



wwPDB X-ray Structure Validation Summary Report

Jun 11, 2024 – 11:04 PM EDT

PDB ID : 2A7K
Title : carboxymethylproline synthase (CarB) from pectobacterium carotovora, apo enzyme
Authors : Sleeman, M.C.; Sorensen, J.L.; Batchelar, E.T.; McDonough, M.A.; Schofield, C.J.
Deposited on : 2005-07-05
Resolution : 2.24 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

<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 : 4.02b-467
Xtriage (Phenix) : 1.20.1
EDS : 2.36.2
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) : 2.36.2

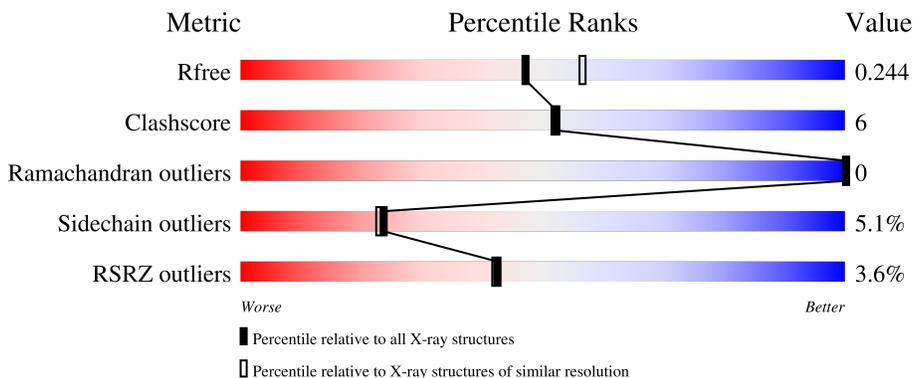
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.24 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	2391 (2.26-2.22)
Clashscore	141614	2539 (2.26-2.22)
Ramachandran outliers	138981	2489 (2.26-2.22)
Sidechain outliers	138945	2490 (2.26-2.22)
RSRZ outliers	127900	2353 (2.26-2.22)

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	250	 4% (poor fit), 76% (0-1 outliers), 14% (2 outliers), 8% (3+ outliers)
1	B	250	 6% (poor fit), 78% (0-1 outliers), 11% (2 outliers), 8% (3+ outliers)
1	C	250	 2% (poor fit), 82% (0-1 outliers), 13% (2 outliers), 5% (3+ outliers)
1	D	250	 3% (poor fit), 76% (0-1 outliers), 14% (2 outliers), 9% (3+ outliers)
1	E	250	 6% (poor fit), 76% (0-1 outliers), 17% (2 outliers), 6% (3+ outliers)

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Mol	Chain	Length	Quality of chain
1	F	250	 <p>2% 78% 12% 10%</p>
1	G	250	 <p>4% 78% 12% 9%</p>
1	H	250	 <p>3% 75% 16% 8%</p>
1	I	250	 <p>2% 78% 12% 9%</p>

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 16704 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 CarB.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	229	Total 1756	C 1104	N 305	O 337	S 10	0	0	0
1	B	230	Total 1764	C 1108	N 310	O 336	S 10	0	0	0
1	C	238	Total 1833	C 1152	N 320	O 351	S 10	0	0	0
1	D	228	Total 1752	C 1102	N 305	O 335	S 10	0	0	0
1	E	236	Total 1798	C 1134	N 311	O 343	S 10	0	0	0
1	F	226	Total 1745	C 1097	N 303	O 335	S 10	0	0	0
1	G	228	Total 1726	C 1087	N 302	O 327	S 10	0	0	0
1	H	231	Total 1769	C 1114	N 305	O 340	S 10	0	0	0
1	I	228	Total 1755	C 1105	N 305	O 335	S 10	0	0	0

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	82	Total 82	O 82	0	0
2	B	102	Total 102	O 102	0	0
2	C	96	Total 96	O 96	0	0
2	D	117	Total 117	O 117	0	0
2	E	80	Total 80	O 80	0	0

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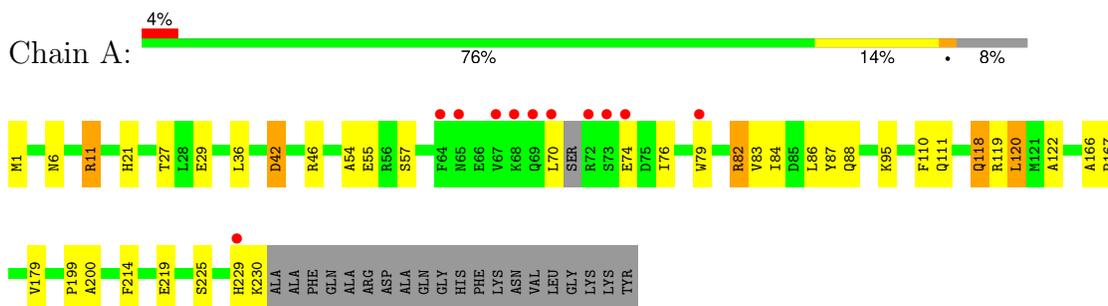
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	F	83	Total 83	O 83	0	0
2	G	77	Total 77	O 77	0	0
2	H	80	Total 80	O 80	0	0
2	I	89	Total 89	O 89	0	0

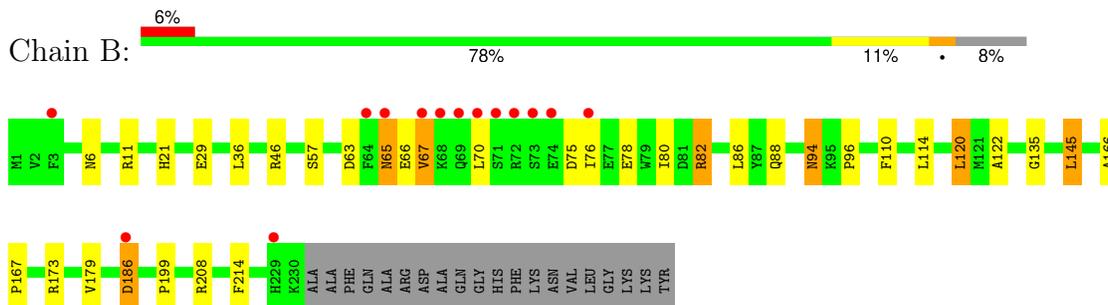
3 Residue-property plots [i](#)

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.

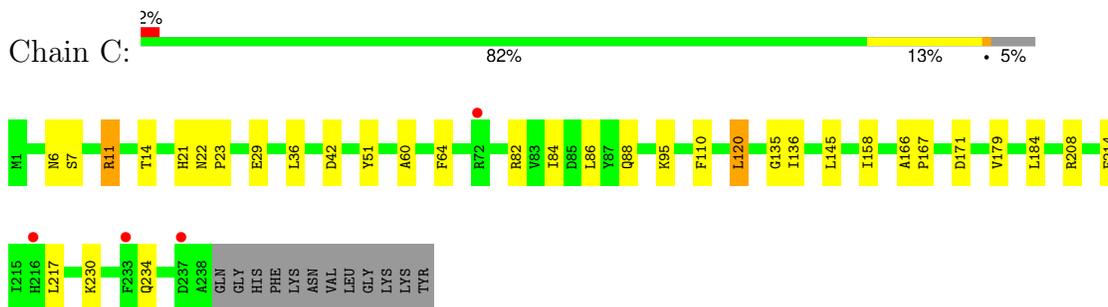
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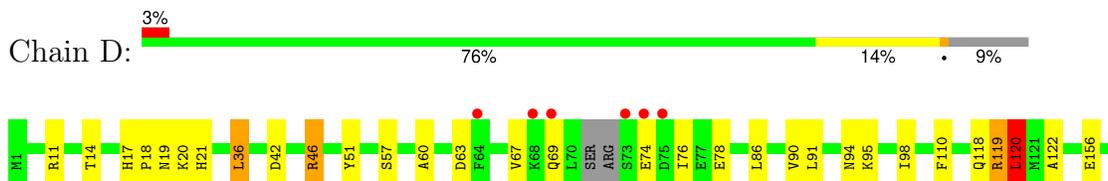
- Molecule 1: CarB



- Molecule 1: CarB

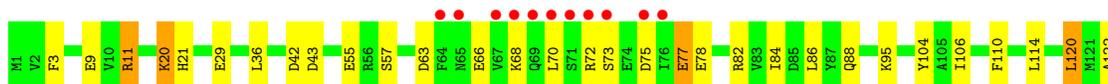
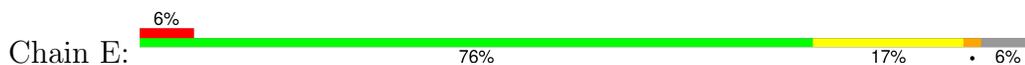


- Molecule 1: CarB

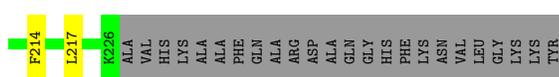
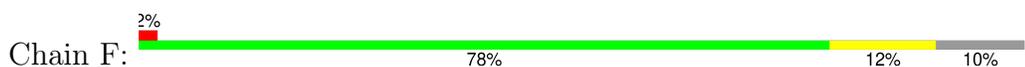




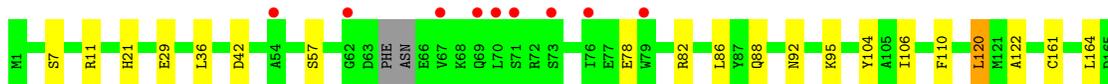
- Molecule 1: CarB



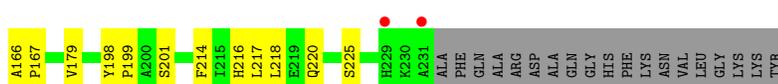
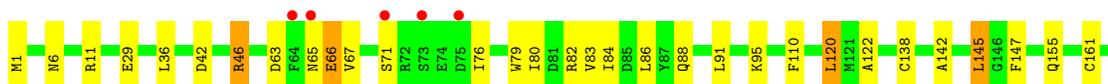
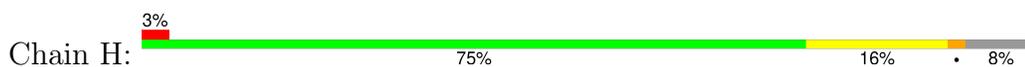
- Molecule 1: CarB



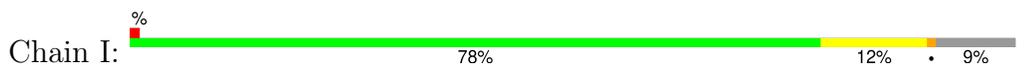
- Molecule 1: CarB

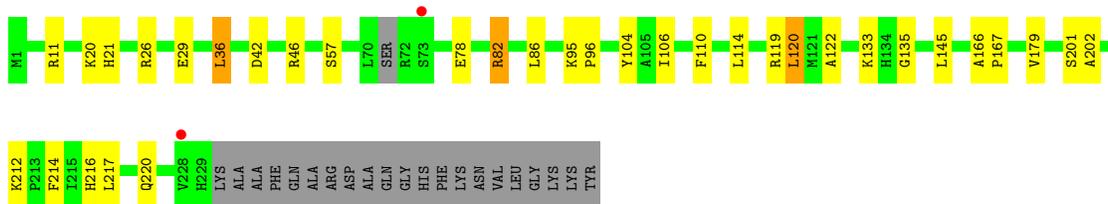


- Molecule 1: CarB



- Molecule 1: CarB





4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	87.21Å 89.86Å 264.58Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	45.60 – 2.24 45.60 – 2.24	Depositor EDS
% Data completeness (in resolution range)	99.7 (45.60-2.24) 99.7 (45.60-2.24)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.08 (at 2.24Å)	Xtriage
Refinement program	REFMAC refmac_5.2.0005	Depositor
R, R_{free}	0.185 , 0.238 0.195 , 0.244	Depositor DCC
R_{free} test set	5084 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	29.1	Xtriage
Anisotropy	0.254	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 39.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.019 for k,h,-l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	16704	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 17.22% 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 i

5.1 Standard geometry i

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	0.74	1/1787 (0.1%)	0.83	7/2421 (0.3%)
1	B	0.78	1/1796 (0.1%)	0.83	5/2434 (0.2%)
1	C	0.76	0/1867	0.83	3/2530 (0.1%)
1	D	0.83	0/1784	0.87	6/2418 (0.2%)
1	E	0.72	0/1832	0.78	2/2486 (0.1%)
1	F	0.73	1/1777 (0.1%)	0.76	0/2408
1	G	0.72	2/1757 (0.1%)	0.80	1/2384 (0.0%)
1	H	0.75	2/1802 (0.1%)	0.80	2/2444 (0.1%)
1	I	0.74	0/1787	0.78	2/2422 (0.1%)
All	All	0.75	7/16189 (0.0%)	0.81	28/21947 (0.1%)

The worst 5 of 7 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	94	ASN	CB-CG	6.45	1.65	1.51
1	G	161	CYS	CB-SG	-6.35	1.71	1.82
1	F	74	GLU	CD-OE2	5.97	1.32	1.25
1	G	92	ASN	CB-CG	5.23	1.63	1.51
1	H	161	CYS	CB-SG	-5.21	1.73	1.81

The worst 5 of 28 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	11	ARG	NE-CZ-NH2	-9.06	115.77	120.30
1	A	42	ASP	CB-CG-OD1	6.68	124.31	118.30
1	E	11	ARG	NE-CZ-NH2	-6.63	116.98	120.30
1	H	120	LEU	CA-CB-CG	6.34	129.87	115.30
1	A	82	ARG	NE-CZ-NH1	6.29	123.45	120.30

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	1756	0	1710	22	0
1	B	1764	0	1724	25	0
1	C	1833	0	1793	16	0
1	D	1752	0	1707	25	0
1	E	1798	0	1747	25	0
1	F	1745	0	1710	17	0
1	G	1726	0	1677	14	0
1	H	1769	0	1727	23	0
1	I	1755	0	1716	15	0
2	A	82	0	0	2	0
2	B	102	0	0	3	0
2	C	96	0	0	1	0
2	D	117	0	0	3	0
2	E	80	0	0	0	0
2	F	83	0	0	0	0
2	G	77	0	0	2	0
2	H	80	0	0	4	0
2	I	89	0	0	2	0
All	All	16704	0	15511	173	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 6.

The worst 5 of 173 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:H:46:ARG:HH11	1:H:46:ARG:HG2	1.32	0.94
1:D:17:HIS:HD2	1:D:19:ASN:H	1.14	0.93
1:A:6:ASN:HD21	1:A:11:ARG:HH11	1.17	0.92
1:B:6:ASN:HD21	1:B:11:ARG:HE	1.25	0.84
1:F:4:GLU:OE2	1:F:38:ARG:NH2	2.11	0.84

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	225/250 (90%)	220 (98%)	5 (2%)	0	100	100
1	B	228/250 (91%)	221 (97%)	7 (3%)	0	100	100
1	C	236/250 (94%)	232 (98%)	4 (2%)	0	100	100
1	D	224/250 (90%)	219 (98%)	5 (2%)	0	100	100
1	E	234/250 (94%)	230 (98%)	4 (2%)	0	100	100
1	F	224/250 (90%)	221 (99%)	3 (1%)	0	100	100
1	G	224/250 (90%)	219 (98%)	5 (2%)	0	100	100
1	H	229/250 (92%)	223 (97%)	6 (3%)	0	100	100
1	I	224/250 (90%)	221 (99%)	3 (1%)	0	100	100
All	All	2048/2250 (91%)	2006 (98%)	42 (2%)	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	185/205 (90%)	177 (96%)	8 (4%)	29	31
1	B	186/205 (91%)	177 (95%)	9 (5%)	25	25
1	C	194/205 (95%)	186 (96%)	8 (4%)	30	33
1	D	186/205 (91%)	177 (95%)	9 (5%)	25	25
1	E	188/205 (92%)	175 (93%)	13 (7%)	15	12

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	F	187/205 (91%)	181 (97%)	6 (3%)	39	44
1	G	180/205 (88%)	170 (94%)	10 (6%)	21	19
1	H	188/205 (92%)	176 (94%)	12 (6%)	17	14
1	I	187/205 (91%)	176 (94%)	11 (6%)	19	17
All	All	1681/1845 (91%)	1595 (95%)	86 (5%)	24	23

5 of 86 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	G	86	LEU
1	H	120	LEU
1	G	120	LEU
1	H	46	ARG
1	I	11	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 22 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	111	GLN
1	H	94	ASN
1	G	229	HIS
1	H	205	ASN
1	C	234	GLN

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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	229/250 (91%)	-0.11	11 (4%) 30 30	21, 34, 63, 84	0
1	B	230/250 (92%)	-0.02	14 (6%) 21 20	19, 31, 68, 92	0
1	C	238/250 (95%)	-0.17	4 (1%) 70 71	20, 34, 52, 69	1 (0%)
1	D	228/250 (91%)	-0.18	8 (3%) 44 43	19, 30, 58, 78	0
1	E	236/250 (94%)	-0.11	14 (5%) 22 21	21, 36, 66, 82	0
1	F	226/250 (90%)	-0.25	5 (2%) 62 63	23, 38, 55, 72	0
1	G	228/250 (91%)	-0.05	10 (4%) 34 34	21, 39, 65, 96	1 (0%)
1	H	231/250 (92%)	-0.02	7 (3%) 50 50	21, 39, 76, 99	0
1	I	228/250 (91%)	-0.24	2 (0%) 84 84	19, 34, 56, 68	0
All	All	2074/2250 (92%)	-0.13	75 (3%) 42 42	19, 35, 63, 99	2 (0%)

The worst 5 of 75 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	G	71	SER	6.6
1	B	67	VAL	6.2
1	E	70	LEU	5.7
1	G	70	LEU	5.7
1	B	73	SER	5.1

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 monosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.