



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 04:22 AM UTC

PDB ID : 1WY0 / pdb_00001wy0
Title : Crystal structure of geranylgeranyl pyrophosphate synthetase from *Pyrococcus horikoshii* Ot3
Authors : Sugahara, M.; Kunishima, N.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)
Deposited on : 2005-02-03
Resolution : 2.20 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

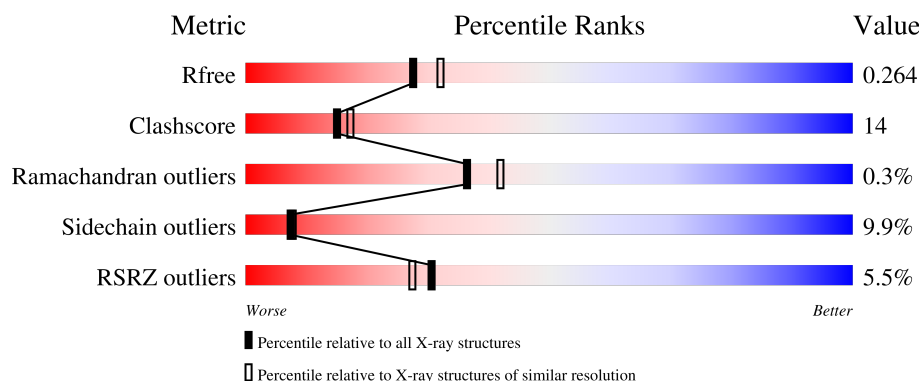
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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}	180053	6164 (2.20-2.20)
Clashscore	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)
RSRZ outliers	180081	6166 (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 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	342	5% 65% 26% ...

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	BR	A	2001	-	-	X	-

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 2774 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 geranylgeranyl pyrophosphate synthetase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	327	Total	C	N	O	S	0	0	0
			2595	1664	440	482	9			

- Molecule 2 is MERCURY (II) ION (CCD ID: HG) (formula: Hg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Hg	0	0
			1	1		

- Molecule 3 is BROMIDE ION (CCD ID: BR) (formula: Br).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Br	0	0
			1	1		

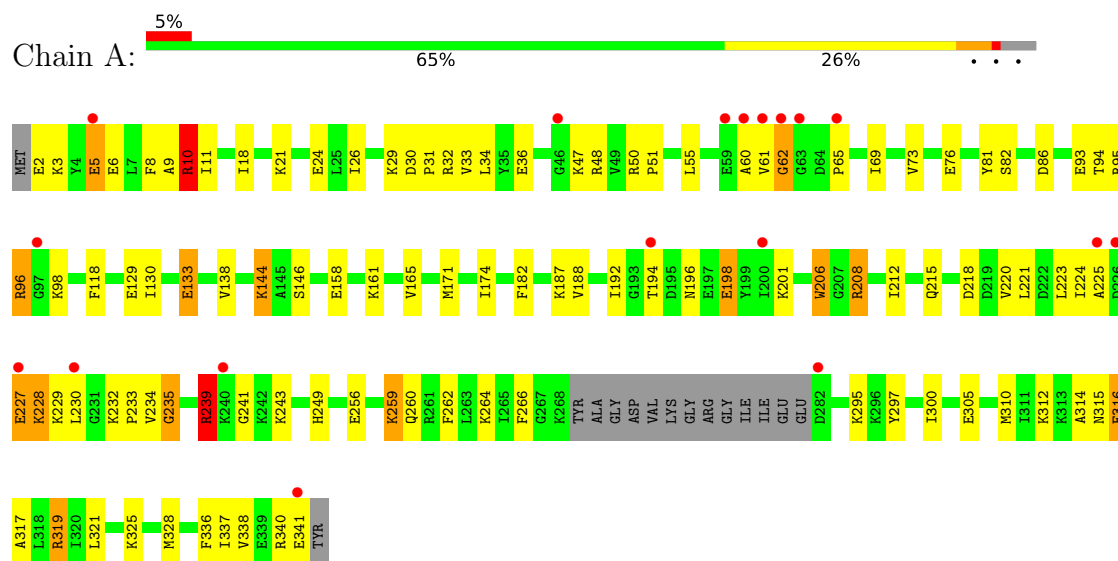
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	177	Total	O	0	0
			177	177		

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: geranylgeranyl pyrophosphate synthetase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	63.35Å 75.78Å 80.86Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	14.90 – 2.20 14.90 – 2.20	Depositor EDS
% Data completeness (in resolution range)	100.0 (14.90-2.20) 99.6 (14.90-2.20)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.66 (at 2.20Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.246 , 0.263 0.246 , 0.264	Depositor DCC
R_{free} test set	997 reflections (4.88%)	wwPDB-VP
Wilson B-factor (Å ²)	40.5	Xtriage
Anisotropy	0.162	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 44.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	2774	wwPDB-VP
Average B, all atoms (Å ²)	47.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.84% 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: HG, BR

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	0.64	1/2637 (0.0%)	1.12	11/3541 (0.3%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	206	TRP	NE1-CE2	10.43	1.49	1.37

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	24	GLU	N-CA-C	-6.70	104.92	113.23
1	A	235	GLY	O-C-N	-5.87	115.39	122.38
1	A	32	ARG	CD-NE-CZ	-5.35	116.91	124.40
1	A	233	PRO	N-CA-CB	5.26	107.92	103.35
1	A	31	PRO	N-CA-CB	5.25	108.37	102.60
1	A	95	ARG	CD-NE-CZ	-5.19	117.13	124.40
1	A	96	ARG	CD-NE-CZ	-5.16	117.18	124.40
1	A	10	ARG	CD-NE-CZ	-5.12	117.23	124.40
1	A	208	ARG	CD-NE-CZ	-5.10	117.26	124.40
1	A	319	ARG	CD-NE-CZ	-5.03	117.35	124.40
1	A	239	ARG	CD-NE-CZ	-5.01	117.38	124.40

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	2595	0	2674	72	0
2	A	1	0	0	0	0
3	A	1	0	0	2	0
4	A	177	0	0	6	0
All	All	2774	0	2674	72	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 14.

All (72) 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:212:ILE:CG2	1:A:310:MET:HE1	1.97	0.95
1:A:144:LYS:O	1:A:144:LYS:HE3	1.77	0.83
1:A:212:ILE:HG21	1:A:310:MET:HE1	1.68	0.73
1:A:198:GLU:HA	1:A:198:GLU:OE1	1.87	0.72
1:A:174:ILE:HD11	1:A:215:GLN:HG2	1.77	0.66
1:A:212:ILE:CB	1:A:310:MET:HE1	2.25	0.65
1:A:212:ILE:HB	1:A:310:MET:HE1	1.78	0.65
1:A:61:VAL:HB	1:A:194:THR:HB	1.78	0.64
1:A:2:GLU:O	1:A:5:GLU:HB2	1.98	0.63
1:A:10:ARG:HB3	1:A:10:ARG:CZ	2.27	0.63
1:A:48:ARG:C	1:A:51:PRO:HD2	2.28	0.59
1:A:51:PRO:HG3	1:A:76:GLU:HB2	1.88	0.56
1:A:50:ARG:HB2	1:A:51:PRO:HD3	1.88	0.56
1:A:262:PHE:O	1:A:266:PHE:HB2	2.07	0.55
1:A:18:ILE:HD11	1:A:55:LEU:HD11	1.88	0.54
1:A:171:MET:HE1	1:A:212:ILE:HG21	1.90	0.54
1:A:8:PHE:HZ	1:A:336:PHE:CZ	2.26	0.53
1:A:10:ARG:NH1	4:A:2164:HOH:O	2.41	0.53
1:A:133:GLU:OE2	1:A:133:GLU:HA	2.07	0.53
1:A:256:GLU:O	1:A:260:GLN:HG2	2.07	0.53
1:A:227:GLU:O	1:A:228:LYS:C	2.51	0.53
1:A:239:ARG:NH1	4:A:2039:HOH:O	2.41	0.53
1:A:241:GLY:HA2	1:A:266:PHE:CZ	2.44	0.52
1:A:61:VAL:HG23	1:A:62:GLY:N	2.25	0.52
1:A:212:ILE:HB	1:A:310:MET:CE	2.40	0.51
1:A:338:VAL:HG22	1:A:338:VAL:O	2.10	0.51
1:A:208:ARG:NH2	4:A:2168:HOH:O	2.43	0.51

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:256:GLU:OE2	1:A:259:LYS:NZ	2.43	0.51
1:A:48:ARG:O	1:A:51:PRO:HD2	2.11	0.50
1:A:47:LYS:NZ	4:A:2046:HOH:O	2.45	0.50
1:A:98:LYS:NZ	4:A:2097:HOH:O	2.44	0.50
1:A:158:GLU:O	1:A:161:LYS:HB2	2.12	0.49
1:A:26:ILE:O	1:A:26:ILE:HG13	2.13	0.48
1:A:225:ALA:HB3	1:A:230:LEU:HD22	1.95	0.48
1:A:6:GLU:O	1:A:9:ALA:HB3	2.13	0.48
1:A:315:ASN:C	1:A:317:ALA:H	2.23	0.47
1:A:208:ARG:HH11	1:A:208:ARG:HD3	1.60	0.46
1:A:295:LYS:HA	3:A:2001:BR:BR	2.70	0.46
1:A:316:GLU:O	1:A:316:GLU:CG	2.63	0.46
1:A:221:LEU:O	1:A:225:ALA:HB3	2.16	0.45
1:A:8:PHE:HD1	1:A:11:ILE:HD12	1.81	0.44
1:A:94:THR:HB	1:A:98:LYS:O	2.17	0.44
1:A:221:LEU:O	1:A:225:ALA:CB	2.66	0.44
1:A:61:VAL:HG23	1:A:62:GLY:H	1.82	0.44
1:A:33:VAL:HG13	1:A:34:LEU:N	2.32	0.44
1:A:312:LYS:O	1:A:316:GLU:HB3	2.16	0.44
1:A:227:GLU:H	1:A:227:GLU:HG2	1.31	0.44
1:A:325:LYS:O	1:A:328:MET:HB3	2.18	0.44
1:A:51:PRO:CG	1:A:76:GLU:HB2	2.48	0.44
1:A:206:TRP:CD1	1:A:314:ALA:HB1	2.54	0.43
1:A:218:ASP:OD1	1:A:340:ARG:NH2	2.42	0.43
1:A:165:VAL:HG11	1:A:243:LYS:HG2	2.01	0.43
1:A:133:GLU:OE2	1:A:133:GLU:CA	2.67	0.43
1:A:223:LEU:HD23	1:A:235:GLY:HA2	1.99	0.42
1:A:300:ILE:HB	3:A:2001:BR:BR	2.74	0.42
1:A:8:PHE:HZ	1:A:336:PHE:CE2	2.37	0.42
1:A:212:ILE:HG22	1:A:310:MET:HE1	1.95	0.42
1:A:55:LEU:O	1:A:65:PRO:HB3	2.20	0.42
1:A:118:PHE:HZ	1:A:146:SER:HG	1.65	0.42
1:A:225:ALA:O	1:A:234:VAL:CG1	2.68	0.42
1:A:21:LYS:HD3	1:A:21:LYS:HA	1.88	0.41
1:A:138:VAL:HG21	1:A:192:ILE:HD11	2.03	0.41
1:A:220:VAL:O	1:A:224:ILE:HG12	2.19	0.41
1:A:264:LYS:NZ	4:A:2151:HOH:O	2.52	0.41
1:A:69:ILE:O	1:A:73:VAL:HG23	2.21	0.41
1:A:82:SER:O	1:A:86:ASP:HB2	2.21	0.41
1:A:60:ALA:O	1:A:321:LEU:HD23	2.21	0.40
1:A:249:HIS:HE1	1:A:297:TYR:O	2.04	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:5:GLU:N	1:A:5:GLU:CD	2.78	0.40
1:A:130:ILE:HG21	1:A:192:ILE:HD12	2.03	0.40
1:A:188:VAL:O	1:A:192:ILE:HG12	2.21	0.40
1:A:196:ASN:OD1	1:A:196:ASN:C	2.65	0.40

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	323/342 (94%)	310 (96%)	12 (4%)	1 (0%)	36	42

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	62	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	273/284 (96%)	246 (90%)	27 (10%)	7	8

All (27) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	3	LYS
1	A	5	GLU
1	A	10	ARG
1	A	29	LYS
1	A	30	ASP
1	A	36	GLU
1	A	81	TYR
1	A	93	GLU
1	A	96	ARG
1	A	129	GLU
1	A	133	GLU
1	A	144	LYS
1	A	182	PHE
1	A	187	LYS
1	A	198	GLU
1	A	201	LYS
1	A	227	GLU
1	A	228	LYS
1	A	229	LYS
1	A	232	LYS
1	A	239	ARG
1	A	259	LYS
1	A	305	GLU
1	A	316	GLU
1	A	319	ARG
1	A	337	ILE
1	A	341	GLU

Sometimes 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 ⓘ

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

Of 2 ligands modelled in this entry, 2 are monoatomic - leaving 0 for Mogul analysis.

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	327/342 (95%)	0.42	18 (5%)	30 27	24, 45, 69, 85	0

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	97	GLY	4.5
1	A	227	GLU	3.3
1	A	63	GLY	3.2
1	A	341	GLU	3.0
1	A	225	ALA	3.0
1	A	60	ALA	2.9
1	A	61	VAL	2.6
1	A	62	GLY	2.6
1	A	200	ILE	2.5
1	A	282	ASP	2.4
1	A	226	ASP	2.4
1	A	240	LYS	2.3
1	A	65	PRO	2.2
1	A	5	GLU	2.2
1	A	194	THR	2.2
1	A	46	GLY	2.1
1	A	59	GLU	2.1
1	A	230	LEU	2.0

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

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](#)

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($\text{\AA}^2$)	Q<0.9
3	BR	A	2001	1/1	0.97	0.15	62,62,62,62	0
2	HG	A	1001	1/1	0.99	0.06	52,52,52,52	0

6.5 Other polymers [i](#)

There are no such residues in this entry.