



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 12:38 PM UTC

PDB ID : 5VT8 / pdb_00005vt8
Title : Crystal Structure of Mouse Cadherin-23 EC24-25
Authors : Jaiganesh, A.; Sotomayor, M.
Deposited on : 2017-05-15
Resolution : 2.92 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	:	4-5-2 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

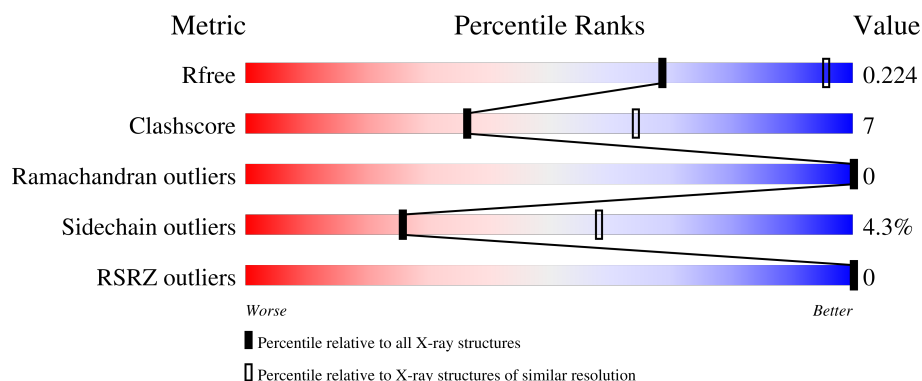
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.92 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	2995 (2.94-2.90)
Clashscore	190562	3213 (2.94-2.90)
Ramachandran outliers	187476	3128 (2.94-2.90)
Sidechain outliers	187428	3130 (2.94-2.90)
RSRZ outliers	180081	2995 (2.94-2.90)

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	221	
1	B	221	
1	C	221	
1	D	221	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 6441 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 Cadherin-23.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	B	207	Total	C	N	O	S	0	0	0
			1625	1026	266	327	6			
1	A	208	Total	C	N	O	S	0	0	0
			1633	1030	267	330	6			
1	C	211	Total	C	N	O	S	0	0	0
			1652	1038	271	337	6			
1	D	195	Total	C	N	O	S	0	0	0
			1522	964	246	306	6			

There are 36 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	2480	MET	-	initiating methionine	UNP Q99PF4
B	2693	LEU	-	expression tag	UNP Q99PF4
B	2694	GLU	-	expression tag	UNP Q99PF4
B	2695	HIS	-	expression tag	UNP Q99PF4
B	2696	HIS	-	expression tag	UNP Q99PF4
B	2697	HIS	-	expression tag	UNP Q99PF4
B	2698	HIS	-	expression tag	UNP Q99PF4
B	2699	HIS	-	expression tag	UNP Q99PF4
B	2700	HIS	-	expression tag	UNP Q99PF4
A	2480	MET	-	initiating methionine	UNP Q99PF4
A	2693	LEU	-	expression tag	UNP Q99PF4
A	2694	GLU	-	expression tag	UNP Q99PF4
A	2695	HIS	-	expression tag	UNP Q99PF4
A	2696	HIS	-	expression tag	UNP Q99PF4
A	2697	HIS	-	expression tag	UNP Q99PF4
A	2698	HIS	-	expression tag	UNP Q99PF4
A	2699	HIS	-	expression tag	UNP Q99PF4
A	2700	HIS	-	expression tag	UNP Q99PF4
C	2480	MET	-	initiating methionine	UNP Q99PF4
C	2693	LEU	-	expression tag	UNP Q99PF4
C	2694	GLU	-	expression tag	UNP Q99PF4

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Chain	Residue	Modelled	Actual	Comment	Reference
C	2695	HIS	-	expression tag	UNP Q99PF4
C	2696	HIS	-	expression tag	UNP Q99PF4
C	2697	HIS	-	expression tag	UNP Q99PF4
C	2698	HIS	-	expression tag	UNP Q99PF4
C	2699	HIS	-	expression tag	UNP Q99PF4
C	2700	HIS	-	expression tag	UNP Q99PF4
D	2480	MET	-	initiating methionine	UNP Q99PF4
D	2693	LEU	-	expression tag	UNP Q99PF4
D	2694	GLU	-	expression tag	UNP Q99PF4
D	2695	HIS	-	expression tag	UNP Q99PF4
D	2696	HIS	-	expression tag	UNP Q99PF4
D	2697	HIS	-	expression tag	UNP Q99PF4
D	2698	HIS	-	expression tag	UNP Q99PF4
D	2699	HIS	-	expression tag	UNP Q99PF4
D	2700	HIS	-	expression tag	UNP Q99PF4

- Molecule 2 is CALCIUM ION (CCD ID: CA) (formula: Ca).

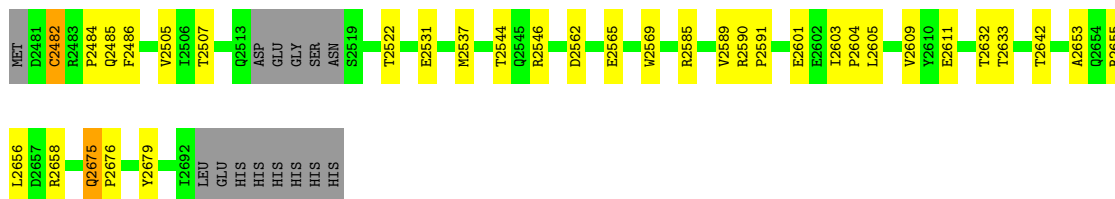
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	2	Total Ca 2 2	0	0
2	A	2	Total Ca 2 2	0	0
2	C	2	Total Ca 2 2	0	0
2	D	3	Total Ca 3 3	0	0

3 Residue-property plots

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.

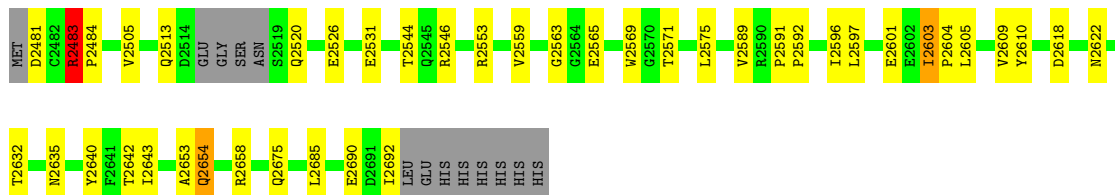
• Molecule 1: Cadherin-23

Chain B: 



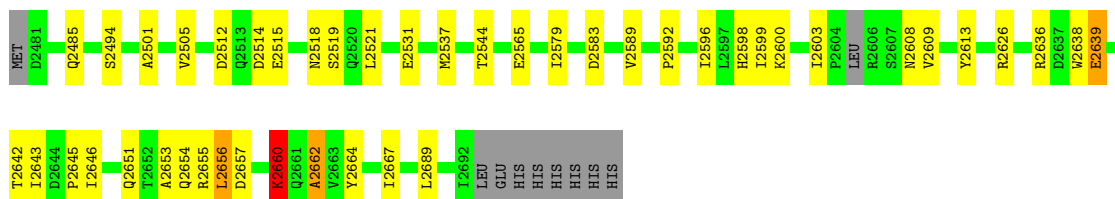
• Molecule 1: Cadherin-23

Chain A: 



• Molecule 1: Cadherin-23

Chain C: 



• Molecule 1: Cadherin-23

Chain D: 



A2653	A2654	ARG	LEU	ASP	ARG	GLU	LYS	GLN	ALA	V2663	I2667	L2668	V2669	D2672	Q2676	P2678	Y2679	M2682	A2688	LEU	GLU	ASP	TLE	LEU	HIS	HIS	HIS	HIS	HIS
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4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	27.61Å 99.39Å 157.43Å 90.00° 90.07° 90.00°	Depositor
Resolution (Å)	47.39 – 2.92 47.39 – 2.92	Depositor EDS
% Data completeness (in resolution range)	93.7 (47.39-2.92) 94.2 (47.39-2.92)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.53 (at 2.91Å)	Xtriage
Refinement program	REFMAC 5.8.0158	Depositor
R, R_{free}	0.208 , 0.221 0.210 , 0.224	Depositor DCC
R_{free} test set	867 reflections (4.59%)	wwPDB-VP
Wilson B-factor (Å ²)	34.2	Xtriage
Anisotropy	0.906	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 0.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.447 for h,-k,-l	Xtriage
Reported twinning fraction	0.499 for H, K, L 0.501 for -h,-k,l	Depositor
Outliers	0 of 17687 reflections	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	6441	wwPDB-VP
Average B, all atoms (Å ²)	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.84% 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

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	0.72	0/1667	0.95	3/2276 (0.1%)
1	B	0.73	0/1659	0.95	3/2265 (0.1%)
1	C	0.67	0/1686	0.97	3/2301 (0.1%)
1	D	0.72	0/1555	1.02	8/2125 (0.4%)
All	All	0.71	0/6567	0.97	17/8967 (0.2%)

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	0	1
1	B	0	1
1	C	0	2
1	D	0	2
All	All	0	6

There are no bond length outliers.

The worst 5 of 17 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	2632	THR	N-CA-C	11.71	126.35	111.24
1	C	2660	LYS	N-CA-C	-8.84	94.79	108.76
1	A	2483	ARG	CA-C-N	7.04	128.64	119.84
1	A	2483	ARG	C-N-CA	7.04	128.64	119.84
1	D	2483	ARG	CA-C-N	6.71	127.07	119.83

There are no chirality outliers.

5 of 6 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	2565	GLU	Peptide
1	B	2565	GLU	Peptide
1	C	2565	GLU	Peptide
1	C	2660	LYS	Peptide
1	D	2565	GLU	Peptide

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	1633	0	1583	25	1
1	B	1625	0	1579	18	2
1	C	1652	0	1592	33	2
1	D	1522	0	1473	19	2
2	A	2	0	0	0	0
2	B	2	0	0	0	0
2	C	2	0	0	0	0
2	D	3	0	0	0	0
All	All	6441	0	6227	91	4

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.

The worst 5 of 91 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:2601:GLU:HG3	1:B:2658:ARG:HB2	1.80	0.62
1:A:2603:ILE:HG13	1:A:2604:PRO:HD2	1.84	0.60
1:B:2522:THR:HB	1:B:2537:MET:HG3	1.85	0.59
1:A:2513:GLN:HA	1:A:2513:GLN:OE1	2.02	0.58
1:C:2656:LEU:HD11	1:C:2664:TYR:CD2	2.39	0.57

All (4) 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)
1:B:2569:TRP:N	1:D:2611:GLU:OE2[1_455]	1.90	0.30
1:C:2592:PRO:CG	1:C:2639:GLU:OE1[1_655]	2.11	0.09
1:B:2611:GLU:OE1	1:D:2483:ARG:NH2[1_455]	2.17	0.03
1:A:2526:GLU:OE2	1:C:2613:TYR:OH[1_455]	2.17	0.03

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	204/221 (92%)	192 (94%)	12 (6%)	0	100	100
1	B	203/221 (92%)	191 (94%)	12 (6%)	0	100	100
1	C	207/221 (94%)	190 (92%)	17 (8%)	0	100	100
1	D	189/221 (86%)	180 (95%)	9 (5%)	0	100	100
All	All	803/884 (91%)	753 (94%)	50 (6%)	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	185/197 (94%)	177 (96%)	8 (4%)	26	58
1	B	184/197 (93%)	180 (98%)	4 (2%)	45	75
1	C	187/197 (95%)	178 (95%)	9 (5%)	23	54
1	D	173/197 (88%)	163 (94%)	10 (6%)	18	47

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	729/788 (92%)	698 (96%)	31 (4%)	26 58

5 of 31 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	2589	VAL
1	D	2630	LEU
1	C	2639	GLU
1	D	2669	VAL
1	D	2597	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	2518	ASN
1	C	2654	GLN
1	D	2485	GLN
1	A	2651	GLN
1	A	2635	ASN

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 9 ligands modelled in this entry, 9 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 [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	208/221 (94%)	-1.33	0 100 100	25, 41, 63, 73	0
1	B	207/221 (93%)	-1.32	0 100 100	29, 42, 68, 88	0
1	C	211/221 (95%)	-1.26	0 100 100	31, 49, 85, 99	0
1	D	195/221 (88%)	-1.18	0 100 100	27, 51, 99, 108	0
All	All	821/884 (92%)	-1.27	0 100 100	25, 44, 86, 108	0

There are no RSRZ outliers to report.

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
2	CA	A	2801	1/1	0.99	0.04	49,49,49,49	0
2	CA	C	2802	1/1	0.99	0.02	51,51,51,51	0
2	CA	D	2802	1/1	0.99	0.02	58,58,58,58	0
2	CA	D	2803	1/1	0.99	0.02	42,42,42,42	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	CA	C	2801	1/1	1.00	0.01	45,45,45,45	0
2	CA	B	2802	1/1	1.00	0.01	36,36,36,36	0
2	CA	D	2801	1/1	1.00	0.01	41,41,41,41	0
2	CA	B	2801	1/1	1.00	0.03	39,39,39,39	0
2	CA	A	2802	1/1	1.00	0.02	35,35,35,35	0

6.5 Other polymers [i](#)

There are no such residues in this entry.