



Full wwPDB X-ray Structure Validation Report ⓘ

May 27, 2020 – 10:38 pm BST

PDB ID : 3A04
Title : Crystal structure of tryptophanyl-tRNA synthetase from hyperthermophilic archaeon, *Aeropyrum pernix* K1
Authors : Tsuchiya, W.; Fujimoto, Z.; Hasegawa, T.
Deposited on : 2009-03-02
Resolution : 1.97 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.11
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) : 2.11

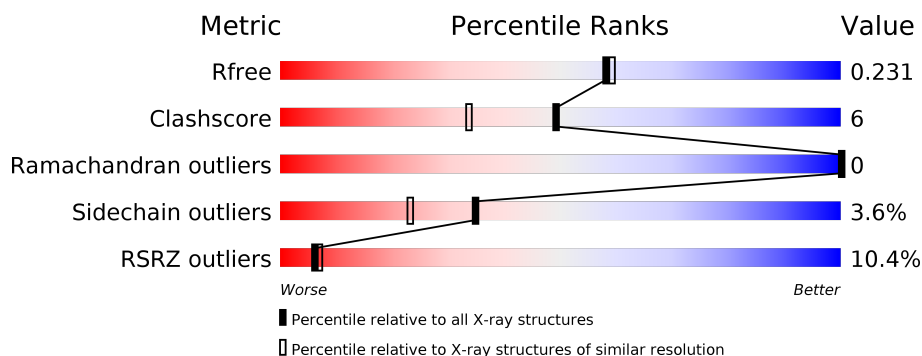
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.97 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	11647 (2.00-1.96)
Clashscore	141614	1014 (1.98-1.98)
Ramachandran outliers	138981	1006 (1.98-1.98)
Sidechain outliers	138945	1006 (1.98-1.98)
RSRZ outliers	127900	11410 (2.00-1.96)

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 on 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	372	<div> <div>10%</div> <div>83%</div> <div>13%</div> <div>..</div> </div>

2 Entry composition [i](#)

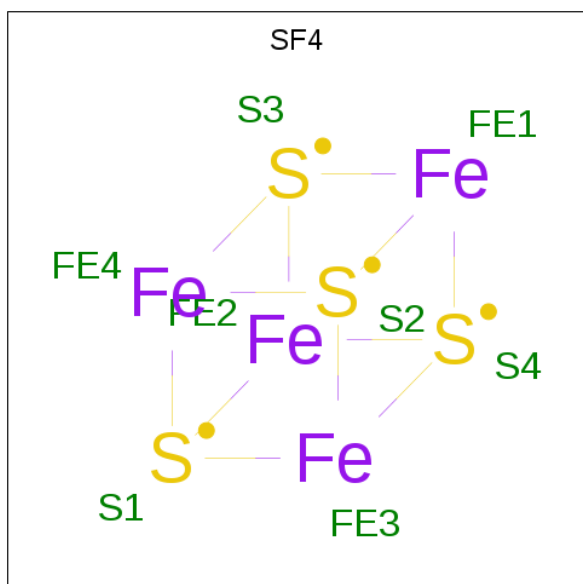
There are 4 unique types of molecules in this entry. The entry contains 3283 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Tryptophanyl-tRNA synthetase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	367	2944	1882	524	522	16	0	3	0

- Molecule 2 is IRON/SULFUR CLUSTER (three-letter code: SF4) (formula: Fe₄S₄).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	Fe	S		
2	A	1	8	4	4	0	0

- Molecule 3 is CADMIUM ION (three-letter code: CD) (formula: Cd).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Cd		
3	A	2	2	2	0	0

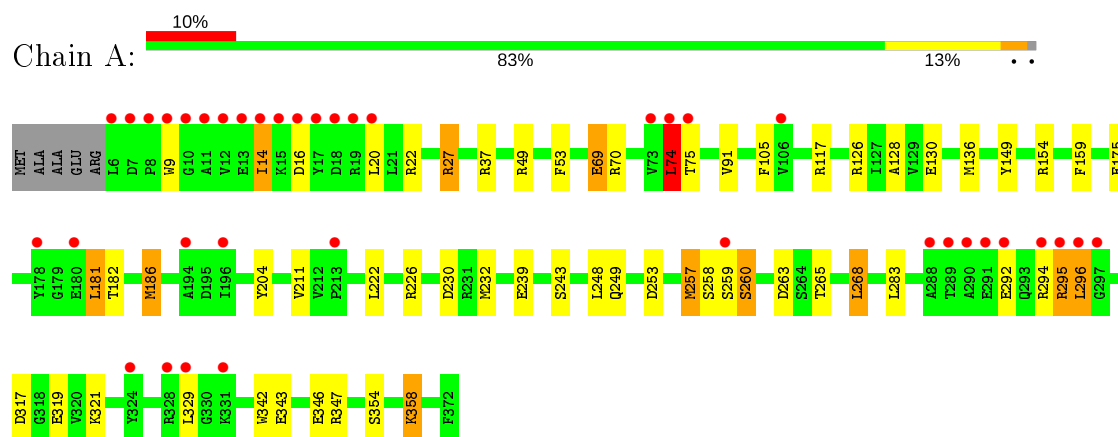
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	329	Total 329	O 329	0	0

3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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: Tryptophanyl-tRNA synthetase



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	98.71Å 103.19Å 97.81Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	32.48 – 1.97 32.48 – 1.97	Depositor EDS
% Data completeness (in resolution range)	99.1 (32.48-1.97) 99.1 (32.48-1.97)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	6.77 (at 1.97Å)	Xtriage
Refinement program	REFMAC 5.5.0072	Depositor
R, R_{free}	0.178 , 0.235 0.176 , 0.231	Depositor DCC
R_{free} test set	1762 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å ²)	37.8	Xtriage
Anisotropy	0.039	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 65.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.021 for -k,-h,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	3283	wwPDB-VP
Average B, all atoms (Å ²)	42.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.82% 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: SF4, CD

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	1.25	7/3023 (0.2%)	1.05	20/4077 (0.5%)

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	239	GLU	CD-OE2	7.01	1.33	1.25
1	A	239	GLU	CB-CG	5.69	1.62	1.52
1	A	211	VAL	CB-CG1	5.64	1.64	1.52
1	A	204	TYR	CD1-CE1	5.63	1.47	1.39
1	A	128	ALA	CA-CB	5.61	1.64	1.52
1	A	69	GLU	CB-CG	5.09	1.61	1.52
1	A	149	TYR	CD1-CE1	5.08	1.47	1.39

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	257	MET	CA-CB-CG	7.63	126.28	113.30
1	A	232	MET	CG-SD-CE	-7.45	88.29	100.20
1	A	347	ARG	NE-CZ-NH2	7.22	123.91	120.30
1	A	181	LEU	CB-CG-CD1	-6.74	99.55	111.00
1	A	226	ARG	NE-CZ-NH1	6.40	123.50	120.30
1	A	343	GLU	OE1-CD-OE2	-6.37	115.66	123.30
1	A	268	LEU	CA-CB-CG	-6.25	100.92	115.30
1	A	347	ARG	NE-CZ-NH1	-6.00	117.30	120.30
1	A	74	LEU	CB-CG-CD1	5.87	120.98	111.00
1	A	69	GLU	OE1-CD-OE2	-5.69	116.48	123.30
1	A	117	ARG	NE-CZ-NH2	-5.61	117.49	120.30
1	A	27	ARG	NE-CZ-NH1	5.50	123.05	120.30
1	A	159[A]	PHE	N-CA-CB	5.43	120.37	110.60
1	A	159[B]	PHE	N-CA-CB	5.43	120.37	110.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	186[A]	MET	N-CA-CB	5.43	120.37	110.60
1	A	186[B]	MET	N-CA-CB	5.43	120.37	110.60
1	A	49	ARG	NE-CZ-NH2	-5.41	117.59	120.30
1	A	74	LEU	CA-CB-CG	-5.25	103.22	115.30
1	A	154	ARG	NE-CZ-NH2	-5.23	117.69	120.30
1	A	230	ASP	CB-CG-OD1	5.11	122.90	118.30

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	2944	0	2959	35	1
2	A	8	0	0	0	0
3	A	2	0	0	0	1
4	A	329	0	0	6	0
All	All	3283	0	2959	35	1

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 6.

All (35) 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:126[B]:ARG:NH2	1:A:130:GLU:OE1	1.89	1.04
1:A:175:GLU:HG3	1:A:181:LEU:HG	1.54	0.89
1:A:319:GLU:OE2	4:A:566:HOH:O	2.07	0.72
1:A:222:LEU:HD21	1:A:243:SER:HB3	1.79	0.65
1:A:126[B]:ARG:HG2	1:A:126[B]:ARG:NH2	2.11	0.64
1:A:317:ASP:O	1:A:321:LYS:HG3	1.99	0.63
1:A:175:GLU:CG	1:A:181:LEU:HG	2.28	0.63
1:A:265:THR:HG23	4:A:699:HOH:O	2.00	0.62
1:A:126[B]:ARG:CG	1:A:126[B]:ARG:HH21	2.13	0.62
1:A:126[B]:ARG:HG2	1:A:126[B]:ARG:HH21	1.67	0.59

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:258:SER:OG	1:A:260:SER:HB3	2.02	0.59
1:A:175:GLU:HG3	1:A:181:LEU:CG	2.31	0.58
1:A:342:TRP:CZ2	1:A:346:GLU:HB2	2.41	0.56
1:A:20:LEU:HD23	1:A:20:LEU:C	2.25	0.56
1:A:259:SER:HB2	4:A:692:HOH:O	2.07	0.53
1:A:258:SER:N	1:A:265:THR:HG21	2.24	0.53
1:A:292:GLU:OE2	1:A:296:LEU:HD12	2.08	0.53
1:A:257:MET:HG3	1:A:265:THR:HG22	1.91	0.51
1:A:70:ARG:HH11	1:A:70:ARG:HG2	1.77	0.50
1:A:91:VAL:HG21	1:A:136:MET:HG2	1.95	0.48
1:A:253:ASP:O	1:A:283:LEU:HD12	2.14	0.47
1:A:295:ARG:HG3	1:A:296:LEU:N	2.26	0.47
1:A:354:SER:O	1:A:358:LYS:HE2	2.15	0.47
1:A:74:LEU:HG	1:A:75:THR:N	2.31	0.46
1:A:258:SER:H	1:A:265:THR:CG2	2.29	0.46
1:A:22:ARG:HG2	1:A:27:ARG:HH21	1.82	0.45
1:A:37:ARG:HG2	4:A:697:HOH:O	2.15	0.45
1:A:248:LEU:N	1:A:248:LEU:HD12	2.32	0.44
1:A:182:THR:O	1:A:186[A]:MET:HG3	2.17	0.44
1:A:268:LEU:HD12	1:A:268:LEU:N	2.33	0.43
1:A:249:GLN:O	4:A:533:HOH:O	2.20	0.43
1:A:14:ILE:HG21	1:A:53:PHE:HB2	2.01	0.43
1:A:258:SER:HB3	4:A:698:HOH:O	2.19	0.42
1:A:258:SER:H	1:A:265:THR:HG21	1.86	0.41
1:A:74:LEU:HD12	1:A:105:PHE:CB	2.51	0.41

All (1) 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:A:69:GLU:OE1	3:A:374:CD:CD[8_445]	1.44	0.76

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	368/372 (99%)	362 (98%)	6 (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	308/309 (100%)	297 (96%)	11 (4%)	35	23

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	9	TRP
1	A	14	ILE
1	A	16	ASP
1	A	74	LEU
1	A	260	SER
1	A	263	ASP
1	A	294	ARG
1	A	295	ARG
1	A	296	LEU
1	A	329	LEU
1	A	358	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA ⓘ

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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 2 are monoatomic - leaving 1 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	SF4	A	373	1	0,12,12	0.00	-	-		

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	SF4	A	373	1	-	-	0/6/5/5

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, 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	367/372 (98%)	0.47	38 (10%) 6 7	24, 36, 74, 114	0

All (38) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	12	VAL	13.5
1	A	11	ALA	10.2
1	A	6	LEU	7.5
1	A	14	ILE	7.0
1	A	296	LEU	6.3
1	A	13	GLU	5.5
1	A	10	GLY	5.4
1	A	17	TYR	4.8
1	A	289	THR	4.7
1	A	7	ASP	4.6
1	A	295	ARG	4.5
1	A	15	LYS	4.2
1	A	259	SER	4.0
1	A	297	GLY	3.8
1	A	290	ALA	3.8
1	A	329	LEU	3.8
1	A	74	LEU	3.6
1	A	328	ARG	3.6
1	A	331	LYS	3.4
1	A	9	TRP	3.4
1	A	18	ASP	3.3
1	A	8	PRO	3.1
1	A	178	TYR	3.1
1	A	292	GLU	3.0
1	A	288	ALA	3.0
1	A	291	GLU	2.9
1	A	20	LEU	2.7

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Mol	Chain	Res	Type	RSRZ
1	A	294	ARG	2.7
1	A	19	ARG	2.7
1	A	180	GLU	2.5
1	A	324	TYR	2.5
1	A	16	ASP	2.4
1	A	196	ILE	2.3
1	A	73	VAL	2.3
1	A	213	PRO	2.1
1	A	75	THR	2.1
1	A	194	ALA	2.1
1	A	106	VAL	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 carbohydrates 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(\AA^2)	Q<0.9
3	CD	A	375	1/1	0.97	0.03	63,63,63,63	0
2	SF4	A	373	8/8	0.98	0.04	42,44,48,49	0
3	CD	A	374	1/1	1.00	0.04	34,34,34,34	0

6.5 Other polymers [i](#)

There are no such residues in this entry.