



Full wwPDB X-ray Structure Validation Report ⓘ

Jan 27, 2018 – 05:22 AM EST

PDB ID : 1PKF
Title : Crystal Structure of Epothilone D-bound Cytochrome P450epoK
Authors : Nagano, S.; Li, H.; Shimizu, H.; Nishida, C.; Ogura, H.; Ortiz de Montellano, P.R.; Poulos, T.L.
Deposited on : 2003-06-05
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) : 1.9-1692
EDS : rb-20030736
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20030736

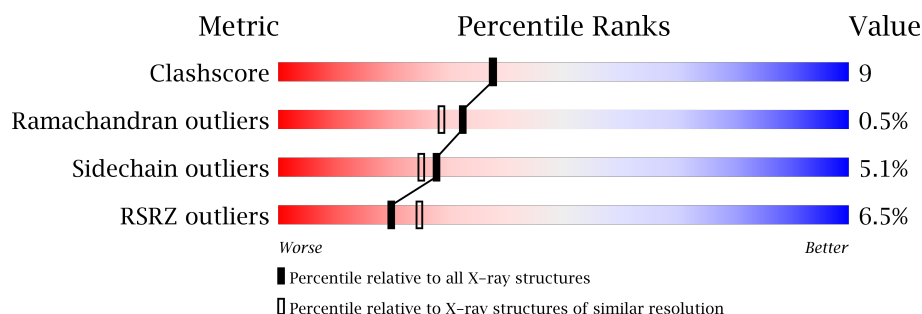
1 Overall quality at a glance

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)
RSRZ outliers	101464	4275 (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.

Mol	Chain	Length	Quality of chain
1	A	419	

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3452 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.

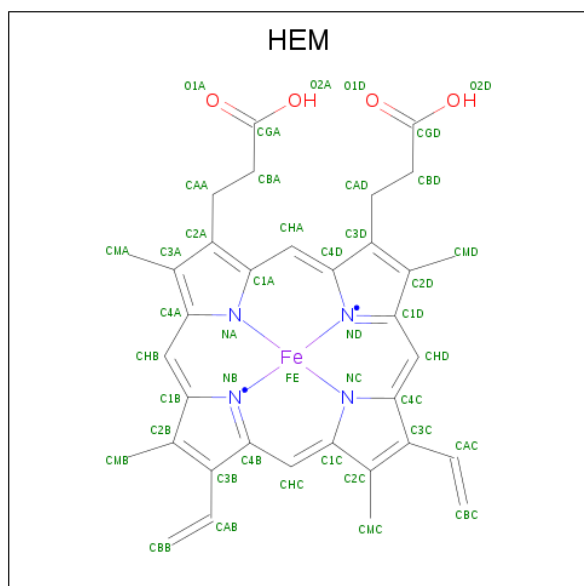
- Molecule 1 is a protein called cytochrome p450EpoK.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	403	Total	C	N	O	S	0	0	0
			3175	2021	557	588	9			

There is a discrepancy between the modelled and reference sequences:

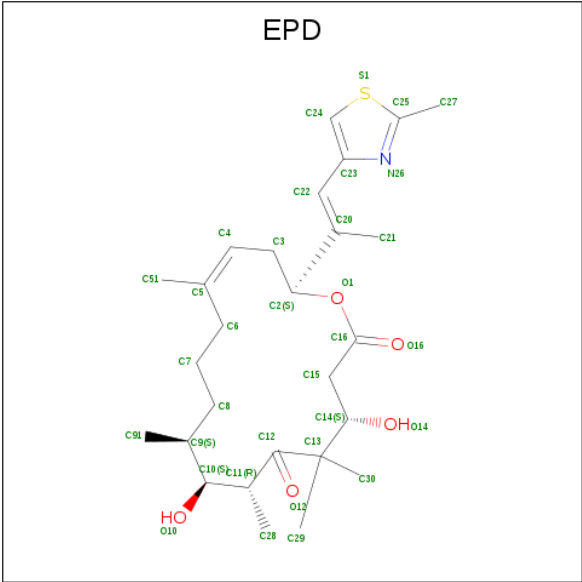
Chain	Residue	Modelled	Actual	Comment	Reference
A	298	GLU	ASP	CONFLICT	UNP Q9KIZ4

- 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
2	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

- Molecule 3 is EPOTHILONE D (three-letter code: EPD) (formula: $C_{27}H_{41}NO_5S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	S	0	0
			34	27	1	5	1		

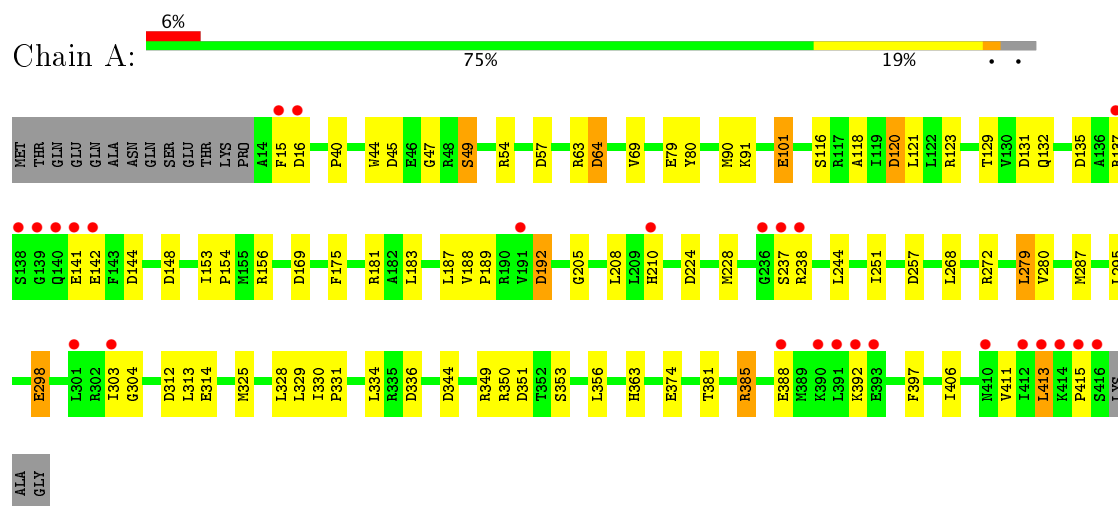
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	200	Total	O	0	0
			200	200		

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.

- Molecule 1: cytochrome p450EpoK



4 Data and refinement statistics

Property	Value	Source
Space group	P 43 2 2	Depositor
Cell constants a, b, c, α , β , γ	60.43 Å 60.43 Å 252.77 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.10 42.73 – 2.10	Depositor EDS
% Data completeness (in resolution range)	95.5 (50.00-2.10) 95.5 (42.73-2.10)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.28 (at 2.10 Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.219 , 0.275 0.226 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	DCC
Wilson B-factor (Å ²)	46.0	Xtriage
Anisotropy	0.355	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 53.3	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	0.94	EDS
Total number of atoms	3452	wwPDB-VP
Average B, all atoms (Å ²)	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.97% 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, EPD

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	0.65	0/3240	0.84	16/4391 (0.4%)

There are no bond length outliers.

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	64	ASP	CB-CG-OD2	7.00	124.60	118.30
1	A	131	ASP	CB-CG-OD2	6.94	124.54	118.30
1	A	344	ASP	CB-CG-OD2	6.58	124.22	118.30
1	A	120	ASP	CB-CG-OD2	6.56	124.20	118.30
1	A	257	ASP	CB-CG-OD2	6.41	124.07	118.30
1	A	312	ASP	CB-CG-OD2	6.26	123.94	118.30
1	A	336	ASP	CB-CG-OD2	6.23	123.91	118.30
1	A	351	ASP	CB-CG-OD2	5.86	123.57	118.30
1	A	16	ASP	CB-CG-OD2	5.67	123.40	118.30
1	A	135	ASP	CB-CG-OD2	5.67	123.40	118.30
1	A	148	ASP	CB-CG-OD2	5.61	123.35	118.30
1	A	169	ASP	CB-CG-OD2	5.54	123.29	118.30
1	A	192	ASP	CB-CG-OD2	5.50	123.25	118.30
1	A	57	ASP	CB-CG-OD2	5.26	123.03	118.30
1	A	144	ASP	CB-CG-OD2	5.23	123.01	118.30
1	A	45	ASP	CB-CG-OD2	5.14	122.92	118.30

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts ⓘ

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3175	0	3190	47	1
2	A	43	0	30	3	0
3	A	34	0	41	9	0
4	A	200	0	0	10	0
All	All	3452	0	3261	57	1

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 (57) 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:450:EPD:C2	3:A:450:EPD:O1	1.77	1.33
1:A:181:ARG:NH1	1:A:192:ASP:OD2	1.83	1.12
3:A:450:EPD:H211	3:A:450:EPD:N26	1.88	0.88
1:A:142:GLU:OE1	1:A:392:LYS:NZ	2.10	0.83
1:A:385:ARG:HG3	1:A:385:ARG:HH11	1.46	0.81
1:A:224:ASP:O	1:A:228:MET:HG3	1.82	0.80
1:A:188:VAL:HB	4:A:649:HOH:O	1.91	0.71
1:A:187:LEU:HD12	1:A:188:VAL:HG13	1.73	0.70
2:A:440:HEM:HBC2	2:A:440:HEM:HHD	1.74	0.69
3:A:450:EPD:C20	3:A:450:EPD:O1	2.41	0.69
1:A:251:ILE:HG23	2:A:440:HEM:HBC1	1.75	0.69
1:A:120:ASP:OD1	1:A:123:ARG:NH1	2.27	0.66
1:A:64:ASP:OD1	4:A:566:HOH:O	2.14	0.66
1:A:90:MET:HE2	4:A:456:HOH:O	1.95	0.65
1:A:238:ARG:HD2	4:A:648:HOH:O	1.95	0.65
1:A:129:THR:OG1	1:A:156:ARG:HG2	1.96	0.64
1:A:181:ARG:HH12	1:A:192:ASP:CG	2.02	0.63
1:A:268:LEU:HD23	1:A:268:LEU:C	2.20	0.62
1:A:385:ARG:HH11	1:A:385:ARG:CG	2.15	0.60
1:A:137:ARG:HB2	4:A:532:HOH:O	2.03	0.58
1:A:244:LEU:HD23	1:A:244:LEU:C	2.23	0.57
1:A:153:ILE:HB	1:A:154:PRO:HD3	1.86	0.57
1:A:397:PHE:CE1	1:A:406:ILE:HG12	2.40	0.56

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:175:PHE:CD1	1:A:205:GLY:HA3	2.40	0.55
1:A:187:LEU:HD12	1:A:188:VAL:CG1	2.38	0.54
3:A:450:EPD:H303	4:A:488:HOH:O	2.07	0.53
1:A:49:SER:HB2	1:A:325:MET:HB3	1.89	0.53
1:A:334:LEU:HD21	1:A:356:LEU:H	1.74	0.51
1:A:268:LEU:HD21	1:A:272:ARG:HD2	1.94	0.49
3:A:450:EPD:C21	3:A:450:EPD:O1	2.60	0.49
1:A:118:ALA:O	1:A:121:LEU:HD23	2.13	0.49
3:A:450:EPD:C21	3:A:450:EPD:N26	2.64	0.49
1:A:69:VAL:HG21	1:A:363:HIS:CD2	2.47	0.48
1:A:268:LEU:CD2	1:A:272:ARG:HD2	2.44	0.48
1:A:101:GLU:HG3	4:A:459:HOH:O	2.14	0.47
3:A:450:EPD:C2	3:A:450:EPD:C16	2.86	0.47
1:A:183:LEU:HD13	3:A:450:EPD:H271	1.98	0.46
1:A:280:VAL:HG11	1:A:287:MET:CE	2.44	0.46
1:A:304:GLY:HA3	1:A:328:LEU:O	2.16	0.46
3:A:450:EPD:H213	3:A:450:EPD:O1	2.16	0.46
1:A:154:PRO:HA	1:A:374:GLU:OE1	2.16	0.45
1:A:411:VAL:HG23	1:A:413:LEU:HD12	1.97	0.45
1:A:63:ARG:NH1	4:A:618:HOH:O	2.50	0.45
1:A:413:LEU:CD1	1:A:413:LEU:N	2.79	0.45
1:A:303:ILE:O	1:A:329:LEU:HD12	2.17	0.45
1:A:80:TYR:CZ	1:A:91:LYS:HE2	2.53	0.44
1:A:381:THR:HG23	1:A:385:ARG:NH1	2.33	0.43
1:A:44:TRP:CE3	1:A:47:GLY:HA3	2.53	0.43
1:A:298:GLU:HG3	1:A:298:GLU:O	2.18	0.43
1:A:101:GLU:CG	4:A:459:HOH:O	2.66	0.42
1:A:413:LEU:O	1:A:415:PRO:HD3	2.20	0.42
2:A:440:HEM:HBC2	2:A:440:HEM:CHD	2.39	0.41
1:A:188:VAL:HA	1:A:189:PRO:HD3	1.84	0.41
1:A:330:ILE:N	1:A:331:PRO:HD2	2.35	0.41
1:A:350:ARG:HD3	4:A:614:HOH:O	2.20	0.40
1:A:279:LEU:HD21	1:A:349:ARG:HH21	1.86	0.40
1:A:40:PRO:HB3	1:A:54:ARG:HD2	2.03	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:120:ASP:OD2	1:A:385:ARG:NH1[7_555]	2.14	0.06

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	401/419 (96%)	386 (96%)	13 (3%)	2 (0%)	32	28

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	15	PHE
1	A	237	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	336/350 (96%)	319 (95%)	17 (5%)	28	25

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	49	SER
1	A	79	GLU
1	A	101	GLU
1	A	116	SER
1	A	132	GLN
1	A	141	GLU
1	A	208	LEU
1	A	210	HIS
1	A	279	LEU

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Mol	Chain	Res	Type
1	A	295	LEU
1	A	298	GLU
1	A	313	LEU
1	A	314	GLU
1	A	353	SER
1	A	385	ARG
1	A	388	GLU
1	A	413	LEU

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

Mol	Chain	Res	Type
1	A	132	GLN
1	A	231	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](#)

2 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	440	1	28,50,50	2.39	10 (35%)	17,82,82	1.73	3 (17%)
3	EPD	A	450	-	31,35,35	3.26	8 (25%)	36,50,50	3.36	18 (50%)

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	440	1	-	0/6/54/54	0/0/8/8
3	EPD	A	450	-	-	0/50/51/51	0/1/2/2

All (18) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	440	HEM	C3B-C2B	-6.29	1.32	1.40
2	A	440	HEM	C3C-C2C	-5.40	1.33	1.40
2	A	440	HEM	C4A-CHB	-2.25	1.34	1.40
2	A	440	HEM	C1D-ND	2.15	1.40	1.36
2	A	440	HEM	C4B-NB	2.24	1.40	1.36
2	A	440	HEM	C3B-CAB	2.27	1.52	1.47
3	A	450	EPD	C11-C10	2.39	1.58	1.54
3	A	450	EPD	O10-C10	2.42	1.48	1.43
3	A	450	EPD	C24-S1	2.64	1.74	1.70
2	A	440	HEM	CMB-C2B	2.73	1.57	1.51
3	A	450	EPD	C15-C16	3.21	1.57	1.50
3	A	450	EPD	C2-C20	3.42	1.60	1.51
2	A	440	HEM	C1B-NB	3.60	1.41	1.36
2	A	440	HEM	C4D-ND	3.98	1.41	1.36
2	A	440	HEM	C3D-C2D	4.31	1.50	1.37
3	A	450	EPD	O1-C16	4.32	1.46	1.34
3	A	450	EPD	C9-C10	4.42	1.61	1.53
3	A	450	EPD	O1-C2	15.08	1.77	1.45

All (21) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	450	EPD	C8-C9-C10	-8.73	97.08	111.38
3	A	450	EPD	O1-C2-C20	-6.49	91.18	109.60
3	A	450	EPD	C91-C9-C10	-4.76	102.60	111.55
3	A	450	EPD	C30-C13-C14	-4.21	101.54	109.36
2	A	440	HEM	CBD-CAD-C3D	-3.94	104.96	112.47

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	450	EPD	C51-C5-C4	-3.30	114.88	123.69
3	A	450	EPD	O14-C14-C15	-2.91	101.64	108.91
3	A	450	EPD	C3-C4-C5	-2.88	122.41	127.22
3	A	450	EPD	C27-C25-S1	-2.53	116.71	120.12
3	A	450	EPD	O16-C16-C15	-2.34	119.42	124.70
2	A	440	HEM	C3C-C4C-NC	-2.29	106.61	110.94
3	A	450	EPD	O10-C10-C9	-2.23	105.63	109.82
3	A	450	EPD	C29-C13-C30	2.34	112.47	108.96
3	A	450	EPD	C51-C5-C6	2.99	120.48	115.29
3	A	450	EPD	O10-C10-C11	3.17	116.24	108.78
2	A	440	HEM	C4C-C3C-C2C	3.18	109.12	106.90
3	A	450	EPD	C7-C8-C9	3.95	126.92	115.00
3	A	450	EPD	O1-C16-C15	4.81	120.49	111.47
3	A	450	EPD	O1-C2-C3	5.31	117.55	106.71
3	A	450	EPD	C2-O1-C16	5.37	124.42	116.46
3	A	450	EPD	C91-C9-C8	7.72	122.52	110.35

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 12 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	440	HEM	3	0
3	A	450	EPD	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 ⓘ

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	403/419 (96%)	0.53	26 (6%)	20 25	36, 48, 70, 86	0

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	236	GLY	7.1
1	A	416	SER	6.2
1	A	15	PHE	5.0
1	A	415	PRO	4.6
1	A	237	SER	4.4
1	A	142	GLU	4.2
1	A	140	GLN	4.1
1	A	139	GLY	4.1
1	A	141	GLU	3.9
1	A	388	GLU	3.3
1	A	238	ARG	3.1
1	A	137	ARG	2.9
1	A	412	ILE	2.7
1	A	391	LEU	2.5
1	A	390	LYS	2.5
1	A	414	LYS	2.5
1	A	16	ASP	2.3
1	A	210	HIS	2.3
1	A	191	VAL	2.2
1	A	301	LEU	2.2
1	A	303	ILE	2.2
1	A	410	ASN	2.1
1	A	392	LYS	2.1
1	A	138	SER	2.1
1	A	413	LEU	2.1
1	A	393	GLU	2.1

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 carbohydrates in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 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	LLDF	B-factors(\AA^2)	Q<0.9
2	HEM	A	440	43/43	0.96	0.17	0.80	31,35,39,41	0
3	EPD	A	450	34/34	0.90	0.17	0.23	40,48,56,56	0

6.5 Other polymers [i](#)

There are no such residues in this entry.