Full wwPDB X-ray Structure Validation Report (i)

Feb 14, 2024 – 09:57 AM EST

PDB ID	:	3KYL
Title	:	Structure of the catalytic subunit of telomerase bound to its RNA template and telomeric DNA
Authors	:	Skordalakes, E.
Deposited on	:	2009-12-06
Resolution	:	2.70 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 (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 (1)) were used in the production of this report:

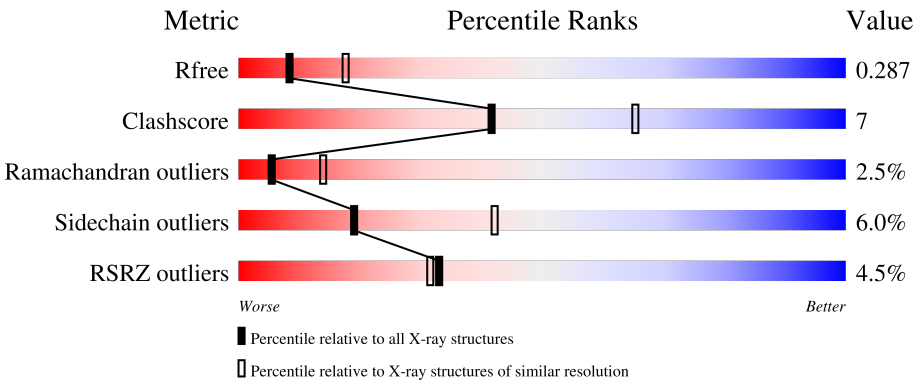
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation 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 2.70 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}	130704	2808 (2.70-2.70)
Clashscore	141614	3122 (2.70-2.70)
Ramachandran outliers	138981	3069 (2.70-2.70)
Sidechain outliers	138945	3069 (2.70-2.70)
RSRZ outliers	127900	2737 (2.70-2.70)

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 <=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	596	5%, 77%, 19%, •
2	E	24	79%, 17%, •

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 5535 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 Telomerase reverse transcriptase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	596	4983	3266	852	843	22	0	0	0

- Molecule 2 is DNA/RNA hybrid called DNA/RNA (5'-R(*CP*UP*GP*AP*CP*CP*UP*GP*AP*C)-D(P*TP*TP*CP*GP*GP*TP*CP*AP*GP*GP*TP*CP*AP*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	E	24	496	231	88	154	23	0	0	0

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

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Mg		
3	A	1	1	1	0	0

- Molecule 4 is water.

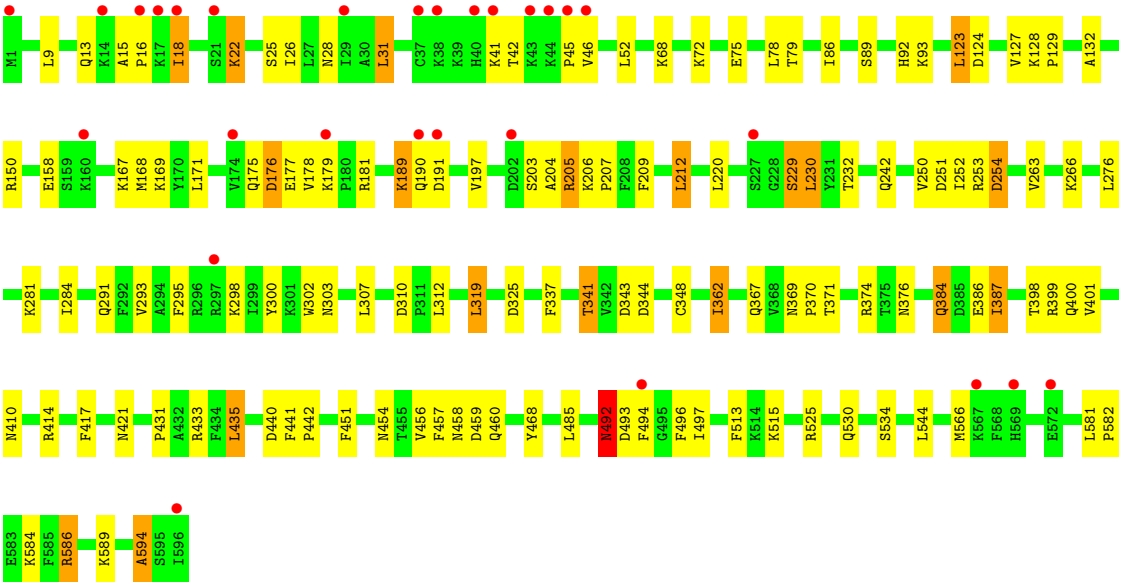
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	A	47	47	47	0	0
4	E	8	8	8	0	0

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: Telomerase reverse transcriptase

Chain A: 5% 77% 19%



• Molecule 2: DNA/RNA (5'-R(*CP*UP*GP*AP*CP*CP*UP*GP*AP*C)-D(P*TP*TP*CP*GP*GP*TP*CP*AP*GP*GP*TP*CP*AP*G)-3')

Chain E: 79% 17%

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	77.23Å 52.78Å 101.61Å 90.00° 101.90° 90.00°	Depositor
Resolution (Å)	25.51 – 2.70 25.51 – 2.70	Depositor EDS
% Data completeness (in resolution range)	93.3 (25.51-2.70) 93.2 (25.51-2.70)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.26 (at 2.72Å)	Xtriage
Refinement program	REFMAC 5.2.0019, ELVES	Depositor
R, R_{free}	0.242 , 0.287 0.239 , 0.287	Depositor DCC
R_{free} test set	1033 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å^2)	37.1	Xtriage
Anisotropy	0.558	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.27 , 34.6	EDS
L-test for twinning[2]	$< \|L\| > = 0.46$, $< L^2 > = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.90	EDS
Total number of atoms	5535	wwPDB-VP
Average B, all atoms (Å^2)	41.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.53% 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 (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: 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	0.34	0/5115	0.44	0/6893
2	E	0.63	0/554	1.10	1/857 (0.1%)
All	All	0.38	0/5669	0.55	1/7750 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	E	19	DG	O4'-C1'-N9	5.21	111.64	108.00

There are no chirality outliers.

There are no planarity outliers.

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	4983	0	5126	73	0
2	E	496	0	268	4	0
3	A	1	0	0	0	0
4	A	47	0	0	3	0
4	E	8	0	0	0	0
All	All	5535	0	5394	76	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 7.

All (76) 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:400:GLN:HE22	1:A:459:ASP:H	1.07	0.99
1:A:204:ALA:O	1:A:207:PRO:HD2	1.70	0.90
1:A:303:ASN:HA	4:A:630:HOH:O	1.82	0.78
1:A:431:PRO:HB3	1:A:485:LEU:HD22	1.71	0.71
1:A:401:VAL:H	1:A:458:ASN:HD21	1.39	0.70
1:A:230:LEU:O	1:A:451:PHE:HZ	1.75	0.69
1:A:203:SER:HA	1:A:204:ALA:C	2.16	0.65
1:A:410:ASN:HB3	1:A:589:LYS:HE3	1.80	0.63
1:A:460:GLN:HE22	1:A:525:ARG:H	1.47	0.63
1:A:460:GLN:NE2	1:A:525:ARG:H	1.97	0.63
1:A:400:GLN:HE22	1:A:459:ASP:N	1.89	0.62
1:A:204:ALA:O	1:A:206:LYS:N	2.33	0.62
1:A:298:LYS:HG3	1:A:300:TYR:HE1	1.65	0.62
1:A:400:GLN:NE2	1:A:459:ASP:H	1.89	0.61
1:A:9:LEU:HD23	1:A:132:ALA:HB2	1.84	0.58
1:A:68:LYS:O	1:A:72:LYS:HG2	2.04	0.58
1:A:45:PRO:HA	1:A:150:ARG:HH22	1.68	0.58
2:E:18:DA:H2'	2:E:19:DG:C8	2.39	0.58
1:A:230:LEU:O	1:A:451:PHE:CZ	2.59	0.55
1:A:75:GLU:HG3	1:A:594:ALA:HB2	1.89	0.54
1:A:176:ASP:O	1:A:178:VAL:N	2.31	0.54
1:A:291:GLN:HB3	1:A:307:LEU:HD12	1.88	0.54
1:A:341:THR:OG1	1:A:344:ASP:HB2	2.07	0.54
1:A:220:LEU:HD21	1:A:319:LEU:HA	1.90	0.53
1:A:337:PHE:HB3	1:A:348:CYS:HB2	1.90	0.52
1:A:253:ARG:HH21	1:A:367:GLN:HE21	1.58	0.52
1:A:22:LYS:H	1:A:22:LYS:HD2	1.75	0.51
1:A:181:ARG:HD3	1:A:310:ASP:OD1	2.10	0.51
1:A:79:THR:HB	1:A:414:ARG:HH22	1.76	0.51
1:A:376:ASN:HB3	1:A:384:GLN:O	2.11	0.51
1:A:41:LYS:CB	1:A:42:THR:HA	2.41	0.50
1:A:421:ASN:HD21	2:E:18:DA:H5"	1.76	0.50
1:A:189:LYS:HG3	1:A:190:GLN:N	2.28	0.48
1:A:454:ASN:HD22	1:A:456:VAL:H	1.60	0.48
1:A:205:ARG:HB3	1:A:209:PHE:CE2	2.49	0.47
1:A:263:VAL:HA	1:A:266:LYS:HD2	1.97	0.47
1:A:298:LYS:HG3	1:A:300:TYR:CE1	2.47	0.47
1:A:229:SER:O	1:A:230:LEU:HB3	2.14	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:158:GLU:HG2	1:A:295:PHE:HZ	1.80	0.46
1:A:189:LYS:HG3	1:A:190:GLN:H	1.79	0.46
1:A:52:LEU:HD21	1:A:127:VAL:HG22	1.97	0.46
1:A:92:HIS:CD2	1:A:93:LYS:HG3	2.50	0.46
1:A:250:VAL:HG21	1:A:362:ILE:HG21	1.96	0.46
1:A:15:ALA:HB1	1:A:31:LEU:HD21	1.96	0.46
1:A:189:LYS:CG	1:A:190:GLN:H	2.29	0.46
1:A:171:LEU:HD13	1:A:302:TRP:HE3	1.81	0.46
1:A:431:PRO:HD2	4:A:621:HOH:O	2.15	0.46
1:A:374:ARG:HB3	1:A:387:ILE:HG22	1.98	0.45
1:A:298:LYS:HE2	1:A:300:TYR:OH	2.16	0.45
1:A:441:PHE:N	1:A:442:PRO:CD	2.80	0.45
1:A:581:LEU:HD23	1:A:586:ARG:HG2	1.98	0.45
1:A:492:ASN:HB2	1:A:493:ASP:H	1.47	0.44
1:A:530:GLN:N	1:A:530:GLN:OE1	2.51	0.44
1:A:252:ILE:HB	1:A:343:ASP:HB2	2.00	0.44
1:A:276:LEU:O	1:A:281:LYS:HD2	2.17	0.43
1:A:494:PHE:HD2	1:A:497:ILE:HD11	1.83	0.43
1:A:253:ARG:O	1:A:254:ASP:C	2.56	0.43
2:E:2:U:H3	2:E:23:DA:H62	1.66	0.43
1:A:13:GLN:HG2	1:A:124:ASP:HB3	2.01	0.43
1:A:212:LEU:HD23	1:A:312:LEU:HD21	2.01	0.43
1:A:468:TYR:HE2	1:A:582:PRO:HD3	1.84	0.42
1:A:123:LEU:HA	1:A:127:VAL:HB	2.01	0.42
1:A:197:VAL:HG11	1:A:293:VAL:CG1	2.50	0.42
1:A:212:LEU:HG	1:A:284:ILE:HD11	2.01	0.42
1:A:79:THR:HB	1:A:414:ARG:NH2	2.35	0.42
1:A:15:ALA:HA	1:A:16:PRO:HD3	1.90	0.42
2:E:19:DG:H2"	2:E:20:DG:O5'	2.20	0.42
1:A:89:SER:HB2	1:A:93:LYS:HD2	2.02	0.41
1:A:435:LEU:HD12	1:A:496:PHE:HE2	1.85	0.41
1:A:454:ASN:ND2	1:A:457:PHE:H	2.18	0.41
1:A:515:LYS:HE2	4:A:615:HOH:O	2.21	0.41
1:A:369:ASN:HA	1:A:370:PRO:HD3	1.75	0.41
1:A:75:GLU:HA	1:A:78:LEU:HD12	2.03	0.41
1:A:398:THR:O	1:A:399:ARG:HB2	2.21	0.40
1:A:128:LYS:HB2	1:A:129:PRO:HD3	2.03	0.40
1:A:41:LYS:HB2	1:A:42:THR:HA	2.02	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	594/596 (100%)	534 (90%)	45 (8%)	15 (2%)	5 14

All (15) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	205	ARG
1	A	492	ASN
1	A	168	MET
1	A	229	SER
1	A	254	ASP
1	A	594	ALA
1	A	176	ASP
1	A	177	GLU
1	A	169	LYS
1	A	230	LEU
1	A	18	ILE
1	A	25	SER
1	A	46	VAL
1	A	175	GLN
1	A	179	LYS

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	552/552 (100%)	519 (94%)	33 (6%)	19 42

All (33) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	18	ILE
1	A	22	LYS
1	A	26	ILE
1	A	28	ASN
1	A	31	LEU
1	A	86	ILE
1	A	123	LEU
1	A	167	LYS
1	A	189	LYS
1	A	191	ASP
1	A	212	LEU
1	A	232	THR
1	A	242	GLN
1	A	251	ASP
1	A	319	LEU
1	A	325	ASP
1	A	341	THR
1	A	362	ILE
1	A	371	THR
1	A	384	GLN
1	A	386	GLU
1	A	387	ILE
1	A	417	PHE
1	A	433	ARG
1	A	435	LEU
1	A	440	ASP
1	A	492	ASN
1	A	513	PHE
1	A	534	SER
1	A	544	LEU
1	A	566	MET
1	A	584	LYS
1	A	586	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	33	ASN
1	A	92	HIS
1	A	282	ASN
1	A	287	HIS

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Mol	Chain	Res	Type
1	A	290	ASN
1	A	351	HIS
1	A	367	GLN
1	A	400	GLN
1	A	454	ASN
1	A	458	ASN
1	A	460	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 1 ligands modelled in this entry, 1 is 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 (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	596/596 (100%)	0.16	28 (4%) 31 30	14, 34, 89, 100	0
2	E	24/24 (100%)	-0.81	0 100 100	16, 23, 38, 55	0
All	All	620/620 (100%)	0.13	28 (4%) 33 31	14, 34, 88, 100	0

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	40	HIS	5.0
1	A	38	LYS	4.4
1	A	17	LYS	3.9
1	A	174	VAL	3.8
1	A	191	ASP	3.4
1	A	45	PRO	3.2
1	A	44	LYS	3.2
1	A	41	LYS	2.9
1	A	14	LYS	2.8
1	A	46	VAL	2.7
1	A	567	LYS	2.7
1	A	16	PRO	2.6
1	A	43	LYS	2.6
1	A	297	ARG	2.6
1	A	29	ILE	2.5
1	A	190	GLN	2.5
1	A	596	ILE	2.4
1	A	37	CYS	2.4
1	A	179	LYS	2.4
1	A	494	PHE	2.3
1	A	202	ASP	2.3
1	A	18	ILE	2.2
1	A	227	SER	2.2
1	A	572	GLU	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	569	HIS	2.1
1	A	1	MET	2.0
1	A	21	SER	2.0
1	A	160	LYS	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 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
3	MG	A	597	1/1	0.74	0.15	43,43,43,43	0

6.5 Other polymers (i)

There are no such residues in this entry.