



# Full wwPDB X-ray Structure Validation Report ⓘ

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PDB ID : 5DKU  
Title : C-terminal His tagged apPOL exonuclease mutant  
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Deposited on : 2015-09-04  
Resolution : 2.90 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
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

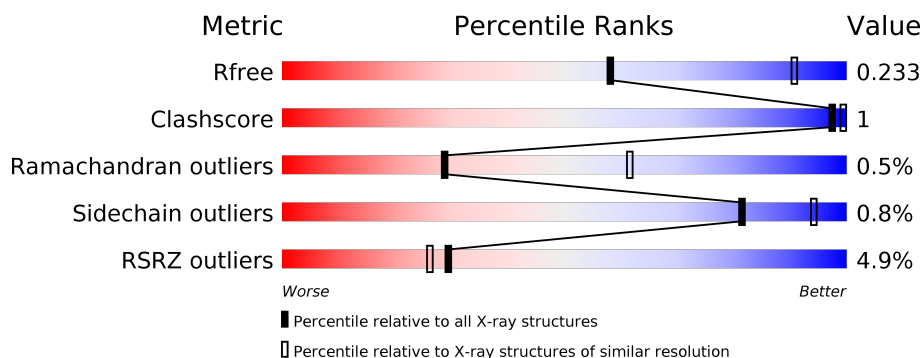
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.90 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	1957 (2.90-2.90)
Clashscore	141614	2172 (2.90-2.90)
Ramachandran outliers	138981	2115 (2.90-2.90)
Sidechain outliers	138945	2117 (2.90-2.90)
RSRZ outliers	127900	1906 (2.90-2.90)

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	635	<div> <div>5%</div> <div> <div></div> <div>87%</div> <div>9%</div> </div> </div>
1	B	635	<div> <div>4%</div> <div> <div></div> <div>89%</div> <div>9%</div> </div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 19642 atoms, of which 9879 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 Prex DNA polymerase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	577	Total	C	H	N	O	S	0	4	0
			9731	3107	4916	802	889	17			
1	B	581	Total	C	H	N	O	S	0	4	0
			9813	3130	4963	809	894	17			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	82	ASN	ASP	engineered mutation	UNP Q8ILY1
A	84	GLN	GLU	engineered mutation	UNP Q8ILY1
A	629	LEU	-	expression tag	UNP Q8ILY1
A	630	GLU	-	expression tag	UNP Q8ILY1
A	631	HIS	-	expression tag	UNP Q8ILY1
A	632	HIS	-	expression tag	UNP Q8ILY1
A	633	HIS	-	expression tag	UNP Q8ILY1
A	634	HIS	-	expression tag	UNP Q8ILY1
A	635	HIS	-	expression tag	UNP Q8ILY1
B	82	ASN	ASP	engineered mutation	UNP Q8ILY1
B	84	GLN	GLU	engineered mutation	UNP Q8ILY1
B	629	LEU	-	expression tag	UNP Q8ILY1
B	630	GLU	-	expression tag	UNP Q8ILY1
B	631	HIS	-	expression tag	UNP Q8ILY1
B	632	HIS	-	expression tag	UNP Q8ILY1
B	633	HIS	-	expression tag	UNP Q8ILY1
B	634	HIS	-	expression tag	UNP Q8ILY1
B	635	HIS	-	expression tag	UNP Q8ILY1

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Mg	0	0
			1	1		

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

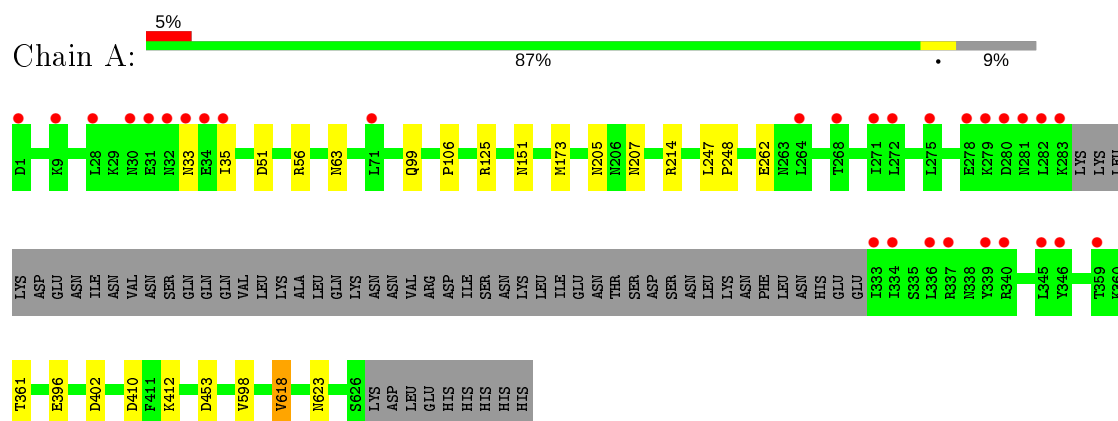
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	51	Total	O	0	2
			53	53		
3	B	42	Total	O	0	1
			43	43		

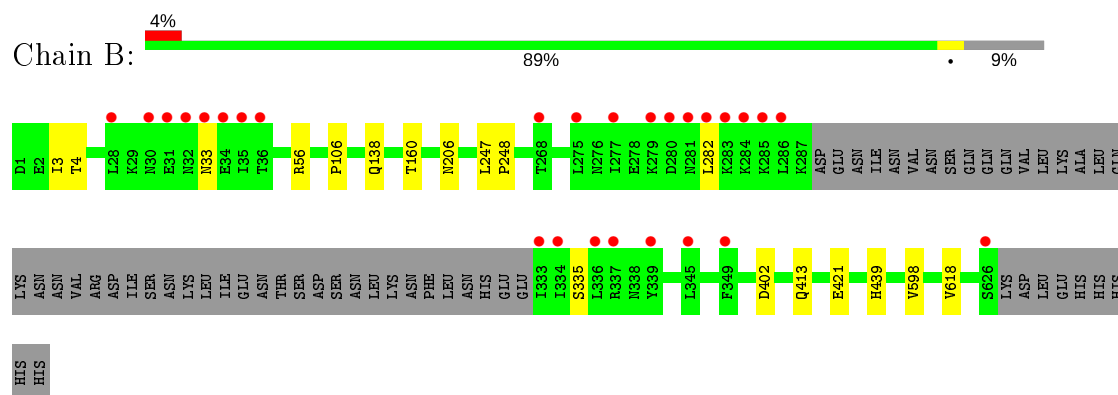
### 3 Residue-property plots [i](#)

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: Prex DNA polymerase



- Molecule 1: Prex DNA polymerase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 65	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	146.38Å 146.38Å 165.67Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	47.91 – 2.90 47.91 – 2.90	Depositor EDS
% Data completeness (in resolution range)	99.3 (47.91-2.90) 96.7 (47.91-2.90)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.11 (at 2.91Å)	Xtriage
Refinement program	PHENIX (1.10_2148: ???)	Depositor
R, $R_{free}$	0.192 , 0.232 0.194 , 0.233	Depositor DCC
$R_{free}$ test set	2007 reflections (4.53%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	50.6	Xtriage
Anisotropy	0.150	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 54.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.039 for h,-h-k,-l	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	19642	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	68.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.53% 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: 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	0.25	0/4910	0.40	0/6609
1	B	0.25	0/4945	0.40	0/6654
All	All	0.25	0/9855	0.40	0/13263

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

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	4815	4916	4925	8	0
1	B	4850	4963	4970	7	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	53	0	0	1	0
3	B	43	0	0	0	0
All	All	9763	9879	9895	15	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 (15) 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:412:LYS:O	3:A:801:HOH:O	2.17	0.58
1:B:413[A]:GLN:OE1	1:B:439:HIS:NE2	2.42	0.52
1:A:205:ASN:OD1	1:A:207:ASN:N	2.41	0.50
1:B:56:ARG:HB2	1:B:106:PRO:HB3	1.96	0.47
1:A:56:ARG:HB2	1:A:106:PRO:HB3	1.99	0.46
1:A:51:ASP:OD2	1:A:214:ARG:NH2	2.48	0.44
1:B:3:ILE:HG13	1:B:4:THR:N	2.33	0.44
1:B:138:GLN:OE1	1:B:160:THR:OG1	2.34	0.44
1:A:247:LEU:HB2	1:A:248:PRO:HD3	2.00	0.43
1:A:125:ARG:NH2	1:A:151:ASN:O	2.51	0.42
1:A:598:VAL:CG2	1:A:618:VAL:HG21	2.50	0.42
1:A:396:GLU:O	1:A:623:ASN:ND2	2.50	0.41
1:B:247:LEU:HB2	1:B:248:PRO:HD3	2.01	0.41
1:B:282:LEU:HD13	1:B:335:SER:CB	2.51	0.41
1:B:598:VAL:CG2	1:B:618:VAL:HG21	2.51	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	577/635 (91%)	551 (96%)	22 (4%)	4 (1%)	22	54
1	B	581/635 (92%)	553 (95%)	26 (4%)	2 (0%)	41	71
All	All	1158/1270 (91%)	1104 (95%)	48 (4%)	6 (0%)	29	61

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	33	ASN
1	B	33	ASN

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Mol	Chain	Res	Type
1	A	402	ASP
1	B	402	ASP
1	A	63	ASN
1	A	35	ILE

### 5.3.2 Protein sidechains ⓘ

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	545/598 (91%)	538 (99%)	7 (1%)	69	90
1	B	549/598 (92%)	547 (100%)	2 (0%)	91	97
All	All	1094/1196 (92%)	1085 (99%)	9 (1%)	81	94

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

Mol	Chain	Res	Type
1	A	99	GLN
1	A	173	MET
1	A	262	GLU
1	A	361	THR
1	A	410	ASP
1	A	453	ASP
1	A	618	VAL
1	B	206	ASN
1	B	421	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	195	GLN
1	B	255	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 carbohydrates in this entry.

### 5.6 Ligand geometry [i](#)

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 [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	577/635 (90%)	0.34	30 (5%)	27 23	21, 54, 131, 183	0
1	B	581/635 (91%)	0.30	27 (4%)	32 29	21, 51, 123, 162	0
All	All	1158/1270 (91%)	0.32	57 (4%)	29 26	21, 53, 130, 183	0

All (57) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	275	LEU	6.6
1	B	36	THR	6.1
1	B	334	ILE	5.3
1	B	275	LEU	5.3
1	B	336	LEU	5.3
1	B	28	LEU	5.3
1	A	333	ILE	5.0
1	A	32	ASN	5.0
1	A	283	LYS	4.9
1	A	336	LEU	4.9
1	B	333	ILE	4.8
1	A	35	ILE	4.6
1	B	30	ASN	4.6
1	A	280	ASP	4.5
1	A	282	LEU	4.4
1	A	279	LYS	4.4
1	A	1	ASP	4.4
1	B	286	LEU	4.1
1	A	345	LEU	4.1
1	B	35	ILE	4.0
1	A	31	GLU	4.0
1	B	282	LEU	3.9
1	A	281	ASN	3.7
1	B	31	GLU	3.7

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Mol	Chain	Res	Type	RSRZ
1	A	34	GLU	3.6
1	B	281	ASN	3.3
1	B	34	GLU	3.3
1	A	30	ASN	3.2
1	A	271	ILE	3.2
1	B	33	ASN	3.2
1	B	345	LEU	3.2
1	A	278	GLU	3.1
1	B	284	LYS	3.1
1	A	337	ARG	3.1
1	A	33	ASN	3.0
1	B	279	LYS	3.0
1	B	277	ILE	2.9
1	B	337	ARG	2.9
1	A	71	LEU	2.9
1	A	339	TYR	2.9
1	B	283	LYS	2.8
1	A	264	LEU	2.8
1	A	268	THR	2.5
1	B	268	THR	2.5
1	B	32	ASN	2.5
1	A	28	LEU	2.4
1	B	349	PHE	2.3
1	B	626	SER	2.3
1	B	280	ASP	2.3
1	B	285	LYS	2.3
1	A	359	THR	2.2
1	B	339	TYR	2.2
1	A	340	ARG	2.2
1	A	272	LEU	2.2
1	A	346	TYR	2.2
1	A	9	LYS	2.1
1	A	334	ILE	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 [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, 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	MG	B	701	1/1	0.93	0.11	62,62,62,62	0
2	MG	A	701	1/1	0.98	0.08	63,63,63,63	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.