Supporting Information

Enantioselective Synthesis of 5,7-Bicyclic Ring Systems from Axially Chiral Allenes Using a Rh(I)-Catalyzed Cyclocarbonylation Reaction

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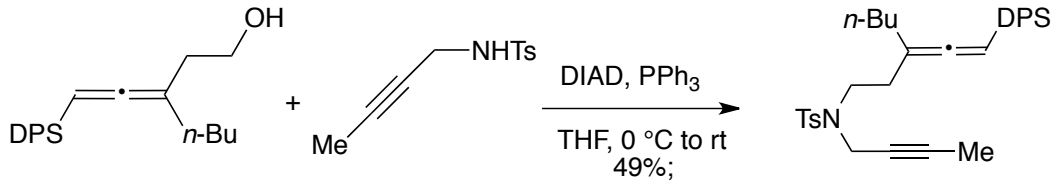
Synthesis of allene-yne 40

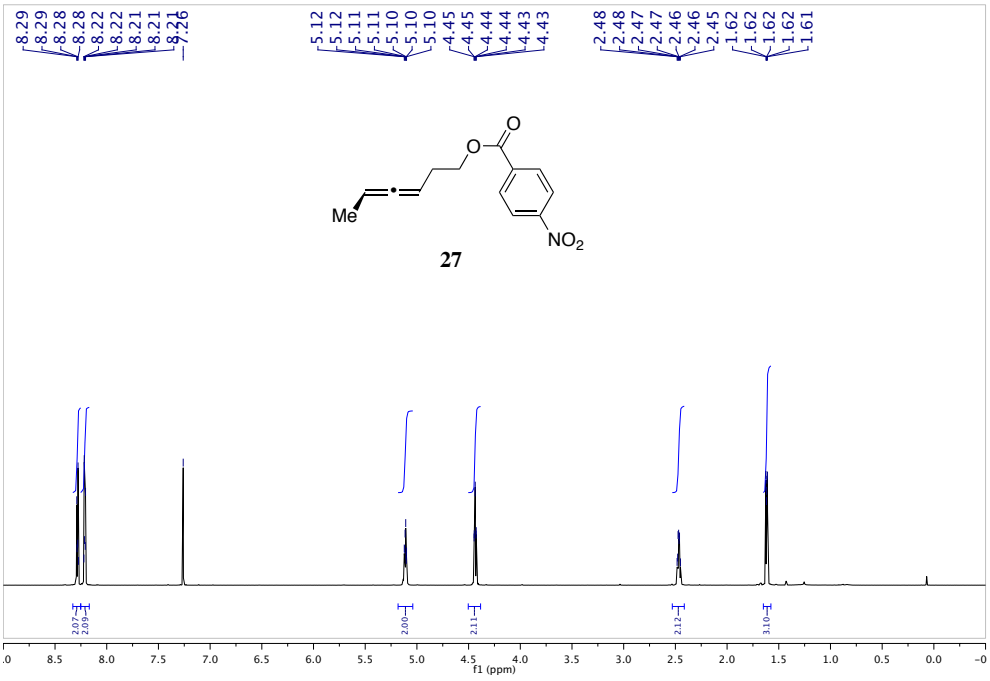


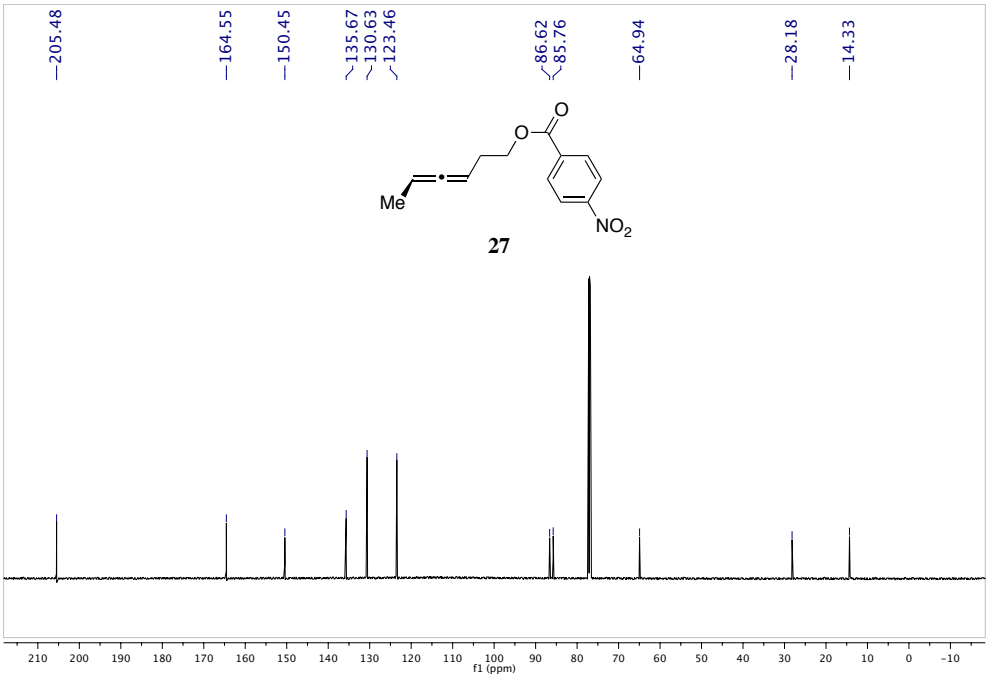
25 **30c** **40**

***N*-(but-2-yn-1-yl)-*N*-(3-(2-(dimethyl(phenyl)silyl)vinylidene)heptyl)-4-methyl benzenesulfonamide (40).** Following the general procedure for preparation of allene-yne *via* Mitsunobu reaction, alcohol **25** (54.8 mg, 0.2 mmol) in THF (1.5 mL) was reacted with triphenylphosphine (63 mg, 0.24 mmol), *N*-(but-2-yn-1-yl)-4-methylbenzenesulfonamide[29] **30c** (54 mg, 0.24 mmol) and $NaHCO_3$ (48 μL, 0.24 mmol) for 2.5 h. Purification of the crude residue by silica gel chromatography using 5% Et_2O/hexanes afforded compound **40** (46.7 mg, 49%) as a colorless oil. ^1H NMR (600 MHz, $CDCl_3$) δ 7.74 (d, *J* = 8.1 Hz, 2H), 7.57 (d, *J* = 5.0 Hz, 2H), 7.39 – 7.37 (m, 3H), 7.29 (d, *J* = 7.4 Hz, 2H), 5.15 – 5.14 (m, 1H), 4.09 (d, *J* = 2.6 Hz, 2H), 3.24 (t, *J* = 8.0 Hz, 2H), 2.44 (s, 3H), 2.22 – 2.20 (m, 2H), 1.96 – 1.95 (m, 2H), 1.56 (t, *J* = 2.3 Hz, 3H), 1.38 – 1.35 (m, 5H), 0.92 (t, *J* = 7.0 Hz, 3H), 0.37 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 208.9, 143.0, 138.5, 136.0, 133.6 (2C), 129.2 (2C), 129.0, 127.7 (2C), 127.6 (2C), 94.1, 82.9, 81.4, 71.7, 44.9, 37.0, 31.3, 29.8 (2C), 22.4, 21.4, 13.9, 3.2, -2.2, -2.3; IR (thin film) 3395, 3064, 2954, 2860, 2165, 1669, 1593, 1438, 1361, 1254, 1160; HRMS (ES+) $C_{28}H_{36}NO_2SSi$ [M-H^+] Calculated: 478.2236; Found: 478.2238.

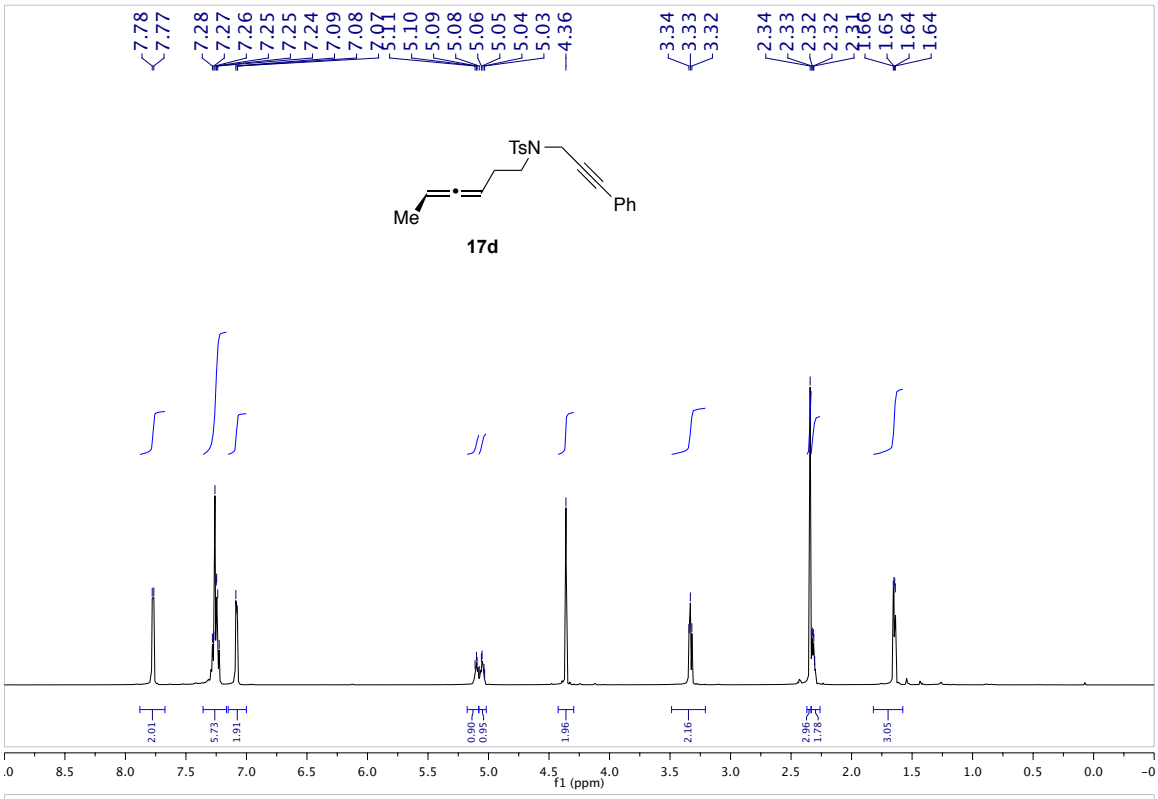
^{1}H and ^{13}C NMR

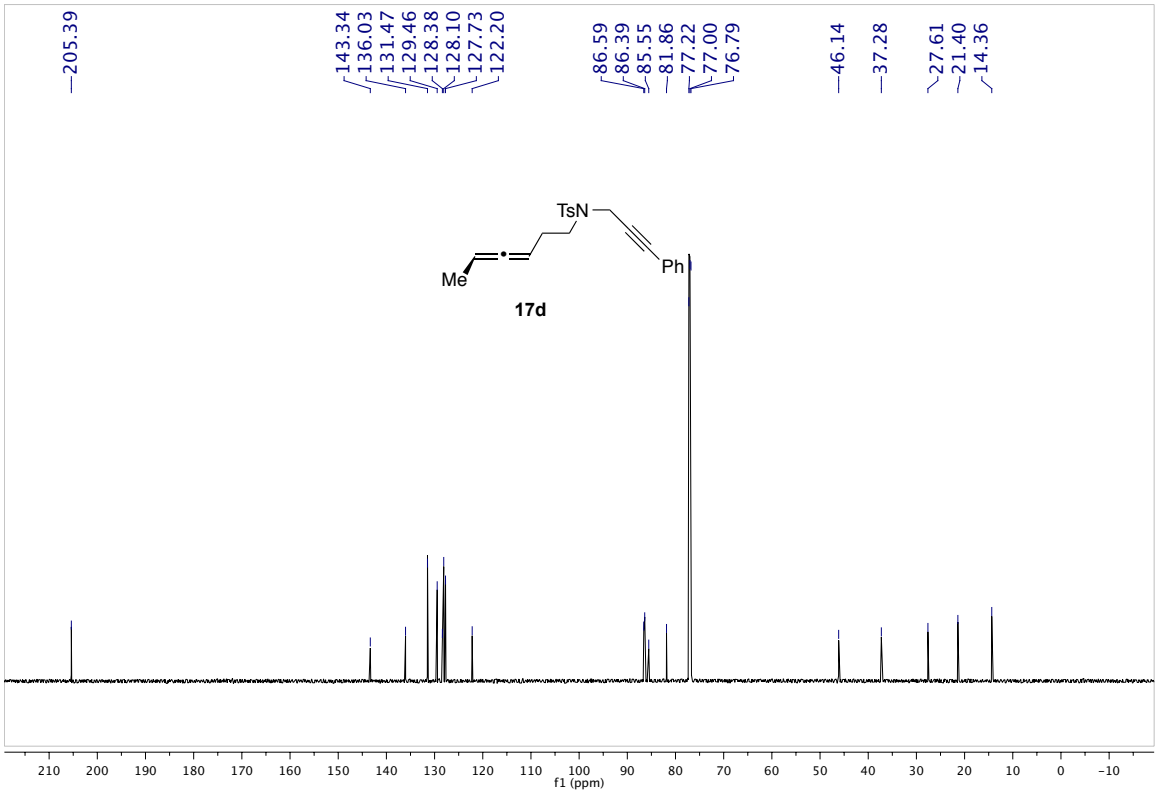
(R_a)-hexa-3,4-dien-1-yl 4-nitrobenzoate (27):



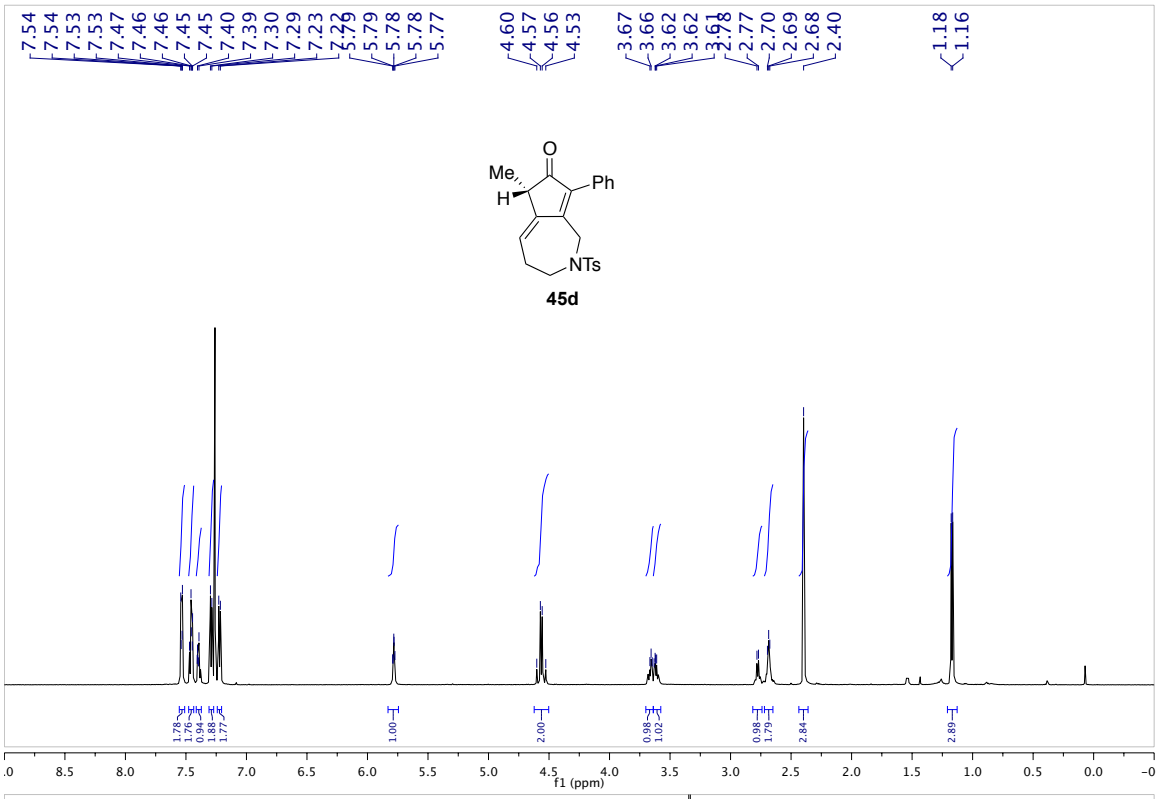


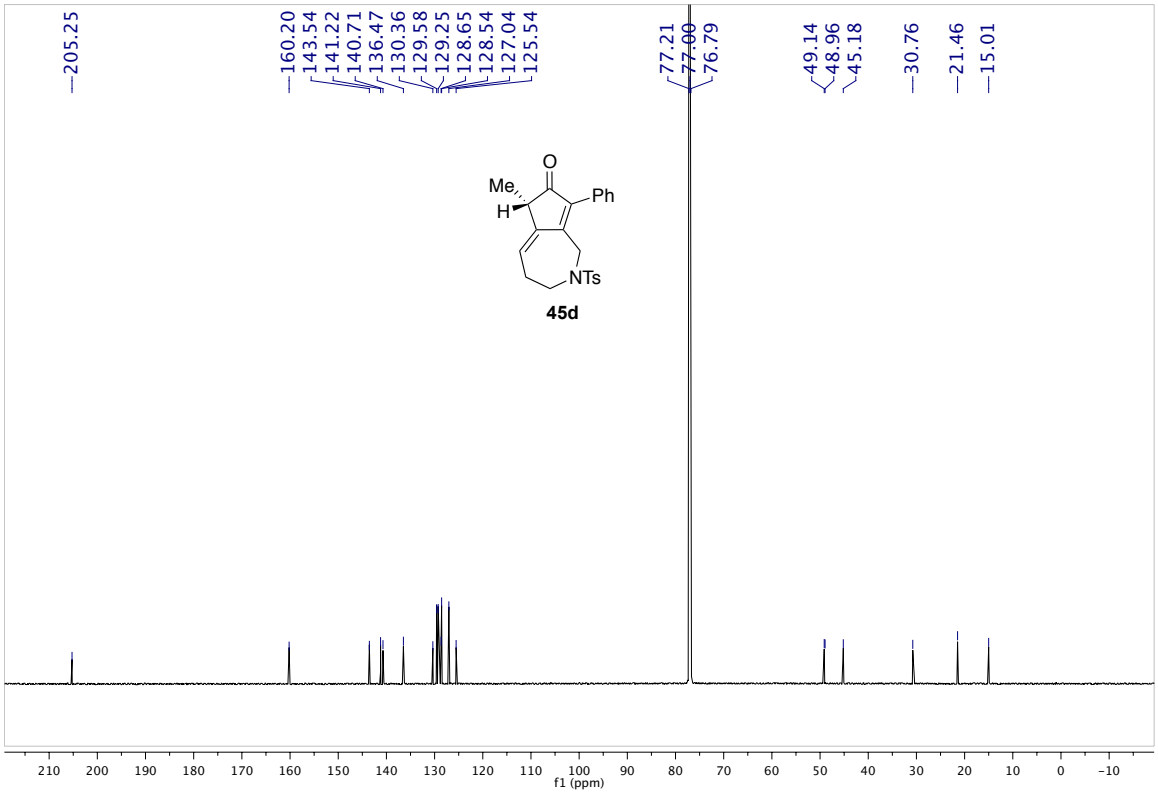
(R_a)-*N*-(hexa-3,4-dien-1-yl)-4-methyl-*N*-(3-phenylprop-2-yn-1-yl) benzenesulfonamide (17d):



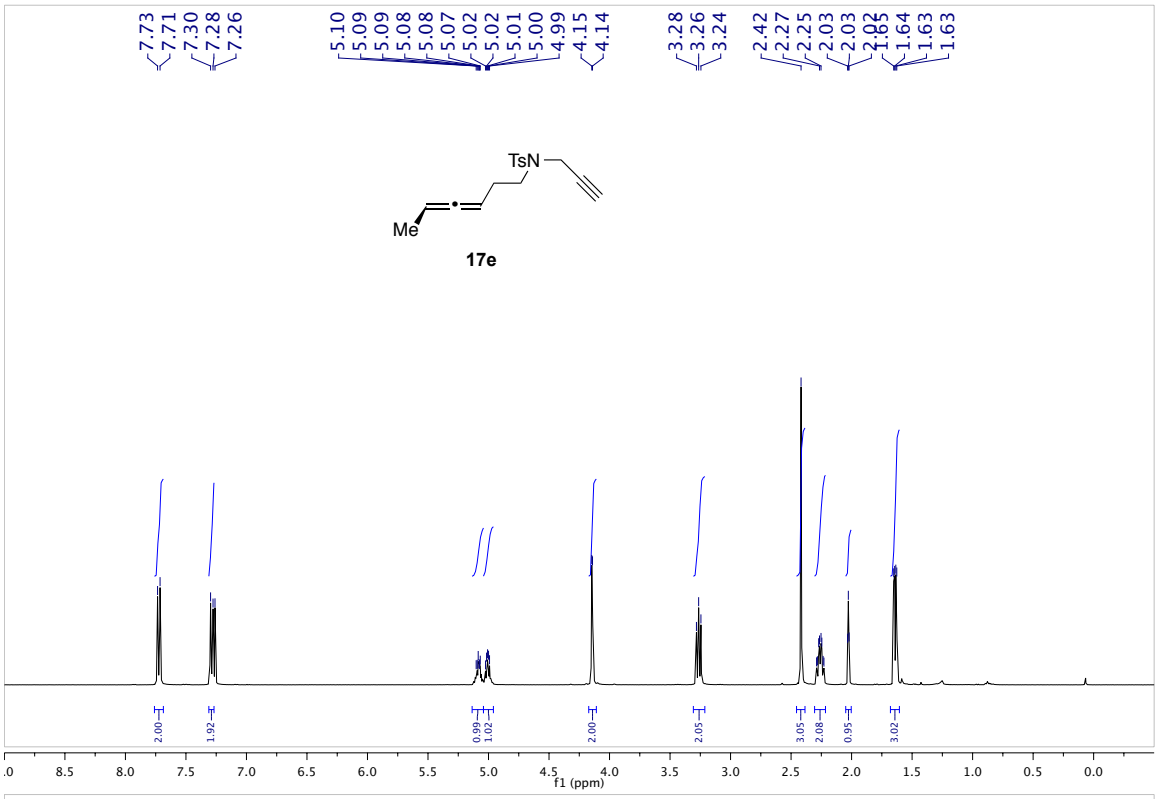


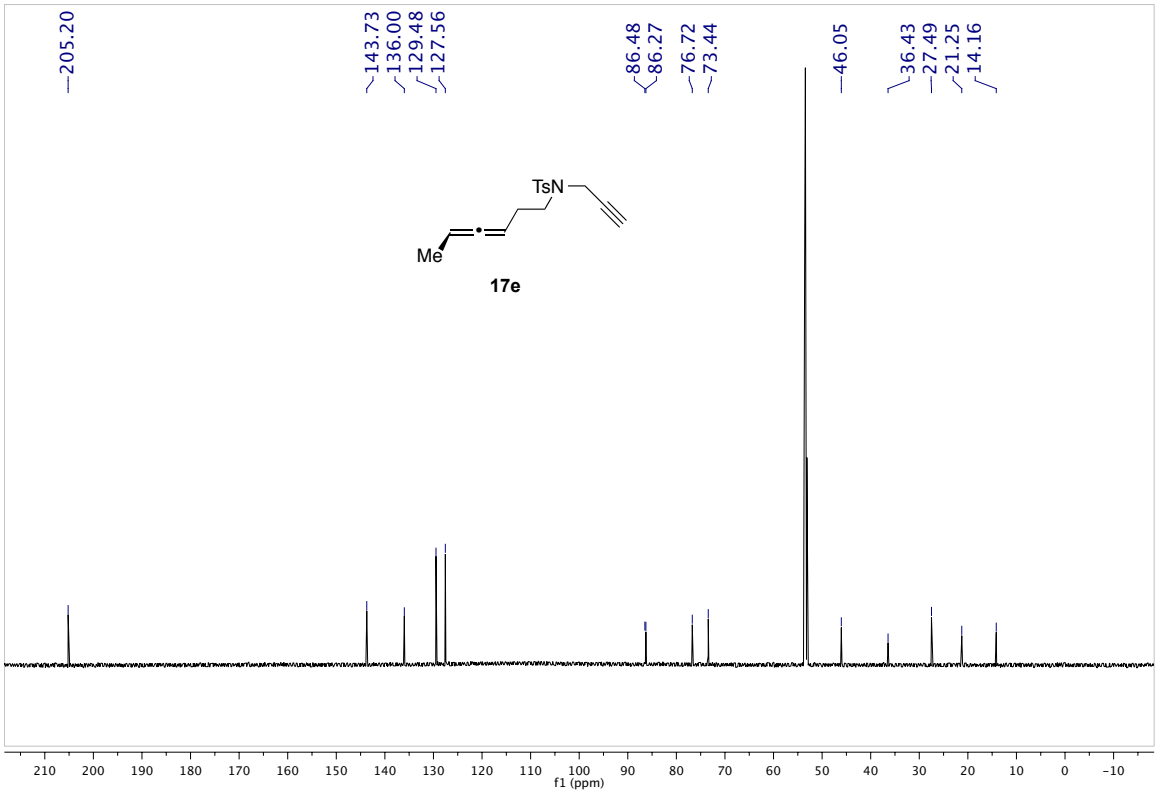
(*S*)-6-methyl-8-phenyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[*c*]azepin-7(6*H*)-one (45d):



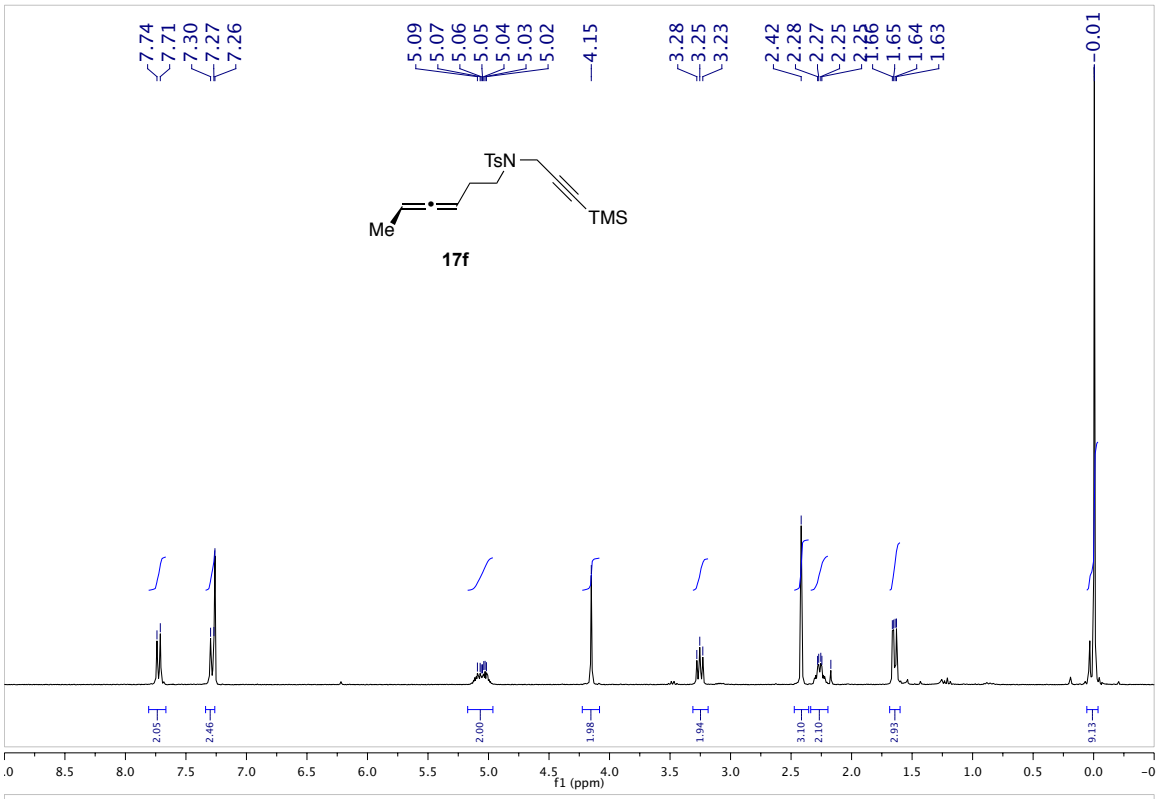


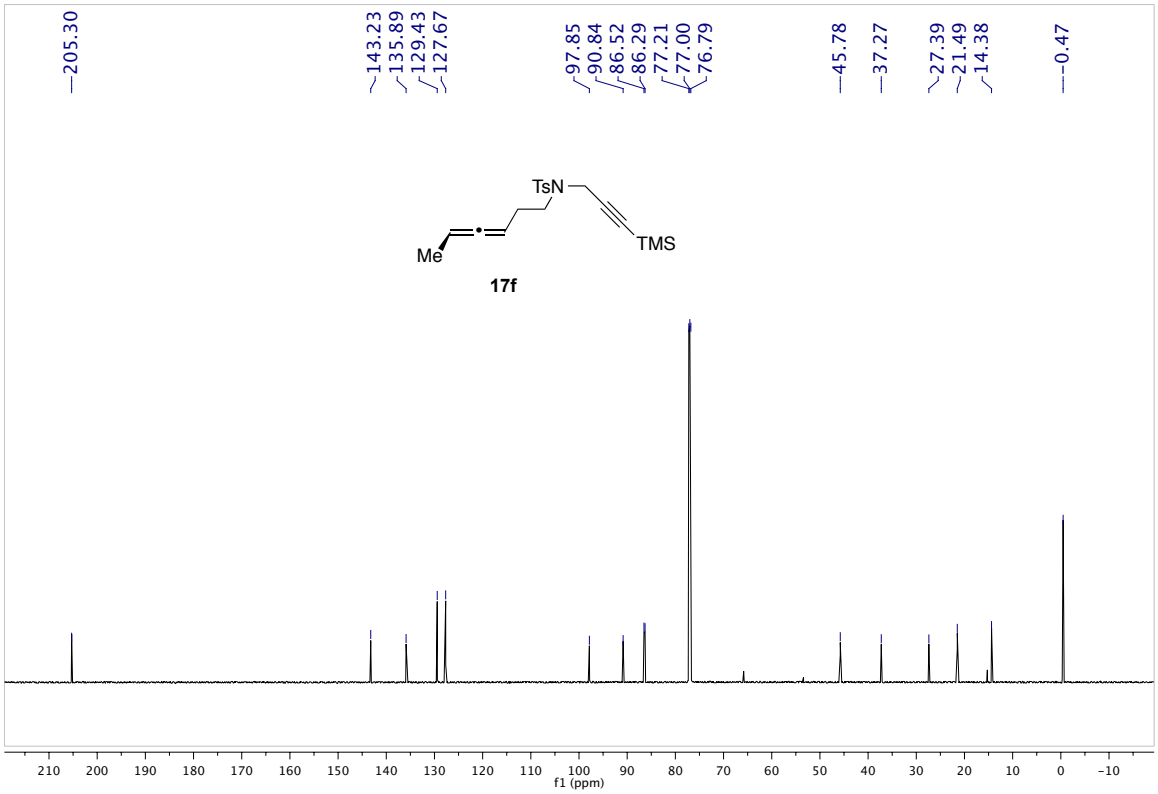
(R_a)-*N*-(hexa-3,4-dien-1-yl)-4-methyl-*N*-(prop-2-yn-1-yl)benzenesulfonamide (17e):



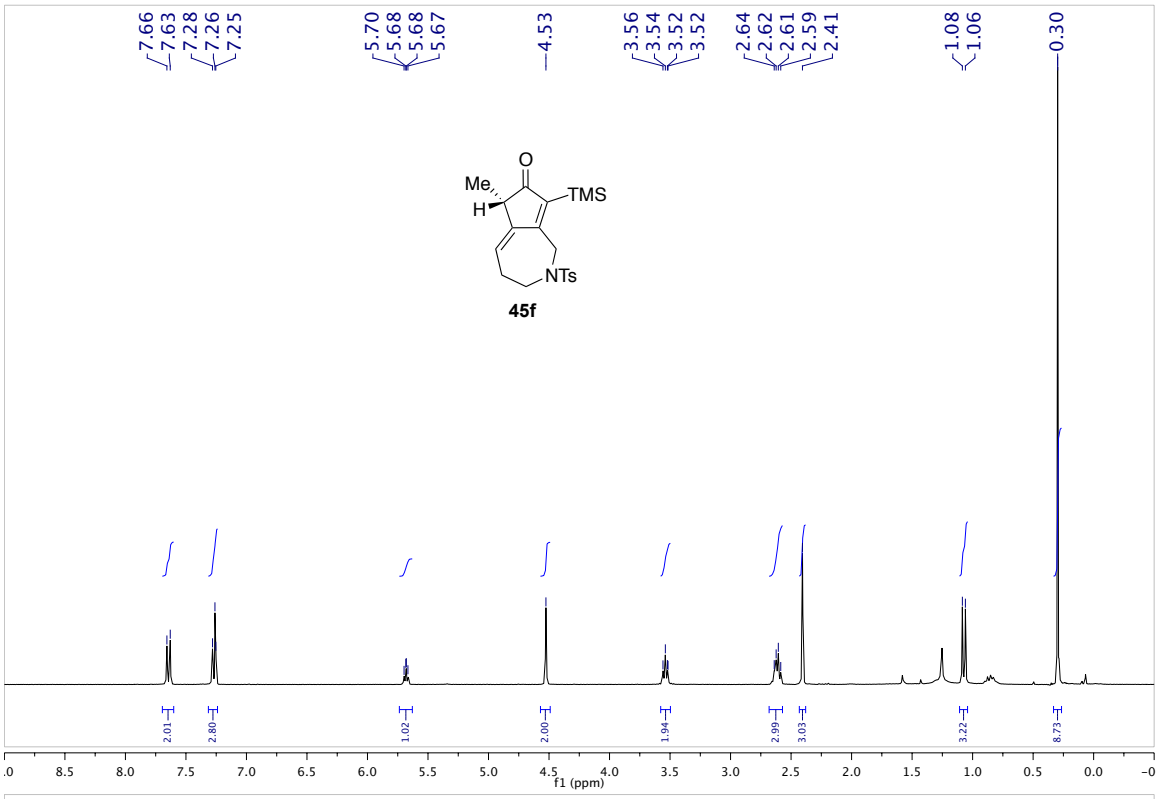


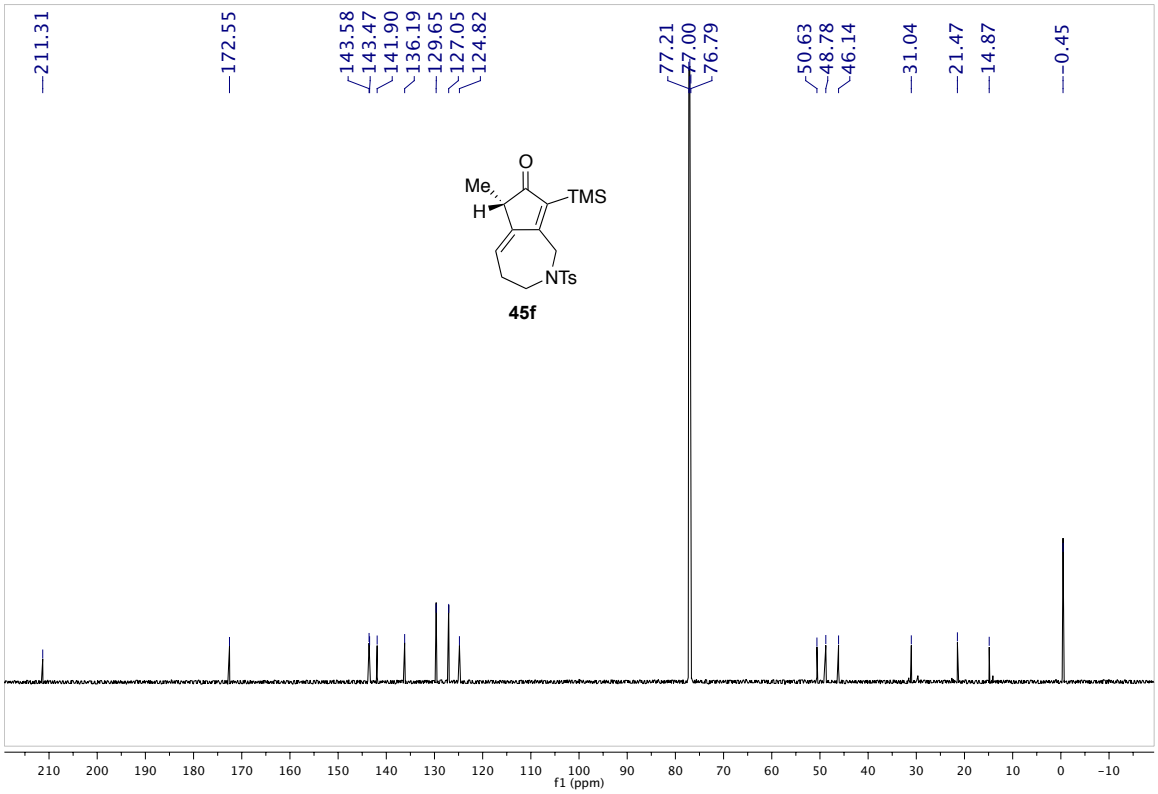
(R_a)-*N*-(hexa-3,4-dien-1-yl)-4-methyl-*N*-(3-(trimethylsilyl)prop-2-yn-1-yl) benzenesulfonamide (17f):



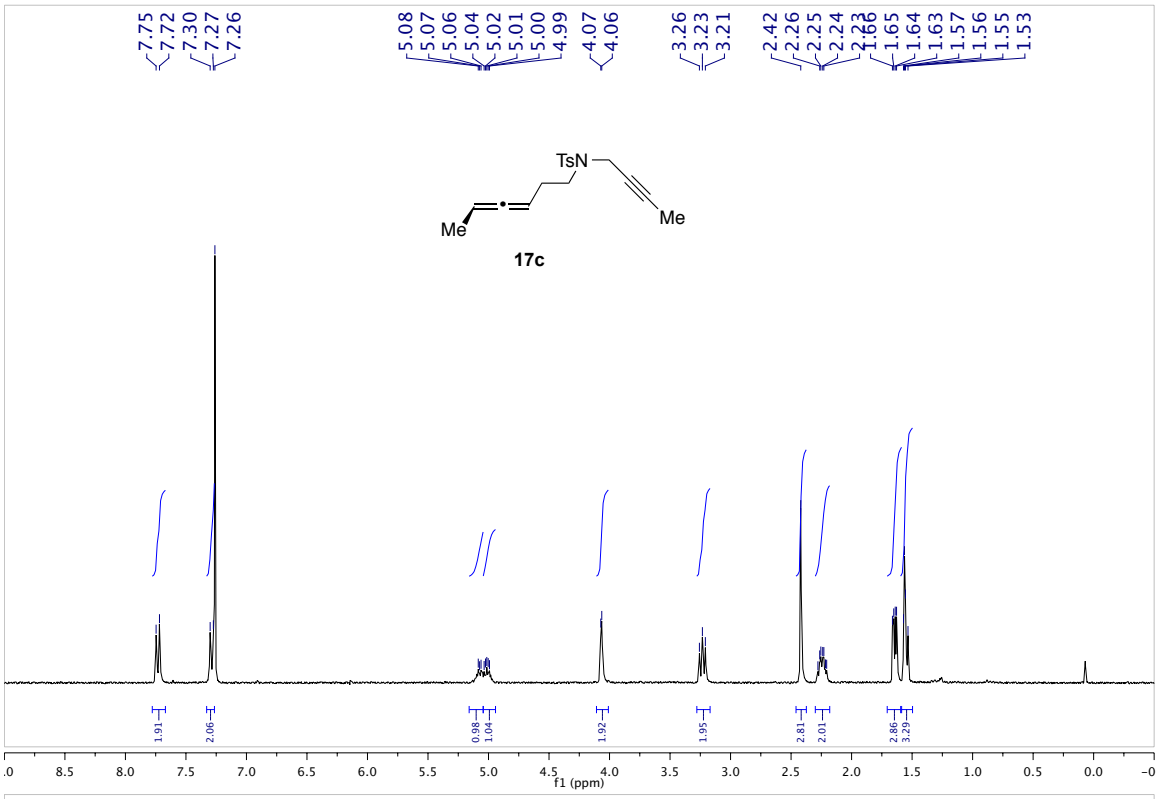


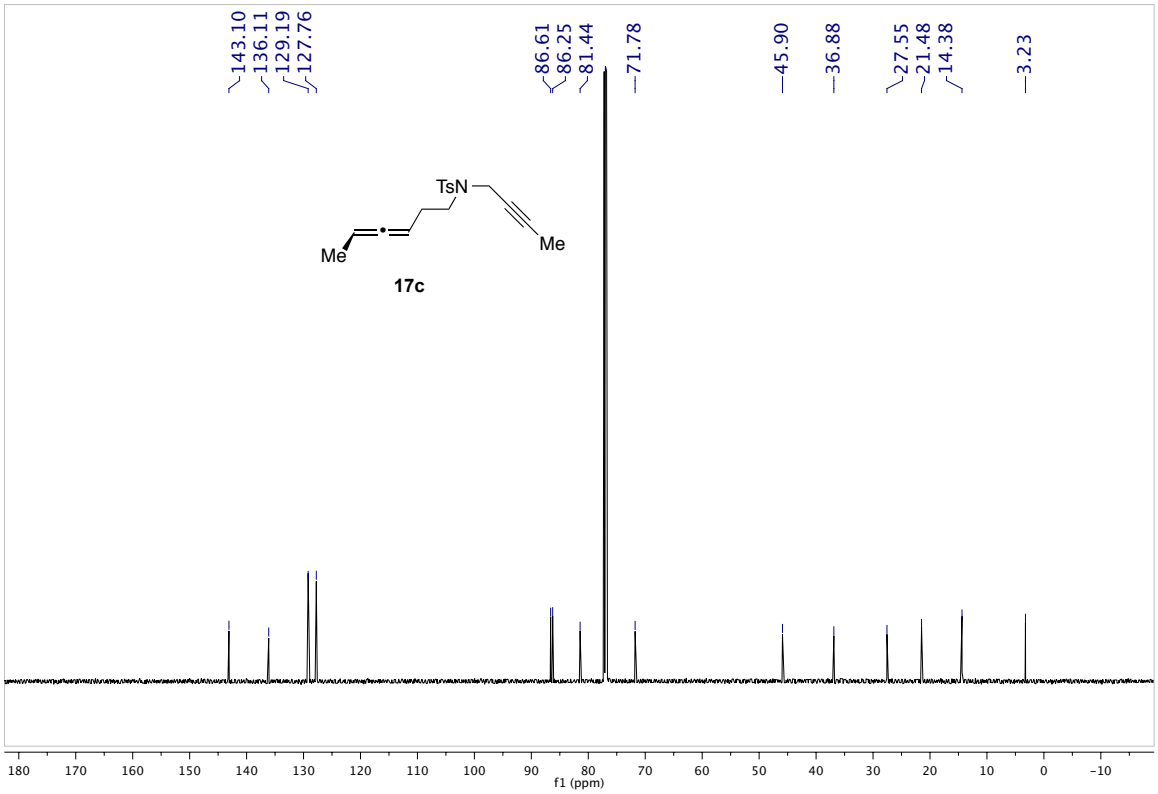
(*S*)-6-methyl-2-tosyl-8-(trimethylsilyl)-1,2,3,4-tetrahydrocyclopenta[*c*]azepin -7(6*H*)-one (45f):



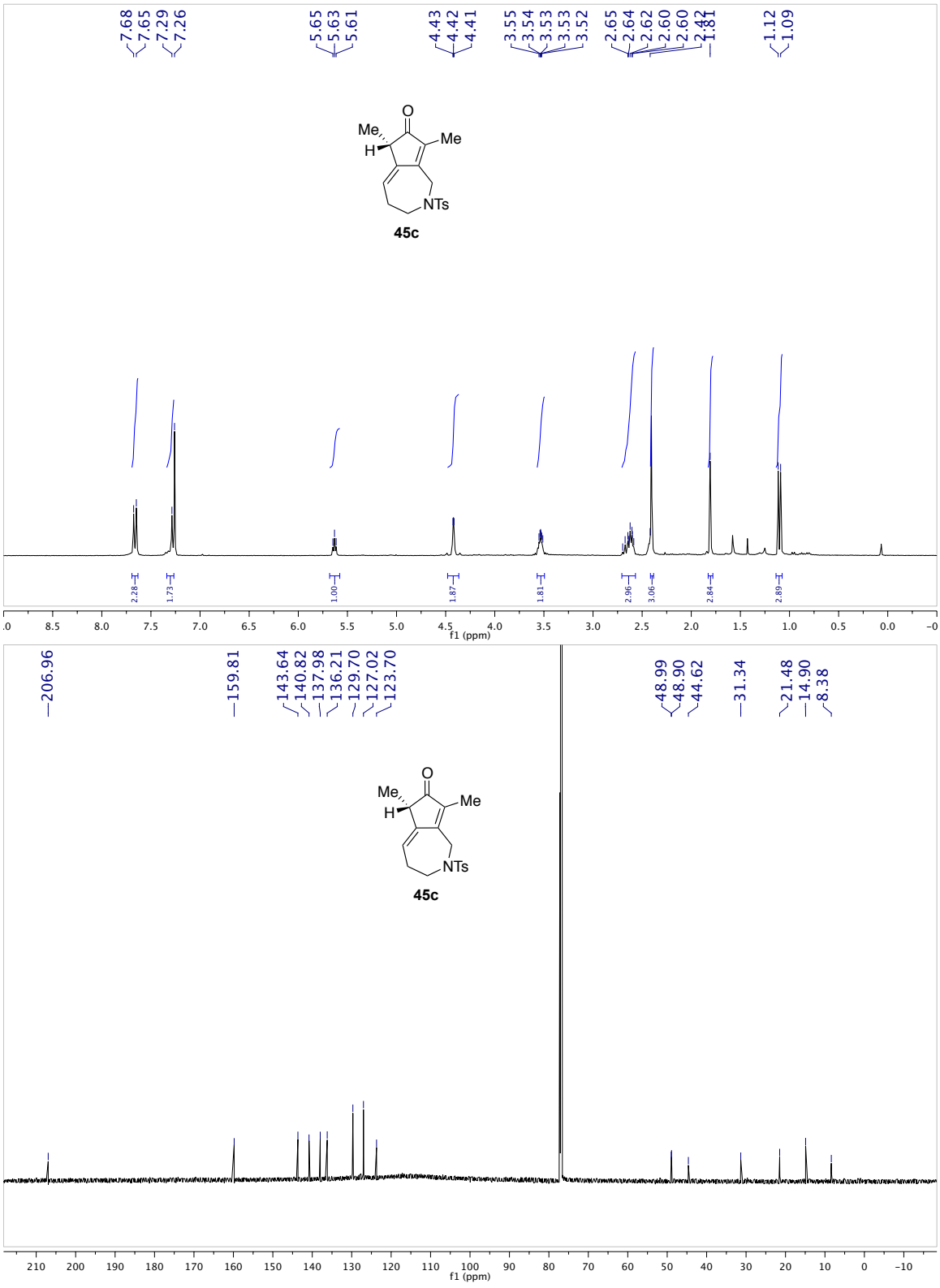


(R_a)-*N*-(but-2-yn-1-yl)-*N*-(hexa-3,4-dien-1-yl)-4-methylbenzenesulfonamide (17c):

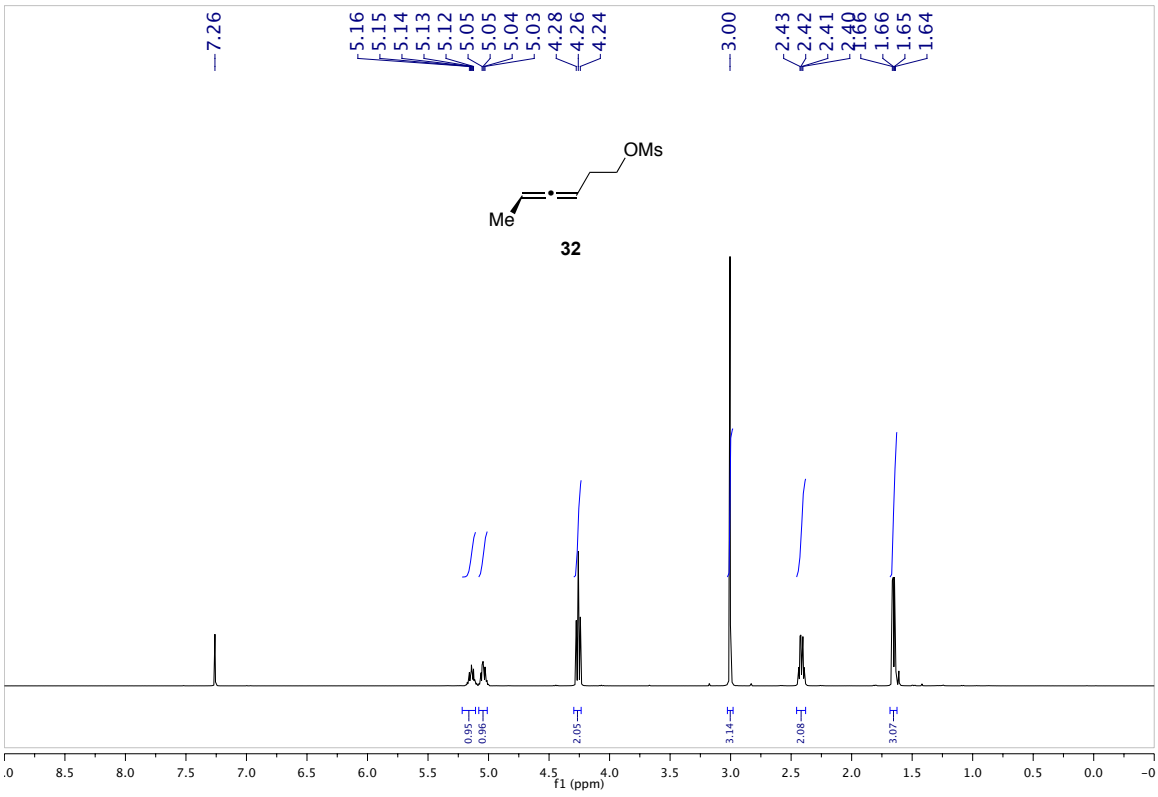


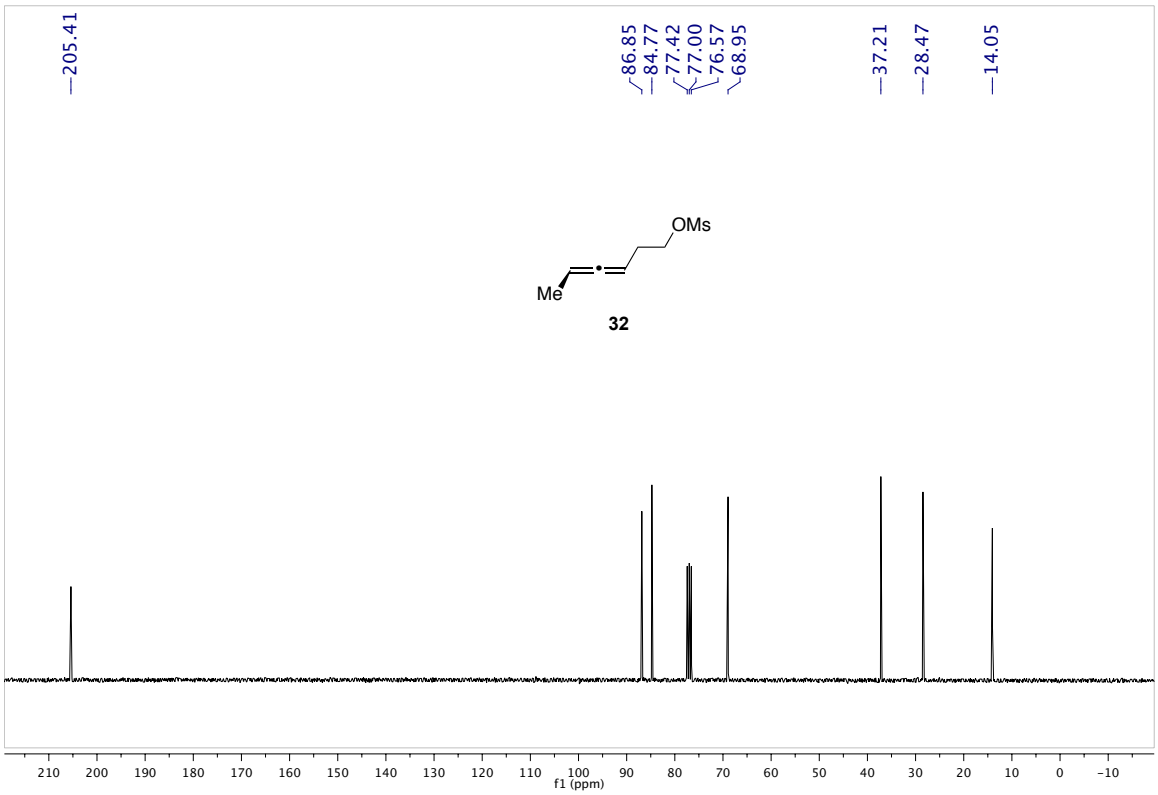


(*S*)-6,8-dimethyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[*c*]azepin-7(6*H*)-one (45c):

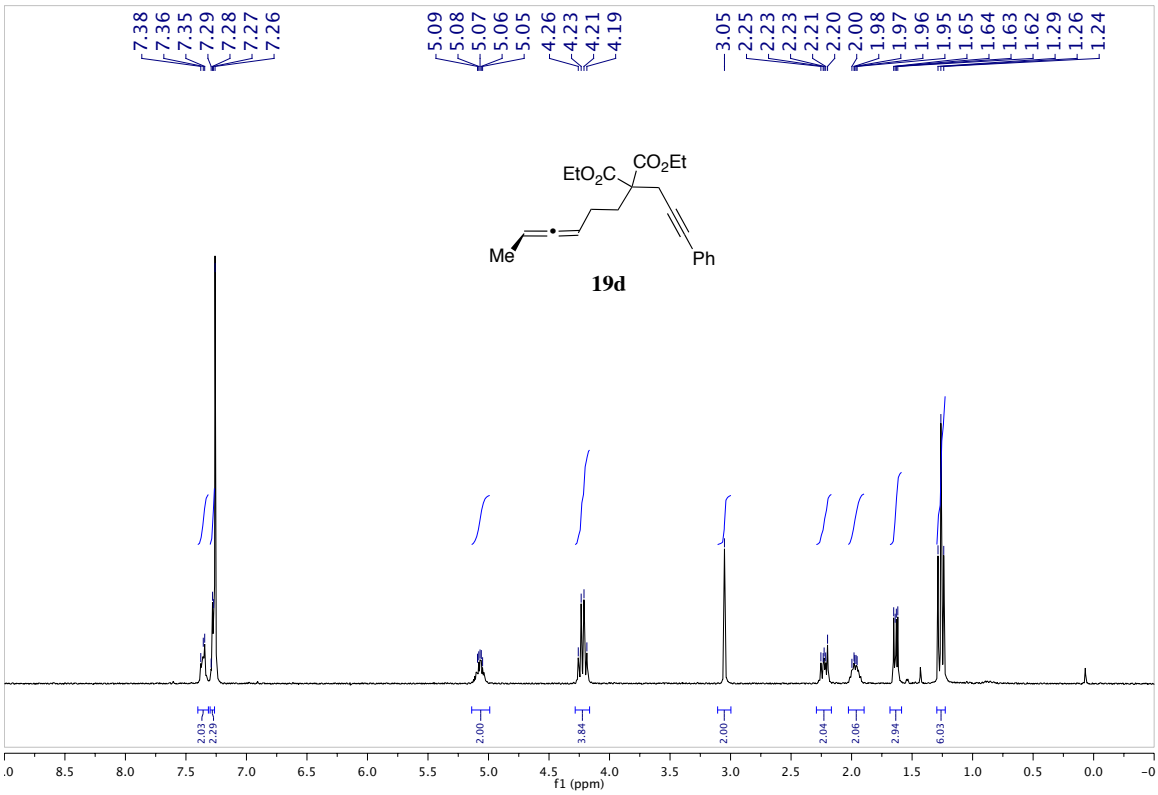


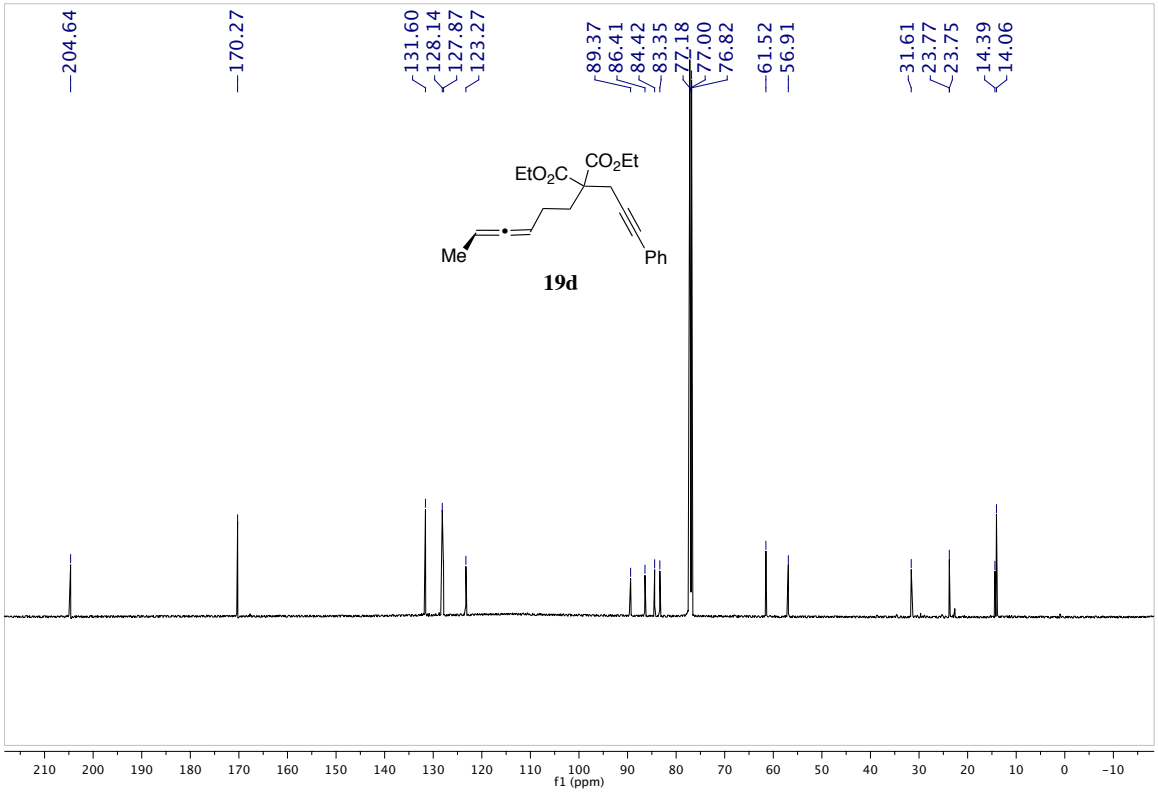
(R_a)-Hexa-3,4-dien-1-yl methanesulfonate (32):



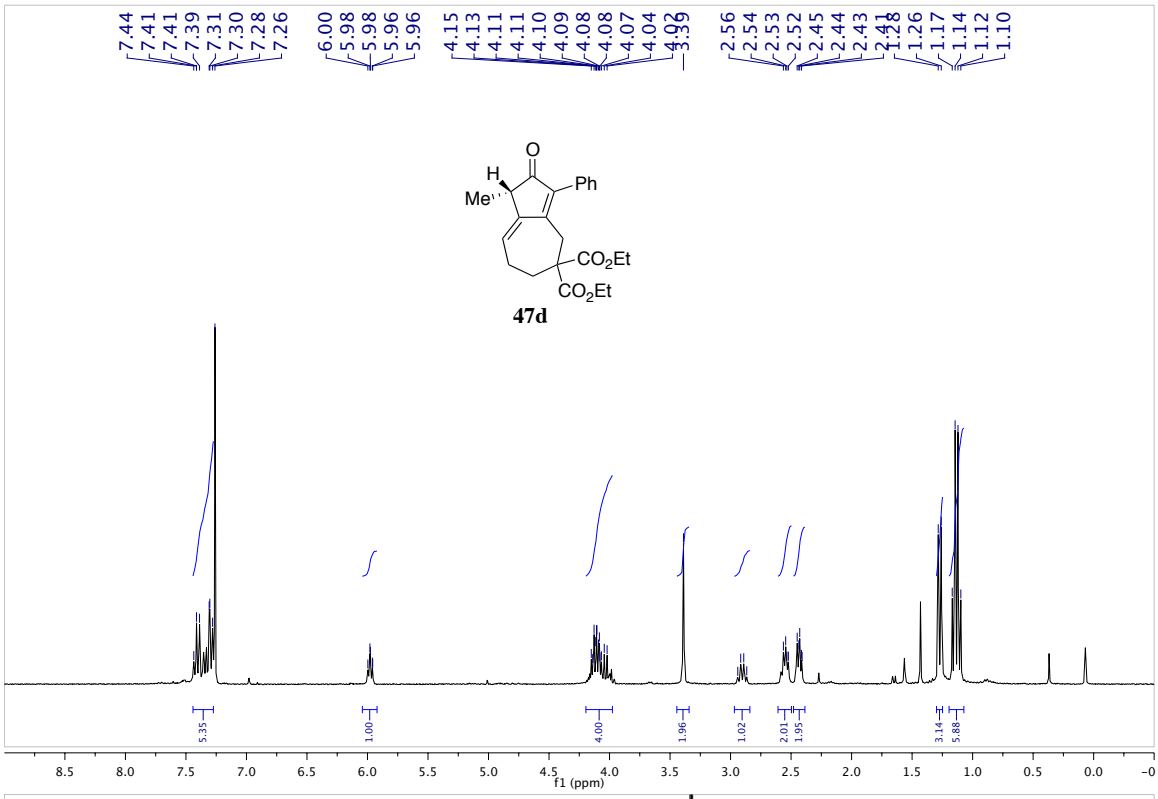


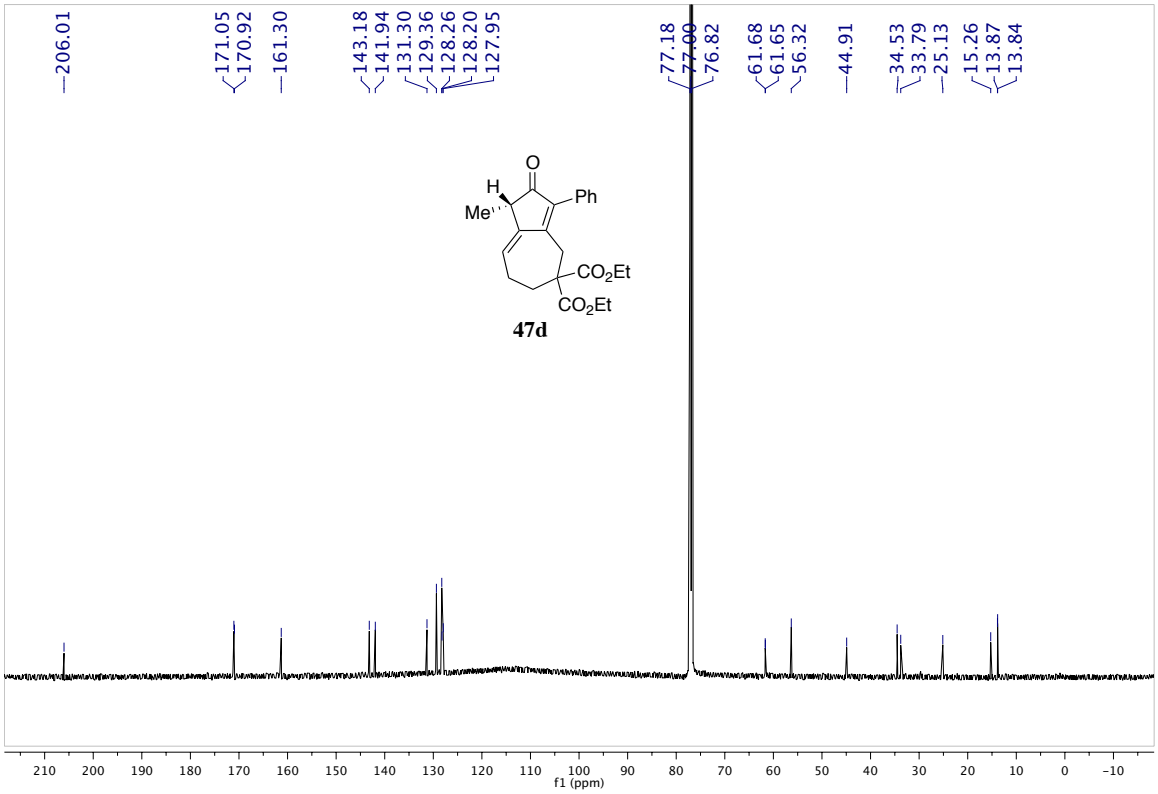
(R_a)-Diethyl 2-(hexa-3,4-dien-1-yl)-2-(3-phenylprop-2-yn-1-yl)malonate (19d):



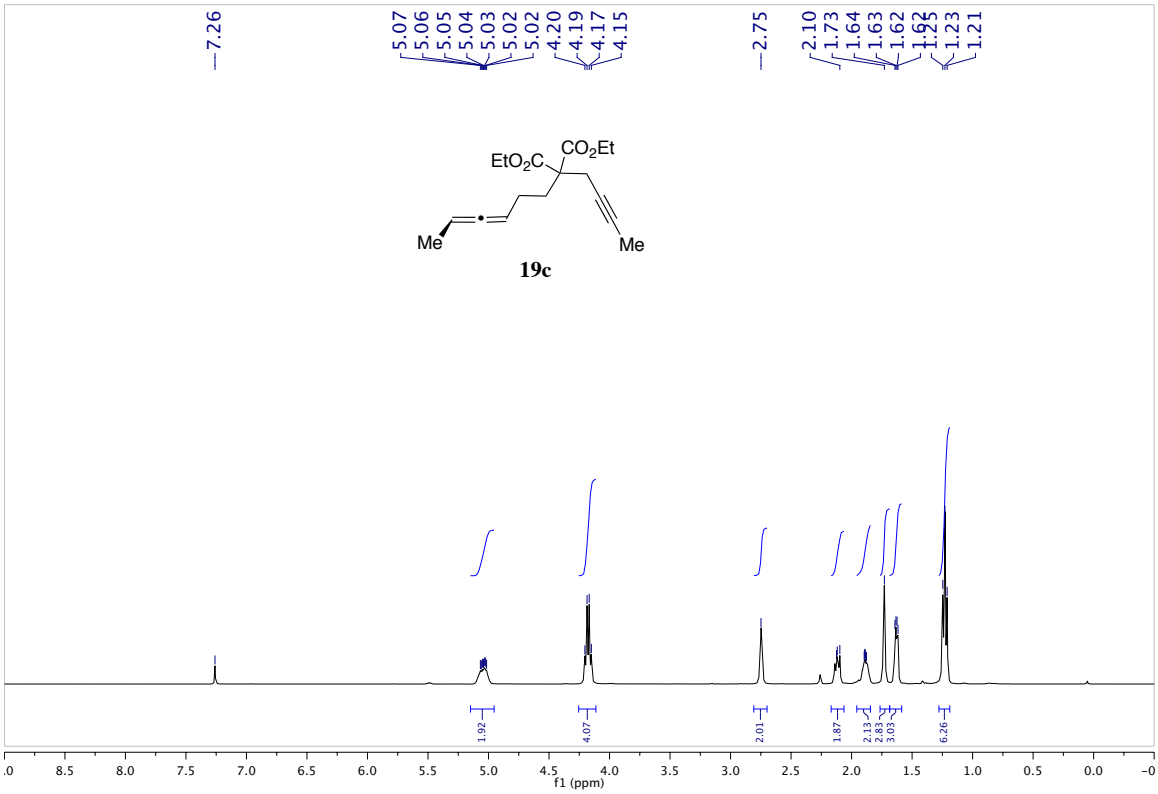


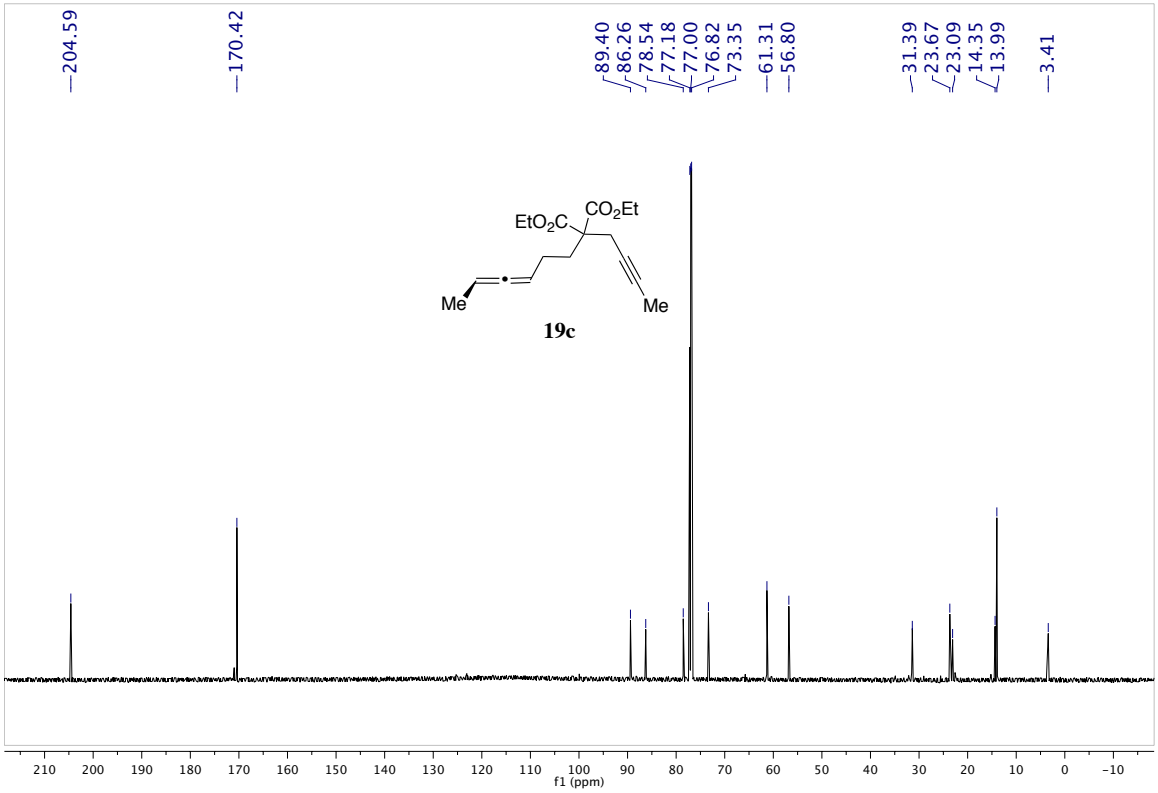
(*S*)-Diethyl 1-methyl-2-oxo-3-phenyl-1,2,6,7-tetrahydroazulene-5,5(4*H*)-dicarboxylate (47d):



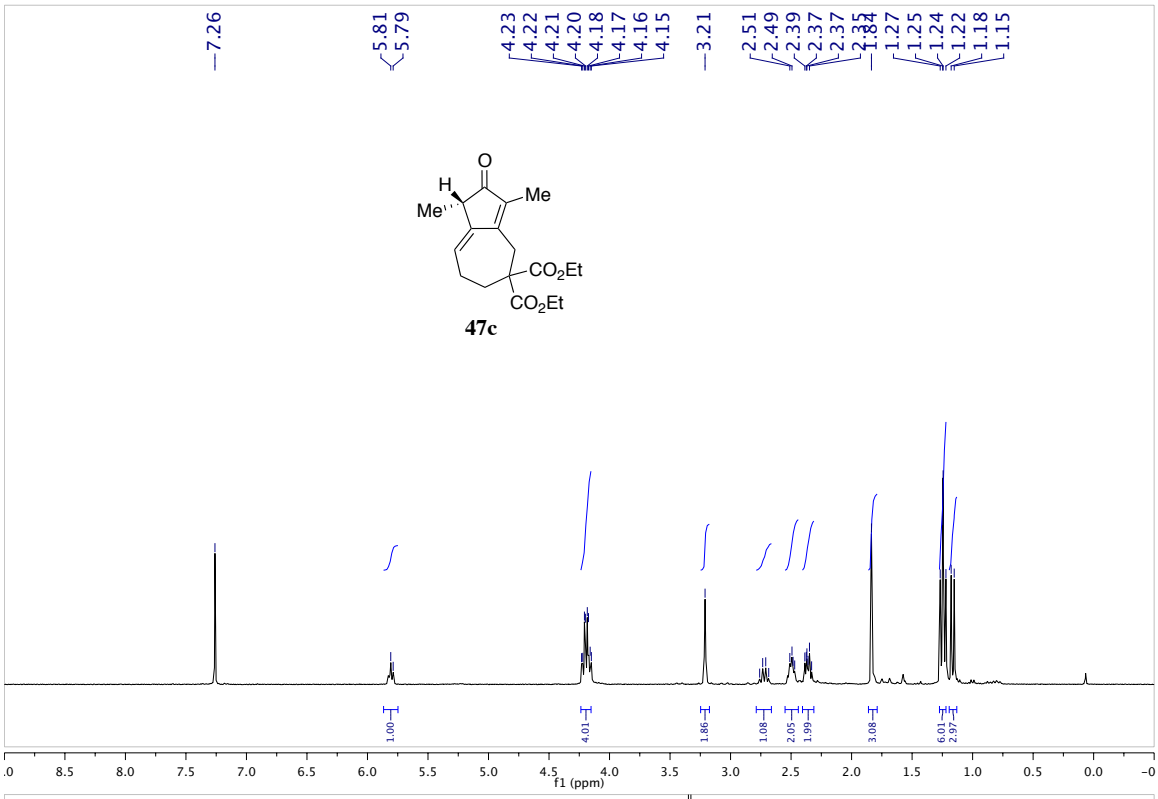


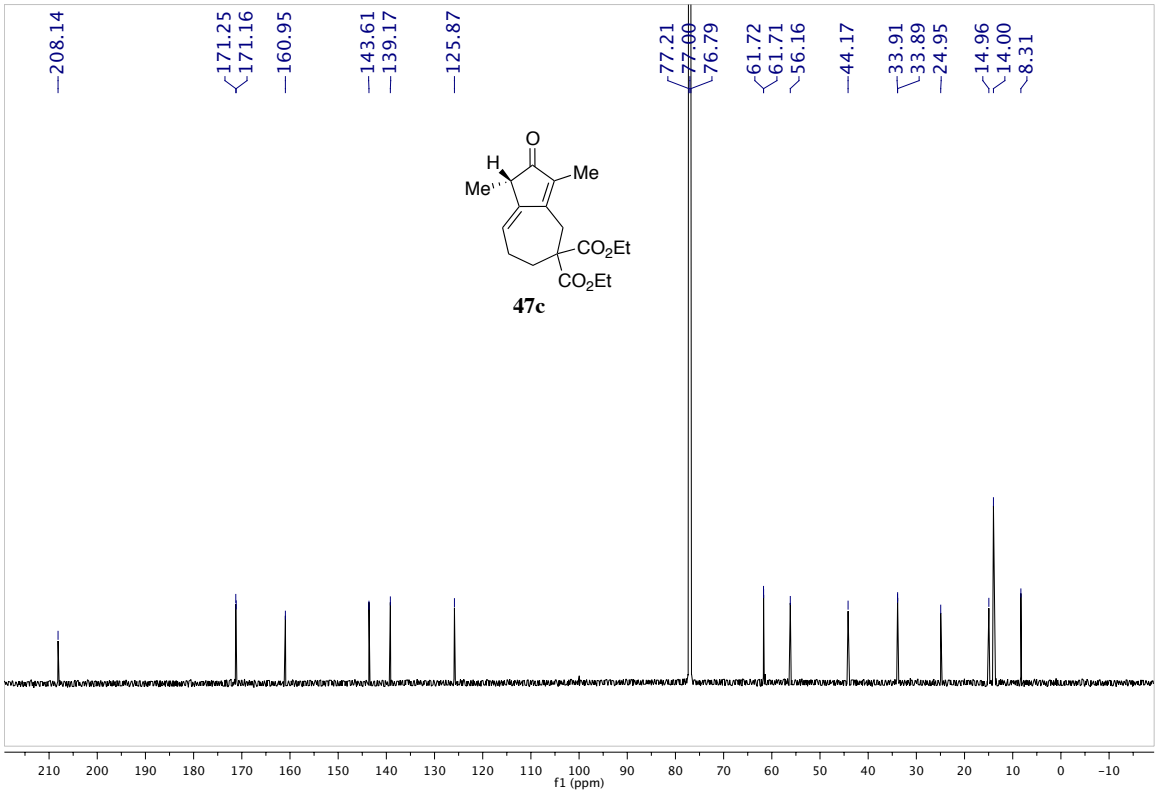
(R_a)-diethyl 2-(but-2-yn-1-yl)-2-(hexa-3,4-dien-1-yl)malonate (19c):



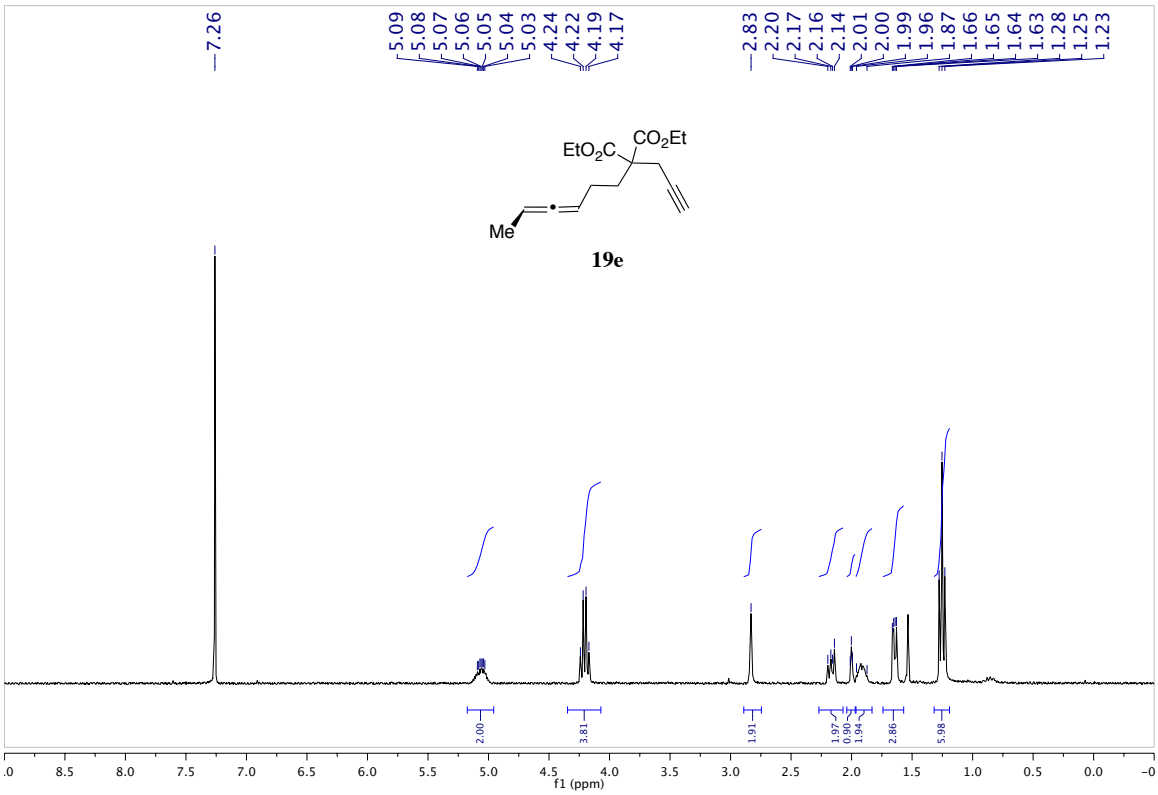


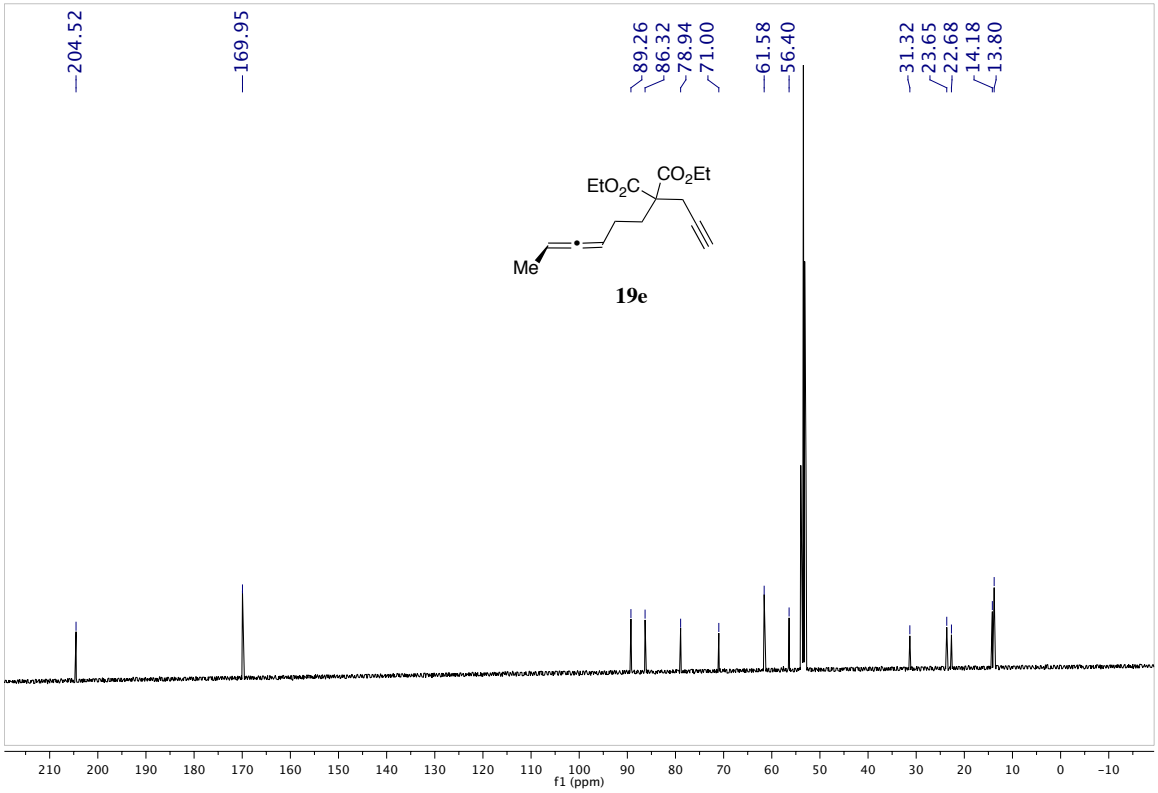
(*S*)-diethyl 1,3-dimethyl-2-oxo-1,2,6,7-tetrahydroazulene-5,5(4*H*)-dicarboxylate (47c):



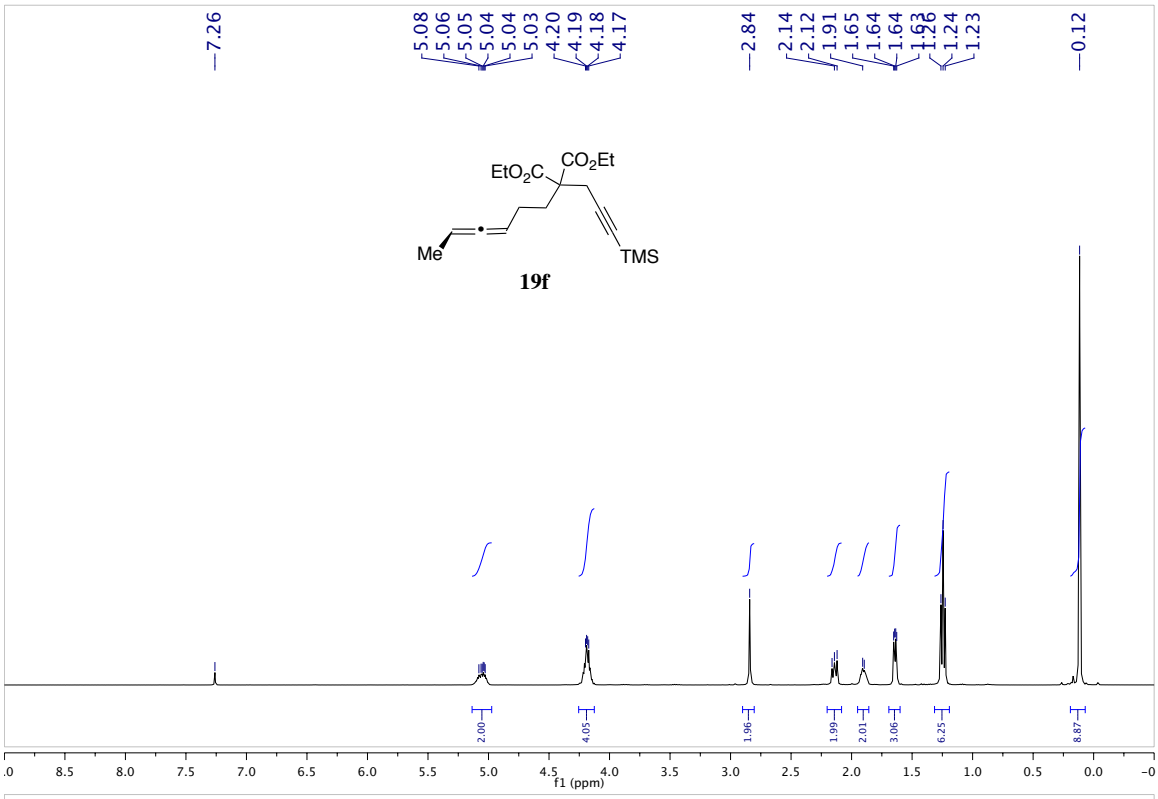


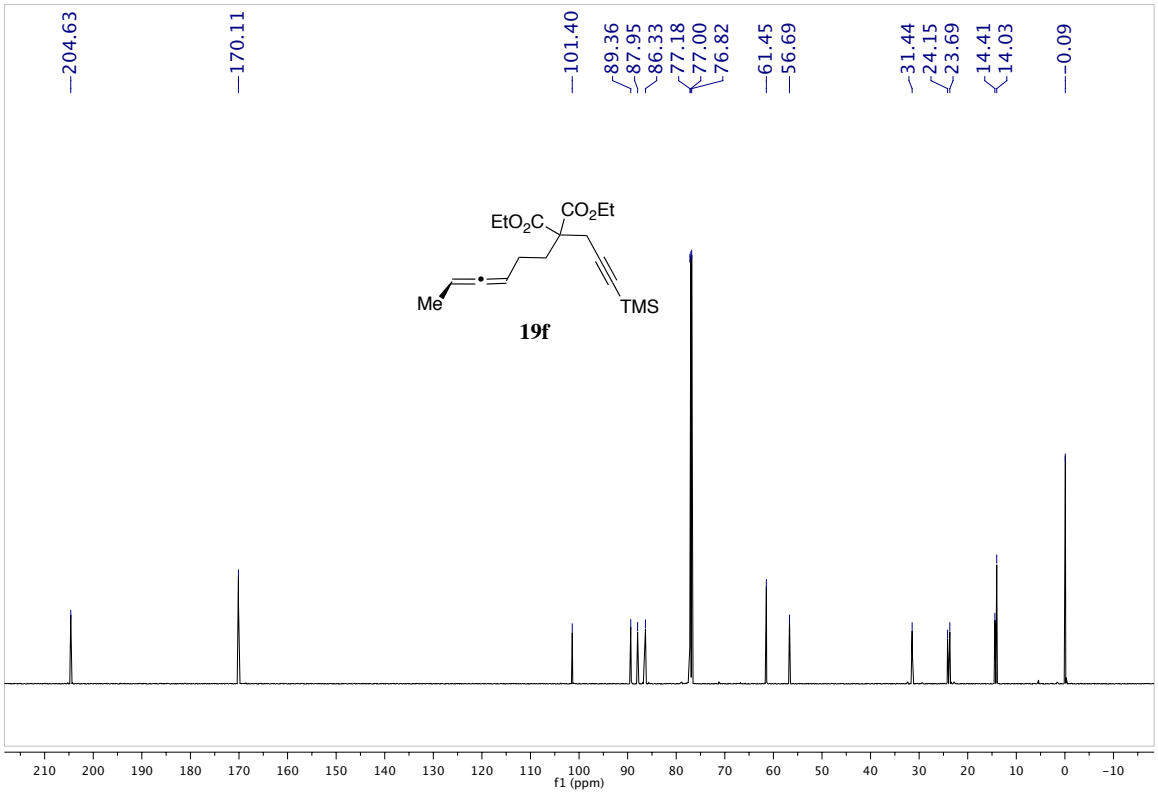
(R_a)-diethyl 2-(hexa-3,4-dien-1-yl)-2-(prop-2-yn-1-yl)malonate (19e):





(R_a)-diethyl 2-(hexa-3,4-dien-1-yl)-2-(3-(trimethylsilyl)prop-2-yn-1-yl)malonate (19f):





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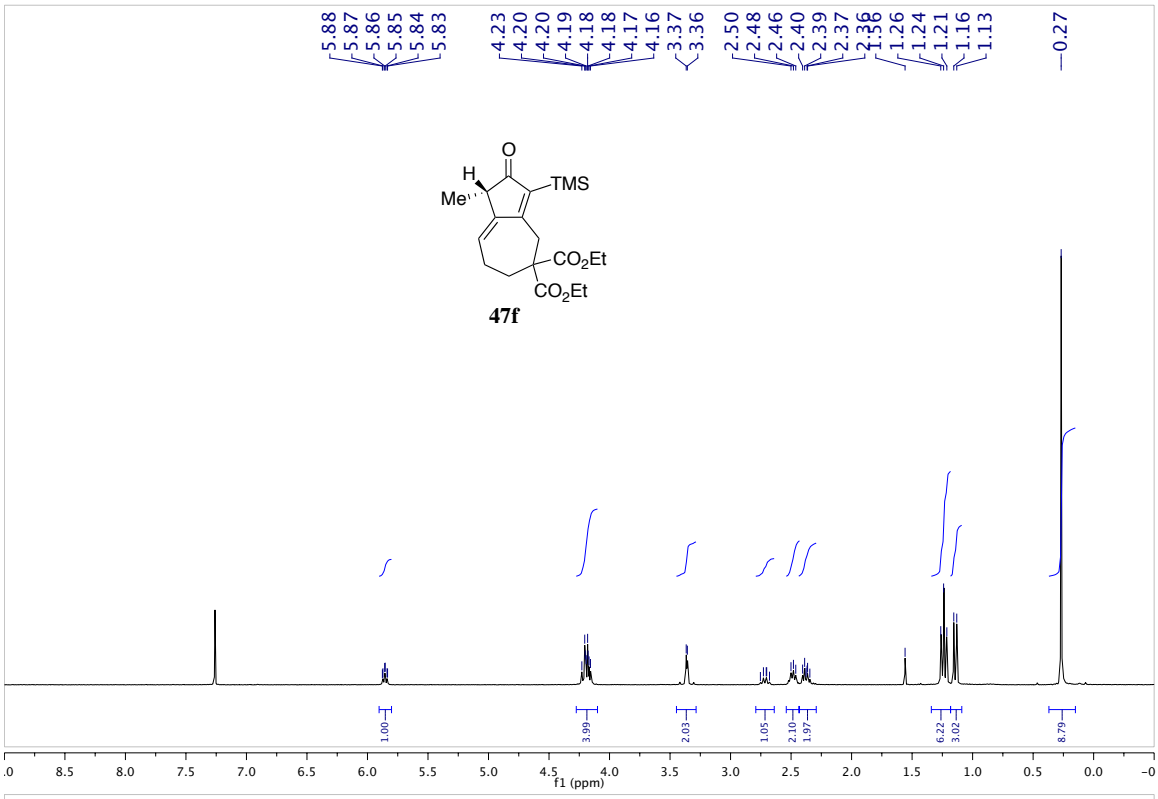
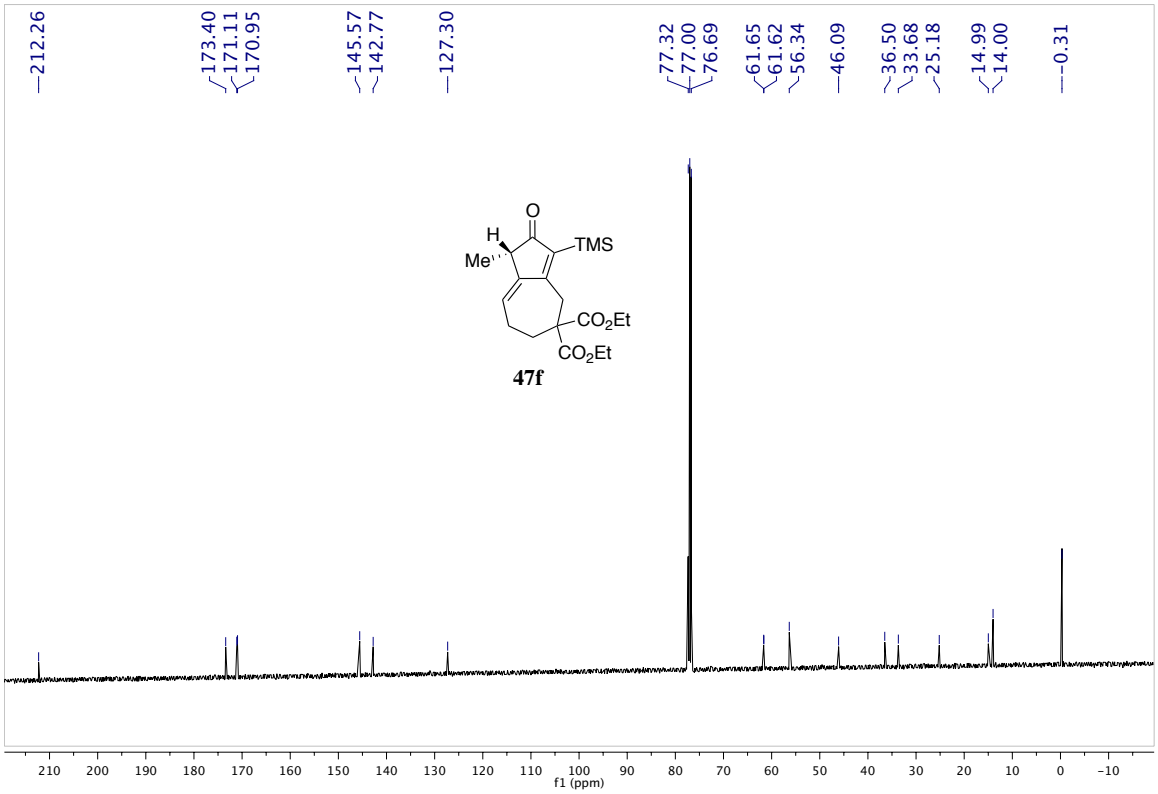
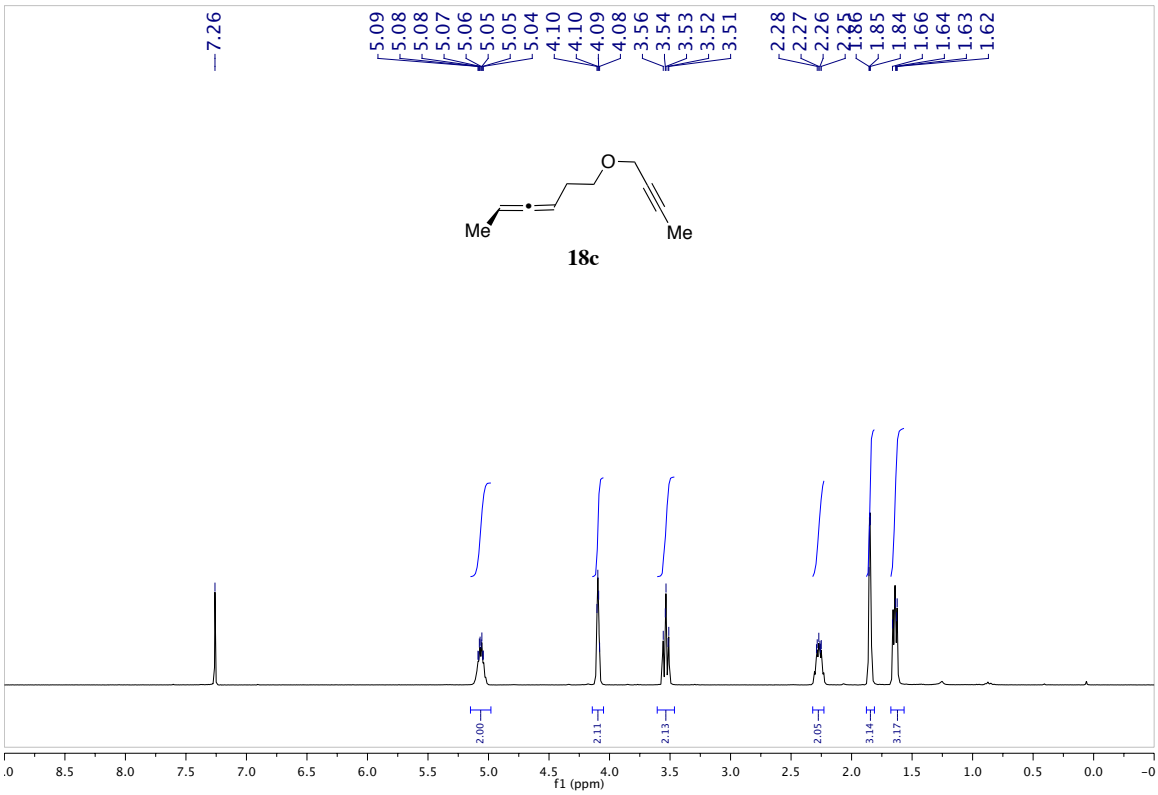
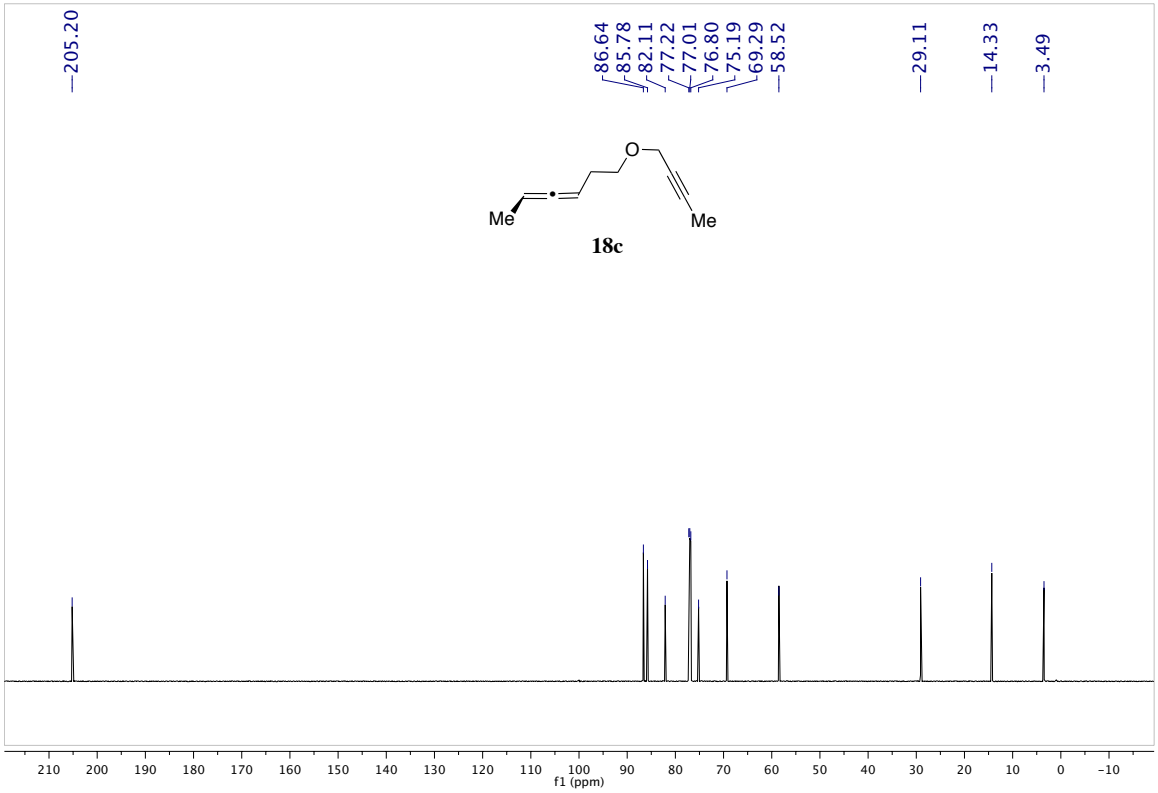


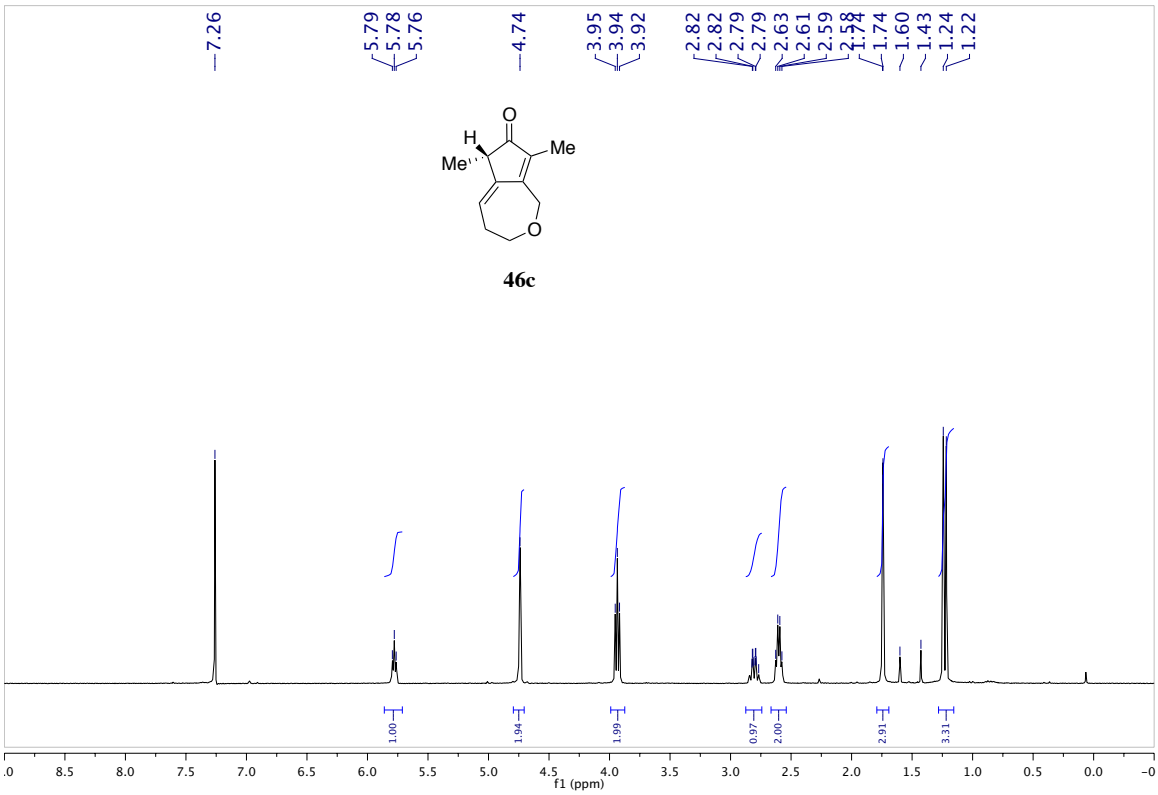


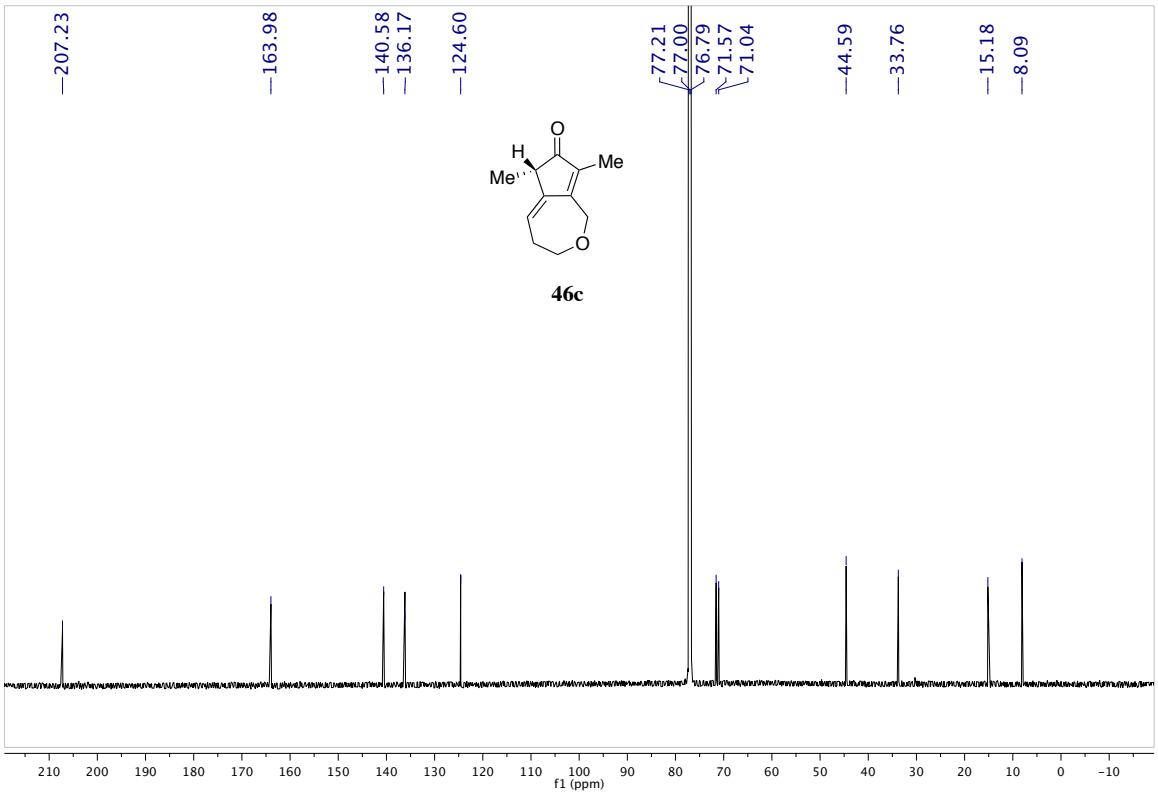
(R_a)-6-(but-2-yn-1-yloxy)hexa-2,3-diene (18c):





(*S*)-6,8-dimethyl-3,4-dihydro-1*H*-cyclopenta[*c*]oxepin-7(6*H*)-one (46c):





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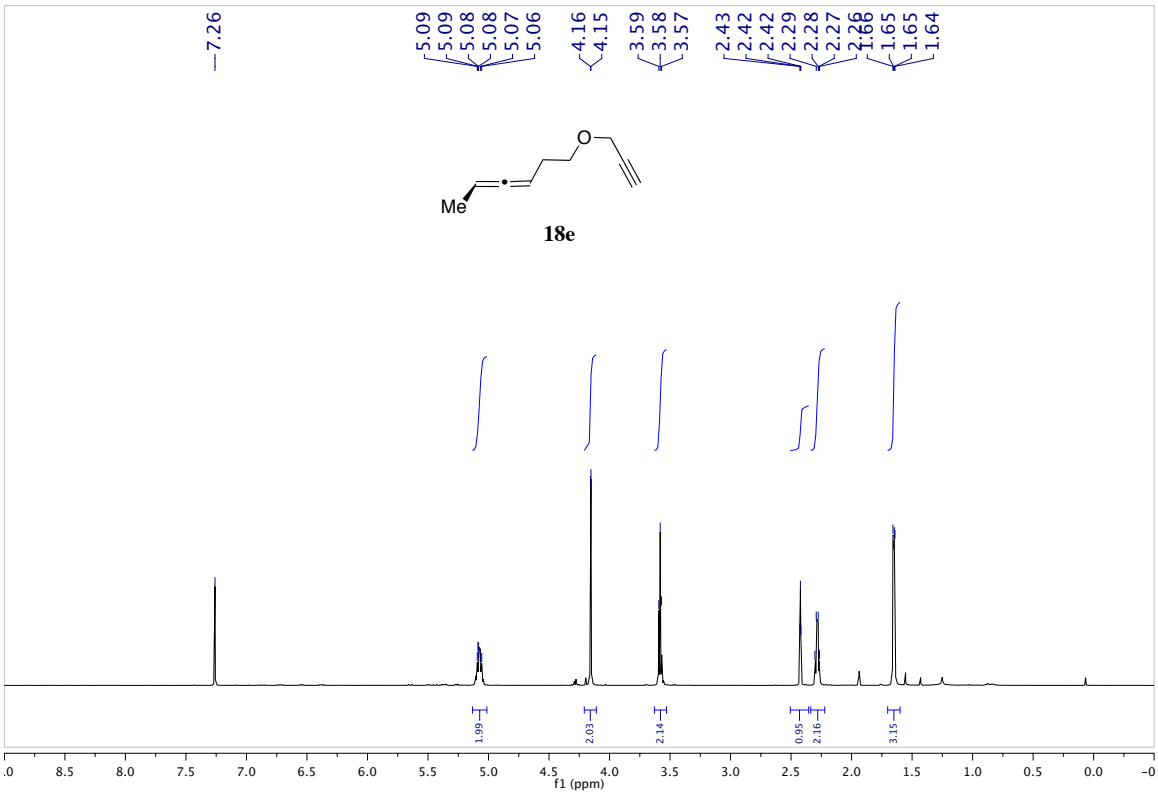

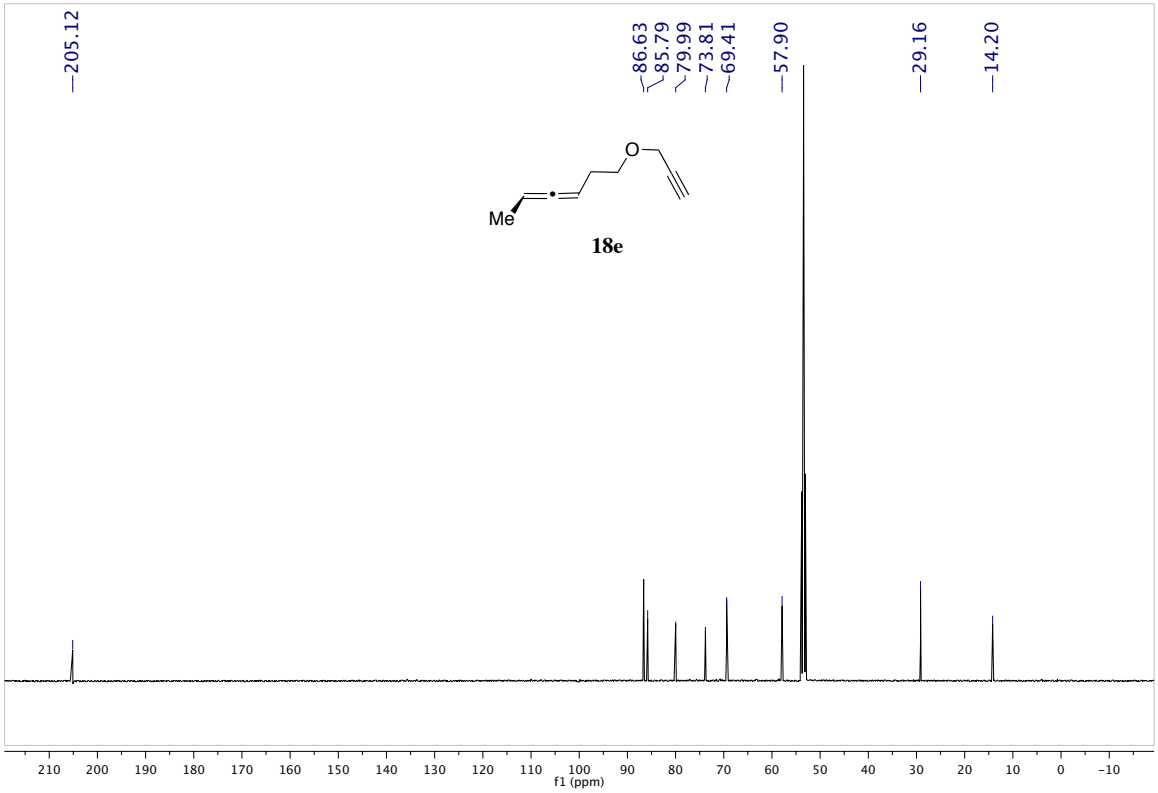

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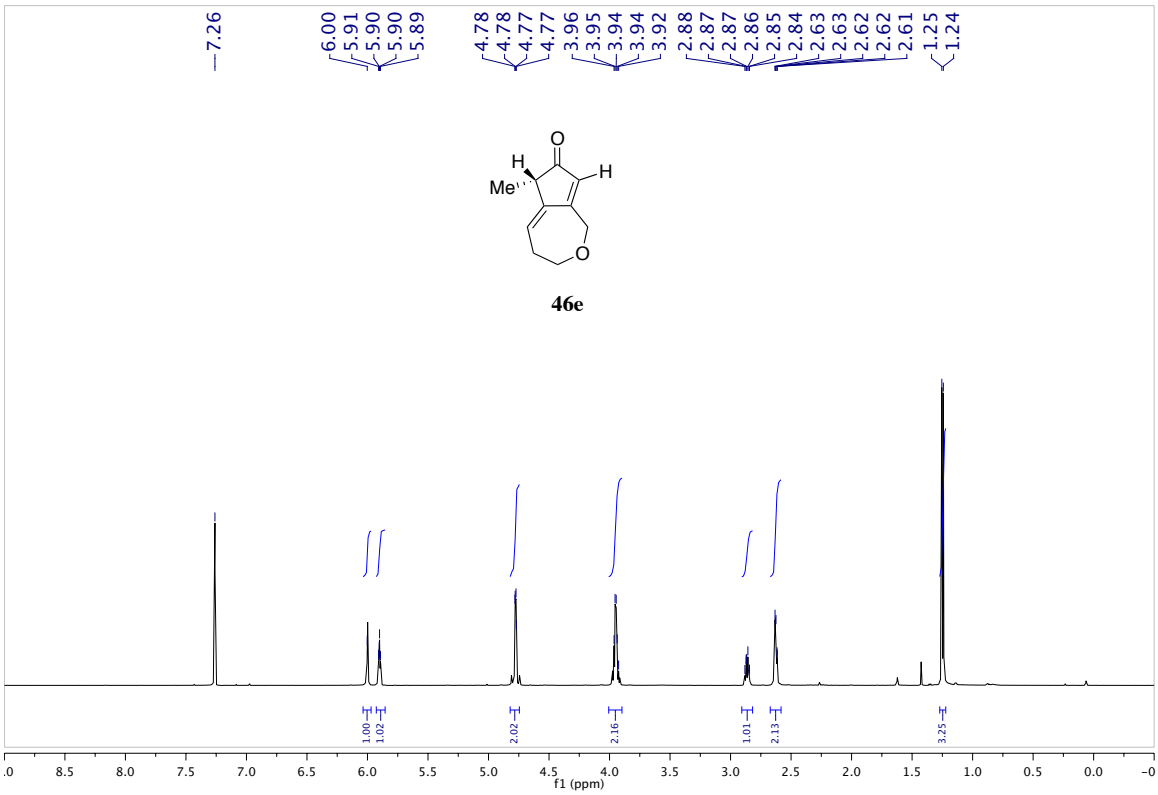
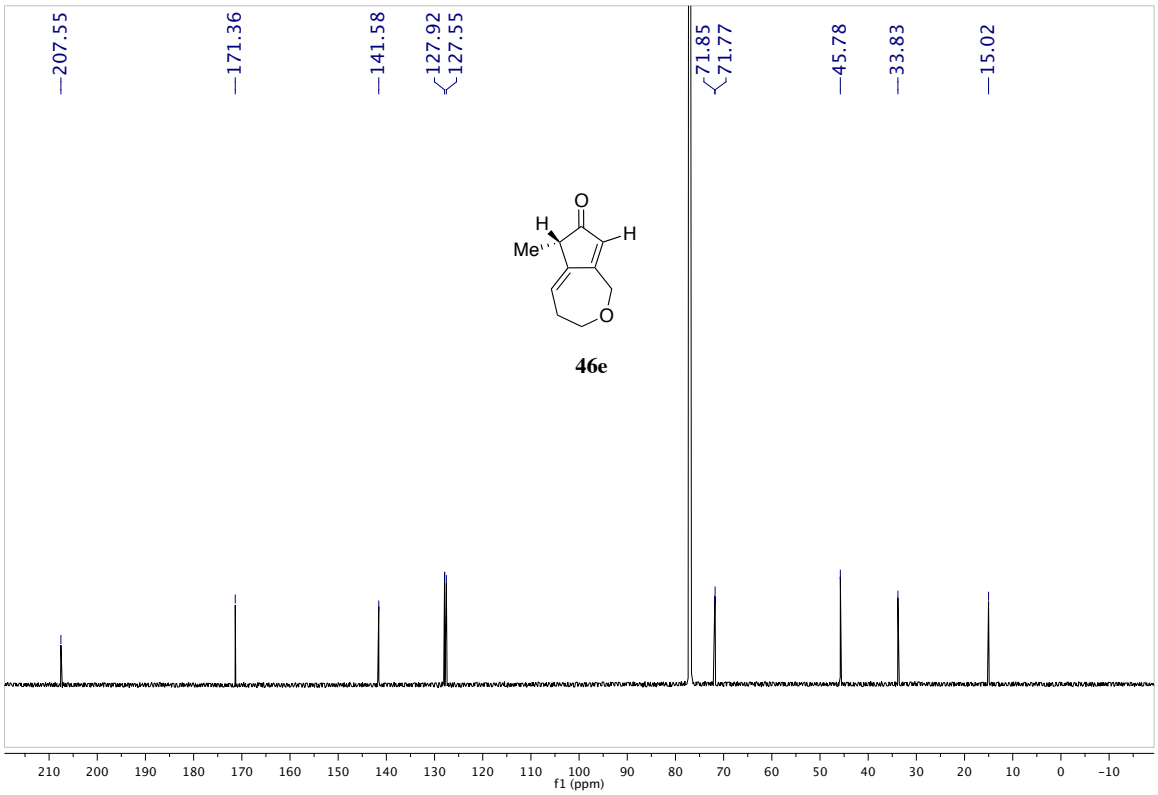
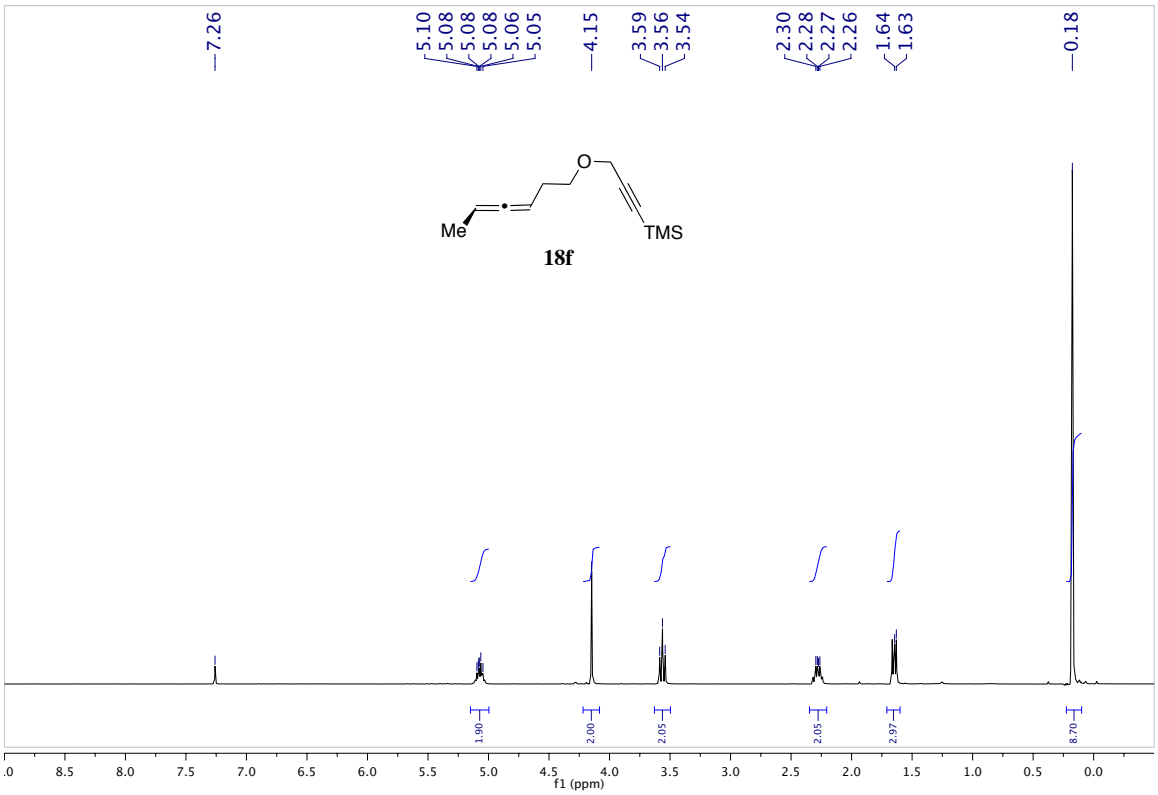
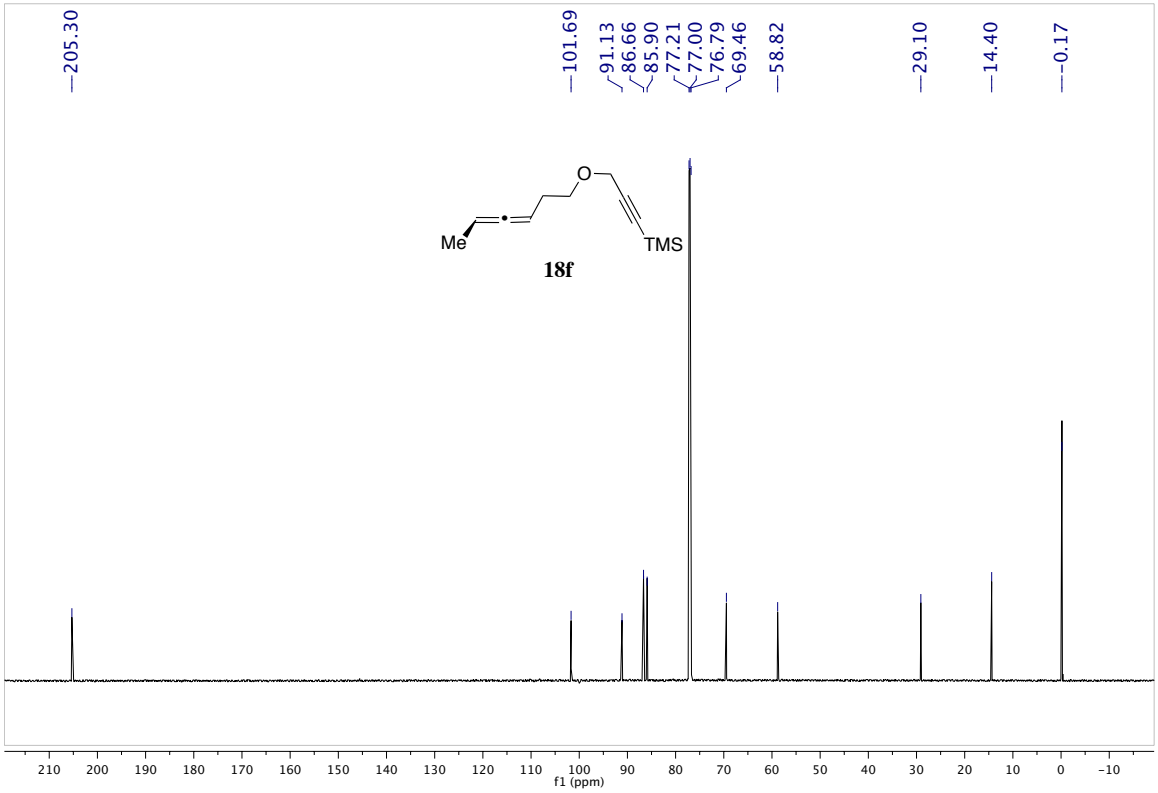




(R_a)-(3-(hexa-3,4-dien-1-yloxy)prop-1-yn-1-yl)trimethylsilane (18f):





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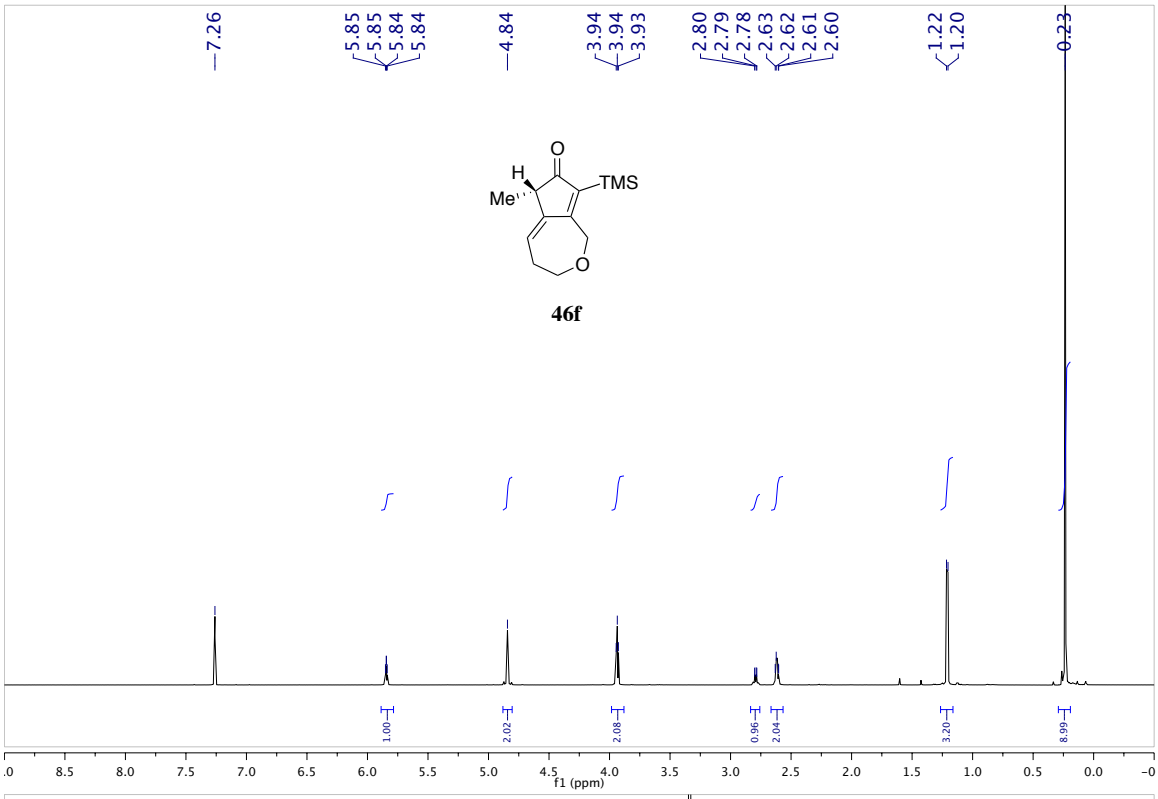
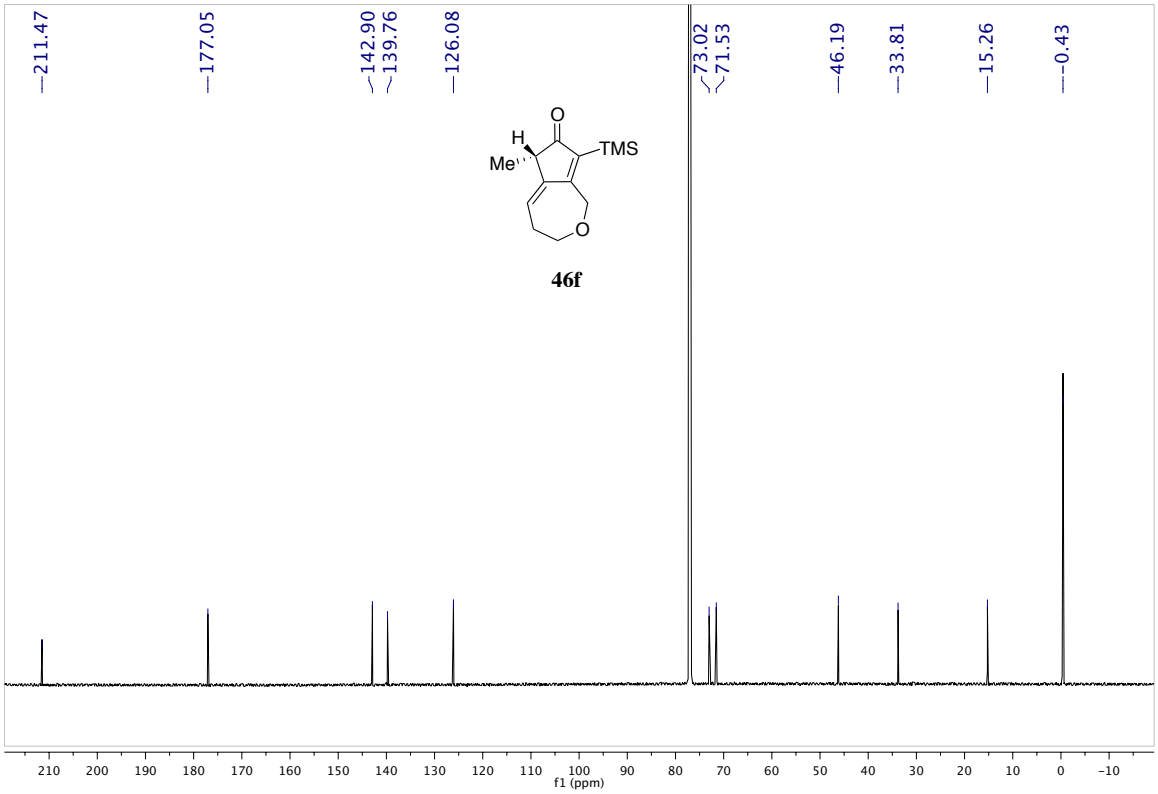
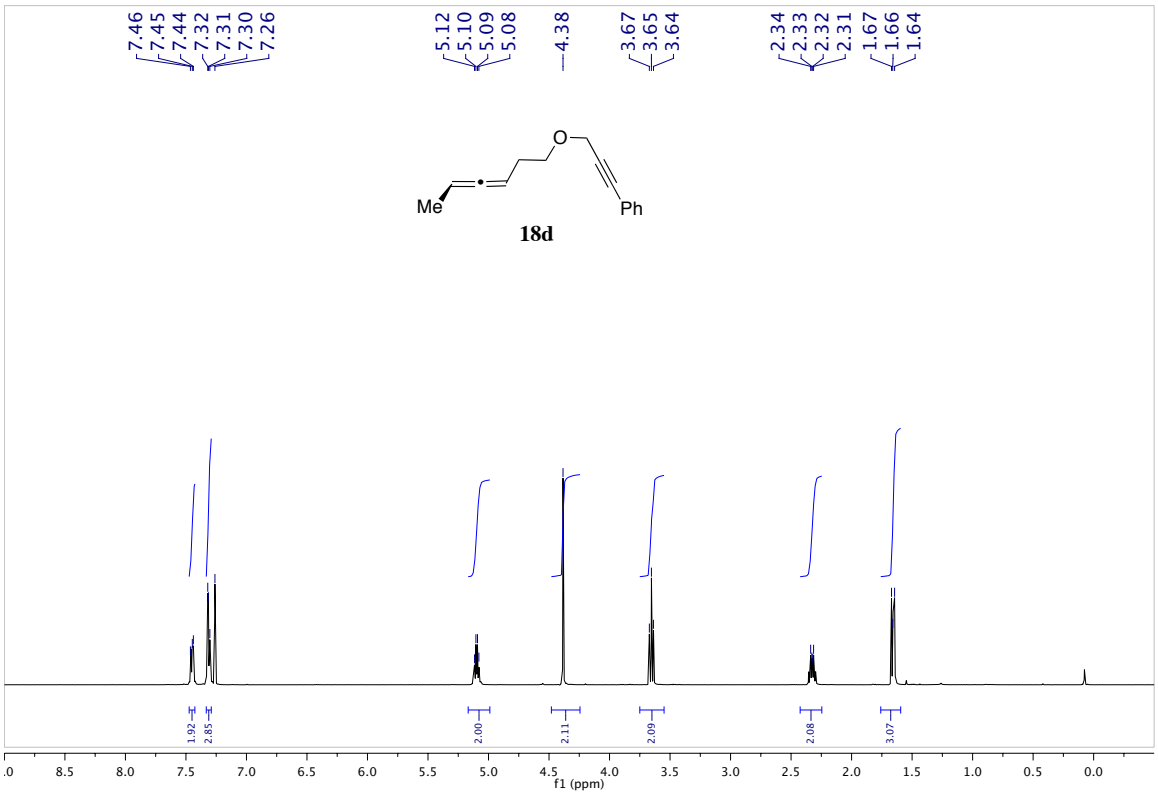
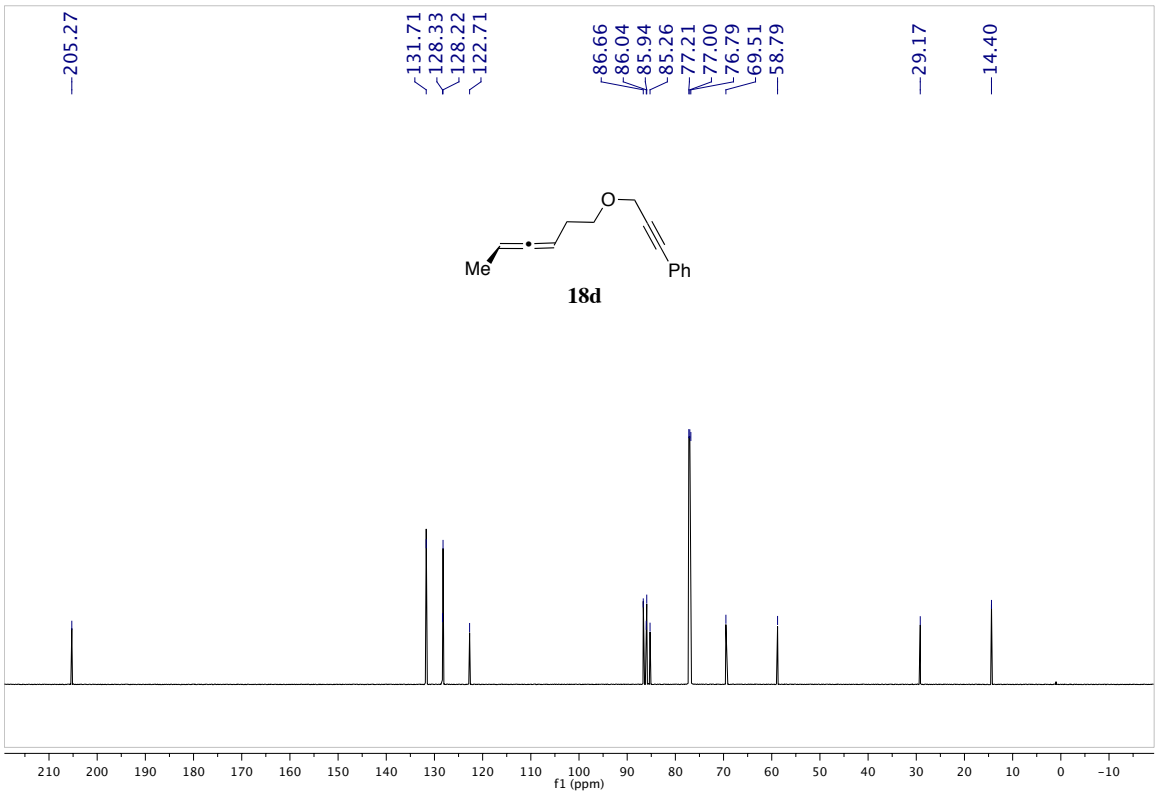


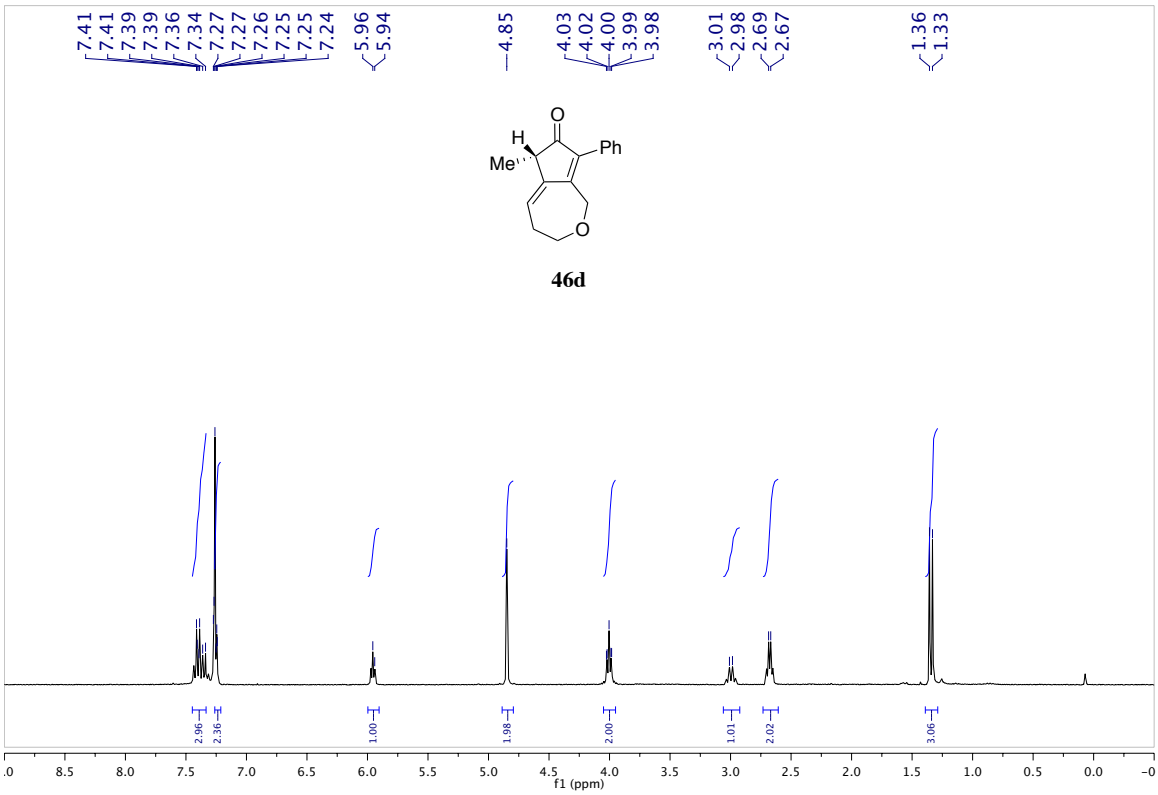


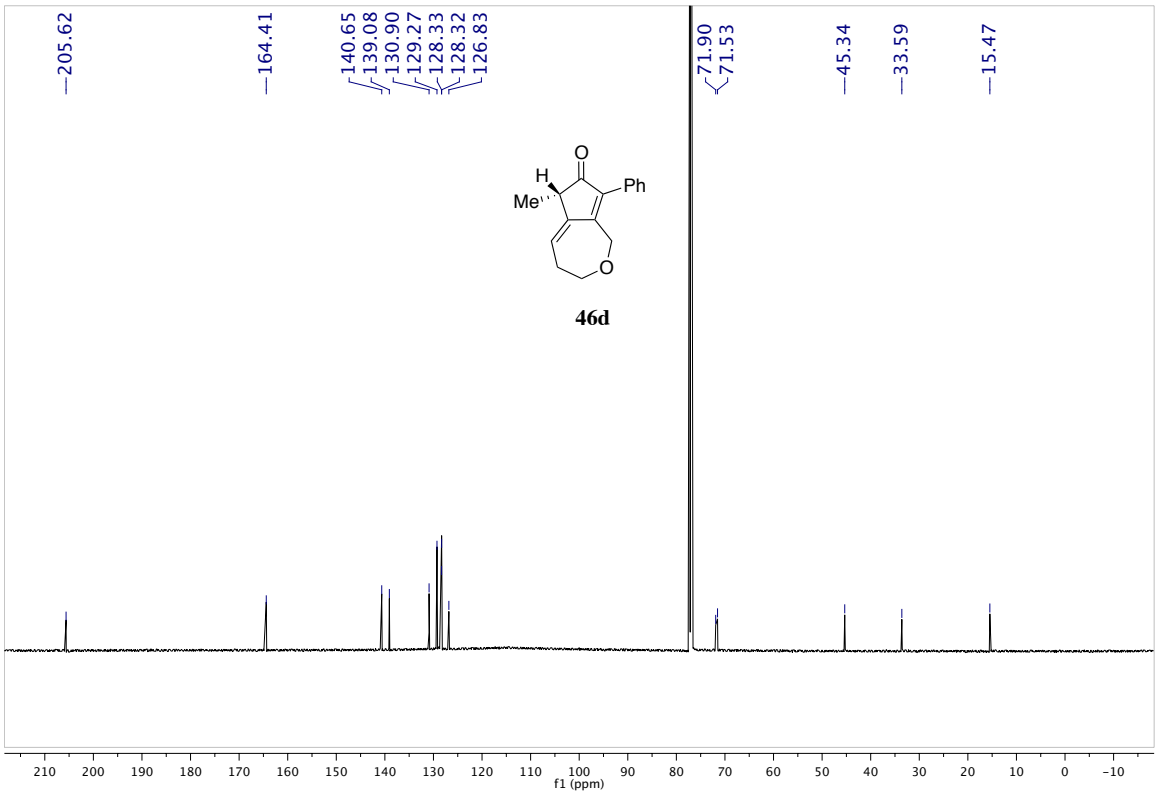
(R_a)-(3-(hexa-3,4-dien-1-yloxy)prop-1-yn-1-yl)benzene (18d):



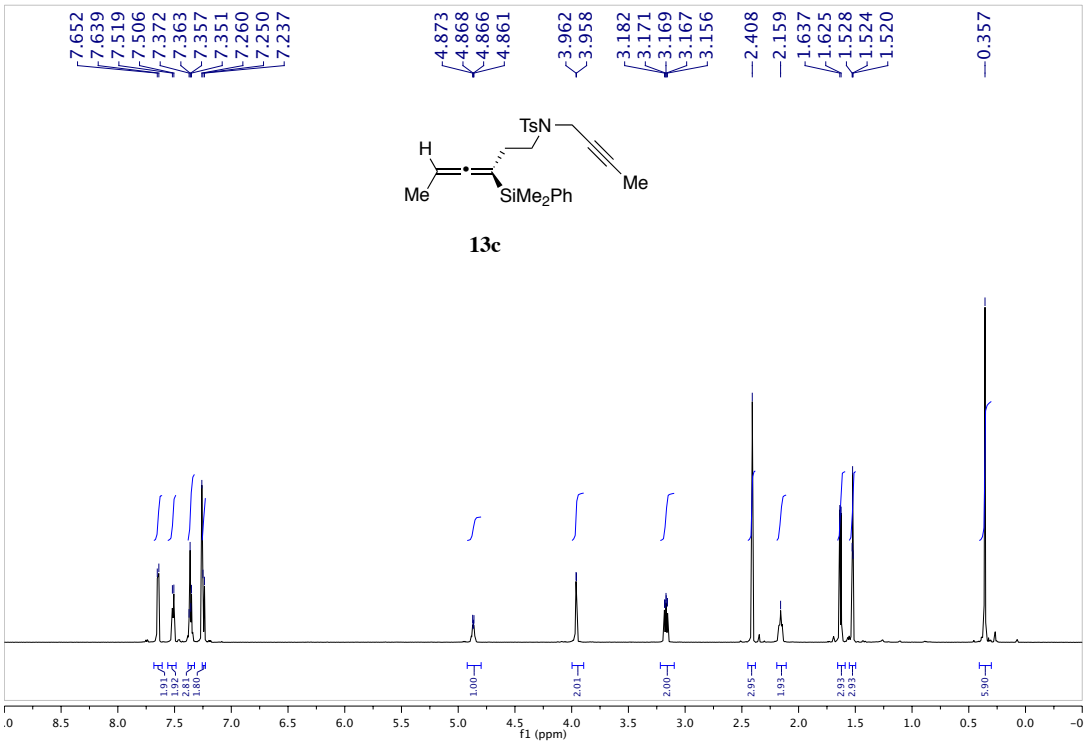


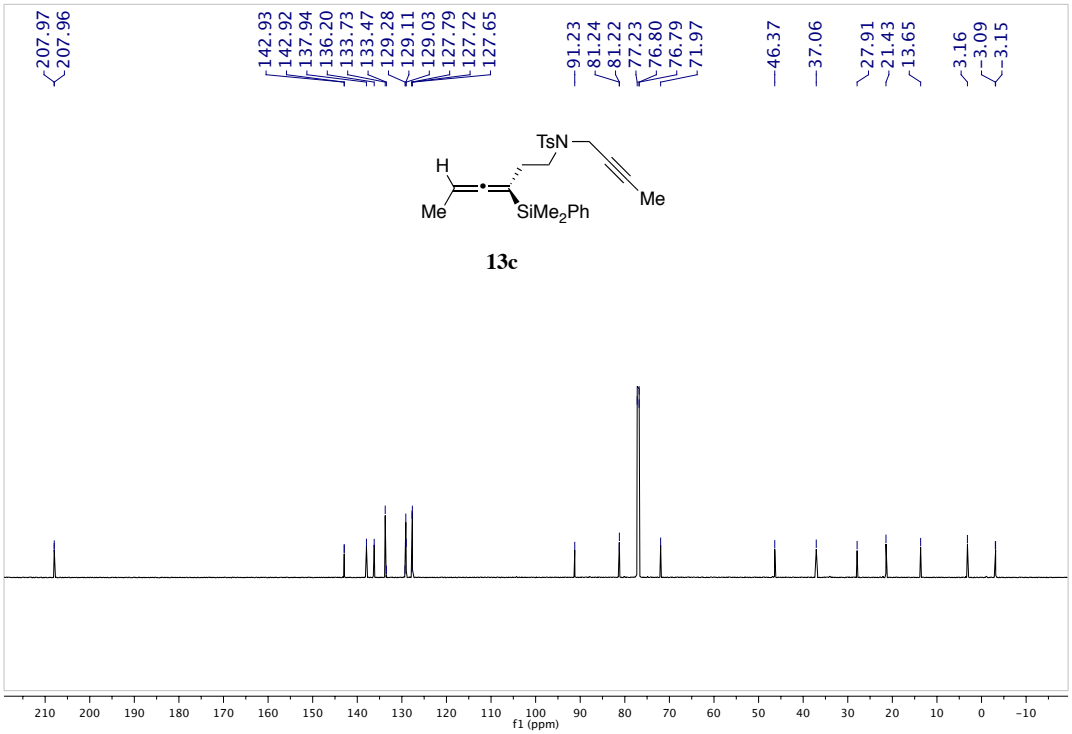
(*S*)-6-methyl-8-phenyl-3,4-dihydro-1*H*-cyclopenta[c]oxepin-7(6*H*)-one (46d):



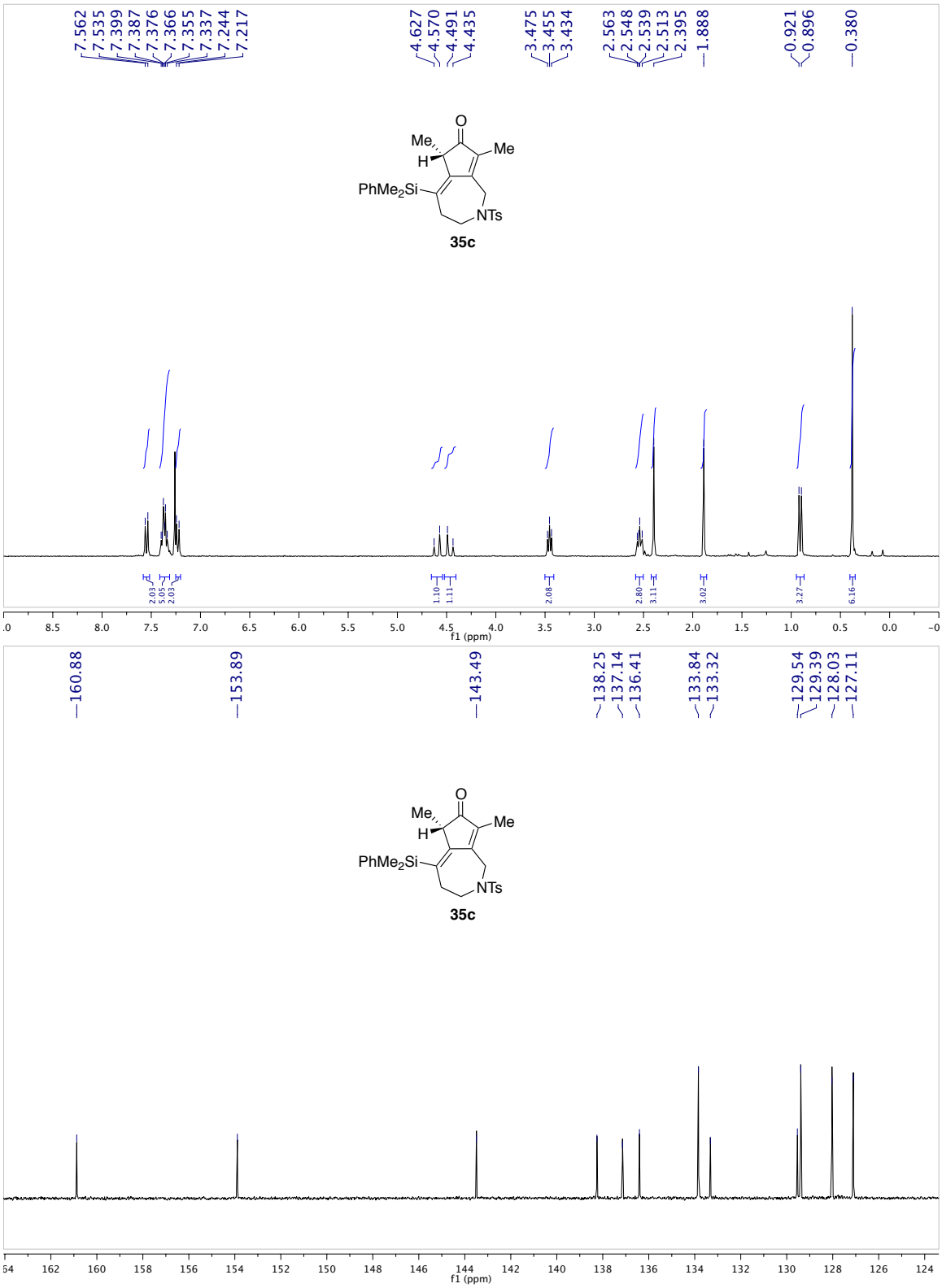


***(R$_a$)-N*-(but-2-yn-1-yl)-*N*-(3-(dimethyl(phenyl)silyl)hexa-3,4-dien-1-yl)-4-methylbenzenesulfonamide (13c):**

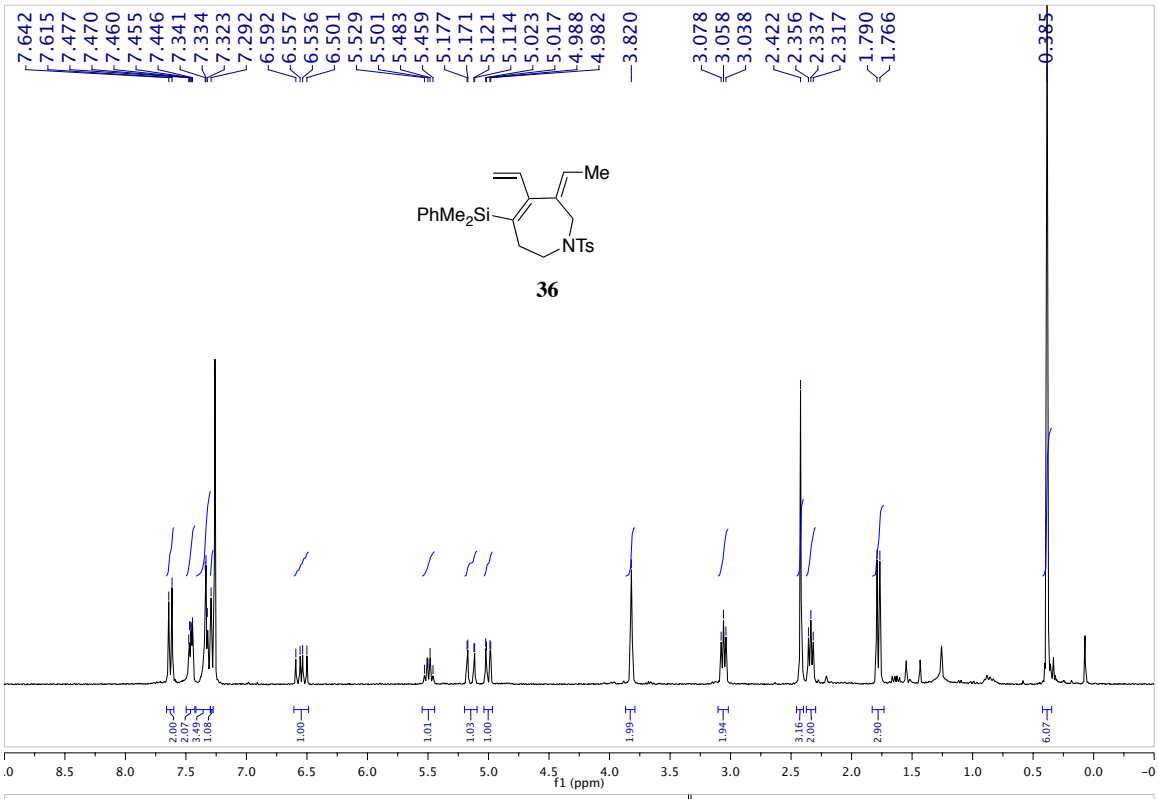


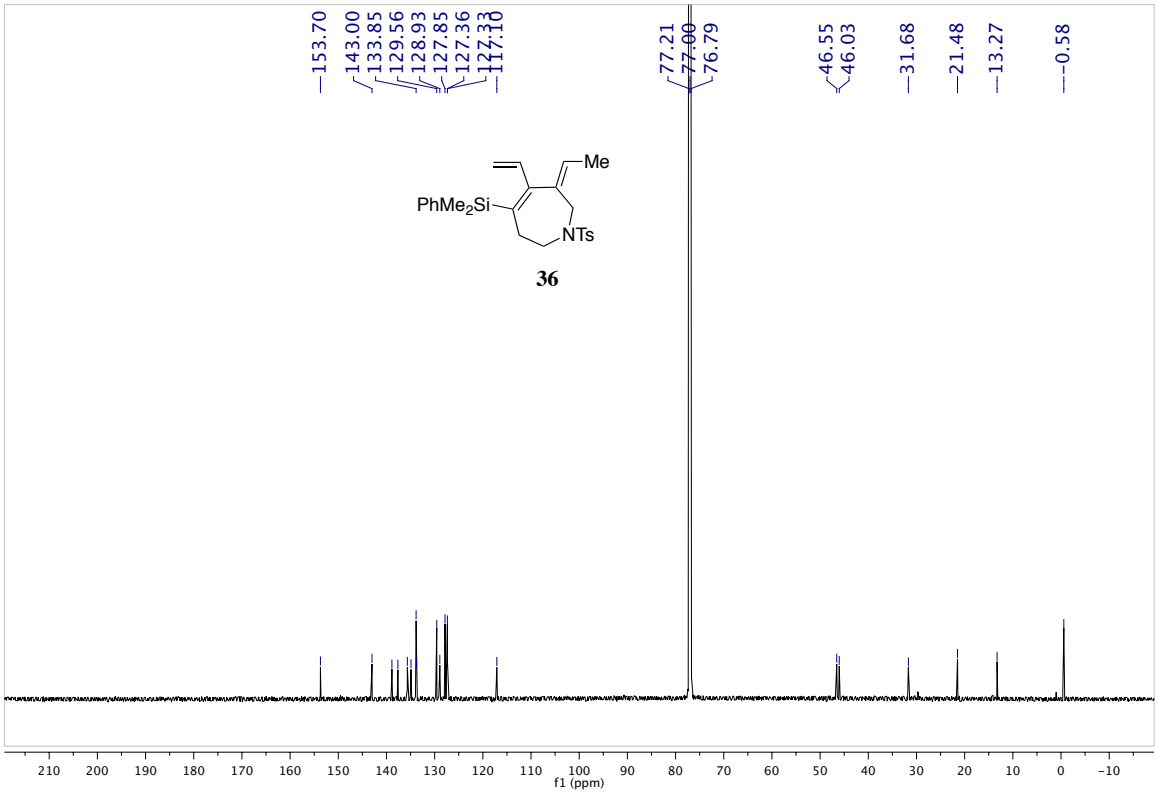


(*S*)-5-(dimethyl(phenyl)silyl)-6,8-dimethyl-2-tosyl-1,2,3,4-tetrahydrocyclo penta[*c*]azepin-7(6*H*)-one (35c):

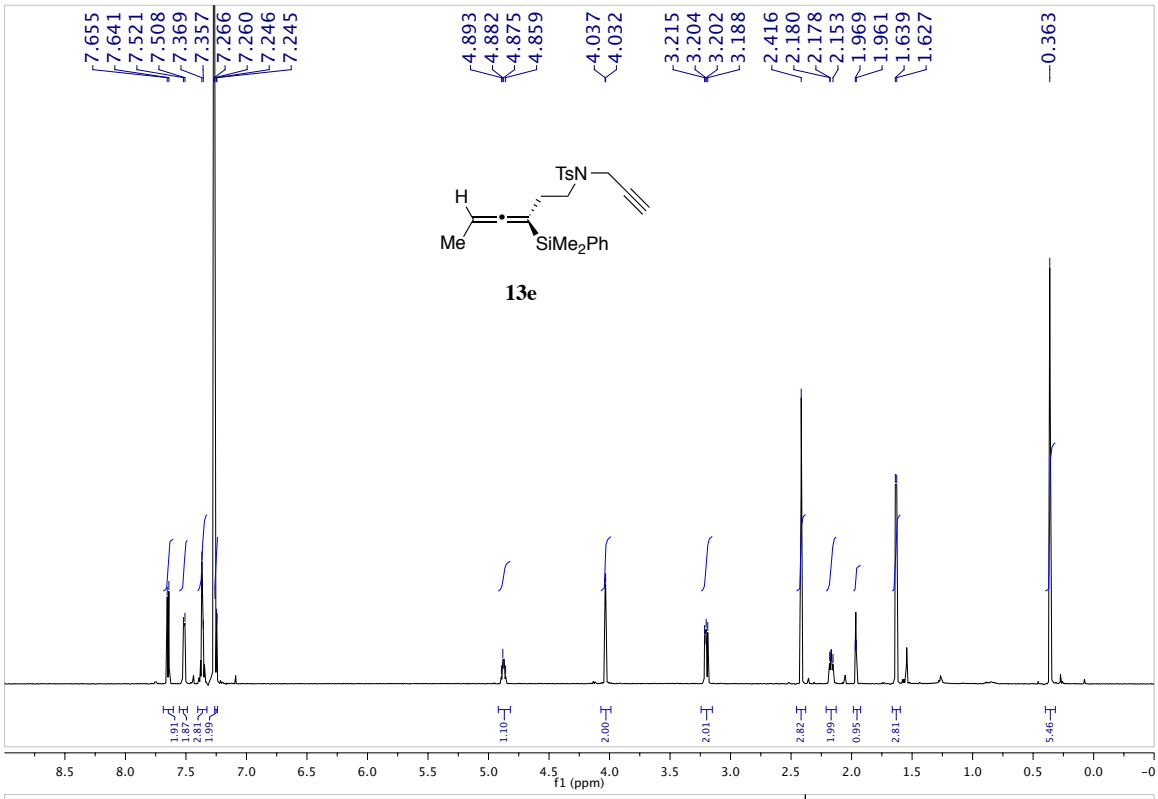


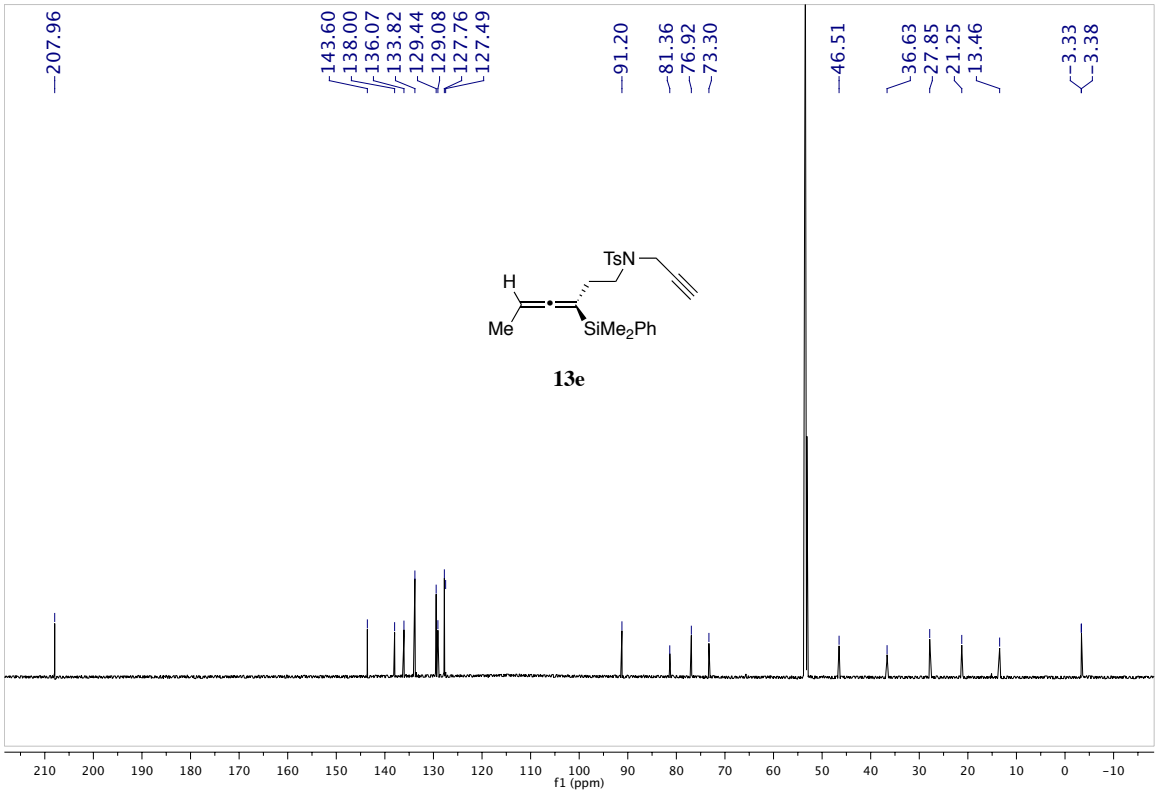
(*Z*)-5-(dimethyl(phenyl)silyl)-3-ethylidene-1-tosyl-4-vinyl-2,3,6,7-tetrahydro-1*H*-azepine (36):



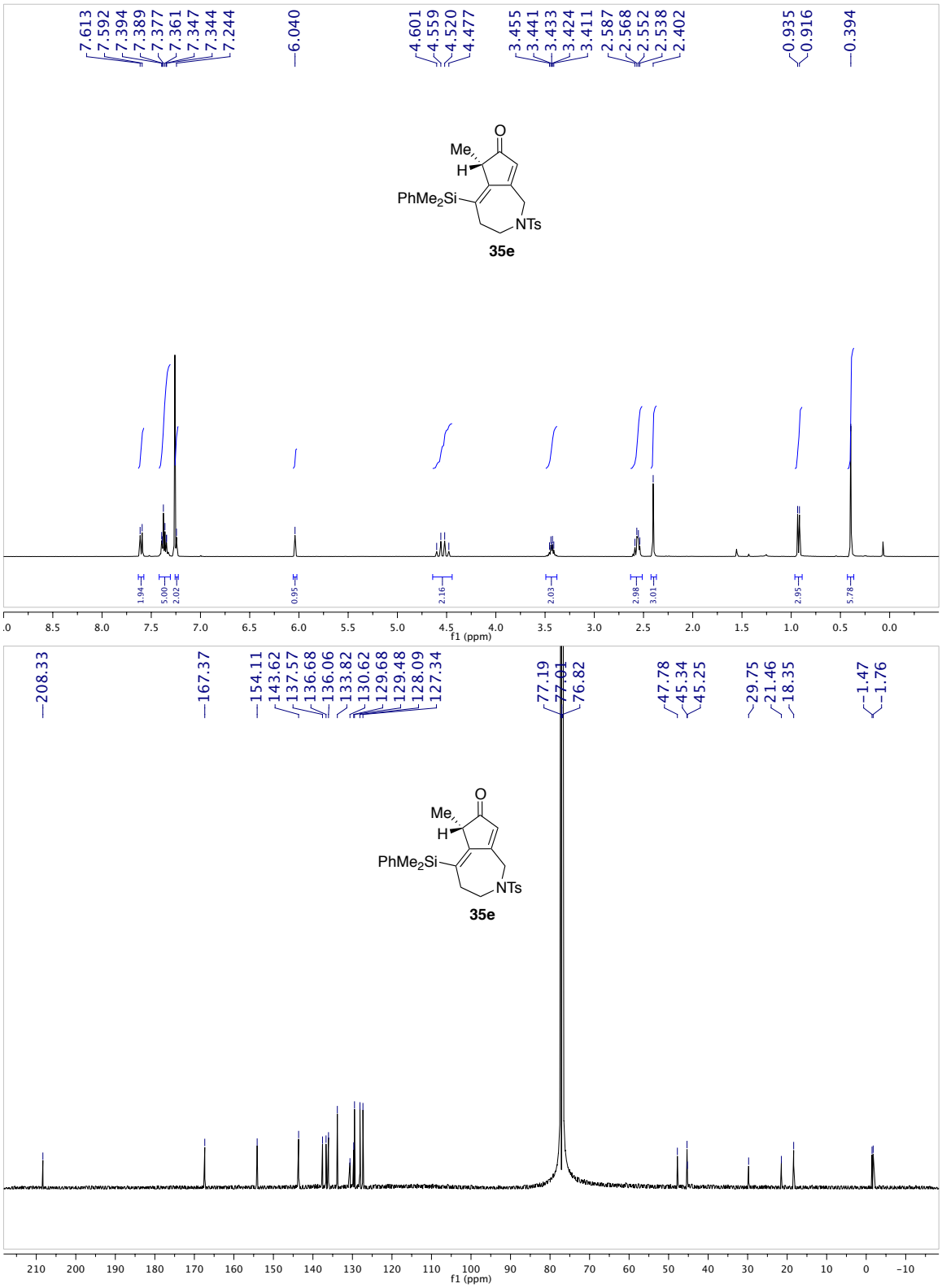


(*R*$_a$)-*N*-(3-(dimethyl(phenyl)silyl)hexa-3,4-dien-1-yl)-4-methyl-*N*-(prop-2-yn-1-yl)benzene sulfonamide (13e):

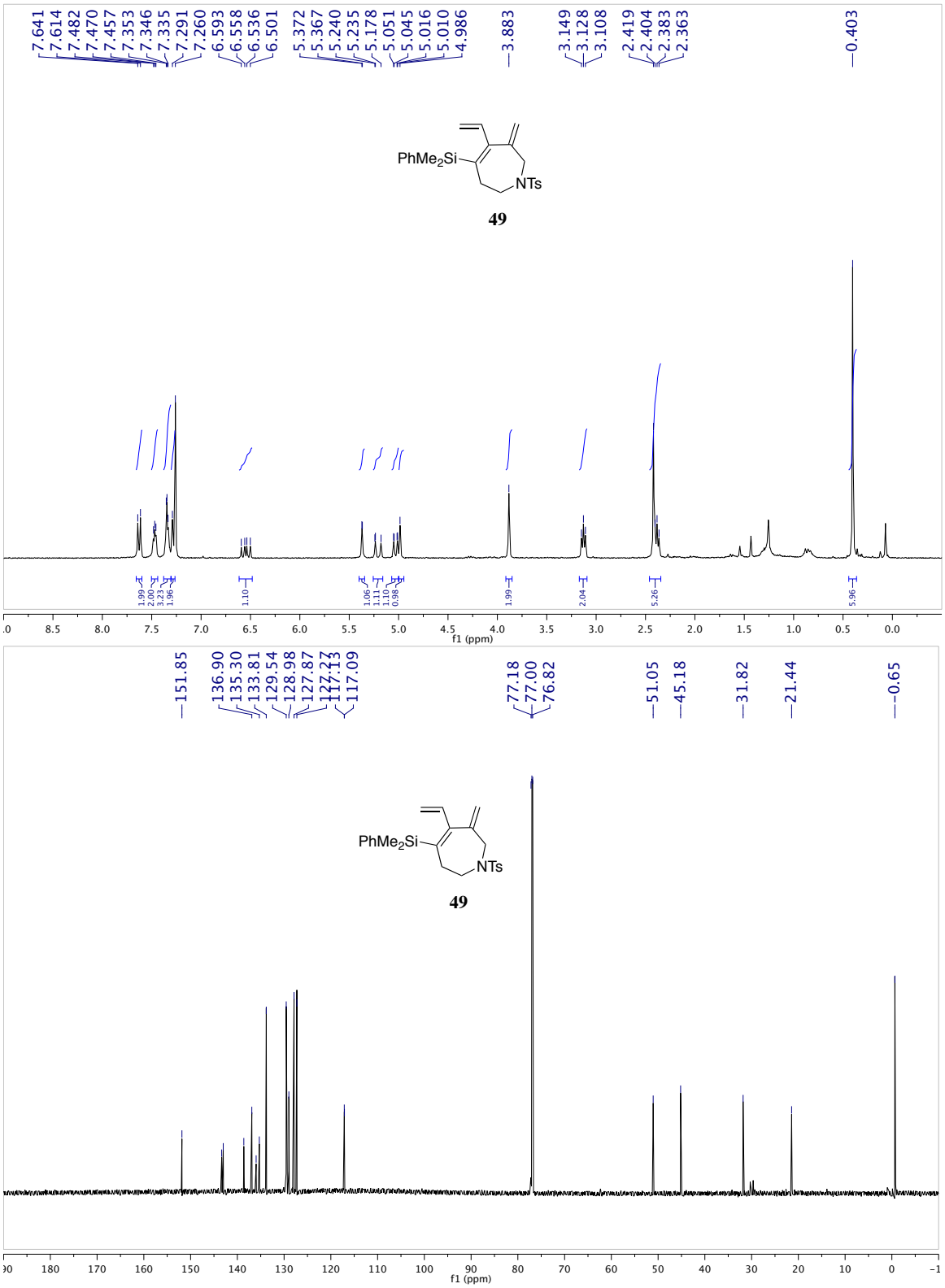




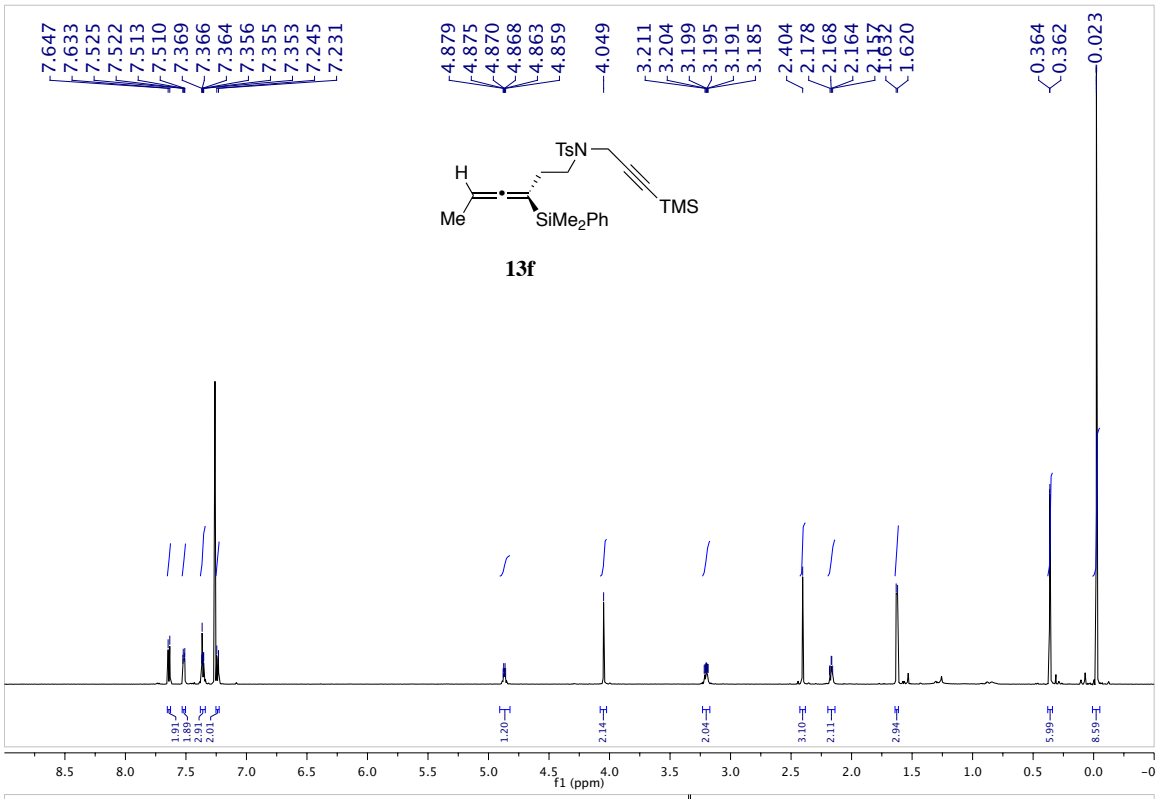
(*S*)-5-(dimethyl(phenyl)silyl)-6-methyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta [*c*]azepin-7(6*H*)-one (35e):

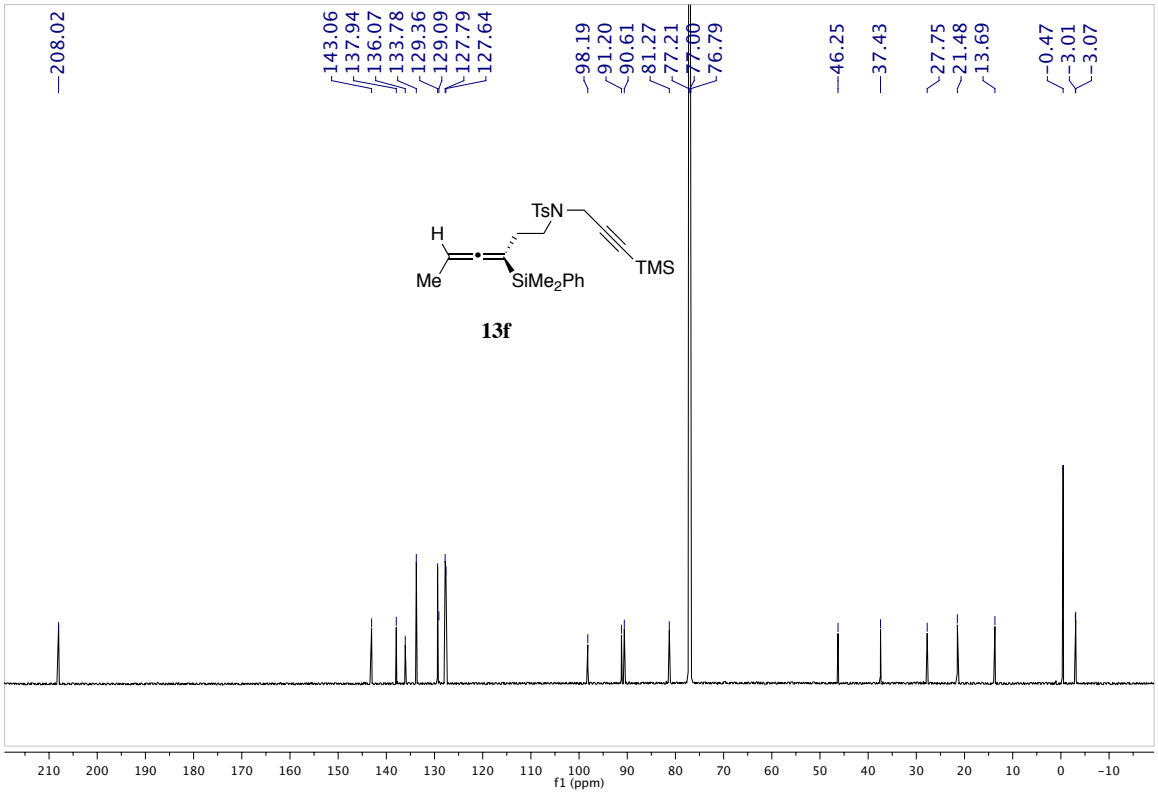


5-(dimethyl(phenyl)silyl)-3-methylene-1-tosyl-4-vinyl-2,3,6,7-tetrahydro-1*H*-azepine (49):

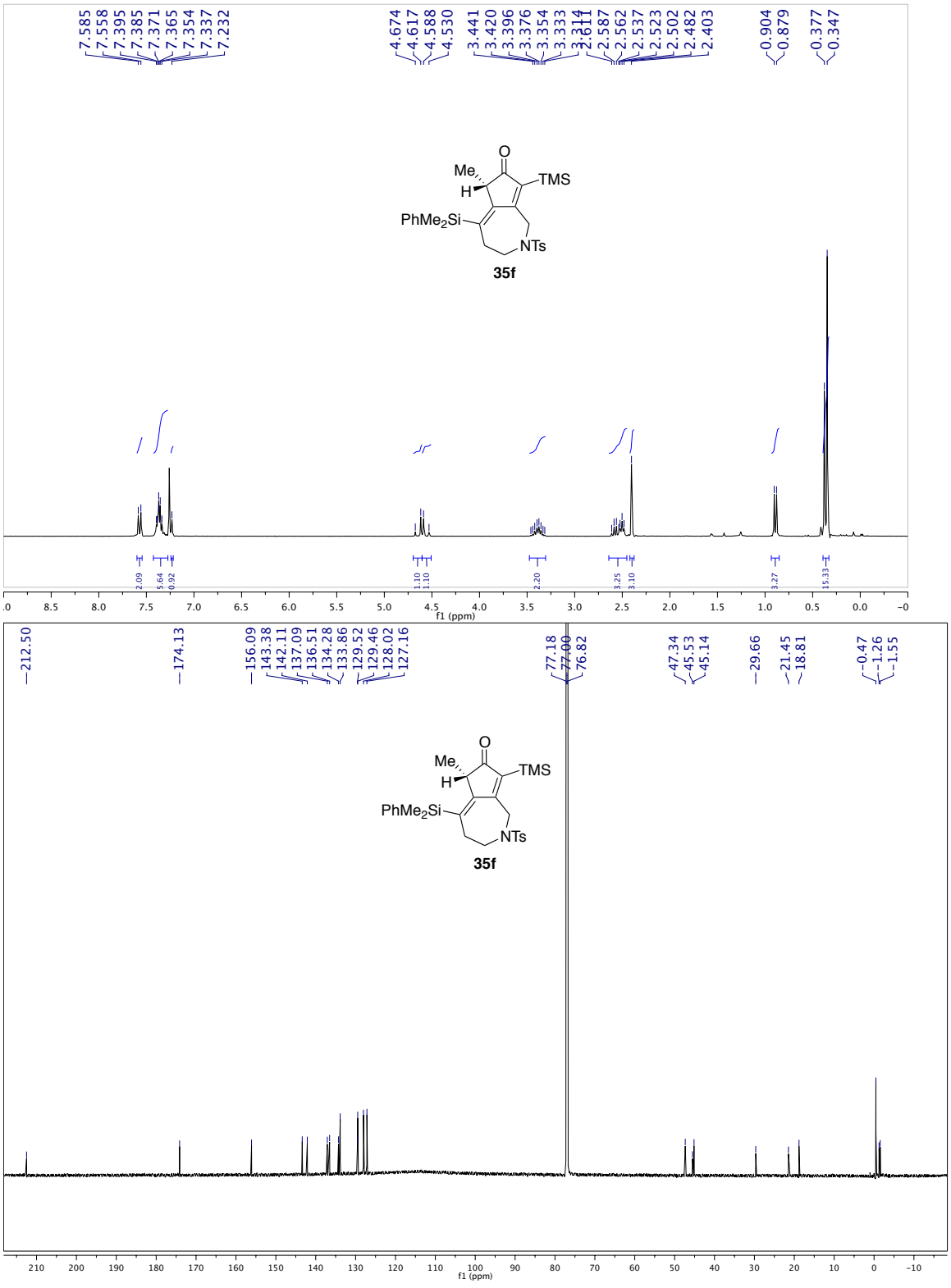


***(R$_a$)-N*-(3-(dimethyl(phenyl)silyl)hexa-3,4-dien-1-yl)-4-methyl-*N*-(3-(trimethyl silyl)prop-2-yn-1-yl)benzenesulfonamide (13f):**

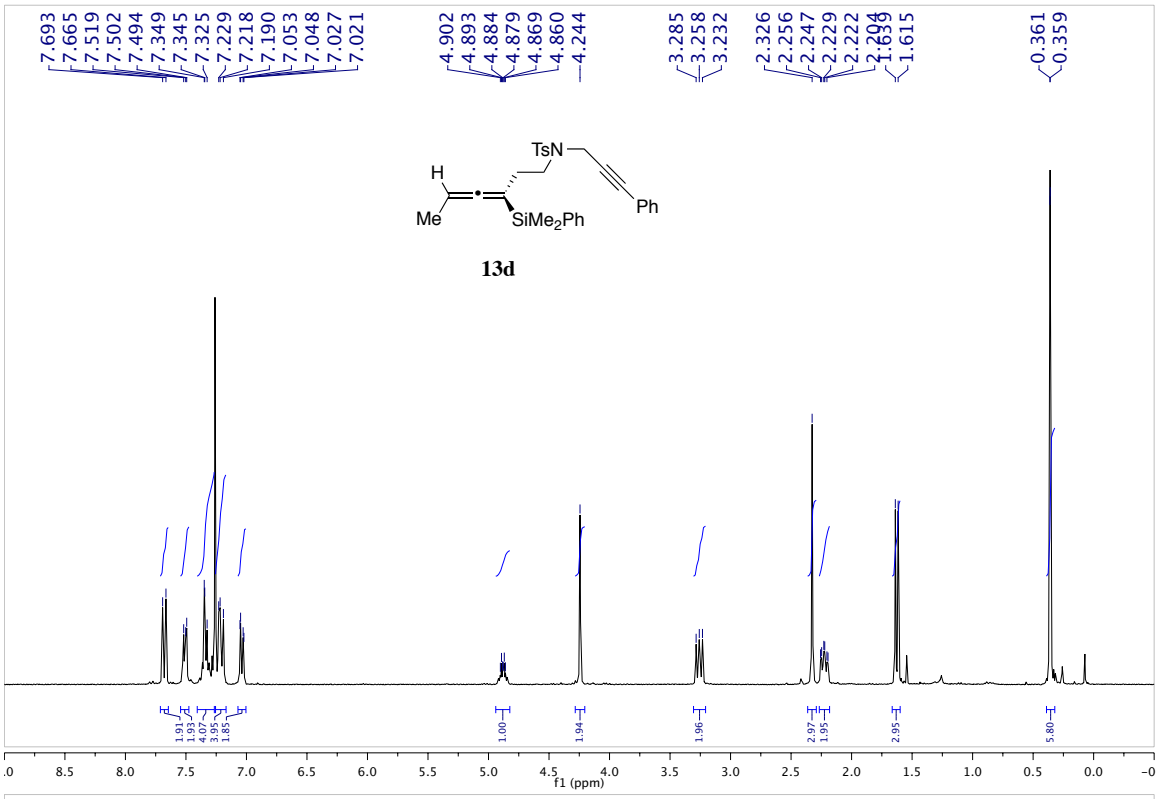


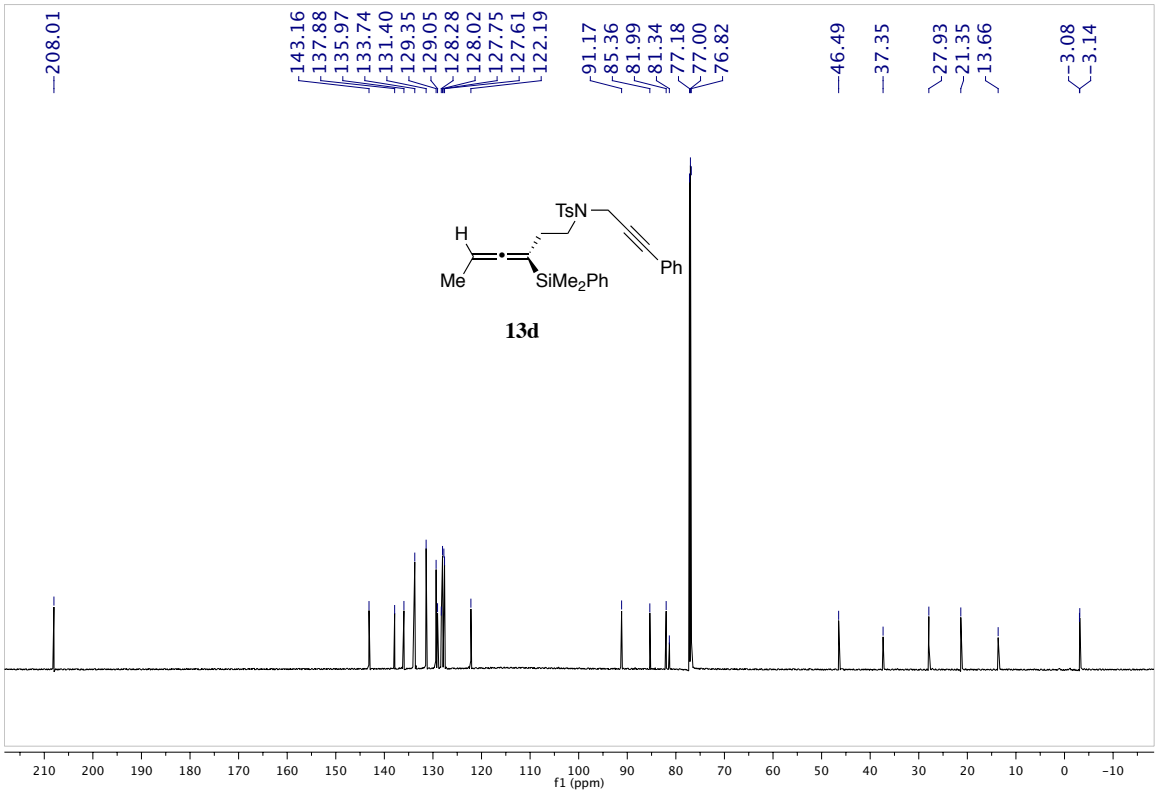


(*S*)-5-(dimethyl(phenyl)silyl)-6-methyl-2-tosyl-8-(trimethylsilyl)-1,2,3,4-tetrahydrocyclopenta[*c*]azepin-7(6*H*)-one (35f):

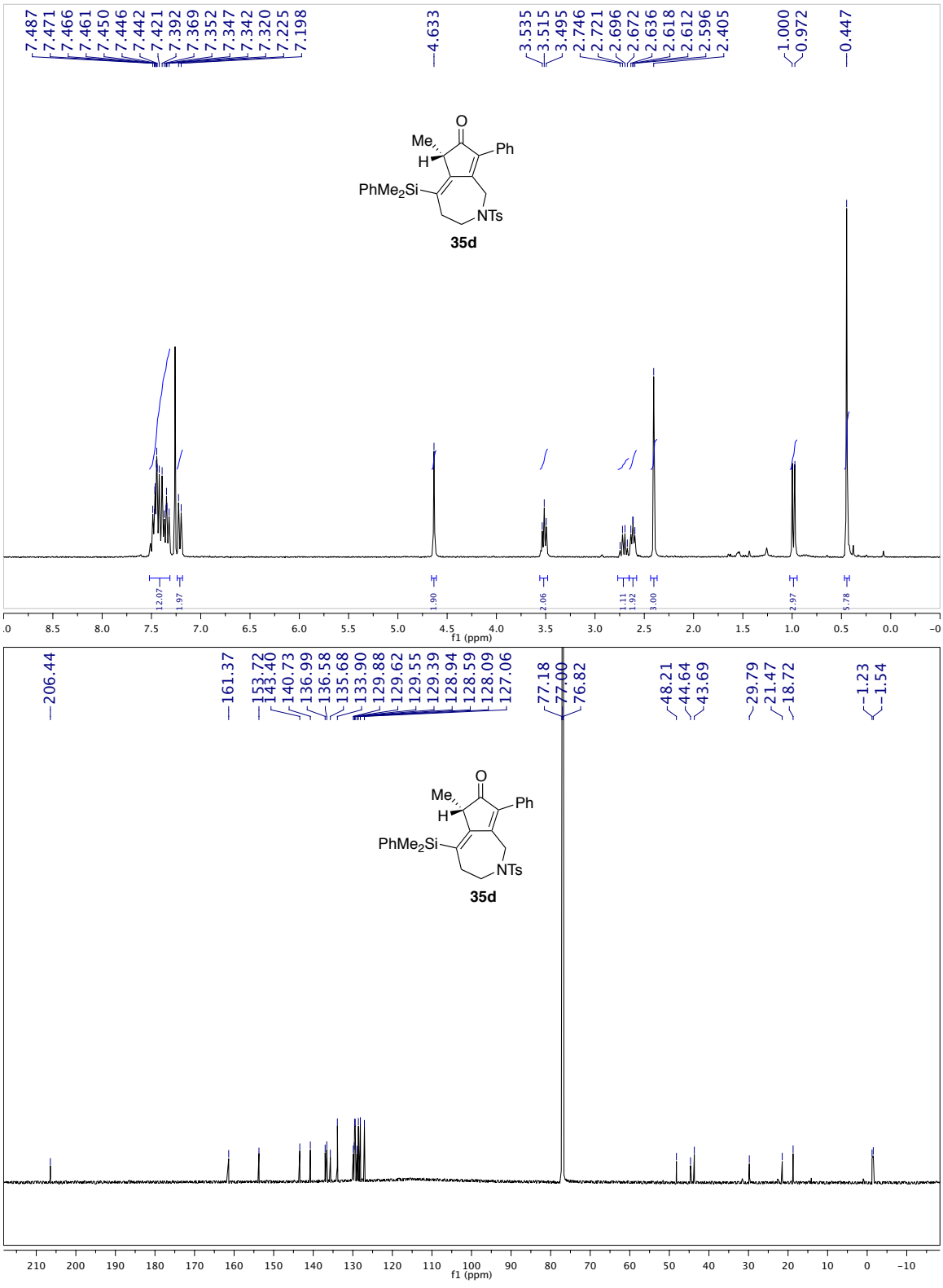


(*R*$_a$)-*N*-(3-(dimethyl(phenyl)silyl)hexa-3,4-dien-1-yl)-4-methyl-*N*-(3-phenylprop-2-yn-1-yl) benzenesulfonamide (13d):

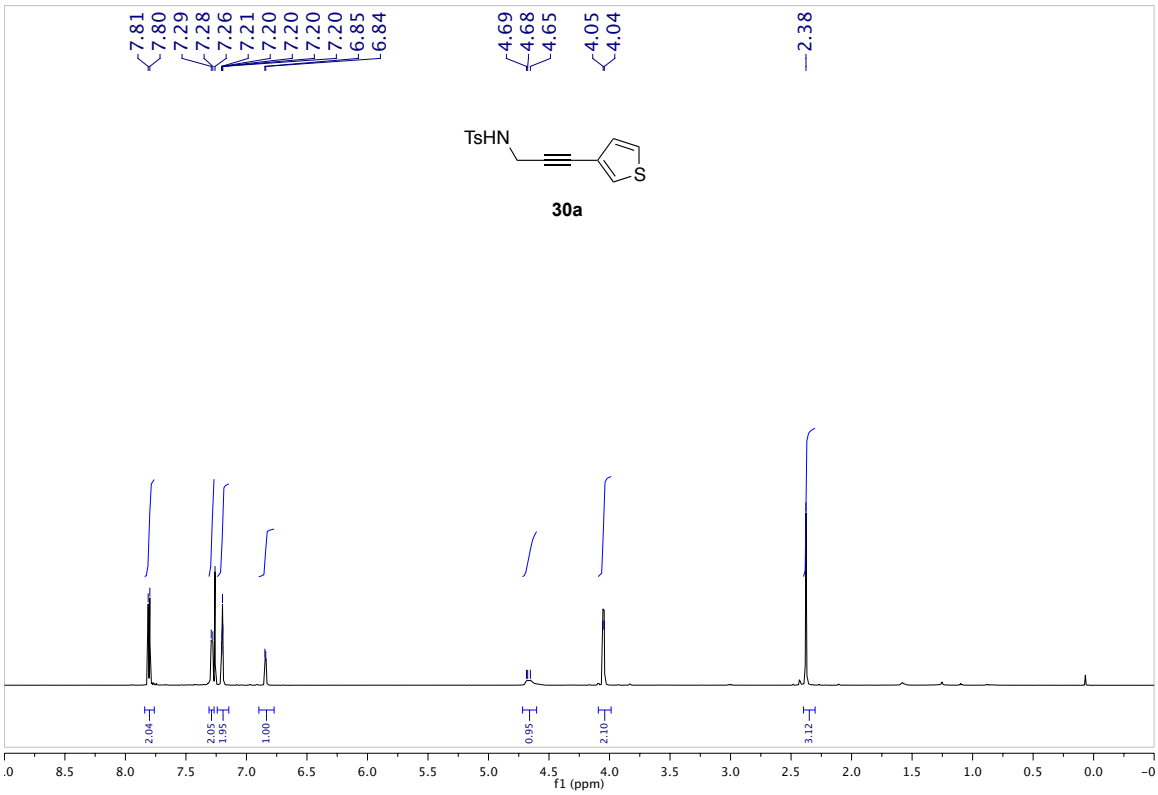


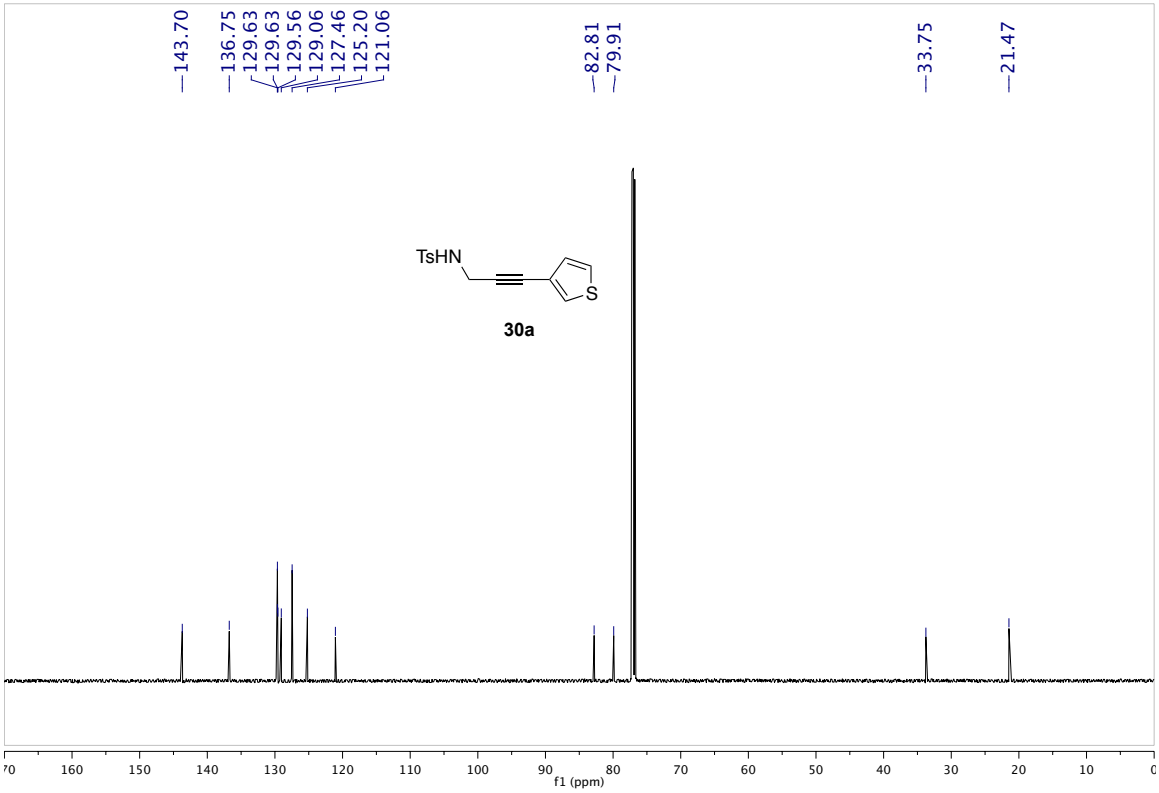


(*S*)-5-(dimethyl(phenyl)silyl)-6-methyl-8-phenyl-2-tosyl-1,2,3,4-tetrahydro cyclopenta[*c*]azepin-7(6*H*)-one (35d):

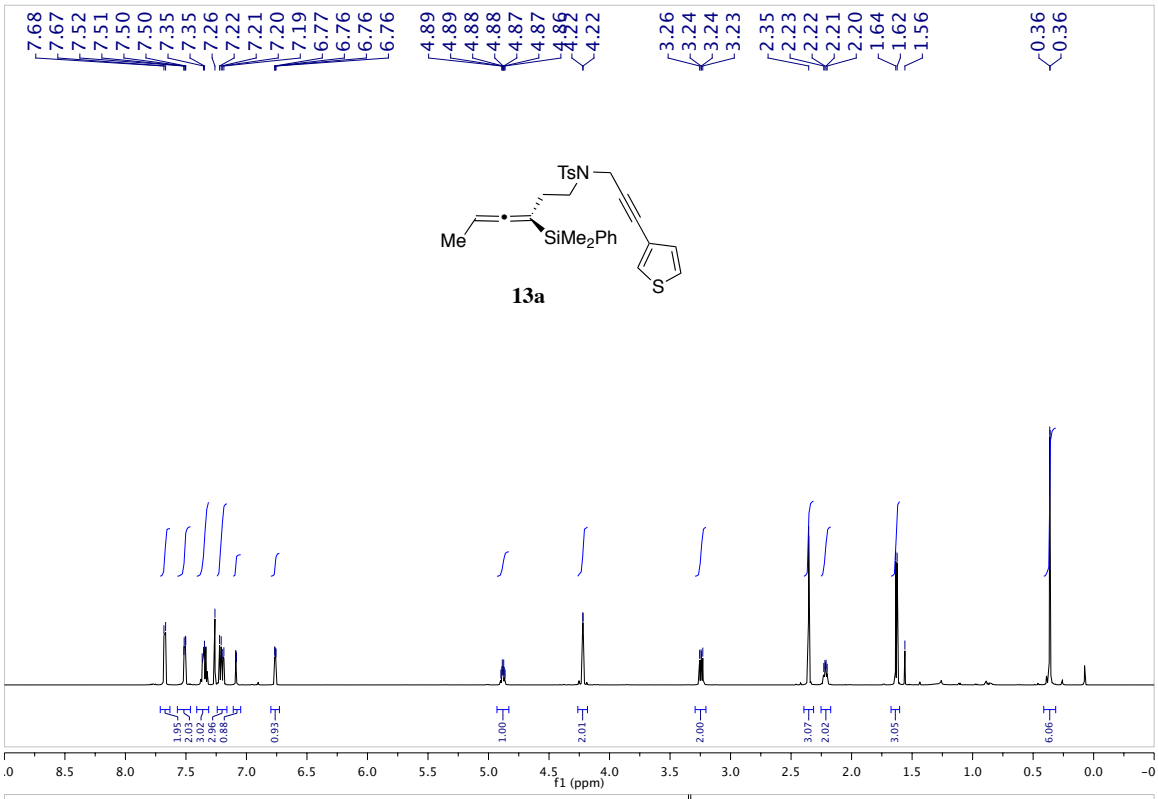


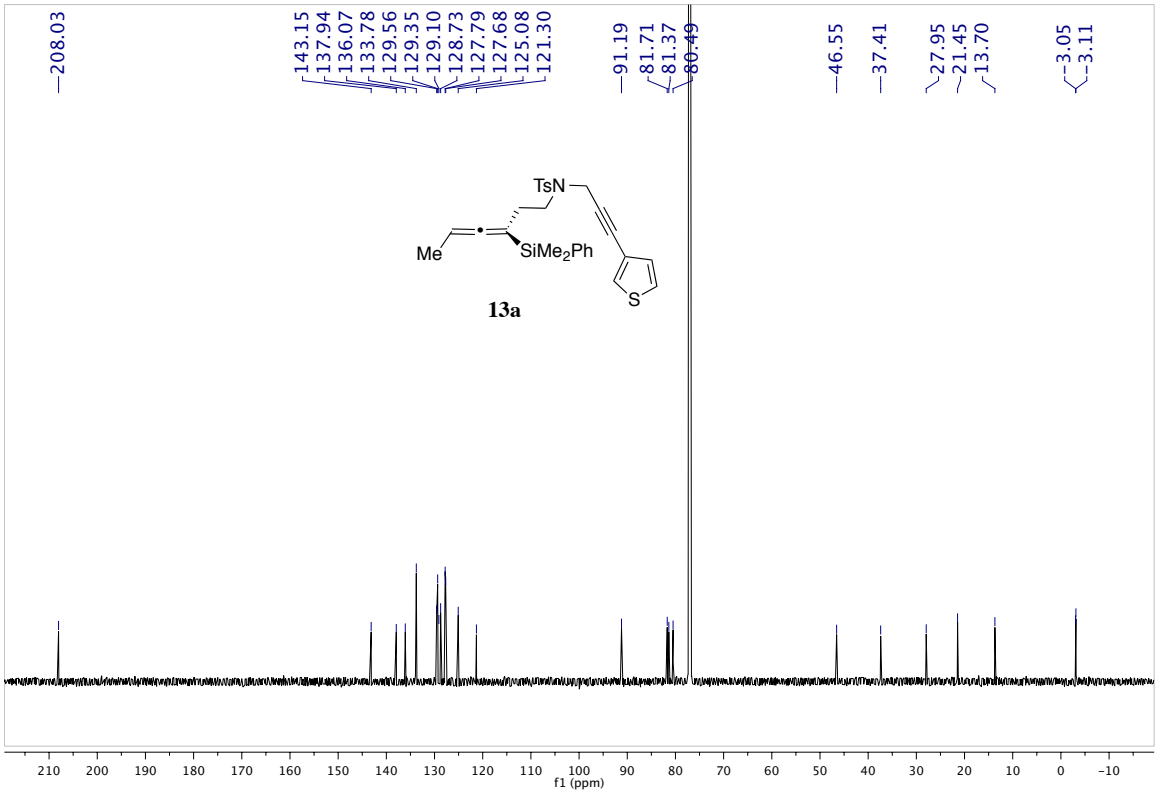
4-methyl-*N*-(3-(thiophen-3-yl)prop-2-yn-1-yl)benzenesulfonamide (30a):



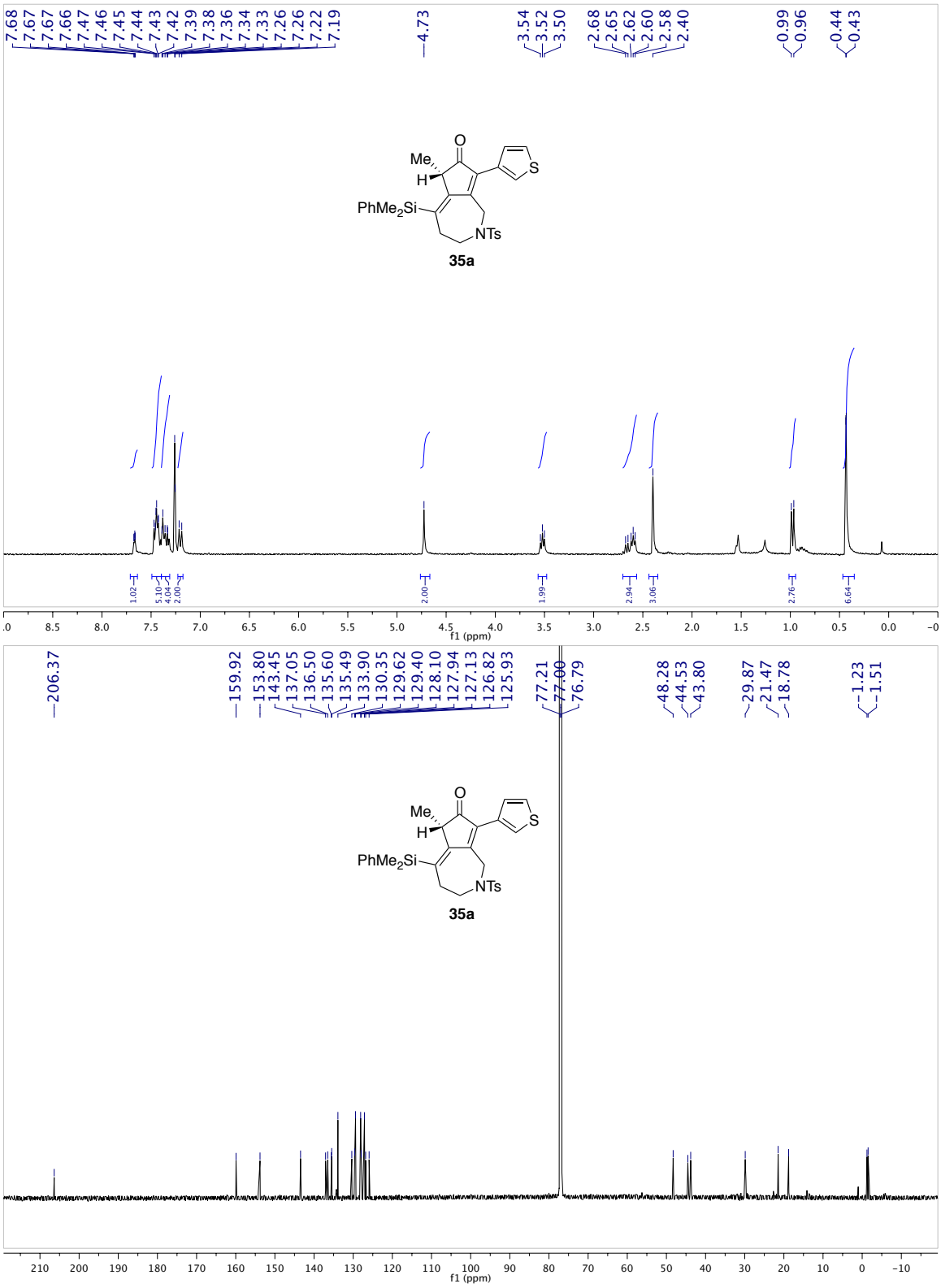


(R_a)-*N*-(3-(dimethyl(phenyl)silyl)hexa-3,4-dien-1-yl)-4-methyl-*N*-(3-(thiophen-3-yl)prop-2-yn-1-yl)benzenesulfonamide (13a):

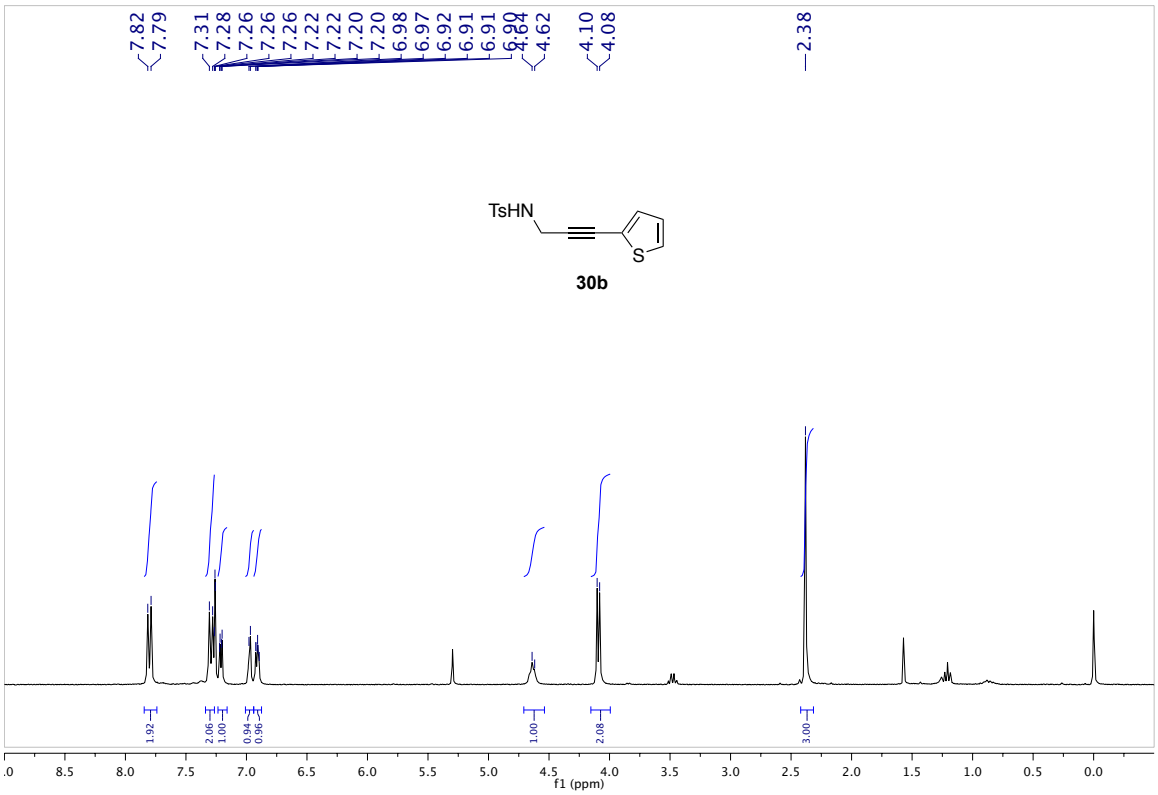


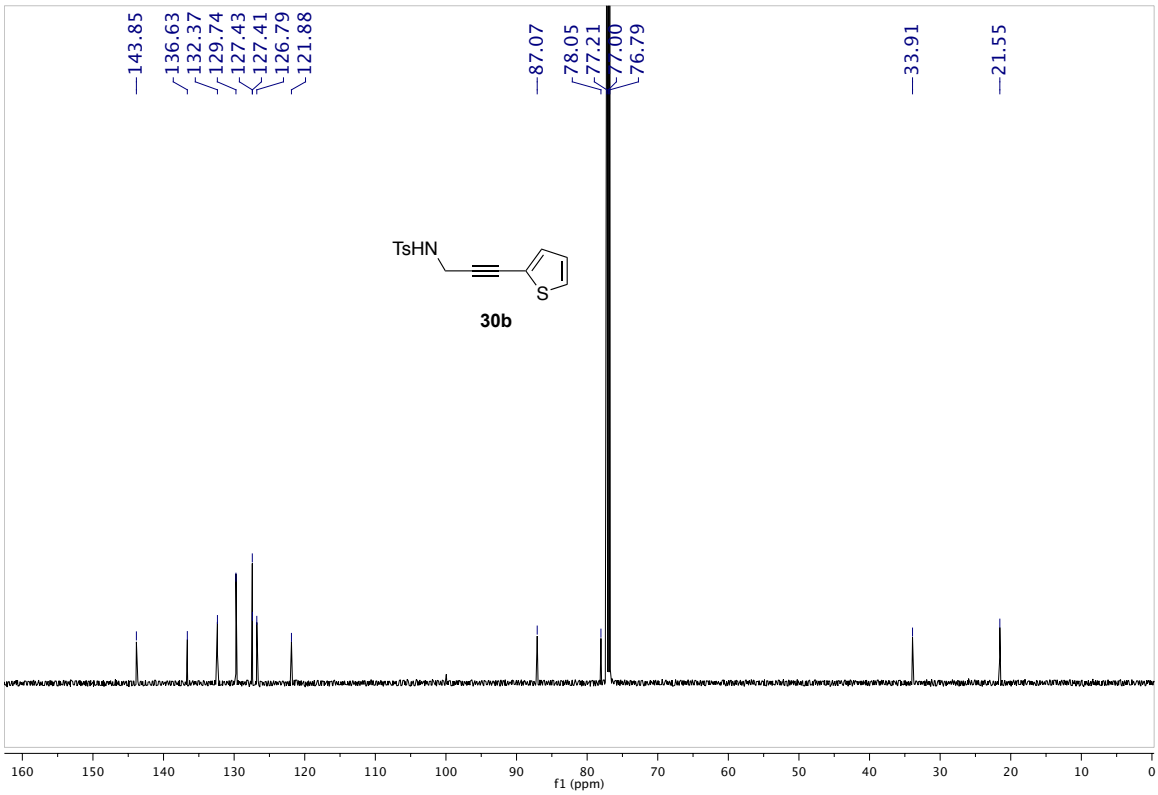


(*S*)-5-(dimethyl(phenyl)silyl)-6-methyl-8-(thiophen-3-yl)-2-tosyl-1,2,3,4-tetrahydrocyclopenta[c]azepin-7(6H)-one (35a):

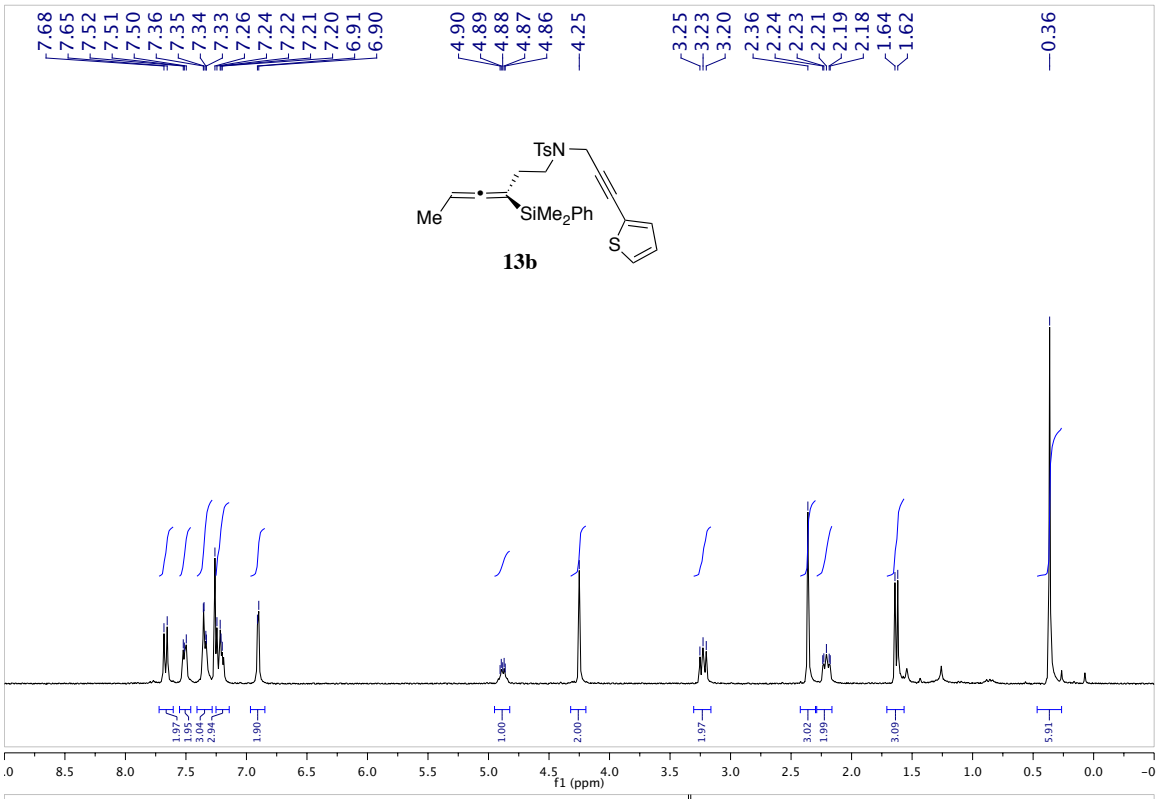


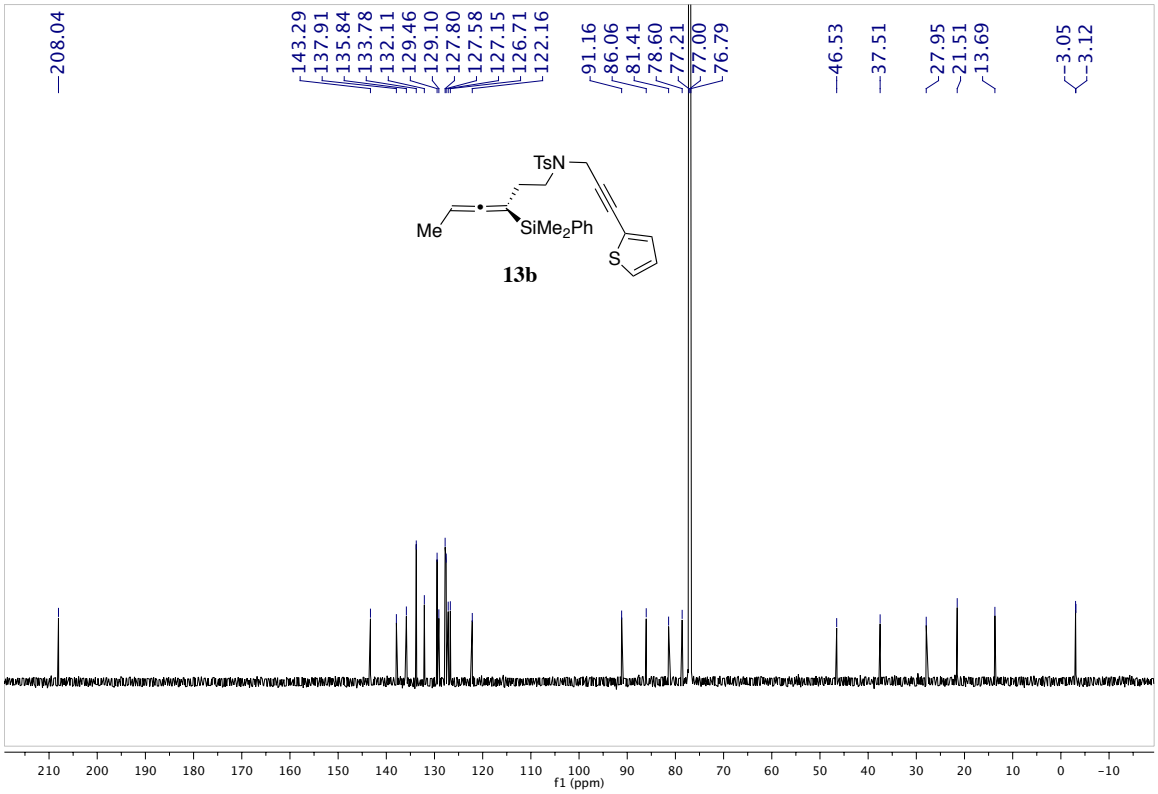
4-methyl-*N*-(3-(thiophen-2-yl)prop-2-yn-1-yl)benzenesulfonamide (30b):



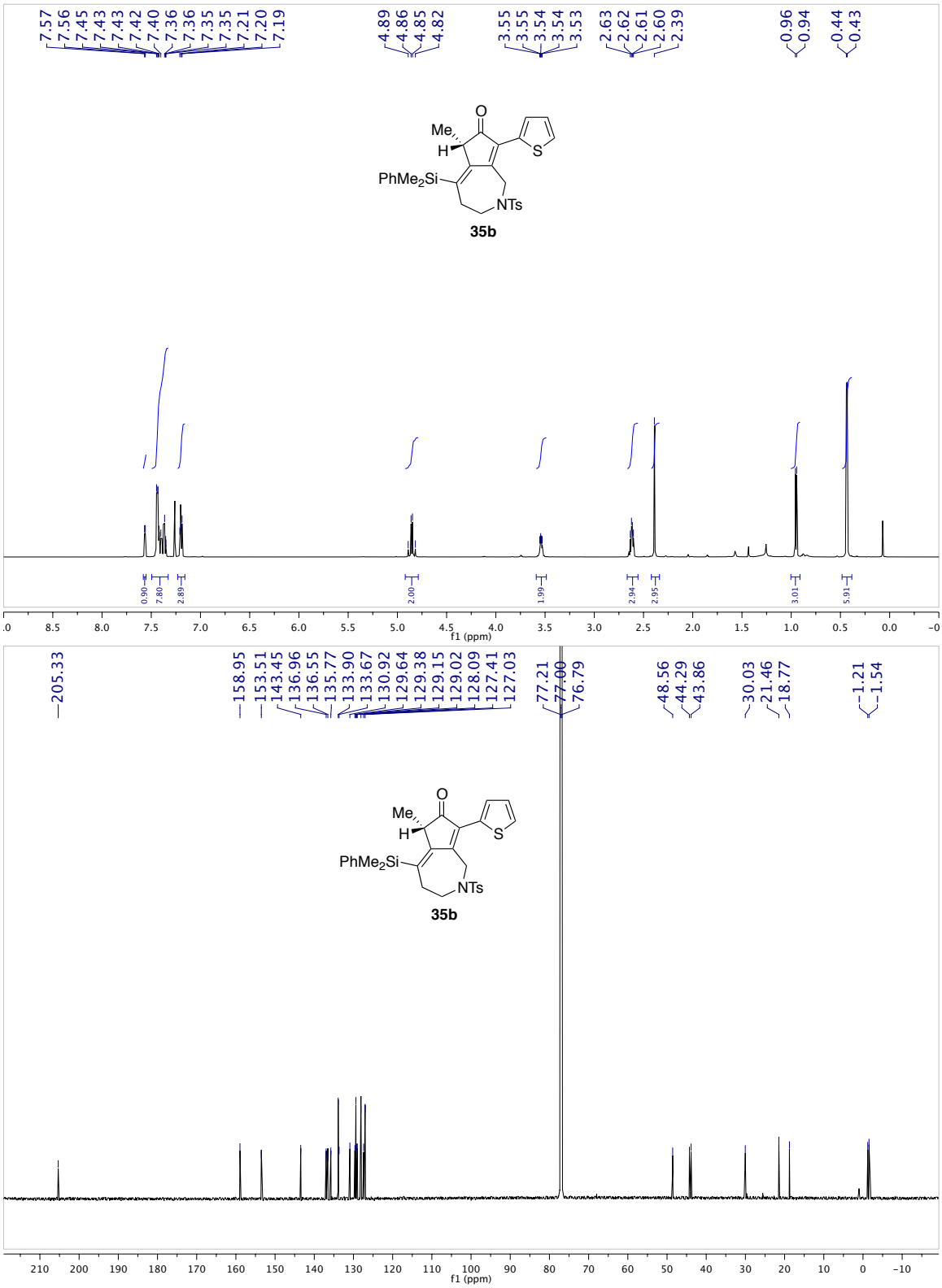


(R_a)-*N*-(3-(dimethyl(phenyl)silyl)hexa-3,4-dien-1-yl)-4-methyl-*N*-(3-(thiophen-2-yl)prop-2-yn-1-yl)benzenesulfonamide (13b):

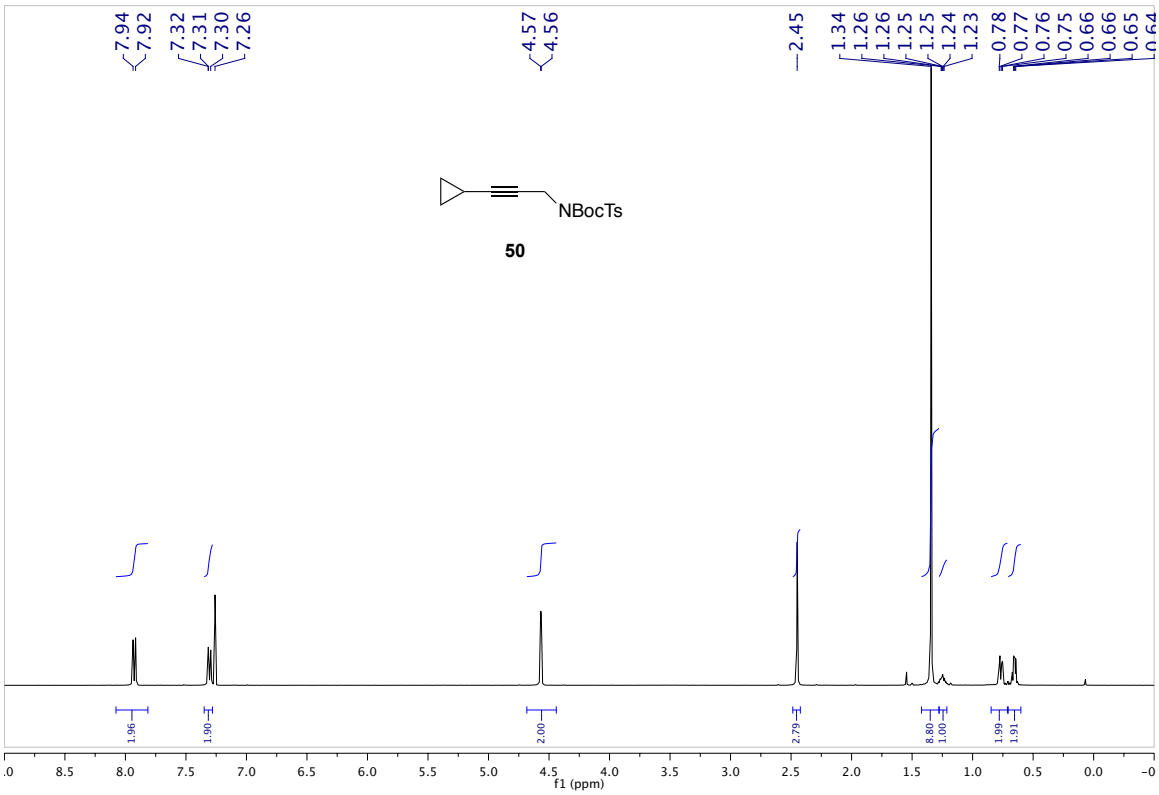


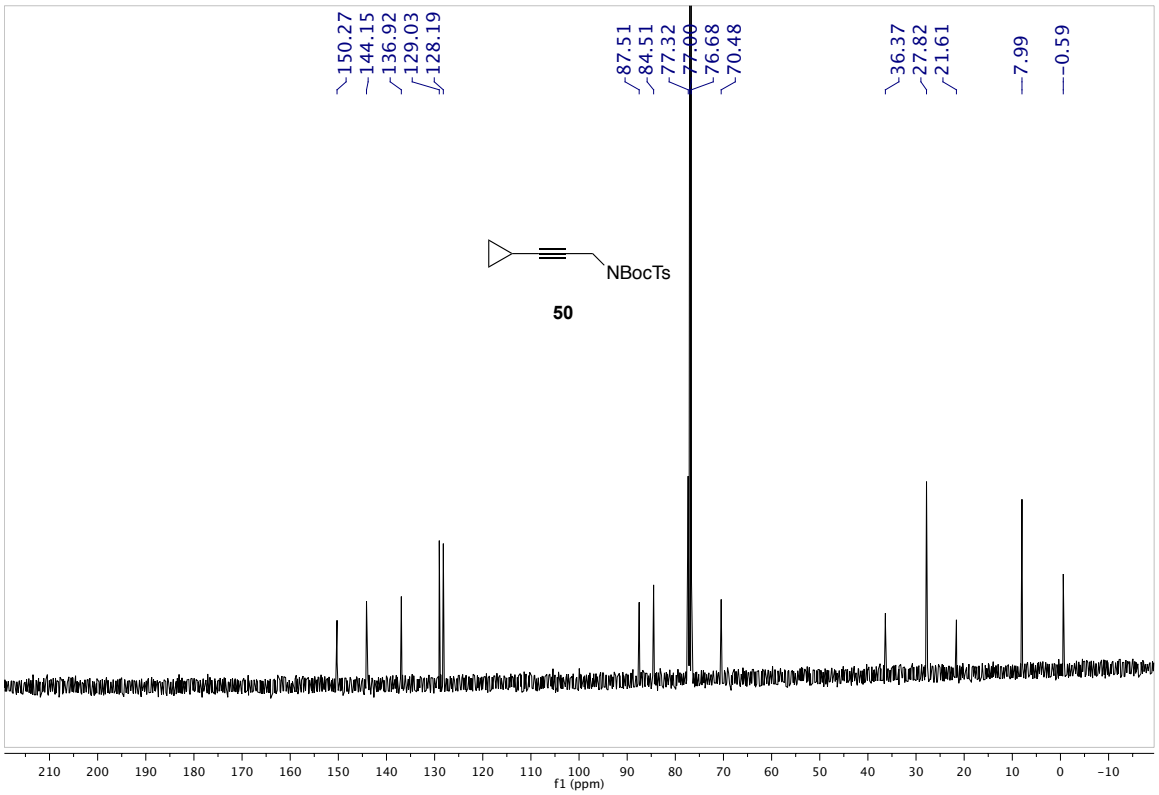


(*S*)-5-(dimethyl(phenyl)silyl)-6-methyl-8-(thiophen-2-yl)-2-tosyl-1,2,3,4-tetra hydrocyclopenta[*c*]azepin-7(6*H*)-one (35b):

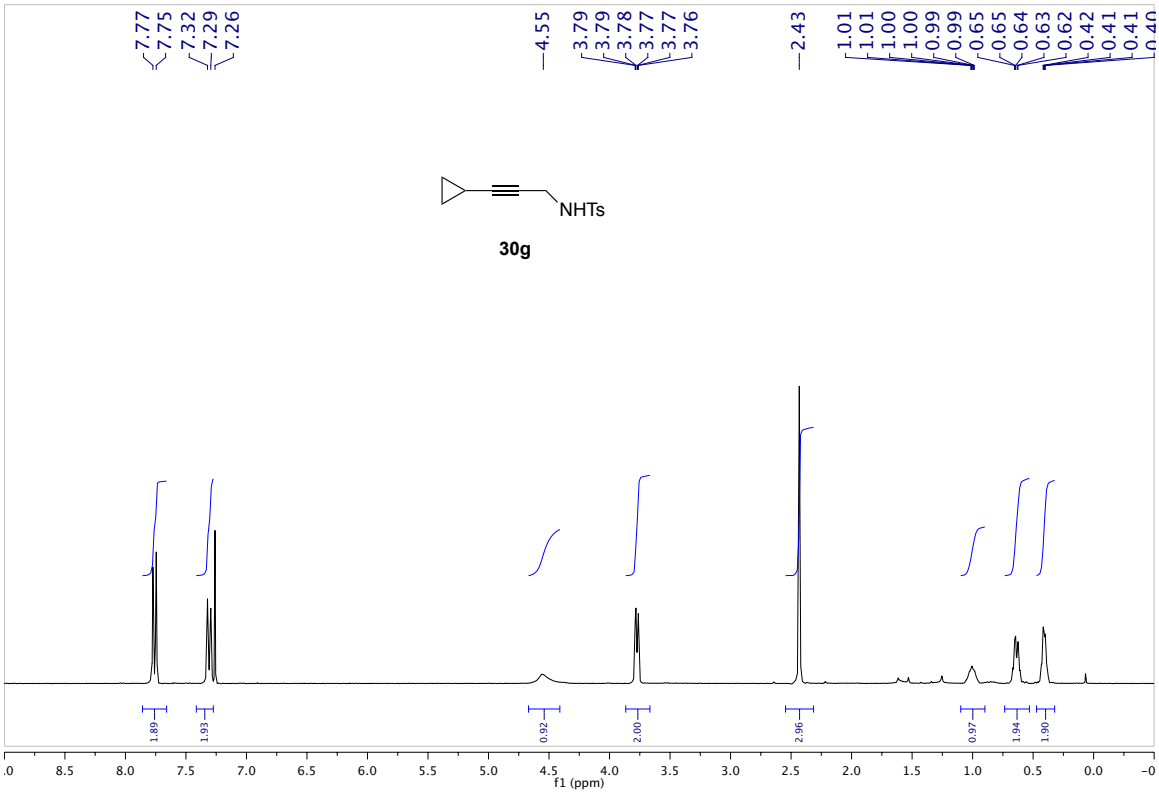


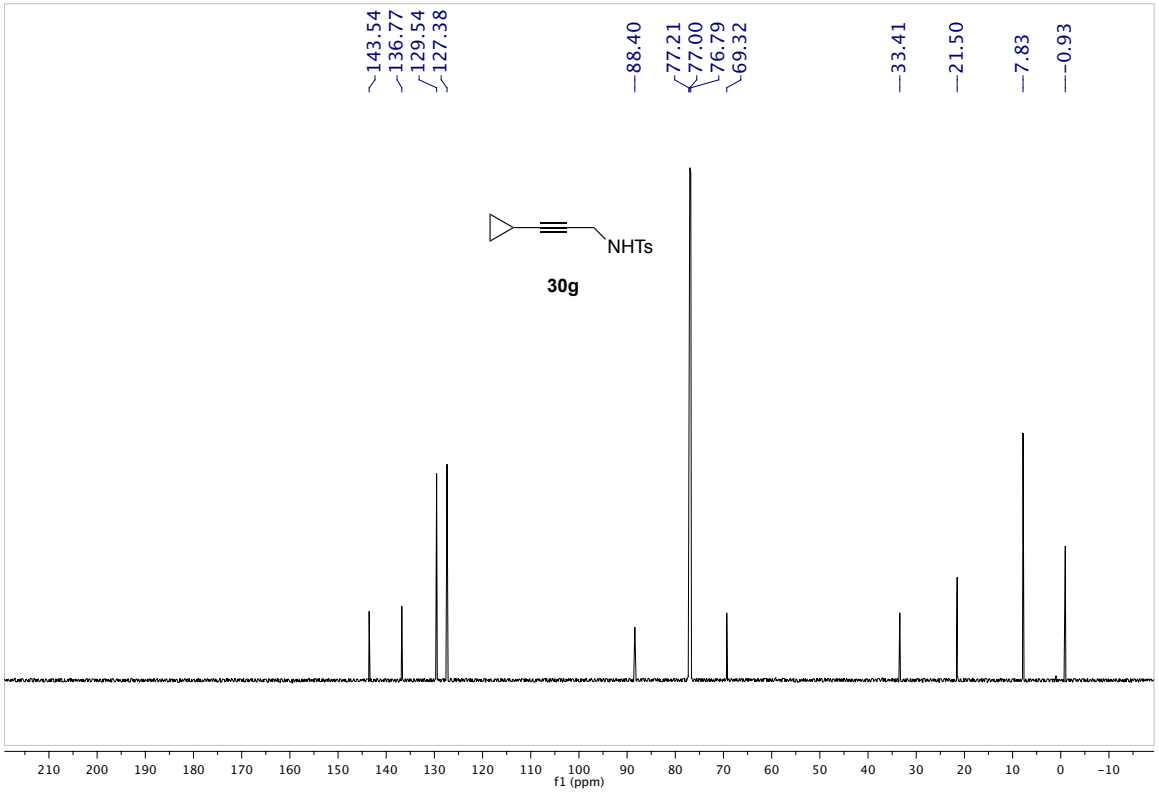
tert-butyl (3-cyclopropylprop-2-yn-1-yl)(tosyl)carbamate (50):



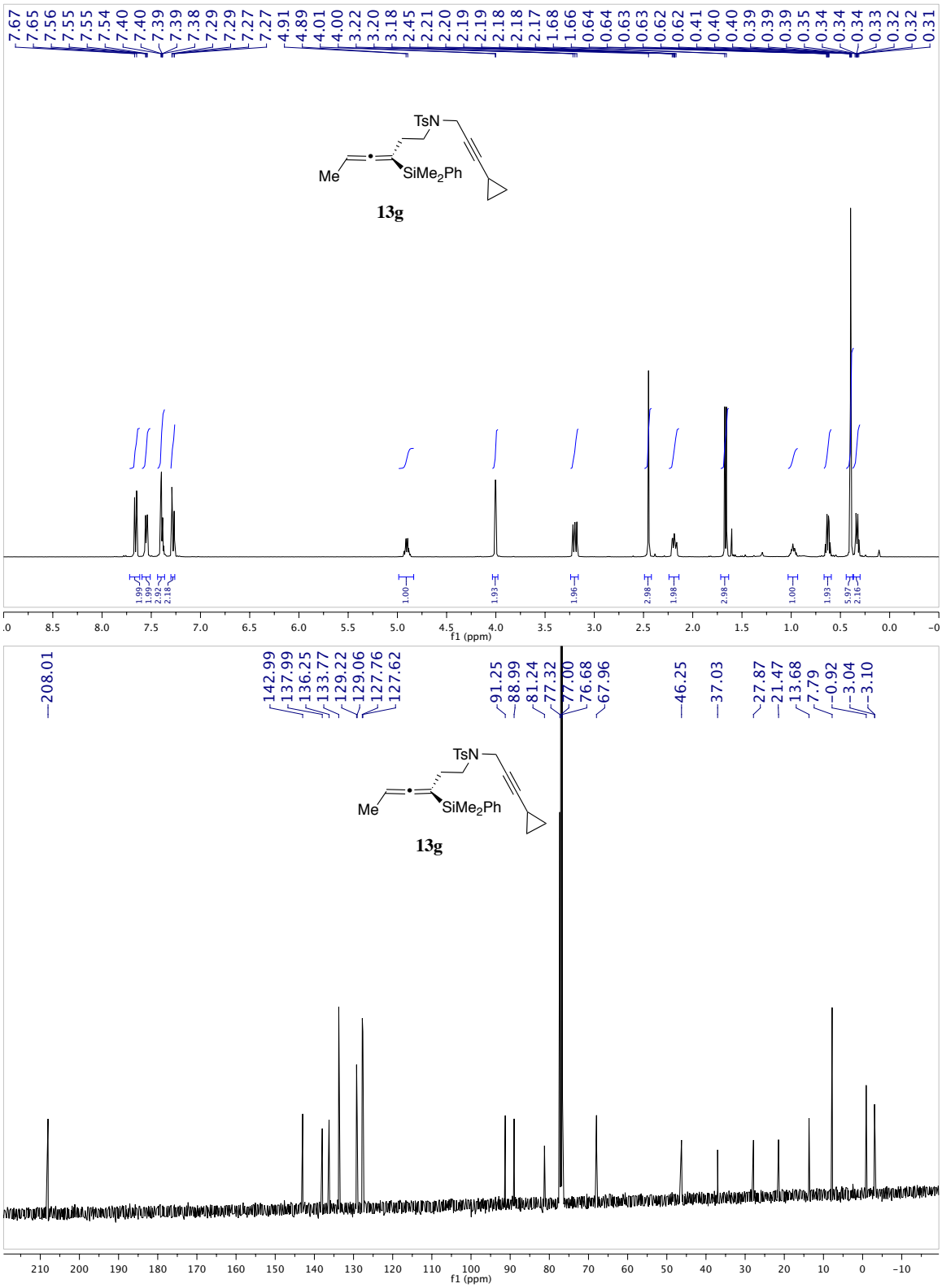


N-(3-cyclopropylprop-2-yn-1-yl)-4-methylbenzenesulfonamide (30g):

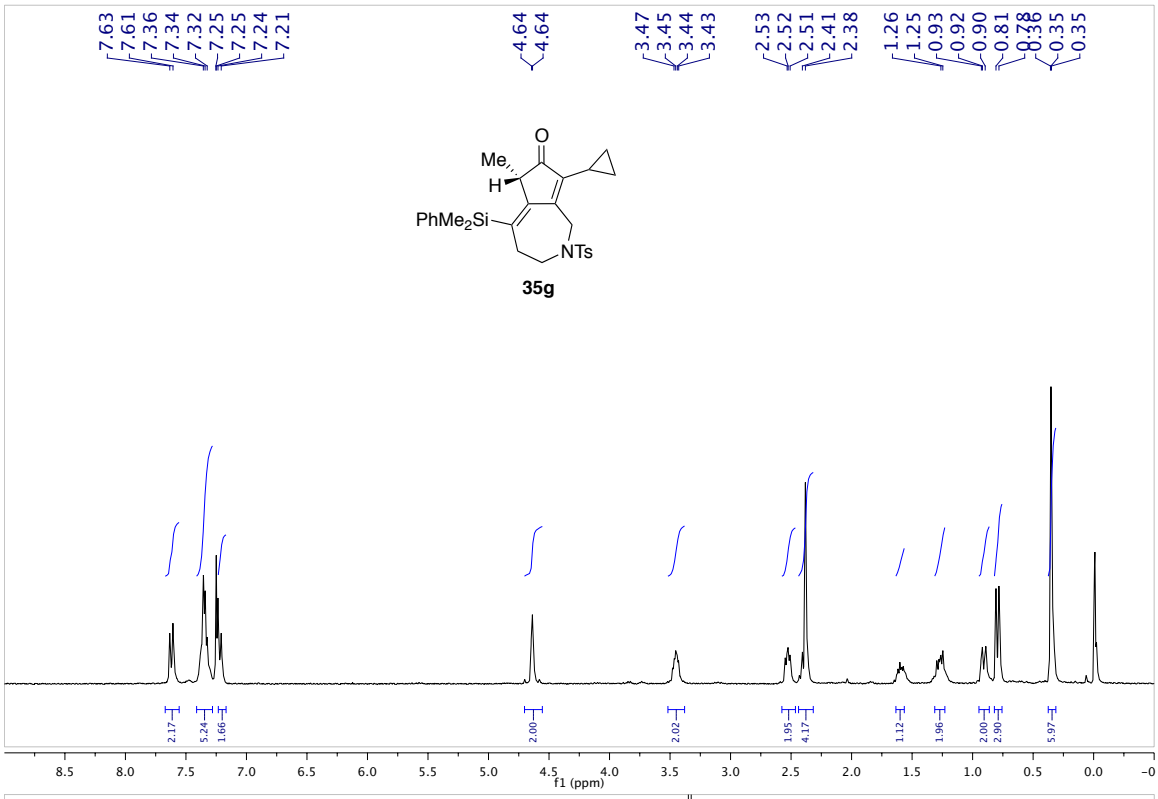


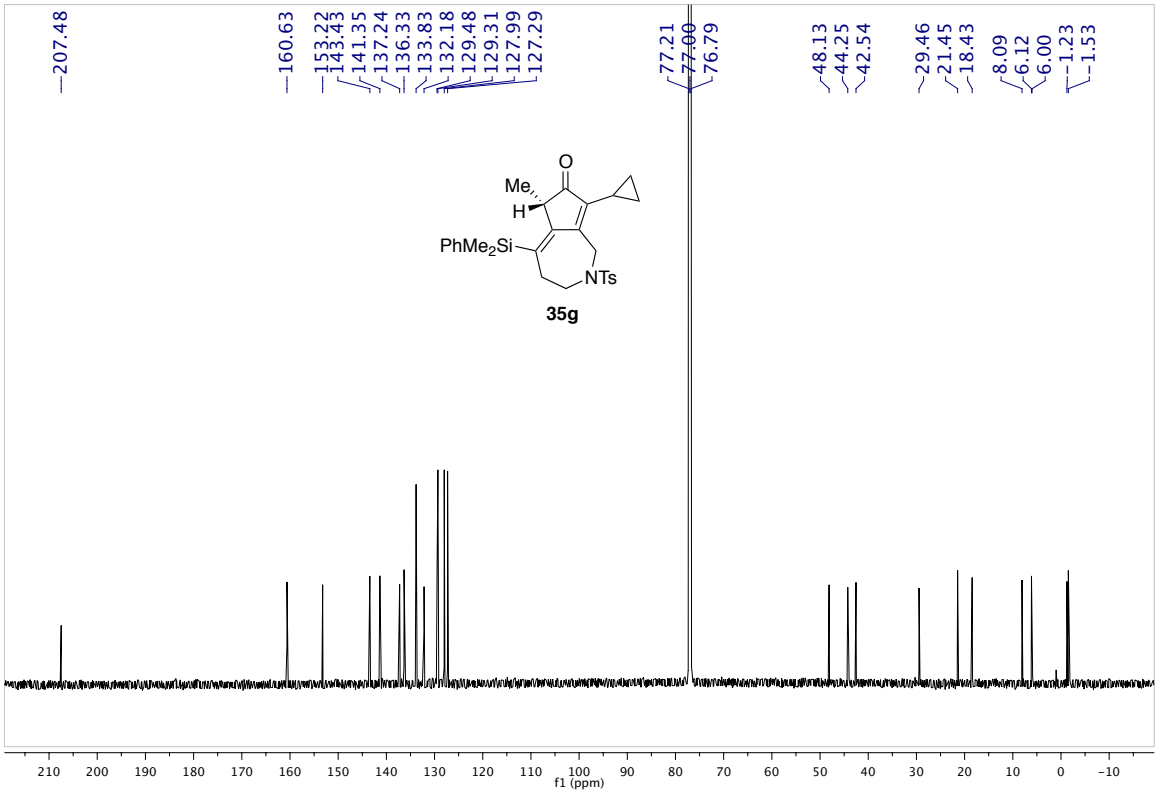


(R_a)-*N*-(3-cyclopropylprop-2-yn-1-yl)-*N*-(3-(dimethyl(phenyl)silyl)hexa-3,4-dien-1-yl)-4-methylbenzenesulfonamide (13g):

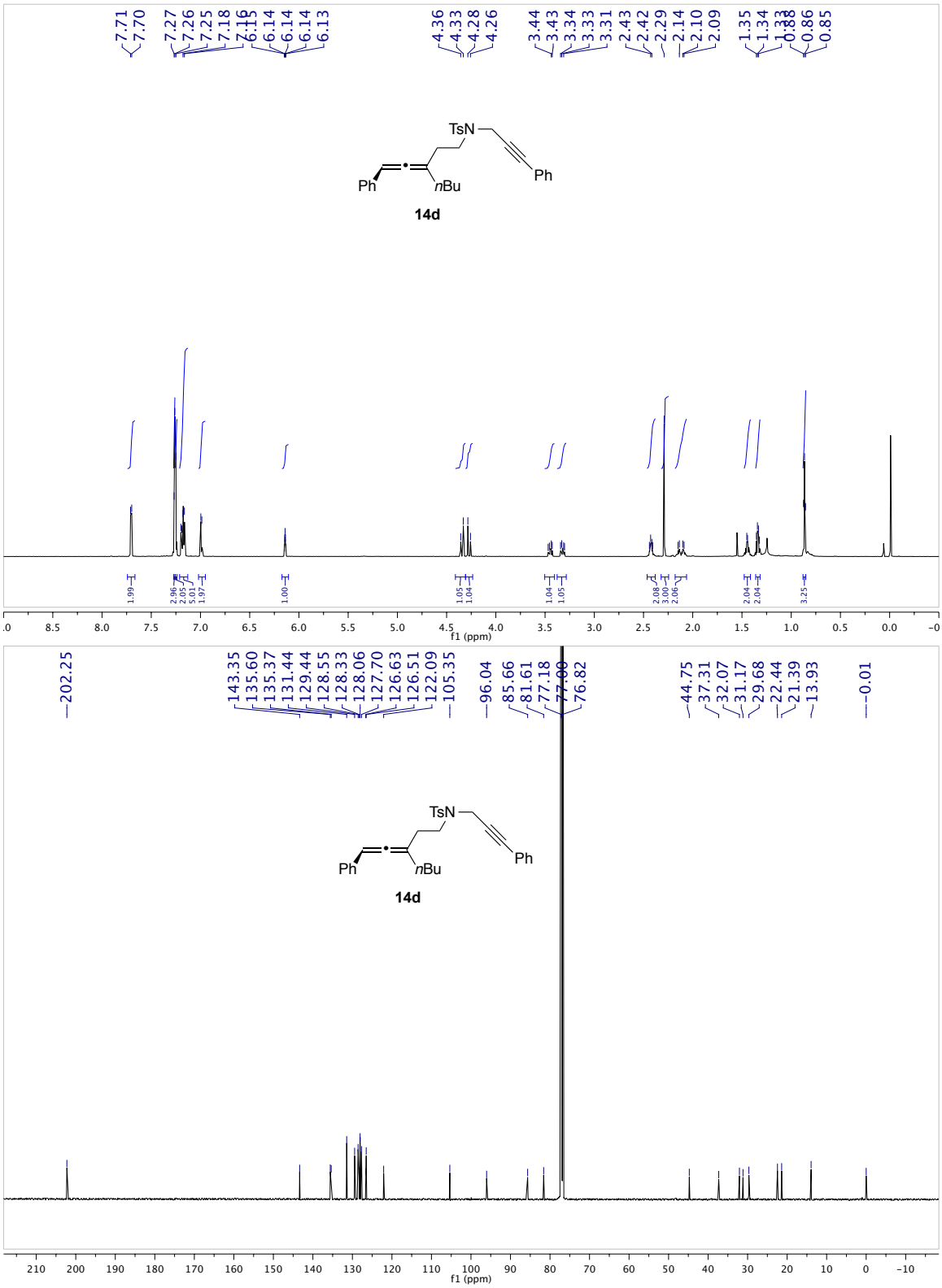


(*S*)-8-cyclopropyl-5-(dimethyl(phenyl)silyl)-6-methyl-2-tosyl-1,2,3,4-tetra hydrocyclopenta[c]azepin-7(6H)-one (35g):

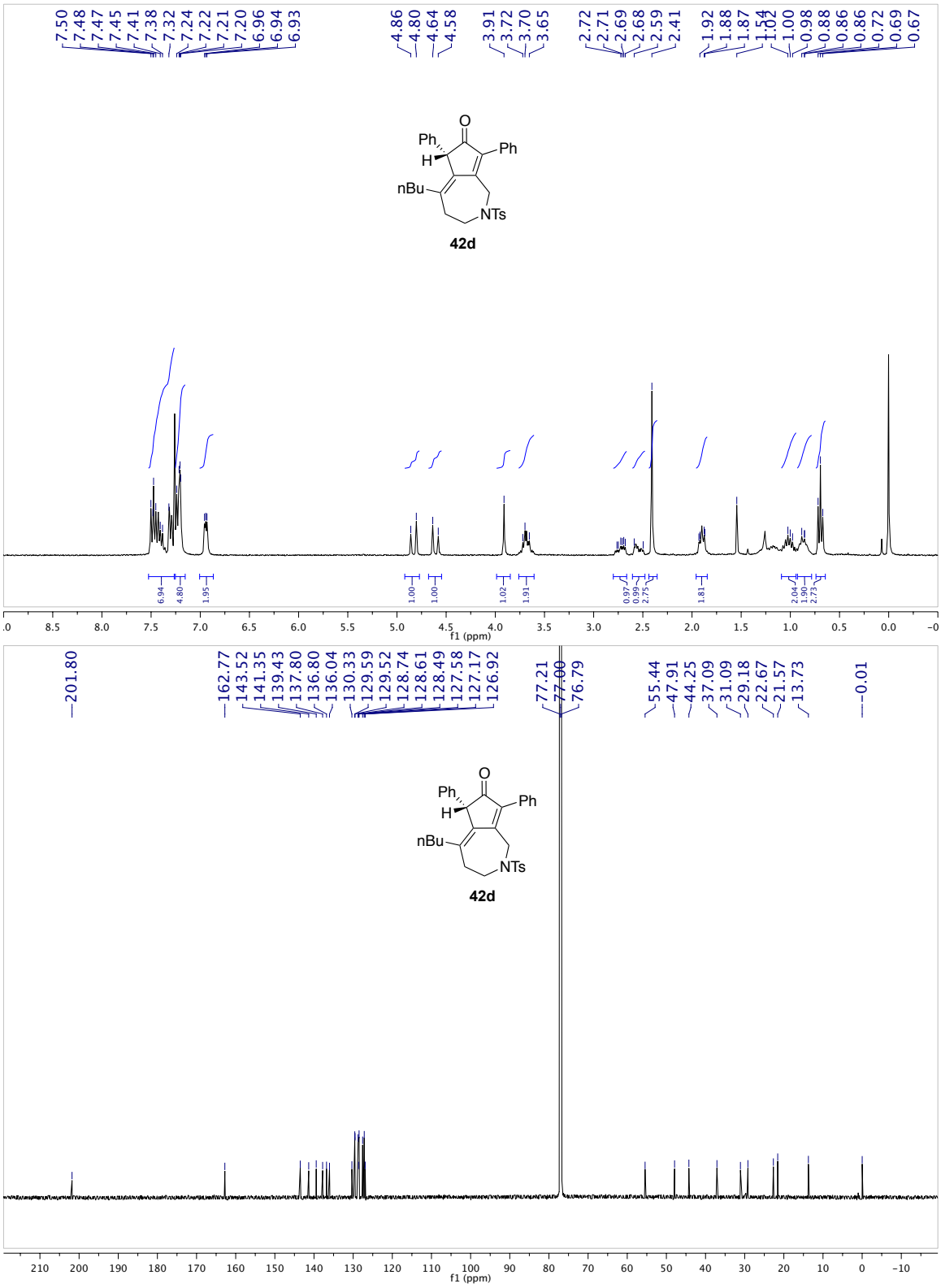




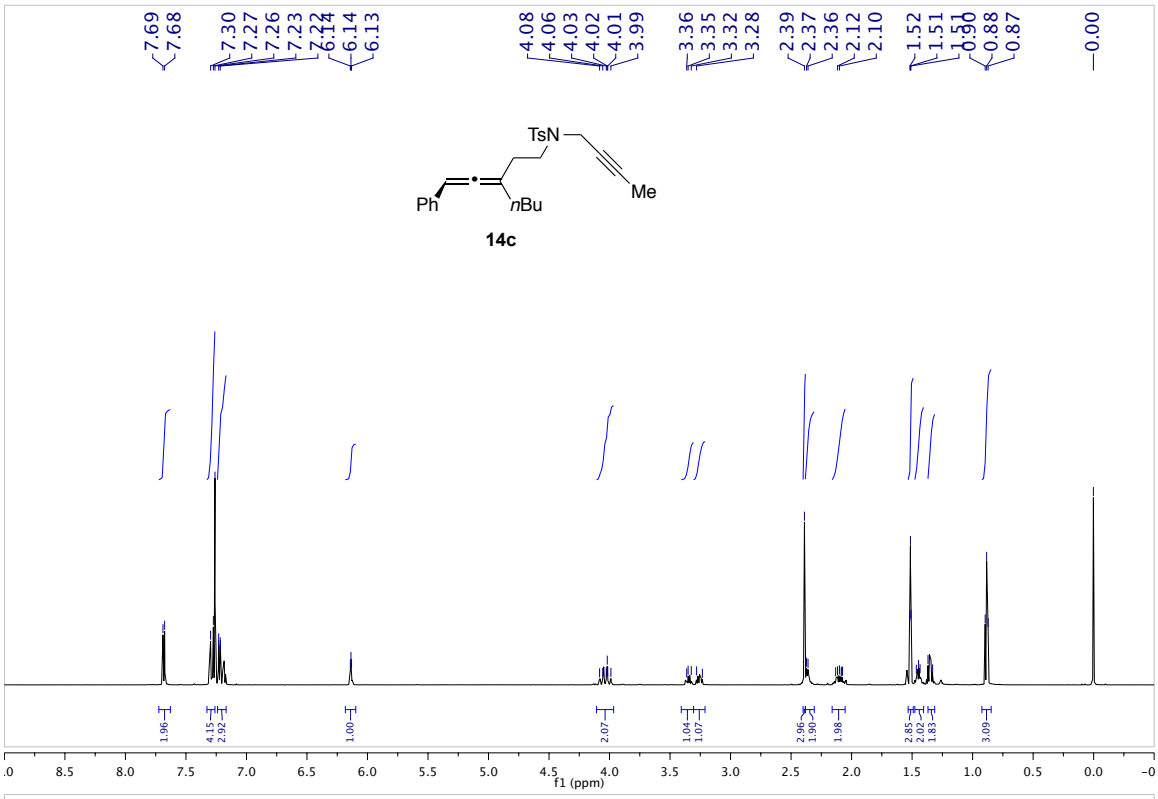
(R_a)-*N*-(hexa-3,4-dien-1-yl)-4-methyl-*N*-(3-phenylprop-2-yn-1-yl)benzene sulfonamide (14d):

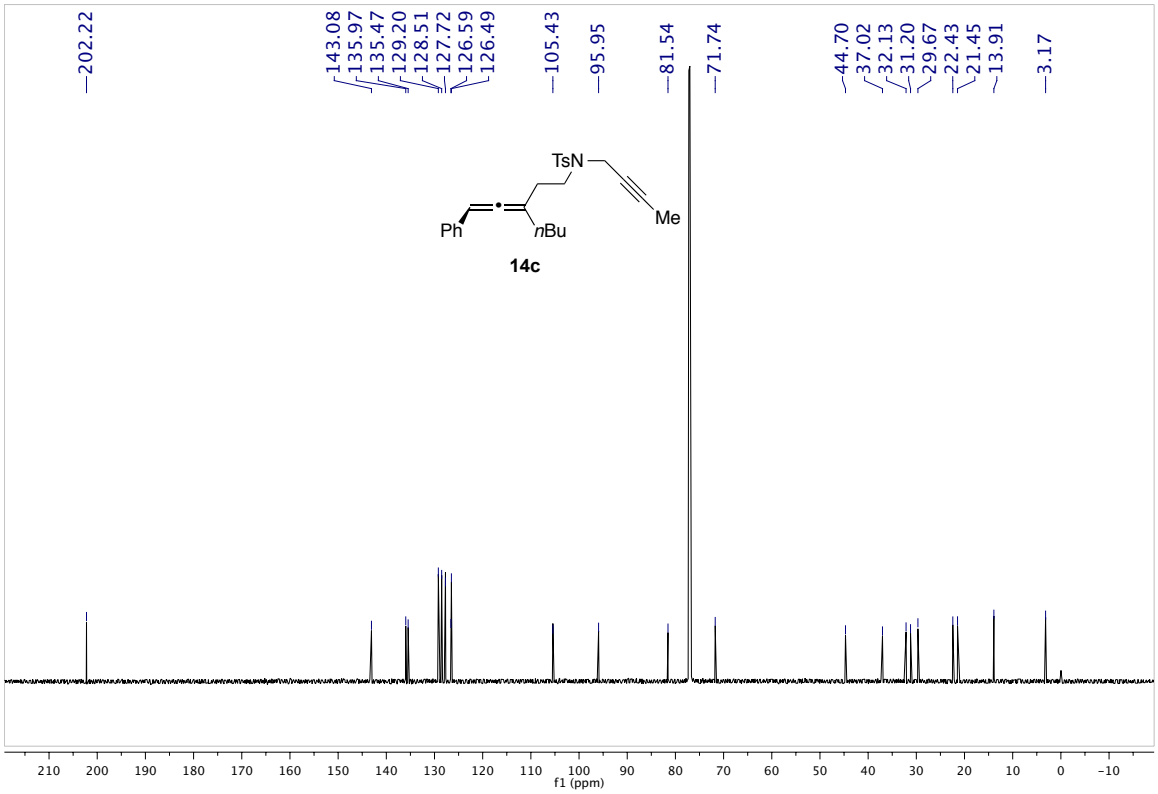


(*S*)-6-methyl-8-phenyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[*c*]azepin-7(6*H*)-one (42d):

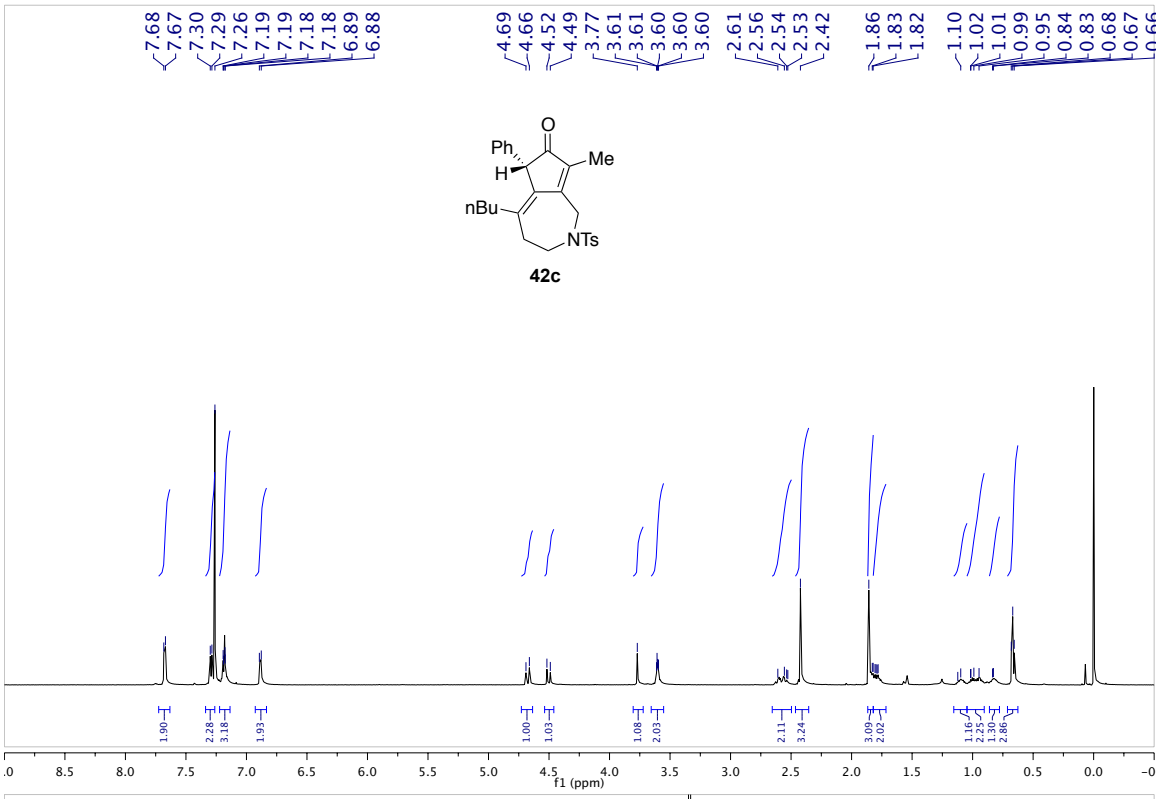


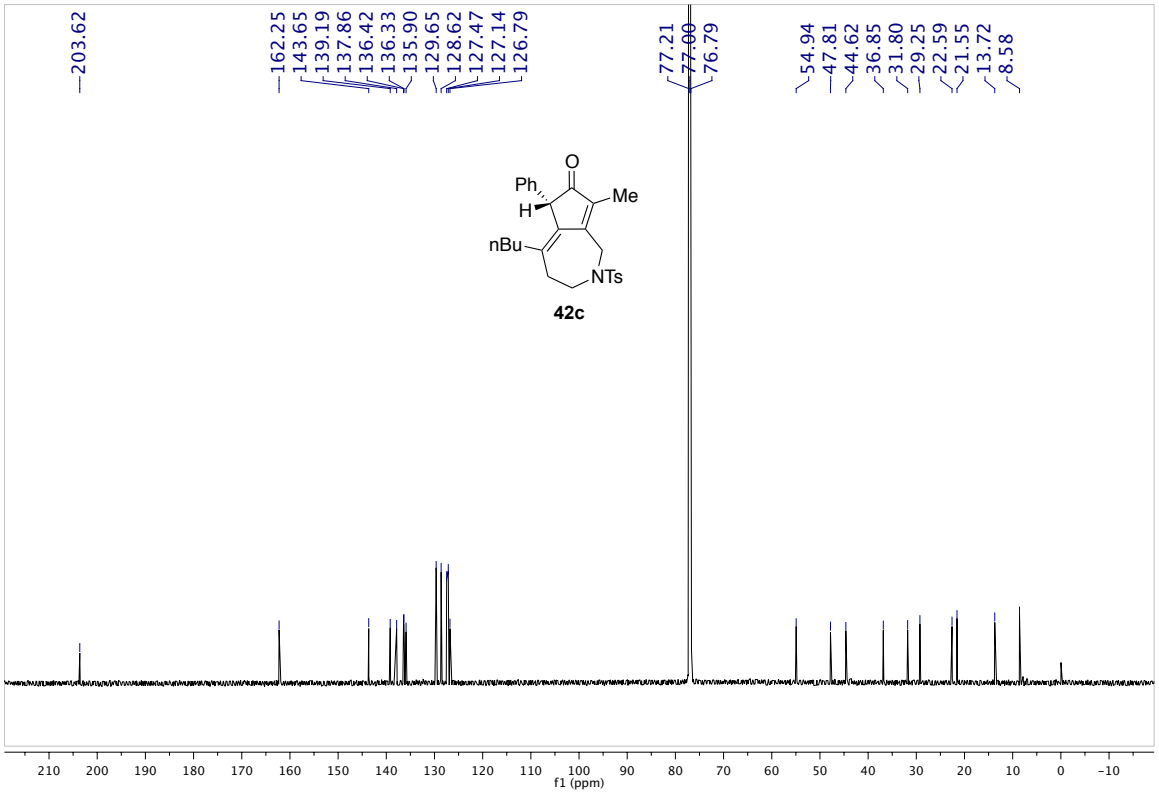
(R_a)-*N*-(hexa-3,4-dien-1-yl)-4-methyl-*N*-(3-phenylprop-2-yn-1-yl)benzene sulfonamide (14c):



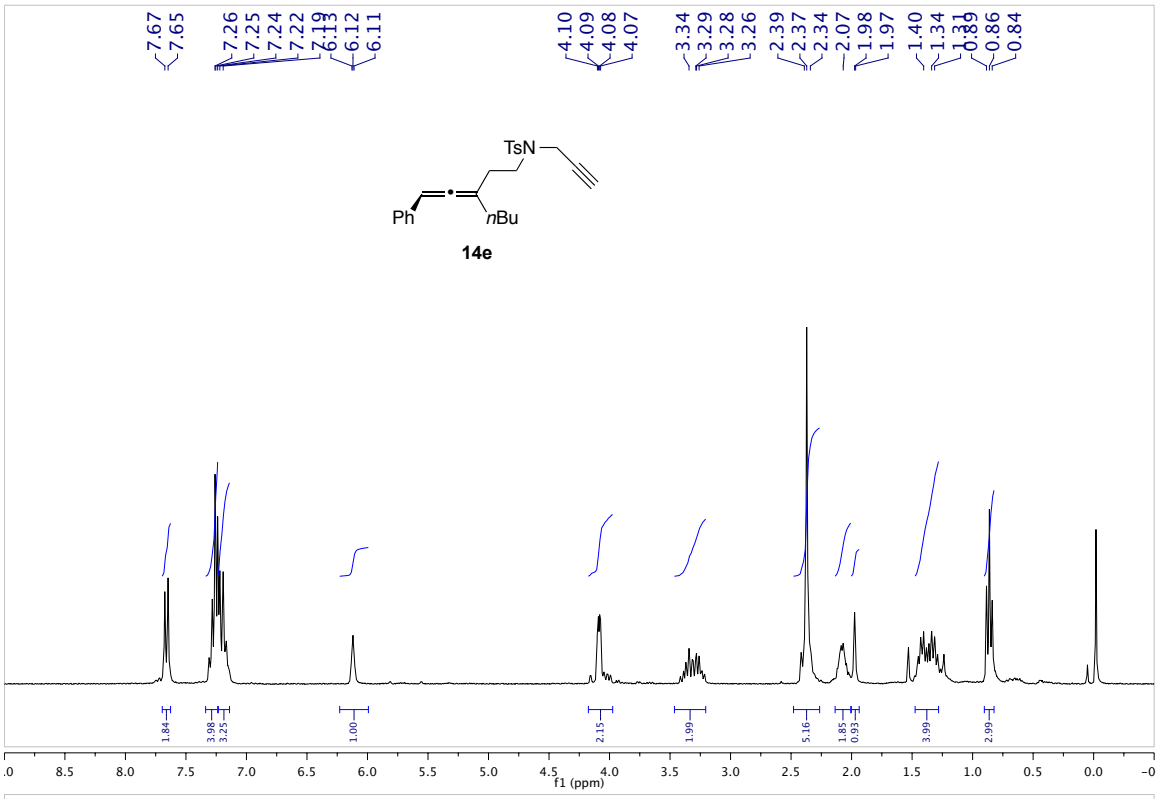


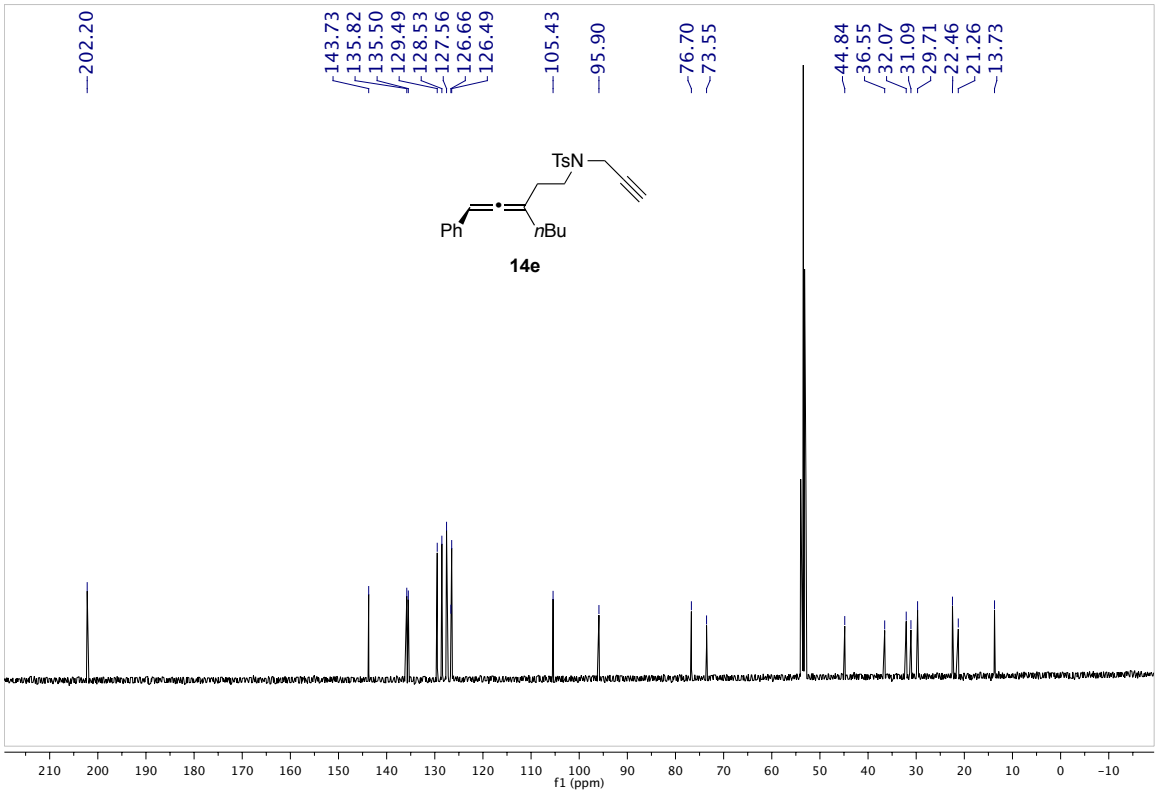
(*S*)-5-butyl-8-methyl-6-phenyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[*c*]azepin -7(6*H*)-one (42c):



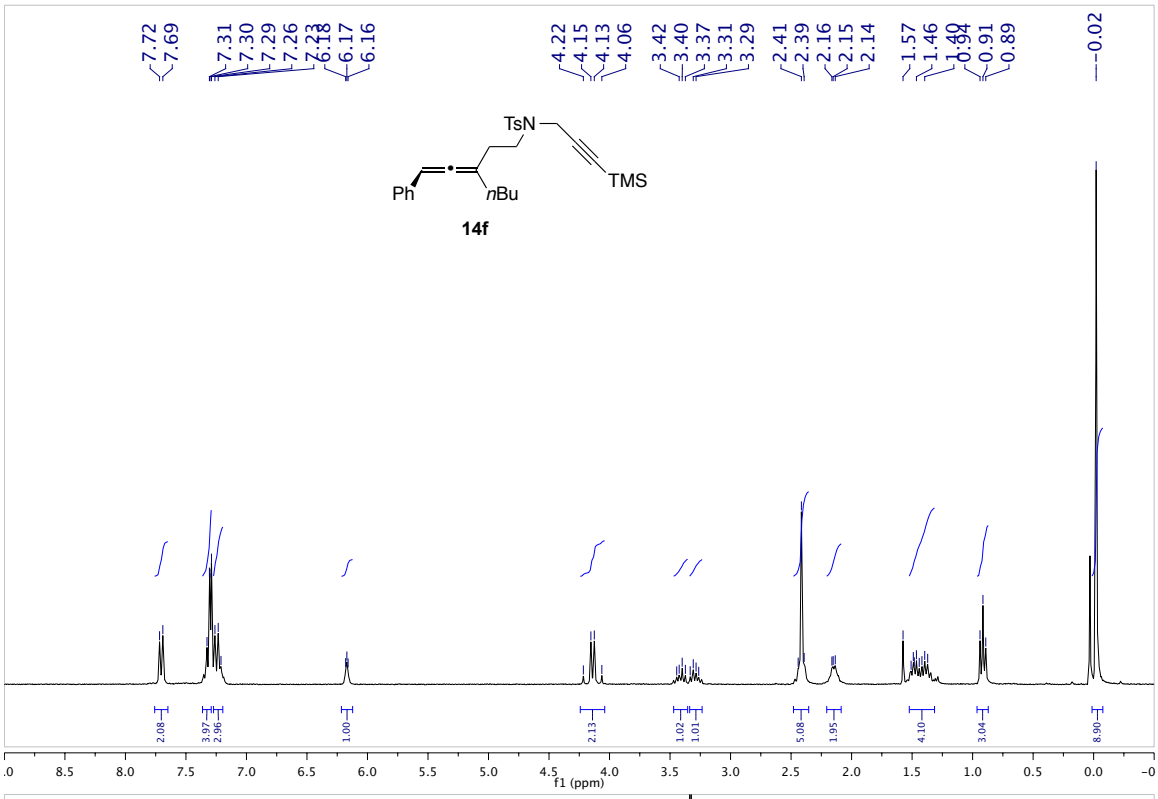


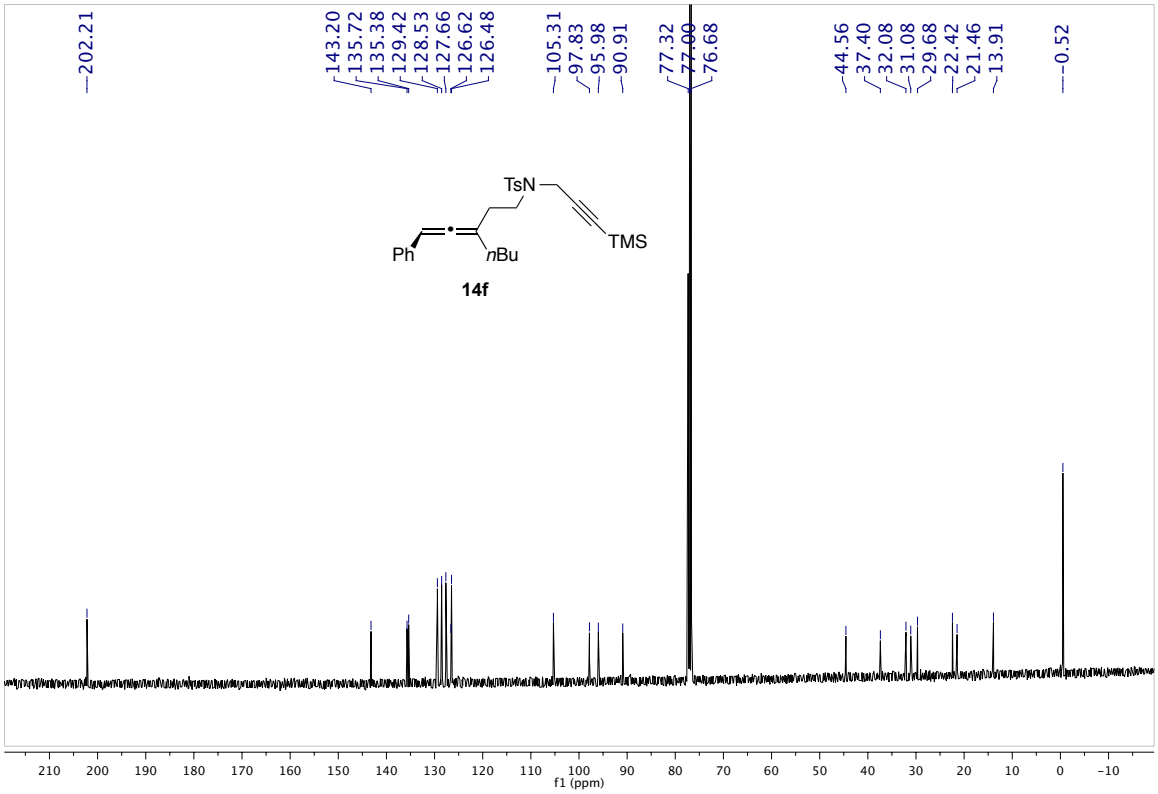
(R_a)-4-methyl-*N*-(3-(2-phenylvinylidene)heptyl)-*N*-(prop-2-yn-1-yl)benzene sulfonamide (14e):



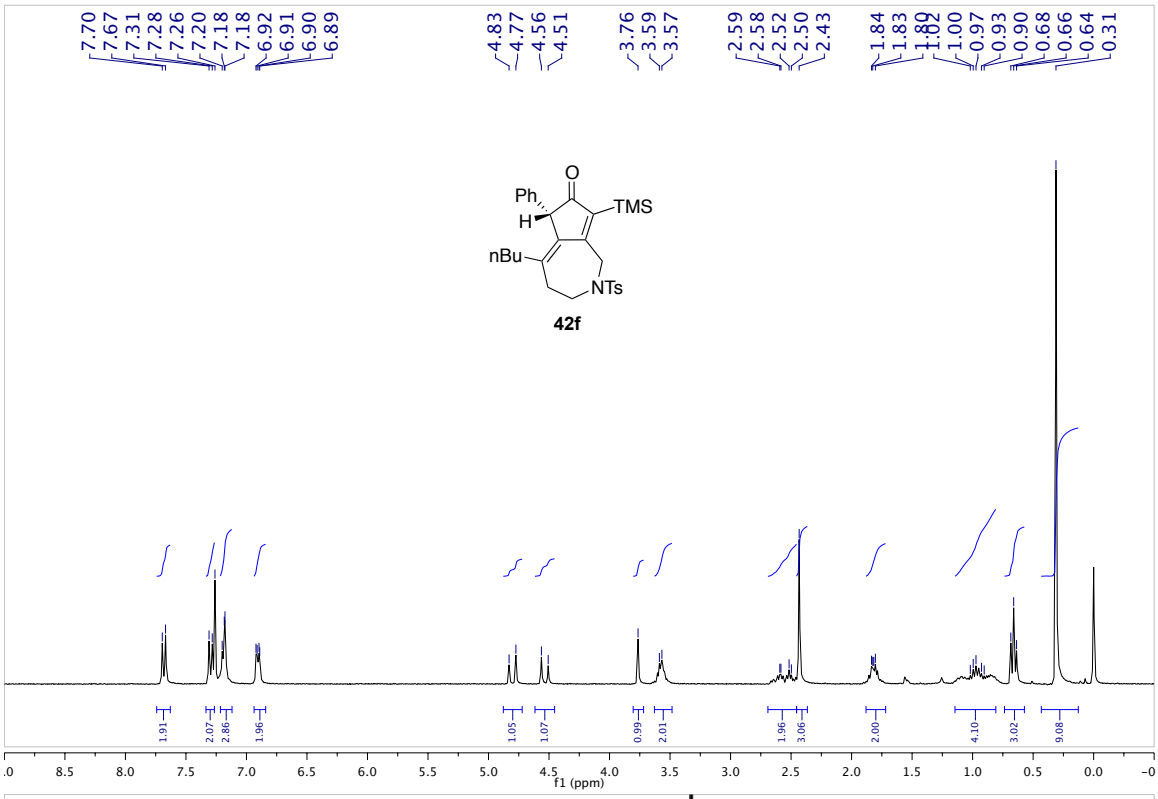


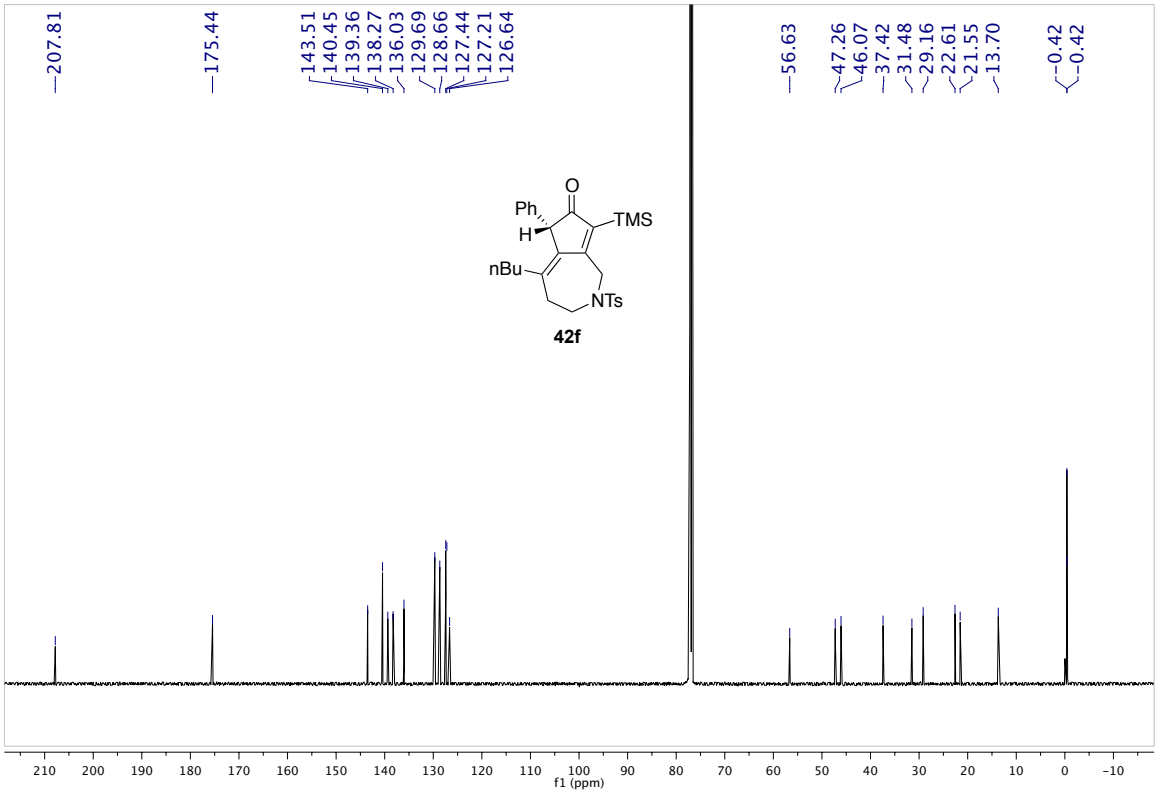
(R_a)-4-methyl-*N*-(3-(2-phenylvinylidene)heptyl)-*N*-(3-(trimethylsilyl)prop-2-yn-1-yl)benzenesulfonamide(14f):



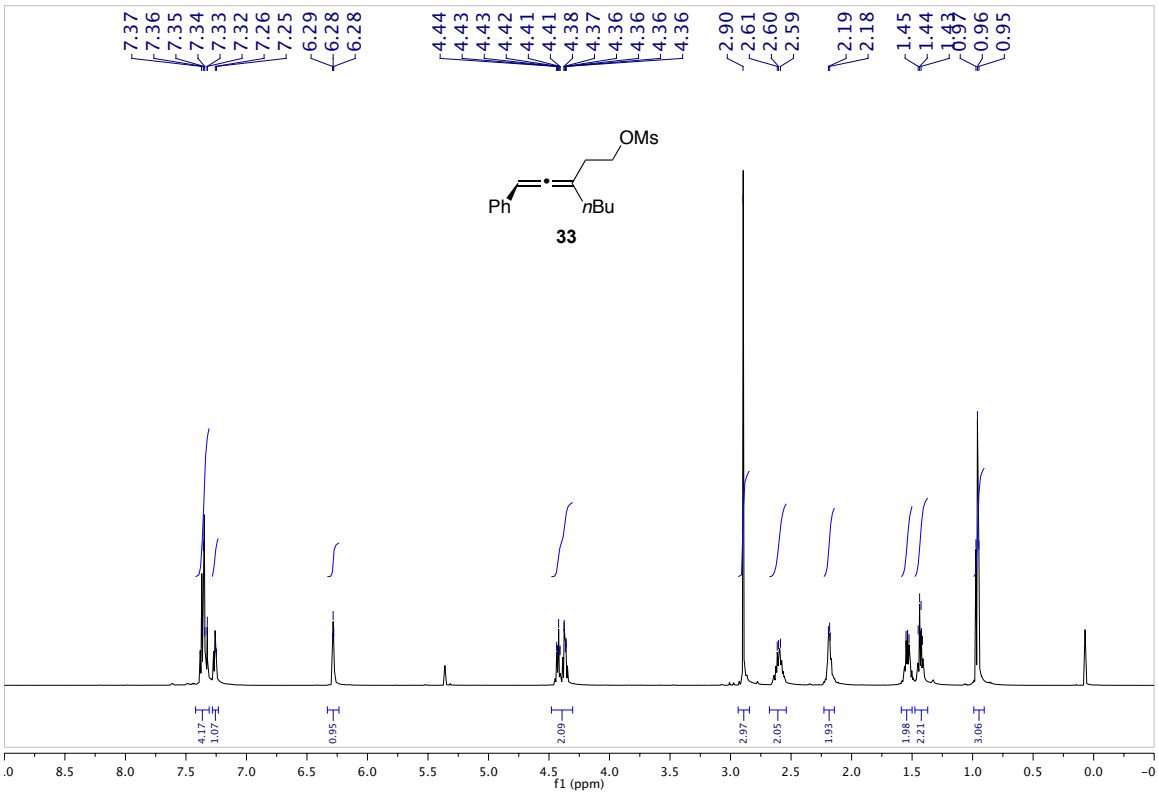


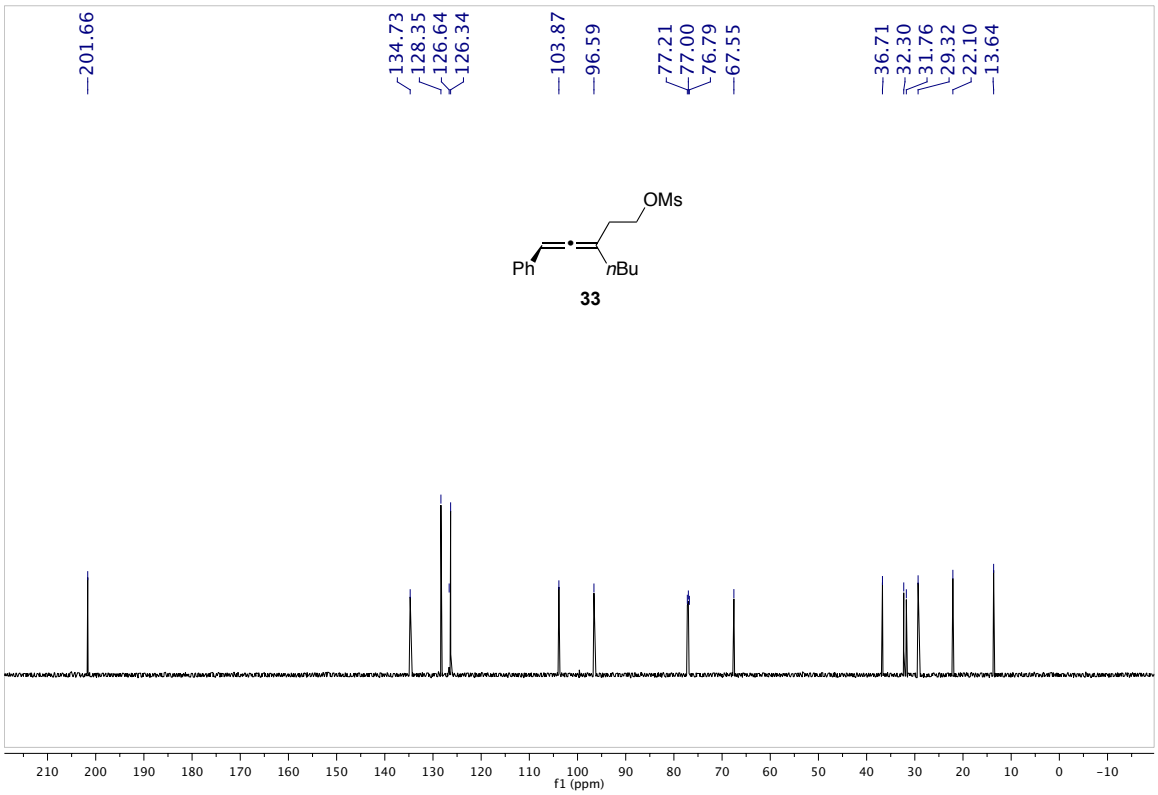
(*S*)-5-butyl-6-phenyl-2-tosyl-8-(trimethylsilyl)-1,2,3,4-tetrahydrocyclopenta [*c*]azepin-7(6*H*)-one (42f):



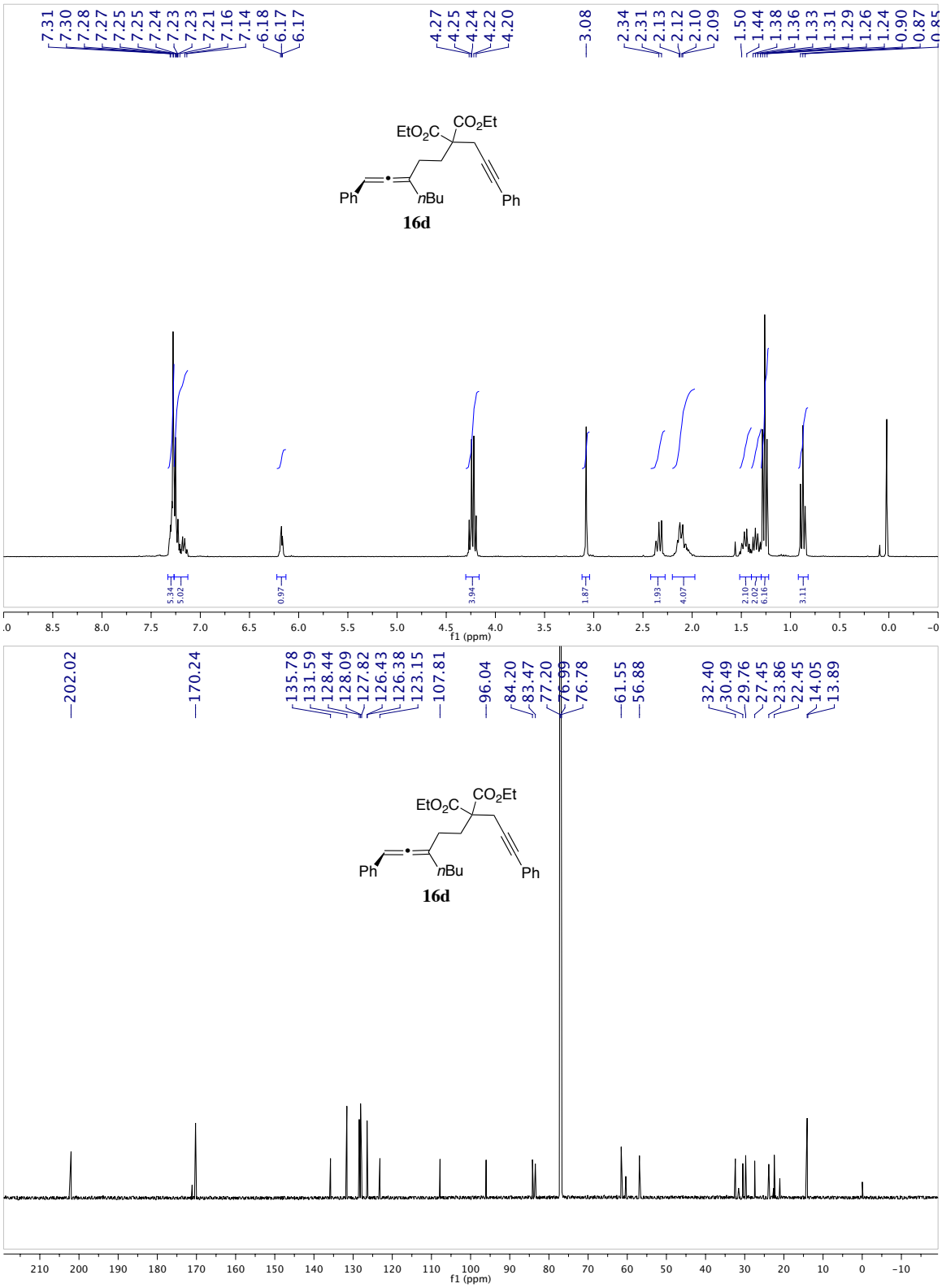


(R_a)-3-(2-phenylvinylidene)heptyl methanesulfonate (33):

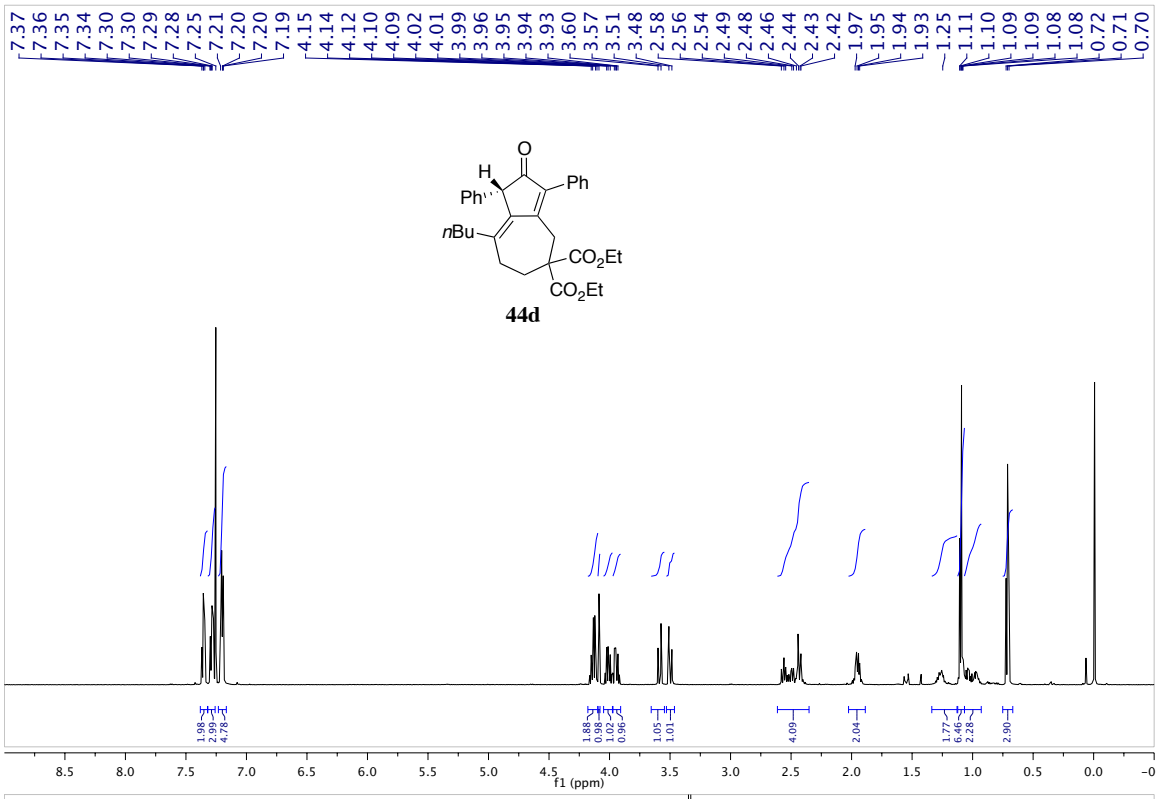


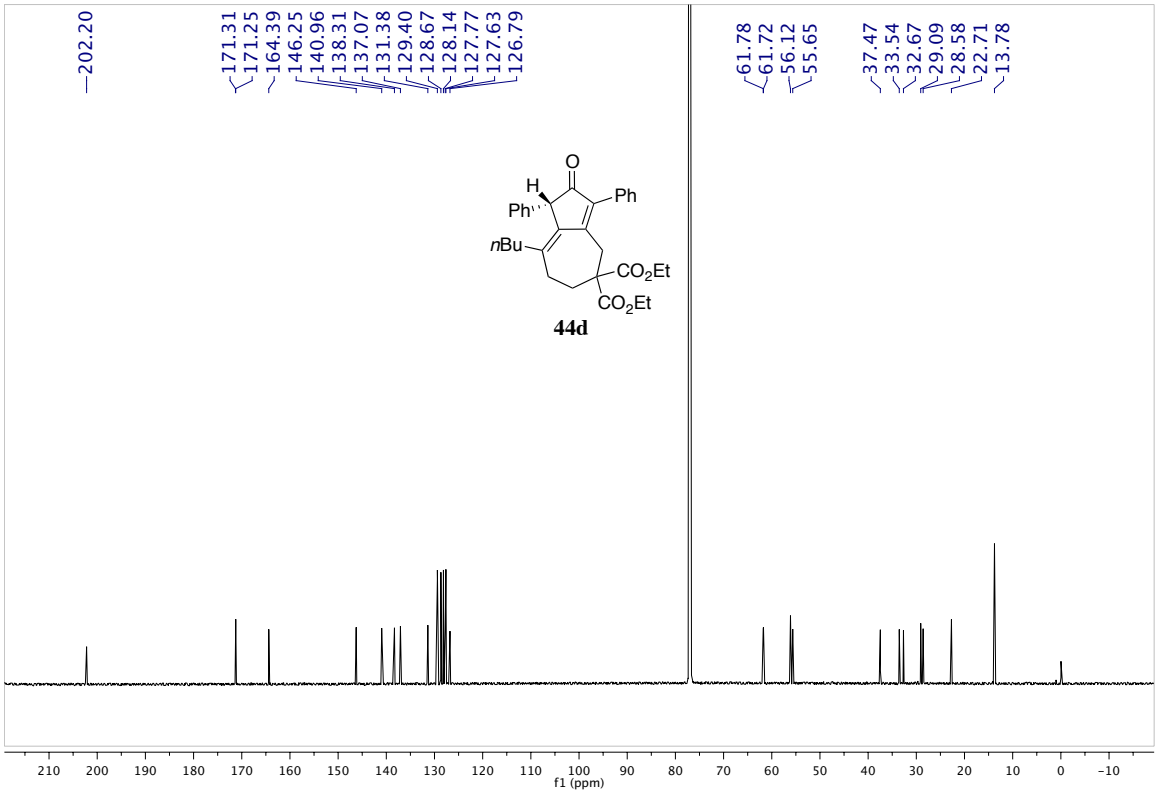


(R_a)-diethyl 2-(3-phenylprop-2-yn-1-yl)-2-(3-(2-phenylvinylidene)heptyl) malonate (16d):

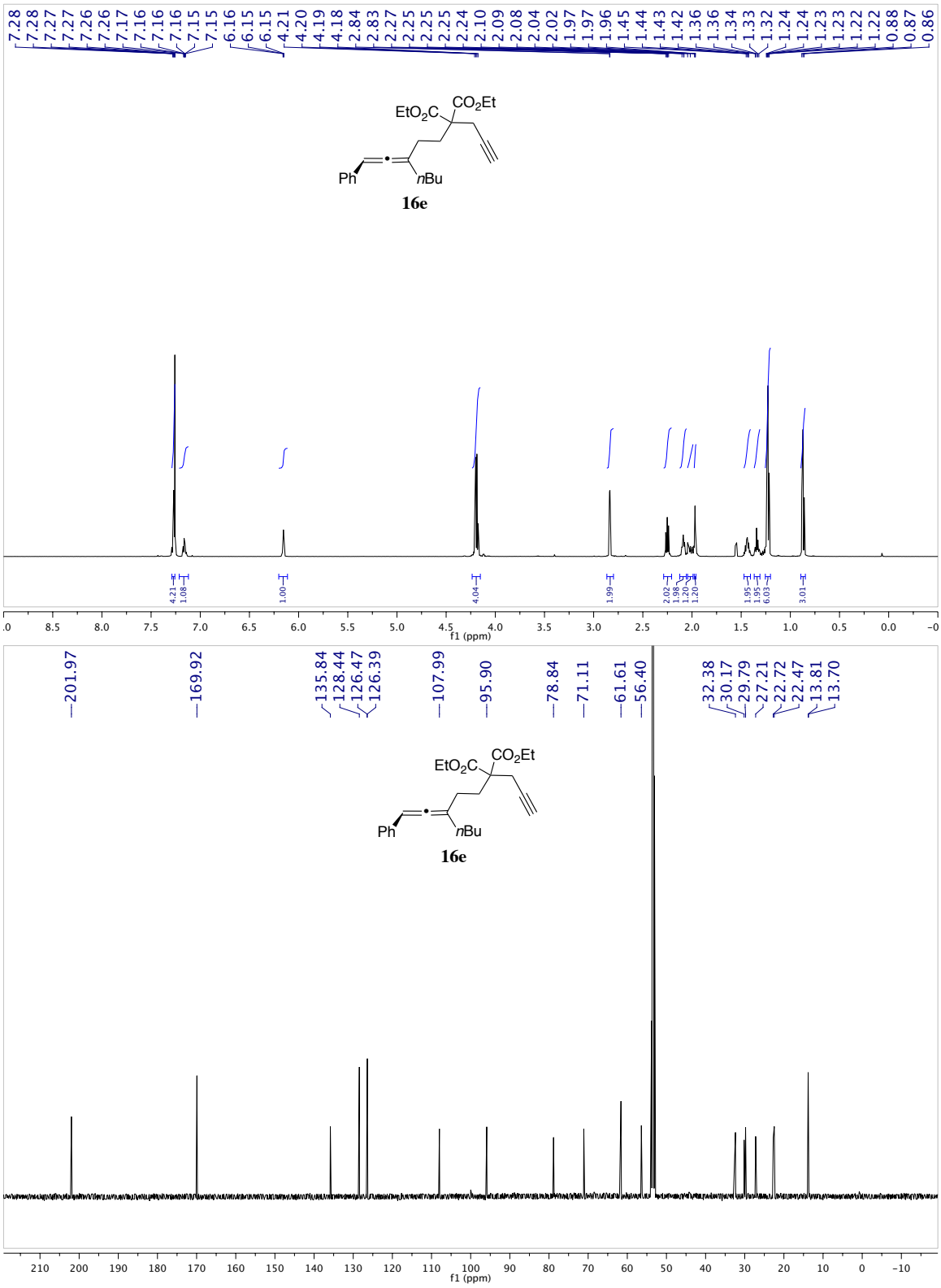


(*S*)-diethyl 8-butyl-2-oxo-1,3-diphenyl-1,2,6,7-tetrahydroazulene-5,5(4*H*)-dicarboxylate (44d):

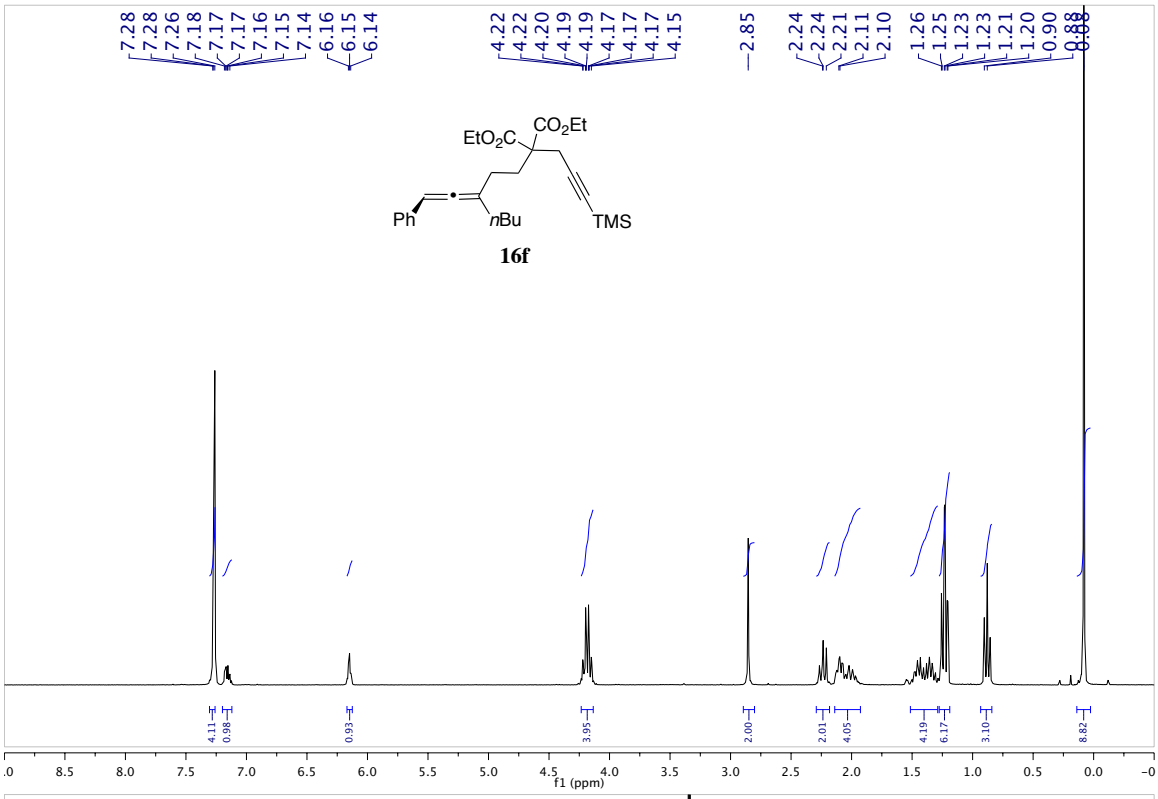


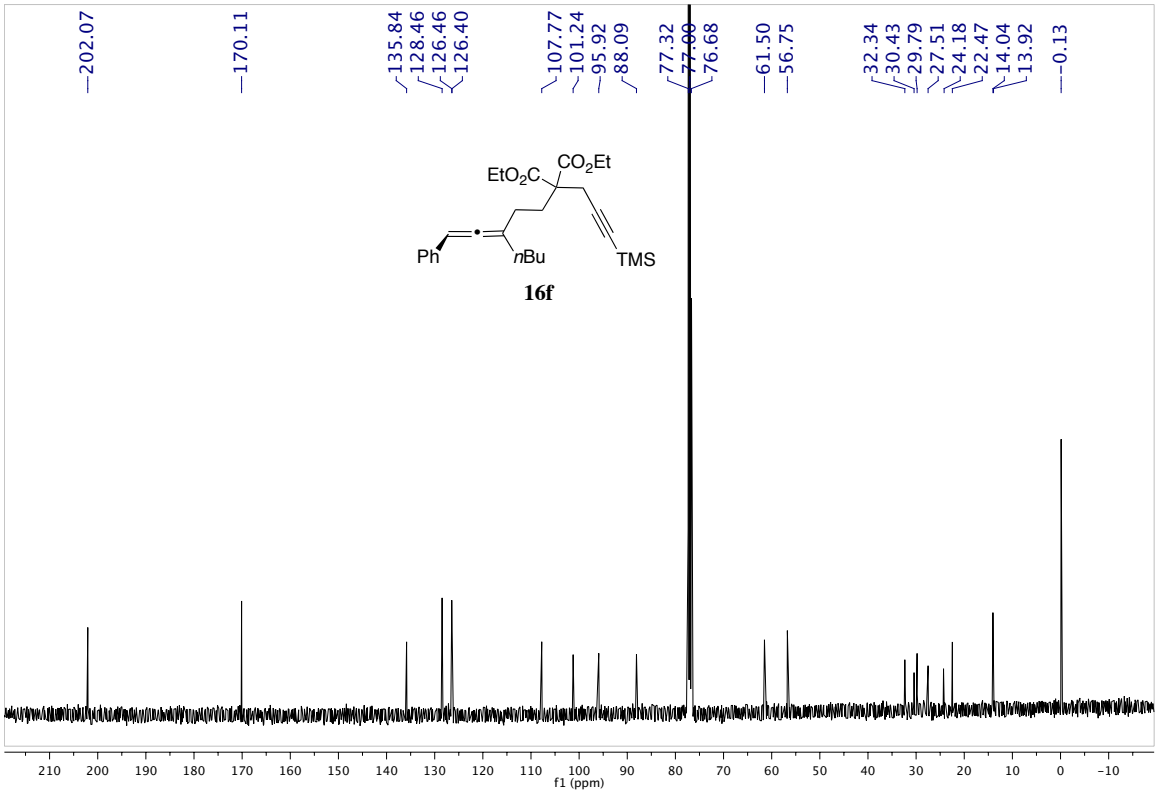


(R_a)-diethyl 2-(3-(2-phenylvinylidene)heptyl)-2-(prop-2-yn-1-yl)malonate (16e):

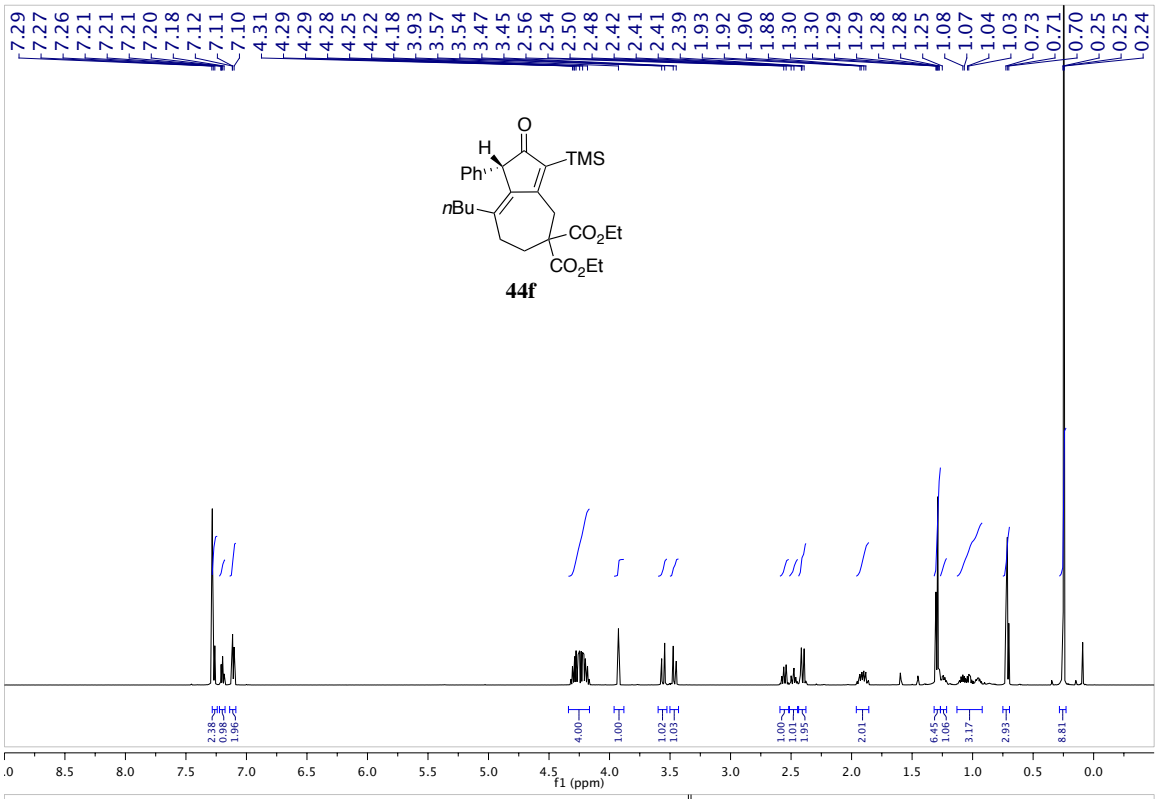


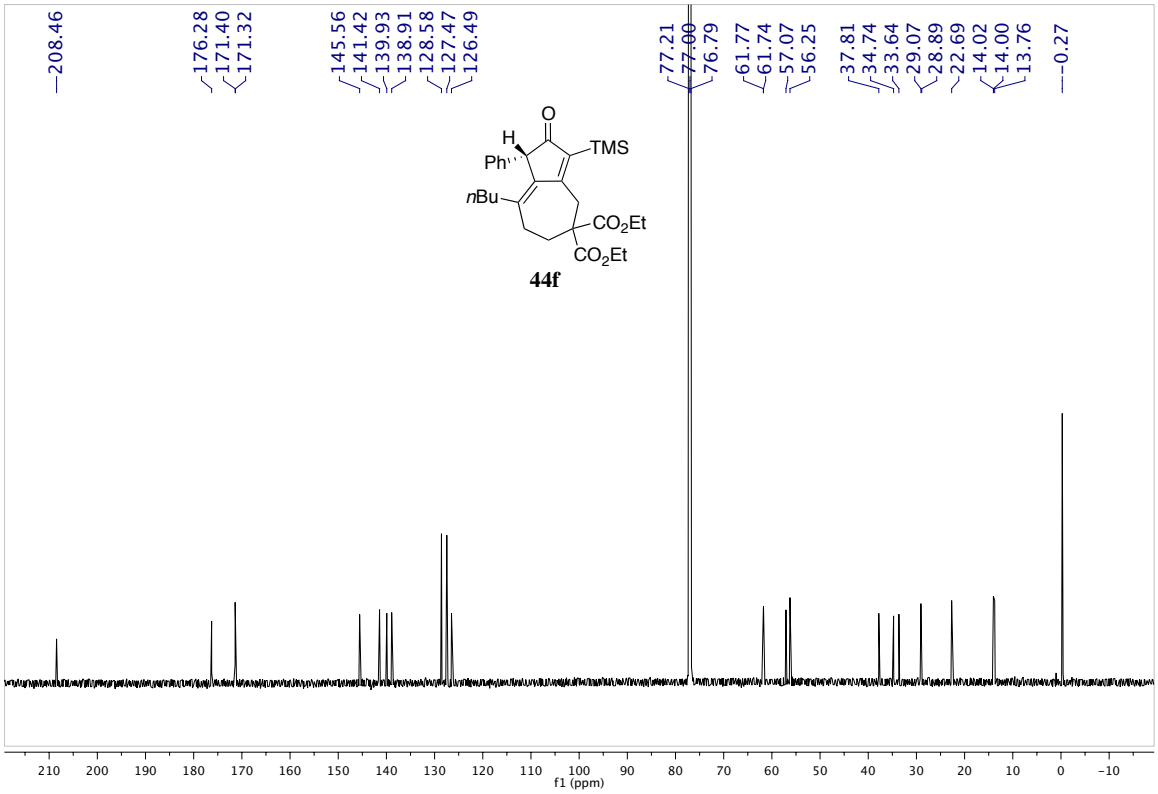
(R_a)-diethyl 2-(3-(2-phenylvinylidene)heptyl)-2-(3-(trimethylsilyl)prop-2-yn-1-yl)malonate (16f):



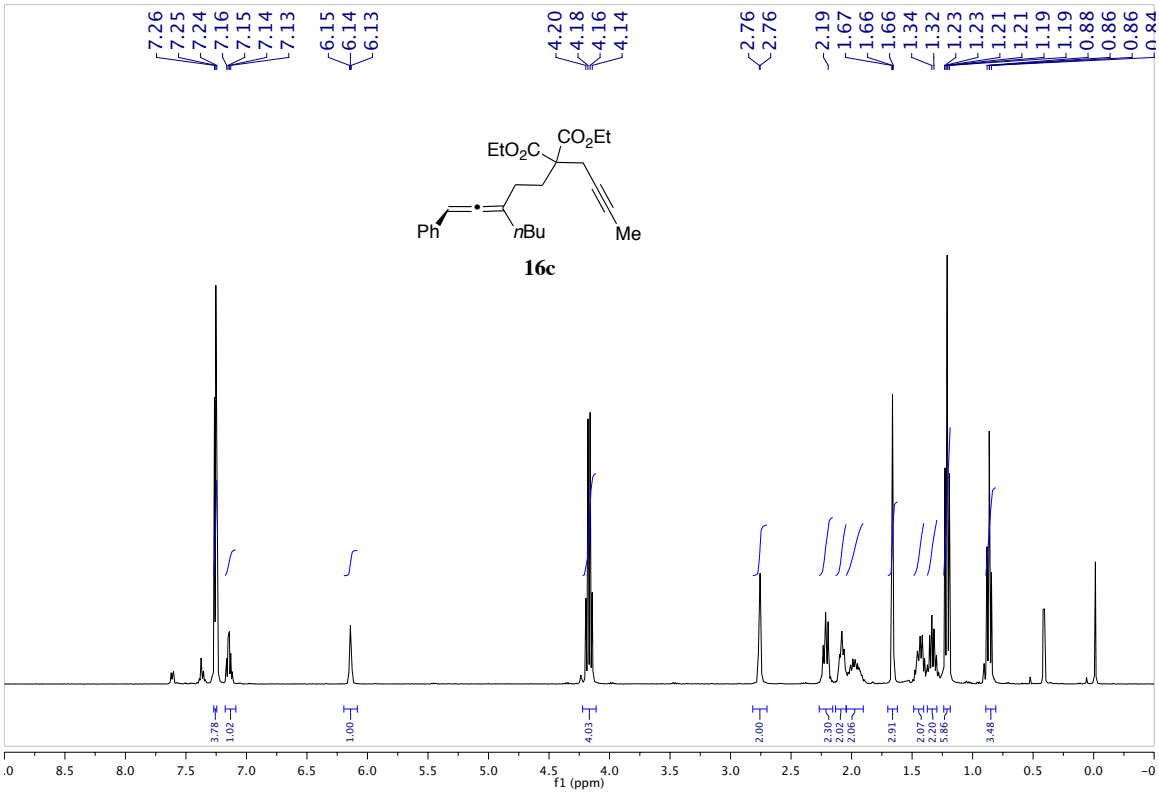


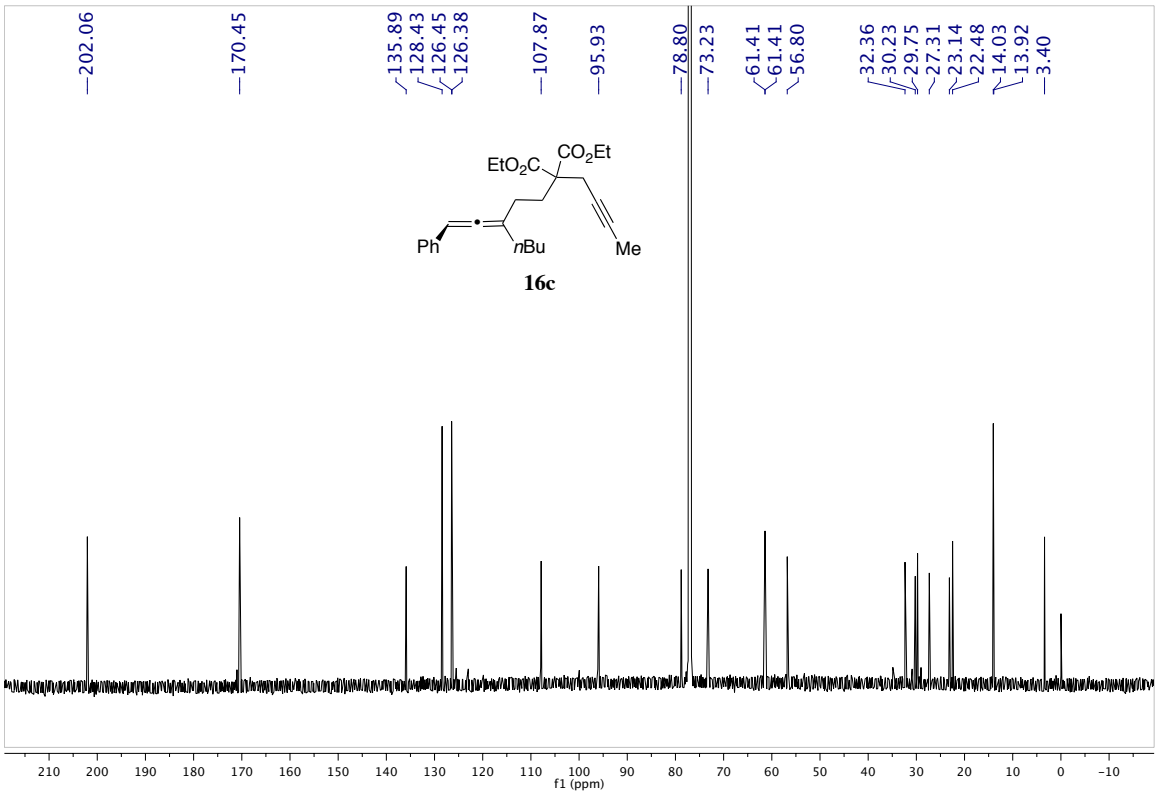
(*S*)-diethyl 8-butyl-2-oxo-1-phenyl-3-(trimethylsilyl)-1,2,6,7-tetrahydro azulene-5,5(4*H*)-dicarboxylate (44f):



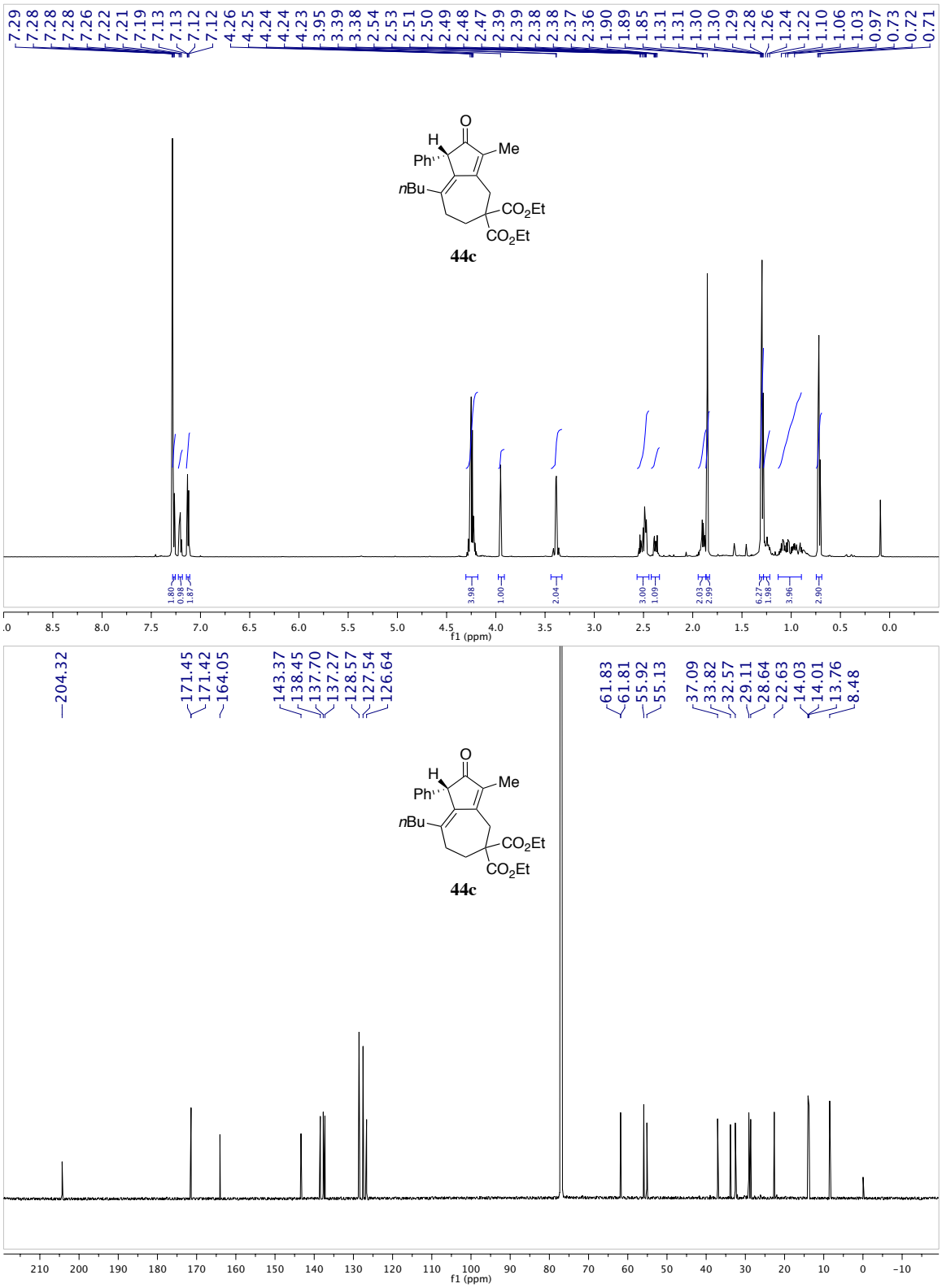


(R_a)-diethyl 2-(but-2-yn-1-yl)-2-(3-(2-phenylvinylidene)heptyl)malonate (16c):

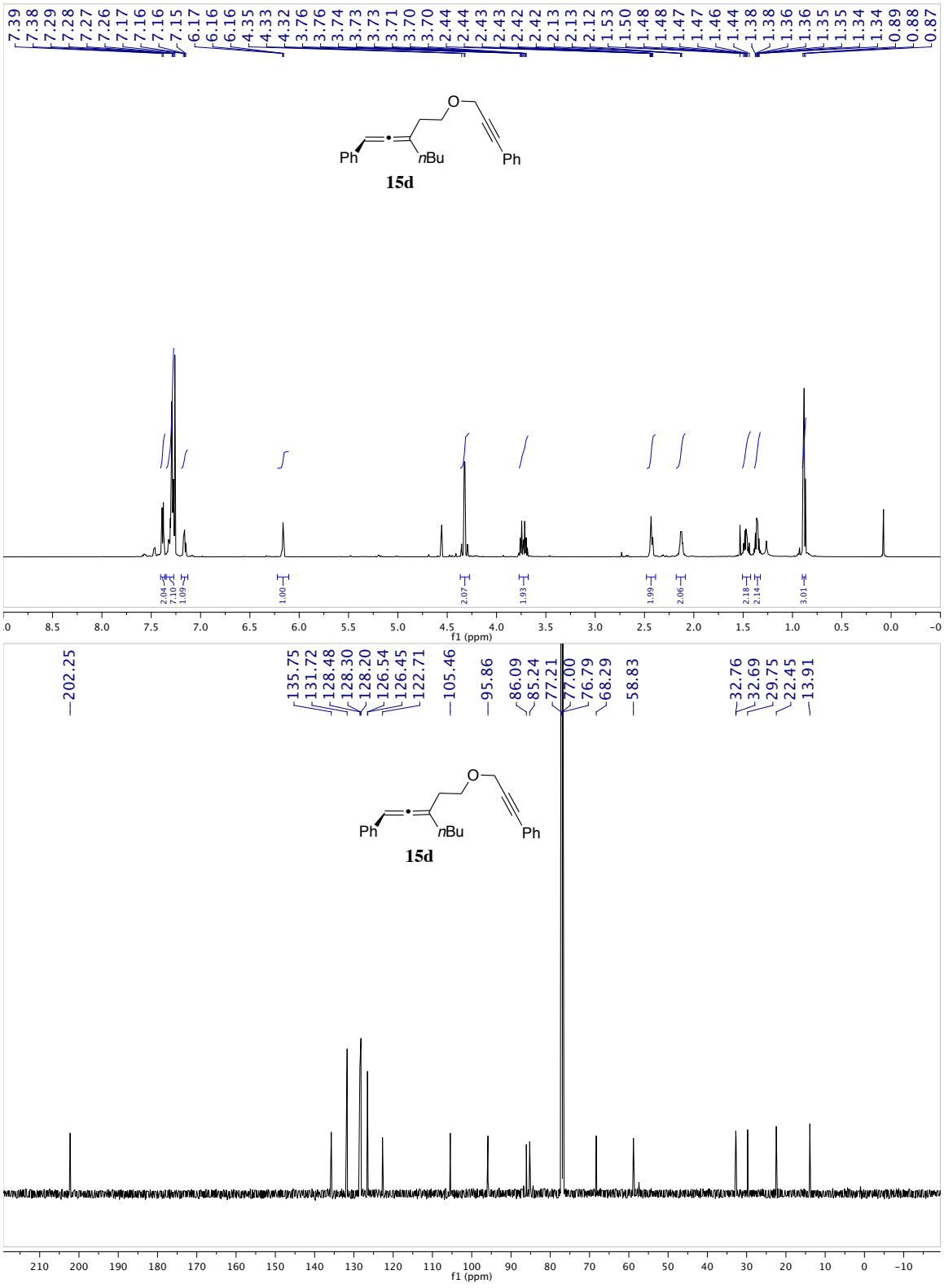




(*S*)-diethyl 8-butyl-3-methyl-2-oxo-1-phenyl-1,2,6,7-tetrahydroazulene-5,5 (4*H*)-dicarboxylate (44c):

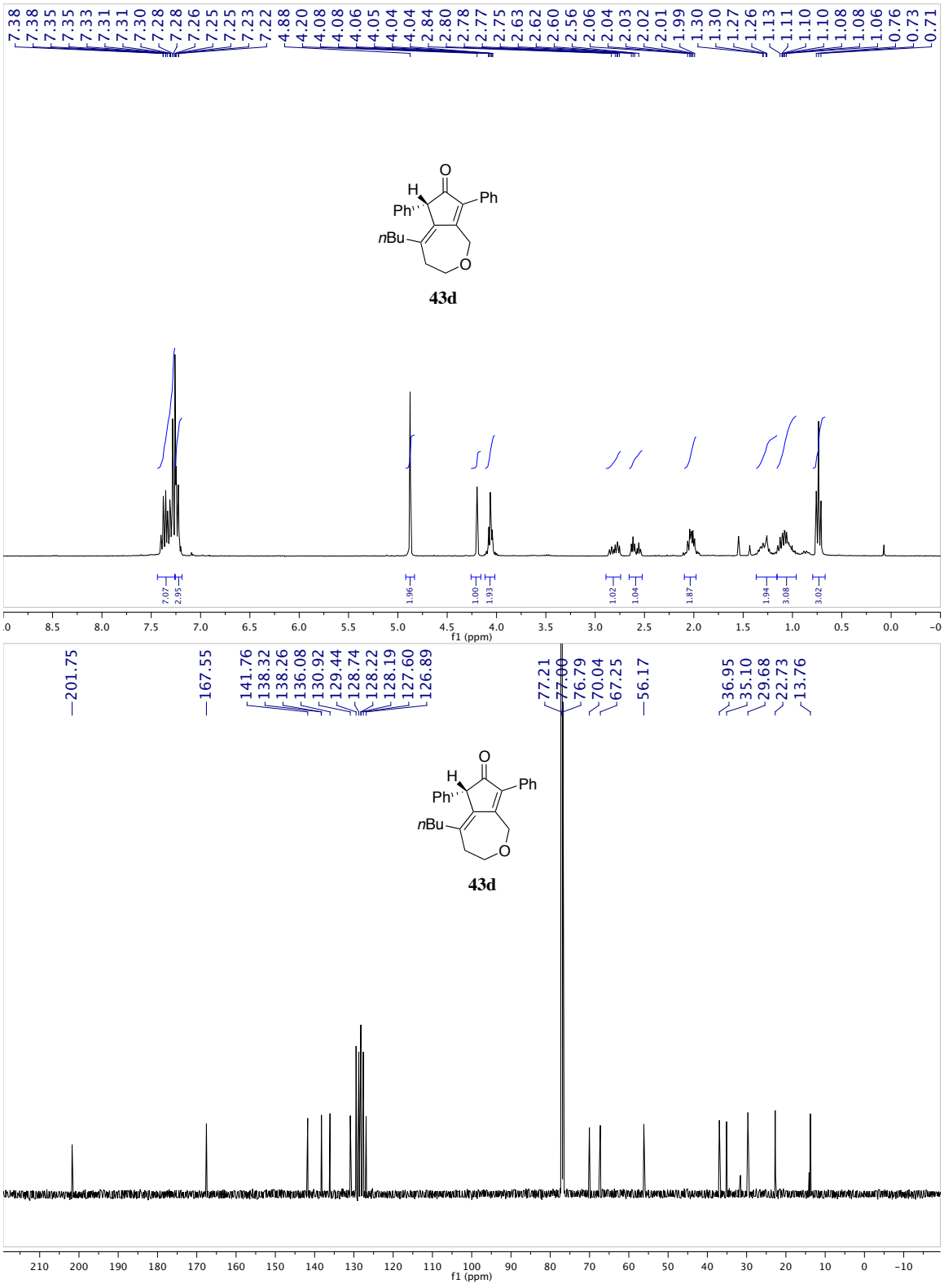


(R_a)-(3-(2-((3-phenylprop-2-yn-1-yl)oxy)ethyl)hepta-1,2-dien-1-yl)benzene (15d):

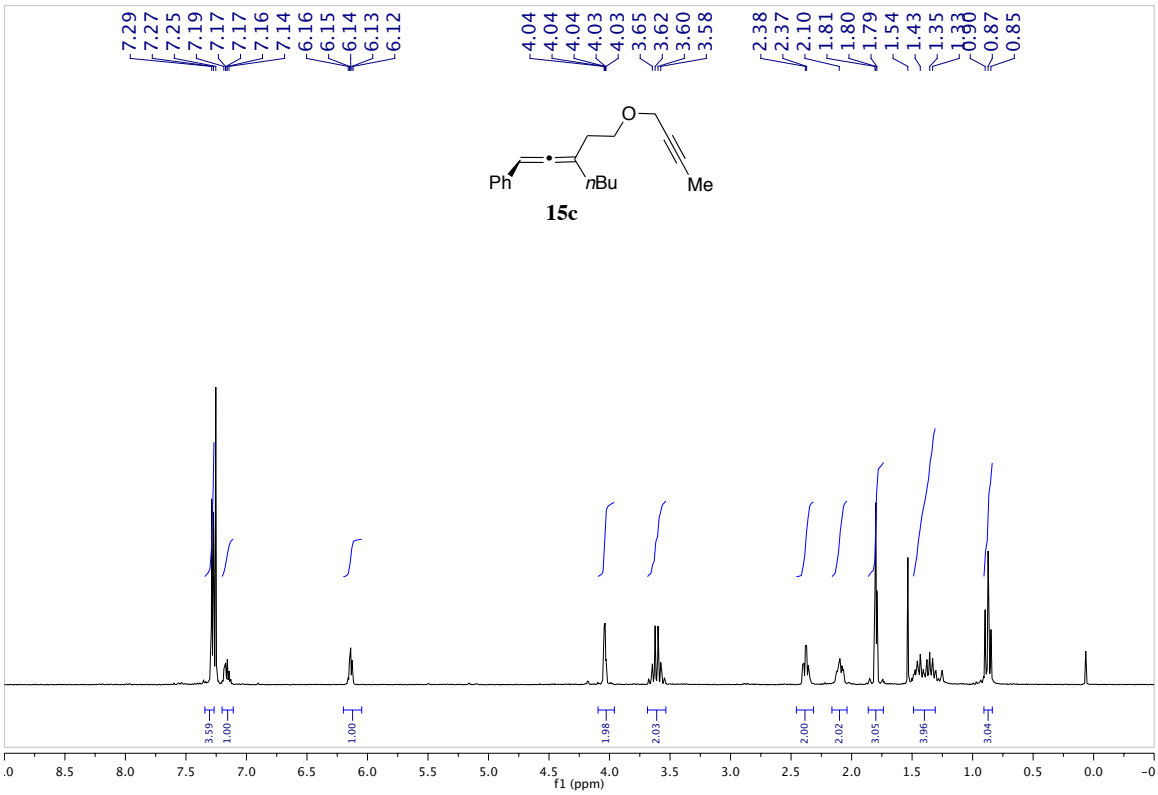


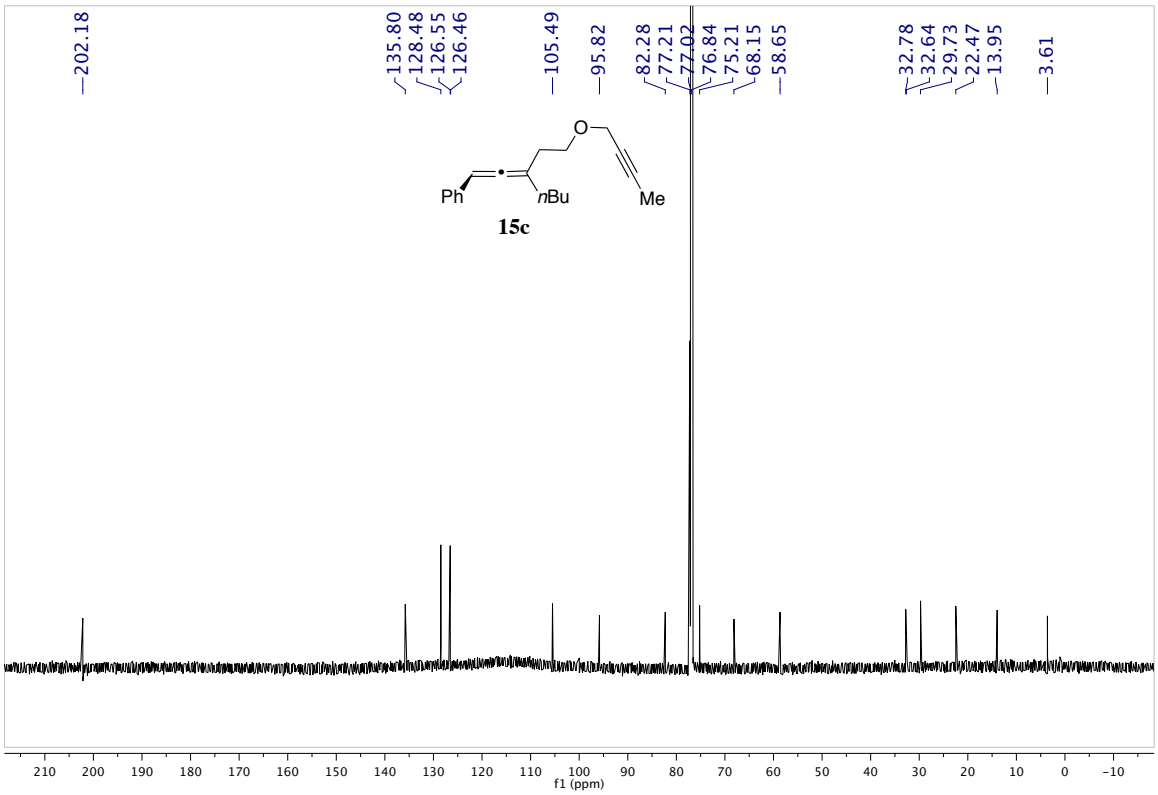
(*S*)-5-butyl-6,8-diphenyl-3,4-dihydro-1*H*-cyclopenta[*c*]oxepin-7(6*H*)-one

(43d):

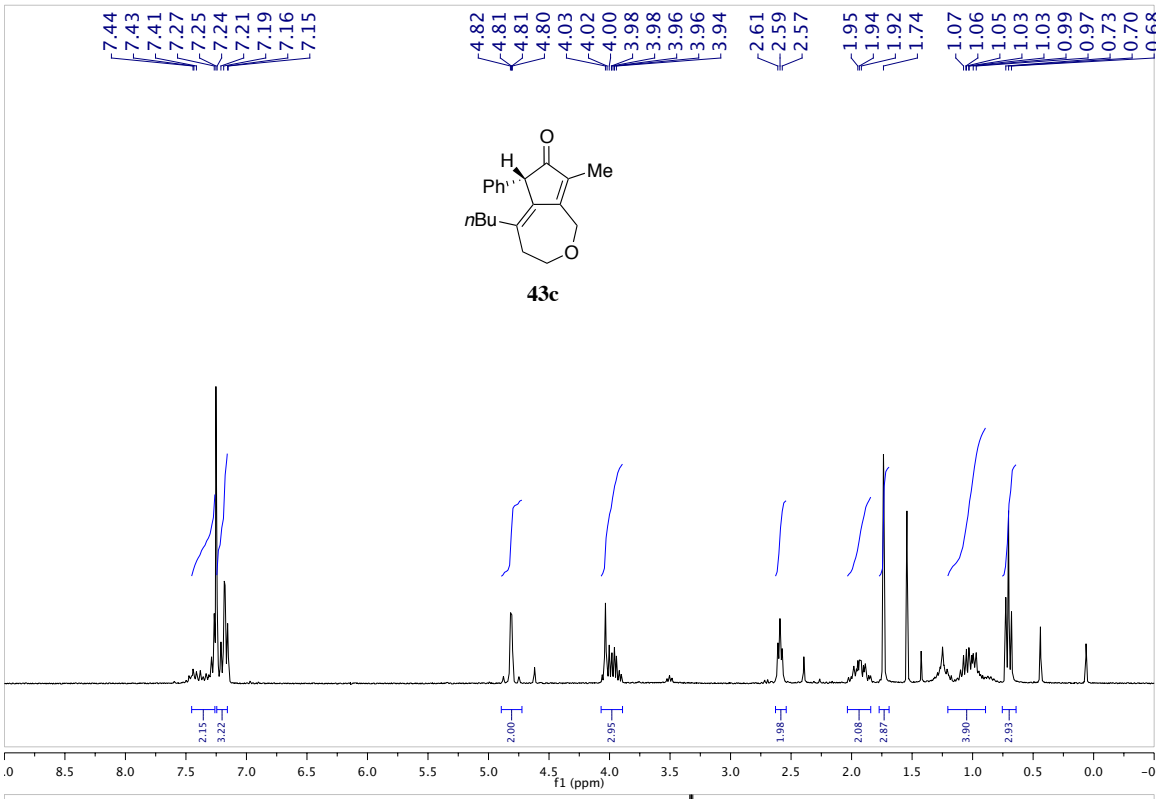


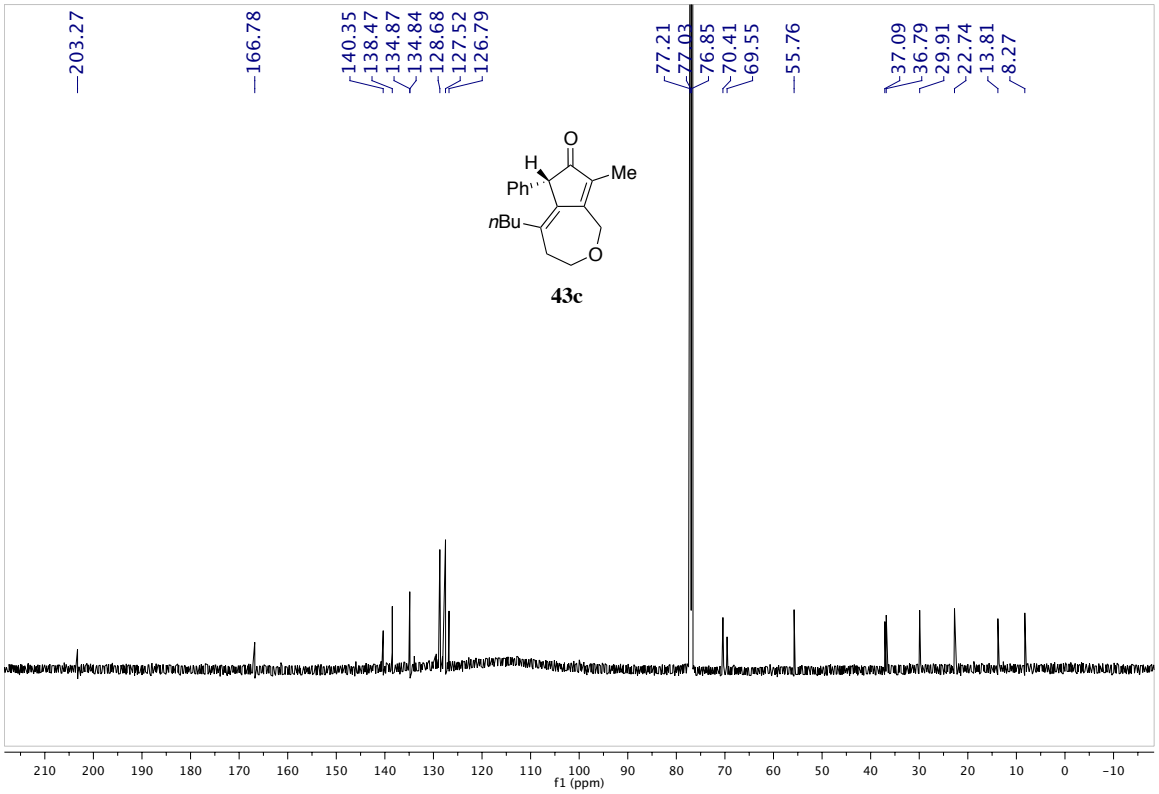
(R_a)-(3-(2-(but-2-yn-1-yloxy)ethyl)hepta-1,2-dien-1-yl)benzene (15c):



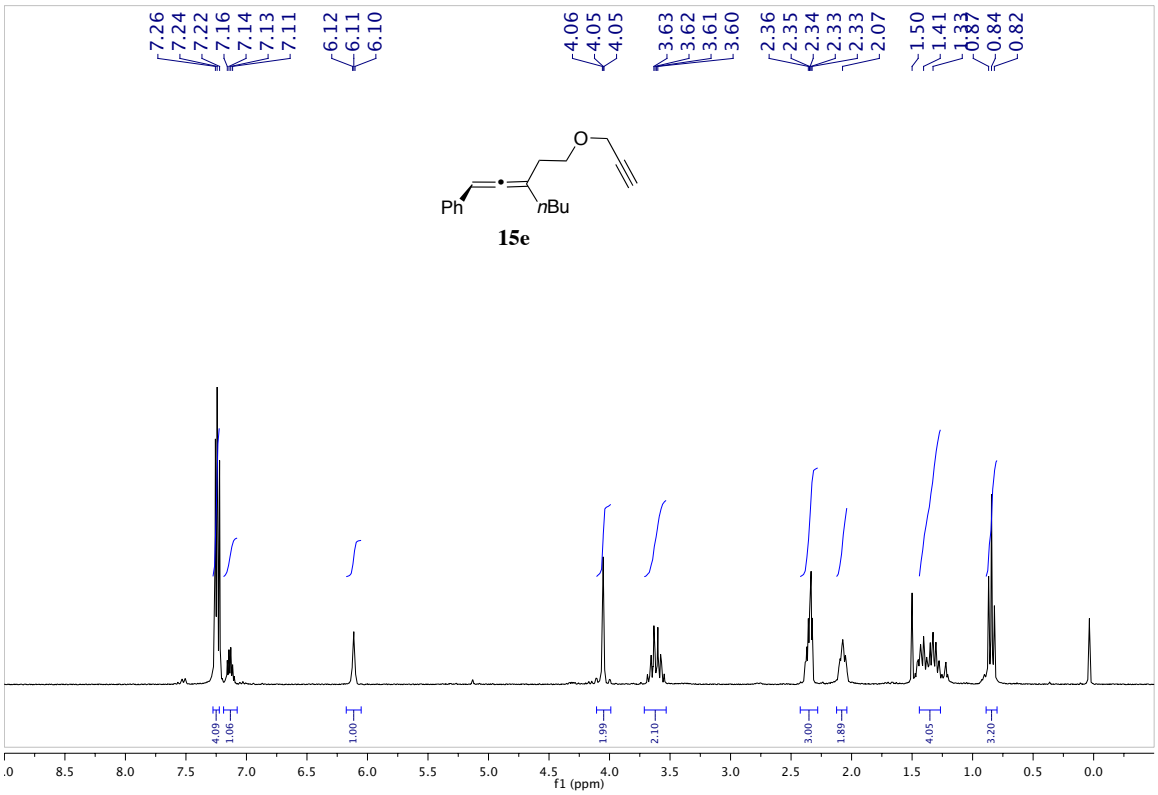


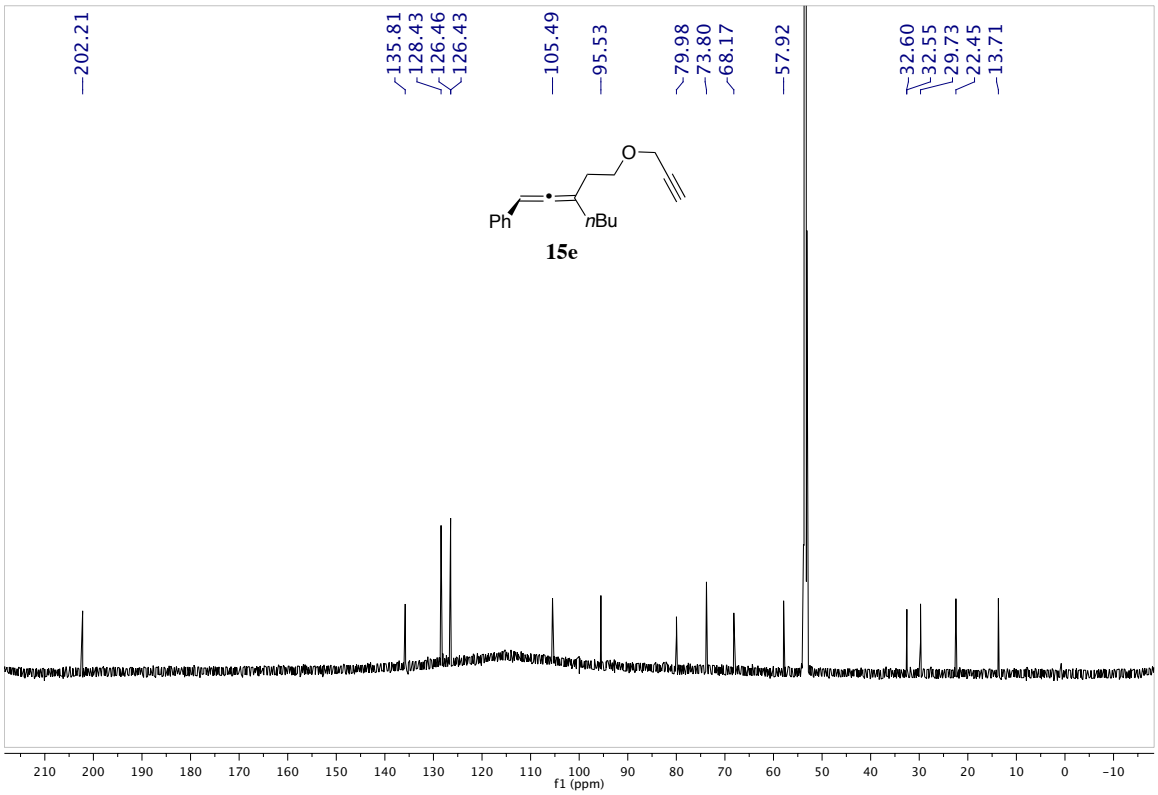
(*S*)-5-butyl-8-methyl-6-phenyl-3,4-dihydro-1*H*-cyclopenta[*c*]oxepin-7(6*H*)-one (43c):



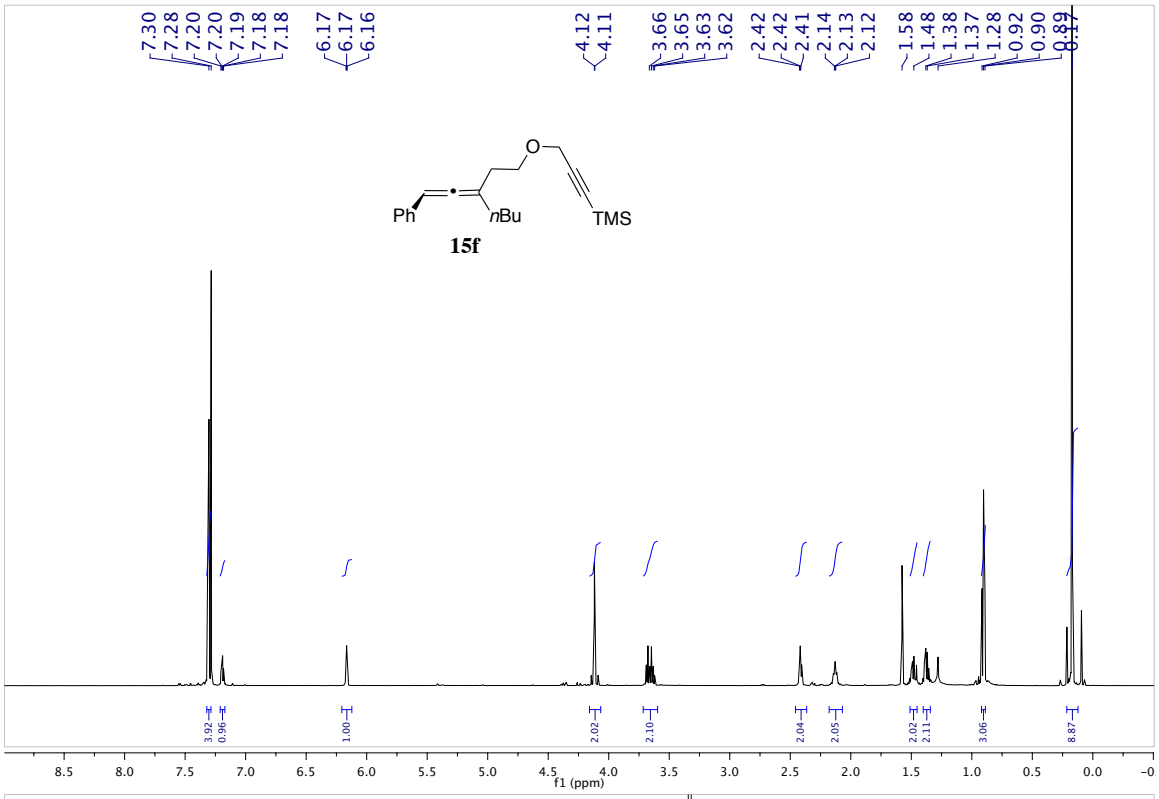


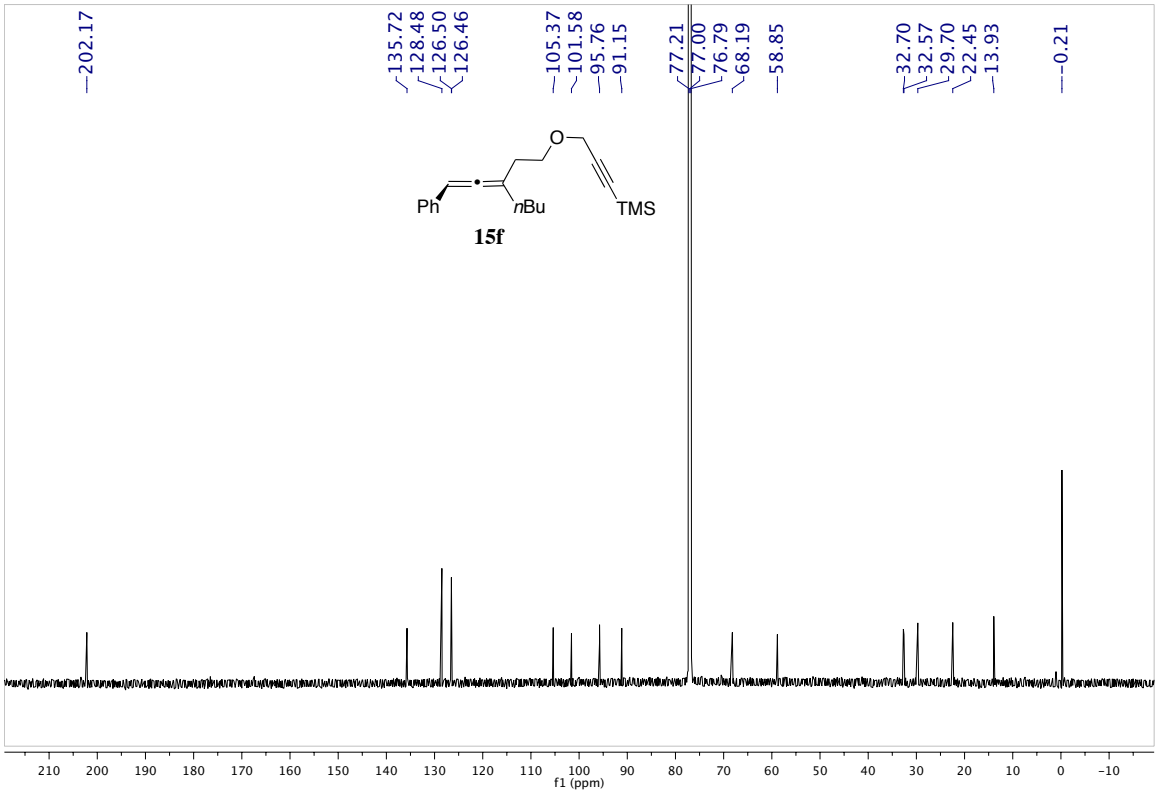
(R_a)-(3-(2-(prop-2-yn-1-yloxy)ethyl)hepta-1,2-dien-1-yl)benzene (15e):



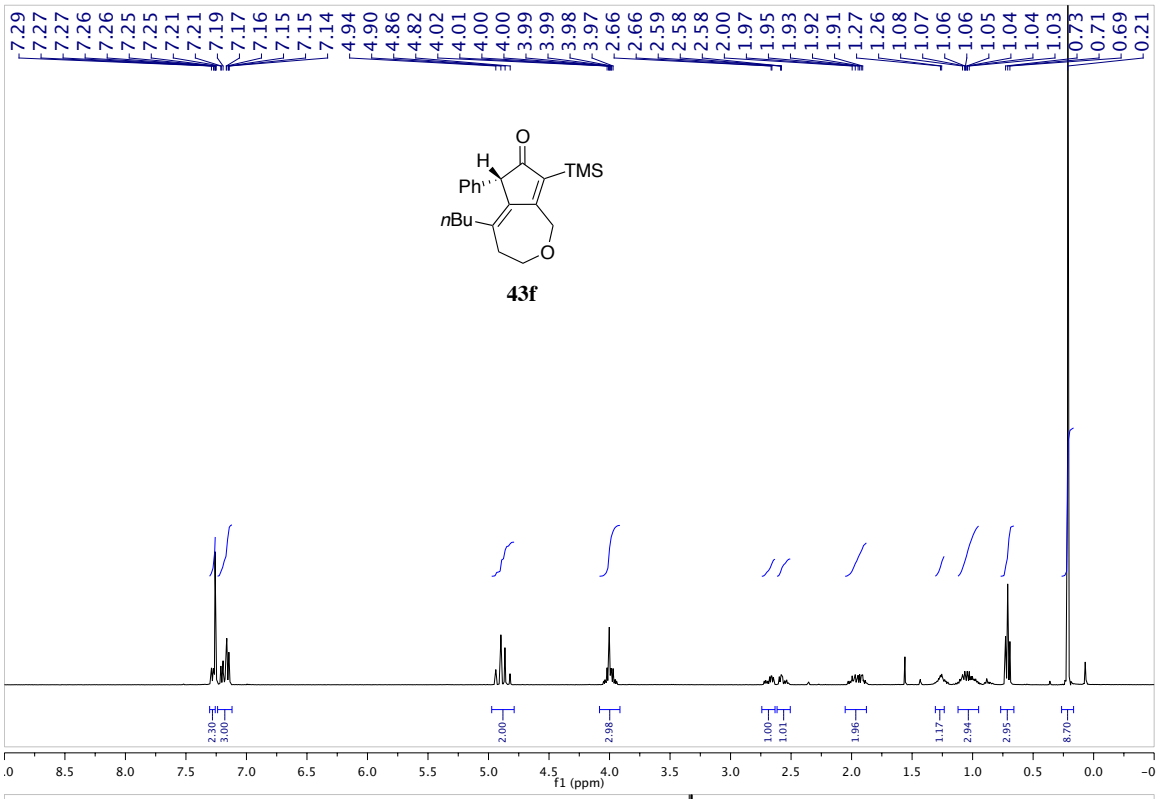


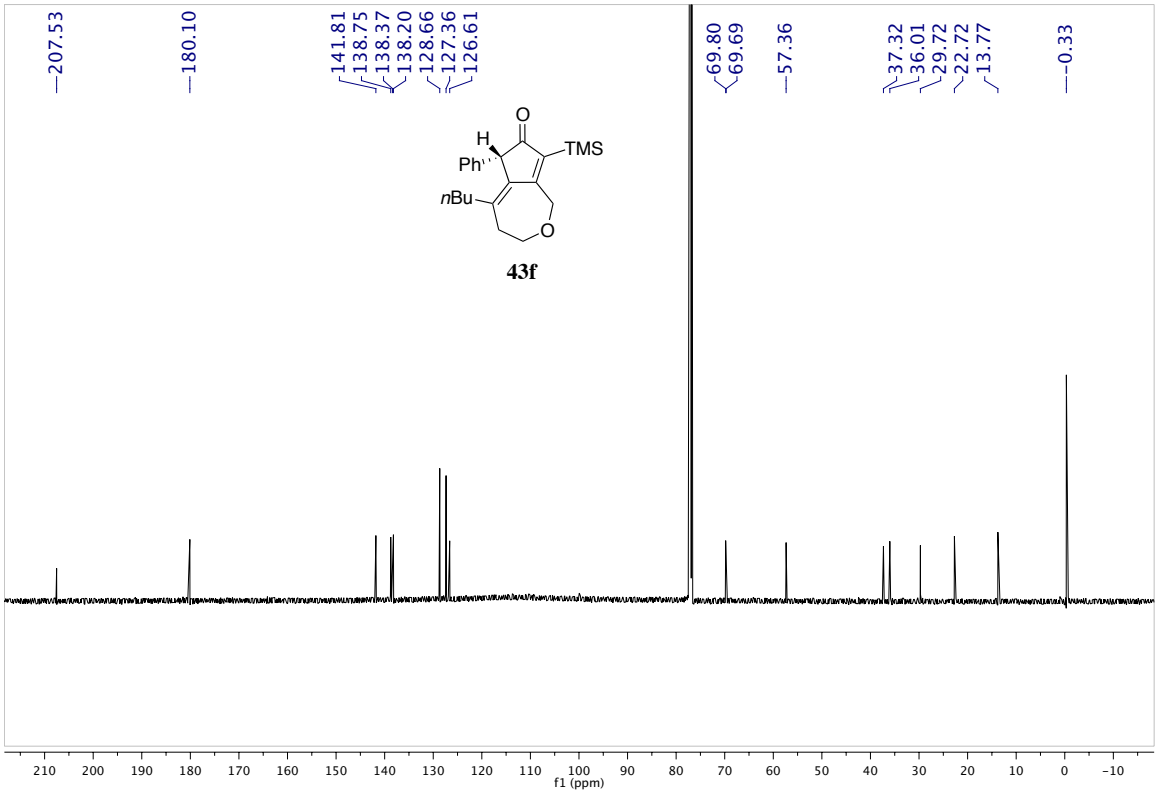
(R_a)-trimethyl(3-((3-(2-phenylvinylidene)heptyl)oxy)prop-1-yn-1-yl)silane (15f):



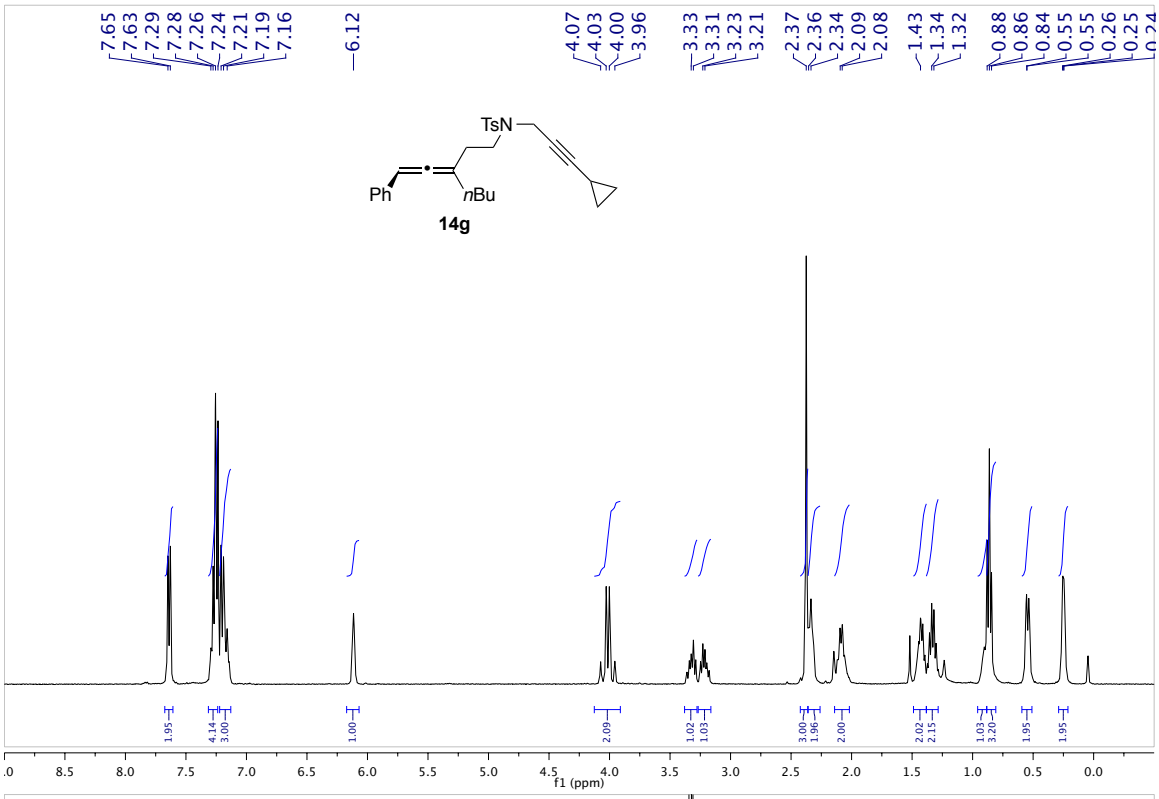


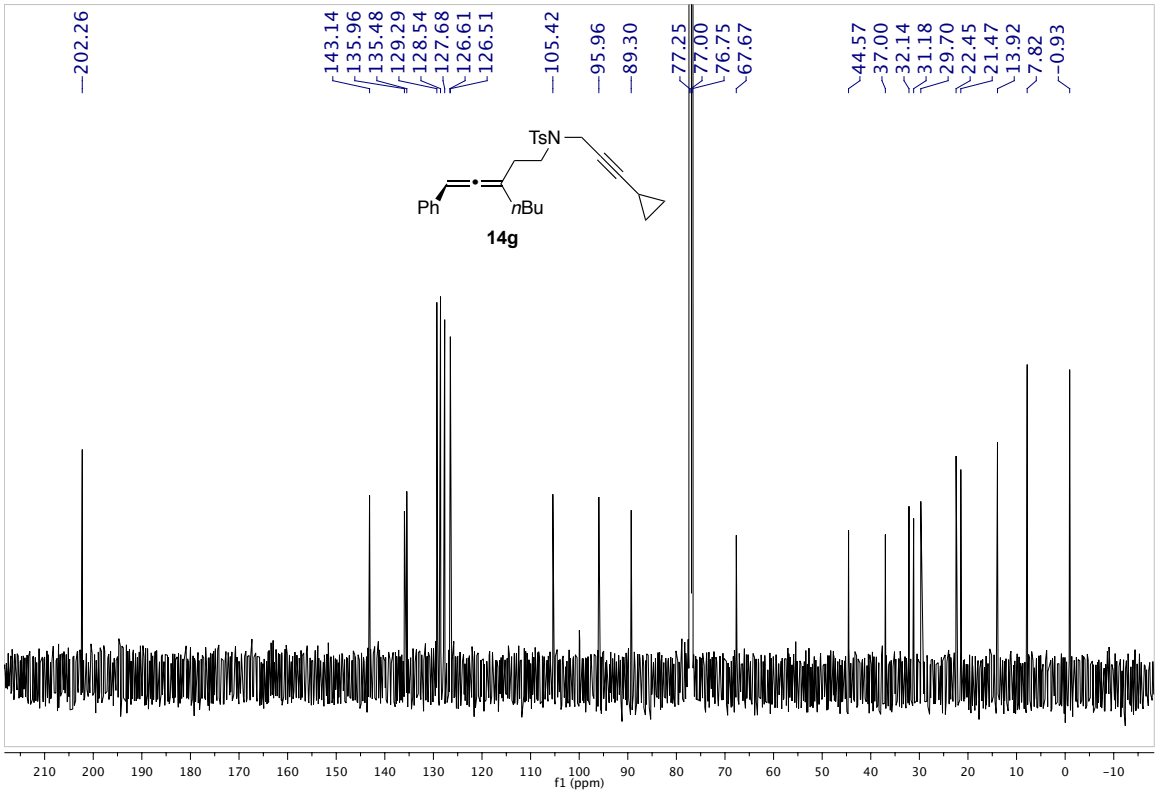
(*S*)-5-butyl-6-phenyl-8-(trimethylsilyl)-3,4-dihydro-1*H*-cyclopenta[*c*]oxepin-7(6*H*)-one (43f):



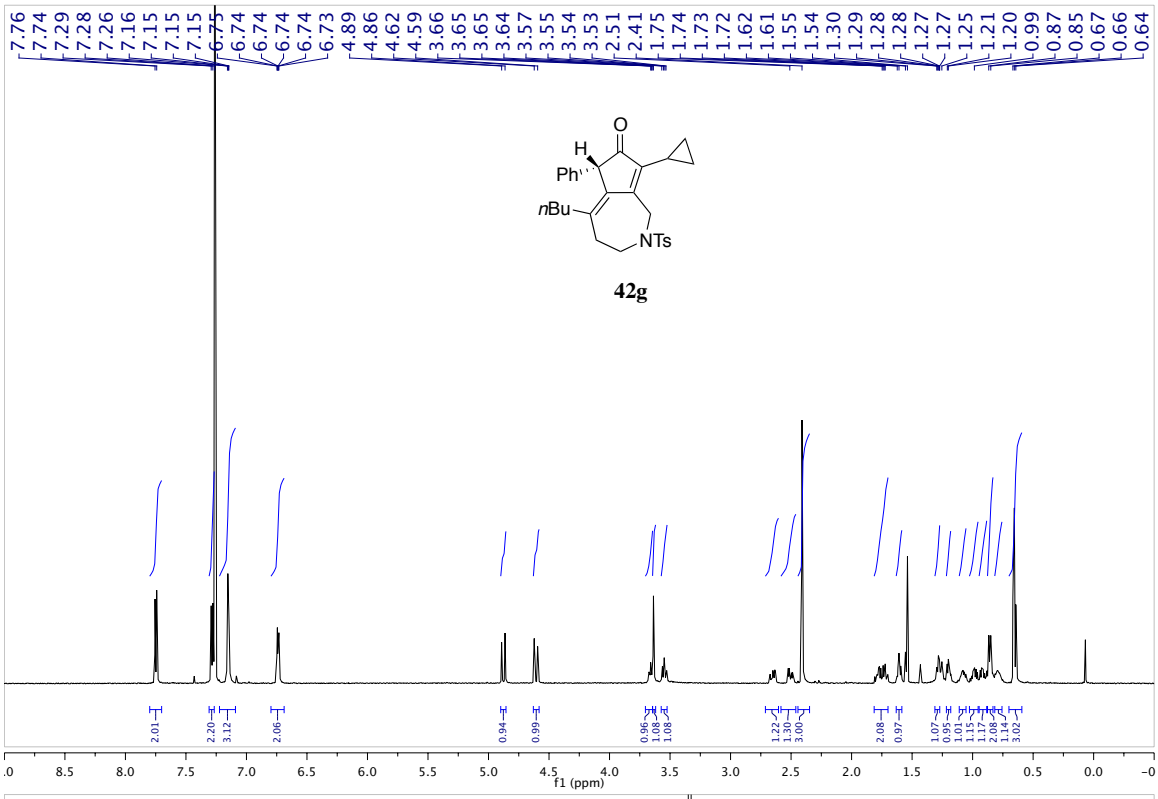


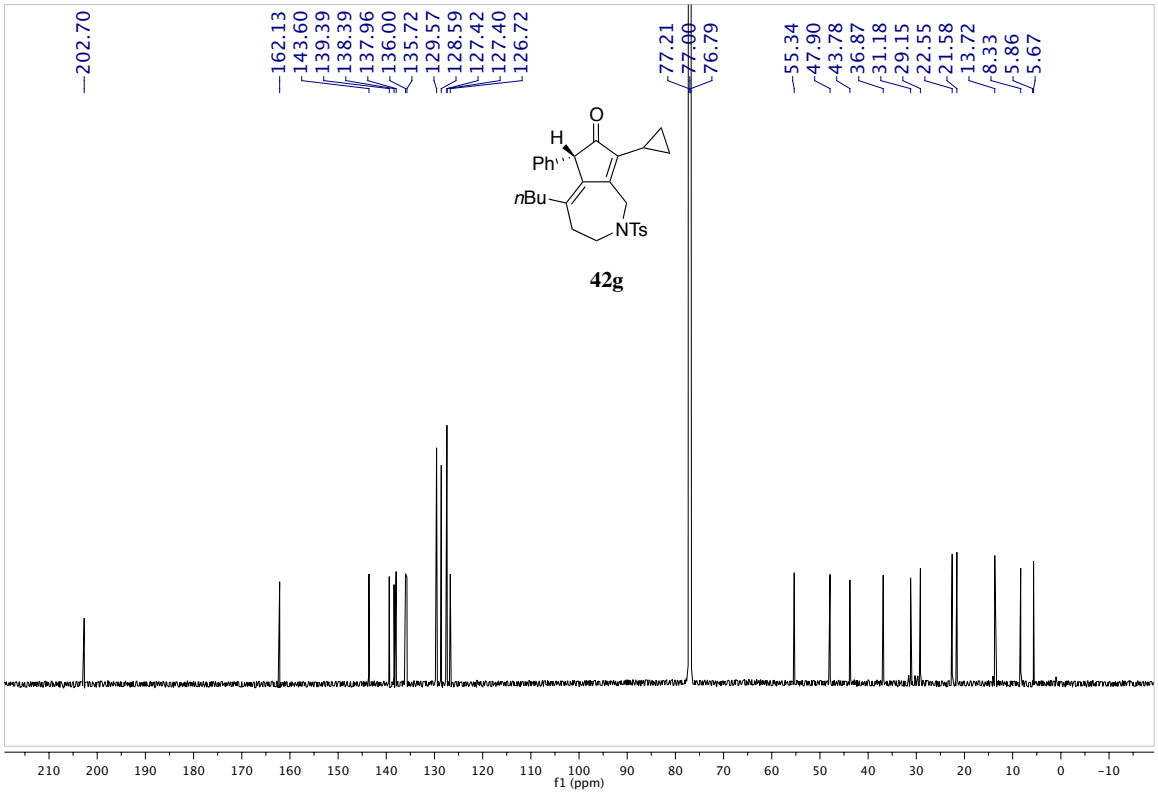
(R_a)-*N*-(3-cyclopropylprop-2-yn-1-yl)-4-methyl-*N*-(3-(2-phenylvinylidene) heptyl)benzenesulfonamide (14g):



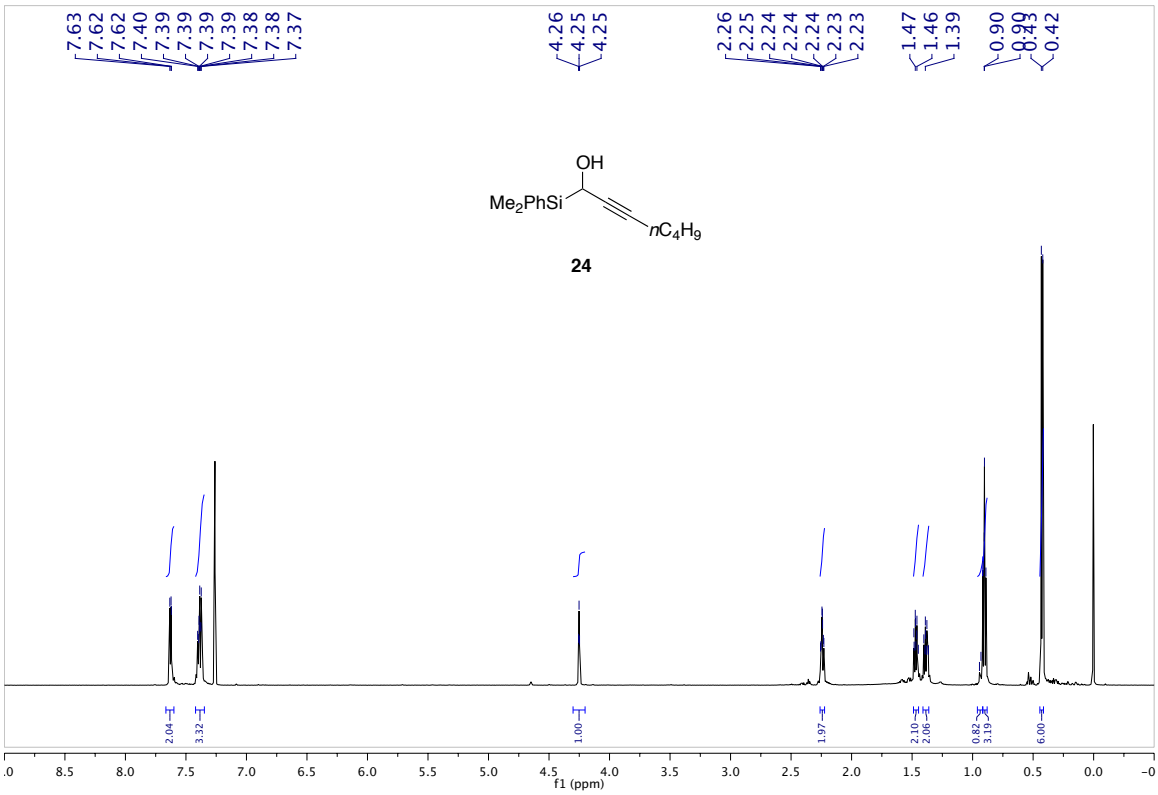


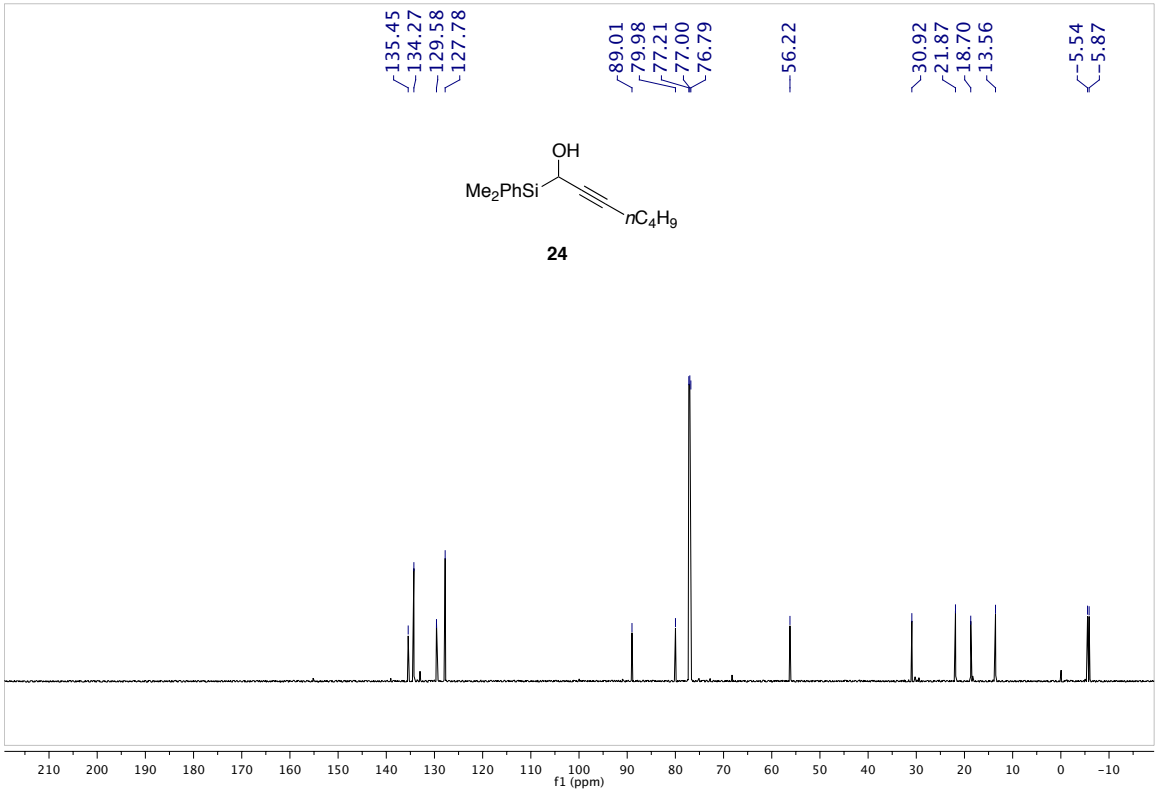
(*S*)-5-butyl-8-cyclopropyl-6-phenyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta [*c*]azepin-7(6*H*)-one (42g):



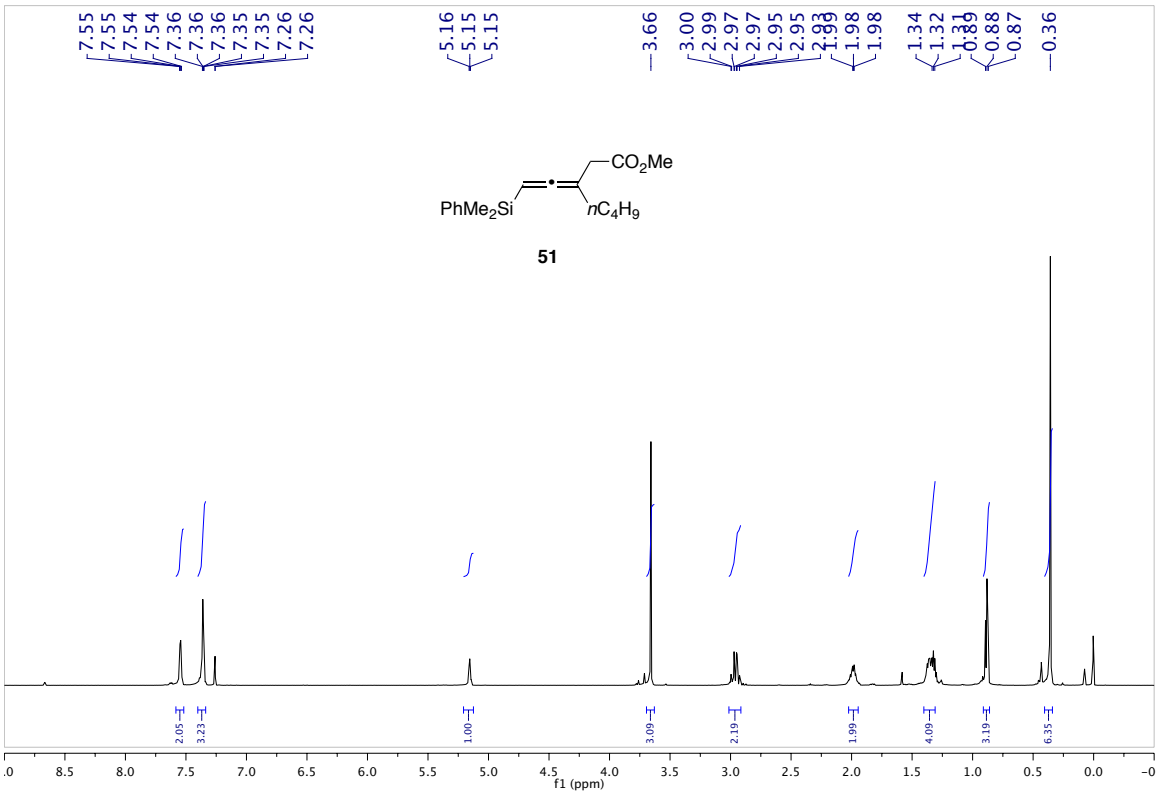


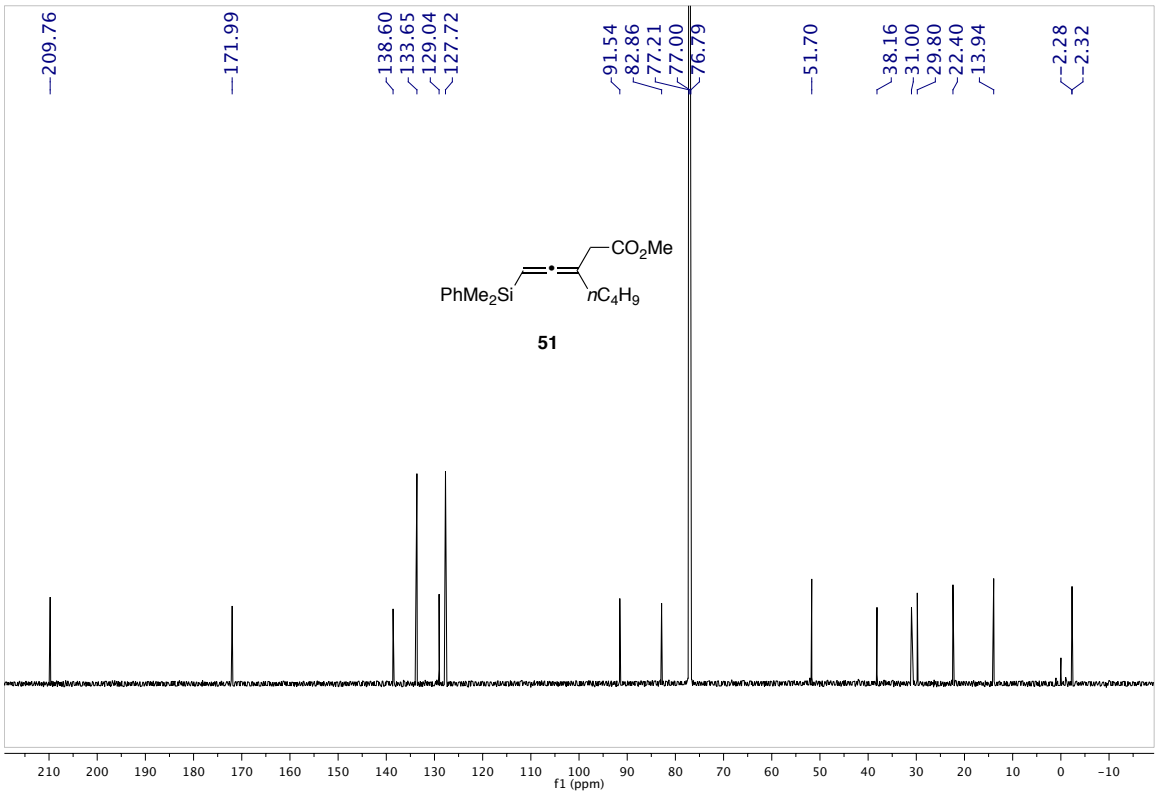
1-(dimethyl(phenyl)silyl)hept-2-yn-1-ol (24):



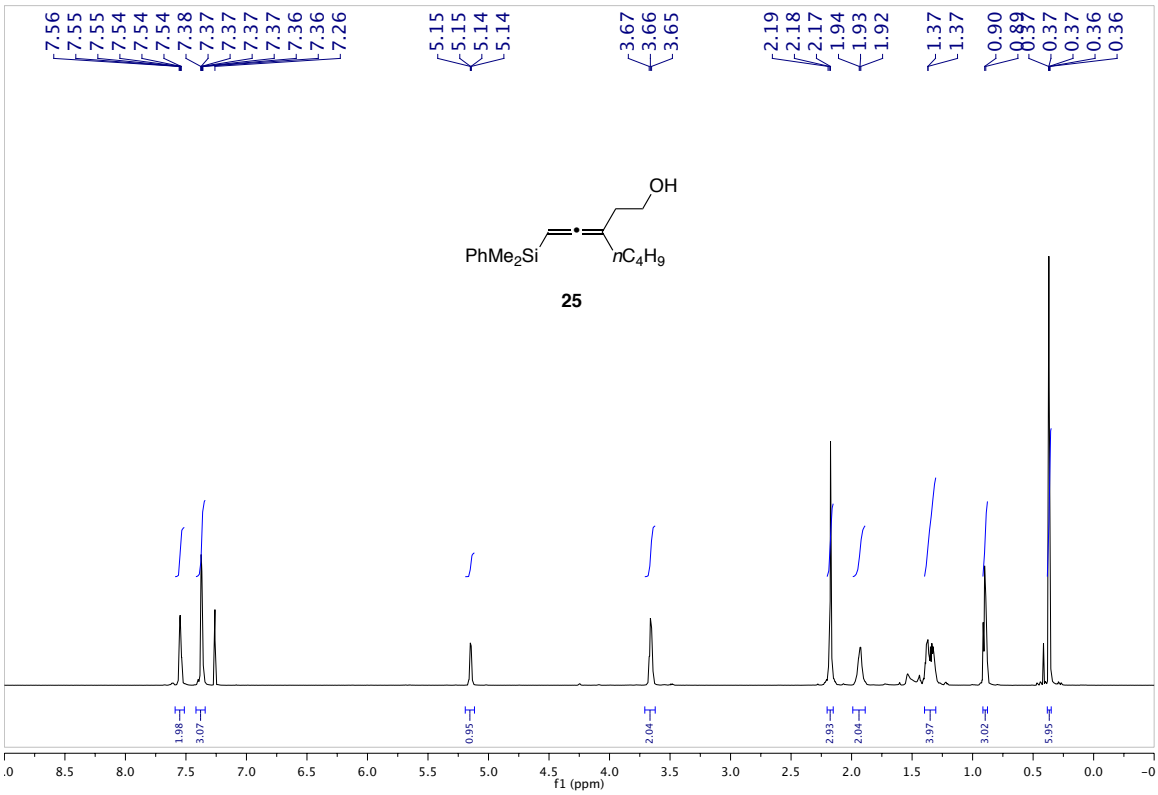


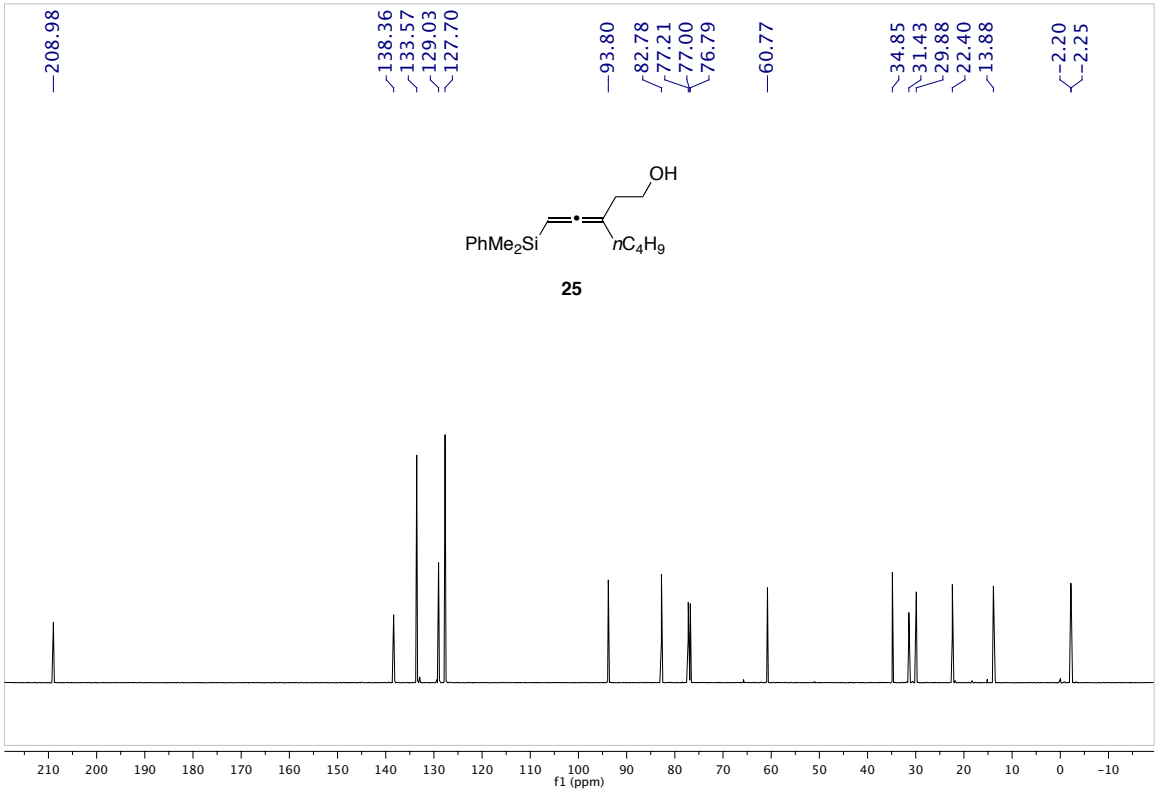
Methyl 3-(2-(dimethyl(phenyl)silyl)vinylidene)heptanoate (51):



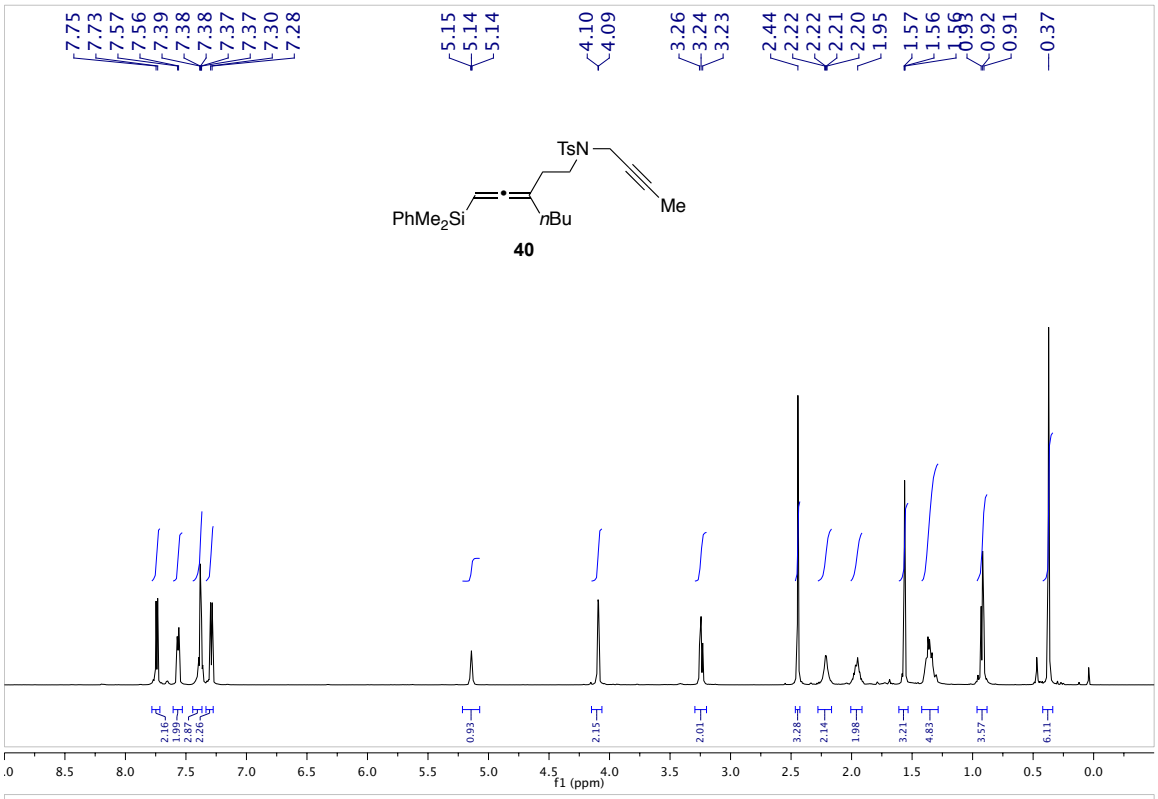


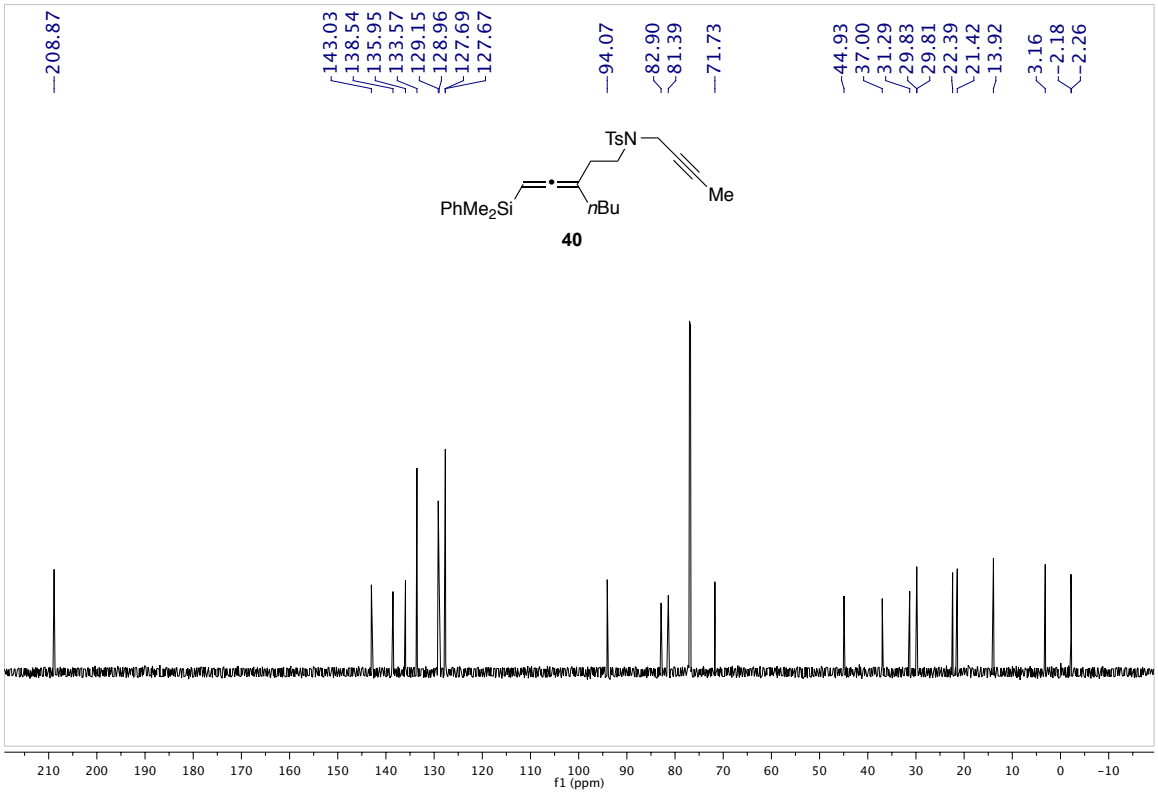
3-(2-(dimethyl(phenyl)silyl)vinylidene)heptan-1-ol (25):



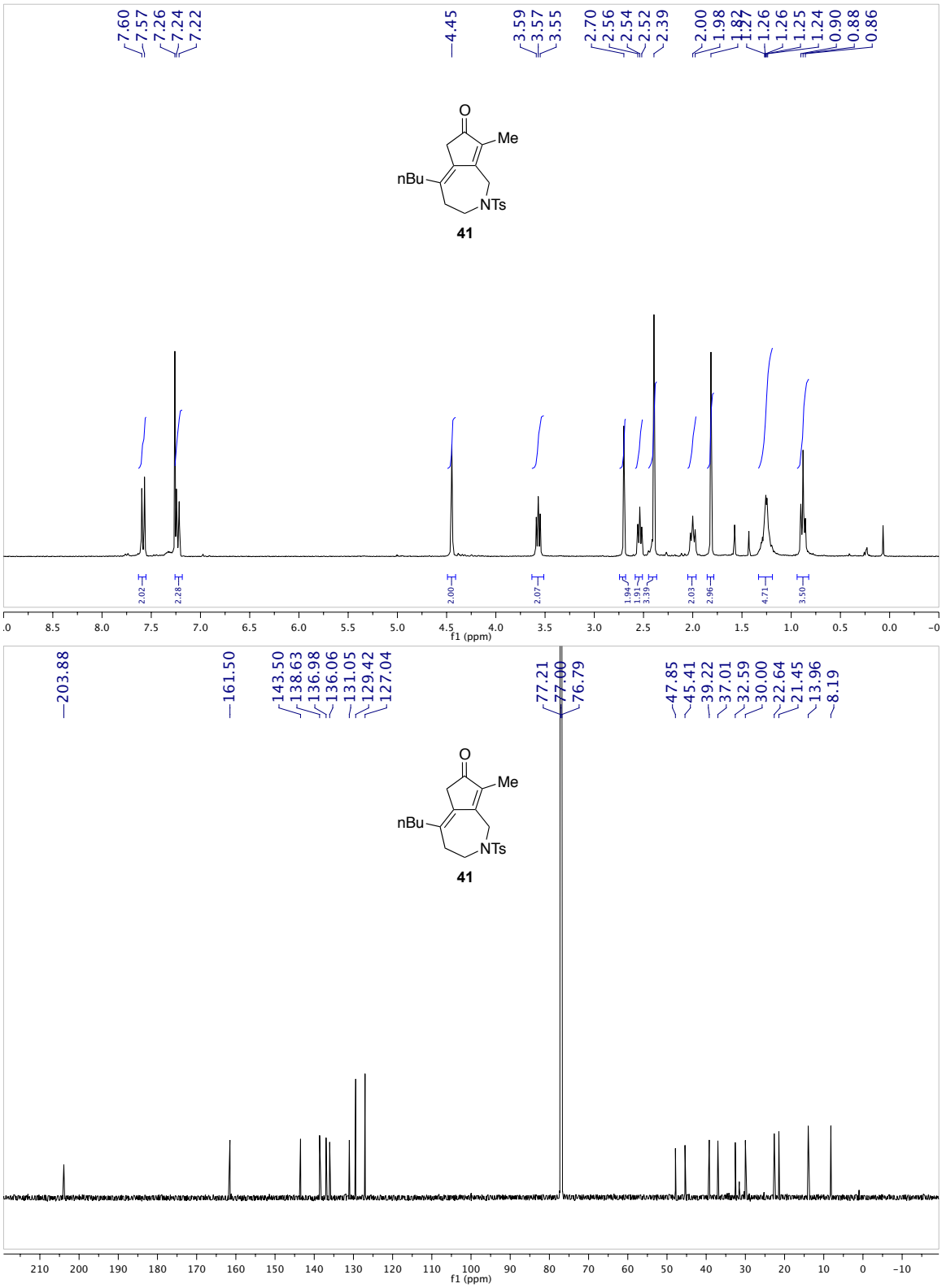


***N*-(but-2-yn-1-yl)-*N*-(3-(2-(dimethyl(phenyl)silyl)vinylidene)heptyl)-4-methyl benzenesulfonamide (40):**

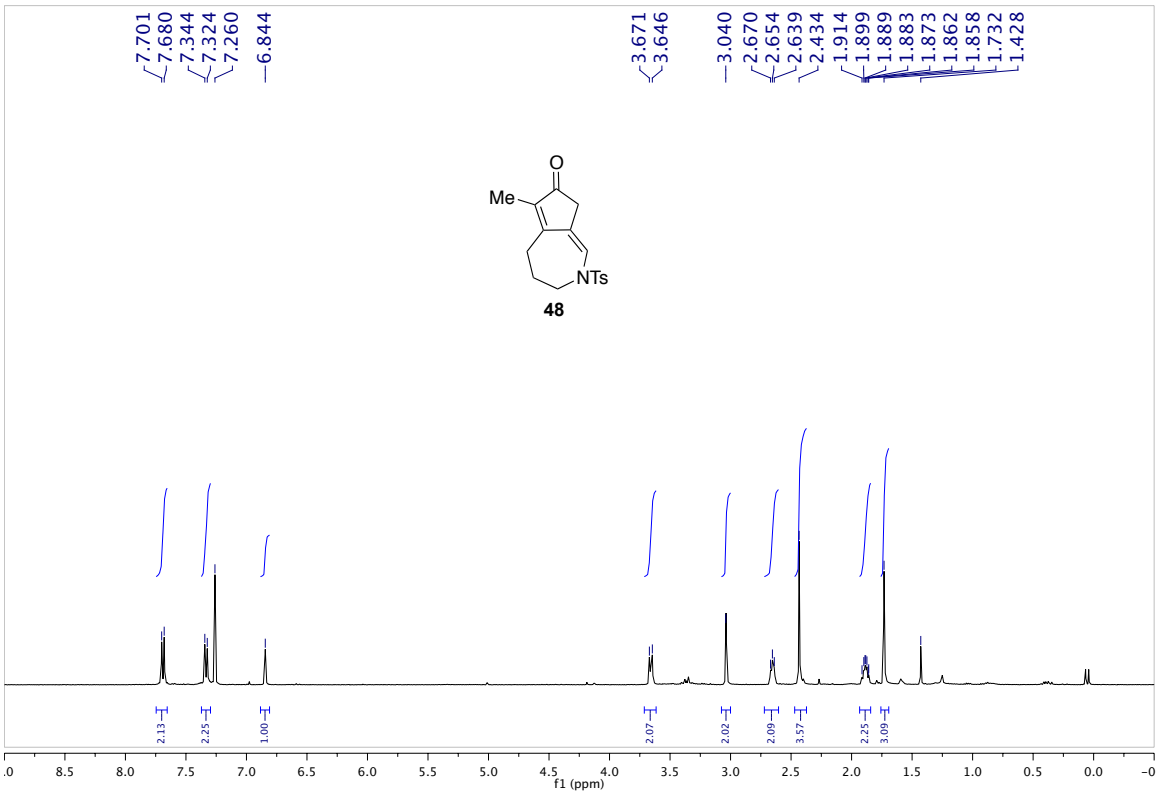


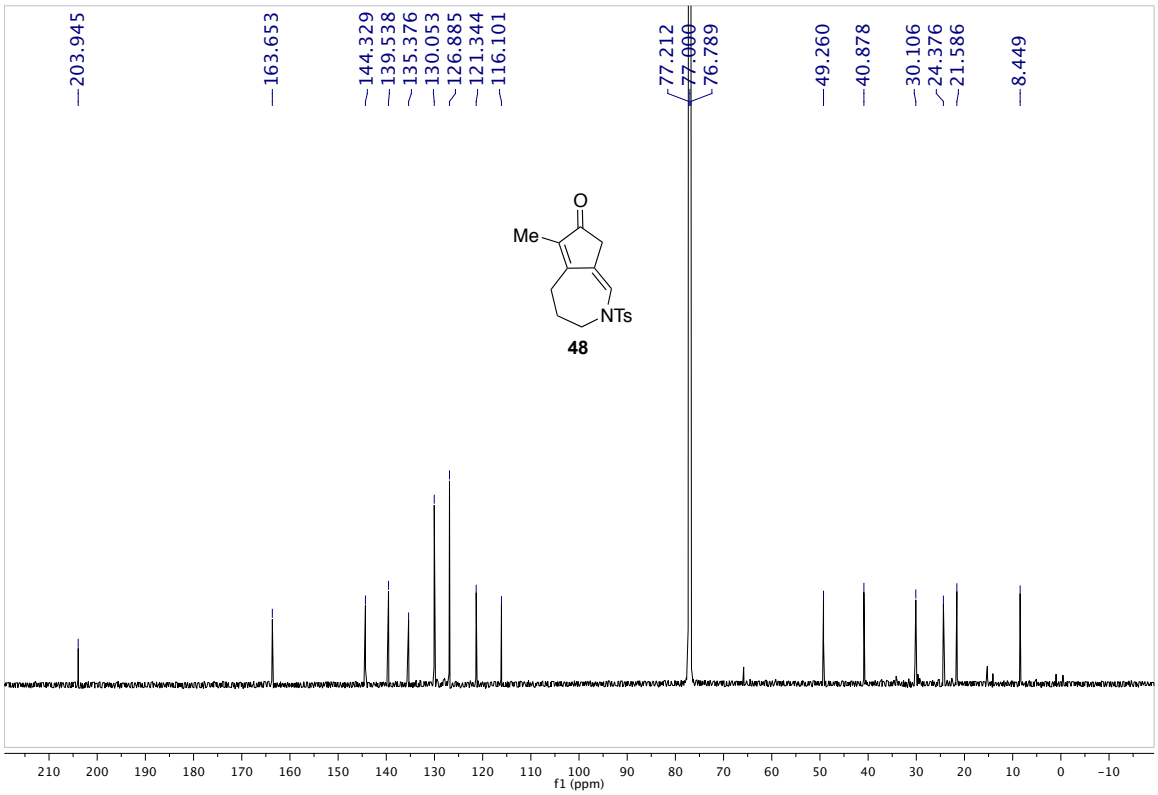


5-butyl-8-methyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[c]azepin-7(6H)-one (41):



6-methyl-2-tosyl-2,3,4,5-tetrahydrocyclopenta[*c*]azepin-7(1*H*)-one (48):





HPLC and SFC analysis

(R_a)-hexa-3,4-dien-1-yl 4-nitrobenzoate (27) :

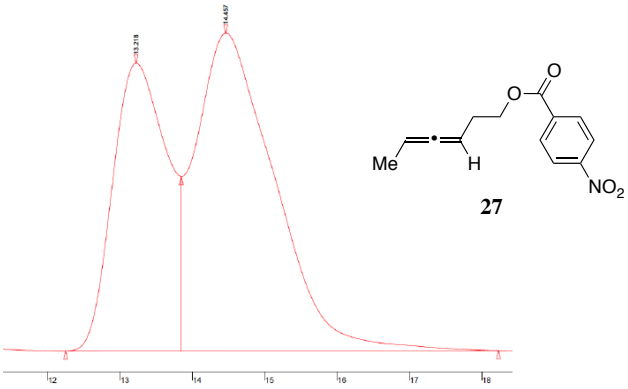
The enantiomeric purity of compound **27** was determined by HPLC analysis run on a ChiralCel OD column eluting in 0.5% 2-Propanol/Hexanes, with a 10.0 µL injection and a 0.7 mL/min flow rate. Compound **27** has >99% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**27** exhibiting peaks with retention times of 13.2 and 14.5 minutes, and the enantioenriched compound **27** exhibiting a major peak with a retention time of 14.5 minutes (minor enantiomer has a retention time of 12.5 minutes).

Values for the racemic compound :

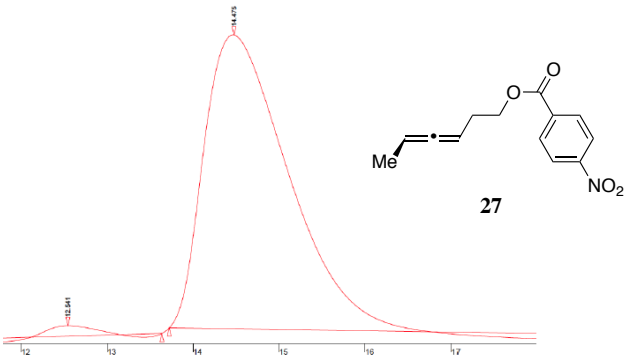
Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
13.218	0.000	25468534	BV	0.0
14.457	0.000	40797532	VB	84.3

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
12.541	0.000	245811	BB	51.4
14.475	0.000	56005160	BB	63.8



27



27

(*S*)-6-methyl-8-phenyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[*c*]azepin-7(6*H*)-one (45d):

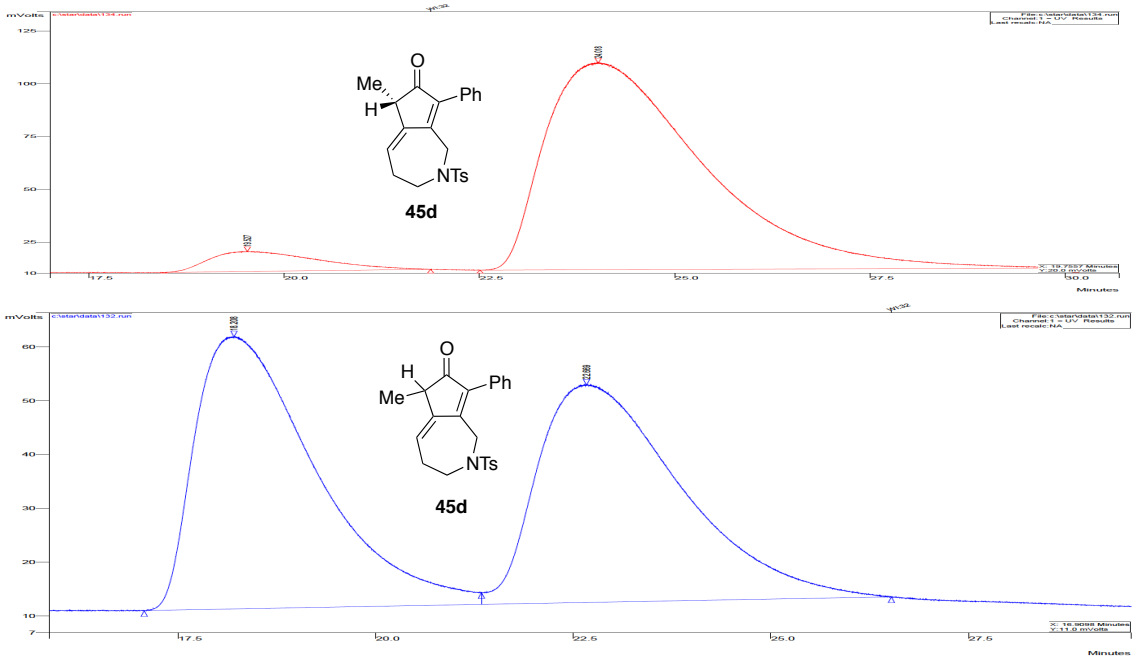
The enantiomeric purity of compound **45d** was determined by HPLC analysis run on a ChiralCel OD column eluting in 10% 2-Propanol/Hexanes, with a 20.0 μL injection and a 1.0 mL/min flow rate. Compound **45d** has 88% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**45d** exhibiting equal peaks with retention times of 18.2 and 22.7 minutes, and the enantioenriched compound **45d** exhibiting a major peak with a retention time of 24.0 minutes (minor enantiomer has a retention time of 19.5 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
18.208	0.000	5360886	BV	97.8
22.669	0.000	5114108	VB	121.5

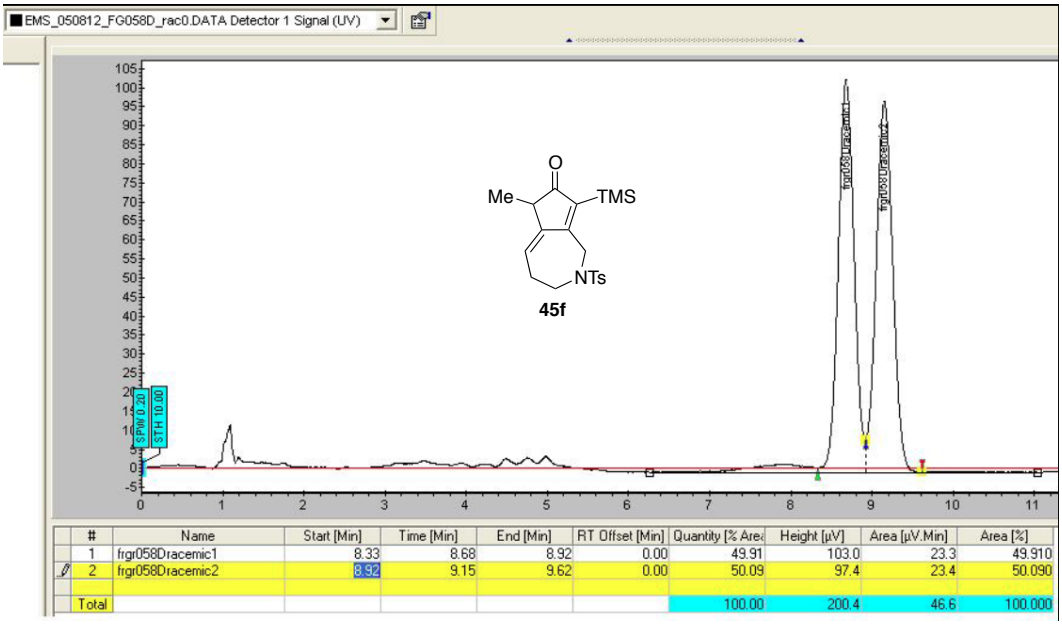
Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
19.527	0.000	905205	BB	100.7
24.018	0.000	13844659	BB	129.4

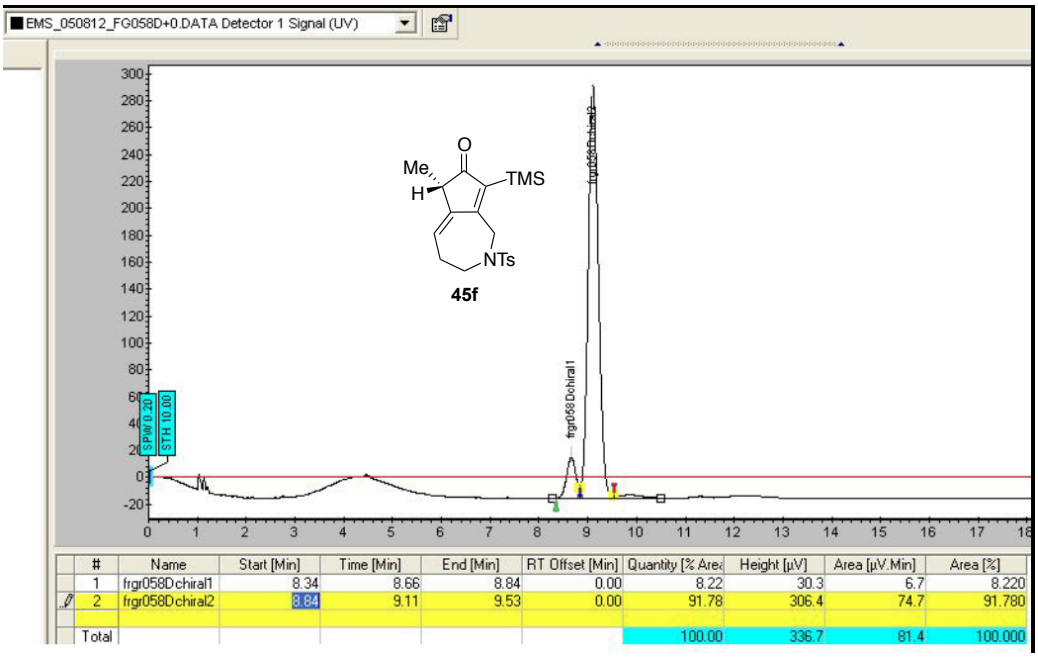


(*S*)-6-methyl-2-tosyl-8-(trimethylsilyl)-1,2,3,4-tetrahydrocyclopenta[*c*]azepin -7(6*H*)-one (45f):

The enantiomeric purity of compound **45f** was determined by SFC analysis run on a Chiralpak IC column using 15% MeOH as mobile phase with a 10 µL injection, a 3.0 mL/min flow rate and a pressure of 100 bar. The compound has 84% ee. The peaks are visualized at 220 nm, with the racemic alcohol (±)-**45f** exhibiting equal peaks with retention times of 8.7 and 9.2 minutes, and the enantioenriched compound **45f** exhibiting a major peak with a retention time of 9.5 minutes (minor enantiomer has a retention time of 8.8 minutes).



#	Name	Start [Min]	Time [Min]	End [Min]	RT Offset [Min]	Quantity [% Area]	Height [µV]	Area [µV.Min]	Area [%]
1	frgr058Dracemic1	8.33	8.68	8.92	0.00	49.91	103.0	23.3	49.910
2	frgr058Dracemic2	8.92	9.15	9.62	0.00	50.09	97.4	23.4	50.090
Total						100.00	200.4	46.6	100.000



#	Name	Start [Min]	Time [Min]	End [Min]	RT Offset [Min]	Quantity [% Area]	Height [µV]	Area [µV.Min]	Area [%]
1	frgr058Dchiral1	8.34	8.66	8.84	0.00	8.22	30.3	6.7	8.220
2	frgr058Dchiral2	8.84	9.11	9.53	0.00	91.78	306.4	74.7	91.780
Total						100.00	336.7	81.4	100.000

(*S*)-6,8-dimethyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[*c*]azepin-7(6*H*)-one (45c):

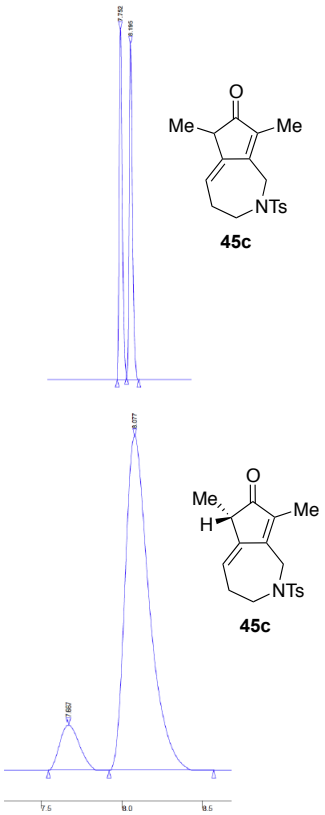
The enantiomeric purity of compound **45c** was determined by HPLC analysis run on a ChiralPak IA-3 column eluting in 25% 2-Propanol/Hexanes, with a 20.0 µL injection and a 1.0 mL/min flow rate. Compound **45c** has 81% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**45c** exhibiting equal peaks with retention times of 7.8 and 8.2 minutes, and the enantioenriched compound **45c** exhibiting a major peak with a retention time of 8.1 minutes (minor enantiomer has a retention time of 7.7 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
7.752	0.000	4731948	BV	8.6
8.195	0.000	4894754	VB	9.2

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
7.667	0.000	1297389	BV	8.0
8.077	0.000	12220102	VB	9.4



(*S*)-Diethyl 1-methyl-2-oxo-3-phenyl-1,2,6,7-tetrahydroazulene-5,5(4*H*)-dicarboxylate (47d):

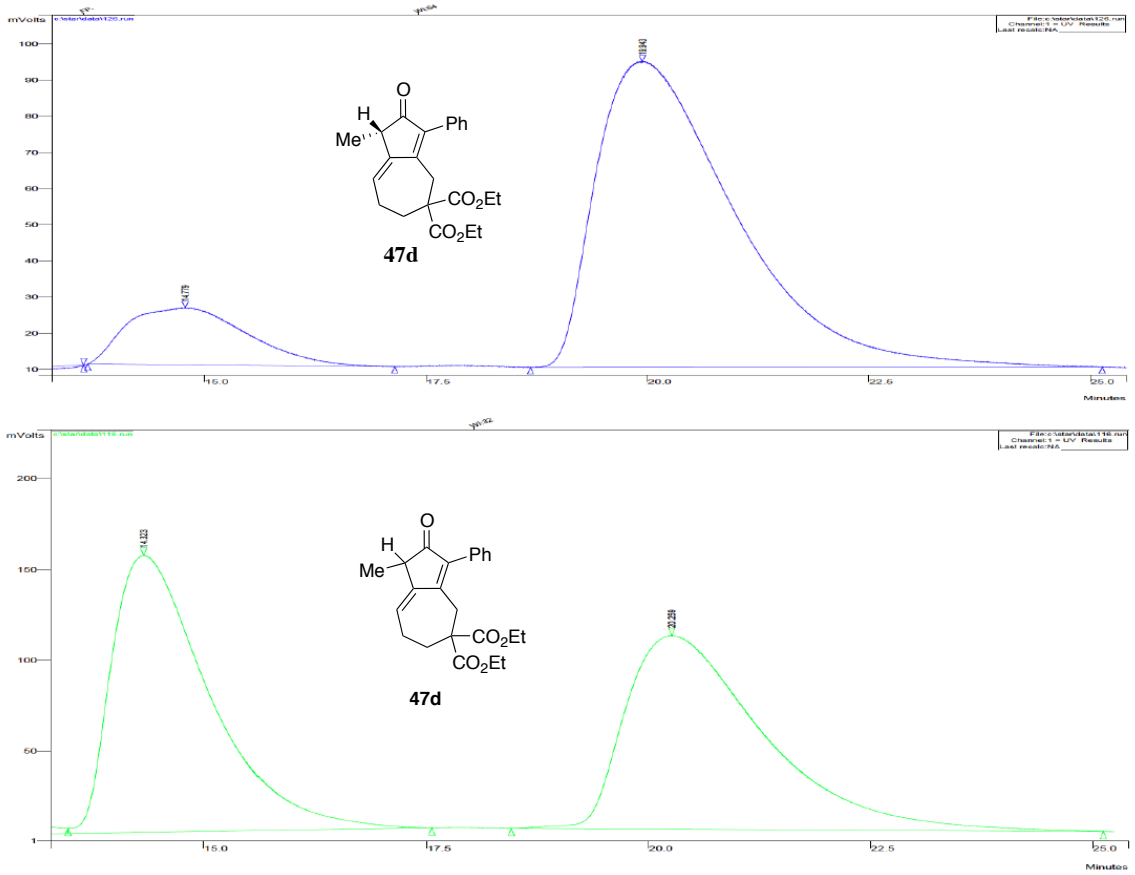
The enantiomeric purity of compound **47d** was determined by HPLC analysis run on a ChiralCel OD column eluting in 2% 2-Propanol/Hexanes, with a 10.0 µL injection and a 1.0 mL/min flow rate. Compound **47d** has 72% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**47d** exhibiting equal peaks with retention times of 14.3 and 20.2 minutes, and the enantioenriched compound **47d** exhibiting a major peak with a retention time of 19.9 minutes (minor enantiomer has a retention time of 14.7 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
14.323	0.000	11606653	VB	69.7
20.259	0.000	11491699	BB	96.7

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
14.779	0.000	1481368	BB	91.5
19.943	0.000	9223214	BB	99.8



(*S*)-diethyl 1,3-dimethyl-2-oxo-1,2,6,7-tetrahydroazulene-5,5(4*H*)-dicarboxylate (47c):

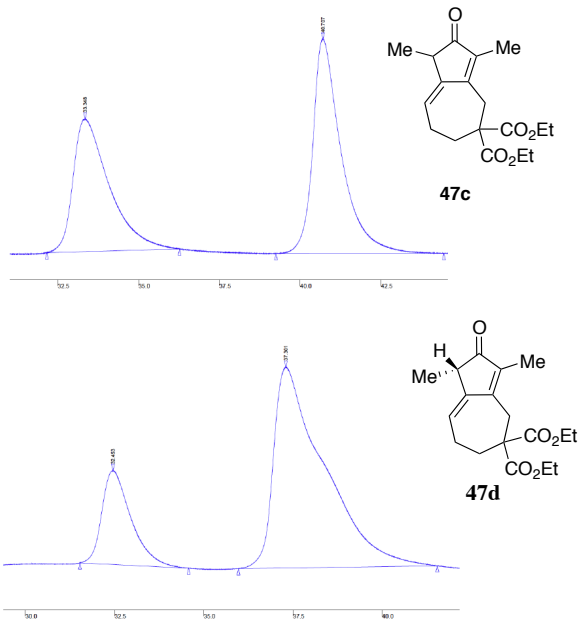
The enantiomeric purity of compound **47c** was determined by HPLC analysis run on a Whelk O-1 column eluting in 3% 2-Propanol/Hexanes, with a 10.0 µL injection and a 1.0 mL/min flow rate. Compound **47c** has 58% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**47c** exhibiting equal peaks with retention times of 33.3 and 40.7 minutes, and the enantioenriched compound **47c** exhibiting a major peak with a retention time of 37.3 minutes (minor enantiomer has a retention time of 32.4 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
33.348	0.000	3892636	BB	69.0
40.707	0.000	4949763	BB	51.1

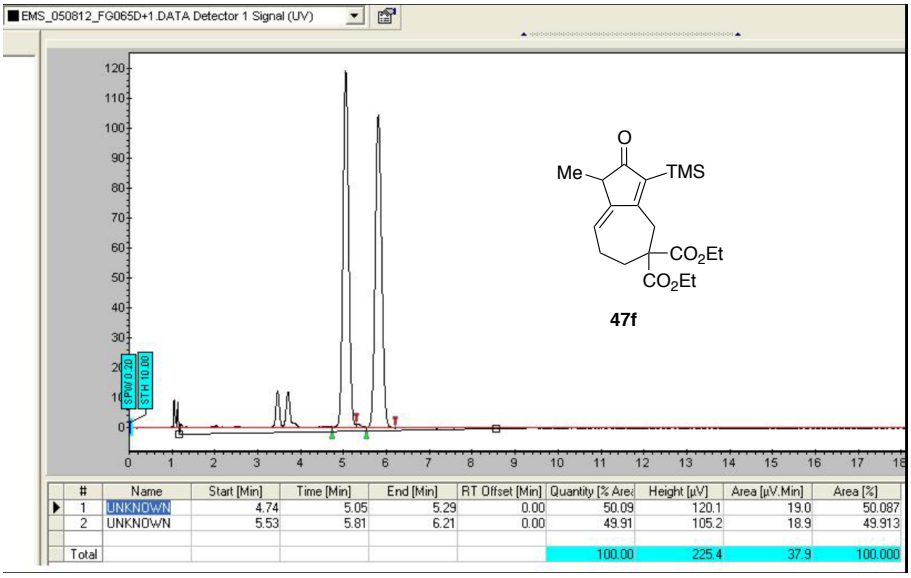
Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
32.453	0.000	1630725	BB	49.5
37.301	0.000	6055692	BB	90.6

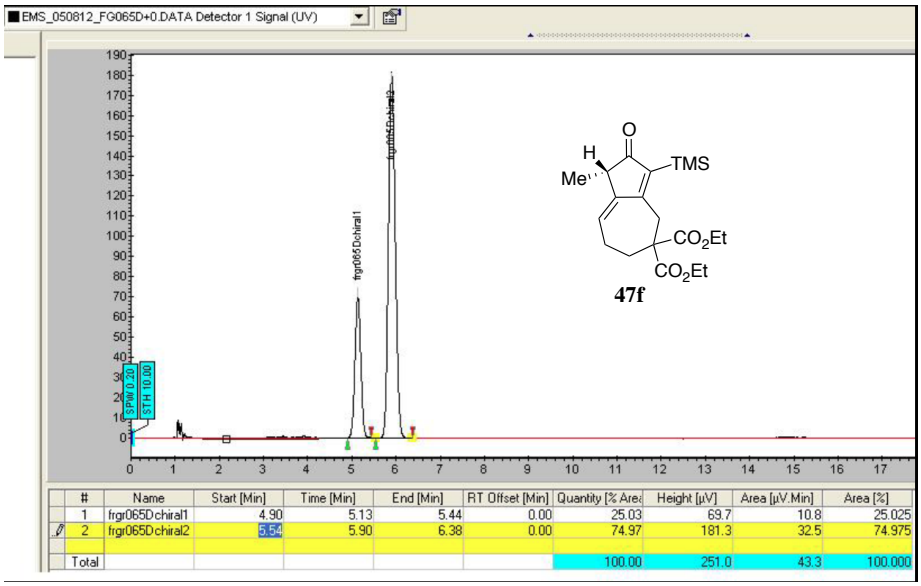


(*S*)-diethyl 1-methyl-2-oxo-3-(trimethylsilyl)-1,2,6,7-tetrahydroazulene-5,5(4*H*)-dicarboxylate (47f):

The enantiomeric purity of compound **47f** was determined by SFC analysis run on a Chiralpak IC column using 5% MeOH as mobile phase with a 10 µL injection, 3.0 mL/min flow rate and a pressure of 100 bars. The compound has 50% ee. The peaks are visualized at 220 nm, with the racemic alcohol (±)-**47f** exhibiting equal peaks with retention times of 5.1 and 5.8 minutes, and the enantioenriched compound **47f** exhibiting a major peak with a retention time of 5.9 minutes (minor enantiomer has a retention time of 5.1 minutes).



#	Name	Start [Min]	Time [Min]	End [Min]	RT Offset [Min]	Quantity [% Area]	Height [µV]	Area [µV.Min]	Area [%]
1	UNKNOWN	4.74	5.05	5.29	0.00	50.09	120.1	19.0	50.087
2	UNKNOWN	5.53	5.81	6.21	0.00	49.91	105.2	18.9	49.913
Total						100.00	225.4	37.9	100.000



#	Name	Start [Min]	Time [Min]	End [Min]	RT Offset [Min]	Quantity [% Area]	Height [µV]	Area [µV.Min]	Area [%]
1	frgr065Dchiral1	4.90	5.13	5.44	0.00	25.03	69.7	10.8	25.025
2	frgr065Dchiral2	5.54	5.90	6.38	0.00	74.97	181.3	32.5	74.975
Total						100.00	251.0	43.3	100.000

(*S*)-6,8-dimethyl-3,4-dihydro-1*H*-cyclopenta[*c*]oxepin-7(6*H*)-one (46c):

The enantiomeric purity of compound **46c** was determined by HPLC analysis run on a ChiralCel OD column eluting in 0.5% 2-Propanol/Hexanes, with a 20.0 µL injection and a 0.7 mL/min flow rate.

HPLC analysis with obtained when 100% of the starting material was consumed :

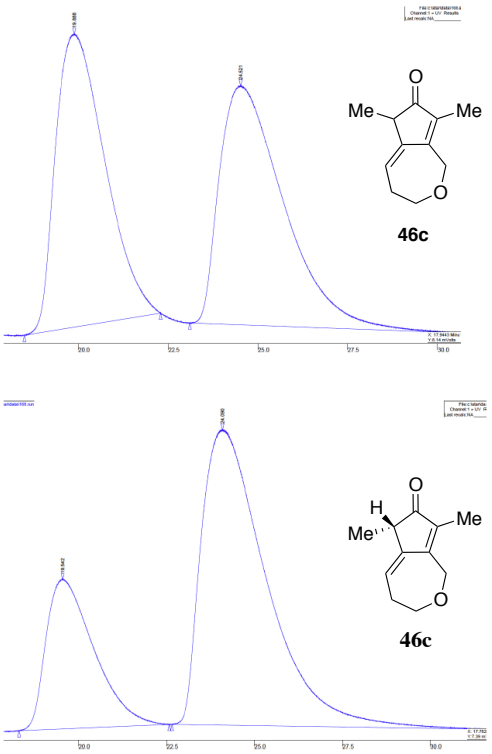
Compound **46c** has 45% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**46c** exhibiting equal peaks with retention times of 19.9 and 24.5 minutes, and the enantioenriched compound **46c** exhibiting a major peak with a retention time of 24.1 minutes (minor enantiomer has a retention time of 19.5 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
19.888	0.000	6517219	BB	94.9
24.521	0.000	6914815	BB	113.9

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
19.542	0.000	4570302	BB	89.9
24.090	0.000	12276439	BB	116.1

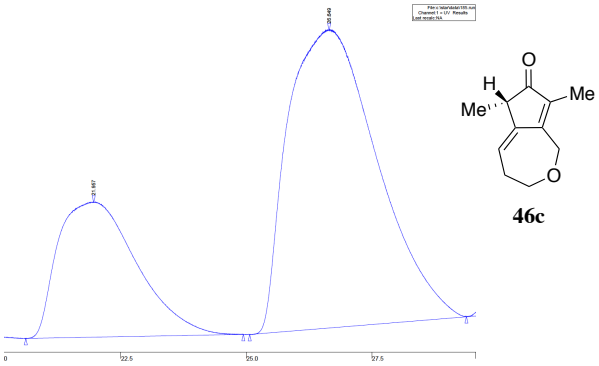


HPLC analysis when the reaction was stopped at 60% conversion[1]:

Compound **46c** has 43% ee. The peaks are visualized at 254 nm, with the enantioenriched compound **46c** exhibiting a major peak with a retention time of 26.6 minutes (minor enantiomer has a retention time of 21.9 minutes).

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
21.957	0.000	3384316	BB	113.6
26.649	0.000	8469223	BV	124.5

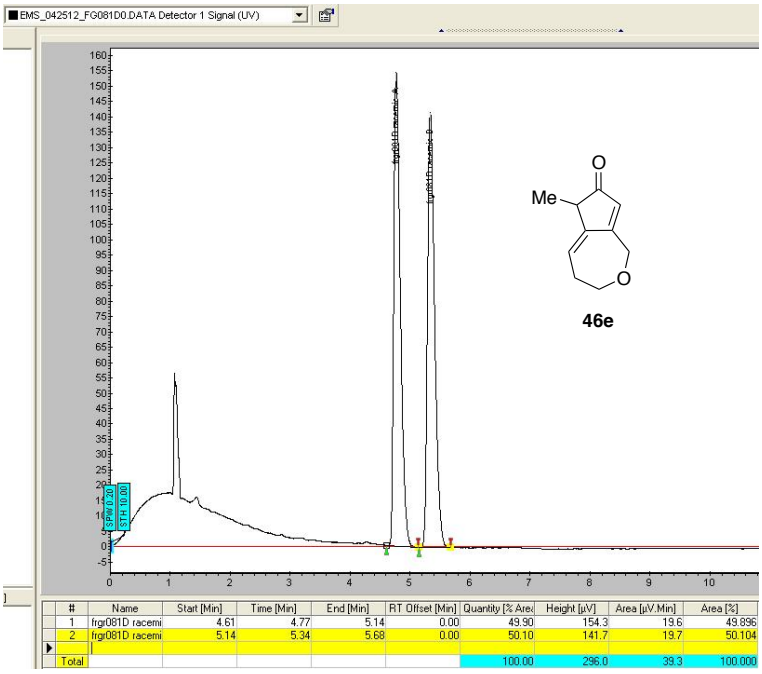


46c

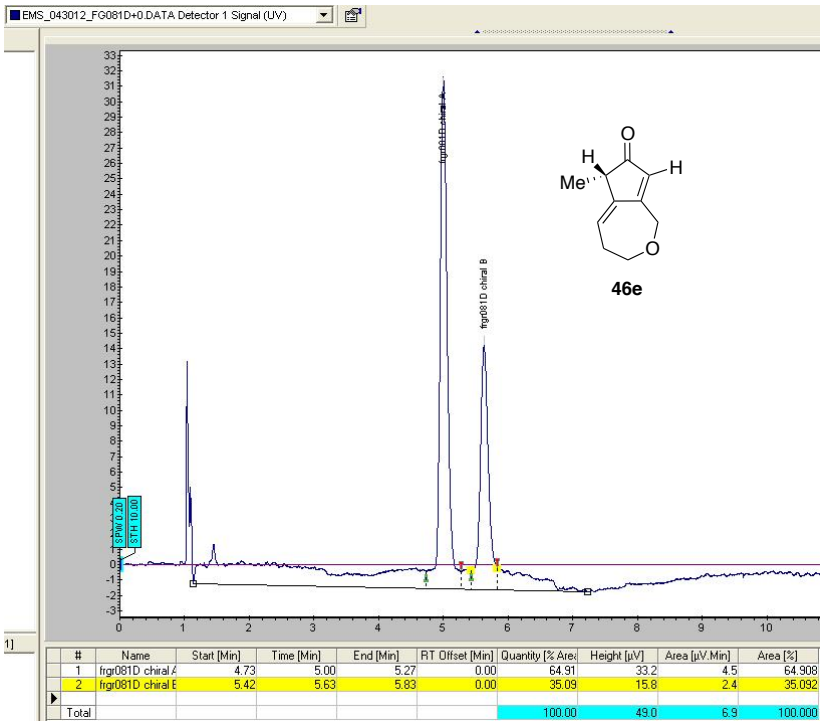
[1] The conversion was determined based on the crude ^{1}H NMR.

(*S*)-6-methyl-3,4-dihydro-1*H*-cyclopenta[*c*]oxepin-7(6*H*)-one (46e):

The enantiomeric purity of compound **46e** was determined by SFC analysis run on a Chiralpak IA column using 5% MeOH as mobile phase with a 10 µL injection, a 3.0 mL/min flow rate and a pressure of 100 bars. The compound has 30% ee. The peaks are visualized at 220 nm, with the racemic alcohol (±)-**46e** exhibiting equal peaks with retention times of 4.7 and 5.3 minutes, and the enantioenriched compound **46e** exhibiting a major peak with a retention time of 5.0 minutes (minor enantiomer has a retention time of 5.6 minutes).

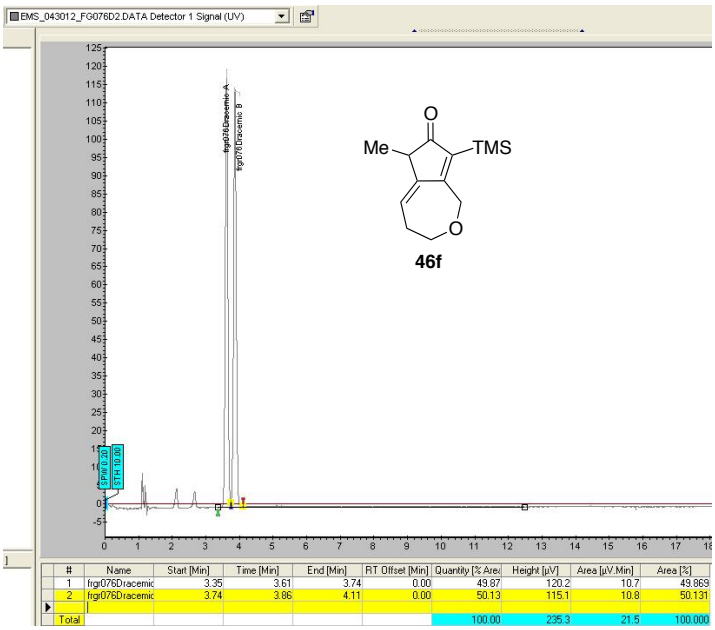


#	Name	Start [Min]	Time [Min]	End [Min]	RT Offset [Min]	Quantity [% Area]	Height [µV]	Area [µV.Min]	Area [%]
1	frgr081D racemi	4.61	4.77	5.14	0.00	49.90	154.3	19.6	49.896
2	frgr081D racemi	5.14	5.34	5.68	0.00	50.10	141.7	19.7	50.104
Total						100.00	296.0	39.3	100.000



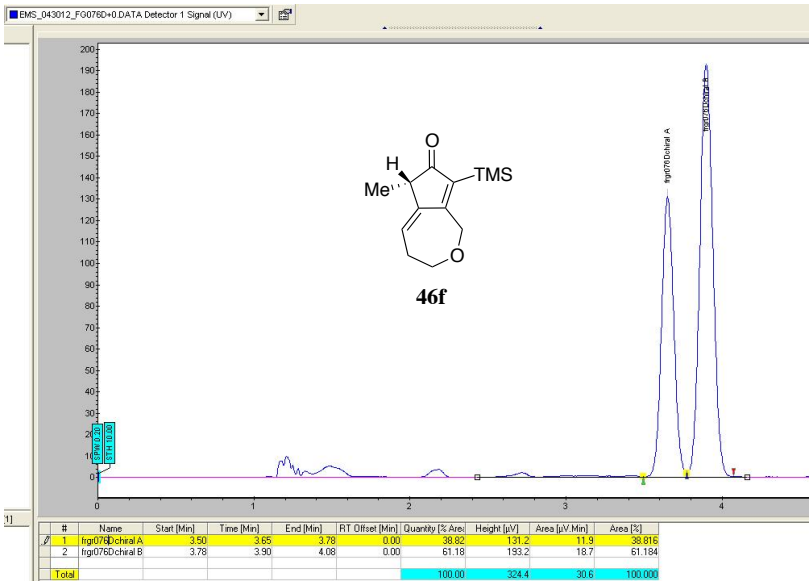
(*S*)-6-methyl-8-(trimethylsilyl)-3,4-dihydro-1*H*-cyclopenta[*c*]oxepin-7(6*H*)-one (46f):

The enantiomeric purity of compound **46f** was determined by SFC analysis run on a Chiralpak IC column using 5% MeOH as mobile phase with a 10 µL injection, a 3.0 mL/min flow rate and a pressure of 100 bars. The compound has 22% ee. The peaks are visualized at 220 nm, with the racemic alcohol (±)-**46f** exhibiting equal peaks with retention times of 3.6 and 3.9 minutes, and the enantioenriched compound **46f** exhibiting a major peak with a retention time of 3.9 minutes (minor enantiomer has a retention time of 3.6 minutes).



46f

#	Name	Start [Min]	Time [Min]	End [Min]	RT Offset [Min]	Quantity [% Area]	Height [µV]	Area [µV.Min]	Area [%]
1	frgr076Dracemic	3.35	3.61	3.74	0.00	49.87	120.2	10.7	49.869
2	frgr076Dracemic	3.74	3.86	4.11	0.00	50.13	115.1	10.8	50.131
Total						100.00	235.3	21.5	100.000



46f

#	Name	Start [Min]	Time [Min]	End [Min]	RT Offset [Min]	Quantity [% Area]	Height [µV]	Area [µV.Min]	Area [%]
1	frgr076Dchiral A	3.50	3.65	3.78	0.00	38.82	131.2	11.9	38.816
2	frgr076Dchiral B	3.78	3.90	4.08	0.00	61.18	193.2	18.7	61.184
Total						100.00	324.4	30.6	100.000

(*S*)-6-methyl-8-phenyl-3,4-dihydro-1*H*-cyclopenta[c]oxepin-7(6*H*)-one (46d):

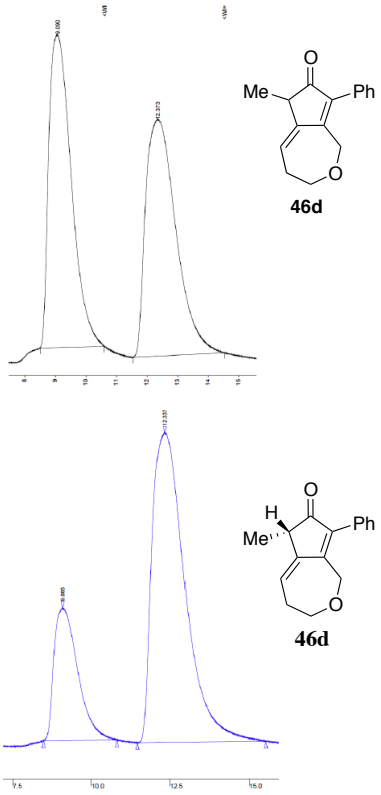
The enantiomeric purity of compound **46d** was determined by HPLC analysis run on a ChiralCel OD column eluting in 5% 2-Propanol/Hexanes, with a 20.0 µL injection and a 1.0 mL/min flow rate. Compound **46d** has 52% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**46d** exhibiting equal peaks with retention times of 9.1 and 12.4 minutes, and the enantioenriched compound **46d** exhibiting a major peak with a retention time of 12.3 minutes (minor enantiomer has a retention time of 9.1 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
9.090	0.000	3725947	BB	59.4
12.373	0.000	3798492	BB	71.2

Values for the enantiopur compound :

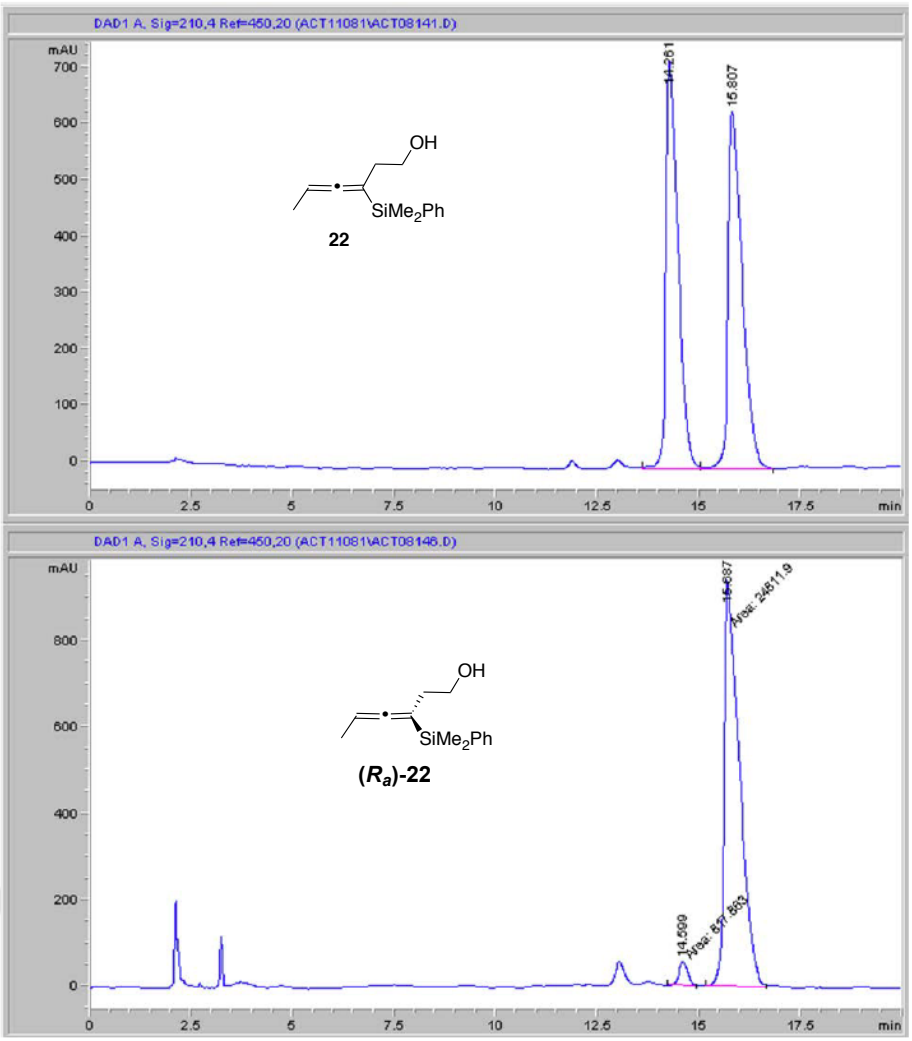
Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
9.085	0.000	1139357	BB	49.1
12.337	0.000	3671502	BB	66.2



(R_a)-3-(dimethyl(phenyl)silyl)hexa-3,4-dien-1-ol (22):

The enantiomeric purity of alcohol **(R_a)-22** was determined[2] by HPLC analysis run on a Chiralpak IB-3 column eluting in 0.5% 2-Propanol/Hexanes, with a 2.0 µL injection and a 1.0 mL/min flow rate. The alcohol has >93% ee. The peaks are visualized at 210 nm, with the racemic alcohol (±)-5 exhibiting equal peaks with retention times of 14.2 and 15.8 minutes, and the enantioenriched alcohol **(R_a)-22** exhibiting a major peak with a retention time of 12.8 minutes (minor enantiomer has a retention time of 11.9 minutes).

[2] Enantiomeric excess determination for this compound was performed by Chiral Technologies Inc.



(*S*)-5-(dimethyl(phenyl)silyl)-6,8-dimethyl-2-tosyl-1,2,3,4-tetrahydrocyclo penta[*c*]azepin-7(6*H*)-one (35c):

The enantiomeric purity of compound **35c** was determined by HPLC analysis run on a ChiralCel OD column eluting in 10% 2-Propanol/Hexanes, with a 10.0 µL injection and a 1.0 mL/min flow rate. Compound **35c** has >96% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**35c** exhibiting equal peaks with retention times of 11.9 and 17.2 minutes, and the enantioenriched

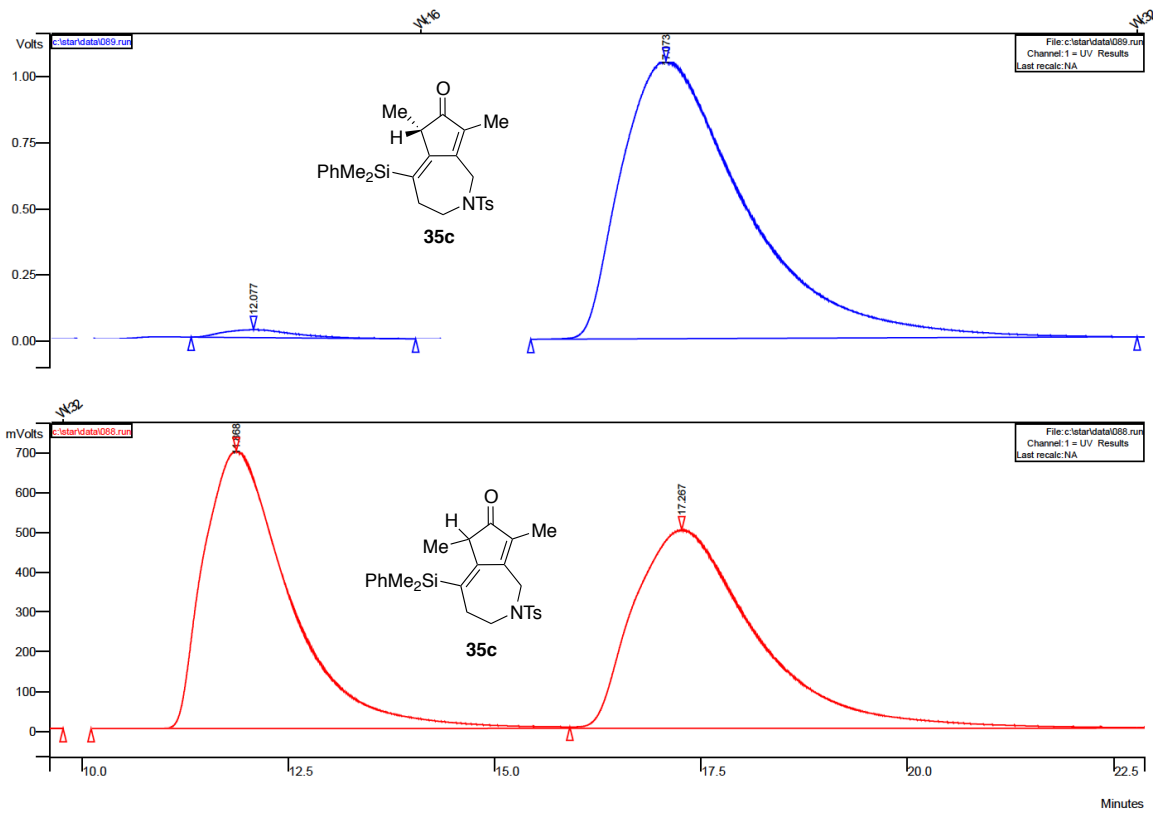
compound **35c** exhibiting a major peak with a retention time of 17.1 minutes (minor enantiomer has a retention time of 12.1 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
11.868	0.000	50556864	BV	64.8
17.267	0.000	51547236	VB	92.9

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
12.077	0.000	1779360	BB	54.6
17.073	0.000	110018416	BB	92.9



(*S*)-5-(dimethyl(phenyl)silyl)-6-methyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta [*c*]azepin-7(6*H*)-one (35e):

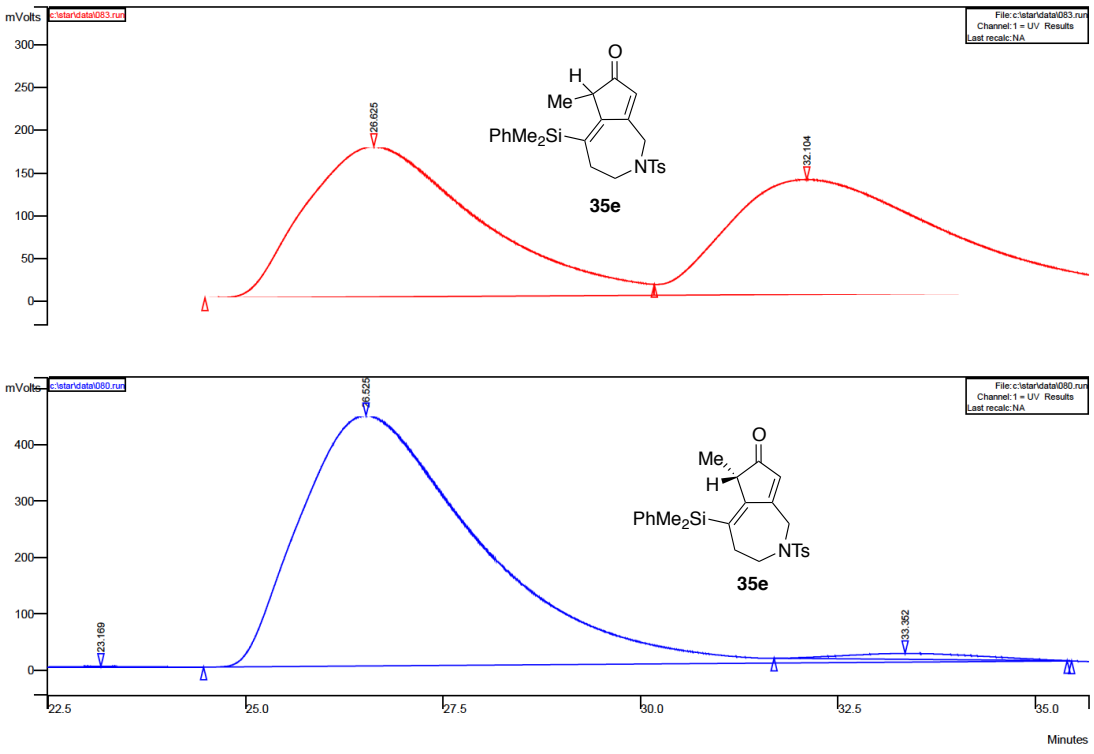
The enantiomeric purity of compound **35e** was determined by HPLC analysis run on a ChiralCel OD column eluting in 10% 2-Propanol/Hexanes, with a 10.0 µL injection and a 1.0 mL/min flow rate. Compound **35e** has >96% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**35e** exhibiting equal peaks with retention times of 26.6 and 32.1 minutes, and the enantioenriched compound **35e** exhibiting a major peak with a retention time of 26.5 minutes (minor enantiomer has a retention time of 33.3 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
26.625	0.000	26719278	BV	143.4
32.104	0.000	26541100	VB	187.8

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
26.525	0.000	70678656	PB	142.9
33.352	0.000	1288559	TS	0.0



(*S*)-5-(dimethyl(phenyl)silyl)-6-methyl-2-tosyl-8-(trimethylsilyl)-1,2,3,4-tetra hydrocyclopenta[*c*]azepin-7(6*H*)-one (35f):

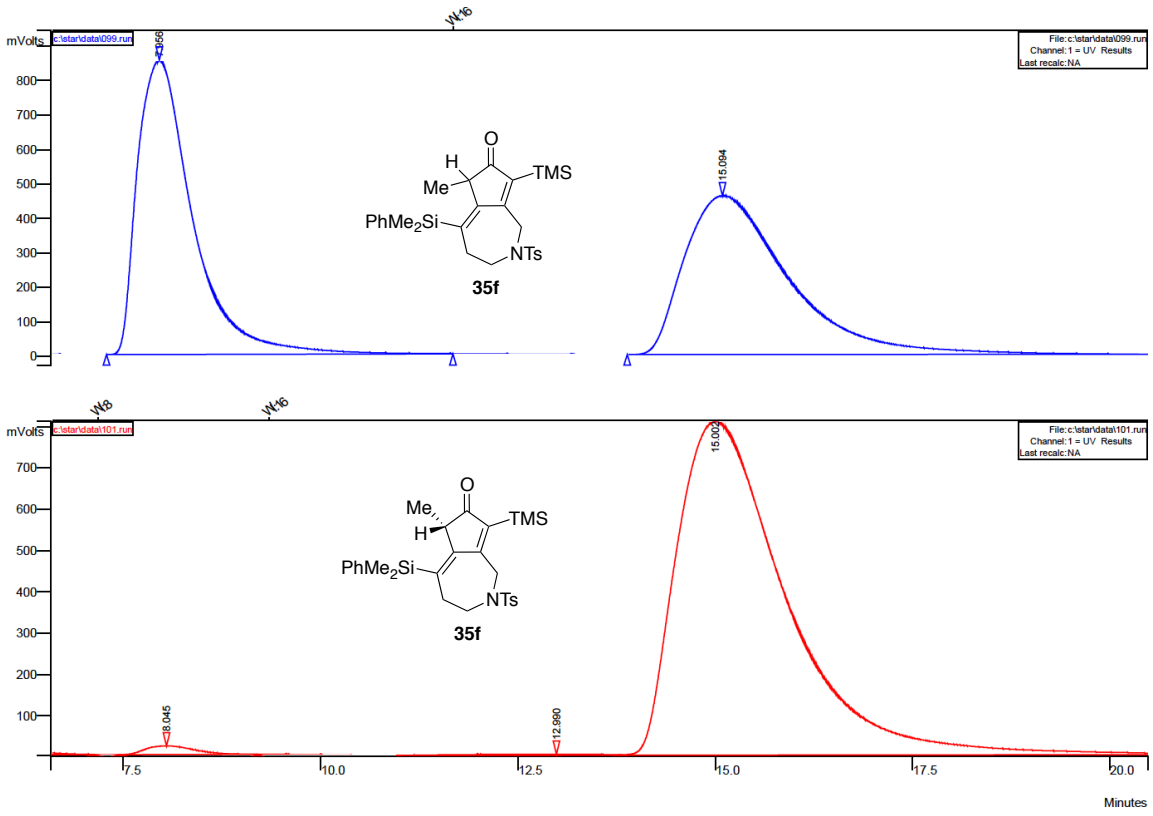
The enantiomeric purity of compound **35f** was determined by HPLC analysis run on a ChiralCel OD column eluting in 10% 2-Propanol/Hexanes, with a 10.0 µL injection and a 1.0 mL/min flow rate. Compound **35f** has >97% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**35f** exhibiting equal peaks with retention times of 7.9 and 15.1 minutes, and the enantioenriched compound **35f** exhibiting a major peak with a retention time of 15.0 minutes (minor enantiomer has a retention time of 12.9 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
7.956	0.000	41519064	BB	42.9
15.094	0.000	42309972	BB	81.9

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
8.045	0.000	910668	BB	41.9
15.002	0.000	77515120	VB	84.9



(*S*)-5-(dimethyl(phenyl)silyl)-6-methyl-8-phenyl-2-tosyl-1,2,3,4-tetrahydro cyclopenta[*c*]azepin-7(6*H*)-one (35d):

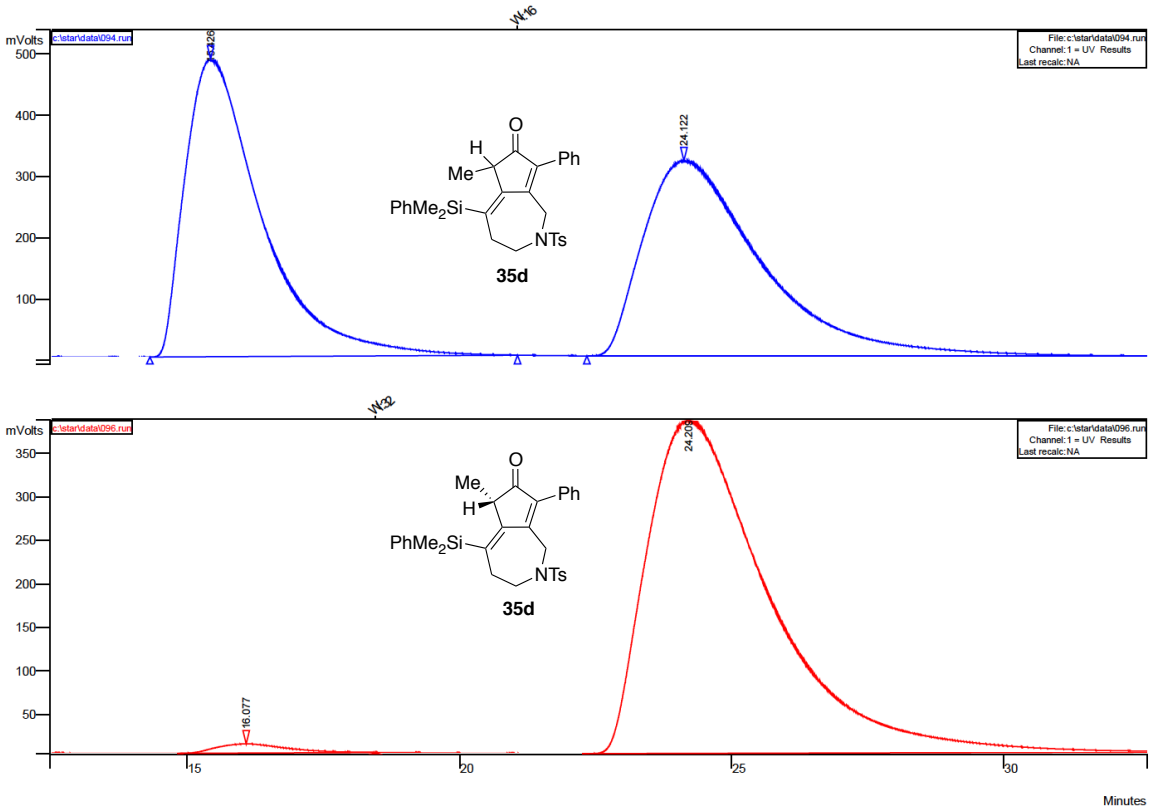
The enantiomeric purity of compound **35d** was determined by HPLC analysis run on a ChiralCel OD column eluting in 10% 2-Propanol/Hexanes, with a 10.0 μL injection and a 1.0 mL/min flow rate. Compound **35d** has >96% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**35d** exhibiting equal peaks with retention times of 15.4 and 24.1 minutes, and the enantioenriched compound **35d** exhibiting a major peak with a retention time of 24.2 minutes (minor enantiomer has a retention time of 16.1 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
15.426	0.000	47444380	BB	90.0
24.122	0.000	47988480	BB	135.7

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
16.077	0.000	933022	BB	87.8
24.209	0.000	59857904	BB	137.3



(*S*)-5-(dimethyl(phenyl)silyl)-6-methyl-8-(thiophen-3-yl)-2-tosyl-1,2,3,4-tetra hydrocyclopenta[c]azepin-7(6H)-one (35a):

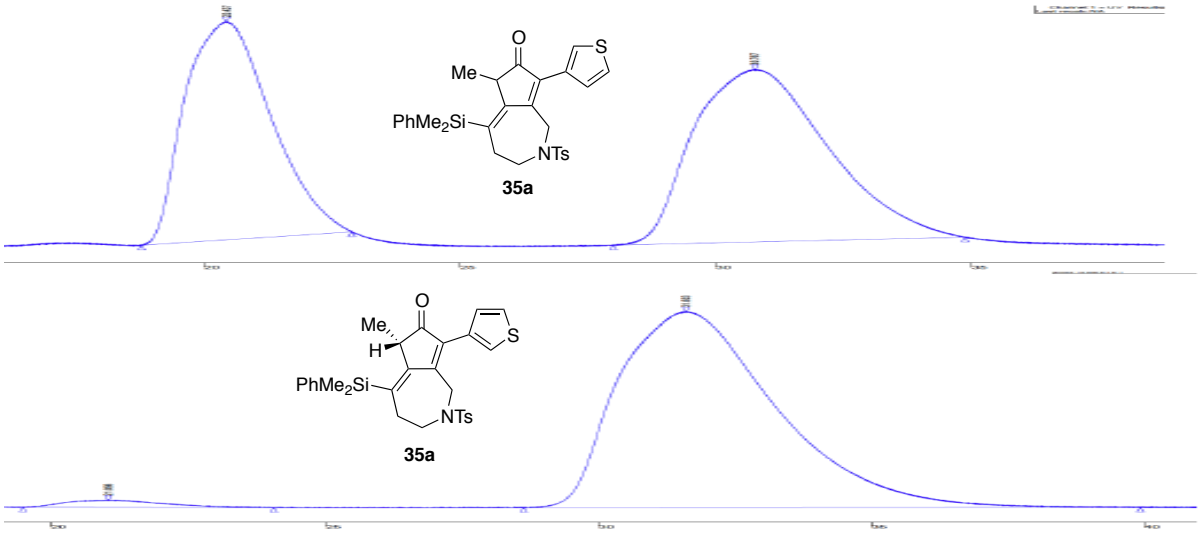
The enantiomeric purity of compound **35a** was determined by HPLC analysis run on a ChiralCel OD column eluting in 10% 2-Propanol/Hexanes, with a 10.0 µL injection and a 1.0 mL/min flow rate. Compound **35a** has >95% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**35a** exhibiting equal peaks with retention times of 20.4 and 30.7 minutes, and the enantioenriched compound **35a** exhibiting a major peak with a retention time of 31.6 minutes (minor enantiomer has a retention time of 21.0 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
20.437	0.000	5860423	BB	133.8
30.767	0.000	7204155	BB	182.5

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
21.056	0.000	440955	BB	118.9
31.603	0.000	20019798	BB	189.6



(*S*)-5-(dimethyl(phenyl)silyl)-6-methyl-8-(thiophen-2-yl)-2-tosyl-1,2,3,4-tetra hydrocyclopenta[*c*]azepin-7(6*H*)-one (35b):

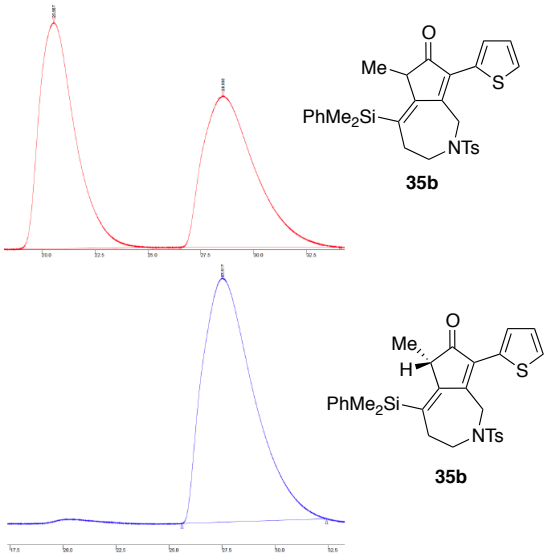
The HPLC analysis run on a ChiralCel OD column eluting in 10% 2-Propanol/Hexanes, with a 10.0 µL injection and a 1.0 mL/min flow rate. Compound **35b** has >95% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**35b** exhibiting equal peaks with retention times of 20.6 and 28.6 minutes, and the enantioenriched compound **35b** exhibiting a major peak with a retention time of 27.5 minutes. The minor enantiomer was not detected (the corresponding peak was below the detection level of the HPLC system).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
20.567	0.000	5495031	BB	108.7
28.555	0.000	5347258	BB	162.4

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
27.517	0.000	10836925	BB	172.1



(*S*)-8-cyclopropyl-5-(dimethyl(phenyl)silyl)-6-methyl-2-tosyl-1,2,3,4-tetra hydrocyclopenta[c]azepin-7(6H)-one (35g):

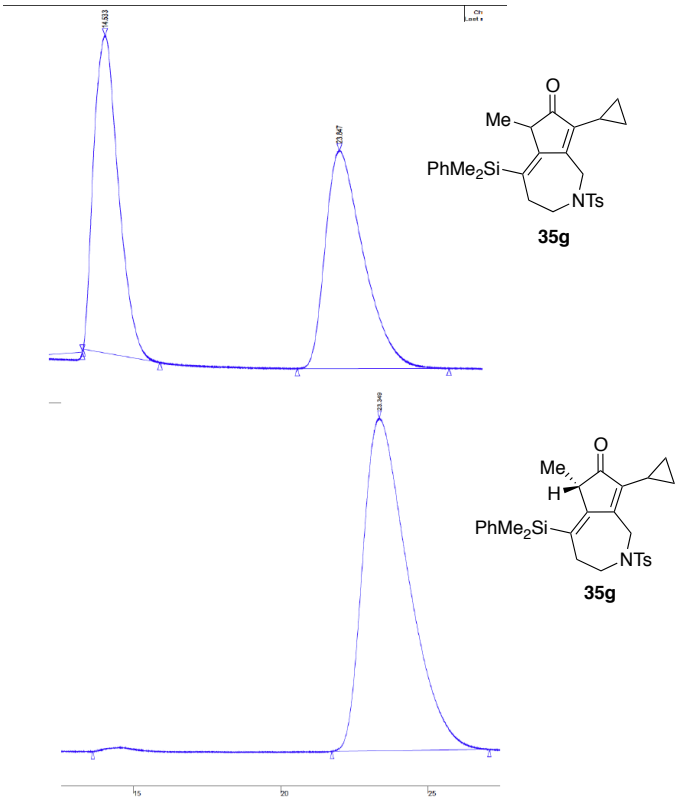
The HPLC analysis run on a ChiralCel OD column eluting in 5% 2-Propanol/Hexanes, with a 10.0 µL injection and a 1.0 mL/min flow rate. Compound **35g** has >99% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**35g** exhibiting equal peaks with retention times of 14.5 and 23.8 minutes, and the enantioenriched compound **35g** exhibiting a major peak with a retention time of 23.3 minutes (the minor enantiomer was not detected).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
14.533	0.000	6606343	BB	64.4
23.847	0.000	7006123	BB	97.3

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
23.349	0.000	12560960	BB	99.4



(*R*$_a$)-3-(2-phenylvinylidene)heptan-1-ol (29):

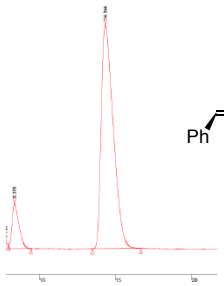
The enantiomeric purity of compound **(*R*$_a$)-29** was determined by HPLC analysis run on a ChiralCel OD column eluting in 3% 2-Propanol/Hexanes, with a 20.0 μL injection and a 1.0 mL/min flow rate. Compound **(*R*$_a$)-29** has >79% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**29** exhibiting equal peaks with retention times of 8.4 and 14.2 minutes, and the enantioenriched compound **(*R*$_a$)-29** exhibiting a major peak with a retention time of 14.3 minutes (minor enantiomer has a retention time of 8.4 minutes).

Values for the racemic compound :

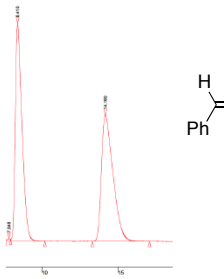
Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
8.410	0.000	28599070	VB	28.2
14.169	0.000	28686952	BB	49.0

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
8.378	0.000	6736711	VB	29.0
14.344	0.000	58590084	BB	51.8



29



29

(*S*)-6-methyl-8-phenyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[*c*]azepin-7(6*H*)-one (42d):

The enantiomeric purity of compound **42d** was determined by HPLC analysis run on a ChiralCel OD column eluting in 10% 2-Propanol/Hexanes, with a 20.0 µL

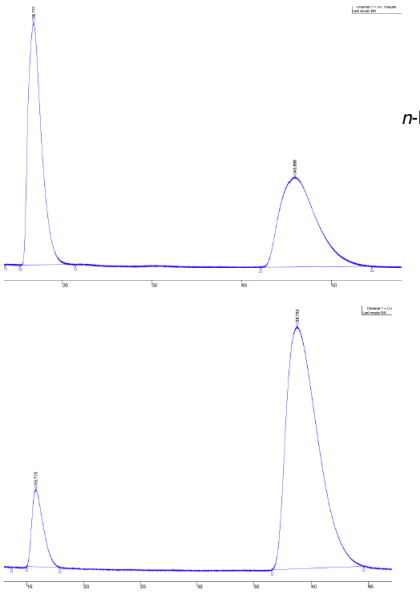
injection and a 1.0 mL/min flow rate. Compound **42d** has 79% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**42d** exhibiting equal peaks with retention times of 16.7 and 45.9 minutes, and the enantioenriched compound **42d** exhibiting a major peak with a retention time of 38.8 minutes (minor enantiomer has a retention time of 15.8 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
16.771	0.000	9215916	BB	98.1
45.896	0.000	9185056	BB	267.8

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
15.775	0.000	1028565	BB	64.8
38.752	0.000	9044723	BB	184.8



(*S*)-5-butyl-8-methyl-6-phenyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[*c*]azepin -7(6*H*)-one (42c):

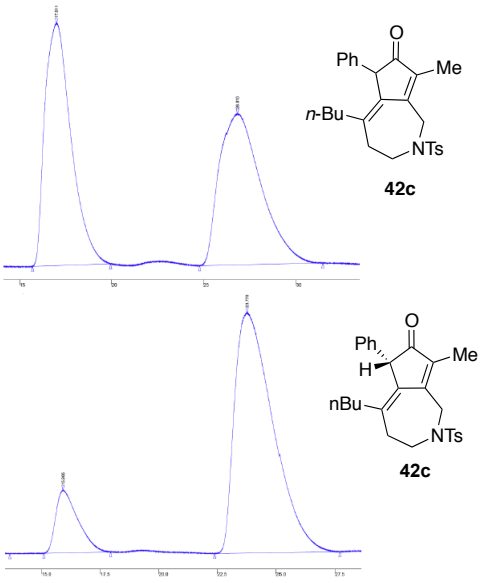
The enantiomeric purity of compound **42c** was determined by HPLC analysis run on a ChiralCel OD column eluting in 7% 2-Propanol/Hexanes, with a 20.0 µL injection and a 1.0 mL/min flow rate. Compound **42c** has 74% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**42c** exhibiting equal peaks with retention times of 17.0 and 26.8 minutes, and the enantioenriched compound **42c** exhibiting a major peak with a retention time of 23.7 minutes (minor enantiomer has a retention time of 15.9 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
17.011	0.000	3744275	BB	94.4
26.810	0.000	3655357	BB	150.1

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
15.905	0.000	1077742	BB	62.4
23.770	0.000	7160657	BB	107.9



(*S*)-5-butyl-6-phenyl-2-tosyl-8-(trimethylsilyl)-1,2,3,4-tetrahydrocyclopenta [*c*]azepin-7(6*H*)-one (42f):

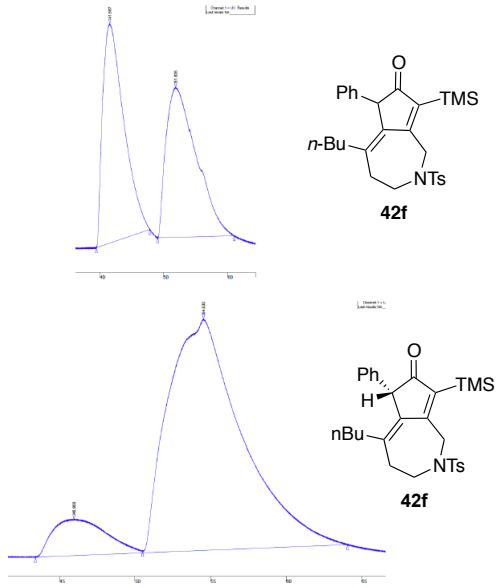
The enantiomeric purity of compound **42f** was determined by HPLC analysis run on a ChiralCel OD column eluting in 0.5% 2-Propanol/Hexanes, with a 20.0 µL injection and a 1.0 mL/min flow rate. Compound **42f** has 79% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**42f** exhibiting equal peaks with retention times of 41.6 and 51.9 minutes, and the enantioenriched compound **42f** exhibiting a major peak with a retention time of 54.5 minutes (minor enantiomer has a retention time of 45.9 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
41.567	0.000	16292488	BB	273.9
51.935	0.000	15671646	BB	333.8

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
45.955	0.000	3626320	BV	318.9
54.530	0.000	31692996	VB	448.8



(*S*)-diethyl 8-butyl-2-oxo-1,3-diphenyl-1,2,6,7-tetrahydroazulene-5,5(4*H*)-dicarboxylate (44d):

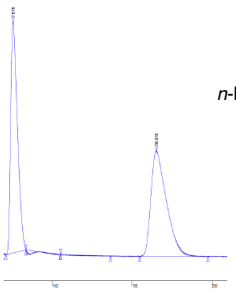
The enantiomeric purity of compound **44d** was determined by HPLC analysis run on a ChiralCel OD column eluting in 5% 2-Propanol/Hexanes, with a 20.0 µL injection and a 1.0 mL/min flow rate. Compound **44d** has 76% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**44d** exhibiting equal peaks with retention times of 7.5 and 16.5 minutes, and the enantioenriched compound **44d** exhibiting a major peak with a retention time of 16.5 minutes (minor enantiomer has a retention time of 7.5 minutes).

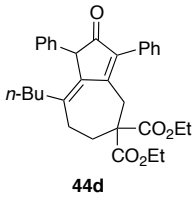
Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
7.515	0.000	4039989	PB	28.3
16.515	0.000	4255920	BB	63.2

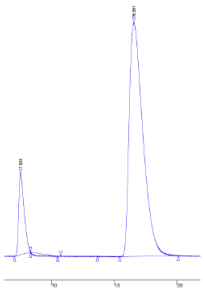
Values for the enantiopur compound :

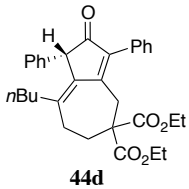
Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
7.533	0.000	2921670	BB	28.8
16.551	0.000	21481534	BB	69.9





44d





44d

(*S*)-diethyl 8-butyl-2-oxo-1-phenyl-3-(trimethylsilyl)-1,2,6,7-tetrahydro azulene-5,5(4*H*)-dicarboxylate (44f):

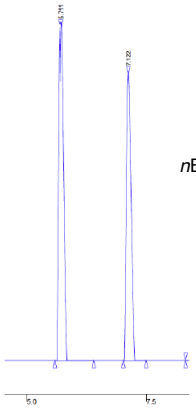
The enantiomeric purity of compound **44f** was determined by HPLC analysis run on a ChiralCel IA-3 column eluting in 3% 2-Propanol/Hexanes, with a 20.0 µL injection and a 1.0 mL/min flow rate. Compound **44f** has 76% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**44f** exhibiting equal peaks with retention times of 5.7 and 7.1 minutes, and the enantioenriched compound **44f** exhibiting a major peak with a retention time of 7.2 minutes (minor enantiomer has a retention time of 5.9 minutes).

Values for the racemic compound :

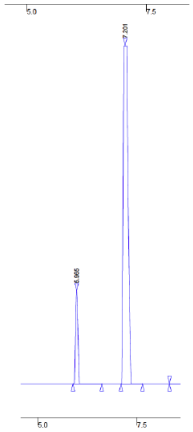
Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
5.711	0.000	6012605	BB	6.1
7.122	0.000	5773154	BB	6.9

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
5.965	0.000	1537564	BB	4.3
7.201	0.000	11192721	BB	8.1



44f



44f

(*S*)-diethyl 8-butyl-3-methyl-2-oxo-1-phenyl-1,2,6,7-tetrahydroazulene-5,5(4*H*)-dicarboxylate (44c):

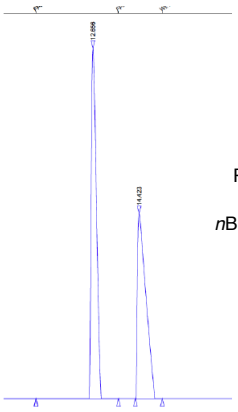
The enantiomeric purity of compound **44c** was determined by HPLC analysis run on a ChiralCel IA-3 column eluting in 3% 2-Propanol/Hexanes, with a 20.0 µL injection and a 1.0 mL/min flow rate. Compound **44c** has 80% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**44c** exhibiting equal peaks with retention times of 12.7 and 14.4 minutes, and the enantioenriched compound **44c** exhibiting a major peak with a retention time of 14.2 minutes (minor enantiomer has a retention time of 12.7 minutes).

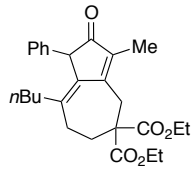
Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
12.656	0.000	15581800	BB	13.3
14.423	0.000	13541313	BB	22.2

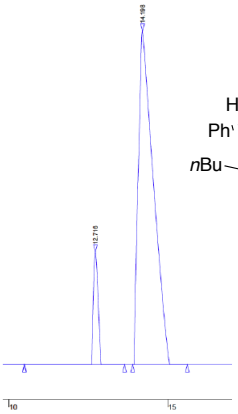
Values for the enantiopur compound :

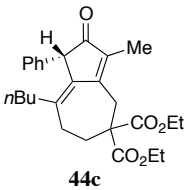
Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
12.716	0.000	3731294	BB	10.6
14.198	0.000	34908856	BB	32.3





44c





44c

(*S*)-5-butyl-6,8-diphenyl-3,4-dihydro-1*H*-cyclopenta[*c*]oxepin-7(6*H*)-one (43d).

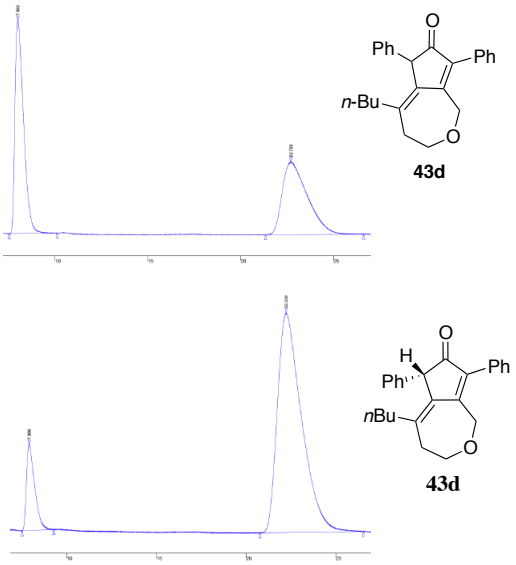
The enantiomeric purity of compound **43d** was determined by HPLC analysis run on a ChiralCel OD column eluting in 5% 2-Propanol/Hexanes, with a 20.0 µL injection and a 1.0 mL/min flow rate. Compound **43d** has 77% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**43d** exhibiting equal peaks with retention times of 7.9 and 22.7 minutes, and the enantioenriched compound **43d** exhibiting a major peak with a retention time of 22.2 minutes (minor enantiomer has a retention time of 7.9 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
7.993	0.000	6590507	BB	30.0
22.700	0.000	6522174	BB	88.8

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
7.886	0.000	2422351	BB	29.4
22.239	0.000	18274828	BB	86.4



***(S)*-5-butyl-8-methyl-6-phenyl-3,4-dihydro-1*H*-cyclopenta[*c*]oxepin-7(6*H*)-one (43c):**

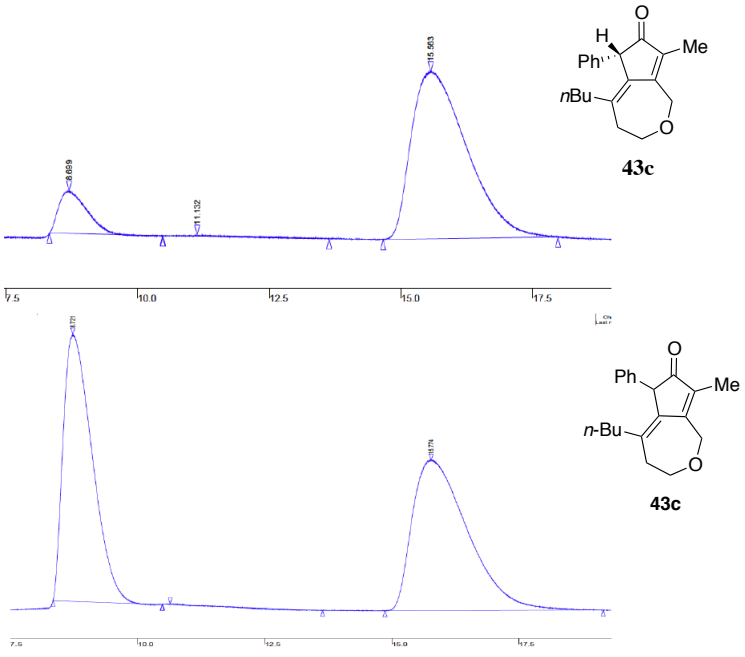
The enantiomeric purity of compound **43c** was determined by HPLC analysis run on a ChiralCel OD column eluting in 2% 2-Propanol/Hexanes, with a 20.0 μL injection and a 1.0 mL/min flow rate. Compound **43c** has 78% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**43c** exhibiting equal peaks with retention times of 8.7 and 15.7 minutes, and the enantioenriched compound **43c** exhibiting a major peak with a retention time of 15.6 minutes (minor enantiomer has a retention time of 8.7 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
8.721	0.000	5070164	BB	37.7
15.774	0.000	5470080	BB	71.1

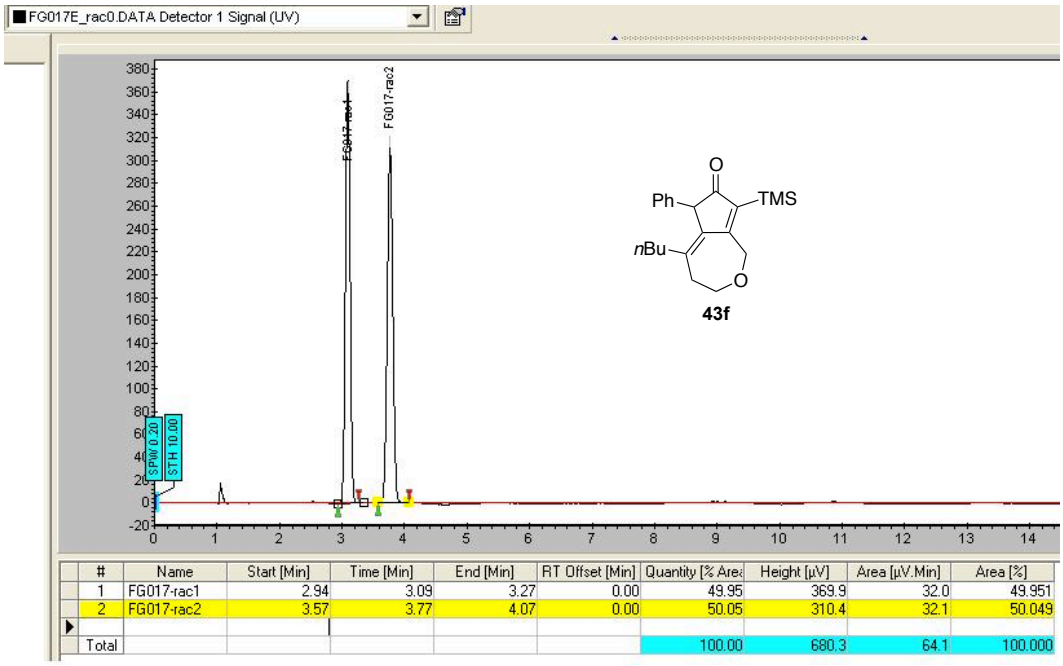
Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
8.699	0.000	569848	BB	35.6
15.563	0.000	4521015	BB	69.7

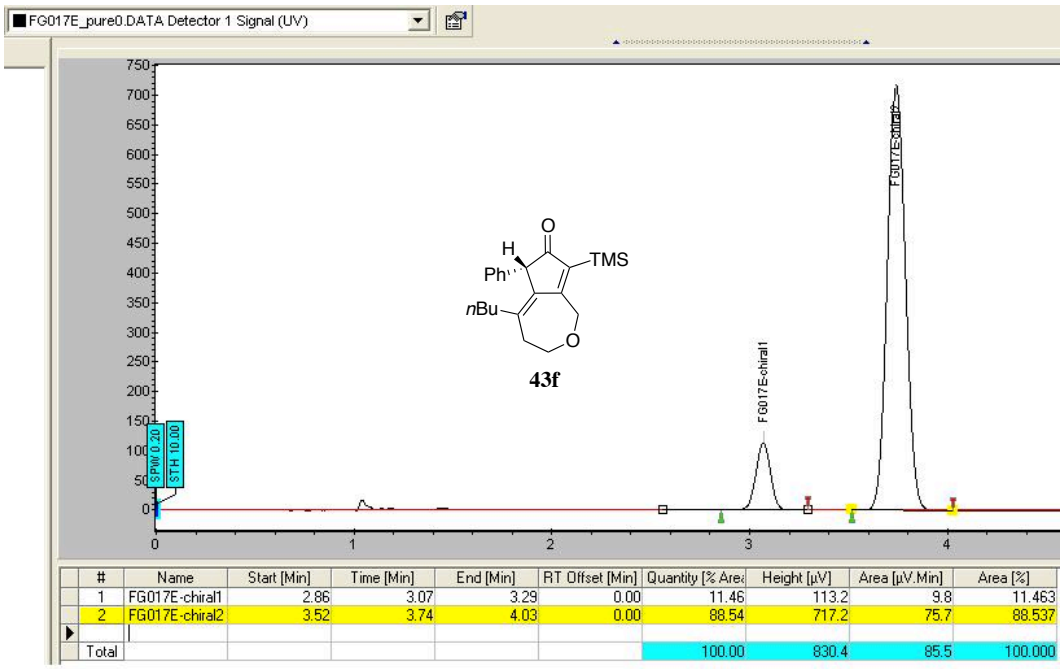


(*S*)-5-butyl-6-phenyl-8-(trimethylsilyl)-3,4-dihydro-1*H*-cyclopenta[*c*]oxepin-7(6*H*)-one (43f):

The enantiomeric purity of compound **43f** was determined by SFC analysis run on a Chiralpak IC column using 10% MeOH as mobile phase with a 10 µL injection, a 3.0 mL/min flow rate and a pressure of 110 bar. The compound has 77% ee. The peaks are visualized at 220 nm, with the racemic alcohol (±)-**43f** exhibiting equal peaks with retention times of 3.1 and 3.8 minutes, and the enantioenriched compound **43f** exhibiting a major peak with a retention time of 3.7 minutes (minor enantiomer has a retention time of 3.1 minutes).



#	Name	Start [Min]	Time [Min]	End [Min]	RT Offset [Min]	Quantity [% Area]	Height [µV]	Area [µV.Min]	Area [%]
1	FG017-rac1	2.94	3.09	3.27	0.00	49.95	369.9	32.0	49.951
2	FG017-rac2	3.57	3.77	4.07	0.00	50.05	310.4	32.1	50.049
Total						100.00	680.3	64.1	100.000



#	Name	Start [Min]	Time [Min]	End [Min]	RT Offset [Min]	Quantity [% Area]	Height [µV]	Area [µV.Min]	Area [%]
1	FG017E-chiral1	2.86	3.07	3.29	0.00	11.46	113.2	9.8	11.463
2	FG017E-chiral2	3.52	3.74	4.03	0.00	88.54	717.2	75.7	88.537
Total						100.00	830.4	85.5	100.000

(*S*)-5-butyl-8-cyclopropyl-6-phenyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[*c*] azepin-7(6*H*)-one (42g):

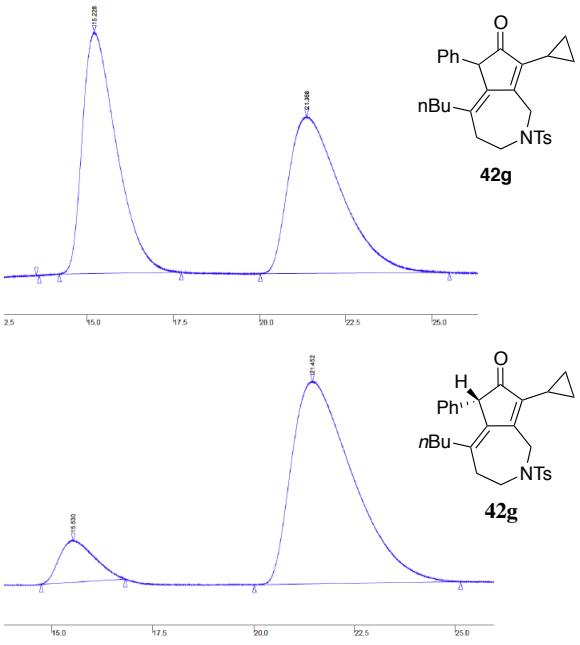
The enantiomeric purity of compound **42g** was determined by HPLC analysis run on a ChiralCel OD column eluting in 5% 2-Propanol/Hexanes, with a 10.0 µL injection and a 1.0 mL/min flow rate. Compound **42g** has 79% ee. The peaks are visualized at 254 nm, with the racemic compound (+)-**42g** exhibiting equal peaks with retention times of 15.2 and 21.4 minutes, and the enantioenriched compound **42g** exhibiting a major peak with a retention time of 21.5 minutes (minor enantiomer has a retention time of 15.5 minutes).

Values for the racemic compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
15.228	0.000	5343053	BB	63.8
21.368	0.000	5377441	BB	98.8

Values for the enantiopur compound :

Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)
15.530	0.000	888939	BB	63.7
21.452	0.000	7508335	BB	99.9

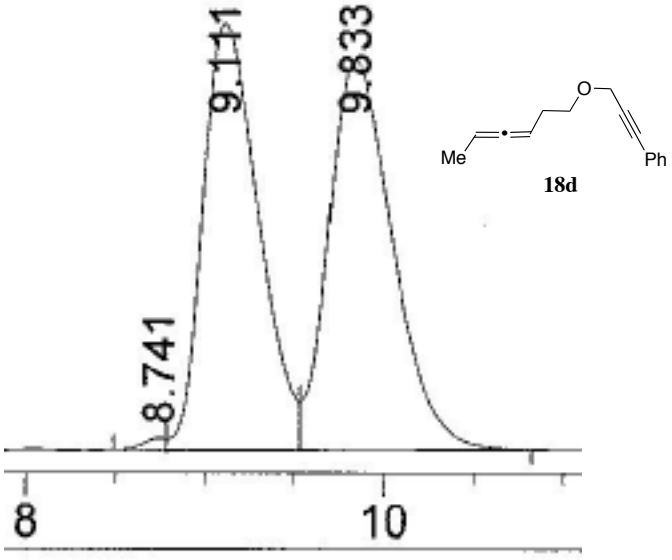


HPLC analysis for the racemization experiment in the disubstituted series

- For (R_a)-(3-(hexa-3,4-dien-1-yloxy)prop-1-yn-1-yl)benzene (18d):

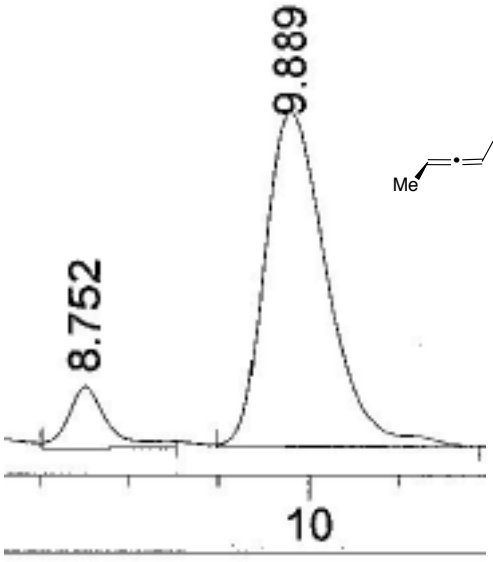
The enantiomeric purity of compound **18d** was determined by HPLC analysis run on a ChiralPak AS-H column eluting in 0.5% 2-Propanol/Heptanes, with a 5.0 µL injection and a 1.0 mL/min flow rate.

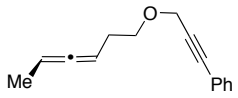
HPLC analysis for the racemic compound:



RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
8.741	BV	0.1247	30.85120	3.57348	0.5351
9.111	VV	0.3354	2809.09546	130.34499	48.7207
9.833	VB	0.3775	2925.77148	119.54026	50.7443

HPLC analysis for the pure chiral compound:



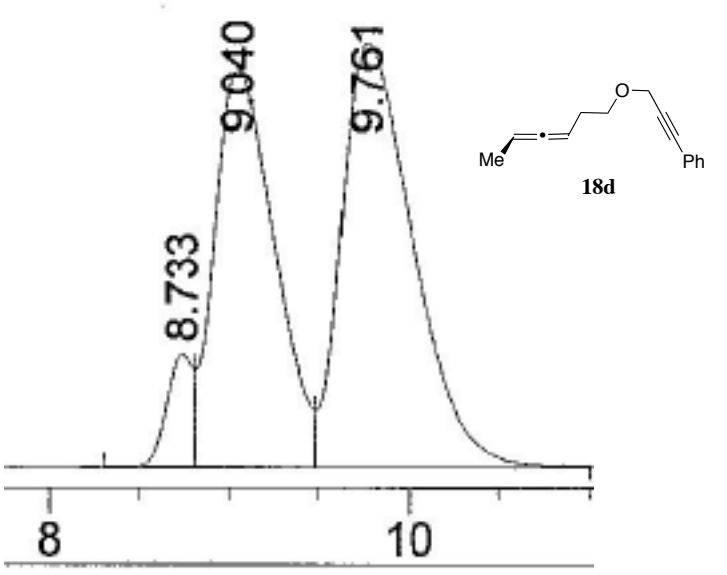


18d

RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
8.752	VB	0.2334	198.23923	12.75234	10.5021
9.889	BB	0.3564	1689.37256	71.31681	89.4979

Compound **18d** has >99% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**18d** exhibiting equal peaks with retention times of 9.1 and 9.8 minutes, and the enantioenriched compound **18d** exhibiting a major peak with a retention time of 9.9 minutes. The minor enantiomer was not detected (the corresponding peak was below the detection level of the HPLC system).

HPLC analysis for the chiral compound when the reaction was stopped at 50% conversion:



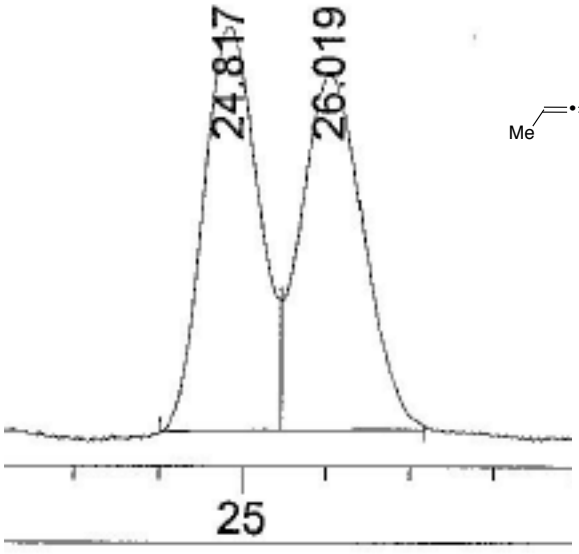
RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
8.733	VV	0.1561	684.70691	66.53085	5.2065
9.040	VV	0.3655	5519.61914	235.44983	41.9714
9.761	VB	0.4311	6946.57764	250.81776	52.8221

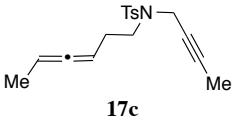
Compound **18d** has 11% ee. The peaks are visualized at 254 nm with enantioenriched compound **18d** exhibiting a major peak with a retention time of 9.8 minutes (minor enantiomer has a retention time of 9.0 minutes).

- For (R_a)-*N*-(but-2-yn-1-yl)-*N*-(hexa-3,4-dien-1-yl)-4-methylbenzene sulfonamide (17c):

The enantiomeric purity of compound **17c** was determined by HPLC analysis run on a ChiralPak AS-H column eluting in 7% 2-Propanol/Heptanes, with a 3.0 μL injection and a 1.0 mL/min flow rate.

HPLC analysis for the racemic compound:

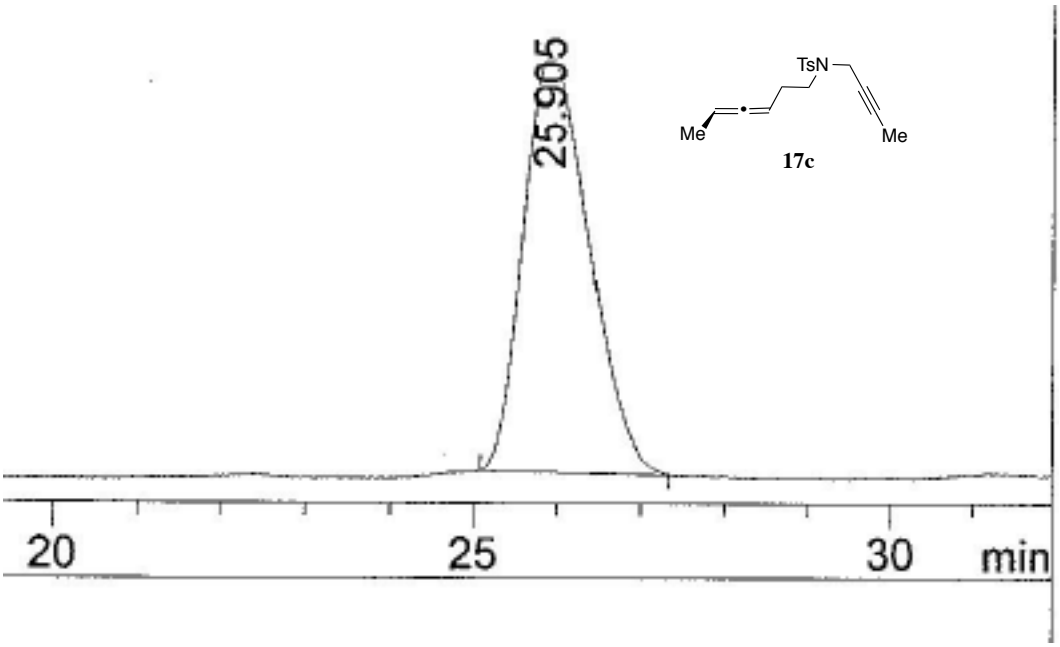




17c

RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
24.817	BV	0.5822	552.32684	12.06149	50.1913
26.019	VB	0.6404	548.11725	10.58058	49.8087

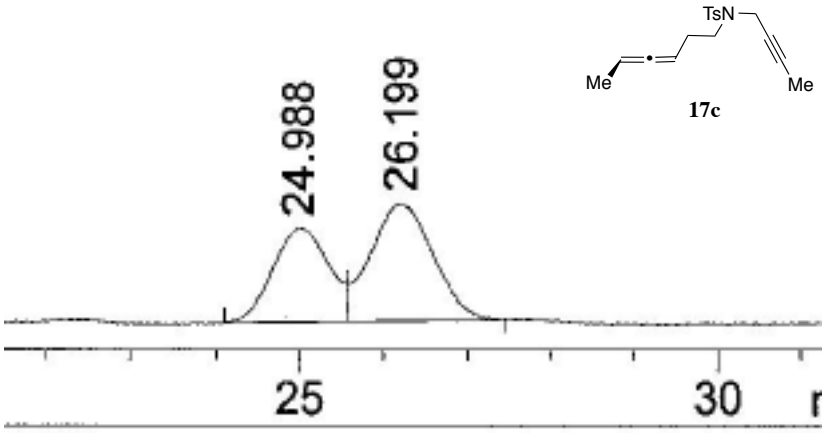
HPLC analysis for the pure chiral compound:



RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
25.905	BB	0.6574	1590.09363	29.47636	100.0000

Compound **17c** has >99% ee. The peaks are visualized at 254 nm, with the racemic compound (±)-**17c** exhibiting equal peaks with retention times of 24.8 and 26.0 minutes, and the enantioenriched compound **17c** exhibiting a major peak with a retention time of 25.9 minutes. The minor enantiomer was not detected (the corresponding peak was below the detection level of the HPLC system).

HPLC analysis for the chiral compound when the reaction was stopped at 29% conversion:

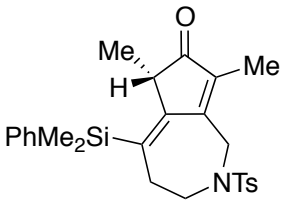


RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
24.988	BV	0.5603	480.47360	10.22376	42.2333
26.199	VB	0.6302	657.19080	12.81791	57.7667

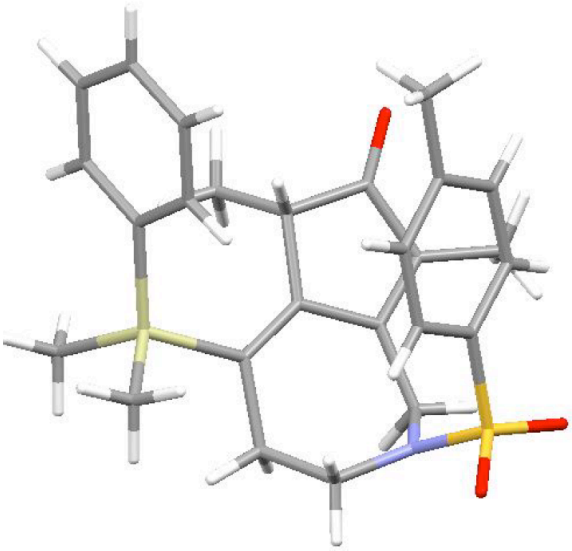
Compound **17c** has 15% ee. The peaks are visualized at 254 nm with enantioenriched compound **17c** exhibiting a major peak with a retention time of 26.2 minutes (minor enantiomer has a retention time of 24.9 minutes).

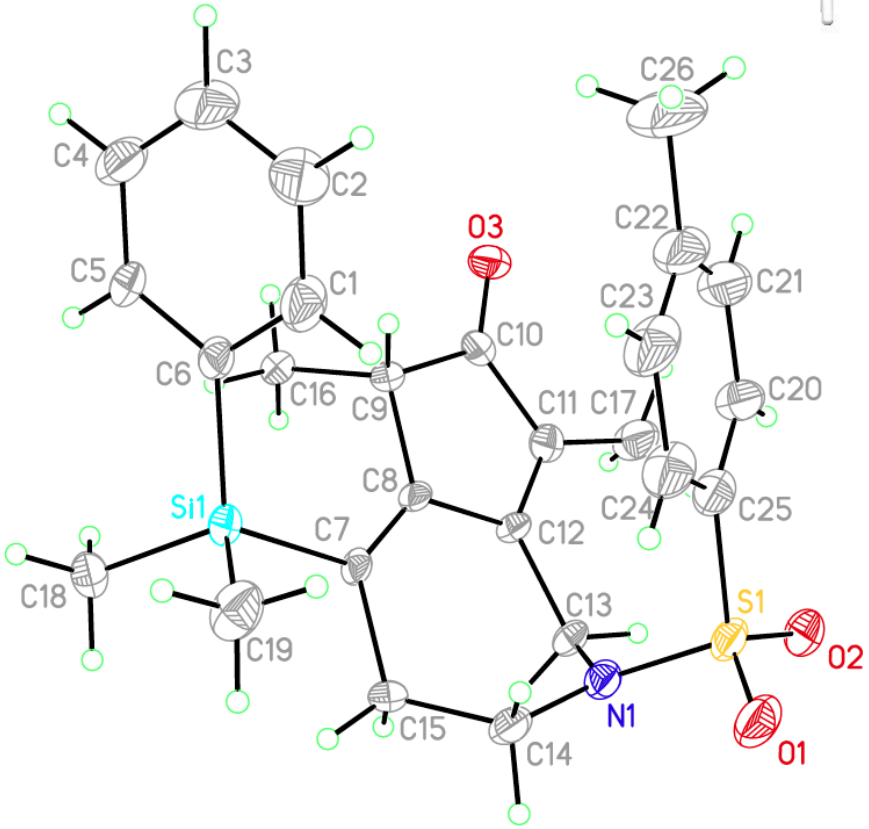
Details of Crystal Structure Determination

- X-ray Crystal Structure of (S)-5-(dimethyl(phenyl)silyl)-6,8-dimethyl-2-tosyl-1,2,3,4-tetrahydrocyclopenta[*c*]azepin-7(6*H*)-one (35c)

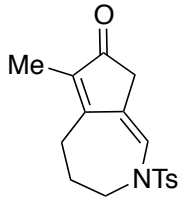


35c





- X-ray Crystal Structure of 6-methyl-2-tosyl-2,3,4,5-tetrahydrocyclo penta[*c*]azepin-7(1*H*)-one (48).



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