



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 18, 2026 – 07:45 AM UTC

PDB ID : 2UW1 / pdb_00002uw1
Title : Ivy Desaturase Structure
Authors : Guy, J.E.; Whittle, E.; Kumaran, D.; Lindqvist, Y.; Shanklin, J.
Deposited on : 2007-03-15
Resolution : 1.95 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 ⓘ 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 ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

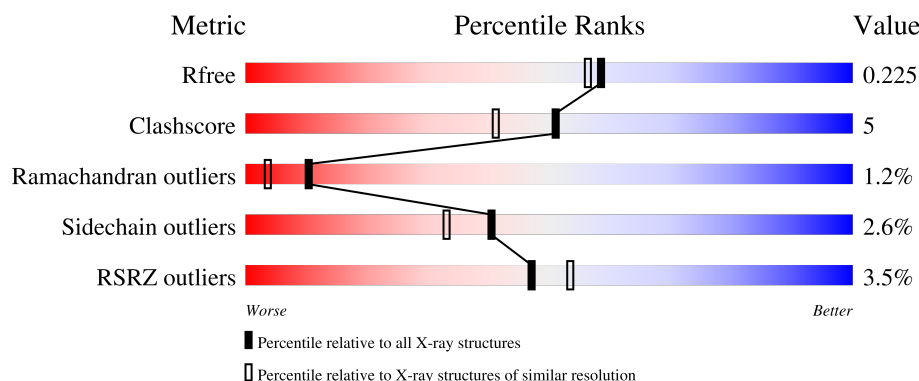
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.95 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}	180053	3494 (1.96-1.96)
Clashscore	190562	3612 (1.96-1.96)
Ramachandran outliers	187476	3587 (1.96-1.96)
Sidechain outliers	187428	3587 (1.96-1.96)
RSRZ outliers	180081	3495 (1.96-1.96)

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 $\leq 5\%$. 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	338	2% 87% 8% ••
2	B	338	4% 87% 10% •

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 6058 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 PLASTID DELTA4 MULTIFUNCTIONAL ACYL-ACYL CARRIER PROTEIN DESATURASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	327	Total	C	N	O	S	4	7	0
			2690	1707	455	511	17			

- Molecule 2 is a protein called PLASTID DELTA4 MULTIFUNCTIONAL ACYL-ACYL CARRIER PROTEIN DESATURASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	338	Total	C	N	O	S	58	12	0
			2797	1775	475	528	19			

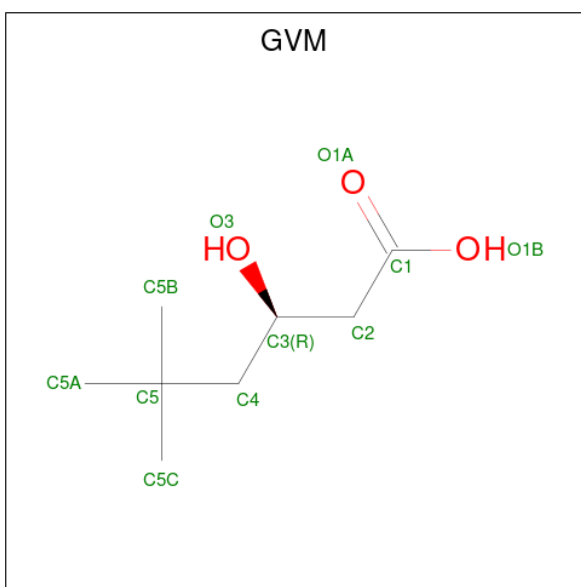
- Molecule 3 is FE (III) ION (CCD ID: FE) (formula: Fe).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total	Fe	0	0
			2	2		
3	B	2	Total	Fe	0	0
			2	2		

- Molecule 4 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Na	0	0
			1	1		
4	B	1	Total	Na	0	0
			1	1		

- Molecule 5 is (3R)-3-HYDROXY-5,5-DIMETHYLHEXANOIC ACID (CCD ID: GVM) (formula: C₈H₁₆O₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			11	8	3		
5	B	1	Total	C	O	0	0
			11	8	3		

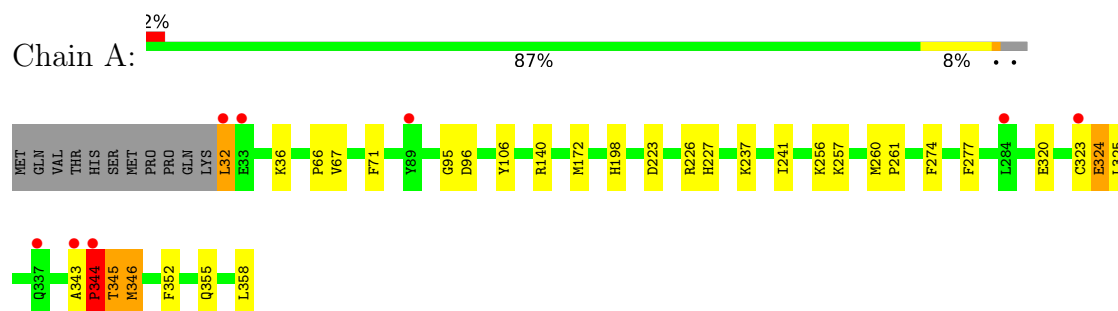
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	287	Total	O	0	0
			287	287		
6	B	256	Total	O	0	0
			256	256		

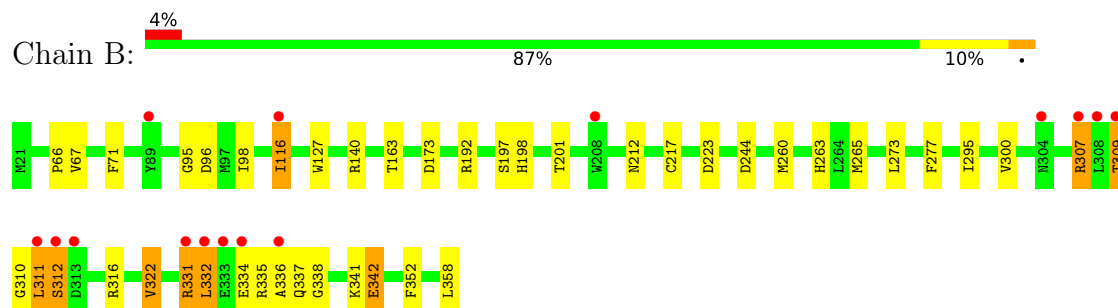
3 Residue-property plots [i](#)

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: PLASTID DELTA4 MULTIFUNCTIONAL ACYL-ACYL CARRIER PROTEIN DESATURASE



- Molecule 2: PLASTID DELTA4 MULTIFUNCTIONAL ACYL-ACYL CARRIER PROTEIN DESATURASE



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	61.12Å 61.86Å 201.00Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 1.95 30.00 – 1.95	Depositor EDS
% Data completeness (in resolution range)	98.7 (30.00-1.95) 98.6 (30.00-1.95)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.76 (at 1.95Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.184 , 0.229 0.183 , 0.225	Depositor DCC
R_{free} test set	2835 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	23.3	Xtriage
Anisotropy	0.229	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 32.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.024 for k,h,-l	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	6058	wwPDB-VP
Average B, all atoms (Å ²)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.09% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ 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: GVM, FE, NA

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	0/2760	0.90	6/3725 (0.2%)
2	B	0.48	0/2896	0.83	3/3913 (0.1%)
All	All	0.50	0/5656	0.87	9/7638 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
2	B	0	3

There are no bond length outliers.

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	323	CYS	N-CA-C	14.28	128.38	111.82
1	A	344	PRO	N-CA-CB	10.43	114.07	102.60
1	A	323	CYS	CA-C-N	8.70	137.37	121.70
1	A	323	CYS	C-N-CA	8.70	137.37	121.70
1	A	32	LEU	N-CA-CB	8.22	124.47	110.50
2	B	331	ARG	CA-C-N	6.21	132.88	121.70
2	B	331	ARG	C-N-CA	6.21	132.88	121.70
1	A	32	LEU	CB-CA-C	-5.34	99.95	110.10
2	B	331	ARG	N-CA-C	5.22	117.77	111.40

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	B	334	GLU	Peptide
2	B	337	GLN	Peptide
2	B	341	LYS	Peptide

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	2690	0	2643	26	0
2	B	2797	0	2765	34	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
5	A	11	0	15	1	0
5	B	11	0	15	0	0
6	A	287	0	0	3	0
6	B	256	0	0	4	0
All	All	6058	0	5438	56	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 5.

All (56) 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:106:TYR:HE1	1:A:172[A]:MET:HE1	1.09	1.14
1:A:106:TYR:CE1	1:A:172[A]:MET:HE1	1.84	1.12
1:A:106:TYR:HE1	1:A:172[A]:MET:CE	1.79	0.96
1:A:226:ARG:NH1	6:A:2176:HOH:O	1.99	0.95
2:B:311:LEU:HA	2:B:312:SER:HB3	1.53	0.86
1:A:343:ALA:HA	1:A:344:PRO:CB	2.14	0.78
2:B:173:ASP:H	2:B:263:HIS:HE1	1.32	0.77
2:B:311:LEU:HA	2:B:312:SER:CB	2.16	0.74
1:A:106:TYR:CE1	1:A:172[A]:MET:CE	2.61	0.74
2:B:312:SER:H	2:B:316:ARG:NH1	1.85	0.74
1:A:67:VAL:HG11	2:B:352:PHE:CZ	2.26	0.71

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:352:PHE:HZ	2:B:67:VAL:HG21	1.56	0.71
2:B:192:ARG:HG2	2:B:295:ILE:HG12	1.76	0.68
2:B:198:HIS:HA	2:B:201[A]:THR:HG22	1.74	0.67
2:B:311:LEU:CA	2:B:312:SER:HB3	2.26	0.63
2:B:116:ILE:HB	2:B:127:TRP:HB3	1.81	0.62
1:A:352:PHE:CZ	2:B:67:VAL:HG21	2.34	0.61
2:B:307:ARG:HH11	2:B:307:ARG:HG2	1.66	0.61
2:B:331:ARG:N	2:B:332:LEU:CB	2.63	0.60
2:B:265[A]:MET:HE3	2:B:273:LEU:HG	1.84	0.59
2:B:140:ARG:NH2	2:B:223:ASP:OD2	2.36	0.59
2:B:173:ASP:H	2:B:263:HIS:CE1	2.19	0.58
1:A:67:VAL:HG11	2:B:352:PHE:HZ	1.68	0.57
2:B:331:ARG:H	2:B:332:LEU:CB	2.17	0.57
1:A:172[A]:MET:HE2	1:A:261:PRO:O	2.05	0.56
1:A:345:THR:HG23	1:A:355:GLN:OE1	2.06	0.55
1:A:343:ALA:CA	1:A:344:PRO:CB	2.85	0.53
1:A:260:MET:HB2	1:A:274:PHE:CZ	2.44	0.52
2:B:260:MET:HE1	6:B:2225:HOH:O	2.09	0.52
2:B:311:LEU:CA	2:B:312:SER:CB	2.88	0.50
2:B:309:THR:HG22	2:B:310:GLY:H	1.77	0.49
2:B:331:ARG:CA	2:B:332:LEU:CB	2.90	0.49
2:B:300:VAL:HG22	2:B:322:VAL:HG13	1.93	0.49
2:B:212:ASN:ND2	6:B:2175:HOH:O	2.46	0.48
2:B:263:HIS:HD2	6:B:2104:HOH:O	1.96	0.48
2:B:201[A]:THR:HG21	6:B:2080:HOH:O	2.13	0.47
2:B:312:SER:N	2:B:316:ARG:NH1	2.57	0.47
2:B:95:GLY:HA3	2:B:277:PHE:CE1	2.50	0.46
1:A:95:GLY:HA3	1:A:277:PHE:CE1	2.50	0.46
2:B:201[A]:THR:HG23	2:B:217:CYS:SG	2.55	0.46
1:A:140:ARG:NH2	1:A:223:ASP:OD2	2.49	0.46
2:B:96[A]:ASP:CG	2:B:198:HIS:HE2	2.24	0.45
1:A:106:TYR:HB3	5:A:1362:GVM:H5A2	1.99	0.45
1:A:320[A]:GLU:HG3	6:A:2256:HOH:O	2.16	0.45
2:B:307:ARG:HH11	2:B:307:ARG:CG	2.28	0.44
1:A:66:PRO:HA	1:A:71:PHE:CD1	2.53	0.43
1:A:237:LYS:HE3	1:A:241:ILE:HD11	2.00	0.43
1:A:96[B]:ASP:CG	1:A:198:HIS:HE2	2.27	0.43
1:A:227:HIS:ND1	6:A:2177:HOH:O	2.37	0.42
1:A:346:MET:HA	1:A:346:MET:HE2	2.02	0.41
1:A:256:LYS:O	1:A:257:LYS:HB2	2.20	0.41
2:B:312:SER:O	2:B:316:ARG:N	2.48	0.41

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:98:ILE:HD13	2:B:163:THR:HG21	2.03	0.40
2:B:66:PRO:HA	2:B:71:PHE:CD1	2.57	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	332/338 (98%)	324 (98%)	6 (2%)	2 (1%)	21	12
2	B	348/338 (103%)	333 (96%)	9 (3%)	6 (2%)	7	2
All	All	680/676 (101%)	657 (97%)	15 (2%)	8 (1%)	10	4

All (8) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	324	GLU
1	A	344	PRO
2	B	332	LEU
2	B	335	ARG
2	B	338	GLY
2	B	342	GLU
2	B	312	SER
2	B	336	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	289/294 (98%)	283 (98%)	6 (2%)	47	41
2	B	305/294 (104%)	296 (97%)	9 (3%)	36	27
All	All	594/588 (101%)	579 (98%)	15 (2%)	40	34

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	32	LEU
1	A	36	LYS
1	A	325	LEU
1	A	345	THR
1	A	346	MET
1	A	358	LEU
2	B	116	ILE
2	B	197	SER
2	B	244	ASP
2	B	307	ARG
2	B	309	THR
2	B	311	LEU
2	B	322	VAL
2	B	342	GLU
2	B	358	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	58	GLN
1	A	190	GLN
1	A	206	GLN
2	B	58	GLN
2	B	263	HIS
2	B	355	GLN

5.3.3 RNA ⓘ

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 8 ligands modelled in this entry, 6 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	$\# Z > 2$
5	GVM	B	1362	3	10,10,10	0.65	0	12,14,14	0.83	0
5	GVM	A	1362	3	10,10,10	0.61	0	12,14,14	1.04	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
5	GVM	B	1362	3	-	0/9/9/9	-
5	GVM	A	1362	3	-	0/9/9/9	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	1362	GVM	1	0

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, 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	327/338 (96%)	0.25	8 (2%) 59 66	11, 25, 32, 40	8 (2%)
2	B	331/338 (97%)	0.53	15 (4%) 38 44	13, 25, 31, 40	12 (3%)
All	All	658/676 (97%)	0.39	23 (3%) 47 53	11, 25, 32, 40	20 (3%)

All (23) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	343	ALA	4.6
2	B	331	ARG	3.6
1	A	344	PRO	3.5
1	A	89	TYR	3.3
1	A	33	GLU	3.2
2	B	313	ASP	3.1
2	B	307	ARG	3.1
2	B	332	LEU	3.0
2	B	309	THR	2.9
2	B	336	ALA	2.9
1	A	32	LEU	2.7
2	B	334	GLU	2.6
1	A	323	CYS	2.6
1	A	284	LEU	2.4
2	B	311	LEU	2.4
2	B	208	TRP	2.4
2	B	333	GLU	2.4
2	B	116	ILE	2.2
2	B	308	LEU	2.2
1	A	337	GLN	2.1
2	B	312	SER	2.1
2	B	304	ASN	2.1
2	B	89	TYR	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 oligosaccharides 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($\text{\AA}^2$)	Q<0.9
5	GVM	A	1362	11/11	0.89	0.10	19,21,23,27	0
4	NA	A	1361	1/1	0.90	0.16	40,40,40,40	0
4	NA	B	1361	1/1	0.91	0.12	33,33,33,33	0
5	GVM	B	1362	11/11	0.93	0.09	22,24,25,28	0
3	FE	B	1359	1/1	0.99	0.02	28,28,28,28	0
3	FE	B	1360	1/1	0.99	0.04	28,28,28,28	0
3	FE	A	1360	1/1	0.99	0.05	28,28,28,28	0
3	FE	A	1359	1/1	1.00	0.02	27,27,27,27	0

6.5 Other polymers [i](#)

There are no such residues in this entry.