



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 4, 2026 – 09:23 PM UTC

PDB ID : 8FMO / pdb\_00008fmo  
Title : Complex structure of K210 deletion Troponin complex with risedronate  
Authors : Wang, P.; Ahmed, M.; Sadek, H.  
Deposited on : 2022-12-24  
Resolution : 2.61 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)

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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  
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

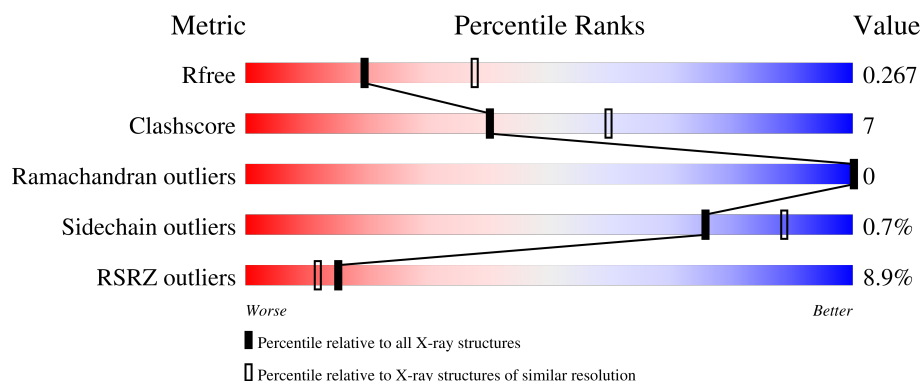
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.61 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	4951 (2.64-2.60)
Clashscore	190562	5303 (2.64-2.60)
Ramachandran outliers	187476	5217 (2.64-2.60)
Sidechain outliers	187428	5217 (2.64-2.60)
RSRZ outliers	180081	4950 (2.64-2.60)

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	164	<div> <div>5%</div> <div>85%</div> <div>10%</div> <div>5%</div> </div>
1	D	164	<div> <div>14%</div> <div>84%</div> <div>12%</div> <div>...</div> </div>
2	B	108	<div> <div>4%</div> <div>47%</div> <div>15%</div> <div>38%</div> </div>
2	E	108	<div> <div>6%</div> <div>52%</div> <div>10%</div> <div>38%</div> </div>
3	C	135	<div> <div>7%</div> <div>58%</div> <div>19%</div> <div>23%</div> </div>

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Mol	Chain	Length	Quality of chain
3	F	135	<div><div></div><div>6%</div><div>68%</div><div>13%</div><div>19%</div></div>

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5425 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 Troponin C, slow skeletal and cardiac muscles.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	156	Total	C	N	O	S	0	0	0
			1242	771	189	271	11			
1	D	158	Total	C	N	O	S	0	0	0
			1260	783	193	273	11			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	GLN	-	expression tag	UNP P63316
A	-1	GLY	-	expression tag	UNP P63316
A	0	SER	-	expression tag	UNP P63316
A	35	SER	CYS	conflict	UNP P63316
A	84	SER	CYS	conflict	UNP P63316
A	115	GLU	ASP	conflict	UNP P63316
D	-2	GLN	-	expression tag	UNP P63316
D	-1	GLY	-	expression tag	UNP P63316
D	0	SER	-	expression tag	UNP P63316
D	35	SER	CYS	conflict	UNP P63316
D	84	SER	CYS	conflict	UNP P63316
D	115	GLU	ASP	conflict	UNP P63316

- Molecule 2 is a protein called Troponin T, cardiac muscle.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	67	Total	C	N	O	0	0	0
			585	367	110	108			
2	E	67	Total	C	N	O	0	0	0
			585	367	110	108			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	180	GLN	-	expression tag	UNP P45379
B	181	GLY	-	expression tag	UNP P45379
B	182	SER	-	expression tag	UNP P45379
E	180	GLN	-	expression tag	UNP P45379
E	181	GLY	-	expression tag	UNP P45379
E	182	SER	-	expression tag	UNP P45379

- Molecule 3 is a protein called Troponin I, cardiac muscle.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	104	Total	C	N	O	S	0	0	0
			830	515	151	162	2			
3	F	109	Total	C	N	O	S	0	0	0
			862	534	159	167	2			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	80	ALA	CYS	conflict	UNP P19429
C	97	ALA	CYS	conflict	UNP P19429
F	80	ALA	CYS	conflict	UNP P19429
F	97	ALA	CYS	conflict	UNP P19429

- Molecule 4 is CALCIUM ION (CCD ID: CA) (formula: Ca) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	3	Total	Ca	0	0
			3	3		
4	D	3	Total	Ca	0	0
			3	3		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	9	Total	O	0	0
			9	9		
5	B	4	Total	O	0	0
			4	4		
5	C	6	Total	O	0	0
			6	6		
5	D	13	Total	O	0	0
			13	13		

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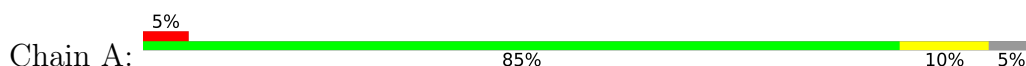
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	E	12	Total	O	0	0
			12	12		
5	F	11	Total	O	0	0
			11	11		

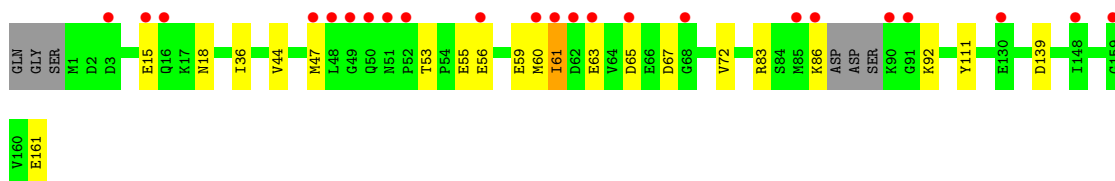
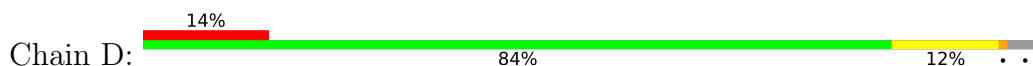
### 3 Residue-property plots

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.

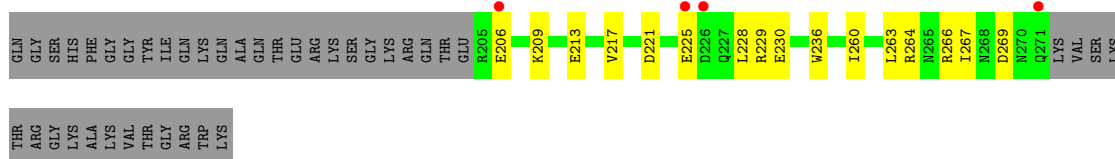
- Molecule 1: Troponin C, slow skeletal and cardiac muscles



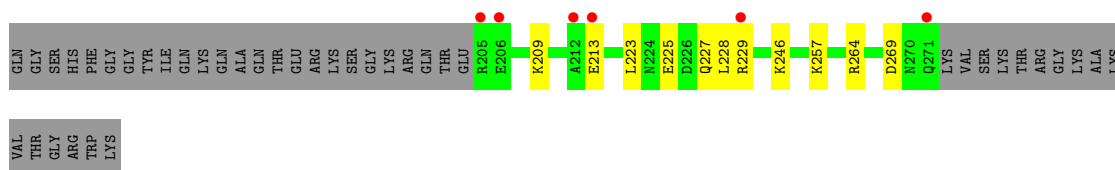
- Molecule 1: Troponin C, slow skeletal and cardiac muscles



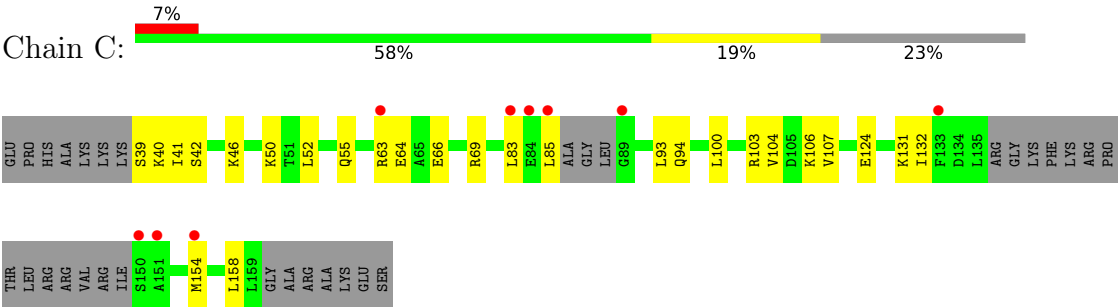
- Molecule 2: Troponin T, cardiac muscle



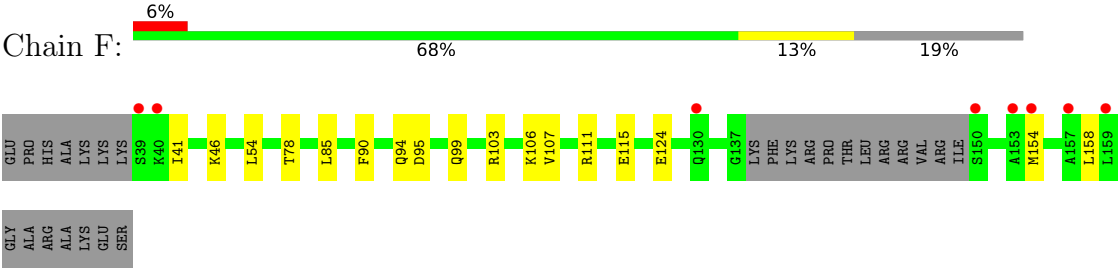
- Molecule 2: Troponin T, cardiac muscle



- Molecule 3: Troponin I, cardiac muscle



● Molecule 3: Troponin I, cardiac muscle





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	39.38Å 169.30Å 69.41Å 90.00° 102.12° 90.00°	Depositor
Resolution (Å)	43.39 – 2.61 43.39 – 2.61	Depositor EDS
% Data completeness (in resolution range)	87.8 (43.39-2.61) 87.9 (43.39-2.61)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.91 (at 2.61Å)	Xtriage
Refinement program	PHENIX 1.15.2_3472	Depositor
R, $R_{free}$	0.215 , 0.262 0.222 , 0.267	Depositor DCC
$R_{free}$ test set	1128 reflections (4.19%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	37.4	Xtriage
Anisotropy	0.061	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 50.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.91	EDS
Total number of atoms	5425	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	53.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.54% 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: CA

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	0.22	0/1254	0.48	0/1675
1	D	0.27	0/1272	0.46	0/1697
2	B	0.25	0/591	0.54	1/786 (0.1%)
2	E	0.20	0/591	0.53	2/786 (0.3%)
3	C	0.35	0/832	0.60	1/1109 (0.1%)
3	F	0.29	0/865	0.45	0/1154
All	All	0.27	0/5405	0.50	4/7207 (0.1%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	209	LYS	CB-CA-C	-6.49	100.65	110.90
2	E	209	LYS	CG-CD-CE	5.89	124.86	111.30
2	B	213	GLU	CB-CG-CD	-5.53	103.20	112.60
3	C	106	LYS	CA-CB-CG	5.03	124.15	114.10

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	1242	0	1175	14	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	D	1260	0	1201	15	0
2	B	585	0	600	15	0
2	E	585	0	600	10	0
3	C	830	0	863	25	0
3	F	862	0	899	14	0
4	A	3	0	0	0	0
4	D	3	0	0	0	0
5	A	9	0	0	0	0
5	B	4	0	0	0	0
5	C	6	0	0	0	0
5	D	13	0	0	0	0
5	E	12	0	0	0	0
5	F	11	0	0	0	0
All	All	5425	0	5338	71	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 7.

The worst 5 of 71 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:D:61:ILE:HD13	1:D:72:VAL:HG23	1.62	0.82
1:D:53:THR:HG23	1:D:56:GLU:H	1.50	0.76
1:D:15:GLU:O	1:D:18:ASN:N	2.21	0.73
2:E:223:LEU:HB3	2:E:227:GLN:HG3	1.71	0.72
3:F:154:MET:HE3	3:F:158:LEU:HD12	1.73	0.70

There are no symmetry-related clashes.

## 5.3 Torsion angles ⓘ

### 5.3.1 Protein backbone ⓘ

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	152/164 (93%)	146 (96%)	6 (4%)	0	100	100
1	D	154/164 (94%)	146 (95%)	8 (5%)	0	100	100
2	B	65/108 (60%)	63 (97%)	2 (3%)	0	100	100
2	E	65/108 (60%)	63 (97%)	2 (3%)	0	100	100
3	C	98/135 (73%)	97 (99%)	1 (1%)	0	100	100
3	F	105/135 (78%)	104 (99%)	1 (1%)	0	100	100
All	All	639/814 (78%)	619 (97%)	20 (3%)	0	100	100

There are no Ramachandran outliers to report.

### 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	137/144 (95%)	137 (100%)	0	100	100
1	D	139/144 (96%)	137 (99%)	2 (1%)	59	80
2	B	63/96 (66%)	62 (98%)	1 (2%)	55	78
2	E	63/96 (66%)	63 (100%)	0	100	100
3	C	88/112 (79%)	87 (99%)	1 (1%)	65	83
3	F	90/112 (80%)	90 (100%)	0	100	100
All	All	580/704 (82%)	576 (99%)	4 (1%)	76	89

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	230	GLU
3	C	131	LYS
1	D	61	ILE
1	D	67	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	144	ASN
3	C	55	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 6 ligands modelled in this entry, 6 are 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, 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	156/164 (95%)	0.55	9 (5%)	29 24	23, 51, 87, 114	0
1	D	158/164 (96%)	0.78	23 (14%)	6 4	28, 57, 100, 107	0
2	B	67/108 (62%)	0.24	4 (5%)	27 23	26, 47, 78, 102	0
2	E	67/108 (62%)	0.31	6 (8%)	15 12	24, 44, 83, 122	0
3	C	104/135 (77%)	0.60	9 (8%)	16 12	28, 51, 80, 110	0
3	F	109/135 (80%)	0.40	8 (7%)	21 17	23, 45, 89, 118	0
All	All	661/814 (81%)	0.53	59 (8%)	15 12	23, 51, 91, 122	0

The worst 5 of 59 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	52	PRO	4.9
3	F	153	ALA	4.4
3	C	151	ALA	4.3
1	D	86	LYS	3.6
3	C	150	SER	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 oligosaccharides in this entry.

## 6.4 Ligands

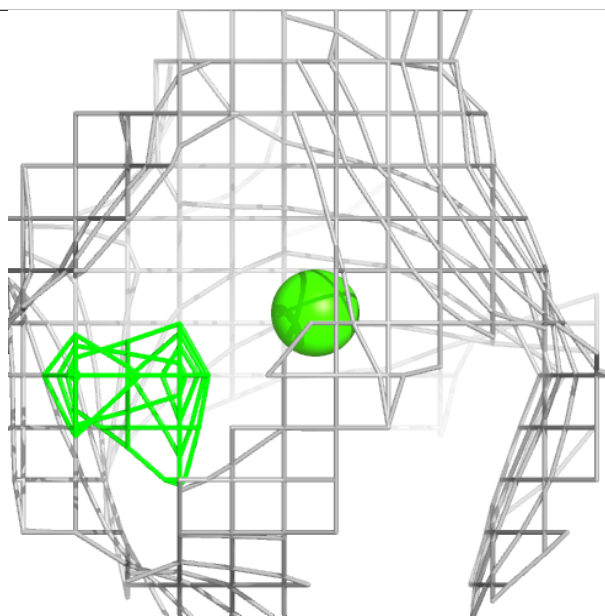
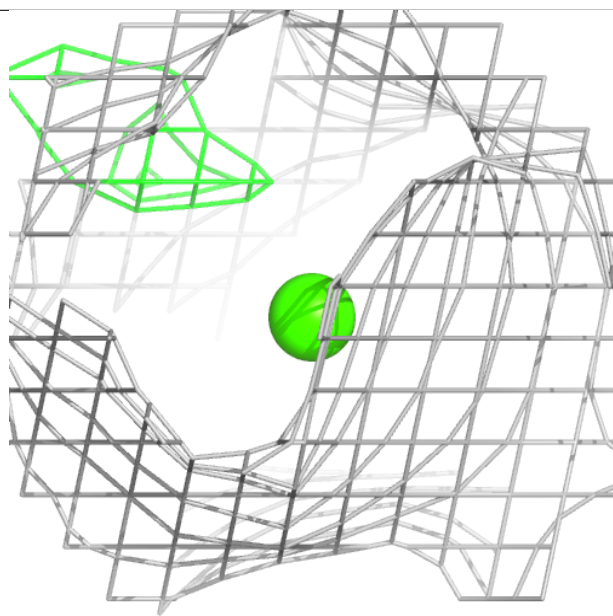
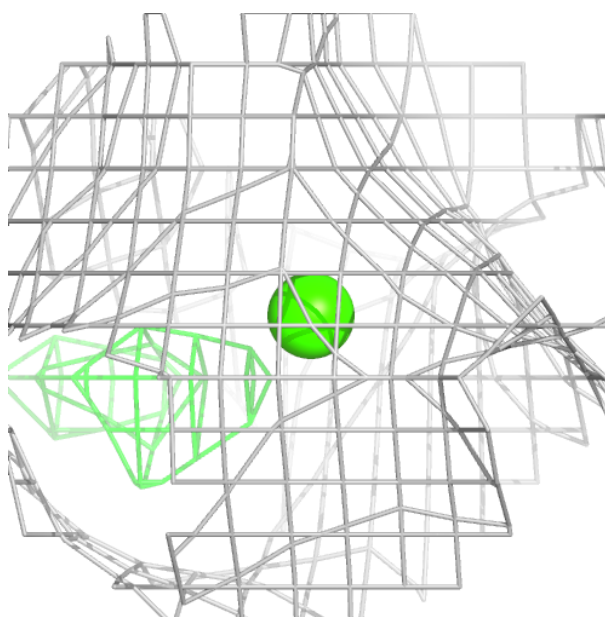
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
4	CA	D	201	1/1	0.95	0.08	69,69,69,69	0
4	CA	A	203	1/1	0.97	0.04	56,56,56,56	0
4	CA	A	201	1/1	0.97	0.10	47,47,47,47	0
4	CA	A	202	1/1	0.98	0.04	43,43,43,43	0
4	CA	D	202	1/1	0.98	0.03	41,41,41,41	0
4	CA	D	203	1/1	0.98	0.05	52,52,52,52	0

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 CA D 201:**

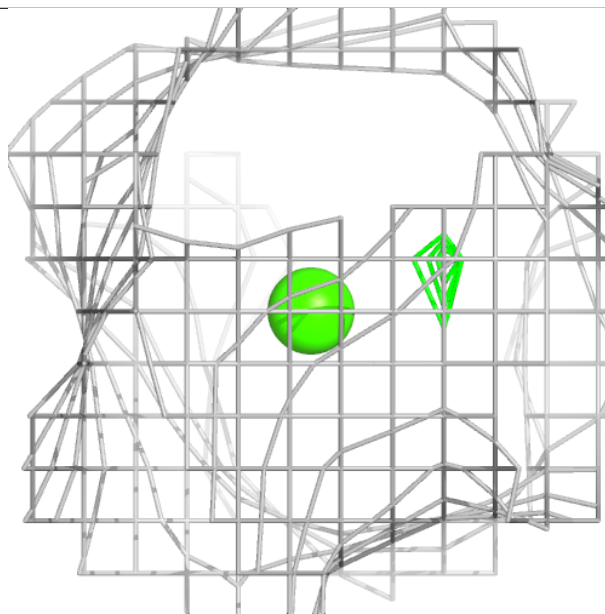
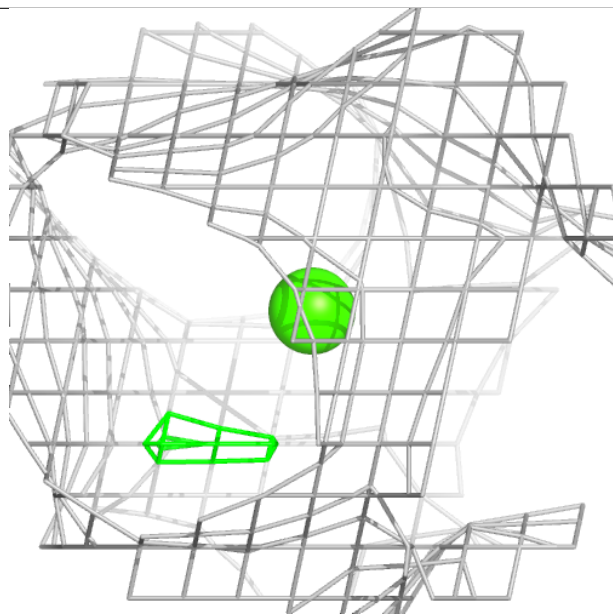
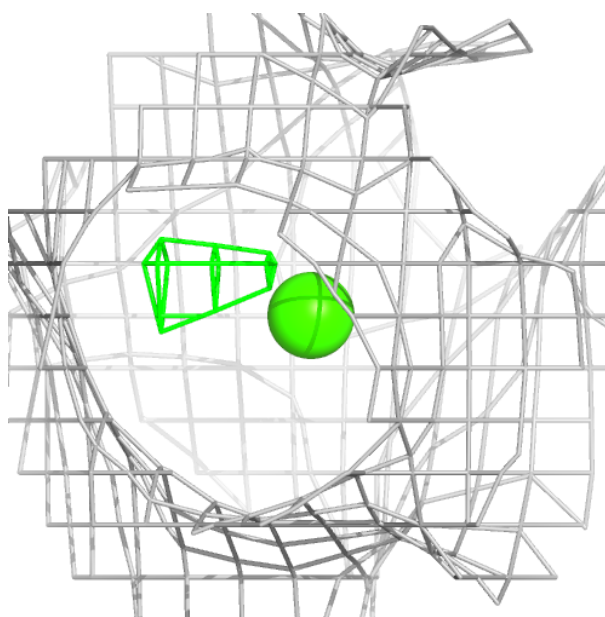
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





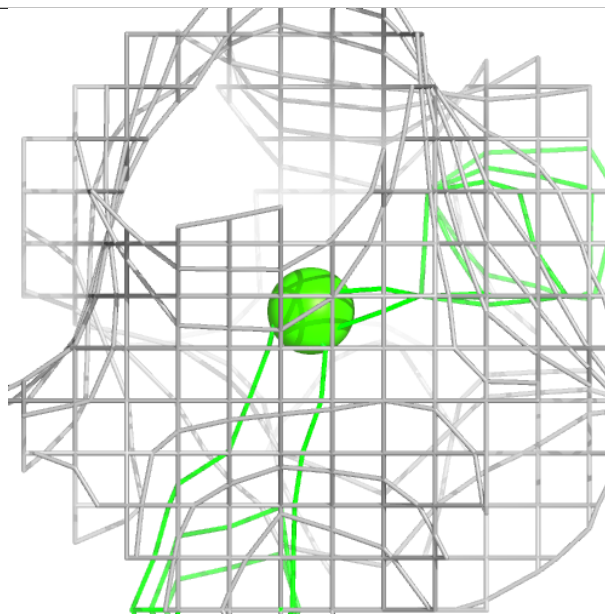
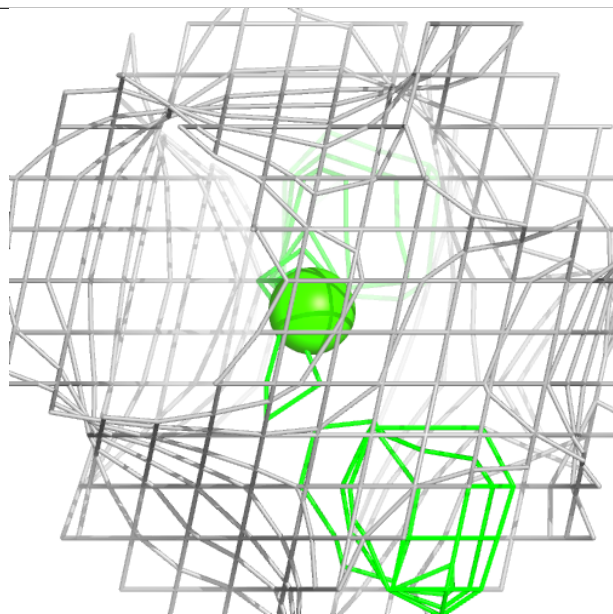
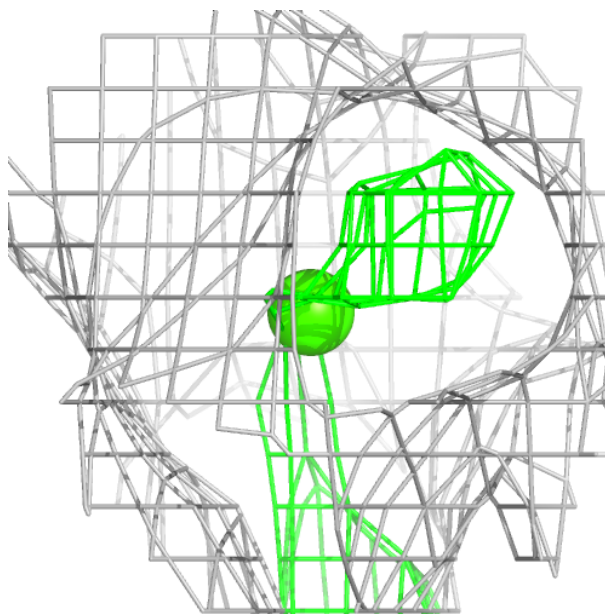
**Electron density around CA A 203:**

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



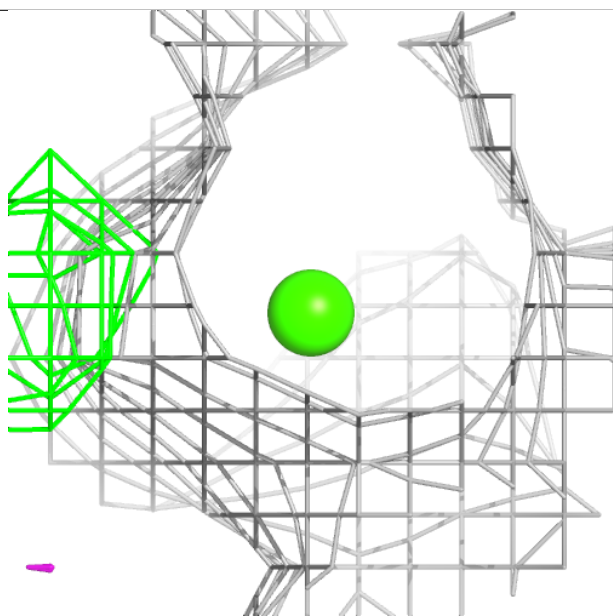
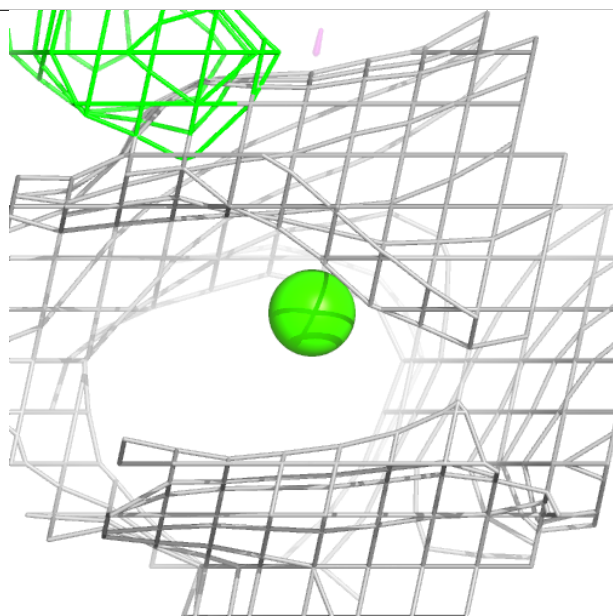
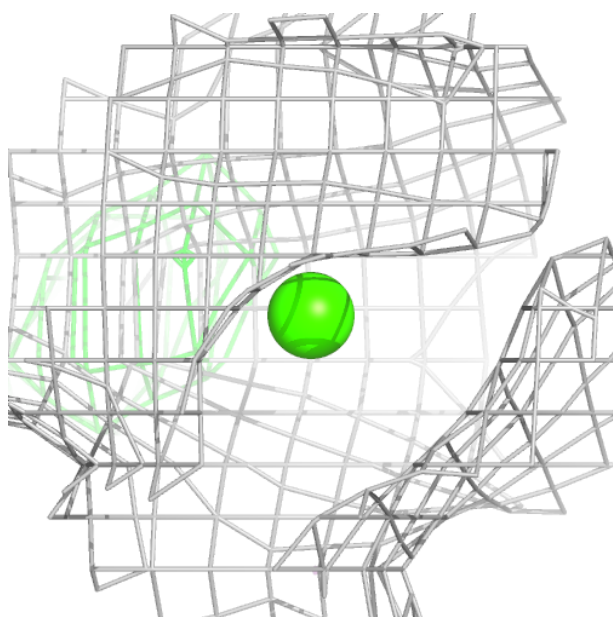
**Electron density around CA A 201:**

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



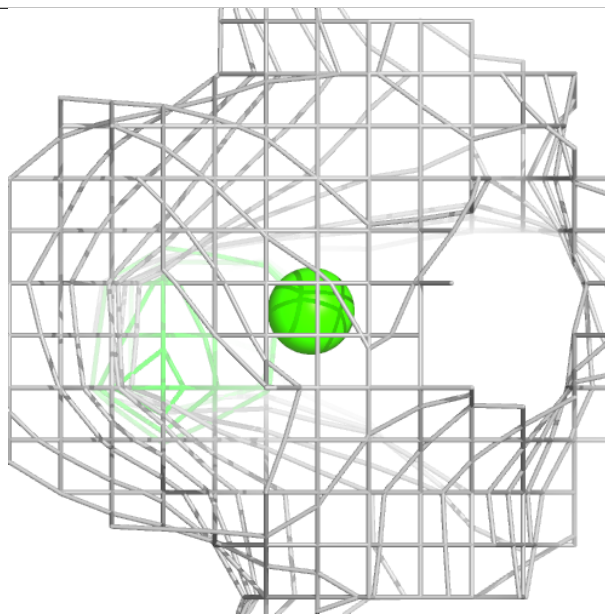
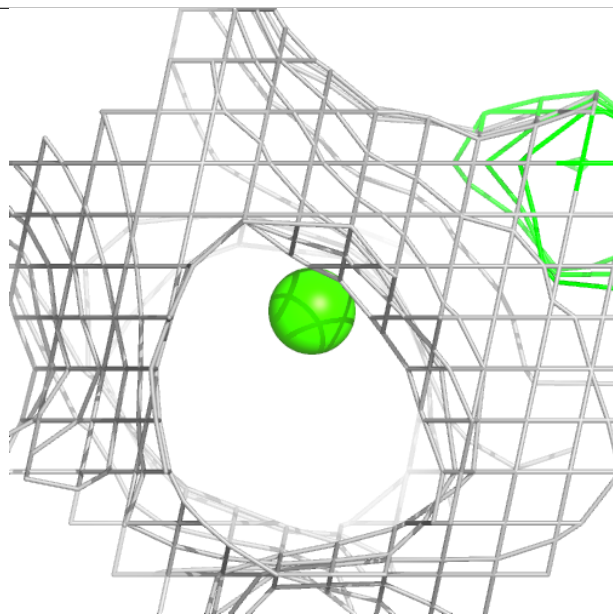
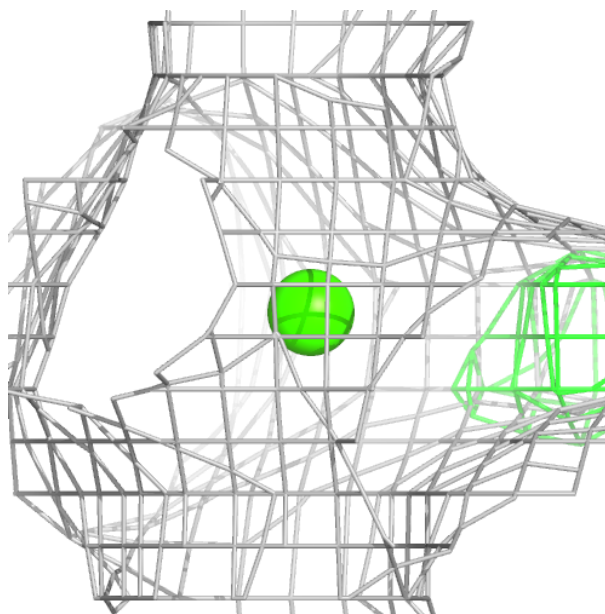
**Electron density around CA A 202:**

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



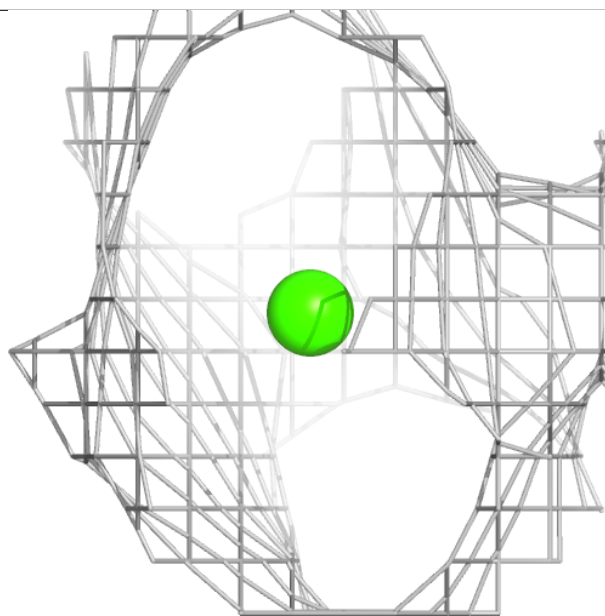
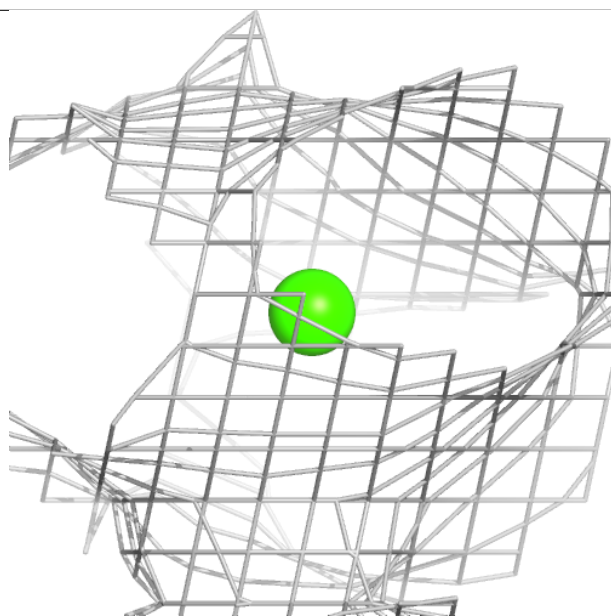
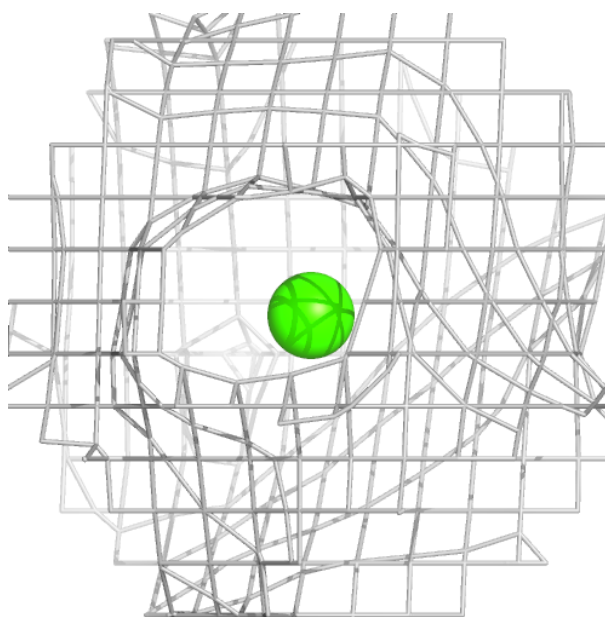
**Electron density around CA D 202:**

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



**Electron density around CA D 203:**

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



## 6.5 Other polymers ⓘ

There are no such residues in this entry.