



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 01:58 AM UTC

PDB ID : 1YSJ / pdb_00001ysj
Title : Crystal Structure of Bacillus Subtilis YXEP Protein (APC1829), a Dinuclear Metal Binding Peptidase from M20 Family
Authors : Minasov, G.; Shuvalova, L.; Brunzelle, J.S.; Collart, F.R.; Anderson, W.F.; Midwest Center for Structural Genomics (MCSG)
Deposited on : 2005-02-08
Resolution : 2.40 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)
Xtriage (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

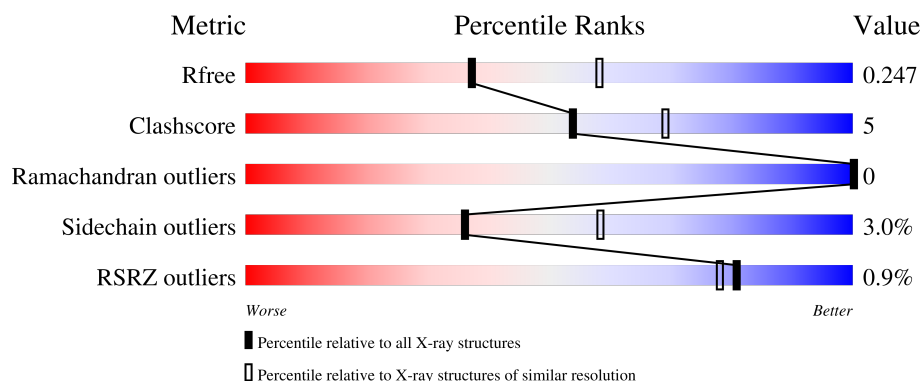
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

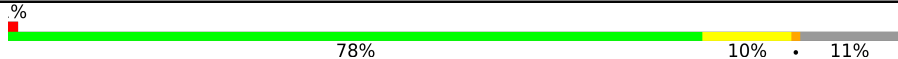
The reported resolution of this entry is 2.40 Å.

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	4912 (2.40-2.40)
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)
RSRZ outliers	180081	4916 (2.40-2.40)

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	404	 78% 10% • 11%
1	B	404	 76% 11% • 12%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5962 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 protein yxeP.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	359	Total	C	N	O	S	Se	0	6	0
			2836	1792	501	534	1	8			
1	B	356	Total	C	N	O	S	Se	0	5	0
			2805	1776	487	533	1	8			

There are 68 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-23	MSE	-	initiating methionine	UNP P54955
A	-22	HIS	-	expression tag	UNP P54955
A	-21	HIS	-	expression tag	UNP P54955
A	-20	HIS	-	expression tag	UNP P54955
A	-19	HIS	-	expression tag	UNP P54955
A	-18	HIS	-	expression tag	UNP P54955
A	-17	HIS	-	expression tag	UNP P54955
A	-16	SER	-	cloning artifact	UNP P54955
A	-15	SER	-	cloning artifact	UNP P54955
A	-14	GLY	-	cloning artifact	UNP P54955
A	-13	VAL	-	cloning artifact	UNP P54955
A	-12	ASP	-	cloning artifact	UNP P54955
A	-11	LEU	-	cloning artifact	UNP P54955
A	-10	GLY	-	cloning artifact	UNP P54955
A	-9	THR	-	cloning artifact	UNP P54955
A	-8	GLU	-	cloning artifact	UNP P54955
A	-7	ASN	-	cloning artifact	UNP P54955
A	-6	LEU	-	cloning artifact	UNP P54955
A	-5	TYR	-	cloning artifact	UNP P54955
A	-4	PHE	-	cloning artifact	UNP P54955
A	-3	GLN	-	cloning artifact	UNP P54955
A	-2	SER	-	cloning artifact	UNP P54955
A	-1	ASN	-	cloning artifact	UNP P54955
A	0	ALA	-	cloning artifact	UNP P54955
A	1	MSE	MET	modified residue	UNP P54955

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Chain	Residue	Modelled	Actual	Comment	Reference
A	13	MSE	MET	modified residue	UNP P54955
A	54	GLY	ALA	engineered mutation	UNP P54955
A	95	MSE	MET	modified residue	UNP P54955
A	112	MSE	MET	modified residue	UNP P54955
A	157	MSE	MET	modified residue	UNP P54955
A	176	MSE	MET	modified residue	UNP P54955
A	249	MSE	MET	modified residue	UNP P54955
A	268	MSE	MET	modified residue	UNP P54955
A	341	MSE	MET	modified residue	UNP P54955
B	-23	MSE	-	initiating methionine	UNP P54955
B	-22	HIS	-	expression tag	UNP P54955
B	-21	HIS	-	expression tag	UNP P54955
B	-20	HIS	-	expression tag	UNP P54955
B	-19	HIS	-	expression tag	UNP P54955
B	-18	HIS	-	expression tag	UNP P54955
B	-17	HIS	-	expression tag	UNP P54955
B	-16	SER	-	cloning artifact	UNP P54955
B	-15	SER	-	cloning artifact	UNP P54955
B	-14	GLY	-	cloning artifact	UNP P54955
B	-13	VAL	-	cloning artifact	UNP P54955
B	-12	ASP	-	cloning artifact	UNP P54955
B	-11	LEU	-	cloning artifact	UNP P54955
B	-10	GLY	-	cloning artifact	UNP P54955
B	-9	THR	-	cloning artifact	UNP P54955
B	-8	GLU	-	cloning artifact	UNP P54955
B	-7	ASN	-	cloning artifact	UNP P54955
B	-6	LEU	-	cloning artifact	UNP P54955
B	-5	TYR	-	cloning artifact	UNP P54955
B	-4	PHE	-	cloning artifact	UNP P54955
B	-3	GLN	-	cloning artifact	UNP P54955
B	-2	SER	-	cloning artifact	UNP P54955
B	-1	ASN	-	cloning artifact	UNP P54955
B	0	ALA	-	cloning artifact	UNP P54955
B	1	MSE	MET	modified residue	UNP P54955
B	13	MSE	MET	modified residue	UNP P54955
B	54	GLY	ALA	engineered mutation	UNP P54955
B	95	MSE	MET	modified residue	UNP P54955
B	112	MSE	MET	modified residue	UNP P54955
B	157	MSE	MET	modified residue	UNP P54955
B	176	MSE	MET	modified residue	UNP P54955
B	249	MSE	MET	modified residue	UNP P54955
B	268	MSE	MET	modified residue	UNP P54955

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Chain	Residue	Modelled	Actual	Comment	Reference
B	341	MSE	MET	modified residue	UNP P54955

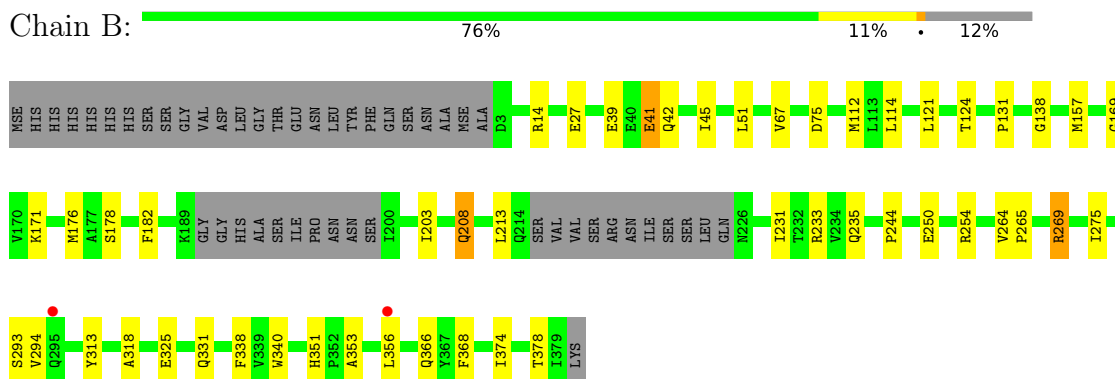
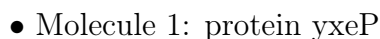
- Molecule 2 is NICKEL (II) ION (CCD ID: NI) (formula: Ni).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	2	Total Ni 2 2	0	0
2	B	2	Total Ni 2 2	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	148	Total O 152 152	0	5
3	B	164	Total O 165 165	0	2

- Molecule 1: protein yxeP



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	233.85Å 42.16Å 75.45Å 90.00° 106.71° 90.00°	Depositor
Resolution (Å)	25.00 – 2.40 25.00 – 2.40	Depositor EDS
% Data completeness (in resolution range)	98.9 (25.00-2.40) 98.7 (25.00-2.40)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.67 (at 2.36Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, R_{free}	0.182 , 0.247 0.180 , 0.247	Depositor DCC
R_{free} test set	1449 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å ²)	46.3	Xtriage
Anisotropy	0.127	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 40.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.017 for -h-2*1,-k,l	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	5962	wwPDB-VP
Average B, all atoms (Å ²)	45.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.55% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: NI

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	0.47	0/2885	0.77	0/3895
1	B	0.46	0/2854	0.76	0/3854
All	All	0.46	0/5739	0.76	0/7749

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	2836	0	2793	27	0
1	B	2805	0	2753	31	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
3	A	152	0	0	2	0
3	B	165	0	0	2	0
All	All	5962	0	5546	55	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 5.

All (55) 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:52:LYS:HE3	1:A:52:LYS:H	1.19	1.02
1:B:269:ARG:HH11	1:B:269:ARG:HG3	1.33	0.91
1:A:95:MSE:HE1	1:A:352:PRO:HA	1.62	0.81
1:A:351:HIS:HD2	1:A:353:ALA:H	1.38	0.71
1:B:269:ARG:HG3	1:B:269:ARG:NH1	2.08	0.69
1:B:233:ARG:HB3	1:B:250:GLU:HB2	1.79	0.63
1:B:176:MSE:HE1	1:B:338:PHE:CD2	2.37	0.59
1:A:131:PRO:O	1:A:138:GLY:HA3	2.03	0.59
1:B:208:GLN:HB3	1:B:275:ILE:HG21	1.87	0.55
1:A:39:GLU:HG3	1:A:45:ILE:HD12	1.88	0.55
1:B:313:TYR:OH	1:B:366:GLN:NE2	2.40	0.55
1:A:306:GLU:HG3	1:A:374:ILE:HD13	1.91	0.53
1:A:348:GLU:HB2	3:A:468:HOH:O	2.08	0.53
1:B:374:ILE:O	1:B:378:THR:HG22	2.10	0.52
1:A:233:ARG:HH11	1:A:235[A]:GLN:HG3	1.75	0.51
1:A:351:HIS:CD2	1:A:353:ALA:H	2.23	0.51
1:B:176:MSE:HE1	1:B:338:PHE:CE2	2.46	0.50
1:A:52:LYS:HE3	1:A:52:LYS:N	2.05	0.50
1:A:235[A]:GLN:HE22	1:B:235:GLN:HG3	1.77	0.50
1:B:39:GLU:HG3	1:B:45:ILE:HD12	1.93	0.49
1:B:171:LYS:HD2	1:B:318:ALA:O	2.12	0.49
1:A:187:LYS:HB3	1:A:246:GLN:HG2	1.95	0.49
1:B:131:PRO:O	1:B:138:GLY:HA3	2.13	0.48
1:A:260:ALA:O	1:A:264:VAL:HG22	2.14	0.48
1:B:42:GLN:HG3	3:B:498:HOH:O	2.14	0.48
1:A:264:VAL:HG23	1:A:265:PRO:HD3	1.96	0.47
1:B:182:PHE:HZ	1:B:231:ILE:HD13	1.80	0.47
1:B:378:THR:HG23	3:B:530:HOH:O	2.14	0.47
1:A:376:LEU:HA	1:A:379:ILE:HG22	1.97	0.46
1:B:27:GLU:OE2	1:B:75:ASP:HB3	2.14	0.46
1:A:259:GLU:CD	1:A:259:GLU:H	2.24	0.45
1:B:351:HIS:CD2	1:B:353:ALA:H	2.34	0.45
1:A:264:VAL:N	1:A:265:PRO:HD2	2.31	0.45
1:A:18:HIS:HB2	1:A:101:ASP:OD2	2.17	0.45
1:A:179:VAL:O	1:A:290:TYR:HB3	2.17	0.44
1:B:269:ARG:NH1	1:B:269:ARG:CG	2.80	0.44
1:A:232:THR:O	1:B:244:PRO:HG3	2.18	0.44
1:B:294:VAL:HG13	1:B:331:GLN:HE22	1.82	0.44
1:A:328:ALA:HA	1:A:331:GLN:HE21	1.83	0.44
1:B:264:VAL:N	1:B:265:PRO:HD2	2.33	0.43
1:B:41[B]:GLU:HG3	1:B:112:MSE:HG2	1.99	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:169:GLY:HA3	1:B:340:TRP:HB2	2.00	0.43
1:B:67:VAL:HG22	1:B:124:THR:HB	2.01	0.43
1:B:176:MSE:O	1:B:293:SER:HB2	2.19	0.43
1:A:17:LEU:HD22	1:A:30:THR:HG23	2.01	0.42
1:B:351:HIS:HD2	1:B:353:ALA:H	1.68	0.41
1:A:203:ILE:HG21	1:B:231:ILE:HB	2.03	0.41
1:B:157:MSE:HB3	1:B:368:PHE:CZ	2.56	0.41
1:A:114:LEU:HD22	1:A:121:LEU:HD21	2.02	0.41
1:A:160:LYS:HA	1:A:161:PRO:HD2	1.96	0.41
1:A:349:TRP:O	1:A:350:HIS:HB2	2.21	0.41
1:B:41[B]:GLU:O	1:B:42:GLN:HG2	2.21	0.40
1:A:284:GLU:HG3	3:A:476:HOH:O	2.21	0.40
1:B:114:LEU:HD22	1:B:121:LEU:HD21	2.02	0.40
1:B:178:SER:O	1:B:254:ARG:HA	2.21	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	359/404 (89%)	353 (98%)	6 (2%)	0	100	100
1	B	355/404 (88%)	349 (98%)	6 (2%)	0	100	100
All	All	714/808 (88%)	702 (98%)	12 (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	293/316 (93%)	284 (97%)	9 (3%)	35	57
1	B	290/316 (92%)	280 (97%)	10 (3%)	32	54
All	All	583/632 (92%)	564 (97%)	19 (3%)	36	55

All (19) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	45	ILE
1	A	46	LEU
1	A	52	LYS
1	A	73	ASP
1	A	235[A]	GLN
1	A	235[B]	GLN
1	A	259	GLU
1	A	325	GLU
1	A	378	THR
1	B	14	ARG
1	B	41[A]	GLU
1	B	41[B]	GLU
1	B	51	LEU
1	B	203	ILE
1	B	208	GLN
1	B	213	LEU
1	B	269	ARG
1	B	325	GLU
1	B	356	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (14) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	12	ASN
1	A	80	GLN
1	A	82	GLN
1	A	116	GLN
1	A	159	ASN
1	A	302	ASN
1	A	320	GLN
1	A	331	GLN

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Mol	Chain	Res	Type
1	A	351	HIS
1	A	366	GLN
1	B	320	GLN
1	B	331	GLN
1	B	351	HIS
1	B	366	GLN

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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

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 ⓘ

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, 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	351/404 (86%)	0.08	4 (1%)	78 74	20, 44, 56, 72	6 (1%)
1	B	348/404 (86%)	-0.04	2 (0%)	85 83	19, 44, 54, 64	5 (1%)
All	All	699/808 (86%)	0.02	6 (0%)	81 78	19, 44, 55, 72	11 (1%)

All (6) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	2	ALA	2.8
1	A	199	SER	2.7
1	B	295[A]	GLN	2.6
1	A	200	ILE	2.3
1	A	245	ASP	2.1
1	B	356	LEU	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 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($\text{\AA}^2$)	Q<0.9
2	NI	A	382	1/1	0.99	0.08	42,42,42,42	0
2	NI	B	382	1/1	0.99	0.09	39,39,39,39	0
2	NI	B	381	1/1	1.00	0.10	36,36,36,36	0
2	NI	A	381	1/1	1.00	0.08	35,35,35,35	0

6.5 Other polymers [i](#)

There are no such residues in this entry.