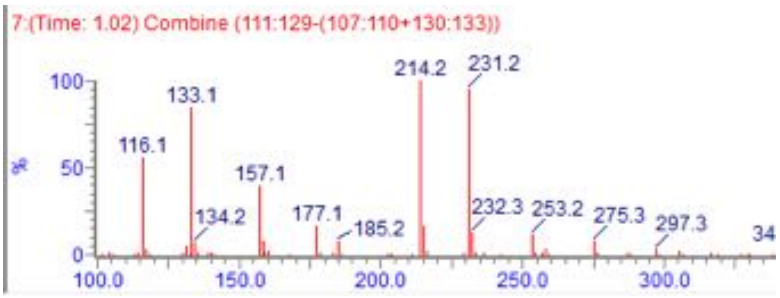
Compound 82b



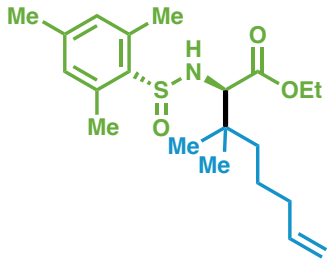
(R)-3-(3,3-dimethylbutanamido)-1-ethoxy-1-oxopropan-2-aminium (82b)

Product obtained as a white solid (1.7 mg). LC-MS data – Ret. time 1.02: MS ES+ *m/z* 231 ($[M+H]^+$).





Compound 84-1



ethyl (R)-2-(((R)-mesitylsulfinyl)amino)-3,3-dimethyloct-7-enoate (84-1).

Following **General Procedure D** on 0.20 mmol scale. Purification by column chromatography (5-25% EtOAc/heptanes) afforded 8.0 mg (11%) of the title compound **84-1**.

Physical State: colorless oil.

$\mathbf{R}_f$ = 0.73 (2:1 hexanes:EtOAc).

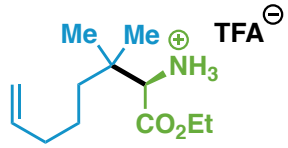
^{1}H NMR (500 MHz, $CDCl_3$): δ 6.87 (s, 2H), 5.86 – 5.73 (m, 1H), 5.06 – 4.90 (m, 3H), 4.32 – 4.14 (m, 2H), 3.70 (d, *J* = 10.1 Hz, 1H), 2.57 (s, 6H), 2.29 (s, 3H), 2.08 – 1.95 (m, 2H), 1.49 – 1.19 (m, 7H), 0.91 (s, 3H), 0.90 (s, 3H) ppm.

^{13}C NMR (126 MHz, $CDCl_3$): δ 172.9, 141.1, 138.8, 138.2, 136.9, 130.9, 114.8, 65.0, 61.5, 39.1, 37.7, 34.6, 23.9, 23.7, 23.3, 21.2, 19.4, 14.3 ppm.

HRMS (ESI-TOF): calc'd for $C_{21}H_{34}NO_3S$ $[M+H]^+$: 380.2259, found: 380.2260.

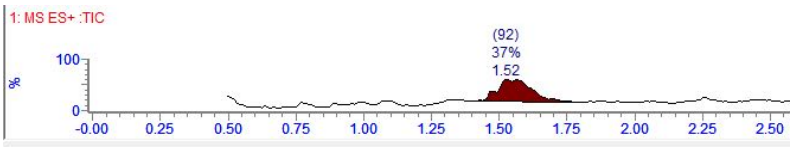
$[\alpha]_D^{20}$ = -128.0 (*c* = 0.5, $CHCl_3$).

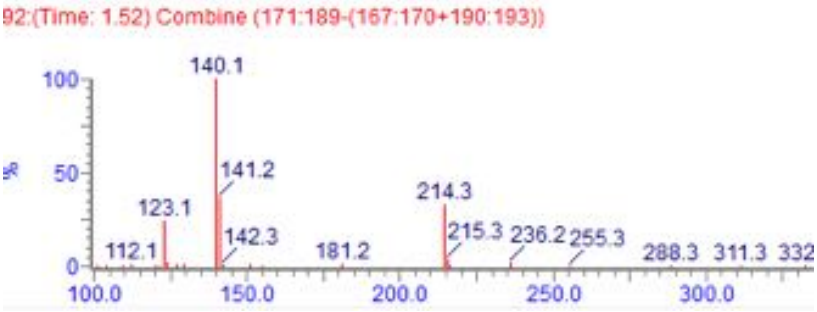
Compound 84b



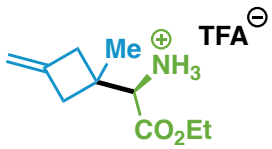
(R)-1-ethoxy-3,3-dimethyl-1-oxooct-7-en-2-aminium (84b)

Product obtained as an off white solid (1.3 mg). LC-MS data – Ret. time 1.52: MS ES+ *m/z* 214 ($[M+H]^+$).



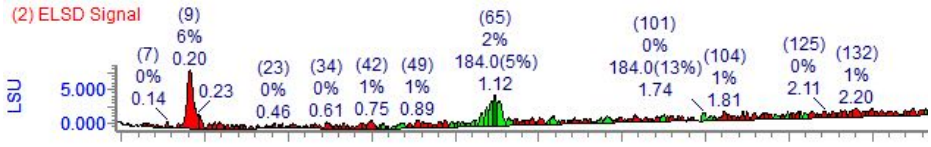


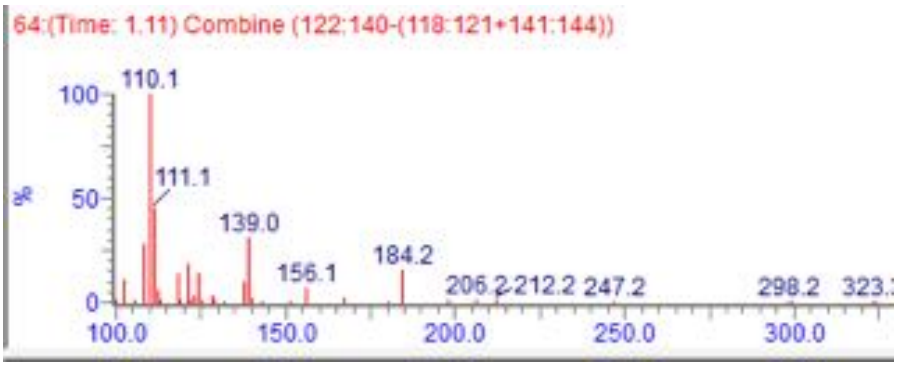
Compound 85b



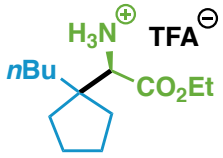
(R)-2-ethoxy-1-(1-methyl-3-methylenecyclobutyl)-2-oxoethan-1-aminium (85b)

Product obtained as a white solid (3.6 mg). LC-MS data – Ret. time 1.12: MS ES+ *m/z* 184 ($[M+H]^+$).



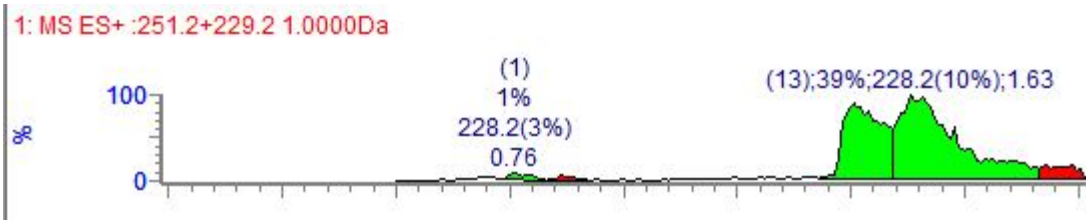


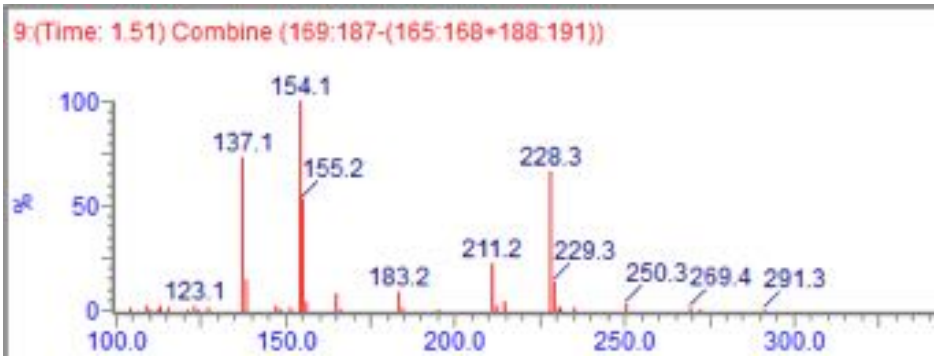
Compound 86b



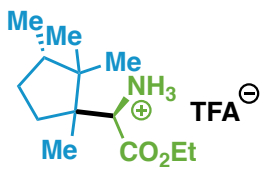
(R)-1-(1-butylcyclopentyl)-2-ethoxy-2-oxoethan-1-aminium (86b)

Product obtained as an off-white solid (8.0 mg). LC-MS data – Ret. time 1.51: MS ES+ *m/z* 228 ($[M+H]^+$).





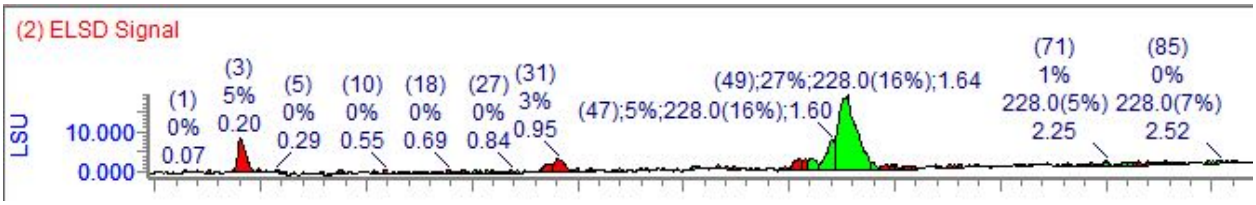
Compound 87b

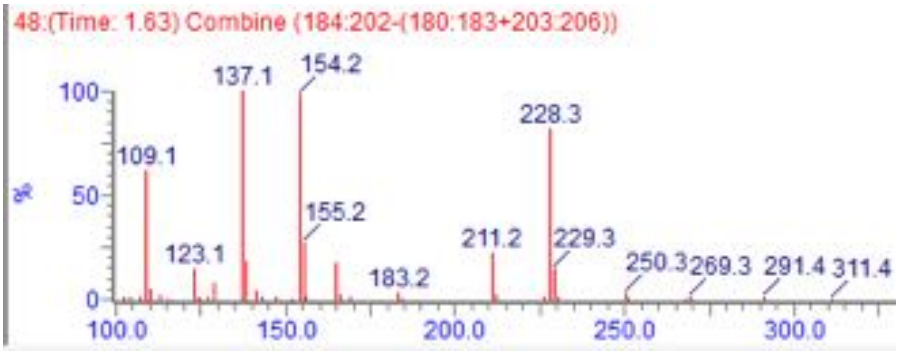


(R)-2-ethoxy-2-oxo-1-((1S,3S)-1,2,2,3-tetramethylcyclopentyl)ethan-1-aminium

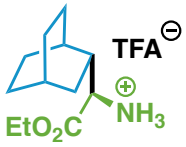
(87b)

Product obtained as an off-white solid (1.1 mg), β stereochemistry unassigned. LC-MS data – Ret. time 1.63: MS ES+ *m/z* 228 ($[M+H]^+$).



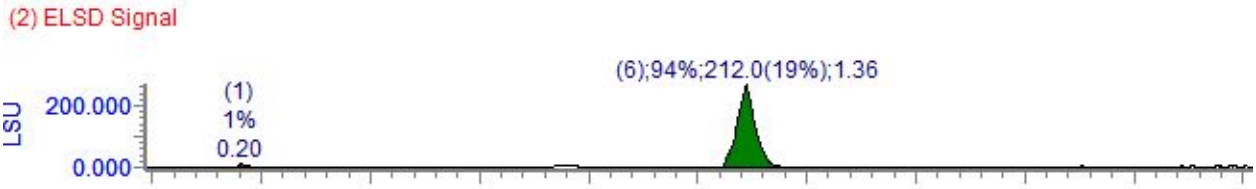


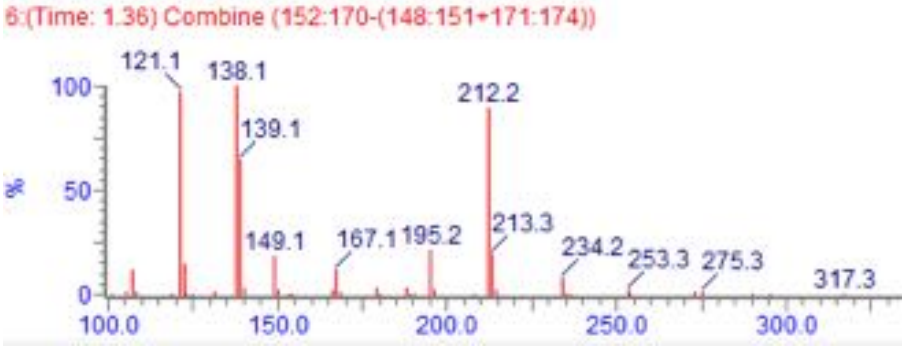
Compound 88b



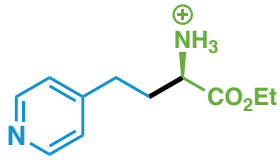
(R)-1-((1S,2R,4S)-bicyclo[2.2.2]octan-2-yl)-2-ethoxy-2-oxoethan-1-aminium (88b)

Product obtained as a white solid (1.8 mg). LC-MS data – Ret. time 1.36: MS ES+ *m/z* 212 ($[M+H]^+$).



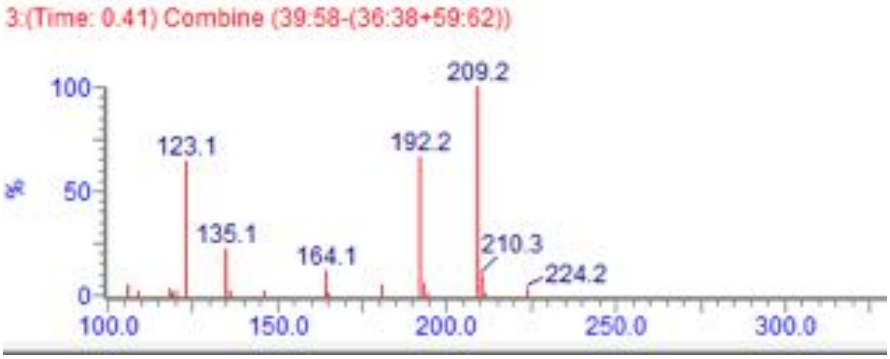


Compound 89b

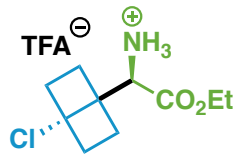


(R)-1-ethoxy-1-oxo-4-(pyridin-4-yl)butan-2-aminium (89b)

Product obtained as a white solid (1.1 mg). LC-MS data – Ret. time 0.41: MS ES+ *m/z* 209 ($[M+H]^+$).

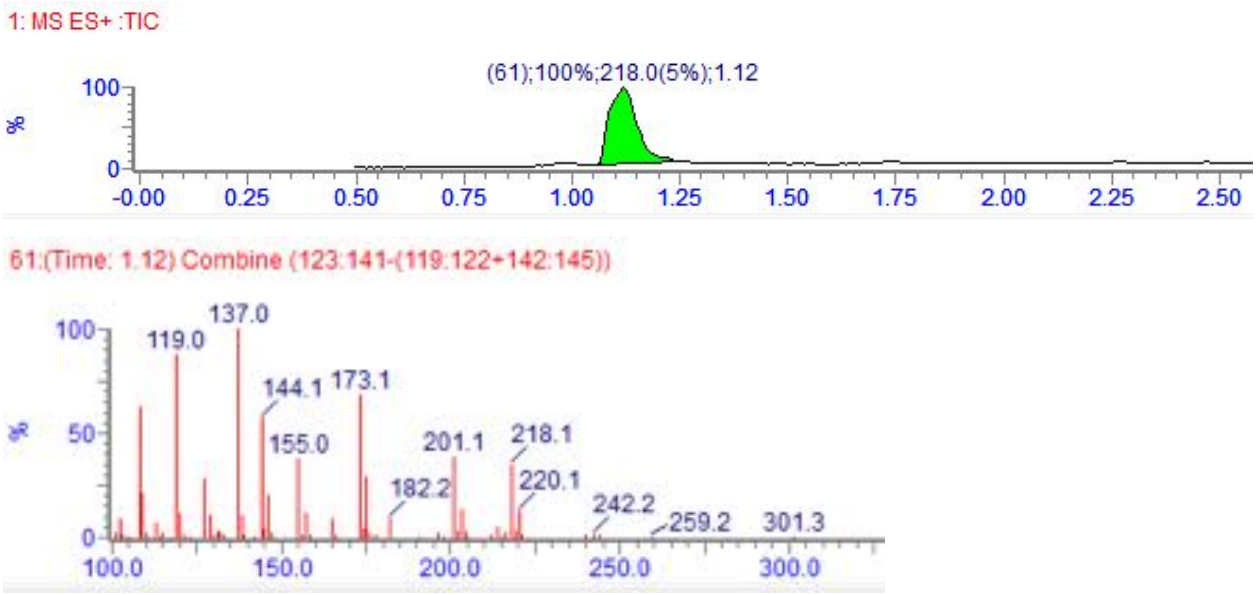


Compound 91b

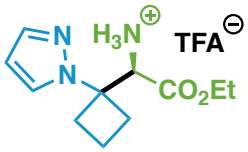


(R)-1-((1s,4R)-4-chlorobicyclo[2.2.0]hexan-1-yl)-2-ethoxy-2-oxoethan-1-aminium (91b)

Product obtained as a white solid (2.8 mg). LC-MS data – Ret. time 1.12: MS ES+ *m/z* 218 ($[M+H]^+$).

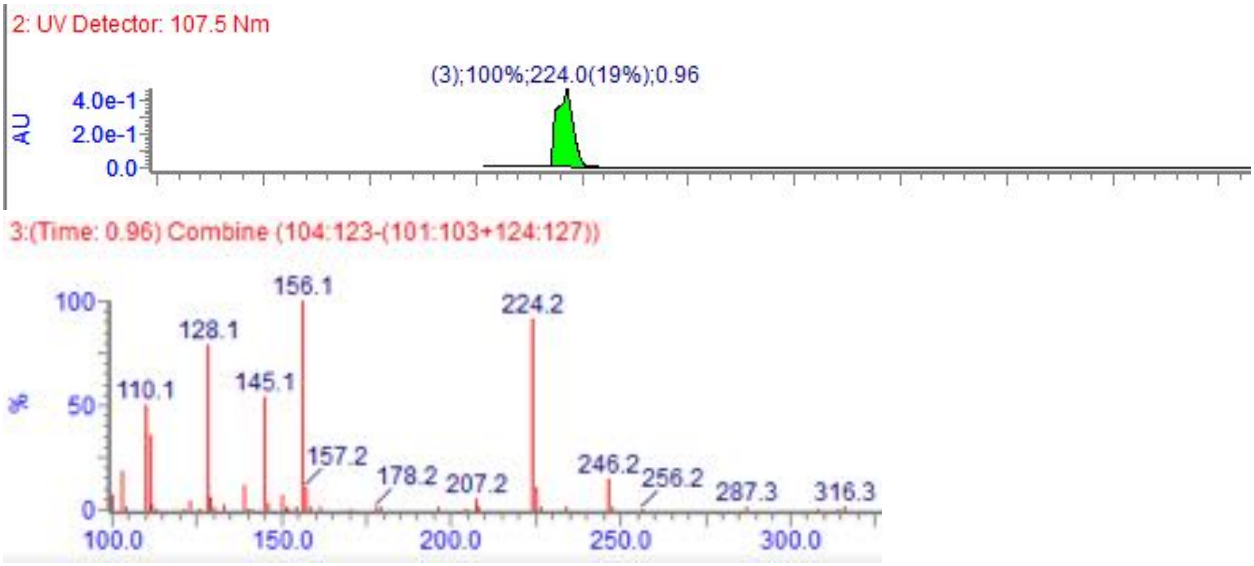


Compound 92b

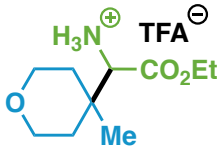


(R)-1-(1-(1H-pyrazol-1-yl)cyclobutyl)-2-ethoxy-2-oxoethan-1-aminium (92b)

Product obtained as a colorless oil (1.5 mg). LC-MS data – Ret. time 0.96: MS ES+ *m/z* 224 ($[M+H]^+$).

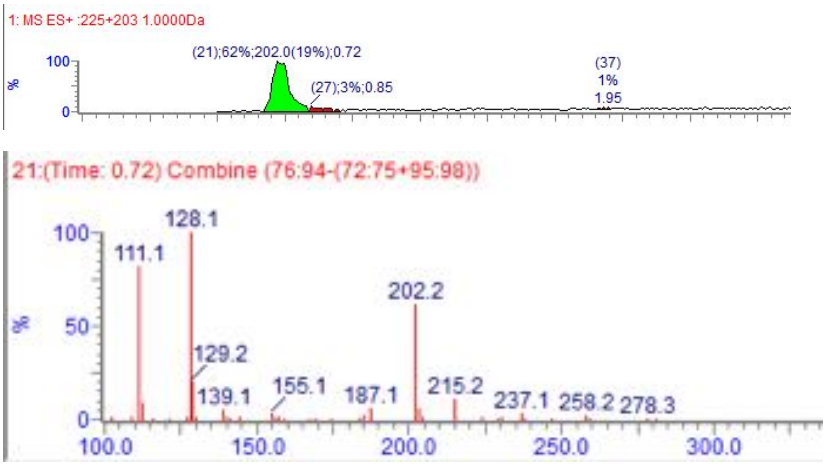


Compound 94b

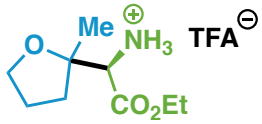


(R)-2-ethoxy-1-(4-methyltetrahydro-2H-pyran-4-yl)-2-oxoethan-1-aminium (94b)

Product obtained as a white solid (1.7 mg). LC-MS data – Ret. time 0.72: MS ES+ *m/z* 202 ($[M+H]^+$).

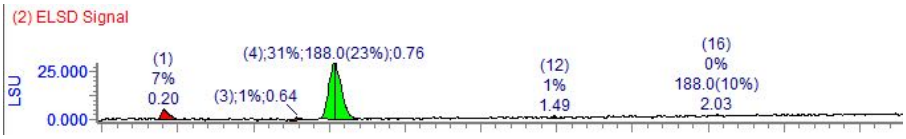


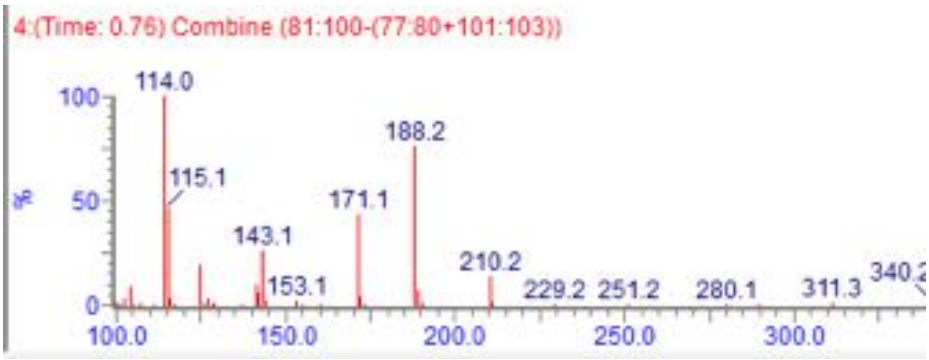
Compound 95b



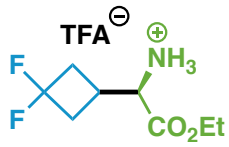
(R)-2-ethoxy-1-(2-methyltetrahydrofuran-2-yl)-2-oxoethan-1-aminium (95b)

Product obtained as a colorless oil (5.0 mg). LC-MS data – Ret. time 0.72: MS ES+ *m/z* 188 ($[M+H]^+$).



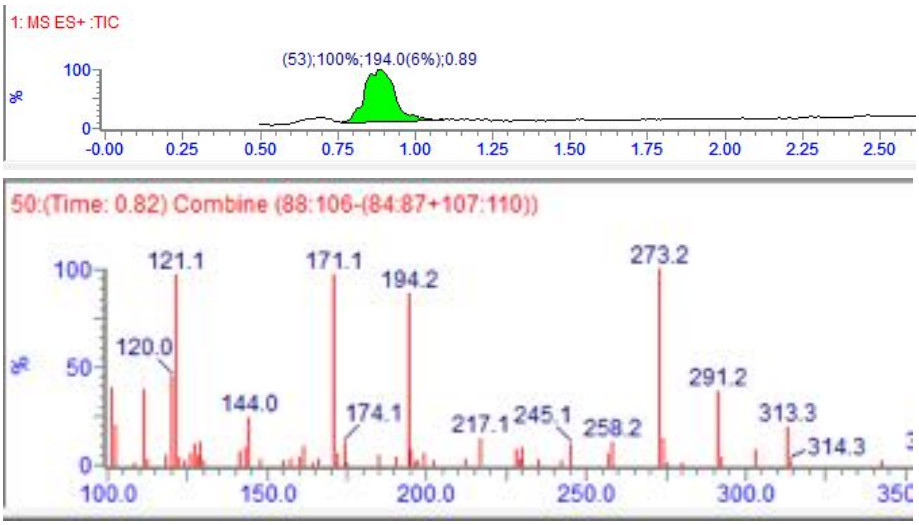


Compound 96b

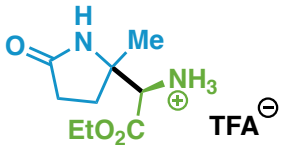


(R)-1-(3,3-difluorocyclobutyl)-2-ethoxy-2-oxoethan-1-aminium (96b)

Product obtained as an off-white solid (2.9 mg). LC-MS data – Ret. time 0.82: MS ES+ *m/z* 194 ($[M+H]^+$).



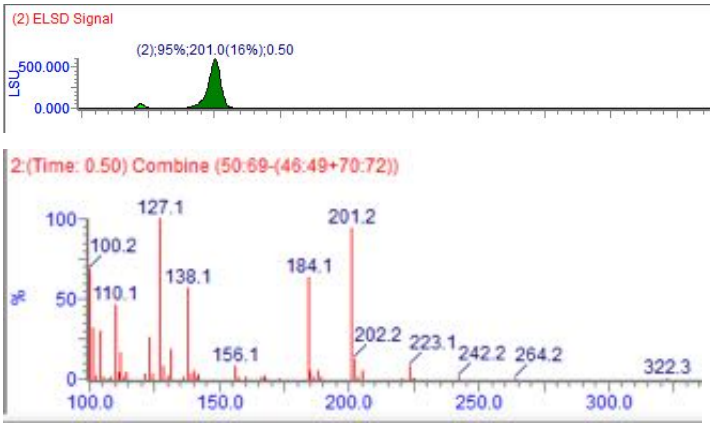
Compound 97b



(R)-2-ethoxy-1-(2-methyl-5-oxopyrrolidin-2-yl)-2-oxoethan-1-aminium (97b)

Product obtained as a colorless oil (3.8 mg), β stereochemistry unassigned. LC-MS

data – Ret. time 0.50: MS ES+ *m/z* 201 ($[M+H]^+$).



X-Ray Crystallographic Data for Compound 3

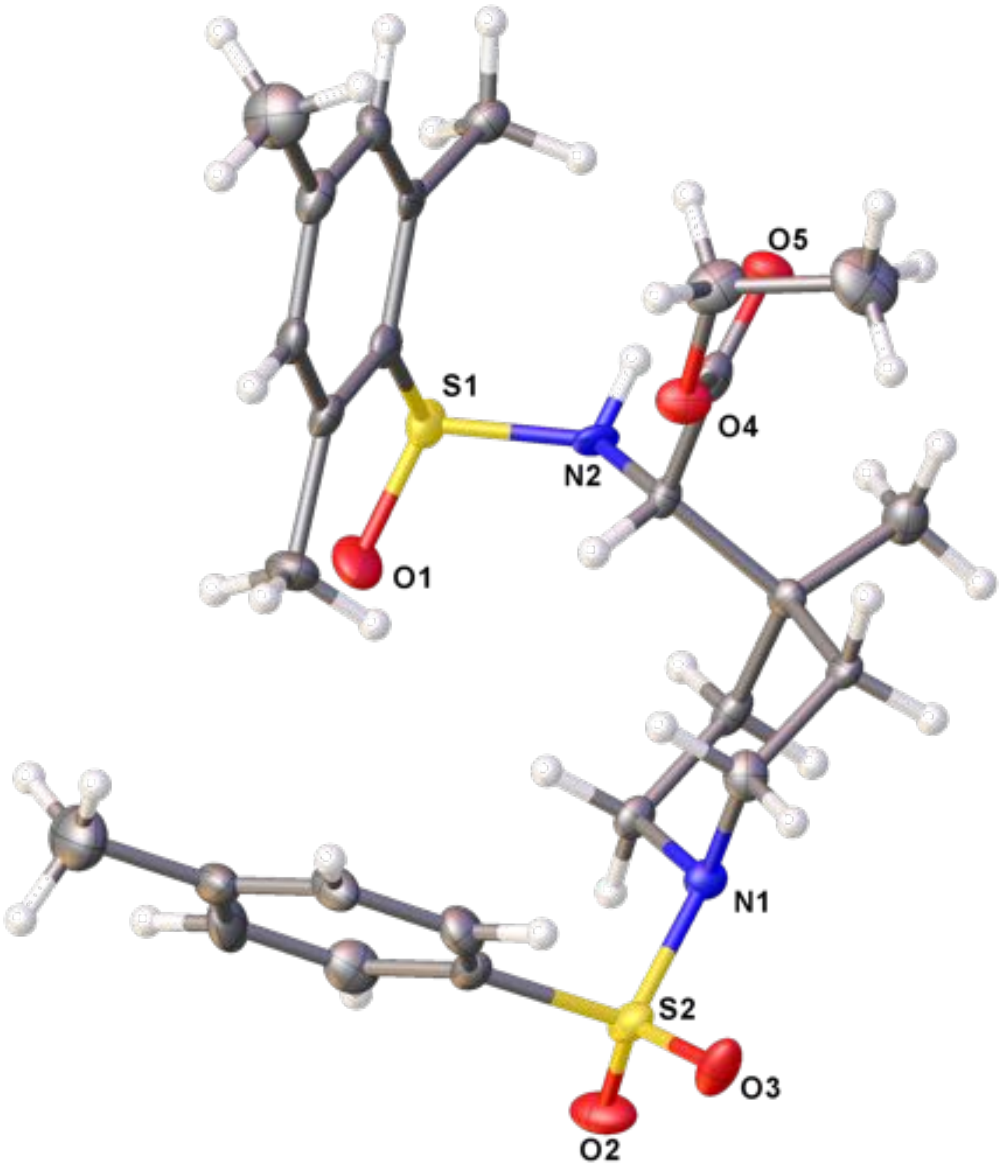


Table 1. Crystal data and structure refinement for compound **3**.

Identification code	CCDC 1861500	
Empirical formula	C26 H36 N2 O5 S2	
Formula weight	520.69	
Temperature	100.0 K	
Wavelength	0.71073 Å	
Crystal system	Trigonal	
Space group	$P3_2$	
Unit cell dimensions	a = 26.5285(11) Å	α= 90°.
	b = 26.5285(11) Å	β= 90°.
	c = 9.7658(5) Å	γ = 120°.
Volume	5952.0(6) $Å^3$	
Z, Z'	9, 3	
Density (calculated)	1.307 Mg/m^3	
Absorption coefficient	0.240 mm^{-1}	
F(000)	2502	
Crystal size	0.26 x 0.08 x 0.04 mm^3	
Theta range for data collection	1.535 to 25.368°.	
Index ranges	-29<=h<=27, -31<=k<=16, -11<=l<=11	
Reflections collected	25779	
Independent reflections	14453 [R(int) = 0.0434]	
Completeness to theta = 25.242°	100.0 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.6024 and 0.5280	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	14453 / 1 / 969	
Goodness-of-fit on F^2	1.019	
Final R indices [I>2sigma(I)]	R1 = 0.0443, wR2 = 0.0716	
R indices (all data)	R1 = 0.0570, wR2 = 0.0765	
Absolute structure parameter	0.00(3)	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.236 and -0.241 e.$Å^{-3}$	

Table 2. Atomic coordinates (x 10^4) and equivalent isotropic displacement parameters ($Å^2$x 10^3)
for compound **3**. U(eq) is defined as one third of the trace of the orthogonalized U^{ij} tensor.

	x	y	z	U(eq)
S(2)	3986(1)	2403(1)	12013(2)	21(1)
S(2")	7521(1)	7560(1)	6733(2)	24(1)
S(1")	10015(1)	9326(1)	9323(2)	24(1)
S(1')	4116(1)	6855(1)	901(2)	16(1)
S(1)	6444(1)	3926(1)	8754(2)	21(1)
S(2')	3579(1)	4384(1)	-2290(2)	26(1)
O(4")	9897(2)	7771(2)	7270(5)	20(1)
O(4)	5727(2)	4904(2)	10534(5)	22(1)
O(1)	5960(2)	3322(2)	8522(5)	31(1)
C(24')	3393(3)	4268(3)	1805(7)	23(2)
C(2")	9685(3)	8308(3)	10913(7)	18(2)
O(3')	3923(2)	4194(2)	-3034(5)	34(1)
O(3)	3602(2)	2528(2)	12791(5)	28(1)
O(1')	3629(2)	6251(2)	1140(5)	24(1)
O(2')	2958(2)	4100(2)	-2506(5)	36(1)
C(5)	6593(3)	5369(3)	6975(7)	21(2)
C(11")	10181(3)	8339(3)	7021(7)	21(2)
N(1)	4657(2)	2931(2)	12387(6)	17(1)
N(2)	6457(2)	4119(2)	10353(6)	18(1)
O(2")	7292(2)	7950(2)	6669(5)	29(1)
O(3")	7249(2)	7028(2)	5937(5)	31(1)
O(5')	5424(2)	6450(2)	-604(5)	28(1)
O(5")	10687(2)	8623(2)	6688(5)	27(1)
C(17)	4745(3)	3518(3)	12306(7)	20(2)
N(1")	8201(2)	7927(2)	6239(6)	23(1)
O(5)	6653(2)	5230(2)	11201(5)	22(1)
C(6)	6696(3)	4980(3)	7713(7)	17(1)
C(10)	5993(3)	4191(2)	10973(7)	14(1)
C(21")	7455(3)	6833(3)	8782(8)	27(2)
C(10")	9770(3)	8587(3)	7171(7)	15(1)
C(4)	6050(3)	5206(3)	6468(7)	23(2)
N(2')	4392(2)	6927(2)	-657(6)	14(1)

C(1)	6237(3)	4403(3)	7906(7)	18(2)
C(6')	5191(3)	7521(3)	1979(7)	15(1)
C(2)	5684(3)	4228(3)	7397(7)	20(2)
C(20')	3702(3)	4349(3)	-532(7)	20(2)
C(23')	3928(3)	4367(3)	2255(6)	16(1)
C(23)	3705(3)	2606(3)	7511(8)	26(2)
O(2)	3978(2)	1863(2)	12195(5)	32(1)
C(1")	10126(3)	8798(3)	10247(7)	18(1)
C(17")	8517(3)	7605(3)	6172(7)	22(2)
C(15)	6364(3)	4276(3)	13436(7)	24(2)
O(1")	9401(2)	9175(2)	9593(5)	31(1)
C(21')	4244(3)	4449(3)	-97(7)	21(2)
C(18')	3529(3)	5348(3)	-2077(7)	21(2)
C(19)	5703(2)	3293(3)	12428(7)	18(2)
C(18")	8561(3)	8522(3)	6872(8)	25(2)
C(14')	4404(3)	6358(3)	-2668(7)	16(2)
C(19")	9096(3)	8874(3)	5983(7)	21(2)
C(13")	10588(3)	7571(3)	8478(8)	33(2)
C(13')	6458(3)	8213(3)	-912(10)	43(2)
C(26)	3613(4)	2675(3)	5998(9)	43(2)
C(16)	5313(2)	3940(3)	13013(7)	15(1)
C(12')	6187(3)	7575(3)	-880(9)	31(2)
C(3")	9858(3)	8000(3)	11780(7)	28(2)
C(25)	4029(3)	2202(3)	9287(8)	27(2)
C(1')	4741(3)	6943(3)	1858(7)	14(1)
C(22')	4348(3)	4462(3)	1286(7)	17(1)
C(4")	10425(4)	8162(3)	12029(8)	36(2)
O(4')	5560(2)	7338(2)	-1116(5)	24(1)
C(7')	4318(3)	5858(3)	2440(8)	30(2)
C(7)	5159(3)	3623(3)	7526(8)	30(2)
C(22")	7438(3)	6680(3)	10121(8)	35(2)
C(24")	7518(3)	7570(3)	10843(7)	24(2)
C(16')	4684(3)	6007(3)	-3265(7)	22(2)
C(14")	9474(3)	8582(3)	5771(7)	19(2)
C(15")	9927(3)	8914(3)	4668(7)	21(2)
C(6")	10716(3)	8967(3)	10421(7)	27(2)
C(26')	4051(3)	4375(3)	3775(7)	22(2)
C(3')	5274(3)	6636(3)	3271(7)	19(2)

C(20'')	7511(3)	7369(3)	8471(7)	18(2)
C(25'')	7550(3)	7744(3)	9513(8)	25(2)
N(1')	3838(2)	5078(2)	-2670(6)	19(1)
C(8'')	10593(4)	7837(4)	13039(10)	63(3)
C(14)	5851(2)	3929(3)	12462(6)	15(1)
C(4')	5716(3)	7194(3)	3425(7)	27(2)
C(8)	5942(3)	5641(3)	5674(9)	38(2)
C(9'')	11192(3)	9460(4)	9646(9)	46(2)
C(9')	5186(3)	8025(3)	1260(7)	21(2)
C(5')	5676(3)	7640(3)	2758(7)	21(2)
C(5'')	10852(3)	8644(4)	11311(8)	36(2)
C(2')	4769(3)	6484(3)	2513(7)	17(1)
C(20)	3872(3)	2477(3)	10277(7)	19(2)
C(7'')	9041(3)	8076(3)	10756(8)	29(2)
C(11')	5236(3)	6766(3)	-900(7)	21(2)
N(2'')	10087(2)	9177(2)	7734(6)	26(1)
C(22)	3554(3)	2878(3)	8494(7)	24(2)
C(25')	3276(3)	4269(3)	433(7)	21(2)
C(11)	6171(3)	4833(3)	10938(7)	19(2)
C(15')	4589(3)	6890(3)	-3588(7)	24(2)
C(8')	6249(3)	7339(3)	4294(9)	39(2)
C(16'')	9061(3)	7947(2)	5288(7)	19(2)
C(3)	5596(3)	4636(3)	6683(6)	19(2)
C(17')	4486(3)	5435(3)	-2555(7)	24(2)
C(13)	5865(3)	5788(3)	11661(9)	39(2)
C(12'')	10236(3)	7476(3)	7166(7)	21(2)
C(23'')	7470(3)	7037(3)	11184(8)	31(2)
C(21)	3632(3)	2813(3)	9870(7)	23(2)
C(10')	4581(3)	6527(3)	-1145(7)	16(1)
C(9)	7296(3)	5199(3)	8346(7)	20(2)
C(12)	5862(3)	5508(3)	10351(8)	27(2)
C(18)	5133(2)	2875(3)	11734(7)	16(1)
C(19')	3746(3)	5955(3)	-2724(7)	18(2)
C(24)	3945(3)	2270(3)	7928(8)	30(2)
C(26'')	7453(4)	6862(4)	12680(8)	49(2)

X-Ray Crystallographic Data for Compound 50

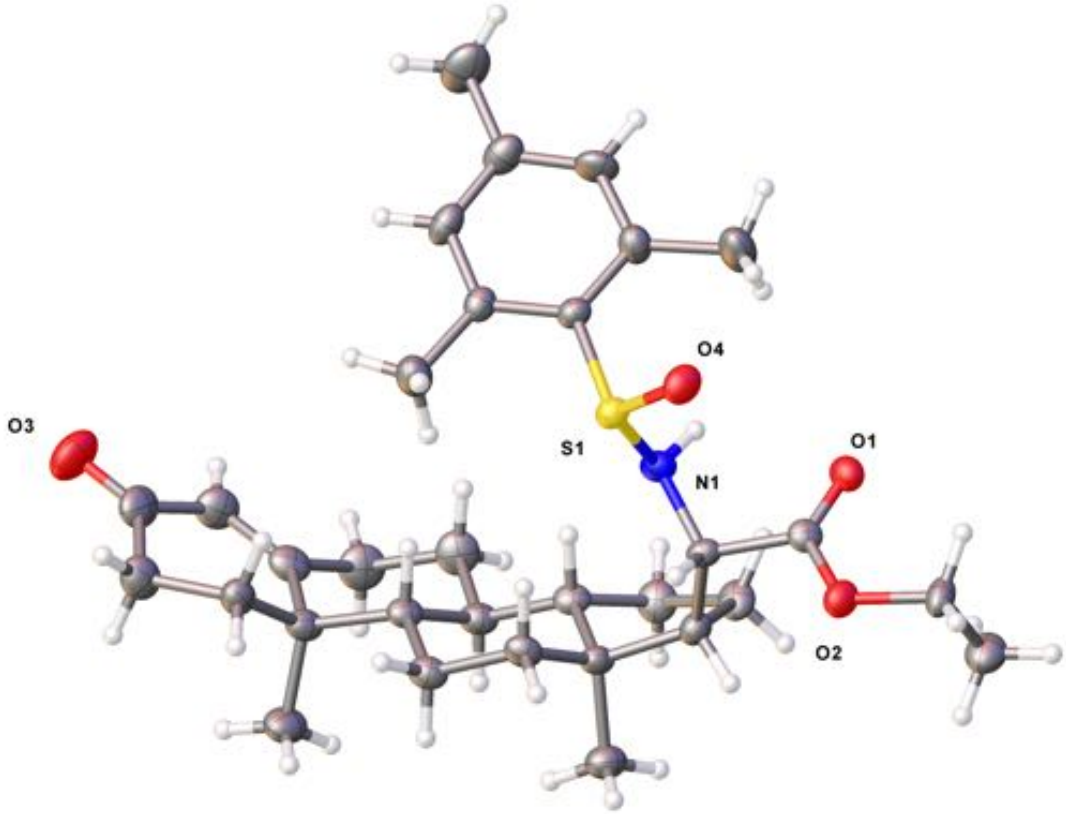


Table 1. Crystal data and structure refinement for compound **50**.

Identification code	CCDC 1861501	
Empirical formula	C35 H52 N O4 S	
Molecular formula	C32 H45 N O4 S, 0.5(C6 H14)	
Formula weight	582.83	
Temperature	100.0 K	
Wavelength	0.71073 Å	
Crystal system	Orthorhombic	
Space group	$P2_12_12_1$	
Unit cell dimensions	a = 9.5622(3) Å	α= 90°.
	b = 23.5391(6) Å	β= 90°.
	c = 28.7418(9) Å	γ = 90°.
Volume	6469.4(3) $Å^3$	
Z	8	
Density (calculated)	1.197 Mg/m^3	
Absorption coefficient	0.138 mm^{-1}	
F(000)	2536	
Crystal size	0.178 x 0.052 x 0.011 mm^3	
Crystal color, habit	Colorless Needle	
Theta range for data collection	1.118 to 25.363°.	
Index ranges	-11<=h<=11, -28<=k<=28, -33<=l<=34	
Reflections collected	53939	
Independent reflections	11733 [R(int) = 0.0655, R(sigma) = 0.0697]	
Completeness to theta = 25.000°	99.9 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.2590 and 0.2268	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	11733 / 3 / 761	
Goodness-of-fit on F^2	1.054	
Final R indices [I>2sigma(I)]	R1 = 0.0596, wR2 = 0.1169	
R indices (all data)	R1 = 0.0962, wR2 = 0.1293	
Absolute structure parameter	0.02(3)	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.376 and -0.338 $e.Å^{-3}$	

Table 2. Atomic coordinates (x 10^4) and equivalent isotropic displacement parameters ($Å^2$x 10^3)
for compound **50**. U(eq) is defined as one third of the trace of the orthogonalized U^{ij} tensor.

	x	y	z	U(eq)
S(1)	3370(1)	7658(1)	6449(1)	24(1)
O(1)	1319(4)	6576(1)	5783(1)	30(1)
O(2)	778(4)	6162(1)	6464(1)	31(1)
O(3)	1279(5)	11283(2)	7088(2)	56(1)
O(4)	4200(4)	7134(1)	6386(1)	33(1)
N(1)	1760(5)	7604(2)	6221(1)	25(1)
C(1)	1041(5)	6607(2)	6189(2)	24(1)
C(2)	901(5)	7166(2)	6450(2)	23(1)
C(3)	-674(5)	7316(2)	6484(2)	26(1)
C(4)	-1371(6)	7420(2)	6001(2)	32(1)
C(5)	-1891(6)	8041(2)	5997(2)	34(1)
C(6)	-1081(5)	8318(2)	6391(2)	25(1)
C(7)	-1032(5)	7855(2)	6768(2)	25(1)
C(8)	-44(6)	8042(2)	7152(2)	27(1)
C(9)	-456(6)	8629(2)	7345(2)	29(1)
C(10)	-540(6)	9084(2)	6961(2)	25(1)
C(11)	-1510(6)	8906(2)	6563(2)	29(1)
C(12)	-1462(7)	9339(2)	6176(2)	38(1)
C(13)	-1784(7)	9934(2)	6351(2)	42(2)
C(14)	-869(6)	10108(2)	6745(2)	32(1)
C(15)	-787(6)	9698(2)	7154(2)	29(1)
C(16)	450(6)	9861(2)	7473(2)	31(1)
C(17)	568(7)	10503(2)	7562(2)	40(2)
C(18)	645(7)	10834(2)	7116(2)	40(2)
C(19)	-158(6)	10599(2)	6731(2)	38(1)
C(20)	-2502(6)	7744(2)	6978(2)	36(1)
C(21)	-2174(6)	9735(2)	7431(2)	43(2)
C(22)	691(6)	5604(2)	6239(2)	32(1)
C(23)	-782(6)	5499(2)	6073(2)	42(2)
C(24)	4000(5)	8185(2)	6047(2)	24(1)
C(25)	4360(6)	8051(2)	5585(2)	32(1)
C(26)	4951(6)	8483(2)	5320(2)	36(1)

C(27)	5198(6)	9023(2)	5490(2)	36(1)
C(28)	4821(6)	9135(2)	5945(2)	33(1)
C(29)	4221(5)	8722(2)	6232(2)	26(1)
C(30)	4158(8)	7474(2)	5367(2)	49(2)
C(31)	5850(8)	9478(3)	5184(2)	56(2)
C(32)	3869(6)	8870(2)	6726(2)	38(2)
S(1')	1575(1)	3782(1)	6318(1)	24(1)
O(1')	3609(4)	4929(2)	5706(2)	46(1)
O(2')	4146(4)	5267(2)	6425(2)	49(1)
O(3')	3869(6)	197(2)	7066(3)	119(3)
O(4')	733(4)	4311(1)	6290(1)	34(1)
N(1')	3182(4)	3857(2)	6084(1)	26(1)
C(1')	3894(6)	4860(2)	6109(2)	39(2)
C(2')	4026(5)	4281(2)	6331(2)	28(1)
C(3')	5609(6)	4129(2)	6345(2)	32(1)
C(4')	6267(6)	4022(2)	5858(2)	38(2)
C(5')	6788(6)	3403(2)	5853(2)	38(1)
C(6')	6025(5)	3121(2)	6256(2)	26(1)
C(7')	6015(5)	3592(2)	6633(2)	26(1)
C(8')	5045(5)	3405(2)	7021(2)	26(1)
C(9')	5519(6)	2830(2)	7221(2)	27(1)
C(10')	5593(5)	2367(2)	6846(2)	26(1)
C(11')	6499(5)	2545(2)	6430(2)	26(1)
C(12')	6385(6)	2100(2)	6050(2)	37(1)
C(13')	6770(7)	1509(2)	6226(2)	44(2)
C(14')	5951(6)	1353(2)	6648(2)	36(1)
C(15')	5945(6)	1770(2)	7047(2)	32(1)
C(16')	4801(6)	1615(2)	7406(2)	42(2)
C(17')	4747(8)	978(3)	7505(3)	69(2)
C(18')	4542(8)	646(3)	7078(4)	75(3)
C(19')	5255(7)	855(3)	6661(3)	57(2)
C(20')	7482(6)	3702(2)	6827(2)	37(1)
C(21')	7399(6)	1761(2)	7285(2)	36(1)
C(22')	4253(7)	5847(2)	6250(3)	68(2)
C(23')	5788(7)	5978(3)	6176(3)	78(3)
C(24')	916(5)	3297(2)	5892(2)	20(1)
C(25')	501(5)	3473(2)	5444(2)	26(1)
C(26')	-130(6)	3074(2)	5157(2)	30(1)

C(27')	-350(5)	2516(2)	5294(2)	33(1)
C(28')	83(6)	2355(2)	5736(2)	34(1)
C(29')	713(5)	2736(2)	6040(2)	24(1)
C(30')	673(7)	4074(2)	5263(2)	40(2)
C(31')	-1079(7)	2102(3)	4976(2)	47(2)
C(32')	1134(6)	2542(2)	6520(2)	35(1)
C(1S)	2641(7)	11219(3)	5809(3)	67(2)
C(2S)	1852(11)	10878(4)	5514(3)	102(3)
C(3S)	2037(12)	10270(4)	5560(3)	104(4)
C(4S)	1212(11)	9928(4)	5295(3)	94(3)
C(5S)	1495(16)	9340(7)	5261(6)	225(9)
C(6S)	611(14)	8862(5)	5078(4)	140(4)

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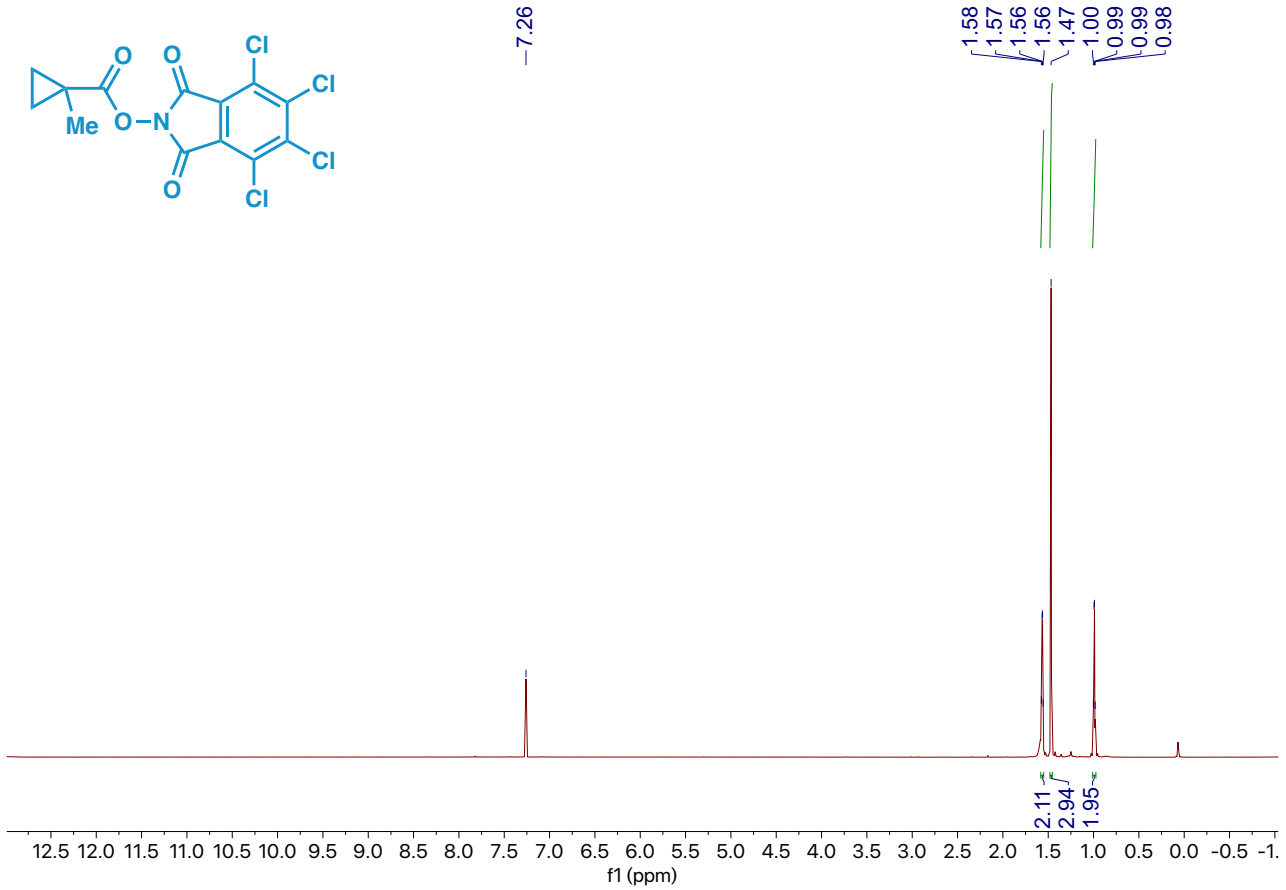
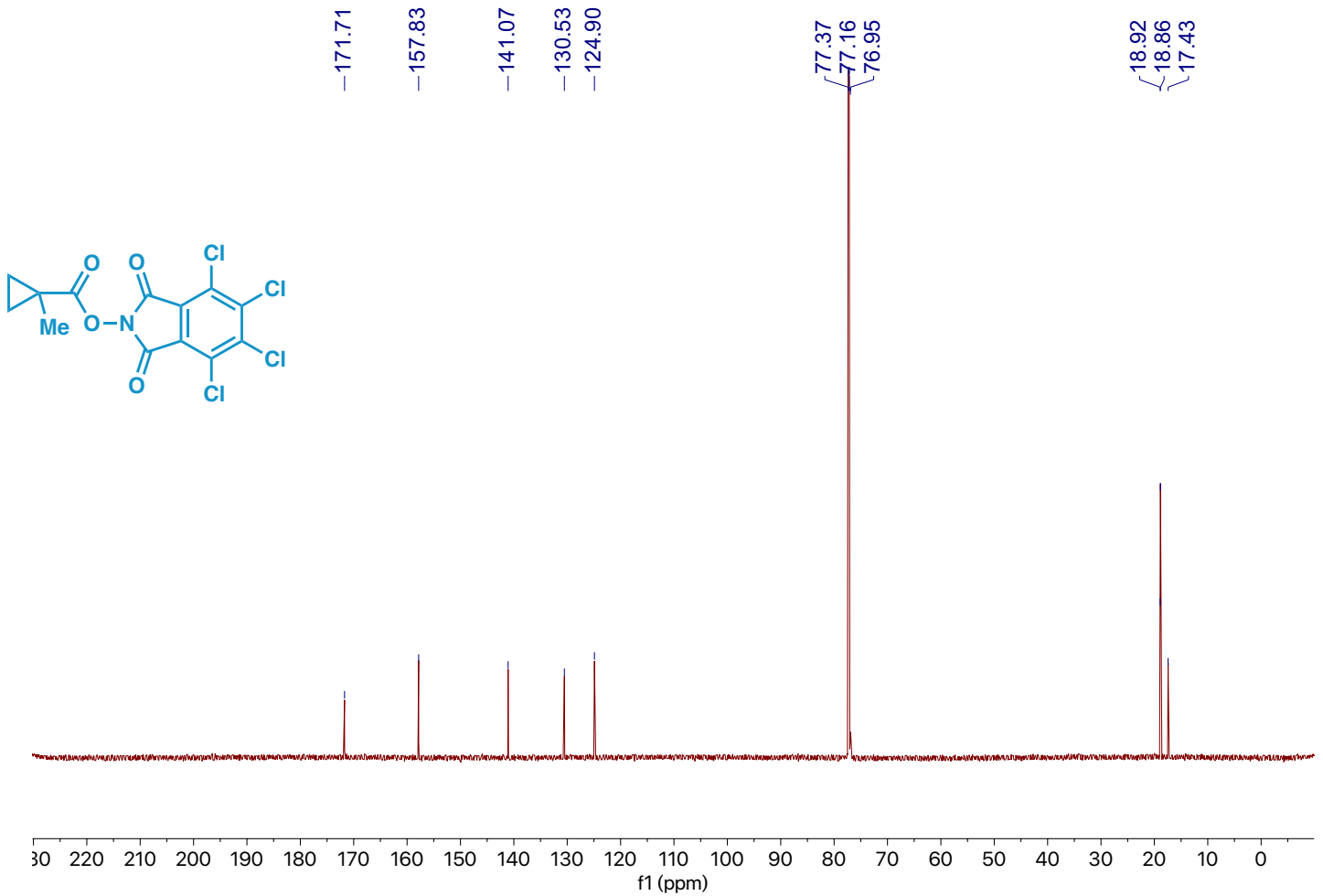
Spectra for Redox-Active Esters

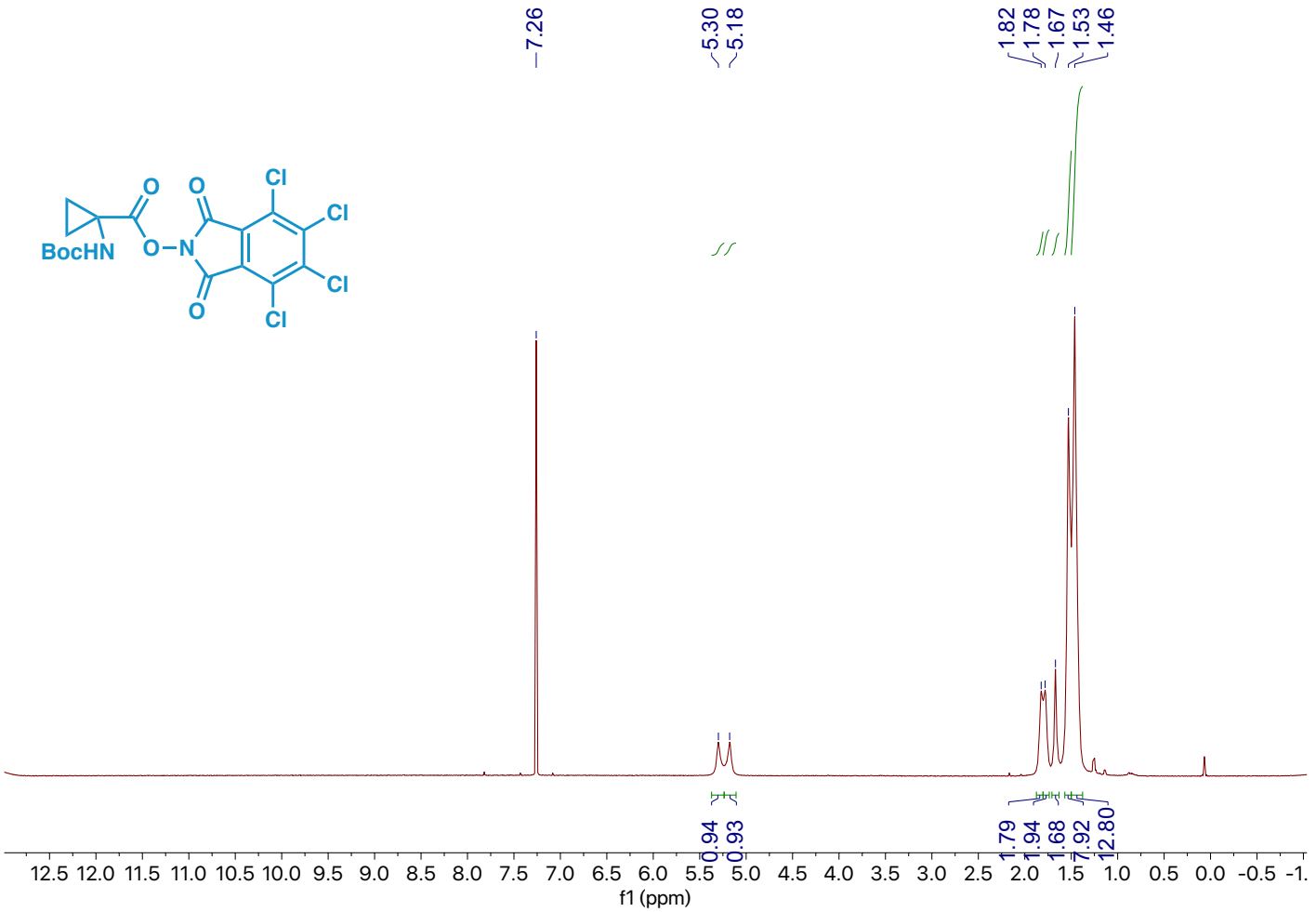
Compound SI-6 ^{1}H NMR



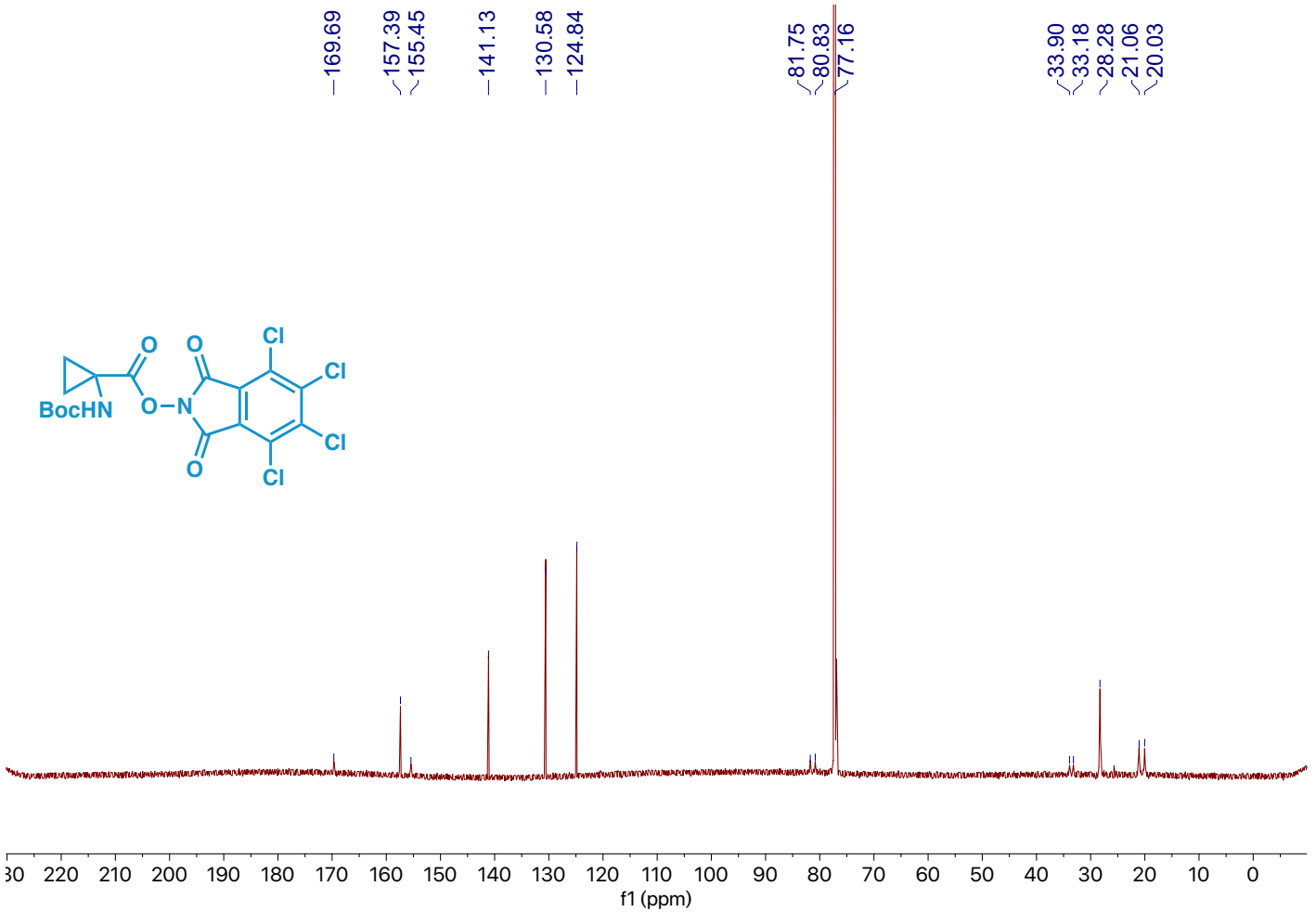
Compound SI-6 ^{13}C NMR



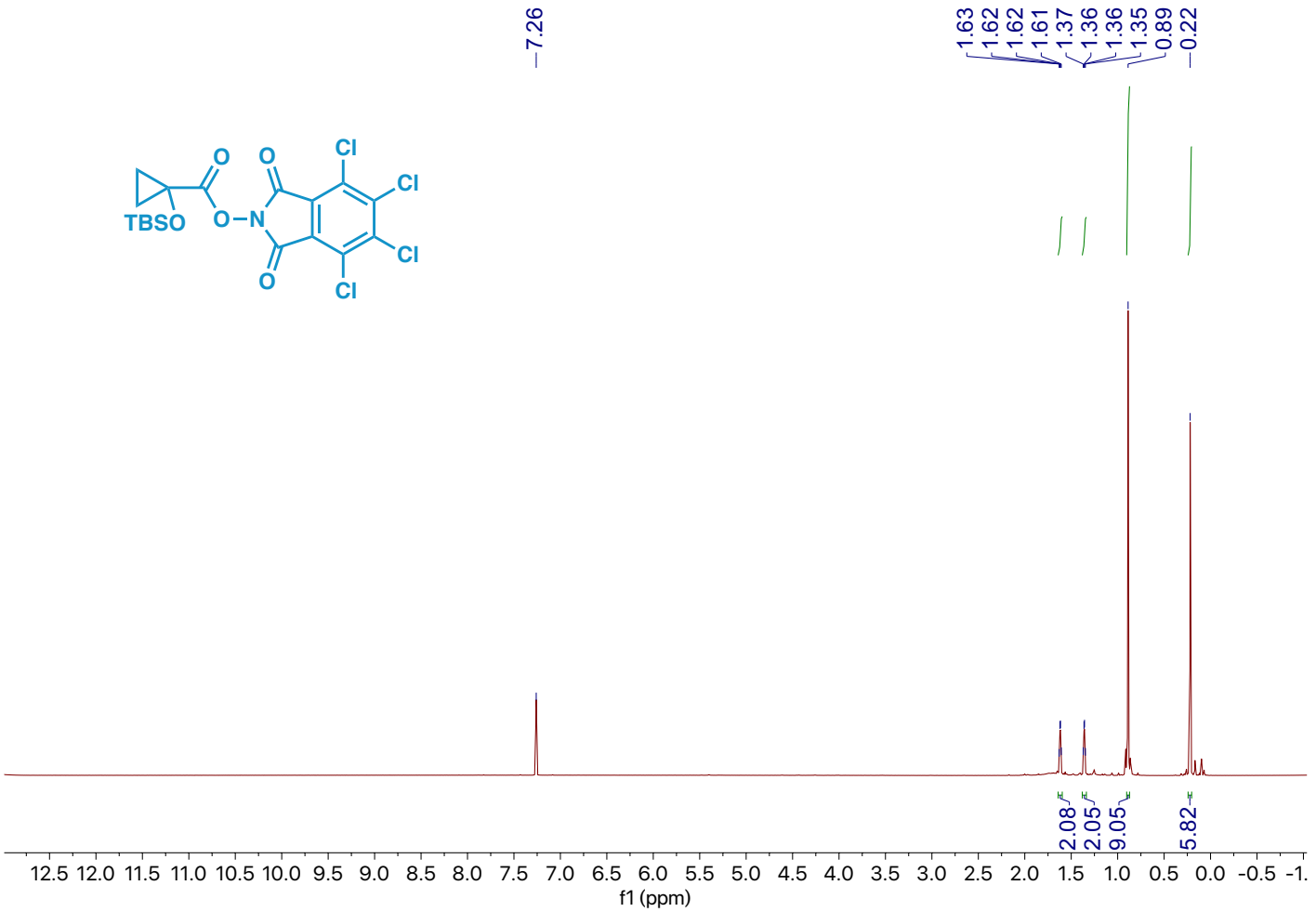
Compound SI-7 ^{1}H NMR



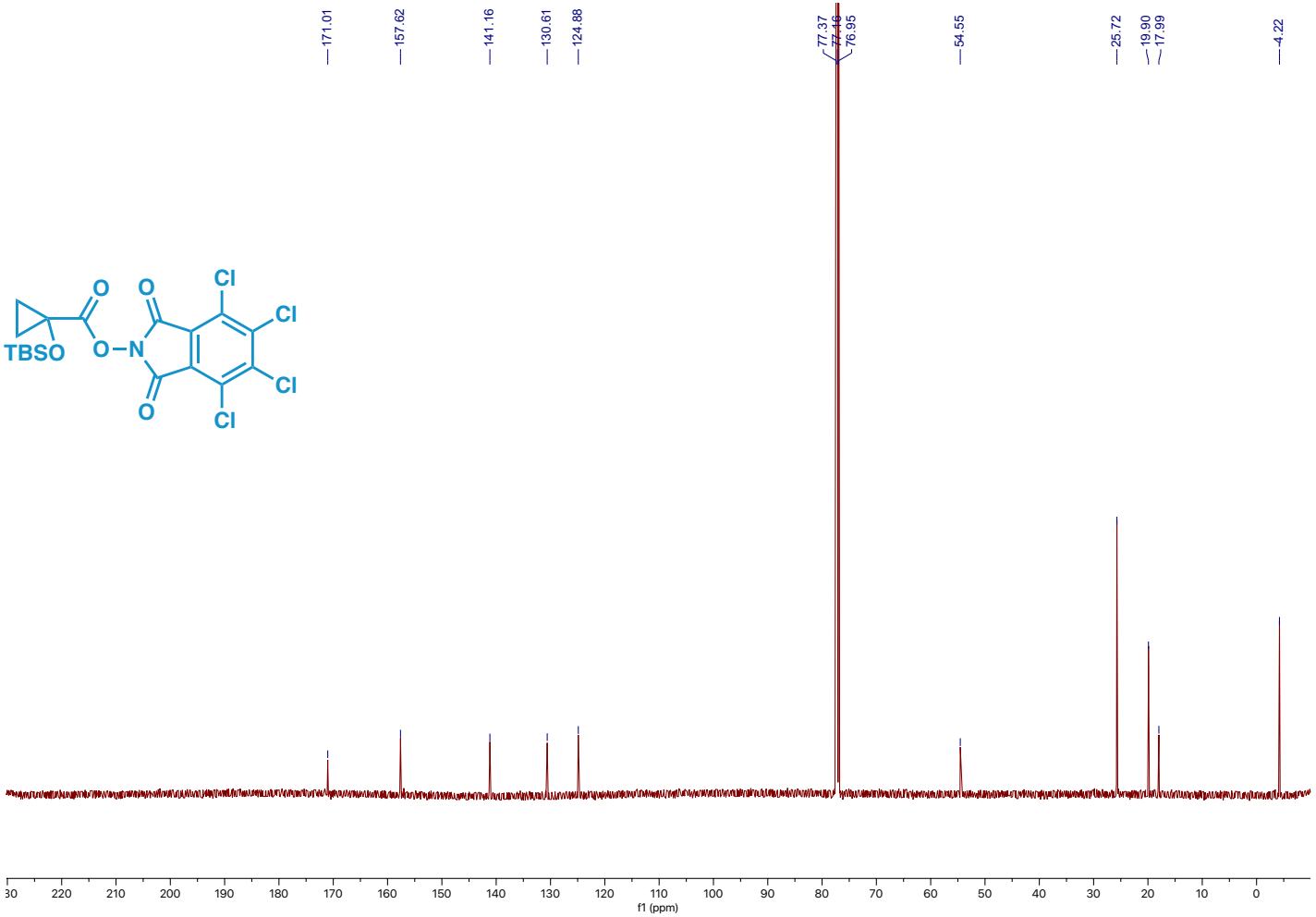
Compound SI-7 ^{13}C NMR



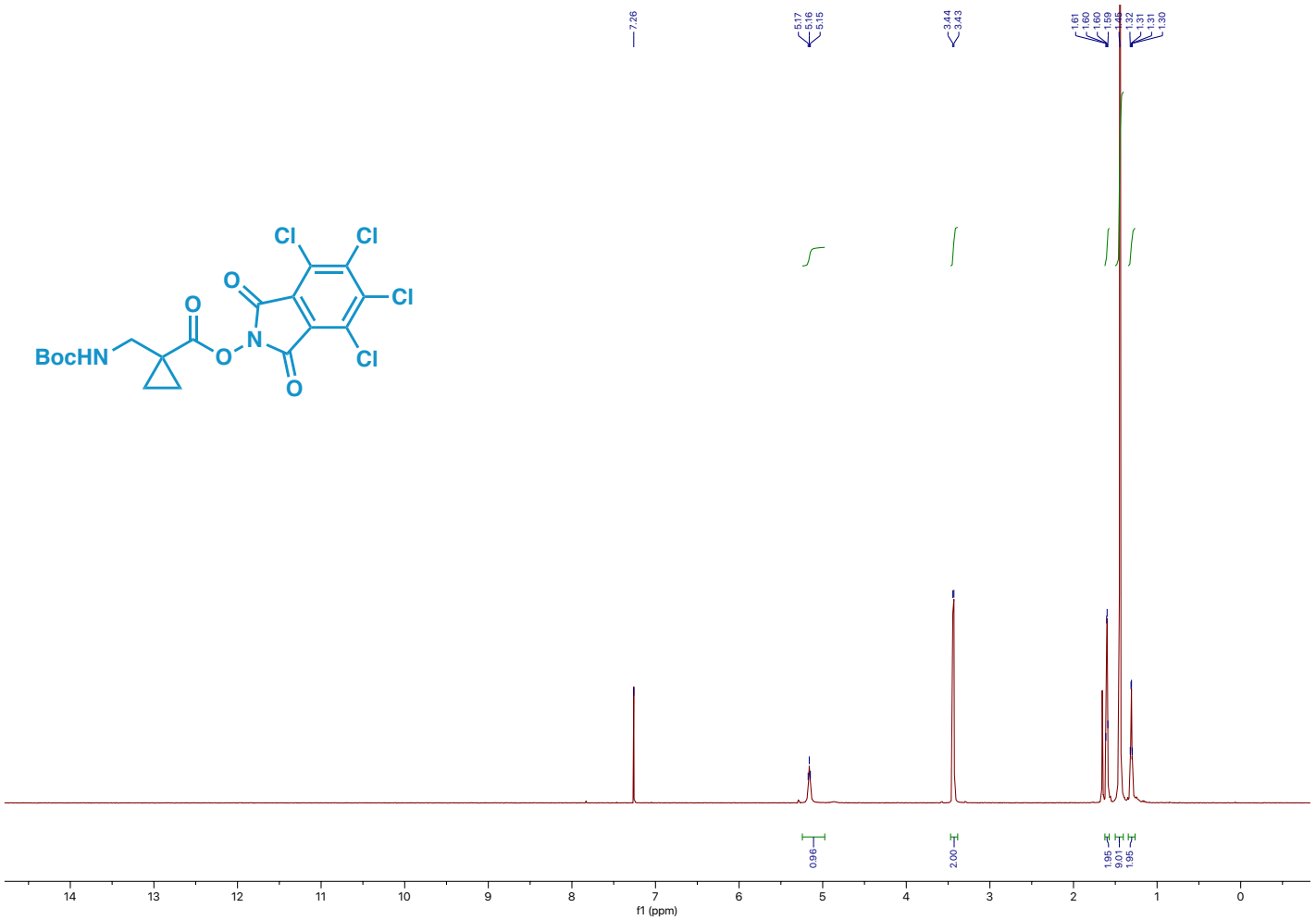
Compound SI-8 ^{1}H NMR



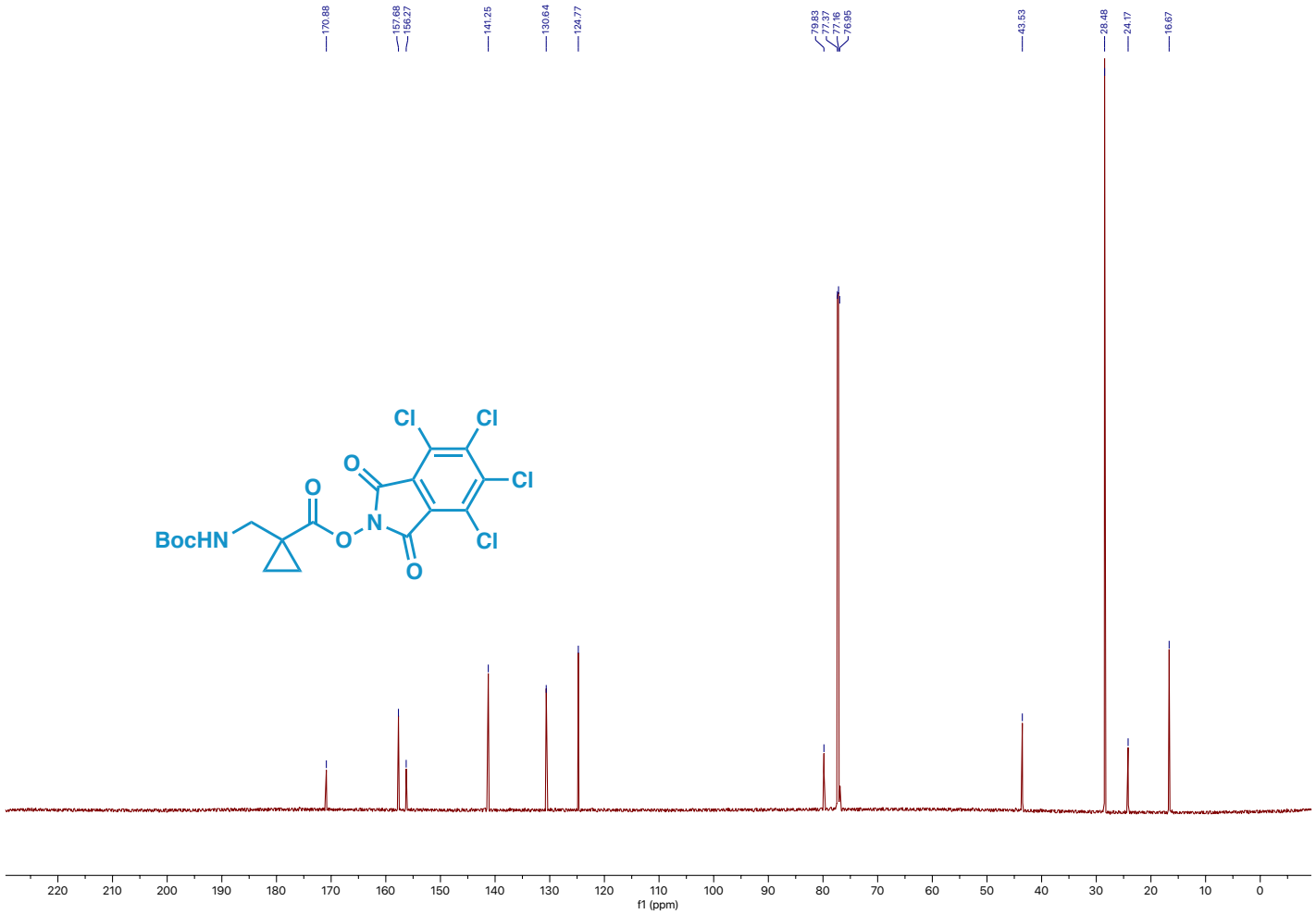
Compound SI-8 ^{13}C NMR



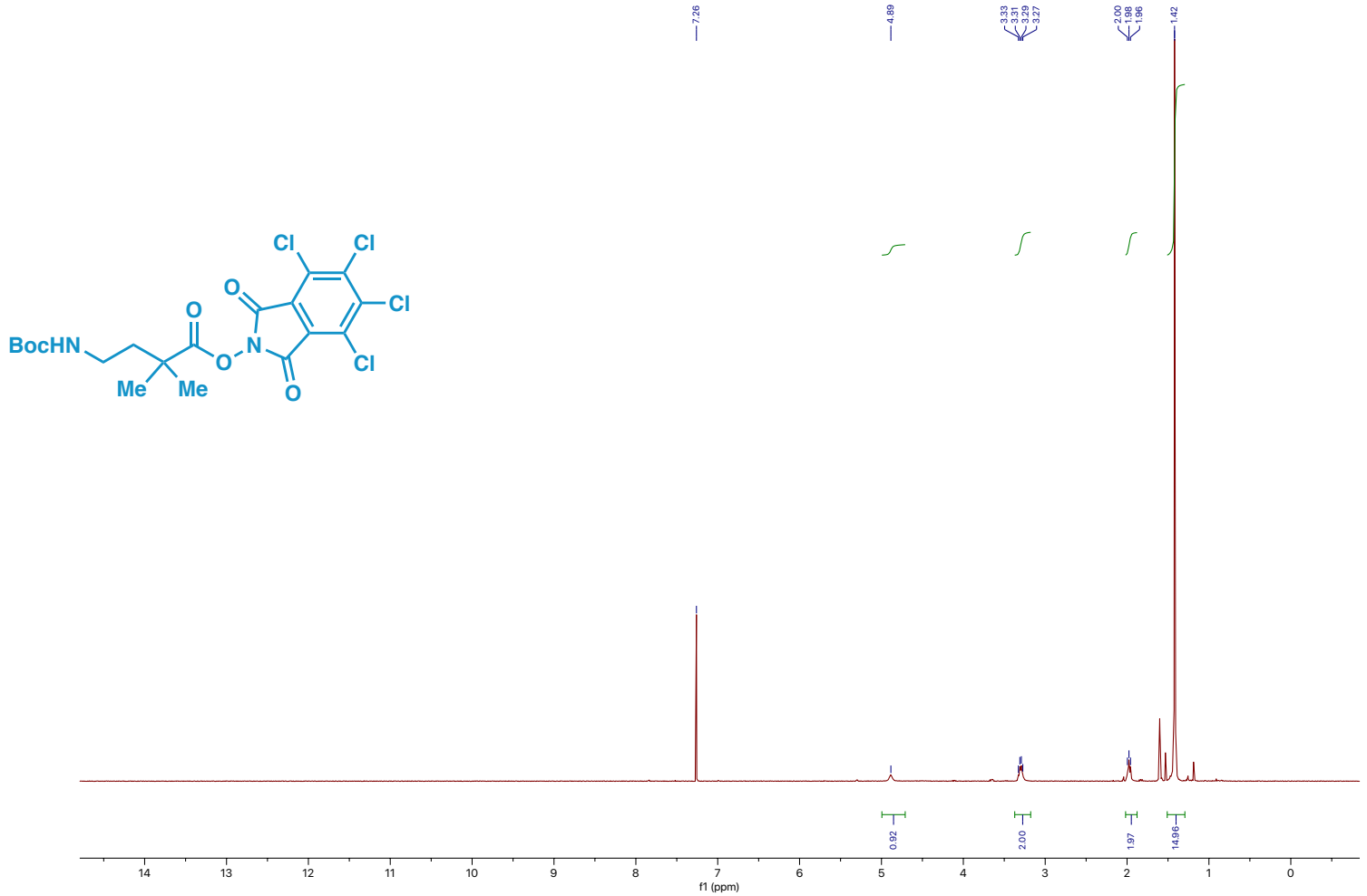
Compound SI-9 ^{1}H NMR



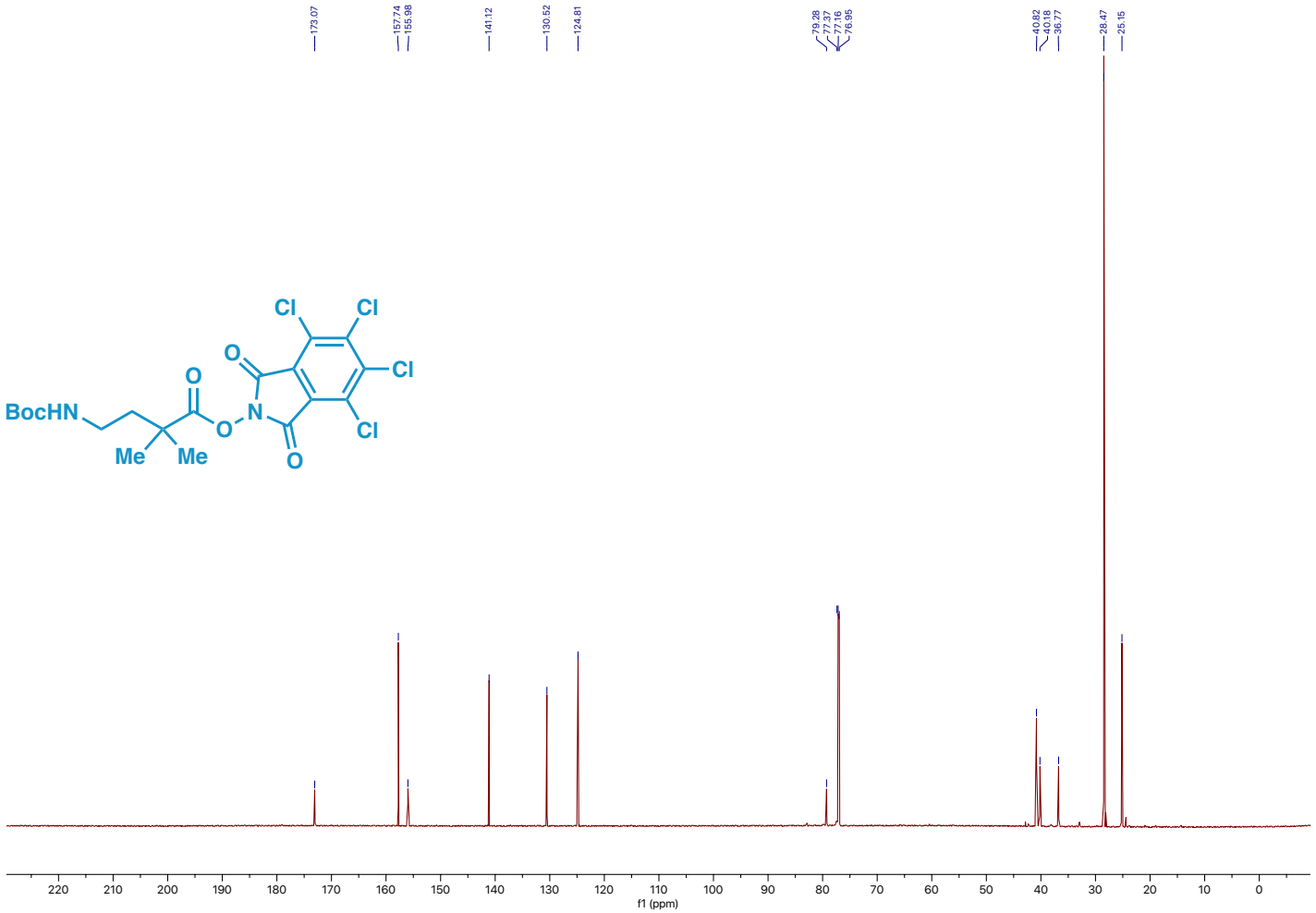
Compound SI-9 ^{13}C NMR



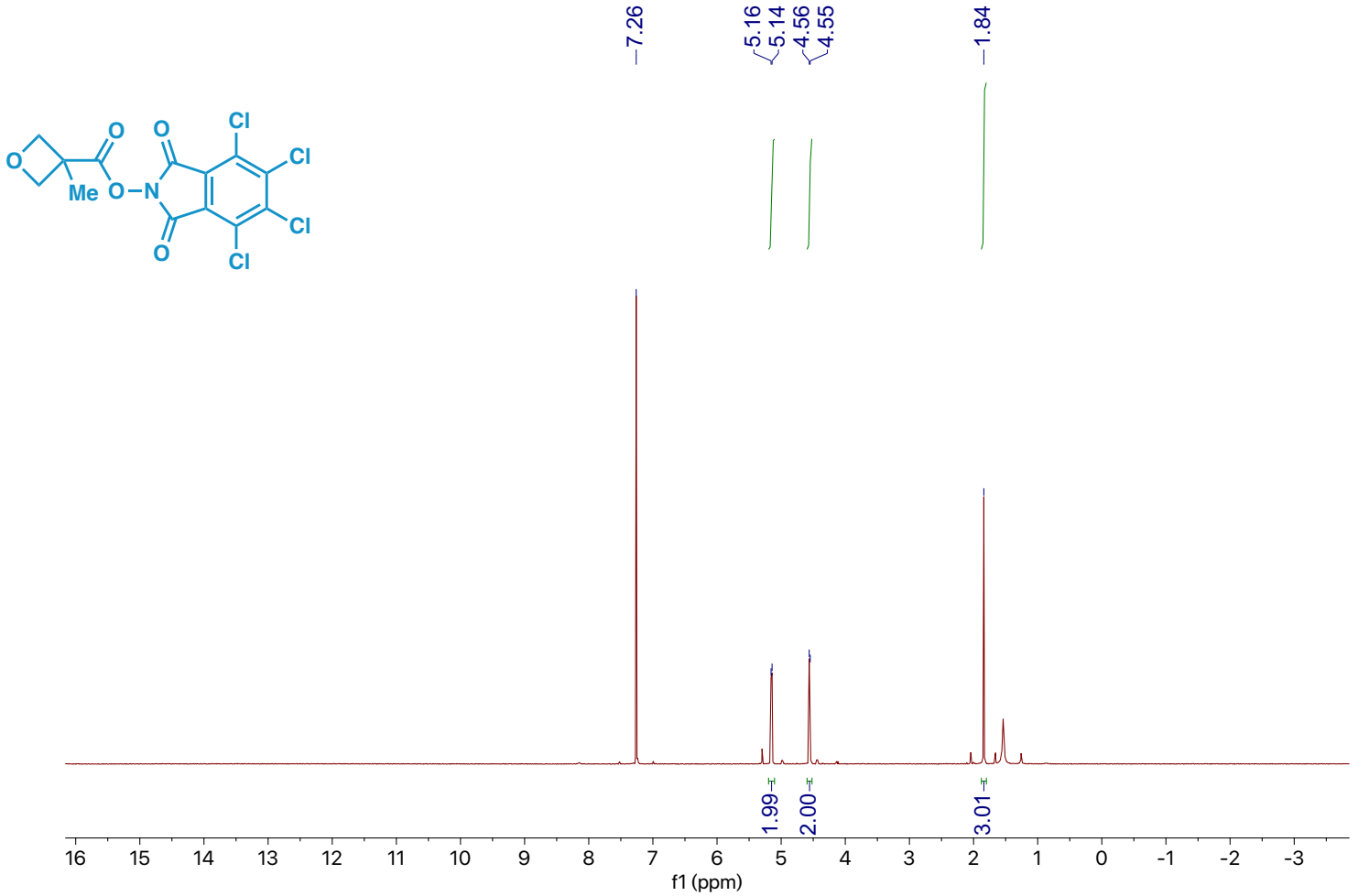
Compound SI-10 ^{1}H NMR



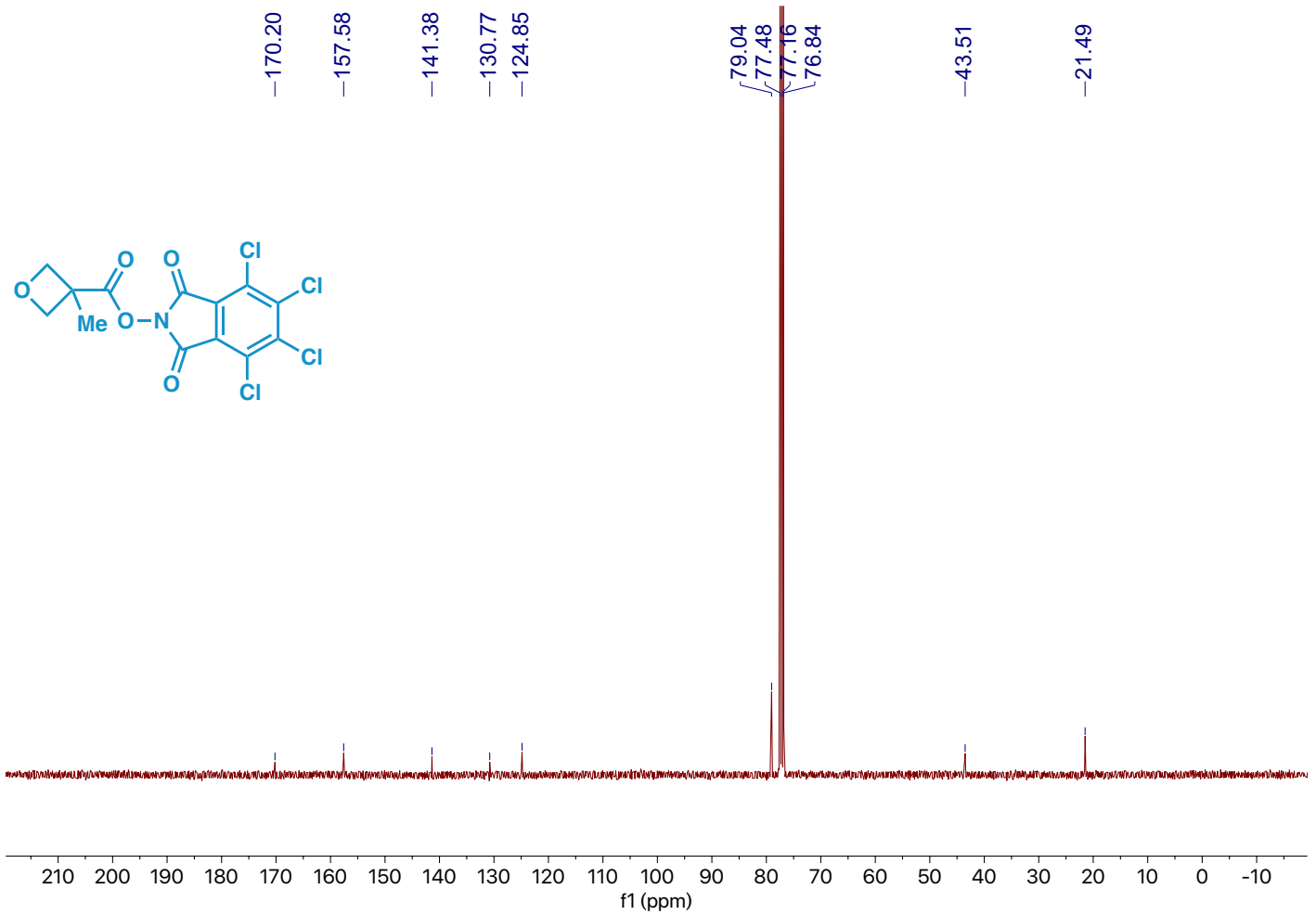
Compound SI-10 ^{13}C NMR



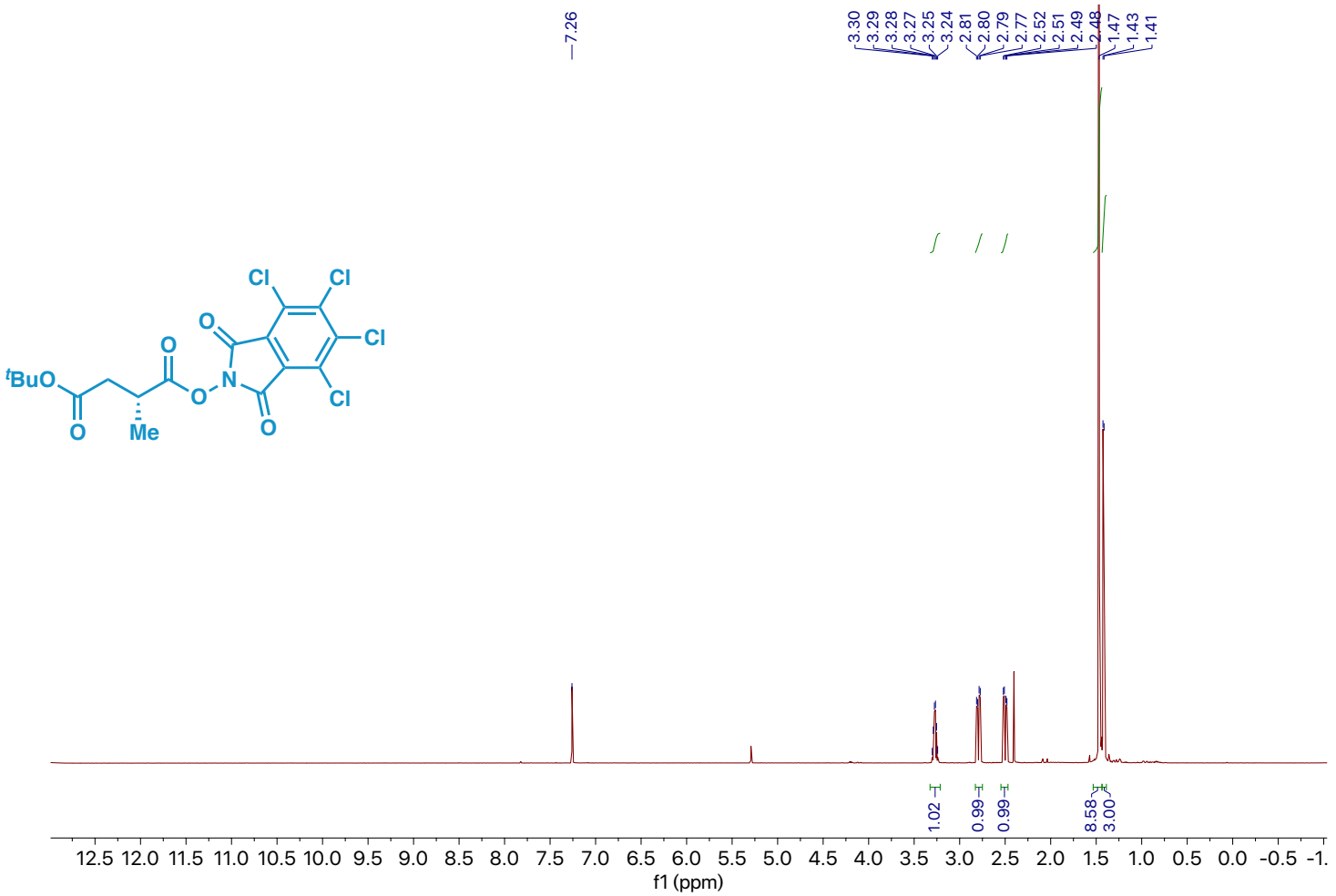
Compound SI-11 ^{1}H NMR



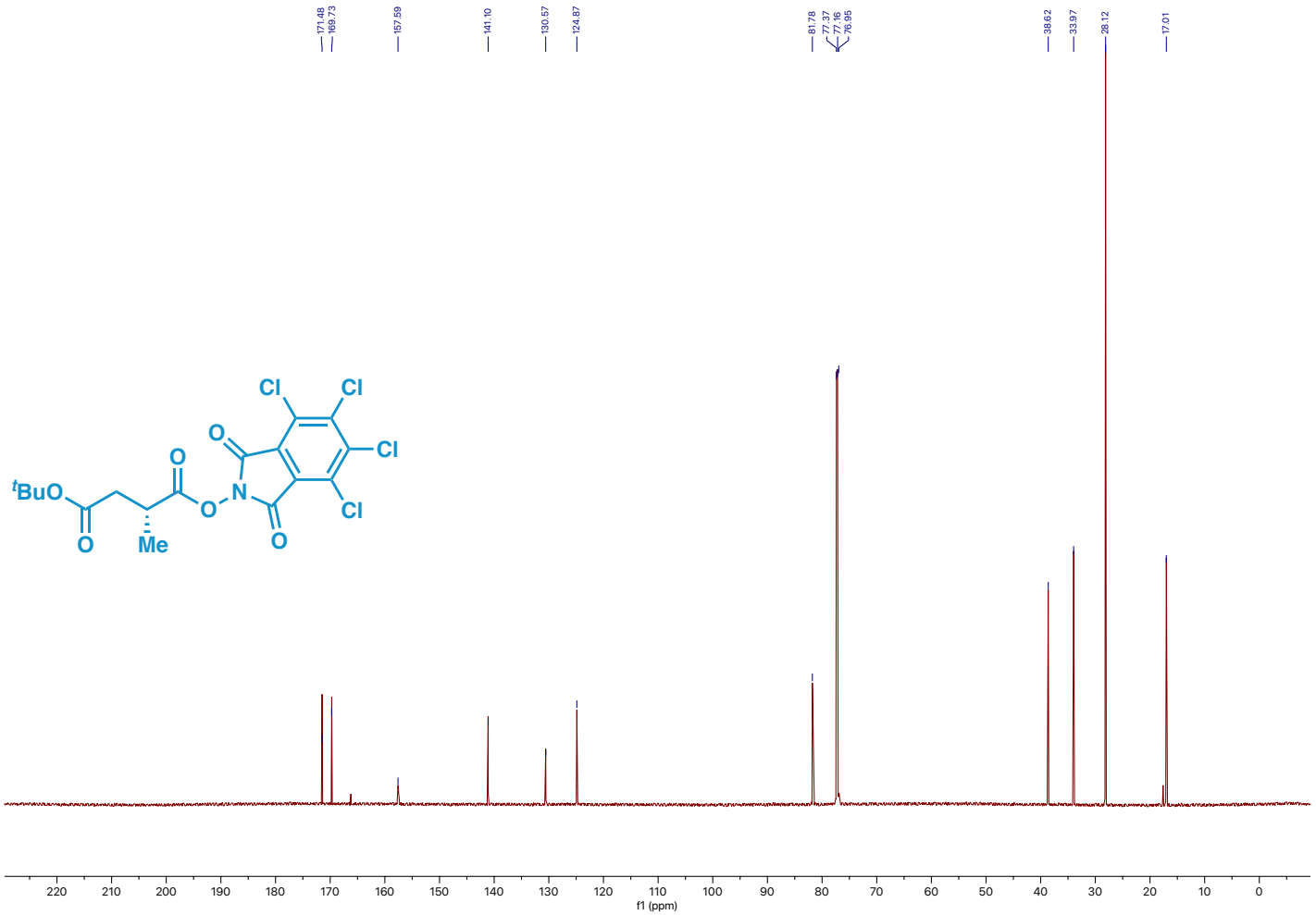
Compound SI-11 ^{13}C NMR



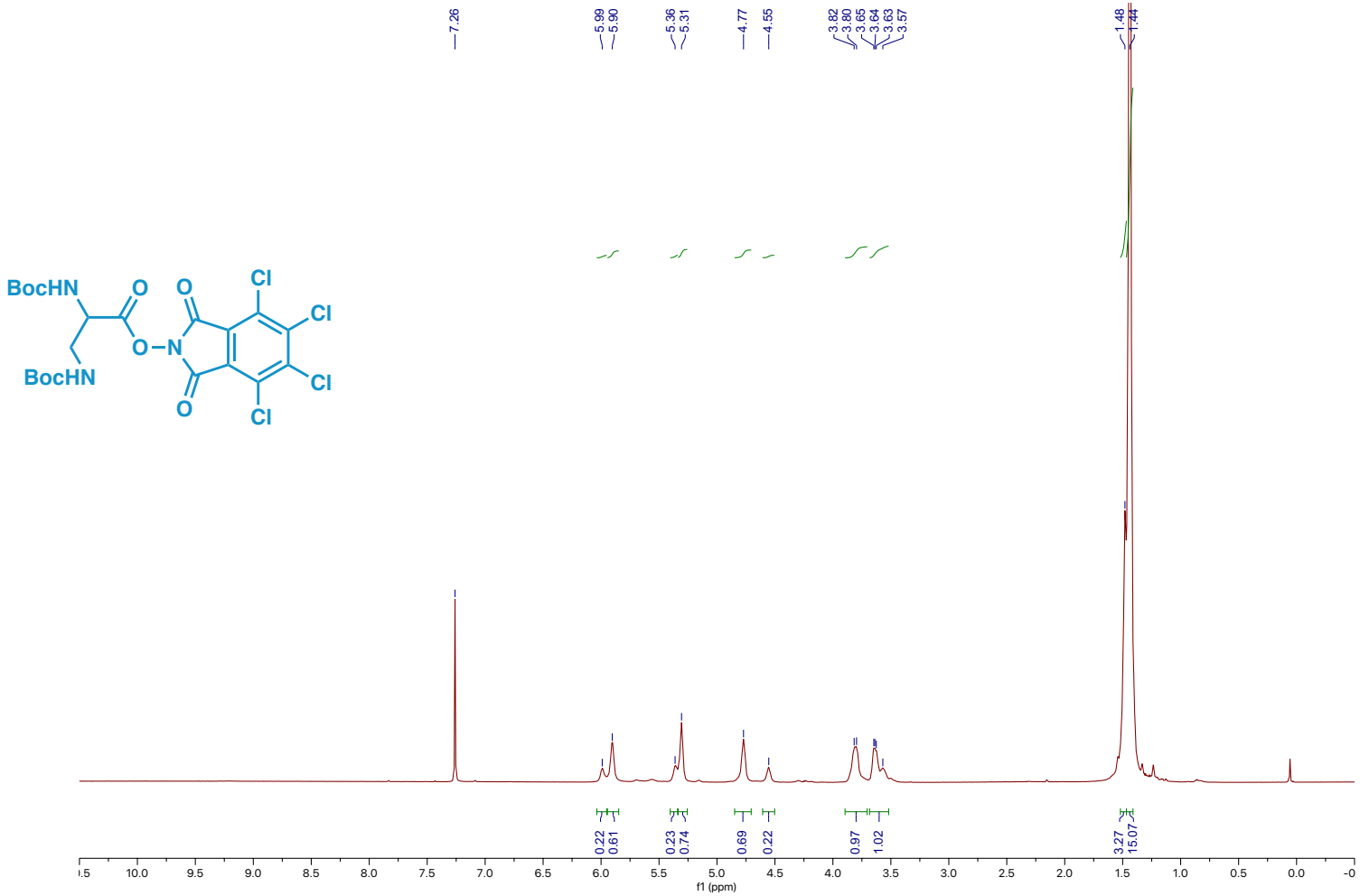
Compound SI-12 ^{1}H NMR



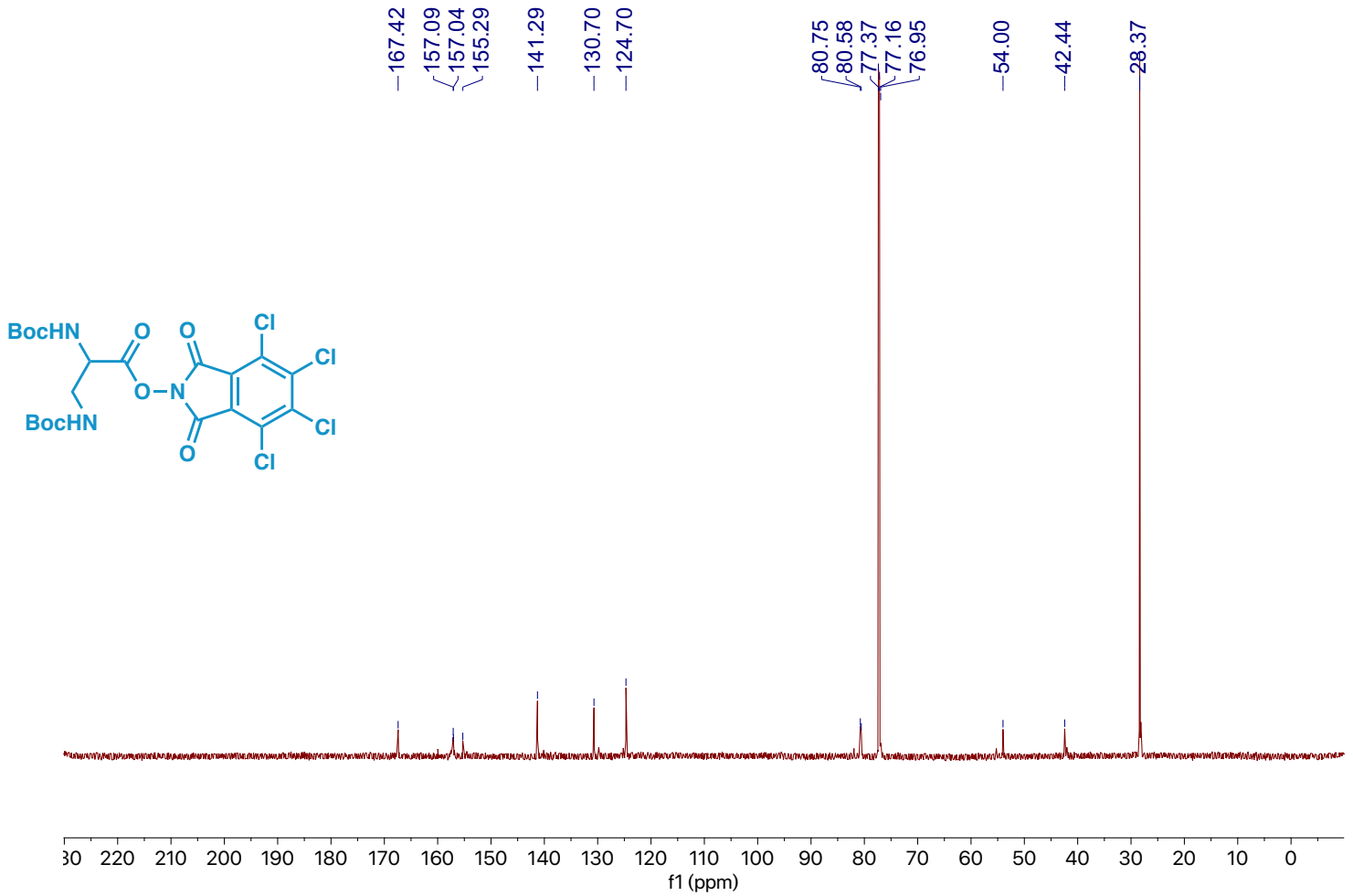
Compound SI-12 ^{13}C NMR



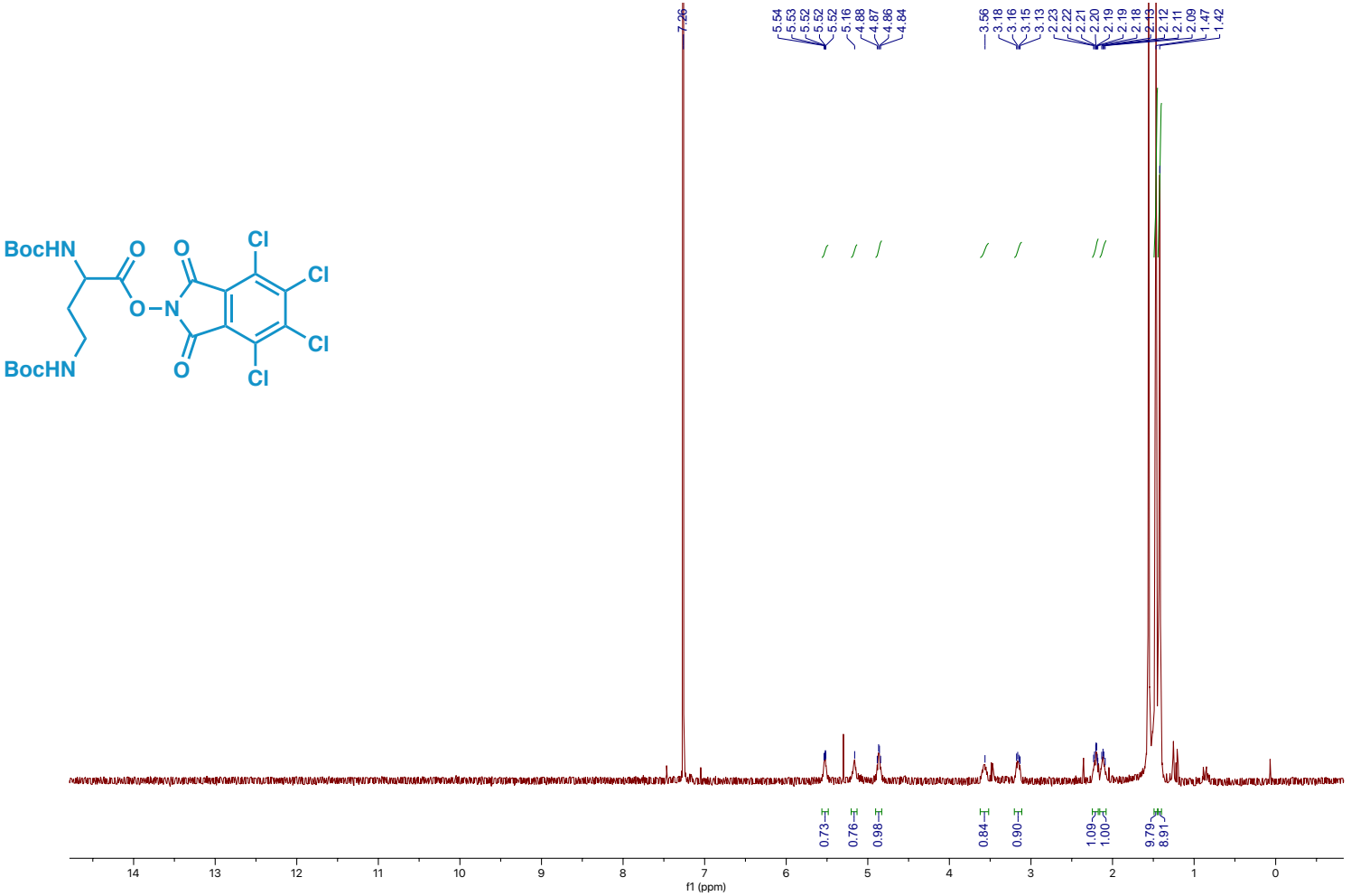
Compound SI-13 ^{1}H NMR



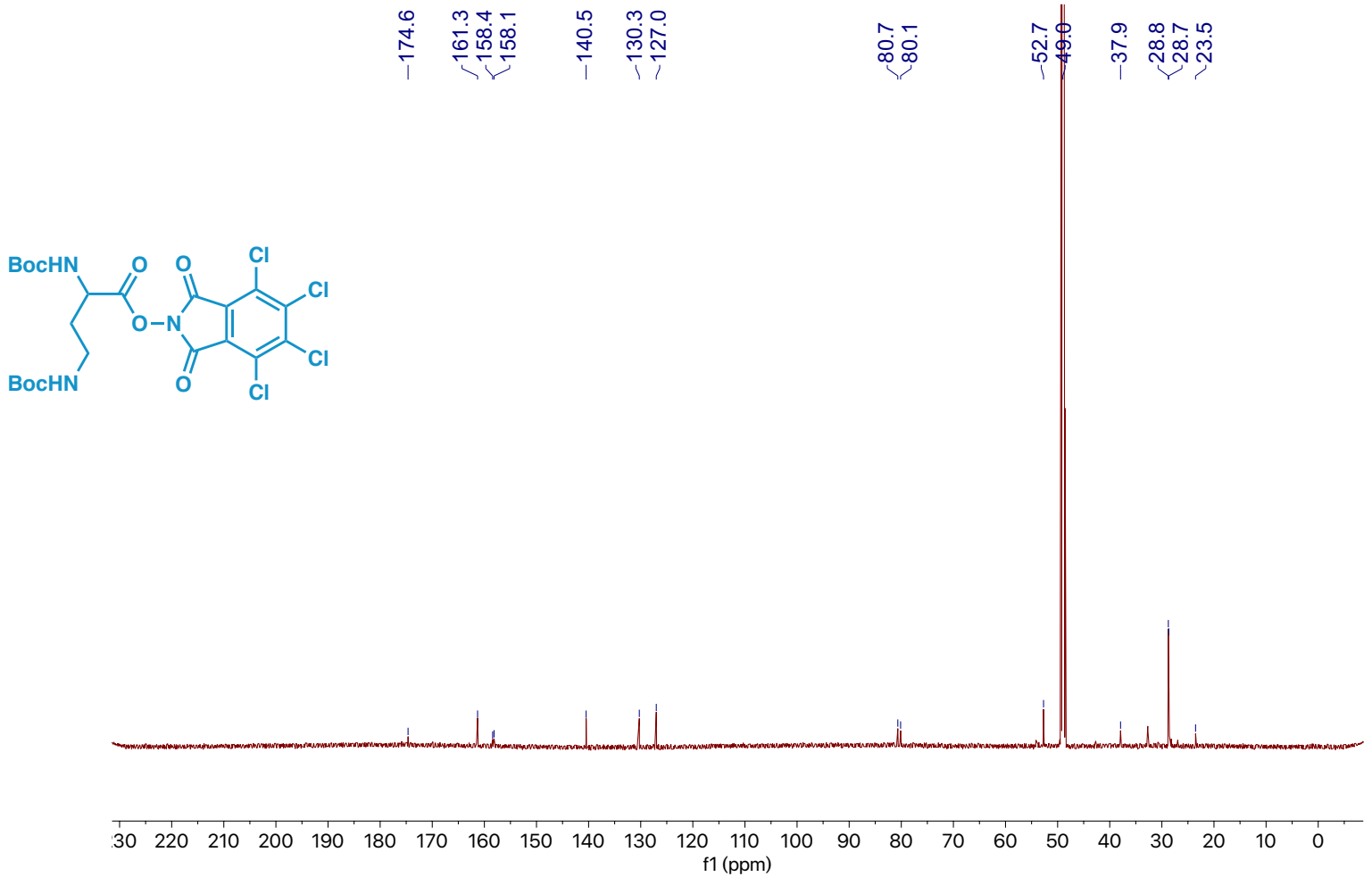
Compound SI-13 ^{13}C NMR



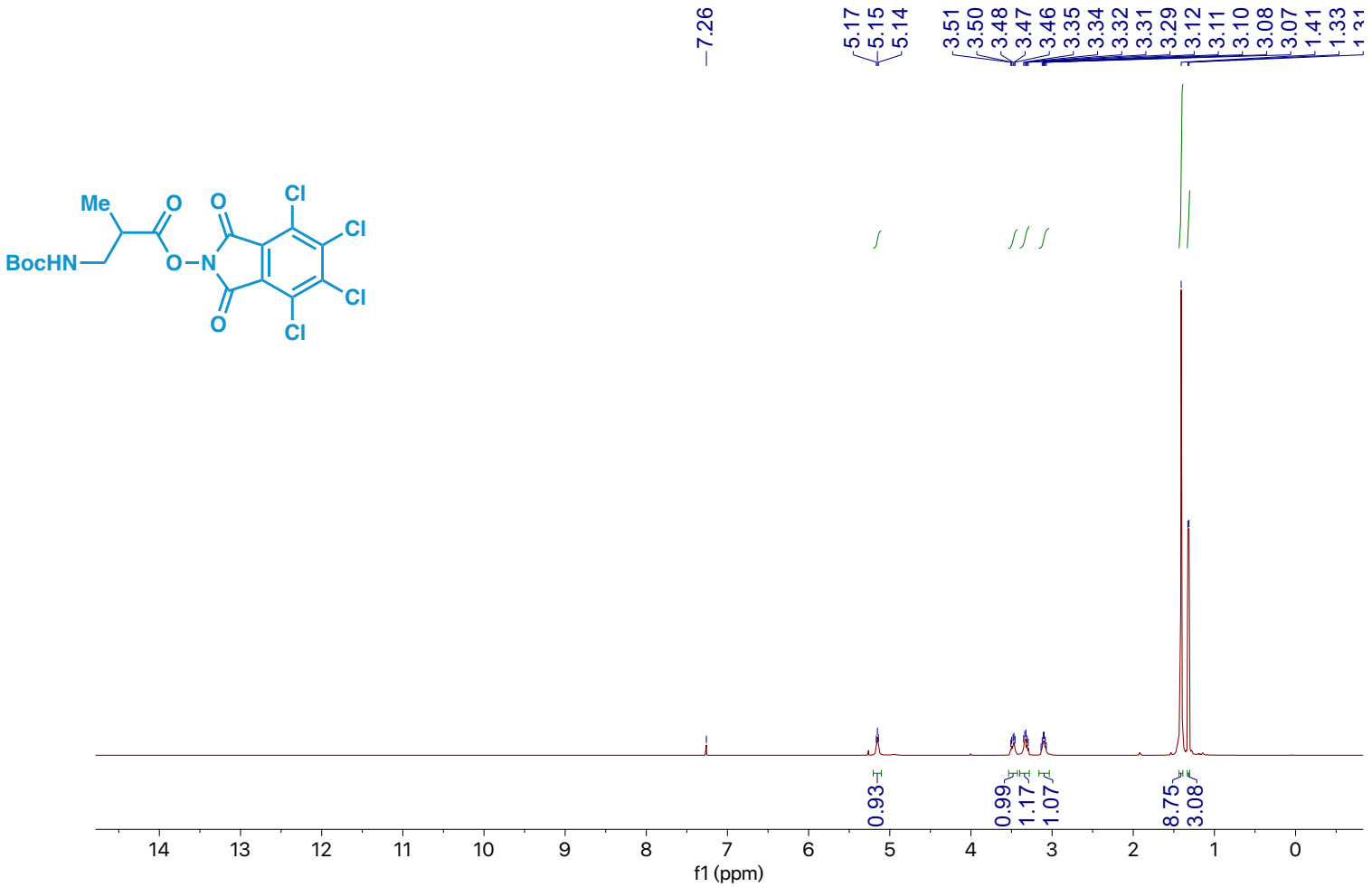
Compound SI-14 ^{1}H NMR



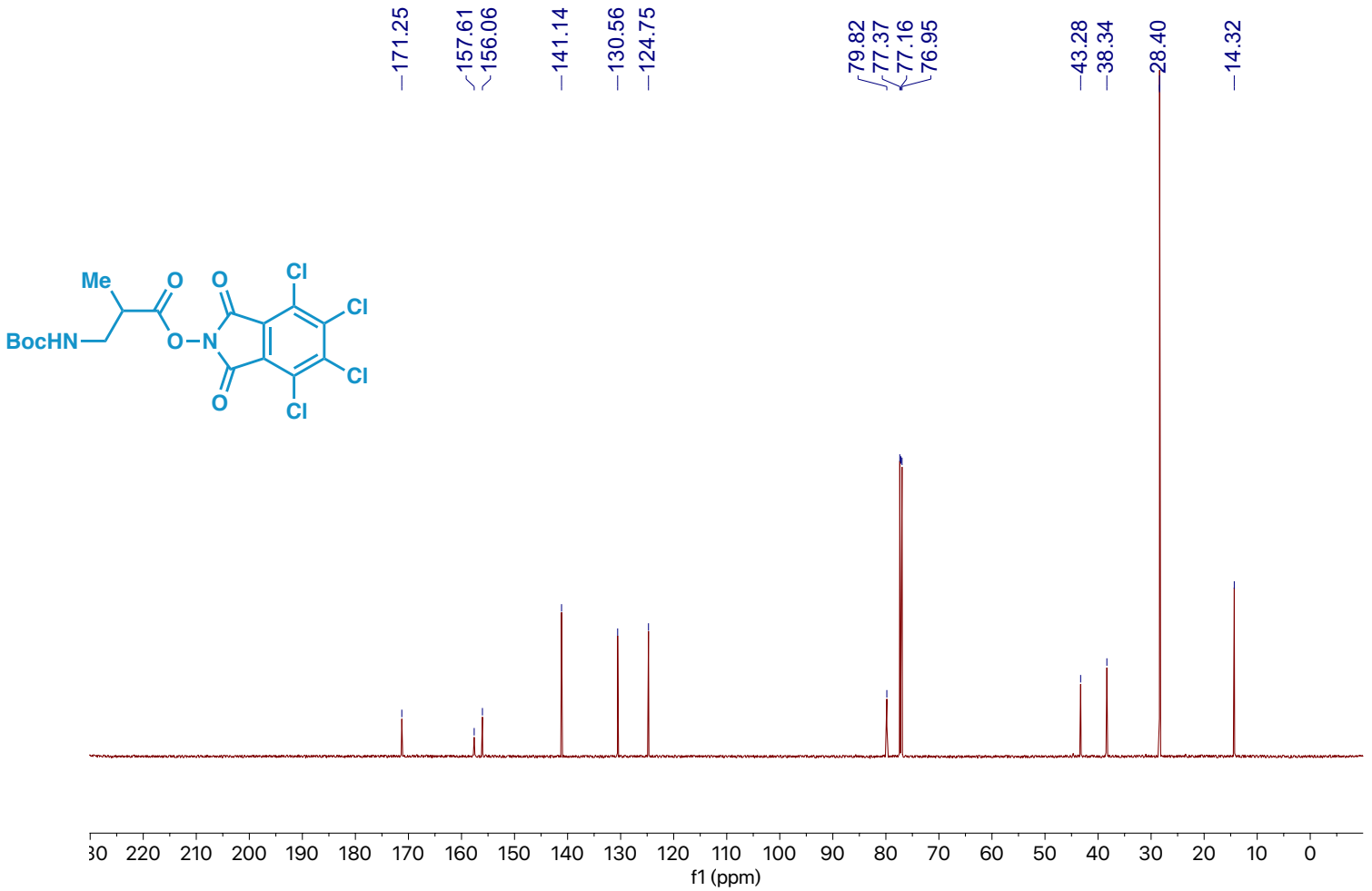
Compound SI-14 ^{13}C NMR



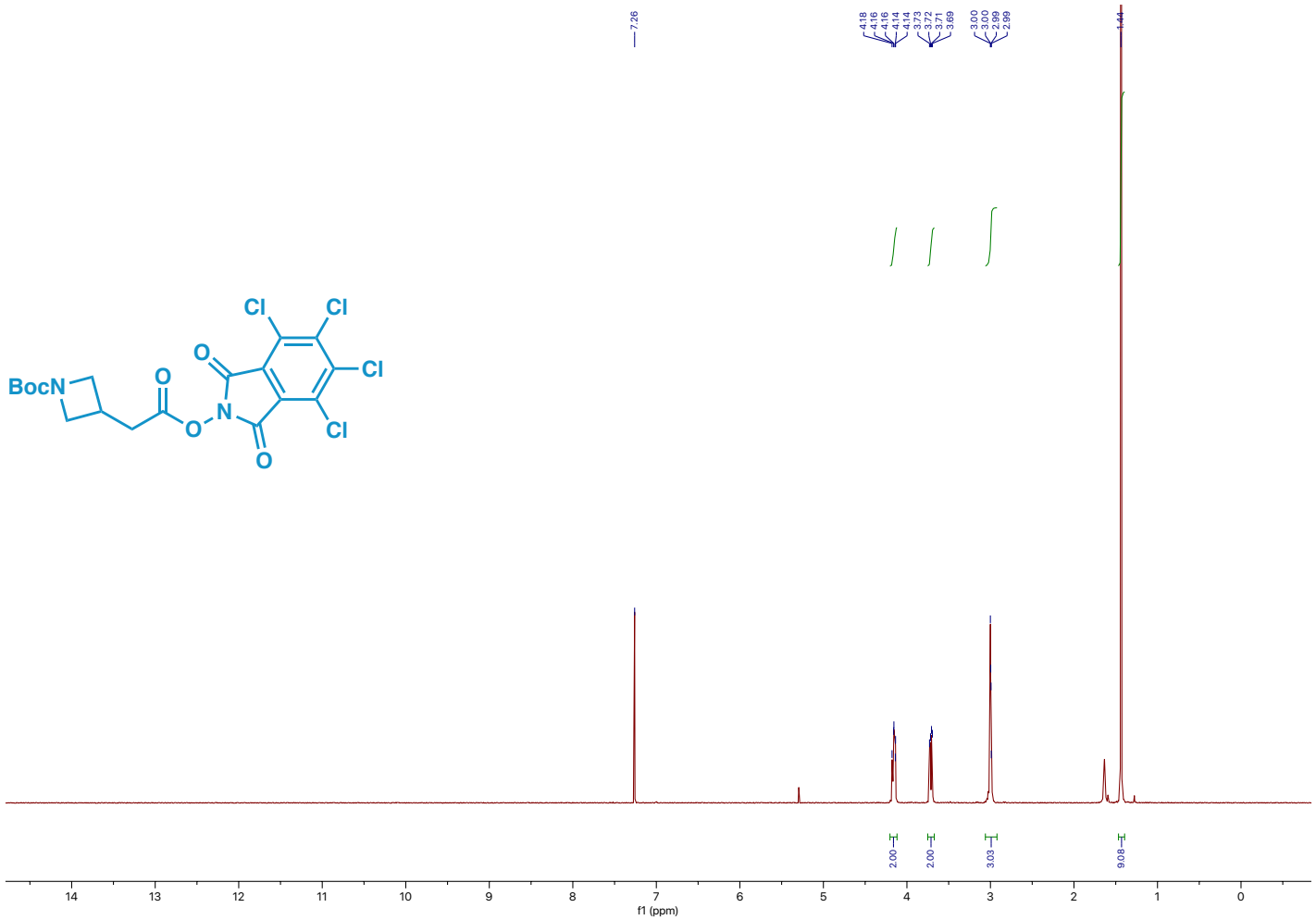
Compound SI-15 ^{1}H NMR



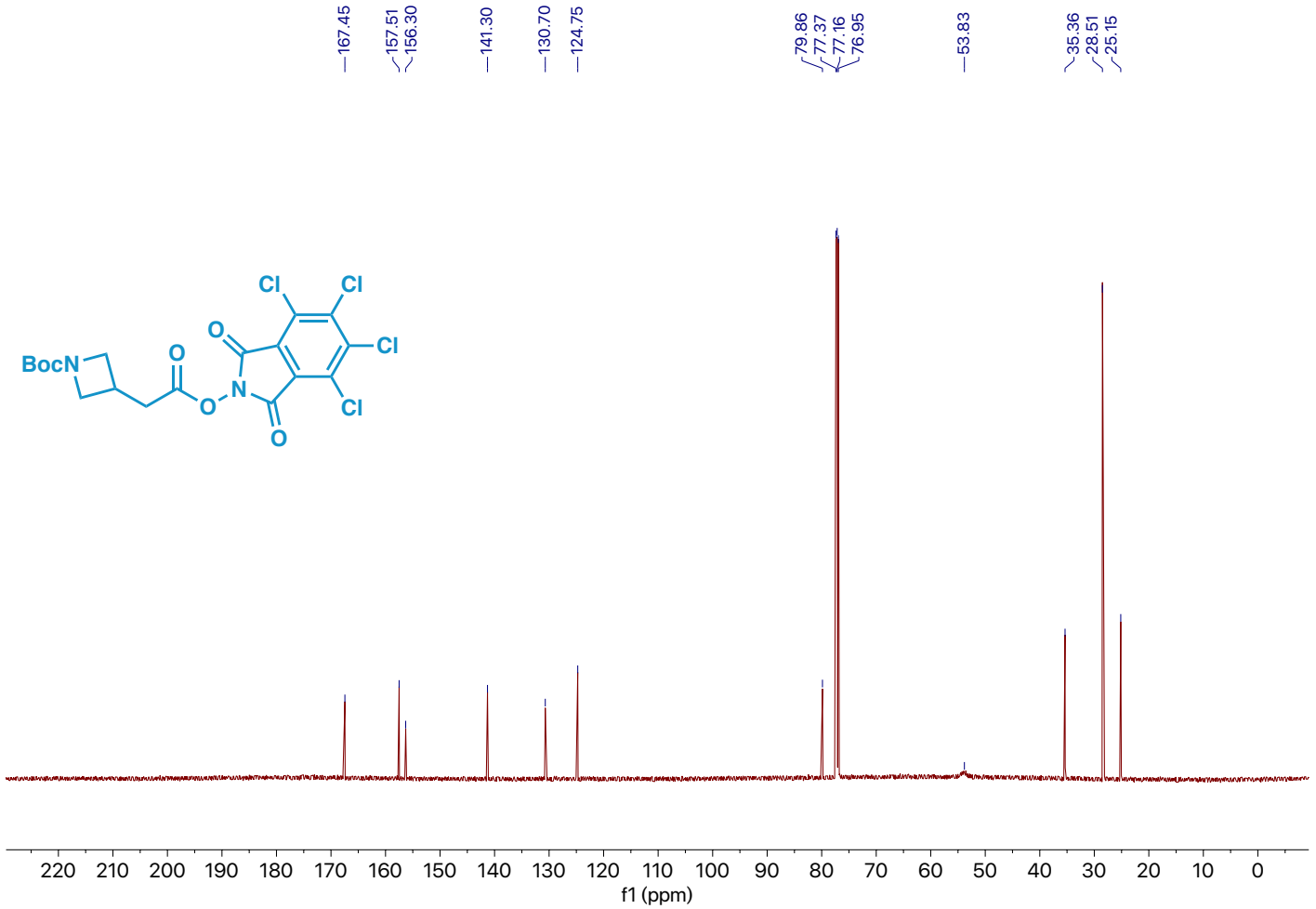
Compound SI-15 ^{13}C NMR



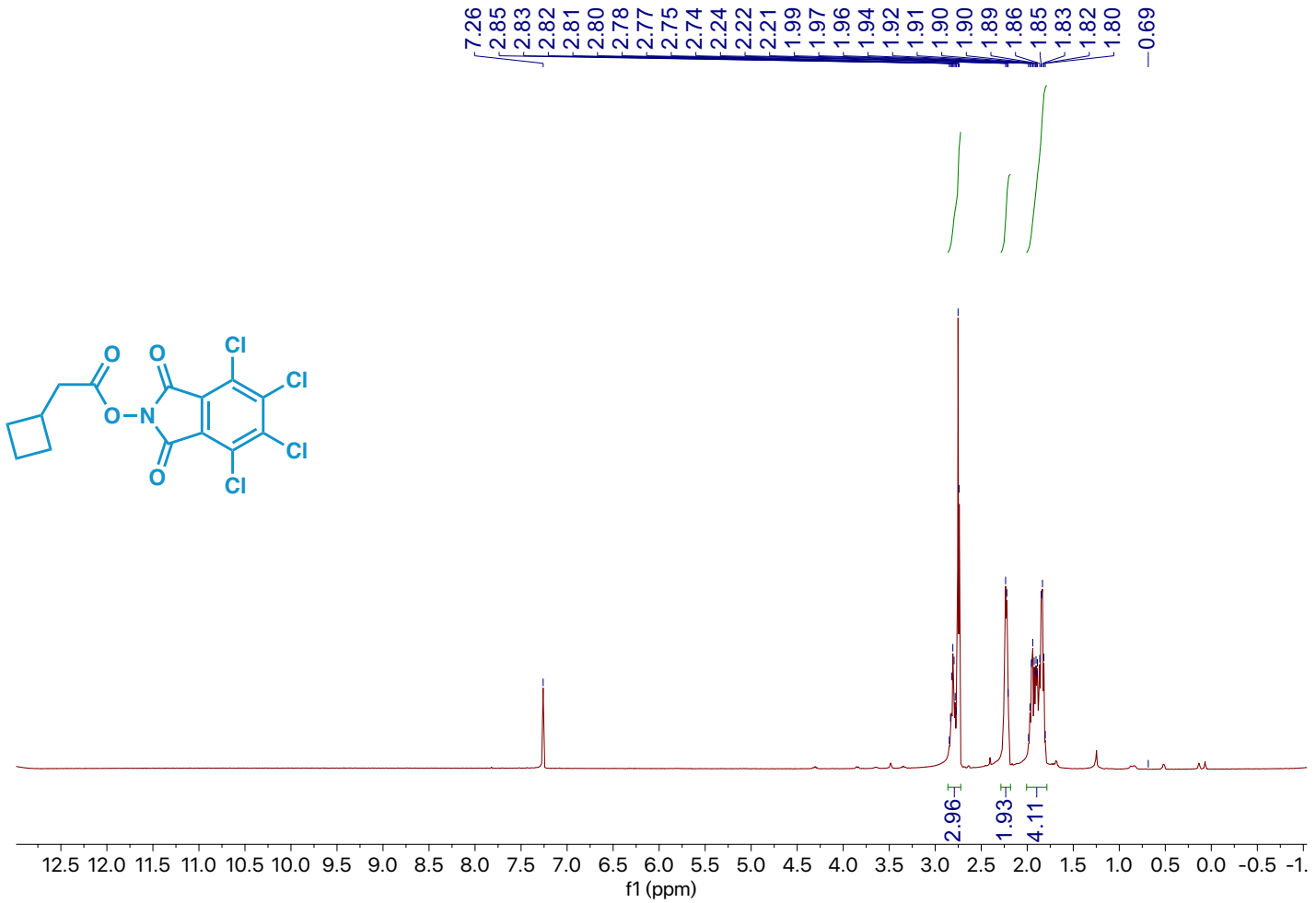
Compound SI-16 ^{1}H NMR



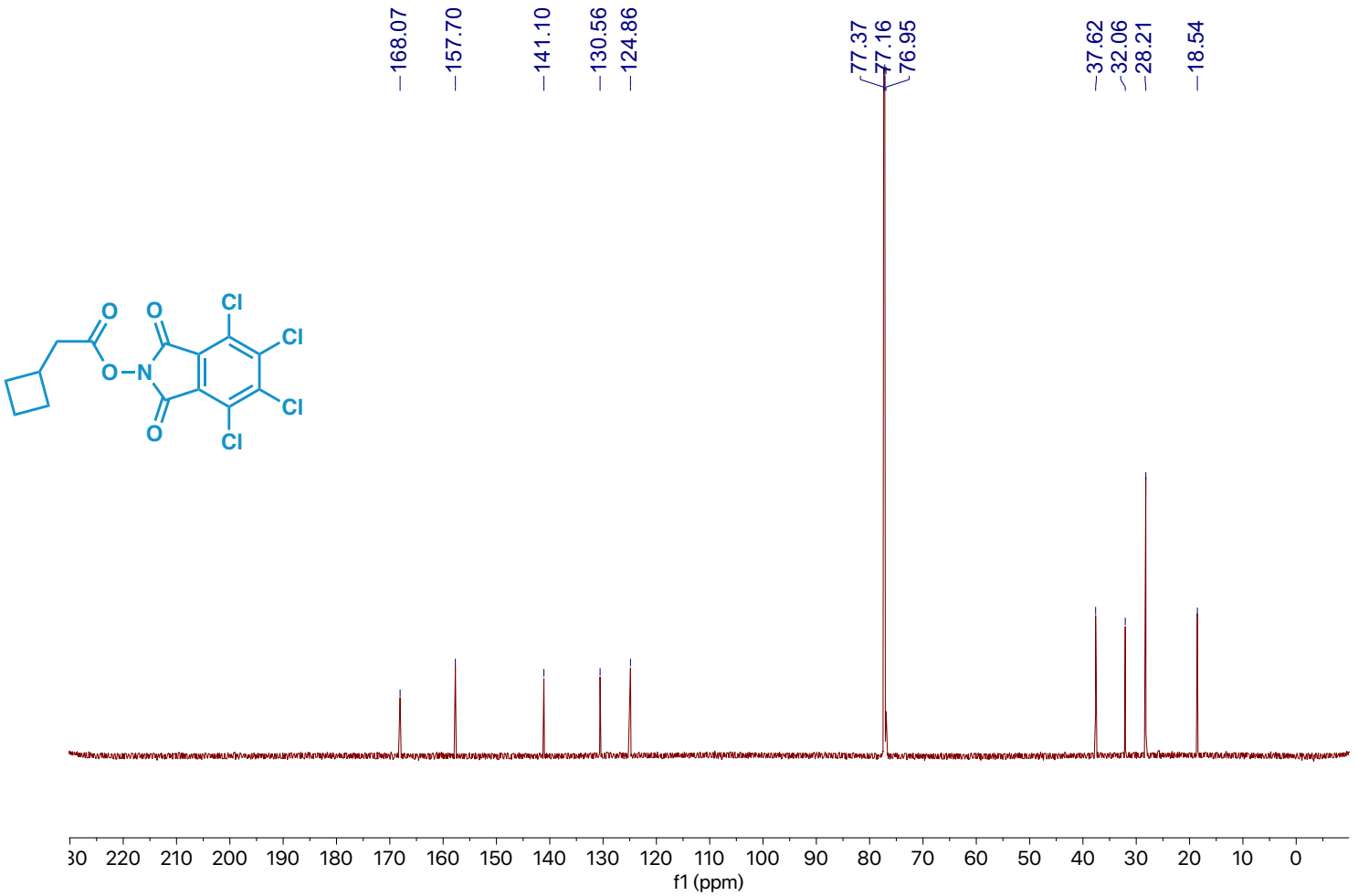
Compound SI-16 ^{13}C NMR



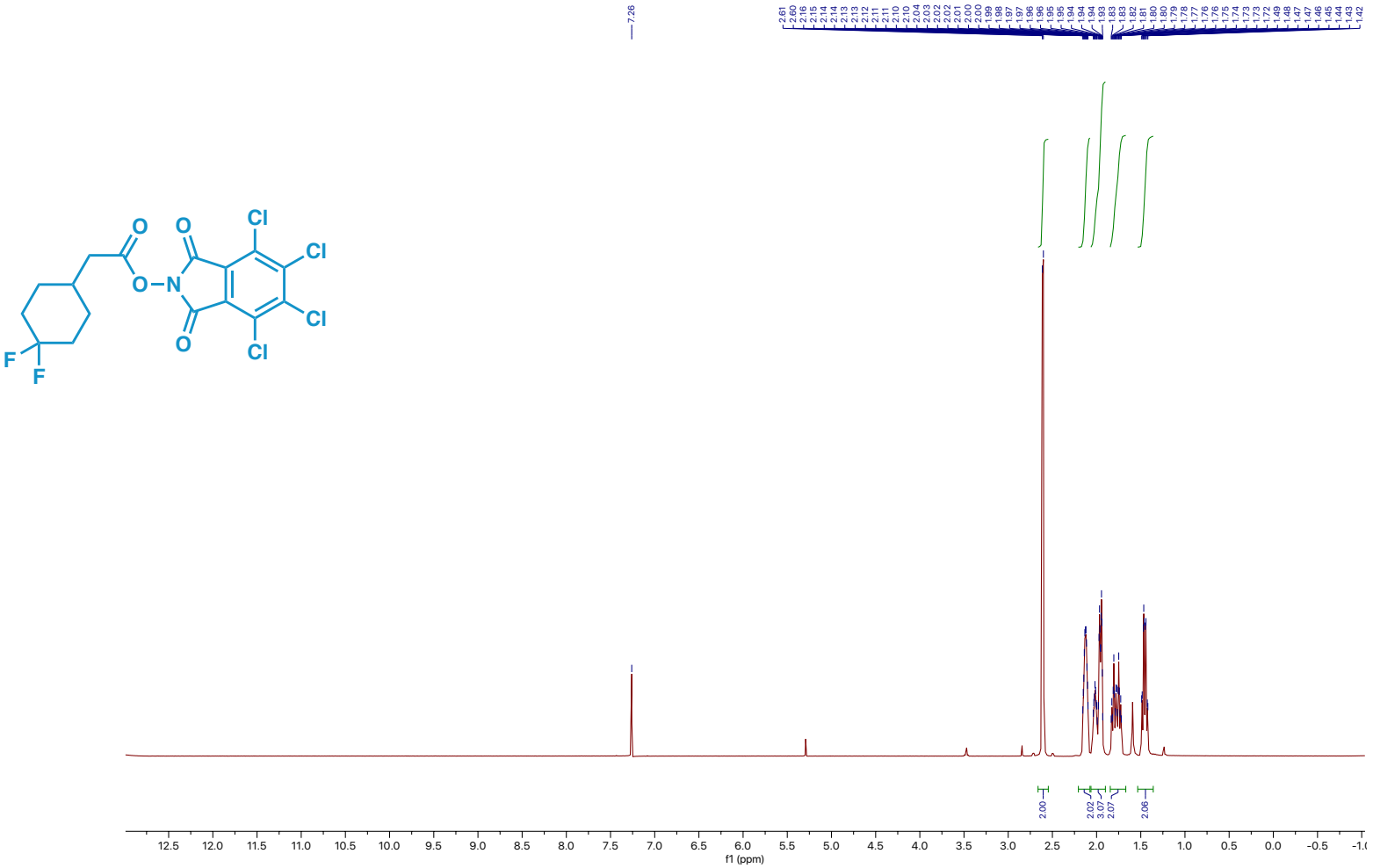
Compound SI-17 ^{1}H NMR



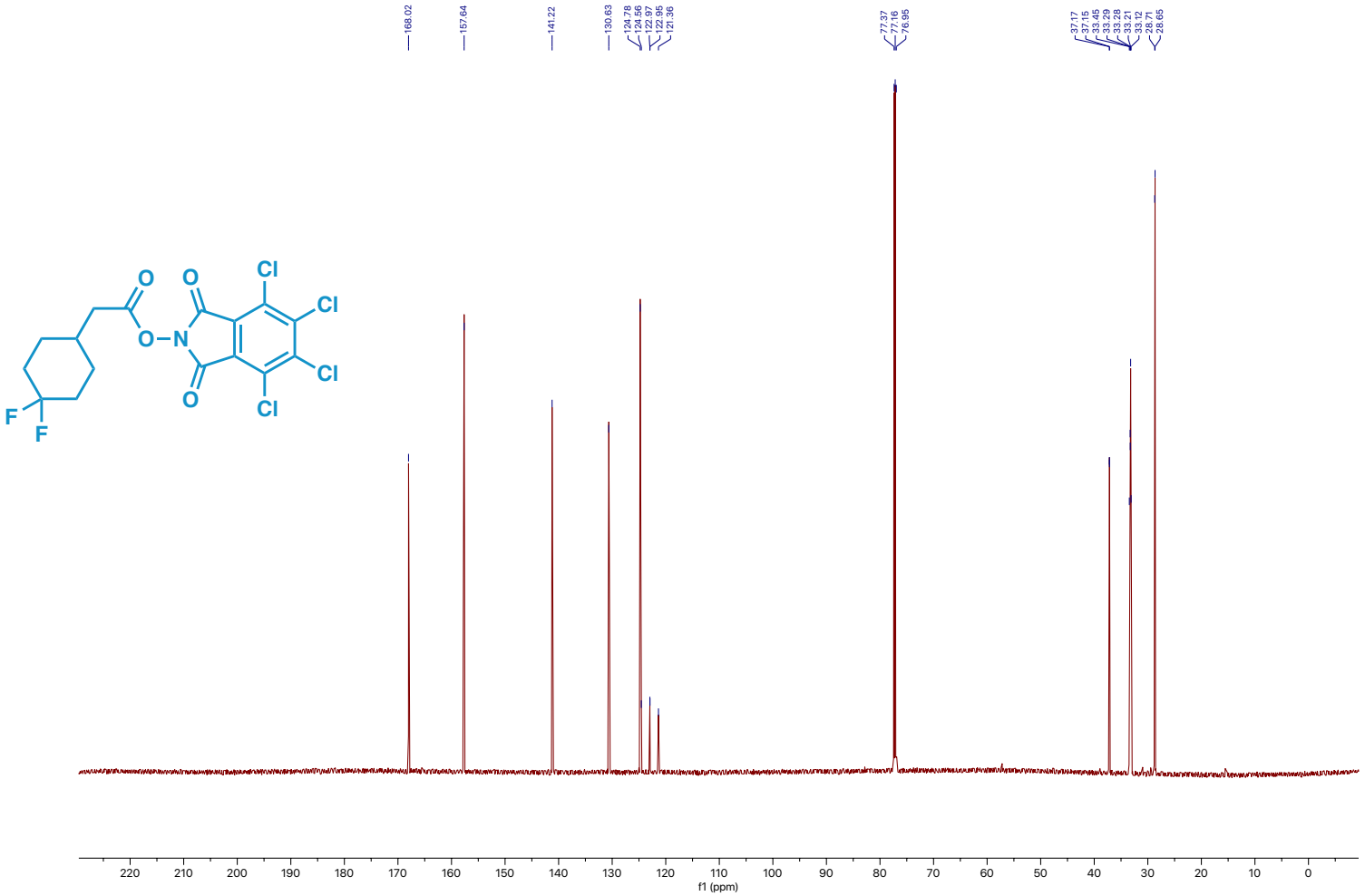
Compound SI-17 ^{13}C NMR



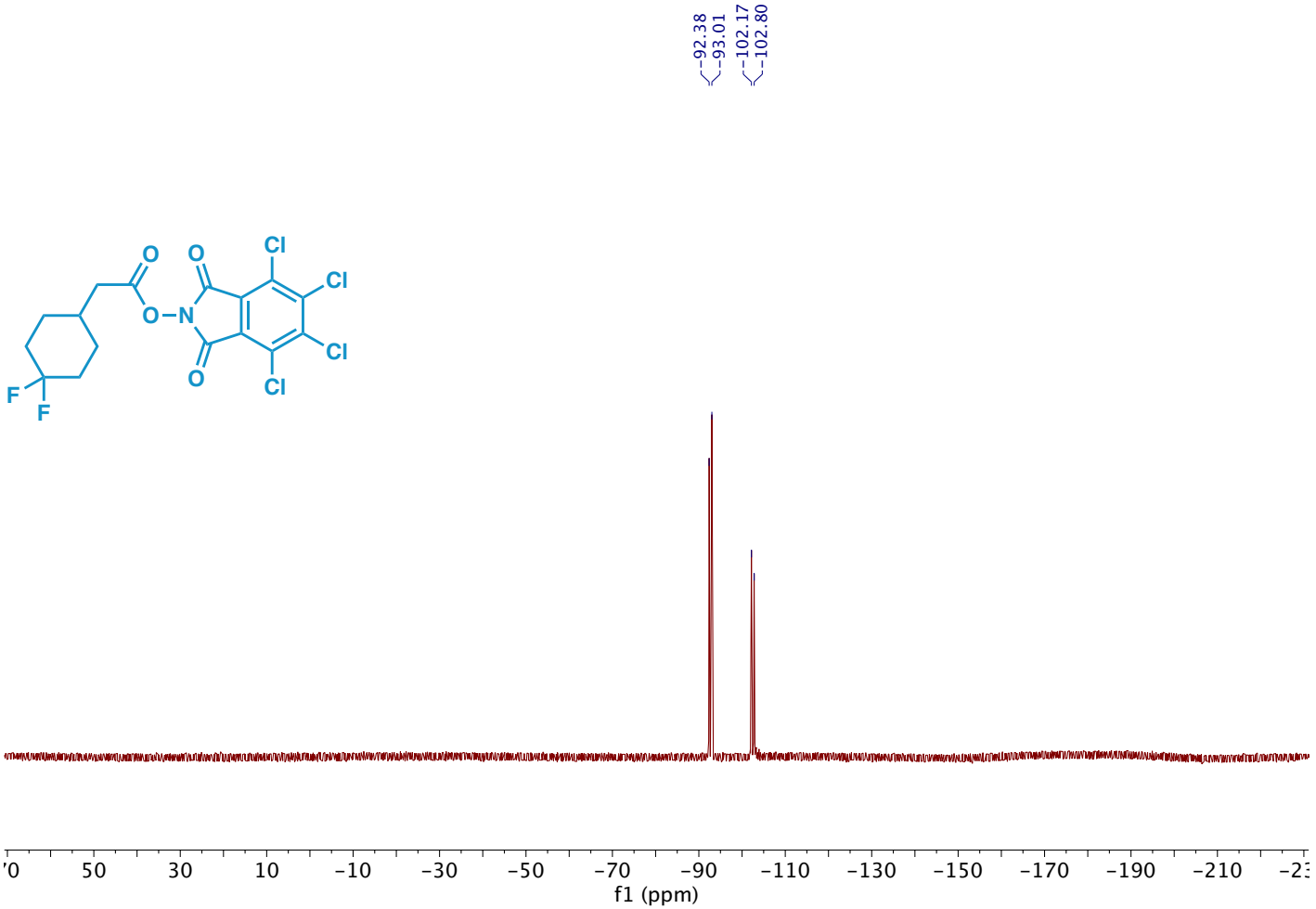
Compound SI-18 ^{1}H NMR



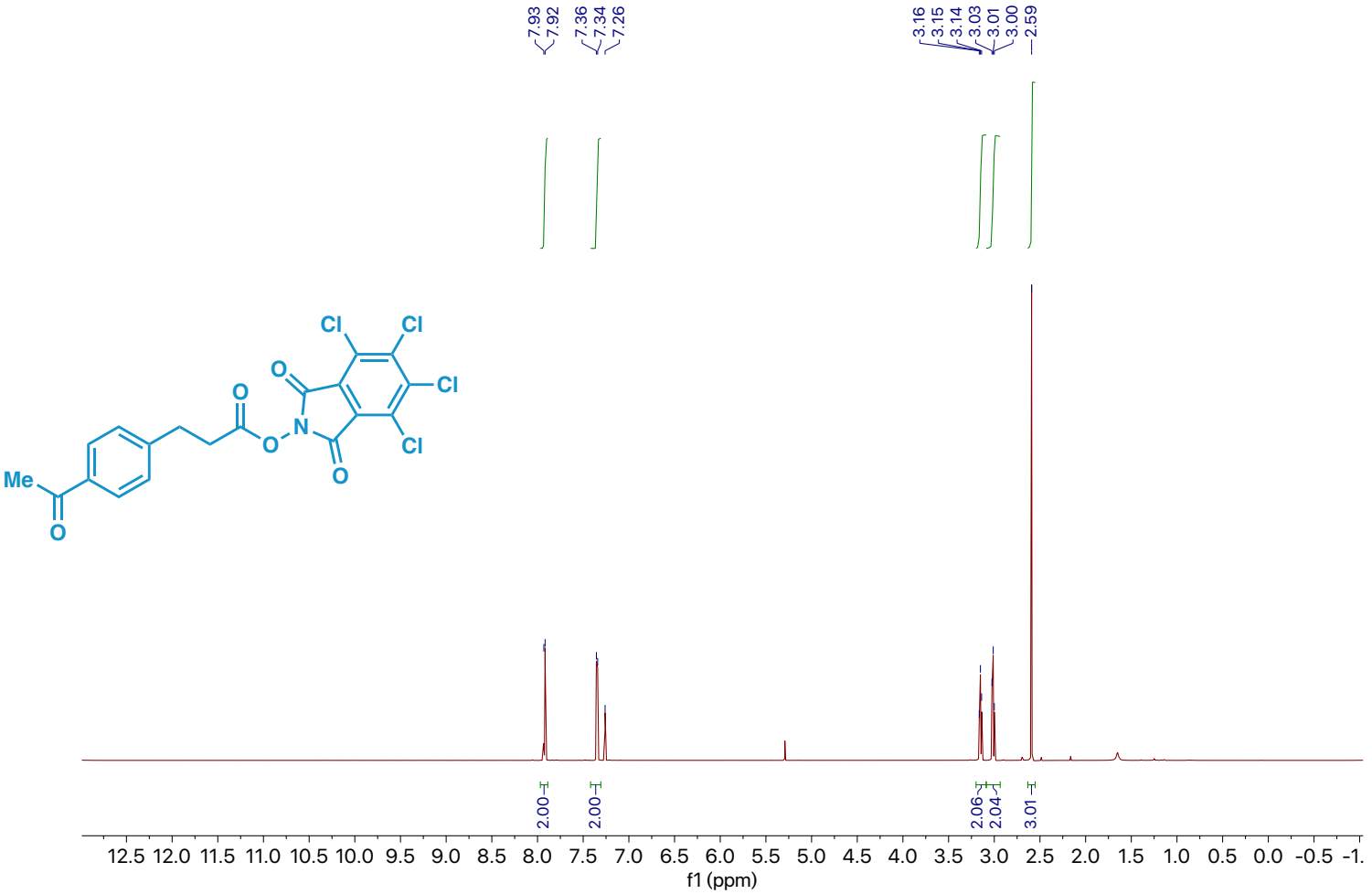
Compound SI-18 ^{13}C NMR



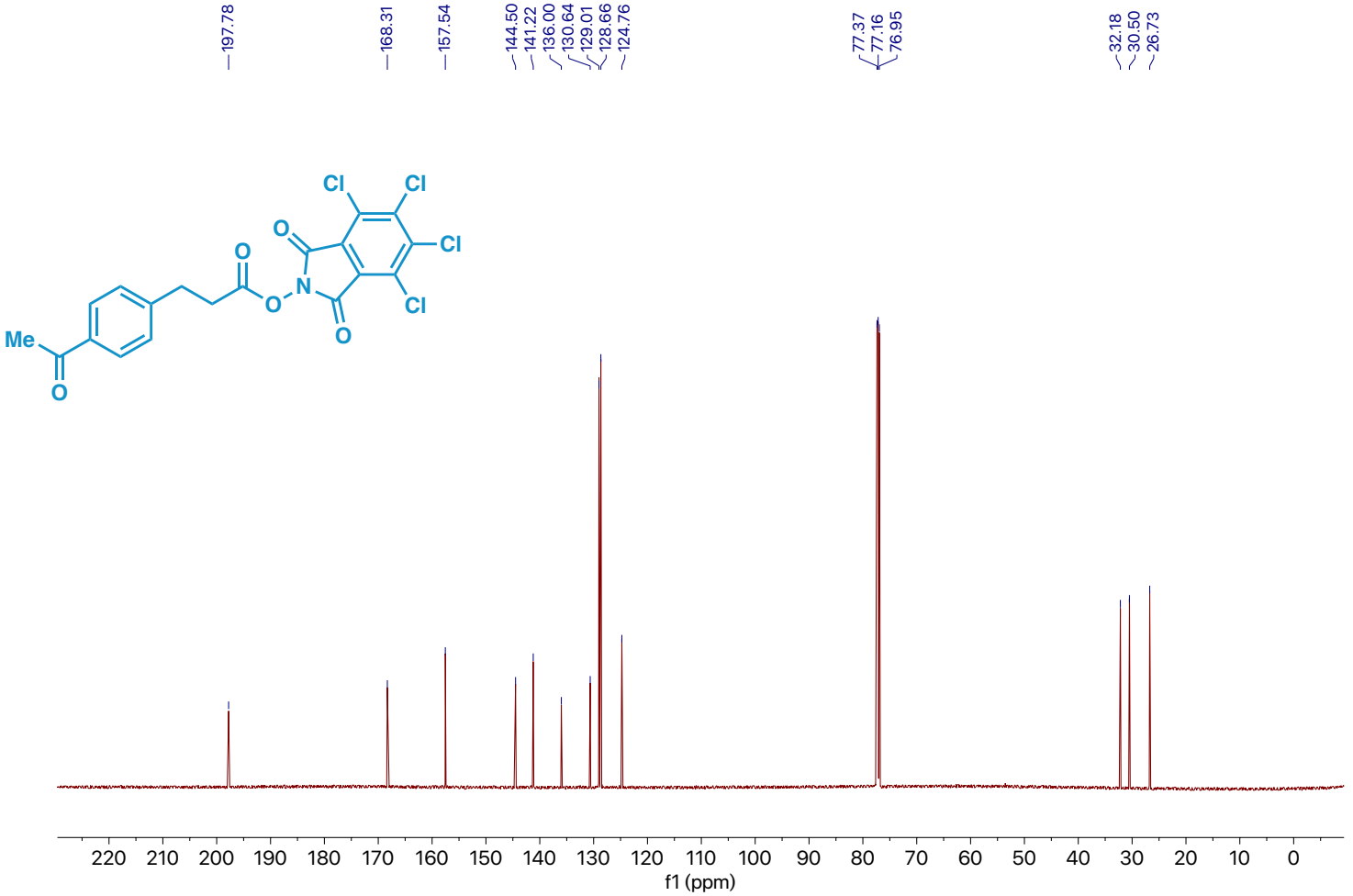
Compound SI-18 ^{19}F NMR



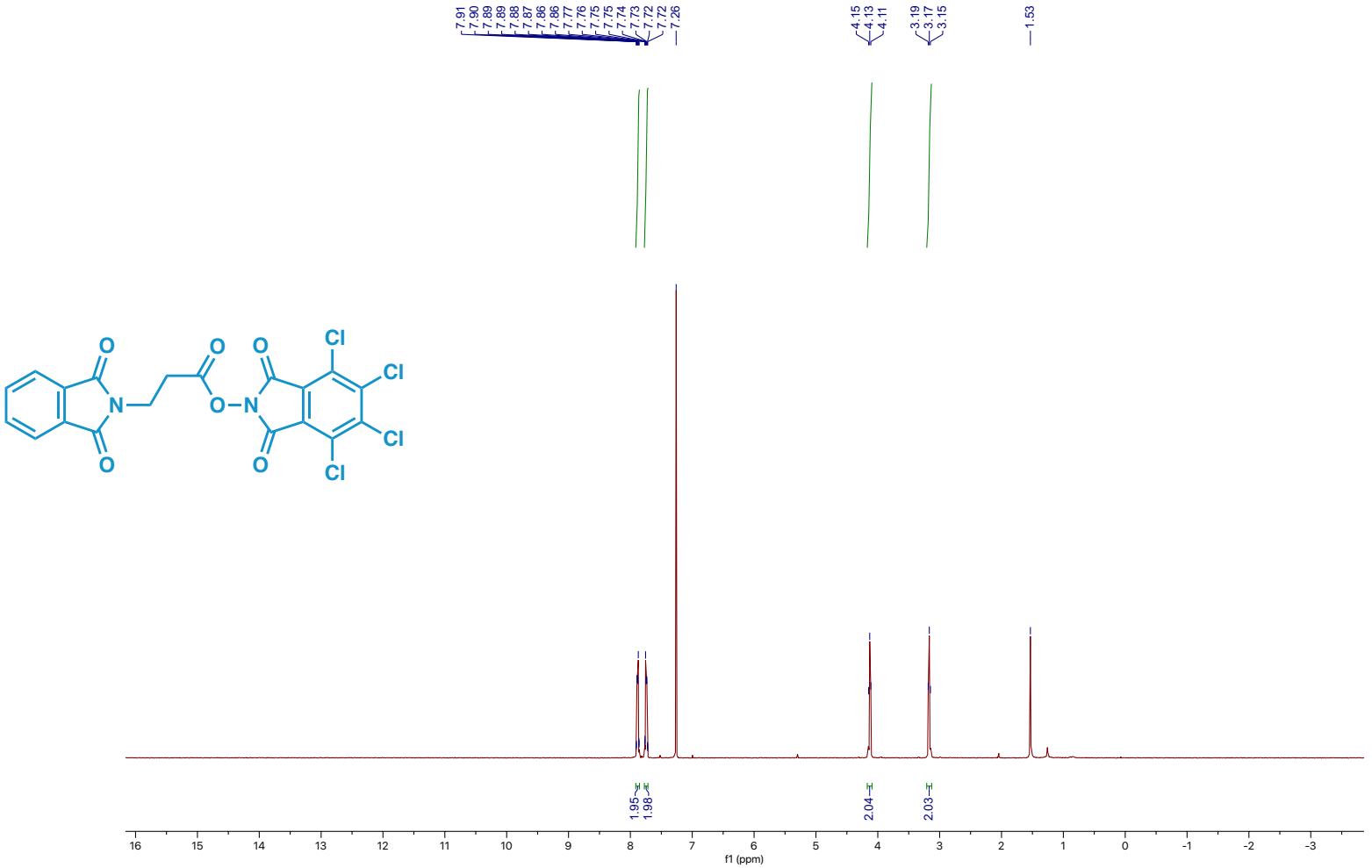
Compound SI-19 ^{1}H NMR



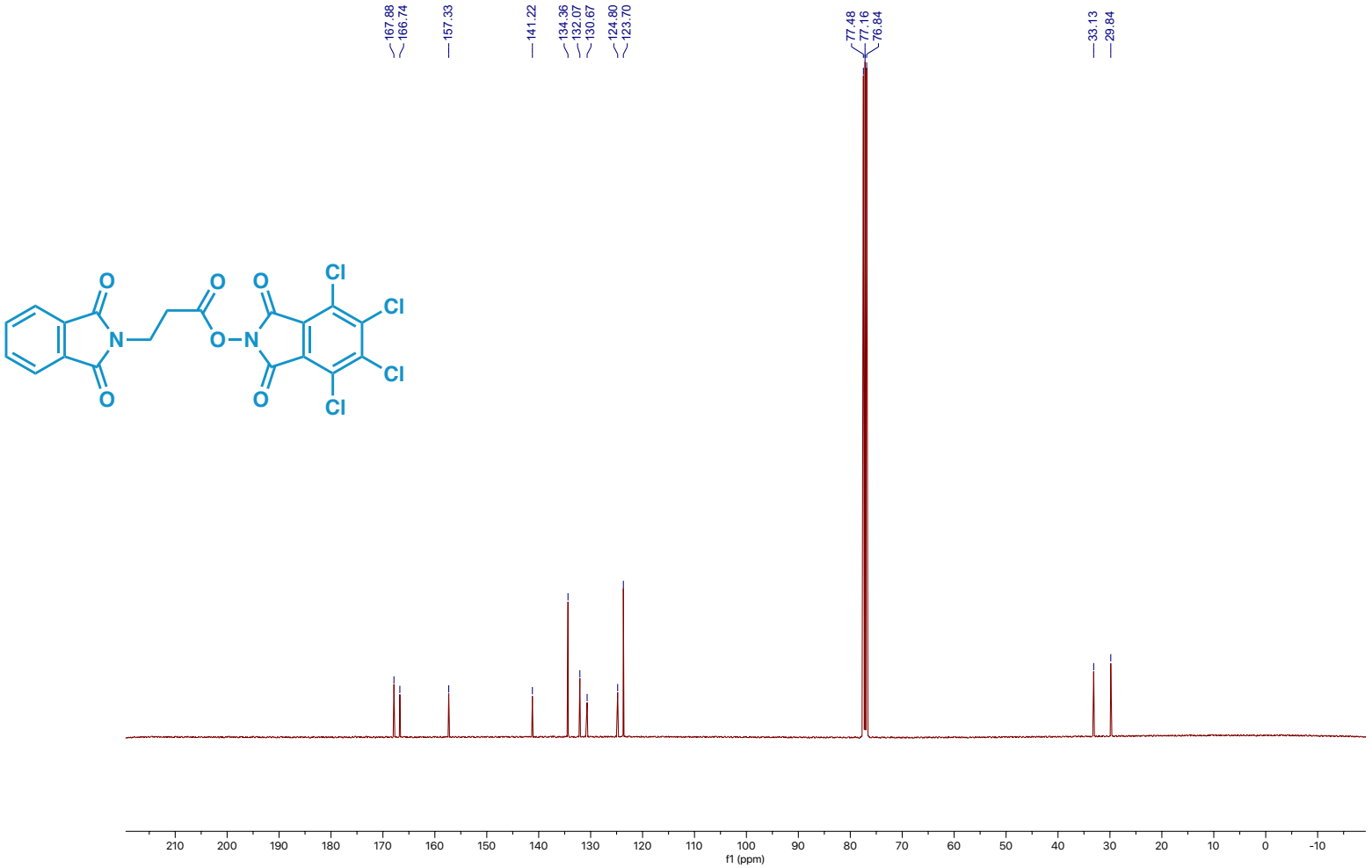
Compound SI-19 ^{13}C NMR



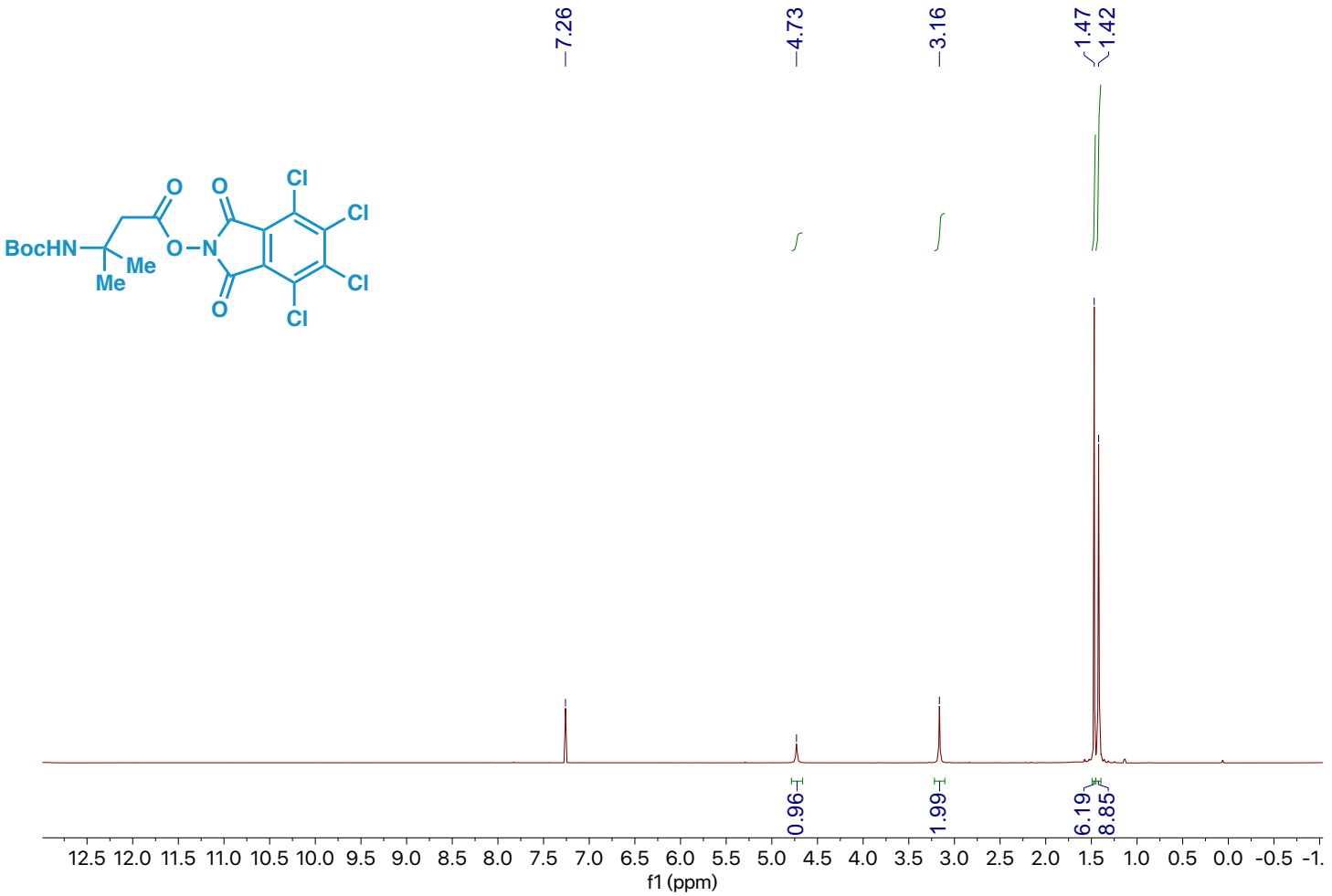
Compound SI-20 ^{1}H NMR



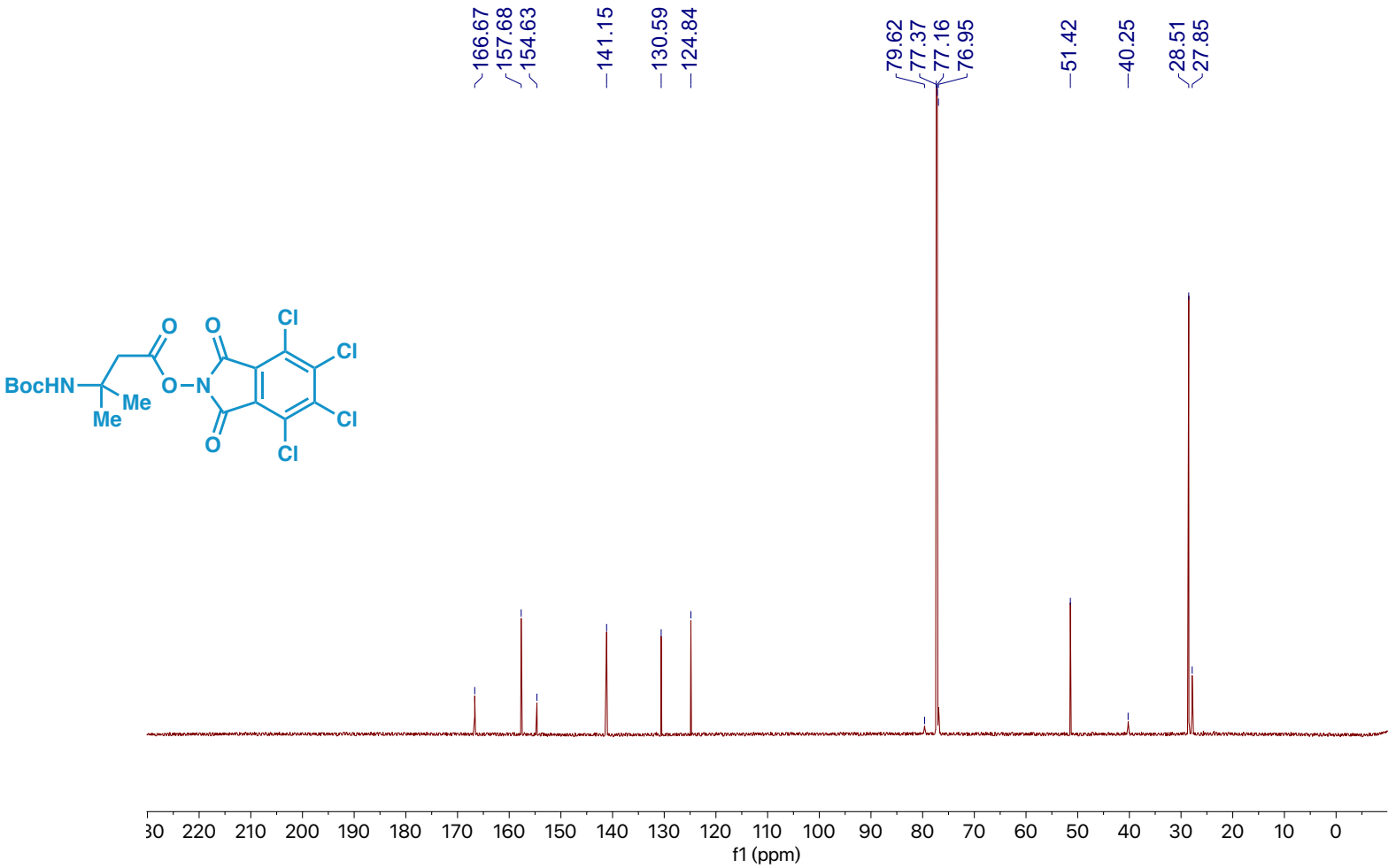
Compound SI-20 ^{13}C NMR



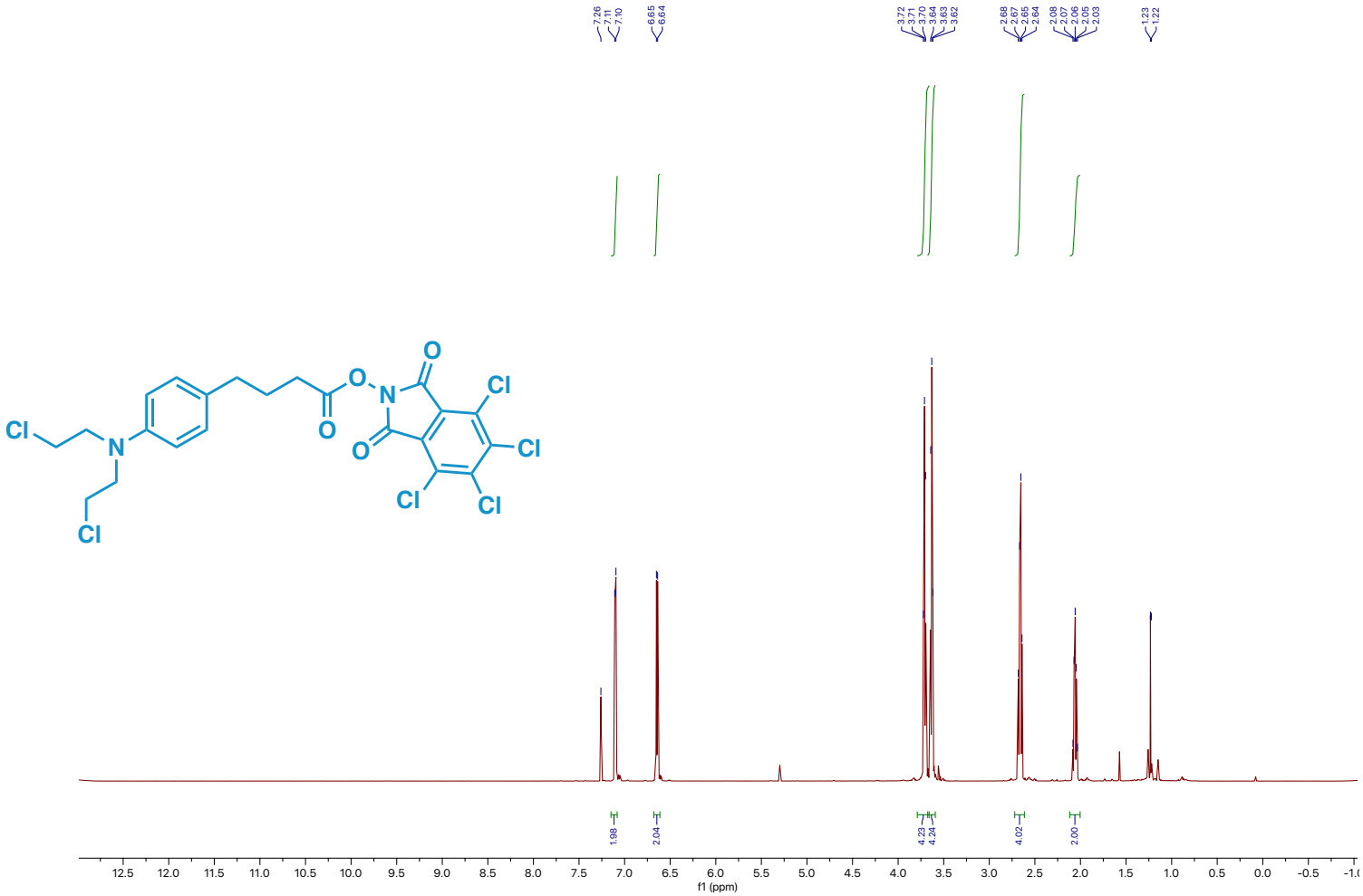
Compound SI-21 ^{1}H NMR



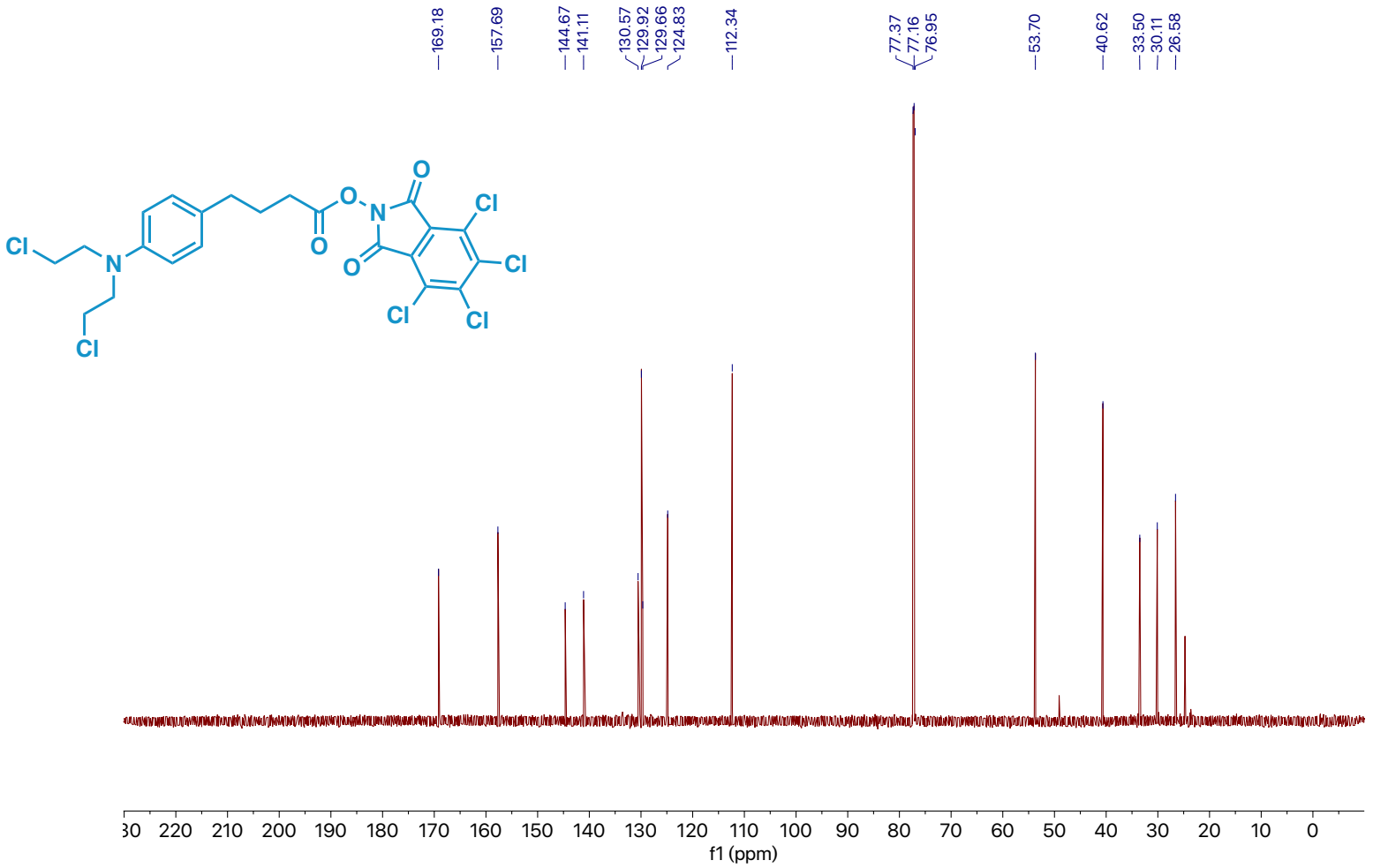
Compound SI-21 ^{13}C NMR



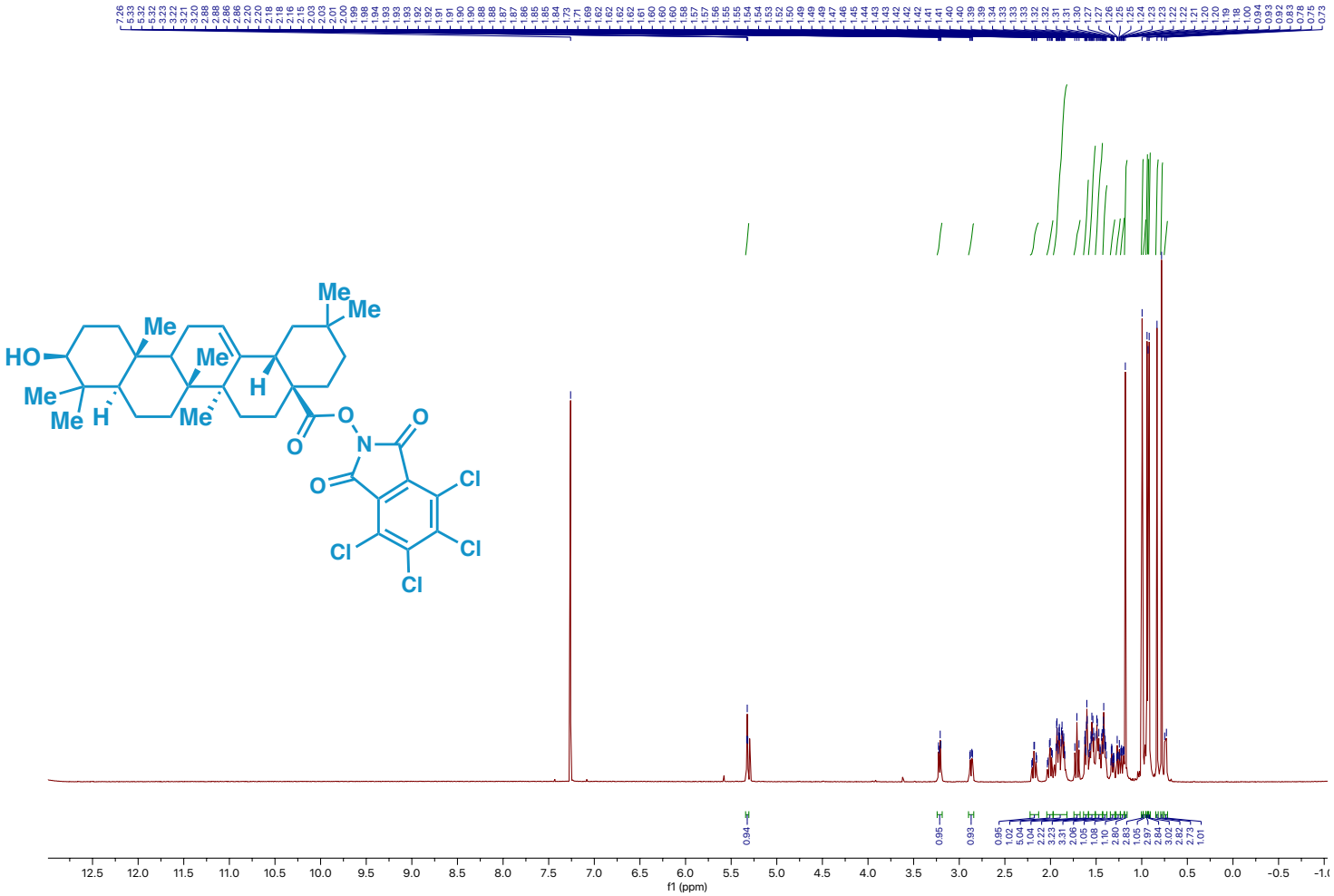
Compound SI-22 ^{1}H NMR



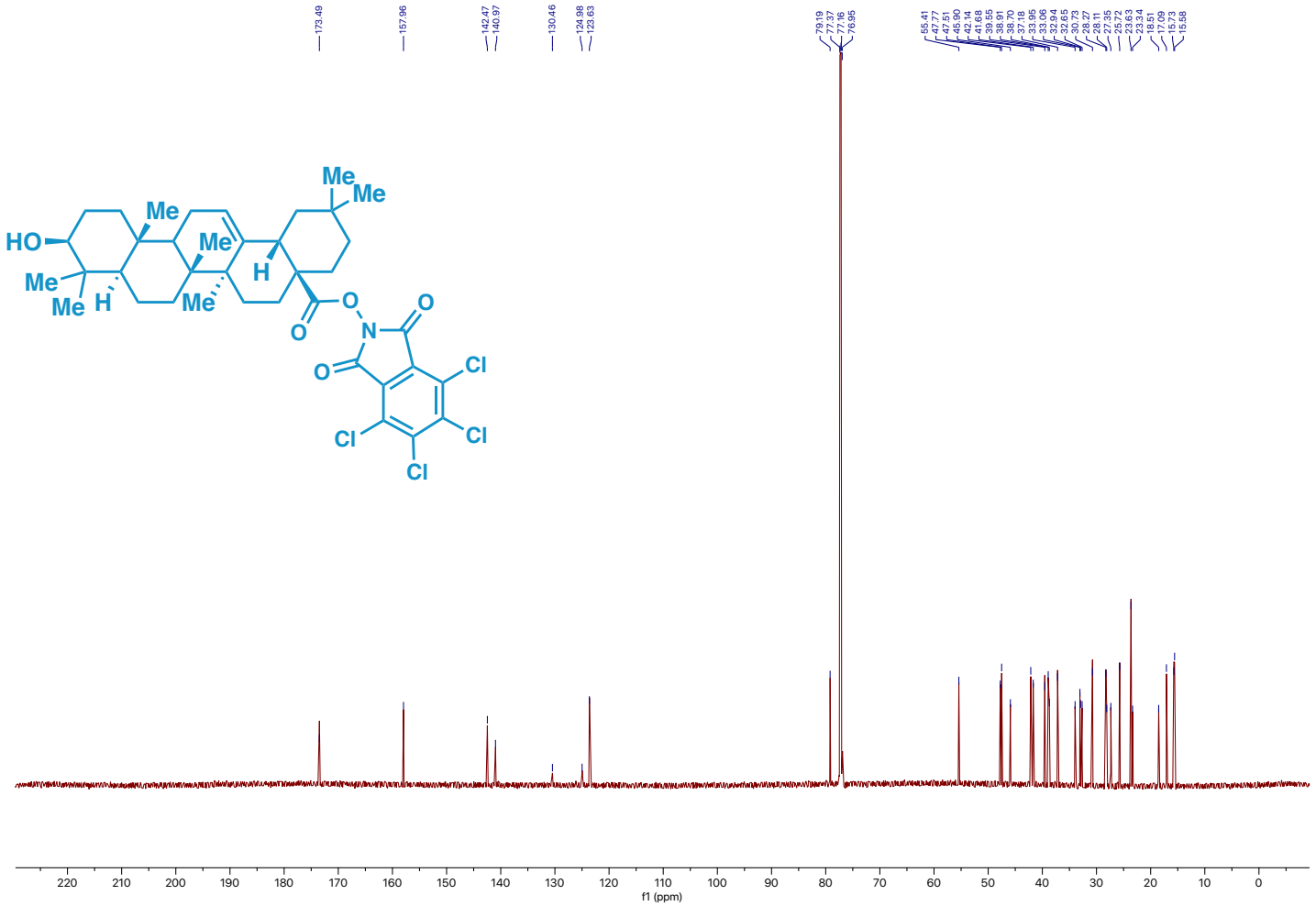
Compound SI-22 ^{13}C NMR



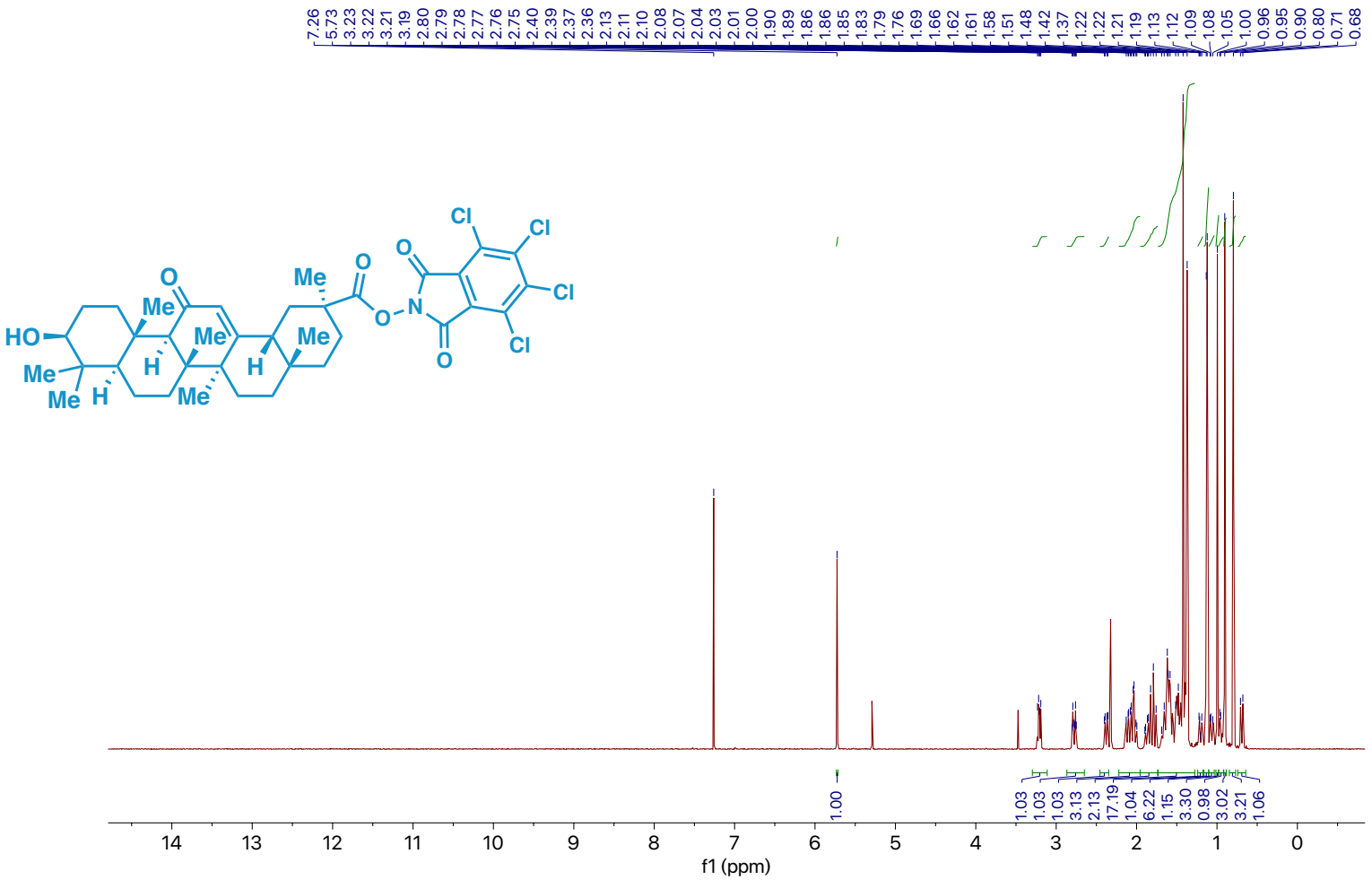
Compound SI-23 ^{1}H NMR



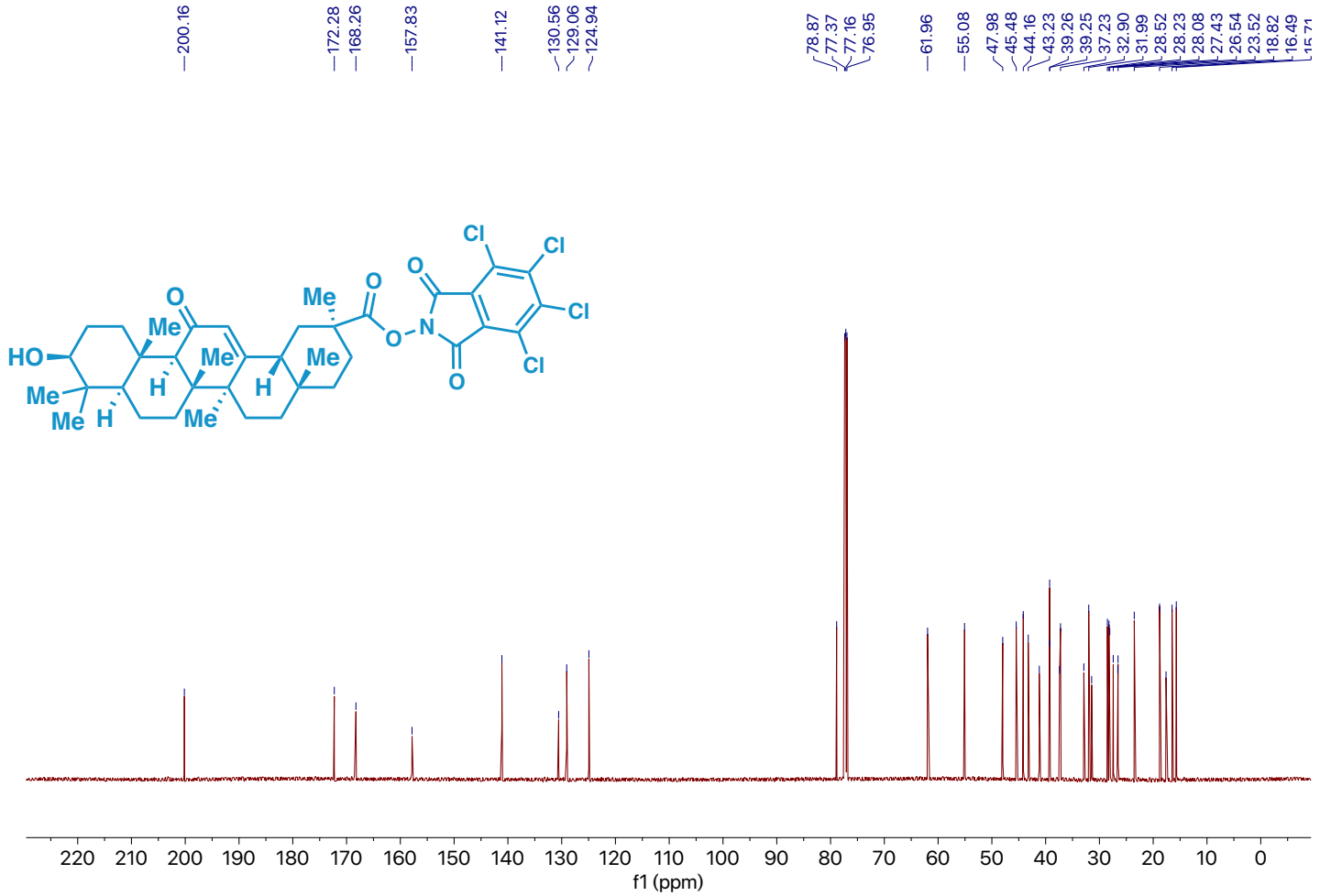
Compound SI-23 ^{13}C NMR



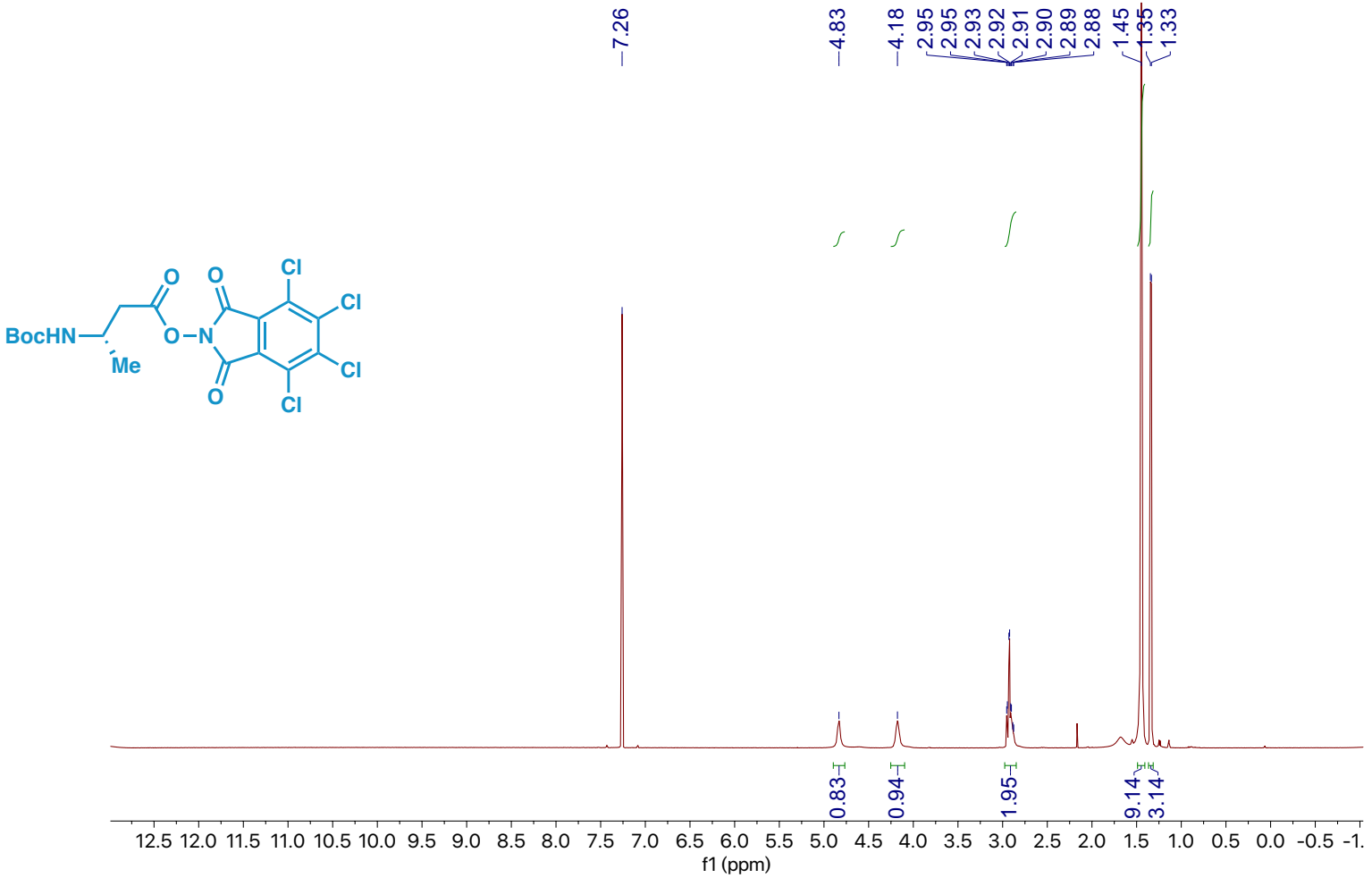
Compound SI-24 ^{1}H NMR



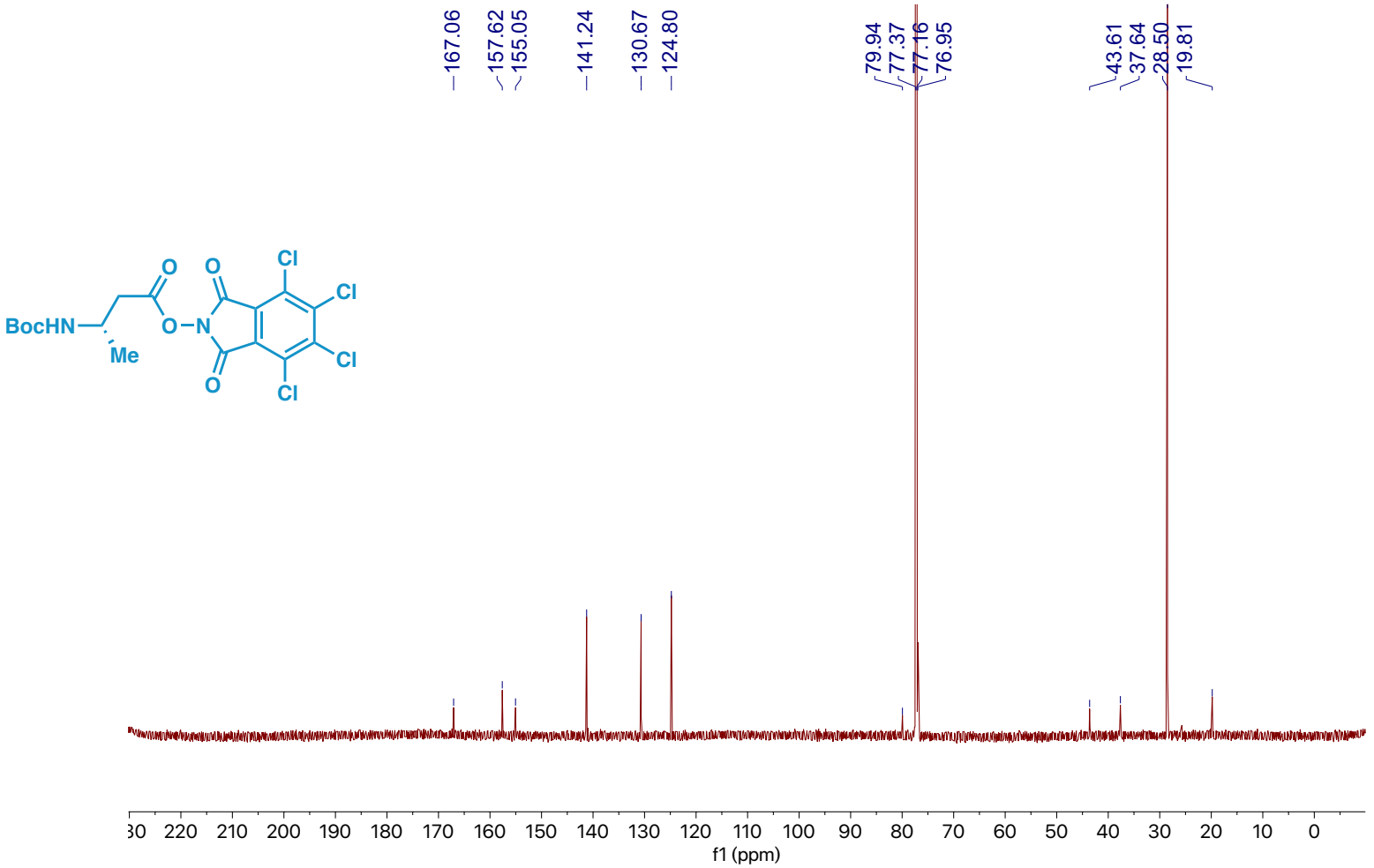
Compound SI-24 ^{13}C NMR



Compound SI-25 ^{1}H NMR

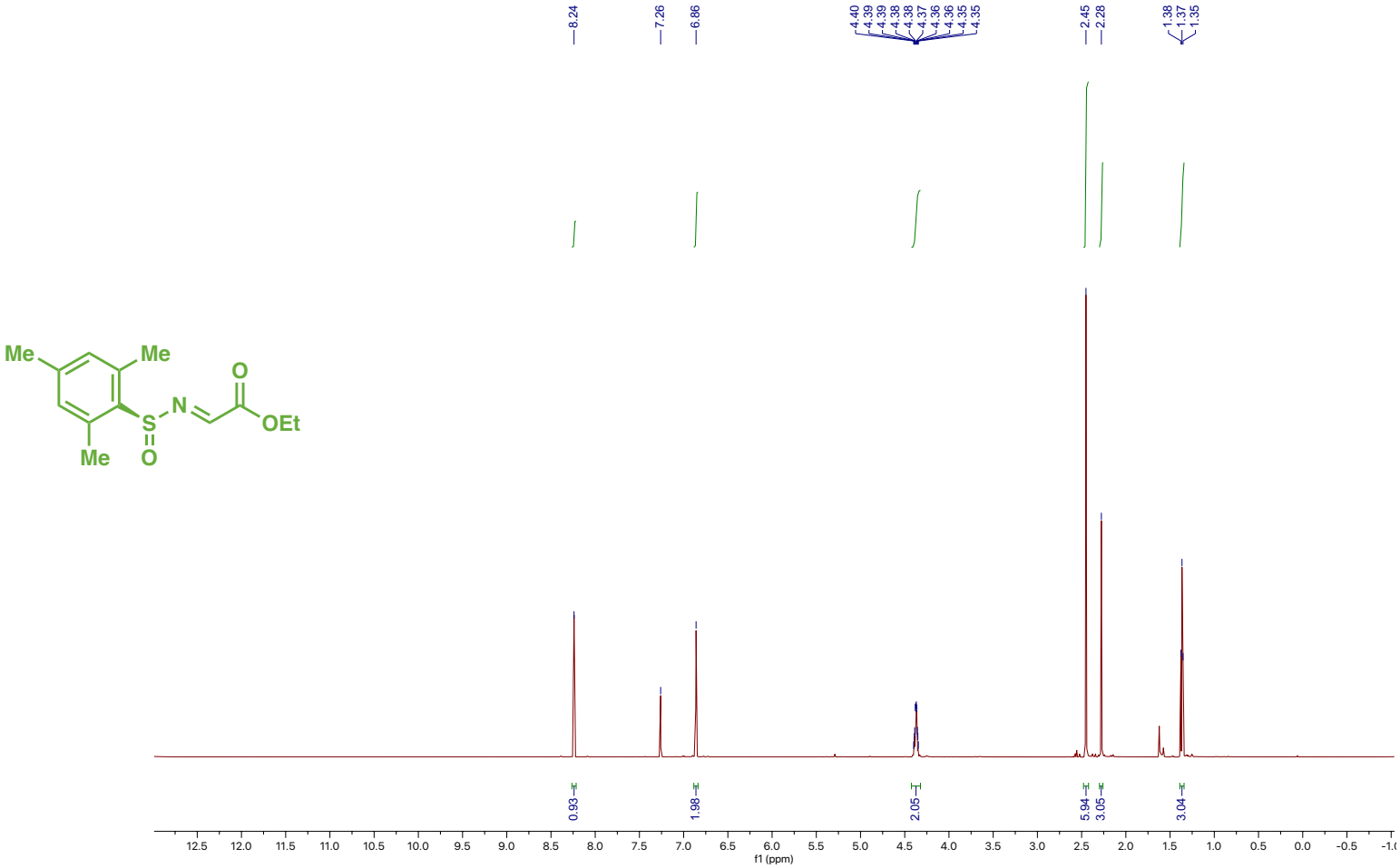


Compound SI-25 ^{13}C NMR

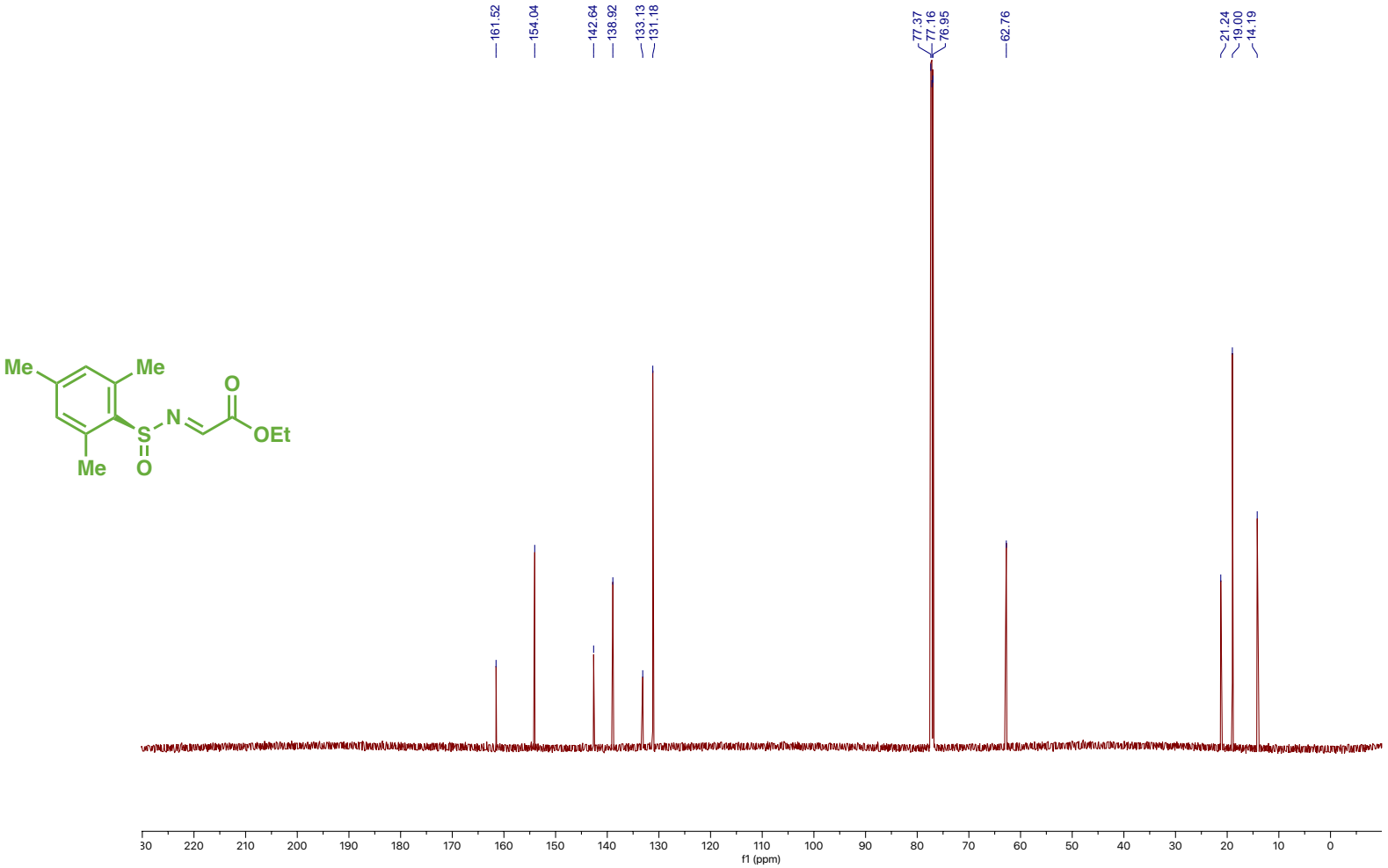


Spectra for Sulfinimines

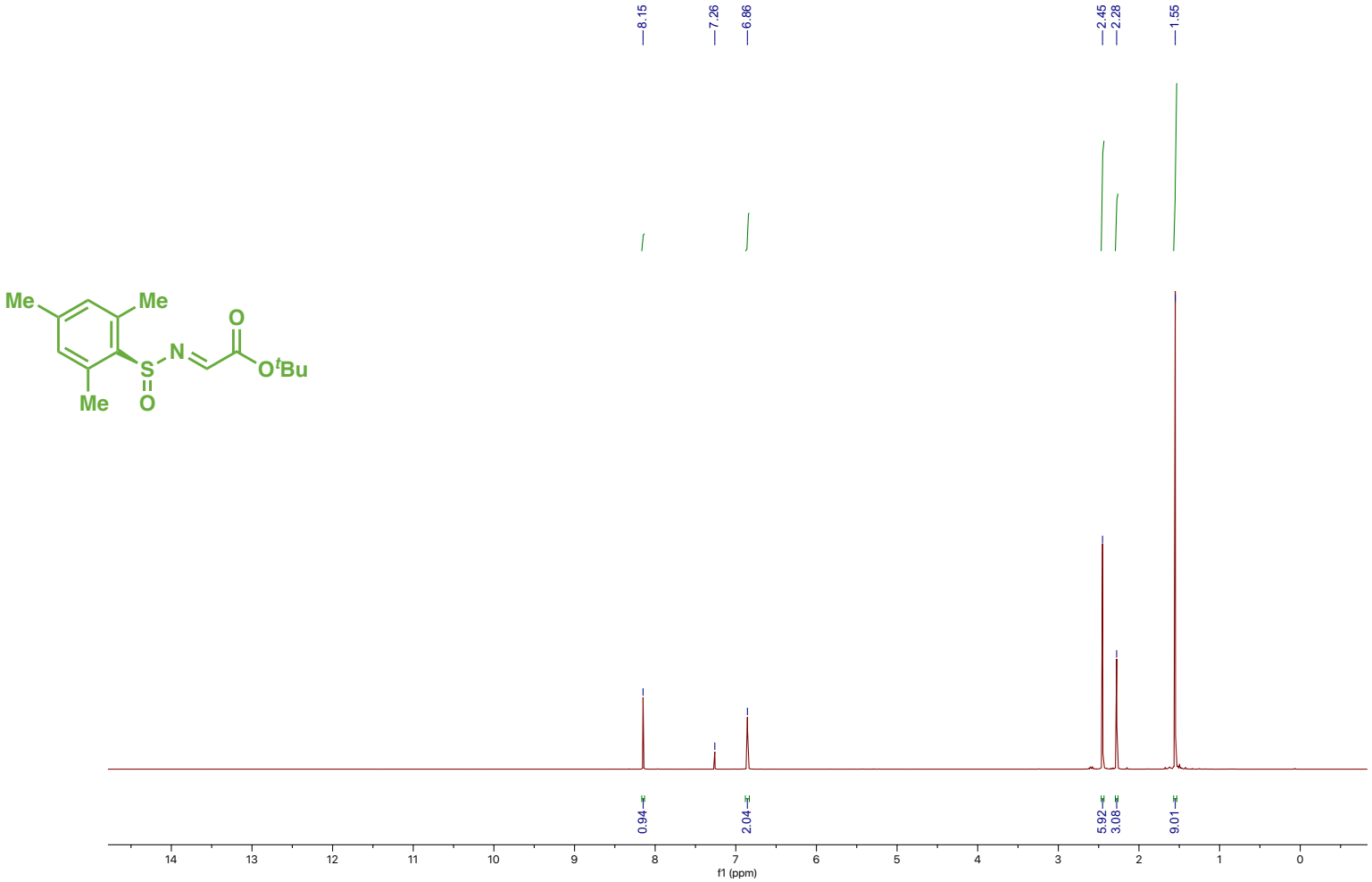
Compound 2 ^{1}H NMR



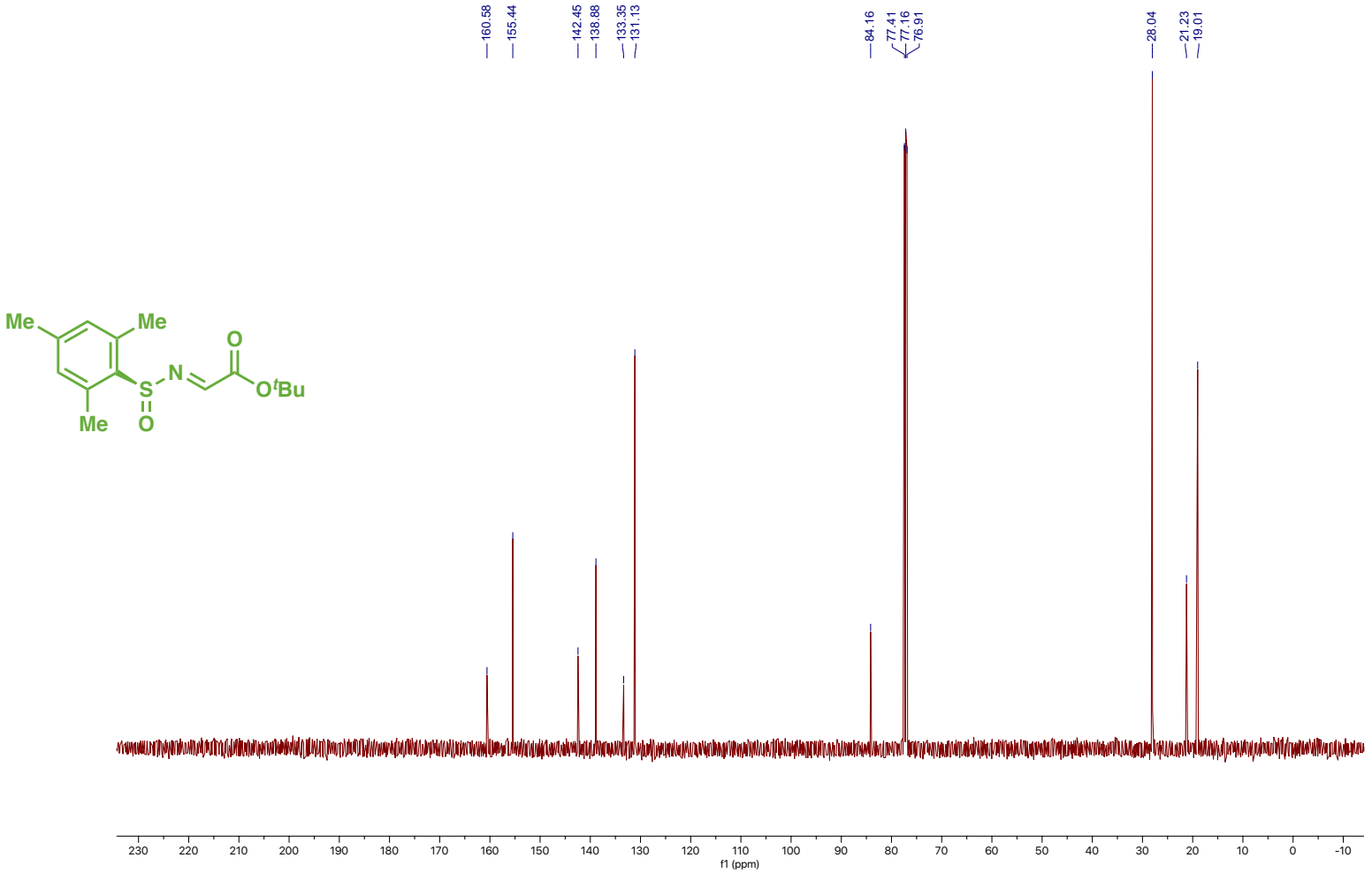
Compound 2 ^{13}C NMR



Compound 2b ^{1}H NMR

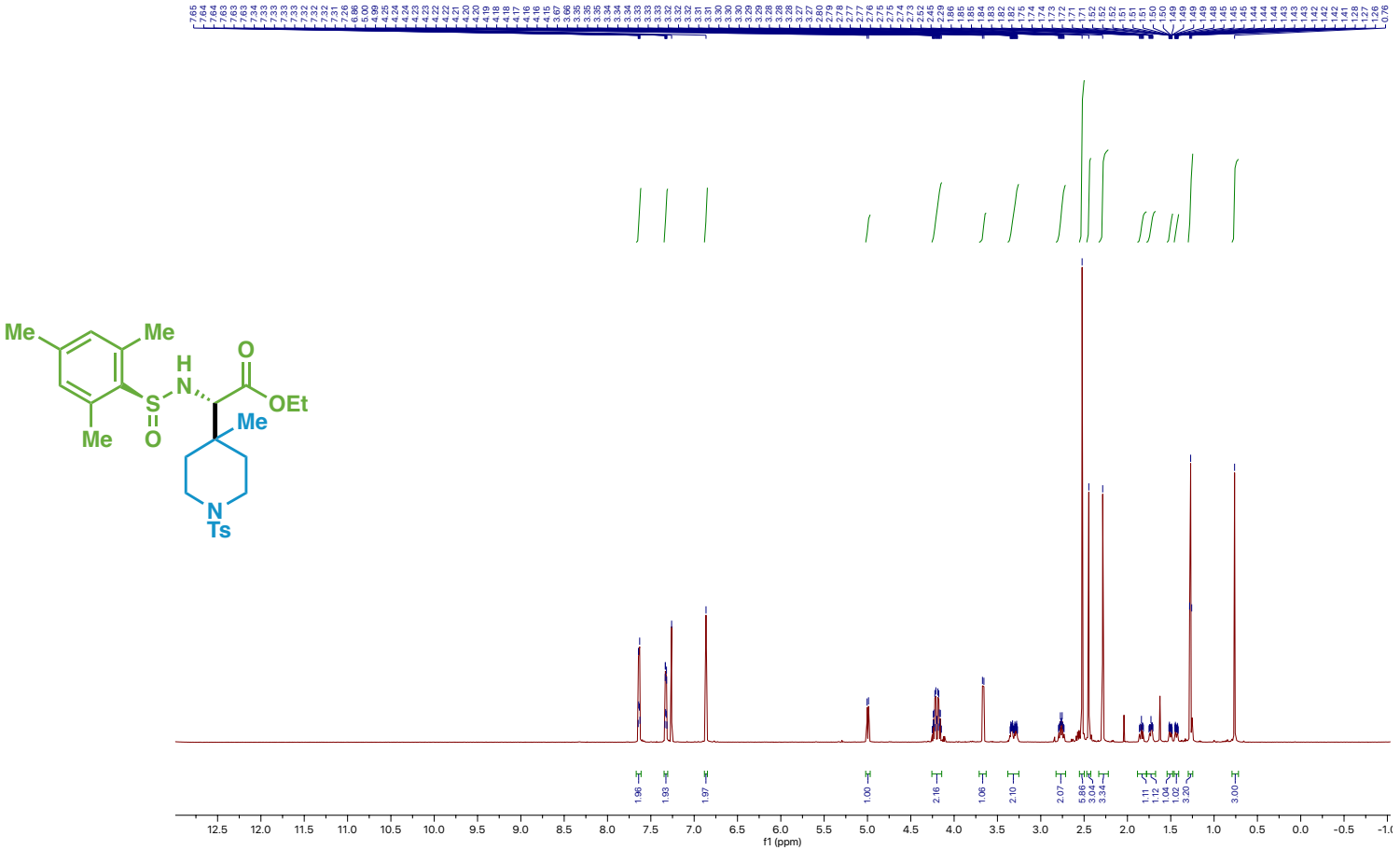


Compound 2b ^{13}C NMR

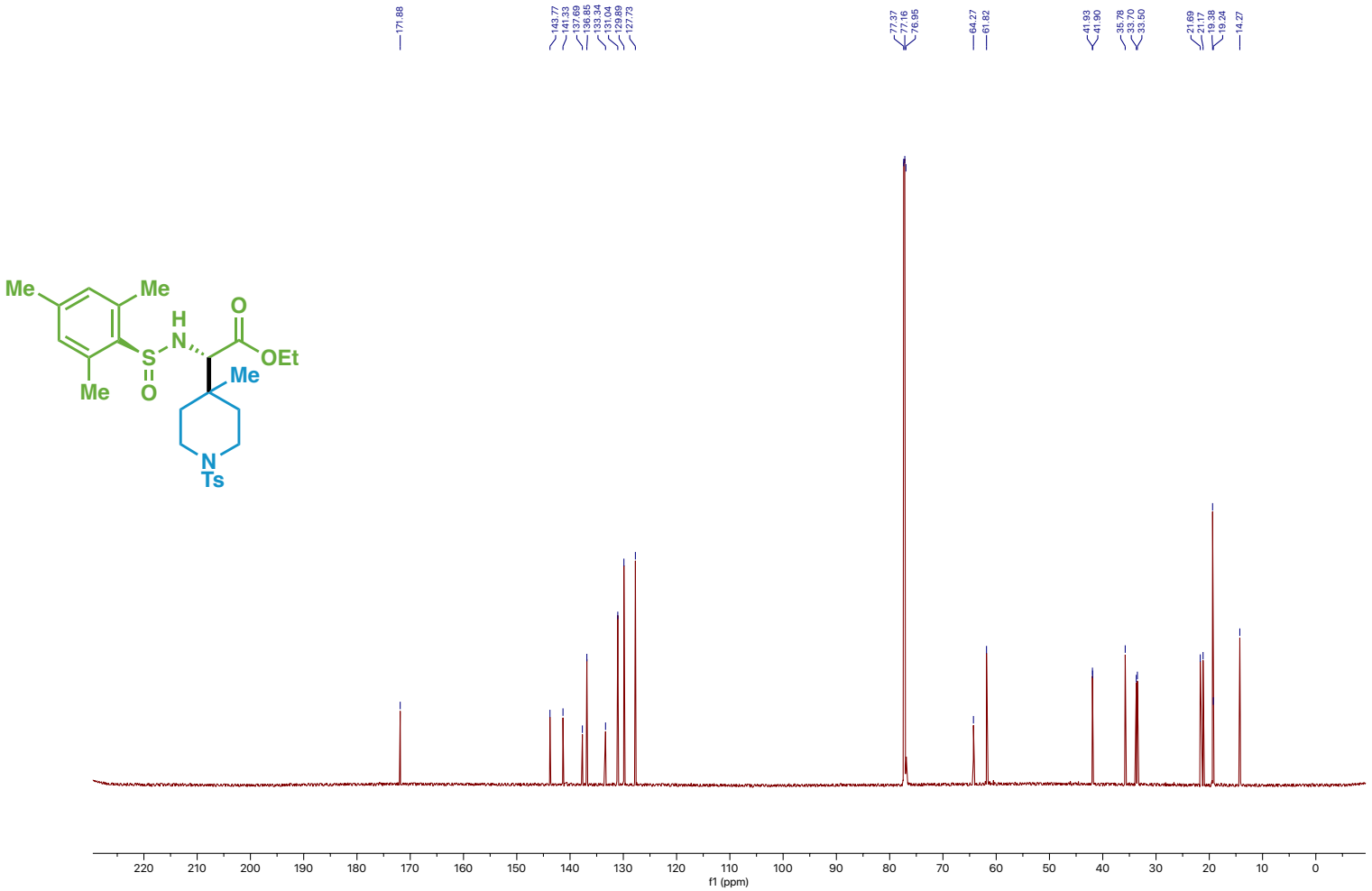


Spectra for Decarboxylative Addition Products

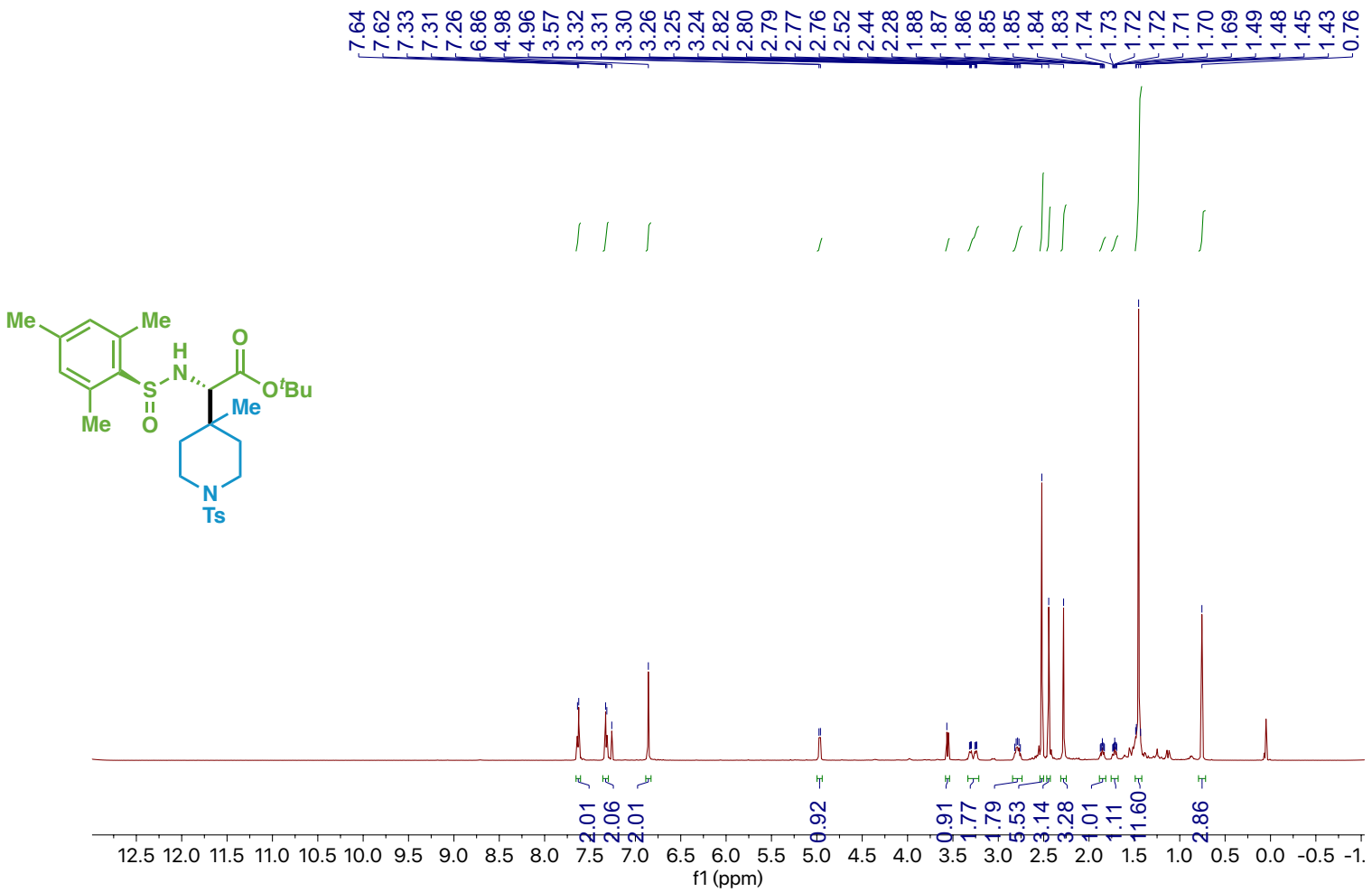
Compound 3 ^{1}H NMR



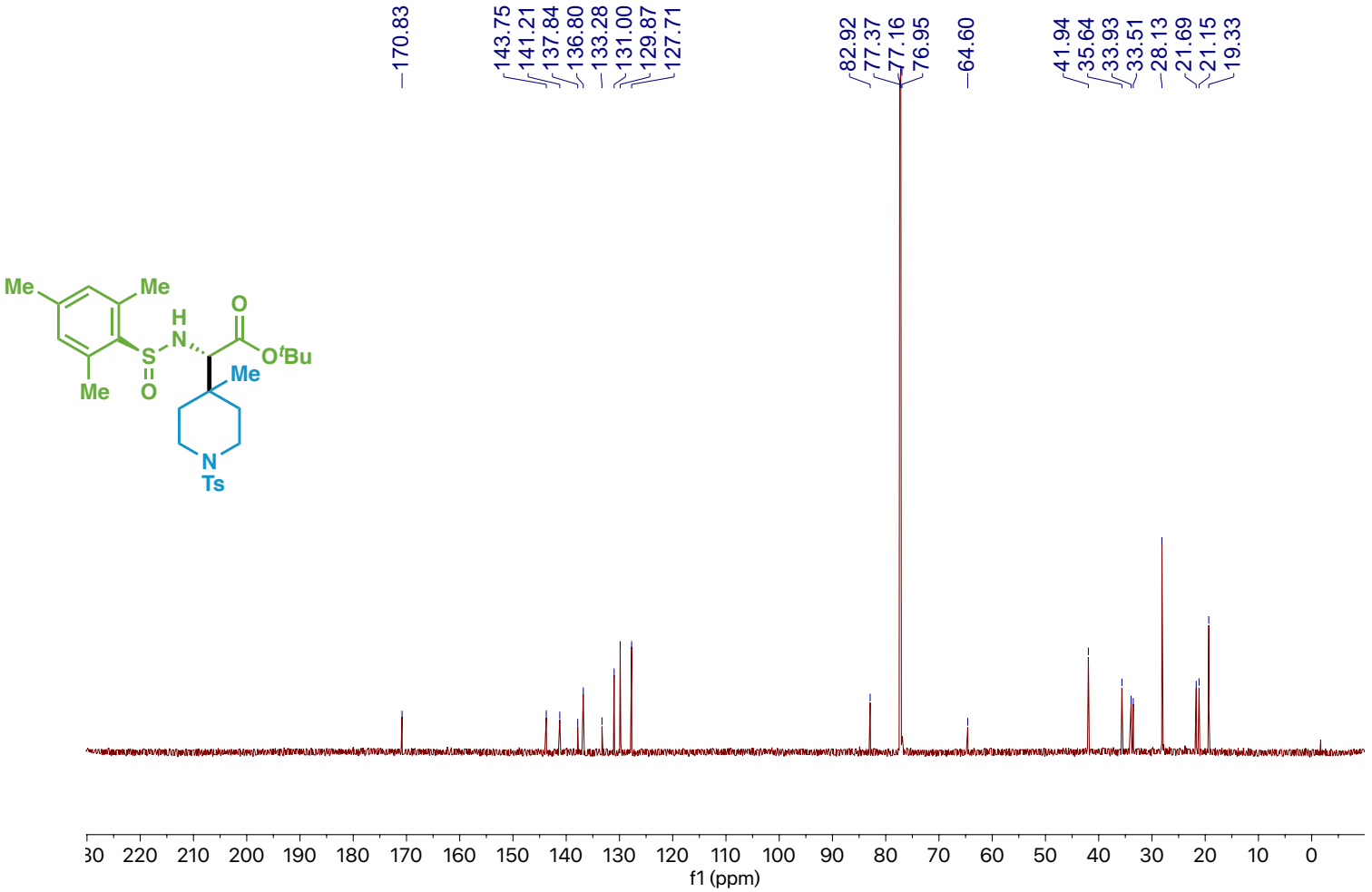
Compound 3 ^{13}C NMR



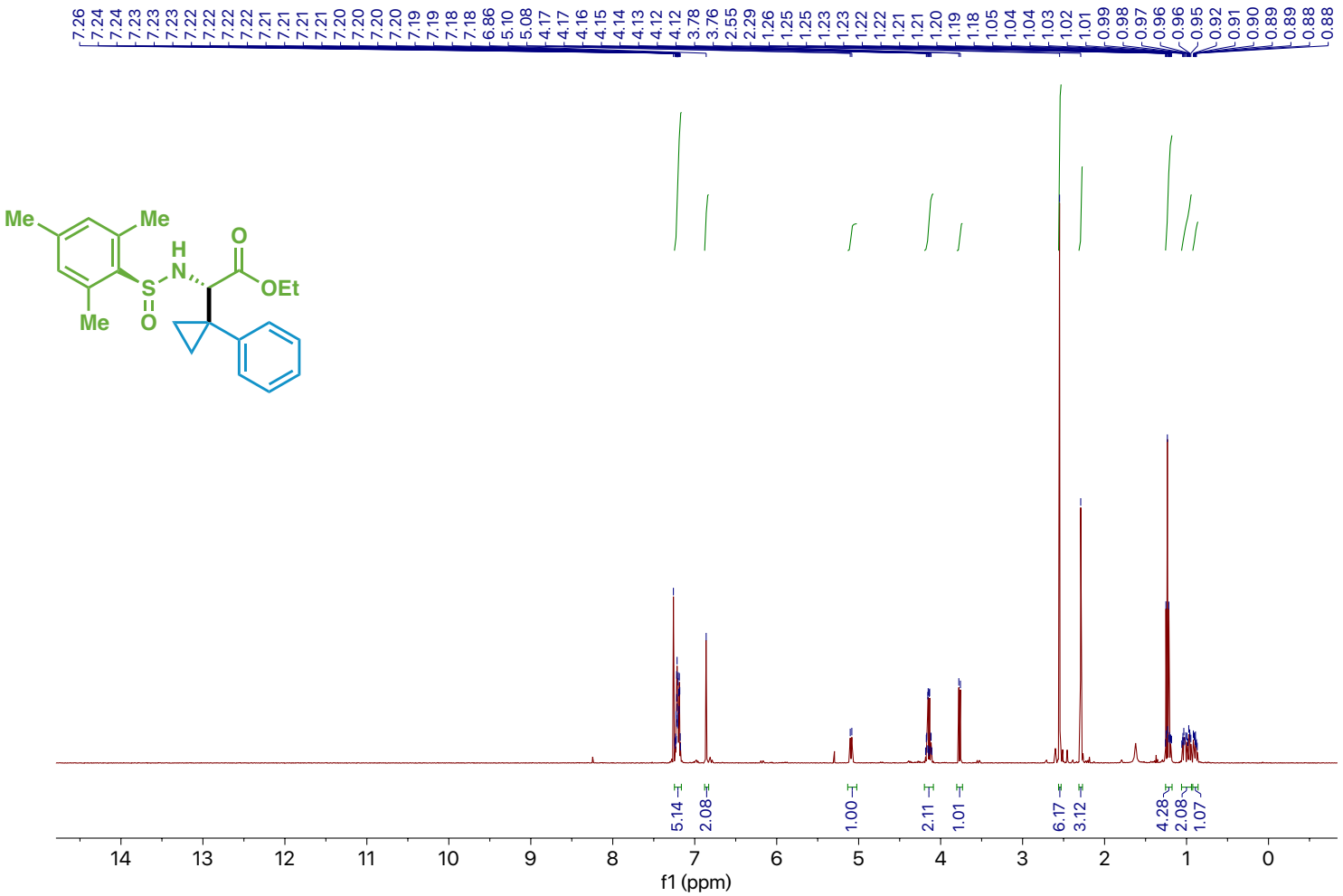
Compound 8 ^{1}H NMR



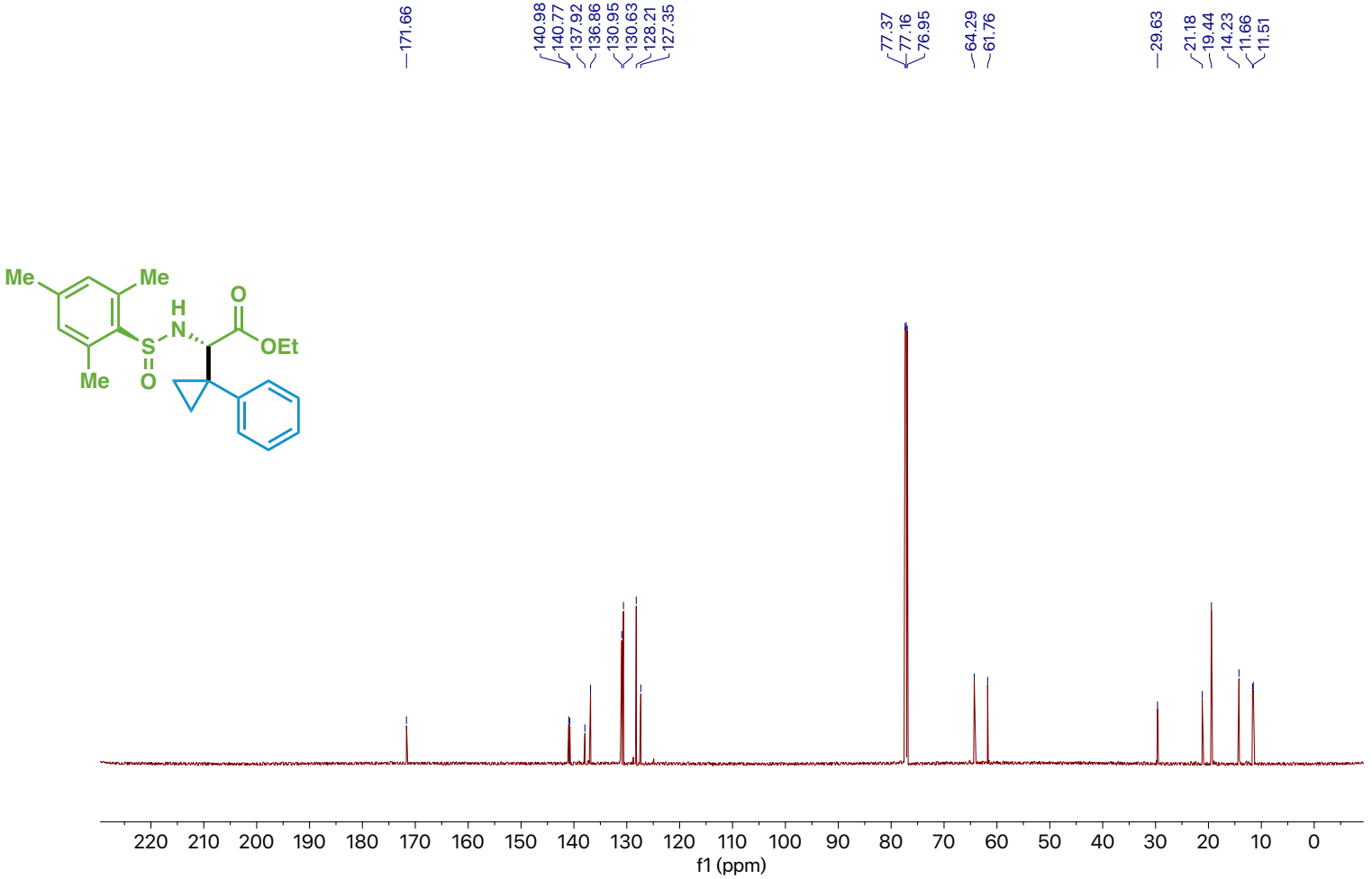
Compound 8 ^{13}C NMR



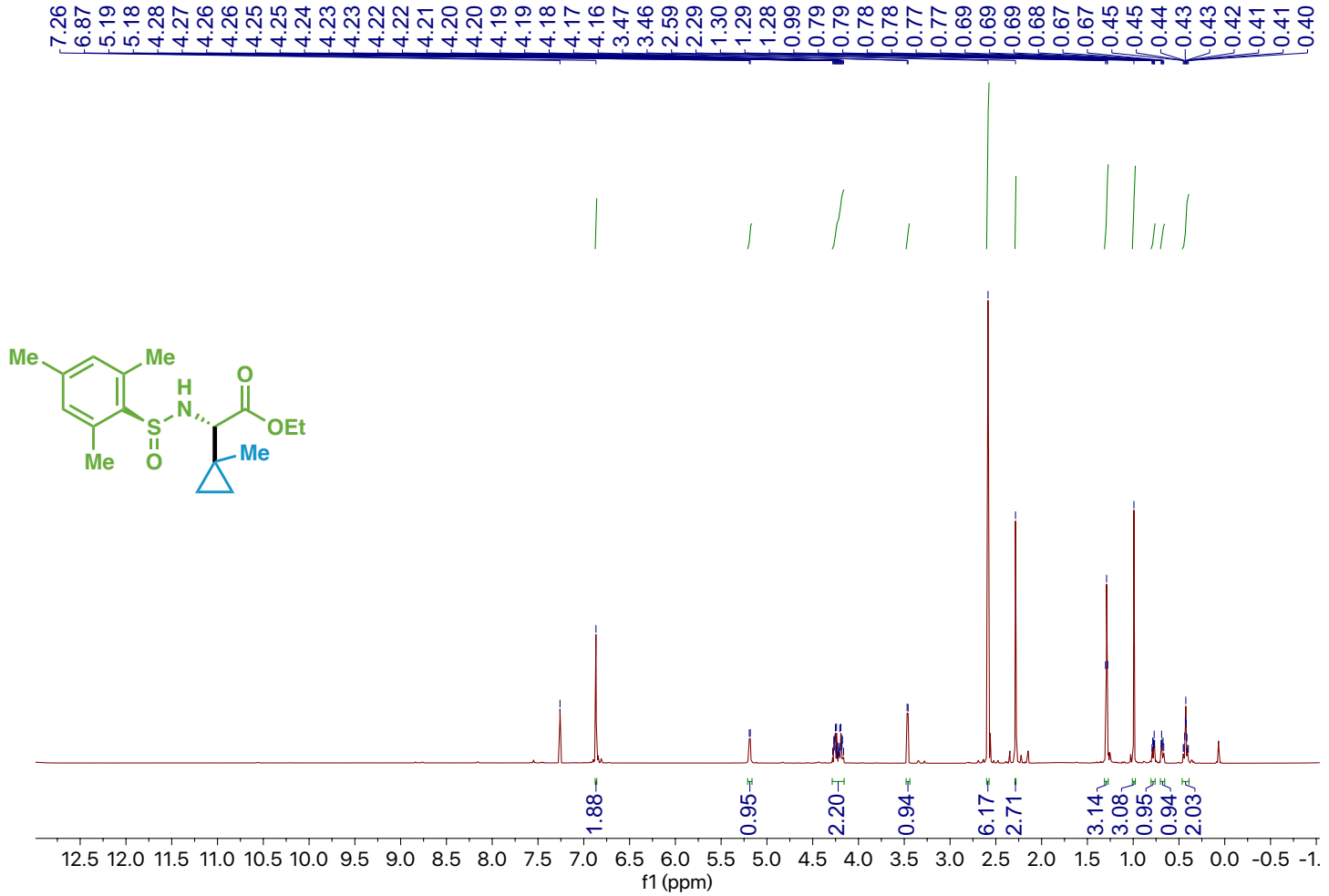
Compound 9 ^{1}H NMR



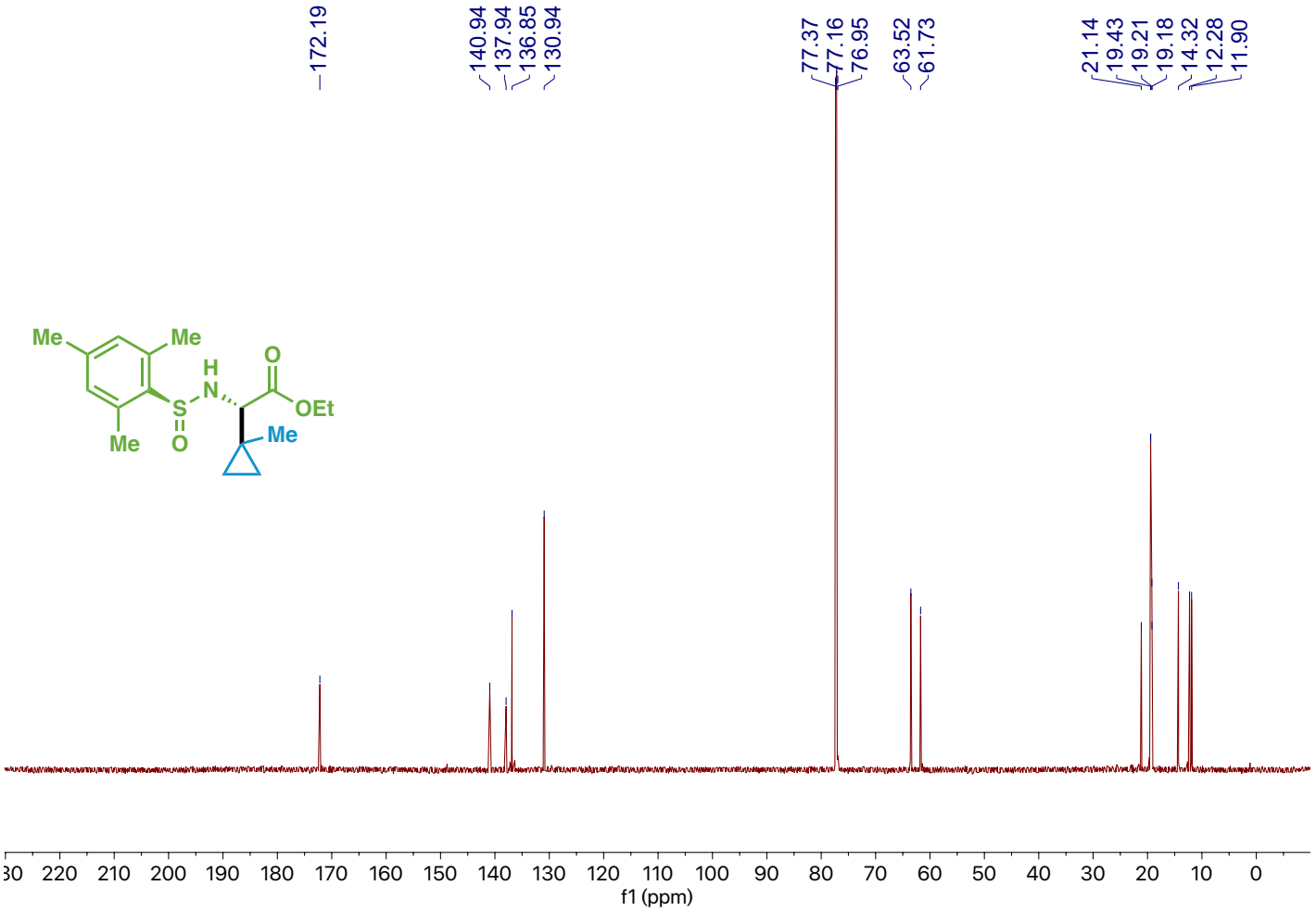
Compound 9 ^{13}C NMR



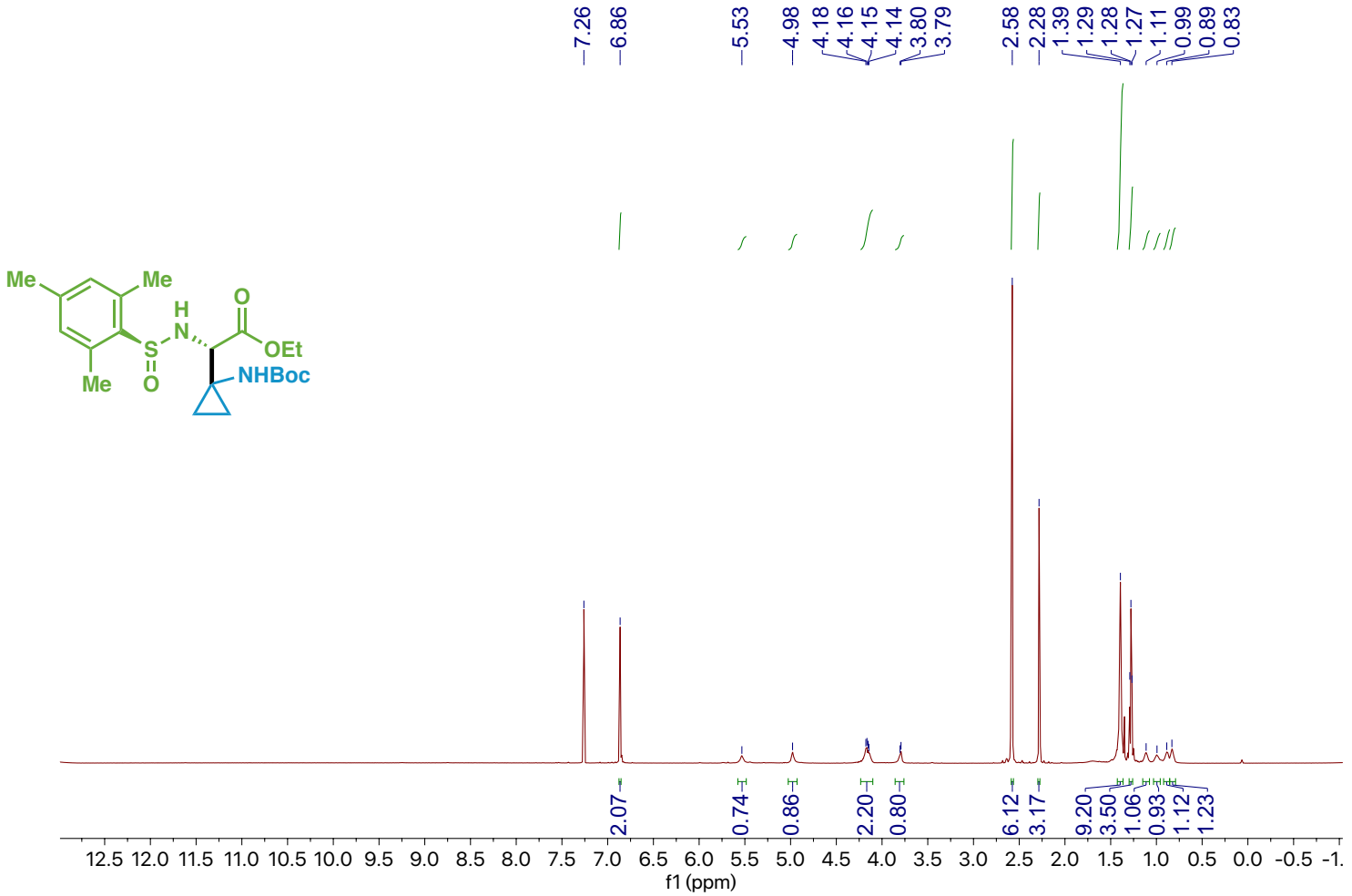
Compound 10 ^{1}H NMR



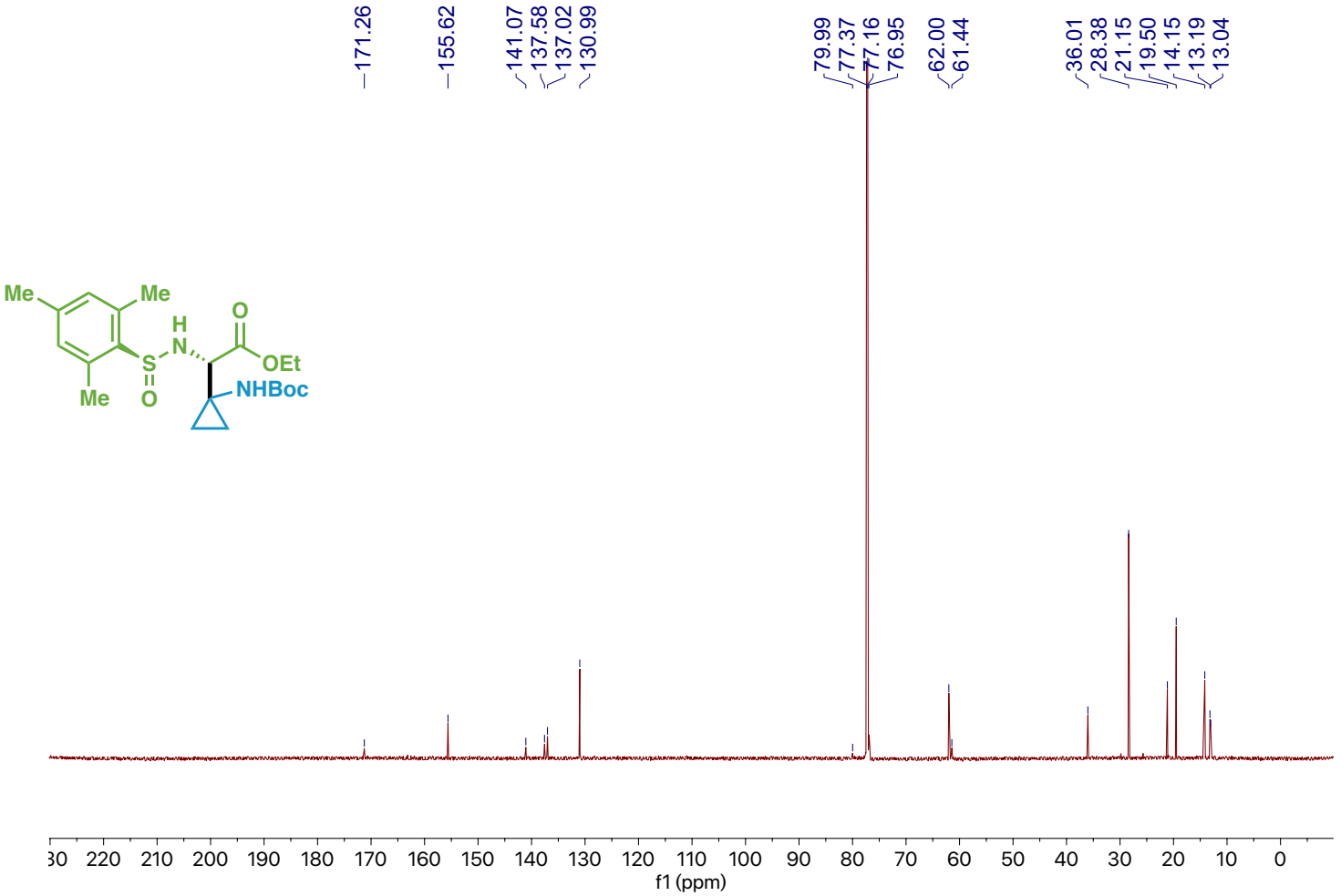
Compound 10 ^{13}C NMR



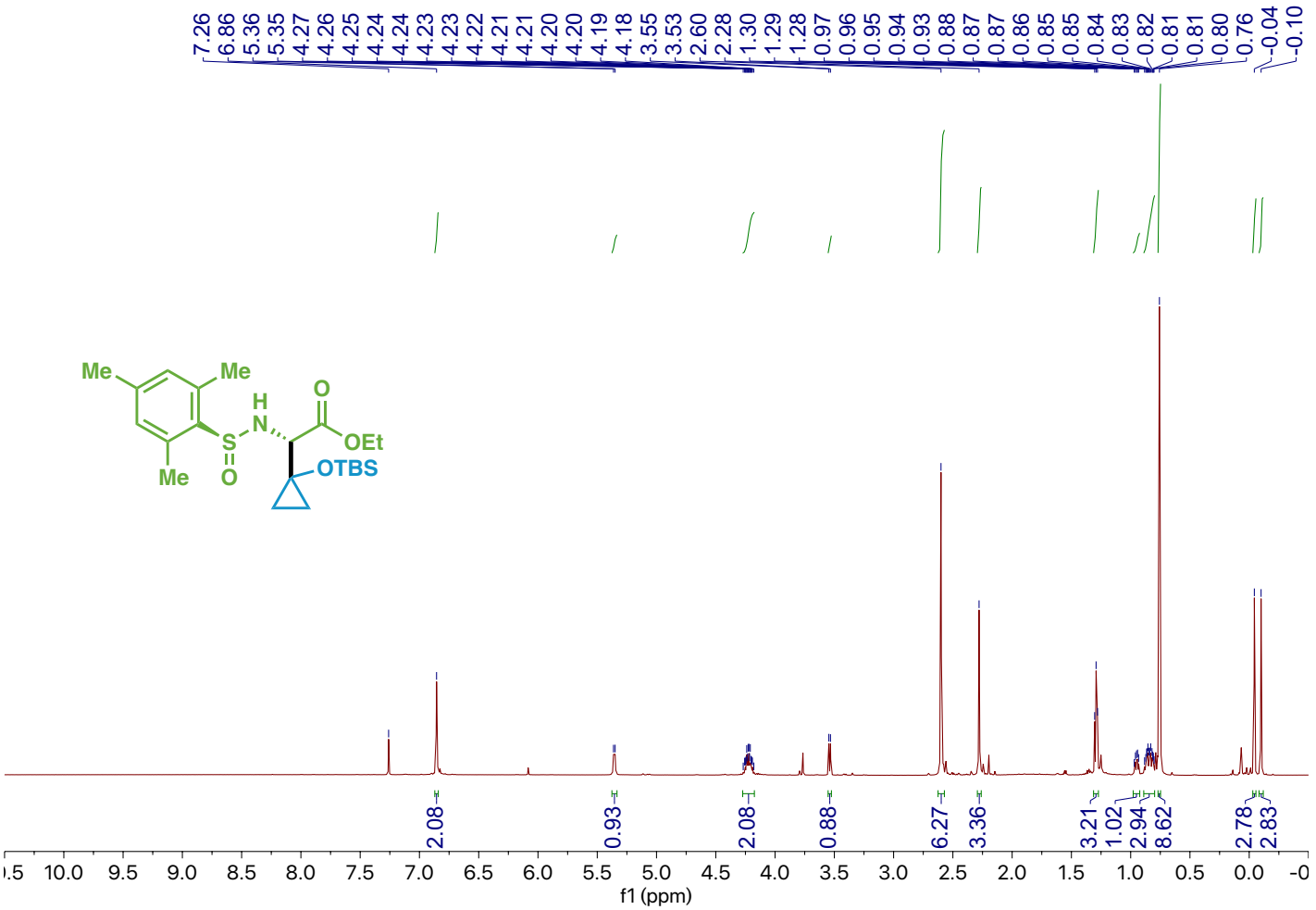
Compound 11 ^{1}H NMR



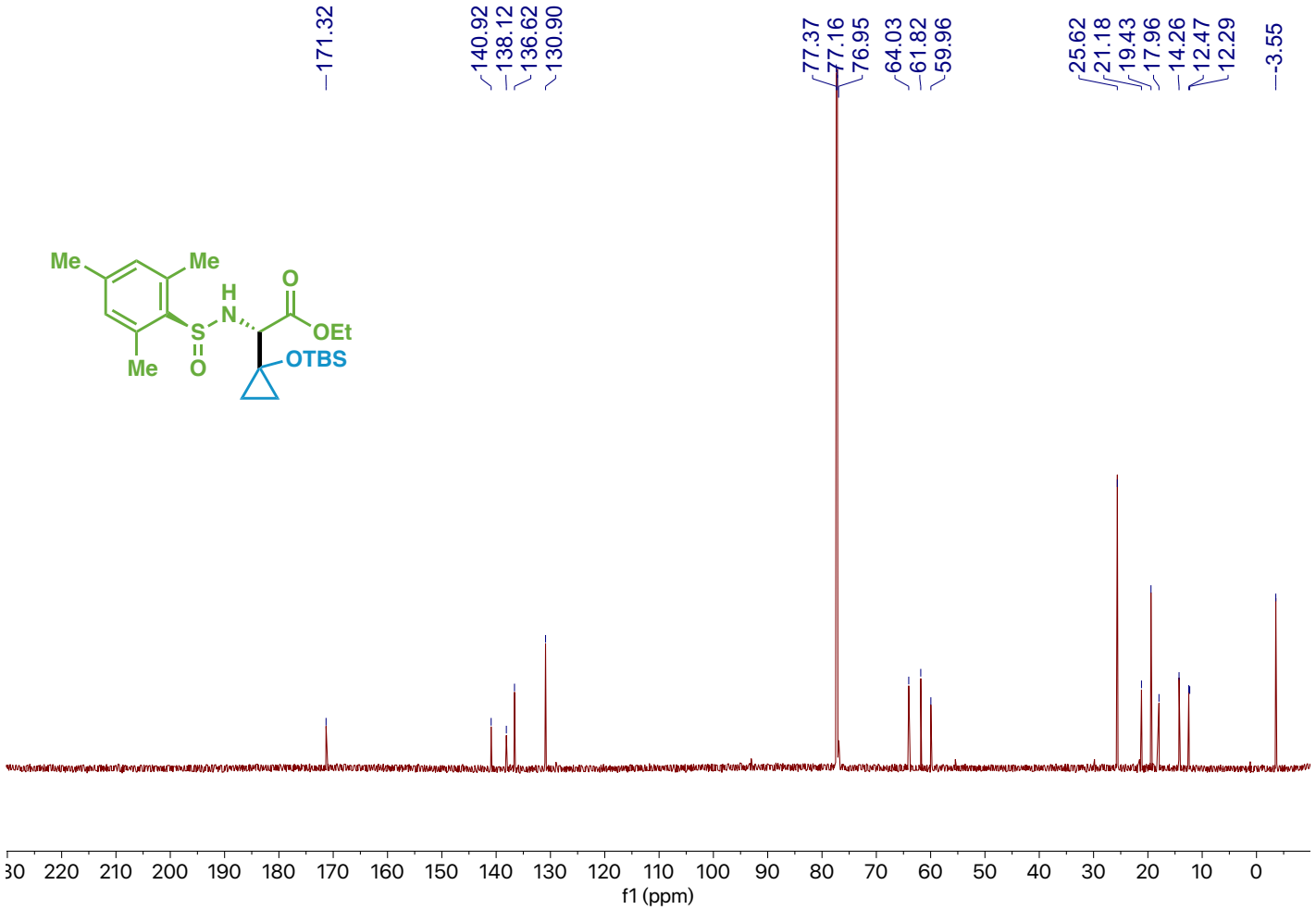
Compound 11 ^{13}C NMR



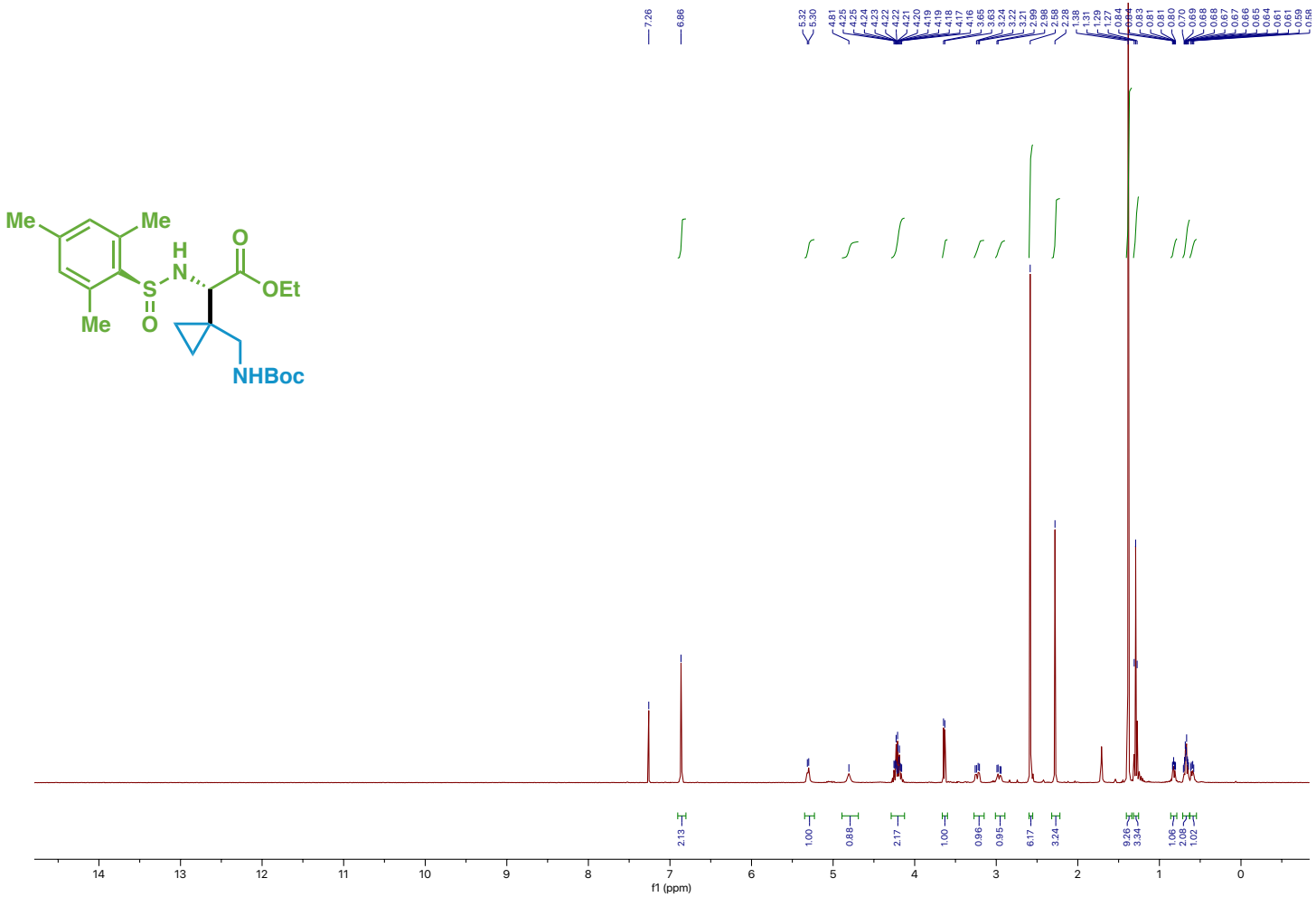
Compound 12 ^{1}H NMR



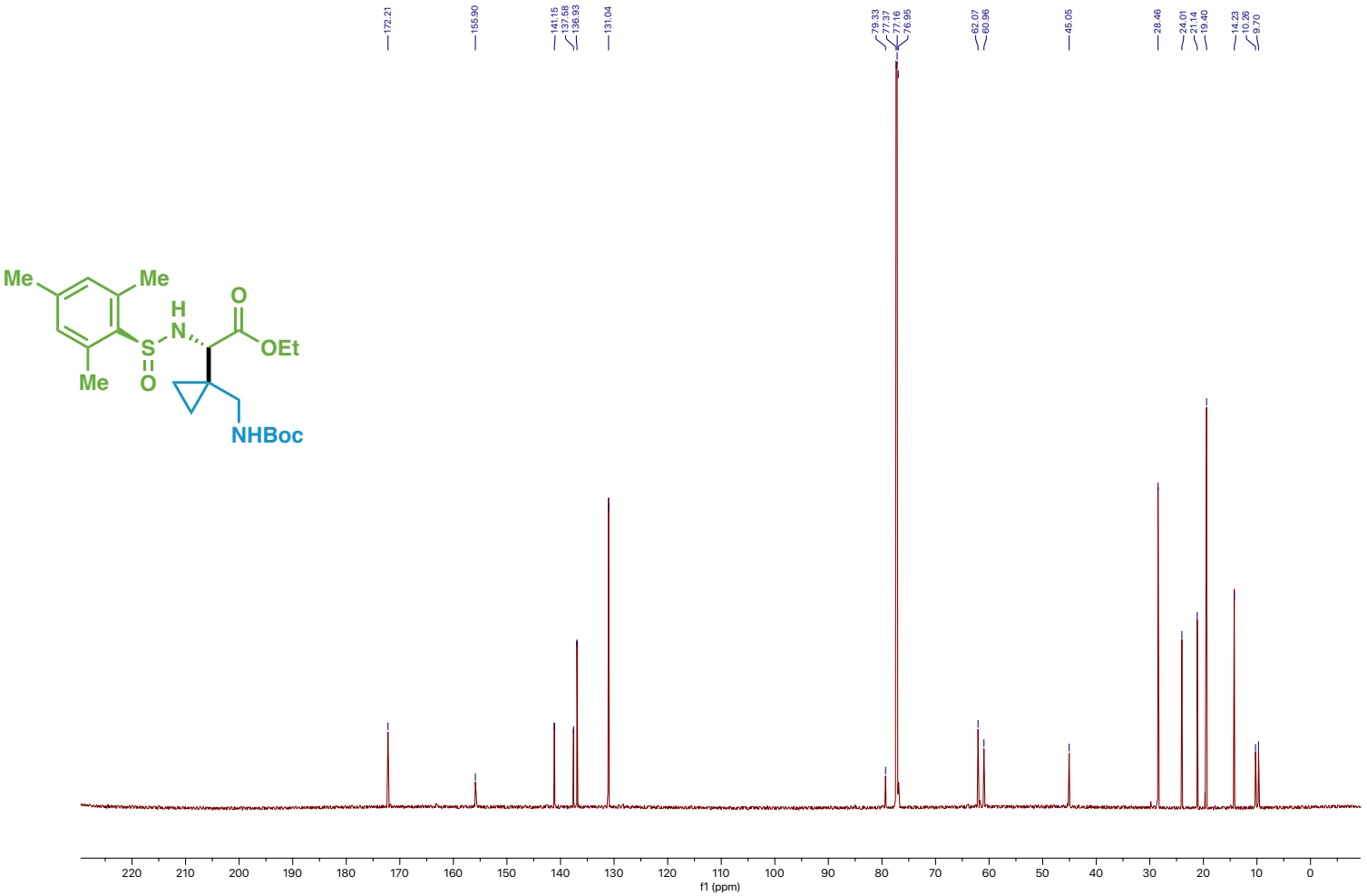
Compound 12 ^{13}C NMR



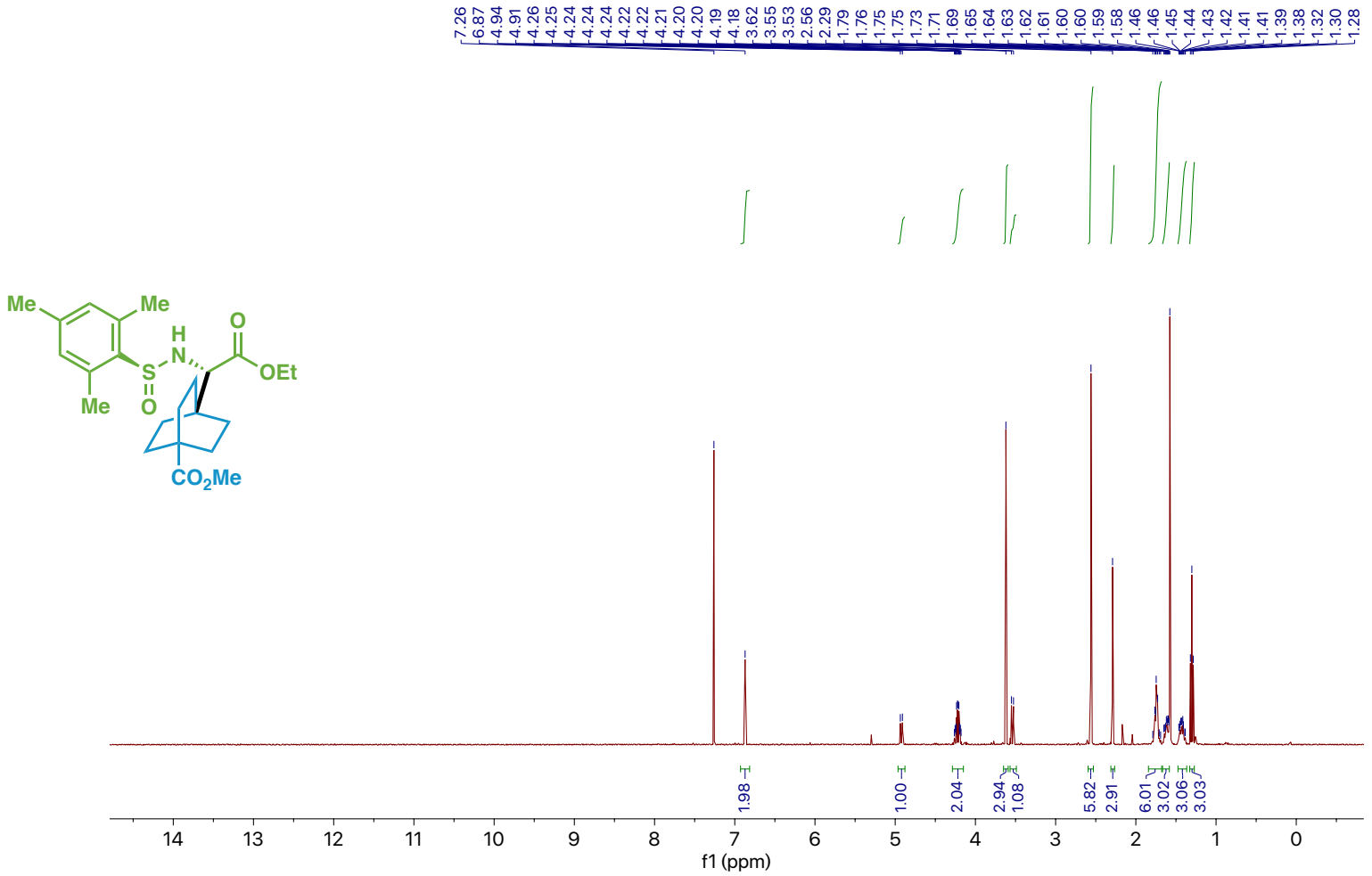
Compound 13 ^{1}H NMR



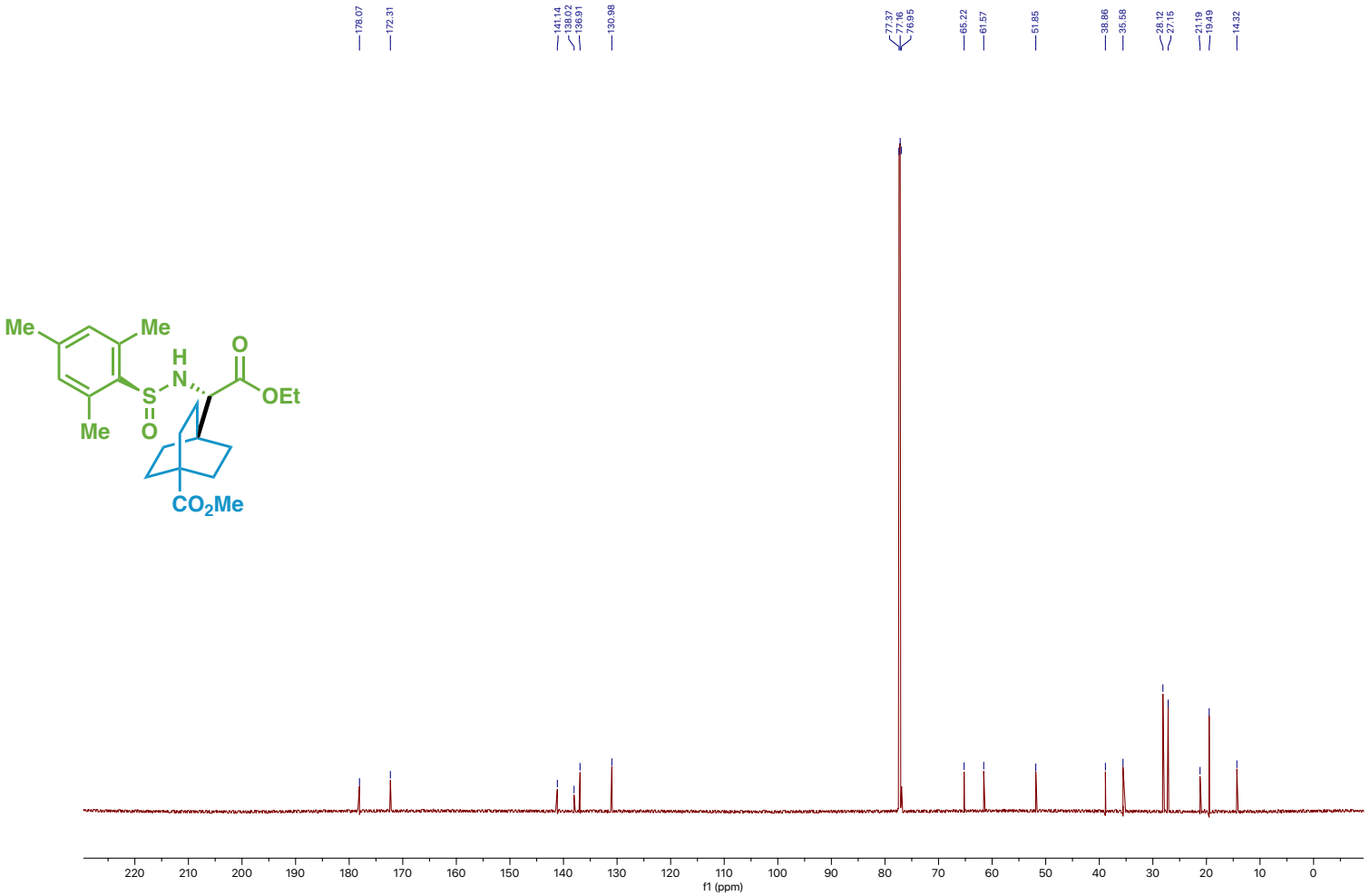
Compound 13 ^{13}C NMR



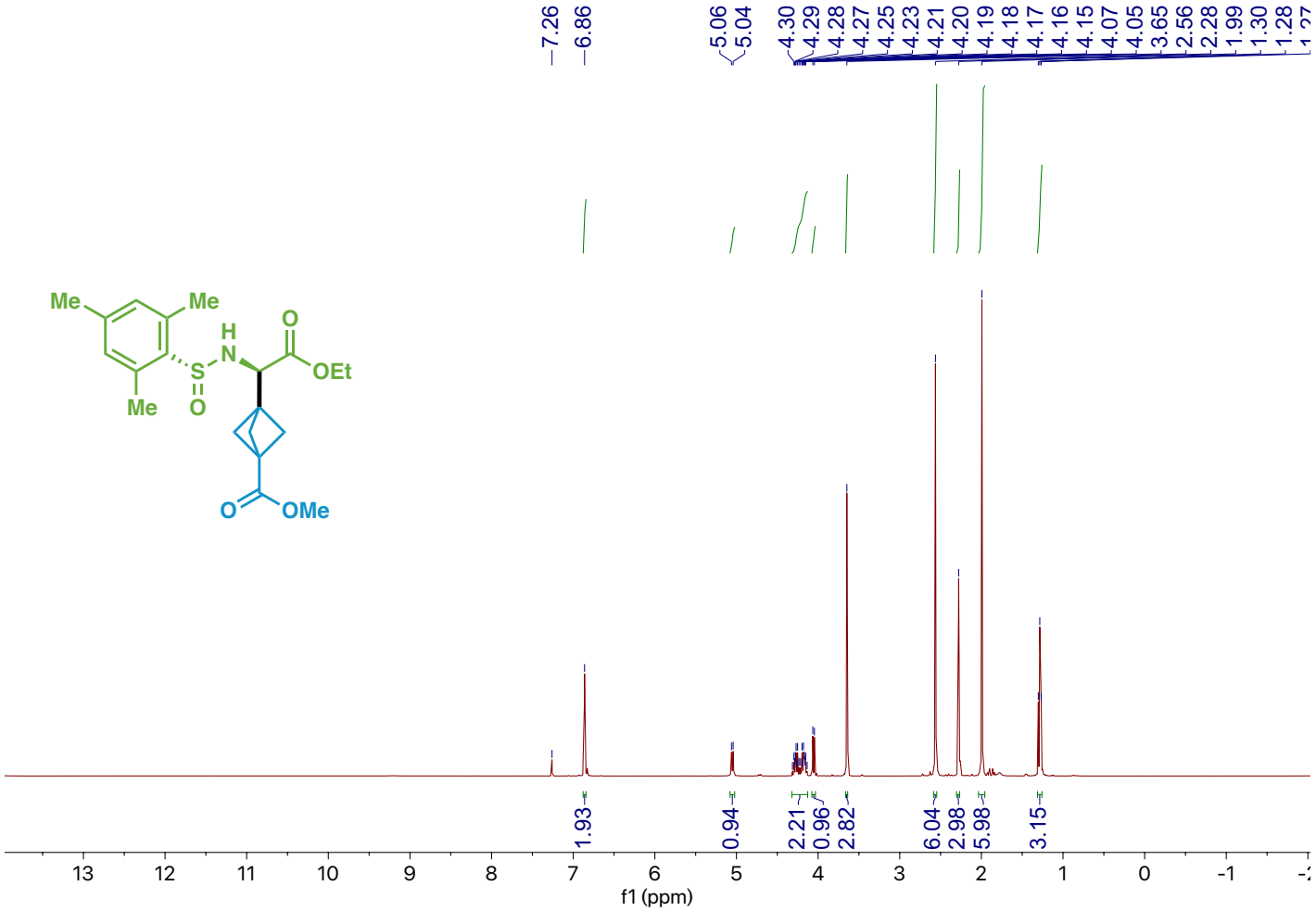
Compound 14 ^{1}H NMR



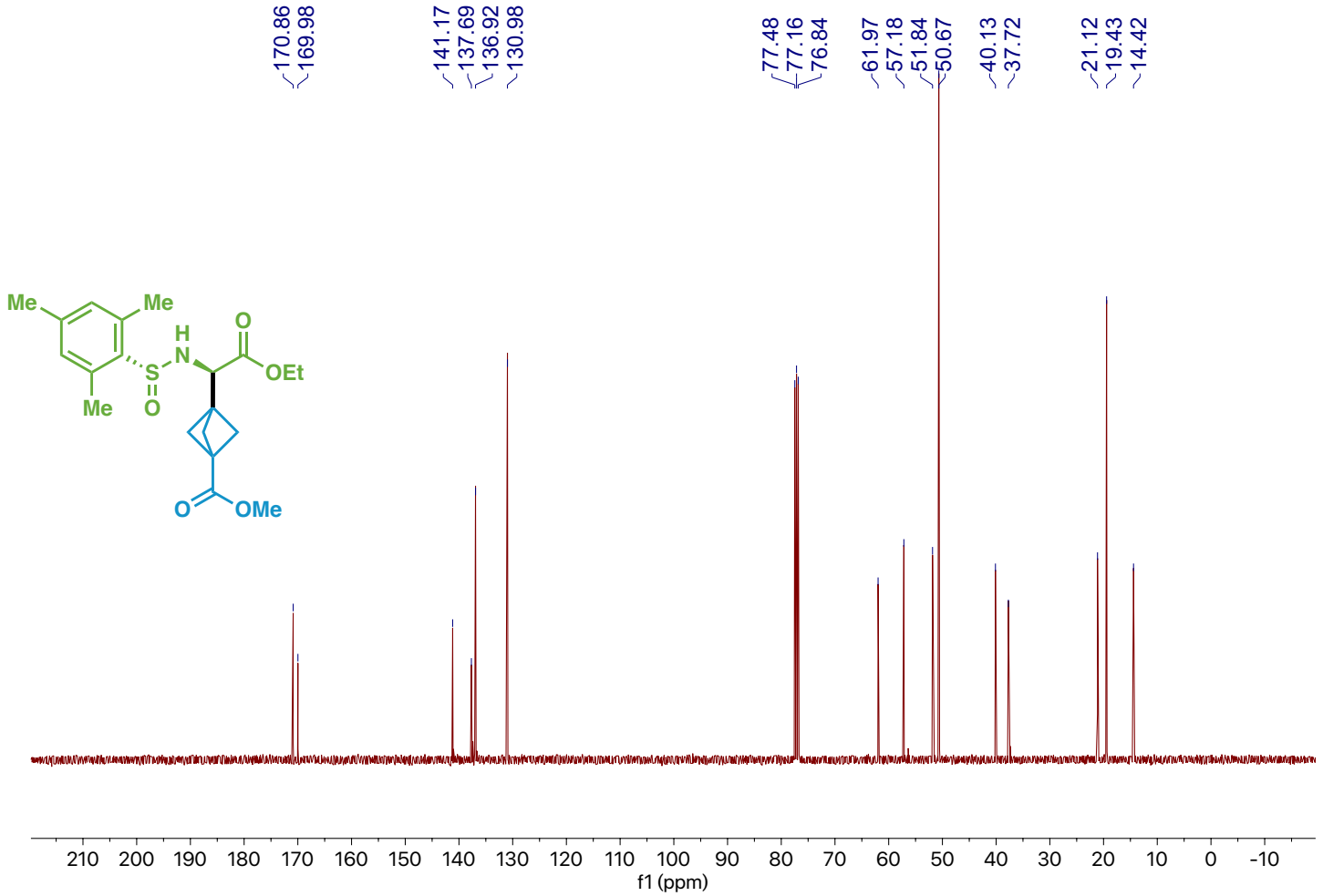
Compound 14 ^{13}C NMR



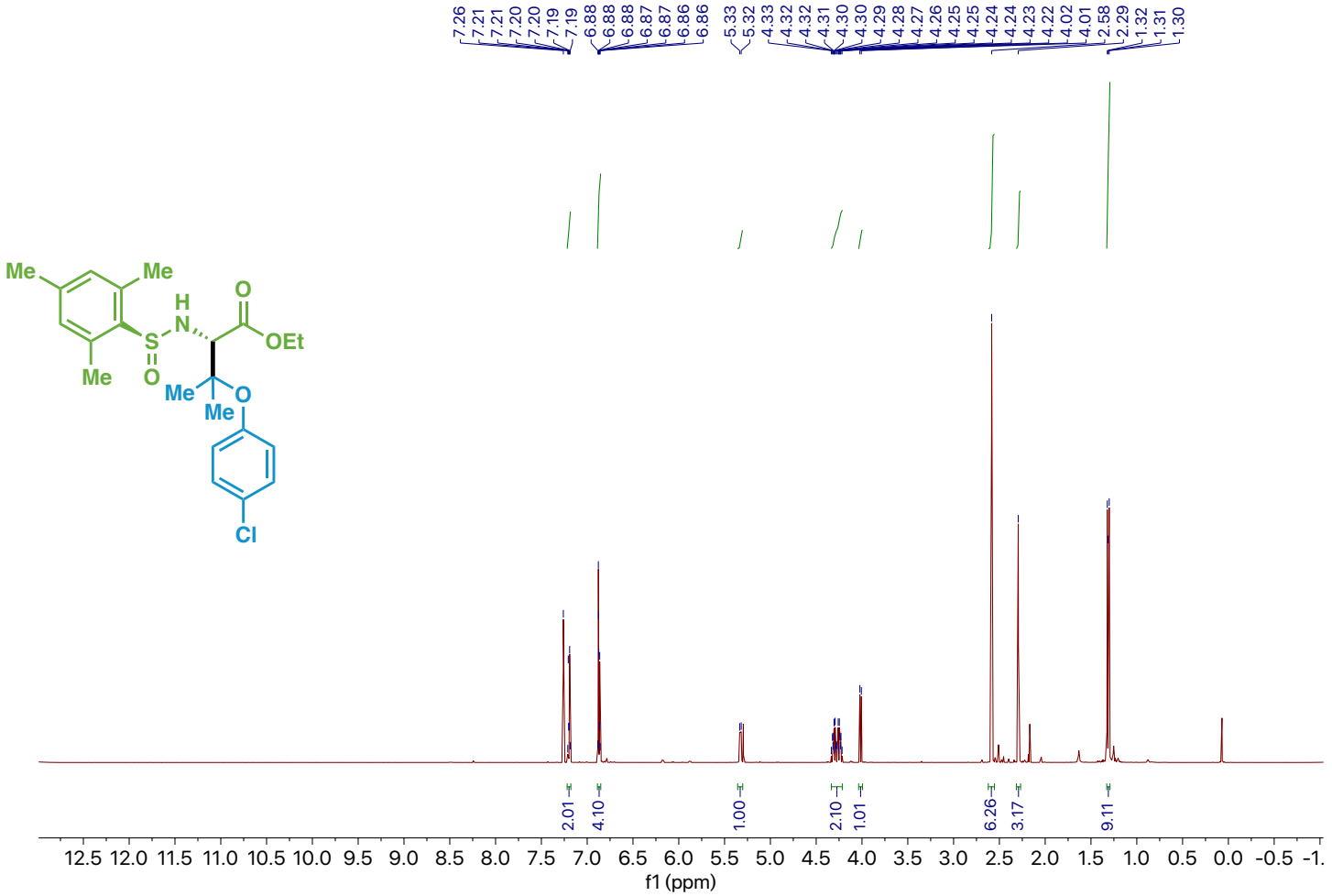
Compound 15 ^{1}H NMR



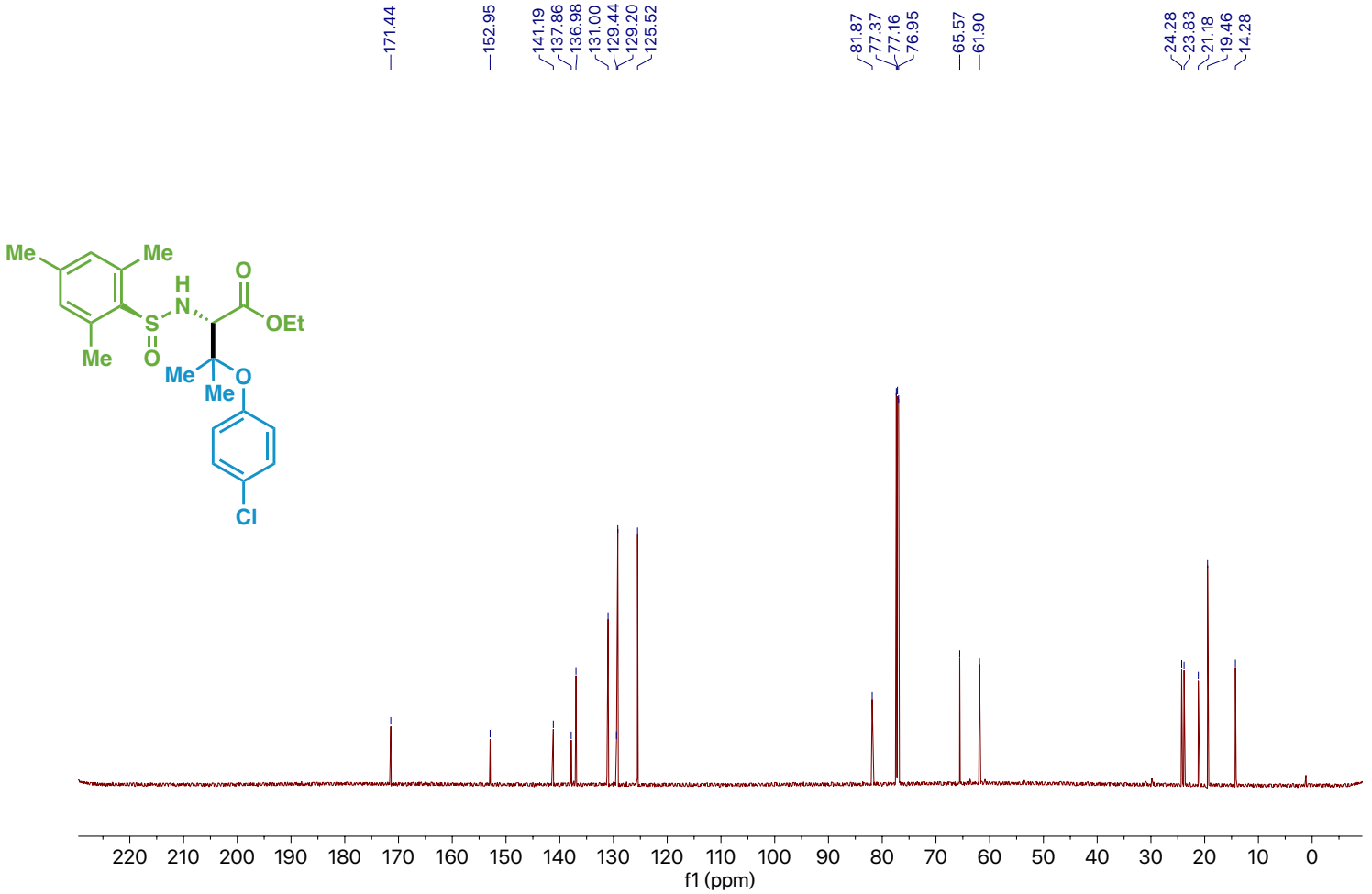
Compound 15 ^{13}C NMR



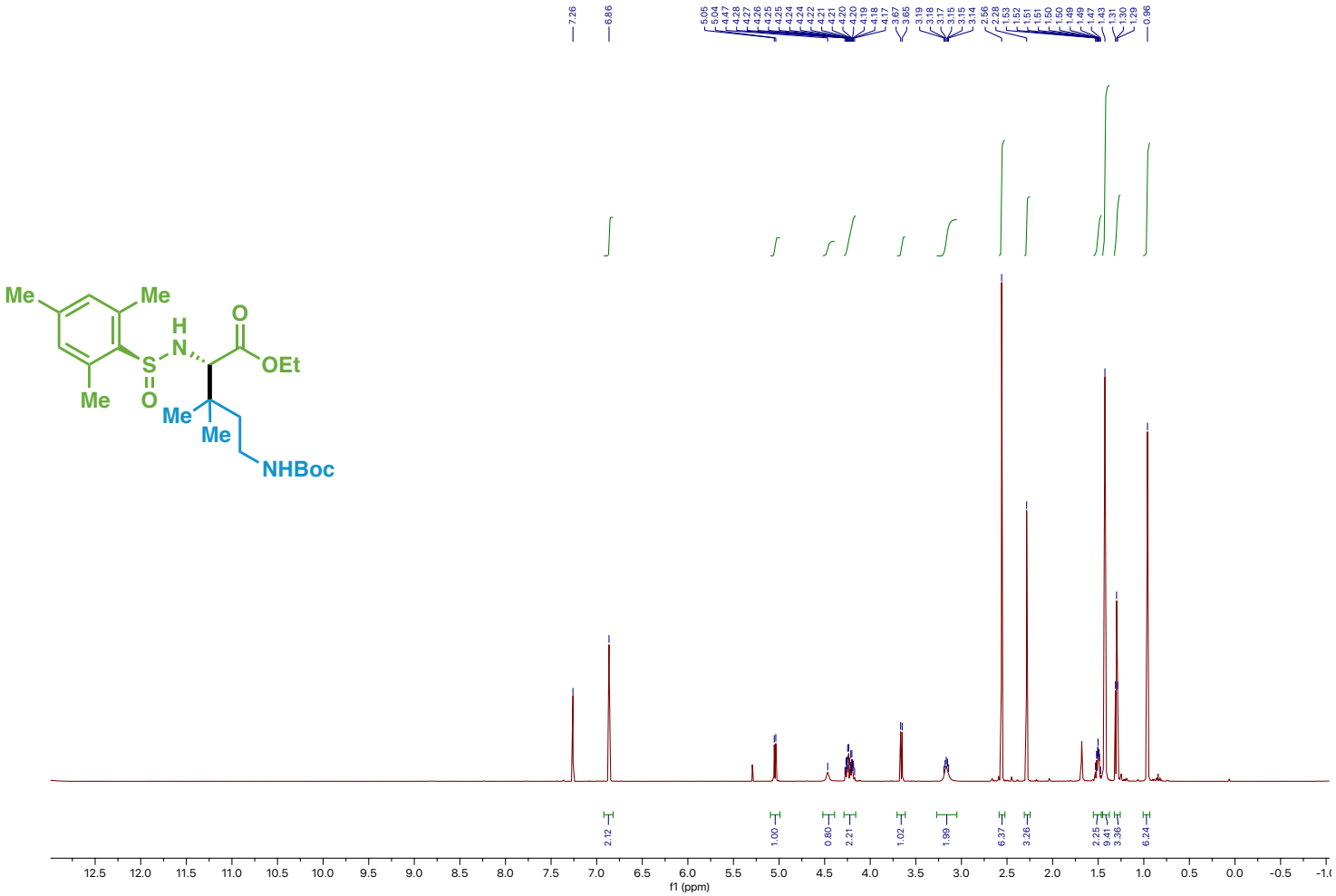
Compound 16 ^{1}H NMR



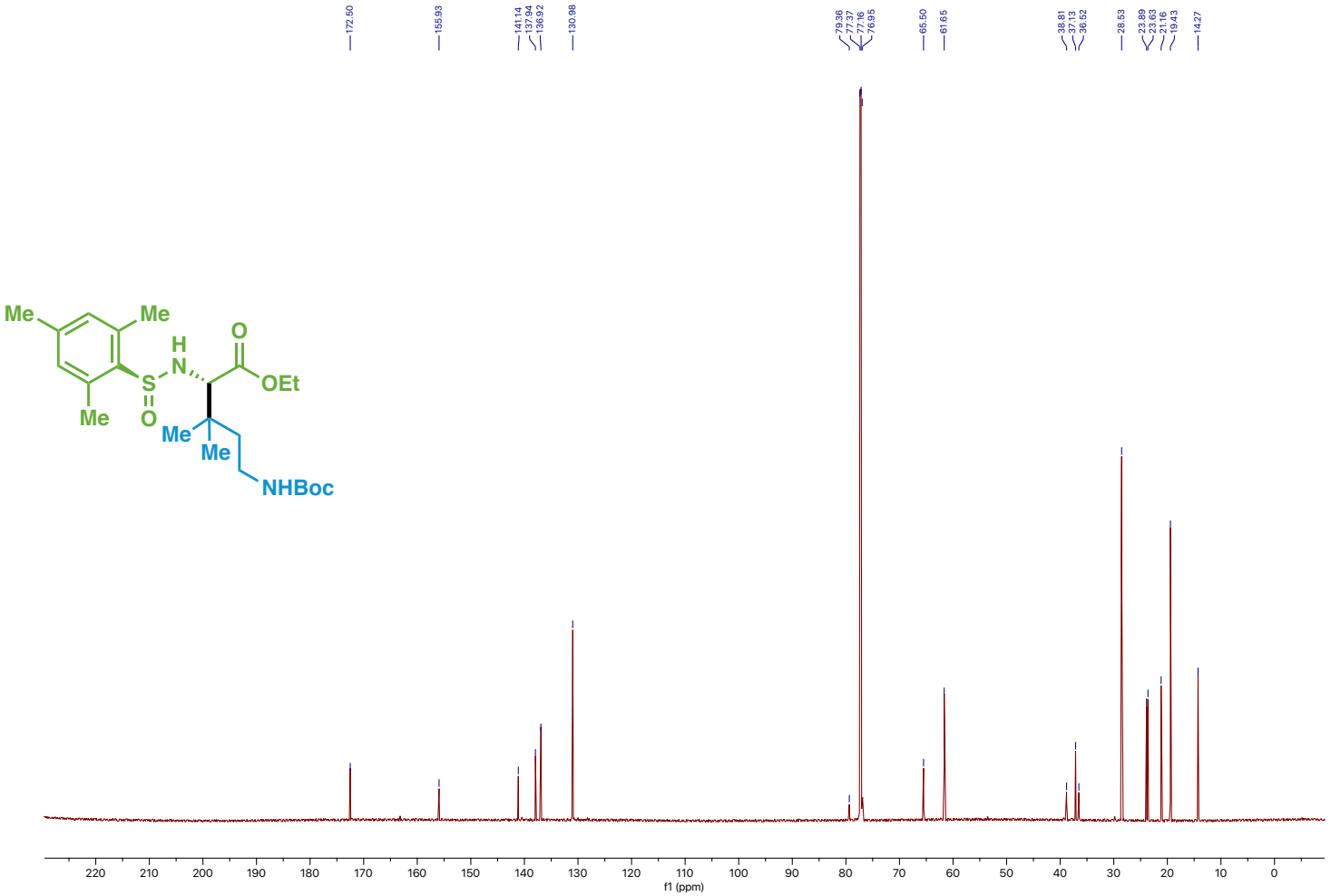
Compound 16 ^{13}C NMR



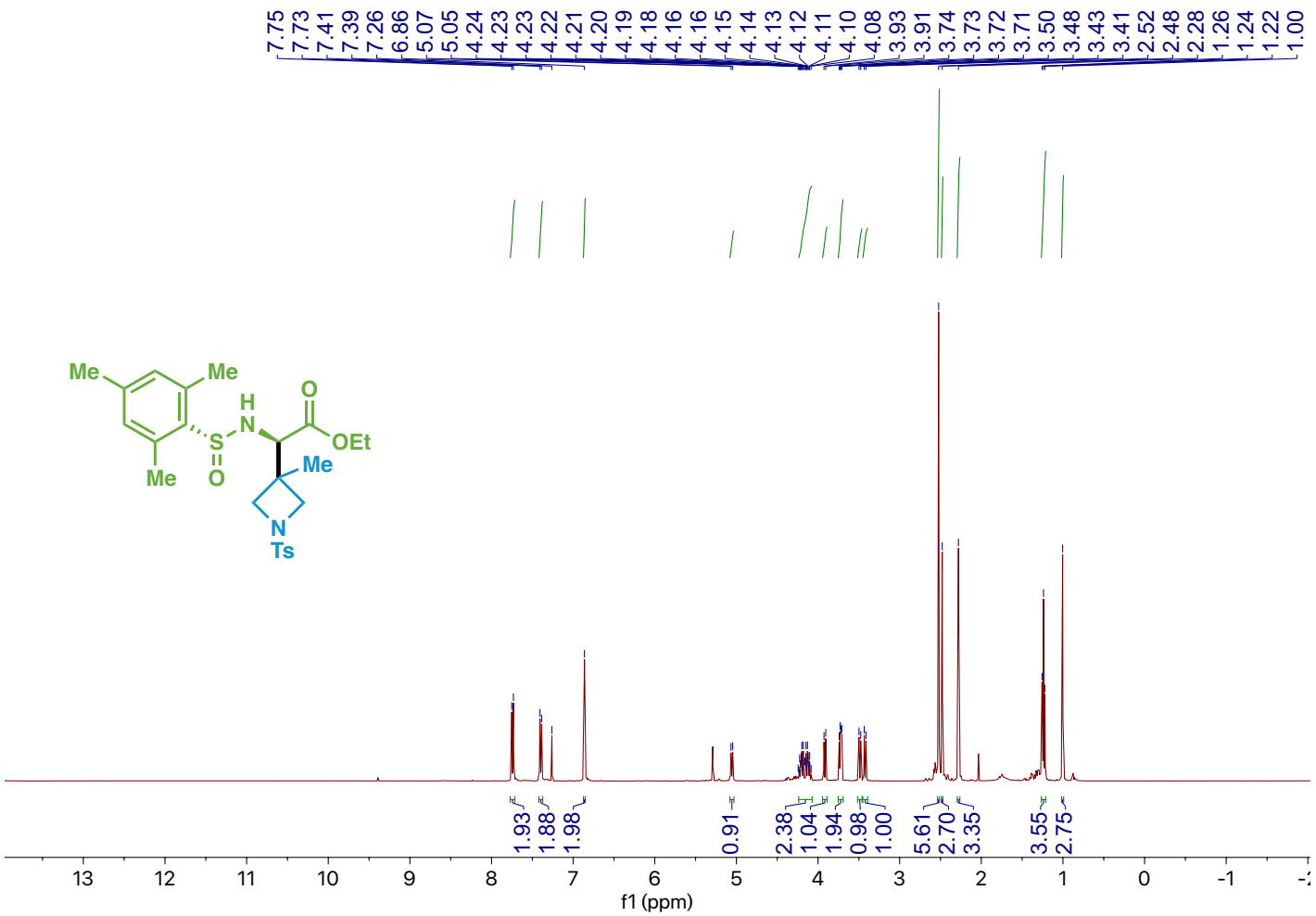
Compound 17 ^{1}H NMR



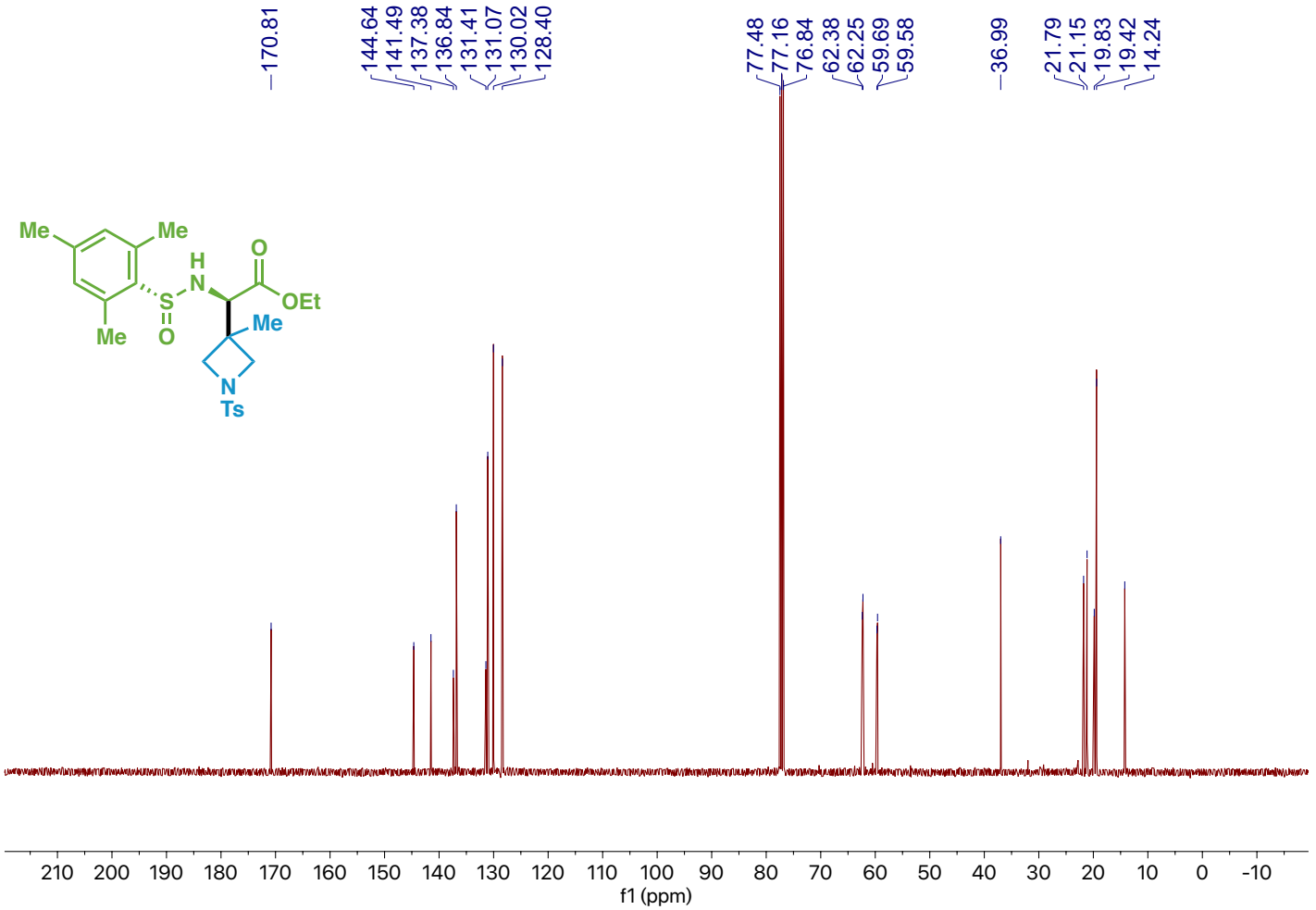
Compound 17 ^{13}C NMR



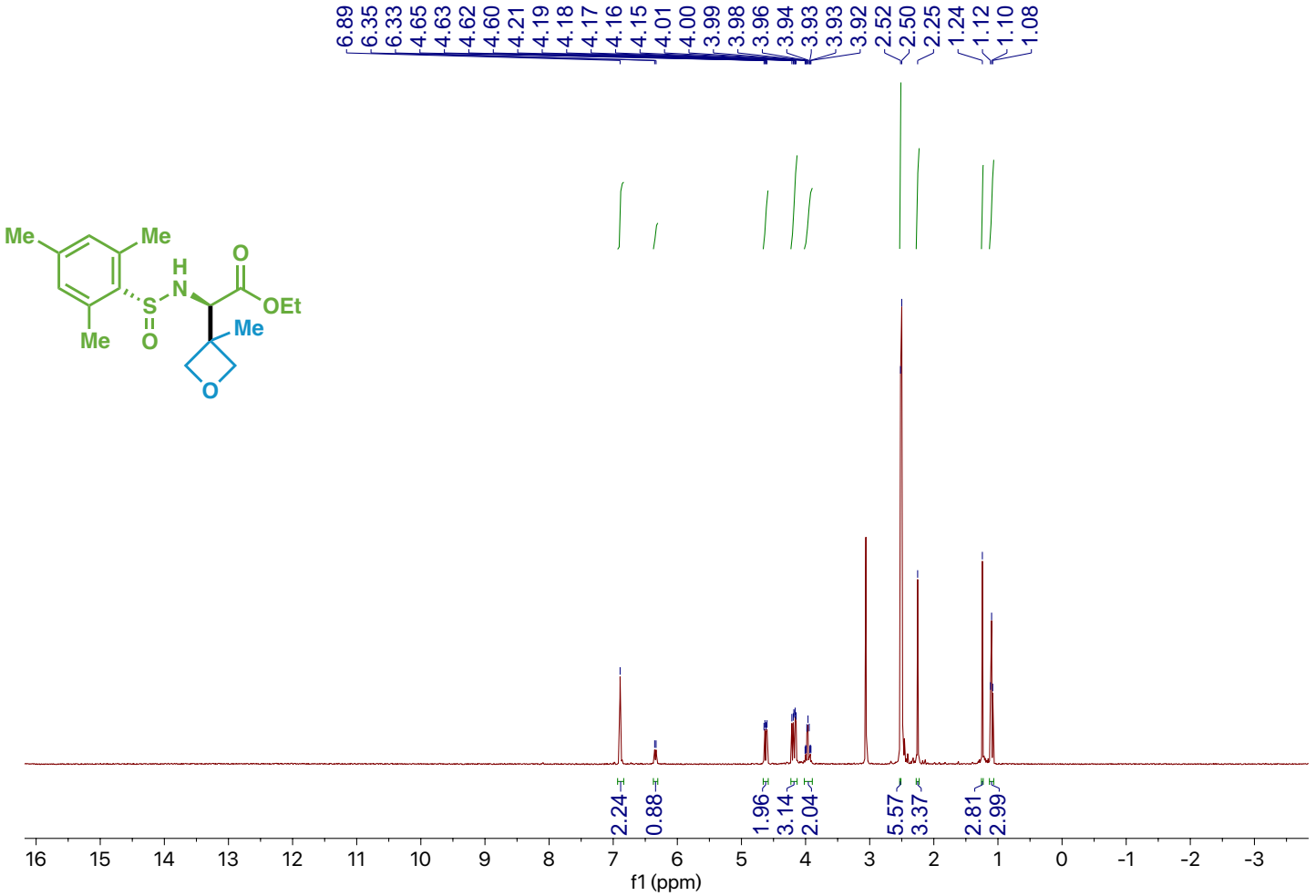
Compound 18 ^{1}H NMR



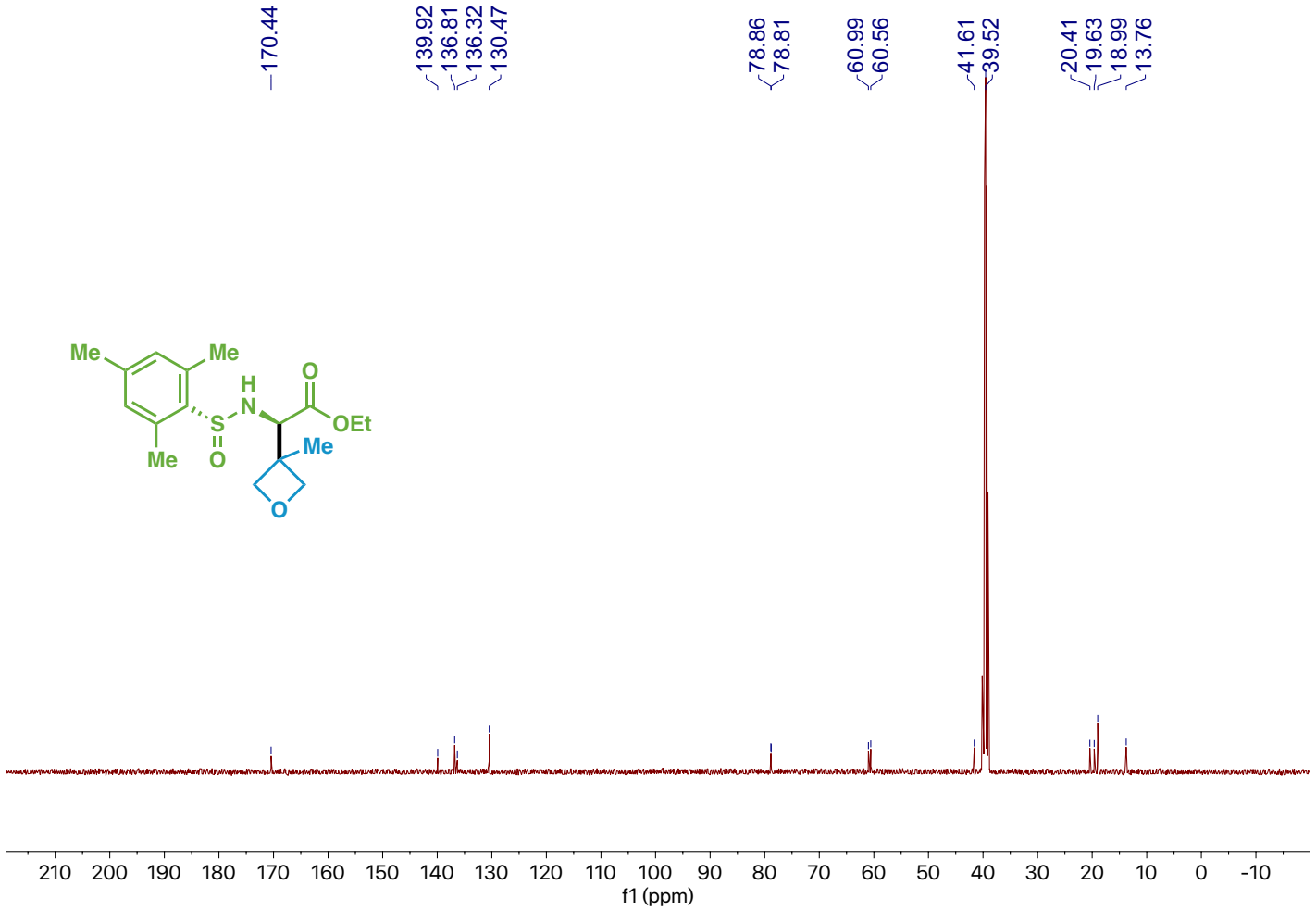
Compound 18 ^{13}C NMR



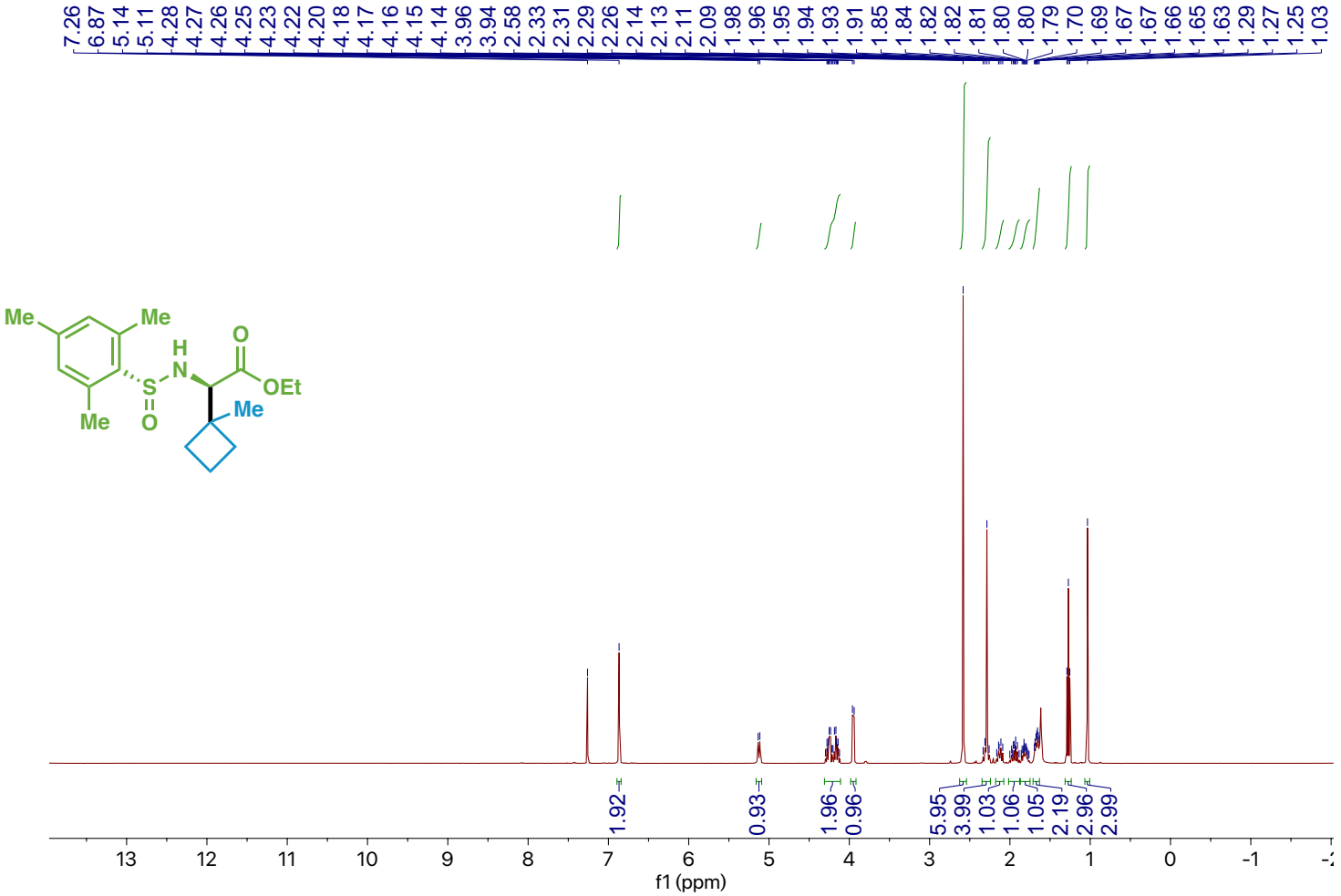
Compound 19 ^{1}H NMR



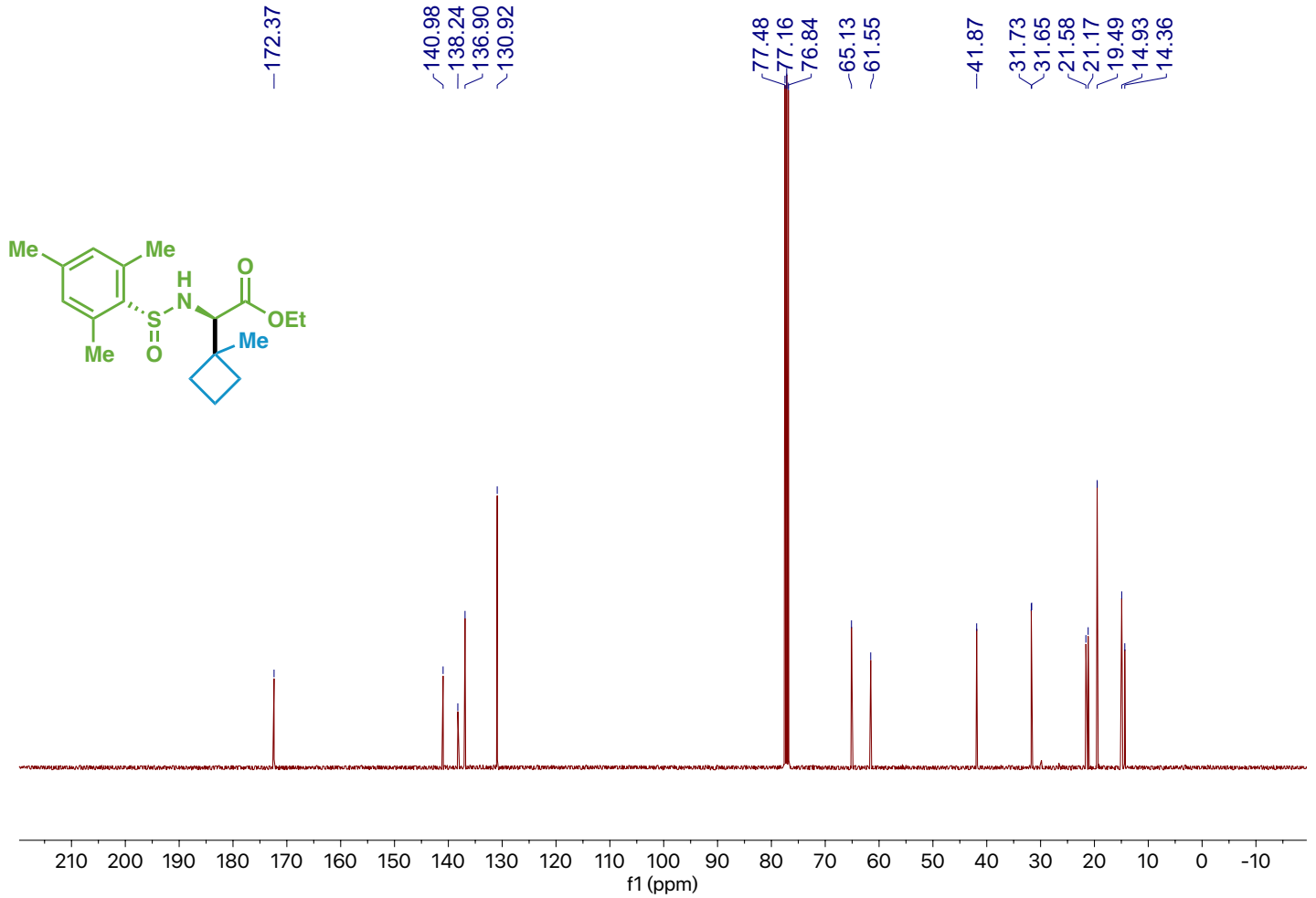
Compound 19 ^{13}C NMR



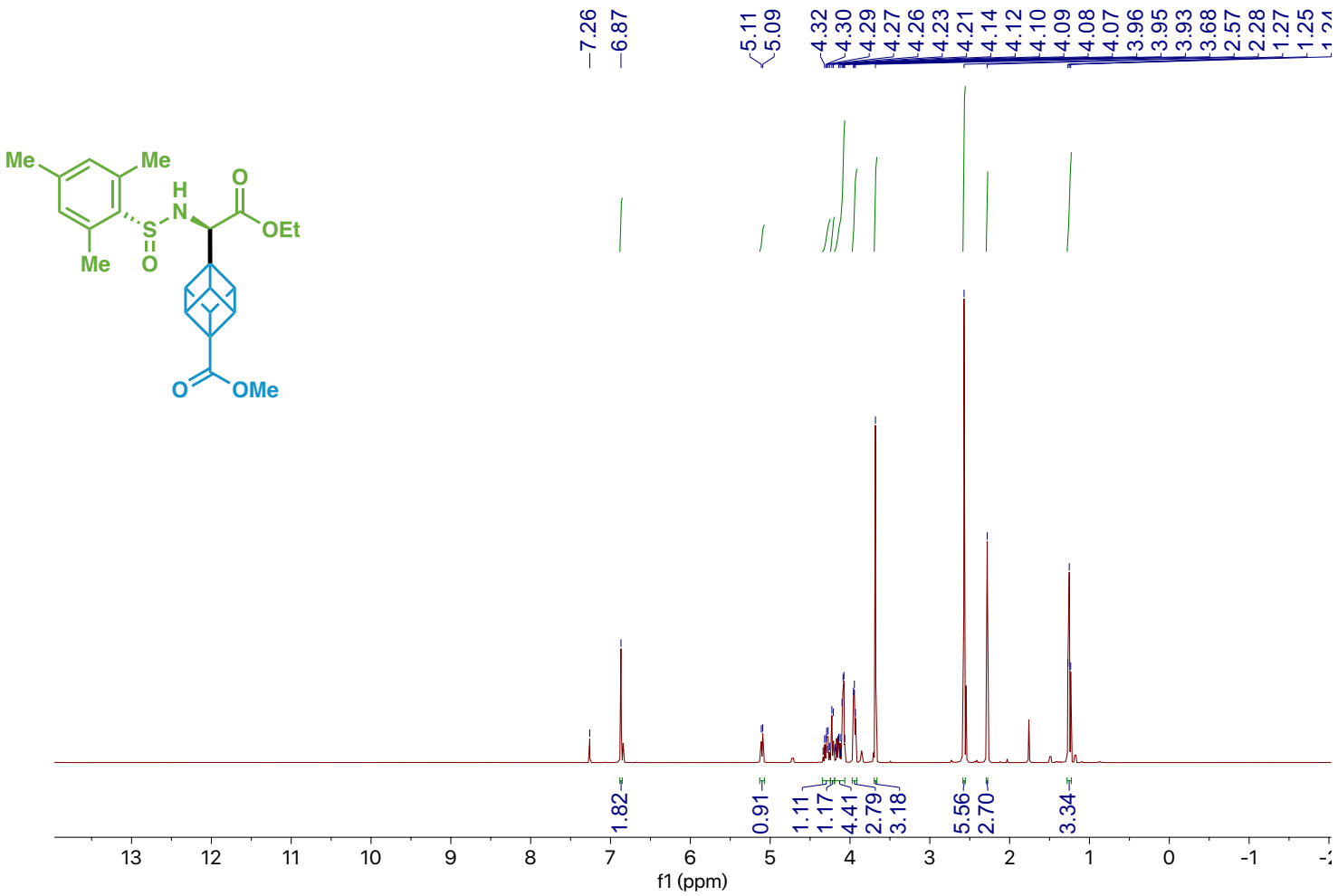
Compound 20 ^{1}H NMR



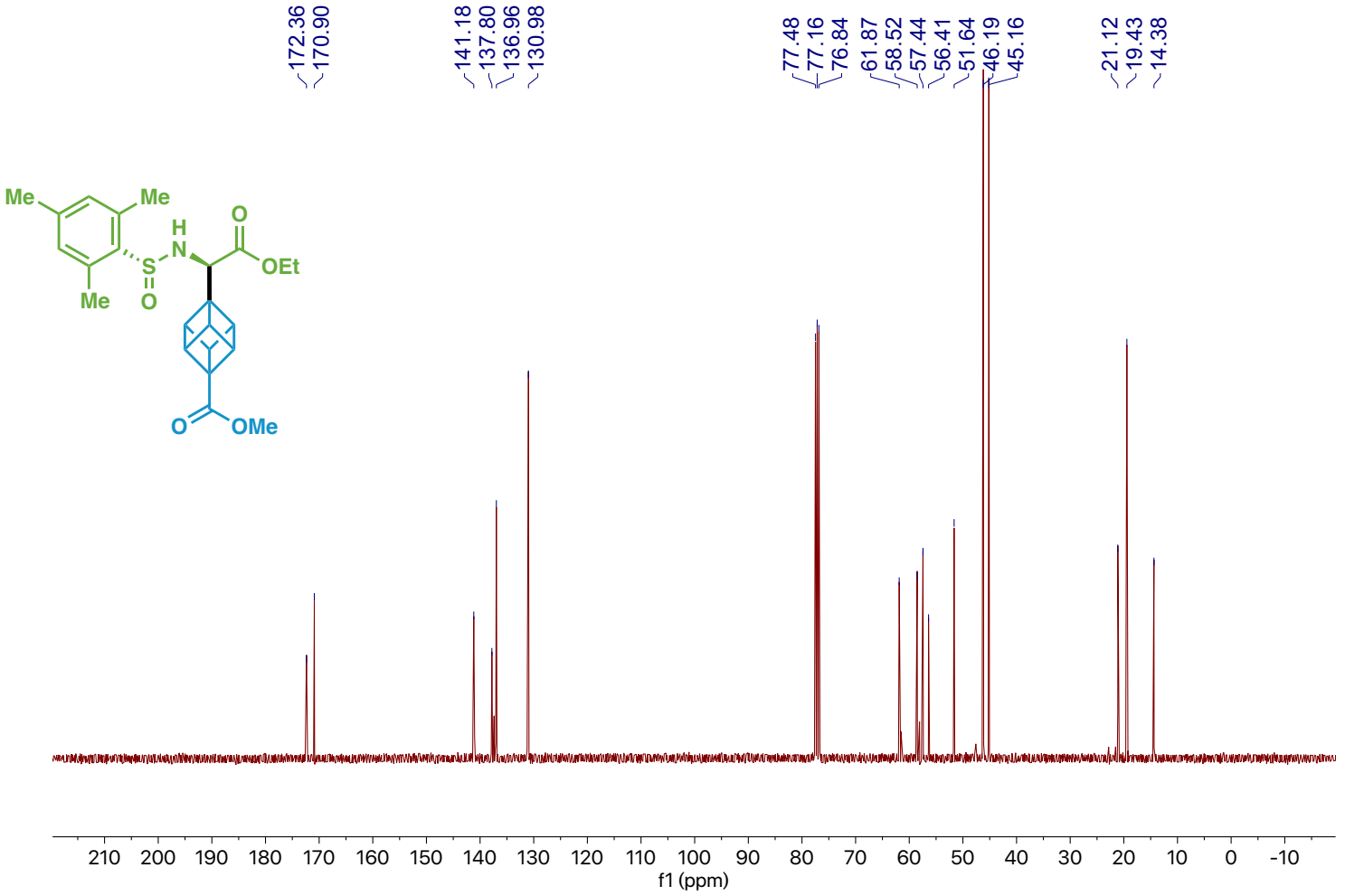
Compound 20 ^{13}C NMR



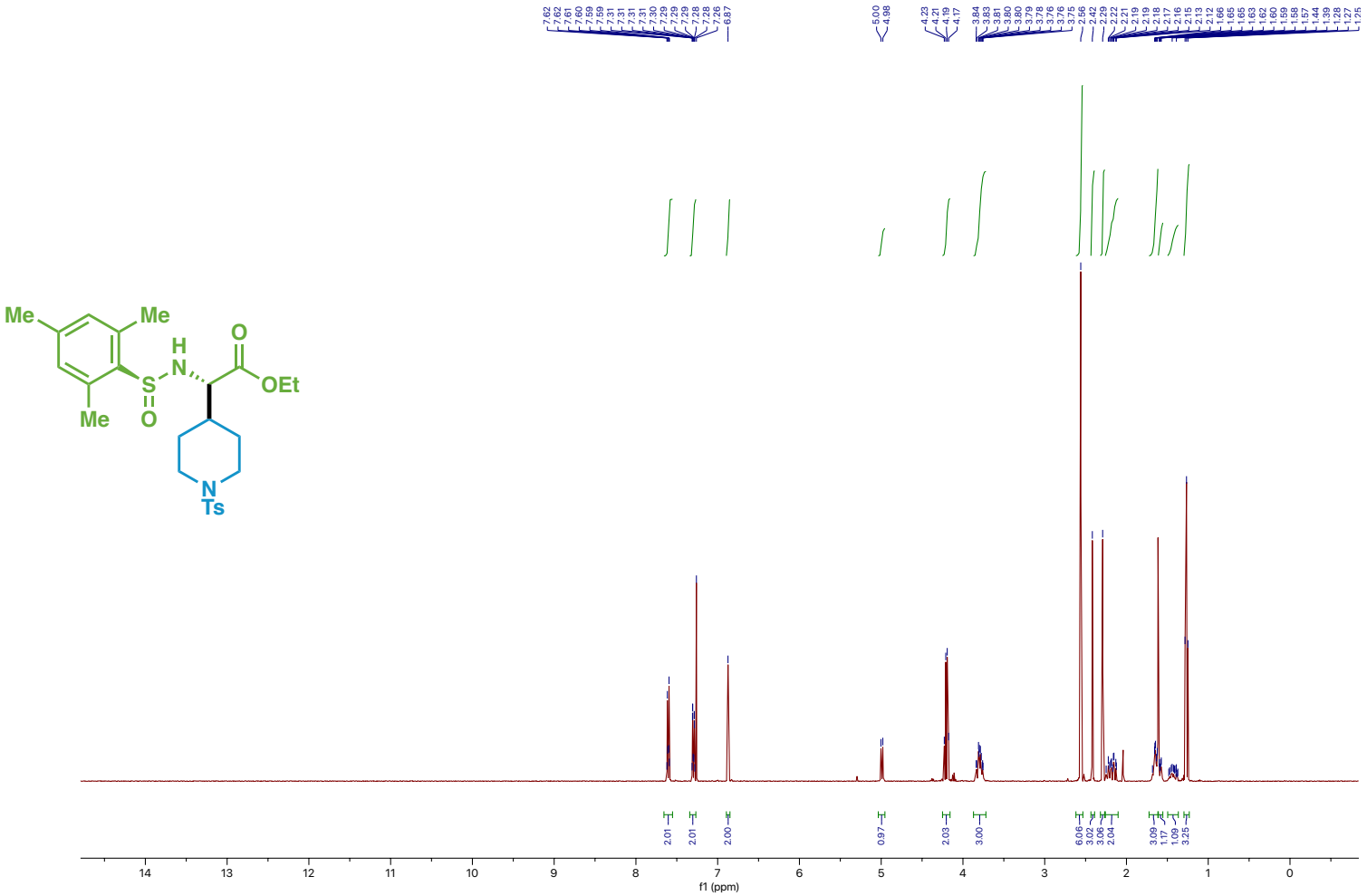
Compound 21 ^{1}H NMR



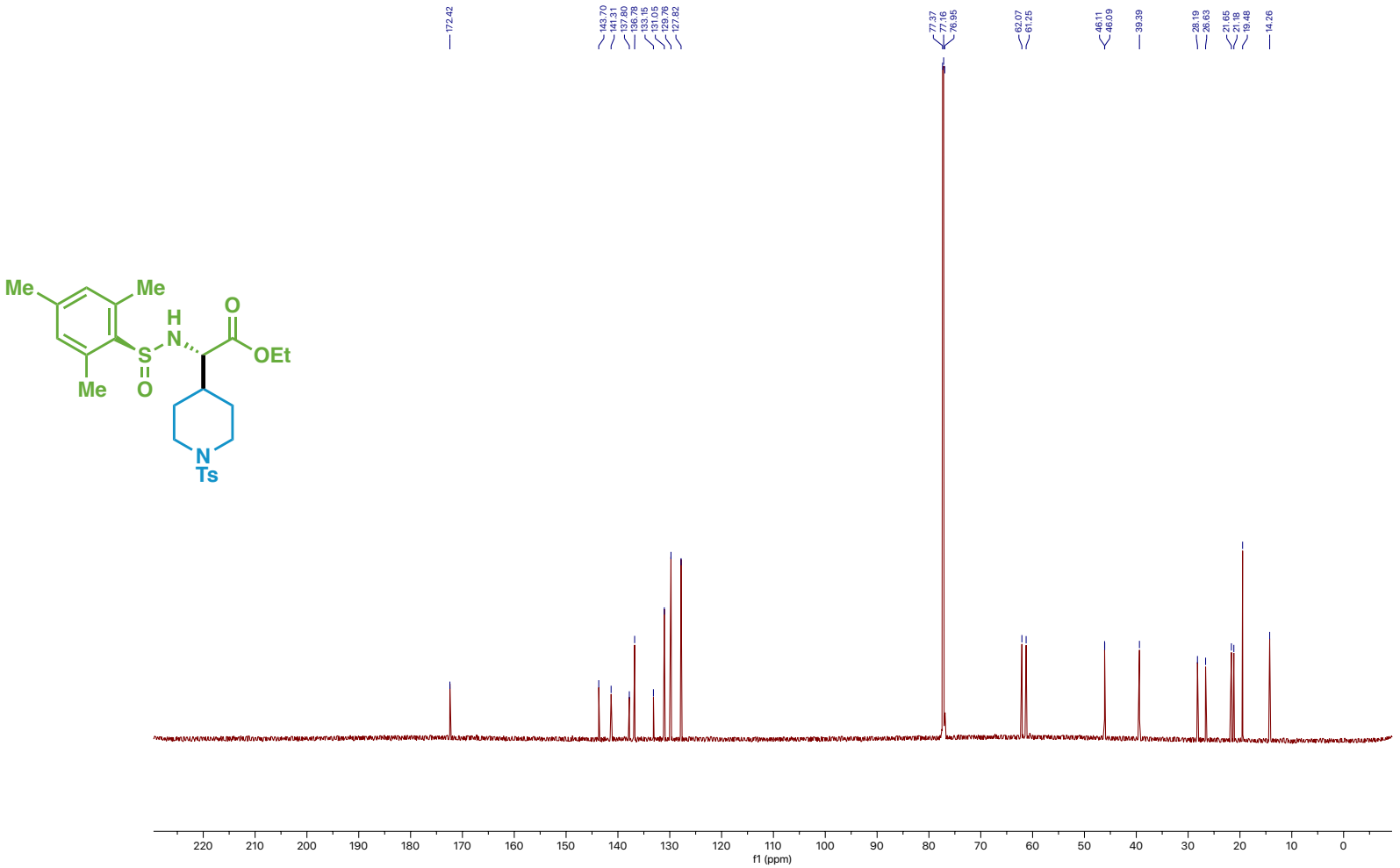
Compound 21 ^{13}C NMR



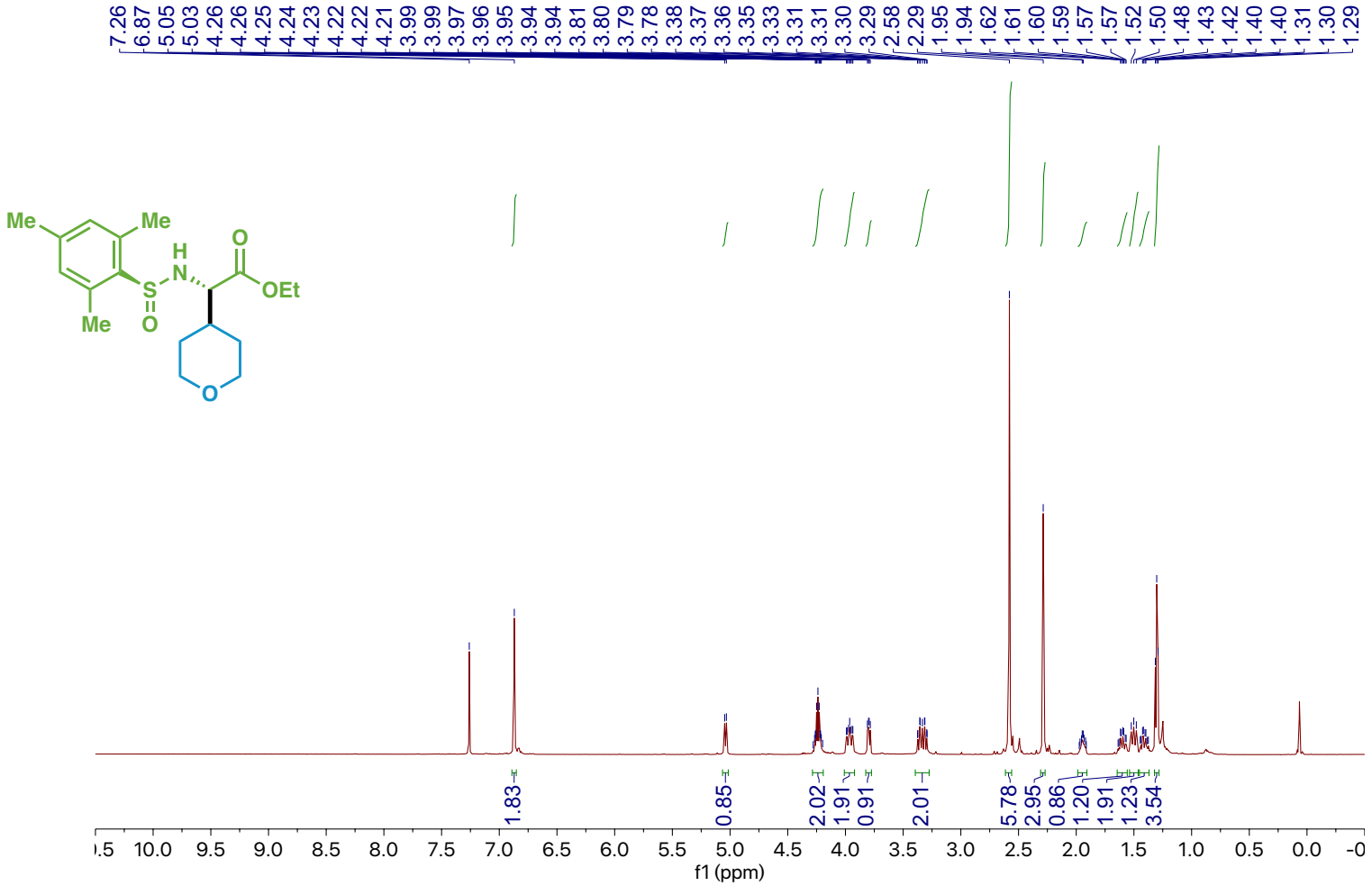
Compound 22 ^{1}H NMR



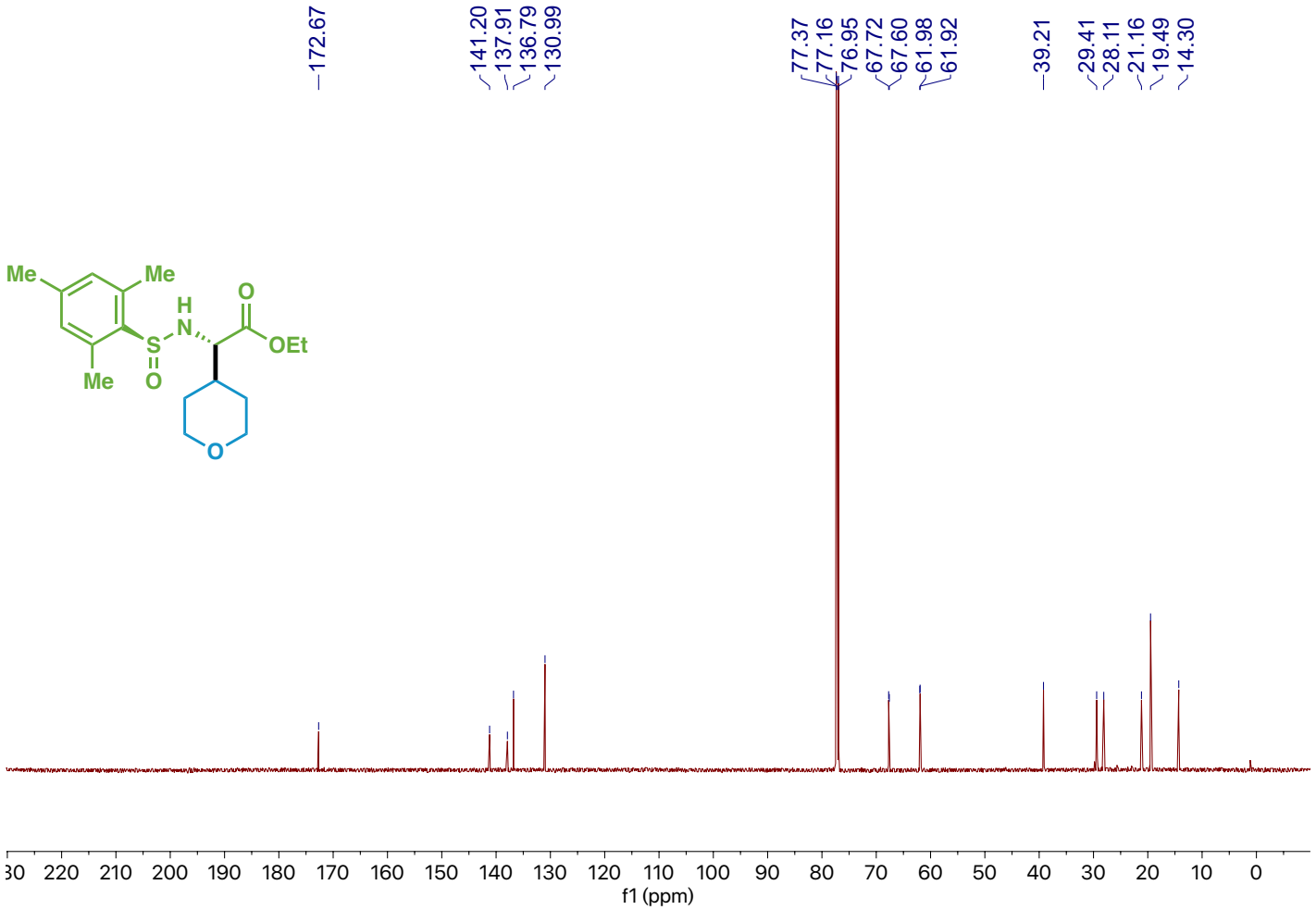
Compound 22 ^{13}C NMR



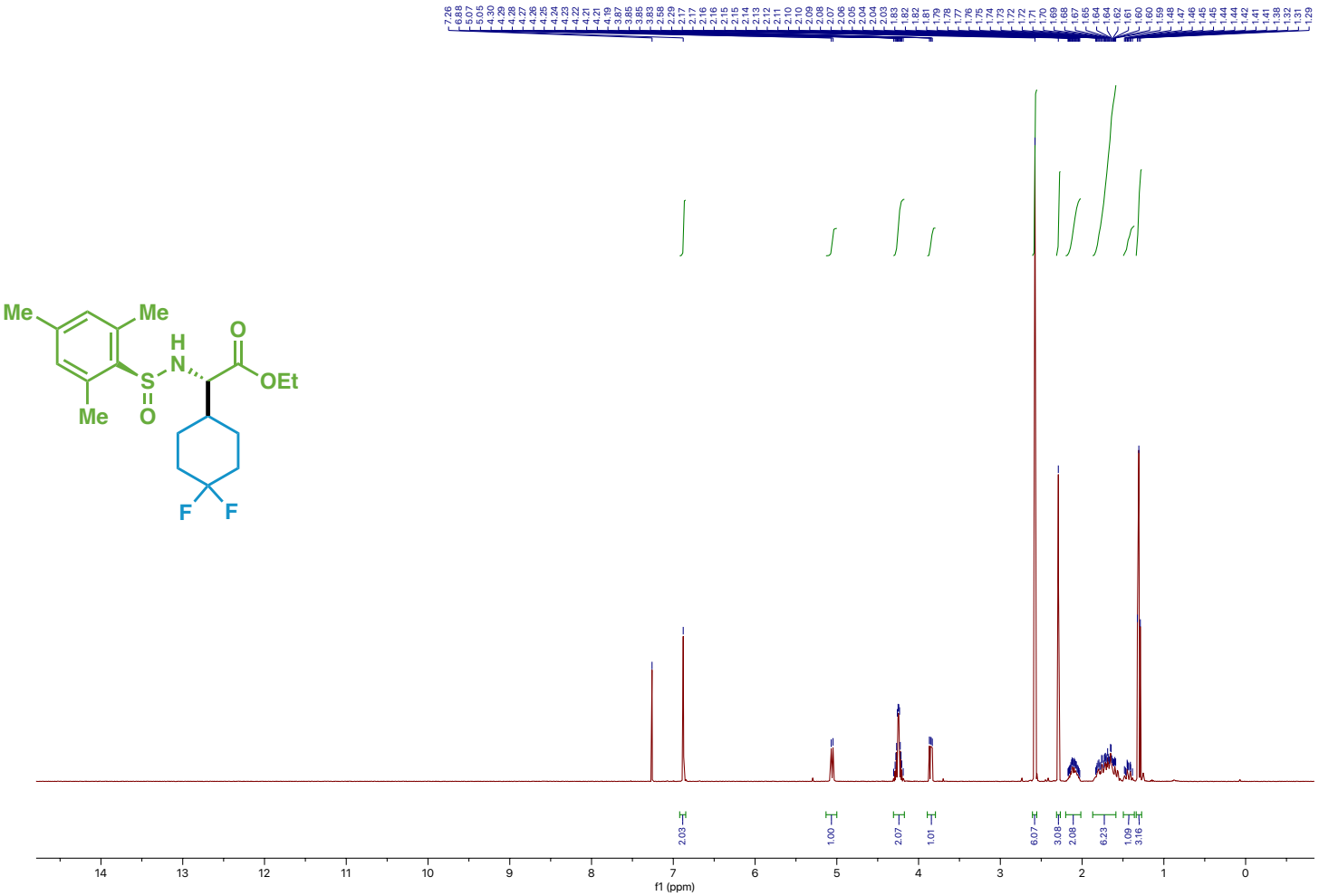
Compound 23 ^{1}H NMR



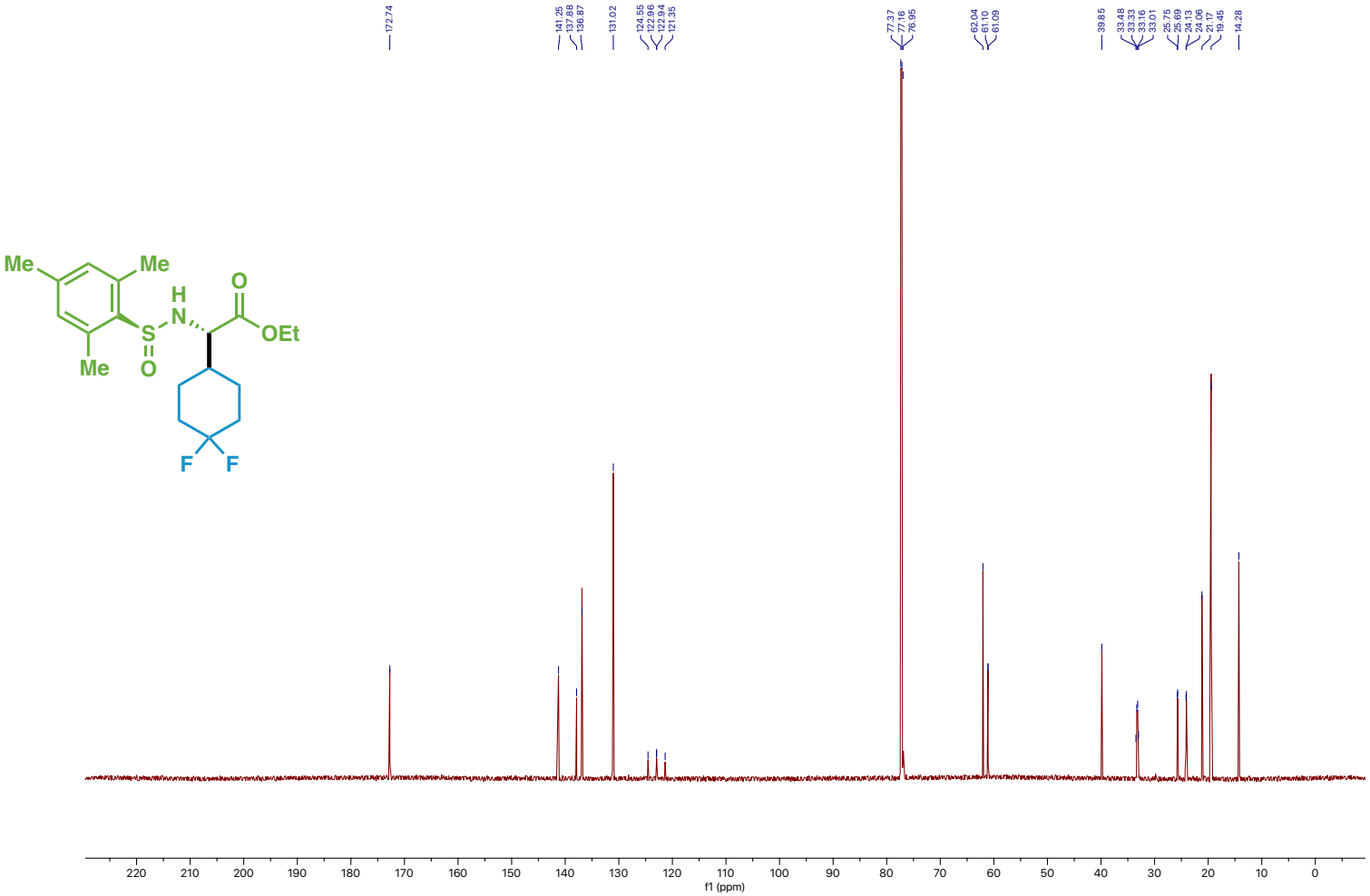
Compound 23 ^{13}C NMR



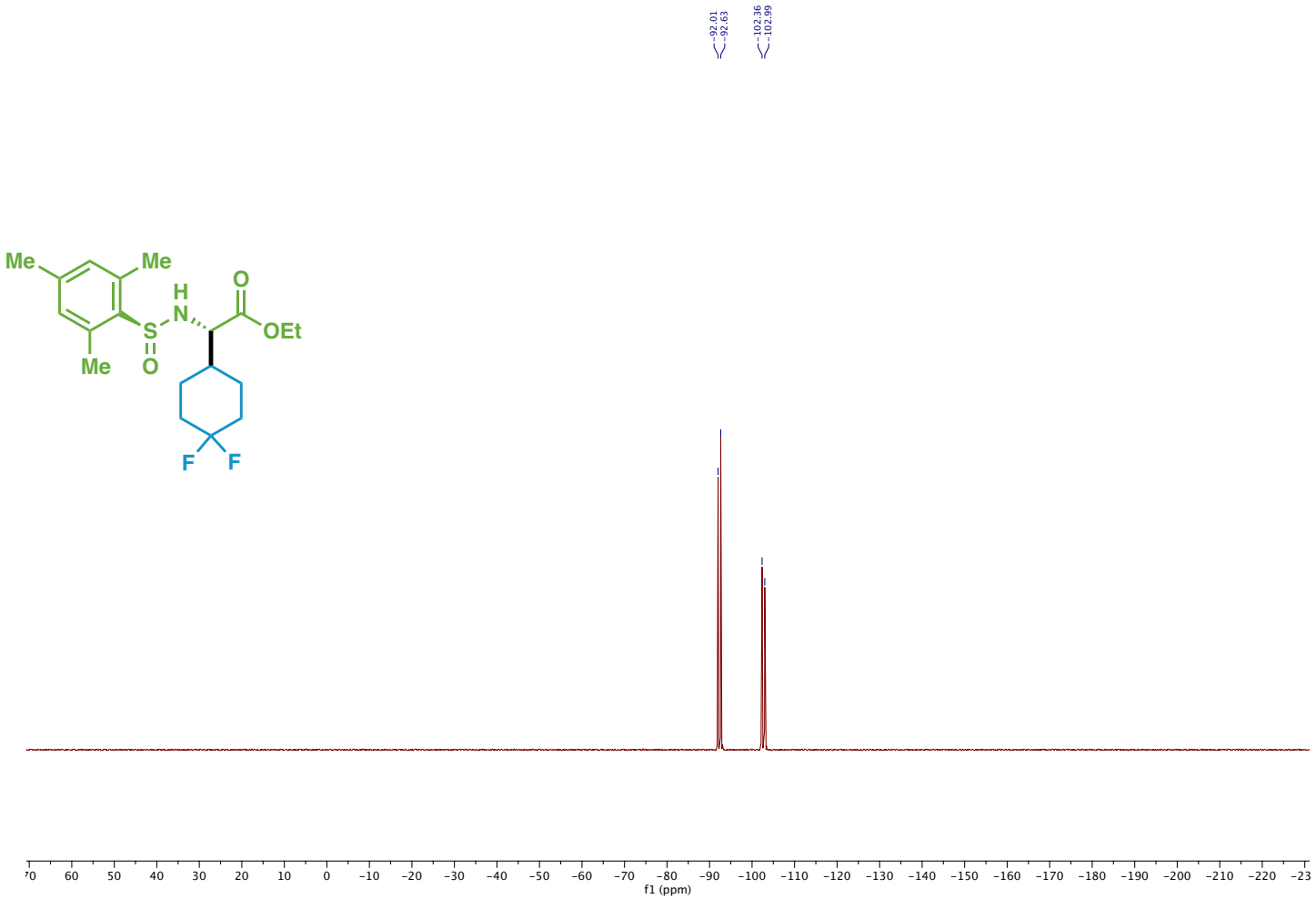
Compound 24 ^{1}H NMR



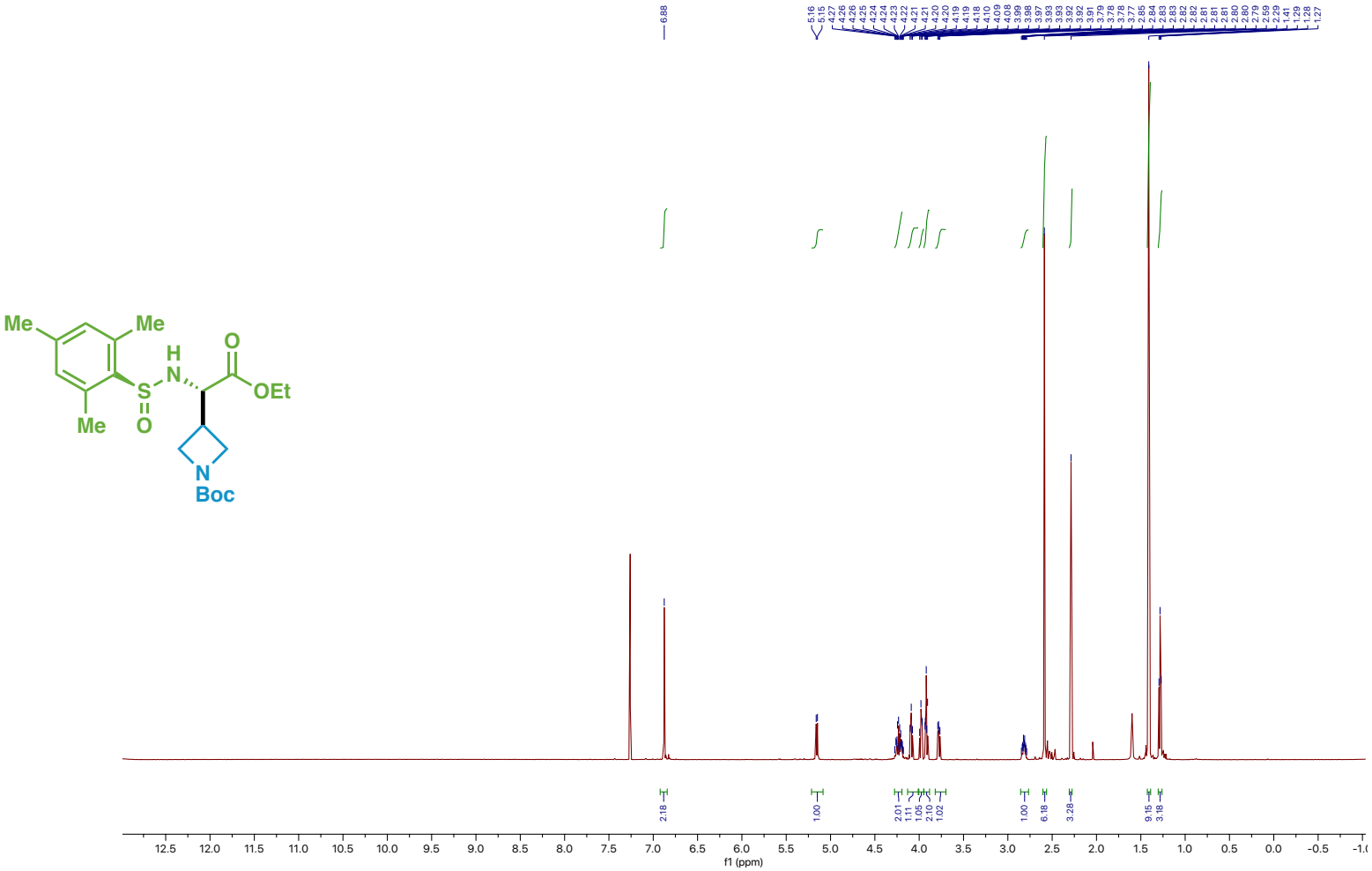
Compound 24 ^{13}C NMR



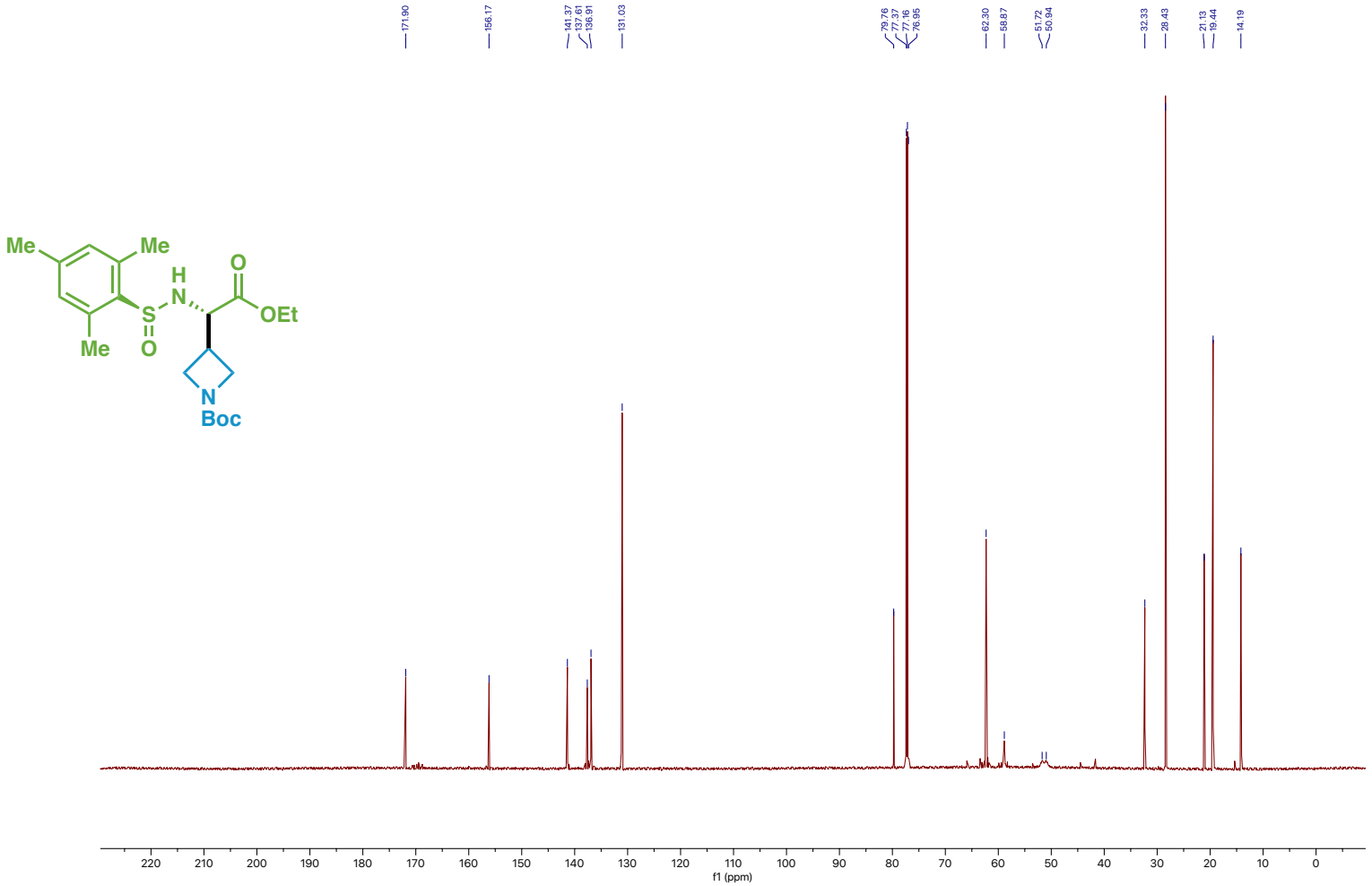
Compound 24 ^{19}F NMR



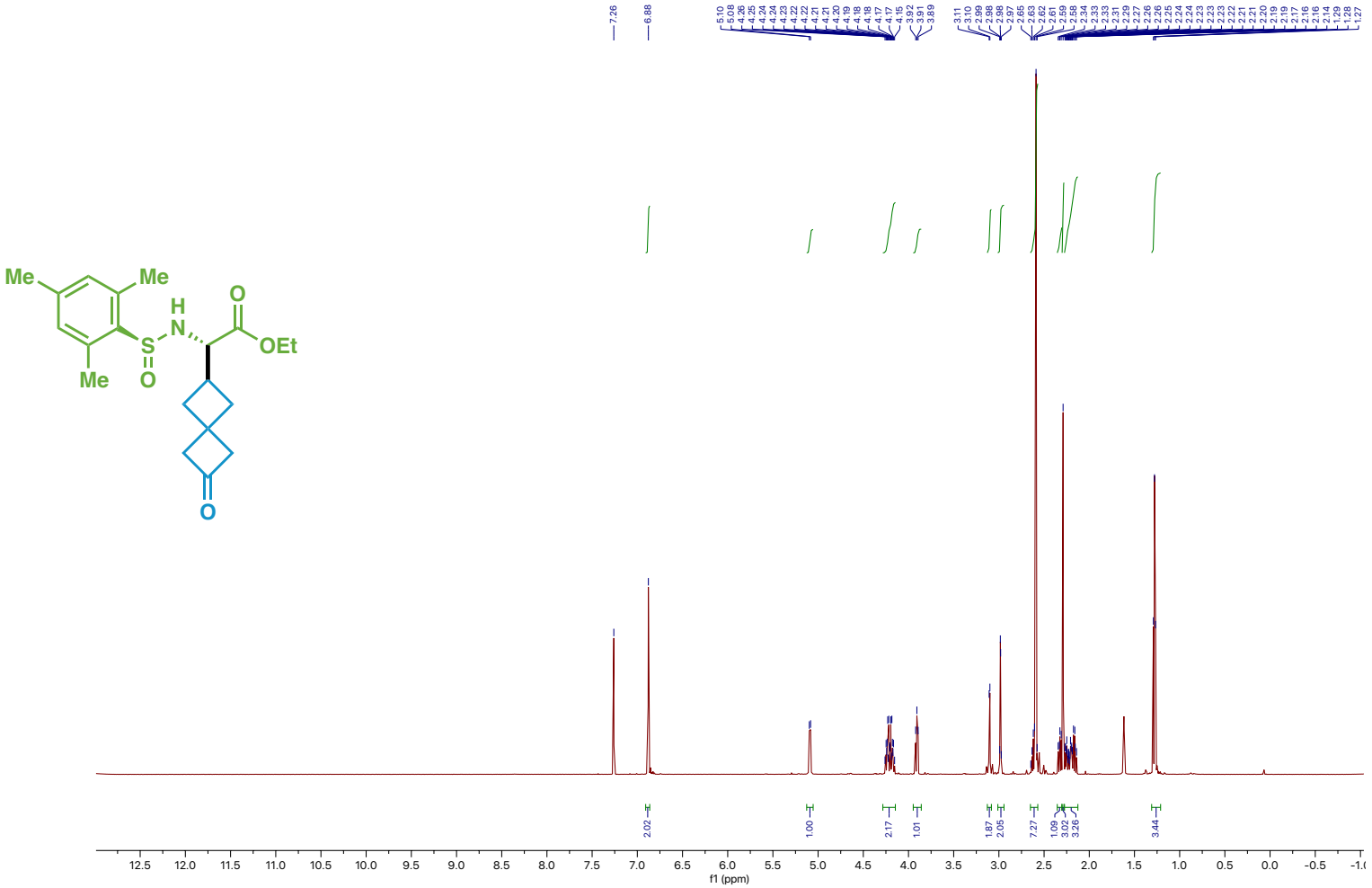
Compound 25 ^{1}H NMR



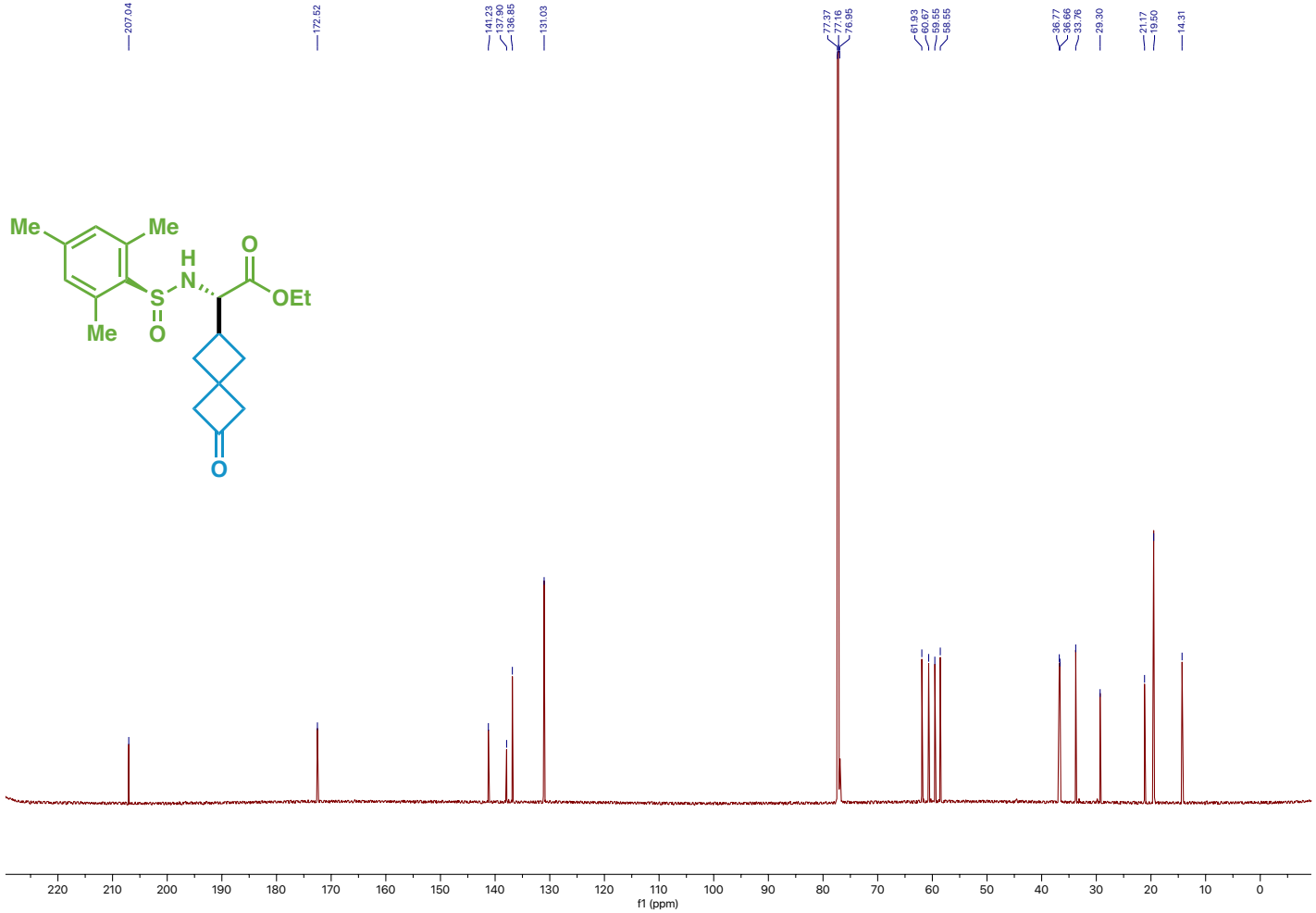
Compound 25 ^{13}C NMR



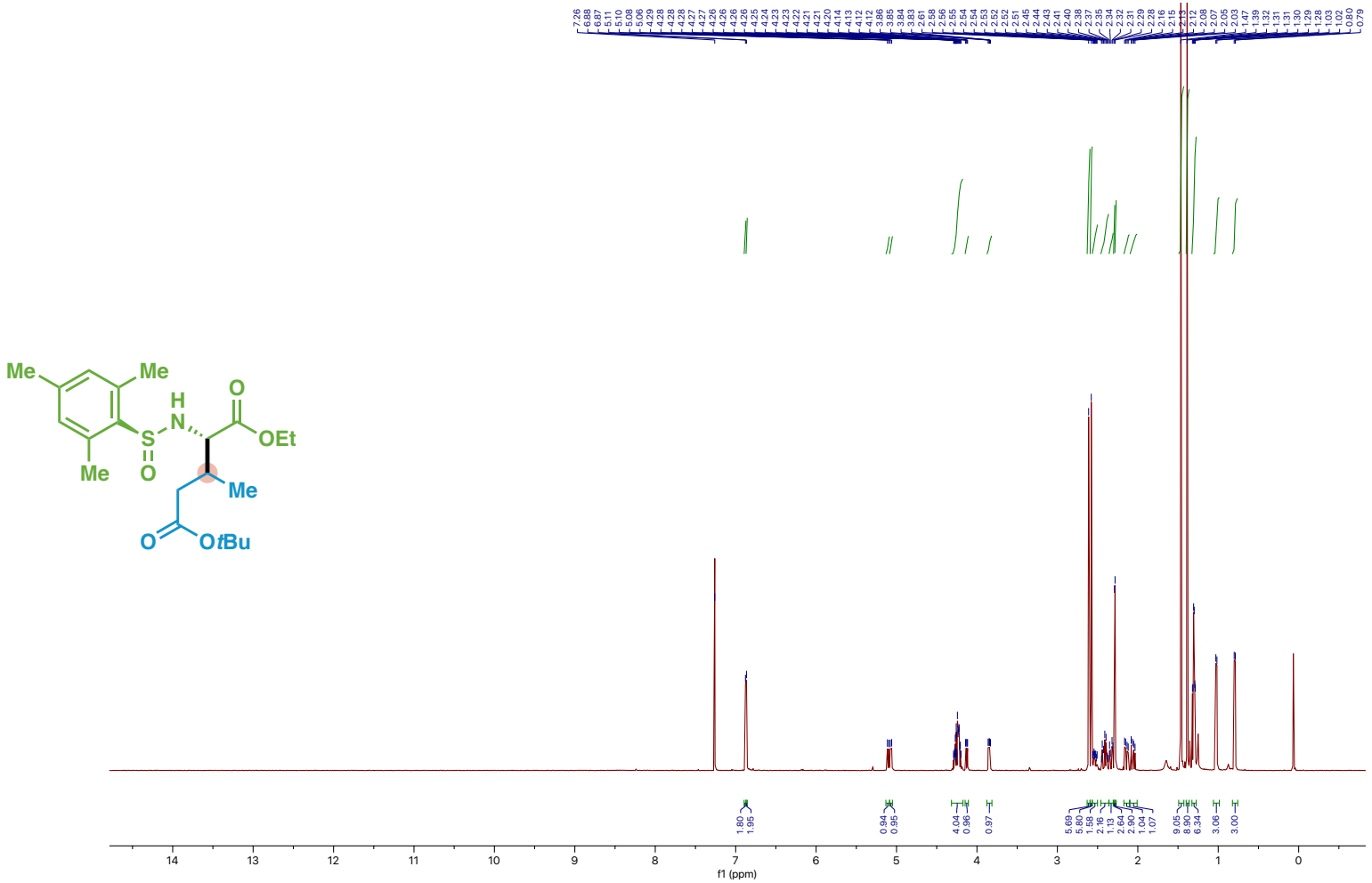
Compound 26 ^{1}H NMR



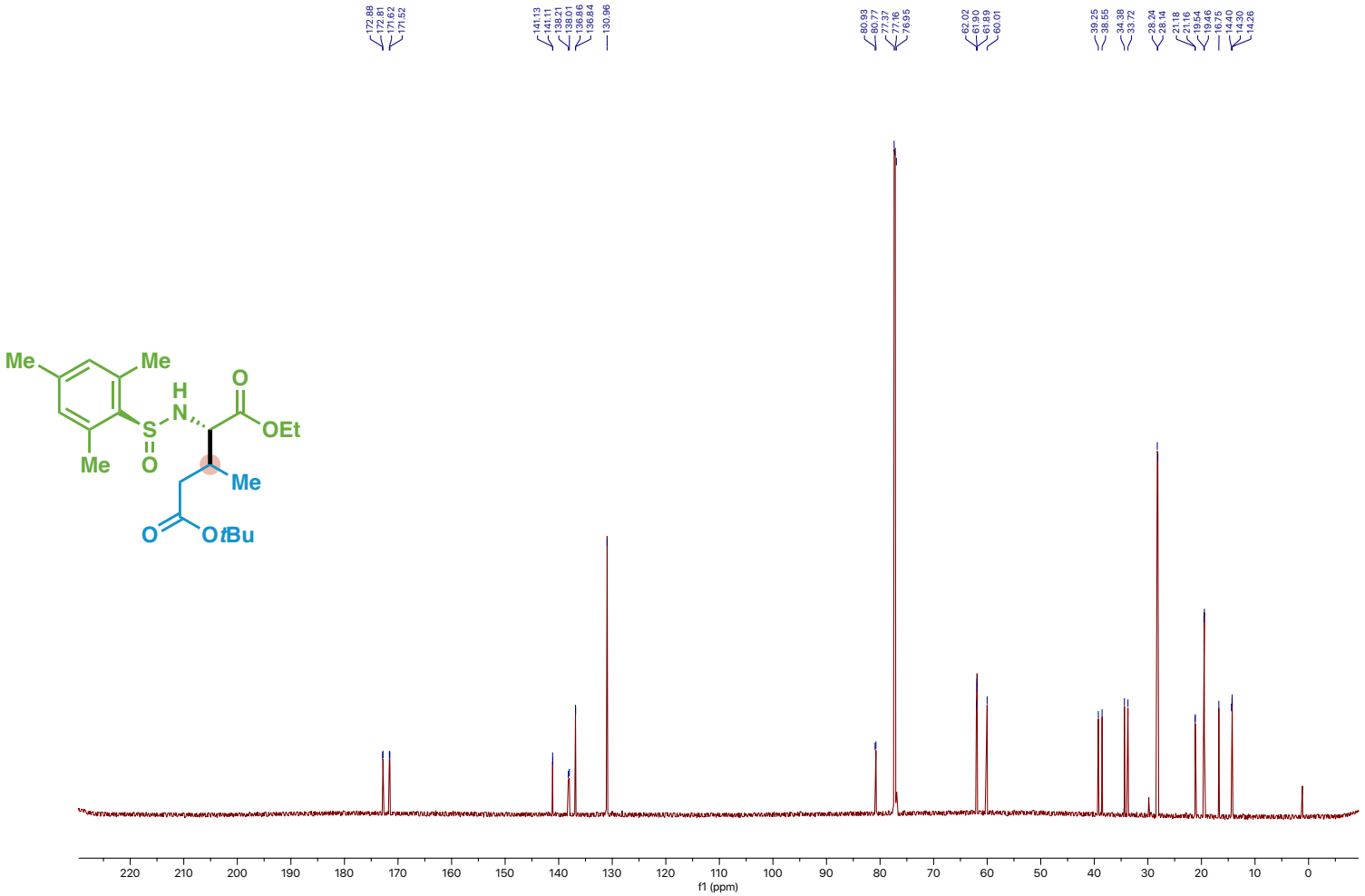
Compound 26 ^{13}C NMR



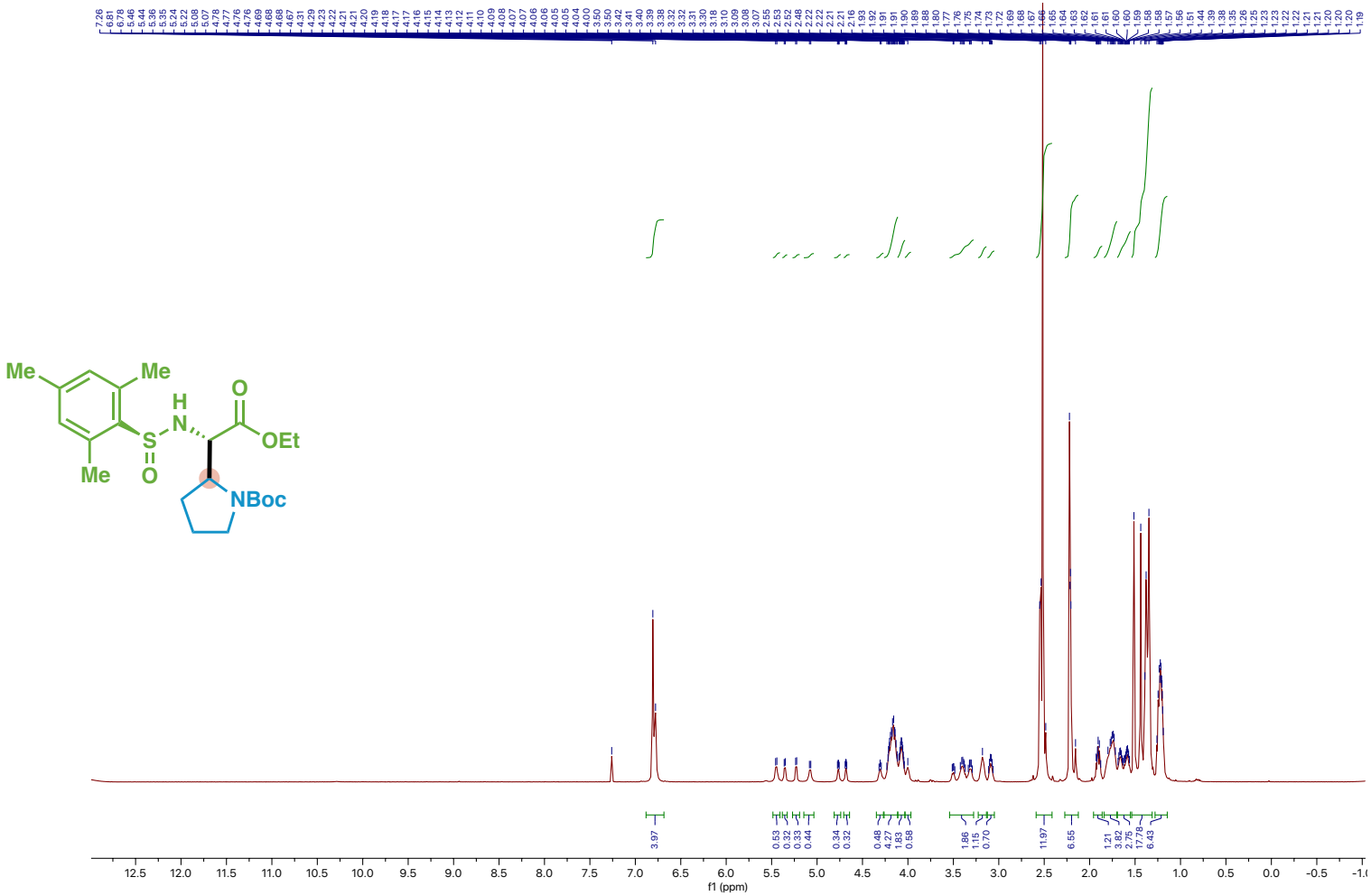
Compound 27 ^{1}H NMR



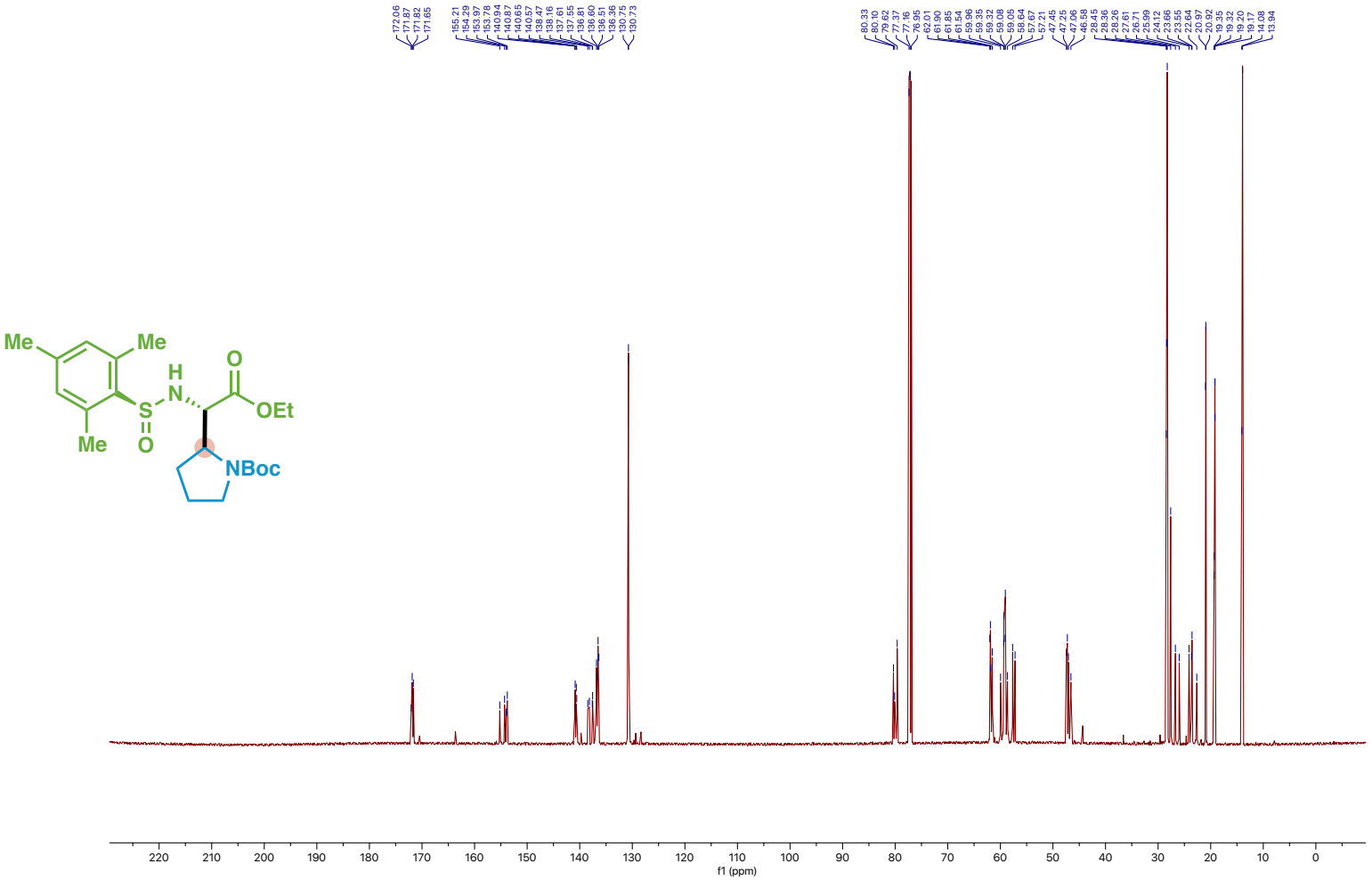
Compound 27 ^{13}C NMR



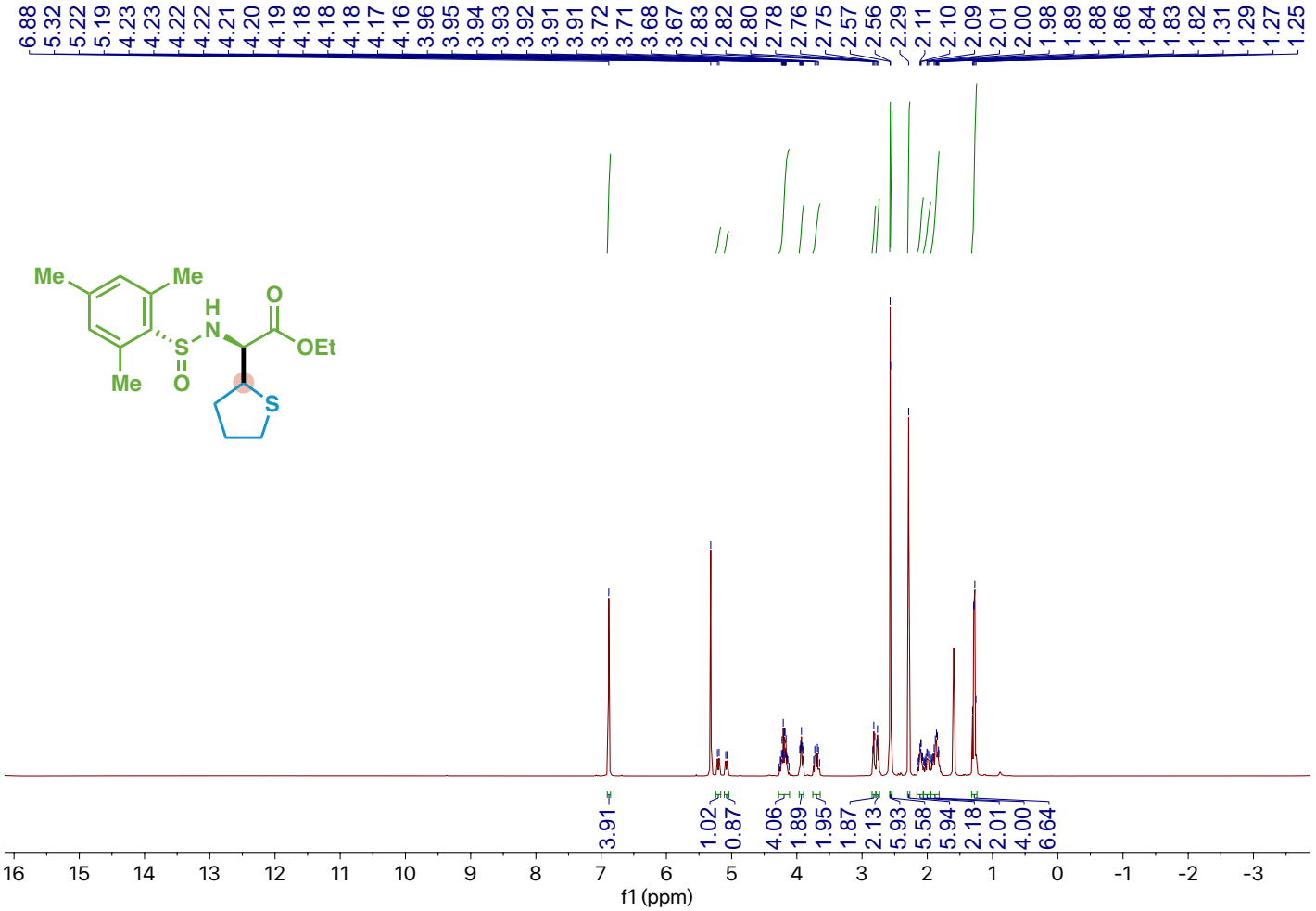
Compound 28 ^{1}H NMR



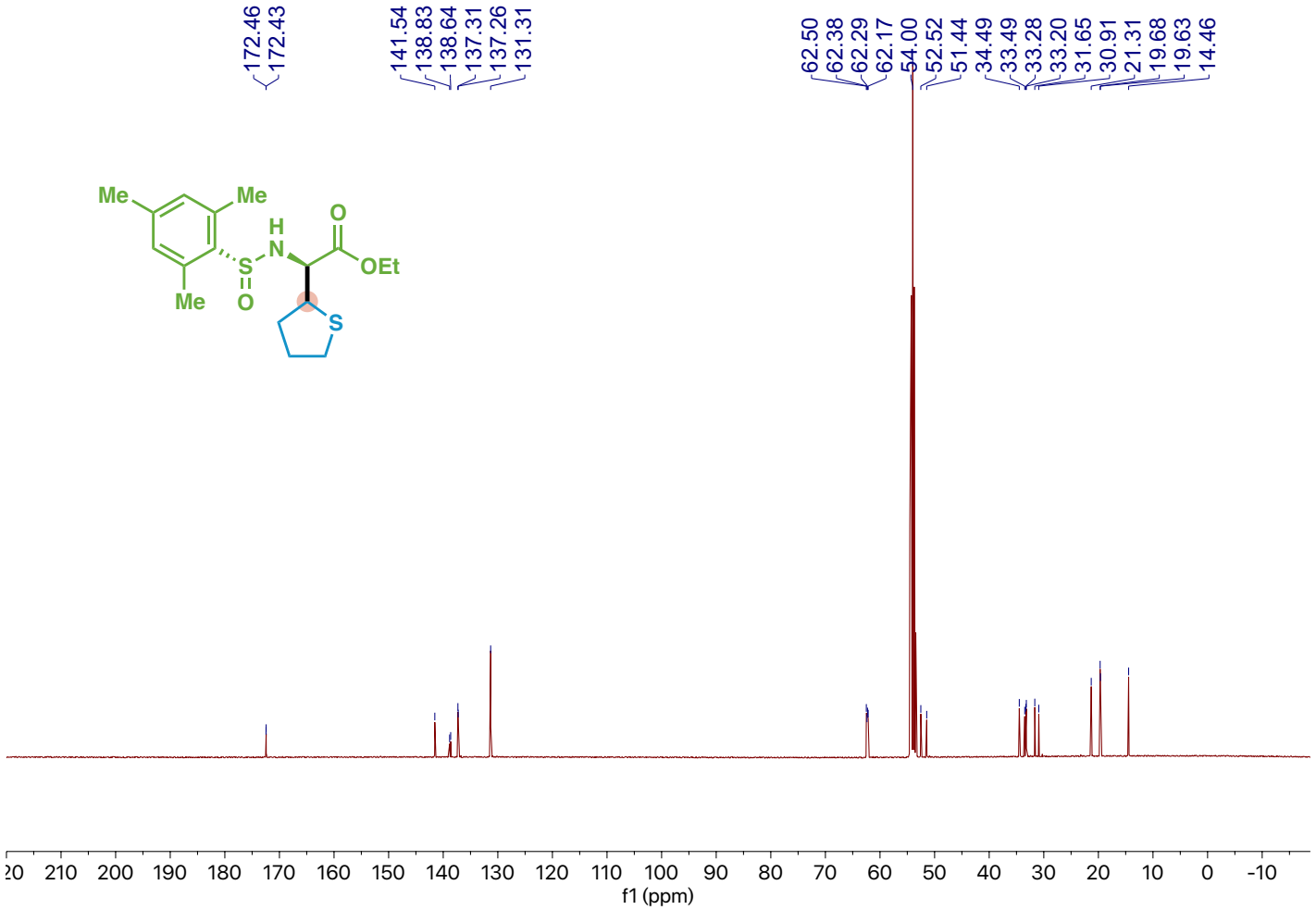
Compound 28 ^{13}C NMR



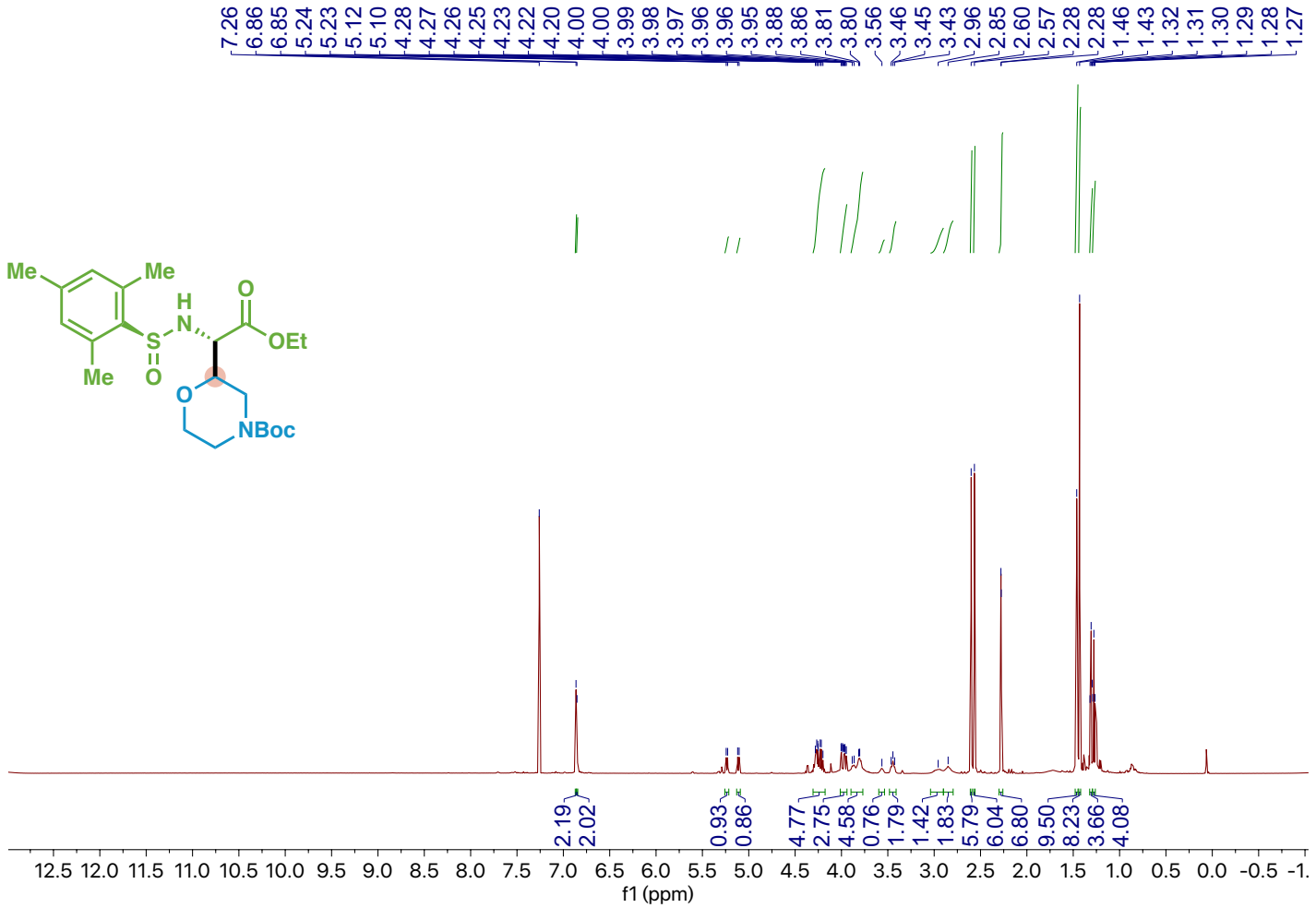
Compound 29 ^{1}H NMR



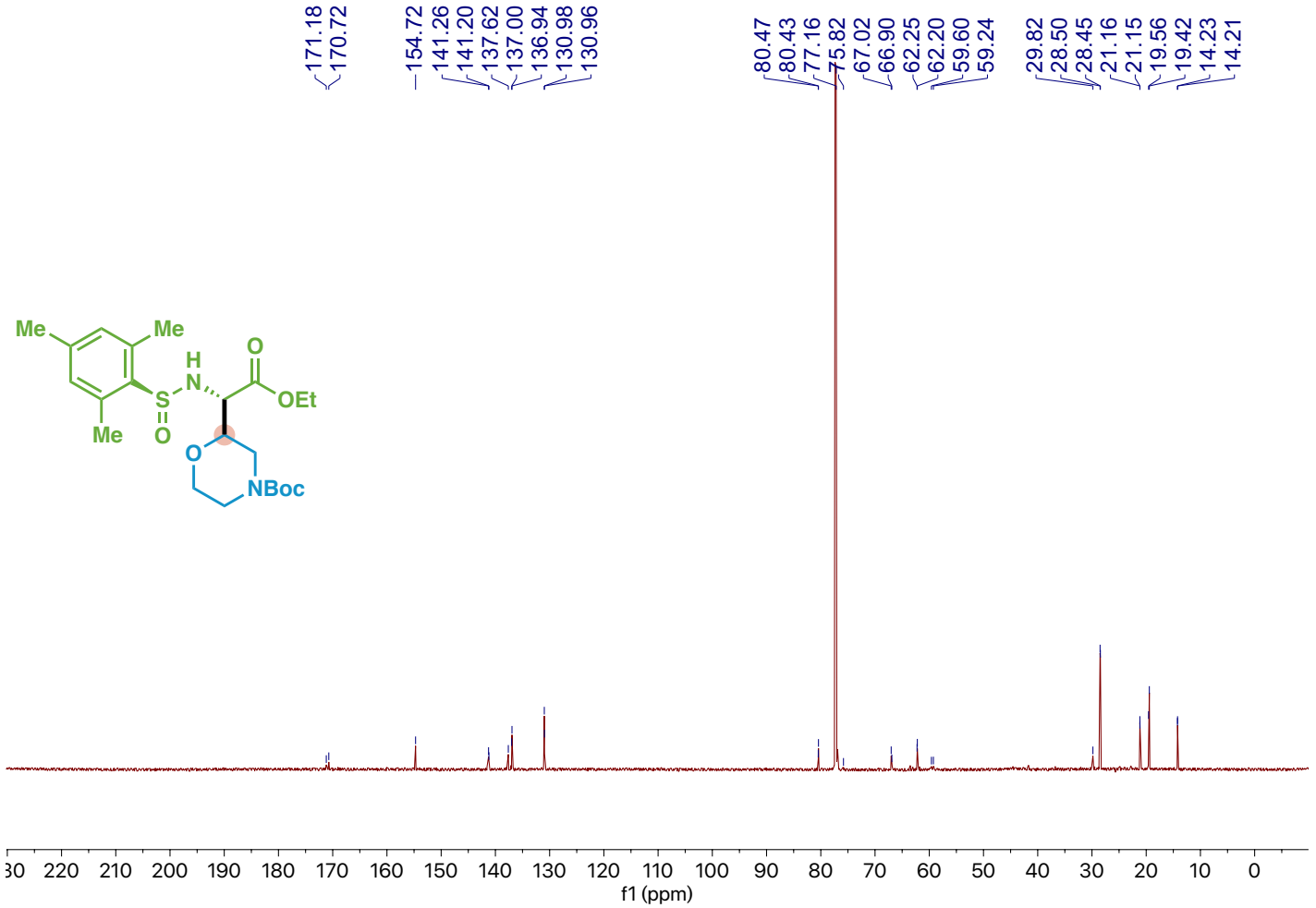
Compound 29 ^{13}C NMR



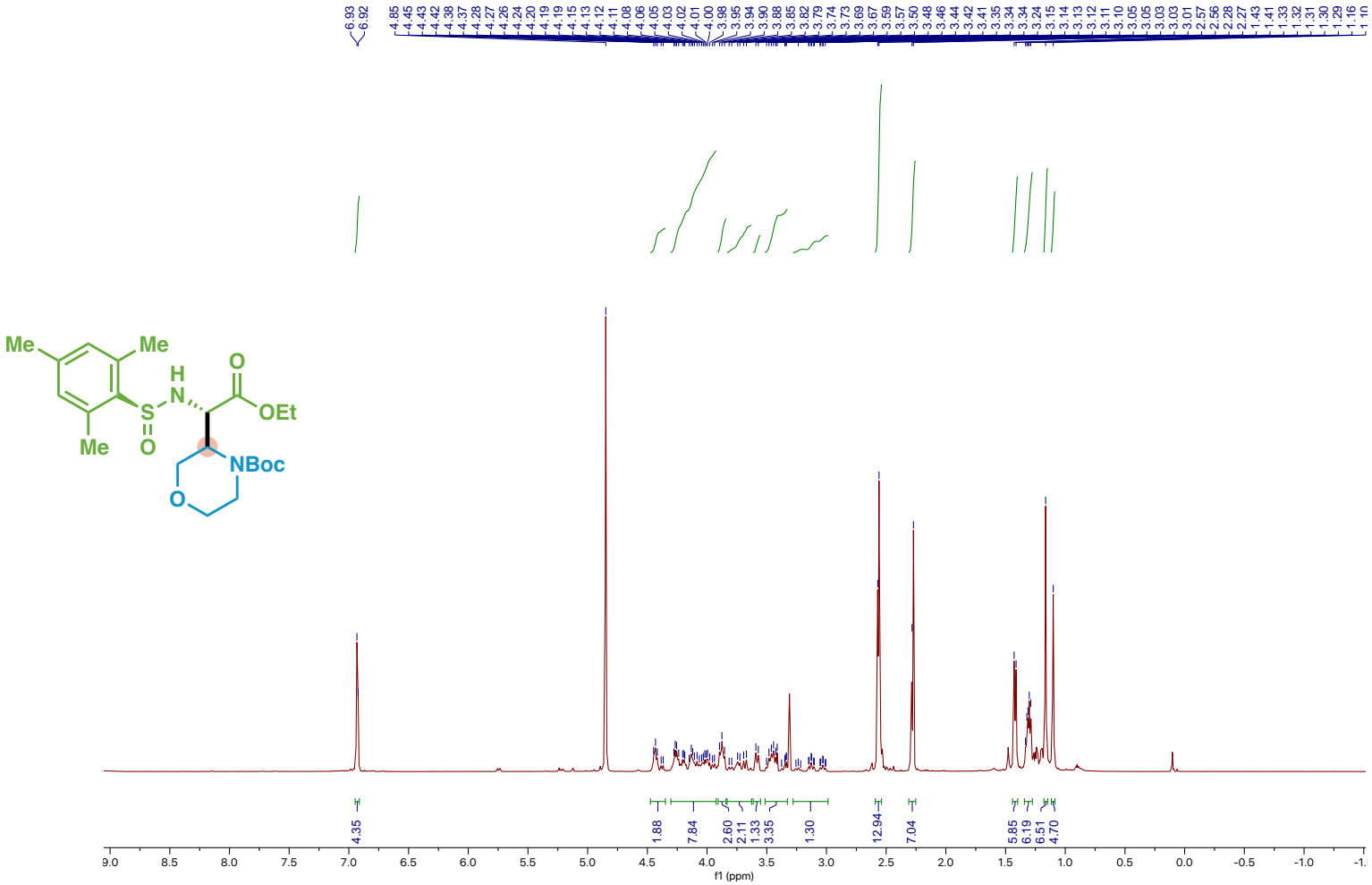
Compound 30 ^{1}H NMR



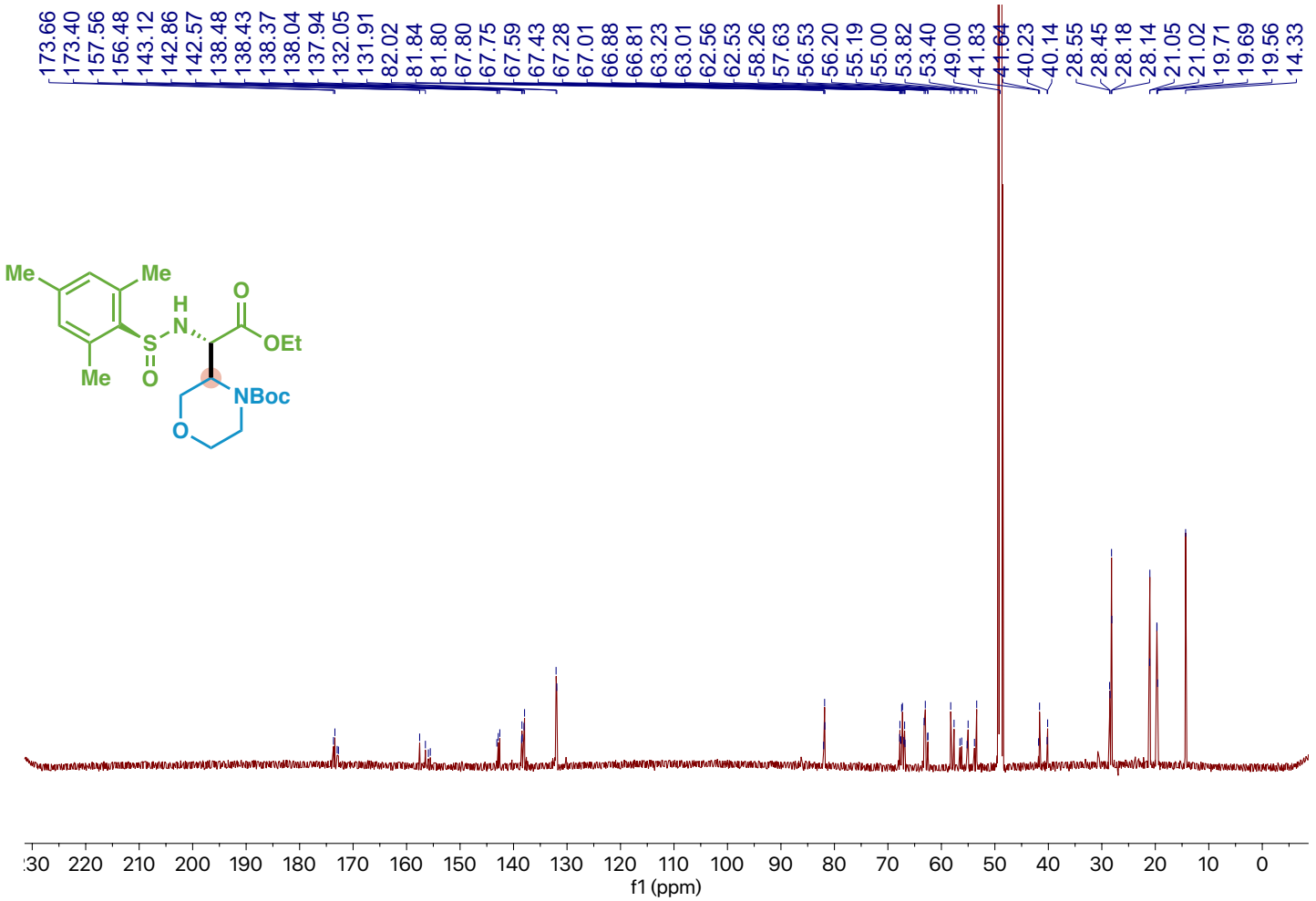
Compound 30 ^{13}C NMR



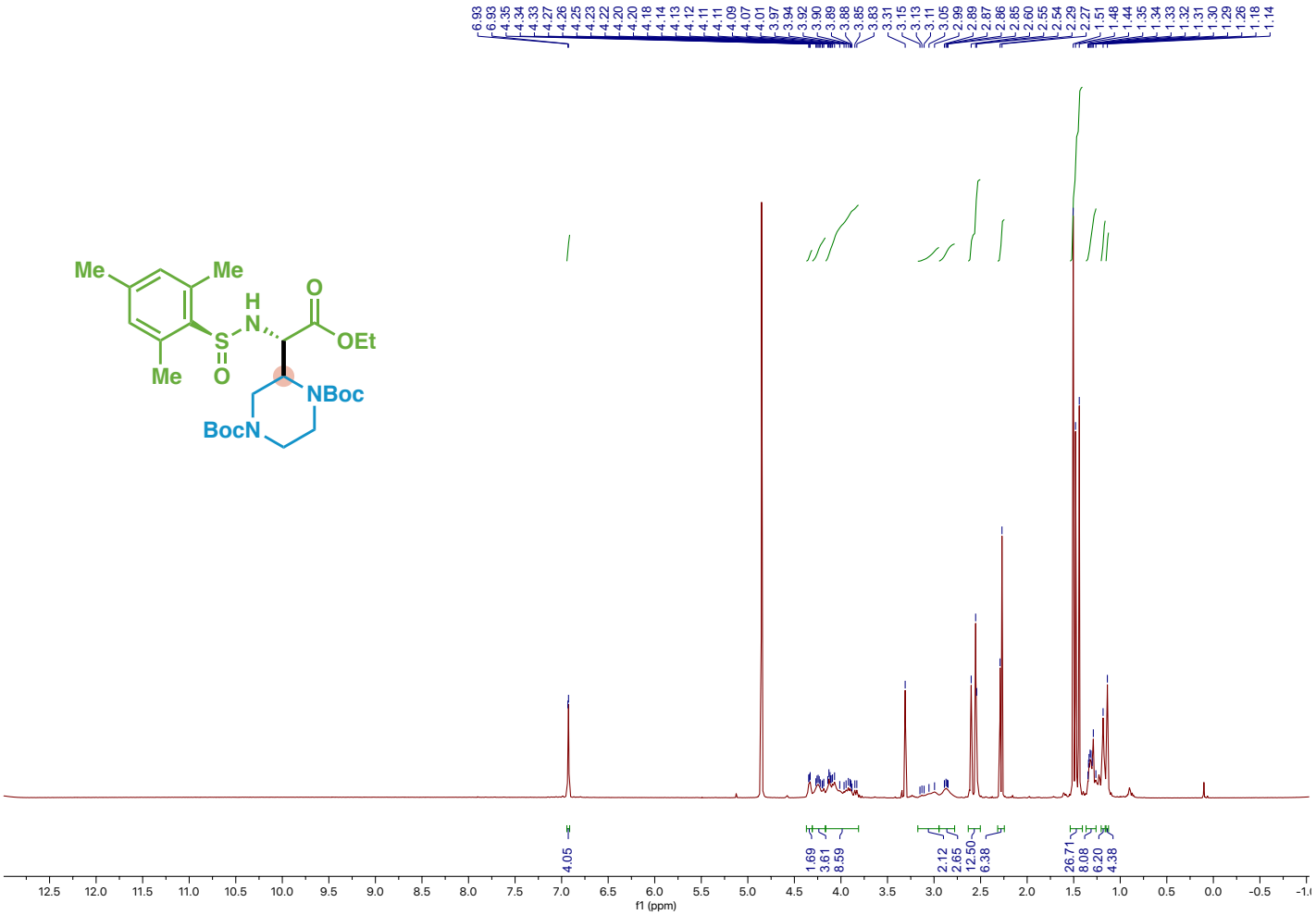
Compound 31 ^{1}H NMR



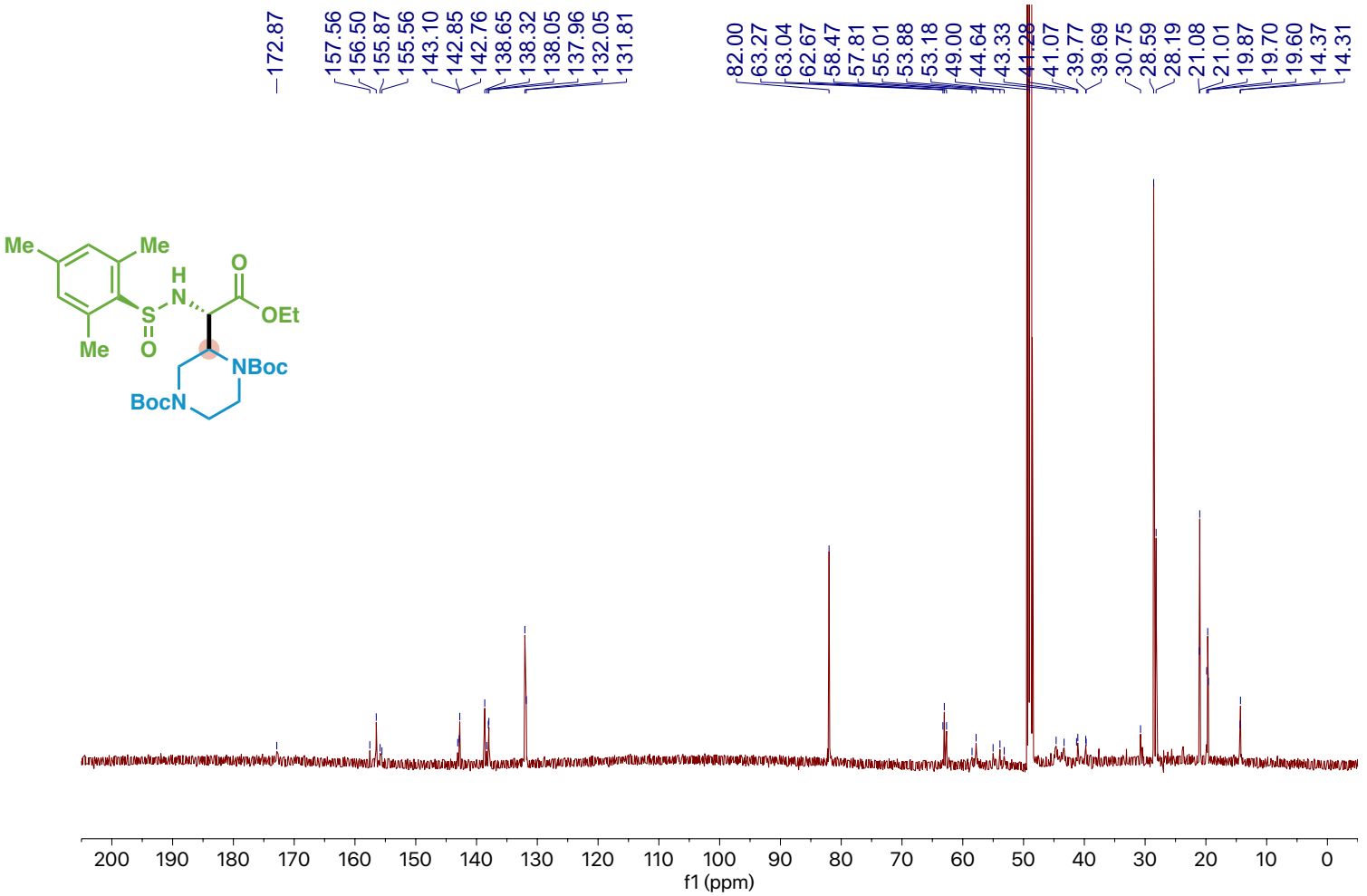
Compound 31 ^{13}C NMR



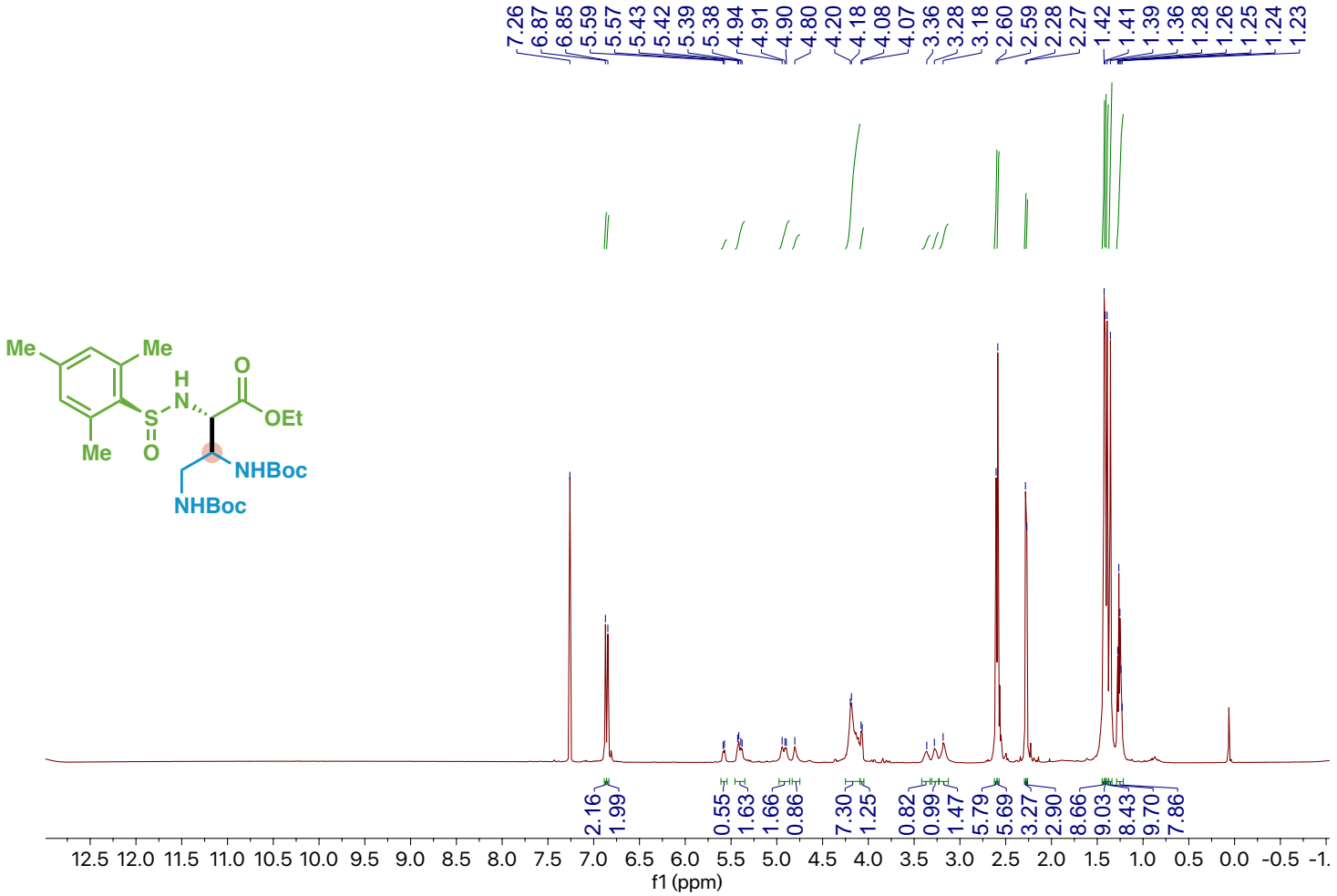
Compound 32 ^{1}H NMR



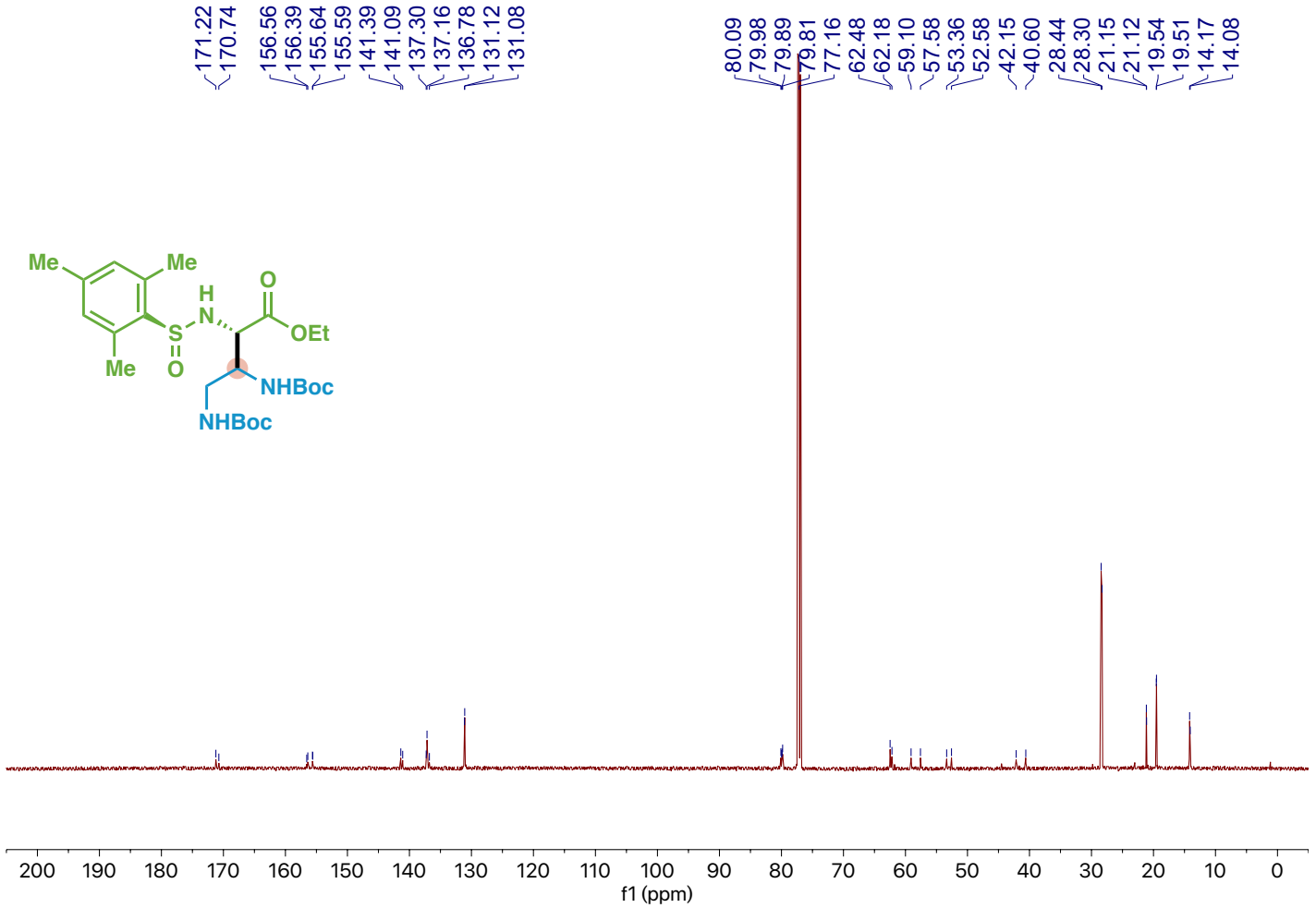
Compound 32 ^{13}C NMR



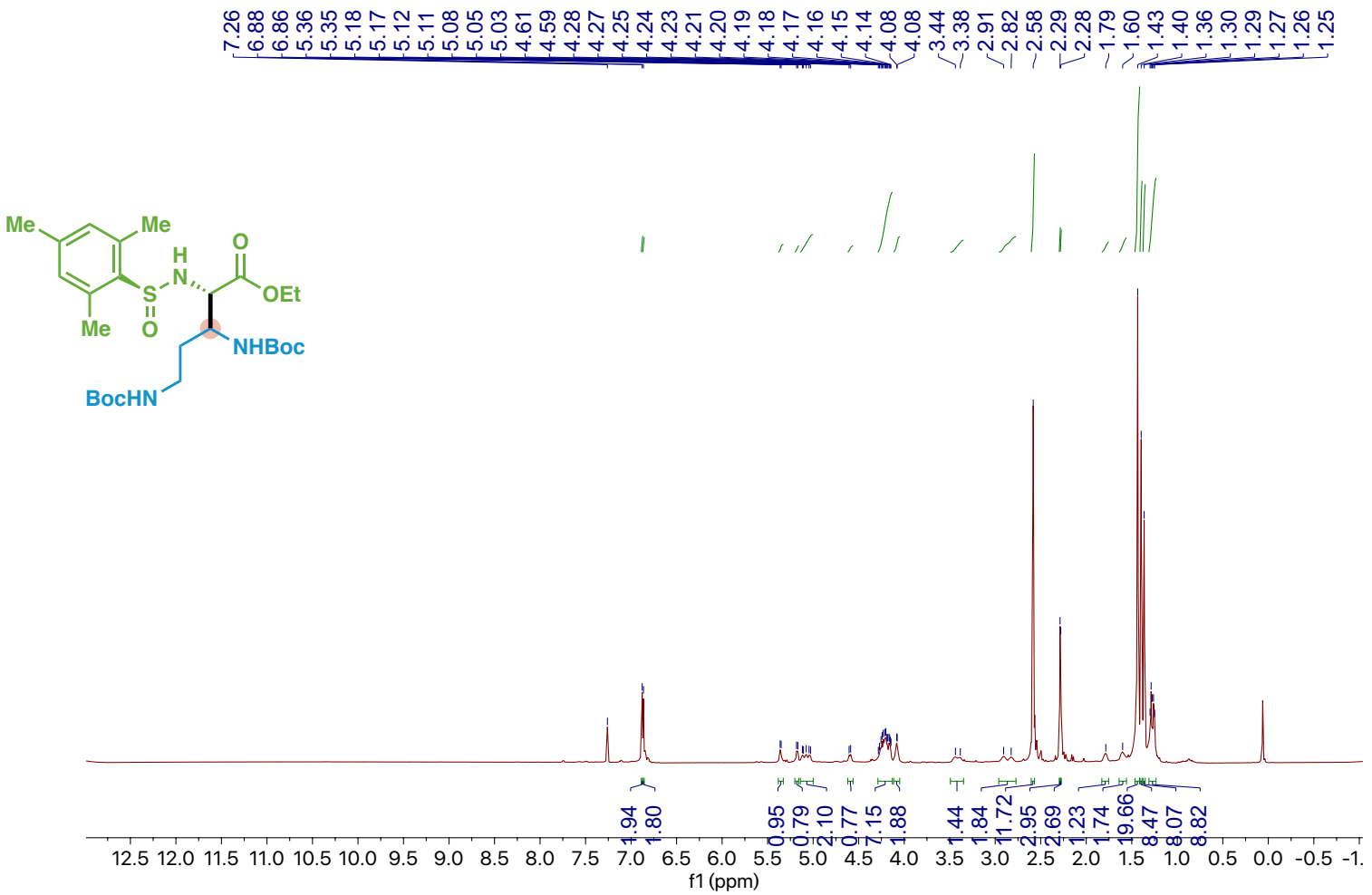
Compound 33 ^{1}H NMR



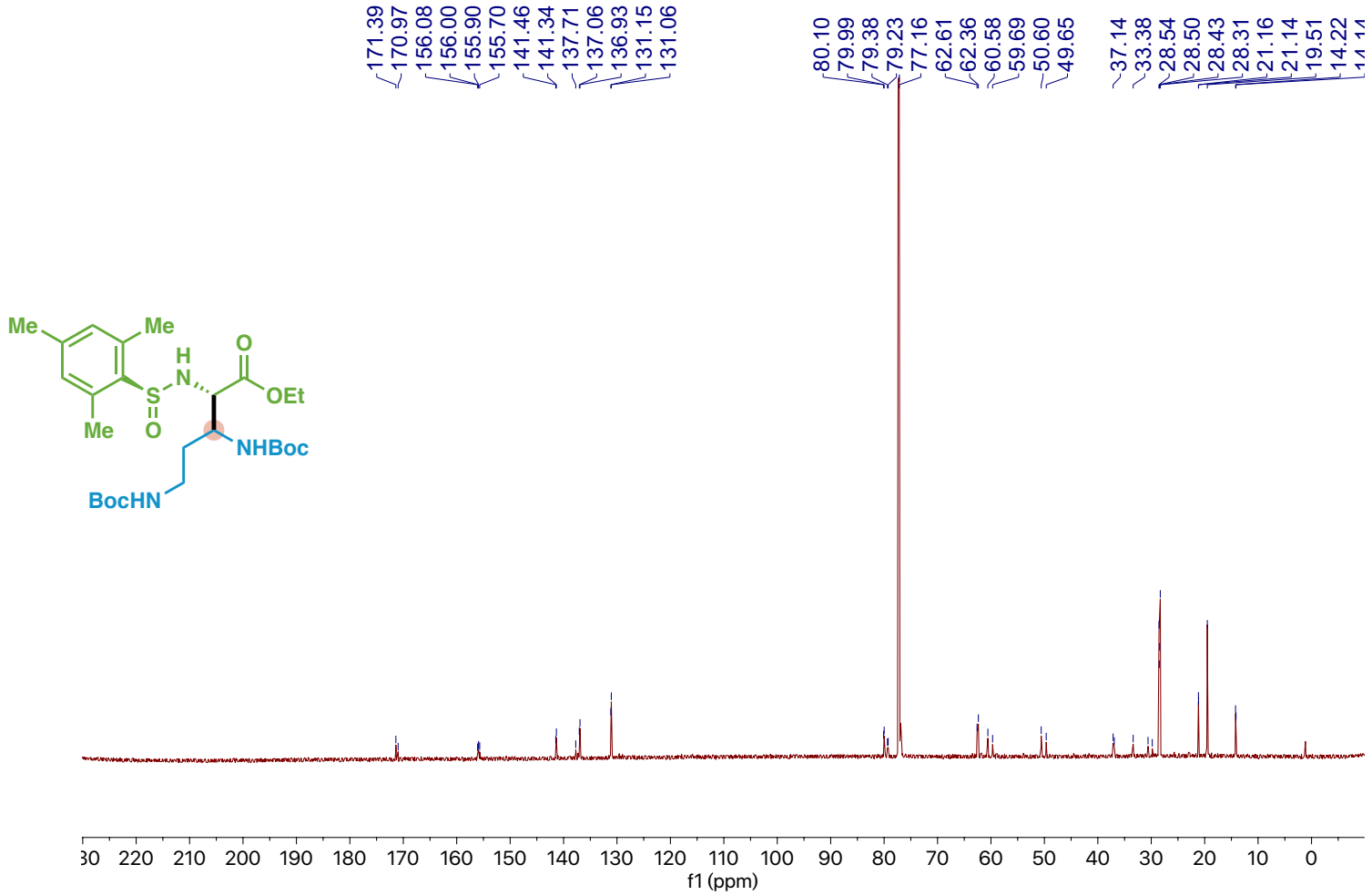
Compound 33 ^{13}C NMR



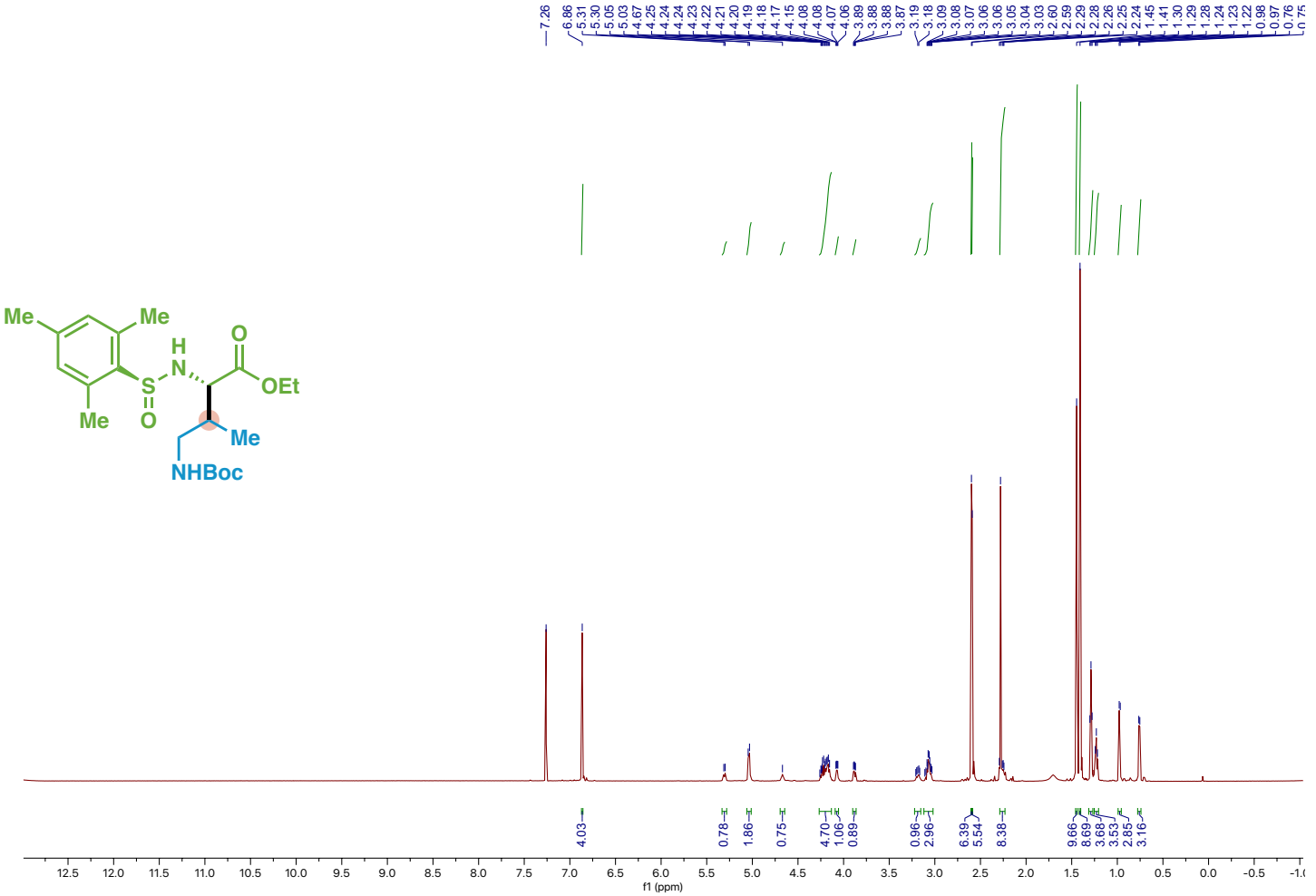
Compound 34 ^{1}H NMR



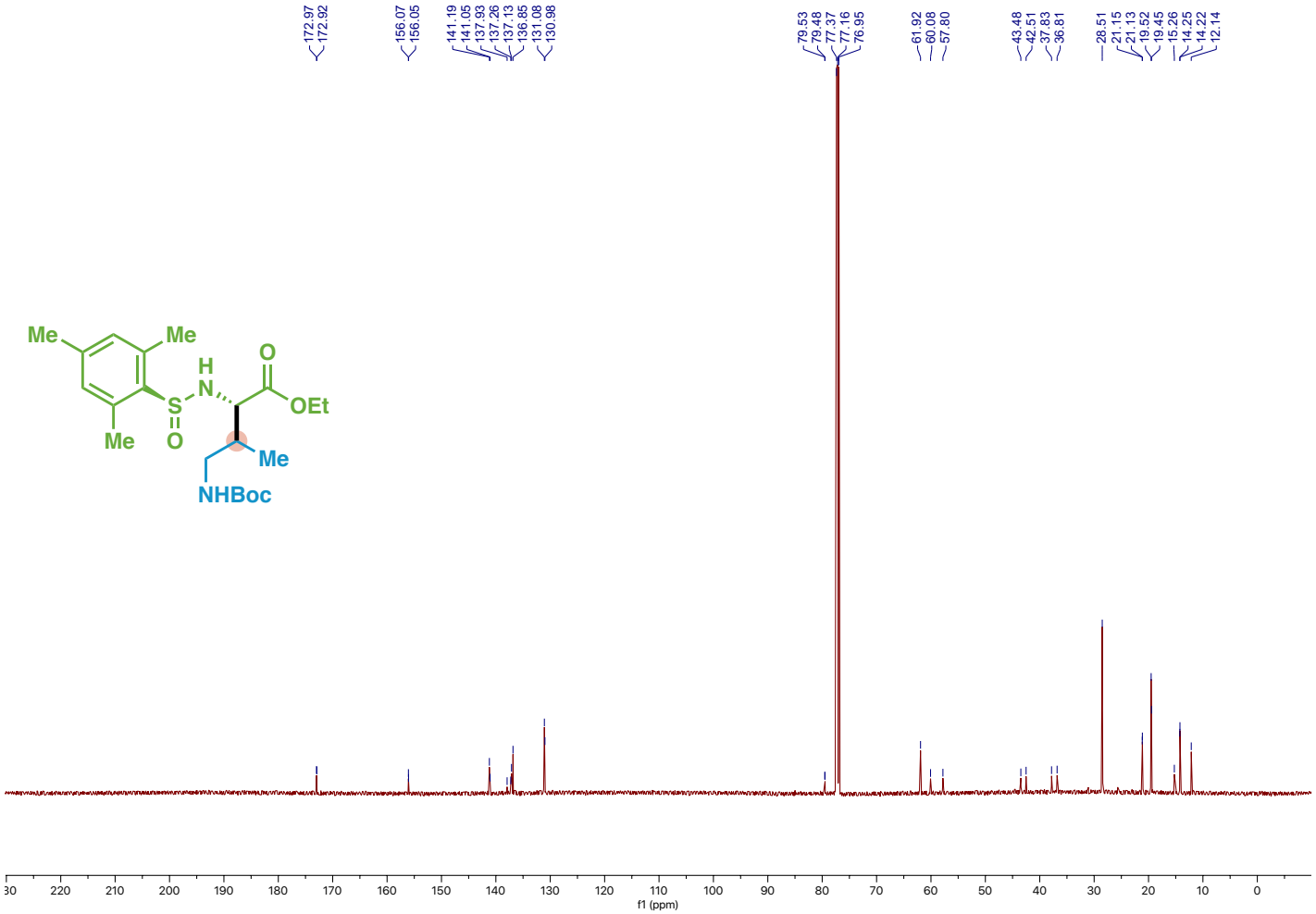
Compound 34 ^{13}C NMR



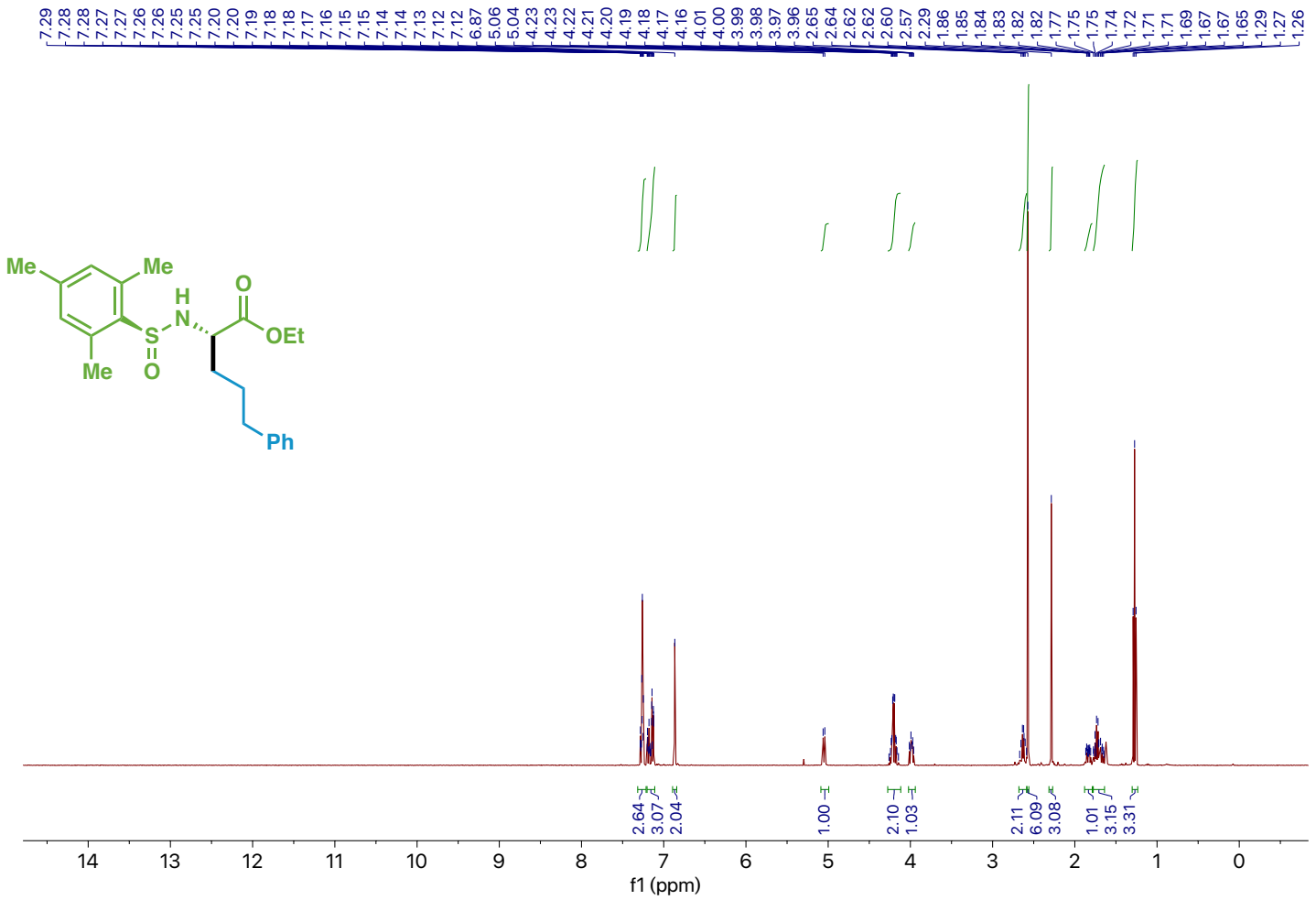
Compound 35 ^{1}H NMR



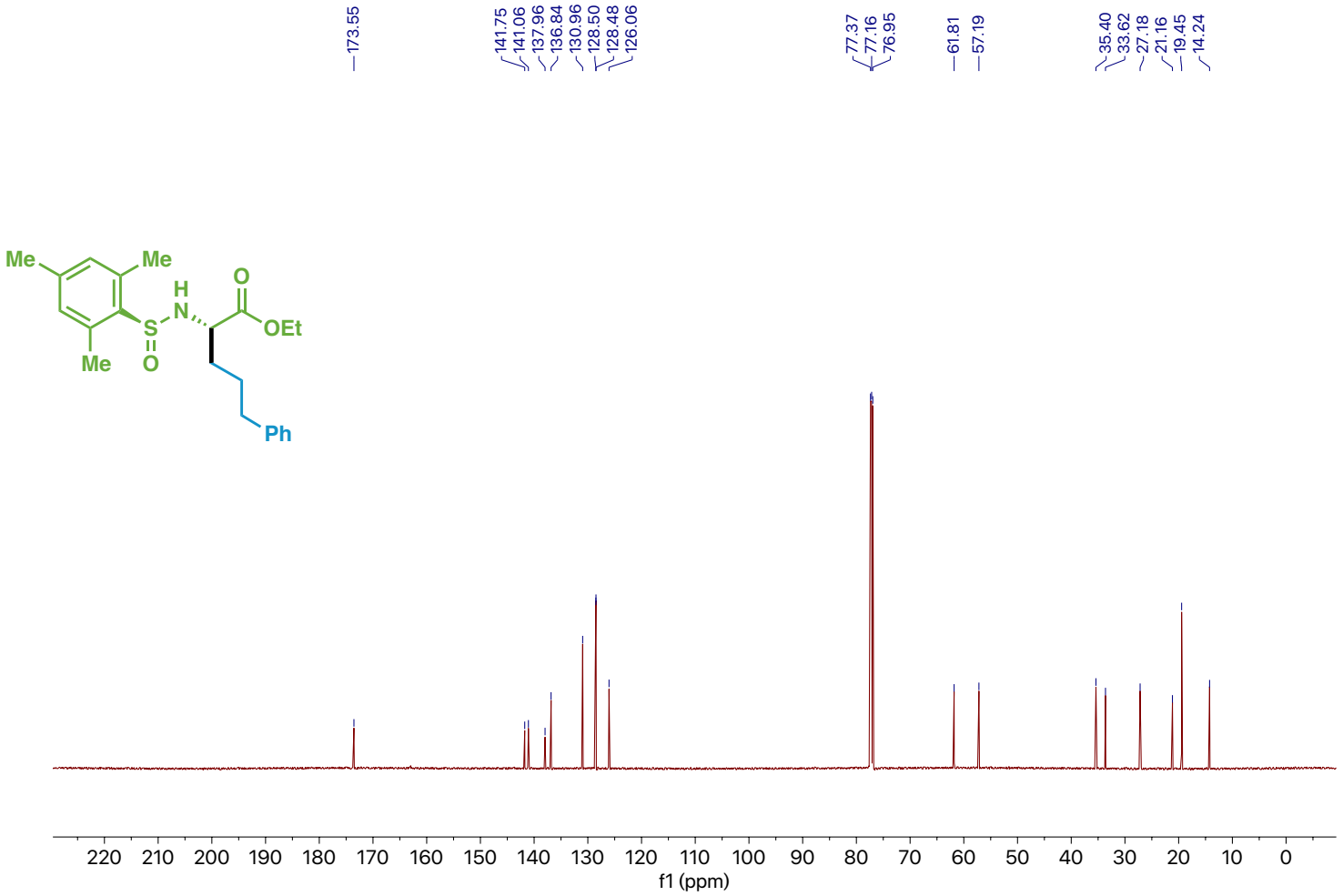
Compound 35 ^{13}C NMR



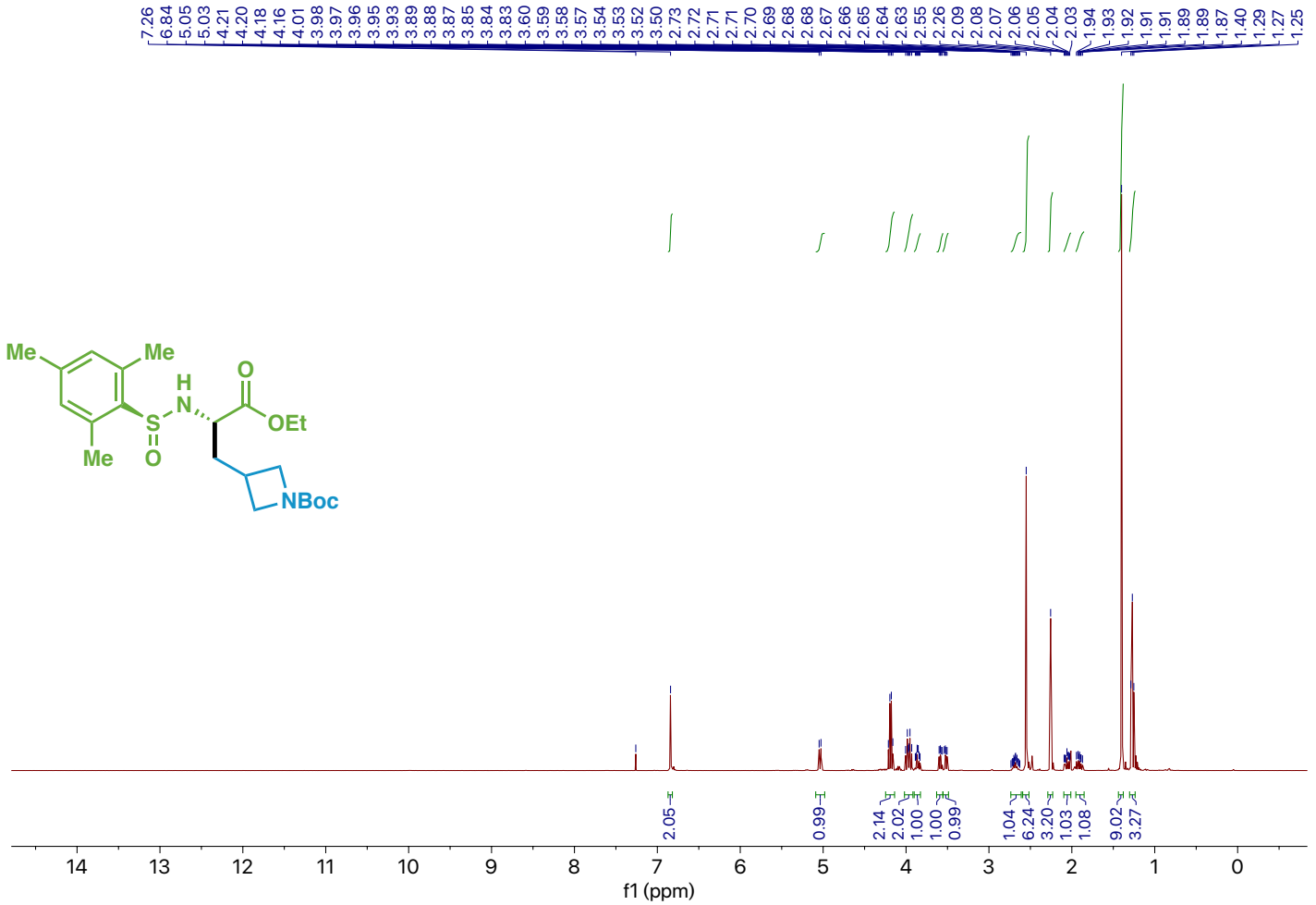
Compound 36 ^{1}H NMR



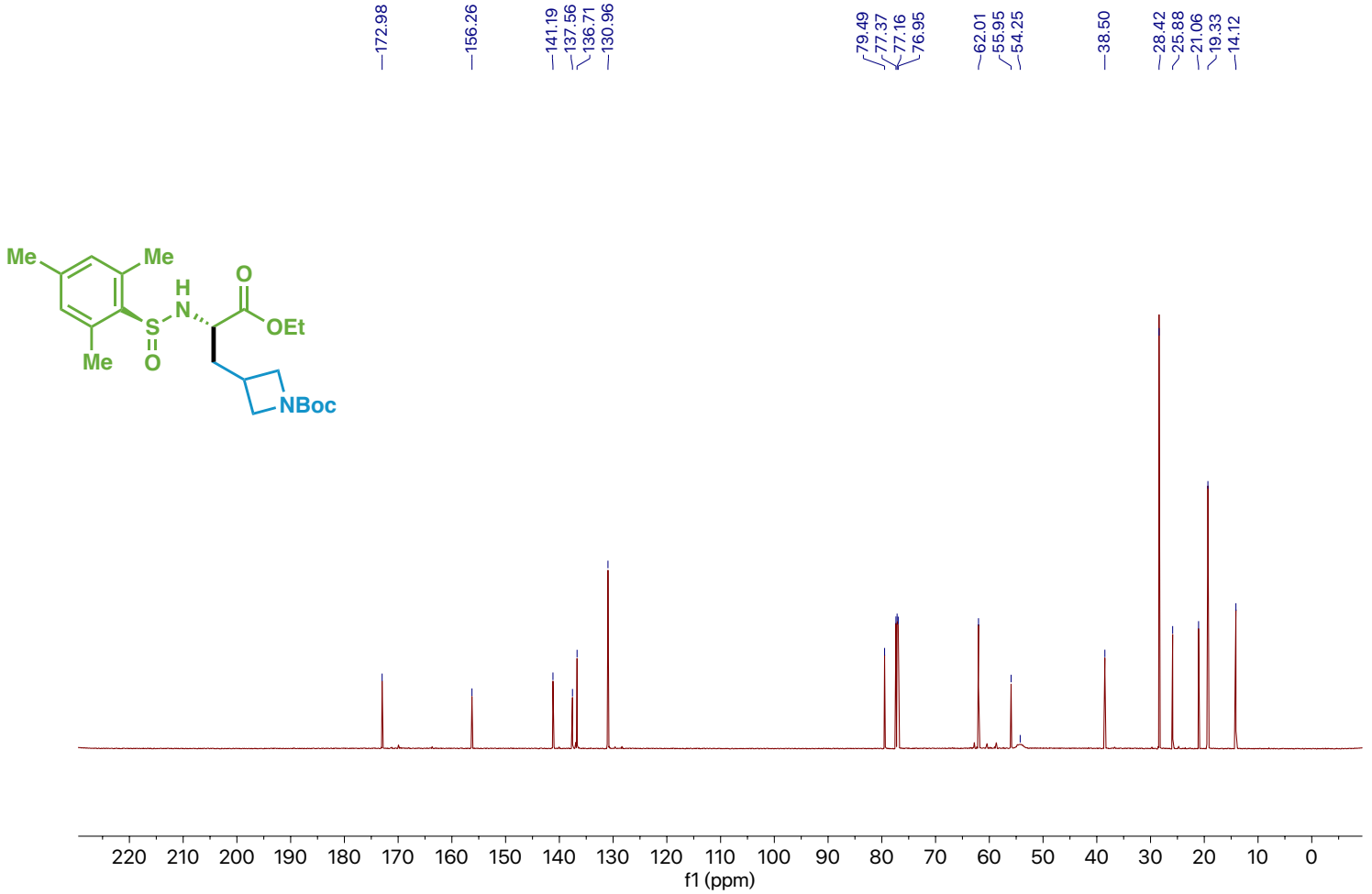
Compound 36 ^{13}C NMR



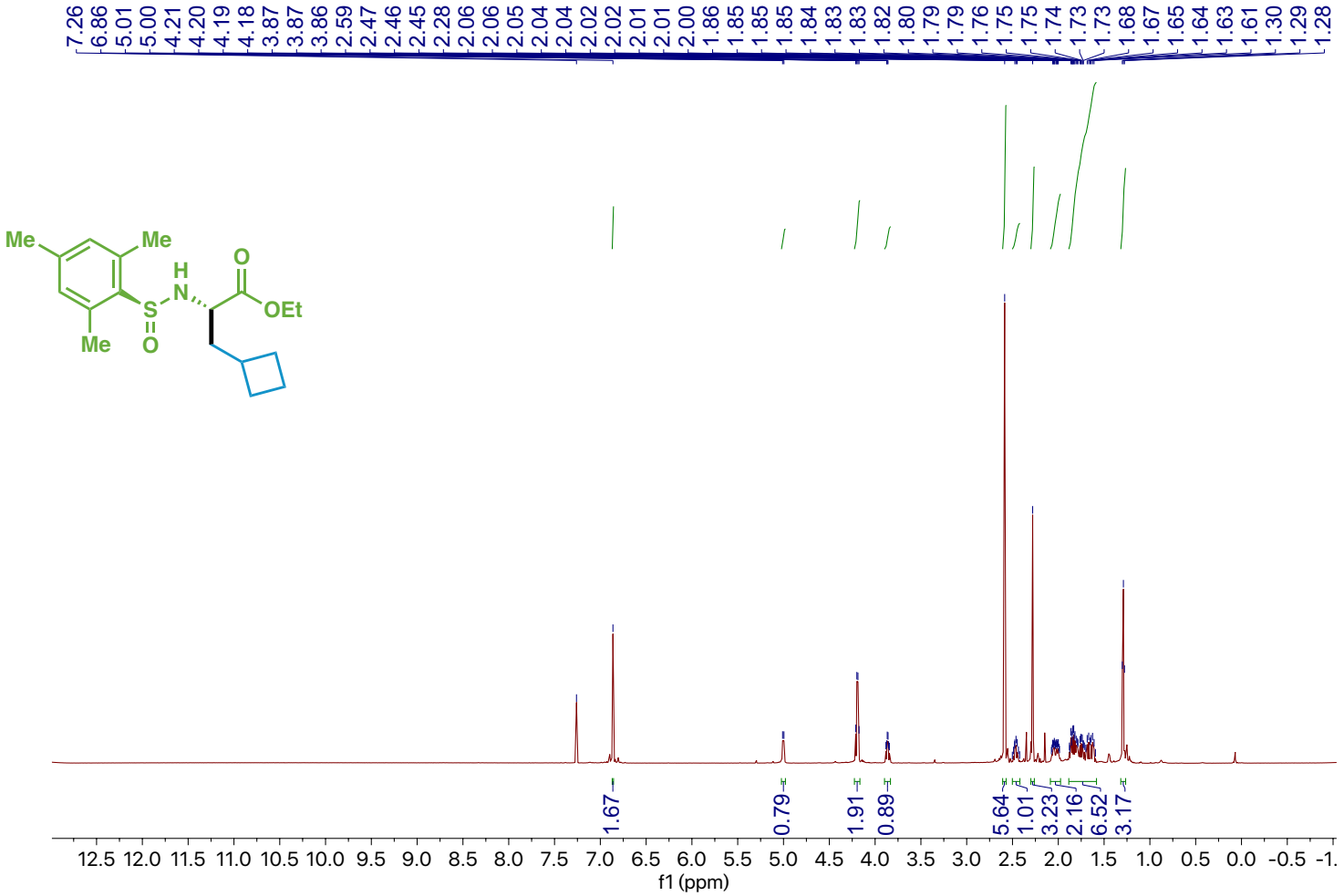
Compound 37 ^{1}H NMR



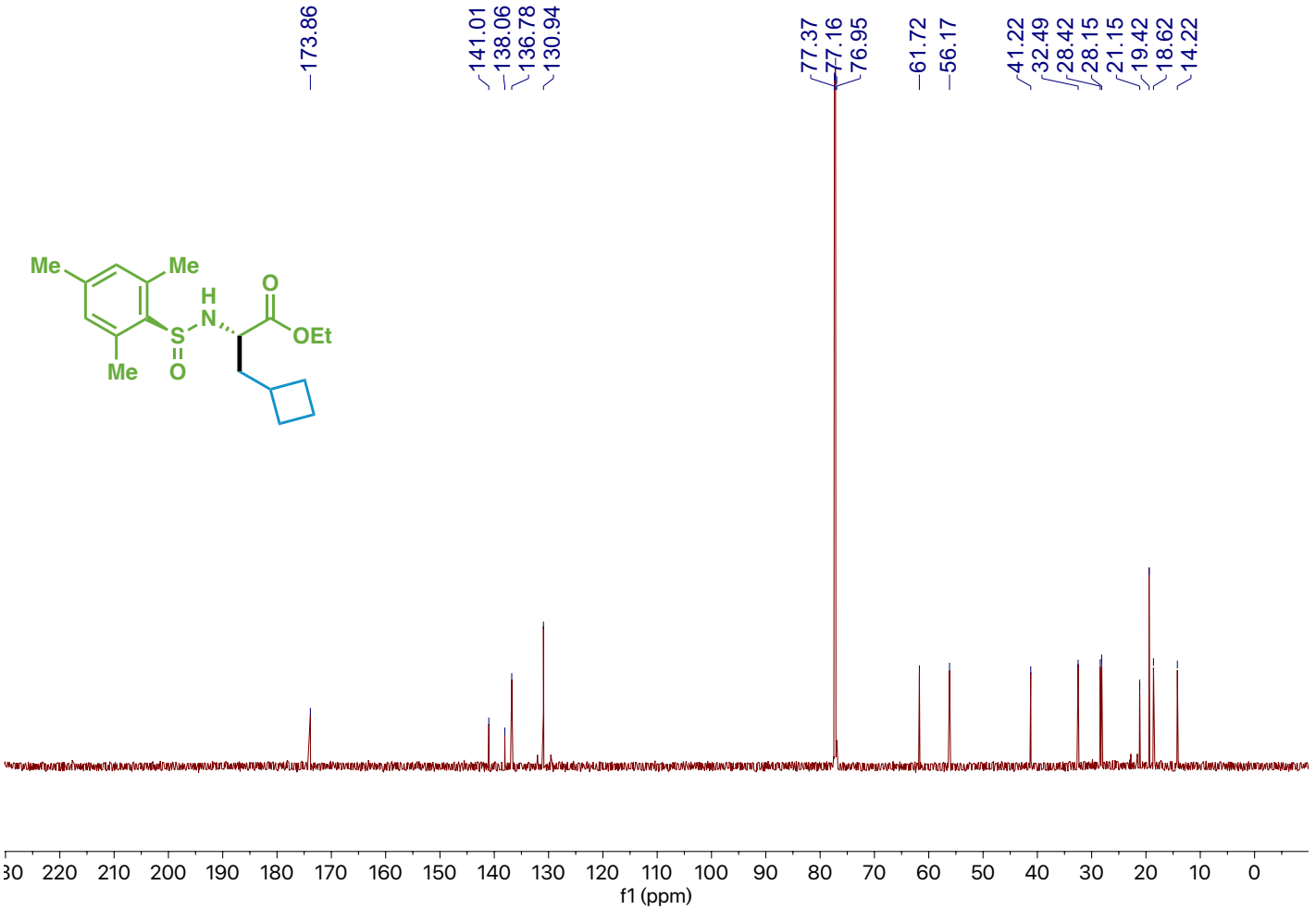
Compound 37 ^{13}C NMR



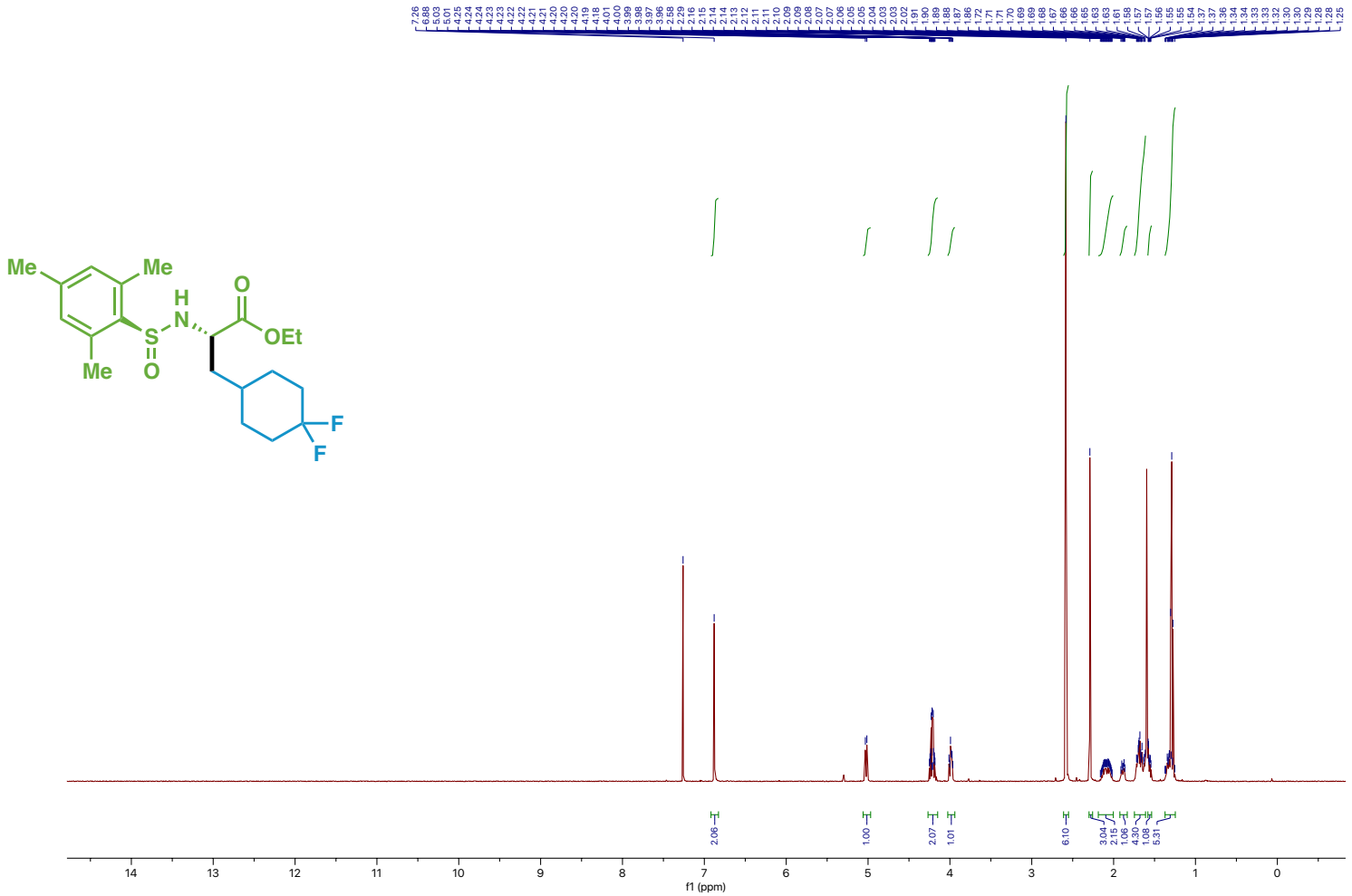
Compound 38 ^{1}H NMR



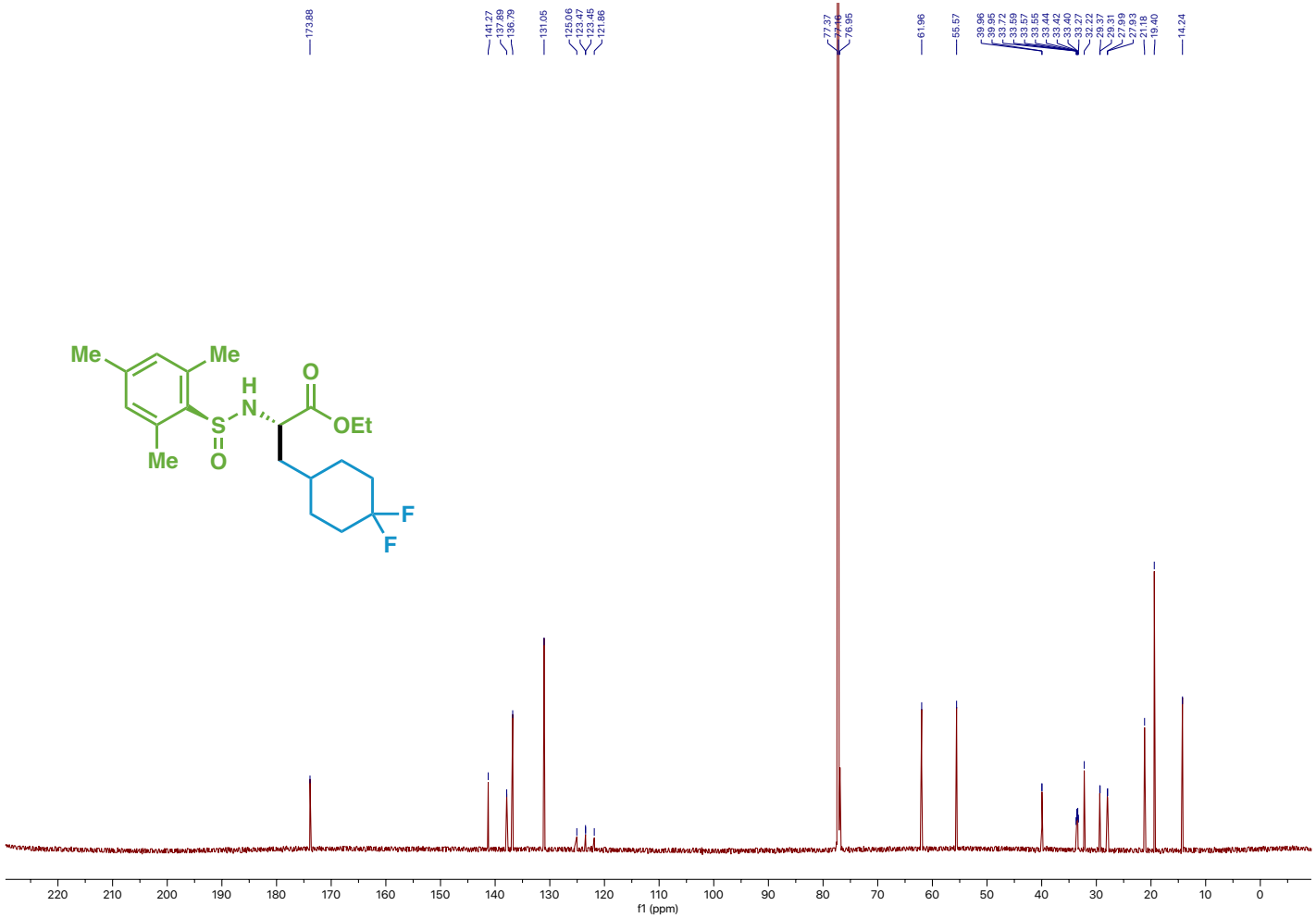
Compound 38 ^{13}C NMR



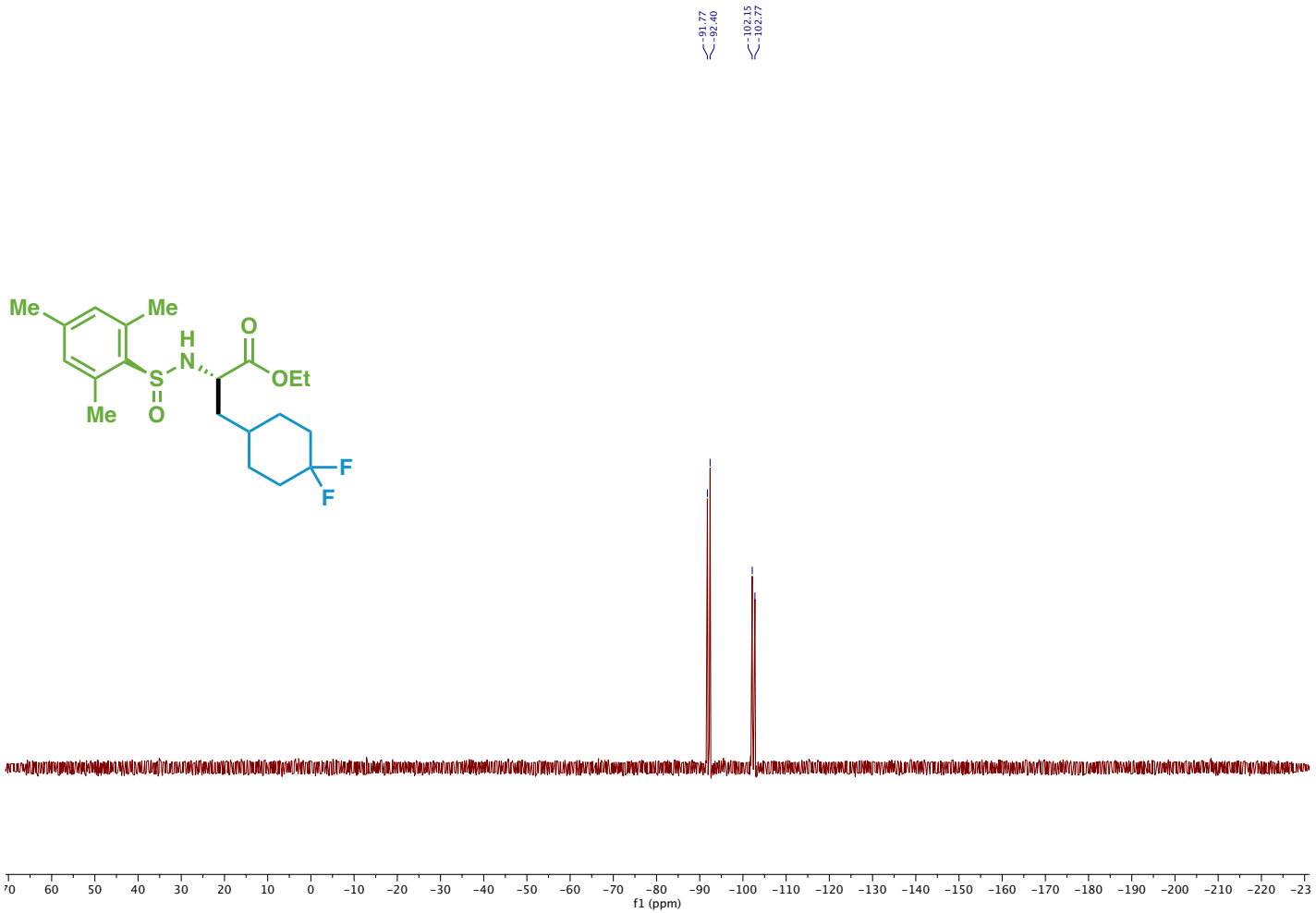
Compound 39 ^{1}H NMR



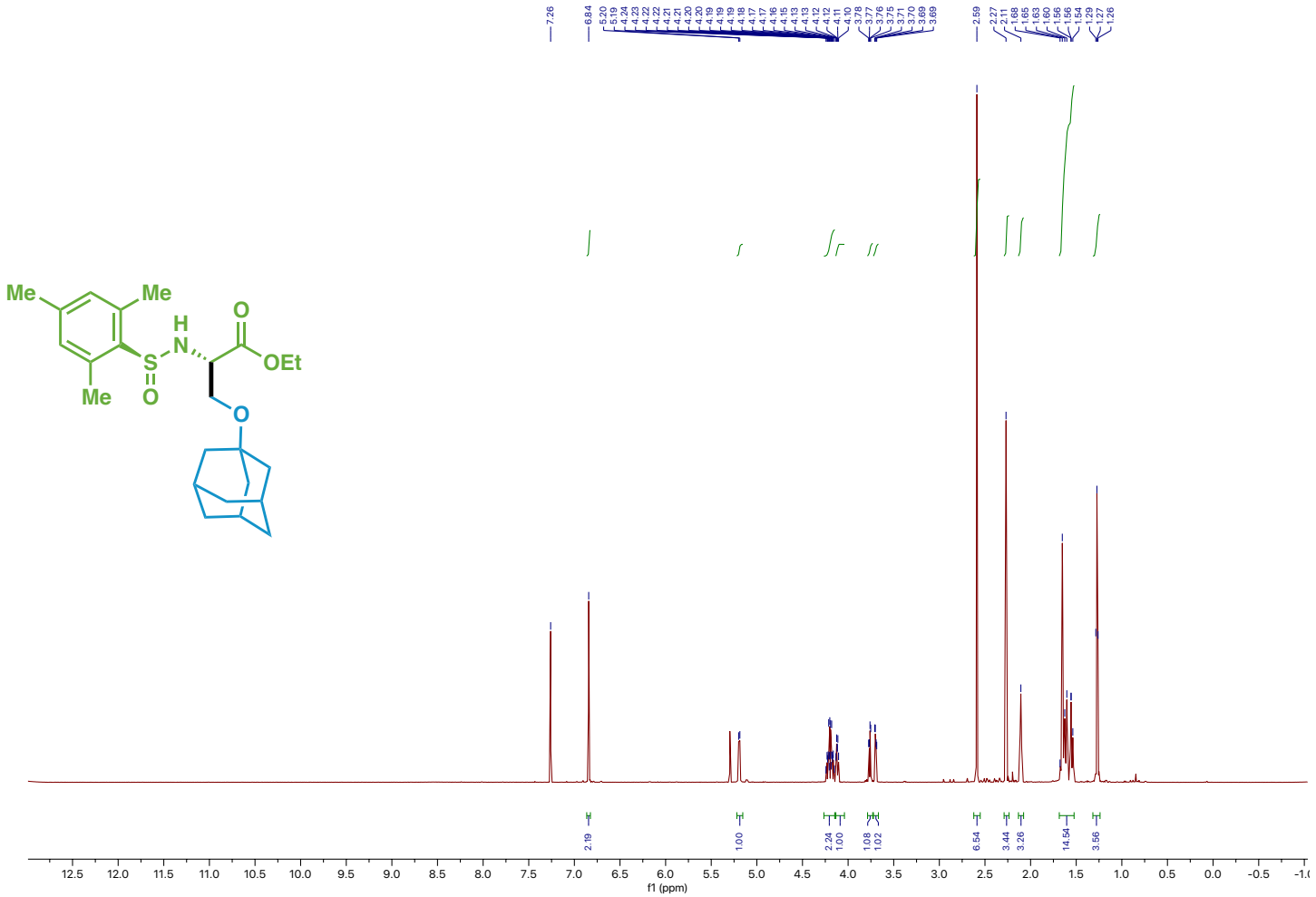
Compound 39 ^{13}C NMR



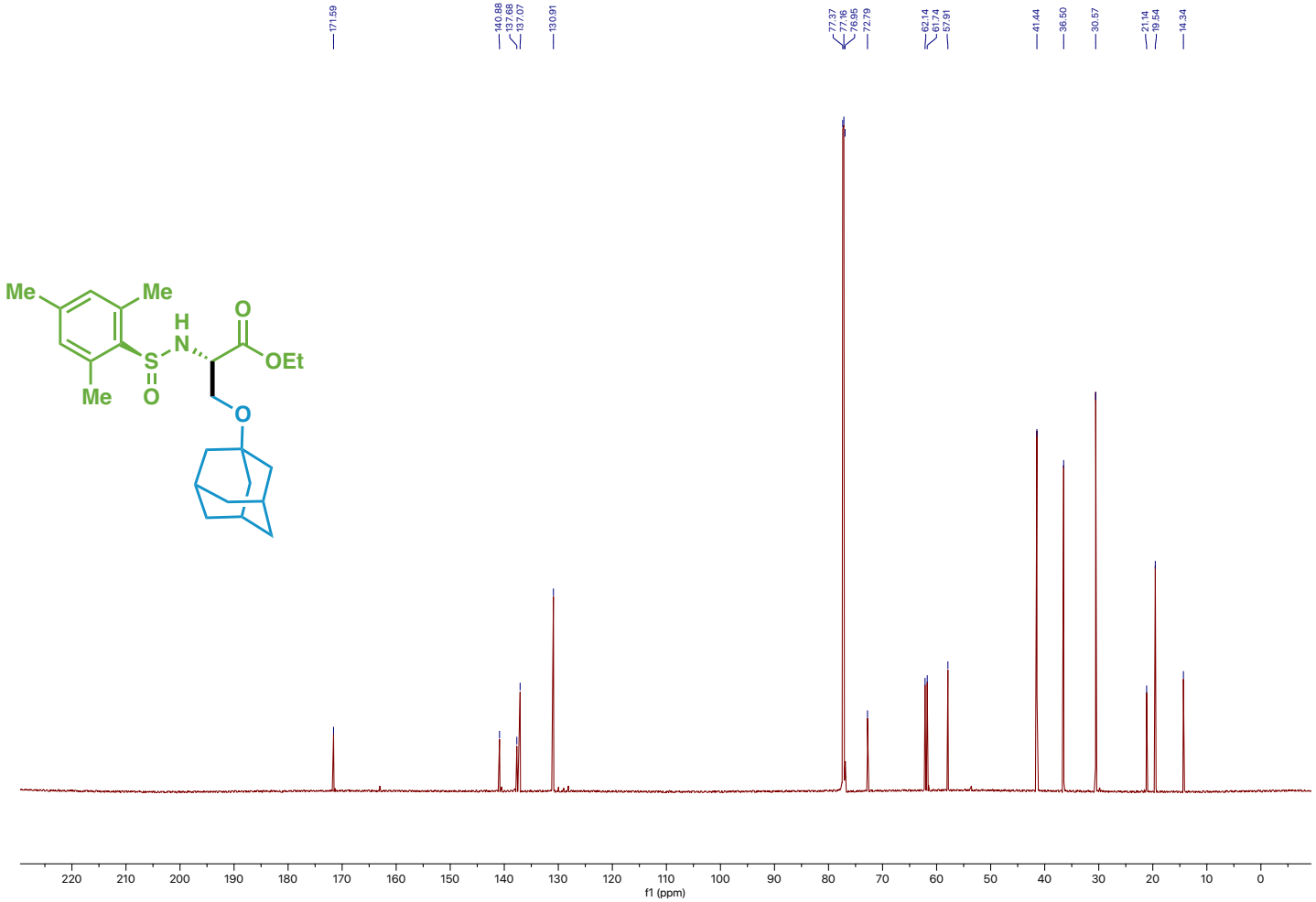
Compound 39 ^{19}F NMR



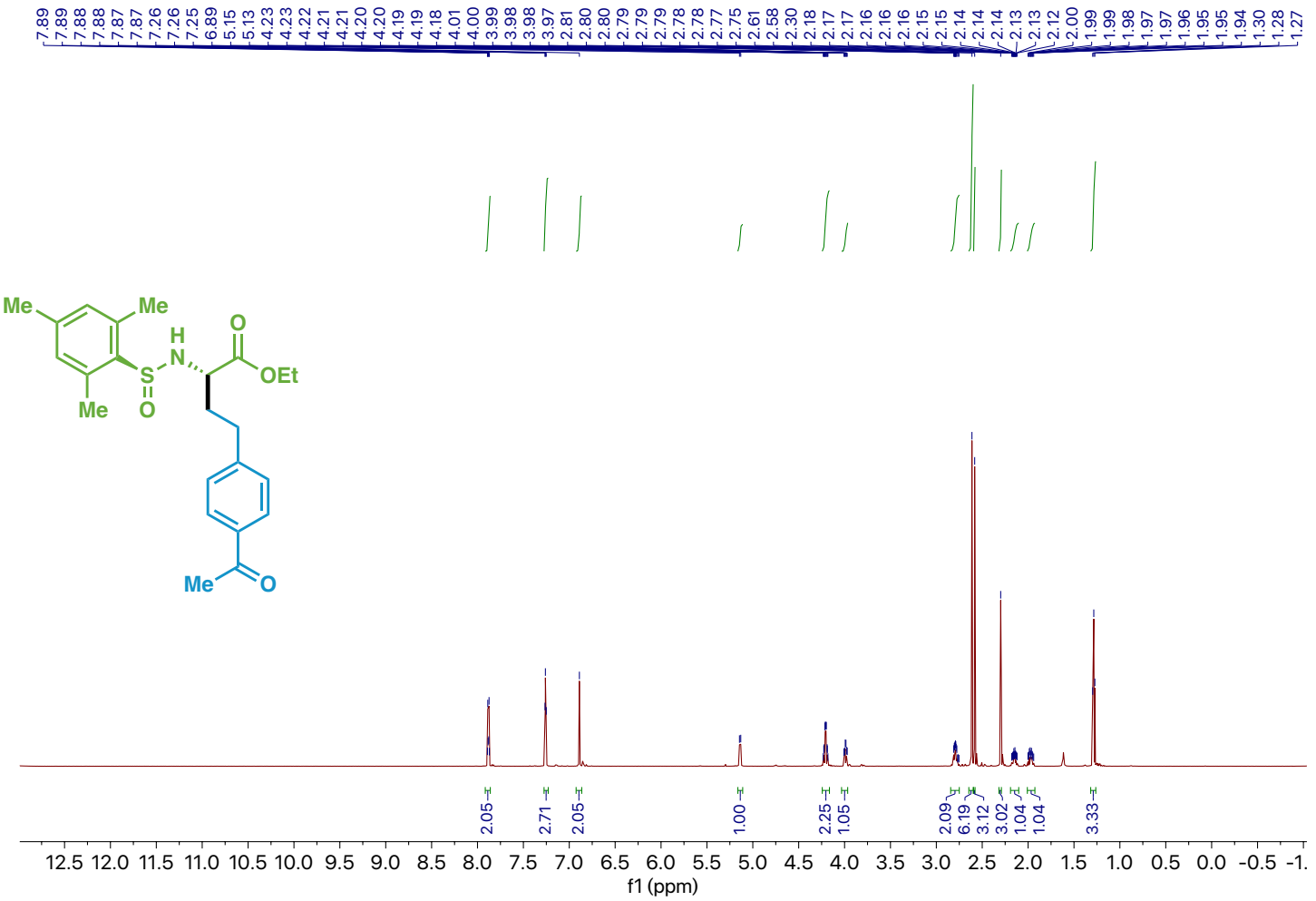
Compound 40 ^{1}H NMR



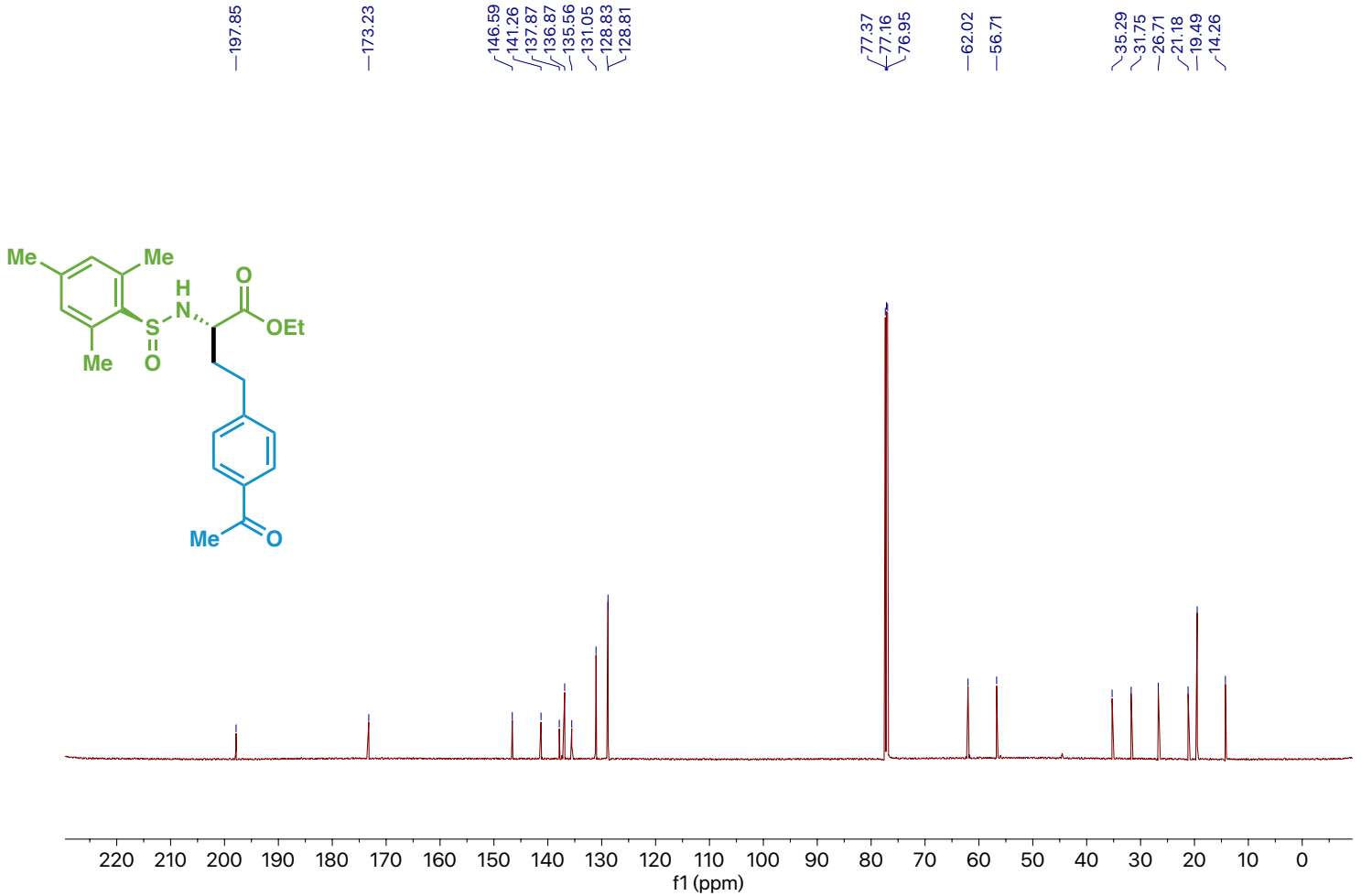
Compound 40 ^{13}C NMR



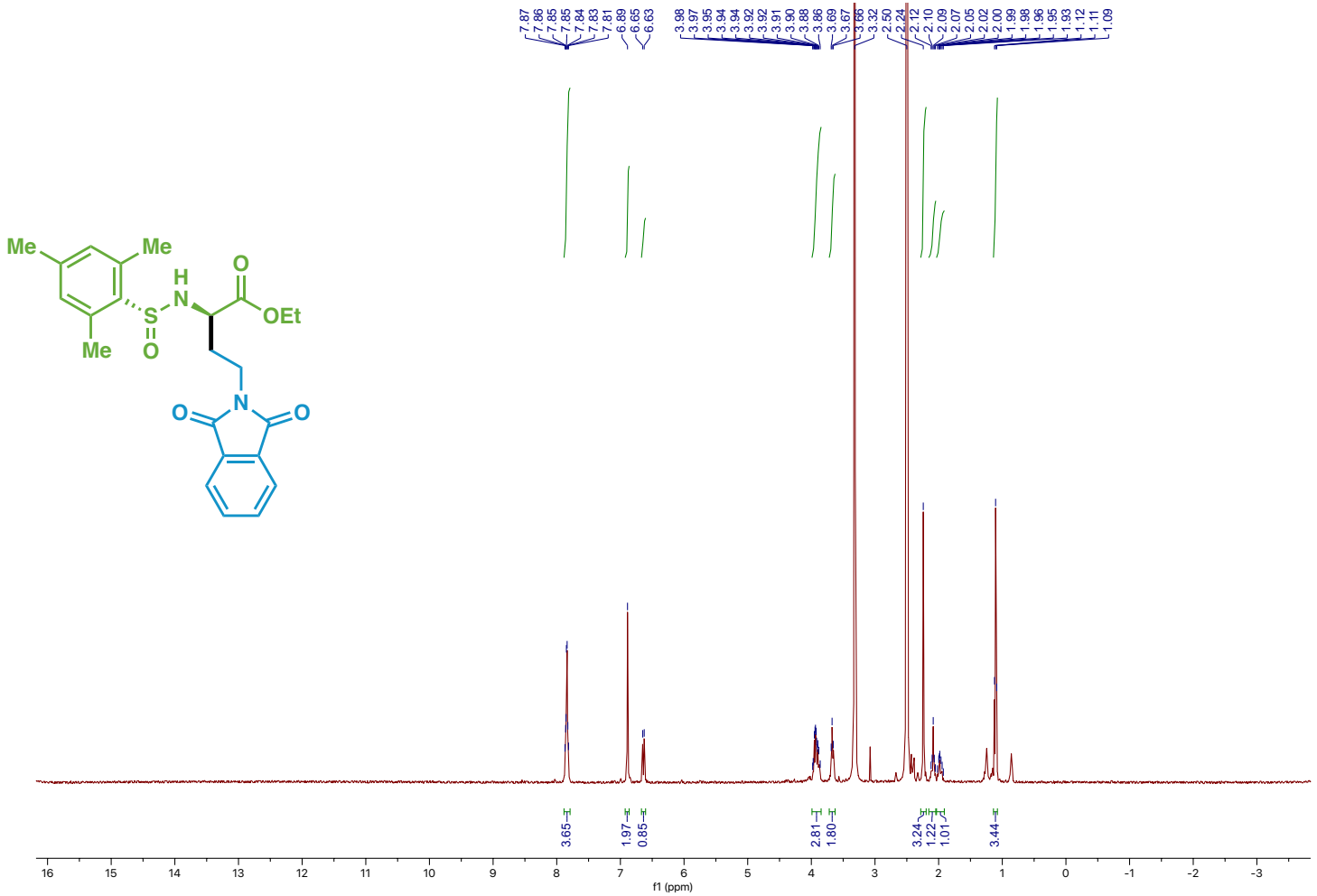
Compound 41 ^{1}H NMR



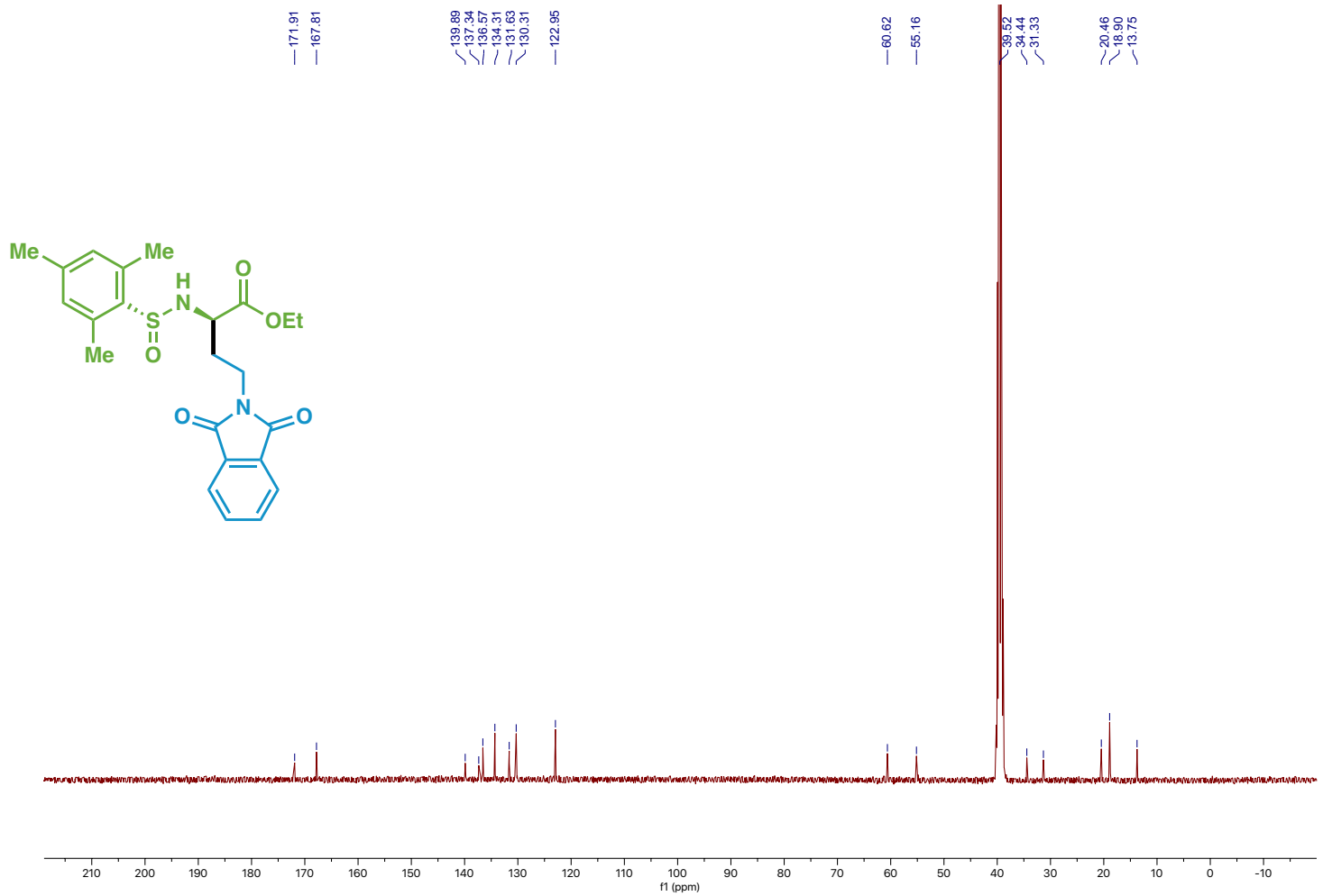
Compound 41 ^{13}C NMR



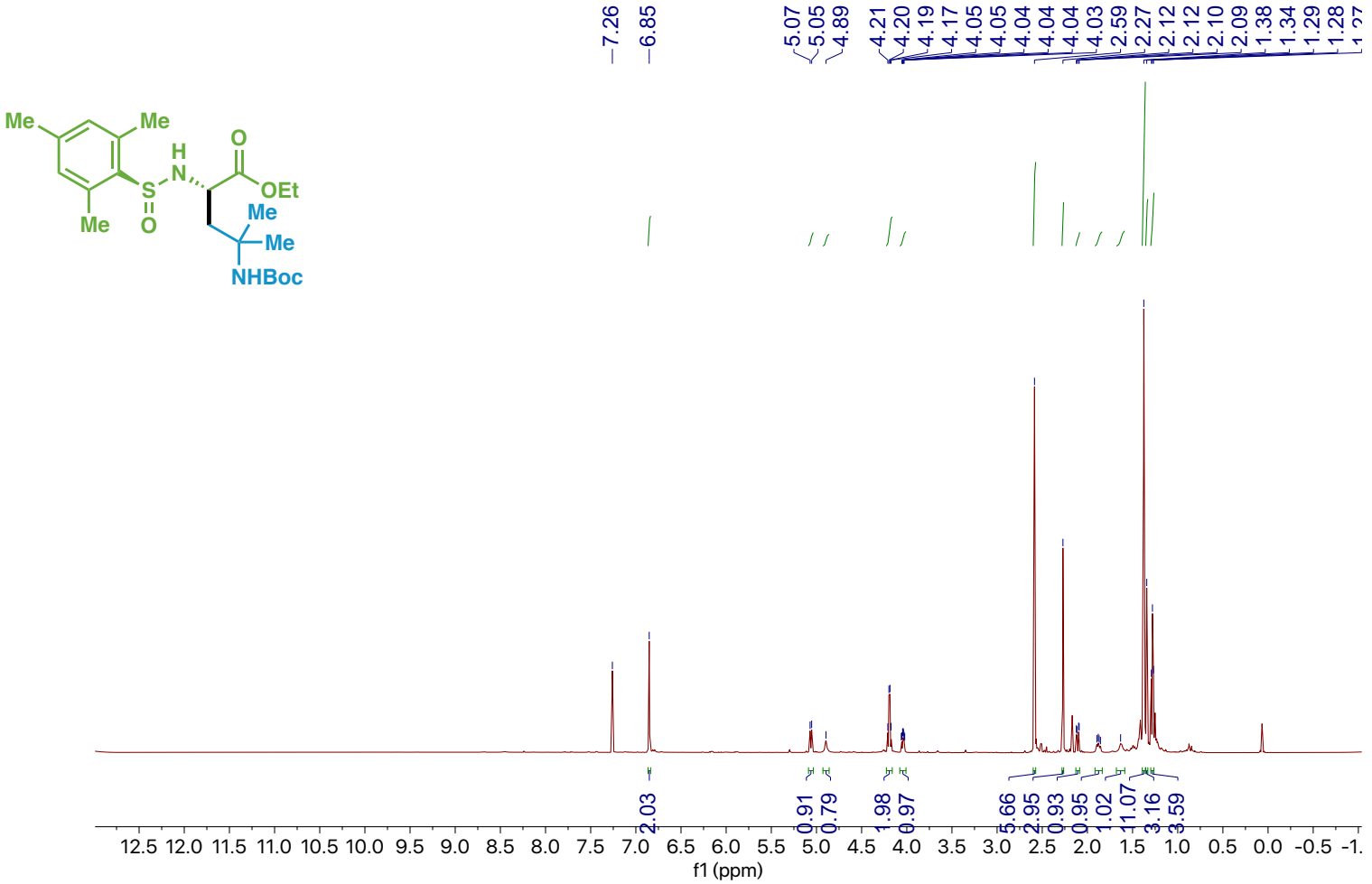
Compound 42 ^{1}H NMR



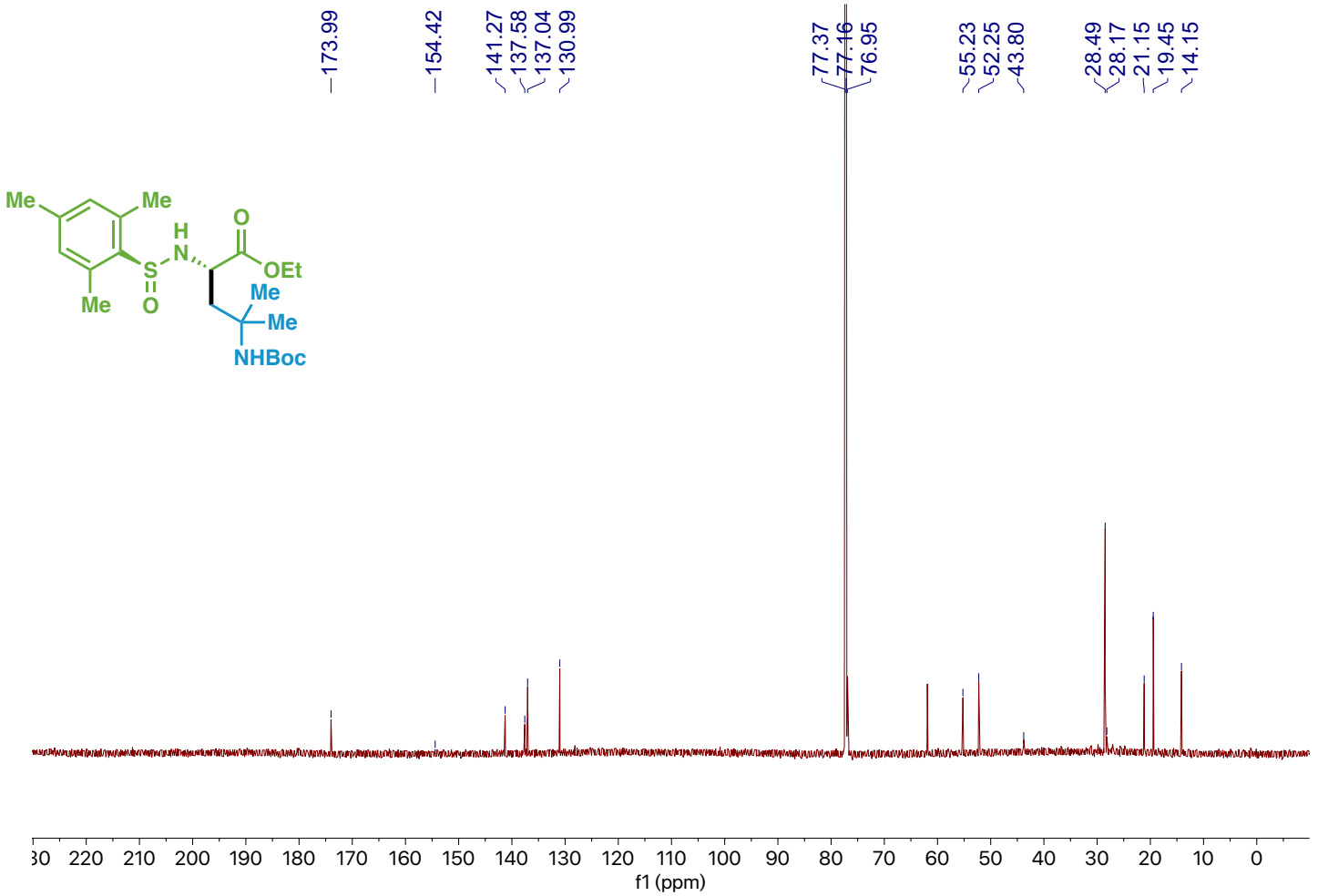
Compound 42 ^{13}C NMR



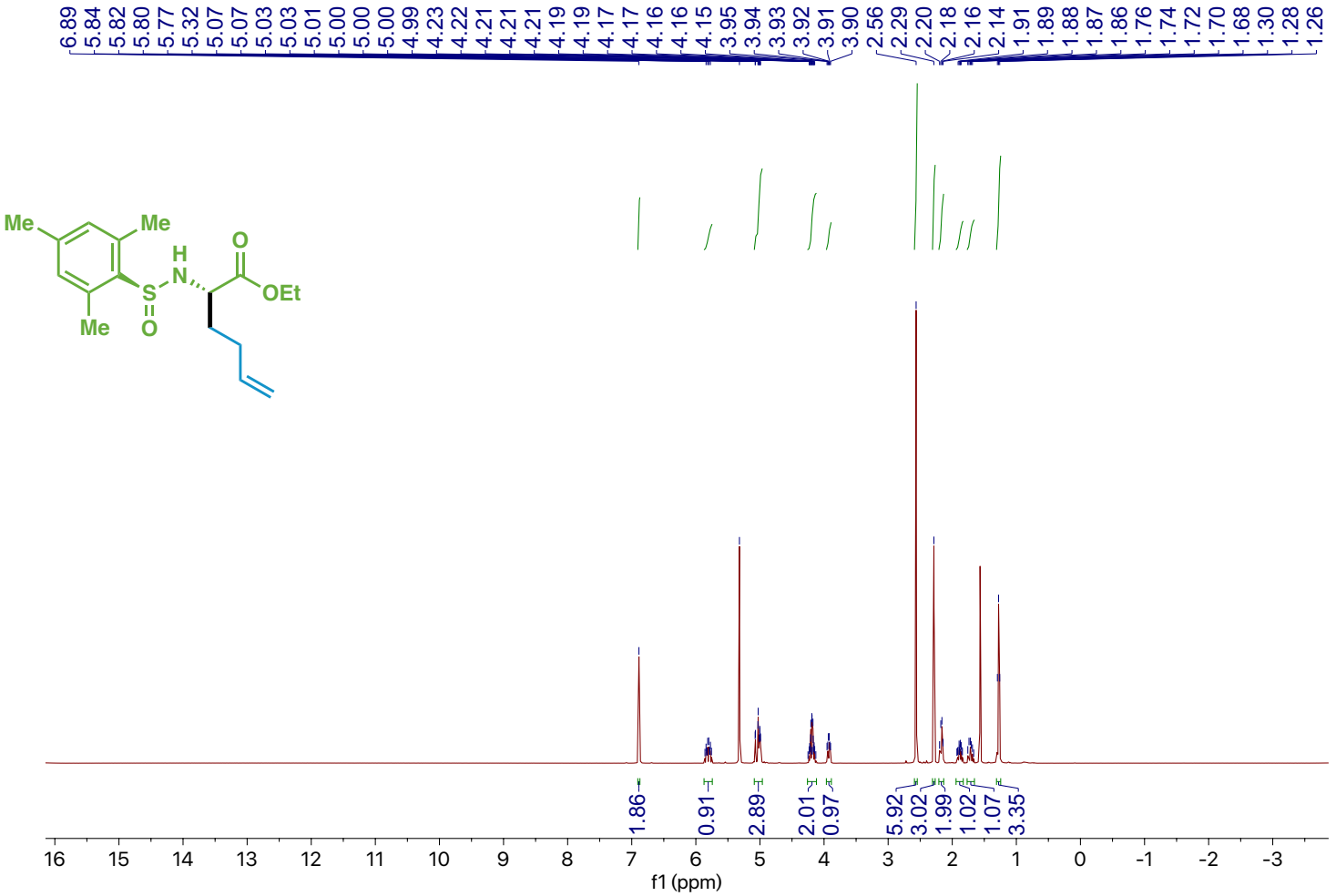
Compound 43 ^{1}H NMR



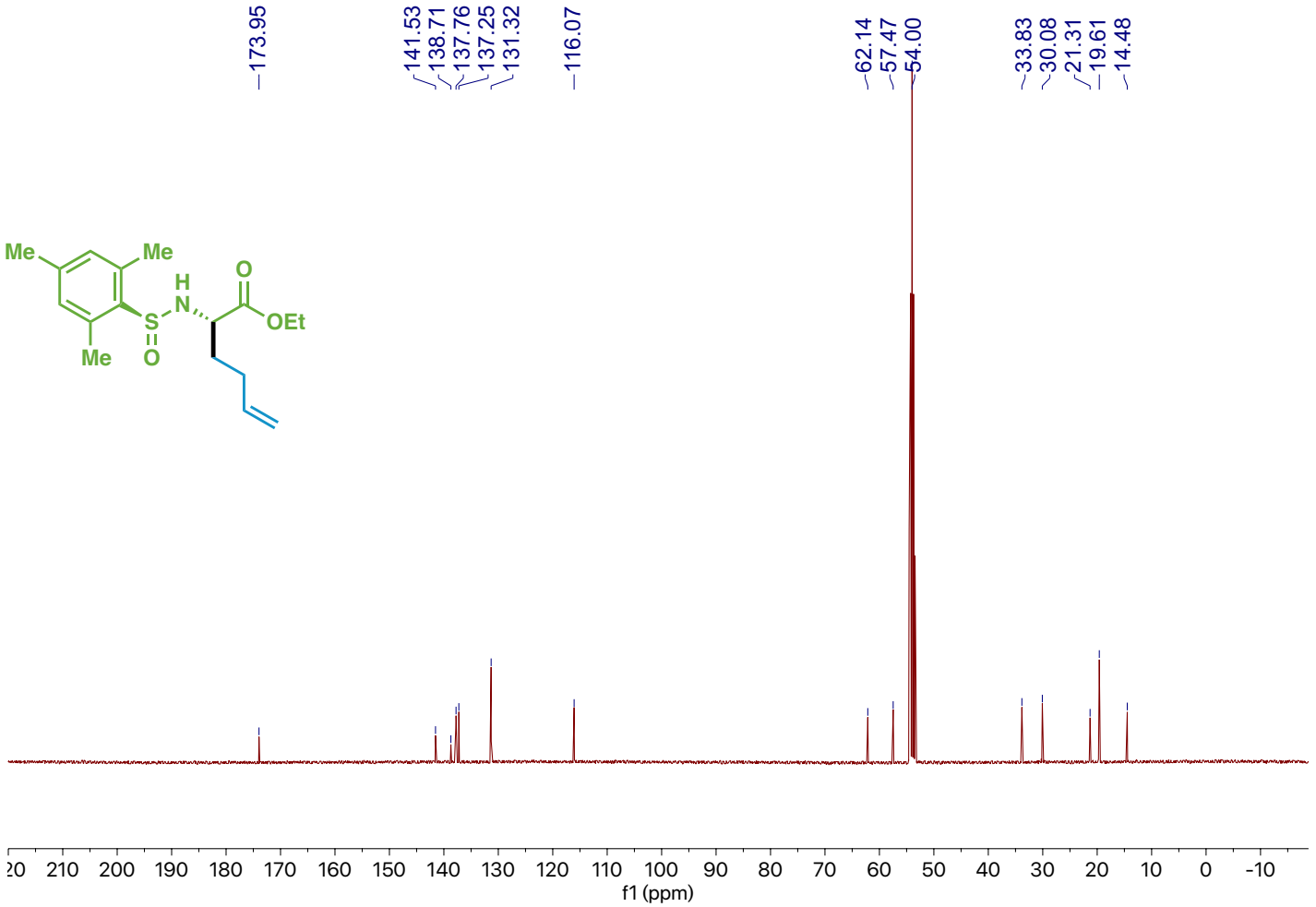
Compound 43 ^{13}C NMR



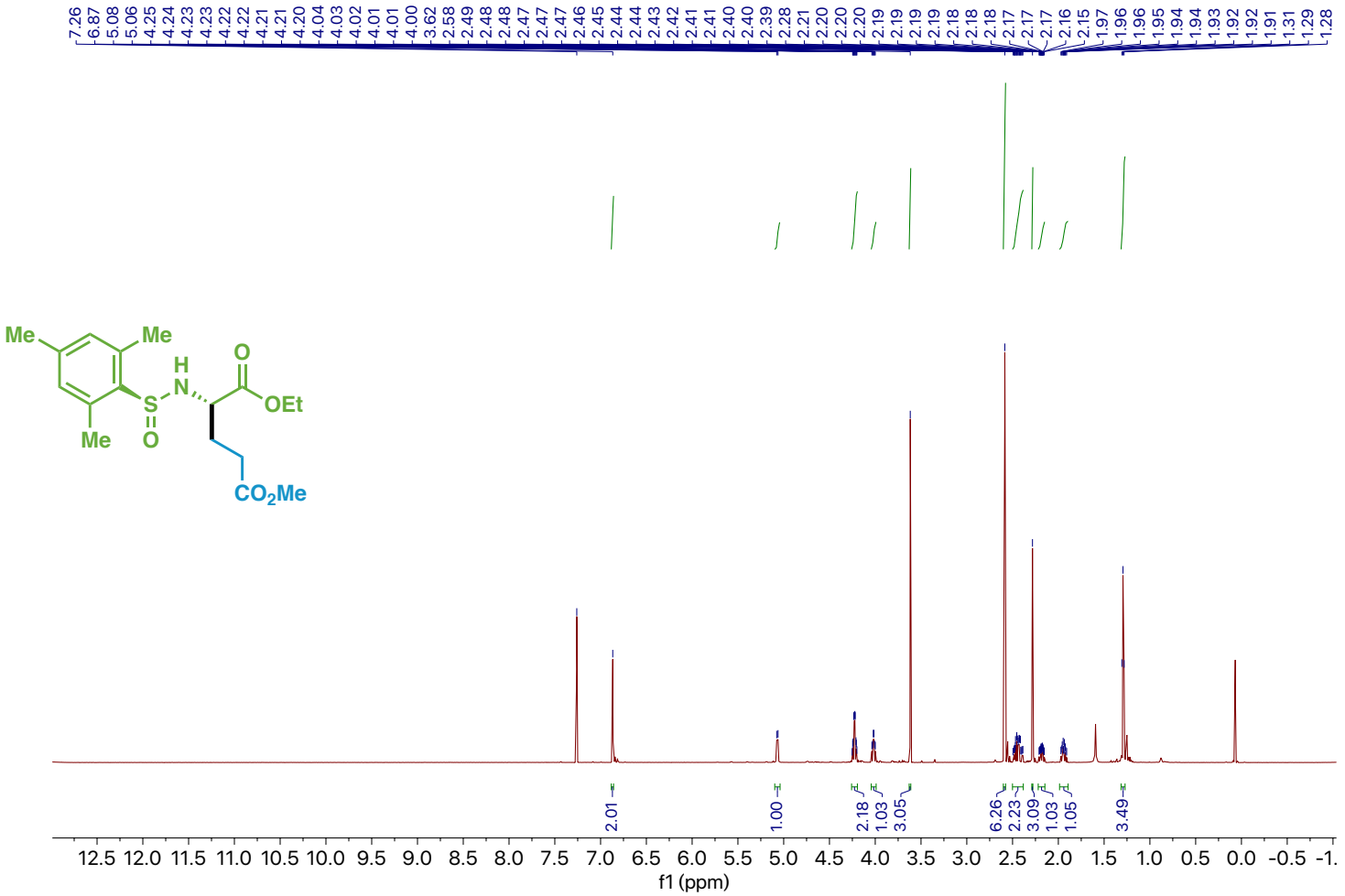
Compound 44 ^{1}H NMR



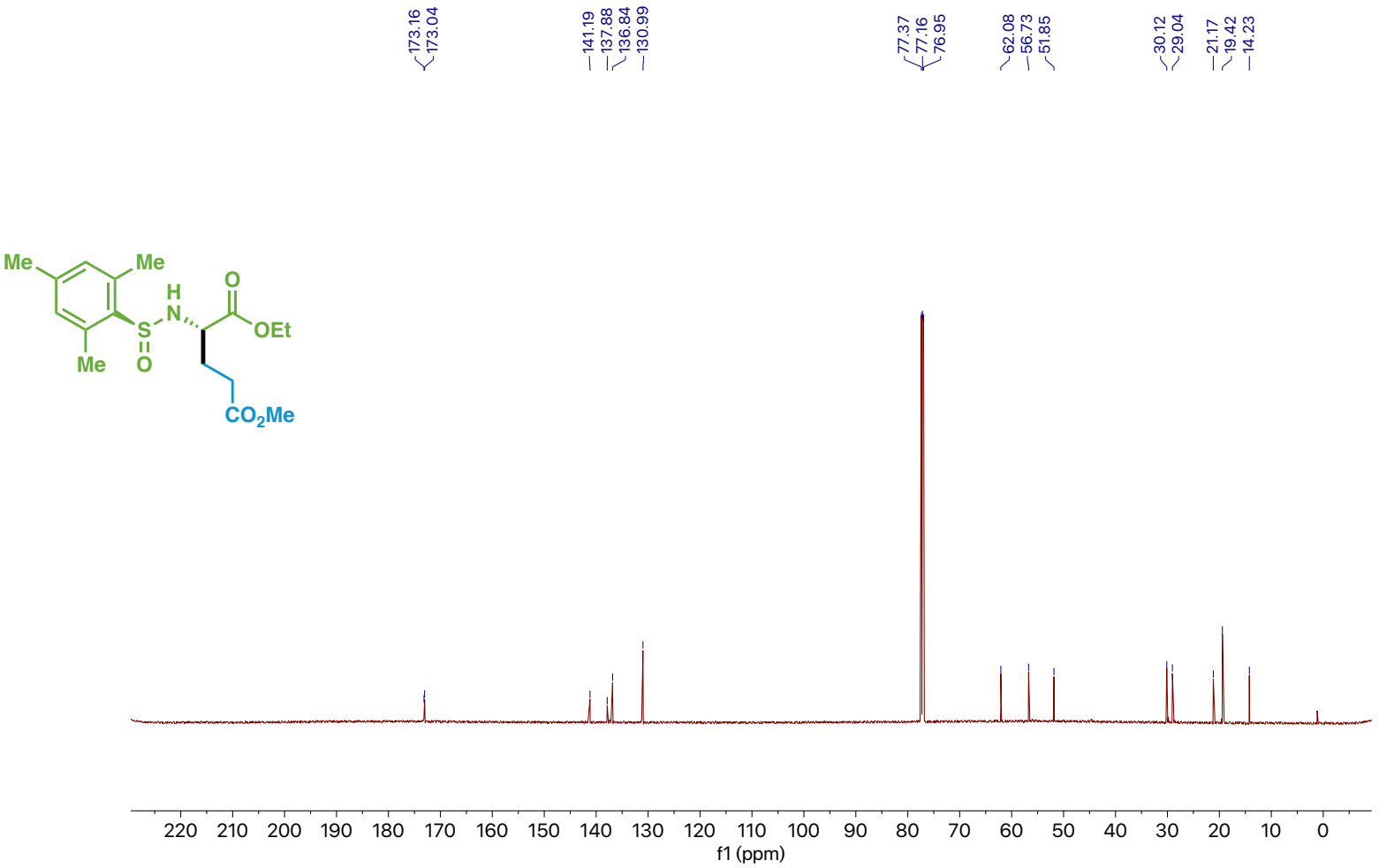
Compound 44 ^{13}C NMR



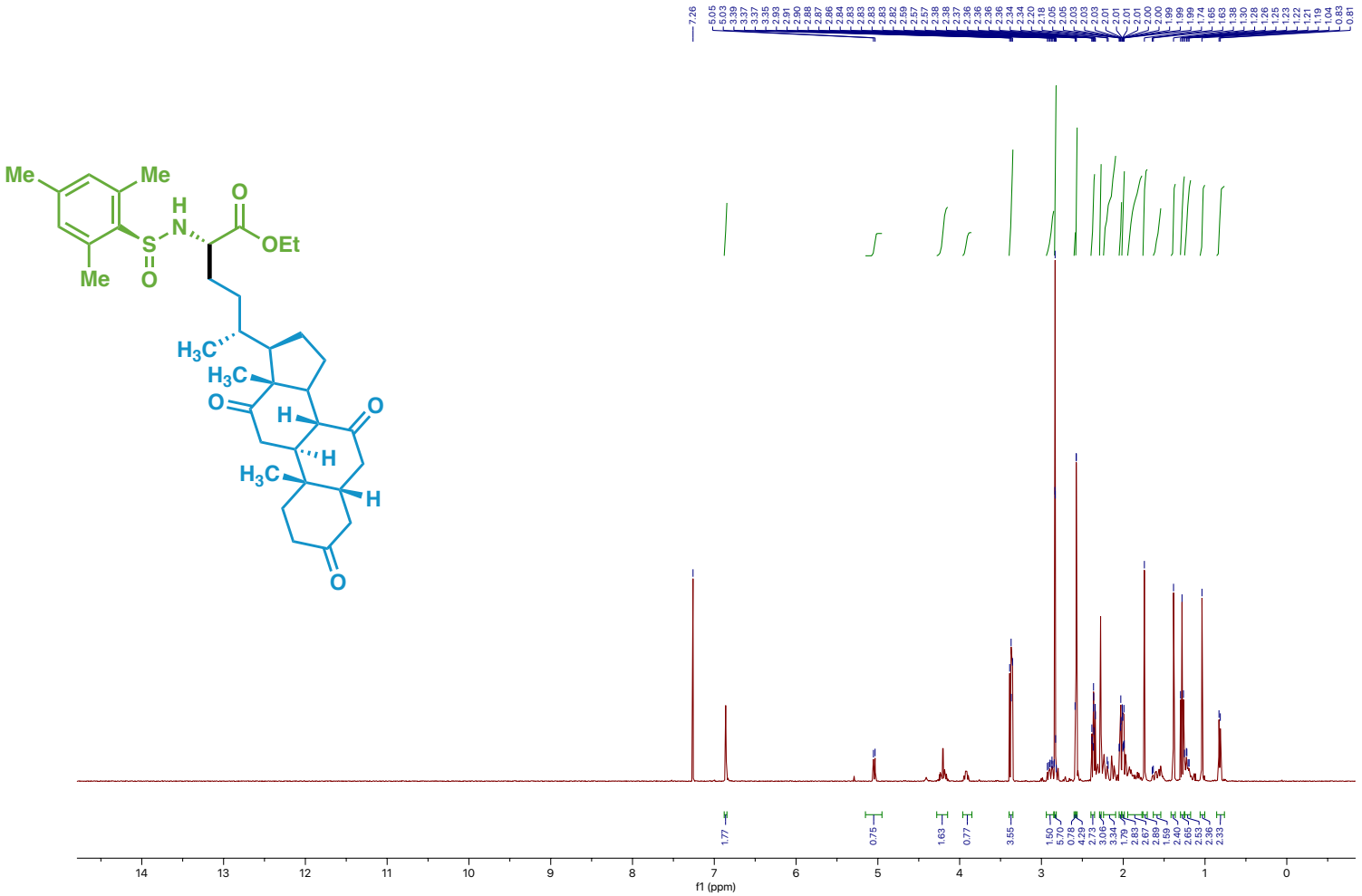
Compound 45 ^{1}H NMR



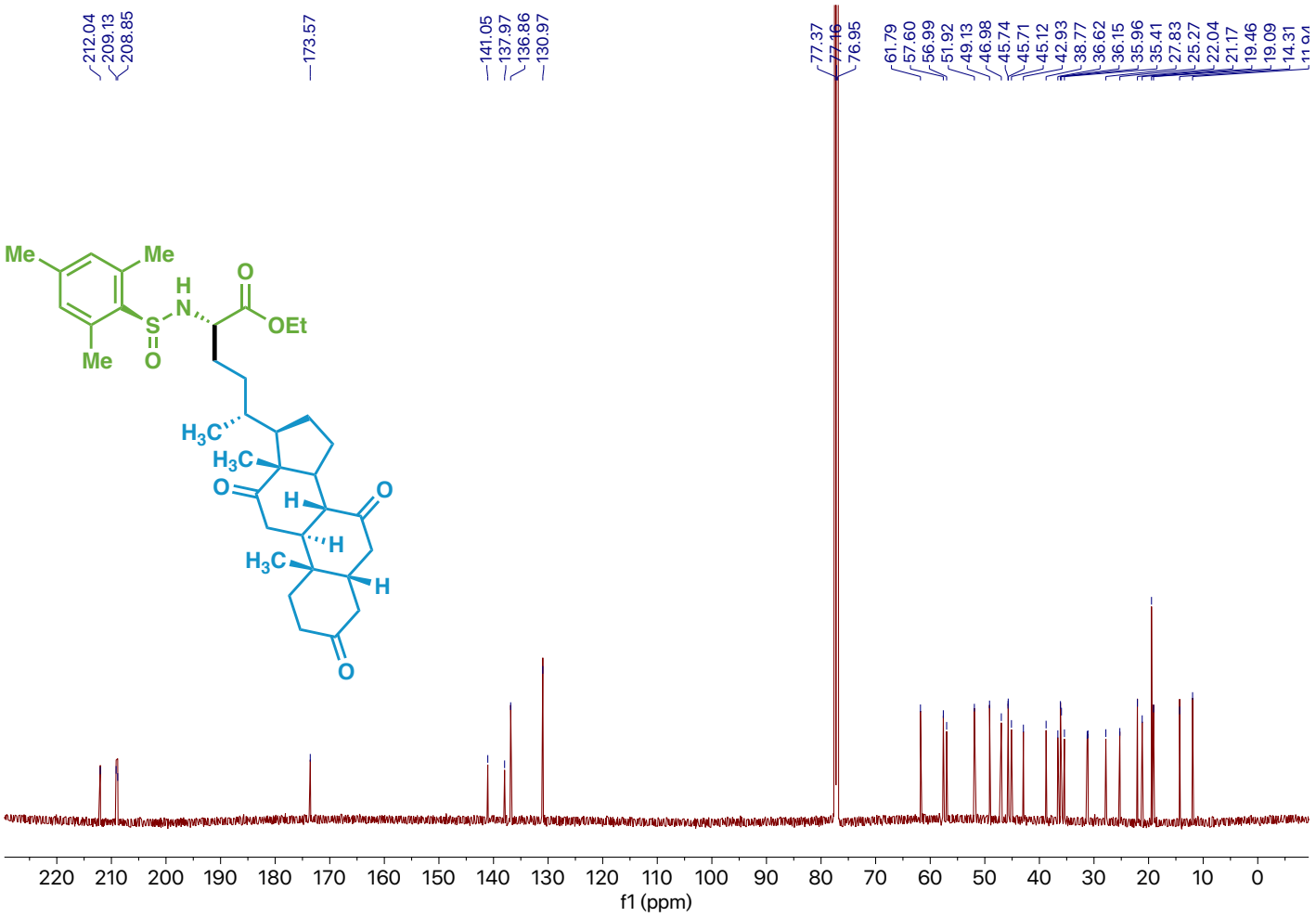
Compound 45 ^{13}C NMR



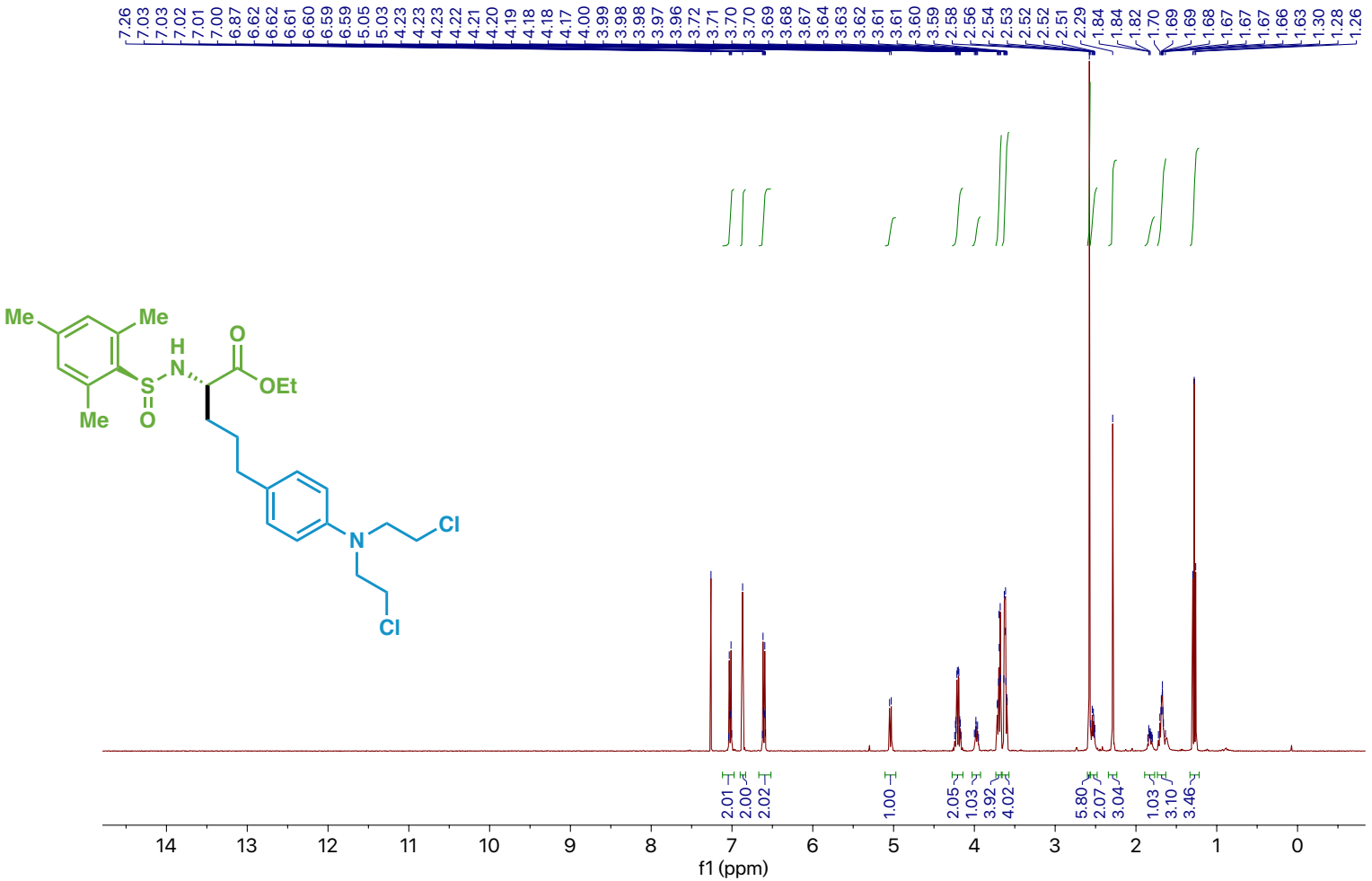
Compound 46 ^{1}H NMR



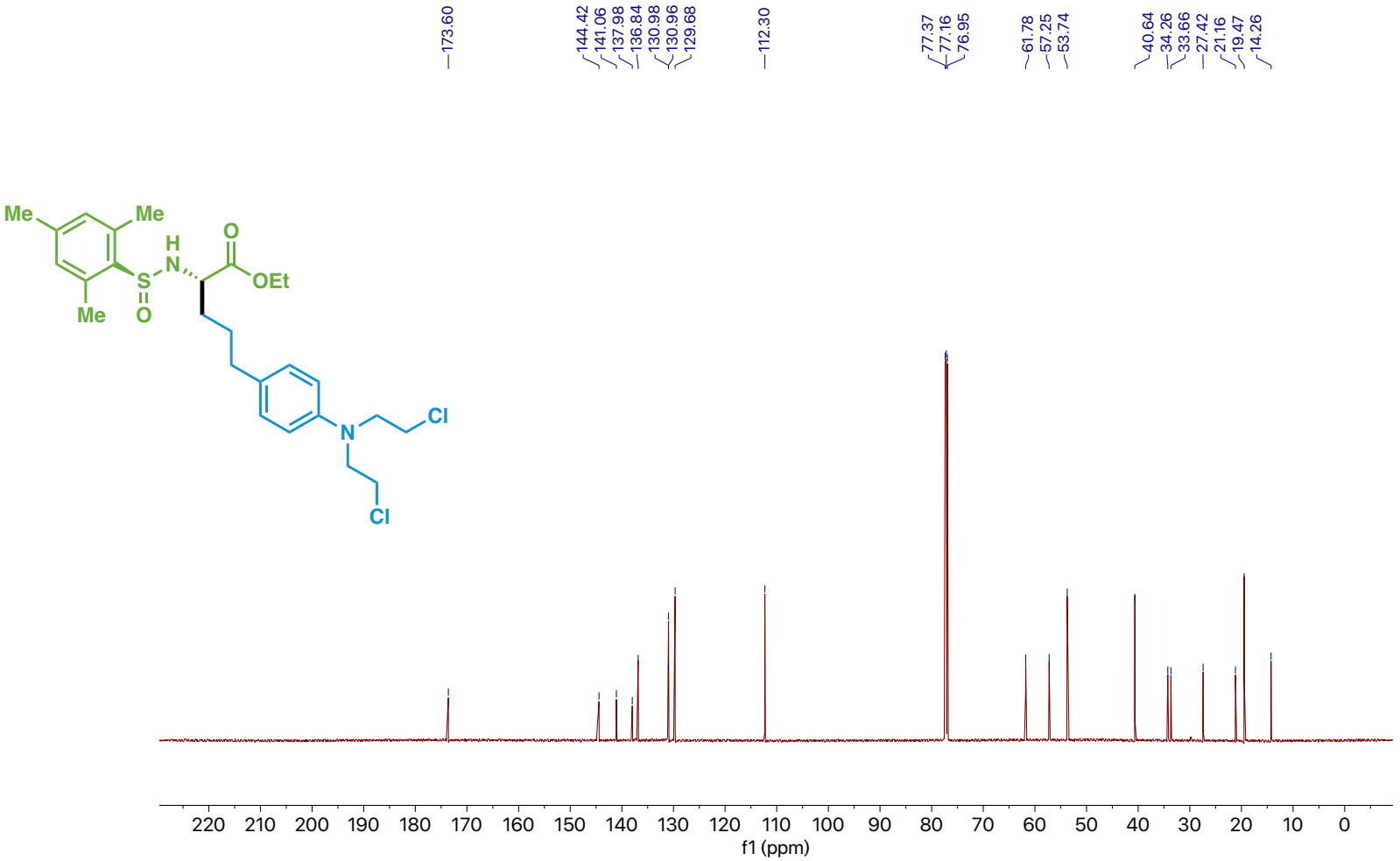
Compound 46 ^{13}C NMR



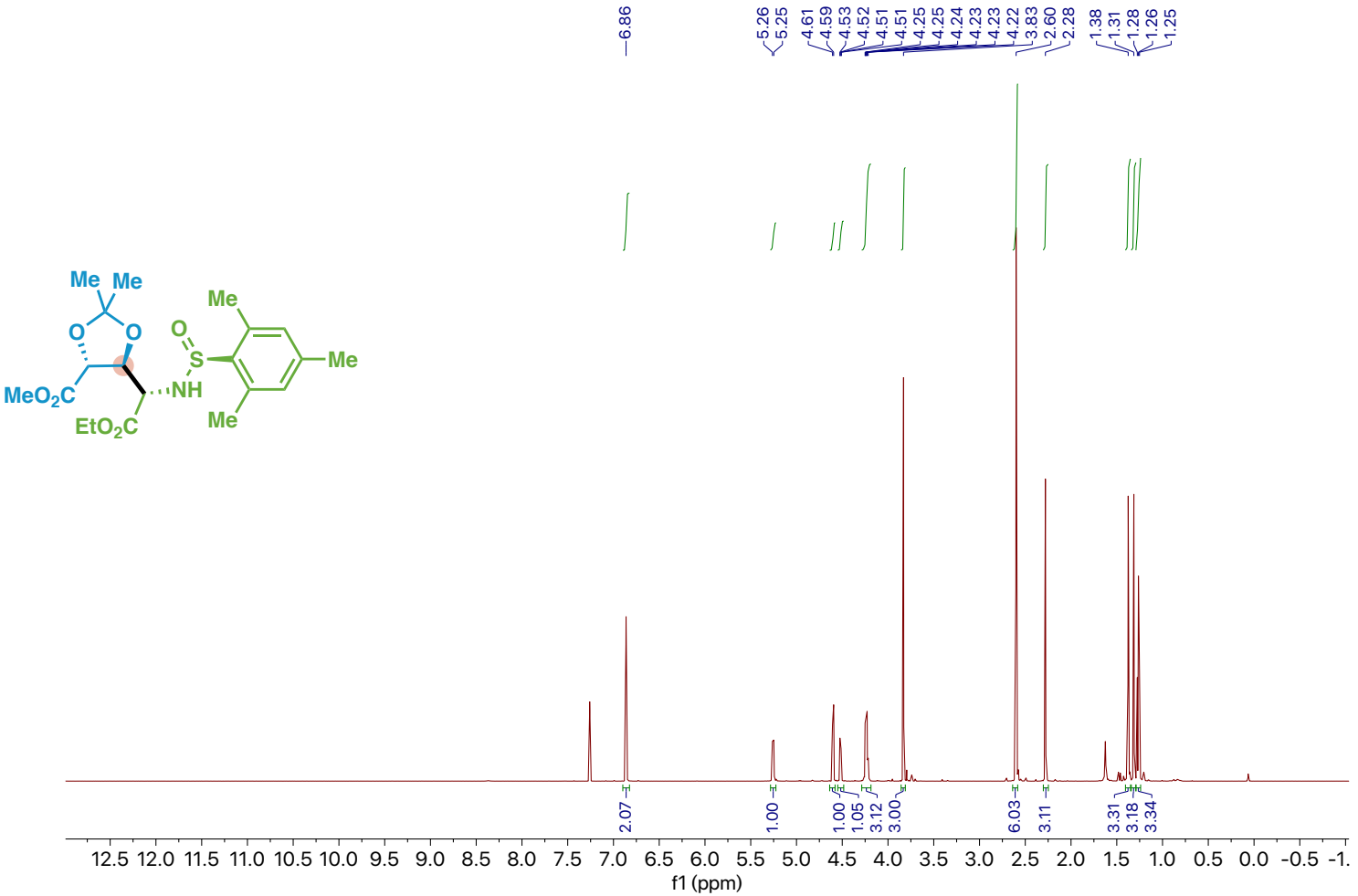
Compound 47 ^{1}H NMR



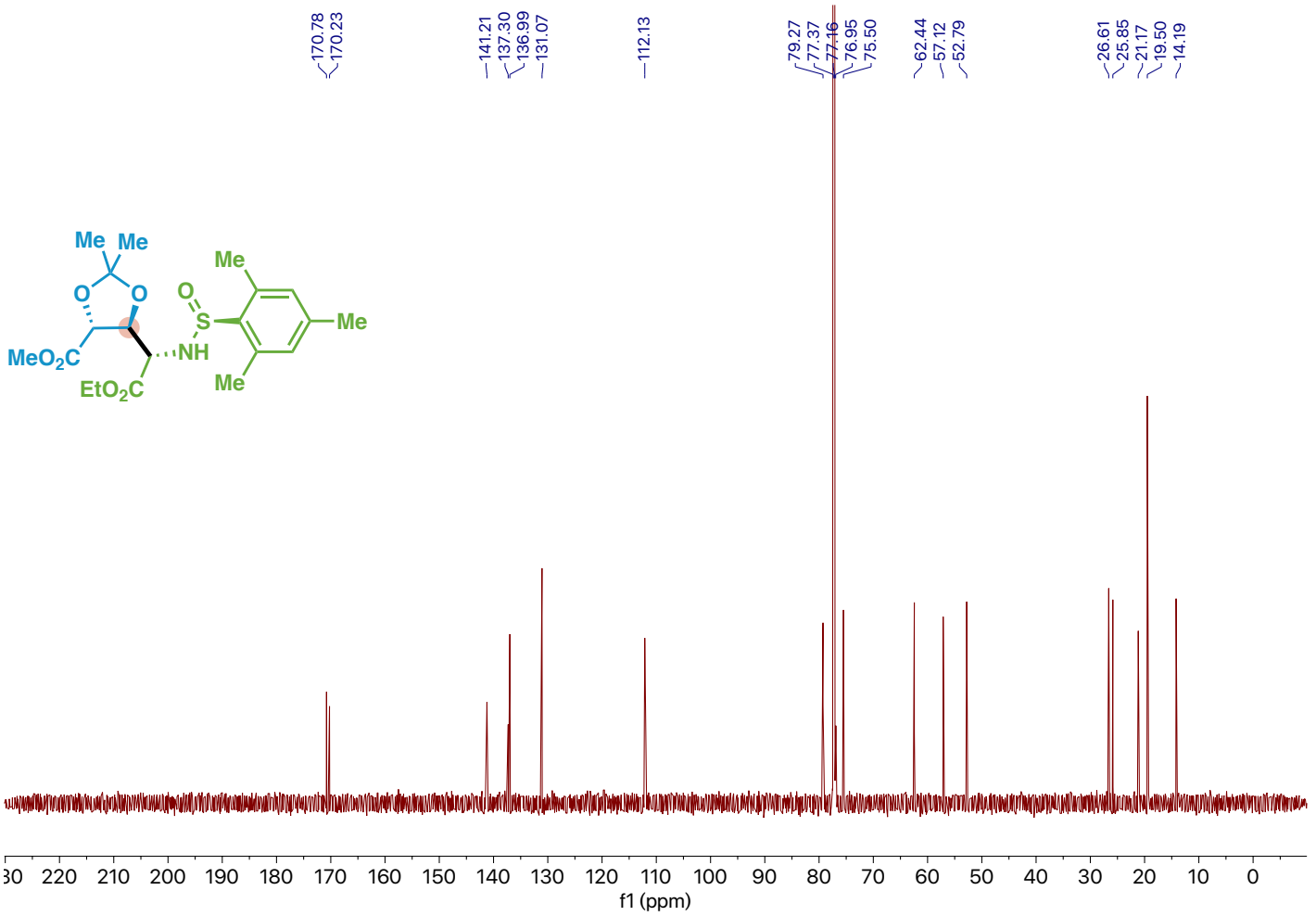
Compound 47 ^{13}C NMR



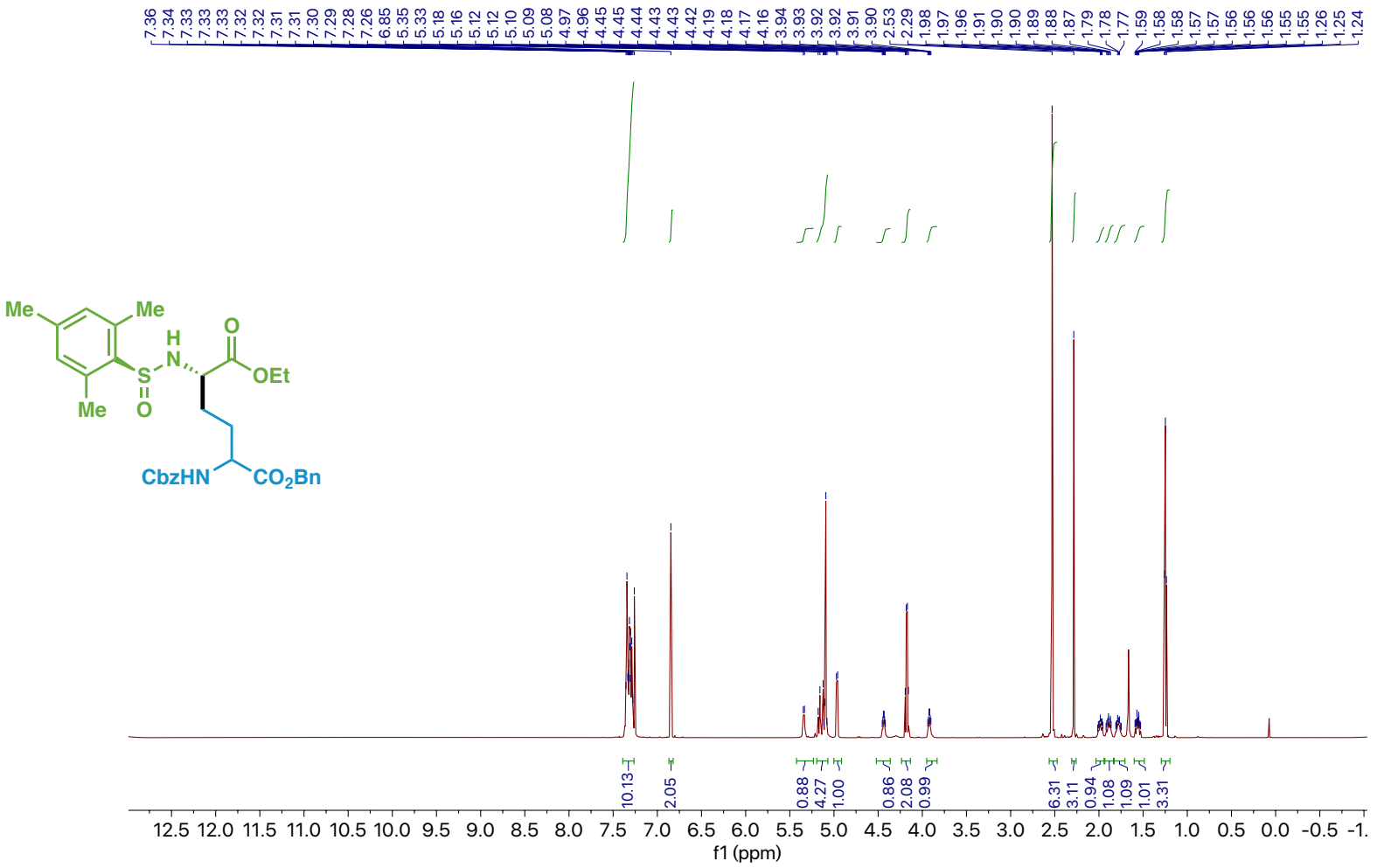
Compound 48 ^{1}H NMR



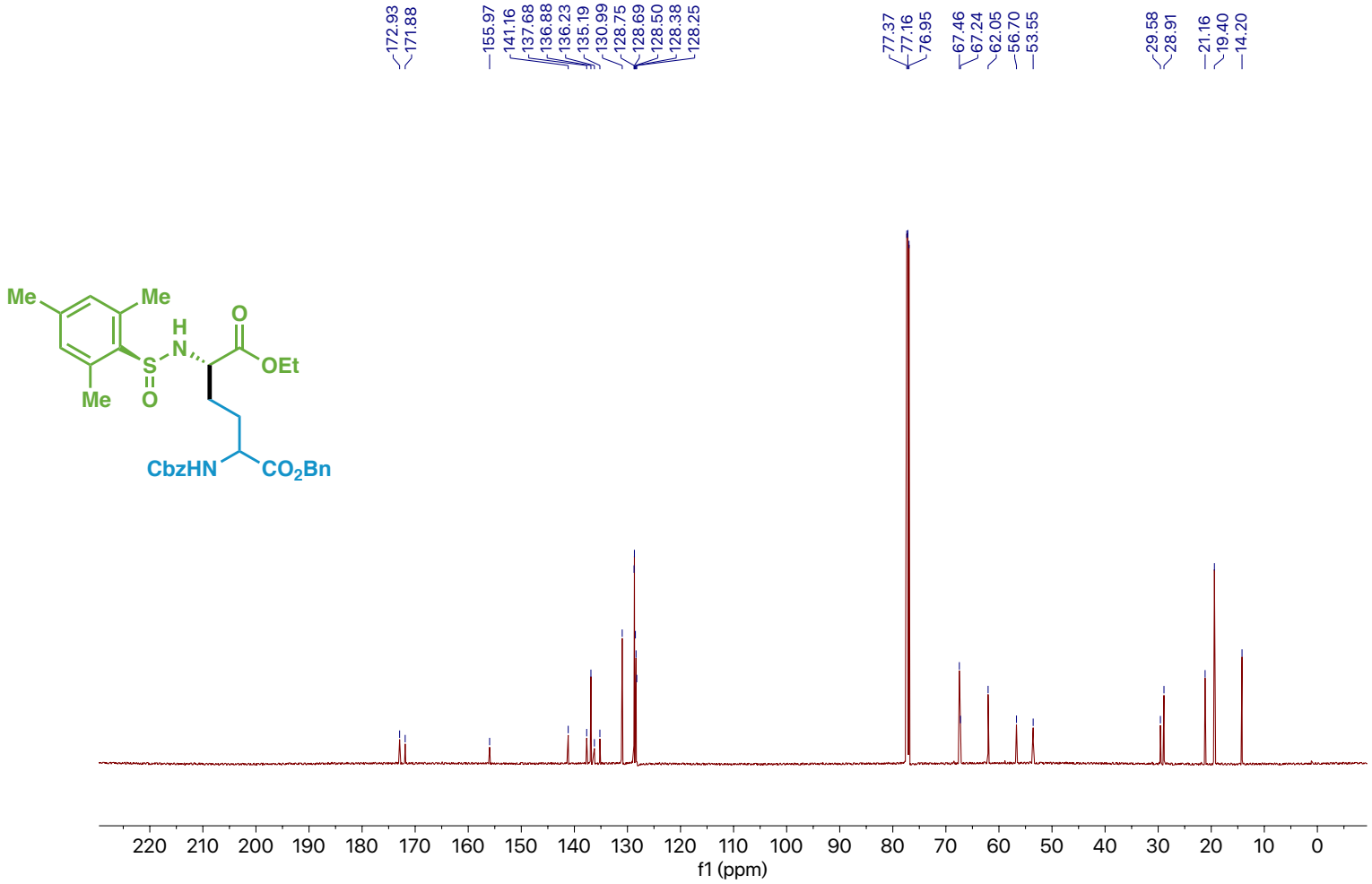
Compound 48 ^{13}C NMR



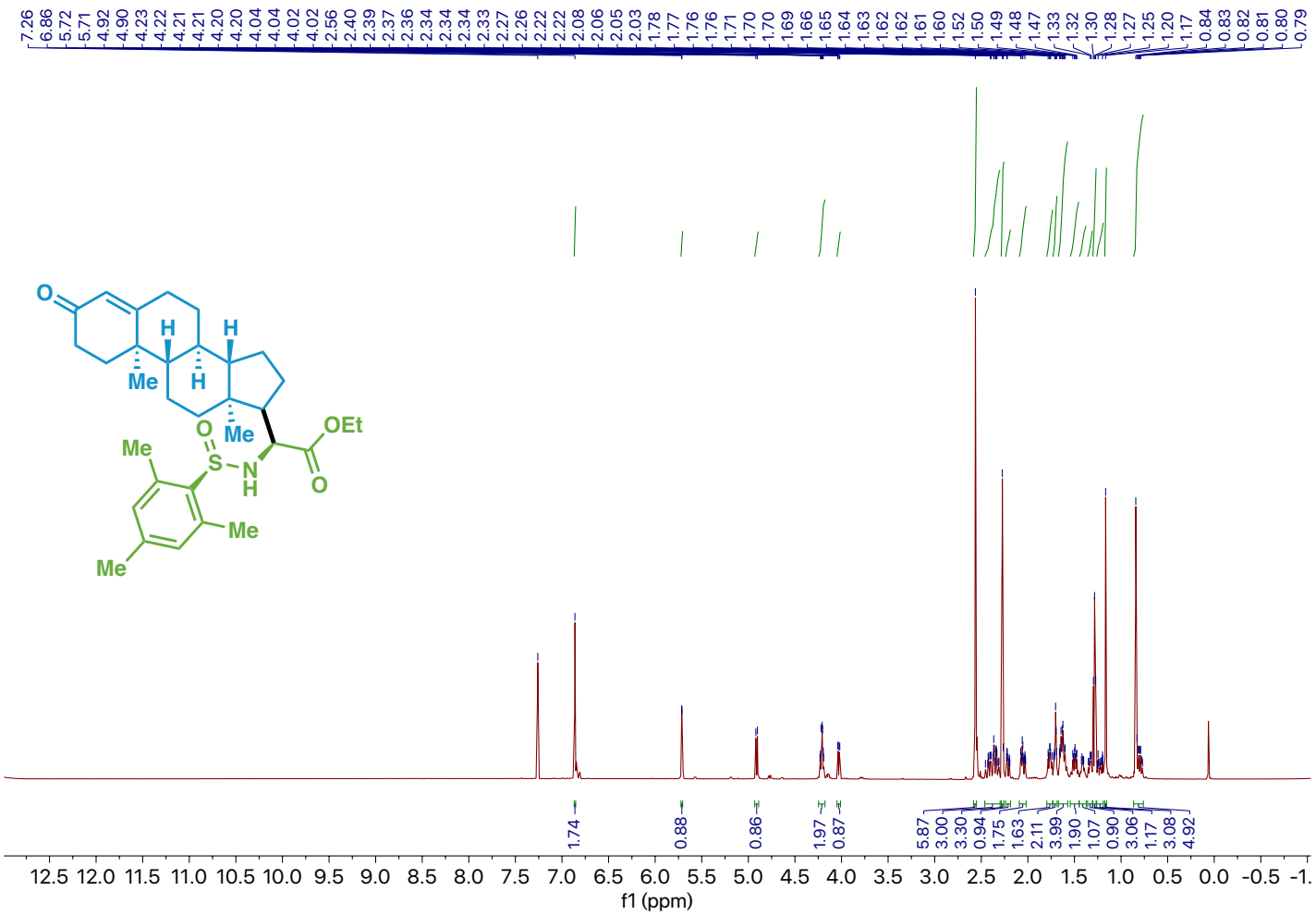
Compound 49 ^{1}H NMR



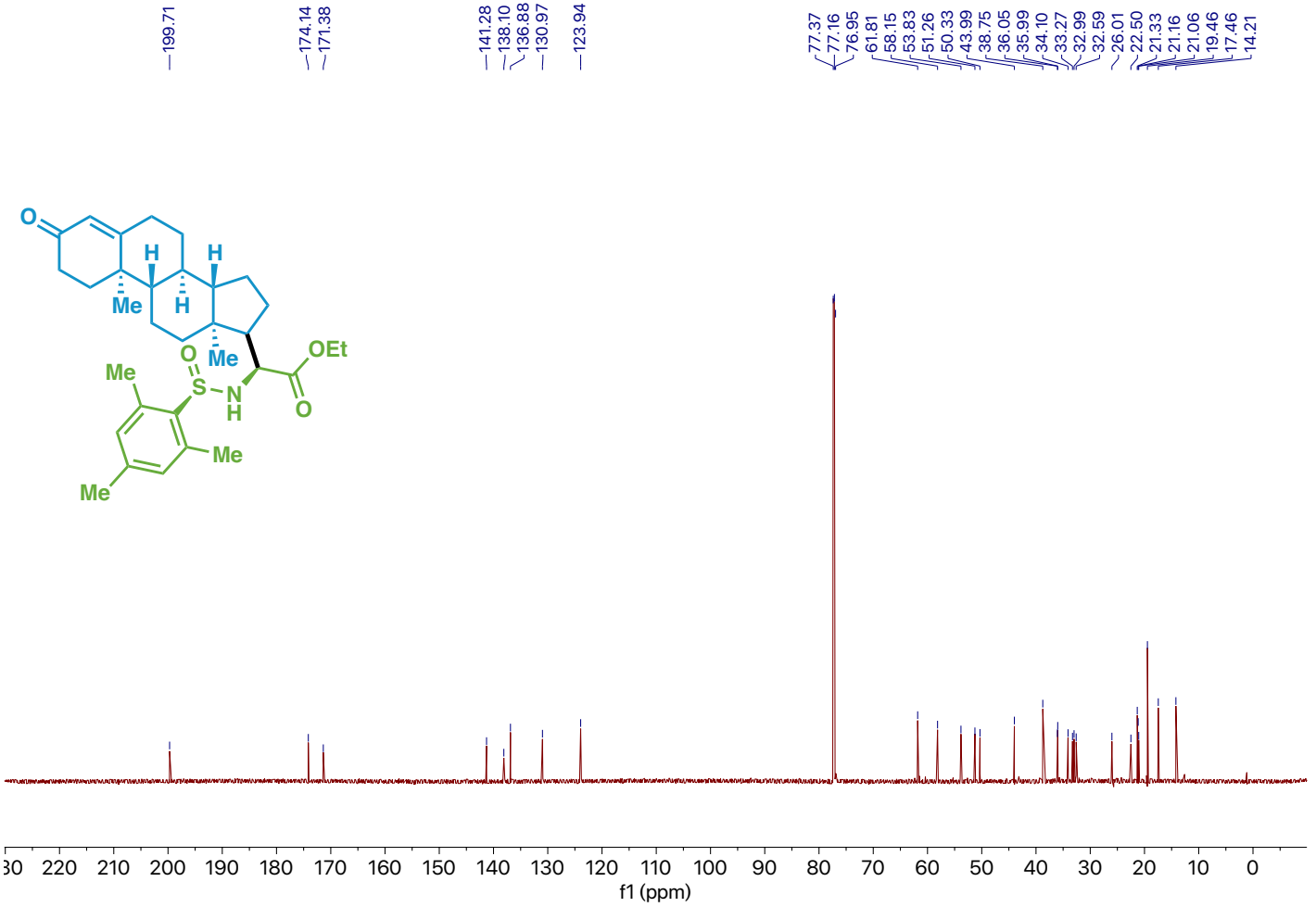
Compound 49 ^{13}C NMR



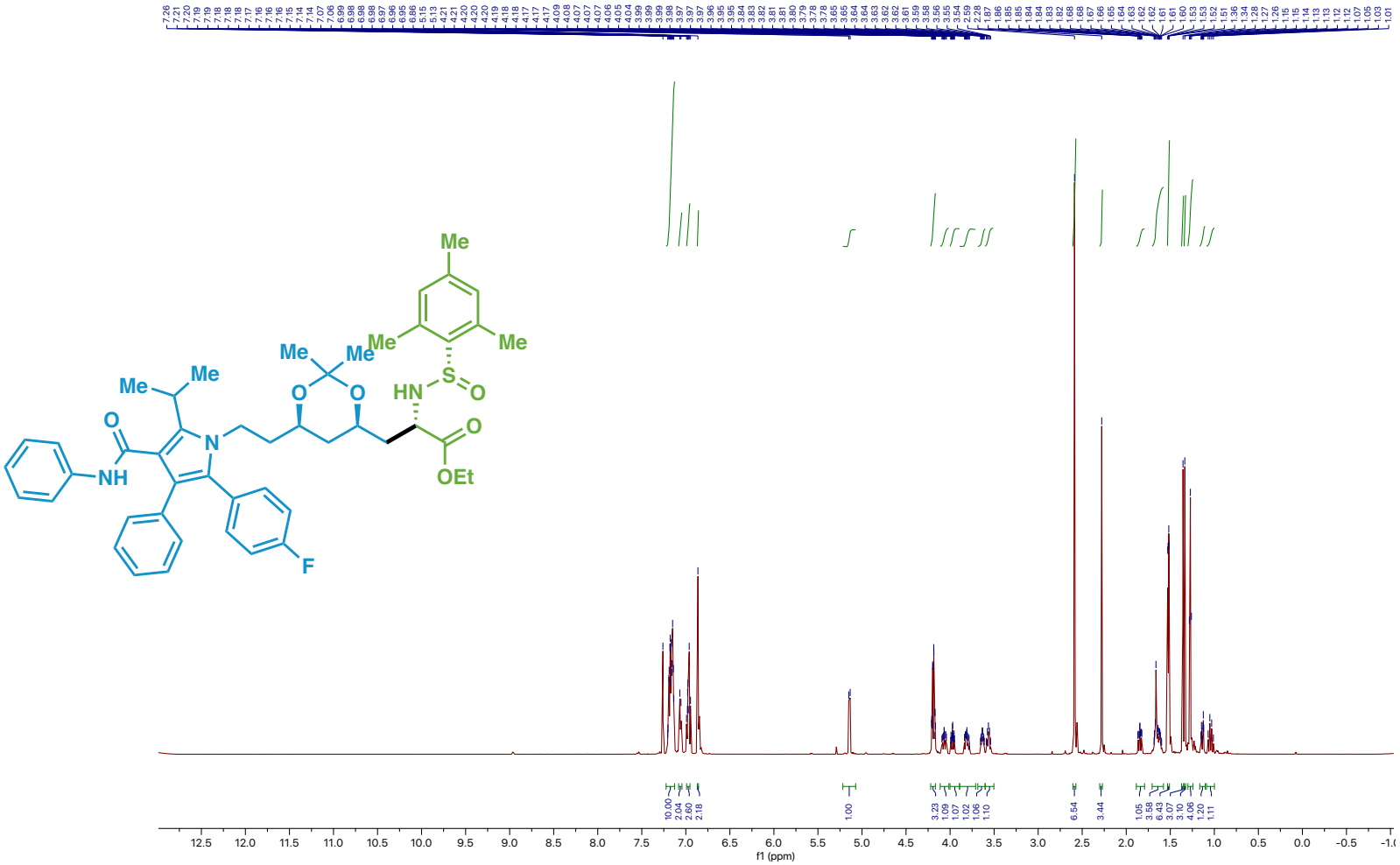
Compound 50 ^{1}H NMR



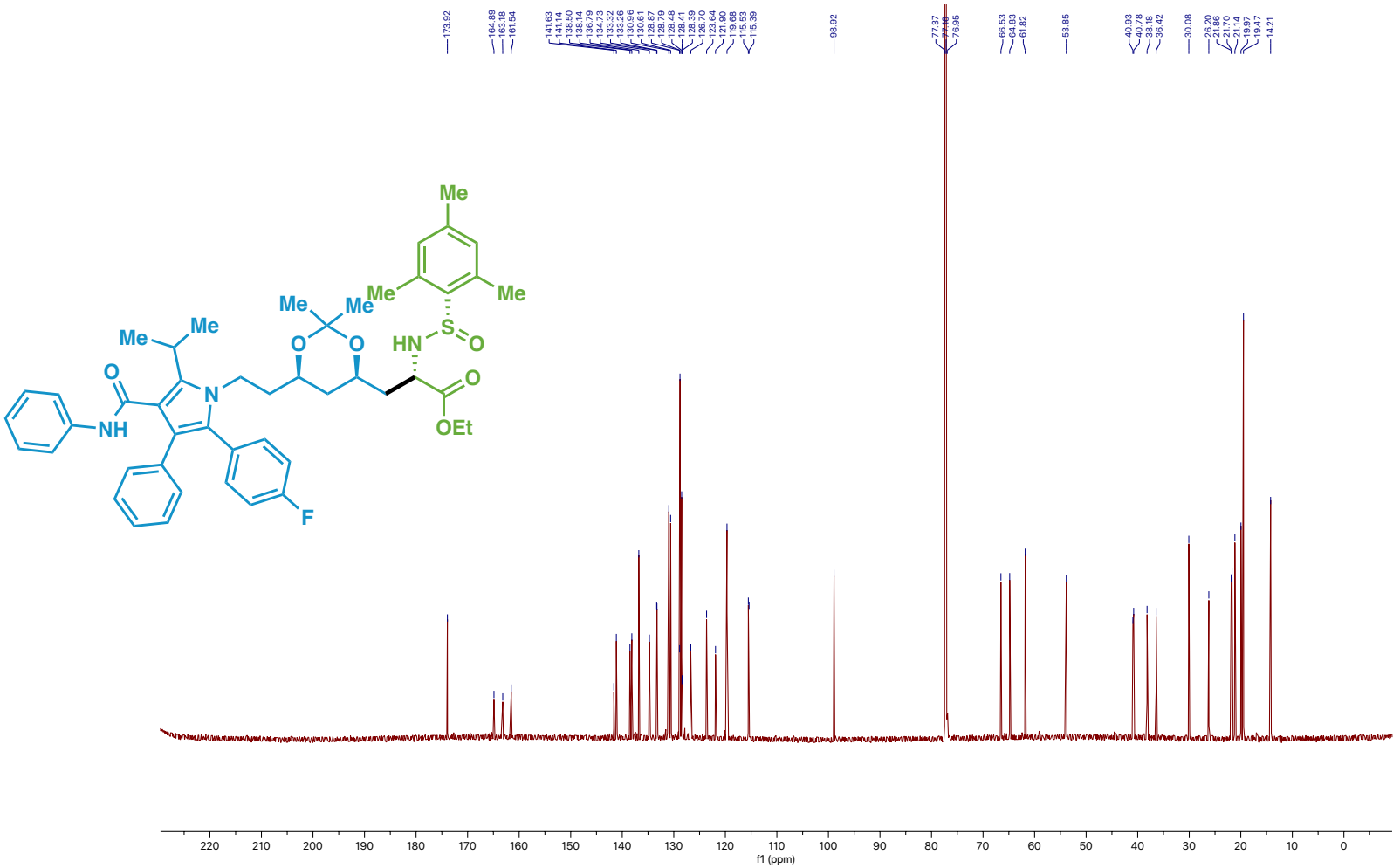
Compound 51 ^{13}C NMR



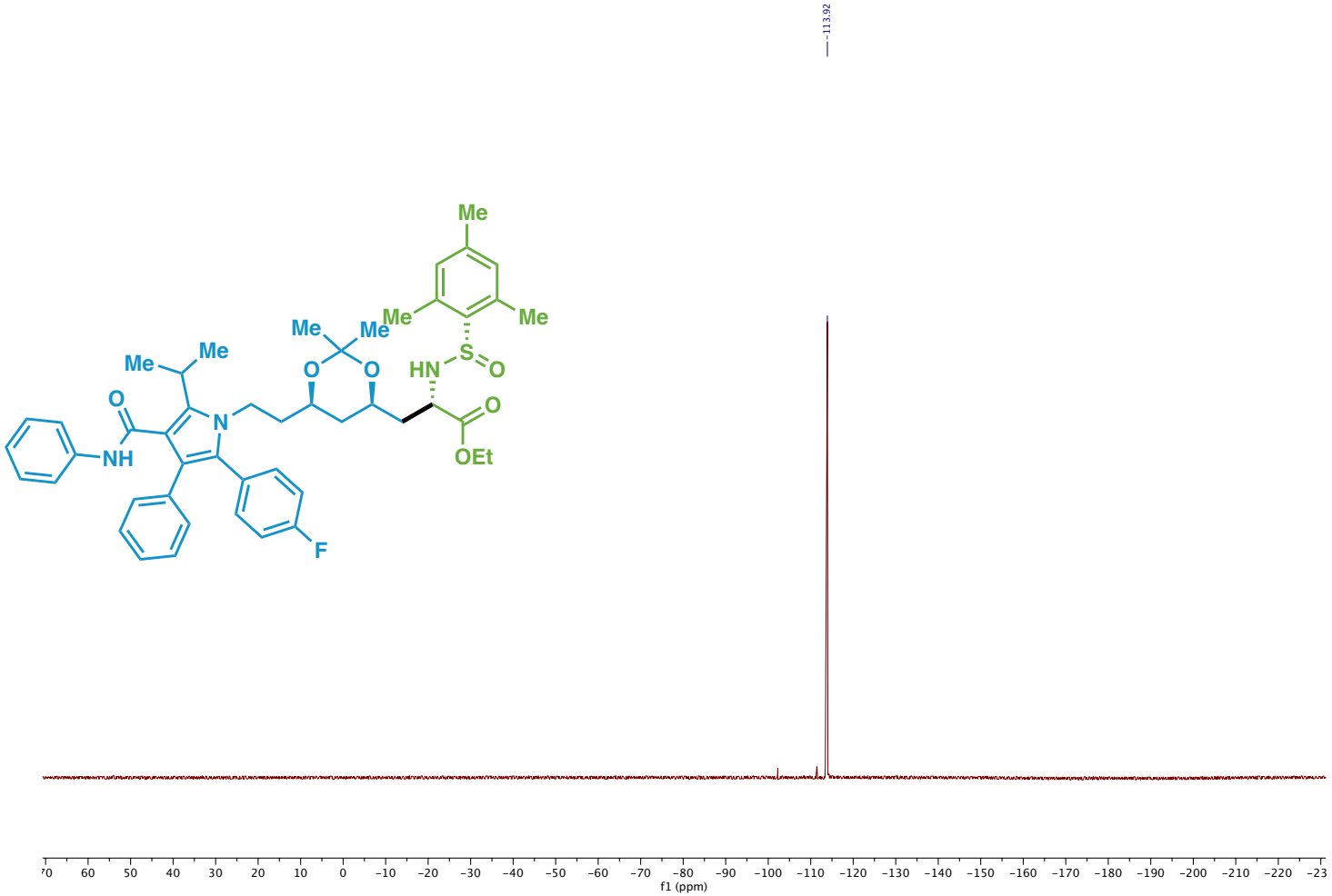
Compound 51 ^{1}H NMR



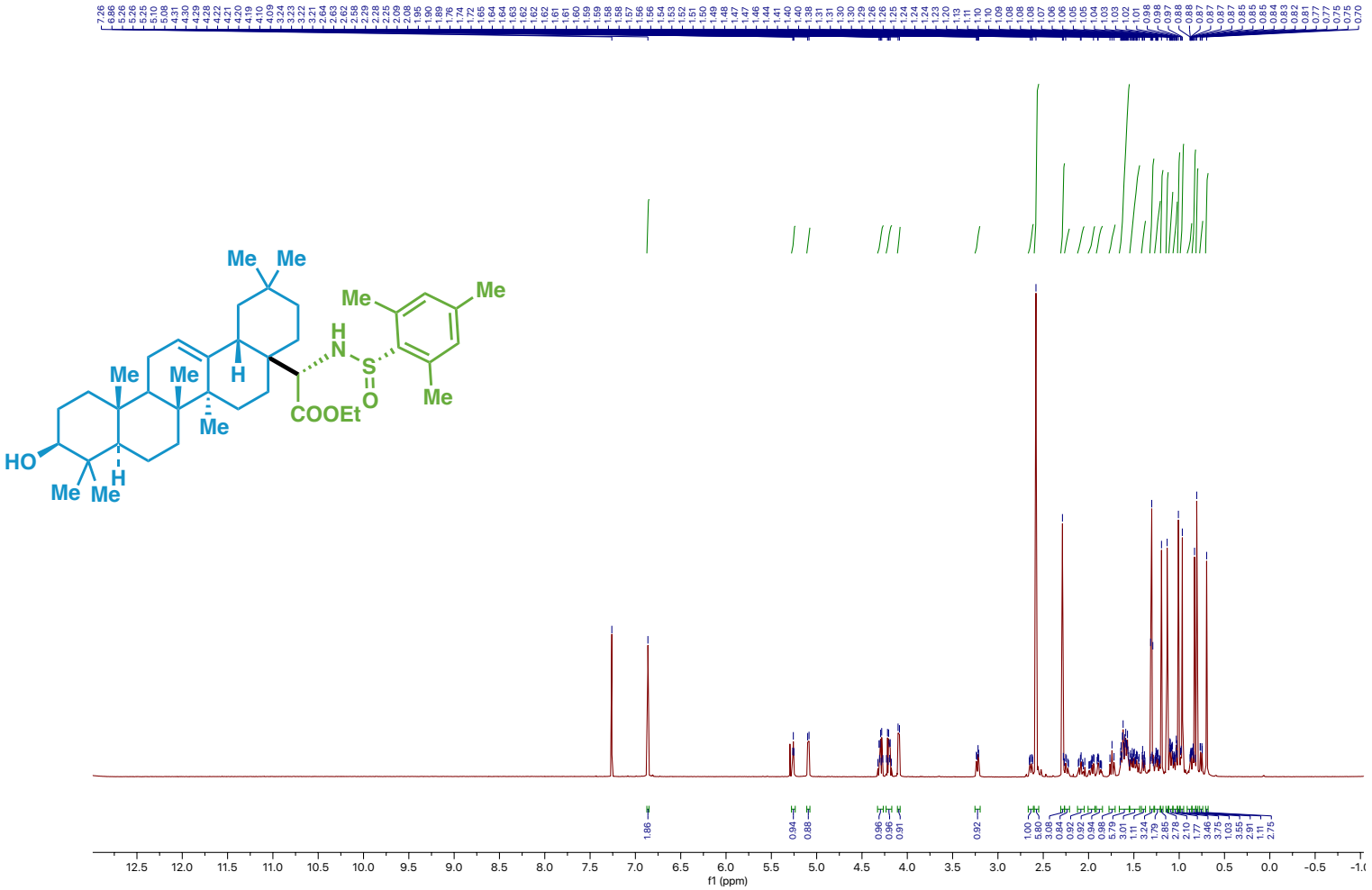
Compound 51 ^{13}C NMR



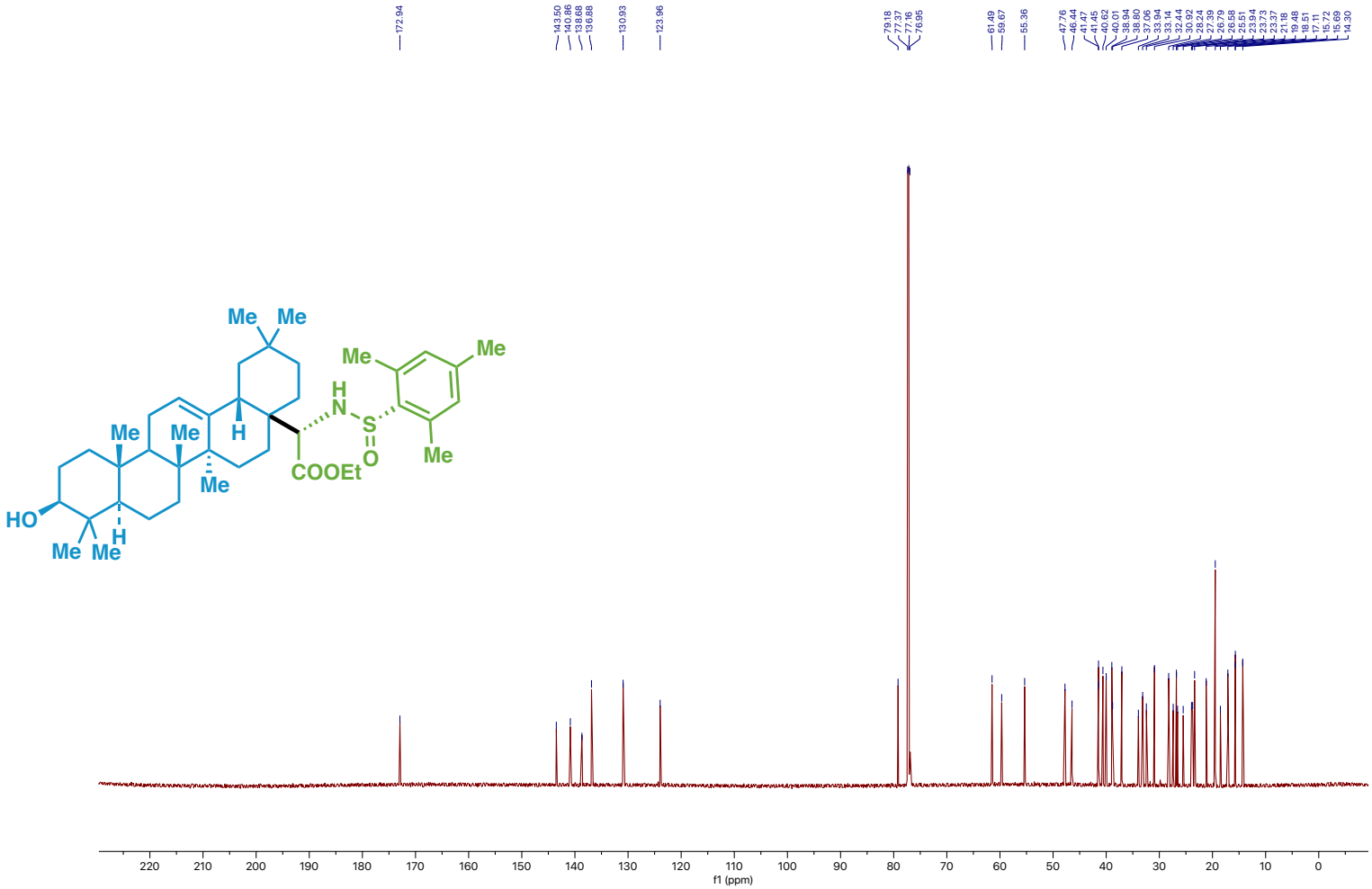
Compound 51 ^{19}F NMR



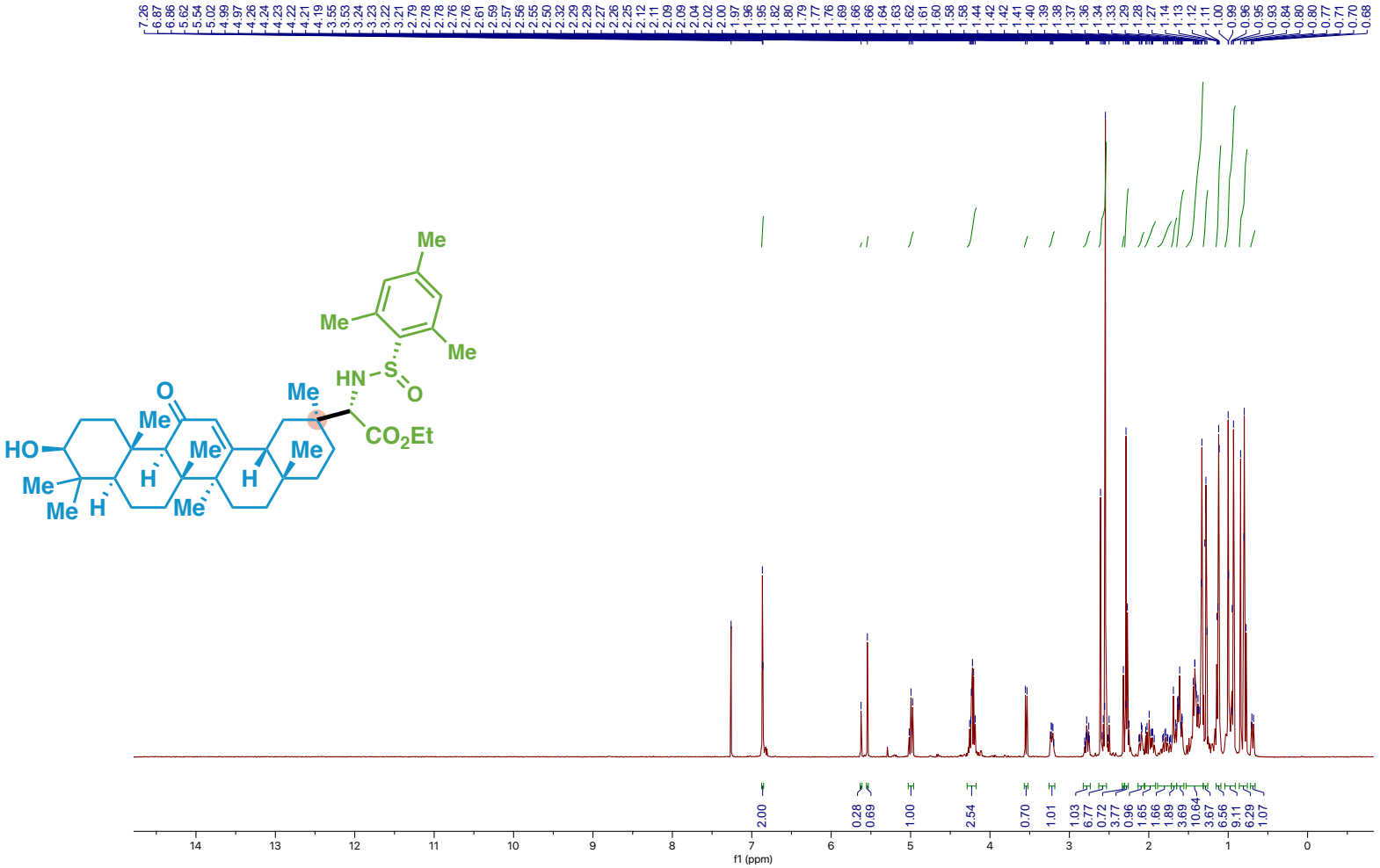
Compound 52 ^{1}H NMR



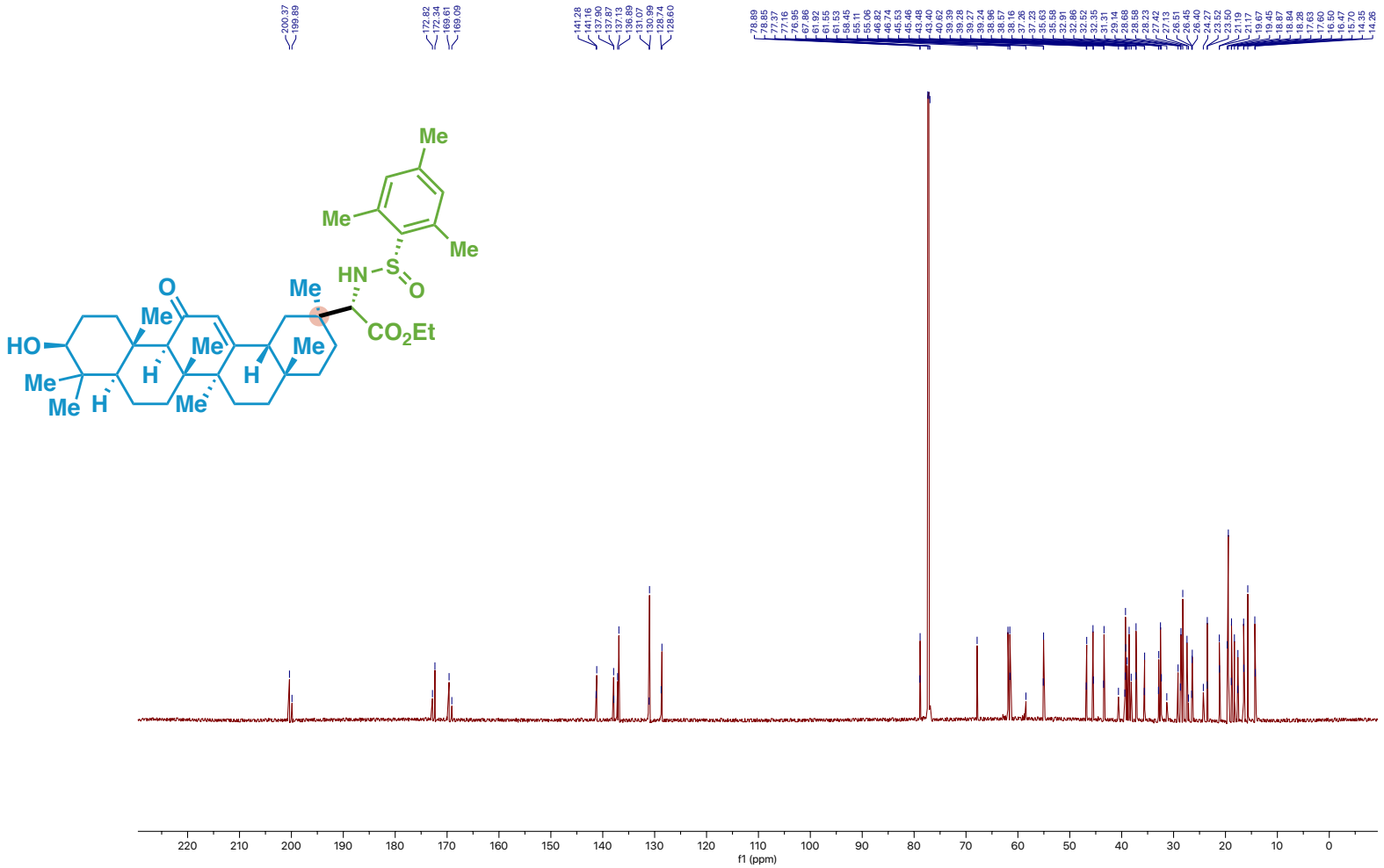
Compound 52 ^{13}C NMR



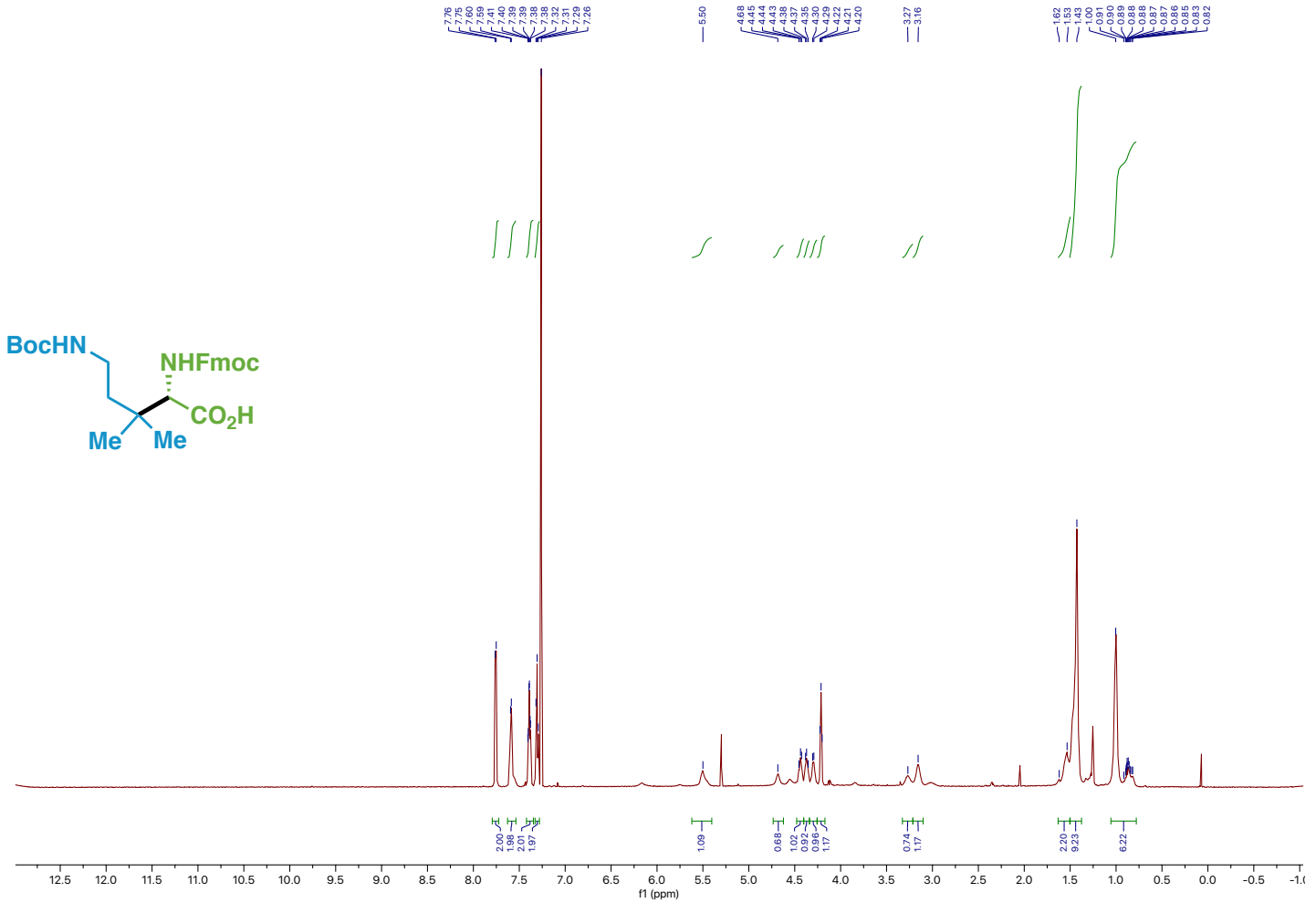
Compound 53 ^{1}H NMR



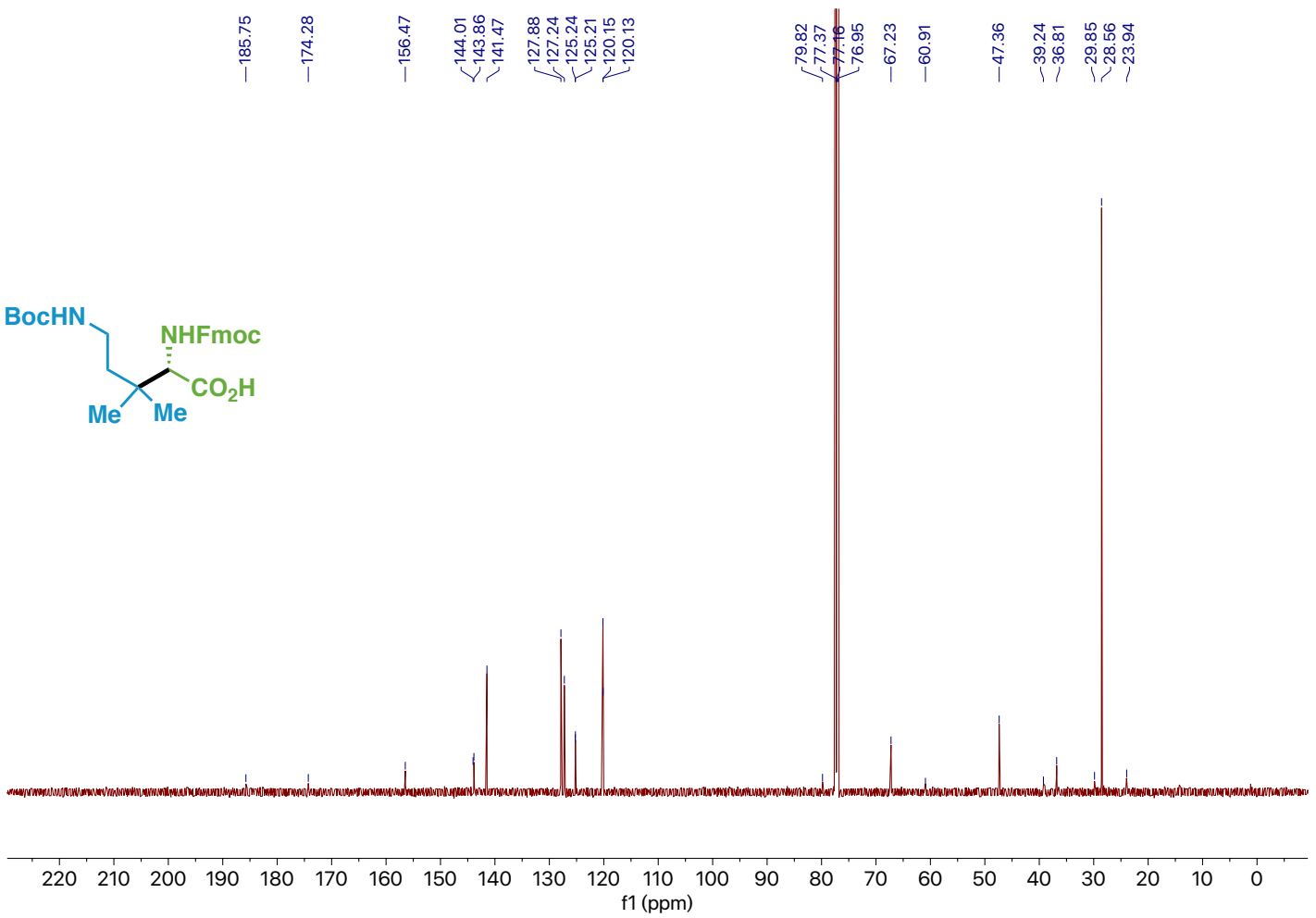
Compound 53 ^{13}C NMR



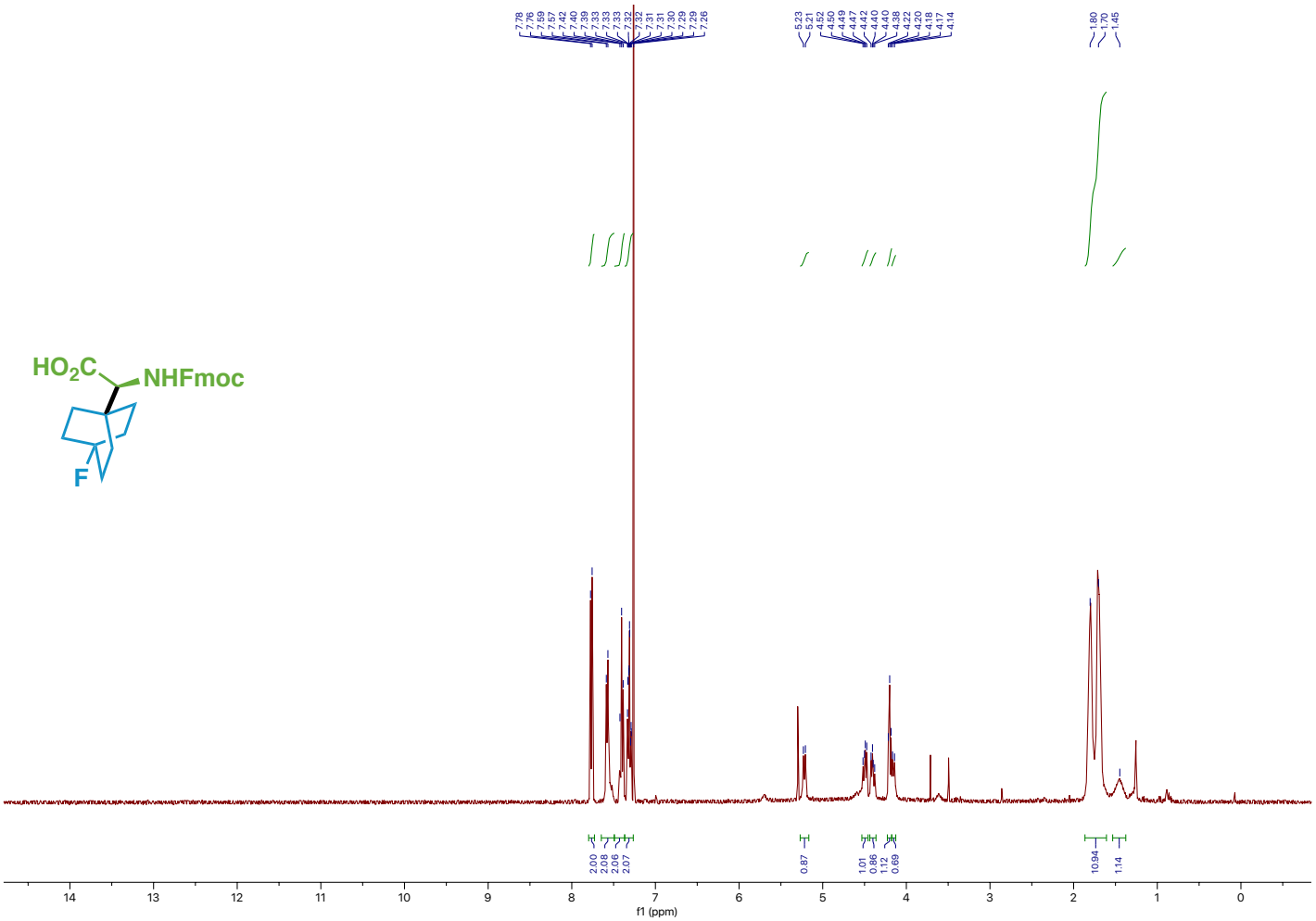
Compound 54 ^{1}H NMR



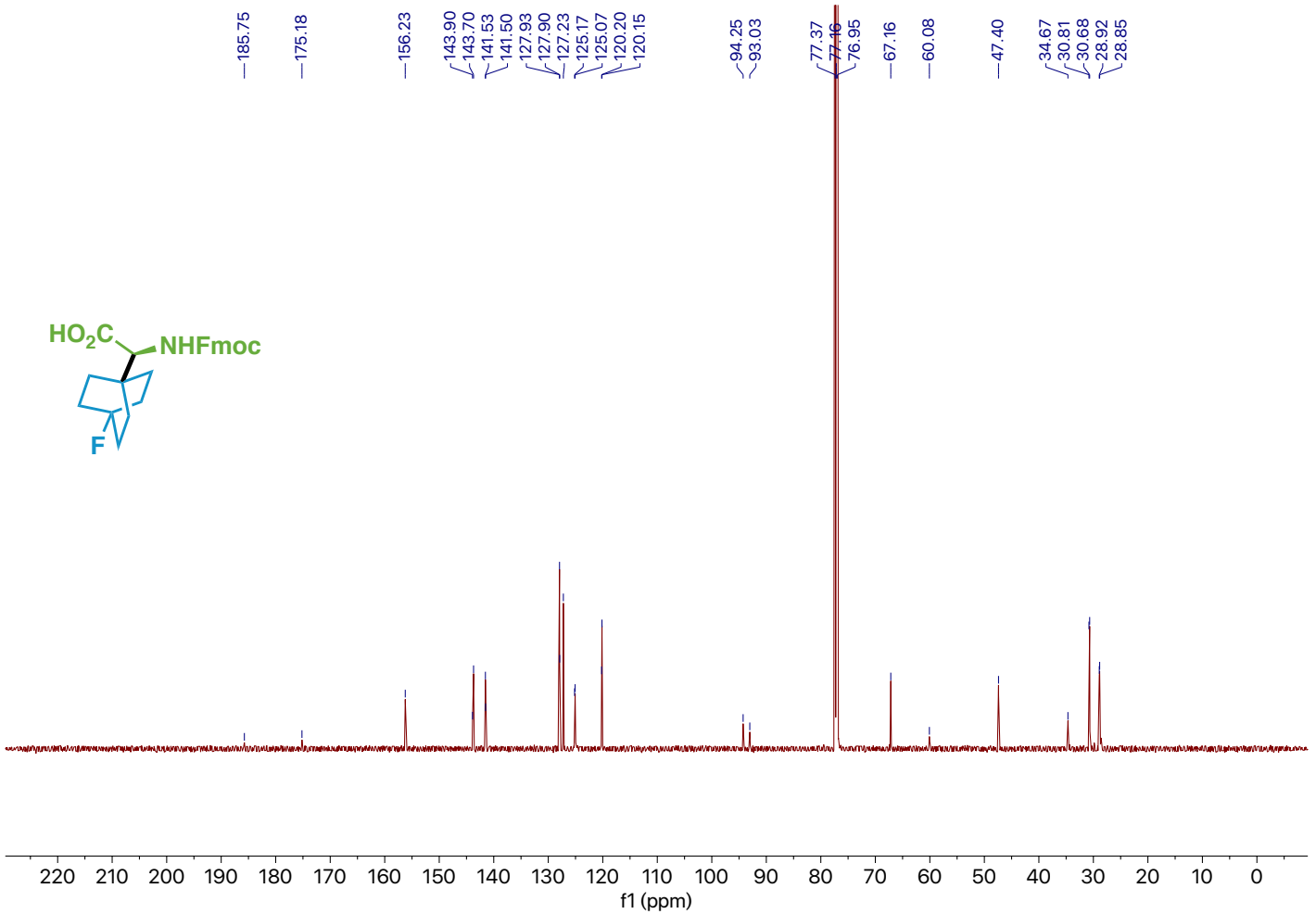
Compound 54 ^{13}C NMR



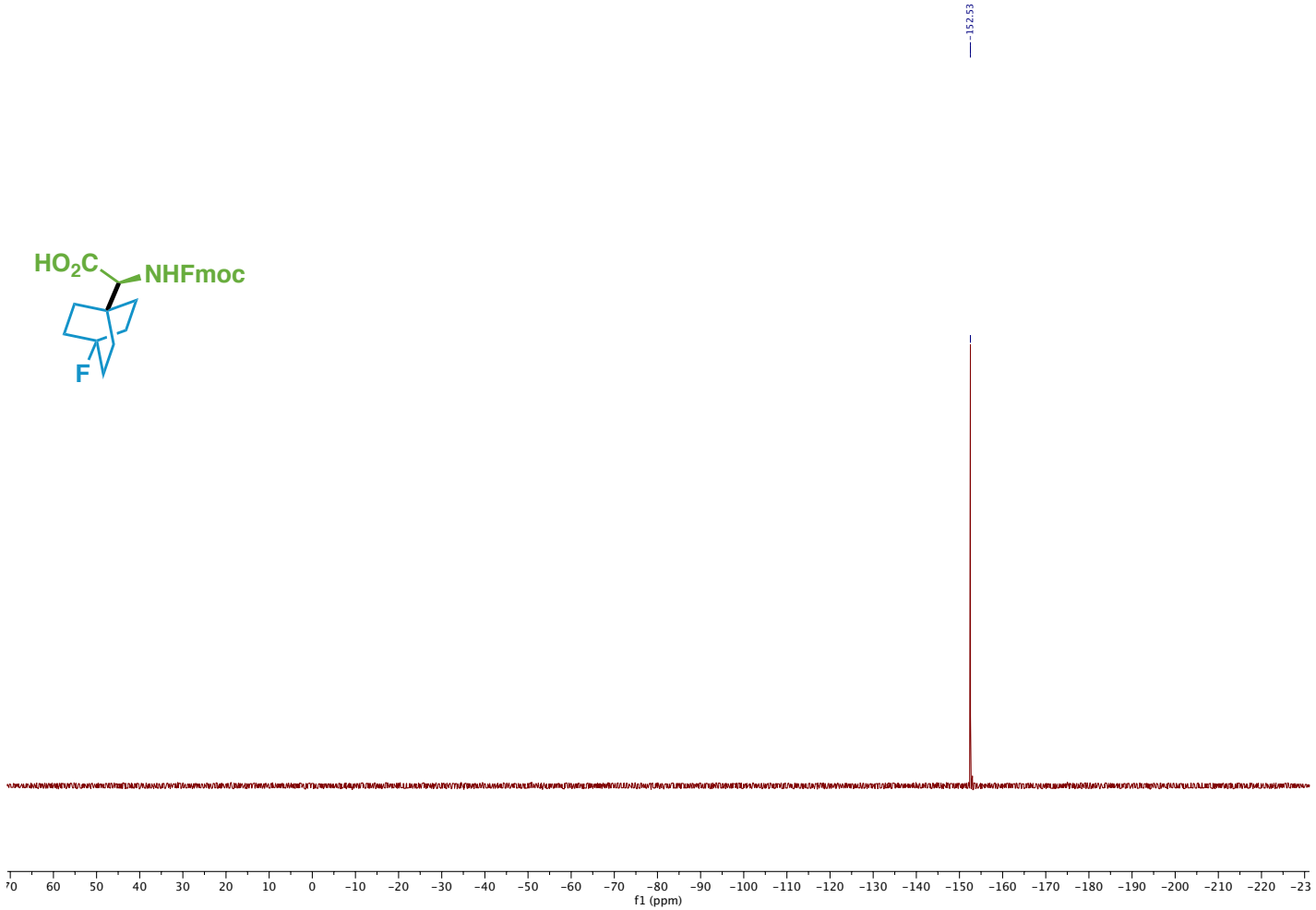
Compound 56 ^{1}H NMR



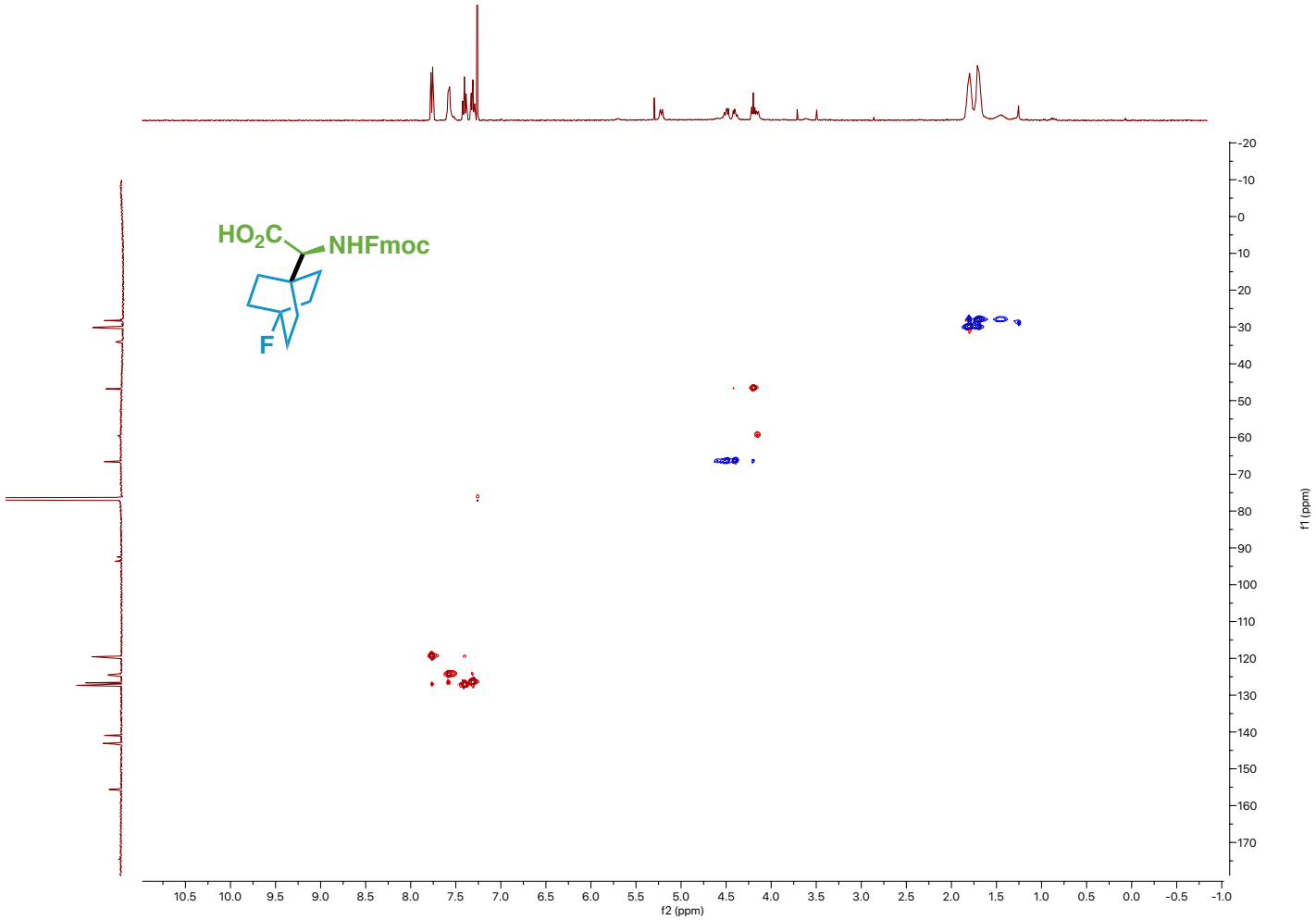
Compound 56 ^{13}C NMR



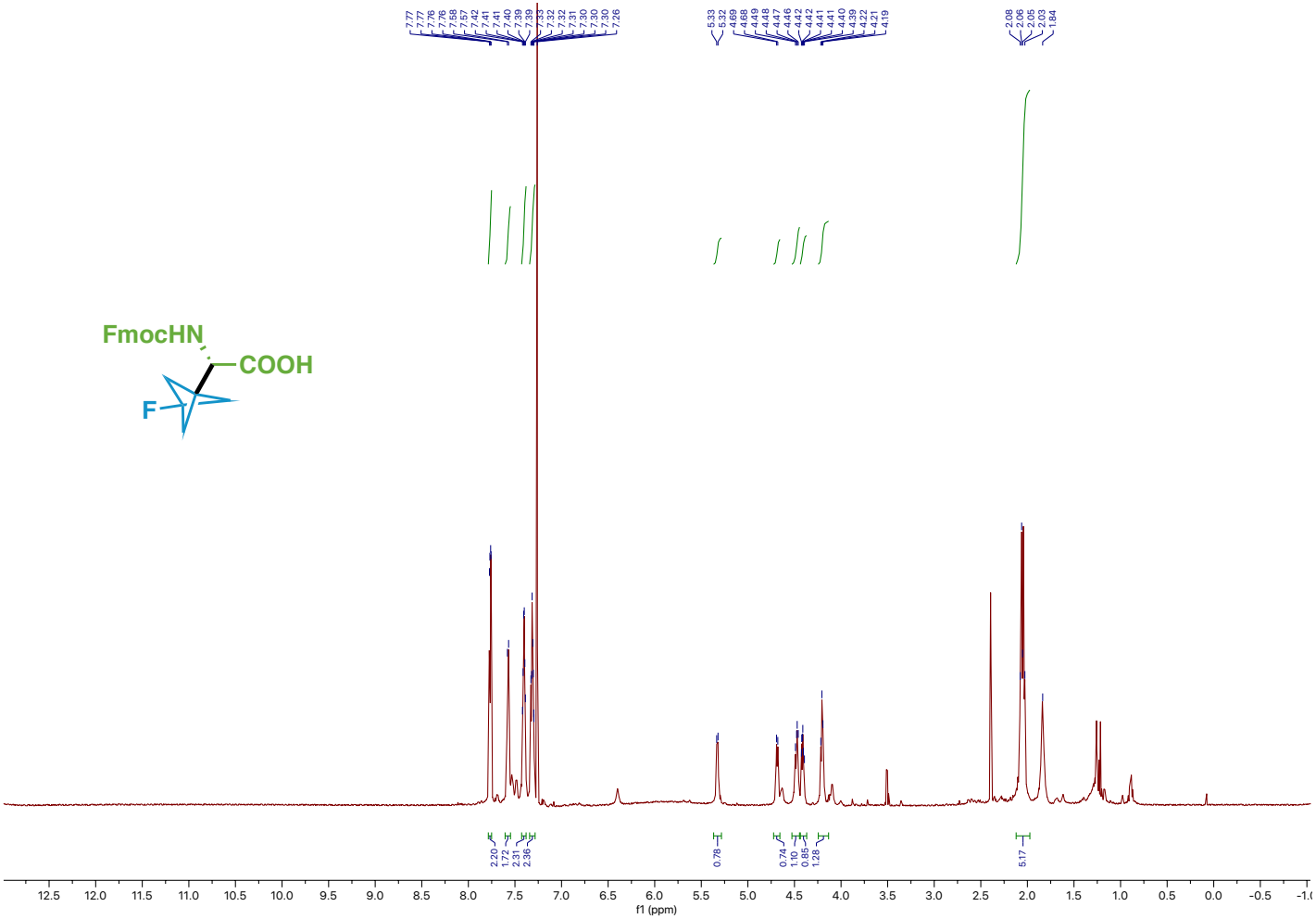
Compound 56 ^{19}F NMR



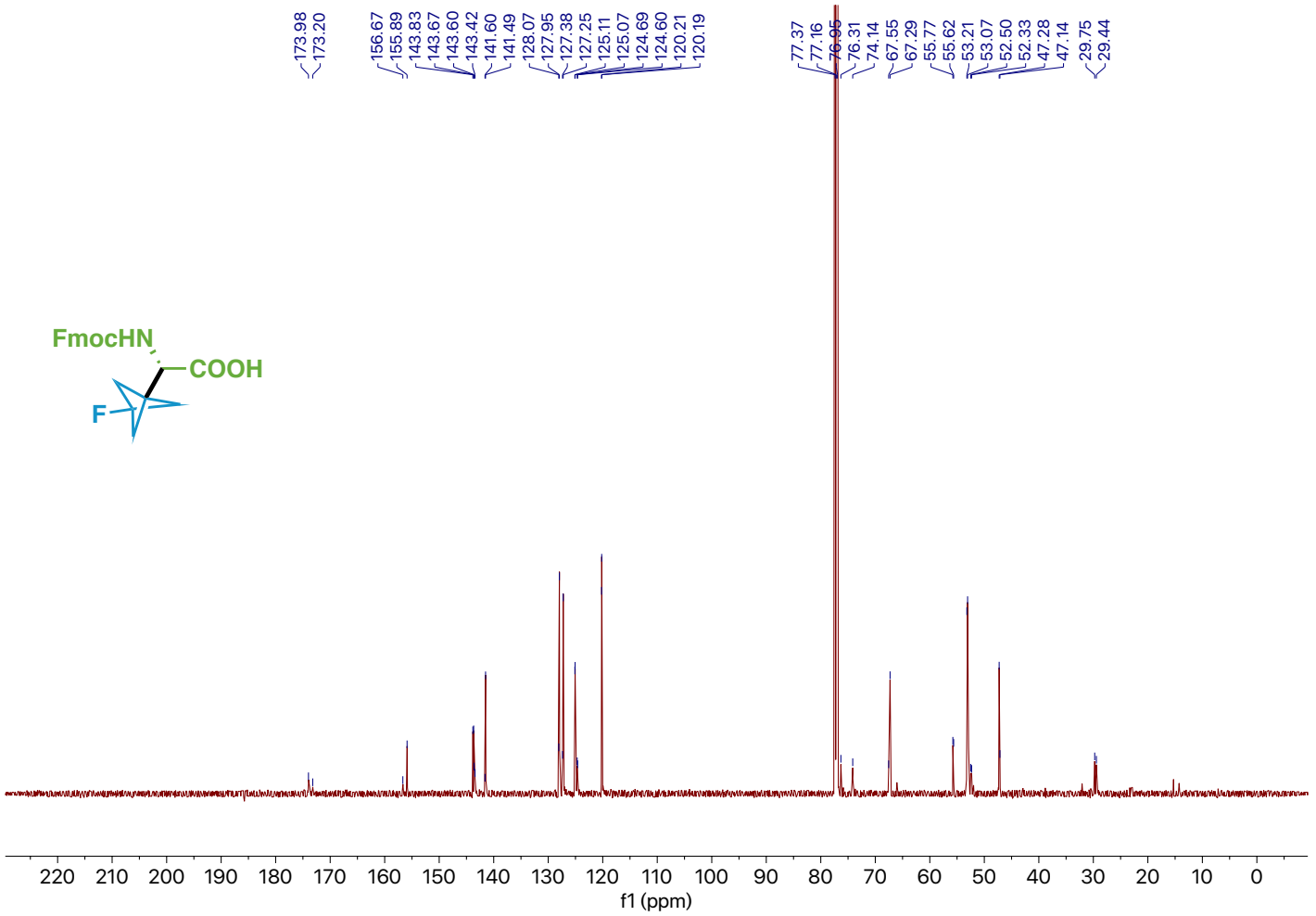
Compound 56 HSQC 2D NMR



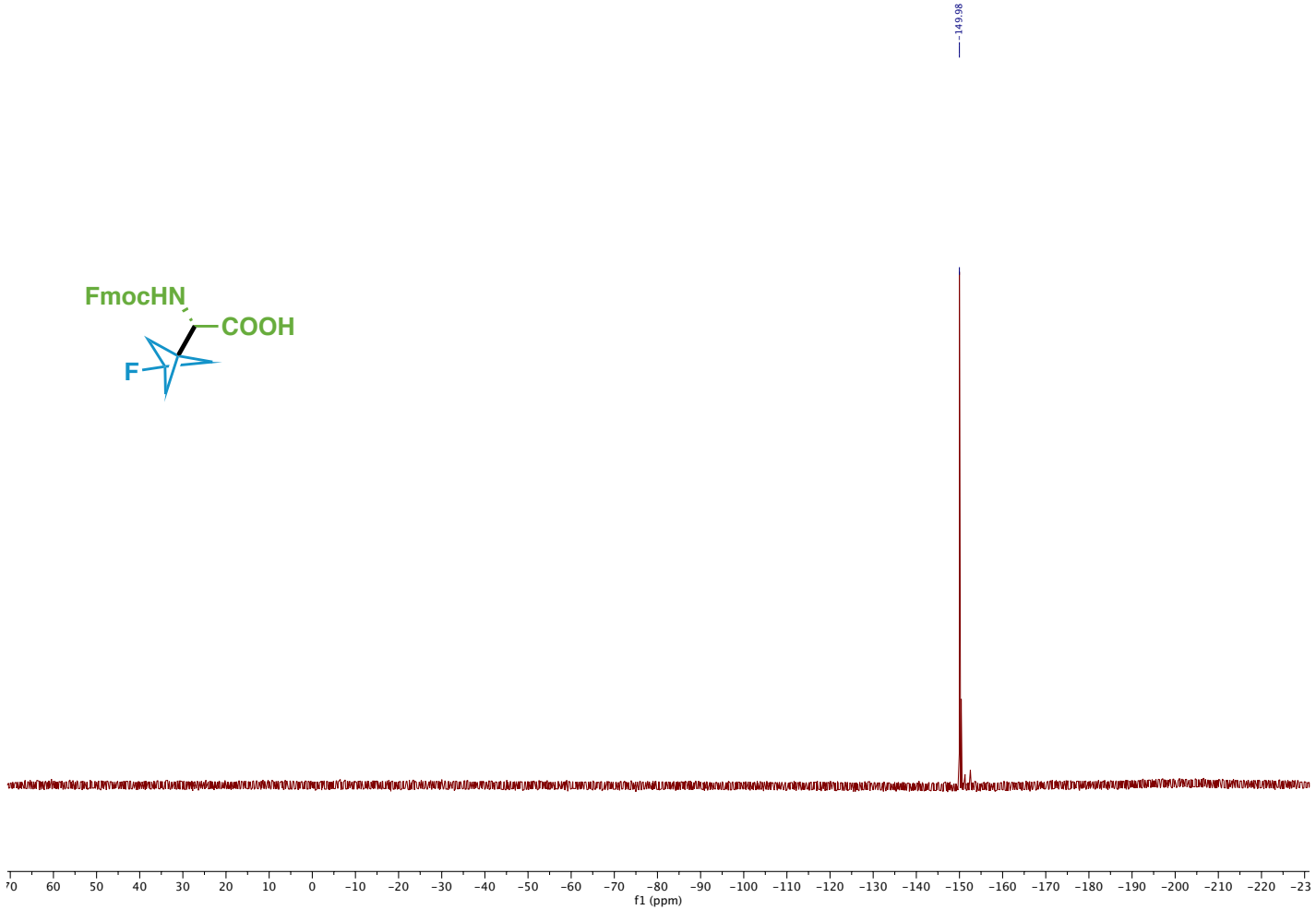
Compound 58 ^{1}H NMR



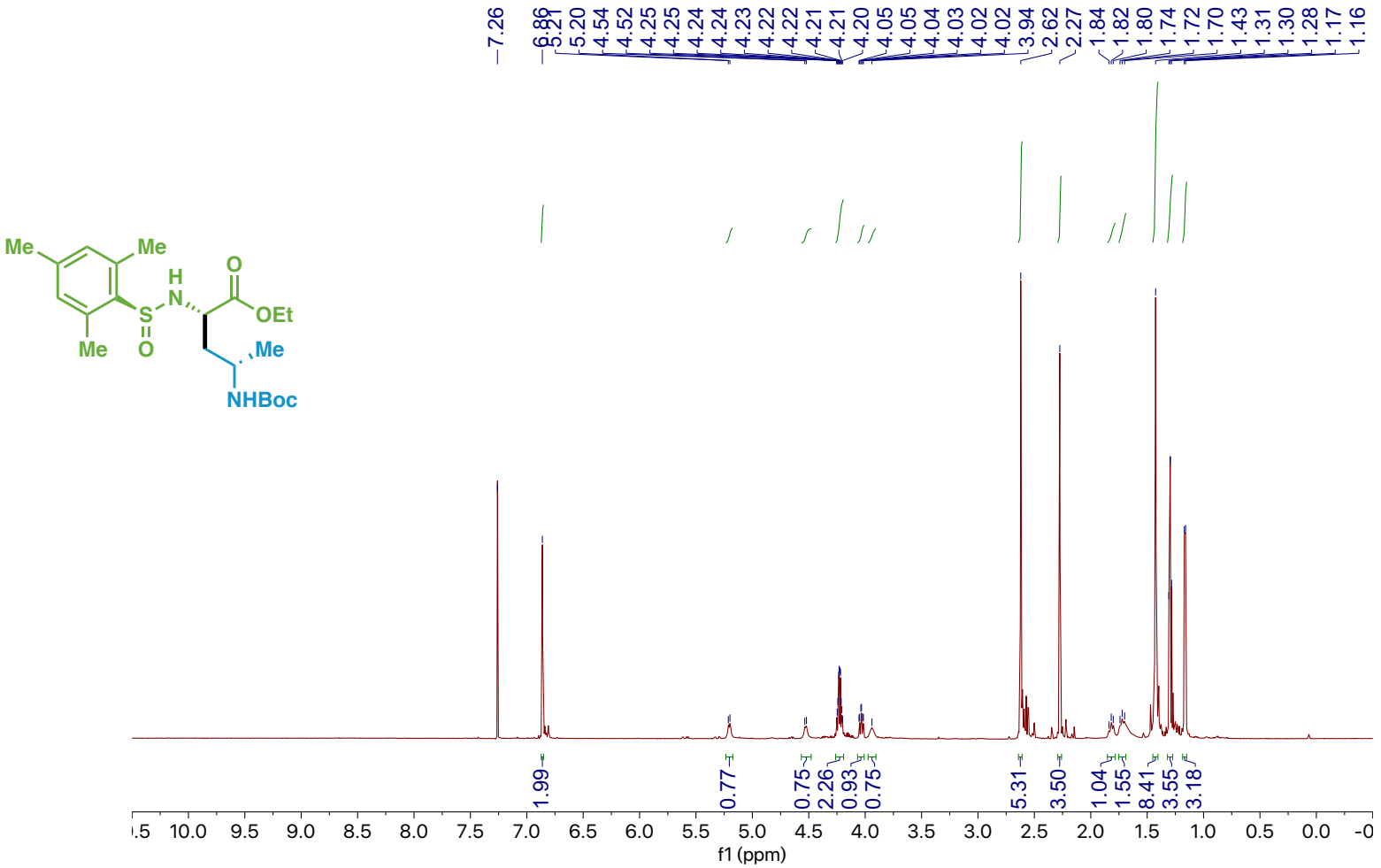
Compound 58 ^{13}C NMR



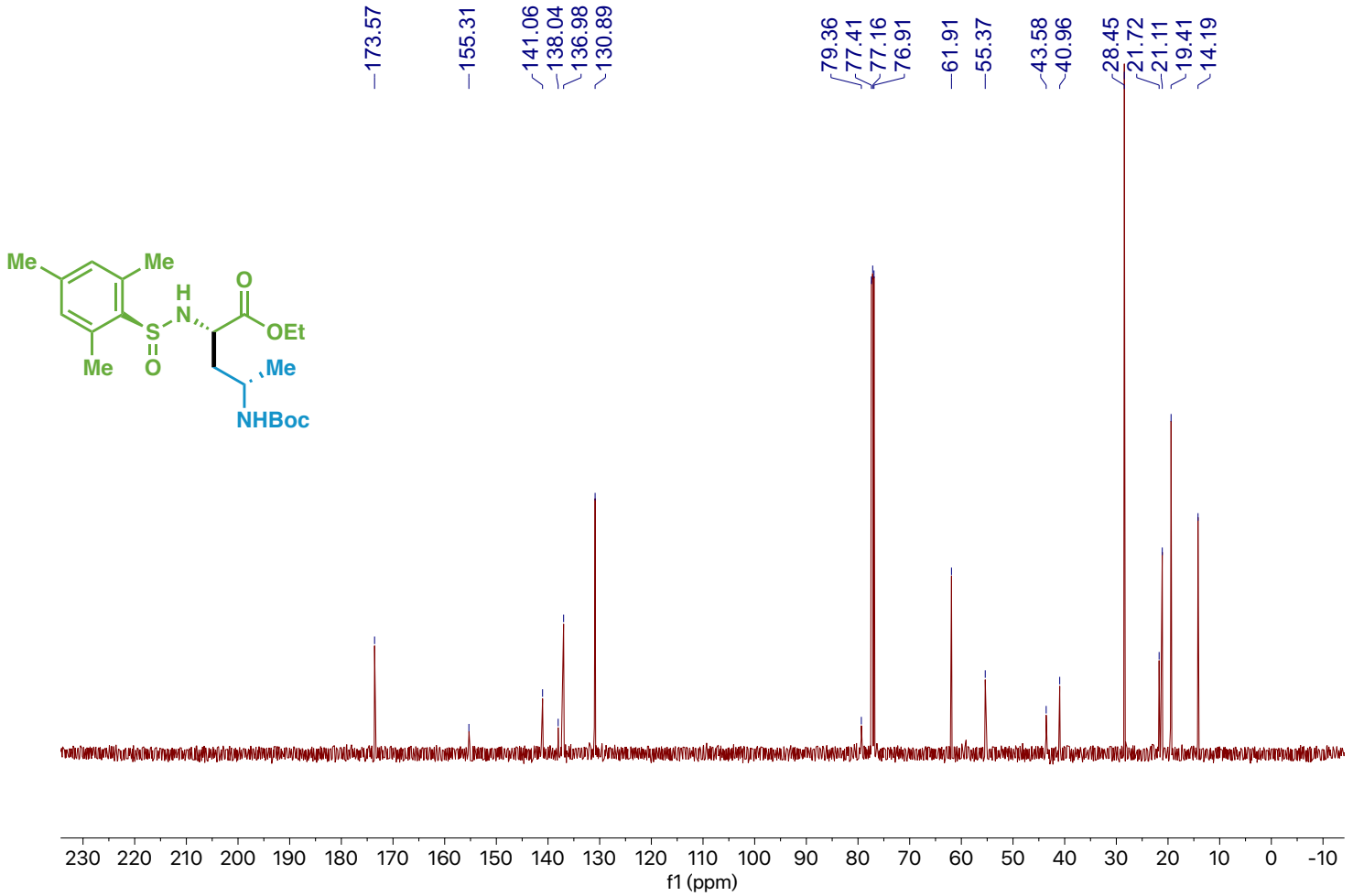
Compound 58 ^{19}F NMR



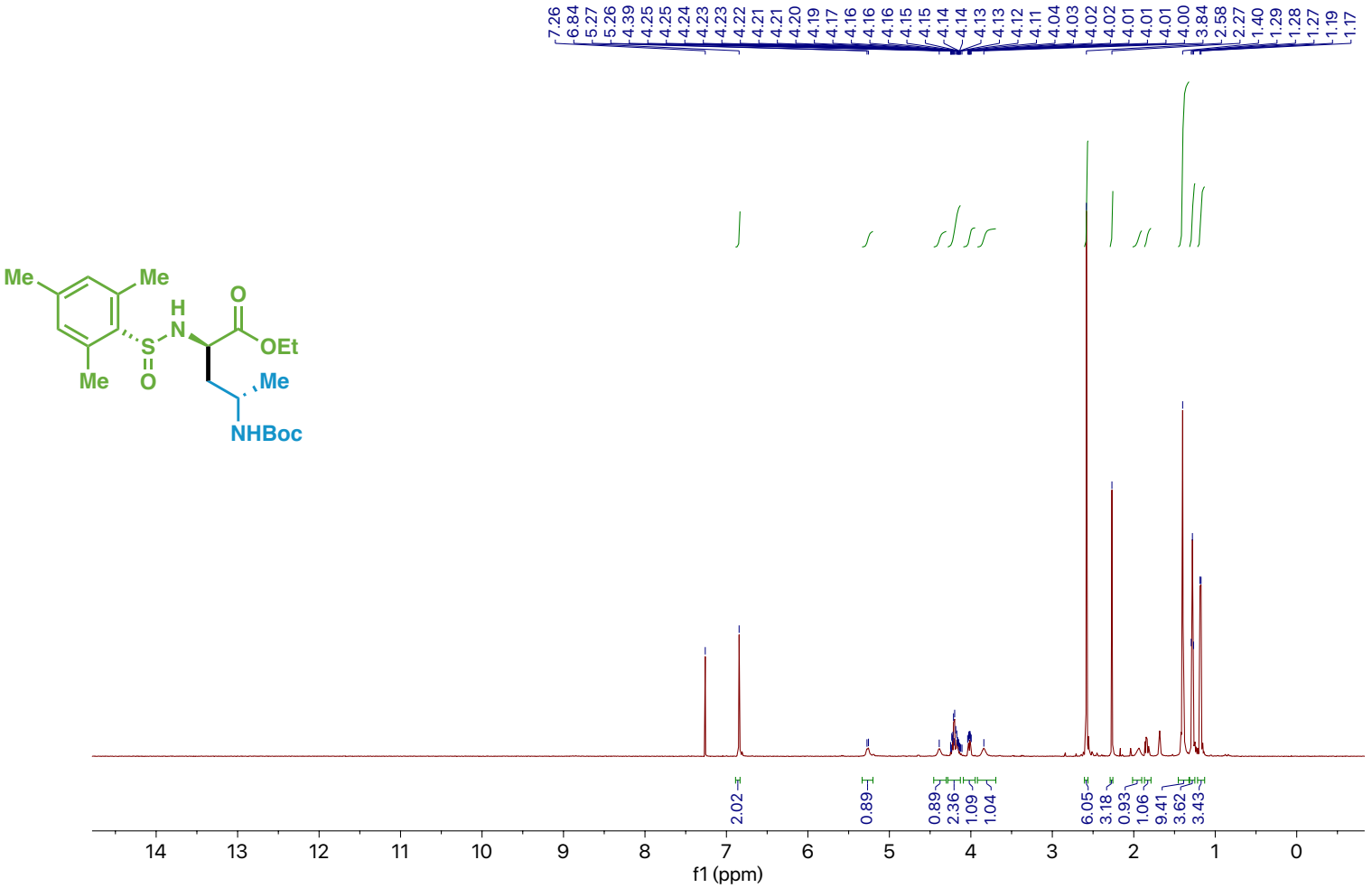
Compound 59 ^{1}H NMR



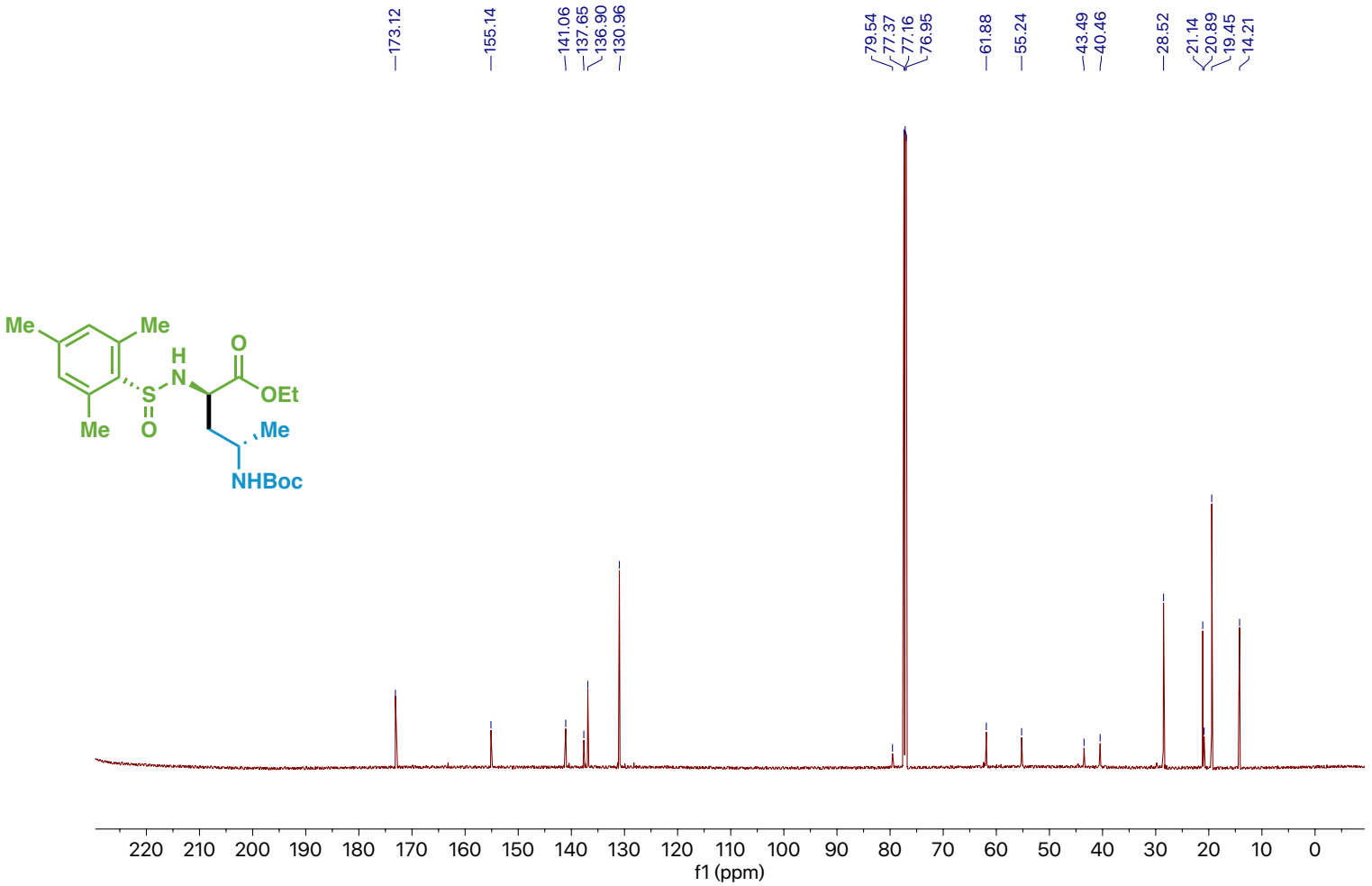
Compound 59 ^{13}C NMR



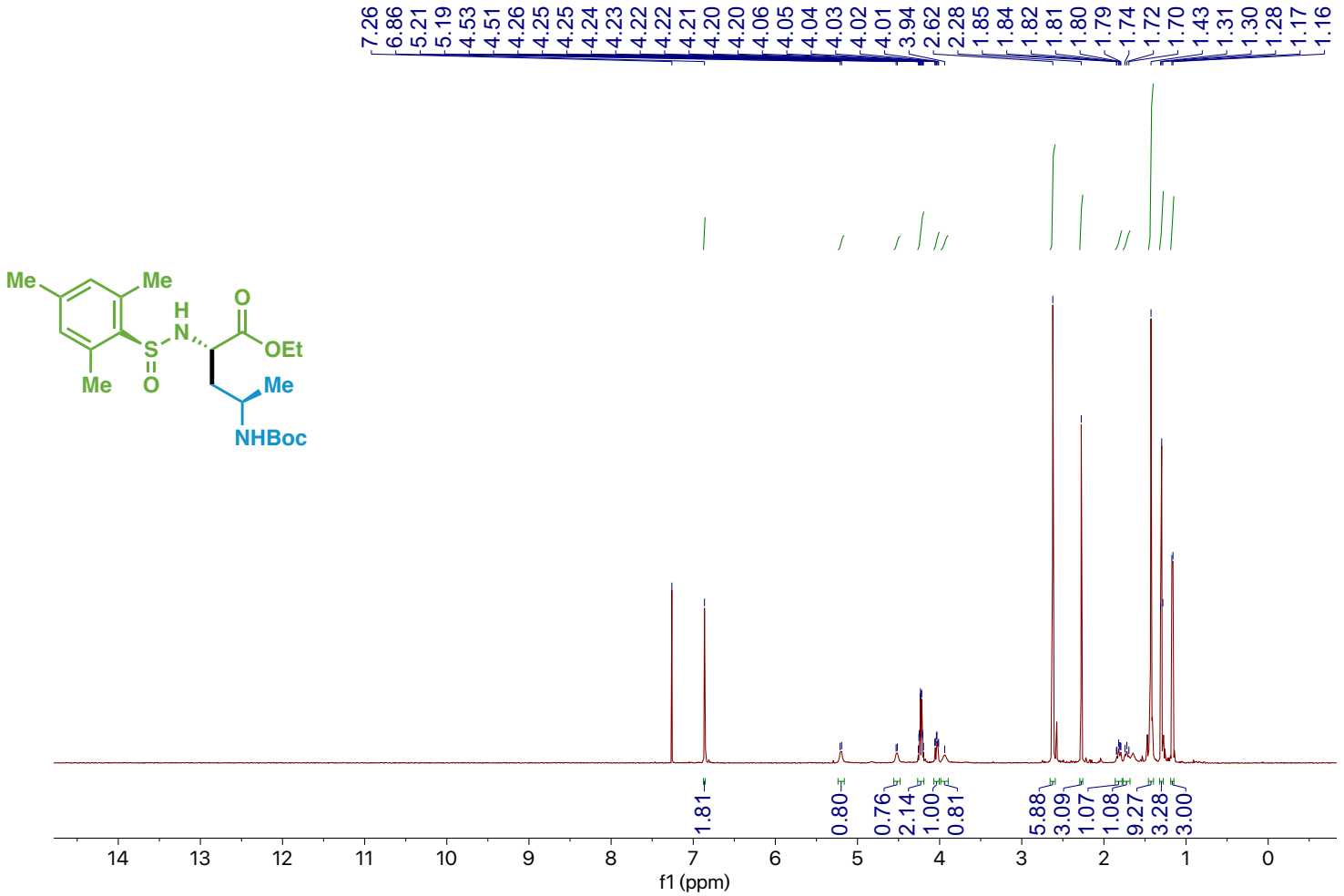
Compound 60 ^{1}H NMR



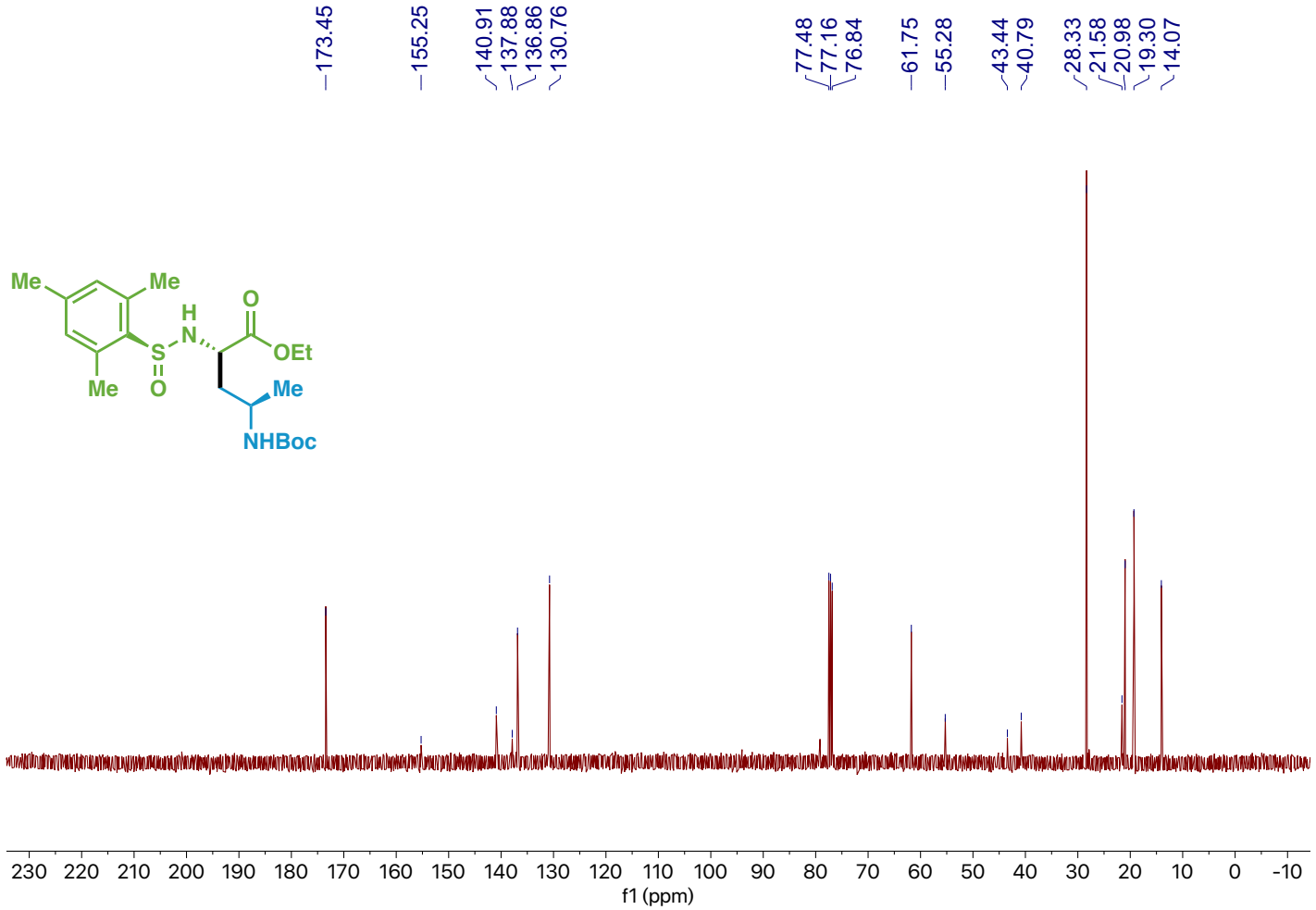
Compound 60 ^{13}C NMR



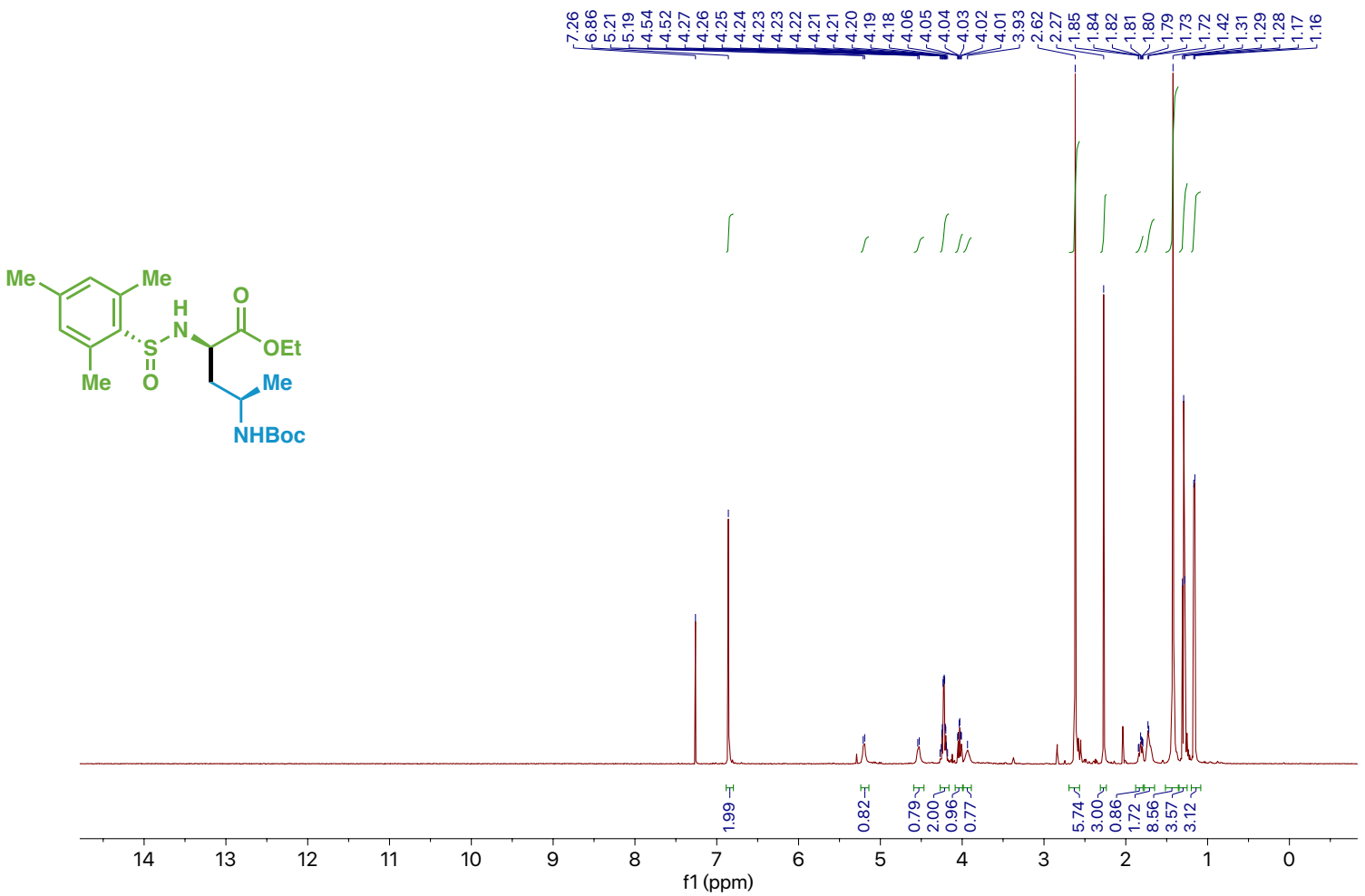
Compound 61 ^{1}H NMR



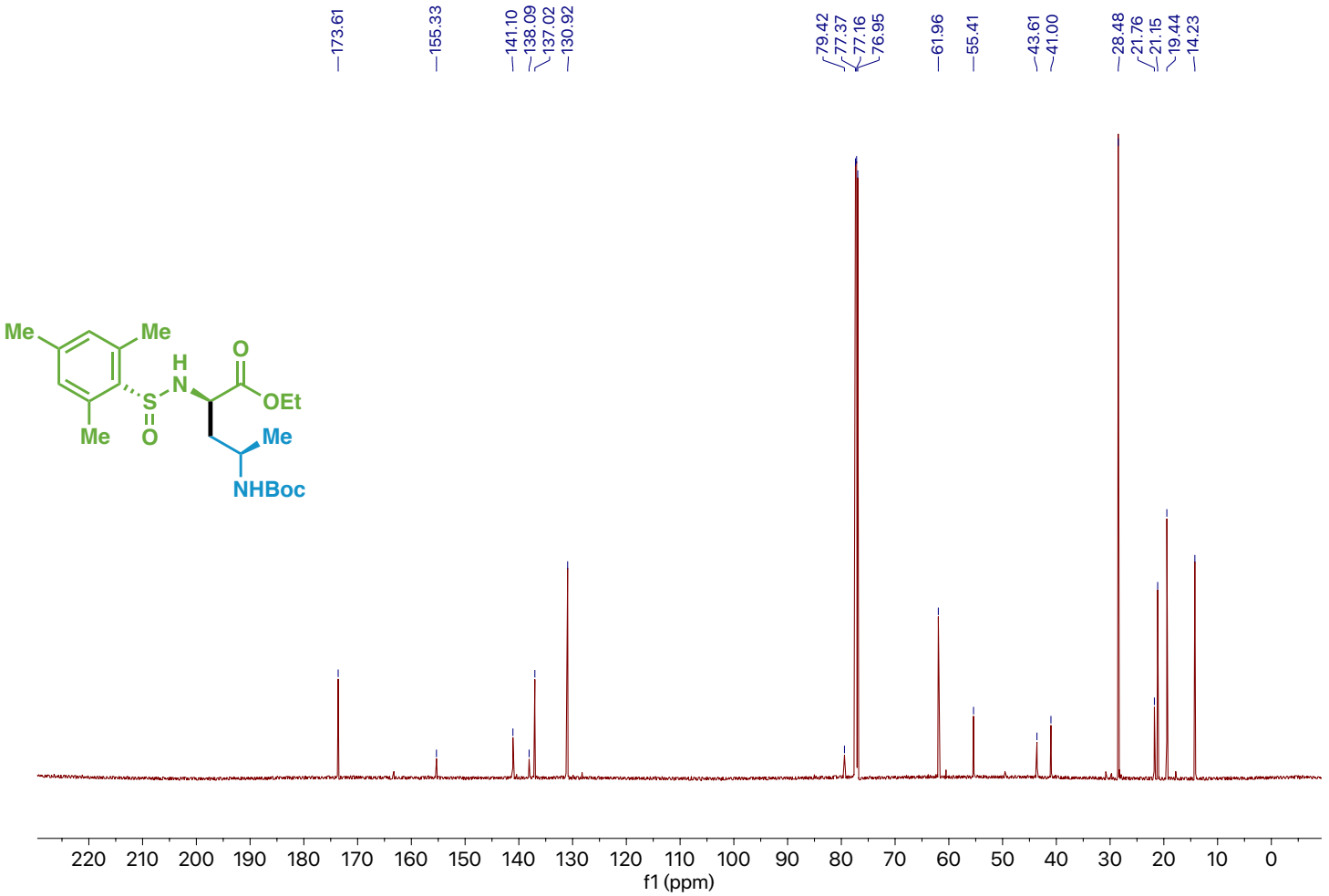
Compound 61 ^{13}C NMR



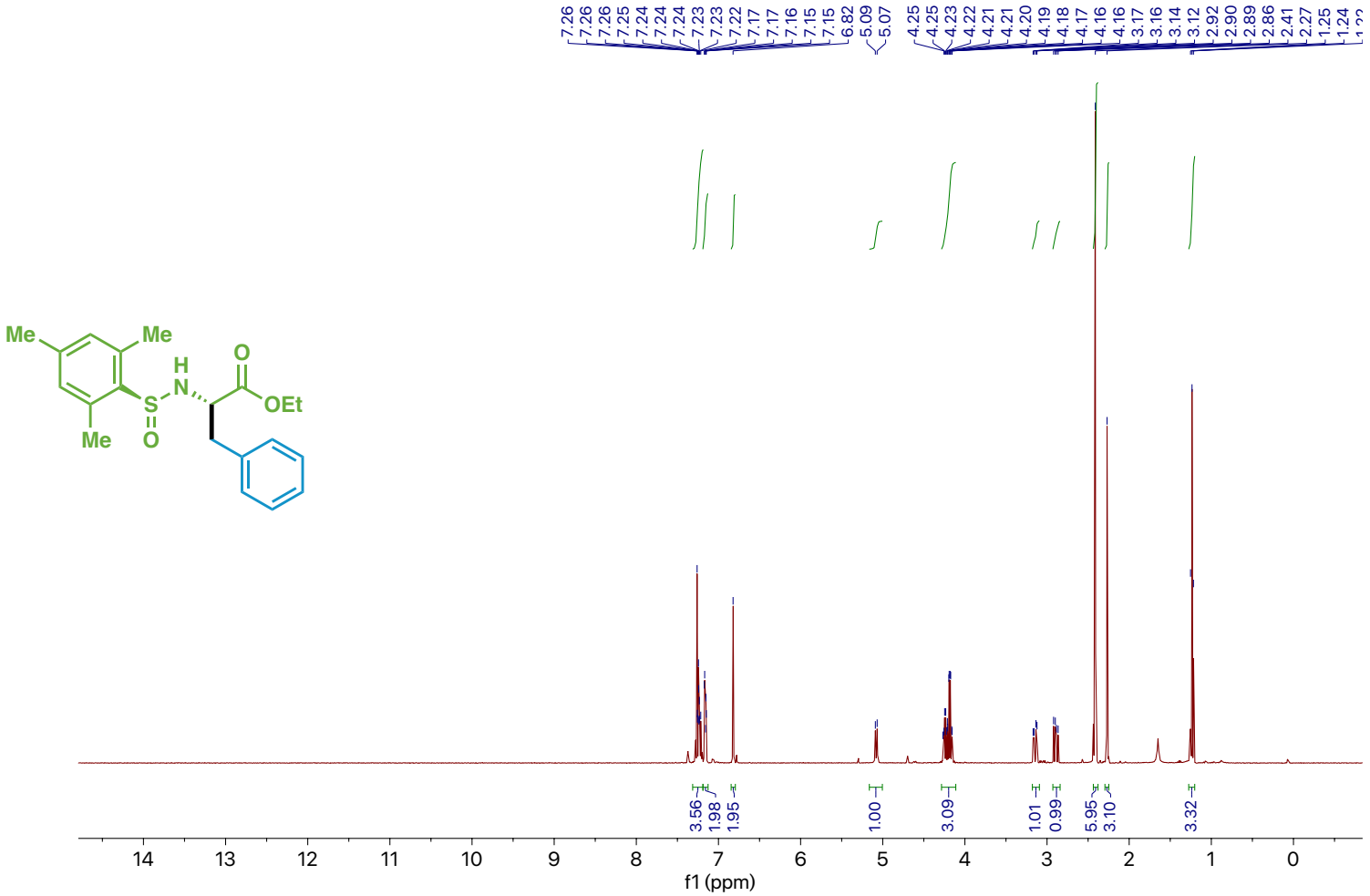
Compound 62 ^{1}H NMR



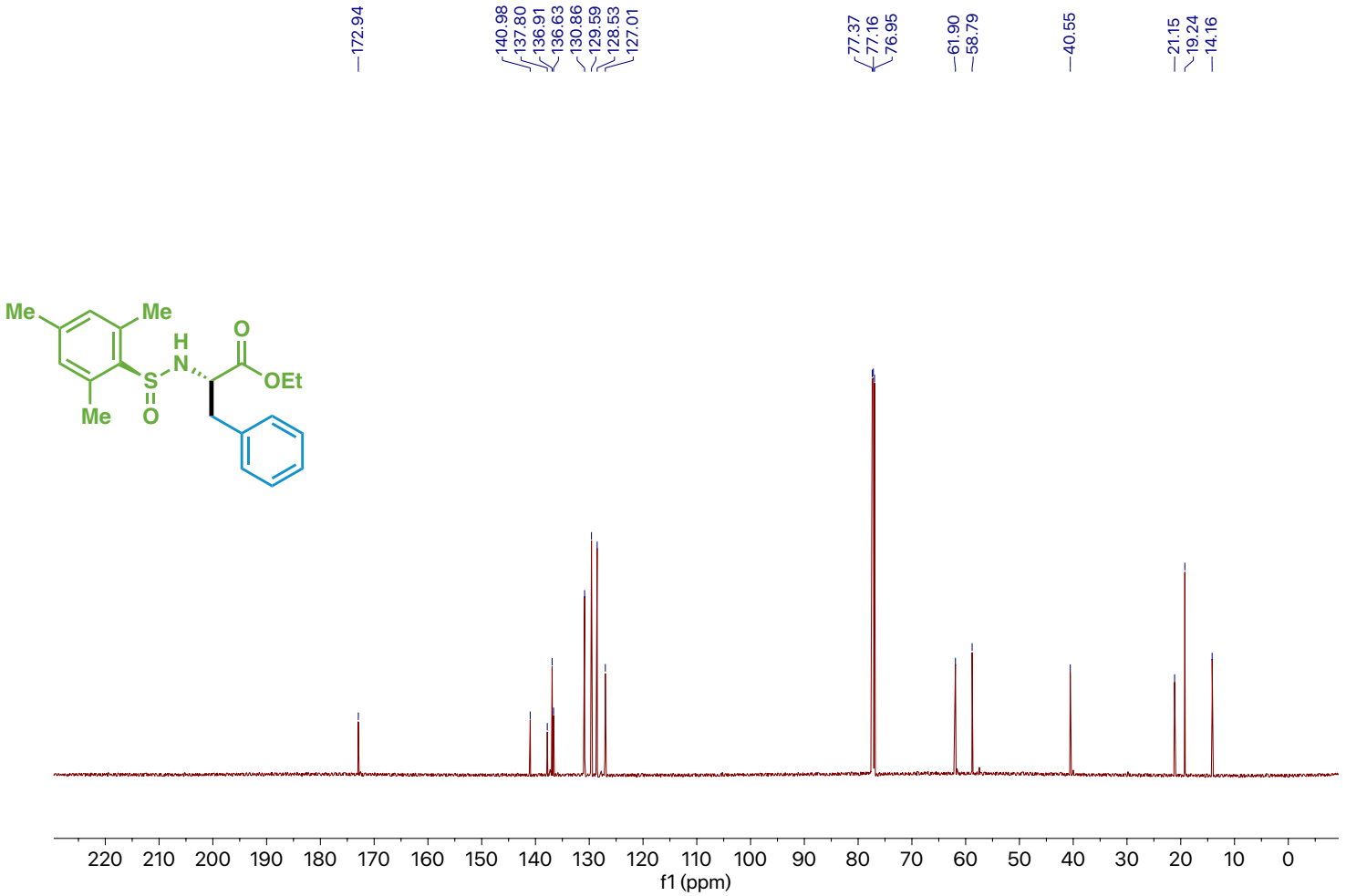
Compound 62 ^{13}C NMR



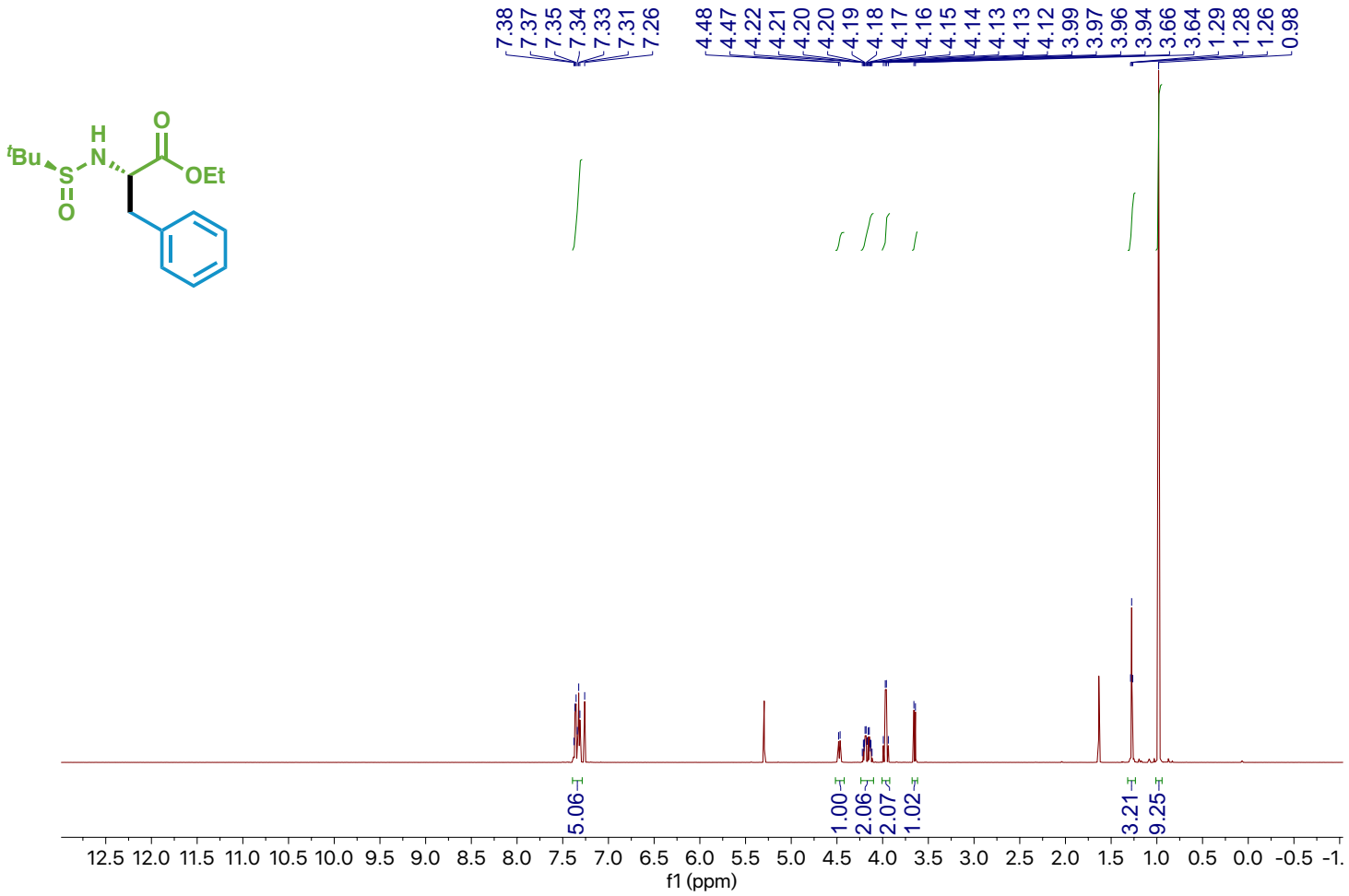
Compound 63 ^{1}H NMR



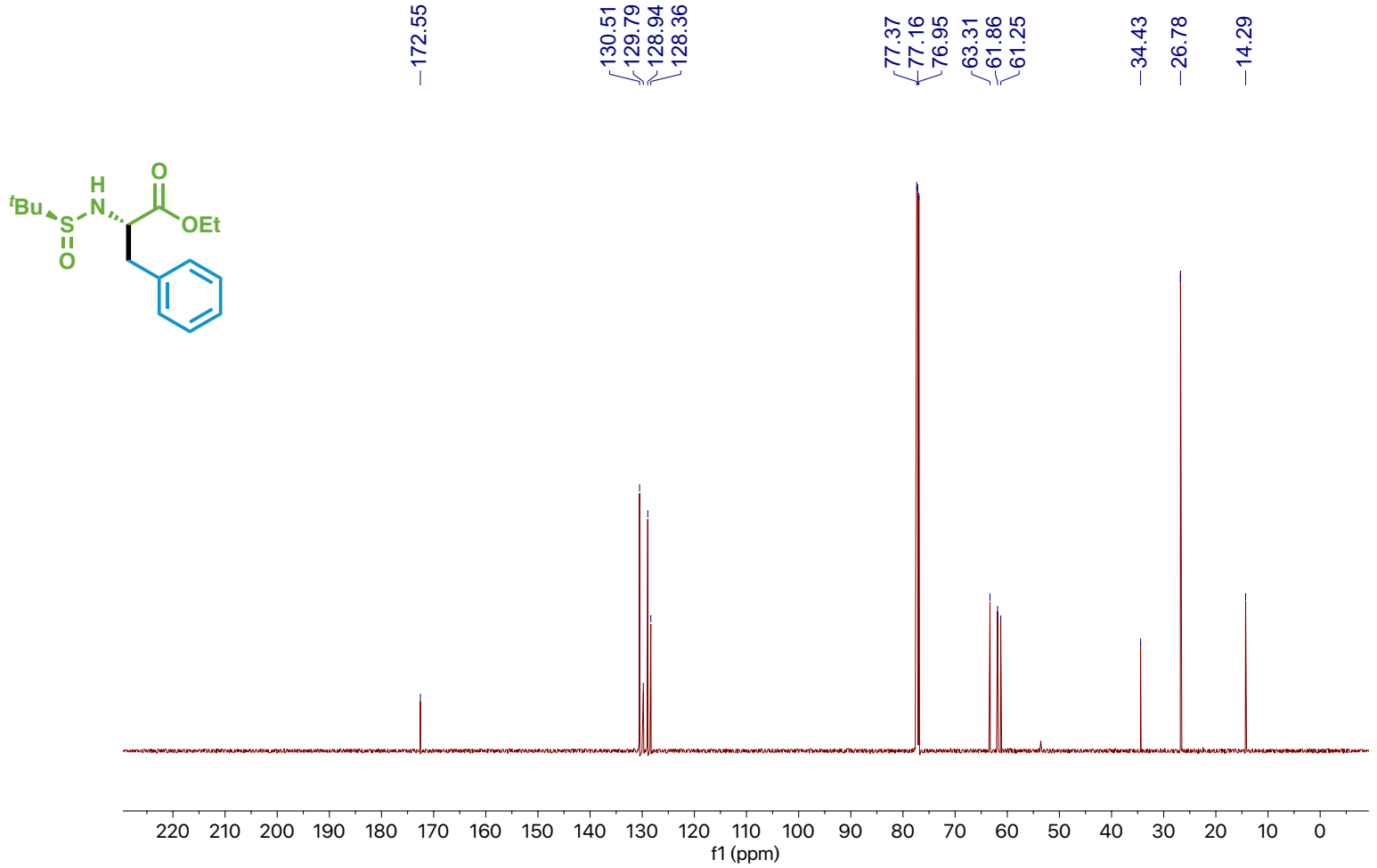
Compound 63 ^{13}C NMR



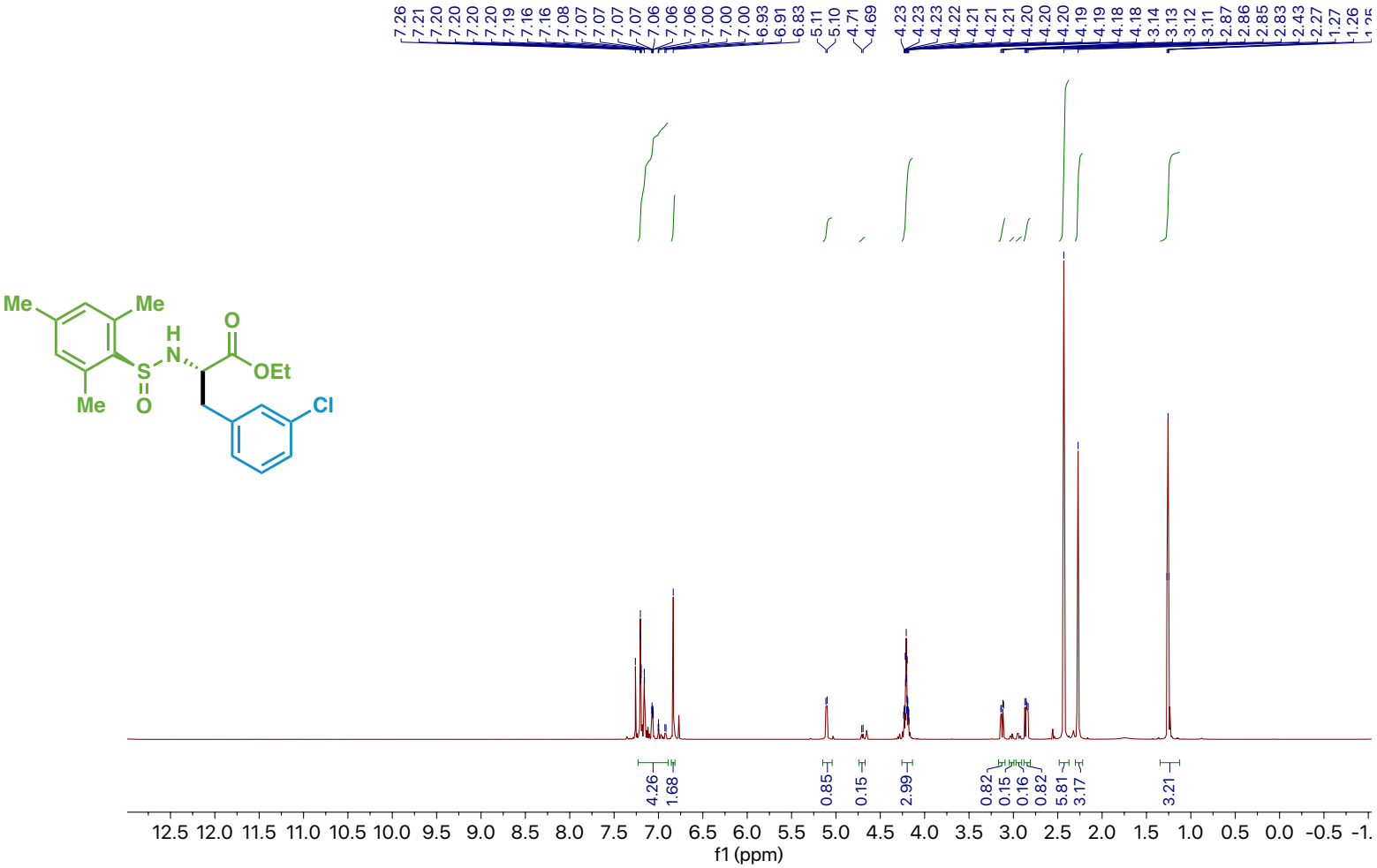
Compound 63-a ^{1}H NMR



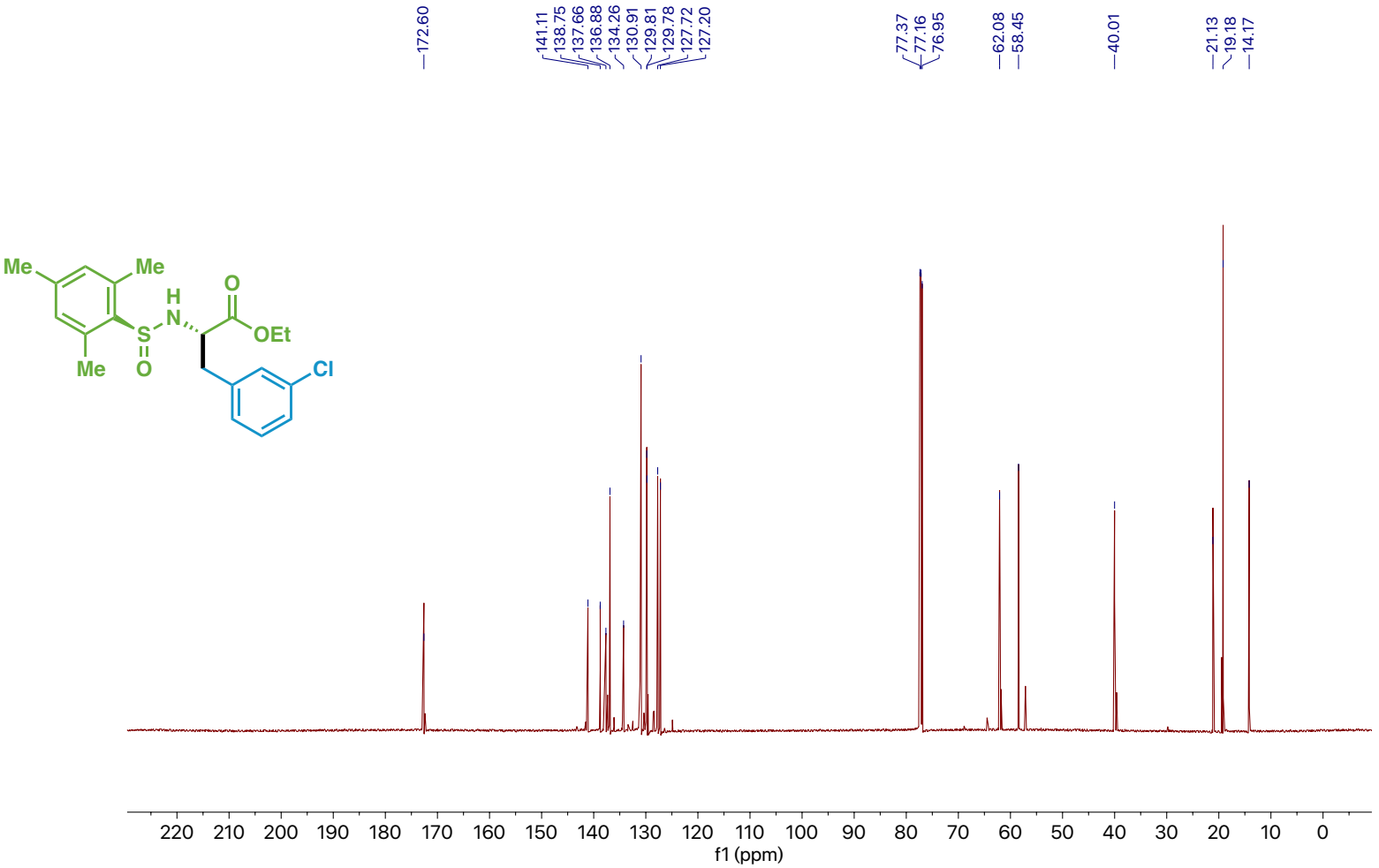
Compound 63-a ^{13}C NMR



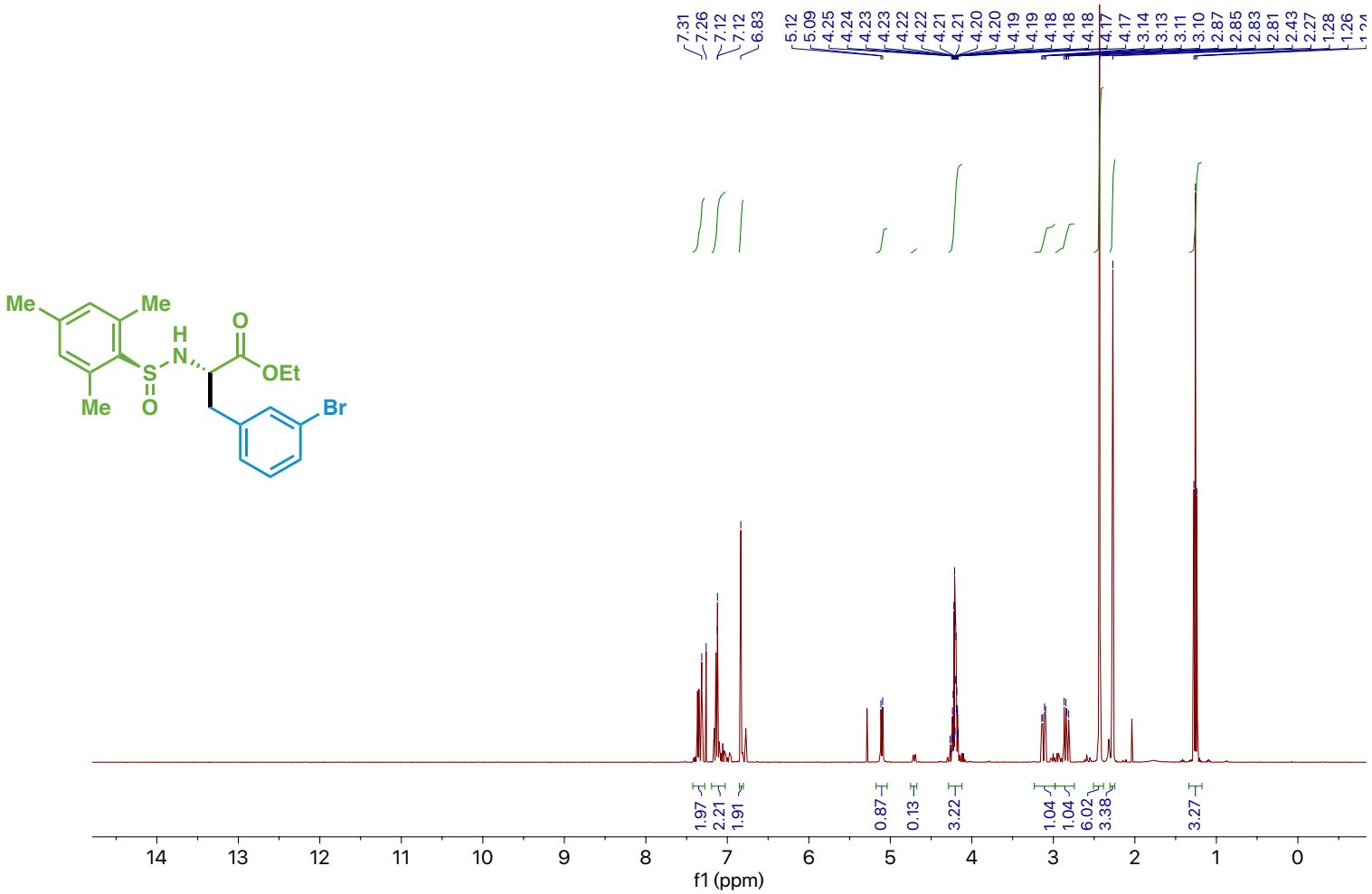
Compound 64 ^{1}H NMR



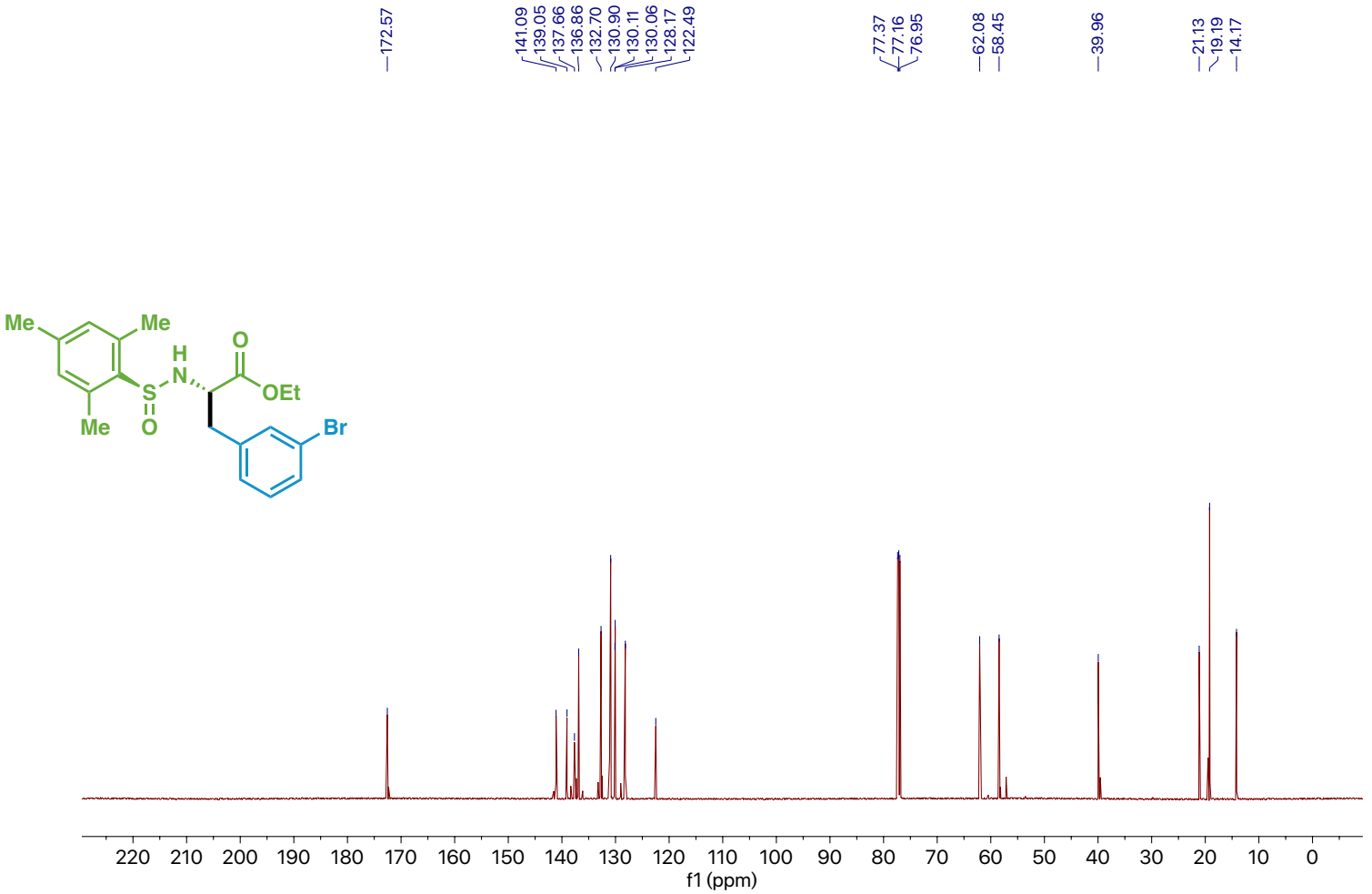
Compound 64 ^{13}C NMR



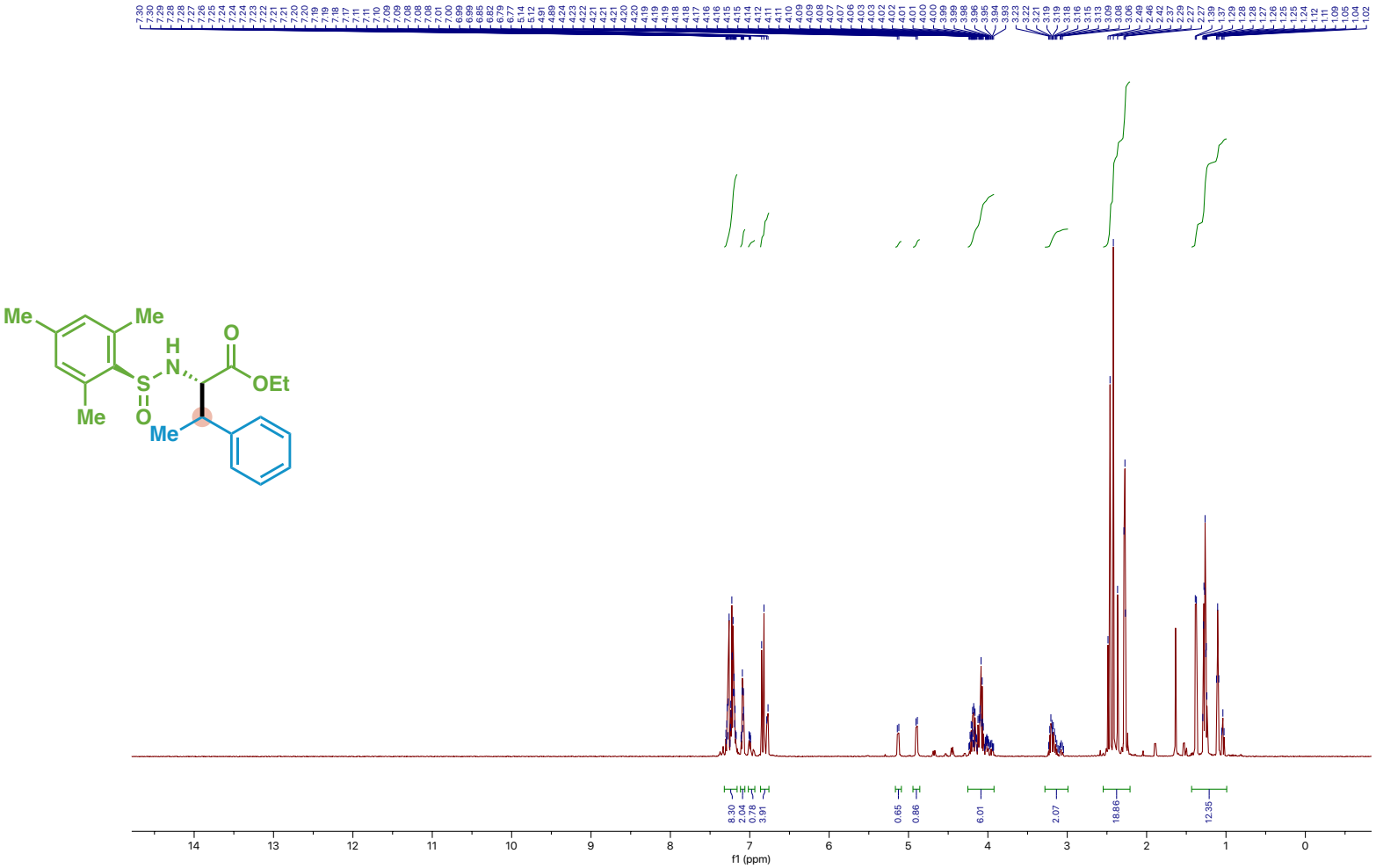
Compound 65 ^{1}H NMR



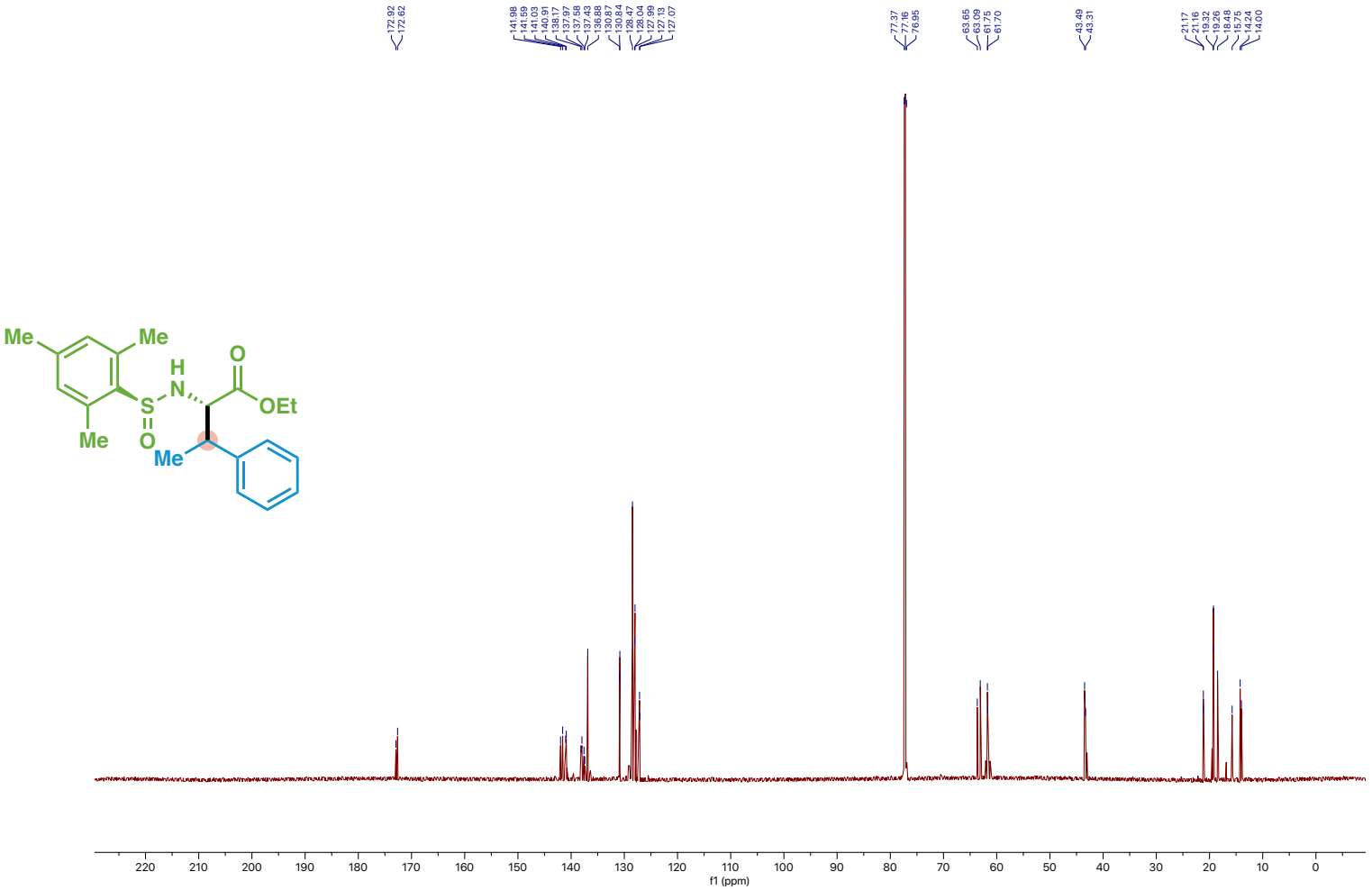
Compound 65 ^{13}C NMR



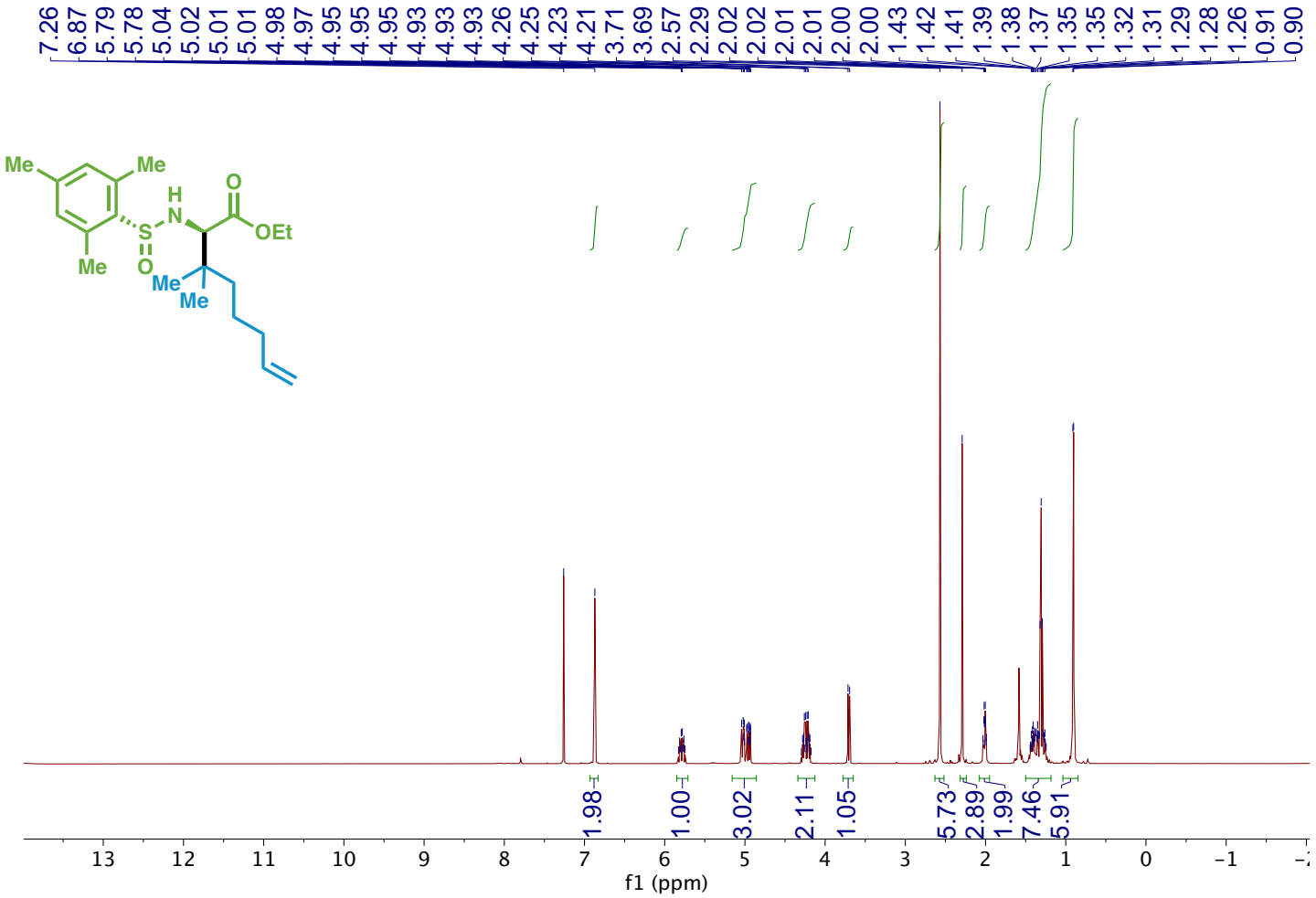
Compound 66 ^{1}H NMR



Compound 66 ^{13}C NMR



Compound 84-1 ^{1}H NMR



Compound 84-1 ^{13}C NMR