



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 19, 2016 – 10:37 PM GMT

PDB ID : 5DPK  
Title : MutY adenine glycosylase bound to a transition state analog (1N) paired with d(8-oxoG) in duplexed DNA to 2.2 Å  
Authors : Horvath, M.P.; O'Shea, V.L.; Cao, S.; David, S.S.  
Deposited on : 2015-09-12  
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](mailto: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.

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

MolProbity : 4.02b-467  
Mogul : 1.7.1 (RC1), CSD as537be (2016)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026982  
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) : rb-20026982

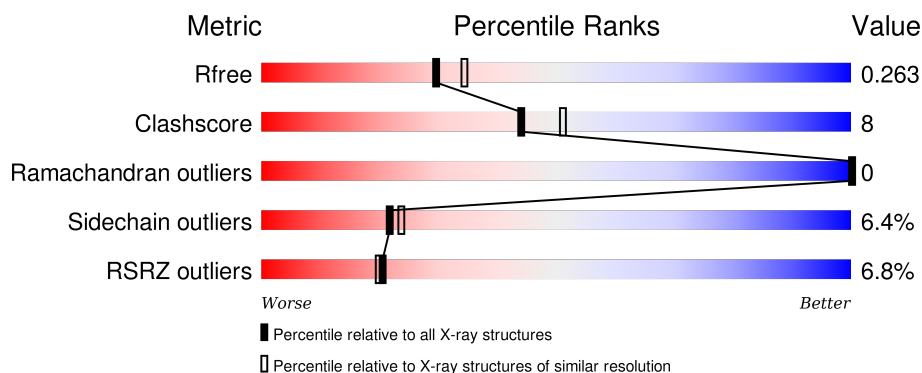
# 1 Overall quality at a glance

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))
$R_{free}$	91344	3774 (2.20-2.20)
Clashscore	102246	4477 (2.20-2.20)
Ramachandran outliers	100387	4404 (2.20-2.20)
Sidechain outliers	100360	4405 (2.20-2.20)
RSRZ outliers	91569	3781 (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  $\geq 3$ , 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	366	<div> <div>7%</div> <div> <div></div> <div>75%</div> <div>18%</div> <div>• 5%</div> </div> </div>
2	B	11	<div> <div></div> <div>91%</div> <div>9%</div> </div>
3	C	11	<div> <div></div> <div>64%</div> <div>27%</div> <div>9%</div> </div>

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 6167 atoms, of which 2912 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 A/G-specific adenine glycosylase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	349	Total	C	H	N	O	S	0	1	0
			5429	1770	2675	473	500	11			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	144	ASP	ASN	variant	UNP P83847

- Molecule 2 is a DNA chain called DNA (5'-D(\*AP\*AP\*GP\*AP\*CP\*(8OG)P\*TP\*GP\*GP\*AP\*C)-3').

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	B	11	Total	C	H	N	O	P	0	0	0
			352	108	124	48	62	10			

- Molecule 3 is a DNA chain called DNA (5'-D(P\*GP\*TP\*CP\*CP\*AP\*(NR1)P\*GP\*TP\*CP\*T)-3').

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
3	C	10	Total	C	H	N	O	P	0	0	0
			306	92	113	31	60	10			

- Molecule 4 is IRON/SULFUR CLUSTER (three-letter code: SF4) (formula: Fe<sub>4</sub>S<sub>4</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 5 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	2	Total	Ca	0	0
			2	2		

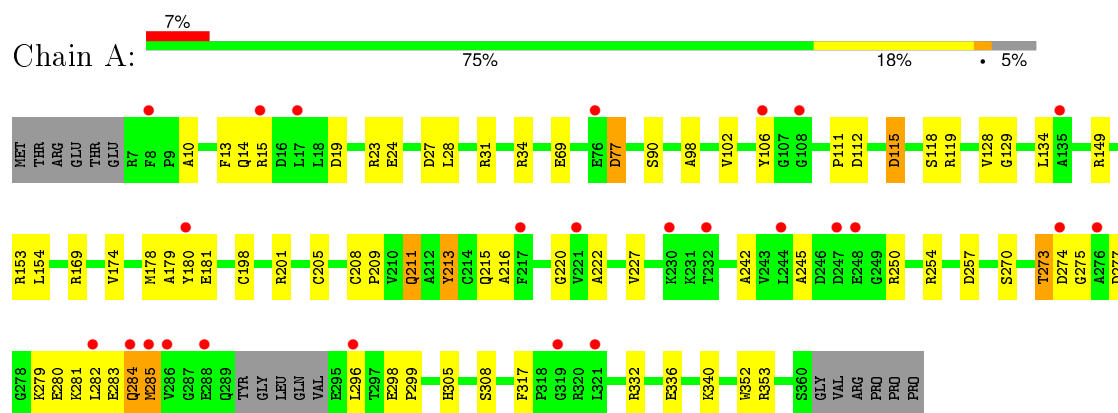
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	44	Total	O	0	0
			44	44		
6	B	15	Total	O	0	0
			15	15		
6	C	11	Total	O	0	0
			11	11		

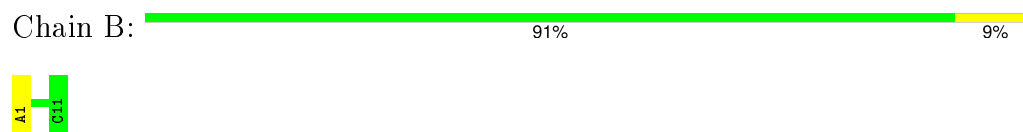
### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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: A/G-specific adenine glycosylase



- Molecule 2: DNA (5'-D(\*AP\*AP\*GP\*AP\*CP\*(8OG)P\*TP\*GP\*GP\*AP\*C)-3')



- Molecule 3: DNA (5'-D(P\*GP\*TP\*CP\*CP\*AP\*(NR1)P\*GP\*TP\*CP\*T)-3')



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	37.85Å 86.62Å 140.77Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.26 – 2.20 41.40 – 2.20	Depositor EDS
% Data completeness (in resolution range)	99.0 (41.26-2.20) 99.0 (41.40-2.20)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.58 (at 2.20Å)	Xtriage
Refinement program	PHENIX (1.10pre_2119: ???)	Depositor
R, $R_{free}$	0.242 , 0.257 0.255 , 0.263	Depositor DCC
$R_{free}$ test set	1163 reflections (5.07%)	DCC
Wilson B-factor (Å <sup>2</sup> )	40.4	Xtriage
Anisotropy	0.222	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 41.9	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.43$ , $\langle L^2 \rangle = 0.26$	Xtriage
Outliers	0 of 24104 reflections	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	6167	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	55.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.90% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: 8OG, NR1, CA, SF4

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	0.28	0/2825	0.45	0/3847
2	B	0.65	0/230	0.91	0/351
3	C	0.62	0/201	1.01	0/305
All	All	0.35	0/3256	0.55	0/4503

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 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	2754	2675	2671	45	0
2	B	228	124	124	1	0
3	C	193	113	114	4	0
4	A	8	0	0	0	0
5	A	2	0	0	0	0
6	A	44	0	0	3	0
6	B	15	0	0	2	0
6	C	11	0	0	1	0
All	All	3255	2912	2909	49	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 8.

All (49) 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:353:ARG:NH1	6:A:501:HOH:O	2.12	0.81
2:B:1:DA:N7	6:B:101:HOH:O	2.19	0.75
3:C:13:DG:H2"	3:C:14:DT:H5'	1.75	0.68
1:A:181:GLU:N	1:A:181:GLU:OE2	2.27	0.67
1:A:277:ASP:O	1:A:281:LYS:HG3	1.94	0.67
1:A:15:ARG:NH2	1:A:19:ASP:OD1	2.20	0.65
3:C:14:DT:OP1	6:C:101:HOH:O	2.14	0.65
1:A:273:THR:HG23	1:A:275:GLY:HA3	1.80	0.63
1:A:115:ASP:O	1:A:119:ARG:HG3	2.00	0.62
1:A:222:ALA:N	6:A:507:HOH:O	2.36	0.57
1:A:69:GLU:N	1:A:69:GLU:OE2	2.36	0.57
1:A:254:ARG:NH1	1:A:285:MET:HE1	2.21	0.56
1:A:299:PRO:HG3	1:A:317:PHE:CE2	2.41	0.55
1:A:274:ASP:HB2	1:A:275:GLY:HA2	1.90	0.54
1:A:13:PHE:HB2	1:A:213:TYR:CE2	2.44	0.53
1:A:98:ALA:O	1:A:102:VAL:HG23	2.10	0.51
1:A:242:ALA:HB2	1:A:282:LEU:HD22	1.93	0.50
1:A:34:ARG:NH1	1:A:134:LEU:O	2.43	0.50
1:A:118:SER:HB2	1:A:128:VAL:HG21	1.93	0.49
1:A:336:GLU:OE2	6:A:502:HOH:O	2.20	0.49
1:A:154:LEU:O	1:A:215:GLN:HG3	2.14	0.47
1:A:153:ARG:NH1	1:A:198:CYS:SG	2.81	0.47
1:A:298:GLU:CG	1:A:299:PRO:HD2	2.45	0.47
1:A:10:ALA:O	1:A:14:GLN:HG3	2.15	0.46
1:A:208:CYS:SG	1:A:209:PRO:HD2	2.56	0.46
1:A:77:ASP:OD1	1:A:77:ASP:N	2.49	0.46
1:A:149:ARG:NH1	3:C:17:DA:OP1	2.48	0.46
1:A:298:GLU:CG	1:A:299:PRO:CD	2.95	0.44
3:C:13:DG:H2'	3:C:14:DT:C6	2.53	0.44
1:A:279:LYS:O	1:A:283:GLU:HG3	2.17	0.44
1:A:274:ASP:N	1:A:275:GLY:CA	2.80	0.43
1:A:14:GLN:HE21	1:A:179:ALA:HB2	1.82	0.43
1:A:305:HIS:CD2	6:B:108:HOH:O	2.70	0.43
1:A:178:MET:HG2	1:A:179:ALA:N	2.34	0.43
1:A:174:VAL:O	1:A:178:MET:HB2	2.19	0.42
1:A:284:GLN:HG3	1:A:285:MET:N	2.33	0.42
1:A:180:TYR:N	1:A:181:GLU:OE2	2.52	0.42
1:A:336:GLU:HG3	1:A:352:TRP:CZ2	2.54	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:205:CYS:O	1:A:211:GLN:HB3	2.21	0.41
1:A:10:ALA:O	1:A:13:PHE:HB3	2.20	0.41
1:A:216:ALA:O	1:A:220:GLY:N	2.54	0.41
1:A:23:ARG:HG2	1:A:24:GLU:HG2	2.03	0.41
1:A:257:ASP:N	1:A:257:ASP:OD1	2.48	0.41
1:A:28:LEU:HB2	1:A:31:ARG:HG3	2.03	0.40
1:A:245:ALA:HA	1:A:250:ARG:O	2.21	0.40
1:A:115:ASP:O	1:A:119:ARG:HD2	2.21	0.40
1:A:128:VAL:HG12	1:A:129:GLY:N	2.36	0.40
1:A:254:ARG:NH2	1:A:270:SER:O	2.55	0.40
1:A:106:TYR:CE2	1:A:111:PRO:HG3	2.57	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	346/366 (94%)	334 (96%)	12 (4%)	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	283/313 (90%)	265 (94%)	18 (6%)	22	24

All (18) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	27	ASP
1	A	77	ASP
1	A	90	SER
1	A	112	ASP
1	A	115	ASP
1	A	169	ARG
1	A	201	ARG
1	A	211	GLN
1	A	213	TYR
1	A	227	VAL
1	A	273	THR
1	A	280	GLU
1	A	284	GLN
1	A	285	MET
1	A	296	LEU
1	A	308	SER
1	A	332	ARG
1	A	340	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

2 non-standard protein/DNA/RNA residues 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	8OG	B	6	2	16,25,26	0.77	1 (6%)	17,37,40	1.84	4 (23%)
3	NR1	C	18	3	5,11,12	0.93	0	5,14,17	0.69	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	8OG	B	6	2	-	0/3/21/22	0/3/3/3
3	NR1	C	18	3	-	0/3/15/16	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	6	8OG	C6-N1	2.19	1.39	1.36

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	6	8OG	O4'-C1'-N9	-5.69	103.31	108.16
2	B	6	8OG	C1'-N9-C4	-2.08	124.86	127.30
2	B	6	8OG	N1-C2-N3	2.03	124.53	121.76
2	B	6	8OG	C4-C5-N7	3.61	109.17	105.94

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 2 are monoatomic - leaving 1 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	$\# Z  > 2$
4	SF4	A	401	1	0,12,12	0.00	-	0,24,24	0.00	-

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
4	SF4	A	401	1	-	0/0/48/48	0/6/5/5

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

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	349/366 (95%)	0.56	25 (7%) 18 18	21, 54, 76, 97	0
2	B	10/11 (90%)	0.02	0 100 100	27, 40, 57, 61	0
3	C	9/11 (81%)	-0.02	0 100 100	25, 31, 55, 66	0
All	All	368/388 (94%)	0.53	25 (6%) 20 20	21, 54, 74, 97	0

All (25) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	321	LEU	4.4
1	A	15	ARG	4.1
1	A	286	VAL	3.9
1	A	284	GLN	3.7
1	A	108	GLY	3.3
1	A	247	ASP	3.1
1	A	248	GLU	3.1
1	A	288	GLU	2.8
1	A	296	LEU	2.8
1	A	232	THR	2.7
1	A	230	LYS	2.5
1	A	135	ALA	2.4
1	A	274	ASP	2.4
1	A	282	LEU	2.4
1	A	217	PHE	2.4
1	A	76	GLU	2.4
1	A	180	TYR	2.4
1	A	319	GLY	2.3
1	A	106	TYR	2.3
1	A	244	LEU	2.3
1	A	8	PHE	2.2
1	A	285	MET	2.1
1	A	17	LEU	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	276	ALA	2.1
1	A	221	VAL	2.1

## 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. 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
2	8OG	B	6	23/24	0.97	0.14	-	18,28,37,40	0
3	NR1	C	18	11/12	0.98	0.17	-	17,26,33,33	0

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
4	SF4	A	401	8/8	0.93	0.14	-0.92	41,54,65,76	0
5	CA	A	402	1/1	0.98	0.14	-1.13	44,44,44,44	0
5	CA	A	403	1/1	0.95	0.09	-	67,67,67,67	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.