Full wwPDB X-ray Structure Validation Report (i)

Jun 16, 2024 – 06:04 PM EDT

PDB ID	:	2WOD
Title	:	Crystal Structure of the dinitrogenase reductase-activating glycohydrolase (DRAG) from Rhodospirillum rubrum in complex with ADP- ribsoyllysine
Authors	:	Berthold, C.L.; Wang, H.; Nordlund, S.; Hogbom, M.
Deposited on	:	2009-07-23
Resolution	:	2.25 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at *validation@mail.wwpdb.org*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

The following versions of software and data (see references (i)) were used in the production of this report:

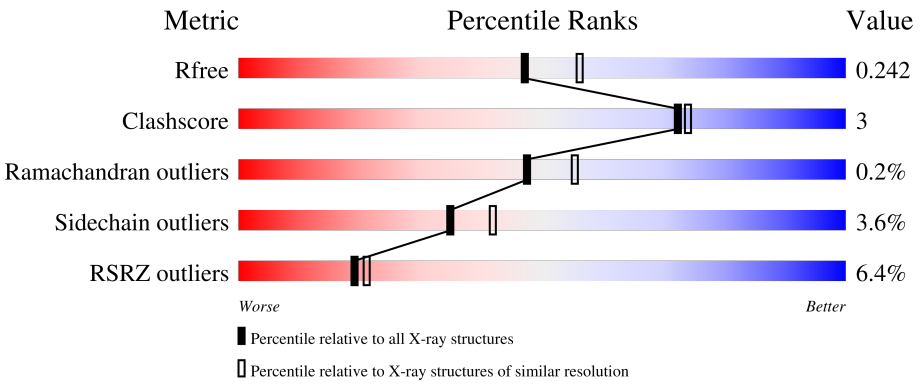
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	2.37.1
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.37.1

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.25 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	1377 (2.26-2.26)
Clashscore	141614	1487 (2.26-2.26)
Ramachandran outliers	138981	1449 (2.26-2.26)
Sidechain outliers	138945	1450 (2.26-2.26)
RSRZ outliers	127900	1356 (2.26-2.26)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions <=5% The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	299	9% 87% 10% • •
1	B	299	4% 88% 9% • •

2 Entry composition (i)

There are 6 unique types of molecules in this entry. The entry contains 4754 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

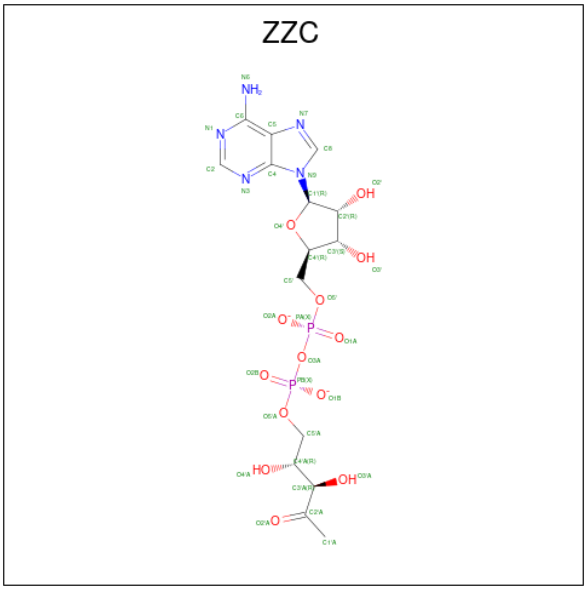
- Molecule 1 is a protein called ADP-RIBOSYL-[DINITROGEN REDUCTASE] GLYCOHYDROLASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	291	2204	1377	401	410	16	0	0	0
1	B	291	2216	1386	403	410	17	0	2	0

- Molecule 2 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Mn		
2	A	1	1	1	0	0
2	B	1	1	1	0	0

- Molecule 3 is [(2R,3S,4R,5R)-5-(6-AMINOPURIN-9-YL)-3,4-DIHYDROXY-OXOLAN-2-YL]METHYL [[(2R,3R)-2,3-DIHYDROXY-4-OXO-PENTOXY]-OXIDO-PHOSPHORYL] PHOSPHATE (three-letter code: ZZC) (formula: $C_{15}H_{21}N_5O_{13}P_2$).

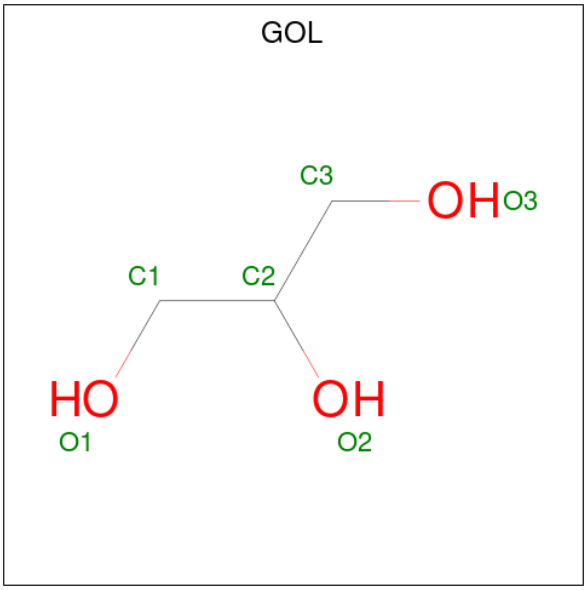


Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			35	15	5	13	2		
3	B	1	Total	C	N	O	P	0	0
			35	15	5	13	2		

- Molecule 4 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Cl	0	0
			1	1		

- Molecule 5 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	B	1	Total	C	O	0	0
			6	3	3		
5	B	1	Total	C	O	0	0
			6	3	3		

- Molecule 6 is water.

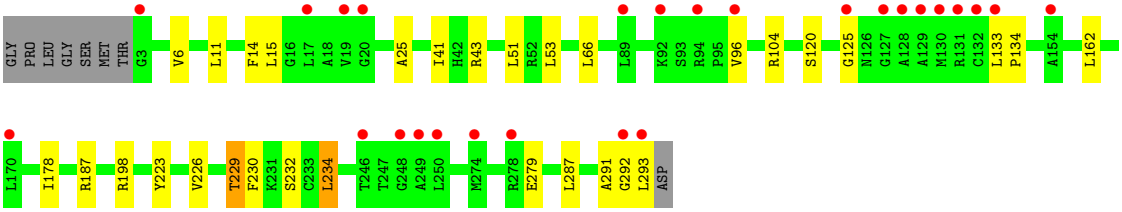
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	102	Total	O	0	0
			102	102		
6	B	147	Total	O	0	0
			147	147		

3 Residue-property plots (i)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

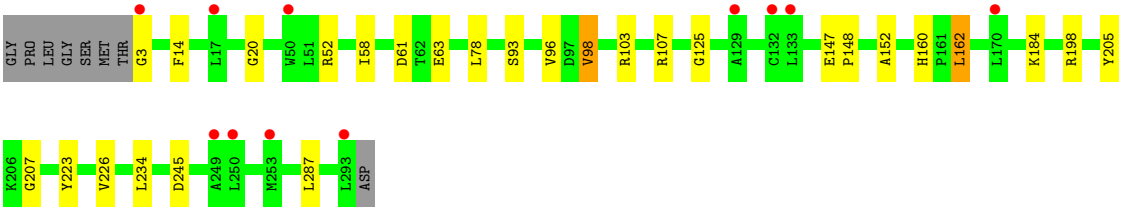
• Molecule 1: ADP-RIBOSYL-[DINITROGEN REDUCTASE] GLYCOHYDROLASE

Chain A:



• Molecule 1: ADP-RIBOSYL-[DINITROGEN REDUCTASE] GLYCOHYDROLASE

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α, β, γ	77.31Å 77.31Å 245.59Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	34.92 – 2.25 33.47 – 2.20	Depositor EDS
% Data completeness (in resolution range)	98.7 (34.92-2.25) 98.5 (33.47-2.20)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.16 (at 2.20Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.197 , 0.242 0.199 , 0.242	Depositor DCC
R_{free} test set	2220 reflections (5.09%)	wwPDB-VP
Wilson B-factor (Å^2)	34.6	Xtriage
Anisotropy	0.852	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 36.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.032 for -h,-k,l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	4754	wwPDB-VP
Average B, all atoms (Å^2)	43.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.54% of the height of the origin peak. No significant pseudotranslation is detected.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: ZZC, MN, GOL, CL

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\#\|Z\|>5$	RMSZ	$\#\|Z\|>5$
1	A	0.44	0/2248	0.57	0/3043
1	B	0.47	0/2267	0.59	0/3068
All	All	0.45	0/4515	0.58	0/6111

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts (i)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2204	0	2177	19	0
1	B	2216	0	2191	13	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	35	0	20	2	0
3	B	35	0	21	1	0
4	B	1	0	0	0	0
5	B	12	0	16	0	0
6	A	102	0	0	1	0
6	B	147	0	0	1	0
All	All	4754	0	4425	30	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 3.

All (30) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:104:ARG:HD3	1:B:93:SER:O	1.96	0.65
1:A:25:ALA:HB1	1:A:53:LEU:HD12	1.82	0.62
1:A:229:THR:HG23	1:A:232:SER:OG	2.00	0.62
1:A:229:THR:CG2	1:A:232:SER:OG	2.49	0.61
1:B:20:GLY:HA2	1:B:234:LEU:HD11	1.83	0.60
1:A:229:THR:HG21	6:A:2085:HOH:O	2.04	0.57
1:B:147:GLU:HB3	1:B:148:PRO:HD3	1.87	0.55
1:A:125:GLY:HA3	3:A:401:ZZC:H5'	1.89	0.54
1:A:51:LEU:HD13	1:A:96:VAL:HG11	1.90	0.54
1:B:61:ASP:OD2	1:B:245:ASP:OD2	2.30	0.49
1:A:66:LEU:HD22	1:A:279:GLU:HG3	1.96	0.47
1:B:125:GLY:HA3	3:B:401:ZZC:H5'	1.96	0.47
1:A:230:PHE:CE2	1:A:234:LEU:HD13	2.51	0.46
1:A:125:GLY:CA	3:A:401:ZZC:H5'	2.46	0.46
1:A:96:VAL:HA	1:B:52:ARG:NH1	2.30	0.45
1:A:292:GLY:O	1:A:293:LEU:HD23	2.16	0.45
1:A:133:LEU:HB3	1:A:134:PRO:HD3	1.99	0.45
1:B:58:ILE:HD12	1:B:63:GLU:HG3	1.98	0.45
1:A:11:LEU:HG	1:A:15:LEU:HD12	2.00	0.43
1:A:41:ILE:HG22	1:A:43:ARG:HG3	2.00	0.43
1:A:51:LEU:HD13	1:A:96:VAL:CG1	2.48	0.43
1:B:3:GLY:N	6:B:2001:HOH:O	2.52	0.43
1:B:78:LEU:HD21	1:B:152:ALA:CB	2.48	0.42
1:B:98:VAL:HG13	1:B:103:ARG:NH2	2.33	0.42
1:A:229:THR:HG23	1:A:232:SER:H	1.84	0.42
1:B:160:HIS:HE1	1:B:162:LEU:HD22	1.85	0.41
1:B:205:TYR:CE2	1:B:207:GLY:HA2	2.56	0.41
1:A:6:VAL:HG13	1:A:178:ILE:CG2	2.51	0.41
1:A:223:TYR:HA	1:A:226:VAL:HG22	2.01	0.41
1:B:223:TYR:HA	1:B:226:VAL:HG22	2.04	0.40

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	289/299 (97%)	282 (98%)	6 (2%)	1 (0%)	41	46
1	B	291/299 (97%)	285 (98%)	6 (2%)	0	100	100
All	All	580/598 (97%)	567 (98%)	12 (2%)	1 (0%)	47	55

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	291	ALA

5.3.2 Protein sidechains (i)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	224/230 (97%)	216 (96%)	8 (4%)	35	42
1	B	226/230 (98%)	218 (96%)	8 (4%)	36	43
All	All	450/460 (98%)	434 (96%)	16 (4%)	35	42

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	14	PHE
1	A	120	SER
1	A	162	LEU
1	A	187	ARG
1	A	198	ARG

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Mol	Chain	Res	Type
1	A	229	THR
1	A	234	LEU
1	A	287	LEU
1	B	14	PHE
1	B	96	VAL
1	B	98	VAL
1	B	107	ARG
1	B	162	LEU
1	B	184	LYS
1	B	198	ARG
1	B	287	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	197	HIS
1	B	38	GLN
1	B	236	GLN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 7 ligands modelled in this entry, 3 are monoatomic - leaving 4 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond

length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
3	ZZC	A	401	1	33,37,37	1.12	3 (9%)	37,56,56	1.83	7 (18%)
5	GOL	B	600	-	5,5,5	0.30	0	5,5,5	0.34	0
3	ZZC	B	401	-	33,37,37	1.07	3 (9%)	37,56,56	1.44	4 (10%)
5	GOL	B	601	-	5,5,5	0.42	0	5,5,5	0.24	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	ZZC	A	401	1	-	5/26/46/46	0/3/3/3
5	GOL	B	600	-	-	0/4/4/4	-
3	ZZC	B	401	-	-	7/26/46/46	0/3/3/3
5	GOL	B	601	-	-	0/4/4/4	-

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	401	ZZC	PB-O3A	2.85	1.62	1.59
3	B	401	ZZC	PB-O3A	2.65	1.62	1.59
3	A	401	ZZC	C3'A-C2'A	-2.40	1.51	1.52
3	A	401	ZZC	C2-N3	2.36	1.35	1.32
3	B	401	ZZC	PA-O3A	2.24	1.61	1.59
3	B	401	ZZC	C2-N3	2.13	1.35	1.32

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	401	ZZC	O4'-C1'-N9	5.35	115.84	108.75
3	B	401	ZZC	N3-C2-N1	-4.71	122.28	128.67
3	A	401	ZZC	N3-C2-N1	-4.18	122.99	128.67
3	A	401	ZZC	O4'-C4'-C5'	-3.66	97.62	109.33
3	A	401	ZZC	O1B-PB-O3A	3.17	115.84	107.27
3	B	401	ZZC	O1B-PB-O3A	2.97	115.29	107.27
3	B	401	ZZC	C4-C5-N7	-2.73	106.46	109.34
3	A	401	ZZC	O3A-PB-O2B	-2.68	102.64	110.70

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	401	ZZC	C1'-N9-C4	-2.62	122.04	126.64
3	B	401	ZZC	C1'A-C2'A-C3'A	2.28	120.53	118.13
3	A	401	ZZC	C4-C5-N7	-2.25	106.96	109.34

There are no chirality outliers.

All (12) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	401	ZZC	O2'A-C2'A-C3'A-O3'A
3	B	401	ZZC	C5'-O5'-PA-O1A
3	B	401	ZZC	C5'-O5'-PA-O3A
3	B	401	ZZC	C1'A-C2'A-C3'A-C4'A
3	B	401	ZZC	O2'A-C2'A-C3'A-C4'A
3	B	401	ZZC	O2'A-C2'A-C3'A-O3'A
3	A	401	ZZC	O4'-C4'-C5'-O5'
3	A	401	ZZC	C3'-C4'-C5'-O5'
3	B	401	ZZC	C5'-O5'-PA-O2A
3	B	401	ZZC	O4'-C4'-C5'-O5'
3	A	401	ZZC	PA-O3A-PB-O1B
3	A	401	ZZC	PA-O3A-PB-O2B

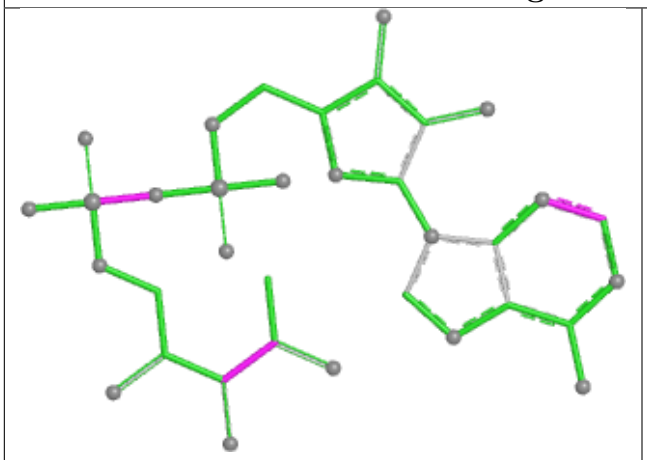
There are no ring outliers.

2 monomers are involved in 3 short contacts:

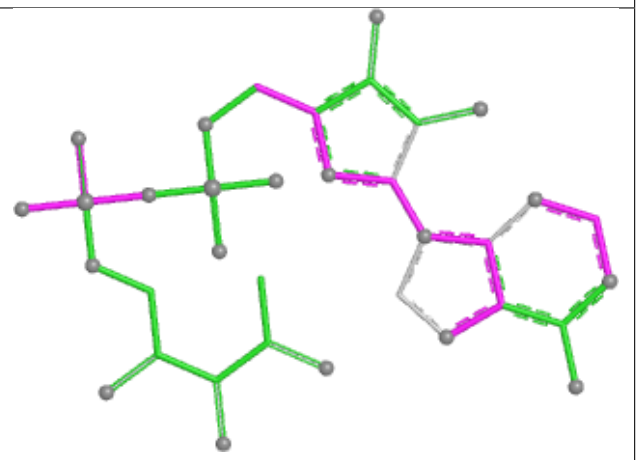
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	401	ZZC	2	0
3	B	401	ZZC	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

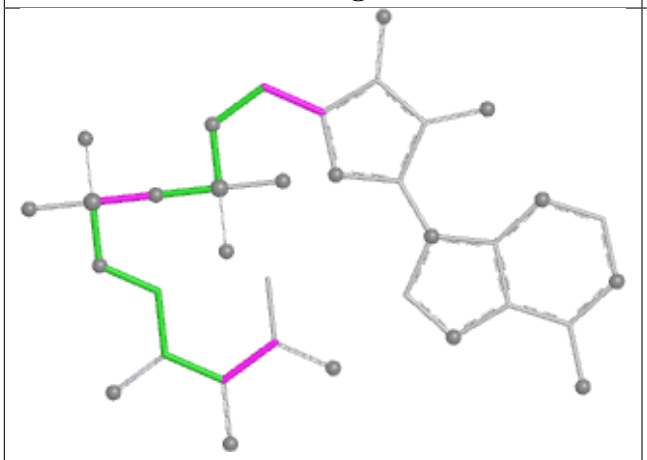
Ligand ZZC A 401



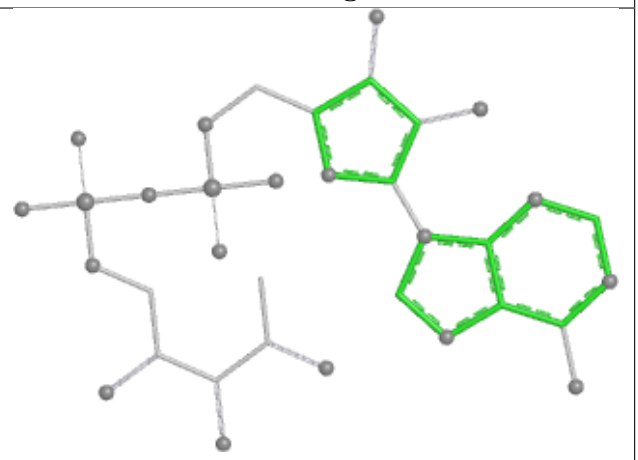
Bond lengths



Bond angles

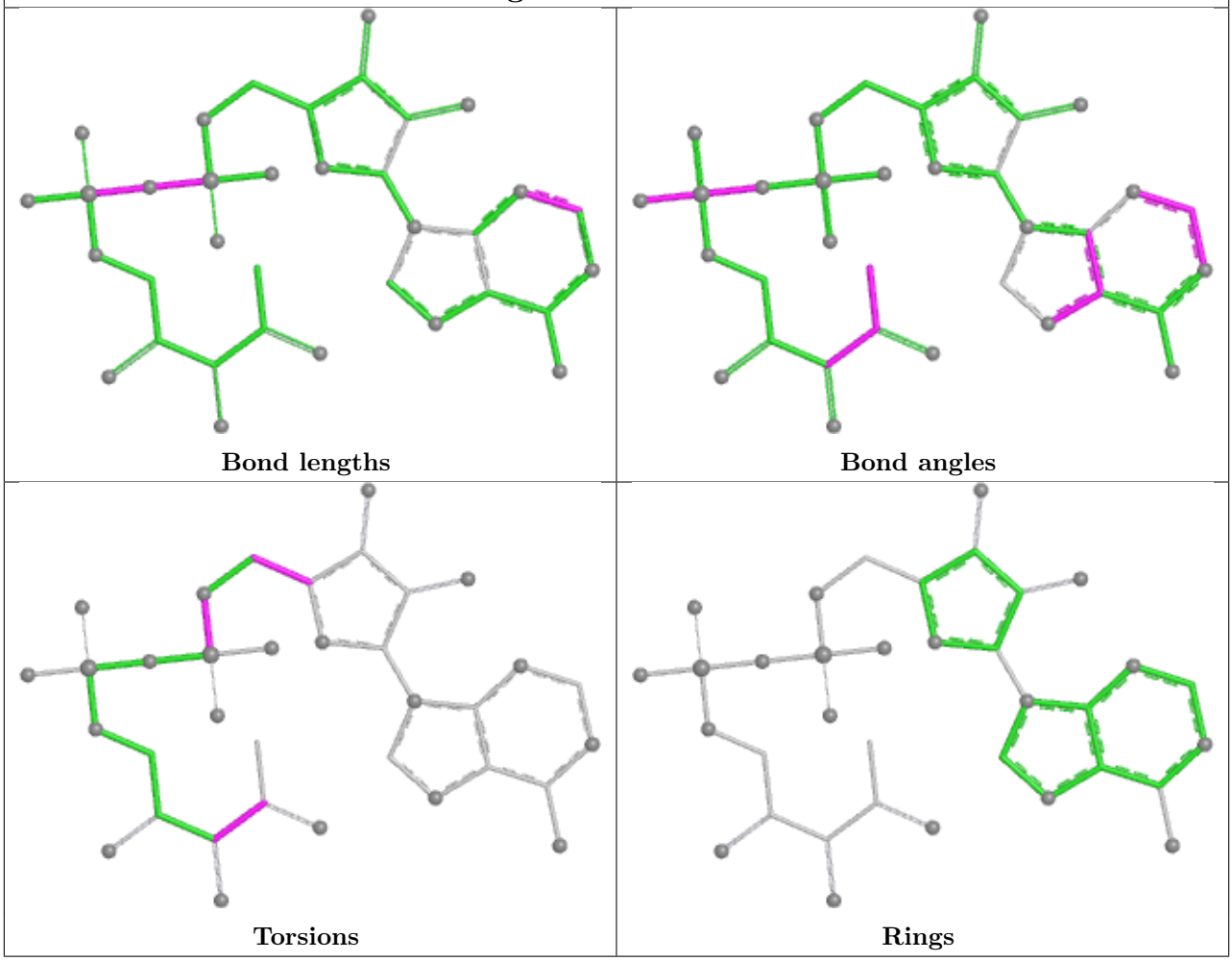


Torsions



Rings

Ligand ZZC B 401



5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Fit of model and data (i)

6.1 Protein, DNA and RNA chains (i)

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2			OWAB(Å^2)	Q<0.9
1	A	291/299 (97%)	0.25	26 (8%)	9	10	38, 44, 49, 54	0
1	B	291/299 (97%)	-0.04	11 (3%)	40	43	39, 43, 49, 57	0
All	All	582/598 (97%)	0.10	37 (6%)	19	21	38, 43, 49, 57	0

All (37) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	293	LEU	8.1
1	A	250	LEU	4.4
1	B	293	LEU	4.2
1	B	133	LEU	4.1
1	A	96	VAL	4.0
1	A	17	LEU	3.7
1	A	292	GLY	3.6
1	B	3	GLY	3.3
1	A	3	GLY	3.2
1	A	94	ARG	3.2
1	A	130	MET	3.2
1	A	92	LYS	3.1
1	A	132	CYS	3.1
1	A	249	ALA	3.1
1	A	133	LEU	2.9
1	B	250	LEU	2.8
1	A	128	ALA	2.7
1	B	170	LEU	2.7
1	A	278	ARG	2.7
1	B	249	ALA	2.7
1	A	274	MET	2.7
1	B	253	MET	2.6
1	A	246	THR	2.5
1	B	17	LEU	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	154	ALA	2.4
1	A	248	GLY	2.4
1	A	89	LEU	2.3
1	A	129	ALA	2.3
1	A	127	GLY	2.3
1	B	50	TRP	2.3
1	A	19	VAL	2.2
1	B	132	CYS	2.1
1	B	129	ALA	2.1
1	A	20	GLY	2.0
1	A	125	GLY	2.0
1	A	170	LEU	2.0
1	A	131	ARG	2.0

6.2 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates (i)

There are no monosaccharides in this entry.

6.4 Ligands (i)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

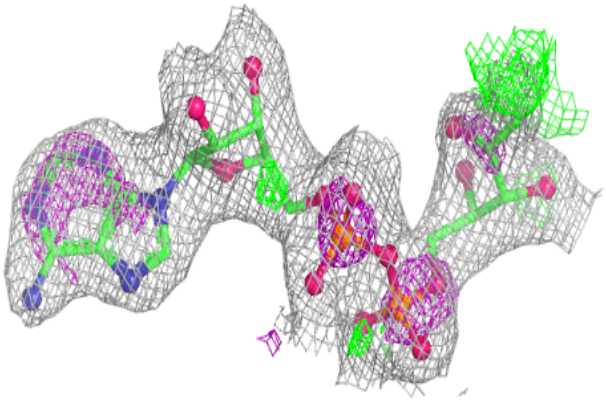
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
5	GOL	B	601	6/6	0.90	0.14	63,65,65,65	0
3	ZZC	B	401	35/35	0.95	0.18	42,47,55,59	0
5	GOL	B	600	6/6	0.96	0.17	39,40,41,43	0
2	MN	B	400	1/1	0.96	0.06	36,36,36,36	1
3	ZZC	A	401	35/35	0.97	0.07	31,33,36,36	0
2	MN	A	400	1/1	0.99	0.02	41,41,41,41	1
4	CL	B	500	1/1	0.99	0.14	38,38,38,38	0

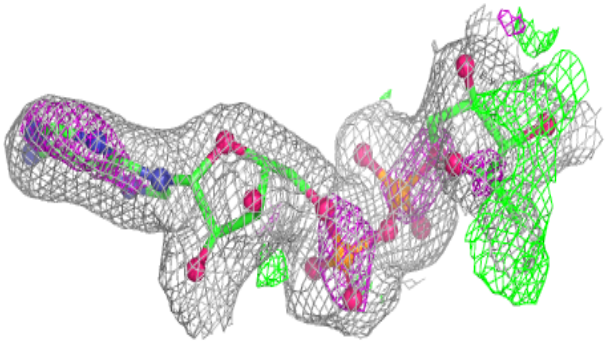
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers

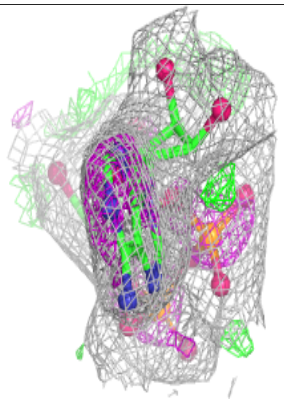
as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around ZZC B 401:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

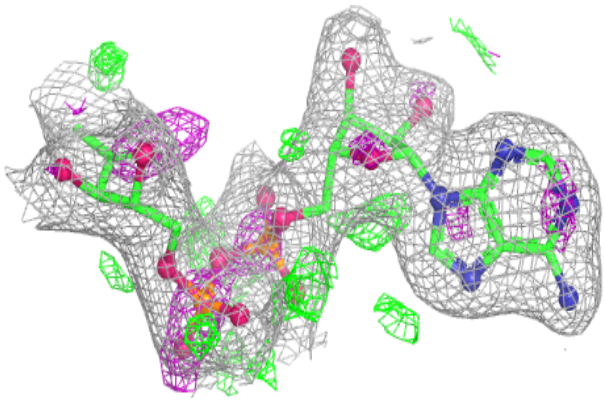


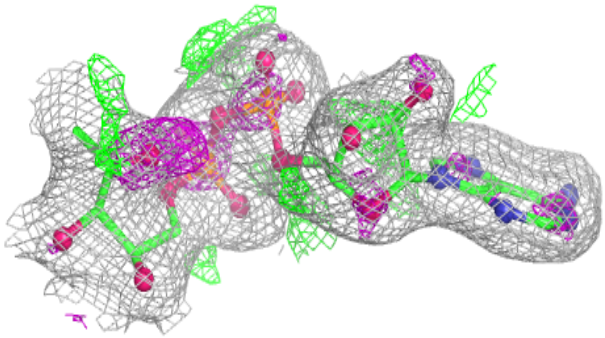


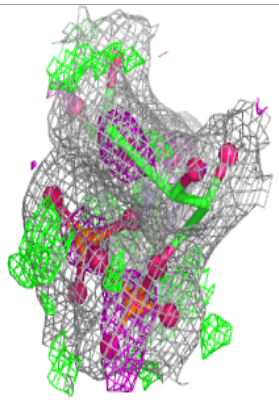


Electron density around ZZC A 401:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)







6.5 Other polymers (i)

There are no such residues in this entry.