



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 01:45 AM UTC

PDB ID : 2PRS / pdb_00002prs
Title : Structure and metal binding properties of ZnuA, a periplasmic zinc transporter from Escherichia coli
Authors : Yatsunyk, L.A.; Kim, L.R.; Vorontsov, I.I.; Rosenzweig, A.C.
Deposited on : 2007-05-04
Resolution : 1.70 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

A user guide is available at

<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>.

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

MolProbity : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtrriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

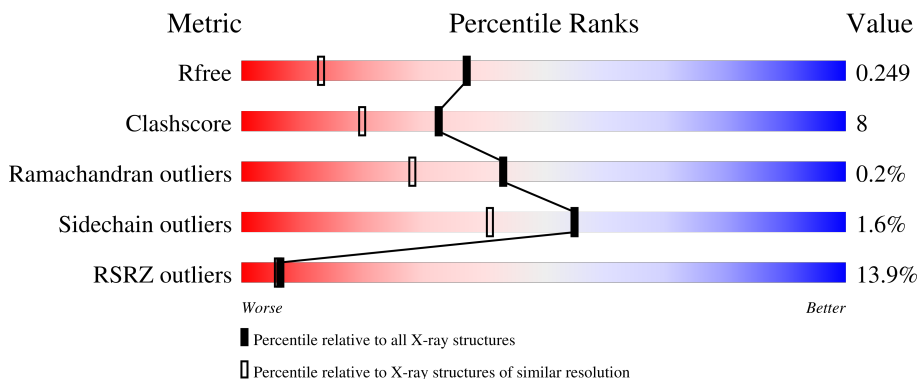
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.70 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}	180053	5551 (1.70-1.70)
Clashscore	190562	5924 (1.70-1.70)
Ramachandran outliers	187476	5846 (1.70-1.70)
Sidechain outliers	187428	5846 (1.70-1.70)
RSRZ outliers	180081	5554 (1.70-1.70)

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 $\leq 5\%$. 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	284	
1	B	284	

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 4608 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.

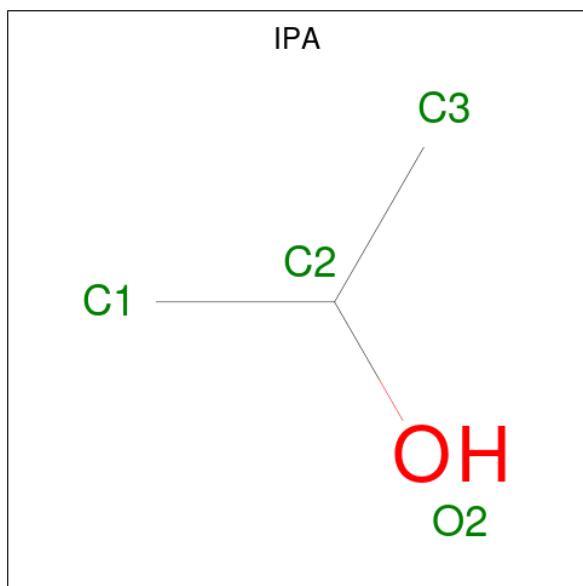
- Molecule 1 is a protein called High-affinity zinc uptake system protein znuA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	263	Total 2063	C 1320	N 348	O 386	S 9	0	7	0
1	B	264	Total 2097	C 1337	N 356	O 395	S 9	0	8	0

- Molecule 2 is ZINC ION (CCD ID: ZN) (formula: Zn).

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

- Molecule 3 is ISOPROPYL ALCOHOL (CCD ID: IPA) (formula: C₃H₈O).



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

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	213	Total	O	0	0
			213	213		
4	B	228	Total	O	0	0
			228	228		

4 Data and refinement statistics i

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	91.38Å 78.07Å 86.37Å 90.00° 91.37° 90.00°	Depositor
Resolution (Å)	28.80 – 1.70 28.80 – 1.70	Depositor EDS
% Data completeness (in resolution range)	97.0 (28.80-1.70) 97.0 (28.80-1.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.05	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.11 (at 1.70Å)	Xtrriage
Refinement program	REFMAC 5.2.0005	Depositor
R, R_{free}	0.211 , 0.250 0.210 , 0.249	Depositor DCC
R_{free} test set	3254 reflections (4.89%)	wwPDB-VP
Wilson B-factor (Å ²)	28.2	Xtrriage
Anisotropy	0.035	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 39.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	0.023 for -h,-k,l	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4608	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.44% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: ZN, IPA

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	0.57	0/2117	0.82	1/2868 (0.0%)
1	B	0.58	0/2142	0.81	0/2903
All	All	0.58	0/4259	0.82	1/5771 (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 (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	227	VAL	N-CA-C	-6.18	105.70	111.45

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	260	ARG	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	2063	0	2092	20	0
1	B	2097	0	2109	46	0
2	A	2	0	0	0	0
2	B	1	0	0	0	0
3	A	4	0	8	0	0
4	A	213	0	0	2	0
4	B	228	0	0	1	0
All	All	4608	0	4209	66	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 8.

All (66) 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:263:VAL:CG1	1:B:263:VAL:O	2.25	0.84
1:B:255:ALA:HB1	1:B:260:ARG:HB2	1.62	0.80
1:B:263:VAL:O	1:B:263:VAL:HG12	1.82	0.78
1:A:245:LEU:HG	1:A:273[A]:VAL:HG21	1.66	0.76
1:B:200:GLY:H	1:B:220[B]:THR:HG21	1.51	0.76
1:B:200:GLY:H	1:B:220[B]:THR:CG2	1.98	0.75
1:B:183[B]:GLN:HG3	1:B:293:SER:OG	1.87	0.73
1:A:264:VAL:HG12	1:A:275[B]:MET:HE1	1.70	0.72
1:A:199:LYS:HD2	1:A:218:GLY:O	1.96	0.65
1:B:263:VAL:HA	1:B:264:VAL:HB	1.78	0.65
1:B:230:GLU:C	1:B:263:VAL:HG11	2.25	0.61
1:B:253[A]:VAL:HG13	1:B:275[A]:MET:SD	2.43	0.59
1:B:261:PRO:HD2	1:B:263:VAL:HB	1.85	0.58
1:B:253[B]:VAL:HG23	1:B:273:VAL:HG11	1.86	0.57
1:B:274:ARG:NH1	1:B:309:GLY:O	2.38	0.57
1:B:259:PHE:O	1:B:260:ARG:HB2	2.04	0.57
1:B:263:VAL:N	1:B:264:VAL:HA	2.20	0.56
1:B:264:VAL:HG22	1:B:265:GLU:HG2	1.87	0.55
1:B:98:GLY:HA2	1:B:101[B]:GLN:HE21	1.72	0.54
1:B:253[A]:VAL:CG1	1:B:275[A]:MET:SD	2.96	0.54
1:B:147:SER:HB2	1:B:212:TYR:HB3	1.89	0.54
1:B:261:PRO:HG2	1:B:263:VAL:HB	1.90	0.54
1:B:265:GLU:HB2	1:B:275[B]:MET:SD	2.48	0.53
1:B:200:GLY:N	1:B:220[B]:THR:HG21	2.21	0.53
1:B:27:ALA:N	1:B:76:ASP:OD2	2.42	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:264:VAL:HG22	1:B:265:GLU:N	2.25	0.52
1:B:263:VAL:O	1:B:263:VAL:HG13	2.10	0.51
1:A:310:ASP:OD1	1:A:310:ASP:N	2.40	0.51
1:B:264:VAL:HG13	1:B:266:SER:OG	2.10	0.50
1:A:230:GLU:HG3	4:A:697:HOH:O	2.10	0.49
1:B:159:HIS:HD2	4:B:527:HOH:O	1.95	0.49
1:A:241:ILE:O	1:A:245:LEU:HB2	2.12	0.49
1:B:152[A]:ARG:HH22	1:B:188:GLU:CD	2.19	0.48
1:B:232:GLN:HG3	1:B:263:VAL:HG22	1.95	0.48
1:A:115:MET:HG2	1:A:212:TYR:CZ	2.48	0.48
1:B:32:LEU:HD22	1:B:53:LEU:HD22	1.96	0.48
1:A:90:GLN:NE2	4:A:748:HOH:O	2.46	0.47
1:B:260:ARG:HG2	1:B:262:ALA:HA	1.95	0.47
1:B:261:PRO:CD	1:B:263:VAL:HB	2.45	0.46
1:A:52:LEU:HD11	1:A:72:LEU:HD21	1.97	0.46
1:A:236:GLN:HG3	1:A:237:ARG:H	1.81	0.46
1:B:262:ALA:C	1:B:264:VAL:HA	2.42	0.45
1:B:144:LEU:HB3	1:B:150:ILE:HG21	1.98	0.45
1:B:93:VAL:CG1	1:B:101[A]:GLN:HE22	2.29	0.45
1:A:148:PRO:HD2	1:A:216:GLN:OE1	2.16	0.45
1:B:34:PRO:HA	1:B:37:PHE:CD2	2.52	0.45
1:B:196:ALA:N	1:B:197:PRO:HD2	2.31	0.45
1:B:261:PRO:HD2	1:B:263:VAL:N	2.32	0.45
1:B:233:PRO:HD2	1:B:264:VAL:HG12	2.00	0.44
1:B:115:MET:HG3	1:B:212:TYR:CE2	2.53	0.43
1:B:159:HIS:HE1	1:B:174:ASP:OD1	2.00	0.43
1:B:232:GLN:HG2	1:B:264:VAL:HB	2.00	0.43
1:A:34:PRO:HA	1:A:37:PHE:CD2	2.53	0.43
1:A:183:GLN:OE1	1:A:290:THR:HA	2.18	0.43
1:A:284[B]:ASN:OD1	1:A:298:GLN:NE2	2.51	0.43
1:B:261:PRO:CG	1:B:263:VAL:HB	2.48	0.42
1:B:149:GLU:OE2	1:B:152[A]:ARG:NH2	2.53	0.42
1:B:225:PHE:CE2	1:B:241:ILE:HG23	2.55	0.42
1:A:245:LEU:HD21	1:A:273[B]:VAL:HG11	2.02	0.41
1:A:72:LEU:HD13	1:A:92:PRO:HB2	2.02	0.41
1:B:146:LEU:HD23	1:B:146:LEU:HA	1.91	0.41
1:A:260:ARG:NE	1:A:260:ARG:HA	2.35	0.41
1:B:260:ARG:HG2	1:B:262:ALA:CA	2.51	0.41
1:A:115:MET:HG2	1:A:212:TYR:CE2	2.56	0.41
1:A:236:GLN:HG3	1:A:237:ARG:N	2.35	0.40
1:A:80:TRP:CE3	1:A:89:MET:HB2	2.56	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	266/284 (94%)	264 (99%)	2 (1%)	0	100	100
1	B	268/284 (94%)	260 (97%)	7 (3%)	1 (0%)	30	16
All	All	534/568 (94%)	524 (98%)	9 (2%)	1 (0%)	43	28

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	260	ARG

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	224/236 (95%)	221 (99%)	3 (1%)	61	48
1	B	227/236 (96%)	222 (98%)	5 (2%)	45	29
All	All	451/472 (96%)	443 (98%)	8 (2%)	55	36

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	69[A]	VAL
1	A	69[B]	VAL

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Mol	Chain	Res	Type
1	A	267	VAL
1	B	70	LYS
1	B	71	ARG
1	B	237	ARG
1	B	263	VAL
1	B	267	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	73	GLN
1	A	74	ASN
1	A	101	GLN
1	A	106	GLN
1	A	159	HIS
1	A	239	HIS
1	B	90	GLN
1	B	159	HIS
1	B	236	GLN

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 3 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
3	IPA	A	601	-	3,3,3	0.54	0	3,3,3	0.33	0

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, 95th 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	263/284 (92%)	0.84	44 (16%) 4 4	12, 29, 54, 60	7 (2%)
1	B	264/284 (92%)	0.89	29 (10%) 10 10	11, 30, 44, 52	8 (3%)
All	All	527/568 (92%)	0.86	73 (13%) 6 6	11, 30, 52, 60	15 (2%)

All (73) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	263	VAL	11.6
1	B	262	ALA	8.2
1	B	261	PRO	7.4
1	B	118	ILE	5.3
1	B	264	VAL	5.2
1	A	309	GLY	5.1
1	B	259	PHE	5.0
1	A	235	ALA	4.7
1	B	310	ASP	4.4
1	A	267	VAL	4.4
1	B	117	SER	4.1
1	A	230	GLU	4.0
1	A	234	GLY	4.0
1	A	246	VAL	4.0
1	A	239	HIS	3.9
1	B	309	GLY	3.8
1	A	275[A]	MET	3.8
1	A	231	ILE	3.6
1	B	226	THR	3.5
1	A	262	ALA	3.5
1	B	260	ARG	3.5
1	A	263	VAL	3.4
1	B	258	GLN	3.3
1	A	270	GLY	3.3

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Mol	Chain	Res	Type	RSRZ
1	A	268	ALA	3.3
1	B	98	GLY	3.2
1	A	238	LEU	3.2
1	A	243	THR	3.1
1	B	275[A]	MET	3.1
1	B	230	GLU	3.1
1	A	138	GLY	2.9
1	A	271	THR	2.9
1	B	231	ILE	2.8
1	A	305	SER	2.8
1	A	139	ASP	2.8
1	A	232	GLN	2.7
1	B	171	ALA	2.7
1	A	163	VAL	2.7
1	B	227	VAL	2.7
1	B	228	ASN	2.6
1	A	269	ARG	2.6
1	A	310	ASP	2.6
1	A	165	LEU	2.6
1	B	74	ASN	2.6
1	A	233	PRO	2.6
1	A	306	CYS	2.5
1	B	139	ASP	2.5
1	A	200	GLY	2.5
1	A	108	GLU	2.5
1	B	265	GLU	2.5
1	A	245	LEU	2.4
1	A	308	LYS	2.4
1	A	220	THR	2.4
1	B	27	ALA	2.3
1	B	257	PRO	2.3
1	A	247	GLU	2.3
1	A	301	ASN	2.3
1	A	179	ASP	2.3
1	A	236	GLN	2.2
1	B	268	ALA	2.2
1	A	171	ALA	2.2
1	B	70	LYS	2.2
1	A	249	LYS	2.2
1	B	190	GLN	2.1
1	A	169	SER	2.1
1	A	164	GLU	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	250	ALA	2.1
1	A	69[A]	VAL	2.1
1	B	69	VAL	2.1
1	B	220[A]	THR	2.1
1	A	241	ILE	2.1
1	A	160	GLY	2.0
1	A	266	SER	2.0

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 oligosaccharides 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, 95th 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(Å ²)	Q<0.9
2	ZN	A	503	1/1	0.87	0.37	38,38,38,38	1
3	IPA	A	601	4/4	0.94	0.08	29,29,30,31	0
2	ZN	B	502	1/1	0.99	0.02	24,24,24,24	0
2	ZN	A	501	1/1	1.00	0.02	23,23,23,23	0

6.5 Other polymers [i](#)

There are no such residues in this entry.