wwPDB X-ray Structure Validation Summary Report (i)

Jan 31, 2016 – 10:22 PM GMT

PDB ID	:	1T9S
Title	:	Catalytic Domain Of Human Phosphodiesterase 5A in Complex with GMP
Authors	:	Zhang, K.Y.J.; Card, G.L.; Suzuki, Y.; Artis, D.R.; Fong, D.; Gillette, S.; Hsieh, D.; Neiman, J.; West, B.L.; Zhang, C.; Milburn, M.V.; Kim, S.-H.; Schlessinger, J.; Bollag, G.
Deposited on	:	2004-05-18
Resolution	:	2.00 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.
We welcome your comments at validation@mail.wwpdb.org
A user guide is available at
http://wwpdb.org/validation/2016/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

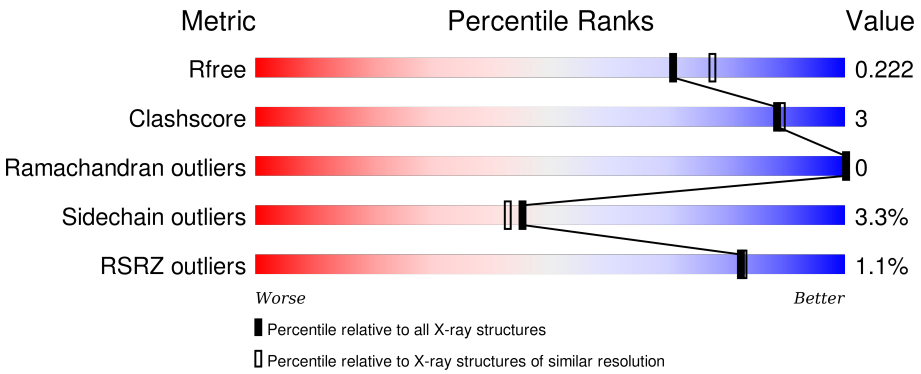
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026688
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	trunk26865

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 2.00 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}	91344	6249 (2.00-2.00)
Clashscore	102246	7340 (2.00-2.00)
Ramachandran outliers	100387	7248 (2.00-2.00)
Sidechain outliers	100360	7247 (2.00-2.00)
RSRZ outliers	91569	6262 (2.00-2.00)

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 >=3, 2, 1 and 0 types of geometric quality criteria. 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	347	83% 10% • 6%
1	B	347	2% 85% 8% • 6%

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 5900 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 cGMP-specific 3',5'-cyclic phosphodiesterase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	326	2637	1678	451	491	17	0	0	0
1	B	326	2637	1678	451	491	17	0	0	0

There are 78 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	513	MET	-	EXPRESSION TAG	UNP O76074
A	514	GLY	-	EXPRESSION TAG	UNP O76074
A	515	SER	-	EXPRESSION TAG	UNP O76074
A	516	SER	-	EXPRESSION TAG	UNP O76074
A	517	HIS	-	EXPRESSION TAG	UNP O76074
A	518	HIS	-	EXPRESSION TAG	UNP O76074
A	519	HIS	-	EXPRESSION TAG	UNP O76074
A	520	HIS	-	EXPRESSION TAG	UNP O76074
A	521	HIS	-	EXPRESSION TAG	UNP O76074
A	522	HIS	-	EXPRESSION TAG	UNP O76074
A	523	SER	-	EXPRESSION TAG	UNP O76074
A	524	SER	-	EXPRESSION TAG	UNP O76074
A	525	GLY	-	EXPRESSION TAG	UNP O76074
A	526	LEU	-	EXPRESSION TAG	UNP O76074
A	527	VAL	-	EXPRESSION TAG	UNP O76074
A	528	PRO	-	EXPRESSION TAG	UNP O76074
A	529	ARG	-	EXPRESSION TAG	UNP O76074
A	530	GLY	-	EXPRESSION TAG	UNP O76074
A	531	SER	-	EXPRESSION TAG	UNP O76074
A	532	HIS	-	EXPRESSION TAG	UNP O76074
A	533	MET	-	EXPRESSION TAG	UNP O76074
A	658	PRO	ARG	ENGINEERED	UNP O76074
A	661	SER	ASN	ENGINEERED	UNP O76074
A	663	GLN	SER	ENGINEERED	UNP O76074
A	664	PHE	TYR	ENGINEERED	UNP O76074

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Chain	Residue	Modelled	Actual	Comment	Reference
A	665	LEU	ILE	ENGINEERED	UNP O76074
A	576	ILE	GLN	ENGINEERED	UNP O76074
A	667	ASN	ARG	ENGINEERED	UNP O76074
A	668	THR	SER	ENGINEERED	UNP O76074
A	669	ASN	GLU	ENGINEERED	UNP O76074
A	670	SER	HIS	ENGINEERED	UNP O76074
A	671	GLU	PRO	ENGINEERED	UNP O76074
A	674	LEU	GLN	ENGINEERED	UNP O76074
A	675	MET	LEU	ENGINEERED	UNP O76074
A	676A	ASN	CYS	ENGINEERED	UNP O76074
A	677	ASP	-	ENGINEERED	UNP O76074
A	678	GLU	HIS	ENGINEERED	UNP O76074
A	680	VAL	ILE	ENGINEERED	UNP O76074
A	681	LEU	MET	ENGINEERED	UNP O76074
B	513	MET	-	EXPRESSION TAG	UNP O76074
B	514	GLY	-	EXPRESSION TAG	UNP O76074
B	515	SER	-	EXPRESSION TAG	UNP O76074
B	516	SER	-	EXPRESSION TAG	UNP O76074
B	517	HIS	-	EXPRESSION TAG	UNP O76074
B	518	HIS	-	EXPRESSION TAG	UNP O76074
B	519	HIS	-	EXPRESSION TAG	UNP O76074
B	520	HIS	-	EXPRESSION TAG	UNP O76074
B	521	HIS	-	EXPRESSION TAG	UNP O76074
B	522	HIS	-	EXPRESSION TAG	UNP O76074
B	523	SER	-	EXPRESSION TAG	UNP O76074
B	524	SER	-	EXPRESSION TAG	UNP O76074
B	525	GLY	-	EXPRESSION TAG	UNP O76074
B	526	LEU	-	EXPRESSION TAG	UNP O76074
B	527	VAL	-	EXPRESSION TAG	UNP O76074
B	528	PRO	-	EXPRESSION TAG	UNP O76074
B	529	ARG	-	EXPRESSION TAG	UNP O76074
B	530	GLY	-	EXPRESSION TAG	UNP O76074
B	531	SER	-	EXPRESSION TAG	UNP O76074
B	532	HIS	-	EXPRESSION TAG	UNP O76074
B	533	MET	-	EXPRESSION TAG	UNP O76074
B	658	PRO	ARG	ENGINEERED	UNP O76074
B	661	SER	ASN	ENGINEERED	UNP O76074
B	663	GLN	SER	ENGINEERED	UNP O76074
B	664	PHE	TYR	ENGINEERED	UNP O76074
B	665	LEU	ILE	ENGINEERED	UNP O76074
B	576	ILE	GLN	ENGINEERED	UNP O76074
B	667	ASN	ARG	ENGINEERED	UNP O76074

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Chain	Residue	Modelled	Actual	Comment	Reference
B	668	THR	SER	ENGINEERED	UNP O76074
B	669	ASN	GLU	ENGINEERED	UNP O76074
B	670	SER	HIS	ENGINEERED	UNP O76074
B	671	GLU	PRO	ENGINEERED	UNP O76074
B	674	LEU	GLN	ENGINEERED	UNP O76074
B	675	MET	LEU	ENGINEERED	UNP O76074
B	676A	ASN	CYS	ENGINEERED	UNP O76074
B	677	ASP	-	ENGINEERED	UNP O76074
B	678	GLU	HIS	ENGINEERED	UNP O76074
B	680	VAL	ILE	ENGINEERED	UNP O76074
B	681	LEU	MET	ENGINEERED	UNP O76074

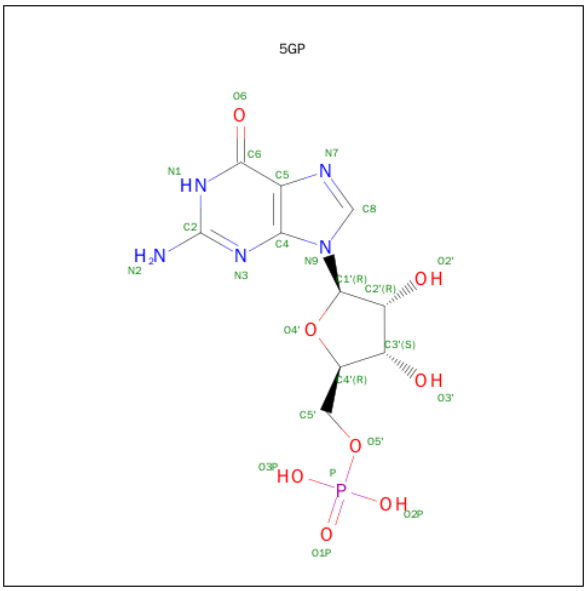
- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

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

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

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

- Molecule 4 is GUANOSINE-5'-MONOPHOSPHATE (three-letter code: 5GP) (formula: $C_{10}H_{14}N_5O_8P$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	P	0	0
			24	10	5	8	1		
4	B	1	Total	C	N	O	P	0	0
			24	10	5	8	1		

- Molecule 5 is water.

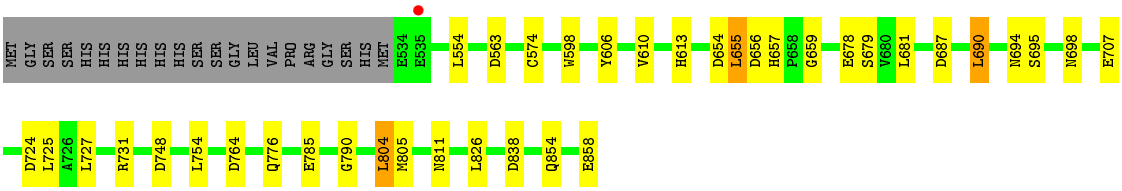
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	296	Total	O	0	0
			296	296		
5	B	278	Total	O	0	0
			278	278		

3 Residue-property plots (i)

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.

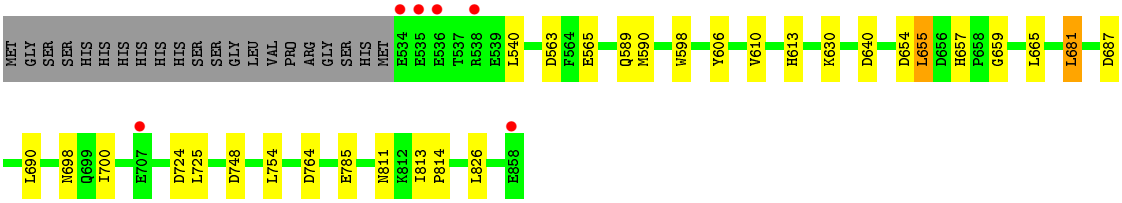
- Molecule 1: cGMP-specific 3',5'-cyclic phosphodiesterase

Chain A:



- Molecule 1: cGMP-specific 3',5'-cyclic phosphodiesterase

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	61.97Å 90.87Å 68.99Å 90.00° 98.07° 90.00°	Depositor
Resolution (Å)	69.01 – 2.00 68.31 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.8 (69.01-2.00) 96.3 (68.31-1.80)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.46 (at 1.80Å)	Xtriage
Refinement program	REFMAC 5.1.25	Depositor
R, R_{free}	0.175 , 0.212 0.186 , 0.222	Depositor DCC
R_{free} test set	2561 reflections (5.28%)	DCC
Wilson B-factor (Å^2)	20.4	Xtriage
Anisotropy	0.153	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 38.1	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Outliers	0 of 67555 reflections	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	5900	wwPDB-VP
Average B, all atoms (Å^2)	10.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.88% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: ZN, 5GP, MG

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	0.43	0/2686	0.73	9/3629 (0.2%)
1	B	0.43	0/2686	0.73	7/3629 (0.2%)
All	All	0.43	0/5372	0.73	16/7258 (0.2%)

There are no bond length outliers.

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	748	ASP	CB-CG-OD2	7.01	124.61	118.30
1	A	654	ASP	CB-CG-OD2	6.73	124.36	118.30
1	B	724	ASP	CB-CG-OD2	6.46	124.11	118.30
1	B	654	ASP	CB-CG-OD2	6.42	124.08	118.30
1	A	764	ASP	CB-CG-OD1	6.05	123.74	118.30

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	2637	0	2643	14	0
1	B	2637	0	2643	13	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	24	0	12	0	0
4	B	24	0	12	0	0
5	A	296	0	0	2	0
5	B	278	0	0	2	0
All	All	5900	0	5310	27	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.

The worst 5 of 27 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:B:598:TRP:HA	1:B:698:ASN:HD22	1.52	0.74
1:A:657:HIS:HD2	1:A:659:GLY:H	1.37	0.73
1:B:610:VAL:HG13	1:B:785:GLU:OE2	1.94	0.67
1:B:657:HIS:HD2	1:B:659:GLY:H	1.47	0.62
1:A:610:VAL:CG1	1:A:785:GLU:OE2	2.52	0.58

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	324/347 (93%)	322 (99%)	2 (1%)	0	100 100
1	B	324/347 (93%)	322 (99%)	2 (1%)	0	100 100
All	All	648/694 (93%)	644 (99%)	4 (1%)	0	100 100

There are no Ramachandran outliers to report.

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	291/309 (94%)	281 (97%)	10 (3%)	44	41
1	B	291/309 (94%)	282 (97%)	9 (3%)	47	46
All	All	582/618 (94%)	563 (97%)	19 (3%)	45	43

5 of 19 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	811	ASN
1	B	540	LEU
1	B	725	LEU
1	A	804	LEU
1	B	754	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 13 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	811	ASN
1	B	589	GLN
1	B	698	ASN
1	A	776	GLN
1	B	694	ASN

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 carbohydrates in this entry.

5.6 Ligand geometry (i)

Of 6 ligands modelled in this entry, 4 are monoatomic - leaving 2 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	$\#\|Z\| > 2$
4	5GP	A	859	3,2	21,26,26	1.39	3 (14%)	25,40,40	2.10	5 (20%)
4	5GP	B	859	3,2	21,26,26	1.26	2 (9%)	25,40,40	2.06	5 (20%)

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
4	5GP	A	859	3,2	-	0/6/26/26	0/3/3/3
4	5GP	B	859	3,2	-	0/6/26/26	0/3/3/3

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	859	5GP	C4-N3	2.46	1.39	1.35
4	B	859	5GP	C6-N1	2.53	1.37	1.33
4	A	859	5GP	C8-N7	2.79	1.40	1.34
4	B	859	5GP	C8-N7	3.18	1.40	1.34
4	A	859	5GP	C6-N1	3.22	1.39	1.33

The worst 5 of 10 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	B	859	5GP	C1'-N9-C4	-6.08	117.78	126.94
4	A	859	5GP	C1'-N9-C4	-5.26	119.01	126.94

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	A	859	5GP	C2'-C1'-N9	-5.09	106.52	114.29
4	A	859	5GP	N3-C2-N1	-4.89	120.00	127.44
4	B	859	5GP	N3-C2-N1	-4.76	120.19	127.44

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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	326/347 (93%)	-0.22	1 (0%)	94	94	2, 8, 14, 21	0
1	B	326/347 (93%)	-0.16	6 (1%)	71	72	2, 8, 14, 23	0
All	All	652/694 (93%)	-0.19	7 (1%)	82	83	2, 8, 14, 23	0

The worst 5 of 7 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	538	ARG	3.3
1	B	535	GLU	3.0
1	A	535	GLU	3.0
1	B	858	GLU	2.7
1	B	534	GLU	2.5

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 carbohydrates 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. 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, 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	LLDF	B-factors(Å^2)	Q<0.9
3	MG	B	2	1/1	0.99	0.10	0.77	11,11,11,11	0
3	MG	A	2	1/1	0.99	0.10	0.47	11,11,11,11	0
4	5GP	A	859	24/24	0.95	0.10	-0.03	11,16,20,23	0
4	5GP	B	859	24/24	0.96	0.09	-0.16	13,16,18,20	0
2	ZN	A	1	1/1	1.00	0.05	-5.24	13,13,13,13	0
2	ZN	B	1	1/1	1.00	0.05	-	14,14,14,14	0

6.5 Other polymers (i)

There are no such residues in this entry.