



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 07:34 PM GMT

PDB ID : 4PAB
Title : Crystal structure of the precursor form of rat DMGDH complexed with tetrahydrofolate
Authors : Luka, Z.; Pakhomova, S.; Loukachevitch, L.V.; Newcomer, M.E.; Wagner, C.
Deposited on : 2014-04-07
Resolution : 1.85 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
<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 (RC4), CSD as536be (2015)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026688
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
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) : trunk26865

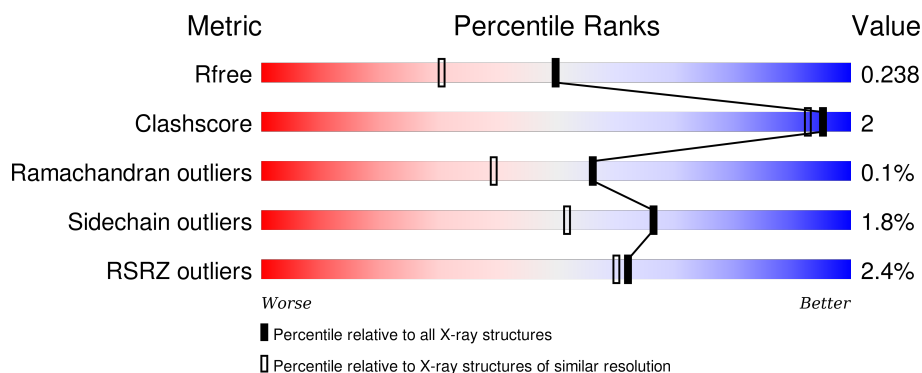
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

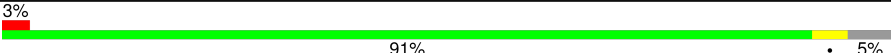

The reported resolution of this entry is 1.85 Å.

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}	91344	1745 (1.86-1.86)
Clashscore	102246	1898 (1.86-1.86)
Ramachandran outliers	100387	1875 (1.86-1.86)
Sidechain outliers	100360	1875 (1.86-1.86)
RSRZ outliers	91569	1747 (1.86-1.86)

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	869	 3% 91% 5%
1	B	869	 2% 90% 5%

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
3	THG	A	902	-	-	-	X
3	THG	B	902	-	-	-	X
4	SCN	A	906	-	-	-	X

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 13995 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 Dimethylglycine dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	823	Total	C	N	O	S	0	2	0
			6540	4184	1126	1211	19			
1	B	824	Total	C	N	O	S	0	1	0
			6540	4184	1126	1211	19			

There are 38 discrepancies between the modelled and reference sequences:

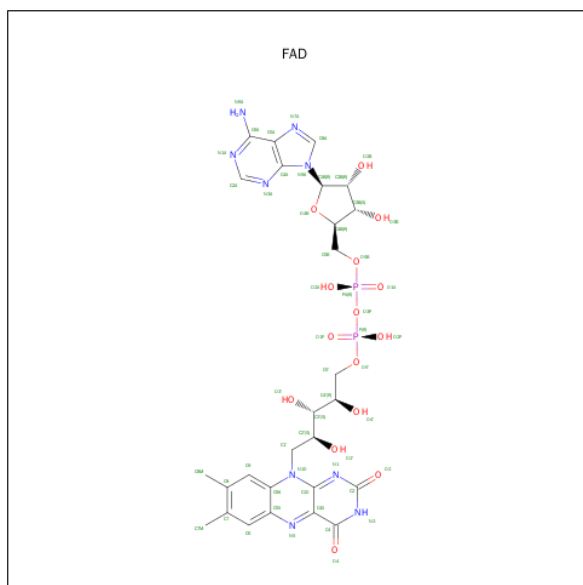
Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	MET	-	expression tag	UNP Q5RKL4
A	0	ALA	-	expression tag	UNP Q5RKL4
A	1	SER	-	expression tag	UNP Q5RKL4
A	204	VAL	ALA	engineered mutation	UNP Q5RKL4
A	267	VAL	ILE	engineered mutation	UNP Q5RKL4
A	402	LYS	THR	engineered mutation	UNP Q5RKL4
A	509	ARG	GLU	engineered mutation	UNP Q5RKL4
A	746	ASP	ASN	engineered mutation	UNP Q5RKL4
A	774	ASP	ASN	engineered mutation	UNP Q5RKL4
A	858	ALA	-	expression tag	UNP Q5RKL4
A	859	ALA	-	expression tag	UNP Q5RKL4
A	860	LEU	-	expression tag	UNP Q5RKL4
A	861	GLU	-	expression tag	UNP Q5RKL4
A	862	HIS	-	expression tag	UNP Q5RKL4
A	863	HIS	-	expression tag	UNP Q5RKL4
A	864	HIS	-	expression tag	UNP Q5RKL4
A	865	HIS	-	expression tag	UNP Q5RKL4
A	866	HIS	-	expression tag	UNP Q5RKL4
A	867	HIS	-	expression tag	UNP Q5RKL4
B	-1	MET	-	expression tag	UNP Q5RKL4
B	0	ALA	-	expression tag	UNP Q5RKL4
B	1	SER	-	expression tag	UNP Q5RKL4
B	204	VAL	ALA	engineered mutation	UNP Q5RKL4
B	267	VAL	ILE	engineered mutation	UNP Q5RKL4
B	402	LYS	THR	engineered mutation	UNP Q5RKL4

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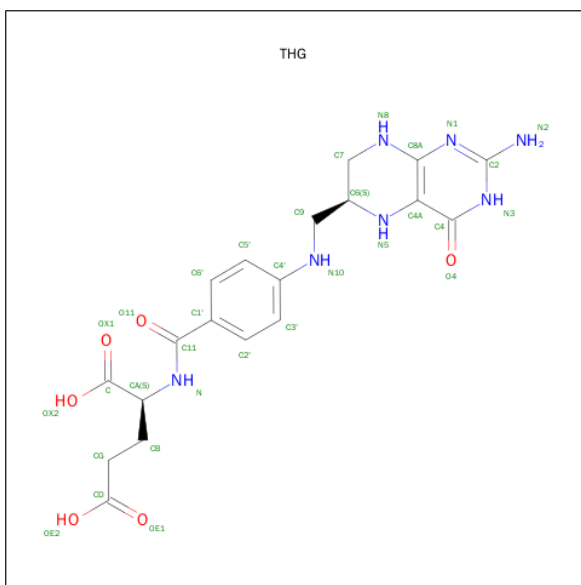
Chain	Residue	Modelled	Actual	Comment	Reference
B	509	ARG	GLU	engineered mutation	UNP Q5RKL4
B	746	ASP	ASN	engineered mutation	UNP Q5RKL4
B	774	ASP	ASN	engineered mutation	UNP Q5RKL4
B	858	ALA	-	expression tag	UNP Q5RKL4
B	859	ALA	-	expression tag	UNP Q5RKL4
B	860	LEU	-	expression tag	UNP Q5RKL4
B	861	GLU	-	expression tag	UNP Q5RKL4
B	862	HIS	-	expression tag	UNP Q5RKL4
B	863	HIS	-	expression tag	UNP Q5RKL4
B	864	HIS	-	expression tag	UNP Q5RKL4
B	865	HIS	-	expression tag	UNP Q5RKL4
B	866	HIS	-	expression tag	UNP Q5RKL4
B	867	HIS	-	expression tag	UNP Q5RKL4

- Molecule 2 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula: $C_{27}H_{33}N_9O_{15}P_2$).



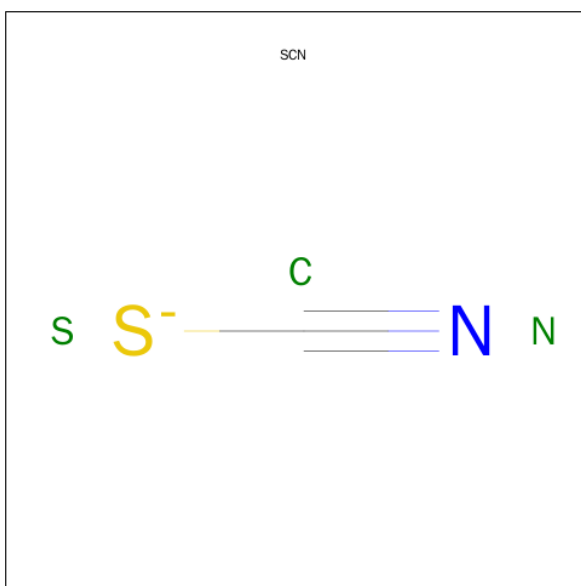
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
2	B	1	Total	C	N	O	P	0	0
			53	27	9	15	2		

- Molecule 3 is (6S)-5,6,7,8-TETRAHYDROFOLATE (three-letter code: THG) (formula: $C_{19}H_{23}N_7O_6$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total 32	C 19	N 7	O 6	0	0
3	B	1	Total 32	C 19	N 7	O 6	0	0

- Molecule 4 is THIOCYANATE ION (three-letter code: SCN) (formula: CNS).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total 3	C 1	N 1	S 1	0	0
4	A	1	Total 3	C 1	N 1	S 1	0	0

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total 3	C 1	N 1	S 1	0	0
4	A	1	Total 3	C 1	N 1	S 1	0	0
4	B	1	Total 3	C 1	N 1	S 1	0	0
4	B	1	Total 3	C 1	N 1	S 1	0	0
4	B	1	Total 3	C 1	N 1	S 1	0	0
4	B	1	Total 3	C 1	N 1	S 1	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	360	Total 360	O 360	0	0
5	B	361	Total 361	O 361	0	0

4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	84.18Å 107.22Å 114.47Å 90.00° 92.16° 90.00°	Depositor
Resolution (Å)	48.19 – 1.85 48.15 – 1.85	Depositor EDS
% Data completeness (in resolution range)	96.4 (48.19-1.85) 96.4 (48.15-1.85)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.04	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.94 (at 1.86Å)	Xtriage
Refinement program	REFMAC 5.7.0032	Depositor
R, R_{free}	0.206 , 0.231 0.213 , 0.238	Depositor DCC
R_{free} test set	3357 reflections (2.05%)	DCC
Wilson B-factor (Å ²)	21.3	Xtriage
Anisotropy	0.697	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 37.9	EDS
Estimated twinning fraction	0.000 for h,-k,-l	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.53$, $\langle L^2 \rangle = 0.37$	Xtriage
Outliers	4 of 166811 reflections (0.002%)	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	13995	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 47.64 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 9.6384e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹ Intensities estimated from amplitudes.

² Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 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: THG, SCN, FAD

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	0.43	0/6711	0.64	2/9105 (0.0%)
1	B	0.45	0/6708	0.64	2/9101 (0.0%)
All	All	0.44	0/13419	0.64	4/18206 (0.0%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	847	ARG	NE-CZ-NH1	7.53	124.06	120.30
1	B	847	ARG	NE-CZ-NH1	7.14	123.87	120.30
1	B	847	ARG	NE-CZ-NH2	-5.50	117.55	120.30
1	A	847	ARG	NE-CZ-NH2	-5.04	117.78	120.30

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	6540	0	6494	22	0
1	B	6540	0	6490	18	0
2	A	53	0	30	3	0
2	B	53	0	30	2	0
3	A	32	0	21	8	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	32	0	21	3	0
4	A	12	0	0	1	0
4	B	12	0	0	0	0
5	A	360	0	0	3	0
5	B	361	0	0	3	0
All	All	13995	0	13086	41	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 2.

The worst 5 of 41 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:740:LYS:HG3	1:B:743:LYS:HB3	1.84	0.60
1:A:150:HIS:HD2	5:A:1290:HOH:O	1.86	0.59
3:A:902:THG:HC5	5:A:1304:HOH:O	2.04	0.57
1:A:218:ARG:NH2	1:A:233:ARG:NH2	2.54	0.56
1:A:575:THR:HG1	3:A:902:THG:C8A	2.22	0.52

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	823/869 (95%)	798 (97%)	24 (3%)	1 (0%)	56	39
1	B	823/869 (95%)	798 (97%)	24 (3%)	1 (0%)	56	39
All	All	1646/1738 (95%)	1596 (97%)	48 (3%)	2 (0%)	56	39

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	371	ILE
1	B	371	ILE

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	696/731 (95%)	684 (98%)	12 (2%)	68	54
1	B	695/731 (95%)	682 (98%)	13 (2%)	65	49
All	All	1391/1462 (95%)	1366 (98%)	25 (2%)	66	52

5 of 25 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	790	ILE
1	B	278	LYS
1	B	770	LEU
1	B	172	ASP
1	B	279	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 12 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	821	GLN
1	A	851	GLN
1	B	462	GLN
1	A	462	GLN
1	B	359	ASN

5.3.3 RNA [i](#)

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 ⓘ

12 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	FAD	A	901	1	48,58,58	1.24	5 (10%)	54,89,89	2.52	11 (20%)
3	THG	A	902	-	26,34,34	1.15	3 (11%)	28,47,47	2.30	9 (32%)
4	SCN	A	903	-	2,2,2	1.48	1 (50%)	1,1,1	0.48	0
4	SCN	A	904	-	2,2,2	1.41	0	1,1,1	0.32	0
4	SCN	A	905	-	2,2,2	1.43	0	1,1,1	0.42	0
4	SCN	A	906	-	2,2,2	1.55	1 (50%)	1,1,1	0.36	0
2	FAD	B	901	1	48,58,58	1.29	6 (12%)	54,89,89	2.26	11 (20%)
3	THG	B	902	-	26,34,34	1.05	1 (3%)	28,47,47	1.59	6 (21%)
4	SCN	B	903	-	2,2,2	1.41	0	1,1,1	0.51	0
4	SCN	B	904	-	2,2,2	1.43	0	1,1,1	0.37	0
4	SCN	B	905	-	2,2,2	1.49	1 (50%)	1,1,1	0.46	0
4	SCN	B	906	-	2,2,2	1.62	1 (50%)	1,1,1	0.41	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	FAD	A	901	1	-	0/30/50/50	0/6/6/6

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	THG	A	902	-	-	0/16/31/31	0/3/3/3
4	SCN	A	903	-	-	0/0/0/0	0/0/0/0
4	SCN	A	904	-	-	0/0/0/0	0/0/0/0
4	SCN	A	905	-	-	0/0/0/0	0/0/0/0
4	SCN	A	906	-	-	0/0/0/0	0/0/0/0
2	FAD	B	901	1	-	0/30/50/50	0/6/6/6
3	THG	B	902	-	-	0/16/31/31	0/3/3/3
4	SCN	B	903	-	-	0/0/0/0	0/0/0/0
4	SCN	B	904	-	-	0/0/0/0	0/0/0/0
4	SCN	B	905	-	-	0/0/0/0	0/0/0/0
4	SCN	B	906	-	-	0/0/0/0	0/0/0/0

The worst 5 of 19 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	902	THG	C4A-N5	-2.76	1.31	1.38
4	B	906	SCN	C-S	-2.29	1.49	1.63
4	A	906	SCN	C-S	-2.19	1.49	1.63
4	B	905	SCN	C-S	-2.09	1.50	1.63
4	A	903	SCN	C-S	-2.09	1.50	1.63

The worst 5 of 37 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	901	FAD	N3A-C2A-N1A	-8.90	122.08	128.89
2	B	901	FAD	N3A-C2A-N1A	-8.18	122.63	128.89
2	A	901	FAD	C4-C4X-C10	-7.52	115.13	119.94
3	A	902	THG	C9-C6-N5	-4.95	99.10	109.34
2	B	901	FAD	C4-C4X-C10	-4.88	116.82	119.94

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5 monomers are involved in 17 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	901	FAD	3	0
3	A	902	THG	8	0
4	A	906	SCN	1	0
2	B	901	FAD	2	0
3	B	902	THG	3	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	823/869 (94%)	-0.02	22 (2%) 58 55	18, 33, 61, 85	0
1	B	824/869 (94%)	-0.04	17 (2%) 67 65	18, 33, 59, 84	0
All	All	1647/1738 (94%)	-0.03	39 (2%) 62 60	18, 33, 61, 85	0

The worst 5 of 39 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	278	LYS	4.2
1	A	358	ILE	3.7
1	A	169	LEU	3.7
1	A	350	PRO	3.5
1	B	278	LYS	3.5

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(\AA^2)	Q<0.9
3	THG	A	902	32/32	0.73	0.26	14.54	36,51,60,60	0
4	SCN	A	906	3/3	0.75	0.21	8.76	33,33,42,58	0
3	THG	B	902	32/32	0.73	0.25	7.60	37,53,59,61	0
4	SCN	A	905	3/3	0.90	0.13	0.45	37,37,44,45	0
4	SCN	B	906	3/3	0.98	0.08	-0.14	34,34,35,38	0
2	FAD	A	901	53/53	0.97	0.10	-0.16	22,26,29,30	0
2	FAD	B	901	53/53	0.97	0.08	-0.45	18,23,26,28	0
4	SCN	A	904	3/3	0.97	0.09	-0.92	33,33,36,38	0
4	SCN	B	904	3/3	0.96	0.08	-0.99	34,34,36,40	0
4	SCN	B	903	3/3	0.98	0.08	-1.15	34,34,35,39	0
4	SCN	A	903	3/3	0.99	0.05	-1.61	33,33,34,34	0
4	SCN	B	905	3/3	0.98	0.08	-	39,39,39,40	0

6.5 Other polymers [i](#)

There are no such residues in this entry.