Full wwPDB X-ray Structure Validation Report (i)

Dec 2, 2023 – 03:28 pm GMT

PDB ID	:	2BP0
Title	:	M144L mutant of nitrite reductase from Alcaligenes xylosoxidans
Authors	:	Hough, M.A.; Ellis, M.J.; Antonyuk, S.; Strange, R.W.; Sawers, G.; Eady, R.R.; Hasnain, S.S.
Deposited on	:	2005-04-17
Resolution	:	1.90 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 (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:

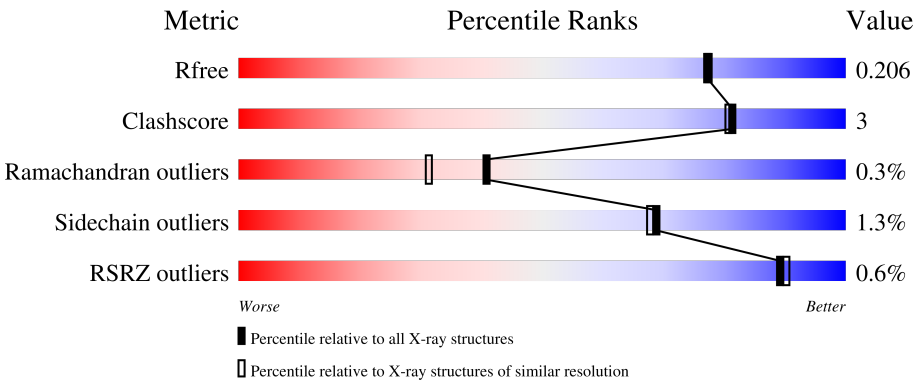
MolProbity	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 1.90 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	6207 (1.90-1.90)
Clashscore	141614	6847 (1.90-1.90)
Ramachandran outliers	138981	6760 (1.90-1.90)
Sidechain outliers	138945	6760 (1.90-1.90)
RSRZ outliers	127900	6082 (1.90-1.90)

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	336	90% 9%
2	B	336	% 94% 5% •

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	SO4	B	1346	-	-	X	-

2 Entry composition (i)

There are 6 unique types of molecules in this entry. The entry contains 5917 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 DISSIMILATORY COPPER-CONTAINING NITRITE REDUCTASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	335	2536	1619	434	473	10	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	26	SER	THR	conflict	UNP O68601
A	28	THR	SER	conflict	UNP O68601
A	144	LEU	MET	engineered mutation	UNP O68601
A	160	GLU	GLN	conflict	UNP O68601

- Molecule 2 is a protein called DISSIMILATORY COPPER-CONTAINING NITRITE REDUCTASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	335	2550	1625	439	476	10	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	144	LEU	MET	engineered mutation	UNP O68601
B	160	GLU	GLN	conflict	UNP O68601

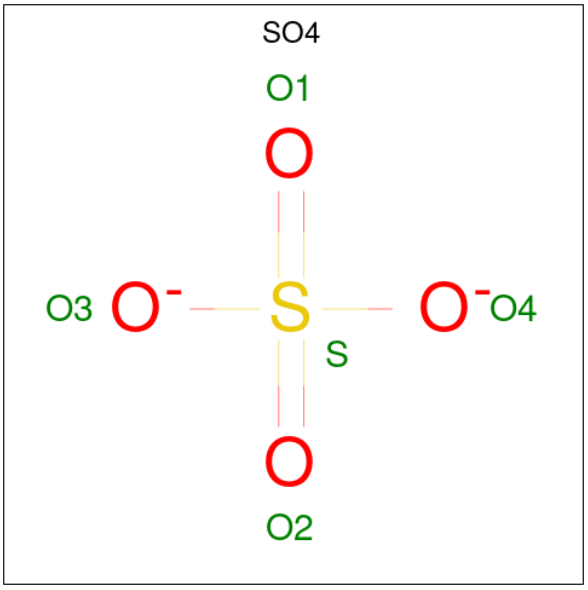
- Molecule 3 is COPPER (II) ION (three-letter code: CU) (formula: Cu).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Cu		
3	A	2	2	2	0	0
3	B	2	2	2	0	0

- Molecule 4 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	6	Total Zn 6 6	0	0
4	B	5	Total Zn 5 5	0	0

- Molecule 5 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total O S 5 4 1	0	0
5	A	1	Total O S 5 4 1	0	0
5	B	1	Total O S 5 4 1	0	0
5	B	1	Total O S 5 4 1	0	0
5	B	1	Total O S 5 4 1	0	0

- Molecule 6 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	427	Total O 427 427	0	0
6	B	364	Total O 364 364	0	0

3 Residue-property plots (i)

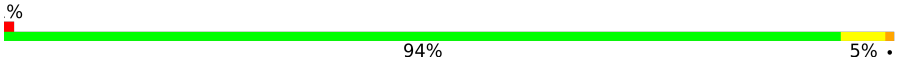
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: DISSIMILATORY COPPER-CONTAINING NITRITE REDUCTASE

Chain A:

- Molecule 2: DISSIMILATORY COPPER-CONTAINING NITRITE REDUCTASE

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	H 3	Depositor
Cell constants a, b, c, α, β, γ	90.61Å 90.61Å 291.44Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	70.00 – 1.90 69.09 – 1.90	Depositor EDS
% Data completeness (in resolution range)	97.5 (70.00-1.90) 97.5 (69.09-1.90)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.50 (at 1.90Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.159 , 0.196 0.171 , 0.206	Depositor DCC
R_{free} test set	3451 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å^2)	22.2	Xtriage
Anisotropy	0.010	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 68.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	0.033 for -h-k,k,-l	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	5917	wwPDB-VP
Average B, all atoms (Å^2)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 59.44 % 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 1.7649e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[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 (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: CU, ZN, SO4

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	0.76	0/2607	0.88	8/3559 (0.2%)
2	B	0.72	0/2621	0.86	9/3576 (0.3%)
All	All	0.74	0/5228	0.87	17/7135 (0.2%)

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	A	0	1
2	B	0	1
All	All	0	2

There are no bond length outliers.

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	205	ARG	NE-CZ-NH2	-8.76	115.92	120.30
2	B	205	ARG	NE-CZ-NH1	7.35	123.98	120.30
2	B	92	ASP	CB-CG-OD1	7.05	124.64	118.30
1	A	167	ASP	CB-CG-OD2	6.79	124.41	118.30
2	B	167	ASP	CB-CG-OD2	6.24	123.92	118.30
1	A	122	ARG	NE-CZ-NH1	6.11	123.35	120.30
2	B	158	ASP	CB-CG-OD1	6.08	123.78	118.30
1	A	92	ASP	CB-CG-OD1	6.02	123.72	118.30
1	A	2	ASP	CB-CG-OD2	5.83	123.54	118.30
1	A	184	ASP	CB-CG-OD2	5.77	123.49	118.30
2	B	189	ASP	CB-CG-OD2	5.72	123.45	118.30
1	A	154	ASP	CB-CG-OD2	5.71	123.44	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	323	ASP	CB-CG-OD2	5.36	123.13	118.30
1	A	153	ARG	NE-CZ-NH2	-5.26	117.67	120.30
1	A	270	ARG	NE-CZ-NH1	5.22	122.91	120.30
2	B	2	ASP	CB-CG-OD2	5.12	122.91	118.30
2	B	154	ASP	CB-CG-OD2	5.05	122.84	118.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	300	HIS	Peptide
2	B	300	HIS	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	2536	0	2452	16	0
2	B	2550	0	2478	8	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	6	0	0	0	0
4	B	5	0	0	0	0
5	A	10	0	0	0	0
5	B	15	0	0	2	0
6	A	427	0	0	10	1
6	B	364	0	0	7	1
All	All	5917	0	4930	25	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 3.

All (25) 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:217:LYS:CA	6:A:2313:HOH:O	1.92	1.15

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:135:MET:SD	6:B:2180:HOH:O	2.13	1.03
1:A:87:MET:SD	6:A:2284:HOH:O	2.19	0.99
2:B:245:ASP:OD2	6:B:2283:HOH:O	2.08	0.71
5:B:1346:SO4:O1	6:B:2364:HOH:O	2.06	0.71
1:A:40:GLU:O	6:A:2077:HOH:O	2.10	0.70
2:B:20:HIS:HE1	2:B:68:VAL:H	1.39	0.69
1:A:269:GLN:NE2	6:A:2357:HOH:O	2.26	0.68
1:A:245:ASP:OD2	6:A:2334:HOH:O	2.09	0.68
1:A:135:MET:HE3	6:A:2216:HOH:O	1.98	0.64
1:A:336:ARG:C	6:A:2409:HOH:O	2.37	0.62
1:A:20:HIS:HE1	1:A:68:VAL:H	1.49	0.61
2:B:205:ARG:HD3	6:B:2250:HOH:O	2.01	0.59
2:B:154:ASP:HB2	6:B:2093:HOH:O	2.03	0.58
1:A:87:MET:HE2	6:A:2221:HOH:O	2.05	0.56
1:A:28:THR:HG22	1:A:29:GLY:O	2.08	0.54
1:A:36:THR:HG22	1:A:78:THR:HB	1.89	0.53
1:A:210:SER:OG	1:A:211:HIS:HD2	1.93	0.51
1:A:336:ARG:C	6:A:2212:HOH:O	2.50	0.49
2:B:199:ASP:OD1	5:B:1346:SO4:O4	2.31	0.47
1:A:28:THR:HG21	1:A:31:LYS:CE	2.47	0.45
1:A:42:LYS:CD	6:A:2077:HOH:O	2.67	0.43
2:B:4:ASP:CG	6:B:2002:HOH:O	2.58	0.41
1:A:75:VAL:O	1:A:117:ARG:HA	2.21	0.41
2:B:87:MET:HE2	6:B:2179:HOH:O	2.20	0.41

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)
6:A:2212:HOH:O	6:A:2212:HOH:O[2_565]	1.07	1.13
6:B:2284:HOH:O	6:B:2318:HOH:O[3_575]	2.18	0.02

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	333/336 (99%)	328 (98%)	4 (1%)	1 (0%)	41	31
2	B	333/336 (99%)	327 (98%)	5 (2%)	1 (0%)	41	31
All	All	666/672 (99%)	655 (98%)	9 (1%)	2 (0%)	41	31

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	24	GLN
2	B	24	GLN

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	260/271 (96%)	257 (99%)	3 (1%)	71	70
2	B	264/271 (97%)	260 (98%)	4 (2%)	65	62
All	All	524/542 (97%)	517 (99%)	7 (1%)	69	68

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	135	MET
1	A	158	ASP
1	A	247	ARG
2	B	2	ASP
2	B	247	ARG
2	B	322	ASP
2	B	336	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	18	GLN
1	A	20	HIS
1	A	211	HIS
1	A	269	GLN
2	B	18	GLN
2	B	20	HIS
2	B	211	HIS
2	B	269	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 20 ligands modelled in this entry, 15 are monoatomic - leaving 5 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	$\#\|Z\| > 2$
5	SO4	A	1345	4	4,4,4	0.14	0	6,6,6	0.57	0
5	SO4	B	1345	4	4,4,4	0.09	0	6,6,6	0.20	0
5	SO4	B	1344	4	4,4,4	0.20	0	6,6,6	0.13	0
5	SO4	B	1346	-	4,4,4	0.35	0	6,6,6	0.54	0
5	SO4	A	1346	4	4,4,4	0.19	0	6,6,6	0.51	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.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	B	1346	SO4	2	0

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, 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	335/336 (99%)	-0.44	0	100	100	12, 23, 38, 60	4 (1%)
2	B	335/336 (99%)	-0.28	4 (1%)	79	81	11, 26, 45, 66	2 (0%)
All	All	670/672 (99%)	-0.36	4 (0%)	89	90	11, 24, 42, 66	6 (0%)

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	2	ASP	3.9
2	B	336	ARG	3.3
2	B	3	ALA	2.5
2	B	5	LYS	2.2

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, 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
5	SO4	B	1346	5/5	0.60	0.20	31,43,45,48	5

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
4	ZN	A	1344	1/1	0.76	0.08	68,68,68,68	1
4	ZN	B	1342	1/1	0.80	0.14	50,50,50,50	1
4	ZN	B	1343	1/1	0.92	0.20	50,50,50,50	1
4	ZN	A	1342	1/1	0.94	0.05	40,40,40,40	1
5	SO4	A	1345	5/5	0.95	0.10	50,50,54,54	0
3	CU	B	1337	1/1	0.96	0.10	26,26,26,26	0
4	ZN	A	1340	1/1	0.96	0.10	40,40,40,40	1
4	ZN	B	1339	1/1	0.97	0.08	46,46,46,46	1
4	ZN	B	1340	1/1	0.97	0.09	30,30,30,30	0
4	ZN	A	1339	1/1	0.98	0.08	31,31,31,31	0
4	ZN	B	1341	1/1	0.98	0.06	34,34,34,34	1
5	SO4	A	1346	5/5	0.98	0.11	39,44,45,45	0
5	SO4	B	1344	5/5	0.98	0.07	53,53,55,55	5
4	ZN	A	1343	1/1	0.98	0.07	38,38,38,38	1
3	CU	A	1337	1/1	0.99	0.09	21,21,21,21	0
3	CU	B	1338	1/1	0.99	0.11	17,17,17,17	0
5	SO4	B	1345	5/5	0.99	0.08	33,38,39,40	5
4	ZN	A	1341	1/1	0.99	0.04	42,42,42,42	0
3	CU	A	1338	1/1	1.00	0.11	15,15,15,15	0

6.5 Other polymers (i)

There are no such residues in this entry.