



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 10, 2023 – 01:12 AM EDT

PDB ID : 7SXQ
Title : Plasmodium falciparum apicoplast DNA polymerase (exo-minus) without affinity tag
Authors : Nieto, N.; Chheda, P.; Kerns, R.; Nelson, S.; Honzatko, R.
Deposited on : 2021-11-24
Resolution : 2.50 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.35.1
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

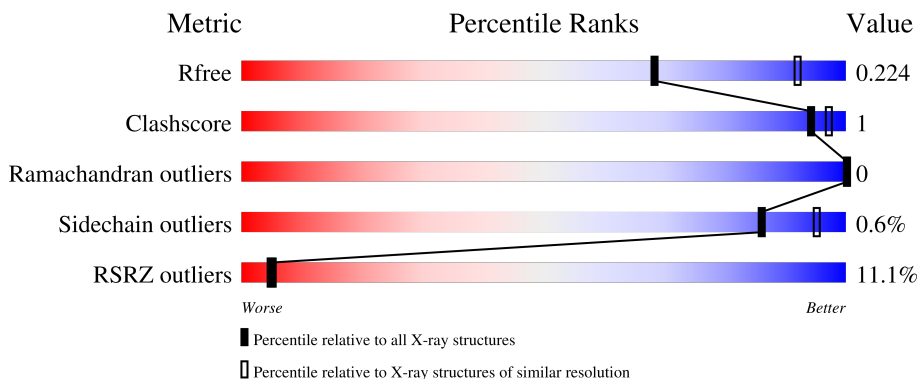
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

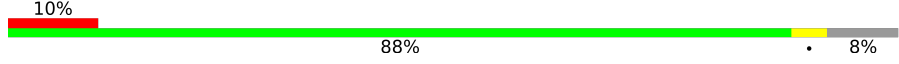
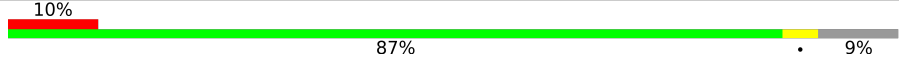
The reported resolution of this entry is 2.50 Å.

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	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)
RSRZ outliers	127900	4559 (2.50-2.50)

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	628	 10% 88% 8%
1	B	628	 10% 87% 9%

2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 19947 atoms, of which 9855 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.

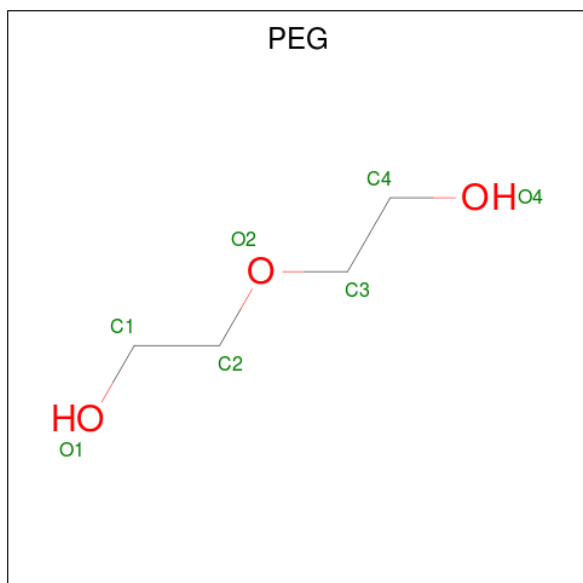
- Molecule 1 is a protein called Apicoplast DNA polymerase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
1	A	576	9727	3102	4912	804	893	16	0	4	0
1	B	573	9699	3094	4897	804	888	16	0	5	0

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	82	ASN	ASP	engineered mutation	UNP Q8ILY1
A	84	GLN	GLU	engineered mutation	UNP Q8ILY1
A	512	PHE	TRP	engineered mutation	UNP Q8ILY1
B	82	ASN	ASP	engineered mutation	UNP Q8ILY1
B	84	GLN	GLU	engineered mutation	UNP Q8ILY1
B	512	PHE	TRP	engineered mutation	UNP Q8ILY1

- Molecule 2 is DI(HYDROXYETHYL)ETHER (three-letter code: PEG) (formula: C₄H₁₀O₃).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	H	O	0	0
			17	4	10	3		
2	A	1	Total	C	H	O	0	0
			17	4	10	3		
2	B	1	Total	C	H	O	0	0
			17	4	10	3		
2	B	1	Total	C	H	O	0	0
			17	4	10	3		

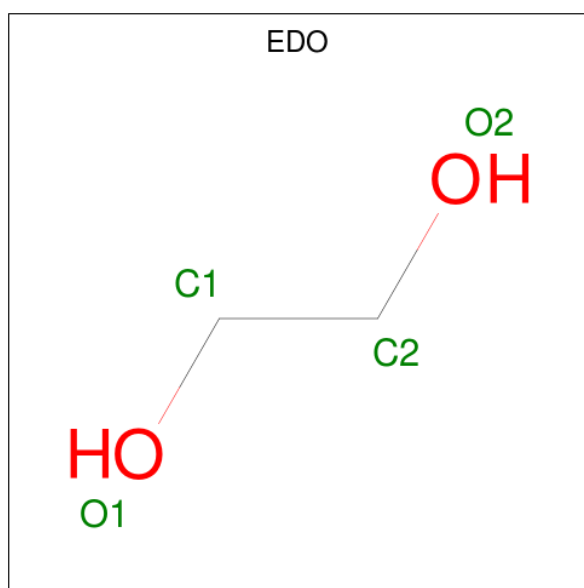
- Molecule 3 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	3	Total	Cl	0	0
			3	3		
3	B	3	Total	Cl	0	0
			3	3		

- Molecule 4 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Na	0	0
			1	1		
4	B	1	Total	Na	0	0
			1	1		

- Molecule 5 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C₂H₆O₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	B	1	Total	C	H	O	0	0
			10	2	6	2		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	219	Total	O	0	0
			219	219		
6	B	216	Total	O	0	0
			216	216		

4 Data and refinement statistics

Property	Value	Source
Space group	P 65	Depositor
Cell constants a, b, c, α , β , γ	144.00Å 144.00Å 165.01Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	19.97 – 2.50 47.13 – 2.50	Depositor EDS
% Data completeness (in resolution range)	100.0 (19.97-2.50) 93.7 (47.13-2.50)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	0.91 (at 2.51Å)	Xtrriage
Refinement program	PHENIX 1.19_4092	Depositor
R, R_{free}	0.201 , 0.225 0.200 , 0.224	Depositor DCC
R_{free} test set	1996 reflections (3.00%)	wwPDB-VP
Wilson B-factor (Å ²)	49.7	Xtrriage
Anisotropy	0.159	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 52.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.037 for h,-h-k,-l	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	19947	wwPDB-VP
Average B, all atoms (Å ²)	75.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.54% 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: EDO, PEG, CL, NA

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	0.25	0/4897	0.43	0/6590
1	B	0.25	0/4884	0.43	0/6573
All	All	0.25	0/9781	0.43	0/13163

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 [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	4815	4912	4907	12	0
1	B	4802	4897	4892	14	0
2	A	14	20	20	0	0
2	B	14	20	20	0	0
3	A	3	0	0	0	0
3	B	3	0	0	0	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
5	B	4	6	6	0	0
6	A	219	0	0	0	0
6	B	216	0	0	0	0
All	All	10092	9855	9845	26	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 1.

All (26) 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:575:LEU:HD21	1:B:577:VAL:HG22	1.78	0.66
1:A:366:THR:HG21	1:A:385:LEU:HD11	1.89	0.55
1:A:25:ILE:HD12	1:A:25:ILE:N	2.22	0.54
1:B:451:ILE:HA	1:B:454:ILE:HD12	1.92	0.51
1:B:590:GLN:CG	1:B:620:ILE:HD13	2.42	0.50
1:B:374:PHE:CE1	1:B:532:VAL:HG21	2.46	0.50
1:A:575:LEU:HD21	1:A:577:VAL:HG22	1.94	0.49
1:B:53:ILE:HD12	1:B:188:VAL:HG11	1.95	0.49
1:A:31:GLU:N	1:A:75:ASP:OD2	2.46	0.48
1:B:27:LYS:O	1:B:105:TYR:OH	2.31	0.46
1:A:259:VAL:HG21	1:A:357:ILE:CD1	2.45	0.46
1:B:247:LEU:HD22	1:B:247:LEU:N	2.30	0.46
1:B:575:LEU:C	1:B:575:LEU:HD23	2.36	0.46
1:B:44:GLU:OE2	1:B:48:LYS:NZ	2.45	0.45
1:A:1:ASP:OD1	1:A:4:THR:N	2.39	0.44
1:B:344:LYS:O	1:B:348:ALA:HB3	2.19	0.43
1:B:247:LEU:HB2	1:B:248:PRO:HD3	2.01	0.43
1:A:594:LEU:HD13	1:A:594:LEU:O	2.18	0.42
1:A:247:LEU:HB2	1:A:248:PRO:HD3	2.02	0.42
1:A:53:ILE:HD12	1:A:188:VAL:HG11	2.02	0.41
1:B:58:PHE:CZ	1:B:106:PRO:HG2	2.56	0.41
1:A:58:PHE:CZ	1:A:106:PRO:HG2	2.56	0.41
1:A:623:ASN:OD1	1:A:625:GLY:N	2.53	0.41
1:A:138:GLN:O	1:A:139:ASN:HB2	2.21	0.41
1:B:590:GLN:HG2	1:B:620:ILE:HD13	2.03	0.40
1:B:135:LYS:NZ	1:B:155:GLU:O	2.46	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	576/628 (92%)	556 (96%)	20 (4%)	0	100	100
1	B	574/628 (91%)	554 (96%)	20 (4%)	0	100	100
All	All	1150/1256 (92%)	1110 (96%)	40 (4%)	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	544/591 (92%)	540 (99%)	4 (1%)	84	94
1	B	542/591 (92%)	539 (99%)	3 (1%)	86	95
All	All	1086/1182 (92%)	1079 (99%)	7 (1%)	86	95

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

Mol	Chain	Res	Type
1	A	99	GLN
1	A	173	MET
1	A	421	GLU
1	A	580	GLU
1	B	99	GLN
1	B	173	MET
1	B	410	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 13 ligands modelled in this entry, 8 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	$\# Z > 2$
2	PEG	B	702	-	6,6,6	0.18	0	5,5,5	0.04	0
5	EDO	B	701	-	3,3,3	0.47	0	2,2,2	0.28	0
2	PEG	A	702	-	6,6,6	0.17	0	5,5,5	0.12	0
2	PEG	B	703	-	6,6,6	0.19	0	5,5,5	0.09	0
2	PEG	A	701	-	6,6,6	0.17	0	5,5,5	0.13	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	PEG	B	702	-	-	1/4/4/4	-
5	EDO	B	701	-	-	1/1/1/1	-
2	PEG	A	702	-	-	1/4/4/4	-
2	PEG	B	703	-	-	0/4/4/4	-
2	PEG	A	701	-	-	2/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	702	PEG	O2-C3-C4-O4
5	B	701	EDO	O1-C1-C2-O2
2	A	702	PEG	C4-C3-O2-C2
2	A	701	PEG	C4-C3-O2-C2
2	A	701	PEG	C1-C2-O2-C3

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	576/628 (91%)	0.88	64 (11%) 5 5	43, 62, 118, 155	0
1	B	573/628 (91%)	0.95	64 (11%) 5 4	42, 64, 115, 155	0
All	All	1149/1256 (91%)	0.92	128 (11%) 5 5	42, 62, 117, 155	0

All (128) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	336	LEU	12.5
1	A	336	LEU	11.1
1	A	275	LEU	10.5
1	B	334	ILE	10.3
1	A	283	LYS	8.3
1	B	275	LEU	7.6
1	B	282	LEU	7.1
1	A	334	ILE	6.8
1	A	282	LEU	6.6
1	A	279	LYS	6.6
1	B	343	TYR	6.6
1	A	272	LEU	6.3
1	B	339	TYR	6.3
1	B	271	ILE	6.2
1	A	281	ASN	6.1
1	B	280	ASP	6.1
1	B	337	ARG	6.0
1	B	281	ASN	5.8
1	A	339	TYR	5.6
1	B	36	THR	5.5
1	A	276	ASN	5.5
1	A	280	ASP	5.3
1	B	335	SER	5.3
1	B	346	TYR	5.2

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Mol	Chain	Res	Type	RSRZ
1	B	25	ILE	5.2
1	B	347	SER	5.2
1	B	338	ASN	5.0
1	B	279	LYS	5.0
1	A	345	LEU	4.9
1	A	343	TYR	4.9
1	B	342	LEU	4.9
1	B	276	ASN	4.8
1	A	335	SER	4.8
1	A	29	LYS	4.7
1	A	340	ARG	4.7
1	A	346	TYR	4.5
1	A	351	LEU	4.4
1	B	37	GLU	4.3
1	A	271	ILE	4.3
1	A	268	THR	4.2
1	A	273	ASN	4.2
1	B	340	ARG	4.2
1	B	344	LYS	4.1
1	B	35	ILE	4.0
1	A	337	ARG	3.9
1	A	25	ILE	3.9
1	B	32	ASN	3.8
1	B	27	LYS	3.8
1	A	338	ASN	3.8
1	A	32	ASN	3.8
1	B	272	LEU	3.7
1	B	33	ASN	3.7
1	A	117	LYS	3.7
1	A	28	LEU	3.7
1	B	264	LEU	3.7
1	B	278	GLU	3.7
1	A	347	SER	3.6
1	B	351	LEU	3.6
1	A	34	GLU	3.6
1	B	277	ILE	3.5
1	A	1	ASP	3.5
1	A	348	ALA	3.4
1	B	268	THR	3.4
1	A	278	GLU	3.4
1	A	394	ILE	3.3
1	B	492	LEU	3.3

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Mol	Chain	Res	Type	RSRZ
1	B	71	LEU	3.3
1	A	389	PRO	3.3
1	B	391	GLN	3.3
1	A	36	THR	3.3
1	A	31	GLU	3.3
1	A	277	ILE	3.2
1	A	9	LYS	3.2
1	B	352	LYS	3.2
1	B	388	ILE	3.2
1	B	394	ILE	3.2
1	A	488	LEU	3.2
1	A	71	LEU	3.1
1	B	348	ALA	3.1
1	A	2	GLU	3.1
1	A	35	ILE	3.1
1	B	28	LEU	3.0
1	B	29	LYS	3.0
1	A	350	TYR	3.0
1	B	341	ARG	3.0
1	B	20	ILE	2.9
1	B	353	LEU	2.9
1	A	360	LYS	2.8
1	B	34	GLU	2.8
1	A	33	ASN	2.7
1	B	488	LEU	2.7
1	B	269	ASN	2.7
1	A	118	LYS	2.7
1	B	345	LEU	2.7
1	B	403	ASN	2.7
1	B	355	LEU	2.6
1	A	349	PHE	2.6
1	A	355	LEU	2.6
1	A	344	LYS	2.6
1	A	493	ASP	2.5
1	A	257	ILE	2.5
1	A	492	LEU	2.5
1	A	3	ILE	2.4
1	A	269	ASN	2.4
1	A	490	MET	2.4
1	A	391	GLN	2.4
1	A	622	GLU	2.4
1	A	30	ASN	2.3

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Mol	Chain	Res	Type	RSRZ
1	B	31	GLU	2.3
1	B	397	ILE	2.3
1	B	274	GLU	2.3
1	B	350	TYR	2.3
1	B	359	THR	2.3
1	B	626	SER	2.3
1	B	26	PHE	2.2
1	B	30	ASN	2.2
1	A	388	ILE	2.2
1	B	349	PHE	2.2
1	B	490	MET	2.2
1	A	274	GLU	2.2
1	A	341	ARG	2.1
1	A	46	LYS	2.1
1	B	624	TRP	2.1
1	B	163	ALA	2.1
1	B	5	LYS	2.1
1	A	270	GLU	2.1
1	B	389	PRO	2.1
1	A	163	ALA	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
2	PEG	B	703	7/7	0.78	0.20	56,67,72,76	0
2	PEG	B	702	7/7	0.84	0.23	59,71,74,80	0
4	NA	B	707	1/1	0.84	0.26	56,56,56,56	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
2	PEG	A	702	7/7	0.86	0.18	58,70,74,76	0
5	EDO	B	701	4/4	0.89	0.20	53,63,67,70	0
3	CL	B	706	1/1	0.93	0.18	64,64,64,64	0
2	PEG	A	701	7/7	0.94	0.13	58,70,72,73	0
4	NA	A	706	1/1	0.94	0.12	58,58,58,58	0
3	CL	A	705	1/1	0.95	0.20	63,63,63,63	0
3	CL	B	705	1/1	0.96	0.10	57,57,57,57	0
3	CL	A	704	1/1	0.97	0.15	59,59,59,59	0
3	CL	B	704	1/1	0.99	0.14	49,49,49,49	0
3	CL	A	703	1/1	0.99	0.19	52,52,52,52	0

6.5 Other polymers [i](#)

There are no such residues in this entry.