



# Full wwPDB X-ray Structure Validation Report ⓘ

May 13, 2020 – 12:01 pm BST

PDB ID : 5GR0  
Title : Crystal structure of branching enzyme D501A mutant from *Cyanothece* sp. ATCC 51142  
Authors : Suzuki, R.; Suzuki, E.  
Deposited on : 2016-08-08  
Resolution : 1.95 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](mailto: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.

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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	:	1.8.5 (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

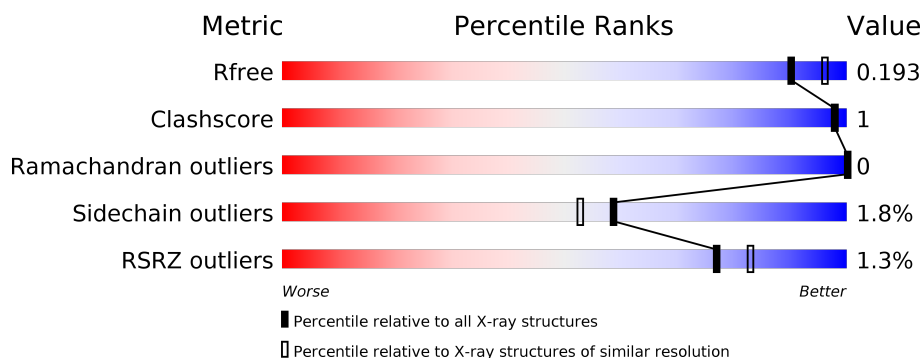
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.95 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	2580 (1.96-1.96)
Clashscore	141614	2705 (1.96-1.96)
Ramachandran outliers	138981	2678 (1.96-1.96)
Sidechain outliers	138945	2678 (1.96-1.96)
RSRZ outliers	127900	2539 (1.96-1.96)

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  $\geq 3$ , 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	793	<div> <div></div> <div>87%</div> <div>7%</div> <div>5%</div> </div>

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 7182 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 1,4-alpha-glucan branching enzyme GlgB.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	755	Total	C	N	O	S	0	1	0
			6275	4059	1042	1150	24			

There are 21 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	initiating methionine	UNP B1WPM8
A	-18	GLY	-	expression tag	UNP B1WPM8
A	-17	SER	-	expression tag	UNP B1WPM8
A	-16	SER	-	expression tag	UNP B1WPM8
A	-15	HIS	-	expression tag	UNP B1WPM8
A	-14	HIS	-	expression tag	UNP B1WPM8
A	-13	HIS	-	expression tag	UNP B1WPM8
A	-12	HIS	-	expression tag	UNP B1WPM8
A	-11	HIS	-	expression tag	UNP B1WPM8
A	-10	HIS	-	expression tag	UNP B1WPM8
A	-9	SER	-	expression tag	UNP B1WPM8
A	-8	SER	-	expression tag	UNP B1WPM8
A	-7	GLY	-	expression tag	UNP B1WPM8
A	-6	LEU	-	expression tag	UNP B1WPM8
A	-5	VAL	-	expression tag	UNP B1WPM8
A	-4	PRO	-	expression tag	UNP B1WPM8
A	-3	ARG	-	expression tag	UNP B1WPM8
A	-2	GLY	-	expression tag	UNP B1WPM8
A	-1	SER	-	expression tag	UNP B1WPM8
A	0	HIS	-	expression tag	UNP B1WPM8
A	501	ALA	ASP	engineered mutation	UNP B1WPM8

- Molecule 2 is GLYCEROL (three-letter code: GOL) (formula: C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	4	Total	Mg	0	0
			4	4		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	873	Total	O	0	0
			873	873		



- Molecule 1: 1,4-alpha-glucan branching enzyme GlgB



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	133.63Å 133.63Å 185.33Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.33 – 1.95 42.95 – 1.95	Depositor EDS
% Data completeness (in resolution range)	98.5 (46.33-1.95) 98.6 (42.95-1.95)	Depositor EDS
$R_{merge}$	0.04	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	10.00 (at 1.95Å)	Xtriage
Refinement program	REFMAC 5.8.0049	Depositor
R, $R_{free}$	0.156 , 0.184 0.169 , 0.193	Depositor DCC
$R_{free}$ test set	6063 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	22.1	Xtriage
Anisotropy	0.022	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 48.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.35$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	7182	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.60% 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

### 5.1 Standard geometry

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

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	1.28	28/6498 (0.4%)	1.11	29/8843 (0.3%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (28) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	58	GLU	CD-OE2	9.12	1.35	1.25
1	A	285	TRP	CB-CG	-7.68	1.36	1.50
1	A	605	SER	CB-OG	-7.27	1.32	1.42
1	A	242	ARG	CZ-NH1	7.26	1.42	1.33
1	A	74	GLU	CG-CD	7.23	1.62	1.51
1	A	74	GLU	CB-CG	-7.18	1.38	1.52
1	A	572	GLU	CD-OE1	-6.75	1.18	1.25
1	A	621	GLU	CD-OE1	-6.72	1.18	1.25
1	A	74	GLU	CD-OE2	6.71	1.33	1.25
1	A	58	GLU	CG-CD	6.60	1.61	1.51
1	A	412	ARG	CZ-NH1	6.55	1.41	1.33
1	A	703	TYR	CG-CD1	6.51	1.47	1.39
1	A	15	TYR	CZ-OH	6.32	1.48	1.37
1	A	654	GLU	CD-OE1	-5.95	1.19	1.25
1	A	572	GLU	CD-OE2	-5.88	1.19	1.25
1	A	480	PRO	C-N	-5.84	1.22	1.33
1	A	206	SER	CB-OG	5.65	1.49	1.42
1	A	135	GLU	CD-OE2	5.38	1.31	1.25

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	8	ASP	CB-CG	5.37	1.63	1.51
1	A	470	GLU	CD-OE1	-5.35	1.19	1.25
1	A	100	ASP	CB-CG	5.33	1.62	1.51
1	A	412	ARG	CZ-NH2	5.29	1.40	1.33
1	A	244	SER	CB-OG	-5.28	1.35	1.42
1	A	658	CYS	CB-SG	-5.17	1.73	1.81
1	A	542	TYR	CB-CG	5.16	1.59	1.51
1	A	299	GLU	CD-OE2	5.13	1.31	1.25
1	A	410	GLU	CD-OE1	-5.10	1.20	1.25
1	A	621	GLU	CD-OE2	-5.01	1.20	1.25

All (29) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	694	ARG	NE-CZ-NH2	-17.93	111.34	120.30
1	A	694	ARG	NE-CZ-NH1	15.29	127.94	120.30
1	A	432	ARG	NE-CZ-NH1	8.38	124.49	120.30
1	A	74	GLU	CG-CD-OE2	7.75	133.79	118.30
1	A	725	LYS	CD-CE-NZ	7.62	129.23	111.70
1	A	459	ASP	CB-CG-OD1	7.20	124.78	118.30
1	A	152	ARG	NE-CZ-NH2	-6.95	116.83	120.30
1	A	694	ARG	CD-NE-CZ	6.84	133.18	123.60
1	A	173	ARG	NE-CZ-NH1	6.84	123.72	120.30
1	A	242	ARG	NE-CZ-NH2	-6.72	116.94	120.30
1	A	74	GLU	CG-CD-OE1	-6.70	104.89	118.30
1	A	225	ASP	CB-CG-OD2	-6.67	112.29	118.30
1	A	580	ARG	NE-CZ-NH1	6.63	123.62	120.30
1	A	8	ASP	CB-CG-OD1	6.62	124.26	118.30
1	A	571	ASP	CB-CG-OD1	6.61	124.25	118.30
1	A	152	ARG	NE-CZ-NH1	6.54	123.57	120.30
1	A	694	ARG	CG-CD-NE	-6.29	98.60	111.80
1	A	412	ARG	NE-CZ-NH2	-6.11	117.25	120.30
1	A	216	ARG	NE-CZ-NH1	6.08	123.34	120.30
1	A	381	ASP	CB-CG-OD1	6.00	123.70	118.30
1	A	111	ASP	CB-CG-OD1	5.98	123.68	118.30
1	A	432	ARG	NE-CZ-NH2	-5.97	117.32	120.30
1	A	434	ASP	CB-CG-OD2	5.96	123.66	118.30
1	A	207	ASP	CB-CG-OD2	-5.94	112.95	118.30
1	A	658	CYS	CB-CA-C	5.75	121.90	110.40
1	A	575	LYS	CD-CE-NZ	-5.62	98.76	111.70
1	A	387	GLU	OE1-CD-OE2	-5.38	116.85	123.30
1	A	58	GLU	CG-CD-OE2	5.23	128.77	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	124	ARG	NE-CZ-NH1	5.03	122.81	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	694	ARG	Sidechain

## 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	6275	0	5862	9	0
2	A	30	0	40	0	0
3	A	4	0	0	0	0
4	A	873	0	0	0	0
All	All	7182	0	5902	9	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 1.

All (9) 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:213:ARG:HH12	1:A:332:THR:HG1	1.63	0.46
1:A:46:PRO:O	1:A:47:LYS:HB2	2.16	0.45
1:A:539:SER:HA	1:A:542:TYR:CE2	2.52	0.44
1:A:725:LYS:HE2	1:A:740:ASP:O	2.17	0.44
1:A:642:ALA:HA	1:A:672:SER:HB2	1.99	0.43
1:A:365:TRP:CZ2	1:A:419:VAL:HB	2.55	0.41
1:A:525:ASP:OD1	1:A:526:PRO:HD2	2.19	0.41
1:A:639:GLN:O	1:A:639:GLN:HG2	2.20	0.41
1:A:652:GLY:O	1:A:670:ARG:HA	2.20	0.41

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	754/793 (95%)	732 (97%)	22 (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	668/699 (96%)	656 (98%)	12 (2%)	59	53

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	59	ARG
1	A	216	ARG
1	A	281	ILE
1	A	369	HIS
1	A	413	ASN
1	A	434	ASP
1	A	447	LYS
1	A	450	GLU
1	A	491	GLU
1	A	686	THR
1	A	694	ARG
1	A	725	LYS

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

Mol	Chain	Res	Type
1	A	16	ASN
1	A	616	HIS
1	A	638	GLN

### 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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

Of 9 ligands modelled in this entry, 4 are monoatomic - leaving 5 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	GOL	A	802	-	5,5,5	0.77	0	5,5,5	0.70	0
2	GOL	A	801	-	5,5,5	2.31	2 (40%)	5,5,5	1.82	1 (20%)
2	GOL	A	804	-	5,5,5	0.26	0	5,5,5	0.74	0
2	GOL	A	803	-	5,5,5	0.27	0	5,5,5	1.20	1 (20%)
2	GOL	A	805	-	5,5,5	0.32	0	5,5,5	1.41	0

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	GOL	A	802	-	-	0/4/4/4	-
2	GOL	A	801	-	-	2/4/4/4	-
2	GOL	A	804	-	-	0/4/4/4	-
2	GOL	A	803	-	-	0/4/4/4	-
2	GOL	A	805	-	-	0/4/4/4	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	801	GOL	O3-C3	3.64	1.57	1.42
2	A	801	GOL	C3-C2	2.75	1.63	1.51

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	801	GOL	O3-C3-C2	3.27	125.90	110.20
2	A	803	GOL	O2-C2-C3	-2.62	97.60	109.12

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	801	GOL	C1-C2-C3-O3
2	A	801	GOL	O2-C2-C3-O3

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 ⓘ

### 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<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	755/793 (95%)	-0.26	10 (1%) 77 83	14, 21, 40, 77	0

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	758	VAL	6.2
1	A	759	PRO	4.0
1	A	456	TYR	3.4
1	A	737	TYR	2.7
1	A	35	ASN	2.7
1	A	756	THR	2.3
1	A	285	TRP	2.1
1	A	253	VAL	2.1
1	A	755	PRO	2.1
1	A	175	TYR	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 ⓘ

There are no carbohydrates in this entry.

### 6.4 Ligands ⓘ

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, 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	B-factors( $\text{\AA}^2$ )	Q<0.9
2	GOL	A	801	6/6	0.84	0.20	28,45,54,54	0
2	GOL	A	803	6/6	0.87	0.23	44,48,54,54	0
3	MG	A	806	1/1	0.92	0.10	44,44,44,44	0
2	GOL	A	802	6/6	0.93	0.12	34,34,35,36	0
2	GOL	A	804	6/6	0.94	0.18	33,51,59,60	0
2	GOL	A	805	6/6	0.95	0.12	24,34,43,50	0
3	MG	A	809	1/1	0.96	0.14	45,45,45,45	0
3	MG	A	808	1/1	0.98	0.18	28,28,28,28	0
3	MG	A	807	1/1	0.98	0.04	22,22,22,22	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.