



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 19, 2026 – 11:49 AM UTC

PDB ID : 1VHQ / pdb_00001vhq
Title : Crystal structure of enhancing lycopene biosynthesis protein 2
Authors : Structural GenomiX
Deposited on : 2003-12-01
Resolution : 1.65 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

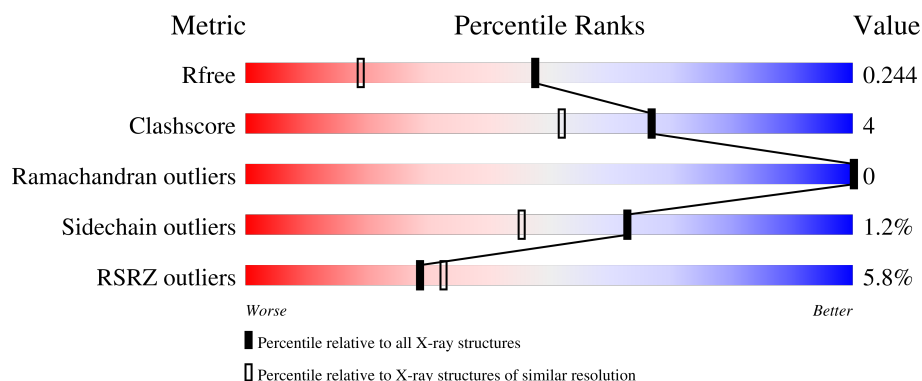
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.65 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	2563 (1.66-1.66)
Clashscore	190562	2662 (1.66-1.66)
Ramachandran outliers	187476	2621 (1.66-1.66)
Sidechain outliers	187428	2621 (1.66-1.66)
RSRZ outliers	180081	2564 (1.66-1.66)

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	232	
1	B	232	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3414 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 Enhancing lycopene biosynthesis protein 2.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	217	Total	C	N	O	S	Se	0	5	0
			1615	1013	271	319	5	7			
1	B	216	Total	C	N	O	S	Se	0	1	0
			1598	1005	270	311	5	7			

There are 42 discrepancies between the modelled and reference sequences:

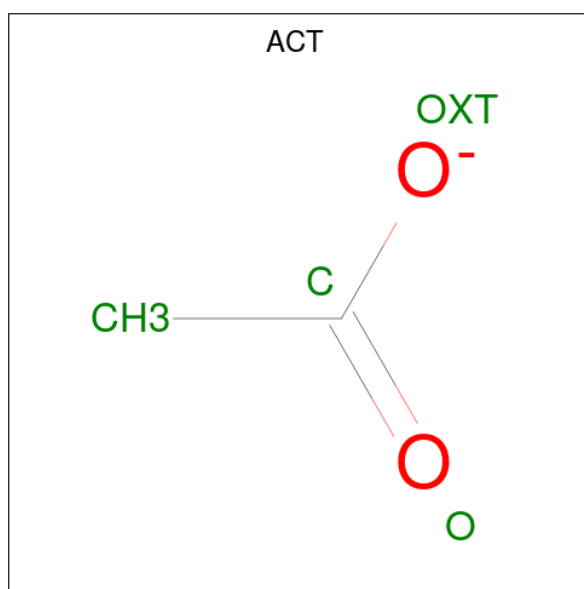
Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	MSE	-	cloning artifact	UNP P0ABU5
A	0	SER	-	cloning artifact	UNP P0ABU5
A	1	LEU	-	cloning artifact	UNP P0ABU5
A	4	MSE	MET	modified residue	UNP P0ABU5
A	60	MSE	MET	modified residue	UNP P0ABU5
A	127	MSE	MET	modified residue	UNP P0ABU5
A	137	MSE	MET	modified residue	UNP P0ABU5
A	138	CSO	CYS	modified residue	UNP P0ABU5
A	143	MSE	MET	modified residue	UNP P0ABU5
A	169	MSE	MET	modified residue	UNP P0ABU5
A	196	MSE	MET	modified residue	UNP P0ABU5
A	221	GLU	-	cloning artifact	UNP P0ABU5
A	222	GLY	-	cloning artifact	UNP P0ABU5
A	223	GLY	-	cloning artifact	UNP P0ABU5
A	224	SER	-	cloning artifact	UNP P0ABU5
A	225	HIS	-	cloning artifact	UNP P0ABU5
A	226	HIS	-	cloning artifact	UNP P0ABU5
A	227	HIS	-	cloning artifact	UNP P0ABU5
A	228	HIS	-	cloning artifact	UNP P0ABU5
A	229	HIS	-	cloning artifact	UNP P0ABU5
A	230	HIS	-	cloning artifact	UNP P0ABU5
B	-1	MSE	-	cloning artifact	UNP P0ABU5
B	0	SER	-	cloning artifact	UNP P0ABU5
B	1	LEU	-	cloning artifact	UNP P0ABU5
B	4	MSE	MET	modified residue	UNP P0ABU5

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Chain	Residue	Modelled	Actual	Comment	Reference
B	60	MSE	MET	modified residue	UNP P0ABU5
B	127	MSE	MET	modified residue	UNP P0ABU5
B	137	MSE	MET	modified residue	UNP P0ABU5
B	138	CSO	CYS	modified residue	UNP P0ABU5
B	143	MSE	MET	modified residue	UNP P0ABU5
B	169	MSE	MET	modified residue	UNP P0ABU5
B	196	MSE	MET	modified residue	UNP P0ABU5
B	221	GLU	-	cloning artifact	UNP P0ABU5
B	222	GLY	-	cloning artifact	UNP P0ABU5
B	223	GLY	-	cloning artifact	UNP P0ABU5
B	224	SER	-	cloning artifact	UNP P0ABU5
B	225	HIS	-	cloning artifact	UNP P0ABU5
B	226	HIS	-	cloning artifact	UNP P0ABU5
B	227	HIS	-	cloning artifact	UNP P0ABU5
B	228	HIS	-	cloning artifact	UNP P0ABU5
B	229	HIS	-	cloning artifact	UNP P0ABU5
B	230	HIS	-	cloning artifact	UNP P0ABU5

- Molecule 2 is ACETATE ION (CCD ID: ACT) (formula: $C_2H_3O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			4	2	2		
2	B	1	Total	C	O	0	0
			4	2	2		

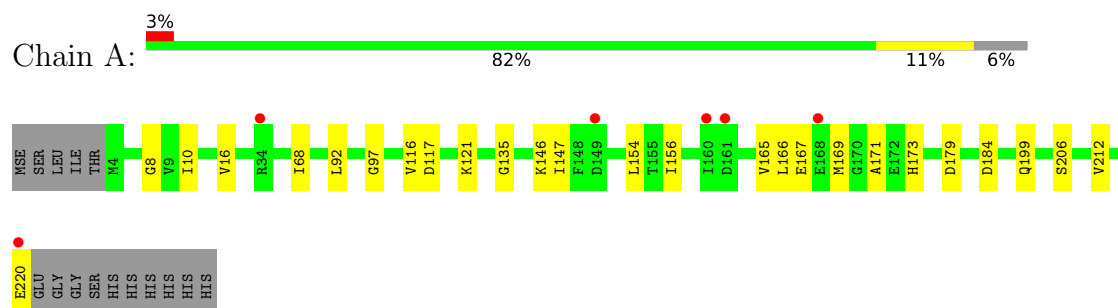
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	123	Total 123	O 123	0	0
3	B	70	Total 70	O 70	0	0

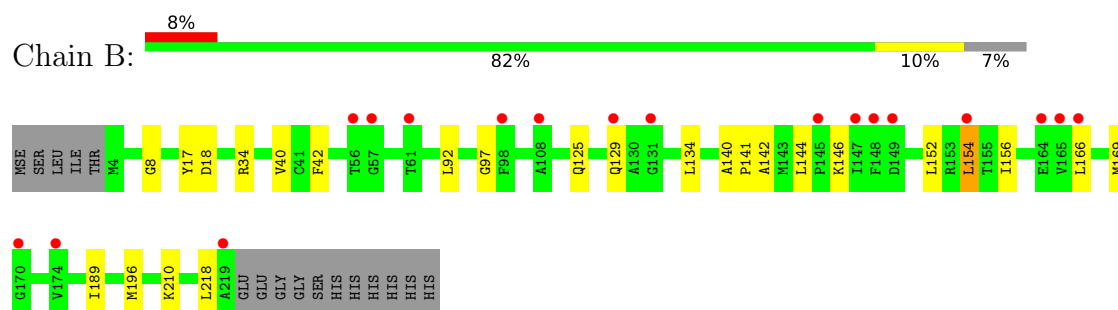
3 Residue-property plots [i](#)

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: Enhancing lycopene biosynthesis protein 2



- Molecule 1: Enhancing lycopene biosynthesis protein 2



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	75.09Å 45.21Å 76.33Å 90.00° 118.78° 90.00°	Depositor
Resolution (Å)	37.14 – 1.65 37.14 – 1.65	Depositor EDS
% Data completeness (in resolution range)	(Not available) (37.14-1.65) 98.0 (37.14-1.65)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.47 (at 1.65Å)	Xtriage
Refinement program	REFMAC 4.0	Depositor
R, R_{free}	0.220 , 0.263 0.208 , 0.244	Depositor DCC
R_{free} test set	2718 reflections (5.09%)	wwPDB-VP
Wilson B-factor (Å ²)	24.0	Xtriage
Anisotropy	0.242	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 33.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.003 for -h-l,k,h 0.003 for l,k,-h-l 0.014 for h,-k,-h-l 0.016 for -h-l,-k,l 0.015 for l,-k,h	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	3414	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.17% 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: ACT, CSO

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	0.98	1/1650 (0.1%)	1.48	8/2228 (0.4%)
1	B	0.81	0/1610	1.34	4/2174 (0.2%)
All	All	0.90	1/3260 (0.0%)	1.41	12/4402 (0.3%)

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
1	A	0	2
1	B	0	1
All	All	0	3

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	97	GLY	N-CA	5.05	1.50	1.45

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	16	VAL	N-CA-C	7.03	118.63	110.62
1	B	196	MSE	N-CA-C	-6.99	103.71	111.82
1	A	173	HIS	CA-CB-CG	-6.44	107.36	113.80
1	A	199	GLN	CA-C-O	6.13	125.89	119.14
1	B	97	GLY	N-CA-C	-5.99	105.58	112.29
1	A	156	ILE	N-CA-C	-5.78	107.11	112.43
1	A	97	GLY	N-CA-C	-5.62	106.00	112.29
1	B	18	ASP	CA-CB-CG	5.37	117.97	112.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	68	ILE	O-C-N	5.23	126.95	121.87
1	A	212	VAL	O-C-N	5.22	126.94	121.87
1	A	184	ASP	N-CA-C	-5.11	98.24	107.75
1	B	17	TYR	N-CA-C	5.11	119.23	112.89

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	135	GLY	Mainchain
1	A	8	GLY	Mainchain
1	B	42	PHE	Mainchain

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	1615	0	1631	11	0
1	B	1598	0	1627	13	0
2	A	4	0	3	0	0
2	B	4	0	3	0	0
3	A	123	0	0	0	0
3	B	70	0	0	1	0
All	All	3414	0	3264	24	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 4.

All (24) 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:179[B]:ASP:OD1	1:A:206[B]:SER:OG	1.79	1.01
1:A:116:VAL:HG11	1:A:147[B]:ILE:HD11	1.48	0.94
1:B:142:ALA:HA	1:B:166:LEU:HD11	1.73	0.69
1:B:92:LEU:HB3	1:B:134:LEU:HD22	1.77	0.66

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:125:GLN:O	1:B:129:GLN:HG2	1.97	0.63
1:B:144:LEU:HD13	1:B:154:LEU:HD22	1.85	0.58
1:A:167[A]:GLU:OE2	1:A:171:ALA:O	2.20	0.58
1:A:116:VAL:CG1	1:A:147[B]:ILE:HD11	2.28	0.56
1:A:165:VAL:O	1:A:169:MSE:HG3	2.12	0.49
1:B:152:LEU:CD2	1:B:189:ILE:HD12	2.46	0.46
1:A:154:LEU:HD11	1:A:166:LEU:HD12	2.00	0.44
1:B:146:LYS:HG2	1:B:169:MSE:HE2	1.99	0.44
1:B:140:ALA:N	1:B:141:PRO:CD	2.81	0.44
1:B:144:LEU:CD1	1:B:154:LEU:HD22	2.46	0.43
1:A:121:LYS:HA	1:A:147[B]:ILE:HD12	1.99	0.43
1:B:8:GLY:HA2	1:B:40:VAL:O	2.19	0.43
1:B:152:LEU:HD22	1:B:189:ILE:HD12	2.01	0.43
1:B:210:LYS:HB2	1:B:210:LYS:HE3	1.74	0.43
1:A:10:ILE:HD11	1:A:92:LEU:HD11	2.01	0.42
1:A:116:VAL:O	1:A:117:ASP:C	2.63	0.42
1:A:154:LEU:HD12	1:A:154:LEU:C	2.45	0.42
1:B:156:ILE:C	1:B:156:ILE:HD12	2.44	0.42
1:B:34:ARG:HD3	3:B:248:HOH:O	2.19	0.41
1:A:121:LYS:CB	1:A:147[B]:ILE:HD12	2.51	0.41

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	219/232 (94%)	215 (98%)	4 (2%)	0	100	100
1	B	214/232 (92%)	212 (99%)	2 (1%)	0	100	100
All	All	433/464 (93%)	427 (99%)	6 (1%)	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	175/175 (100%)	173 (99%)	2 (1%)	65	48
1	B	170/175 (97%)	168 (99%)	2 (1%)	63	45
All	All	345/350 (99%)	341 (99%)	4 (1%)	63	45

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	146	LYS
1	A	220	GLU
1	B	154	LEU
1	B	218	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	48	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues are modelled in this entry.

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	$\# Z > 2$
1	CSO	B	138	1	3,6,7	1.09	0	1,6,8	0.75	0
1	CSO	A	138	1	3,6,7	0.78	0	1,6,8	1.51	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
1	CSO	B	138	1	-	0/1/5/7	-
1	CSO	A	138	1	-	0/1/5/7	-

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.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

2 ligands are modelled in this entry.

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	ACT	B	231	-	3,3,3	1.27	1 (33%)	3,3,3	0.81	0
2	ACT	A	231	-	3,3,3	1.19	0	3,3,3	0.98	0

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	231	ACT	O-C	2.14	1.31	1.22

There are no bond angle outliers.

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

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	209/232 (90%)	0.25	6 (2%) 53 58	16, 23, 35, 45	5 (2%)
1	B	208/232 (89%)	0.66	18 (8%) 16 17	18, 29, 43, 50	1 (0%)
All	All	417/464 (89%)	0.46	24 (5%) 29 32	16, 26, 40, 50	6 (1%)

All (24) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	220	GLU	4.1
1	B	219	ALA	3.5
1	A	149	ASP	3.3
1	B	61	THR	3.2
1	B	174	VAL	3.2
1	B	154	LEU	3.0
1	B	164	GLU	3.0
1	B	98	PHE	2.9
1	B	56	THR	2.8
1	B	149	ASP	2.8
1	B	108	ALA	2.5
1	A	168	GLU	2.4
1	B	57	GLY	2.3
1	B	165	VAL	2.3
1	A	161	ASP	2.3
1	B	148	PHE	2.3
1	B	129	GLN	2.2
1	B	145	PRO	2.2
1	A	34	ARG	2.2
1	A	160	ILE	2.2
1	B	131	GLY	2.1
1	B	166	LEU	2.1
1	B	170	GLY	2.1
1	B	147	ILE	2.1

6.2 Non-standard residues in protein, DNA, RNA chains [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
1	CSO	B	138	7/8	0.89	0.13	25,28,39,41	0
1	CSO	A	138	7/8	0.90	0.12	18,20,30,37	0

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(Å ²)	Q<0.9
2	ACT	B	231	4/4	0.76	0.19	44,44,44,45	0
2	ACT	A	231	4/4	0.84	0.20	33,33,34,35	0

6.5 Other polymers [i](#)

There are no such residues in this entry.