



# wwPDB X-ray Structure Validation Summary Report

Feb 11, 2024 – 05:01 PM EST

PDB ID : 3E59  
Title : Crystal structure of the PvcA (PA2254) protein from Pseudomonas aeruginosa  
Authors : Gulick, A.M.; Drake, E.J.  
Deposited on : 2008-08-13  
Resolution : 2.10 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

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<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>.

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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 : 2.36  
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) : 2.36

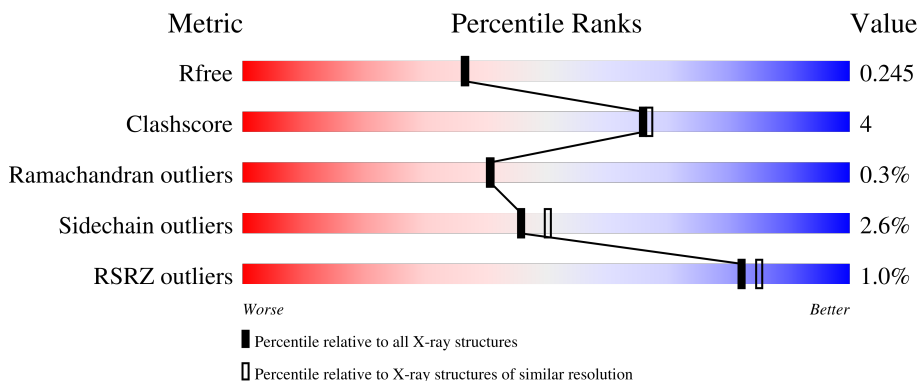
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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  $\geq 3$ , 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	330	 86% 8% 6%
1	B	330	 78% 13% 8%
1	C	330	 83% 8% 8%
1	D	330	 85% 10% 5%

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 10092 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 Pyoverdine biosynthesis protein PvcA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	311	Total 2443	C 1557	N 435	O 444	S 7	0	1	0
1	B	305	Total 2378	C 1524	N 423	O 424	S 7	0	2	0
1	C	303	Total 2348	C 1503	N 417	O 421	S 7	0	1	0
1	D	313	Total 2456	C 1567	N 429	O 453	S 7	0	2	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	GLY	-	expression tag	UNP Q9I1L5
A	0	HIS	-	expression tag	UNP Q9I1L5
B	-1	GLY	-	expression tag	UNP Q9I1L5
B	0	HIS	-	expression tag	UNP Q9I1L5
C	-1	GLY	-	expression tag	UNP Q9I1L5
C	0	HIS	-	expression tag	UNP Q9I1L5
D	-1	GLY	-	expression tag	UNP Q9I1L5
D	0	HIS	-	expression tag	UNP Q9I1L5

- Molecule 2 is PHOSPHATE ION (three-letter code: PO4) (formula: O<sub>4</sub>P).



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

- Molecule 3 is TRIETHYLENE GLYCOL (three-letter code: PGE) (formula: C<sub>6</sub>H<sub>14</sub>O<sub>4</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	1	Total C O 10 6 4	0	0
3	B	1	Total C O 10 6 4	0	0

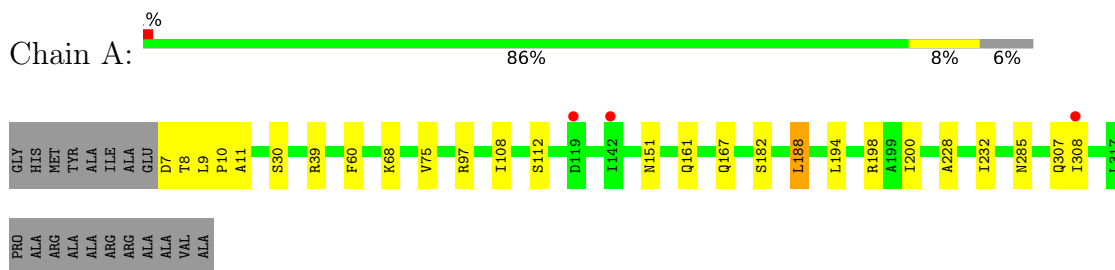
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	130	Total O 130 130	0	0
4	B	93	Total O 93 93	0	0
4	C	77	Total O 77 77	0	0
4	D	117	Total O 117 117	0	0

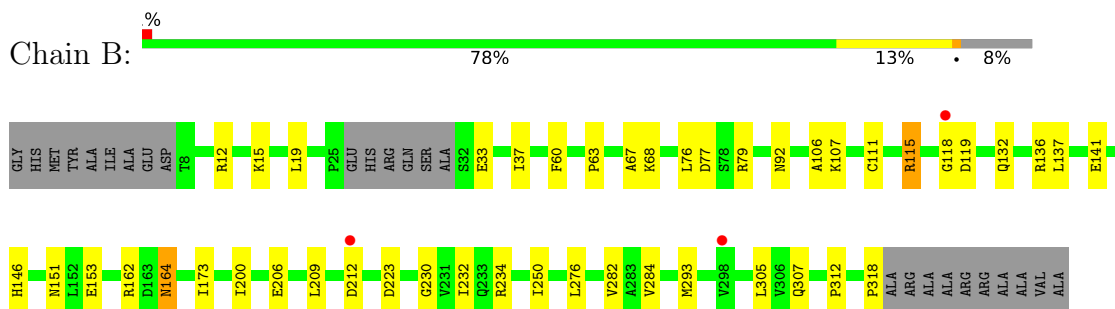
### 3 Residue-property plots [i](#)

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.

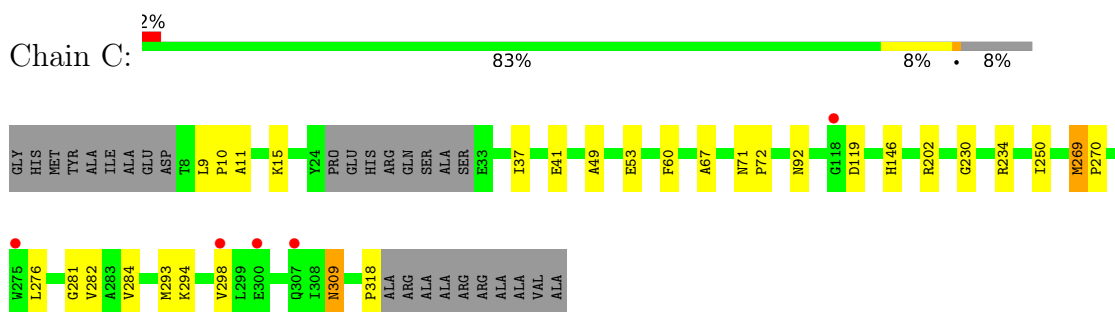
- Molecule 1: Pyoverdine biosynthesis protein PvcA



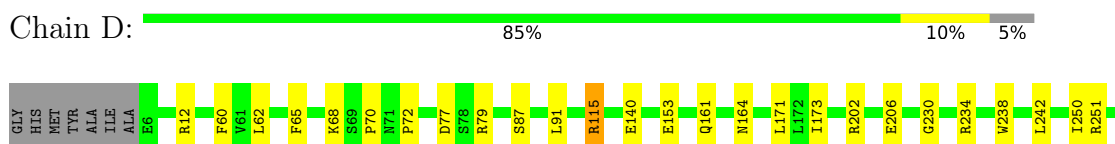
- Molecule 1: Pyoverdine biosynthesis protein PvcA

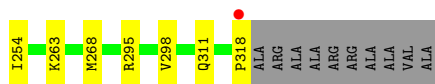


- Molecule 1: Pyoverdine biosynthesis protein PvcA



- Molecule 1: Pyoverdine biosynthesis protein PvcA





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	56.23Å 132.53Å 96.90Å 90.00° 97.93° 90.00°	Depositor
Resolution (Å)	30.00 – 2.10 47.99 – 2.09	Depositor EDS
% Data completeness (in resolution range)	96.2 (30.00-2.10) 86.3 (47.99-2.09)	Depositor EDS
$R_{merge}$	0.05	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.80 (at 2.10Å)	Xtrriage
Refinement program	REFMAC 5.2.0005	Depositor
R, $R_{free}$	0.197 , 0.246 0.199 , 0.245	Depositor DCC
$R_{free}$ test set	3549 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	39.2	Xtrriage
Anisotropy	0.577	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 49.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	10092	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	42.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 46.50 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.1352e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: PGE, PO4

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	0.49	0/2499	0.59	0/3395
1	B	0.50	0/2435	0.60	1/3310 (0.0%)
1	C	0.47	0/2401	0.61	2/3265 (0.1%)
1	D	0.51	0/2515	0.60	1/3419 (0.0%)
All	All	0.49	0/9850	0.60	4/13389 (0.0%)

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	B	0	1

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	309	ASN	N-CA-C	7.12	130.22	111.00
1	B	318	PRO	N-CA-CB	5.88	110.36	103.30
1	C	318	PRO	N-CA-CB	5.74	110.19	103.30
1	D	318	PRO	N-CA-CB	5.53	109.94	103.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	119	ASP	Peptide

## 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	2443	0	2388	14	0
1	B	2378	0	2334	28	0
1	C	2348	0	2281	15	0
1	D	2456	0	2390	22	0
2	A	10	0	0	0	0
2	B	5	0	0	0	0
2	C	5	0	0	0	0
2	D	10	0	0	0	0
3	B	20	0	28	0	0
4	A	130	0	0	0	0
4	B	93	0	0	3	0
4	C	77	0	0	1	0
4	D	117	0	0	0	0
All	All	10092	0	9421	76	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.

The worst 5 of 76 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:B:118:GLY:O	4:B:1058:HOH:O	1.82	0.95
1:A:200:ILE:HG13	1:A:232:ILE:HD11	1.49	0.94
1:D:91:LEU:HD11	1:D:268:MET:HE3	1.61	0.81
1:D:91:LEU:HD11	1:D:268:MET:CE	2.17	0.73
1:C:37:ILE:O	1:C:41:GLU:HG2	1.89	0.72

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	310/330 (94%)	301 (97%)	8 (3%)	1 (0%)	41	41
1	B	303/330 (92%)	297 (98%)	5 (2%)	1 (0%)	41	41
1	C	300/330 (91%)	293 (98%)	5 (2%)	2 (1%)	22	18
1	D	313/330 (95%)	307 (98%)	6 (2%)	0	100	100
All	All	1226/1320 (93%)	1198 (98%)	24 (2%)	4 (0%)	41	41

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	8	THR
1	B	67	ALA
1	C	67	ALA
1	C	309	ASN

### 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	248/272 (91%)	241 (97%)	7 (3%)	43	47
1	B	239/272 (88%)	228 (95%)	11 (5%)	27	26
1	C	233/272 (86%)	231 (99%)	2 (1%)	78	84
1	D	250/272 (92%)	244 (98%)	6 (2%)	49	53
All	All	970/1088 (89%)	944 (97%)	26 (3%)	46	48

5 of 26 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	212	ASP
1	B	307	GLN
1	D	251	ARG

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Mol	Chain	Res	Type
1	B	276	LEU
1	C	202	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 14 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	311	GLN
1	C	92	ASN
1	D	221	GLN
1	C	311	GLN
1	D	164	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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

8 ligands are modelled in this entry.

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	PO4	B	329	-	4,4,4	1.25	0	6,6,6	0.45	0
3	PGE	B	992	-	9,9,9	0.51	0	8,8,8	0.18	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	PO4	D	330	-	4,4,4	0.80	0	6,6,6	0.50	0
2	PO4	D	329	-	4,4,4	0.75	0	6,6,6	0.98	0
3	PGE	B	991	-	9,9,9	0.48	0	8,8,8	0.26	0
2	PO4	A	330	-	4,4,4	0.84	0	6,6,6	0.44	0
2	PO4	C	329	-	4,4,4	0.91	0	6,6,6	0.72	0
2	PO4	A	329	-	4,4,4	0.72	0	6,6,6	0.68	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. '2' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	PGE	B	992	-	-	4/7/7/7	-
3	PGE	B	991	-	-	4/7/7/7	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 8 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	992	PGE	O3-C5-C6-O4
3	B	991	PGE	O1-C1-C2-O2
3	B	992	PGE	O2-C3-C4-O3
3	B	992	PGE	C1-C2-O2-C3
3	B	991	PGE	O2-C3-C4-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 [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, 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	311/330 (94%)	0.23	3 (0%) 82 85	28, 40, 53, 71	0
1	B	305/330 (92%)	0.14	3 (0%) 82 85	31, 42, 57, 69	0
1	C	303/330 (91%)	0.28	5 (1%) 70 74	23, 44, 63, 74	0
1	D	313/330 (94%)	0.16	1 (0%) 94 94	24, 39, 53, 70	0
All	All	1232/1320 (93%)	0.20	12 (0%) 82 85	23, 41, 59, 74	0

The worst 5 of 12 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	119	ASP	3.1
1	B	298	VAL	2.6
1	C	275	TRP	2.6
1	C	307	GLN	2.4
1	B	212	ASP	2.3

### 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 monosaccharides 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
3	PGE	B	992	10/10	0.83	0.21	51,57,60,60	0
3	PGE	B	991	10/10	0.85	0.15	59,61,63,64	0
2	PO4	C	329	5/5	0.88	0.22	25,34,38,39	5
2	PO4	A	330	5/5	0.93	0.16	81,82,82,82	0
2	PO4	D	330	5/5	0.93	0.24	84,84,84,85	0
2	PO4	B	329	5/5	0.94	0.32	30,34,39,40	5
2	PO4	D	329	5/5	0.95	0.17	39,48,49,49	0
2	PO4	A	329	5/5	0.97	0.11	31,37,38,39	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.