



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 7, 2026 – 01:06 AM UTC

PDB ID : 3VEO / pdb_00003veo
Title : Crystal structure of the O-carbamoyltransferase TobZ in complex with carbamoyl phosphate
Authors : Parthier, C.; Stubbs, M.T.; Goerlich, S.; Jaenecke, F.
Deposited on : 2012-01-09
Resolution : 2.19 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 Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
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

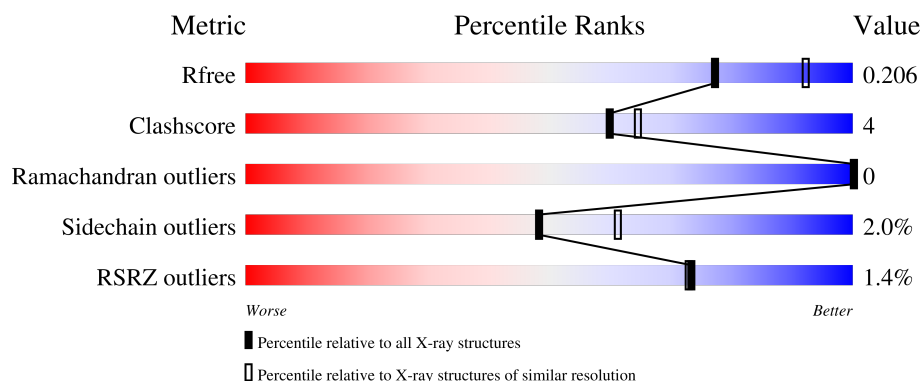
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.19 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	8975 (2.20-2.16)
Clashscore	190562	9786 (2.20-2.16)
Ramachandran outliers	187476	9664 (2.20-2.16)
Sidechain outliers	187428	9664 (2.20-2.16)
RSRZ outliers	180081	8979 (2.20-2.16)

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	576	

2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 4906 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.

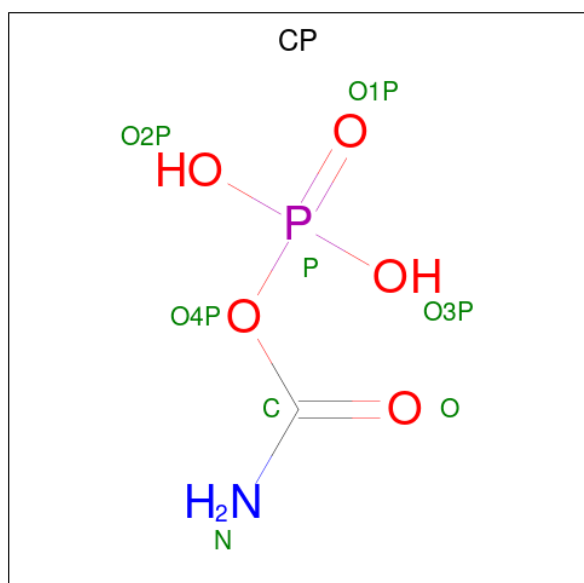
- Molecule 1 is a protein called O-carbamoyltransferase TobZ.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	571	4471	2815	806	836	14	0	7	0

There are 7 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-5	HIS	-	expression tag	UNP Q70IY1
A	-4	HIS	-	expression tag	UNP Q70IY1
A	-3	HIS	-	expression tag	UNP Q70IY1
A	-2	HIS	-	expression tag	UNP Q70IY1
A	-1	HIS	-	expression tag	UNP Q70IY1
A	0	HIS	-	expression tag	UNP Q70IY1
A	35	LEU	PHE	engineered mutation	UNP Q70IY1

- Molecule 2 is PHOSPHORIC ACID MONO(FORMAMIDE)ESTER (CCD ID: CP) (formula: $\text{CH}_4\text{NO}_5\text{P}$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			8	1	1	5	1		

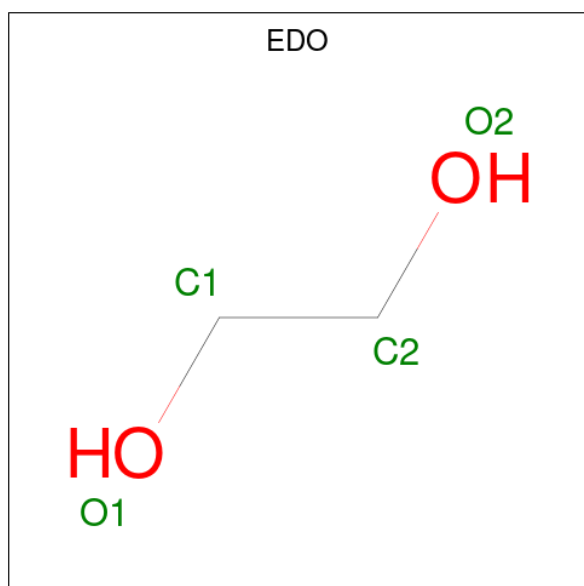
- Molecule 3 is FE (II) ION (CCD ID: FE2) (formula: Fe).

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

- Molecule 4 is POTASSIUM ION (CCD ID: K) (formula: K).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	2	Total	K	0	0
			2	2		

- Molecule 5 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			4	2	2		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	420	Total	O	0	0
			420	420		

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.

Chain A:

88% 11%

HIS
HIS
HIS
HIS
HIS
H0
W9
P10
F13
D23
E33
R39
G41
R80
R103
D106
H114
F125
H149
V161
P162
V174
T178
K187
V198
F207
D210
N215
R222
D223
P224
W227
D228
E229
R397

S295
R303
D328
K329
K330
D338
I339
G340
V341
K360
F370
R381
W408
A409
Q410
G416
V442
R449
A452
L456
D461
E465
V466
M473
D494
W495
R498
S507
F508
R509
Y510
H511
L520
P524
N532
D533
R534

P542
S550
R551
K566
D567
L568
R569
H570

4 Data and refinement statistics

Property	Value	Source
Space group	P 61 2 2	Depositor
Cell constants a, b, c, α , β , γ	98.20Å 98.20Å 279.20Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	29.20 – 2.19 29.20 – 2.19	Depositor EDS
% Data completeness (in resolution range)	99.6 (29.20-2.19) 99.5 (29.20-2.19)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	10.61 (at 2.20Å)	Xtriage
Refinement program	PHENIX 1.7_650	Depositor
R, R_{free}	0.164 , 0.211 0.159 , 0.206	Depositor DCC
R_{free} test set	2100 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	22.9	Xtriage
Anisotropy	0.437	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 45.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	4906	wwPDB-VP
Average B, all atoms (Å ²)	24.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.59% 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: K, FE2, EDO, CP

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	0.45	0/4603	0.76	3/6266 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	442	VAL	N-CA-C	5.53	115.62	110.42
1	A	507	ASN	CA-C-N	5.53	124.99	119.24
1	A	507	ASN	C-N-CA	5.53	124.99	119.24

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	4471	0	4362	38	0
2	A	8	0	2	0	0
3	A	1	0	0	0	0
4	A	2	0	0	0	0
5	A	4	0	6	0	0
6	A	420	0	0	7	0
All	All	4906	0	4370	38	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 4.

All (38) 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:0:HIS:HA	1:A:23[B]:ASP:OD1	1.94	0.67
1:A:149:HIS:ND1	6:A:974:HOH:O	2.26	0.67
1:A:550:SER:HB2	6:A:1120:HOH:O	1.95	0.66
1:A:114:HIS:CE1	1:A:341:VAL:HG11	2.39	0.58
1:A:473:MET:O	1:A:498:ARG:HD3	2.05	0.57
1:A:456:LEU:HG	1:A:524:PRO:HB2	1.89	0.54
1:A:465[A]:GLU:HG3	1:A:466:VAL:HG23	1.90	0.52
1:A:452:ALA:HB1	1:A:498:ARG:O	2.10	0.51
1:A:80:ARG:HG3	1:A:227:TRP:HB2	1.93	0.51
1:A:222:ARG:O	1:A:224:PRO:HD3	2.11	0.50
1:A:473:MET:HB3	1:A:498:ARG:HD3	1.93	0.50
1:A:339:ILE:HD11	1:A:416:GLY:HA2	1.94	0.50
1:A:532:ASN:N	1:A:532:ASN:HD22	2.12	0.47
1:A:207:PHE:CG	1:A:287:ARG:HG2	2.49	0.47
1:A:338:ASP:O	1:A:341:VAL:HG22	2.14	0.47
1:A:456:LEU:HD22	1:A:511:HIS:CD2	2.50	0.47
1:A:461:ASP:HB3	6:A:1105:HOH:O	2.14	0.47
1:A:494:ASP:O	1:A:495:TRP:HB2	2.15	0.46
1:A:187:LYS:HE2	1:A:449:ARG:NH1	2.31	0.46
1:A:303:ARG:HE	1:A:328:ASP:CG	2.24	0.45
1:A:568:LEU:HD22	6:A:1074:HOH:O	2.15	0.45
1:A:520:LEU:HD11	6:A:839:HOH:O	2.15	0.45
1:A:566:LYS:HA	1:A:566:LYS:HD2	1.70	0.44
1:A:39:LYS:O	1:A:40:HIS:HB2	2.18	0.43
1:A:103[A]:ARG:NE	1:A:106:ASP:OD1	2.49	0.43
1:A:408:TRP:CE2	1:A:410:GLN:HG3	2.53	0.43
1:A:210:ASP:HA	1:A:295:SER:HB2	2.01	0.43
1:A:381:ARG:HD2	1:A:381:ARG:HA	1.80	0.43
1:A:498:ARG:O	1:A:498:ARG:HD2	2.19	0.42
1:A:41:GLY:HA2	6:A:787:HOH:O	2.18	0.42
1:A:33:GLU:HG3	1:A:34:ARG:N	2.34	0.42
1:A:125:PHE:HB3	1:A:360:MET:HG3	2.02	0.42
1:A:370:PHE:CD2	1:A:542:PRO:HD3	2.56	0.41
1:A:9:TRP:CD2	1:A:10:PRO:HD2	2.56	0.40
1:A:550:SER:CB	6:A:1120:HOH:O	2.60	0.40
1:A:533:ASP:CG	1:A:551:ARG:HH22	2.29	0.40
1:A:174:VAL:O	1:A:178:THR:HG23	2.21	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:161:VAL:HA	1:A:162:PRO:HD3	1.94	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	576/576 (100%)	557 (97%)	19 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	460/458 (100%)	451 (98%)	9 (2%)	48	61

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	13	PHE
1	A	35	LEU
1	A	229	GLU
1	A	287	ARG
1	A	330	MET

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Mol	Chain	Res	Type
1	A	509	ARG
1	A	532	ASN
1	A	566	LYS
1	A	568	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	220	GLN
1	A	511	HIS
1	A	532	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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 5 ligands modelled in this entry, 3 are monoatomic - leaving 2 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	$\# Z > 2$
5	EDO	A	605	-	3,3,3	0.51	0	2,2,2	0.42	0
2	CP	A	601	-	6,7,7	0.64	0	7,10,10	1.52	2 (28%)

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
5	EDO	A	605	-	-	0/1/1/1	-
2	CP	A	601	-	-	0/3/5/5	-

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	601	CP	O4P-P-O1P	-2.95	100.03	109.47
2	A	601	CP	O3P-P-O2P	2.26	116.28	107.80

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 [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	A	571/576 (99%)	-0.66	8 (1%) 73 73	9, 20, 42, 105	8 (1%)

All (8) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	569	ARG	4.9
1	A	198	VAL	4.6
1	A	0	HIS	3.5
1	A	534	ARG	3.2
1	A	570	HIS	2.6
1	A	215	ASN	2.2
1	A	567	ASP	2.2
1	A	568	LEU	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](#)

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
4	K	A	603	1/1	0.90	0.09	32,32,32,32	0
4	K	A	604	1/1	0.90	0.11	43,43,43,43	0
5	EDO	A	605	4/4	0.97	0.06	17,23,24,26	0
2	CP	A	601	8/8	0.99	0.05	16,21,22,23	0
3	FE2	A	602	1/1	1.00	0.05	13,13,13,13	0

6.5 Other polymers [i](#)

There are no such residues in this entry.