



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 12, 2026 – 12:59 PM UTC

PDB ID : 2WTL / pdb\_00002wtl  
Title : Crystal structure of BfrA from *M. tuberculosis*  
Authors : Gupta, V.; Gupta, R.K.; Khare, G.; Salunke, D.M.; Tyagi, A.K.  
Deposited on : 2009-09-17  
Resolution : 2.59 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](mailto: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 ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity : 4-5-2 with Phenix2.0  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtriage (Phenix) : 2.0  
EDS : 3.0  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
CCP4 : 9.0.010 (Gargrove)  
Density-Fitness : 1.0.12  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.49

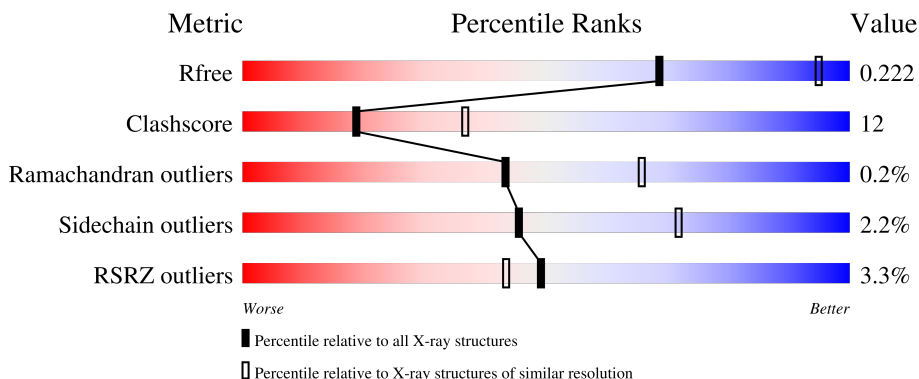
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.59 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))
$R_{free}$	180053	4008 (2.60-2.60)
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)
RSRZ outliers	180081	4008 (2.60-2.60)

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  $\geq 3$ , 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  $\leq 5\%$ . 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	173	
1	B	173	
1	C	173	
1	D	173	
1	E	173	

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Mol	Chain	Length	Quality of chain
1	F	173	

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
4	UNL	A	1500	-	-	X	-
4	UNL	C	1500	-	-	X	X
4	UNL	E	1500	-	-	X	X

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 8104 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 BACTERIOFERRITIN.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	161	1298	811	220	261	2	4	0	0	0
1	B	161	1297	809	220	262	2	4	0	1	0
1	C	161	1302	814	221	261	2	4	0	0	0
1	D	161	1293	806	220	261	2	4	0	0	0
1	E	161	1302	814	221	261	2	4	0	0	0
1	F	161	1298	812	221	259	2	4	0	0	0

- Molecule 2 is FE (III) ION (CCD ID: FE) (formula: Fe).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Fe	0	0
			2	2		
2	B	2	Total	Fe	0	0
			2	2		
2	C	2	Total	Fe	0	0
			2	2		
2	D	2	Total	Fe	0	0
			2	2		
2	E	2	Total	Fe	0	0
			2	2		
2	F	2	Total	Fe	0	0
			2	2		

- Molecule 3 is UNKNOWN ATOM OR ION (CCD ID: UNX) (formula: X).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	2	Total X 2 2	0	0
3	E	1	Total X 1 1	0	0

- Molecule 4 is UNKNOWN LIGAND (CCD ID: UNL) (formula: ).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C N O 43 33 4 6	0	0
4	C	1	Total C N O 43 33 4 6	0	0
4	E	1	Total C N O 43 33 4 6	0	0

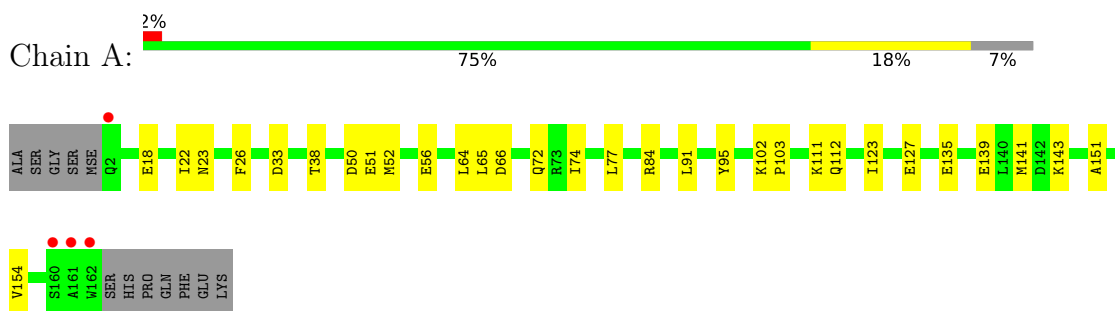
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	29	Total O 29 29	0	0
5	B	33	Total O 33 33	0	0
5	C	29	Total O 29 29	0	0
5	D	25	Total O 25 25	0	0
5	E	20	Total O 20 20	0	0
5	F	34	Total O 34 34	0	0

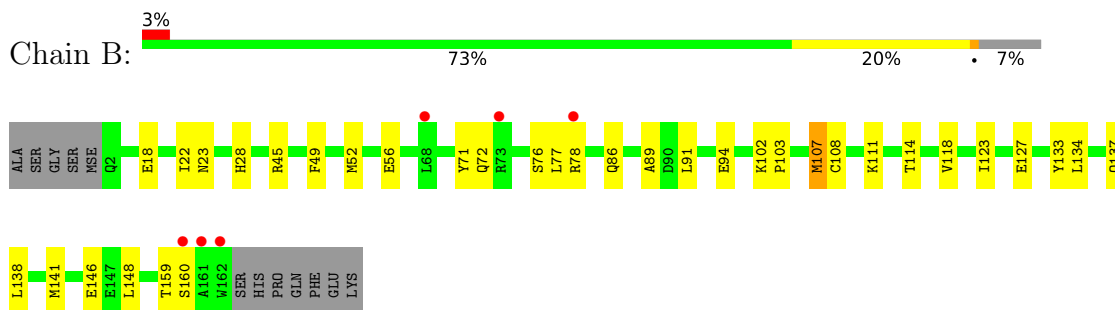
### 3 Residue-property plots [i](#)

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.

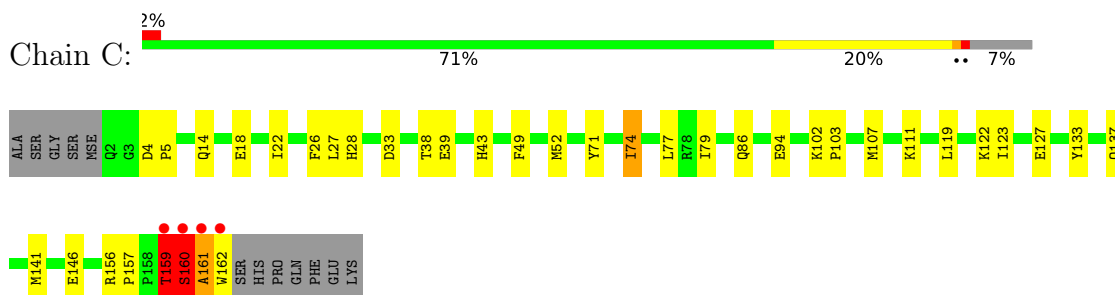
- Molecule 1: BACTERIOFERRITIN



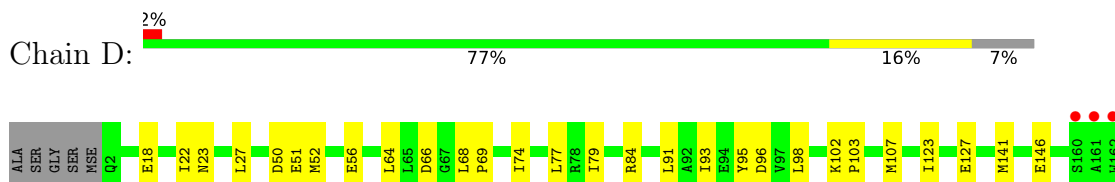
- Molecule 1: BACTERIOFERRITIN



- Molecule 1: BACTERIOFERRITIN




- Molecule 1: BACTERIOFERRITIN



SER  
HIS  
PRO  
GLN  
PHE  
GLU  
LYS

• Molecule 1: BACTERIOFERRITIN

Chain E: 

ALA SER HIS PRO GLN PHE GLU LYS  
 SER GLY SER NSE Q2 G3 D4 P5 E18 I22 F26 R45 F49 B50 E51 M52 D60 L64 L65 D66 G67 L68 P69 Q72 R73 S76 L77 R78 L91 E94 Y95 D96 K102 P103 T114 V118 I123 E127 Y133 Q137

M141 E146 R156 P157 E158 T159 S160 A161 W162 SER HIS PRO PHE GLU LYS

• Molecule 1: BACTERIOFERRITIN

Chain F: 

ALA SER HIS PRO PHE GLU LYS  
 SER GLY SER NSE Q2 G3 D4 P5 R9 Q14 E18 L19 I22 H28 M31 F49 D50 E51 M52 E56 L64 L68 Q72 L77 R78 I79 L91 E94 Y95 K102 P103 T114 V118 I123 E127 Y133 Q137 L138

E139 L140 M141 E146 E147 L148 P157 T159 S160 A161 W162 SER HIS PRO PHE GLU LYS

## 4 Data and refinement statistics

Property	Value	Source
Space group	I 4	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	125.96Å 125.96Å 175.84Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	36.05 – 2.59 36.05 – 2.59	Depositor EDS
% Data completeness (in resolution range)	99.7 (36.05-2.59) 99.7 (36.05-2.59)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.84 (at 2.51Å)	Xtrriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, $R_{free}$	0.183 , 0.228 0.193 , 0.222	Depositor DCC
$R_{free}$ test set	2025 reflections (4.31%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	31.1	Xtrriage
Anisotropy	0.038	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 28.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.52$ , $\langle L^2 \rangle = 0.36$	Xtrriage
Estimated twinning fraction	0.000 for $-1/2^*h+1/2^*k-1/2^*l, 1/2^*h-1/2^*k-1/2^*l, -h-k$ 0.000 for $-1/2^*h+1/2^*k+1/2^*l, 1/2^*h-1/2^*k+1/2^*l, h+k$ 0.000 for $-1/2^*h-1/2^*k+1/2^*l, -1/2^*h-1/2^*k-1/2^*l, h-k$ 0.000 for $-1/2^*h-1/2^*k-1/2^*l, -1/2^*h-1/2^*k+1/2^*l, -h+k$ 0.005 for $-h, k, -l$	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	8104	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	31.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.54% 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, 0.333 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: UNX, UNL, FE

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	0.33	0/1315	0.66	0/1775
1	B	0.34	0/1312	0.66	0/1771
1	C	0.34	0/1319	0.68	1/1779 (0.1%)
1	D	0.33	0/1308	0.66	0/1763
1	E	0.32	0/1319	0.67	0/1779
1	F	0.33	0/1315	0.66	0/1774
All	All	0.33	0/7888	0.67	1/10641 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	159	THR	CB-CA-C	-5.55	109.07	117.07

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	1298	0	1257	25	0
1	B	1297	0	1260	34	0
1	C	1302	0	1268	40	0
1	D	1293	0	1260	21	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	E	1302	0	1268	37	0
1	F	1298	0	1264	47	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
2	C	2	0	0	0	0
2	D	2	0	0	0	0
2	E	2	0	0	0	0
2	F	2	0	0	0	0
3	A	2	0	0	0	0
3	E	1	0	0	0	0
4	A	43	0	0	16	0
4	C	43	0	0	18	0
4	E	43	0	0	23	0
5	A	29	0	0	0	0
5	B	33	0	0	0	0
5	C	29	0	0	3	0
5	D	25	0	0	0	0
5	E	20	0	0	0	0
5	F	34	0	0	3	0
All	All	8104	0	7577	184	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 12.

The worst 5 of 184 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:E:159:THR:HG22	1:E:160:SER:H	0.97	1.13
1:F:159:THR:HG22	1:F:160:SER:H	0.89	1.06
1:F:159:THR:HG22	1:F:160:SER:N	1.71	1.04
1:E:159:THR:HG22	1:E:160:SER:N	1.70	1.02
4:A:1500:UNL:CMD	1:B:56:GLU:HB2	1.91	1.01

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	159/173 (92%)	156 (98%)	3 (2%)	0	100	100
1	B	160/173 (92%)	159 (99%)	1 (1%)	0	100	100
1	C	159/173 (92%)	156 (98%)	1 (1%)	2 (1%)	9	21
1	D	159/173 (92%)	157 (99%)	2 (1%)	0	100	100
1	E	159/173 (92%)	156 (98%)	3 (2%)	0	100	100
1	F	159/173 (92%)	155 (98%)	4 (2%)	0	100	100
All	All	955/1038 (92%)	939 (98%)	14 (2%)	2 (0%)	43	66

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	161	ALA
1	C	160	SER

### 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	142/148 (96%)	140 (99%)	2 (1%)	59	81
1	B	142/148 (96%)	139 (98%)	3 (2%)	47	73
1	C	143/148 (97%)	139 (97%)	4 (3%)	38	66
1	D	142/148 (96%)	138 (97%)	4 (3%)	38	66
1	E	143/148 (97%)	140 (98%)	3 (2%)	47	73

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	F	142/148 (96%)	139 (98%)	3 (2%)	47	73
All	All	854/888 (96%)	835 (98%)	19 (2%)	45	72

5 of 19 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	77	LEU
1	F	68	LEU
1	F	78	ARG
1	F	50	ASP
1	C	160	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	43	HIS
1	F	72	GLN
1	B	72	GLN
1	C	43	HIS
1	E	72	GLN

### 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 oligosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

Of 18 ligands modelled in this entry, 12 are monoatomic and 6 are unknown - 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

There are no such residues in this entry.

## 5.8 Polymer linkage issues

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, 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	157/173 (90%)	-0.03	4 (2%) 58 52	16, 29, 36, 54	3 (1%)
1	B	157/173 (90%)	0.03	6 (3%) 44 38	15, 29, 36, 47	4 (2%)
1	C	157/173 (90%)	0.07	4 (2%) 58 52	17, 30, 37, 46	3 (1%)
1	D	157/173 (90%)	0.11	3 (1%) 66 61	16, 30, 38, 51	3 (1%)
1	E	157/173 (90%)	0.05	8 (5%) 33 28	16, 30, 37, 47	3 (1%)
1	F	157/173 (90%)	0.13	6 (3%) 44 38	16, 30, 37, 51	3 (1%)
All	All	942/1038 (90%)	0.06	31 (3%) 49 43	15, 30, 37, 54	19 (2%)

The worst 5 of 31 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	162	TRP	13.2
1	F	162	TRP	11.4
1	F	161	ALA	11.3
1	D	162	TRP	10.8
1	C	161	ALA	9.9

### 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 oligosaccharides in this entry.

## 6.4 Ligands

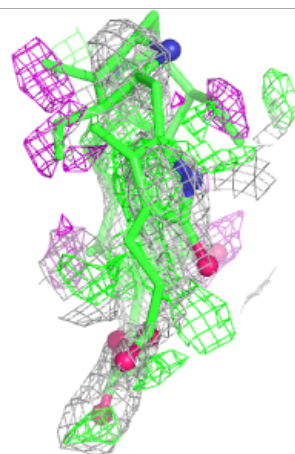
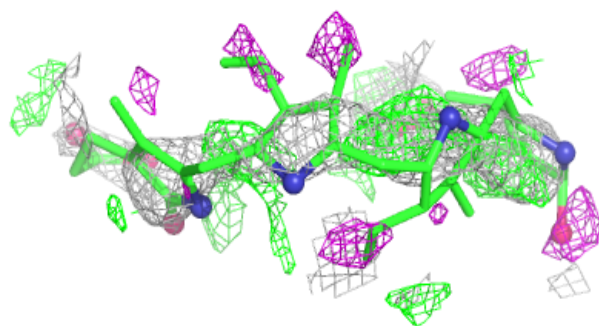
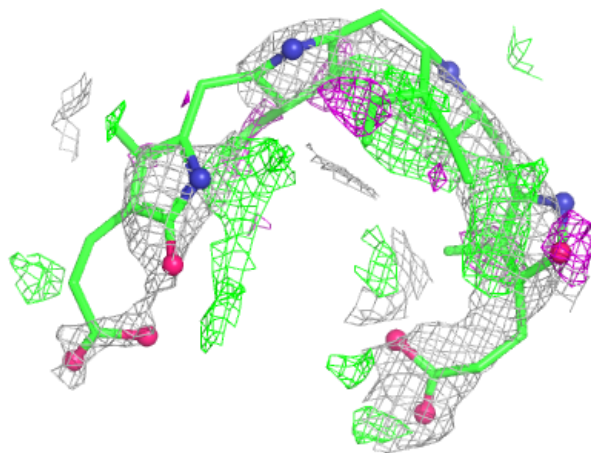
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

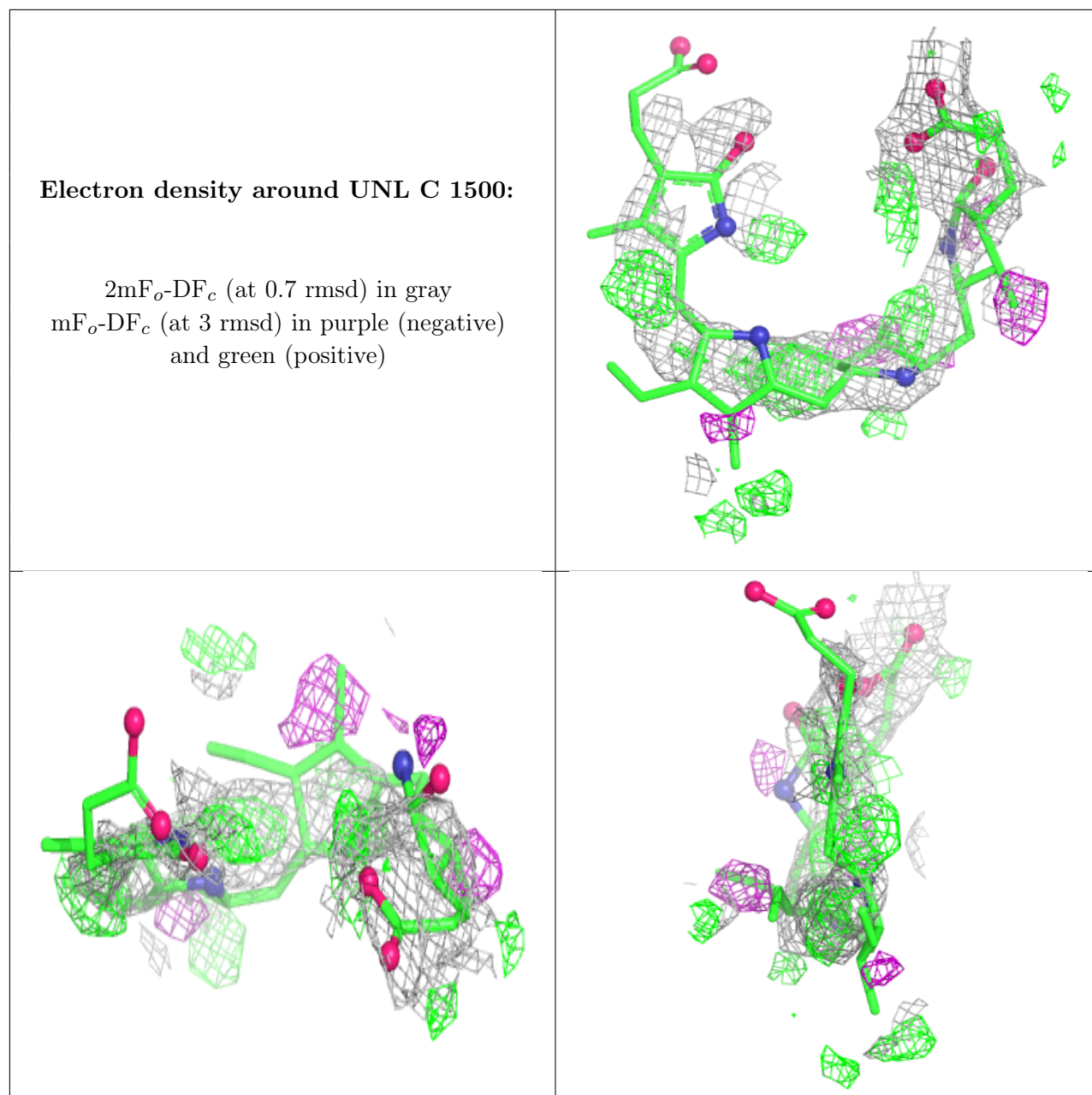
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	FE	F	202	1/1	0.62	0.23	39,39,39,39	1
2	FE	D	202	1/1	0.66	0.22	46,46,46,46	1
2	FE	B	201	1/1	0.67	0.21	34,34,34,34	1
4	UNL	E	1500	43/-	0.67	0.42	31,33,36,37	43
4	UNL	C	1500	43/-	0.69	0.40	32,33,37,39	43
2	FE	E	201	1/1	0.70	0.20	33,33,33,33	1
2	FE	F	201	1/1	0.72	0.21	33,33,33,33	1
4	UNL	A	1500	43/-	0.74	0.37	28,31,36,37	43
2	FE	D	201	1/1	0.77	0.19	36,36,36,36	1
2	FE	C	201	1/1	0.77	0.24	35,35,35,35	1
2	FE	A	201	1/1	0.81	0.21	33,33,33,33	1
2	FE	B	202	1/1	0.83	0.12	35,35,35,35	1
2	FE	C	202	1/1	0.84	0.14	48,48,48,48	1
2	FE	E	202	1/1	0.88	0.17	42,42,42,42	1
3	UNX	E	1001	1/1	0.95	0.11	20,20,20,20	1
2	FE	A	202	1/1	0.95	0.07	34,34,34,34	1
3	UNX	A	1001	1/1	0.99	0.10	17,17,17,17	1
3	UNX	A	1002	1/1	0.99	0.08	23,23,23,23	1

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

**Electron density around UNL E 1500:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





## 6.5 Other polymers [i](#)

There are no such residues in this entry.