

# **Novel dipyridinium lipophiles based ionic liquids tethering hydrazone linkage: Design, Synthesis and antitumorigenic study**

Salsabeel Al-Sodies<sup>1</sup>, Nadjat Rezki<sup>1,\*</sup>, Fawzia Faleh Albelwi<sup>1</sup>,  
Mouslim Messali<sup>1</sup>, Mohamed R. Aouad<sup>1</sup>, Sanaa K. Bardaweel<sup>2,\*</sup>,  
Mohamed Hagar<sup>3</sup>

*<sup>a</sup>Department of Chemistry, Faculty of Science, Taibah University, Al-Madinah Al-Munawarah 30002, Saudi Arabia*

*<sup>b</sup>Department of Pharmaceutical Sciences, Faculty of Pharmacy, University of Jordan, Amman 11942, Jordan*

*<sup>c</sup>Chemistry Department, Faculty of Science, Alexandria University, Alexandria 21321, Egypt*

## Spectroscopic characterization

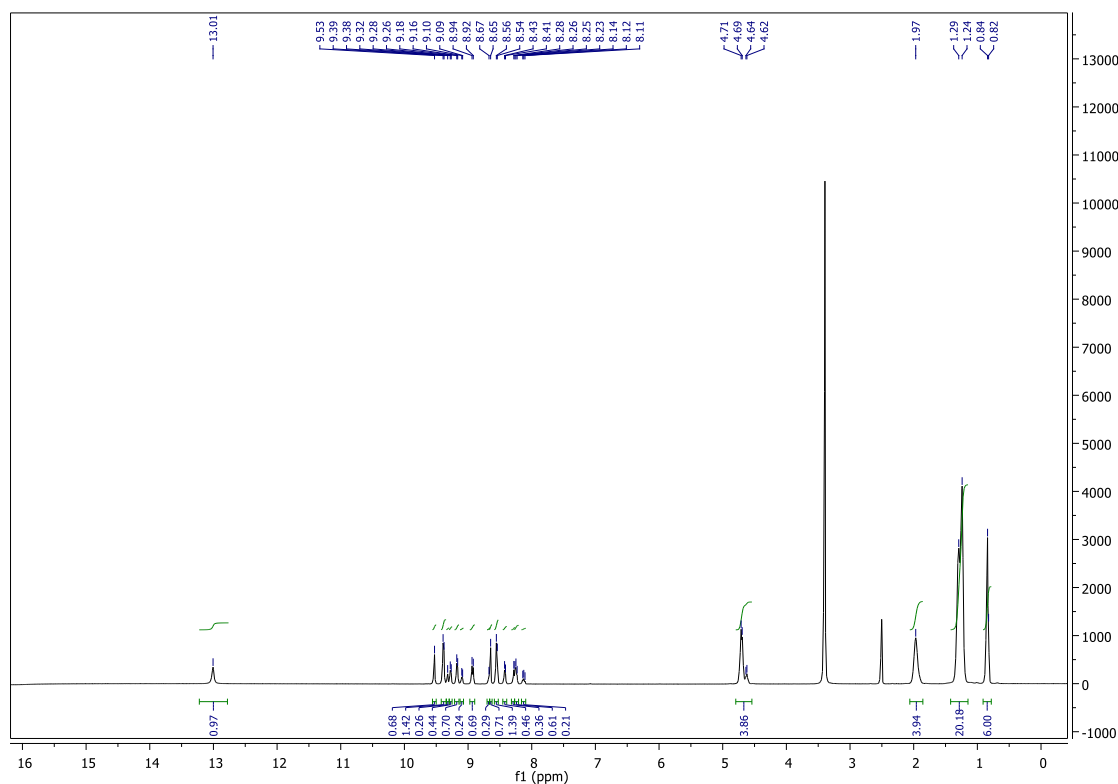


Figure S1.  $^1\text{H}$  NMR of Compound 9

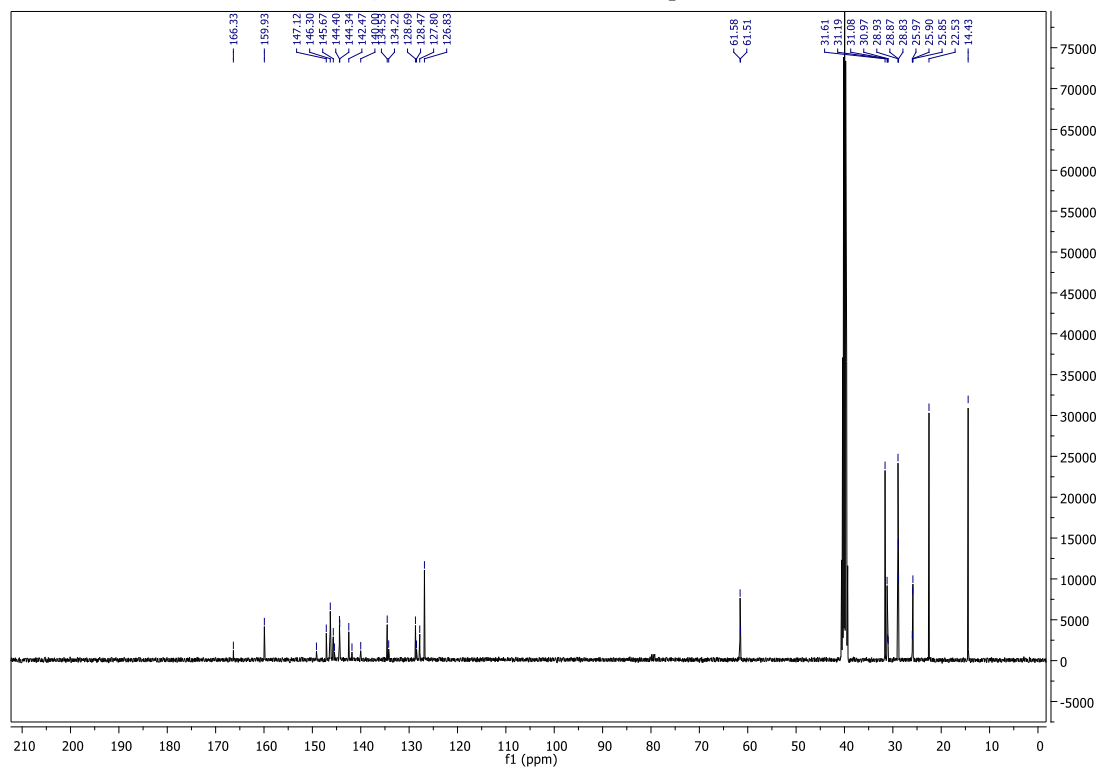


Figure S2.  $^{13}\text{C}$  NMR of Compound 9

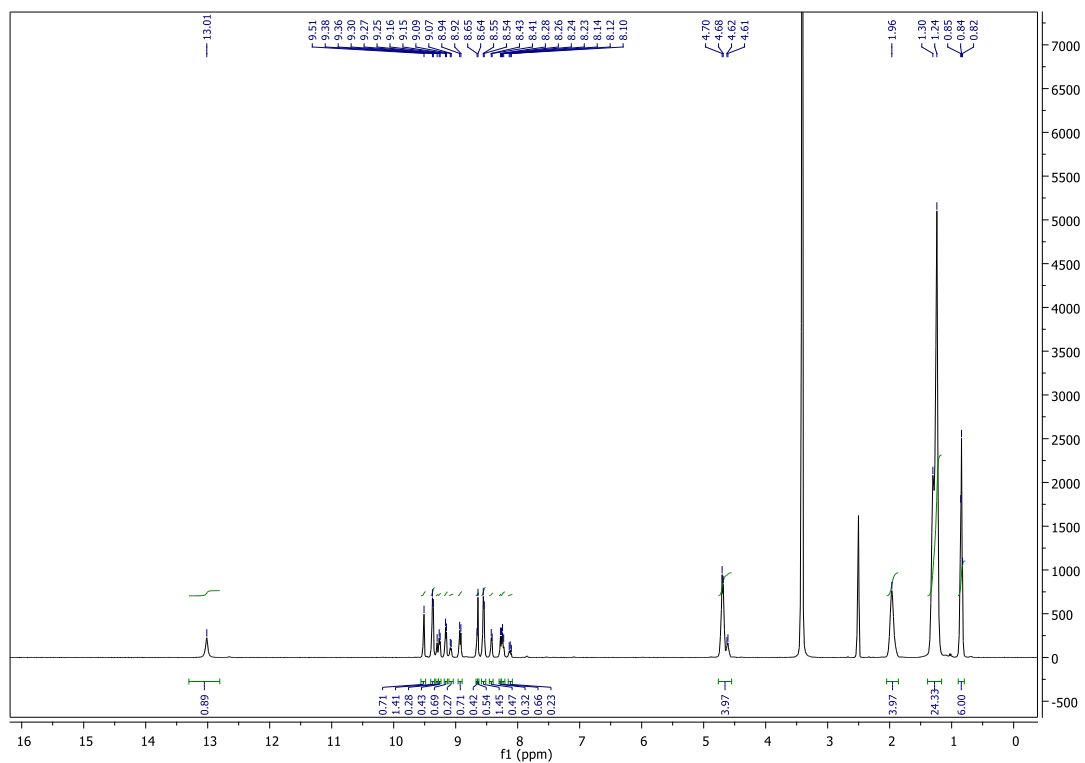


Figure S3.  $^1\text{H}$  NMR of Compound 10

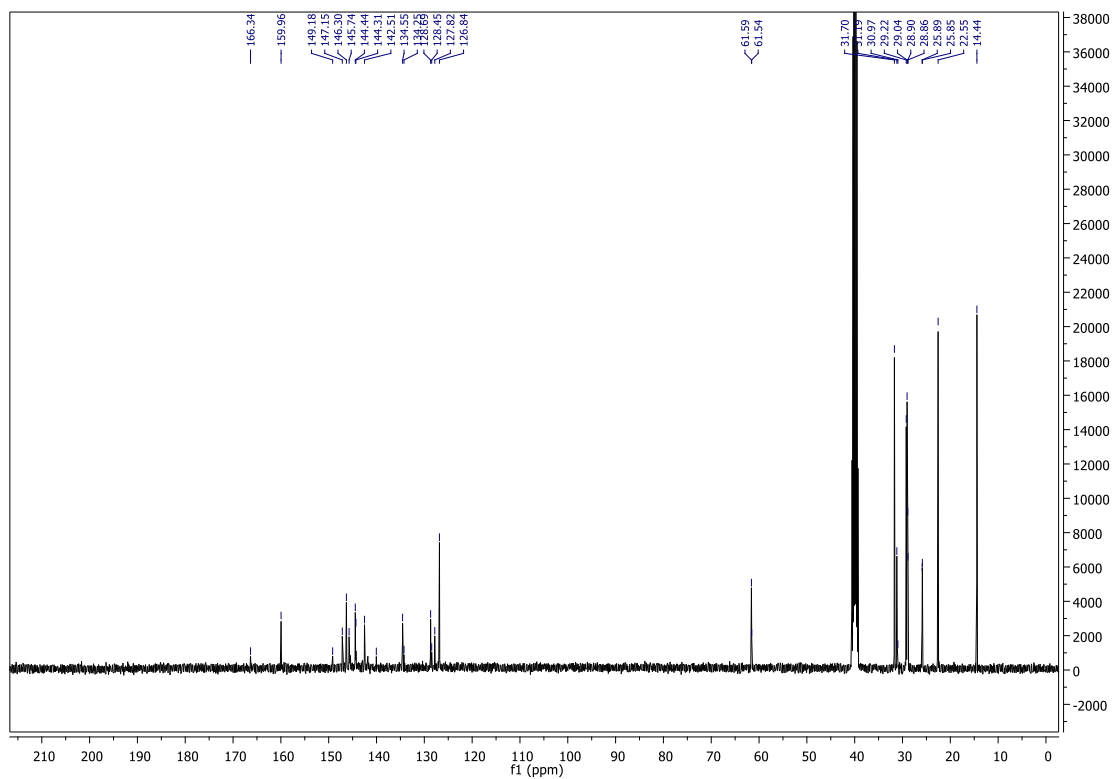


Figure S4.  $^{13}\text{C}$  NMR of Compound 10

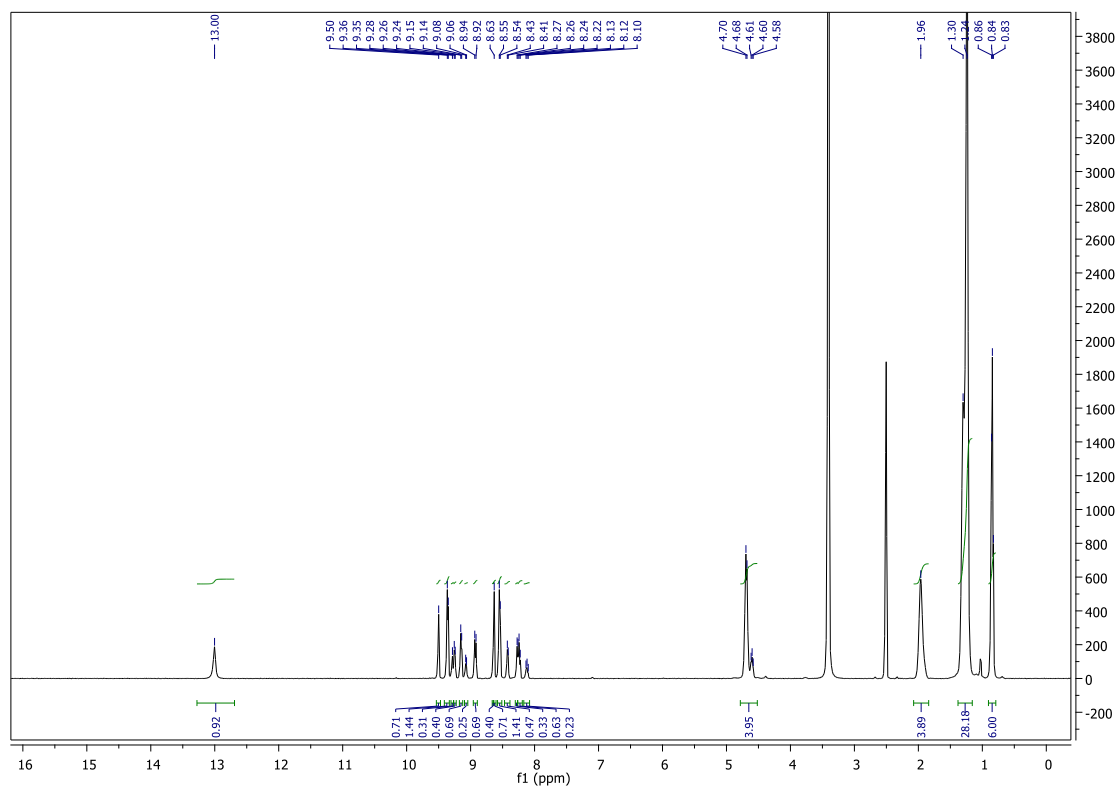


Figure S5. <sup>1</sup>H NMR of Compound 11

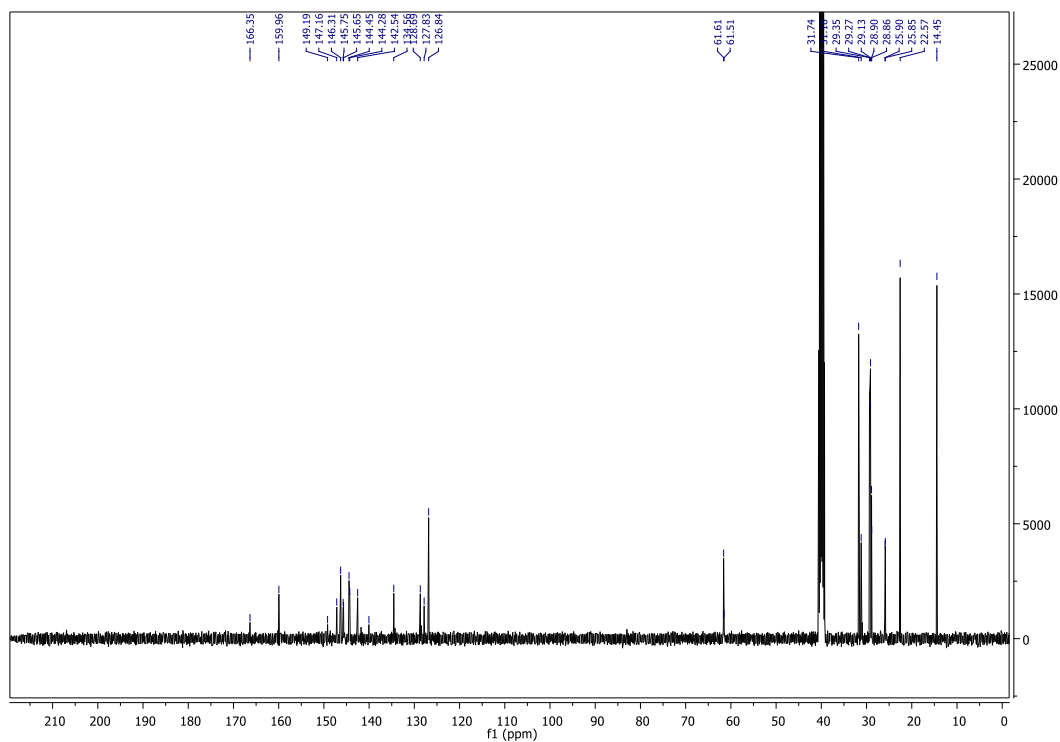


Figure S6. <sup>13</sup>C NMR of Compound 11

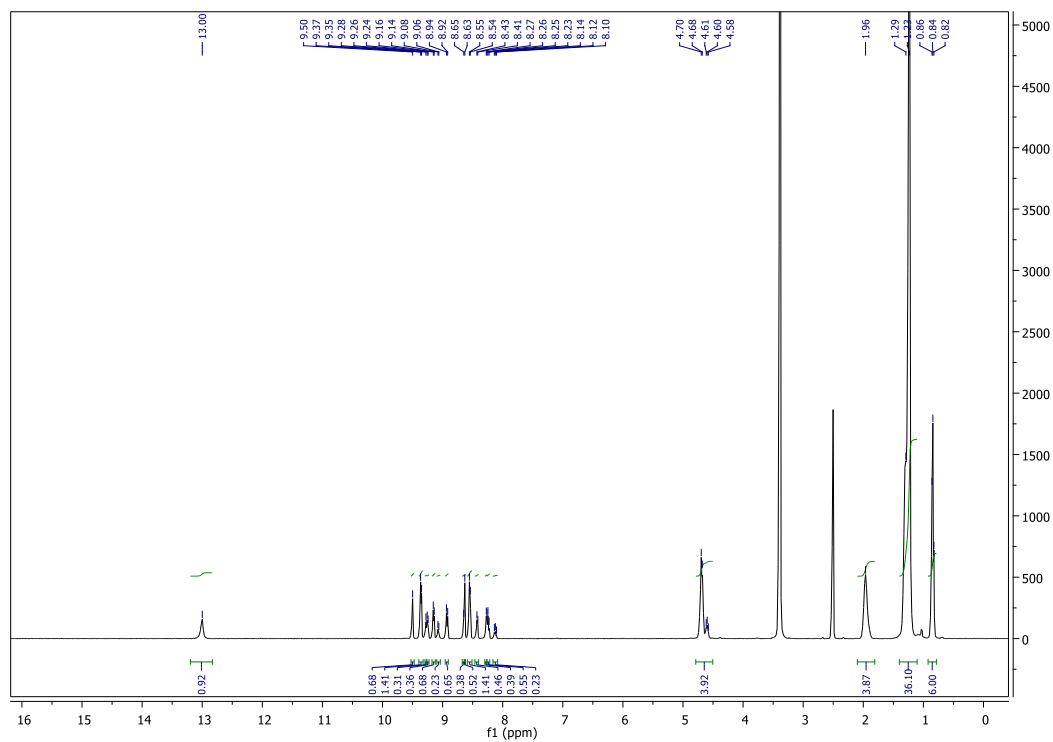


Figure S7.  $^1\text{H}$  NMR of Compound 12

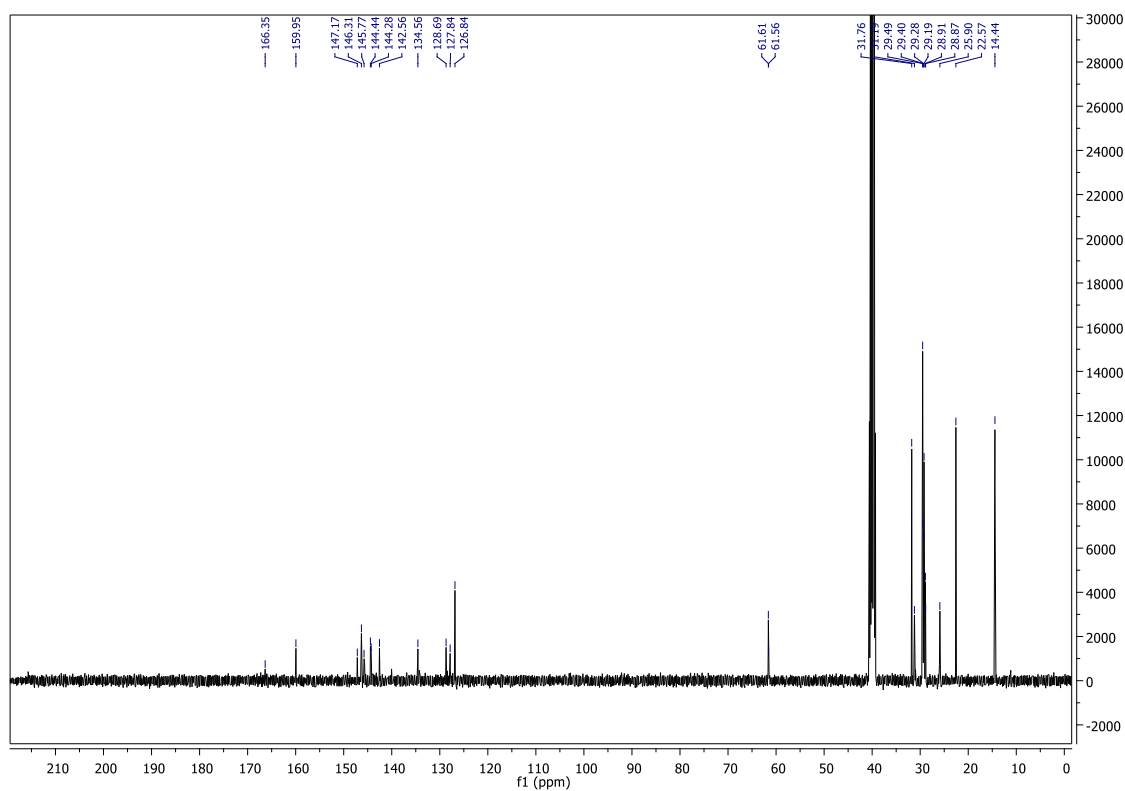


Figure S8.  $^{13}\text{C}$  NMR of Compound 12

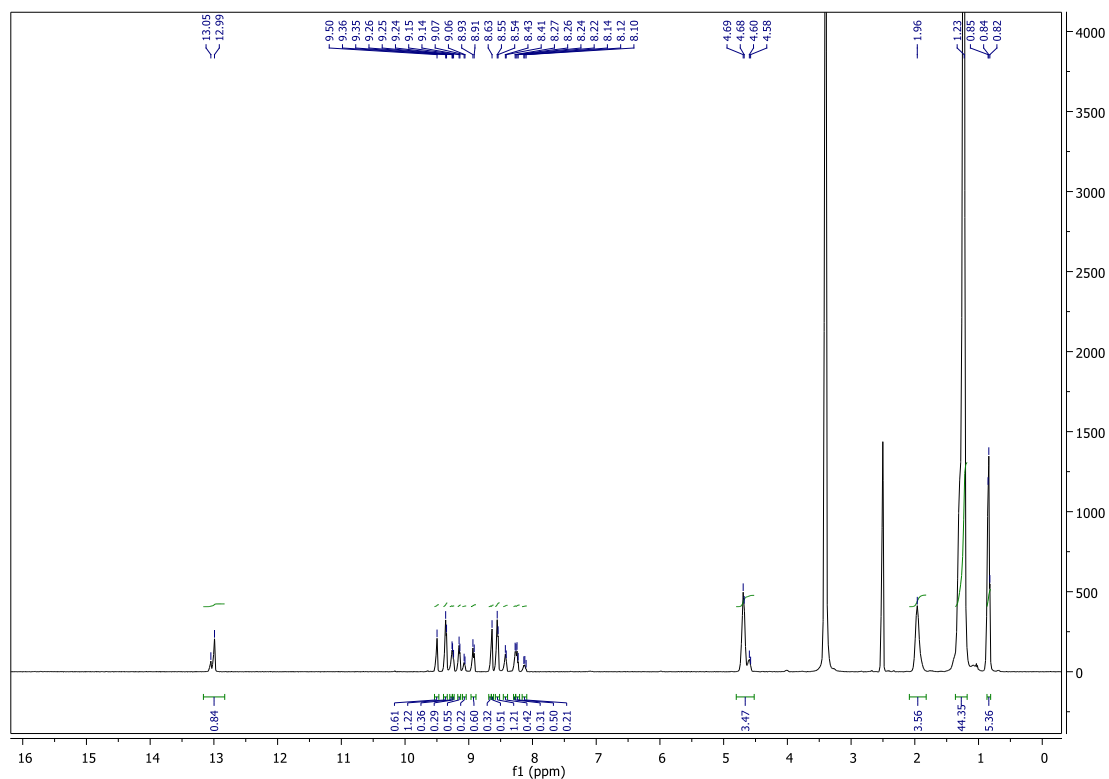


Figure S9.  $^1\text{H}$  NMR of Compound 13

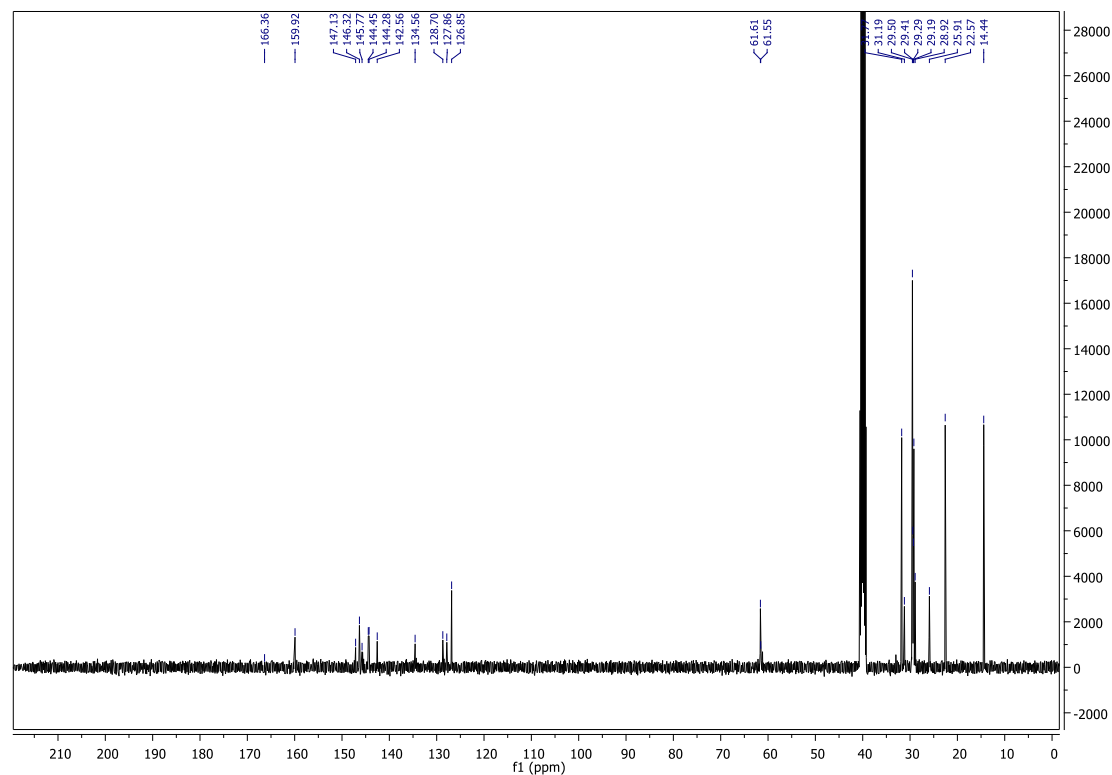


Figure S10.  $^{13}\text{C}$  NMR of Compound 13

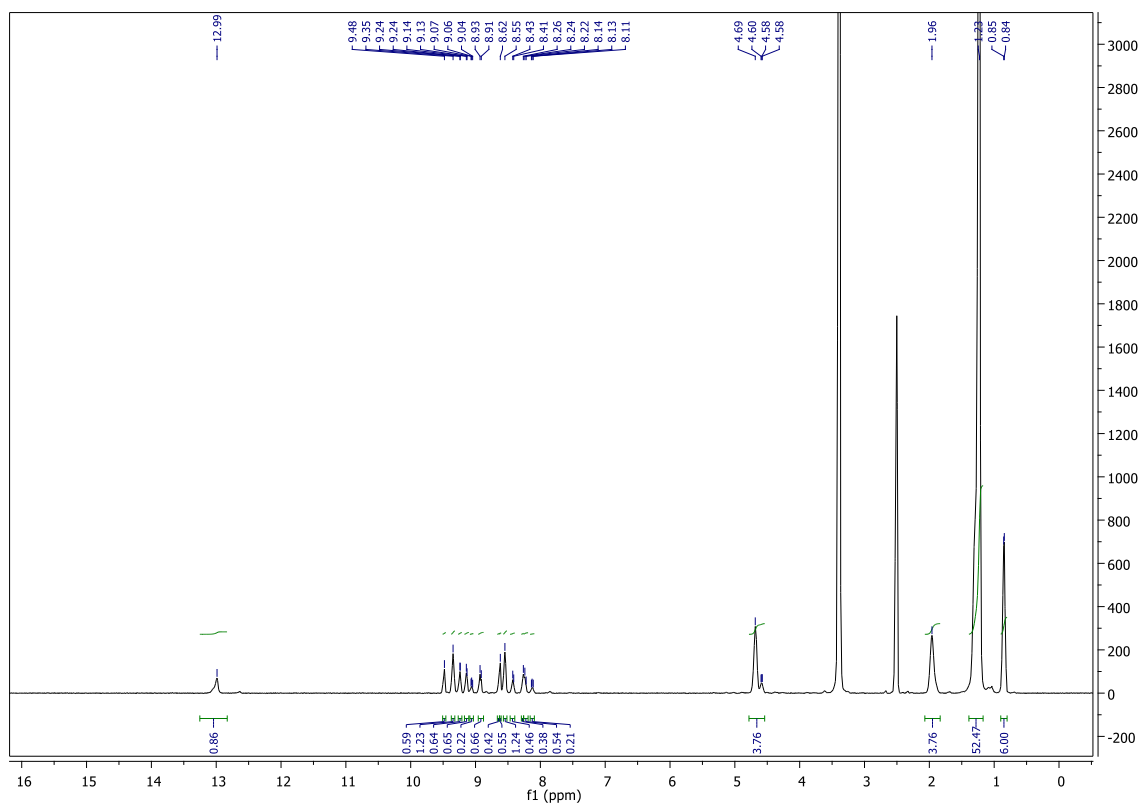


Figure S11. <sup>1</sup>H NMR of Compound 14

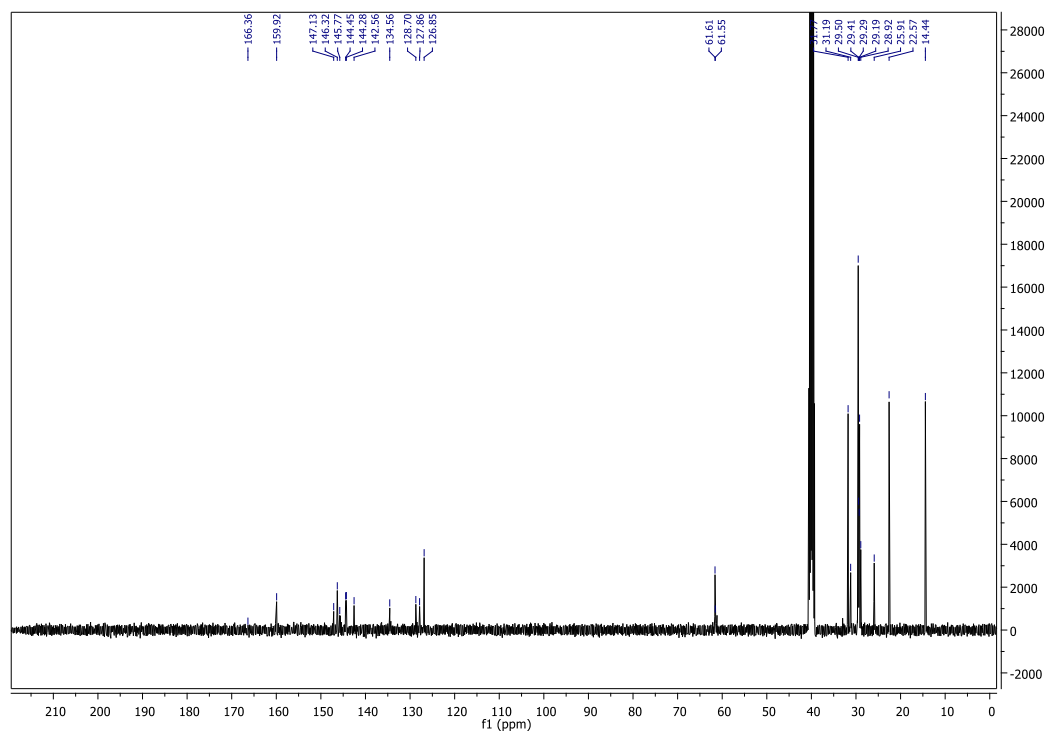


Figure S12. <sup>13</sup>C NMR of Compound 14

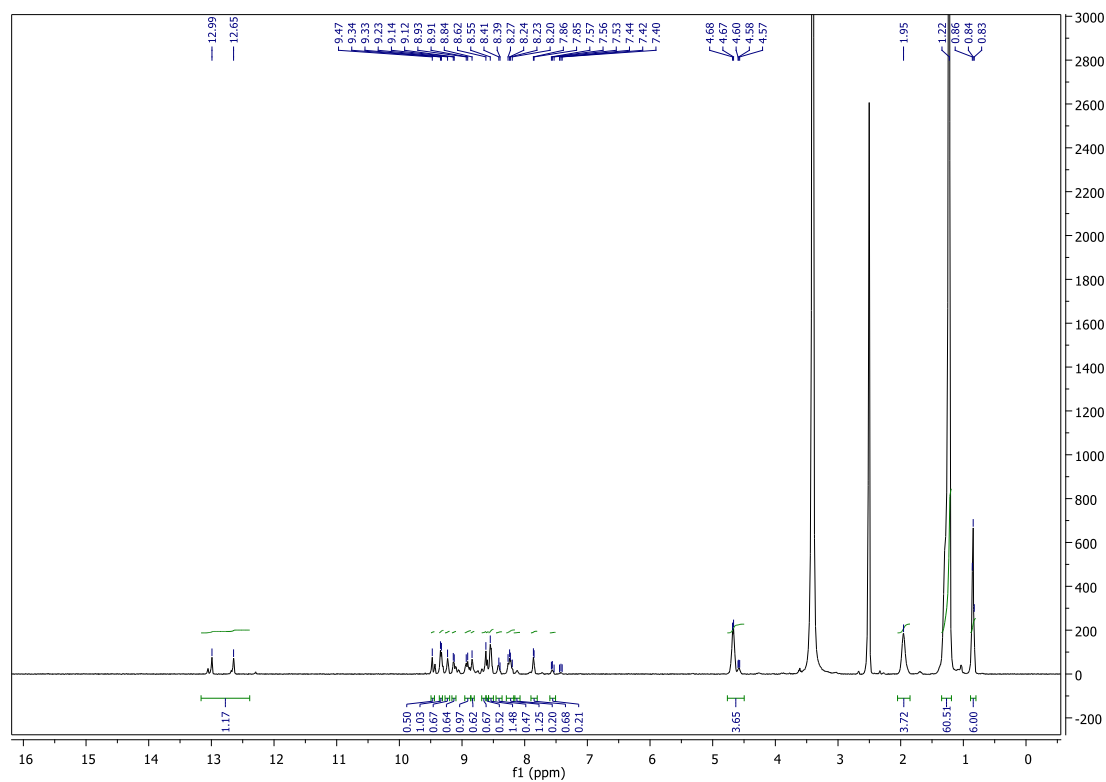


Figure S13.  $^1\text{H}$  NMR of Compound 15

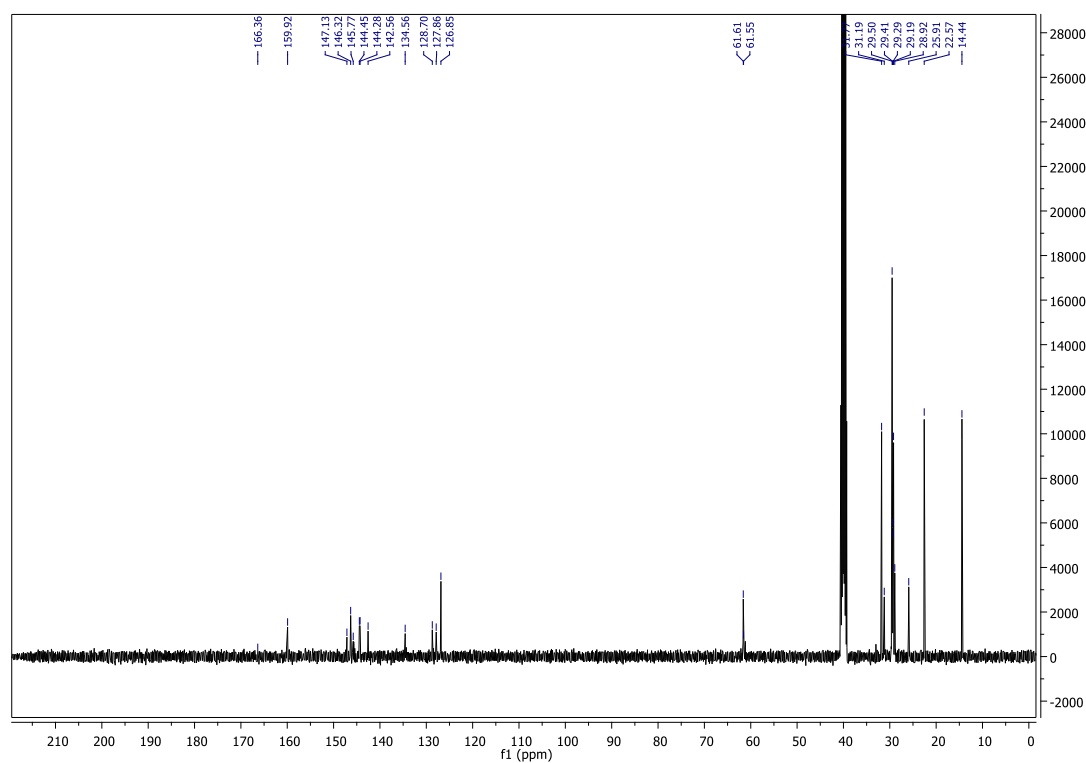


Figure S14.  $^{13}\text{C}$  NMR of Compound 15



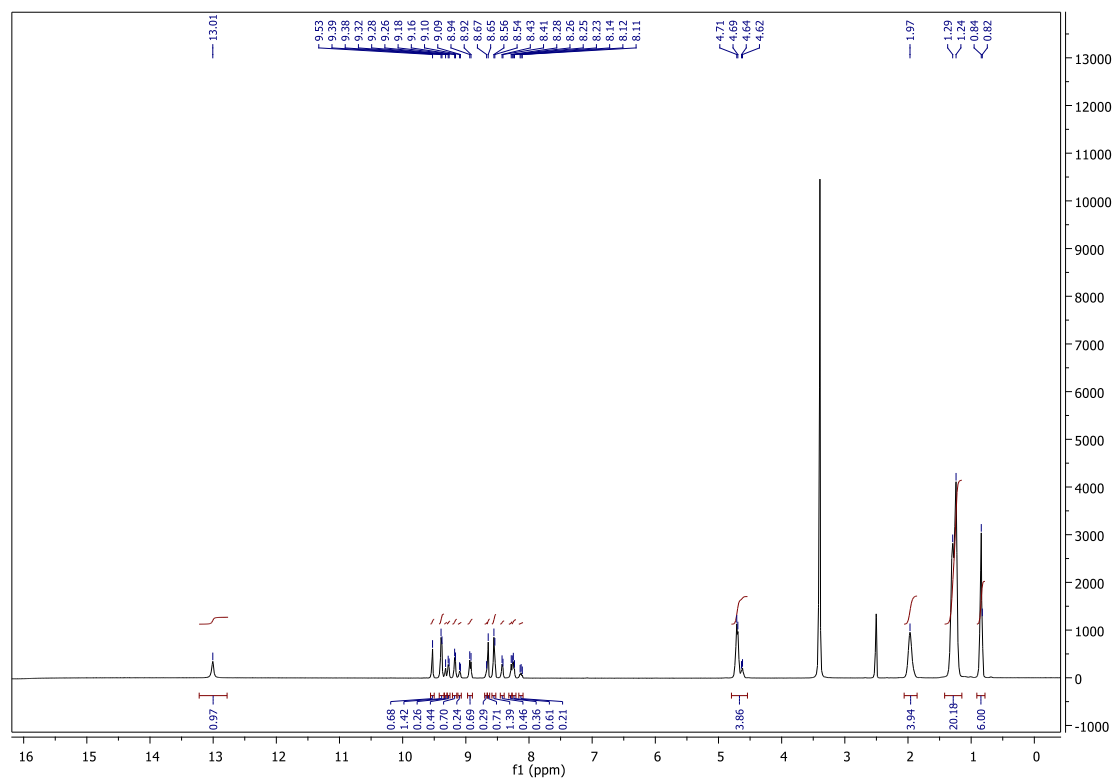


Figure S15.  $^1\text{H}$  NMR of Compound 16

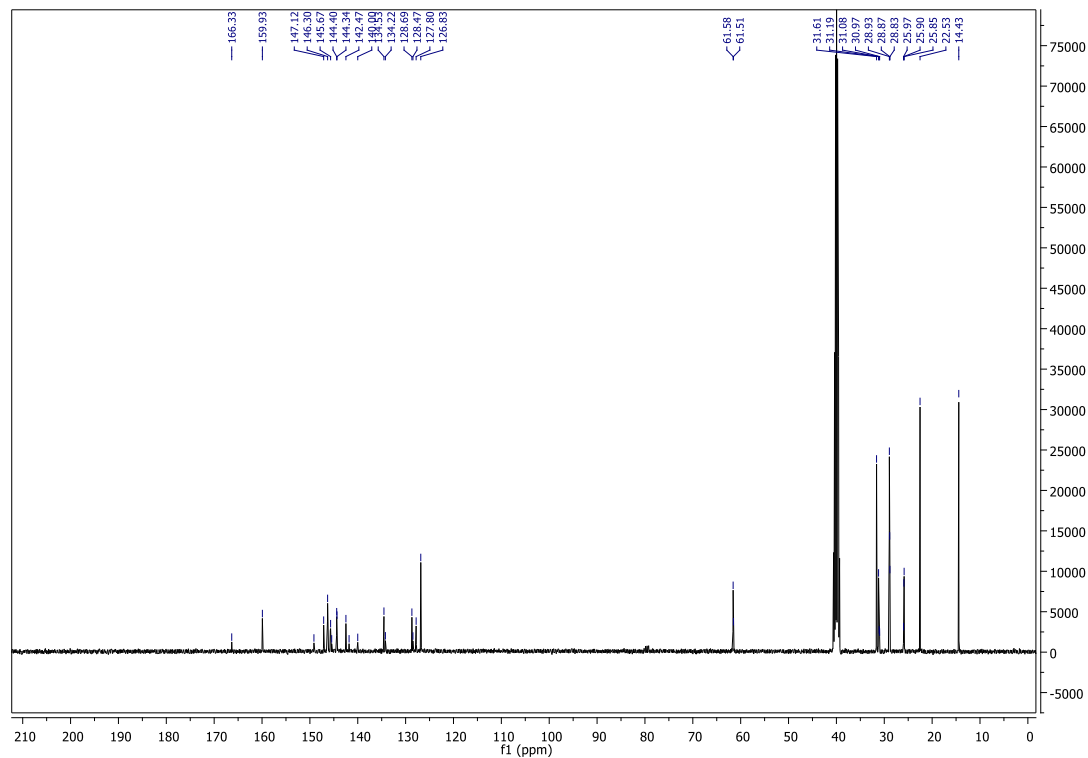


Figure S16.  $^{13}\text{C}$  NMR of Compound 16

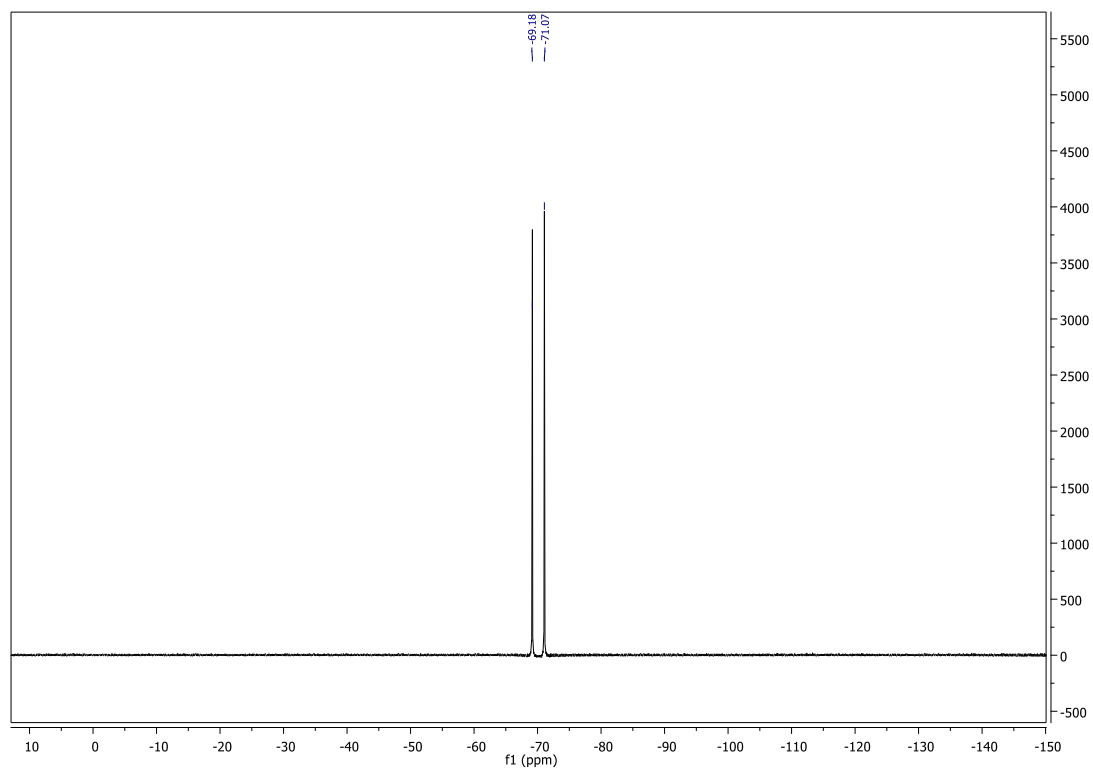


Figure S17.  $^{19}\text{F}$  NMR of Compound 16

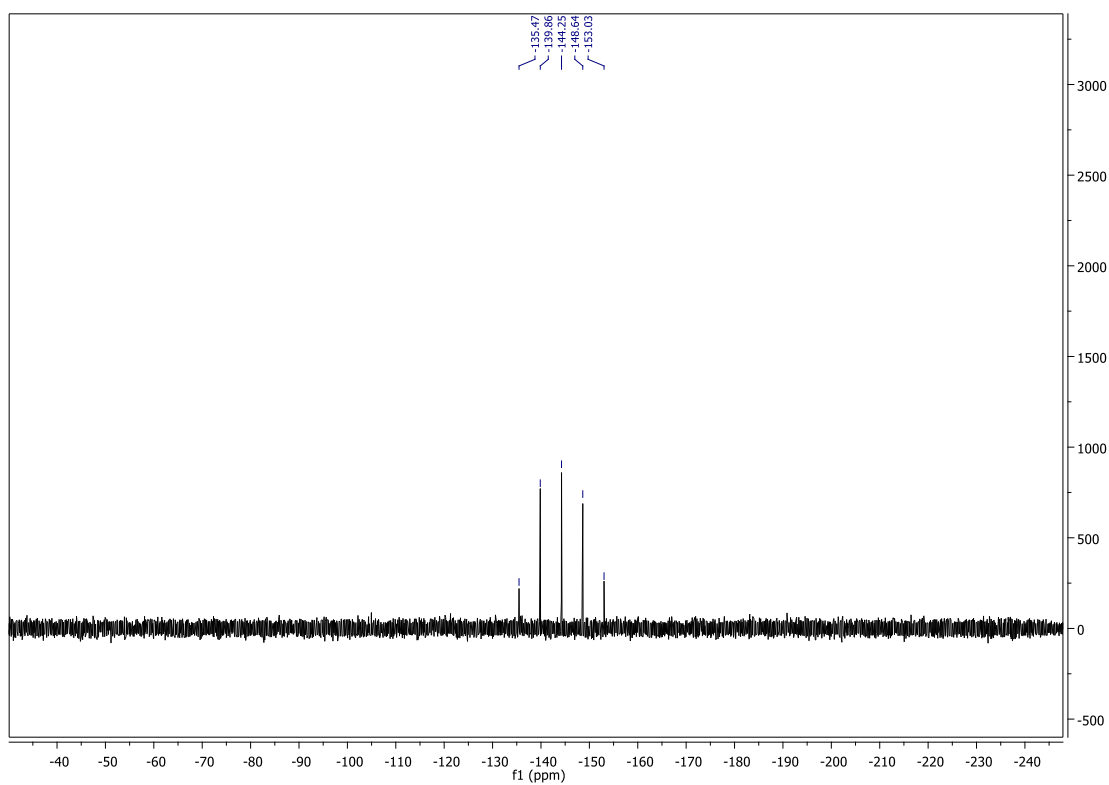


Figure S18.  $^{31}\text{P}$  NMR of Compound 16

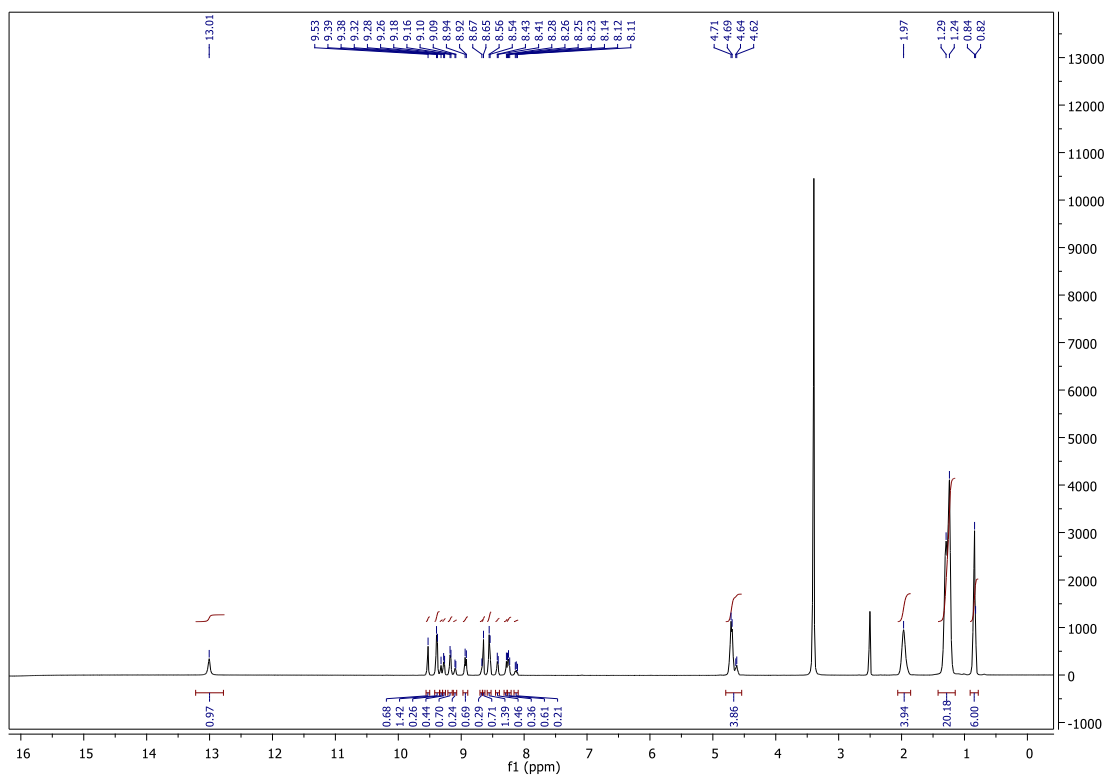


Figure S19. <sup>1</sup>H NMR of Compound 17

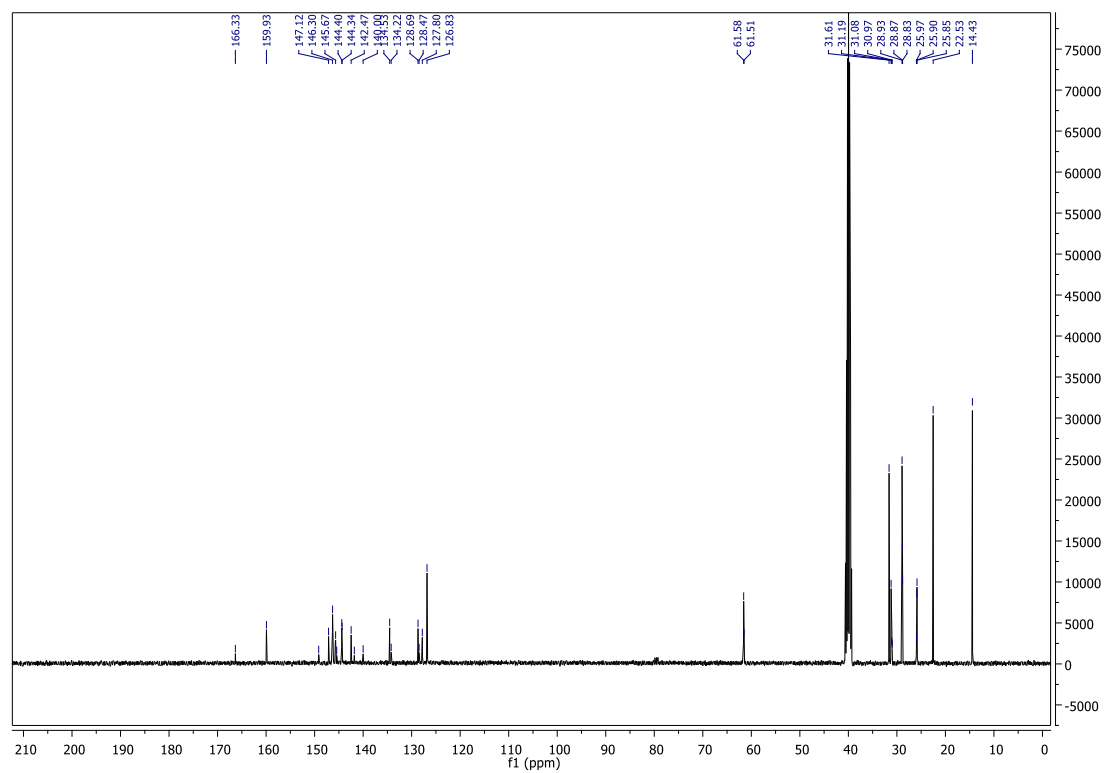


Figure S20. <sup>13</sup>C NMR of Compound 17

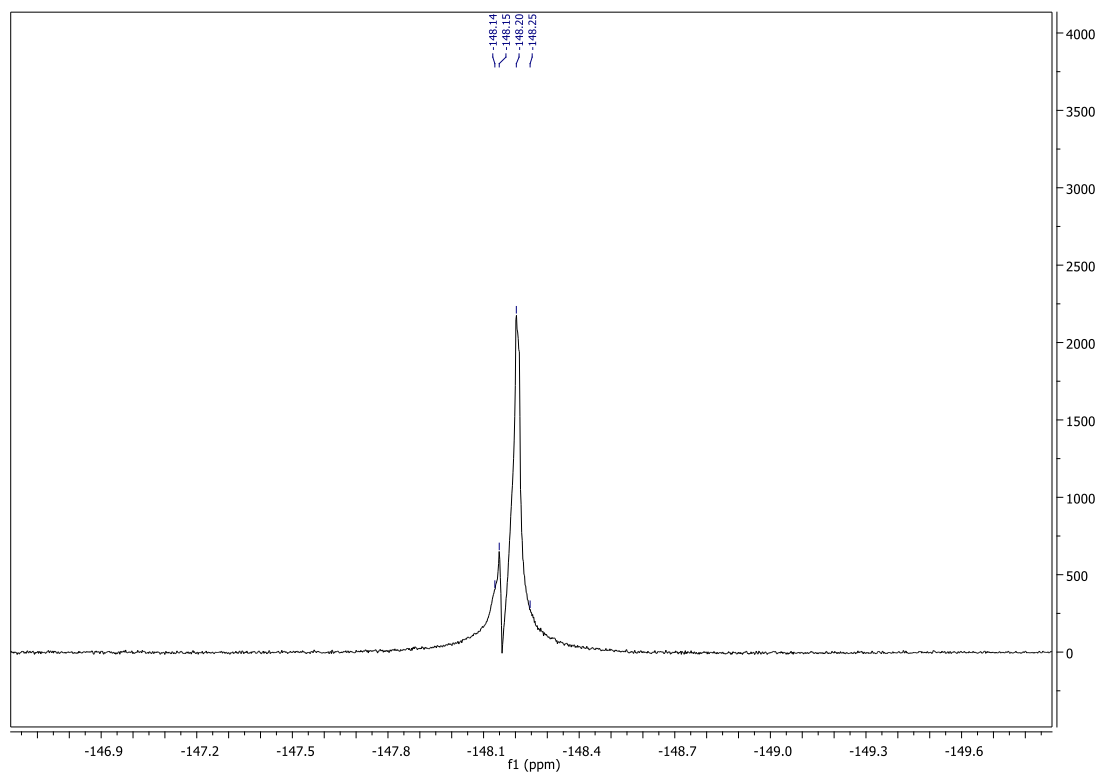


Figure S21.  $^{19}\text{F}$  NMR of Compound 17

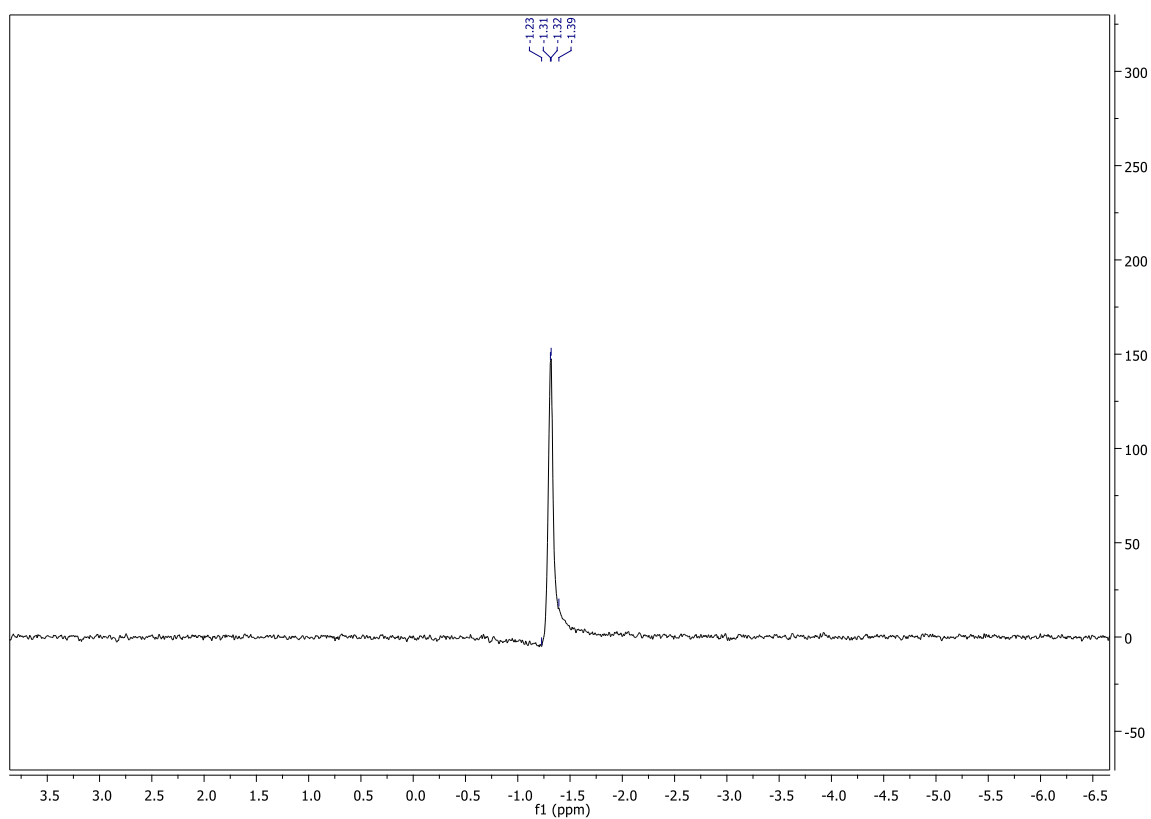


Figure S22.  $^{11}\text{B}$  NMR of Compound 17

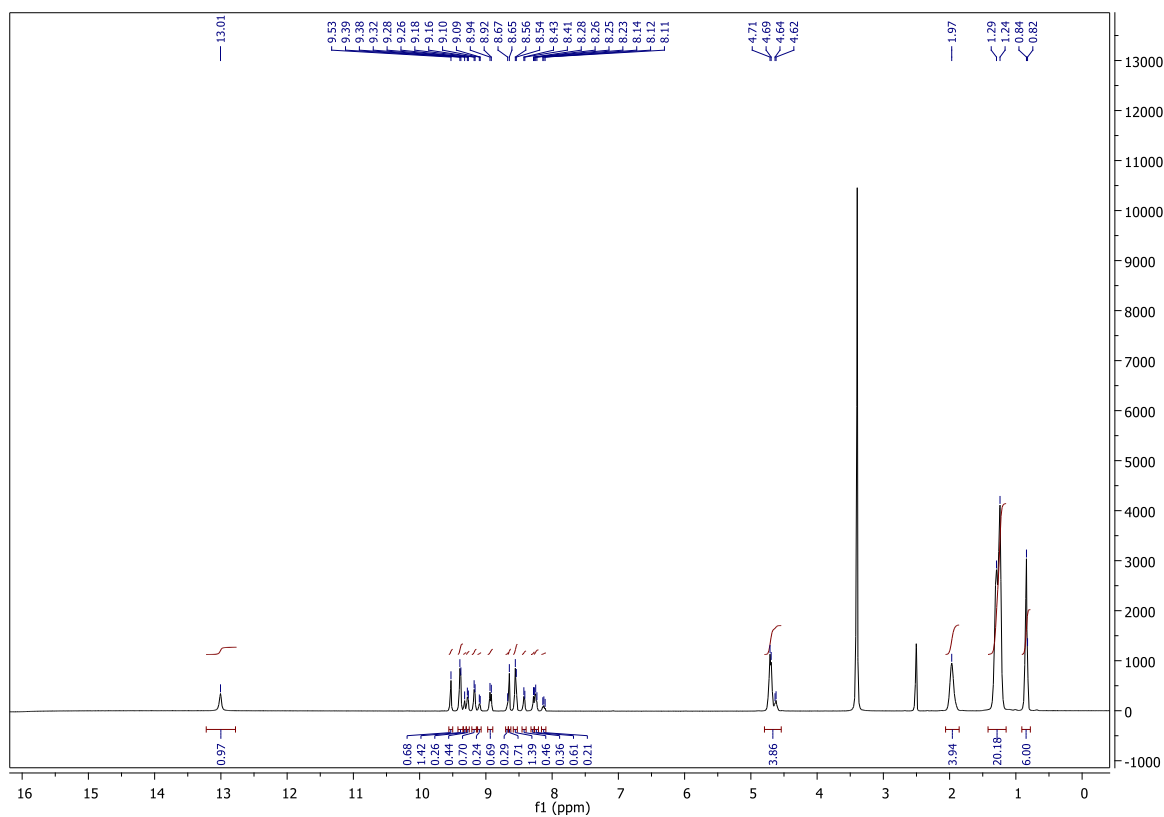


Figure S23. <sup>1</sup>H NMR of Compound 18

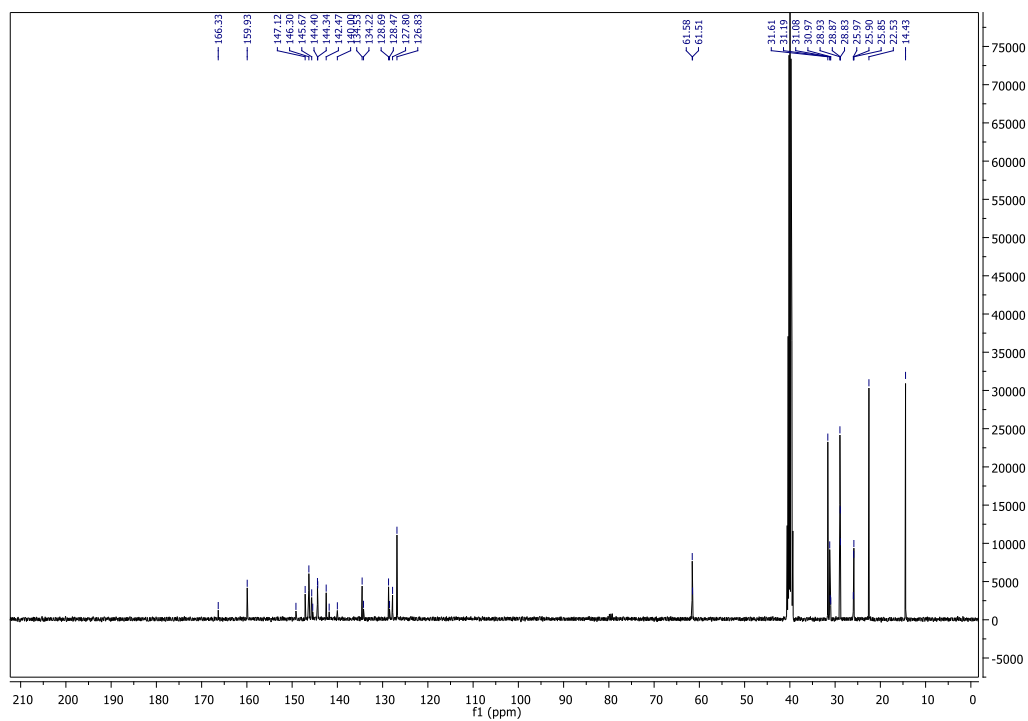


Figure S24. <sup>13</sup>C NMR of Compound 18

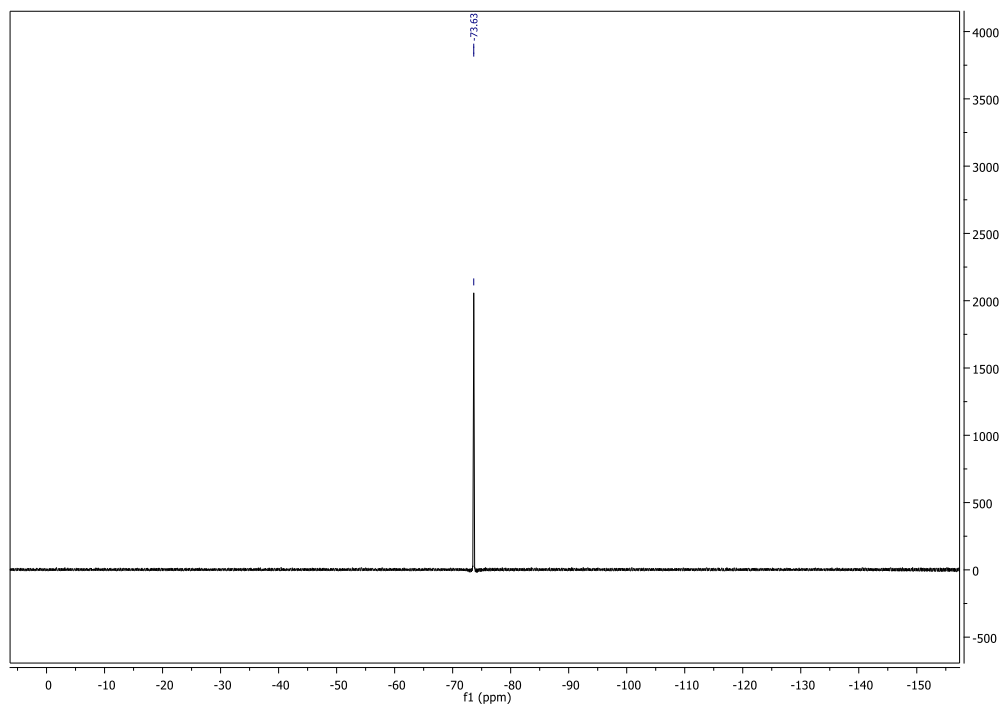


Figure S25.  $^{19}\text{F}$  NMR of Compound 18

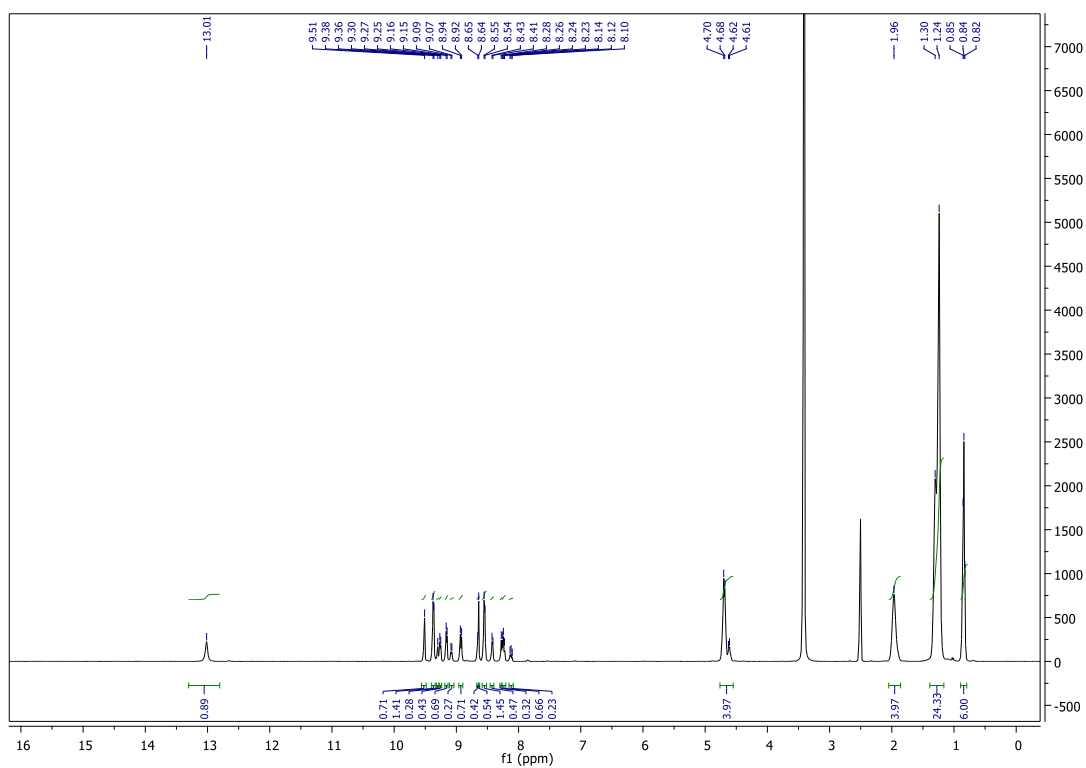


Figure S26.  $^1\text{H}$  NMR of Compound 19

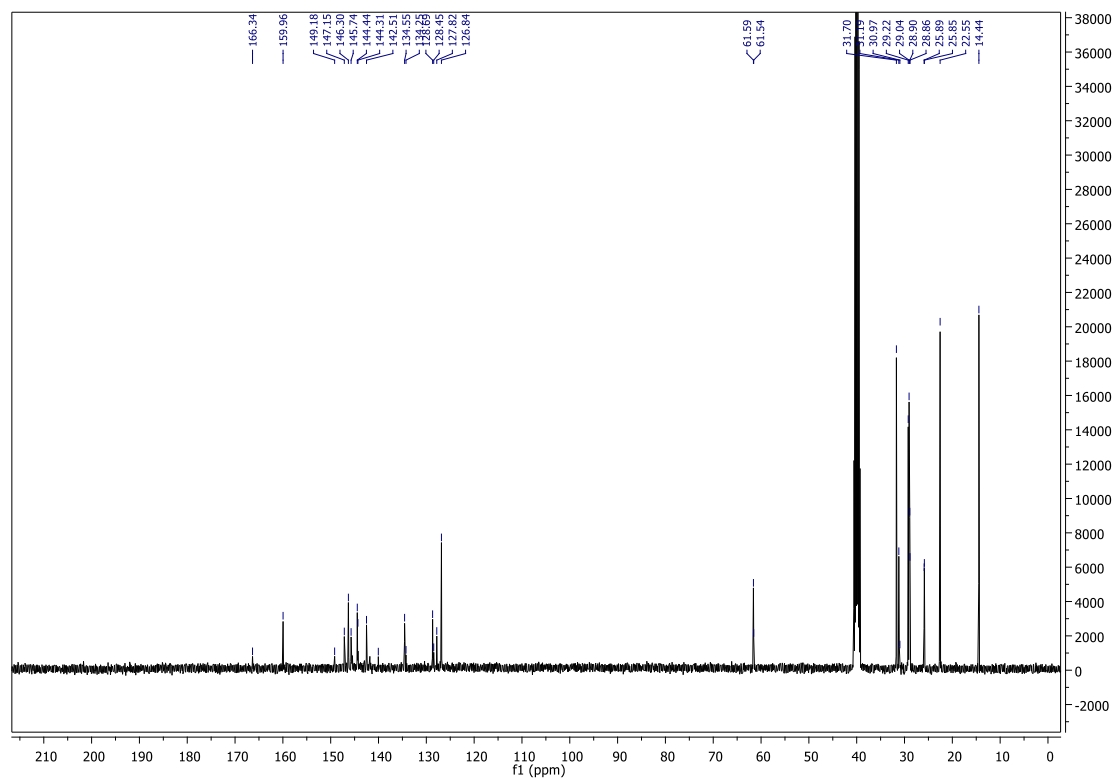


Figure S27. <sup>13</sup>C NMR of Compound 19

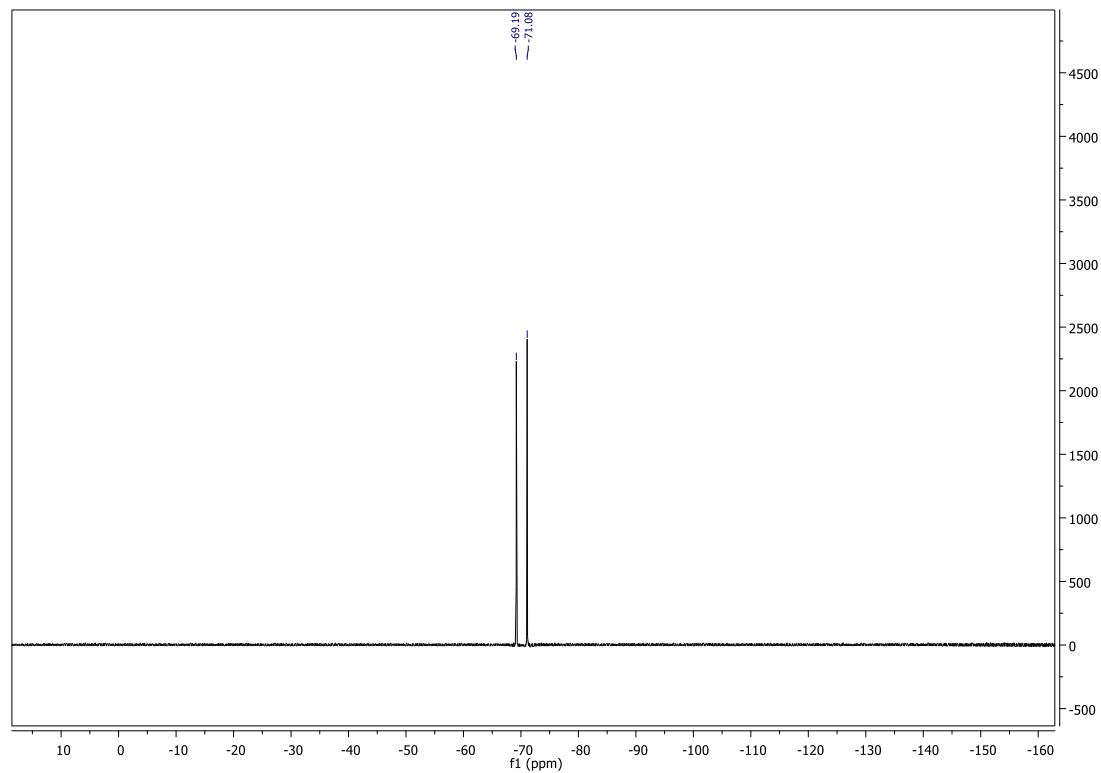


Figure S28. <sup>19</sup>F NMR of Compound 19

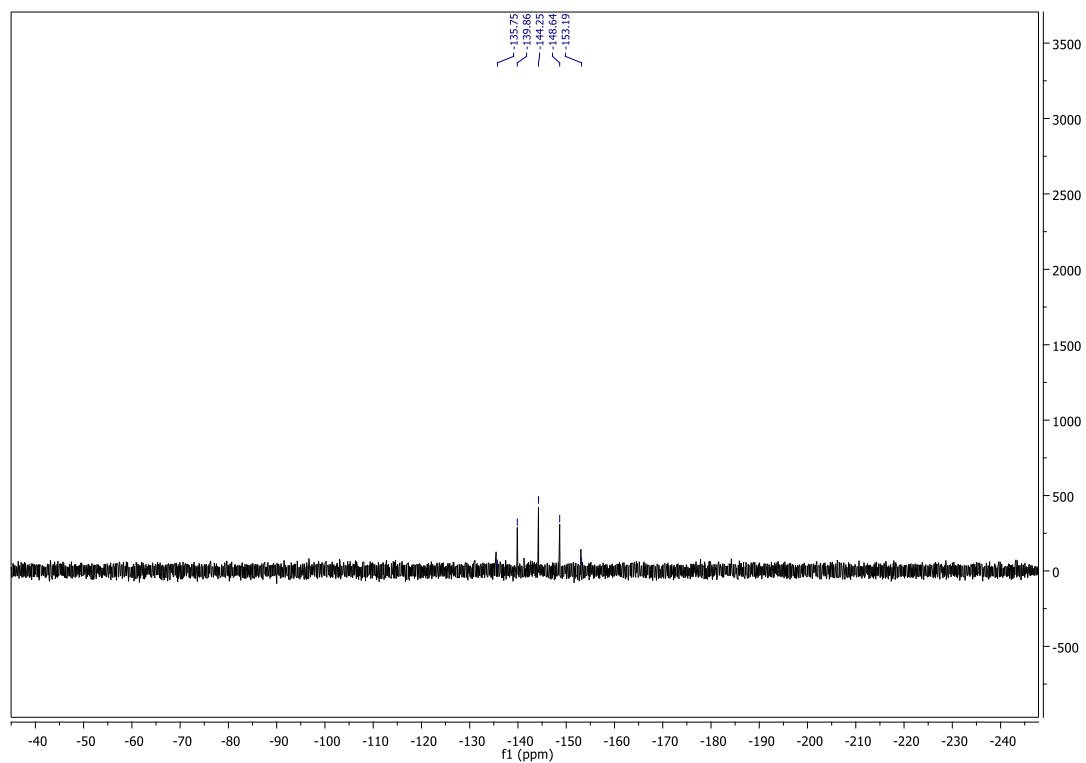


Figure S29.  $^{31}\text{P}$  NMR of Compound 19

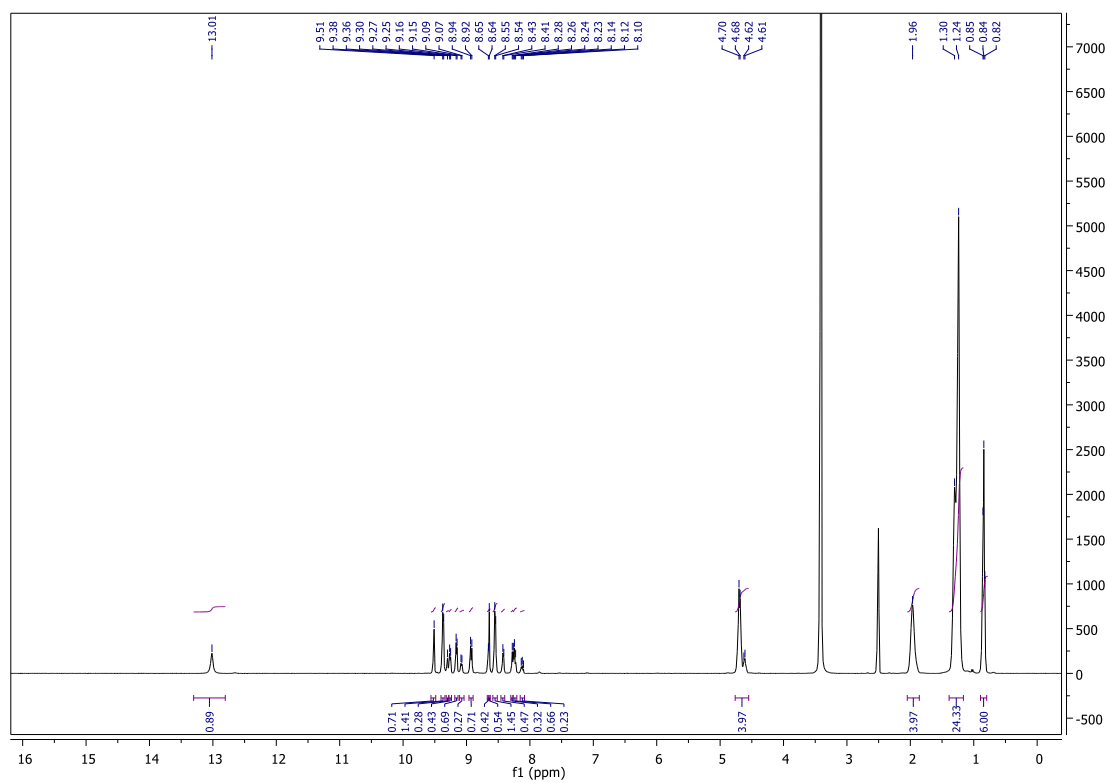


Figure S30.  $^1\text{H}$  NMR of Compound 20



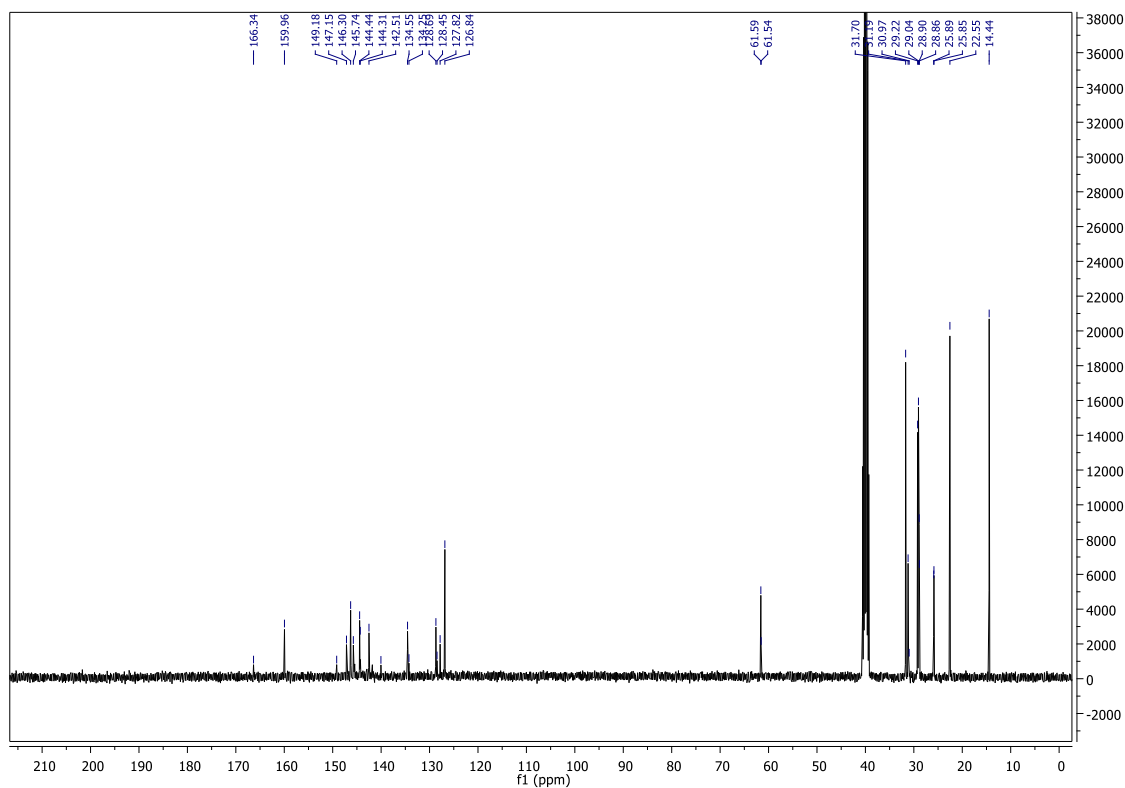


Figure S31. <sup>13</sup>C NMR of Compound 20

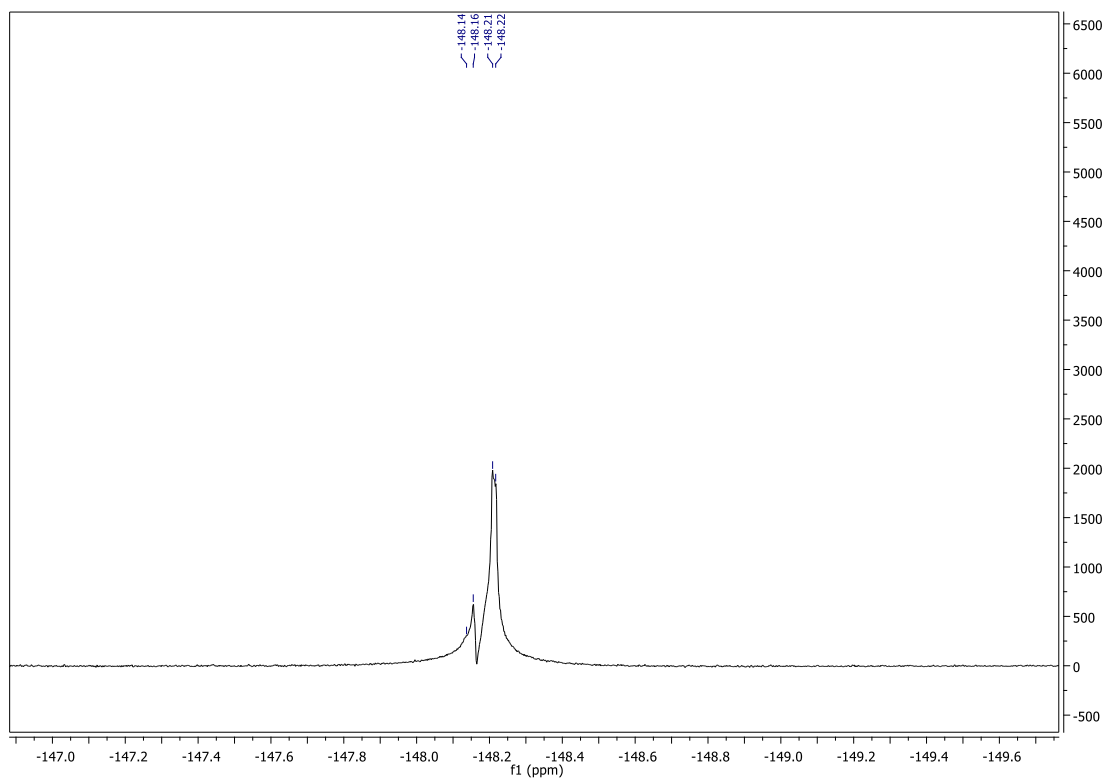


Figure S32. <sup>19</sup>F NMR of Compound 20

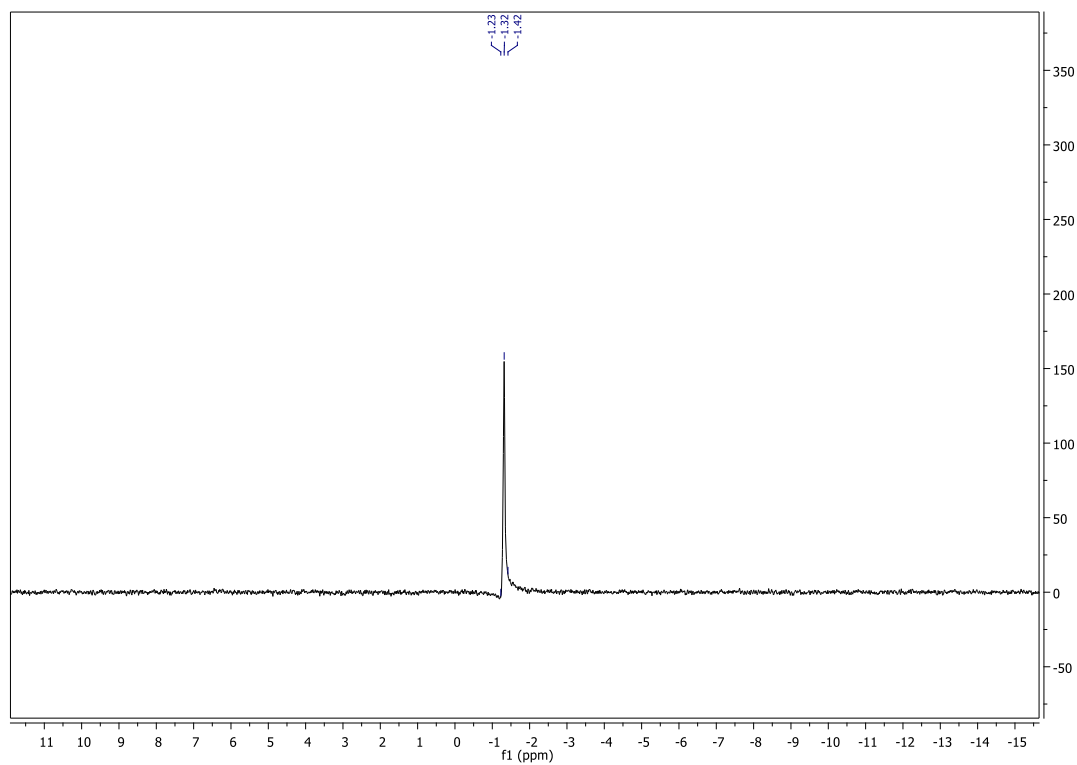


Figure S33.  $^{11}\text{B}$  NMR of Compound 20

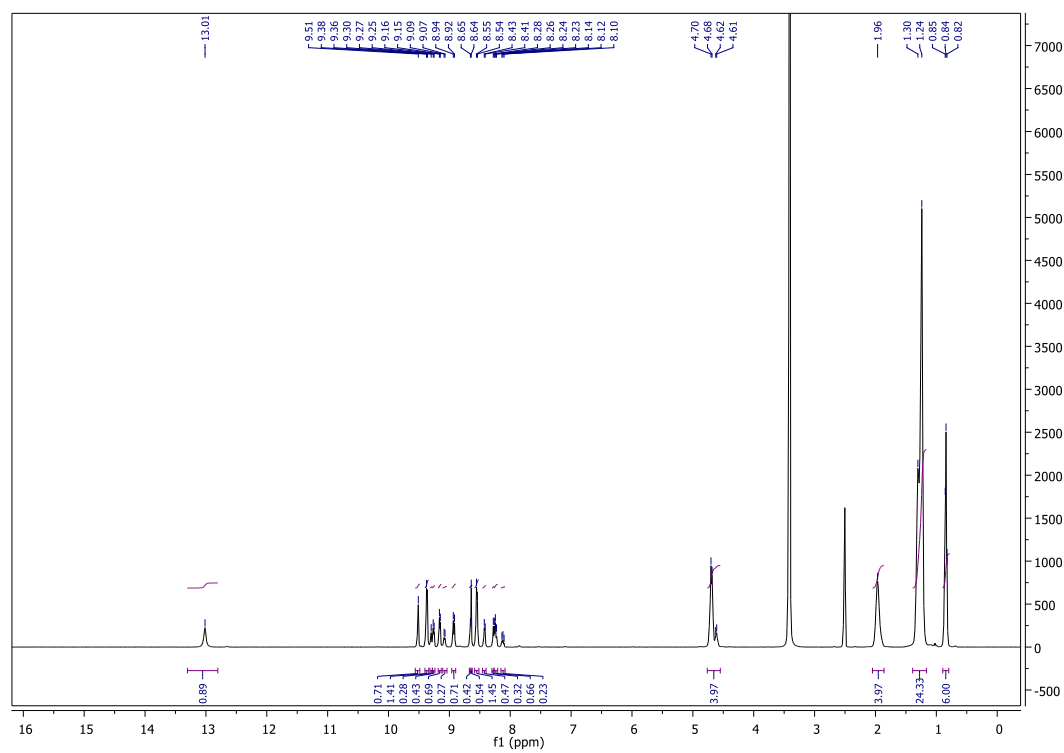


Figure S34.  $^1\text{H}$  NMR of Compound 21

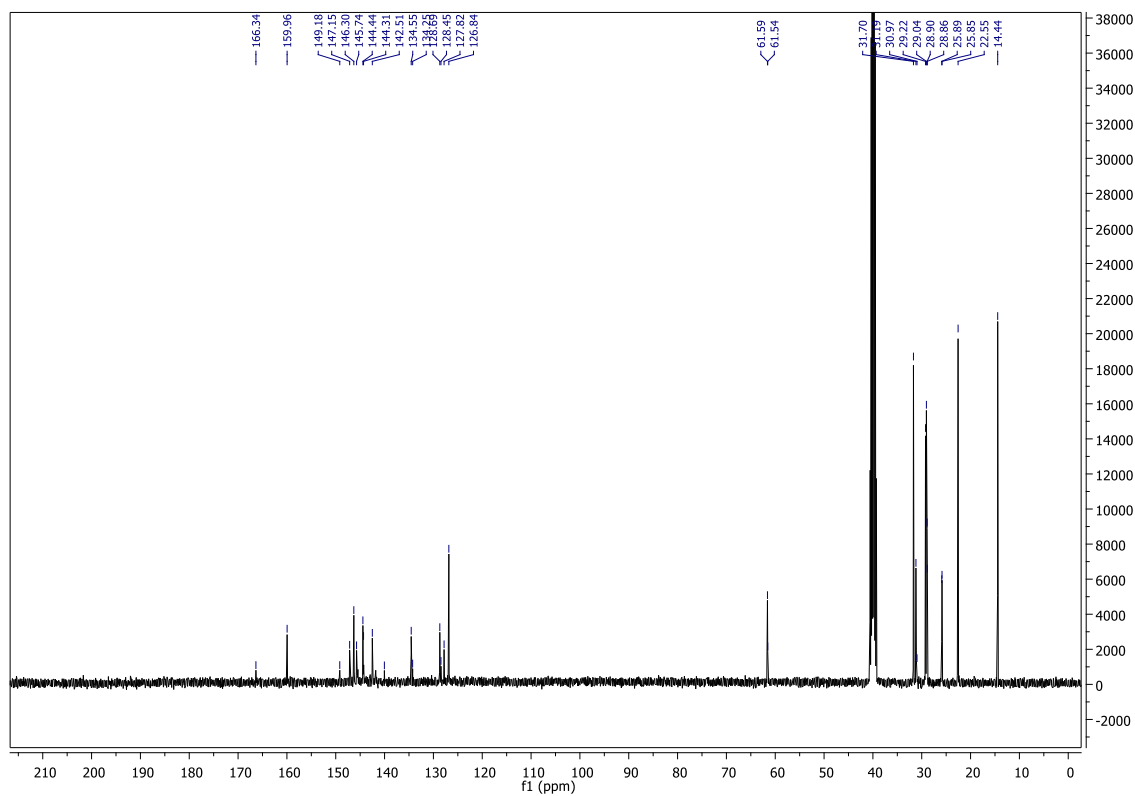


Figure S35. <sup>13</sup>C NMR of Compound 21

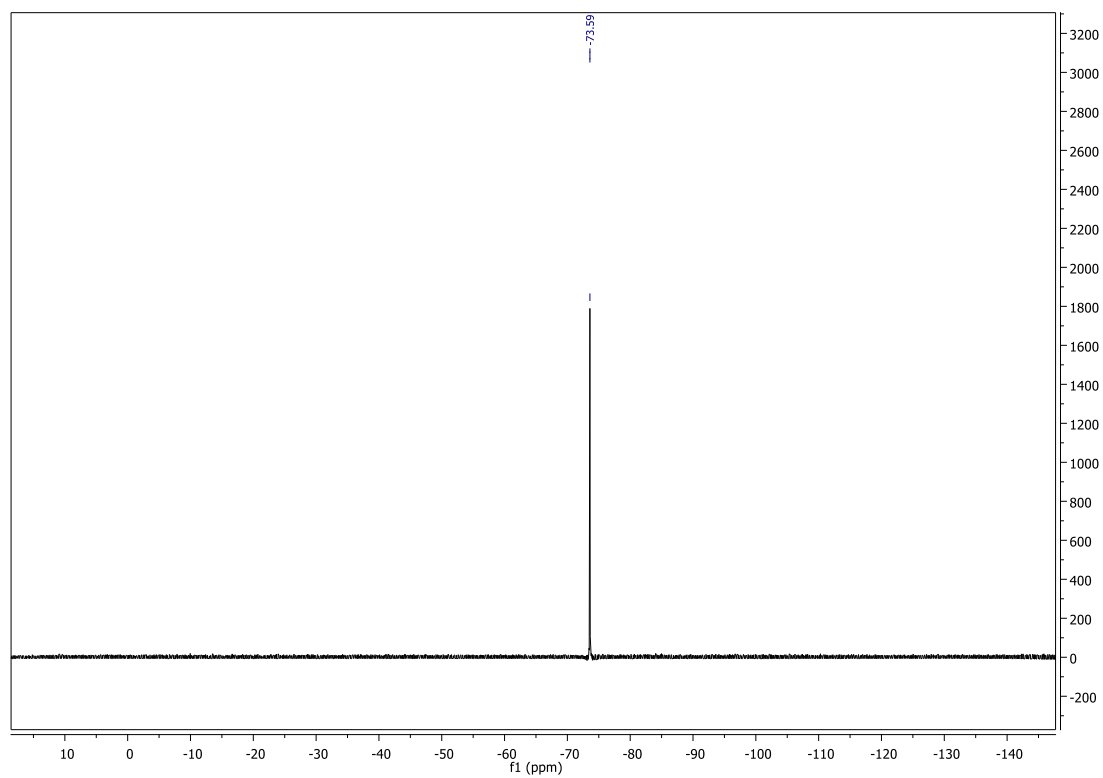


Figure S36. <sup>19</sup>F NMR of Compound 21

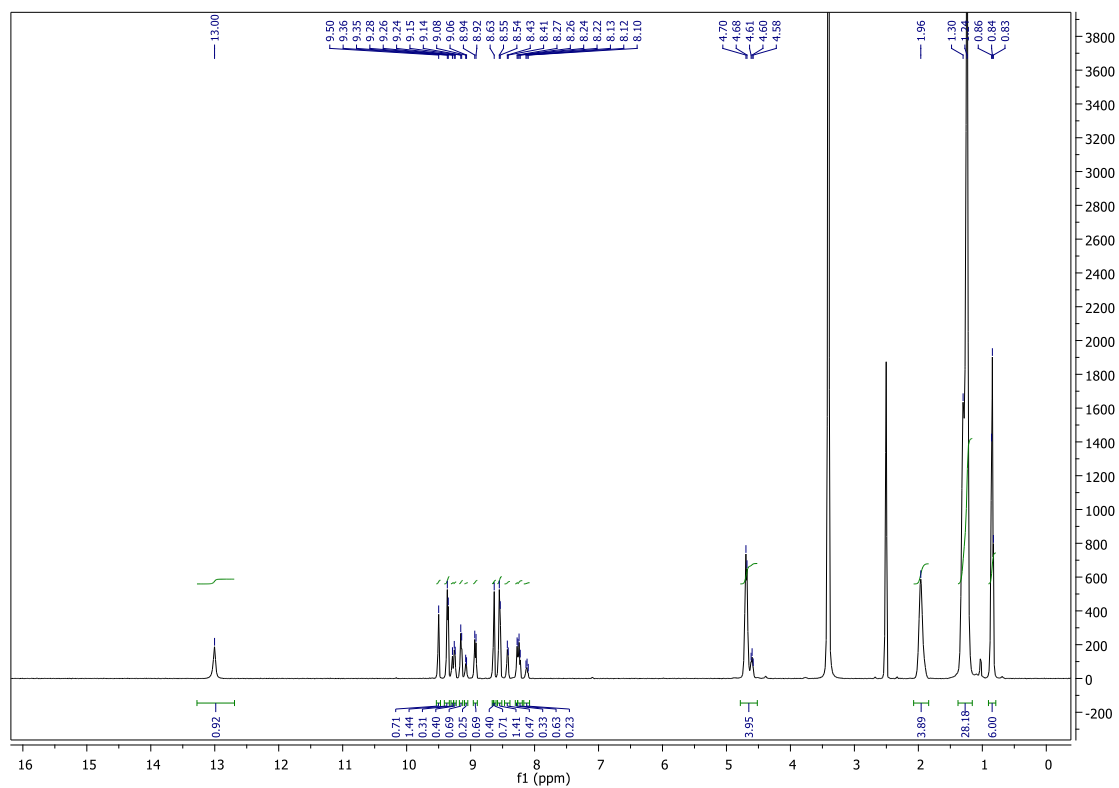


Figure S37. <sup>1</sup>H NMR of Compound 22

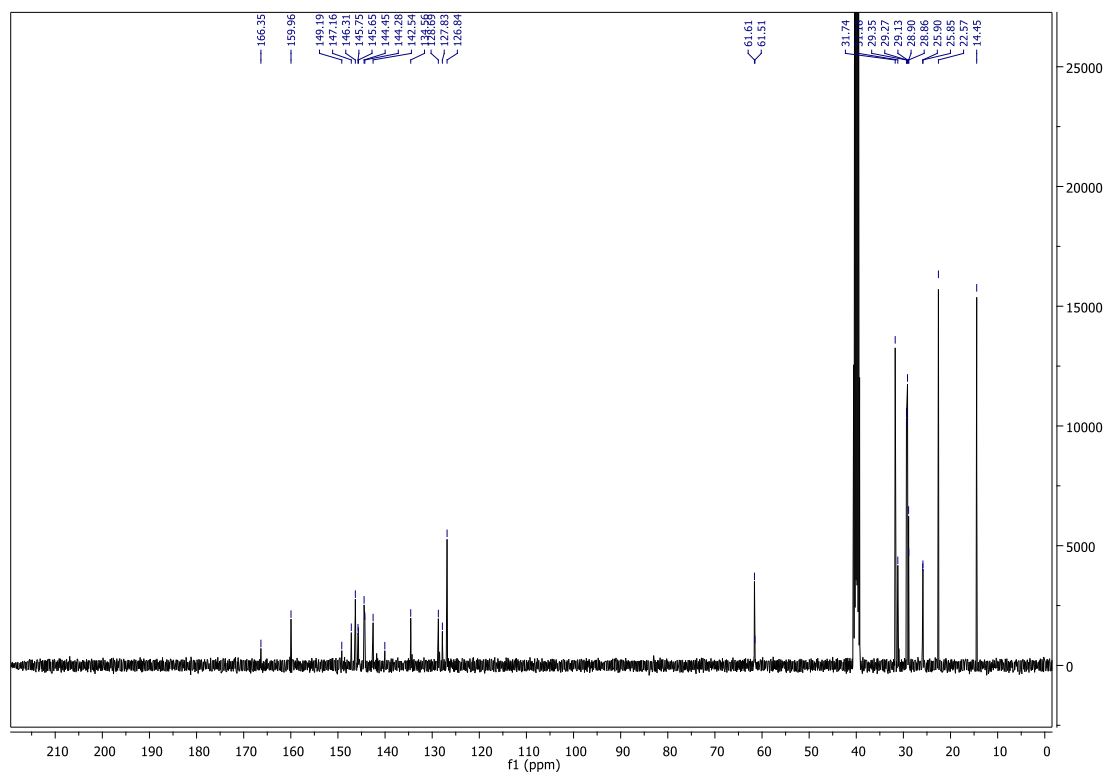


Figure S38. <sup>13</sup>C NMR of Compound 22

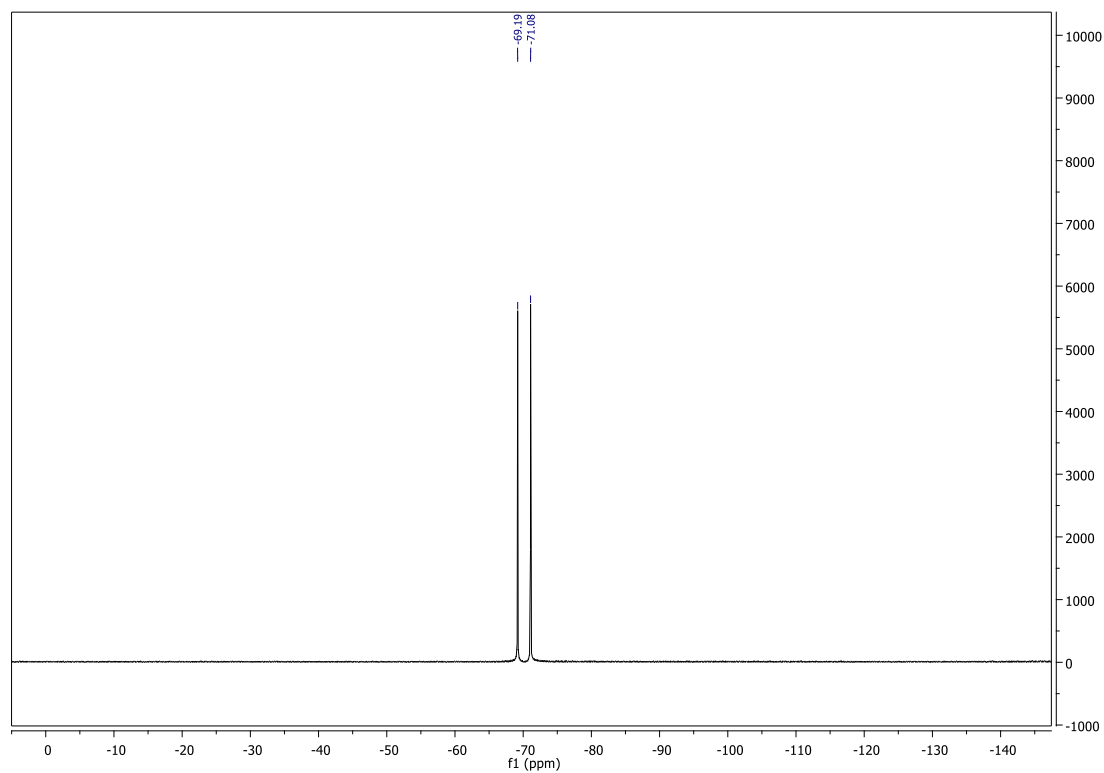


Figure S39.  $^{19}\text{F}$  NMR of Compound 22

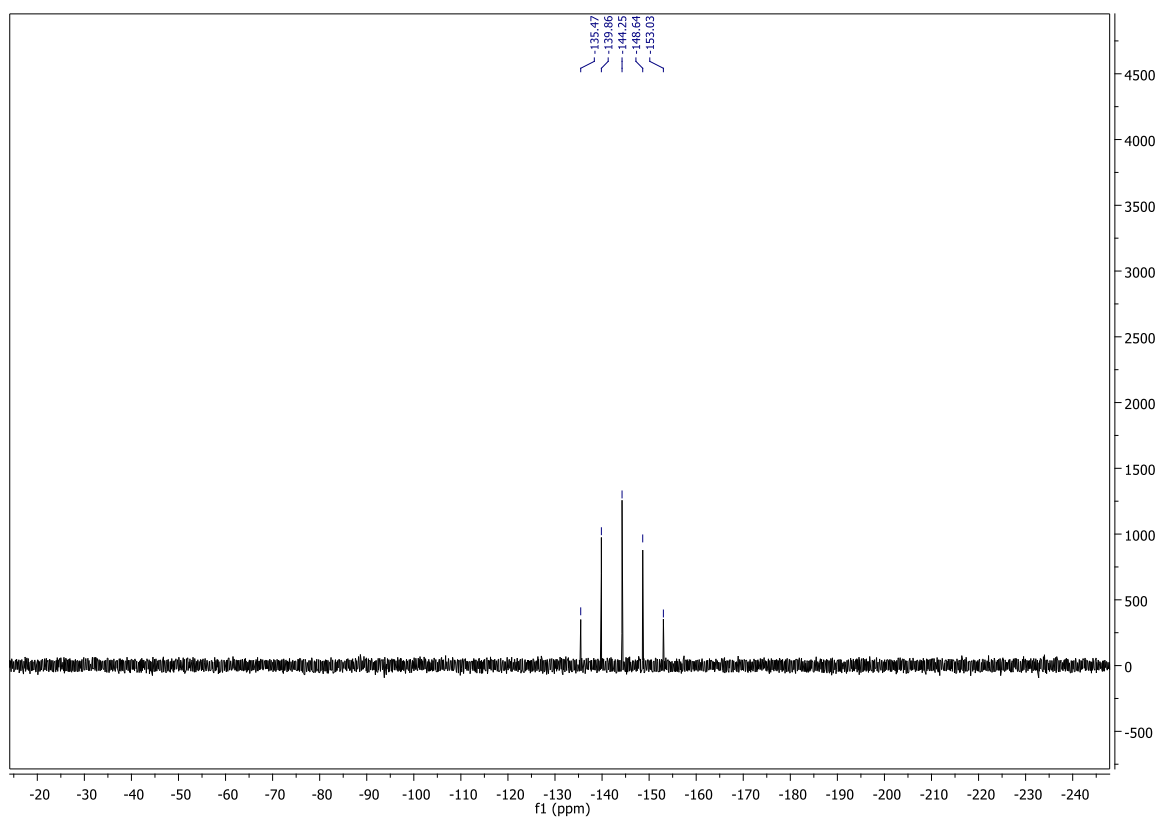


Figure S40.  $^{31}\text{P}$  NMR of Compound 22

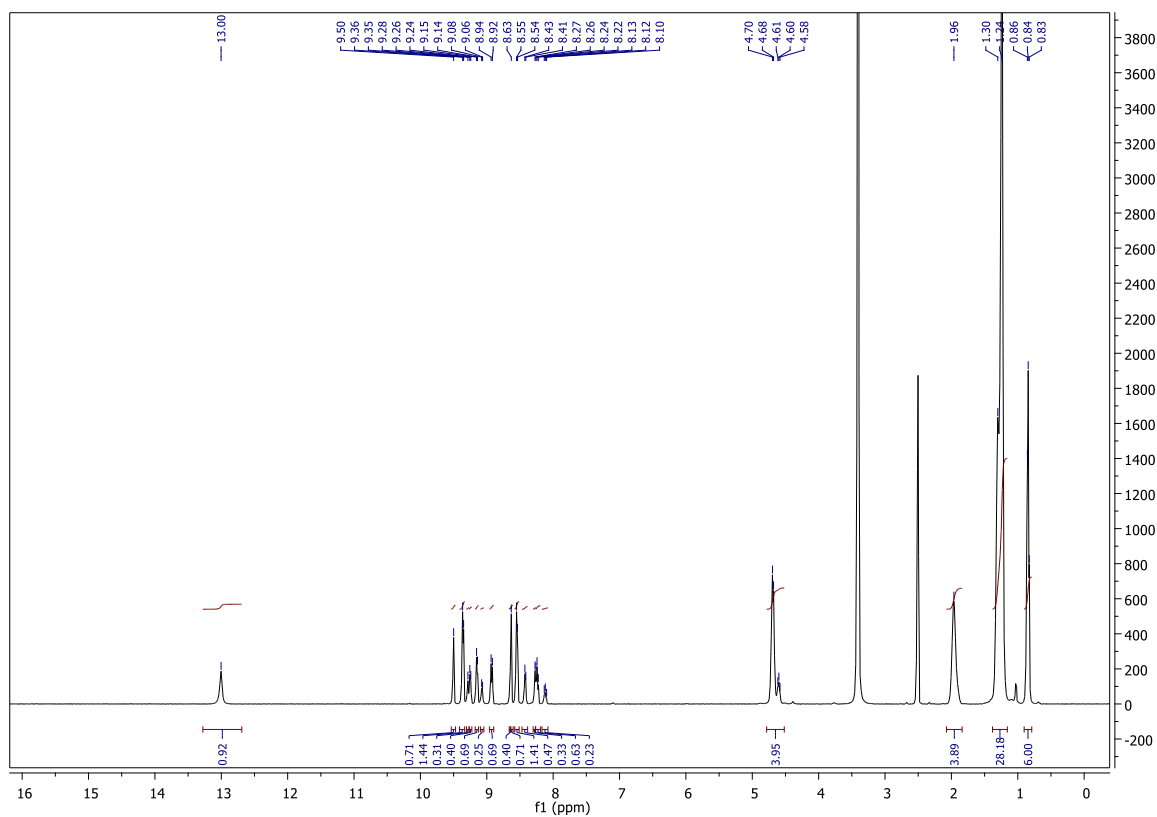


Figure S41.  $^1\text{H}$  NMR of Compound 23

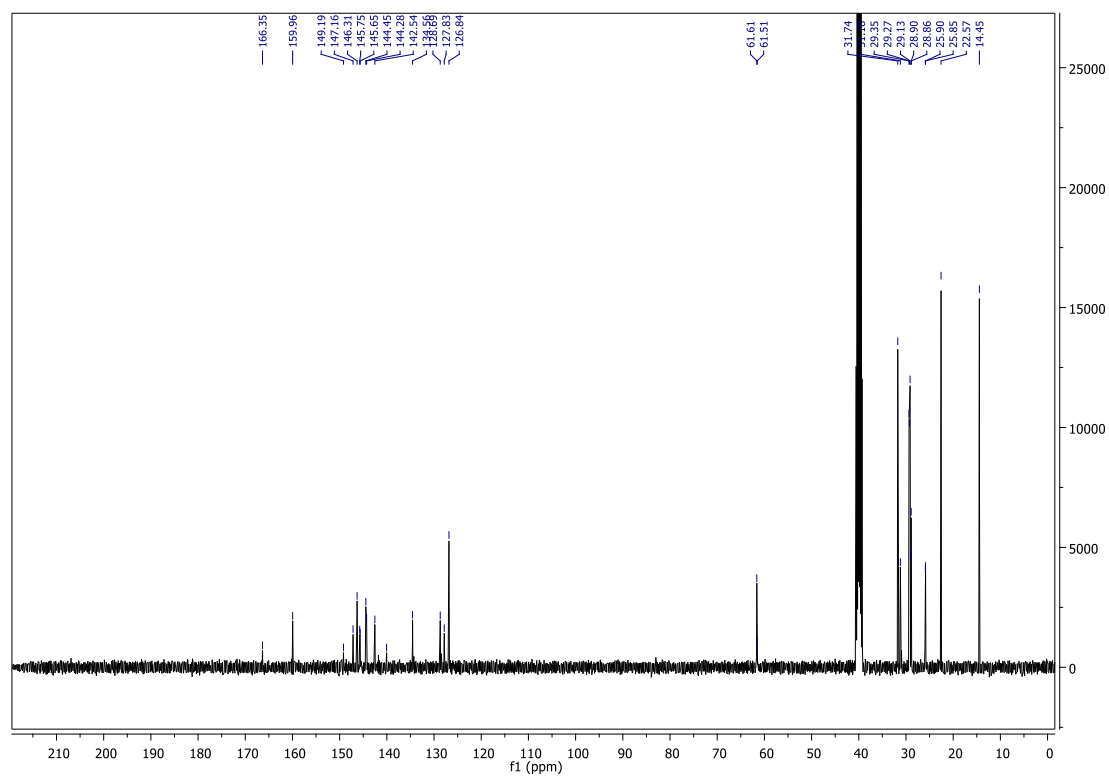


Figure S42.  $^{13}\text{C}$  NMR of Compound 23

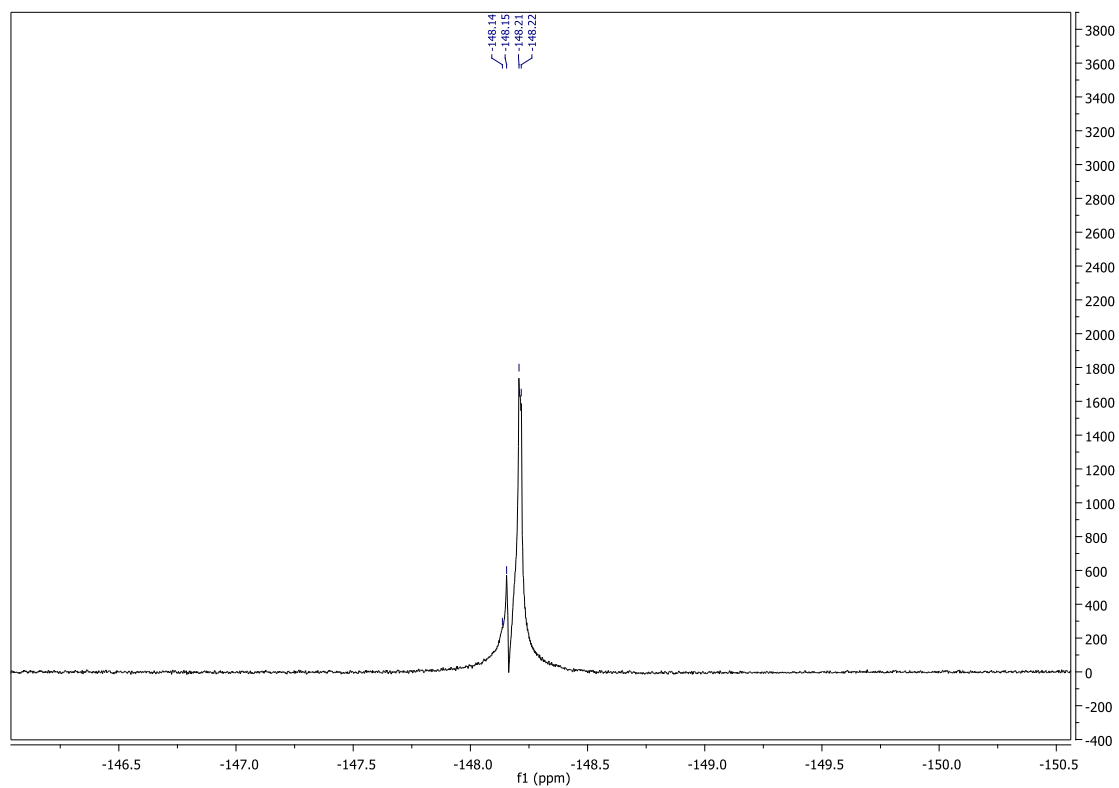


Figure S43.  $^{19}\text{F}$  NMR of Compound 23

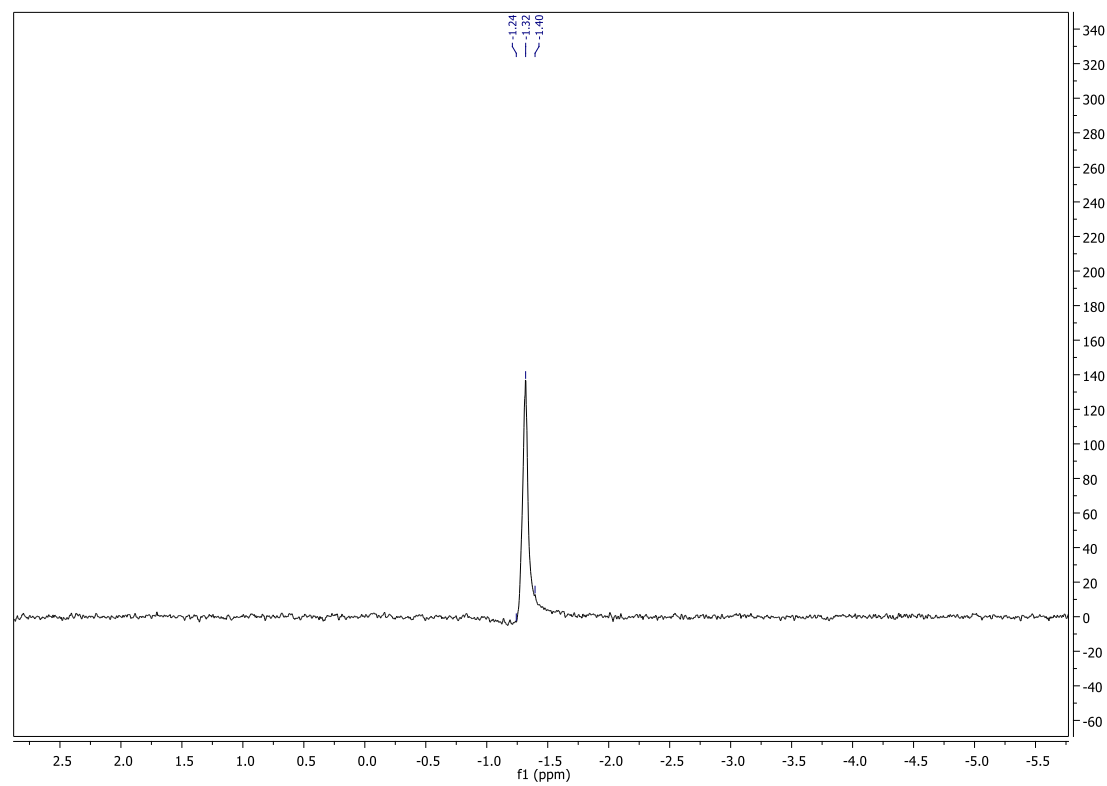


Figure S44.  $^{11}\text{B}$  NMR of Compound 23

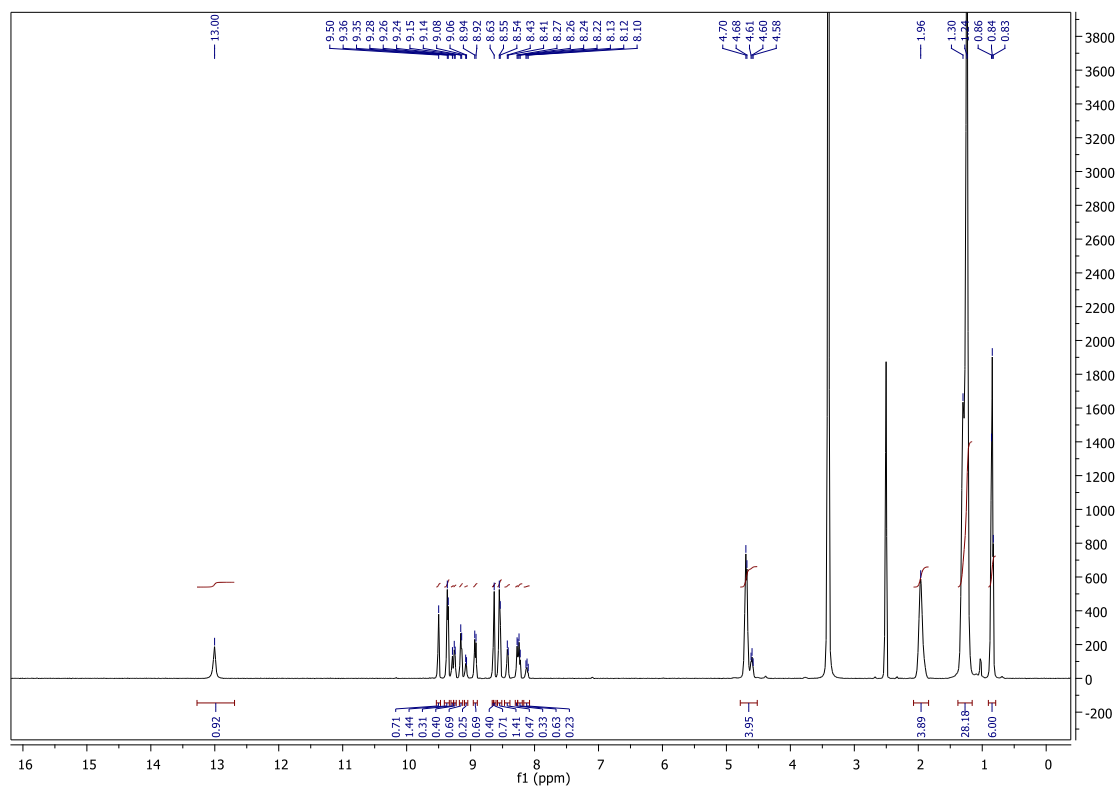


Figure S45. <sup>1</sup>H NMR of Compound 24

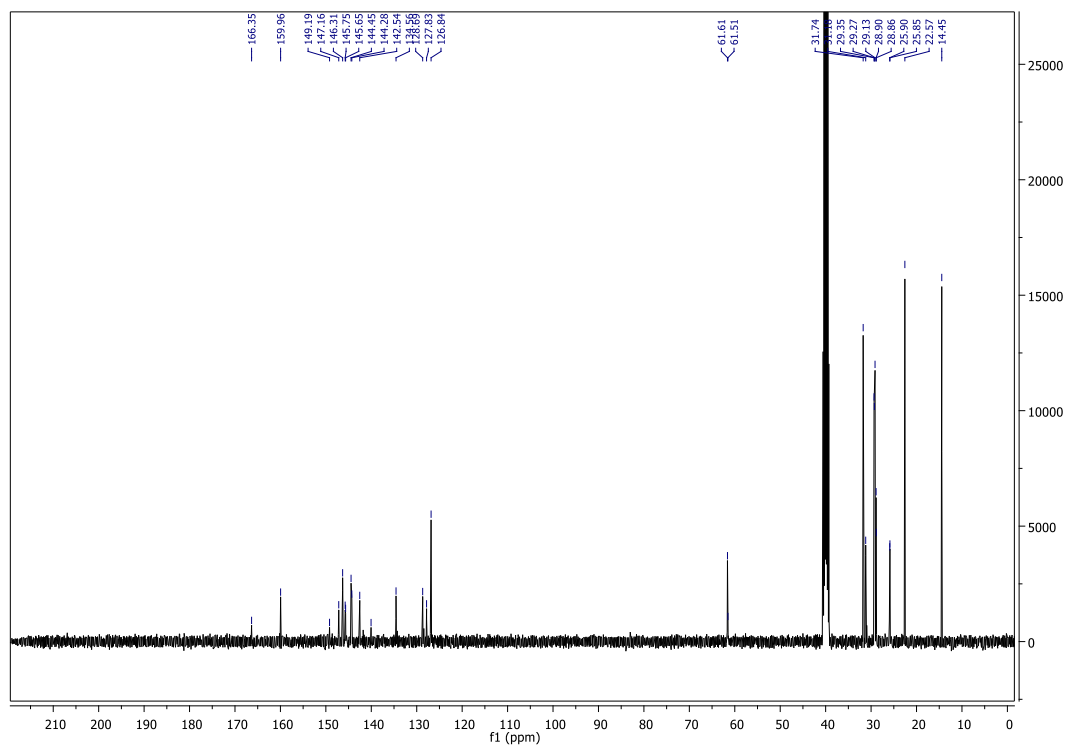


Figure S46. <sup>13</sup>C NMR of Compound 24



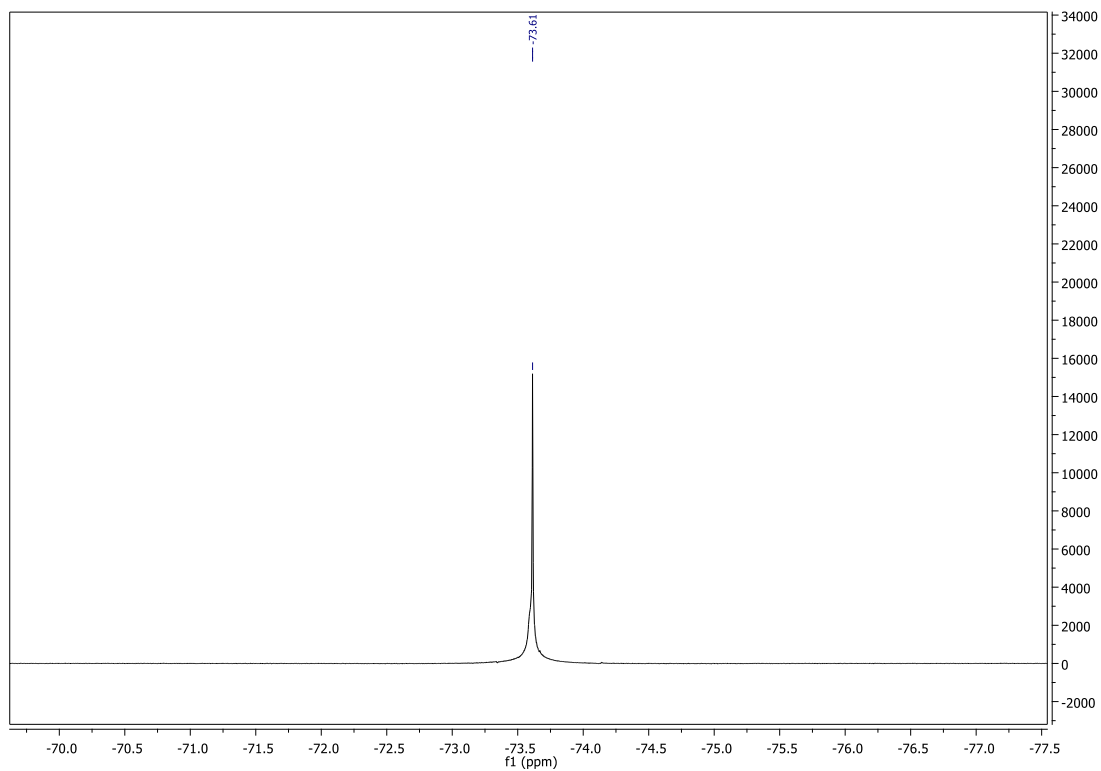


Figure S47.  $^{19}\text{F}$  NMR of Compound 24

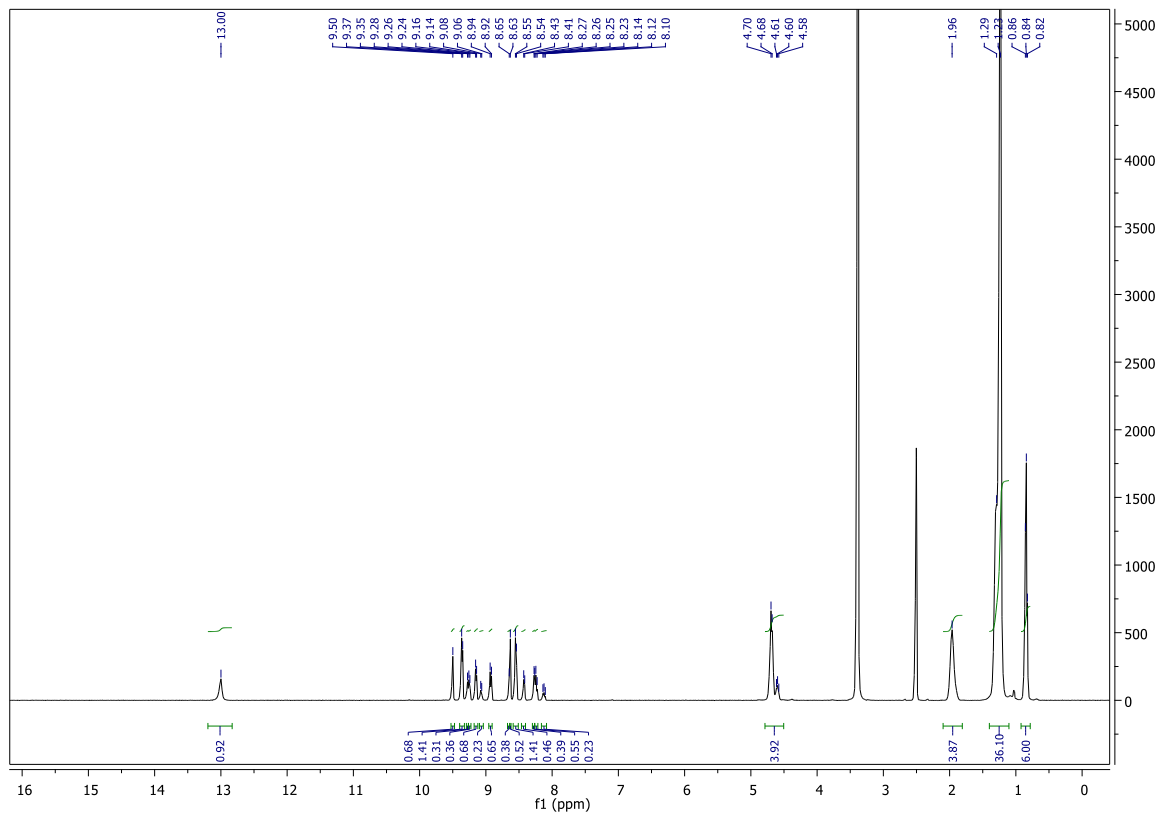


Figure S48.  $^1\text{H}$  NMR of Compound 25

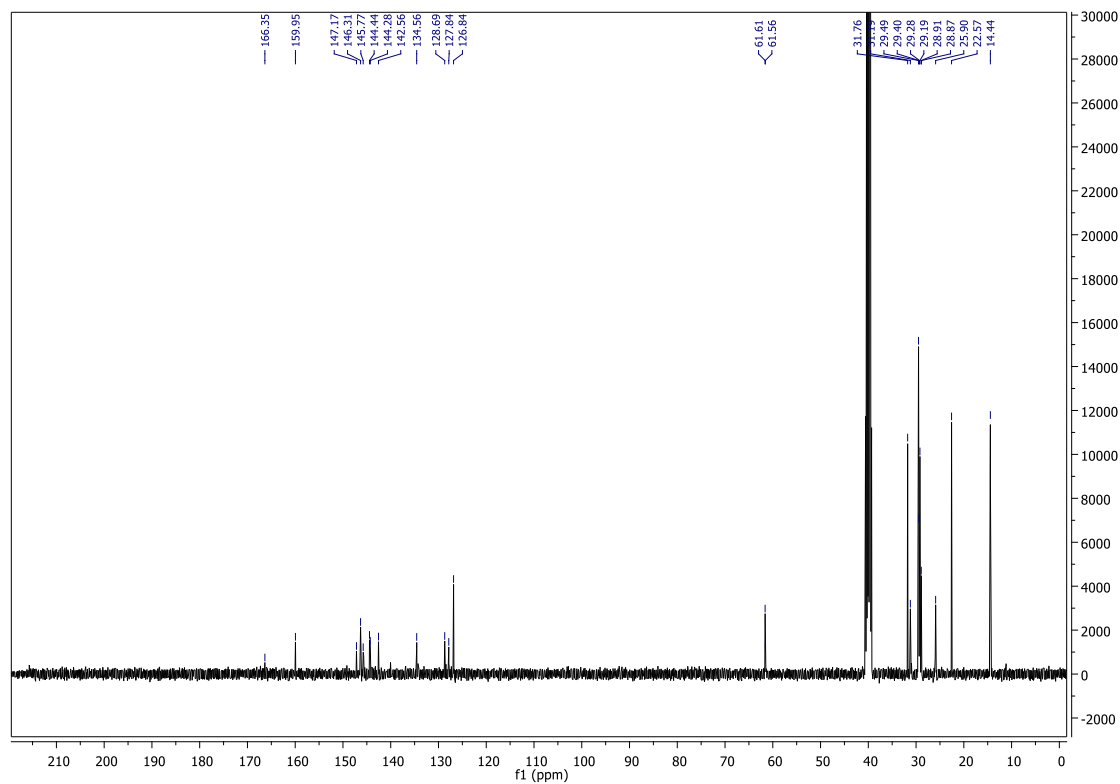


Figure S49. <sup>13</sup>C NMR of Compound 25

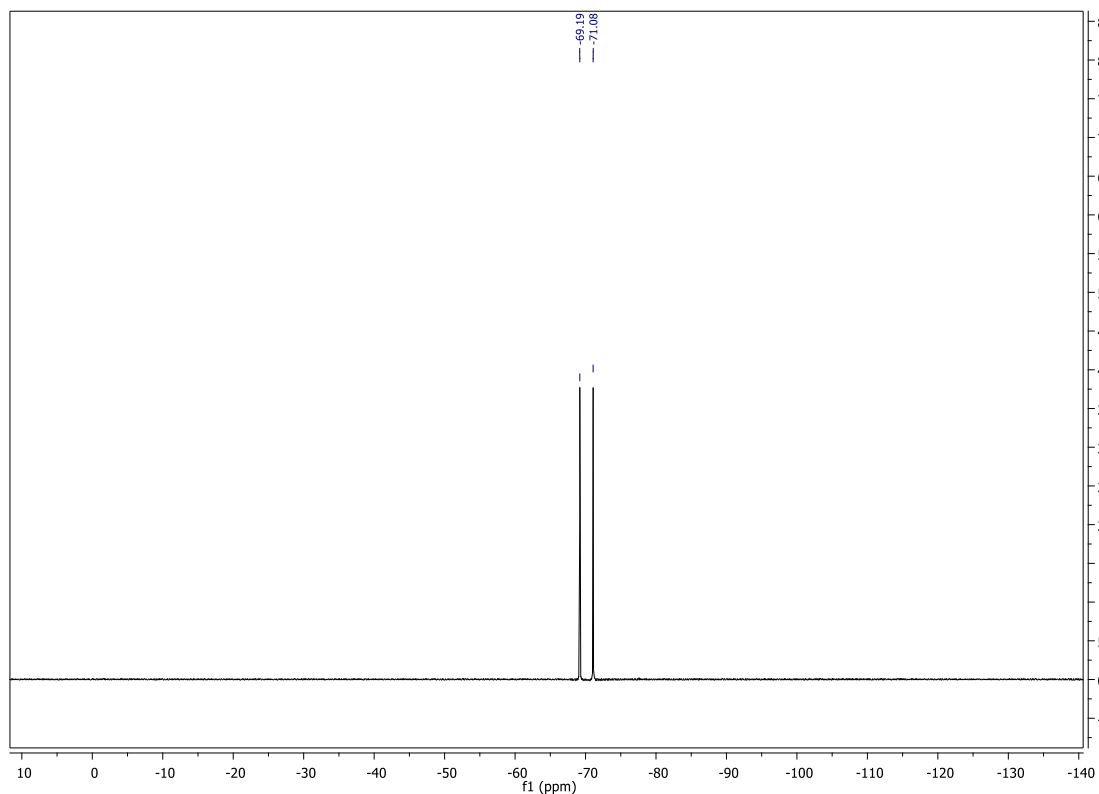


Figure S50. <sup>19</sup>F NMR of Compound 25

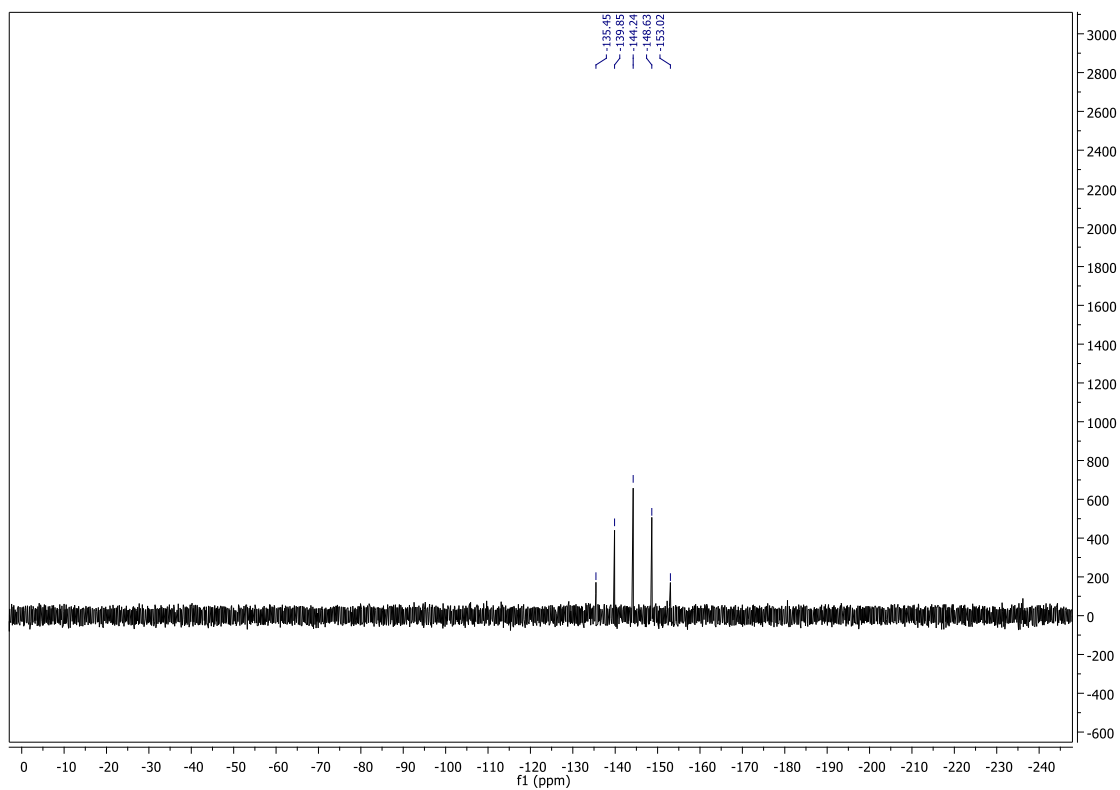


Figure S51. <sup>31</sup>P NMR of Compound 25

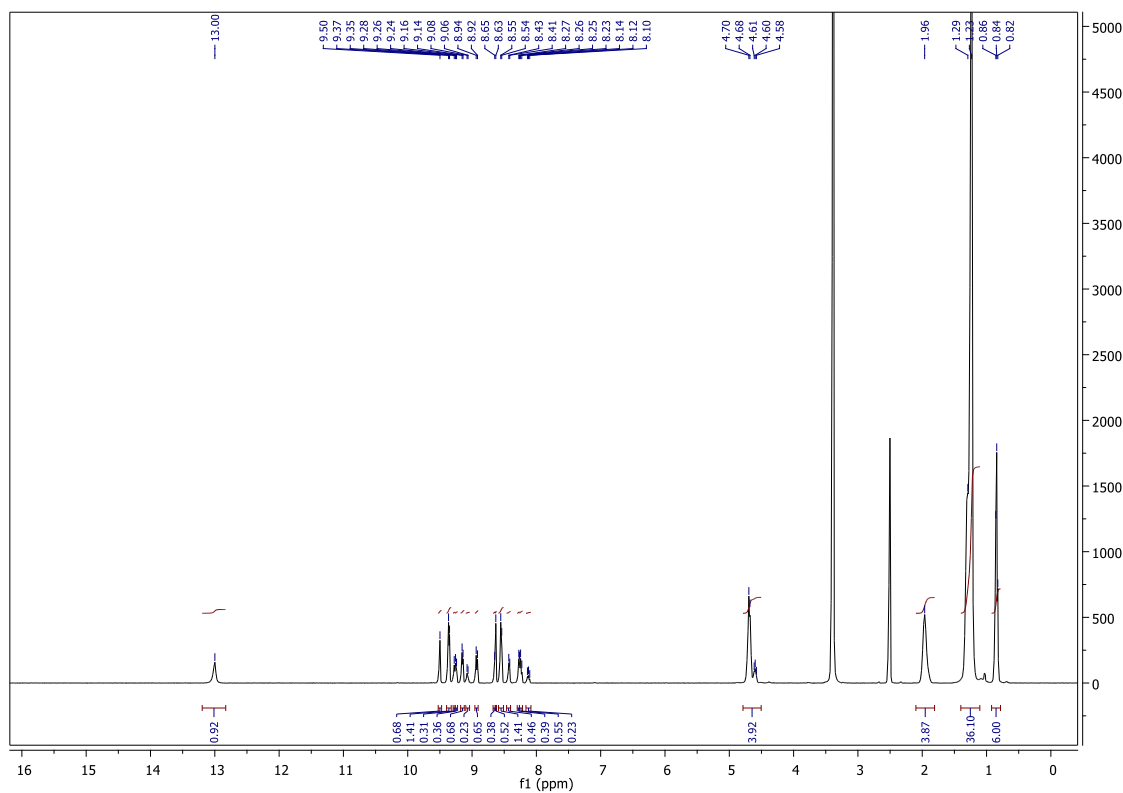


Figure S52. <sup>1</sup>H NMR of Compound 26

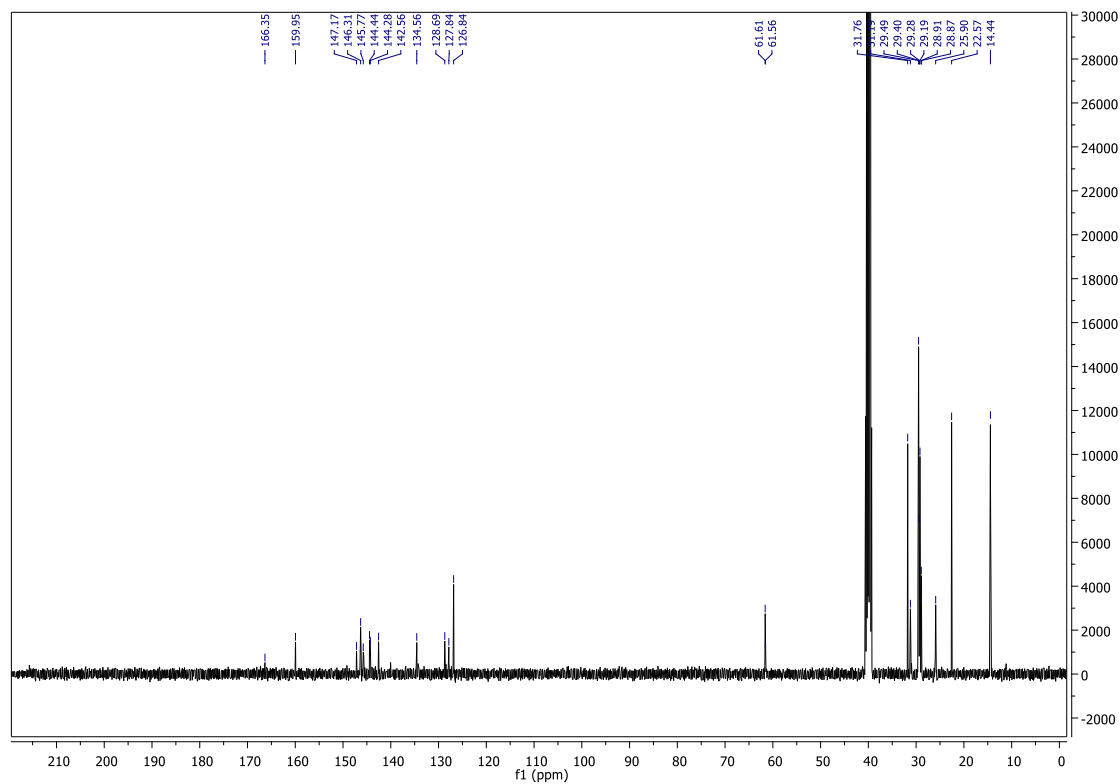


Figure S53.  $^{13}\text{C}$  NMR of Compound 26

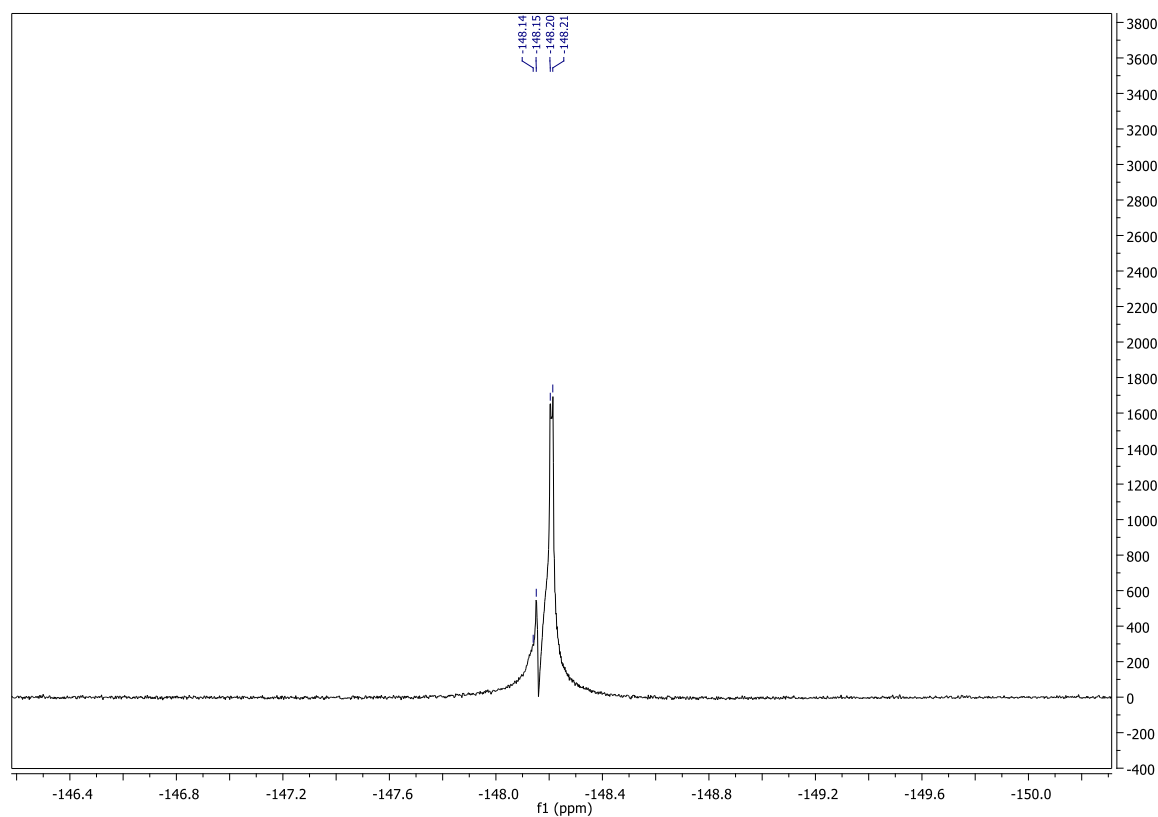


Figure S54.  $^{19}\text{F}$  NMR of Compound 26

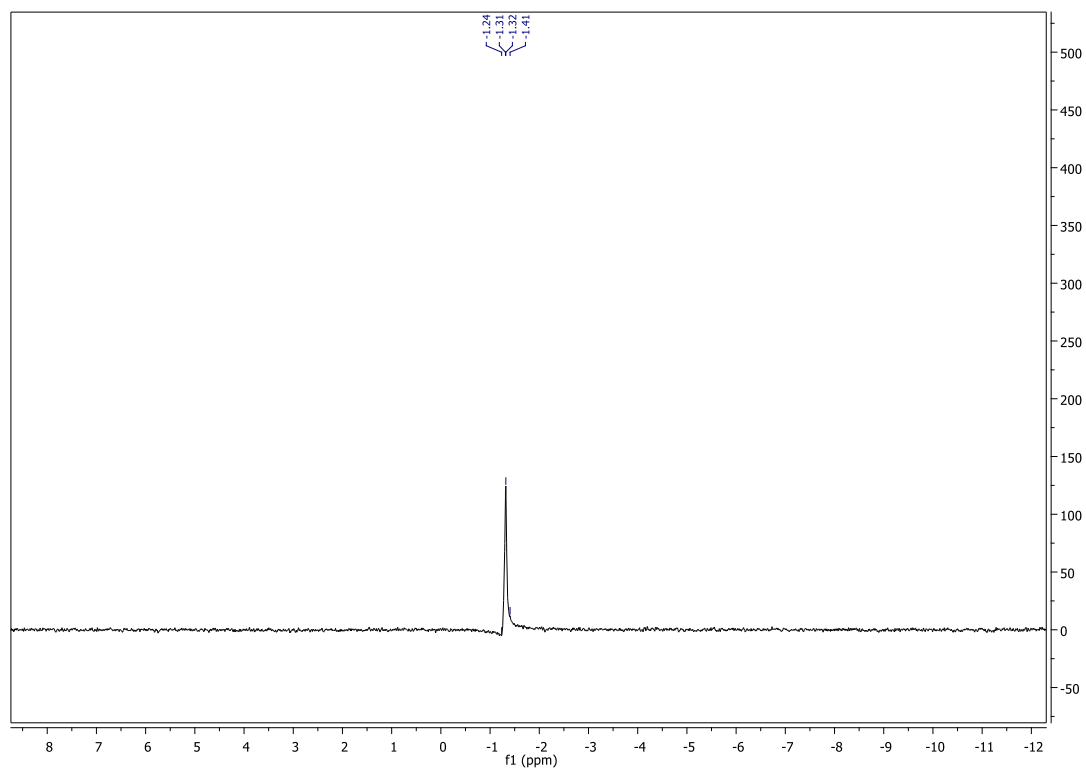


Figure S55.  $^{11}\text{B}$  NMR of Compound 26

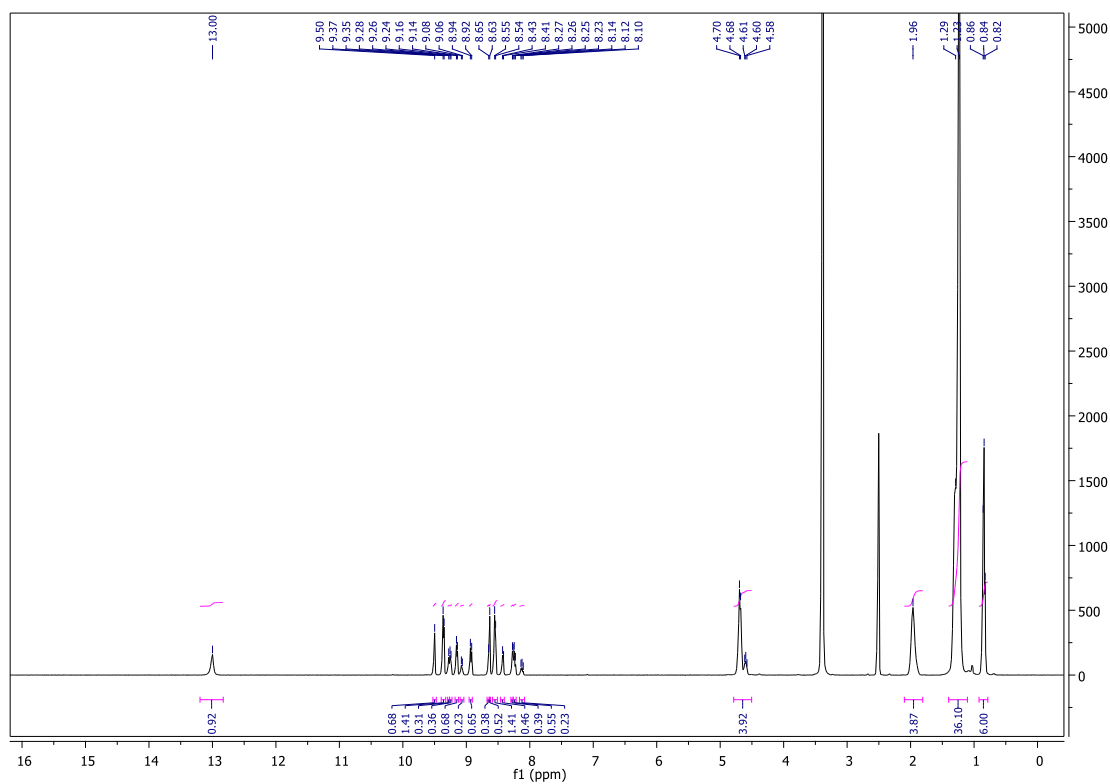


Figure S56.  $^1\text{H}$  NMR of Compound 27

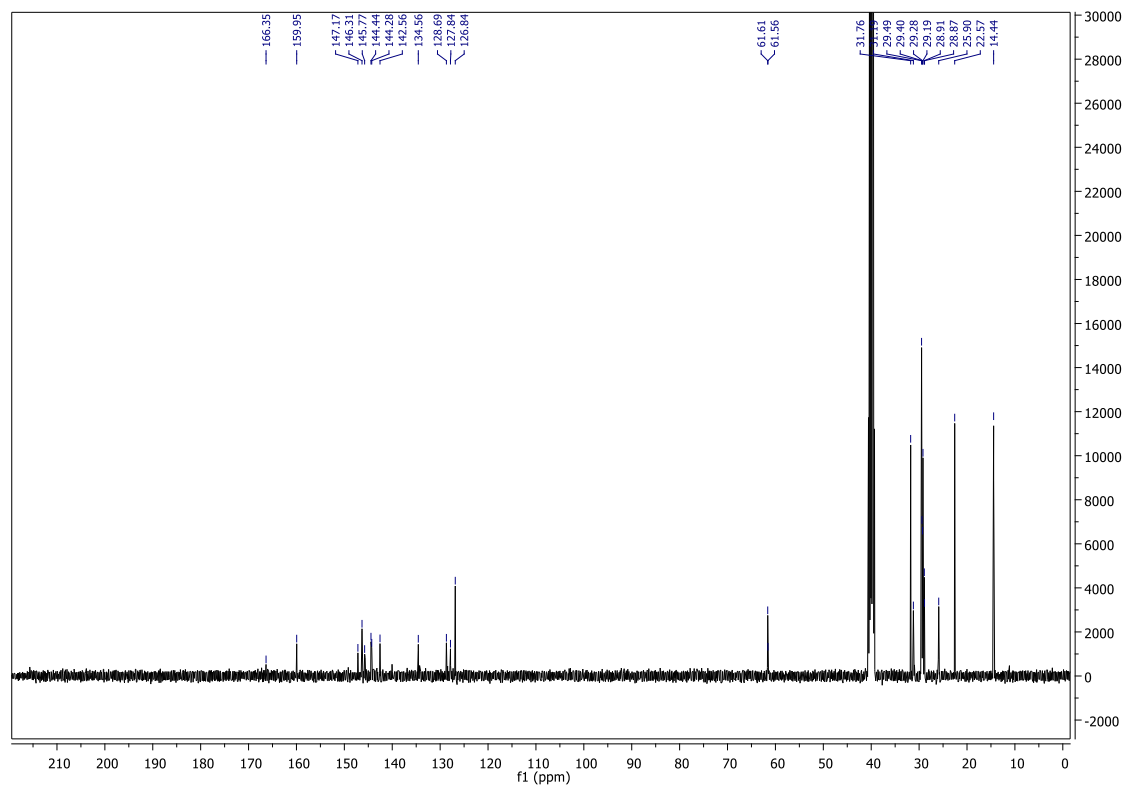


Figure S57. <sup>13</sup>C NMR of Compound 27

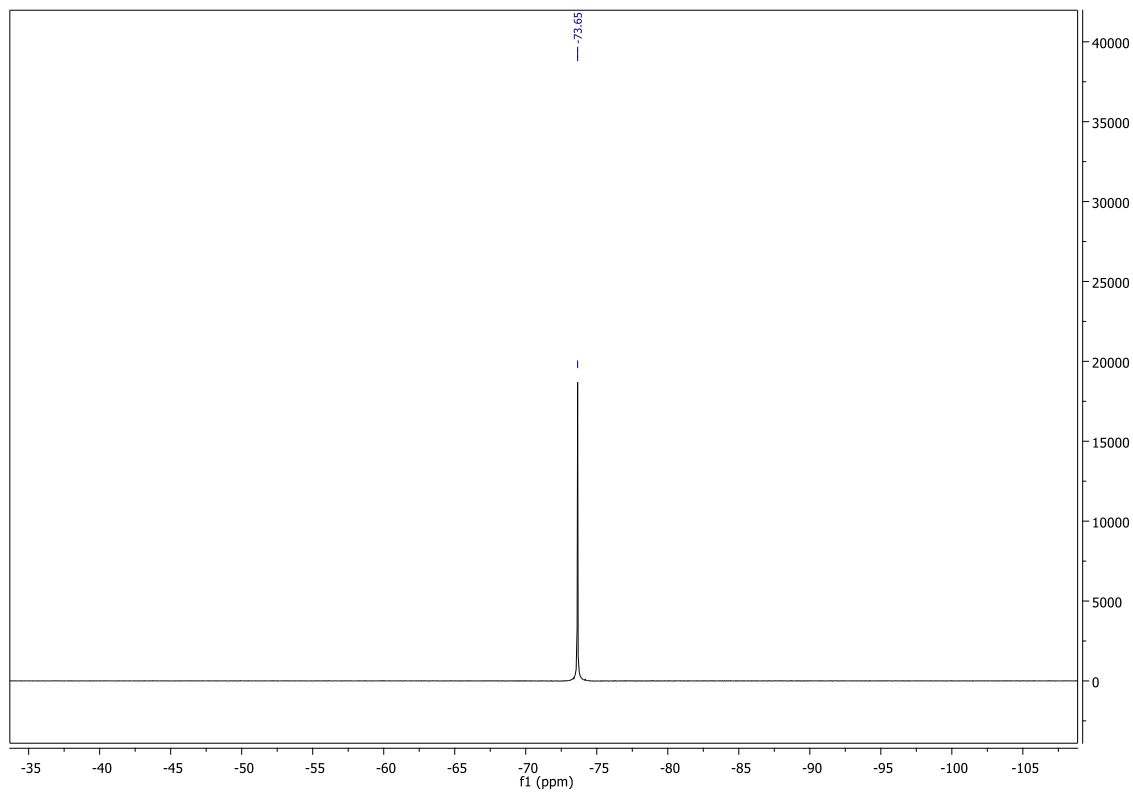


Figure S58. <sup>19</sup>F NMR of Compound 27

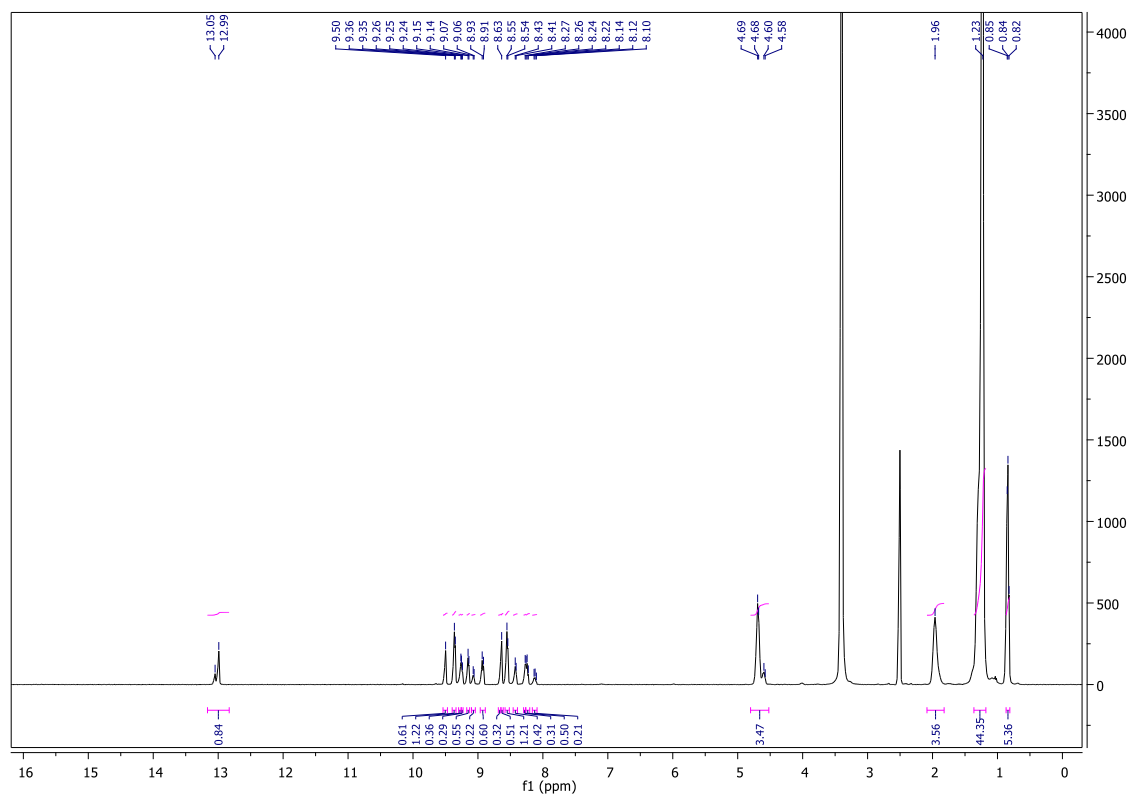


Figure S59.  $^1\text{H}$  NMR of Compound 28

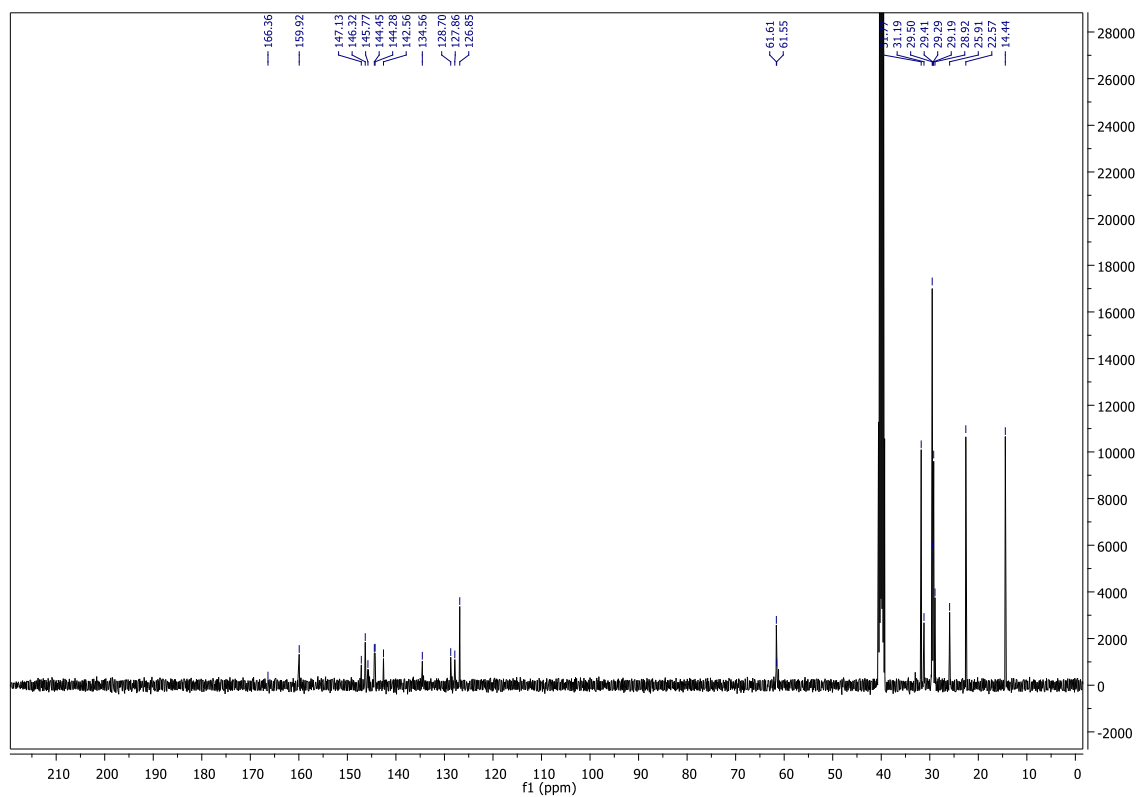


Figure S60.  $^{13}\text{C}$  NMR of Compound 28

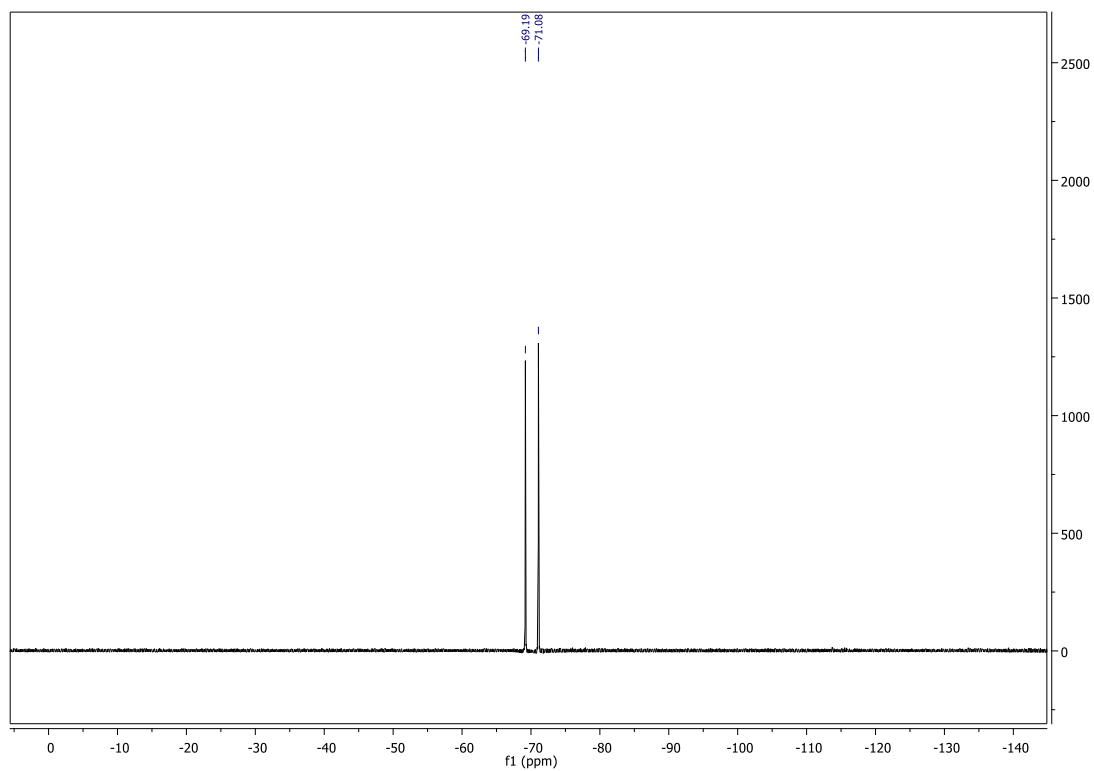


Figure S61.  $^{19}\text{F}$  NMR of Compound 28

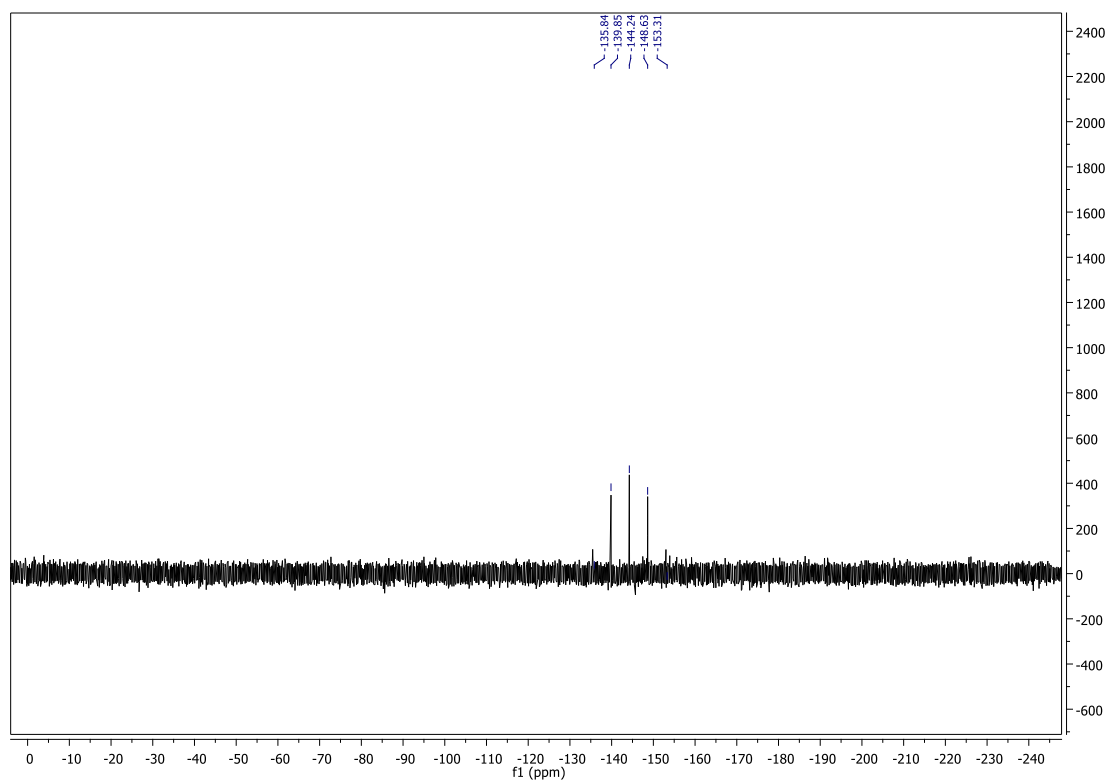


Figure S62.  $^{31}\text{P}$  NMR of Compound 28



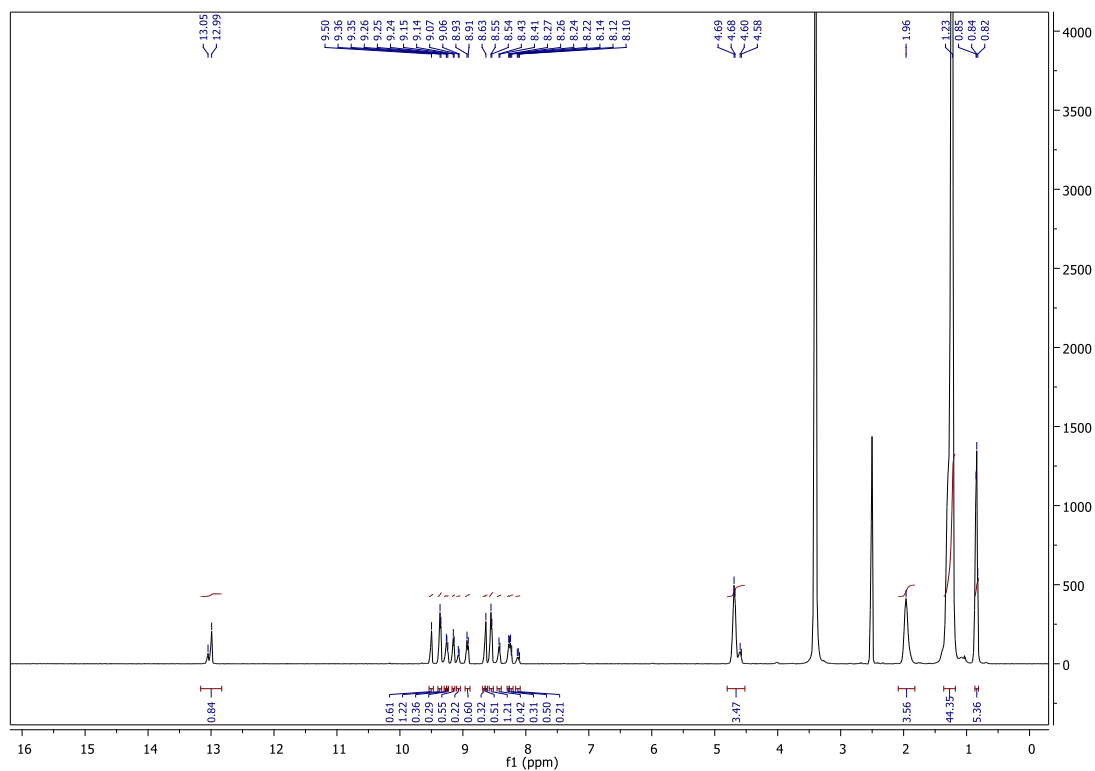


Figure S63.  $^1\text{H}$  NMR of Compound 29

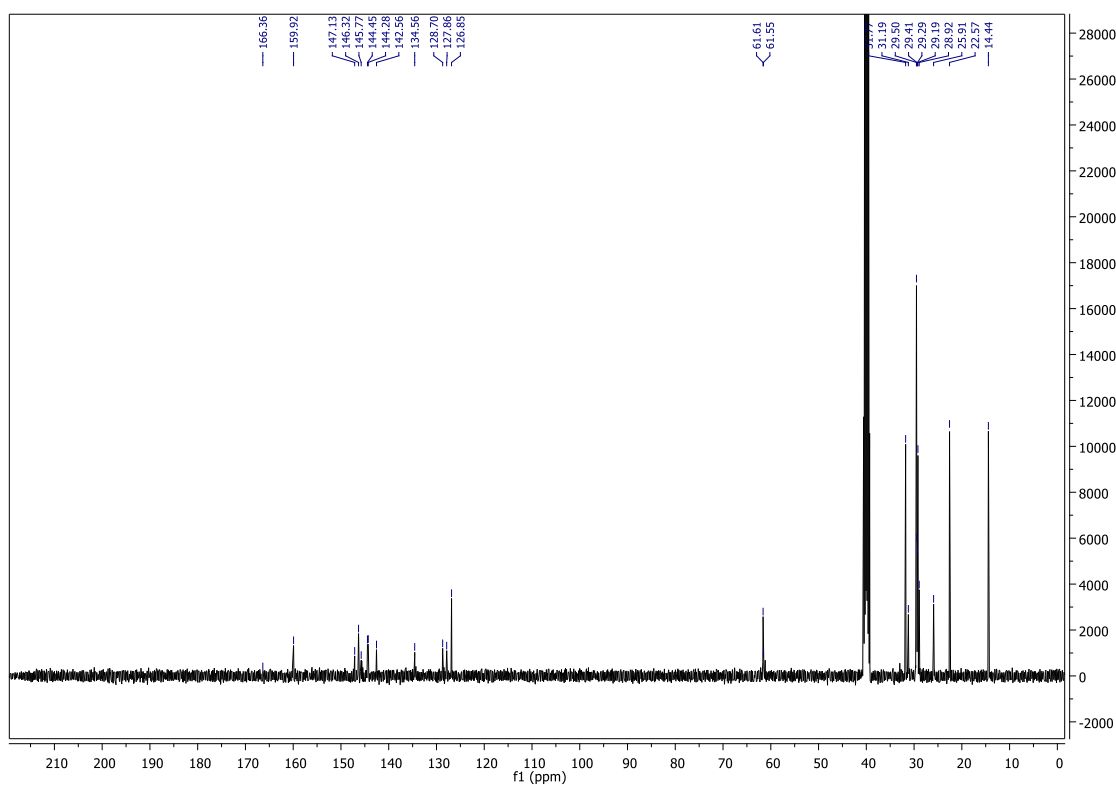


Figure S64.  $^{13}\text{C}$  NMR of Compound 29

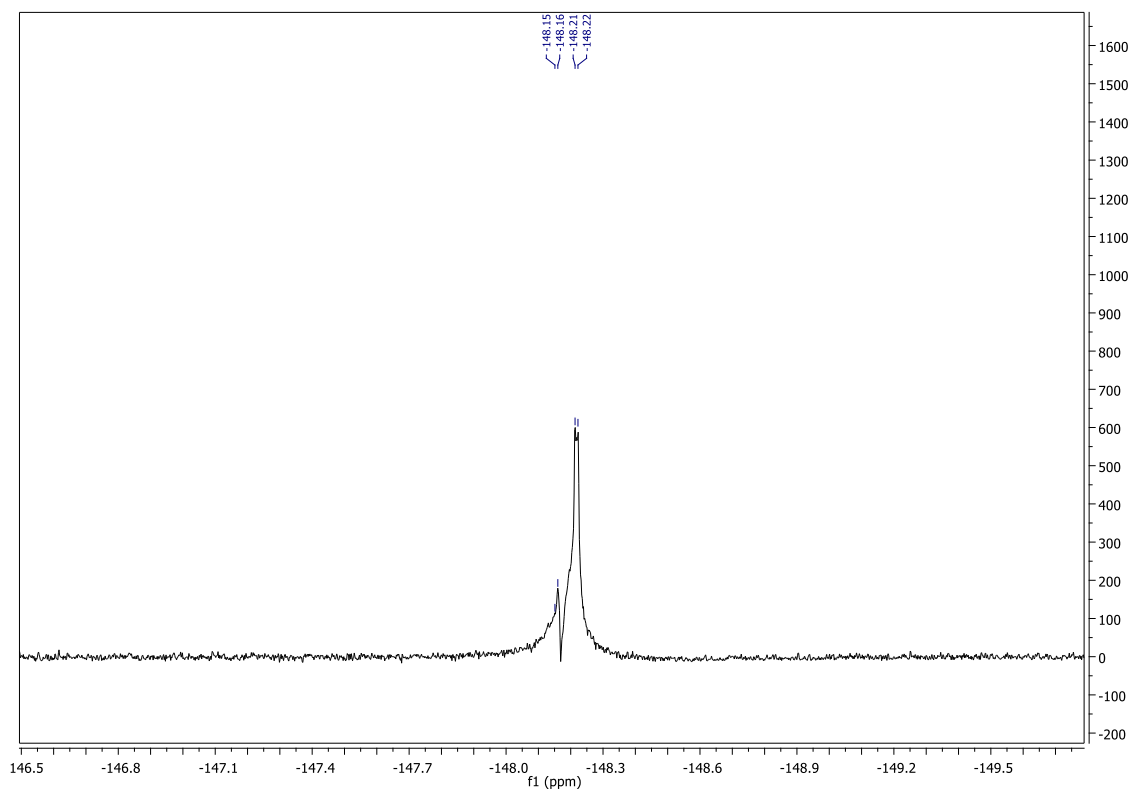


Figure S65.  $^{19}\text{F}$  NMR of Compound 29

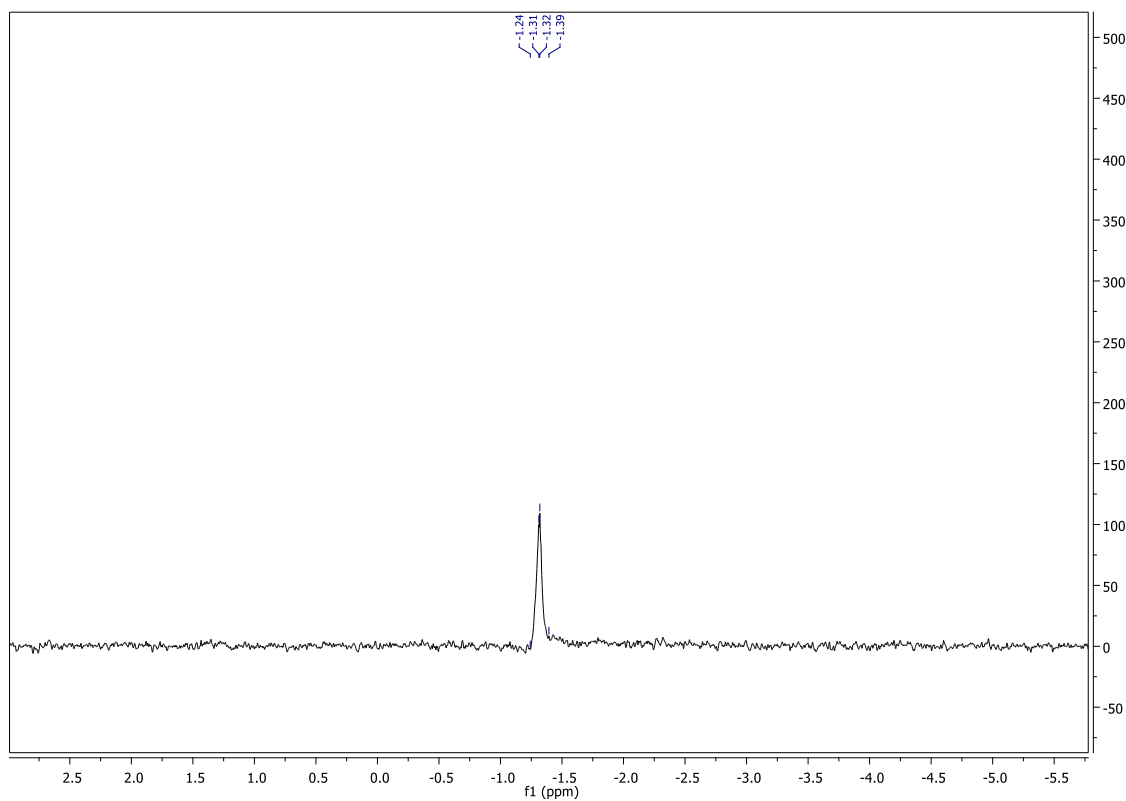


Figure S66.  $^{11}\text{B}$  NMR of Compound 29

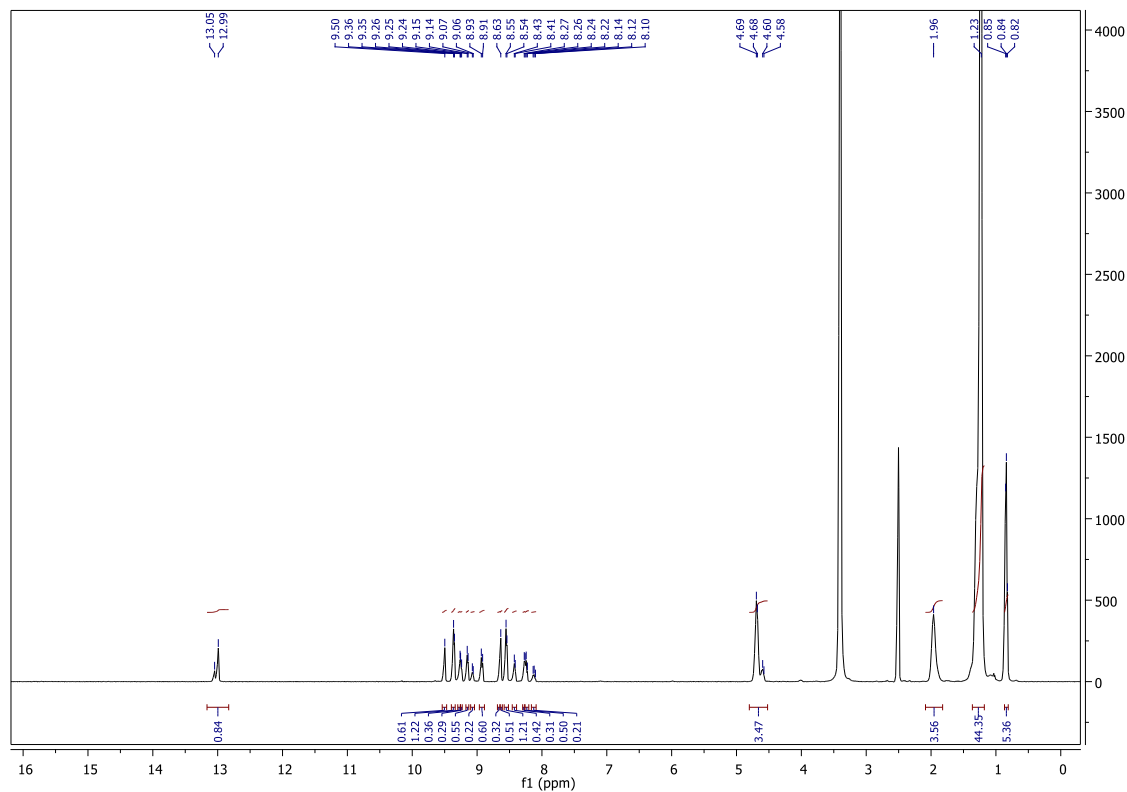


Figure S67.  $^1\text{H}$  NMR of Compound 30

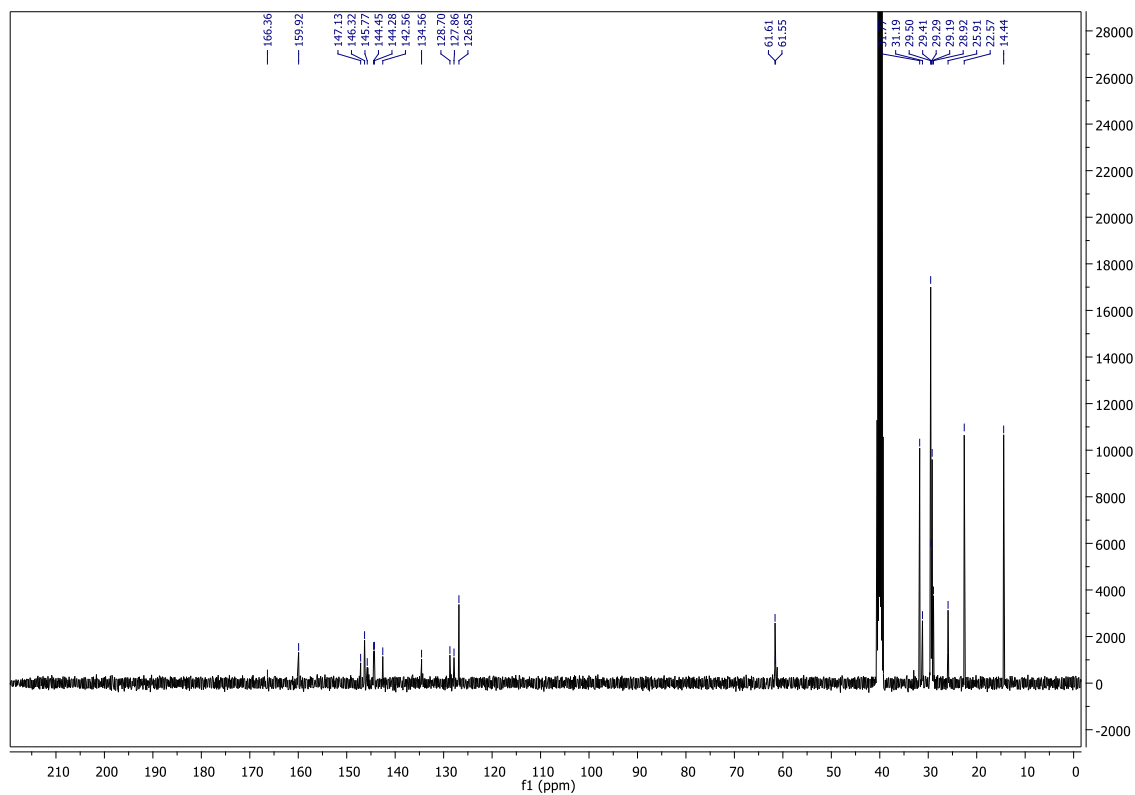


Figure S68.  $^{13}\text{C}$  NMR of Compound 30

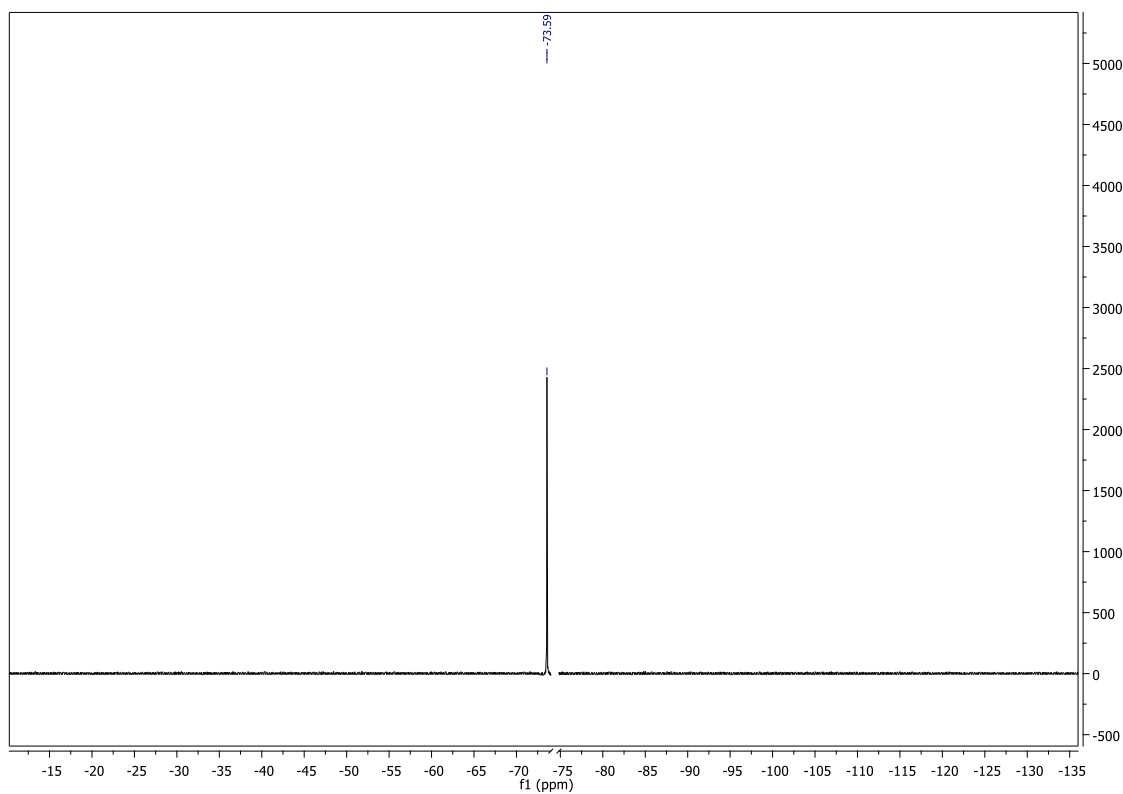


Figure S69.  $^{19}\text{F}$  NMR of Compound 30

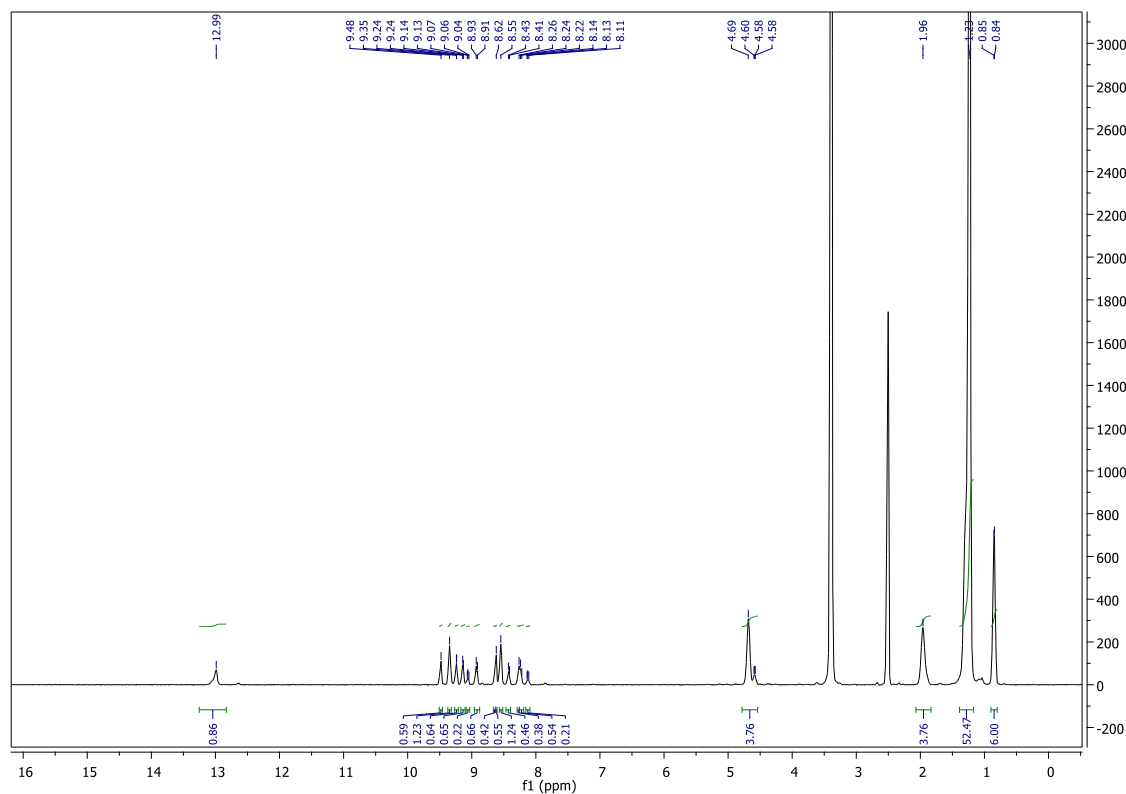


Figure S70.  $^1\text{H}$  NMR of Compound 31

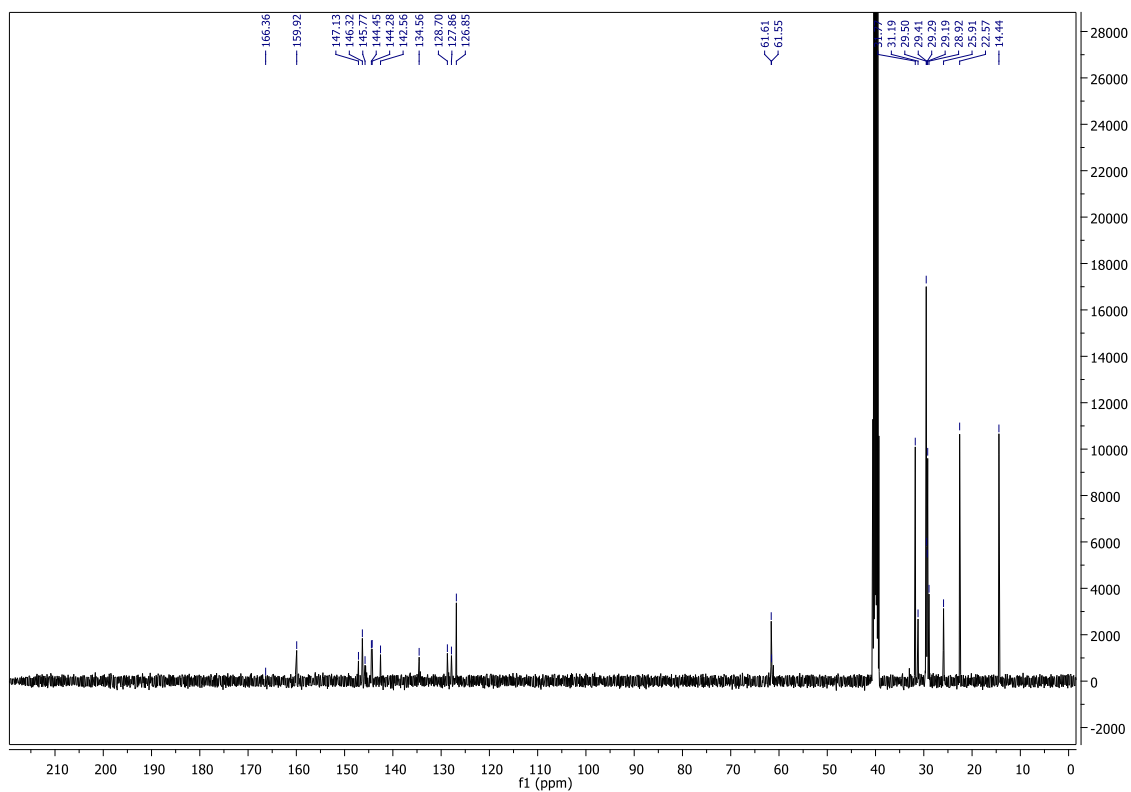


Figure S71.  $^{13}\text{C}$  NMR of Compound 31

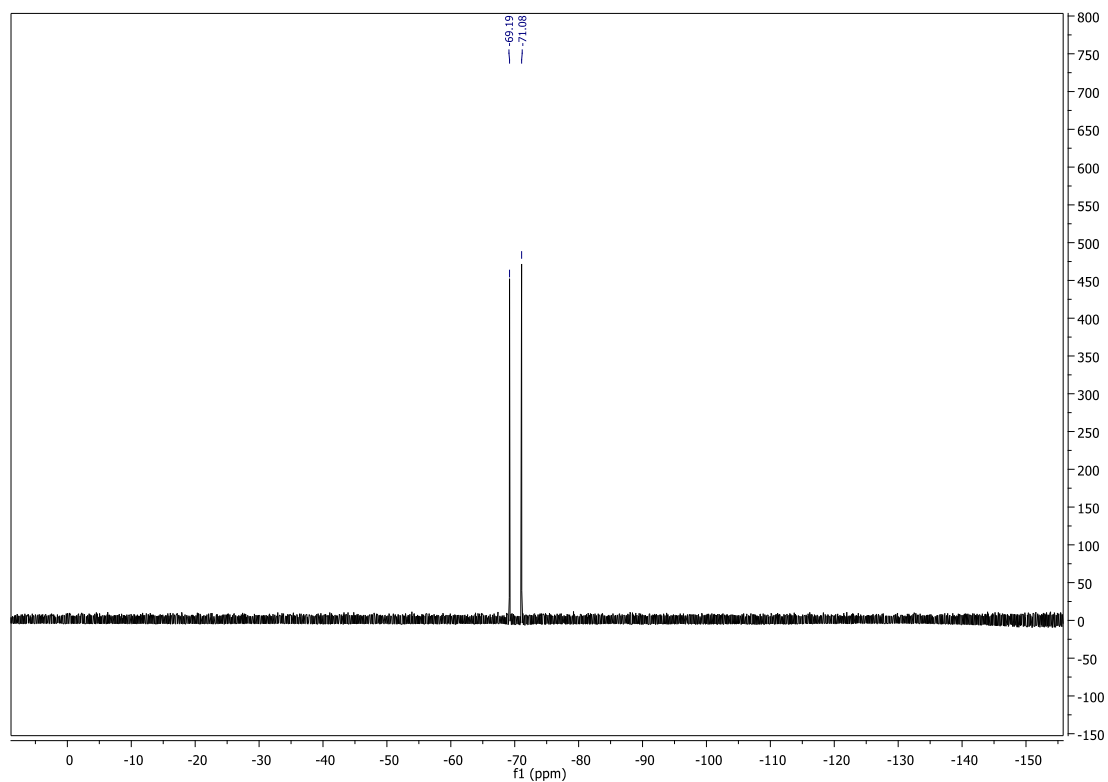


Figure S72.  $^{19}\text{F}$  NMR of Compound 31

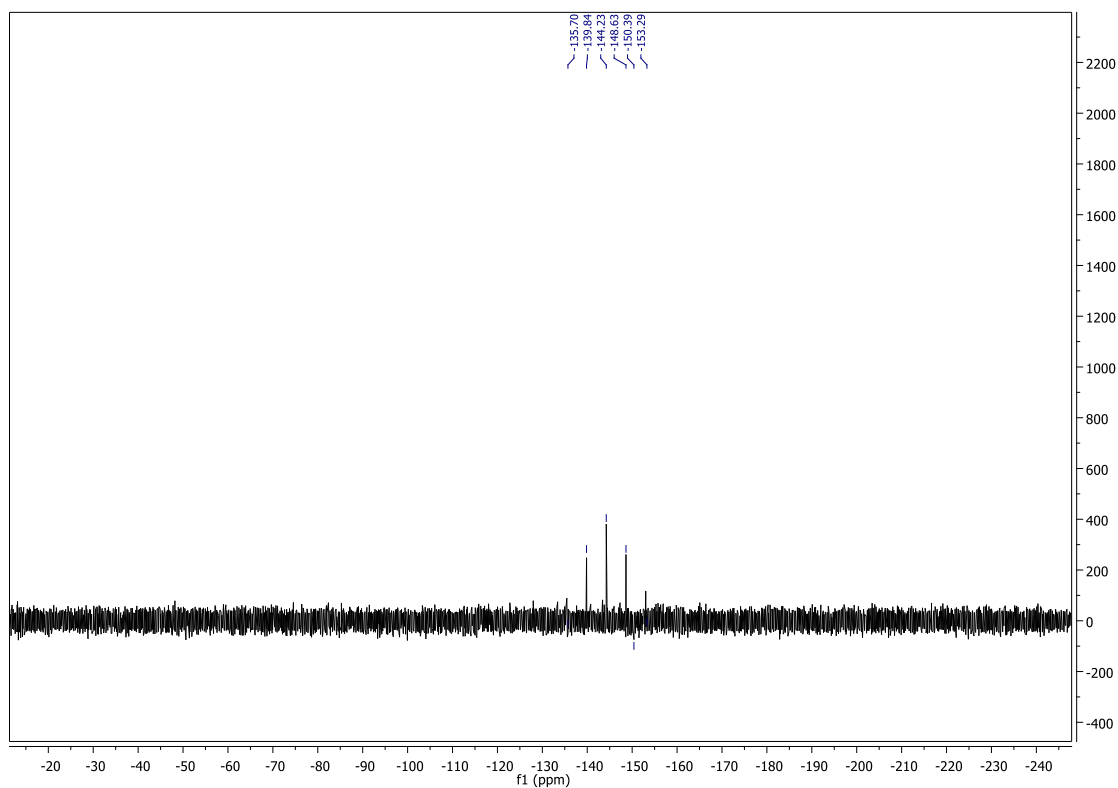


Figure S73. <sup>31</sup>P NMR of Compound 31

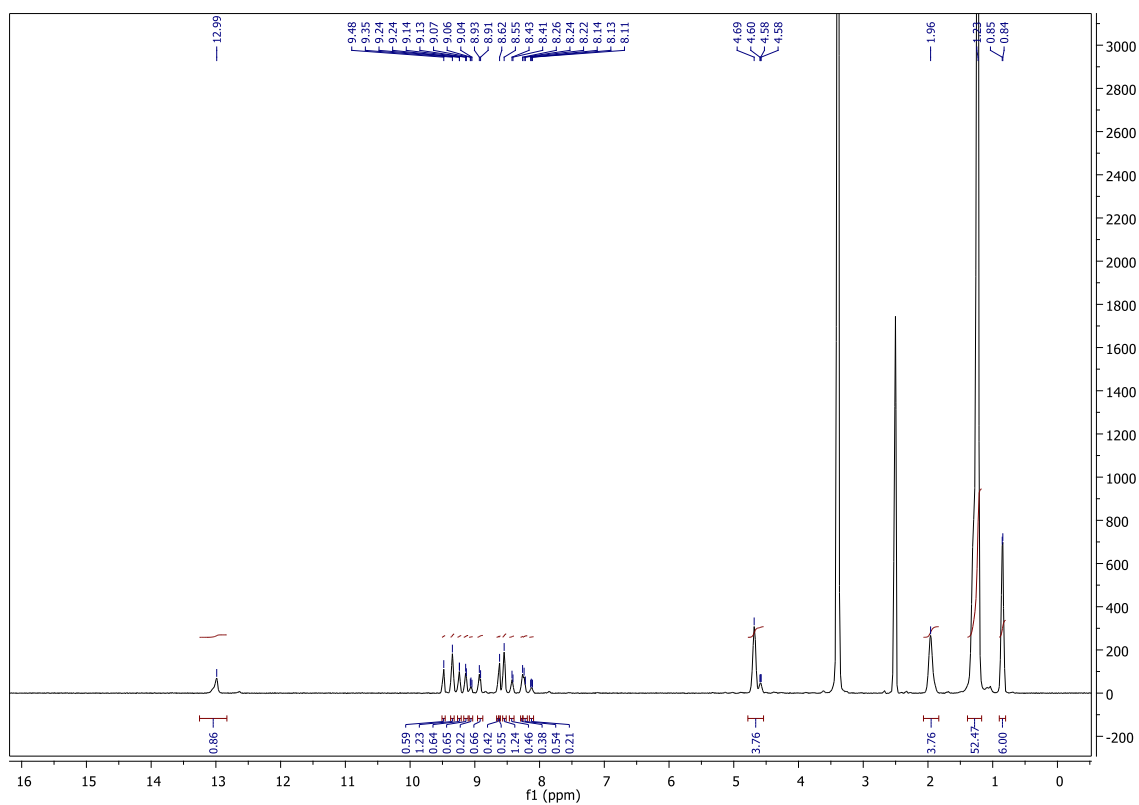


Figure S74. <sup>1</sup>H NMR of Compound 32

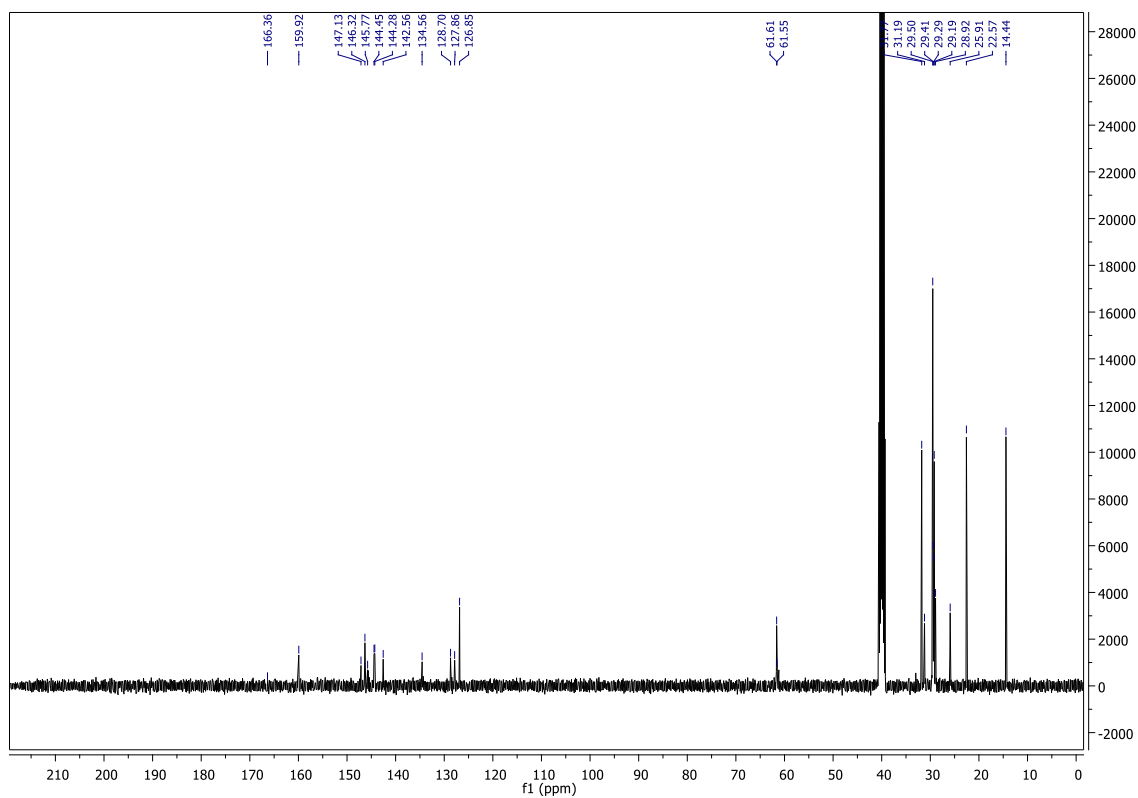


Figure S75.  $^{13}\text{C}$  NMR of Compound 32

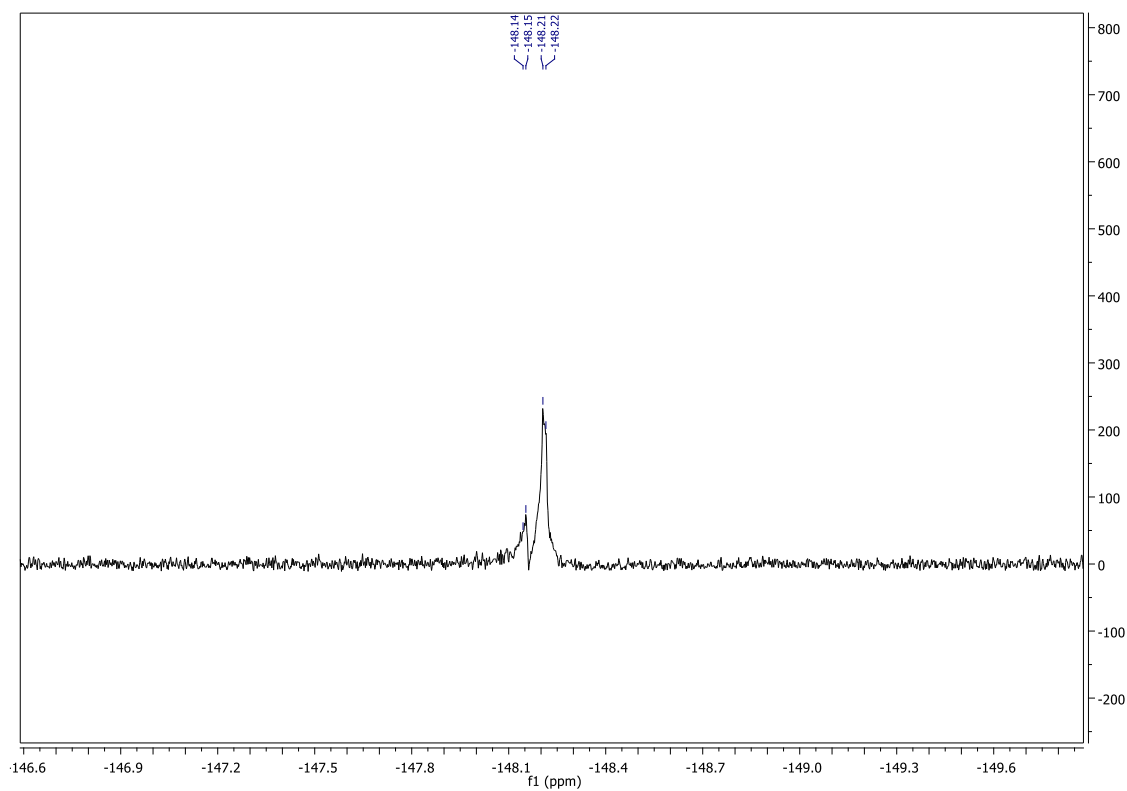


Figure S76.  $^{19}\text{F}$  NMR of Compound 32

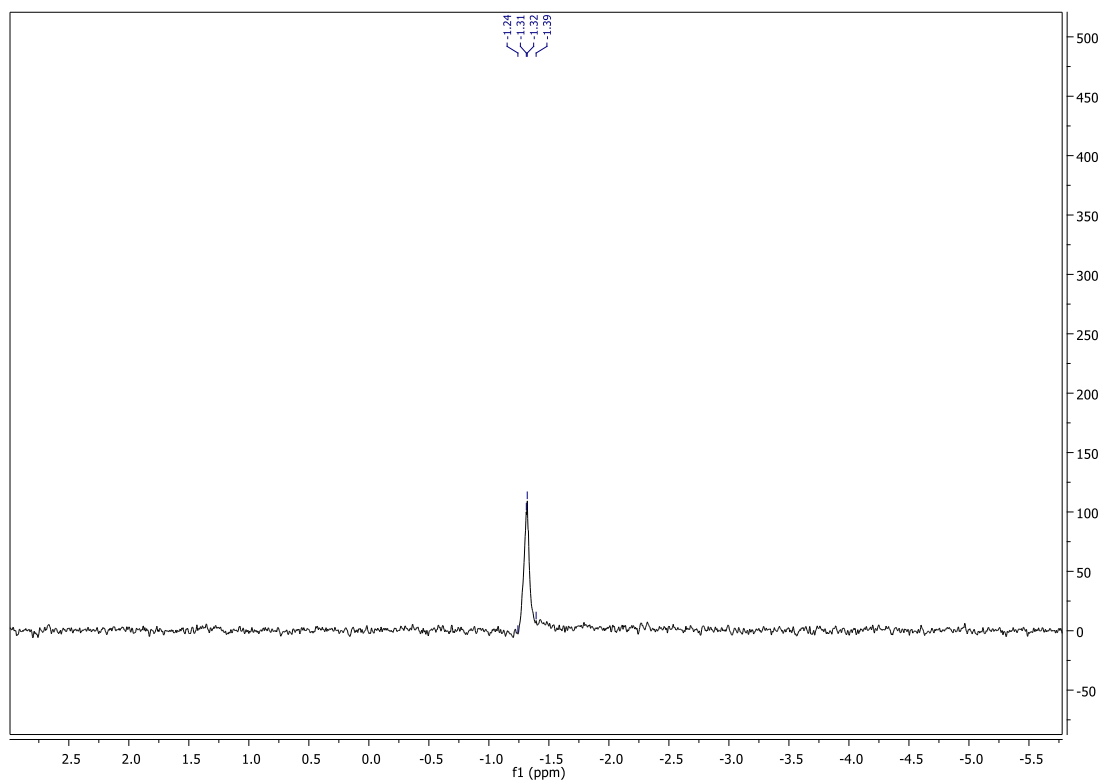


Figure S77.  $^{11}\text{B}$  NMR of Compound 32

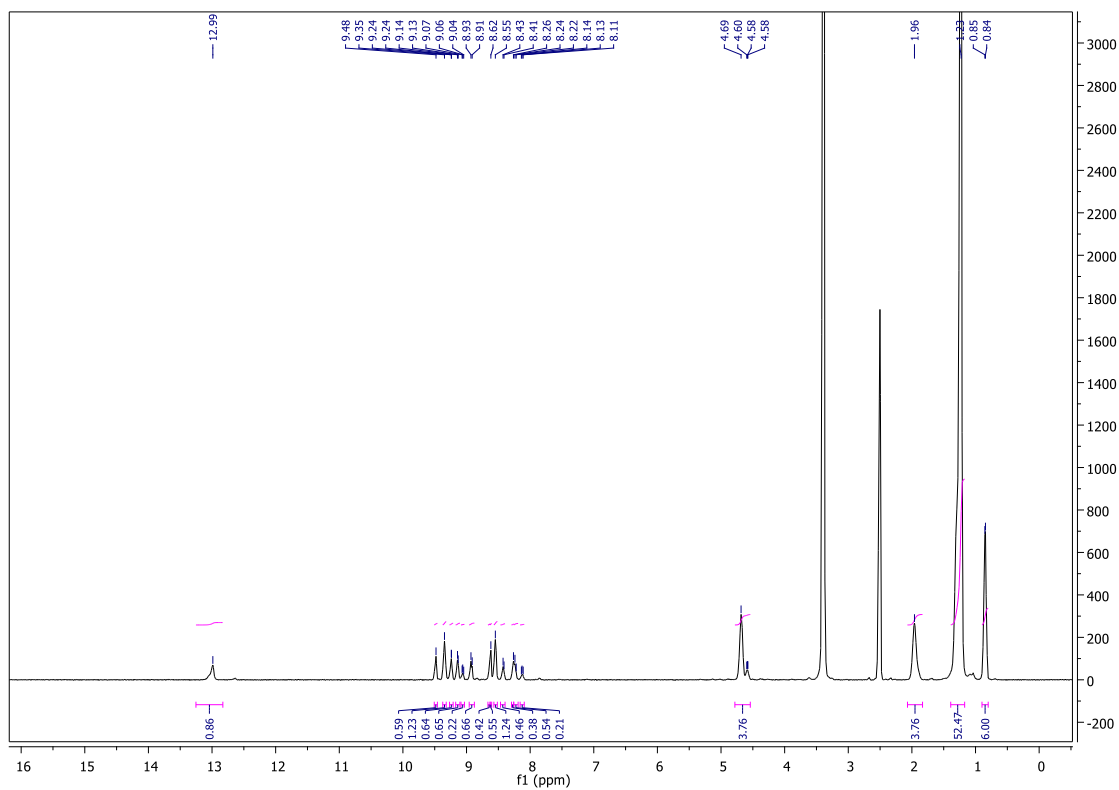


Figure S78.  $^1\text{H}$  NMR of Compound 33



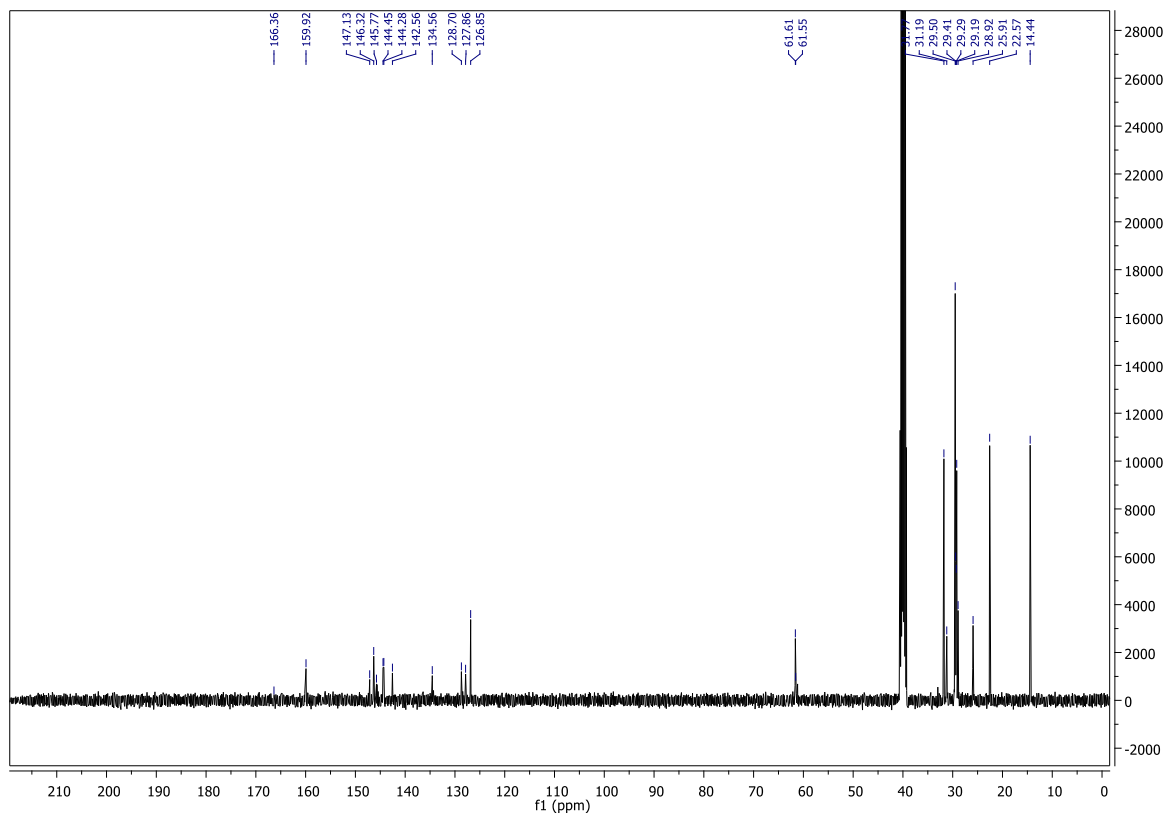


Figure S79. <sup>13</sup>C NMR of Compound 33

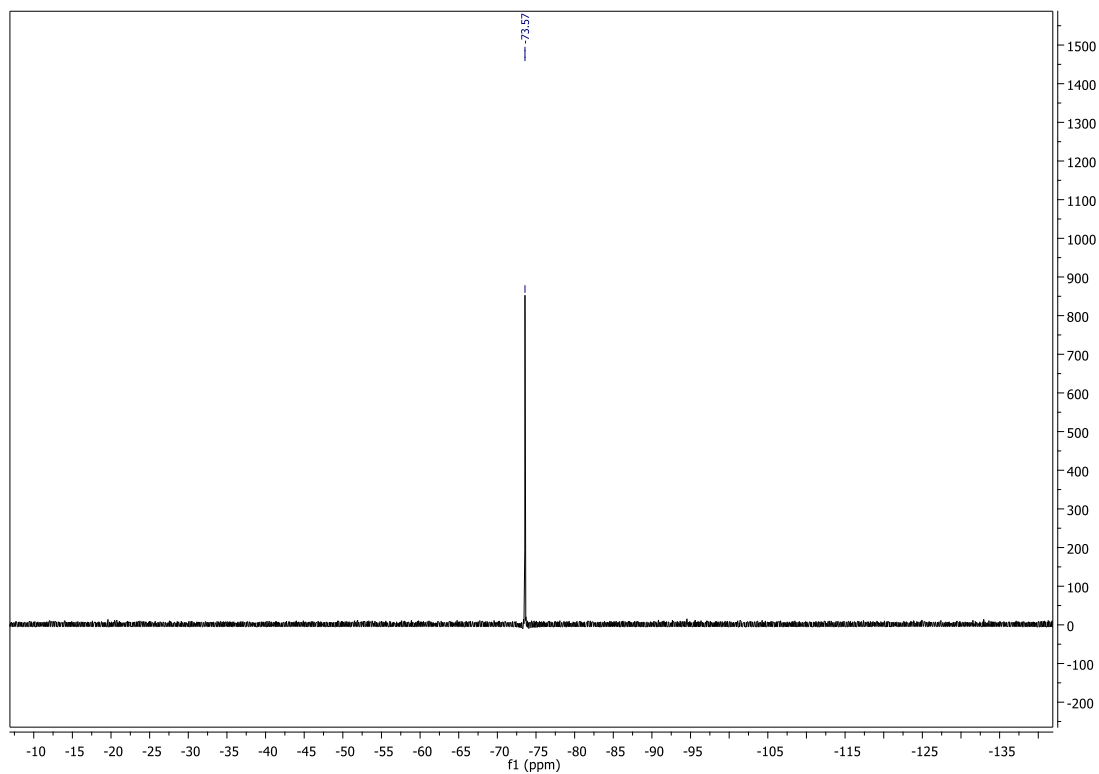


Figure S80. <sup>19</sup>F NMR of Compound 33

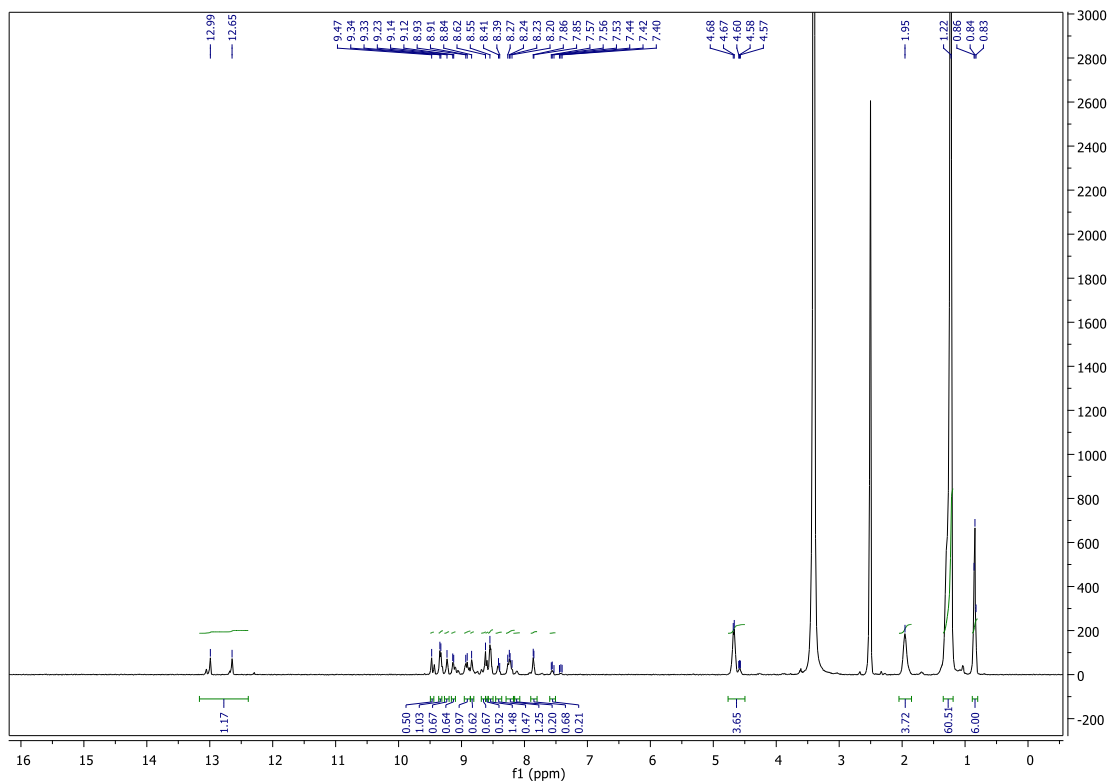


Figure S81.  $^1\text{H}$  NMR of Compound 34

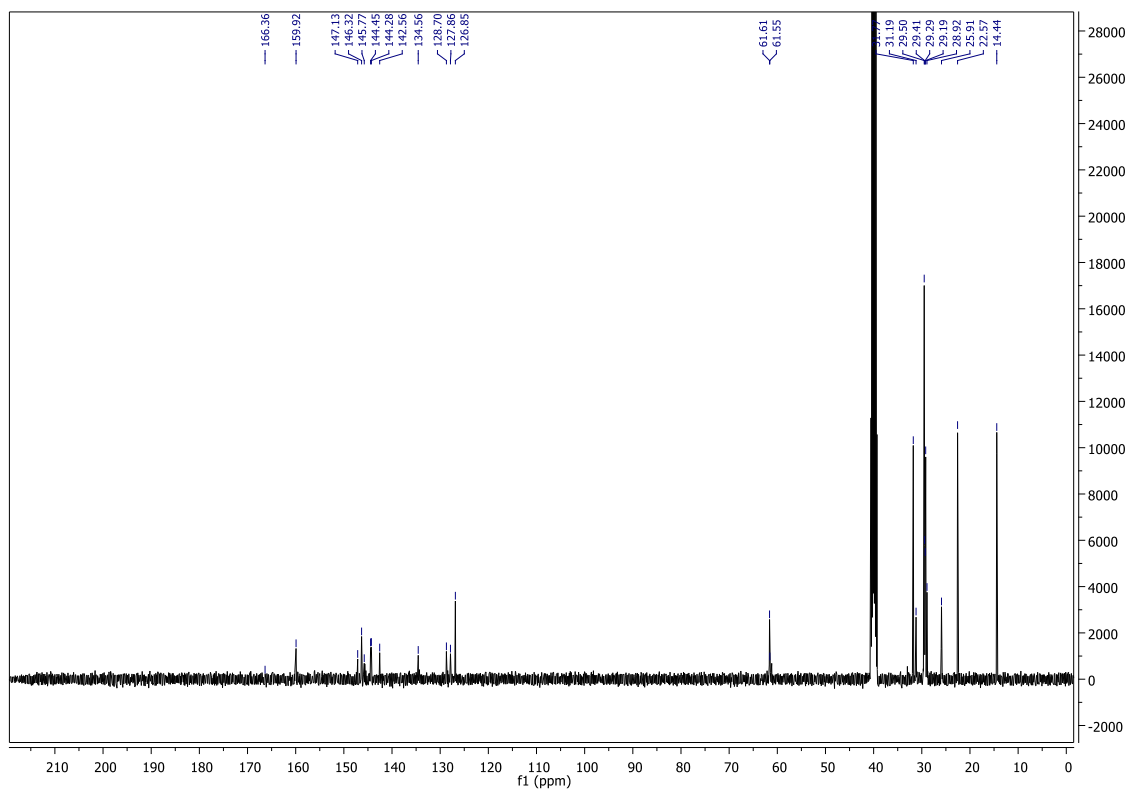


Figure S82.  $^{13}\text{C}$  NMR of Compound 34

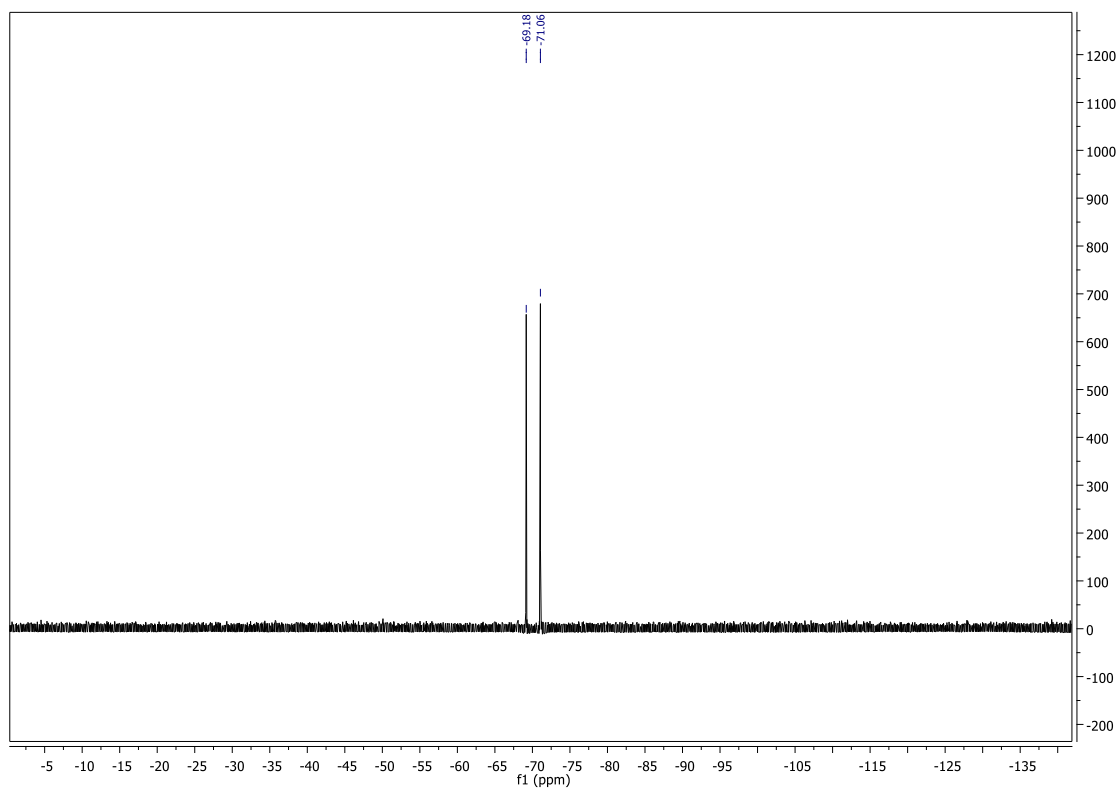


Figure S83.  $^{19}\text{F}$  NMR of Compound 34

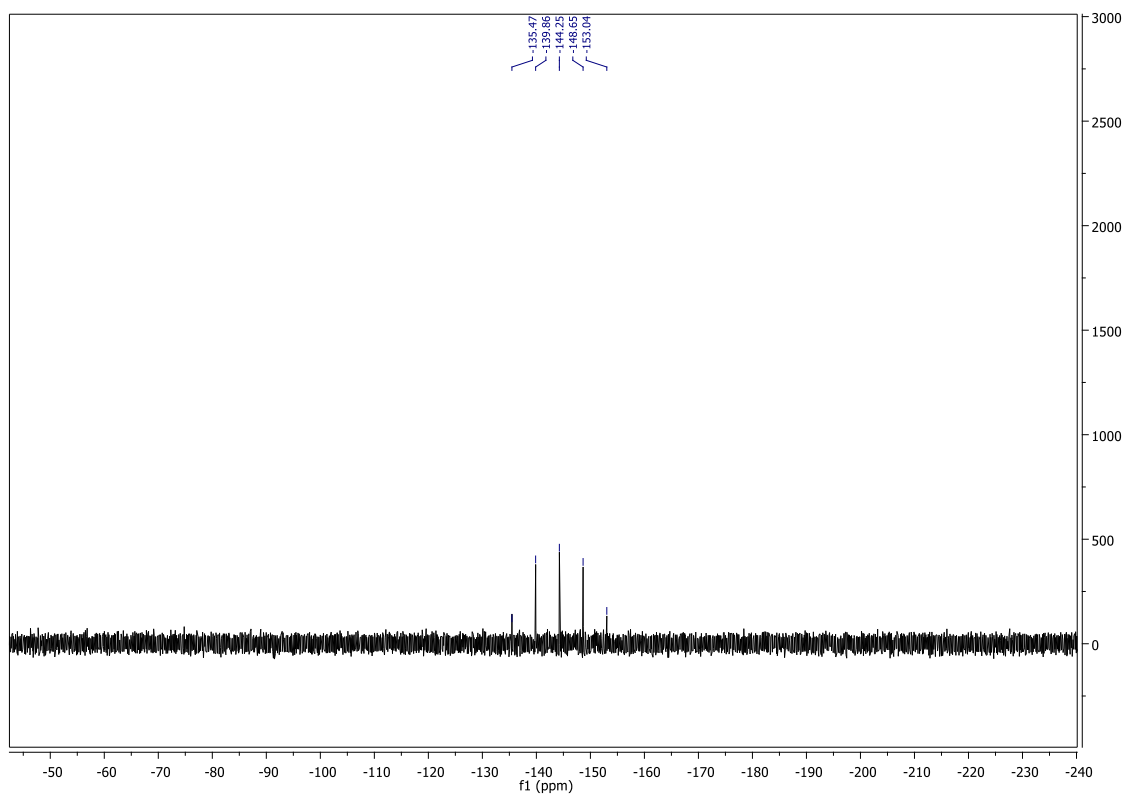


Figure S84.  $^{31}\text{P}$  NMR of Compound 34

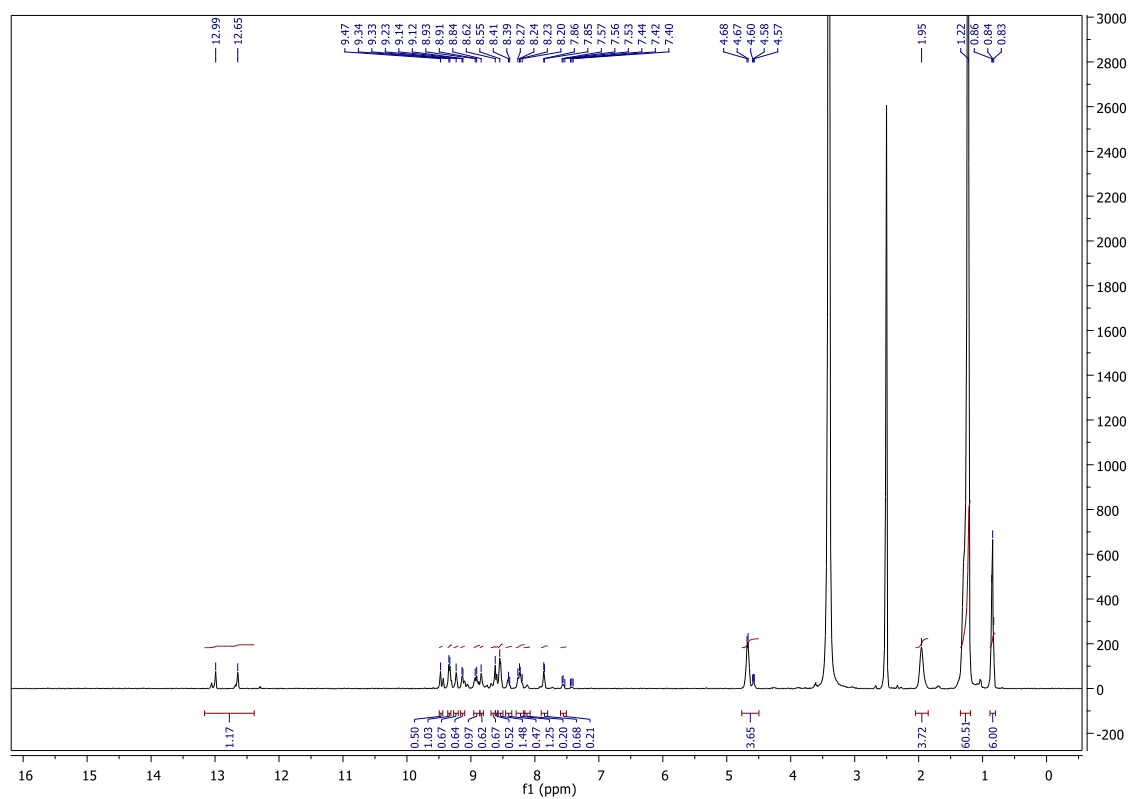


Figure S85.  $^1\text{H}$  NMR of Compound 35

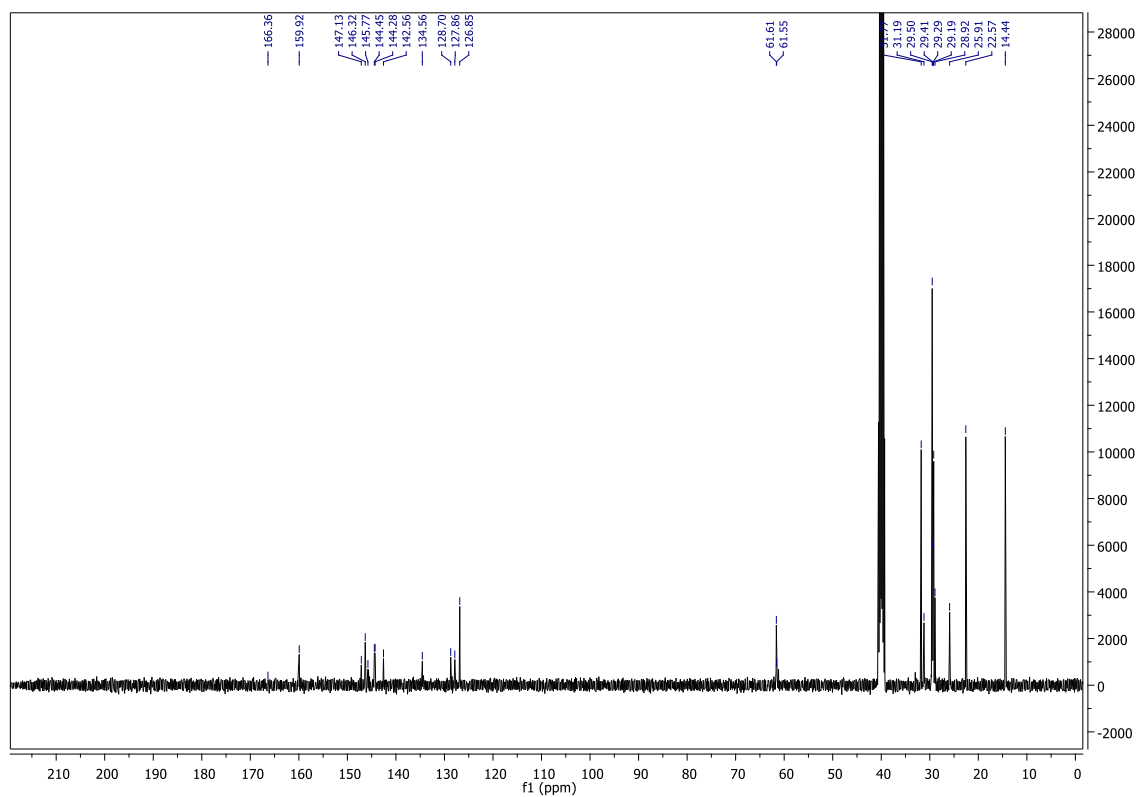


Figure S86.  $^{13}\text{C}$  NMR of Compound 35

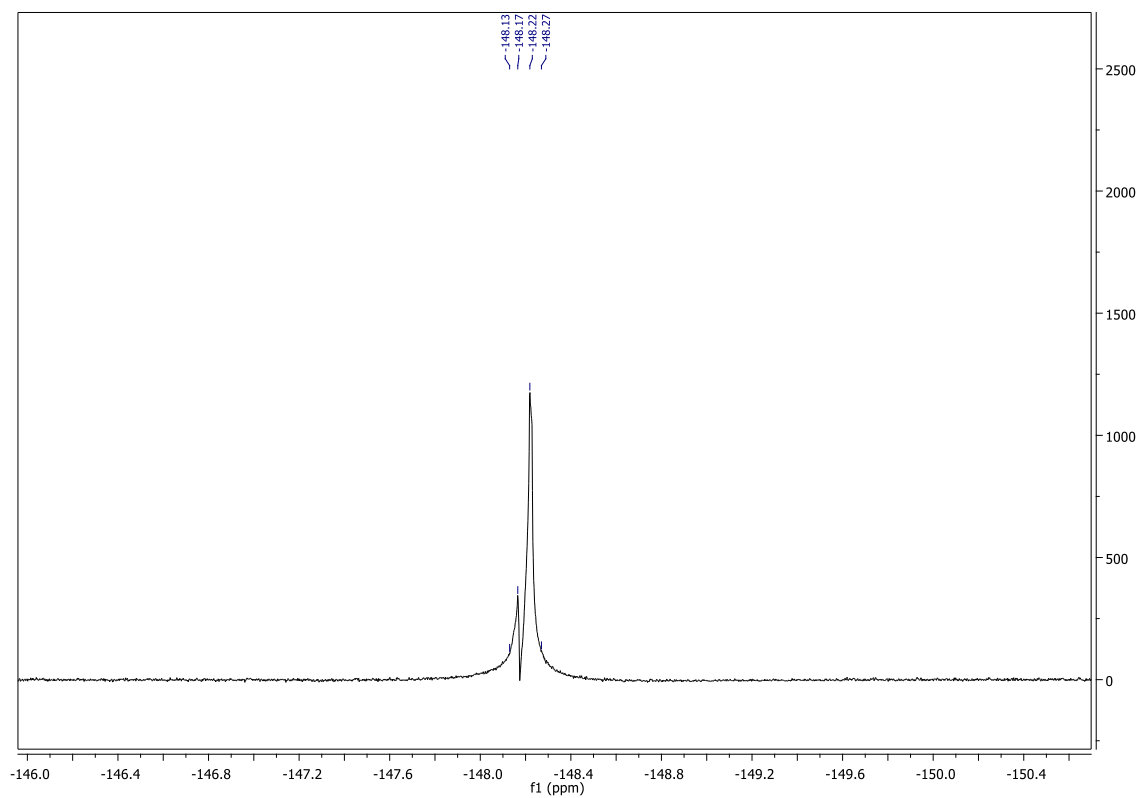


Figure S87.  $^{19}\text{F}$  NMR of Compound 35

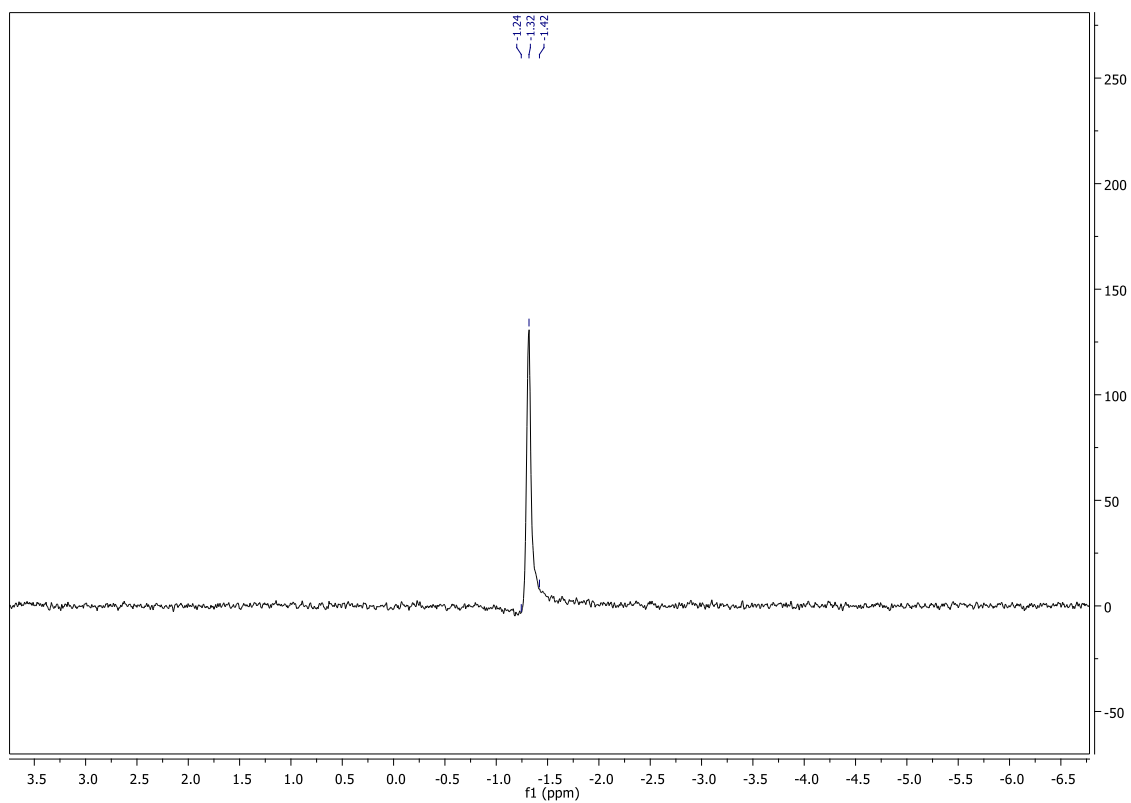


Figure S88.  $^{11}\text{B}$  NMR of Compound 35

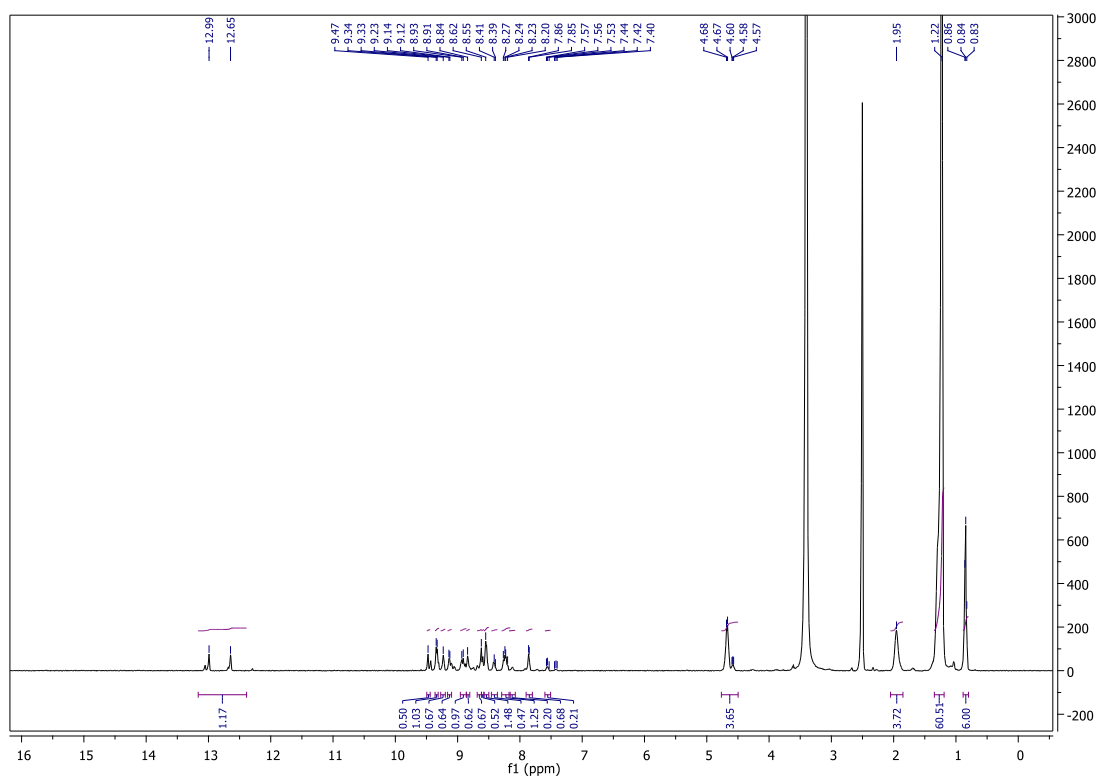


Figure S89.  $^1\text{H}$  NMR of Compound 36

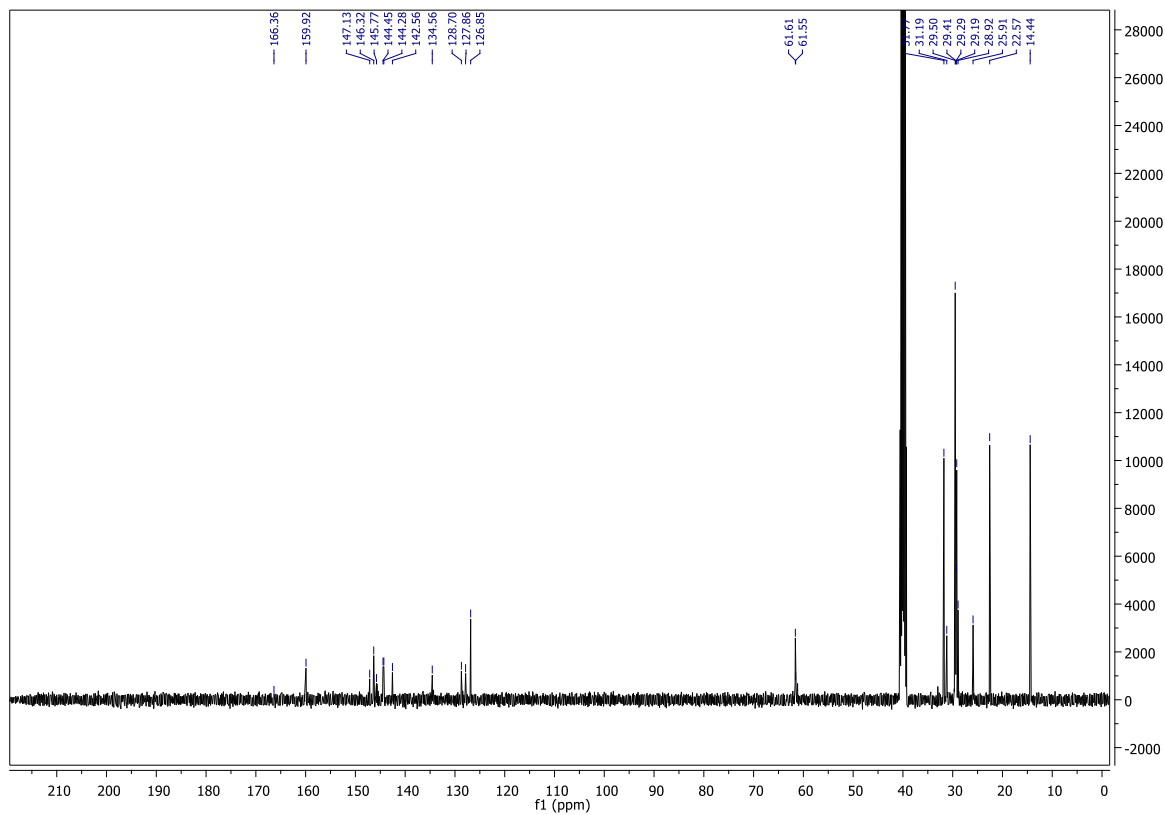


Figure S90.  $^{13}\text{C}$  NMR of Compound 36

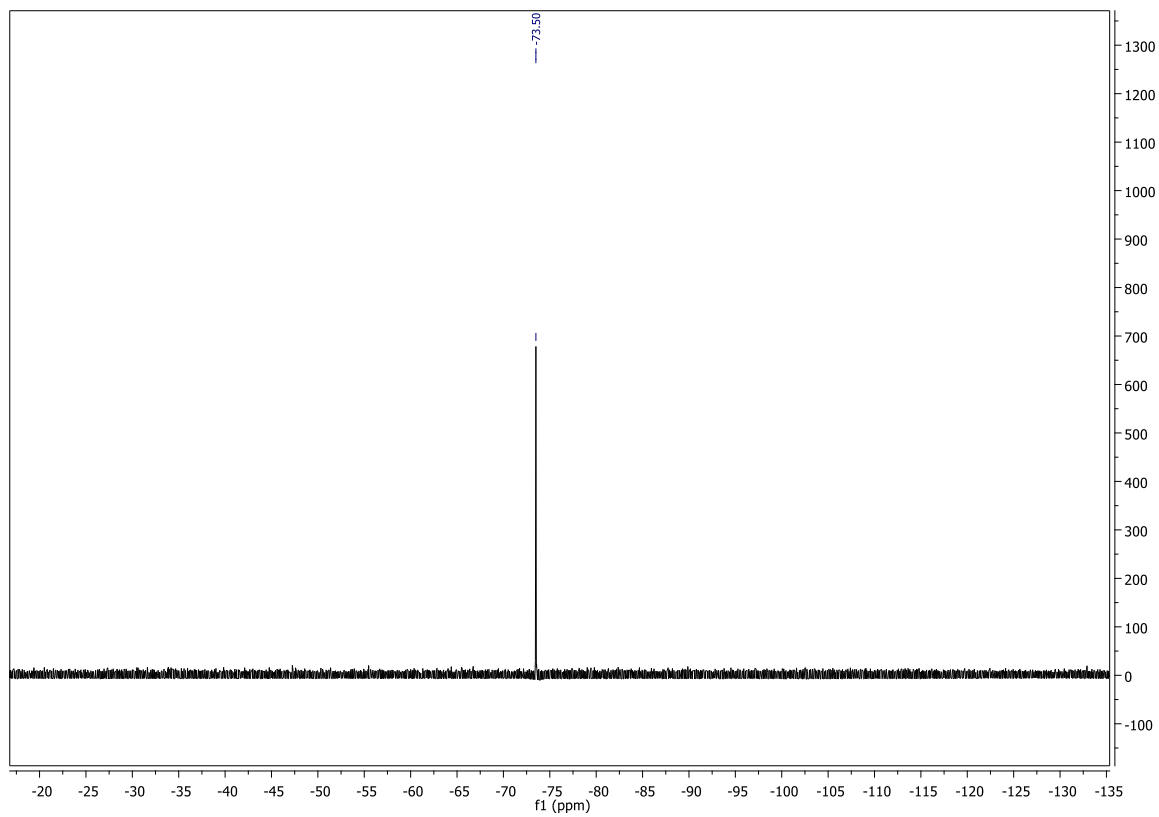
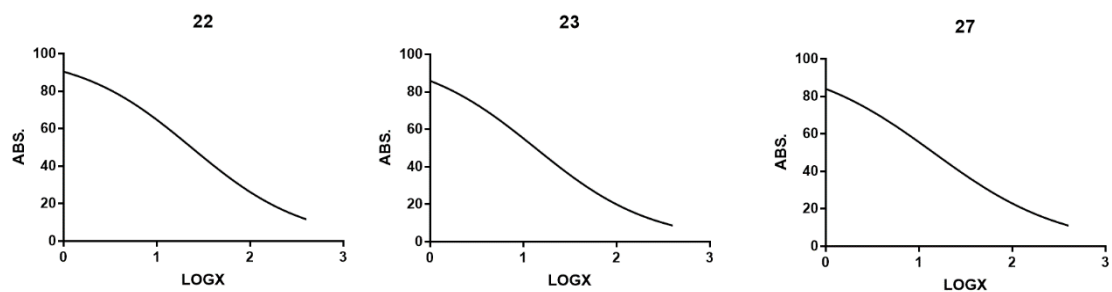


Figure S91.  $^{19}\text{F}$  NMR of Compound 36



**Figure S92.:** Representative dose response curves