wwPDB X-ray Structure Validation Summary Report (i)

Aug 20, 2023 – 06:22 PM EDT

PDB ID	:	2NTM
Title	:	Crystal structure of PurO from Methanothermobacter thermoautotrophicus
Authors	:	Kang, Y.N.; Tran, A.; White, R.H.; Ealick, S.E.
Deposited on	:	2006-11-07
Resolution	:	2.60 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*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

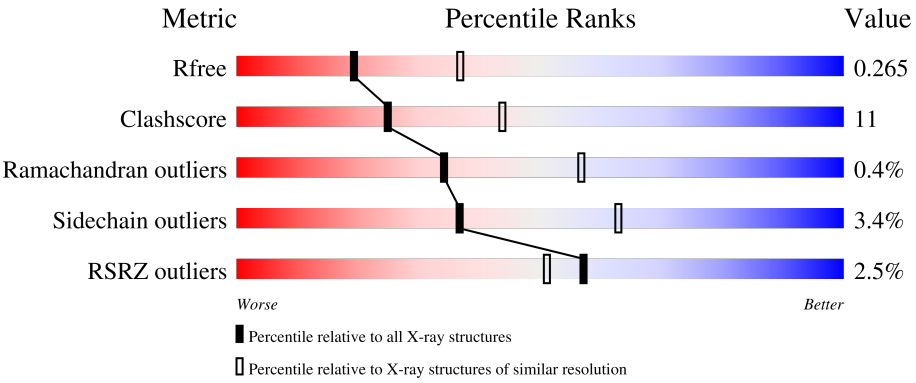
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.35
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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	3163 (2.60-2.60)
Clashscore	141614	3518 (2.60-2.60)
Ramachandran outliers	138981	3455 (2.60-2.60)
Sidechain outliers	138945	3455 (2.60-2.60)
RSRZ outliers	127900	3104 (2.60-2.60)

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 >=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 <=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	222	2% 66% 24% • 9%
1	B	222	% 73% 18% • 9%
1	C	222	3% 71% 19% • 9%
1	D	222	3% 68% 22% • 8%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 6182 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 IMP cyclohydrolase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	202	Total	C	N	O	S	0	0	0
			1537	962	265	304	6			
1	B	202	Total	C	N	O	S	0	0	0
			1537	962	265	304	6			
1	C	202	Total	C	N	O	S	0	0	0
			1537	962	265	304	6			
1	D	205	Total	C	N	O	S	0	0	0
			1557	973	270	308	6			

There are 80 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	cloning artifact	UNP O27099
A	-18	GLY	-	cloning artifact	UNP O27099
A	-17	SER	-	cloning artifact	UNP O27099
A	-16	SER	-	cloning artifact	UNP O27099
A	-15	HIS	-	expression tag	UNP O27099
A	-14	HIS	-	expression tag	UNP O27099
A	-13	HIS	-	expression tag	UNP O27099
A	-12	HIS	-	expression tag	UNP O27099
A	-11	HIS	-	expression tag	UNP O27099
A	-10	HIS	-	expression tag	UNP O27099
A	-9	SER	-	cloning artifact	UNP O27099
A	-8	SER	-	cloning artifact	UNP O27099
A	-7	GLY	-	cloning artifact	UNP O27099
A	-6	LEU	-	cloning artifact	UNP O27099
A	-5	VAL	-	cloning artifact	UNP O27099
A	-4	PRO	-	cloning artifact	UNP O27099
A	-3	ARG	-	cloning artifact	UNP O27099
A	-2	GLY	-	cloning artifact	UNP O27099
A	-1	SER	-	cloning artifact	UNP O27099
A	0	HIS	-	cloning artifact	UNP O27099
B	-19	MET	-	cloning artifact	UNP O27099

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-18	GLY	-	cloning artifact	UNP O27099
B	-17	SER	-	cloning artifact	UNP O27099
B	-16	SER	-	cloning artifact	UNP O27099
B	-15	HIS	-	expression tag	UNP O27099
B	-14	HIS	-	expression tag	UNP O27099
B	-13	HIS	-	expression tag	UNP O27099
B	-12	HIS	-	expression tag	UNP O27099
B	-11	HIS	-	expression tag	UNP O27099
B	-10	HIS	-	expression tag	UNP O27099
B	-9	SER	-	cloning artifact	UNP O27099
B	-8	SER	-	cloning artifact	UNP O27099
B	-7	GLY	-	cloning artifact	UNP O27099
B	-6	LEU	-	cloning artifact	UNP O27099
B	-5	VAL	-	cloning artifact	UNP O27099
B	-4	PRO	-	cloning artifact	UNP O27099
B	-3	ARG	-	cloning artifact	UNP O27099
B	-2	GLY	-	cloning artifact	UNP O27099
B	-1	SER	-	cloning artifact	UNP O27099
B	0	HIS	-	cloning artifact	UNP O27099
C	-19	MET	-	cloning artifact	UNP O27099
C	-18	GLY	-	cloning artifact	UNP O27099
C	-17	SER	-	cloning artifact	UNP O27099
C	-16	SER	-	cloning artifact	UNP O27099
C	-15	HIS	-	expression tag	UNP O27099
C	-14	HIS	-	expression tag	UNP O27099
C	-13	HIS	-	expression tag	UNP O27099
C	-12	HIS	-	expression tag	UNP O27099
C	-11	HIS	-	expression tag	UNP O27099
C	-10	HIS	-	expression tag	UNP O27099
C	-9	SER	-	cloning artifact	UNP O27099
C	-8	SER	-	cloning artifact	UNP O27099
C	-7	GLY	-	cloning artifact	UNP O27099
C	-6	LEU	-	cloning artifact	UNP O27099
C	-5	VAL	-	cloning artifact	UNP O27099
C	-4	PRO	-	cloning artifact	UNP O27099
C	-3	ARG	-	cloning artifact	UNP O27099
C	-2	GLY	-	cloning artifact	UNP O27099
C	-1	SER	-	cloning artifact	UNP O27099
C	0	HIS	-	cloning artifact	UNP O27099
D	-19	MET	-	cloning artifact	UNP O27099
D	-18	GLY	-	cloning artifact	UNP O27099
D	-17	SER	-	cloning artifact	UNP O27099

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Chain	Residue	Modelled	Actual	Comment	Reference
D	-16	SER	-	cloning artifact	UNP O27099
D	-15	HIS	-	expression tag	UNP O27099
D	-14	HIS	-	expression tag	UNP O27099
D	-13	HIS	-	expression tag	UNP O27099
D	-12	HIS	-	expression tag	UNP O27099
D	-11	HIS	-	expression tag	UNP O27099
D	-10	HIS	-	expression tag	UNP O27099
D	-9	SER	-	cloning artifact	UNP O27099
D	-8	SER	-	cloning artifact	UNP O27099
D	-7	GLY	-	cloning artifact	UNP O27099
D	-6	LEU	-	cloning artifact	UNP O27099
D	-5	VAL	-	cloning artifact	UNP O27099
D	-4	PRO	-	cloning artifact	UNP O27099
D	-3	ARG	-	cloning artifact	UNP O27099
D	-2	GLY	-	cloning artifact	UNP O27099
D	-1	SER	-	cloning artifact	UNP O27099
D	0	HIS	-	cloning artifact	UNP O27099

- Molecule 2 is water.

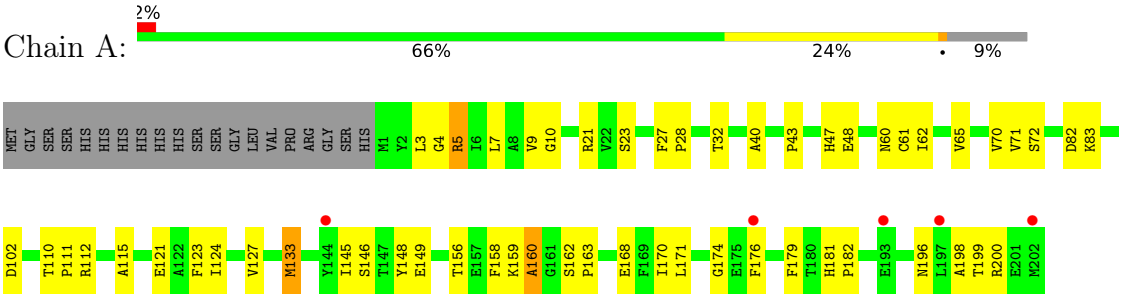
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total O 1 1	0	0
2	B	6	Total O 6 6	0	0
2	C	7	Total O 7 7	0	0

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.

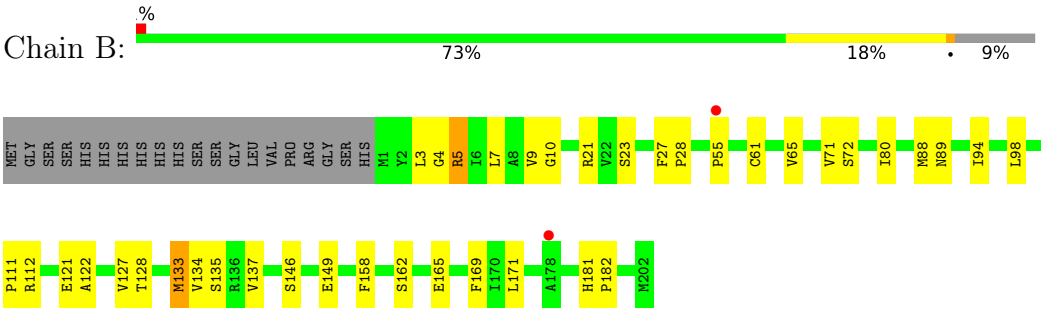
• Molecule 1: IMP cyclohydrolase

Chain A:



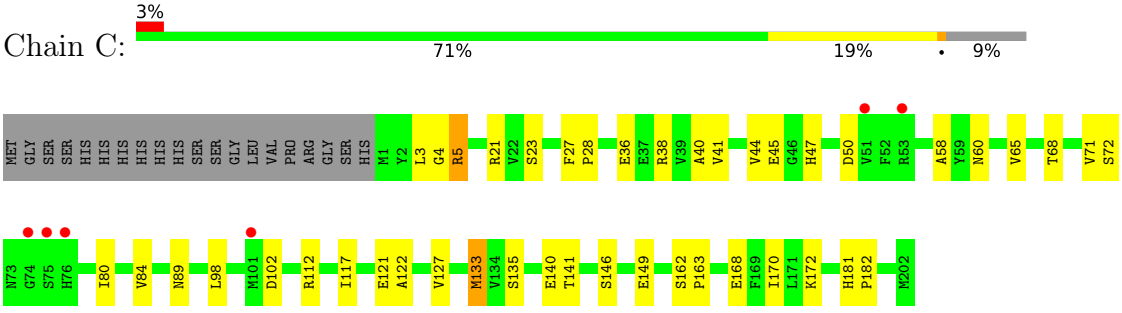
• Molecule 1: IMP cyclohydrolase

Chain B:



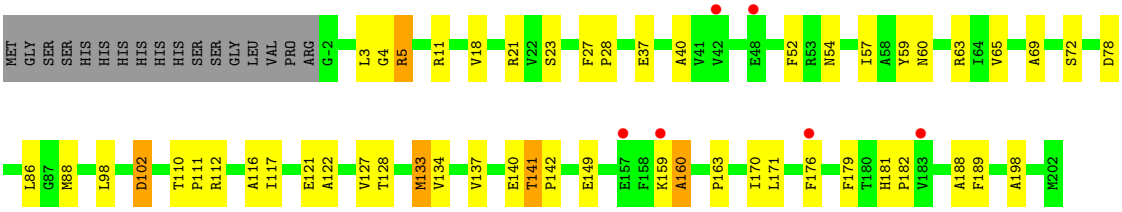
• Molecule 1: IMP cyclohydrolase

Chain C:



• Molecule 1: IMP cyclohydrolase

Chain D:


MET GLY SER SER HIS HIS HIS HIS HIS HIS SER SER GLY LEU VAL PRO ARG G-2 L3 G4 R5 R11 V18 R21 V22 S23 F27 P28 E37 A40 V41 V42 E48 F52 R53 N54 I57 A58 Y59 N60 R63 I64 V65 A69 S72 D78
L86 G87 M88 L98 D102 T110 P111 R112 A116 I117 E121 A122 V127 T128 M133 V134 V137 E140 T141 P142 E149 E157 F158 K159 A160 P163 I170 L171 F176 F179 T180 H181 P182 V183 A188 F189 A198 M202

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 32	Depositor
Cell constants a, b, c, α, β, γ	84.28Å 84.28Å 124.77Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	36.49 – 2.60 36.49 – 2.61	Depositor EDS
% Data completeness (in resolution range)	88.2 (36.49-2.60) 88.3 (36.49-2.61)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.06	Depositor
$< I/\sigma(I) >$ [1]	5.13 (at 2.61Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.225 , 0.274 0.220 , 0.265	Depositor DCC
R_{free} test set	2671 reflections (8.91%)	wwPDB-VP
Wilson B-factor (Å^2)	62.8	Xtriage
Anisotropy	0.453	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 44.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	0.013 for -h,-k,l 0.035 for h,-h-k,-l 0.023 for -k,-h,-l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	6182	wwPDB-VP
Average B, all atoms (Å^2)	70.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.86% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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

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	0.58	0/1566	0.75	1/2127 (0.0%)
1	B	0.58	0/1566	0.77	0/2127
1	C	0.56	0/1566	0.76	0/2127
1	D	0.57	0/1587	0.75	0/2155
All	All	0.57	0/6285	0.76	1/8536 (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	D	0	1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	82	ASP	CB-CG-OD1	-5.19	113.63	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	D	59	TYR	Sidechain

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	1537	0	1495	36	0
1	B	1537	0	1495	29	0
1	C	1537	0	1495	32	0
1	D	1557	0	1510	38	0
2	A	1	0	0	0	0
2	B	6	0	0	0	0
2	C	7	0	0	0	0
All	All	6182	0	5995	131	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 11.

The worst 5 of 131 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:3:LEU:HD22	1:B:149:GLU:HB2	1.73	0.71
1:C:5:ARG:HD3	1:C:5:ARG:N	2.06	0.70
1:D:65:VAL:HG23	1:D:65:VAL:O	1.92	0.68
1:A:181:HIS:N	1:A:182:PRO:HD3	2.09	0.68
1:A:21:ARG:NH2	1:A:182:PRO:HG3	2.10	0.67

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	200/222 (90%)	182 (91%)	16 (8%)	2 (1%)	15 32
1	B	200/222 (90%)	182 (91%)	18 (9%)	0	100 100
1	C	200/222 (90%)	186 (93%)	14 (7%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	D	203/222 (91%)	184 (91%)	18 (9%)	1 (0%)	29 52
All	All	803/888 (90%)	734 (91%)	66 (8%)	3 (0%)	34 57

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	160	ALA
1	D	160	ALA
1	A	174	GLY

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	160/177 (90%)	155 (97%)	5 (3%)	40 66
1	B	160/177 (90%)	154 (96%)	6 (4%)	33 59
1	C	160/177 (90%)	155 (97%)	5 (3%)	40 66
1	D	162/177 (92%)	156 (96%)	6 (4%)	34 60
All	All	642/708 (91%)	620 (97%)	22 (3%)	37 63

5 of 22 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	121	GLU
1	D	72	SER
1	D	5	ARG
1	D	102	ASP
1	B	55	PRO

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 10 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	181	HIS

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Mol	Chain	Res	Type
1	D	29	ASN
1	D	47	HIS
1	B	29	ASN
1	B	47	HIS

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 monosaccharides in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

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^{th} 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^2)	Q<0.9
1	A	202/222 (90%)	0.09	5 (2%)	57	51	52, 74, 94, 102	0
1	B	202/222 (90%)	0.00	3 (1%)	73	70	48, 66, 83, 99	0
1	C	202/222 (90%)	0.07	6 (2%)	50	43	48, 63, 86, 97	0
1	D	205/222 (92%)	0.09	6 (2%)	51	45	48, 72, 92, 102	0
All	All	811/888 (91%)	0.06	20 (2%)	57	51	48, 69, 90, 102	0

The worst 5 of 20 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	183	VAL	3.8
1	A	144	TYR	3.1
1	A	202	MET	3.1
1	C	101	MET	3.1
1	D	157	GLU	2.9

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 monosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.