



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 12, 2017 – 03:19 PM EDT

PDB ID : 2PSS
Title : The structure of Plasmodium falciparum spermidine synthase in its apo-form
Authors : Dufe, V.T.; Qiu, W.; Muller, I.B.; Hui, R.; Walter, R.D.; Al-Karadaghi, S.;
Structural Genomics Consortium (SGC)
Deposited on : unknown
Resolution : 2.20 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20030345
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20030345

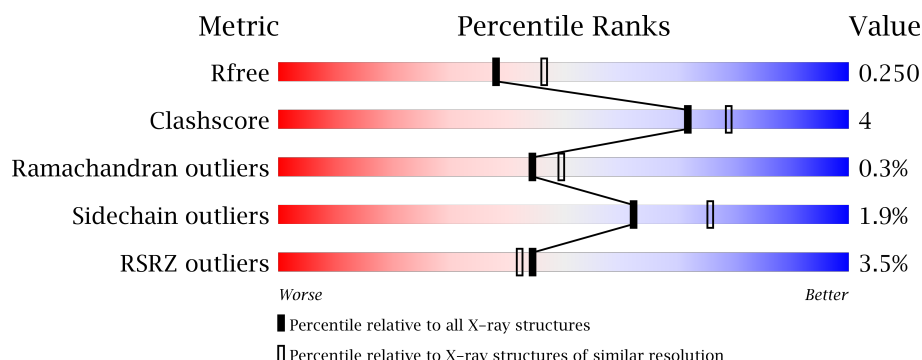
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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}	100719	4002 (2.20-2.20)
Clashscore	112137	4730 (2.20-2.20)
Ramachandran outliers	110173	4656 (2.20-2.20)
Sidechain outliers	110143	4657 (2.20-2.20)
RSRZ outliers	101464	4033 (2.20-2.20)

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 $\leq 5\%$. 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	321	<div> <div>3%</div> <div>74% 9% 16%</div> </div>
1	B	321	<div> <div>4%</div> <div>74% 9% 17%</div> </div>
1	C	321	<div> <div>2%</div> <div>74% 9% 16%</div> </div>

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	1PG	B	702	-	-	-	X
3	GOL	B	601	-	-	-	X

2 Entry composition [i](#)

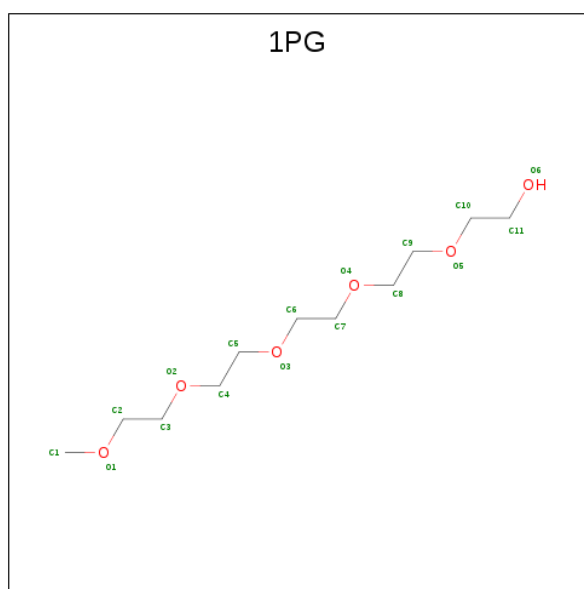
There are 5 unique types of molecules in this entry. The entry contains 6748 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Spermidine synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	269	Total	C	N	O	S	0	1	0
			2166	1407	338	406	15			
1	B	268	Total	C	N	O	S	3	1	0
			2159	1403	337	404	15			
1	C	269	Total	C	N	O	S	0	0	0
			2163	1405	338	406	14			

- Molecule 2 is 2-(2-{2-[2-(2-METHOXY-ETHOXY)-ETHOXY]-ETHOXY}-ETHOXY)-ETHANOL (three-letter code: 1PG) (formula: C₁₁H₂₄O₆).



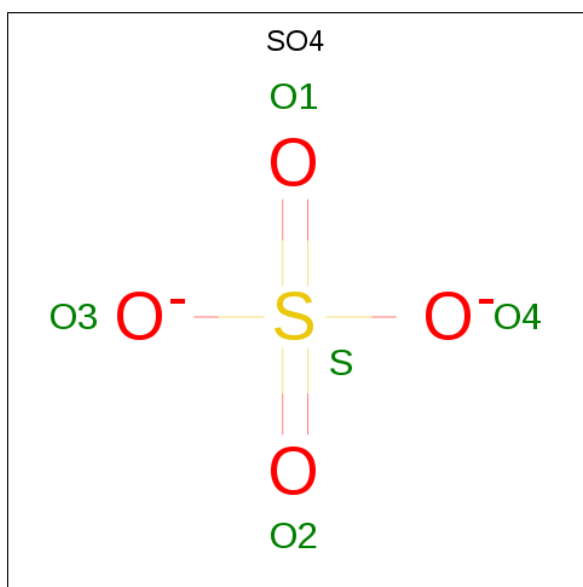
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			17	11	6		
2	B	1	Total	C	O	0	0
			17	11	6		

- Molecule 3 is GLYCEROL (three-letter code: GOL) (formula: C₃H₈O₃).



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

- Molecule 4 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



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

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	59	Total 59	O 59	0	0
5	B	71	Total 71	O 71	0	0
5	C	73	Total 73	O 73	0	0

- Molecule 1: Spermidine synthase



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	195.63 Å 134.18 Å 48.42 Å 90.00° 94.07° 90.00°	Depositor
Resolution (Å)	19.75 – 2.20 19.75 – 2.20	Depositor EDS
% Data completeness (in resolution range)	94.3 (19.75-2.20) 97.4 (19.75-2.20)	Depositor EDS
R_{merge}	0.78	Depositor
R_{sym}	0.14	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.13 (at 2.19 Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.205 , 0.247 0.209 , 0.250	Depositor DCC
R_{free} test set	3068 reflections (5.26%)	DCC
Wilson B-factor (Å ²)	33.3	Xtriage
Anisotropy	0.134	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 46.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	6748	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.40% 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: GOL, 1PG, SO4

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	0.58	0/2215	0.62	0/2986
1	B	0.65	1/2208 (0.0%)	0.66	0/2977
1	C	0.68	0/2209	0.67	0/2978
All	All	0.64	1/6632 (0.0%)	0.65	0/8941

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	70	LYS	CG-CD	-9.70	1.19	1.52

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	2166	0	2185	17	0
1	B	2159	0	2178	15	0
1	C	2163	0	2180	21	0
2	A	17	0	24	0	0
2	B	17	0	24	2	0
3	A	6	0	8	0	0
3	B	6	0	8	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	6	0	8	0	0
4	B	5	0	0	0	0
5	A	59	0	0	2	0
5	B	71	0	0	0	0
5	C	73	0	0	1	0
All	All	6748	0	6615	52	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 4.

All (52) 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:C:211:ASN:HD21	1:C:215:LYS:NZ	1.81	0.78
1:C:127:ASP:HA	1:C:156:SER:OG	1.84	0.77
1:C:297:LYS:HD3	5:C:603:HOH:O	1.83	0.76
1:C:244:ILE:HG22	1:C:248:LYS:HD2	1.72	0.69
1:C:61:LYS:HB3	1:C:78:GLU:HG2	1.75	0.69
1:C:88:LEU:HD12	1:C:93:GLN:HG3	1.74	0.69
1:C:41:LYS:HB2	1:C:59:LYS:HE2	1.81	0.61
1:C:88:LEU:HD12	1:C:93:GLN:CG	2.30	0.61
1:A:88:LEU:HD12	1:A:93:GLN:HG3	1.82	0.61
1:A:50:MET:O	1:A:236:HIS:NE2	2.35	0.59
1:A:302:GLU:HG3	5:A:710:HOH:O	2.03	0.57
1:A:284:PRO:HG2	1:A:301:TYR:CE1	2.40	0.57
1:C:88:LEU:CD1	1:C:93:GLN:HG3	2.37	0.55
1:C:211:ASN:HD21	1:C:215:LYS:HZ2	1.55	0.54
1:C:284:PRO:HG3	1:C:304:HIS:ND1	2.24	0.52
1:B:42:LYS:HG3	1:B:43:TRP:H	1.74	0.52
1:A:82:TYR:CD2	1:A:97:LYS:HD3	2.44	0.52
1:A:197:SER:O	1:A:198:SER:HB2	2.10	0.51
1:C:131:ILE:HG22	1:C:166:GLY:HA3	1.92	0.50
1:C:269:ILE:HG13	1:C:270:GLY:N	2.26	0.50
1:C:237:VAL:HG11	1:C:317:GLU:HG3	1.92	0.50
1:A:88:LEU:CD1	1:A:93:GLN:HG3	2.40	0.50
1:B:48:SER:HB3	1:B:51:TRP:CE2	2.47	0.50
1:B:42:LYS:HE2	1:B:42:LYS:HA	1.93	0.48
1:A:107:THR:O	1:A:110:PRO:HD2	2.14	0.48
1:A:309:LYS:HE2	5:A:754:HOH:O	2.13	0.48
1:B:221:LYS:O	1:B:276:LYS:HD2	2.14	0.47
1:C:50:MET:O	1:C:236:HIS:NE2	2.47	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:251:PHE:CG	1:A:274:CYS:HB3	2.50	0.47
1:B:241:LYS:HD2	1:B:317:GLU:HB3	1.98	0.46
1:B:47:PHE:HZ	2:B:702:1PG:H112	1.81	0.46
1:B:282:THR:HG22	1:B:308:PHE:CG	2.51	0.45
1:A:82:TYR:CE2	1:A:97:LYS:HD3	2.51	0.45
1:A:221:LYS:HB3	1:A:222:PRO:HD2	1.99	0.45
1:B:47:PHE:CZ	2:B:702:1PG:H112	2.52	0.45
1:B:41:LYS:HD2	1:B:59:LYS:HE2	1.98	0.44
1:B:98:ASP:OD2	1:B:263:THR:OG1	2.24	0.44
1:A:197:SER:O	1:A:198:SER:CB	2.66	0.43
1:B:212:PHE:CE2	1:B:216:ILE:HD11	2.53	0.43
1:B:85:VAL:HG22	1:B:95:THR:HG22	2.01	0.43
1:C:244:ILE:CG2	1:C:248:LYS:HD2	2.46	0.43
1:C:85:VAL:HG13	1:C:95:THR:HG22	2.00	0.43
1:A:241:LYS:HG2	1:A:321:ILE:HD11	2.00	0.42
1:A:243:MET:HB3	1:A:272:LEU:HD22	2.02	0.42
1:B:271:ILE:HD13	1:B:271:ILE:HG21	1.86	0.42
1:B:234:TRP:CE2	1:C:262:PRO:HD3	2.55	0.41
1:C:211:ASN:ND2	1:C:215:LYS:NZ	2.59	0.41
1:C:193:ILE:O	1:C:226:CYS:HA	2.20	0.41
1:A:273:CYS:HB3	1:A:281:LEU:HD12	2.03	0.41
1:A:98:ASP:OD2	1:A:262:PRO:HG2	2.21	0.40
1:C:231:GLU:HG3	1:C:239:THR:HB	2.04	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	266/321 (83%)	254 (96%)	12 (4%)	0	100	100
1	B	265/321 (83%)	257 (97%)	8 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	265/321 (83%)	255 (96%)	8 (3%)	2 (1%)	22	21
All	All	796/963 (83%)	766 (96%)	28 (4%)	2 (0%)	44	49

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	231	GLU
1	C	197	SER

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	244/290 (84%)	239 (98%)	5 (2%)	60	74
1	B	243/290 (84%)	236 (97%)	7 (3%)	48	60
1	C	243/290 (84%)	241 (99%)	2 (1%)	85	92
All	All	730/870 (84%)	716 (98%)	14 (2%)	62	76

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	116	GLU
1	A	198	SER
1	A	235	ILE
1	A	252	LYS
1	A	278	ASP
1	B	42	LYS
1	B	49	ILE
1	B	116	GLU
1	B	185	ASN
1	B	198	SER
1	B	253	LYS
1	B	320	ASN
1	C	197	SER

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Mol	Chain	Res	Type
1	C	278	ASP

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

Mol	Chain	Res	Type
1	A	142	ASN
1	A	173	ASN
1	A	218	ASN
1	B	142	ASN
1	B	185	ASN
1	B	285	ASN
1	B	320	ASN
1	C	211	ASN
1	C	218	ASN
1	C	229	GLN
1	C	285	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 ⓘ

6 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
3	GOL	A	603	-	5,5,5	0.34	0	5,5,5	0.39	0
2	1PG	A	701	-	16,16,16	0.51	0	15,15,15	0.21	0
3	GOL	B	601	-	5,5,5	0.38	0	5,5,5	0.24	0
4	SO4	B	604	-	4,4,4	0.14	0	6,6,6	0.51	0
2	1PG	B	702	-	16,16,16	0.56	0	15,15,15	0.28	0
3	GOL	C	602	-	5,5,5	0.43	0	5,5,5	0.47	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
3	GOL	A	603	-	-	0/4/4/4	0/0/0/0
2	1PG	A	701	-	-	0/14/14/14	0/0/0/0
3	GOL	B	601	-	-	0/4/4/4	0/0/0/0
4	SO4	B	604	-	-	0/0/0/0	0/0/0/0
2	1PG	B	702	-	-	0/14/14/14	0/0/0/0
3	GOL	C	602	-	-	0/4/4/4	0/0/0/0

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.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	702	1PG	2	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 ⓘ

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	269/321 (83%)	-0.08	9 (3%)	47 44	27, 39, 51, 67	20 (7%)
1	B	268/321 (83%)	-0.05	12 (4%)	34 32	21, 36, 51, 70	17 (6%)
1	C	269/321 (83%)	-0.21	7 (2%)	56 54	19, 34, 49, 56	7 (2%)
All	All	806/963 (83%)	-0.11	28 (3%)	44 42	19, 36, 50, 70	44 (5%)

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	320	ASN	5.2
1	B	216	ILE	4.1
1	C	198	SER	3.9
1	B	319	GLU	3.8
1	C	41	LYS	3.6
1	A	320	ASN	3.6
1	B	41	LYS	3.6
1	A	321	ILE	3.4
1	A	246	TYR	3.3
1	A	319	GLU	3.3
1	B	246	TYR	3.2
1	B	278	ASP	3.0
1	C	185	ASN	3.0
1	A	278	ASP	2.8
1	C	71	TYR	2.8
1	A	41	LYS	2.6
1	B	185	ASN	2.6
1	C	246	TYR	2.5
1	B	50[A]	MET	2.5
1	B	71	TYR	2.5
1	B	211	ASN	2.5
1	B	138	LYS	2.3
1	C	170	LYS	2.3

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Mol	Chain	Res	Type	RSRZ
1	C	156	SER	2.3
1	A	216	ILE	2.3
1	A	168	GLU	2.2
1	B	49	ILE	2.2
1	A	85	VAL	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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å ²)	Q<0.9
2	1PG	B	702	17/17	0.69	0.27	3.25	62,65,80,81	0
3	GOL	B	601	6/6	0.93	0.16	2.81	45,48,49,50	0
4	SO4	B	604	5/5	0.97	0.10	-0.31	48,49,51,52	0
3	GOL	C	602	6/6	0.96	0.13	-	41,45,46,49	0
3	GOL	A	603	6/6	0.90	0.13	-	44,49,50,51	0
2	1PG	A	701	17/17	0.93	0.17	-	57,59,63,63	17

6.5 Other polymers [i](#)

There are no such residues in this entry.