wwPDB X-ray Structure Validation Summary Report (i)

Sep 12, 2023 – 11:15 AM EDT

PDB ID	:	4OFH
Title	:	Structural basis for thymine glycosylase activity on T:O6-methylG mismatch by methyl-CpG binding domain protein 4: Implications for roles of Arg468 in mismatch recognition and catalysis
Authors	:	Ouzon-Shubeita, H.; Lin, Y.-L.; Lee, S.
Deposited on	:	2014-01-14
Resolution	:	2.22 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:

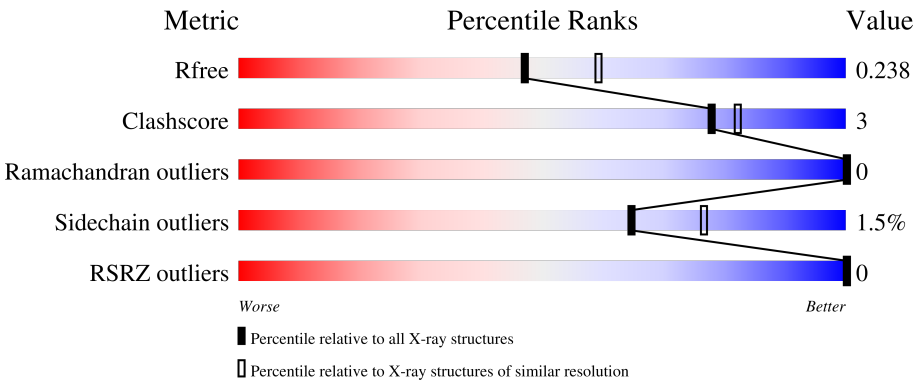
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.22 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	5912 (2.24-2.20)
Clashscore	141614	6646 (2.24-2.20)
Ramachandran outliers	138981	6543 (2.24-2.20)
Sidechain outliers	138945	6544 (2.24-2.20)
RSRZ outliers	127900	5797 (2.24-2.20)

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 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	192	67% 7% 27%
2	C	12	75% 25%
3	D	12	42% 50% 8%

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 1782 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 Methyl-CpG-binding domain protein 4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	141	1202	791	203	206	2	0	0	0

There are 38 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	389	MET	-	expression tag	UNP O95243
A	390	GLY	-	expression tag	UNP O95243
A	391	SER	-	expression tag	UNP O95243
A	392	SER	-	expression tag	UNP O95243
A	393	HIS	-	expression tag	UNP O95243
A	394	HIS	-	expression tag	UNP O95243
A	395	HIS	-	expression tag	UNP O95243
A	396	HIS	-	expression tag	UNP O95243
A	397	HIS	-	expression tag	UNP O95243
A	398	HIS	-	expression tag	UNP O95243
A	399	SER	-	expression tag	UNP O95243
A	400	SER	-	expression tag	UNP O95243
A	401	GLY	-	expression tag	UNP O95243
A	402	LEU	-	expression tag	UNP O95243
A	403	VAL	-	expression tag	UNP O95243
A	404	PRO	-	expression tag	UNP O95243
A	405	ARG	-	expression tag	UNP O95243
A	406	GLY	-	expression tag	UNP O95243
A	407	SER	-	expression tag	UNP O95243
A	408	HIS	-	expression tag	UNP O95243
A	409	MET	-	expression tag	UNP O95243
A	410	ALA	-	expression tag	UNP O95243
A	411	SER	-	expression tag	UNP O95243
A	412	MET	-	expression tag	UNP O95243
A	413	THR	-	expression tag	UNP O95243
A	414	GLY	-	expression tag	UNP O95243
A	415	GLY	-	expression tag	UNP O95243

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Chain	Residue	Modelled	Actual	Comment	Reference
A	416	GLN	-	expression tag	UNP O95243
A	417	GLN	-	expression tag	UNP O95243
A	418	MET	-	expression tag	UNP O95243
A	419	GLY	-	expression tag	UNP O95243
A	420	ARG	-	expression tag	UNP O95243
A	421	GLY	-	expression tag	UNP O95243
A	422	SER	-	expression tag	UNP O95243
A	423	GLU	-	expression tag	UNP O95243
A	424	PHE	-	expression tag	UNP O95243
A	425	MET	-	expression tag	UNP O95243
A	560	ASN	ASP	engineered mutation	UNP O95243

- Molecule 2 is a DNA chain called 12-mer DNA(T).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	C	12	242	115	47	69	11	0	0	0

- Molecule 3 is a DNA chain called 12-mer DNA(O6MeG).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
3	D	12	246	117	46	72	11	0	0	0

- Molecule 4 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Mg		
4	A	1	1	1	0	0

- Molecule 5 is water.

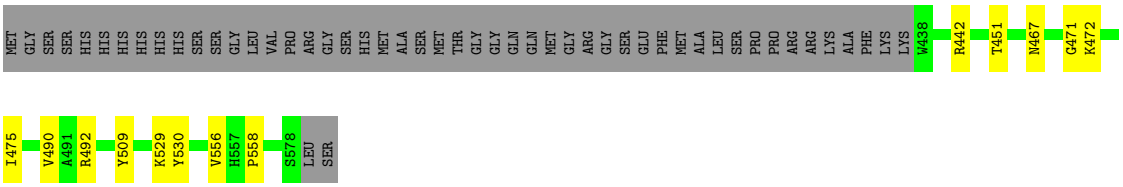
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	A	58	58	58	0	0
			Total	O		
5	C	21	21	21	0	0
			Total	O		
5	D	12	12	12	0	0

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.

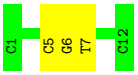
- Molecule 1: Methyl-CpG-binding domain protein 4

Chain A:



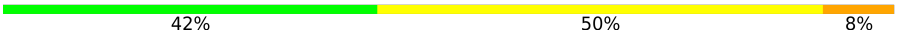
- Molecule 2: 12-mer DNA(T)

Chain C:



- Molecule 3: 12-mer DNA(O6MeG)

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	40.98Å 57.64Å 105.10Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.83 – 2.22 38.83 – 2.22	Depositor EDS
% Data completeness (in resolution range)	94.5 (38.83-2.22) 94.5 (38.83-2.22)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.68 (at 2.22Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.186 , 0.230 0.191 , 0.238	Depositor DCC
R_{free} test set	627 reflections (4.87%)	wwPDB-VP
Wilson B-factor (Å^2)	33.6	Xtriage
Anisotropy	0.509	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 33.9	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	0.95	EDS
Total number of atoms	1782	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 8.16% 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: 6OG, MG

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	0.73	0/1245	0.77	3/1694 (0.2%)
2	C	0.55	0/271	0.87	1/416 (0.2%)
3	D	0.50	0/248	0.82	0/379
All	All	0.68	0/1764	0.80	4/2489 (0.2%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	492	ARG	NE-CZ-NH1	7.45	124.03	120.30
1	A	492	ARG	NE-CZ-NH2	-6.50	117.05	120.30
2	C	7	DT	O5'-P-OP1	-5.96	100.34	105.70
1	A	490	VAL	CB-CA-C	-5.02	101.87	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	1202	0	1185	5	0
2	C	242	0	135	1	0
3	D	246	0	138	4	0
4	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	58	0	0	0	0
5	C	21	0	0	0	0
5	D	12	0	0	0	0
All	All	1782	0	1458	9	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 3.

The worst 5 of 9 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)
3:D:7:DC:H2'	3:D:8:DG:C8	2.47	0.49
1:A:529:LYS:HG3	1:A:530:TYR:CD2	2.48	0.48
1:A:442:ARG:NH2	1:A:451:THR:HG22	2.30	0.47
1:A:471:GLY:O	1:A:475:ILE:HG12	2.15	0.46
1:A:556:VAL:HG12	1:A:558:PRO:HD3	1.96	0.46

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	139/192 (72%)	138 (99%)	1 (1%)	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	130/171 (76%)	128 (98%)	2 (2%)	65 76

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	467	ASN
1	A	472	LYS

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)

1 non-standard protein/DNA/RNA residue is 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	6OG	D	6	3	18,25,26	1.06	1 (5%)	20,36,39	2.27	6 (30%)

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	6OG	D	6	3	-	2/5/23/24	0/3/3/3

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	D	6	6OG	C6-N1	2.66	1.36	1.31

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

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	D	6	6OG	O6-C6-N1	7.66	129.66	119.03
3	D	6	6OG	O6-C6-C5	-3.21	111.42	116.01
3	D	6	6OG	C2-N3-C4	2.83	118.59	115.36
3	D	6	6OG	C5-C6-N1	-2.32	118.84	123.26
3	D	6	6OG	C2-N1-C6	2.32	119.80	116.08

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	D	6	6OG	N1-C6-O6-C
3	D	6	6OG	C5-C6-O6-C

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	D	6	6OG	1	0

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

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.

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 (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	141/192 (73%)	-0.50	0	100	100	21, 32, 51, 72	0
2	C	12/12 (100%)	-0.68	0	100	100	25, 35, 54, 54	0
3	D	11/12 (91%)	-0.78	0	100	100	34, 41, 53, 60	0
All	All	164/216 (75%)	-0.53	0	100	100	21, 34, 54, 72	0

There are no RSRZ outliers to report.

6.2 Non-standard residues in protein, DNA, RNA chains (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
3	6OG	D	6	23/24	0.98	0.10	26,31,35,40	0

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
4	MG	A	601	1/1	0.99	0.08	30,30,30,30	0

6.5 Other polymers (i)

There are no such residues in this entry.