



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 05:24 PM GMT

PDB ID : 4I9Z  
Title : Crystal structure of the PDE5A1 catalytic domain in complex with novel inhibitors  
Authors : Ren, J.; Chen, T.; Xu, Y.  
Deposited on : 2012-12-05  
Resolution : 2.08 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  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

---

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

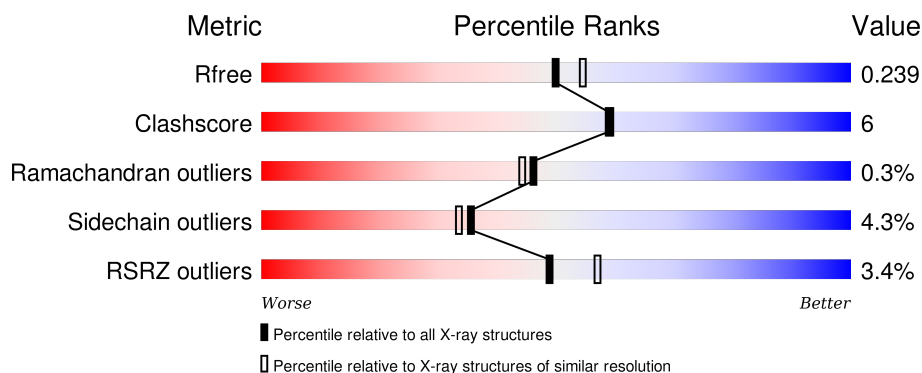
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.08 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))
$R_{free}$	91344	4546 (2.10-2.06)
Clashscore	102246	5101 (2.10-2.06)
Ramachandran outliers	100387	5048 (2.10-2.06)
Sidechain outliers	100360	5049 (2.10-2.06)
RSRZ outliers	91569	4556 (2.10-2.06)

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. 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	347	<div> <div>3%</div> <div>71%</div> <div>13%</div> <div>•</div> <div>15%</div> </div>

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
5	PEG	A	904	-	-	-	X

*Continued on next page...*

*Continued from previous page...*

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
5	PEG	A	905	-	-	X	X

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 2572 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.

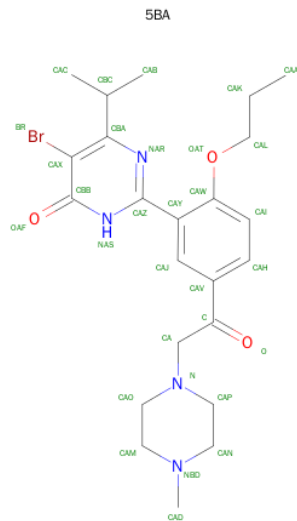
- Molecule 1 is a protein called cGMP-specific 3',5'-cyclic phosphodiesterase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	296	Total	C	N	O	S	0	1	0
			2366	1513	405	431	17			

There are 21 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	514	MET	-	EXPRESSION TAG	UNP O76074
A	515	GLY	-	EXPRESSION TAG	UNP O76074
A	516	SER	-	EXPRESSION TAG	UNP O76074
A	517	SER	-	EXPRESSION TAG	UNP O76074
A	518	HIS	-	EXPRESSION TAG	UNP O76074
A	519	HIS	-	EXPRESSION TAG	UNP O76074
A	520	HIS	-	EXPRESSION TAG	UNP O76074
A	521	HIS	-	EXPRESSION TAG	UNP O76074
A	522	HIS	-	EXPRESSION TAG	UNP O76074
A	523	HIS	-	EXPRESSION TAG	UNP O76074
A	524	SER	-	EXPRESSION TAG	UNP O76074
A	525	SER	-	EXPRESSION TAG	UNP O76074
A	526	GLY	-	EXPRESSION TAG	UNP O76074
A	527	LEU	-	EXPRESSION TAG	UNP O76074
A	528	VAL	-	EXPRESSION TAG	UNP O76074
A	529	PRO	-	EXPRESSION TAG	UNP O76074
A	530	ARG	-	EXPRESSION TAG	UNP O76074
A	531	GLY	-	EXPRESSION TAG	UNP O76074
A	532	SER	-	EXPRESSION TAG	UNP O76074
A	533	HIS	-	EXPRESSION TAG	UNP O76074
A	534	MET	-	EXPRESSION TAG	UNP O76074

- Molecule 2 is 5-BROMO-2-{5-[(4-METHYLPIPERAZIN-1-YL)ACETYL]-2-PROPOXYPHENYL}-6-(PROPAN-2-YL)PYRIMIDIN-4(3H)-ONE (three-letter code: 5BA) (formula: C<sub>23</sub>H<sub>31</sub>BrN<sub>4</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total 31	Br 1	C 23	N 4	O 3	0	0

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

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

- Molecule 4 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

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

- Molecule 5 is DI(HYDROXYETHYL)ETHER (three-letter code: PEG) (formula:  $\text{C}_4\text{H}_{10}\text{O}_3$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			7	4	3		
5	A	1	Total	C	O	0	0
			7	4	3		

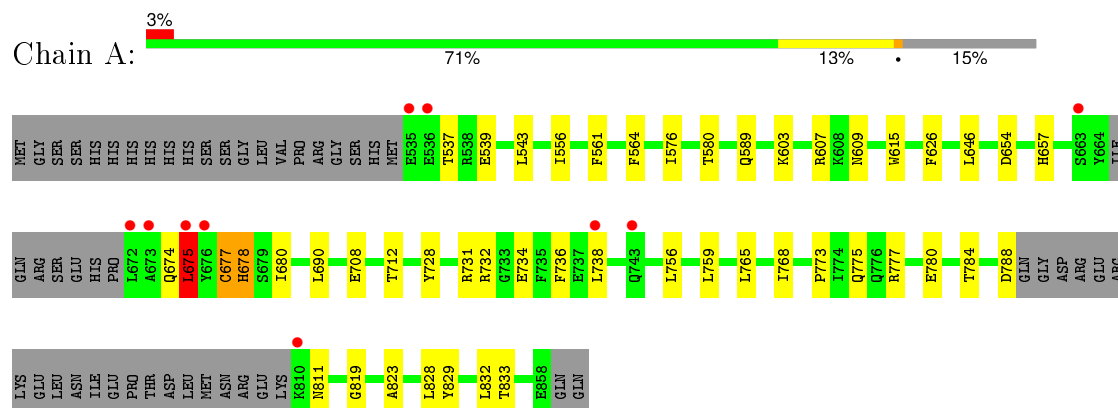
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	159	Total	O	0	0
			159	159		

### 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 errors 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: cGMP-specific 3',5'-cyclic phosphodiesterase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	74.85Å 74.85Å 132.28Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	46.30 – 2.08 46.30 – 2.08	Depositor EDS
% Data completeness (in resolution range)	98.8 (46.30-2.08) 98.8 (46.30-2.08)	Depositor EDS
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.58 (at 2.08Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8_1069)	Depositor
R, $R_{free}$	0.201 , 0.237 0.204 , 0.239	Depositor DCC
$R_{free}$ test set	783 reflections (3.09%)	DCC
Wilson B-factor (Å <sup>2</sup> )	27.3	Xtriage
Anisotropy	0.096	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 58.9	EDS
Estimated twinning fraction	0.062 for -h,-k,l	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.43$ , $\langle L^2 \rangle = 0.26$	Xtriage
Outliers	0 of 26096 reflections	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	2572	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.19% 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, 0.375 respectively for untwinned datasets, and 0.333, 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, PEG, ZN, 5BA

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	0.39	0/2414	0.55	0/3264

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	2366	0	2353	27	0
2	A	31	0	31	1	0
3	A	1	0	0	0	0
4	A	1	0	0	0	0
5	A	14	0	20	7	0
6	A	159	0	0	1	0
All	All	2572	0	2404	28	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 6.

All (28) 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:819:GLY:HA3	5:A:904:PEG:H11	1.73	0.70
1:A:576:ILE:O	1:A:580:THR:HG23	1.94	0.68
1:A:732:ARG:HD2	1:A:736:PHE:CE2	2.36	0.60
1:A:564:PHE:HD2	5:A:905:PEG:H12	1.68	0.59
1:A:777:ARG:HG3	5:A:905:PEG:H42	1.84	0.58
1:A:823:ALA:HB2	5:A:904:PEG:H41	1.86	0.57
1:A:556:ILE:HG23	1:A:626:PHE:CE1	2.42	0.55
1:A:829:TYR:O	1:A:833:THR:HG23	2.07	0.55
1:A:564:PHE:CD2	5:A:905:PEG:H12	2.44	0.53
1:A:677:CYS:O	1:A:678:HIS:ND1	2.42	0.52
1:A:708:GLU:O	1:A:712:THR:HG23	2.11	0.51
1:A:728:TYR:CZ	1:A:732:ARG:HD3	2.48	0.49
1:A:674:GLN:HB3	1:A:675:LEU:HD13	1.97	0.47
1:A:603:LYS:HG3	1:A:615:TRP:CE2	2.50	0.47
2:A:901:5BA:NBD	5:A:904:PEG:H21	2.31	0.46
1:A:539:GLU:OE1	1:A:603:LYS:NZ	2.48	0.46
1:A:731:ARG:HG2	1:A:731:ARG:HH11	1.81	0.45
1:A:784:THR:O	1:A:788:ASP:HA	2.16	0.45
1:A:773:PRO:O	5:A:905:PEG:H41	2.17	0.44
1:A:734:GLU:O	1:A:738:LEU:HG	2.18	0.43
1:A:646:LEU:HD11	1:A:756:LEU:HD22	2.01	0.43
1:A:654:ASP:O	1:A:657:HIS:HB2	2.17	0.43
1:A:589:GLN:HG3	6:A:1147:HOH:O	2.18	0.43
1:A:678:HIS:CE1	1:A:680:ILE:HG12	2.54	0.43
1:A:607:ARG:HB3	1:A:609:ASN:OD1	2.20	0.42
1:A:765:LEU:O	1:A:768:ILE:HG13	2.20	0.42
1:A:556:ILE:HD12	1:A:561:PHE:CE2	2.54	0.41
1:A:777:ARG:O	1:A:780:GLU:HB2	2.22	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles ⓘ

### 5.3.1 Protein backbone ⓘ

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	291/347 (84%)	281 (97%)	9 (3%)	1 (0%)	46	44

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	675	LEU

### 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	256/309 (83%)	245 (96%)	11 (4%)	35	33

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	537	THR
1	A	543	LEU
1	A	675	LEU
1	A	677	CYS
1	A	678	HIS
1	A	690	LEU
1	A	759	LEU
1	A	775	GLN
1	A	811	ASN
1	A	828	LEU
1	A	832	LEU

Some 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 carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 5 ligands modelled in this entry, 2 are monoatomic - leaving 3 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	5BA	A	901	-	32,33,33	1.52	3 (9%)	40,46,46	2.54	15 (37%)
5	PEG	A	904	-	6,6,6	0.52	0	5,5,5	2.06	3 (60%)
5	PEG	A	905	-	6,6,6	0.51	0	5,5,5	1.84	2 (40%)

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	5BA	A	901	-	-	0/20/30/30	0/3/3/3
5	PEG	A	904	-	-	0/4/4/4	0/0/0/0
5	PEG	A	905	-	-	0/4/4/4	0/0/0/0

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	901	5BA	BR-CAX	2.04	1.94	1.89
2	A	901	5BA	CBA-CBC	3.61	1.56	1.51
2	A	901	5BA	OAF-CBB	5.73	1.38	1.24

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	901	5BA	CAX-CBB-NAS	-3.73	120.02	124.00
2	A	901	5BA	NAS-CAZ-NAR	-3.00	120.58	125.37
5	A	905	PEG	O2-C2-C1	2.01	119.68	110.43
2	A	901	5BA	CAZ-NAR-CBA	2.02	120.51	117.06
5	A	904	PEG	C3-O2-C2	2.02	122.01	113.31
2	A	901	5BA	O-C-CA	2.12	123.05	120.10
2	A	901	5BA	CAL-OAT-CAW	2.14	122.90	117.64
5	A	905	PEG	O2-C3-C4	2.14	120.30	110.43
2	A	901	5BA	CAB-CBC-CBA	2.17	115.17	111.26
2	A	901	5BA	CAY-CAZ-NAR	2.36	121.47	117.43
5	A	904	PEG	O2-C3-C4	2.55	122.19	110.43
5	A	904	PEG	O2-C2-C1	2.88	123.70	110.43
2	A	901	5BA	CAM-NBD-CAN	3.07	113.56	109.53
2	A	901	5BA	CA-N-CAO	3.66	116.48	111.07
2	A	901	5BA	CAD-NBD-CAM	3.77	116.50	110.63
2	A	901	5BA	CA-N-CAP	4.04	117.03	111.07
2	A	901	5BA	CBC-CBA-NAR	4.75	119.72	115.68
2	A	901	5BA	CBB-NAS-CAZ	5.21	121.36	116.23
2	A	901	5BA	CAD-NBD-CAN	5.23	118.79	110.63
2	A	901	5BA	C-CA-N	7.38	123.14	113.05

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	901	5BA	1	0
5	A	904	PEG	3	0
5	A	905	PEG	4	0

## 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, 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	296/347 (85%)	-0.21	10 (3%)	49 57	15, 27, 52, 73	0

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	673	ALA	5.1
1	A	536	GLU	4.6
1	A	810	LYS	4.3
1	A	675	LEU	3.5
1	A	535	GLU	2.7
1	A	663	SER	2.4
1	A	743	GLN	2.3
1	A	676	TYR	2.2
1	A	672	LEU	2.1
1	A	738	LEU	2.1

### 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
5	PEG	A	905	7/7	0.88	0.27	12.39	25,30,33,39	0
5	PEG	A	904	7/7	0.81	0.25	6.96	29,34,37,39	0
2	5BA	A	901	31/31	0.96	0.11	-0.08	23,30,49,52	0
4	MG	A	903	1/1	0.86	0.07	-1.18	26,26,26,26	0
3	ZN	A	902	1/1	1.00	0.03	-6.06	31,31,31,31	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.