



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 25, 2026 – 04:37 PM EDT

PDB ID : 6RQQ / pdb_00006rqq
Title : X-ray crystal structure of protiated (H) large monoclinic unit cell CA IX SV.
Authors : Fisher, Z.; Koruza, K.
Deposited on : 2019-05-16
Resolution : 1.28 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

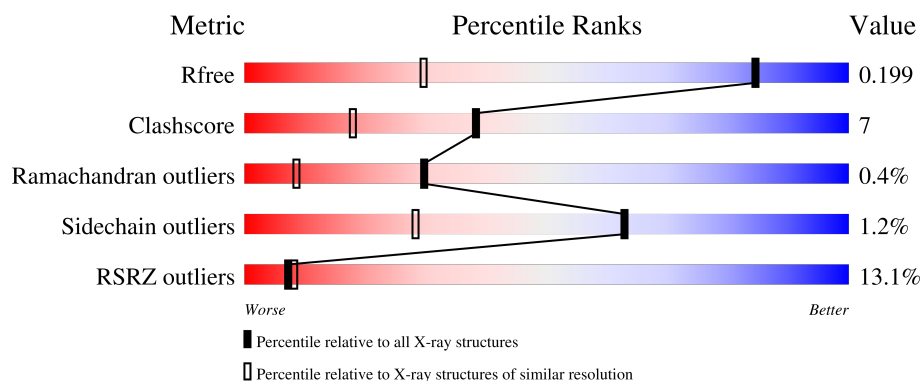
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.28 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	2836 (1.30-1.26)
Clashscore	190562	2911 (1.30-1.26)
Ramachandran outliers	187476	2841 (1.30-1.26)
Sidechain outliers	187428	2840 (1.30-1.26)
RSRZ outliers	180081	2832 (1.30-1.26)

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	256	13% 89% 10%
1	C	256	13% 91% 7%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 4898 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 Carbonic anhydrase 9.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	256	Total	C	N	O	S	0	22	0
			2107	1343	371	389	4			
1	C	255	Total	C	N	O	S	0	23	0
			2105	1340	373	388	4			

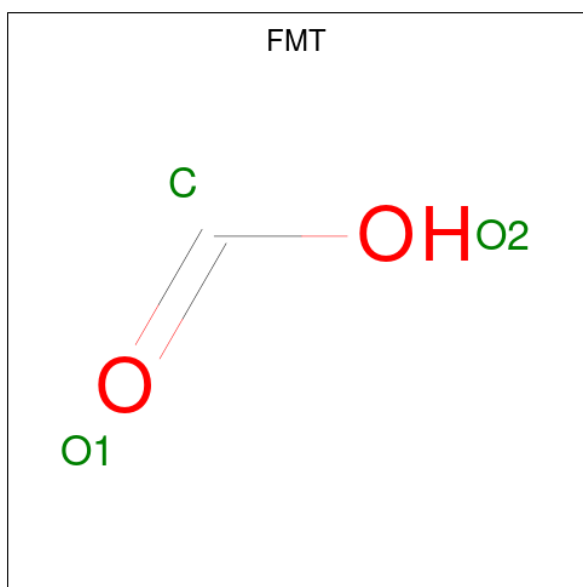
There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	174	SER	CYS	engineered mutation	UNP Q16790
A	183	SER	LEU	engineered mutation	UNP Q16790
A	213	LYS	ALA	engineered mutation	UNP Q16790
A	258	LYS	ALA	engineered mutation	UNP Q16790
A	259	TYR	PHE	engineered mutation	UNP Q16790
A	350	SER	MET	engineered mutation	UNP Q16790
C	174	SER	CYS	engineered mutation	UNP Q16790
C	183	SER	LEU	engineered mutation	UNP Q16790
C	213	LYS	ALA	engineered mutation	UNP Q16790
C	258	LYS	ALA	engineered mutation	UNP Q16790
C	259	TYR	PHE	engineered mutation	UNP Q16790
C	350	SER	MET	engineered mutation	UNP Q16790

- Molecule 2 is ZINC ION (CCD ID: ZN) (formula: Zn).

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

- Molecule 3 is FORMIC ACID (CCD ID: FMT) (formula: CH₂O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			3	1	2		
3	C	1	Total	C	O	0	0
			3	1	2		

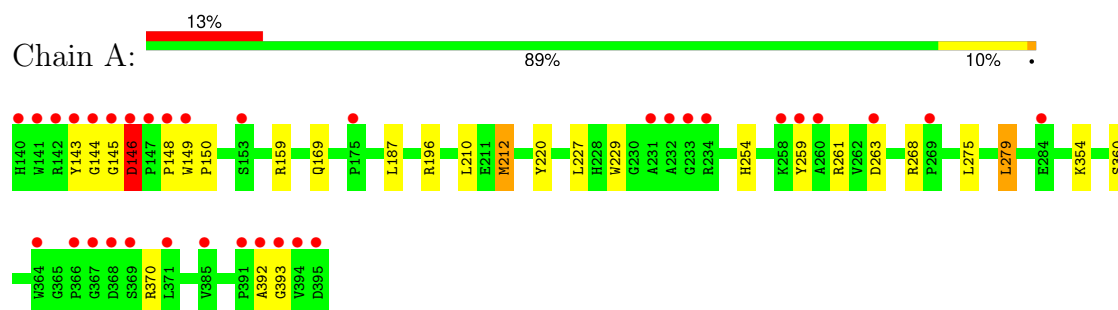
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	335	Total	O	0	2
			337	337		
4	C	339	Total	O	0	2
			341	341		

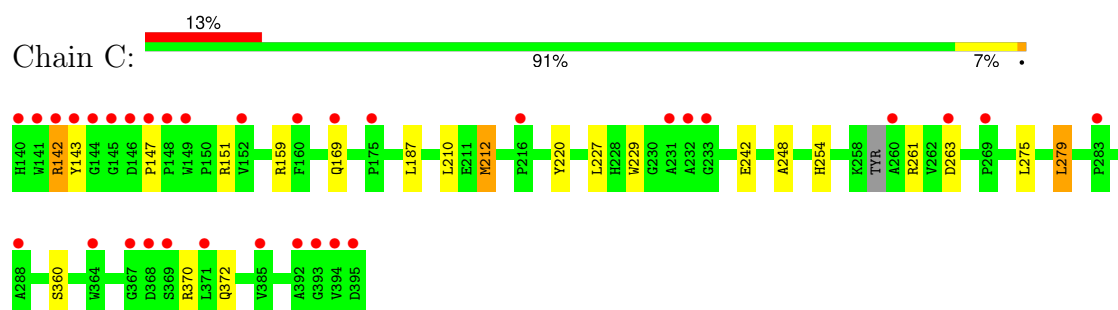
3 Residue-property plots [i](#)

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: Carbonic anhydrase 9



• Molecule 1: Carbonic anhydrase 9



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	48.94Å 65.10Å 76.29Å 90.00° 92.86° 90.00°	Depositor
Resolution (Å)	48.88 – 1.28 48.88 – 1.28	Depositor EDS
% Data completeness (in resolution range)	98.3 (48.88-1.28) 98.3 (48.88-1.28)	Depositor EDS
R_{merge}	0.03	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.53 (at 1.28Å)	Xtriage
Refinement program	PHENIX 1.12_2829	Depositor
R, R_{free}	0.181 , 0.196 0.187 , 0.199	Depositor DCC
R_{free} test set	6057 reflections (4.88%)	wwPDB-VP
Wilson B-factor (Å ²)	15.9	Xtriage
Anisotropy	0.062	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 39.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.026 for h,-k,-l	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	4898	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 89.31 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 3.5744e-08. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: FMT, ZN

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	0.36	2/2222 (0.1%)	0.54	1/3031 (0.0%)
1	C	0.34	2/2216 (0.1%)	0.48	0/3021
All	All	0.35	4/4438 (0.1%)	0.51	1/6052 (0.0%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	212[A]	MET	CA-C	7.17	1.61	1.52
1	C	212[B]	MET	CA-C	7.17	1.61	1.52
1	A	212[A]	MET	CA-C	6.54	1.60	1.52
1	A	212[B]	MET	CA-C	6.54	1.60	1.52

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	146	ASP	C-N-CD	5.28	132.22	120.60

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	2107	0	2068	35	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	2105	0	2065	23	0
2	A	1	0	0	0	0
2	C	1	0	0	0	0
3	A	3	0	1	0	0
3	C	3	0	1	0	0
4	A	337	0	0	10	0
4	C	341	0	0	5	0
All	All	4898	0	4135	58	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 7.

All (58) 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:212[B]:MET:CE	1:A:275:LEU:HD21	1.87	1.04
1:C:212[B]:MET:CE	1:C:275:LEU:HD21	1.95	0.94
1:A:212[B]:MET:HE2	1:A:275:LEU:HD21	1.52	0.92
1:A:212[B]:MET:HE1	1:A:275:LEU:HD21	1.55	0.89
1:C:212[B]:MET:HE2	1:C:275:LEU:HD21	1.55	0.89
1:A:145:GLY:HA2	1:A:146:ASP:HB2	1.58	0.85
1:A:169:GLN:HG2	4:A:508:HOH:O	1.79	0.82
1:C:212[B]:MET:HE1	1:C:275:LEU:HD21	1.66	0.78
1:A:212[B]:MET:CE	1:A:275:LEU:CD2	2.64	0.74
1:C:242:GLU:OE2	4:C:723[B]:HOH:O	2.07	0.72
1:A:144:GLY:HA2	4:A:531:HOH:O	1.89	0.72
1:A:212[B]:MET:HE2	1:A:275:LEU:HD11	1.73	0.71
1:C:212[B]:MET:HE2	1:C:275:LEU:HD11	1.71	0.71
1:C:212[B]:MET:CE	1:C:275:LEU:CD2	2.69	0.70
1:C:142:ARG:NH1	4:C:501:HOH:O	2.23	0.70
1:A:145:GLY:CA	1:A:146:ASP:HB2	2.21	0.69
1:A:169:GLN:CG	4:A:508:HOH:O	2.40	0.68
1:A:145:GLY:HA3	1:A:146:ASP:O	1.96	0.66
1:A:212[B]:MET:HE1	1:A:275:LEU:CD2	2.26	0.66
1:A:259:TYR:OH	1:A:268:ARG:HD2	1.97	0.65
1:A:259:TYR:CZ	1:A:268:ARG:HD2	2.32	0.65
1:A:370[B]:ARG:NH2	4:A:506:HOH:O	2.30	0.64
1:A:212[B]:MET:HE2	1:A:275:LEU:CD2	2.27	0.63
1:C:212[B]:MET:HE2	1:C:275:LEU:CD2	2.29	0.61
1:A:149:TRP:N	1:A:150:PRO:CD	2.65	0.59
1:A:143:TYR:HE1	4:A:511[B]:HOH:O	1.87	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:212[B]:MET:HE1	1:C:275:LEU:CD2	2.34	0.57
1:A:259:TYR:OH	1:A:268:ARG:CD	2.54	0.56
1:A:220:TYR:HB3	1:A:254:HIS:HB3	1.88	0.55
1:A:148:PRO:HG2	4:A:660:HOH:O	2.06	0.55
1:C:220:TYR:HB3	1:C:254:HIS:HB3	1.90	0.54
1:A:354:LYS:HG3	4:A:542:HOH:O	2.08	0.54
1:C:142:ARG:HG3	1:C:143:TYR:N	2.22	0.53
1:A:145:GLY:HA3	1:A:146:ASP:C	2.34	0.53
1:A:196:ARG:NH1	4:A:507:HOH:O	2.30	0.52
1:A:145:GLY:CA	1:A:146:ASP:CB	2.86	0.52
1:C:212[B]:MET:CE	1:C:275:LEU:CG	2.88	0.51
1:A:212[B]:MET:CE	1:A:275:LEU:CG	2.89	0.50
1:C:372:GLN:NE2	4:C:511:HOH:O	2.47	0.48
1:A:227[A]:LEU:HD23	1:A:279[A]:LEU:HD11	1.96	0.48
1:C:169[B]:GLN:HG2	4:C:723[B]:HOH:O	2.14	0.47
1:C:212[B]:MET:HE2	1:C:275:LEU:CD1	2.41	0.47
1:A:261:ARG:NH1	1:A:263:ASP:OD1	2.47	0.47
1:C:227[A]:LEU:HD23	1:C:279[A]:LEU:HD11	1.97	0.47
1:A:212[B]:MET:HE2	1:A:275:LEU:CD1	2.42	0.47
1:A:159[B]:ARG:NH1	4:A:521:HOH:O	2.47	0.46
1:C:159[B]:ARG:NH1	4:C:515:HOH:O	2.48	0.46
1:C:212[B]:MET:HE2	1:C:275:LEU:CG	2.47	0.45
1:C:229:TRP:CD1	1:C:360:SER:HA	2.52	0.45
1:A:169:GLN:NE2	4:A:524:HOH:O	2.50	0.44
1:C:147:PRO:HB3	1:C:151:ARG:CZ	2.47	0.44
1:A:229:TRP:CD1	1:A:360:SER:HA	2.53	0.44
1:C:187:LEU:HD21	1:C:210:LEU:HD11	1.99	0.44
1:A:149:TRP:H	1:A:150:PRO:CD	2.29	0.44
1:C:261:ARG:NH1	1:C:263:ASP:OD2	2.52	0.43
1:A:212[B]:MET:HE2	1:A:275:LEU:CG	2.50	0.42
1:A:187:LEU:HD21	1:A:210:LEU:HD11	2.03	0.40
1:C:248:ALA:HB3	1:C:279[A]:LEU:HD12	2.02	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	276/256 (108%)	265 (96%)	9 (3%)	2 (1%)	18	2
1	C	274/256 (107%)	269 (98%)	5 (2%)	0	100	100
All	All	550/512 (107%)	534 (97%)	14 (2%)	2 (0%)	30	8

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	392	ALA
1	A	393	GLY

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	232/210 (110%)	229 (99%)	3 (1%)	61	25
1	C	232/210 (110%)	227 (98%)	5 (2%)	45	10
All	All	464/420 (110%)	456 (98%)	8 (2%)	63	17

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	146	ASP
1	A	279[A]	LEU
1	A	279[B]	LEU
1	C	142	ARG
1	C	279[A]	LEU
1	C	279[B]	LEU
1	C	370[A]	ARG
1	C	370[B]	ARG

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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 4 ligands modelled in this entry, 2 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	$\# Z > 2$
3	FMT	C	402	2	2,2,2	0.89	0	1,1,1	0.51	0
3	FMT	A	402	2	2,2,2	0.91	0	1,1,1	0.52	0

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.

5.7 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	256/256 (100%)	1.00	34 (13%) 7 8	7, 18, 42, 73	22 (8%)
1	C	255/256 (99%)	0.93	33 (12%) 7 8	7, 18, 37, 64	23 (9%)
All	All	511/512 (99%)	0.96	67 (13%) 7 8	7, 18, 38, 73	45 (8%)

All (67) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	393	GLY	10.8
1	C	394	VAL	10.2
1	A	392	ALA	8.8
1	A	144	GLY	8.1
1	A	147	PRO	8.0
1	A	393	GLY	7.9
1	A	394	VAL	7.9
1	A	148	PRO	7.7
1	C	392	ALA	7.4
1	A	259	TYR	7.1
1	A	146	ASP	6.6
1	A	371[A]	LEU	6.2
1	C	145	GLY	5.7
1	A	143	TYR	5.3
1	C	371[A]	LEU	5.1
1	A	145	GLY	5.0
1	A	367	GLY	4.6
1	C	144	GLY	4.5
1	A	149	TRP	4.3
1	A	395	ASP	4.0
1	A	233	GLY	3.9
1	C	233	GLY	3.8
1	C	367	GLY	3.7
1	A	269	PRO	3.7

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Mol	Chain	Res	Type	RSRZ
1	C	140	HIS	3.6
1	C	147	PRO	3.5
1	C	146	ASP	3.4
1	C	148	PRO	3.4
1	C	364	TRP	3.2
1	A	140	HIS	3.2
1	C	169[A]	GLN	3.2
1	C	232	ALA	3.1
1	A	263	ASP	3.1
1	C	260	ALA	3.1
1	A	364	TRP	3.1
1	C	395	ASP	3.0
1	A	369	SER	2.9
1	A	258	LYS	2.9
1	A	385	VAL	2.8
1	C	385	VAL	2.8
1	A	232	ALA	2.8
1	A	368	ASP	2.7
1	C	368	ASP	2.7
1	A	391	PRO	2.7
1	A	142	ARG	2.7
1	C	142	ARG	2.7
1	C	160	PHE	2.6
1	A	153[A]	SER	2.6
1	C	141	TRP	2.5
1	A	260	ALA	2.5
1	C	263	ASP	2.4
1	A	366	PRO	2.4
1	C	269	PRO	2.3
1	A	175	PRO	2.3
1	C	288	ALA	2.2
1	A	141	TRP	2.2
1	C	369	SER	2.2
1	C	175	PRO	2.2
1	A	234	ARG	2.1
1	C	149	TRP	2.1
1	C	143	TYR	2.1
1	A	284	GLU	2.1
1	A	231	ALA	2.1
1	C	231	ALA	2.1
1	C	216	PRO	2.1
1	C	283	PRO	2.0

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Mol	Chain	Res	Type	RSRZ
1	C	152	VAL	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(Å ²)	Q<0.9
3	FMT	A	402	3/3	0.93	0.10	19,19,23,26	0
3	FMT	C	402	3/3	0.94	0.10	19,19,24,25	0
2	ZN	A	401	1/1	0.99	0.02	12,12,12,12	0
2	ZN	C	401	1/1	1.00	0.01	12,12,12,12	0

6.5 Other polymers [i](#)

There are no such residues in this entry.