



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 14, 2017 – 10:47 am GMT

PDB ID : 3K9V
Title : Crystal structure of rat mitochondrial P450 24A1 S57D in complex with CHAPS
Authors : Annalora, A.J.; Goodin, D.B.; Hong, W.; Zhang, Q.; Johnson, E.F.; Stout, C.D.
Deposited on : 2009-10-16
Resolution : 2.50 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

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	:	trunk28620
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)	:	recalc28949

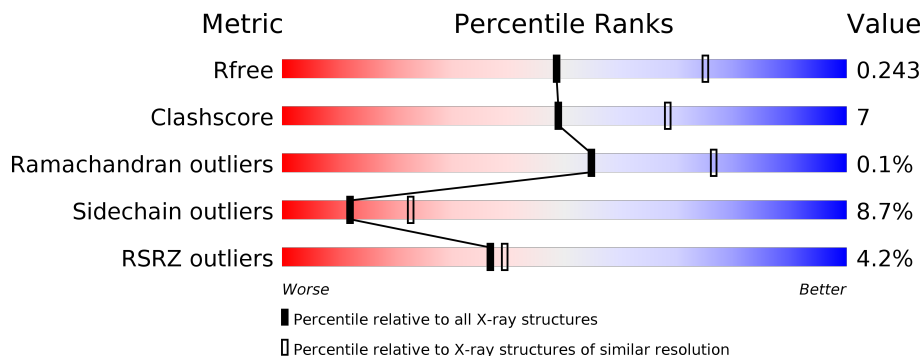
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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}	100719	3846 (2.50-2.50)
Clashscore	112137	4554 (2.50-2.50)
Ramachandran outliers	110173	4463 (2.50-2.50)
Sidechain outliers	110143	4465 (2.50-2.50)
RSRZ outliers	101464	3876 (2.50-2.50)

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	482	<div> <div>5%</div> <div> <div></div> <div>75%</div> <div>19%</div> <div>• •</div> </div> </div>
1	B	482	<div> <div>4%</div> <div> <div></div> <div>78%</div> <div>16%</div> <div>• •</div> </div> </div>

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	CPS	A	600	-	-	-	X
3	CPS	A	602	-	-	-	X
3	CPS	B	701	-	-	-	X

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 8157 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.

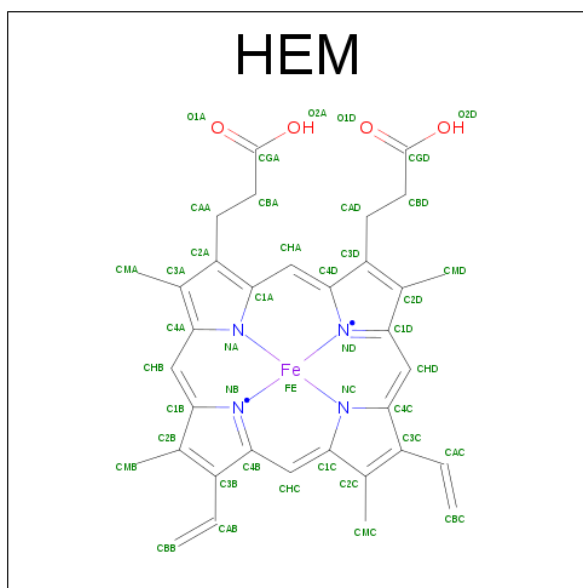
- Molecule 1 is a protein called 1,25-dihydroxyvitamin D(3) 24-hydroxylase, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	464	Total	C	N	O	S	0	0	0
			3797	2430	662	684	21			
1	B	464	Total	C	N	O	S	0	0	0
			3797	2430	662	684	21			

There are 4 discrepancies between the modelled and reference sequences:

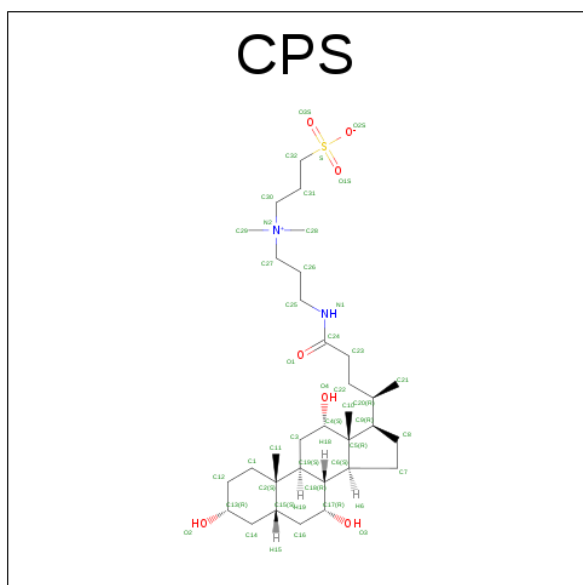
Chain	Residue	Modelled	Actual	Comment	Reference
A	33	MET	-	EXPRESSION TAG	UNP Q09128
A	57	ASP	SER	ENGINEERED	UNP Q09128
B	33	MET	-	EXPRESSION TAG	UNP Q09128
B	57	ASP	SER	ENGINEERED	UNP Q09128

- 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	
			43	34	1	4	4	
2	B	1	Total	C	Fe	N	O	
			43	34	1	4	4	

- Molecule 3 is 3-[(3-CHOLAMIDOPROPYL)DIMETHYLAMMONIO]-1-PROPANESULFONATE (three-letter code: CPS) (formula: C₃₂H₅₈N₂O₇S).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	S	
			42	32	2	7	1	
3	A	1	Total	C	N	O		
			32	27	1	4		
3	A	1	Total	C	N	O		
			32	27	1	4		
3	B	1	Total	C	N	O	S	
			42	32	2	7	1	
3	B	1	Total	C	N	O		
			32	27	1	4		
3	B	1	Total	C	N	O		
			32	27	1	4		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	147	Total	O		
			147	147	0	0

Continued on next page...

Continued from previous page...

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	118	Total 118	O 118	0	0

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 ($RSRZ > 2$). 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.

- Chain A:
-
- 5% 75% 19%
- MET ALA SER ARG ALA PRO LYS GLU VAL PRO LEU CYS PRO LEU MET THR ASP GLY E51 T52 R53 N54 V55 T56 D57 P61 W64 L67 L70 L71 E72 W75 K81 D84 R98 L101 S106 V107 L128 R129 R141 Y145 I149 L150 C153

- Chain B:
-
- Sequence logo for Chain B showing amino acid conservation across 100 positions. The y-axis represents information content in bits (0.00 to 0.25). The x-axis shows positions 1 to 100. A color scale at the top indicates conservation levels: 4% (red), 78% (green), and 16% (yellow). Amino acids are labeled above the bars. Notable conserved residues include T321, E322, L323, L335, Y340, N341, L342, S343, R344, L352, V359, P361, D362, N363, Q364, L377, L381, K382, E383, S390, V403, L404, E405, E406, L409, S425, N428, F429, E430, K434, R439, E441, K445, K446, T447, R460, G464, R465, R466, A475, and V472. A large green bar at the top indicates a highly conserved region from position 1 to approximately 80.

4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	182.61Å 81.65Å 108.70Å 90.00° 122.89° 90.00°	Depositor
Resolution (Å)	30.00 – 2.50 30.00 – 2.50	Depositor EDS
% Data completeness (in resolution range)	97.4 (30.00-2.50) 97.4 (30.00-2.50)	Depositor EDS
R_{merge}	0.15	Depositor
R_{sym}	0.15	Depositor
$\langle I/\sigma(I) \rangle$ ¹	6.04 (at 2.51Å)	Xtriage
Refinement program	REFMAC 5.5.0072	Depositor
R, R_{free}	0.206 , 0.252 0.199 , 0.243	Depositor DCC
R_{free} test set	2287 reflections (5.30%)	DCC
Wilson B-factor (Å ²)	37.3	Xtriage
Anisotropy	0.030	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 49.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	8157	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.00% 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, CPS

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	0.47	0/3885	0.62	2/5252 (0.0%)
1	B	0.46	0/3885	0.61	3/5252 (0.1%)
All	All	0.47	0/7770	0.62	5/10504 (0.0%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	150	LEU	CA-CB-CG	5.55	128.07	115.30
1	A	457	ILE	CB-CA-C	-5.26	101.08	111.60
1	B	263	LEU	CA-CB-CG	5.15	127.15	115.30
1	B	150	LEU	CA-CB-CG	5.11	127.04	115.30
1	B	58	LEU	CA-CB-CG	5.01	126.81	115.30

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	3797	0	3853	56	0
1	B	3797	0	3853	51	0
2	A	43	0	30	1	0
2	B	43	0	30	2	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	106	0	146	1	0
3	B	106	0	146	3	0
4	A	147	0	0	2	0
4	B	118	0	0	1	0
All	All	8157	0	8058	109	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 109 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:B:317:TYR:O	1:B:321:THR:HG23	1.70	0.91
1:B:229:LYS:O	1:B:230:GLU:HB2	1.72	0.87
1:A:293:TYR:HB2	1:A:303:CYS:SG	2.18	0.84
1:A:145:TYR:HB2	1:A:150:LEU:HD13	1.57	0.83
1:A:466:ARG:HG3	1:A:466:ARG:HH11	1.41	0.83

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	462/482 (96%)	446 (96%)	16 (4%)	0	100	100
1	B	462/482 (96%)	448 (97%)	13 (3%)	1 (0%)	51	73
All	All	924/964 (96%)	894 (97%)	29 (3%)	1 (0%)	55	76

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	230	GLU

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	418/433 (96%)	381 (91%)	37 (9%)	11	22
1	B	418/433 (96%)	382 (91%)	36 (9%)	12	23
All	All	836/866 (96%)	763 (91%)	73 (9%)	12	23

5 of 73 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	442	GLN
1	B	107	VAL
1	B	403	VAL
1	B	55	VAL
1	B	114	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	347	GLN
1	A	373	ASN
1	A	428	ASN
1	A	448	ASN

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](#)

8 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	520	1	28,50,50	2.90	11 (39%)	17,82,82	1.25	2 (11%)
3	CPS	A	600	-	45,45,45	2.37	5 (11%)	68,70,70	1.60	13 (19%)
3	CPS	A	601	-	35,35,45	1.05	1 (2%)	54,54,70	1.21	6 (11%)
3	CPS	A	602	-	35,35,45	1.01	1 (2%)	54,54,70	1.58	7 (12%)
2	HEM	B	520	1	28,50,50	2.91	11 (39%)	17,82,82	1.45	4 (23%)
3	CPS	B	700	-	45,45,45	2.39	5 (11%)	68,70,70	1.47	11 (16%)
3	CPS	B	701	-	35,35,45	1.06	1 (2%)	54,54,70	1.40	9 (16%)
3	CPS	B	702	-	35,35,45	1.04	1 (2%)	54,54,70	1.40	8 (14%)

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	520	1	-	0/6/54/54	0/0/8/8
3	CPS	A	600	-	-	0/25/90/90	0/4/4/4
3	CPS	A	601	-	-	0/13/78/90	0/4/4/4
3	CPS	A	602	-	-	0/13/78/90	0/4/4/4
2	HEM	B	520	1	-	0/6/54/54	0/0/8/8
3	CPS	B	700	-	-	0/25/90/90	0/4/4/4
3	CPS	B	701	-	-	1/13/78/90	0/4/4/4
3	CPS	B	702	-	-	0/13/78/90	0/4/4/4

The worst 5 of 36 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	520	HEM	C3B-CAB	-7.36	1.33	1.47
2	B	520	HEM	C3B-CAB	-7.28	1.33	1.47
3	B	700	CPS	C32-S	-4.12	1.71	1.77
3	A	600	CPS	C32-S	-4.09	1.71	1.77
2	A	520	HEM	C1D-CHD	-3.21	1.31	1.40

The worst 5 of 60 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	602	CPS	C9-C5-C6	-7.60	92.34	100.08
3	B	702	CPS	C9-C5-C6	-4.27	95.73	100.08
3	A	600	CPS	C9-C5-C6	-4.14	95.87	100.08
3	B	701	CPS	C9-C5-C6	-3.77	96.24	100.08
3	A	600	CPS	C5-C9-C20	-3.44	115.32	119.49

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	701	CPS	C23-C24-N1-C25

There are no ring outliers.

6 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	520	HEM	1	0
3	A	601	CPS	1	0
2	B	520	HEM	2	0
3	B	700	CPS	1	0
3	B	701	CPS	1	0
3	B	702	CPS	1	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 [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, 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	464/482 (96%)	0.10	22 (4%) 32 34	17, 33, 54, 75	0
1	B	464/482 (96%)	0.08	17 (3%) 42 44	15, 35, 57, 69	0
All	All	928/964 (96%)	0.09	39 (4%) 37 39	15, 34, 56, 75	0

The worst 5 of 39 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	52	THR	6.5
1	B	52	THR	6.4
1	A	51	GLU	6.1
1	B	230	GLU	4.9
1	A	75	TRP	4.6

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
3	CPS	B	701	32/42	0.65	0.28	3.09	86,87,89,89	0
3	CPS	A	602	32/42	0.85	0.32	2.51	75,76,80,80	0
3	CPS	A	600	42/42	0.79	0.25	2.03	27,33,74,75	0
3	CPS	B	700	42/42	0.82	0.24	1.94	31,36,76,77	0
3	CPS	B	702	32/42	0.83	0.30	1.05	66,69,75,76	0
3	CPS	A	601	32/42	0.88	0.17	1.02	49,50,59,59	0
2	HEM	A	520	43/43	0.98	0.17	-0.28	9,14,18,19	0
2	HEM	B	520	43/43	0.98	0.15	-0.57	11,14,15,16	0

6.5 Other polymers [i](#)

There are no such residues in this entry.