Full wwPDB X-ray Structure Validation Report ⓘ

Jul 2, 2025 – 04:07 PM JST

PDB ID	:	9KUQ / pdb_00009kuq
Title	:	Crystal structure of a C45 isoprenyl diphosphate synthase, Rv0562 from Mycobacterium tuberculosis
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Deposited on	:	2024-12-04
Resolution	:	2.00 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 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:

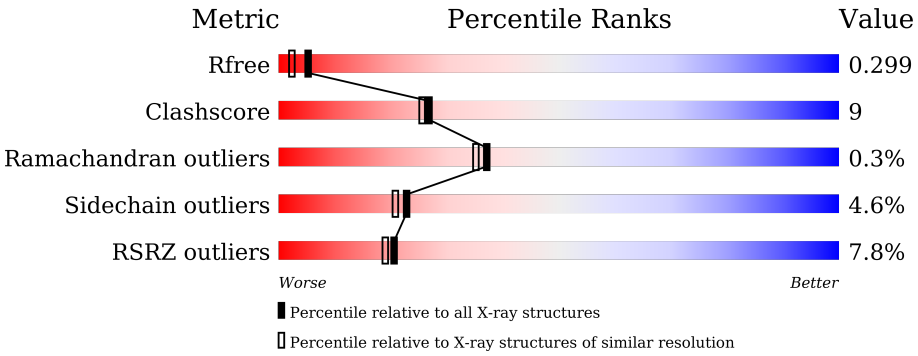
MolProbity	:	4-5-2 with Phenix2.0rc1
Xtriage (Phenix)	:	2.0rc1
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.006 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.44

1 Overall quality at a glance (i)

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}	164625	9409 (2.00-2.00)
Clashscore	180529	10737 (2.00-2.00)
Ramachandran outliers	177936	10628 (2.00-2.00)
Sidechain outliers	177891	10627 (2.00-2.00)
RSRZ outliers	164620	9409 (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 <=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	335	7% 74% 17% • 8%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 2456 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 Nonaprenyl diphosphate synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	309	2307	1436	414	448	9	0	0	0

- Molecule 2 is water.

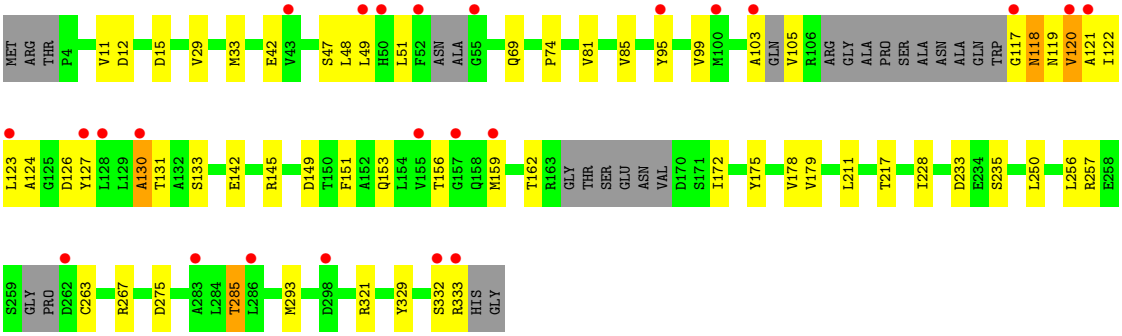
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
2	A	149	149	149	0	0

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: Nonaprenyl diphosphate synthase

Chain A:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α, β, γ	84.19Å 84.19Å 80.55Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	22.65 – 2.00 22.65 – 2.00	Depositor EDS
% Data completeness (in resolution range)	99.5 (22.65-2.00) 99.5 (22.65-2.00)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	5.97 (at 2.01Å)	Xtriage
Refinement program	REFMAC 5.8.0238	Depositor
R, R_{free}	0.227 , 0.294 0.235 , 0.299	Depositor DCC
R_{free} test set	1154 reflections (5.11%)	wwPDB-VP
Wilson B-factor (Å^2)	44.7	Xtriage
Anisotropy	0.177	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 43.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.028 for -h,-k,l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	2456	wwPDB-VP
Average B, all atoms (Å^2)	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.78% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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	1.13	0/2330	1.66	9/3153 (0.3%)

There are no bond length outliers.

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	130	ALA	CA-C-N	8.46	131.81	120.65
1	A	130	ALA	C-N-CA	8.46	131.81	120.65
1	A	15	ASP	CA-CB-CG	6.28	118.88	112.60
1	A	285	THR	CB-CA-C	6.16	122.03	110.63
1	A	151	PHE	N-CA-C	-5.42	105.37	111.28
1	A	178	VAL	CA-C-O	-5.31	115.89	121.41
1	A	211	LEU	CA-C-N	5.13	125.63	119.94
1	A	211	LEU	C-N-CA	5.13	125.63	119.94
1	A	131	THR	CA-CB-OG1	-5.05	102.03	109.60

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	2307	0	2325	42	0
2	A	149	0	0	4	2
All	All	2456	0	2325	42	2

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 9.

All (42) 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:121:ALA:HA	2:A:466:HOH:O	1.65	0.96
1:A:99:VAL:HG11	1:A:122:ILE:HD11	1.67	0.77
1:A:159:MET:HE2	2:A:502:HOH:O	1.86	0.74
1:A:263:CYS:O	1:A:267:ARG:HG3	1.92	0.69
1:A:256:LEU:O	1:A:267:ARG:NH2	2.27	0.67
1:A:51:LEU:HD12	1:A:95:TYR:CD1	2.30	0.66
1:A:99:VAL:HG21	1:A:122:ILE:CD1	2.29	0.63
1:A:47:SER:HB3	1:A:124:ALA:HB2	1.80	0.62
1:A:51:LEU:HB2	1:A:95:TYR:CE1	2.35	0.61
1:A:48:LEU:HD21	1:A:127:TYR:HB3	1.85	0.57
1:A:99:VAL:HG21	1:A:122:ILE:HD13	1.86	0.57
1:A:117:GLY:N	1:A:119:ASN:HD21	2.04	0.55
1:A:29:VAL:HG12	1:A:33:MET:HE2	1.88	0.54
1:A:123:LEU:O	1:A:126:ASP:HB2	2.07	0.54
1:A:48:LEU:HD11	1:A:127:TYR:CD2	2.44	0.53
1:A:51:LEU:HD12	1:A:95:TYR:CE1	2.43	0.53
1:A:118:ASN:OD1	1:A:118:ASN:C	2.52	0.51
1:A:179:VAL:HG23	1:A:217:THR:HG23	1.94	0.49
1:A:257:ARG:HD2	2:A:509:HOH:O	2.13	0.49
1:A:130:ALA:O	1:A:133:SER:HB3	2.13	0.48
1:A:332:SER:C	1:A:333:ARG:HD2	2.39	0.47
1:A:119:ASN:HA	2:A:460:HOH:O	2.13	0.47
1:A:156:THR:O	1:A:159:MET:HB3	2.15	0.47
1:A:332:SER:O	1:A:333:ARG:HD2	2.14	0.47
1:A:51:LEU:HB2	1:A:95:TYR:CZ	2.51	0.46
1:A:99:VAL:HG21	1:A:122:ILE:HD11	1.96	0.46
1:A:329:TYR:O	1:A:333:ARG:N	2.48	0.46
1:A:51:LEU:HD12	1:A:95:TYR:CG	2.51	0.45
1:A:228:ILE:HG21	1:A:293:MET:CE	2.47	0.44
1:A:81:VAL:O	1:A:85:VAL:HG23	2.18	0.44
1:A:12:ASP:C	1:A:12:ASP:OD1	2.61	0.44
1:A:127:TYR:O	1:A:130:ALA:N	2.51	0.44
1:A:145:ARG:HD2	1:A:149:ASP:OD2	2.17	0.43
1:A:118:ASN:OD1	1:A:118:ASN:O	2.36	0.43
1:A:103:ALA:O	1:A:105:VAL:N	2.52	0.42
1:A:175:TYR:CE2	1:A:250:LEU:HB2	2.54	0.42
1:A:42:GLU:H	1:A:42:GLU:CD	2.27	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:124:ALA:O	1:A:127:TYR:N	2.48	0.41
1:A:233:ASP:OD1	1:A:235:SER:N	2.53	0.41
1:A:69:GLN:HA	1:A:74:PRO:HB3	2.01	0.41
1:A:175:TYR:CD2	1:A:250:LEU:HD13	2.57	0.40
1:A:233:ASP:OD1	1:A:233:ASP:C	2.64	0.40

All (2) 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:505:HOH:O	2:A:505:HOH:O[6_554]	2.01	0.19
2:A:546:HOH:O	2:A:546:HOH:O[6_554]	2.12	0.08

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	297/335 (89%)	282 (95%)	14 (5%)	1 (0%)	37 35

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	120	VAL

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	237/255 (93%)	226 (95%)	11 (5%)	23 21

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

Mol	Chain	Res	Type
1	A	11	VAL
1	A	49	LEU
1	A	118	ASN
1	A	120	VAL
1	A	142	GLU
1	A	153	GLN
1	A	162	THR
1	A	172	ILE
1	A	275	ASP
1	A	285	THR
1	A	321	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	90	HIS
1	A	180	GLN
1	A	220	GLN
1	A	271	ASN

5.3.3 RNA (i)

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 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

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, 95^{th} 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	309/335 (92%)	0.46	24 (7%)	20	19	32, 54, 81, 108	0

All (24) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	283	ALA	3.3
1	A	95	TYR	3.1
1	A	121	ALA	3.0
1	A	155	VAL	3.0
1	A	286	LEU	3.0
1	A	50	HIS	2.8
1	A	49	LEU	2.6
1	A	103	ALA	2.6
1	A	262	ASP	2.5
1	A	120	VAL	2.5
1	A	332	SER	2.5
1	A	55	GLY	2.5
1	A	123	LEU	2.4
1	A	157	GLY	2.4
1	A	100	MET	2.4
1	A	52	PHE	2.4
1	A	298	ASP	2.3
1	A	159	MET	2.3
1	A	130	ALA	2.1
1	A	128	LEU	2.1
1	A	127	TYR	2.1
1	A	117	GLY	2.1
1	A	43	VAL	2.1
1	A	333	ARG	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.