



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 24, 2023 – 03:21 AM EDT

PDB ID : 2Z56
Title : Crystal structure of G56S-propeptide:S324A-subtilisin complex
Authors : Pulido, M.A.; Tanaka, S.; Sringiew, C.; You, D.J.; Matsumura, H.; Koga, Y.;
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Deposited on : 2007-06-29
Resolution : 1.90 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 : 4.02b-467
Xtriage (Phenix) : 1.13
EDS : 2.36
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

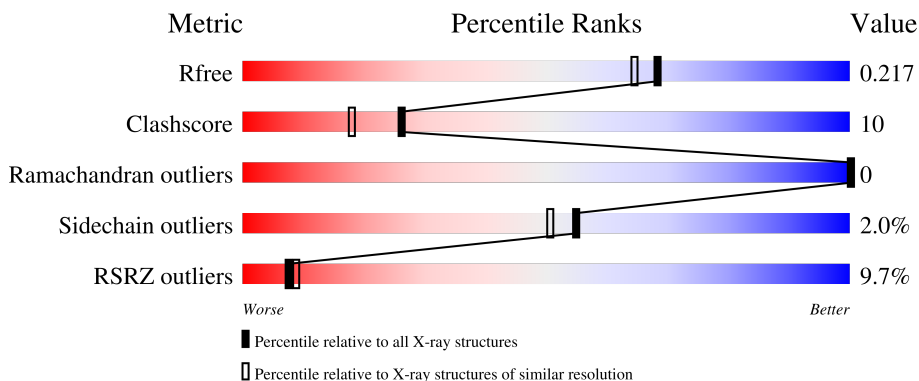
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION


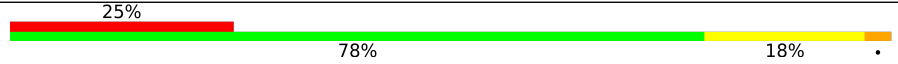
The reported resolution of this entry is 1.90 Å.

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	6207 (1.90-1.90)
Clashscore	141614	6847 (1.90-1.90)
Ramachandran outliers	138981	6760 (1.90-1.90)
Sidechain outliers	138945	6760 (1.90-1.90)
RSRZ outliers	127900	6082 (1.90-1.90)

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	318	
2	B	65	

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 2978 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 Tk-subtilisin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	318	2314	1452	384	472	6	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	324	ALA	SER	engineered mutation	UNP P58502

- Molecule 2 is a protein called Tk-subtilisin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	65	502	330	85	86	1	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	56	SER	GLY	engineered mutation	UNP P58502

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Ca		
3	A	7	7	7	0	0

- Molecule 4 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Zn		
4	B	1	1	1	0	0

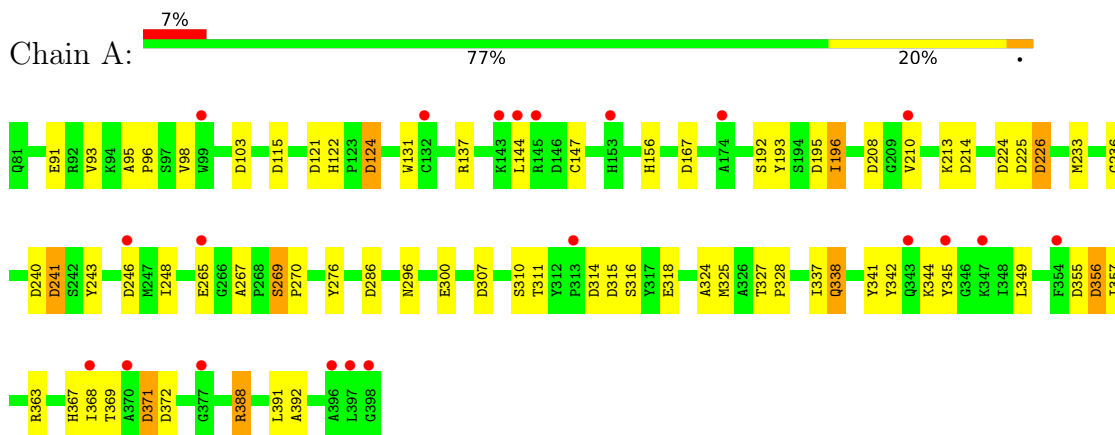
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	128	Total 128	O 128	0	0
5	B	26	Total 26	O 26	0	0

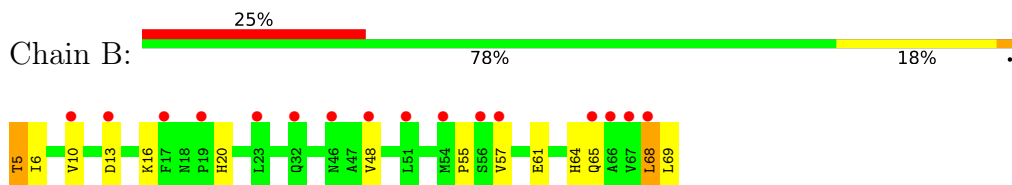
3 Residue-property plots [i](#)

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: Tk-subtilisin



- Molecule 2: Tk-subtilisin



4 Data and refinement statistics i

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	64.52Å 67.46Å 74.05Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 1.90 49.87 – 1.90	Depositor EDS
% Data completeness (in resolution range)	99.9 (50.00-1.90) 99.7 (49.87-1.90)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.85 (at 1.90Å)	Xtrriage
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.189 , 0.209 0.197 , 0.217	Depositor DCC
R_{free} test set	1310 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	26.3	Xtrriage
Anisotropy	0.186	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 51.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.018 for k,h,-l	Xtrriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	2978	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.83% 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

Bond lengths and bond angles in the following residue types are not validated in this section: CA, 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	1.47	13/2361 (0.6%)	1.35	28/3235 (0.9%)
2	B	1.29	1/512 (0.2%)	1.00	0/693
All	All	1.44	14/2873 (0.5%)	1.29	28/3928 (0.7%)

All (14) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	243	TYR	CD2-CE2	-8.52	1.26	1.39
1	A	233	MET	SD-CE	-8.03	1.32	1.77
1	A	91	GLU	CD-OE2	-7.01	1.18	1.25
1	A	98	VAL	CB-CG2	-6.73	1.38	1.52
1	A	210	VAL	C-O	6.25	1.35	1.23
1	A	93	VAL	CB-CG1	-6.11	1.40	1.52
1	A	193	TYR	CE1-CZ	-6.07	1.30	1.38
1	A	243	TYR	CD1-CE1	-5.83	1.30	1.39
1	A	341	TYR	CD1-CE1	5.77	1.48	1.39
1	A	269	SER	CB-OG	5.76	1.49	1.42
1	A	236	GLY	C-O	5.64	1.32	1.23
2	B	61	GLU	CD-OE2	5.28	1.31	1.25
1	A	388	ARG	CD-NE	-5.19	1.37	1.46
1	A	131	TRP	CG-CD1	5.14	1.44	1.36

All (28) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	226	ASP	CB-CG-OD2	13.25	130.23	118.30
1	A	388	ARG	NE-CZ-NH1	11.71	126.15	120.30
1	A	388	ARG	NE-CZ-NH2	-11.31	114.65	120.30
1	A	286	ASP	CB-CG-OD2	10.21	127.49	118.30
1	A	226	ASP	CB-CG-OD1	-9.57	109.69	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	225	ASP	CB-CG-OD2	8.30	125.77	118.30
1	A	356	ASP	CB-CG-OD2	8.00	125.50	118.30
1	A	246	ASP	CB-CG-OD2	7.89	125.40	118.30
1	A	372	ASP	CB-CG-OD1	7.86	125.38	118.30
1	A	241	ASP	CB-CG-OD2	7.59	125.13	118.30
1	A	371	ASP	CB-CG-OD2	7.20	124.78	118.30
1	A	286	ASP	CB-CG-OD1	-7.15	111.86	118.30
1	A	103	ASP	CB-CG-OD2	7.15	124.73	118.30
1	A	214	ASP	CB-CG-OD2	7.05	124.64	118.30
1	A	363	ARG	NE-CZ-NH2	-6.43	117.09	120.30
1	A	121	ASP	CB-CG-OD2	6.39	124.06	118.30
1	A	356	ASP	CB-CG-OD1	-6.27	112.66	118.30
1	A	363	ARG	NE-CZ-NH1	6.00	123.30	120.30
1	A	240	ASP	CB-CG-OD2	5.82	123.54	118.30
1	A	355	ASP	CB-CG-OD2	5.80	123.52	118.30
1	A	315	ASP	CB-CG-OD2	5.79	123.51	118.30
1	A	115	ASP	CB-CG-OD1	5.67	123.41	118.30
1	A	124	ASP	CB-CG-OD1	5.62	123.36	118.30
1	A	91	GLU	OE1-CD-OE2	-5.61	116.57	123.30
1	A	167	ASP	CB-CG-OD2	5.61	123.35	118.30
1	A	391	LEU	CB-CG-CD1	-5.39	101.83	111.00
1	A	363	ARG	CG-CD-NE	5.26	122.85	111.80
1	A	195	ASP	CB-CG-OD2	5.12	122.91	118.30

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	2314	0	2239	42	1
2	B	502	0	536	19	0
3	A	7	0	0	1	0
4	B	1	0	0	0	0
5	A	128	0	0	11	1
5	B	26	0	0	5	1

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	2978	0	2775	58	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 10.

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:147:CYS:HB3	5:A:1134:HOH:O	0.92	1.08
2:B:5:THR:N	5:B:2009:HOH:O	1.92	1.01
2:B:13:ASP:CG	2:B:16:LYS:NZ	2.15	1.00
2:B:13:ASP:CG	2:B:16:LYS:HZ3	1.66	0.97
1:A:314:ASP:OD2	5:A:1064:HOH:O	1.84	0.96
1:A:122:HIS:HD2	1:A:124:ASP:H	1.28	0.80
1:A:241:ASP:OD2	2:B:64:HIS:HD2	1.69	0.76
2:B:68:LEU:HD12	2:B:68:LEU:O	1.87	0.73
1:A:307:ASP:OD2	5:A:1037:HOH:O	2.06	0.73
1:A:357:ILE:HB	1:A:368:ILE:HD11	1.72	0.72
1:A:338:GLN:HE22	1:A:349:LEU:H	1.37	0.71
1:A:371:ASP:OD1	5:A:1117:HOH:O	2.08	0.71
2:B:13:ASP:CG	2:B:16:LYS:HZ1	1.93	0.70
2:B:10:VAL:HG13	2:B:57:VAL:HG13	1.74	0.67
2:B:13:ASP:OD2	2:B:16:LYS:NZ	2.27	0.67
1:A:356:ASP:O	1:A:367:HIS:HD2	1.78	0.67
2:B:13:ASP:CB	2:B:16:LYS:HZ1	2.09	0.65
2:B:10:VAL:CG1	2:B:57:VAL:HG13	2.30	0.61
1:A:300:GLU:OE2	1:A:367:HIS:HE1	1.83	0.61
1:A:226:ASP:OD2	3:A:1002:CA:CA	1.78	0.60
1:A:147:CYS:CB	5:A:1134:HOH:O	1.78	0.59
1:A:338:GLN:HA	1:A:338:GLN:HE21	1.68	0.59
1:A:318:GLU:OE2	5:A:1013:HOH:O	2.18	0.57
1:A:122:HIS:HE1	1:A:316:SER:O	1.88	0.56
1:A:267:ALA:H	1:A:296:ASN:ND2	2.05	0.55
1:A:208:ASP:OD2	1:A:213:LYS:HD2	2.07	0.53
1:A:144:LEU:HA	1:A:147:CYS:SG	2.48	0.53
2:B:55:PRO:HB3	5:B:2025:HOH:O	2.10	0.52
1:A:137:ARG:NH2	5:A:1099:HOH:O	2.43	0.51
1:A:342:TYR:O	1:A:345:TYR:O	2.28	0.51
2:B:13:ASP:CB	2:B:16:LYS:NZ	2.70	0.51
1:A:213:LYS:HD2	5:A:1119:HOH:O	2.10	0.51
1:A:213:LYS:NZ	5:A:1041:HOH:O	2.29	0.51

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:269:SER:HB2	1:A:270:PRO:CD	2.42	0.50
1:A:369:THR:O	1:A:388:ARG:HD3	2.13	0.49
1:A:327:THR:N	1:A:328:PRO:HD2	2.28	0.48
2:B:5:THR:CA	5:B:2009:HOH:O	2.54	0.48
1:A:324:ALA:HB2	2:B:69:LEU:C	2.34	0.48
1:A:357:ILE:CB	1:A:368:ILE:HD11	2.44	0.48
1:A:213:LYS:CE	5:A:1041:HOH:O	2.62	0.47
2:B:5:THR:HA	5:B:2009:HOH:O	2.16	0.46
1:A:241:ASP:OD2	2:B:64:HIS:CD2	2.59	0.46
2:B:20:HIS:CE1	5:B:2027:HOH:O	2.69	0.46
1:A:95:ALA:N	1:A:96:PRO:CD	2.79	0.46
1:A:344:LYS:HD3	1:A:345:TYR:CZ	2.51	0.45
1:A:192:SER:O	1:A:196:ILE:HG23	2.17	0.45
1:A:371:ASP:N	1:A:388:ARG:HD2	2.31	0.45
2:B:6:ILE:HD11	2:B:48:VAL:CG2	2.48	0.44
1:A:338:GLN:NE2	1:A:349:LEU:H	2.12	0.44
1:A:248:ILE:HD13	1:A:276:TYR:CD2	2.52	0.43
1:A:156:HIS:CD2	1:A:310:SER:HB3	2.53	0.43
1:A:224:ASP:HA	5:A:1133:HOH:O	2.19	0.42
1:A:371:ASP:HB2	1:A:388:ARG:HD2	2.01	0.42
1:A:156:HIS:HA	1:A:311:THR:O	2.19	0.42
1:A:337:ILE:HD11	1:A:392:ALA:HB1	2.02	0.42
1:A:300:GLU:OE2	1:A:367:HIS:CE1	2.68	0.41
1:A:196:ILE:HD12	1:A:196:ILE:C	2.41	0.41
2:B:68:LEU:HD12	2:B:68:LEU:C	2.42	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)
5:A:1034:HOH:O	5:A:1057:HOH:O[2_554]	2.12	0.08
1:A:265:GLU:OE2	5:B:2017:HOH:O[2_565]	2.19	0.01

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	316/318 (99%)	302 (96%)	14 (4%)	0	100	100
2	B	63/65 (97%)	63 (100%)	0	0	100	100
All	All	379/383 (99%)	365 (96%)	14 (4%)	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	242/242 (100%)	239 (99%)	3 (1%)	71	70
2	B	56/56 (100%)	53 (95%)	3 (5%)	22	13
All	All	298/298 (100%)	292 (98%)	6 (2%)	55	51

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	196	ILE
1	A	325	MET
1	A	338	GLN
2	B	5	THR
2	B	65	GLN
2	B	68	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	122	HIS
1	A	296	ASN
1	A	338	GLN
1	A	367	HIS

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Mol	Chain	Res	Type
2	B	64	HIS

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](#)

Of 8 ligands modelled in this entry, 8 are monoatomic - leaving 0 for Mogul analysis.

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	318/318 (100%)	0.42	21 (6%) 18 20	20, 27, 39, 56	0
2	B	65/65 (100%)	1.11	16 (24%) 0 0	25, 35, 48, 60	0
All	All	383/383 (100%)	0.54	37 (9%) 7 9	20, 28, 43, 60	0

All (37) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	398	GLY	12.5
2	B	48	VAL	7.2
2	B	56	SER	5.3
1	A	174	ALA	4.5
1	A	396	ALA	4.5
2	B	66	ALA	4.5
1	A	265	GLU	4.3
2	B	57	VAL	4.1
2	B	68	LEU	4.0
1	A	153	HIS	3.9
2	B	65	GLN	3.7
1	A	144	LEU	3.5
2	B	17	PHE	3.5
2	B	67	VAL	3.3
2	B	46	ASN	3.2
1	A	132	CYS	3.1
1	A	99	TRP	3.1
1	A	354	PHE	2.9
1	A	347	LYS	2.8
1	A	343	GLN	2.8
2	B	23	LEU	2.8
2	B	32	GLN	2.6
1	A	143	LYS	2.6
1	A	368	ILE	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	370	ALA	2.4
1	A	397	LEU	2.4
2	B	51	LEU	2.4
1	A	313	PRO	2.3
2	B	54	MET	2.3
1	A	210	VAL	2.2
1	A	345	TYR	2.2
2	B	10	VAL	2.1
2	B	13	ASP	2.1
1	A	246	ASP	2.1
1	A	145	ARG	2.1
2	B	19	PRO	2.0
1	A	377	GLY	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 monosaccharides 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(\AA^2)	Q<0.9
3	CA	A	1007	1/1	0.91	0.19	21,21,21,21	0
3	CA	A	1006	1/1	0.97	0.05	28,28,28,28	0
4	ZN	B	2001	1/1	0.97	0.06	37,37,37,37	0
3	CA	A	1001	1/1	0.99	0.05	24,24,24,24	0
3	CA	A	1003	1/1	0.99	0.07	22,22,22,22	0
3	CA	A	1004	1/1	0.99	0.16	14,14,14,14	0
3	CA	A	1005	1/1	1.00	0.05	22,22,22,22	0
3	CA	A	1002	1/1	1.00	0.16	14,14,14,14	0

6.5 Other polymers [i](#)

There are no such residues in this entry.