



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 11:50 AM UTC

PDB ID : 2AUM / pdb_00002aum
Title : Active site Ser115Ala mutant of LD-carboxypeptidase
Authors : Korza, H.J.; Bochtler, M.
Deposited on : 2005-08-28
Resolution : 2.40 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
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

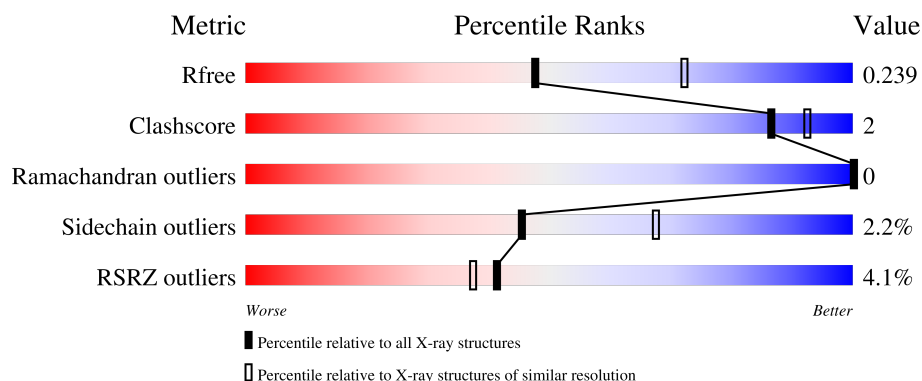
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

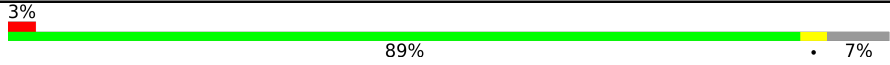
The reported resolution of this entry is 2.40 Å.

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	4912 (2.40-2.40)
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)
RSRZ outliers	180081	4916 (2.40-2.40)

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	317	
1	B	317	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4813 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 hypothetical protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	294	Total	C	N	O	S	0	0	0
			2249	1425	411	406	7			
1	B	294	Total	C	N	O	S	0	0	0
			2254	1427	412	408	7			

There are 26 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-9	MET	-	cloning artifact	UNP Q9HTZ1
A	-8	GLY	-	cloning artifact	UNP Q9HTZ1
A	-7	HIS	-	expression tag	UNP Q9HTZ1
A	-6	HIS	-	expression tag	UNP Q9HTZ1
A	-5	HIS	-	expression tag	UNP Q9HTZ1
A	-4	HIS	-	expression tag	UNP Q9HTZ1
A	-3	HIS	-	expression tag	UNP Q9HTZ1
A	-2	HIS	-	expression tag	UNP Q9HTZ1
A	-1	GLU	-	cloning artifact	UNP Q9HTZ1
A	0	PHE	-	cloning artifact	UNP Q9HTZ1
A	30	GLU	ASP	variant	UNP Q9HTZ1
A	104	GLU	GLN	variant	UNP Q9HTZ1
A	115	ALA	SER	engineered mutation	UNP Q9HTZ1
B	-9	MET	-	cloning artifact	UNP Q9HTZ1
B	-8	GLY	-	cloning artifact	UNP Q9HTZ1
B	-7	HIS	-	expression tag	UNP Q9HTZ1
B	-6	HIS	-	expression tag	UNP Q9HTZ1
B	-5	HIS	-	expression tag	UNP Q9HTZ1
B	-4	HIS	-	expression tag	UNP Q9HTZ1
B	-3	HIS	-	expression tag	UNP Q9HTZ1
B	-2	HIS	-	expression tag	UNP Q9HTZ1
B	-1	GLU	-	cloning artifact	UNP Q9HTZ1
B	0	PHE	-	cloning artifact	UNP Q9HTZ1
B	30	GLU	ASP	variant	UNP Q9HTZ1
B	104	GLU	GLN	variant	UNP Q9HTZ1

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
B	115	ALA	SER	engineered mutation	UNP Q9HTZ1

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	155	Total 155	O 155	0	0
2	B	155	Total 155	O 155	0	0

- Molecule 1: hypothetical protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	52.45Å 77.84Å 71.15Å 90.00° 104.53° 90.00°	Depositor
Resolution (Å)	15.00 – 2.40 15.00 – 2.40	Depositor EDS
% Data completeness (in resolution range)	98.6 (15.00-2.40) 98.1 (15.00-2.40)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	0.10	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.72 (at 2.39Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.242 , 0.247 0.230 , 0.239	Depositor DCC
R_{free} test set	1082 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	15.1	Xtriage
Anisotropy	0.607	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 43.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.89	EDS
Total number of atoms	4813	wwPDB-VP
Average B, all atoms (Å ²)	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.02% 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

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	0.81	0/2304	0.85	0/3133
1	B	0.82	0/2308	0.87	0/3138
All	All	0.81	0/4612	0.86	0/6271

There are no bond length outliers.

There are no bond angle outliers.

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	2249	0	2225	5	0
1	B	2254	0	2226	14	0
2	A	155	0	0	3	0
2	B	155	0	0	3	0
All	All	4813	0	4451	19	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 2.

All (19) 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:B:279:HIS:CE1	1:B:280:HIS:CE1	2.78	0.71

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:47:HIS:HE1	1:B:72:ASN:OD1	1.74	0.70
1:A:51:HIS:CE1	2:A:359:HOH:O	2.46	0.69
1:B:238:ASP:OD2	1:B:241:GLN:NE2	2.32	0.63
1:B:115:ALA:HB1	2:B:337:HOH:O	2.01	0.60
1:A:142:LEU:C	2:A:382:HOH:O	2.48	0.56
1:A:36:LEU:HD11	1:A:48:LEU:HD11	1.88	0.55
1:A:152:GLN:N	2:A:459:HOH:O	2.40	0.55
1:B:17:ARG:CD	2:B:424:HOH:O	2.57	0.53
1:B:17:ARG:HD3	2:B:424:HOH:O	2.10	0.52
1:B:51:HIS:HE1	1:B:68:GLU:OE2	1.96	0.47
1:B:170:HIS:HA	1:B:307:TRP:CE2	2.50	0.46
1:A:37:ARG:HG3	1:A:38:GLN:N	2.29	0.46
1:B:176:HIS:HE1	1:B:180:HIS:O	1.99	0.45
1:B:170:HIS:HA	1:B:307:TRP:NE1	2.32	0.45
1:B:9:GLN:HE21	1:B:156:ALA:HB2	1.81	0.44
1:B:21:ILE:HD13	1:B:70:LEU:HD13	2.00	0.43
1:B:176:HIS:CE1	1:B:180:HIS:O	2.74	0.41
1:B:215:VAL:HA	1:B:246:CYS:O	2.21	0.40

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	290/317 (92%)	286 (99%)	4 (1%)	0	100	100
1	B	290/317 (92%)	285 (98%)	5 (2%)	0	100	100
All	All	580/634 (92%)	571 (98%)	9 (2%)	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	227/248 (92%)	221 (97%)	6 (3%)	40	63
1	B	227/248 (92%)	223 (98%)	4 (2%)	51	73
All	All	454/496 (92%)	444 (98%)	10 (2%)	45	67

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

Mol	Chain	Res	Type
1	A	15	ASP
1	A	37	ARG
1	A	102	ARG
1	A	257	GLU
1	A	279	HIS
1	A	288	GLN
1	B	70	LEU
1	B	76	MET
1	B	168	ILE
1	B	288	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (15) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	38	GLN
1	A	42	HIS
1	A	51	HIS
1	A	152	GLN
1	A	182	GLN
1	A	279	HIS
1	B	9	GLN
1	B	42	HIS
1	B	47	HIS
1	B	51	HIS
1	B	152	GLN
1	B	175	GLN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	B	176	HIS
1	B	182	GLN
1	B	241	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 oligosaccharides 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

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	294/317 (92%)	0.32	11 (3%) 45 41	13, 19, 30, 41	0
1	B	294/317 (92%)	0.34	13 (4%) 39 34	13, 18, 31, 43	0
All	All	588/634 (92%)	0.33	24 (4%) 41 37	13, 18, 31, 43	0

All (24) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	167	GLY	4.5
1	A	252	ASP	3.7
1	B	9	GLN	3.6
1	B	10	THR	3.4
1	B	152	GLN	3.2
1	A	251	THR	3.1
1	B	7	SER	3.1
1	B	166	ALA	3.0
1	B	75	ASP	3.0
1	A	241	GLN	3.0
1	B	8	ASP	2.6
1	A	33	GLU	2.6
1	B	76	MET	2.5
1	A	257	GLU	2.5
1	B	168	ILE	2.4
1	A	258	VAL	2.4
1	B	170	HIS	2.4
1	B	30	GLU	2.4
1	A	253	CYS	2.3
1	A	8	ASP	2.3
1	A	284	GLY	2.3
1	A	153	GLU	2.2
1	B	153	GLU	2.2
1	A	37	ARG	2.1

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 oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.