



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 13, 2017 – 10:44 pm GMT

PDB ID : 2PID  
Title : Crystal structure of human mitochondrial tyrosyl-tRNA synthetase in complex with an adenylate analog  
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Deposited on : 2007-04-13  
Resolution : 2.20 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](mailto:validation@mail.wwpdb.org)

A user guide is available at

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix)	:	1.9-1692
EDS	:	trunk28620
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	recalc28949

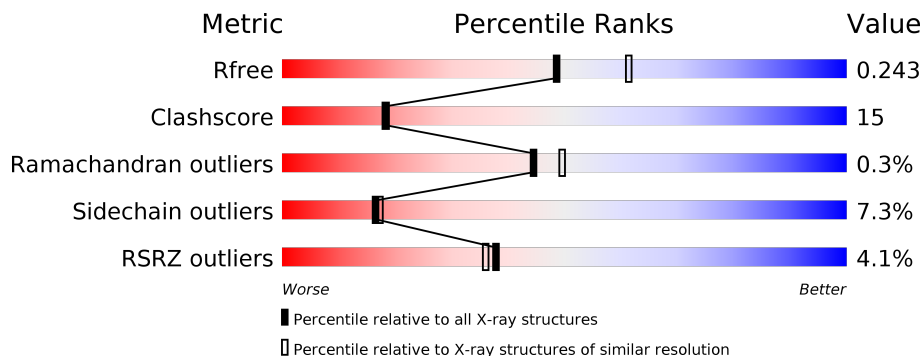
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.20 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))
$R_{free}$	100719	4002 (2.20-2.20)
Clashscore	112137	4730 (2.20-2.20)
Ramachandran outliers	110173	4656 (2.20-2.20)
Sidechain outliers	110143	4657 (2.20-2.20)
RSRZ outliers	101464	4033 (2.20-2.20)

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  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	356	<div> <div>4%</div> <div> <div></div> <div>60%</div> <div>26%</div> <div>•</div> <div>11%</div> </div> </div>
1	B	356	<div> <div>4%</div> <div> <div></div> <div>64%</div> <div>25%</div> <div>•</div> <div>9%</div> </div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5262 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 Tyrosyl-tRNA synthetase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	317	Total	C	N	O	S	0	0	0
			2525	1618	448	452	7			
1	B	324	Total	C	N	O	S	0	0	0
			2577	1649	458	463	7			

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	28	MET	-	EXPRESSION TAG	UNP Q9Y2Z4
A	29	ARG	-	EXPRESSION TAG	UNP Q9Y2Z4
A	30	GLY	-	EXPRESSION TAG	UNP Q9Y2Z4
A	31	SER	-	EXPRESSION TAG	UNP Q9Y2Z4
A	376	ARG	-	EXPRESSION TAG	UNP Q9Y2Z4
A	377	SER	-	EXPRESSION TAG	UNP Q9Y2Z4
A	378	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
A	379	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
A	380	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
A	381	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
A	382	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
A	383	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
B	28	MET	-	EXPRESSION TAG	UNP Q9Y2Z4
B	29	ARG	-	EXPRESSION TAG	UNP Q9Y2Z4
B	30	GLY	-	EXPRESSION TAG	UNP Q9Y2Z4
B	31	SER	-	EXPRESSION TAG	UNP Q9Y2Z4
B	376	ARG	-	EXPRESSION TAG	UNP Q9Y2Z4
B	377	SER	-	EXPRESSION TAG	UNP Q9Y2Z4
B	378	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
B	379	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
B	380	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
B	381	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
B	382	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4
B	383	HIS	-	EXPRESSION TAG	UNP Q9Y2Z4

- # YSA
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- The chemical structure of YSA is a complex molecule. It features a pyrimidine ring system (top) with atoms labeled N1, N3, N7, C2, C4, C5, and C6. This ring is connected to a ribose sugar (middle) with atoms labeled C1', C2', C3', C4', and C5'. The ribose sugar is further connected to a phosphate group (bottom) with atoms labeled O1, O2, O3, O4, and O5. The phosphate group is connected to a hydroxyl group (bottom) with atoms labeled H and O. The structure is labeled with various atom types and bond types, including single, double, and triple bonds, as well as stereochemistry (R, S, E, Z).

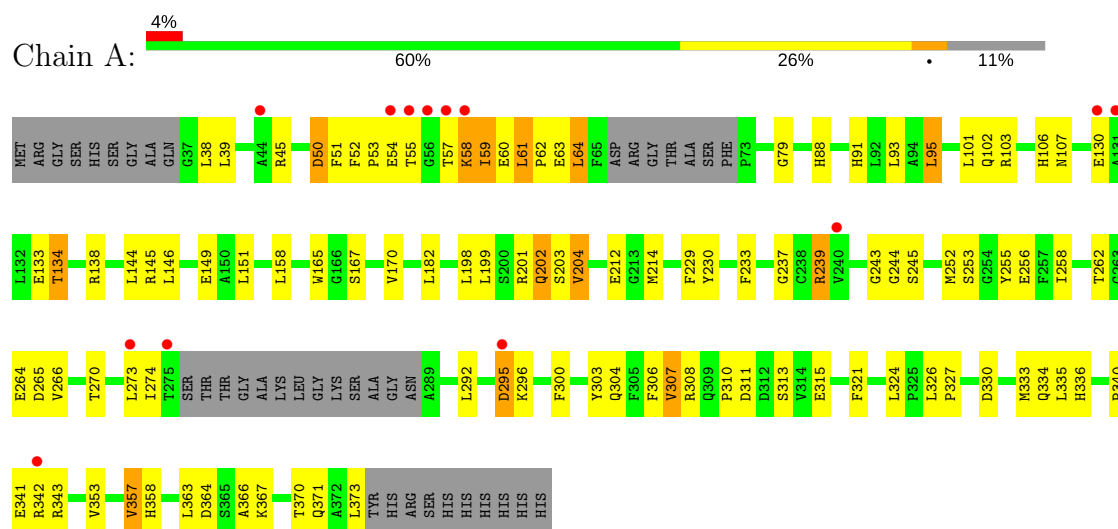
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total 35	C 19	N 7	O 8	S 1	0	0
2	B	1	Total 35	C 19	N 7	O 8	S 1	0	0

- | Mol | Chain | Residues | Atoms            | ZeroOcc | AltConf |
|-----|-------|----------|------------------|---------|---------|
| 3   | A     | 42       | Total O<br>42 42 | 0       | 0       |
| 3   | B     | 48       | Total O<br>48 48 | 0       | 0       |

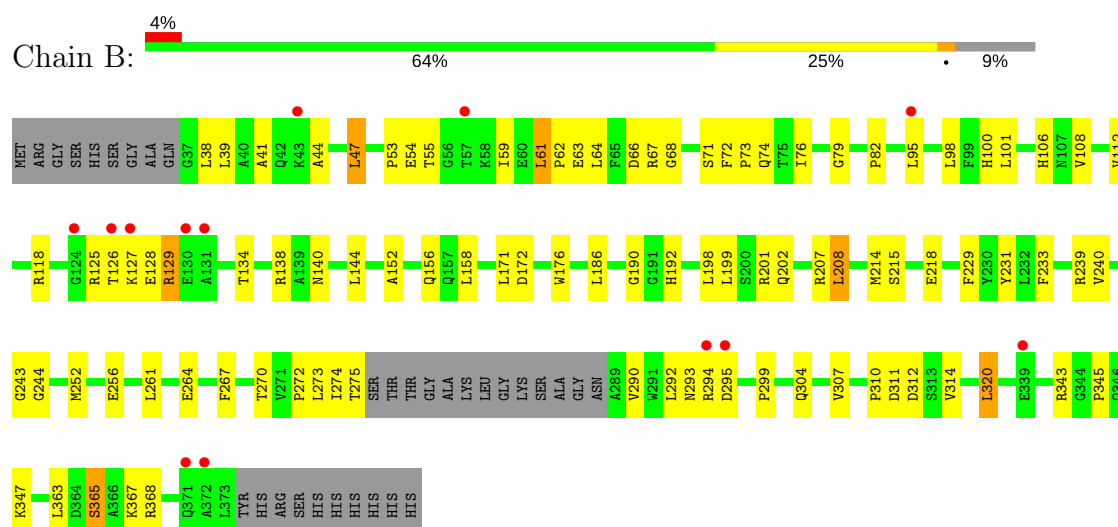
### 3 Residue-property plots [i](#)

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: Tyrosyl-tRNA synthetase



#### • Molecule 1: Tyrosyl-tRNA synthetase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	54.00Å 62.40Å 194.60Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.98 – 2.20 19.98 – 2.20	Depositor EDS
% Data completeness (in resolution range)	99.6 (19.98-2.20) 99.8 (19.98-2.20)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	0.10	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	7.42 (at 2.21Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.193 , 0.244 0.193 , 0.243	Depositor DCC
$R_{free}$ test set	1700 reflections (4.98%)	DCC
Wilson B-factor (Å <sup>2</sup> )	33.3	Xtriage
Anisotropy	0.509	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 53.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	5262	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	40.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.18% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: YSA

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	0.44	0/2582	0.65	0/3486
1	B	0.45	0/2636	0.62	0/3561
All	All	0.44	0/5218	0.63	0/7047

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 [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	2525	0	2514	86	0
1	B	2577	0	2560	64	0
2	A	35	0	22	6	0
2	B	35	0	22	4	0
3	A	42	0	0	2	0
3	B	48	0	0	3	0
All	All	5262	0	5118	154	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 15.

The worst 5 of 154 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:274:ILE:HD11	1:B:320:LEU:HD23	1.38	1.05
2:B:384:YSA:H8	2:B:384:YSA:H5'2	1.36	1.03
2:A:384:YSA:H8	2:A:384:YSA:H5'2	1.45	0.98
1:B:38:LEU:HD21	1:B:101:LEU:HD23	1.43	0.98
1:B:125:ARG:HH22	1:B:129:ARG:NE	1.65	0.93

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	
1	A	311/356 (87%)	301 (97%)	8 (3%)	2 (1%)	28	29
1	B	320/356 (90%)	313 (98%)	7 (2%)	0	100	100
All	All	631/712 (89%)	614 (97%)	15 (2%)	2 (0%)	44	49

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	61	LEU
1	A	59	ILE

### 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	263/292 (90%)	239 (91%)	24 (9%)	11	11
1	B	268/292 (92%)	253 (94%)	15 (6%)	25	29
All	All	531/584 (91%)	492 (93%)	39 (7%)	16	17

5 of 39 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	295	ASP
1	A	363	LEU
1	B	292	LEU
1	A	307	VAL
1	A	335	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 16 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	102	GLN
1	B	107	ASN
1	B	202	GLN
1	B	100	HIS
1	B	293	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 carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

2 ligands are modelled in this entry.

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	YSA	A	384	-	34,38,38	3.18	5 (14%)	39,56,56	2.43	10 (25%)
2	YSA	B	384	-	34,38,38	3.18	5 (14%)	39,56,56	2.37	10 (25%)

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	YSA	A	384	-	-	0/18/39/39	0/4/4/4
2	YSA	B	384	-	-	0/18/39/39	0/4/4/4

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	384	YSA	O5'-SBI	-11.48	1.43	1.59
2	A	384	YSA	O5'-SBI	-11.30	1.43	1.59
2	B	384	YSA	O4'-C1'	2.21	1.44	1.41
2	A	384	YSA	O4'-C1'	2.31	1.44	1.41
2	B	384	YSA	SBI-NAT	3.67	1.63	1.59

The worst 5 of 20 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	384	YSA	N3-C2-N1	-7.99	121.90	128.86
2	A	384	YSA	N3-C2-N1	-7.82	122.04	128.86
2	A	384	YSA	O5'-SBI-NAT	-4.04	97.76	106.34
2	A	384	YSA	C5'-C4'-C3'	-4.00	100.04	115.29
2	B	384	YSA	O5'-SBI-NAT	-3.79	98.28	106.34

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	384	YSA	6	0
2	B	384	YSA	4	0

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	317/356 (89%)	0.06	13 (4%) 38 36	24, 37, 68, 85	1 (0%)
1	B	324/356 (91%)	0.01	13 (4%) 39 37	20, 36, 67, 86	0
All	All	641/712 (90%)	0.03	26 (4%) 38 36	20, 37, 67, 86	1 (0%)

The worst 5 of 26 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	371	GLN	4.9
1	A	57	THR	4.4
1	B	127	LYS	4.4
1	B	126	THR	4.1
1	A	56	GLY	3.9

### 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95<sup>th</sup> 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	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
2	YSA	B	384	35/35	0.95	0.11	-0.36	17,30,43,58	0
2	YSA	A	384	35/35	0.94	0.12	-0.38	20,33,44,59	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.