Supplementary Information

A sequential direct arylation/Suzuki-Miyaura cross-coupling transformation of unprotected 2'-deoxyadenosine affords a novel class of fluorescent analogues

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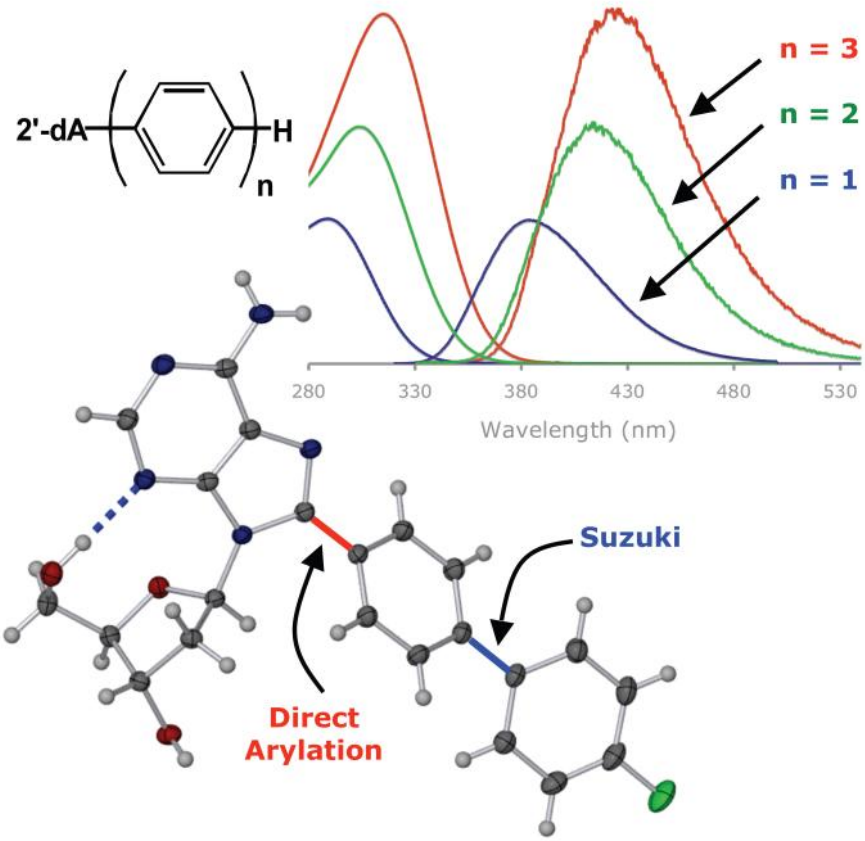


Supplementary Information Contents:

General Experimental Details.

Proton (^{1}H, 400 MHz), Fluorine (^{19}F, 376 MHz) and carbon (^{13}C{^{1}H}, 100.6 MHz) NMR spectra were recorded using an Oxford AS400 spectrometer. For proton NMR, samples were prepared using ca. 5 mg of compound dissolved in 0.7 mL of DMSO-*d*6, fluorine NMR spectra were obtained for the fluorine containing analogues on the same samples. For proton NMR, chemical shifts were referenced to residual non-deuterated solvent in DMSO-*d*6 at δ = 2.50 ppm. Carbon NMR samples were prepared using ca. 15 mg of compound dissolved in 0.7 mL of DMSO-*d*6. Chemical shifts were referenced to DMSO-*d*6 at δ = 39.43 ppm. All spectra were reprocessed using MestReNova version 5.2.1 on a PC (SineBell apodization was used to obtain detailed proton spin-spin coupling patterns and constants). MS (mass spectrometry) spectra were recorded on a Bruker Daltronics micrOTOF machine using electrospray ionisation (ESI). The mass to charge ratio (m/z) of the protonated molecular ion is reported with any major fragments formed. Reaction progress was monitored by TLC (thin layer chromatography) on a silica-gel matrix on aluminium, with a fluorescent indicator at 254 nm. Common abbreviations used: EtOAc = ethyl acetate; iPrOH = iso-propanol; DMF = N,N-dimethylformamide; MeOH = methanol; XPhos = 2-dicyclohexylphosphino-2',4',6'-tri-iso-propylbiphenyl; TPPTS = tris-(3-sulfophenyl)phosphine trisodium salt. Commercial chemicals were purchased from Sigma Aldrich or Alfa Aesar.

Steady-State Spectroscopy.

UV-vis spectroscopy was performed using a Jasco V-550 spectrophotometer with a thermostatted cell holder (20 ºC using a water bath). Spectra were measured in DMSO at 5-7 different concentrations (ranging between 6.25×10^{-7} to 1×10^{-4} molar solutions) using a quartz cuvette (λ_{max} and ε values are reported). Fluorescence emission spectra (λ_{em} value is reported) were recorded using a Fluoromax-3 spectrofluorimeter (Jobin Yvon Horiba). Fluorescence quantum yield (φ) was determined using the same spectrofluorimeter equipped with an integrating sphere (Jobin Yvon Horiba). The range of the integrating sphere was extended down to an excitation wavelength of 285 nm by applying a modified sphere correction factor determined using a previously established method.[1] All solutions for φ determination were prepared to give an absorbance ≤ 0.1, thus minimising the effects of reabsorption.

Acquisition of Fluorescence Lifetimes.

Fluorescence lifetimes were determined using the time-correlated single-photon counting (TCSPC) technique in the laboratory of Dr. A. Beeby (University of Durham, UK). Details of the method[2] and instrumentation[3] used for this work have been published elsewhere. All solutions for analysis by TCSPC were prepared to give an absorbance ≤ 0.1 to eliminate the effects of reabsorption.

[1] J. A. Gardecki, M. Maroncelli, *Applied Spectroscopy*, **1998**, *52*, 1179.

[2] A. Beeby, S. FitzGerald, C. F. Stanley, *Photochem. Photobiol.*, **2001**, *74*, 566.

[3] A. N. Swinburne, M. J. Paterson, A. Beeby, J. W. Steed, *Chem. Eur. J.*, **2010**, *16*, 2714.

General Experimental Procedures.

General Procedure for the Direct Arylation of 2'-Deoxyadenosine.

To a vacuum dried Schlenk tube was added 2'-deoxyadenosine (473 mg, 1.88 mmol, 1.0 eq), Cs_2CO_3 (1.53 g, 4.68 mmol, 2.5 eq), CuI (1.07 g, 5.64 mmol, 3.0 eq), $Pd(OAc)_2$ (21 mg, 94 μmol, 5 mol%) and the haloiodobenzene (3.74 mmol, 2.0 eq). The reaction vessel was evacuated under high vacuum at 25 °C with stirring, then flushed with N_2 (three cycles). 'Extra dry' DMF (Acros, 10 ml) was then added in addition to degassed piperidine (stored over 3Å molecular sieves, 74 μl, 0.75 mmol, 0.4 eq). The vessel was sealed and heated in an oil bath at 80 °C and stirred continuously for 15 hours. The mixture was subsequently allowed to cool to 25 °C and 1M HCl solution (10 mL) added. The pH was then adjusted to 6.5 with 1M NaOH and the aqueous solution extracted with a ^{i}PrOH:EtOAc (1:9, v/v, 5 × 50 mL) mixture, by decanting from the reaction mixture. The organic extracts were combined, dried ($MgSO_4$), filtered and reduced *in vacuo* to yield a thick gum, which was dried under high vacuum (ca. 0.8 mmHg). The crude mixture was re-dissolved/suspended in MeOH:CH_2Cl_2 (1:1, v/v, 20 mL) and adsorbed onto silica-gel (ca. 0.5 g) with reduction *in vacuo*. A short silica-gel column (ca. 10 g) using MeOH:CH_2Cl_2 as the elutent (2:98, v/v, moving in stepwise increments to 10:90 by gradient elution). The fractions containing the product were combined and the solvents removed in vacuo, CH_2Cl_2 (10 ml) was added and then removed. The purified material was then dried under high vacuum to yield the product in solid form.

General Procedures for the Suzuki/Miyaura Cross-Coupling of 8-Haloaryl-2'-deoxyadenosines.

Conditions A

To an oven dried 10 ml microwave tube was added the 8-(bromoaryl)-2'-deoxyadenosine (0.15 mmol, 1.0 eq), Na_2CO_3 (32 mg, 0.30 mmol, 2.5 eq), TPPTS (4.2 mg, 7.4 μmol, 5.0 mol%), $Pd(OAc)_2$ (0.8 mg, 3.7 μmol, 2.5 mol%) and the arylboronic acid (0.30 mmol, 2.0 eq). The reaction vessel was flushed with argon, *via* a rubber septum, for 5 minutes at 25 °C with stirring. The solvent mix of distilled MeCN:deionised water (2:1, v/v, 1.5 ml) was then added *via* the rubber septum. The rubber septum was secured with para-film and the reaction was heated in an oil bath at 80 °C with continuous stirring for 1.5 hours. The mixture was then allowed to cool to 25 °C and was dried under high vacuum (ca. 0.8 mmHg) for 30 minutes to leave a solid residue. The crude mixture was re-dissolved/suspended in MeOH:CH_2Cl_2 (1:1, v/v, 10 mL) and adsorbed onto silica-gel (ca. 0.3 g) with reduction *in vacuo*. A short silica-gel column (ca. 6 g) was eluted using MeOH:CH_2Cl_2 (2:98 and 5:95, v/v). The fractions containing the product were combined and the solvents removed *in vacuo*, CH_2Cl_2 (10 ml) was added and then removed. The purified material was then dried under high vacuum to yield the product as a fine powder.

Conditions B

To an oven dried 10 ml microvave tube was added the 8-(chloroaryl)-2'-deoxyadenosine (60 mg, 0.166 mmol, 1.0 eq), XPhos (7.9 mg, 16.6 μmol, 10.0 mol%), $Pd(OAc)_2$ (1.9 mg, 8.3 μmol, 2.5 mol%) and the arylboronic acid (0.33 mmol, 2.0 eq). The reaction vessel was flushed with Ar, *via* a rubber septum, for 5 minutes at 25 °C with stirring. The solvent mix of distilled THF: 2 M $Na_2CO_{3(aq)}$ (2:1, v/v, 1.2 ml) was then added *via* the rubber septum. The vessel was sealed with para-film and heated in an oil bath at 80 °C with vigorous stirring for 3.5 hours. The mixture was then allowed to cool to 25 °C and was dried under high vacuum (ca. 0.8 mmHg) for 30 minutes to leave a solid residue. The crude mixture was re-dissolved/suspended in MeOH:CH_2Cl_2 (1:1, v/v, 10 mL) and adsorbed onto silica-gel (ca. 0.3 g) with reduction *in vacuo*. A short silica-gel column (ca. 6 g) was eluted using MeOH:CH_2Cl_2 (2:98 and 5:95, v/v). The fractions containing the product were combined and the solvents removed *in vacuo*, CH_2Cl_2 (10 ml) was added and then removed. The purified material was then dried under high vacuum to yield the product as a fine powder.

Characterisation Data for Compounds 1-4.

8-(4-Bromophenyl)-2'-deoxyadenosine (1)

The title compound was isolated as a light brown powder (415 mg, 54 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.16 (s, 1H), 7.75 (d, *J* = 8.6, 2H), 7.68 (d, *J* = 8.6, 2H), 7.48 (bs, 2H), 6.12 (dd, *J* = 8.3, 6.3, 1H), 5.47 (dd, *J* = 8.1, 4.2, 1H), 5.25 (d, *J* = 4.3, 1H), 4.46 (m, 1H), 3.87 (ddd, *J* = 4.6, 4.4, 2.2, 1H), 3.69 (ddd, *J* = 12.0, 4.4, 4.2, 1H), 3.52 (ddd, *J* = 12.0, 8.1, 4.6, 1H), 2.15 (ddd, *J* = 13.2, 6.3, 2.1, 1H) (one proton signal obscured by H_2O in solvent); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.1, 152.1, 149.9, 149.3, 135.0, 131.2, 128.8, 128.5, 119.1, 88.3, 85.5, 71.3, 62.2, 37.0; ESI MS, *m/z* 408 [90.2 % (M(Br^{81}) + H)+], 406 [100 % (M(Br^{79}) + H)+], 292 [65.6 % (M(Br^{81}) - βD-Ribose + 2H)+], 290 [68.9 % (M(Br^{79}) - βD-Ribose + 2H)+])+]; HRMS (M(Br^{79})H+) 406.0508 (Calcd. for $C_{16}H_{17}O_3N_5Br$ 406.509).

8-(4-Chlorophenyl)-2'-deoxyadenosine (2)

The title compound was isolated as an off white solid (659 mg, 97 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.16 (s, 1H), 7.75 (d, *J* = 8.6, 2H), 7.68 (d, *J* = 8.6, 2H), 7.48 (brs, 2H), 6.12 (dd, *J* = 8.4, 6.4, 1H), 5.50 (dd, *J* = 8.1, 4.1, 1H), 5.27 (d, *J* = 4.3, 1H), 4.46 (dddd, *J* = 6.2, 4.3, 2.3, 2.2, 1H), 3.87 (ddd, *J* = 4.5, 4.3, 2.2, 1H), 3.69 (ddd, *J* = 12.1, 4.3, 4.1, 1H), 3.52 (ddd, *J* = 12.1, 8.1, 4.5, 1H), 3.31 (ddd, *J* = 13.0, 8.4, 6.2, 1H), 2.15 (ddd, *J* = 13.0, 6.4, 2.3, 1H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.2, 152.2, 150.0, 149.5, 135.2, 131.3, 129.0, 128.4, 119.2, 88.5, 85.7, 71.5, 62.4, 37.3; ESI MS, *m/z* 364 [32.5 % (M(Cl^{37}) + H)+], 362 [100 % (M(Cl^{35}) + H)+], 248 [13.6 % (M(Cl^{37}) - βD-Ribose + 2H)+], 246 [31.8 % (M(Cl^{35}) - βD-Ribose + 2H)+]; HRMS (M(Cl^{35})H+) 362.1010 (Calcd. for $C_{16}H_{17}O_3N_5Cl$ 362.1010).

8-(4-Bromo-3-fluorophenyl)-2'-deoxyadenosine (3)

The title compound was isolated as a brown solid (422 mg, 53 %), ^{1}H NMR (400 MHz, DMSO-D6) δ 8.17 (s, 1H), 7.97 (dd, *J* = 8.3, 7.2, 1H), 7.73 (dd, *J* = 9.3, 2.1, 1H), 7.53 (dd, *J* = 8.3, 2.1, 1H), 7.51 (brs, 2H), 6.13 (dd, *J* = 8.3, 6.3, 1H), 5.39 (dd, *J* = 7.9, 4.3, 1H), 5.25 (d, *J* = 4.4, 1H), 4.49 – 4.43 (m, 1H), 3.87 (ddd, *J* = 4.7, 4.5, 2.5, 1H), 3.68 (ddd, *J* = 11.8, 4.5, 4.3, 1H), 3.51 (ddd, *J* = 11.8, 7.9, 4.7, 1H), 2.17 (ddd, *J* = 13.1, 6.3, 2.4, 1H) (one proton signal obscured by H_2O in solvent); ^{13}C NMR (101 MHz, DMSO-d_6) δ 158.0 (d, J_{CF} = 246.0), 156.2, 152.4, 149.9, 148.3, 134.1, 131.1, 127.0, 119.1, 117.6 (d, J_{CF} = 23.9), 110.3 (d, J_{CF} = 20.9), 88.3, 85.4, 71.3, 62.1, 37.0; ^{19}F NMR (376 MHz, DMSO-d_6) δ 106.71 (dd, *J* = 7.2, 9.3, 1F); ESI MS, *m/z* 426 [100 % (M(Br^{81}) + H)+], 424 [98.2 % (M(Br^{79}) + H)+]; HRMS (M(Br^{79})H+) 424.0404 (Calcd. for $C_{16}H_{16}O_3N_5BrF$ 424.0415).

8-(3-Chlorophenyl)-2'-deoxyadenosine (4)

The title compound was isolated as a light yellow (590 mg, 87 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.18 (s, 1H), 7.79 (t, *J* = 1.8, 1H), 7.72-7.60 (m, 3H) 7.54 (brs, 2H), 6.14 (dd, *J* = 8.3, 6.3, 1H), 5.47 (brs, 1H), 5.28 (brs, 1H), 4.46 (m, 1H), 3.88 (ddd, *J* = 4.7, 4.6, 2.4, 1H), 3.69 (ddd, *J* = 11.9, 4.6, 1H), 3.53 (dd, *J* = 11.9, 4.7, 1H), 3.32 (ddd, *J* = 13.2, 8.3, 6.0, 1H), 2.17 (ddd, *J* = 13.2, 6.3, 2.3, 1H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.2, 152.2, 149.9, 149.0, 133.4, 131.7, 130.7, 130.0, 129.2, 128.0, 119.2, 88.3, 85.5, 71.3, 62.2, 37.0; ESI MS, *m/z* 364 [29.0 % (M(Cl^{37}) + H)+], 362 [100 % (M(Cl^{35}) + H)+], 248 [11.0 % (M(Cl^{37}) - βD-Ribose + 2H)+], 246 [32.3 % (M(Cl^{35}) - βD-Ribose + 2H)+]; HRMS (M(Cl^{35})H+) 362.1011 (Calcd. for $C_{16}H_{17}O_3N_5Cl$ 362.1011).

Characterisation Data for Compounds 5a-5j.

8-(4'-Methoxybiphen-4-yl)-2'-deoxyadenosine (5a)

Using *Conditions A* from **1** performed on a 0.15 mmol scale – the title compound was obtained as a fine white solid (46 mg, 71 %), using *Conditions B* from **2** performed on a 0.21 mmol scale – the title compound was obtained as a fine white solid (79 mg, 88 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.16 (s, 1H), 7.86 (d, *J* = 8.5, 2H), 7.78 (d, *J* = 8.5, 2H), 7.74 (d, *J* = 8.9, 2H), 7.48 (brs, 2H), 7.07 (d, *J* = 8.9, 2H), 6.23 (dd, *J* = 8.6, 6.2, 1H), 5.57 (dd, *J* = 8.3, 4.1, 1H), 5.27 (d, *J* = 4.2, 1H), 4.48 (dddd, *J* = 6.2, 4.2, 2.2, 2.1, 1H), 3.90 (ddd, *J* = 4.5, 4.3, 2.1, 1H), 3.82 (s, 3H), 3.72 (ddd, *J* = 12.1, 4.3, 4.1, 1H), 3.55 (ddd, *J* = 12.1, 8.3, 4.5, 1H), 2.17 (ddd, *J* = 12.9, 6.2, 2.2, 1H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 159.3, 156.1, 151.9, 150.3, 149.9, 141.2, 131.3, 129.9, 127.9, 127.8, 126.3, 119.2, 114.5, 88.4, 85.7, 71.4, 62.3, 55.2, 37.1; ESI MS, *m/z* 456 [3.8 % (M + Na)+], 434 [100 % (M + H)+], 318 [37.6 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 434.1824 (Calcd. for $C_{23}H_{24}O_4N_5$ 434.1823); UV-Vis, λ_{max} 309 nm (ε = 3.13 x10^4 $M^{-1}cm^{-1}$).

8-(4'-Methybiphen-4-yl)-2'-deoxyadenosine (5b)

Using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (50 mg, 72 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.17 (brs, 1H), 7.88 (d, *J* = 8.0, 2H), 7.80 (d, *J* = 8.0, 2H), 7.68 (d, *J* = 7.9, 2H), 7.49 (brs, 2H), 7.32 (d, *J* = 7.9, 2H), 6.23 (dd, *J* = 8.4, 6.3, 1H), 5.57 (dd, *J* = 8.3, 4.0, 1H), 5.27 (d, *J* = 4.0, 1H), 4.48 (m, 1H), 3.90 (m, 1H), 3.72 (ddd, *J* = 12.2, 4.2, 4.0, 1H), 3.55 (ddd, *J* = 12.2, 8.3, 4.5, 1H), 2.36 (s, 3H), 2.17 (ddd, *J* = 13.1, 6.3, 1.7, 1H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.7, 152.5, 150.8, 150.5, 142.1, 138.1, 136.7, 130.5, 130.2, 128.8, 127.2, 119.9, 89.0, 86.3, 72.0, 62.9, 37.7, 21.3 (18 out of a possible 19 carbon resonances observed); ESI MS, *m/z* 418 [100 % (M + H)+], 302 [36.5 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 418.1862 (Calcd. for $C_{23}H_{24}O_3N_5$ 418.1874); UV-Vis, λ_{max} 305 nm (ε = 2.26 x10^4 $M^{-1}cm^{-1}$).

8-(Biphen-4-yl)-2'-deoxyadenosine (5c)

Using *Conditions A* from **1** performed on a 0.20 mmol scale – the title compound was obtained as a fine white solid (73 mg, 89 %), using *Conditions B* from **2** performed on a 0.21 mmol scale

– the title compound was obtained as a fine white solid (76 mg, 91 %, using phenyltrifluoroborate as the coupling partner on a 0.17 mmol scale: 54 mg, 81%), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.16 (s, 1H), 7.91 (d, *J* = 8.2, 2H), 7.82 (d, *J* = 8.2, 2H), 7.79 (d, *J* = 7.6, 2H), 7.52 (t, *J* = 7.6, 2H), 7.48 (brs, 2H), 7.43 (t, *J* = 7.6, 1H), 6.24 (dd, *J* = 8.4, 6.2, 1H), 5.55 (dd, *J* = 8.2, 4.0, 1H), 5.27 5.27 (d, *J* = 4.2, 1H), 4.48 (dddd, *J* = 6.2, 4.2, 2.1, 2.0, 1H), 3.90 (ddd, *J* = 4.4, 4.2, 2.1, 1H), 3.72 (ddd, *J* = 11.9, 4.2, 4.0, 1H), 3.54 (ddd, *J* = 11.9, 8.2, 4.4, 1H), 2.18 (ddd, *J* = 12.8, 6.2, 2.0, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.1, 152.0, 150.2, 149.9, 141.6, 139.0, 130.0, 129.0, 128.6, 128.0, 126.9, 126.8, 119.2, 88.4, 85.7, 71.4, 62.3, 37.1; ESI MS, *m/z* 426 [3.8 % (M + Na)+], 404 [100 % (M + H)+], 288 [38.8 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 404.1715 (Calcd. for $C_{22}H_{22}O_3N_5$ 404.1717); UV-Vis, λ_{max} 304 nm (ε = 1.93 x10^4 M^{-1}cm^{-1}).

8-(4'-Fluorobiphen-4-yl)-2'-deoxyadenosine (5d)

Using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (64 mg, 92 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.16 (s, 1H), 7.89 (d, *J* = 8.3, 2H), 7.86 – 7.77 (m, 4H), 7.46 (brs, 2H), 7.35 (t, *J* = 8.8, 2H), 6.23 (dd, *J* = 8.6, 6.2, 1H), 5.53 (dd, *J* = 8.3, 4.0, 1H), 5.25 (d, *J* = 4.0, 1H), 4.49 (dddd, *J* = 6.0, 4.0, 2.2, 2.1, 1H), 3.90 (ddd, *J* = 4.4, 4.2, 2.1, 1H), 3.72 (ddd, *J* = 12.0, 4.2, 4.0, 1H), 3.55 (ddd, *J* = 12.0, 8.3, 4.4, 1H), 2.17 (ddd, *J* = 13.0, 6.2, 2.2, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 162.2 (d, *J* = 244.7), 156.1, 152.0, 150.1, 149.9, 140.5, 135.5 (d, *J* = 3.0), 130.0, 128.9 (d, *J* = 8.3), 128.5, 126.9, 119.2, 115.8 (d, *J* = 21.3), 88.4, 85.6, 71.4, 62.3, 37.0; ^{19}F NMR (376 MHz, DMSO-d_6) δ -114.45 (tt, *J* = 5.6, 8.8, 1F); ESI MS, *m/z* 444 [4.9 % (M + Na)+], 422 [100 % (M + H)+], 306 [38.8 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 421.1619 (Calcd. for $C_{22}H_{21}O_3N_5F$ 422.1623); UV-Vis, λ_{max} 304 nm (ε = 2.30 x10^4 M^{-1}cm^{-1}).

8-(4'-Chlorobiphen-4-yl)-2'-deoxyadenosine (5e)

Using *Conditions A* from **1** performed on a 0.10 mmol scale – the title compound was obtained as a fine white solid (35 mg, 81 %) (some unreacted 4-chlorophenyl boronic acid remained in the product after column chromatography), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.16 (s, 1H), 7.92 (d, *J* = 8.4, 2H), 7.83 (d, *J* = 8.4, 2H), 7.83 (d, *J* = 8.7, 2H), 7.58 (d, *J* = 8.7, 2H), 7.50 (brs, 2H), 6.22 (dd, *J* = 8.5, 6.3, 1H), 5.54 (dd, *J* = 8.2, 4.1, 1H), 5.27 (d, *J* = 4.1, 1H), 4.49 (dddd, *J* = 6.1, 4.1, 2.2, 2.1, 1H), 3.89 (ddd, *J* = 4.5, 4.3, 2.1, 1H), 3.71 (ddd, *J* = 11.9, 4.3, 4.1, 1H),

3.54 (ddd, *J* = 11.9, 8.2, 4.5, 1H), 2.17 (ddd, *J* = 13.1, 6.3, 2.2, 1H) (selected peaks, one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.1, 152.0, 150.0, 149.9, 140.2, 137.8, 132.9, 130.1, 129.0, 128.9, 128.6, 126.9, 119.2, 88.4, 85.7, 71.4, 62.3, 37.0 (selected peaks) ESI MS, *m/z* 440 [35.5 % (M(Cl^{37}) + H)+], 438 [100 % (M(Cl^{35}) + H)+], 324 [5.2 % (M(Cl^{37}) - βD-Ribose + 2H)+], 322 [17.0 % (M(Cl^{35}) - βD-Ribose + 2H)+]; HRMS (M(Cl^{35})H+) 438.1329 (Calcd. for $C_{22}H_{21}O_3N_5Cl$ 438.1327).

8-(3',5'-Difluorobiphen-4-yl)-2'-deoxyadenosine (5f)

Using *Conditions A* from **1** performed on a 0.15 mmol scale – the title compound was obtained as a fine white solid (54 mg, 82 %), using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (69 mg, 94 %), ^1H NMR (400 MHz, DMSO-d_6) δ 8.17 (s, 1H), 7.99 (d, *J* = 8.4, 2H), 7.84 (d, *J* = 8.4, 2H), 7.59 (dd, *J* = 9.2, 2.3, 2H), 7.51 (brs, 2H), 7.30 (tt, *J* = 9.2, 2.3, 1H), 6.22 (dd, *J* = 8.5, 6.3, 1H), 5.54 (dd, *J* = 8.2, 4.1, 1H), 5.28 (d, *J* = 4.0, 1H), 4.49 (dddd, *J* = 5.9, 4.0, 2.2, 2.1, 1H), 3.91 (ddd, *J* = 4.4, 4.3, 2.2, 1H), 3.72 (ddd, *J* = 11.9, 4.3, 4.1, 1H), 3.55 (ddd, *J* = 11.9, 8.2, 4.4, 1H), 3.38 (ddd, *J* = 13.0, 8.5, 5.9, 1H), 2.18 (ddd, *J* = 13.0, 6.3, 2.1, 1H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 162.9 (dd, *J* = 245.9, 13.4), 156.2, 152.1, 150.0, 149.9, 142.6 (t, *J* = 9.9), 138.9 (t, J_{CF} = 2.3), 130.0, 129.7, 127.2, 119.3, 110.0 (d, J_{CF} = 19.0), 103.3 (t, J_{CF} = 26.1), 88.4, 85.7, 71.4, 62.3, 37.0; ^{19}F NMR (376 MHz, DMSO-d_6) δ -109.02 (m); ESI MS, *m/z* 440 [100 % (M + H)+], 324 [28.9 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 440.1529 (Calcd. for $C_{22}H_{20}O_3N_5F_2$ 440.1529); UV-Vis, λ_{max} 307 nm (ε = 1.71 x10^4 $M^{-1}cm^{-1}$).

8-(4'-Trifluoromethylbiphen-4-yl)-2'-deoxyadenosine (5g)

Using *Conditions A* from **1** performed on a 0.15 mmol scale – the title compound was obtained as a fine white solid (54 mg, 77 %), using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (69 mg, 88 %), ^1H NMR (400 MHz, DMSO-D6) δ 8.17 (brs, 1H), 8.03 – 7.95 (m, 4H), 7.87 (d, *J* = 8.4, 4H), 7.51 (brs, 2H), 6.23 (dd, *J* = 8.4, 6.3, 1H), 5.54 (dd, *J* = 8.2, 4.1, 1H), 5.27 (d, *J* = 4.2, 1H), 4.45 (dddd, *J* = 6.1, 4.2, 2.2, 2.1, 1H), 3.90 (ddd, *J* = 4.5, 4.2, 2.1, 1H), 3.72 (ddd, *J* = 12.1, 4.2, 4.1, 1H), 3.55 (ddd, *J* = 12.1, 8.2, 4.5, 1H), 2.18 (ddd, *J* = 13.0, 6.3, 2.2, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.2, 152.0, 150.0, 149.9, 143.1, 139.9, 134.6, 130.1, 128.3 (q, *J* = 32.0), 127.7, 127.4, 125.9 (q, *J* = 3.6), 124.3 (q, *J* = 271.6), 119.3, 88.4, 85.7, 71.4, 62.3,

37.0; ^{19}F NMR (376 MHz, DMSO-d_6) δ -60.84 (s, 3F); ESI MS, *m/z* 472 [100 % (M + H)+], 356 [22.4 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 472.1591 (Calcd. for $C_{23}H_{21}O_3N_5F_3$ 472.1591). UV-Vis, λ_{max} 307 nm (ε = 1.75 x10^4 M^{-1}cm^{-1}).

8-(3'-Trifluoromethylbiphen-4-yl)-2'-deoxyadenosine (5h)

Using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (62 mg, 79 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.17 (brs, 1H), 8.14 – 8.08 (m, 2H), 7.99 (d, *J* = 8.4, 2H), 7.87 (d, *J* = 8.4, 2H), 7.82 – 7.73 (m, 2H), 7.51 (brs, 2H), 6.24 (dd, *J* = 8.2, 6.4, 1H), 5.55 (dd, *J* = 8.3, 4.1, 1H), 5.27 (d, *J* = 4.2 Hz, 1H), 4.49 (m, 1H), 3.90 (m, 1H), 3.73 (ddd, *J* = 12.0, 4.3, 4.1, 1H), 3.56 (ddd, *J* = 12.0, 8.3, 4.4, 1H), 2.18 (ddd, *J* = 13.0, 8.2, 2.2, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.2, 152.0, 150.0, 140.1, 139.9, 131.2, 130.9, 129.9 (q, *J* = 32), 129.3, 127.3, 124.6 (q, *J* = 3), 124.1 (q, *J* = 273), 123.3 (q, *J* = 4), 119.3, 88.4, 85.7, 71.4, 62.3, 37.1 (only 20 out of a posible 21 carbon resonances observed); ^{19}F NMR (376 MHz, DMSO-d_6) δ -60.87 (s, 3F); ESI MS, *m/z* 472 [100 % (M + H)+], 356 [23.3 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 472.1601 (Calcd. for $C_{23}H_{21}O_3N_5F_3$ 472.1591); UV-Vis, λ_{max} 304 nm (ε = 1.76 x10^4 M^{-1}cm^{-1}).

8-(4'-Acetylbiphen-4-yl)-2'-deoxyadenosine (5i)

Using *Conditions A* from **1** performed on a 0.10 mmol scale – the title compound was obtained as a fine white solid (40 mg, 89 %), using *Conditions B* from **2** performed on a 0.21 mmol scale – the title compound was obtained as a fine white solid (70 mg, 76 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.17 (brs, 1H), 8.09 (d, *J* = 8.6 Hz, 2H), 8.00 (d, *J* = 8.6, 2H), 7.95 (d, *J* = 8.6, 2H), 7.87 (d, *J* = 8.6, 2H), 7.50 (brs, 2H), 6.23 (dd, *J* = 8.3, 6.3, 1H), 5.53 (dd, *J* = 8.2, 4.1, 1H), 5.27 (d, *J* = 4.1, 1H), 4.49 (dddd, *J* = 6.2, 4.1, 2.2, 2.1, 1H), 3.90 (ddd, *J* = 4.4, 4.3, 2.1, 1H), 3.72 (ddd, *J* = 11.9, 4.3, 4.1, 1H), 3.55 (ddd, *J* = 11.9, 8.2, 4.4, 1H), 2.64 (s, 3H), 2.18 (ddd, *J* = 13.0, 6.3, 2.2, 1H) (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 197.5, 156.2, 152.0, 150.0, 143.3, 140.2, 136.0, 130.1, 129.4, 128.9, 127.3, 127.0, 119.2, 88.4, 85.7, 71.4, 62.3, 37.0, 26.8 (only 19 out of a possible 20 carbon resonances observed); ESI MS, *m/z* 446 [100 % (M + H)+], 330 [24.7 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 446.1821 (Calcd. for $C_{24}H_{24}O_4N_5$ 446.1823); UV-Vis, λ_{max} 314 nm (ε = 2.02 x10^4 M^{-1}cm^{-1}).

8-(4'-Formylbiphen-4-yl)-2'-deoxyadenosine (5j)

Using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (60 mg, 84 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.08 (s, 1H), 8.17 (s, 1H), 8.04 (s, 4H), 8.02 (d, *J* = 8.5, 1H), 7.88 (d, *J* = 8.5, 1H), 7.51 (brs, 2H), 6.23 (dd, *J* = 8.4, 6.4, 1H), 5.55 (dd, *J* = 8.2, 4.1, 1H), 5.28 (d, *J* = 4.2, 1H), 4.49 (dddd, *J* = 6.2, 4.2, 2.3, 2.2, 1H), 3.90 (ddd, *J* = 4.5, 4.3, 2.3, 1H), 3.72 (ddd, *J* = 12.1, 4.3, 4.1, 1H), 3.55 (ddd, *J* = 12.1, 8.2, 4.5, 1H), 2.18 (ddd, *J* = 13.0, 6.4, 2.2, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 192.8, 156.2, 152.1, 150.0, 149.9, 144.7, 140.2, 135.4, 130.2, 130.1, 129.6, 127.5, 127.4, 119.3, 88.4, 85.7, 71.4, 62.3, 37.0; ESI MS, *m/z* 432 [100 % (M + H)+], 316 [28.2 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 432.1666 (Calcd. for $C_{23}H_{22}O_4N_5$ 432.1666); UV-Vis, λ_{max} 318 nm ($\varepsilon = 2.53 \times 10^4$ $M^{-1}cm^{-1}$).

Characterisation Data for Compounds 6a, 6b, 7a-c, 5k-m and 8.

8-(4'-Methoxy-2-fluorobiphen-4-yl)-2'-deoxyadenosine (6a)

Using *Conditions A* from **1** performed on a 0.15 mmol scale – the title compound was obtained as a fine white solid (44 mg, 65 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.17 (s, 1H), 7.75 (t, *J* = 8.2, 1H), 7.65 (dd, *J* = 11.5, 1.7, 1H), 7.64 (dd, *J* = 8.2, 1.7, 1H), 7.61 (dd, *J* = 8.9, 1.7, 2H), 7.50 (brs, 2H), 7.09 (d, *J* = 8.9, 2H), 6.23 (dd, *J* = 8.3, 6.3, 1H), 5.46 (dd, *J* = 8.0, 4.2, 1H), 5.28 (d, *J* = 4.2, 1H), 4.49 (dddd, *J* = 6.2, 4.2, 2.4, 2.2, 1H), 3.90 (ddd, *J* = 4.6, 4.4, 2.2, 1H), 3.83 (s, 3H), 3.71 (ddd, *J* = 11.9, 4.4, 4.2, 1H), 3.53 (ddd, *J* = 11.9, 8.0, 4.6, 1H), 2.20 (ddd, *J* = 13.2, 6.3, 2.4, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 159.3, 158.6 (d, J_{CF} = 247), 156.19, 152.21, 149.95, 134.05 (d, *J* = 16.0), 128.83, 128.81, 128.69, 127.25, 125.89 (d, *J* = 3.5), 119.16, 117.05 (d, J_{CF} = 24.8), 88.3, 85.5, 71.3, 62.2, 55.2, 36.9 (19 out of a possible 21 carbon resonances observed); ^{19}F NMR (376 MHz, DMSO-d_6) δ -117.26 (m, 1F); ESI MS, *m/z* 452 [100 % (M + H)+], 336 [34.4 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 452.1733 (Calcd. for $C_{23}H_{23}O_4N_5F$ 352.1729); UV-Vis, λ_{max} 310 nm (ε = 2.21 x10^4 $M^{-1}cm^{-1}$).

8-(2-Fluorobiphen-4-yl)-2'-deoxyadenosine (6b)

Using *Conditions A* from **1** performed on a 0.15 mmol scale – the title compound was obtained as a fine white solid (59 mg, 93 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.18 (s, 1H), 7.78 (t, *J* = 8.2, 1H), 7.66 – 7.59 (m, 4H), 7.52 – 7.40 (m, 5H), 6.24 (dd, *J* = 8.3, 6.3, 1H), 5.45 (dd, *J* = 8.0, 4.3, 1H), 5.28 (d, *J* = 4.5, 1H), 4.49 (dddd, *J* = 6.4, 4.5, 2.5, 2.3, 1H), 3.90 (ddd, *J* = 4.6, 4.4, 2.3, 1H), 3.71 (ddd, *J* = 11.9, 4.4, 4.3, 1H), 3.54 (ddd, *J* = 11.9, 8.0, 4.6, 1H), 2.20 (ddd, *J* = 13.0, 6.3, 2.5, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 158.6 (d, J_{CF} = 247), 156.2, 152.2, 150.0, 148.8, 134.2, 131.2 (d, J_{CF} = 3.3), 129.8 (d, J_{CF} = 15.4), 128.9 (d, J_{CF} = 2.7), 128.7, 128.4, 125.9 (d, J_{CF} = 2.9), 119.2, 117.1 (d, J_{CF} = 24.6), 88.4, 85.6, 71.4, 62.2, 36.9 (19 out of a possible 20 carbon resonances observed); ^{19}F NMR (376 MHz, DMSO-d_6) δ -117.16 (m, 1F); ESI MS, *m/z* 422 [100 % (M + H)+], 306 [44.2 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 422.1626 (Calcd. for $C_{22}H_{21}O_3N_5F$ 422.1623); UV-Vis, λ_{max} 304 nm (ε = 1.89 x10^4 $M^{-1}cm^{-1}$).

8-(4'-Methoxybiphen-3-yl)-2'-deoxyadenosine (7a)

Using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (63 mg, 88 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.16 (s, 1H), 7.94 (dd, *J* = 2.2, 1.5, 1H), 7.85 (ddd, *J* = 6.0, 3.1, 2.2, 1H), 7.69 (d, *J* = 8.7, 2H), 7.67-7.64 (m, 2H), 7.49 (brs, 2H), 7.07 (d, *J* = 8.7, 2H), 6.22 (dd, *J* = 8.6, 6.1, 1H), 5.59 (dd, *J* = 8.4, 4.0, 1H), 5.27 (d, *J* = 4.1, 1H), 4.47 (dddd, *J* = 5.9, 4.1, 2.2, 2.0, 1H), 3.89 (ddd, *J* = 4.4, 4.2, 2.0, 1H), 3.81 (s, 3H), 3.70 (ddd, *J* = 12.3, 4.2, 4.0, 1H), 3.54 (ddd, *J* = 12.3, 8.4, 4.4, 1H), 2.18 (ddd, *J* = 12.9, 6.1, 2.2, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 159.2, 156.2, 152.0, 150.5, 149.9, 140.2, 131.5, 130.2, 129.3, 127.9, 127.8, 127.6, 127.1, 119.2, 114.5, 88.4, 85.7, 71.4, 62.3, 55.2, 37.2; ESI MS, *m/z* 434 [100 % (M + H)+], 318 [14.5 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 434.1829 (Calcd. for $C_{23}H_{24}O_4N_5$ 434.1829); UV-Vis, λ_{max} 275 nm (ε = 3.30 x10^4 $M^{-1}cm^{-1}$).

8-(Biphen-3-yl)-2'-deoxyadenosine (7b)

Using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (58 mg, 87 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.17 (s, 1H), 8.00 (t, *J* = 1.9, 1H), 7.90 (td, *J* = 6.5, 1.9, 1H), 7.77-7.68 (m, 4H), 7.52 (t, *J* = 7.4, 2H), 7.48 (brs, 2H), 7.42 (t, *J* = 7.4, 1H), 6.24 (dd, *J* = 8.6, 6.1, 1H), 5.58 (dd, *J* = 8.4, 4.1, 1H), 5.27 (d, *J* = 4.1, 1H), 4.47 (dddd, *J* = 6.1, 4.1, 2.1, 2.0, 1H), 3.89 (ddd, *J* = 4.4, 4.2, 2.0, 1H), 3.70 (ddd, *J* = 12.2, 4.2, 4.1, 1H), 3.54 (ddd, *J* = 12.2, 8.4, 4.4, 1H), 2.19 (ddd, *J* = 13.0, 6.1, 2.1, 1H) , (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.2, 152.0, 150.3, 149.9, 140.6, 139.2, 130.3, 129.4, 129.1, 128.3, 128.3, 127.9, 127.7, 126.8, 119.2, 88.4, 85.7, 71.4, 62.3, 37.2; ESI MS, *m/z* 404 [100 % (M + H)+], 288 [17.8 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 404.1716 (Calcd. for $C_{22}H_{22}O_3N_5$ 404.1717); UV-Vis, λ_{max} 266 nm (ε = 1.93 x10^4 $M^{-1}cm^{-1}$);

8-(3',5'-Difluorobiphen-3-yl)-2'-deoxyadenosine (7c)

Using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (64 mg, 87 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.17 (s, 1H), 8.07 (t, *J* =

1.8, 1H), 7.98 (ddd, *J* = 7.6, 1.8, 1.4, 1H), 7.77 (ddd, *J* = 7.6, 1.8, 1.4, 1H), 7.72 (t, *J* = 7.6, 1H), 7.54 (dd, *J* = 9.0, 2.3, 2H), 7.50 (brs, 2H), 7.31 (tt, *J* = 9.2, 2.3, 1H), 6.20, (dd, *J* = 8.5, 6.1, 1H), 5.56 (dd, *J* = 8.3, 4.0, 1H), 5.27 (d, *J* = 4.3, 1H), 4.46 (dddd, *J* = 5.9, 4.3, 2.2, 2.0, 1H), 3.88 (ddd, *J* = 4.4, 4.2, 2.0, 1H), 3.69 (ddd, *J* = 12.0, 4.2, 4.0, 1H), 3.53 (ddd, *J* = 12.2, 8.3, 4.4, 1H), 2.19 (ddd, *J* = 13.0, 6.1, 2.1, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 162.9 (dd, J_{CF} = 245.9, 13.5), 156.2, 152.1, 150.0, 149.9, 142.7 (d, J_{CF} = 9.5), 138.0, 130.5, 129.5, 129.5, 128.6, 128.0, 119.1, 110.0 (d, J_{CF} = 26.1), 88.4, 85.7, 71.4, 62.3, 37.2 (19 out of a possible 20 carbon resonances observed); ^{19}F NMR (376 MHz, DMSO-d_6) δ -108.9 (m, 1F); ESI MS, *m/z* 440 [100 % (M + H)+], 324 [14.8 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 440.1534 (Calcd. for $C_{22}H_{20}O_3N_5F_2$ 440.1529); UV-Vis, λ_{max} 260 nm (ε = 1.98 x10^4 $M^{-1}cm^{-1}$).

8-(4-(2-Furyl)-phenyl)-2'-deoxyadenosine (5k)

Using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (46 mg, 71 %), ^1H NMR (400 MHz, DMSO-d_6) δ 8.14 (s, 1H), 7.90 (d, *J* = 8.6, 2H), 7.83 (dd, *J* = 1.8, 0.7, 1H), 7.76 (d, *J* = 8.6, 2H), 7.47 (brs, 2H), 7.12 (dd, *J* = 3.5, 0.7, 1H), 6.65 (dd, *J* = 3.5, 1.8, 1H), 6.18 (dd, *J* = 8.6, 6.2, 1H), 5.53 (dd, *J* = 8.2, 4.0, 1H), 5.24 (d, *J* = 4.2, 1H), 4.45 (dddd, *J* = 6.2, 4.2, 2.3, 2.2, 1H), 3.87 (ddd, *J* = 4.4, 4.2, 2.2, 1H), 3.69 (ddd, *J* = 11.9, 4.0, 4.2, 1H), 3.52 (ddd, *J* = 4.4, 8.2, 11.9, 1H), 2.15 (ddd, *J* = 13.0, 6.2, 2.3, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.1, 152.1, 152.0, 150.0, 149.9, 143.8, 131.6, 130.0, 128.2, 123.5, 119.2, 112.3, 107.5, 88.3, 85.6, 71.4, 62.2, 37.1; ESI MS, *m/z* 394 [100 % (M + H)+], 278 [39.7 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 394.1504 (Calcd. for $C_{20}H_{20}O_4N_5$ 394.1510). UV-Vis, λ_{max} 320 nm (ε = 2.71 x10^4 $M^{-1}cm^{-1}$).

8-(4-(2-Thienyl)-phenyl)-2'-deoxyadenosine (5l)

Using *Conditions B* from **2** performed on a 0.07 mmol scale – the title compound was obtained as a fine white solid (15 mg, 52 %), ^1H NMR (400 MHz, DMSO-d_6) δ 8.15 (s, 1H), 7.90 (d, *J* = 8.4, 2H), 7.77 (d, *J* = 8.4, 2H), 7.68 (d, *J* = 3.6, 1H), 7.65 (d, *J* = 5.0, 1H), 7.47 (brs, 2H), 7.21 (dd, *J* = 5.0, 3.6, 1H), 6.20 (dd, *J* = 8.4, 6.2, 1H), 5.52 (dd, *J* = 8.3, 4.1, 1H), 5.25 (d, *J* = 4.2, 1H), 4.47 (m, 1H), 3.89 (ddd, *J* = 4.4, 4.2, 2.1, 1H), 3.71 (ddd, *J* = 12.1, 4.2, 4.1, 1H), 3.54 (ddd, *J* = 12.1, 8.3, 4.4, 1H), 2.17 (ddd, *J* = 13.1, 6.2, 1.9, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.1, 152.0, 150.0, 149.9, 142.2, 135.2, 130.1,

128.7, 128.4, 126.8, 125.5, 124.8, 119.2, 88.3, 85.6, 71.4, 62.2, 37.08. ESI MS, *m/z* 432 [3.3 % $(M + Na)^+$], 410 [100 % $(M + H)^+$], 294 [44.3 % (M – βD-Ribose + 2H)$^+$]; HRMS (MH^+) 410.1270 (Calcd. for $C_{20}H_{20}N_5O_3S$ 410.1281); UV-Vis, λ_{max} 322 nm ($\varepsilon = 2.25 \times 10^4$ $M^{-1}cm^{-1}$).

8-(4-(3-Thienyl)-phenyl)-2'-deoxyadenosine (5m)

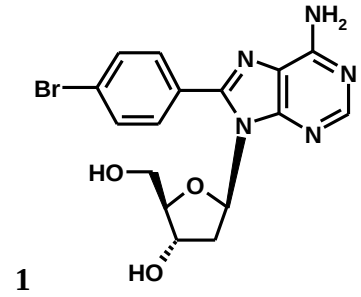
Using *Conditions B* from **2** performed on a 0.17 mmol scale – the title compound was obtained as a fine white solid (43mg, 63%), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.16 (s, 1H), 8.06 (dd, *J* = 2.8, 1.5, 1H), 7.96 (d, *J* = 8.5, 2H), 7.77 (d, *J* = 8.5, 2H), 7.71 (dd, *J* = 5.1, 2.8, 1H), 7.68 (dd, *J* = 5.1, 1.5, 1H), 7.48 (brs, 2H), 6.21 (dd, *J* = 8.5, 6.2, 1H), 5.57 (dd, *J* = 8.3, 4.1, 1H), 5.27 (d, *J* = 4.1, 1H), 4.48 (m, 1H), 3.90 (m, 1H), 3.71 (ddd, *J* = 12.0, 4.1, 4.1, 1H), 3.54 (ddd, *J* = 12.0, 8.3, 4.4, 1H), 2.17 (ddd, *J* = 13.0, 6.2, 2.1, 1H), (one signal obscured by H_2O peak); ^{13}C NMR (101 MHz, DMSO-d_6) δ 156.1, 151.9, 150.2, 149.9, 140.4, 136.5, 129.9, 128.0, 127.4, 126.2, 126.1, 122.2, 119.2, 88.3, 85.6, 71.4, 62.3, 37.1; ESI MS, *m/z* 410 [100 % (M + H)+], 294 [31.6 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 410.1284 (Calcd. for $C_{20}H_{20}O_3N_5S$ 410.1281). UV-Vis, λ_{max} 307 nm ($\varepsilon = 2.14 \times 10^4$ $M^{-1}cm^{-1}$).

8-(1-1':4'-1''-Terphen-4-yl)-2'-deoxyadenosine (8)

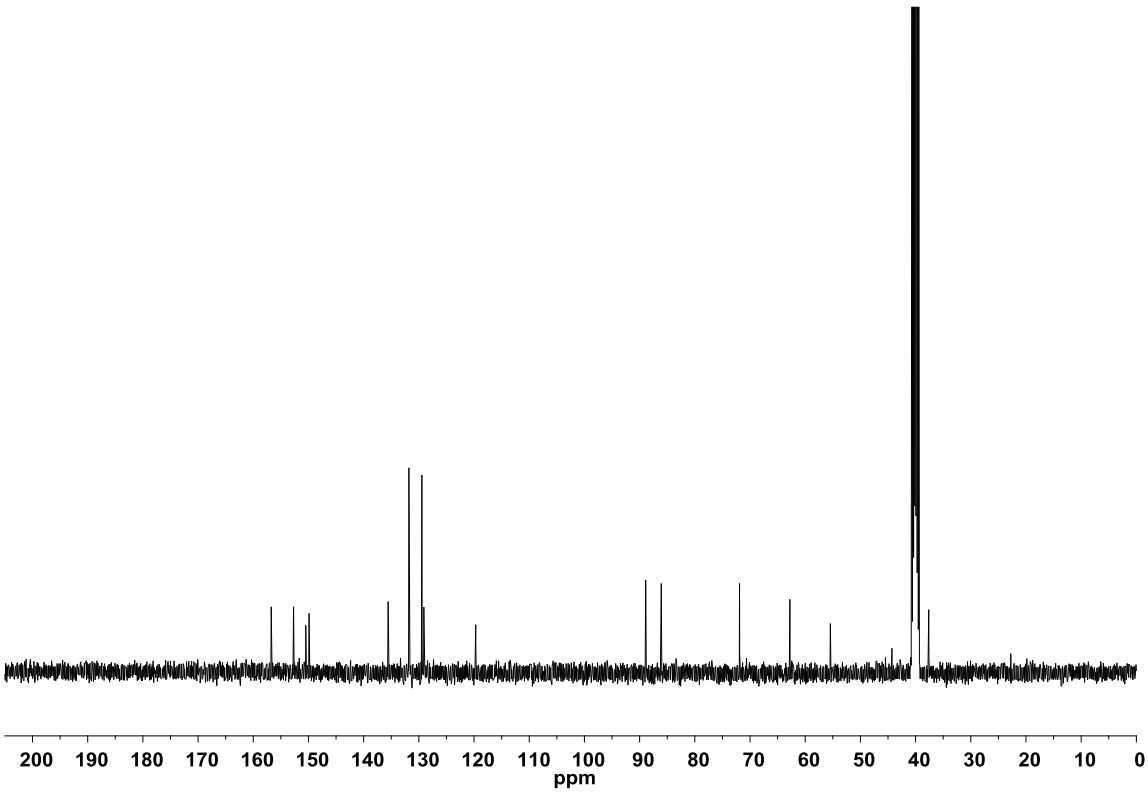
Using *Conditions B* from **2** performed on a 32 μmol scale – the title compound was obtained as a fine white solid (11.6 mg, 76 %), ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.17 (s, 1H), 7.98 (d, *J* = 8.6, 2H), 7.91 (d, *J* = 8.8, 2H), 7.85 (d, *J* = 8.6, 2H), 7.83 (d, *J* = 8.8, 2H), 7.76 (dd, *J* = 8.3, 1.3, 2H), 7.51 (dd, *J* = 7.2, 8.3, 2H), 7.47 (brs, 2H), 7.40 (tt, *J* = 7.2, 1.3, 1H), 6.25 (dd, *J* = 8.4, 6.1, 1H), 5.52 (dd, *J* = 8.1, 4.1, 1H), 5.26 (d, *J* = 4.2, 1H), 4.49 (m, 1H), 3.91 (ddd, *J* = 4.5, 4.3, 2.2, 1H), 3.72 (ddd, *J* = 11.9, 4.3, 4.1, 1H), 3.55 (ddd, *J* = 11.9, 8.1, 4.5 Hz, 1H), 2.19 (ddd, *J* = 12.8, 6.1, 2.3, 1H) (one proton signal obscured by H_2O in solvent); ^{13}C NMR (101 MHz, DMSO-D6) δ 156.1, 152.0, 150.1, 149.9, 141.0, 139.7, 139.4, 138.0, 130.0, 129.0, 128.6, 127.6, 127.3, 127.3, 126.8, 126.6, 119.2, 88.4, 85.7, 71.4, 62.3, 37.1; ^{13}C NMR ; ESI MS, *m/z* 480 [100 % (M + H)+], 364 [10.7 % (M - βD-Ribose + 2H)+]; HRMS (MH+) 480.2018 (Calcd. for $C_{28}H_{26}O_3N_5$ 480.2030); UV-Vis, λ_{max} 315 nm ($\varepsilon = 3.14 \times 10^4$ $M^{-1}cm^{-1}$).

Copies of ^{1}H and ^{13}C NMR Spectra for All Compounds.

^{1}H NMR (400 MHz) d_6-DMSO

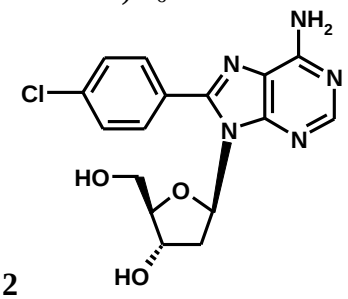


1

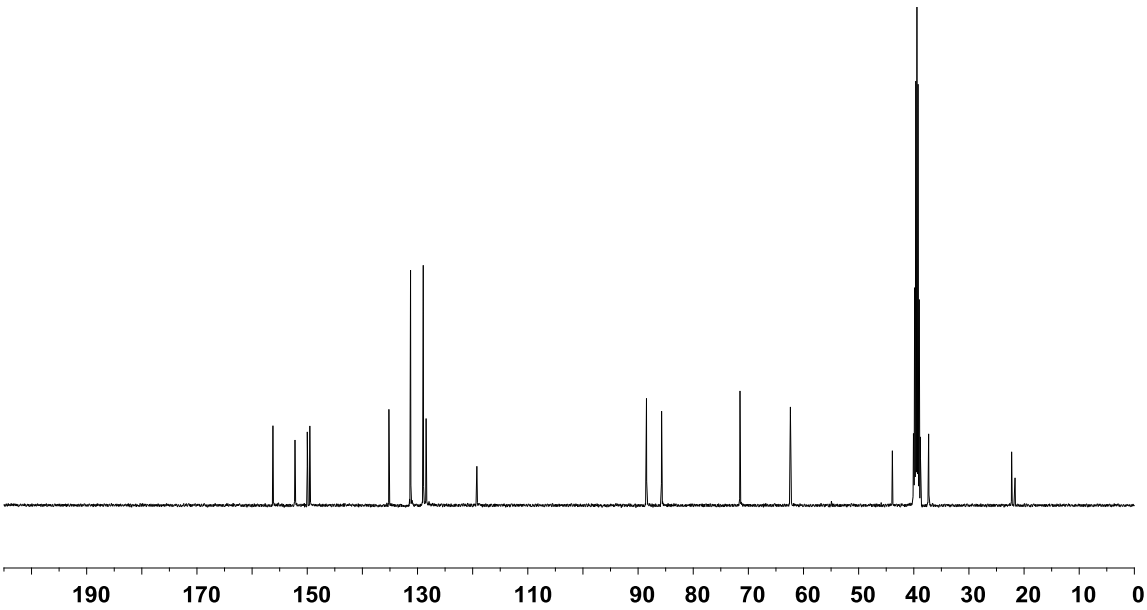


Residual MeOH remains in the ^{13}C NMR spectrum at 54.8 ppm.

^{1}H NMR (400 MHz) d_6-DMSO

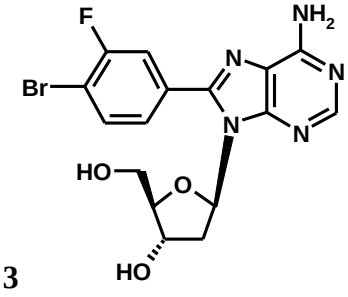


2

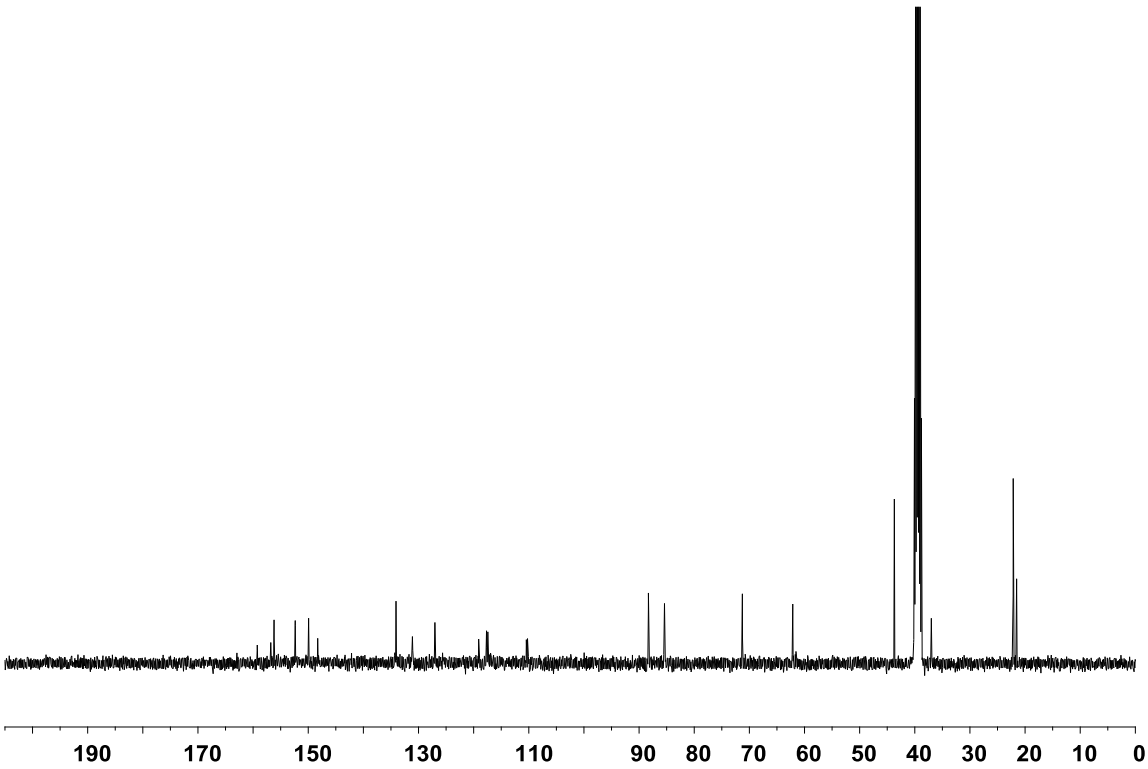


Residual piperidine remains in the ^{1}H NMR spectrum at 1.56, 1.64 and 3.01 ppm and in the ^{13}C NMR spectrum at 21.5, 22.2 and 43.7 ppm.

^{1}H NMR (400 MHz) d_6-DMSO

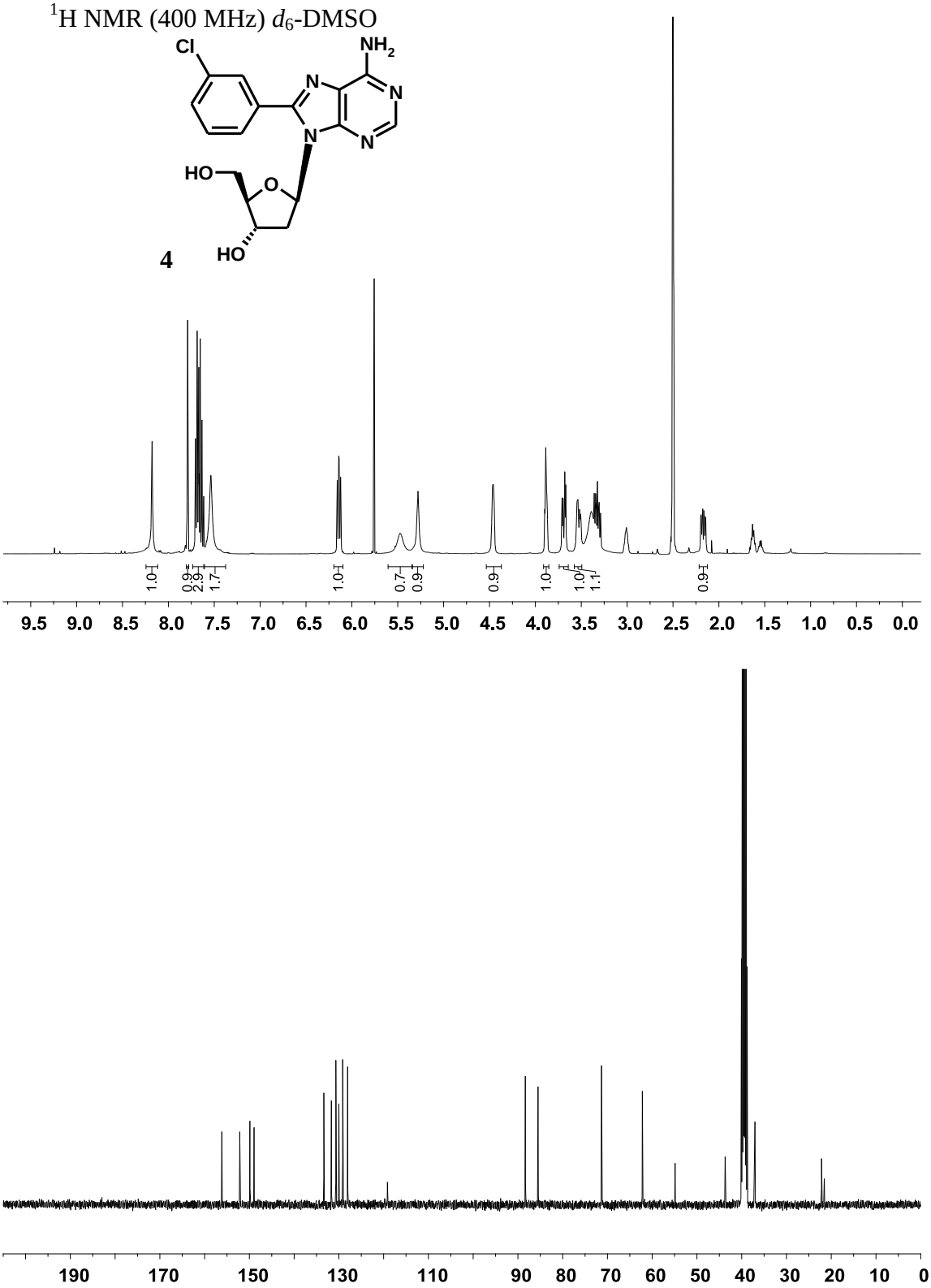


3



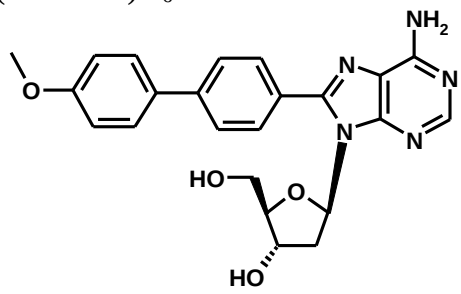
Residual piperidine remains in the ^{1}H NMR spectrum at 1.56, 1.64 and 3.01 ppm and in the ^{13}C NMR spectrum at 21.5, 22.2 and 43.7 ppm.

^{1}H NMR (400 MHz) d_6-DMSO

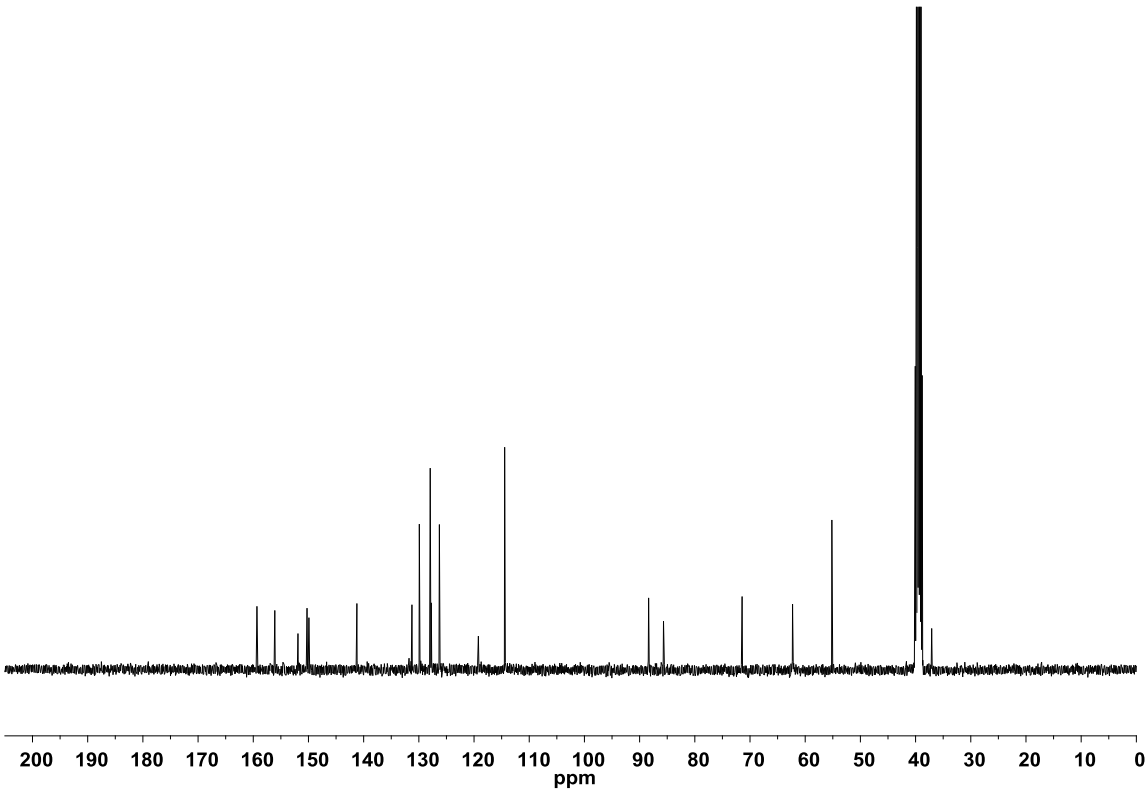


Residual piperidine remains in the ^{1}H NMR spectrum at 1.56, 1.64 and 3.01 ppm. Residual MeOH and piperidine in the ^{13}C NMR spectrum at 54.8 and 21.5, 22.2 and 43.7 ppm.

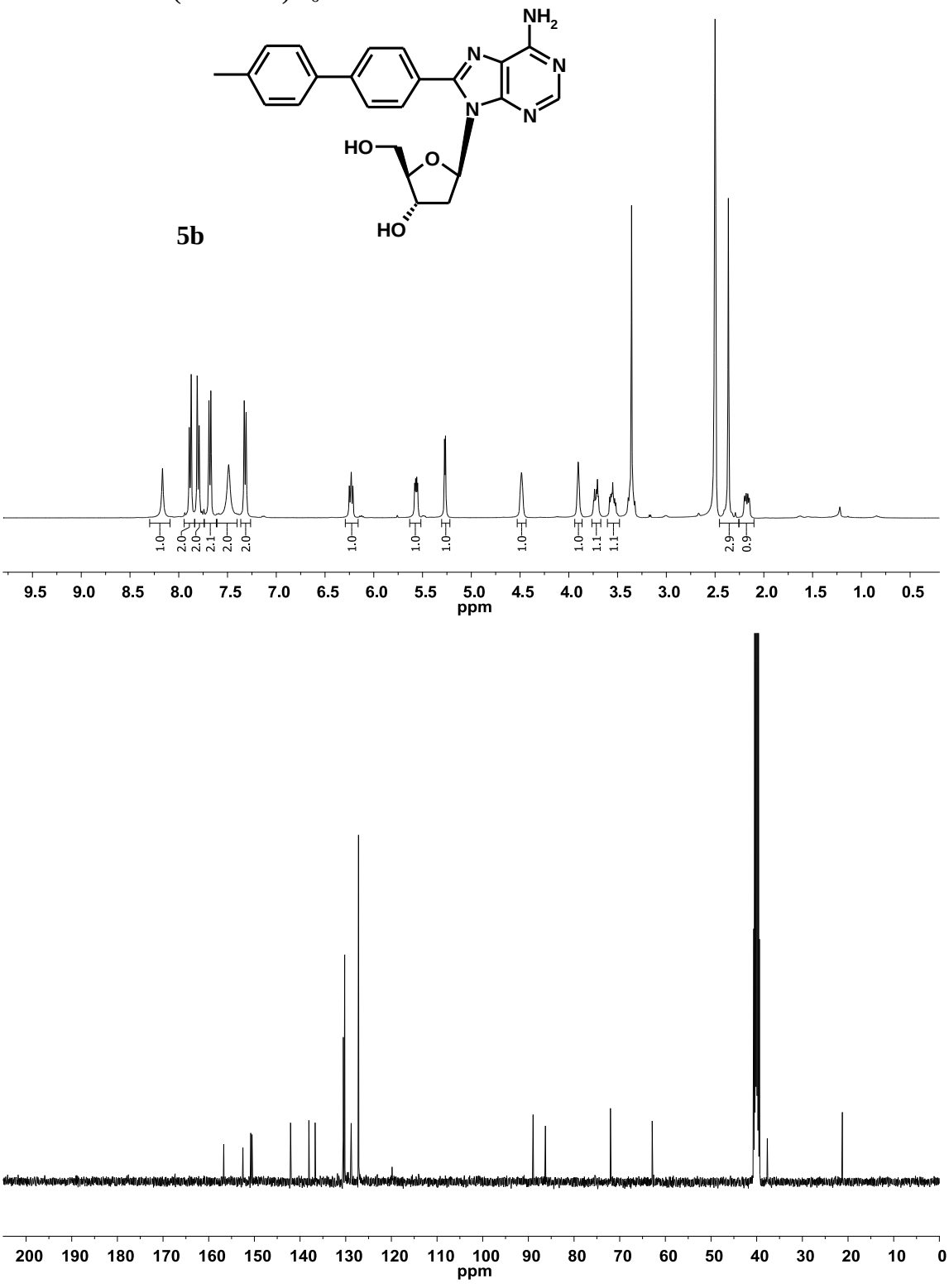
^{1}H NMR (400 MHz) d_6-DMSO



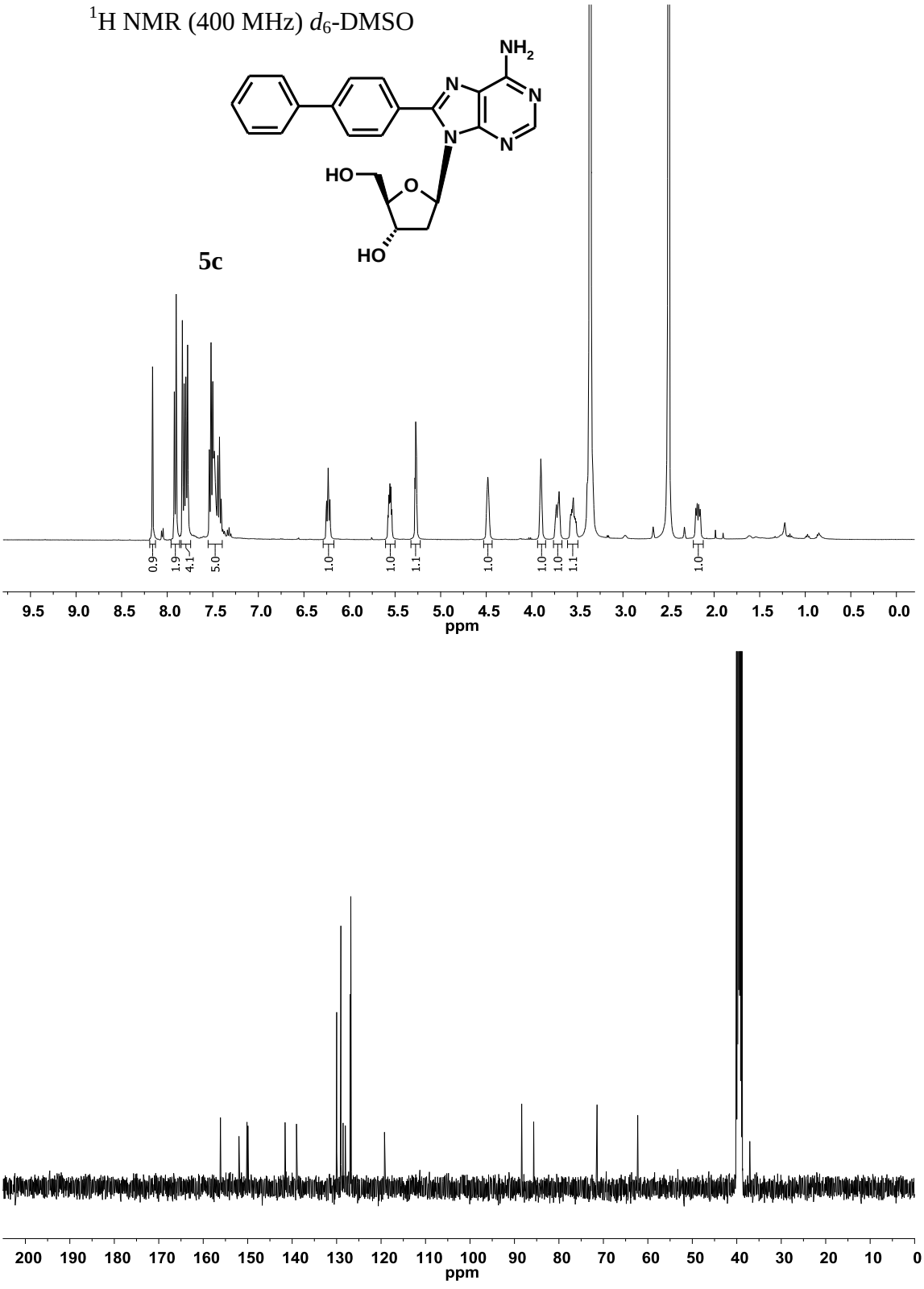
5a



^{1}H NMR (400 MHz) d_6-DMSO

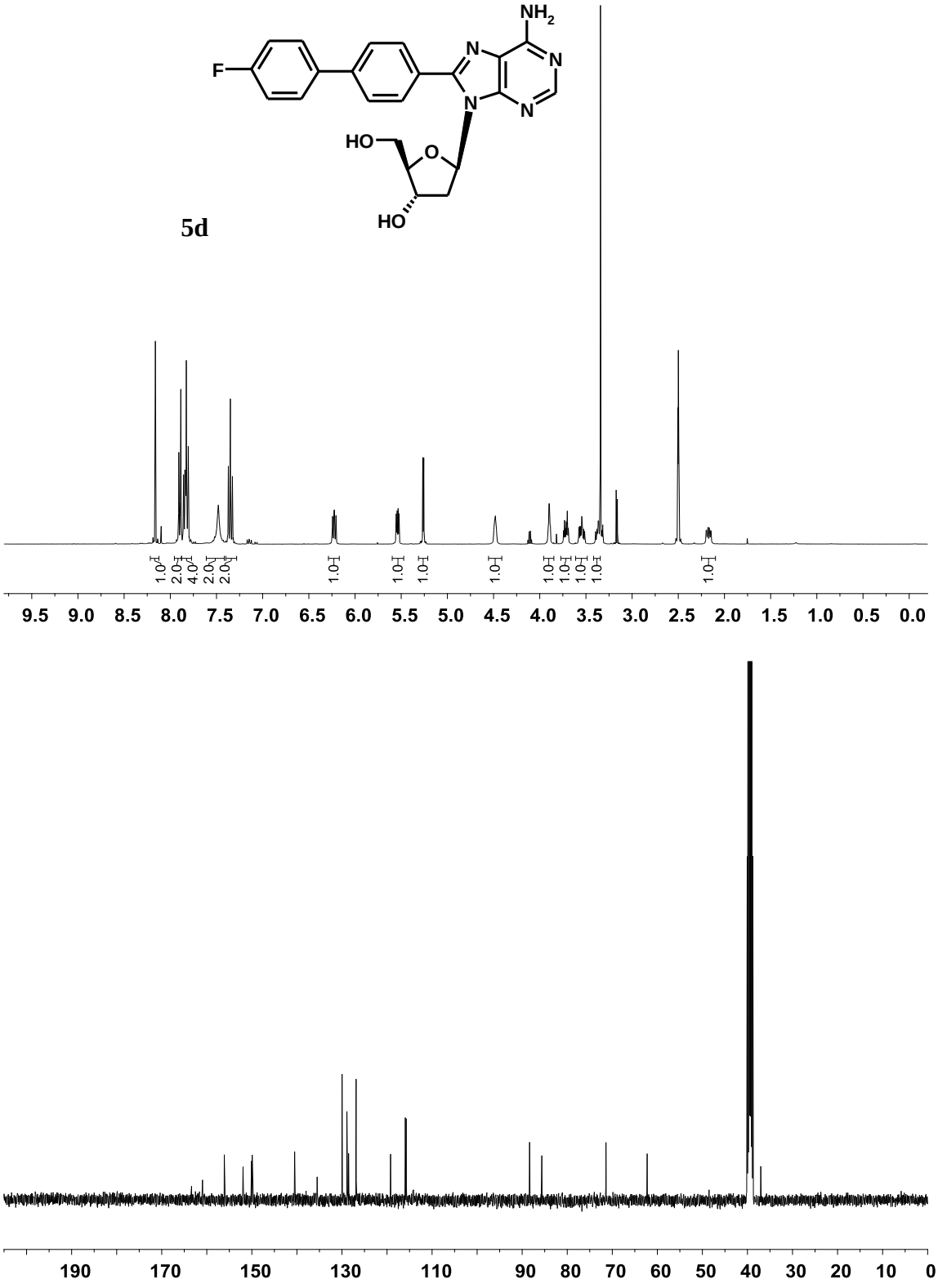


^{1}H NMR (400 MHz) d_6-DMSO



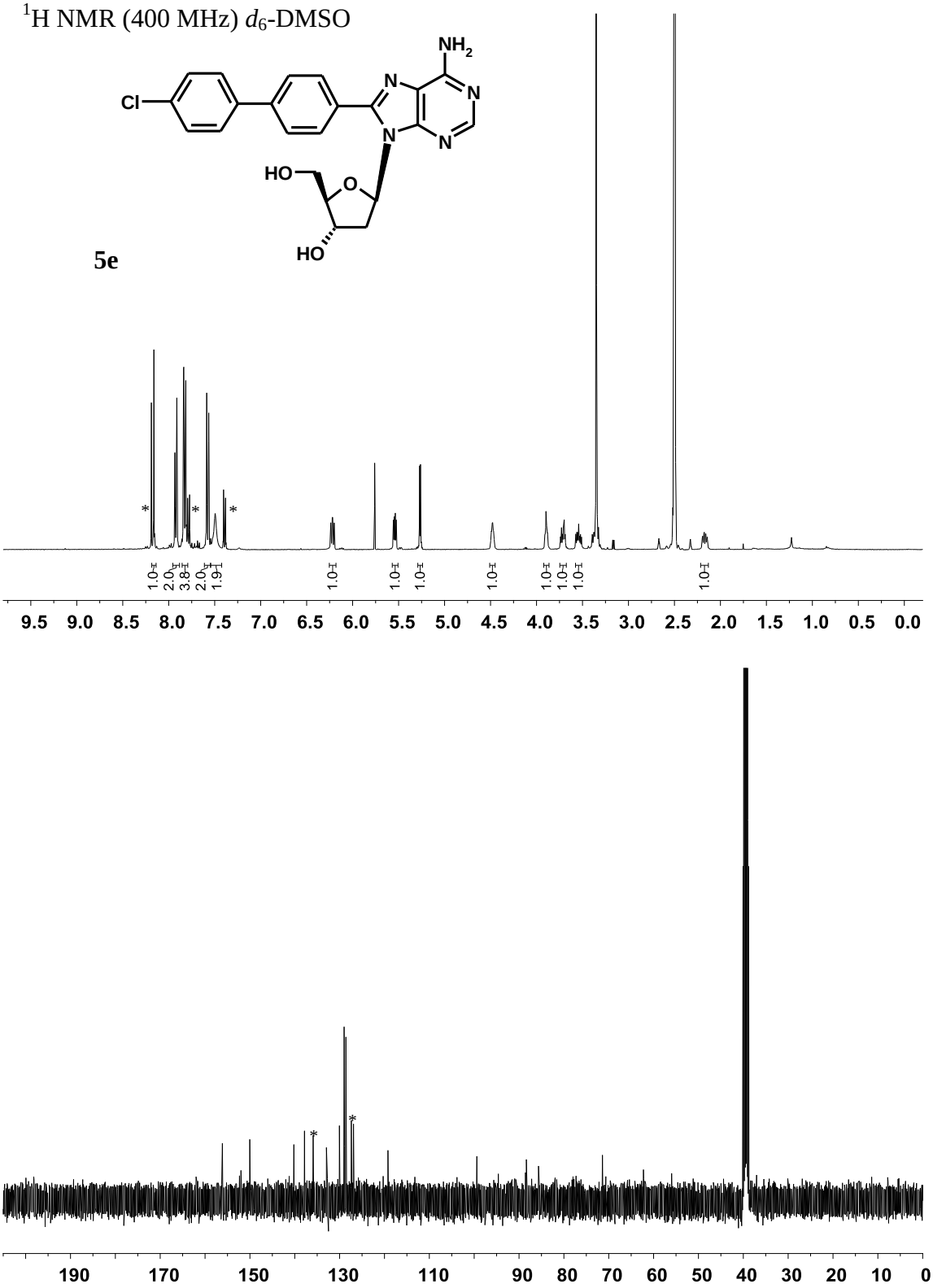
5c

^{1}H NMR (400 MHz) d_6-DMSO



Residual MeOH remains in the ^{1}H NMR spectrum at 3.16 and 4.07 ppm.

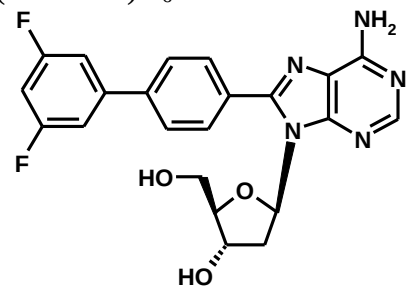
^{1}H NMR (400 MHz) d_6-DMSO



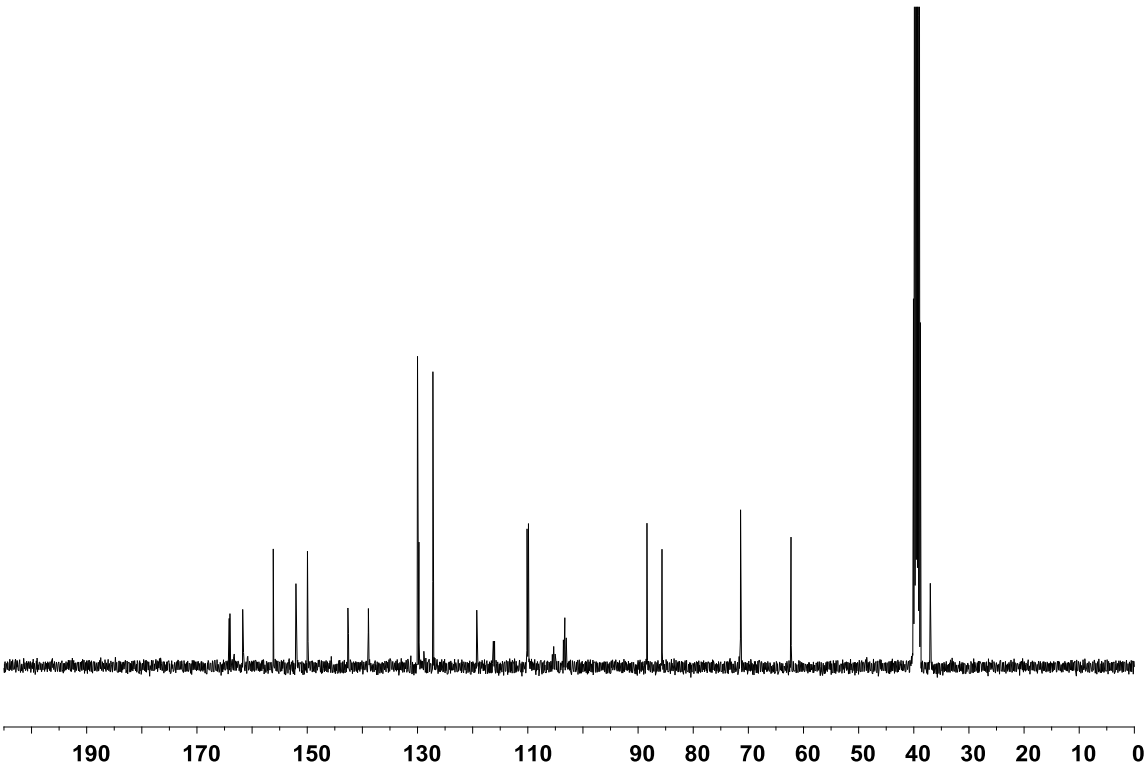
5e

* - Remaining 4-chlorophenyl boronic acid remains in the ^{1}H NMR spectrum at 8.19, 7.78 and 7.39 ppm and the ^{13}C NMR spectrum at 135.9 and 127.4 ppm.
Residual CH_2Cl_2 appears in the ^{1}H NMR spectrum at 5.76 ppm.

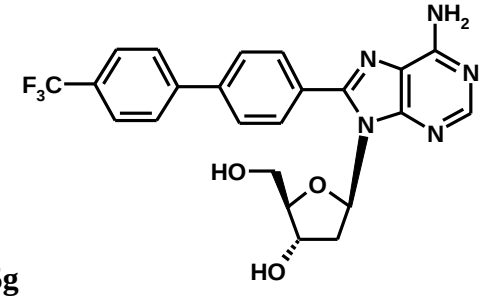
^{1}H NMR (400 MHz) d_6-DMSO



5f

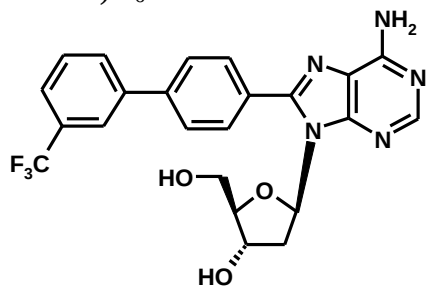


^{1}H NMR (400 MHz) d_6-DMSO

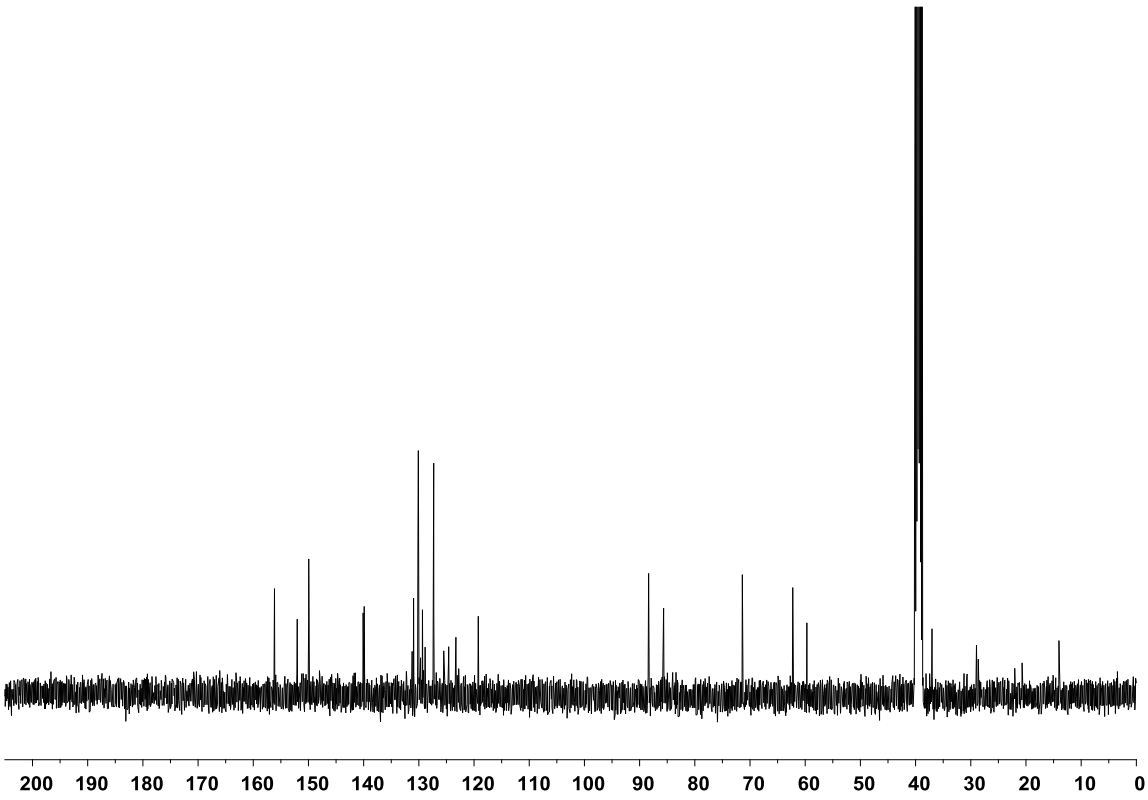


5g

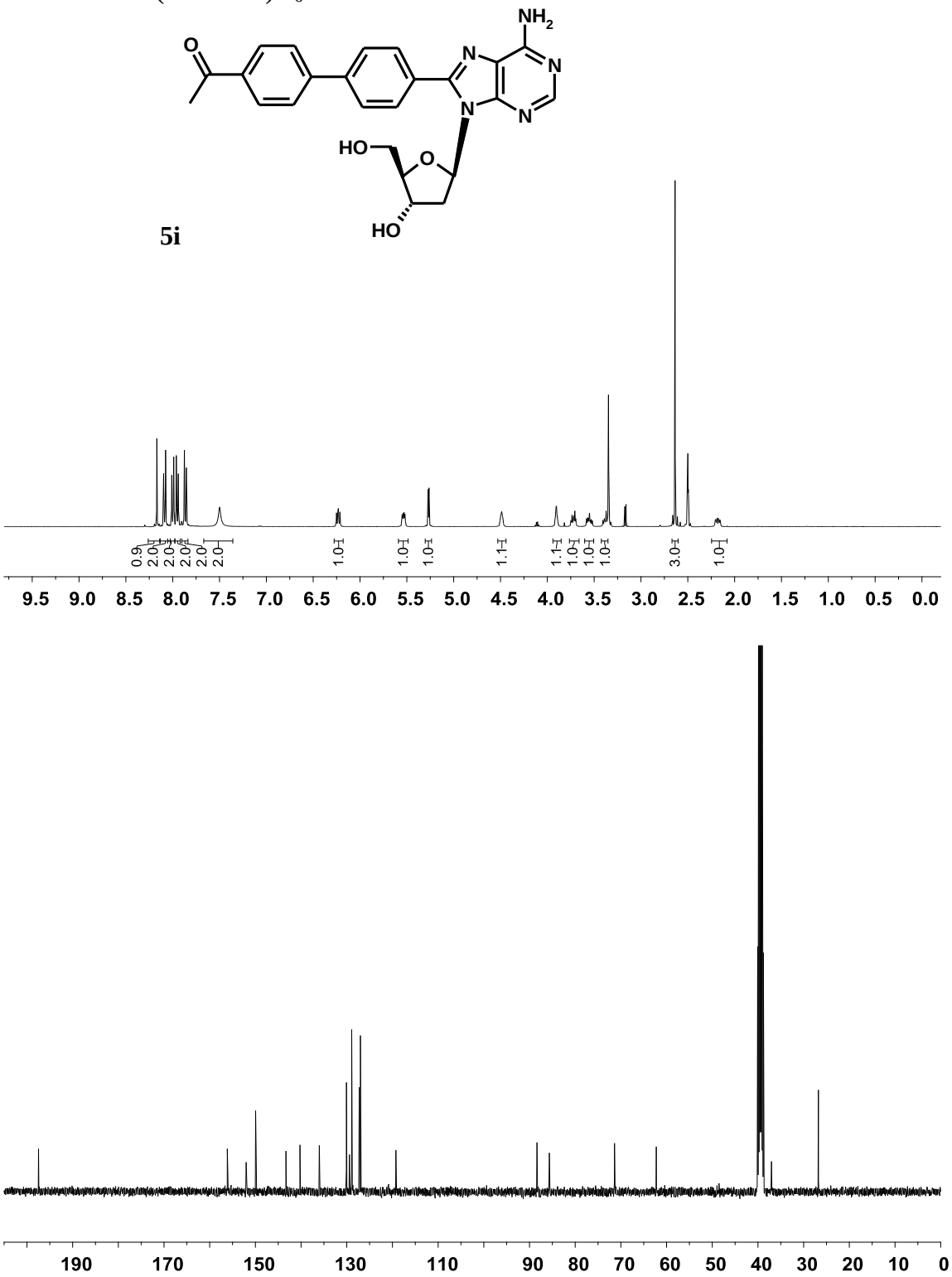
^{1}H NMR (400 MHz) d_6-DMSO



5h

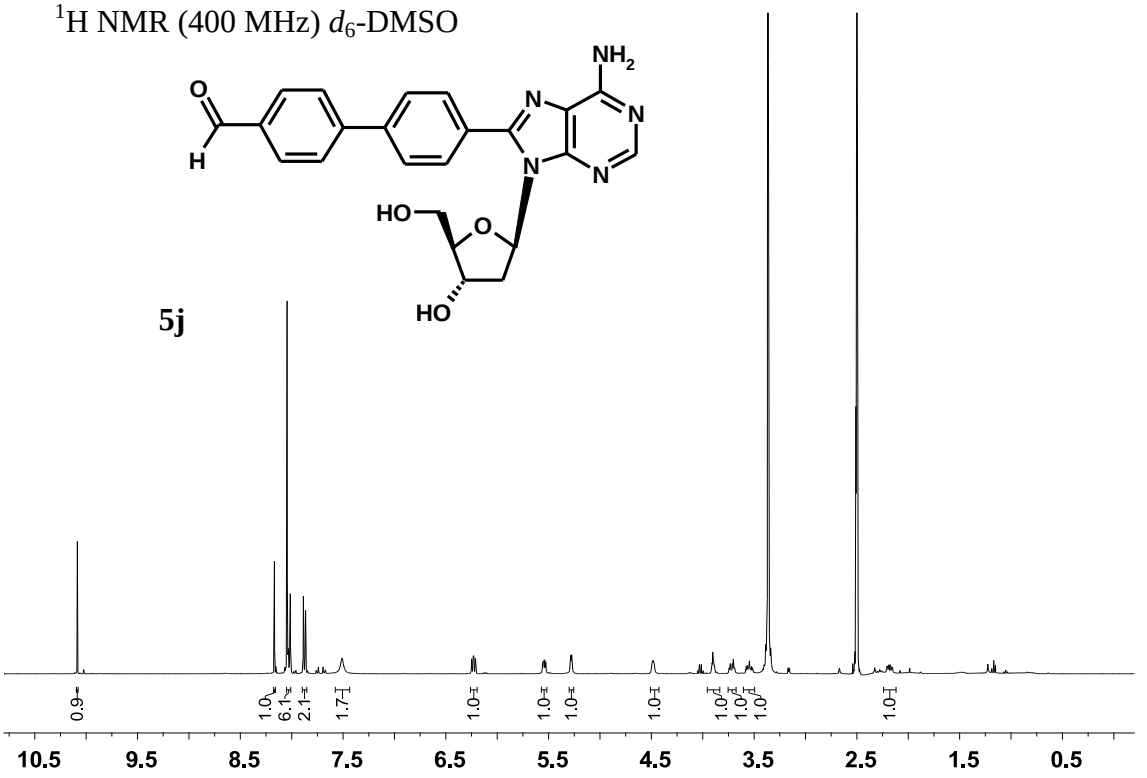


^{1}H NMR (400 MHz) d_6-DMSO

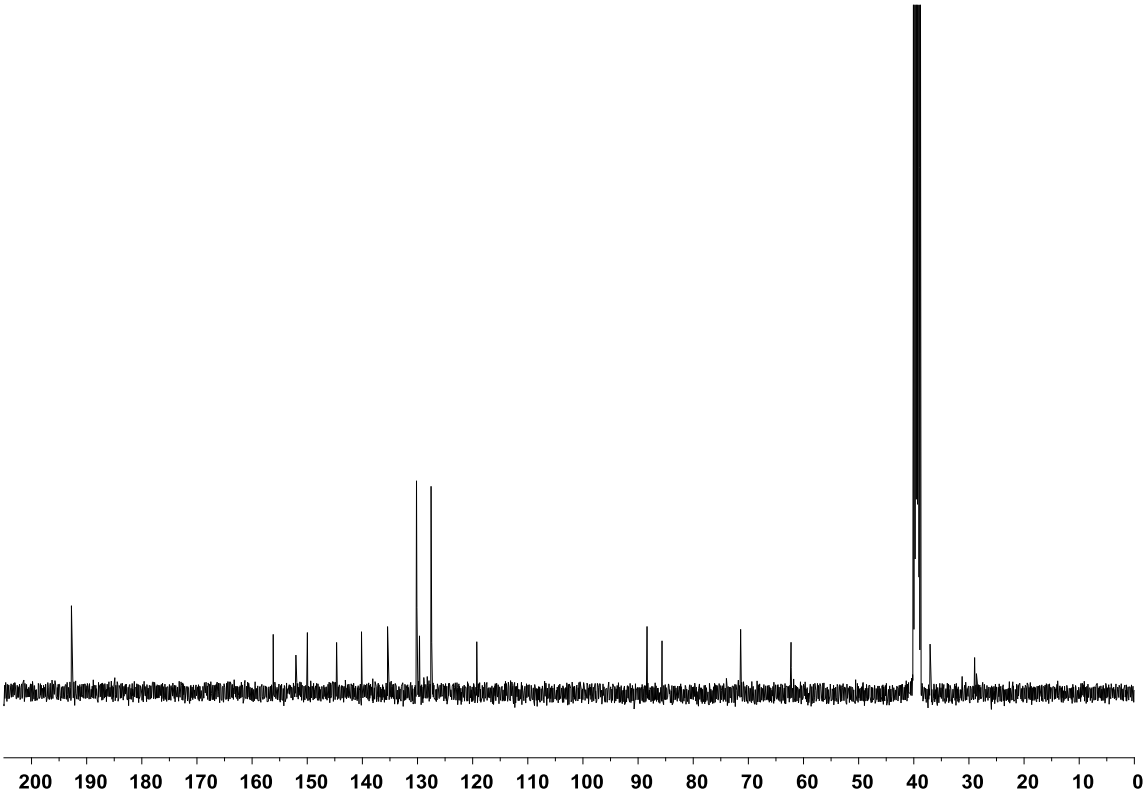


Residual MeOH remains in the ^{1}H NMR spectrum at 3.16 and 4.07 ppm.

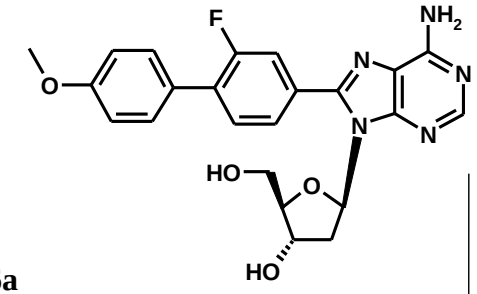
^{1}H NMR (400 MHz) d_6-DMSO



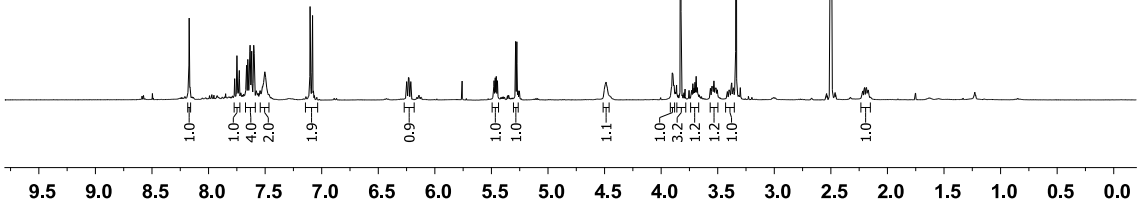
5j

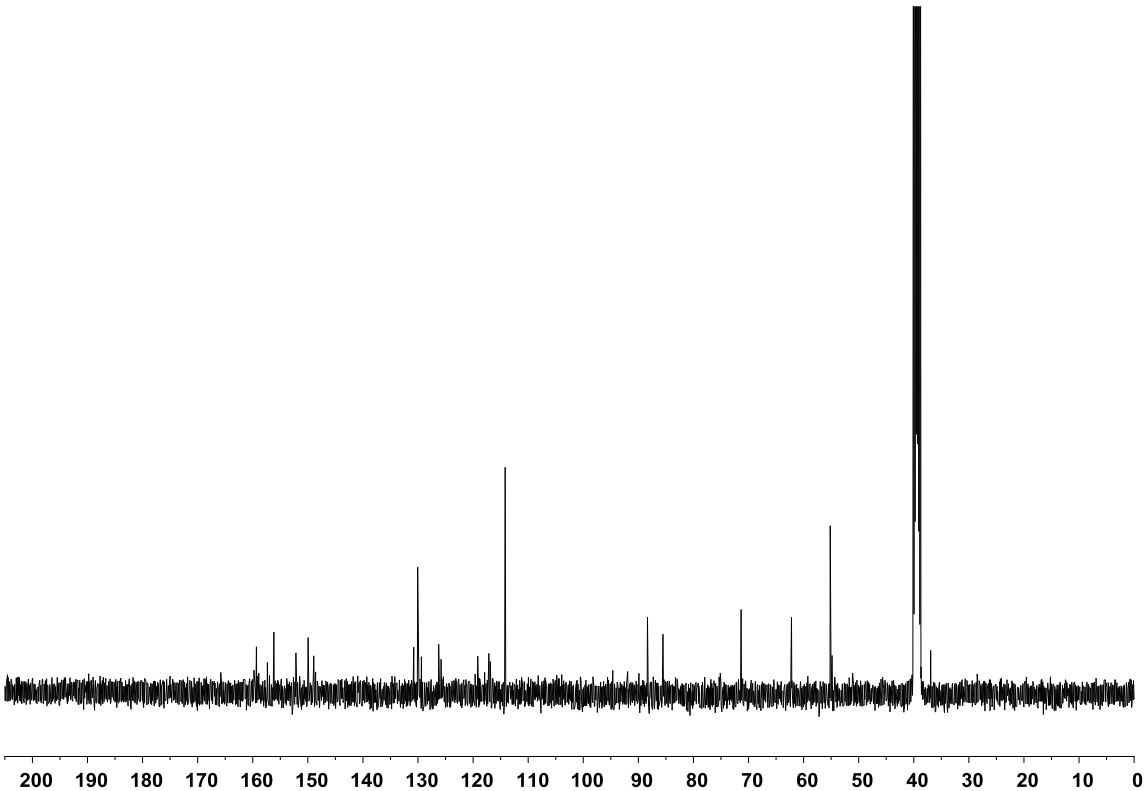


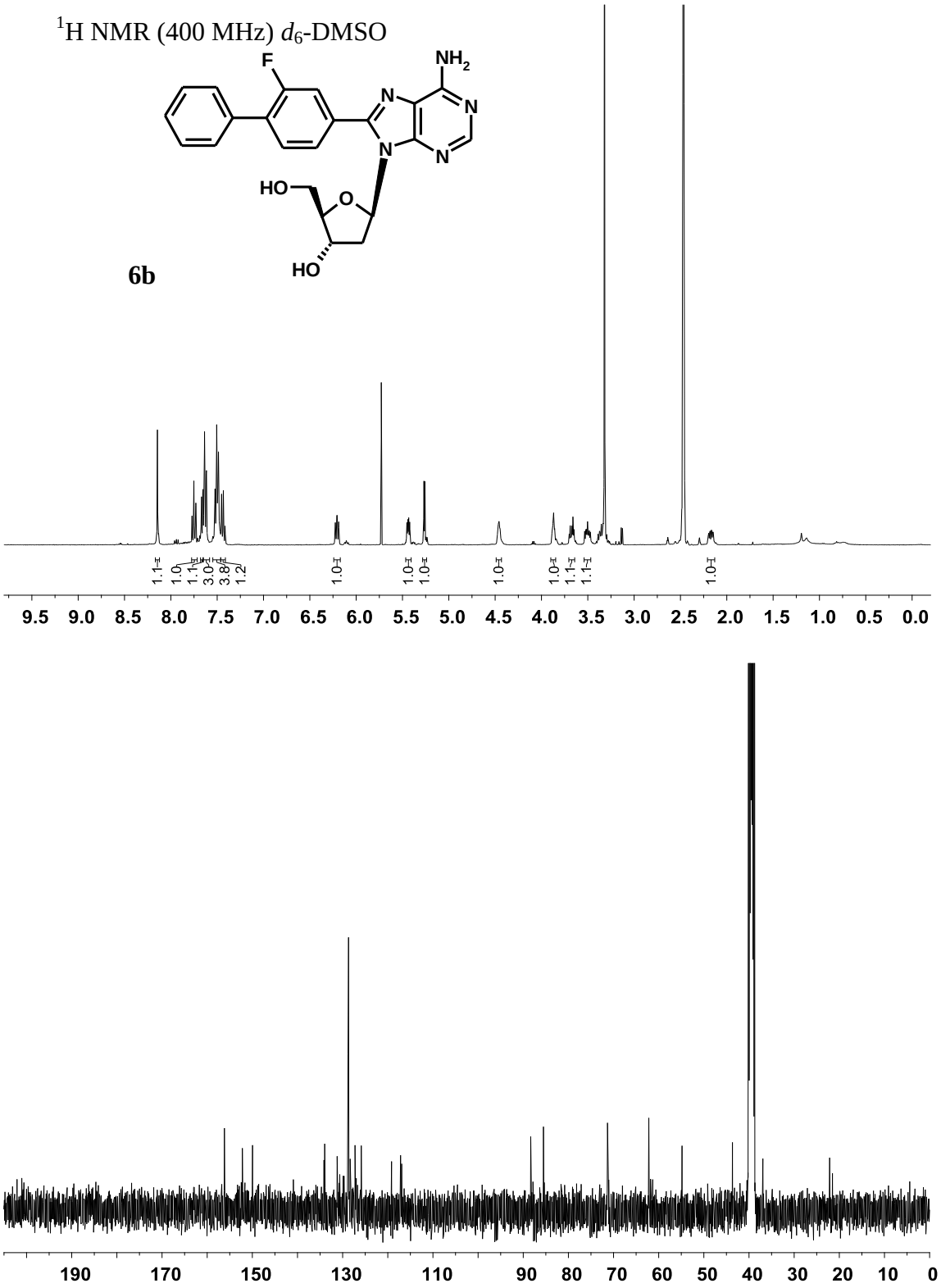
^{1}H NMR (400 MHz) d_6-DMSO



6a

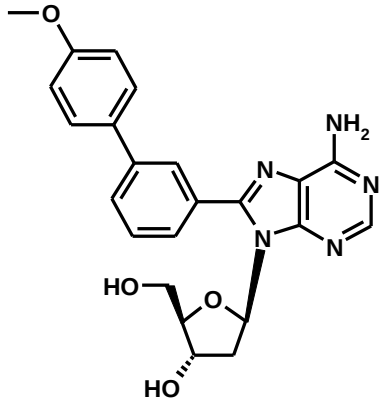






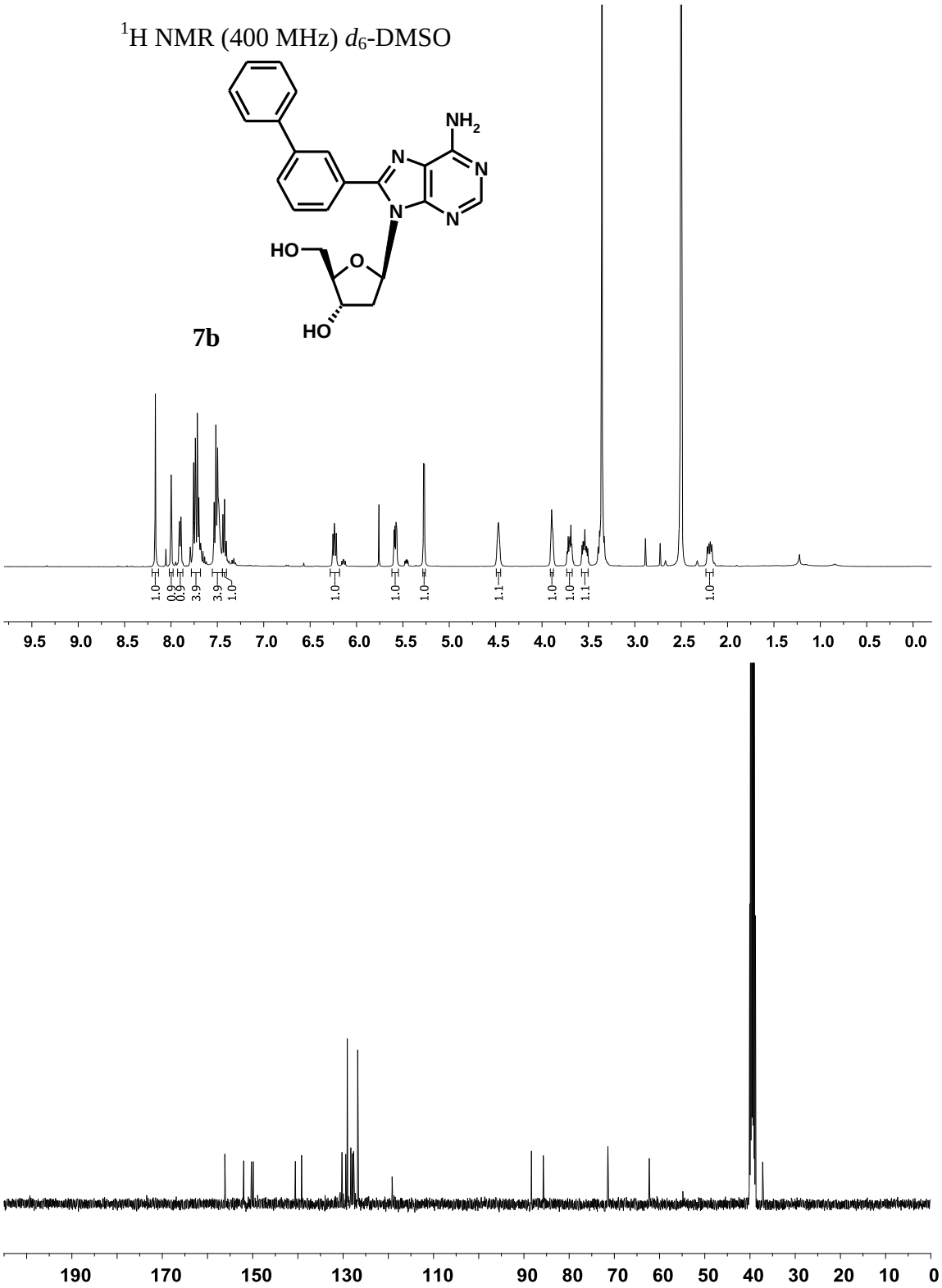
Residual piperidine remains in the ^{13}C NMR spectrum at 21.5, 22.2 and 43.7 ppm also esidual CH_2Cl_2 appears in the ^{1}H NMR spectrum at 5.76 ppm and the ^{13}C NMR spectrum at 54.8 ppm.

^{1}H NMR (400 MHz) d_6-DMSO



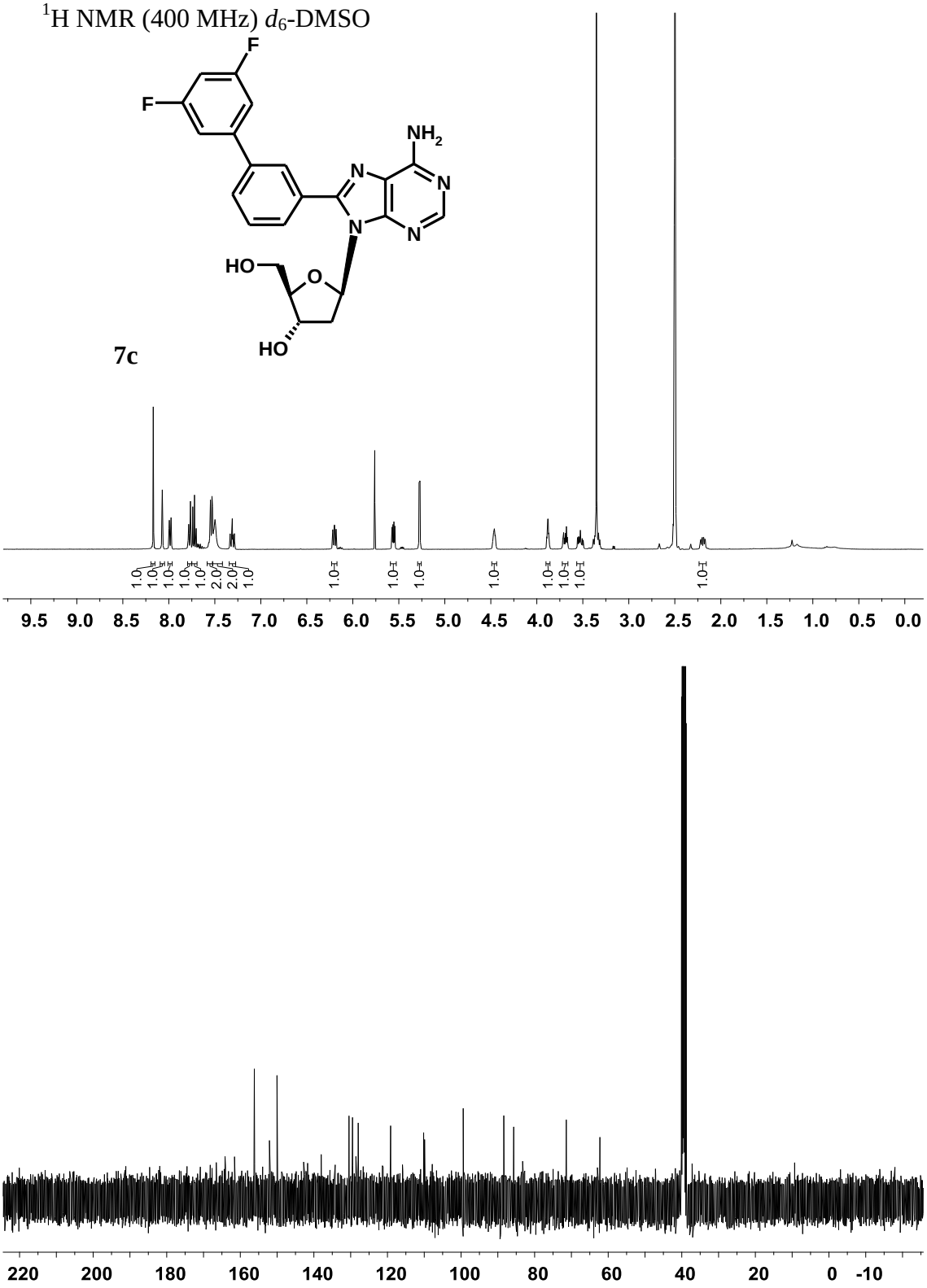
7a

Residual $CHCl_3$ remains in the ^{1}H NMR spectrum at 5.76 ppm.



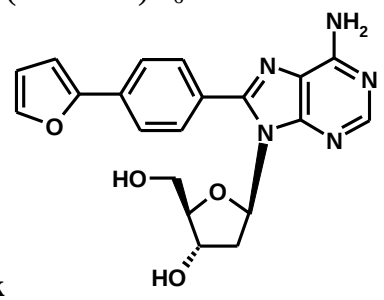
Residual $CHCl_3$ remains in the ^{1}H NMR spectrum at 5.76 ppm.

^{1}H NMR (400 MHz) d_6-DMSO

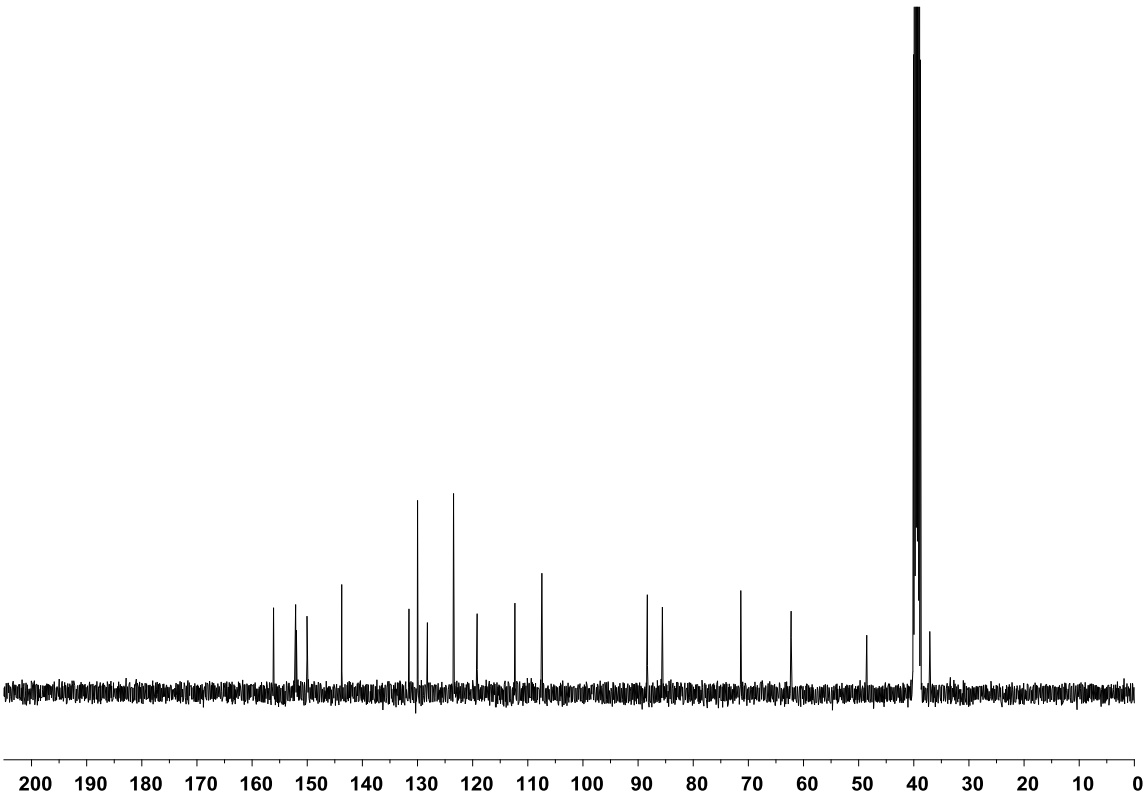


Residual $CHCl_3$ remains in the ^{1}H NMR spectrum at 5.76 ppm.

^{1}H NMR (400 MHz) d_6-DMSO



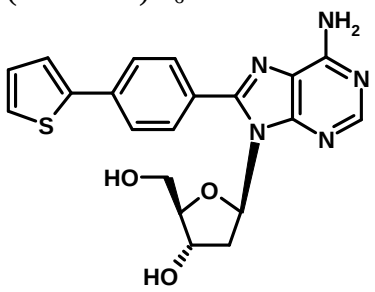
5k



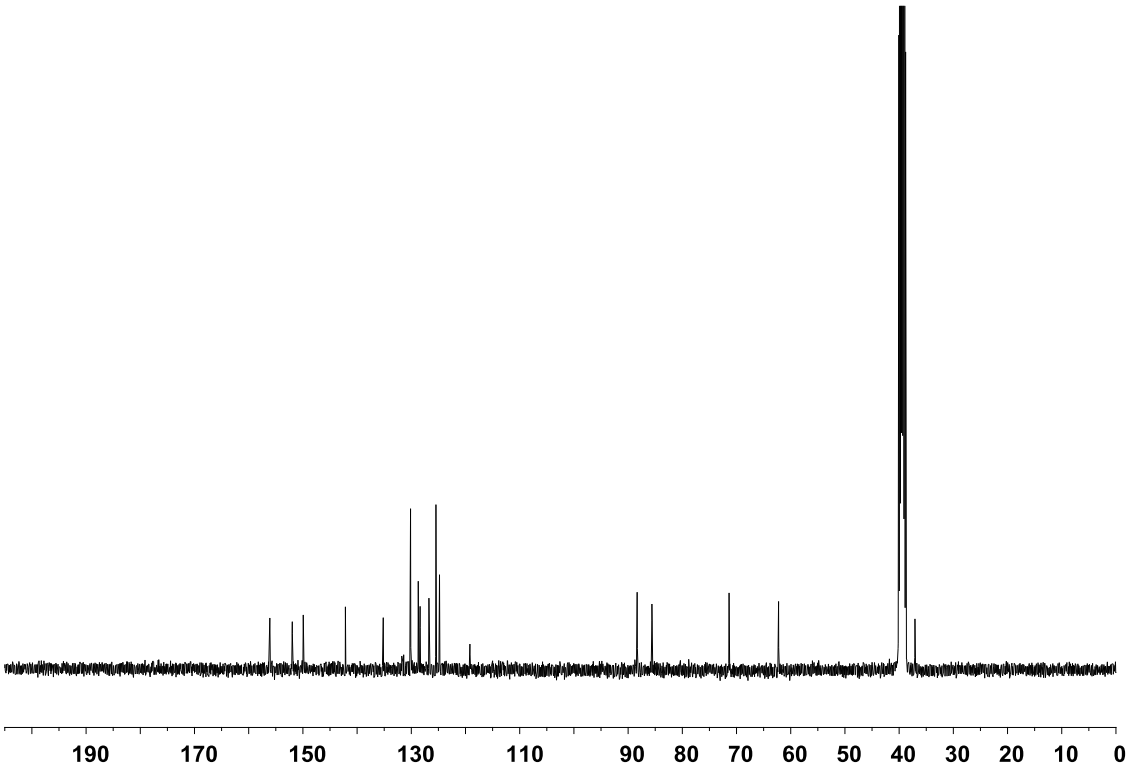
Residual MeOH remains in the ^{1}H NMR spectrum at 3.16 and 4.07 ppm, also residual $CHCl_3$ remains in the ^{13}C NMR spectrum at 48.5 ppm.

.

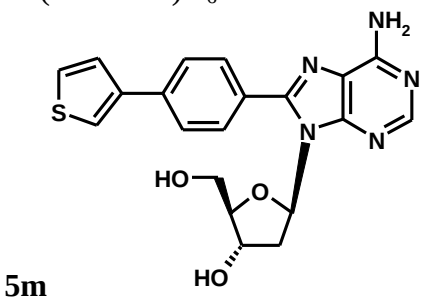
^{1}H NMR (400 MHz) d_6-DMSO



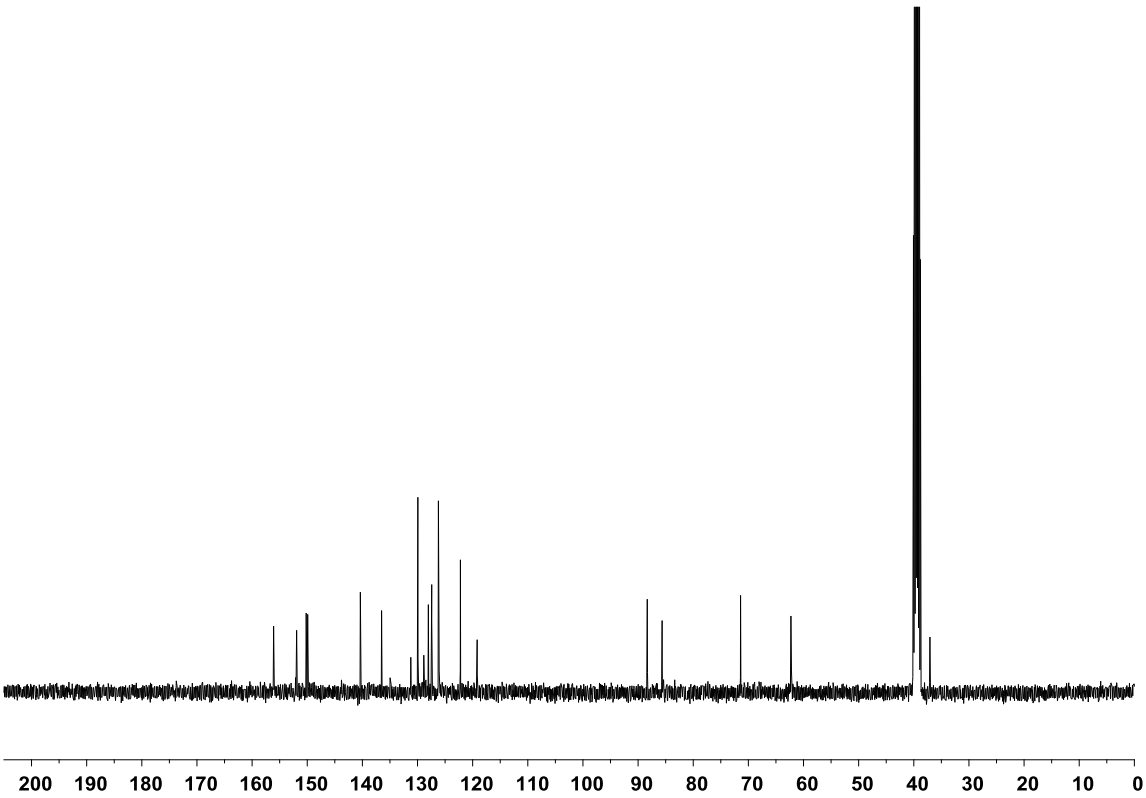
5l



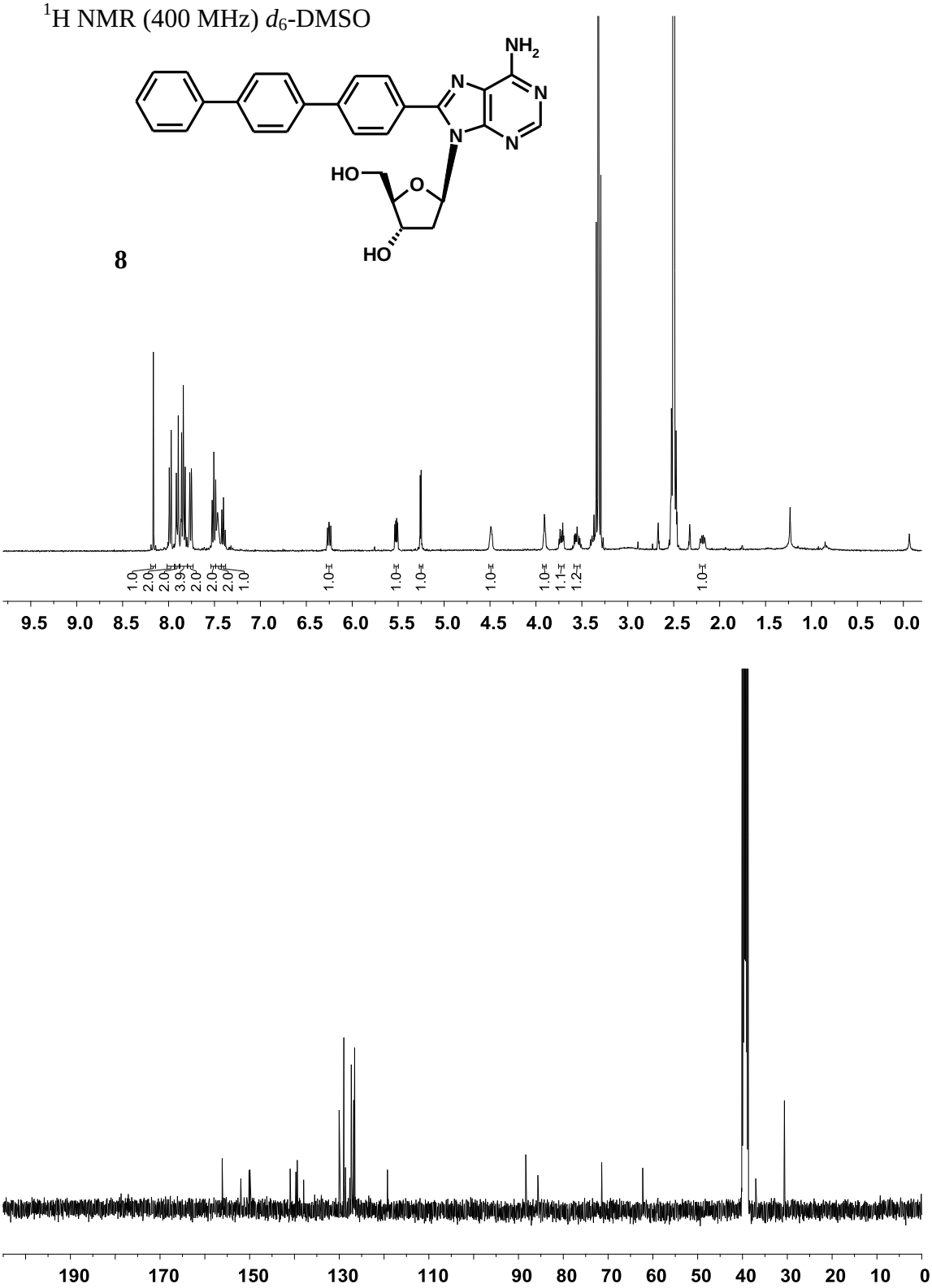
^{1}H NMR (400 MHz) d_6-DMSO



5m

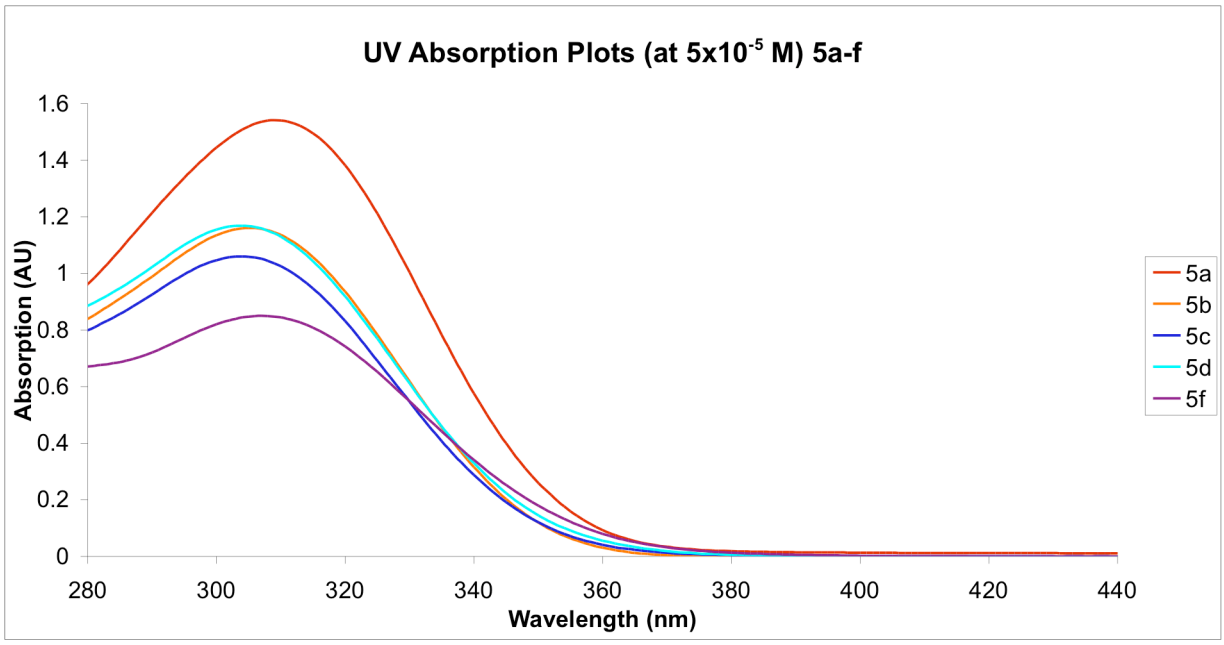


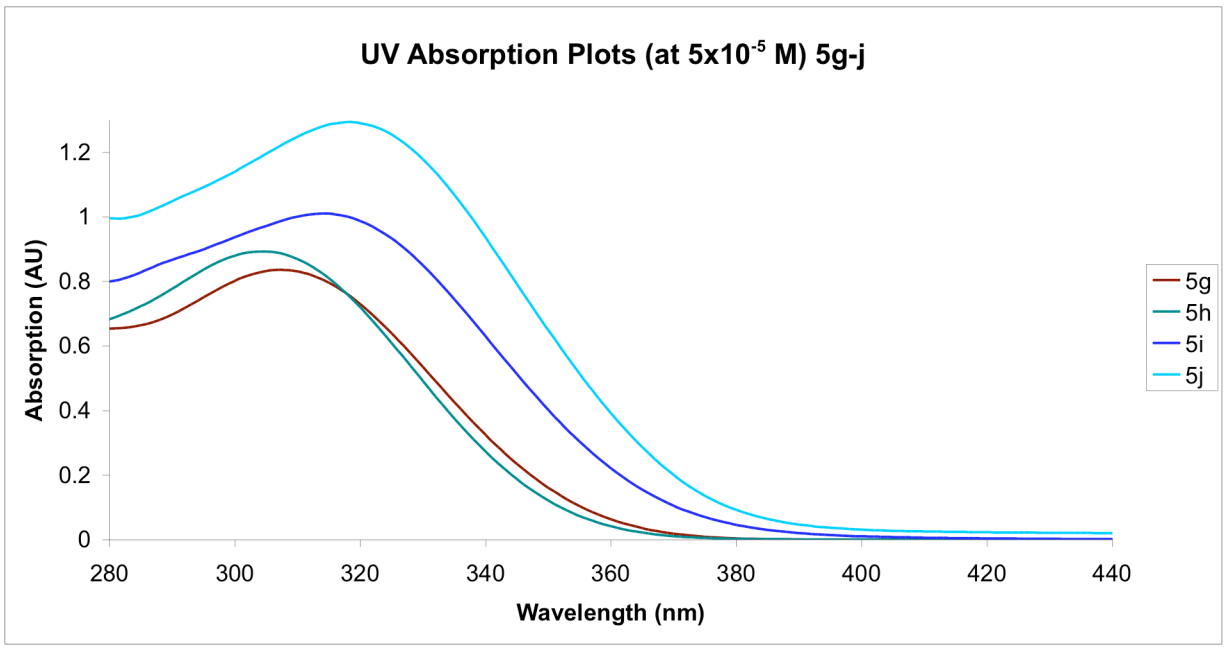
^{1}H NMR (400 MHz) d_6-DMSO

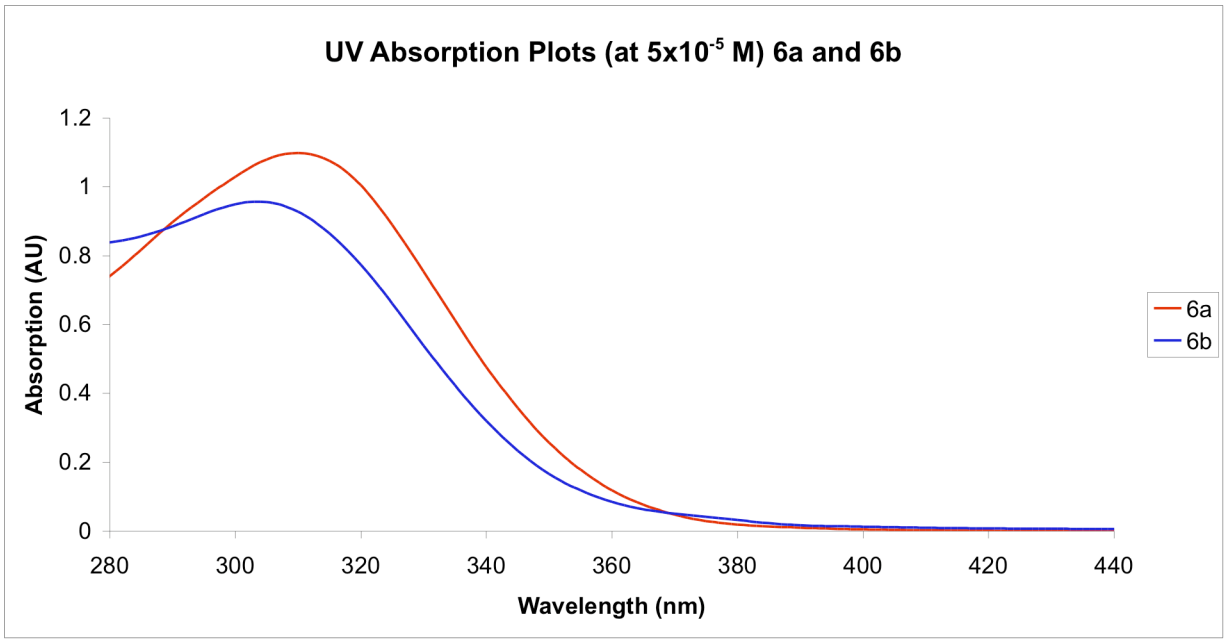


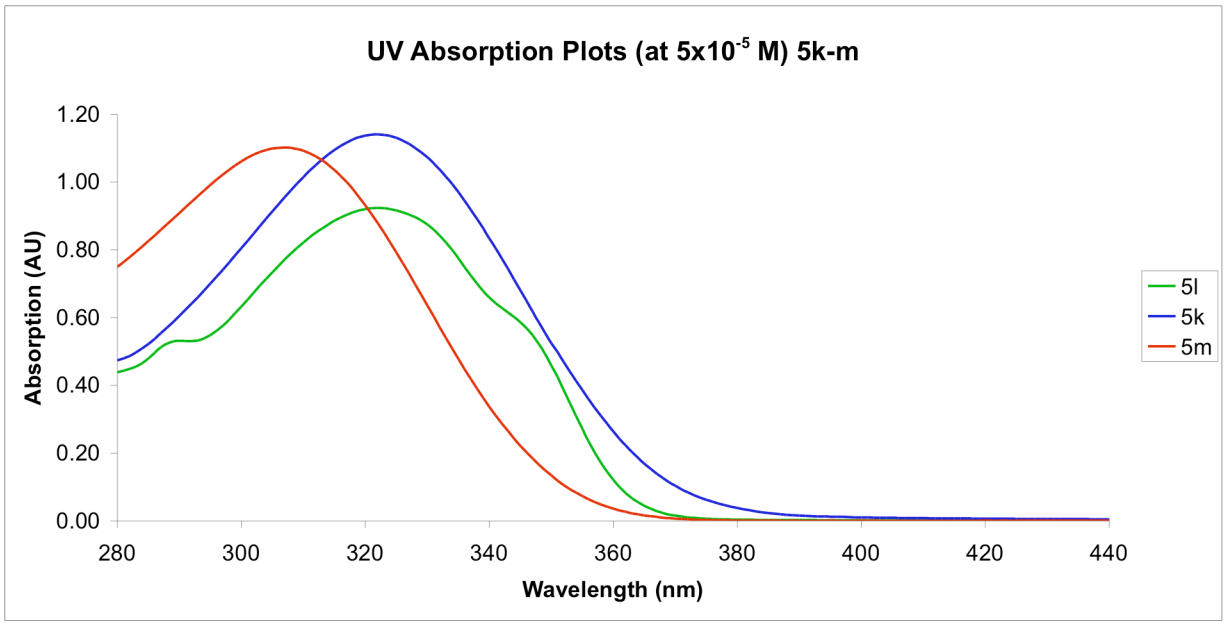
Acetone appears in the ^{13}C NMR spectrum at 30.1 ppm.

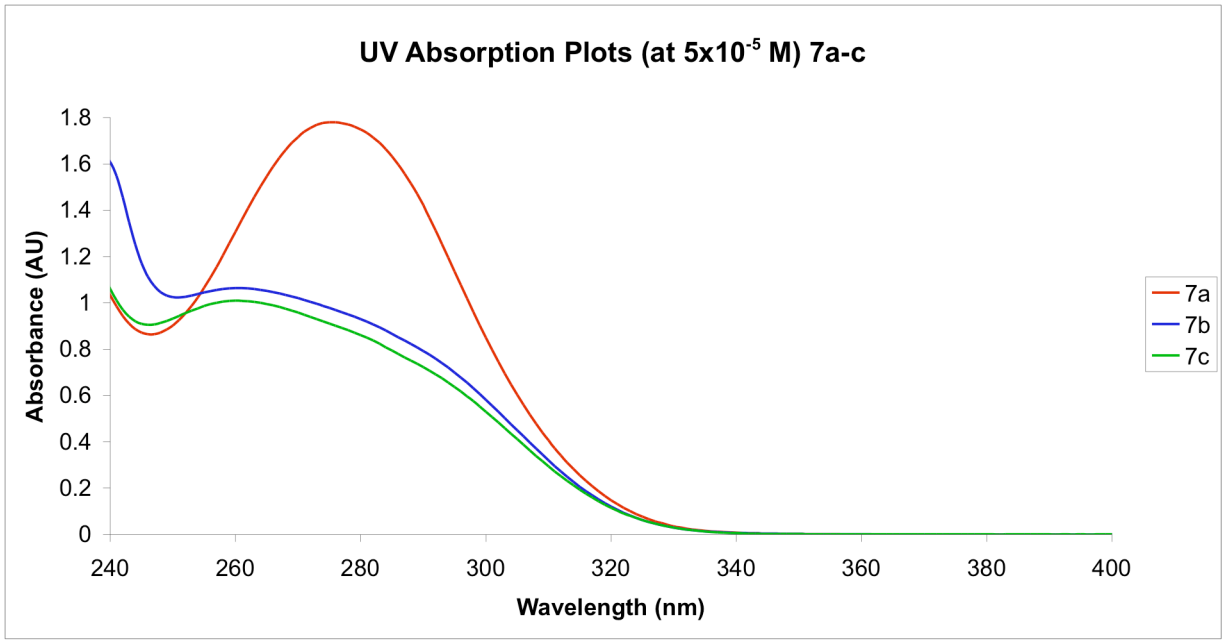
UV-Vis Spectra Overlays for 8-Biaryl-2'-deoxyadenosines.

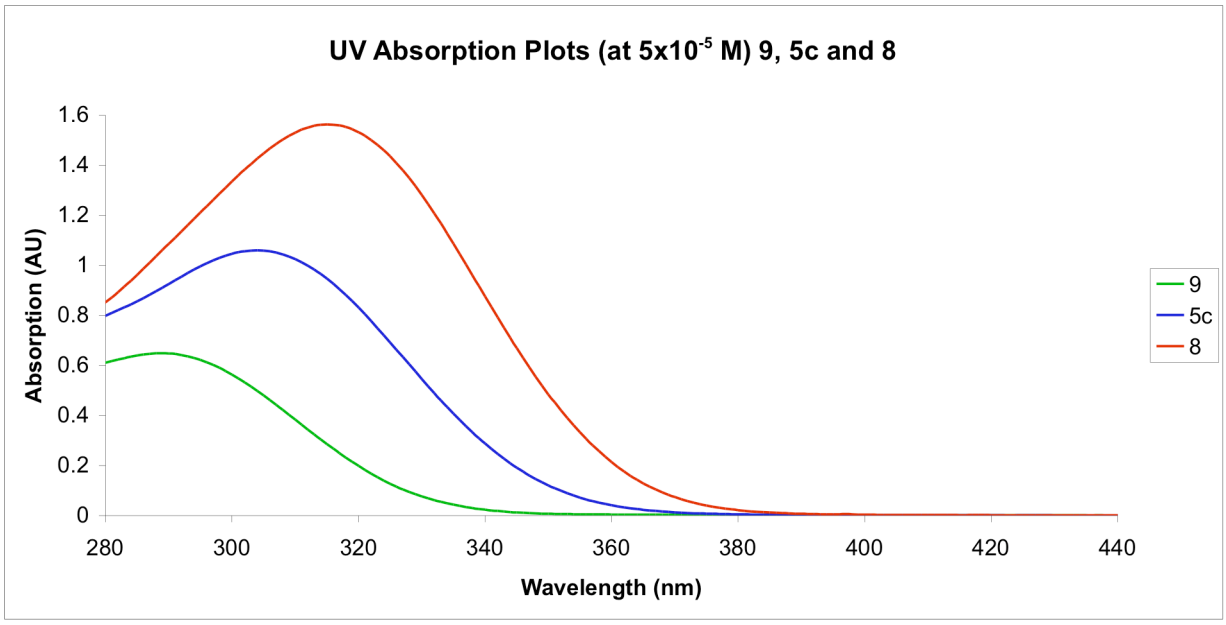




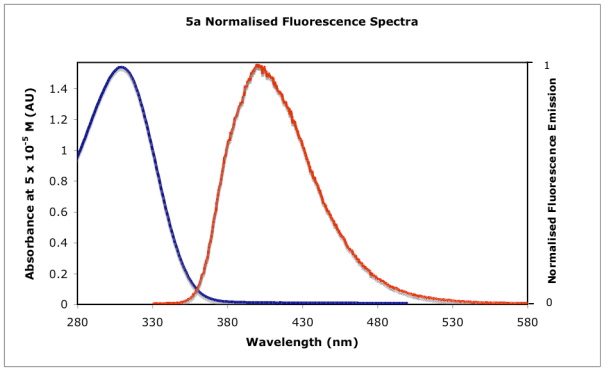

UV Absorption Plots (at 5x10-5 M) 6a and 6b
Absorption (AU)
1.2
1
0.8
0.6
0.4
0.2
0
280
300
320
340
360
380
400
420
440
Wavelength (nm)
6a
6b

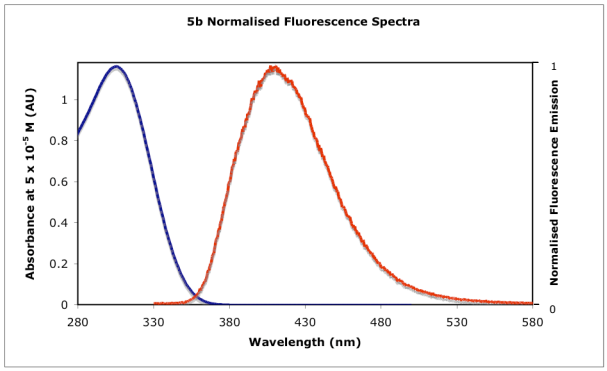

UV Absorption Plots (at 5x10-5 M) 5k-m
Absorption (AU)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
280
300
320
340
360
380
400
420
440
Wavelength (nm)
5l
5k
5m

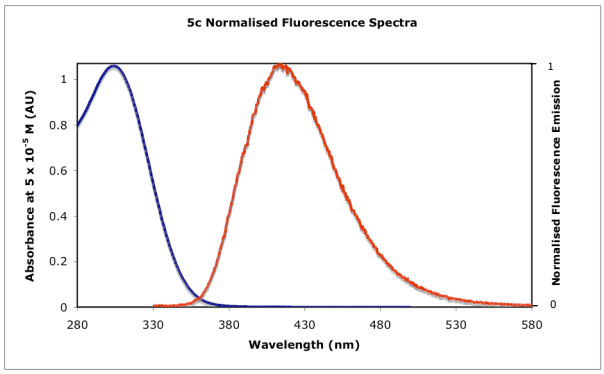

UV Absorption Plots (at 5x10-5 M) 7a-c
Absorbance (AU)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
240
260
280
300
320
340
360
380
400
Wavelength (nm)
7a
7b
7c

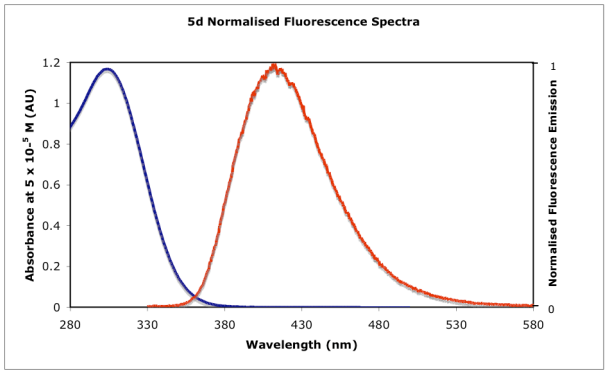

UV Absorption Plots (at 5x10-5 M) 9, 5c and 8
Absorption (AU)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
280
300
320
340
360
380
400
420
440
Wavelength (nm)
9
5c
8

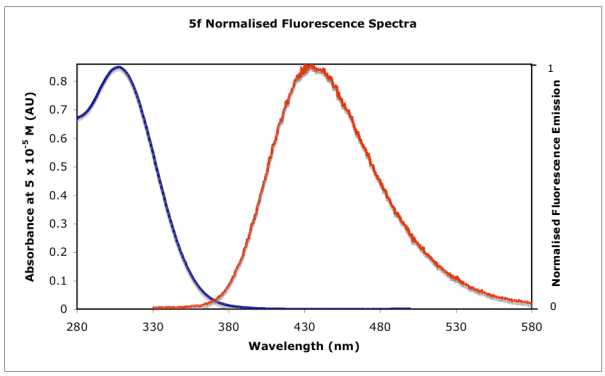
Fluorescence Emission Spectra Overlays for All Compounds.

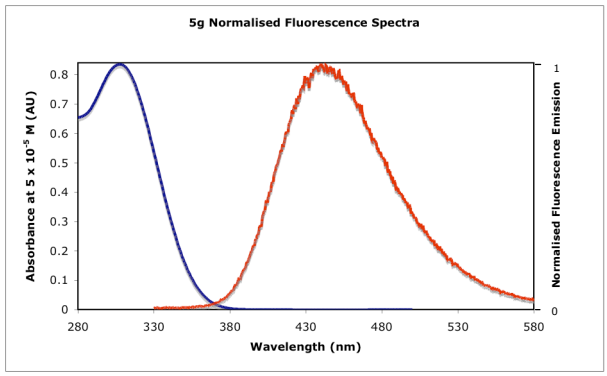


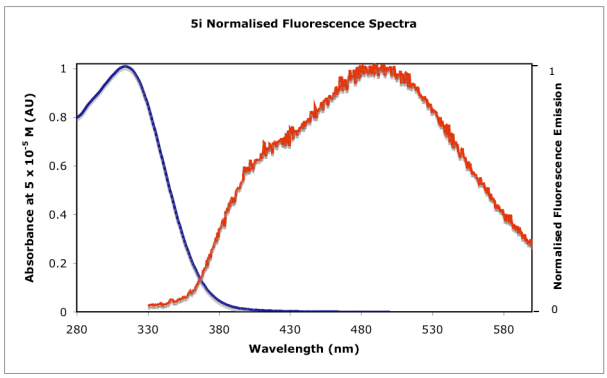


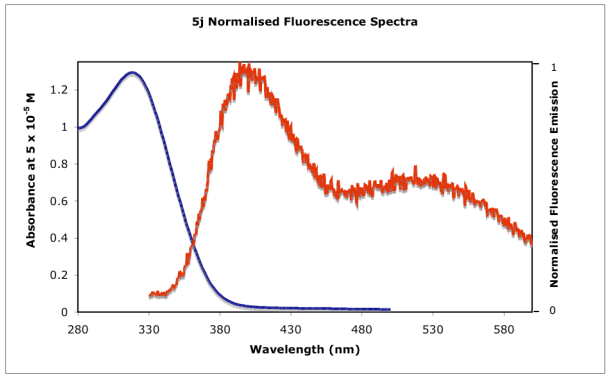


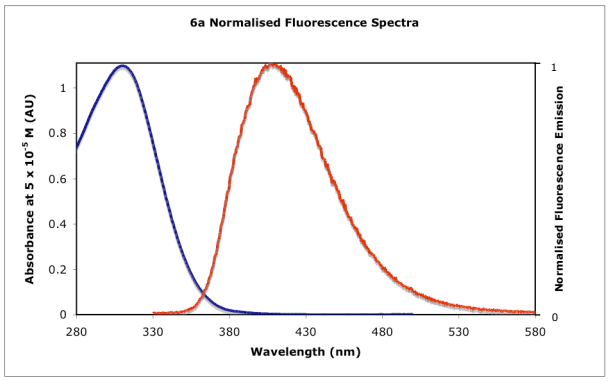


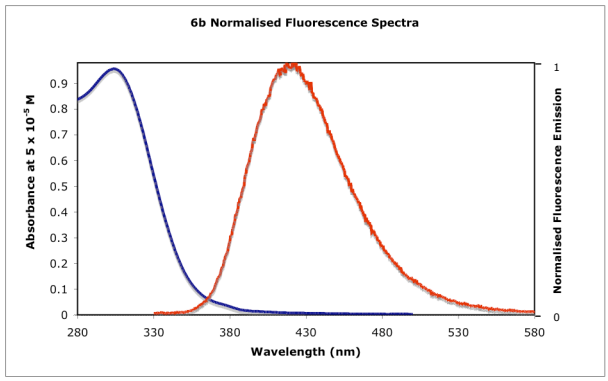


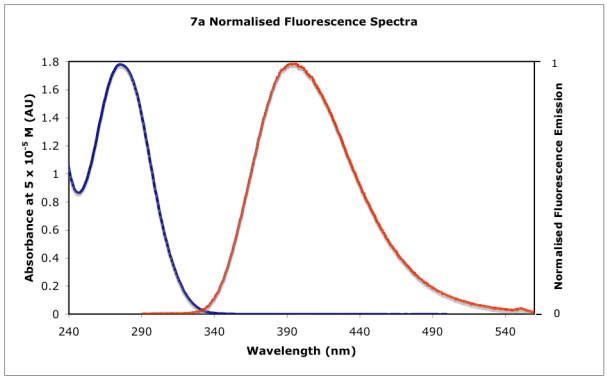


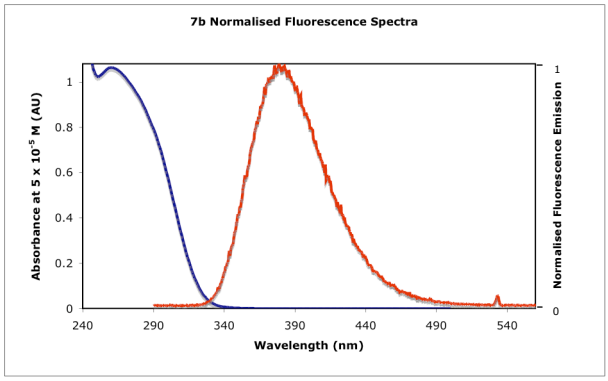


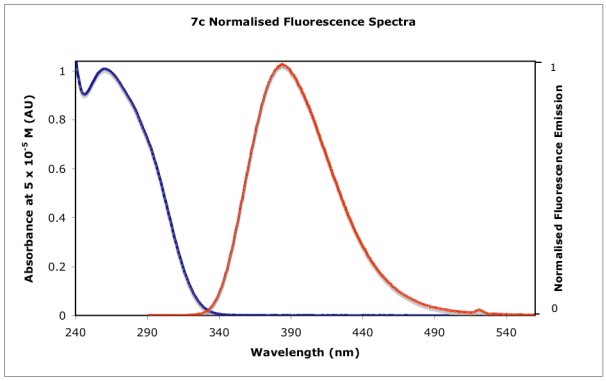


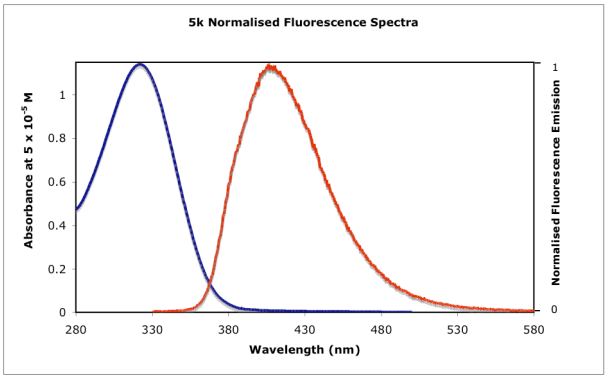

6a Normalised Fluorescence Spectra
Absorbance at 5 x 10-5 M (AU)
Normalised Fluorescence Emission
Wavelength (nm)

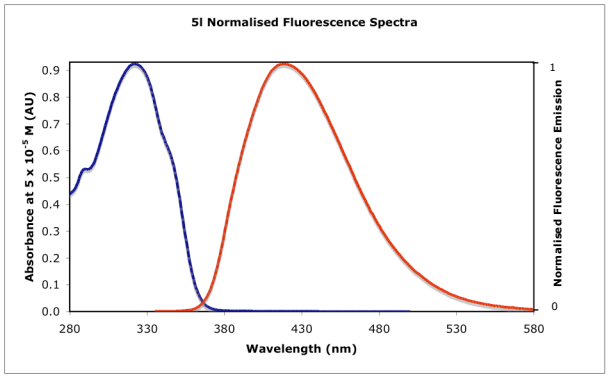

6b Normalised Fluorescence Spectra
Absorbance at 5 x 10-5 M
Normalised Fluorescence Emission
Wavelength (nm)

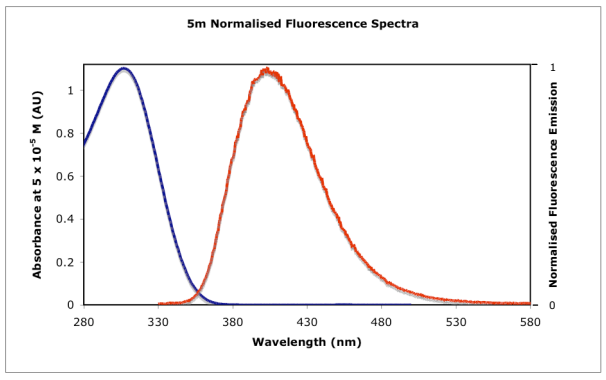

7a Normalised Fluorescence Spectra
Absorbance at 5 x 10-5 M (AU)
Normalised Fluorescence Emission
Wavelength (nm)

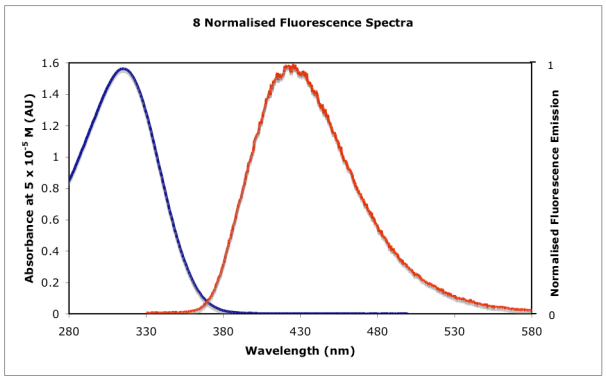

7b Normalised Fluorescence Spectra
Absorbance at 5 x 10-5 M (AU)
Normalised Fluorescence Emission
Wavelength (nm)

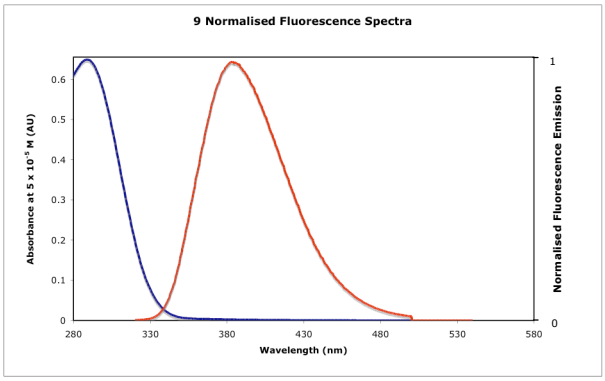

7c Normalised Fluorescence Spectra
Absorbance at 5 x 10-5 M (AU)
Normalised Fluorescence Emission
Wavelength (nm)

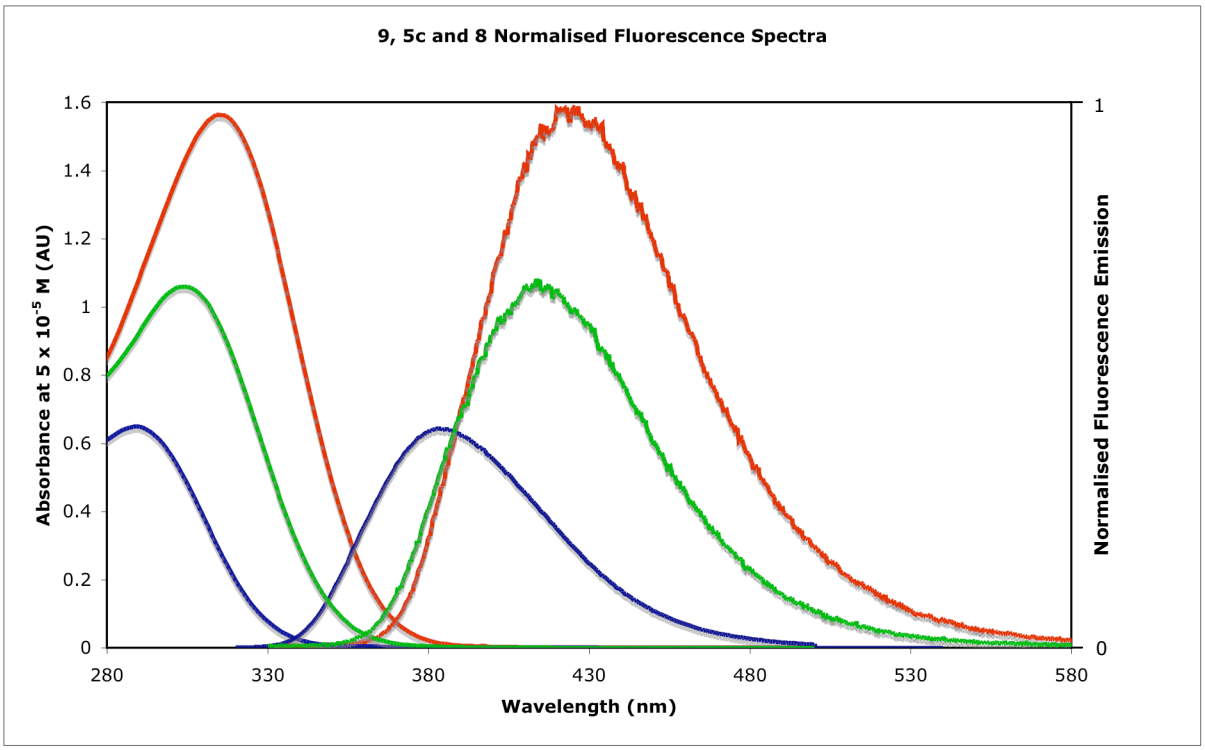

5k Normalised Fluorescence Spectra
Absorbance at 5 x 10-5 M
Normalised Fluorescence Emission
Wavelength (nm)


5l Normalised Fluorescence Spectra
Absorbance at 5 x 10-5 M (AU)
Normalised Fluorescence Emission
Wavelength (nm)


5m Normalised Fluorescence Spectra
Absorbance at 5 x 10-5 M (AU)
Normalised Fluorescence Emission
Wavelength (nm)


8 Normalised Fluorescence Spectra
Absorbance at 5 x 10⁻⁵ M (AU)
Normalised Fluorescence Emission
Wavelength (nm)


9 Normalised Fluorescence Spectra
Absorbance at 5 x 10⁻⁵ M (AU)
Normalised Fluorescence Emission
Wavelength (nm)


9, 5c and 8 Normalised Fluorescence Spectra
Absorbance at 5 x 10⁻⁵ M (AU)
Normalised Fluorescence Emission
Wavelength (nm)

Summary of Photophysical Data for 8-Biary-2'-deoxyadenosines.

Name	Solvent	λ_{max} (nm)	ε (1×10^4 $M^{-1}cm^{-1}$)	λ_{em} (nm)	Stokes shift (cm^{-1})	Φ*
5a	DMSO	309	3.13	400	7362	0.65
5b	DMSO	305	2.26	409	8337	0.68
5c	DMSO	304	2.07	414	8740	0.69
5d	DMSO	304	2.30	412	8623	0.69
5f	DMSO	307	1.71	434	9532	0.72
5g	DMSO	307	1.7.5	440	9846	0.75
5h	DMSO	304	1.7.6	427	9475	0.77
5i	DMSO	314	2.02	491	11481	0.27
5j	DMSO	318	2.53	399	6384	0.10
5k	DMSO	320	2.71	407	6680	0.70
5l	DMSO	322	2.25	419	7190	0.59
5m	DMSO	307	2.14	403	7759	0.64
6a	DMSO	310	2.21	408	7748	0.60
6b	DMSO	304	1.89	420	9085	0.69
7a	MeOH	275	3.30	393	10918	-
7b	MeOH	261	1.93	380	11278	-
7c	MeOH	260	1.98	383	12352	-
8	DMSO	315	3.14	424	8161	0.77
9	DMSO	289	1.29	384	8560	0.81

* - Quantum yields obtained using a Jobin-Yvon integrated sphere using a modified sphere correction file.

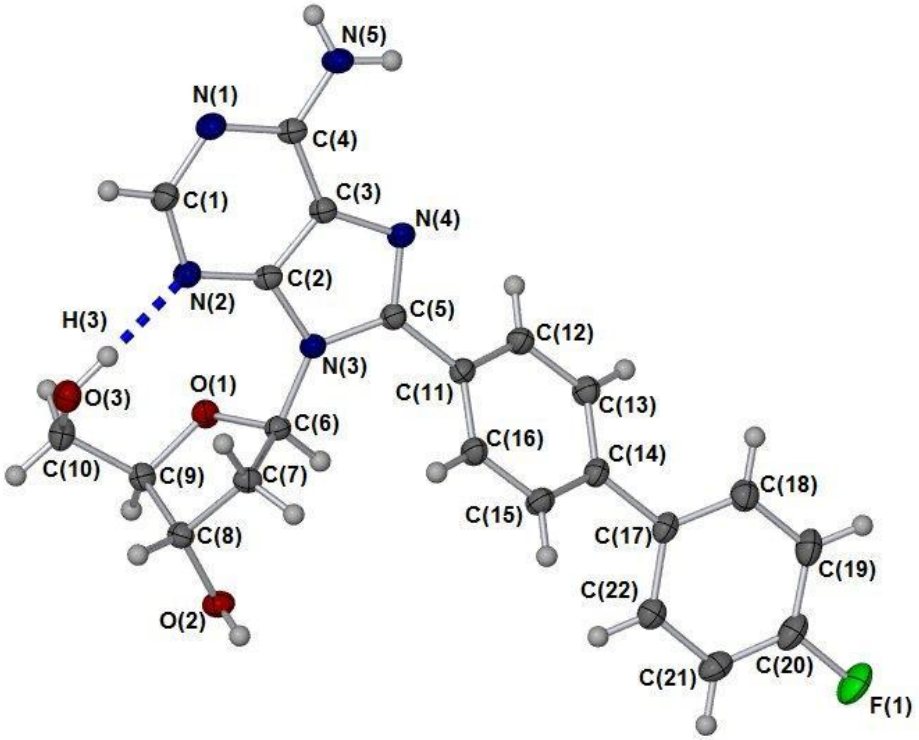
Fluorescence Lifetime Determinations for 9, 5c and 8.

Name	λ_{max} (nm)	Monitoring Emission @ λ (nm)	$\tau^{\dagger}$ (ns)	Monitoring Emission @ λ (nm)	$\tau^{\dagger}$ (ns)
9	289	380	2.6	420	2.6
5c	304	410	1.9	450	1.9
8	315	420	1.7	-	-

† - Obtained using TCSPC in collaboration with Andy Beeby (Durham).

Single Crystal X-ray Diffraction Data

Compound 5d

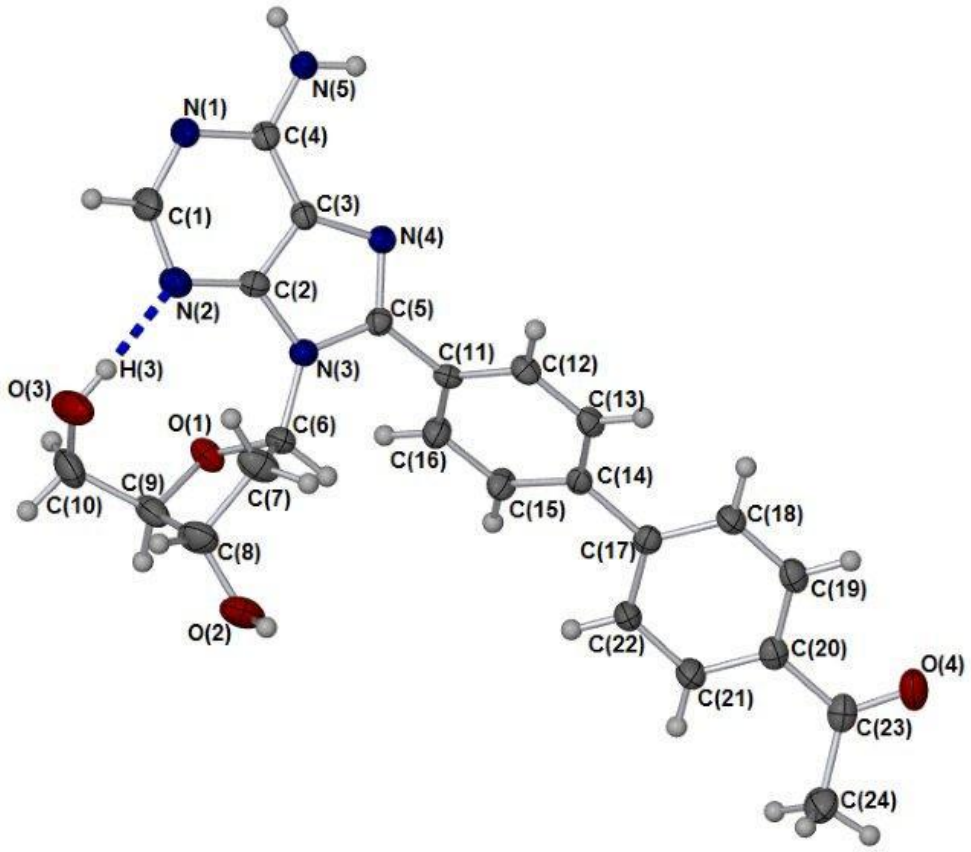


Compound **5d** was crystalised from MeOH using slow evaporation.

X-ray structure of compound **5d**.H_2O, one molecule of water removed for clarity (note: arbitrary numbering used). Thermal ellipsoids are shown at 50% probability. X-ray data for compound 5d (CCDC 779420): $C_{22}H_{22}FN_5O_4$; M_w = 439.45; T = 110(2) K; λ = 0.71073 Å; Monoclinic; P21 space group; a = 9.7550(5) Å, b = 7.1898(4) Å, c = 14.7231(7) Å; α = 90.0°, β = 90.0630(10)°, γ = 90.0°; V = 1032.63(9) $Å^3$; Z = 2; D = 1.413 Mg/m^3; crystal size = 0.40 x 0.12 x 0.06 mm^3; *R1* = 0.0320, *wR2* = 0.0823, GOF = 1.052.

The X-ray data indicates that the molecule adopts a *syn*-C2'-*endo* (south) conformation; {torsion angle O(1)-C(6)-N(3)-C(2) = 45.73°}. An intramolecular H-bond is observed between C5'-OH and N3 {O(3)-H(3)...N(2), 2.7234(15) Å; 177.8(19)°}.

Compound 5i



Compound **5i** was crystalised from MeOH using slow evaporation.

X-ray structure of compound **5i**$_4$.$(MeOH)_5.H_2O$, only one molecule of compound shown for clarity (note: arbitrary numbering used). Thermal ellipsoids are shown at 50% probability. X-ray data for compound 5d (CCDC 779419): $C_{101}H_{114}N_{20}O_{22}$; M_w = 1960.12; T = 110(2) K; λ = 0.71073 Å; Monoclinic; P21 space group; a = 12.5839(14) Å, b = 29.990(3) Å, c = 13.3097(15) Å; α = 90.0°, β = 90.783(2)°, γ = 90.0°; V = 4964.0(10) Å^3; Z = 2; D = 1.311 Mg/m^3; crystal size = 0.43 x 0.29 x 0.25 mm^3; *R1* = 0.0783, *wR2* = 0.1800, GOF = 1.087.

The X-ray data shows four molecules of compound **5i** have co-crystalised with five molecules of methanol and a water molecule per unit cell. All four of the compound molecules adopt a *syn*-C2'-*endo* (south) conformation with an intramolecular H-bond between C5'-OH and N3; {Molecule 1 torsion angle O(1)-C(6)-N(3)-C(2) = 58.05°, H-bond {O(3)-H(3)...N(2), 2.682(5) Å; 177.4 °; Molecule 2 torsion angle O(9)-C(54)-N(13)-C(50) = 51.63°, H-bond {O(11)-H(11)...N(12), 2.787(5) Å; 176.6 °; Molecule 3 torsion angle O(13)-C(78)-N(17)-C(74) = 58.75°, H-bond {O(15)-H(15C)...N(17), 2.729(5) Å; 172.0 °; Molecule 4 torsion angle O(5)-C(30)-N(8)-C(26) = 52.70°, H-bond {O(7)-H(7)...N(7), 2.718(5) Å; 167.2 °}.