



Supporting Information

for

[1,3]/[1,4]-Sulfur atom migration in β -hydroxyalkylphosphine sulfides

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Copies of NMR spectra of all pure compounds and their mixtures

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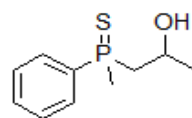
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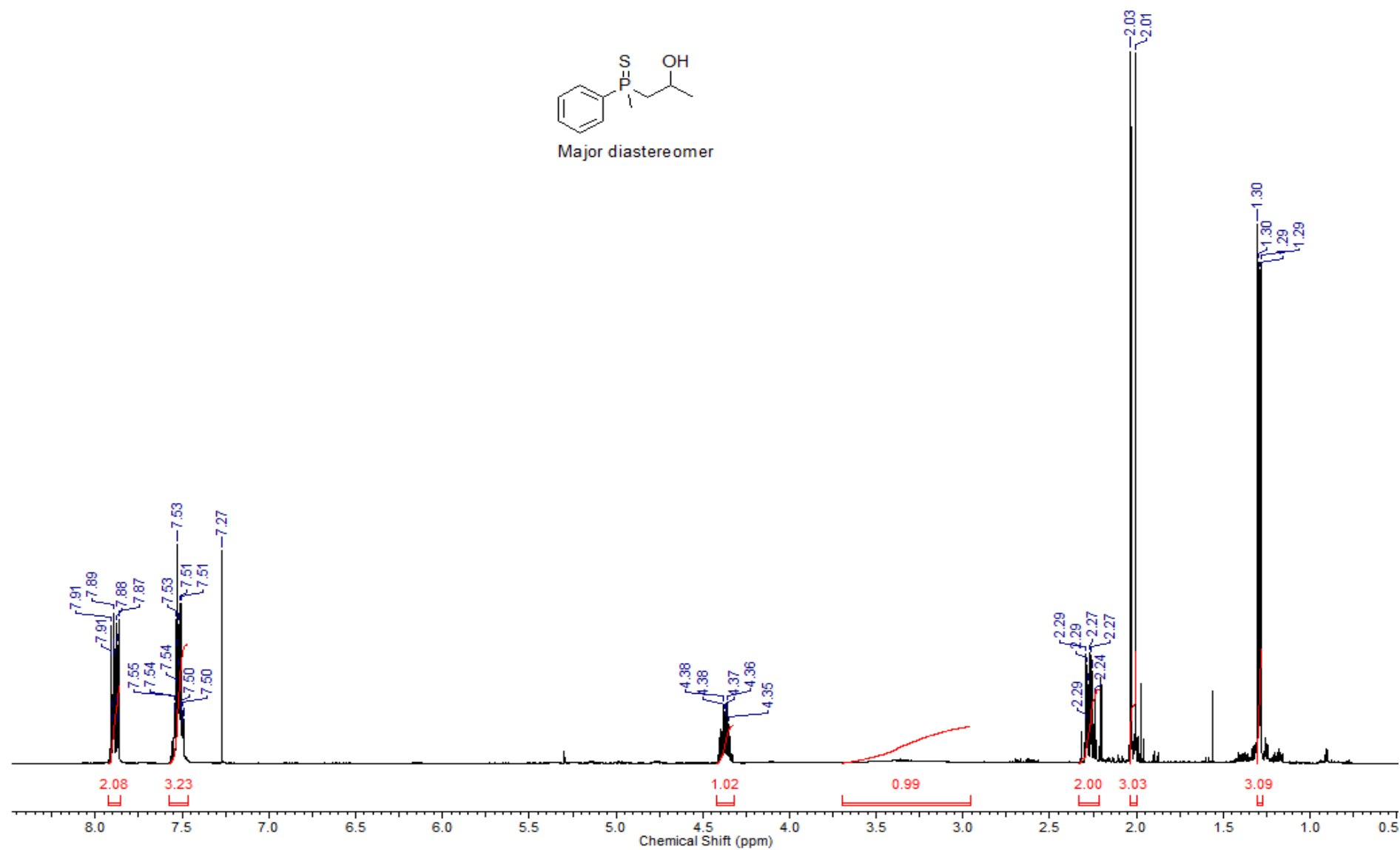
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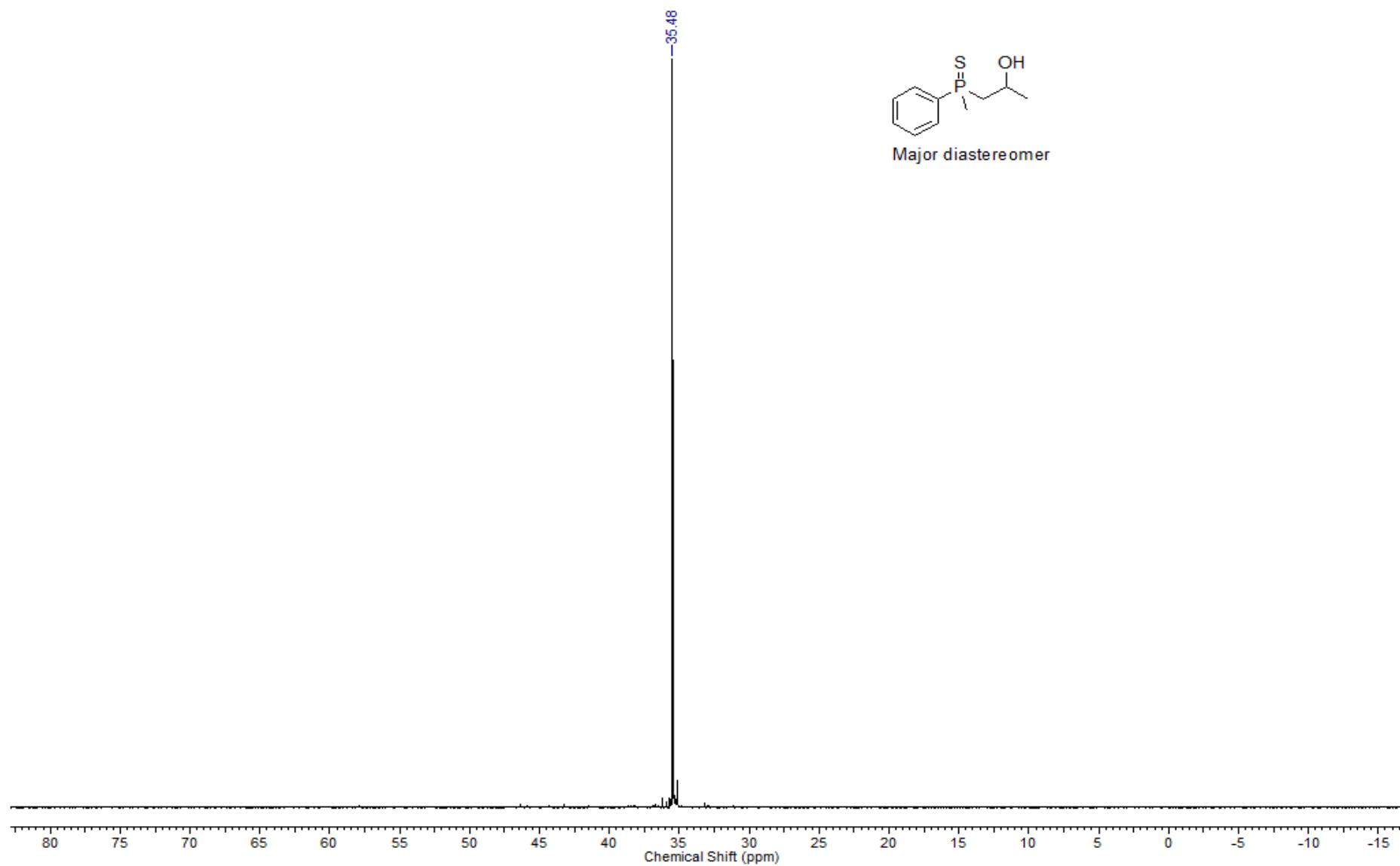
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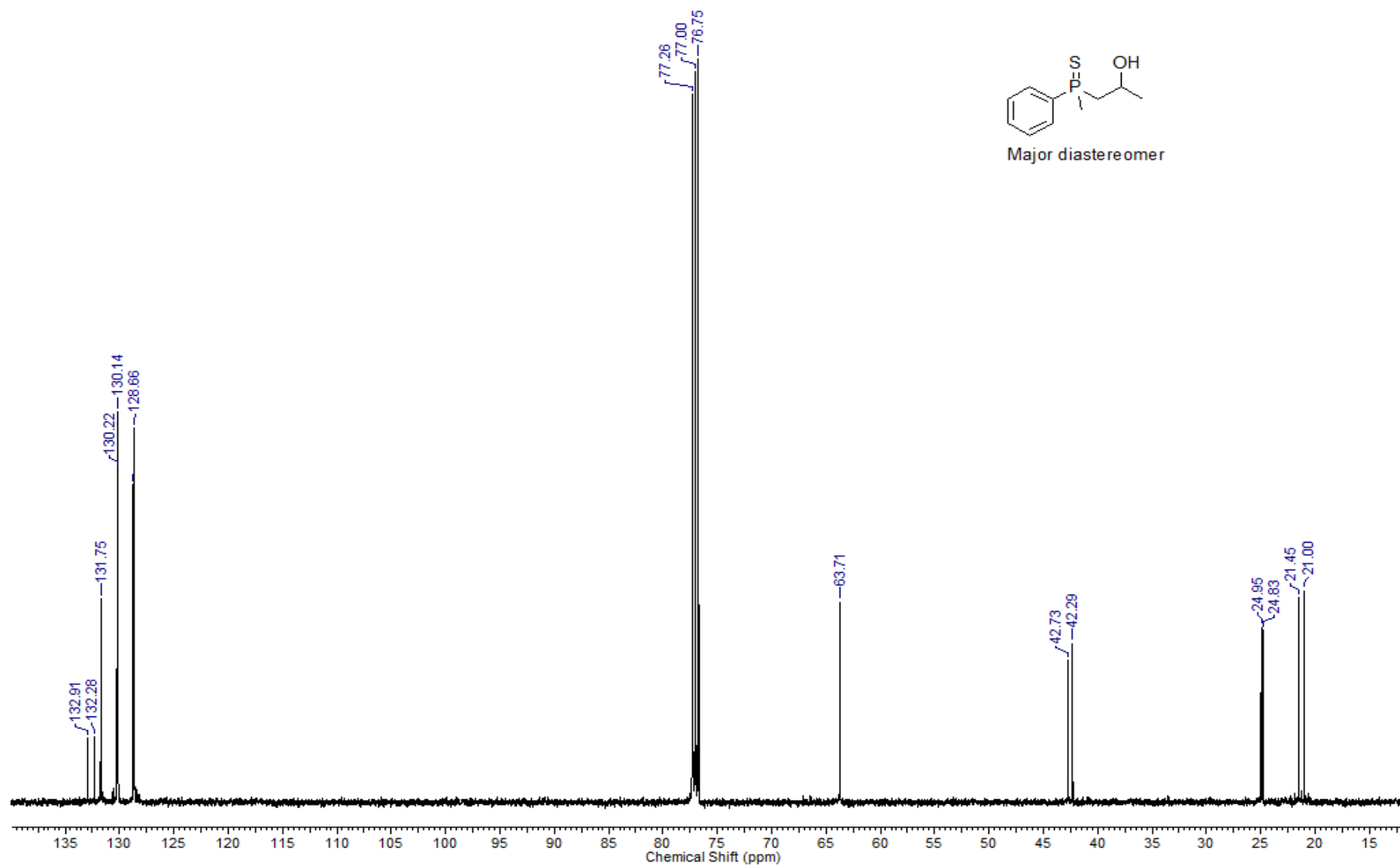
Major diastereomer



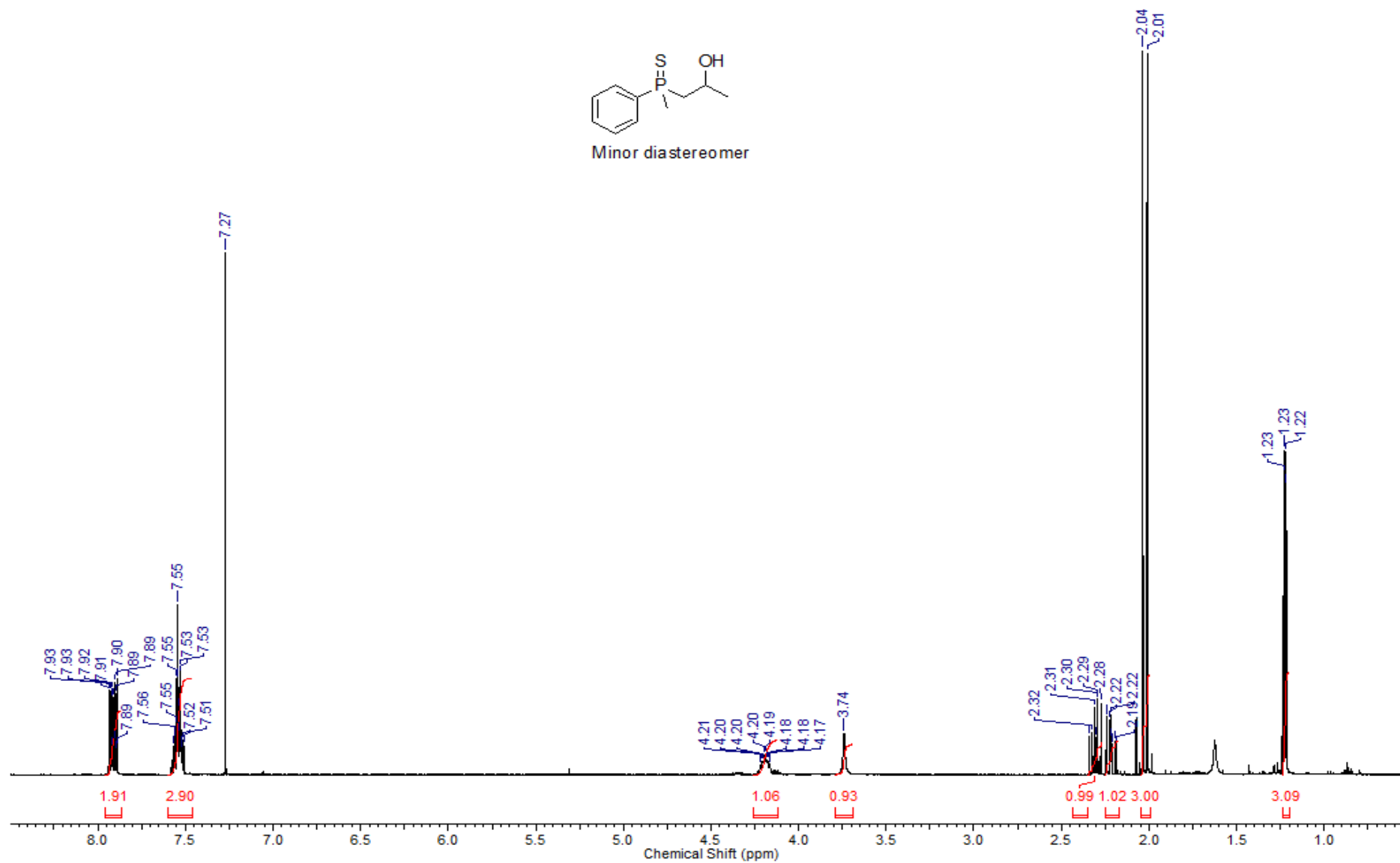
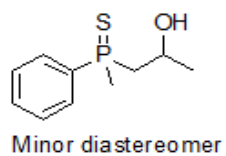
^1H NMR spectrum of (2-hydroxypropyl)methylphenylphosphine sulfide (major diastereomer) (**6**) (CDCl_3 , 500 MHz).



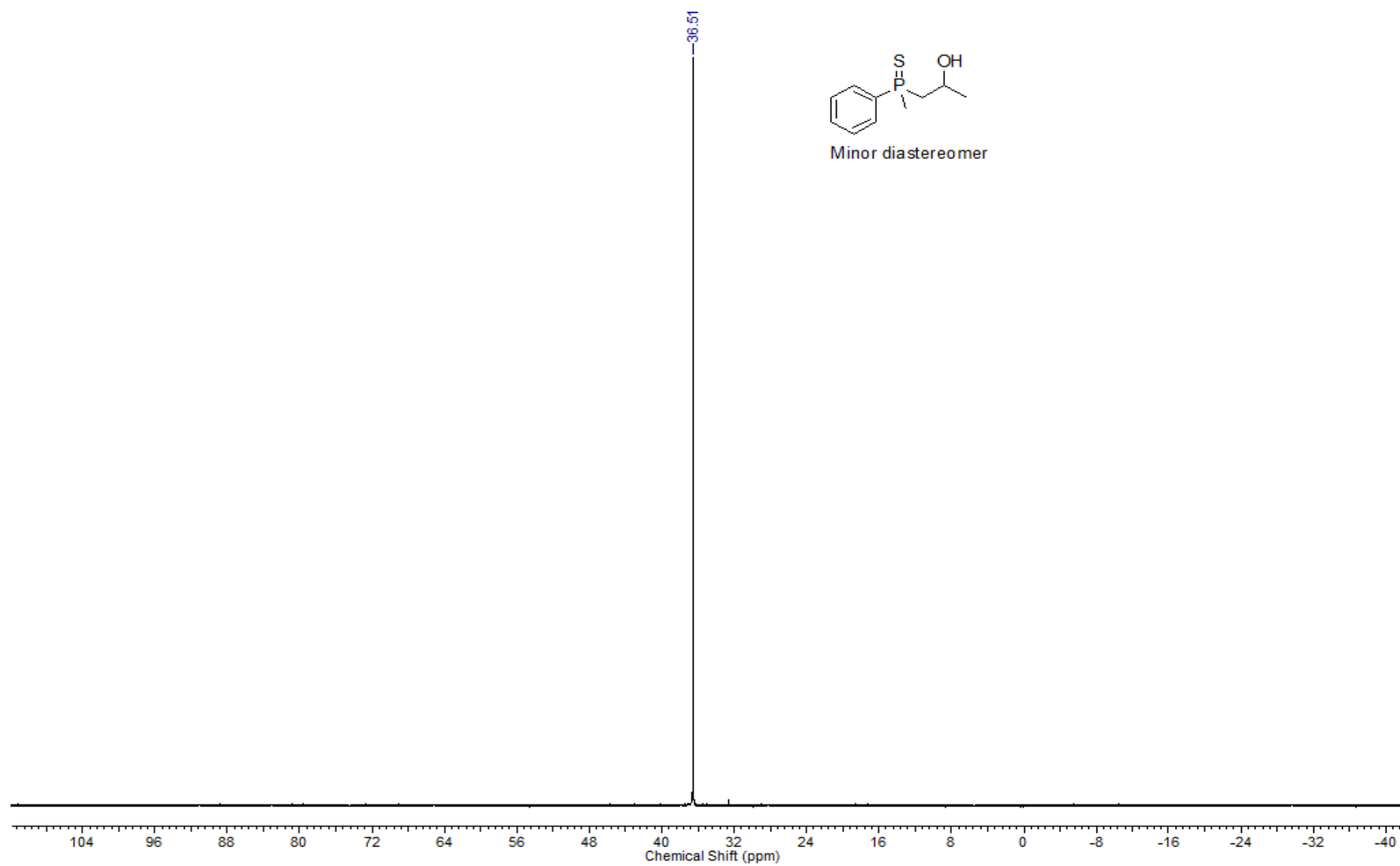
^{31}P NMR spectrum of (2-hydroxypropyl)methylphenylphosphine sulfide (major diastereomer) (**6**) (CDCl_3 , 202 MHz).



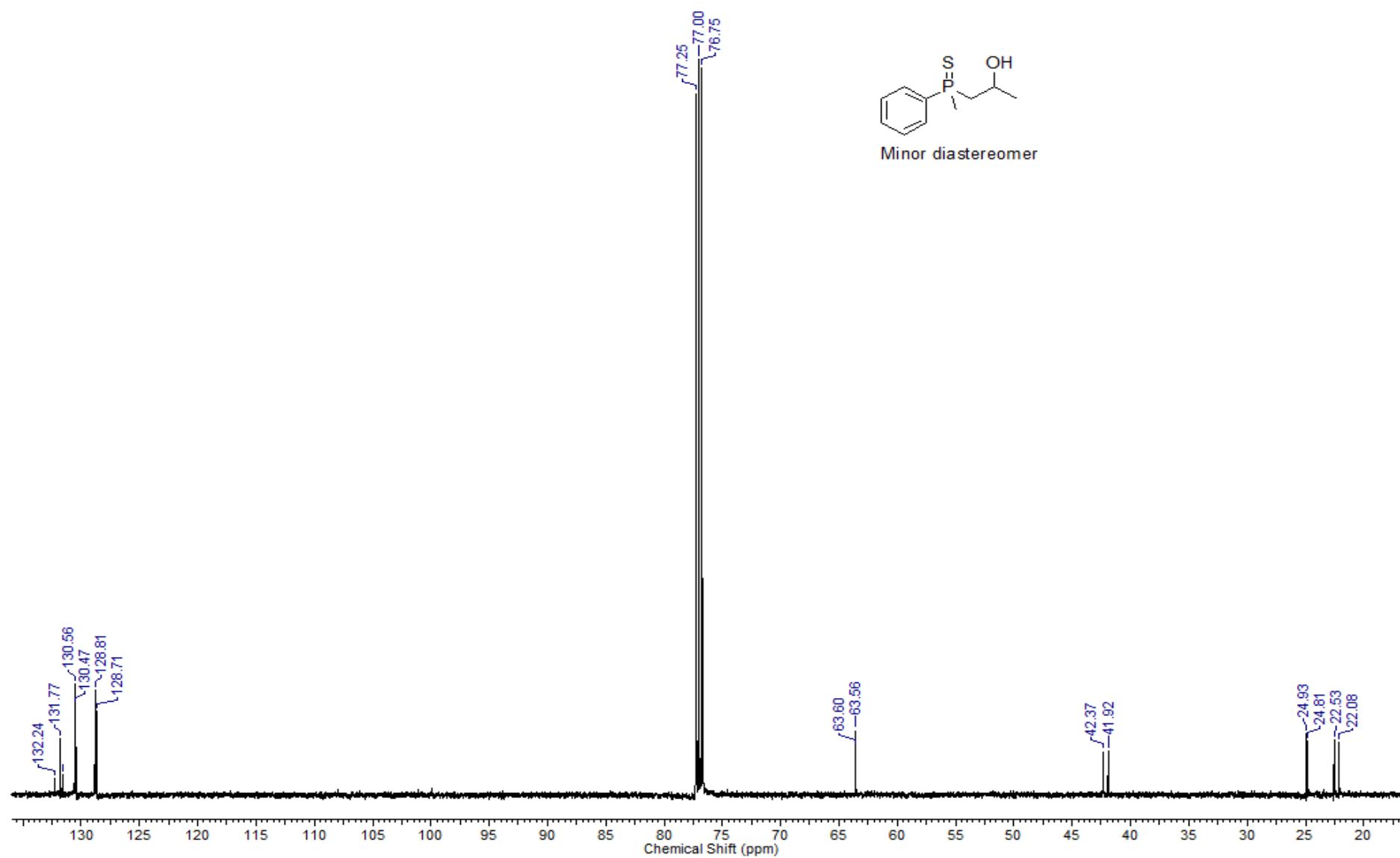
¹³C NMR spectrum of (2-hydroxypropyl)methylphenylphosphine sulfide (major diastereomer) (**6**) (CDCl₃, 126 MHz).



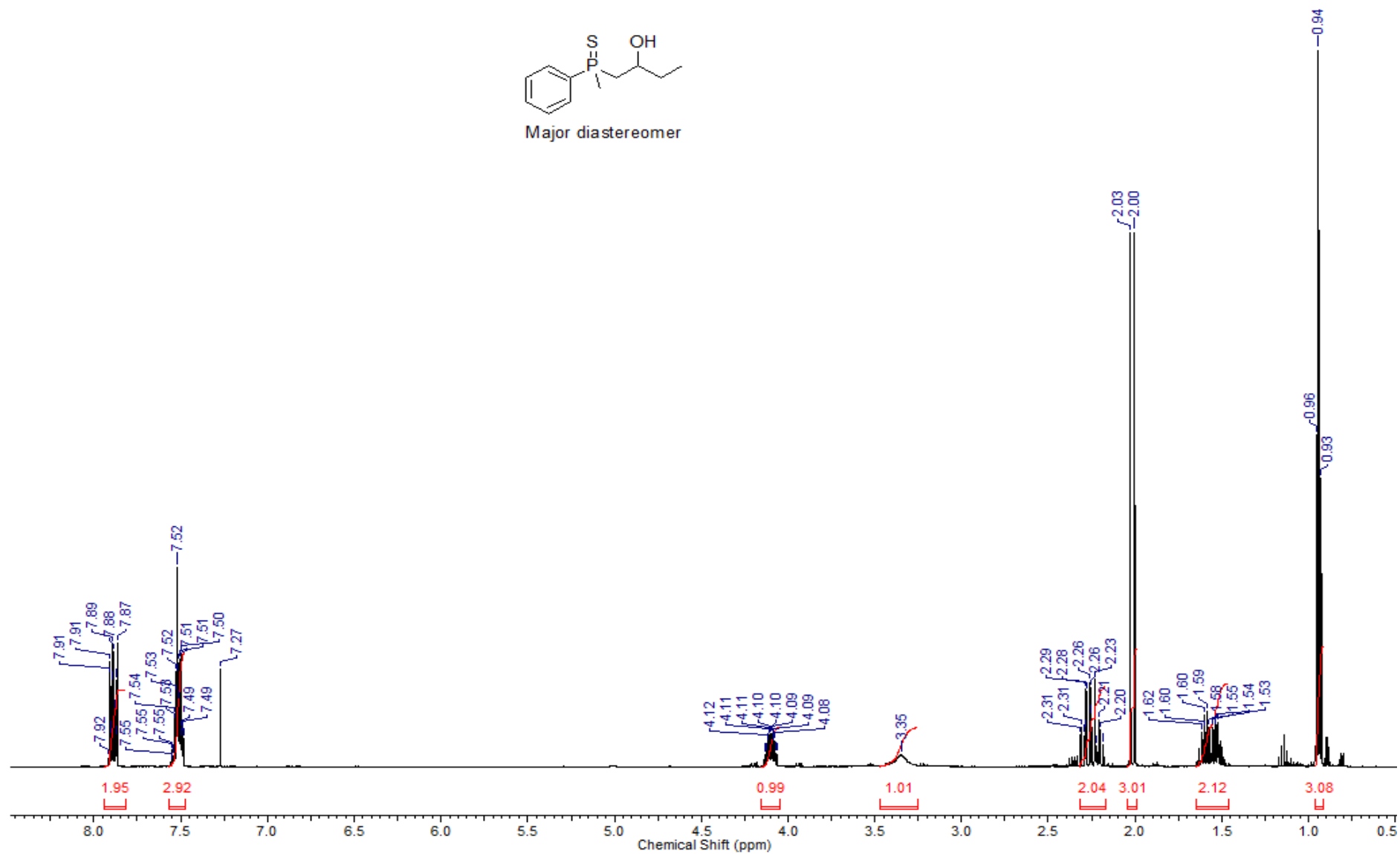
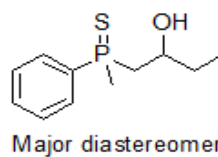
^1H NMR spectrum of (2-hydroxypropyl)methylphenylphosphine sulfide (minor diastereomer) (**6**) (CDCl_3 , 500 MHz).



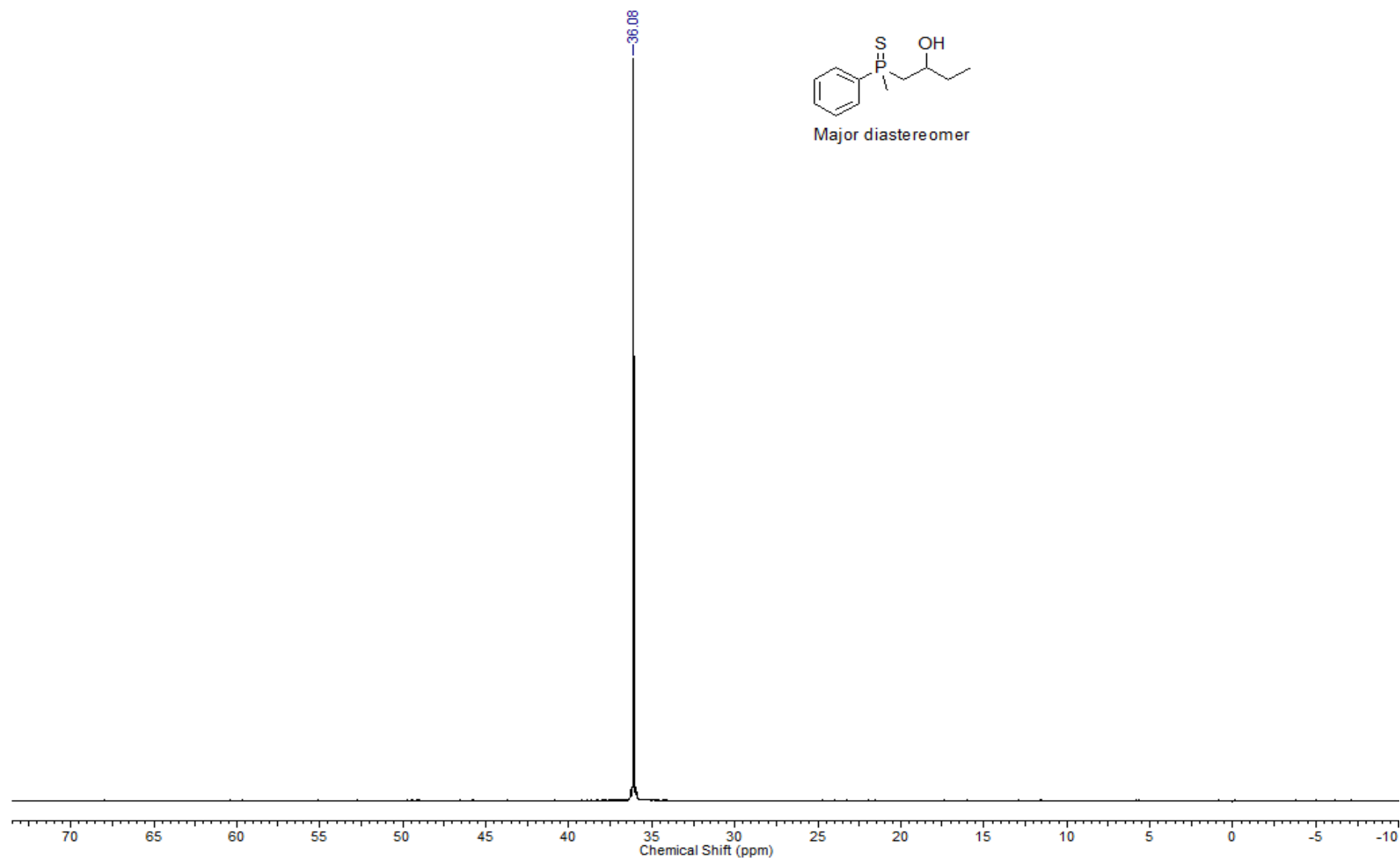
^{31}P NMR spectrum of (2-hydroxypropyl)methylphenylphosphine sulfide (minor diastereomer) (**6**) (CDCl_3 , 202 MHz).



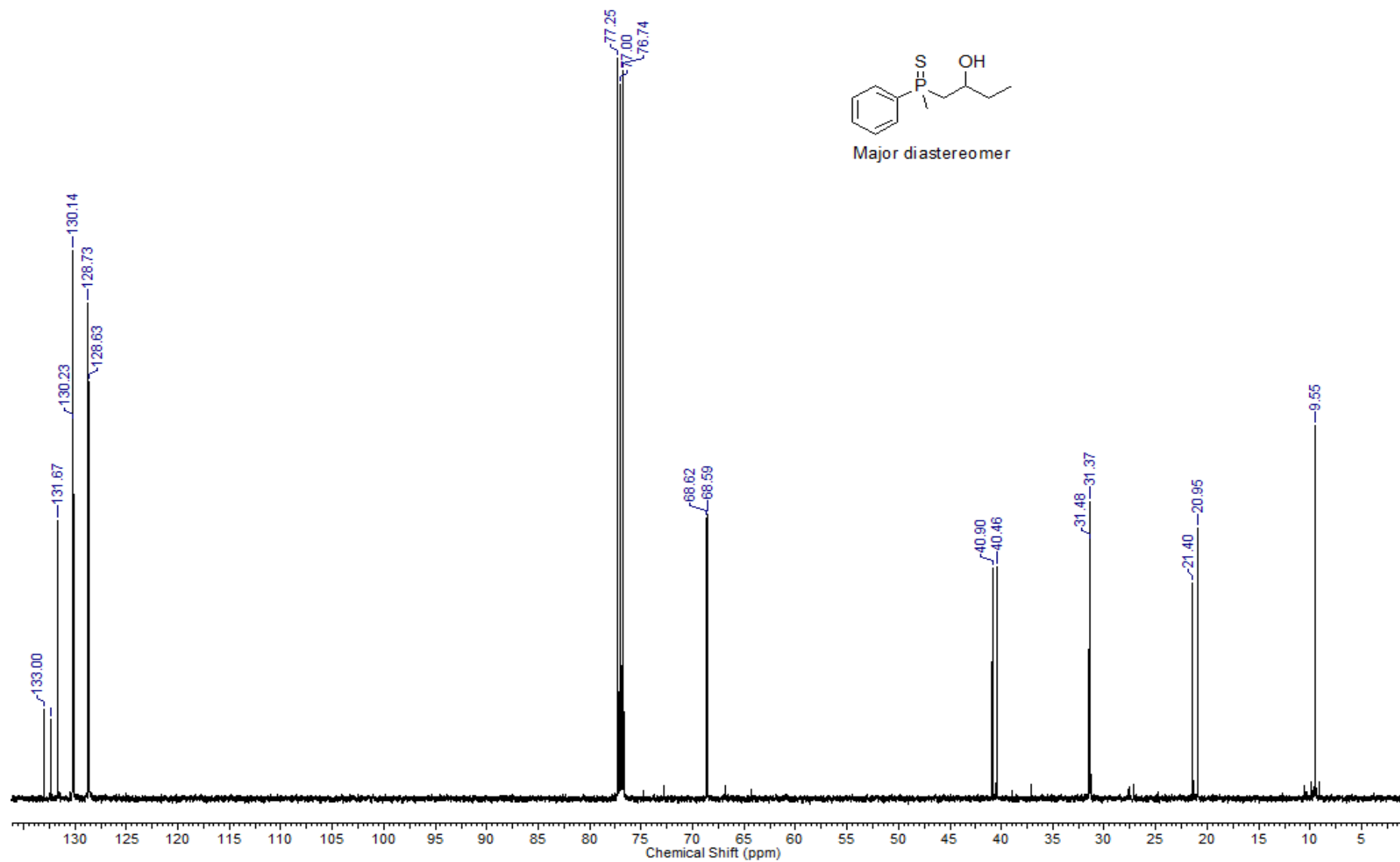
¹³C NMR spectrum of (2-hydroxypropyl)methylphenylphosphine sulfide (minor diastereomer) (**6**) (CDCl₃, 126 MHz).



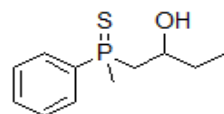
^1H NMR spectrum of (2-hydroxybutyl)methylphenylphosphine sulfide (major diastereomer) (7) (CDCl_3 , 500 MHz).



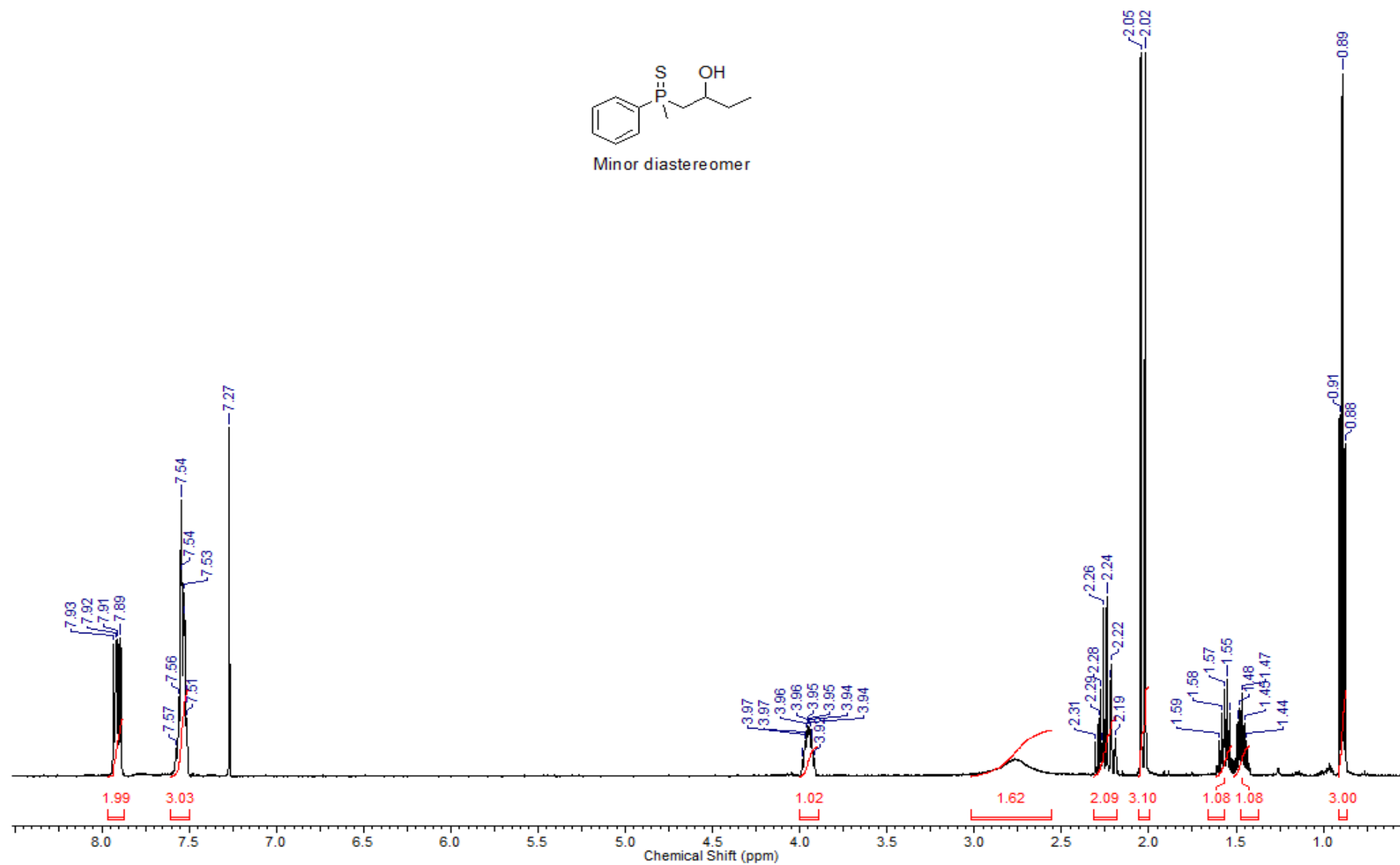
^{31}P NMR spectrum of (2-hydroxybutyl)methylphenylphosphine sulfide (major diastereomer) (7) (CDCl_3 , 202 MHz).



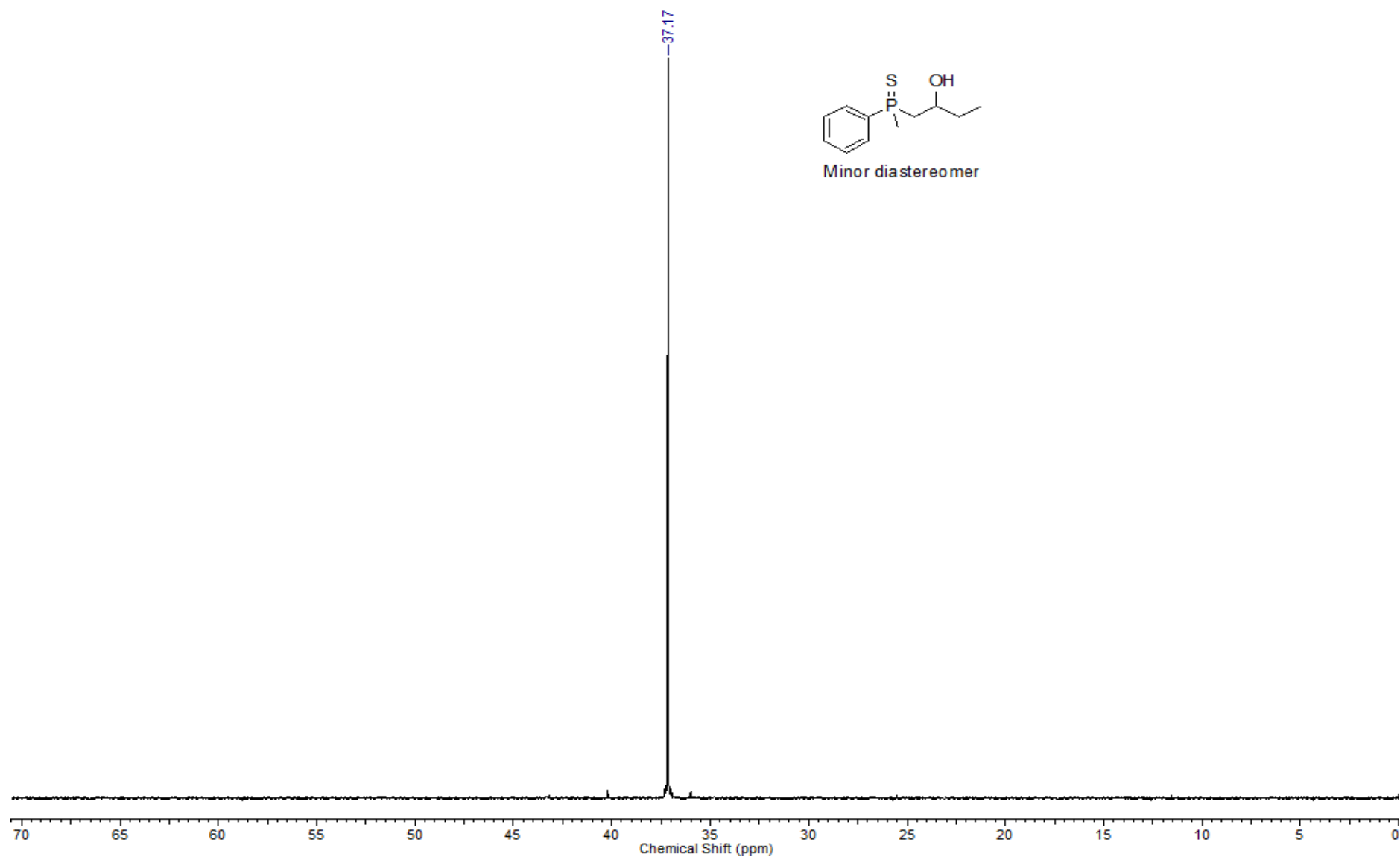
¹³C NMR spectrum of (2-hydroxybutyl)methylphenylphosphine sulfide (major diastereomer) (7) (CDCl₃, 126 MHz).



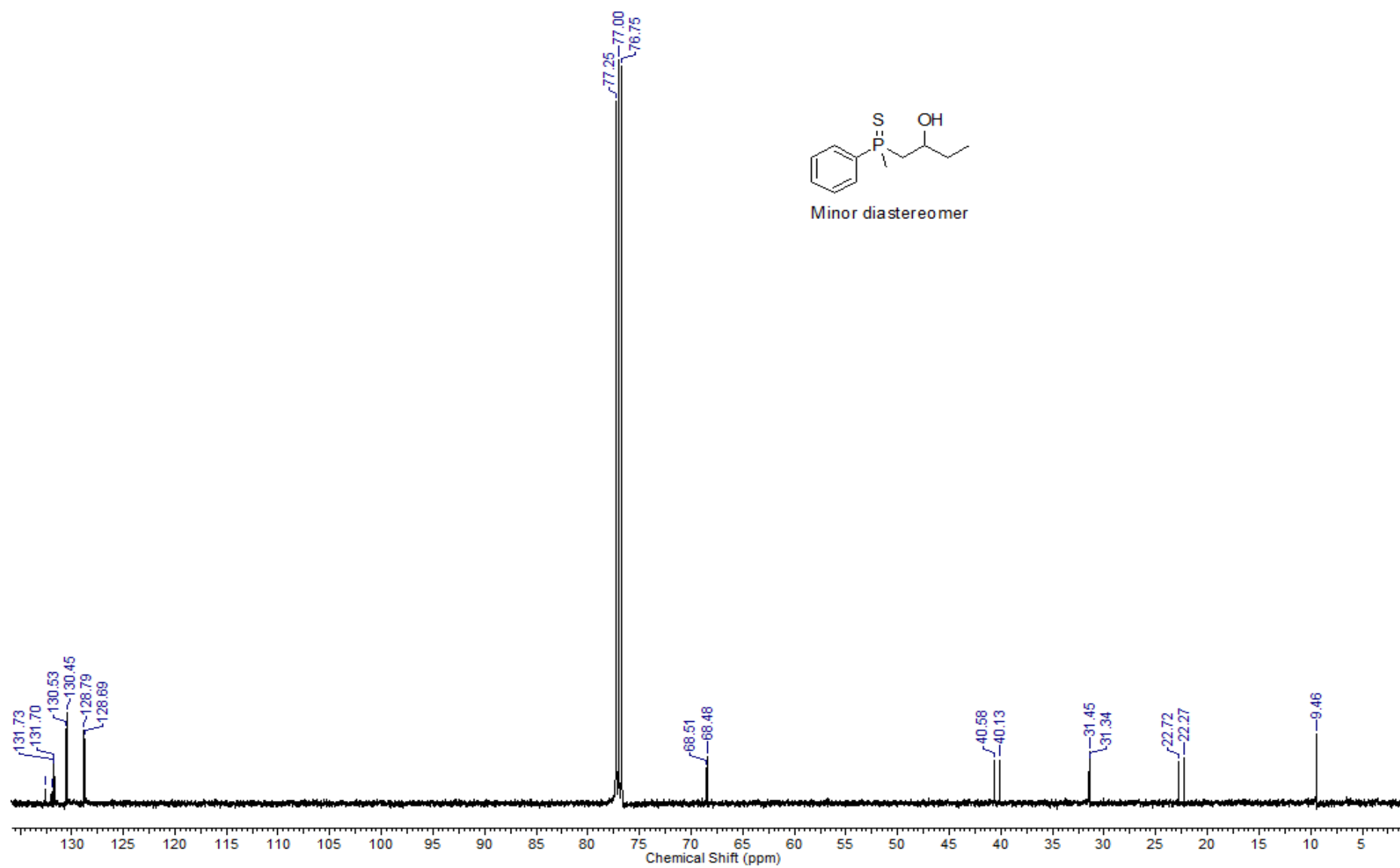
Minor diastereomer



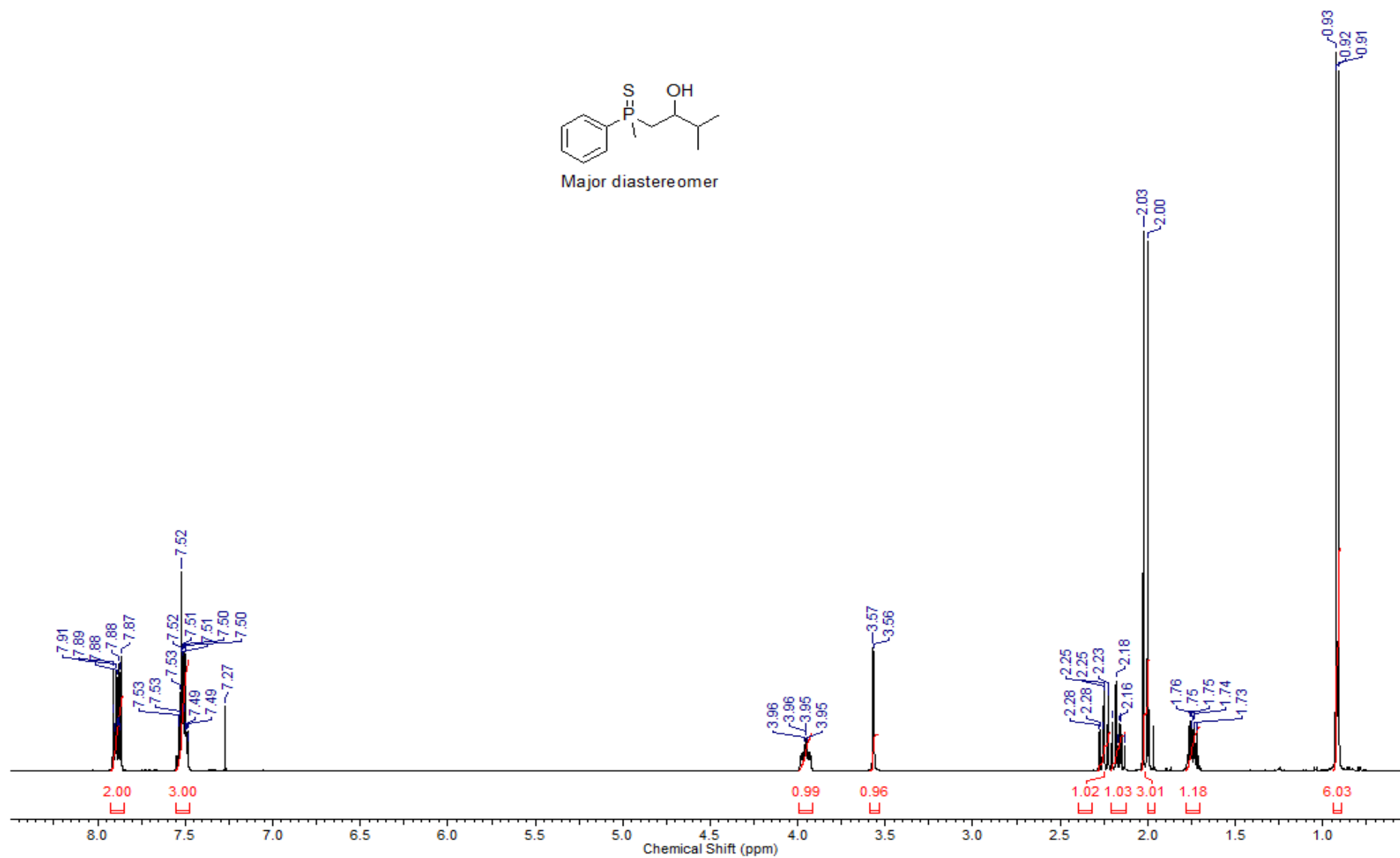
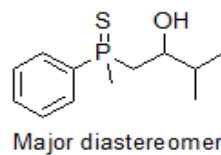
¹H NMR spectrum of (2-hydroxybutyl)methylphenylphosphine sulfide (minor diastereomer) (7) (CDCl₃, 500 MHz).



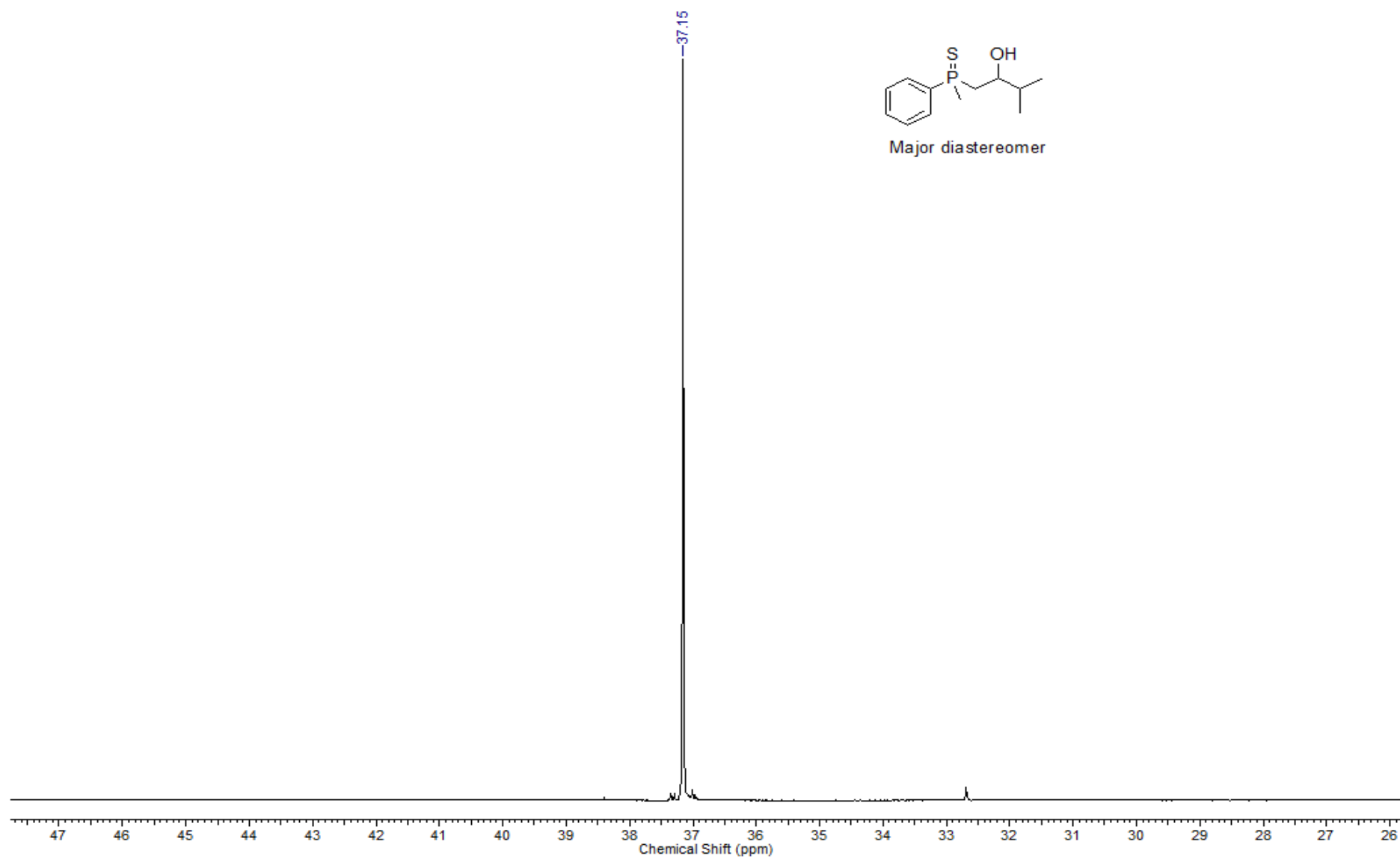
^{31}P NMR spectrum of (2-hydroxybutyl)methylphenylphosphine sulfide (minor diastereomer) (7) (CDCl_3 , 202 MHz).



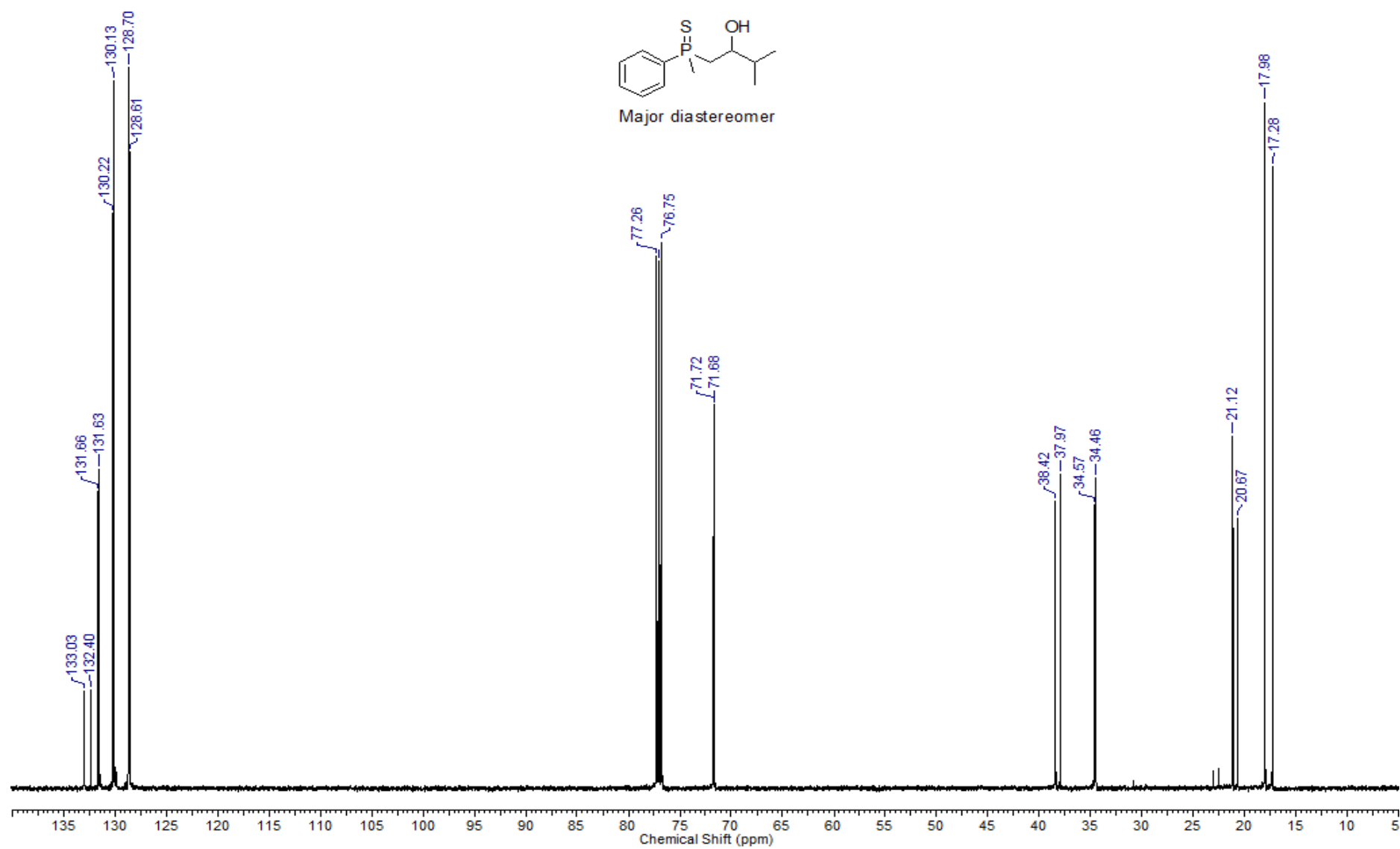
¹³C NMR spectrum of (2-hydroxybutyl)methylphenylphosphine sulfide (minor diastereomer) (7) (CDCl₃, 126 MHz).



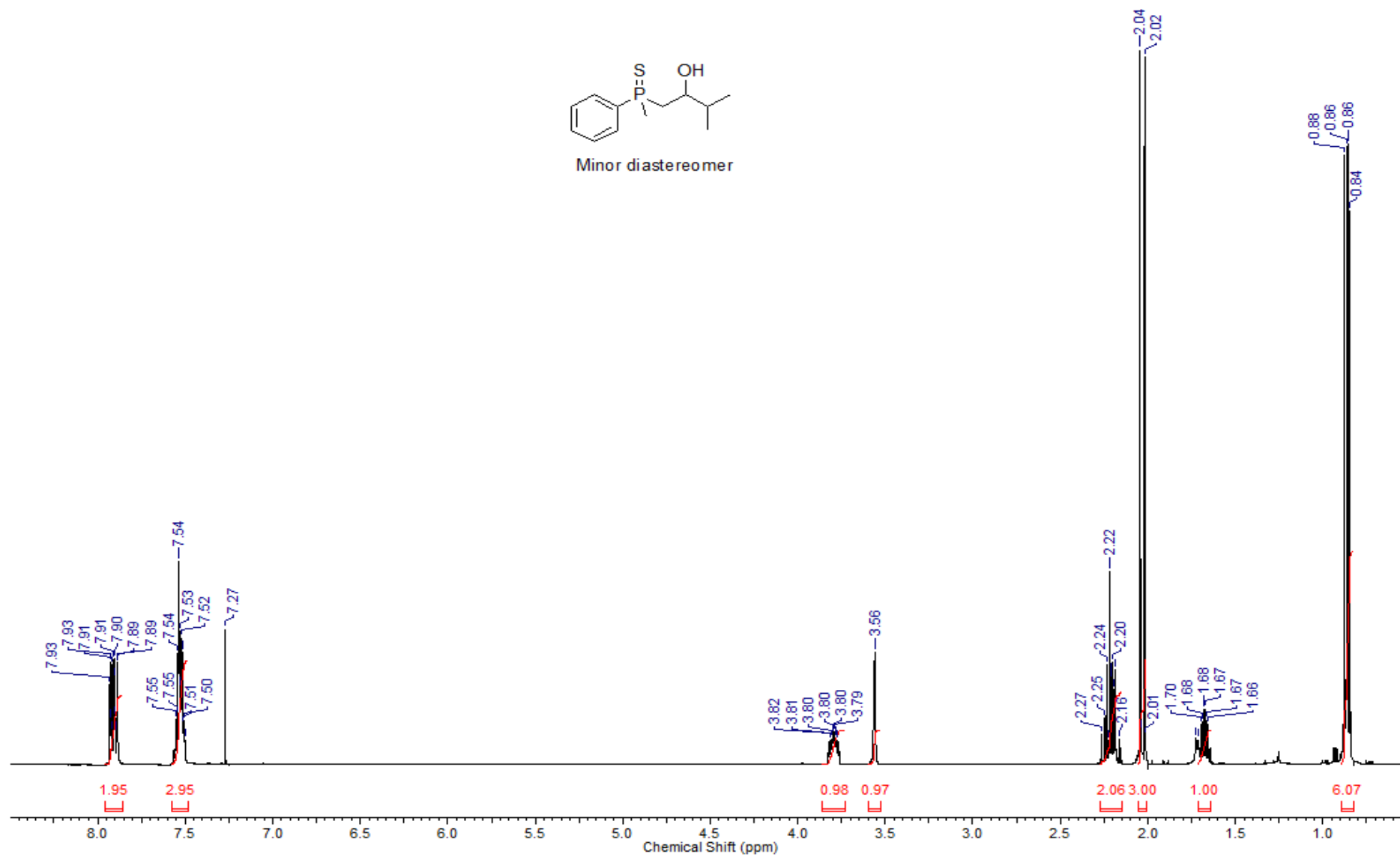
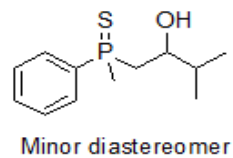
¹H NMR spectrum of (2-hydroxy-3-methylbutyl)methylphenylphosphine sulfide (major diastereomer) (**8**) (CDCl₃, 500 MHz).



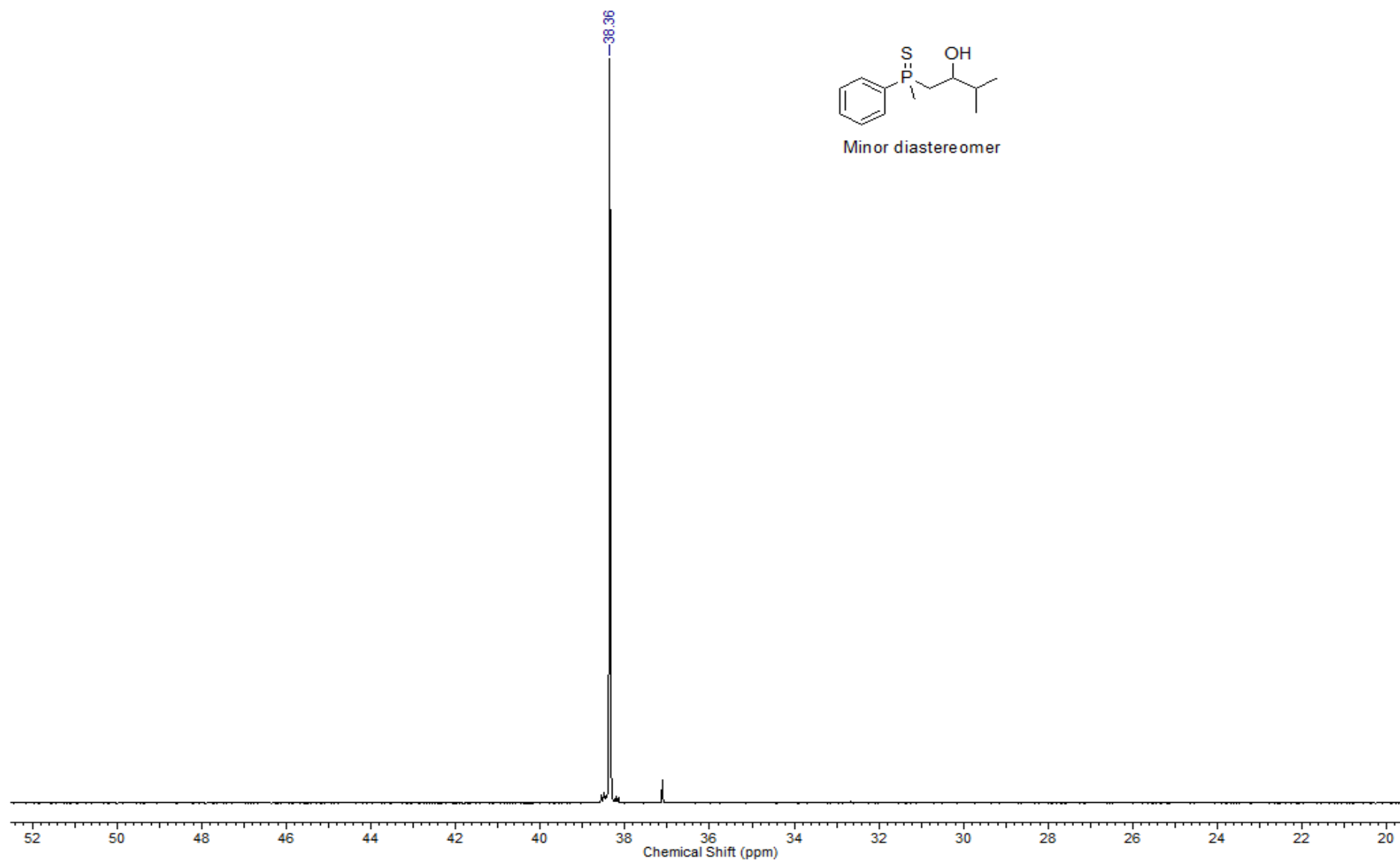
^{31}P NMR spectrum of (2-hydroxy-3-methylbutyl)methylphenylphosphine sulfide (major diastereomer) (**8**) (CDCl_3 , 202 MHz).



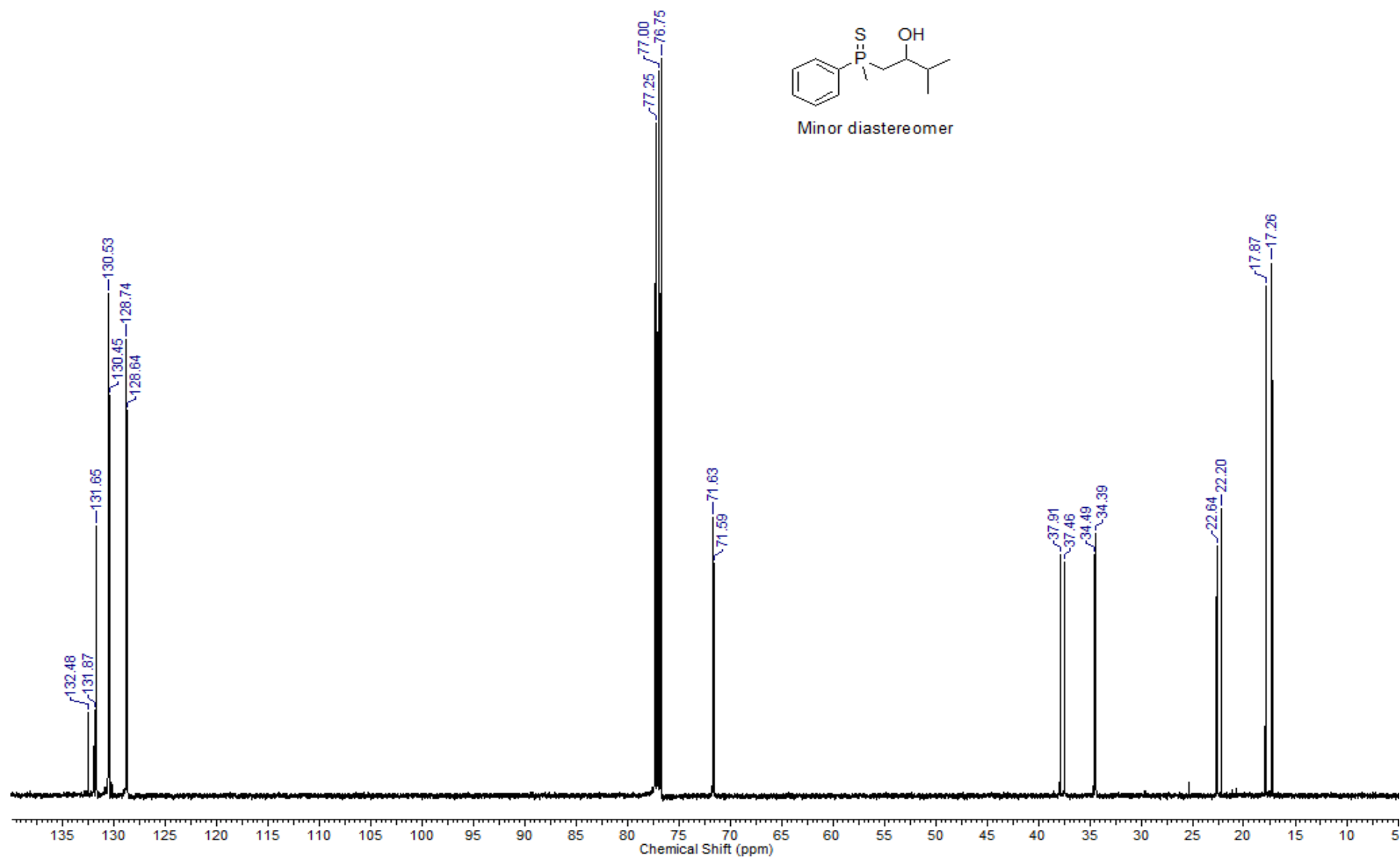
¹³C NMR spectrum of (2-hydroxy-3-methylbutyl)methylphenylphosphine sulfide (major diastereomer) (**8**) (CDCl₃, 126 MHz).



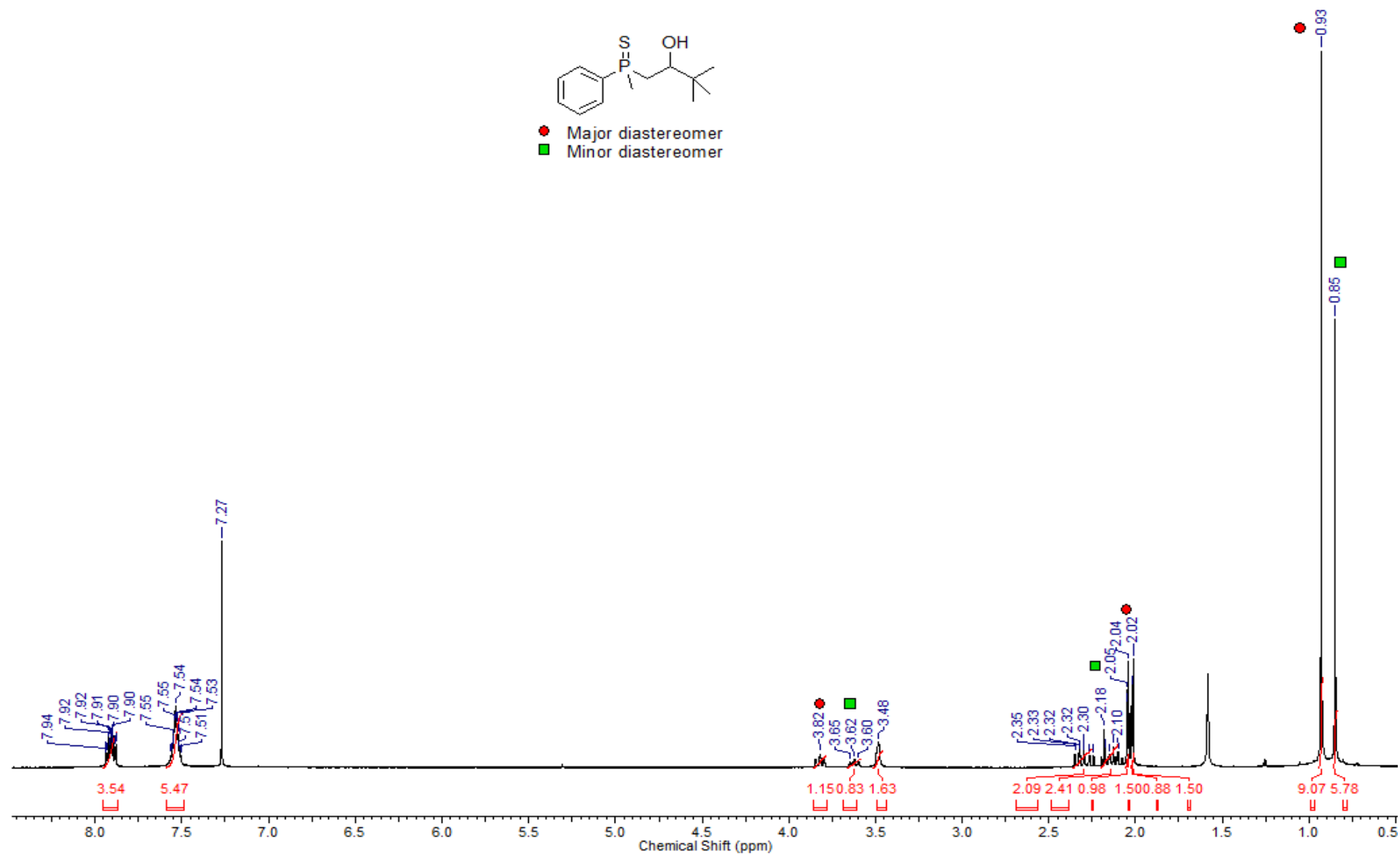
¹H NMR spectrum of (2-hydroxy-3-methylbutyl)methylphenylphosphine sulfide (minor diastereomer) (**8**) (CDCl₃, 500 MHz).



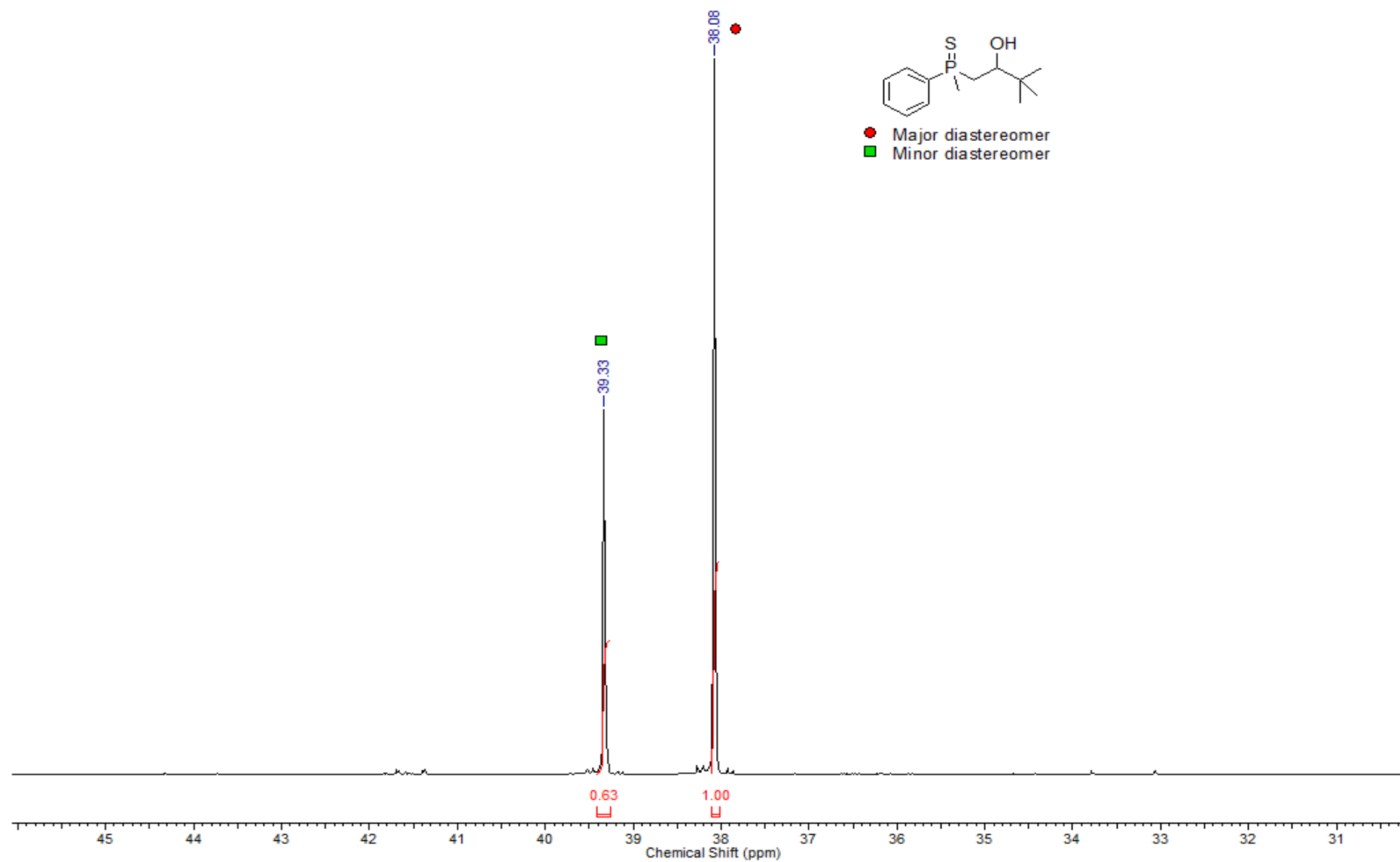
^{31}P NMR spectrum of (2-hydroxy-3-methylbutyl)methylphenylphosphine sulfide (minor diastereomer) (**8**) (CDCl_3 , 202 MHz).



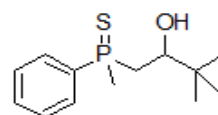
¹³C NMR spectrum of (2-hydroxy-3-methylbutyl)methylphenylphosphine sulfide (minor diastereomer) (**8**) (CDCl₃, 126 MHz).



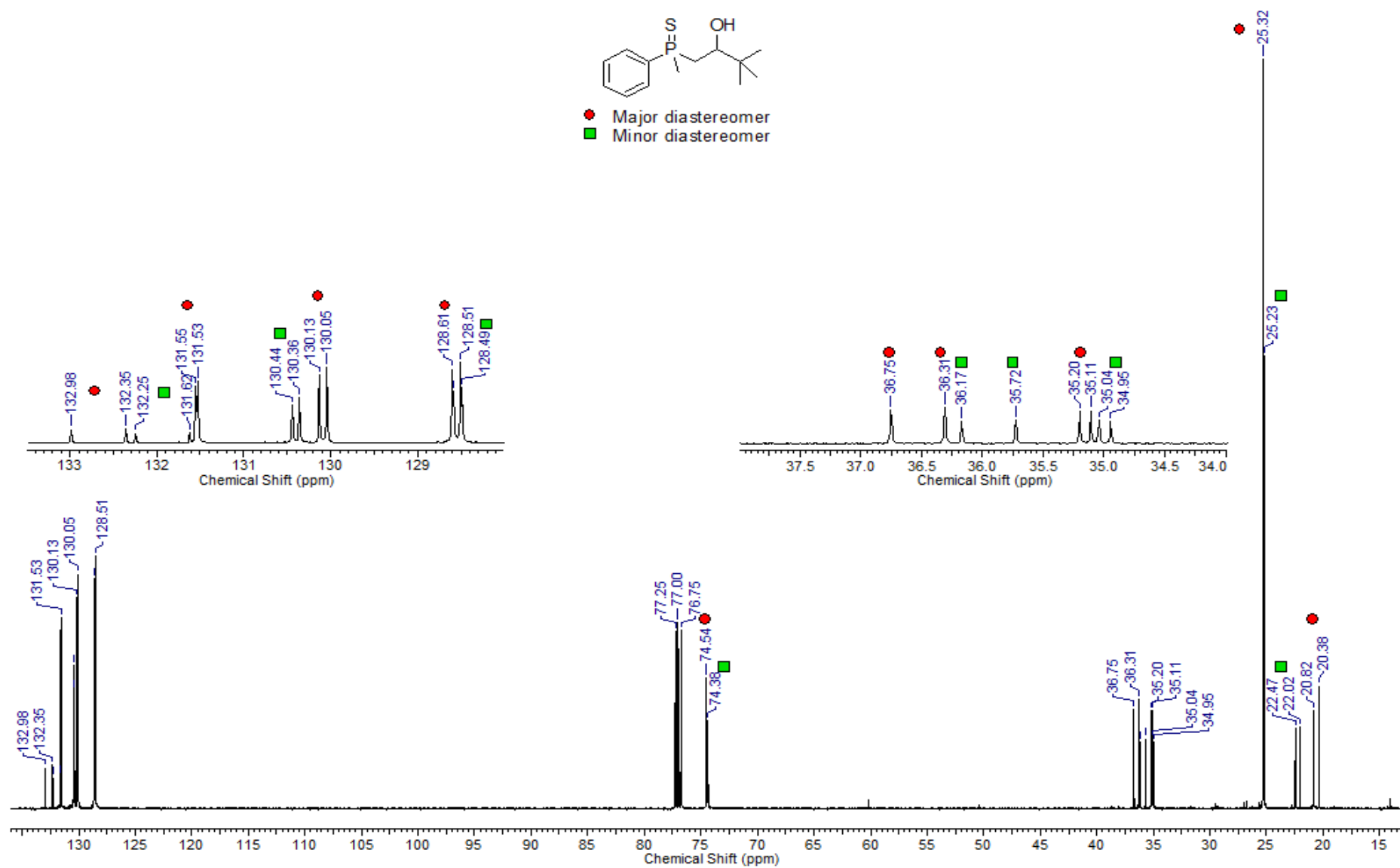
^1H NMR spectrum of (2-hydroxy-3,3-dimethylbutyl)methylphenylphosphine sulfide (**9**) (CDCl_3 , 500 MHz).



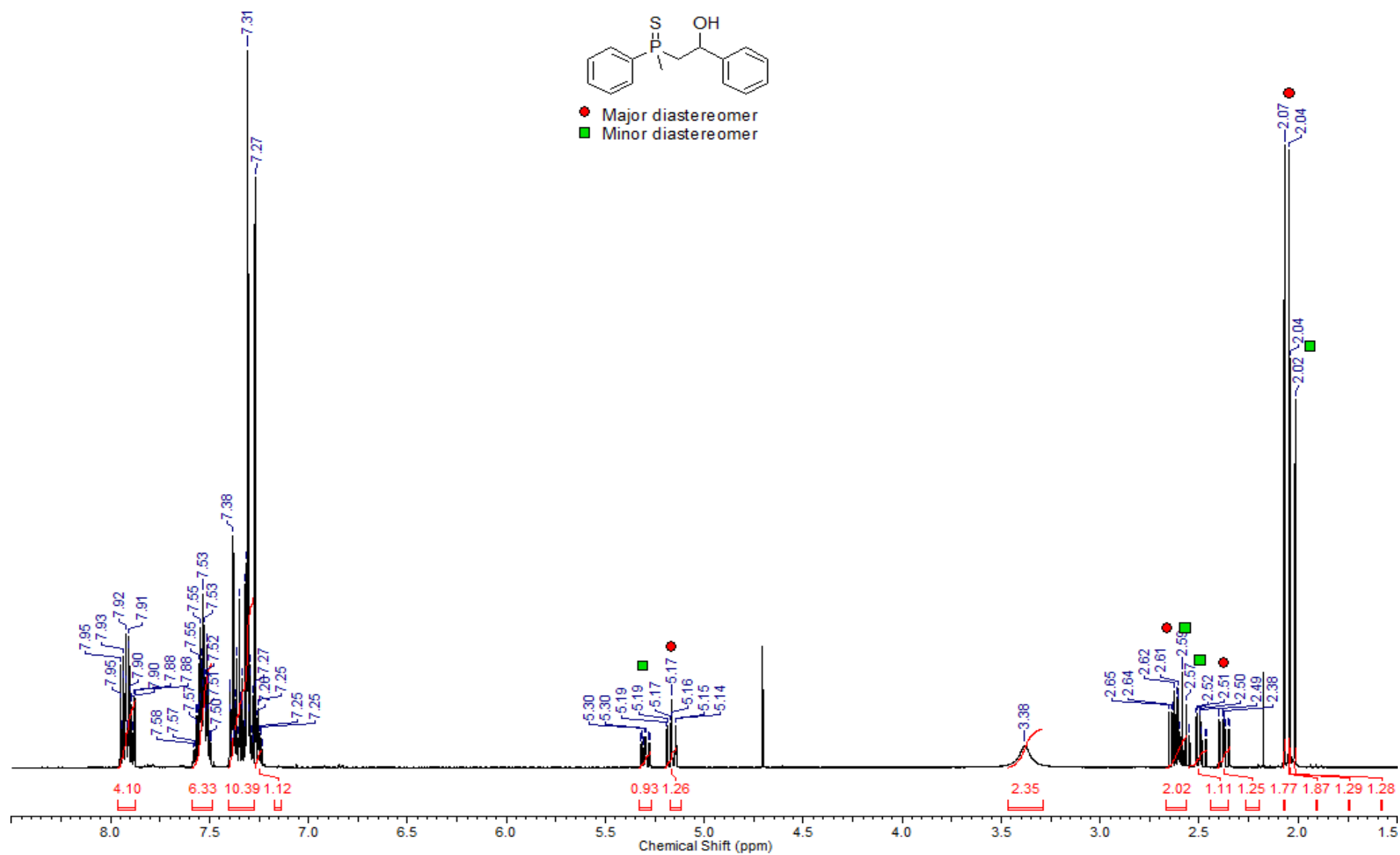
^{31}P NMR spectrum of (2-hydroxy-3,3-dimethylbutyl)methylphenylphosphine sulfide (**9**) (CDCl_3 , 202 MHz).



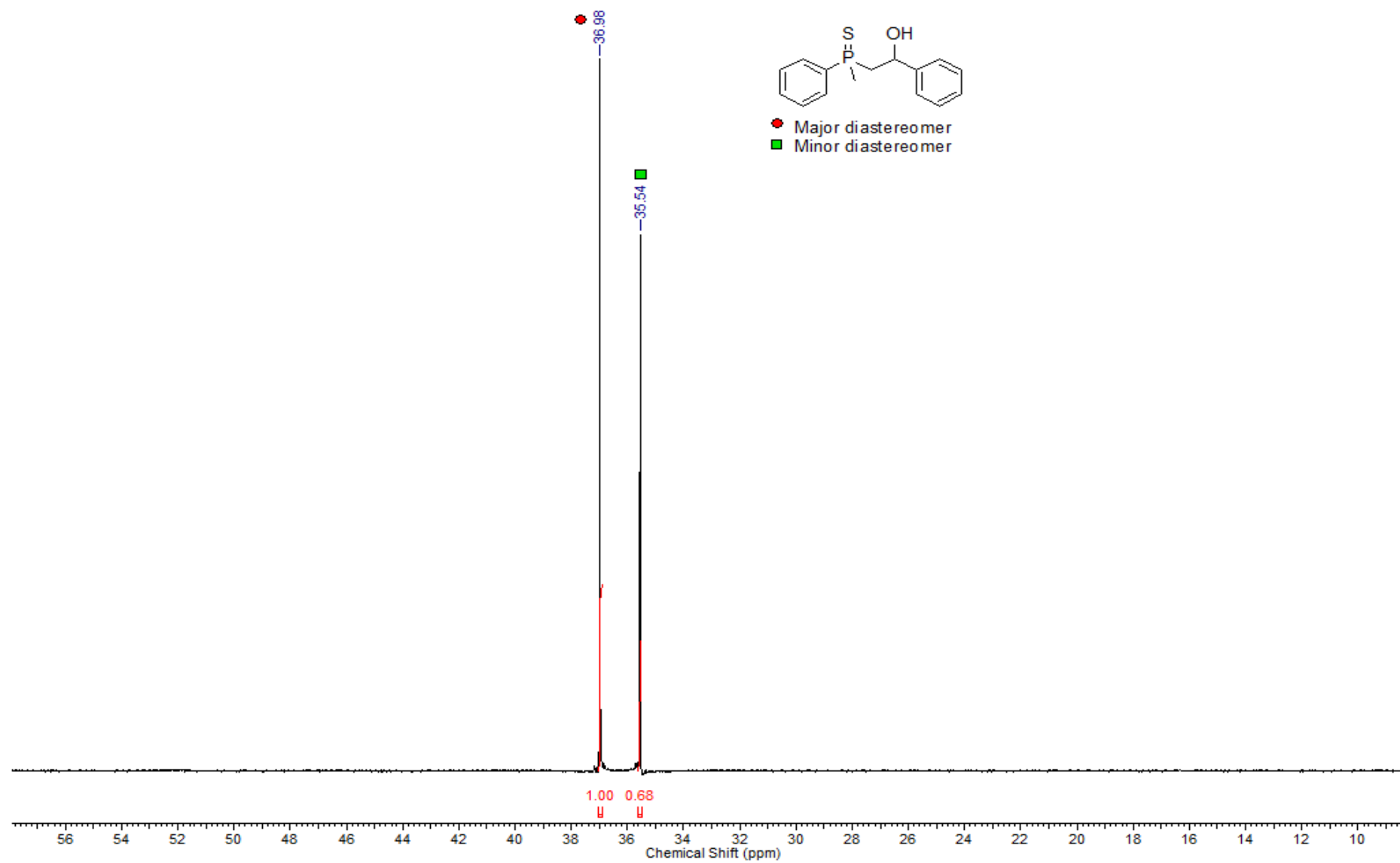
● Major diastereomer
 ■ Minor diastereomer



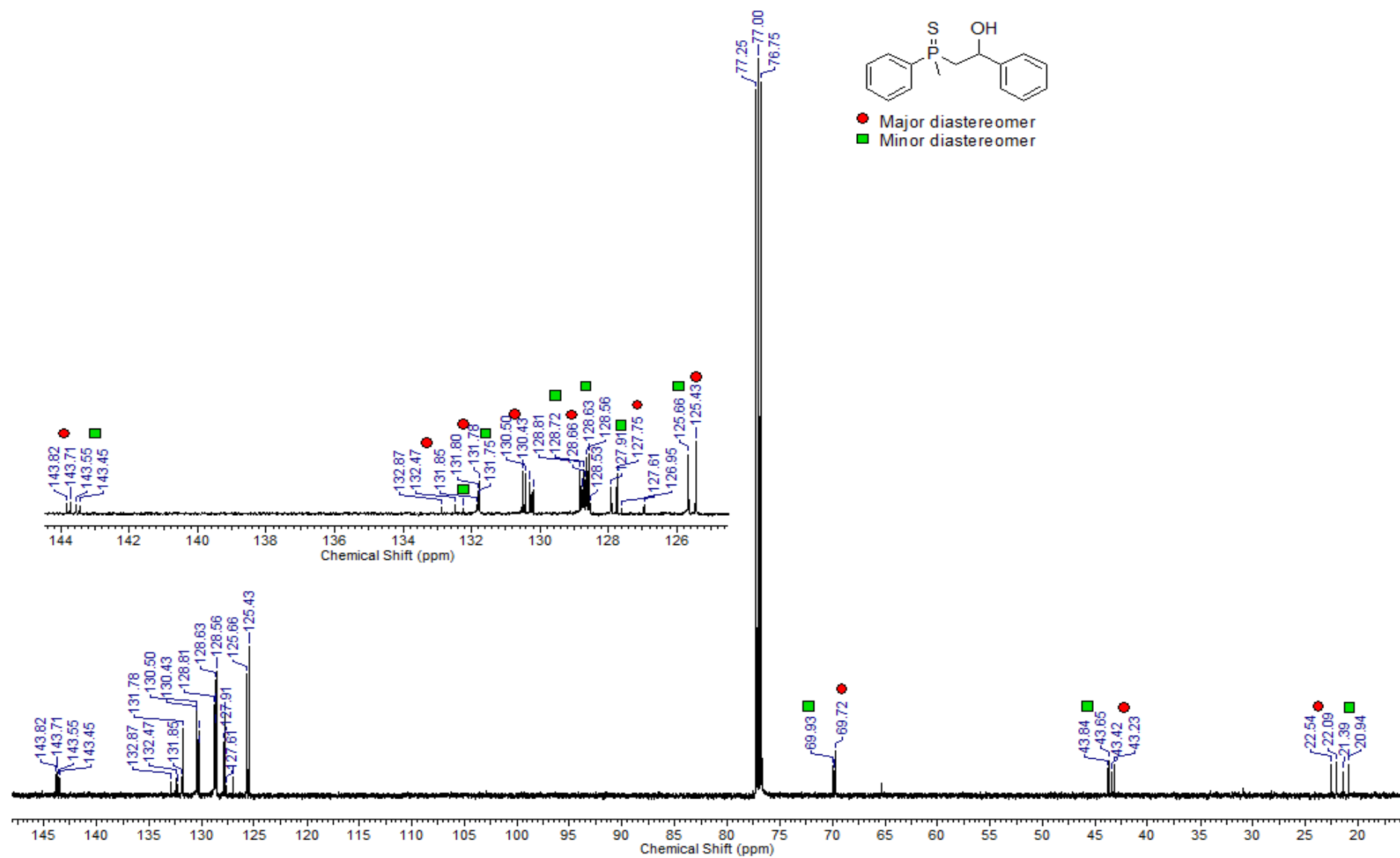
^{13}C NMR spectrum of (2-hydroxy-3,3-dimethylbutyl)methylphenylphosphine sulfide (**9**) (CDCl_3 , 126 MHz).



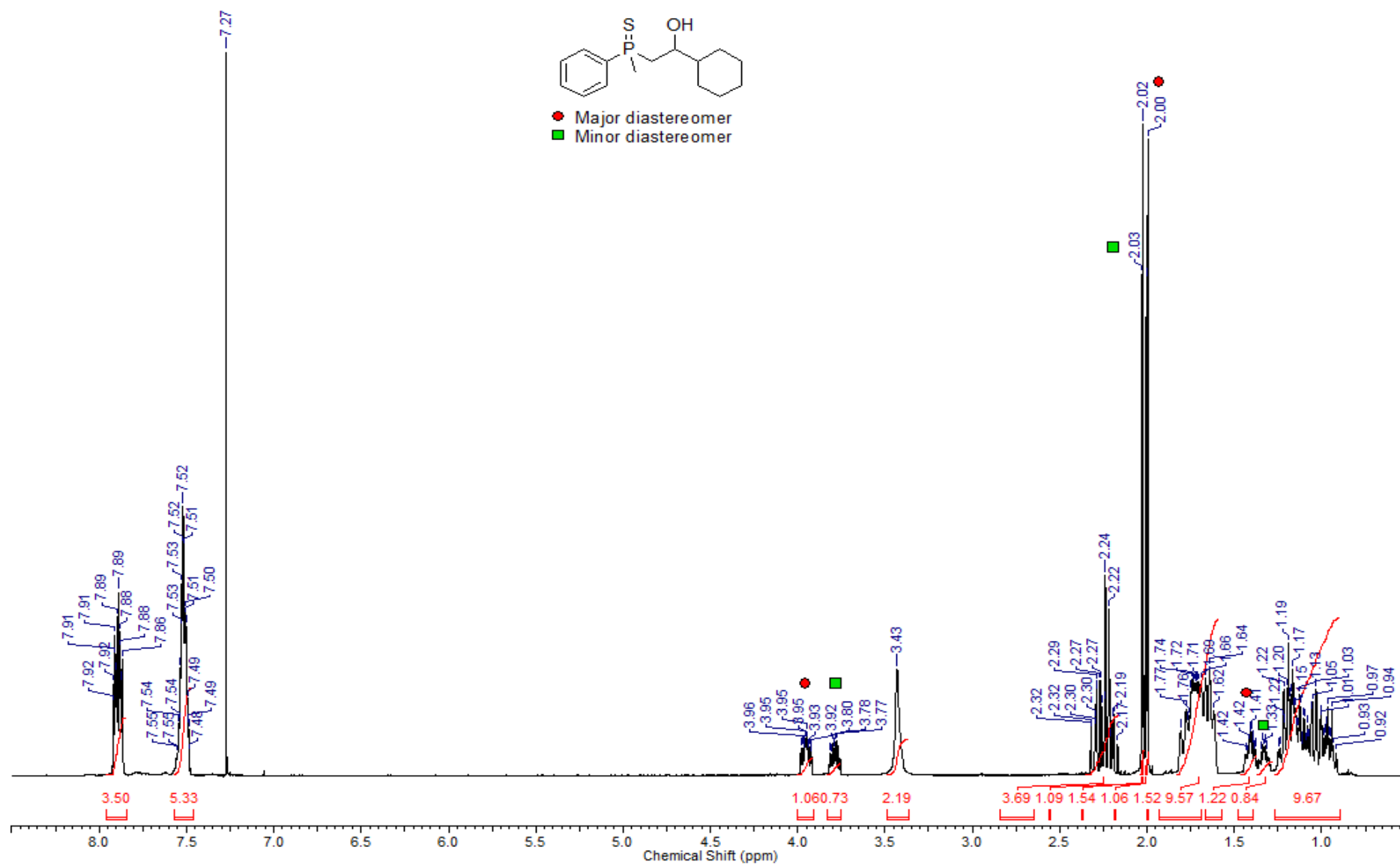
¹H NMR spectrum of (2-hydroxy-2-phenylethyl)methylphenylphosphine sulfide (**10**) (CDCl₃, 500 MHz).



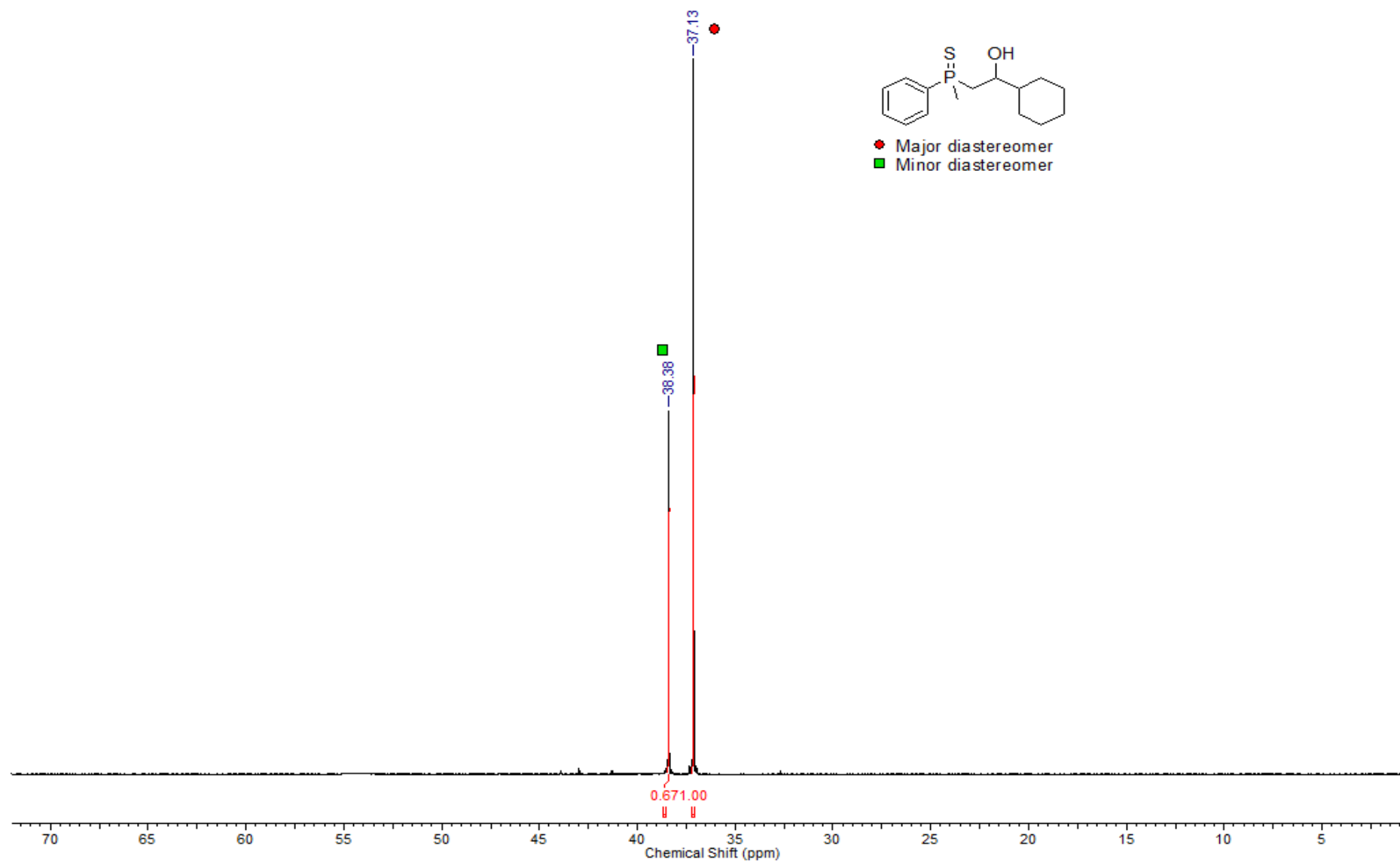
^{31}P NMR spectrum of (2-hydroxy-2-phenylethyl)methylphenylphosphine sulfide (**10**) (CDCl_3 , 202 MHz).



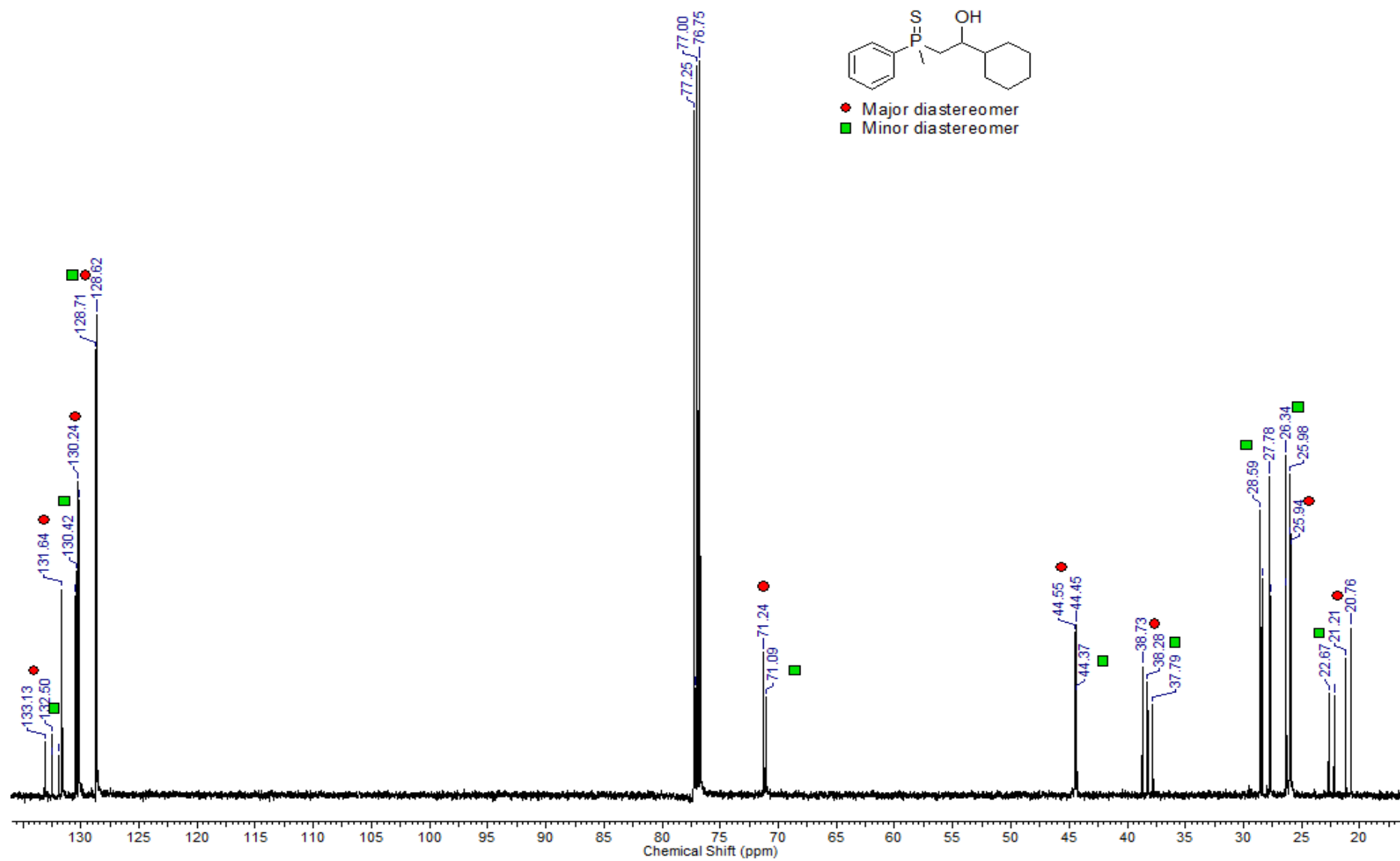
¹³C NMR spectrum of (2-hydroxy-2-phenylethyl)methylphenylphosphine sulfide (**10**) (CDCl₃, 126 MHz).



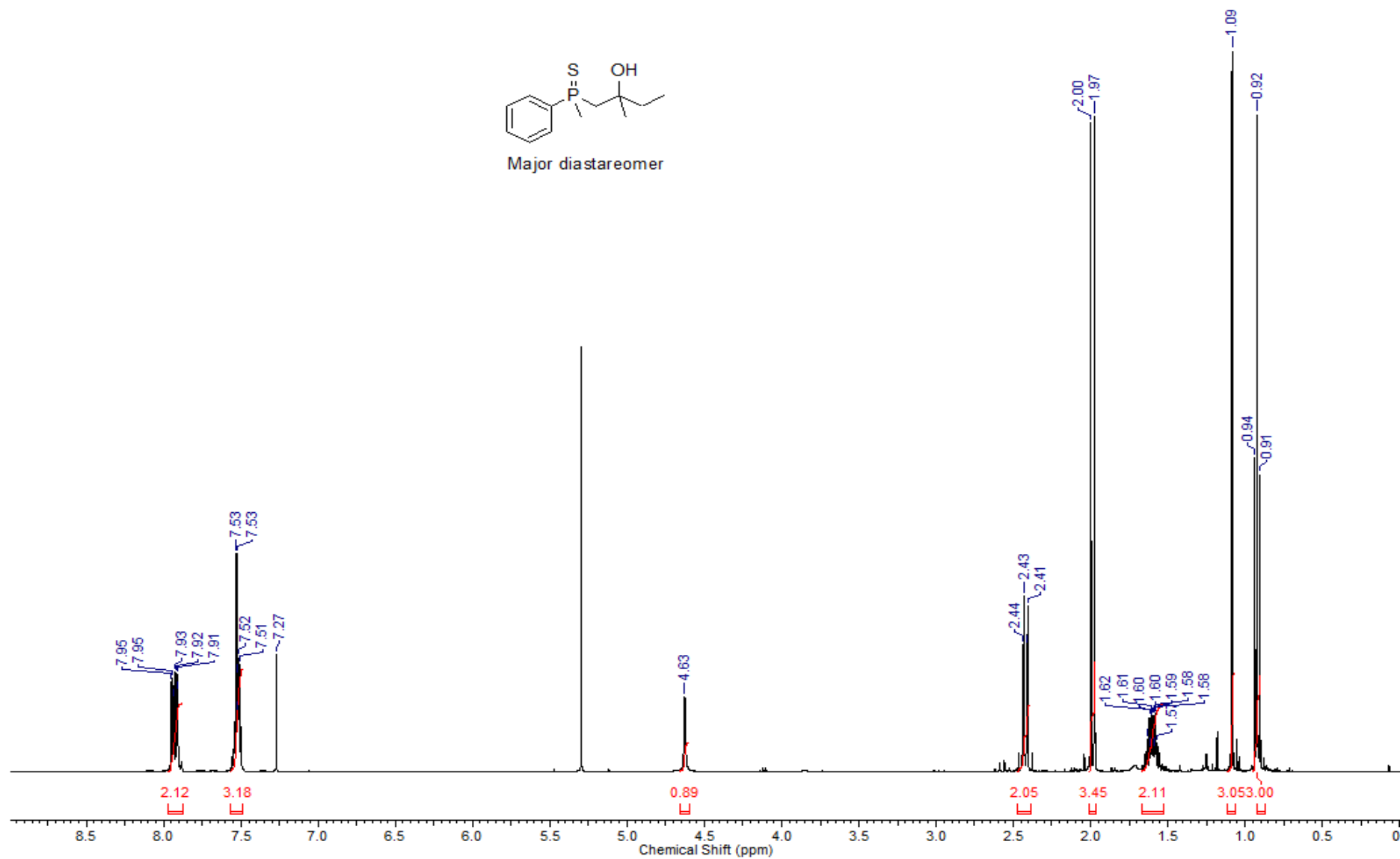
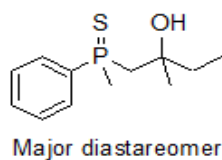
¹H NMR spectrum of (2-cyclohexyl-2-hydroxyethyl)methylphenylphosphine sulfide (**11**) (CDCl₃, 500 MHz).



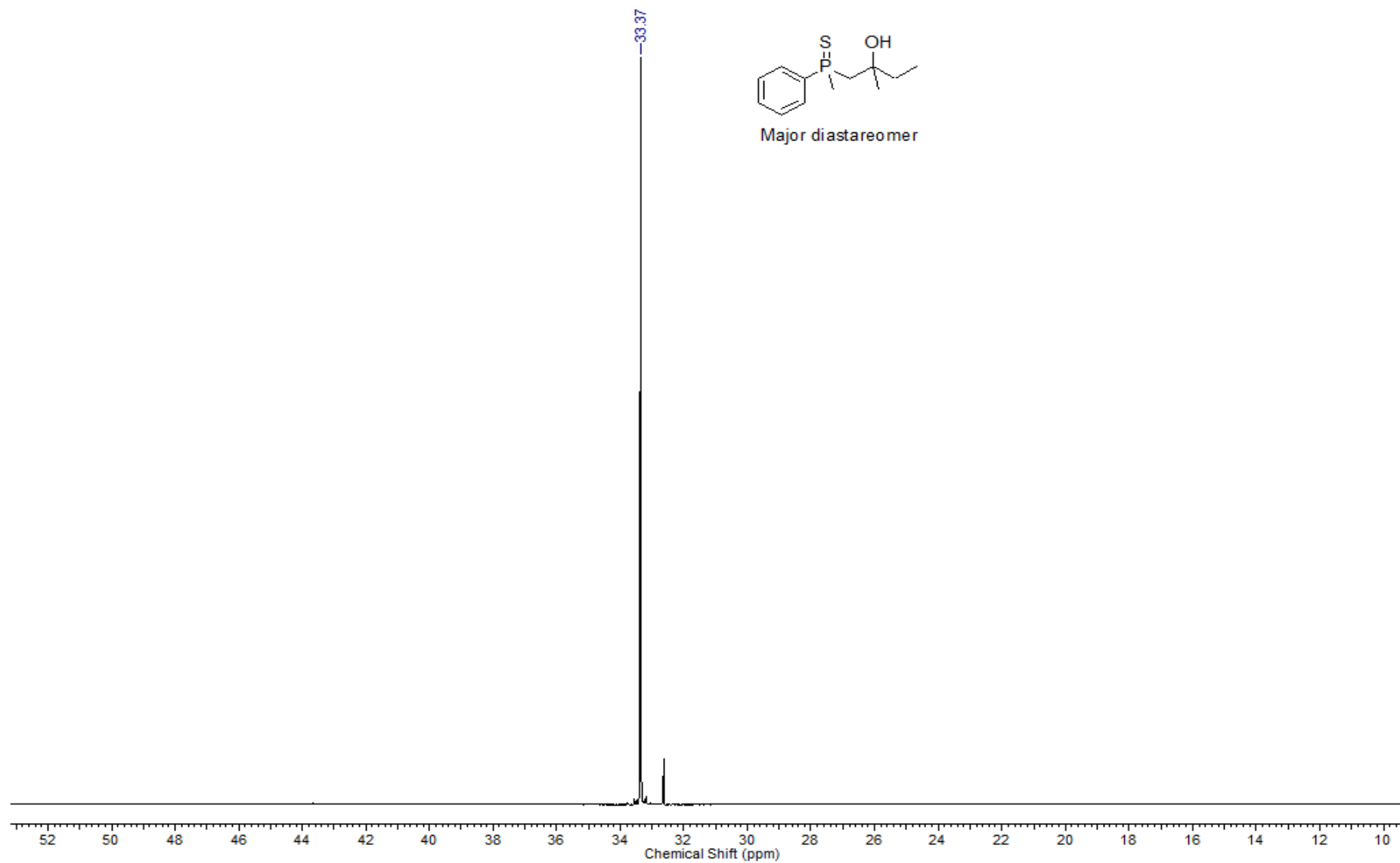
^{31}P NMR spectrum of (2-cyclohexyl-2-hydroxyethyl)methylphenylphosphine sulfide (**11**) (CDCl_3 , 202 MHz).



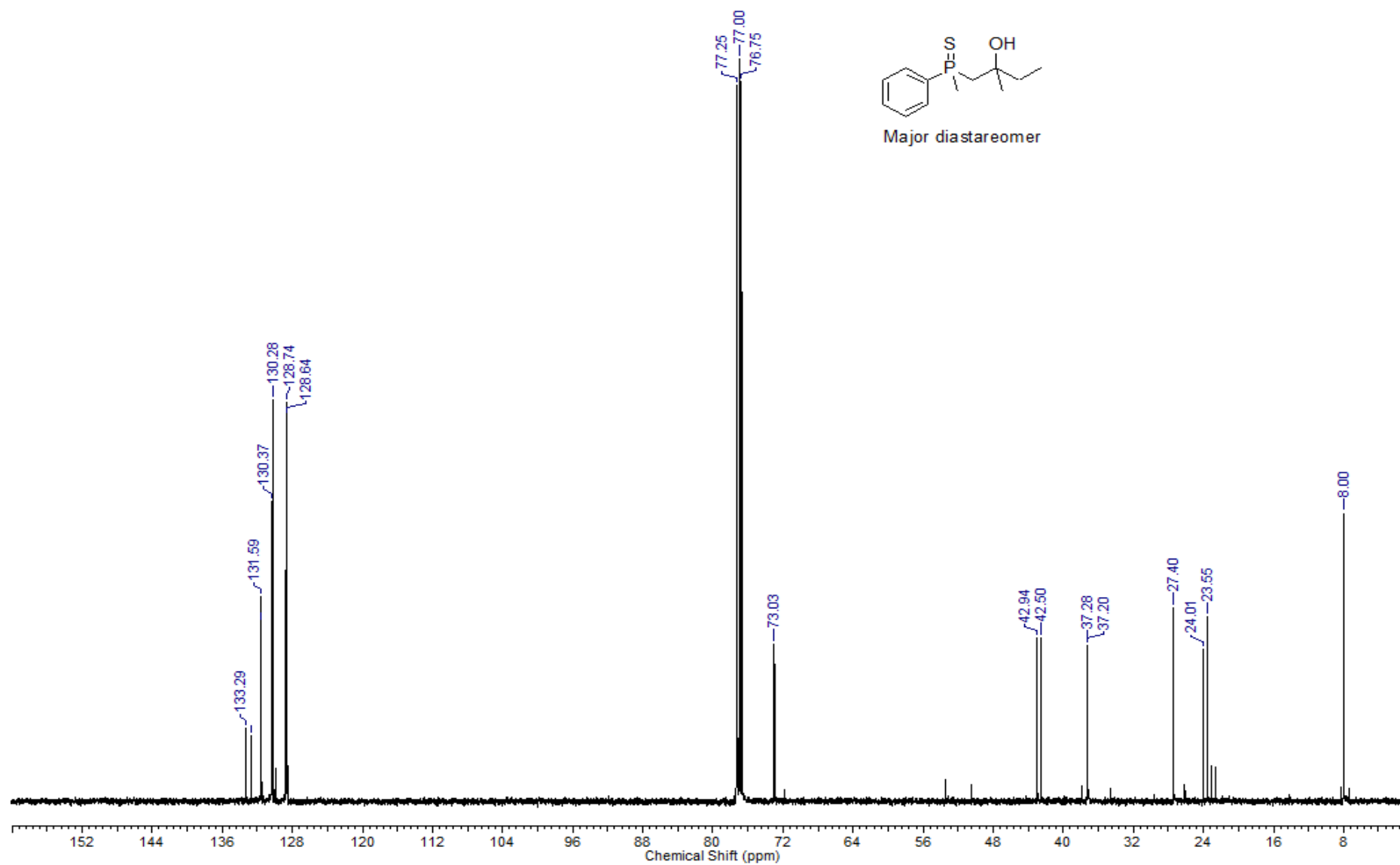
¹³C NMR spectrum of (2-cyclohexyl-2-hydroxyethyl)methylphenylphosphine sulfide (**11**) (CDCl₃, 126 MHz).



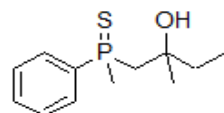
^1H NMR spectrum of (2-hydroxy-2-methylbutyl)methylphenylphosphine sulfide (major diastereomer) (**12**) (CDCl_3 , 500 MHz).



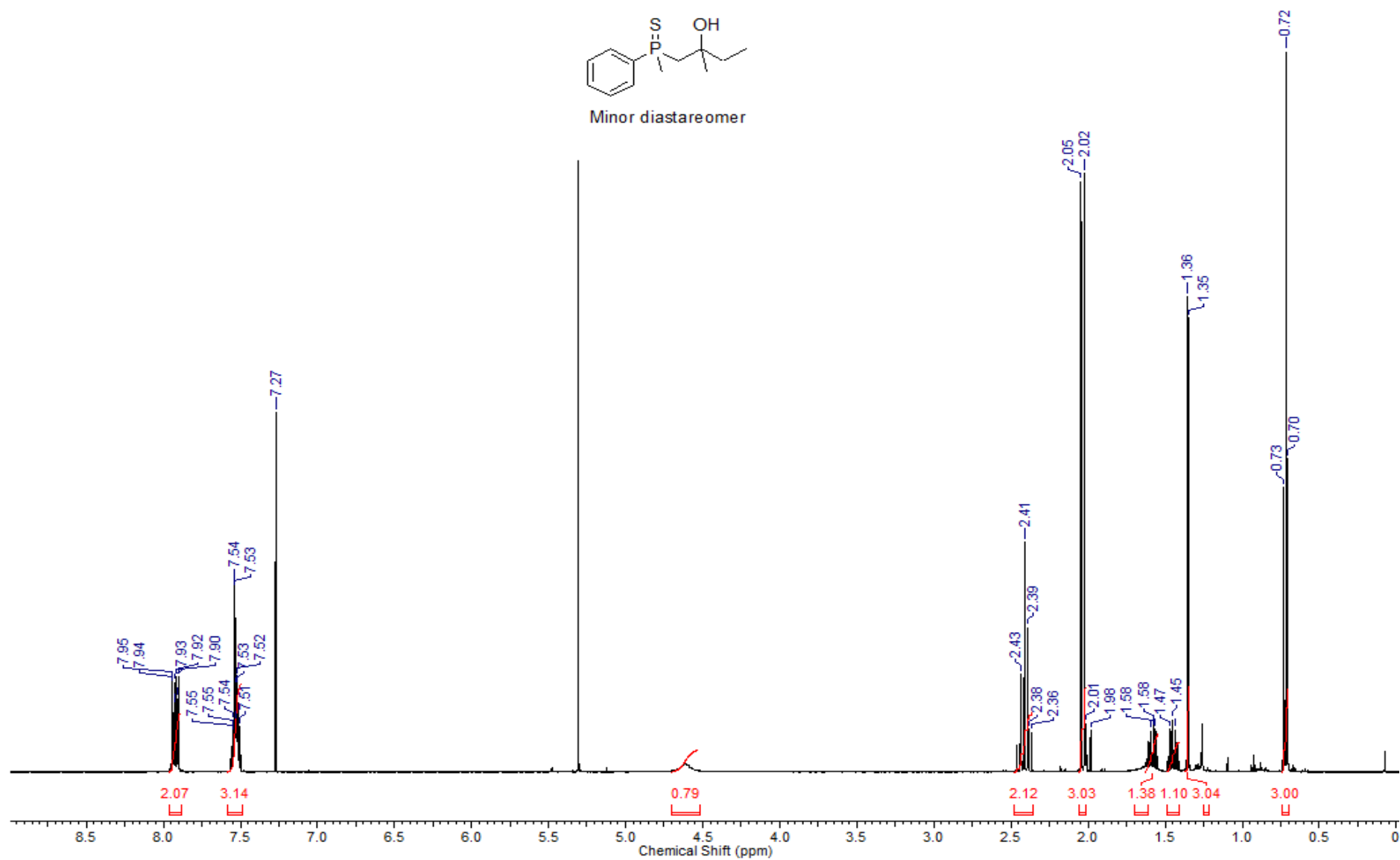
^{31}P NMR spectrum of (2-hydroxy-2-methylbutyl)methylphenylphosphine sulfide (major diastereomer) (**12**) (CDCl_3 , 202 MHz).



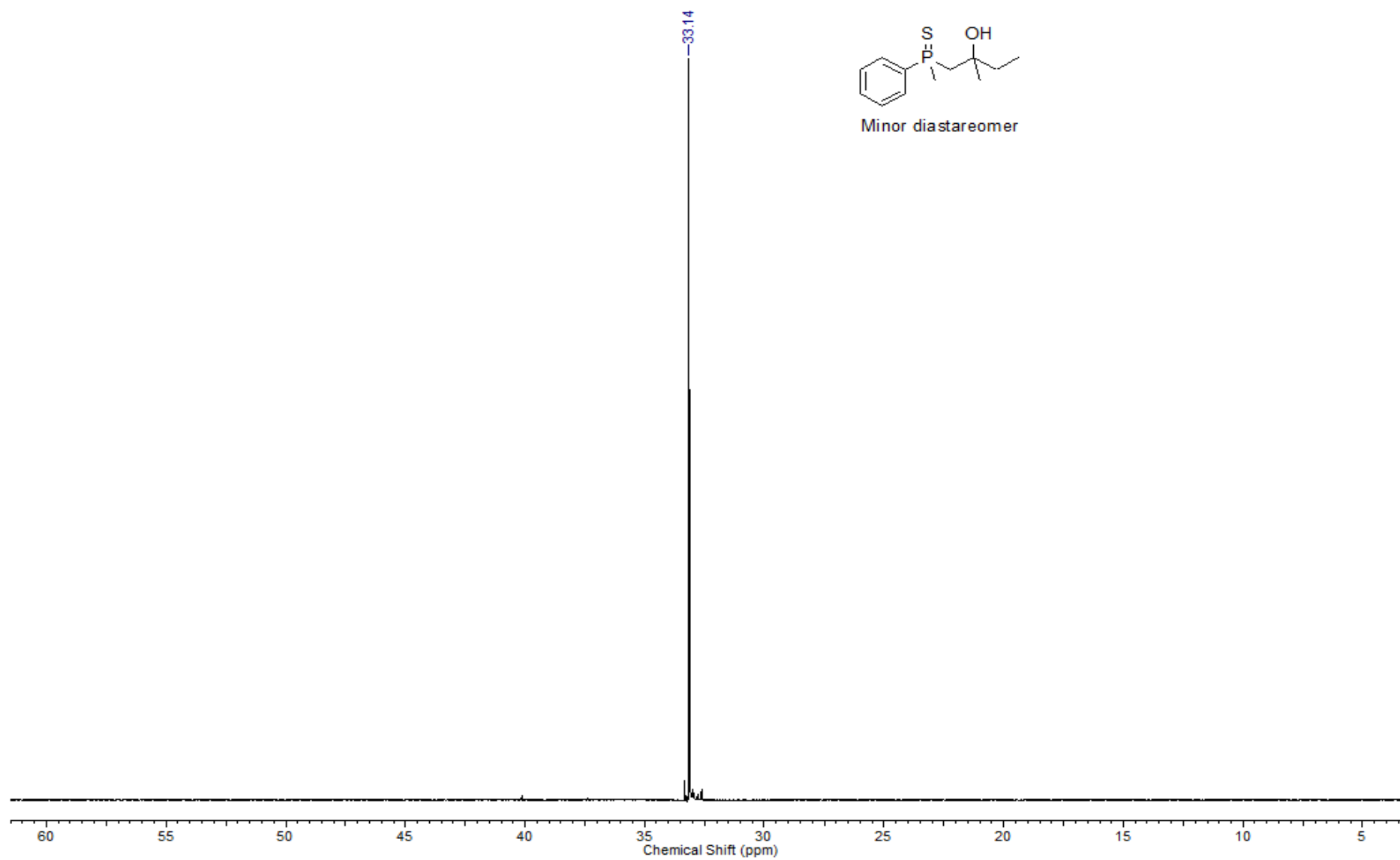
¹³C NMR spectrum of (2-hydroxy-2-methylbutyl)methylphenylphosphine sulfide (major diastereomer) (**12**) (CDCl₃, 126 MHz).



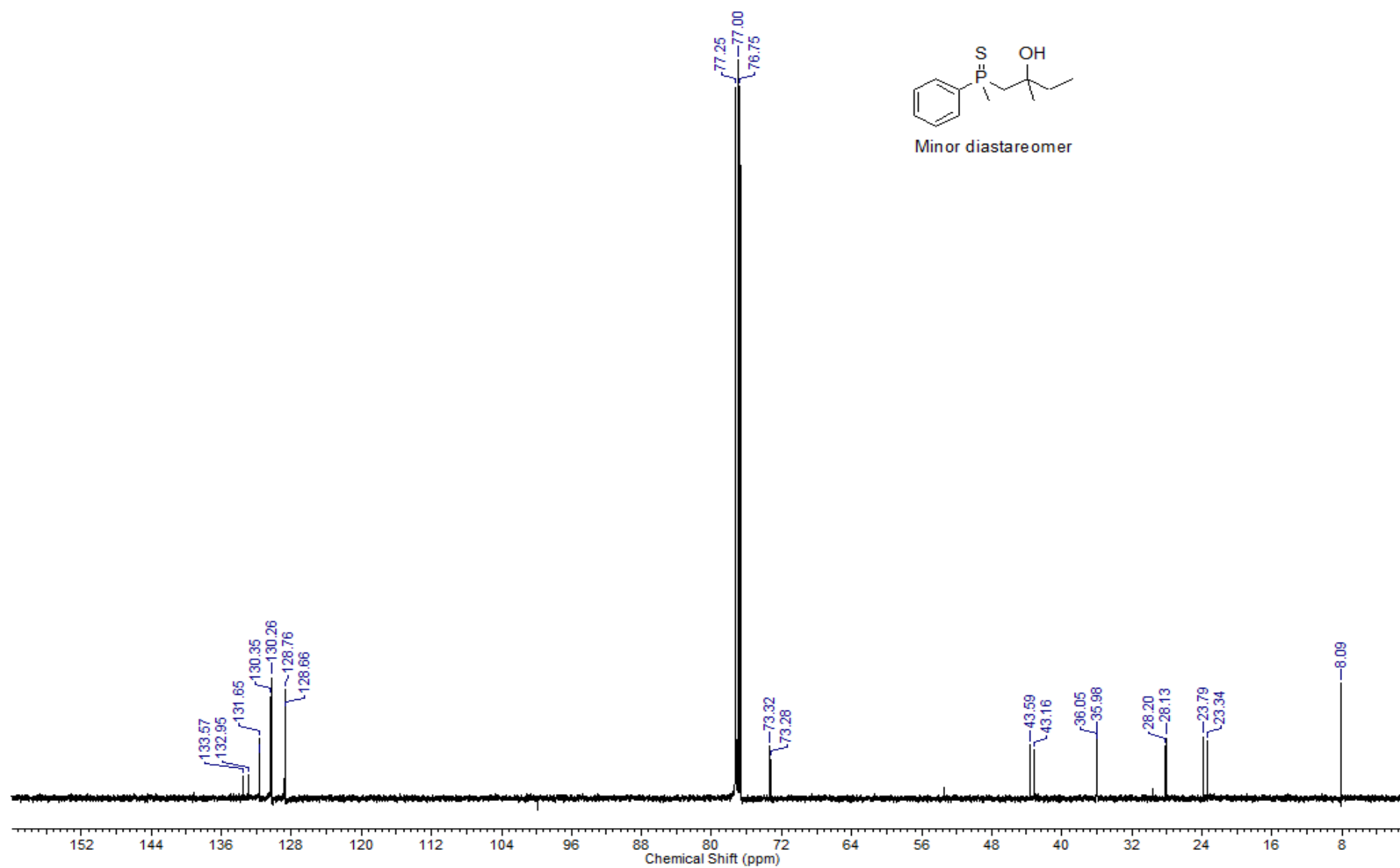
Minor diastereomer



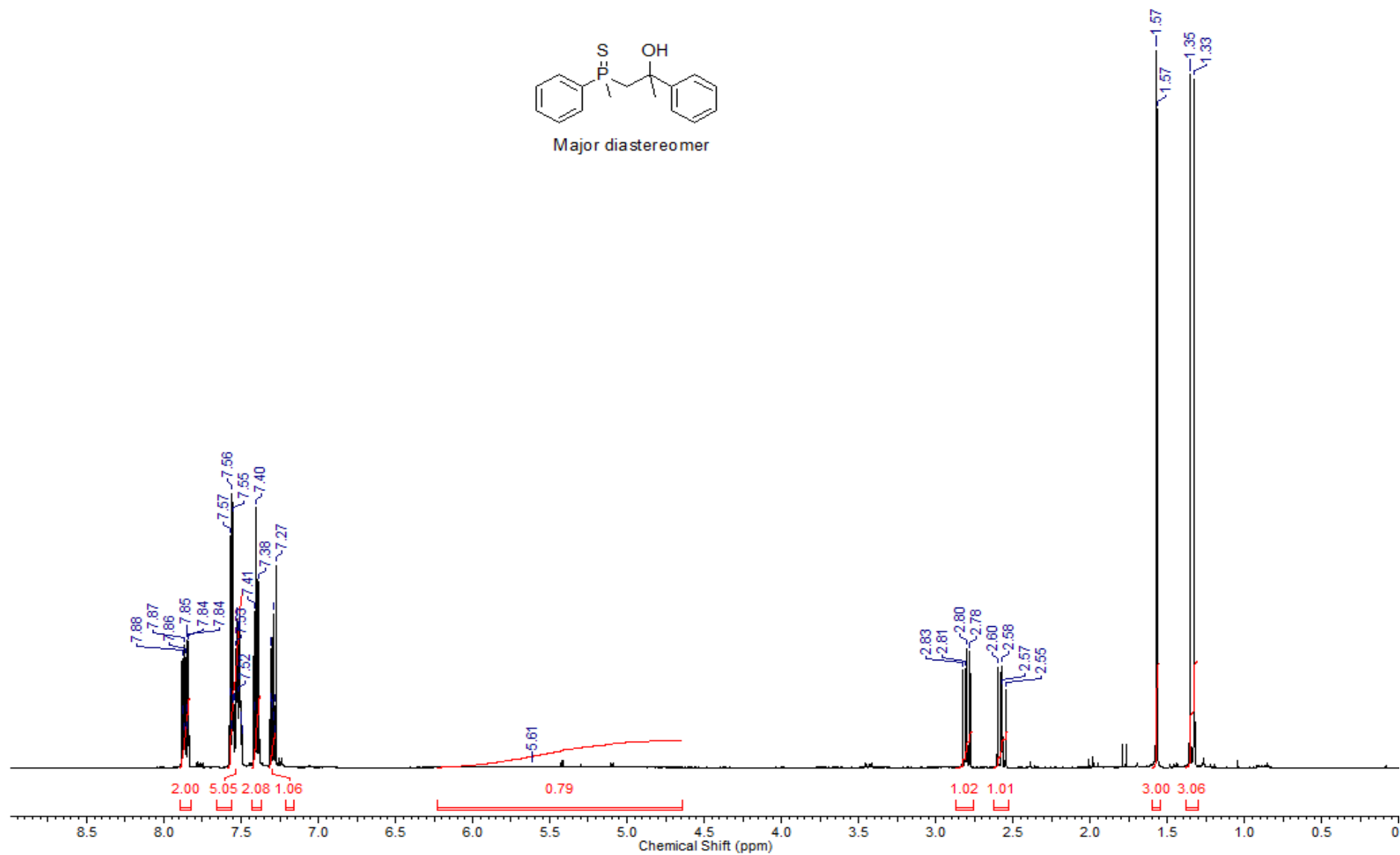
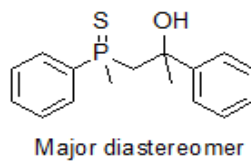
^1H NMR spectrum of (2-hydroxy-2-methylbutyl)methylphenylphosphine sulfide (minor diastereomer) (**12**) (CDCl_3 , 500 MHz).



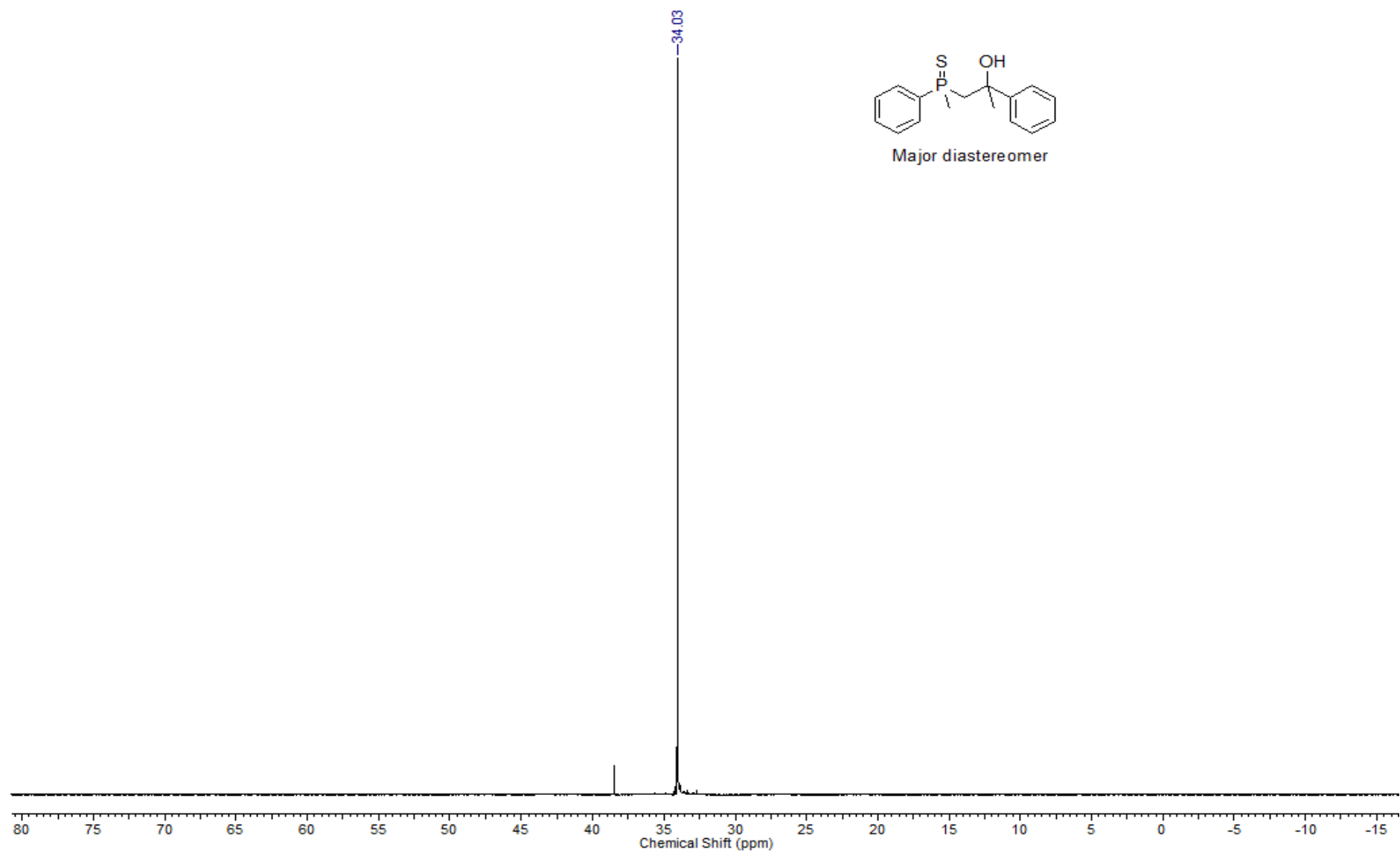
³¹P NMR spectrum of (2-hydroxy-2-methylbutyl)methylphenylphosphine sulfide (minor diastereomer) (**12**) (CDCl₃, 202 MHz).



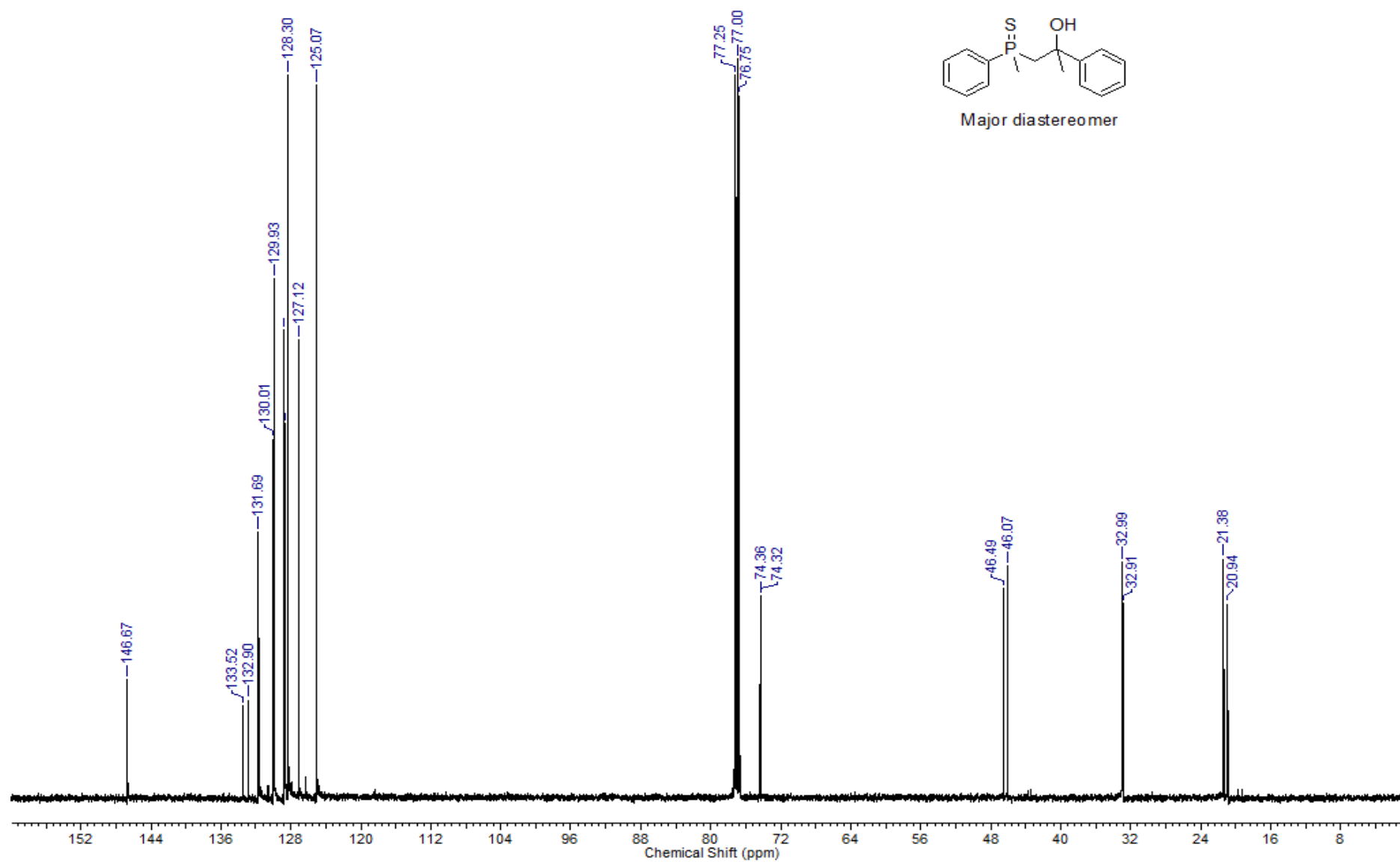
¹³C NMR spectrum of (2-hydroxy-2-methylbutyl)methylphenylphosphine sulfide (minor diastereomer) (**12**) (CDCl₃, 126 MHz).



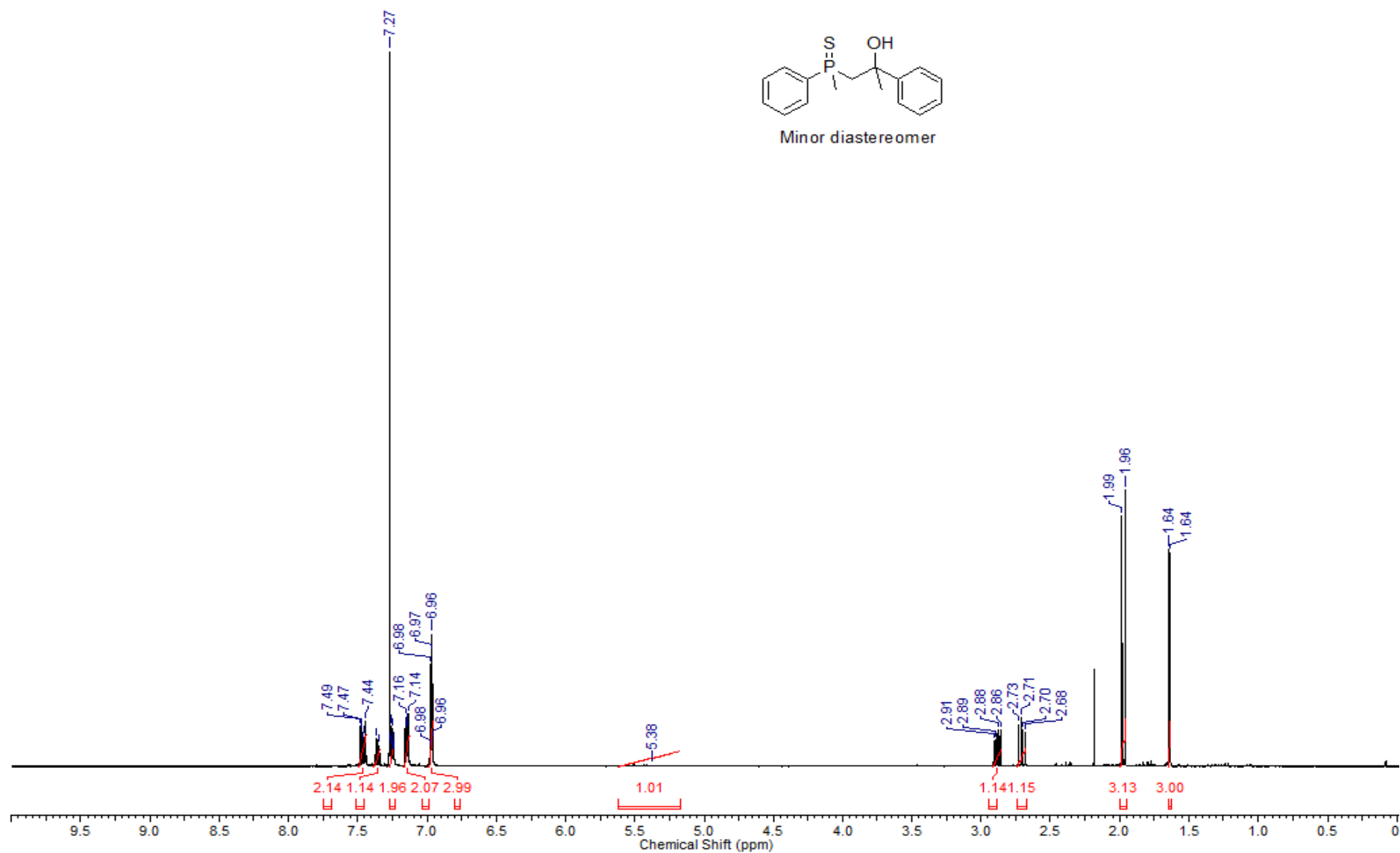
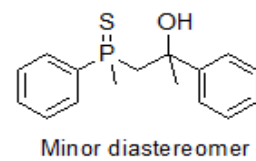
^1H NMR spectrum of (2-hydroxy-2-phenylpropyl)methylphenylphosphine sulfide (major diastereomer) (**13**) (CDCl_3 , 500 MHz).



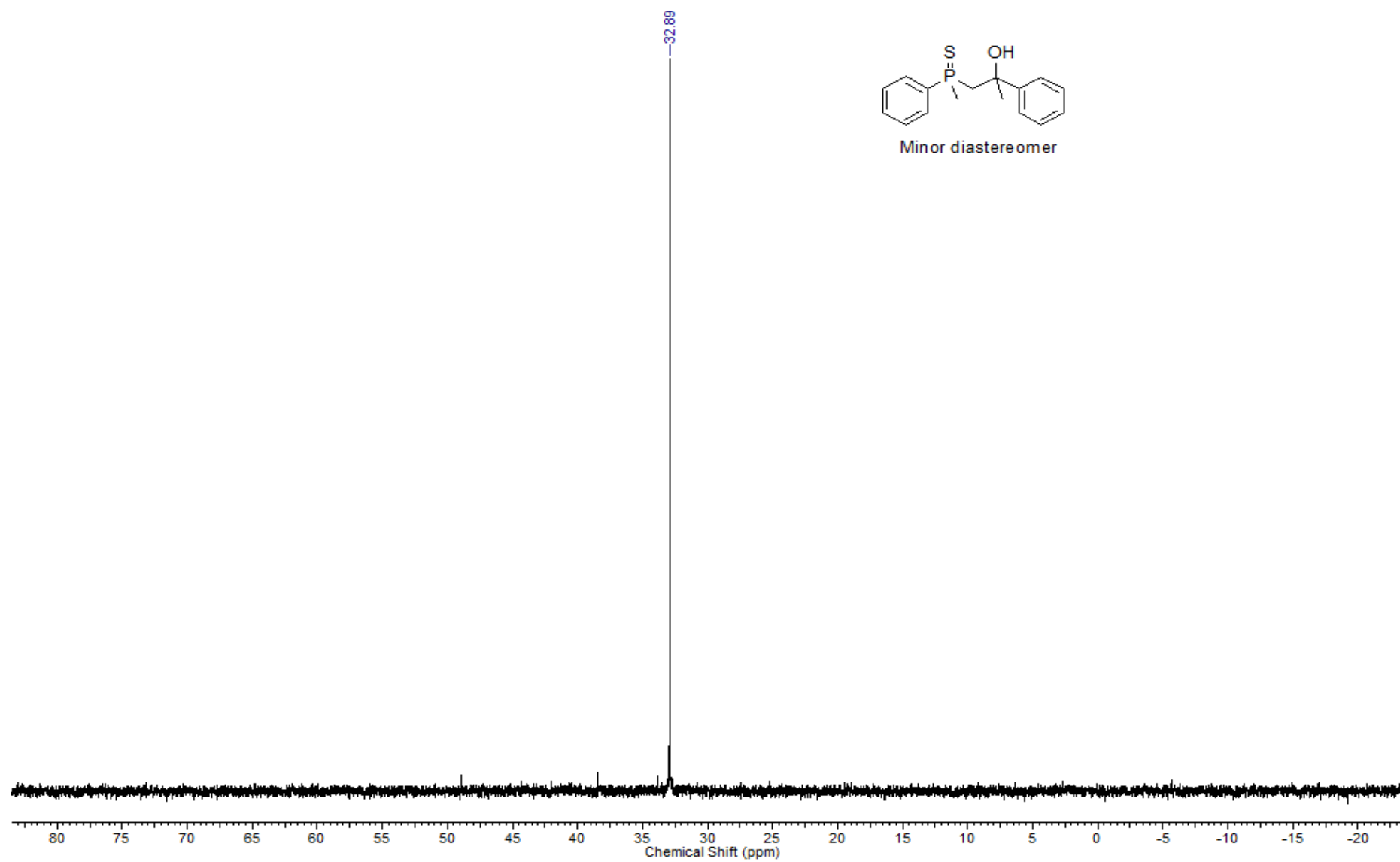
^{31}P NMR spectrum of (2-hydroxy-2-phenylpropyl)methylphenylphosphine sulfide (major diastereomer) (**13**) (CDCl_3 , 202 MHz).



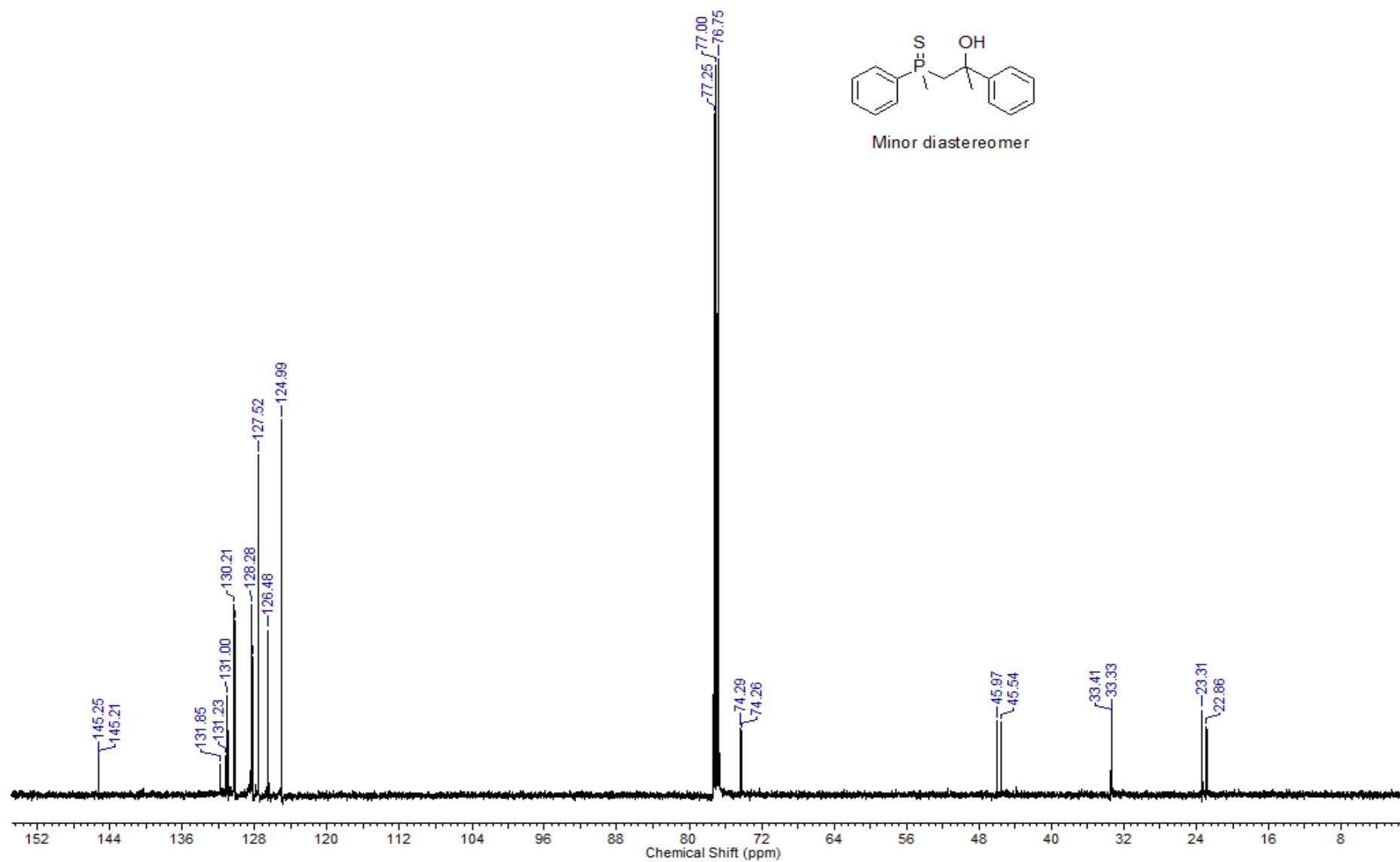
¹³C NMR spectrum of (2-hydroxy-2-phenylpropyl)methylphenylphosphine sulfide (major diastereomer) (**13**) (CDCl₃, 126 MHz).



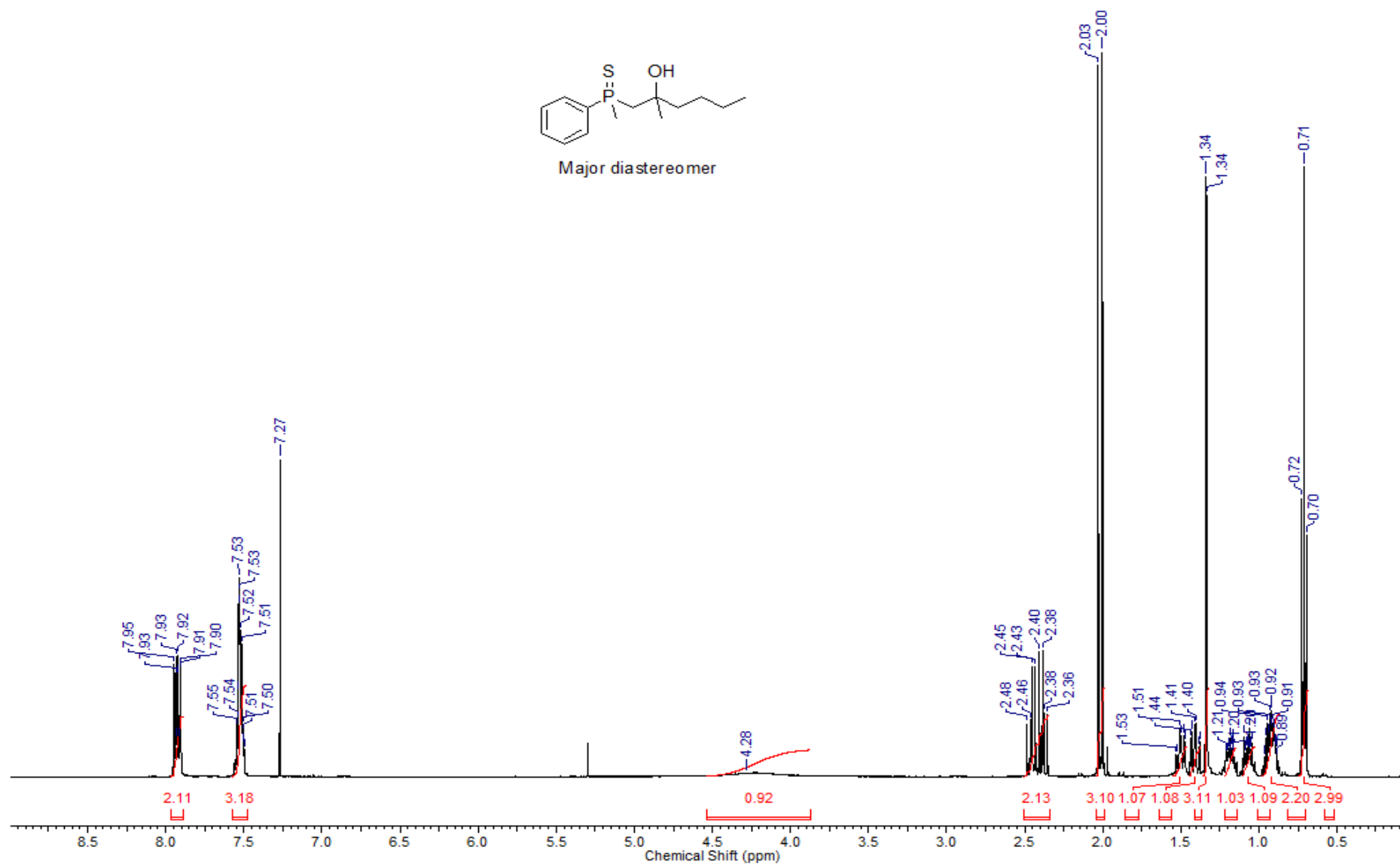
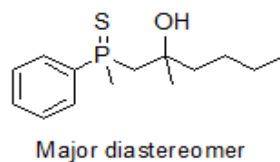
^1H NMR spectrum of (2-hydroxy-2-phenylpropyl)methylphenylphosphine sulfide (minor diastereomer) (**13**) (CDCl_3 , 500 MHz).



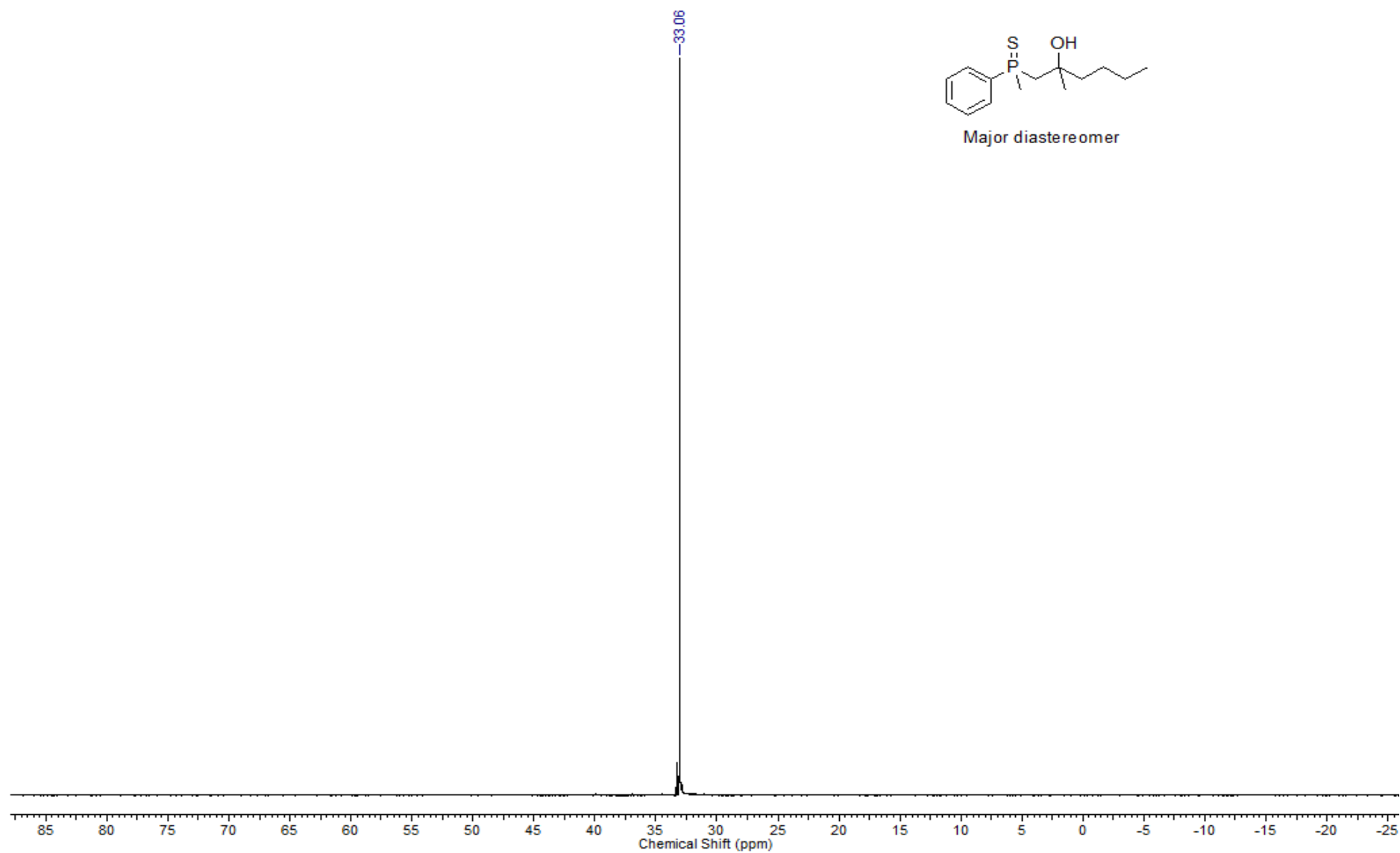
^{31}P NMR spectrum of (2-hydroxy-2-phenylpropyl)methylphenylphosphine sulfide (minor diastereomer) (**13**) (CDCl_3 , 202 MHz).



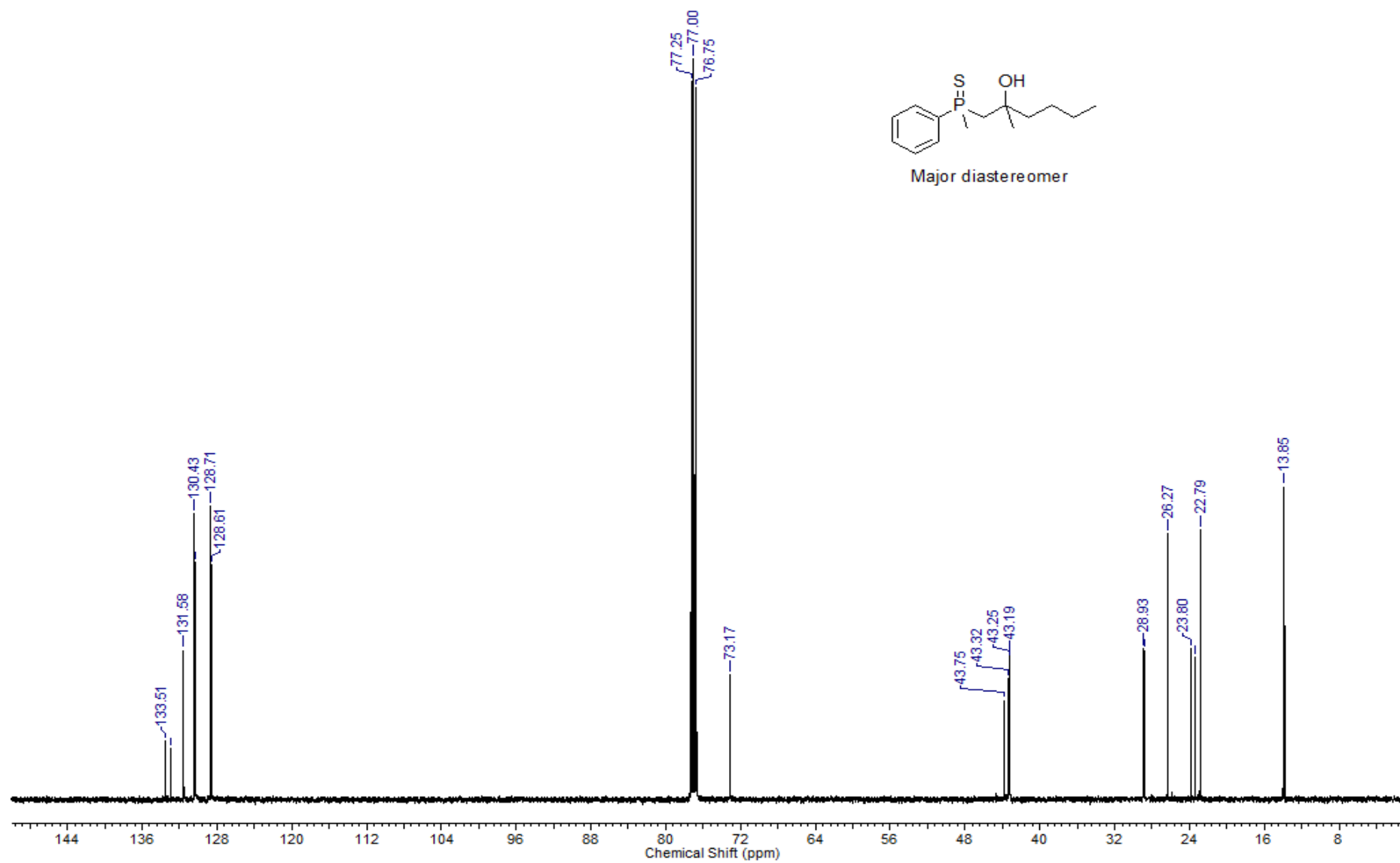
¹³C NMR spectrum of (2-hydroxy-2-phenylpropyl)methylphenylphosphine sulfide(minor diastereomer) (**13**) (CDCl₃, 126 MHz).



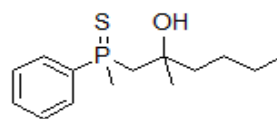
^1H NMR spectrum of (2-hydroxy-2-methylhexyl)methylphenylphosphine sulfide (major diastereomer) (**14**) (CDCl_3 , 500 MHz).



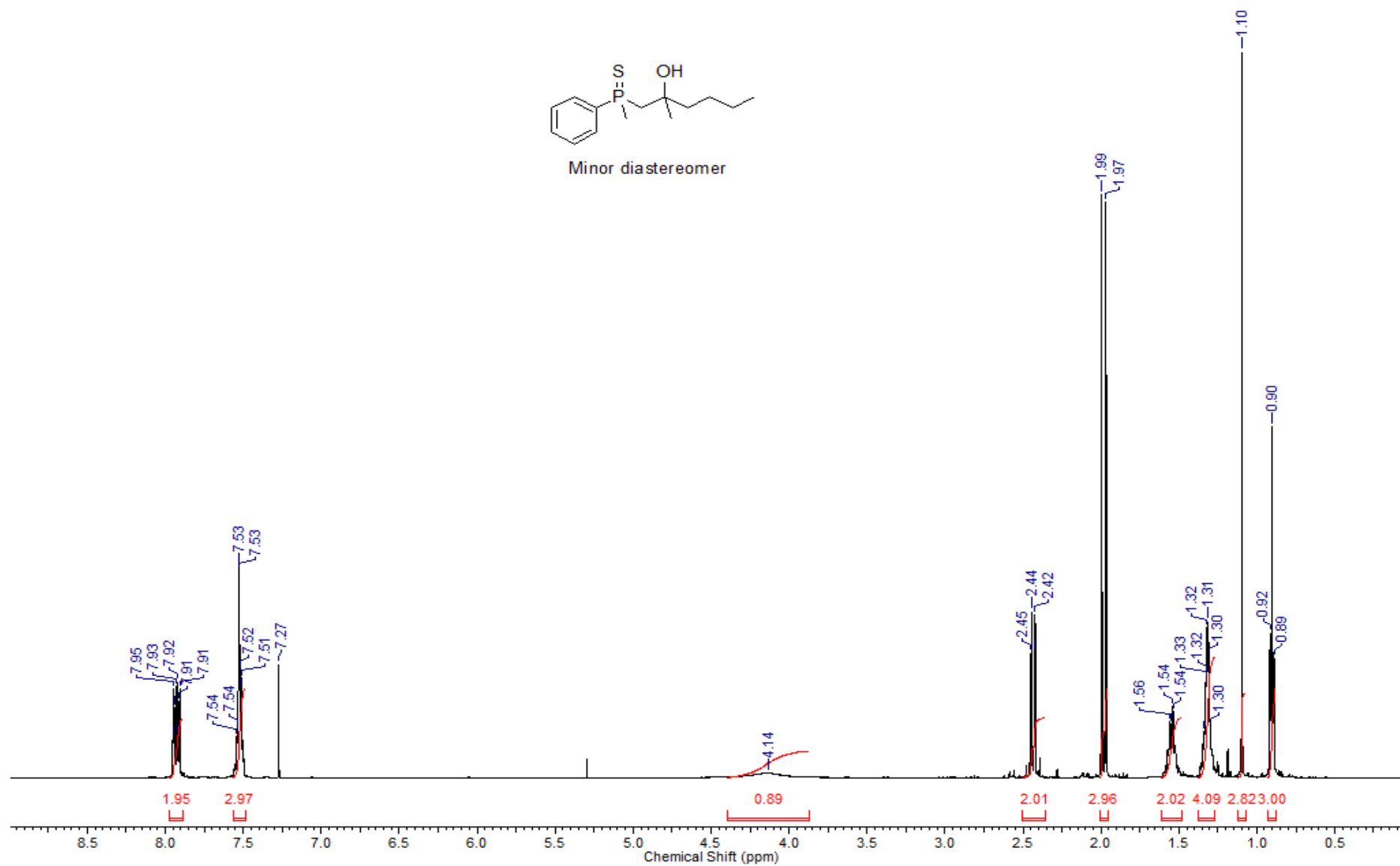
^{31}P NMR spectrum of (2-hydroxy-2-methylhexyl)methylphenylphosphine sulfide (major diastereomer) (**14**) (CDCl_3 , 202 MHz).



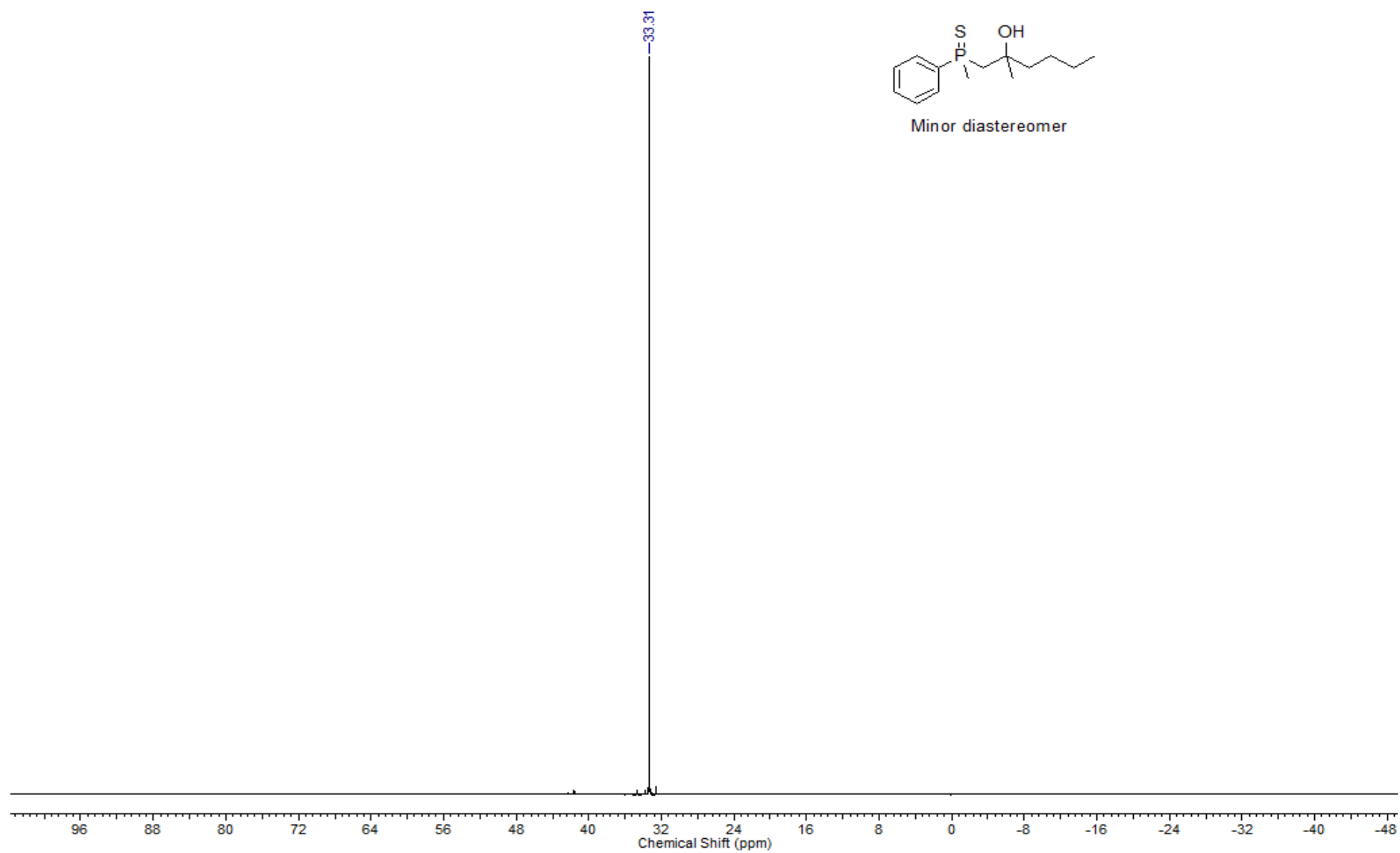
¹³C NMR spectrum of (2-hydroxy-2-methylhexyl)methylphenylphosphine sulfide (major diastereomer) (**14**) (CDCl₃, 126 MHz).



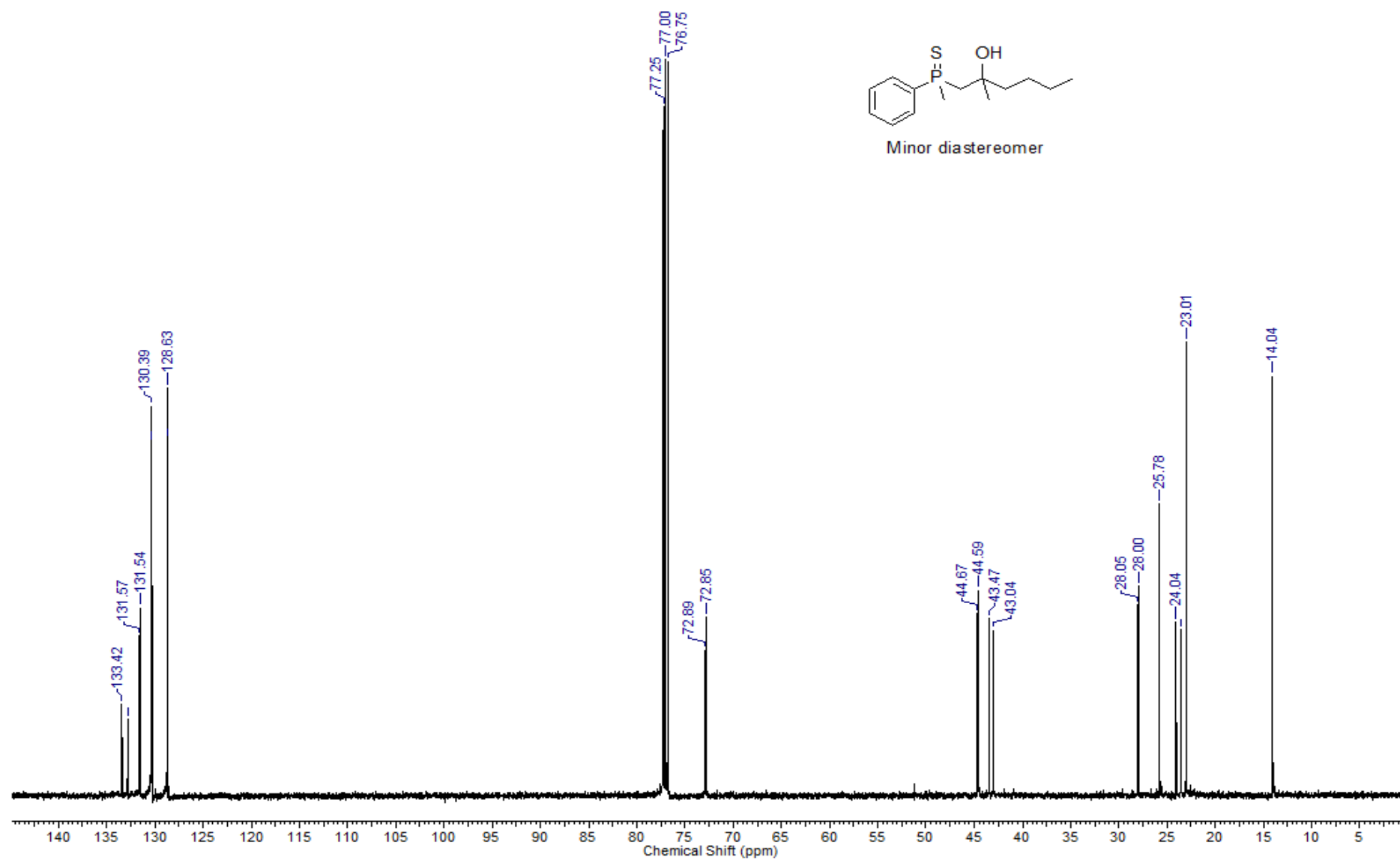
Minor diastereomer



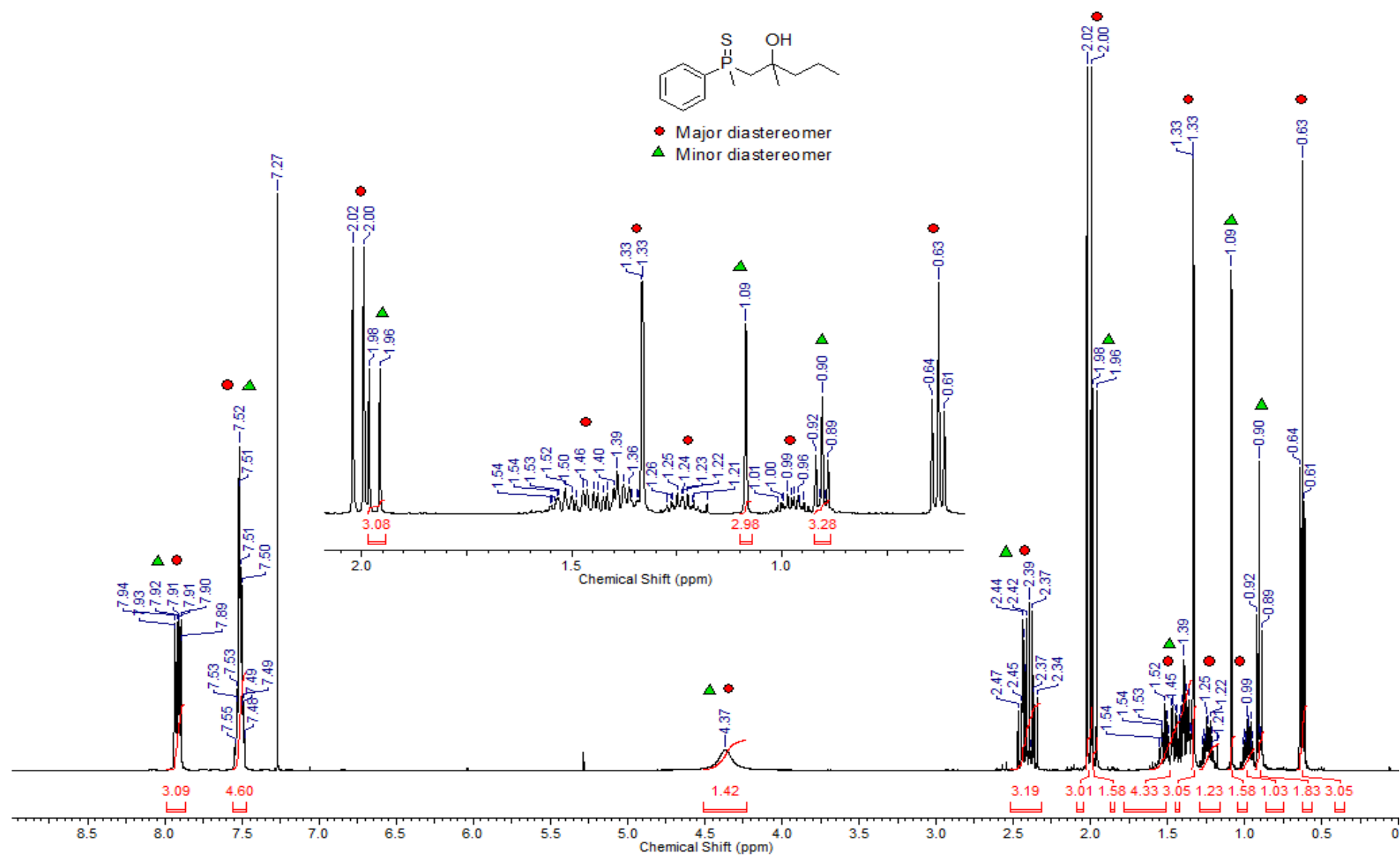
^1H NMR spectrum of (2-hydroxy-2-methylhexyl)methylphenylphosphine sulfide (minor diastereomer) (**14**) (CDCl_3 , 500 MHz).



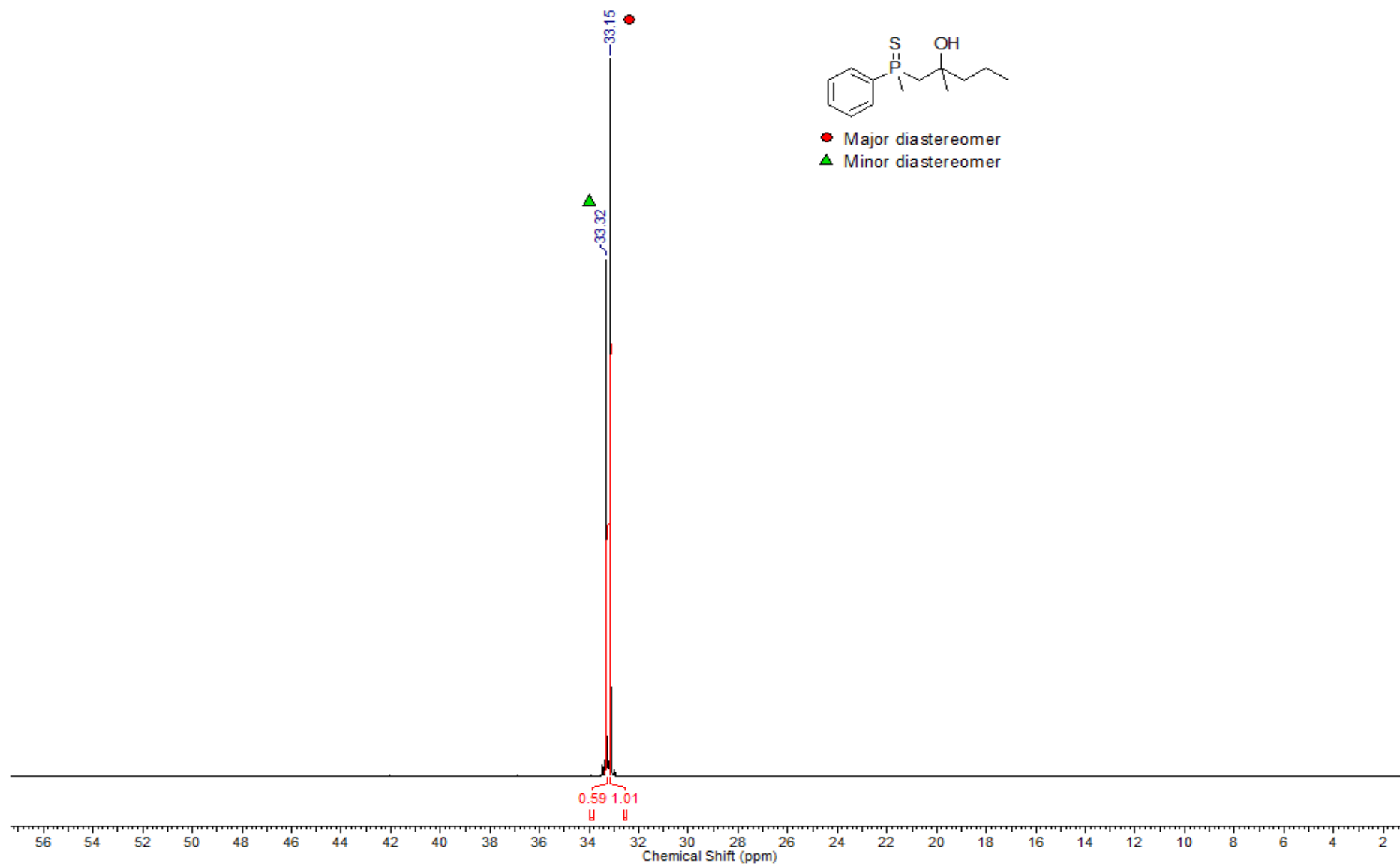
³¹P NMR spectrum of (2-hydroxy-2-methylhexyl)methylphenylphosphine sulfide (minor diastereomer) (**14**) (CDCl₃, 202 MHz).



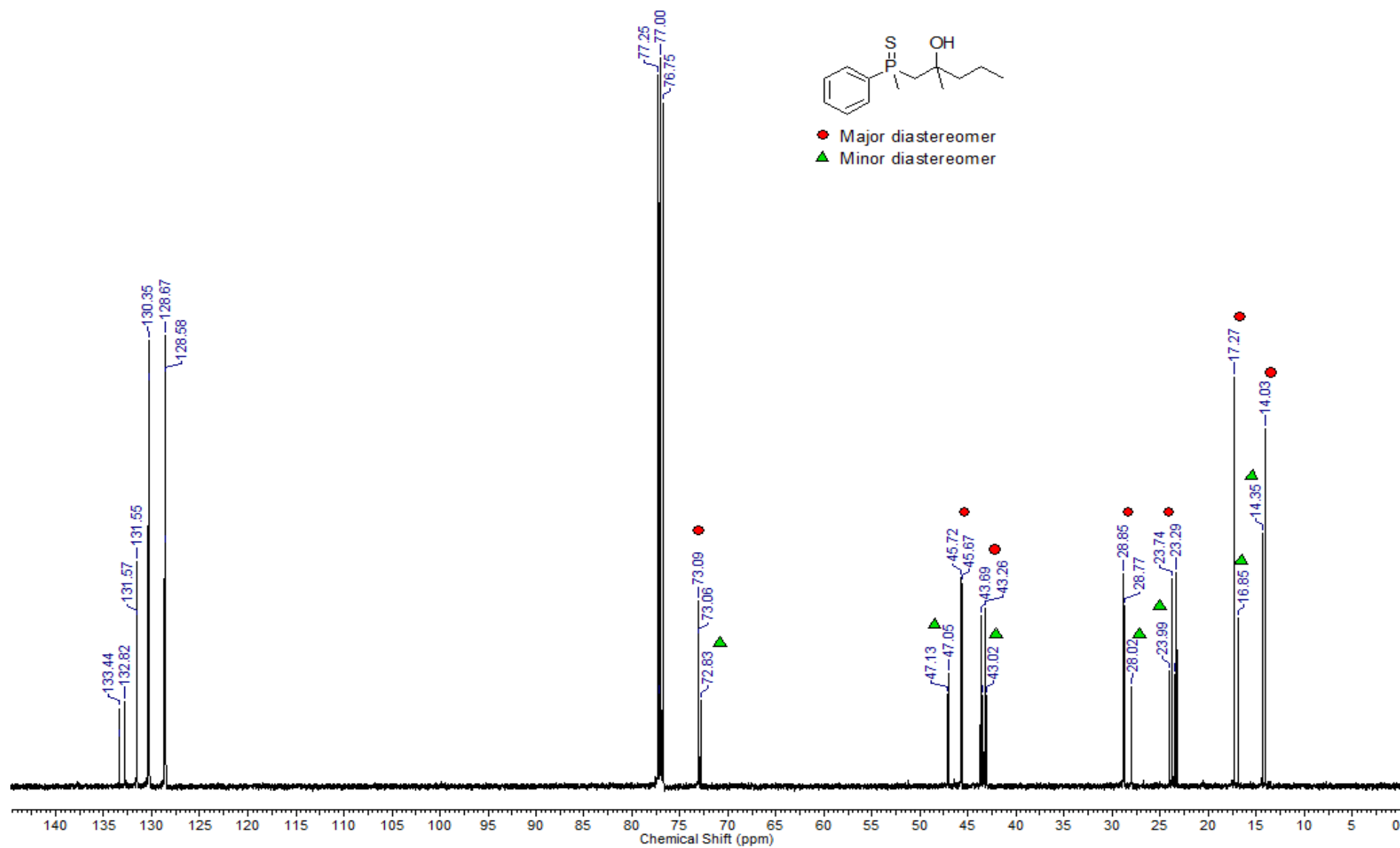
¹³C NMR spectrum of (2-hydroxy-2-methylhexyl)methylphenylphosphine sulfide (minor diastereomer) (**14**) (CDCl₃, 126 MHz).



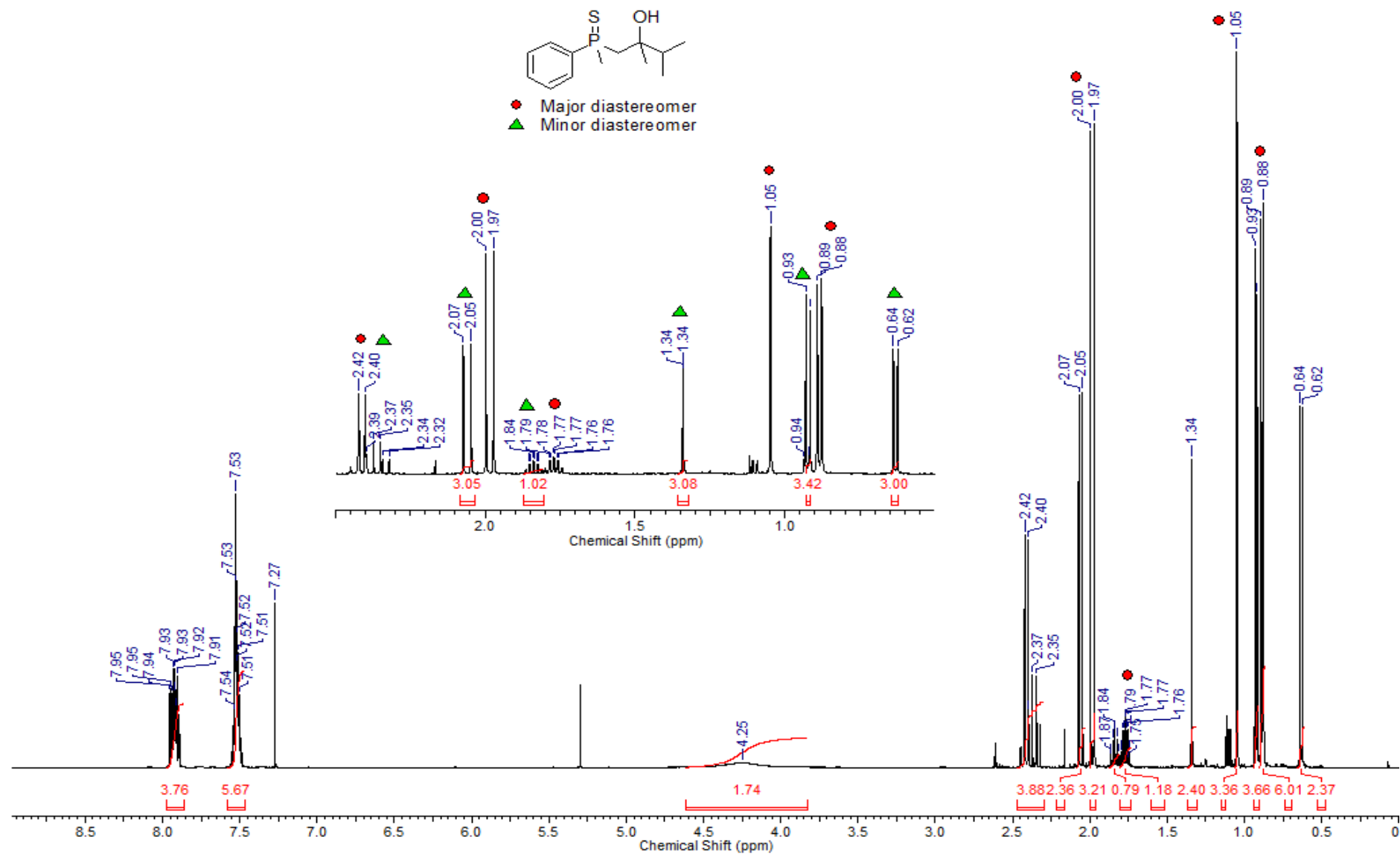
^1H NMR spectrum of (2-hydroxy-2-methylpentyl)methylphenylphosphine sulfide (**15**) (CDCl_3 , 500 MHz).



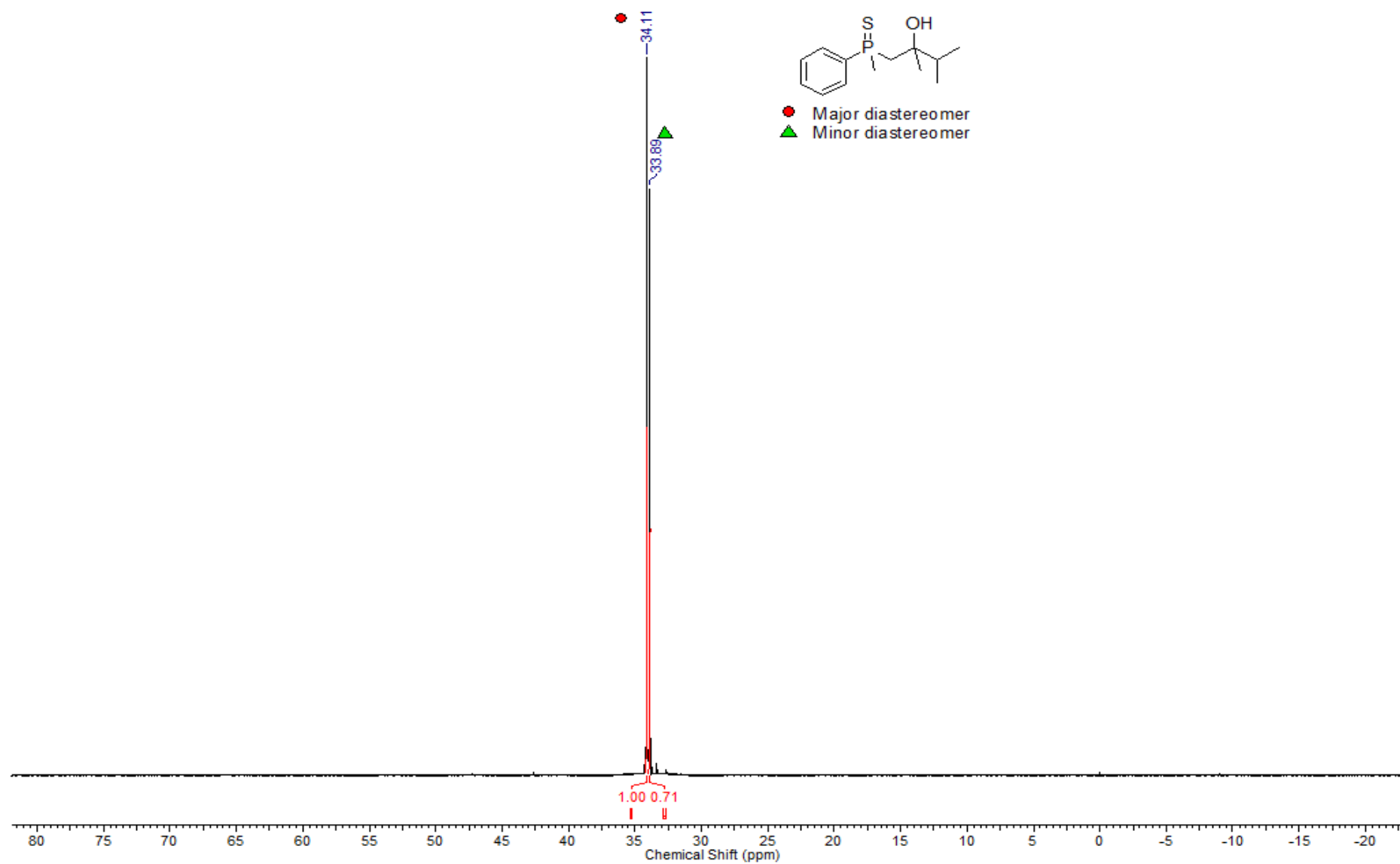
^{31}P NMR spectrum of (2-hydroxy-2-methylpentyl)methylphenylphosphine sulfide (15) (CDCl_3 , 202 MHz).



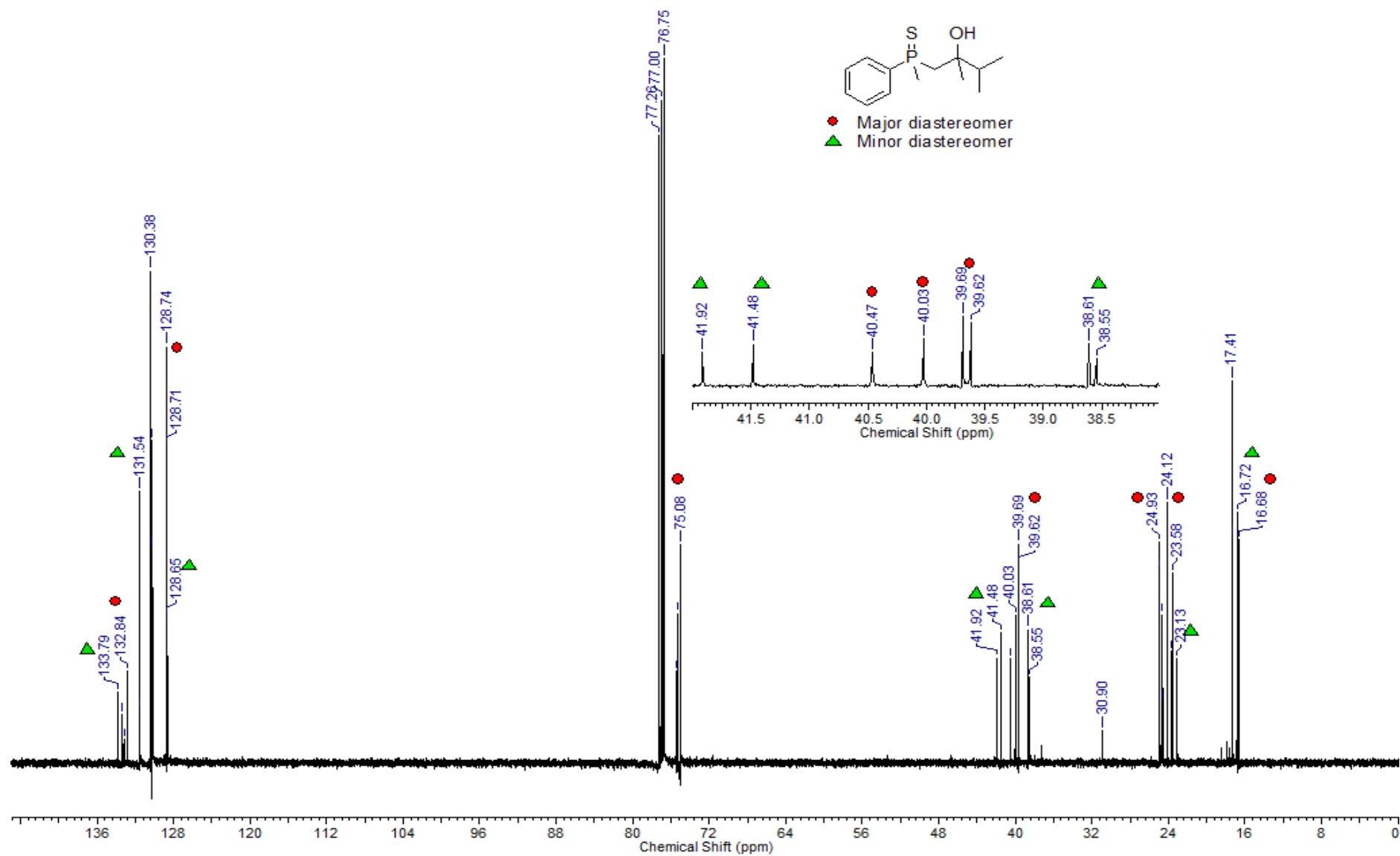
^{13}C NMR spectrum of (2-hydroxy-2-methylpentyl)methylphenylphosphine sulfide (15) (CDCl_3 , 126 MHz).



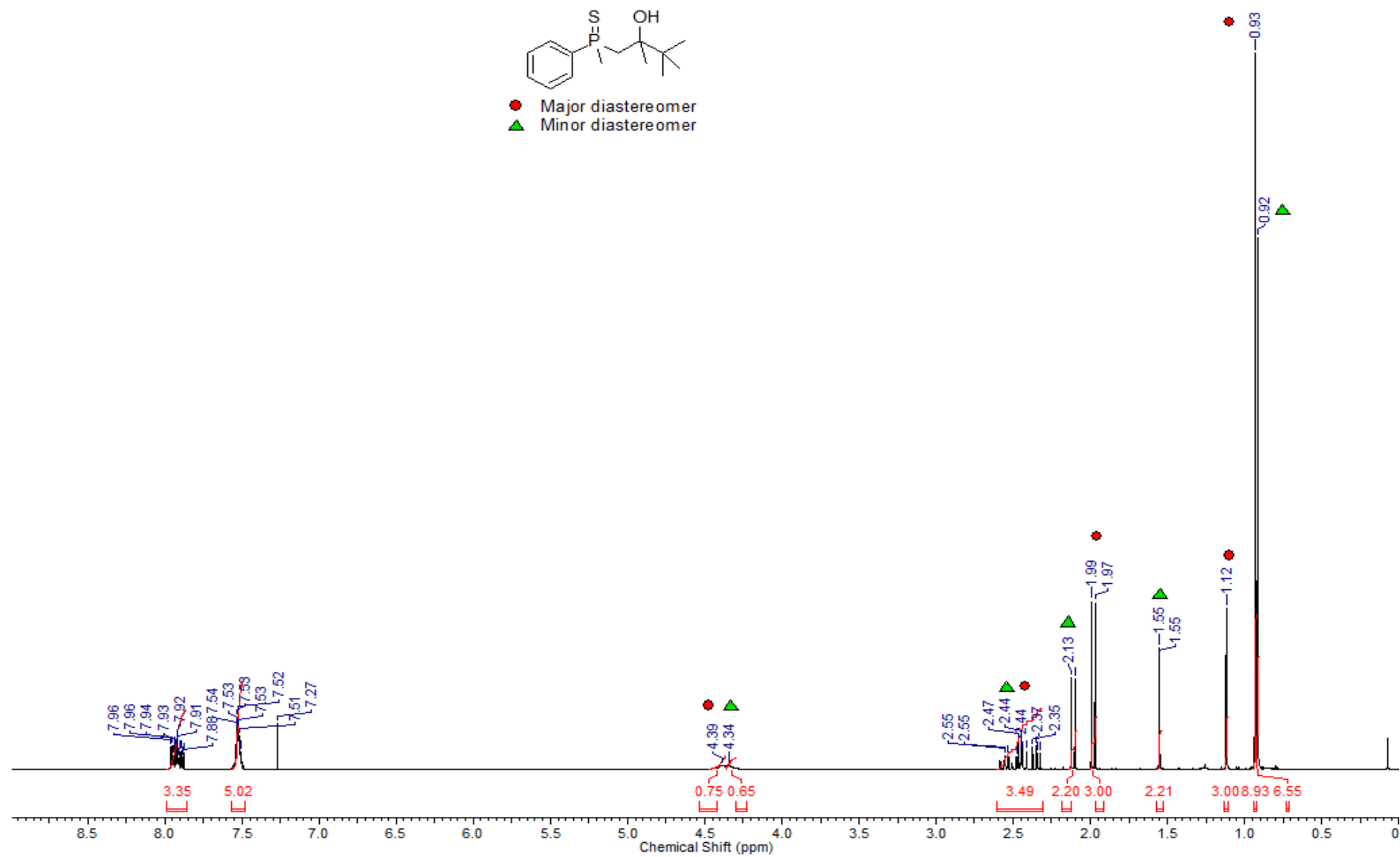
¹H NMR spectrum of (2-hydroxy-2,3-dimethylbutyl)methylphenylphosphine sulfide (**16**) (CDCl₃, 500 MHz).



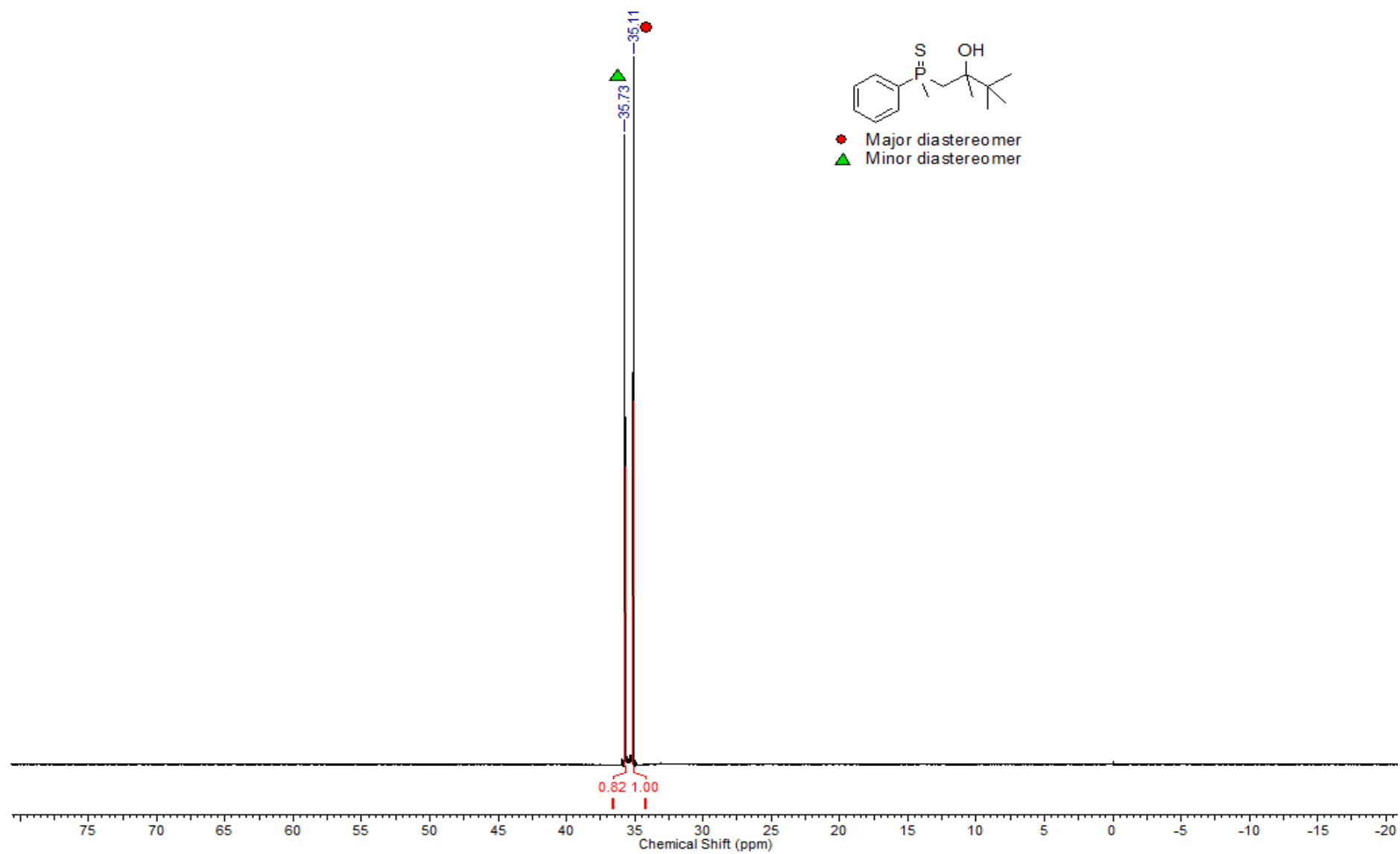
^{31}P NMR spectrum of (2-hydroxy-2,3-dimethylbutyl)methylphenylphosphine sulfide (**16**) (CDCl_3 , 202 MHz).



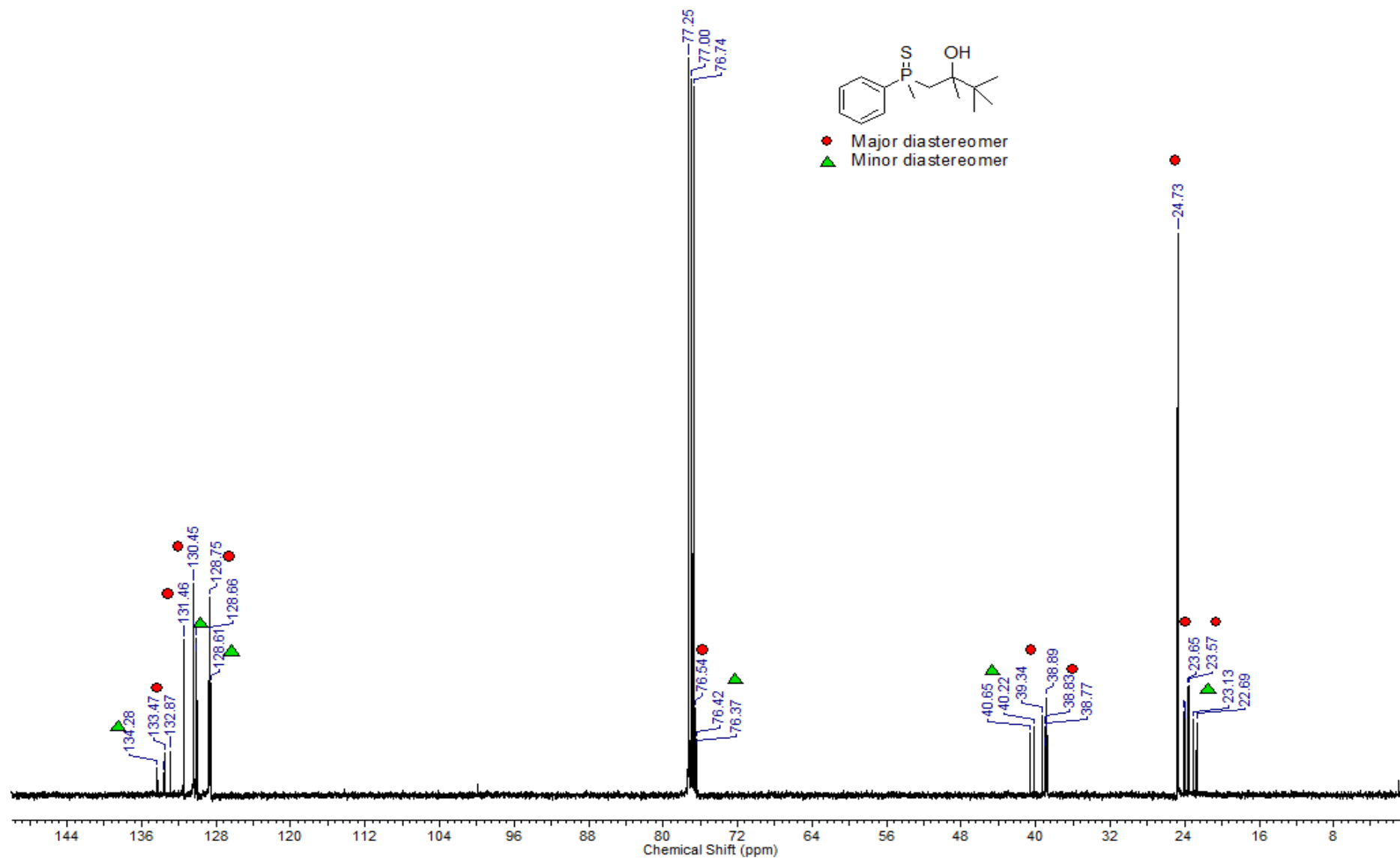
¹³C NMR spectrum of (2-hydroxy-2,3-dimethylbutyl)methylphenylphosphine sulfide (**16**) (CDCl₃, 126 MHz).



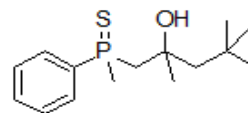
¹H NMR spectrum of (2-hydroxy-2,3,3-trimethylbutyl)methylphenylphosphine sulfide (**17**) (CDCl₃, 500 MHz).



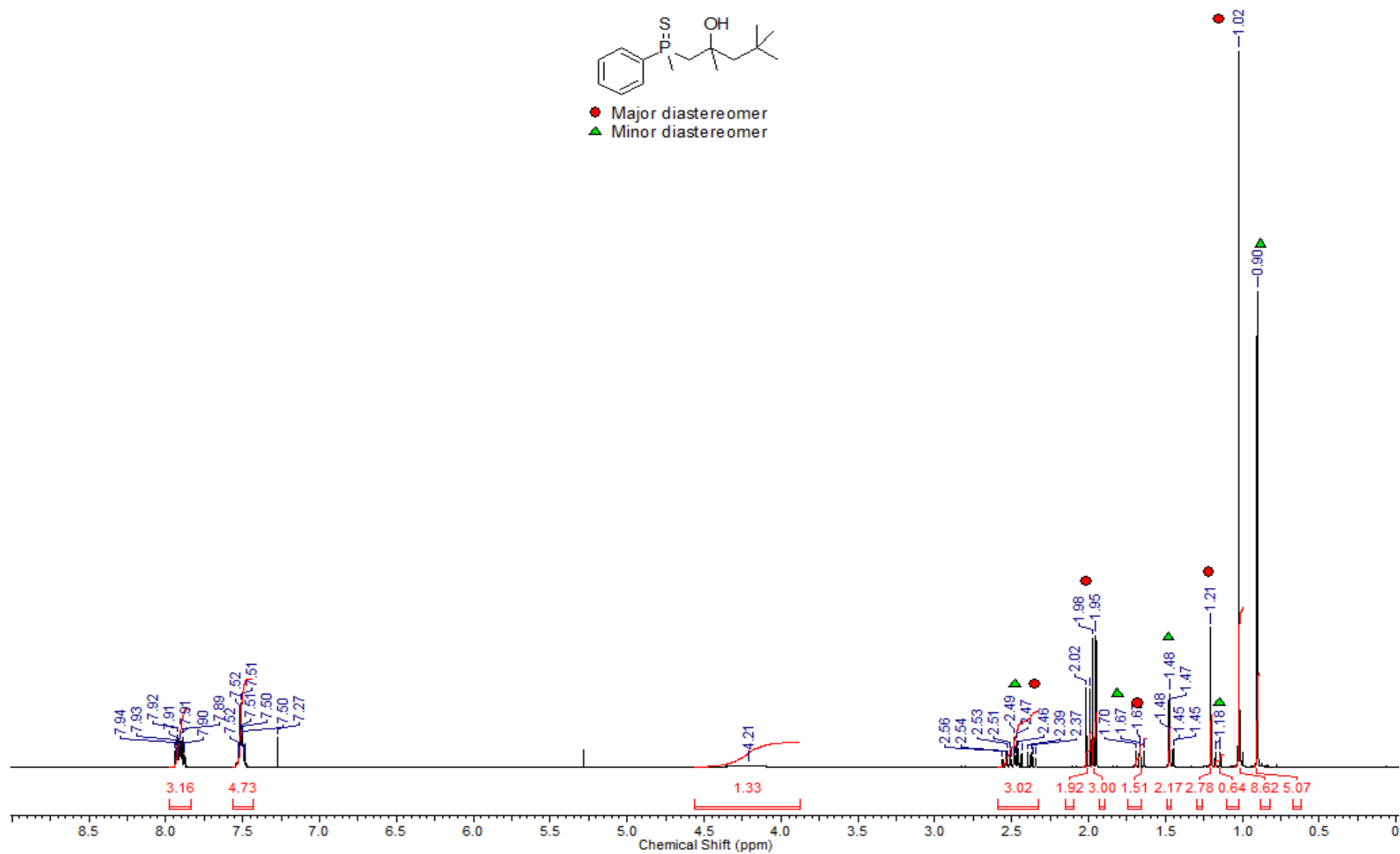
^{31}P NMR spectrum of (2-hydroxy-2,3,3-trimethylbutyl)methylphenylphosphine sulfide (**17**) (CDCl_3 , 202 MHz).



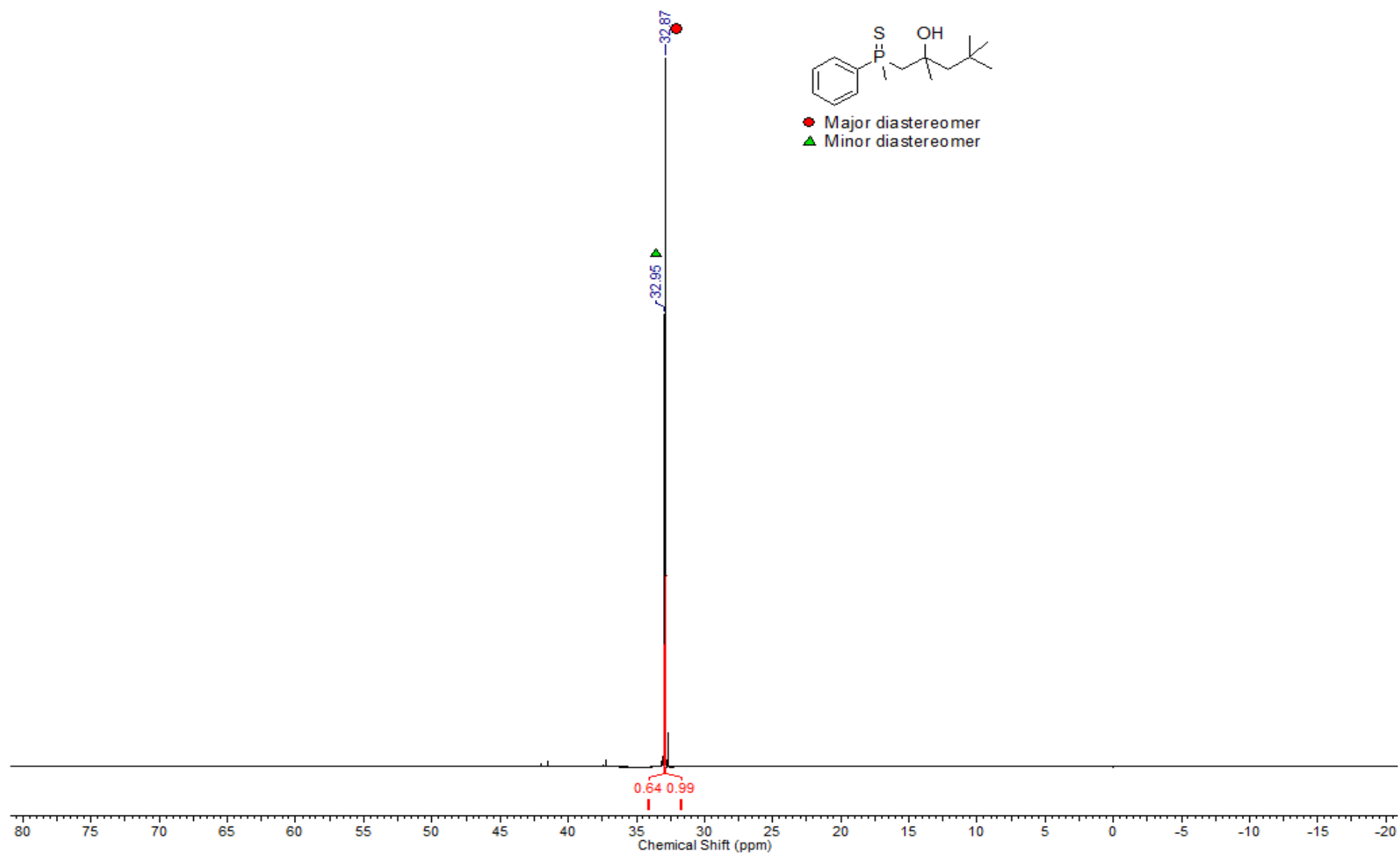
^{13}C NMR spectrum of (2-hydroxy-2,3,3-trimethylbutyl)methylphenylphosphine sulfide (17) (CDCl_3 , 126 MHz).



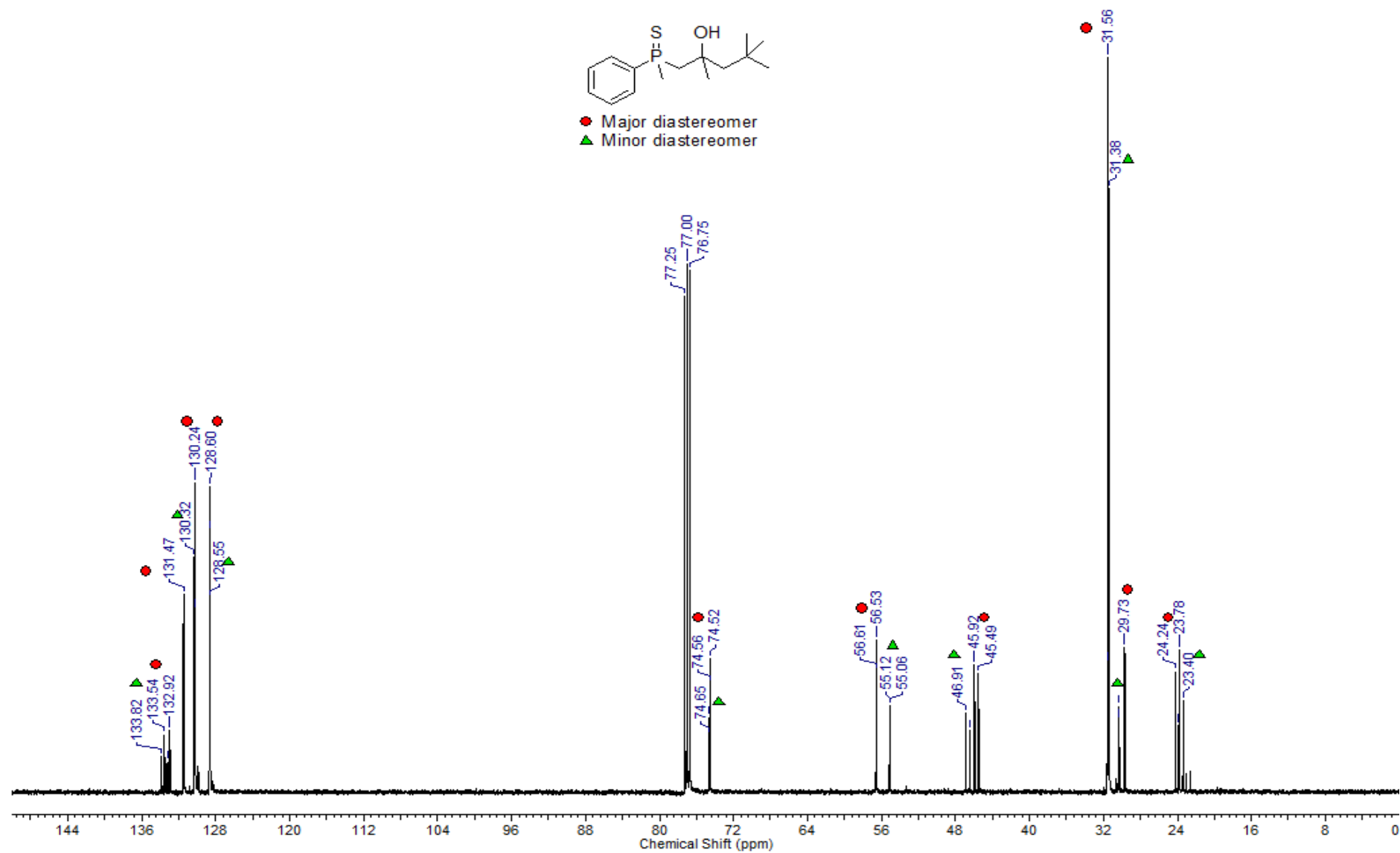
● Major diastereomer
▲ Minor diastereomer



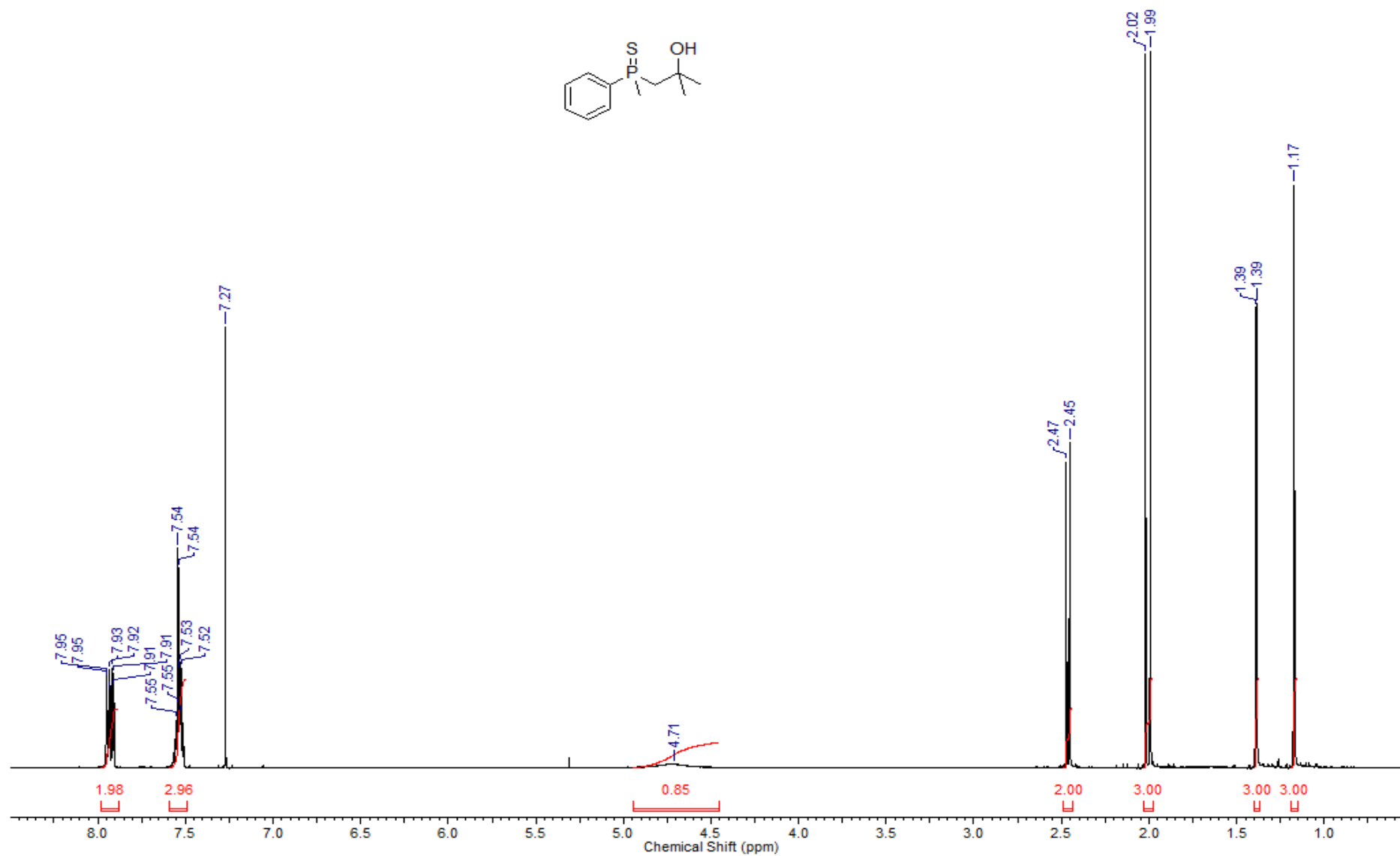
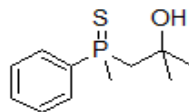
^1H NMR spectrum of (2-hydroxy-2,4,4-trimethylpentyl)methylphenylphosphine sulfide (**18**) (CDCl_3 , 500 MHz).



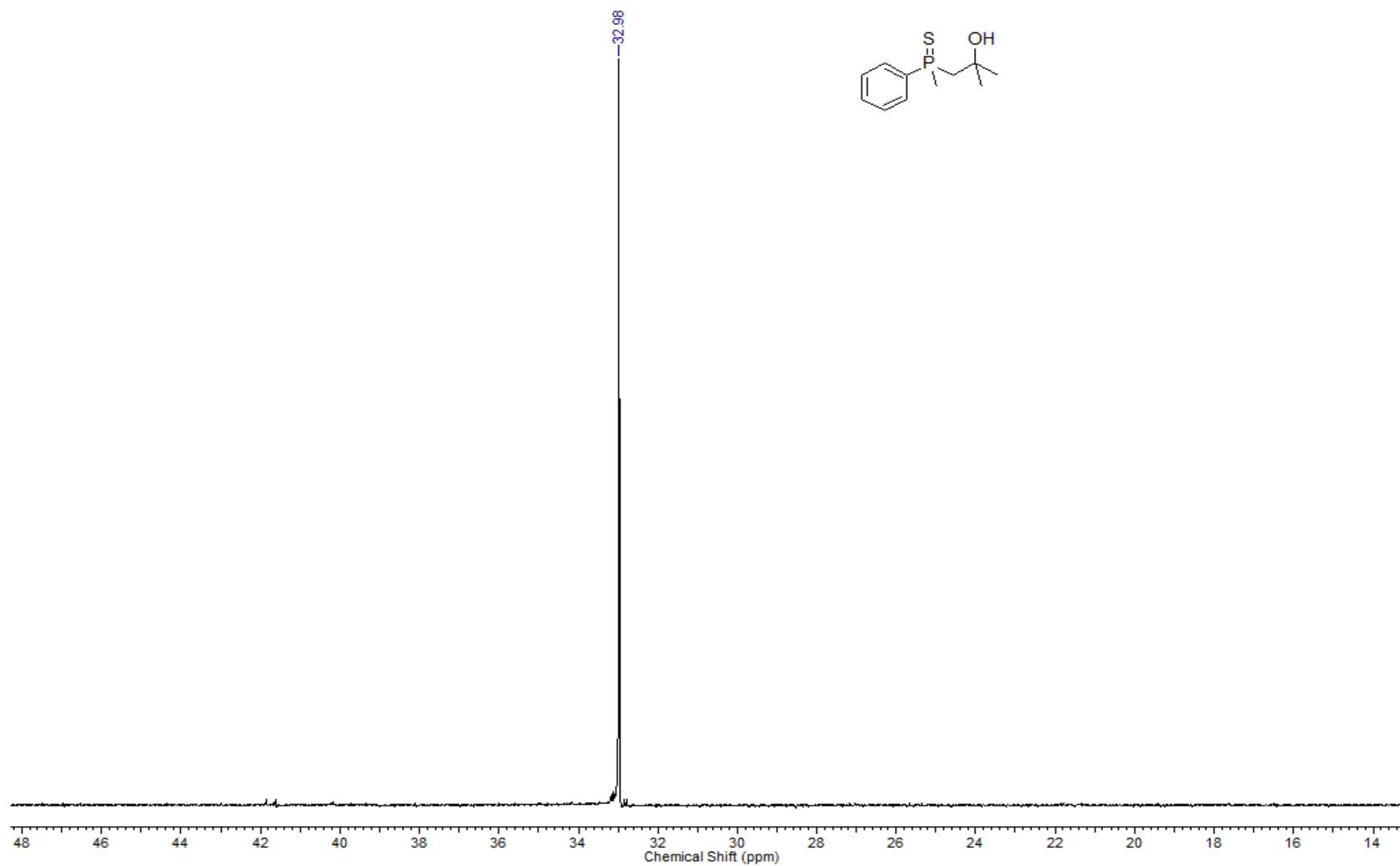
^{31}P NMR spectrum of (2-hydroxy-2,4,4-trimethylpentyl)methylphenylphosphine sulfide (**18**) (CDCl_3 , 202 MHz).



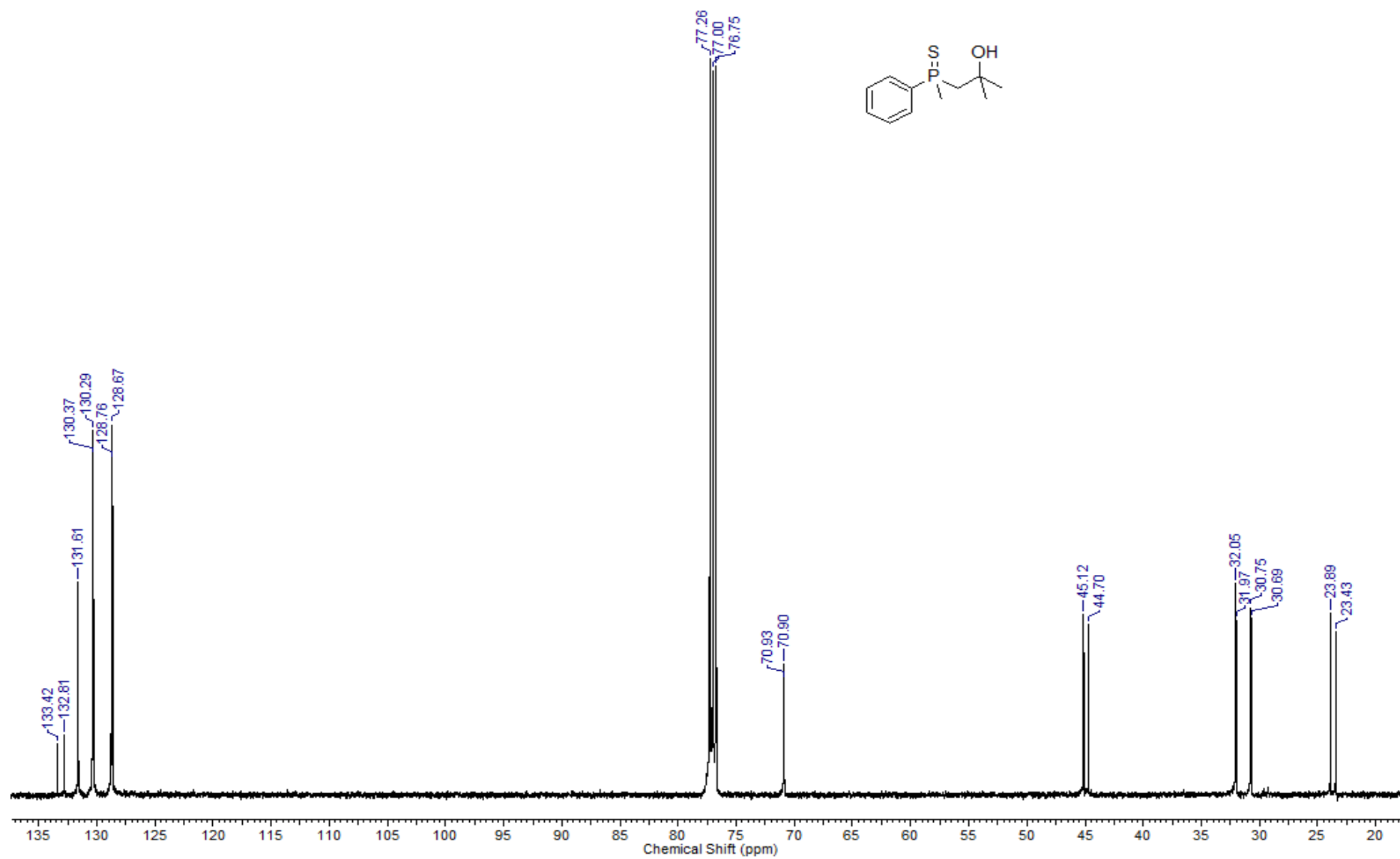
¹³C NMR spectrum of (2-hydroxy-2,4,4-trimethylpentyl)methylphenylphosphine sulfide (**18**) (CDCl₃, 126 MHz).



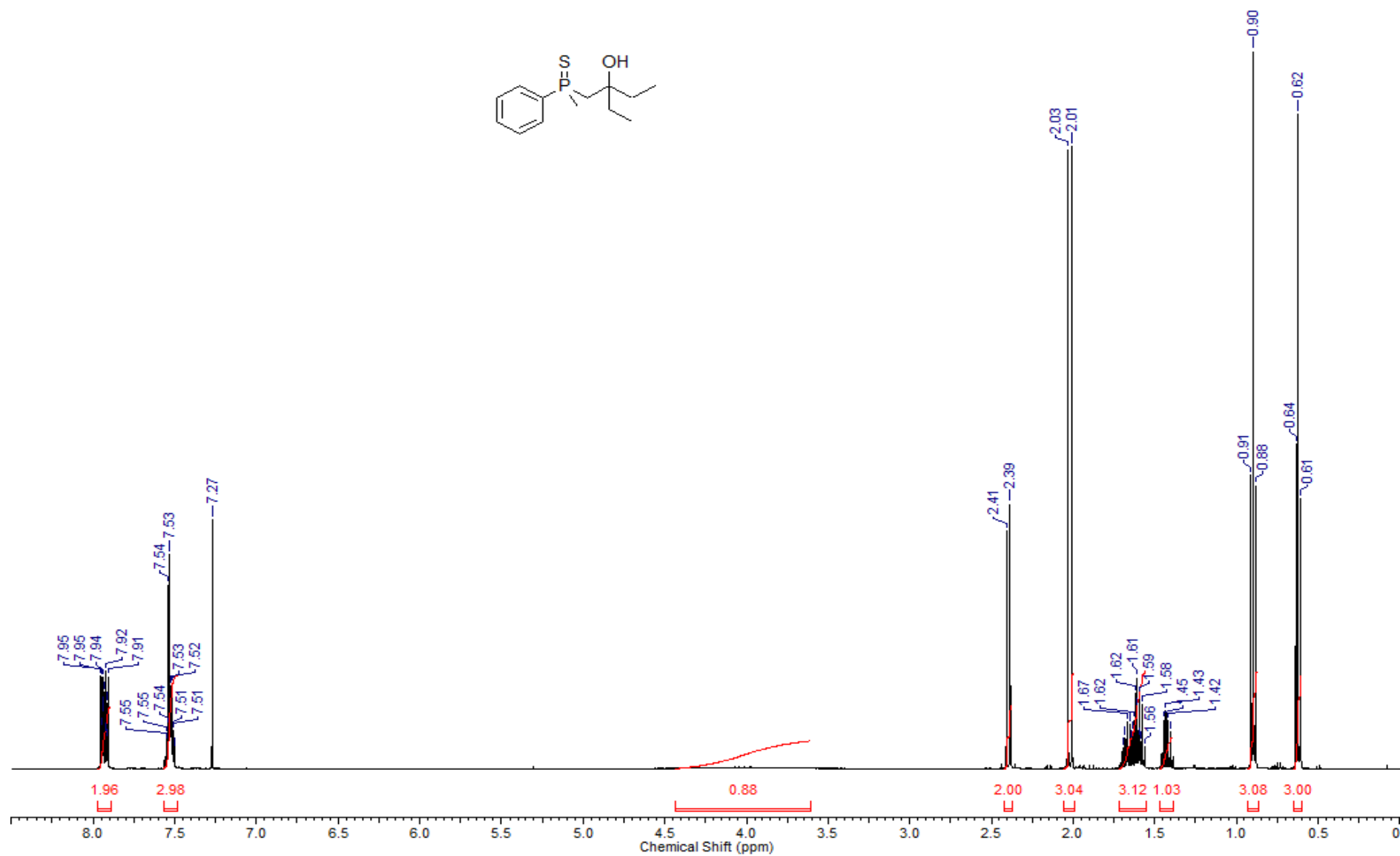
^1H NMR spectrum of (2-hydroxy-2-methylpropyl)methylphenylphosphine sulfide (**19**) (CDCl_3 , 500 MHz).



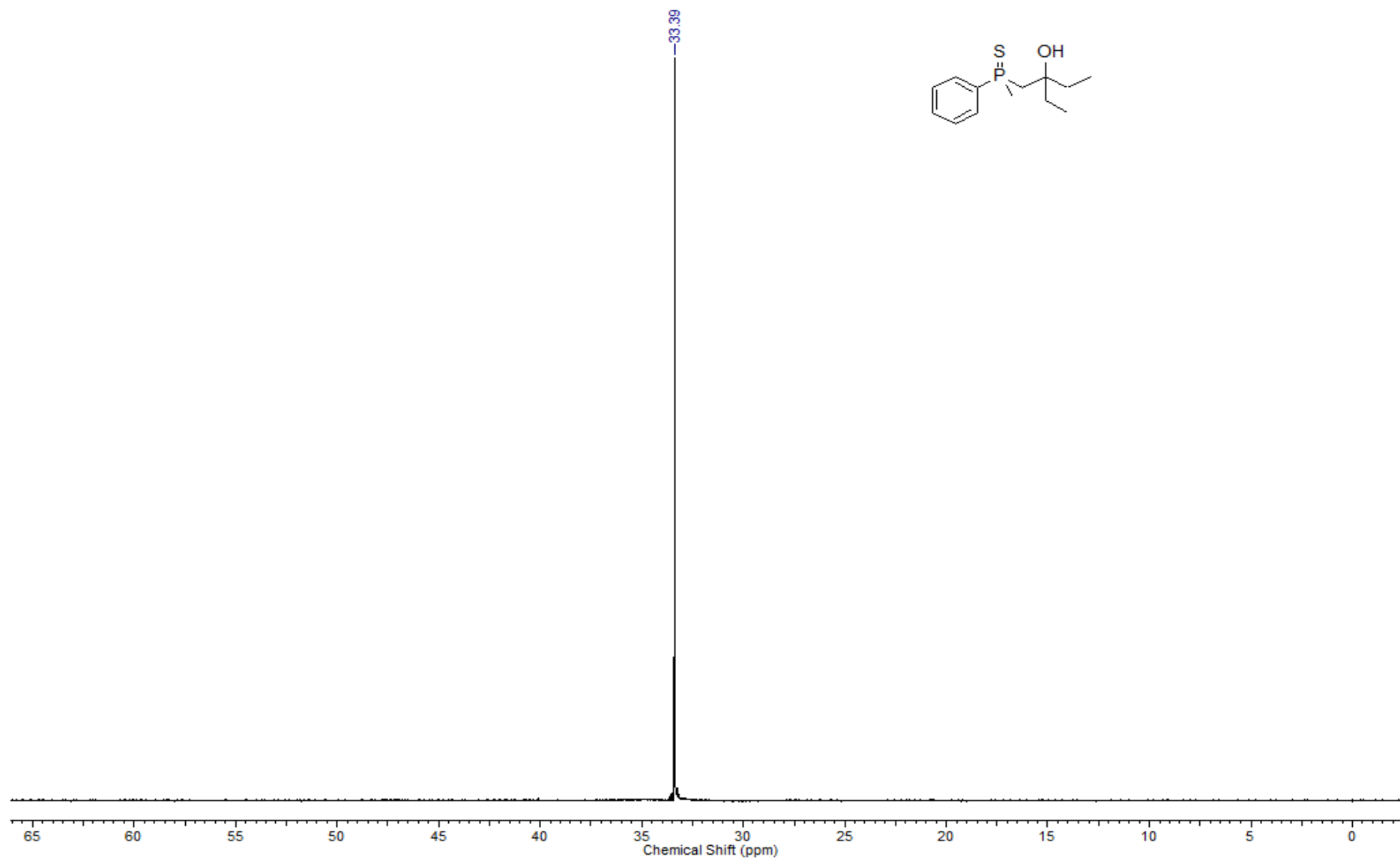
^{31}P NMR spectrum of (2-hydroxy-2-methylpropyl)methylphenylphosphine sulfide (**19**) (CDCl_3 , 202 MHz).



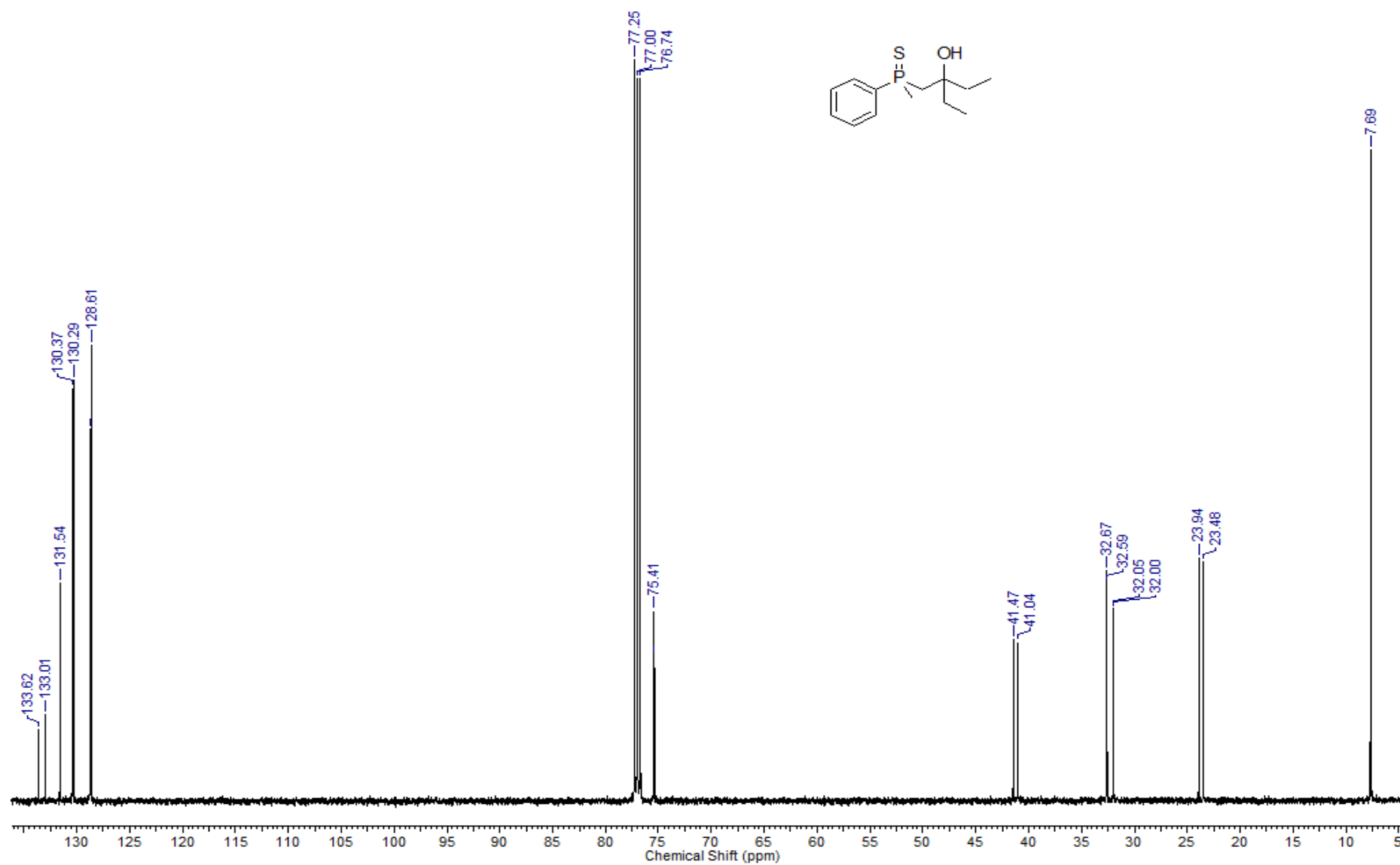
¹³C NMR spectrum of (2-hydroxy-2-methylpropyl)methylphenylphosphine sulfide (**19**) (CDCl₃, 126 MHz).



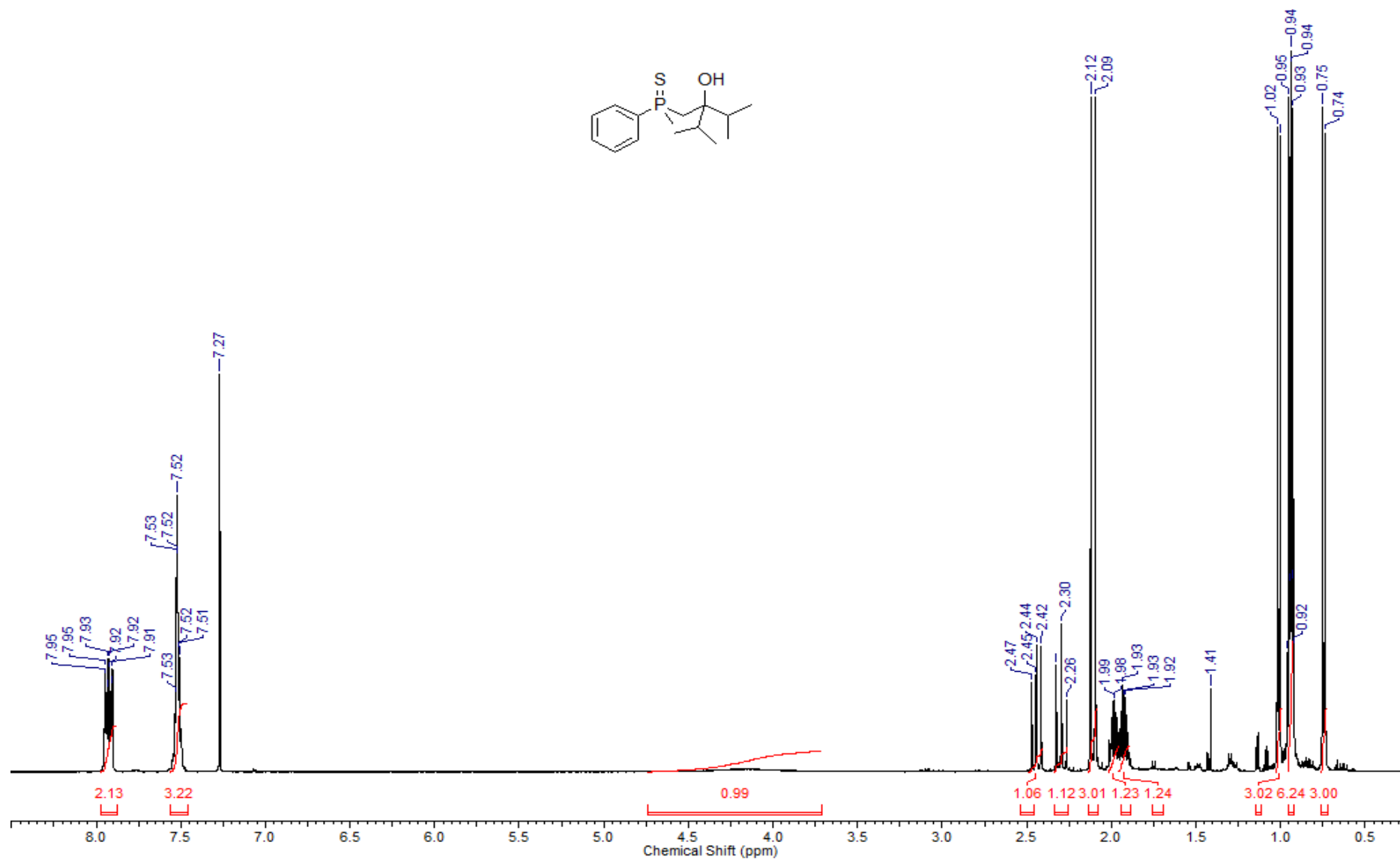
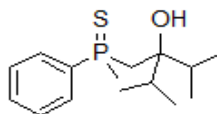
¹H NMR spectrum of (2-ethyl-2-hydroxybutyl)methylphenylphosphine sulfide (**20**) (CDCl₃, 500 MHz).



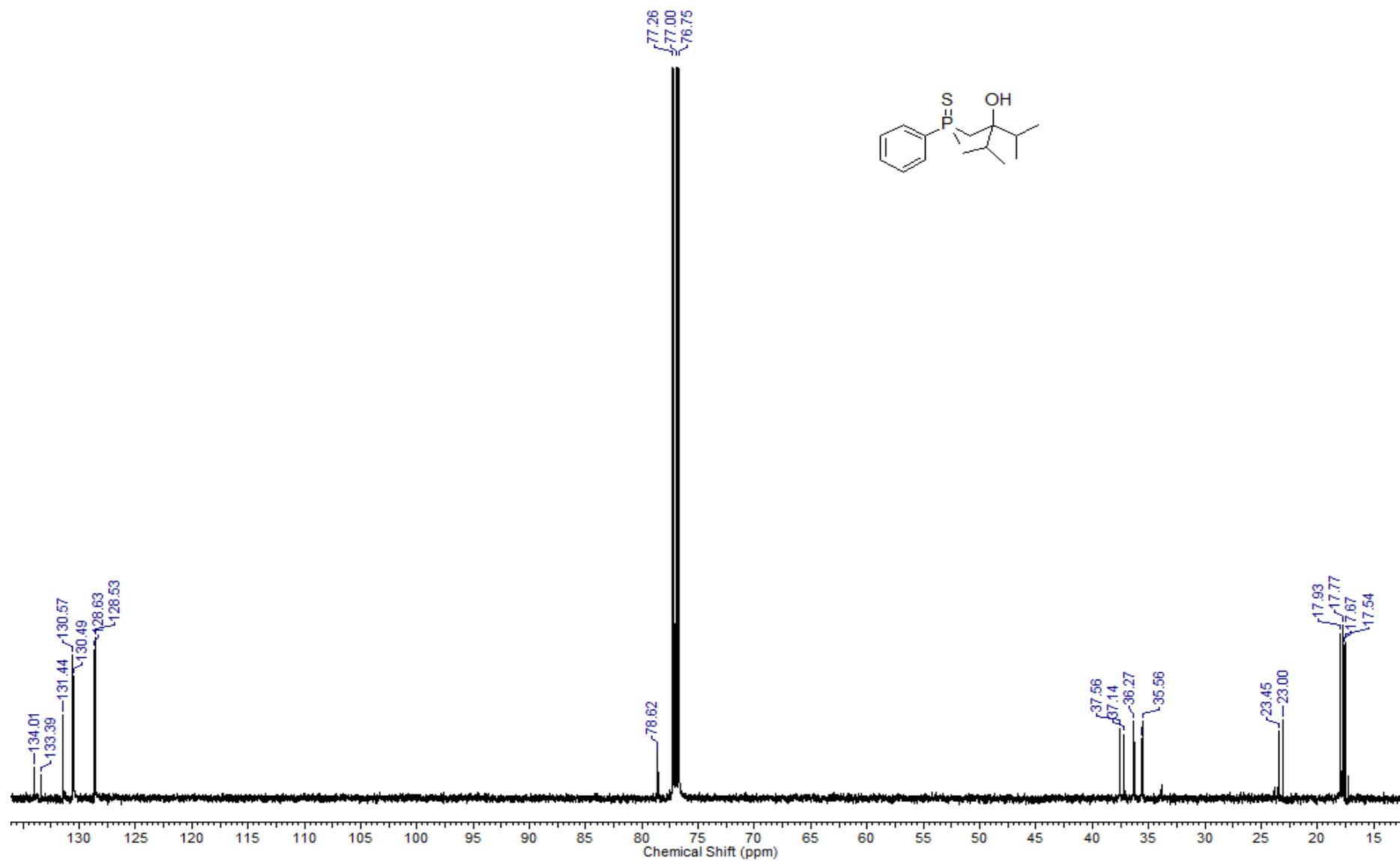
^{31}P NMR spectrum of (2-ethyl-2-hydroxybutyl)methylphenylphosphine sulfide (**20**) (CDCl_3 , 202 MHz).



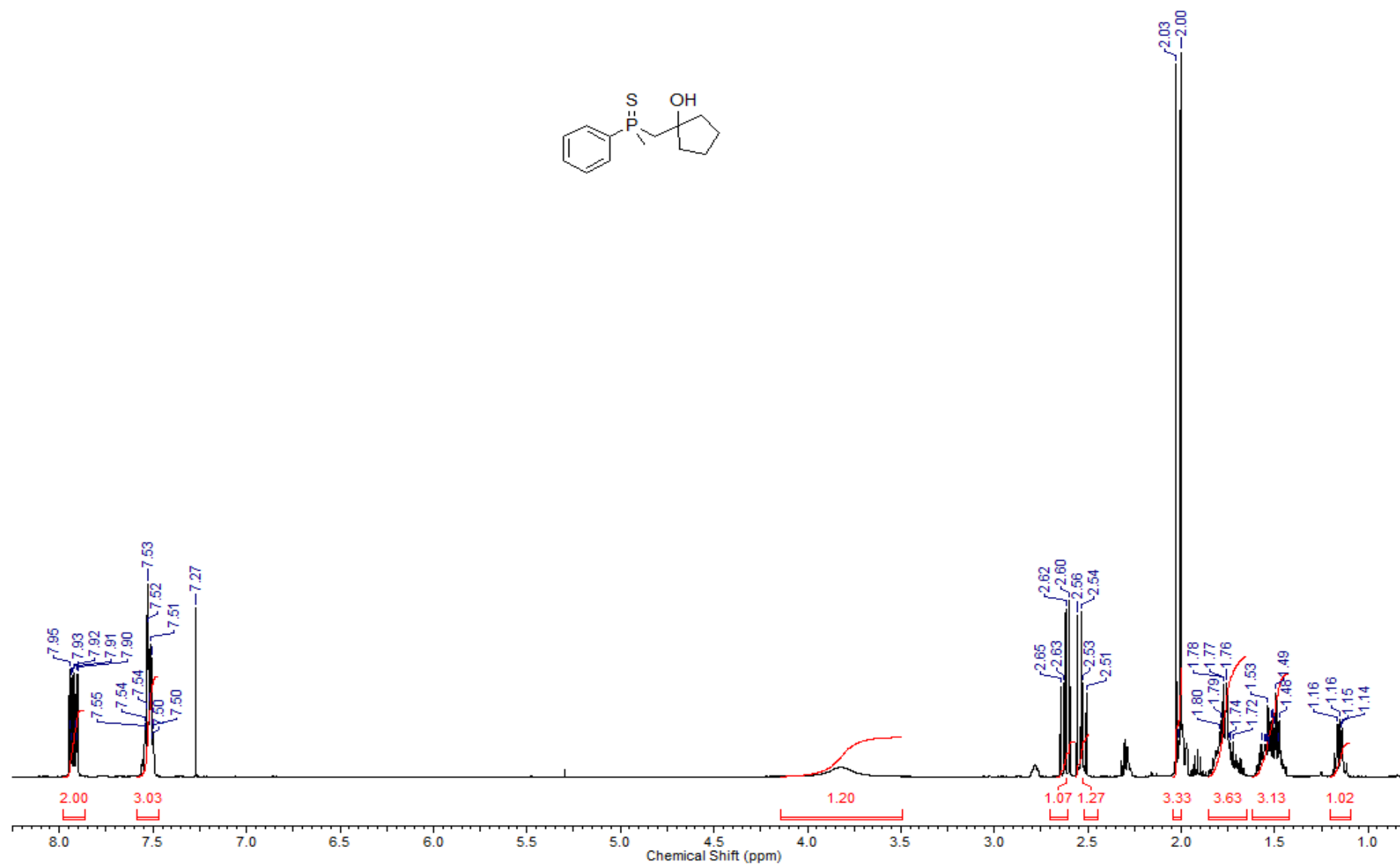
¹³C NMR spectrum of (2-ethyl-2-hydroxybutyl)methylphenylphosphine sulfide (**20**) (CDCl₃, 126 MHz).



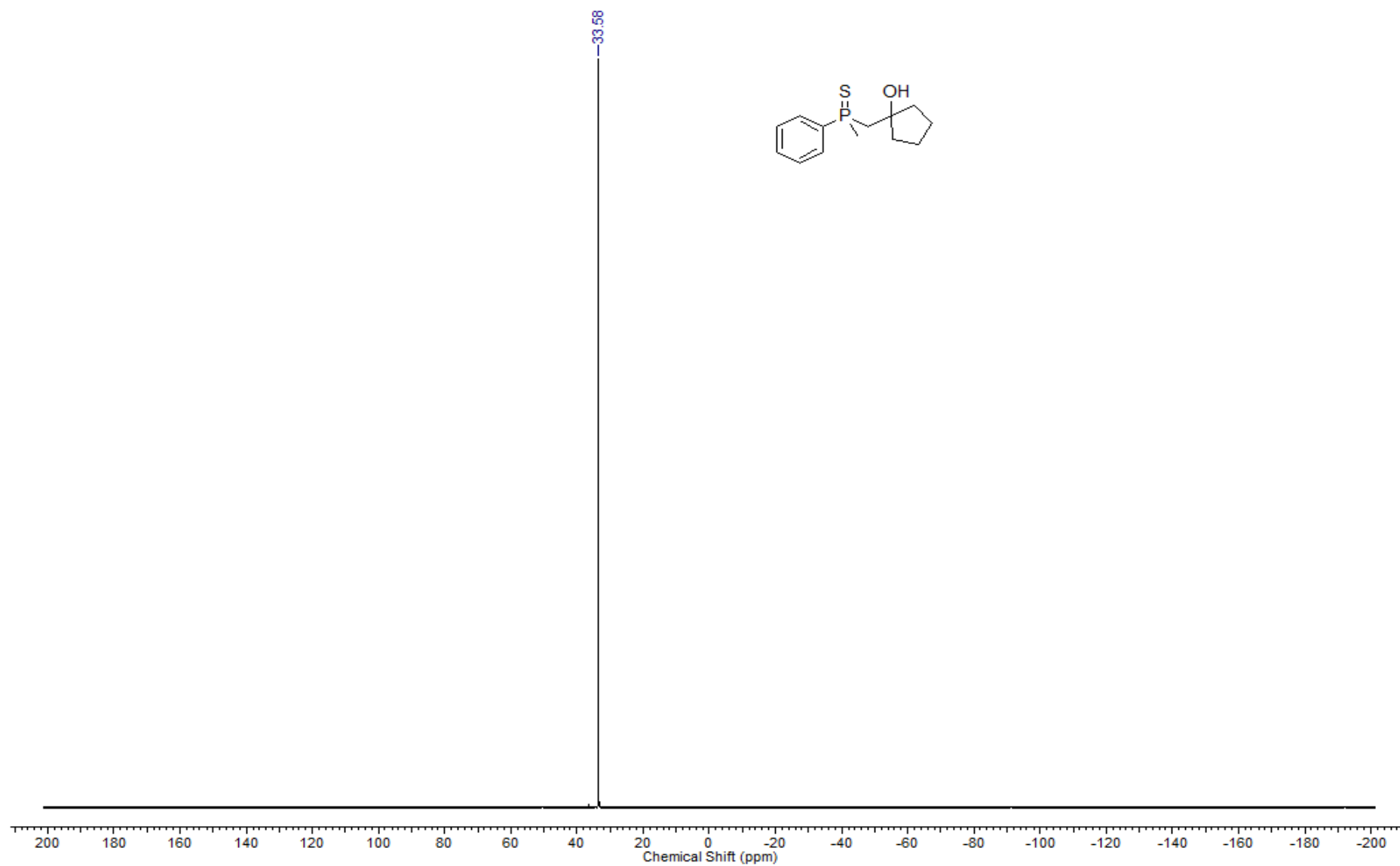
^1H NMR spectrum of (2-hydroxy-2-iso-propyl-3-methylbutyl)methylphenylphosphine sulfide (**21**) (CDCl_3 , 500 MHz).



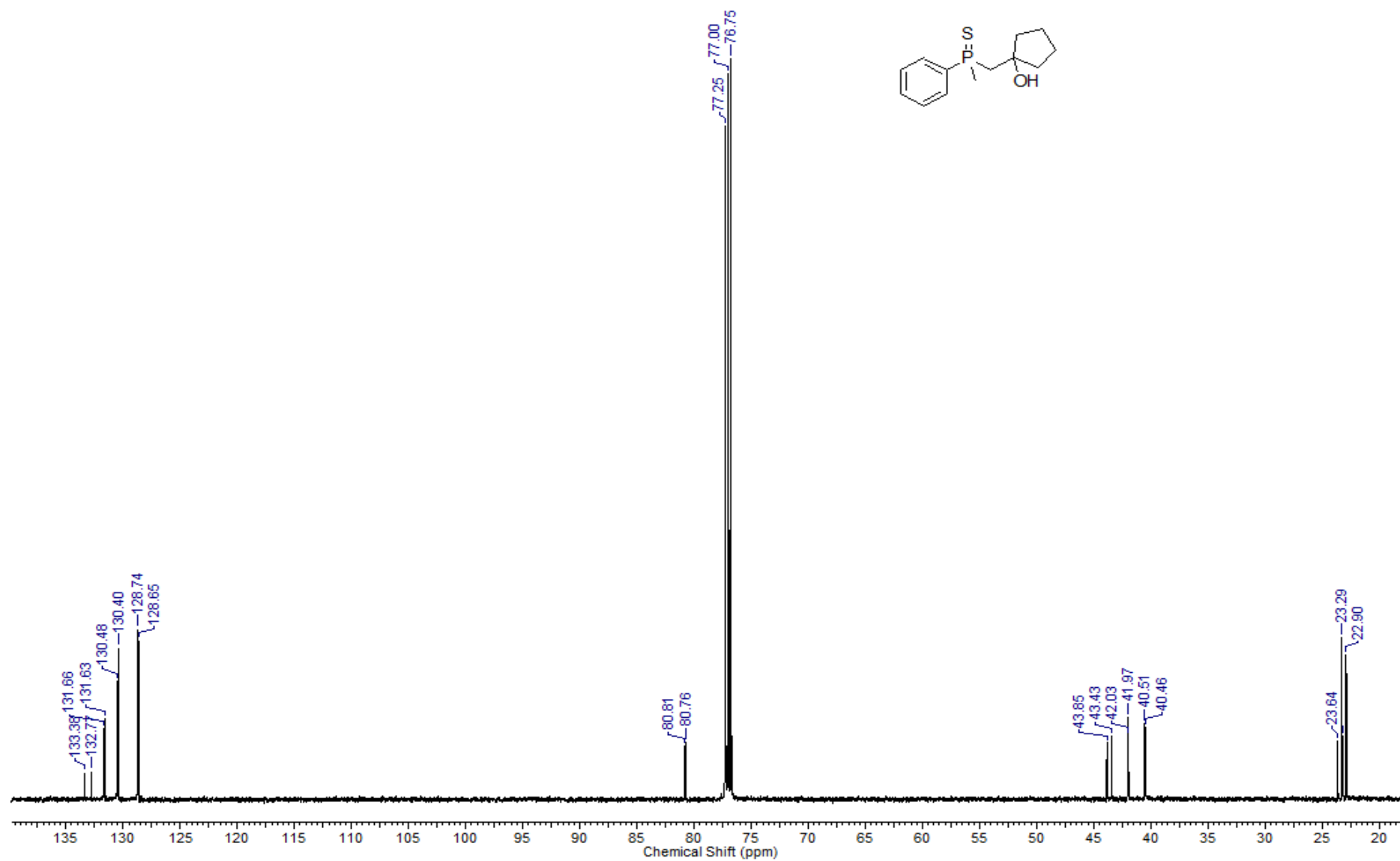
¹³C NMR spectrum of (2-hydroxy-2-*iso*-propyl-3-methylbutyl)methylphenylphosphine sulfide (**21**) (CDCl₃, 126 MHz).



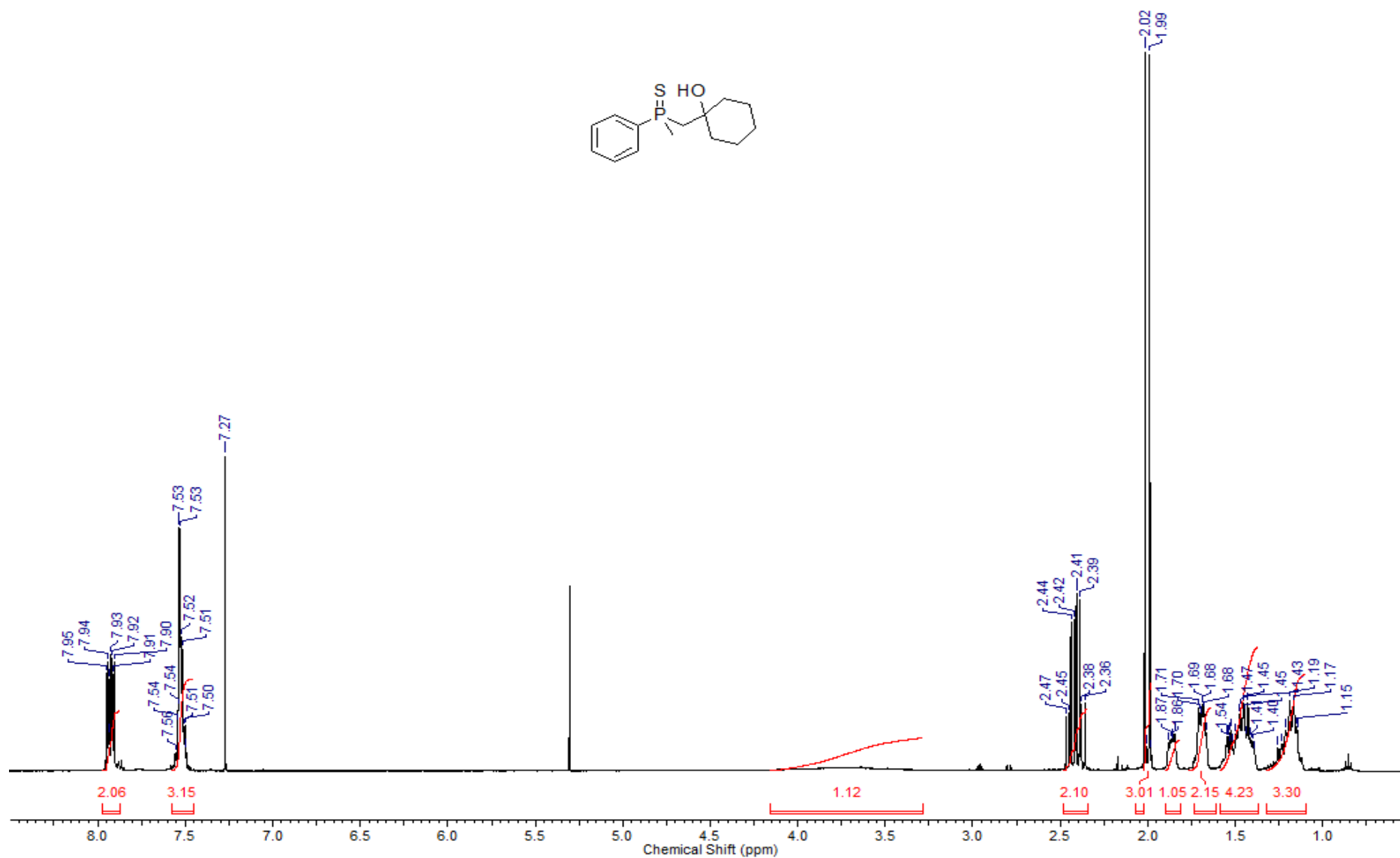
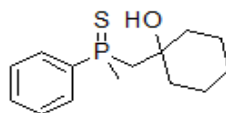
¹H NMR spectrum of [(1-hydroxy)cyclopentylmethyl]methylphenylphosphine sulfide (22) (CDCl₃, 500 MHz).



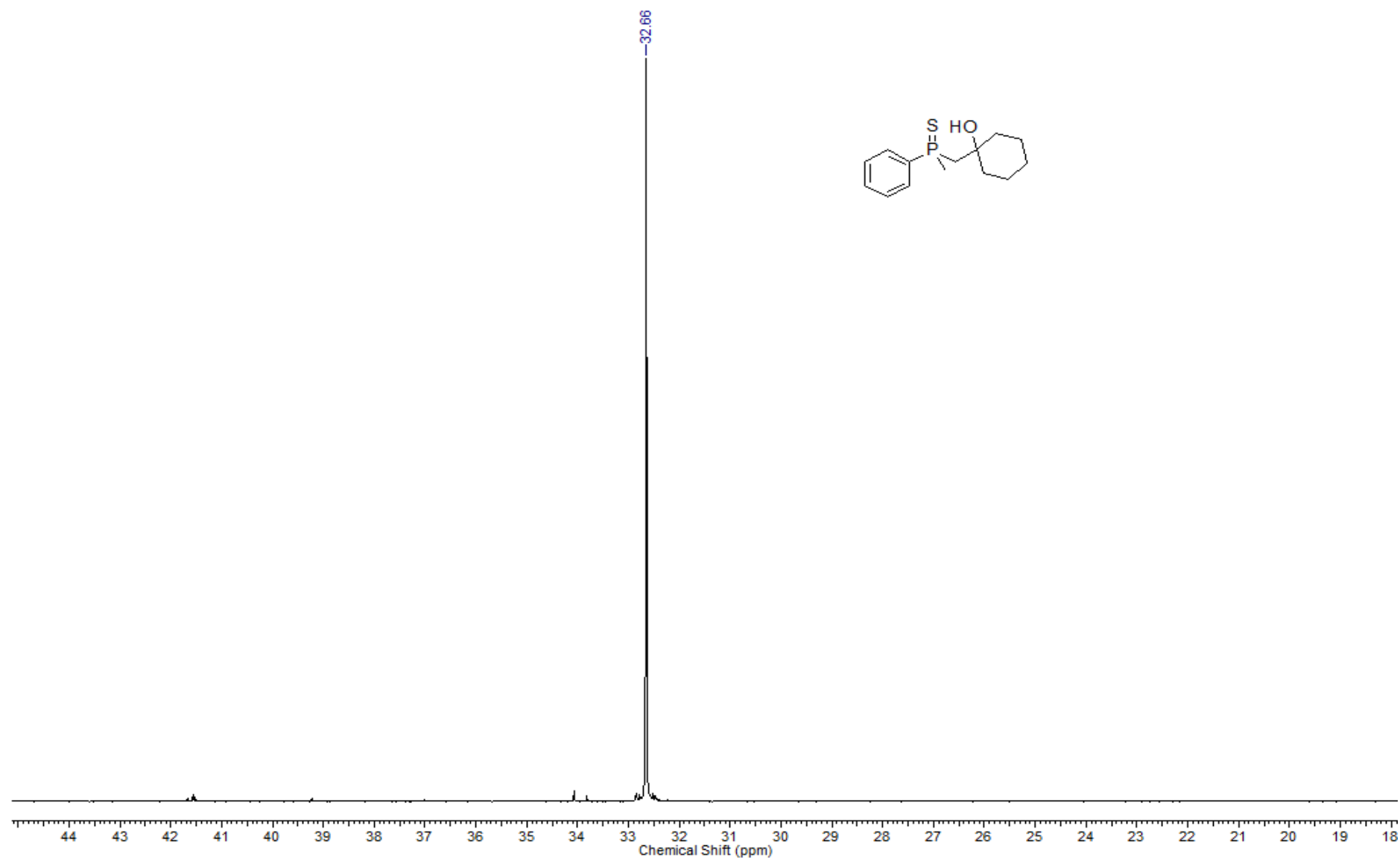
^{31}P NMR spectrum of [(1-hydroxy)cyclopentylmethyl]methylphenylphosphine sulfide (**22**) (CDCl_3 , 202 MHz).



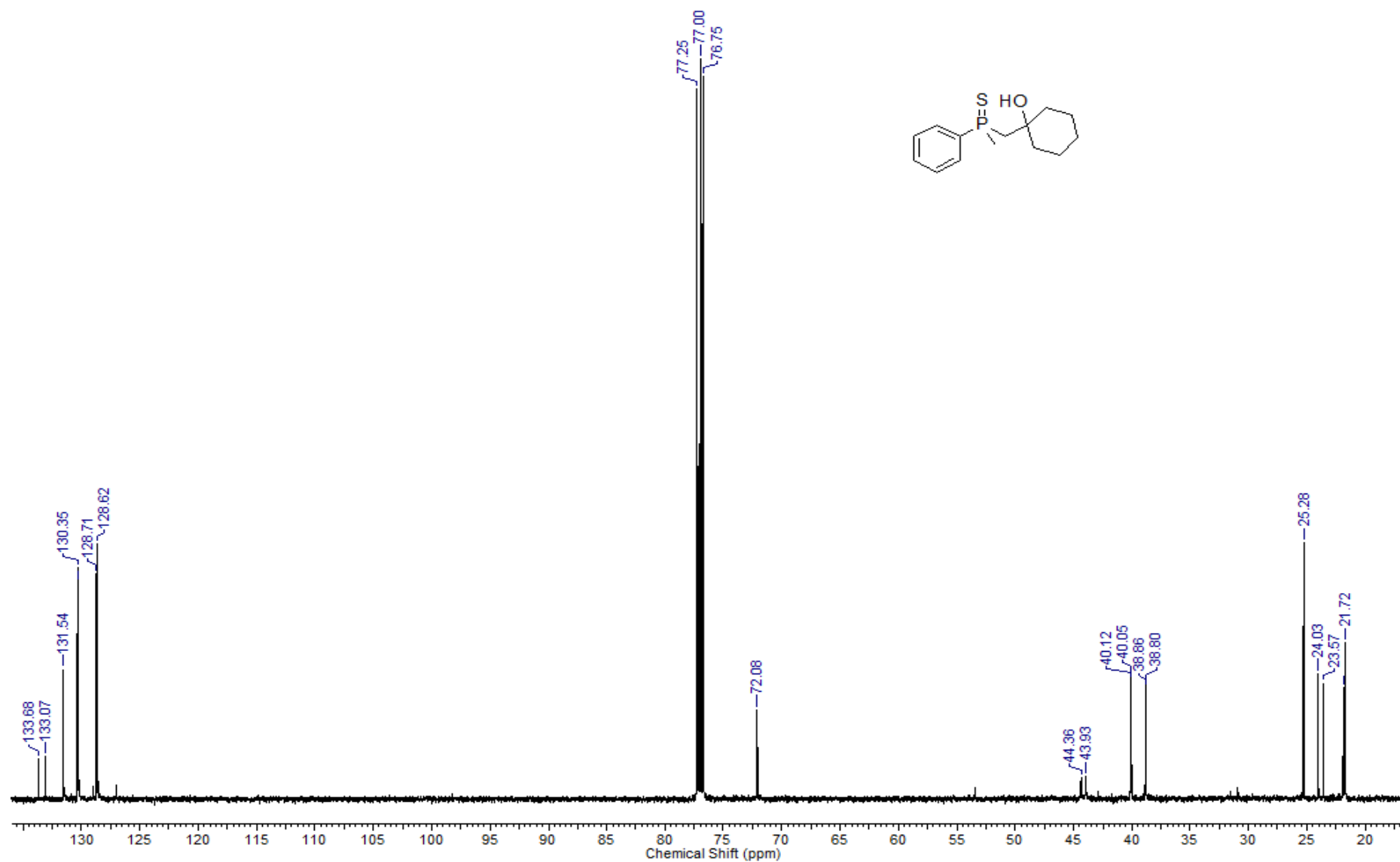
¹³C NMR spectrum of [(1-hydroxy)cyclopentylmethyl]methylphenylphosphine sulfide (22) (CDCl₃, 126 MHz).



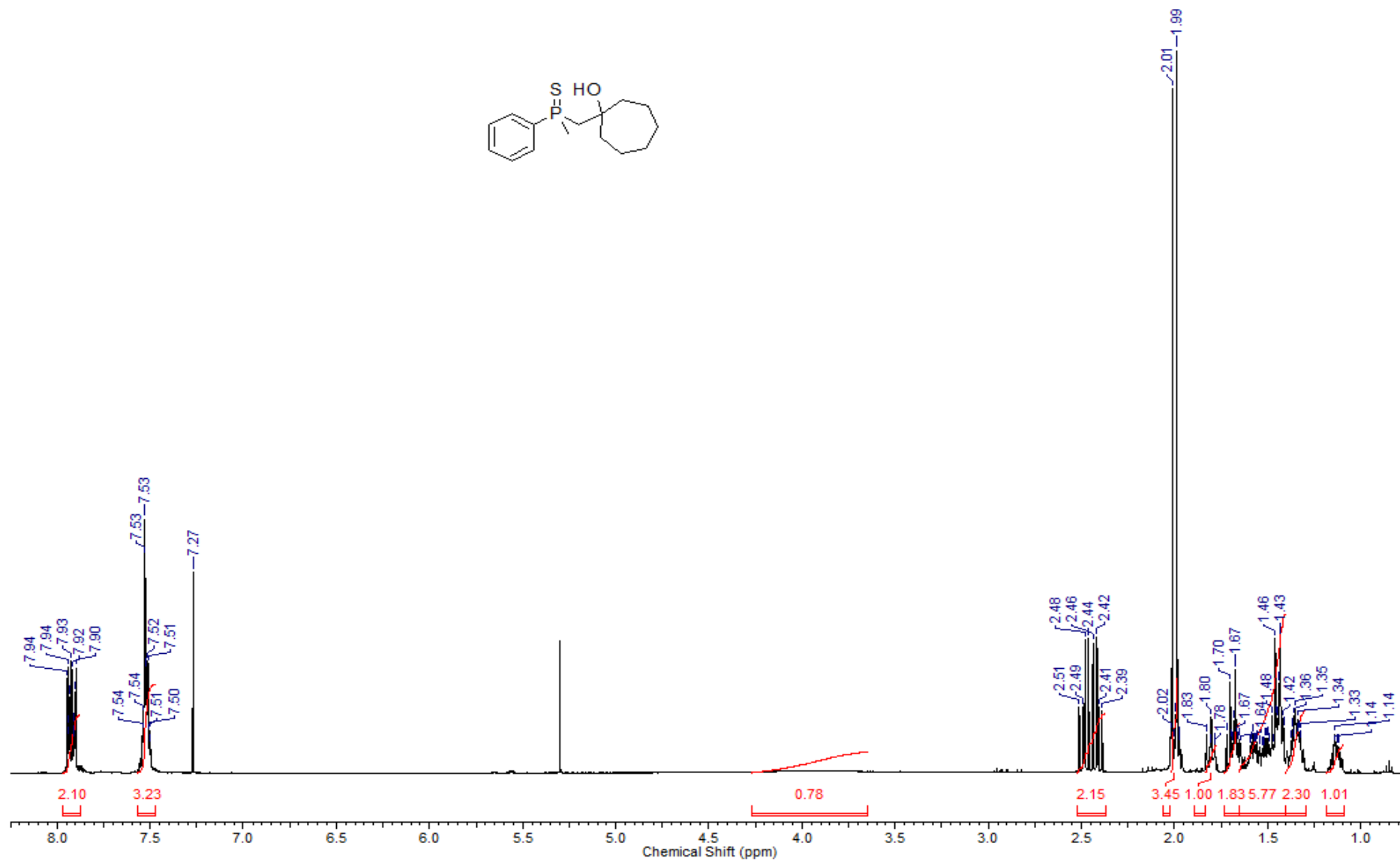
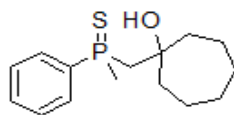
¹H NMR spectrum of [(1-hydroxy)cyclohexylmethyl]methylphenylphosphine sulfide (23) (CDCl₃, 500 MHz).



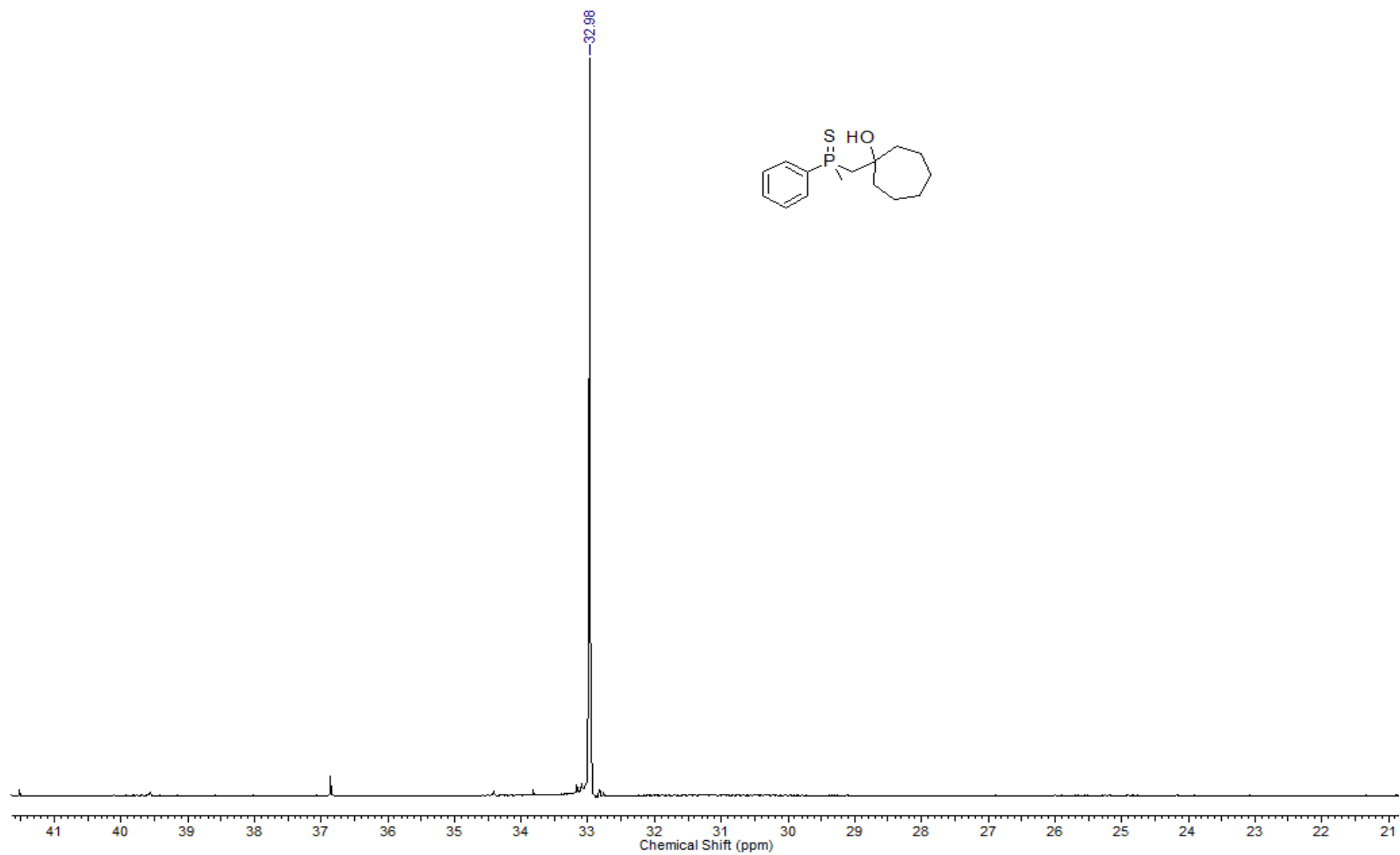
^{31}P NMR spectrum of [(1-hydroxy)cyclohexylmethyl]methylphenylphosphine sulfide (**23**) (CDCl_3 , 202 MHz).



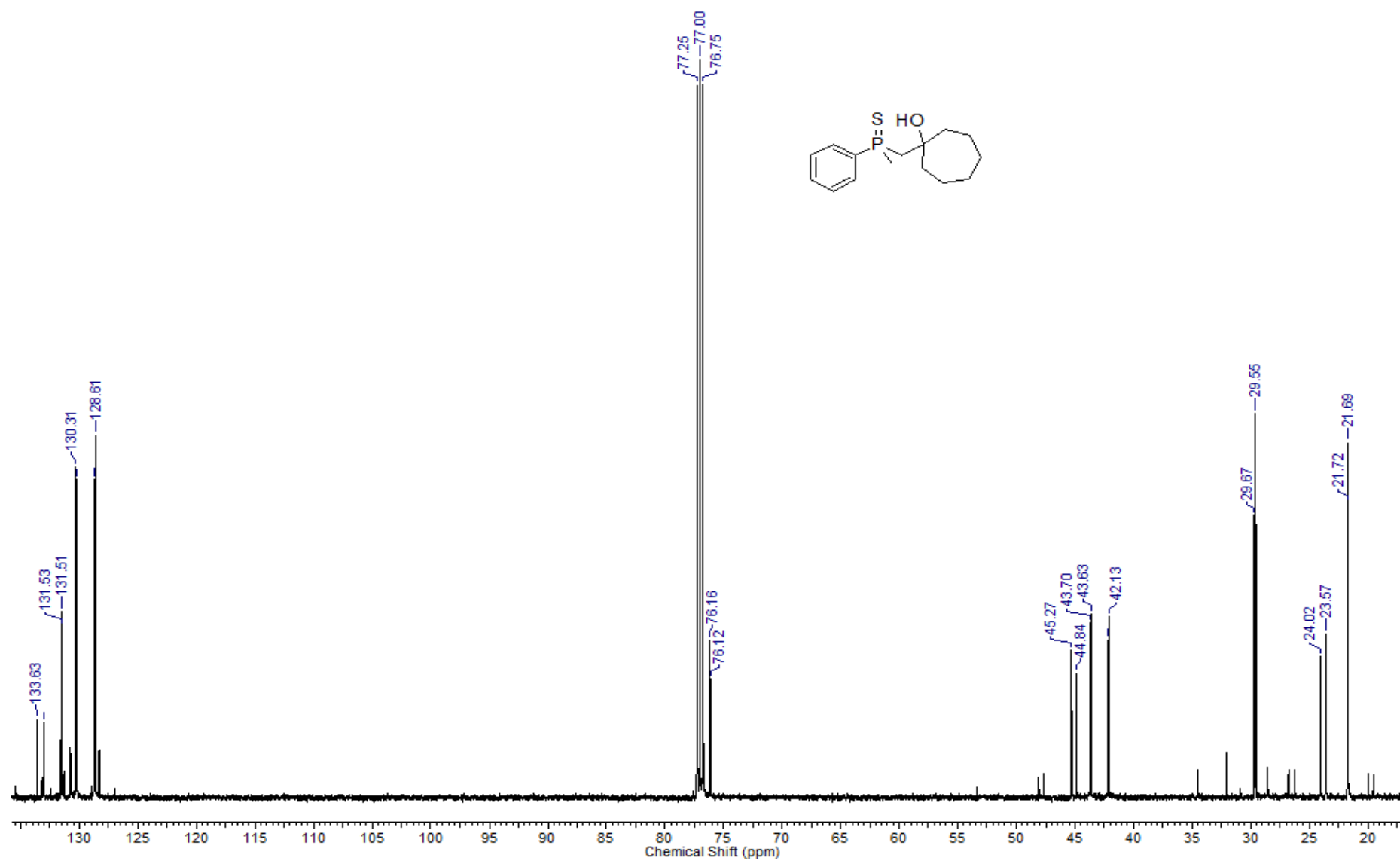
¹³C NMR spectrum of [(1-hydroxy)cyclohexylmethyl]methylphenylphosphine sulfide (23) (CDCl₃, 126 MHz).



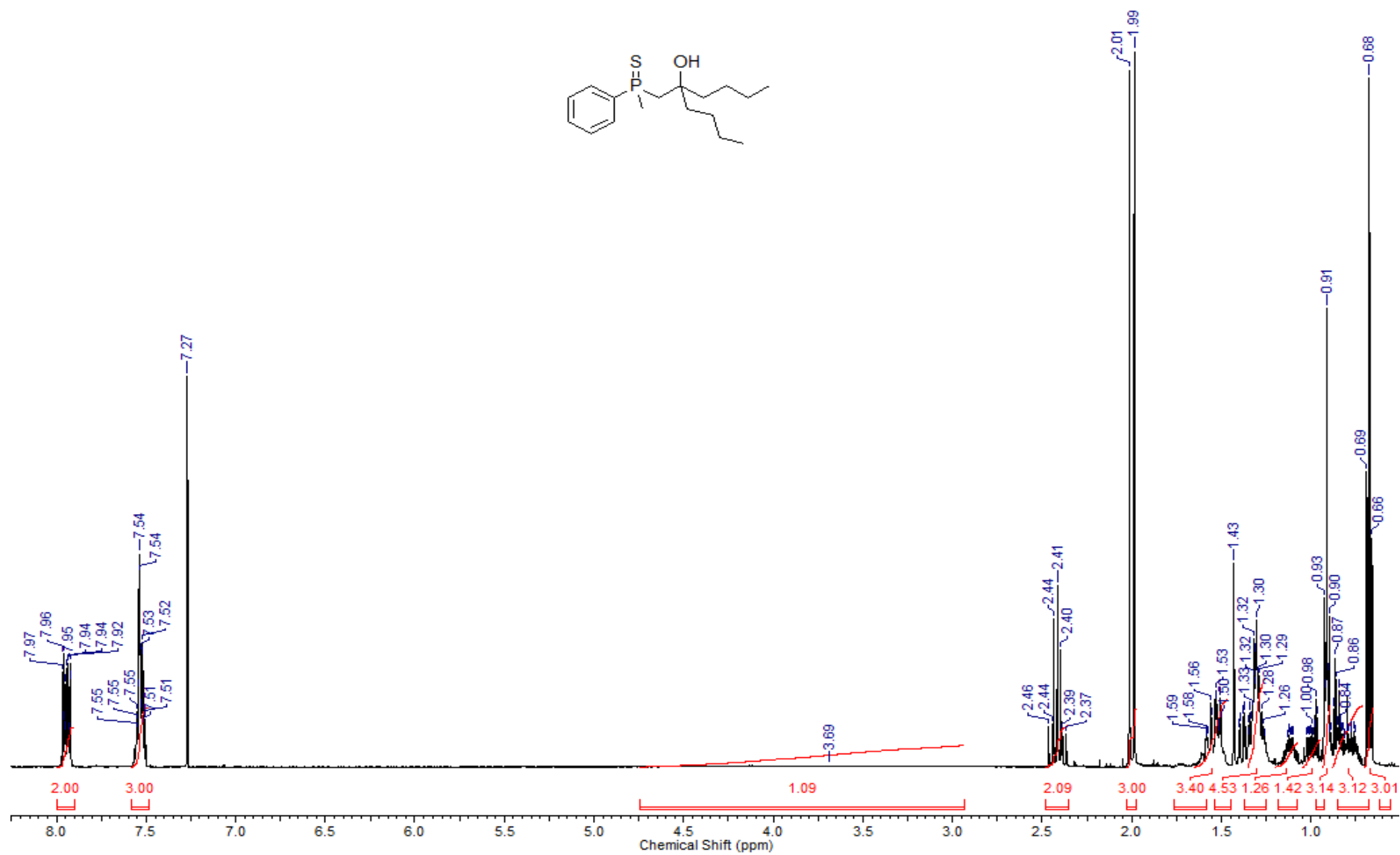
^1H NMR spectrum of [(1-hydroxy)cycloheptylmethyl]methylphenylphosphine sulfide (**24**) (CDCl_3 , 500 MHz).



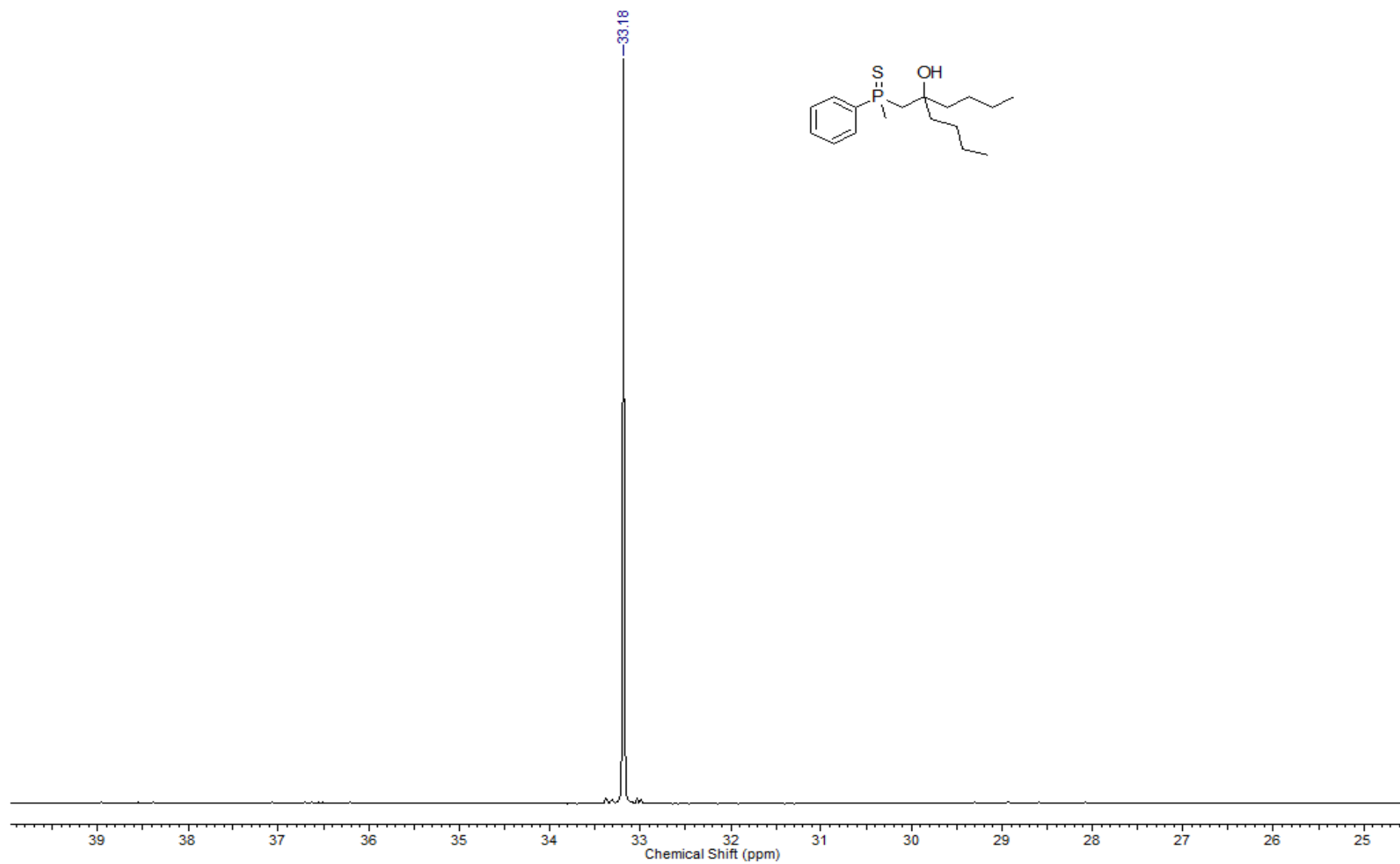
^{31}P NMR spectrum of [(1-hydroxy)cycloheptylmethyl]methylphenylphosphine sulfide (**24**) (CDCl_3 , 202 MHz).



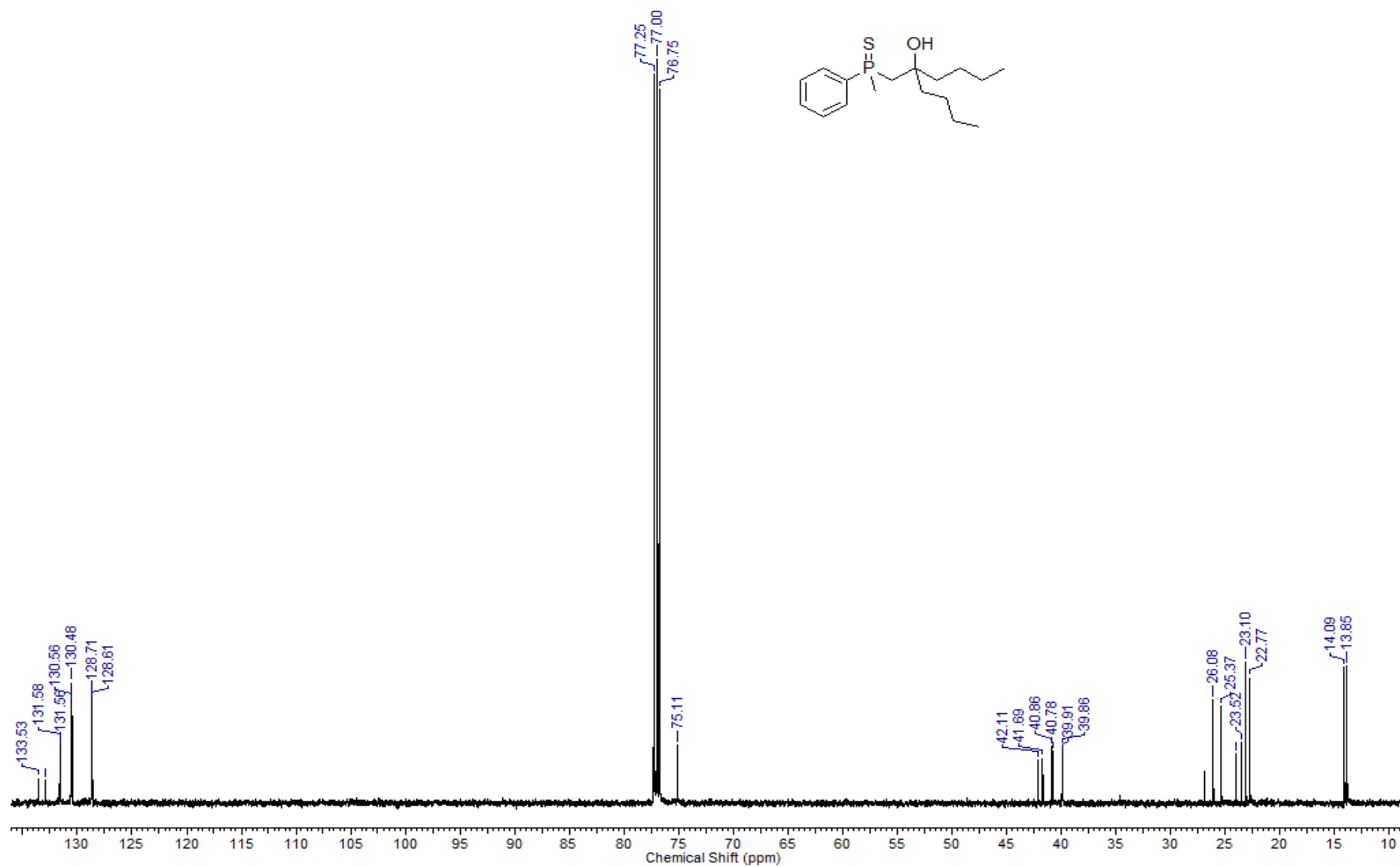
¹³C NMR spectrum of [(1-hydroxy)cycloheptylmethyl]methylphenylphosphine sulfide (**24**) (CDCl₃, 126 MHz).



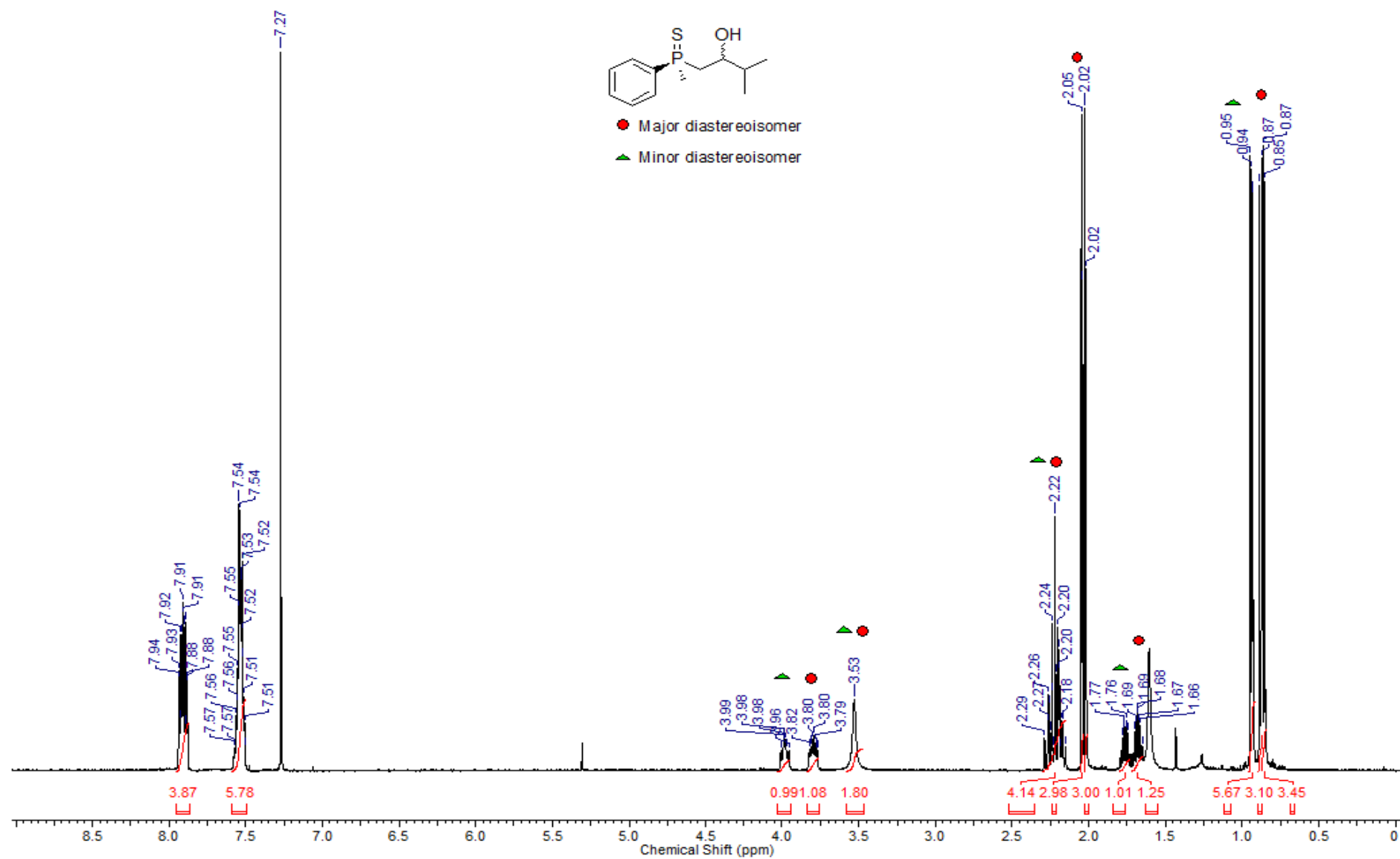
¹H NMR spectrum of (2-butyl-2-hydroxyhexyl)methylphenylphosphine sulfide (25) (CDCl₃, 500 MHz).



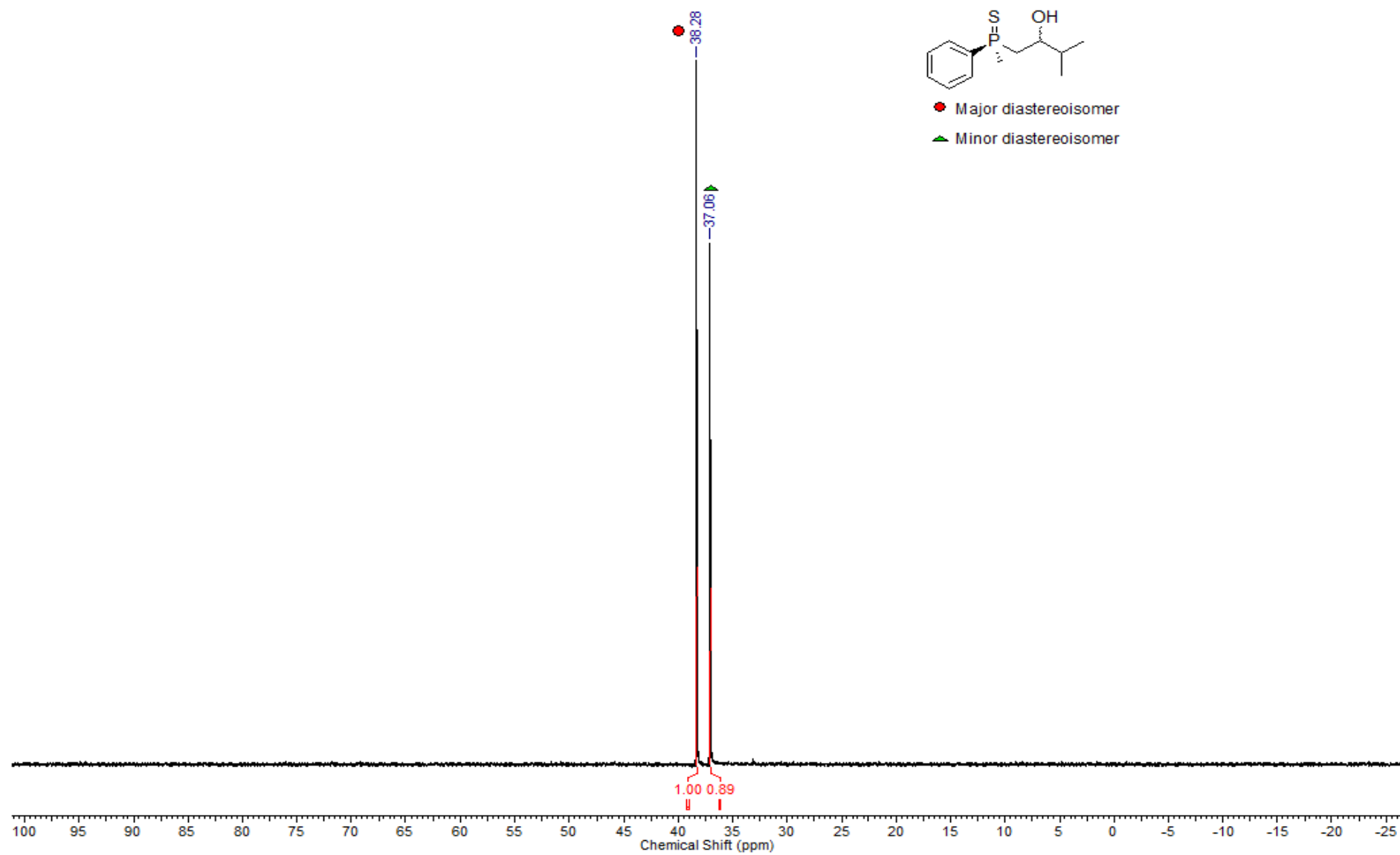
^{31}P NMR spectrum of (2-butyl-2-hydroxyhexyl)methylphenylphosphine sulfide (**25**) (CDCl_3 , 202 MHz).



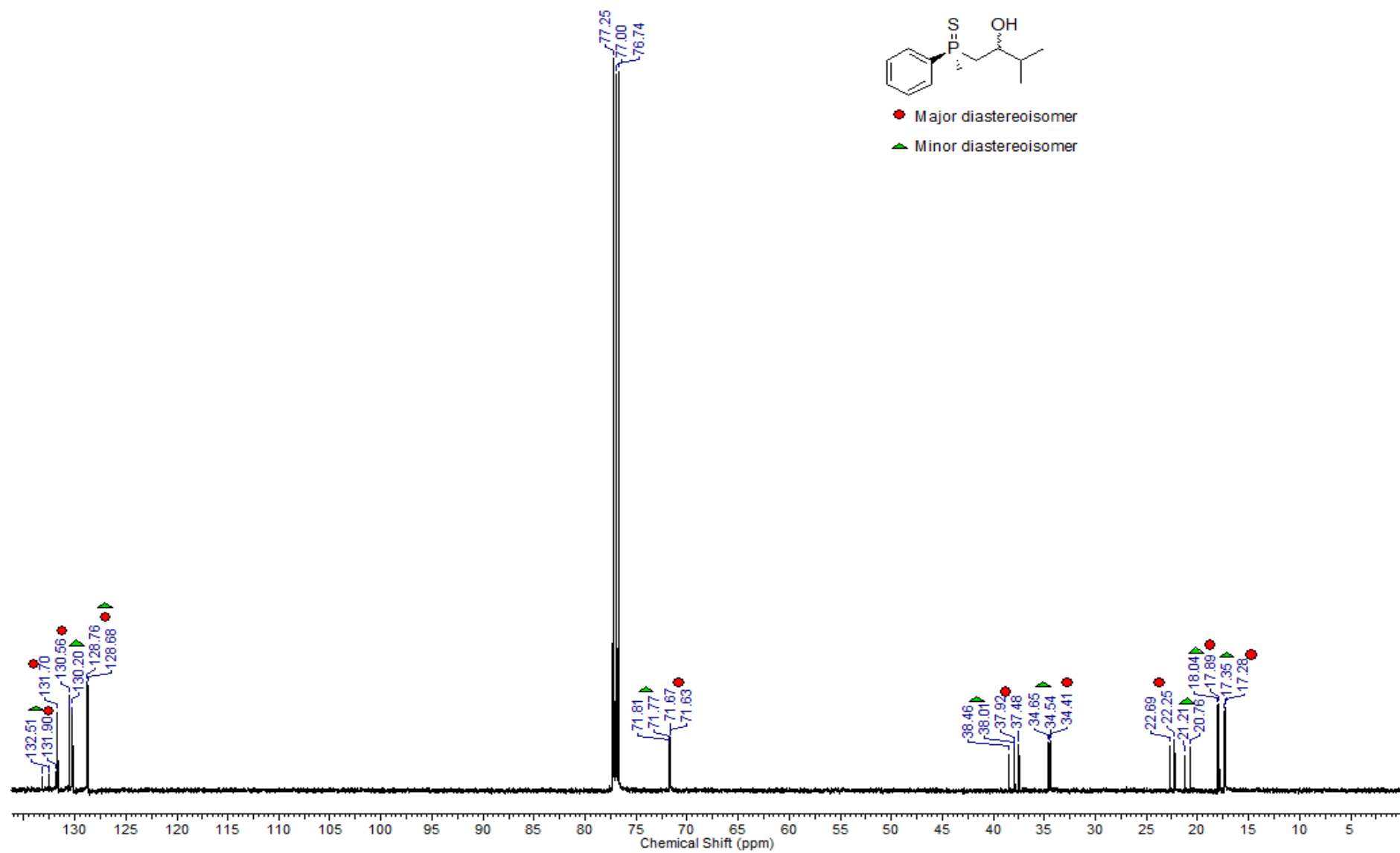
¹³C NMR spectrum of (2-butyl-2-hydroxyhexyl)methylphenylphosphine sulfide (25) (CDCl₃, 126 MHz).



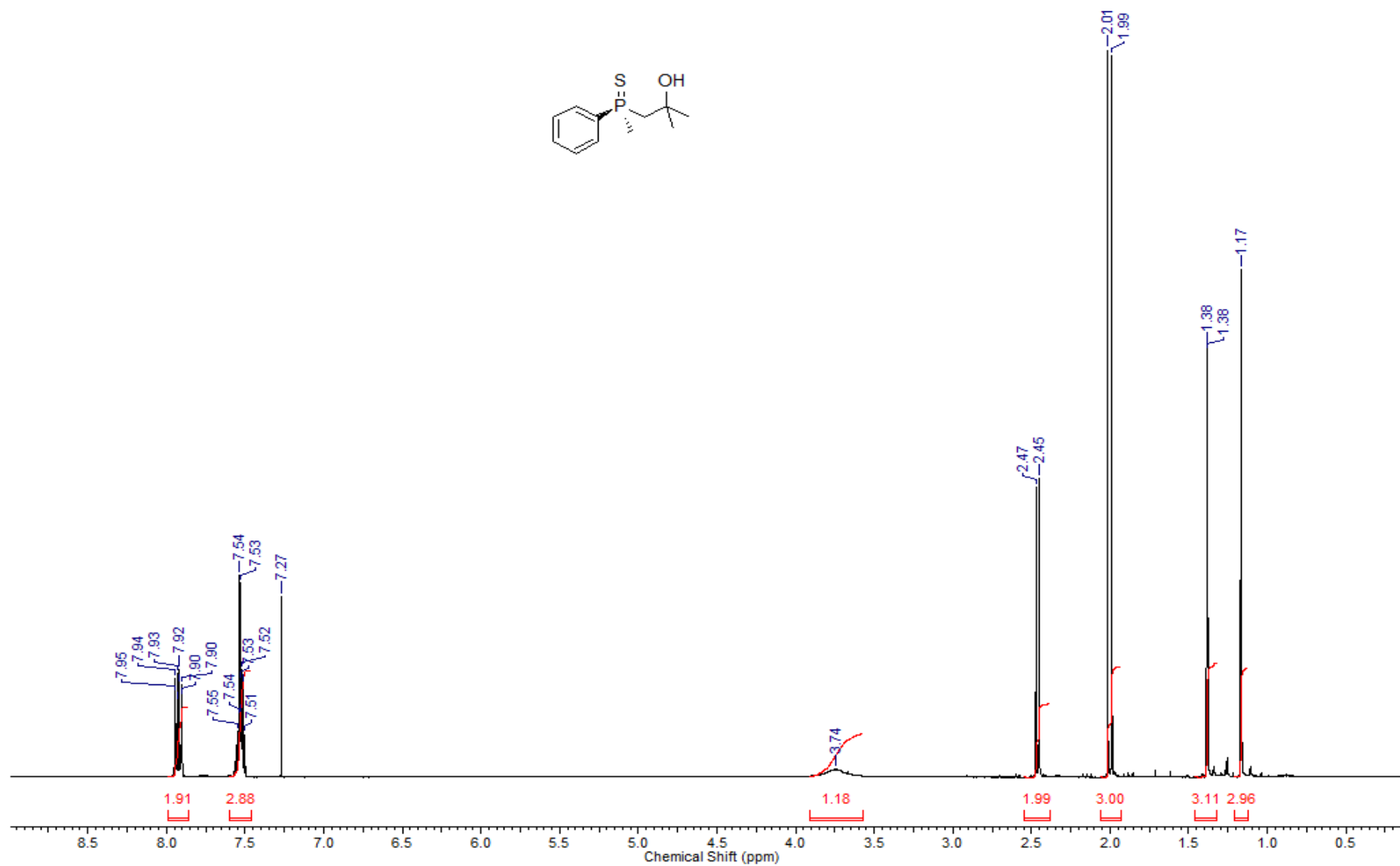
¹H NMR spectrum of (S_P)-(2-hydroxy-3-methylbutyl)methylphenylphosphine sulfide (S_P)-(8) (CDCl₃, 500 MHz).



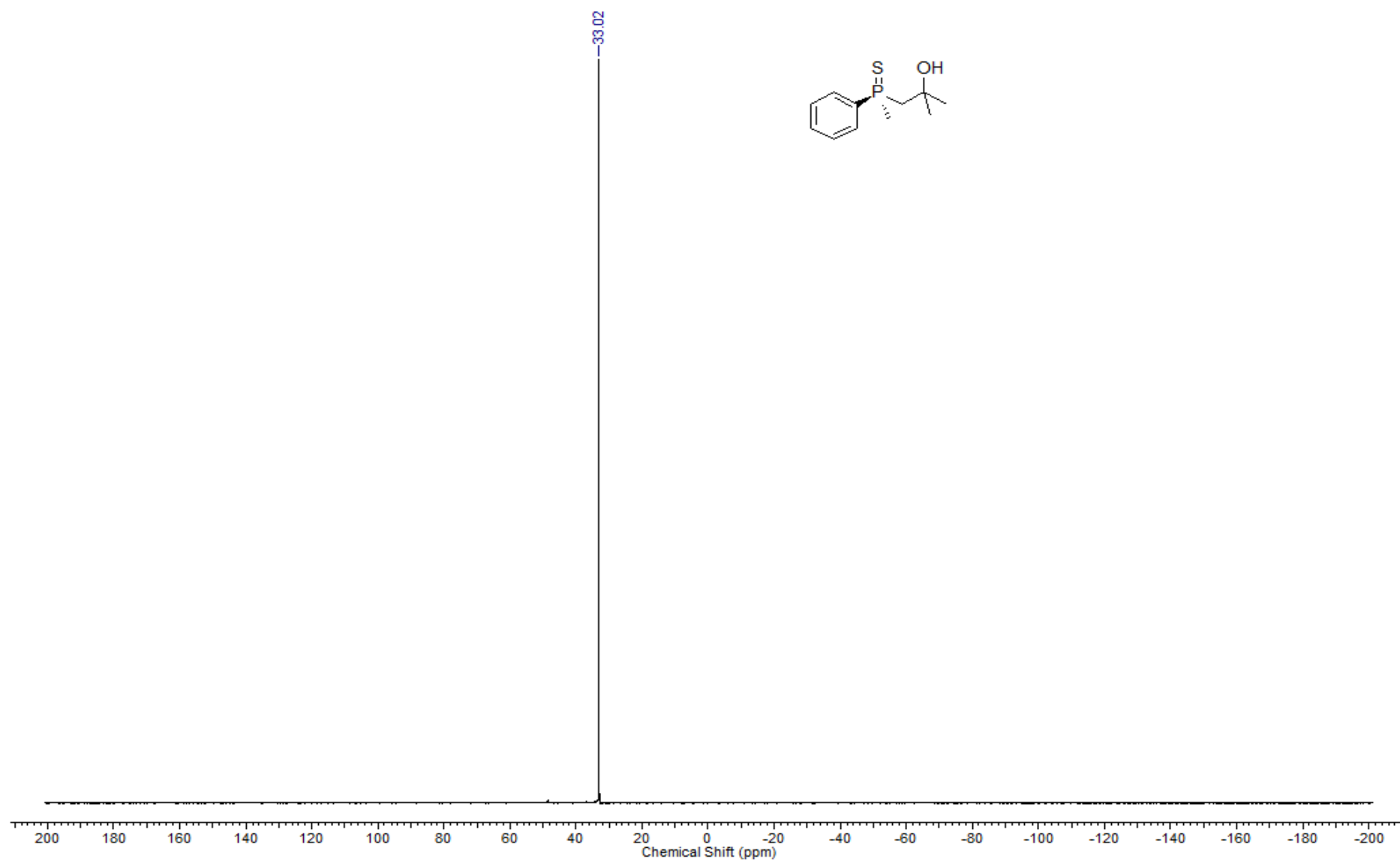
^{31}P NMR spectrum of (S_P) -(2-hydroxy-3-methylbutyl)methylphenylphosphine sulfide (S_P)-(8) (CDCl₃, 202 MHz).



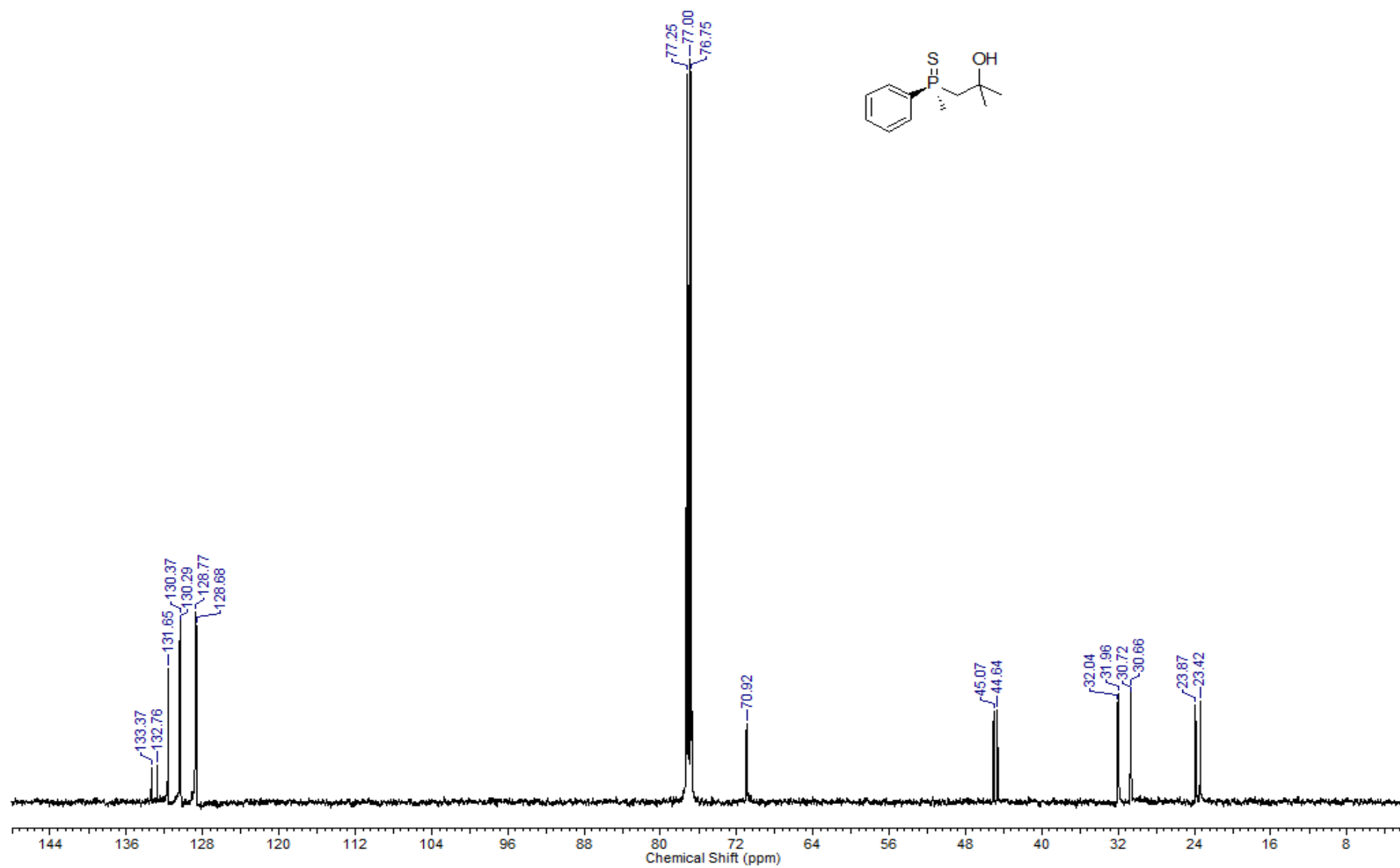
^{13}C NMR spectrum of *(S_P)-(2-hydroxy-3-methylbutyl)methylphenylphosphine sulfide* (*S_P)-(8)* (CDCl_3 , 126 MHz).



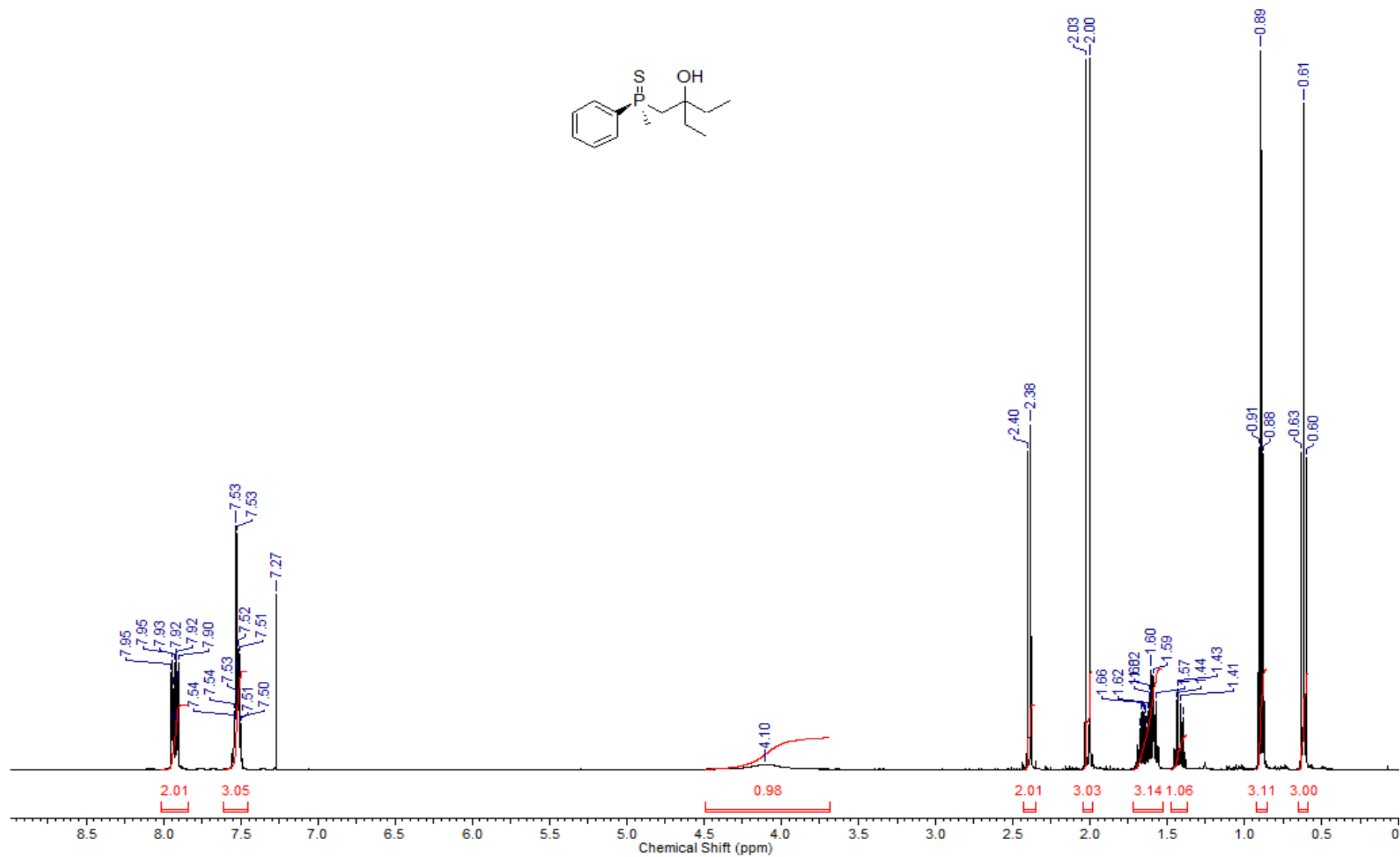
^1H NMR spectrum of (S_P) -(2-hydroxy-2-methylpropyl)methylphenylphosphine sulfide (S_P)-(19) (CDCl₃, 500 MHz).



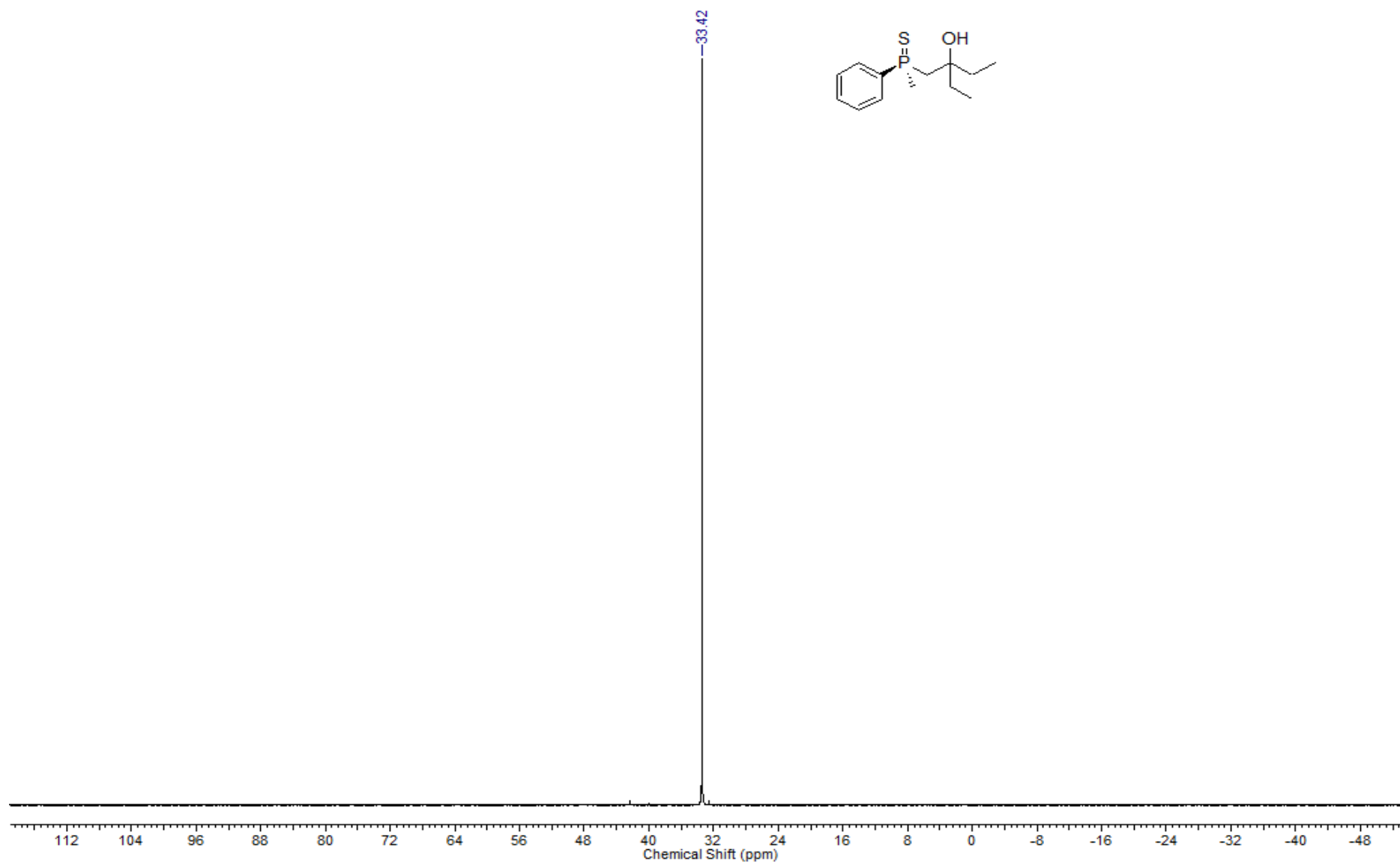
^{31}P NMR spectrum of (S_P)-(2-hydroxy-2-methylpropyl)methylphenylphosphine sulfide (S_P)-(19) (CDCl₃, 202 MHz).



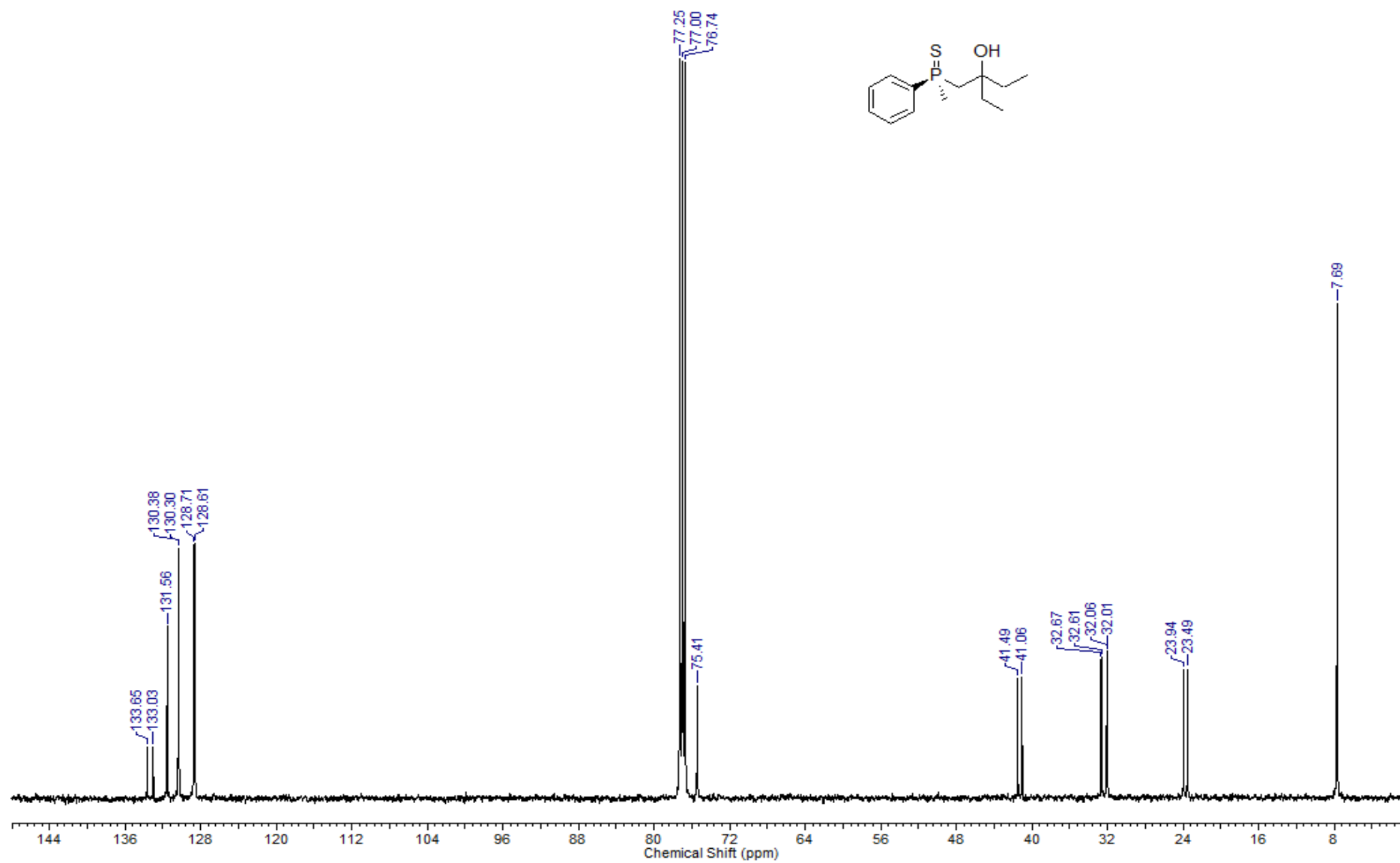
^{13}C NMR spectrum of (S_P) -(2-hydroxy-2-methylpropyl)methylphenylphosphine sulfide (S_P)-(19) (CDCl_3 , 126 MHz).



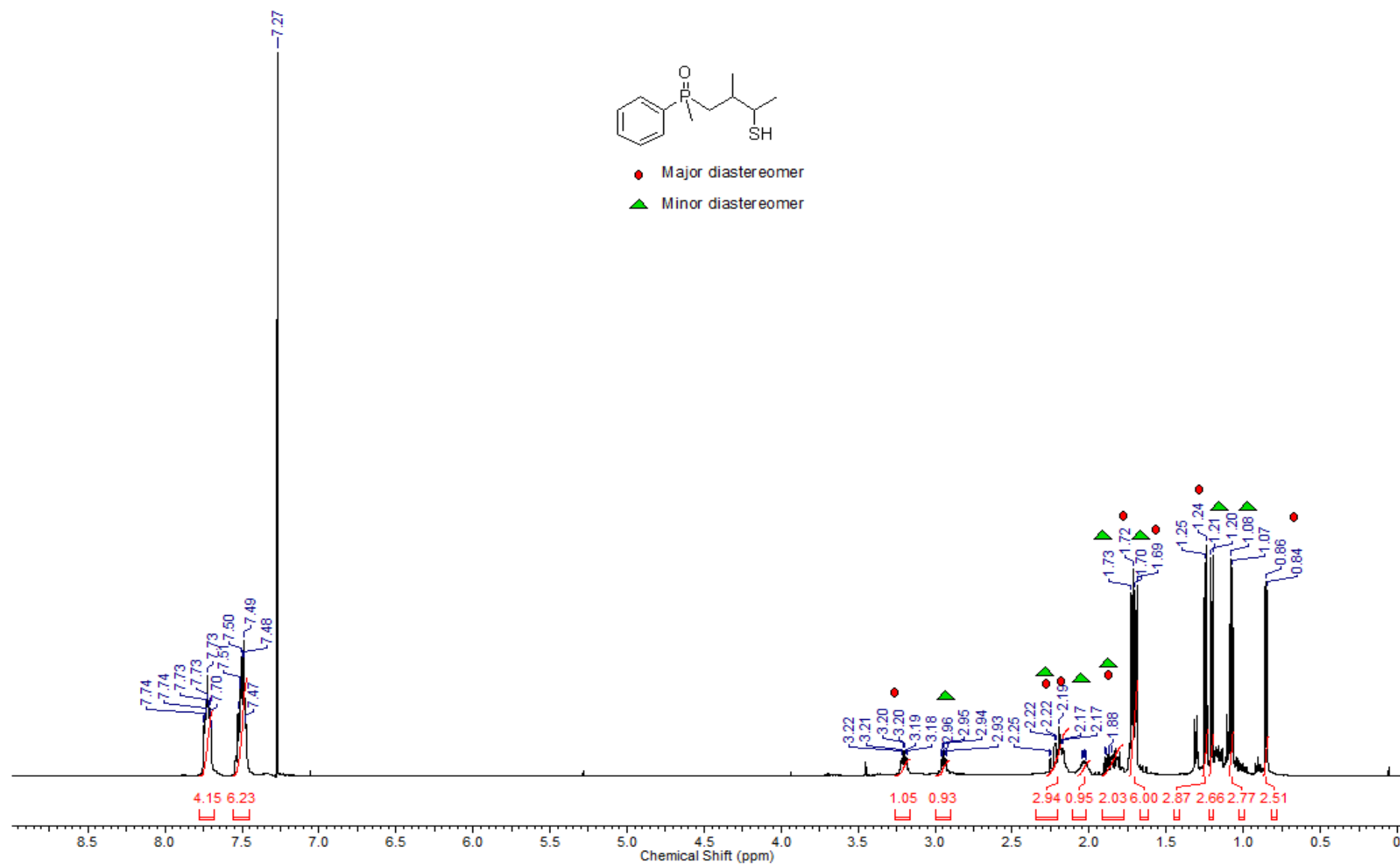
^1H NMR spectrum of (S_P) -(2-ethyl-2-hydroxybutyl)methylphenylphosphine sulfide (S_P)-(20) (CDCl₃, 500 MHz).



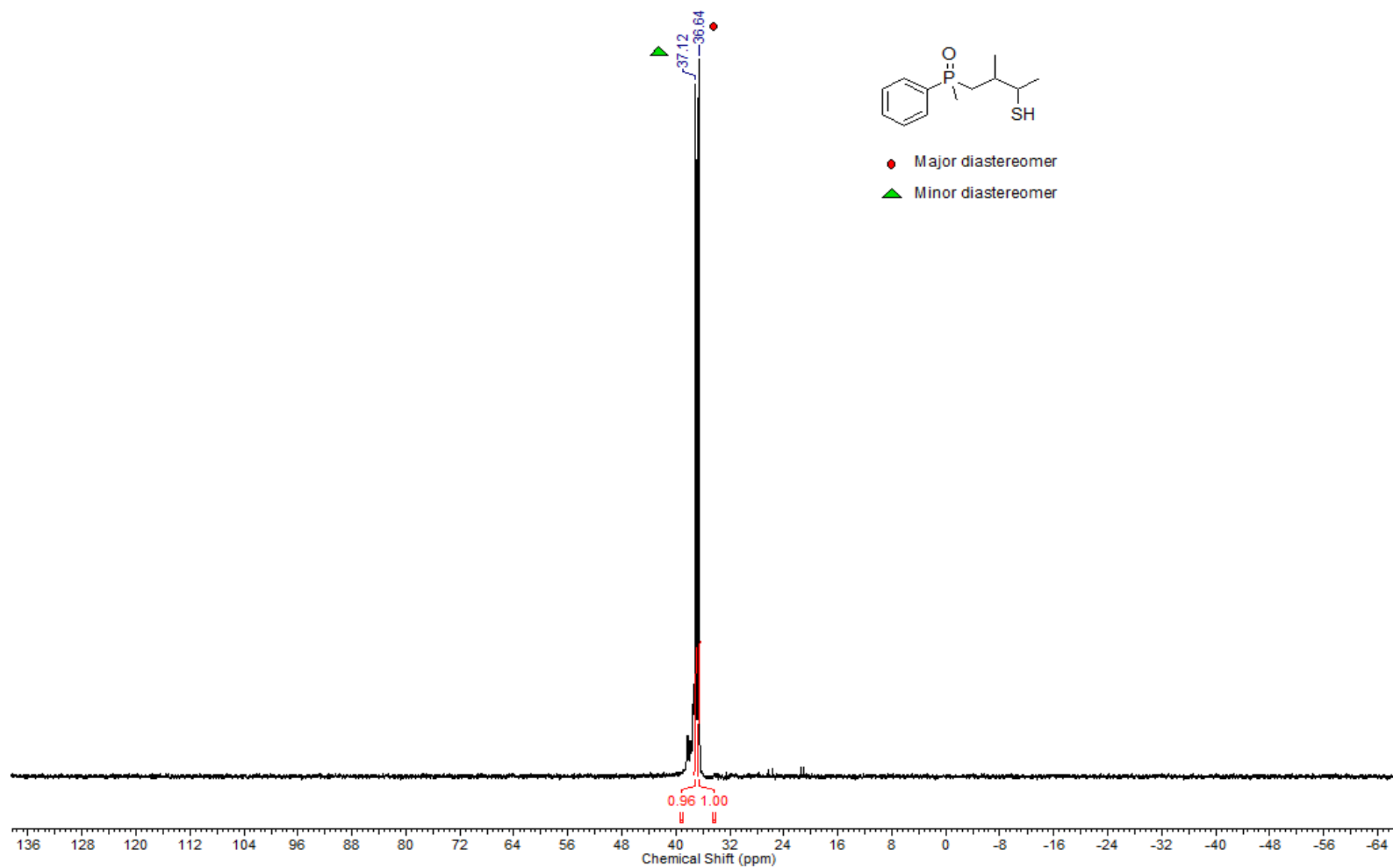
^{31}P NMR spectrum of (S_P)-(2-ethyl-2-hydroxybutyl)methylphenylphosphine sulfide (S_P)-(20) (CDCl₃, 202 MHz).



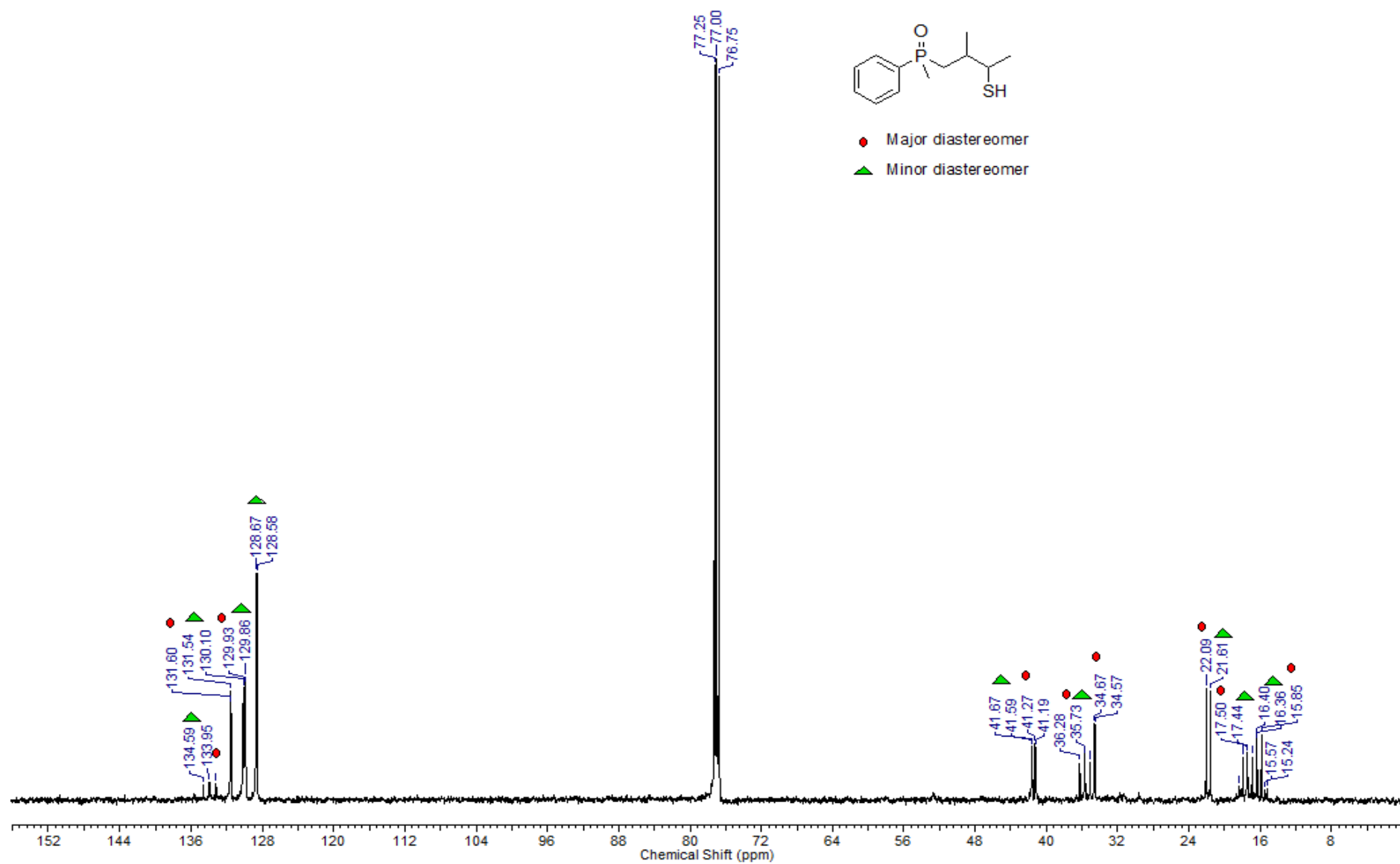
^{13}C NMR spectrum of (S_P) -(2-ethyl-2-hydroxybutyl)methylphenylphosphine sulfide (S_P)-(20) (CDCl₃, 126 MHz).



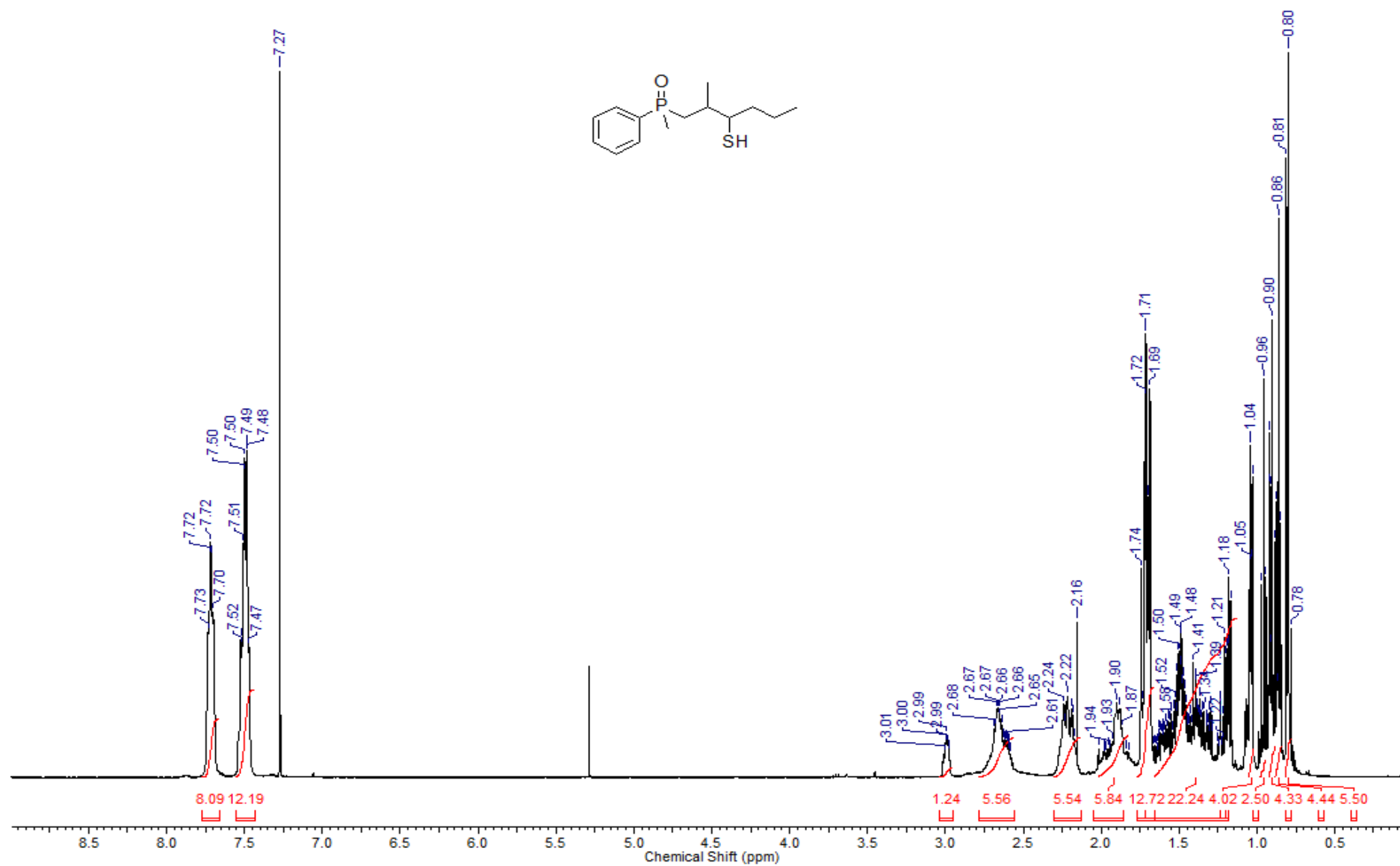
^1H NMR spectrum of (2-methyl-3-mercaptobutyl)methylphenylphosphine oxide (**29**) (CDCl_3 , 500 MHz).



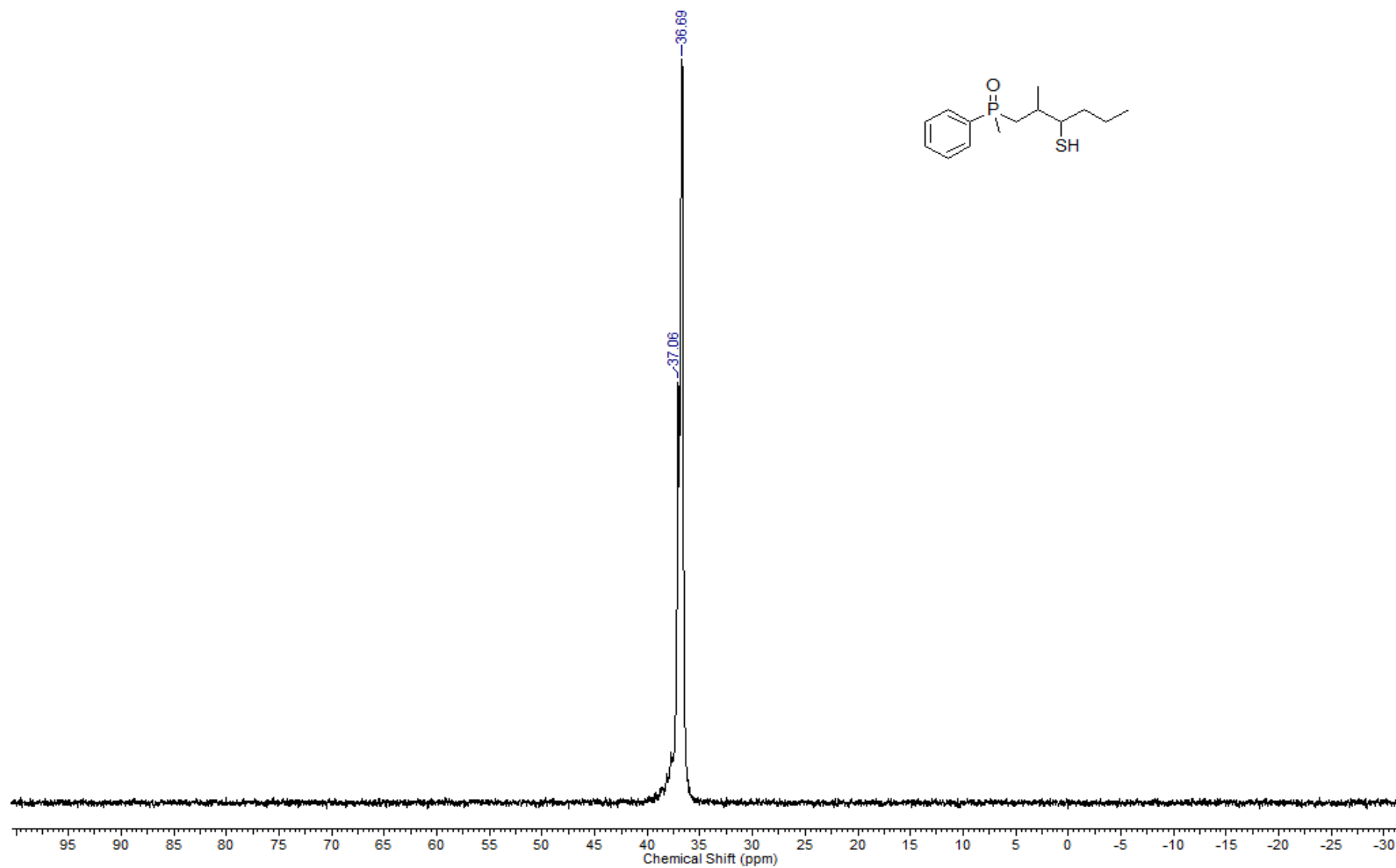
^{31}P NMR spectrum of (2-methyl-3-mercaptopbutyl)methylphenylphosphine oxide (**29**) (CDCl_3 , 202 MHz).



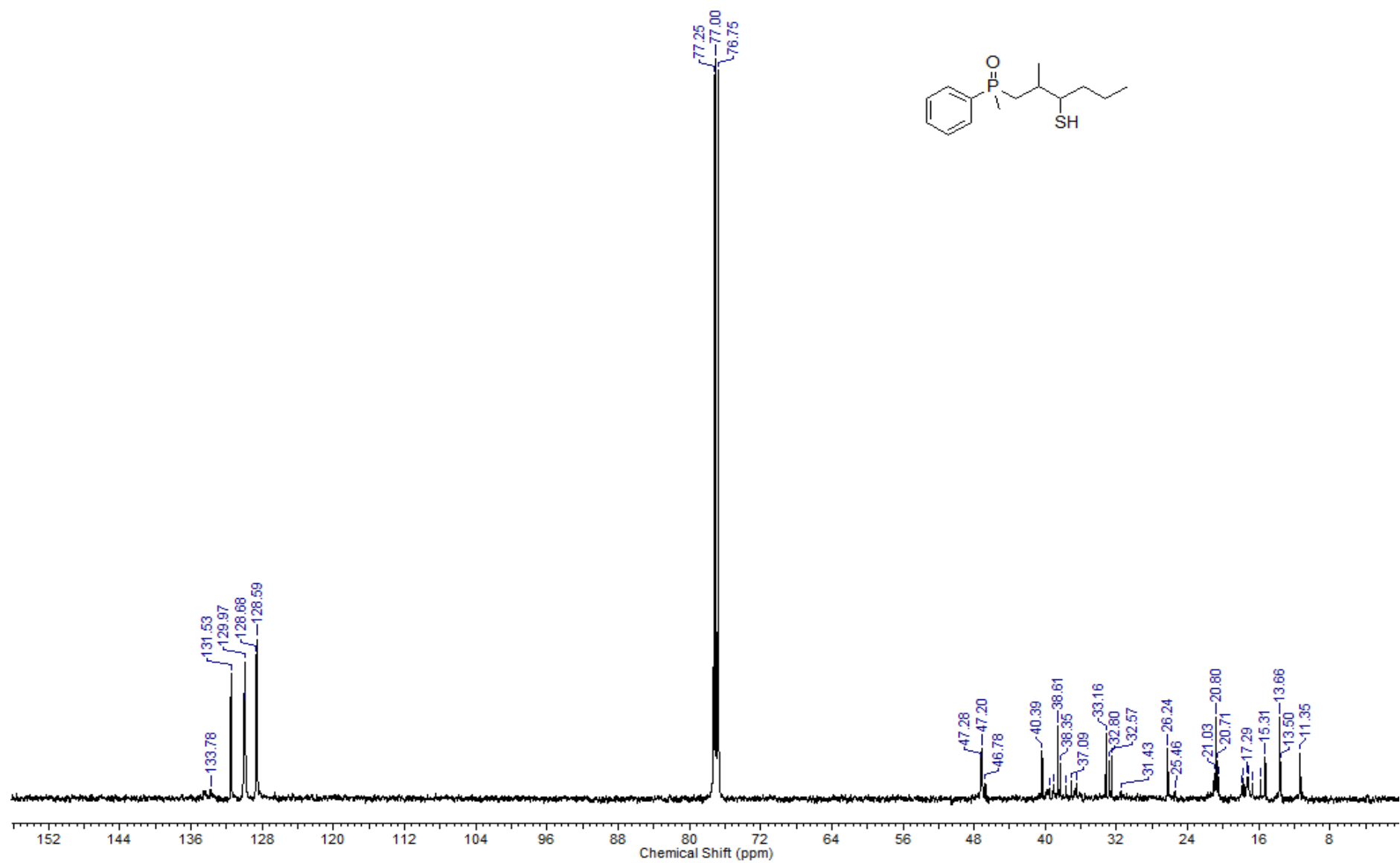
¹³C NMR spectrum of (2-methyl-3-mercaptopbutyl)methylphenylphosphine oxide (**29**) (CDCl₃, 126 MHz).



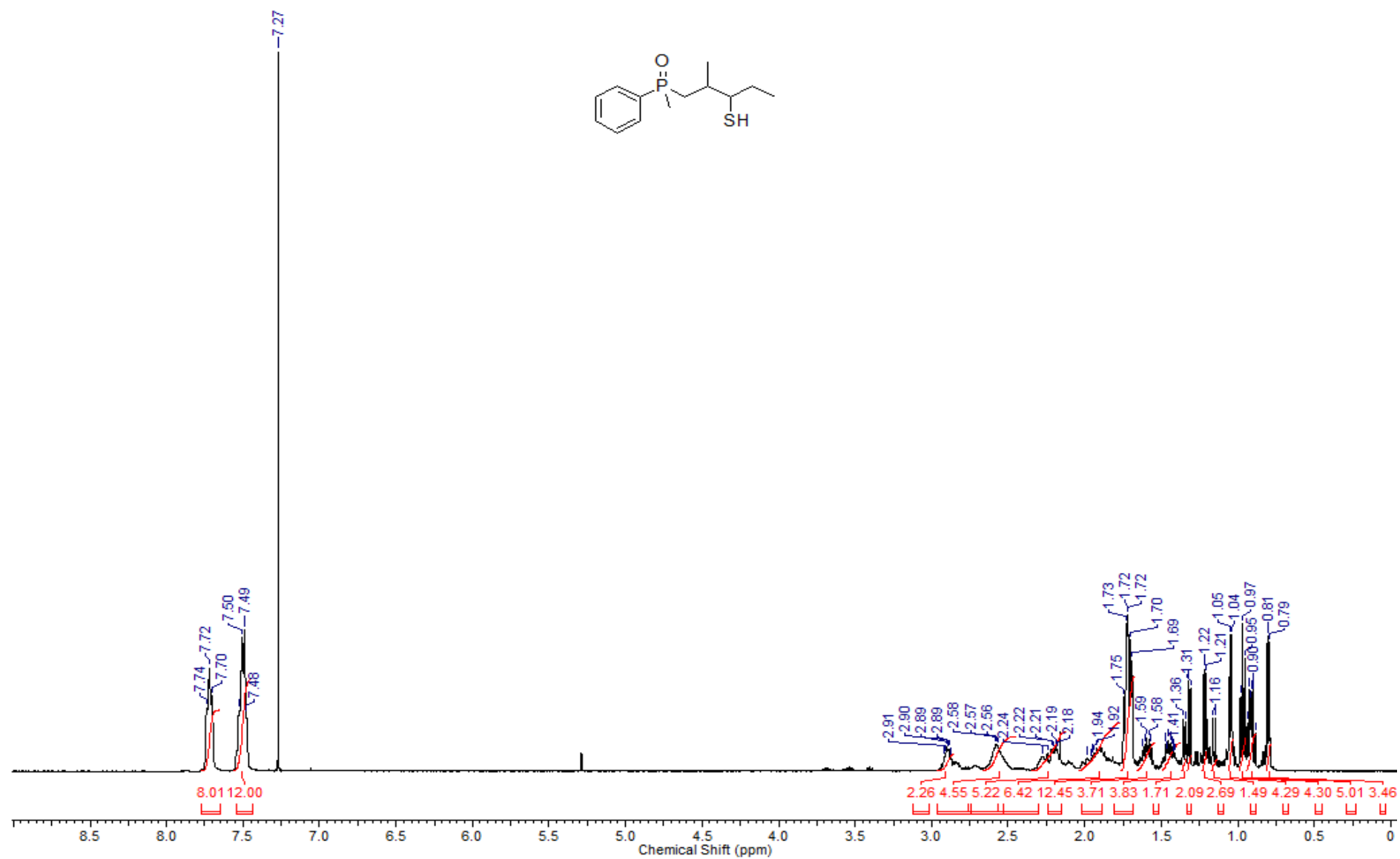
¹H NMR spectrum of (2-methyl-3-mercaptohexyl)methylphenylphosphine oxide (**30**) (CDCl₃, 500 MHz).



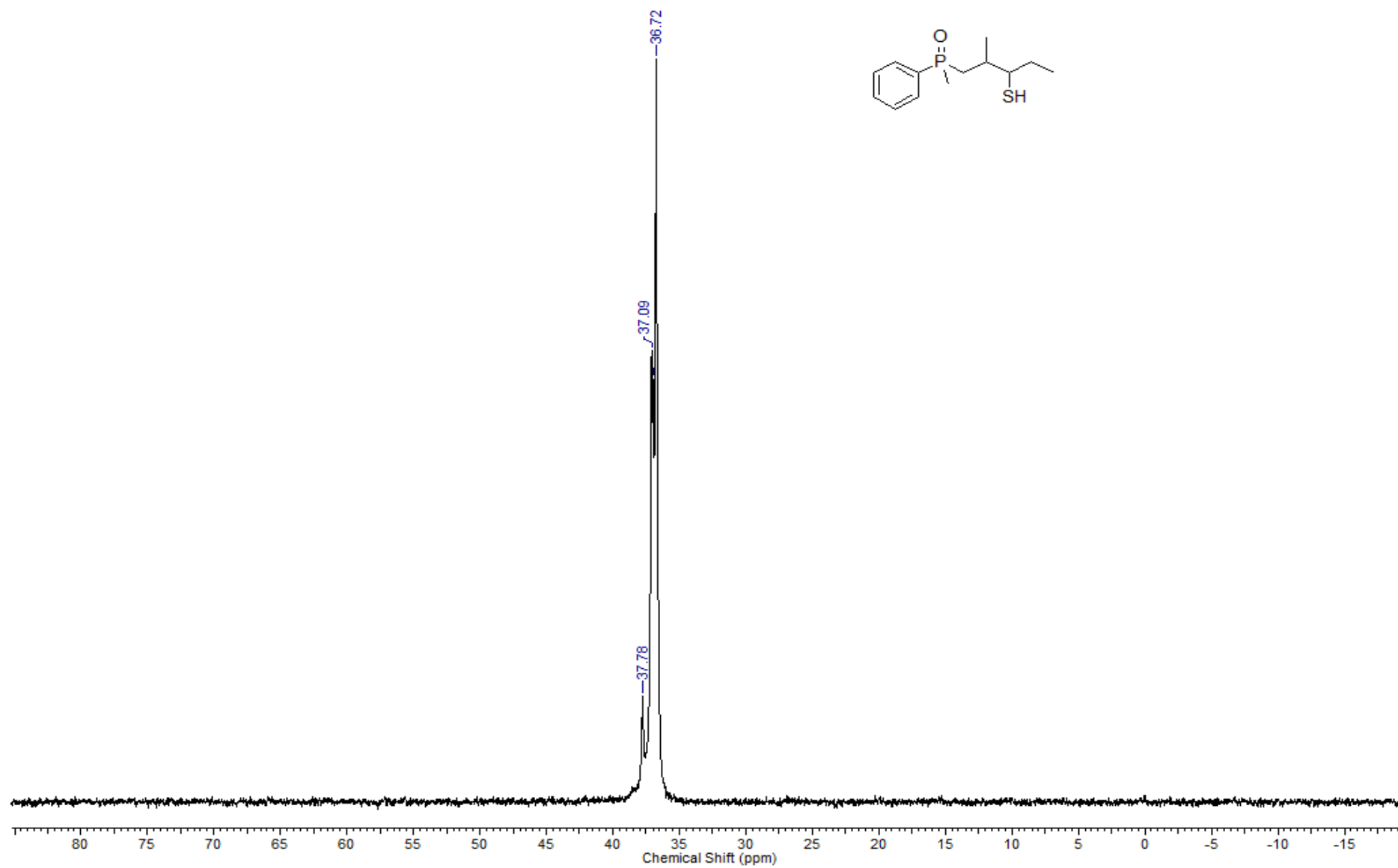
^{31}P NMR spectrum of (2-methyl-3-mercaptohexyl)methylphenylphosphine oxide (**30**) (CDCl_3 , 202 MHz).



¹³C NMR spectrum of (2-methyl-3-hexyl)methylphenylphosphine oxide (**30**) (CDCl₃, 126 MHz).



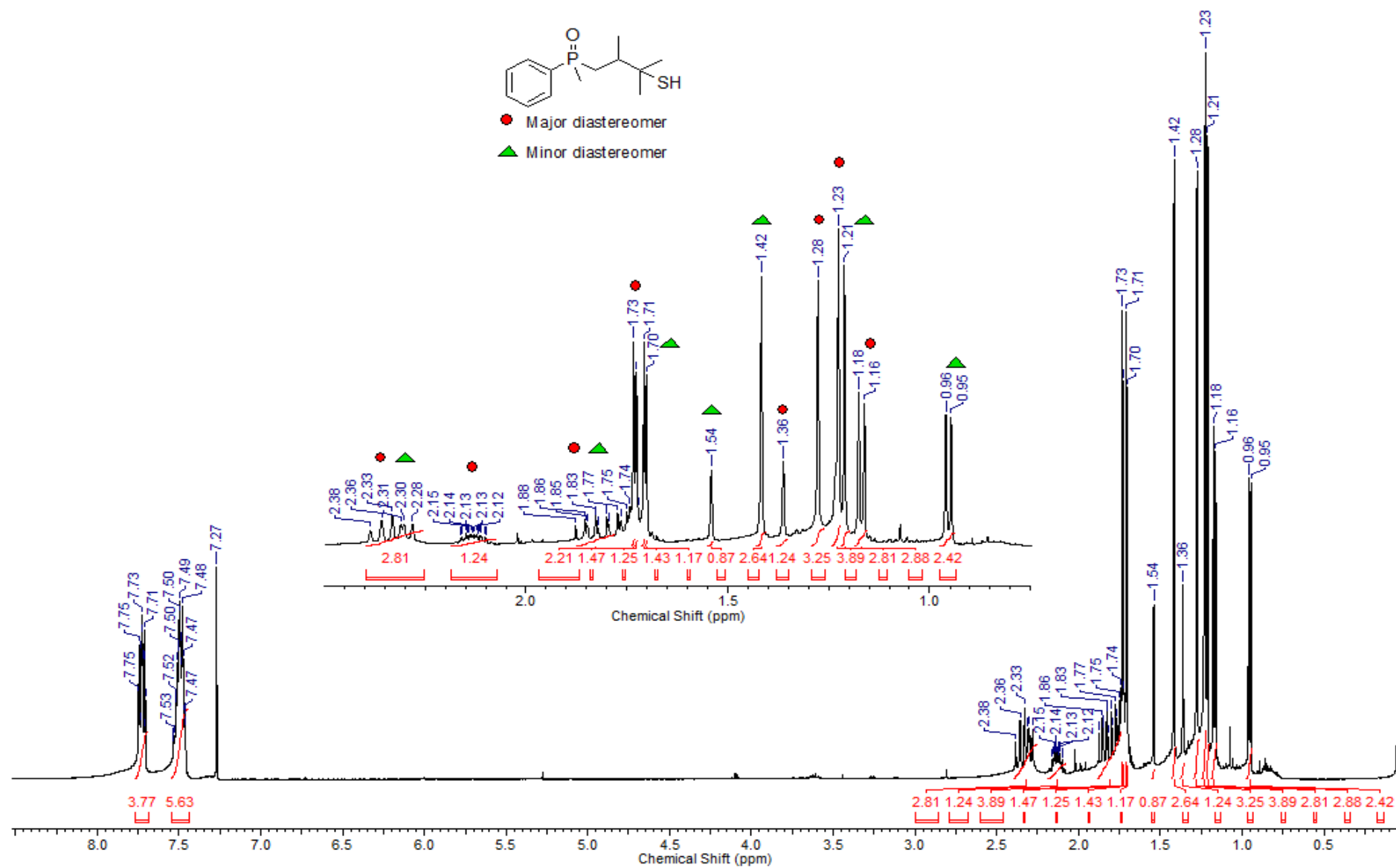
¹H NMR spectrum of (2-methyl-3-mercaptopentyl)methylphenylphosphine oxide (**31**) (CDCl₃, 500 MHz).



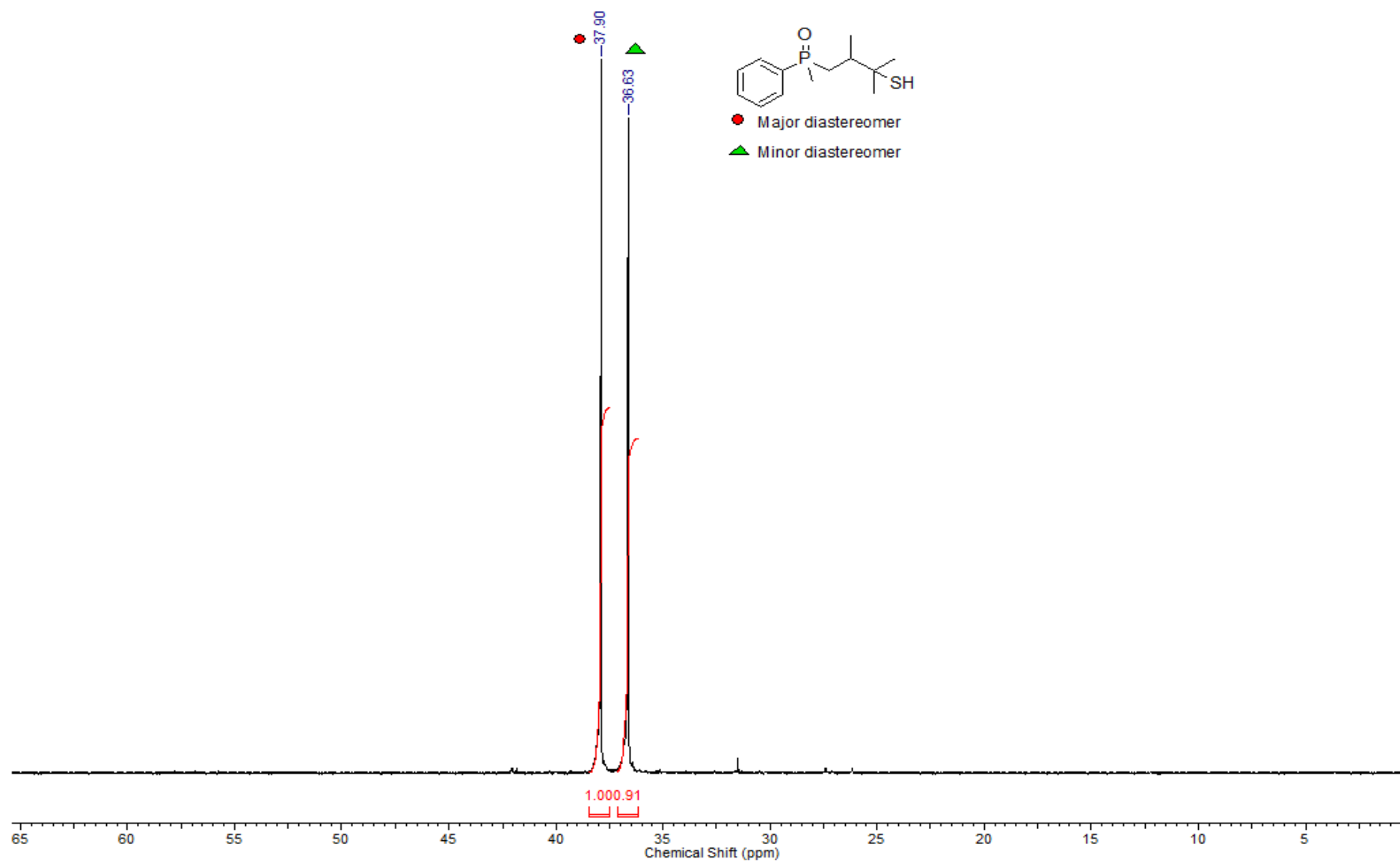
^{31}P NMR spectrum of (2-methyl-3-mercaptopentyl)methylphenylphosphine oxide (**31**) (CDCl_3 , 202 MHz).



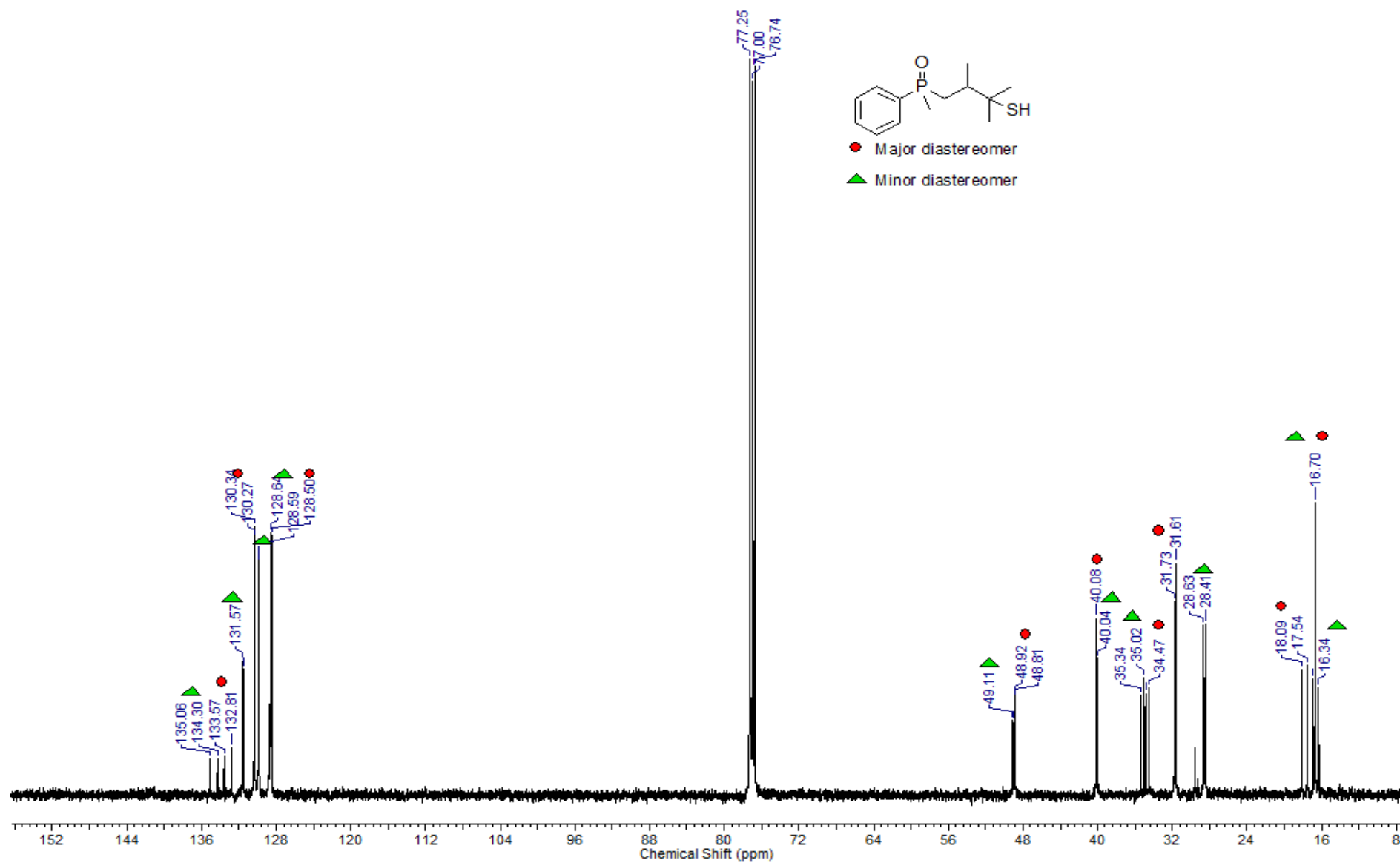
¹³C NMR spectrum of (2-methyl-3-mercaptopentyl)methylphenylphosphine oxide (**31**) (CDCl₃, 126 MHz).



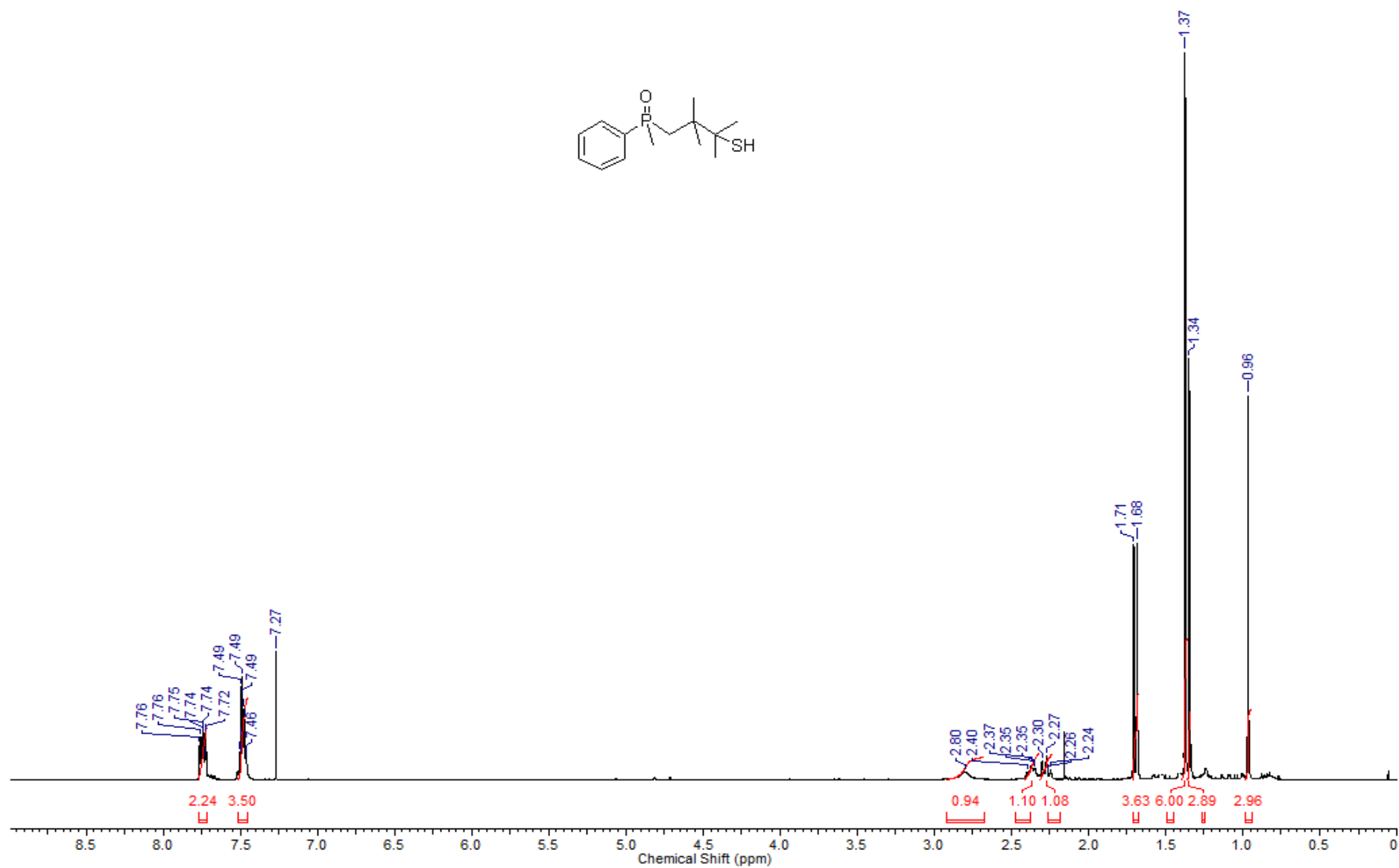
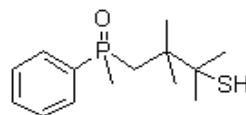
^1H NMR spectrum of (2,3-dimethyl-3-mercaptobutyl)methylphenylphosphine oxide (**32**) (CDCl_3 , 500 MHz).



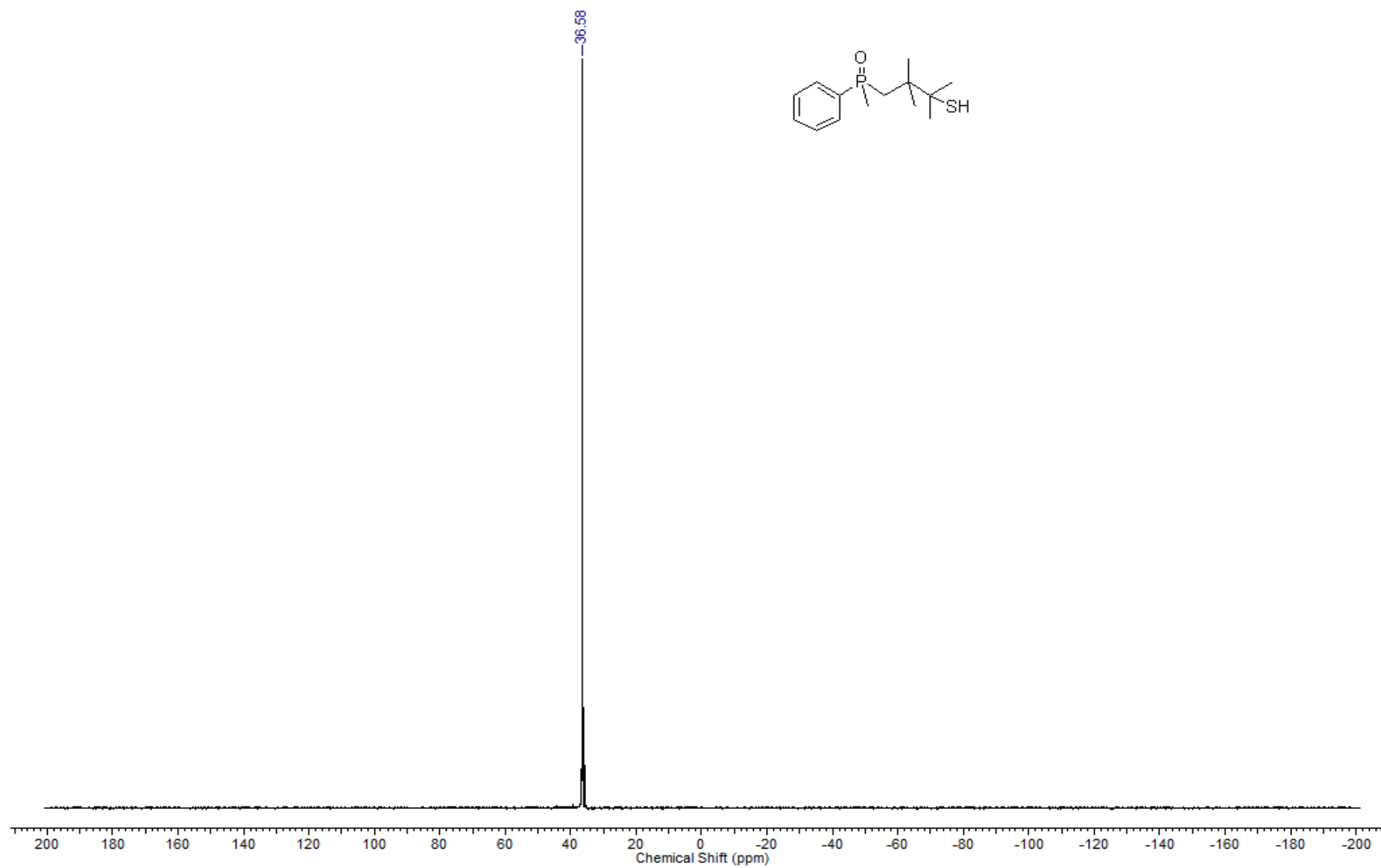
^{31}P NMR spectrum of (2,3-dimethyl-3-mercaptopbutyl)methylphenylphosphine oxide (**32**) (CDCl_3 , 202 MHz).



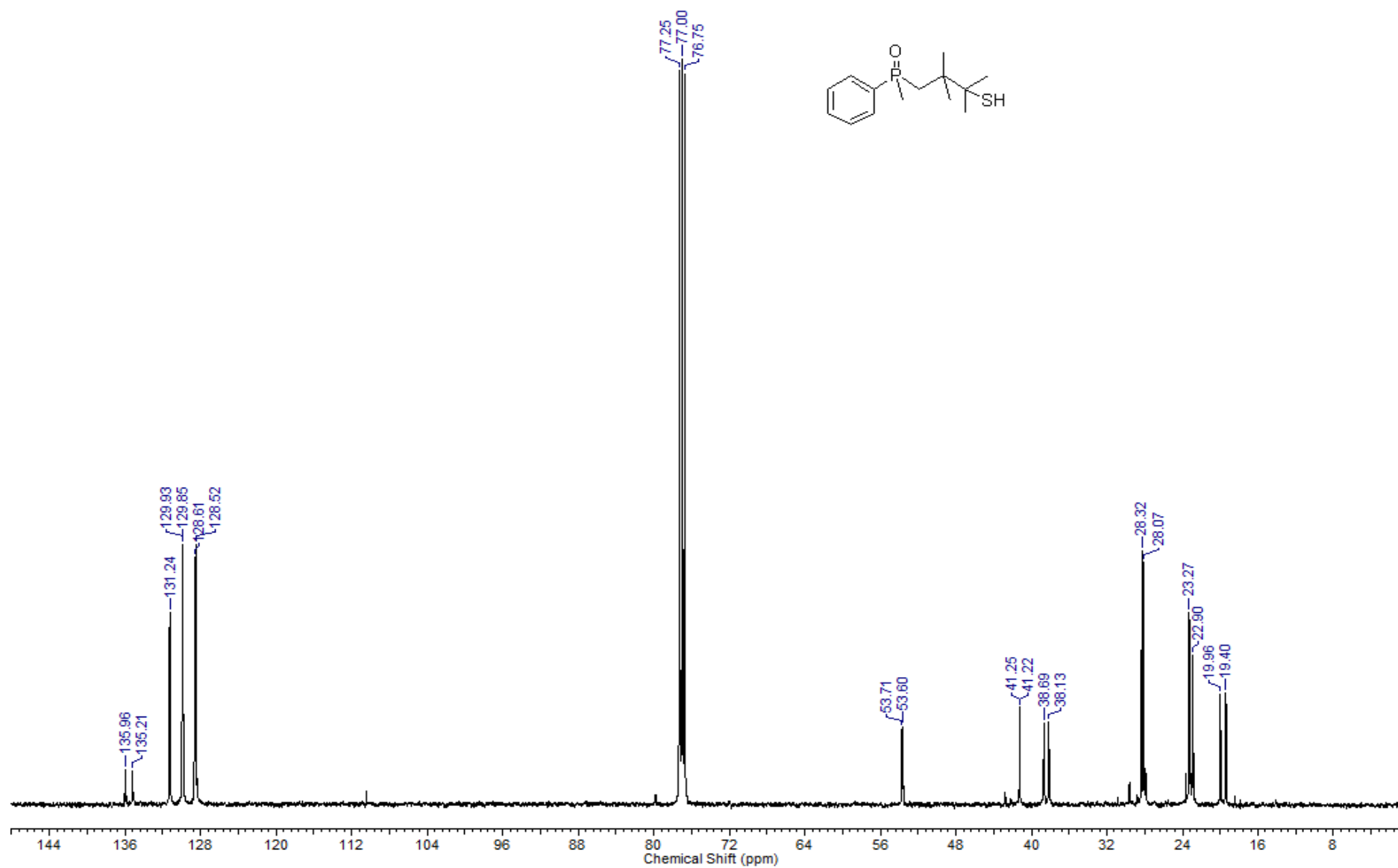
¹³C NMR spectrum of (2,3-dimethyl-3-mercaptobutyl)methylphenylphosphine oxide (32) (CDCl₃, 126 MHz).



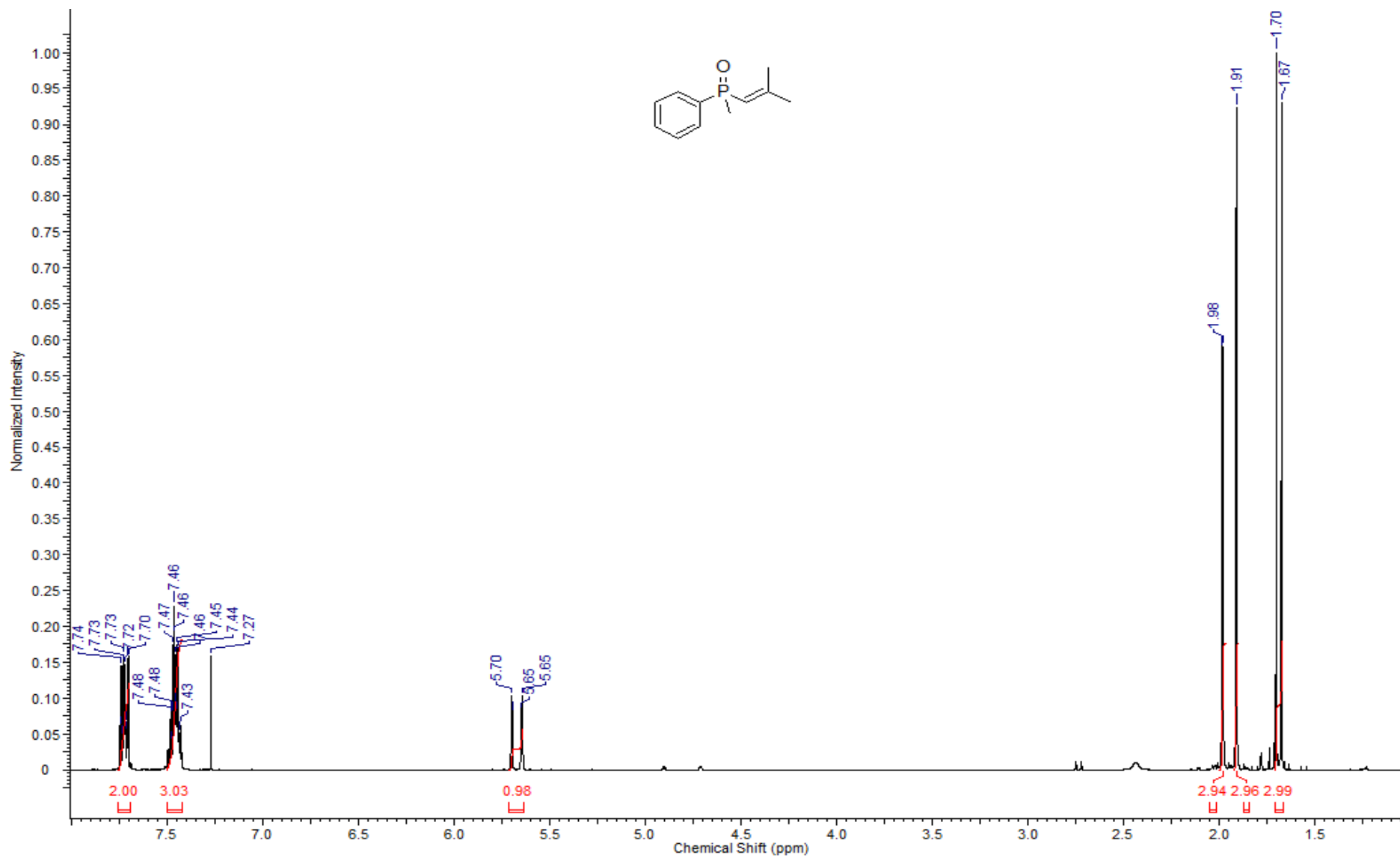
^1H NMR spectrum of (2,2-dimethyl-3-mercaptobutyl)methylphenylphosphine oxide (**33**) (CDCl_3 , 500 MHz).



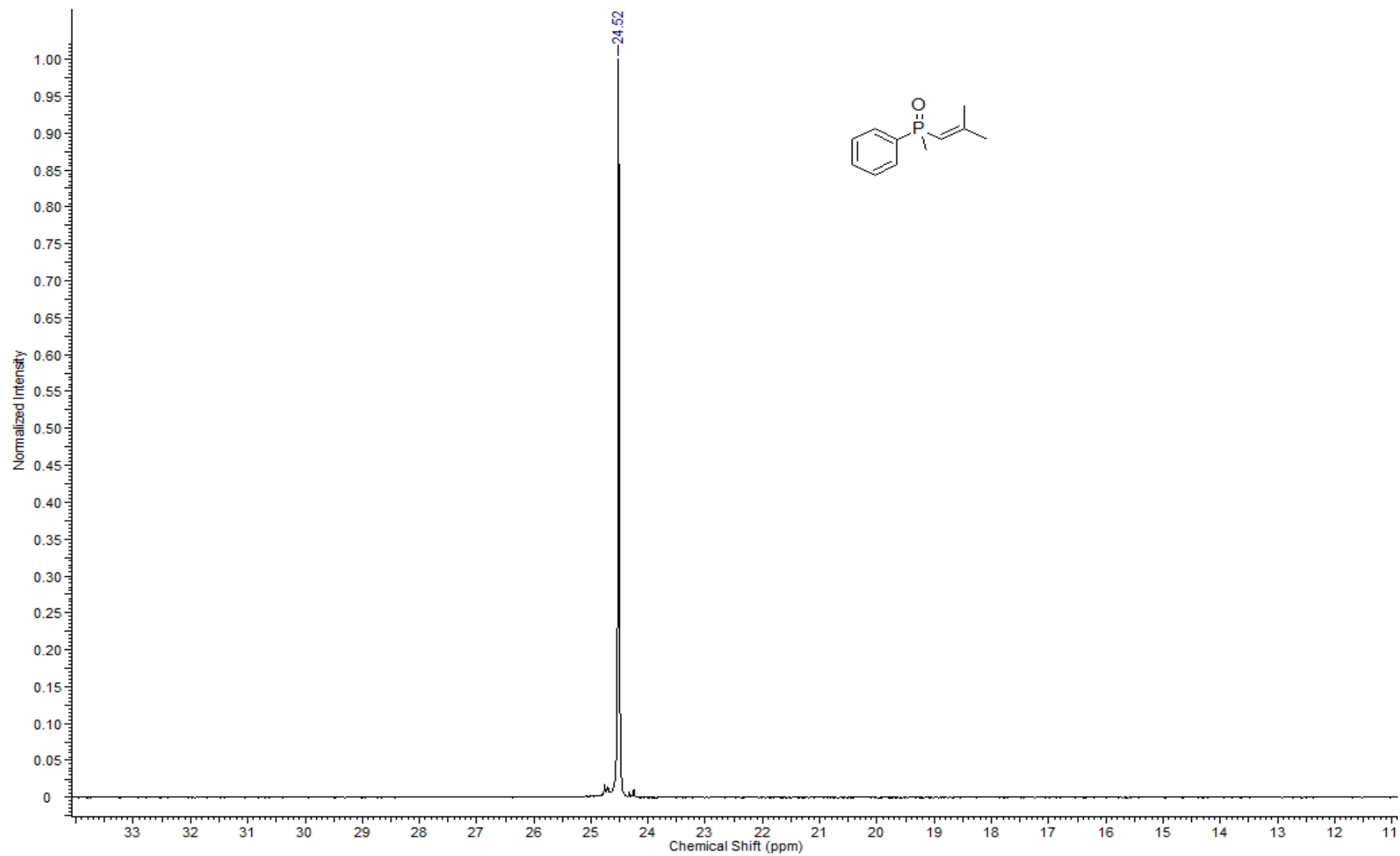
^{31}P NMR spectrum of (2,2-dimethyl-3-mercaptopbutyl)methylphenylphosphine oxide (**33**) (CDCl_3 , 202 MHz).



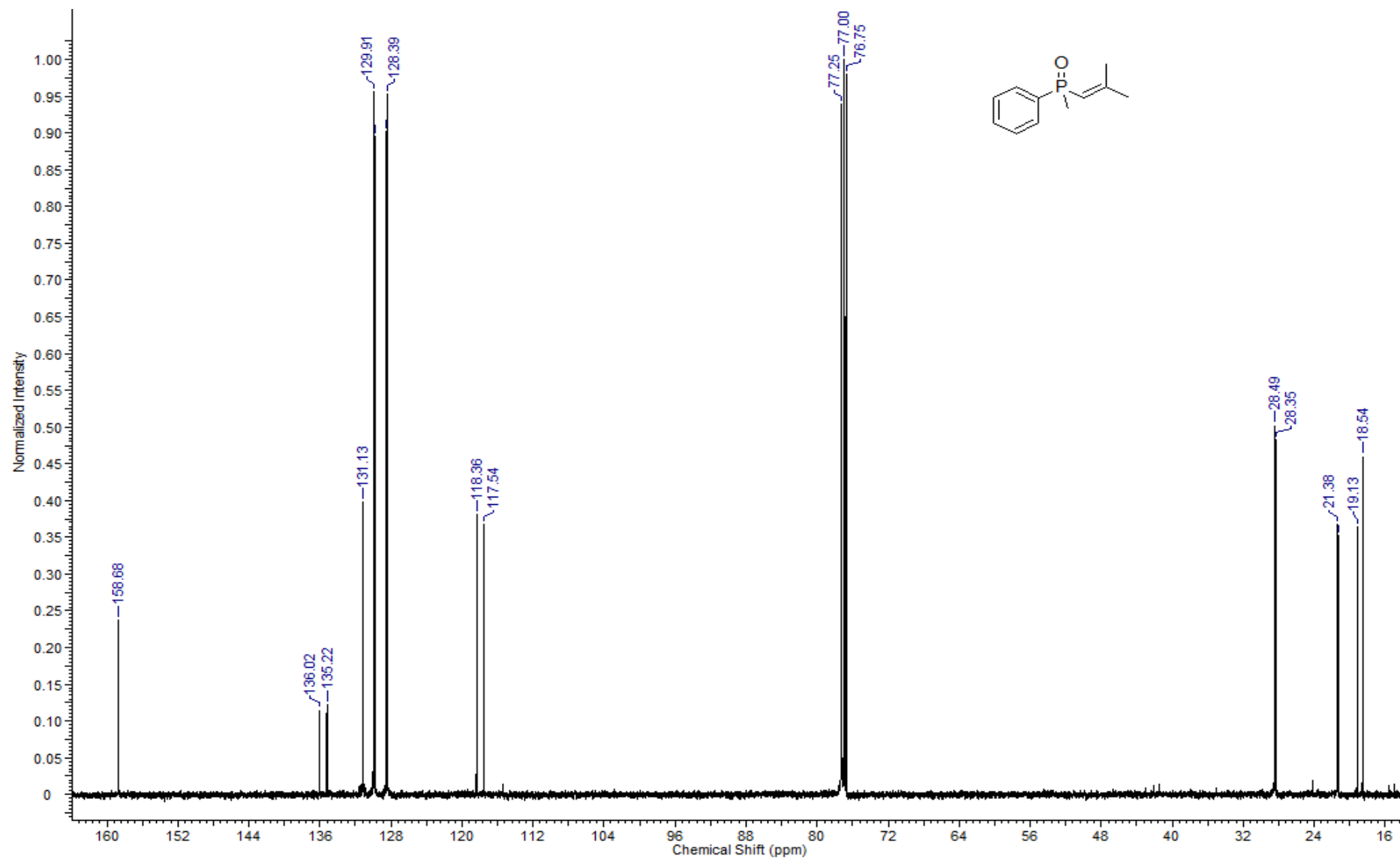
¹³C NMR spectrum of (2,2-dimethyl-3-mercaptobutyl)methylphenylphosphine oxide (**33**) (CDCl₃, 126 MHz).



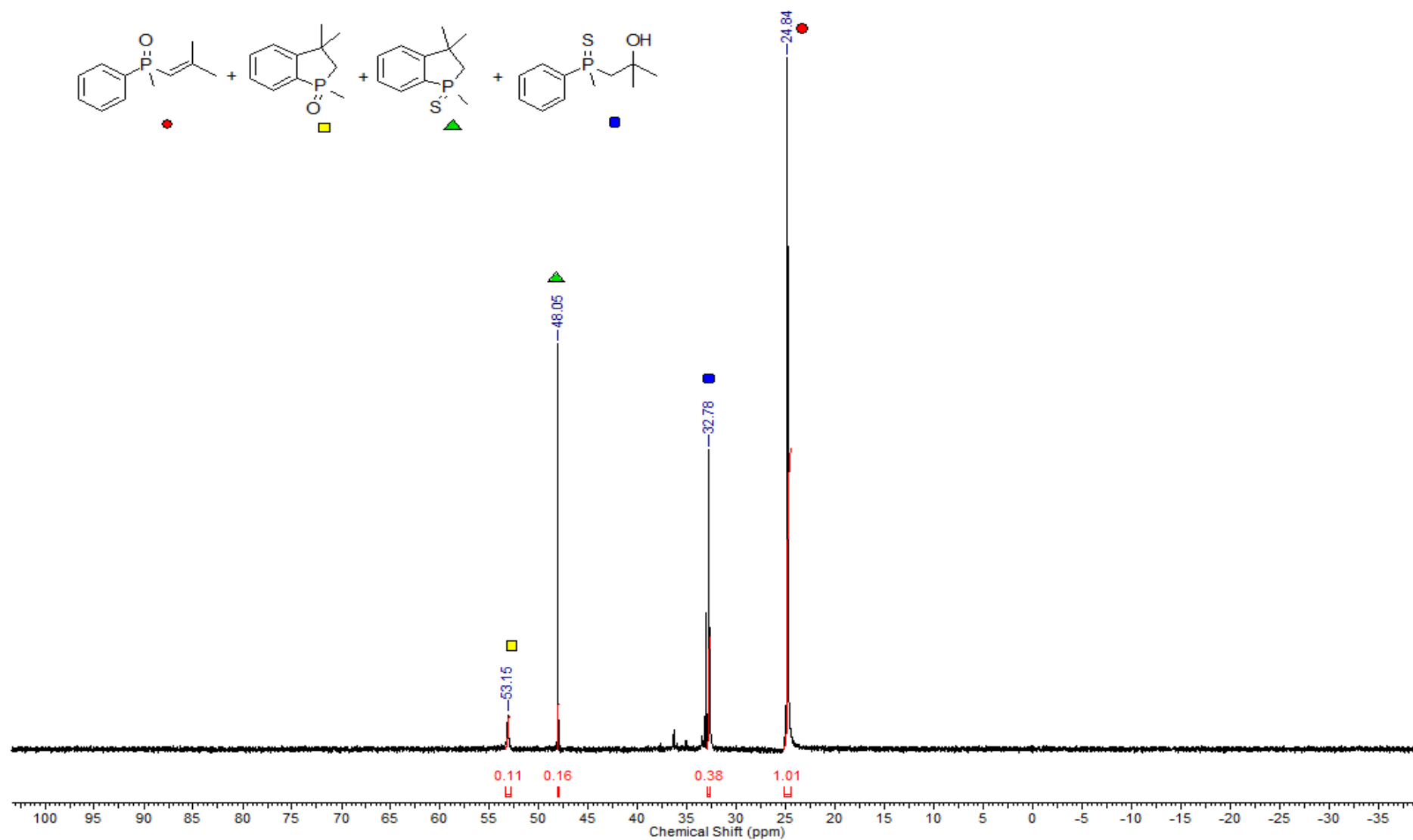
¹H NMR spectrum of (2-methylprop-1-enyl)(methylphenyl)phosphine oxide (**34**) (CDCl₃, 500 MHz).



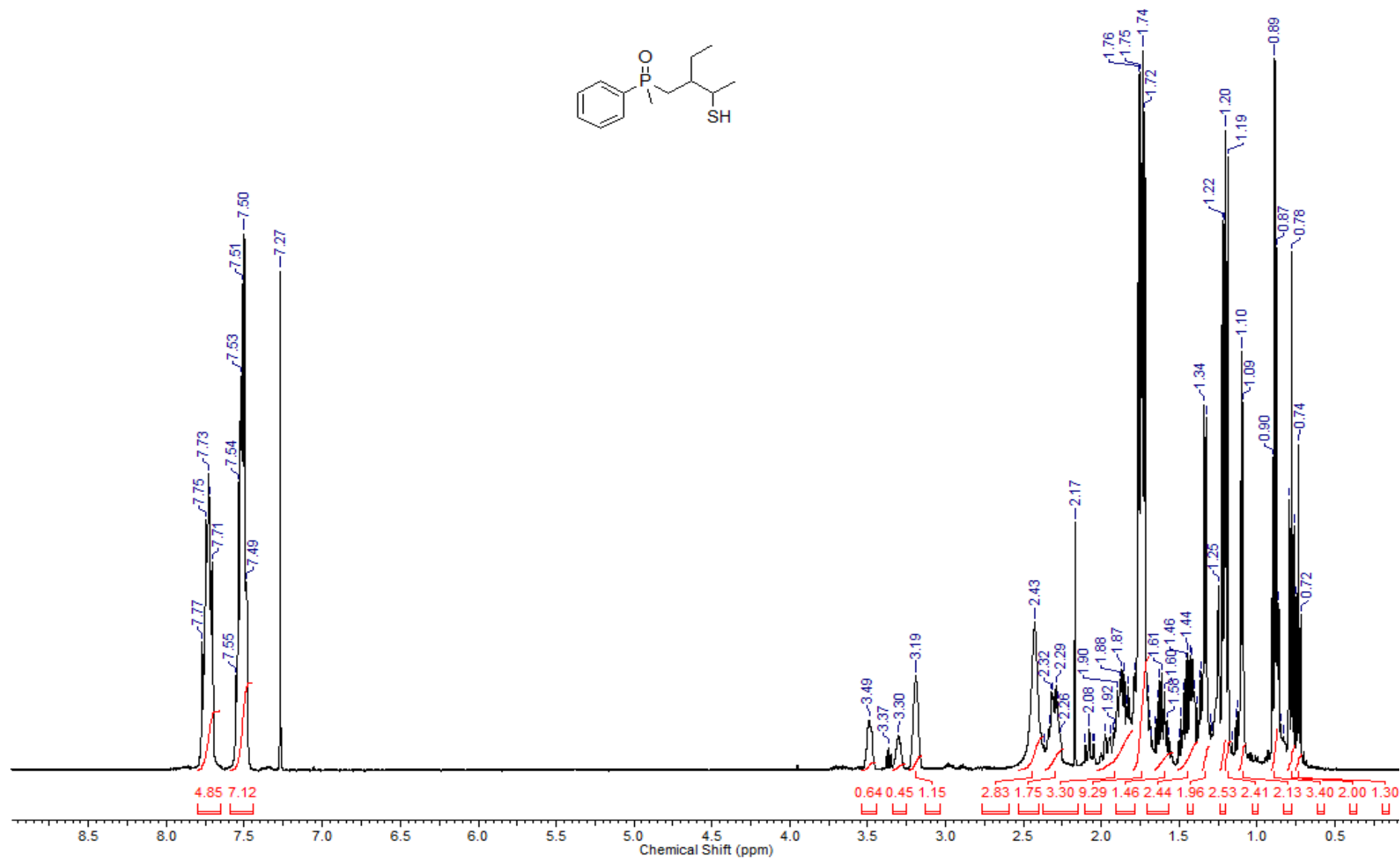
^{31}P NMR spectrum of (2-methylprop-1-enyl)(methylphenyl)phosphine oxide (**34**) (CDCl_3 , 202 MHz).



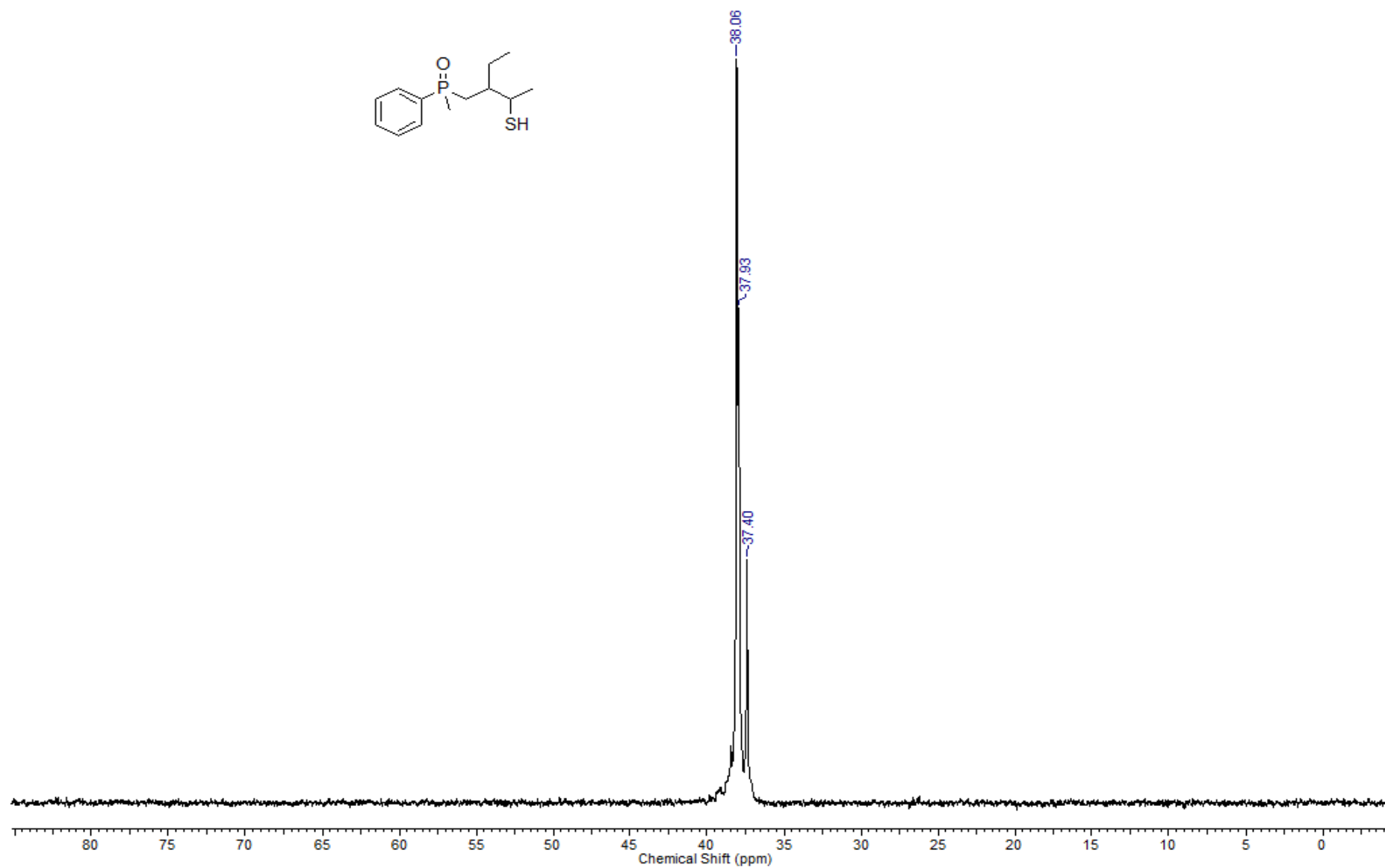
¹³C NMR spectrum of (2-methylprop-1-enyl)(methylphenyl)phosphine oxide (**34**) (CDCl₃, 126 MHz).



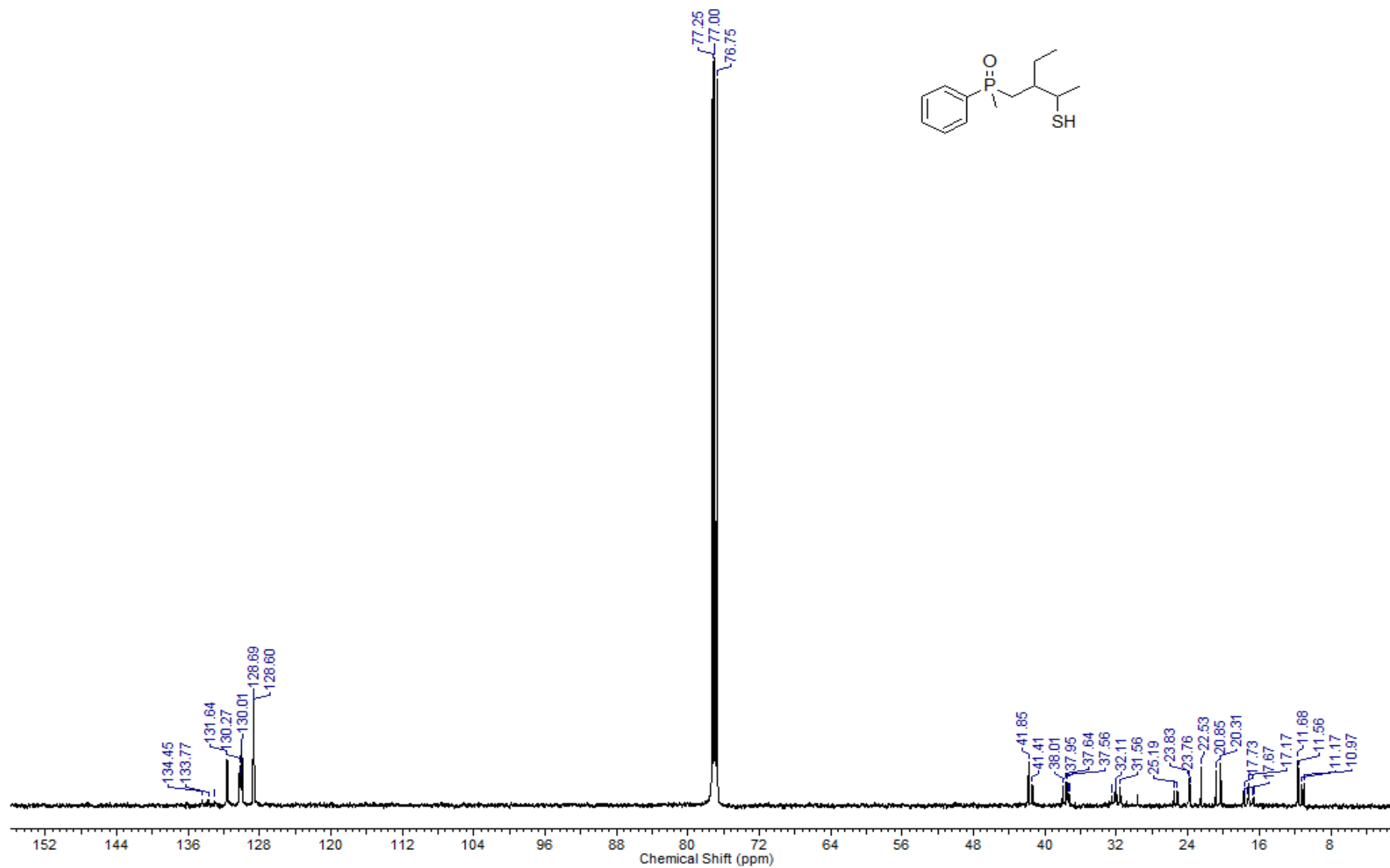
^1P NMR spectrum of 1,3,3-trimethylphosphindoline 1-sulfide (**35**) with (2-methylprop-1-enyl)(methylphenyl)phosphine oxide (**34**) and 1,3,3-trimethylphosphindoline 1-oxide (**3**) and (2-hydroxy-2-methylpropyl)methylphenylphosphine sulfide (**19**) (CDCl_3 , 202 MHz).



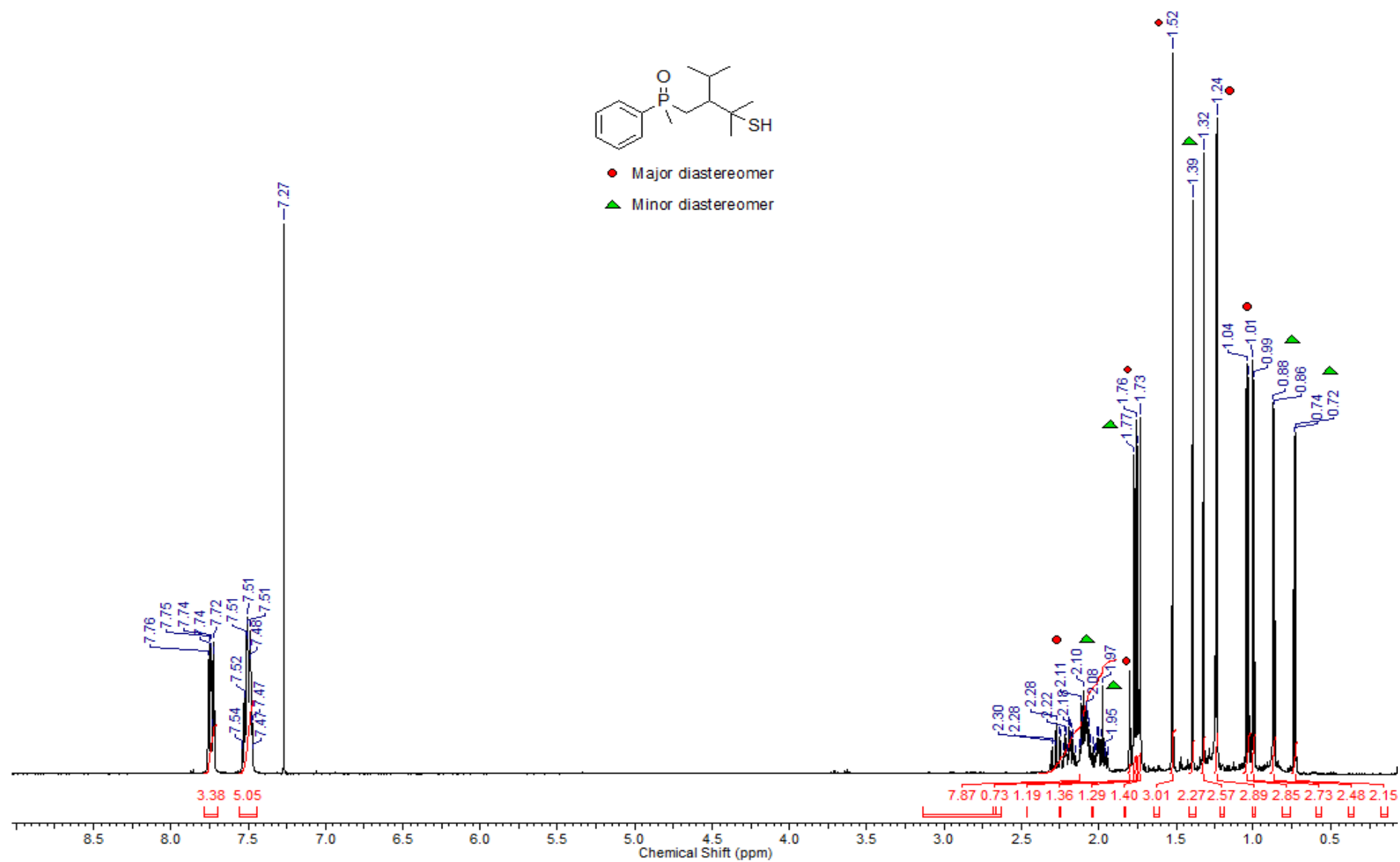
¹H NMR spectrum of (2-ethyl-3-mercaptobutyl)methylphenylphosphine oxide (**36**) (CDCl₃, 500 MHz).



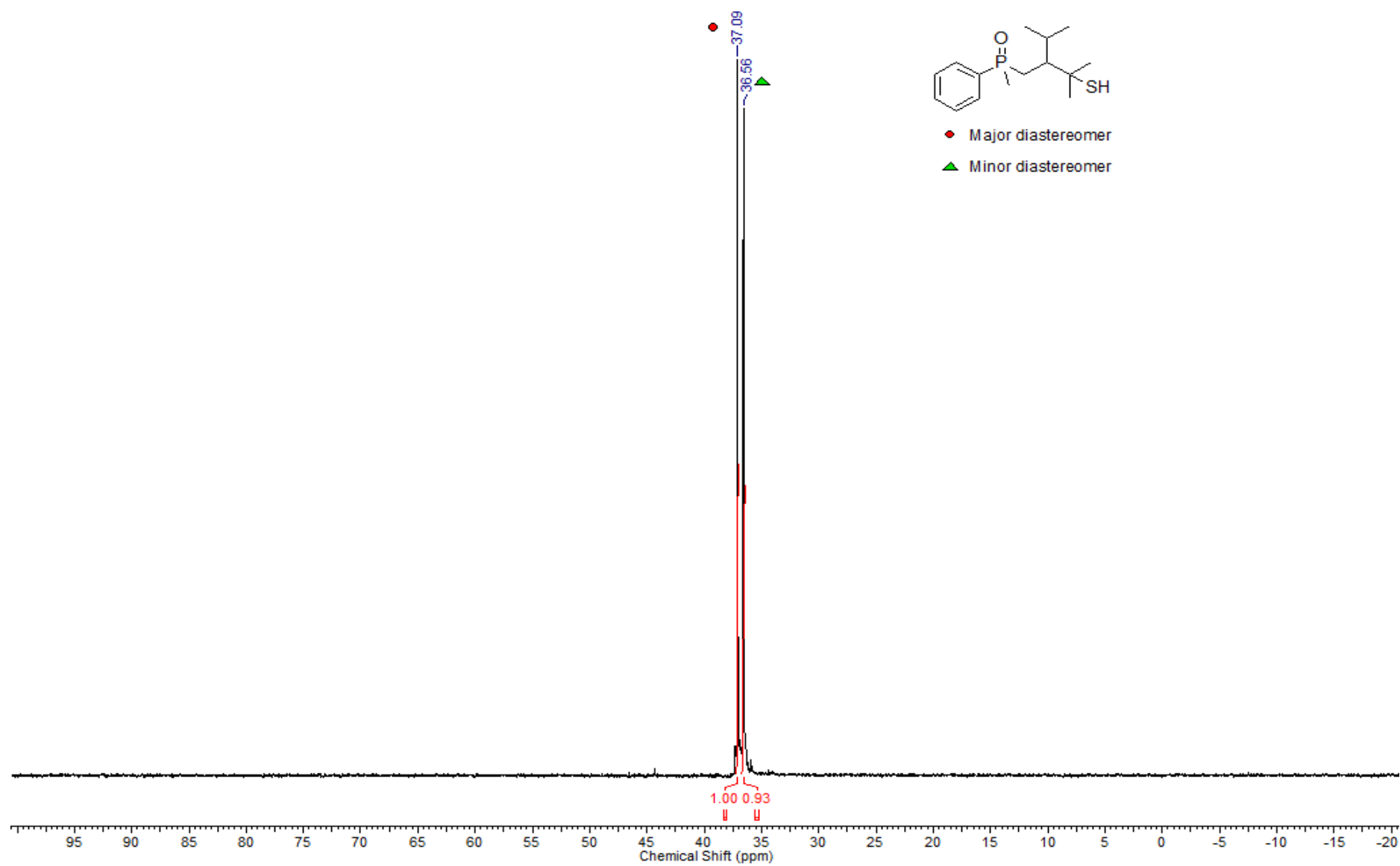
^{31}P NMR spectrum of (2-ethyl-3-mercaptobutyl)methylphenylphosphine oxide (**36**) (CDCl_3 , 202 MHz).



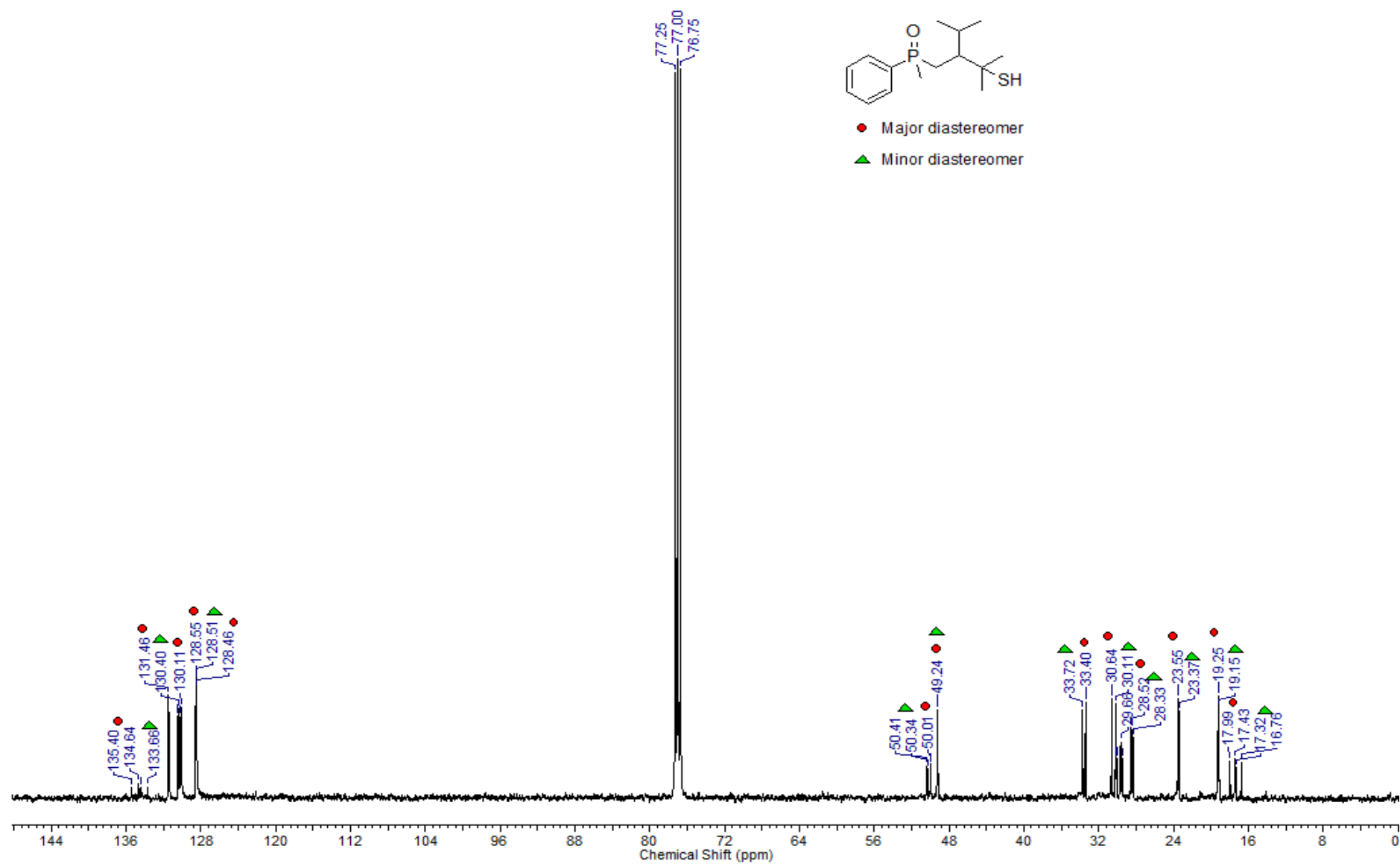
¹³C NMR spectrum of (2-ethyl-3-mercaptobutyl)methylphenylphosphine oxide (**36**) (CDCl₃, 126 MHz).



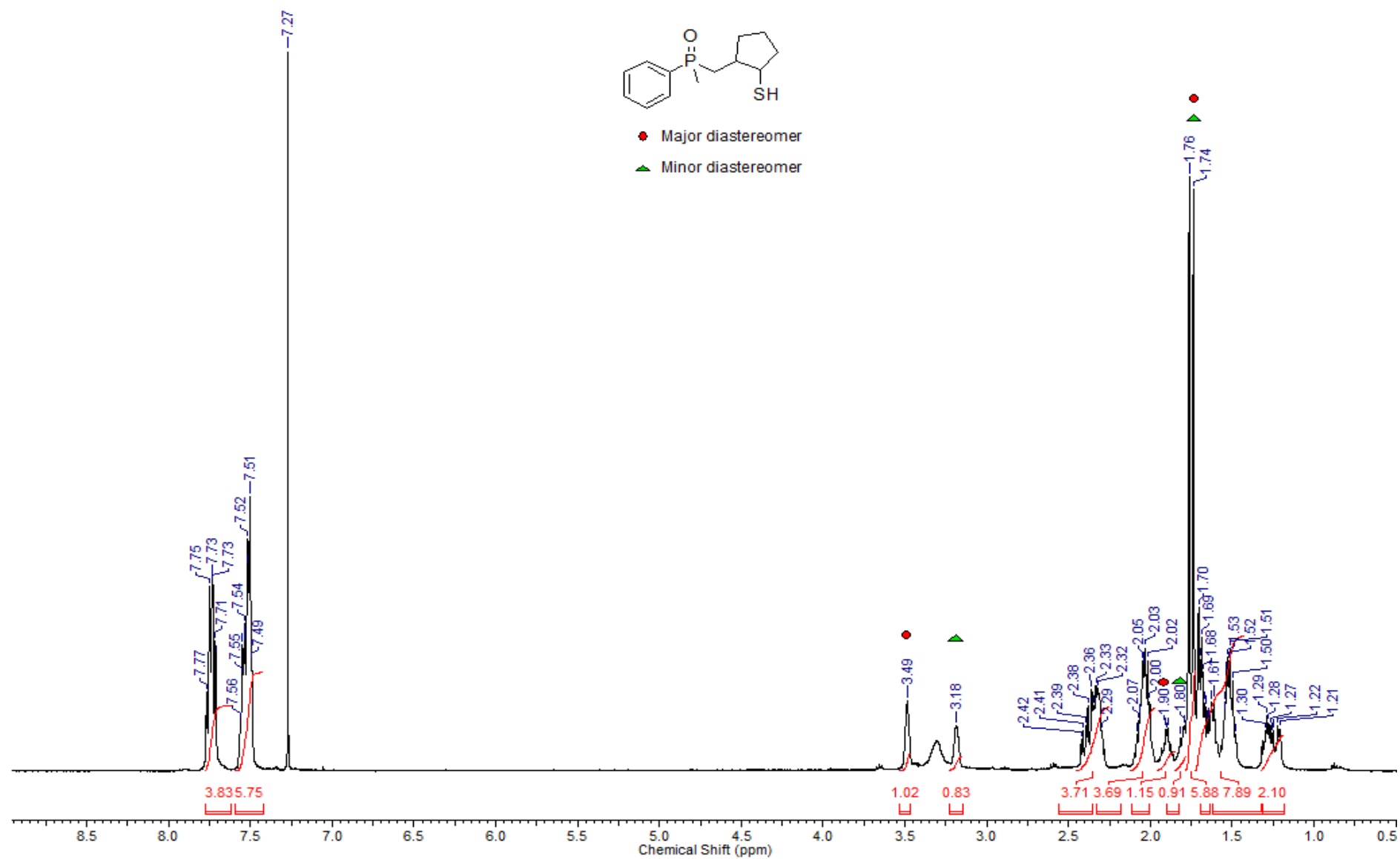
¹H NMR spectrum of (2-isopropyl-3-methyl-3-mercaptopbutyl)methylphenylphosphine oxide (37) (CDCl₃, 500 MHz).



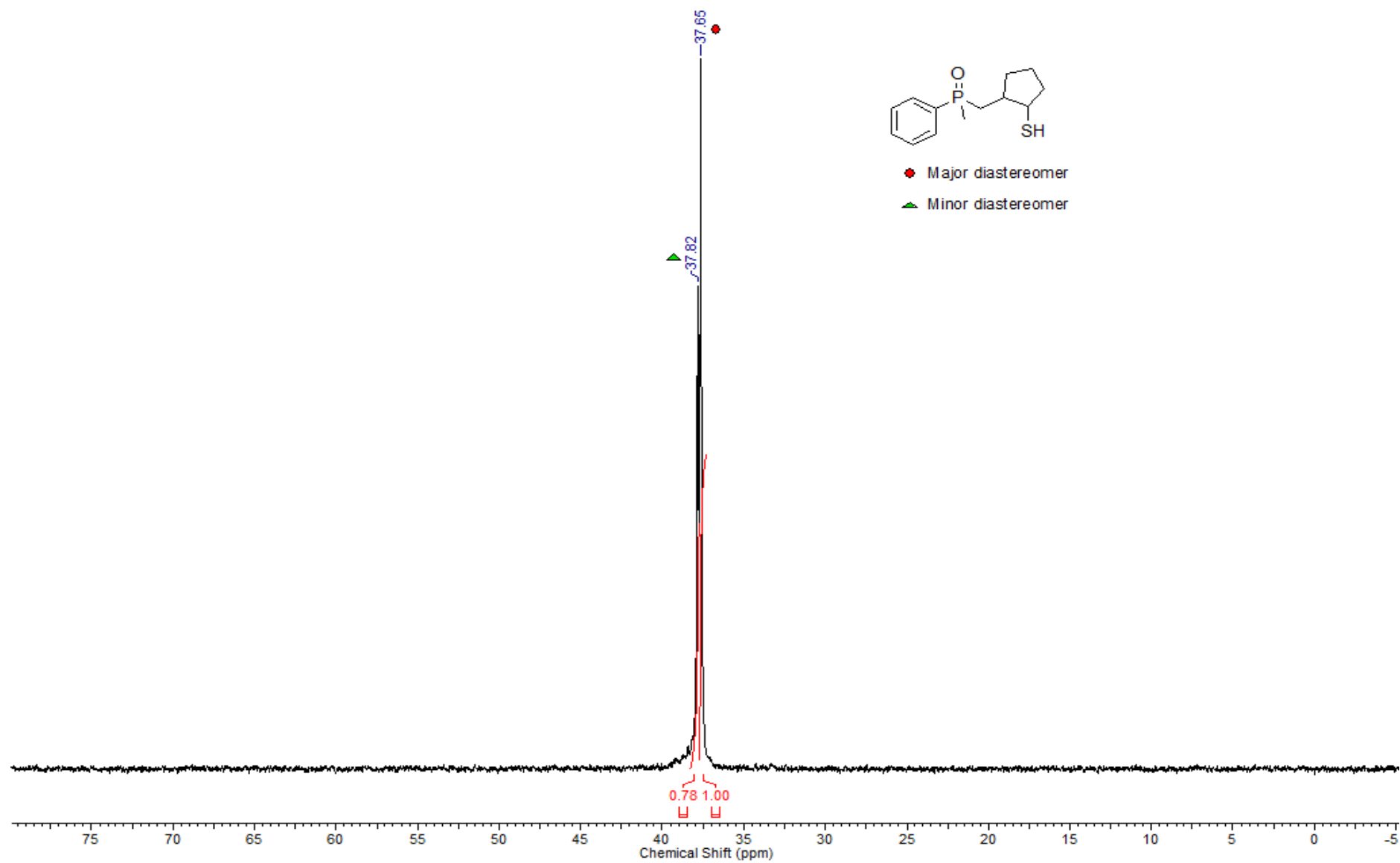
^{31}P NMR spectrum of (2-isopropyl-3-methyl-3-mercaptopbutyl)methylphenylphosphine oxide (37) (CDCl_3 , 202 MHz).



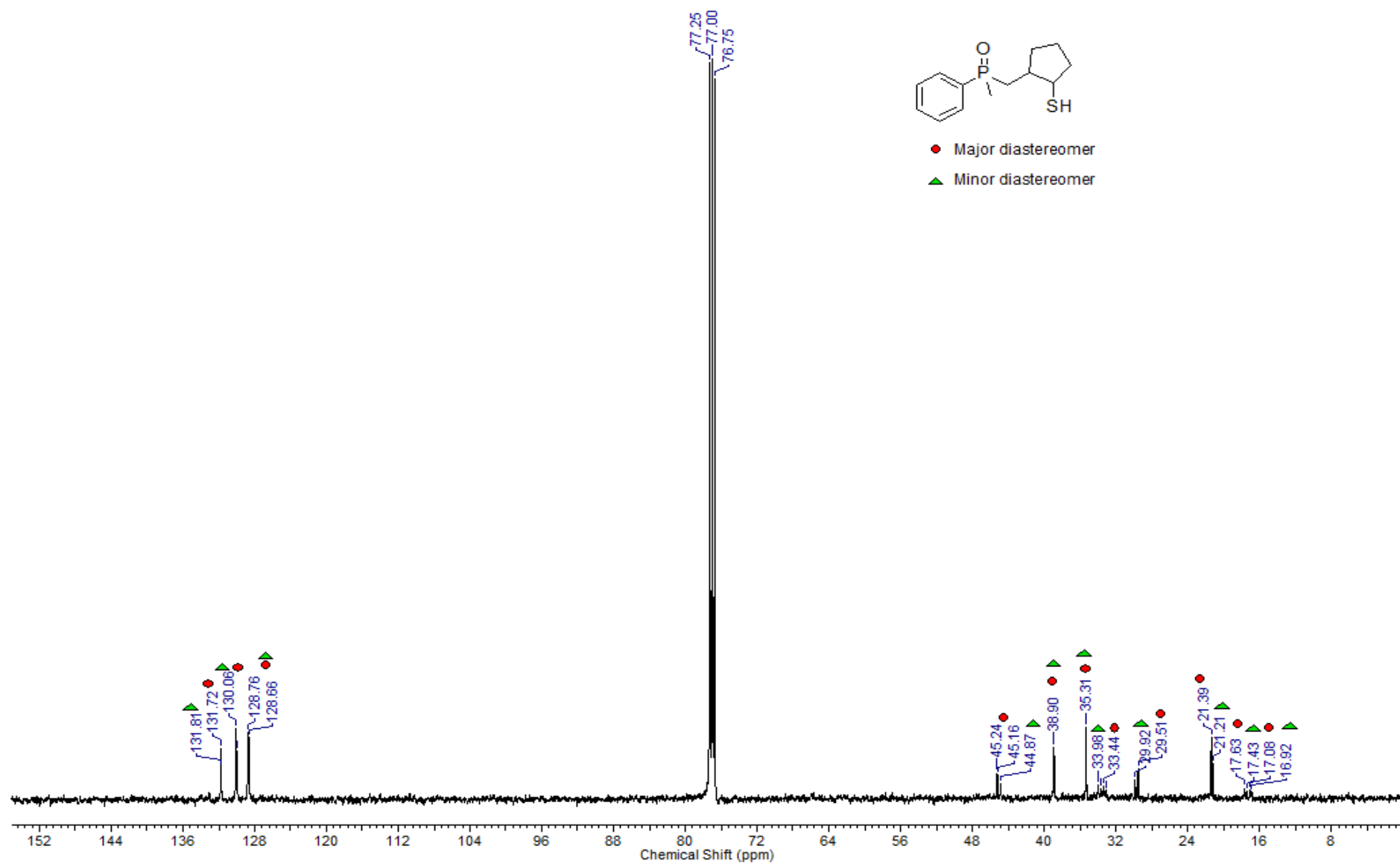
¹³C NMR spectrum of (2-isopropyl-3-methyl-3-mercaptopbutyl)methylphenylphosphine oxide (37) (CDCl₃, 126 MHz).



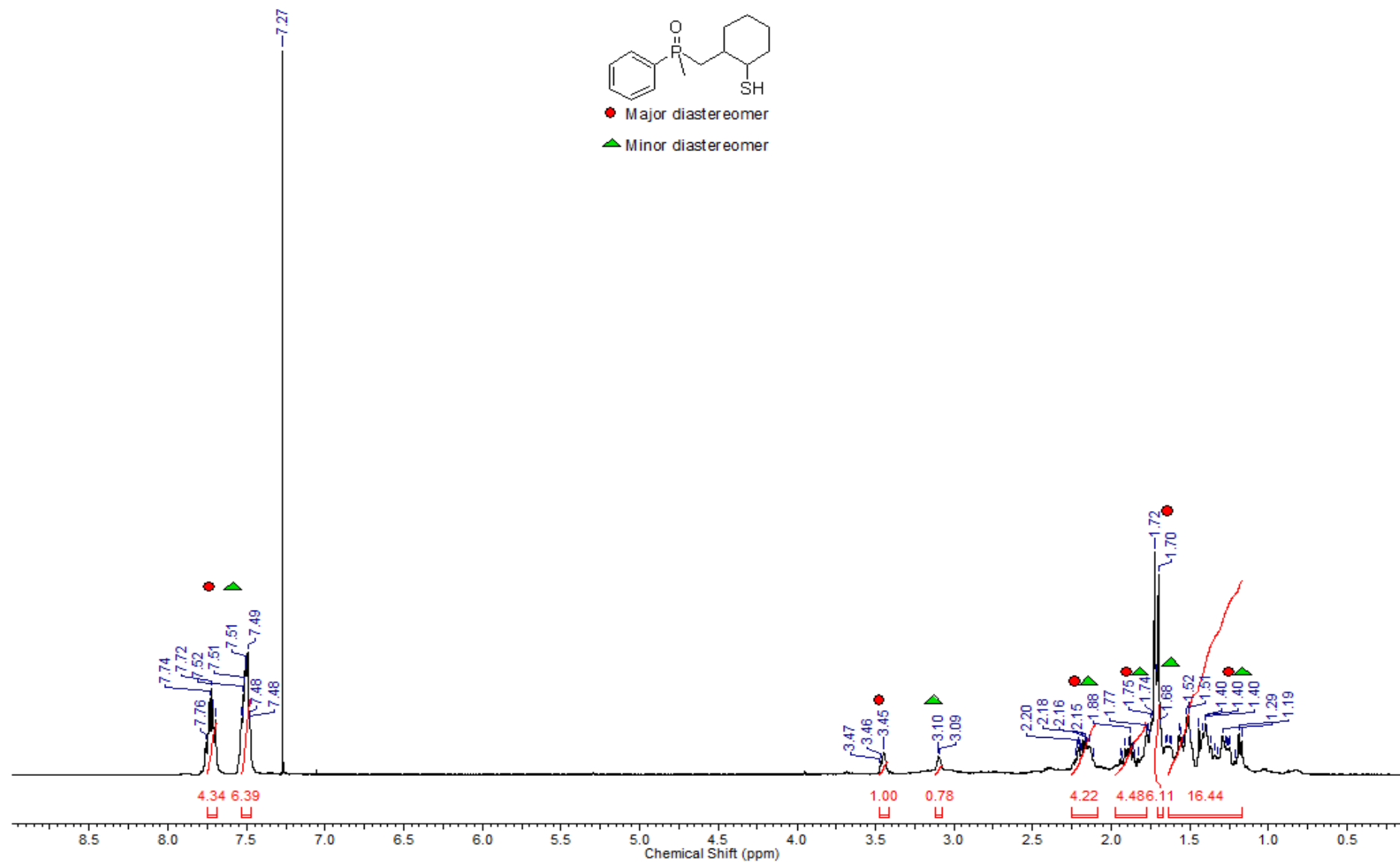
¹H NMR spectrum of [(2-mercapto)cyclopentylmethyl]methylphenylphosphine sulfide (**38**) (CDCl₃, 500 MHz).



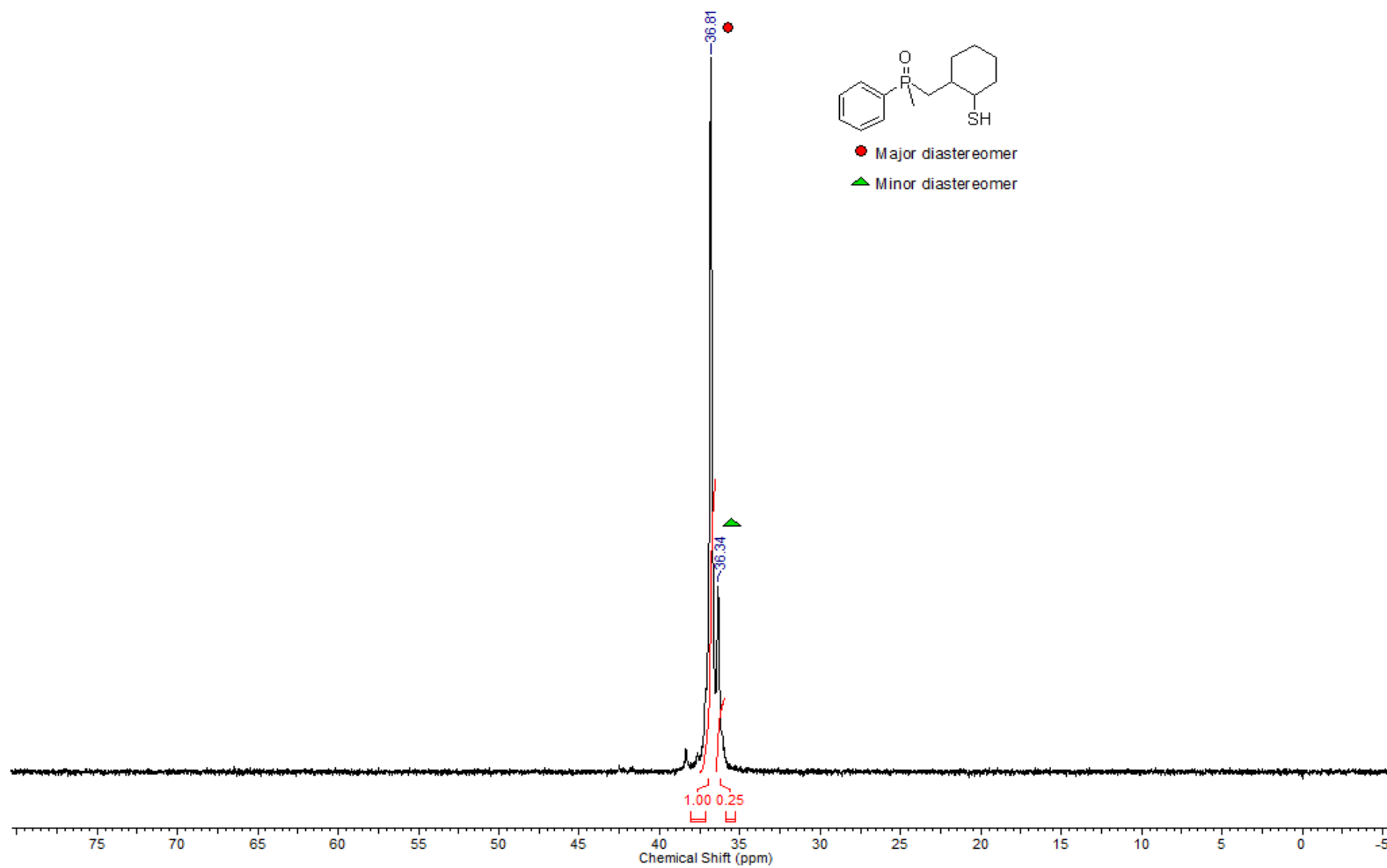
^{31}P NMR spectrum of [(2-mercapto)cyclopentylmethyl]methylphenylphosphine sulfide (**38**) (CDCl_3 , 202 MHz).



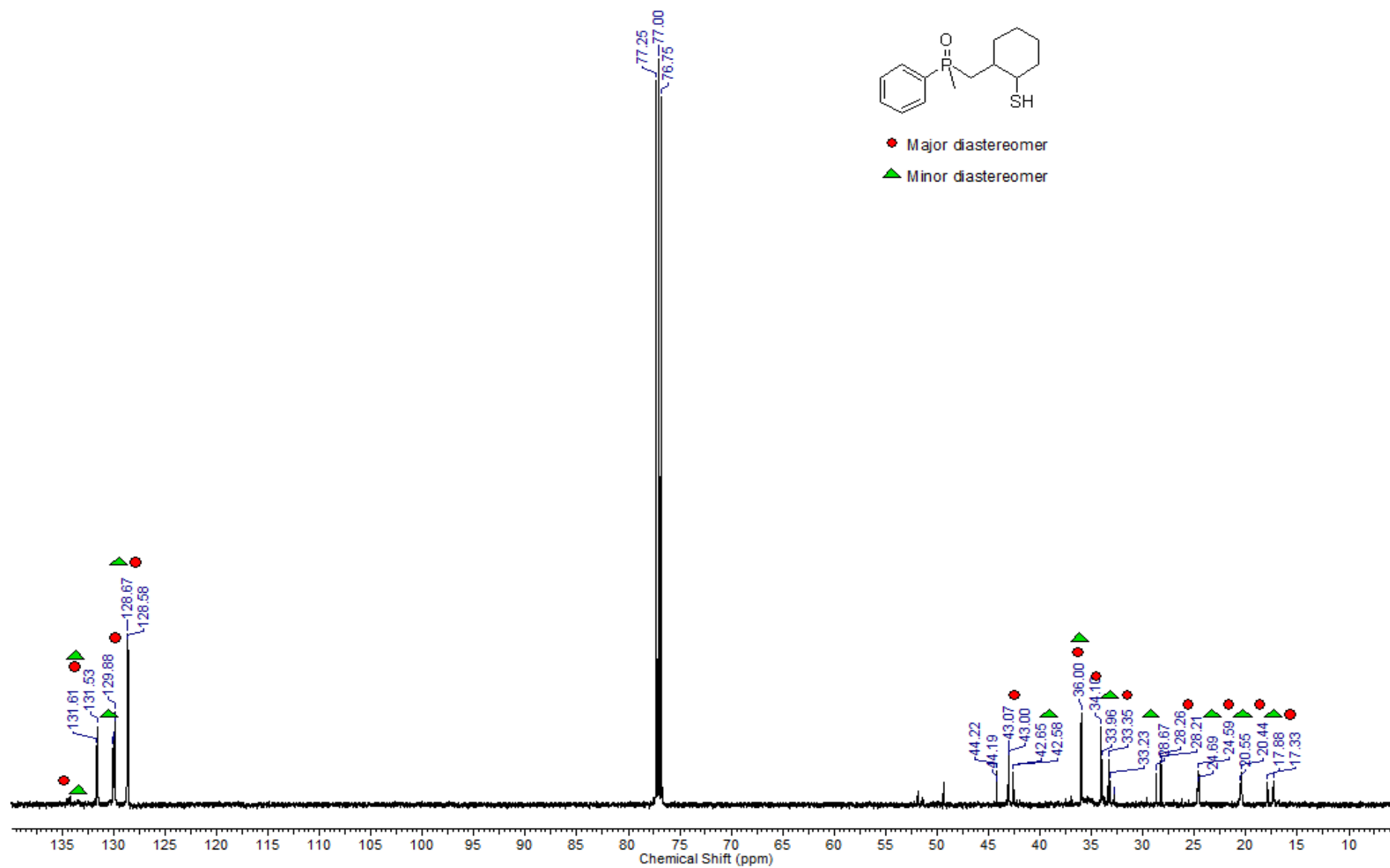
¹³C NMR spectrum of [(2-mercapto)cyclopentylmethyl]methylphenylphosphine sulfide (**38**) (CDCl₃, 126 MHz).



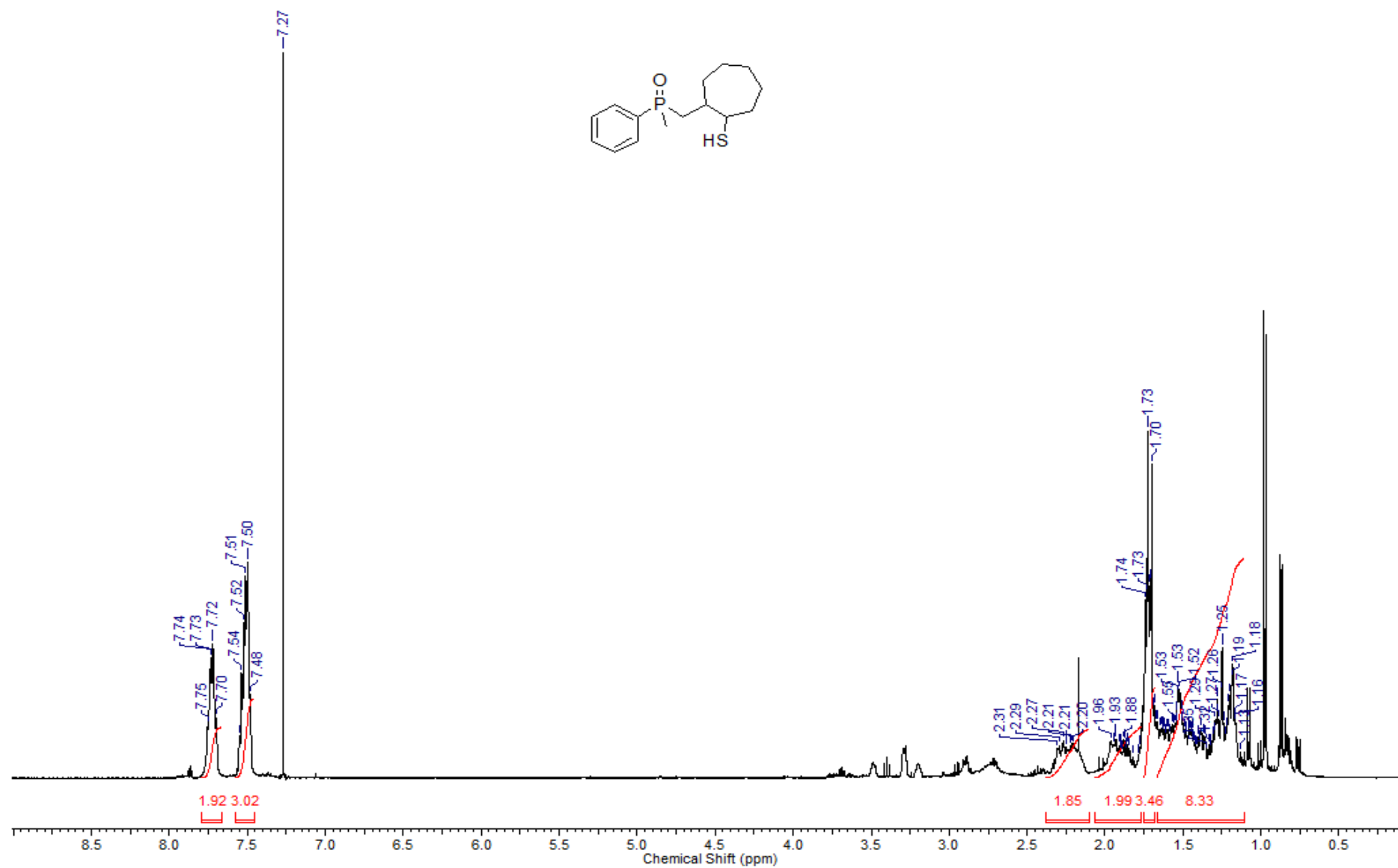
¹H NMR spectrum of [(2-mercapto)cyclohexylmethyl]methylphenylphosphine sulfide (**39**) (CDCl₃, 500 MHz).



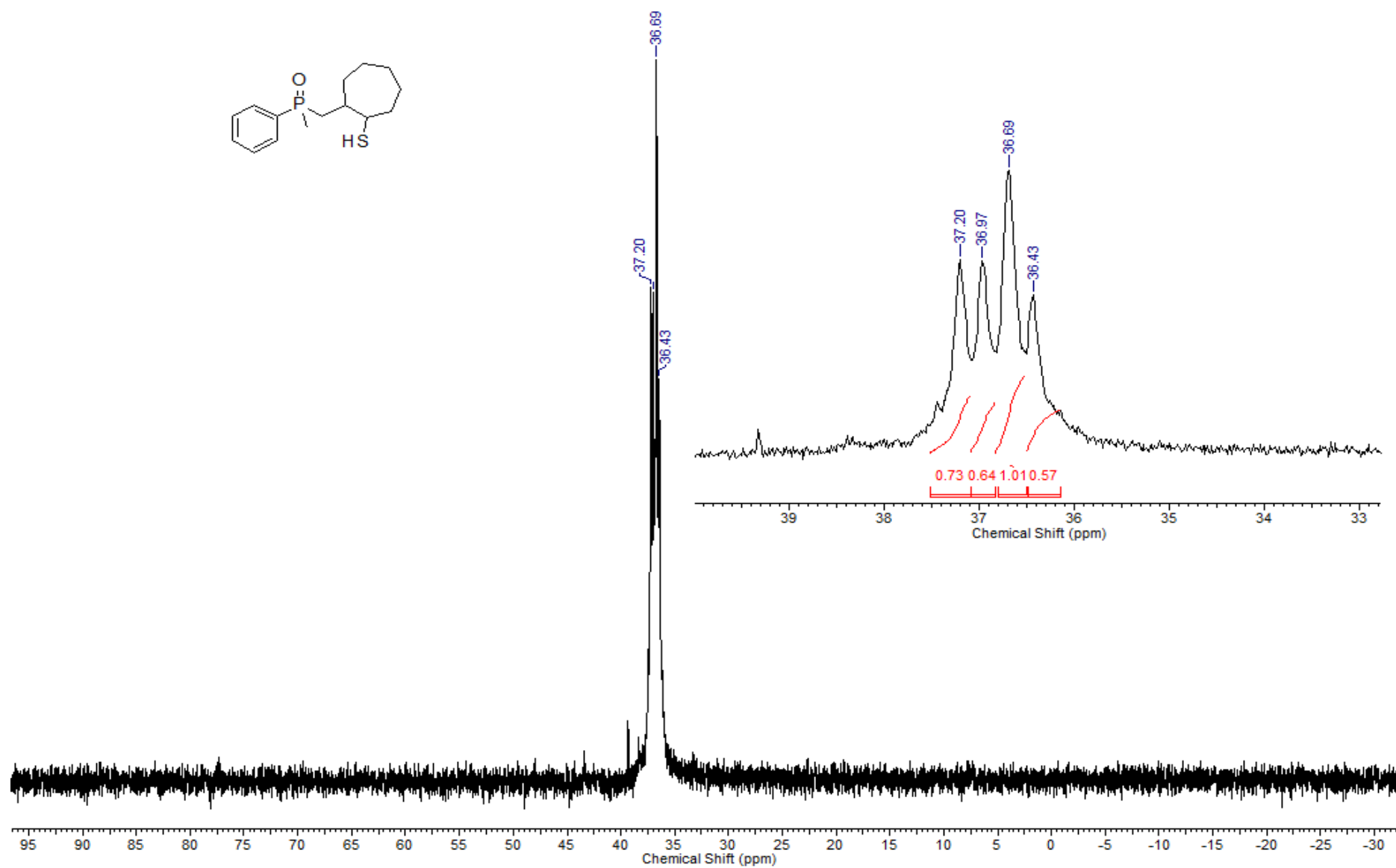
³¹P NMR spectrum of [(2-mercapto)cyclohexylmethyl]methylphenylphosphine sulfide (**39**) (CDCl₃, 202 MHz).



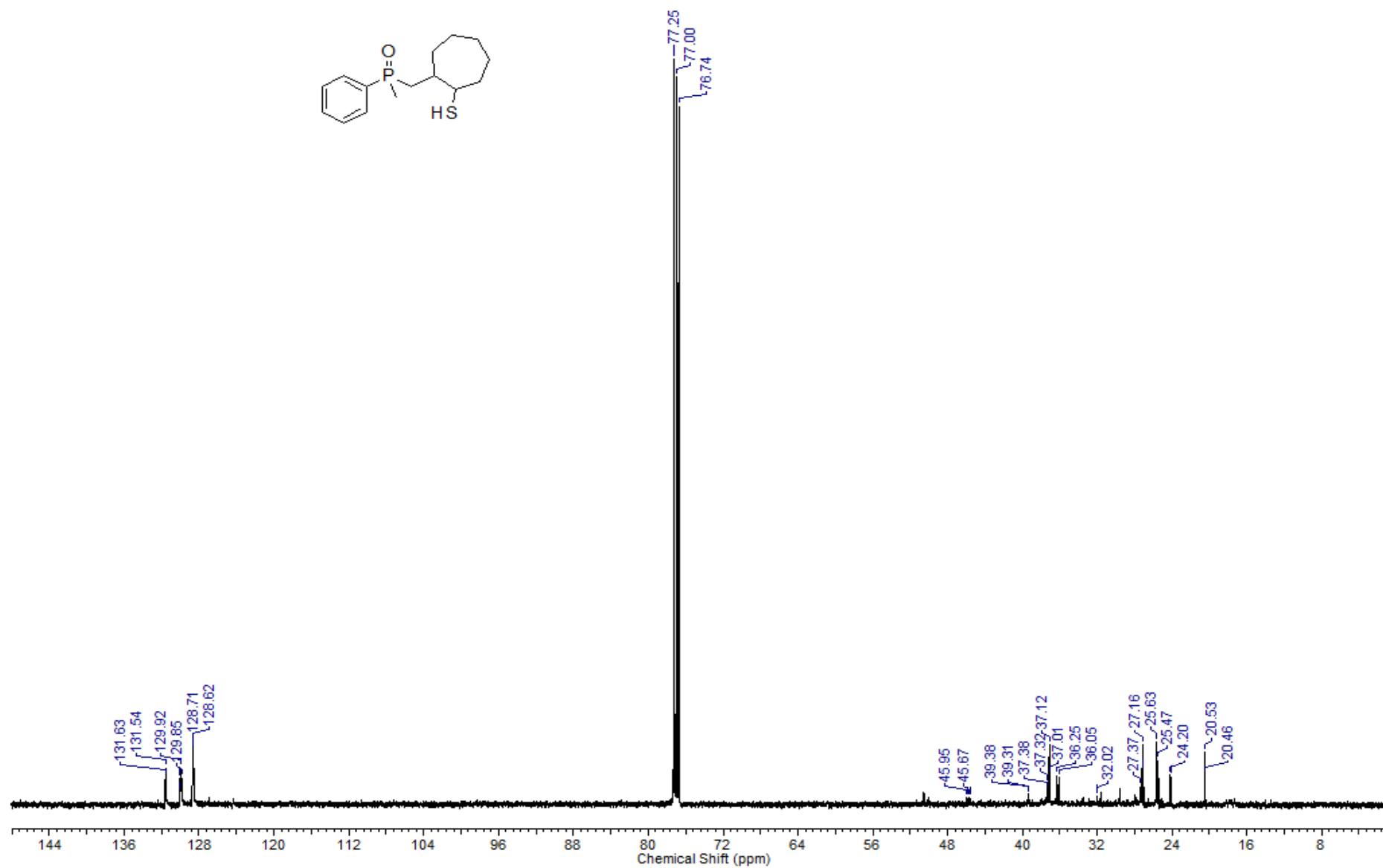
^{13}C NMR spectrum of [(2-mercapto)cyclohexylmethyl]methylphenylphosphine sulfide (39) (CDCl_3 , 126 MHz).



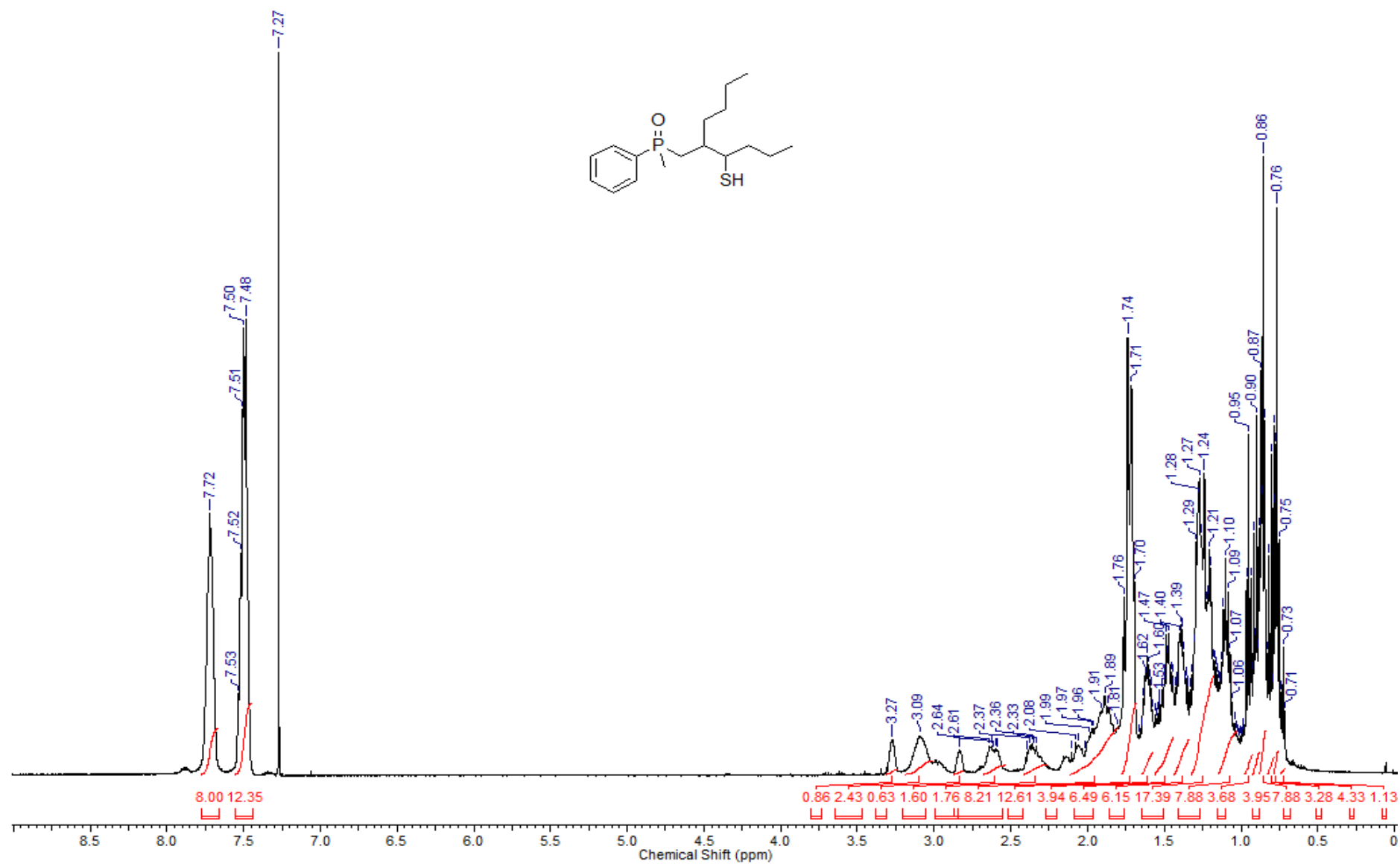
¹H NMR spectrum of [(2-mercapto)cycloheptylmethyl]methylphenylphosphine sulfide (**40**) (CDCl₃, 500 MHz).



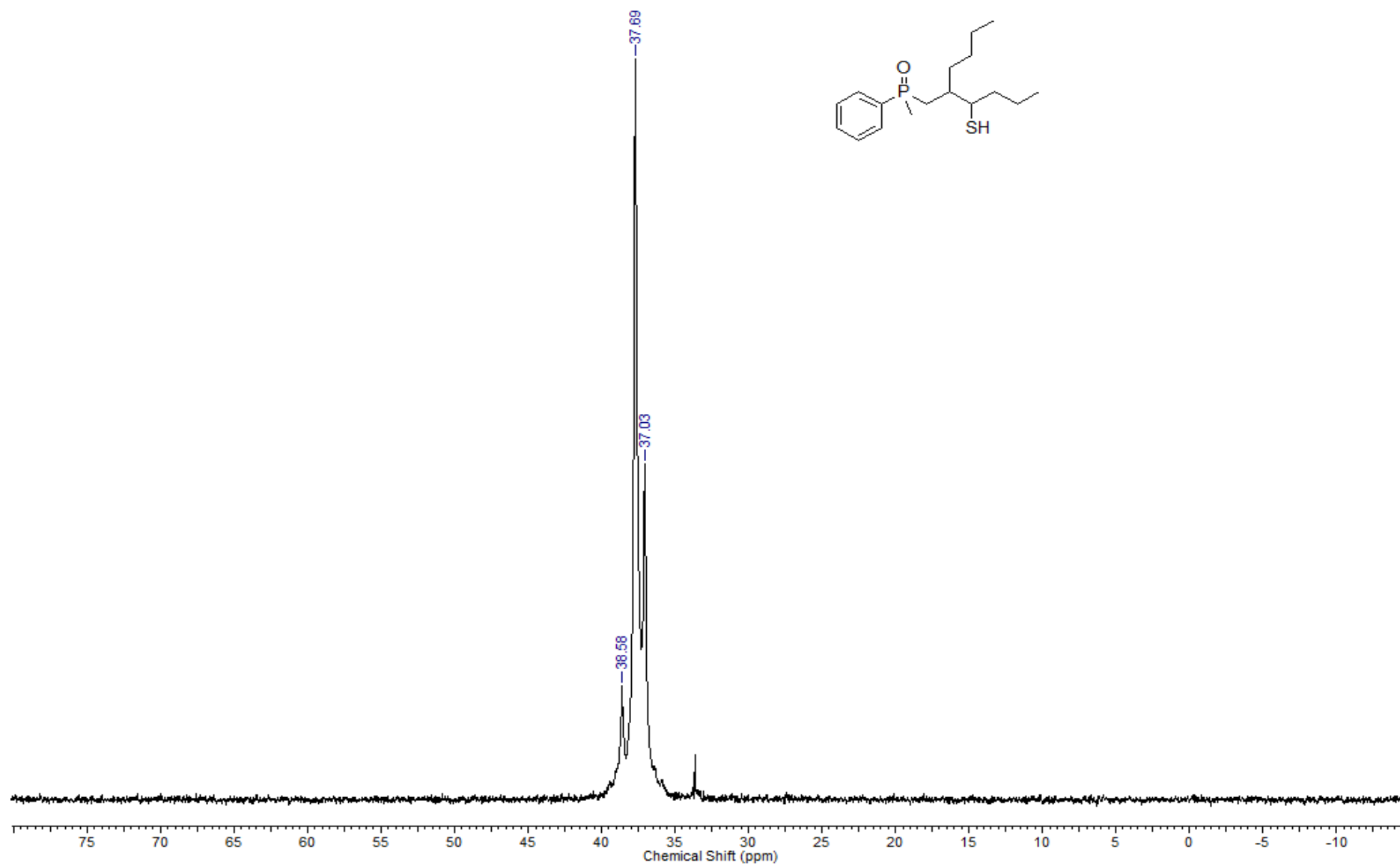
^{31}P NMR spectrum of [(2-mercapto)cycloheptylmethyl]methylphenylphosphine sulfide (**40**) (CDCl₃, 202 MHz).



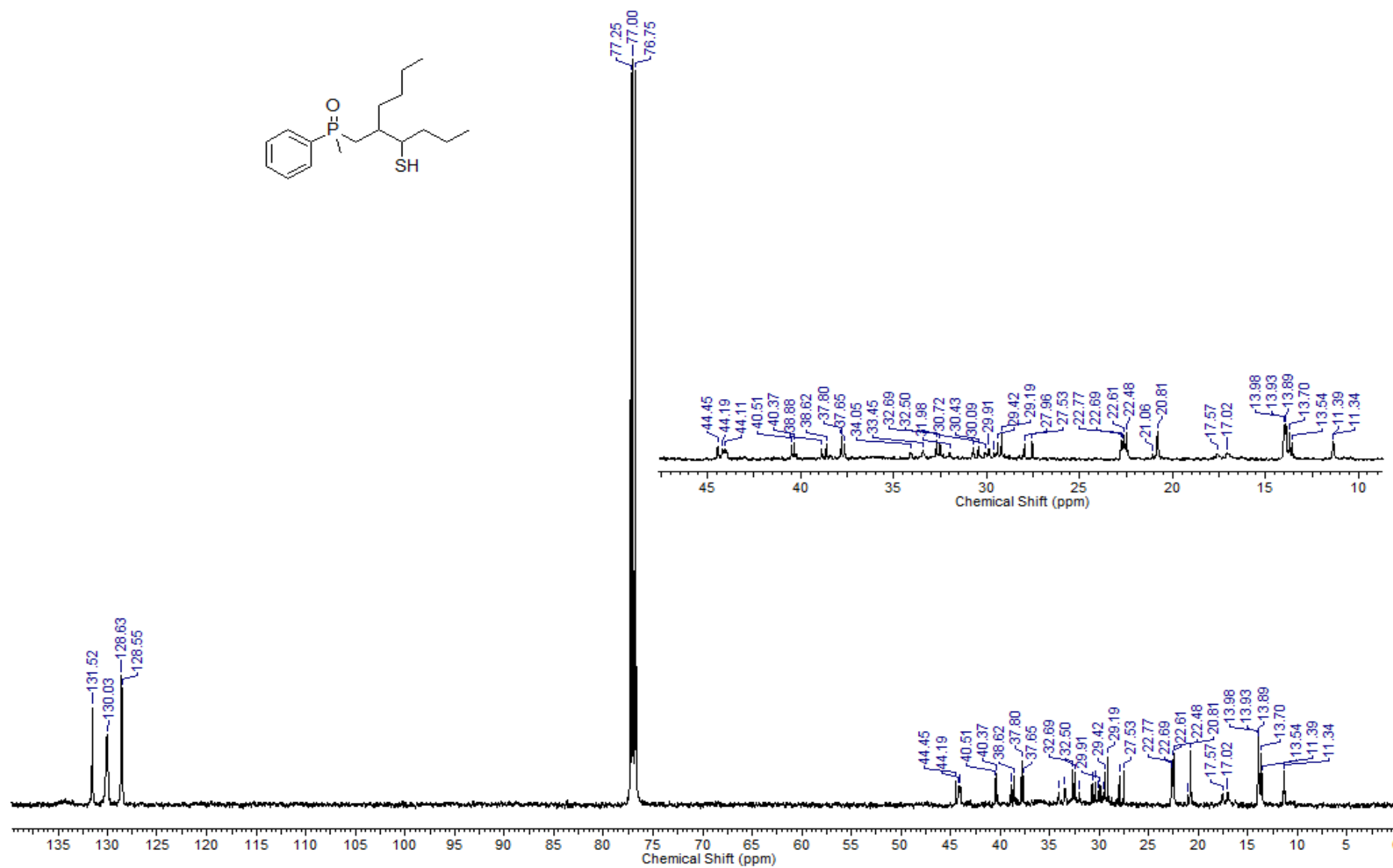
¹³C NMR spectrum of [(2-mercapto)cycloheptylmethyl]methylphenylphosphine sulfide (**40**) (CDCl₃, 126 MHz).



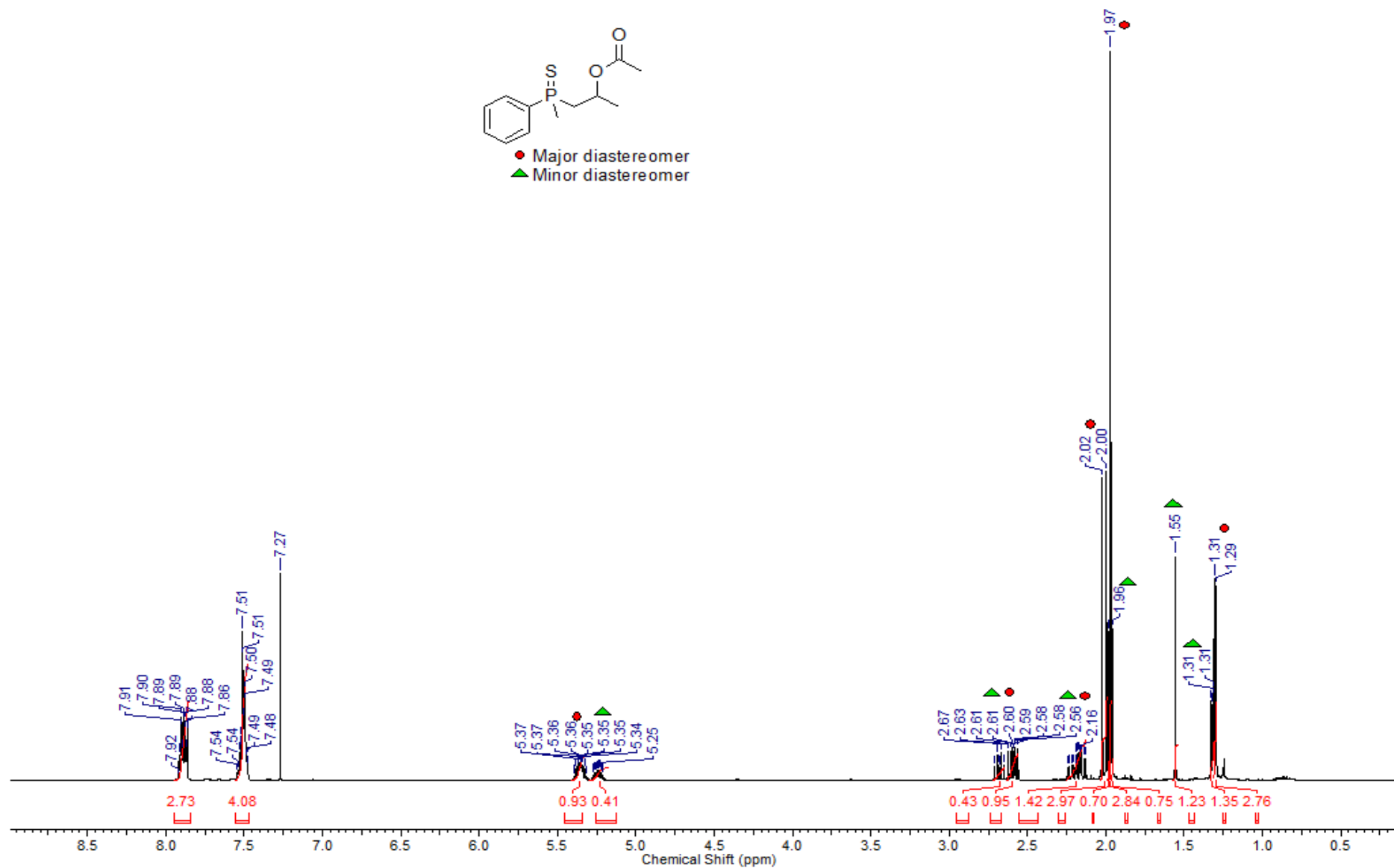
¹H NMR spectrum of (2-butyl-3-mercaphohexyl)methylphenylphosphine oxide (**41**) (CDCl₃, 500 MHz).



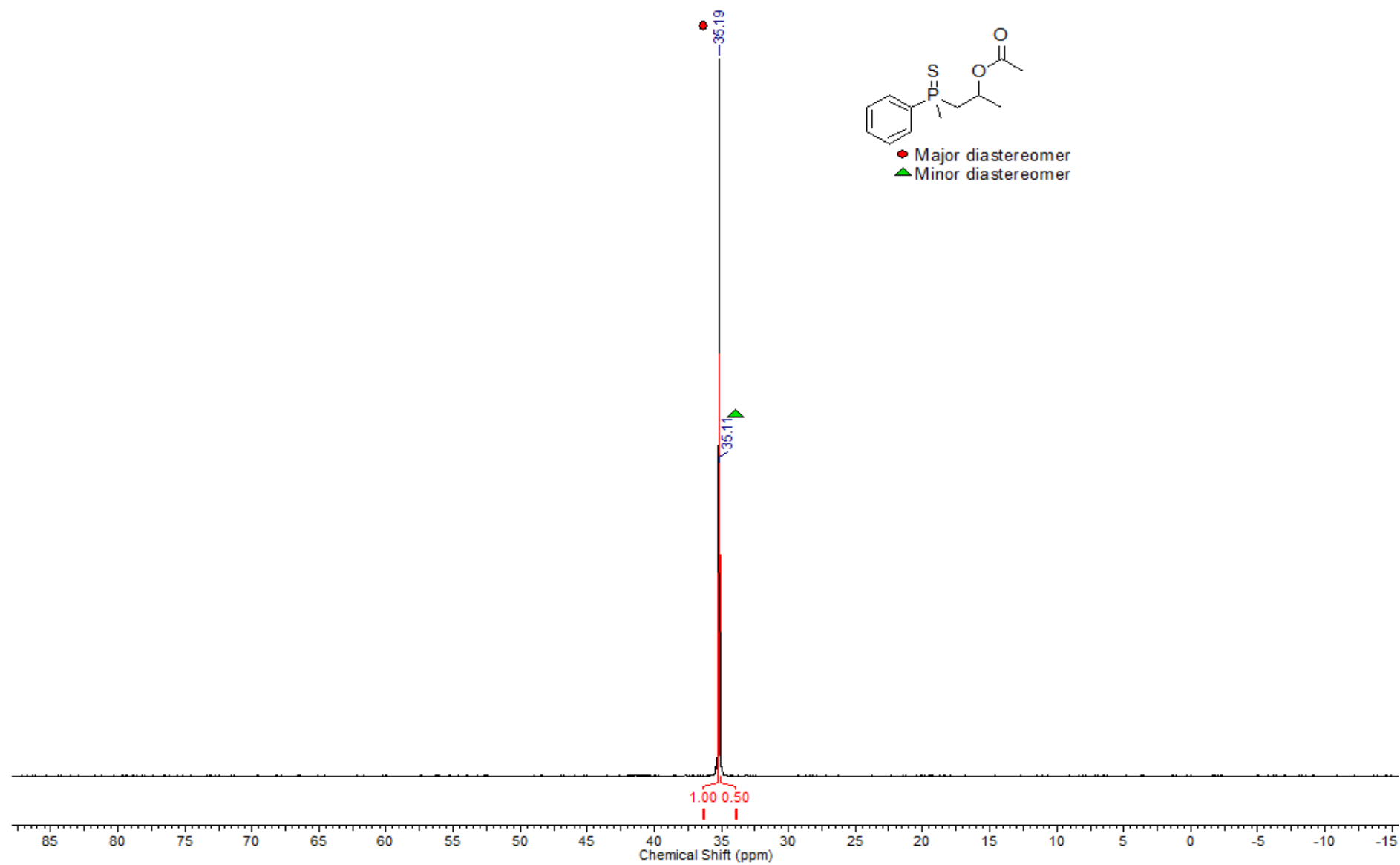
^{31}P NMR spectrum of (2-butyl-3-mercaptohexyl)methylphenylphosphine oxide (**41**) (CDCl_3 , 202 MHz).



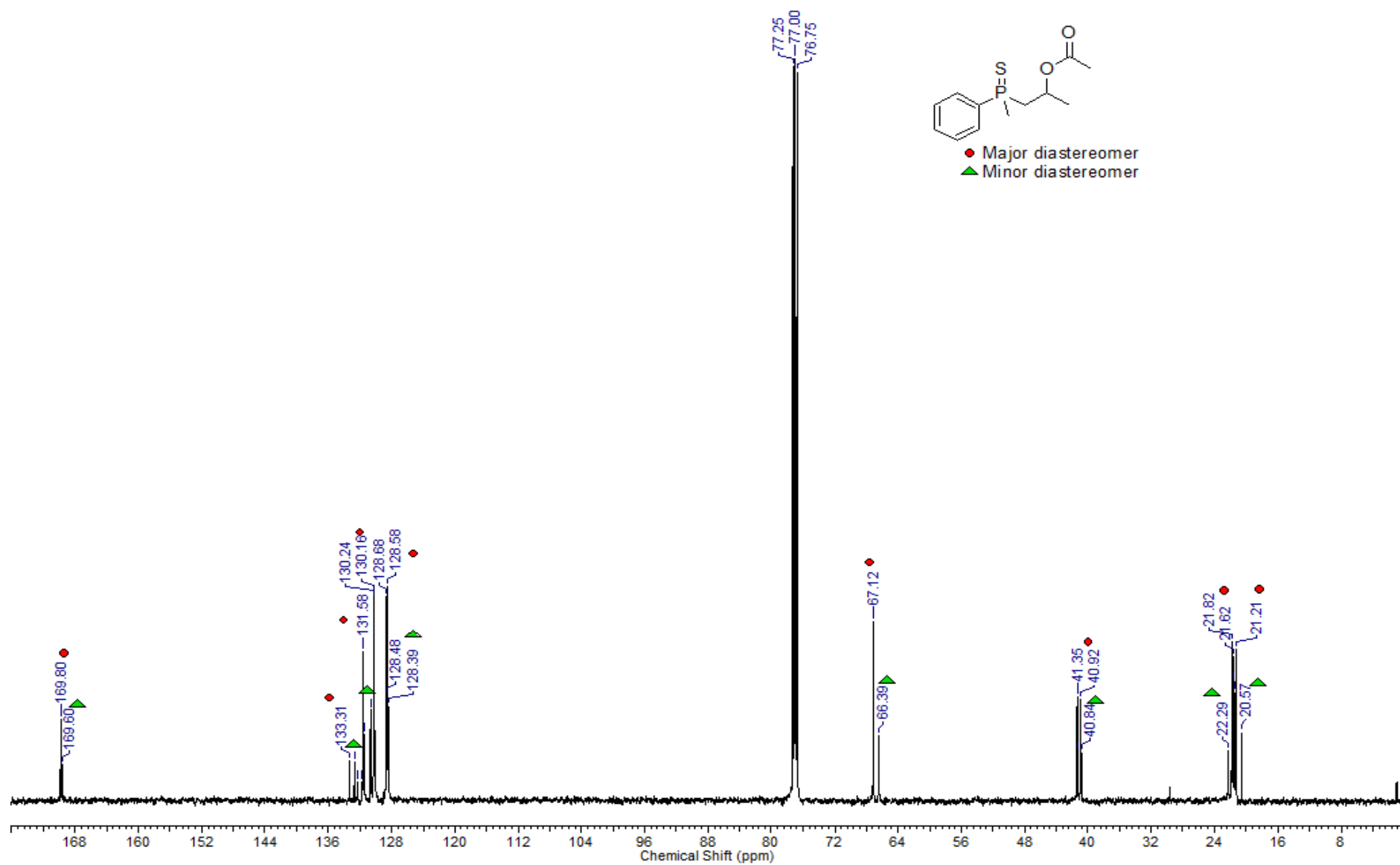
¹³C NMR spectrum of (2-butyl-3-mercaptohexyl)methylphenylphosphine oxide (**41**) (CDCl₃, 126 MHz).



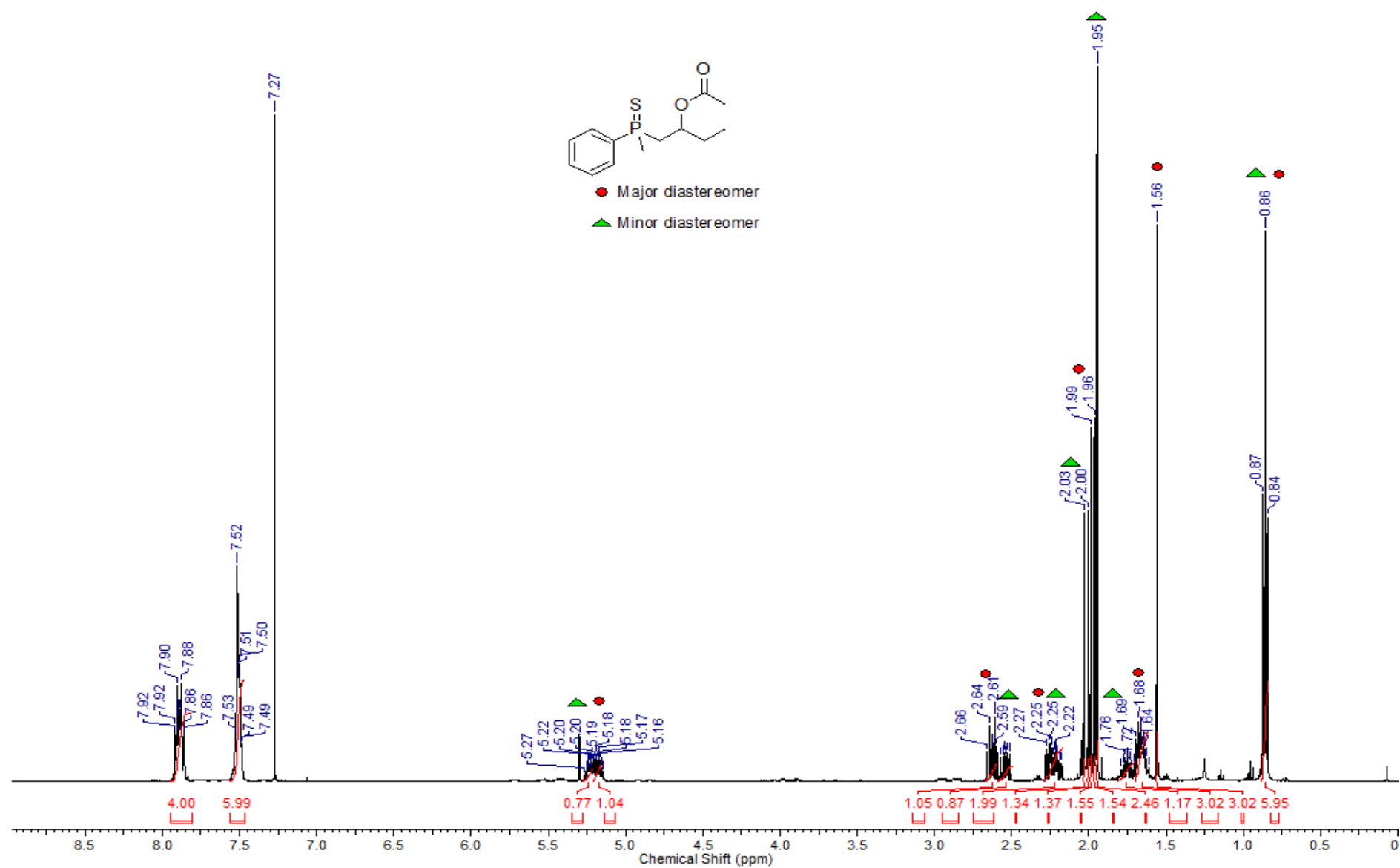
^1H NMR spectrum of (2-acetoxypropyl)methylphenylphosphine sulfide (**42**) (CDCl_3 , 500 MHz).



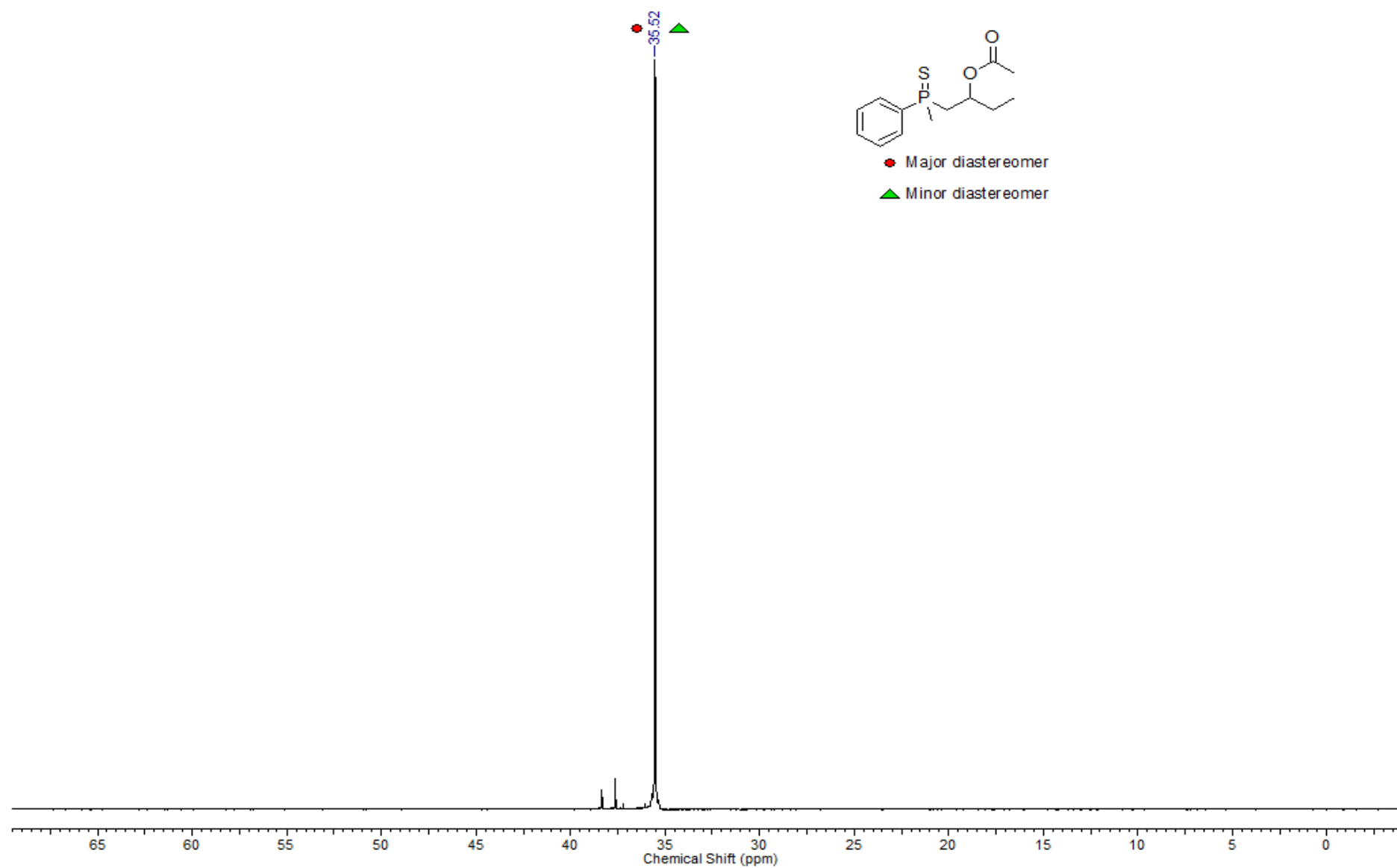
^{31}P NMR spectrum of (2-acetoxypropyl)methylphenylphosphine sulfide (**42**) (CDCl_3 , 202 MHz).



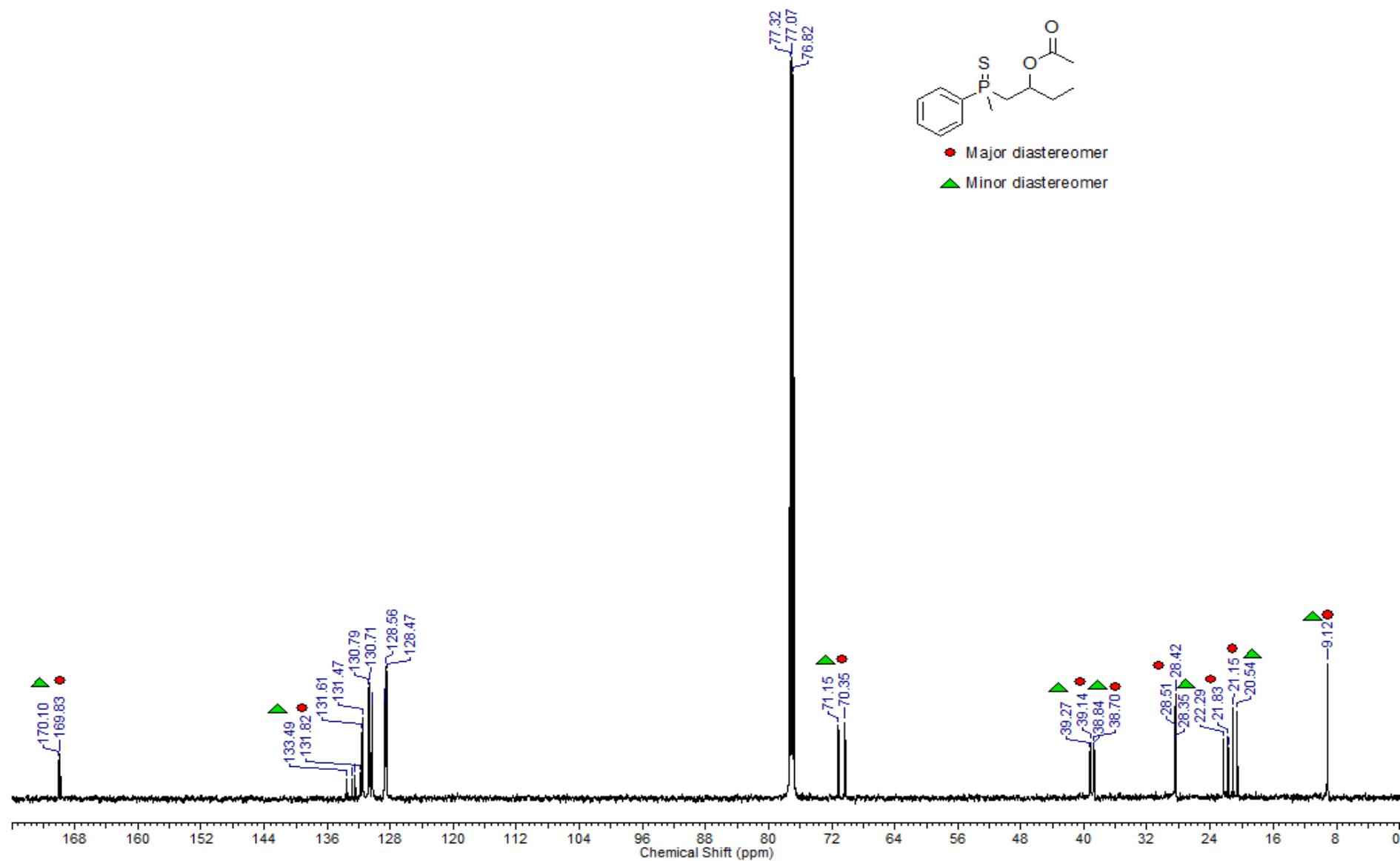
¹³C NMR spectrum of (2-acetoxypropyl)methylphenylphosphine sulfide (**42**) (CDCl₃, 126 MHz).



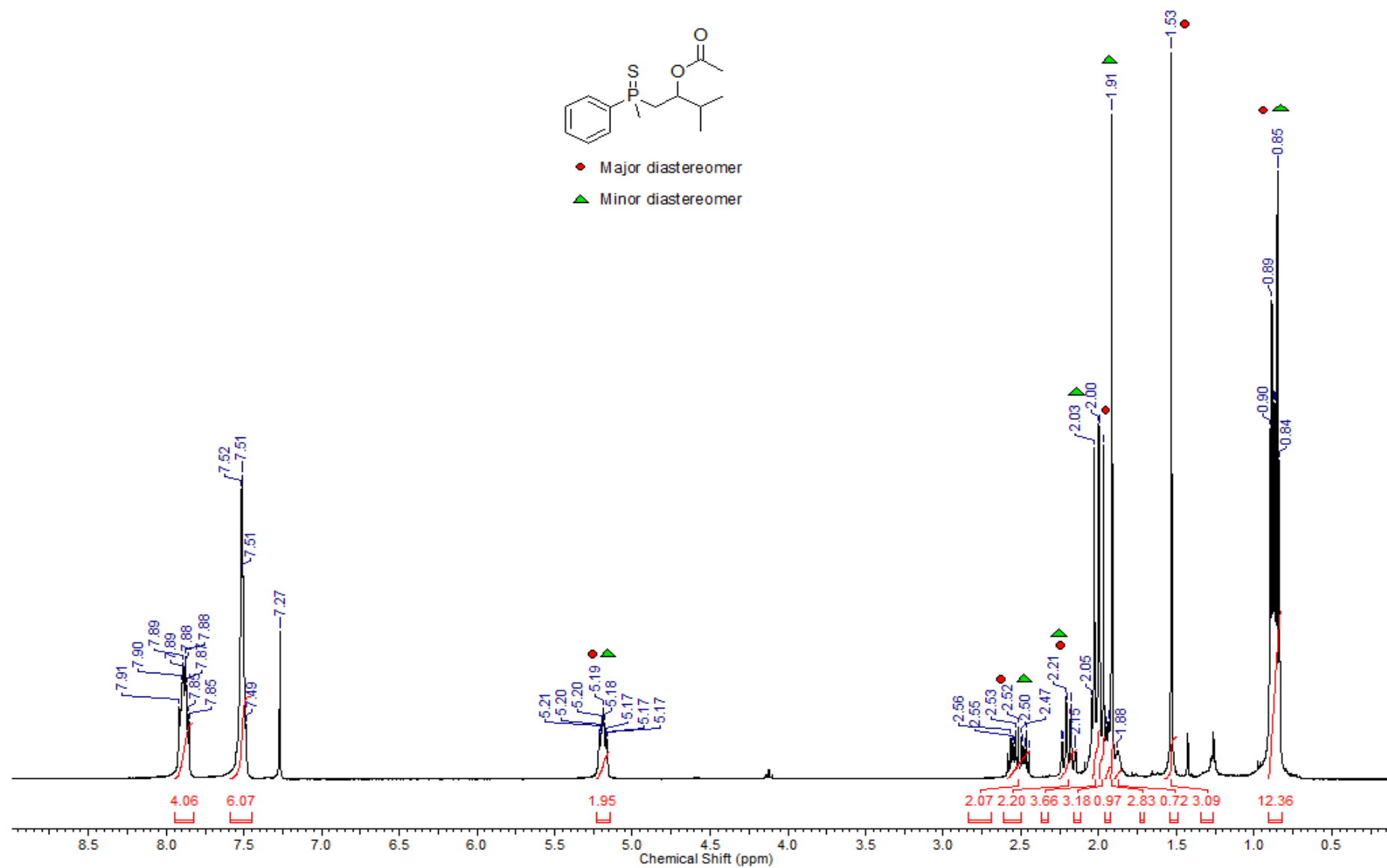
¹H NMR spectrum of (2-acetoxybutyl)methylphenylphosphine sulfide (**43**) (CDCl₃, 500 MHz).



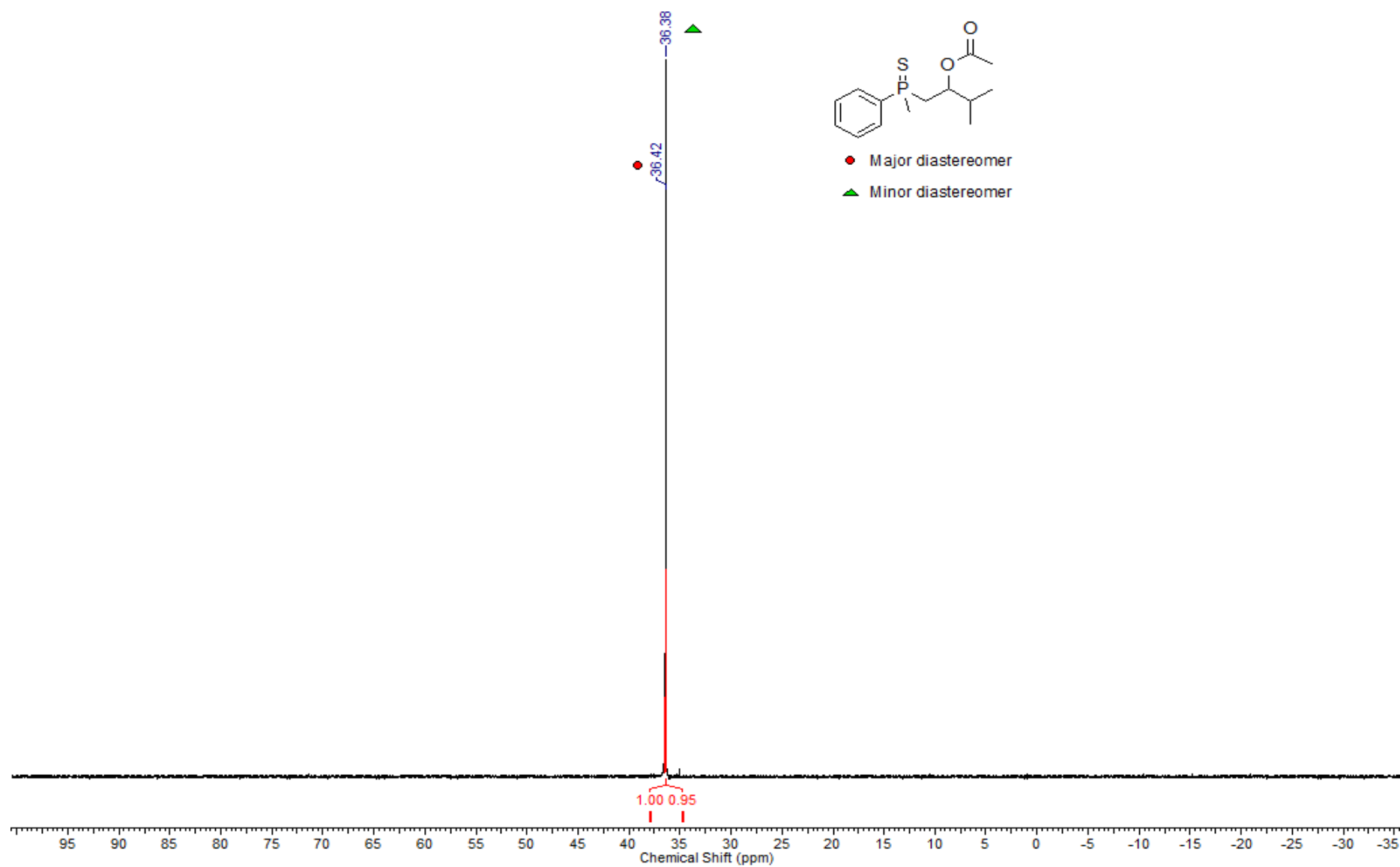
^{31}P NMR spectrum of (2-acetoxybutyl)methylphenylphosphine sulfide (**43**) (CDCl_3 , 202 MHz).



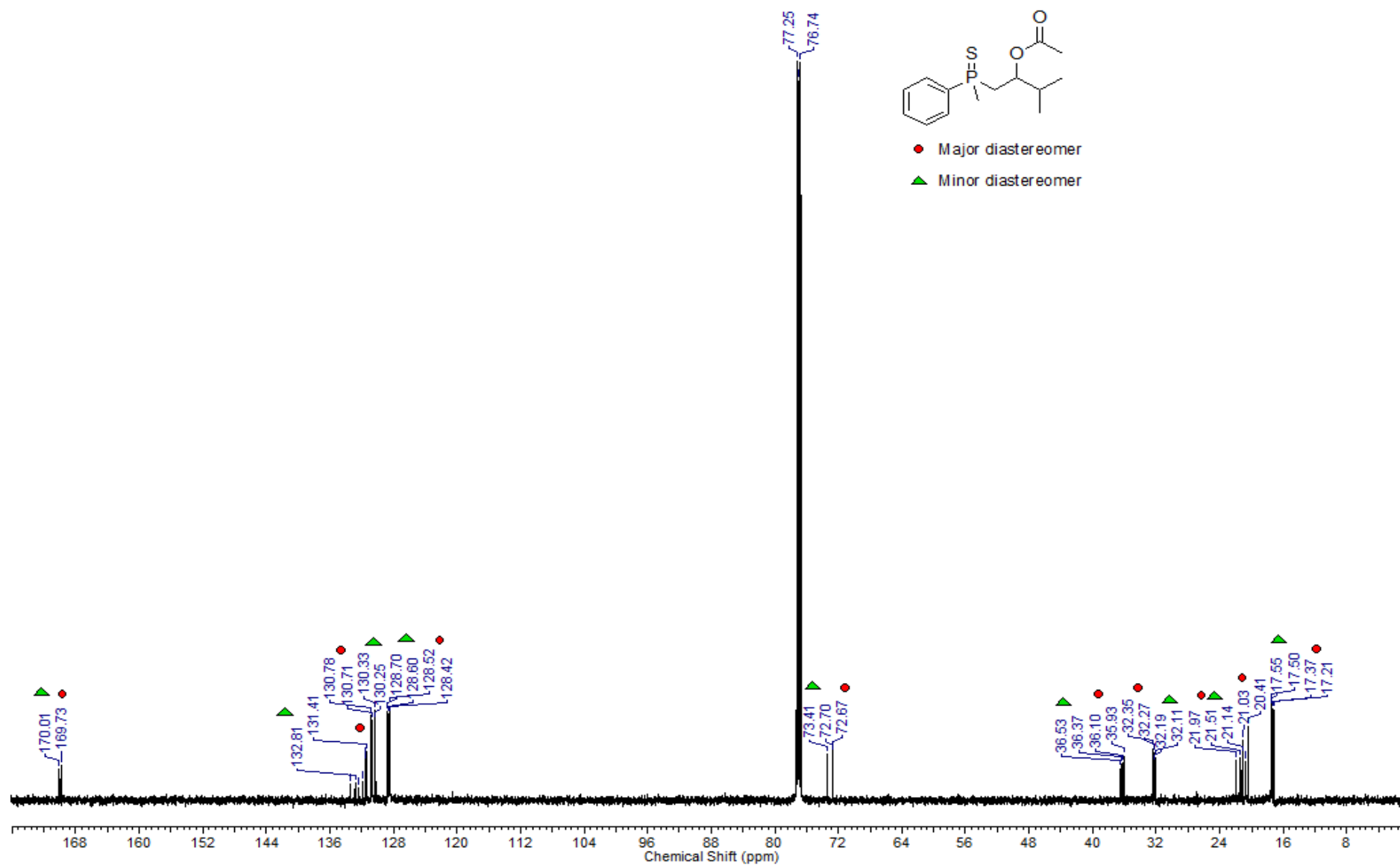
¹³C NMR spectrum of (2-acetoxybutyl)methylphenylphosphine sulfide (**43**) (CDCl₃, 126 MHz).



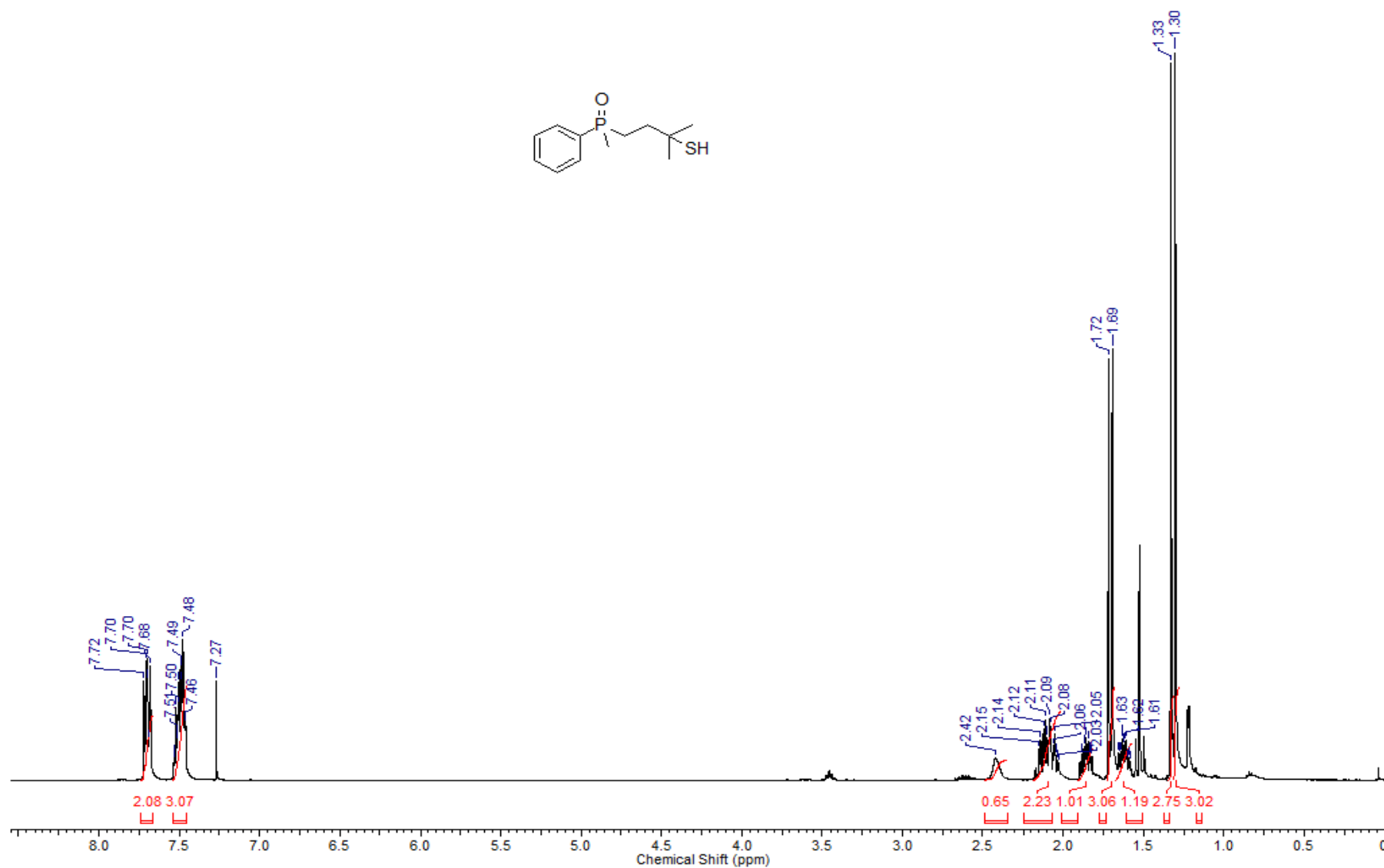
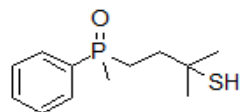
¹H NMR spectrum of (2-acetoxy-3-methylbutyl)methylphenylphosphine sulfide (**44**) (CDCl₃, 500 MHz).



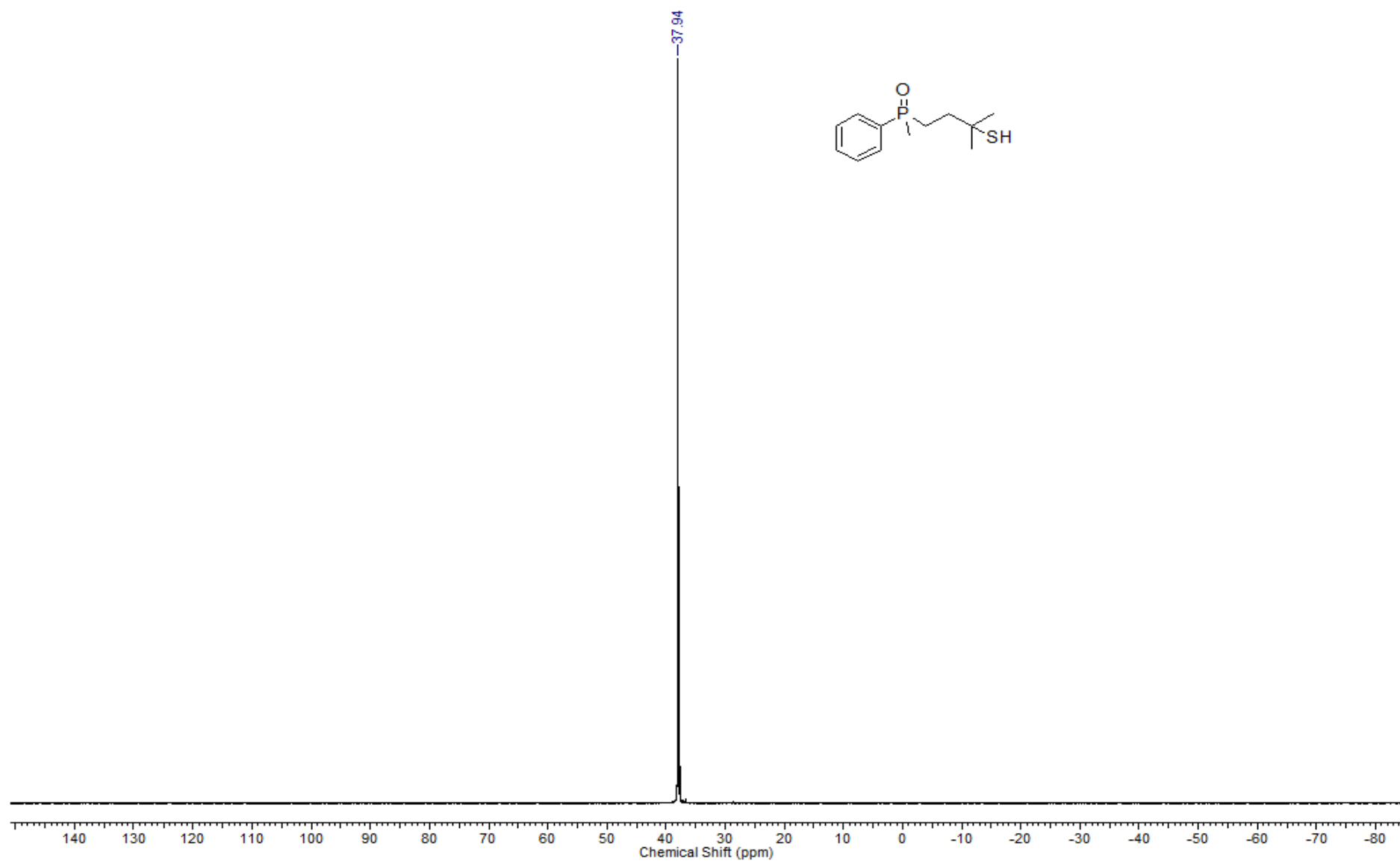
^{31}P NMR spectrum of (2-acetoxy-3-methylbutyl)methylphenylphosphine sulfide (**44**) (CDCl_3 , 202 MHz).



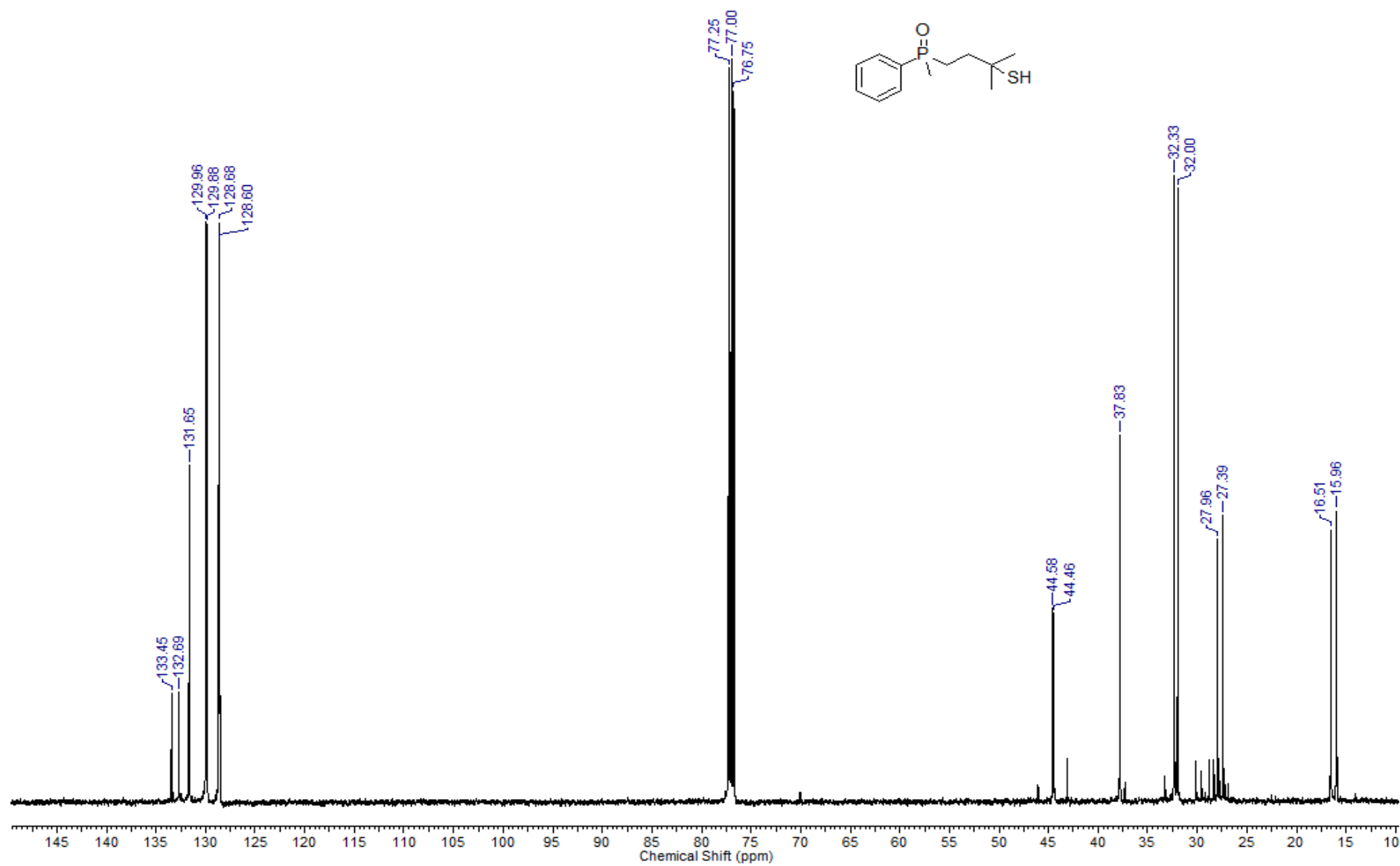
^{13}C NMR spectrum of (2-acetoxy-3-methylbutyl)methylphenylphosphine sulfide (**44**) (CDCl_3 , 126 MHz).



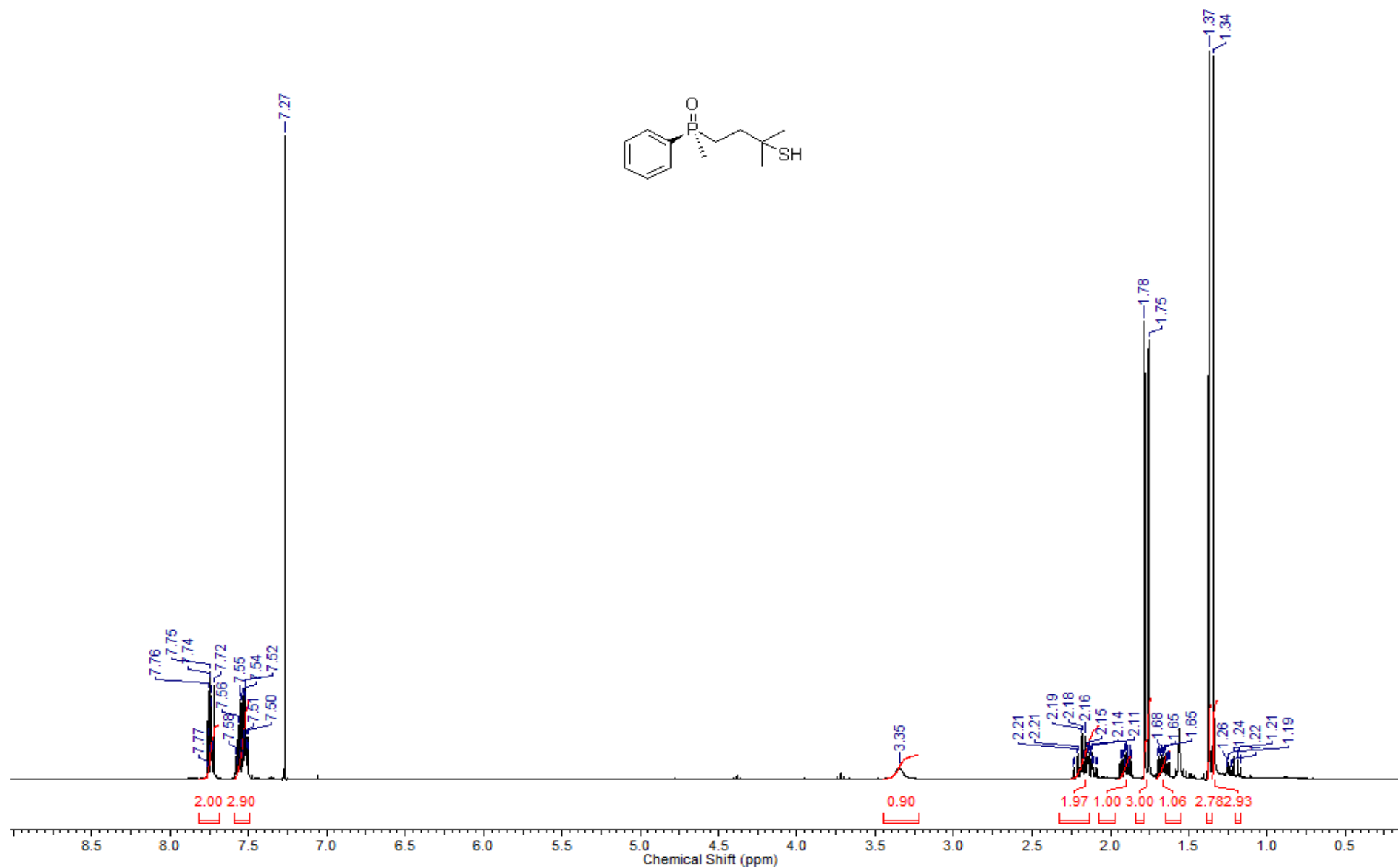
^1H NMR spectrum of (3-methyl-3-mercaptopbutyl)methylphenylphosphine oxide (**45**) (CDCl_3 , 500 MHz).



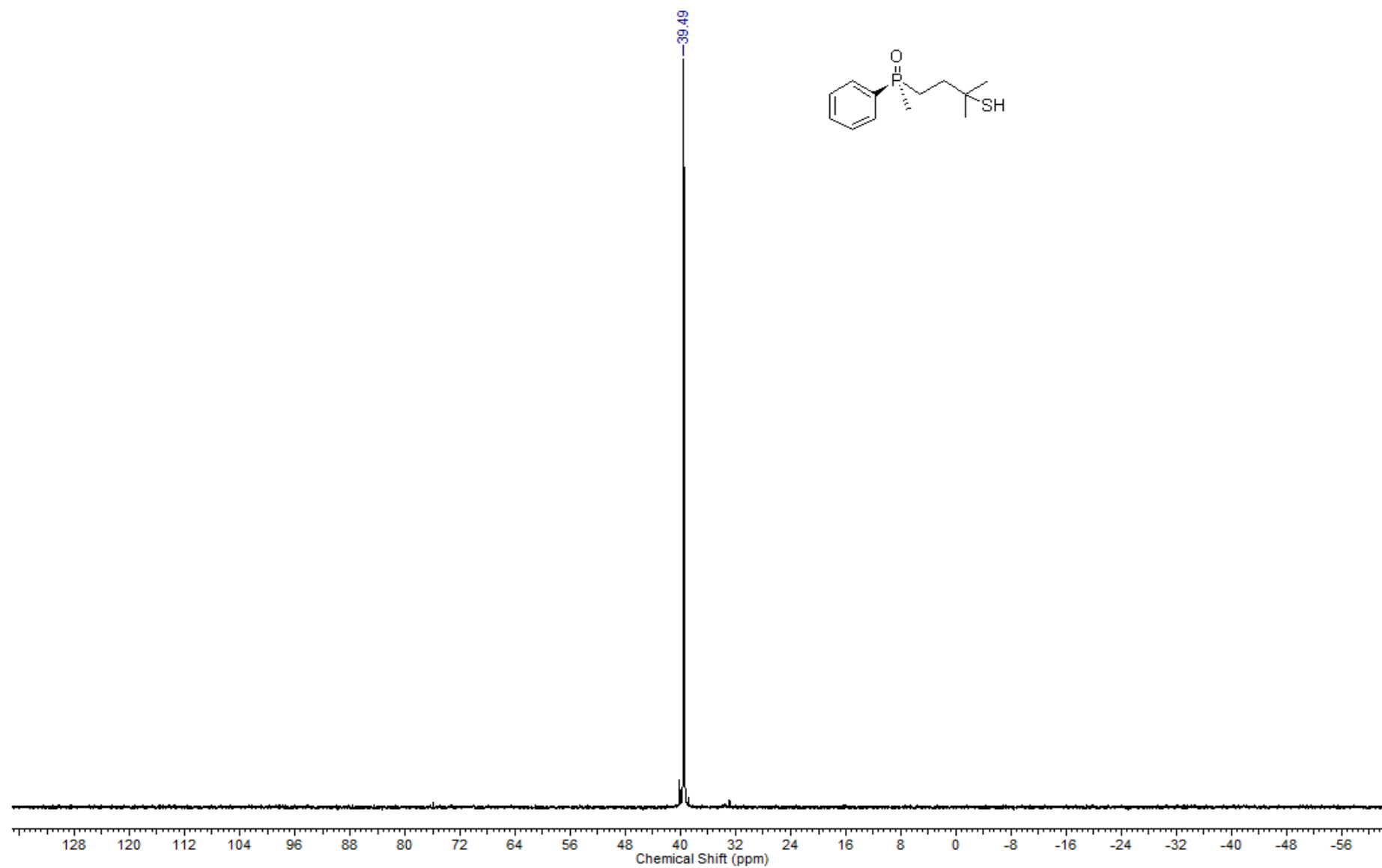
^{31}P NMR spectrum of (3-methyl-3-mercaptopbutyl)methylphenylphosphine oxide (**45**) (CDCl_3 , 202 MHz).



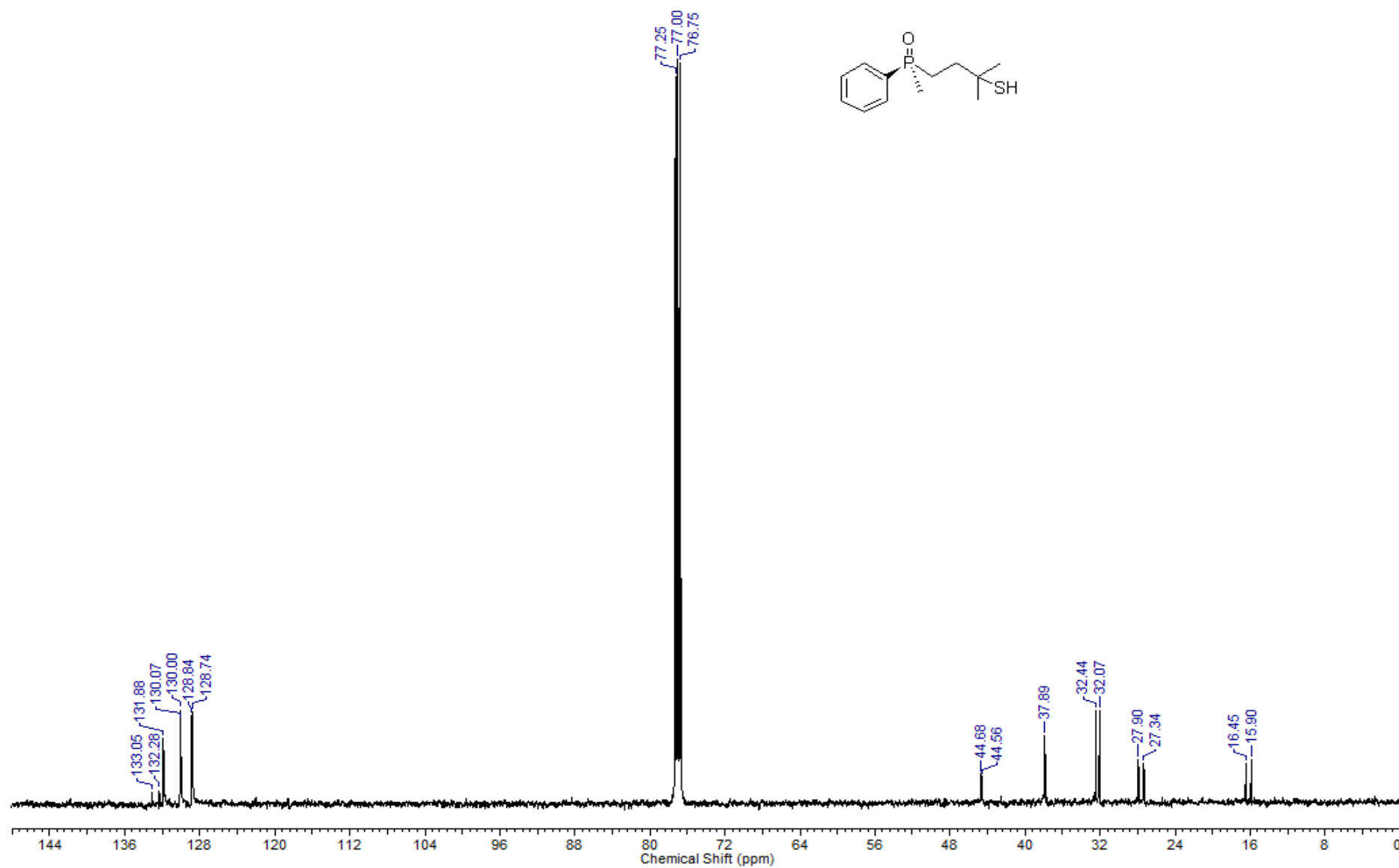
¹³C NMR spectrum of (3-methyl-3-mercaptopbutyl)methylphenylphosphine oxide (**45**) (CDCl₃, 126 MHz).



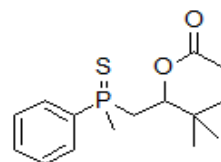
^1H NMR spectrum of (R_P) -(3-methyl-3-mercaptobutyl)methylphenylphosphine oxide (R_P)-(45) (CDCl₃, 500 MHz).



^{31}P NMR spectrum of (*R_P*)-(3-methyl-3-mercaptopbutyl)methylphenylphosphine oxide (*R_P*)-(45) (CDCl_3 , 202 MHz).

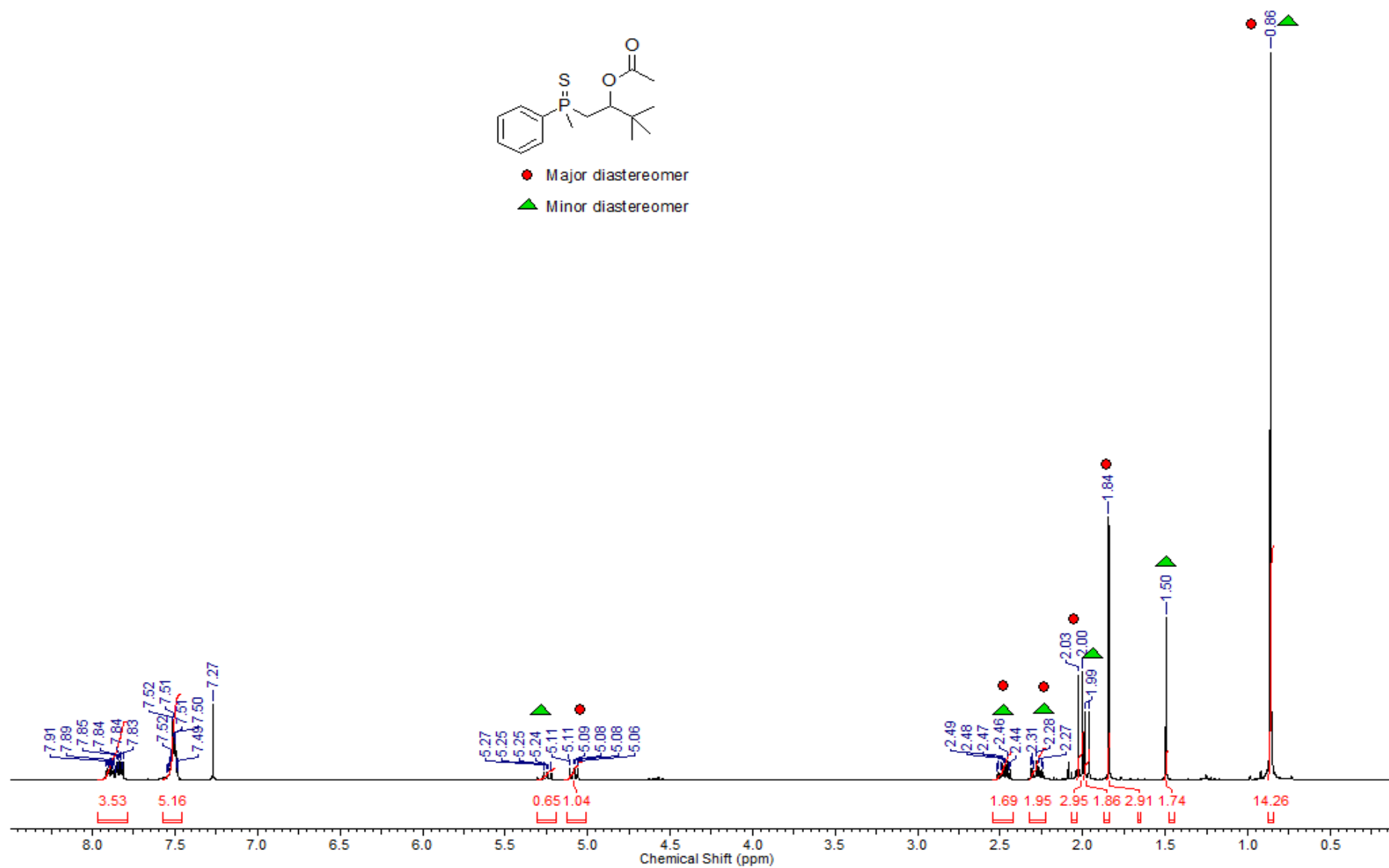


¹³C NMR spectrum of (*R_p*)-(3-methyl-3-mercaptopbutyl)methylphenylphosphine oxide (*R_p*)-(45) (CDCl₃, 126 MHz).

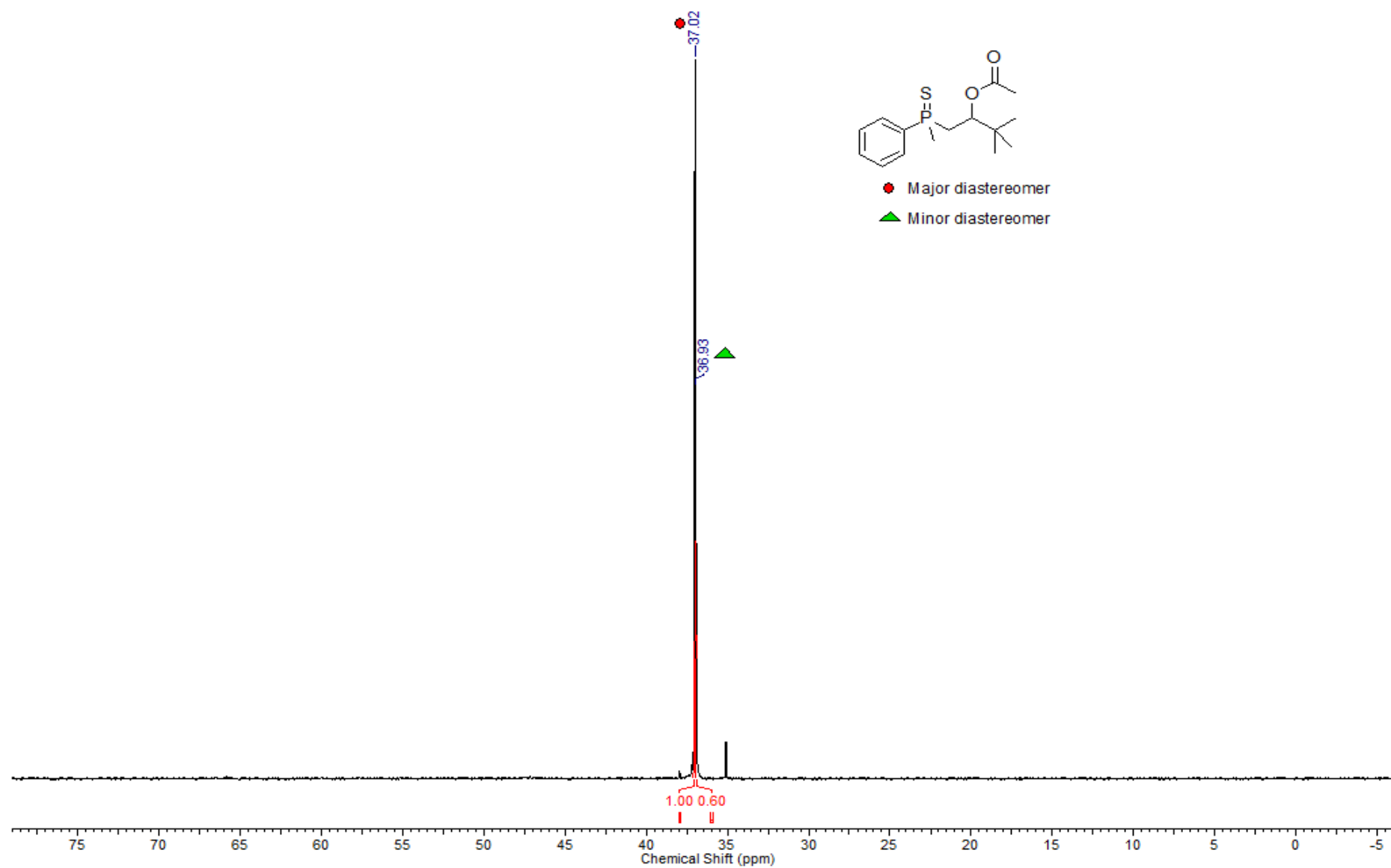


● Major diastereomer

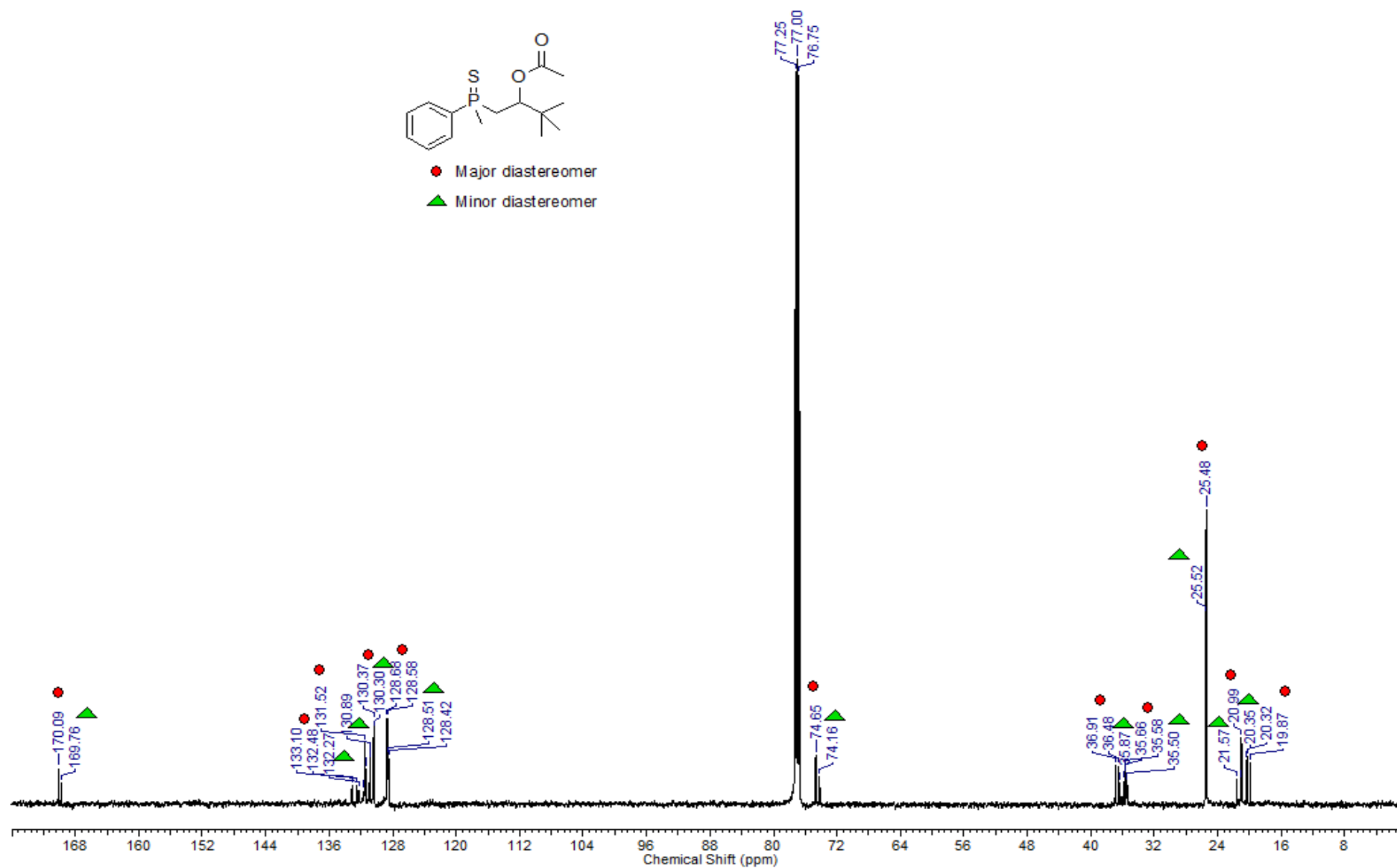
▲ Minor diastereomer



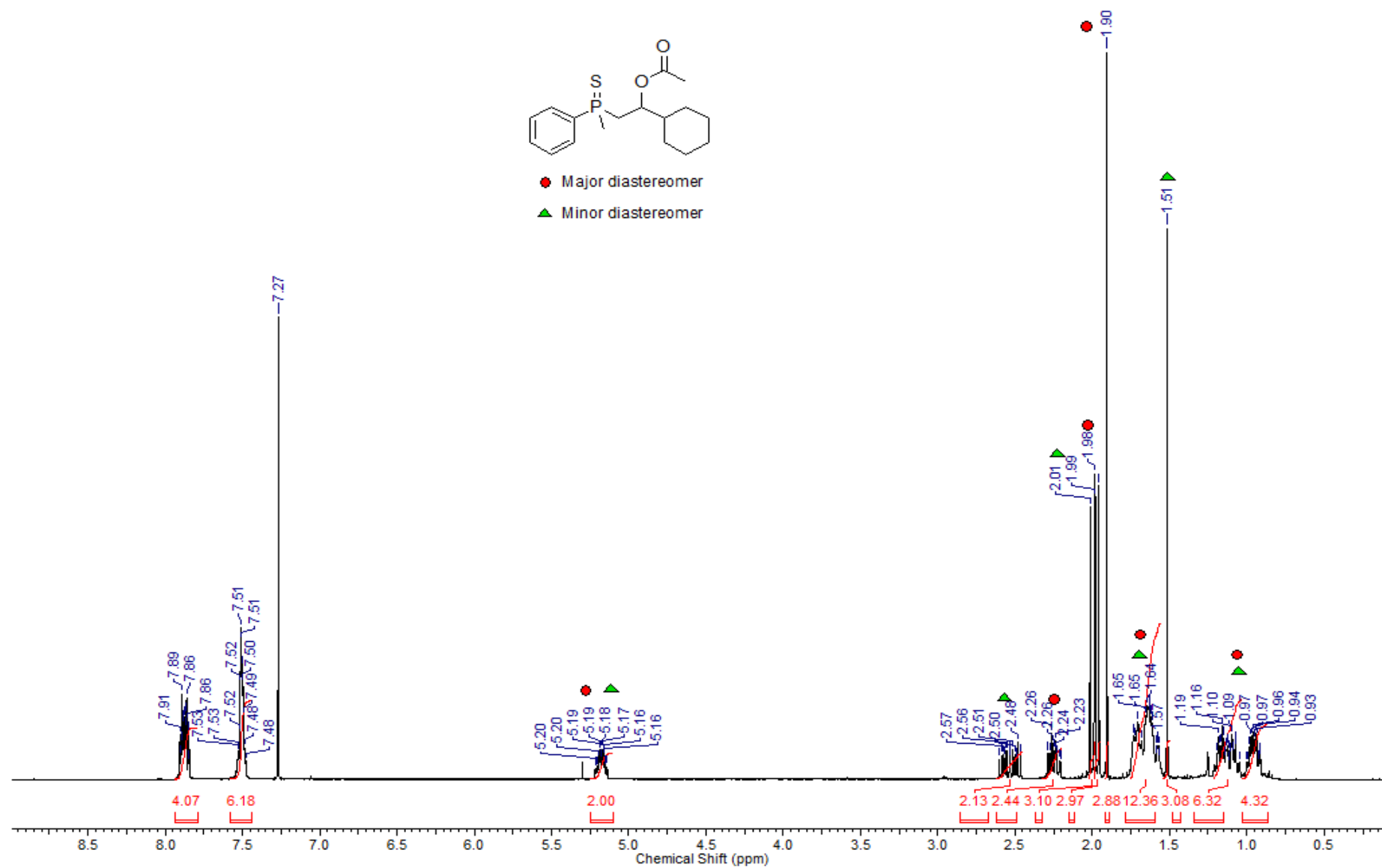
^1H NMR spectrum of (2-acetoxy-3,3-dimethylbutyl)methylphenylphosphine sulfide (**46**) (CDCl_3 , 500 MHz).



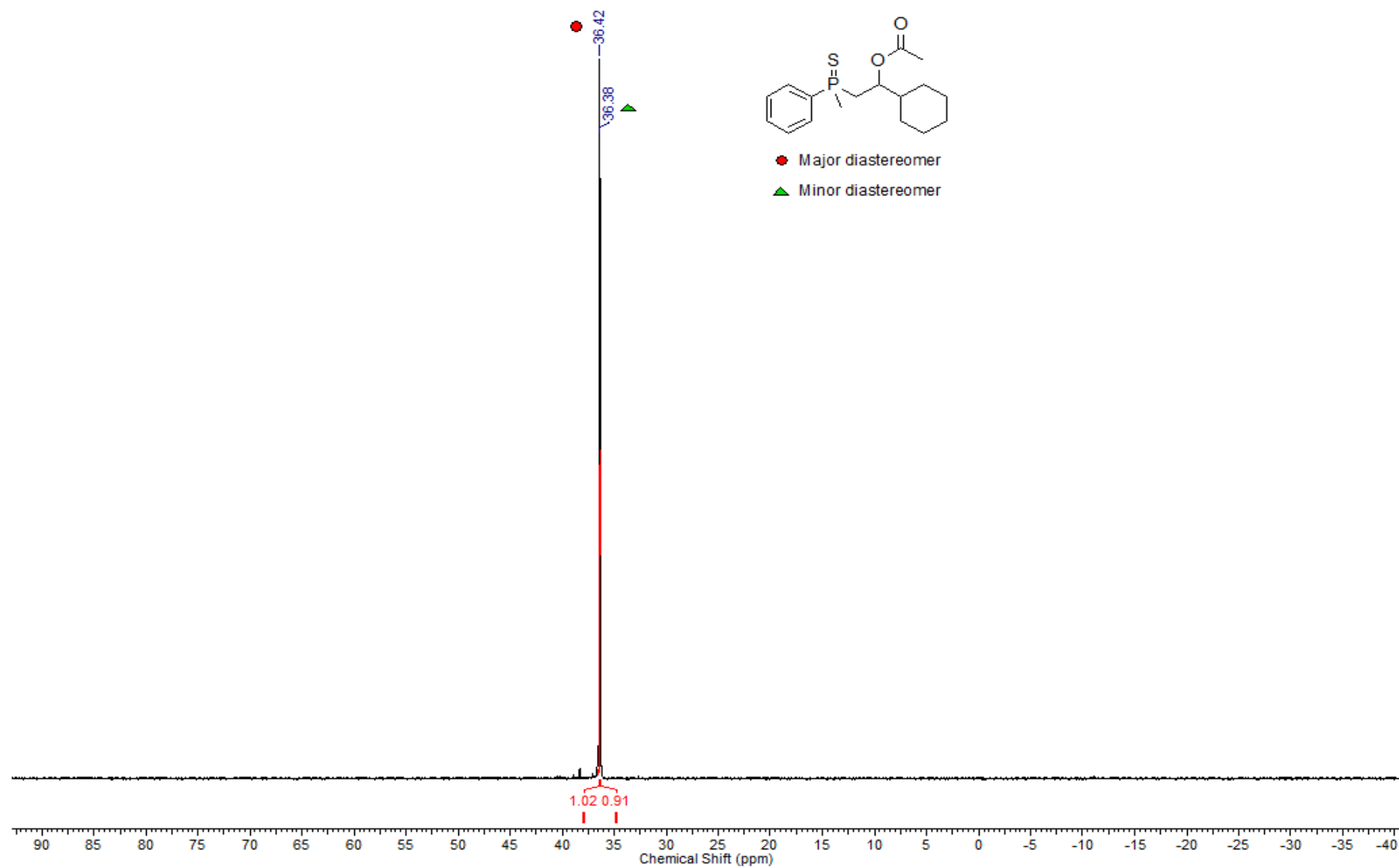
^{31}P NMR spectrum of (2-acetoxy-3,3-dimethylbutyl)methylphenylphosphine sulfide (**46**) (CDCl_3 , 202 MHz).



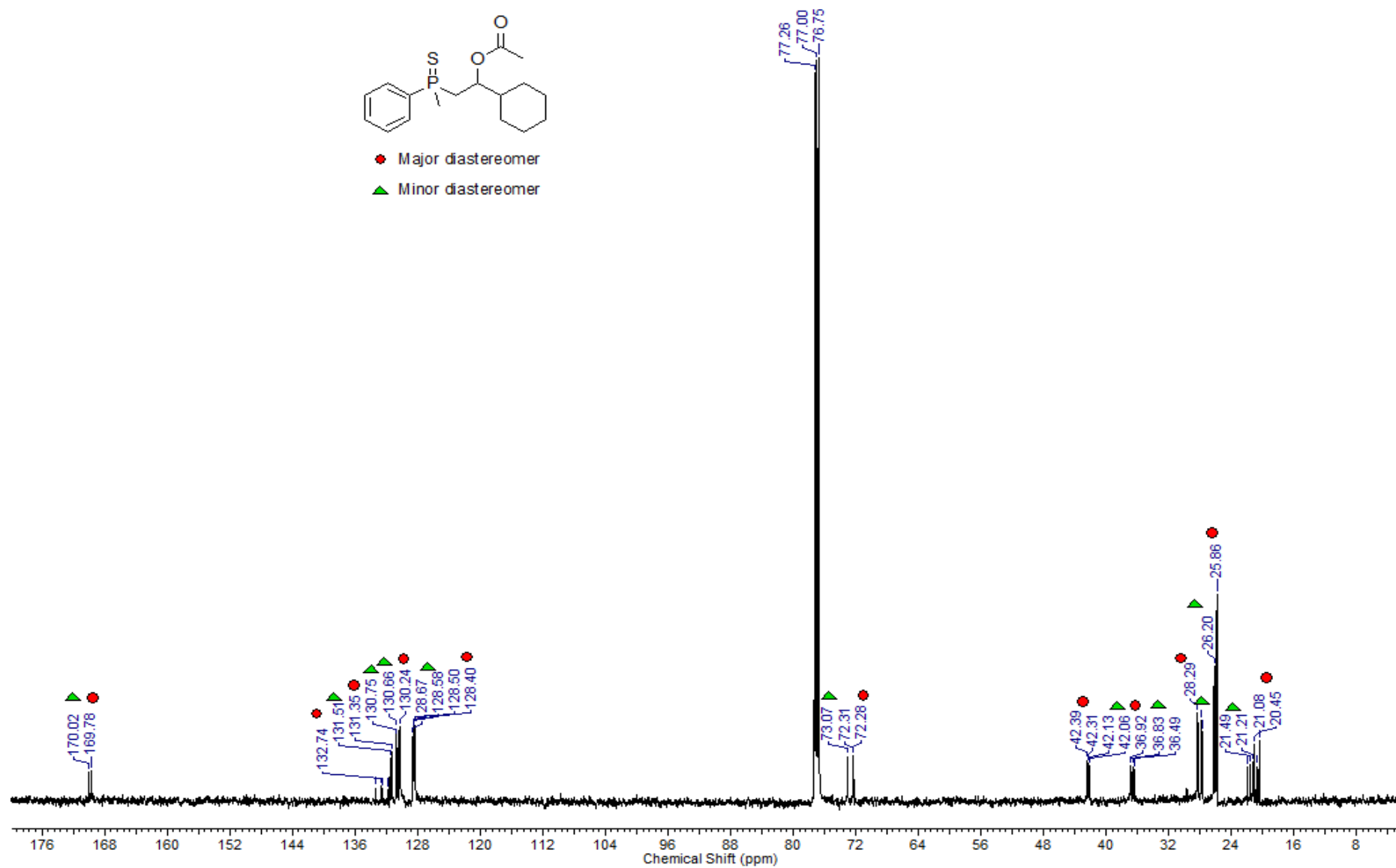
¹³C NMR spectrum of (2-acetoxy-3,3-dimethylbutyl)methylphenylphosphine sulfide (**46**) (CDCl₃, 126 MHz).



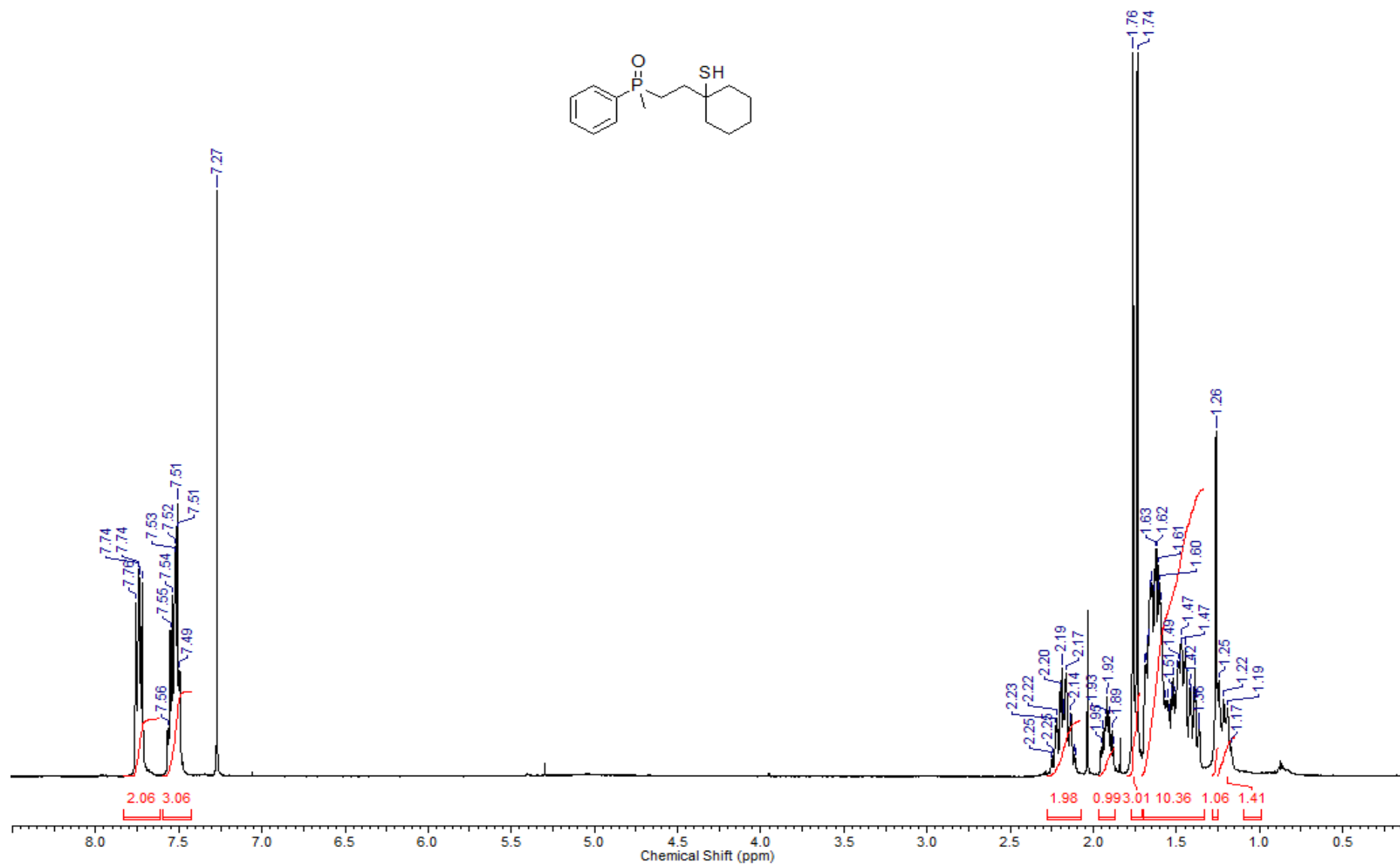
^1H NMR spectrum of (2-acetoxy-2-cyclohexylethyl)methylphenylphosphine sulfide (**47**) (CDCl_3 , 500 MHz).



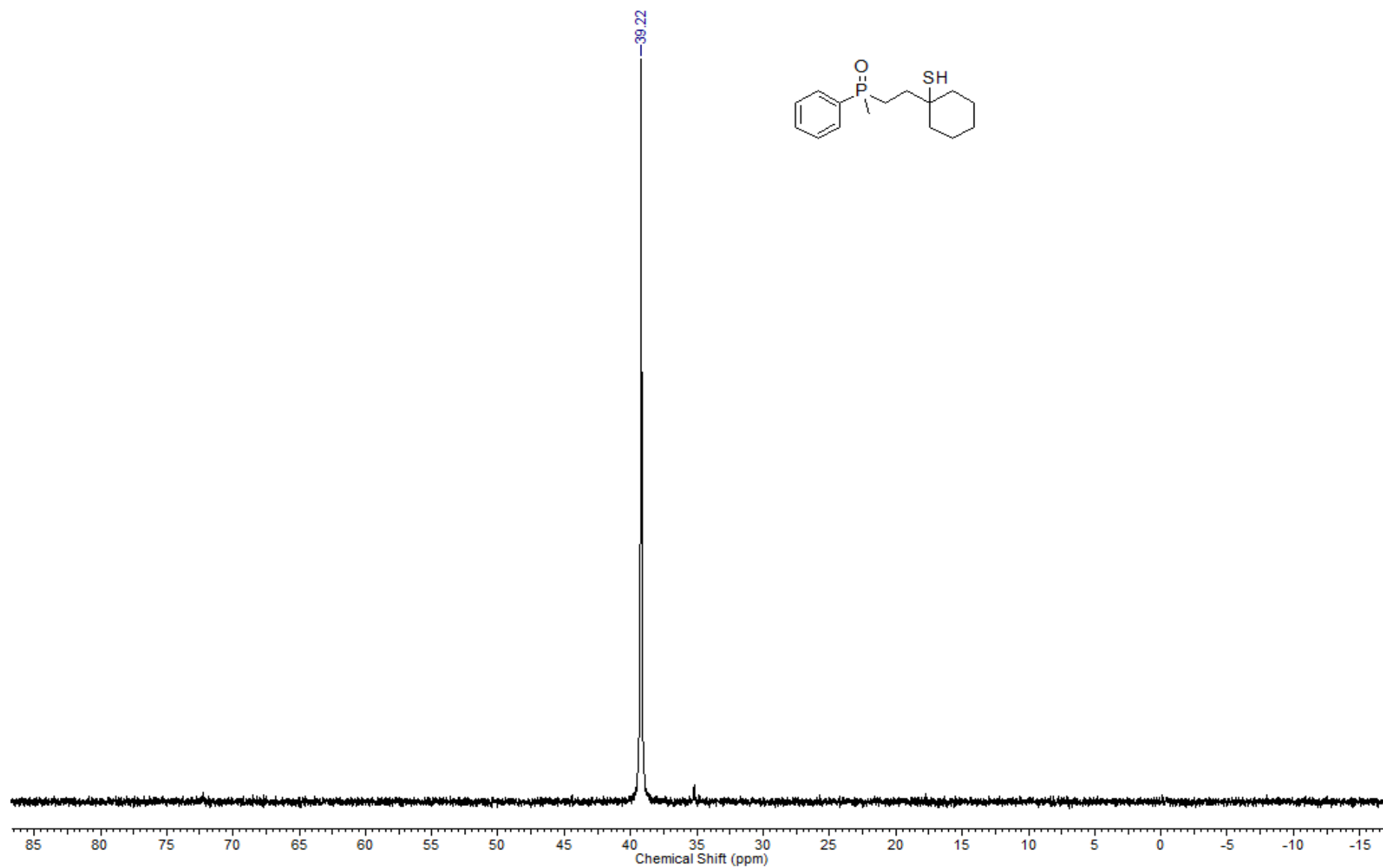
^{31}P NMR spectrum of (2-acetoxy-2-cyclohexylethyl)methylphenylphosphine sulfide (**47**) (CDCl_3 , 202 MHz).



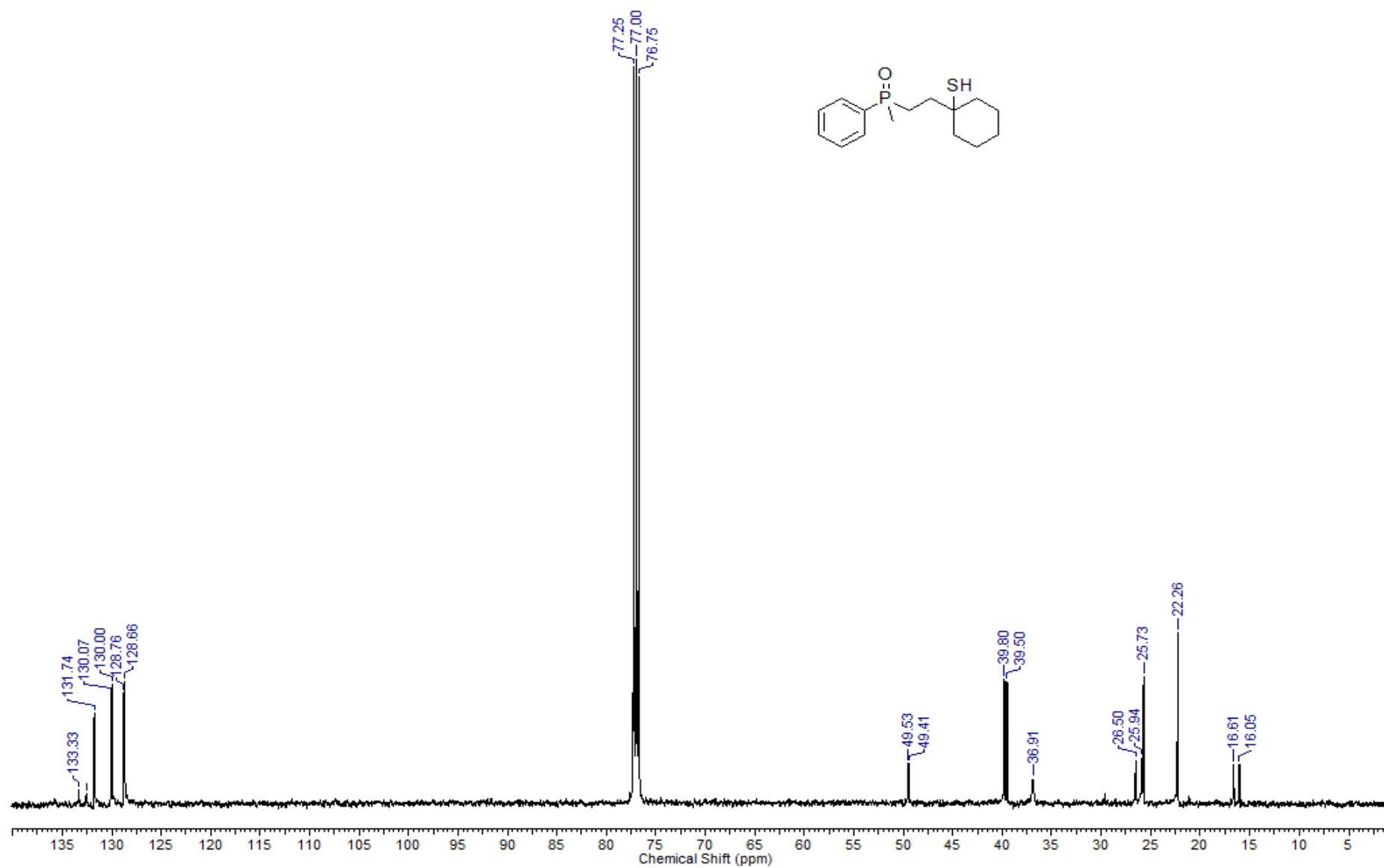
¹³C NMR spectrum of (2-acetoxy-2-cyclohexylethyl)methylphenylphosphine sulfide (47) (CDCl₃, 126 MHz).



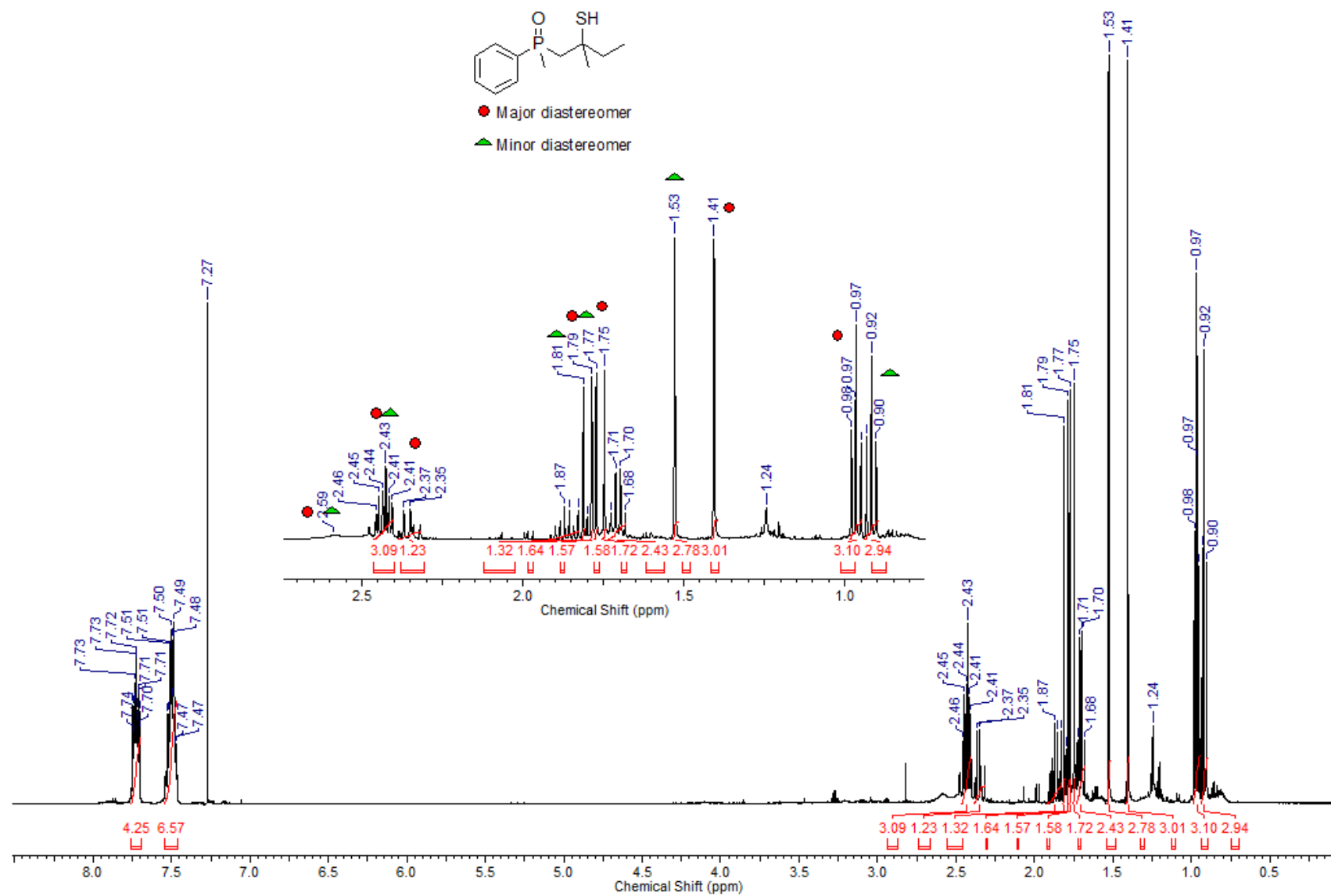
¹H NMR spectrum of [(1-mercapto)cyclohexylethyl]methylphenylphosphine sulfide (**48**) (CDCl₃, 500 MHz).



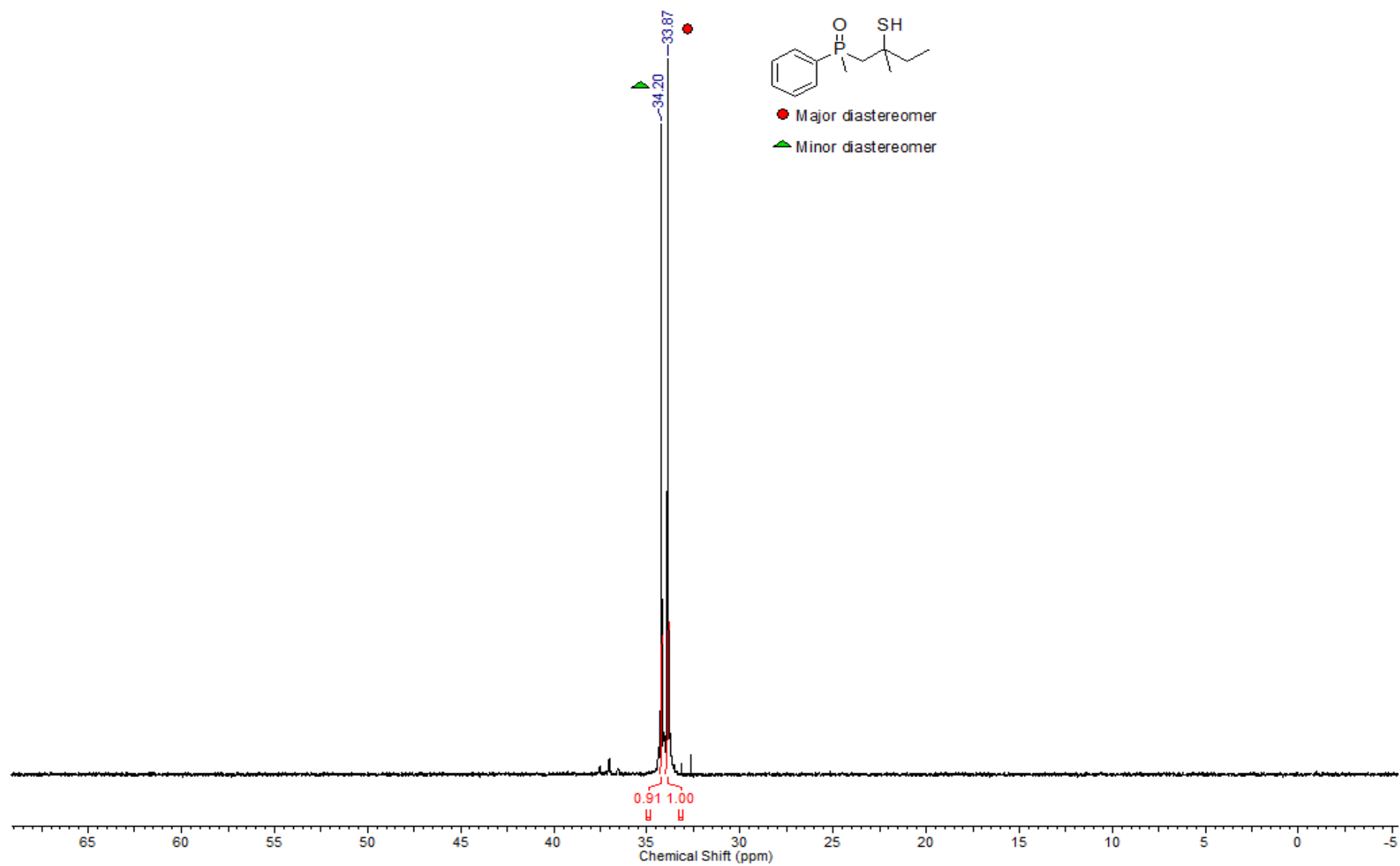
^{31}P NMR spectrum of [(1-mercapto)cyclohexylethyl]methylphenylphosphine sulfide (**48**) (CDCl_3 , 202 MHz).



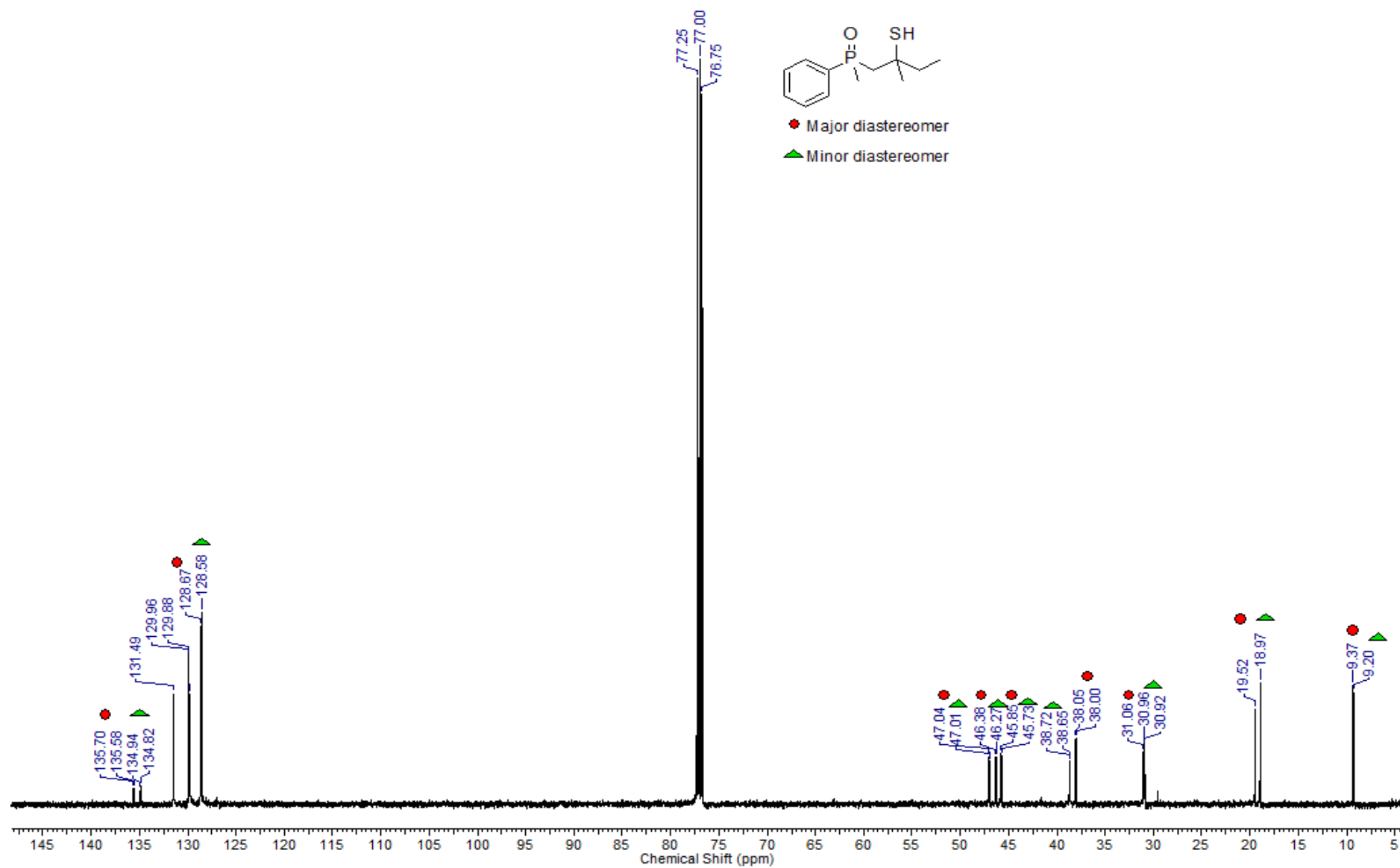
¹³C NMR spectrum of [(1-mercapto)cyclohexylethyl]methylphenylphosphine sulfide (**48**) (CDCl₃, 126 MHz).



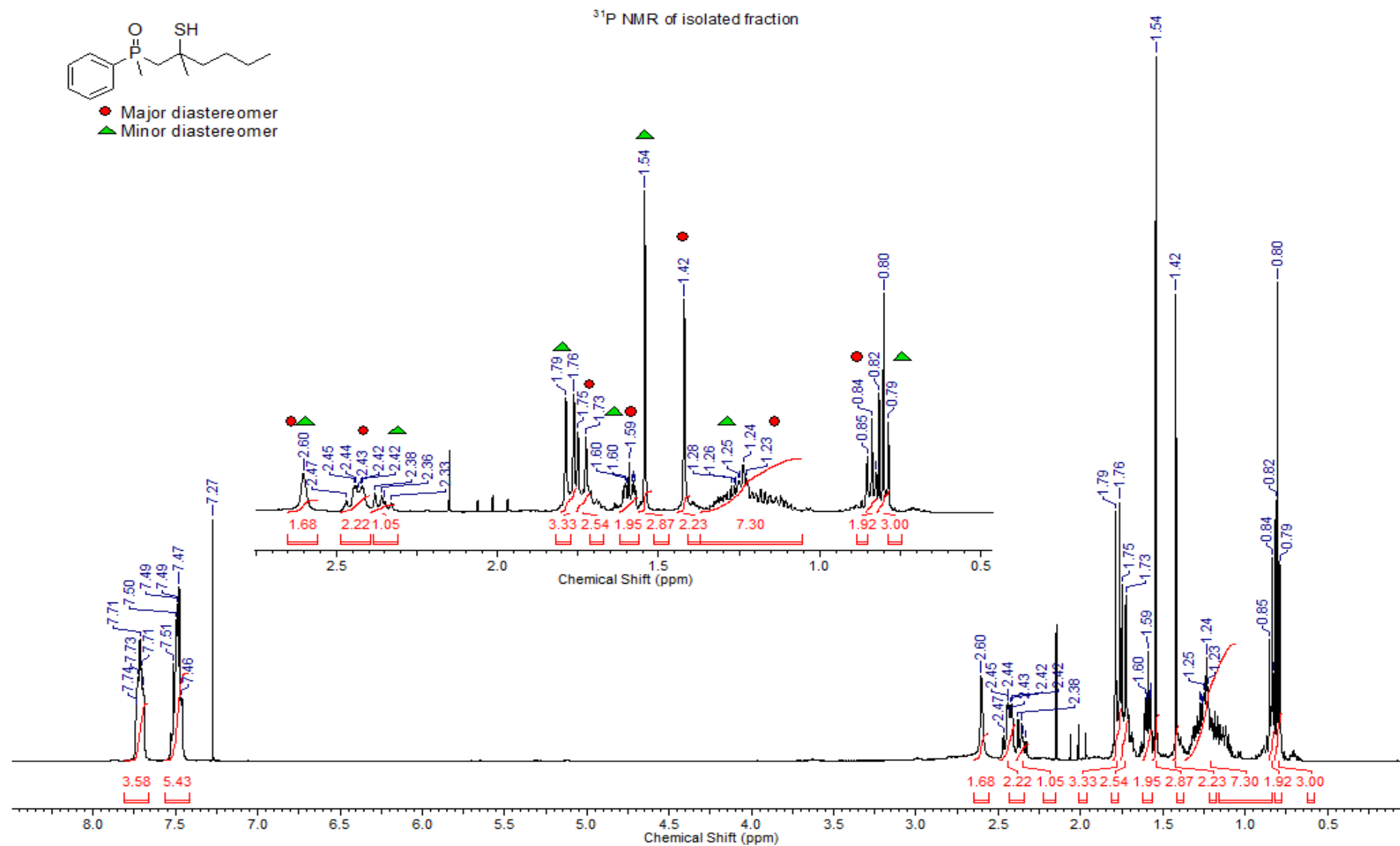
^1H NMR spectrum of (2-methyl-2-mercaptobutyl)methylphenylphosphine oxide (**49**) (CDCl_3 , 500 MHz).



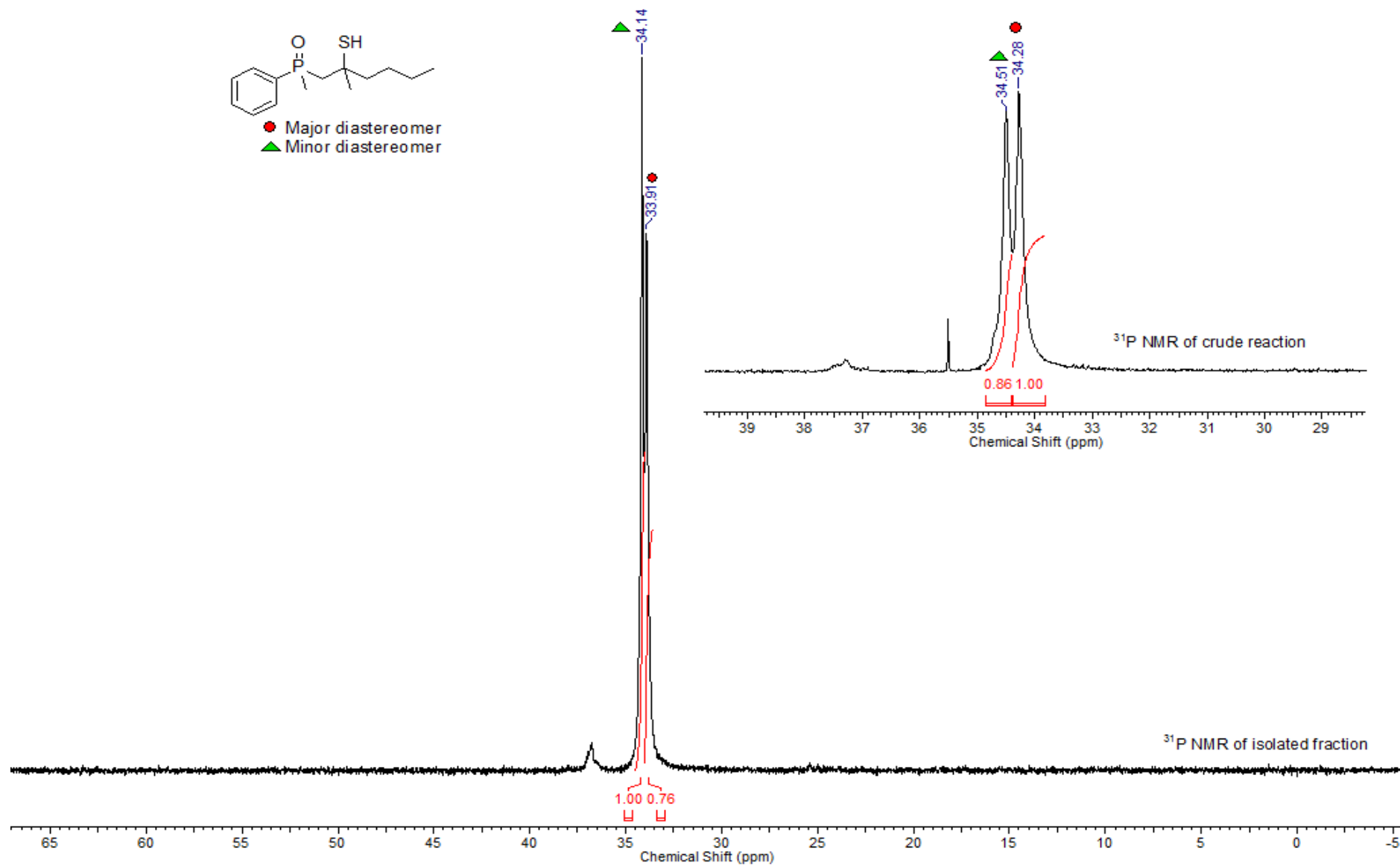
^{31}P NMR spectrum of (2-methyl-2-mercaptobutyl)methylphenylphosphine oxide (**49**) (CDCl_3 , 202 MHz).



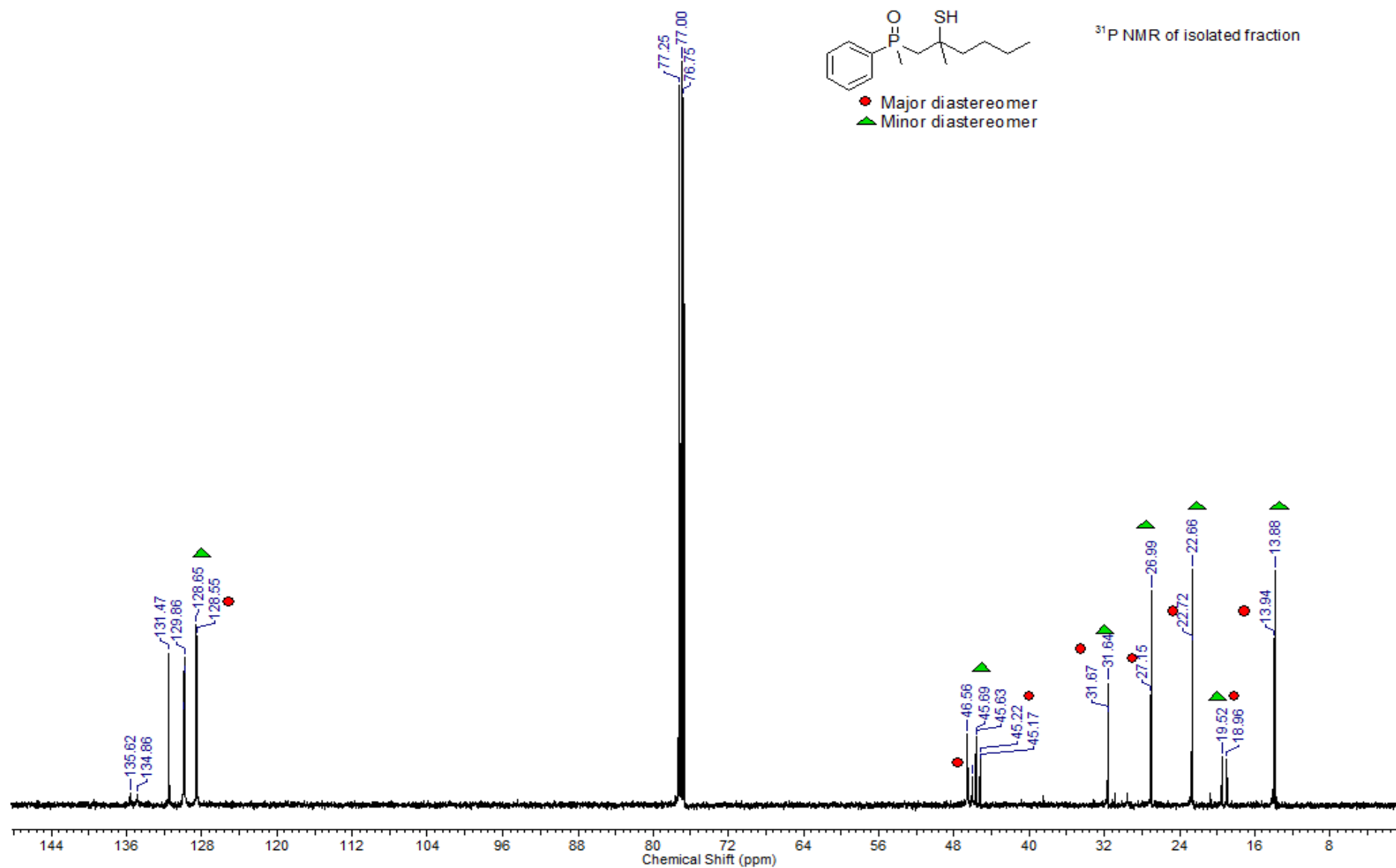
¹³C NMR spectrum of (2-methyl-2-mercaptobutyl)methylphenylphosphine oxide (**49**) (CDCl₃, 126 MHz).



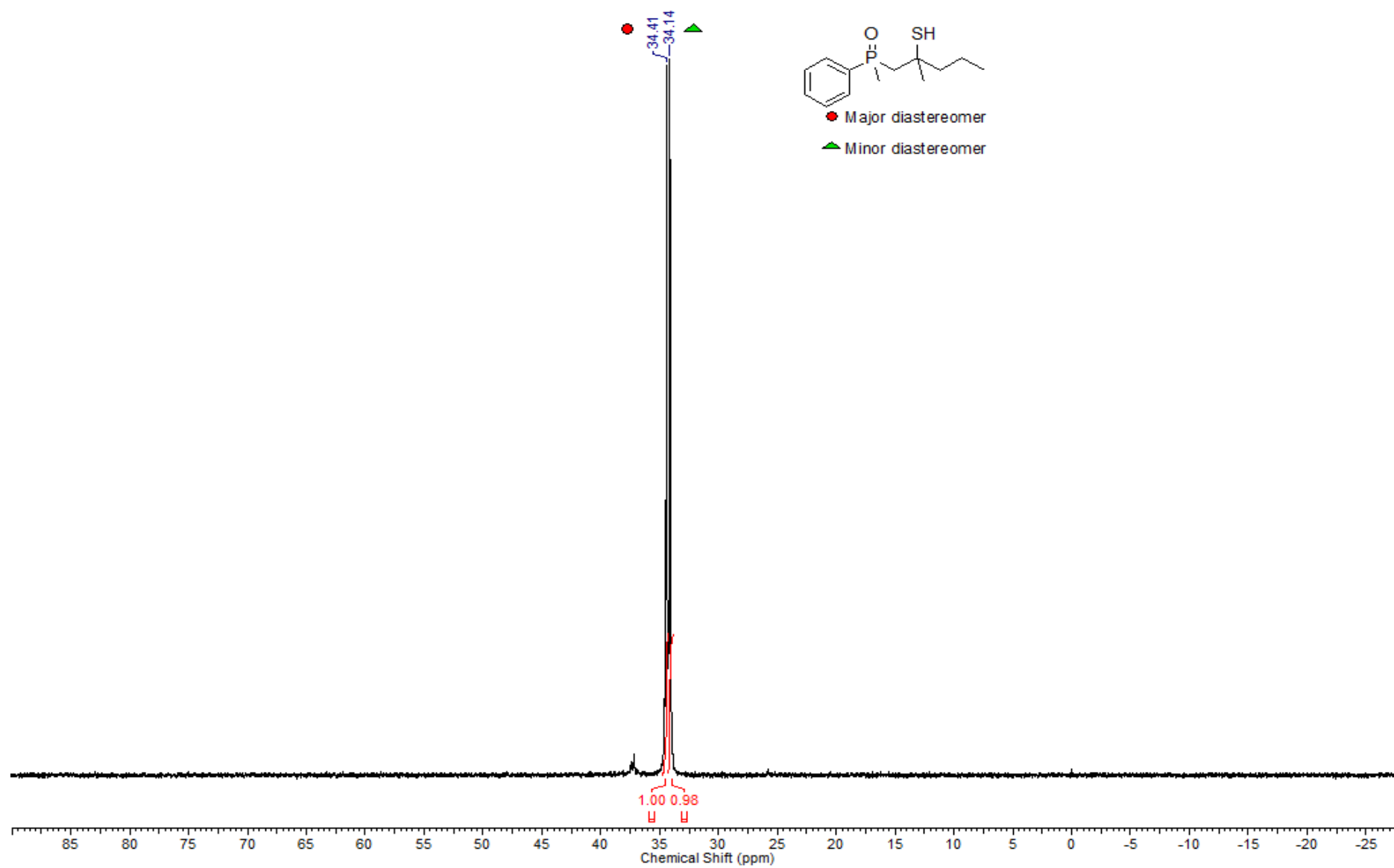
¹H NMR spectrum of (2-methyl-2-mercaptohexyl)methylphenylphosphine oxide (**50**) (CDCl₃, 500 MHz).



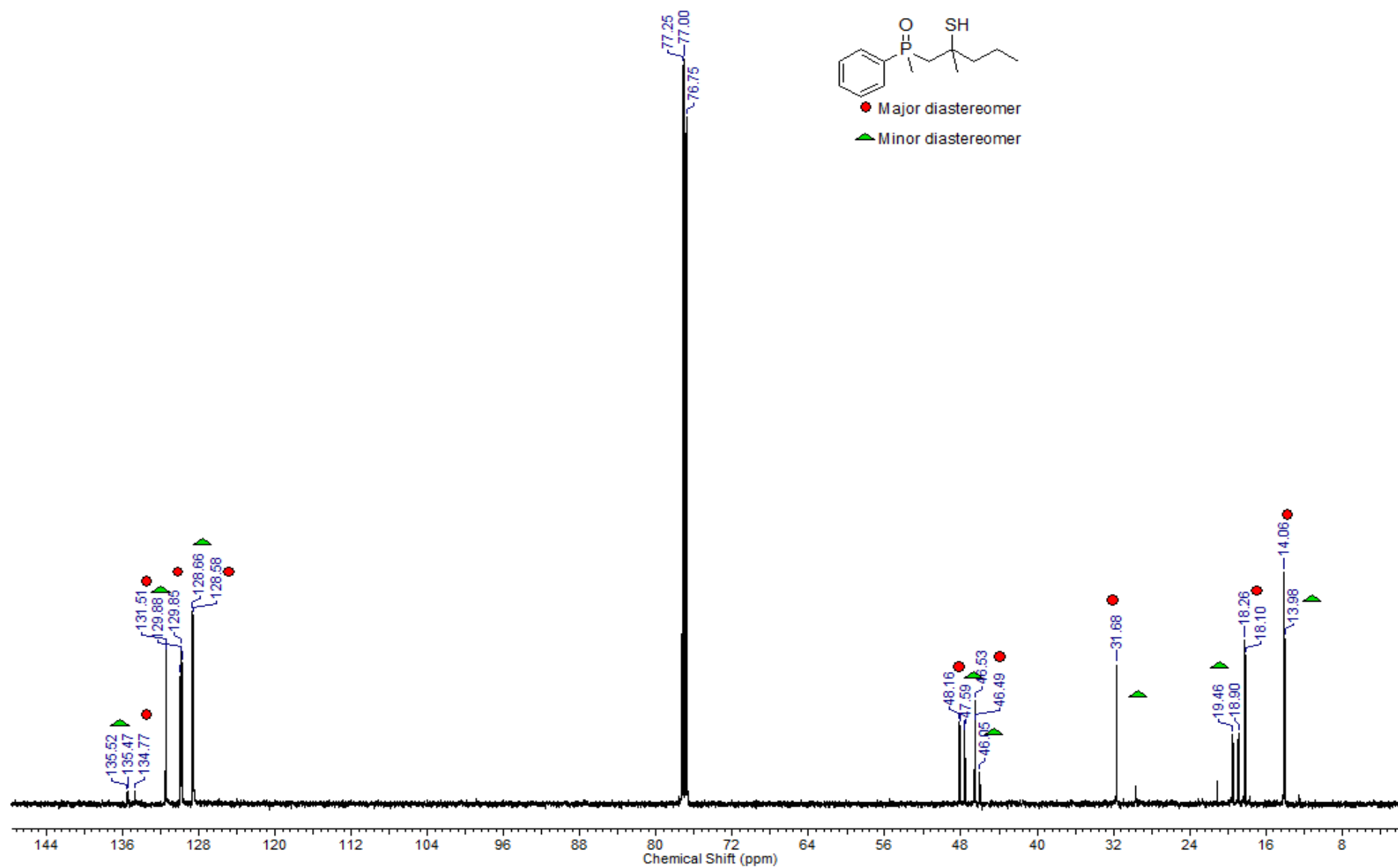
³¹P NMR spectrum of (2-methyl-2-mercaptohexyl)methylphenylphosphine oxide (**50**) (CDCl₃, 202 MHz).



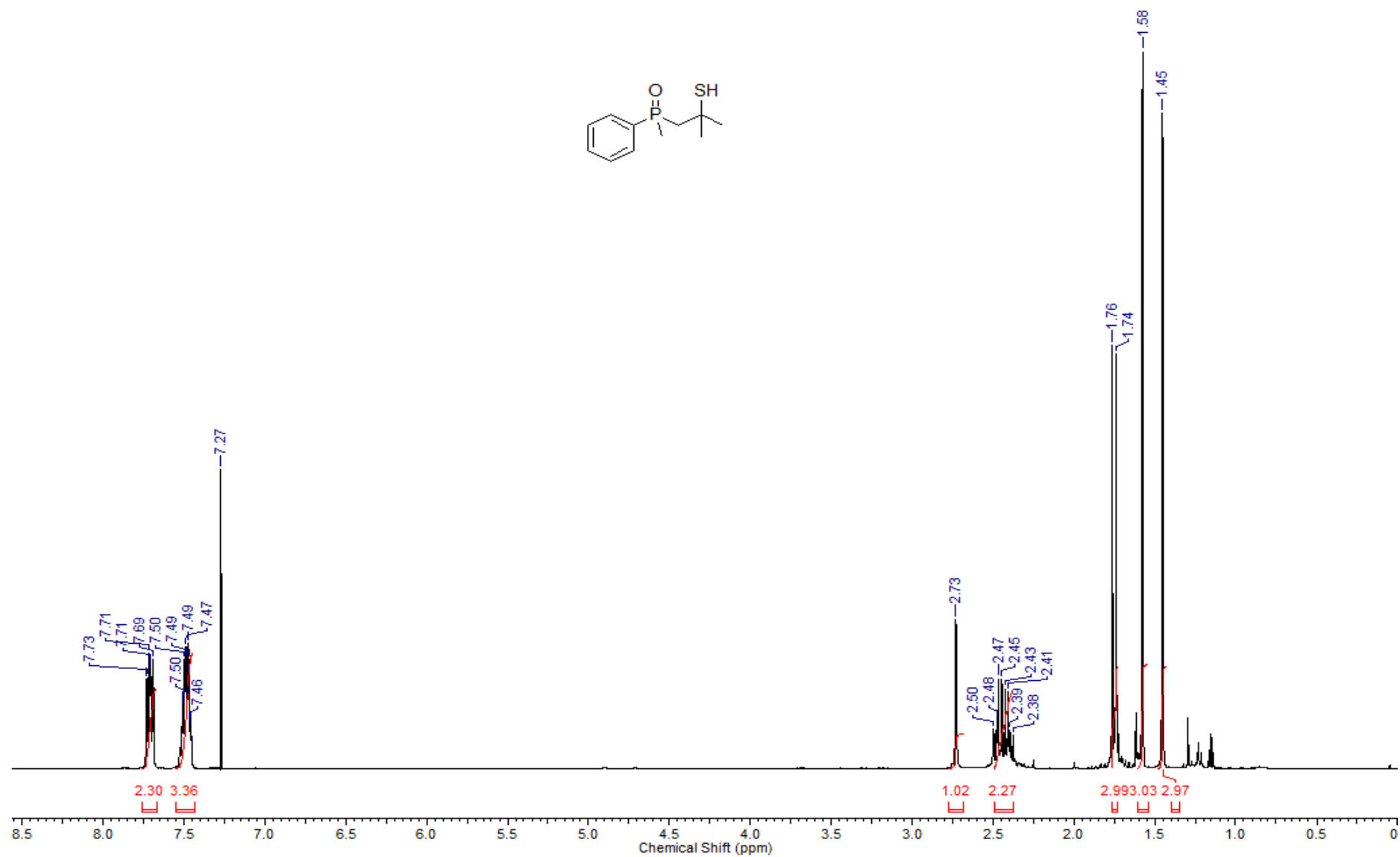
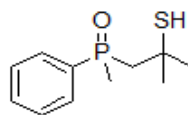
¹³C NMR spectrum of (2-methyl-2-mercaptohexyl)methylphenylphosphine oxide (**50**) (CDCl₃, 126 MHz).



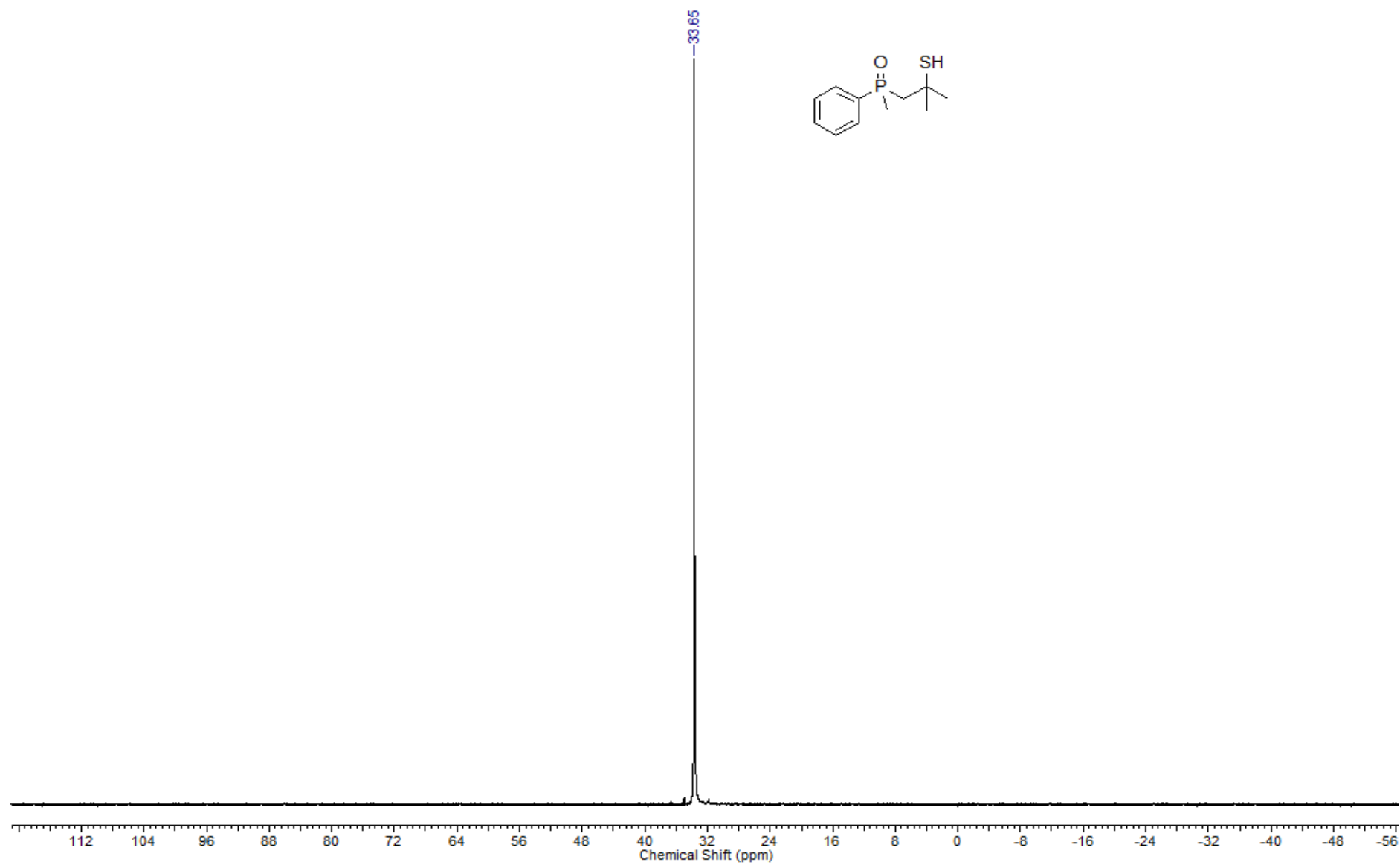
^{31}P NMR spectrum of (2-methyl-2-mercaptopentyl)methylphenylphosphine oxide (**51**) (CDCl_3 , 202 MHz).



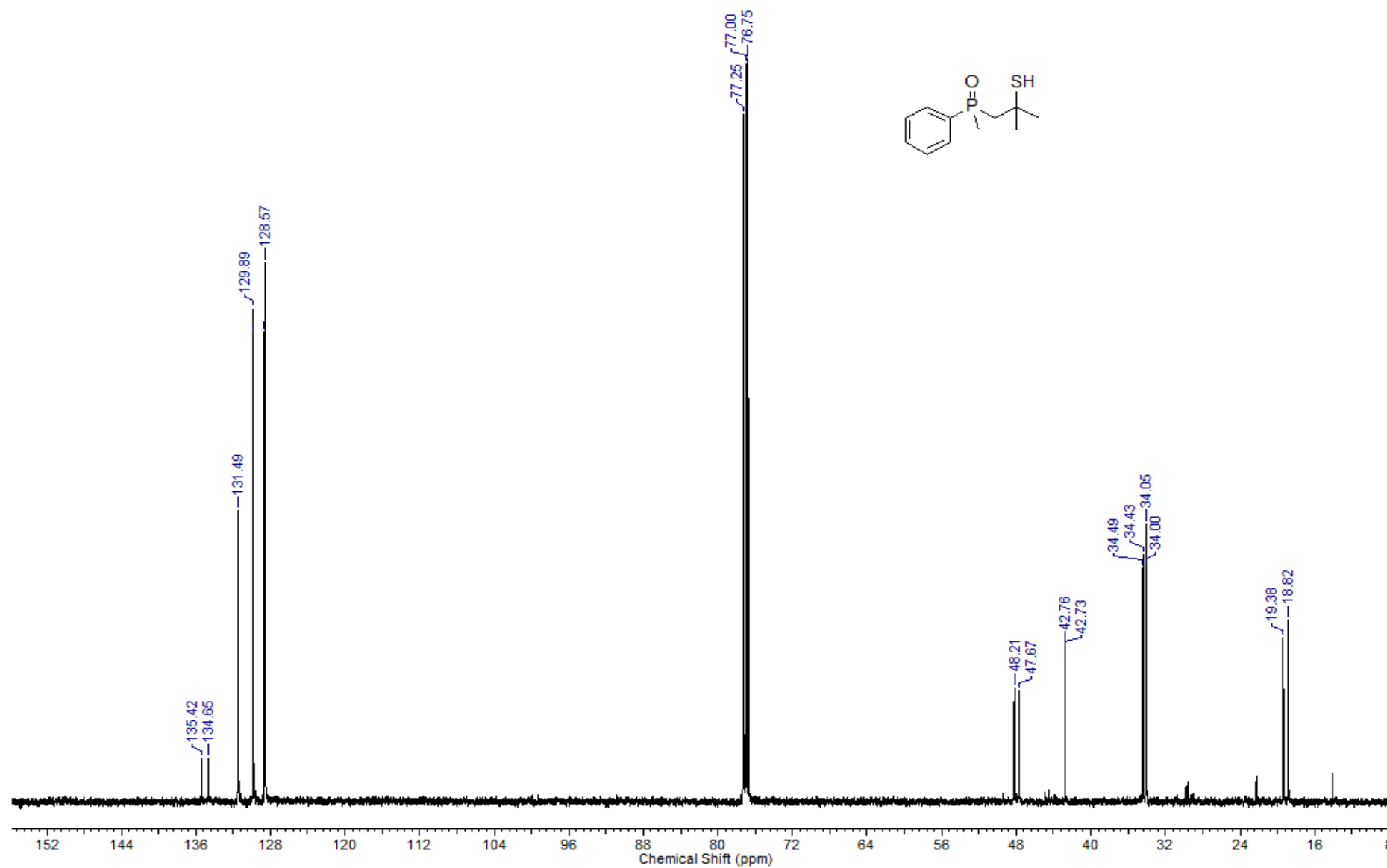
¹³C NMR spectrum of (2-methyl-2-mercaptopentyl)methylphenylphosphine oxide (**51**) (CDCl₃, 126 MHz).



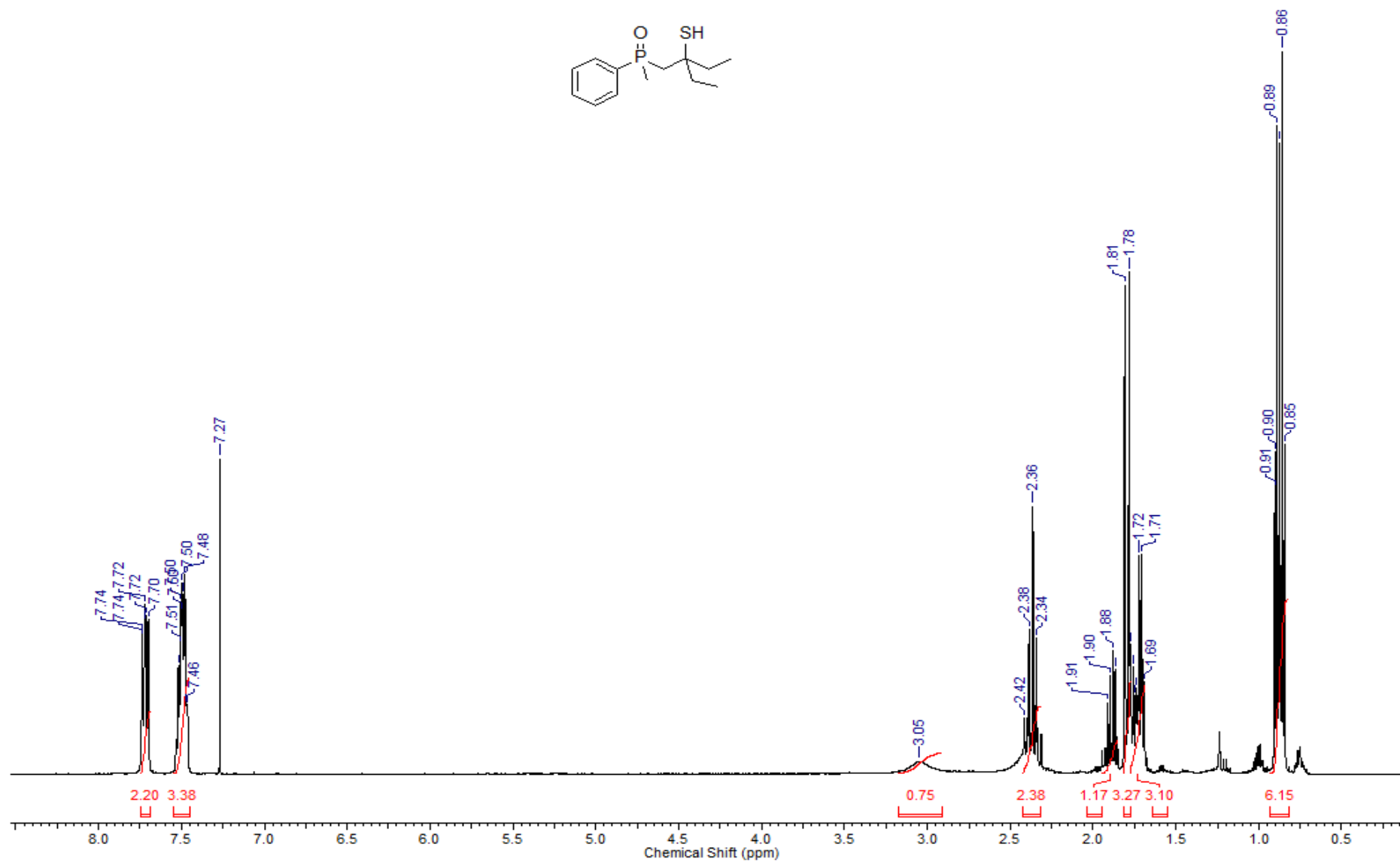
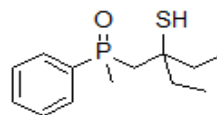
^1H NMR spectrum of (2-methyl-2-mercaptopropyl)methylphenylphosphine oxide (**52**) (CDCl_3 , 500 MHz).



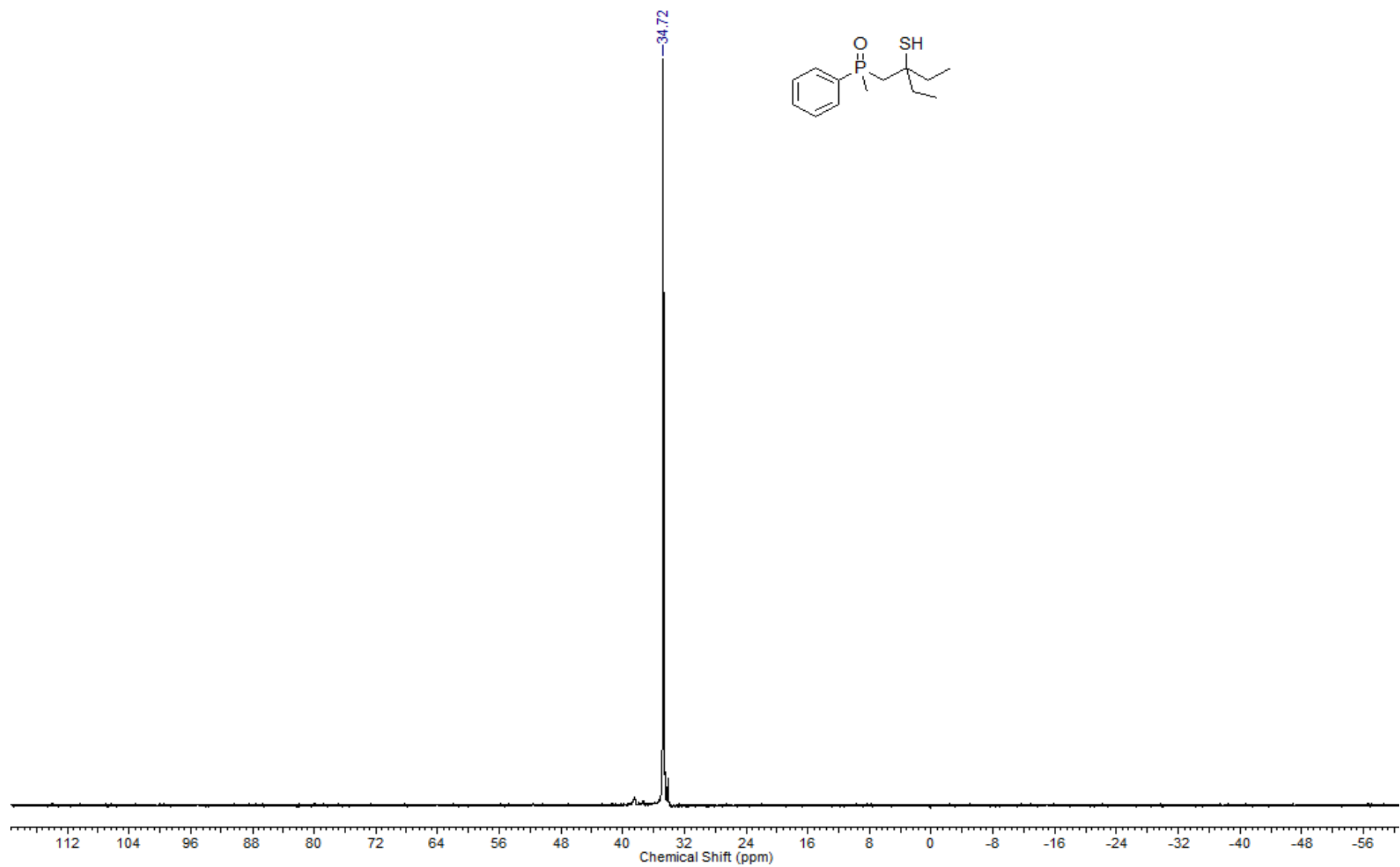
^{31}P NMR spectrum of (2-methyl-2-mercaptopropyl)methylphenylphosphine oxide (**52**) (CDCl_3 , 202 MHz).



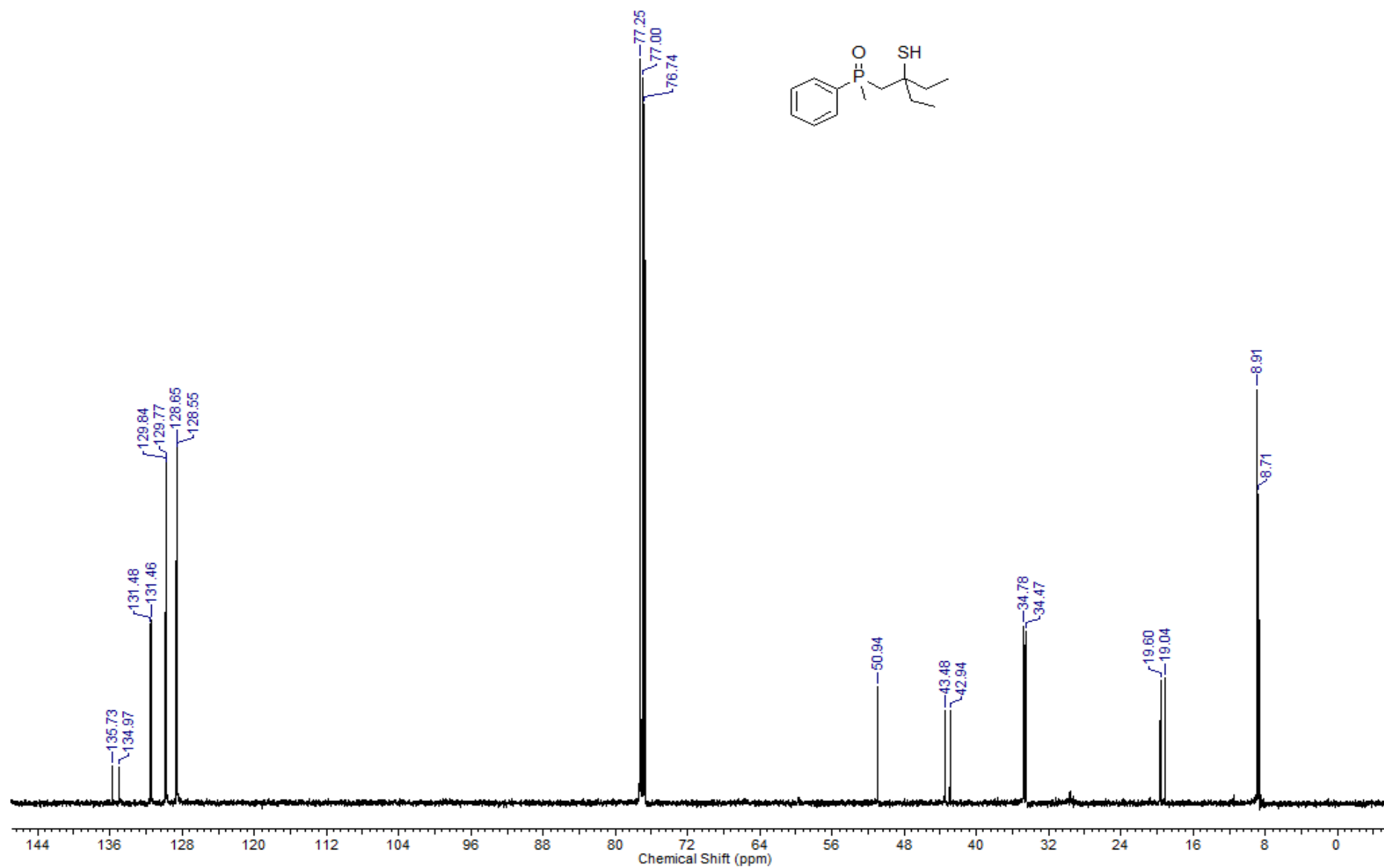
^{13}C NMR spectrum of (2-methyl-2-mercaptopropyl)methylphenylphosphine oxide (**52**) (CDCl_3 , 126 MHz).



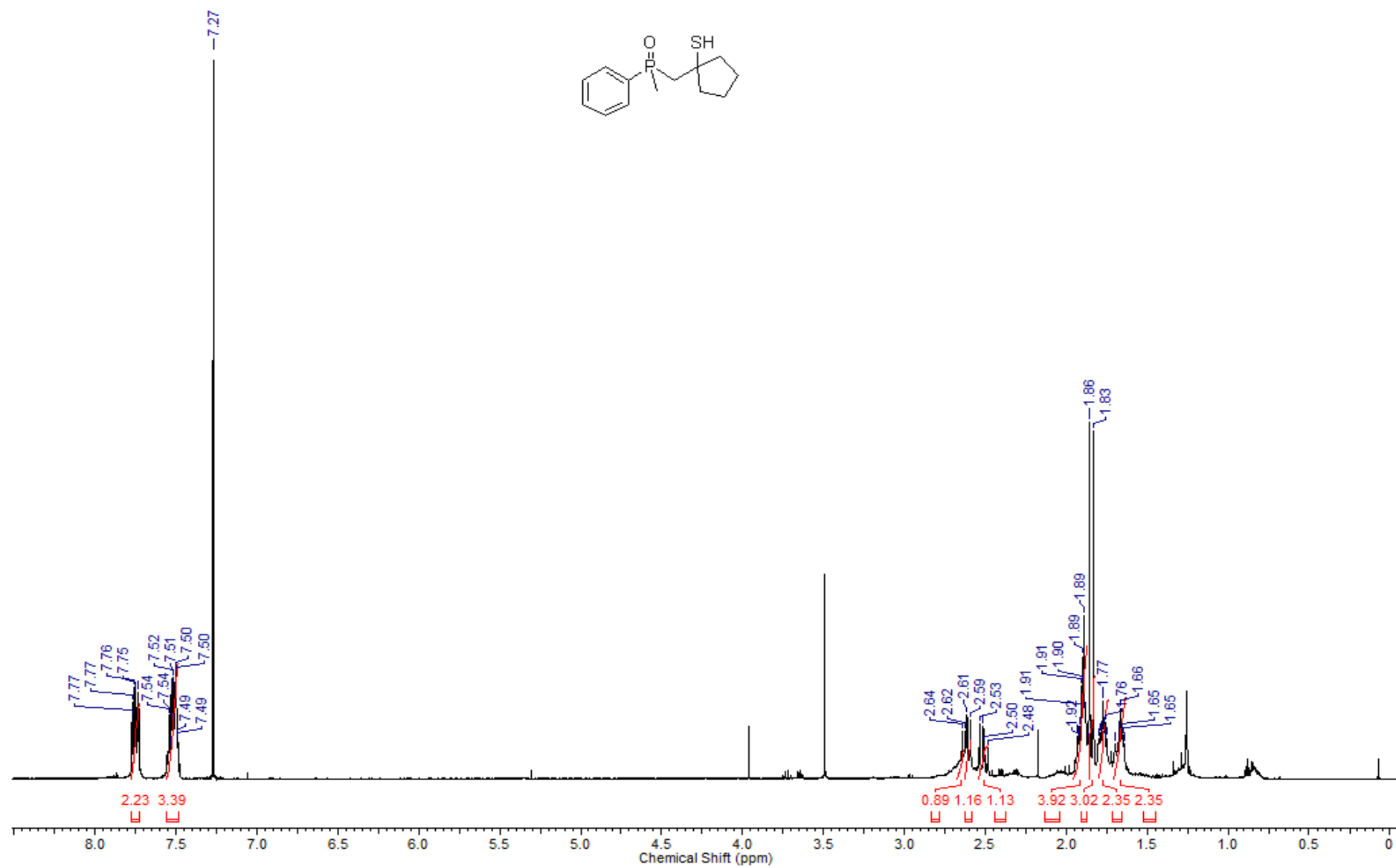
^1H NMR spectrum of (2-ethyl-2-mercaptobutyl)methylphenylphosphine oxide (**53**) (CDCl_3 , 500 MHz).



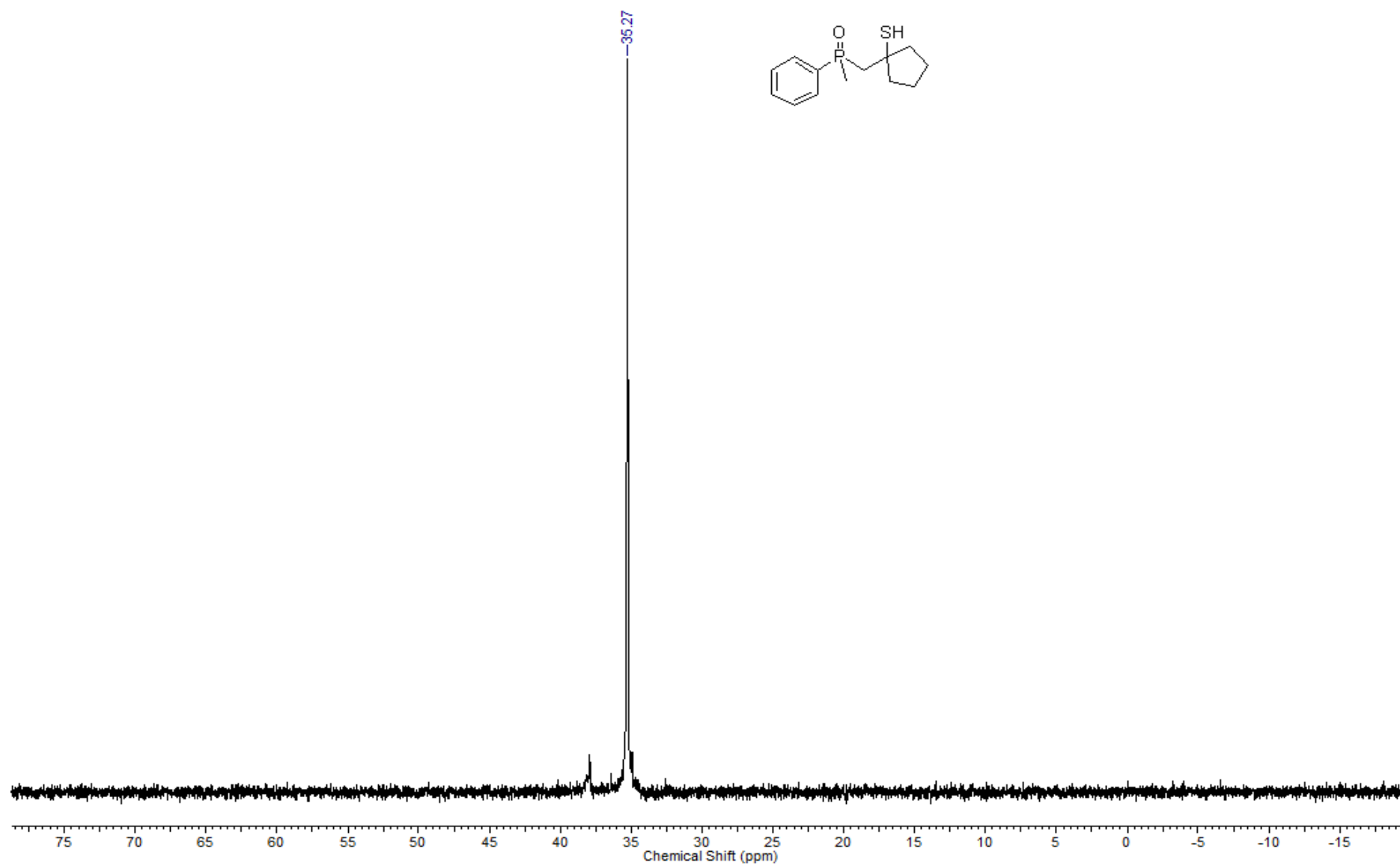
^{31}P NMR spectrum of (2-ethyl-2-mercaptobutyl)methylphenylphosphine oxide (**53**) (CDCl_3 , 202 MHz).



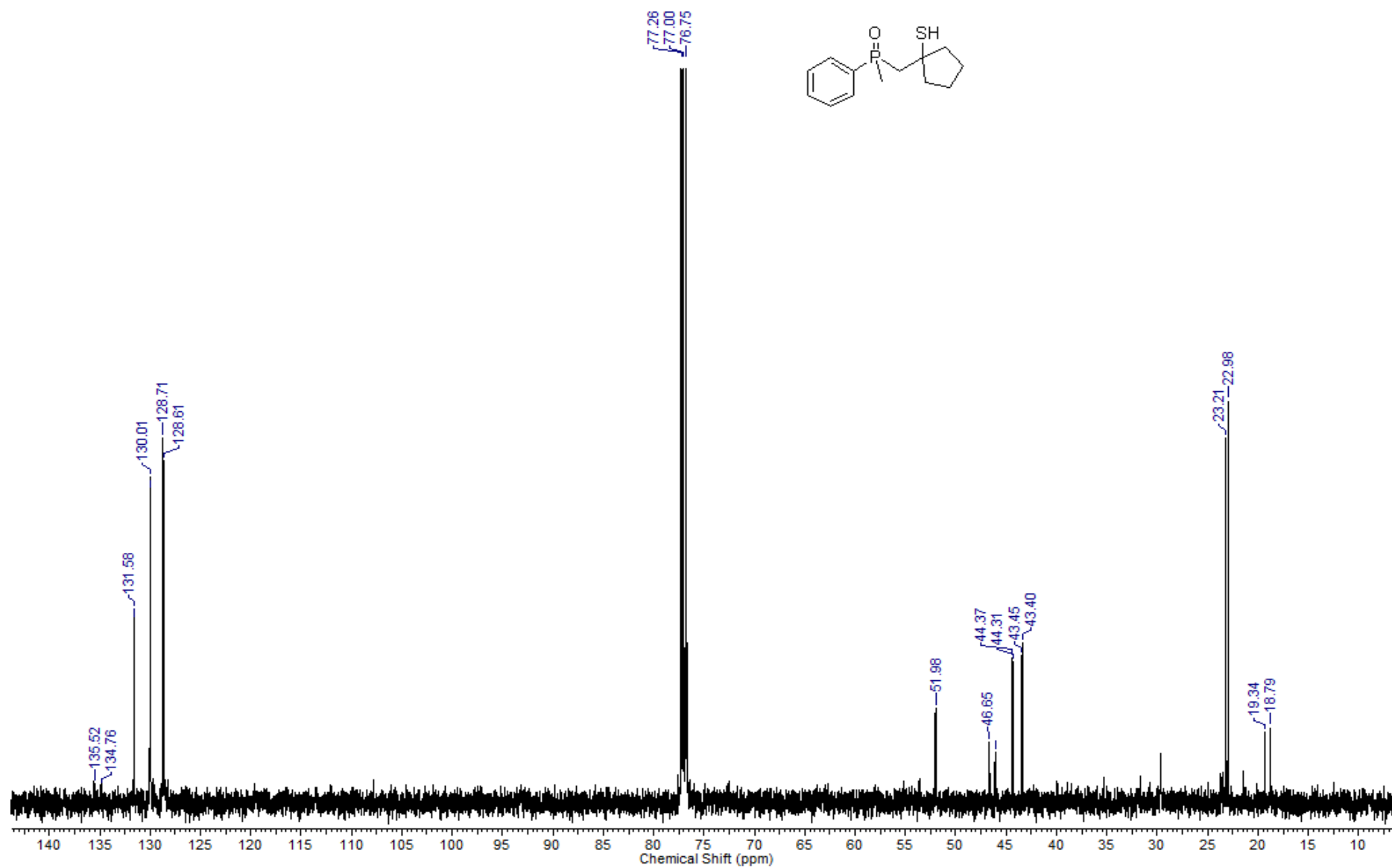
¹³C NMR spectrum of (2-ethyl-2-mercaptobutyl)methylphenylphosphine oxide (53) (CDCl₃, 126 MHz).



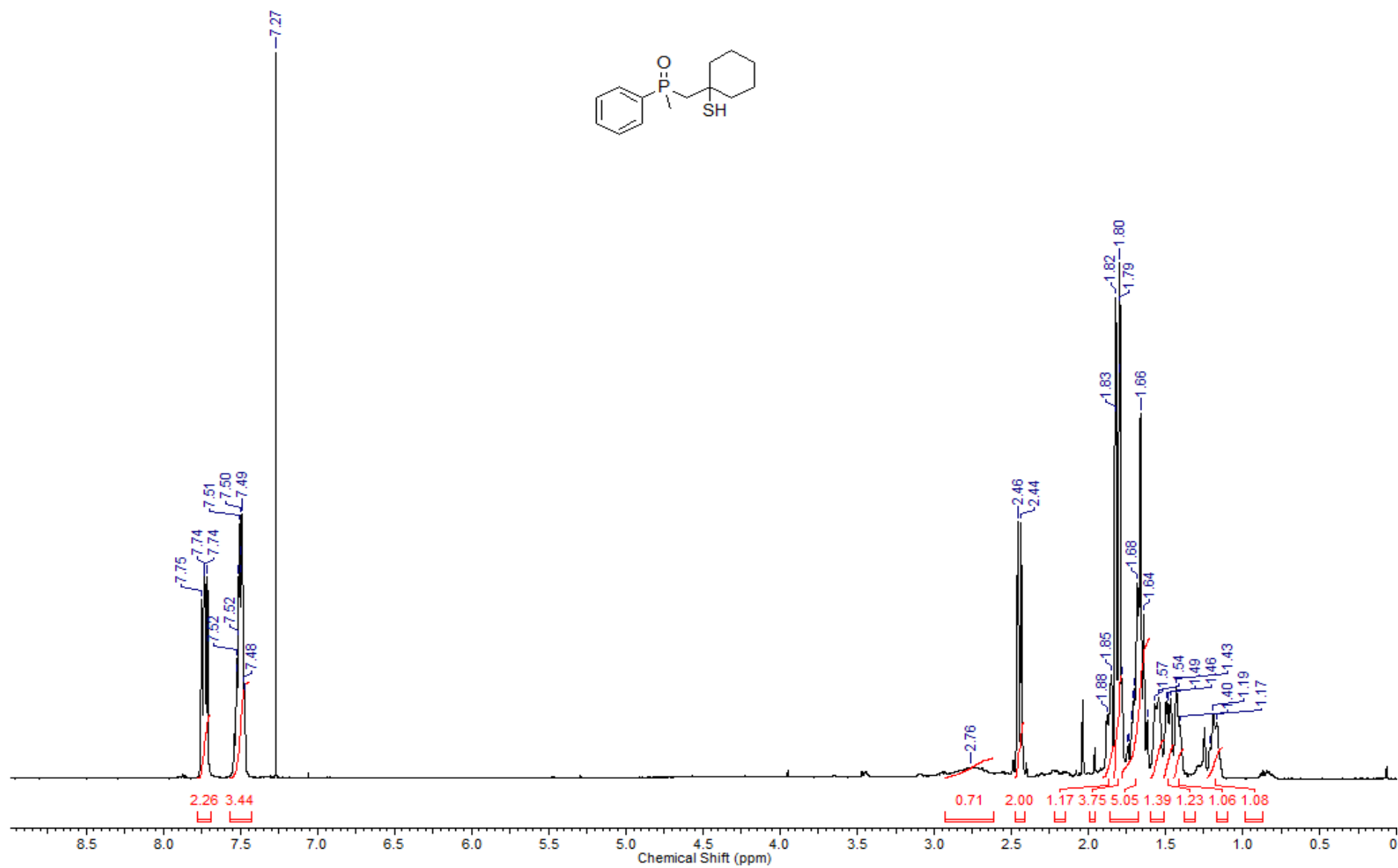
¹H NMR spectrum of [(1-mercapto)cyclopentylmethyl]methylphenylphosphine oxide (**54**) (CDCl₃, 500 MHz).



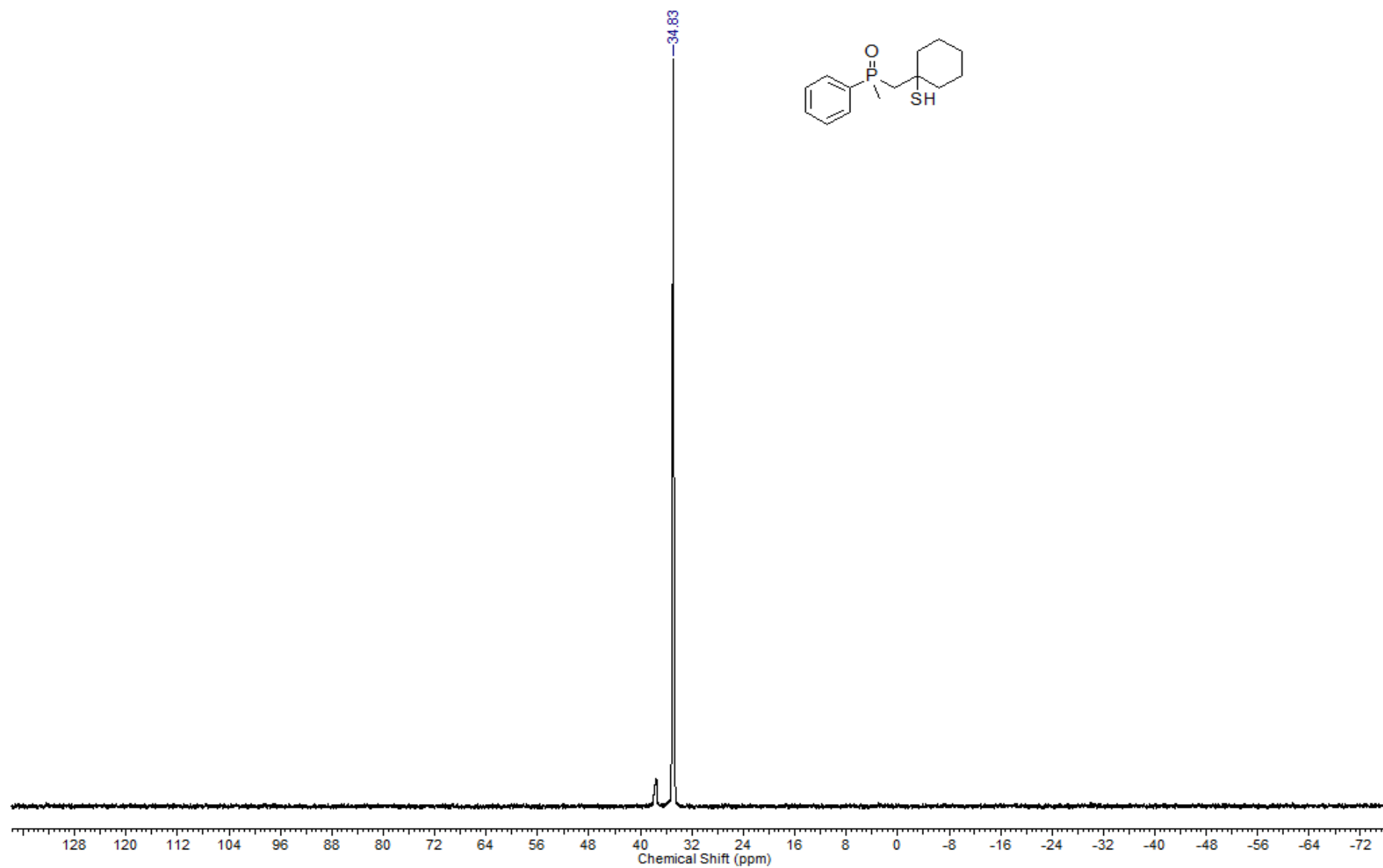
^{31}P NMR spectrum of [(1-mercapto)cyclopentylmethyl]methylphenylphosphine oxide (**54**) (CDCl_3 , 202 MHz).



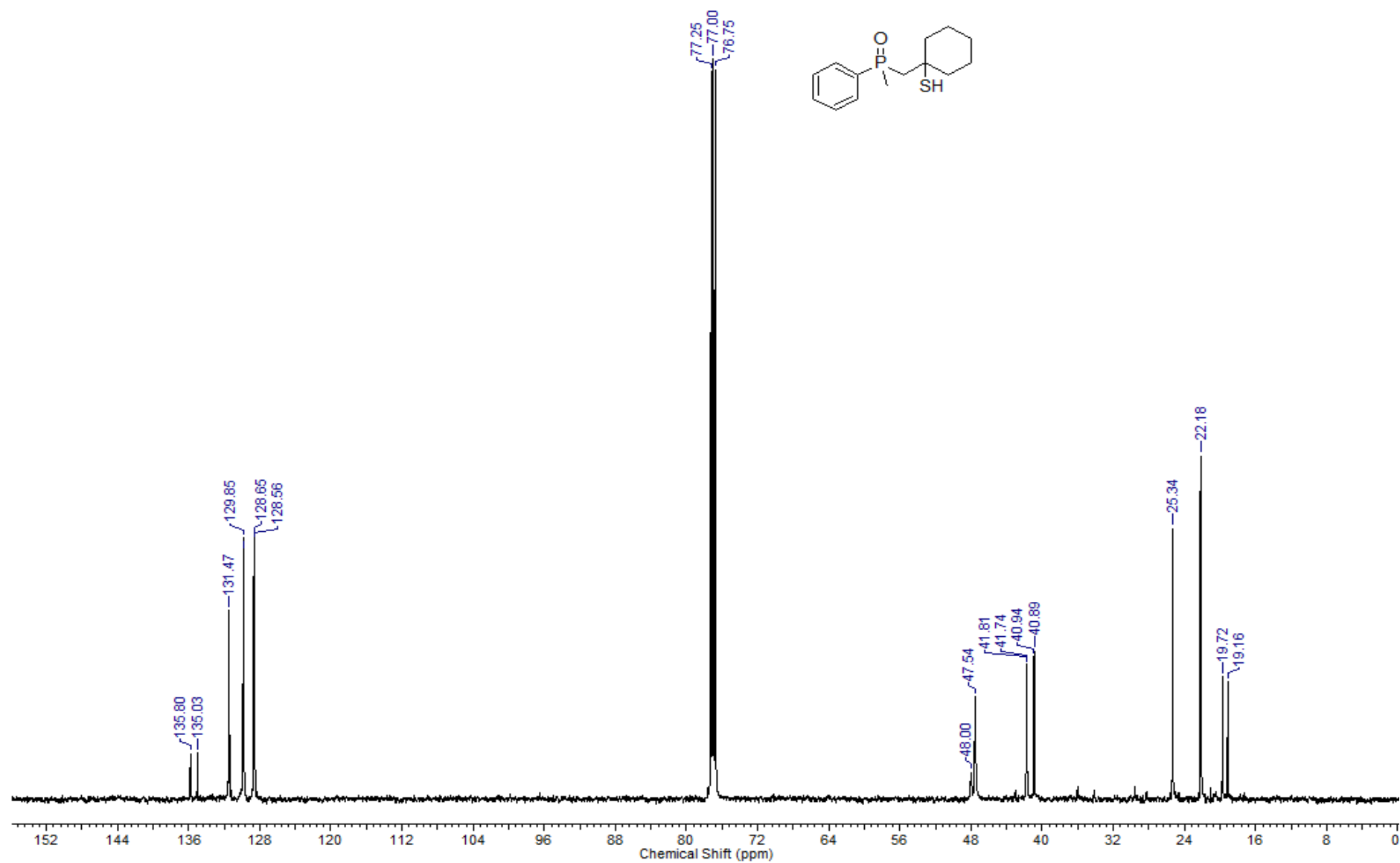
¹³C NMR spectrum of [(1-mercapto)cyclopentylmethyl]methylphenylphosphine oxide (**54**) (CDCl₃, 126 MHz).



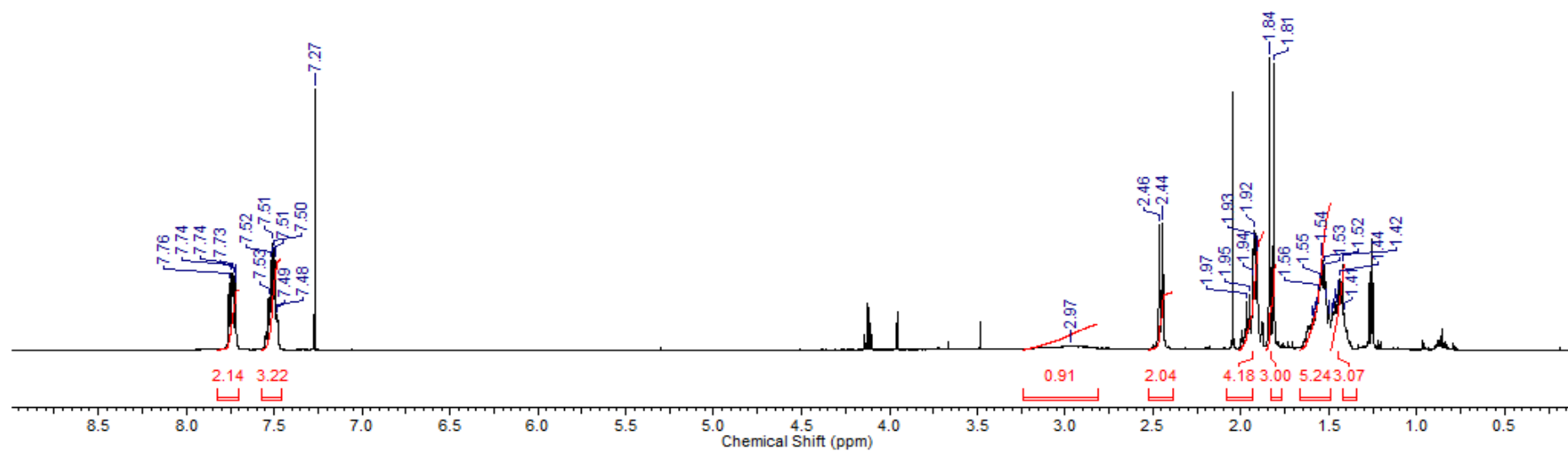
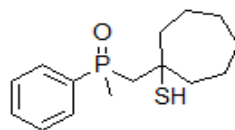
¹H NMR spectrum of [(1-mercapto)cyclohexylmethyl]methylphenylphosphine oxide (55) (CDCl₃, 500 MHz).



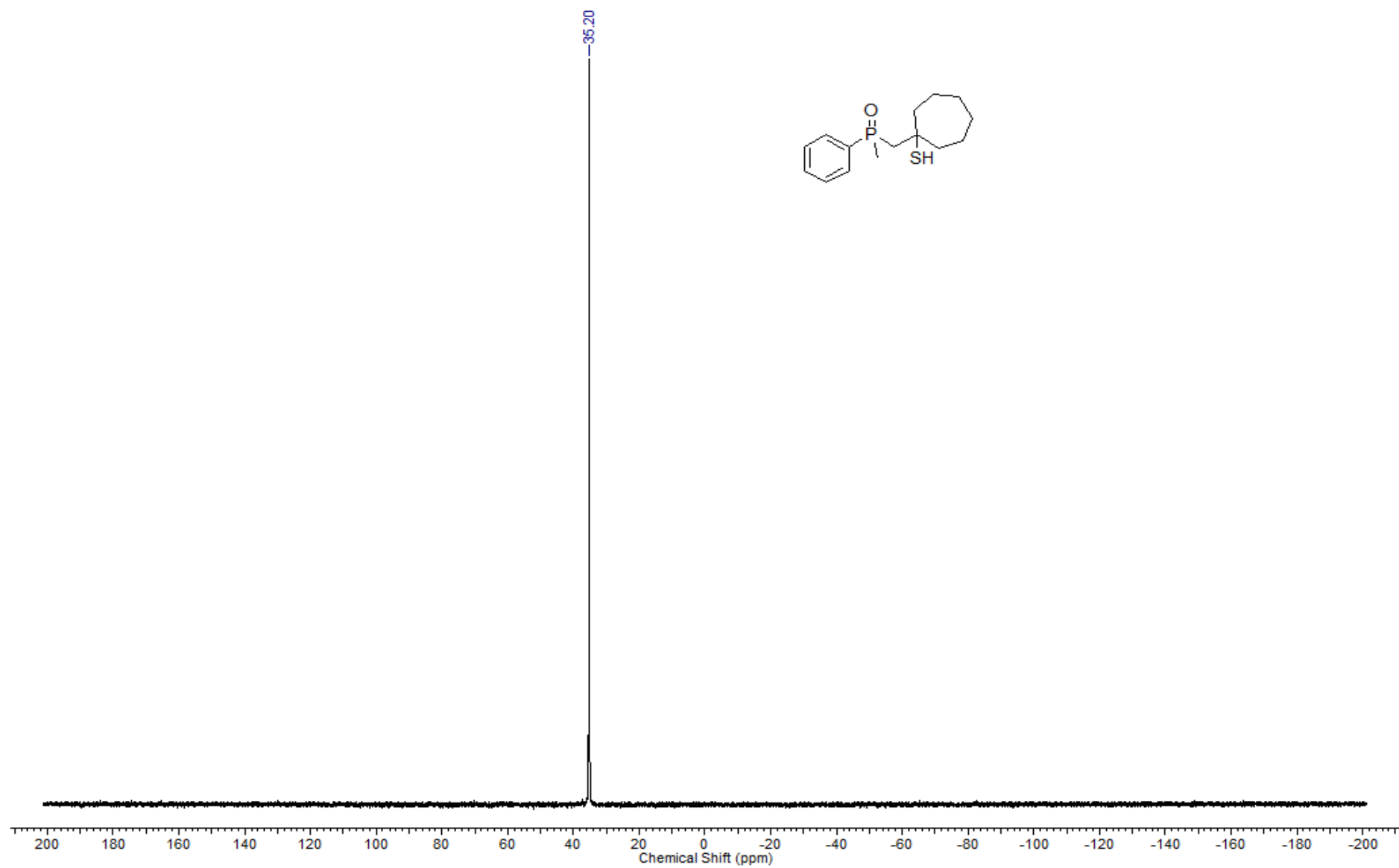
^{31}P NMR spectrum of [(1-mercapto)cyclohexylmethyl]methylphenylphosphine oxide (55) (CDCl_3 , 202 MHz).



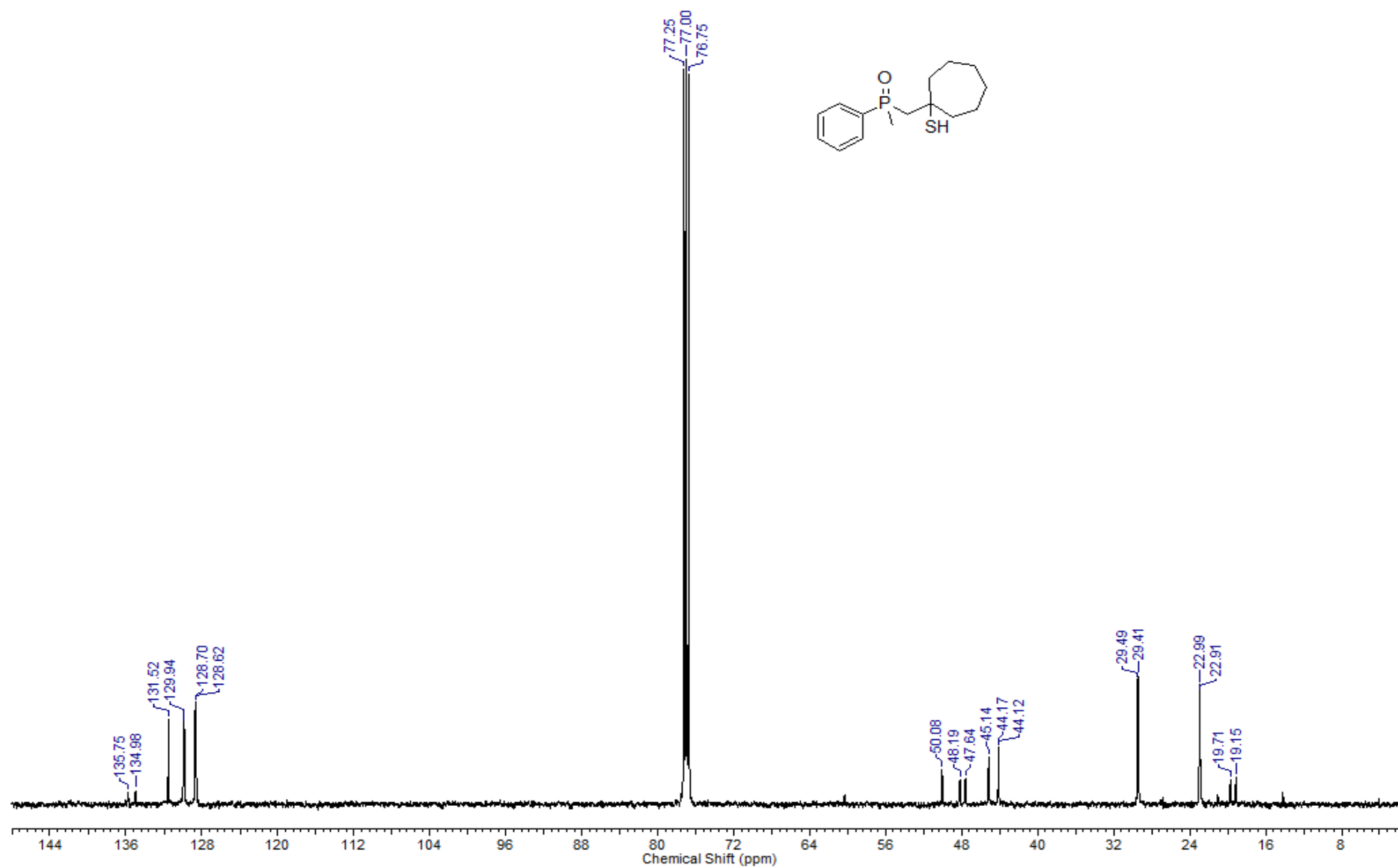
¹³C NMR spectrum of [(1-mercapto)cyclohexylmethyl]methylphenylphosphine oxide (55) (CDCl₃, 126 MHz).



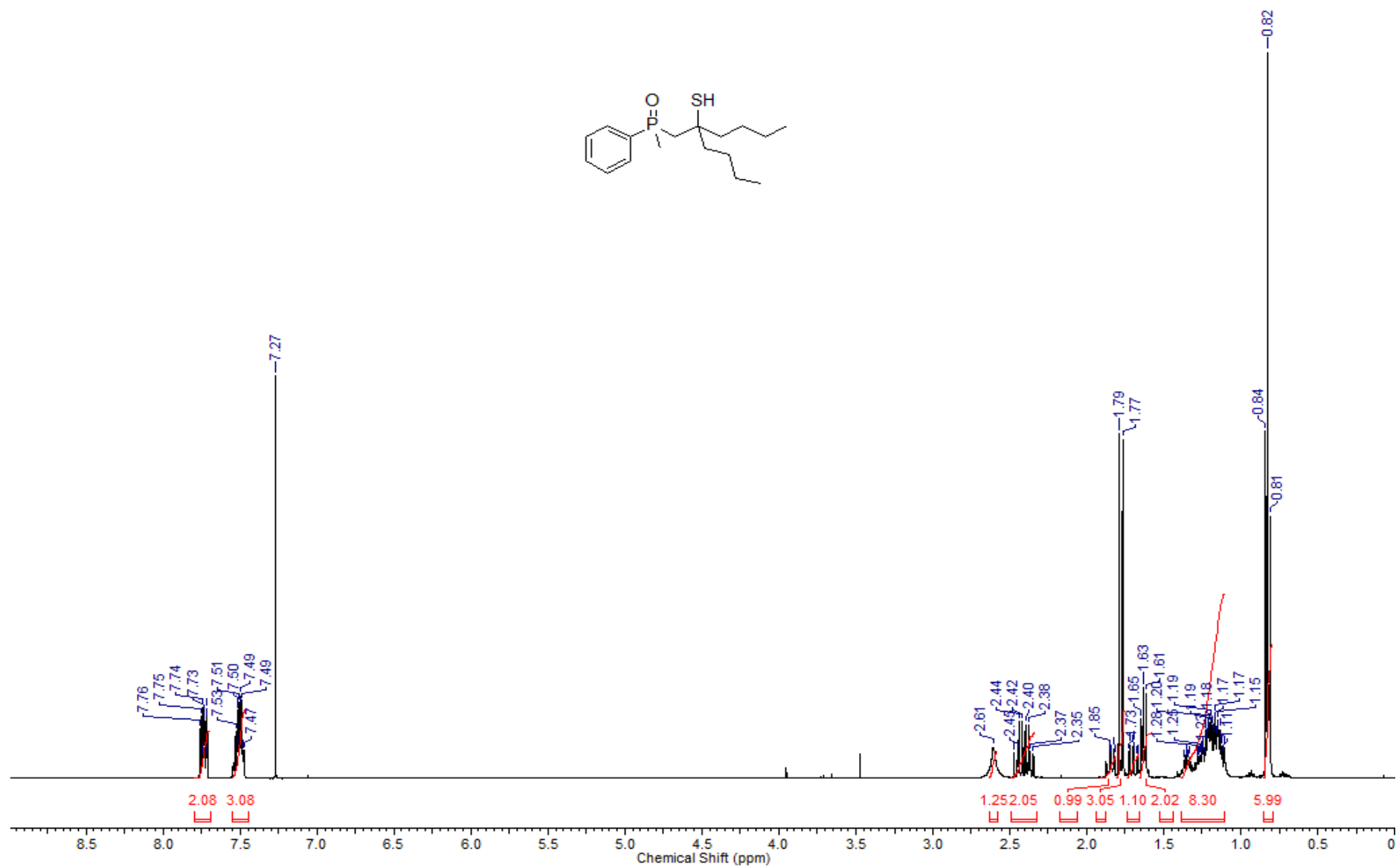
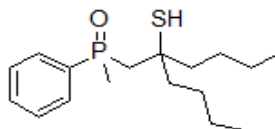
^1H NMR spectrum of [(1-mercapto)cycloheptylmethyl]methylphenylphosphine oxide (**56**) (CDCl_3 , 500 MHz).



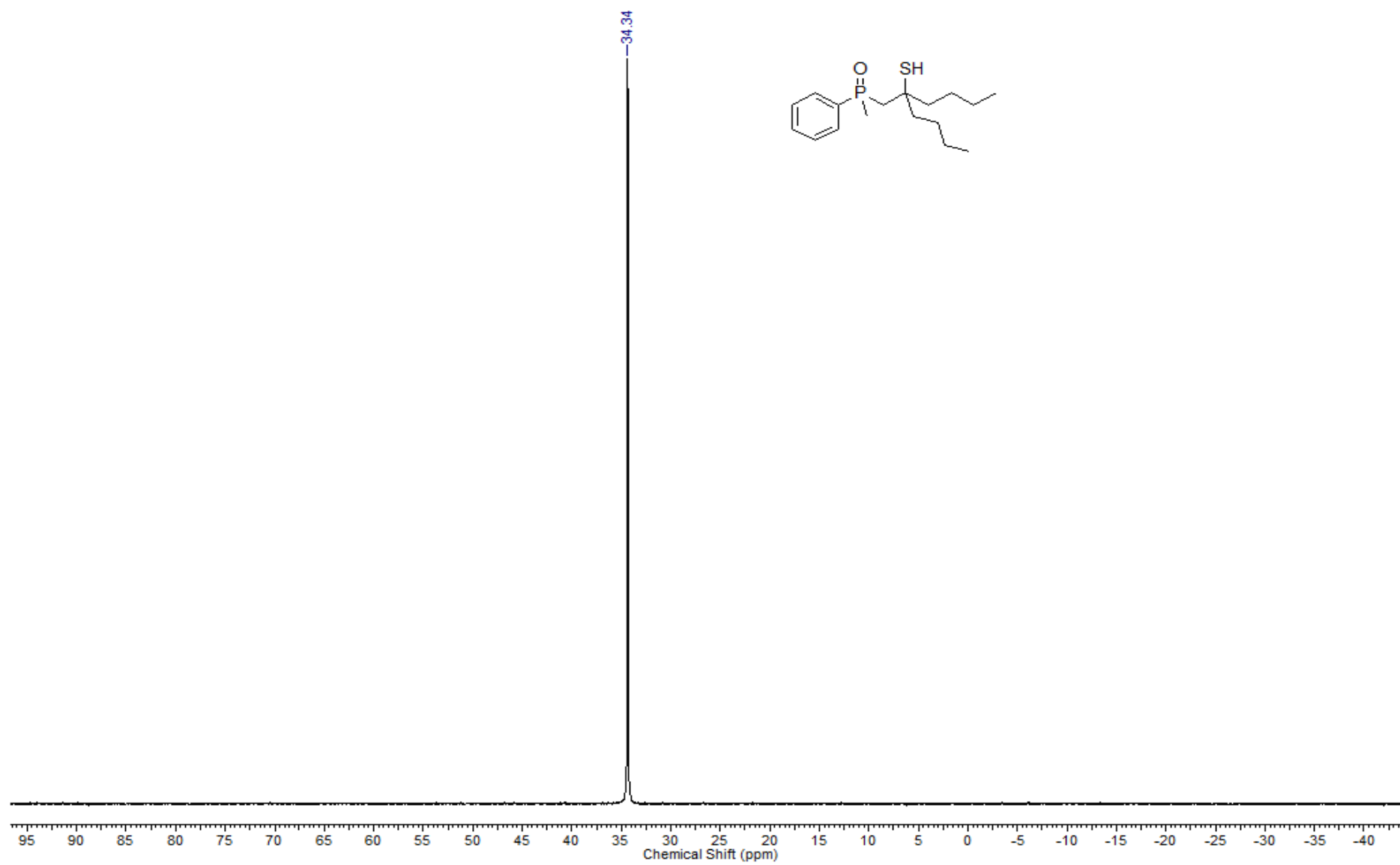
^{31}P NMR spectrum of [(1-mercapto)cycloheptylmethyl]methylphenylphosphine oxide (**56**) (CDCl_3 , 202 MHz).



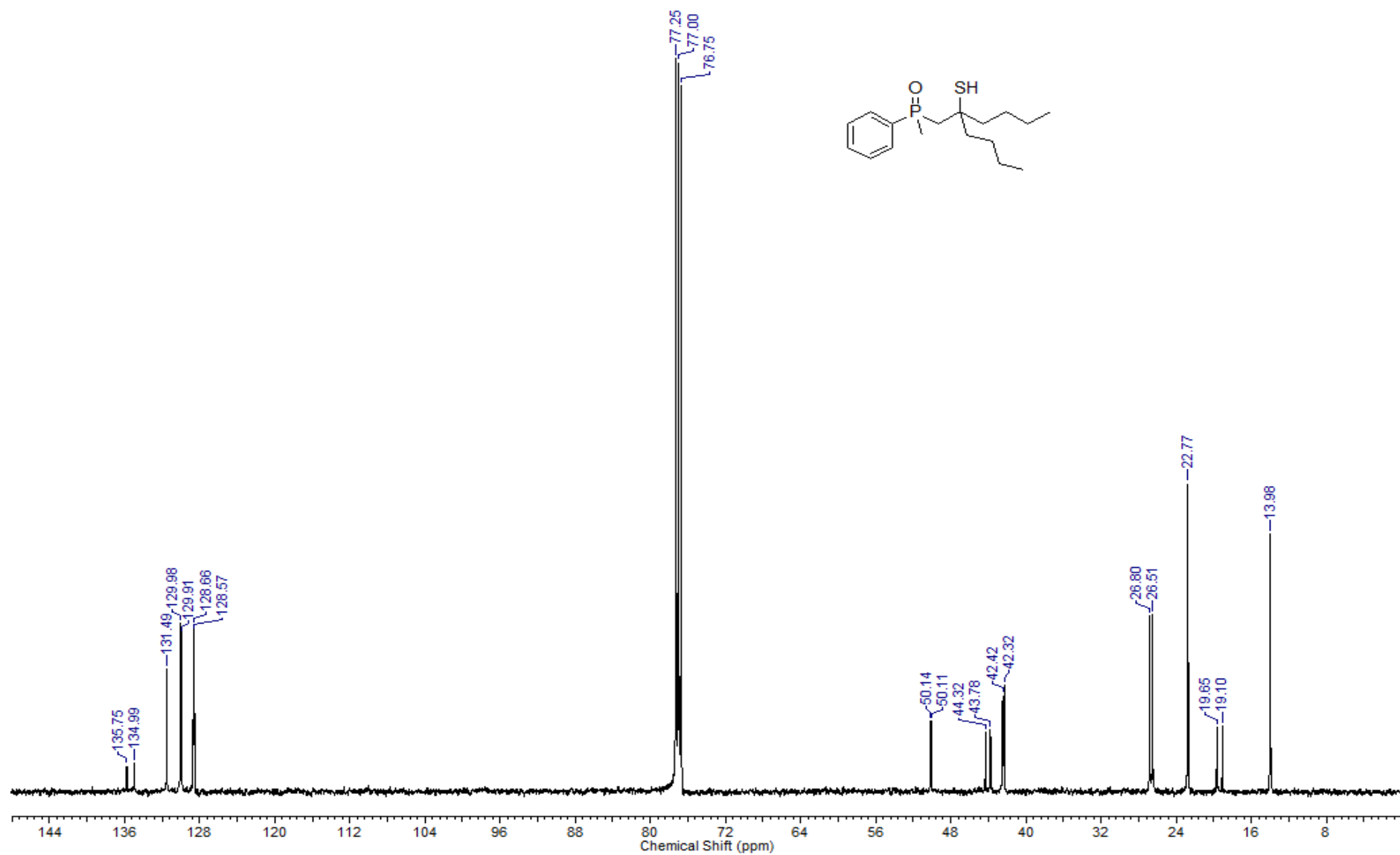
¹³C NMR spectrum of [(1-mercapto)cycloheptylmethyl]methylphenylphosphine oxide (**56**) (CDCl₃, 126 MHz).



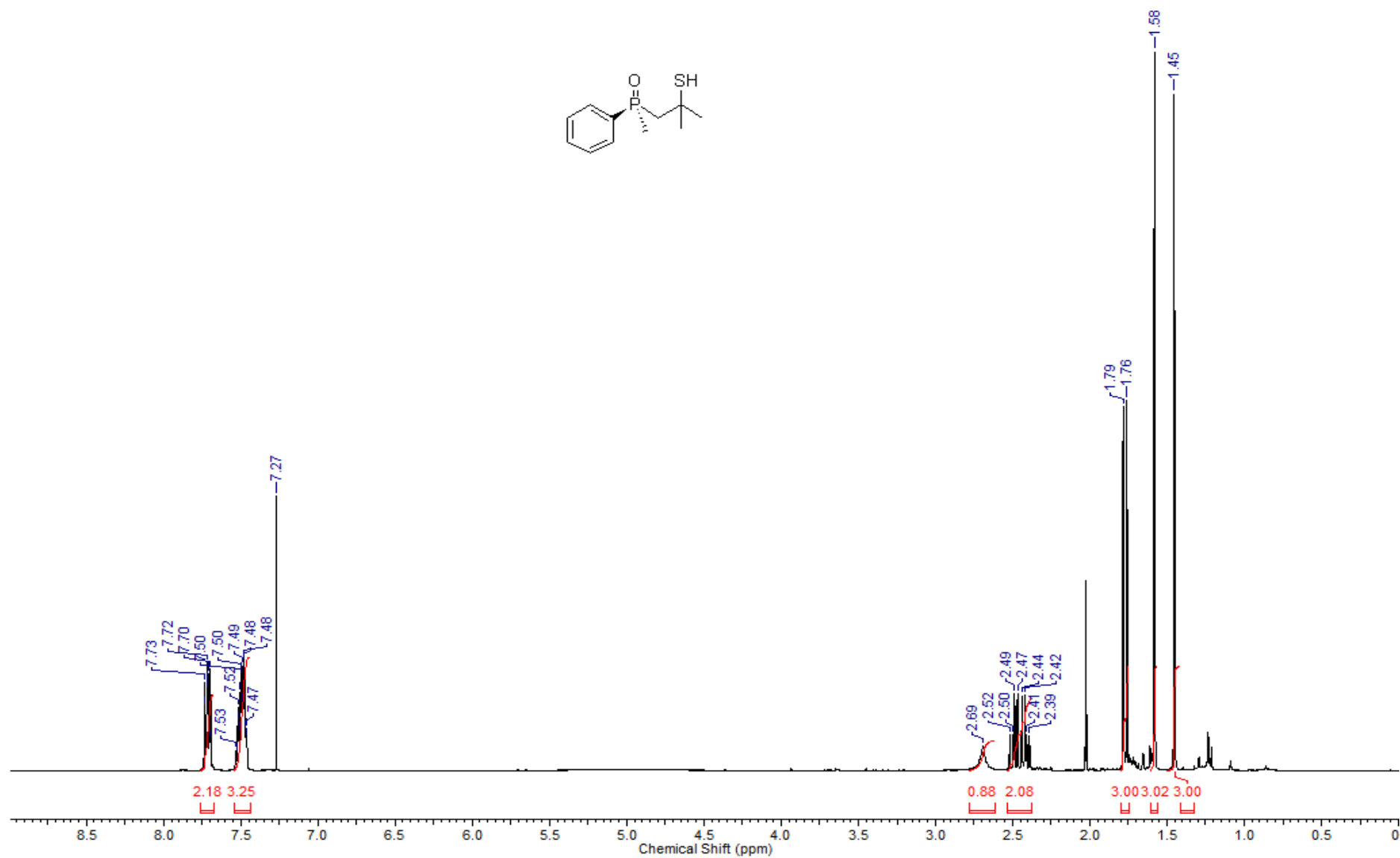
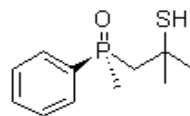
^1H NMR spectrum of (2-butyl-2-mercaptohexyl)methylphenylphosphine sulfide (**57**) (CDCl_3 , 500 MHz).



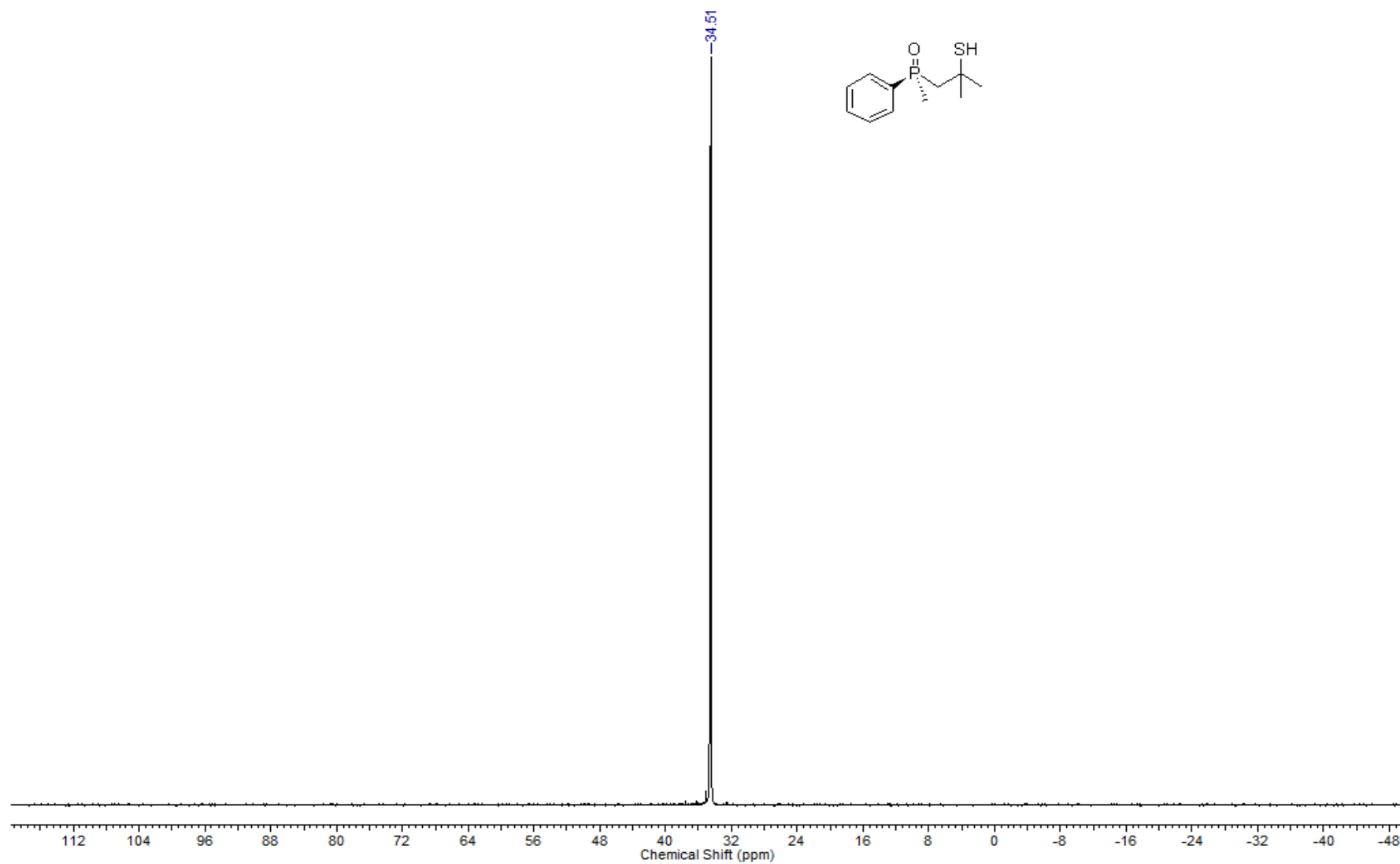
^{31}P NMR spectrum of (2-butyl-2-mercaptohexyl)methylphenylphosphine sulfide (57) (CDCl_3 , 202 MHz).



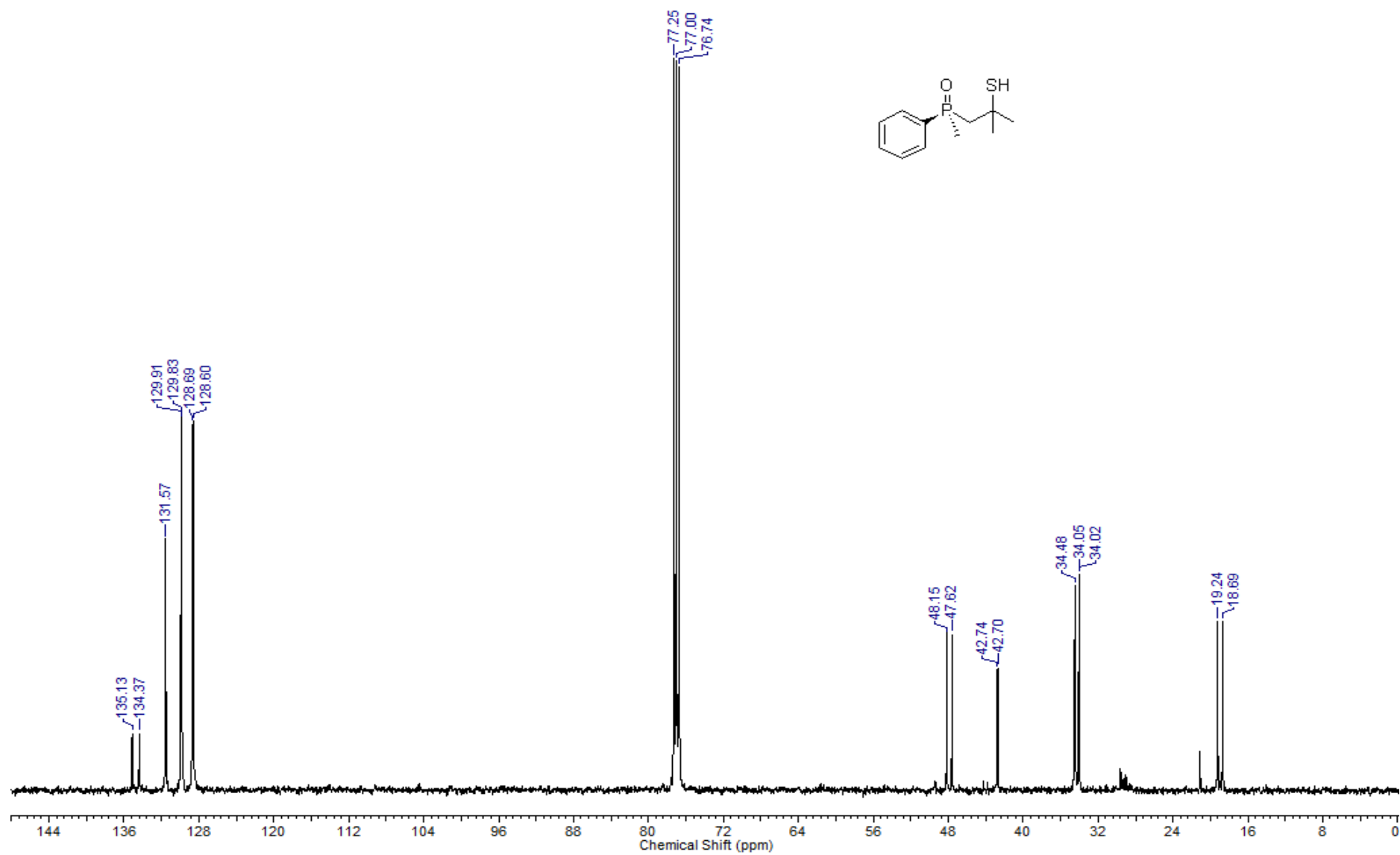
¹³C NMR spectrum of (2-butyl-2-mercaptohexyl)methylphenylphosphine sulfide (57) (CDCl₃, 126 MHz).



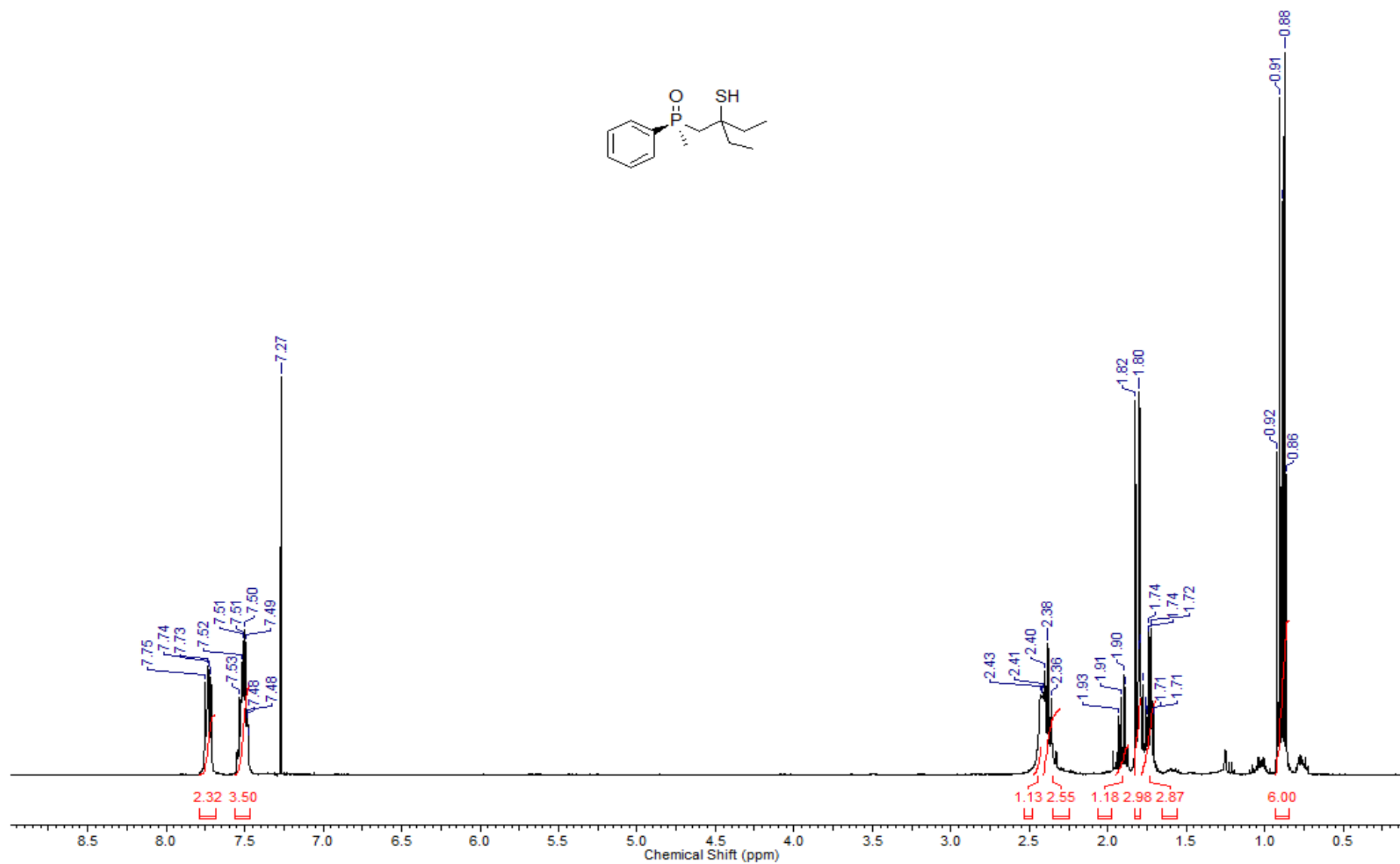
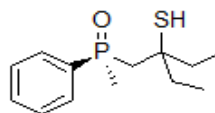
^1H NMR spectrum of (R_P)-(2-methyl-2-mercaptopropyl)methylphenylphosphine oxide (R_P)-(52) (CDCl_3 , 500 MHz).



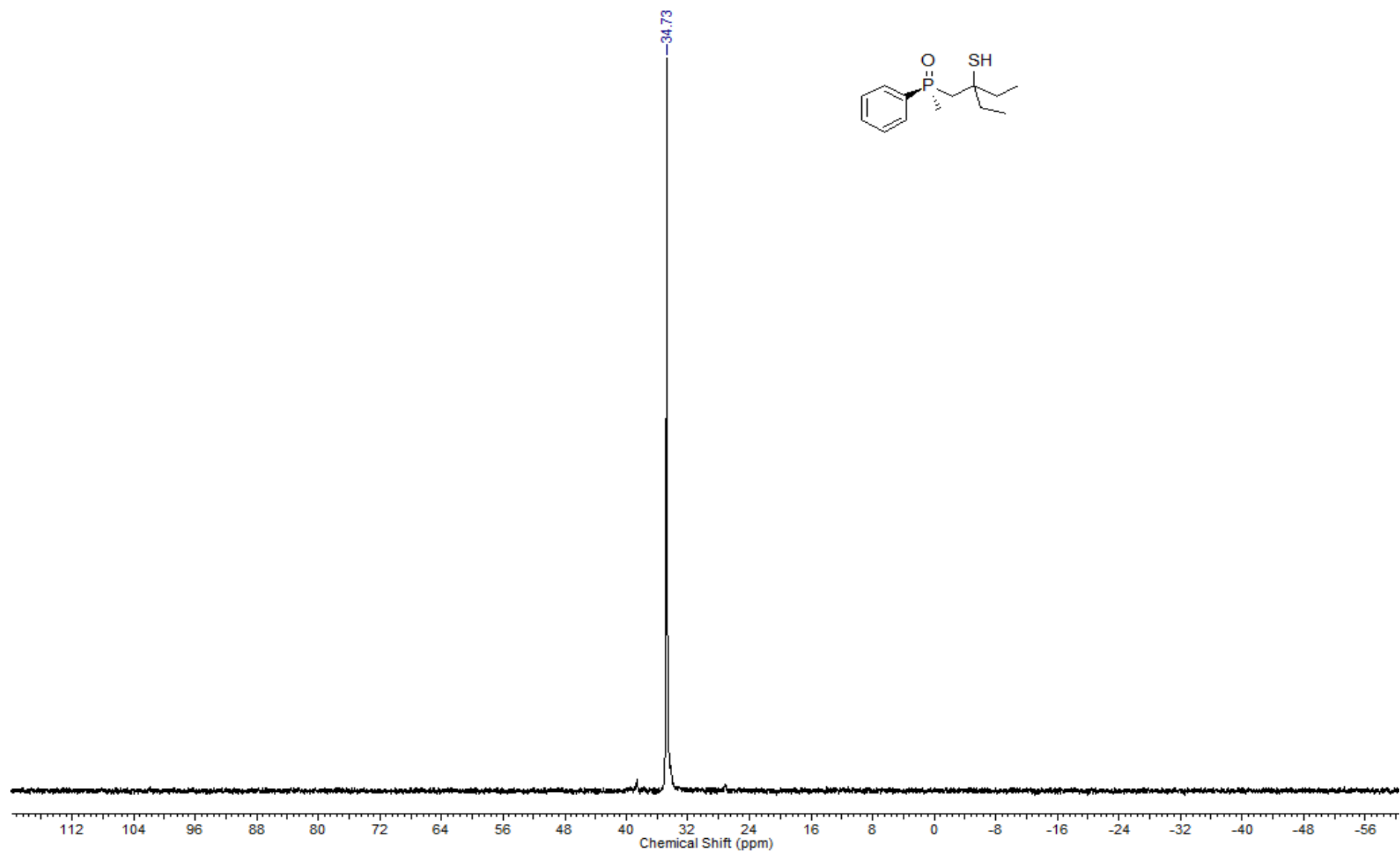
^{31}P NMR spectrum of (*R_P*)-(2-methyl-2-mercaptopropyl)methylphenylphosphine oxide (*R_P*)-(52) (CDCl_3 , 202 MHz).



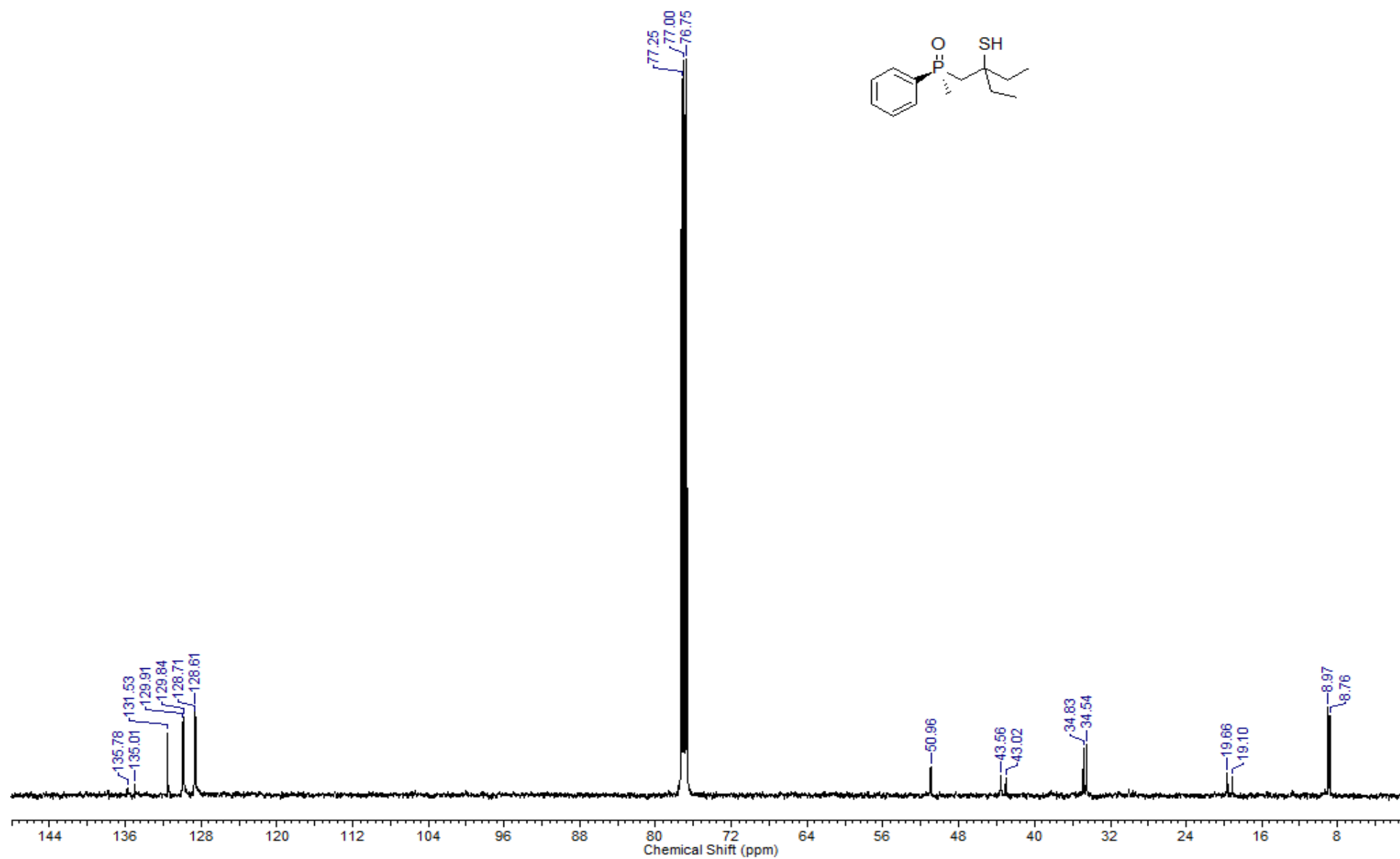
¹³C NMR spectrum of *(R_P)*-(2-methyl-2-mercaptopropyl)methylphenylphosphine oxide (*(R_P)*-(52) (CDCl₃, 126 MHz).



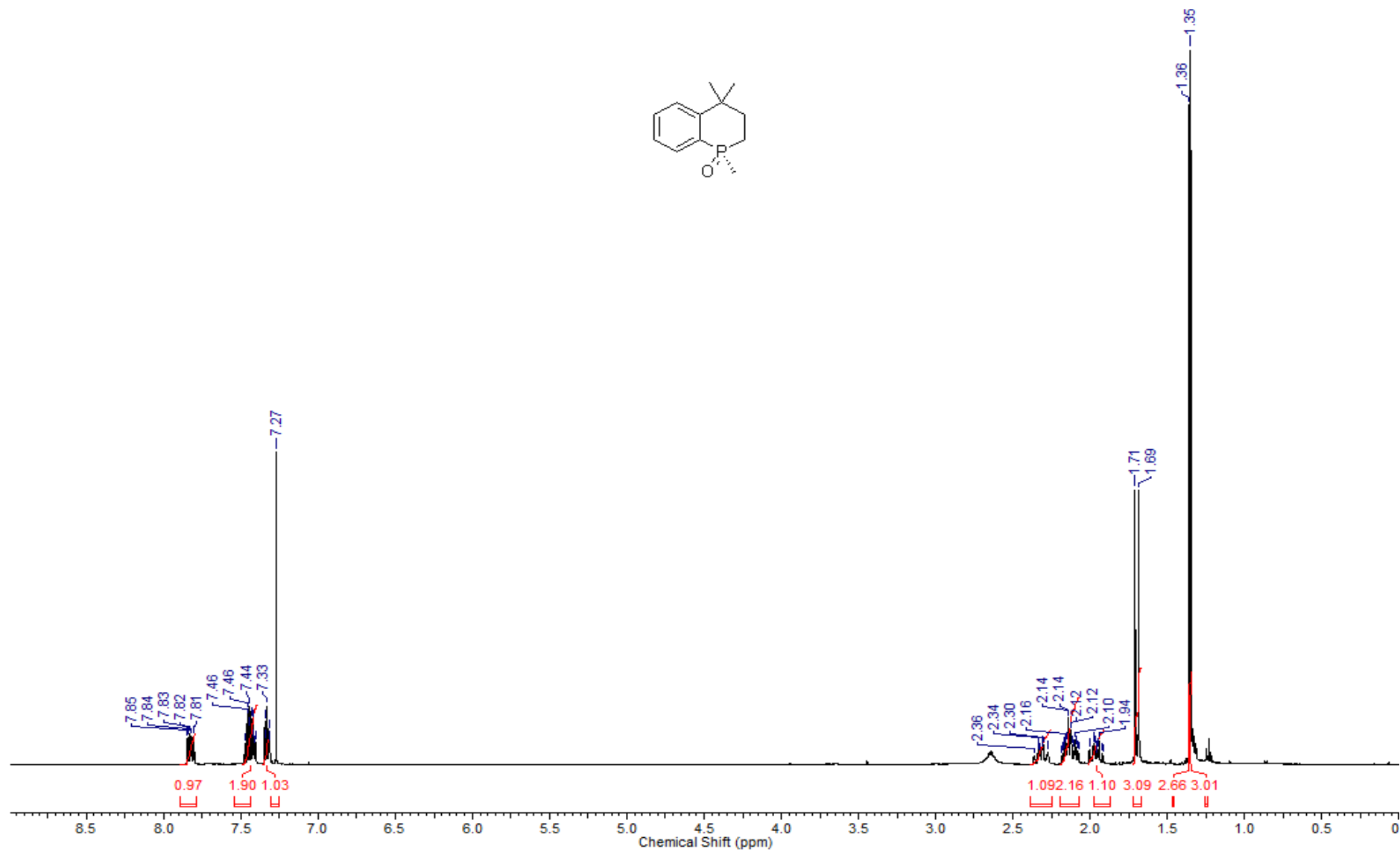
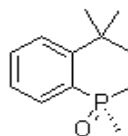
^1H NMR spectrum of (R_P)-(2-ethyl-2-mercaptobutyl)methylphenylphosphine oxide (R_P)-(53) (CDCl_3 , 500 MHz).



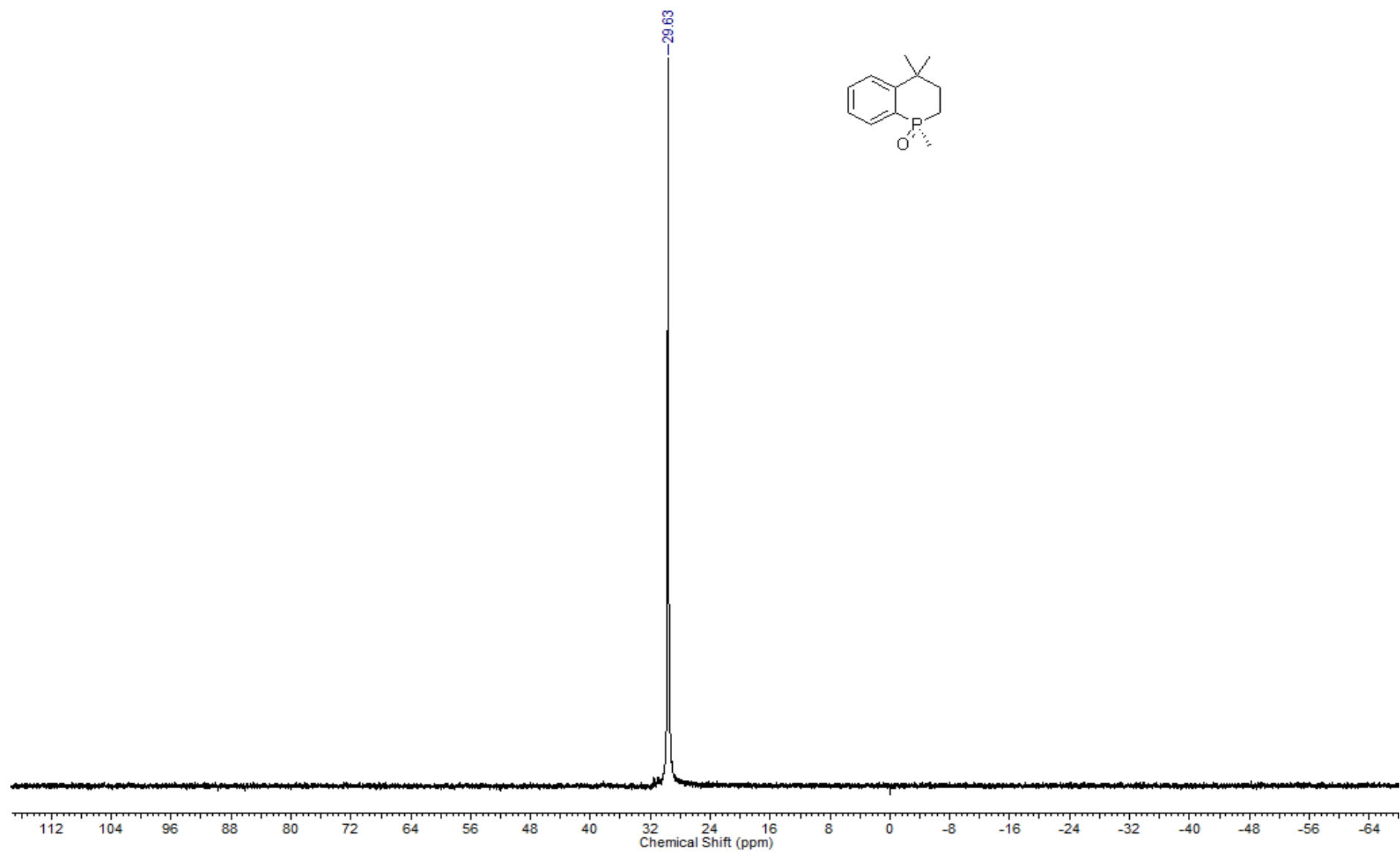
^{31}P NMR spectrum of (R_P) -(2-ethyl-2-mercaptobutyl)methylphenylphosphine oxide (R_P)-(53) (CDCl_3 , 202 MHz).



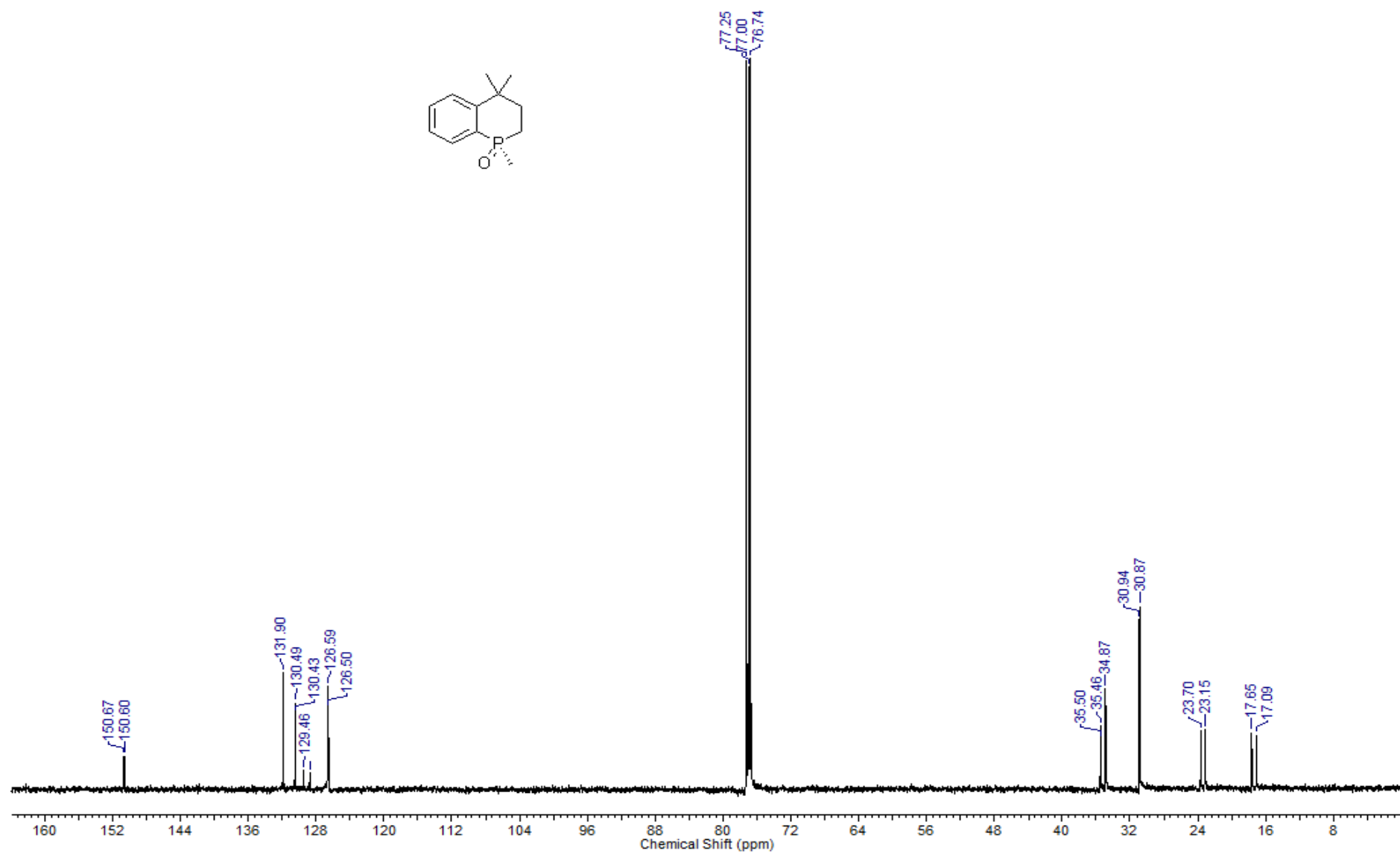
^{13}C NMR spectrum of (R_P) -(2-ethyl-2-mercaptobutyl)methylphenylphosphine oxide (R_P)-(53) (CDCl₃, 126 MHz).



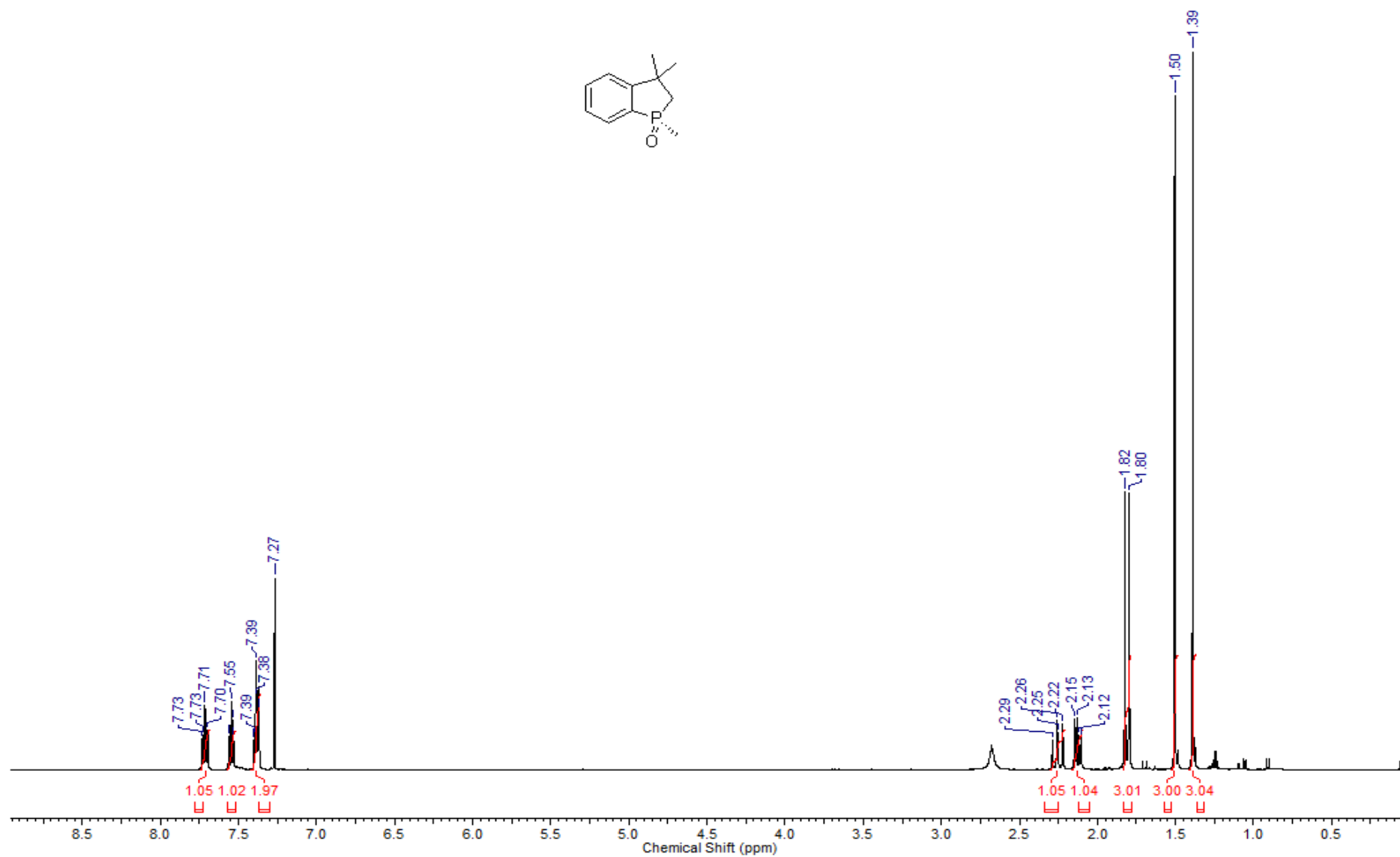
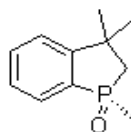
^1H NMR spectrum of (R_P)-1,4,4-Trimethyl-1,2,3,4-tetrahydrophosphinoline 1-oxide (R_P)-**26** (CDCl_3 , 500 MHz).



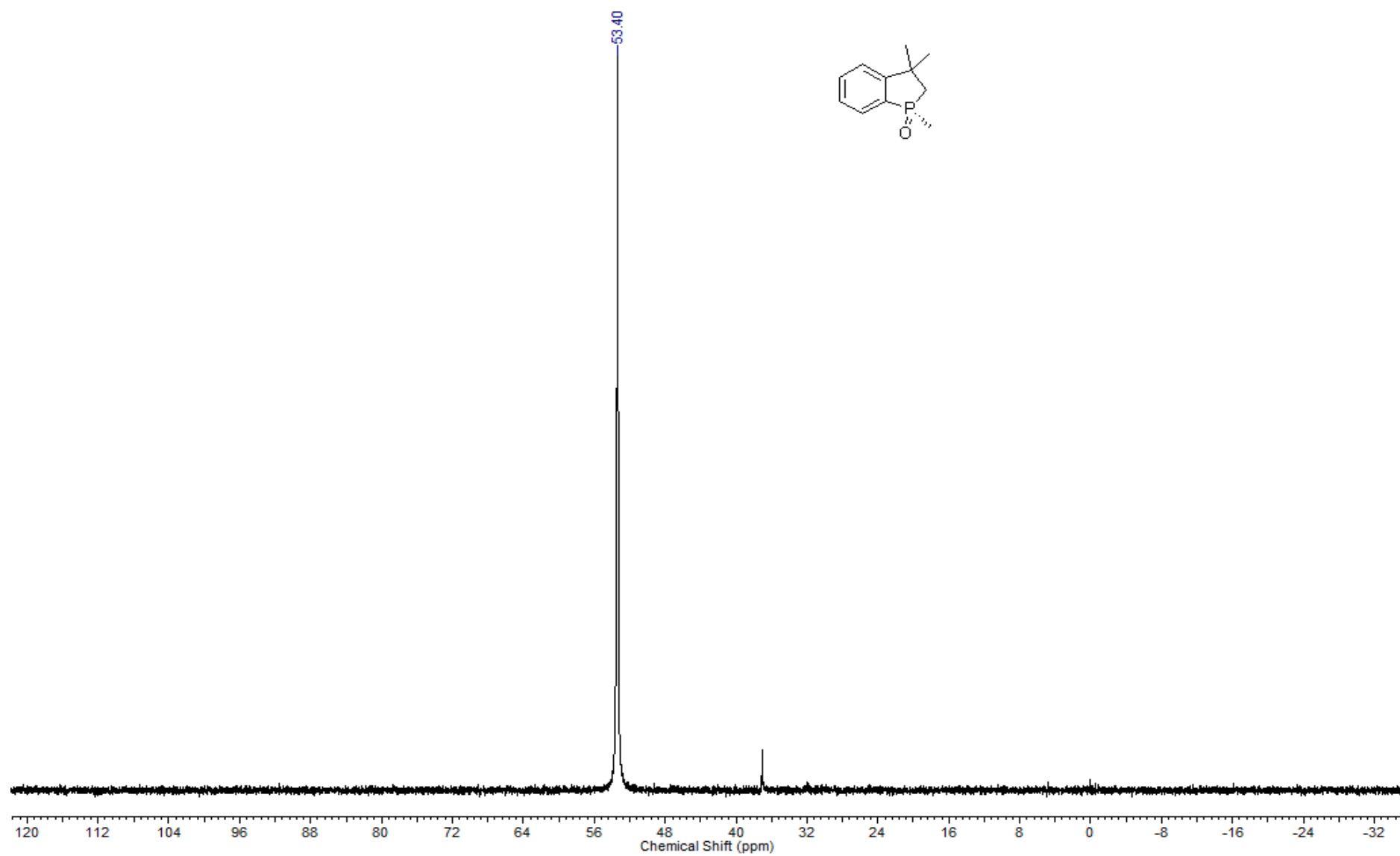
^{31}P NMR spectrum of (*R_P*)-1,4,4-Trimethyl-1,2,3,4-tetrahydrophosphinoline 1- oxide (*R_P*)-**26** (CDCl_3 , 202 MHz).



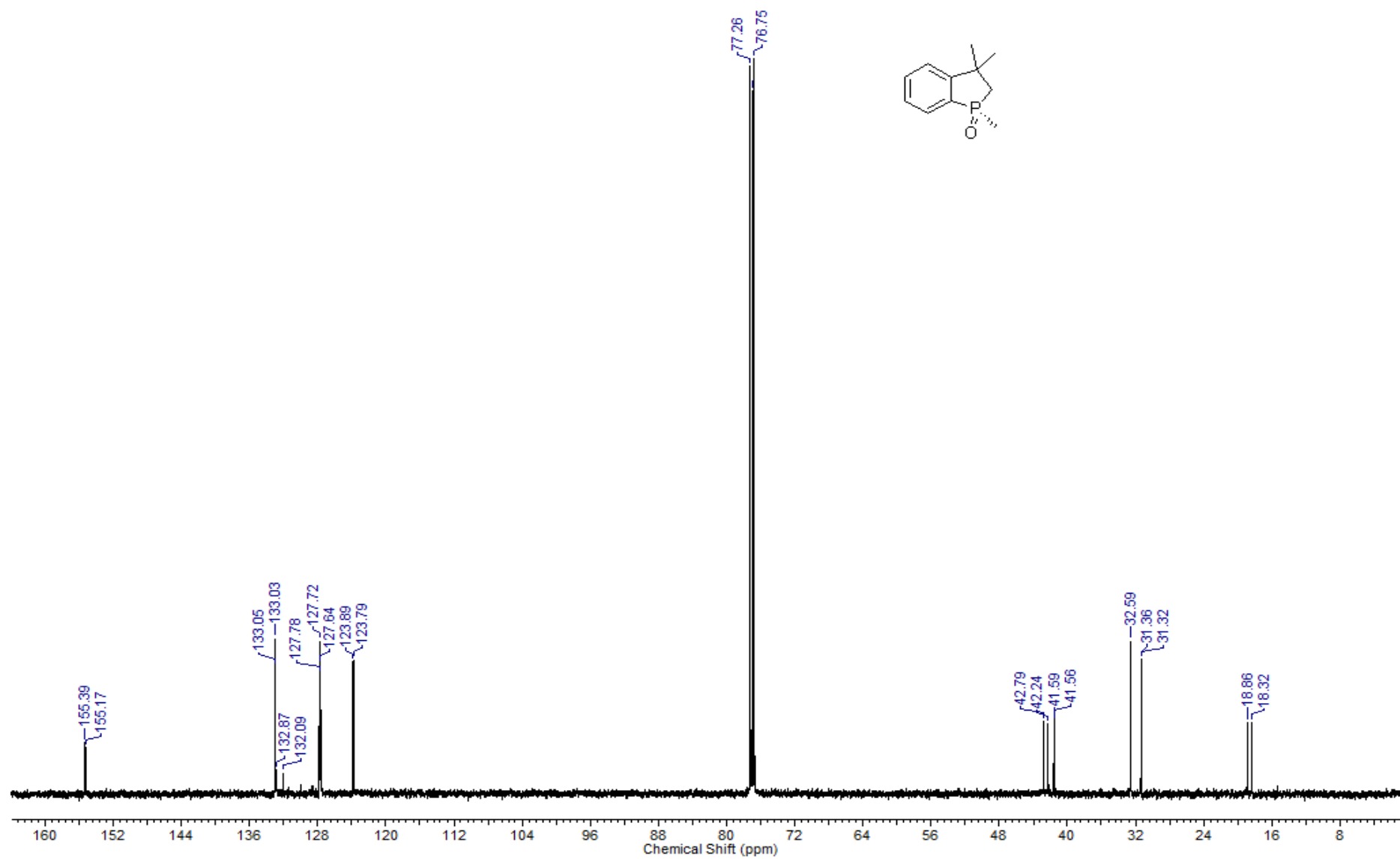
¹³C NMR spectrum of (*R_p*)-1,4,4-Trimethyl-1,2,3,4-tetrahydroposphinoline 1-oxide (*R_p*)-**26** (CDCl₃, 126 MHz).



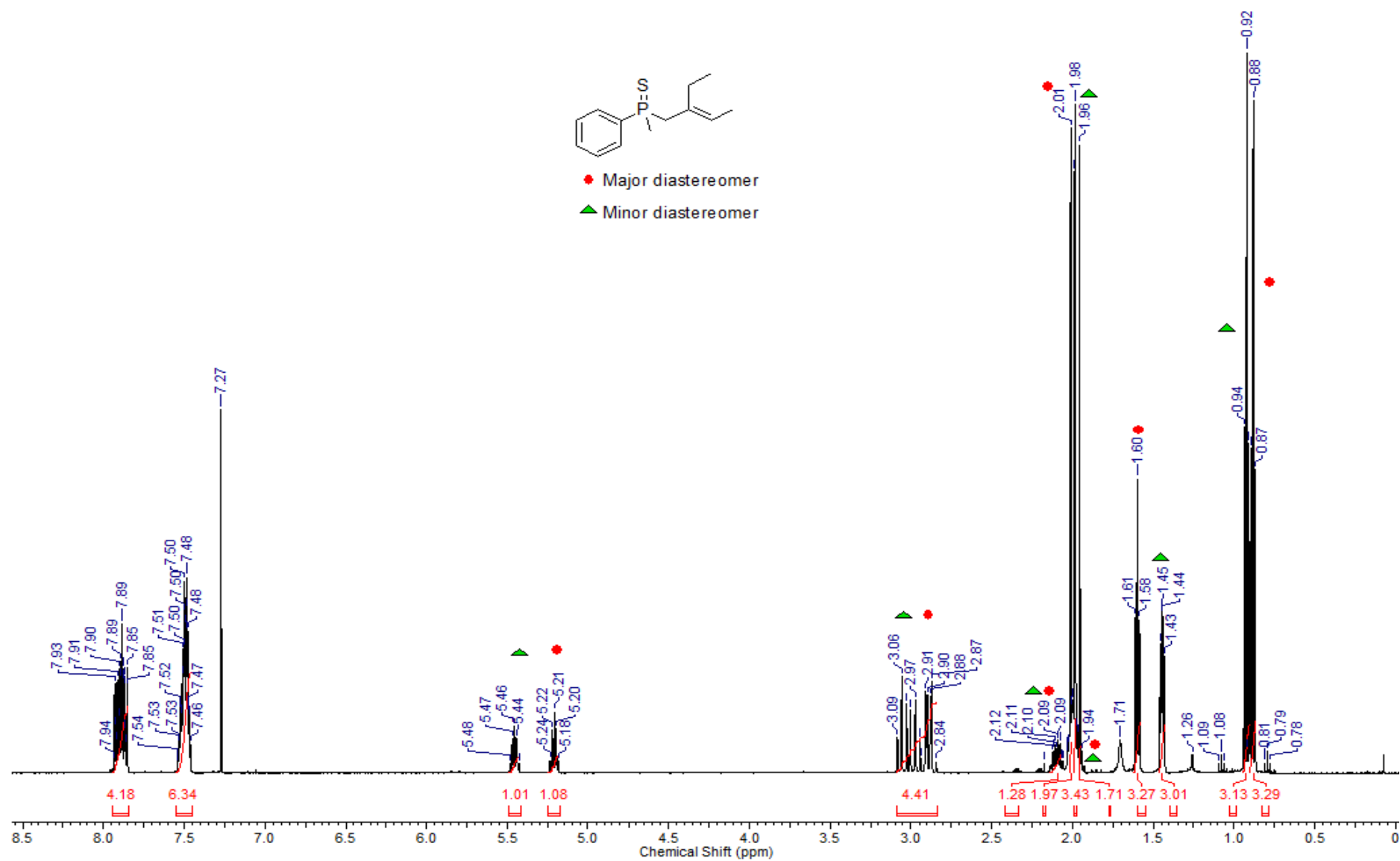
^1H NMR spectrum of (R_P)-1,3,3-Trimethylphosphindoline 1-oxide (R_P)-3 (CDCl_3 , 500 MHz).



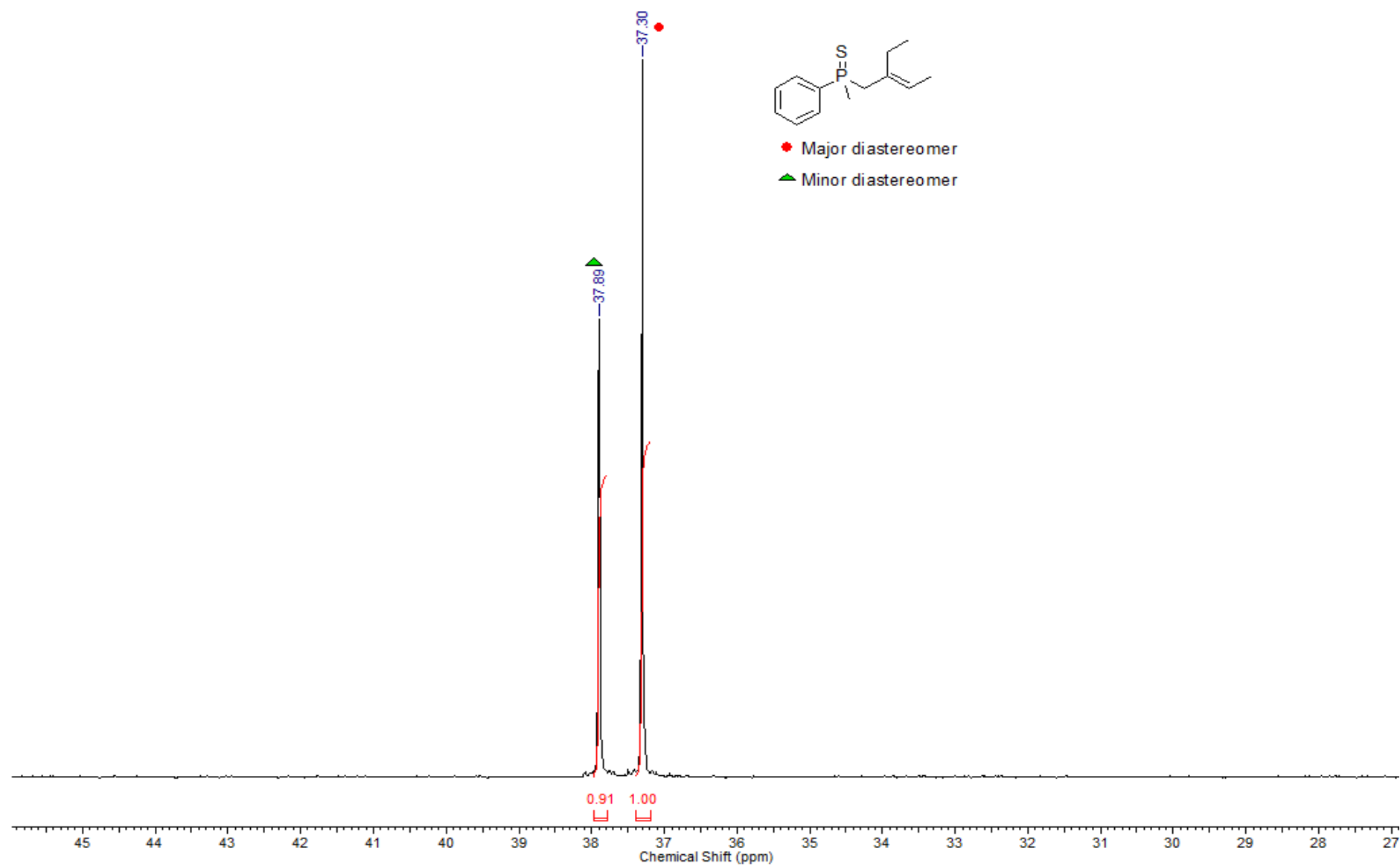
^{31}P NMR spectrum of *(R_P)*-1,3,3-Trimethylphosphindoline 1-oxide (*(R_P)*-**3**) (CDCl_3 , 202 MHz).



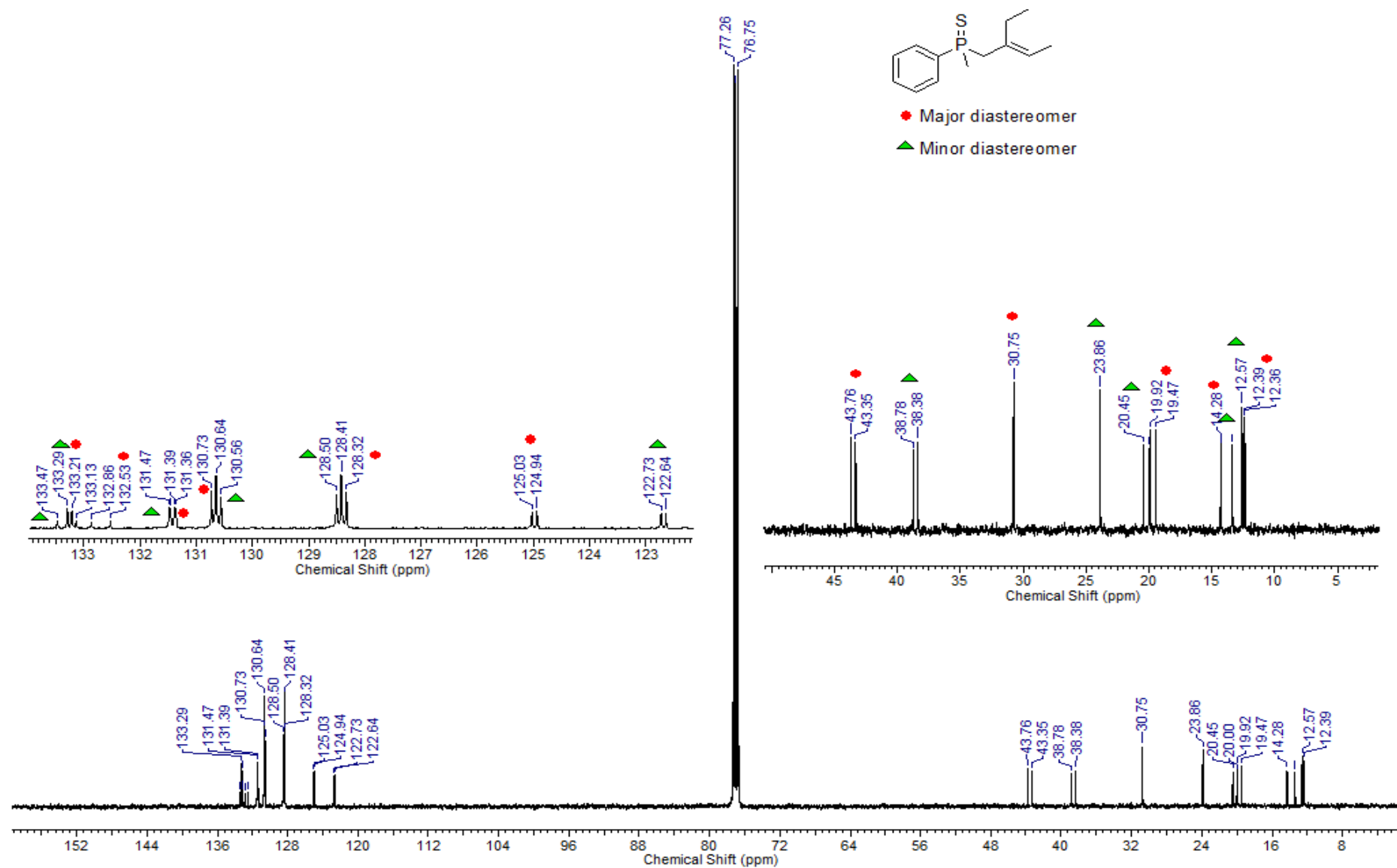
^{13}C NMR spectrum of *(R_p)*-1,3,3-Trimethylphosphindoline 1-oxide (*R_p*)-3 (CDCl_3 , 126 MHz).



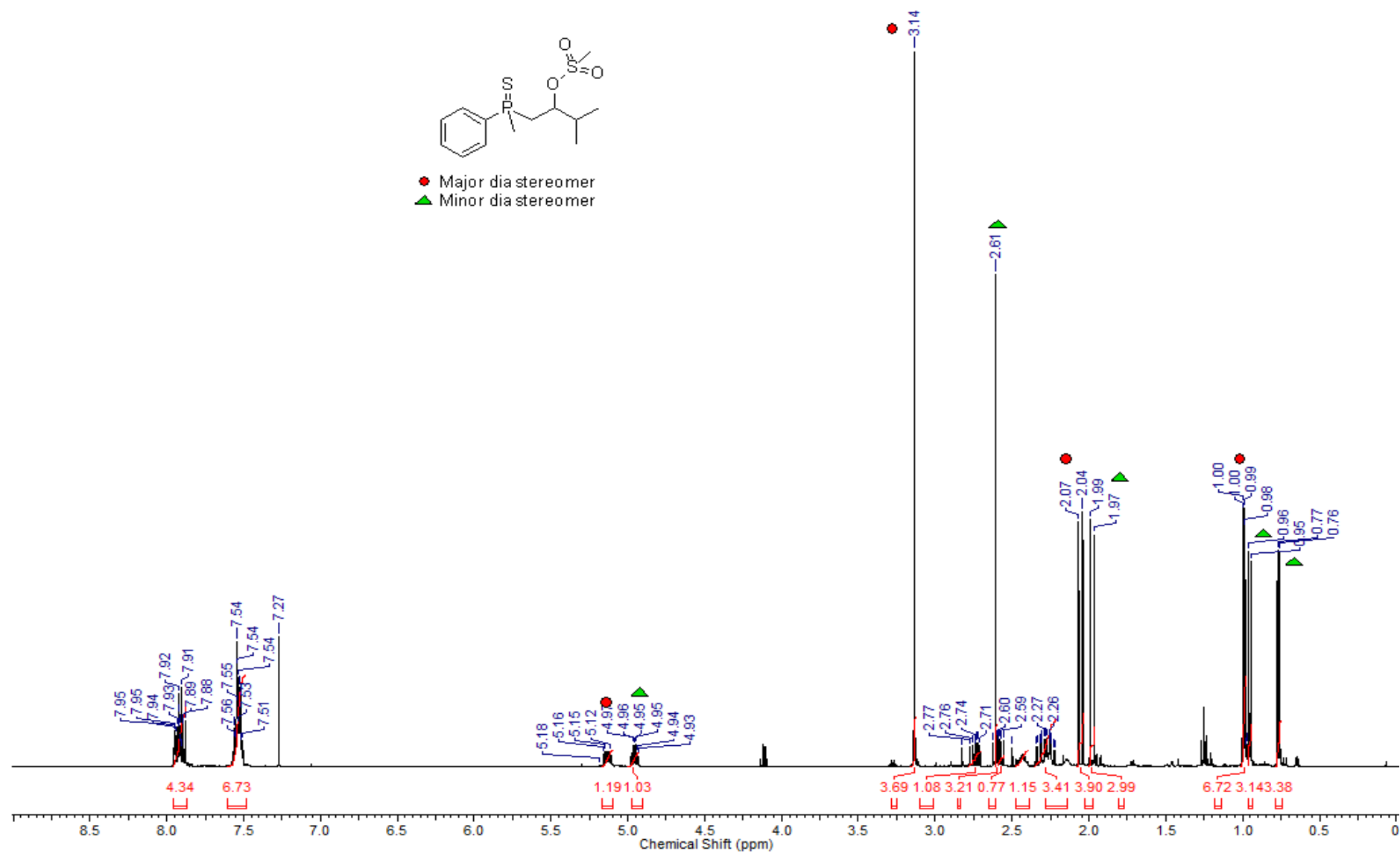
¹H NMR spectrum of (2-ethylbut-2-enyl)(methylphenyl)phosphine oxide (**58**) (CDCl₃, 500 MHz).



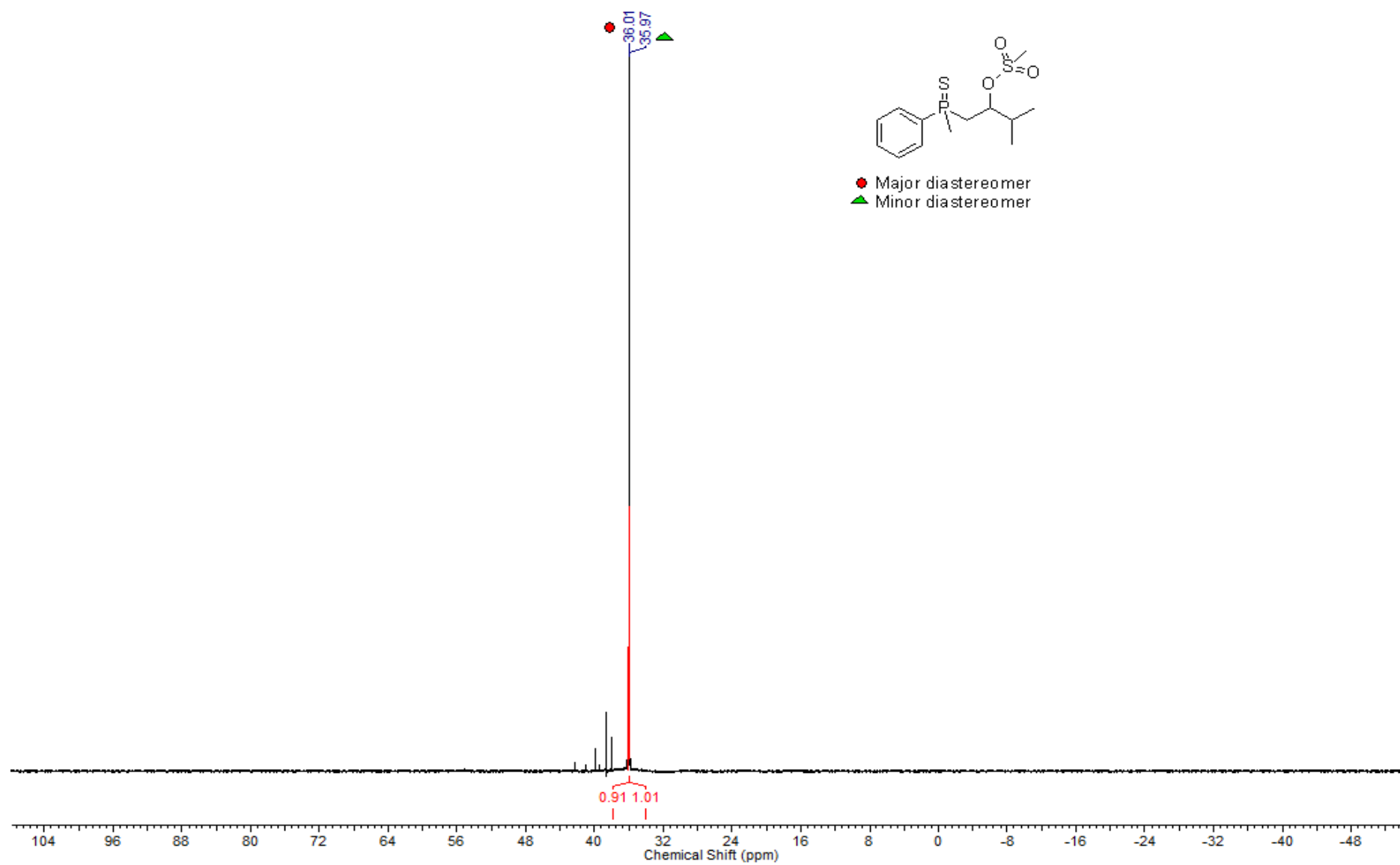
^{31}P NMR spectrum of (2-ethylbut-2-enyl)(methylphenyl)phosphine oxide (**58**) (CDCl_3 , 202 MHz).



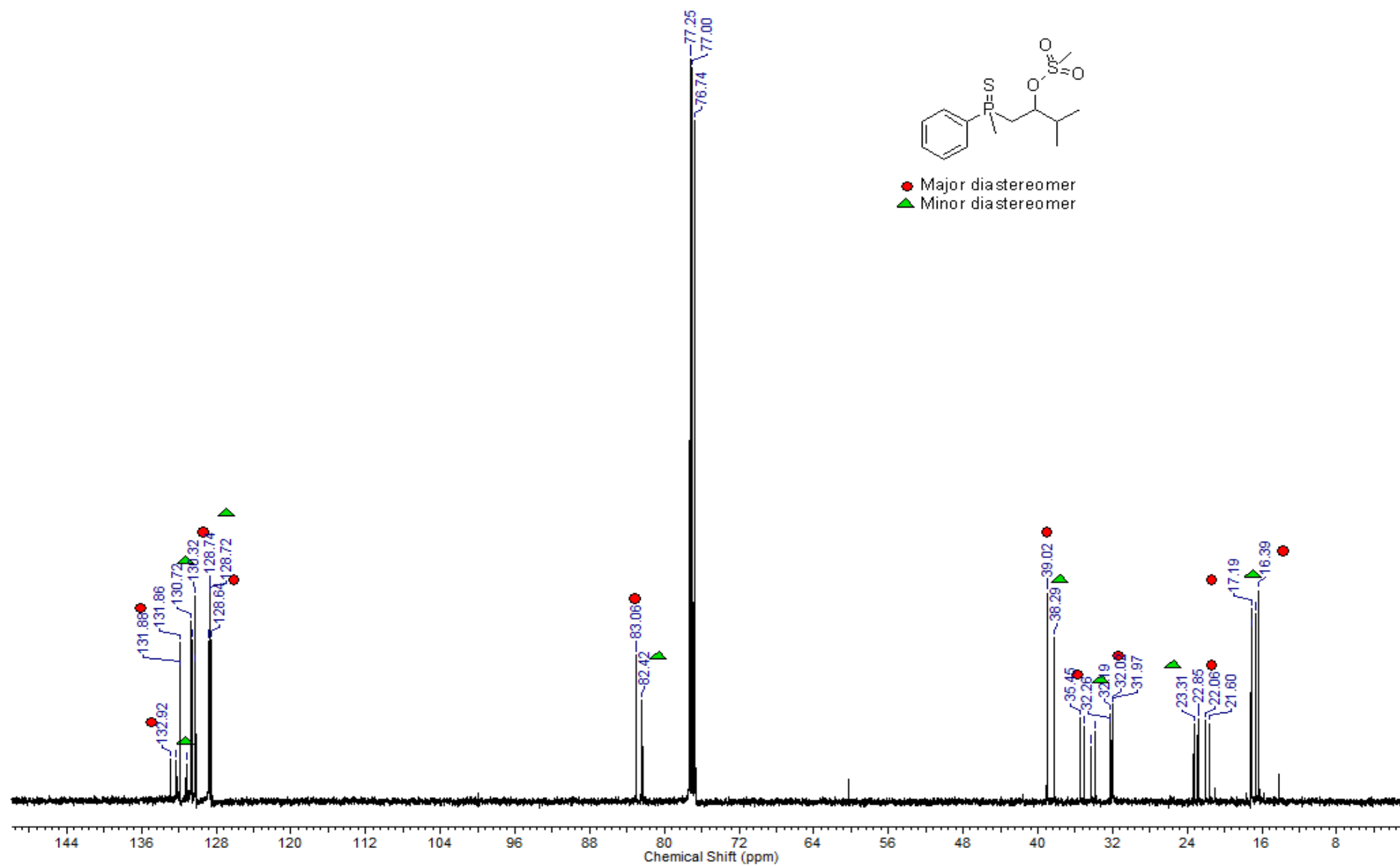
¹³C NMR spectrum of (2-ethylbut-2-enyl)(methylphenyl)phosphine oxide (**58**) (CDCl₃, 126 MHz).



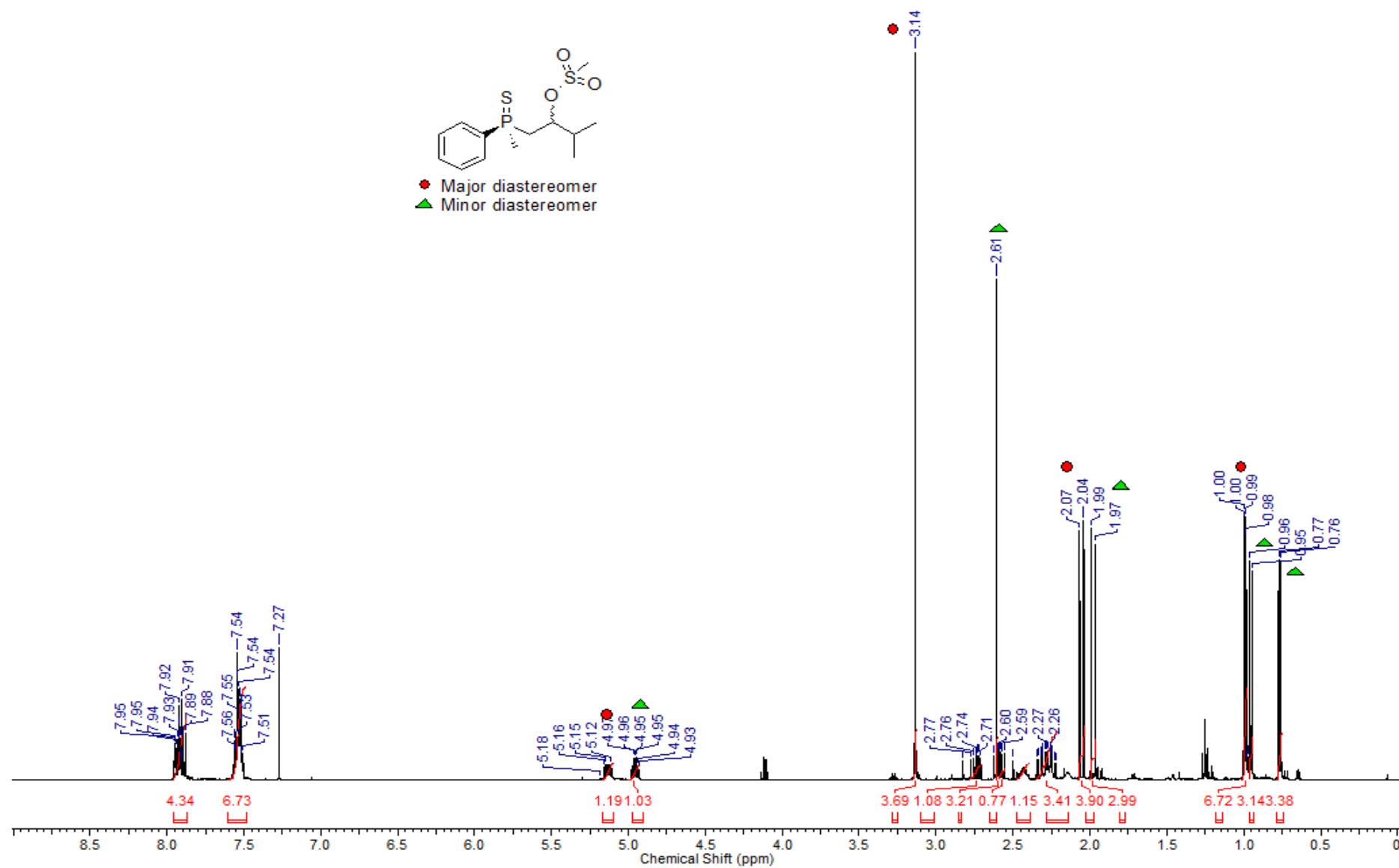
¹H NMR spectrum of (2-mesyloxy-3-methylbutyl)methylphenylphosphine sulfide (59) (CDCl₃, 500 MHz).



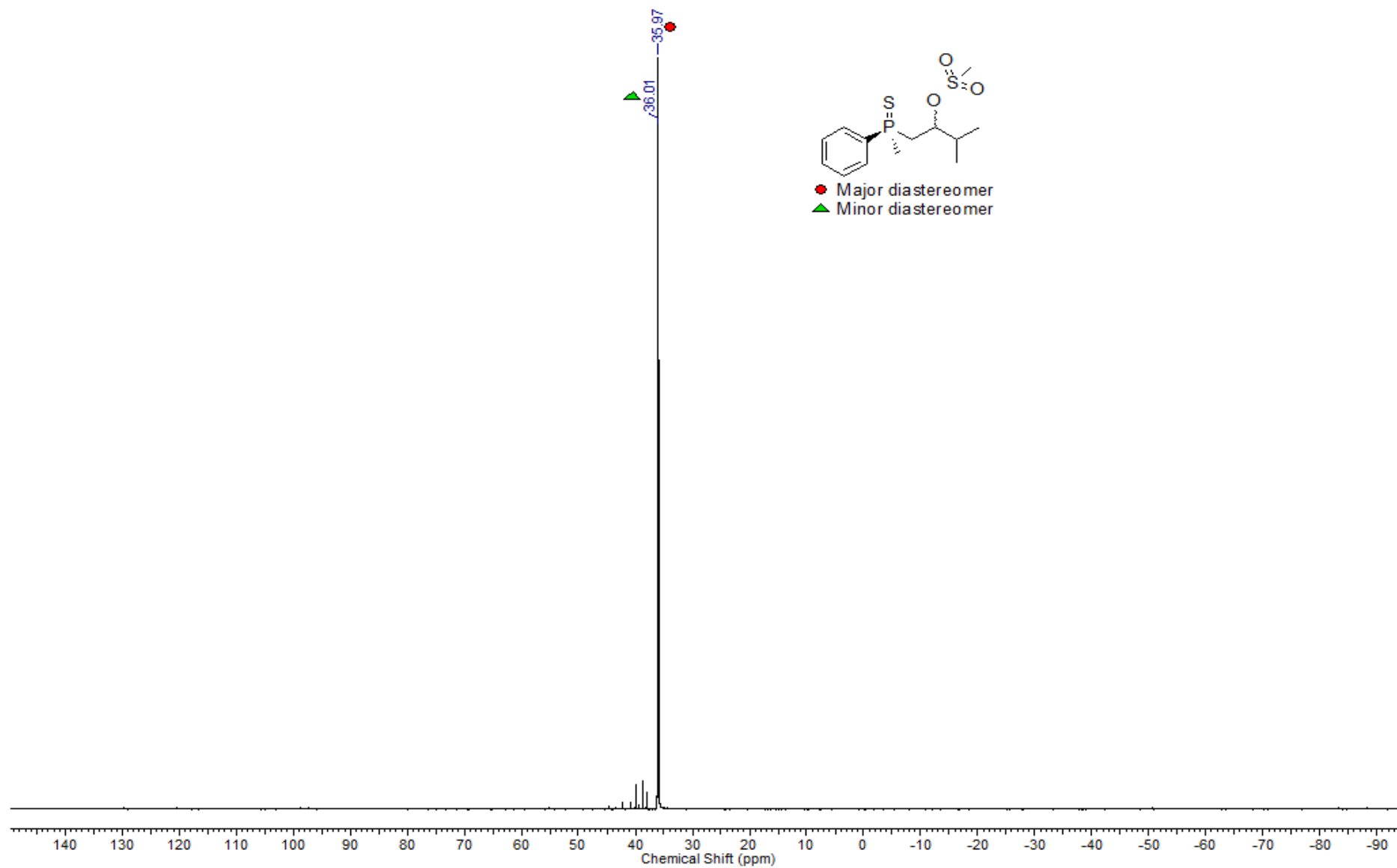
^{31}P NMR spectrum of (2-mesyloxy-3-methylbutyl)methylphenylphosphine sulfide (**59**) (CDCl_3 , 202 MHz).



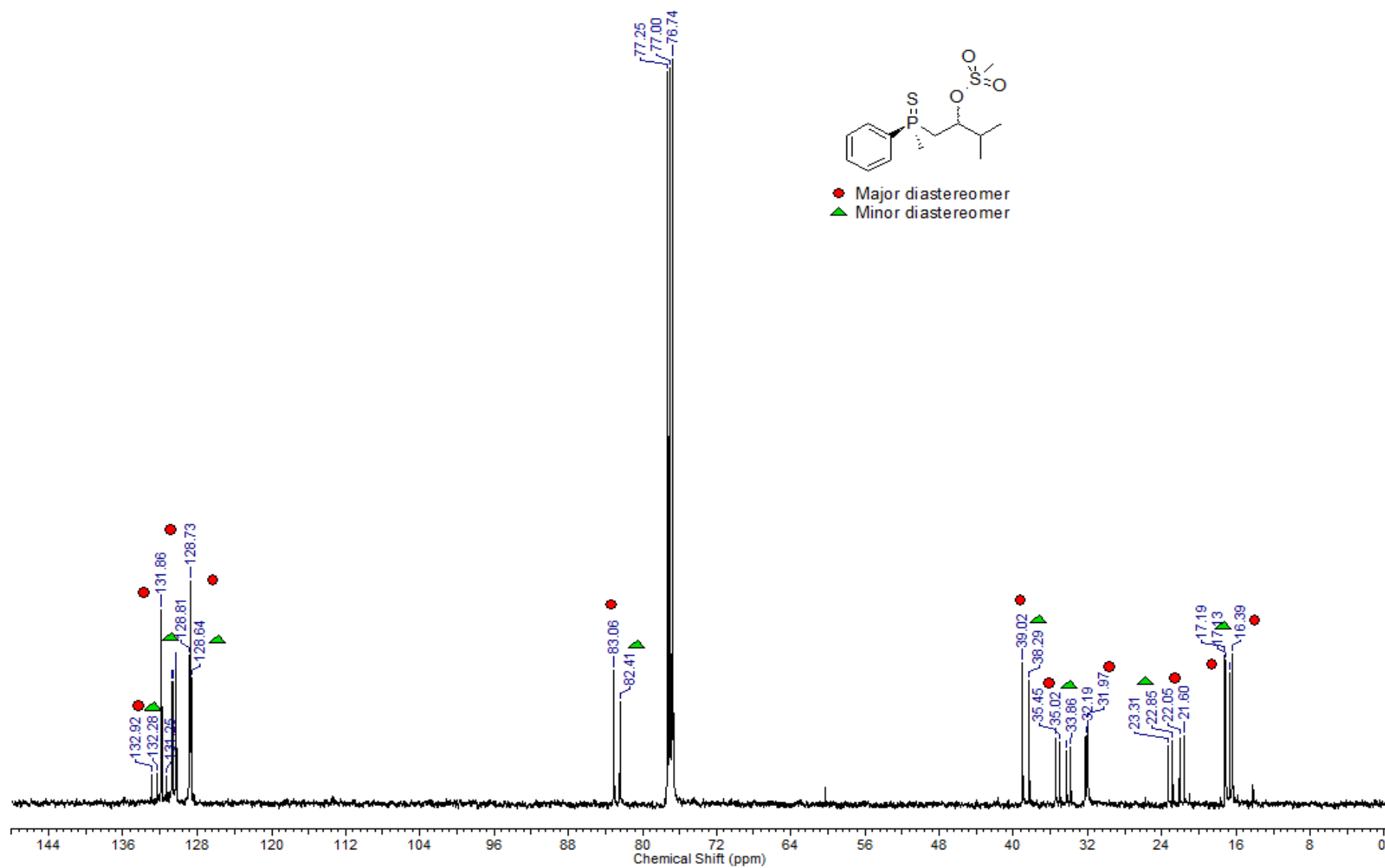
¹³C NMR spectrum of (2-mesyloxy-3-methylbutyl)methylphenylphosphine sulfide (59) (CDCl₃, 126 MHz).



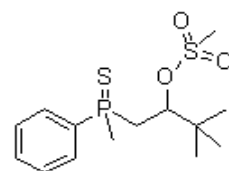
¹H NMR spectrum of (S_P)-(2-mesyloxy-3-methylbutyl)methylphenylphosphine sulfide (S_P)-(59) (CDCl₃, 500 MHz).



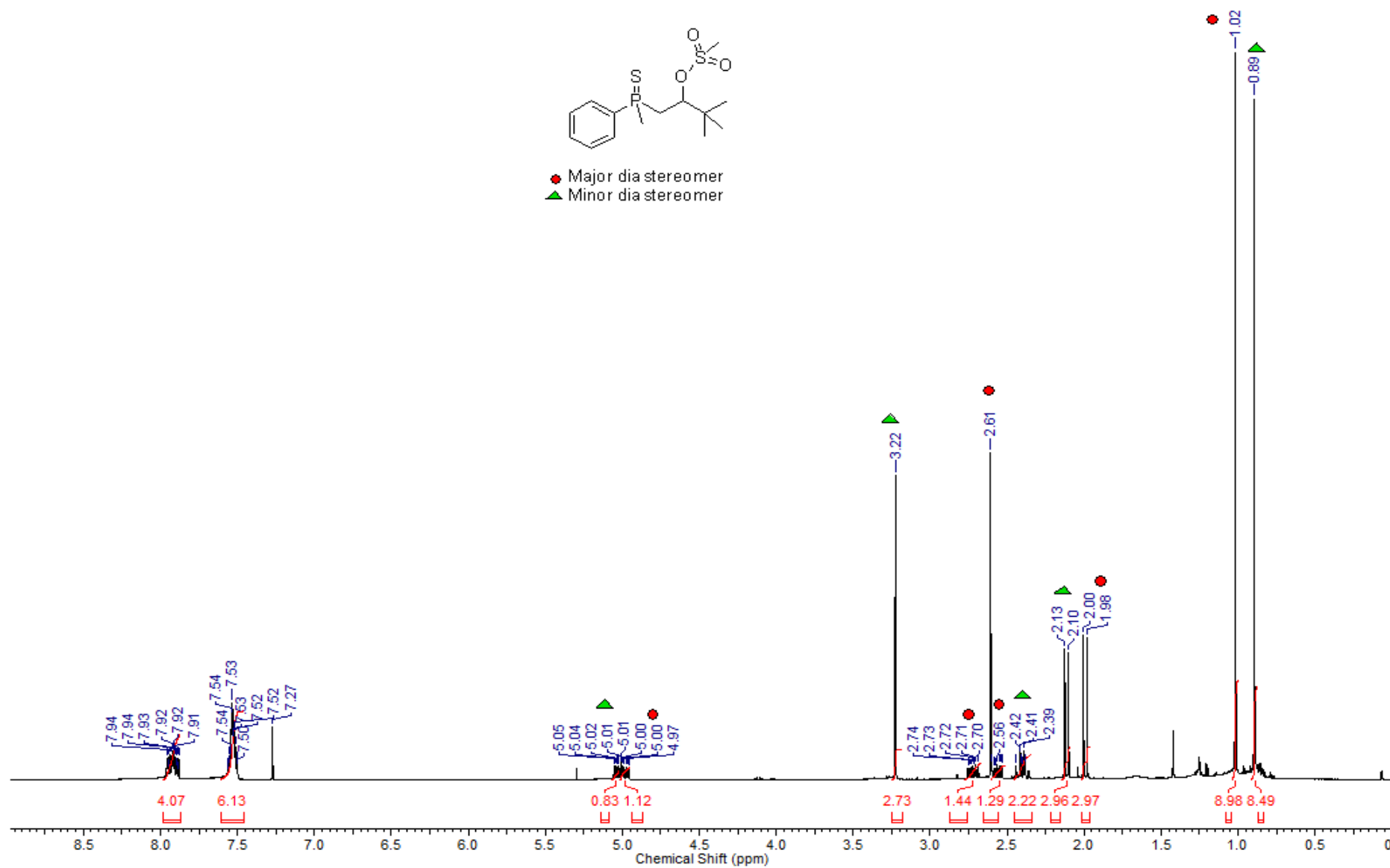
^{31}P NMR spectrum of (S_P) -(2-mesyloxy-3-methylbutyl)methylphenylphosphine sulfide (S_P)-(59) (CDCl_3 , 202 MHz).



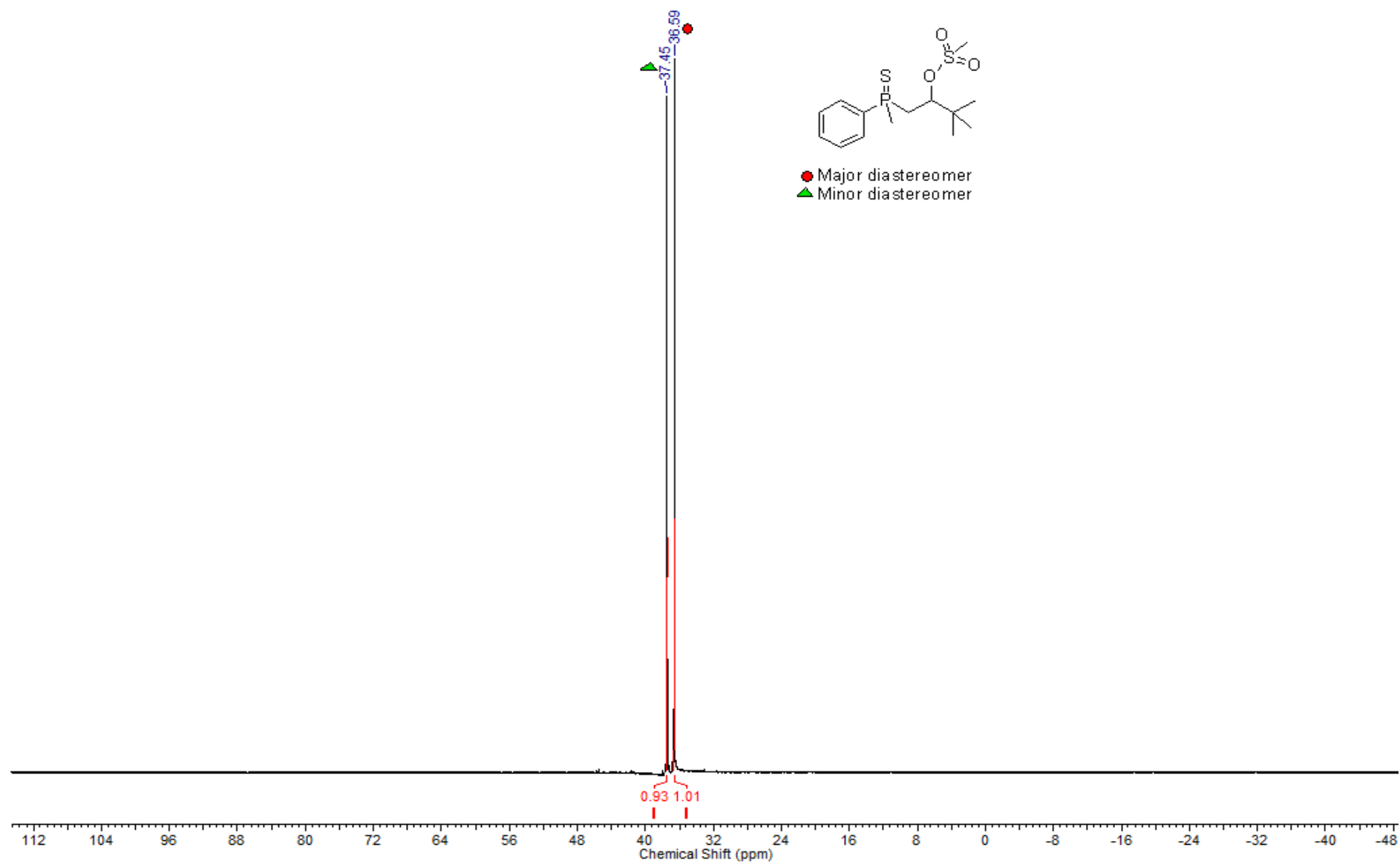
¹³C NMR spectrum of (*S_P*)-(2-mesyloxy-3-methylbutyl)methylphenylphosphine sulfide (*S_P*)-(59) (CDCl₃, 126 MHz).



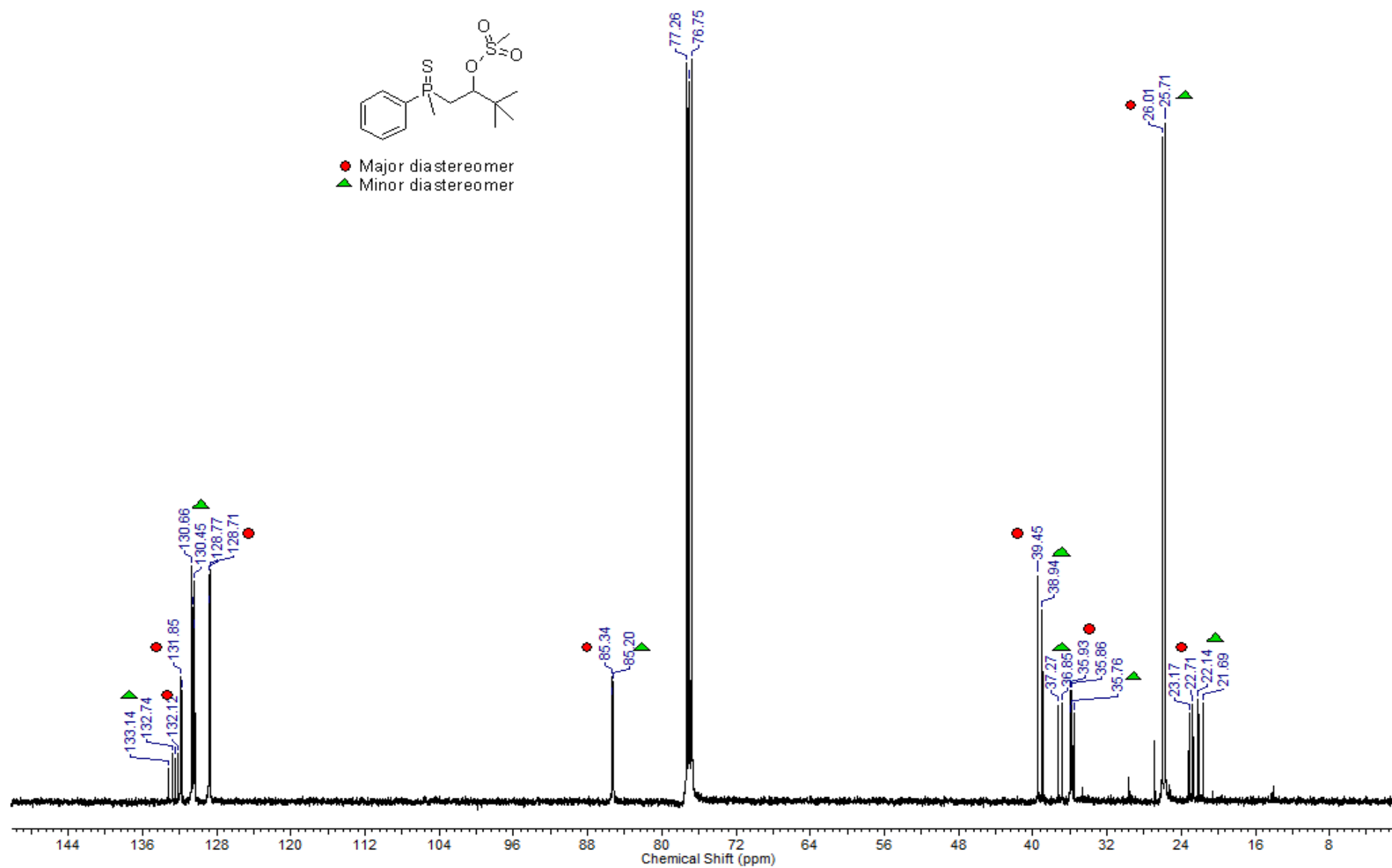
● Major dia stereomer
 ▲ Minor dia stereomer



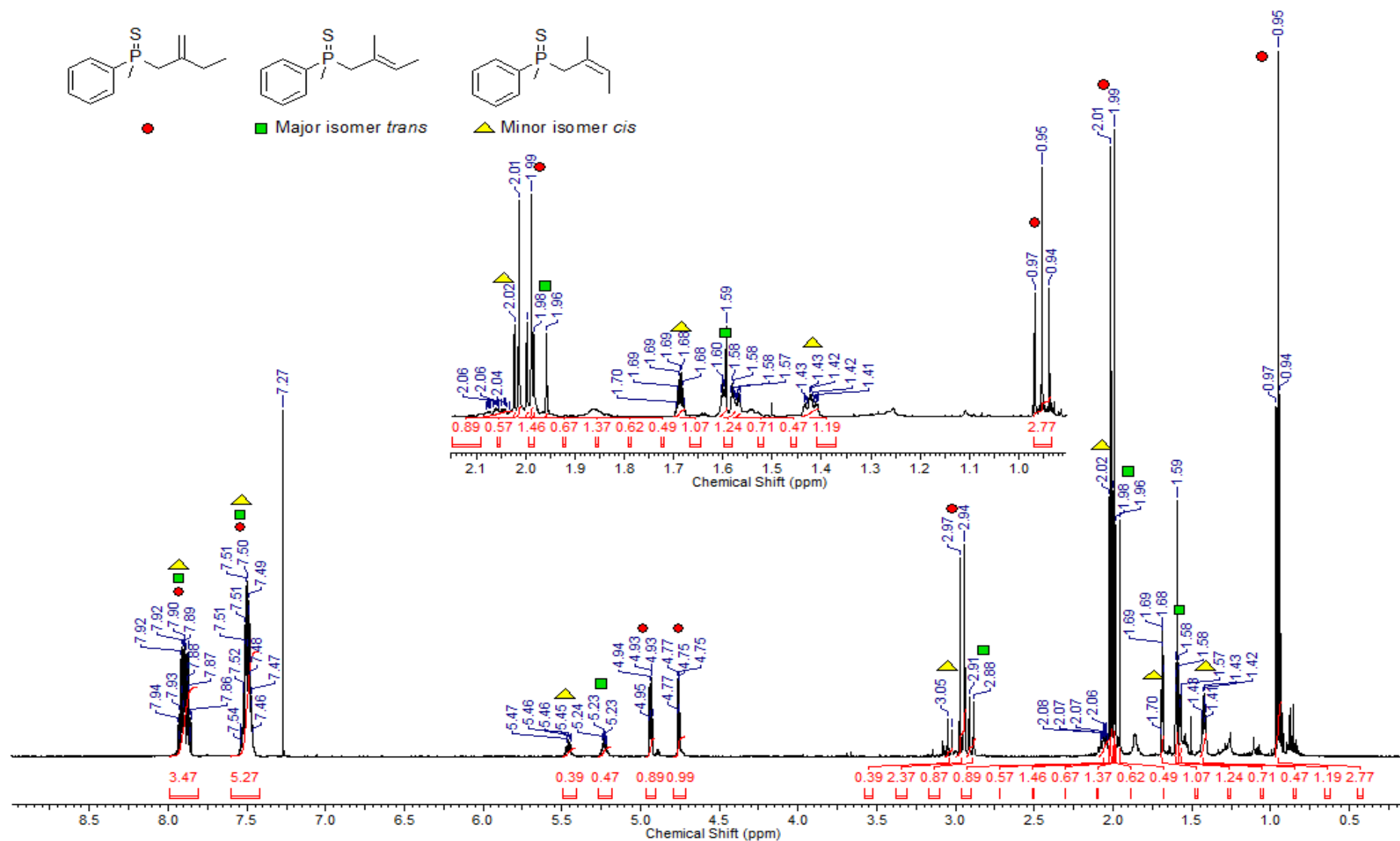
^1H NMR spectrum of (2-mesyloxy-3,3-dimethylbutyl)methylphenylphosphine sulfide (**60**) (CDCl_3 , 500 MHz).



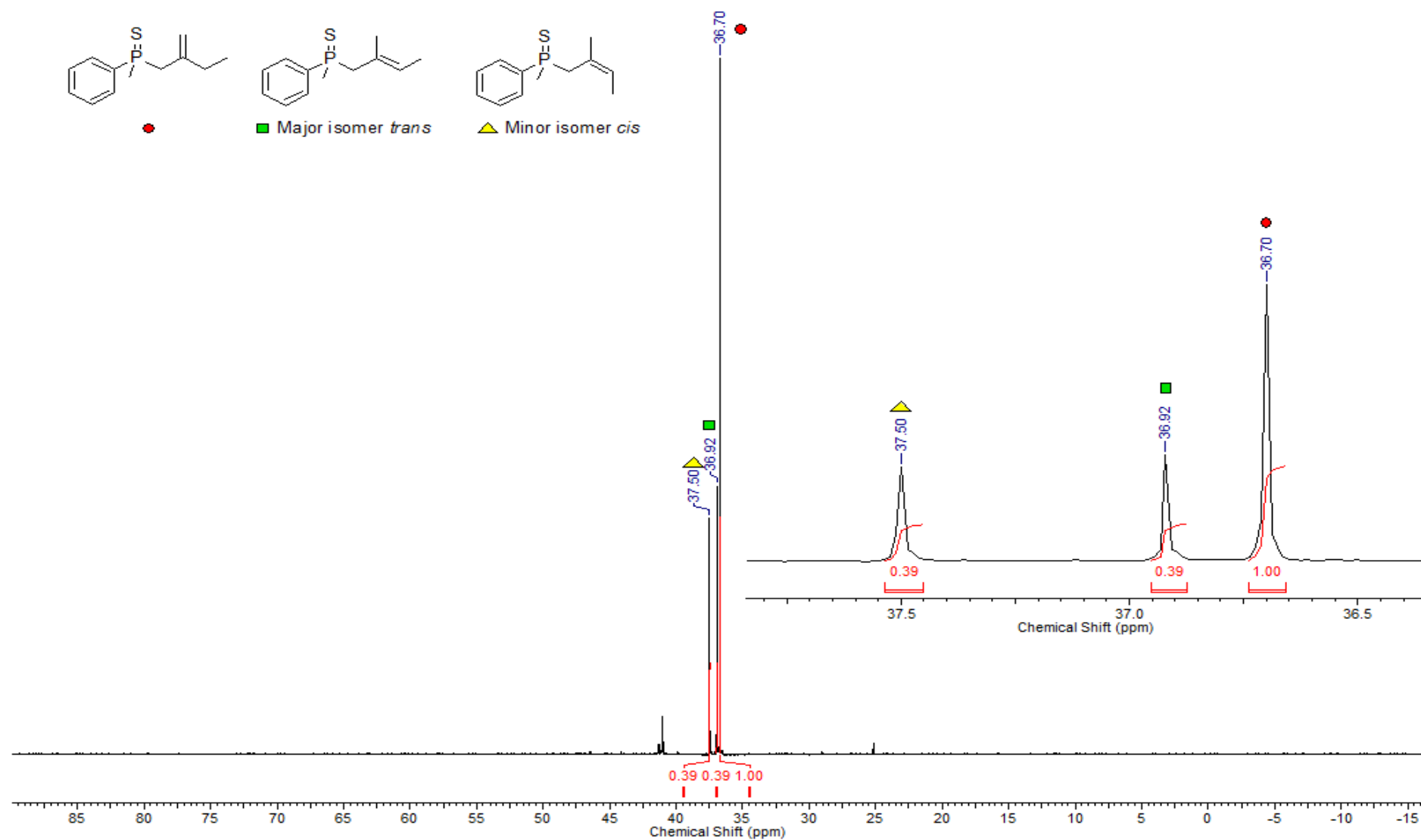
^{31}P NMR spectrum of (2-mesyloxy-3,3-dimethylbutyl)methylphenylphosphine sulfide (**60**) (CDCl_3 , 202 MHz).



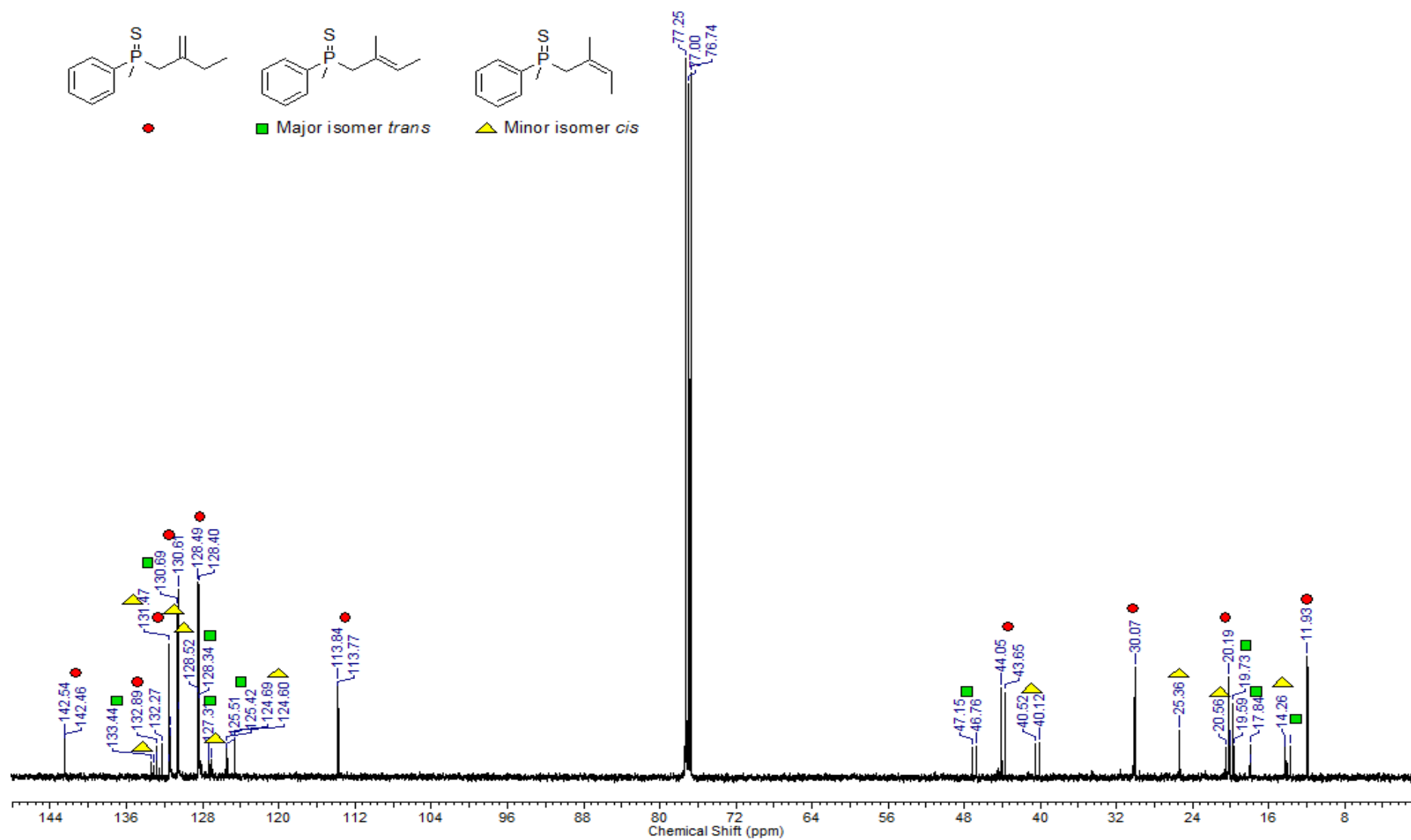
¹³C NMR spectrum of (2-mesyloxy-3,3-dimethylbutyl)methylphenylphosphine sulfide (**60**) (CDCl₃, 126 MHz).



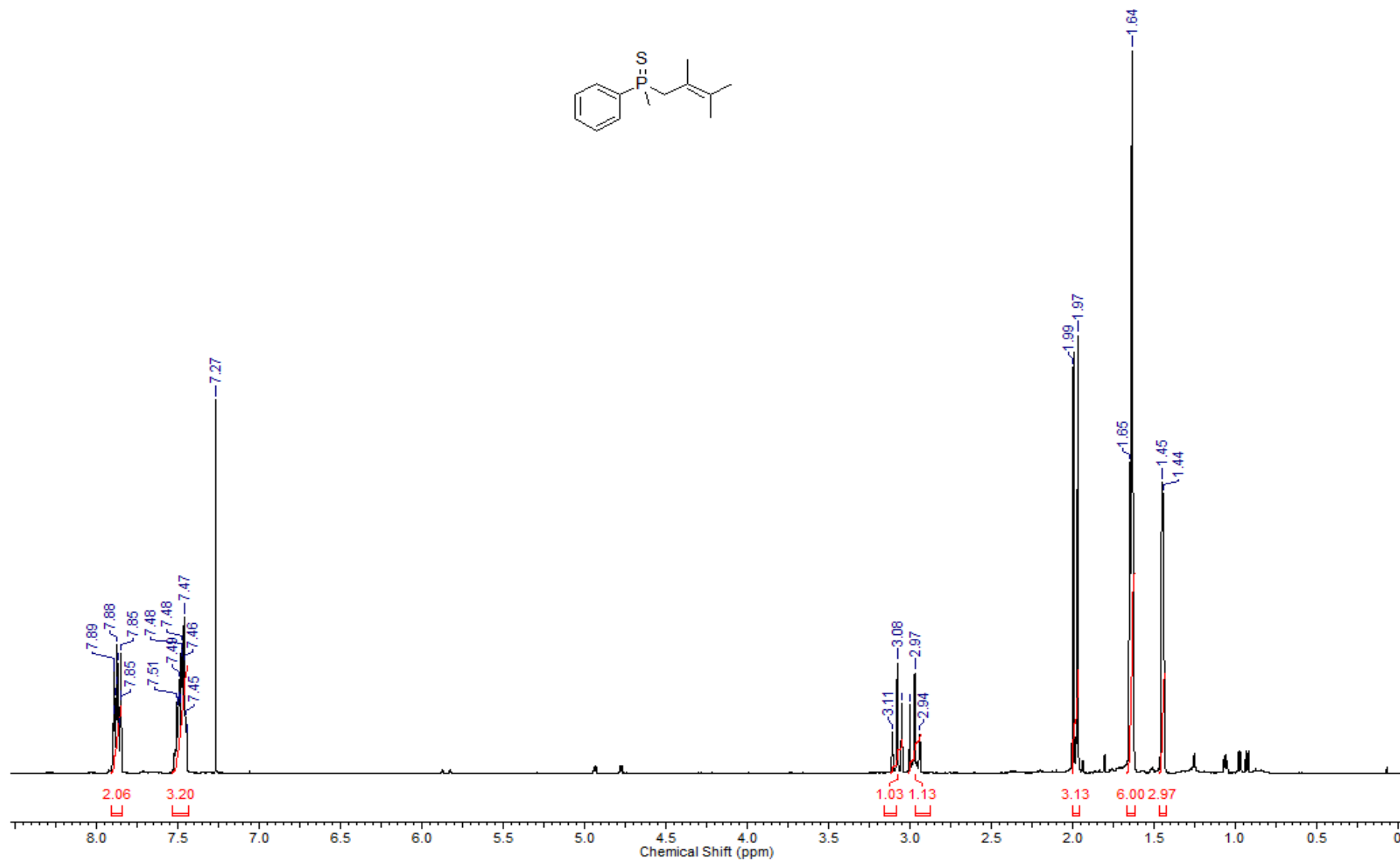
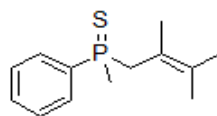
¹H NMR spectrum of mixture of (2-methylbut-2-enyl)(methylphenyl)phosphine oxide (**61**) and (2-ethylprop-2-enyl)(methylphenyl)phosphine oxide (**62**) (CDCl₃, 500 MHz).



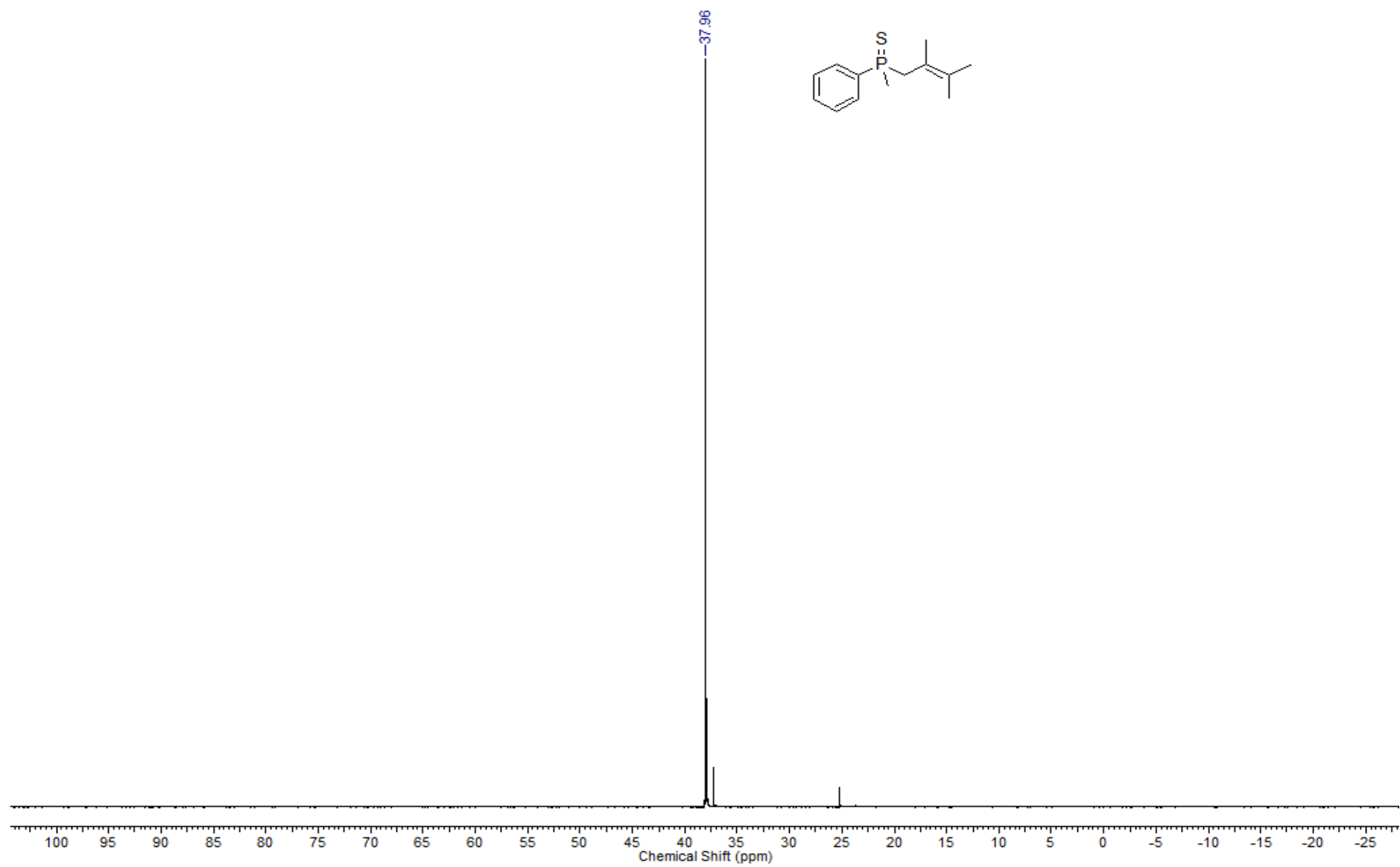
^{31}P NMR spectrum of mixture of (2-methylbut-2-enyl)(methylphenyl)phosphine oxide (**61**) and (2-ethylprop-2-enyl)(methylphenyl)phosphine oxide (**62**) (CDCl_3 , 202 MHz).



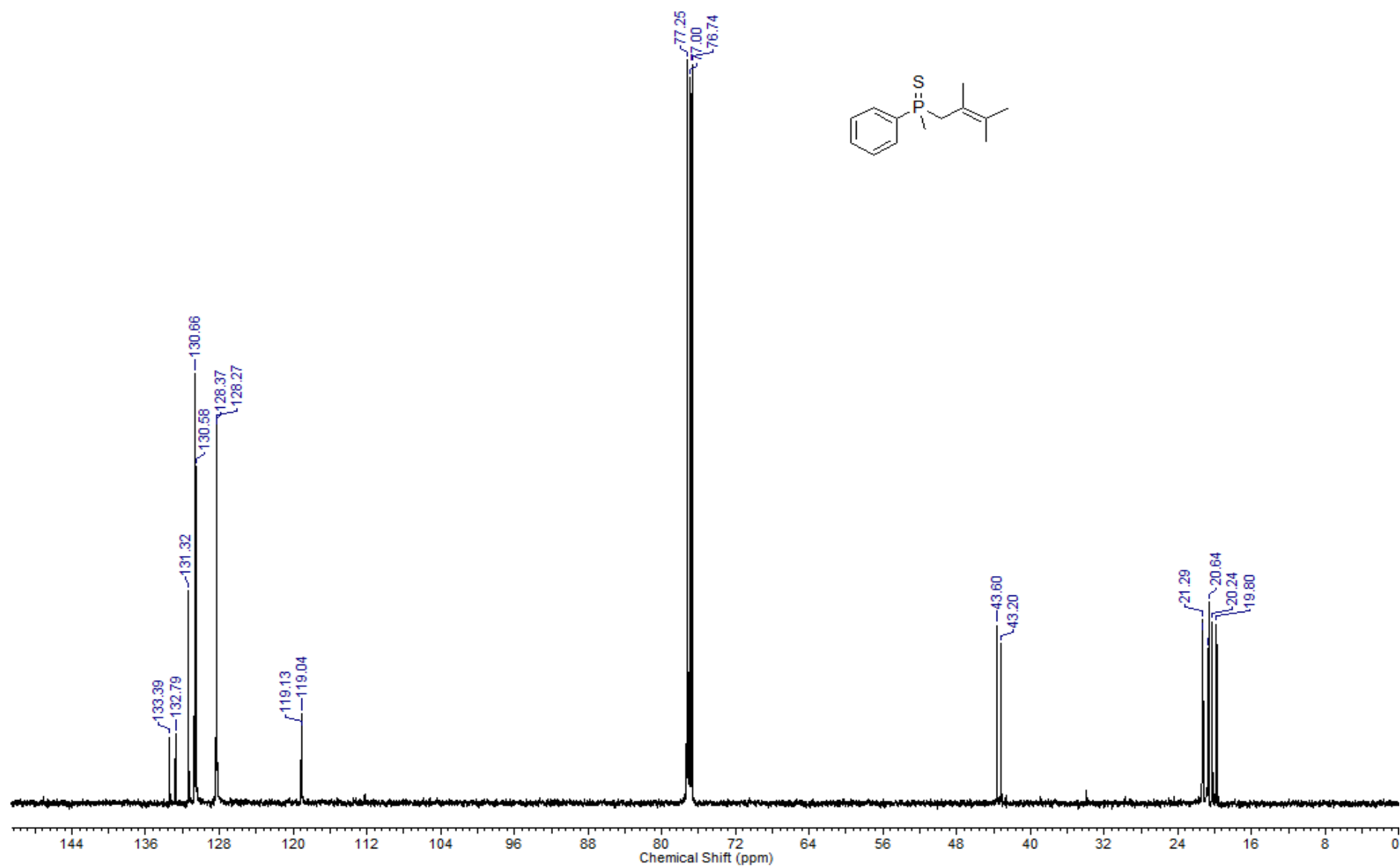
¹³C NMR spectrum of mixture of (2-methylbut-2-enyl)(methylphenyl)phosphine oxide (**61**) and (2-ethylprop-2-enyl)(methylphenyl)phosphine oxide (**62**) (CDCl₃, 126 MHz).



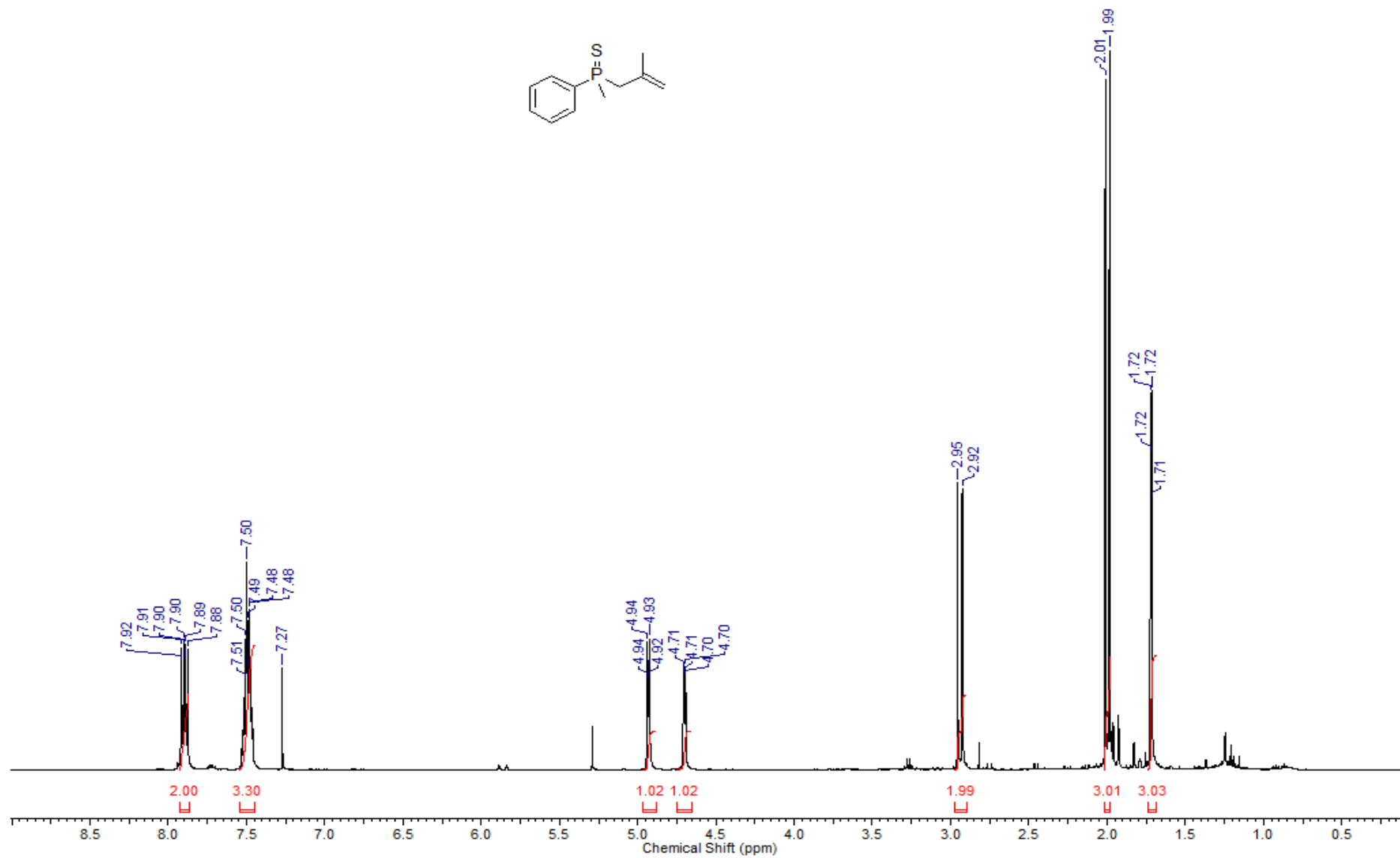
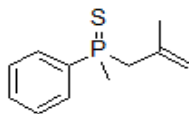
¹H NMR spectrum of (2,3-dimethylbut-2-enyl)(methylphenyl)phosphine oxide (**63**) (CDCl₃, 500 MHz).



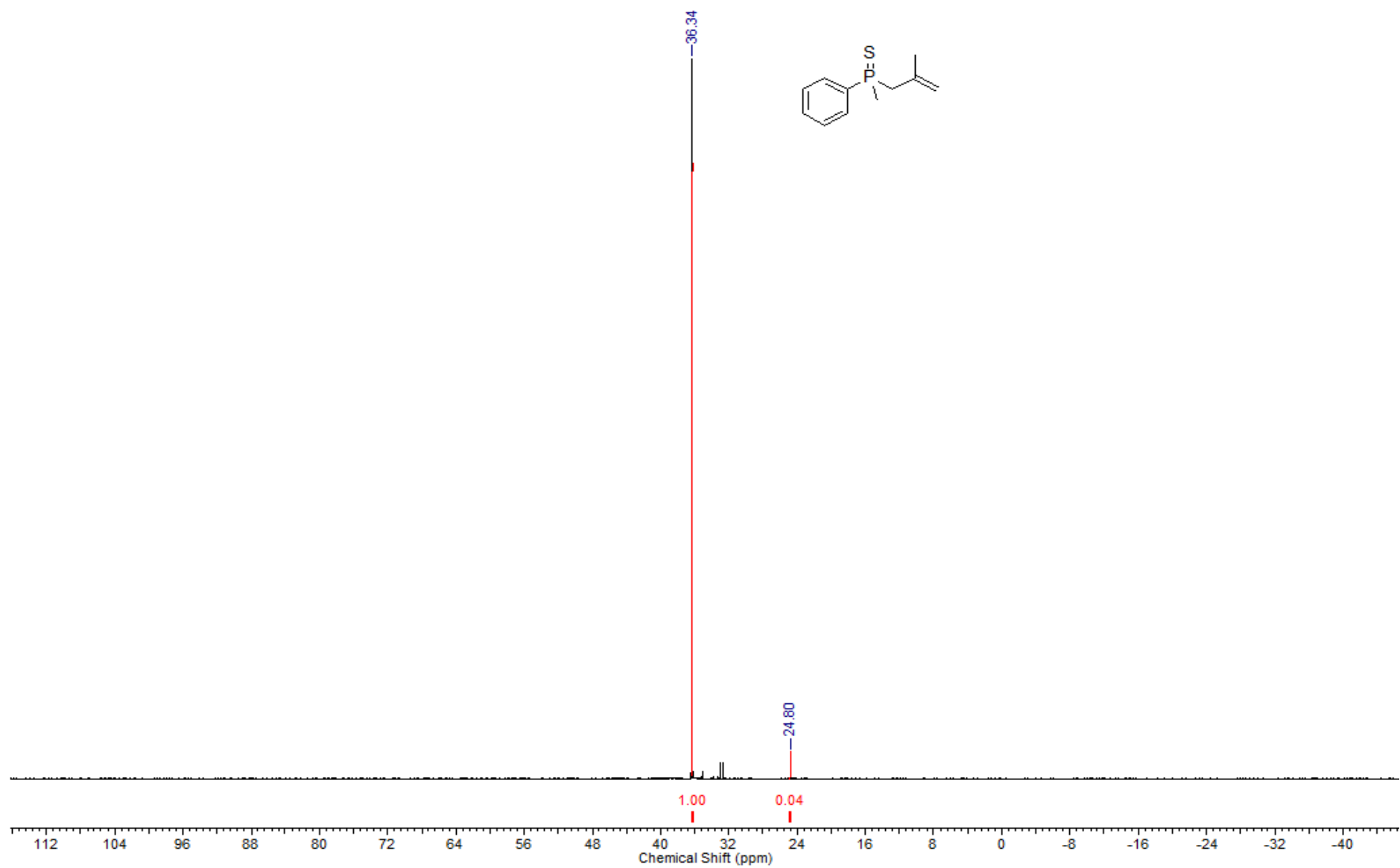
^{31}P NMR spectrum of (2,3-dimethylbut-2-enyl)(methylphenyl)phosphine oxide (**63**) (CDCl_3 , 202 MHz).



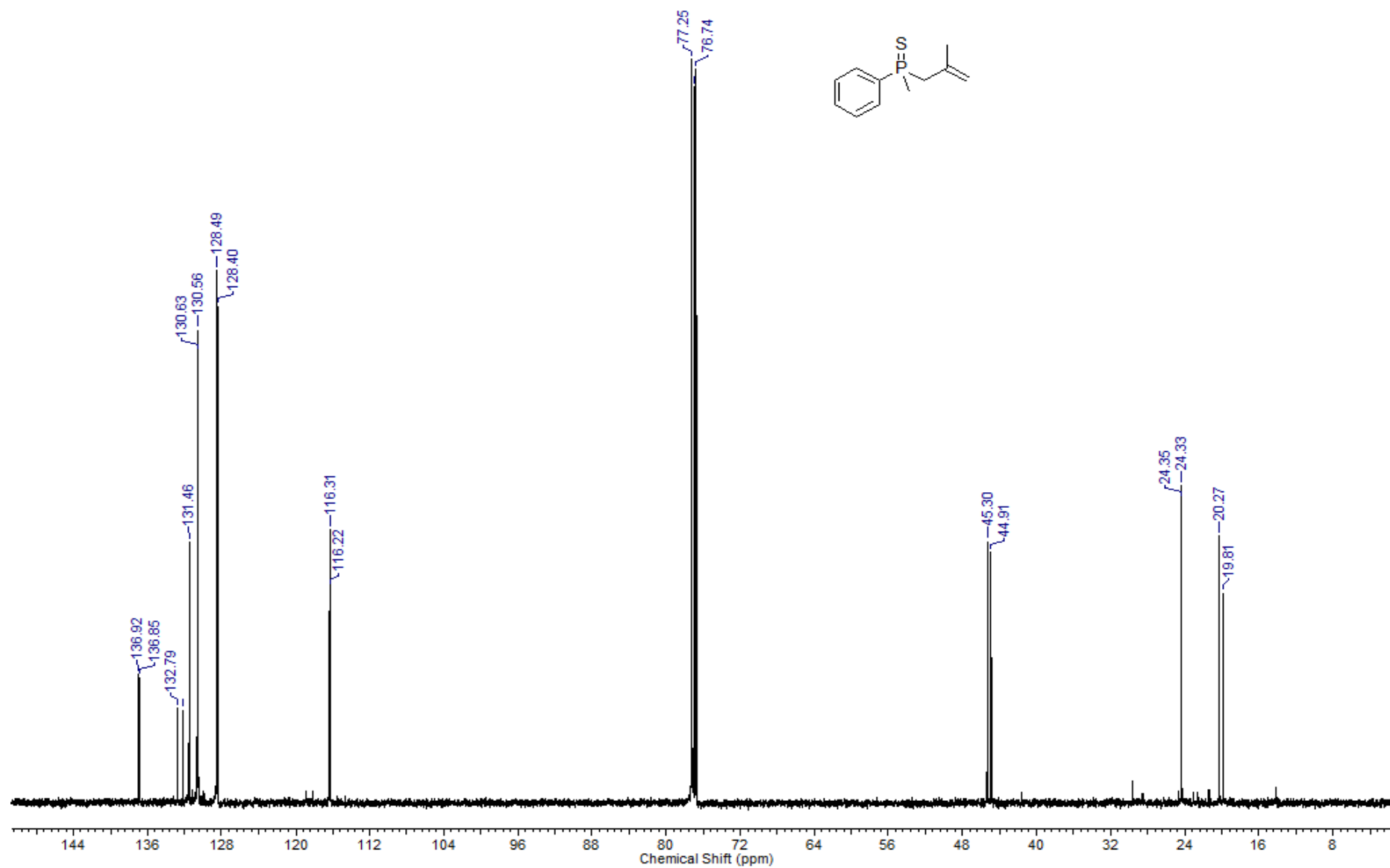
¹³C NMR spectrum of (2,3-dimethylbut-2-enyl)(methylphenyl)phosphine oxide (**63**) (CDCl₃, 126 MHz).



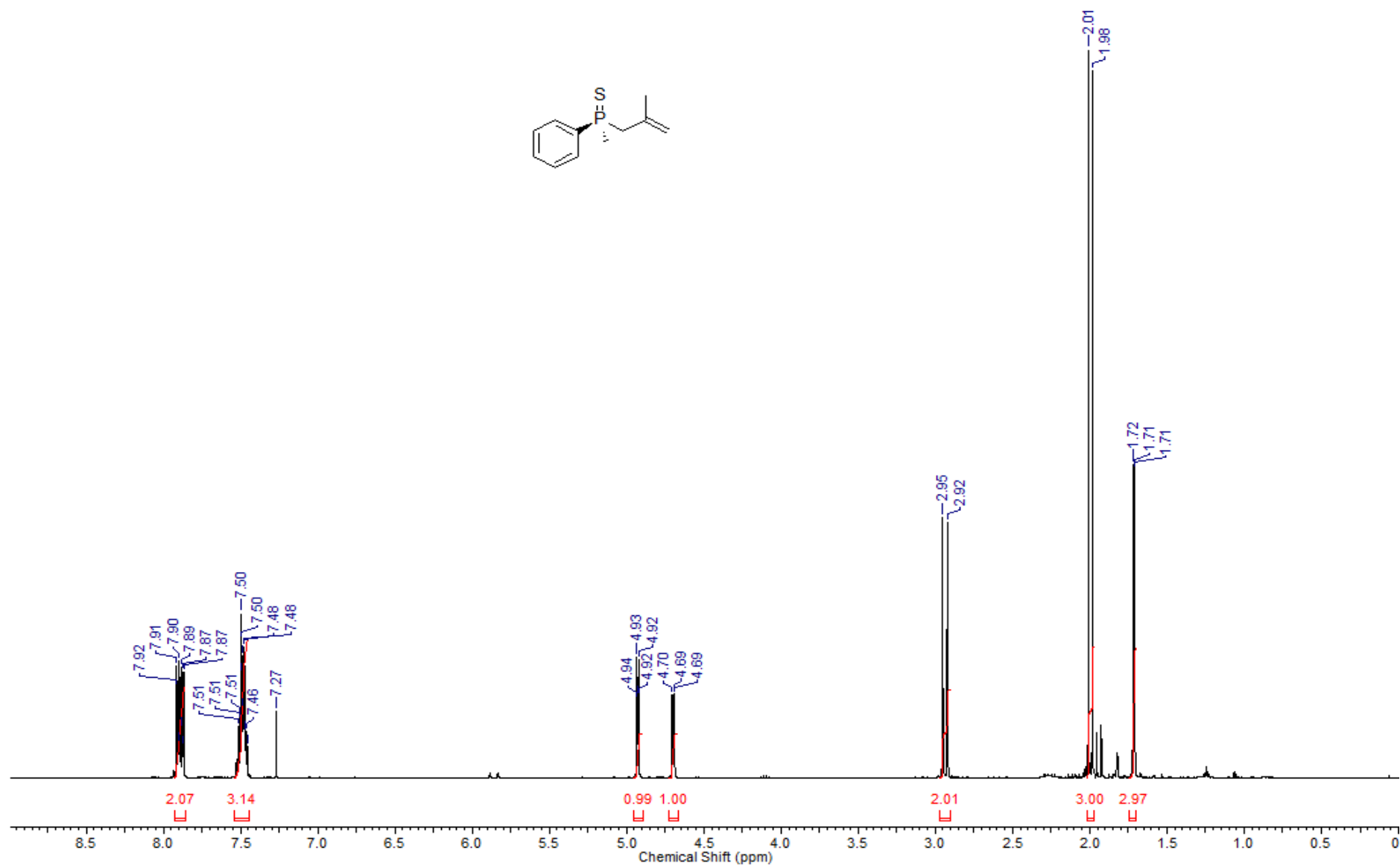
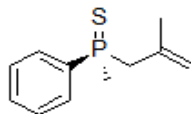
¹H NMR spectrum of (2-methylprop-2-enyl)(methylphenyl)phosphine sulfide (**64**) (CDCl₃, 500 MHz).



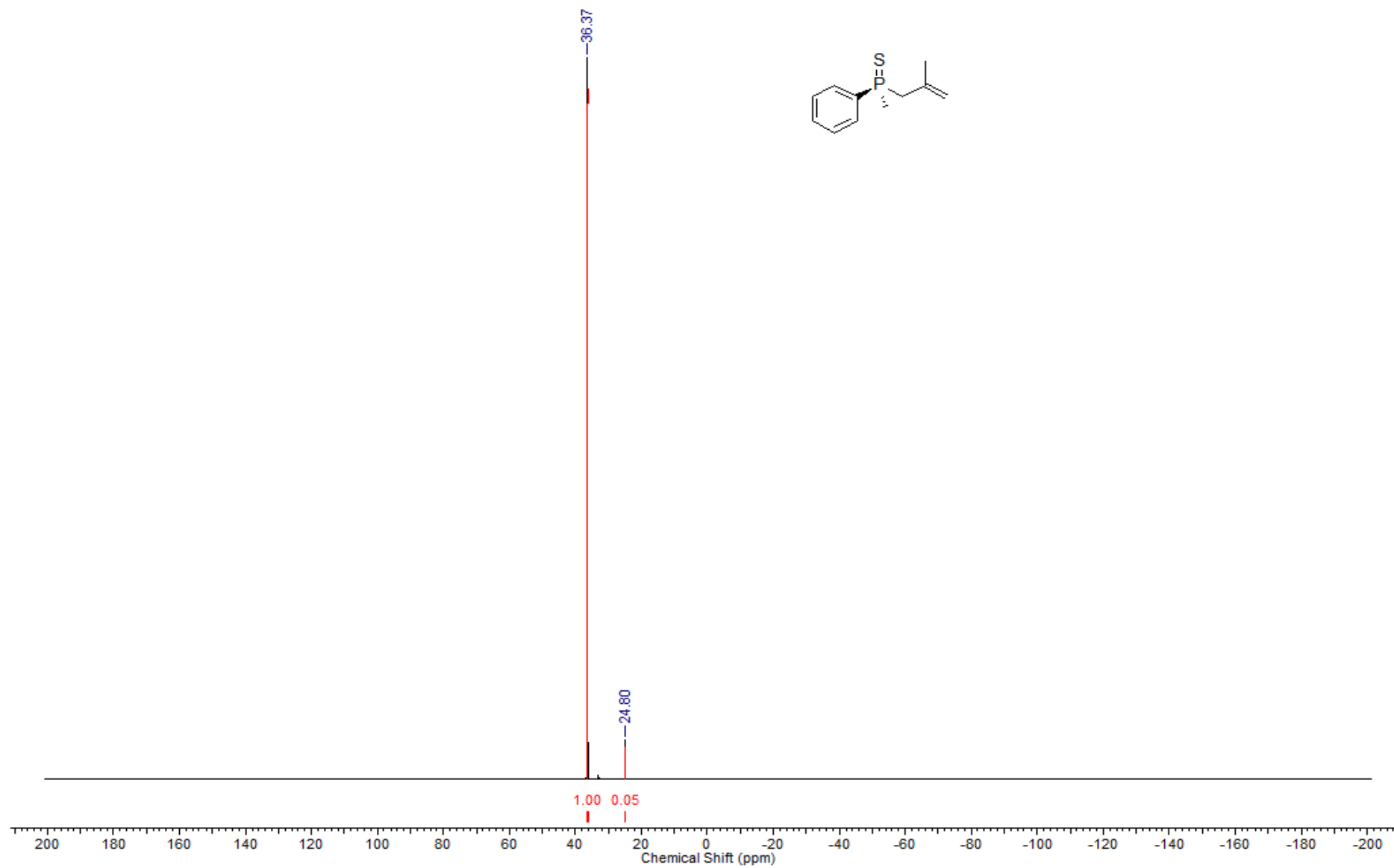
^{31}P NMR spectrum of (2-methylprop-2-enyl)(methylphenyl)phosphine sulfide (**64**) (CDCl_3 , 202 MHz).



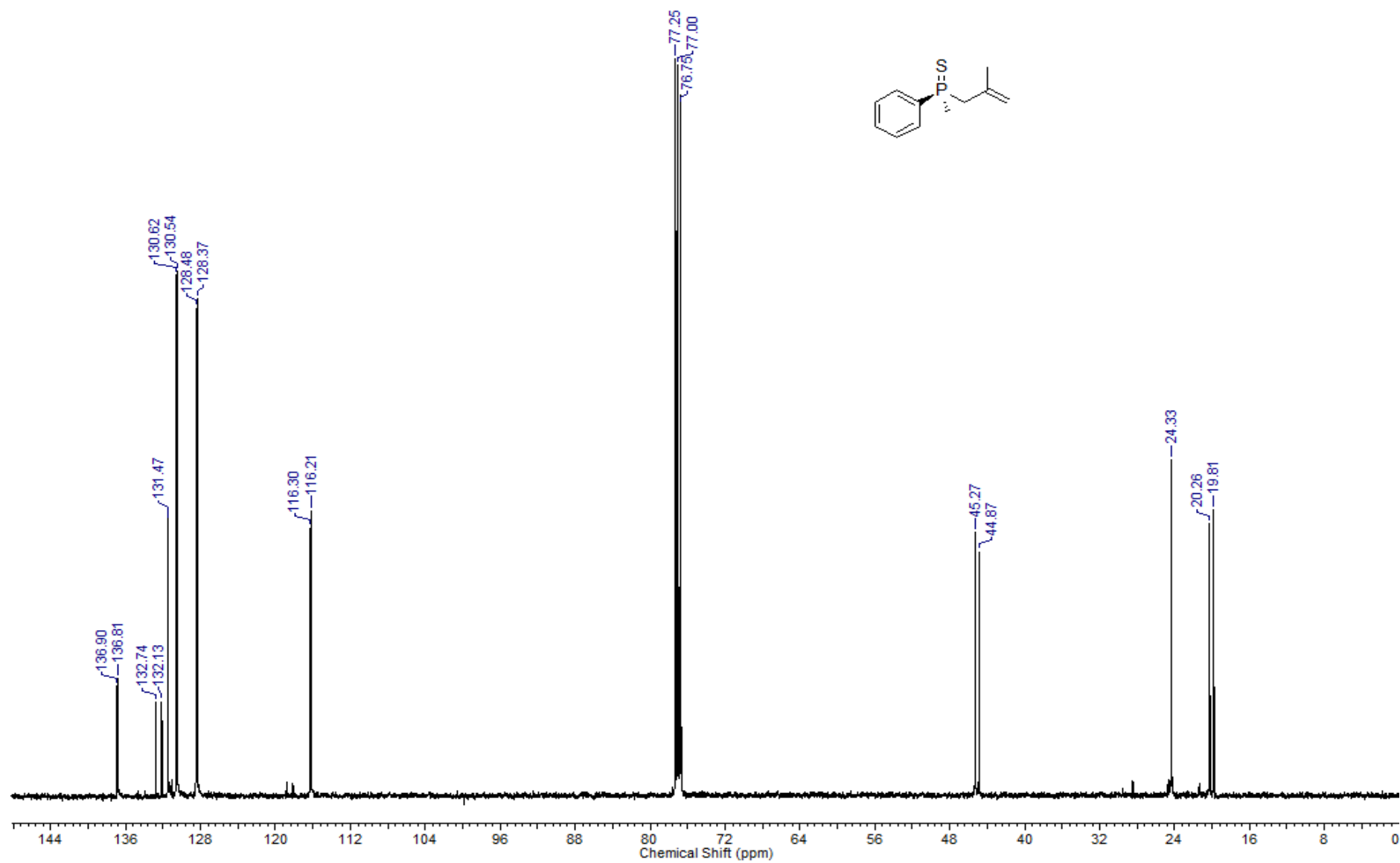
¹³C NMR spectrum of (2-methylprop-2-enyl)(methylphenyl)phosphine sulfide (**64**) (CDCl₃, 126 MHz).



¹H NMR spectrum of (S_P)-(2-methylprop-2-enyl)(methylphenyl)phosphine oxide (S_P)-**(64)** (CDCl₃, 500 MHz).



^{31}P NMR spectrum of (S_P) -(2-methylprop-2-enyl)(methylphenyl)phosphine oxide (S_P) -(**64**) (CDCl_3 , 202 MHz).



^{13}C NMR spectrum of (S_P) -(2-methylprop-2-enyl)(methylphenyl)phosphine oxide (S_P)-(64) (CDCl_3 , 126 MHz).