wwPDB X-ray Structure Validation Summary Report (i)

Mar 18, 2024 – 11:44 AM JST

PDB ID	:	5YKA
Title	:	Crystal structure of the Kdo hydroxylase KdoO, a non-heme Fe(II) alphaketoglutarate dependent dioxygenase in complex with cobalt(II)
Authors	:	Chung, H.S.; Pemble, C.W.; Joo, S.H.; Raetz, C.R.
Deposited on	:	2017-10-12
Resolution	:	1.45 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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:

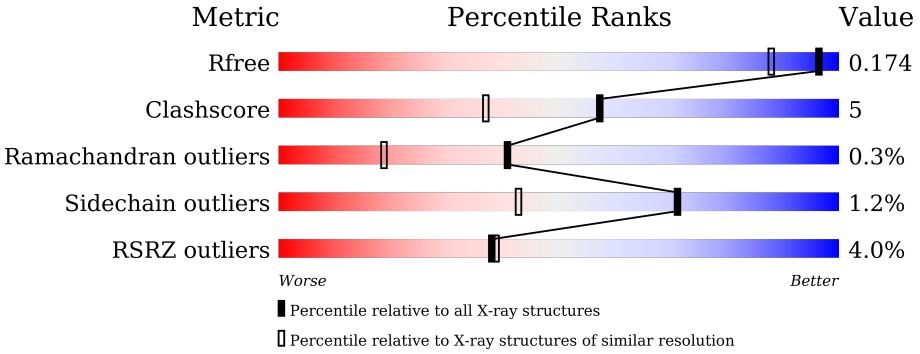
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, 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 1.45 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	2021 (1.46-1.42)
Clashscore	141614	2086 (1.46-1.42)
Ramachandran outliers	138981	2047 (1.46-1.42)
Sidechain outliers	138945	2047 (1.46-1.42)
RSRZ outliers	127900	1993 (1.46-1.42)

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	318	

2 Entry composition (i)

There are 8 unique types of molecules in this entry. The entry contains 2801 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 Uncharacterized protein KdoO.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	297	2418	1576	402	439	1	2	8	0

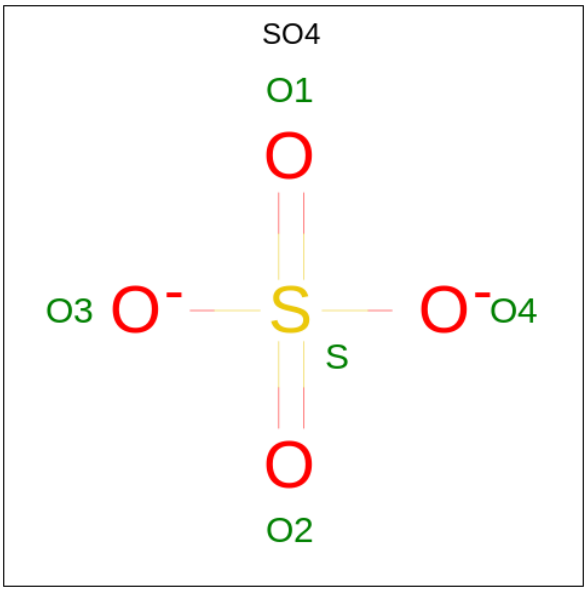
There are 13 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	306	LYS	-	expression tag	UNP B3DUR4
A	307	LEU	-	expression tag	UNP B3DUR4
A	308	ALA	-	expression tag	UNP B3DUR4
A	309	ALA	-	expression tag	UNP B3DUR4
A	310	ALA	-	expression tag	UNP B3DUR4
A	311	LEU	-	expression tag	UNP B3DUR4
A	312	GLU	-	expression tag	UNP B3DUR4
A	313	HIS	-	expression tag	UNP B3DUR4
A	314	HIS	-	expression tag	UNP B3DUR4
A	315	HIS	-	expression tag	UNP B3DUR4
A	316	HIS	-	expression tag	UNP B3DUR4
A	317	HIS	-	expression tag	UNP B3DUR4
A	318	HIS	-	expression tag	UNP B3DUR4

- Molecule 2 is COBALT (II) ION (three-letter code: CO) (formula: Co).

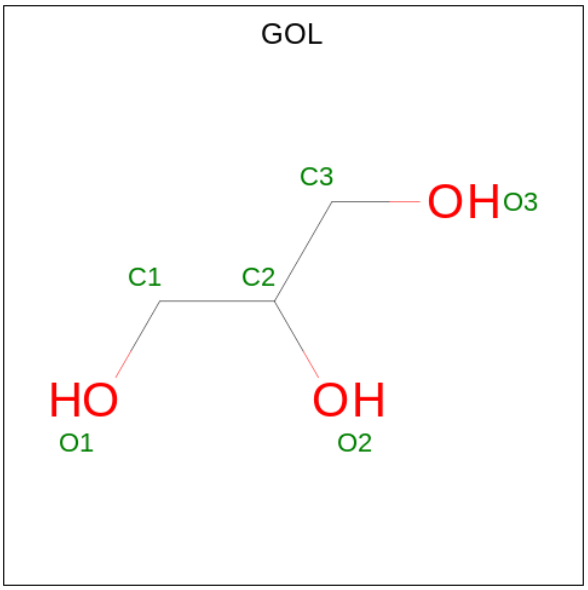
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Co		
2	A	1	1	1	0	0

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



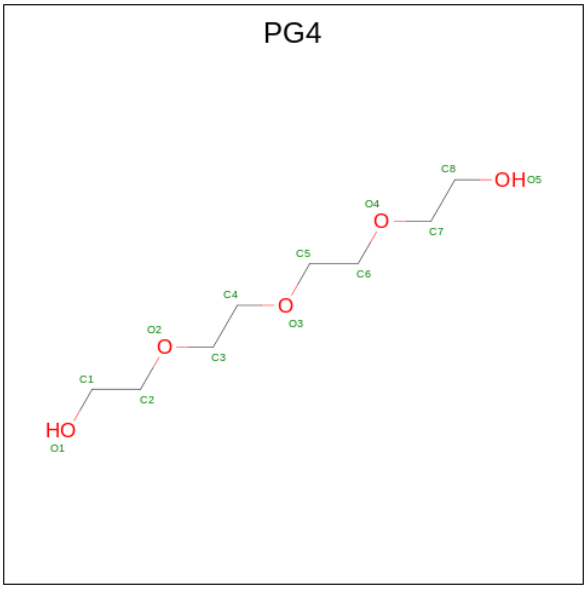
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total O S 5 4 1	0	0
3	A	1	Total O S 5 4 1	0	0
3	A	1	Total O S 5 4 1	0	0
3	A	1	Total O S 5 4 1	0	0

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



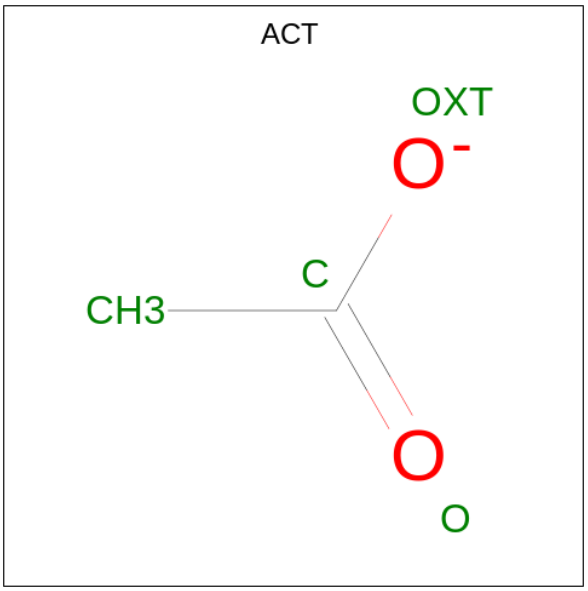
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
4	A	1	6	3	3	0	0

- Molecule 5 is TETRAETHYLENE GLYCOL (three-letter code: PG4) (formula: $C_8H_{18}O_5$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
5	A	1	7	4	3	0	0
			Total	C	O		
5	A	1	11	6	5	0	0
			Total	C	O		
5	A	1	20	12	8	0	1
			Total	C	O		
5	A	1	4	2	2	0	0
			Total	C	O		
5	A	1	4	2	2	0	0
			Total	C	O		
5	A	1	7	4	3	0	0
			Total	C	O		
5	A	1	7	4	3	0	0
			Total	C	O		
5	A	1	4	2	2	0	0

- Molecule 6 is ACETATE ION (three-letter code: ACT) (formula: $C_2H_3O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
6	A	1	4	2	2	0	0
			Total	C	O		
6	A	1	4	2	2	0	0
			Total	C	O		
6	A	1	4	2	2	0	0
			Total	C	O		
6	A	1	4	2	2	0	0

- Molecule 7 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Cl		
7	A	2	2	2	0	0

- Molecule 8 is water.

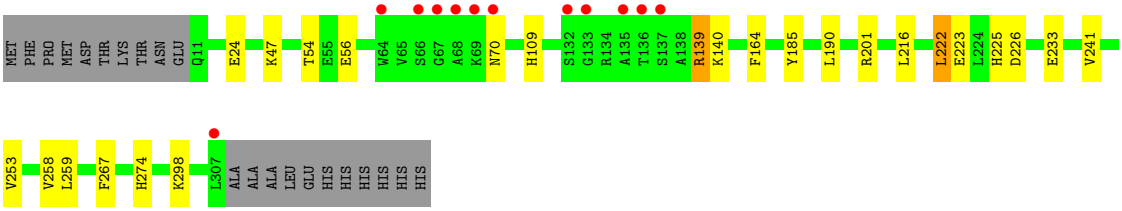
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
8	A	274	274	274	0	0

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: Uncharacterized protein KdoO

Chain A:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	45.80Å 59.61Å 116.44Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	23.64 – 1.45 42.62 – 1.45	Depositor EDS
% Data completeness (in resolution range)	99.5 (23.64-1.45) 95.0 (42.62-1.45)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.56 (at 1.45Å)	Xtriage
Refinement program	PHENIX 1.10.1_2155	Depositor
R, R_{free}	0.157 , 0.179 0.160 , 0.174	Depositor DCC
R_{free} test set	2866 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å^2)	14.2	Xtriage
Anisotropy	0.512	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.39 , 53.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	2801	wwPDB-VP
Average B, all atoms (Å^2)	23.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.27% 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: CL, CO, SO4, ACT, PG4, GOL

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	0.99	6/2507 (0.2%)	0.78	1/3395 (0.0%)

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	222[A]	LEU	C-O	-5.82	1.12	1.23
1	A	222[B]	LEU	C-O	-5.82	1.12	1.23
1	A	54[A]	THR	N-CA	5.80	1.57	1.46
1	A	54[B]	THR	N-CA	5.80	1.57	1.46
1	A	56	GLU	CD-OE2	-5.28	1.19	1.25

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	253	VAL	CB-CA-C	-6.24	99.55	111.40

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	2418	0	2453	22	0
2	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	20	0	0	1	0
4	A	6	0	8	1	0
5	A	64	0	78	9	0
6	A	16	0	12	2	0
7	A	2	0	0	0	0
8	A	274	0	0	10	0
All	All	2801	0	2551	25	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.

The worst 5 of 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:70:ASN:HB2	8:A:502:HOH:O	1.43	1.14
1:A:233:GLU:HG2	8:A:515:HOH:O	1.72	0.89
1:A:201:ARG:HH12	5:A:411:PG4:H12	1.46	0.80
1:A:216:LEU:HG	5:A:411:PG4:H11	1.67	0.77
6:A:417:ACT:OXT	8:A:501:HOH:O	2.02	0.77

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	303/318 (95%)	299 (99%)	3 (1%)	1 (0%)	41 19

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	267	PHE

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	268/279 (96%)	265 (99%)	3 (1%)	73 47

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	24	GLU
1	A	139	ARG
1	A	190	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	225	HIS

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 21 ligands modelled in this entry, 3 are monoatomic - leaving 18 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	PG4	A	409[A]	-	9,9,12	1.00	0	8,8,11	1.86	3 (37%)
5	PG4	A	413	-	6,6,12	0.98	0	5,5,11	1.51	1 (20%)
6	ACT	A	415	-	3,3,3	1.81	1 (33%)	3,3,3	0.23	0
3	SO4	A	404	-	4,4,4	0.14	0	6,6,6	0.04	0
5	PG4	A	409[B]	-	9,9,12	1.00	0	8,8,11	1.97	3 (37%)
5	PG4	A	410	-	3,3,12	0.86	0	2,2,11	0.85	0
6	ACT	A	416	-	3,3,3	1.14	0	3,3,3	0.41	0
3	SO4	A	403	-	4,4,4	0.14	0	6,6,6	0.18	0
5	PG4	A	407	-	6,6,12	1.16	0	5,5,11	1.79	1 (20%)
5	PG4	A	412	-	6,6,12	0.62	0	5,5,11	1.88	2 (40%)
4	GOL	A	406	-	5,5,5	0.44	0	5,5,5	0.51	0
5	PG4	A	408	-	9,9,12	1.14	0	7,7,11	1.65	1 (14%)
5	PG4	A	411	-	3,3,12	1.29	1 (33%)	2,2,11	1.40	0
6	ACT	A	417	-	3,3,3	1.09	0	3,3,3	0.38	0
5	PG4	A	414	-	3,3,12	0.83	0	2,2,11	0.85	0
3	SO4	A	402	-	4,4,4	0.12	0	6,6,6	0.12	0
6	ACT	A	418	-	3,3,3	1.05	0	3,3,3	0.57	0
3	SO4	A	405	-	4,4,4	0.13	0	6,6,6	1.15	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
5	PG4	A	409[A]	-	-	5/7/7/10	-
5	PG4	A	413	-	-	0/4/4/10	-
5	PG4	A	409[B]	-	-	5/7/7/10	-
5	PG4	A	410	-	-	0/1/1/10	-
5	PG4	A	407	-	-	2/4/4/10	-
5	PG4	A	412	-	-	3/4/4/10	-
4	GOL	A	406	-	-	0/4/4/4	-
5	PG4	A	408	-	-	4/5/5/10	-
5	PG4	A	411	-	-	1/1/1/10	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	PG4	A	414	-	-	0/1/1/10	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	415	ACT	O-C	-2.48	1.11	1.22
5	A	411	PG4	O2-C2	-2.10	1.31	1.42

The worst 5 of 11 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	A	408	PG4	O2-C3-C4	3.52	125.54	110.07
5	A	409[B]	PG4	O4-C7-C8	3.18	124.05	110.07
5	A	407	PG4	O2-C2-C1	2.95	123.02	110.07
5	A	412	PG4	O3-C4-C3	2.58	121.42	110.07
5	A	409[B]	PG4	O3-C4-C3	2.43	120.75	110.07

There are no chirality outliers.

5 of 20 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	409[B]	PG4	C3-C4-O3-C5
5	A	409[A]	PG4	C3-C4-O3-C5
5	A	408	PG4	O1-C1-C2-O2
5	A	409[B]	PG4	O4-C7-C8-O5
5	A	412	PG4	O3-C5-C6-O4

There are no ring outliers.

8 monomers are involved in 13 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	409[A]	PG4	1	0
6	A	415	ACT	1	0
5	A	409[B]	PG4	1	0
4	A	406	GOL	1	0
5	A	408	PG4	3	0
5	A	411	PG4	4	0
6	A	417	ACT	1	0
3	A	405	SO4	1	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	297/318 (93%)	-0.29	12 (4%) 38 39	10, 18, 40, 74	9 (3%)

The worst 5 of 12 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	68	ALA	5.5
1	A	136	THR	4.6
1	A	133	GLY	3.9
1	A	69	LYS	3.5
1	A	67	GLY	3.4

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	PG4	A	412	7/13	0.63	0.15	55,56,58,61	0
5	PG4	A	414	4/13	0.70	0.12	58,59,60,64	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
5	PG4	A	409[A]	10/13	0.72	0.19	43,51,55,57	10
5	PG4	A	409[B]	10/13	0.72	0.19	43,51,56,57	10
3	SO4	A	405	5/5	0.73	0.20	88,93,94,94	0
5	PG4	A	413	7/13	0.78	0.12	54,54,58,61	0
3	SO4	A	404	5/5	0.79	0.19	127,127,127,129	0
6	ACT	A	418	4/4	0.79	0.16	64,64,64,65	0
5	PG4	A	407	7/13	0.82	0.18	56,58,66,68	0
5	PG4	A	408	11/13	0.82	0.13	42,48,68,73	0
6	ACT	A	417	4/4	0.90	0.11	46,48,52,52	0
3	SO4	A	403	5/5	0.92	0.14	39,39,48,52	5
6	ACT	A	416	4/4	0.92	0.10	23,39,43,52	0
5	PG4	A	410	4/13	0.93	0.13	21,37,47,54	0
4	GOL	A	406	6/6	0.94	0.13	14,20,22,27	0
5	PG4	A	411	4/13	0.95	0.12	19,34,39,49	0
7	CL	A	419	1/1	0.96	0.06	24,24,24,24	1
3	SO4	A	402	5/5	0.97	0.09	22,22,24,30	5
6	ACT	A	415	4/4	0.98	0.12	14,25,31,34	1
7	CL	A	420	1/1	0.98	0.04	23,23,23,23	1
2	CO	A	401	1/1	1.00	0.06	13,13,13,13	0

6.5 Other polymers (i)

There are no such residues in this entry.