



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 05:24 PM UTC

PDB ID : 2E4L / pdb_00002e4l
Title : Thermodynamic and Structural Analysis of Thermolabile RNase HI from *Shewanella oneidensis* MR-1
Authors : Tadokoro, T.; You, D.J.; Chon, H.; Matsumura, H.; Koga, Y.; Takano, K.; Kanaya, S.
Deposited on : 2006-12-13
Resolution : 2.00 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

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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

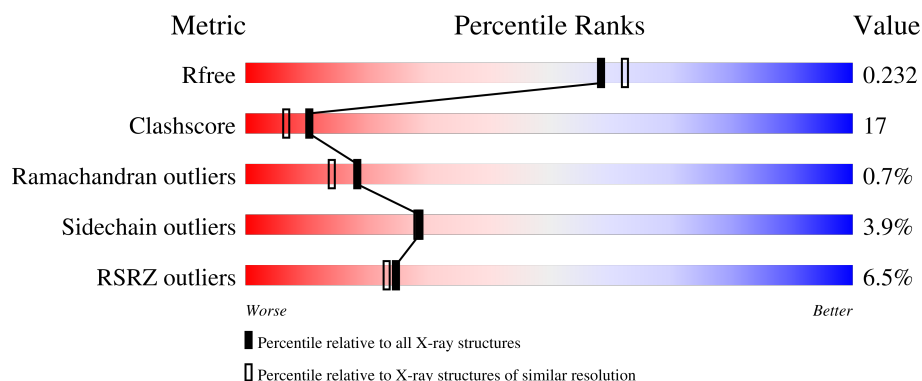
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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	158	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 1386 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 Ribonuclease HI.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	155	Total	C	N	O	S	0	0	0
			1223	769	221	224	9			

- Molecule 2 is water.

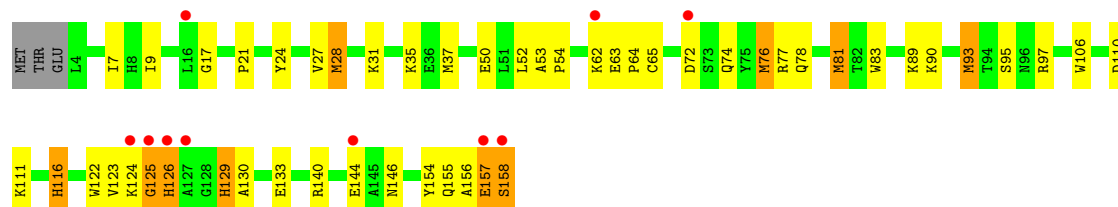
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	163	Total	O	0	0
			163	163		

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: Ribonuclease HI

Chain A: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 4 2 2	Depositor
Cell constants a, b, c, α , β , γ	77.13Å 77.13Å 76.66Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	27.22 – 2.00 27.22 – 2.00	Depositor EDS
% Data completeness (in resolution range)	100.0 (27.22-2.00) 99.9 (27.22-2.00)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	12.95 (at 1.99Å)	Xtriage
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.189 , 0.219 0.199 , 0.232	Depositor DCC
R_{free} test set	801 reflections (4.93%)	wwPDB-VP
Wilson B-factor (Å ²)	22.5	Xtriage
Anisotropy	0.036	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 39.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.018 for -h,-l,-k 0.009 for l,-k,h	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	1386	wwPDB-VP
Average B, all atoms (Å ²)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.23% 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	1.88	18/1252 (1.4%)	1.42	11/1691 (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 (18) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	76	MET	SD-CE	-13.64	1.45	1.79
1	A	93	MET	SD-CE	12.16	2.10	1.79
1	A	28	MET	SD-CE	-10.64	1.52	1.79
1	A	81	MET	SD-CE	8.15	2.00	1.79
1	A	63	GLU	C-O	-7.45	1.17	1.24
1	A	130	ALA	CA-CB	6.76	1.64	1.53
1	A	146	ASN	N-CA	6.54	1.51	1.46
1	A	76	MET	CG-SD	-6.25	1.65	1.80
1	A	52	LEU	CA-C	6.00	1.60	1.52
1	A	72	ASP	CA-C	5.80	1.60	1.52
1	A	27	VAL	CB-CG1	5.55	1.70	1.52
1	A	106	TRP	CA-CB	-5.50	1.44	1.53
1	A	17	GLY	C-N	-5.48	1.27	1.33
1	A	116	HIS	C-O	-5.44	1.16	1.23
1	A	31	LYS	CA-C	-5.38	1.48	1.53
1	A	146	ASN	C-O	-5.33	1.21	1.23
1	A	146	ASN	CA-CB	5.24	1.57	1.52
1	A	110	ASP	C-O	5.18	1.30	1.24

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	17	GLY	N-CA-C	8.88	121.09	112.04
1	A	126	HIS	CB-CA-C	7.09	123.56	110.10
1	A	126	HIS	N-CA-CB	7.01	122.41	110.50
1	A	72	ASP	N-CA-CB	-6.81	100.41	110.49
1	A	17	GLY	CA-C-O	6.31	127.00	122.45
1	A	97	ARG	NE-CZ-NH1	-6.24	115.26	121.50
1	A	129	HIS	N-CA-C	-5.94	102.53	110.55
1	A	146	ASN	CB-CA-C	5.44	115.06	111.20
1	A	140	ARG	CG-CD-NE	-5.32	100.30	112.00
1	A	95	SER	N-CA-C	-5.21	106.88	113.18
1	A	7	ILE	CB-CA-C	-5.16	102.99	110.63

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	A	126	HIS	CA

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	1223	0	1207	41	3
2	A	163	0	0	7	2
All	All	1386	0	1207	41	5

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 17.

All (41) 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:93:MET:SD	1:A:93:MET:CE	2.10	1.38
1:A:155:GLN:O	1:A:158:SER:HB2	1.32	1.24
1:A:123:VAL:CG1	1:A:126:HIS:HB2	1.72	1.20
1:A:81:MET:HG2	2:A:265:HOH:O	0.89	1.06

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:154:TYR:CE1	1:A:158:SER:HB3	1.91	1.05
1:A:123:VAL:HG12	1:A:126:HIS:CB	1.88	1.04
1:A:129:HIS:ND1	2:A:285:HOH:O	1.95	0.98
1:A:123:VAL:HG12	1:A:126:HIS:HB2	1.40	0.97
1:A:155:GLN:O	1:A:158:SER:CB	2.15	0.95
1:A:89:LYS:NZ	2:A:254:HOH:O	1.83	0.90
1:A:123:VAL:HG11	1:A:126:HIS:HB2	1.54	0.87
1:A:65:CYS:H	1:A:116:HIS:HD2	1.24	0.86
1:A:125:GLY:HA2	1:A:126:HIS:CD2	2.17	0.79
1:A:125:GLY:HA2	1:A:126:HIS:CB	2.13	0.78
1:A:111:LYS:HE3	2:A:290:HOH:O	1.83	0.77
1:A:123:VAL:HG12	1:A:126:HIS:HB3	1.67	0.75
1:A:125:GLY:HA2	1:A:126:HIS:HB3	1.68	0.74
1:A:123:VAL:CG1	1:A:126:HIS:CB	2.52	0.73
1:A:50:GLU:HG2	2:A:268:HOH:O	1.89	0.71
1:A:125:GLY:CA	1:A:126:HIS:HB3	2.22	0.70
1:A:74:GLN:HE22	1:A:77:ARG:HD3	1.56	0.69
1:A:125:GLY:HA2	1:A:126:HIS:CG	2.28	0.69
1:A:65:CYS:H	1:A:116:HIS:CD2	2.12	0.62
1:A:154:TYR:HE1	1:A:158:SER:HB3	1.57	0.60
1:A:156:ALA:C	1:A:158:SER:H	2.12	0.57
1:A:65:CYS:N	1:A:116:HIS:HD2	1.98	0.56
1:A:125:GLY:CA	1:A:126:HIS:CB	2.81	0.55
1:A:156:ALA:O	1:A:157:GLU:HB3	2.06	0.54
1:A:77:ARG:HD2	1:A:122:TRP:CG	2.44	0.52
1:A:35:LYS:HE2	1:A:37:MET:SD	2.52	0.50
1:A:78:GLN:HG2	1:A:83:TRP:CZ2	2.47	0.49
1:A:81:MET:CG	2:A:265:HOH:O	1.79	0.47
1:A:21:PRO:HD3	2:A:203:HOH:O	2.15	0.47
1:A:54:PRO:HG3	1:A:76:MET:SD	2.56	0.46
1:A:125:GLY:N	1:A:126:HIS:HB3	2.32	0.44
1:A:125:GLY:HA2	1:A:126:HIS:HD2	1.75	0.44
1:A:78:GLN:HG2	1:A:83:TRP:CE2	2.53	0.43
1:A:156:ALA:C	1:A:158:SER:N	2.75	0.43
1:A:24:TYR:HB2	1:A:53:ALA:HB2	2.00	0.43
1:A:9:ILE:CD1	1:A:28:MET:HE3	2.49	0.42
1:A:64:PRO:HA	1:A:116:HIS:CD2	2.57	0.40

All (5) 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)
2:A:236:HOH:O	2:A:238:HOH:O[4_555]	1.30	0.90
1:A:126:HIS:O	1:A:126:HIS:O[5_554]	1.58	0.62
1:A:144:GLU:OE2	1:A:144:GLU:OE2[7_554]	2.07	0.13
2:A:236:HOH:O	2:A:239:HOH:O[4_555]	2.07	0.13
1:A:126:HIS:N	1:A:133:GLU:OE2[5_554]	2.10	0.10

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	153/158 (97%)	147 (96%)	5 (3%)	1 (1%)	18 14

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	125	GLY

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	128/131 (98%)	123 (96%)	5 (4%)	28 28

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	62	LYS

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Mol	Chain	Res	Type
1	A	90	LYS
1	A	124	LYS
1	A	157	GLU
1	A	158	SER

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	47	ASN
1	A	74	GLN
1	A	116	HIS
1	A	117	GLN
1	A	126	HIS
1	A	129	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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

There are no ligands in this entry.

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	155/158 (98%)	0.23	10 (6%) 25 23	15, 23, 45, 59	0

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	125	GLY	9.0
1	A	158	SER	5.9
1	A	126	HIS	5.7
1	A	127	ALA	4.0
1	A	124	LYS	3.2
1	A	72	ASP	3.0
1	A	144	GLU	3.0
1	A	62	LYS	2.7
1	A	157	GLU	2.6
1	A	16	LEU	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.