



# Full wwPDB X-ray Structure Validation Report ⓘ

Jul 24, 2018 – 10:39 AM EDT

PDB ID : 5Y1W  
Title : Crystal structure of Plasmodium falciparum aminopeptidase N with Magnesium bound to active site Zinc  
Authors : Marapaka, A.K.; Addlagatta, A.  
Deposited on : 2017-07-21  
Resolution : 1.56 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 : 1.7.3 (157068), CSD as539be (2018)  
Xtriage (Phenix) : 1.13  
EDS : rb-20031172  
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)  
Refmac : 5.8.0158  
CCP4 : 7.0 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : rb-20031172

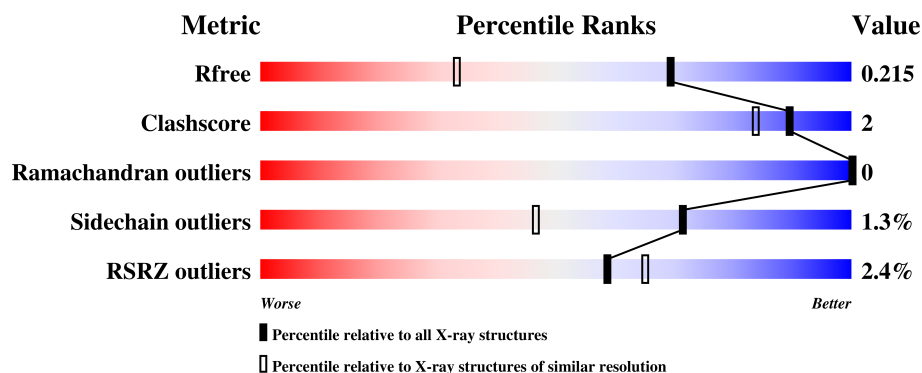
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

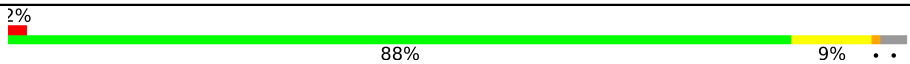
The reported resolution of this entry is 1.56 Å.

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))
$R_{free}$	111664	1224 (1.56-1.56)
Clashscore	122126	1265 (1.56-1.56)
Ramachandran outliers	120053	1240 (1.56-1.56)
Sidechain outliers	120020	1238 (1.56-1.56)
RSRZ outliers	108989	1207 (1.56-1.56)

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	914	

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 8085 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 M1 family aminopeptidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	890	7361	4727	1199	1408	27	0	11	0

There are 23 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	172	MET	-	expression tag	UNP O96935
A	173	GLY	-	expression tag	UNP O96935
A	174	SER	-	expression tag	UNP O96935
A	175	SER	-	expression tag	UNP O96935
A	176	HIS	-	expression tag	UNP O96935
A	177	HIS	-	expression tag	UNP O96935
A	178	HIS	-	expression tag	UNP O96935
A	179	HIS	-	expression tag	UNP O96935
A	180	HIS	-	expression tag	UNP O96935
A	181	HIS	-	expression tag	UNP O96935
A	182	SER	-	expression tag	UNP O96935
A	183	SER	-	expression tag	UNP O96935
A	184	GLY	-	expression tag	UNP O96935
A	185	LEU	-	expression tag	UNP O96935
A	186	VAL	-	expression tag	UNP O96935
A	187	PRO	-	expression tag	UNP O96935
A	188	ARG	-	expression tag	UNP O96935
A	189	GLY	-	expression tag	UNP O96935
A	190	SER	-	expression tag	UNP O96935
A	191	HIS	-	expression tag	UNP O96935
A	192	MET	-	expression tag	UNP O96935
A	193	ALA	-	expression tag	UNP O96935
A	194	SER	-	expression tag	UNP O96935

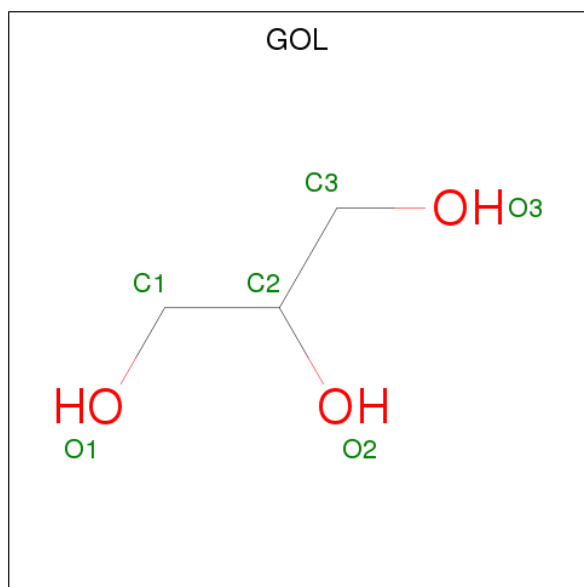
- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

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

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

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

- Molecule 4 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
4	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	714	Total	O	0	0
			714	714		



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	74.42Å 109.20Å 112.48Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	34.67 – 1.56 34.67 – 1.56	Depositor EDS
% Data completeness (in resolution range)	96.0 (34.67-1.56) 96.0 (34.67-1.56)	Depositor EDS
$R_{merge}$	0.03	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	7.89 (at 1.56Å)	Xtriage
Refinement program	REFMAC 5.8.0135	Depositor
R, $R_{free}$	0.170 , 0.206 0.184 , 0.215	Depositor DCC
$R_{free}$ test set	6311 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	18.5	Xtriage
Anisotropy	0.026	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 46.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.007 for -h,l,k	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	8085	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	19.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.89% 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, ZN, 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	1.14	17/7558 (0.2%)	1.17	44/10215 (0.4%)

All (17) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	572	GLU	CD-OE1	9.89	1.36	1.25
1	A	449	LEU	N-CA	9.18	1.64	1.46
1	A	572	GLU	CG-CD	8.54	1.64	1.51
1	A	864	TYR	CE2-CZ	-7.30	1.29	1.38
1	A	409	GLU	CD-OE2	6.38	1.32	1.25
1	A	302	TYR	CE2-CZ	-5.99	1.30	1.38
1	A	921	SER	CB-OG	5.88	1.49	1.42
1	A	299	GLU	CG-CD	5.74	1.60	1.51
1	A	688	PHE	CG-CD2	-5.66	1.30	1.38
1	A	853	TYR	CE1-CZ	-5.57	1.31	1.38
1	A	572	GLU	CD-OE2	5.45	1.31	1.25
1	A	242	GLU	CD-OE2	5.41	1.31	1.25
1	A	850	GLU	CD-OE1	5.38	1.31	1.25
1	A	765	TYR	CZ-OH	5.37	1.47	1.37
1	A	599	TYR	CG-CD1	-5.34	1.32	1.39
1	A	618	GLU	CG-CD	-5.21	1.44	1.51
1	A	427	GLU	CG-CD	-5.13	1.44	1.51

All (44) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	898	ARG	NE-CZ-NH1	17.54	129.07	120.30
1	A	898	ARG	NE-CZ-NH2	-13.50	113.55	120.30
1	A	548	ARG	NE-CZ-NH2	-9.38	115.61	120.30
1	A	858	ASP	CB-CG-OD1	9.31	126.68	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	489	ARG	NE-CZ-NH1	-8.93	115.83	120.30
1	A	379	LEU	CA-CB-CG	8.74	135.40	115.30
1	A	201	ARG	NE-CZ-NH1	8.48	124.54	120.30
1	A	717	ASP	CB-CG-OD1	8.23	125.71	118.30
1	A	840	LEU	CB-CG-CD1	-7.49	98.26	111.00
1	A	201	ARG	NE-CZ-NH2	-7.34	116.63	120.30
1	A	880	TYR	CB-CG-CD2	-6.96	116.83	121.00
1	A	590	TYR	CB-CG-CD1	6.48	124.89	121.00
1	A	546	LEU	CB-CG-CD1	6.31	121.73	111.00
1	A	506	ARG	NE-CZ-NH1	6.26	123.43	120.30
1	A	794	PHE	CB-CG-CD1	6.26	125.19	120.80
1	A	748	ASP	CB-CG-OD2	-6.19	112.73	118.30
1	A	1029	ASP	CB-CG-OD2	6.19	123.87	118.30
1	A	817	ASP	CB-CG-OD2	6.00	123.70	118.30
1	A	864	TYR	CB-CG-CD1	5.97	124.58	121.00
1	A	972	ARG	NE-CZ-NH2	-5.96	117.32	120.30
1	A	864	TYR	CB-CG-CD2	-5.95	117.43	121.00
1	A	661	ASP	CB-CG-OD2	-5.90	112.99	118.30
1	A	282	PHE	CB-CG-CD1	-5.69	116.82	120.80
1	A	866	LYS	CD-CE-NZ	5.63	124.65	111.70
1	A	717	ASP	CB-CG-OD2	-5.63	113.23	118.30
1	A	765	TYR	CZ-CE2-CD2	-5.58	114.78	119.80
1	A	995	ASP	CB-CG-OD1	5.55	123.29	118.30
1	A	511	ASP	CB-CG-OD1	-5.51	113.34	118.30
1	A	997	ARG	NE-CZ-NH1	-5.41	117.59	120.30
1	A	525	ARG	NE-CZ-NH2	-5.40	117.60	120.30
1	A	847	ASP	CB-CG-OD2	-5.40	113.44	118.30
1	A	618	GLU	OE1-CD-OE2	5.37	129.74	123.30
1	A	302	TYR	CB-CG-CD2	-5.36	117.78	121.00
1	A	548	ARG	NE-CZ-NH1	5.34	122.97	120.30
1	A	209	PHE	CB-CG-CD1	-5.31	117.08	120.80
1	A	748	ASP	CB-CG-OD1	5.30	123.07	118.30
1	A	862	ASP	CB-CG-OD1	5.30	123.07	118.30
1	A	810	LEU	CB-CG-CD1	5.29	119.99	111.00
1	A	997	ARG	NE-CZ-NH2	5.23	122.91	120.30
1	A	1008	ARG	NE-CZ-NH1	5.23	122.91	120.30
1	A	743	GLU	OE1-CD-OE2	5.22	129.57	123.30
1	A	721	PHE	CB-CG-CD1	-5.14	117.20	120.80
1	A	831	ARG	NE-CZ-NH2	-5.12	117.74	120.30
1	A	898	ARG	CD-NE-CZ	5.07	130.69	123.60

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	7361	0	7303	29	1
2	A	1	0	0	0	0
3	A	3	0	0	0	0
4	A	6	0	8	0	0
5	A	714	0	0	9	1
All	All	8085	0	7311	29	2

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 2.

All (29) 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:543[B]:HIS:CE1	5:A:1201:HOH:O	2.05	1.09
1:A:543[B]:HIS:ND1	5:A:1201:HOH:O	2.06	0.86
1:A:492:THR:HG23	1:A:526[B]:GLU:OE1	1.76	0.86
1:A:543[B]:HIS:CD2	5:A:1575:HOH:O	2.35	0.79
1:A:834:ILE:HG12	1:A:840:LEU:HD22	1.65	0.78
1:A:492:THR:CG2	1:A:526[B]:GLU:OE1	2.49	0.61
1:A:608:LYS:HD3	5:A:1486:HOH:O	2.02	0.59
1:A:831:ARG:NH1	1:A:1041:GLU:OE1	2.37	0.57
1:A:609:LYS:NZ	1:A:622:TYR:HE2	2.03	0.56
1:A:553:LEU:C	1:A:553:LEU:HD23	2.29	0.53
1:A:543[B]:HIS:HE1	1:A:584:SER:OG	1.90	0.53
1:A:977:GLU:HG2	5:A:1484:HOH:O	2.11	0.50
1:A:918:ILE:HD11	1:A:941:LYS:CE	2.43	0.48
1:A:1046:TRP:O	1:A:1054:GLN:HG2	2.15	0.46
1:A:407:LYS:CD	5:A:1475:HOH:O	2.63	0.46
1:A:811:LEU:HB3	1:A:867:MET:SD	2.55	0.46
1:A:658:TYR:OH	1:A:732:LEU:HD11	2.16	0.45
1:A:492:THR:HG23	1:A:526[B]:GLU:CD	2.36	0.45
1:A:407:LYS:HD3	5:A:1475:HOH:O	2.16	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:918:ILE:HD11	1:A:941:LYS:HE2	1.99	0.45
1:A:609:LYS:NZ	1:A:622:TYR:CE2	2.83	0.45
1:A:620:PHE:CZ	1:A:624:MET:HE3	2.52	0.44
1:A:319:GLU:OE1	5:A:1202:HOH:O	2.21	0.43
1:A:1009[A]:ARG:HD2	1:A:1009[A]:ARG:HA	1.69	0.43
1:A:488:ALA:HB2	5:A:1274:HOH:O	2.16	0.43
1:A:538:THR:HG21	1:A:819:GLY:HA3	2.01	0.43
1:A:550:VAL:HG12	1:A:577:THR:HG21	2.00	0.43
1:A:693:VAL:O	1:A:707:GLN:HG3	2.19	0.43
1:A:199:HIS:O	1:A:567:SER:HA	2.22	0.40

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:723:ASN:ND2	1:A:792:GLU:OE1[4_545]	2.08	0.12
5:A:1624:HOH:O	5:A:1760:HOH:O[4_555]	2.12	0.08

## 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	899/914 (98%)	881 (98%)	18 (2%)	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	833/842 (99%)	822 (99%)	11 (1%)	71	46

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

Mol	Chain	Res	Type
1	A	287	LYS
1	A	370	HIS
1	A	379	LEU
1	A	436	ASP
1	A	555	ASP
1	A	688	PHE
1	A	745	ASN
1	A	810	LEU
1	A	989	ASP
1	A	1045	LEU
1	A	1085	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	199	HIS

### 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 5 ligands modelled in this entry, 4 are monoatomic - leaving 1 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$
4	GOL	A	1105	-	5,5,5	1.07	1 (20%)	5,5,5	1.25	1 (20%)

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
4	GOL	A	1105	-	-	0/4/4/4	0/0/0/0

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	1105	GOL	O2-C2	2.24	1.50	1.43

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	1105	GOL	O1-C1-C2	2.06	120.12	110.11

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

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 [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	890/914 (97%)	0.22	21 (2%) 59 65	12, 17, 30, 54	0

All (21) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	196	PRO	4.3
1	A	633	ALA	3.5
1	A	637	ALA	3.4
1	A	989	ASP	3.2
1	A	815	HIS	3.1
1	A	403	TYR	3.0
1	A	635	ASN	3.0
1	A	1085	LEU	2.9
1	A	622	TYR	2.7
1	A	683	GLU	2.7
1	A	485	PHE	2.6
1	A	973	LYS	2.6
1	A	814	PRO	2.4
1	A	598	TYR	2.4
1	A	384	LEU	2.4
1	A	222	ASP	2.4
1	A	636	SER	2.3
1	A	940	ASP	2.3
1	A	947	ASP	2.2
1	A	809	TYR	2.2
1	A	200	TYR	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 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
4	GOL	A	1105	6/6	0.87	0.14	19,25,36,38	0
3	MG	A	1102	1/1	0.97	0.09	25,25,25,25	0
3	MG	A	1103	1/1	0.98	0.14	25,25,25,25	0
3	MG	A	1104	1/1	0.99	0.26	24,24,24,24	0
2	ZN	A	1101	1/1	1.00	0.03	14,14,14,14	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.