



wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 25, 2026 – 05:28 AM EDT

PDB ID : 2CSX / pdb_00002csx
Title : Crystal structure of Aquifex aeolicus methionyl-tRNA synthetase complexed with tRNA(Met)
Authors : Nakanishi, K.; Ogiso, Y.; Nakama, T.; Fukai, S.; Nureki, O.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)
Deposited on : 2005-05-23
Resolution : 2.70 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

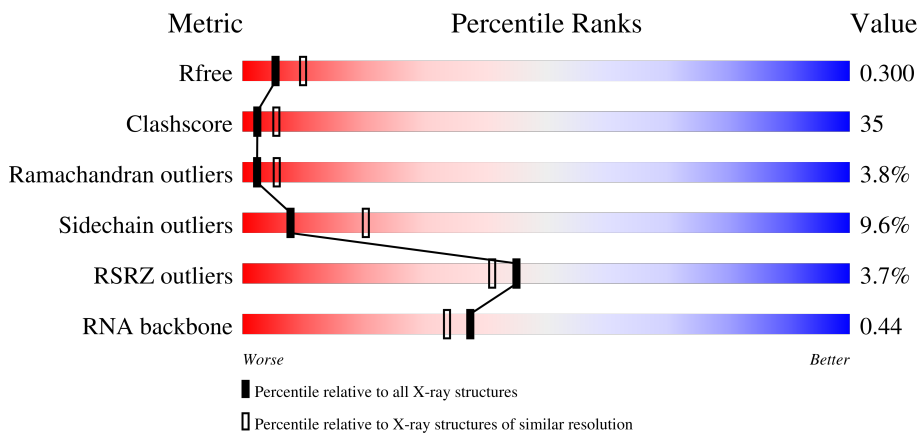
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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	3538 (2.70-2.70)
Clashscore	190562	3843 (2.70-2.70)
Ramachandran outliers	187476	3778 (2.70-2.70)
Sidechain outliers	187428	3778 (2.70-2.70)
RSRZ outliers	180081	3538 (2.70-2.70)
RNA backbone	3983	1044 (2.90-2.50)

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	C	75	
1	D	75	
2	A	497	
2	B	497	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 11058 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 RNA chain called RNA (75-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
1	C	75	1603	713	288	527	75	0	0	0
1	D	75	1603	713	288	527	75	0	0	0

- Molecule 2 is a protein called Methionyl-tRNA synthetase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	A	464	3905	2561	637	698	9	0	0	0
2	B	464	3905	2561	637	698	9	0	0	0

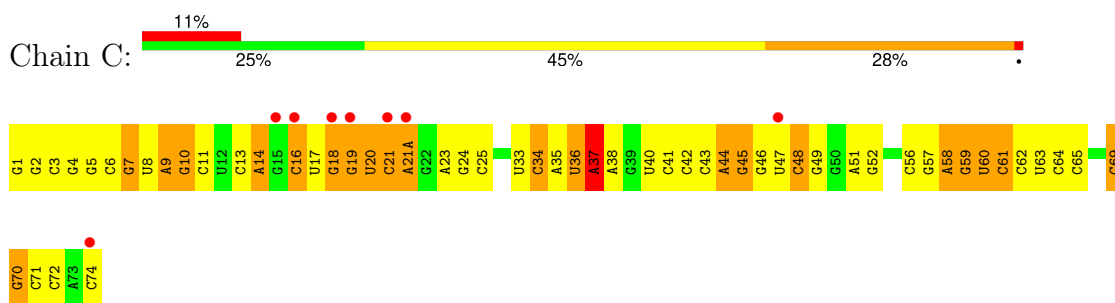
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	C	4	Total 4	O 4	0	0
3	D	2	Total 2	O 2	0	0
3	A	18	Total 18	O 18	0	0
3	B	18	Total 18	O 18	0	0

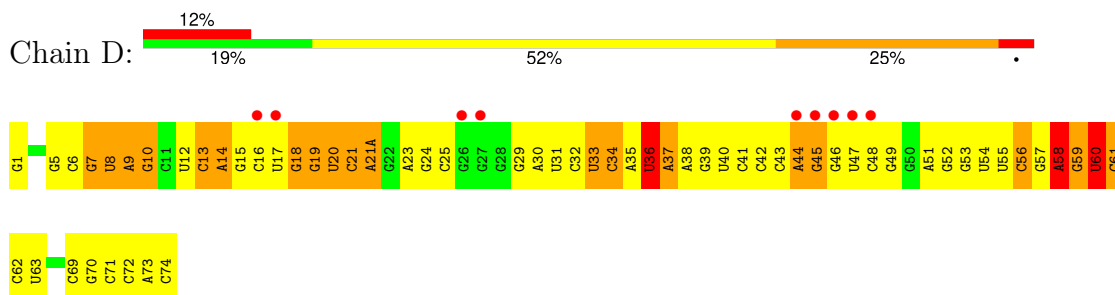
3 Residue-property plots [i](#)

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.

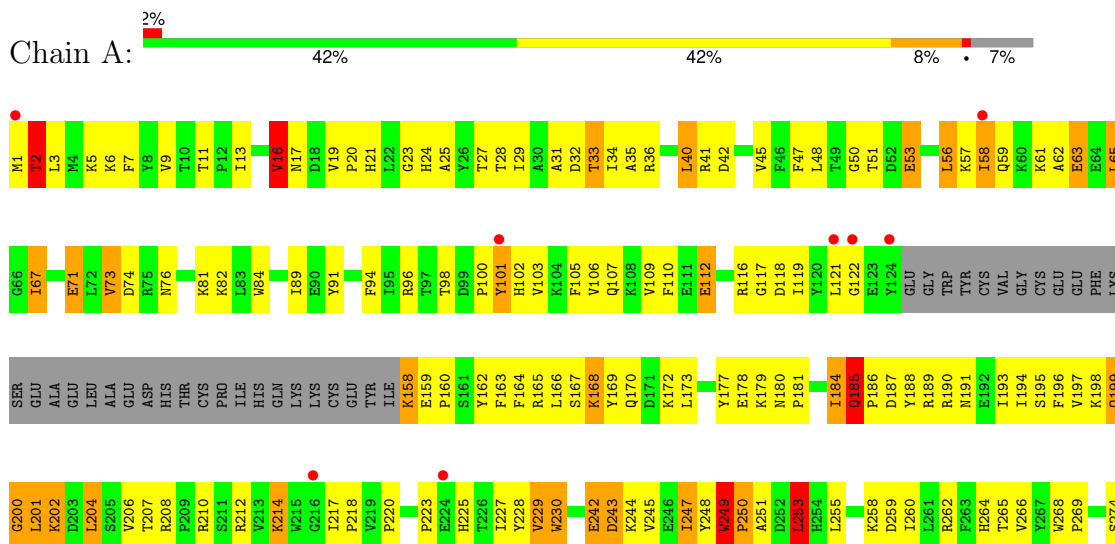
- Molecule 1: RNA (75-MER)

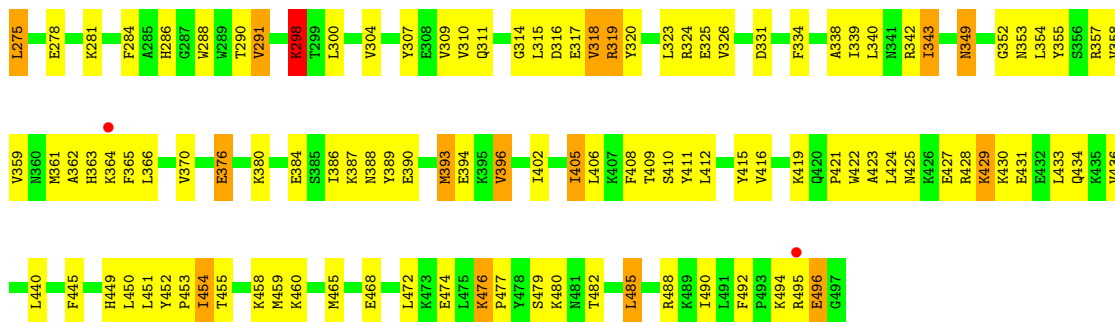


- Molecule 1: RNA (75-MER)

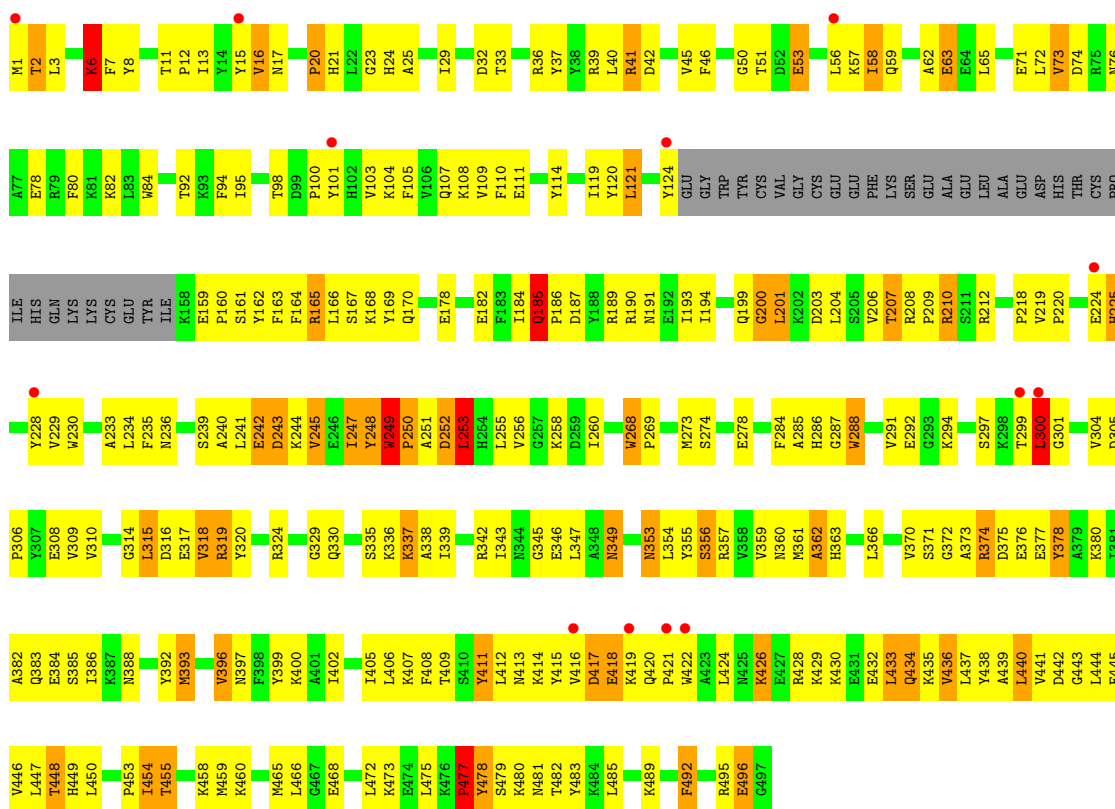


- Molecule 2: Methionyl-tRNA synthetase





● Molecule 2: Methionyl-tRNA synthetase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	94.10Å 108.12Å 162.07Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.08 – 2.70 38.08 – 2.70	Depositor EDS
% Data completeness (in resolution range)	97.8 (38.08-2.70) 97.7 (38.08-2.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.11 (at 2.61Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.239 , 0.302 0.239 , 0.300	Depositor DCC
R_{free} test set	3472 reflections (7.07%)	wwPDB-VP
Wilson B-factor (Å ²)	45.7	Xtrriage
Anisotropy	0.538	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 51.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	11058	wwPDB-VP
Average B, all atoms (Å ²)	59.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.13% 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](#)

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	C	0.37	0/1790	0.83	5/2788 (0.2%)
1	D	0.36	0/1790	0.74	2/2788 (0.1%)
2	A	0.56	1/4012 (0.0%)	1.07	31/5414 (0.6%)
2	B	0.53	0/4012	1.06	33/5414 (0.6%)
All	All	0.50	1/11604 (0.0%)	0.98	71/16404 (0.4%)

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	C	0	1
1	D	0	1
All	All	0	2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	393	MET	SD-CE	-5.11	1.66	1.79

The worst 5 of 71 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	244	LYS	N-CA-C	-10.33	100.35	113.16
2	B	11	THR	N-CA-C	-9.59	95.62	110.58
2	A	11	THR	CA-C-N	-9.28	111.05	120.98
2	A	11	THR	C-N-CA	-9.28	111.05	120.98
2	A	53	GLU	N-CA-C	8.47	123.43	113.18

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	48	C	Sidechain
1	D	36	U	Sidechain

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	C	1603	0	813	60	0
1	D	1603	0	813	95	0
2	A	3905	0	3907	281	0
2	B	3905	0	3907	306	0
3	A	18	0	0	1	0
3	B	18	0	0	1	0
3	C	4	0	0	0	0
3	D	2	0	0	1	0
All	All	11058	0	9440	715	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 35.

The worst 5 of 715 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)
2:B:170:GLN:HB2	2:B:201:LEU:HD13	1.40	1.02
2:B:297:SER:HB3	2:B:300:LEU:HB2	1.41	1.00
2:B:346:GLU:OE1	2:B:406:LEU:HD21	1.64	0.97
2:B:162:TYR:H	2:B:207:THR:HG22	1.32	0.95
1:D:34:C:H1'	2:B:361:MET:HE2	1.49	0.94

There are no symmetry-related clashes.

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	
2	A	460/497 (93%)	404 (88%)	40 (9%)	16 (4%)	3	6
2	B	460/497 (93%)	396 (86%)	45 (10%)	19 (4%)	2	5
All	All	920/994 (93%)	800 (87%)	85 (9%)	35 (4%)	2	5

5 of 35 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	A	201	LEU
2	A	249	TRP
2	A	477	PRO
2	B	201	LEU
2	B	228	TYR

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	
2	A	418/447 (94%)	380 (91%)	38 (9%)	9	22
2	B	418/447 (94%)	376 (90%)	42 (10%)	7	19
All	All	836/894 (94%)	756 (90%)	80 (10%)	8	20

5 of 80 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	278	GLU
2	B	426	LYS
2	B	294	LYS
2	B	353	ASN
2	B	448	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 23

such sidechains are listed below:

Mol	Chain	Res	Type
2	B	24	HIS
2	B	286	HIS
2	B	225	HIS
2	B	330	GLN
2	A	286	HIS

5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	C	74/75 (98%)	20 (27%)	9 (12%)
1	D	74/75 (98%)	20 (27%)	6 (8%)
All	All	148/150 (98%)	40 (27%)	15 (10%)

5 of 40 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
1	C	7	G
1	C	8	U
1	C	9	A
1	C	10	G
1	C	14	A

5 of 15 RNA pucker outliers are listed below:

Mol	Chain	Res	Type
1	C	60	U
1	D	36	U
1	C	69	C
1	D	58	A
1	D	21	C

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 [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	C	75/75 (100%)	0.56	8 (10%) 11 9	47, 69, 122, 135	0
1	D	75/75 (100%)	1.24	9 (12%) 9 7	63, 100, 143, 154	0
2	A	464/497 (93%)	-0.04	10 (2%) 62 59	17, 43, 73, 94	0
2	B	464/497 (93%)	0.08	13 (2%) 55 51	17, 45, 84, 112	0
All	All	1078/1144 (94%)	0.14	40 (3%) 45 41	17, 48, 102, 154	0

The worst 5 of 40 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	A	1	MET	4.9
2	B	1	MET	4.8
1	D	44	A	4.0
1	D	45	G	3.7
1	C	21	C	3.6

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.