WORLDWIDE wwPDB PROTEIN DATA BANK

Full wwPDB X-ray Structure Validation Report ⓘ

Feb 12, 2017 – 09:43 pm GMT

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PDB ID	:	1BM1
Title	:	CRYSTAL STRUCTURE OF BACTERIORHODOPSIN IN THE LIGHT-ADAPTED STATE
Authors	:	Sato, H.; Takeda, K.; Tani, K.; Hino, T.; Okada, T.; Nakasako, M.; Kamiya, N.; Kouyama, T.
Deposited on	:	1998-07-28
Resolution	:	3.50 Å(reported)

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 3.50 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	Percentile Ranks	Value
Clashscore		27
Ramachandran outliers		3.7%
Sidechain outliers		3.9%

Worse   *Better*

■ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution
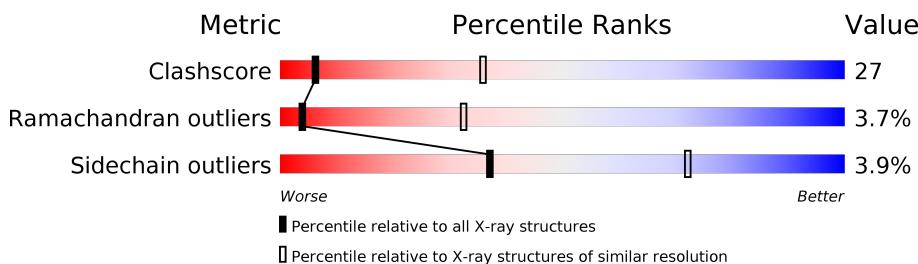
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	112137	1322 (3.60-3.40)
Ramachandran outliers	110173	1283 (3.60-3.40)
Sidechain outliers	110143	1284 (3.60-3.40)

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 on the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria. 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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	248	48% 38% • 11%
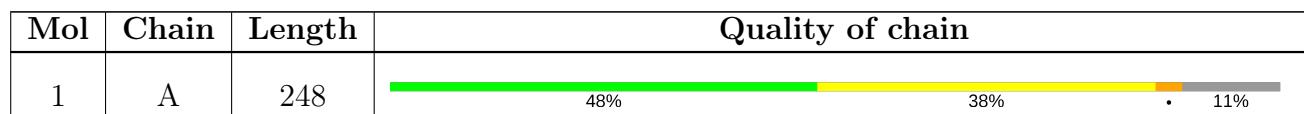
The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

| Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	RET	A	250	-	-	X	-

2 Entry composition ⓘ

There are 3 unique types of molecules in this entry. The entry contains 1787 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 BACTERIORHODOPSIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	221	Total	C	N	O	S	0	0	0
			1717	1154	262	292	9			

- Molecule 2 is RETINAL (three-letter code: RET) (formula: $C_{20}H_{28}O$).
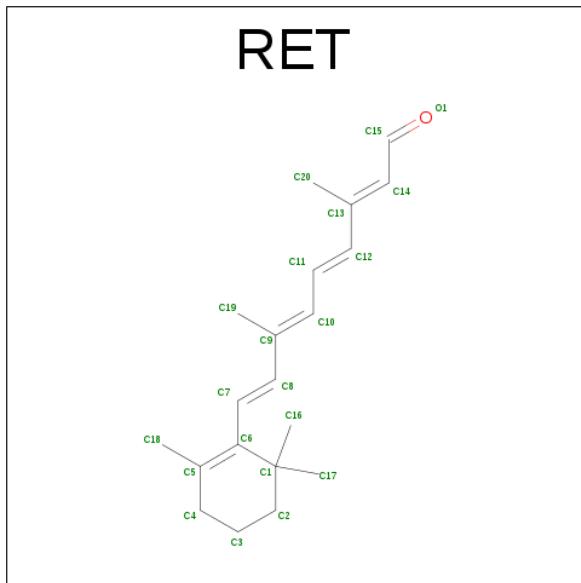
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	C	0	0
			20	20		

- Molecule 3 is PHOSPHORIC ACID 2,3-BIS-(3,7,11,15-TETRAMETHYL-HEXADEC YLOXY)-PROPYL ESTER 2-HYDROXO-3-PHOSPHONOOXY-PROPYL ESTER (three-letter code: DPG) (formula: $C_{46}H_{96}O_{11}P_2$).

DPG
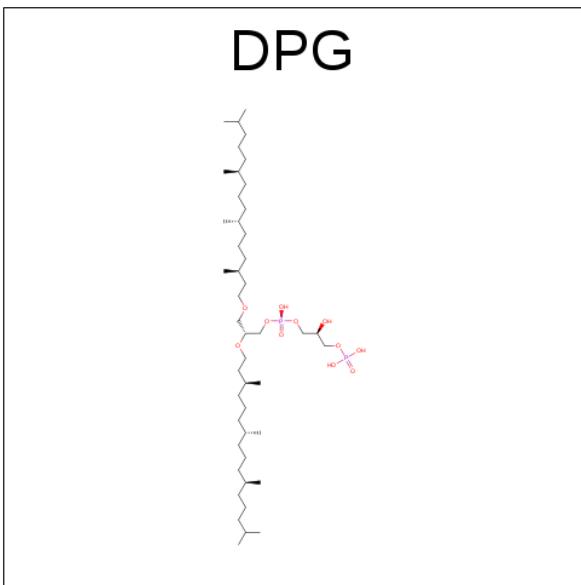
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	O	P	0	0
			50	37	11	2		

3 Residue-property plots (i)

These plots are drawn for all protein, RNA and DNA 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.

Note EDS was not executed.

• Molecule 1: BACTERIORHODOPSIN

4 Data and refinement statistics (i)

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 6 2 2	Depositor
Cell constants a, b, c, α, β, γ	104.70Å 104.70Å 114.10Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	8.00 – 3.50	Depositor
% Data completeness (in resolution range)	72.1 (8.00-3.50)	Depositor
R_{merge}	0.10	Depositor
R_{sym}	0.10	Depositor
Refinement program	X-PLOR 3.851	Depositor
R, R_{free}	0.260 , 0.311	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1787	wwPDB-VP
Average B, all atoms (Å^2)	22.0	wwPDB-VP

5   Model quality ⓘ

5.1   Standard geometry ⓘ

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

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	0.39	0/1764	0.62	0/2410

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

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	164	ARG	Sidechain

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	1717	0	1775	95	0
2	A	20	0	27	12	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	50	0	72	5	0
All	All	1787	0	1874	99	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 27.

All (99) 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)
2:A:250:RET:H161	2:A:250:RET:H8	1.20	1.12
2:A:250:RET:H161	2:A:250:RET:C8	1.96	0.93
1:A:47:THR:HB	3:A:269:DPG:H472	1.61	0.81
1:A:118:MET:HE3	1:A:145:MET:HB2	1.65	0.78
1:A:118:MET:HE2	2:A:250:RET:H7	1.65	0.78
1:A:44:ALA:HA	3:A:269:DPG:H461	1.68	0.76
1:A:35:SER:HA	3:A:269:DPG:O5	1.89	0.72
1:A:71:PHE:HB3	1:A:76:ASN:ND2	2.07	0.69
1:A:66:LEU:HD13	1:A:79:TYR:CE1	2.28	0.69
1:A:138:TRP:HD1	1:A:189:TRP:CE3	2.12	0.67
1:A:128:THR:CG2	1:A:134:ARG:HG2	2.25	0.66
1:A:184:ALA:O	1:A:188:VAL:HG23	1.96	0.66
1:A:8:PRO:O	1:A:11:ILE:HG22	1.96	0.65
1:A:78:ILE:HG21	1:A:127:LEU:HD21	1.79	0.65
1:A:220:GLY:O	1:A:224:LEU:HB2	1.97	0.65
1:A:91:PRO:HB3	1:A:112:VAL:HG23	1.79	0.63
1:A:100:LEU:HD22	1:A:101:VAL:HG23	1.81	0.63
1:A:49:VAL:HG22	1:A:50:PRO:HD3	1.80	0.62
2:A:250:RET:C8	2:A:250:RET:C16	2.71	0.61
1:A:216:LYS:HG3	2:A:250:RET:C15	2.31	0.61
1:A:29:VAL:O	1:A:32:MET:HG2	2.01	0.59
1:A:65:GLY:HA2	1:A:80:TRP:CZ2	2.38	0.58
1:A:172:LYS:O	1:A:175:ARG:HG3	2.03	0.58
1:A:13:LEU:HD22	1:A:60:MET:HG2	1.85	0.58
1:A:118:MET:CE	2:A:250:RET:H192	2.34	0.57
1:A:49:VAL:CG2	1:A:50:PRO:HD3	2.33	0.57
1:A:225:ARG:HG3	1:A:225:ARG:HH11	1.69	0.57
1:A:46:THR:HG21	1:A:224:LEU:HD13	1.87	0.57
1:A:77:PRO:HG3	1:A:201:LEU:HD22	1.86	0.57
1:A:128:THR:HG22	1:A:134:ARG:HG2	1.85	0.57
1:A:86:TRP:CZ3	2:A:250:RET:H162	2.40	0.56
1:A:53:ALA:HA	1:A:85:ASP:OD2	2.04	0.56

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:60:MET:CE	1:A:81:ALA:HB3	2.36	0.56
1:A:191:ILE:HG22	1:A:199:VAL:HB	1.88	0.55
1:A:134:ARG:NH1	1:A:194:GLU:HA	2.21	0.55
1:A:100:LEU:HD21	1:A:167:VAL:HG13	1.88	0.54
1:A:111:LEU:HD11	1:A:156:PHE:CZ	2.42	0.54
1:A:34:VAL:HG11	1:A:43:TYR:CD2	2.42	0.53
1:A:89:THR:HG21	2:A:250:RET:C15	2.39	0.53
1:A:31:GLY:O	1:A:34:VAL:HG22	2.09	0.53
1:A:142:THR:O	1:A:146:LEU:HG	2.10	0.53
1:A:100:LEU:CD2	1:A:167:VAL:HG13	2.39	0.52
1:A:65:GLY:HA2	1:A:80:TRP:CE2	2.45	0.52
1:A:131:TYR:C	1:A:133:TYR:H	2.12	0.52
1:A:42:PHE:CE1	1:A:99:LEU:HB3	2.44	0.52
1:A:128:THR:HG21	1:A:134:ARG:HG2	1.91	0.52
1:A:215:ALA:O	1:A:219:PHE:HB2	2.11	0.51
1:A:17:THR:OG1	1:A:57:TYR:HB3	2.11	0.51
1:A:115:ASP:O	1:A:118:MET:HB3	2.10	0.51
1:A:78:ILE:HG21	1:A:127:LEU:CD2	2.39	0.50
1:A:49:VAL:HG12	1:A:92:LEU:HD12	1.93	0.50
1:A:225:ARG:HG3	1:A:225:ARG:NH1	2.26	0.50
2:A:250:RET:C16	2:A:250:RET:H8	2.04	0.50
1:A:60:MET:CE	1:A:82:ARG:HG3	2.42	0.50
1:A:138:TRP:CD1	1:A:189:TRP:CE3	2.97	0.49
1:A:70:PRO:C	1:A:130:VAL:HG12	2.33	0.49
1:A:71:PHE:HB3	1:A:76:ASN:HD22	1.75	0.49
1:A:53:ALA:HB2	1:A:216:LYS:HE3	1.96	0.48
1:A:107:THR:HG21	1:A:156:PHE:HE1	1.79	0.48
1:A:24:THR:O	1:A:28:LEU:HB2	2.14	0.47
1:A:90:THR:HG22	1:A:115:ASP:OD2	2.14	0.47
1:A:71:PHE:HD1	1:A:130:VAL:O	1.97	0.47
1:A:123:LEU:HD23	1:A:123:LEU:O	2.15	0.47
1:A:194:GLU:CD	1:A:194:GLU:H	2.19	0.47
1:A:111:LEU:HD11	1:A:156:PHE:HZ	1.81	0.46
1:A:60:MET:HE1	1:A:81:ALA:HB3	1.97	0.46
1:A:44:ALA:HA	3:A:269:DPG:C46	2.43	0.46
1:A:104:ASP:N	1:A:104:ASP:OD1	2.49	0.46
1:A:208:PHE:O	1:A:212:ASP:HB2	2.16	0.45
1:A:86:TRP:CD1	2:A:250:RET:H12	2.51	0.45
1:A:60:MET:HE3	1:A:81:ALA:HB3	1.98	0.45
1:A:175:ARG:C	1:A:175:ARG:HD2	2.37	0.44
1:A:40:LYS:HE2	3:A:269:DPG:H31	1.98	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:101:VAL:O	1:A:101:VAL:HG12	2.16	0.44
1:A:163:MET:HG3	1:A:167:VAL:HG11	1.99	0.43
1:A:170:THR:O	1:A:174:LEU:HG	2.18	0.43
1:A:118:MET:HE2	2:A:250:RET:H192	2.00	0.43
1:A:188:VAL:HB	1:A:208:PHE:CE1	2.55	0.42
1:A:123:LEU:HD21	1:A:127:LEU:HD12	2.00	0.42
1:A:156:PHE:HB2	1:A:171:PHE:CZ	2.54	0.42
1:A:77:PRO:CG	1:A:201:LEU:HD22	2.50	0.42
1:A:208:PHE:HA	1:A:208:PHE:HD1	1.73	0.42
1:A:45:ILE:HG21	1:A:92:LEU:O	2.19	0.42
1:A:121:THR:HG21	1:A:140:ILE:HG22	2.02	0.42
1:A:34:VAL:HG11	1:A:43:TYR:CE2	2.54	0.42
1:A:49:VAL:HG21	1:A:93:LEU:HD21	2.01	0.42
1:A:88:PHE:O	1:A:91:PRO:HD2	2.20	0.42
1:A:223:LEU:C	1:A:223:LEU:HD23	2.41	0.41
1:A:90:THR:HB	1:A:91:PRO:HD3	2.02	0.41
1:A:118:MET:HE2	2:A:250:RET:C7	2.41	0.41
1:A:123:LEU:C	1:A:123:LEU:HD23	2.40	0.41
1:A:169:SER:O	1:A:172:LYS:HB3	2.20	0.41
1:A:47:THR:C	1:A:50:PRO:HD2	2.41	0.41
1:A:60:MET:HE2	1:A:79:TYR:HB3	2.03	0.41
1:A:97:LEU:HD21	1:A:174:LEU:HB3	2.03	0.41
1:A:98:ALA:HB1	1:A:108:ILE:HG12	2.01	0.41
1:A:145:MET:O	1:A:149:LEU:HG	2.20	0.41
1:A:60:MET:HE2	1:A:82:ARG:HG3	2.01	0.41
1:A:88:PHE:O	1:A:92:LEU:HG	2.21	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	219/248 (88%)	192 (88%)	19 (9%)	8 (4%)	4	32

All (8) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	129	LYS
1	A	153	PHE
1	A	193	SER
1	A	102	ASP
1	A	130	VAL
1	A	226	SER
1	A	71	PHE
1	A	34	VAL

5.3.2 Protein sidechains ⓘ

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	179/193 (93%)	172 (96%)	7 (4%)	37	72

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

Mol	Chain	Res	Type
1	A	75	GLN
1	A	104	ASP
1	A	128	THR
1	A	175	ARG
1	A	208	PHE
1	A	212	ASP
1	A	227	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	75	GLN

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Mol	Chain	Res	Type
1	A	76	ASN
1	A	202	ASN

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 carbohydrates in this entry.

5.6   Ligand geometry ⓘ

2 ligands are modelled in this entry.

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	RET	A	250	1	19,20,21	0.99	2 (10%)	27,27,28	0.81	0
3	DPG	A	269	-	49,49,58	1.31	7 (14%)	53,62,73	1.03	2 (3%)

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	RET	A	250	1	-	0/13/30/31	0/1/1/1
3	DPG	A	269	-	-	0/57/57/67	0/0/0/0

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	250	RET	C2-C3	-2.76	1.45	1.52
2	A	250	RET	C15-C14	-2.44	1.39	1.49
3	A	269	DPG	P1-O3	2.07	1.68	1.59
3	A	269	DPG	O6-C4	2.07	1.53	1.44
3	A	269	DPG	C12-C11	2.18	1.58	1.50
3	A	269	DPG	C42-C41	2.32	1.59	1.50
3	A	269	DPG	P2-O8	2.39	1.67	1.60
3	A	269	DPG	O2-C2	2.43	1.49	1.43
3	A	269	DPG	C4-C5	2.75	1.61	1.51

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	269	DPG	C46-C47-C48	2.30	123.29	115.73
3	A	269	DPG	C41-O2-C2	3.16	122.78	115.38

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 17 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	250	RET	12	0
3	A	269	DPG	5	0

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 ⓘ

6.1 Protein, DNA and RNA chains ⓘ

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

6.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

6.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.