Full wwPDB X-ray Structure Validation Report ⓘ

Jun 22, 2024 – 09:40 AM EDT

PDB ID	:	6I9W
Title	:	Crystal structure of the halohydrin dehalogenase HheG T123G mutant
Authors	:	Kluenemann, T.; Blankenfeldt, W.; Schallmey, A.
Deposited on	:	2018-11-26
Resolution	:	1.55 Å(reported)

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

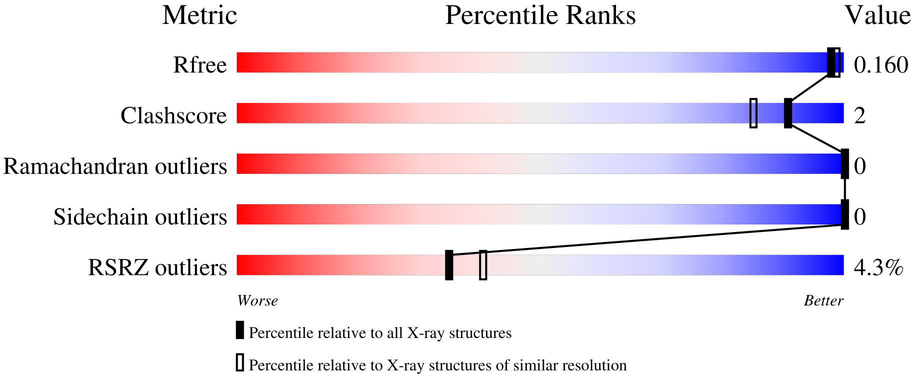
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	2.37.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, 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

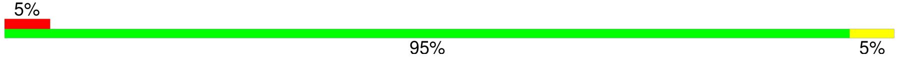
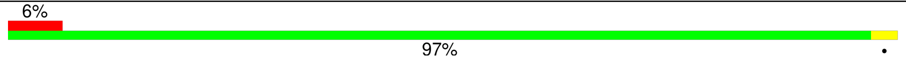
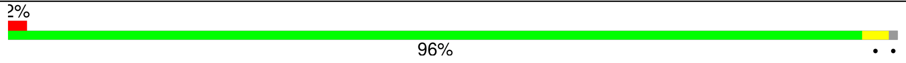
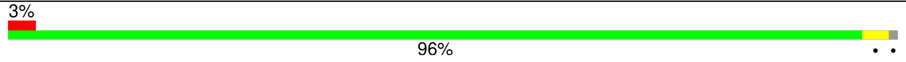
The reported resolution of this entry is 1.55 Å.

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	1483 (1.56-1.56)
Clashscore	141614	1529 (1.56-1.56)
Ramachandran outliers	138981	1498 (1.56-1.56)
Sidechain outliers	138945	1495 (1.56-1.56)
RSRZ outliers	127900	1465 (1.56-1.56)

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	259	
1	B	259	
1	C	259	
1	D	259	

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 16529 atoms, of which 7863 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.

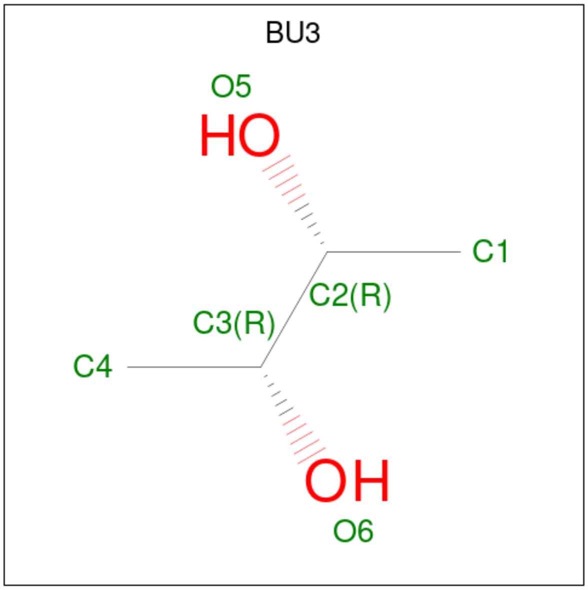
- Molecule 1 is a protein called Putative oxidoreductase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	259	Total 3907	C 1222	H 1954	N 345	O 371	S 15	0	10	0
1	B	259	Total 3913	C 1222	H 1956	N 351	O 369	S 15	0	9	0
1	C	257	Total 3937	C 1225	H 1978	N 352	O 366	S 16	0	10	0
1	D	257	Total 3853	C 1203	H 1925	N 345	O 364	S 16	0	5	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	123	GLY	THR	engineered mutation	UNP M5A5Y8
B	123	GLY	THR	engineered mutation	UNP M5A5Y8
C	123	GLY	THR	engineered mutation	UNP M5A5Y8
D	123	GLY	THR	engineered mutation	UNP M5A5Y8

- Molecule 2 is (R,R)-2,3-BUTANEDIOL (three-letter code: BU3) (formula: $C_4H_{10}O_2$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C H O 16 4 10 2	0	0
2	B	1	Total C H O 16 4 10 2	0	0
2	C	1	Total C H O 16 4 10 2	0	0
2	C	1	Total C H O 16 4 10 2	0	0
2	D	1	Total C H O 16 4 10 2	0	0

- Molecule 3 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Cl 1 1	0	0
3	B	1	Total Cl 1 1	0	0
3	C	1	Total Cl 1 1	0	0
3	D	1	Total Cl 1 1	0	0

- Molecule 4 is water.

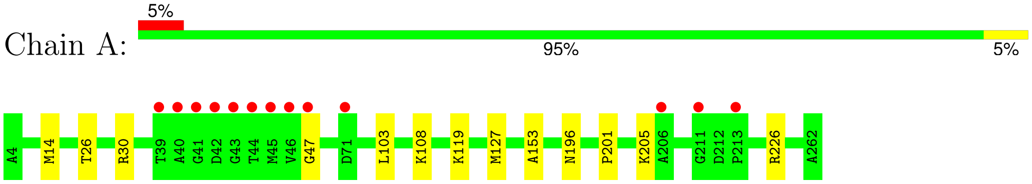
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	218	Total 218	O 218	0	0
4	B	202	Total 202	O 202	0	0
4	C	212	Total 212	O 212	0	0
4	D	203	Total 203	O 203	0	0

3 Residue-property plots ⓘ

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.

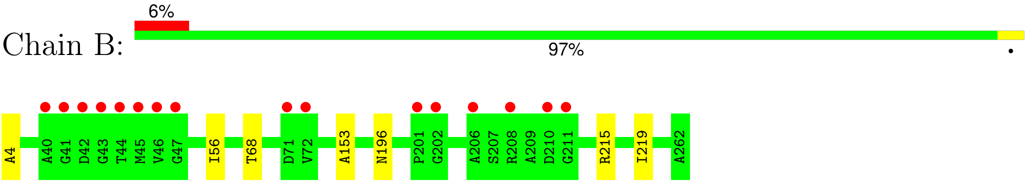
- Molecule 1: Putative oxidoreductase

Chain A:



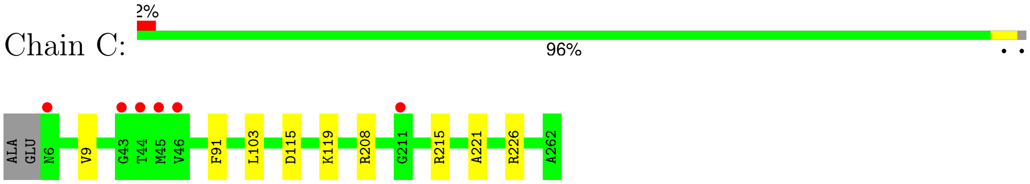
- Molecule 1: Putative oxidoreductase

Chain B:



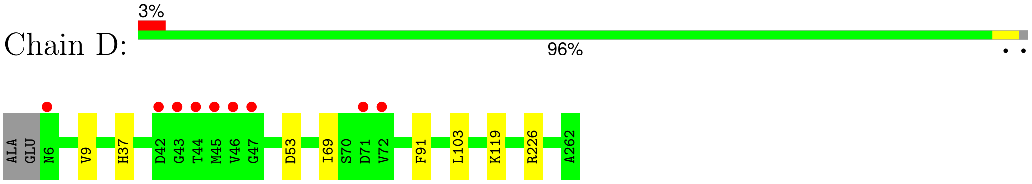
- Molecule 1: Putative oxidoreductase

Chain C:



- Molecule 1: Putative oxidoreductase

Chain D:



4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	66.61Å 107.42Å 67.24Å 90.00° 90.97° 90.00°	Depositor
Resolution (Å)	53.71 – 1.55 53.71 – 1.55	Depositor EDS
% Data completeness (in resolution range)	99.2 (53.71-1.55) 99.2 (53.71-1.55)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.89 (at 1.55Å)	Xtriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.138 , 0.159 0.139 , 0.160	Depositor DCC
R_{free} test set	6863 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å^2)	15.6	Xtriage
Anisotropy	0.490	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.40 , 49.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.000 for l,k,-h 0.025 for h,-k,-l 0.015 for l,-k,h	Xtriage
F_o,F_c correlation	0.98	EDS
Total number of atoms	16529	wwPDB-VP
Average B, all atoms (Å^2)	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.69% 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 ⓘ

5.1 Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: BU3, 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	0.33	0/2017	0.56	0/2728
1	B	0.32	0/2015	0.57	0/2726
1	C	0.32	0/2020	0.58	0/2727
1	D	0.31	0/1974	0.55	0/2667
All	All	0.32	0/8026	0.56	0/10848

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 ⓘ

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	1953	1954	1942	11	0
1	B	1957	1956	1956	5	0
1	C	1959	1978	1977	6	2
1	D	1928	1925	1925	5	2
2	A	6	10	10	0	0
2	B	6	10	10	0	0
2	C	12	20	20	0	0
2	D	6	10	10	0	0
3	A	1	0	0	0	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
4	A	218	0	0	3	0
4	B	202	0	0	1	0
4	C	212	0	0	2	0
4	D	203	0	0	1	0
All	All	8666	7863	7850	27	2

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 2.

All (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:D:226[B]:ARG:NH1	4:D:401:HOH:O	2.00	0.91
1:B:4:ALA:N	4:B:401:HOH:O	2.14	0.79
1:A:47:GLY:O	4:A:401:HOH:O	2.03	0.77
1:A:26[B]:THR:HG22	1:A:30:ARG:HE	1.57	0.70
1:D:103[B]:LEU:CD2	1:D:119:LYS:HB3	2.24	0.67
1:C:215[B]:ARG:NH1	4:C:402:HOH:O	2.29	0.65
1:A:226:ARG:NH1	4:A:404:HOH:O	2.31	0.64
1:B:215:ARG:O	1:B:219:ILE:HD13	1.97	0.64
1:C:115[A]:ASP:OD1	4:C:401:HOH:O	2.16	0.61
1:A:108:LYS:NZ	4:A:406:HOH:O	2.35	0.59
1:A:26[B]:THR:HG22	1:A:30:ARG:NE	2.23	0.53
1:D:103[B]:LEU:HD21	1:D:119:LYS:HB3	1.90	0.52
1:C:221:ALA:O	1:C:226[B]:ARG:NH2	2.43	0.52
1:A:201:PRO:O	1:A:205:LYS:HG2	2.10	0.51
1:A:26[B]:THR:CG2	1:A:30:ARG:HH21	2.27	0.46
1:D:9:VAL:HG21	1:D:91:PHE:HB3	1.99	0.45
1:C:9:VAL:HG21	1:C:91:PHE:HB3	1.98	0.45
1:C:103[B]:LEU:HD23	1:C:119[B]:LYS:HB3	1.99	0.45
1:D:37:HIS:HA	1:D:69:ILE:O	2.17	0.44
1:B:153:ALA:HB3	1:B:196:ASN:HB2	1.99	0.44
1:A:103[A]:LEU:HD23	1:A:119:LYS:CG	2.49	0.43
1:A:14[A]:MET:HE3	1:A:127:MET:CE	2.49	0.42
1:C:115[B]:ASP:OD2	1:C:119[B]:LYS:HE2	2.18	0.42
1:A:153:ALA:HB3	1:A:196:ASN:HB2	2.02	0.42
1:A:103[A]:LEU:HD23	1:A:119:LYS:HG3	2.01	0.42
1:B:56:ILE:HD11	1:B:68:THR:HG21	2.02	0.42

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:215:ARG:O	1:B:219:ILE:CD1	2.66	0.41

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:208:ARG:NH2	1:D:53:ASP:OD1[2_446]	2.04	0.16
1:C:208:ARG:HH22	1:D:53:ASP:OD1[2_446]	1.57	0.03

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	267/259 (103%)	259 (97%)	8 (3%)	0	100	100
1	B	266/259 (103%)	260 (98%)	6 (2%)	0	100	100
1	C	265/259 (102%)	261 (98%)	4 (2%)	0	100	100
1	D	260/259 (100%)	255 (98%)	5 (2%)	0	100	100
All	All	1058/1036 (102%)	1035 (98%)	23 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	205/196 (105%)	205 (100%)	0	100	100
1	B	203/196 (104%)	203 (100%)	0	100	100
1	C	205/196 (105%)	205 (100%)	0	100	100
1	D	200/196 (102%)	200 (100%)	0	100	100
All	All	813/784 (104%)	813 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes 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 molecules 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 monosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 9 ligands modelled in this entry, 4 are monoatomic - leaving 5 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	$\#\|Z\| > 2$
2	BU3	C	302	-	4,5,5	0.06	0	6,6,6	0.35	0
2	BU3	D	301	-	4,5,5	0.06	0	6,6,6	0.44	0
2	BU3	B	301	-	4,5,5	0.07	0	6,6,6	0.46	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	#$\|Z\|>2$	Counts	RMSZ	#$\|Z\|>2$
2	BU3	A	301	-	4,5,5	0.07	0	6,6,6	0.52	0
2	BU3	C	301	-	4,5,5	0.07	0	6,6,6	0.40	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
2	BU3	C	302	-	-	0/4/4/4	-
2	BU3	D	301	-	-	0/4/4/4	-
2	BU3	B	301	-	-	0/4/4/4	-
2	BU3	A	301	-	-	0/4/4/4	-
2	BU3	C	301	-	-	2/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	C	301	BU3	C1-C2-C3-O6
2	C	301	BU3	O5-C2-C3-C4

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 ⓘ

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^{th} 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	259/259 (100%)	-0.15	13 (5%)	28	33	10, 17, 50, 81	0
1	B	259/259 (100%)	-0.15	16 (6%)	20	24	11, 17, 54, 88	0
1	C	257/259 (99%)	-0.32	6 (2%)	60	66	11, 19, 41, 71	0
1	D	257/259 (99%)	-0.27	9 (3%)	44	52	11, 21, 45, 82	0
All	All	1032/1036 (99%)	-0.22	44 (4%)	35	40	10, 19, 47, 88	0

All (44) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	46	VAL	13.9
1	A	46	VAL	11.9
1	A	44	THR	9.6
1	D	46	VAL	9.3
1	B	44	THR	8.1
1	C	46	VAL	6.8
1	B	45	MET	6.2
1	C	44	THR	6.1
1	A	45	MET	5.7
1	A	43	GLY	5.5
1	B	43	GLY	4.9
1	A	40	ALA	4.9
1	B	206	ALA	4.6
1	A	47	GLY	4.5
1	B	40	ALA	4.5
1	A	41	GLY	4.4
1	B	41	GLY	4.4
1	A	211	GLY	4.3
1	D	6	ASN	4.3
1	B	42	ASP	4.2
1	B	208	ARG	3.8

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	D	45	MET	3.8
1	A	213	PRO	3.7
1	A	42	ASP	3.7
1	A	39	THR	3.6
1	B	71	ASP	3.5
1	D	71	ASP	3.5
1	C	43	GLY	3.5
1	C	45	MET	3.4
1	D	44	THR	3.3
1	B	211	GLY	3.1
1	D	47	GLY	2.9
1	A	206	ALA	2.9
1	B	47	GLY	2.7
1	B	72	VAL	2.4
1	D	43	GLY	2.4
1	B	201	PRO	2.3
1	C	6	ASN	2.2
1	D	42	ASP	2.2
1	A	71	ASP	2.2
1	D	72	VAL	2.2
1	B	202	GLY	2.1
1	B	210	ASP	2.1
1	C	211	GLY	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 monosaccharides 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. The B-factors column lists the minimum, median, 95^{th} 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.

Continued on next page...

Continued from previous page...

Mol	**Type**	**Chain**	**Res**	**Atoms**	**RSCC**	**RSR**	**B-factors($\mathring{A}^2$)**	**Q<0.9**

Mol	**Type**	**Chain**	**Res**	**Atoms**	**RSCC**	**RSR**	**B-factors($\mathring{A}^2$)**	**Q<0.9**
2	BU3	D	301	6/6	0.84	0.11	40,48,53,56	0
2	BU3	C	301	6/6	0.85	0.10	35,42,46,52	0
2	BU3	B	301	6/6	0.85	0.13	22,32,39,40	0
2	BU3	C	302	6/6	0.87	0.10	26,36,45,45	0
2	BU3	A	301	6/6	0.88	0.12	26,33,42,42	0
3	CL	A	302	1/1	0.99	0.05	18,18,18,18	0
3	CL	B	302	1/1	0.99	0.04	19,19,19,19	0
3	CL	D	302	1/1	0.99	0.05	22,22,22,22	0
3	CL	C	303	1/1	1.00	0.06	14,14,14,14	0

6.5 Other polymers

There are no such residues in this entry.