Full wwPDB X-ray Structure Validation Report ⓘ

Oct 25, 2023 – 04:02 AM EDT

PDB ID	:	2Z2Z
Title	:	Crystal structure of unautoprocessed form of Tk-subtilisin soaked by 10mM CaCl2
Authors	:	Tanaka, S.; Matsumura, H.; Koga, Y.; Takano, K.; Kanaya, S.
Deposited on	:	2007-05-29
Resolution	:	1.87 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:

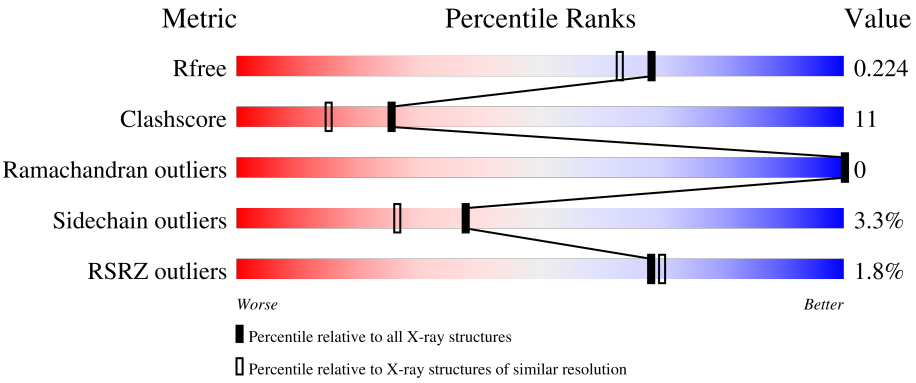
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.87 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	9470 (1.90-1.86)
Clashscore	141614	10282 (1.90-1.86)
Ramachandran outliers	138981	10152 (1.90-1.86)
Sidechain outliers	138945	10152 (1.90-1.86)
RSRZ outliers	127900	9303 (1.90-1.86)

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 <=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	395	2% 78% 15%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 3278 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 precursor.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	389	Total	C	N	O	S	0	0	0
			2861	1812	478	564	7			

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

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

- Molecule 3 is water.

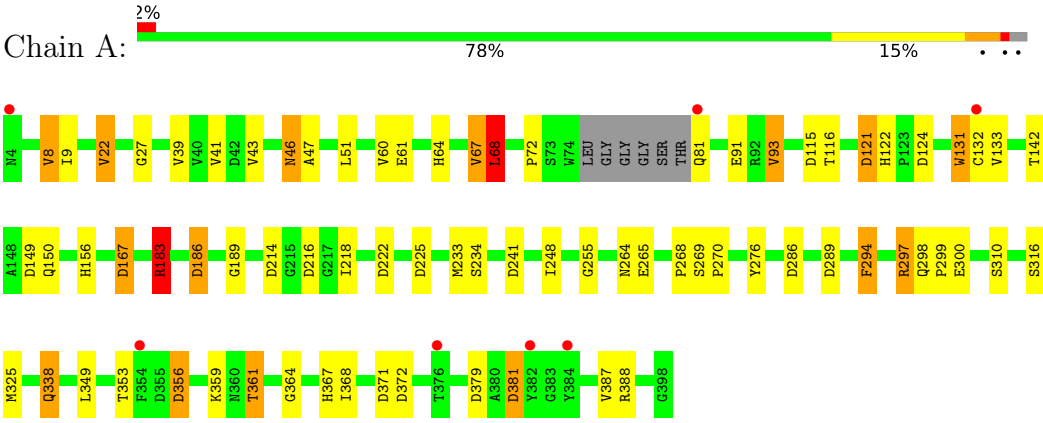
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	410	Total	O	0	0
			410	410		

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 precursor

Chain A:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, α, β, γ	92.66Å 124.17Å 72.31Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.33 – 1.87 46.33 – 1.87	Depositor EDS
% Data completeness (in resolution range)	99.6 (46.33-1.87) 99.6 (46.33-1.87)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	7.66 (at 1.87Å)	Xtriage
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.169 , 0.212 0.181 , 0.224	Depositor DCC
R_{free} test set	1752 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å^2)	19.7	Xtriage
Anisotropy	0.042	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 47.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	3278	wwPDB-VP
Average B, all atoms (Å^2)	23.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.25% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: CA

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	1.34	16/2921 (0.5%)	1.38	26/3995 (0.7%)

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	1	0

All (16) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	91	GLU	CD-OE2	12.44	1.39	1.25
1	A	39	VAL	CB-CG2	-8.64	1.34	1.52
1	A	93	VAL	CB-CG2	-7.68	1.36	1.52
1	A	41	VAL	CB-CG2	-7.42	1.37	1.52
1	A	22	VAL	CB-CG2	-7.12	1.37	1.52
1	A	8	VAL	CB-CG1	-7.07	1.38	1.52
1	A	361	THR	CB-CG2	-6.82	1.29	1.52
1	A	183	ARG	NE-CZ	6.15	1.41	1.33
1	A	131	TRP	CE3-CZ3	-6.11	1.28	1.38
1	A	67	VAL	CB-CG1	-5.79	1.40	1.52
1	A	132	CYS	CA-CB	5.79	1.66	1.53
1	A	255	GLY	C-O	-5.57	1.14	1.23
1	A	147	CYS	CB-SG	-5.38	1.73	1.81
1	A	294	PHE	CA-CB	-5.30	1.42	1.53
1	A	265	GLU	CD-OE2	5.26	1.31	1.25
1	A	233	MET	SD-CE	-5.26	1.48	1.77

All (26) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	183	ARG	NE-CZ-NH1	30.92	135.76	120.30
1	A	183	ARG	NE-CZ-NH2	-21.03	109.78	120.30
1	A	121	ASP	CB-CG-OD1	18.36	134.82	118.30
1	A	183	ARG	CD-NE-CZ	11.08	139.12	123.60
1	A	214	ASP	CB-CG-OD2	9.89	127.20	118.30
1	A	186	ASP	CB-CG-OD1	9.76	127.09	118.30
1	A	149	ASP	CB-CG-OD2	9.55	126.90	118.30
1	A	132	CYS	CB-CA-C	8.29	126.97	110.40
1	A	121	ASP	CB-CG-OD2	-8.20	110.92	118.30
1	A	372	ASP	CB-CG-OD1	7.63	125.17	118.30
1	A	297	ARG	NE-CZ-NH2	-7.56	116.52	120.30
1	A	297	ARG	NE-CZ-NH1	7.31	123.95	120.30
1	A	379	ASP	CB-CG-OD2	-6.53	112.42	118.30
1	A	144	LEU	CB-CG-CD2	6.39	121.86	111.00
1	A	225	ASP	CB-CG-OD1	6.32	123.99	118.30
1	A	115	ASP	CB-CG-OD2	6.26	123.94	118.30
1	A	289	ASP	CB-CG-OD2	6.13	123.82	118.30
1	A	167	ASP	CB-CG-OD2	6.09	123.78	118.30
1	A	68	LEU	CB-CG-CD2	5.95	121.12	111.00
1	A	216	ASP	CB-CG-OD2	5.83	123.54	118.30
1	A	286	ASP	CB-CG-OD2	5.82	123.54	118.30
1	A	132	CYS	N-CA-C	-5.80	95.33	111.00
1	A	320	LEU	CB-CG-CD1	5.74	120.75	111.00
1	A	320	LEU	CB-CG-CD2	5.56	120.46	111.00
1	A	183	ARG	NH1-CZ-NH2	-5.21	113.67	119.40
1	A	381	ASP	CB-CG-OD2	5.06	122.85	118.30

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	A	361	THR	CB

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	2861	0	2817	60	0
2	A	7	0	0	1	0
3	A	410	0	0	7	3
All	All	3278	0	2817	60	3

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 11.

All (60) 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:81:GLN:NE2	3:A:1413:HOH:O	1.63	1.27
1:A:8:VAL:HG11	1:A:60:VAL:CG1	1.92	1.00
1:A:122:HIS:HD2	1:A:124:ASP:H	1.16	0.94
1:A:8:VAL:HG11	1:A:60:VAL:HG13	1.49	0.94
1:A:133:VAL:HG12	1:A:142:THR:HG22	1.54	0.88
1:A:361:THR:HG23	1:A:364:GLY:H	1.47	0.79
1:A:64:HIS:HD2	1:A:241:ASP:OD2	1.67	0.78
1:A:8:VAL:HG13	1:A:61:GLU:O	1.85	0.77
1:A:371:ASP:HB2	1:A:388:ARG:HD2	1.67	0.77
1:A:300:GLU:OE2	1:A:367:HIS:HE1	1.68	0.76
1:A:131:TRP:CZ2	1:A:133:VAL:HG11	2.21	0.75
1:A:67:VAL:HG22	1:A:68:LEU:HD23	1.67	0.74
1:A:93:VAL:HG23	1:A:387:VAL:O	1.90	0.71
1:A:338:GLN:HE22	1:A:349:LEU:H	1.38	0.71
1:A:356:ASP:OD1	1:A:361:THR:HG21	1.90	0.71
1:A:361:THR:CG2	1:A:364:GLY:H	2.06	0.69
1:A:122:HIS:CD2	1:A:124:ASP:H	2.07	0.68
1:A:268:PRO:HD2	3:A:1392:HOH:O	1.94	0.67
1:A:359:LYS:HG2	1:A:368:ILE:HD11	1.76	0.67
1:A:356:ASP:O	1:A:367:HIS:HD2	1.78	0.66
1:A:186:ASP:HB2	3:A:1039:HOH:O	1.96	0.65
1:A:8:VAL:HG11	1:A:60:VAL:HG12	1.78	0.64
1:A:121:ASP:OD1	2:A:1002:CA:CA	1.75	0.64
1:A:46:ASN:C	1:A:46:ASN:HD22	2.02	0.63
1:A:8:VAL:HG12	1:A:9:ILE:N	2.14	0.62
1:A:338:GLN:HA	1:A:338:GLN:HE21	1.64	0.61
1:A:8:VAL:CG1	1:A:60:VAL:HG13	2.27	0.60
1:A:300:GLU:OE2	1:A:367:HIS:CE1	2.52	0.60
1:A:381:ASP:OD2	3:A:1376:HOH:O	2.16	0.59
1:A:122:HIS:HE1	1:A:316:SER:O	1.86	0.58
1:A:167:ASP:OD2	3:A:1341:HOH:O	2.18	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:156:HIS:CD2	1:A:310:SER:HB3	2.43	0.54
1:A:116:THR:O	1:A:183:ARG:CD	2.56	0.53
1:A:298:GLN:N	1:A:299:PRO:CD	2.71	0.53
1:A:46:ASN:HD22	1:A:47:ALA:N	2.06	0.53
1:A:67:VAL:HG22	1:A:68:LEU:N	2.24	0.52
1:A:116:THR:O	1:A:183:ARG:HD3	2.11	0.51
1:A:264:ASN:HA	1:A:294:PHE:O	2.09	0.51
1:A:72:PRO:HA	1:A:320:LEU:HD22	1.92	0.51
1:A:93:VAL:CG2	1:A:387:VAL:HG13	2.45	0.47
1:A:218:ILE:HG22	1:A:222:ASP:HB2	1.96	0.46
1:A:27:GLY:HA3	1:A:43:VAL:HG12	1.97	0.46
1:A:131:TRP:CE2	1:A:133:VAL:CG1	2.99	0.46
1:A:8:VAL:CG1	1:A:9:ILE:N	2.79	0.45
1:A:297:ARG:N	1:A:297:ARG:HD2	2.32	0.44
1:A:67:VAL:HG22	1:A:68:LEU:CD2	2.41	0.44
1:A:9:ILE:N	1:A:9:ILE:HD12	2.32	0.44
1:A:338:GLN:NE2	1:A:349:LEU:H	2.10	0.44
1:A:276:TYR:O	3:A:1009:HOH:O	2.21	0.44
1:A:131:TRP:CE2	1:A:133:VAL:HG11	2.53	0.43
1:A:234:SER:HB3	1:A:324:ALA:HB1	2.00	0.43
1:A:93:VAL:HG22	1:A:93:VAL:O	2.18	0.43
1:A:68:LEU:HD13	1:A:189:GLY:HA3	2.02	0.42
1:A:269:SER:HB2	1:A:270:PRO:CD	2.49	0.42
1:A:8:VAL:CG1	1:A:60:VAL:CG1	2.80	0.41
1:A:150:GLN:NE2	3:A:1158:HOH:O	2.40	0.41
1:A:353:THR:O	1:A:356:ASP:HB2	2.21	0.41
1:A:356:ASP:O	1:A:367:HIS:CD2	2.67	0.41
1:A:67:VAL:CG2	1:A:68:LEU:HD23	2.43	0.40
1:A:93:VAL:HG21	1:A:387:VAL:HG13	2.03	0.40

All (3) 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)
3:A:1407:HOH:O	3:A:1407:HOH:O[3_656]	0.78	1.42
3:A:1173:HOH:O	3:A:1173:HOH:O[4_556]	1.67	0.53
3:A:1321:HOH:O	3:A:1347:HOH:O[8_555]	2.12	0.08

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	385/395 (98%)	374 (97%)	11 (3%)	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	302/305 (99%)	292 (97%)	10 (3%)	38 26

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	22	VAL
1	A	46	ASN
1	A	51	LEU
1	A	68	LEU
1	A	147	CYS
1	A	183	ARG
1	A	248	ILE
1	A	325	MET
1	A	338	GLN
1	A	356	ASP

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	46	ASN
1	A	64	HIS
1	A	122	HIS
1	A	150	GLN
1	A	338	GLN
1	A	367	HIS

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 monosaccharides in this entry.

5.6 Ligand geometry

Of 7 ligands modelled in this entry, 7 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

There are no such residues in this entry.

5.8 Polymer linkage issues

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, 95^{th} 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	389/395 (98%)	-0.18	7 (1%)	68	70	12, 20, 35, 56	0

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	4	ASN	4.1
1	A	132	CYS	4.1
1	A	376	THR	3.4
1	A	354	PHE	3.0
1	A	81	GLN	2.8
1	A	382	TYR	2.6
1	A	384	TYR	2.2

6.2 Non-standard residues in protein, DNA, RNA chains

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates

There are no monosaccharides in this entry.

6.4 Ligands

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, 95^{th} 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	CA	A	1006	1/1	0.95	0.11	29,29,29,29	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	CA	A	1002	1/1	0.98	0.08	22,22,22,22	0
2	CA	A	1005	1/1	0.99	0.05	18,18,18,18	0
2	CA	A	1004	1/1	0.99	0.03	17,17,17,17	0
2	CA	A	1003	1/1	1.00	0.03	15,15,15,15	0
2	CA	A	1001	1/1	1.00	0.05	14,14,14,14	0
2	CA	A	1007	1/1	1.00	0.07	15,15,15,15	0

6.5 Other polymers (i)

There are no such residues in this entry.