



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 4, 2026 – 11:17 PM UTC

PDB ID : 3OFT / pdb_00003oft
Title : Crystal Structure of Cytochrome P450 CYP101C1
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Wong, L.-L.; Rao, Z.
Deposited on : 2010-08-16
Resolution : 1.90 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

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>.

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
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
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

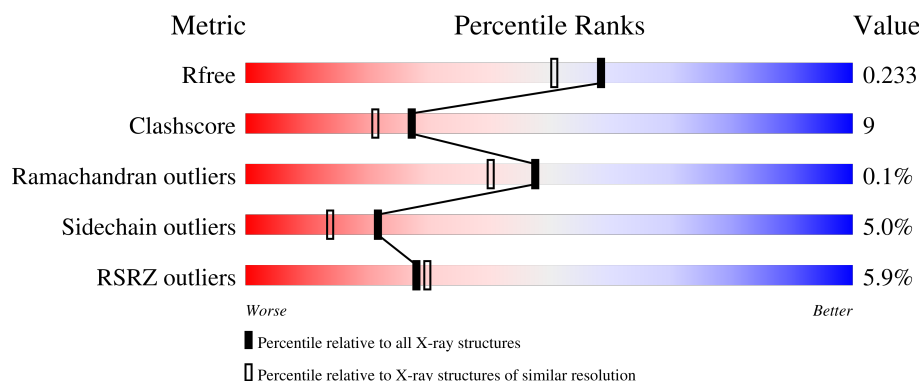
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 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	7789 (1.90-1.90)
Clashscore	190562	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (1.90-1.90)

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 $\leq 5\%$. 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	396	<div> <div>4%</div> <div>83%</div> <div>16%</div> <div>.</div> </div>
1	B	396	<div> <div>2%</div> <div>83%</div> <div>15%</div> <div>..</div> </div>
1	C	396	<div> <div>12%</div> <div>79%</div> <div>17%</div> <div>..</div> </div>

2 Entry composition [i](#)

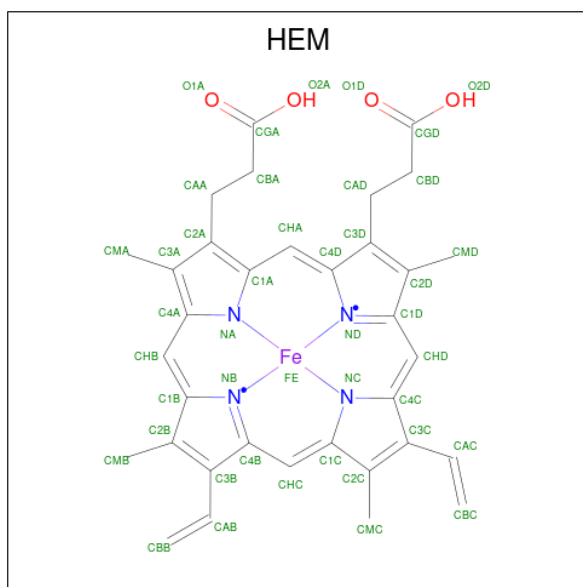
There are 4 unique types of molecules in this entry. The entry contains 10470 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Cytochrome P450.

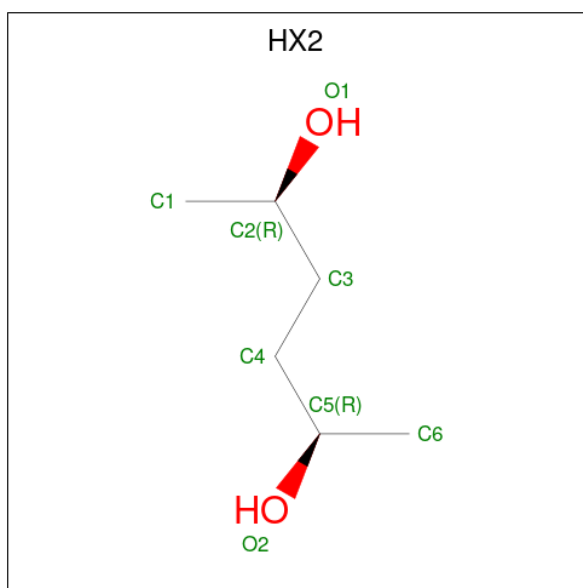
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	396	Total	C	N	O	S	0	0	0
			3068	1950	552	547	19			
1	B	393	Total	C	N	O	S	0	0	0
			3049	1939	549	542	19			
1	C	390	Total	C	N	O	S	0	0	0
			3025	1926	543	537	19			

- Molecule 2 is PROTOPORPHYRIN IX CONTAINING FE (CCD ID: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
2	B	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
2	C	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

- Molecule 3 is (2R,5R)-hexane-2,5-diol (CCD ID: HX2) (formula: $C_6H_{14}O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			8	6	2		
3	B	1	Total	C	O	0	0
			8	6	2		
3	C	1	Total	C	O	0	0
			8	6	2		

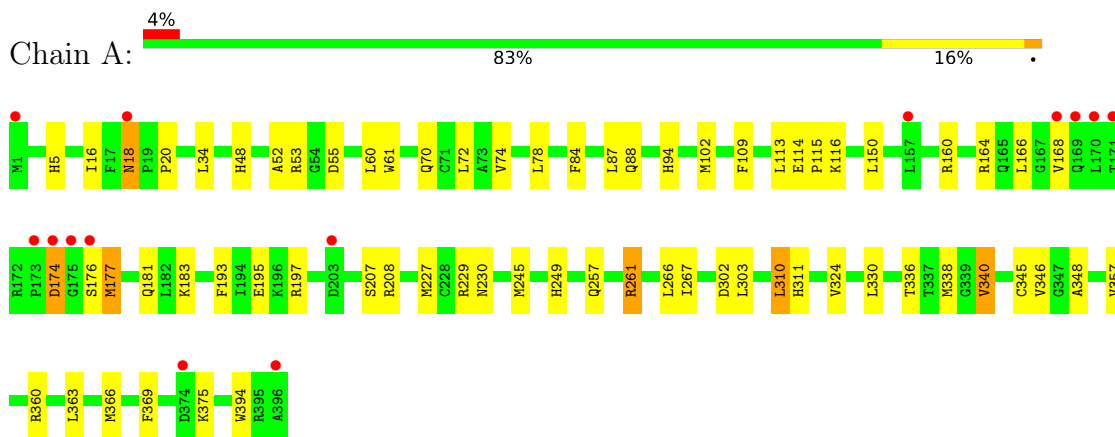
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	437	Total	O	0	0
			437	437		
4	B	431	Total	O	0	0
			431	431		
4	C	307	Total	O	0	0
			307	307		

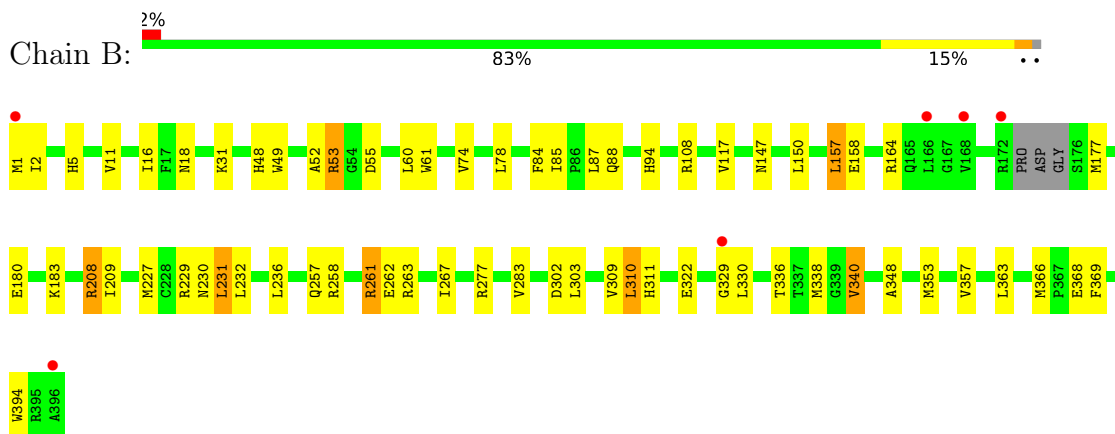
3 Residue-property plots [i](#)

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.

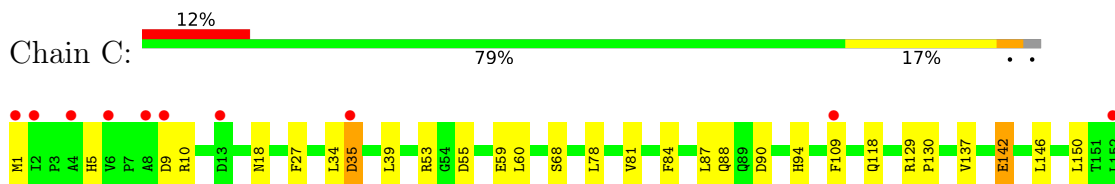
• Molecule 1: Cytochrome P450

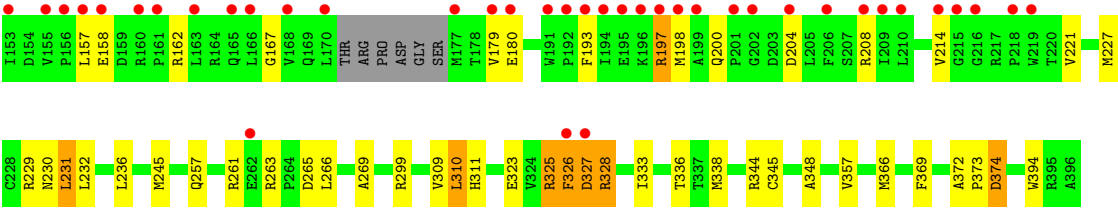


• Molecule 1: Cytochrome P450



• Molecule 1: Cytochrome P450





4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	57.99Å 150.15Å 68.45Å 90.00° 99.89° 90.00°	Depositor
Resolution (Å)	50.00 – 1.90 50.00 – 1.90	Depositor EDS
% Data completeness (in resolution range)	95.0 (50.00-1.90) 99.0 (50.00-1.90)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	0.10	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.43 (at 1.89Å)	Xtriage
Refinement program	REFMAC 5.5.0110	Depositor
R, R_{free}	0.174 , 0.232 0.174 , 0.233	Depositor DCC
R_{free} test set	4494 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å ²)	16.9	Xtriage
Anisotropy	0.232	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 43.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	10470	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.98% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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 ⓘ

5.1 Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: HEM, HX2

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	0.94	1/3140 (0.0%)	1.02	3/4269 (0.1%)
1	B	0.96	2/3119 (0.1%)	1.01	6/4238 (0.1%)
1	C	0.86	0/3095	1.01	10/4206 (0.2%)
All	All	0.92	3/9354 (0.0%)	1.01	19/12713 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	B	0	1
1	C	0	1
All	All	0	2

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	267	ILE	CA-CB	5.67	1.57	1.53
1	B	209	ILE	CA-CB	-5.60	1.47	1.54
1	A	267	ILE	CA-CB	5.28	1.57	1.54

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	330	LEU	N-CA-C	8.85	123.66	107.99
1	B	261	ARG	NE-CZ-NH2	-8.80	111.28	119.20
1	A	261	ARG	NE-CZ-NH2	-8.75	111.32	119.20
1	B	261	ARG	NE-CZ-NH1	7.23	128.73	121.50
1	A	261	ARG	NE-CZ-NH1	7.00	128.50	121.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	328	ARG	N-CA-C	6.63	118.16	111.07
1	C	18	ASN	CA-C-N	6.17	124.17	119.66
1	C	18	ASN	C-N-CA	6.17	124.17	119.66
1	C	372	ALA	CA-C-N	-5.76	114.03	119.85
1	C	372	ALA	C-N-CA	-5.76	114.03	119.85
1	C	325	ARG	CA-C-N	-5.72	113.15	122.65
1	C	325	ARG	C-N-CA	-5.72	113.15	122.65
1	B	53	ARG	NE-CZ-NH2	-5.65	114.11	119.20
1	B	261	ARG	CD-NE-CZ	5.47	132.06	124.40
1	C	326	PHE	N-CA-CB	5.34	117.93	110.56
1	C	18	ASN	N-CA-C	5.28	118.00	108.55
1	A	261	ARG	CD-NE-CZ	5.25	131.75	124.40
1	B	277	ARG	N-CA-C	5.12	117.75	111.82
1	C	35	ASP	N-CA-CB	5.07	119.34	110.42

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	329	GLY	Peptide
1	C	327	ASP	Peptide

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	3068	0	3088	50	0
1	B	3049	0	3073	52	0
1	C	3025	0	3048	63	0
2	A	43	0	30	2	0
2	B	43	0	30	3	0
2	C	43	0	30	2	0
3	A	8	0	14	0	0
3	B	8	0	14	5	0
3	C	8	0	14	0	0
4	A	437	0	0	13	0
4	B	431	0	0	9	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	C	307	0	0	8	0
All	All	10470	0	9341	169	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 9.

All (169) 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:C:55:ASP:O	1:C:59:GLU:HG3	1.50	1.09
1:A:53:ARG:HD2	1:A:55:ASP:OD1	1.55	1.06
1:B:283:VAL:HG12	3:B:397:HX2:H6B	1.06	1.05
1:B:283:VAL:HG12	3:B:397:HX2:C6	1.88	1.03
1:A:261:ARG:HD3	1:A:363:LEU:O	1.62	0.99
1:C:53:ARG:HD2	1:C:55:ASP:OD1	1.64	0.96
1:B:53:ARG:HD2	1:B:55:ASP:OD1	1.65	0.94
1:C:257:GLN:HE21	1:C:261:ARG:HH22	1.11	0.92
1:C:257:GLN:HE21	1:C:261:ARG:NH2	1.65	0.92
1:B:108:ARG:HD3	4:B:874:HOH:O	1.70	0.89
1:A:257:GLN:HE21	1:A:261:ARG:HH22	1.21	0.88
1:B:257:GLN:HE21	1:B:261:ARG:HH22	1.19	0.86
1:A:245:MET:HE3	4:A:596:HOH:O	1.78	0.83
1:C:78:LEU:HD12	1:C:179:VAL:HG21	1.59	0.83
1:A:208:ARG:HD3	4:A:895:HOH:O	1.76	0.82
1:C:257:GLN:NE2	1:C:261:ARG:HH22	1.76	0.82
1:C:55:ASP:O	1:C:59:GLU:CG	2.28	0.81
1:C:245:MET:HE3	4:C:481:HOH:O	1.78	0.81
1:C:5:HIS:CD2	1:C:299:ARG:HD3	2.19	0.77
1:C:84:PHE:HE1	1:C:229:ARG:HG2	1.50	0.77
1:C:137:VAL:O	1:C:142:GLU:HG2	1.86	0.74
1:C:78:LEU:CD1	1:C:179:VAL:HG21	2.18	0.74
1:B:257:GLN:HE21	1:B:261:ARG:NH2	1.85	0.74
1:A:257:GLN:HE21	1:A:261:ARG:NH2	1.86	0.73
1:A:338:MET:HE2	1:A:348:ALA:HA	1.70	0.73
1:C:84:PHE:CE1	1:C:229:ARG:HG2	2.24	0.73
1:B:147:ASN:OD1	1:B:164:ARG:HD3	1.89	0.72
1:C:326:PHE:O	1:C:326:PHE:CG	2.43	0.71
1:C:257:GLN:NE2	1:C:261:ARG:NH2	2.38	0.69
1:A:245:MET:CE	4:A:596:HOH:O	2.39	0.68
1:B:257:GLN:NE2	1:B:261:ARG:HH22	1.92	0.68
1:A:193:PHE:HA	1:A:197:ARG:HH21	1.58	0.68

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:174:ASP:N	1:A:174:ASP:OD1	2.29	0.66
3:B:397:HX2:H6A	4:B:519:HOH:O	1.95	0.66
1:B:261:ARG:HD3	1:B:363:LEU:O	1.95	0.66
1:C:373:PRO:O	1:C:374:ASP:OD1	2.12	0.66
1:A:197:ARG:HG2	1:A:207:SER:OG	1.97	0.65
1:B:283:VAL:CG1	3:B:397:HX2:H6B	2.02	0.64
1:A:53:ARG:CD	1:A:55:ASP:OD1	2.40	0.64
1:A:16:ILE:HD11	1:A:74:VAL:HG21	1.80	0.64
1:B:117:VAL:HG12	1:B:357:VAL:HG21	1.80	0.63
1:C:323:GLU:OE1	1:C:325:ARG:NH1	2.30	0.63
1:A:360:ARG:NE	4:A:571:HOH:O	2.31	0.63
1:B:5:HIS:HE1	1:B:302:ASP:OD1	1.81	0.62
1:A:257:GLN:NE2	1:A:261:ARG:HH22	1.94	0.61
1:C:257:GLN:HE22	1:C:369:PHE:H	1.48	0.61
1:B:257:GLN:HE22	1:B:369:PHE:H	1.48	0.61
1:A:5:HIS:HE1	1:A:302:ASP:OD1	1.83	0.61
1:A:338:MET:HE3	1:A:345:CYS:CB	2.30	0.61
1:A:84:PHE:H	1:A:88:GLN:NE2	1.99	0.60
1:B:208:ARG:HH11	1:B:208:ARG:HG2	1.67	0.60
1:B:227:MET:SD	1:B:231:LEU:HD22	2.42	0.59
2:A:417:HEM:HMB2	2:A:417:HEM:HBB2	1.84	0.59
1:C:87:LEU:HB2	1:C:230:ASN:HD21	1.66	0.59
1:C:197:ARG:HD3	1:C:204:ASP:OD1	2.02	0.59
2:B:417:HEM:HBB2	2:B:417:HEM:HMB1	1.86	0.58
1:B:94:HIS:HE1	2:B:417:HEM:O2D	1.86	0.58
1:A:109:PHE:CZ	1:A:113:LEU:HD11	2.39	0.57
1:A:257:GLN:HE22	1:A:369:PHE:H	1.51	0.57
1:A:84:PHE:HE1	1:A:229:ARG:HG2	1.69	0.57
1:B:52:ALA:HA	1:B:310:LEU:HD23	1.85	0.57
1:A:94:HIS:HE1	2:A:417:HEM:O2D	1.88	0.56
1:A:48:HIS:HE1	4:A:413:HOH:O	1.88	0.56
1:C:53:ARG:CD	1:C:55:ASP:OD1	2.48	0.55
1:A:94:HIS:HD2	4:A:476:HOH:O	1.88	0.55
1:A:102:MET:HG2	1:A:346:VAL:HG12	1.87	0.55
1:B:258:ARG:NH1	1:B:368:GLU:OE2	2.39	0.55
1:C:27:PHE:CE2	1:C:245:MET:HE2	2.42	0.55
1:A:338:MET:HE3	1:A:345:CYS:HB3	1.89	0.55
1:C:94:HIS:HE1	2:C:417:HEM:O2D	1.89	0.55
1:B:84:PHE:HE1	1:B:229:ARG:HG2	1.72	0.55
1:B:311:HIS:CD2	1:B:336:THR:OG1	2.60	0.54
1:C:162:ARG:HB2	4:C:575:HOH:O	2.07	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:18:ASN:ND2	4:A:450:HOH:O	2.40	0.54
1:B:262:GLU:HG3	4:C:600:HOH:O	2.08	0.54
1:B:5:HIS:HD2	4:B:621:HOH:O	1.91	0.54
1:C:94:HIS:HD2	4:C:502:HOH:O	1.91	0.53
1:B:48:HIS:HE1	4:B:438:HOH:O	1.91	0.52
2:B:417:HEM:HBB2	2:B:417:HEM:CMB	2.39	0.52
1:C:311:HIS:HE1	4:C:438:HOH:O	1.91	0.52
1:B:61:TRP:CG	1:B:340:VAL:HG13	2.45	0.52
1:A:5:HIS:CD2	1:A:5:HIS:H	2.27	0.52
1:C:309:VAL:HG13	1:C:310:LEU:HD13	1.91	0.52
1:C:326:PHE:O	1:C:327:ASP:C	2.51	0.52
1:B:16:ILE:HD11	1:B:74:VAL:HG21	1.91	0.51
1:C:269:ALA:HB1	1:C:326:PHE:CG	2.44	0.51
1:B:157:LEU:HD12	1:C:200:GLN:NE2	2.25	0.51
1:B:5:HIS:CD2	4:B:621:HOH:O	2.63	0.51
1:B:157:LEU:HD12	1:C:200:GLN:HE22	1.76	0.51
1:B:336:THR:HG23	1:B:340:VAL:HG12	1.92	0.51
1:C:344:ARG:NH2	4:C:494:HOH:O	2.35	0.51
1:A:176:SER:O	1:A:177:MET:C	2.53	0.50
1:C:193:PHE:HB3	1:C:197:ARG:HE	1.76	0.50
1:B:84:PHE:H	1:B:88:GLN:NE2	2.10	0.50
1:C:118:GLN:HA	1:C:357:VAL:HG13	1.94	0.50
1:B:53:ARG:CD	1:B:55:ASP:OD1	2.51	0.50
1:C:118:GLN:HA	1:C:357:VAL:CG1	2.42	0.50
1:C:129:ARG:N	1:C:130:PRO:CD	2.75	0.49
1:A:109:PHE:CE2	1:A:113:LEU:HD11	2.47	0.49
1:B:2:ILE:HD13	1:B:11:VAL:HG21	1.95	0.49
1:C:5:HIS:CG	1:C:299:ARG:HD3	2.47	0.49
1:C:232:LEU:O	1:C:236:LEU:HG	2.12	0.49
1:C:269:ALA:HB1	1:C:326:PHE:CD1	2.48	0.49
1:B:311:HIS:HD2	1:B:336:THR:OG1	1.96	0.49
1:B:87:LEU:HB2	1:B:230:ASN:HD21	1.77	0.48
1:C:326:PHE:C	1:C:328:ARG:N	2.71	0.48
1:A:116:LYS:NZ	4:A:1004:HOH:O	2.47	0.48
1:B:31:LYS:HE2	1:B:322:GLU:OE1	2.14	0.48
1:C:366:MET:HE1	1:C:394:TRP:CE2	2.48	0.47
1:B:87:LEU:H	1:B:230:ASN:ND2	2.12	0.47
1:B:85:ILE:C	1:B:230:ASN:HD22	2.22	0.47
1:B:366:MET:HE1	1:B:394:TRP:CE2	2.49	0.47
1:A:102:MET:SD	4:A:702:HOH:O	2.61	0.47
1:B:338:MET:HE2	1:B:348:ALA:HA	1.96	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:48:HIS:HD2	1:B:49:TRP:O	1.98	0.46
1:A:160:ARG:O	1:A:164:ARG:HB2	2.14	0.46
1:A:177:MET:HA	1:A:181:GLN:OE1	2.14	0.46
1:C:338:MET:HE2	1:C:348:ALA:HA	1.98	0.46
1:C:68:SER:OG	1:C:90:ASP:OD2	2.34	0.46
3:B:397:HX2:H6A	4:B:518:HOH:O	2.15	0.46
1:B:208:ARG:HH11	1:B:208:ARG:CG	2.28	0.46
1:C:146:LEU:HD21	1:C:167:GLY:HA3	1.98	0.46
1:C:263:ARG:HG3	1:C:265:ASP:OD1	2.16	0.46
1:A:366:MET:HE1	1:A:394:TRP:CE2	2.51	0.45
1:B:16:ILE:HD11	1:B:74:VAL:CG2	2.45	0.45
1:A:87:LEU:HB2	1:A:230:ASN:HD21	1.82	0.45
1:C:59:GLU:HG2	4:C:448:HOH:O	2.16	0.45
1:C:84:PHE:H	1:C:88:GLN:NE2	2.15	0.45
1:C:87:LEU:H	1:C:230:ASN:ND2	2.15	0.45
1:C:227:MET:SD	1:C:231:LEU:HD22	2.56	0.45
1:C:227:MET:HE3	1:C:227:MET:HB3	1.89	0.45
1:C:81:VAL:HG21	1:C:179:VAL:HG22	1.98	0.44
1:A:311:HIS:CD2	1:A:336:THR:OG1	2.70	0.44
1:C:81:VAL:HG21	1:C:179:VAL:CG2	2.48	0.44
1:A:336:THR:HG22	1:A:336:THR:O	2.17	0.44
1:A:61:TRP:HB3	1:A:340:VAL:HG13	2.00	0.44
1:A:109:PHE:CE2	1:A:208:ARG:NH2	2.86	0.44
1:B:309:VAL:HG13	1:B:310:LEU:HD13	1.97	0.44
1:B:117:VAL:HG21	1:B:353:MET:HE1	2.00	0.44
1:C:311:HIS:CD2	1:C:336:THR:OG1	2.71	0.44
1:C:336:THR:O	1:C:336:THR:HG22	2.18	0.43
1:C:338:MET:HE3	1:C:345:CYS:CB	2.48	0.43
2:C:417:HEM:HBB2	2:C:417:HEM:HMB2	1.99	0.43
1:A:48:HIS:CE1	4:A:413:HOH:O	2.67	0.43
1:C:27:PHE:HE2	1:C:245:MET:CE	2.30	0.43
1:B:5:HIS:CD2	1:B:5:HIS:H	2.37	0.43
1:C:109:PHE:HB3	4:C:692:HOH:O	2.18	0.43
1:A:52:ALA:HA	1:A:310:LEU:HD23	2.00	0.43
1:C:311:HIS:HD2	1:C:336:THR:OG1	2.02	0.43
1:C:326:PHE:O	1:C:326:PHE:CD2	2.72	0.42
1:A:375:LYS:NZ	4:A:430:HOH:O	2.52	0.42
1:B:61:TRP:HB3	1:B:340:VAL:HG13	2.01	0.42
1:A:5:HIS:CD2	4:A:463:HOH:O	2.72	0.42
1:A:72:LEU:HD23	1:A:78:LEU:HD22	2.01	0.42
1:C:193:PHE:O	1:C:197:ARG:HB2	2.20	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:198:MET:CE	1:C:221:VAL:HG22	2.49	0.42
1:B:1:MET:HA	4:B:1098:HOH:O	2.18	0.42
1:C:27:PHE:CE2	1:C:245:MET:CE	3.02	0.42
1:A:227:MET:HE3	1:A:227:MET:HB3	1.99	0.42
1:B:366:MET:HE1	1:B:394:TRP:CZ2	2.55	0.42
1:B:158:GLU:HB2	4:B:996:HOH:O	2.19	0.42
1:A:114:GLU:HB3	1:A:115:PRO:HD3	2.02	0.41
1:B:227:MET:HE3	1:B:227:MET:HB3	1.99	0.41
1:A:109:PHE:CZ	1:A:208:ARG:NH2	2.87	0.41
1:A:249:HIS:CE1	1:A:324:VAL:HG21	2.56	0.41
1:B:232:LEU:O	1:B:236:LEU:HG	2.20	0.41
1:C:10:ARG:HD2	1:C:39:LEU:O	2.20	0.41
1:A:20:PRO:HD3	4:A:583:HOH:O	2.21	0.40
1:B:311:HIS:HE1	4:B:1056:HOH:O	2.03	0.40

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	394/396 (100%)	382 (97%)	11 (3%)	1 (0%)	36	29
1	B	389/396 (98%)	379 (97%)	10 (3%)	0	100	100
1	C	386/396 (98%)	371 (96%)	15 (4%)	0	100	100
All	All	1169/1188 (98%)	1132 (97%)	36 (3%)	1 (0%)	48	40

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	177	MET

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	321/321 (100%)	305 (95%)	16 (5%)	22	14
1	B	319/321 (99%)	305 (96%)	14 (4%)	25	17
1	C	316/321 (98%)	298 (94%)	18 (6%)	18	11
All	All	956/963 (99%)	908 (95%)	48 (5%)	22	14

All (48) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	18	ASN
1	A	34	LEU
1	A	60	LEU
1	A	70	GLN
1	A	150	LEU
1	A	166	LEU
1	A	168	VAL
1	A	174	ASP
1	A	183	LYS
1	A	195	GLU
1	A	266	LEU
1	A	303	LEU
1	A	310	LEU
1	A	330	LEU
1	A	340	VAL
1	A	357	VAL
1	B	18	ASN
1	B	60	LEU
1	B	78	LEU
1	B	150	LEU
1	B	157	LEU
1	B	177	MET
1	B	180	GLU
1	B	183	LYS
1	B	208	ARG
1	B	231	LEU

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Mol	Chain	Res	Type
1	B	263	ARG
1	B	303	LEU
1	B	310	LEU
1	B	340	VAL
1	C	1	MET
1	C	9	ASP
1	C	34	LEU
1	C	35	ASP
1	C	60	LEU
1	C	142	GLU
1	C	150	LEU
1	C	157	LEU
1	C	158	GLU
1	C	180	GLU
1	C	197	ARG
1	C	208	ARG
1	C	214	VAL
1	C	231	LEU
1	C	266	LEU
1	C	310	LEU
1	C	333	ILE
1	C	374	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (35) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	5	HIS
1	A	18	ASN
1	A	24	GLN
1	A	45	ASN
1	A	48	HIS
1	A	70	GLN
1	A	88	GLN
1	A	94	HIS
1	A	184	GLN
1	A	230	ASN
1	A	257	GLN
1	A	286	ASN
1	A	311	HIS
1	A	383	ASN
1	B	5	HIS
1	B	45	ASN

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Mol	Chain	Res	Type
1	B	48	HIS
1	B	88	GLN
1	B	94	HIS
1	B	184	GLN
1	B	230	ASN
1	B	253	HIS
1	B	257	GLN
1	B	311	HIS
1	B	383	ASN
1	C	5	HIS
1	C	48	HIS
1	C	88	GLN
1	C	94	HIS
1	C	184	GLN
1	C	230	ASN
1	C	253	HIS
1	C	257	GLN
1	C	286	ASN
1	C	311	HIS

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](#)

6 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	HEM	B	417	4,1	50,50,50	1.76	10 (20%)	67,82,82	1.61	16 (23%)
3	HX2	A	397	-	7,7,7	0.52	0	8,8,8	0.42	0
2	HEM	A	417	4,1	50,50,50	1.89	13 (26%)	67,82,82	1.55	15 (22%)
3	HX2	B	397	-	7,7,7	0.32	0	8,8,8	1.59	1 (12%)
2	HEM	C	417	4,1	50,50,50	1.96	12 (24%)	67,82,82	1.51	11 (16%)
3	HX2	C	397	-	7,7,7	0.35	0	8,8,8	0.77	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	HEM	B	417	4,1	-	2/14/54/54	-
3	HX2	A	397	-	-	0/5/5/5	-
2	HEM	A	417	4,1	-	0/14/54/54	-
3	HX2	B	397	-	-	1/5/5/5	-
2	HEM	C	417	4,1	-	2/14/54/54	-
3	HX2	C	397	-	-	0/5/5/5	-

All (35) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	417	HEM	C3D-C2D	7.64	1.53	1.36
2	A	417	HEM	C3D-C2D	7.15	1.52	1.36
2	B	417	HEM	C3D-C2D	6.53	1.50	1.36
2	B	417	HEM	FE-NA	4.27	2.09	1.95
2	A	417	HEM	FE-ND	3.81	2.06	1.94
2	C	417	HEM	FE-ND	3.67	2.06	1.94
2	C	417	HEM	FE-NC	3.59	2.07	1.95
2	C	417	HEM	CMC-C2C	3.51	1.58	1.50
2	C	417	HEM	FE-NA	3.49	2.06	1.95
2	A	417	HEM	FE-NC	3.47	2.06	1.95
2	B	417	HEM	FE-NC	3.44	2.06	1.95
2	A	417	HEM	CMD-C2D	3.26	1.57	1.50
2	A	417	HEM	FE-NB	3.23	2.04	1.94
2	B	417	HEM	FE-NB	3.05	2.04	1.94
2	B	417	HEM	CAC-C3C	3.04	1.55	1.47

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	417	HEM	CAC-C3C	2.96	1.55	1.47
2	A	417	HEM	CMC-C2C	2.88	1.56	1.50
2	B	417	HEM	FE-ND	2.86	2.03	1.94
2	C	417	HEM	CAC-C3C	2.82	1.54	1.47
2	B	417	HEM	CMC-C2C	2.80	1.56	1.50
2	C	417	HEM	FE-NB	2.80	2.03	1.94
2	A	417	HEM	FE-NA	2.67	2.04	1.95
2	C	417	HEM	CAB-C3B	2.65	1.54	1.47
2	C	417	HEM	CMB-C2B	2.64	1.56	1.50
2	C	417	HEM	CMD-C2D	2.62	1.56	1.50
2	B	417	HEM	CMD-C2D	2.51	1.55	1.50
2	C	417	HEM	CMA-C3A	2.47	1.55	1.50
2	A	417	HEM	CAB-C3B	2.33	1.53	1.47
2	B	417	HEM	CAB-C3B	2.29	1.53	1.47
2	A	417	HEM	CMA-C3A	2.25	1.55	1.50
2	A	417	HEM	C4B-NB	-2.21	1.34	1.38
2	A	417	HEM	C2A-C3A	-2.16	1.33	1.38
2	A	417	HEM	O2D-CGD	-2.06	1.24	1.30
2	B	417	HEM	CMB-C2B	2.04	1.55	1.50
2	C	417	HEM	C2A-C3A	-2.02	1.33	1.38

All (43) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	417	HEM	C4D-ND-C1D	5.25	111.42	105.21
2	C	417	HEM	C4D-ND-C1D	4.63	110.69	105.21
2	B	417	HEM	CHD-C4C-NC	3.88	128.68	124.45
3	B	397	HX2	C3-C4-C5	-3.81	107.83	113.10
2	C	417	HEM	C3B-C4B-NB	-3.69	106.82	109.47
2	B	417	HEM	C4D-ND-C1D	3.49	109.34	105.21
2	C	417	HEM	CHC-C4B-NB	3.28	127.95	124.42
2	B	417	HEM	C2A-C1A-NA	-3.15	106.65	110.15
2	A	417	HEM	CAD-CBD-CGD	-2.99	105.73	113.67
2	B	417	HEM	C4C-C3C-C2C	2.89	109.32	106.81
2	A	417	HEM	C1B-NB-C4B	2.87	108.61	105.21
2	B	417	HEM	C3B-C4B-NB	-2.86	107.42	109.47
2	B	417	HEM	CHB-C1B-NB	2.83	127.87	124.37
2	C	417	HEM	C1B-NB-C4B	2.83	108.56	105.21
2	A	417	HEM	C4C-C3C-C2C	2.72	109.18	106.81
2	C	417	HEM	C1D-C2D-C3D	-2.71	104.13	106.98
2	B	417	HEM	C4C-NC-C1C	2.64	110.12	105.82
2	C	417	HEM	C2A-C1A-NA	-2.60	107.26	110.15

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	417	HEM	O2A-CGA-CBA	2.58	122.16	114.00
2	C	417	HEM	C4B-C3B-C2B	2.58	109.65	107.28
2	C	417	HEM	CHD-C4C-NC	2.57	127.25	124.45
2	B	417	HEM	C1B-NB-C4B	2.54	108.22	105.21
2	A	417	HEM	CHD-C1D-ND	2.51	127.12	124.42
2	A	417	HEM	CBD-CAD-C3D	-2.42	105.85	112.53
2	B	417	HEM	CAC-C3C-C4C	-2.41	119.06	124.82
2	C	417	HEM	CBD-CAD-C3D	-2.38	105.95	112.53
2	A	417	HEM	CAD-C3D-C4D	2.37	128.84	124.70
2	C	417	HEM	O2A-CGA-CBA	2.37	121.50	114.00
2	B	417	HEM	CHC-C4B-NB	2.35	126.96	124.42
2	B	417	HEM	CHA-C4D-ND	2.29	127.20	124.37
2	B	417	HEM	C4A-NA-C1A	2.28	109.54	105.82
2	B	417	HEM	C2B-C1B-NB	-2.27	107.23	109.84
2	A	417	HEM	CHC-C4B-NB	2.22	126.81	124.42
2	B	417	HEM	C4B-C3B-C2B	2.21	109.31	107.28
2	A	417	HEM	C1D-C2D-C3D	-2.21	104.66	106.98
2	C	417	HEM	O1A-CGA-CBA	-2.17	116.21	123.09
2	B	417	HEM	CBD-CAD-C3D	-2.16	106.55	112.53
2	A	417	HEM	C3D-C4D-ND	-2.10	107.87	110.17
2	A	417	HEM	CHA-C1A-NA	2.09	127.66	123.86
2	A	417	HEM	C2A-C1A-NA	-2.09	107.83	110.15
2	B	417	HEM	CMA-C3A-C2A	2.06	129.99	125.62
2	A	417	HEM	CAD-C3D-C2D	-2.04	124.05	127.87
2	A	417	HEM	CAC-C3C-C4C	-2.04	119.95	124.82

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	417	HEM	CAA-CBA-CGA-O2A
2	C	417	HEM	CAA-CBA-CGA-O1A
2	C	417	HEM	CAA-CBA-CGA-O2A
2	B	417	HEM	CAA-CBA-CGA-O1A
3	B	397	HX2	C2-C3-C4-C5

There are no ring outliers.

4 monomers are involved in 12 short contacts:

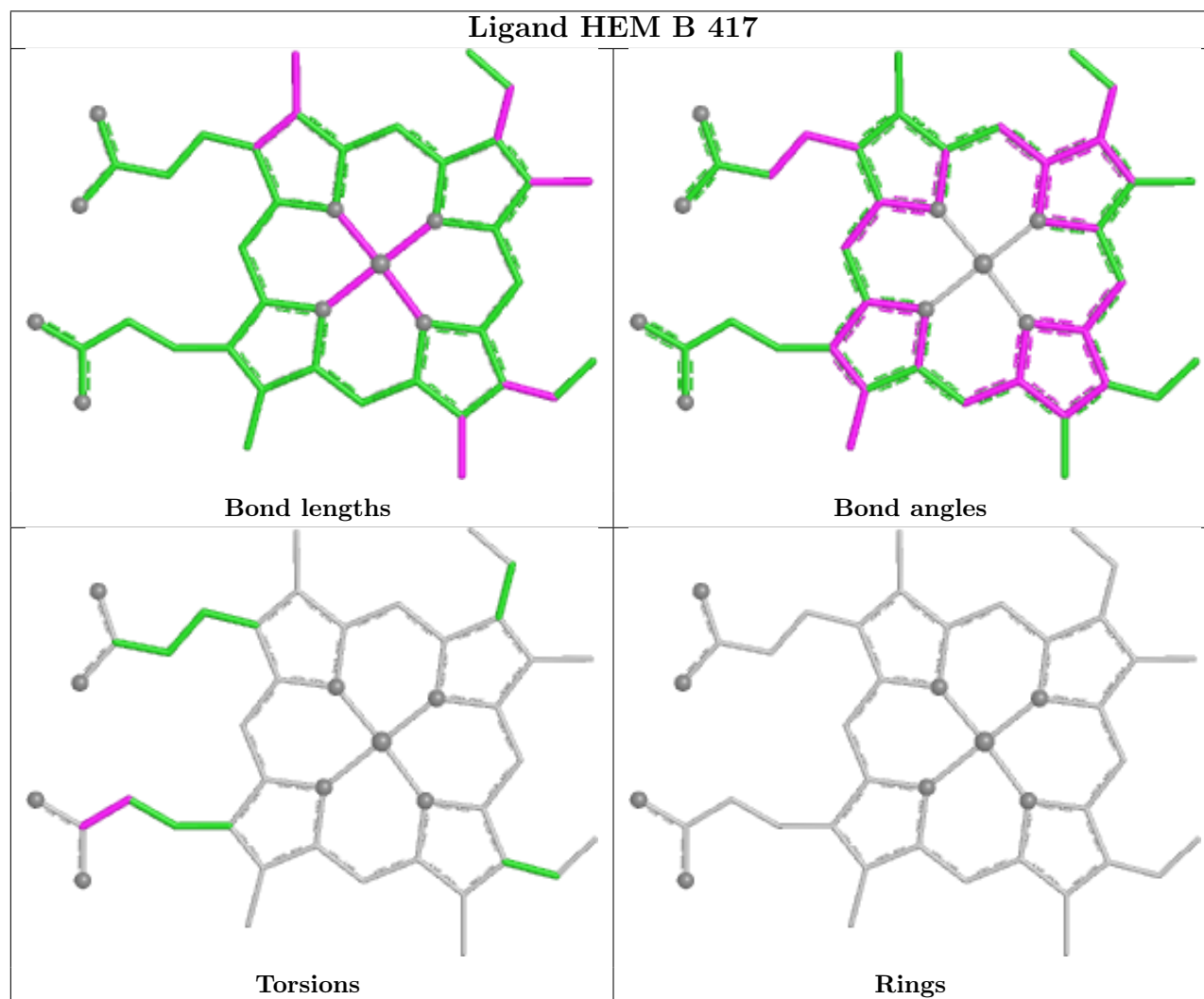
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	417	HEM	3	0

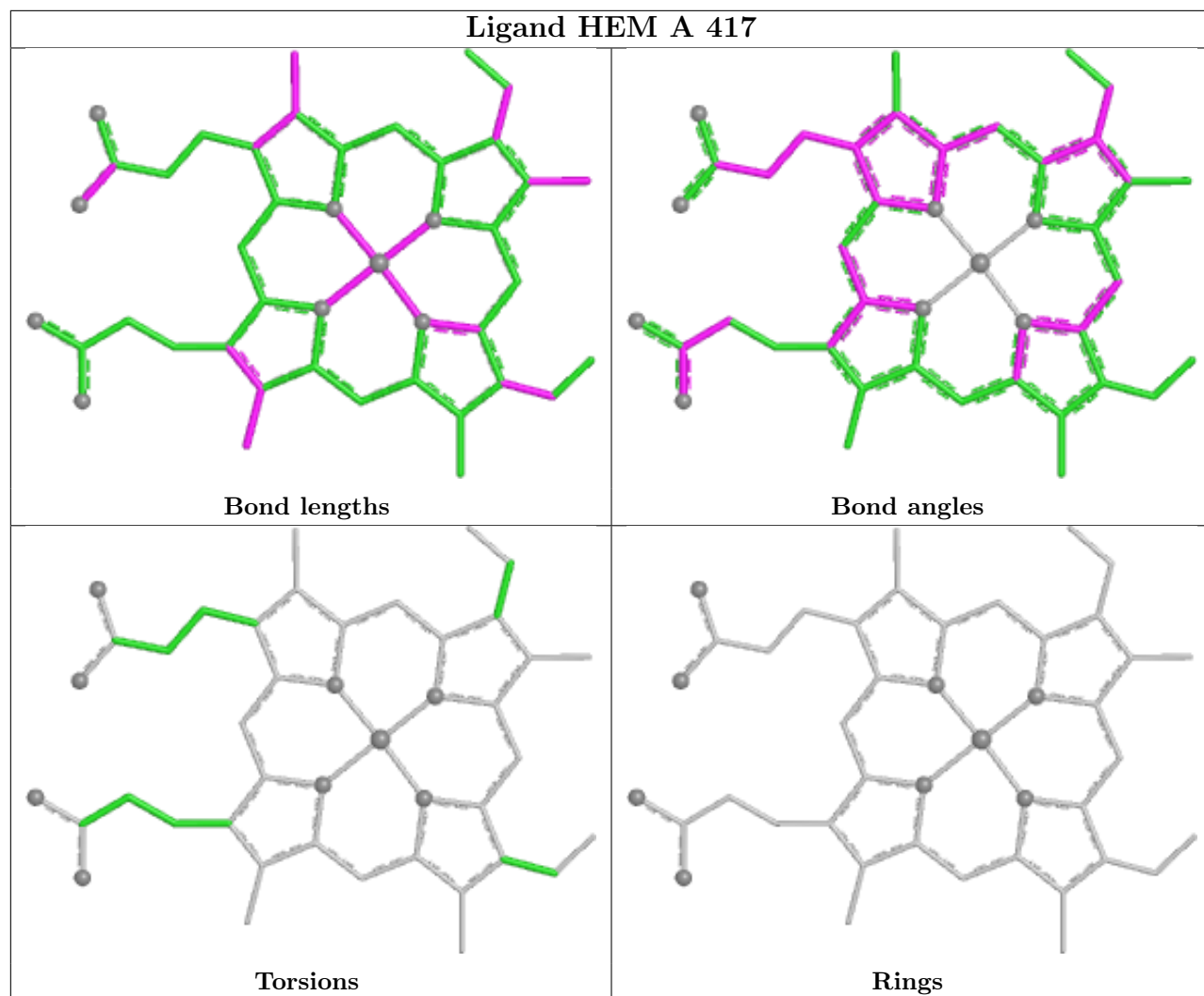
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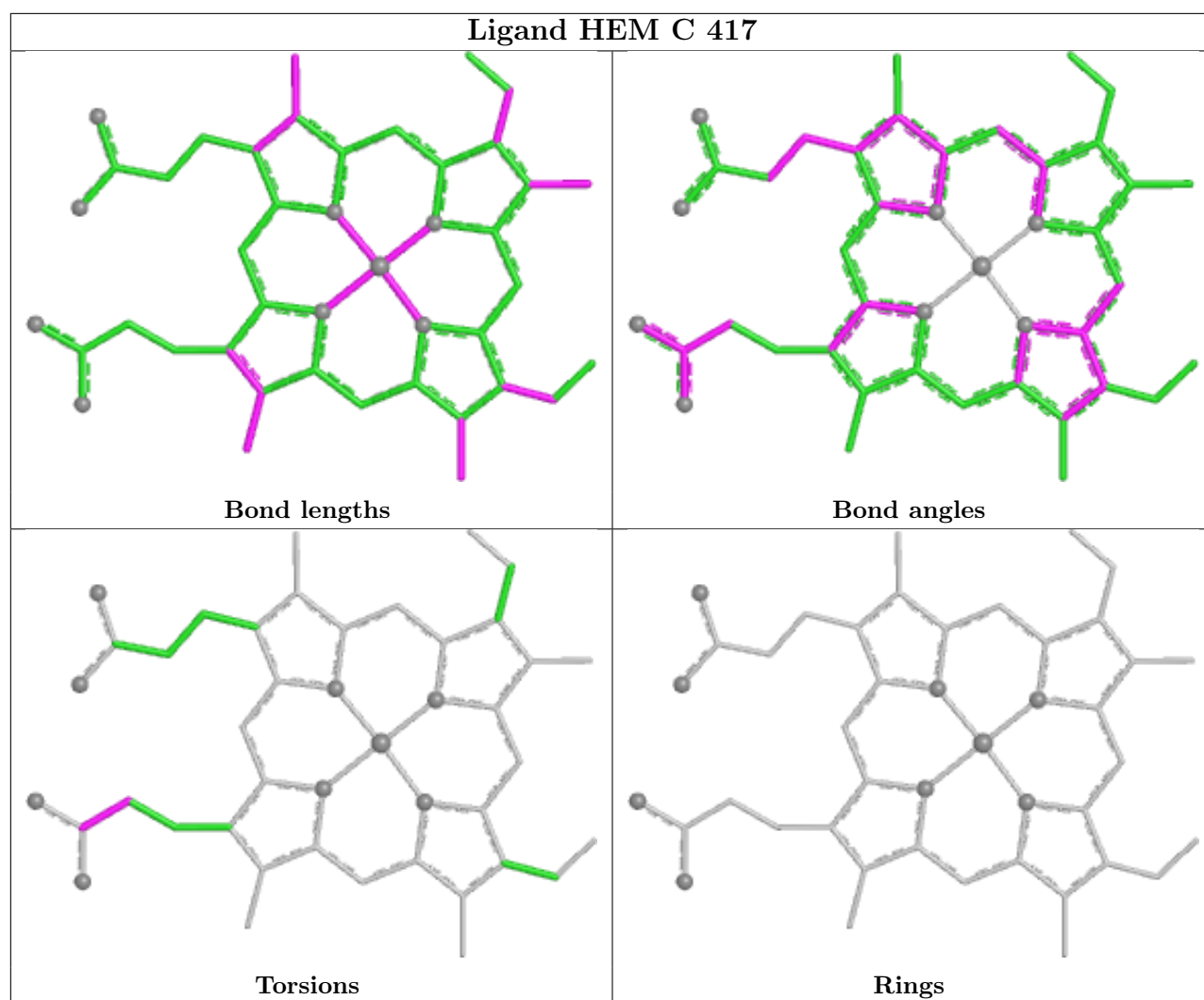
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Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	417	HEM	2	0
3	B	397	HX2	5	0
2	C	417	HEM	2	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.







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, 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	396/396 (100%)	-0.19	14 (3%) 47 50	7, 15, 32, 59	0
1	B	393/396 (99%)	-0.22	6 (1%) 72 75	6, 15, 33, 54	0
1	C	390/396 (98%)	0.56	49 (12%) 8 8	9, 23, 55, 62	0
All	All	1179/1188 (99%)	0.05	69 (5%) 28 30	6, 17, 43, 62	0

All (69) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	326	PHE	5.4
1	A	173	PRO	4.5
1	C	166	LEU	4.1
1	C	1	MET	4.1
1	A	176	SER	4.1
1	A	175	GLY	4.0
1	C	155	VAL	3.9
1	C	201	PRO	3.8
1	A	374	ASP	3.8
1	C	13	ASP	3.7
1	C	157	LEU	3.7
1	C	6	VAL	3.6
1	C	327	ASP	3.6
1	C	194	ILE	3.6
1	C	216	GLY	3.6
1	C	202	GLY	3.5
1	B	172	ARG	3.5
1	C	193	PHE	3.5
1	A	174	ASP	3.3
1	C	156	PRO	3.2
1	C	199	ALA	3.1
1	C	215	GLY	3.1
1	C	191	TRP	3.1

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Mol	Chain	Res	Type	RSRZ
1	C	109	PHE	3.0
1	A	171	THR	3.0
1	C	165	GLN	3.0
1	C	8	ALA	3.0
1	C	4	ALA	2.9
1	A	168	VAL	2.9
1	A	1	MET	2.9
1	C	210	LEU	2.9
1	C	196	LYS	2.8
1	B	166	LEU	2.8
1	C	197	ARG	2.7
1	C	158	GLU	2.7
1	A	18	ASN	2.7
1	C	179	VAL	2.7
1	C	218	PRO	2.7
1	C	2	ILE	2.7
1	C	177	MET	2.6
1	C	170	LEU	2.6
1	A	396	ALA	2.6
1	A	169	GLN	2.6
1	C	161	PRO	2.6
1	C	209	ILE	2.6
1	A	157	LEU	2.5
1	C	160	ARG	2.5
1	C	219	TRP	2.5
1	C	198	MET	2.4
1	B	168	VAL	2.4
1	C	204	ASP	2.3
1	C	262	GLU	2.3
1	C	168	VAL	2.3
1	C	35	ASP	2.2
1	C	195	GLU	2.2
1	C	9	ASP	2.2
1	C	152	LEU	2.1
1	A	203	ASP	2.1
1	C	214	VAL	2.1
1	A	170	LEU	2.1
1	B	396	ALA	2.1
1	C	206	PHE	2.1
1	B	329	GLY	2.1
1	C	208	ARG	2.1
1	B	1	MET	2.0

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Mol	Chain	Res	Type	RSRZ
1	C	192	PRO	2.0
1	C	163	LEU	2.0
1	C	180	GLU	2.0
1	C	153	ILE	2.0

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 [i](#)

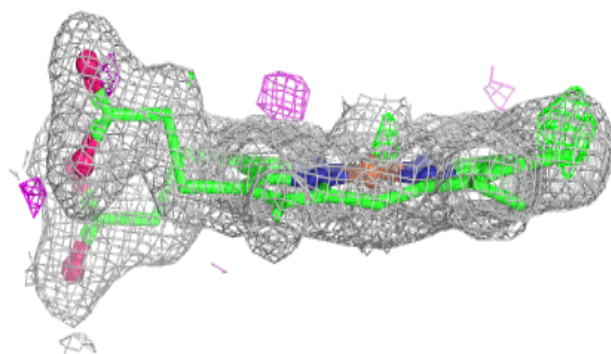
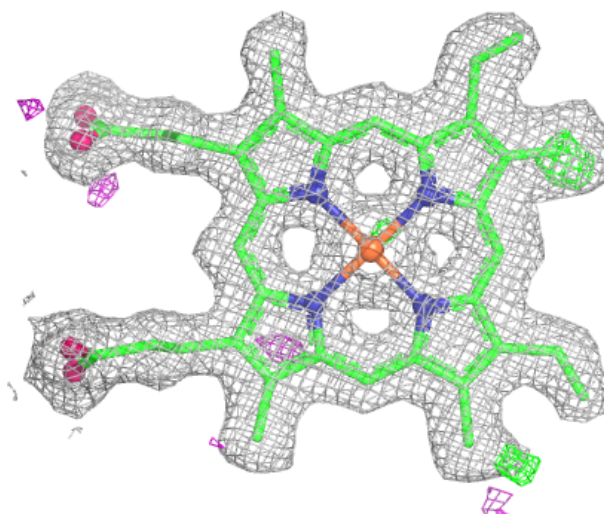
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
3	HX2	A	397	8/8	0.92	0.09	16,17,24,24	0
3	HX2	B	397	8/8	0.92	0.11	15,21,25,29	0
3	HX2	C	397	8/8	0.94	0.08	16,23,24,25	0
2	HEM	A	417	43/43	0.98	0.05	2,6,12,21	0
2	HEM	B	417	43/43	0.98	0.05	4,7,11,21	0
2	HEM	C	417	43/43	0.98	0.05	6,10,14,23	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.

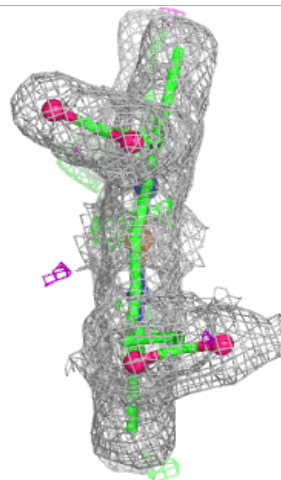
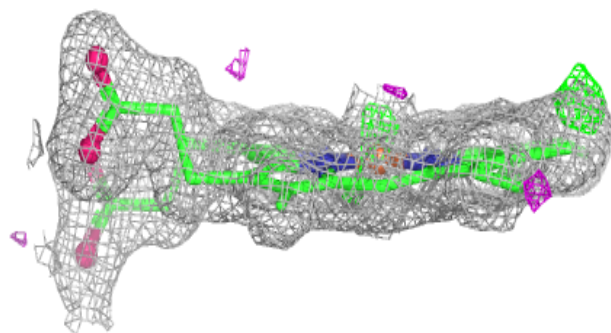
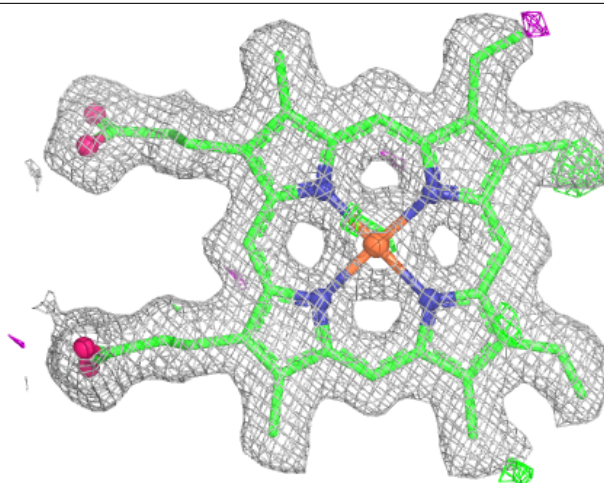
Electron density around HEM A 417:

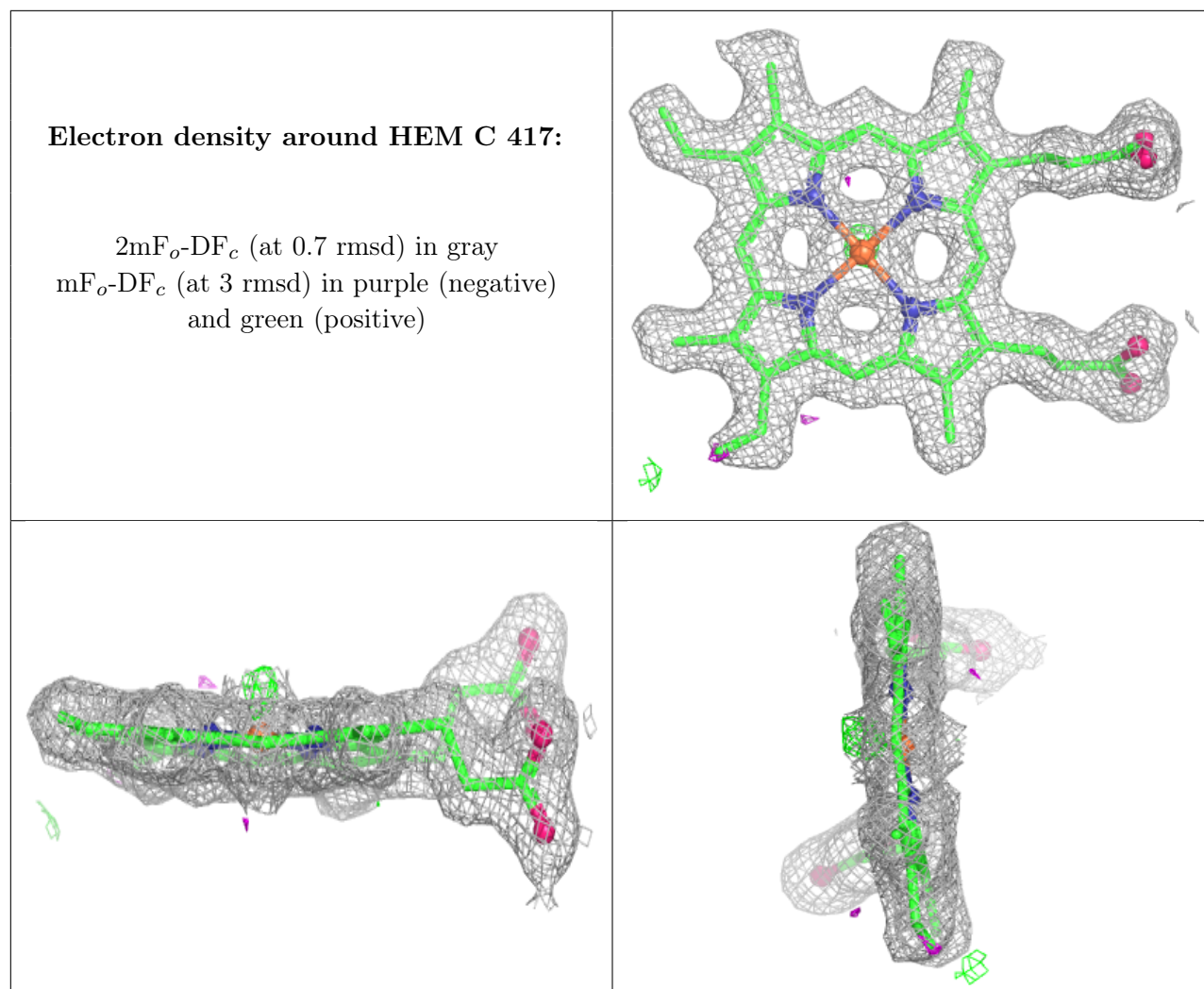
$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around HEM B 417:

$2mF_o-DF_c$ (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.