



Full wwPDB X-ray Structure Validation Report ⓘ

Nov 20, 2017 – 10:06 PM EST

PDB ID : 8CPP
Title : CRYSTAL STRUCTURES OF CYTOCHROME P450-CAM COMPLEXED WITH CAMPHANE, THIOCAMPHOR, AND ADAMANTANE: FACTORS CONTROLLING P450 SUBSTRATE HYDROXYLATION
Authors : Raag, R.; Poulos, T.L.
Deposited on : unknown
Resolution : 2.10 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467
Mogul : 1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20030345

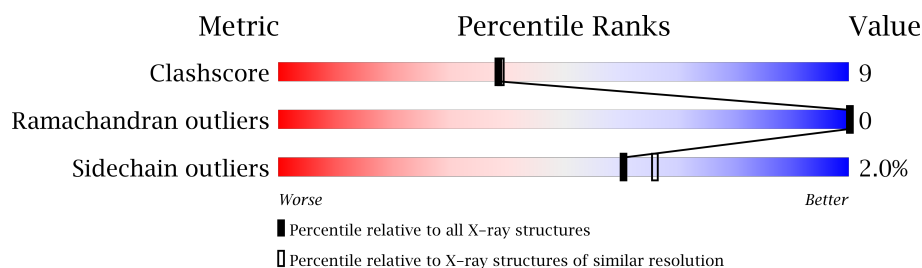
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.10 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))
Clashscore	112137	4788 (2.10-2.10)
Ramachandran outliers	110173	4740 (2.10-2.10)
Sidechain outliers	110143	4741 (2.10-2.10)

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 ≥ 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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	414	73% 21% ...

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
3	TCM	A	422[B]	-	-	X	-

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3478 atoms, of which 0 are hydrogens and 0 are deuteriums.

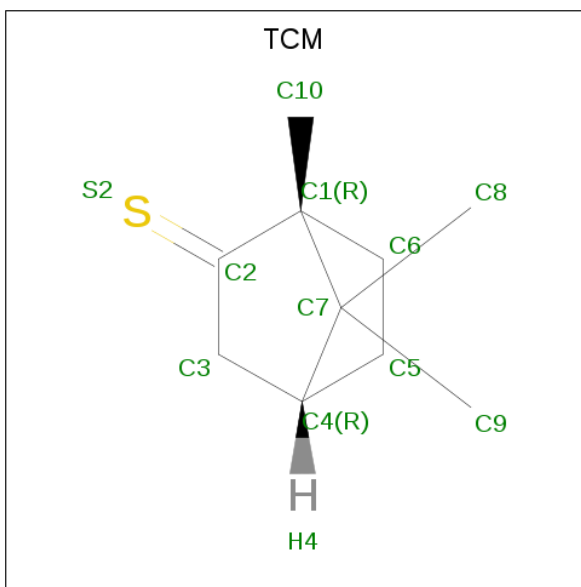
In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called CYTOCHROME P450CAM.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	405	Total	C	N	O	S	0	0	0
			3208	2033	560	597	18			

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





Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	S	0	1
			22	20	2		

- Molecule 4 is water.

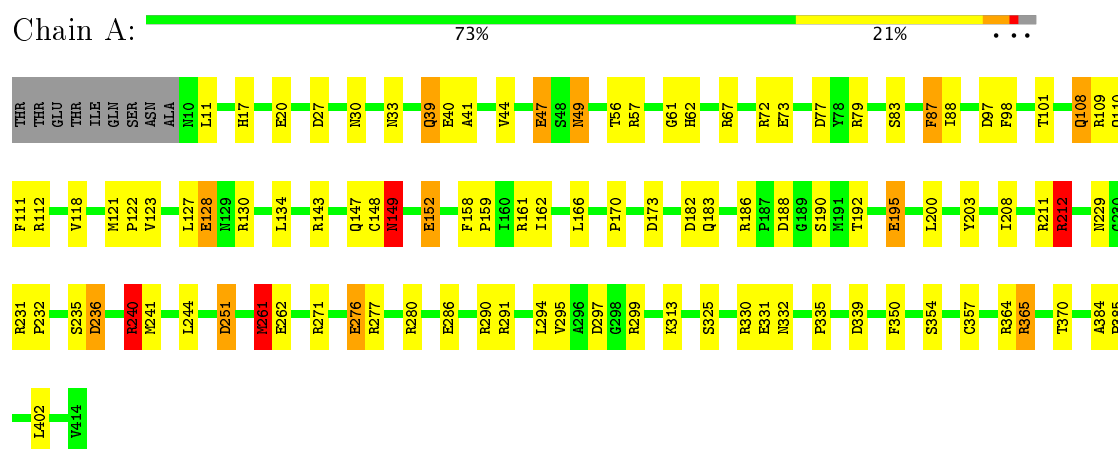
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	205	Total	O	0	0
			205	205		

3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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 ($\text{RSRZ} > 2$). 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.

Note EDS was not executed.

• Molecule 1: CYTOCHROME P450CAM



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	108.67Å 103.90Å 36.38Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	(Not available) – 2.10	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-2.10)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROFFT	Depositor
R, R_{free}	0.175 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3478	wwPDB-VP
Average B, all atoms (Å ²)	19.0	wwPDB-VP

5 Model quality ⓘ

5.1 Standard geometry ⓘ

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

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	1.14	4/3287 (0.1%)	1.86	63/4465 (1.4%)

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	A	1	8

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	276	GLU	CD-OE2	7.05	1.33	1.25
1	A	286	GLU	CD-OE1	-7.04	1.18	1.25
1	A	73	GLU	CD-OE1	-5.24	1.19	1.25
1	A	262	GLU	CD-OE1	-5.01	1.20	1.25

All (63) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	211	ARG	CD-NE-CZ	34.62	172.06	123.60
1	A	240	ARG	NE-CZ-NH1	17.55	129.08	120.30
1	A	240	ARG	NE-CZ-NH2	-16.94	111.83	120.30
1	A	67	ARG	NE-CZ-NH2	-15.80	112.40	120.30
1	A	211	ARG	NE-CZ-NH1	13.98	127.29	120.30
1	A	290	ARG	NE-CZ-NH1	13.49	127.05	120.30
1	A	330	ARG	NE-CZ-NH1	13.29	126.94	120.30
1	A	161	ARG	NE-CZ-NH2	-13.16	113.72	120.30
1	A	212	ARG	CD-NE-CZ	12.66	141.33	123.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	299	ARG	NE-CZ-NH2	-12.64	113.98	120.30
1	A	280	ARG	NE-CZ-NH2	-11.68	114.46	120.30
1	A	20	GLU	CA-CB-CG	10.52	136.55	113.40
1	A	67	ARG	NE-CZ-NH1	10.35	125.47	120.30
1	A	271	ARG	NE-CZ-NH1	10.29	125.44	120.30
1	A	112	ARG	NE-CZ-NH2	-10.12	115.24	120.30
1	A	212	ARG	NE-CZ-NH1	9.83	125.21	120.30
1	A	72	ARG	NE-CZ-NH2	-9.72	115.44	120.30
1	A	280	ARG	NE-CZ-NH1	9.17	124.88	120.30
1	A	33	ASN	CB-CA-C	8.58	127.56	110.40
1	A	186	ARG	NE-CZ-NH2	8.54	124.57	120.30
1	A	152	GLU	CA-CB-CG	8.50	132.11	113.40
1	A	291	ARG	NE-CZ-NH1	8.27	124.43	120.30
1	A	112	ARG	NE-CZ-NH1	8.19	124.40	120.30
1	A	195	GLU	CA-CB-CG	8.00	131.00	113.40
1	A	79	ARG	NE-CZ-NH2	-7.92	116.34	120.30
1	A	161	ARG	NE-CZ-NH1	7.71	124.15	120.30
1	A	236	ASP	CB-CG-OD2	-7.42	111.63	118.30
1	A	27	ASP	CB-CG-OD1	6.96	124.56	118.30
1	A	212	ARG	NE-CZ-NH2	-6.93	116.83	120.30
1	A	182	ASP	CB-CG-OD1	-6.91	112.08	118.30
1	A	40	GLU	OE1-CD-OE2	-6.88	115.04	123.30
1	A	280	ARG	CD-NE-CZ	6.41	132.57	123.60
1	A	130	ARG	NE-CZ-NH1	-6.28	117.16	120.30
1	A	72	ARG	NH1-CZ-NH2	6.19	126.21	119.40
1	A	251	ASP	O-C-N	-6.04	113.04	122.70
1	A	149	ASN	N-CA-CB	6.03	121.46	110.60
1	A	87	PHE	CB-CG-CD1	-5.89	116.68	120.80
1	A	277	ARG	NE-CZ-NH2	-5.88	117.36	120.30
1	A	109	ARG	NE-CZ-NH1	5.87	123.23	120.30
1	A	211	ARG	NH1-CZ-NH2	-5.86	112.95	119.40
1	A	79	ARG	NE-CZ-NH1	5.76	123.18	120.30
1	A	299	ARG	NH1-CZ-NH2	5.67	125.64	119.40
1	A	128	GLU	CG-CD-OE1	5.67	129.63	118.30
1	A	261	MET	CG-SD-CE	5.64	109.22	100.20
1	A	330	ARG	NH1-CZ-NH2	-5.46	113.40	119.40
1	A	47	GLU	CG-CD-OE2	-5.36	107.57	118.30
1	A	365	ARG	NE-CZ-NH1	5.33	122.97	120.30
1	A	143	ARG	NE-CZ-NH1	5.32	122.96	120.30
1	A	364	ARG	CD-NE-CZ	5.28	130.99	123.60
1	A	297	ASP	CB-CA-C	5.25	120.91	110.40
1	A	152	GLU	OE1-CD-OE2	5.25	129.60	123.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	123	VAL	CA-CB-CG1	5.25	118.77	110.90
1	A	339	ASP	CB-CG-OD1	-5.23	113.59	118.30
1	A	251	ASP	CB-CA-C	5.22	120.84	110.40
1	A	295	VAL	CG1-CB-CG2	-5.20	102.58	110.90
1	A	276	GLU	N-CA-CB	5.19	119.94	110.60
1	A	339	ASP	CB-CG-OD2	5.18	122.96	118.30
1	A	290	ARG	NE-CZ-NH2	-5.18	117.71	120.30
1	A	291	ARG	NH1-CZ-NH2	-5.17	113.71	119.40
1	A	262	GLU	CA-CB-CG	5.10	124.63	113.40
1	A	370	THR	CA-CB-CG2	5.07	119.50	112.40
1	A	128	GLU	CG-CD-OE2	-5.07	108.17	118.30
1	A	87	PHE	CB-CG-CD2	5.02	124.32	120.80

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	A	33	ASN	CA

All (8) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	118	VAL	Mainchain
1	A	147	GLN	Mainchain
1	A	148	CYS	Mainchain
1	A	149	ASN	Mainchain
1	A	212	ARG	Sidechain
1	A	240	ARG	Sidechain
1	A	251	ASP	Mainchain
1	A	77	ASP	Mainchain

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	3208	0	3156	45	0
2	A	43	0	30	5	0
3	A	22	0	32	12	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	205	0	0	7	0
All	All	3478	0	3218	55	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 (55) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:A:422[B]:TCM:S2	3:A:422[B]:TCM:C2	1.20	1.29
3:A:422[B]:TCM:S2	3:A:422[B]:TCM:C3	2.44	1.03
3:A:422[B]:TCM:S2	3:A:422[B]:TCM:C1	2.51	0.98
3:A:422[A]:TCM:S2	4:A:705:HOH:O	2.35	0.83
2:A:417:HEM:NC	4:A:705:HOH:O	2.14	0.81
2:A:417:HEM:NB	4:A:705:HOH:O	2.15	0.80
1:A:244:LEU:HD11	3:A:422[B]:TCM:H52	1.72	0.70
1:A:127:LEU:HD11	1:A:166:LEU:HD13	1.74	0.67
1:A:244:LEU:HD11	3:A:422[A]:TCM:H62	1.82	0.62
2:A:417:HEM:HBA1	3:A:422[A]:TCM:H101	1.82	0.61
2:A:417:HEM:NA	4:A:705:HOH:O	2.31	0.61
1:A:231:ARG:HB2	1:A:232:PRO:HD2	1.84	0.60
1:A:158:PHE:HB3	1:A:159:PRO:HD3	1.84	0.59
1:A:365:ARG:HD3	4:A:625:HOH:O	2.04	0.58
1:A:208:ILE:O	1:A:212:ARG:HG3	2.05	0.56
1:A:108:GLN:HE22	1:A:354:SER:HB2	1.71	0.55
1:A:170:PRO:HG2	1:A:173:ASP:OD1	2.07	0.55
1:A:294:LEU:HD23	1:A:294:LEU:H	1.74	0.53
1:A:244:LEU:HD11	3:A:422[B]:TCM:C5	2.39	0.52
1:A:261:MET:HA	1:A:261:MET:HE2	1.92	0.52
1:A:149:ASN:ND2	1:A:402:LEU:H	2.07	0.52
1:A:192:THR:OG1	1:A:195:GLU:HG2	2.10	0.52
1:A:62:HIS:CG	1:A:88:ILE:HD13	2.45	0.51
1:A:121:MET:HB2	1:A:122:PRO:HD3	1.91	0.51
1:A:97:ASP:O	1:A:240:ARG:HD2	2.12	0.50
1:A:56:THR:O	1:A:61:GLY:HA2	2.11	0.49
1:A:83:SER:HB3	1:A:101:THR:O	2.13	0.49
1:A:11:LEU:HG	1:A:57:ARG:HB2	1.95	0.49
1:A:200:LEU:O	1:A:203:TYR:HB3	2.14	0.48
1:A:325:SER:O	1:A:331:GLU:HG3	2.14	0.48
1:A:98:PHE:HB3	1:A:244:LEU:HB2	1.95	0.48
1:A:39:GLN:NE2	1:A:39:GLN:H	2.12	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:87:PHE:CE2	3:A:422[B]:TCM:H92	2.48	0.47
1:A:49:ASN:H	1:A:49:ASN:HD22	1.62	0.47
1:A:41:ALA:O	1:A:44:VAL:HG22	2.14	0.47
1:A:87:PHE:CZ	3:A:422[B]:TCM:H92	2.50	0.46
1:A:183:GLN:HE22	1:A:188:ASP:HB2	1.80	0.46
1:A:384:ALA:HA	1:A:385:PRO:HD3	1.82	0.46
1:A:231:ARG:HB2	1:A:232:PRO:CD	2.45	0.45
1:A:47:GLU:HB2	1:A:49:ASN:ND2	2.32	0.44
3:A:422[B]:TCM:S2	3:A:422[B]:TCM:C10	3.06	0.44
1:A:236:ASP:O	1:A:240:ARG:HG3	2.18	0.43
1:A:152:GLU:HB3	4:A:563:HOH:O	2.18	0.43
1:A:188:ASP:HB3	1:A:190:SER:H	1.84	0.42
1:A:158:PHE:CB	1:A:159:PRO:HD3	2.50	0.42
1:A:30:ASN:ND2	4:A:556:HOH:O	2.37	0.42
1:A:350:PHE:HB3	1:A:357:CYS:HB3	2.01	0.42
2:A:417:HEM:HBA1	3:A:422[B]:TCM:H62	2.01	0.42
1:A:332:ASN:O	1:A:335:PRO:HD3	2.19	0.42
1:A:294:LEU:HD23	1:A:294:LEU:N	2.34	0.41
1:A:134:LEU:HD23	1:A:162:ILE:HG13	2.01	0.41
1:A:110:GLN:NE2	1:A:229:ASN:HA	2.36	0.41
1:A:121:MET:CB	1:A:122:PRO:HD3	2.48	0.41
1:A:111:PHE:HD2	1:A:241:MET:HE2	1.85	0.41
1:A:17:HIS:CD2	1:A:313:LYS: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	403/414 (97%)	386 (96%)	17 (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	350/358 (98%)	343 (98%)	7 (2%)	60 66

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	39	GLN
1	A	49	ASN
1	A	108	GLN
1	A	128	GLU
1	A	235	SER
1	A	261	MET
1	A	276	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	39	GLN
1	A	46	GLN
1	A	49	ASN
1	A	59	ASN
1	A	69	GLN
1	A	108	GLN
1	A	129	ASN
1	A	149	ASN
1	A	213	GLN
1	A	225	ASN
1	A	388	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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

3 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	A	417	1,4	28,50,50	1.99	6 (21%)	17,82,82	2.18	7 (41%)
3	TCM	A	422[A]	-	10,12,12	1.18	0	20,21,21	1.32	2 (10%)
3	TCM	A	422[B]	-	10,12,12	1.14	0	20,21,21	1.29	2 (10%)

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	A	417	1,4	-	0/6/54/54	0/0/8/8
3	TCM	A	422[A]	-	-	0/0/31/31	0/0/2/2
3	TCM	A	422[B]	-	-	0/0/31/31	0/0/2/2

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	417	HEM	C3C-C2C	-5.39	1.33	1.40
2	A	417	HEM	C3B-C2B	-5.38	1.33	1.40
2	A	417	HEM	CMC-C2C	2.22	1.56	1.51
2	A	417	HEM	CAA-C2A	2.35	1.56	1.52

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	417	HEM	C3B-CAB	2.80	1.53	1.47
2	A	417	HEM	C3C-CAC	3.87	1.55	1.47

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	422[B]	TCM	C9-C7-C8	-3.80	97.95	107.60
3	A	422[A]	TCM	C9-C7-C8	-3.68	98.28	107.60
2	A	417	HEM	CMD-C2D-C1D	-3.65	122.86	128.46
2	A	417	HEM	CMA-C3A-C4A	-3.03	123.81	128.46
3	A	422[A]	TCM	C6-C1-C2	2.29	106.81	103.25
2	A	417	HEM	CMA-C3A-C2A	2.35	129.38	124.94
2	A	417	HEM	CAA-CBA-CGA	2.37	116.70	112.66
2	A	417	HEM	CMB-C2B-C3B	2.43	129.40	124.89
3	A	422[B]	TCM	C9-C7-C1	2.56	119.02	113.06
2	A	417	HEM	CMD-C2D-C3D	2.61	129.86	124.94
2	A	417	HEM	CBD-CAD-C3D	4.87	121.76	112.47

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 15 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	417	HEM	5	0
3	A	422[A]	TCM	3	0
3	A	422[B]	TCM	9	0

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 ⓘ

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

6.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

6.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.