

Supporting Information

**Iridium(I)-Catalyzed Intramolecular Hydrocarbonation of Alkenes:
Efficient Access to Cyclic Systems Bearing Quaternary Stereocenters**

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Supporting Information
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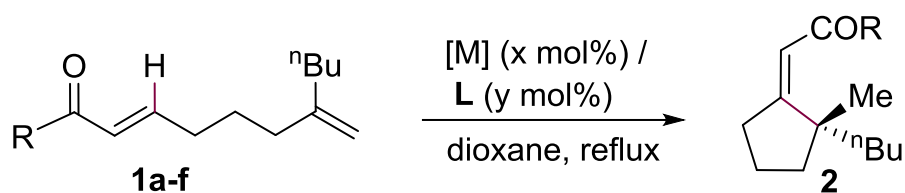
General Procedures

Dry solvents were freshly distilled under argon from an appropriate drying agent before use. Bis(cyclooctadiene)iridium(I) tetrakis(3,5-bis(trifluoromethyl) phenyl) borate (abbreviated as Ir(cod)₂BARF), Bis(1,5-cyclooctadiene)iridium(I) tetrafluoroborate (abbreviated as Ir(cod)₂BF₄), 1,2-Bis[bis(pentafluoro-phenyl)phosphino]ethane (abbreviated as dpp^Fe) were purchased from Aldrich. Other bisphosphines were purchased from Aldrich or Strem-Chemicals. All other reagents used were bought from Aldrich, Alfa Aesar, TCI or Acros and used without further purification.

All reactions dealing with air- and moisture-sensitive compounds were carried out in oven-dried reaction flask under argon atmosphere with dry solvents. The abbreviation “rt” refers to reactions carried out approximately at 23 °C. Reaction mixtures were stirred using Teflon-coated magnetic stirring bars. Reaction temperatures were maintained using Thermowatch-controlled silicone oil baths. Thin-layer chromatography (TLC) was performed on silica gel plates and components were visualized by observation under UV light, and / or by treating the plates with p-anisaldehyde or phosphomolybdic acid solutions, followed by heating. Flash chromatography was carried out on silica gel unless otherwise stated. Dryings were performed with anhydrous Na₂SO₄ or MgSO₄. Concentration refers to the removal of volatile solvents via distillation using a Büchi rotary evaporator followed by residual solvent removal under high vacuum. NMR spectra were recorded in CDCl₃, at 300 MHz (Varian), 400 MHz (Varian) or 500 MHz (Varian). Carbon types and structure assignments were determined from DEPT-NMR. NMR spectra were analyzed using MestreNova© NMR data processing software (www.mestrelab.com). 1,3,5-Trimethoxybenzene was used as internal standard. The following abbreviations are used to indicate signal multiplicity: s, singlet; d, doublet; t, triplet; q, quartet; dd, double doublet; ddd, doublet of doublet of doublets; td, triple doublet; dt, doublet of triplets; dq, doublet of quartet; m, multiplet; br, broad. Mass spectra (ESI-MS) were acquired using IT-MS Bruker AmaZon SL at CIQUS and also using chemical ionization (CI) electron impact (EI), or electrospray ionization (ESI) at the CACTUS facility of the University of Santiago de Compostela. The reactions were monitored by TLC. Enantioselectivities were determined in an Agilent HPLC 1100 Series with Chiralpak IA, IB, IC, IA3 or OZ-H analytical columns.

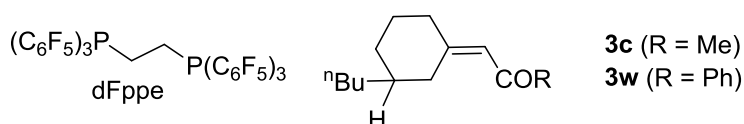
Optimization of the reaction conditions

Table S1. Optimization of the reaction conditions^[a]



entry	1	R	[M] (X mol%)	L (y mol%)	Yield (%) ^[b]
1	1a	NEt ₂	Ir(cod) ₂ BArF (5)	d ^F ppe (5)	2a , 91
2	1a	NEt ₂	Ir(cod) ₂ BArF (5)	P(C ₆ F ₅) ₃ (10)	2a , <5
3	1a	NEt ₂	Ir(cod) ₂ BArF (5)	dppe (5)	2a , 32
4	1a	NEt ₂	Ir(cod) ₂ BArF (5)	dppb (5)	2a , 62
5	1a	NEt ₂	Ir(cod) ₂ BArF (5)	<i>rac</i> -Binap (5)	2a , 80
6 ^[c]	1a	NEt ₂	Ir(cod) ₂ BF ₄ (5)	d ^F ppe (5)	2a , 75
7	1a	NEt ₂	[Ir(cod)Cl] ₂ (2.5)	d ^F ppe (5)	2a , –
8 ^[d]	1a	NEt ₂	Rh(cod) ₂ BArF (5)	dppe (5)	2a , <2
9 ^[d]	1a	NEt ₂	Rh(cod) ₂ BArF (5)	d ^F ppe (5)	2a , <2
10	1a	NEt ₂	Rh(cod) ₂ BArF (5)	<i>rac</i> -Binap (5)	2a , <2
11	1b	Pyr	Ir(cod) ₂ BArF (5)	d ^F ppe (5)	2b , 44
12	1u	OEt	Ir(cod) ₂ BArF (5)	d ^F ppe (5)	2u , –
13	1v	OH	Ir(cod) ₂ BArF (5)	d ^F ppe (5)	2v , –
14	1c	Me	Ir(cod) ₂ BArF (5)	d ^F ppe (5)	3c , 32
15	1w	Ph	Ir(cod) ₂ BArF (5)	d ^F ppe (5)	3w , 33

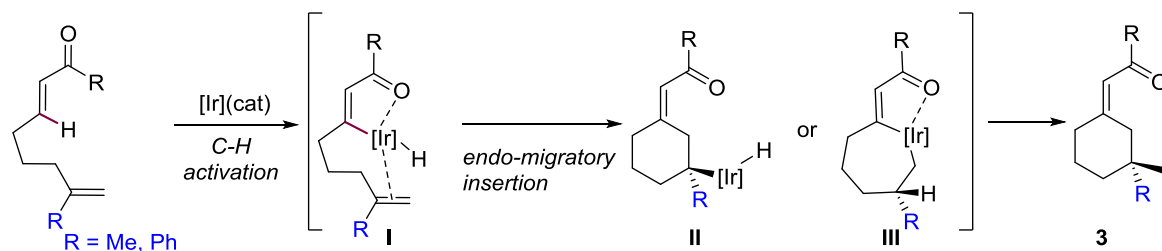
[a] Conditions: **1** was added to a solution of complex [M] (x mol%) and L (y mol%) in dioxane and the mixture was heated at the indicated temperature. [b] Isolated yield. [c] The same result was obtained when the catalyst was generated from [Ir(cod)Cl]₂ (2.5 %), d^Fppe (5 %) and AgBF₄ (5 %). [d] The same result was obtained at 140 °C.



Hypothesis for the formation of products of type **3**

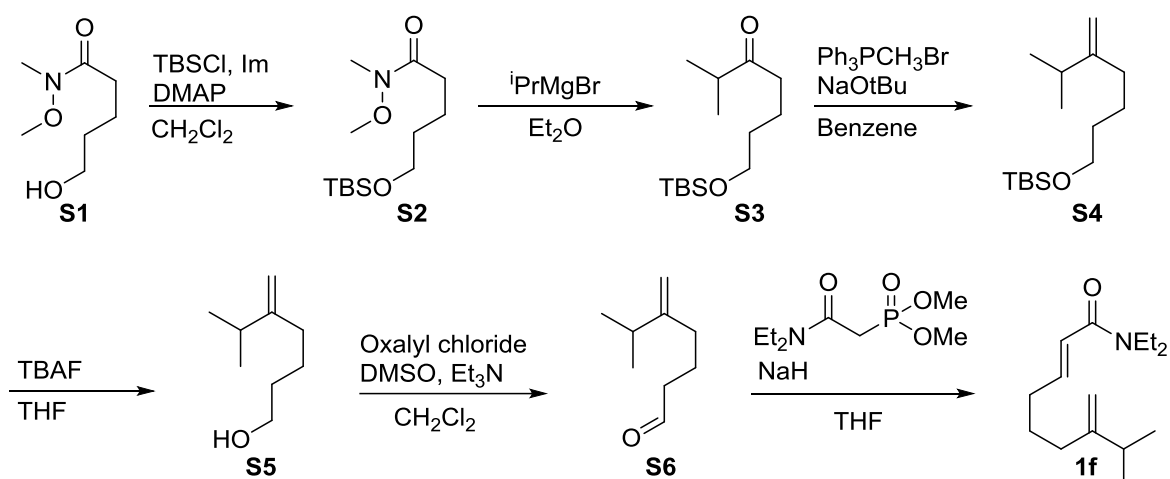
The results obtained with the methyl and phenyl ketone derivatives **1c** and **1w** (Table S1, entries 14 and 15) would suggest that, for these substrates, an *endo*-cyclization to afford intermediates like **II** and **III** would be preferred, eventually leading to products of type **3** after a reductive elimination. The

reason for the formation of *endo* product **3** is not clear, but might be related to the weaker coordinating ability of the keto with respect to the amide group



Synthesis of the substrates for catalysis

General procedure A for preparation of 1,6-diene precursors 1a, 1b, 1d, 1e, 1f, 1g, 1j, 1h and 1i (exemplified for the synthesis of 1f).

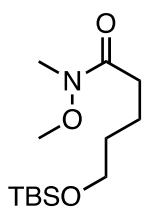


5-Hydroxy-*N*-methoxy-*N*-methylpentanamide (S1)

Prepared following a procedure described by Flick and coworkers.^[1]

AlMe3, (60 mL, 120 mmol, 2.0 M in hexane) was added dropwise to a stirred solution of *N*,*O*-dimethylhydroxyl-amine hydrochloride¹ (11.7 g, 120 mmol) in dry CH2Cl2 (26 mL) at 0 °C. (CAUTION: The reaction is very exothermic). The mixture was stirred for 20 min at 0 °C and *D*-valerolactone (8.0 g, 80 mmol) of was added dropwise. After stirring at 0 °C for 20 min, the mixture was diluted with CHCl3 (125 mL) and then HCl (aq) (15 mL, 0.1 N) was added dropwise at 0 °C. The mixture was stirred for 1 h, the organic phases were separated, dried, filtered, and concentrated under reduced pressure to give 5-hydroxy-*N*-methoxy-*N*-methylpentanamide (12.9 g, 99% yield) as a white solid. The NMR data was consistent with previous characterization.

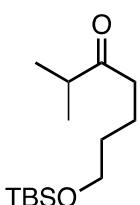
5-((*tert*-Butyldimethylsilyl)oxy)-*N*-methoxy-*N*-methylpentanamide (**S2**)



Prepared following a modified procedure described by Stork and coworkers.^[2]

imidazole (13.2 g, 194 mmol), *tert*-butyldimethylsilyl chloride (17.3 g, 115 mmol) and 4-dimethyl aminopyridine (117 mg, 0.96 mmol) were sequentially added to a solution of 5-hydroxy-*N*-methoxy-*N*-methylpentanamide (12.9 g, 80 mmol) in CH₂Cl₂ (275 mL, 0.29 M). The solution was stirred for 15 minutes, water (10 ml) was added and the reaction mixture was extracted with Et₂O (3 x 10 mL). The combined organic extracts were washed with water and brine, dried and evaporated. The crude was purified by column chromatography on silica gel (1:1 Et₂O – hexane) to obtain the desired product as colorless oil (21.0 g, 95% yield). The characterization analysis was consistent with the previous data.²

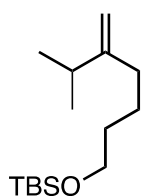
7-((*tert*-Butyldimethylsilyl)oxy)-2-methylheptan-3-one (**S3**)^[3]



*i*PrMgBr (98 mL, 98 mmol), 1.0 M) was added dropwise to a solution of 5-((*tert*-butyldimethylsilyl)oxy)-*N*-methoxy-*N*-methylpentanamide (**S2**, 9.0 g, 32.6 mmol) in Et₂O (220 mL, 0.15 M) at -78 °C. The reaction was allowed to warm to rt and stirred overnight. Then Rochelle's Salt (sat) (50 mL) was added at 0 °C, the organic phase was separated and subsequently washed with NH₄Cl (sat) (250 mL), water (200 mL) and brine (200 mL). After extraction with Et₂O (3 x 280 mL), the combined organic extracts were dried and evaporated to yield a crude residue that was purified by column chromatography on silica gel (1:8 Et₂O – hexanes) to obtain the desired product (**S3**) as colorless oil (8.4 g, 57% yield) The NMR data is consistent with that previously described in literature.³

¹H NMR (300 MHz, CDCl₃): δ 3.56 (t, *J* = 6.2 Hz, 2H), 2.54 (p, *J* = 6.9 Hz, 1H), 2.42 (t, *J* = 7.2 Hz, 2H), 1.63 – 1.52 (m, 2H), 1.50 – 1.41 (m, 2H), 1.03 (d, *J* = 6.9 Hz, 6H), 0.84 (s, 9H), -0.01 (s, 6H). ¹³C NMR (75 MHz, CDCl₃): δ 214.64 (C), 62.95 (CH₂), 40.78 (CH), 40.12 (CH₂), 32.39 (CH₂), 26.01 (CH₃), 20.33 (CH₂), 18.32 (CH₃), -5.26 (CH₃). MS (ESI): ([M+H]⁺) 259.2.

tert-Butyldimethyl((6-methyl-5-methyleneheptyl)oxy)silane (**S4**)

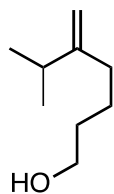


Sodium *tert*-butoxide (3.84 g, 40 mmol) was added to a suspension of methyltriphenylphosphonium bromide (16.2 g, 45.4 mmol) in benzene (90 mL, 0.2 M).

The mixture was refluxed for 4 hours, allowed to cooled down to rt and a solution of 7-((*tert*-butyldimethylsilyl)oxy)-2-methylheptan-3-one, (**S3**, 4.7 g, 18.18 mmol) in benzene (10 mL) was added. The mixture was stirred for 12 hours, concentrated and most of the phosphine oxide was precipitated by adding cold hexane. After filtration of this oxide and evaporation of the solvent, the resulting crude was purified by column chromatography (1:40 Et₂O – hexane) to obtain desired product as colorless oil (3.9 g, 84 % yield). ¹H NMR (300 MHz, CDCl₃): δ 4.77 – 4.66 (m, 2H), 3.63 (t, *J* = 6.2 Hz, 2H), 2.31 – 2.16 (m, 1H), 2.04 (t, *J* = 6.9 Hz, 2H), 1.61 – 1.43 (m, 2H), 1.03 (d, *J* = 6.8 Hz, 6H), 0.90 (s, 9H), 0.05 (s, 6H). ¹³C NMR (75 MHz, CDCl₃): δ 156.06 (C), 106.41

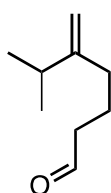
(CH₂), 63.29, (CH₂) 34.34 (CH₂), 33.86 (CH), 32.87 (CH₂), 26.15 (CH₃), 24.51(CH₂), 22.05 (CH₃), -5.10 (CH₃). **MS (ESI):** ([M+H]⁺) 257.2

6-Methyl-5-methyleneheptan-1-ol (S5)



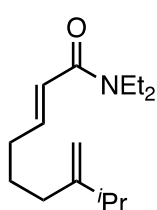
TBAF (38 mL, 1 M, 38 mmol) was added to a solution of *tert*-butyldimethyl((6-methyl-5-methyleneheptyl)oxy)silane (**S4**, 3.90 g, 15.2 mmol) in THF (152 mL, 0.1M) at 0 °C. The reaction mixture was allowed to warm to rt and stirred for 30 min. NH₄Cl (sat) (20 mL) was then added and the layers were separated. The aqueous phase was extracted with Et₂O (3 x 70 mL) and the combined organic extracts were dried, evaporated and purified by column chromatography (1:5 Ethyl acetate – hexane) to yield the desired alcohol as a colorless oil (1.90 g, 88% yield). **¹H NMR** (300 MHz, CDCl₃): δ 4.76 – 4.62 (m, 2H), 3.60 (t, *J* = 6.4 Hz, 2H), 2.32 – 2.14 (m, 2H), 2.02 (t, *J* = 7.2 Hz, 2H), 1.62 – 1.43 (m, 4H), 0.99 (d, *J* = 6.8 Hz, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 155.80 (C), 106.43 (CH₂), 62.78 (CH₂), 34.20 (CH₂), 33.75 (CH), 32.64 (CH₂), 24.34 (CH₂), 21.92 (CH₃). **MS (ESI):** ([M+H]⁺) 143.1

6-Methyl-5-methyleneheptanal (S6)



DMSO (2.7 mL, 38.0 mmol) in CH₂Cl₂ (4.1 mL, 2.5 M) was added dropwise to a solution of oxalyl chloride (1.6 mL, 19.0 mmol) in CH₂Cl₂ (60 mL, 0.18 M) at –78 °C. The reaction was stirred for 10 min and then a solution of 6-methyl-5-methyleneheptan-1-ol (**S5**) (1.5 g, 10.6 mmol) in CH₂Cl₂ (7.5 mL, 1.4 M) was added slowly. After 45 min Et₃N (7.3 mL) was added at –78 °C. After stirring at that temperature for 30 min, the mixture was warmed to rt and stirred for 30 min. H₂O (10 mL) was then added, the organic phase was separated and washed with HCl (1.0 M solution), NaHCO₃ (sat) and brine. The organic phases was dried and carefully concentrated under vacuum at 0 °C. The crude aldehyde was submitted to the next step without purification. **¹H NMR** (300 MHz, CDCl₃): δ 9.78 (t, *J* = 1.7 Hz, 1H), 4.80 – 4.68 (m, 2H), 2.48 – 2.41 (m, 2H), 2.27 – 2.17 (m, 1H), 2.06 (t, *J* = 7.6 Hz, 2H), 1.86 – 1.72 (m, 2H), 1.02 (d, *J* = 6.9 Hz, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 202.47 (COH), 154.74 (C), 107.22 (CH₂), 43.53 (CH₂), 33.64 (CH₂), 21.90 (CH), 21.83 (CH₃), 20.48 (CH₂).

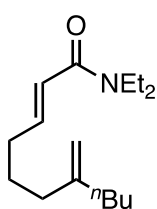
(*E*)-*N,N*-Diethyl-8-methyl-7-methylenonon-2-enamide (1f)



Dimethyl (2-(diethylamino)-2-oxoethyl) phosphonate (1.52 g, 6.85 mmol) was added dropwise to a suspension of NaH (60 %) (251 mg, 6.28 mmol) in THF (36 mL) at rt. The mixture was stirred for 15 minutes before 6-methyl-5-methyleneheptanal (800 mg, 5.71 mmol) was added dropwise to the mixture. After one hour, water and Et₂O were successively added and the layers were separated. The organic phase was washed with water (2 x 10 mL). The aqueous combined phases were extracted with CH₂Cl₂ (2 x 10

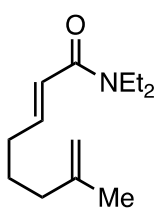
mL) and the combined organic phases were dried and concentrated. Purification of the crude residue by flash chromatography on silica gel (1:10 to 1:3 EtOAc: Hexanes) afforded the desired product as a colorless oil (907 mg, 67 % yield). **¹H NMR** (300 MHz, CDCl₃): δ 6.92 – 6.75 (m, 1H), 6.19 – 6.02 (m, 1H), 4.75 – 4.56 (m, 2H), 3.39 – 3.26 (m, 4H), 2.21 – 2.11 (m, 3H), 2.03 – 1.95 (m, 2H), 1.60 – 1.50 (m, 2H), 1.18 – 1.04 (m, 6H), 1.00 – 0.89 (m, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 165.79 (C), 155.27 (C), 145.72 (CH), 120.65 (CH), 106.59 (CH₂), 42.08 (CH₂), 40.73 (CH₂), 33.80 (CH₂), 33.64 (CH), 32.16 (CH₂), 26.79 (CH₂), 21.83 (CH₃), 14.84 (CH₃), 13.15 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₁₅H₂₈NO ([M+H]⁺) 238.2164, found 238.2165.

(E)-N,N-Diethyl-7-methyleneundec-2-enamide (1a)



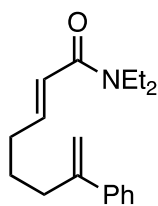
This compound was prepared according to the general procedure **A** using *n*BuMgBr instead of *i*PrMgBr. **¹H NMR** (300 MHz, CDCl₃): δ 6.85 (dt, *J* = 14.5, 7.0 Hz, 1H), 6.15 (dd, *J* = 15.0, 1.6 Hz, 1H), 4.69 – 4.63 (m, 2H), 3.40 – 3.30 (m, 4H), 2.20 – 2.11 (m, 2H), 2.02 – 1.91 (m, 4H), 1.60 – 1.48 (m, 2H), 1.39 – 1.20 (m, 4H), 1.17 – 1.06 (m, 6H), 0.85 (t, *J* = 7.1 Hz, 3H). **¹³C NMR** (75 MHz, CDCl₃): δ 165.86 (C), 149.40 (C), 145.78 (CH), 120.71 (CH), 109.04 (CH₂), 42.13 (CH₂), 40.80 (CH₂), 35.68 (CH₂), 35.49 (CH₂), 32.10 (CH₂), 30.02 (CH₂), 26.50 (CH₂), 22.49 (CH₂), 14.89 (CH₃), 14.00 (CH₃), 13.20 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₁₆H₃₀NO ([M+H]⁺) 252.2321, found 252.2322.

(E)-N,N-Diethyl-7-methylocta-2,7-dienamide (1d)



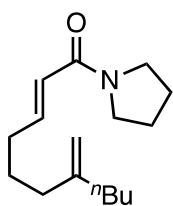
This compound was prepared according the general procedure **A** using MeMgBr instead of *i*PrMgBr. **¹H NMR** (300 MHz, CDCl₃): δ 6.79 (dt, *J* = 14.5, 7.0 Hz, 1H), 6.13 – 6.05 (m, 1H), 4.61 – 4.55 (m, 2H), 3.33 – 3.23 (m, 4H), 2.14 – 2.05 (m, 2H), 1.96 – 1.90 (m, 2H), 1.59 (s, 3H), 1.55 – 1.43 (m, 2H), 1.12 – 0.99 (m, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 165.66 (C), 145.53 (CH), 145.07 (C), 120.62 (CH), 110.12 (CH₂), 41.98 (CH₂), 40.64 (CH₂), 37.03 (CH₂), 31.81 (CH₂), 26.16 (CH₂), 22.12 (CH₃), 14.74 (CH₃), 13.05 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₁₃H₂₄NO ([M+H]⁺) 210.1851, found 210.1852.

(E)-N,N-Diethyl-7-phenylocta-2,7-dienamide (1h)



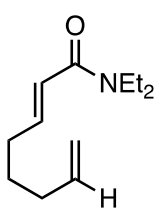
This compound was prepared according to the general procedure **A** using PhMgBr instead of *i*PrMgBr. **¹H NMR** (300 MHz, CDCl₃): δ 7.41 – 7.22 (m, 5H), 6.94 – 6.82 (m, 1H), 6.16 (dt, *J* = 15.0, 1.5 Hz, 1H), 5.29 – 5.01 (m, 2H), 3.44 – 3.29 (m, 4H), 2.53 (td, *J* = 7.5, 1.2 Hz, 2H), 2.28 – 2.17 (m, 2H), 1.67 – 1.55 (m, 2H), 1.21 – 1.06 (m, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 165.83 (C), 148.08 (C), 145.55 (CH), 141.16 (C), 128.33 (CH), 127.41 (CH), 126.16 (CH), 120.90 (CH), 112.68 (CH₂), 42.14 (CH₂), 40.81 (CH₂), 34.76, (CH₂) 31.92 (CH₂), 26.93 (CH₂), 14.92 (CH₃), 13.24 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₁₈H₂₆NO ([M+H]⁺) 272.2009, found 272.2009.

(E)-7-Methylene-1-(pyrrolidin-1-yl)undec-2-en-1-one (1b)



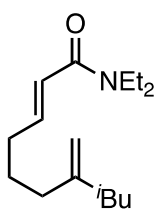
This compound was prepared according to the general procedure **A** using dimethyl (2-oxo-2-(pyrrolidin-1-yl)ethyl)phosphonate in the last step. **¹H NMR** (300 MHz, CDCl₃): δ 6.89 (dt, *J* = 15.1, 7.0 Hz, 1H), 6.08 (dt, *J* = 15.1, 1.6 Hz, 1H), 4.72 – 4.64 (m, 2H), 3.48 (dd, *J* = 6.7, 3.6 Hz, 4H), 2.23 – 2.13 (m, 2H), 2.05 – 1.90 (m, 6H), 1.88 – 1.80 (m, 2H), 1.61 – 1.53 (m, 2H), 1.43 – 1.22 (m, 4H), 0.88 (t, *J* = 7.1 Hz, 3H). **¹³C NMR** (75 MHz, CDCl₃): δ 164.63 (C), 149.14 (C), 145.11 (CH), 121.77 (CH), 108.89 (CH₂), 46.31 (CH₂), 45.59 (CH₂), 35.51 (CH₂), 35.28 (CH₂), 31.81 (CH₂), 29.84 (CH₂), 26.31 (CH₂), 25.99 (CH₂), 24.18 (CH₂), 22.31 (CH₂), 13.83 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₆H₂₈NO ([M+H]⁺) 250.2167, found 250.2165.

(E)-N,N-Diethylocta-2,7-dienamide (1i)



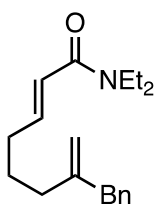
This compound was prepared according to the last two steps of the general procedure **A** using the commercial available hex-5-enal as the aldehyde. **¹H NMR** (300 MHz, CDCl₃): δ 6.84 (dt, *J* = 14.4, 7.0 Hz, 1H), 6.14 (d, *J* = 15.1 Hz, 1H), 5.82 – 5.65 (m, 1H), 4.99 – 4.88 (m, 2H), 3.34 (dd, *J* = 16.2, 7.6 Hz, 4H), 2.21 – 2.1 (m, 2H), 2.08 – 1.98 (m, 2H), 1.56 – 1.44 (m, 2H), 1.18 – 1.05 (m, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 165.81 (C), 145.60 (CH), 138.24 (CH), 120.76 (CH), 114.90 (CH₂), 42.11 (CH₂), 40.78 (CH₂), 33.17 (CH₂), 31.82 (CH₂), 27.61 (CH₂), 14.88 (CH₃), 13.18 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₂H₂₂NO ([M+H]⁺) 196.1697, found 196.1697.

(E)-N,N-Diethyl-8-methyl-7-methylenenon-2-enamide (1e)



This compound was prepared according to the general procedure **A** using *i*BuMgBr instead of *i*PrMgBr. **¹H NMR** (300 MHz, CDCl₃): δ 6.94 – 6.80 (m, 1H), 6.16 (dd, *J* = 15.0, 1.7 Hz, 1H), 4.73 – 4.62 (m, 2H), 3.37 (dq, *J* = 14.7, 7.2 Hz, 4H), 2.22 – 2.12 (m, 2H), 1.98 (t, *J* = 7.7 Hz, 2H), 1.88 – 1.80 (m, 2H), 1.78 – 1.63 (m, 1H), 1.62 – 1.50 (m, 2H), 1.22 – 1.07 (m, 6H), 0.89 – 0.79 (m, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 165.93 (C), 148.15 (C), 145.85 (CH), 120.76 (CH), 110.57 (CH₂), 45.92 (CH₂), 42.18 (CH₂), 40.85 (CH₂), 35.21 (CH₂), 32.18 (CH₂), 26.49 (CH₂), 26.06 (CH), 22.57 (CH₃), 14.95 (CH₃), 13.26 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₆H₃₀NO ([M+H]⁺) 252.2320, found 252.2322.

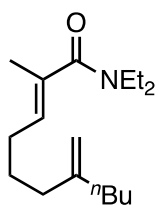
(E)-7-Benzyl-N,N-diethylocta-2,7-dienamide (1g)



This compound was prepared according to the general procedure **A** using BnMgBr instead of *i*PrMgBr. **¹H NMR** (300 MHz, CDCl₃): δ 7.30 – 7.23 (m, 2H), 7.21 – 7.14 (m, 3H), 6.93 – 6.81 (m, 1H), 6.15 (dd, *J* = 15.0, 1.3 Hz, 1H), 4.79 (d, *J* = 19.5 Hz, 2H), 3.46 – 3.24 (m, 6H), 2.24 – 2.10 (m, 2H), 2.06 – 1.94 (m, 2H), 1.66 – 1.53 (m, 2H),

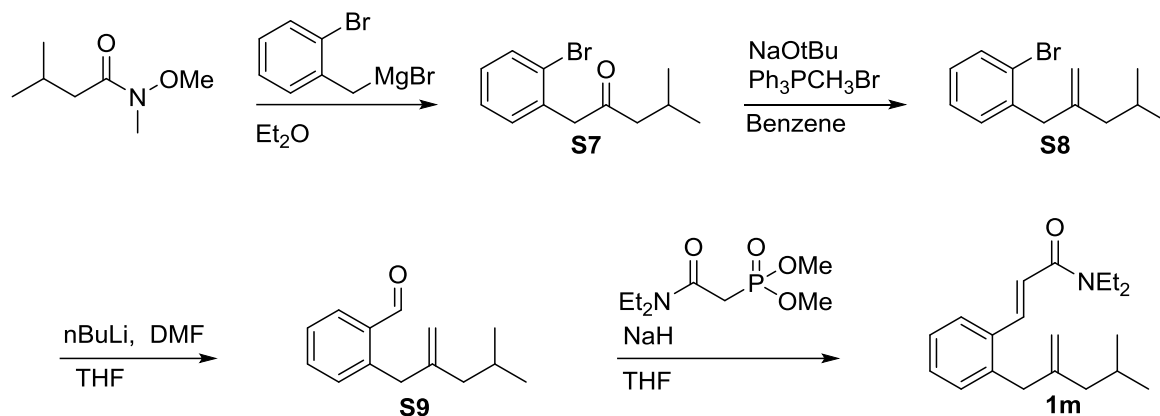
1.21 – 1.09 (m, 6H). ¹³C NMR (75 MHz, CDCl₃): δ 165.86 (C), 148.39 (C), 145.64 (CH), 139.69 (C), 129.00 (CH), 128.33 (CH), 126.13 (CH), 120.81 (CH), 111.62 (CH₂), 43.03 (CH₂), 42.15 (CH₂), 40.82 (CH₂), 34.91 (CH₂), 32.05 (CH₂), 26.37 (CH₂), 14.93 (CH₃), 13.24 (CH₃). HRMS (ESI-TOF): m/z calculated for C₁₉H₂₈NO ([M+H]⁺) 286.2165, found 286.2165.

(E)-N,N-Diethyl-2-methyl-7-methyleneundec-2-enamide (1j)

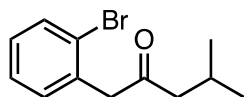


This compound was prepared according the general procedure **A** using **S6** and the appropriate dimethyl (1-(diethylamino)-1-oxopropan-2-yl)phosphonate instead of dimethyl (2-(diethylamino)-2-oxoethyl)phosphonate. ¹H NMR (300 MHz, CDCl₃): δ 5.45 (t, *J* = 7.2 Hz, 1H), 4.67 (d, *J* = 7.0 Hz, 2H), 3.33 (q, *J* = 7.1 Hz, 3H), 2.10 – 1.93 (m, 6H), 1.79 (s, 3H), 1.56 – 1.44 (m, 2H), 1.42 – 1.22 (m, 4H), 1.14 – 1.05 (m, 6H), 0.87 (t, *J* = 7.0 Hz, 3H). ¹³C NMR (75 MHz, CDCl₃): δ 173.51 (C), 149.62 (C), 132.28 (C), 129.34 (CH), 108.95 (CH₂), 42.61 (CH₂), 38.77 (CH₂), 35.74 (CH₂), 30.05 (CH₂), 27.25 (CH₂), 27.21 (CH₂), 22.53 (CH₂), 14.56 (CH₃), 14.06 (CH₃), 13.47 (CH₃) {NOTE: This latter signal at 13.47 ppm corresponds to the methyl group of the amide moiety which, due to the existence of rotamers, can only be clearly observed carrying out the NMR at 60 °C}. HRMS (ESI-TOF): m/z calculated for C₁₇H₃₂NO ([M+H]⁺) 266.2479, found 266.2478.

General procedure B for preparation of indene precursors 1l, 1m, 1n and 1t (exemplified for the synthesis of **1m**)



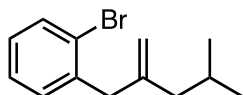
1-(2-Bromophenyl)-4-methylpentan-2-one (S7)



(2-Bromobenzyl)magnesium bromide was prepared following a modified procedure described by Whitesides et. al.^[5] Under an inert atmosphere, magnesium turnings (1.1 equiv) were covered with Et₂O (0.35 M) and activated with iodine and 1,2-dibromoethane. A solution of bromobenzyl-bromide (1 equiv) in Et₂O (0.35 M) was added dropwise to the activated magnesium. The solution was refluxed for 20 min before being allowed to cool down to rt. The resulting solution containing the Grignard reagent (17.2 mmol) was

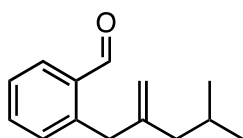
added dropwise to a solution of *N*-methoxy-*N*,3-dimethylbutanamide⁴ (6.88 mmol) at -78 °C in Et₂O (46 mL). The reaction was allowed to warm to rt and was stirred overnight. The mixture was cooled in an ice-water bath and a solution of Rochelle salt was added. NH₄Cl (sat) was added and the layers were separated. The aqueous phase was extracted with Et₂O and the combined organic phases were dried and concentrated to yield a crude residue that was purified by flash chromatography (from 1 : 40 to 1 : 10, Et₂O: Hexanes) to afford the desired product (**S7**) as colorless oil (1.35 g, 77 % yield). **¹H NMR** (300 MHz, CDCl₃): δ 7.56 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.27 (td, *J* = 7.4, 1.3 Hz, 1H), 7.20 (dd, *J* = 7.6, 2.0 Hz, 1H), 7.13 (ddd, *J* = 7.9, 7.1, 1.9 Hz, 1H), 3.83 (s, 2H), 2.38 (d, *J* = 6.9 Hz, 2H), 2.25 – 2.12 (m, 1H), 0.93 (d, *J* = 6.6, 0.6 Hz, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 206.61 (C), 134.87 (C), 132.90 (CH), 131.82 (CH), 128.80 (CH), 127.65 (CH), 125.11 (C), 51.53 (CH₂), 50.55 (CH₂), 24.55 (CH), 22.66 (CH₃). **MS** (ESI): ([M+H]⁺) 255.0 and 257.0

1-Bromo-2-(4-methyl-2-methylenepentyl)benzene (**S8**)



Methyltriphenylphosphonium bromide (3.35 g, 9.40 mmol) was dissolved in benzene (20 mL) under argon. Sodium *tert*-butoxide (0.83 g, 8.62 mmol) was added portion wise to this solution and the mixture was refluxed for 2 hours. The yellow solution was allowed to reach rt, the ketone (**S7**, 3.92 mmol) in benzene (0.2 M) was added dropwise and the reaction was stirred overnight. Water (40 mL) and Et₂O (40 mL) were sequentially added. The layers were separated and the aqueous phase was extracted with Et₂O (2 x 40 mL). The combined organic layers were dried and concentrated. The crude residue was dissolved in Et₂O, cooled to -78 °C, and carefully decanted into another flask to separate the phosphine oxide (this operation was repeated three times). Combined organic phases were concentrated and the resulting crude residue was chromatographed (1:40 to 1:20, Et₂O : Hexane) to afford the desired **S8** as colorless oil (678 mg, 67% yield) **¹H NMR** (300 MHz, CDCl₃): δ 7.60 – 7.55 (m, 1H), 7.30 – 7.22 (m, 2H), 7.16 – 7.04 (m, 1H), 4.97 – 4.52 (m, 2H), 3.47 (s, 2H), 2.02 – 1.83 (m, 3H), 0.96 (d, *J* = 6.2 Hz, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 146.47 (C), 139.44 (C), 132.90 (CH), 131.29 (CH), 127.88 (CH), 127.38 (CH), 125.33 (C), 112.92 (CH₂), 46.23 (CH₂), 42.31 (CH₂), 26.28 (CH₃), 22.68 (CH₃). **MS** (ESI): ([M+H]⁺) 253.1 and 255.1

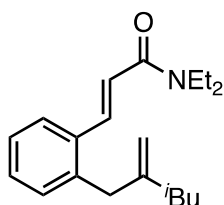
2-(4-Methyl-2-methylenepentyl) benzaldehyde (**S9**)



ⁿBuLi (6.52 mmol, 2.6 mL, 2.5 M) was added dropwise to a solution of **S8** (550 mg, 2.1 mmol) in THF (2 mL) at -78 °C. After stirring for 30 min, DMF (0.83 mL, 10.8 mmol) in THF (0.67 mL) was added dropwise and the reaction was allowed to slowly warm to rt. After TLC indicates full conversion, NH₄Cl (sat) (5 mL) was added. After extraction with Et₂O (3 x 10 mL), the combined organic phases were dried and concentrated. Purification of the crude residue by flash chromatography on silica gel (Et₂O: Pentane 1 : 20) afforded the titled aldehyde as colorless oil (222 mg, 51% yield). **¹H NMR** (300 MHz, CDCl₃): δ

10.22 (s, 1H), 7.86 (dd, $J = 7.7, 1.5$ Hz, 1H), 7.55 – 7.47 (m, 1H), 7.37 (t, $J = 7.6$ Hz, 1H), 7.25 (d, $J = 7.3$ Hz, 1H), 4.86 – 4.35 (m, 2H), 3.69 (s, 2H), 1.96 (d, $J = 7.1$ Hz, 2H), 1.91 – 1.79 (m, 1H), 0.90 (d, $J = 6.5$ Hz, 6H). $^{13}\text{C NMR}$ (75 MHz, CDCl_3): δ $^{13}\text{C NMR}$ (75 MHz, cdcl_3) δ 192.07 (C), 148.32 (C), 142.29 (C), 134.43 (C), 133.87 (CH), 131.89 (CH), 130.39 (CH), 127.02 (CH), 113.20 (CH_2), 46.58 (CH_2), 38.52 (CH_2), 26.19 (CH), 22.58 (CH_3). **MS (ESI)**: ($[\text{M}+\text{H}]^+$) 203.1

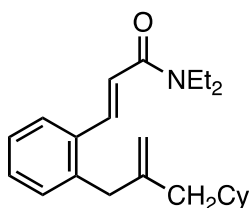
(E)-N,N-Diethyl-3-(2-(4-methyl-2-methylenepentyl)phenyl) acrylamide (1m)



Following the procedure for the Horner–Wadsworth–Emmons reaction (previously exemplified for the synthesis of compound **1f**, (see page S7), the product was obtained as a white solid. (206 mg, 63% yield). $^1\text{H NMR}$ (300 MHz, CDCl_3): δ 7.93 (d, $J = 15.2$ Hz, 1H), 7.53 (dd, $J = 7.3, 1.7$ Hz, 1H), 7.29 – 7.14 (m, 3H), 6.70 (d, $J = 15.2$ Hz, 1H), 4.65 (d, $J = 90.7$ Hz, 2H), 3.50 – 3.38 (m, 6H),

1.94 – 1.77 (m, 3H), 1.24 – 1.16 (m, 6H), 0.88 (d, $J = 6.3$ Hz, 6H). $^{13}\text{C NMR}$ (75 MHz, CDCl_3): δ 165.72 (C), 147.33 (C), 140.27 (CH), 139.02 (C), 135.27 (C), 130.91 (CH), 129.17 (CH), 126.62 (CH), 126.53 (CH), 119.59 (CH), 113.13 (CH_2), 46.24 (CH_2), 42.33 (CH_2), 41.07 (CH_2), 39.71 (CH_2), 26.15 (CH), 22.58 (CH_3), 15.16 (CH_3), 13.33 (CH_3). **HRMS** (ESI-TOF): m/z calculated for $\text{C}_{20}\text{H}_{30}\text{NO}$ ($[\text{M}+\text{H}]^+$) 300.2322, found 300.2322.

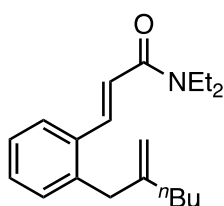
(E)-3-(2-(2-(Cyclohexylmethyl)allyl)phenyl)-N,N-diethylacrylamide (1n)



This compound was prepared according the general procedure **B** starting from 2-cyclohexyl-*N*-methoxy-*N*-methylacetamide instead of *N*-methoxy-*N*,3-dimethylbutanamide. $^1\text{H NMR}$ (300 MHz, CDCl_3): δ 7.93 (d, $J = 15.2$ Hz, 1H), 7.53 – 7.48 (m, 1H), 7.28 – 7.11 (m, 3H), 6.68 (d, $J = 15.2$ Hz, 1H), 4.64 (d, $J = 79.4$ Hz, 2H), 3.48 – 3.37 (m, 6H), 1.90 (d, $J = 7.1$ Hz, 2H), 1.74 – 1.58 (m, 6H), 1.53 – 1.38 (m, 1H), 1.27 – 1.12 (m, 8H), 0.89 – 0.77 (m, 2H).

$^{13}\text{C NMR}$ (75 MHz, CDCl_3): δ 165.57 (C), 146.63 (C), 140.16 (CH), 138.92 (C), 135.16 (C), 130.75 (CH), 129.02 (CH), 126.50 (CH), 126.44 (CH), 119.49 (CH), 113.01 (CH_2), 44.52 (CH_2), 42.21 (CH_2), 40.96 (CH_2), 39.74 (CH_2), 35.50 (CH), 33.28 (CH_2), 26.59 (CH_2), 26.28 (CH_2), 15.05 (CH_3), 13.22 (CH_3). **HRMS** (ESI-TOF): m/z calculated for $\text{C}_{23}\text{H}_{34}\text{NO}$ ($[\text{M}+\text{H}]^+$) 340.2635, found 340.2635.

(E)-N,N-Diethyl-3-(2-(2-methylenehexyl)phenyl)acrylamide (1l)

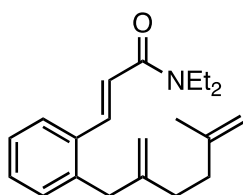


This compound was prepared according the general procedure **B** starting from *N*-methoxy-*N*-methylpentanamide instead of *N*-methoxy-*N*,3-dimethylbutanamide. $^1\text{H NMR}$ (300 MHz, CDCl_3): δ 7.94 (d, $J = 15.2$ Hz, 1H), 7.56 – 7.47 (m, 1H), 7.31 – 7.13 (m, 3H), 6.69 (d, $J = 15.3$ Hz, 1H), 4.82 (s, 1H), 4.48 (s, 1H), 3.49 – 3.38 (m, 6H), 2.02 (t, $J = 7.6$ Hz, 2H), 1.50 – 1.38 (m, 2H),

1.36 – 1.12 (m, 8H), 0.88 (t, $J = 7.2$ Hz, 3H). $^{13}\text{C NMR}$ (75 MHz, CDCl_3): δ 165.68 (C), 148.55 (C),

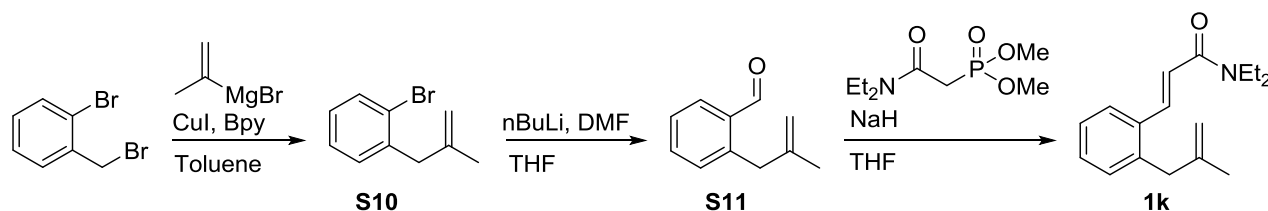
140.22 (CH), 138.95 (C), 135.17 (C), 130.82 (CH), 129.11 (CH), 126.56 (CH), 126.50 (CH), 119.49 (CH), 111.42 (CH₂), 42.28 (CH₂), 41.02 (CH₂), 39.95 (CH₂), 35.99 (CH₂), 29.90 (CH₂), 22.46 (CH₂), 15.10 (CH₃), 14.00 (CH₃), 13.27 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₂₀H₃₀NO ([M+H]⁺) 300.2321, found 300.2322.

(E)-N,N-Diethyl-3-(2-(5-methyl-2-methylenehex-5-en-1-yl)phenyl)acrylamide (1t)

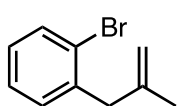


This compound was prepared according the general procedure **B** starting from *N*-methoxy-*N*,4-dimethylpent-4-enamide instead of *N*-methoxy-*N*,3-dimethylbutanamide. **¹H NMR** (300 MHz, CDCl₃): δ 7.94 (d, *J* = 15.2 Hz, 1H), 7.53 (dd, *J* = 7.5, 1.8 Hz, 1H), 7.32 – 7.12 (m, 3H), 6.70 (d, *J* = 15.4 Hz, 1H), 4.85 (s, 1H), 4.70 – 4.65 (m, 2H), 4.52 (s, 1H), 3.53 – 3.38 (m, 6H), 2.20 – 2.14 (m, 4H), 1.70 (s, 3H), 1.28 – 1.16 (m, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 165.71 (C), 148.09 (C), 145.52 (C), 140.23 (CH), 138.80 (C), 135.21 (C), 130.88 (CH), 129.20 (CH), 126.67 (CH), 126.56 (CH), 119.57 (CH), 111.77 (CH₂), 110.10 (CH₂), 42.33 (CH₂), 41.08 (CH₂), 40.06 (CH₂), 36.08 (CH₂), 34.42 (CH₂), 22.53 (CH₃), 15.15 (CH₃), 13.31 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₂₁H₃₀NO ([M+H]⁺) 312.2321, found 312.2322; *m/z* calculated for C₂₁H₂₉NNaO ([M+Na]⁺) 334.2142, found 334.2141.

General procedure C for preparation of precursors 1k and 1o (exemplified for the synthesis of 1k)



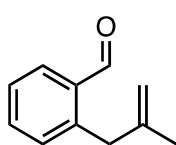
1-Bromo-2-(2-methylallyl)benzene (S10)



This compound was synthesized according of a previous slightly modified procedure by Toste and coworkers.^[6]

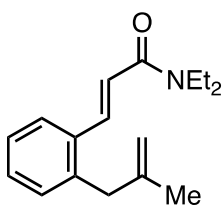
Prop-1-en-2-ylmagnesium bromide solution (0.5 M, 1 equiv) was slowly added to solution of 2-bromobenzyl bromide (2.50 g, 10.0 mmol), CuI (190.5 mg, 1.0 mmol,) and 2,2'-bipyridyne (156.2 mg, 1.0 mmol) in toluene (15.1 mL) at 0 °C. The reaction was allowed to warm to rt and stirred for 4 h, when TLC indicates that the reaction is complete. NH₄Cl (sat) (25 mL) was added. After extraction (3 × 25 mL, Et₂O), the combined organic layers were dried and concentrated and chromatographed to yield the product⁸ as a colorless oil (87% yield).

2-(2-Methylallyl)benzaldehyde (S11)



This compound was prepared according to the procedure described for the synthesis of **S9** (see page S11). The product was isolated as clear oil (89% yield). The NMR and MS analysis were consistent with those previously reported in the literature.^[6]

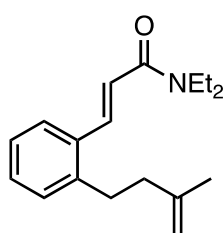
(E)-N,N-Diethyl-3-(2-(2-methylallyl)phenyl)acrylamide (1k)



Prepared following the previously shown Horner–Wadsworth–Emmons procedure from **S11** (see experimental procedure at page S7), the product was obtained in 76% yield as clear oil. **¹H NMR** (300 MHz, CDCl₃): δ 7.96 (d, *J* = 15.2 Hz, 1H), 7.55 – 7.50 (m, 1H), 7.30 – 7.14 (m, 3H), 6.70 (d, *J* = 15.2 Hz, 1H), 4.85 – 4.48 (m, 2H), 3.51 – 3.39 (m, 6H), 1.73 (s, 3H), 1.28 – 1.14 (m, 6H).

¹³C NMR (75 MHz, CDCl₃): δ 165.78 (C), 144.46 (C), 140.23 (CH), 138.90 (C), 135.16 (C), 130.84 (CH), 129.22 (CH), 126.68 (CH), 126.59 (CH), 119.53 (CH), 112.54 (CH₂), 42.36 (CH₂), 41.51 (CH₂), 41.11 (CH₂), 22.87 (CH₃), 15.17 (CH₃), 13.33 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₇H₂₄NO ([M+H]⁺) 258.1851, found 258.1852.

(E)-N,N-Diethyl-3-(2-(3-methylbut-3-en-1-yl)phenyl)acrylamide (1o)

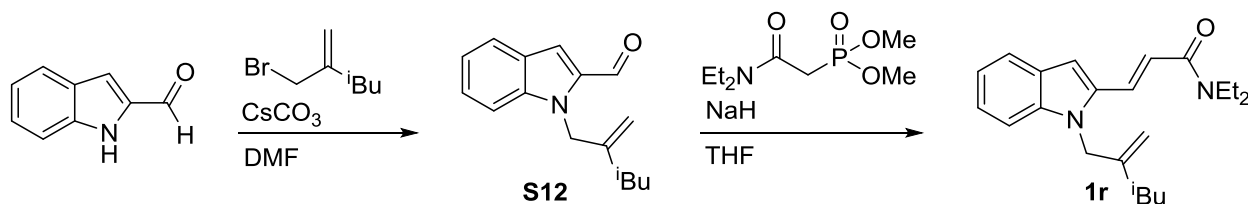


This compound was prepared according the general procedure **C** using (2-methylallyl)magnesium bromide instead of prop-1-en-2-ylmagnesium bromide.

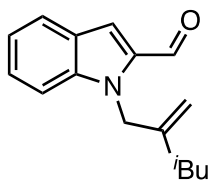
¹H NMR (300 MHz, CDCl₃): δ 8.01 (d, *J* = 15.2 Hz, 1H), 7.55 – 7.49 (m, 1H), 7.27 – 7.15 (m, 3H), 6.73 (d, *J* = 15.2 Hz, 1H), 4.75 – 4.68 (m, 2H), 3.51 – 3.43 (m, 4H), 2.92 – 2.86 (m, 2H), 2.30 – 2.23 (m, 2H), 1.77 (s, 3H), 1.29 – 1.16 (m,

6H). **¹³C NMR** (75 MHz, CDCl₃): δ 165.71 (C), 145.03 (C), 141.55 (C), 139.89 (CH), 134.27 (C), 129.81 (CH), 129.30 (CH), 126.51 (CH), 126.35 (CH), 119.59 (CH), 110.55 (CH₂), 42.33 (CH₂), 41.10 (CH₂), 39.40 (CH₂), 31.75 (CH₂), 22.68 (CH₃), 15.15 (CH₃), 13.31 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₈H₂₆NO ([M+H]⁺) 272.2009, found 272.2009.

General procedure D for preparation of precursors 1p, 1q, 1r and 1s, (exemplified for the synthesis of 1r)

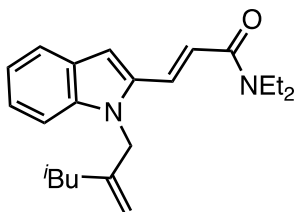


1-(4-Methyl-2-methylenepentyl)-1*H*-indole-2-carbaldehyde (**S12**)



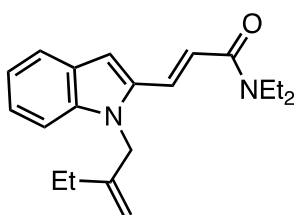
Following a modified procedure reported by L. M. Stanley,^[7] DMF (7.65 mL, 0.27 M) was added to 1*H*-indole-2-carbaldehyde (300 mg, 2.06 mmol,) and Cs₂CO₃ (875 mg, 2.68 mmol) and the resulting mixture was stirred at rt for 0.5 h. 2-(Bromomethyl)-4-methylpent-1-ene^[8,9] (2.7 mmol) was added dropwise. The mixture was stirred at rt until the TLC indicates full conversion of the limiting reagent. Water (30 mL) was added to the mixture, and the resulting solution was extracted with EtOAc (3 x 10 mL). The combined organic layers were washed with water (100 mL), brine (100 mL), dried and concentrated to yield a crude residue that was purified by flash column chromatography on silica gel (hexane : EtOAc) to give the product as orange oil (404 mg, 81% yield). **¹H NMR** (300 MHz, CDCl₃): δ 9.88 (s, 1H), 7.78 – 7.73 (m, 1H), 7.44 – 7.32 (m, 2H), 7.29 (s, 1H), 7.22 – 7.15 (m, 1H), 5.19 – 5.11 (m, 2H), 4.78 – 4.72 (m, 1H), 4.27 – 4.19 (m, 1H), 1.97 (d, *J* = 7.0 Hz, 2H), 1.93 – 1.83 (m, 1H), 0.95 (d, *J* = 6.3 Hz, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 182.49 (CHO), 144.08, (C) 140.79 (C), 135.55 (C), 127.04 (CH), 126.45 (C), 123.43 (CH), 121.13 (CH), 117.96 (CH), 111.14 (CH), 110.84 (CH₂), 49.05 (CH₂), 43.93 (CH₂), 26.31 (CH), 22.62 (CH₃).

(*E*)-*N,N*-Diethyl-3-(1-(4-methyl-2-methylenepentyl)-1*H*-indol-2-yl)acrylamide (**1r**)



Prepared following the previously shown Horner–Wadsworth–Emmons procedure from **S12** (see experimental procedure at page S7) (471 mg, 84% yield). **¹H NMR** (300 MHz, CDCl₃): δ 7.79 (d, *J* = 15.1 Hz, 1H), 7.65 (d, *J* = 7.9 Hz, 1H), 7.28 – 7.23 (m, 2H), 7.20 – 7.11 (m, 1H), 7.00 – 6.89 (m, 2H), 4.86 (s, 1H), 4.73 (s, 2H), 4.43 (s, 1H), 3.57 – 3.45 (m, 4H), 2.00 (d, *J* = 7.1 Hz, 2H), 1.96 – 1.85 (m, 1H), 1.32 – 1.20 (m, 6H), 1.00 (d, *J* = 6.3 Hz, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 165.26 (C), 143.33 (C), 138.42 (C), 136.15 (C), 130.58 (CH), 127.52 (C), 122.99 (CH), 120.93 (CH), 120.27 (CH), 118.32 (CH), 111.82 (CH₂), 109.77 (CH), 102.20 (CH), 47.82 (CH₂), 43.59 (CH₂), 42.20 (CH₂), 41.08 (CH₂), 26.34 (CH), 22.51 (CH₃), 15.11 (CH₃), 13.22 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₂₂H₃₁N₂O ([*M*+*H*]⁺) 339.2432, found 339.2431.

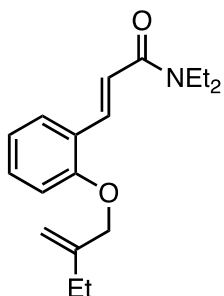
(*E*)-*N,N*-Diethyl-3-(1-(2-methylenebutyl)-1*H*-indol-2-yl)acrylamide (**1s**)



This compound was prepared according the general procedure **D** using 2-(bromomethyl)but-1-ene instead of 2-(bromomethyl)-4-methylpent-1-ene (see the synthesis of **S12** at page S14). **¹H NMR** (300 MHz, CDCl₃): δ 7.80 – 7.74 (m, 1H), 7.63 – 7.58 (m, 1H), 7.27 – 7.20 (m, 2H), 7.14 – 7.07 (m, 1H), 6.96 – 6.84 (m, 2H), 4.86 (d, *J* = 1.2 Hz, 1H), 4.75 (s, 2H), 4.44 (d, *J* = 1.0 Hz, 1H), 3.52 – 3.42 (m, 4H), 2.11 – 2.02 (m, 2H), 1.22 (dt, *J* = 16.7, 7.1 Hz, 6H), 1.12 (t, *J* = 7.4 Hz, 3H). **¹³C NMR** (75 MHz, CDCl₃): δ 165.39 (C), 146.21 (C), 138.56 (C), 136.23 (C), 130.73 (CH), 127.58 (C), 123.07 (CH), 120.99 (CH), 120.34 (CH), 118.29 (CH), 109.92 (CH), 109.39 (CH₂),

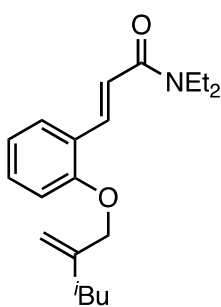
102.40 (CH), 48.19 (CH₂), 42.29 (CH₂), 41.19 (CH₂), 26.39 (CH₂), 15.18 (CH₃), 13.28 (CH₃), 11.97 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₂₀H₂₇N₂O ([M+H]⁺) 311.2119, found 311.2118.

(E)-N,N-Diethyl-3-(2-(2-methylenebutoxy)phenyl)acrylamide (1p)



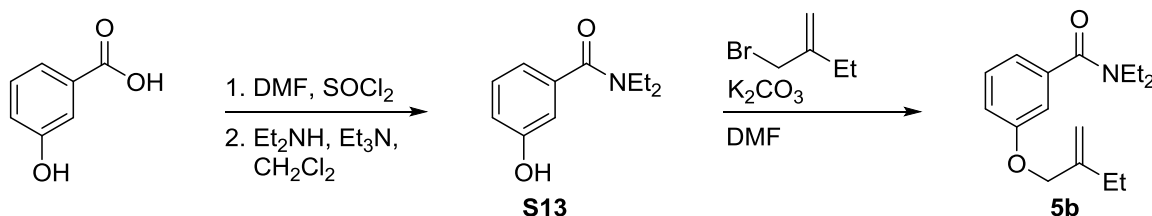
This compound was prepared according the general procedure **D** using 2-hydroxybenzaldehyde and 2-(bromomethyl)but-1-ene as starting materials. **¹H NMR** (300 MHz, CDCl₃): δ 7.94 (d, *J* = 15.5 Hz, 1H), 7.48 (dd, *J* = 7.6, 1.8 Hz, 1H), 7.31 – 7.23 (m, 1H), 7.05 – 6.87 (m, 3H), 5.16 – 4.97 (m, 2H), 4.53 (s, 2H), 3.51 – 3.41 (m, 4H), 2.19 (q, *J* = 7.5 Hz, 2H), 1.25 – 1.15 (m, 6H), 1.10 (t, *J* = 7.5 Hz, 3H). **¹³C NMR** (75 MHz, CDCl₃): δ 166.46 (C), 157.57 (C), 146.22 (C), 138.18 (CH), 130.42 (CH), 129.79 (CH), 124.81 (C), 120.80 (CH), 119.12 (CH), 112.41 (CH), 111.61 (CH₂), 71.42 (CH₂), 42.34 (CH₂), 41.12 (CH₂), 26.11 (CH₂), 15.16 (CH₃), 13.38 (CH₃), 12.10 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₈H₂₆NO₂ ([M+H]⁺) 288.1958, found 288.1958.

(E)-N,N-Diethyl-3-(2-((4-methyl-2-methylenepentyl)oxy)phenyl) acrylamide (1q)

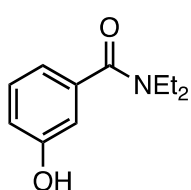


This compound was prepared according the general procedure **D** using 2-hydroxybenzaldehyde and 2-(bromomethyl)-4-methylpent-1-ene as starting materials. **¹H NMR** (300 MHz, CDCl₃): δ 7.91 (d, *J* = 15.5 Hz, 1H), 7.44 (dd, *J* = 7.6, 1.7 Hz, 1H), 7.27 – 7.17 (m, 1H), 7.05 – 6.80 (m, 3H), 5.06 (dd, *J* = 64.4, 1.5 Hz, 2H), 4.46 (s, 2H), 3.48 – 3.38 (m, 4H), 2.03 – 2.00 (m, 2H), 1.83 – 1.71 (m, 1H), 1.25 – 1.11 (m, 6H), 0.88 (d, *J* = 6.5 Hz, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 166.32 (C), 157.45 (C), 143.34 (C), 138.02 (CH), 130.30 (CH), 129.63 (CH), 124.78 (C), 120.72 (CH), 119.13 (CH), 113.71 (CH₂), 112.38 (CH), 70.90 (CH₂), 43.05 (CH₂), 42.23 (CH₂), 40.97 (CH₂), 26.23 (CH₃), 22.50 (CH₃), 15.06 (CH₃), 13.26 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₂₀H₃₀NO₂ ([M+H]⁺) 316.2272, found 316.2271.

Procedure E for preparation of precursors 5a and 5b (exemplified for the synthesis of 5b)



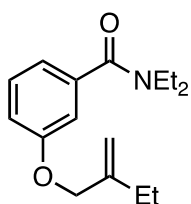
N,N-Diethyl-3-hydroxybenzamide (S13)



3-Hydroxybenzoic acid (5.0 g, 36.2 mmol) was placed in a flask equipped with a reflux condenser. Thionyl chloride (20 mL, 270 mmol) and a few drops of DMF were added and the mixture was refluxed for 4 hours. The reaction was allowed to

cool to rt and the excess of SOCl_2 was carefully removed with a rotary evaporator equipped with a intermediate cooled trap ($\text{Et}_2\text{O} - \text{N}_2$ bath). The crude acid chloride was dissolved in CH_2Cl_2 (72 mL) and Et_3N (15.26 mL, 108.6 mmol) was added. The mixture was cooled in a ice-water bath and Et_2NH (13.9 mL, 133.9 mmol) was added dropwise. The reaction was stirred for 19 hours at rt, concentrated and the resulting crude mixture was purified via flash column chromatography (1:2 to 3:1 EtOAc: Hex) to provide the amide product as yellow solid (6.50 g, 95% yield). The NMR and MS analysis were consistent with those previously published.^[10]

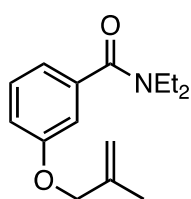
N,N-Diethyl-3-(2-methylenebutoxy)benzamide (**5b**)



2-(Bromomethyl)but-1-ene (463 mg, 3.1 mmol) was added dropwise to a solution of *N,N*-diethyl-3-hydroxybenzamide (**S13**, 500 mg, 2.59 mmol) and K_2CO_3 (430 mg, 3.1 mmol) in DMF (3 mL). The mixture was stirred 20 hours at rt, diluted with Et_2O (10 mL) and washed with water (3 x 15 mL). The organic phase was dried, concentrated and chromatographed to yield **5b** as colorless oil (278 mg, 41 %). **¹H**

NMR (300 MHz, CDCl_3): δ 7.28 – 7.21 (m, 1H), 6.93 – 6.86 (m, 3H), 5.02 (d, $J = 37.6$ Hz, 2H), 4.45 (s, 2H), 3.58 – 3.11 (m, 4H), 2.12 (q, $J = 7.4$ Hz, 2H), 1.25 – 1.01 (m, 9H). **¹³C NMR** (75 MHz, CDCl_3): δ 170.98 (C), 158.80 (C), 146.20 (C), 138.56 (C), 129.52 (CH), 118.53 (CH), 115.76 (CH), 112.61 (CH), 110.98 (CH_2), 71.03 (CH_2), 43.22 (CH_2), 39.15 (CH_2), 25.85 (CH_2), 14.20 (CH_3), 12.90 (CH_3), 12.02 (CH_3). **HRMS** (ESI-TOF): m/z calculated for $\text{C}_{16}\text{H}_{24}\text{NO}_2$ ($[\text{M}+\text{H}]^+$) 262.1801, found 262.1802.

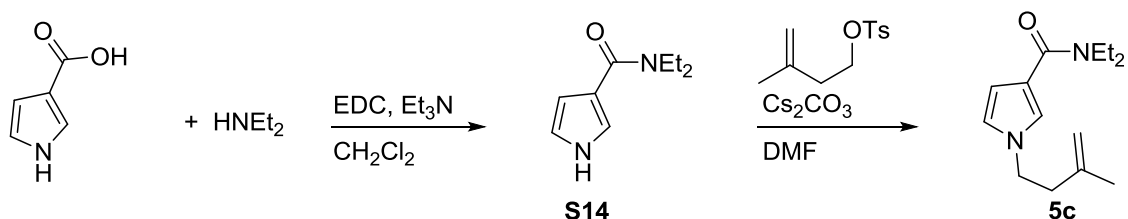
N,N-Diethyl-3-((2-methylallyl)oxy)benzamide (**5a**)



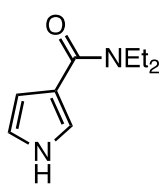
This compound was prepared according the general procedure **E** using 3-bromo-2-methylprop-1-ene as alkylating agent. **¹H NMR** (300 MHz, CDCl_3): δ 7.29 – 7.22 (m, 1H), 6.94 – 6.87 (m, 3H), 5.08 – 4.94 (m, 2H), 4.41 (s, 2H), 3.58 – 3.14 (m, 4H), 1.80 (s, 3H), 1.27 – 1.00 (m, 6H). **¹³C NMR** (75 MHz, CDCl_3): δ 170.99 (C), 158.77 (C), 140.65 (C), 138.58 (C), 129.55 (CH), 118.60 (CH), 115.78 (CH), 112.86 (CH_2),

112.66 (CH), 71.83 (CH_2), 43.29 (CH_2), 39.26 (CH_2), 19.43 (CH_3), 14.30 (CH_3), 12.98 (CH_3). **HRMS** (ESI-TOF): m/z calculated for $\text{C}_{15}\text{H}_{22}\text{NO}_2$ ($[\text{M}+\text{H}]^+$) 248.1645, found 248.1645.

Synthesis of *N,N*-Diethyl-1-(3-methylbut-3-en-1-yl)-1*H*-pyrrole-3-carboxamide (**5c**).

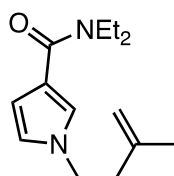


N,N-Diethyl-1*H*-pyrrole-3-carboxamide (**S14**)



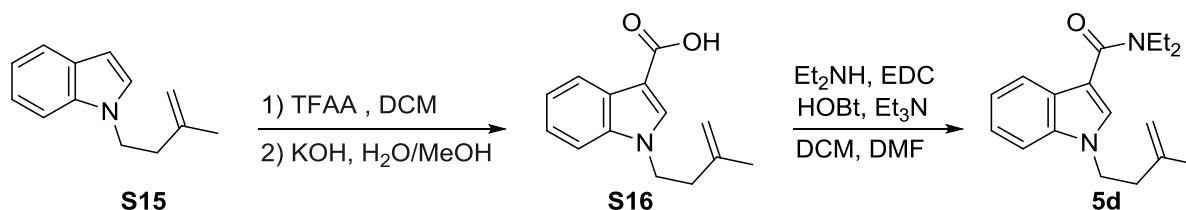
Et₂NH (2.14 mL, 20.7 mmol) was added to a solution of 1*H*-pyrrole-3-carboxylic acid (2.0 g, 18.0 mmol), EDC.HCl (5.17 g, 27.0 mmol) and Et₃N (7.5 mL, 53.9 mmol) in CH₂Cl₂ (72 mL, 0.25 M). The resulting mixture was stirred for 16 h and then water (50 mL) was added. The layers were separated and the aqueous phase was extracted with CH₂Cl₂ (2 x 50 mL). The combined organic layers were dried and concentrated to yield a crude residue that was purified by column chromatography (1:1 to 9:1, EtOAc : Hexane) to yield **S14** as a pale yellow solid (1.88 g, 63% yield). **¹H NMR** (300 MHz, CDCl₃): δ 10.40 (s, 1H), 6.97 – 6.92 (m, 1H), 6.61 – 6.57 (m, 1H), 6.34 – 6.30 (m, 1H), 3.52 (q, *J* = 7.1 Hz, 4H), 1.20 (t, *J* = 7.1 Hz, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 167.87 (C), 121.01 (CH), 118.98 (C), 118.22 (CH), 108.31 (CH), 41.75 (CH₂), 13.82 (CH₃). **HRMS** (ESI): *m/z* calculated for C₉H₁₅N₂O ([M+H]⁺) 167.1178, found 167.1179.

N,N-Diethyl-1-(3-methylbut-3-en-1-yl)-1*H*-pyrrole-3-carboxamide (**5c**)

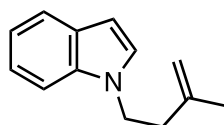


Prepared following a modified procedure from Schreiber and coworkers.^[11] 3-methylbut-3-en-1-yl 4-methylbenzenesulfonate (694 mg, 2.9 mmol) was slowly added to a solution of *N,N*-diethyl-1*H*-pyrrole-3-carboxamide (300 mg, 1.80 mmol) and cesium carbonate (1.35 g, 4.14 mmol) in anhydrous DMF (4.5 mL, 0.4 M). The reaction mixture was stirred at 85 °C for 16 hours, allowed to cool to rt and water (30 mL) was added. The mixture was extracted with Et₂O (5 x 10 mL). The organic phase was dried, concentrated and the crude residue was purified by flash chromatography (1:3 to 2:1 AcOEt : Hexane) to yield **5c** as clear oil (402 mg, 96% yield). **¹H NMR** (500 MHz, CDCl₃): δ 7.04 – 7.01 (m, 1H), 6.56 – 6.52 (m, 1H), 6.29 – 6.26 (m, 1H), 4.78 – 4.76 (m, 1H), 4.66 (s, 1H), 3.94 (t, *J* = 7.4 Hz, 2H), 3.49 (q, *J* = 7.1 Hz, 4H), 2.44 (t, *J* = 7.4 Hz, 2H), 1.71 (s, 3H), 1.18 (td, *J* = 7.1, 1.5 Hz, 6H). **¹³C NMR** (126 MHz, CDCl₃): δ 166.58 (C), 141.77 (C), 123.59 (CH), 120.36 (CH), 119.32 (C), 112.66 (CH₂), 108.78 (CH), 48.41 (CH₂), 41.43 (CH₂), 39.45 (CH₂), 22.41 (CH₃), 13.79 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₄H₂₃N₂O ([M+H]⁺) 235.1806, found 235.1805.

Synthesis of *N,N*-Diethyl-1-(3-methylbut-3-en-1-yl)-1*H*-indole-3-carboxamide (**5d**).



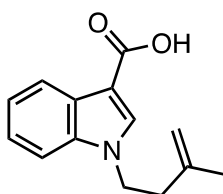
1-(3-Methylbut-3-en-1-yl)-1*H*-indole (**S15**)



Following a modified reported procedure.^[12] Indole (1.17 g, 10.0 mmol, 1.0 equiv) was added in portions to a NaH (560 mg, 14.0 mmol, 1.4 equiv) suspension in DMF (25 mL, 0.4 M), at 0°C. The reaction mixture was then

warmed to 50 °C to ensure complete deprotonation. Subsequently, it was cooled to 0 °C and 3-methylbut-3-enyl methanesulfonate^[13] was added dropwise. (CAUTION, the reaction is very exothermic!) The ice bath was removed and the reaction mixture was allowed to slowly warm up and stirred overnight at rt. After quenching with water, the aqueous phase was extracted with hexane (4 x 20 mL), the combined organic layers were washed with brine, dried, filtered and the organic phases were concentrated to yield a crude residue that was purified by flash chromatography (hexane–EtOAc = 99:1) to afford the product as a colorless oil (690 mg, 37% yield). The data was consistent with that previously described.^[12]

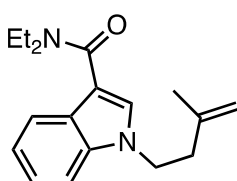
1-(3-Methylbut-3-en-1-yl)-1*H*-indole-3-carboxylic acid (**S16**)



To a solution of 1-(3-Methylbut-3-en-1-yl)-1*H*-indole (**S15**, 690 mg, 3.72 mmol, 1 equiv) in CH₂Cl₂ (5.0 mL, 0.75 M) at 0 °C was added dropwise trifluoroacetic anhydride (0.79 mL, 5.59 mmol). The solution was stirred at rt for 1h, and the volatile components were removed in a rotary evaporator under vacuum: The

crude product was carried to the next step without further purification. To a solution of 2,2,2-Trifluoro-1-(1-(3-methylbut-3-en-1-yl)-1*H*-indol-3-yl)ethan-1-one (1.04 g, 3.72 mmol) in MeOH (3.7 mL, 1 M), was added an aqueous solution of KOH (3.7 mL, 5M). The mixture was stirred overnight at 80 °C. The reaction was cooled to rt and HCl (10 %) was added until the solution reach pH 1-2. At this point, the mixture was extracted with EtOAc (3 x 10 mL). The organic layer was dried with Na₂SO₄ and the solvent was removed. The pure product (825 mg, 97% yield) was obtained as white solid after column chromatography (1:3 to 2:1, EtOAc:Hexane). The data was consistent with the previous described.^[14]

N,N-Diethyl-1-(3-methylbut-3-en-1-yl)-1*H*-indole-3-carboxamide (**5d**)



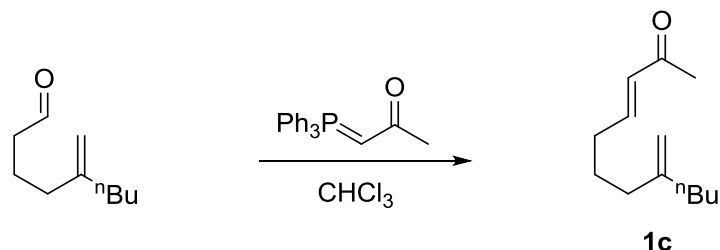
To a solution of 1-(3-Methylbut-3-en-1-yl)-1*H*-indole-3-carboxylic acid (**S16**, 825 mg, 3.60 mmol, 1.0 equiv), in CH₂Cl₂ (58 mL, 0.06 M) and DMF (2.9 mL, 1.25M), EDC.HCl (897 mg, 4.68 mmol, 1.3 equiv), HOBt (606 mg, 3.96 mmol, 1.1 equiv) and triethylamine (1.6 mL, 11.52 mmol, 3.2 equiv) were added. The

mixture was stirred 20 minutes and diethylamine (0.43 mL, 4.14 mmol, 1.15 equiv) was added. The resulting mixture was stirred at 40 °C for 4 h and at rt for 16 hours. The reaction was poured into water and the organic layer was separated. The aqueous phase was extracted with EtOAc (3 x 20 mL) The combined organic layers were washed and dried with Na₂SO₄ and the solvent was evaporated. The crude product was purified by column chromatography (1:2 to 3:1, AcOEt:Hexane). The indole derivative was obtained as beige solid (645 mg, 63 %). ¹H NMR (300 MHz, CDCl₃): δ 7.74 (d, *J* = 7.8 Hz, 1H), 7.32 – 7.27 (m, 2H), 7.23 – 7.10 (m, 2H), 4.77 – 4.61 (m, 2H), 4.17 (t, *J* = 7.3 Hz, 2H), 3.55 – 3.47 (m, 4H), 2.48 (t, *J* = 7.4 Hz, 2H), 1.72 (s, 3H), 1.20 – 1.13 (m, 6H). ¹³C NMR (75 MHz, CDCl₃): δ 166.81 (C), 141.84 (C), 135.56 (C), 128.26 (CH), 126.98 (C), 122.29 (CH),

121.08 (CH), 120.60 (CH), 112.91 (CH₂), 111.14 (C), 109.52 (CH), 45.08 (CH₂), 41.34 (CH₂), 37.98 (CH₂), 22.47 (CH₃), 13.96 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₈H₂₅N₂O ([M+H]⁺) 285.1961, found 285.1961.

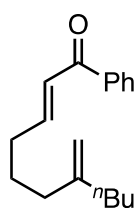
Synthesis of ketones, ester and acid **1c**, **1u**, **1v**, and **1w**.

(*E*)-8-Methylenedodec-3-en-2-one (**1c**)



5-Methylenenonanal (700 mg, 4.54 mmol) was added to a solution of 1-(triphenyl-λ5-phosphaneylidene)propan-2-one (1.7 g, 5.45 mmol, 1.2 equiv) in CHCl₃ (18 mL, 0.25 M). The mixture was stirred for 20 hours at rt, the solvent was removed, and the crude residue was purified by column chromatography (1:10, Et₂O:Hexane) to afford (*E*)-8-methylenedodec-3-en-2-one as clear oil (514 mg, 58% yield). **¹H NMR** (300 MHz, CDCl₃): δ 6.79 (dt, *J* = 16.0, 6.9 Hz, 1H), 6.06 (dt, *J* = 15.9, 1.5 Hz, 1H), 4.73 – 4.67 (m, 2H), 2.26 – 2.16 (m, 5H), 2.00 (dt, *J* = 13.9, 7.8 Hz, 4H), 1.65 – 1.53 (m, 2H), 1.44 – 1.23 (m, 4H), 0.88 (t, *J* = 7.1 Hz, 3H). **¹³C NMR** (75 MHz, CDCl₃): δ 198.69 (C), 149.16 (C), 148.25 (CH), 131.53 (CH), 109.32 (CH₂), 35.73 (CH₂), 35.50 (CH₂), 32.13 (CH₂), 30.06 (CH₂), 26.93 (CH₃), 26.19 (CH₂), 22.55 (CH₂), 14.07 (CH₃). **MS** (ESI): ([M+H]⁺) 195.2

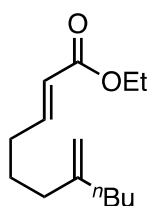
(*E*)-7-Methylene-1-phenylundec-2-en-1-one (**1w**)



Prepared following the procedure for the synthesis of **1c**, using 1-phenyl-2-(triphenyl-λ5-phosphaneylidene)ethan-1-one as Wittig reagent. **¹H NMR** (300 MHz, CDCl₃): δ 7.90 (d, *J* = 7.4 Hz, 2H), 7.53 – 7.45 (m, 1H), 7.40 (t, *J* = 7.4 Hz, 2H), 7.10 – 6.98 (m, 1H), 6.86 (d, *J* = 15.4 Hz, 1H), 4.71 (d, *J* = 6.6 Hz, 2H), 2.33 – 2.22 (m, 2H), 2.07 – 1.94 (m, 4H), 1.70 – 1.56 (m, 2H), 1.44 – 1.23 (m, 4H), 0.88 (t, *J* = 7.0 Hz, 3H). **¹³C**

NMR (75 MHz, CDCl₃): δ 190.47 (C), 149.44 (CH), 148.95 (C), 137.90 (C), 132.48 (CH), 128.41 (CH), 125.95 (CH), 109.21 (CH₂), 35.58 (CH₂), 35.41 (CH₂), 32.32 (CH₂), 29.91 (CH₂), 26.15 (CH₂), 22.41 (CH₂), 13.94 (CH₃). **MS** (ESI): ([M+H]⁺) 257.2

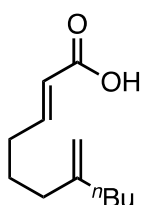
Ethyl (*E*)-7-methyleneundec-2-enoate (**1u**)



Prepared following the procedure for the synthesis of **1c**, using ethyl 2-(triphenyl-λ5-phosphaneylidene)acetate as Wittig reagent. **¹H NMR** (300 MHz, CDCl₃): δ 6.95 (dt, *J* = 15.5, 6.9 Hz, 1H), 5.81 (d, *J* = 15.7 Hz, 1H), 4.70 (d, *J* = 8.2 Hz, 2H), 4.17 (q, *J* = 7.1 Hz, 2H), 2.23 – 2.14 (m, 2H), 2.05 – 1.94 (m, 4H), 1.64 – 1.52 (m, 2H), 1.44 –

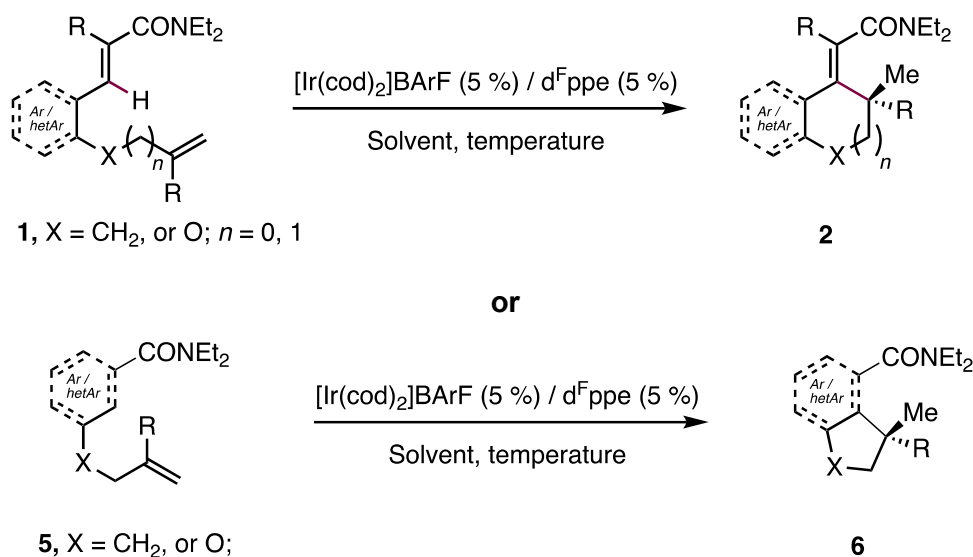
1.21 (m, 7H), 0.89 (t, $J = 7.0$ Hz, 3H). ^{13}C NMR (75 MHz, CDCl_3): δ 166.81 (C), 149.27 (C), 149.15 (CH), 121.59 (CH), 109.27 (CH), 60.24 (CH_2), 35.76 (CH_2), 35.50 (CH_2), 31.88 (CH_2), 30.09 (CH_2), 26.16 (CH_2), 22.58 (CH_2), 14.38 (CH_3), 14.09 (CH_3). HRMS (ESI-TOF): m/z calculated for $\text{C}_{14}\text{H}_{24}\text{NaO}_2$ ($[\text{M}+\text{Na}]^+$) 247.1662, found 247.1669.

(E)-7-Methyleneundec-2-enoic acid (1v).



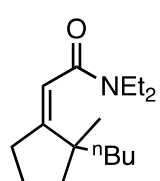
LiOH (42 mg, 0.178 mmol, 2 equiv) in water (3.3 mL) was added to a solution of ethyl (E)-7-methyleneundec-2-enoate (**1u**, 200 mg, 0.89 mmol, 1 equiv) in MeOH (1.6 mL) and THF (4 mL), and the reaction mixture was stirred at 45 °C for 20 hours. Then, HCl (10 %) was added until a pH of 1-2 was reached. After extraction with EtOAc (3 x 10 mL), the organic layer was dried and the solvent removed. The pure product (156 mg, 89% yield) was obtained as white solid after column chromatography (1:3 to 1:1, AcOEt:Hexane). ^1H NMR (300 MHz, CDCl_3): δ 11.60 (s, 1H), 7.09 (dt, $J = 15.6, 7.0$ Hz, 1H), 5.84 (dt, $J = 15.6, 1.6$ Hz, 1H), 4.76 – 4.68 (m, 2H), 2.29 – 2.18 (m, 2H), 2.08 – 1.96 (m, 4H), 1.68 – 1.55 (m, 2H), 1.45 – 1.25 (m, 4H), 0.90 (t, $J = 7.1$ Hz, 3H). ^{13}C NMR (75 MHz, CDCl_3): δ 172.41 (C), 152.25 (CH), 149.18 (C), 121.02 (CH), 109.41 (CH_2), 35.77 (CH_2), 35.51 (CH_2), 32.01 (CH_2), 30.11 (CH_2), 26.02 (CH_2), 22.61 (CH_2), 14.12 (CH_3). MS (ESI): ($[\text{M}+\text{H}]^+$) 197.1

Procedure for the Iridium-catalyzed intramolecular hydrocarbonation reaction



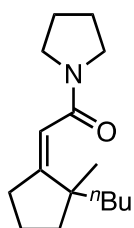
Ir(cod)₂BArF (0.05 equiv), d^Fppe (0.05 equiv), the carboxamide precursor (typically 50 -200 mg, 1.0 equiv) and the appropriate solvent [dioxane or 1,2-DCE (0.124 M)] were sequentially added to a Schlenk tube under Argon. The reaction mixture was then stirred at the appropriate temperature [100 °C for dioxane or 140 °C for 1,2-DCE (in a sealed tube)]. After 19 h, the reaction mixture was concentrated and the crude residue was purified by flash chromatography on silica gel (typically 1:20 to 1:10 EtOAc : Hexanes) to afford the cyclic product.

(Z)-2-(2-Butyl-2-methylcyclopentylidene)-N,N-diethylacetamide (**2a**)



Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as a pale yellow oil (91% yield). **¹H NMR** (300 MHz, CDCl₃): δ 5.82 (t, *J* = 2.1 Hz, 1H), 3.51 – 3.20 (m, 4H), 2.48 – 2.38 (m, 2H), 1.77 – 1.38 (m, 8H), 1.28 – 1.22 (m, 2H), 1.20 (s, 3H), 1.15 – 1.08 (m, 6H), 0.85 (t, *J* = 7.0 Hz, 3H). **¹³C NMR** (75 MHz, CDCl₃): δ 167.81 (C), 161.80 (C), 114.45 (CH), 46.18 (C), 42.57 (CH₂), 40.70 (CH₂), 39.15 (CH₂), 38.51 (CH₂), 36.88 (CH₂), 27.37 (CH₂), 25.44 (CH₃), 23.60 (CH₂), 22.68 (CH₂), 14.34 (CH₃), 13.99 (CH₃), 12.90 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₆H₃₀NO ([M+H]⁺) 252.2322, found 252.2322.

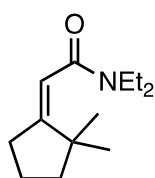
(Z)-2-(2-Butyl-2-methylcyclopentylidene)-1-(pyrrolidin-1-yl)ethan-1-one (**2b**)



Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 15 % EtOAc/Hexanes) as a yellow pale oil (44 %). **¹H NMR** (400 MHz, CDCl₃): δ 5.84 (s, 1H), 3.50 – 3.34 (m, 4H), 2.51 – 2.36 (m, 2H), 1.95 – 1.81 (m, 4H), 1.78 – 1.71 (m, 2H), 1.71 – 1.57 (m, 4H), 1.49 – 1.42 (m, 1H), 1.27 – 1.24 (m, 5H), 1.14 – 1.04 (m,

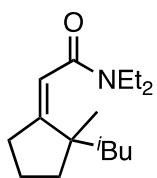
1H), 0.86 (t, $J = 6.9$ Hz, 3H). ^{13}C NMR (101 MHz, CDCl_3): δ 166.55 (C), 163.63 (C), 114.80 (CH), 46.20 (C), 40.93 (CH_2), 38.19 (CH_2), 37.74 (CH_2), 27.39 (CH_2), 25.59 (CH_3), 23.61 (CH_2), 22.86 (CH_2), 14.36 (CH_3). HRMS (ESI-TOF): m/z calculated for $\text{C}_{16}\text{H}_{28}\text{NO}$ ($[\text{M}+\text{H}]^+$) 250.2167, found 250.2165.

(Z)-2-(2,2-Dimethylcyclopentylidene)-N,N-diethylacetamide (2d)



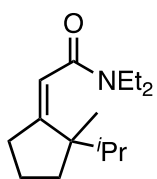
Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as a pale yellow oil (80% yield). ^1H NMR (500 MHz, CDCl_3): δ 5.81 (t, $J = 2.1$ Hz, 1H), 3.38 (q, $J = 7.1$ Hz, 2H), 3.32 (q, $J = 7.1$ Hz, 2H), 2.47 (td, $J = 7.3, 2.1$ Hz, 2H), 1.67 – 1.59 (m, 2H), 1.56 (t, $J = 6.4$ Hz, 2H), 1.22 (s, 5H), 1.14 – 1.10 (m, 7H). ^{13}C NMR (126 MHz, CDCl_3): δ 167.99 (C), 161.21 (C), 114.67 (CH), 44.76 (CH_2), 42.86 (C), 42.69 (CH_2), 39.18 (CH_2), 36.05 (CH_2), 26.88 (CH_3), 22.44 (CH_2), 14.06 (CH_3), 12.90 (CH_3). HRMS (ESI-TOF): m/z calculated for $\text{C}_{13}\text{H}_{24}\text{NO}$ ($[\text{M}+\text{H}]^+$) 210.1851, found 210.1852.

(Z)-N,N-Diethyl-2-(2-isobutyl-2-methylcyclopentylidene)acetamide (2e)



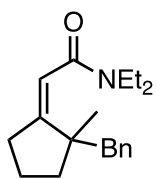
Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as a pale yellow oil (93% yield). ^1H NMR (300 MHz, CDCl_3): δ 5.81 – 5.78 (m, 1H), 3.52 – 3.38 (m, 1H), 3.37 – 3.21 (m, 3H), 2.48 – 2.41 (m, 2H), 1.80 – 1.72 (m, 1H), 1.70 – 1.57 (m, 4H), 1.54 – 1.40 (m, 2H), 1.23 (s, 3H), 1.15 – 1.08 (m, 6H), 0.93 – 0.83 (m, 6H). ^{13}C NMR (75 MHz, CDCl_3): δ 167.99 (C), 162.65 (C), 114.37 (CH), 47.05 (CH_2), 46.52 (C), 42.54 (CH_2), 41.06 (CH_2), 39.10 (CH_2), 36.51 (CH_2), 25.51 (CH), 25.34 (CH_3), 25.24 (CH_3), 24.85 (CH_3), 22.52 (CH_2), 13.87 (CH_3), 12.77 (CH_3). HRMS (ESI-TOF): m/z calculated for $\text{C}_{16}\text{H}_{30}\text{NO}$ ($[\text{M}+\text{H}]^+$) 252.2322, found 252.2322.

(Z)-N,N-Diethyl-2-(2-isopropyl-2-methylcyclopentylidene)acetamide (2f)



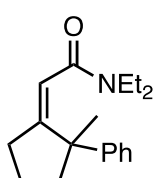
Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as a yellow oil (96% yield). ^1H NMR (300 MHz, CDCl_3): δ 5.88 – 5.85 (m, 1H), 3.47 – 3.23 (m, 4H), 2.53 – 2.25 (m, 3H), 1.82 – 1.70 (m, 1H), 1.67 – 1.50 (m, 2H), 1.36 – 1.27 (m, 1H), 1.24 (s, 3H), 1.17 – 1.07 (m, 6H), 0.86 – 0.75 (m, 6H). ^{13}C NMR (75 MHz, CDCl_3): δ 167.72 (C), 162.70 (C), 114.01 (CH), 49.76 (C), 42.38 (CH_2), 39.04 (CH_2), 38.70 (CH_2), 35.01 (CH_2), 33.13 (CH), 25.43 (CH_3), 22.90 (CH_2), 18.54 (CH_3), 17.89 (CH_3), 13.92 (CH_3), 12.74 (CH_3). HRMS (ESI-TOF): m/z calculated for $\text{C}_{15}\text{H}_{28}\text{NO}$ ($[\text{M}+\text{H}]^+$) 238.2161, found 238.2165.

(Z)-2-(2-Benzyl-2-methylcyclopentylidene)-N,N-diethylacetamide (2g)



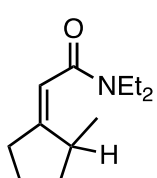
Carried out in refluxing Dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as yellow oil (94% yield). **¹H NMR** (300 MHz, CDCl₃): δ 7.20 – 7.10 (m, 5H), 5.87 (t, *J* = 1.6 Hz, 1H), 3.40 – 3.28 (m, 3H), 3.02 – 2.88 (m, 2H), 2.43 – 2.25 (m, 2H), 1.82 – 1.68 (m, 1H), 1.53 – 1.42 (m, 2H), 1.28 – 1.19 (m, 2H), 1.15 (s, 3H), 1.14 – 1.06 (m, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 167.92 (C), 162.01 (C), 139.98 (C), 130.92 (CH), 127.84 (CH), 125.94 (CH), 115.07 (CH), 47.06 (C), 44.31 (CH₂), 42.64 (CH₂), 40.08 (CH₂), 39.35 (CH₂), 36.76 (CH₂), 24.79 (CH₃), 22.28 (CH₂), 14.01 (CH₃), 12.88 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₉H₂₈NO ([M+H]⁺) 286.2164, found 286.2165.

(Z)-N,N-Diethyl-2-(2-methyl-2-phenylcyclopentylidene)acetamide (2h)



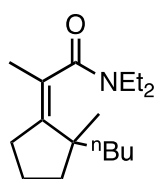
Carried out in 1,2-DCE at 140 °C (in a sealed tube). The product was isolated by flash chromatography (5 to 15 % EtOAc/Hexanes) as white solid (83% yield). **¹H NMR** (400 MHz, CDCl₃): δ 7.33 – 7.28 (m, 2H), 7.22 (t, *J* = 7.7 Hz, 2H), 7.11 – 7.06 (m, 1H), 5.92 (t, *J* = 2.1 Hz, 1H), 3.22 – 3.13 (m, 2H), 2.86 – 2.74 (m, 2H), 2.72 – 2.65 (m, 2H), 2.09 – 2.01 (m, 1H), 1.89 – 1.73 (m, 3H), 1.71 (s, 3H), 1.02 (t, *J* = 7.2 Hz, 3H), 0.63 (t, *J* = 7.2 Hz, 3H). **¹³C NMR** (101 MHz, CDCl₃): δ 166.66 (C), 161.78 (C), 148.08 (C), 127.65 (CH), 126.93 (CH), 125.44 (CH), 116.16 (CH), 50.86 (C), 47.71 (CH₂), 42.10 (CH₂), 38.83 (CH₂), 36.08 (CH₂), 24.73 (CH₃), 23.08 (CH₂), 13.89 (CH₃), 12.59 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₈H₂₆NO ([M+H]⁺) 272.2005, found 272.2009.

(Z)-N,N-Diethyl-2-(2-methylcyclopentylidene)acetamide (2i)



Carried out in 1,2-DCE at 140 °C (in a sealed tube). The product was isolated by flash chromatography (2 to 10 % EtOAc/Hexanes) as a yellow pale oil (38% yield). **¹H NMR** (400 MHz, CDCl₃): δ 5.96 – 5.94 (m, 1H), 3.51 – 3.28 (m, 5H), 2.56 – 2.43 (m, 1H), 2.41 – 2.29 (m, 1H), 1.92 – 1.82 (m, 1H), 1.77 – 1.65 (m, 1H), 1.64 – 1.53 (m, 1H), 1.47 – 1.38 (m, 1H), 1.18 – 1.11 (m, 6H), 1.06 (d, *J* = 7.0 Hz, 3H). **¹³C NMR** (101 MHz, CDCl₃): δ 167.18 (C), 165.21 (C), 112.54 (CH), 42.41 (CH₂), 39.93 (CH₂), 36.53 (CH), 35.17 (CH₂), 34.98 (CH₂), 23.29 (CH₂), 19.98 (CH₃), 14.59 (CH₃), 13.28 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₂H₂₂NO ([M+H]⁺) 196.1697, found 196.1696.

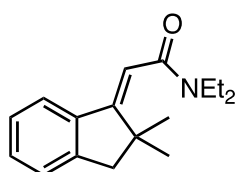
(Z)-2-(2-Butyl-2-methylcyclopentylidene)-N,N-diethylpropanamide (2j)



98% yield. {NOTE: The presence of two rotamers is clearly observed in the ¹H and ¹³C NMR spectra. This was further confirmed by performing the spectra at different temperatures} **¹H NMR** (300 MHz, CDCl₃, *rt*): δ 3.71 – 3.53 (m, 1H), 3.49 – 3.36 (m, 1H), 3.23 – 3.05 (m, 2H), 2.38 – 2.17 (m, 2H), 1.71 (s, 3H), 1.66 – 1.44 (m, 5H), 1.32 – 1.07 (m, 14H), 0.84 (t, *J* = 7.0 Hz, 3H). **¹³C NMR** (75 MHz, CDCl₃): δ 172.80 (C), 172.68 (C),

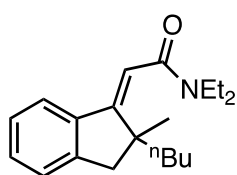
149.69 (C), 148.77 (C), 121.98 (C), 121.91 (C), 46.11 (C), 46.07 (C), 42.61 (CH₂), 42.40 (CH₂), 40.73 (CH₂), 39.80 (CH₂), 38.90 (CH₂), 38.71 (CH₂), 37.44 (CH₂), 37.28 (CH₂), 32.30 (CH₂), 32.12 (CH₂), 27.48 (CH₂), 27.08 (CH₂), 24.64 (CH₃), 23.78 (CH₂), 23.59 (CH₃), 23.48 (CH₂), 21.93 (CH₂), 21.73 (CH₂)*, 19.04 (CH₃), 19.01 (CH₃), 14.36 (CH₃), 14.33 (CH₃), 13.91 (CH₃), 13.81 (CH₃), 12.29 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₁₇H₃₂NO ([M+H]⁺) 266.2479, found 266.2478.

(E)-2-(2,2-Dimethyl-2,3-dihydro-1H-inden-1-ylidene)-N,N-diethylacetamide (2k)



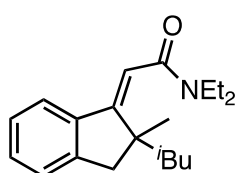
Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as a yellow solid (99% yield). **¹H NMR** (300 MHz, CDCl₃): δ 7.38 (d, *J* = 7.3 Hz, 1H), 7.23 – 7.09 (m, 3H), 6.32 (s, 1H), 3.46 – 3.27 (m, 5H), 2.79 (s, 2H), 1.34 (s, 6H), 1.16 – 1.04 (m, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 167.72 (C), 158.03 (C), 144.54 (C), 140.50 (C), 129.39 (CH), 126.69 (CH), 125.43 (CH), 121.15 (CH), 112.14 (CH), 49.06 (C), 44.28 (CH₂), 42.80 (CH₂), 39.35 (CH₂), 27.31 (CH₃), 14.09 (CH₃), 12.87 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₁₇H₂₄NO ([M+H]⁺) 258.1852, found 258.1852.

(E)-2-(2-Butyl-2-methyl-2,3-dihydro-1H-inden-1-ylidene)-N,N-diethylacetamide (2l)



Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as a pale yellow oil (99% yield). **¹H NMR** (500 MHz, CDCl₃): δ 7.47 (d, *J* = 7.6 Hz, 1H), 7.31 – 7.19 (m, 3H), 6.46 (s, 1H), 3.53 – 3.36 (m, 4H), 3.05 (d, *J* = 16.5 Hz, 1H), 2.74 (d, *J* = 16.5 Hz, 1H), 1.89 (ddd, *J* = 13.0, 11.9, 4.5 Hz, 1H), 1.75 (ddd, *J* = 13.1, 12.1, 4.4 Hz, 1H), 1.40 (s, 3H), 1.31 – 1.23 (m, 3H), 1.20 (t, *J* = 7.1 Hz, 6H), 1.17 – 1.10 (m, 1H), 0.85 (t, *J* = 7.2 Hz, 3H). **¹³C NMR** (75 MHz, CDCl₃): δ 167.60 (C), 158.12 (C), 145.12 (C), 141.02 (C), 129.43 (CH), 126.65 (CH), 125.33 (CH), 120.85 (CH), 112.07 (CH), 47.61 (C), 45.71 (CH₂), 41.5 (br, CH₂), 39.37 (CH₂), 27.56 (CH₃), 26.46 (CH₂), 23.51 (CH₂), 14.25 (CH₃), 13.52 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₂₀H₃₀NO ([M+H]⁺) 300.2322, found 300.2322.

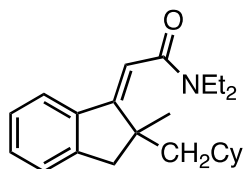
(E)-N,N-Diethyl-2-(2-isobutyl-2-methyl-2,3-dihydro-1H-inden-1-ylidene)acetamide (2m)



Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as a colorless oil (99% yield). **¹H NMR** (300 MHz, CDCl₃) δ 7.48 – 7.42 (m, 1H), 7.31 – 7.17 (m, 3H), 6.42 (s, 1H), 3.51 – 3.34 (m, 4H), 3.10 (d, *J* = 16.6 Hz, 1H), 2.79 (d, *J* = 16.6 Hz, 1H), 1.90 – 1.70 (m, 2H), 1.70 – 1.55 (m, 1H), 1.40 (s, 3H), 1.18 (t, *J* = 7.2 Hz, 6H), 0.86 (t, *J* = 6.5 Hz, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 167.59 (C), 158.80 (C), 145.22 (C), 140.97 (C), 129.48 (CH), 126.68 (CH), 125.32 (CH), 120.89 (CH), 111.98 (CH), 48.35 (CH₂), 47.75 (C), 46.49 (CH₂), 41.0 (br, CH₂), 26.87 (CH₃), 25.70 (CH), 25.04 (CH₃), 24.69 (CH₃), 13.48 (CH₃). **HRMS** (ESI-TOF): m/z

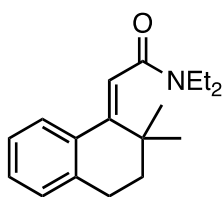
calculated for C₂₀H₃₀NO ([M+H]⁺) 300.2322, found 300.2322; m/z calculated for C₂₀H₂₉NONa ([M+Na]⁺) 322.2143, found 322.2141.

(E)-2-(2-(Cyclohexylmethyl)-2-methyl-2,3-dihydro-1H-inden-1-ylidene)-N,N-diethylacetamide (2n)



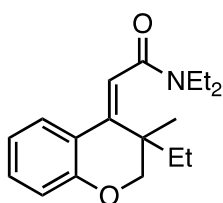
Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as a colorless oil (98% yield). **¹H NMR** (500 MHz, CDCl₃): δ 7.47 – 7.44 (m, 1H), 7.29 – 7.25 (m, 1H), 7.24 – 7.19 (m, 2H), 6.41 (s, 1H), 3.51 – 3.33 (m, 4H), 3.09 (d, *J* = 16.5 Hz, 1H), 2.78 (d, *J* = 16.5 Hz, 1H), 1.80 – 1.71 (m, 2H), 1.69 – 1.51 (m, 5H), 1.40 (s, 3H), 1.33 – 1.25 (m, 1H), 1.19 (t, *J* = 7.1 Hz, 6H), 1.16 – 1.05 (m, 3H), 1.02 – 0.89 (m, 2H). **¹³C NMR** (75 MHz, CDCl₃): δ 167.57 (C), 158.90 (C), 145.14 (C), 140.88 (C), 129.43 (CH), 126.61 (CH), 125.33 (CH), 120.90 (CH), 111.81 (CH), 47.73 (C), 46.53 (CH₂), 42.02 (br, N-CH₂), 40.25 (br, N-CH₂), 35.44 (CH₂), 35.29 (CH), 35.16 (CH₂), 26.86 (CH₃), 26.62 (CH₂), 26.43 (CH₂), 13.47 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₂₃H₃₄NO ([M+H]⁺) 340.2634, found 340.2635.

(E)-2-(2,2-Dimethyl-3,4-dihydronaphthalen-1(2H)-ylidene)-N,N-diethylacetamide (2o)



Carried out in refluxing dioxane. The product was isolated by flash chromatography (10 to 20 % EtOAc/ Hexanes) as an orange pale oil (92% yield) **¹H NMR** (300 MHz, CDCl₃): δ 7.53 – 7.47 (m, 1H), 7.22 – 7.14 (m, 2H), 7.14 – 7.08 (m, 1H), 6.23 (s, 1H), 3.43 (dq, *J* = 18.7, 7.1 Hz, 4H), 2.82 (t, *J* = 6.5 Hz, 2H), 1.69 (t, *J* = 6.5 Hz, 2H), 1.26 (s, 6H), 1.20 – 1.11 (m, 6H). **¹³C NMR** (75 MHz, CDCl₃): δ 169.44 (C), 148.62 (C), 137.87 (C), 136.47 (C), 128.46 (CH), 127.85 (CH), 126.27 (CH), 126.20 (CH), 118.73 (CH), 42.78 (CH₂), 39.20 (CH₂), 38.77 (CH₂), 36.35 (CH₂), 29.81 (C), 27.14 (CH₃), 26.83 (CH₂), 13.78 (CH₃), 12.34 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₁₈H₂₆NO ([M+H]⁺) 272.2010, found 272.2009.

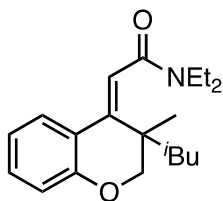
(E)-N,N-Diethyl-2-(3-ethyl-3-methylchroman-4-ylidene)acetamide (2p)



Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as yellow oil (82 % yield). **¹H NMR** (300 MHz, CDCl₃): δ 7.48 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.19 (ddd, *J* = 8.4, 7.2, 1.6 Hz, 1H), 6.90 (ddd, *J* = 8.2, 7.2, 1.3 Hz, 1H), 6.83 (dd, *J* = 8.2, 1.3 Hz, 1H), 6.37 (s, 1H), 3.94 (d, *J* = 11.1 Hz, 1H), 3.79 (d, *J* = 11.1 Hz, 1H), 3.62 – 3.41 (m, 2H), 3.40 – 3.26 (m, 2H), 1.83 – 1.70 (m, 1H), 1.61 – 1.47 (m, 1H), 1.20 – 1.12 (m, 9H), 0.91 (t, *J* = 7.5 Hz, 3H). **¹³C NMR** (75 MHz, CDCl₃): δ 168.75 (C), 154.58 (C), 143.34 (C), 129.91 (CH), 125.72 (CH), 121.46 (C), 121.03 (CH), 117.12 (CH), 116.35 (CH), 73.83 (CH₂), 42.83 (CH₂), 38.99 (CH₂),

38.52 (C), 28.17 (CH₂), 19.02 (CH₃), 13.85 (CH₃), 12.41 (CH₃), 8.66 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₁₈H₂₆NO₂ ([M+H]⁺) 288.1959, found 288.1958.

(E)-N,N-Diethyl-2-(3-isobutyl-3-methylchroman-4-ylidene) acetamide (2q)

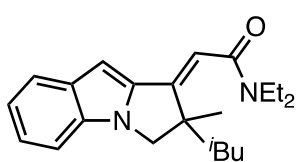


Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as yellow pale oil (90 %). **¹H NMR** (400 MHz, CDCl₃): δ 7.43 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.22 – 7.17 (m, 1H), 6.93 – 6.87 (m, 1H), 6.82 (dd, *J* = 8.1, 1.3 Hz, 1H), 6.29 (s, 1H), 3.90 (d, *J* = 11.0 Hz, 1H), 3.79 (d, *J* = 11.0 Hz, 1H), 3.63 – 3.53 (m, 1H), 3.52 – 3.41 (m, 1H), 3.37 –

3.25 (m, 2H), 1.98 – 1.87 (m, 1H), 1.67 (dd, *J* = 14.3, 6.6 Hz, 1H), 1.34 (dd, *J* = 14.2, 4.5 Hz, 1H), 1.21 (s, 3H), 1.19 – 1.13 (m, 6H), 0.90 (d, *J* = 6.7 Hz, 3H), 0.82 (d, *J* = 6.6 Hz, 3H). **¹³C NMR** (101 MHz, CDCl₃): δ 168.67 (C), 154.37 (C), 144.18 (C), 129.93 (CH), 126.08 (CH), 121.92 (C), 121.04 (CH), 116.85 (CH), 116.59 (CH), 75.42 (CH₂), 44.62 (CH₂), 42.81 (CH₂), 39.05 (CH₂), 38.61 (C), 25.52 (CH), 24.51 (CH₃), 24.14 (CH₃), 19.96 (CH₃), 13.87 (CH₃), 12.47 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₂₀H₃₀NO₂ ([M+H]⁺) 316.2275, found 316.2271.

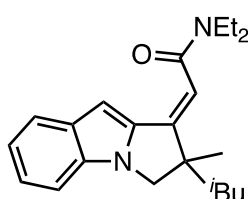
(E)-N,N-Diethyl-2-(2-isobutyl-2-methyl-2,3-dihydro-1H-pyrrolo[1,2-a]indol-1-ylidene)acetamide (E-2r) and **(Z)-N,N-Diethyl-2-(2-isobutyl-2-methyl-2,3-dihydro-1H-pyrrolo[1,2-a]indol-1-ylidene)acetamide (Z-2r)**

Carried out in refluxing dioxane, the products were isolated by flash chromatography (5 to 20 % EtOAc/Hexanes) as dark brown oil [90% combined yield, E / Z = 1:1]



E-2r : NMR data of *E*-2r was deduced from a 3.9 : 1 E / Z sample of **2r**, obtained after careful column chromatography. **¹H NMR** (400 MHz, CDCl₃): δ 7.53 (d, *J* = 7.9 Hz, 1H), 7.21 – 7.17 (m, 1H), 7.10 (ddd, *J* = 8.2, 6.9, 1.2 Hz, 1H), 7.02 (ddd, *J* = 8.1, 6.9, 1.2 Hz, 1H), 6.47 (s, 2H), 4.12 (d,

J = 10.1 Hz, 1H), 3.82 (d, *J* = 10.1 Hz, 1H), 3.44 – 3.30 (m, 4H), 2.07 (dd, *J* = 13.9, 6.3 Hz, 1H), 1.75 (dd, *J* = 14.0, 6.0 Hz, 1H), 1.62 – 1.57 (m, 1H), 1.51 (s, 3H), 1.16 – 1.10 (m, 6H), 0.83 – 0.77 (m, 6H). **¹³C NMR** (101 MHz, CDCl₃): δ 166.29 (C), 148.97 (C), 143.83 (C), 133.64 (C), 132.77 (C), 121.95 (CH), 121.51 (CH), 120.23 (CH), 113.33 (CH), 109.96 (CH), 92.08 (CH), 56.64 (CH₂), 51.80 (C), 47.54 (CH₂), 42.88 (CH₂), 39.90 (CH₂), 26.39 (CH), 25.77 (CH₃), 24.69 (CH₃), 24.38 (CH₃), 14.33 (CH₃), 13.08 (CH₃). **HRMS** (ESI-TOF): m/z calculated for C₂₂H₃₁N₂O ([M+H]⁺) 339.2434, found 339.2431.

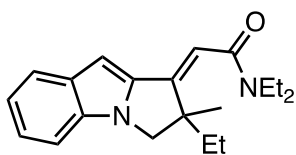


Z-2r: NMR data of *Z*-2r was deduced from a 1 : 3.5 E / Z sample of **2r**, obtained after careful column chromatography. **¹H NMR** (400 MHz, CDCl₃): δ 7.55 (d, *J* = 8.1 Hz, 1H), 7.17 (d, *J* = 8.5 Hz, 1H), 7.10 (ddd, *J* = 8.2, 6.7, 1.1 Hz, 1H), 7.04 (s, 1H), 6.99 (ddd, *J* = 8.0, 6.8, 1.2 Hz, 1H), 5.86 (s, 1H), 4.06 (d,

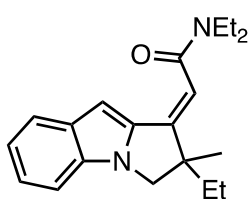
$J = 10.1$ Hz, 1H), 3.80 (d, $J = 10.1$ Hz, 1H), 3.50 – 3.31 (m, 4H), 1.68 – 1.61 (m, 1H), 1.58 (t, $J = 5.7$ Hz, 2H), 1.34 (s, 3H), 1.21 – 1.07 (m, 6H), 0.86 – 0.80 (m, 6H). ^{13}C NMR (101 MHz, CDCl_3): δ 166.75 (C), 148.74 (C), 139.17 (C), 133.56 (C), 133.00 (C), 122.43 (CH), 122.33 (CH), 119.90 (CH), 112.01 (CH), 109.71 (CH), 100.50 (CH), 54.13 (CH_2), 51.78 (C), 50.42 (CH_2), 42.91 (CH_2), 40.24 (CH_2), 28.11 (CH), 25.44 (CH_3), 25.01 (CH_3), 24.76 (CH_3), 14.80 (CH_3), 13.45 (CH_3). HRMS (ESI-TOF): m/z calculated for $\text{C}_{22}\text{H}_{31}\text{N}_2\text{O}$ ($[\text{M}+\text{H}]^+$) 339.2433, found 339.2431.

(E)-N,N-Diethyl-2-(2-ethyl-2-methyl-2,3-dihydro-1H-pyrrolo[1,2-a]indol-1-ylidene)acetamide (E-2s) and **(Z)-N,N-Diethyl-2-(2-ethyl-2-methyl-2,3-dihydro-1H-pyrrolo[1,2-a]indol-1-ylidene)acetamide (Z-2s)**

Carried out in refluxing Dioxane. The products were separately isolated by flash chromatography (5 to 20 % EtOAc/Hexanes) [**E-2s**: 43 % yield and **Z-2s**: 43% yield].



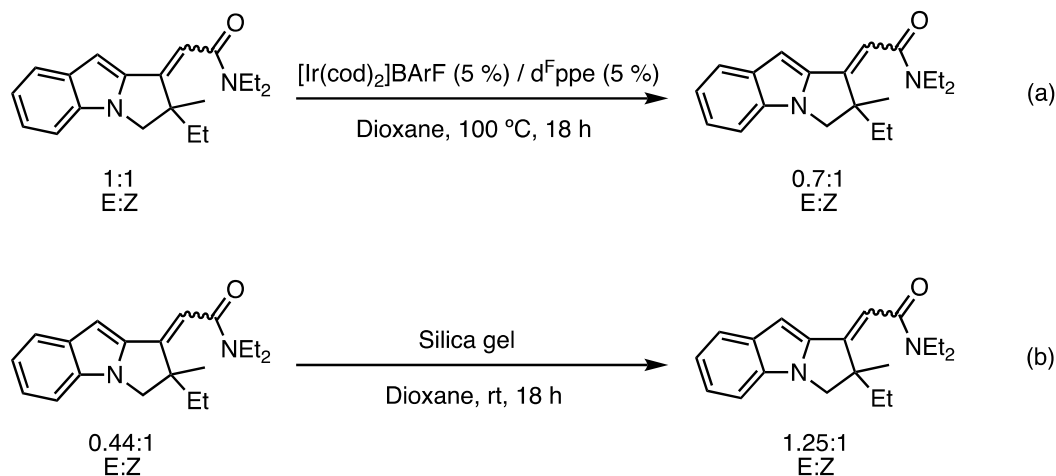
E-2s: ^1H NMR (400 MHz, CDCl_3) δ 7.59 (d, $J = 8.0$ Hz, 1H), 7.25 (d, $J = 7.7$ Hz, 1H), 7.19 – 7.13 (m, 1H), 7.08 (ddd, $J = 8.1, 7.0, 1.1$ Hz, 1H), 6.55 (s, 1H), 6.52 (s, 1H), 4.09 (d, $J = 10.1$ Hz, 1H), 3.83 (d, $J = 10.1$ Hz, 1H), 3.49 – 3.38 (m, 4H), 2.22 – 2.11 (m, 1H), 1.95 – 1.84 (m, 1H), 1.55 (s, 3H), 1.22 – 1.15 (m, 6H), 0.83 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, CDCl_3): δ 166.34 (C), 148.12 (C), 143.90 (C), 133.64 (C), 132.71 (C), 121.95 (CH), 121.50 (CH), 120.21 (CH), 113.57 (CH), 109.94 (CH), 91.98 (CH), 55.35 (CH_2), 52.15 (C), 42.91 (CH_2), 39.85 (CH_2), 31.57 (CH_2), 25.11 (CH_3), 14.34 (CH_3), 13.04 (CH_3), 9.43 (CH_3). HRMS (ESI-TOF): m/z calculated for $\text{C}_{20}\text{H}_{27}\text{N}_2\text{O}$ ($[\text{M}+\text{H}]^+$) 311.2118, found 311.2118; m/z calculated for $\text{C}_{20}\text{H}_{27}\text{N}_2\text{ONa}$ ($[\text{M}+\text{Na}]^+$) 333.1941, found 333.1937.



Z-2s: ^1H NMR (400 MHz, CDCl_3): δ 7.61 (d, $J = 8.0$ Hz, 1H), 7.22 (d, $J = 9.1$ Hz, 1H), 7.16 (ddd, $J = 8.1, 6.8, 1.1$ Hz, 1H), 7.11 (s, 1H), 7.05 (ddd, $J = 8.1, 6.8, 1.2$ Hz, 1H), 5.90 (s, 1H), 4.04 (d, $J = 10.1$ Hz, 1H), 3.83 (d, $J = 10.1$ Hz, 1H), 3.55 – 3.50 (m, 2H), 3.43 – 3.36 (m, 2H), 1.72 (q, $J = 7.4, 6.9$ Hz, 2H), 1.39 (s, 3H), 1.26 – 1.14 (m, 6H), 0.88 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, CDCl_3): δ 166.74 (C), 148.13 (C), 139.35 (C), 133.59 (C), 132.96 (C), 122.44 (CH), 122.35 (CH), 119.88 (CH), 111.88 (CH), 109.70 (CH), 100.47 (CH), 53.22 (CH_2), 51.87 (C), 42.97 (CH_2), 40.33 (CH_2), 34.40 (CH_2), 26.82 (CH_3), 14.81 (CH_3), 13.47 (CH_3), 9.15 (CH_3). HRMS (ESI-TOF): m/z calculated for $\text{C}_{20}\text{H}_{27}\text{N}_2\text{O}$ ($[\text{M}+\text{H}]^+$) 311.2116, found 311.2118.

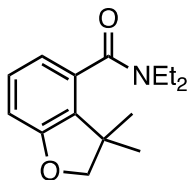
Control experiments related to the formation of E / Z isomers of 2r and 2s

Control experiments carried out for the cyclizations of **1r** and **1s** suggest that these mixtures are the result of an isomerization of the initially formed *e*-isomer (*E*-**2r**, *E*-**2s**), presumably mediated by the Ir(I) catalyst (Scheme S1, eq. a). The isomerization is also observed during the isolation process in the contact to silica-gel (Scheme S1, eq. b).



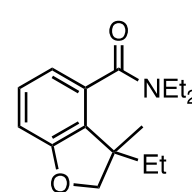
Scheme S1. Isomerization experiments of **2s**.

N,N-Diethyl-3,3-dimethyl-2,3-dihydrobenzofuran-4-carboxamide (**6a**)



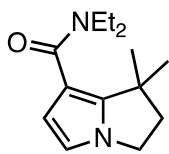
Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as yellow oil (82 % yield). **¹H NMR** (500 MHz, CDCl₃): δ 7.12 (td, *J* = 7.8, 2.6 Hz, 1H), 6.79 (dd, *J* = 8.0, 2.6 Hz, 1H), 6.69 (dd, *J* = 7.5, 2.6 Hz, 1H), 4.25 – 4.21 (m, 1H), 4.17 – 4.13 (m, 1H), 4.03 – 3.96 (m, 1H), 3.21 – 3.03 (m, 3H), 1.40 (s, 3H), 1.28 (s, 3H), 1.24 – 1.19 (m, 3H), 1.09 – 1.04 (m, 3H). **¹³C NMR** (126 MHz, CDCl₃): δ 169.31 (C), 159.56 (C), 133.01 (C), 131.05 (C), 128.52 (CH), 117.57 (CH), 110.30 (CH), 84.44 (CH₂), 42.70 (CH₂), 42.64 (C), 38.01 (CH₂), 27.54 (CH₃), 24.31 (CH₃), 13.76 (CH₃), 12.34 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₅H₂₁NO₂ ([M+H]⁺) 248.1644, found 248.1645.

N,N,3-Triethyl-3-methyl-2,3-dihydrobenzofuran-4-carboxamide (**6b**)



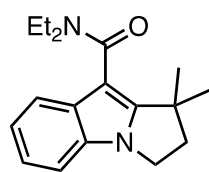
Carried out in refluxing dioxane. The product was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as yellow oil (92 % yield). **¹H NMR** (400 MHz, CDCl₃): **¹H NMR** (300 MHz, CDCl₃, at 60 °C): δ 7.09 (td, *J* = 7.8, 1.6 Hz, 1H), 6.75 (dd, *J* = 8.1, 0.7 Hz, 1H), 6.65 (dd, *J* = 7.6, 0.8 Hz, 1H), 4.34 (d, *J* = 8.5 Hz, 1H), 4.08 (d, *J* = 8.5 Hz, 1H), 3.54 (br, 2H), 3.23 – 3.09 (m, 2H), 1.89 – 1.60 (m, 2H), 1.34 (s, 3H), 1.28 – 1.21 (m, 3H), 1.15 – 1.06 (m, 3H), 0.81 (t, *J* = 7.5 Hz, 3H). **¹³C NMR** (75 MHz, CDCl₃, at 60 °C): δ 169.59 (C), 160.89 (C), 134.02 (C), 131.07 (C), 128.23 (CH), 118.27 (CH), 110.16 (CH), 82.06 (CH₂), 46.98 (C), 43.25 (CH), 38.67 (CH₂), 32.37 (CH₂), 24.55 (CH₂), 13.94 (CH₃), 12.64 (CH₃), 9.04 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₆H₂₄NO₂ ([M+H]⁺) 262.1799, found 262.1802.

***N,N*-Diethyl-1,1-dimethyl-2,3-dihydro-1*H*-pyrrolizine-7-carboxamide (6c)**



Carried out in refluxing dioxane. The product was isolated by flash chromatography (10 to 30 % EtOAc/Hexanes) as light brown solid (95% yield) **¹H NMR (300 MHz, CDCl₃):** δ 6.38 (d, *J* = 2.8 Hz, 1H), 6.16 (d, *J* = 2.8 Hz, 1H), 3.92 (t, *J* = 6.9 Hz, 2H), 3.49 (q, *J* = 7.1 Hz, 4H), 2.28 (t, *J* = 6.9 Hz, 2H), 1.40 (s, 6H), 1.17 (t, *J* = 7.1 Hz, 6H). **¹³C NMR (75 MHz, CDCl₃):** δ 167.85 (C), 146.94 (C), 112.15 (CH), 111.39 (CH), 109.94 (C), 45.16 (CH₂), 44.78 (CH₂), 41.42 (CH₂), 39.68 (C), 26.92 (CH₃), 13.86 (CH₃). **HRMS (ESI-TOF):** *m/z* calculated for C₁₄H₂₃N₂O ([M+H]⁺) 235.1805, found 235.1805.

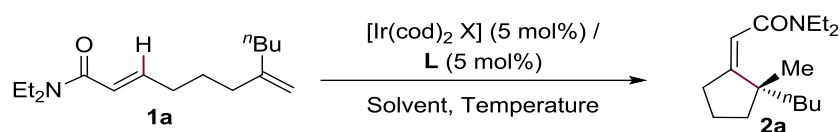
***N,N*-Diethyl-1,1-dimethyl-2,3-dihydro-1*H*-pyrrolo[1,2-*a*]indole-9-carboxamide (6d)**



Carried out in 1,2-DCE at 140 °C. The product was isolated by flash chromatography (10 to 20 % EtOAc/ Hexanes) as a pale yellow oil (99% yield). **¹H NMR (500 MHz, CDCl₃):** δ 7.40 (dt, *J* = 7.8, 1.1 Hz, 1H), 7.22 (dt, *J* = 8.0, 1.1 Hz, 1H), 7.16 – 7.12 (m, 1H), 7.12 – 7.07 (m, 1H), 4.10 (t, *J* = 6.8 Hz, 2H), 3.62 – 3.45 (m, 4H), 2.44 – 2.41 (m, 2H), 1.50 (s, 6H), 1.22 – 1.11 (m, 6H). **¹³C NMR (126 MHz, CDCl₃):** δ 167.42 (C), 152.91 (C), 131.29 (C), 129.99 (C), 121.03 (CH), 120.07 (CH), 119.73 (CH), 109.76 (CH), 102.67 (C), 44.31 (CH₂), 42.69 (CH₂), 39.58 (C), 27.02 (CH₃), 14.00 (CH₃). **HRMS (ESI-TOF):** *m/z* calculated for C₁₈H₂₅N₂O ([M+H]⁺) 285.1961, found 285.1961. {NOTE: This compound was also characterized at 60 °C in CDCl₃, in order to more clearly show the amide carbons, which sometimes are not fully visible at rt due to the existence of rotamers. **¹H NMR (300 MHz, CDCl₃)** δ 7.41 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.23 – 7.19 (m, 1H), 7.17 – 7.06 (m, 2H), 4.09 (t, *J* = 6.9 Hz, 2H), 3.55 (q, *J* = 7.1 Hz, 4H), 2.43 (t, *J* = 7.0 Hz, 2H), 1.51 (s, 6H), 1.18 (t, *J* = 7.1 Hz, 6H). **¹³C NMR (75 MHz, CDCl₃)** δ 167.51 (C), 152.87 (C), 131.57 (C), 130.32 (C), 121.13 (CH), 120.18 (CH), 119.86 (CH), 109.78 (CH), 103.10 (C), 44.52 (CH₂), 42.71 (CH₂), 41.30 (CH₂), 39.67 (C), 27.15 (CH₃), 13.99 (CH₃).

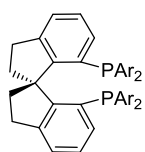
Assays for the development of an enantioselective version

Table S2. Preliminary screening of an asymmetric catalyst for the hydrocarbonation of **1a**.^[a]

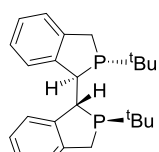


entry	L	X	Solvent	Temp (°C)	time (h)	Yield (%)	er
1	L1	BArF	dioxane	reflux	19	40	88 : 12
2	L2	BArF	dioxane	reflux	19	72	84 : 16
3	L3	BArF	dioxane	reflux	19	74	79 : 21
4	L4	BArF	dioxane	reflux	19	65	68 : 32
5	L5	BArF	dioxane	reflux	19	70	51 : 49
6	L6	BArF	dioxane	reflux	19	40	59: 41
7	L7	BArF	dioxane	reflux	19	99	56 : 44
8	L8	BArF	dioxane	reflux	19	68	65 : 35
9	L9	BArF	dioxane	reflux	19	61	52 : 48
10	L1	BArF	dioxane	80	19	34	90 : 10
11 ^[c]	L2	BArF	dioxane	80	19	30	85 : 15
12	L3	BArF	dioxane	80	19	80	82 : 18
13 ^[b]	L1	BF ₄	dioxane	80	48	95	80 : 20
14 ^[b]	L3	BF ₄	dioxane	80	19	90	91 : 9
15 ^[b]	L3	BF ₄	1,2-DCE	60	7	70	87 : 13
16 ^[d]	L3	BF ₄	CH ₂ Cl ₂	50	19	95	89 : 11

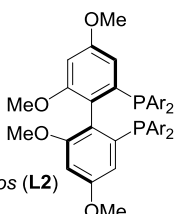
[a] **1a** was added to a solution of [Ir(cod)₂X] (5 %) and **L** (5 %) in the solvent (125 mM) and the mixture was heated at the indicated temperature. Isolated yields. [b] Carried out at 250 mM (**1a**). [c] 67% conversion. [d] In a sealed tube.



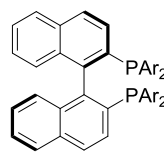
Ar = 3,5-Me₂-Ph, (S)-DM-SDP (**L1**)
Ar = Ph, (S)-SDP (**L4**)



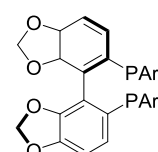
(R,R,S,S)-Duanphos (**L2**)



Ar = 3,5-(CF₃)₂-Ph, (R)-BTfM-Garphos (**L3**)
Ar = Ph, (R)-Garphos (**L5**)
Ar = 3,5-Me₂Ph, (R)-DM-Garphos (**L6**)

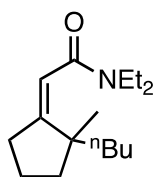


Ar = Ph, (**L7**): (R)-Binap
Ar = 3,5-Me₂Ph, (**L8**): (R)-DM-Binap



Ar = 3,5-Me₂Ph
(R)-DM-Segphos (**L9**)

Conditions for the determination of the er of **2a** and HPLC traces of all entries of Table S2



(Z)-2-(2-Butyl-2-methylcyclopentylidene)-N,N-diethylacetamide (2a).

Enantiomeric ratios determined by chiral HPLC on Chiralpak IF3 at rt, (Hexane : iPrOH = 98:2, 1 ml/min).

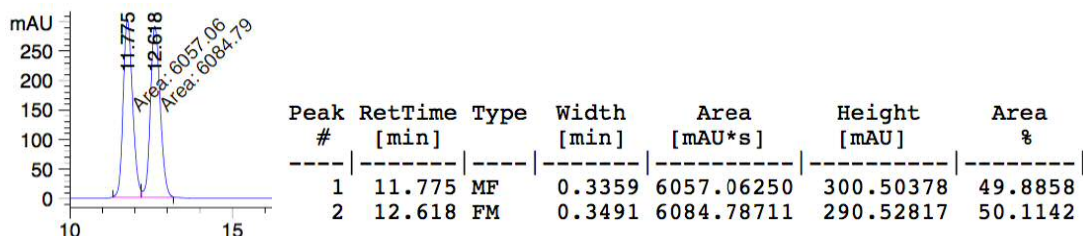


Figure S1. HPLC trace and report of a racemic sample of **2a** [Chiralpak IF3 at rt, (Hexane : iPrOH = 98:2, 1 ml/min)]

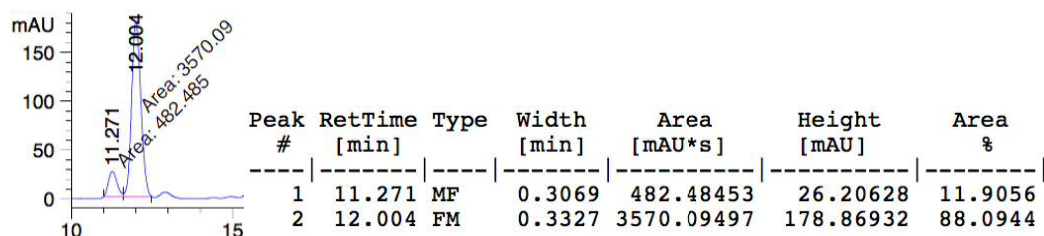


Figure S2. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by [Ir(cod)₂]BARF / **L1** at reflux (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 1.

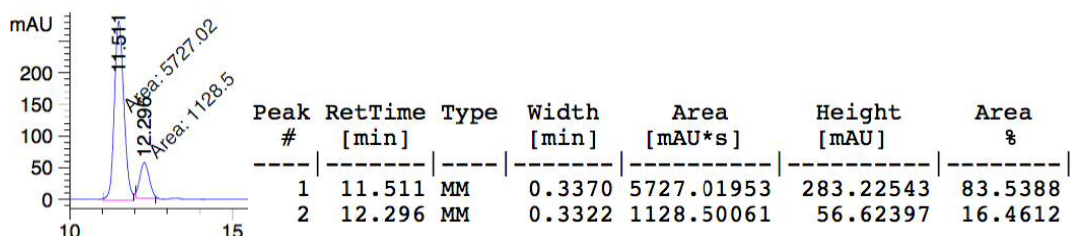


Figure S3. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by [Ir(cod)₂]BARF / **L2** at reflux (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 2.

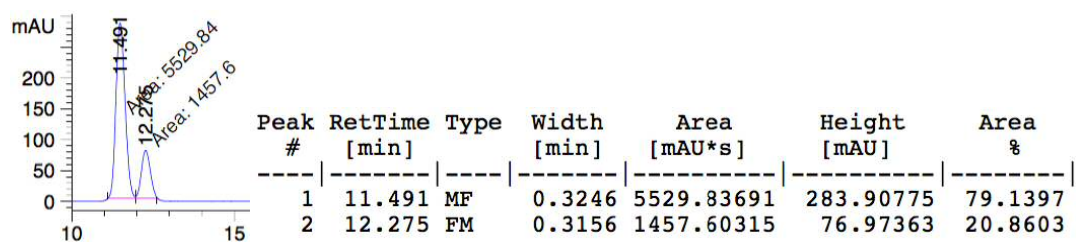


Figure S4. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by [Ir(cod)₂]BARF / **L3** at reflux (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 3.

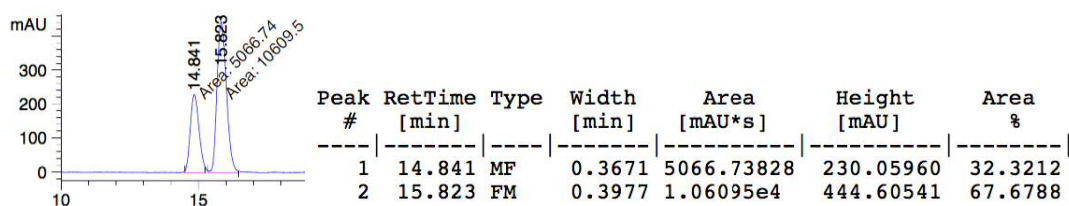


Figure S5. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BARf}$ / **L4** at reflux (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 4.

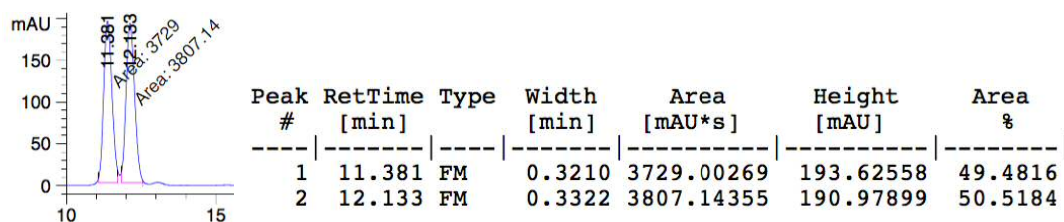


Figure S6. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BARf}$ / **L5** at reflux (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 5.

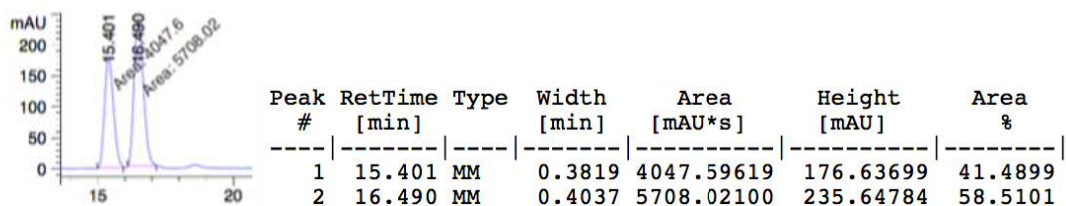


Figure S7. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BARf}$ / **L6** at reflux (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 6.

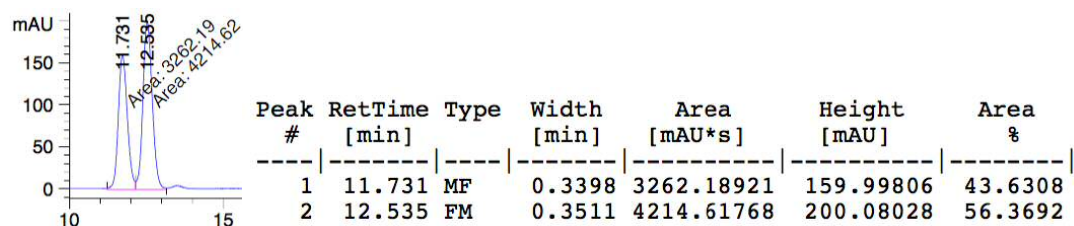


Figure S8. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BARf}$ / **L7** at reflux (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 7.

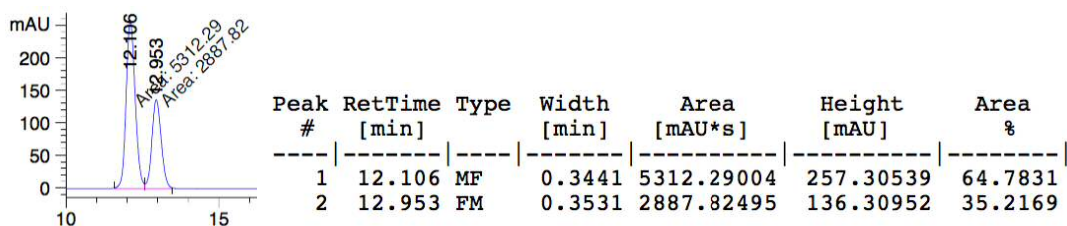


Figure S9. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BARf}$ / **L8** at reflux (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 8.

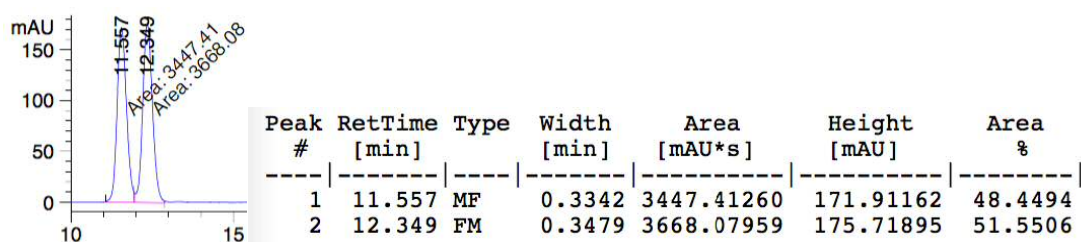


Figure S10. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BARf}$ / **L9** at reflux (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 9.

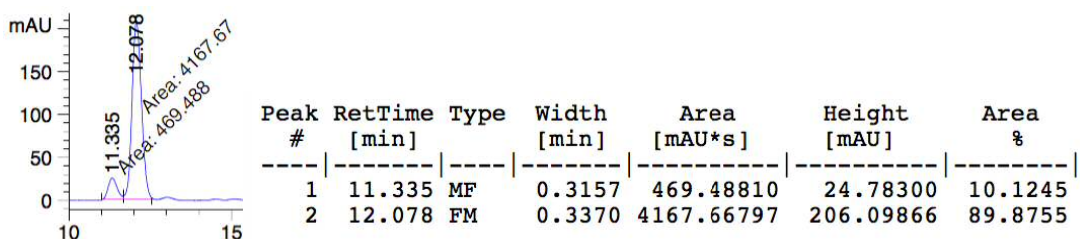


Figure S11. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BARf}$ / **L1** at 80 °C (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 10.

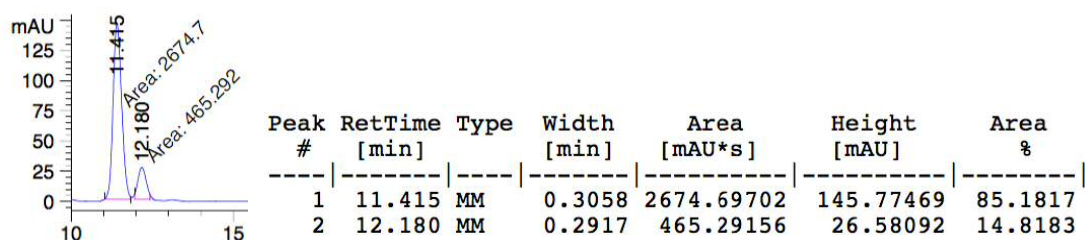


Figure S12. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BARf}$ / **L2** at 80 °C (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 11.

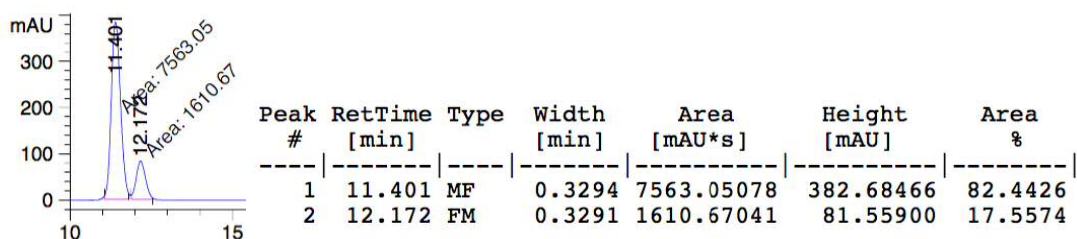


Figure S13. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BARf}$ / **L3** at 80 °C (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 12.

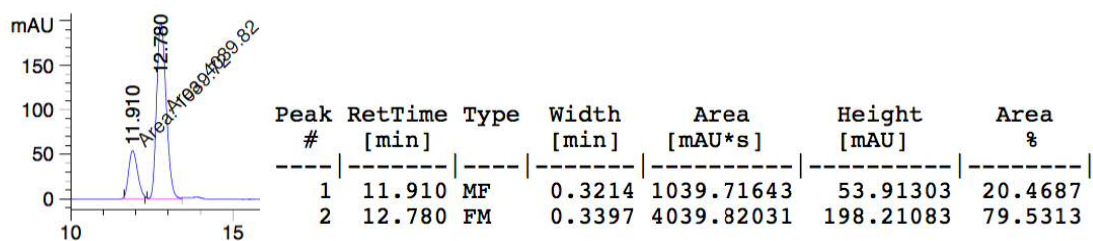


Figure S14. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{L1}$ at 80 °C (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 13.

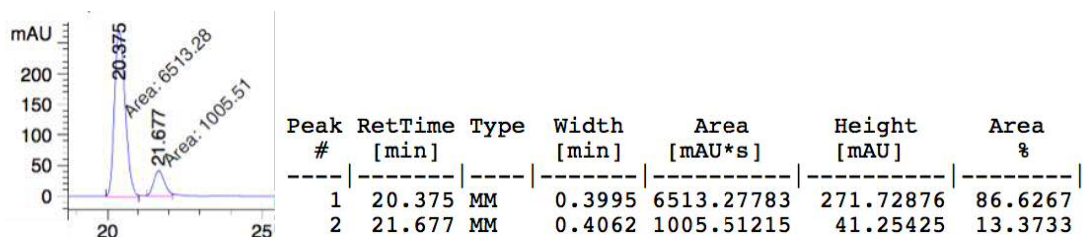


Figure S15 HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{L3}$ at 60 °C in 1,2-DCE (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 15, Supporting information.

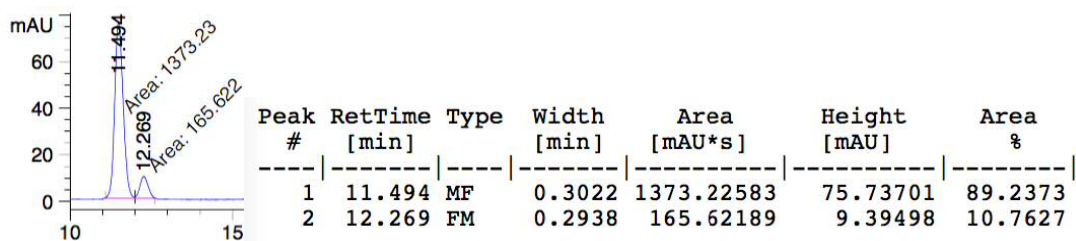
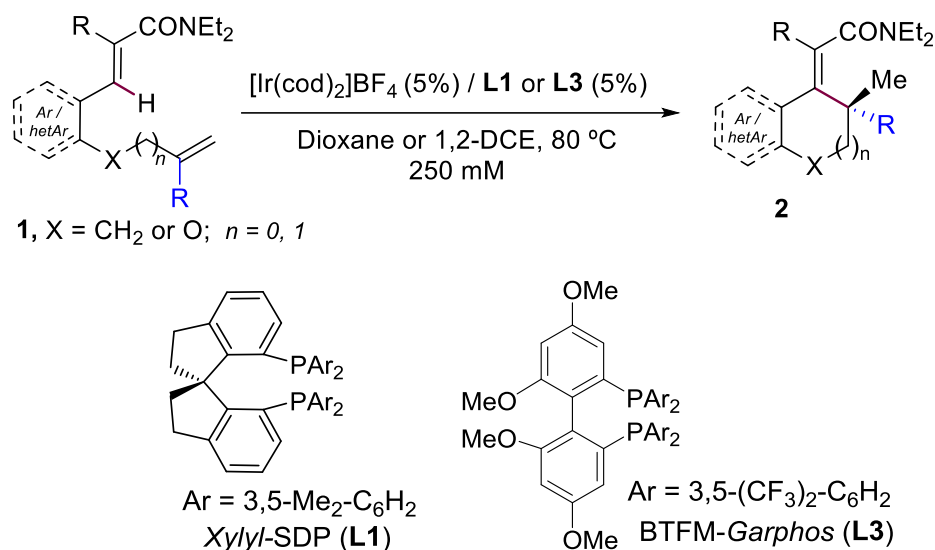


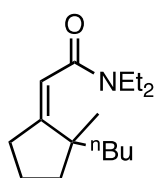
Figure S16. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{L3}$ at 50 °C in CH_2Cl_2 (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table S2, entry 16, Supporting information.

Procedure for the enantioselective Ir-catalyzed intramolecular hydrocarbonation process



An oven dried schlenk tube equipped with a Teflon septum and magnetic stir bar was charged with **L1** or **L3** (5 mol%), Bis(1,5-cyclooctadiene)iridium(I) tetrafluoroborate (5 mol%), the amide substrate (1.0 equiv) and the solvent (dioxane or 1,2-DCE, 0.250 M). The reaction mixture was then stirred at 80 °C. After TLC indicated full conversion of the starting material, the reaction mixture was concentrated in vacuo. Purification of the crude product by flash chromatography on silica gel (typically 1:20 to 1:10 EtOAc : hexanes) afforded the desired product.

(Z)-2-(2-Butyl-2-methylcyclopentylidene)-N,N-diethylacetamide (**2a**)



Using the general procedure, dioxane and **L3**, (Z)-2-(2-butyl-2-methylcyclopentylidene)-N,N-diethylacetamide (**2a**) was obtained in 90 % yield and 91:9 er. Enantioselectivity was determined by chiral HPLC analysis on Chiralpak IF3 at rt, (Hexane : iPrOH = 98:2, 1 ml/min).

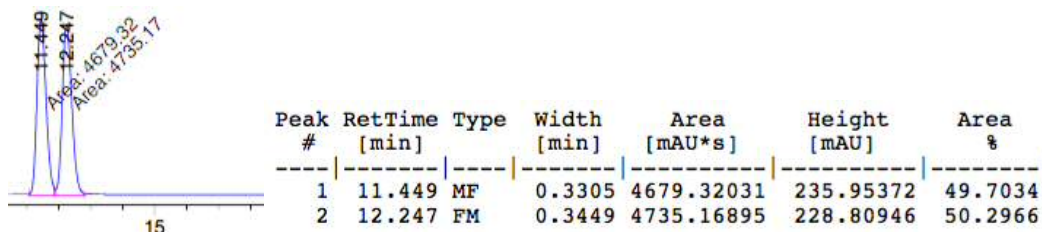


Figure S17. HPLC trace and report of a racemic sample of **2a** [Chiralpak IF3 at rt, (Hexane : iPrOH = 98:2, 1 ml/min)]

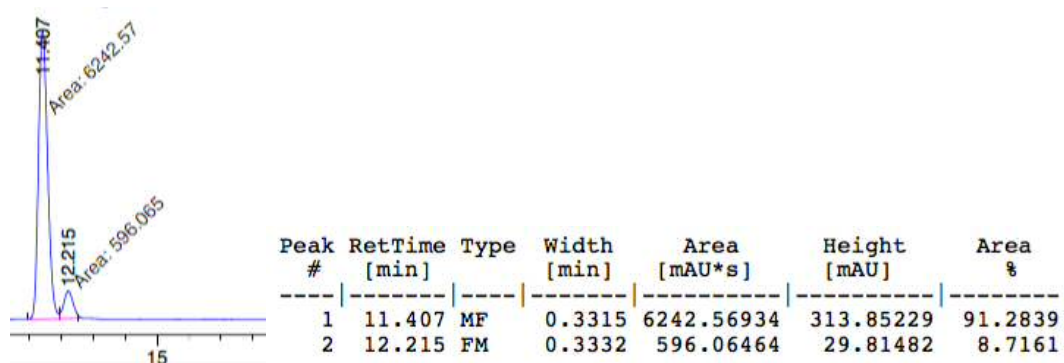
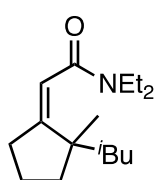


Figure S18. HPLC trace and report of a sample of **2a** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{L3}$ (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table 4, entry 5, main manuscript or Table S2, entry 14.

(Z)-N,N-Diethyl-2-(2-isobutyl-2-methylcyclopentylidene)acetamide (2e)



Using the general procedure, 1,2-DCE and **L3**, (Z)-N,N-diethyl-2-(2-isobutyl-2-methylcyclopentylidene)acetamide (**2e**) was obtained in 82 % yield and 91:9 er. Enantioselectivity was determined by chiral HPLC analysis on Chiralpak IF3 at rt, (Hexane : iPrOH = 99:1, 1 ml/min).

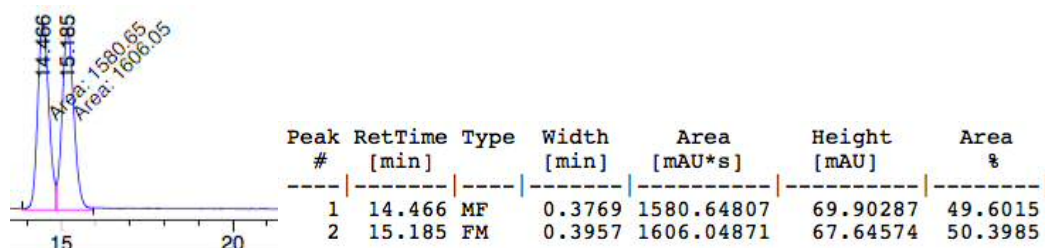


Figure S19. HPLC trace and report of a racemic sample of **2e** [Chiralpak IF3 at rt, (Hexane : iPrOH = 99:1, 1 ml/min)]

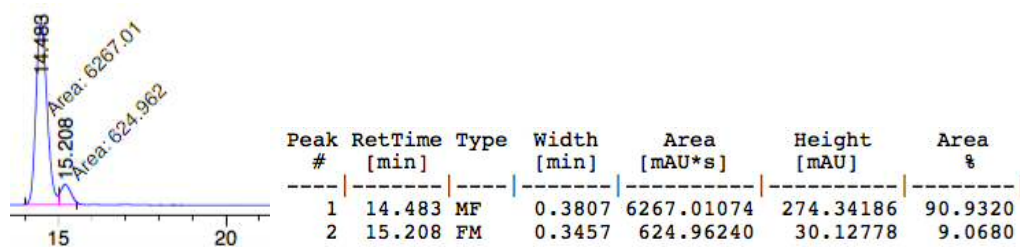
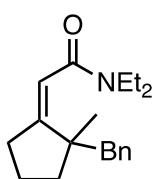


Figure S20. HPLC trace and report of a sample of **2e** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{L3}$ (Chiralpak IF3 at rt, Hexane : iPrOH = 99:1, 1 ml/min). Table 4, entry 8, main manuscript.

(Z)-2-(2-Benzyl-2-methylcyclopentylidene)-*N,N*-diethylacetamide (**2g**)



Using the general procedure, dioxane and **L1** (10 mol%), (Z)-2-(2-benzyl-2-methylcyclopentylidene)-*N,N*-diethylacetamide (**2g**) was obtained after 48 hours in 81 % yield and 83:17 er. Enantioselectivity was determined by chiral HPLC analysis on Chiralpak IF3 at rt, (Hexane : iPrOH = 98:2, 1 ml/min).

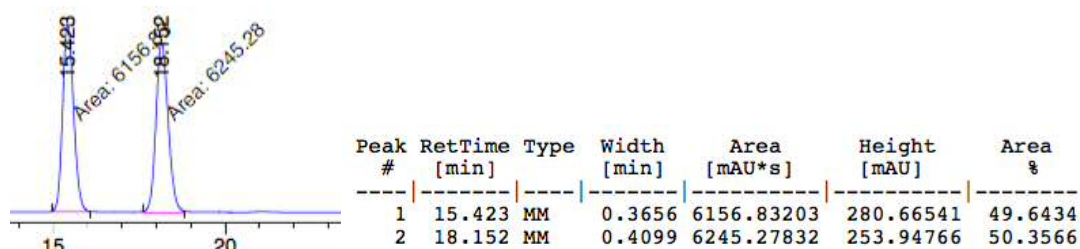


Figure S21. HPLC trace and report of a racemic sample of **2g** [Chiralpak IF3 at rt, (Hexane : iPrOH = 98:2, 1 ml/min)]

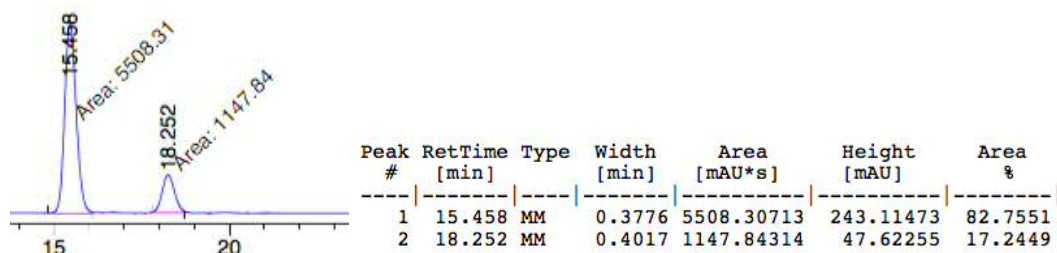
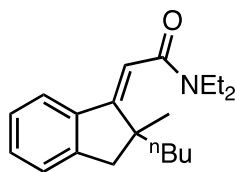


Figure S22. HPLC trace and report of a sample of **2g** obtained from the reaction catalyzed by [Ir(cod)₂]₂BF₄ / **L1** (Chiralpak IF3 at rt, Hexane : iPrOH = 98:2, 1 ml/min). Table 4, entry 9, main manuscript.

(E)-2-(2-Butyl-2-methyl-2,3-dihydro-1*H*-inden-1-ylidene)-*N,N*-diethylacetamide (**2l**)



Using the general procedure, dioxane and DM-SDP (**L1**, 10 %), (E)-2-(2-butyl-2-methyl-2,3-dihydro-1*H*-inden-1-ylidene)-*N,N*-diethylacetamide (**2l**) was obtained after 48 hours in 98 % yield and 82:18 er. Enantioselectivity was determined by chiral HPLC analysis on Chiralpak IF3 at rt, (Hexane : iPrOH = 99:1, 1 ml/min). **Note:** In this reaction, DM-SDP (**L1**) proved to be superior to BTM-Garphos, which provided the product **2l** in 95% yield and 61:39 er (5% catalyst, dioxane, 80 °C for 19 h).

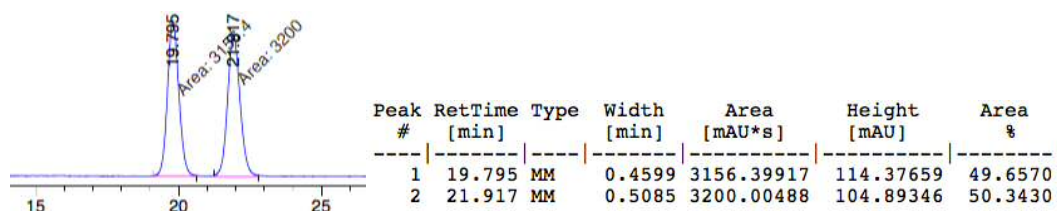


Figure S23. HPLC trace and report of a racemic sample of **2l** [Chiralpak IF3 at rt, (Hexane : iPrOH = 99:1, 1 ml/min)]

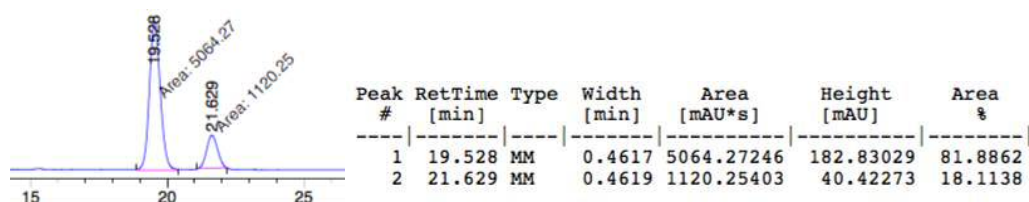


Figure S24. HPLC trace and report of a sample of **2l** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{L1}$ (Chiralpak IF3 at rt, Hexane : iPrOH = 99:1, 1 ml/min). Table 4, entry 10, main manuscript.

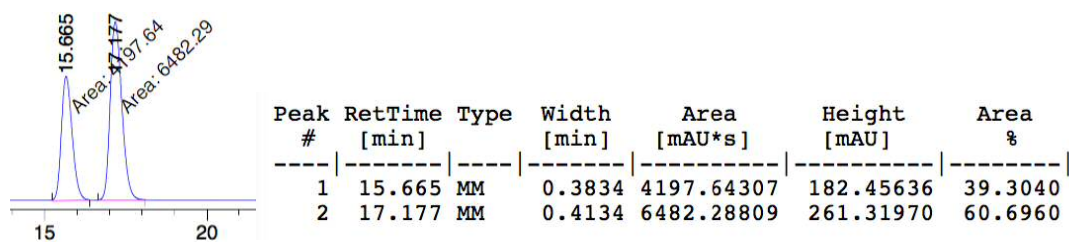
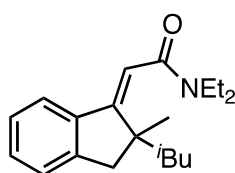


Figure S25. HPLC trace and report of a sample of **2l** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{BTFM-Garphos}$ (Chiralpak IF3 at rt, Hexane : iPrOH = 99:1, 1 ml/min).

(E)-N,N-Diethyl-2-(2-isobutyl-2-methyl-2,3-dihydro-1H-inden-1-ylidene)acetamide (2m)



Using the general procedure, dioxane and DM-SDP (**L1**, 10 %), (*E*)-*N,N*-diethyl-2-(2-isobutyl-2-methyl-2,3-dihydro-1*H*-inden-1-ylidene)acetamide (**2m**) was obtained after 48 hours in 95 % yield and 91:9 er. Enantioselectivity was determined by chiral HPLC analysis on Chiralpak IF3 at rt, (Hexane : iPrOH = 99:1, 1 ml/min). {**Note:** In this reaction, DM-SDP (**L1**) proved to be superior to BTFM-Garphos, which provided the product **2m** in 90% yield and 71:29 er (5% catalyst, dioxane, 80 °C for 19 h)}.

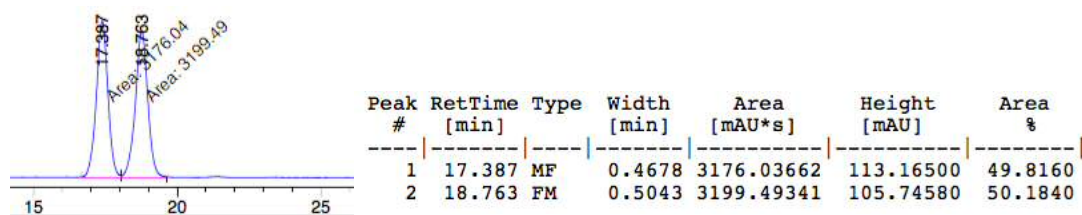


Figure S26. HPLC trace and report of a racemic sample of **2m** [Chiralpak IF3 at rt, (Hexane : iPrOH = 99:1, 1 ml/min)]

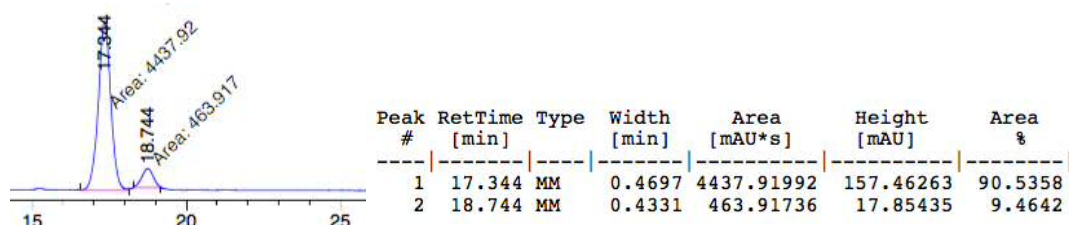


Figure S27. HPLC trace and report of a sample of **2m** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{L1}$ (Chiralpak IF3, rt, Hex.: iPrOH = 99:1, 1 ml/min). Table 4, entry 11, main manuscript.

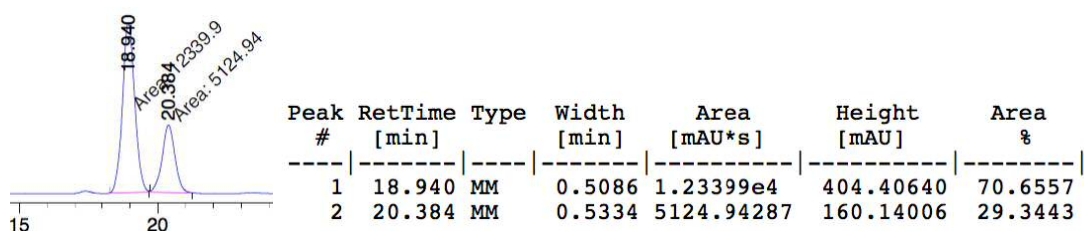
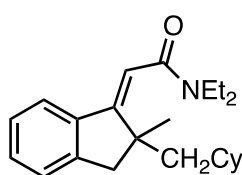


Figure S28. HPLC trace and report of a sample of **2m** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{BTFM-Garphos (L3)}$ (Chiralpak IF3 at rt, Hexane : iPrOH = 99:1, 1 ml/min).

(E)-2-(2-(Cyclohexylmethyl)-2-methyl-2,3-dihydro-1H-inden-1-ylidene)-N,N-diethylacetamide (2n)



Using the general procedure, dioxane and DM-SDP (**L1**, 10 %), (E)-2-(2-(cyclohexylmethyl)-2-methyl-2,3-dihydro-1H-inden-1-ylidene)-N,N-diethylacetamide (**2n**) was obtained after 48 hours in 90 % yield and 86:14 er.

Enantioselectivity was determined by chiral HPLC analysis on Chiralpak IF3 at rt, (Hexane : iPrOH = 99:1, 1 ml/min). {**Note:** In this reaction, DM-SDP (**L1**) proved to be superior to BTFM-Garphos, which provided the product **2n** in 85% yield and a 66:34 er (5 mol% catalyst, Dioxane, 80 °C for 19 h)}.

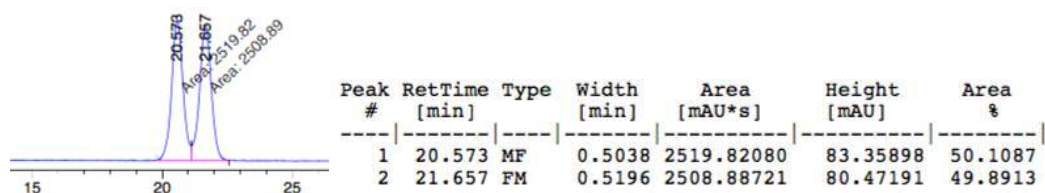


Figure S29. HPLC trace and report of a racemic sample of **2n** [Chiralpak IF3 at rt, (Hexane : iPrOH = 99:1, 1 ml/min)]

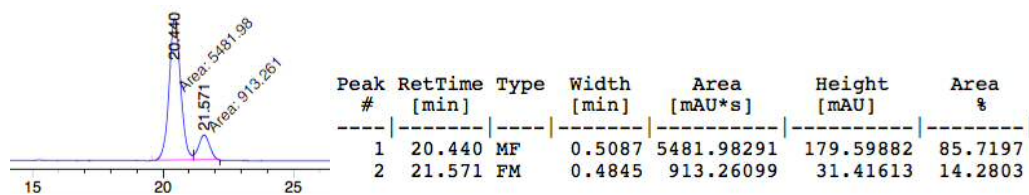


Figure S30. HPLC trace and report of a sample of **2n** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{L1}$ (Chiralpak IF3 at rt, Hexane : iPrOH = 99:1, 1 ml/min). Table 4, entry 12, main manuscript.

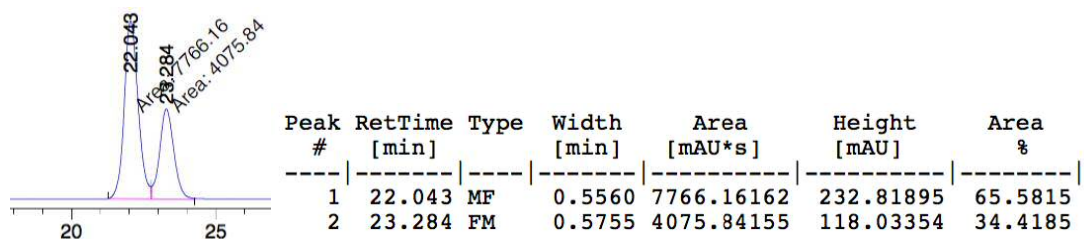
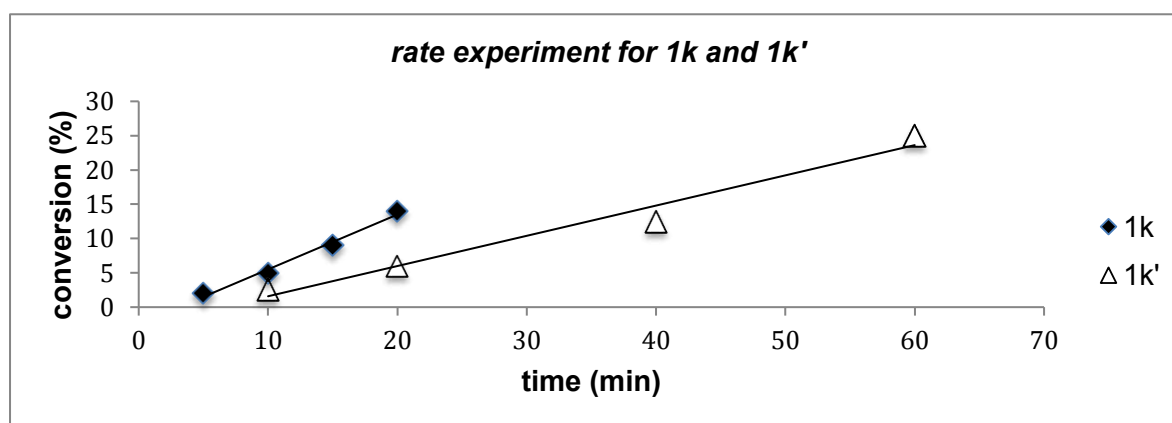
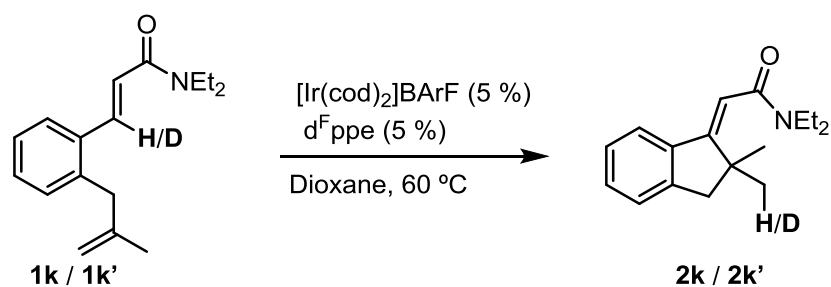


Figure S31. HPLC trace and report of a sample of **2n** obtained from the reaction catalyzed by $[\text{Ir}(\text{cod})_2]\text{BF}_4 / \text{BTFM-Garphos (L3)}$.

Determination of the Kinetic Isotope effect



In two different Schlenk flasks equipped with their respective stirring bars, $\text{Ir}(\text{cod})_2\text{BARf}$ (24.7 mg, 0.019 mmol), $\text{dpp}^{\text{F}}\text{e}$ (14.7 mg, 0.019 mmol) and **1k** (100 mg, 0.389 mmol, Schlenk 1) or **1k'** (101 mg, 0.389 mmol, Schlenk 2), were successively added under Argon. Dioxane (1.6 mL, each one) was then added and the flasks were sealed with rubber septa and placed in a pre-heated (70 °C) oil bath. Aliquots (300 μL) were taken at the times indicated in the Table S3 (for **1k**) and Table S4 (for **1k'**). The aliquots were filtered through a florisil pad and the volatiles were removed so that the crude residues were taken and analyzed by ^1H NMR.

Table S3. Conversions observed from the reaction of **1k** (determined by ^1H -NMR analysis).

t (min)	2k (%)
5	2
10	5
15	9
20	14

$y = 0,8x - 2,5$
 $R^2 = 0,98765$

Table S4. Conversions observed from the reaction of **1k'** (determined by ¹H-NMR analysis)..

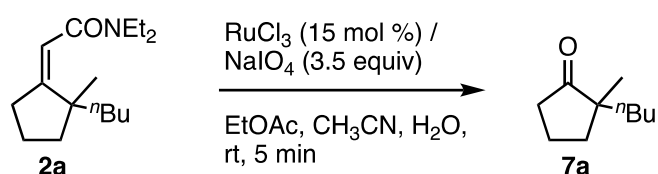
t (min)	2k' (%)
10	2.5
20	6
40	12.5
60	25

$y' = 0,4407x' - 2,822$
 $R^2 = 0,97263$

$$\text{KIE} = (0.8)(0.4407) = 1.8$$

Transformation of the products into the corresponding ketone derivatives.

Synthesis of ketones **7a**, **7g**, **7m** and **7q** (exemplified for **7a**).



2-Butyl-2-methylcyclopentan-1-one (**7a**)

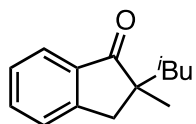
A solution of NaIO₄ (89.3 mg, 0.42 mmol) in water (0.7 mL, 0.17 M) was added to a solution of RuCl₃ (3.7 mg, 0.018 mmol) in MeCN (0.9 mL, 0.13 M). This mixture was stirred 2 minutes and then a solution of the **2a** (30 mg, 0.12 mmol) in EtOAc (0.9 mL, 0.13 M) was added. The mixture was stirred for 5-10 minutes until TLC indicates complete consumption of the starting material. MgSO₄ was added and the resulting heterogeneous mixture was washed with EtOAc. The combined organic phases were carefully evaporated and the crude residue was purified by column chromatography (1:10 Et₂O : Pentane) to yield **7a** as a colorless oil (17 mg, 93% yield). ¹H NMR (500 MHz, CDCl₃): δ 2.32 – 2.13 (m, 2H), 1.93 – 1.82 (m, 3H), 1.73 – 1.63 (m, 1H), 1.42 – 1.23 (m, 5H), 1.17 – 1.07 (m, 1H), 0.98 (s, 3H), 0.88 (t, *J* = 7.0 Hz, 3H). ¹³C NMR (126 MHz, CDCl₃): δ 223.95 (C), 48.43 (C), 37.85 (CH₂), 36.57 (CH₂), 35.81 (CH₂), 26.63 (CH₂), 23.43 (CH₂), 21.99 (CH₃), 18.85 (CH₂), 14.12 (CH₃). HRMS (APCI-FIA-TOF): *m/z* calculated for C₁₀H₁₉O ([M+H]⁺) 155.1431, found 155.1430.

2-Benzyl-2-methylcyclopentan-1-one (**7g**)

Colorless oil, 85% yield. ¹H NMR (500 MHz, CDCl₃): δ 7.21 – 7.17 (m, 2H), 7.16 – 7.11 (m, 1H), 7.05 – 7.02 (m, 2H), 2.79 (d, *J* = 13.3 Hz, 1H), 2.52 (d, *J* = 13.3 Hz, 1H), 2.22 (ddd, *J* = 18.9, 8.4, 5.3 Hz, 1H), 1.98 (dt, *J* = 19.0, 8.6 Hz, 1H), 1.89 (dt, *J* = 13.0, 7.6 Hz, 1H), 1.76 – 1.62 (m, 2H), 1.59 – 1.53 (m, 1H), 0.95 (s, 3H). ¹³C NMR (126 MHz, CDCl₃): δ 223.39 (C), 138.12 (C), 130.38 (CH), 128.26 (CH), 126.50 (CH), 49.89 (C), 42.81 (CH₂), 38.13

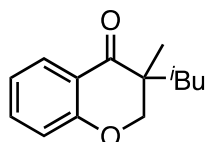
(CH₂), 34.79 (CH₂), 22.84 (CH₃), 18.75 (CH₂). **HRMS** (ESI-TOF): *m/z* calculated for C₁₃H₁₆NaO ([M+Na]⁺) 211.1091, found 211.1093.

2-Isobutyl-2-methyl-2,3-dihydro-1*H*-inden-1-one (7m)



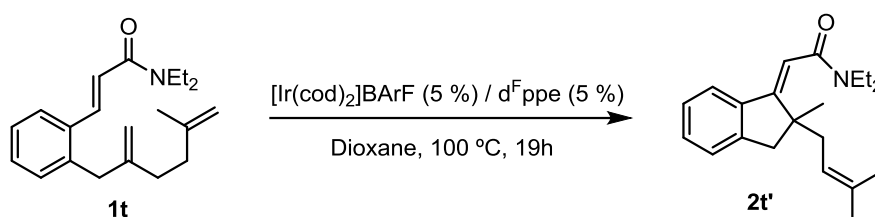
Colorless oil, 66% yield. **¹H NMR** (400 MHz, CDCl₃): δ 7.76 (d, *J* = 7.6 Hz, 1H), 7.58 (td, *J* = 7.5, 1.2 Hz, 1H), 7.43 (dt, *J* = 7.7, 1.0 Hz, 1H), 7.39 – 7.34 (m, 1H), 3.21 (d, *J* = 17.2 Hz, 1H), 2.88 (d, *J* = 17.2 Hz, 1H), 1.69 – 1.61 (m, 2H), 1.59 – 1.50 (m, 1H), 1.19 (s, 3H), 0.90 (d, *J* = 6.4 Hz, 3H), 0.78 (d, *J* = 6.5 Hz, 3H). **¹³C NMR** (101 MHz, CDCl₃): δ 211.70 (C), 152.82 (C), 136.06 (C), 134.85 (CH), 127.50 (CH), 126.70 (CH), 124.46 (CH), 49.25 (C), 46.57 (CH₂), 40.61 (CH₂), 25.48 (C), 25.33 (CH₃), 24.94 (CH₃), 23.75 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₄H₁₉O ([M+H]⁺) 203.1430, found 203.1430.

3-Isobutyl-3-methylchroman-4-one (7q)

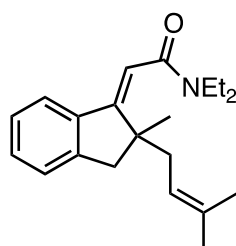


Colorless oil, 87% yield. **¹H NMR** (400 MHz, CDCl₃): δ 7.89 (dd, *J* = 7.9, 1.8 Hz, 1H), 7.46 (ddd, *J* = 8.4, 7.2, 1.8 Hz, 1H), 7.02 (ddd, *J* = 8.1, 7.1, 1.1 Hz, 1H), 6.95 (dd, *J* = 8.4, 1.1 Hz, 1H), 4.27 (d, *J* = 11.5 Hz, 1H), 4.13 (d, *J* = 11.5 Hz, 1H), 1.77 – 1.67 (m, 1H), 1.61 (dd, *J* = 6.0, 2.1 Hz, 2H), 1.18 (s, 3H), 0.93 (d, *J* = 6.6 Hz, 3H), 0.83 (d, *J* = 6.5 Hz, 3H). **¹³C NMR** (101 MHz, CDCl₃): 197.41 (C), 161.12 (C), 135.56 (CH), 127.92 (CH), 121.56 (CH), 120.15 (C), 117.66 (CH), 75.62 (CH₂), 45.19 (CH), 42.86 (CH₂), 24.82 (CH₃), 24.69 (CH₃), 24.34 (CH), 18.70 (CH₃). **HRMS** (ESI-TOF): *m/z* calculated for C₁₄H₁₉O₂ ([M+H]⁺) 219.1378, found 219.1380.

Cycloisomerization of **1t** to afford the isomerized indene product **2t'**



Carried out following the general procedure, in Dioxane at reflux for 19 h. The product (**2t'**) was isolated by flash chromatography (5 to 10 % EtOAc/Hexanes) as a pale yellow oil (99 % yield). (*E*)-*N,N*-Diethyl-2-(2-methyl-2-(3-methylbut-2-en-1-yl)-2,3-dihydro-1*H*-inden-1-ylidene) acetamide (**2t'**)



¹H NMR (300 MHz, CDCl₃): δ 7.46 (dd, *J* = 8.1, 1.6 Hz, 1H), 7.29 – 7.17 (m, 3H), 6.44 (s, 1H), 5.09 – 5.02 (m, 1H), 3.51 – 3.32 (m, 4H), 3.04 (d, *J* = 16.4 Hz, 1H), 2.65 (d, *J* = 16.4 Hz, 1H), 2.61 – 2.43 (m, 2H), 1.63 (s, 3H), 1.59 (s, 3H), 1.40 (s, 3H),

1.21 – 1.13 (m, 6H). ¹³C NMR (75 MHz, CDCl₃): δ 167.61 (C), 157.90 (C), 145.09 (C), 140.87 (C), 133.33 (C), 129.41 (CH), 126.60 (CH), 125.43 (CH), 121.54 (CH), 120.98 (CH), 112.22 (CH), 48.21 (C), 45.15 (CH₂), 42.83 (CH₂), 39.46 (CH₂), 36.95 (CH₂), 26.02 (CH₃), 18.24 (CH₃), 14.09 (CH₃), 12.92 (CH₃). HRMS (ESI-TOF): *m/z* calculated for C₂₁H₃₀NO ([*M*+*H*]⁺) 312.2322, found 312.2322.

Assignment of structure of **2t'** was based on the HMBC, HSQC, COSY and nOe experiments.

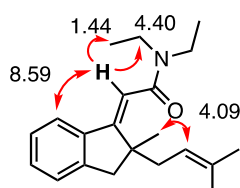
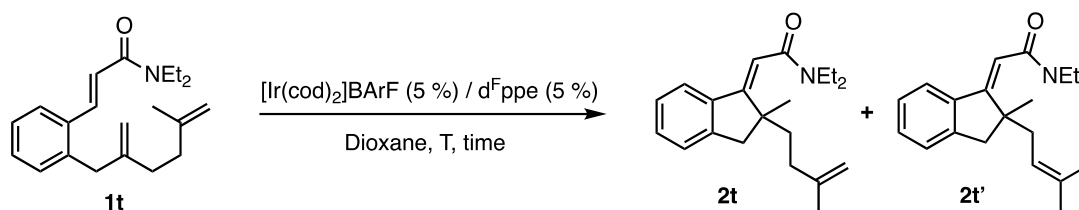


Figure S1. Significant nOe signals observed for **2t'**

The following control experiments, carrying out the cyclization of **1t** at lower temperatures indicate that the observed isomerization of the pendant double bond occurs in the reaction media, after the initial formation of the expected, non-isomerized, product **2t**.

Table S3. Control experiments related to the cycloisomerization of **1t** (ref. 21, main manuscript)

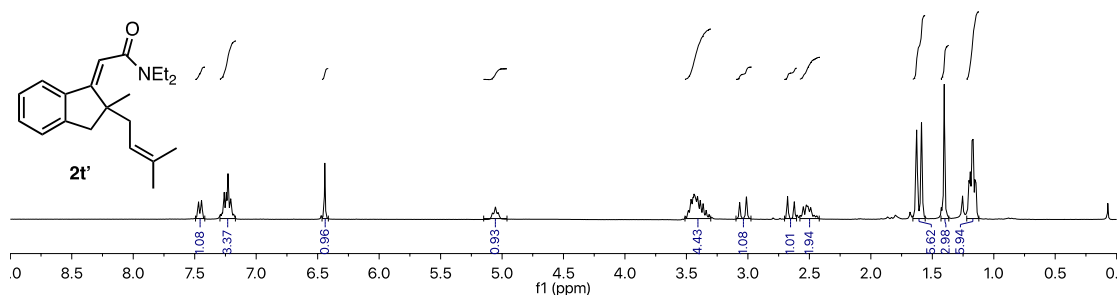


entry	Temperature	time (h)	Conversion	2t (%)	2t' (%)
1	60 °C	1	55%	55	-
2	100 °C	1	70%	20	50
3	100 °C	18	100%	-	99

Mechanistic probe: NMR spectra of D-2t', resulting from the cycloaddition of D-1t (related to Scheme 3, eq. 2, main manuscript)

As can be seen in the following Figures, deuteration of D-2t' is only observed at the methyl group of the quaternary stereocenter (signal at 1.40 ppm). While in 2t' the signal for this methyl group integrates for 3H, that of D-2t' corresponds to 2H. Accordingly, ²H-NMR spectra of D-2t' shows that deuterium is only located at this particular methyl group (1.40 ppm).

¹H-NMR



²H-NMR

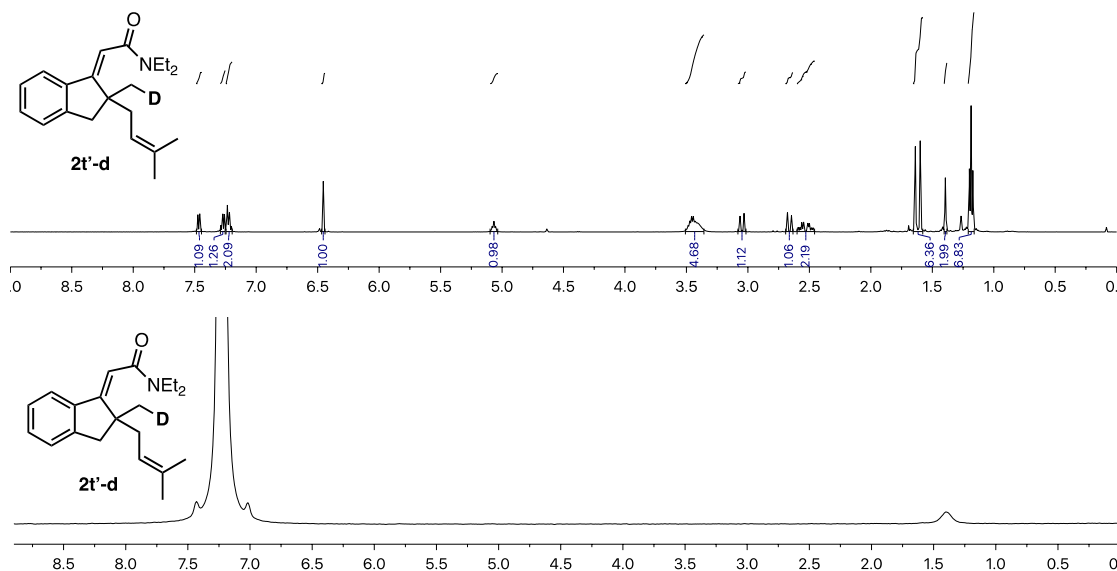


Figure S14. ¹H-NMR and ²H-NMR of 2t' and D-2t'.

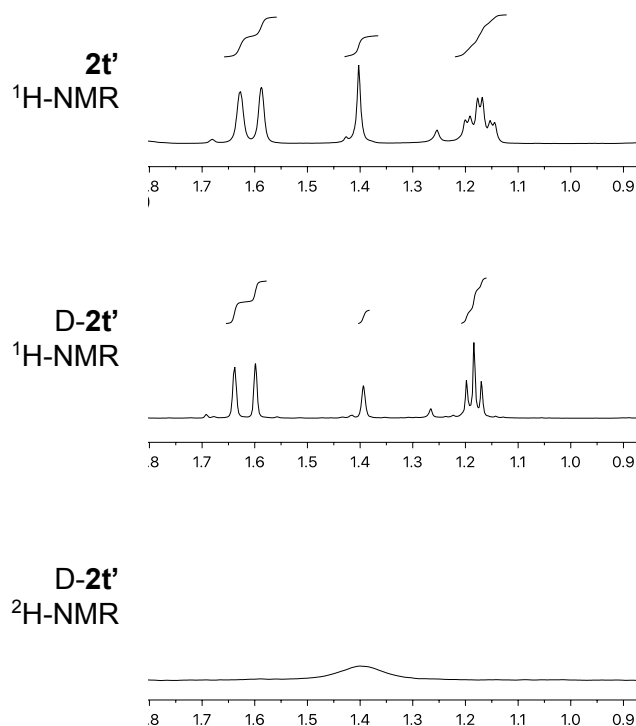
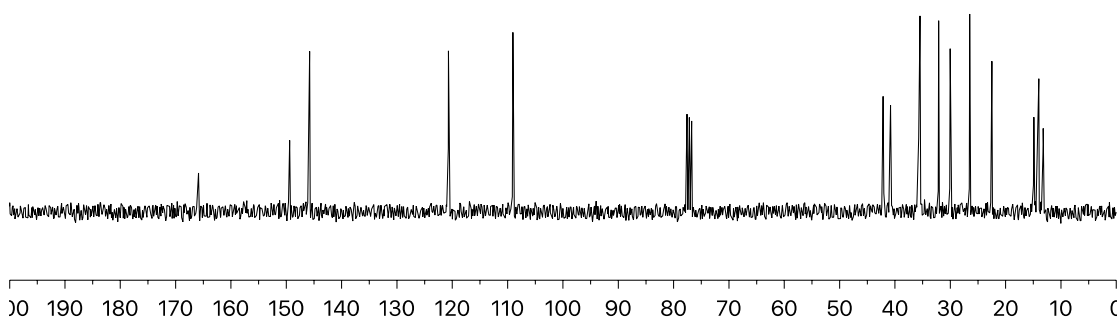
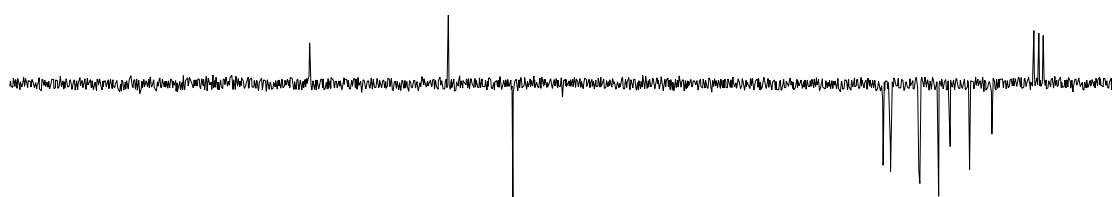
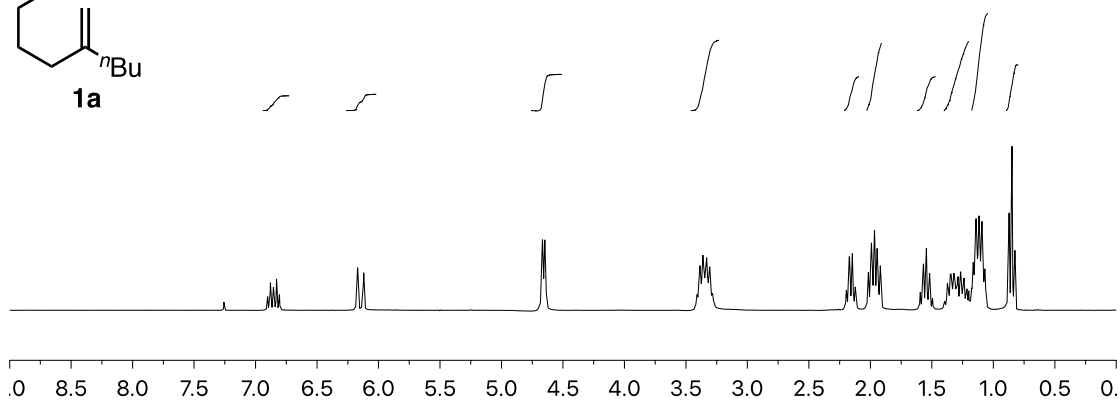
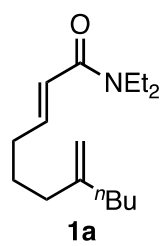
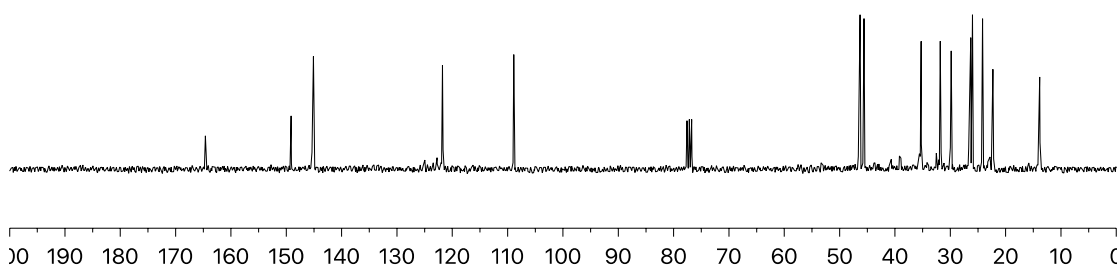
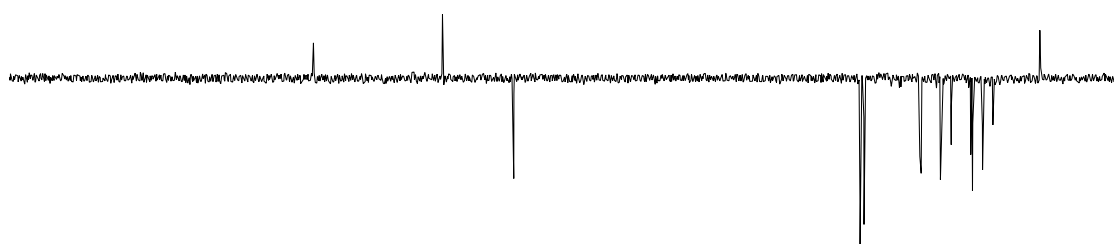
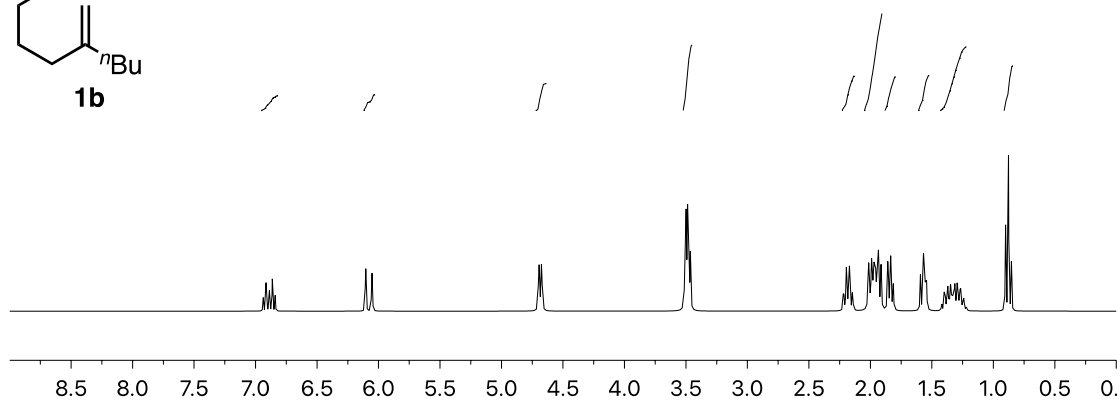
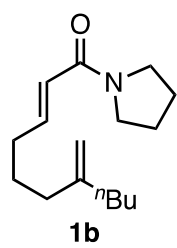


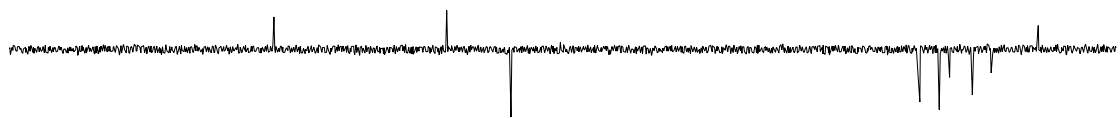
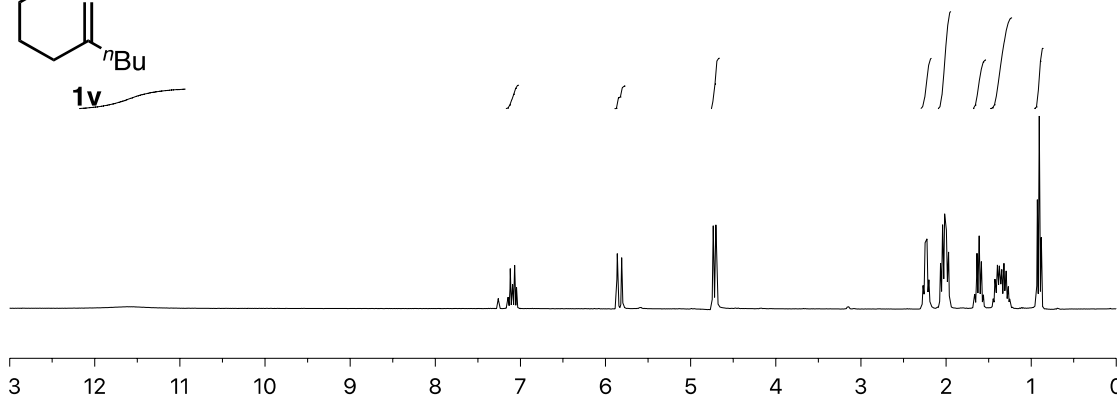
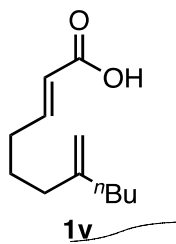
Figure S15. Amplified NMR window between 1.8 and 0.9 ppm (**2t'** and **D-2t'**)

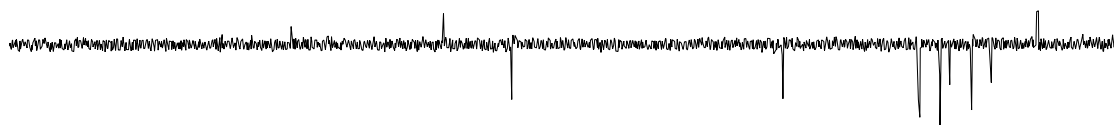
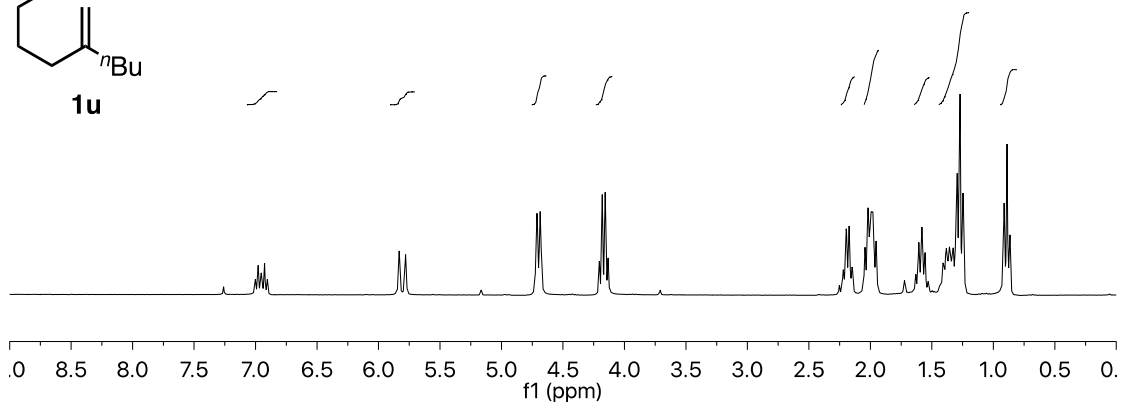
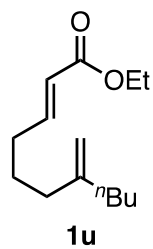
References

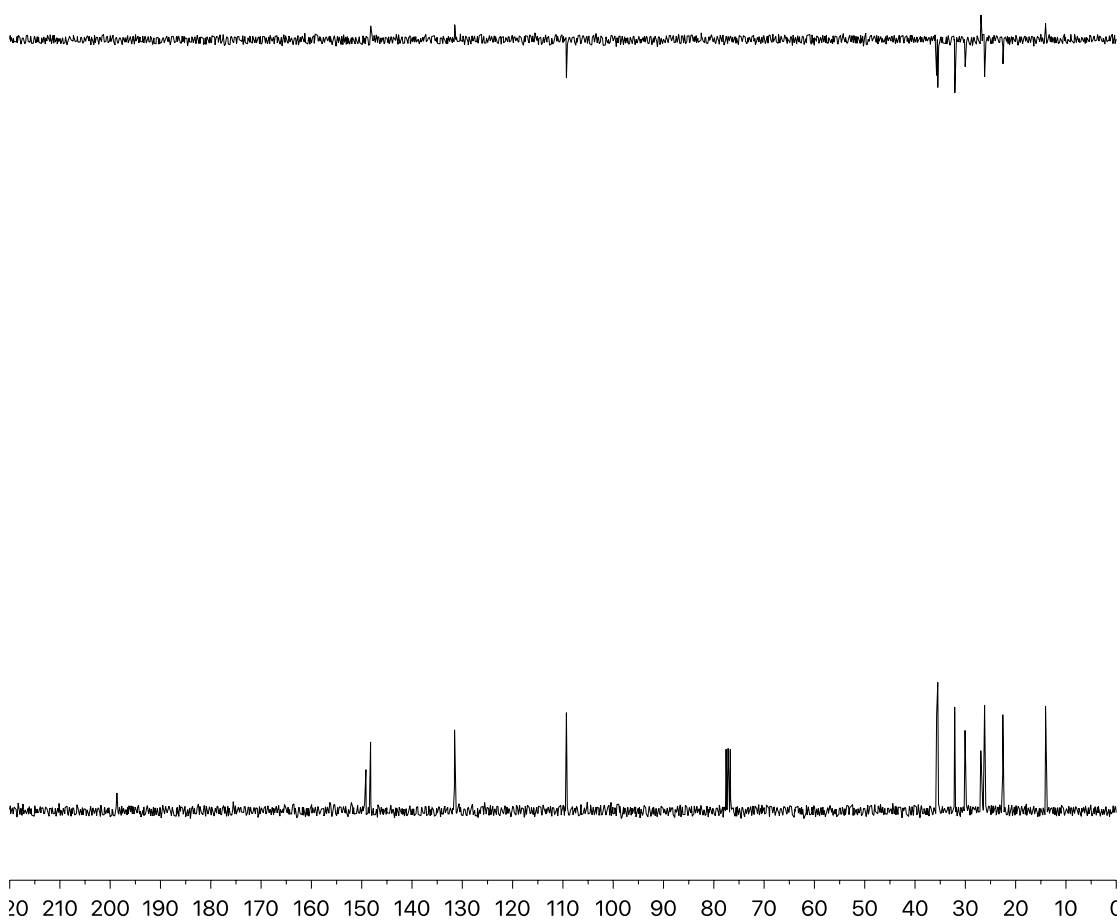
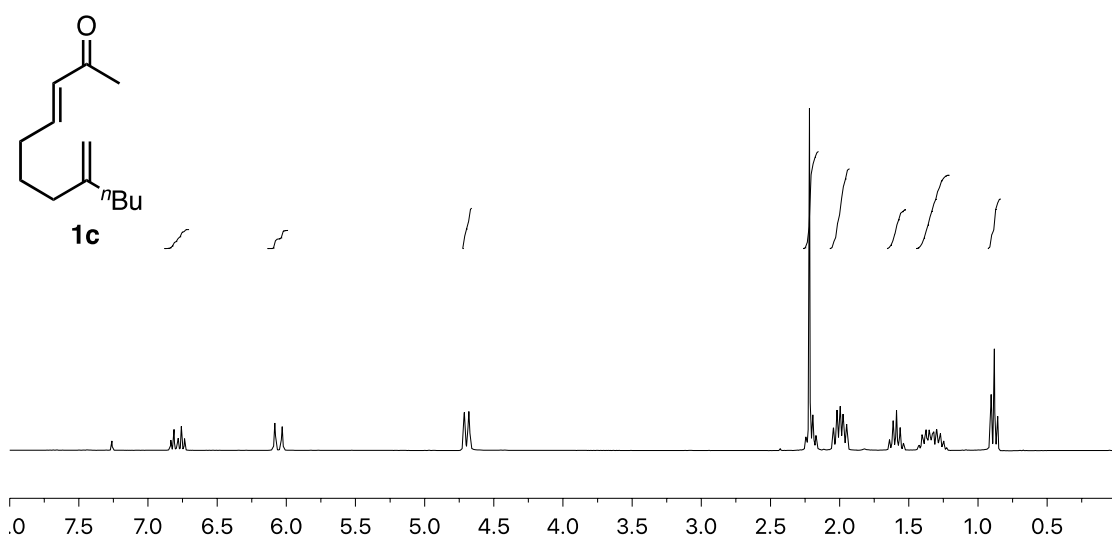
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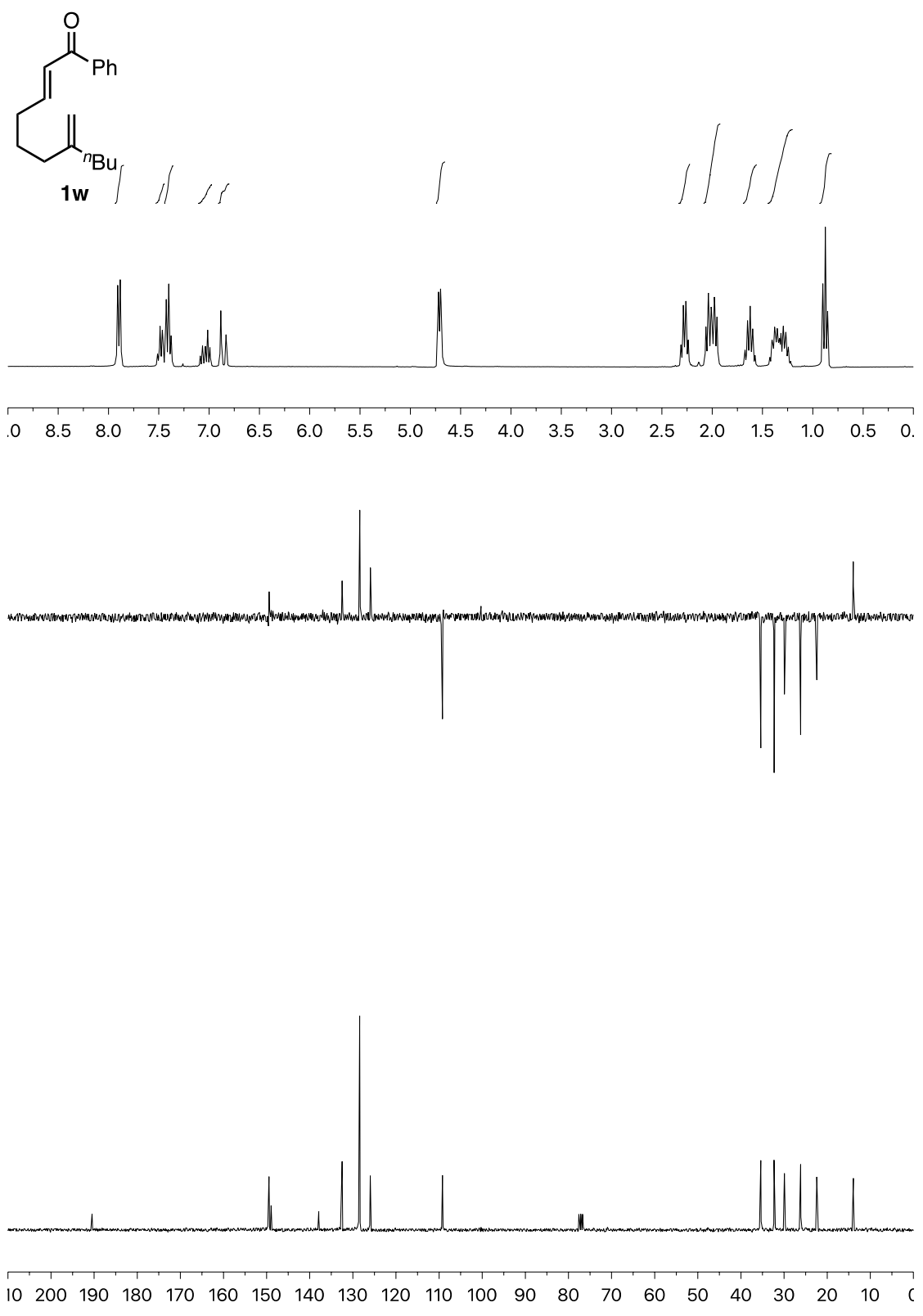


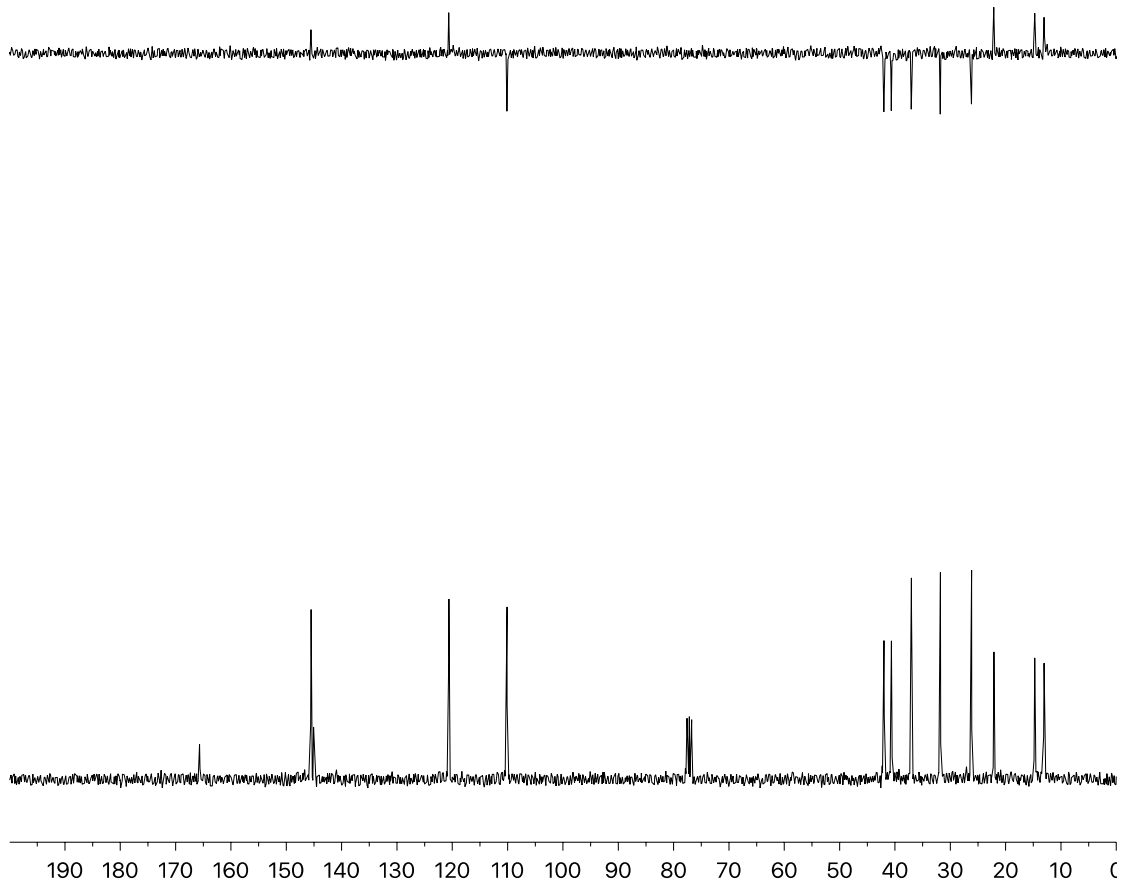
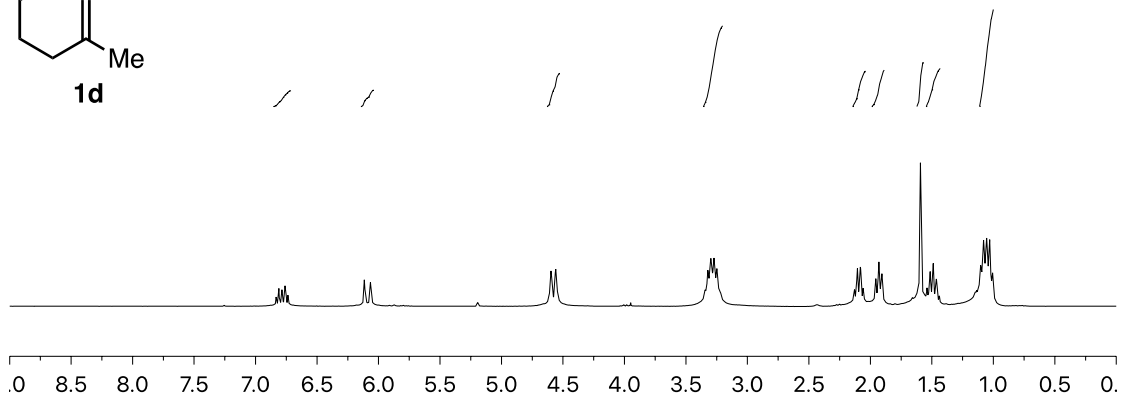
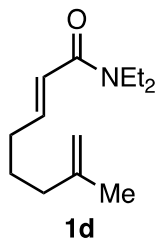


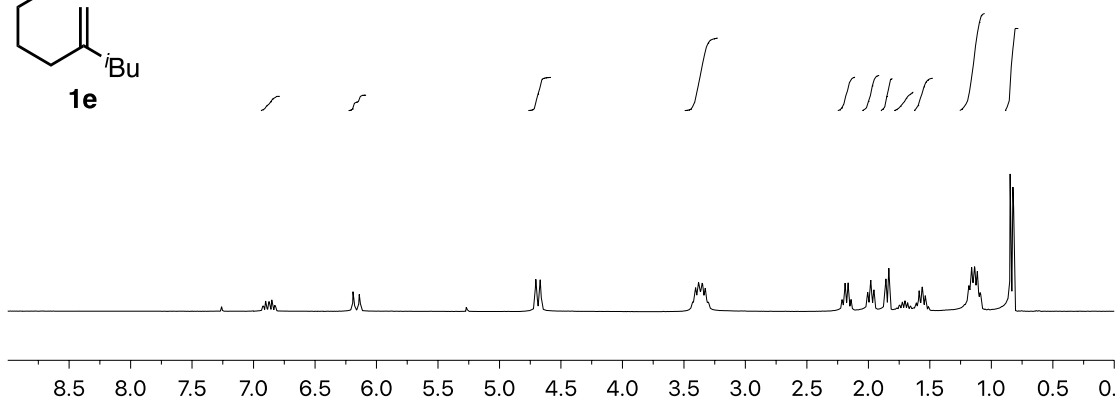
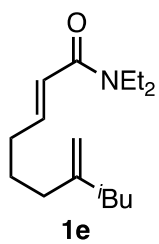


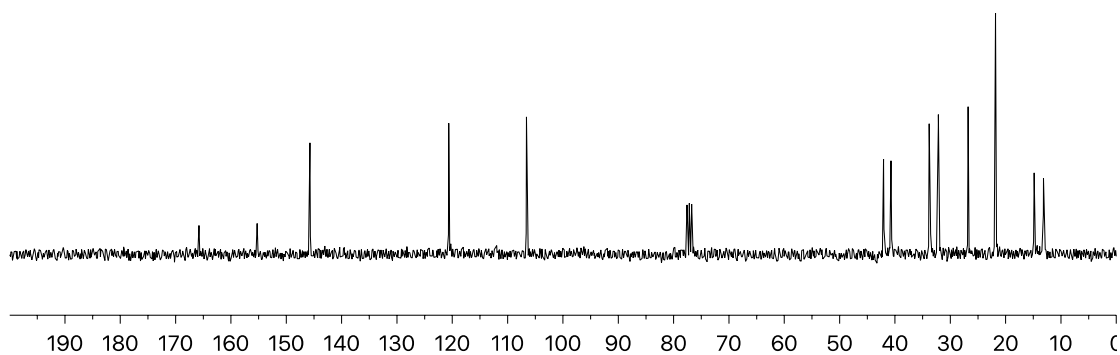
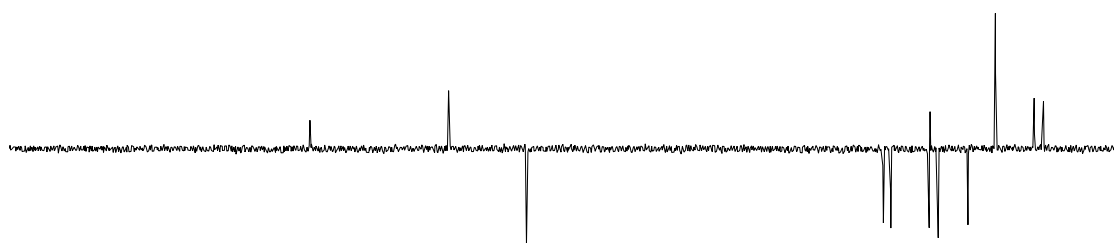
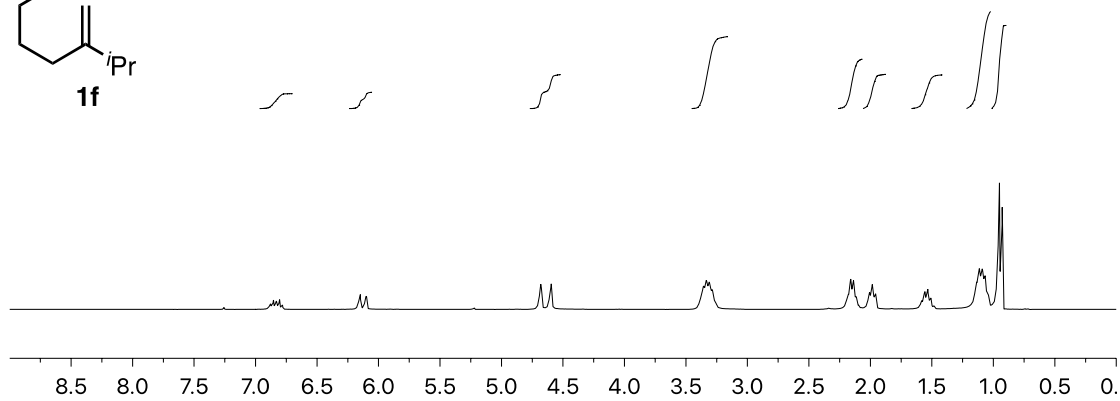
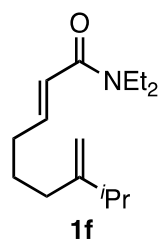


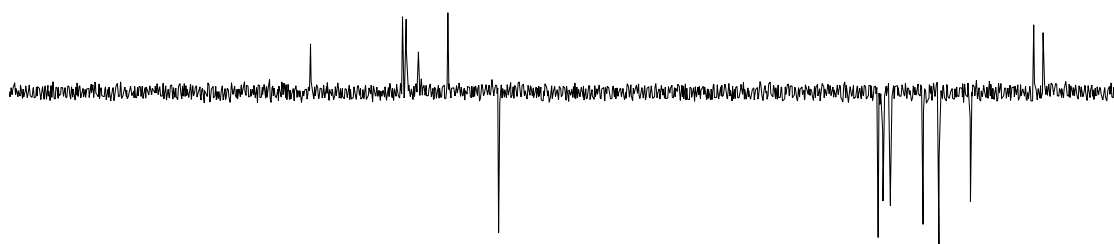
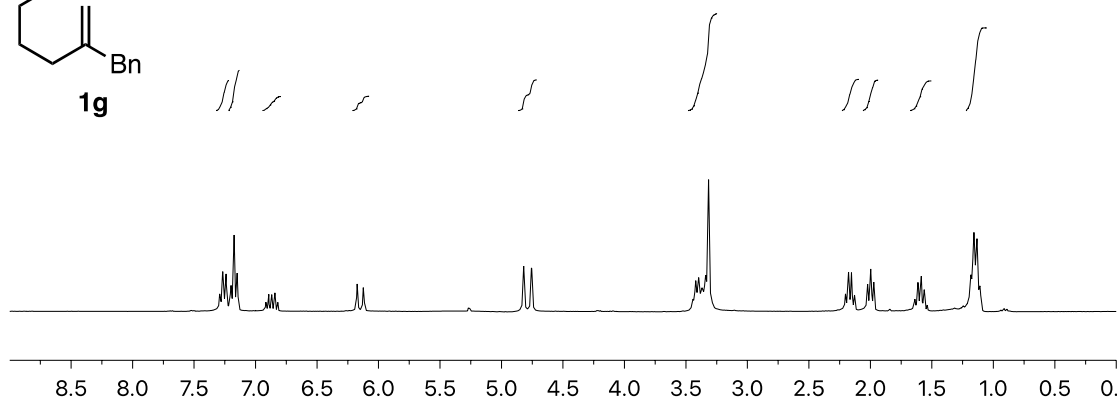
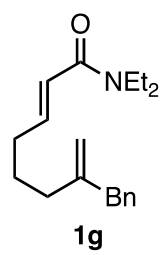


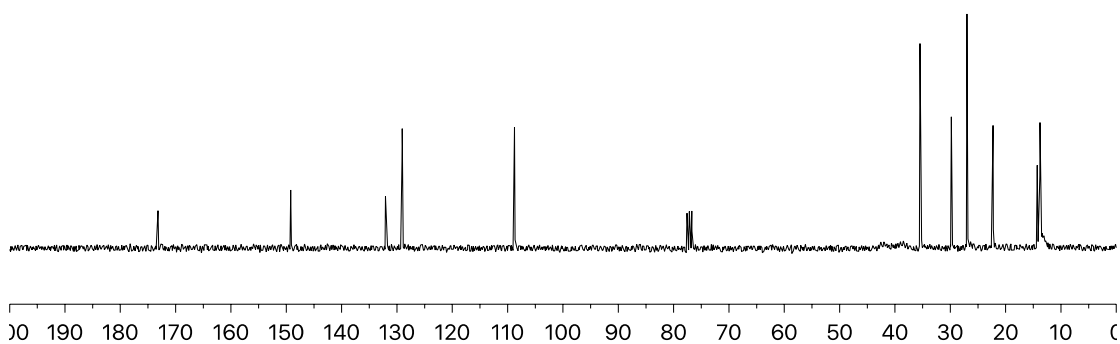
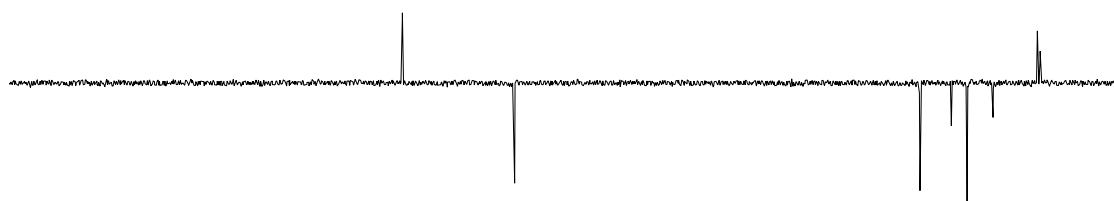
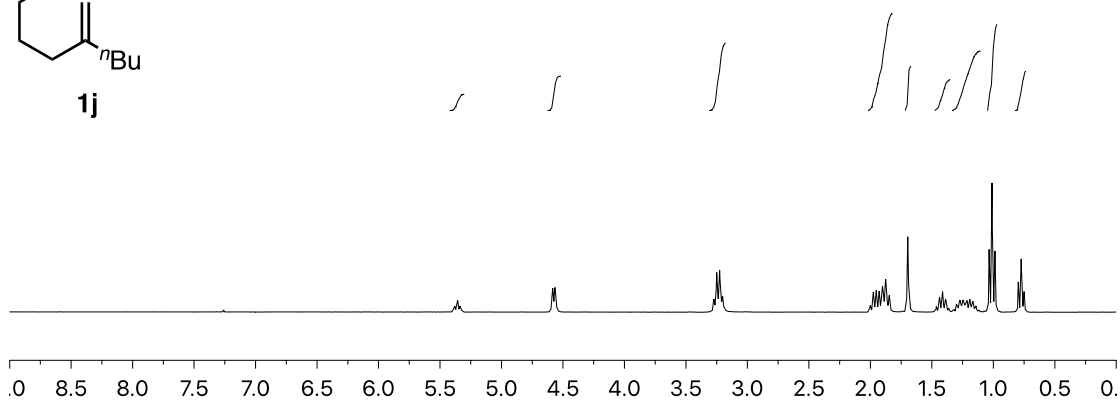
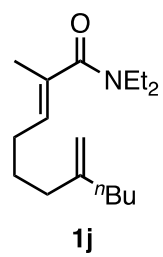


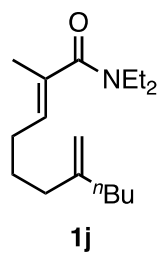




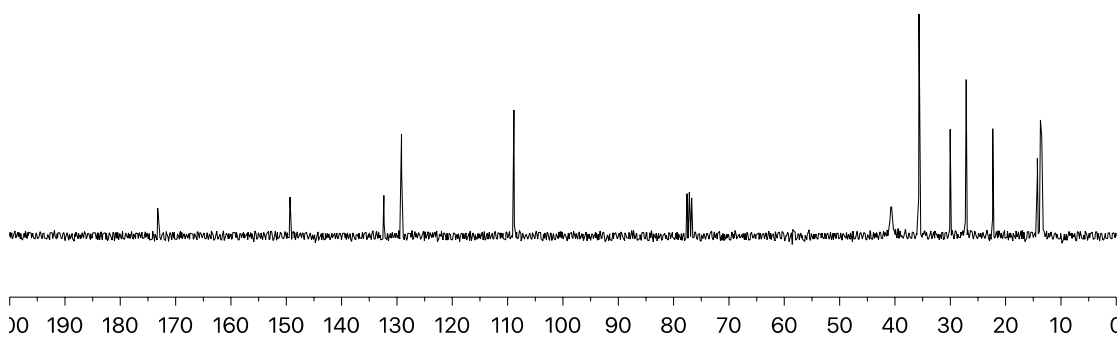
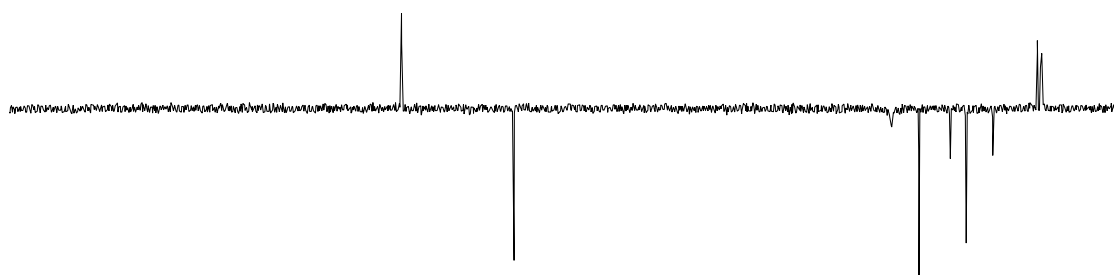
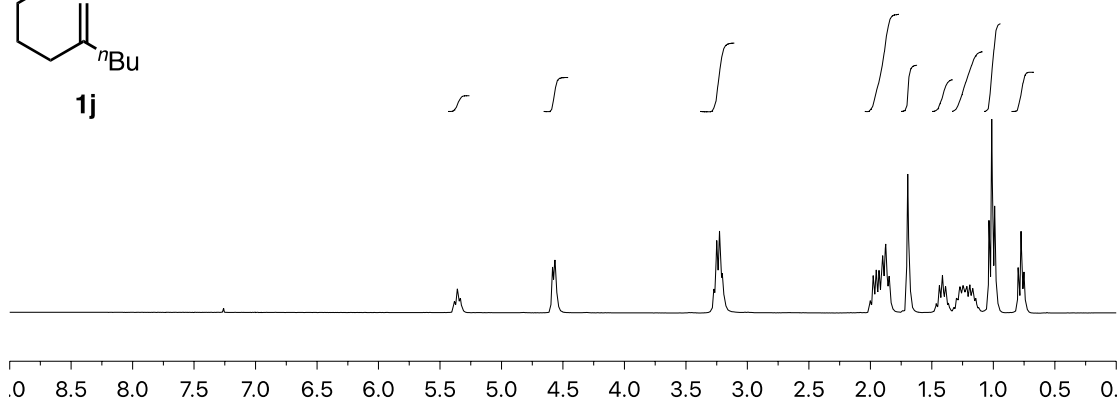


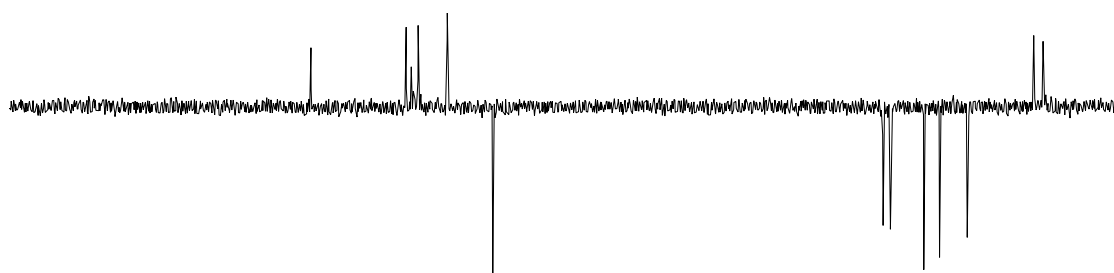
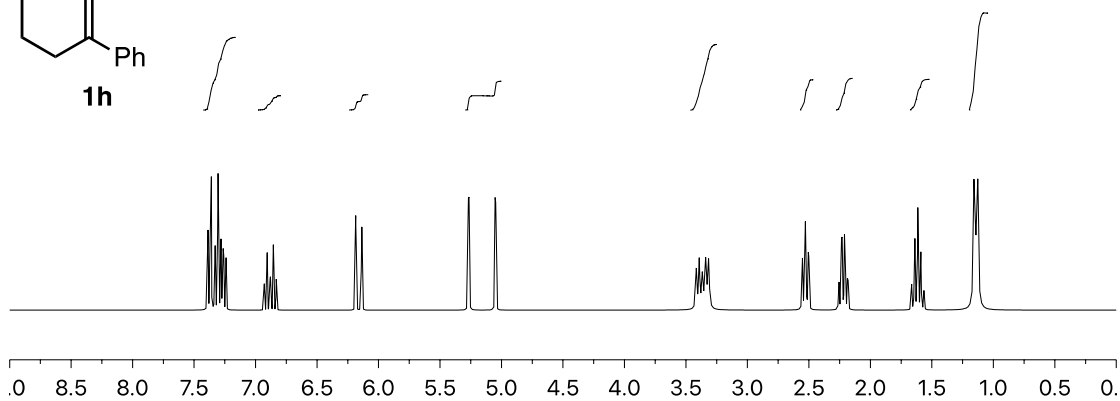
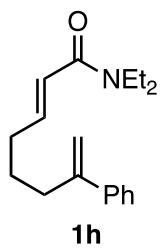


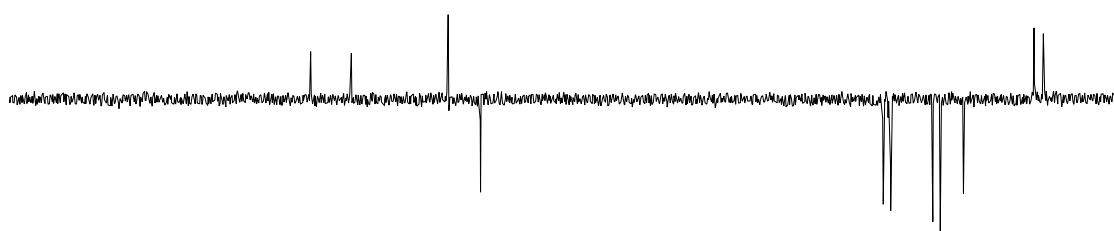
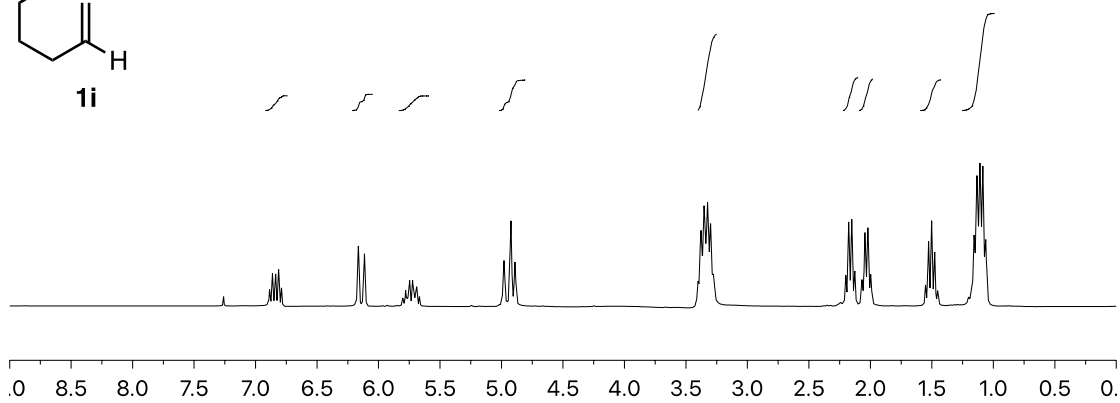
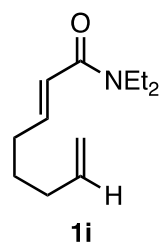


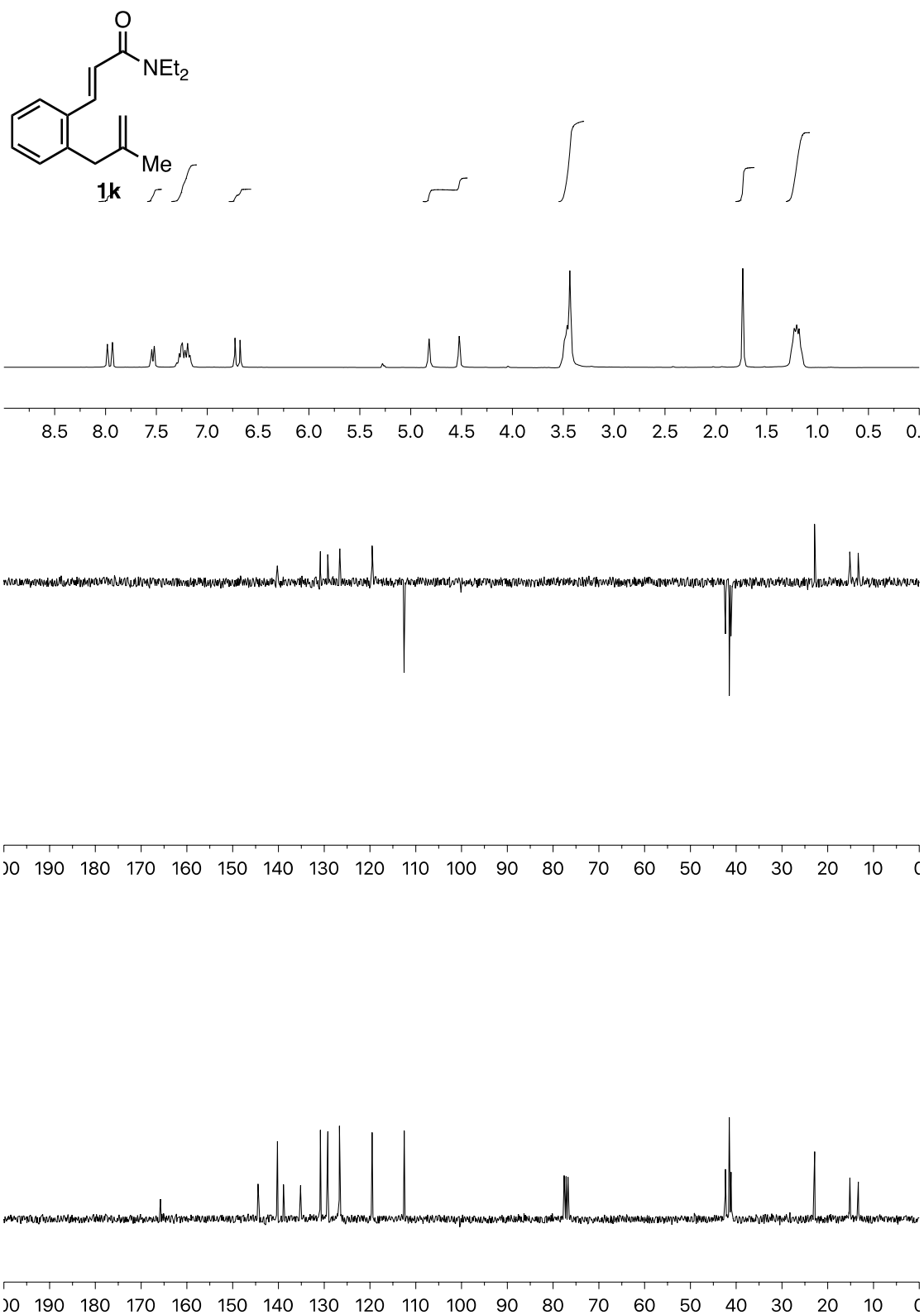


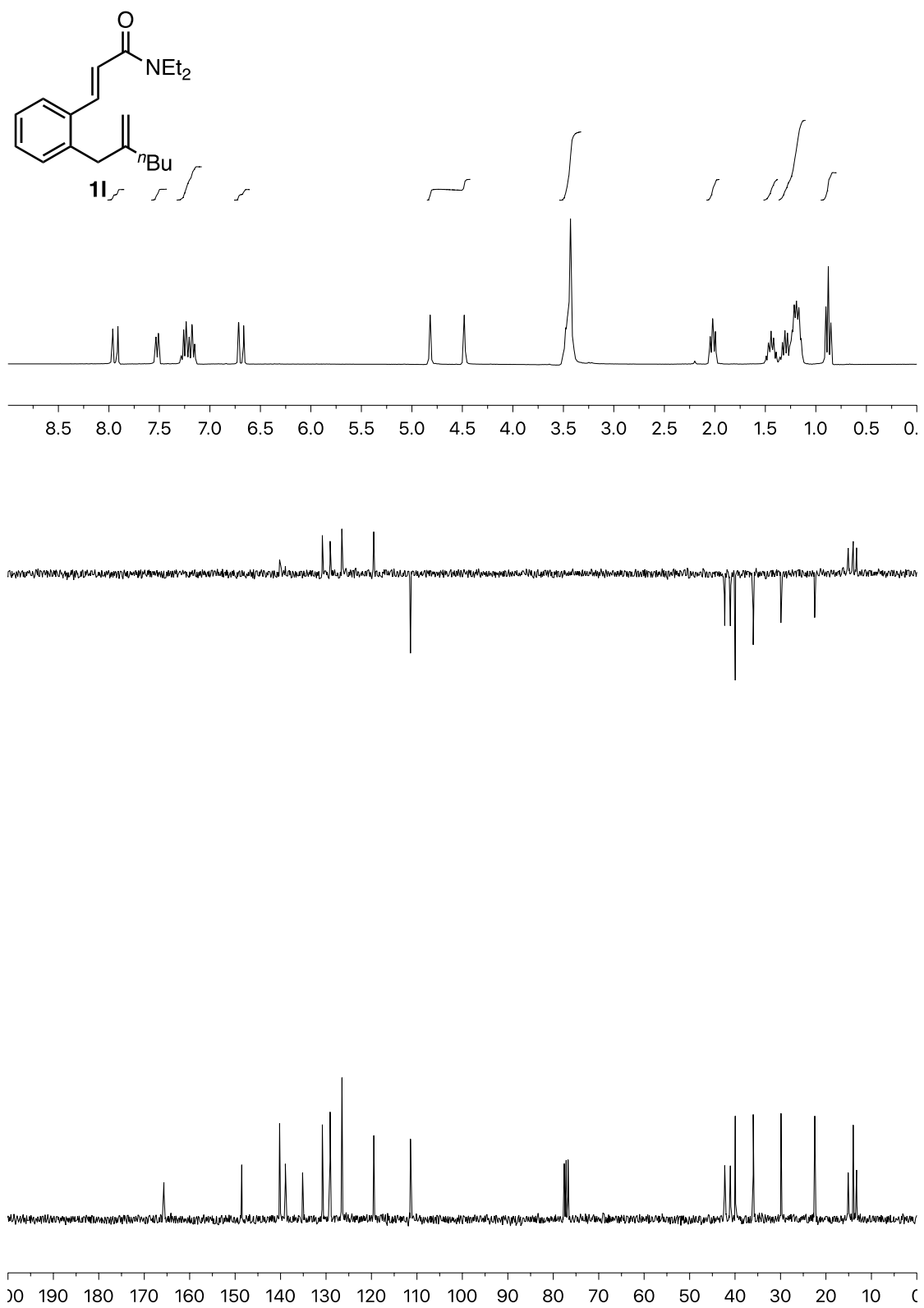
NMR at 60 °C

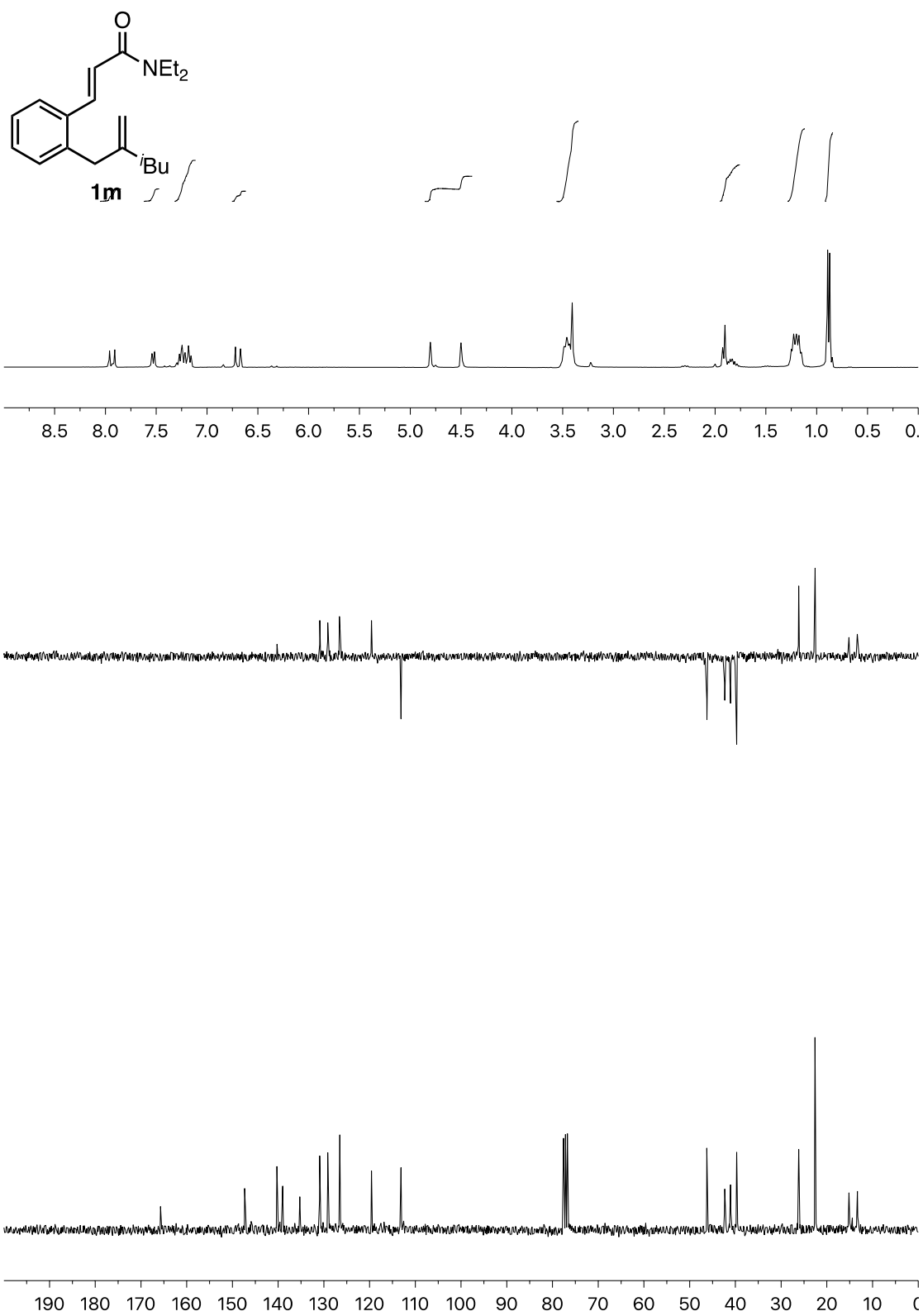


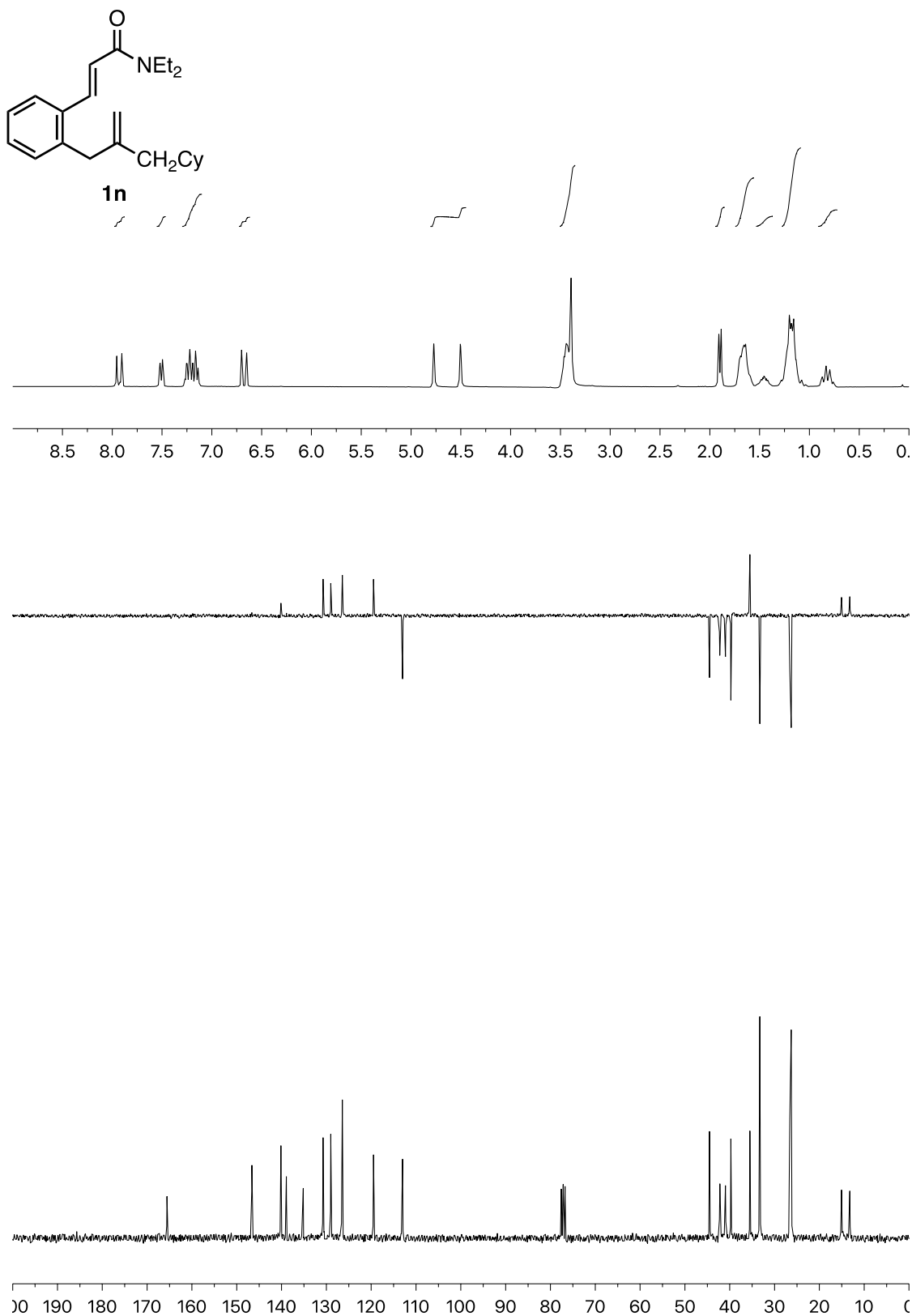


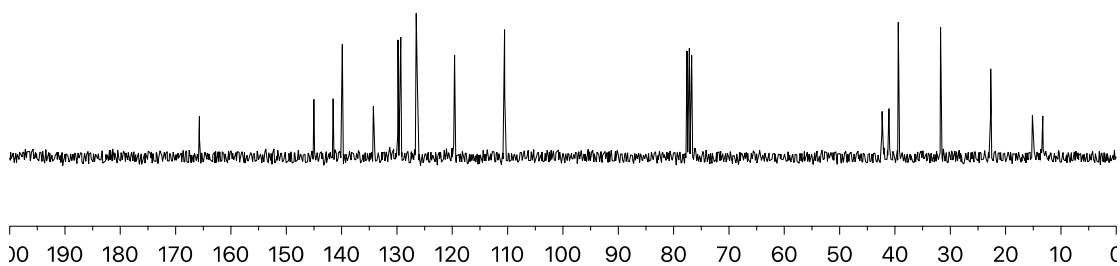
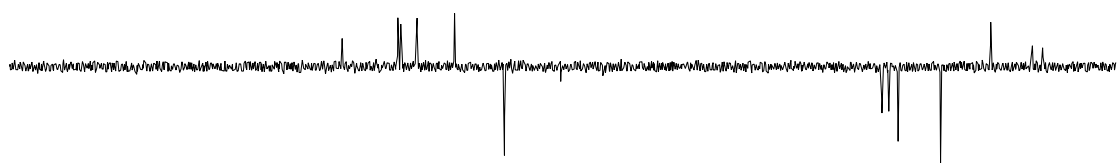
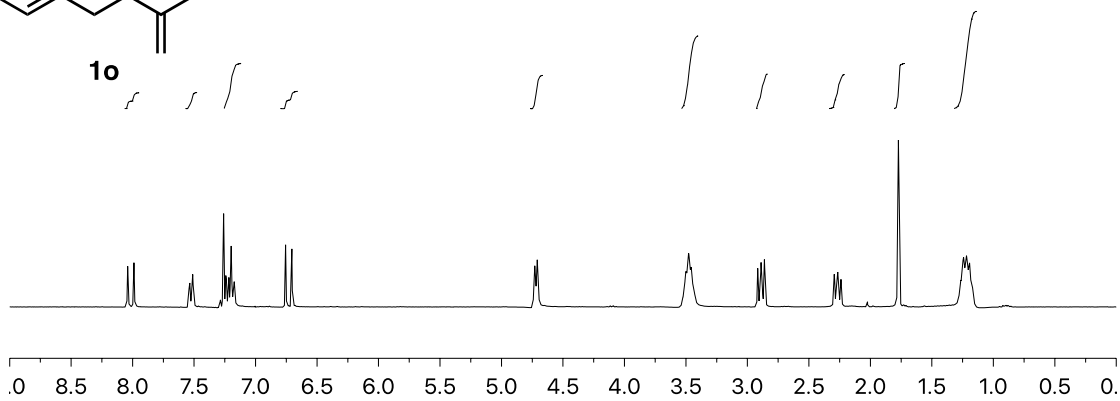
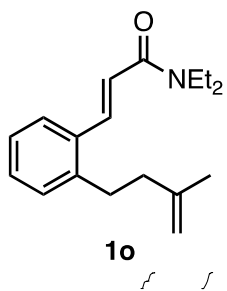


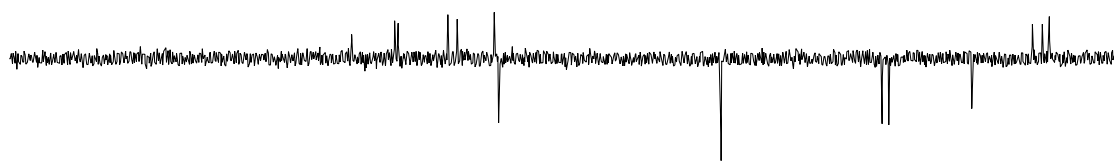
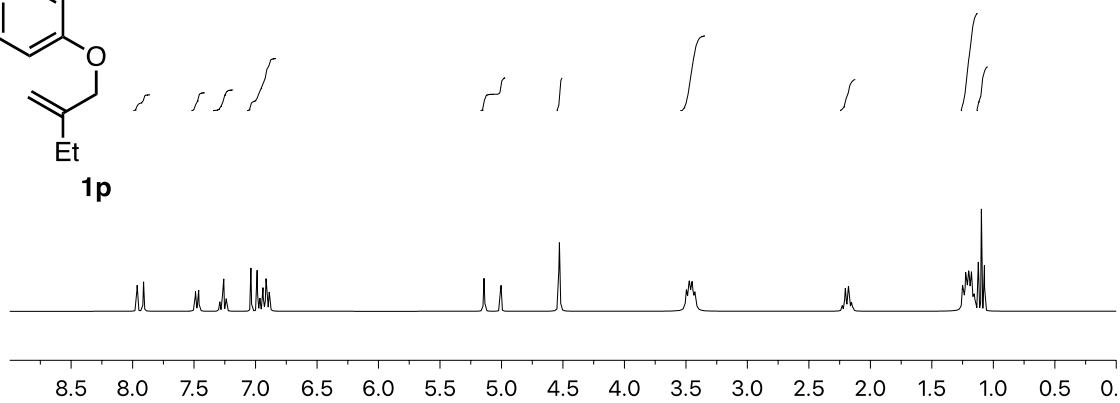
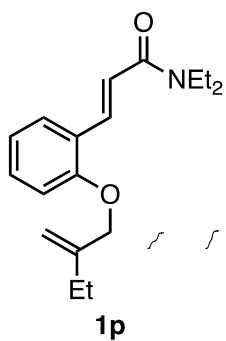


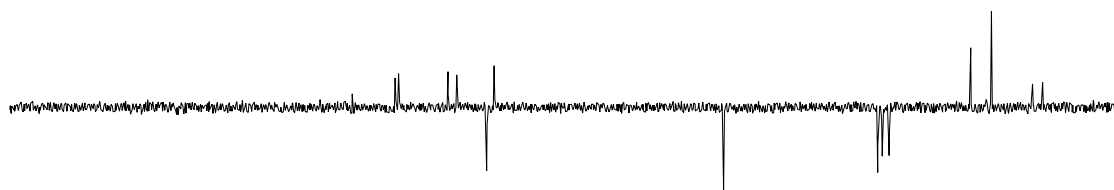
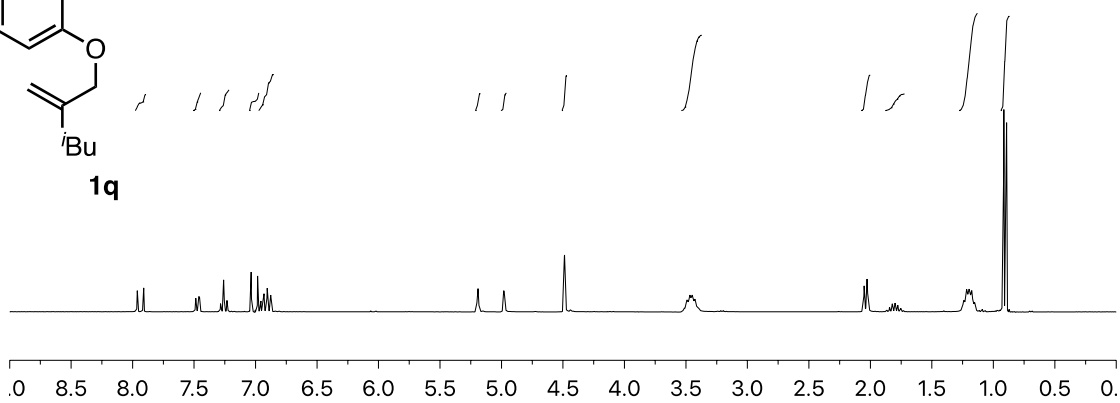
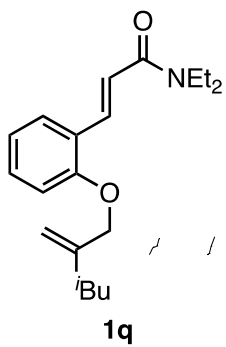


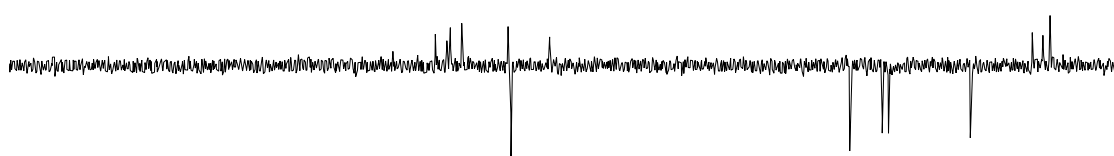
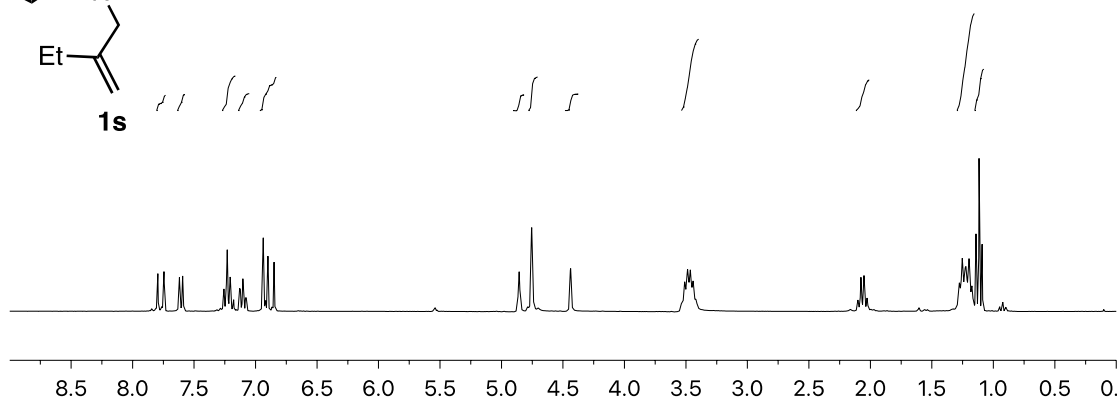
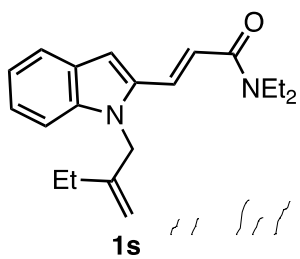


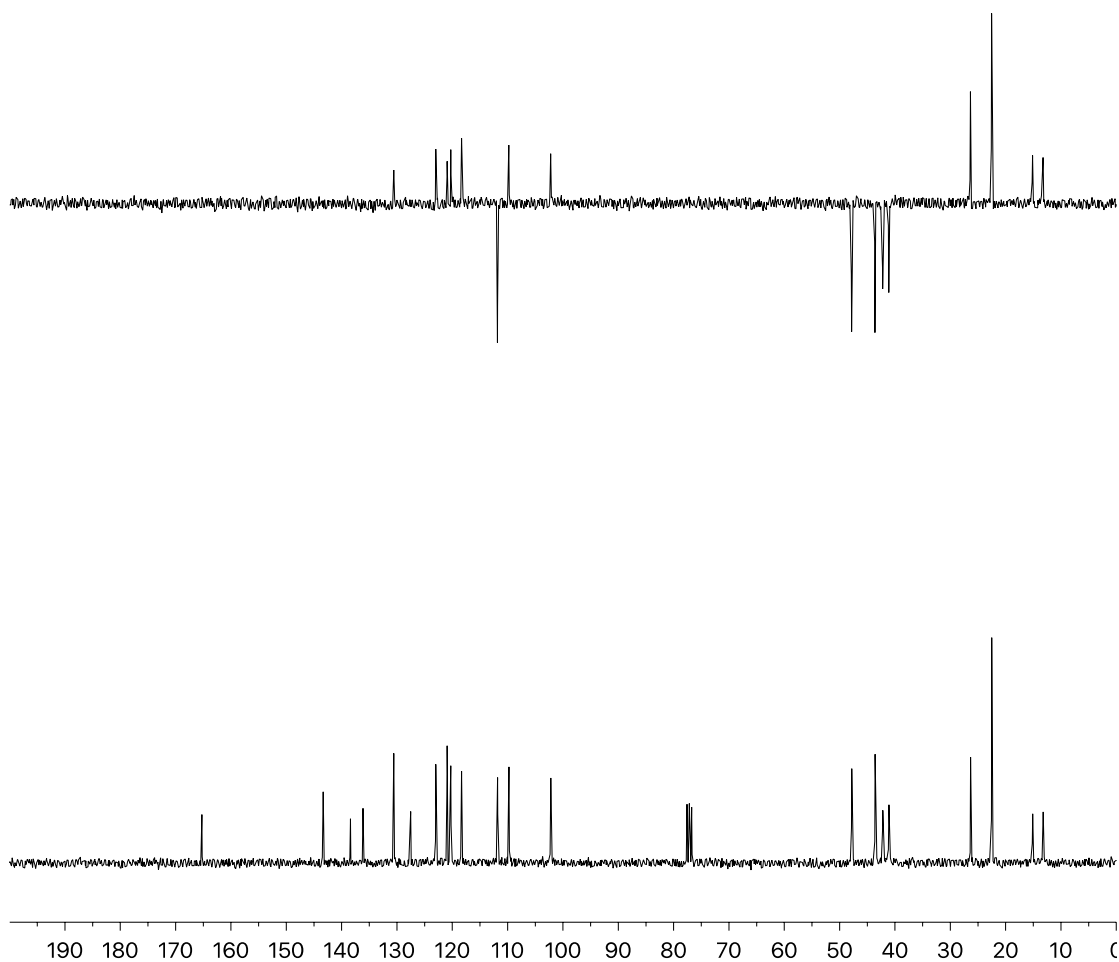
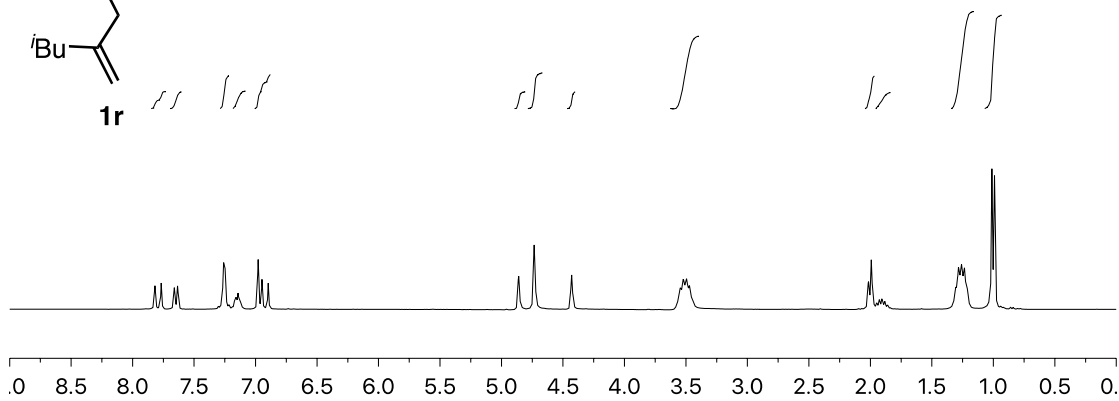
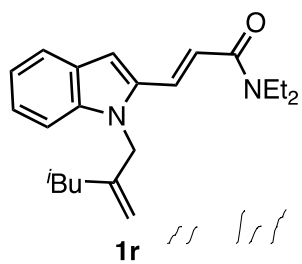


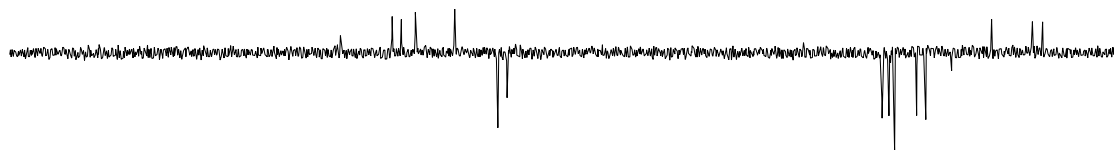
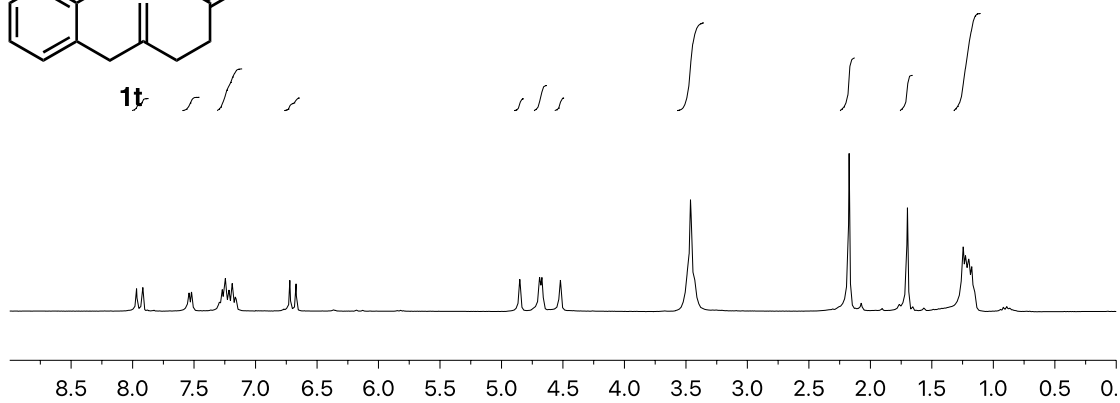
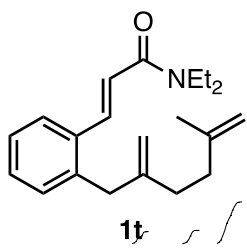


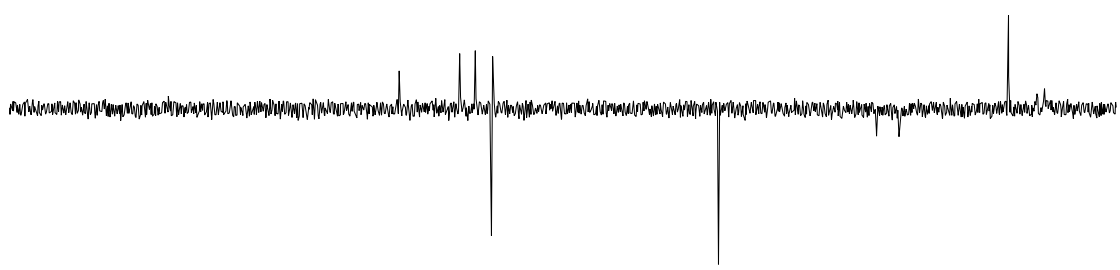
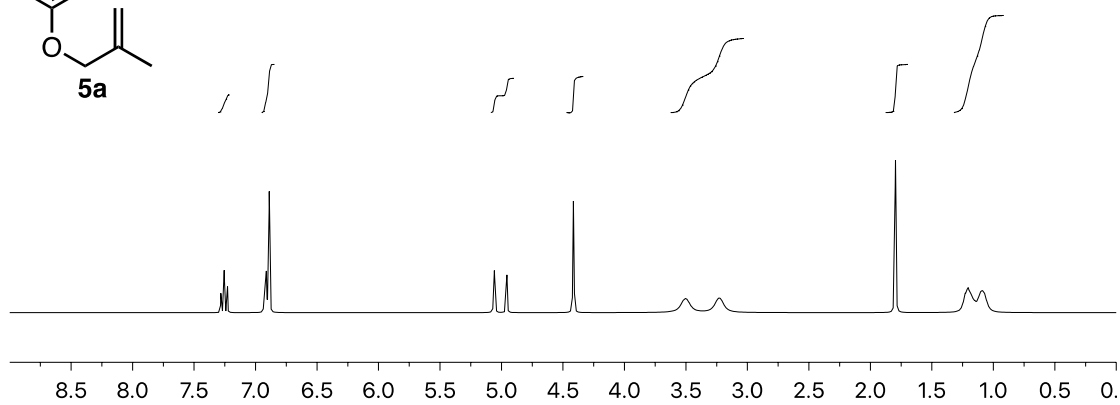
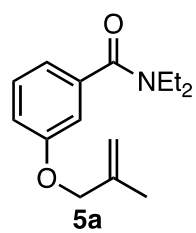


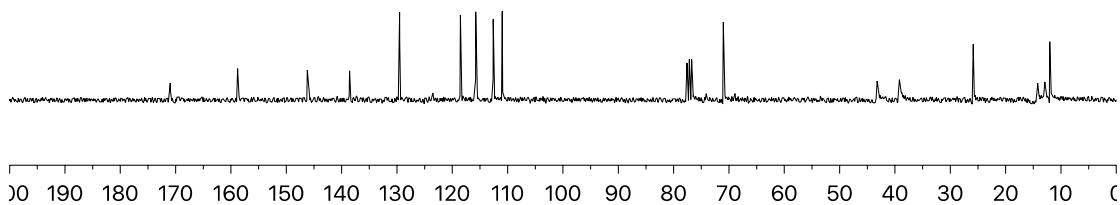
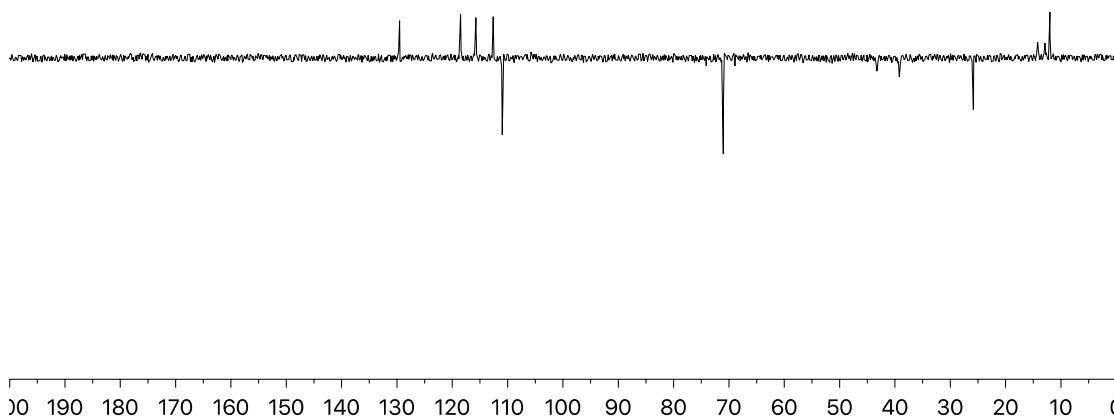
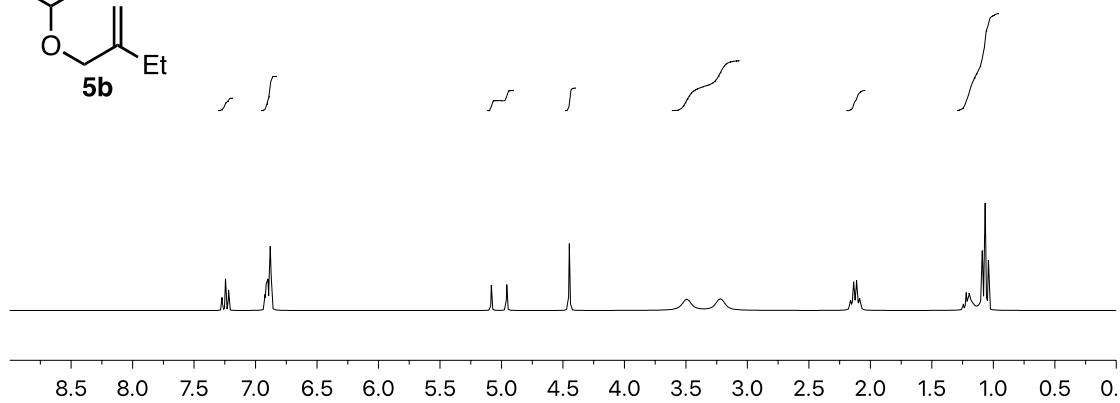
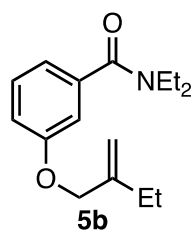


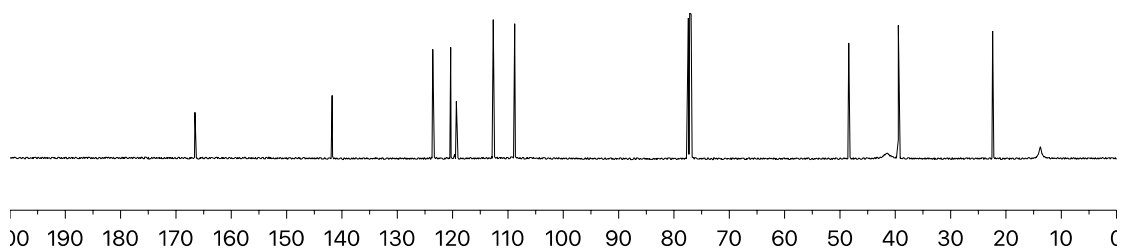
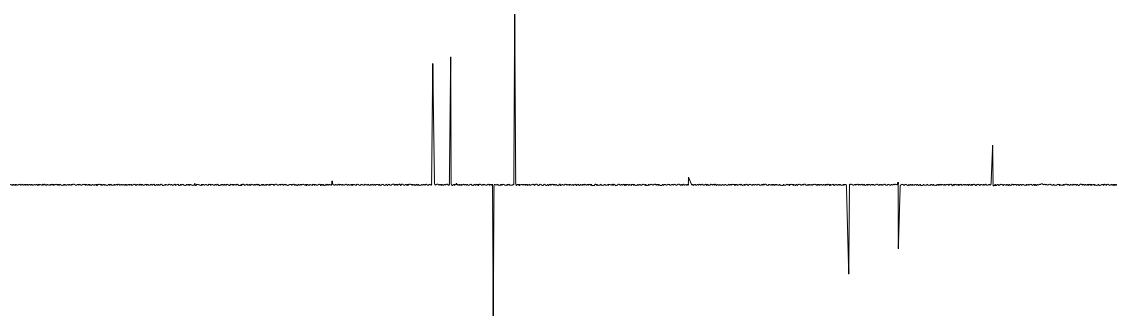
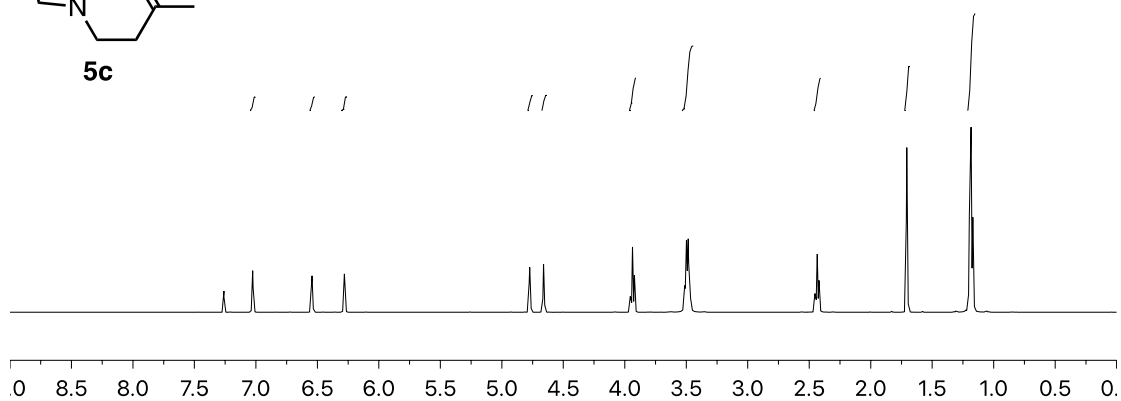
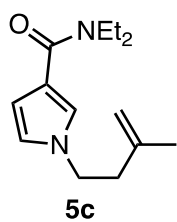


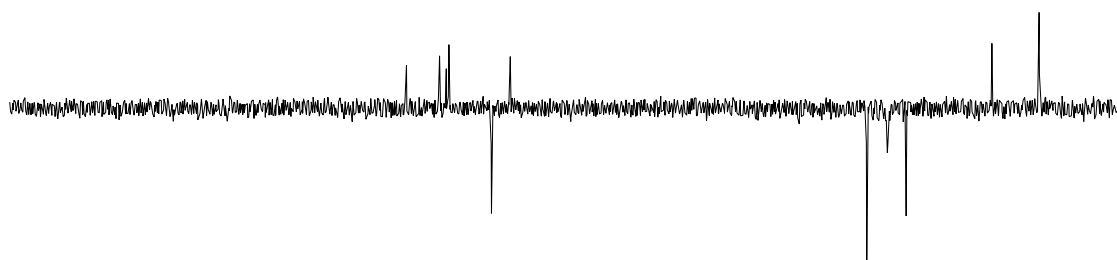
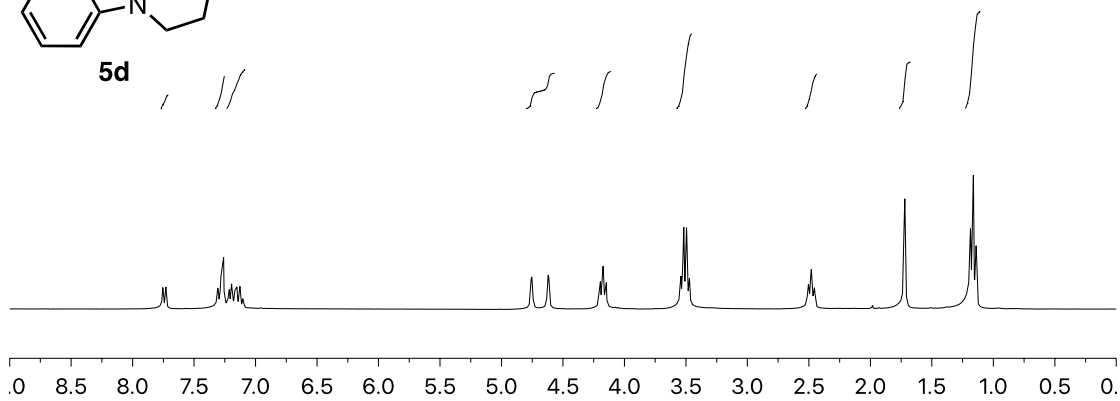
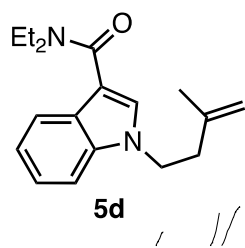


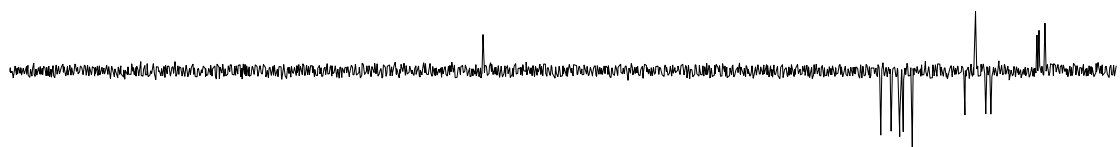
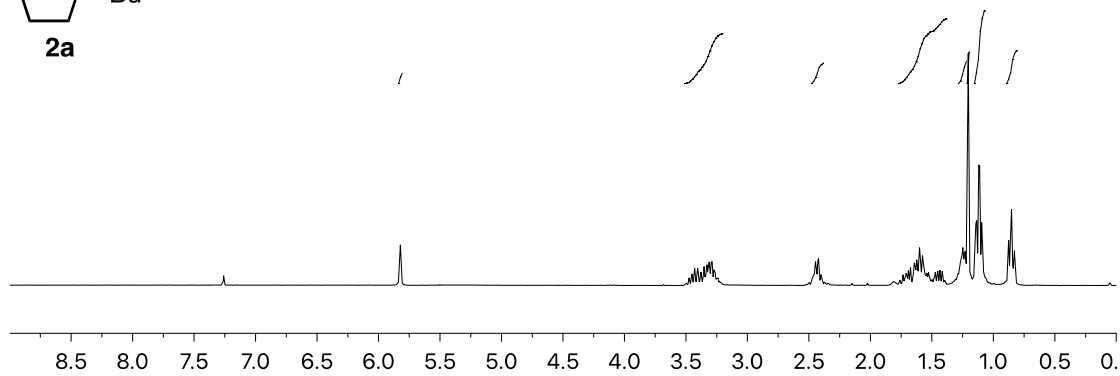
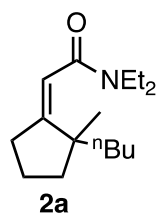


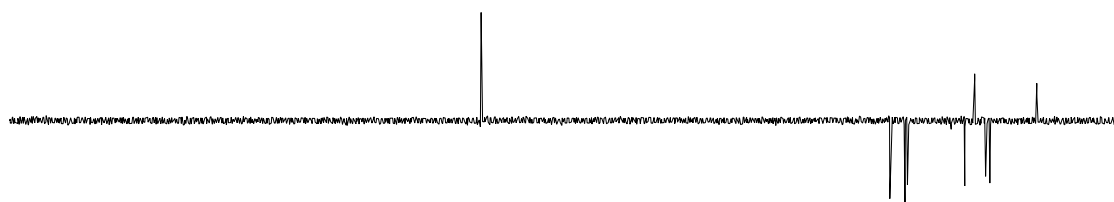
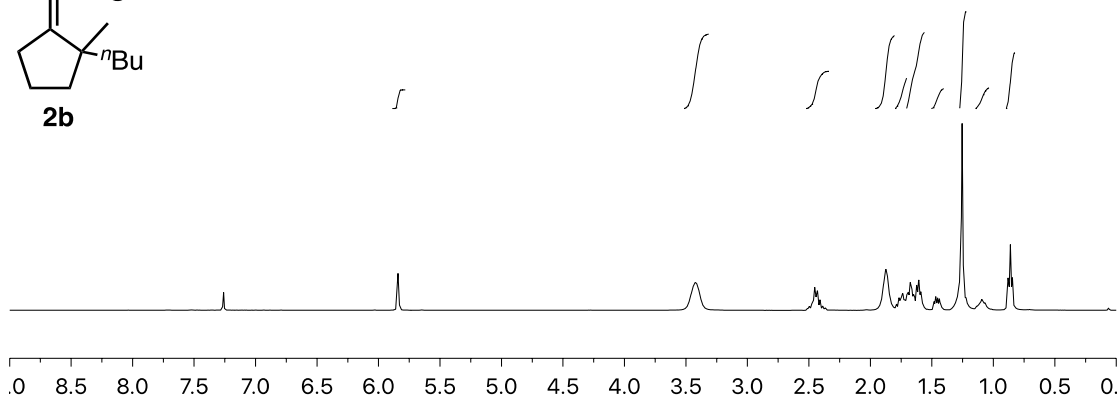
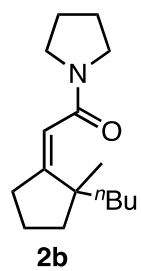


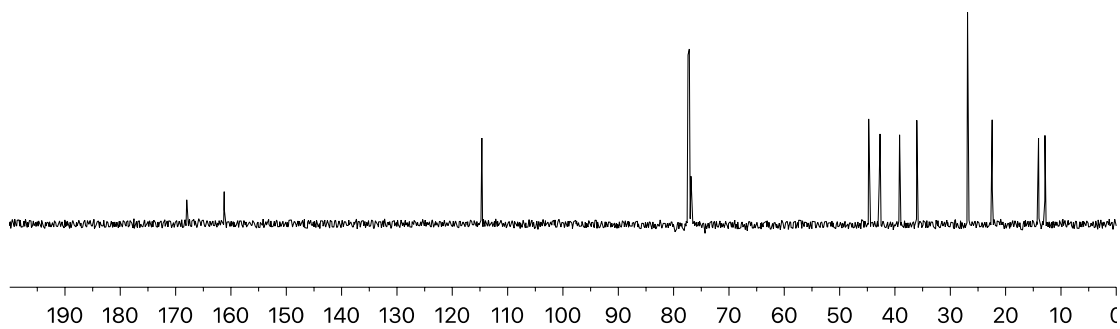
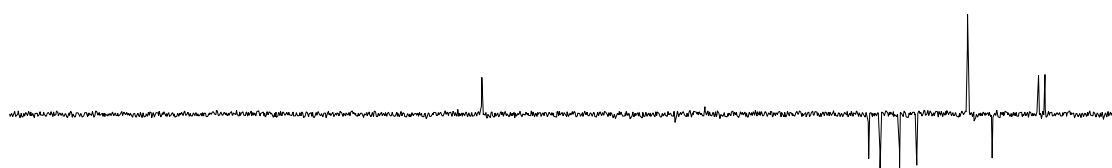
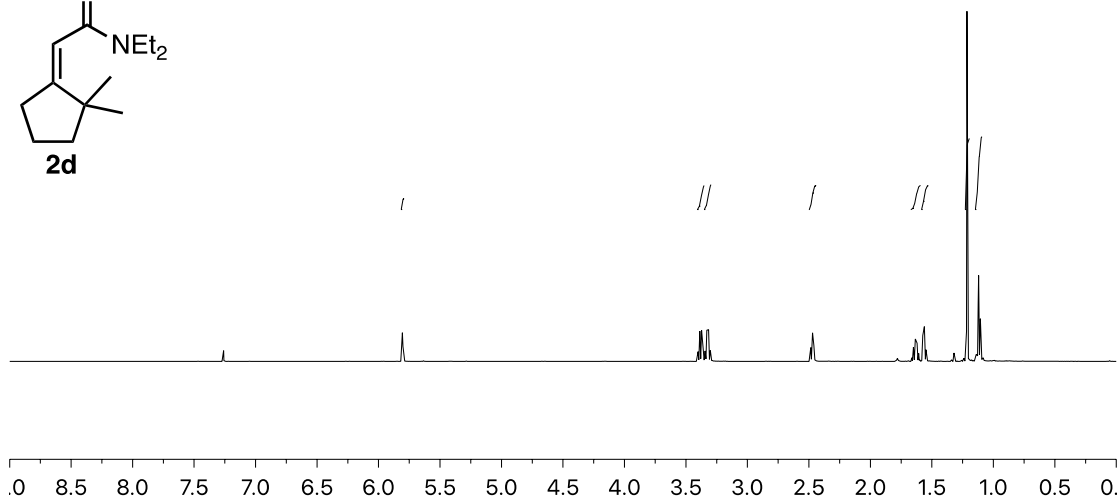
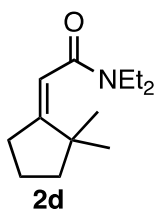


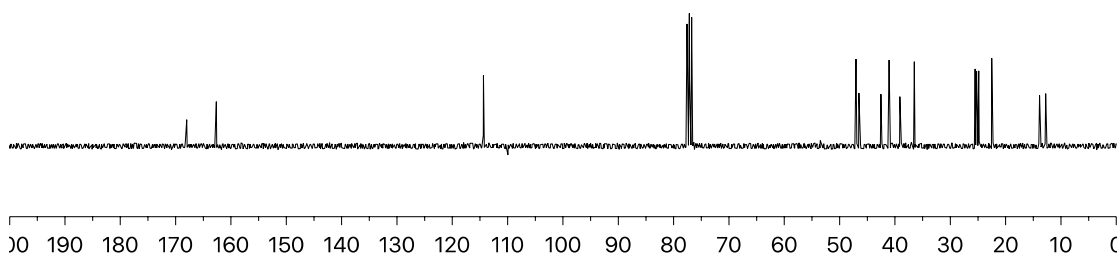
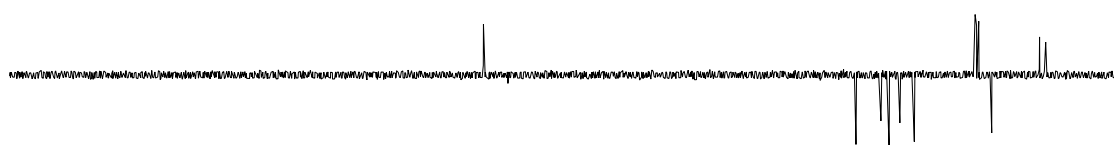
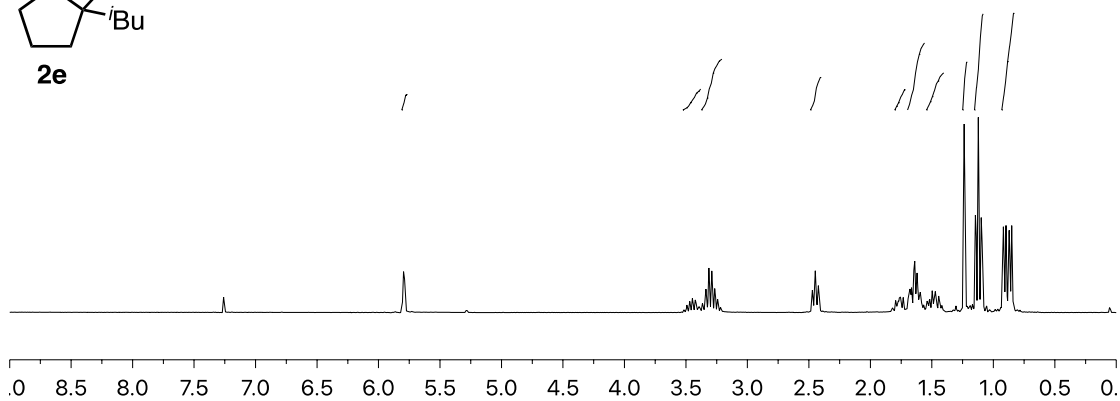
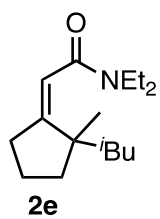


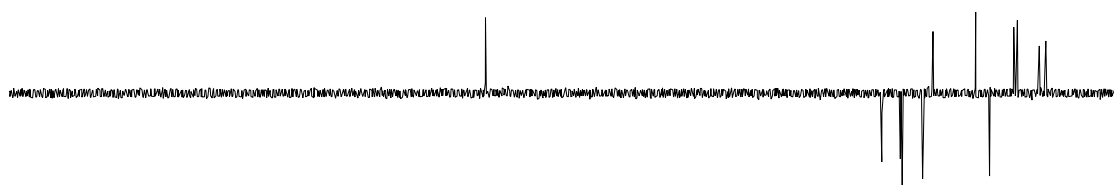
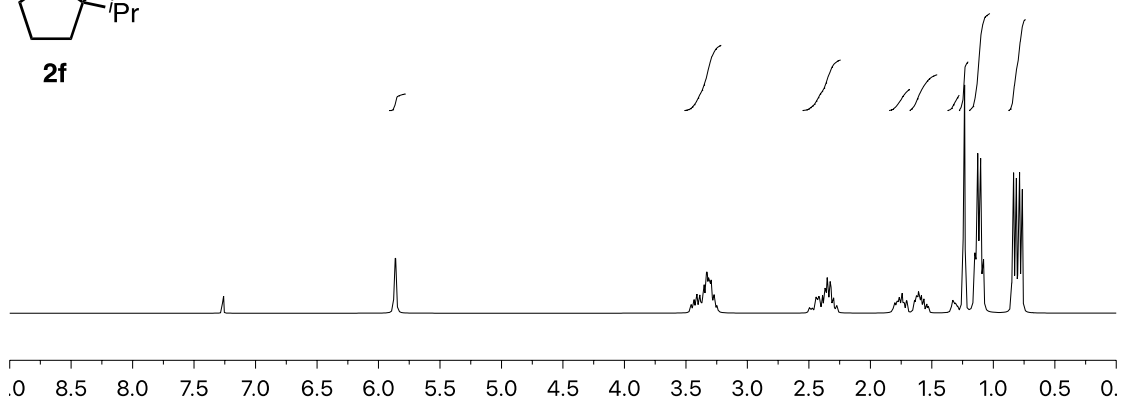
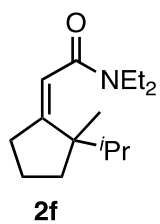


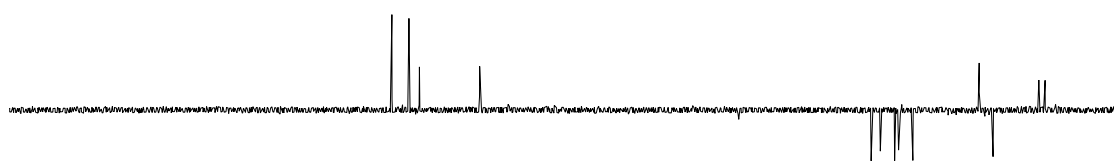
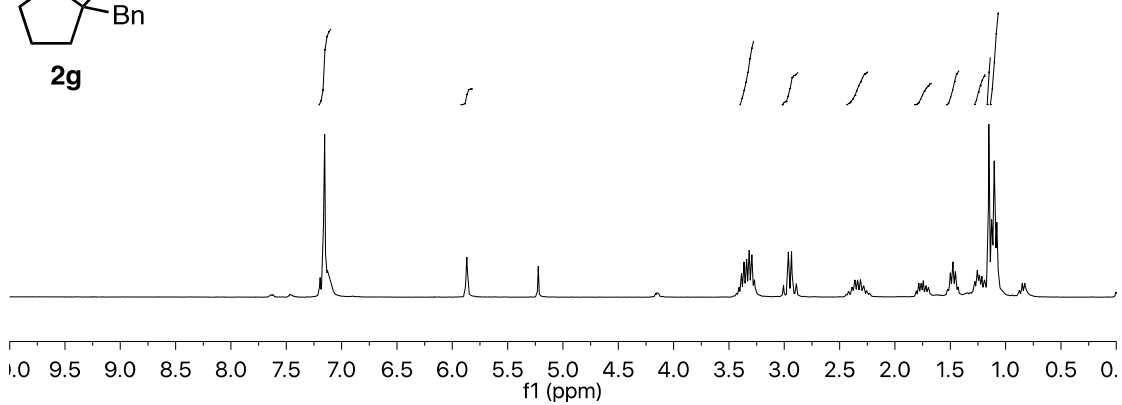
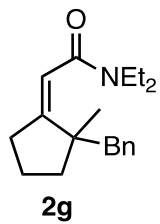


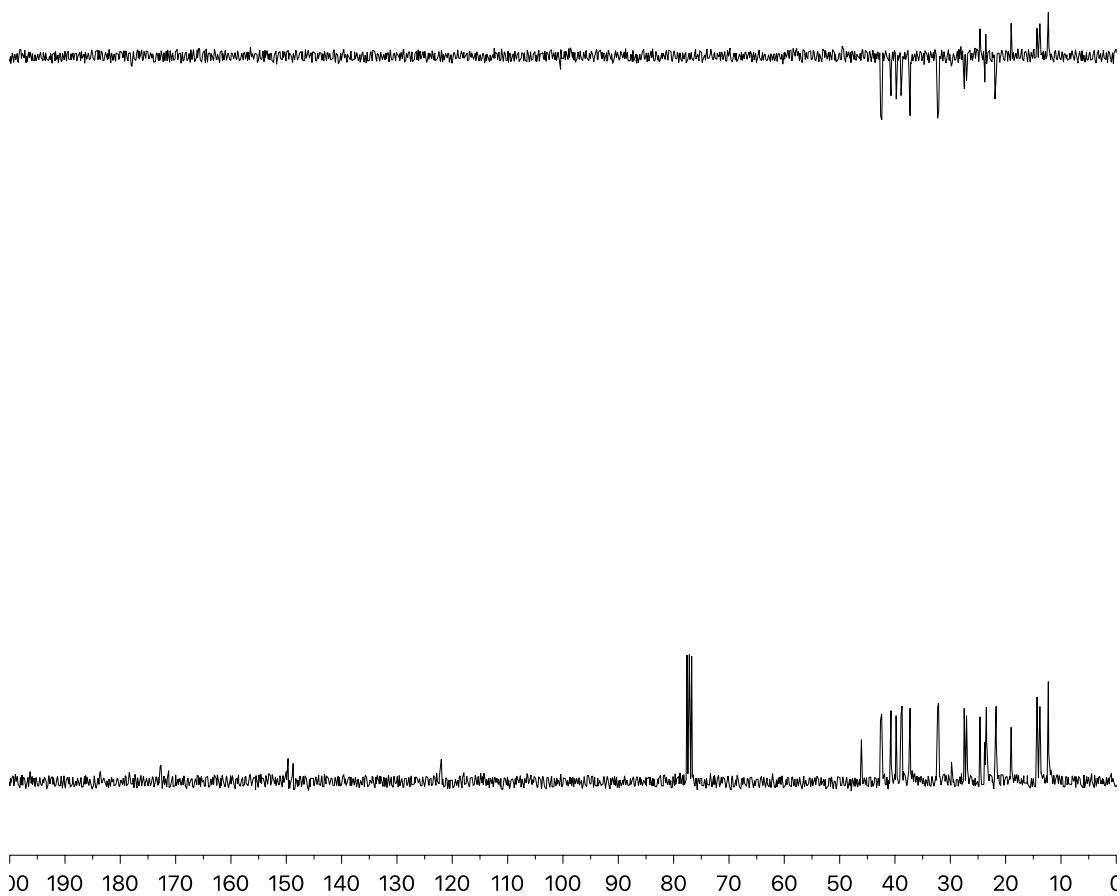
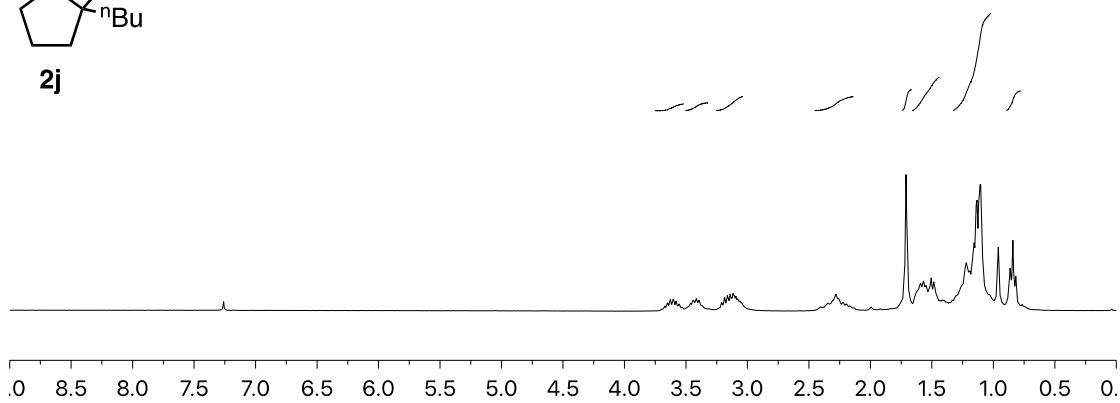
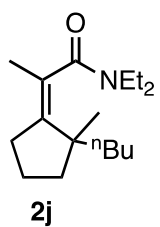


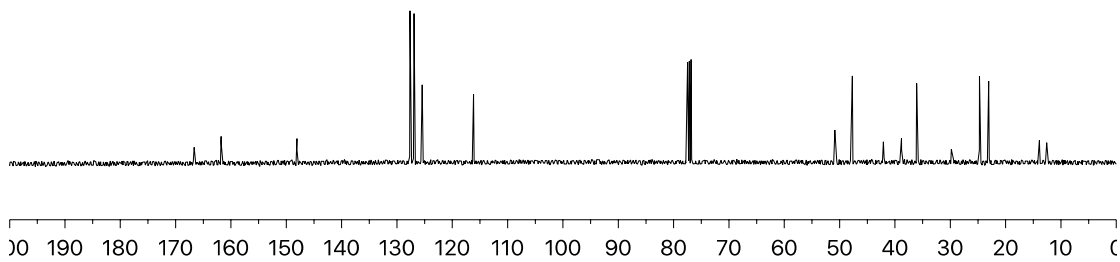
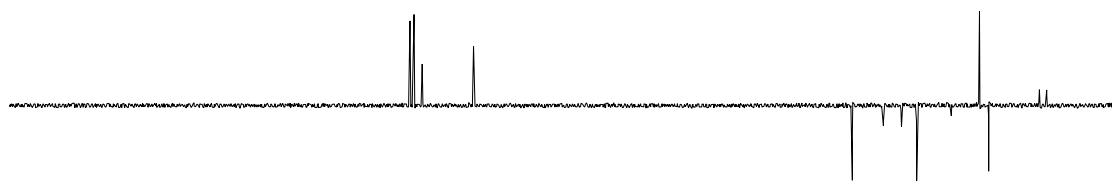
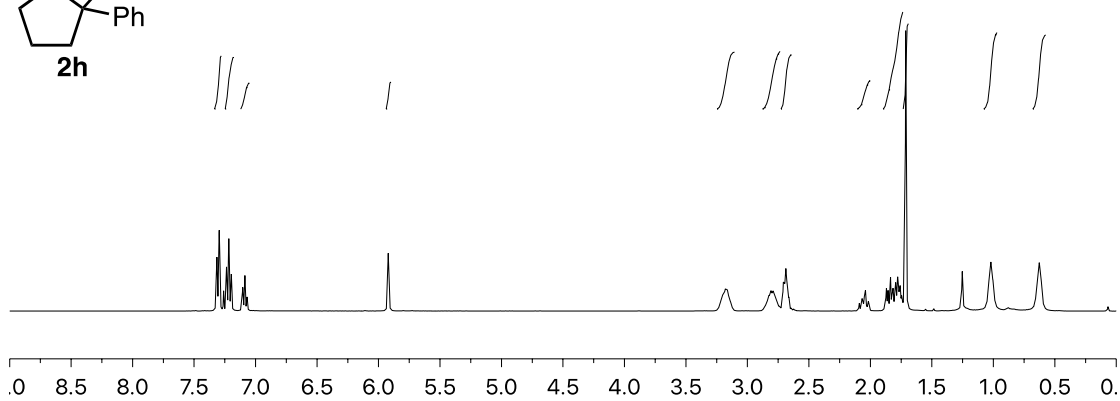
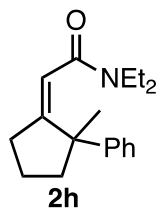


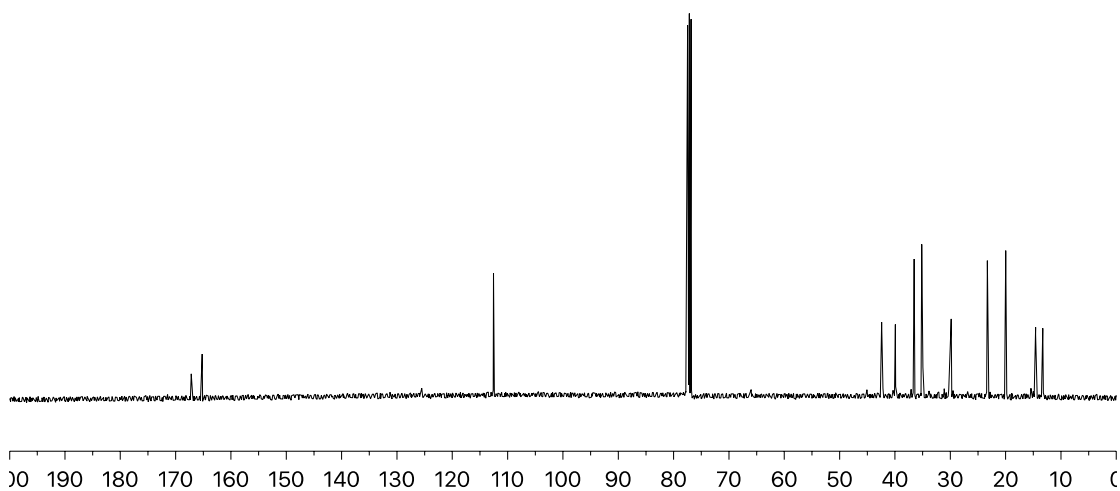
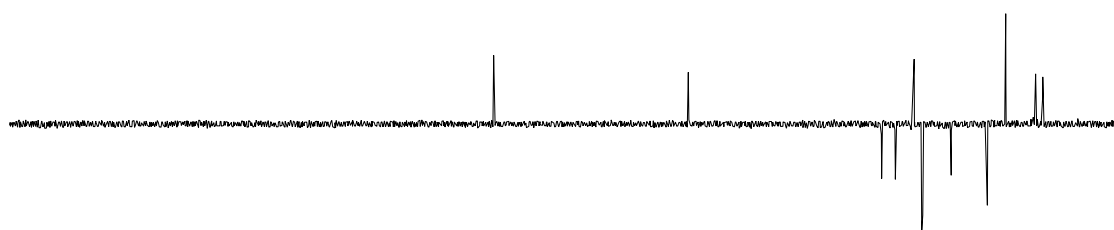
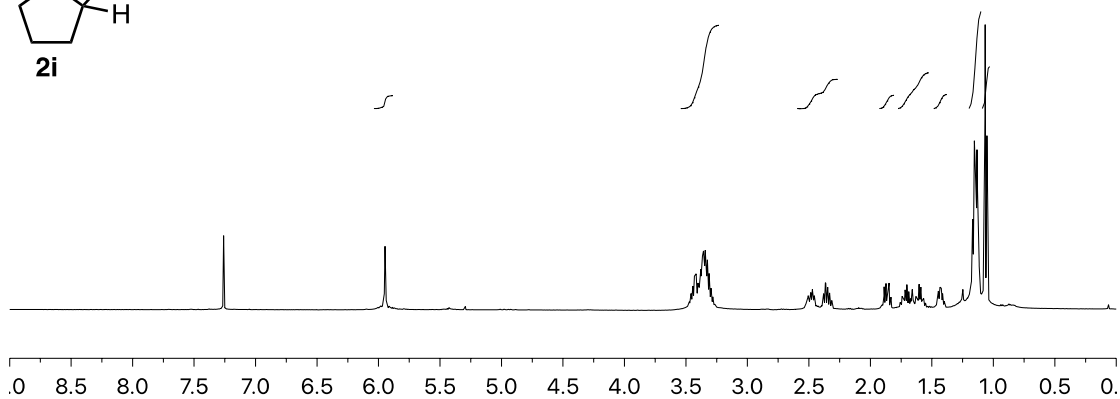
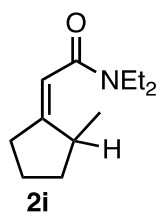


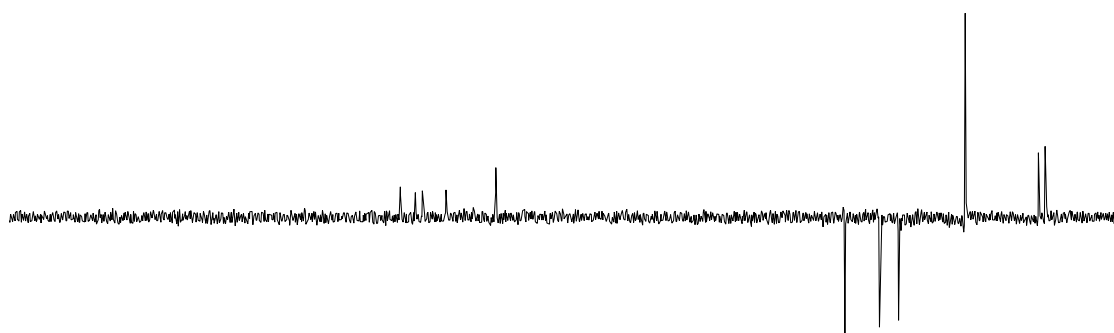
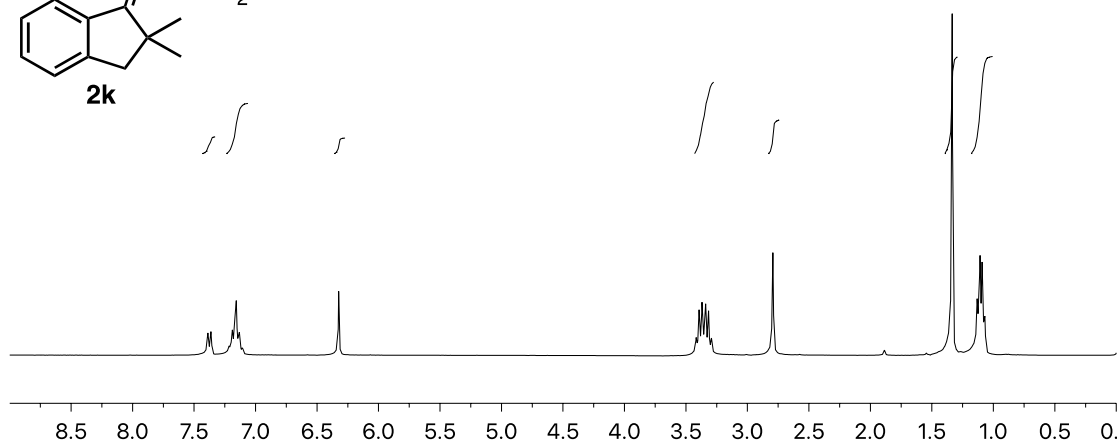
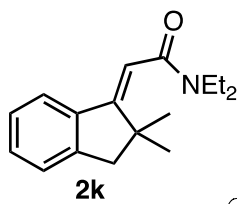


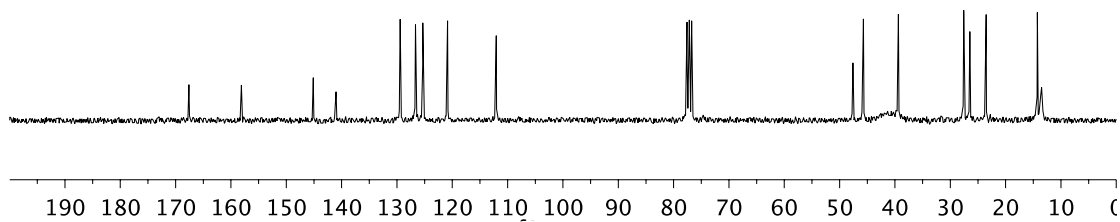
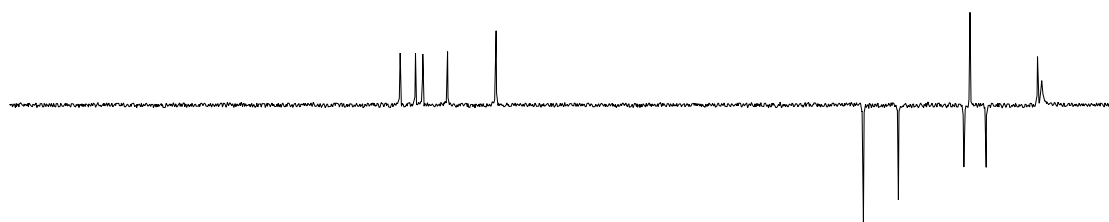
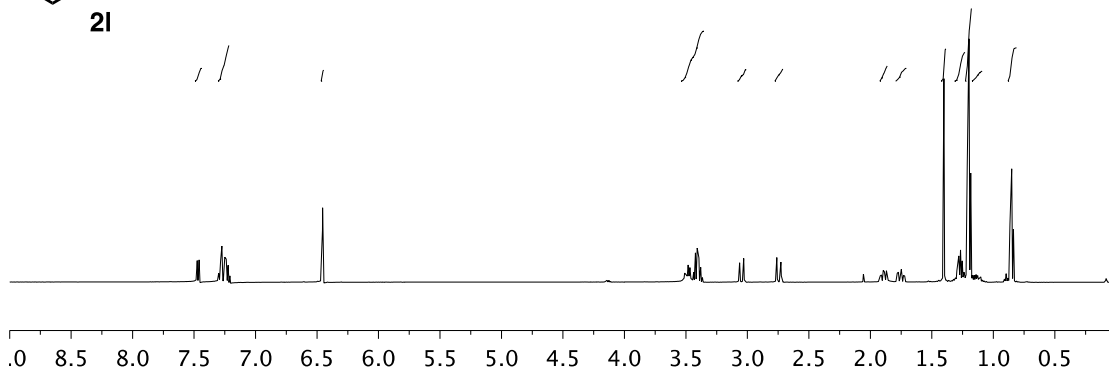
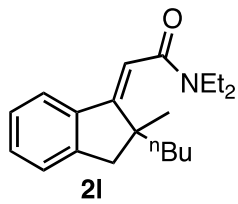


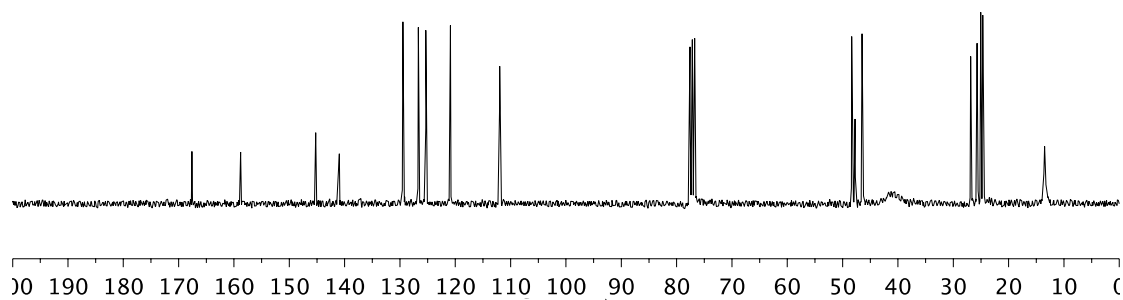
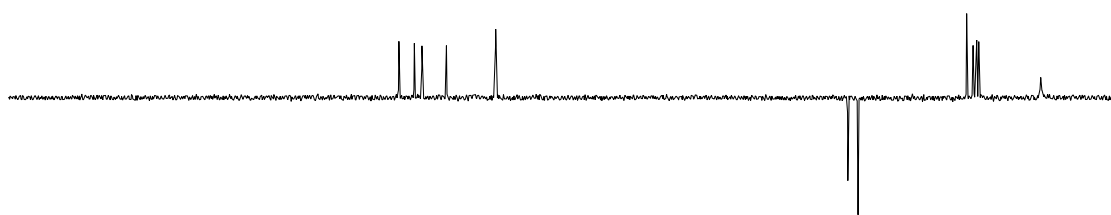
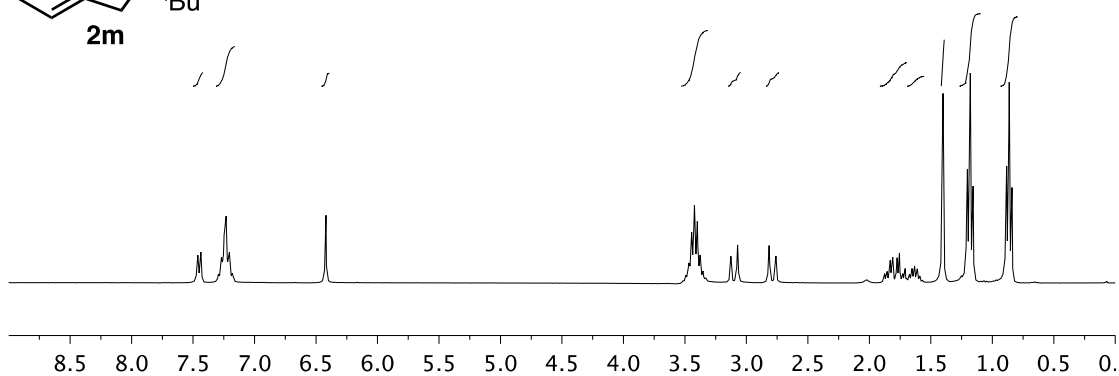
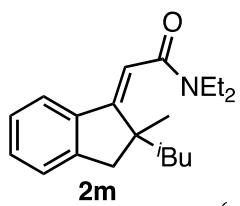


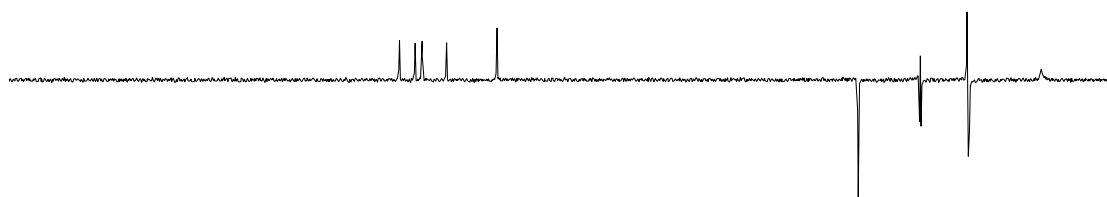
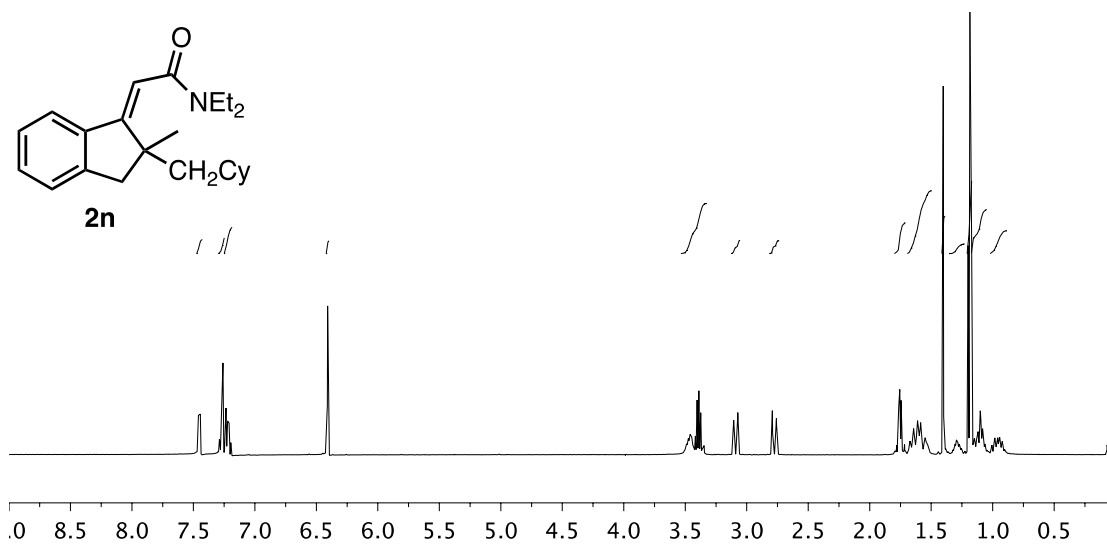
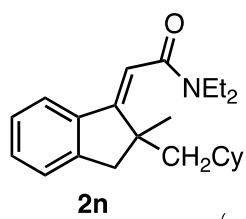


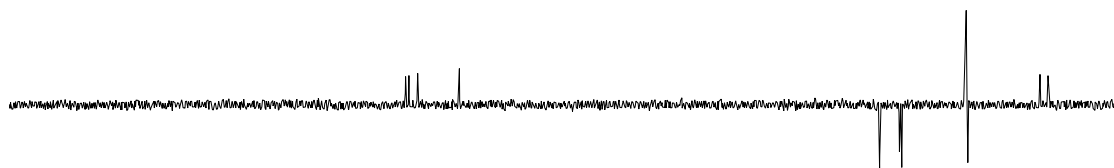
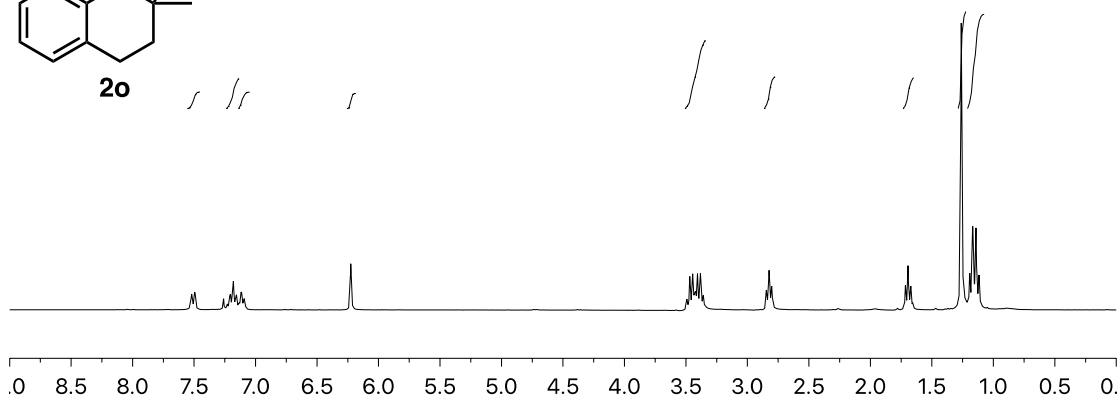
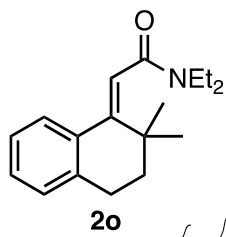


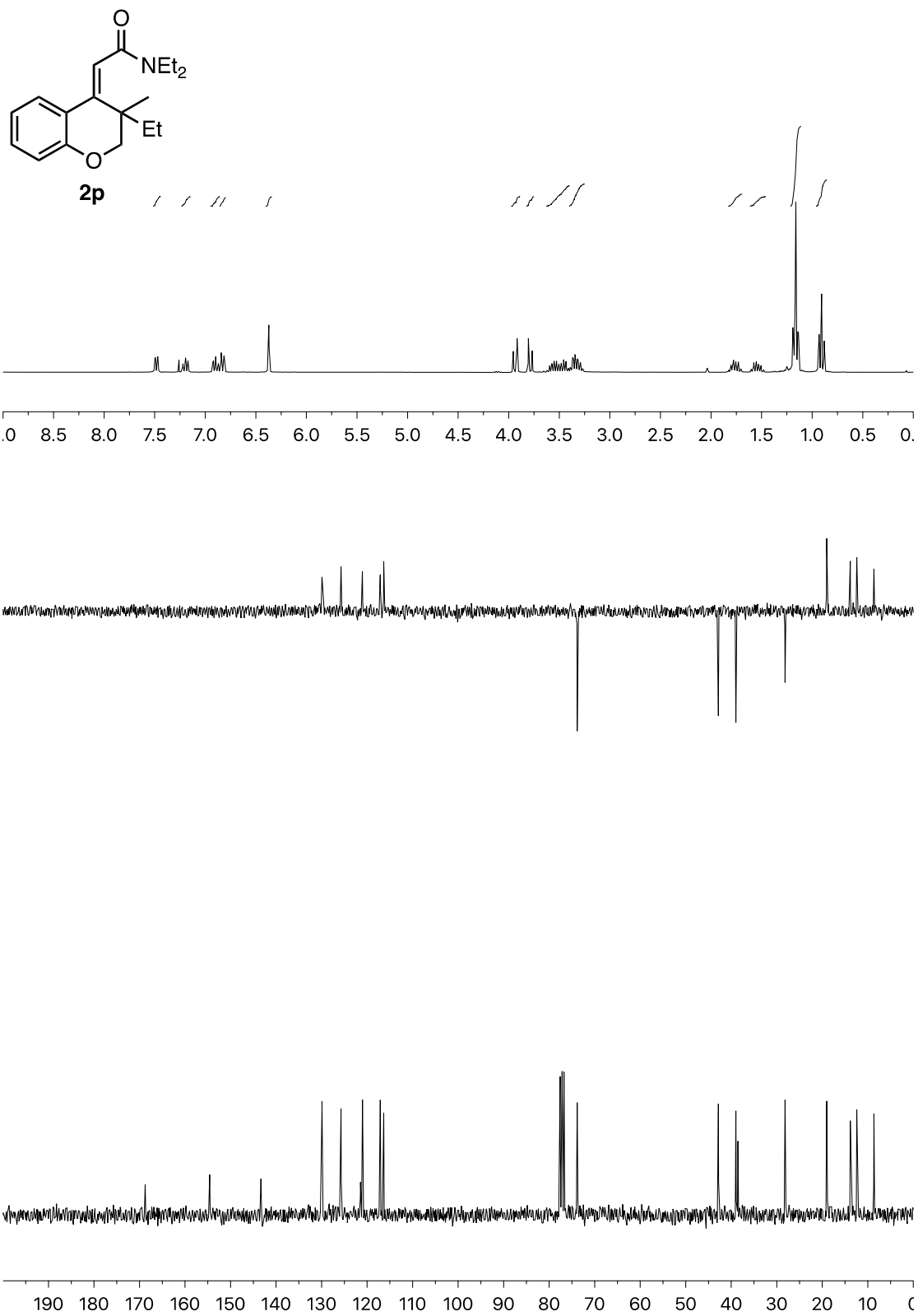


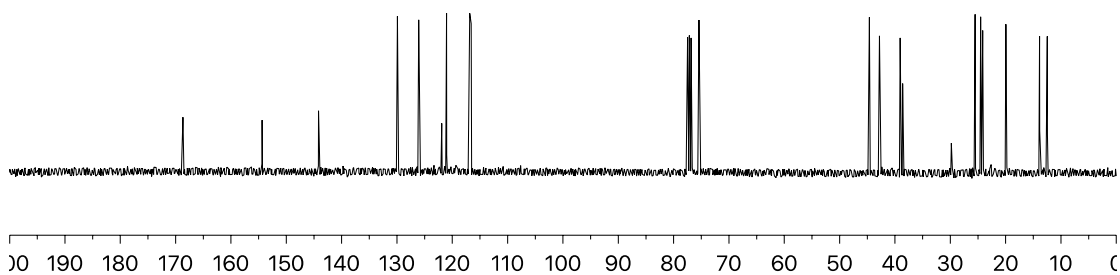
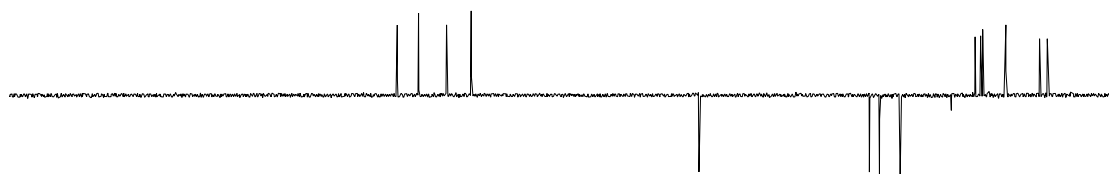
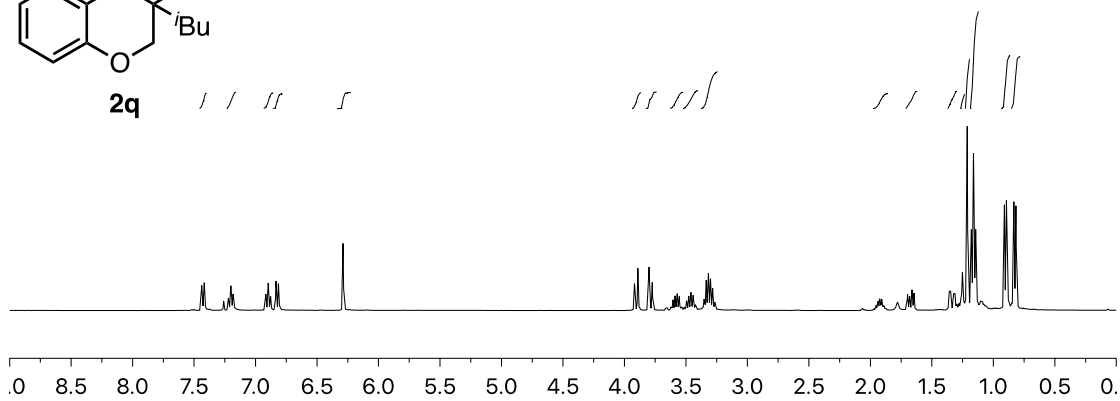
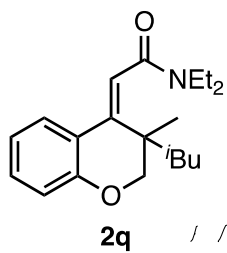


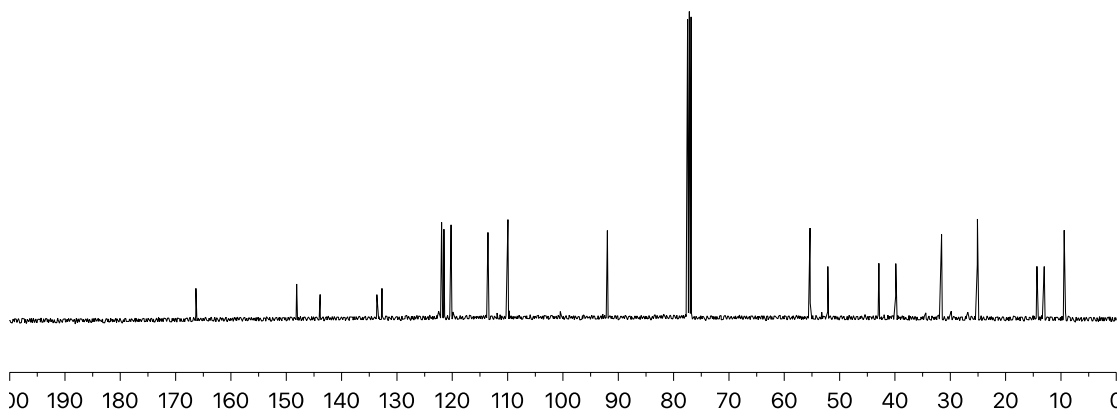
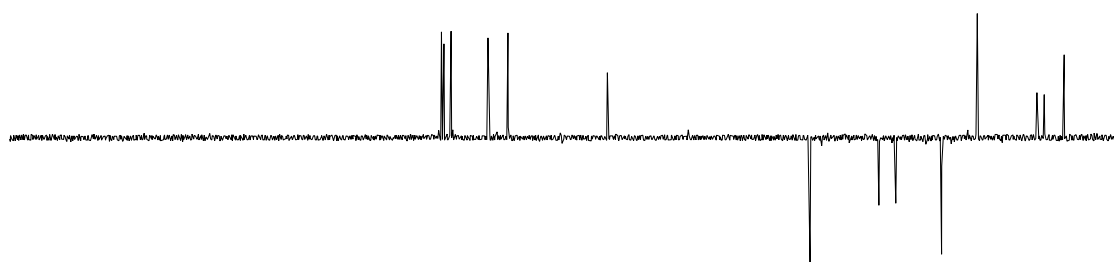
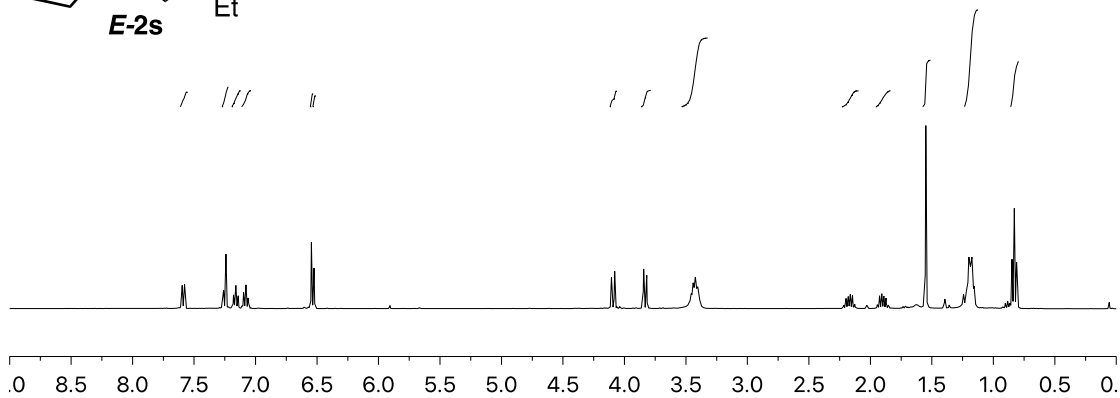
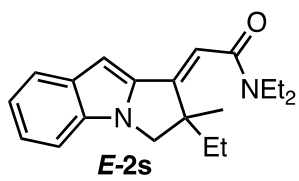


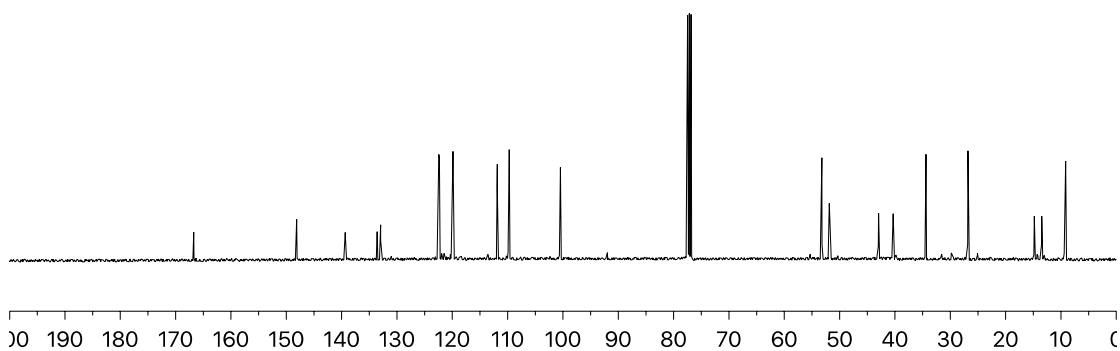
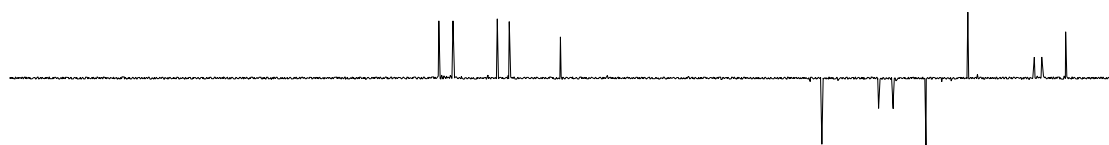
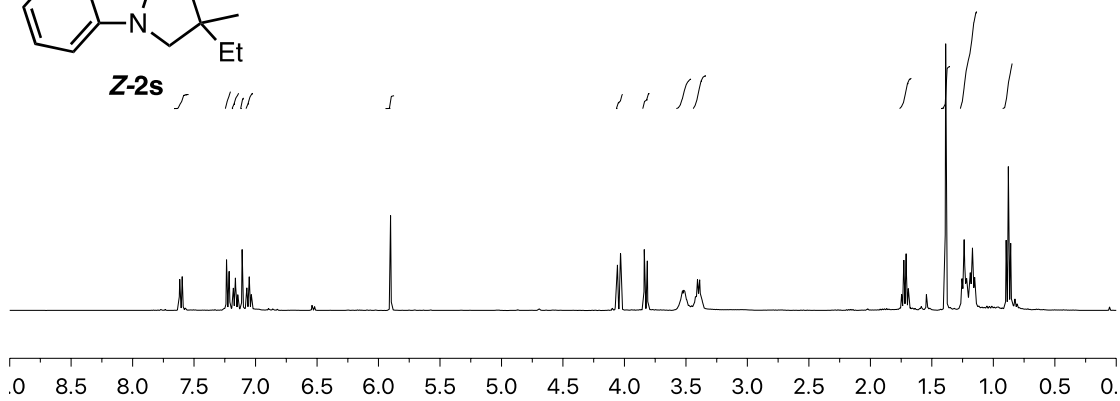
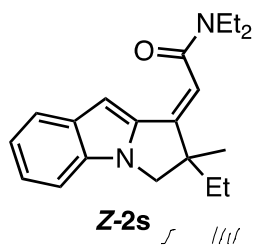


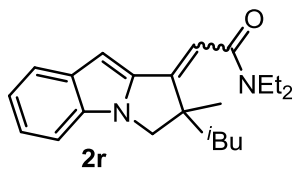




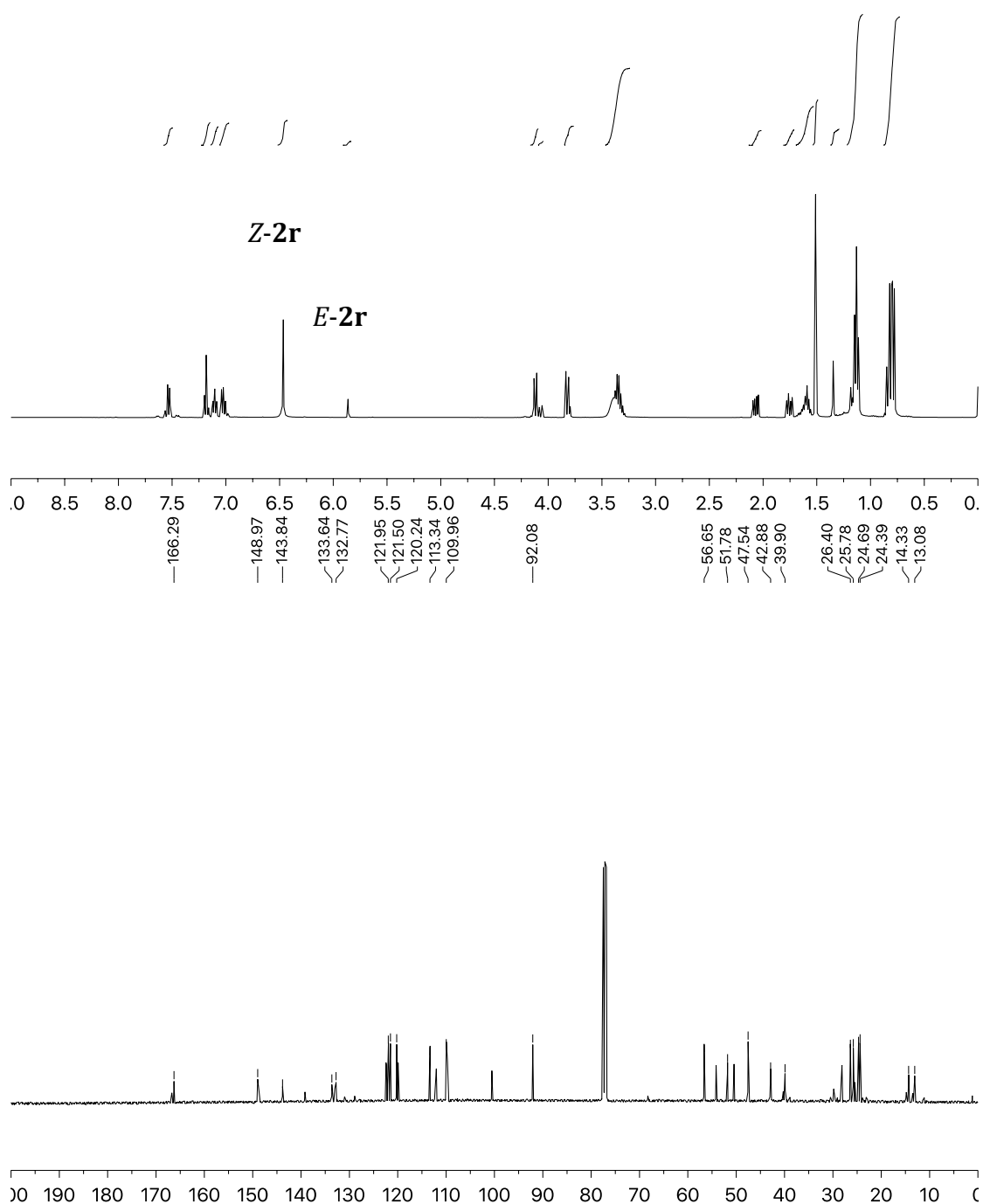


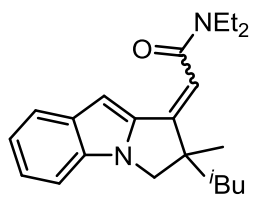






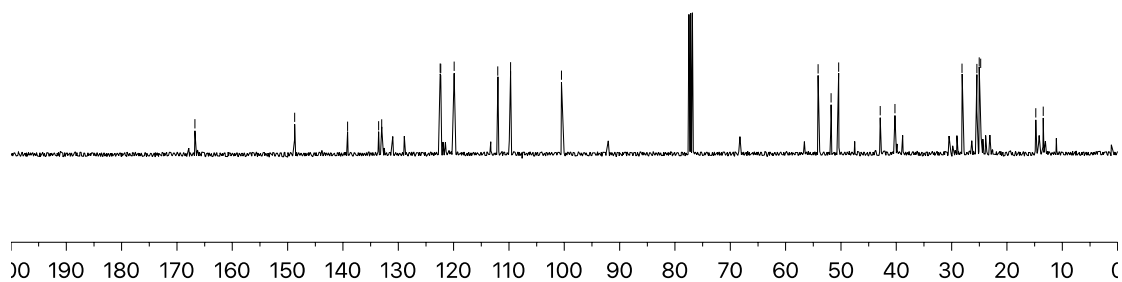
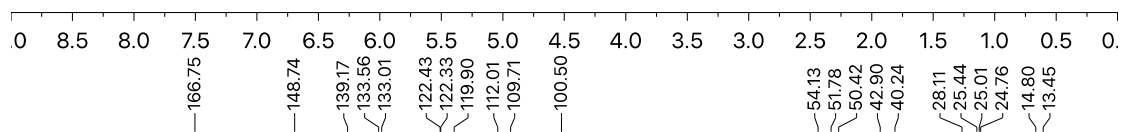
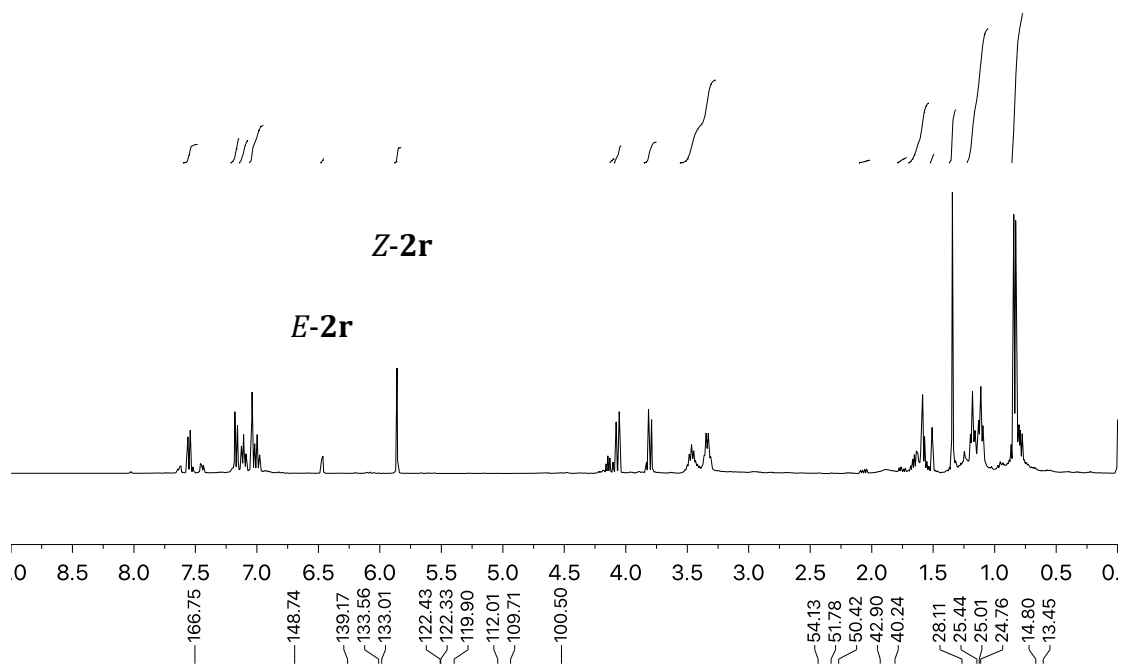
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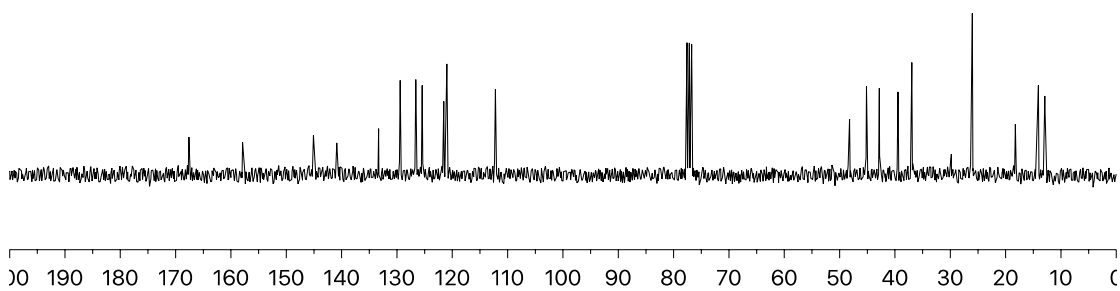
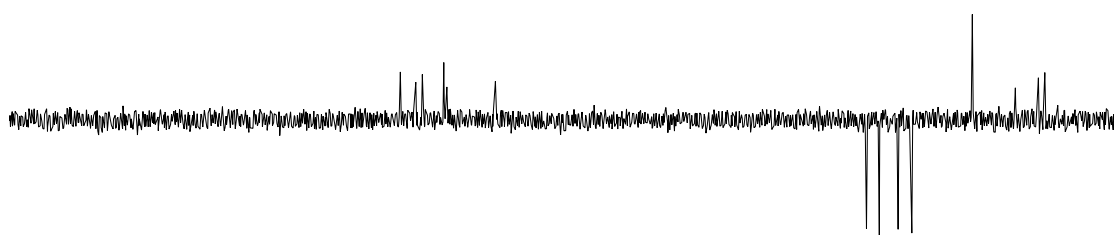
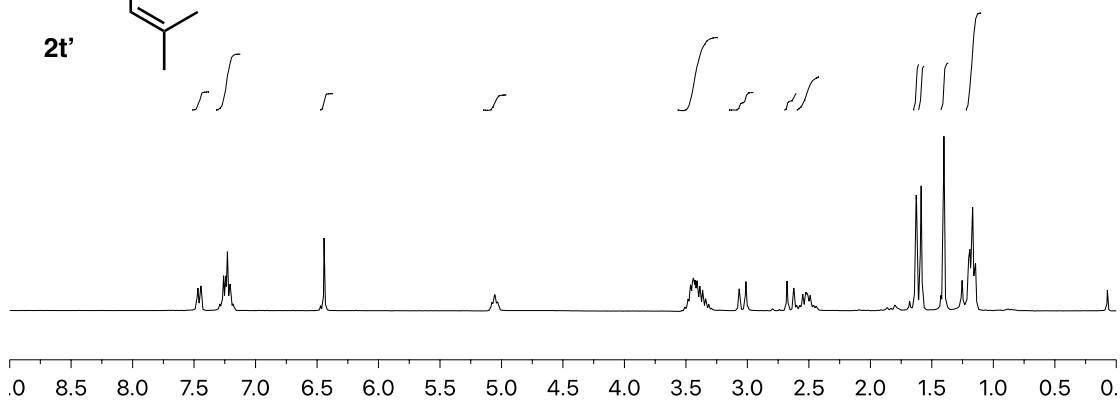
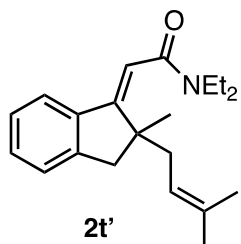


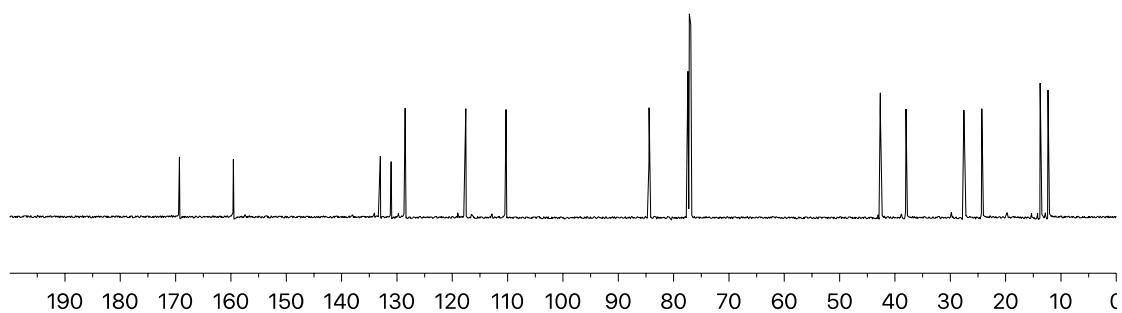
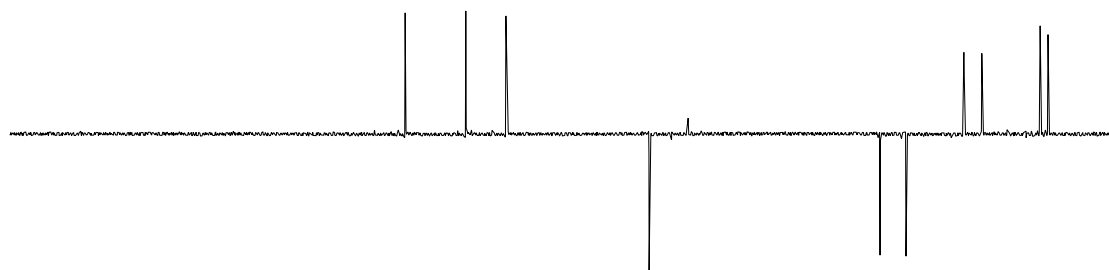
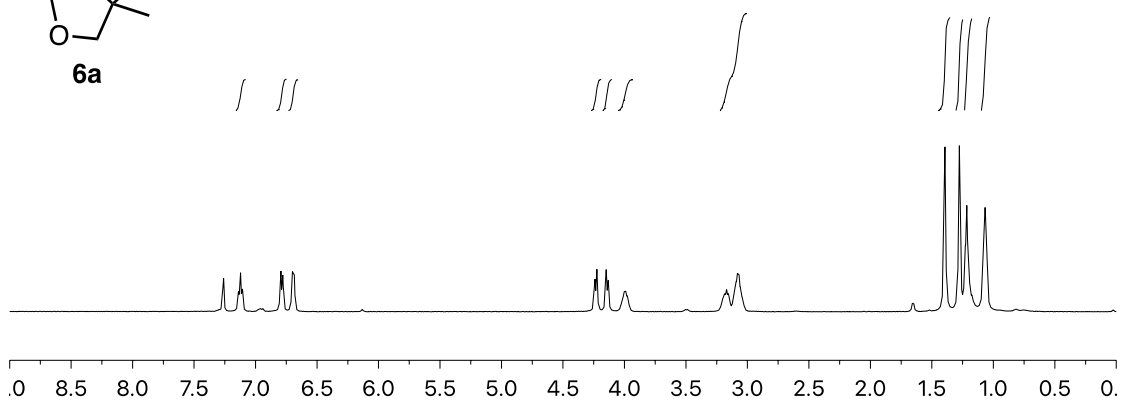
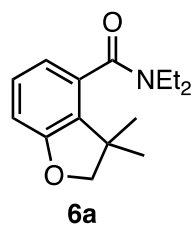


2r

E : *Z* = 1 : 3.5







At 60° C

