



# Full wwPDB X-ray Structure Validation Report

Feb 28, 2014 – 10:02 AM GMT

PDB ID : 3HNC  
Title : Crystal structure of human ribonucleotide reductase 1 bound to the effector TTP  
Authors : Fairman, J.W.; Wijerathna, S.R.; Xu, H.; Dealwis, C.G.  
Deposited on : 2009-05-31  
Resolution : 2.41 Å(reported)

This is a full wwPDB validation report for a publicly released PDB entry.  
We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)  
A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

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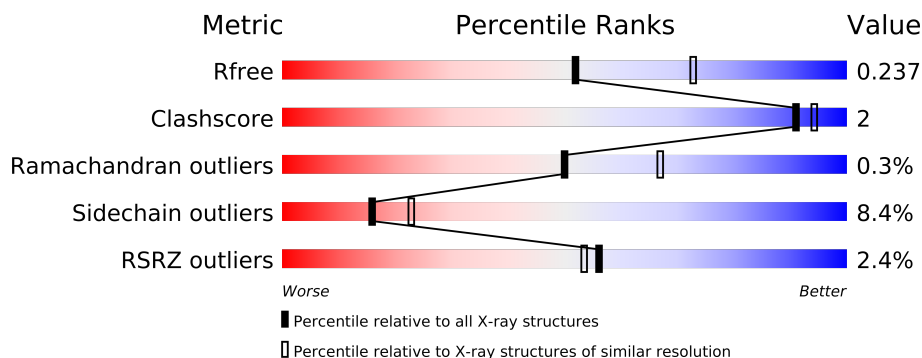
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.15 2013  
Xtriage (Phenix) : dev-1323  
EDS : stable22639  
Percentile statistics : 21963  
Refmac : 5.8.0049  
CCP4 : 6.3.0 (Settle)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)  
Validation Pipeline (wwPDB-VP) : stable22683

# 1 Overall quality at a glance



The reported resolution of this entry is 2.41 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))
$R_{free}$	66092	2496 (2.44-2.40)
Clashscore	79885	3124 (2.44-2.40)
Ramachandran outliers	78287	3067 (2.44-2.40)
Sidechain outliers	78261	3068 (2.44-2.40)
RSRZ outliers	66119	2499 (2.44-2.40)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	792	
1	B	792	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
4	SO4	A	805	-	X

## 2 Entry composition i

There are 5 unique types of molecules in this entry. The entry contains 11778 atoms, of which 0 are hydrogen and 0 are deuterium.

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.

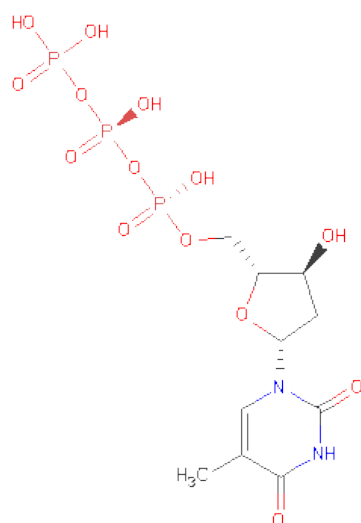
- Molecule 1 is a protein called Ribonucleoside-diphosphatereductase large subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	714	Total	C	N	O	S	6	0	0
			5577	3567	926	1052	32			
1	B	738	Total	C	N	O	S	0	0	0
			5751	3669	968	1080	34			

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

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

- Molecule 3 is THYMIDINE-5'-TRIPHOSPHATE (three-letter code: TTP) (formula: C<sub>10</sub>H<sub>17</sub>N<sub>2</sub>O<sub>14</sub>P<sub>3</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			29	10	2	14	3		
3	B	1	Total	C	N	O	P	0	0
			29	10	2	14	3		

- Molecule 4 is SULFATE ION (three-letter code: SO<sub>4</sub>) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	O	S	0	0
			5	4	1		
4	A	1	Total	O	S	0	0
			5	4	1		
4	A	1	Total	O	S	0	0
			5	4	1		
4	B	1	Total	O	S	0	0
			5	4	1		
4	B	1	Total	O	S	0	0
			5	4	1		
4	B	1	Total	O	S	0	0
			5	4	1		

- Molecule 5 is water.

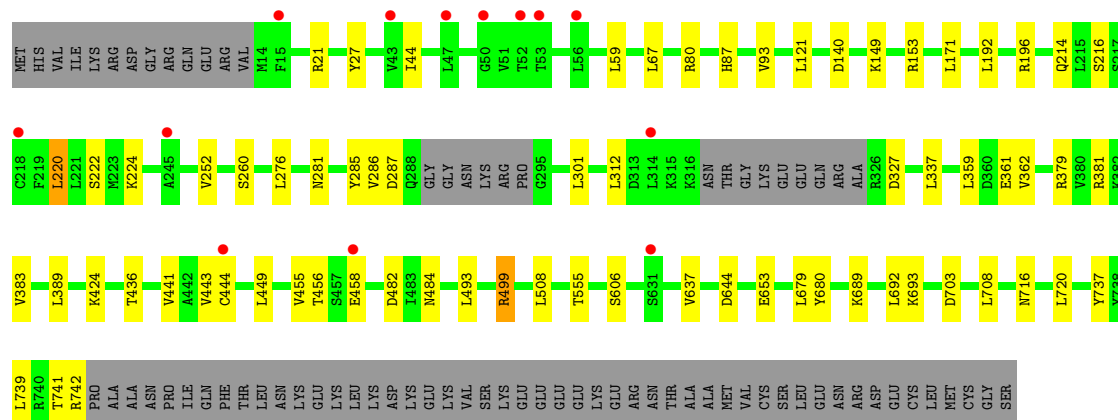
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	187	Total	O	0	0
			187	187		
5	B	173	Total	O	0	0
			173	173		

### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

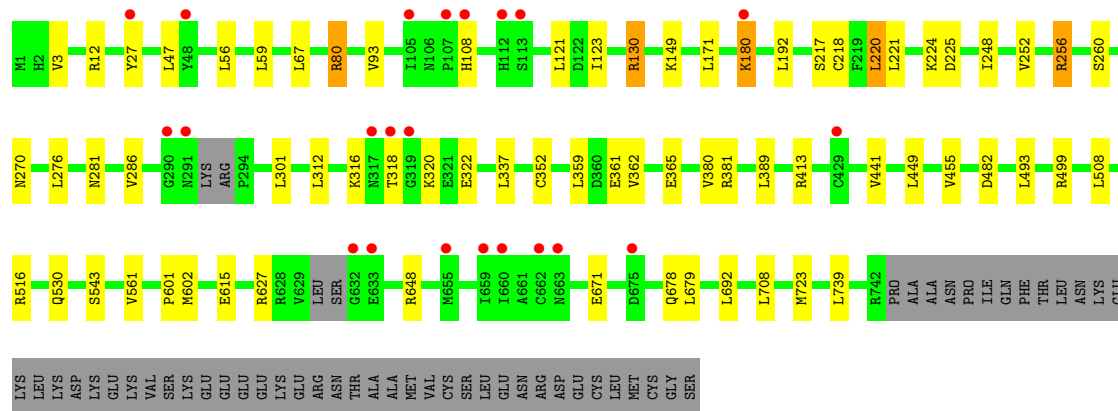
- Molecule 1: Ribonucleoside-diphosphatereductase large subunit

Chain A: 



- Molecule 1: Ribonucleoside-diphosphatereductase large subunit

Chain B: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	68.98Å 114.10Å 219.28Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	39.53 – 2.41 37.67 – 2.41	Depositor EDS
% Data completeness (in resolution range)	97.0 (39.53-2.41) 97.0 (37.67-2.41)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.52 (at 2.42Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.186 , 0.236 0.187 , 0.237	Depositor DCC
$R_{free}$ test set	3306 reflections (5.33%)	DCC
Wilson B-factor (Å <sup>2</sup> )	42.5	Xtriage
Anisotropy	0.075	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 32.4	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	0 of 65388 reflections	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	11778	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	46.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.95% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

## 5 Model quality

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MG, TTP, SO4

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	0.52	0/5700	0.63	3/7754 (0.0%)
1	B	0.45	0/5877	0.60	1/7989 (0.0%)
All	All	0.49	0/11577	0.61	4/15743 (0.0%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	220	LEU	CA-CB-CG	7.01	131.42	115.30
1	A	499	ARG	NE-CZ-NH2	-6.49	117.05	120.30
1	A	220	LEU	CA-CB-CG	5.90	128.88	115.30
1	A	508	LEU	CA-CB-CG	5.29	127.47	115.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Close contacts

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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	5577	0	0	12	0
1	B	5751	0	0	13	0
2	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	1	0	0	0	0
3	A	29	0	13	0	0
3	B	29	0	13	2	0
4	A	15	0	0	1	0
4	B	15	0	0	0	0
5	A	187	0	0	1	0
5	B	173	0	0	2	0
All	All	11778	0	26	23	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 2.

All (23) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:B:123:ILE:CD1	1:B:180:LYS:CG	2.70	0.70
1:A:281:ASN:ND2	1:B:281:ASN:OD1	2.31	0.63
1:A:482:ASP:OD2	1:A:499:ARG:NH2	2.32	0.62
1:B:256:ARG:CD	3:B:802:TTP:H4'	2.28	0.62
1:A:27:TYR:O	1:A:80:ARG:NH2	2.39	0.55
1:B:482:ASP:OD2	1:B:499:ARG:NH2	2.44	0.51
1:A:260:SER:OG	1:A:381:ARG:NH2	2.44	0.50
1:B:256:ARG:NH2	3:B:802:TTP:O2G	2.45	0.49
1:B:27:TYR:O	1:B:80:ARG:NH2	2.46	0.49
1:A:689:LYS:N	4:A:805:SO4:O3	2.47	0.48
1:B:260:SER:OG	1:B:352:CYS:SG	2.73	0.46
1:A:285:TYR:O	1:B:270:ASN:ND2	2.50	0.45
1:B:221:LEU:CD1	1:B:248:ILE:CG2	2.95	0.45
1:A:87:HIS:NE2	1:A:140:ASP:OD1	2.50	0.44
1:A:644:ASP:OD2	1:A:680:TYR:OH	2.36	0.44
1:A:222:SER:OG	1:A:436:THR:OG1	2.37	0.42
1:A:361:GLU:OE2	1:A:424:LYS:NZ	2.53	0.41
1:B:413:ARG:NH1	5:B:827:HOH:O	2.53	0.41
1:B:530:GLN:NE2	5:B:842:HOH:O	2.54	0.41
1:B:320:LYS:O	1:B:322:GLU:N	2.53	0.41
1:B:130:ARG:NH1	1:B:130:ARG:CG	2.82	0.40
1:A:196:ARG:NH1	5:A:914:HOH:O	2.53	0.40
1:A:216:SER:OG	1:A:484:ASN:ND2	2.54	0.40

There are no symmetry-related clashes.



## 5.3 Torsion angles

### 5.3.1 Protein backbone ⓘ

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	708/792 (89%)	685 (97%)	21 (3%)	2 (0%)	50	67
1	B	732/792 (92%)	702 (96%)	28 (4%)	2 (0%)	50	67
All	All	1440/1584 (91%)	1387 (96%)	49 (3%)	4 (0%)	50	67

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	224	LYS
1	B	224	LYS
1	A	737	TYR
1	B	601	PRO

### 5.3.2 Protein sidechains ⓘ

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	592/693 (85%)	545 (92%)	47 (8%)	18	26
1	B	607/693 (88%)	553 (91%)	54 (9%)	14	20
All	All	1199/1386 (86%)	1098 (92%)	101 (8%)	16	23

All (101) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	21	ARG
1	A	44	ILE
1	A	59	LEU
1	A	67	LEU
1	A	93	VAL

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Mol	Chain	Res	Type
1	A	121	LEU
1	A	149	LYS
1	A	153	ARG
1	A	171	LEU
1	A	192	LEU
1	A	214	GLN
1	A	220	LEU
1	A	252	VAL
1	A	276	LEU
1	A	286	VAL
1	A	287	ASP
1	A	301	LEU
1	A	312	LEU
1	A	327	ASP
1	A	337	LEU
1	A	359	LEU
1	A	362	VAL
1	A	379	ARG
1	A	383	VAL
1	A	389	LEU
1	A	441	VAL
1	A	443	VAL
1	A	444	CYS
1	A	449	LEU
1	A	455	VAL
1	A	456	THR
1	A	458	GLU
1	A	493	LEU
1	A	555	THR
1	A	606	SER
1	A	637	VAL
1	A	653	GLU
1	A	679	LEU
1	A	692	LEU
1	A	693	LYS
1	A	703	ASP
1	A	708	LEU
1	A	716	ASN
1	A	720	LEU
1	A	739	LEU
1	A	741	THR
1	A	742	ARG

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Mol	Chain	Res	Type
1	B	3	VAL
1	B	12	ARG
1	B	47	LEU
1	B	56	LEU
1	B	59	LEU
1	B	67	LEU
1	B	80	ARG
1	B	93	VAL
1	B	108	HIS
1	B	121	LEU
1	B	130	ARG
1	B	149	LYS
1	B	171	LEU
1	B	180	LYS
1	B	192	LEU
1	B	217	SER
1	B	218	CYS
1	B	220	LEU
1	B	225	ASP
1	B	252	VAL
1	B	256	ARG
1	B	276	LEU
1	B	286	VAL
1	B	301	LEU
1	B	312	LEU
1	B	316	LYS
1	B	318	THR
1	B	337	LEU
1	B	359	LEU
1	B	361	GLU
1	B	362	VAL
1	B	365	GLU
1	B	380	VAL
1	B	381	ARG
1	B	389	LEU
1	B	441	VAL
1	B	449	LEU
1	B	455	VAL
1	B	493	LEU
1	B	508	LEU
1	B	516	ARG
1	B	543	SER

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Mol	Chain	Res	Type
1	B	561	VAL
1	B	602	MET
1	B	615	GLU
1	B	627	ARG
1	B	648	ARG
1	B	671	GLU
1	B	678	GLN
1	B	679	LEU
1	B	692	LEU
1	B	708	LEU
1	B	723	MET
1	B	739	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 5.3.3 RNA ⓘ

There are no RNA chains in this entry.

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

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

## 5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 10 ligands modelled in this entry, 2 are monoatomic - leaving 8 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	TTP	A	802	2	30,30,30	1.19	2 (6%)	42,47,47	1.69	6 (14%)
4	SO4	A	804	-	4,4,4	0.08	0	6,6,6	0.19	0
4	SO4	A	805	-	4,4,4	1.40	0	6,6,6	0.18	0
4	SO4	A	809	-	4,4,4	1.28	0	6,6,6	0.19	0
3	TTP	B	802	2	30,30,30	1.08	2 (6%)	42,47,47	1.57	6 (14%)
4	SO4	B	803	-	4,4,4	0.12	0	6,6,6	0.19	0
4	SO4	B	806	-	4,4,4	1.31	0	6,6,6	0.10	0
4	SO4	B	807	-	4,4,4	1.41	0	6,6,6	0.20	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	TTP	A	802	2	-	0/19/34/34	0/2/2/2
4	SO4	A	804	-	-	0/0/0/0	0/0/0/0
4	SO4	A	805	-	-	0/0/0/0	0/0/0/0
4	SO4	A	809	-	-	0/0/0/0	0/0/0/0
3	TTP	B	802	2	-	0/19/34/34	0/2/2/2
4	SO4	B	803	-	-	0/0/0/0	0/0/0/0
4	SO4	B	806	-	-	0/0/0/0	0/0/0/0
4	SO4	B	807	-	-	0/0/0/0	0/0/0/0

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	802	TTP	C2-N1	4.06	1.42	1.38
3	B	802	TTP	C2-N1	3.62	1.42	1.38
3	A	802	TTP	C4-C5	2.65	1.48	1.42
3	B	802	TTP	C4-C5	2.65	1.48	1.42

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	802	TTP	N3-C2-N1	6.18	121.13	115.97
3	A	802	TTP	C6-N1-C2	-6.16	120.66	122.41
3	A	802	TTP	N3-C2-N1	6.15	121.11	115.97
3	B	802	TTP	C6-N1-C2	-3.61	121.38	122.41
3	B	802	TTP	PB-O3B-PG	-3.28	122.07	131.68
3	B	802	TTP	C4-N3-C2	-2.78	119.69	125.39
3	A	802	TTP	PB-O3B-PG	-2.60	124.06	131.68

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	802	TTP	PB-O3A-PA	-2.41	124.63	131.68
3	B	802	TTP	C5-C6-N1	-2.33	119.33	121.59
3	A	802	TTP	PB-O3A-PA	-2.31	124.91	131.68
3	A	802	TTP	C4-N3-C2	-2.28	120.72	125.39
3	A	802	TTP	C5-C6-N1	-2.16	119.49	121.59

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

## 5.7 Other polymers ⓘ

There are no such residues in this entry.

## 5.8 Polymer linkage issues

There are no chain breaks in this entry.

## 6 Fit of model and data

### 6.1 Protein, DNA and RNA chains

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	714/792 (90%)	-0.11	13 (1%) 65 62	31, 44, 63, 87	2 (0%)
1	B	738/792 (93%)	-0.04	22 (2%) 48 45	31, 46, 74, 88	0
All	All	1452/1584 (91%)	-0.07	35 (2%) 56 53	31, 44, 71, 88	2 (0%)

All (35) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	444	CYS	13.4
1	A	218	CYS	11.4
1	B	107	PRO	5.1
1	B	108	HIS	5.1
1	A	53	THR	4.4
1	B	48	TYR	3.9
1	B	105	ILE	3.9
1	A	314	LEU	3.3
1	A	43	VAL	3.1
1	B	633	GLU	3.1
1	B	180	LYS	2.9
1	A	56	LEU	2.9
1	B	318	THR	2.9
1	B	291	ASN	2.7
1	A	47	LEU	2.6
1	A	631	SER	2.6
1	B	290	GLY	2.6
1	A	50	GLY	2.6
1	B	655	MET	2.5
1	B	632	GLY	2.5
1	B	27	TYR	2.4
1	B	660	ILE	2.4
1	B	663	ASN	2.4
1	A	52	THR	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	659	ILE	2.4
1	B	319	GLY	2.4
1	A	245	ALA	2.2
1	B	675	ASP	2.2
1	B	429	CYS	2.2
1	B	317	ASN	2.2
1	B	662	CYS	2.1
1	A	458	GLU	2.1
1	A	15	PHE	2.1
1	B	112	HIS	2.1
1	B	113	SER	2.1

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

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

## 6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 6.4 Ligands ⓘ

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95<sup>th</sup> 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	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
4	SO4	A	805	5/5	0.24	5.51	71,72,72,73	0
4	SO4	A	809	5/5	0.18	1.16	83,83,84,85	0
4	SO4	B	807	5/5	0.22	0.68	75,75,76,77	0
2	MG	B	801	1/1	0.13	0.54	50,50,50,50	0
2	MG	A	801	1/1	0.11	0.00	52,52,52,52	0
3	TTP	A	802	29/29	0.09	-1.08	37,40,49,49	0
3	TTP	B	802	29/29	0.10	-1.34	39,41,54,55	0
4	SO4	B	806	5/5	0.08	-2.42	82,82,83,83	0
4	SO4	A	804	5/5	0.08	-2.83	48,48,49,50	0
4	SO4	B	803	5/5	0.07	-4.46	49,50,50,51	0



## 6.5 Other polymers ⓘ

There are no such residues in this entry.