



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 1, 2014 – 04:10 AM GMT

PDB ID : 1S5X
Title : The crystal structure of Trematomus bernacchii hemoglobin oxidized by air
Authors : Vitagliano, L.; Bonomi, G.; Riccio, A.; di Prisco, G.; Smulevich, G.; Mazarella, L.
Deposited on : 2004-01-22
Resolution : 2.40 Å(reported)

This is a full wwPDB 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/ValidationPDFNotes.html>

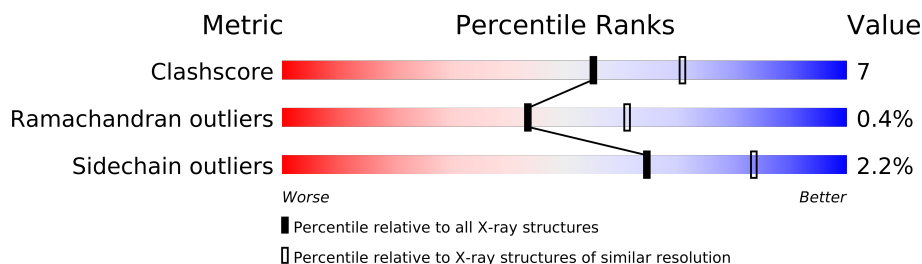
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.15 2013
Xtriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 21963
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : stable22683

1 Overall quality at a glance

The reported resolution of this entry is 2.40 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	79885	2789 (2.40-2.40)
Ramachandran outliers	78287	2736 (2.40-2.40)
Sidechain outliers	78261	2737 (2.40-2.40)

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. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	143	
2	B	146	

2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 2267 atoms, of which 0 are hydrogen and 0 are deuterium.

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.

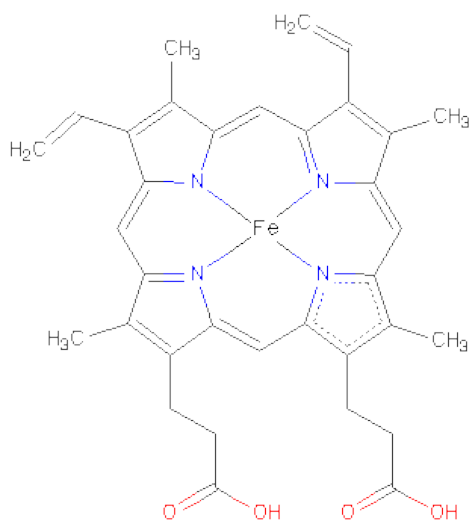
- Molecule 1 is a protein called Hemoglobin alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	143	Total	C	N	O	S	0	0	0
			1104	710	190	199	5			

- Molecule 2 is a protein called Hemoglobin beta chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	136	Total	C	N	O	S	0	0	0
			1050	669	182	194	5			

- Molecule 3 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	Fe	N	O	0	0
			43	34	1	4	4		
3	B	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	15	Total 15	O 15	0	0
4	B	12	Total 12	O 12	0	0

3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

Note EDS was not executed.

- Molecule 1: Hemoglobin alpha chain

Chain A: 



- Molecule 2: Hemoglobin beta chain

Chain B: 



4 Data and refinement statistics

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

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	108.52Å 65.09Å 55.75Å 90.00° 113.48° 90.00°	Depositor
Resolution (Å)	20.00 – 2.40	Depositor
% Data completeness (in resolution range)	(Not available) (20.00-2.40)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.190 , 0.233	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2267	wwPDB-VP
Average B, all atoms (Å ²)	34.0	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, ACE

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	0.46	0/1127	0.68	1/1523 (0.1%)
2	B	0.42	0/1071	0.56	0/1449
All	All	0.44	0/2198	0.63	1/2972 (0.0%)

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	0	1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	1	SER	O-C-N	-11.73	103.93	122.70

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	1	SER	Mainchain

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit,

and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1104	0	1136	15	0
2	B	1050	0	1047	15	0
3	A	43	0	30	0	0
3	B	43	0	30	2	0
4	A	15	0	0	1	0
4	B	12	0	0	1	0
All	All	2267	0	2243	30	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 7.

All (30) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:93:ARG:HH11	1:A:93:ARG:HB3	1.43	0.82
2:B:23:ILE:HD11	2:B:117:LYS:HD2	1.62	0.80
1:A:140:ARG:HB3	1:A:140:ARG:HH11	1.53	0.72
2:B:89:SER:OG	2:B:144:GLN:HB2	1.91	0.70
2:B:20:TYR:HA	2:B:68:LEU:HD23	1.73	0.70
1:A:140:ARG:HB3	1:A:140:ARG:NH1	2.12	0.65
1:A:116:LYS:HD2	1:A:117:GLU:OE2	1.97	0.65
1:A:22:ASP:OD1	1:A:61:LYS:HE3	2.05	0.56
2:B:1:VAL:HG11	2:B:136:VAL:HG22	1.88	0.56
2:B:8:ARG:HH12	2:B:79:ASP:CG	2.10	0.54
1:A:93:ARG:NH1	1:A:93:ARG:HB3	2.17	0.53
2:B:106:LEU:HD23	3:B:400:HEM:HBB2	1.90	0.52
1:A:105:CYS:O	1:A:109:VAL:HG23	2.12	0.49
2:B:69:HIS:HE1	4:B:516:HOH:O	1.93	0.49
2:B:85:TYR:HD2	2:B:88:LEU:HD12	1.79	0.47
1:A:116:LYS:HB3	4:A:502:HOH:O	2.15	0.47
2:B:141:LEU:CD1	3:B:400:HEM:HAB	2.45	0.46
2:B:89:SER:CB	2:B:144:GLN:HB2	2.46	0.46
1:A:33:ILE:HG23	1:A:40:LYS:HG2	1.97	0.45
2:B:6:LYS:O	2:B:10:ILE:HG13	2.16	0.44
1:A:114:PHE:HB3	1:A:117:GLU:OE1	2.17	0.44
1:A:50:THR:O	1:A:56:ILE:HD12	2.18	0.44
2:B:14:ILE:HD11	2:B:126:THR:HG23	2.00	0.43
2:B:92:HIS:HA	2:B:96:LEU:HB2	2.01	0.43
1:A:98:ASN:HD22	1:A:101:ILE:HD12	1.83	0.43
2:B:143:LYS:HE3	2:B:144:GLN:HE21	1.85	0.41

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:32:MET:HE3	1:A:39:THR:HB	2.03	0.41
1:A:21:ALA:O	1:A:64:MET:HG3	2.20	0.41
2:B:94:GLU:HA	2:B:94:GLU:OE2	2.20	0.40
1:A:140:ARG:HH11	1:A:140:ARG:CB	2.30	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	141/143 (99%)	137 (97%)	3 (2%)	1 (1%)	30	43
2	B	132/146 (90%)	127 (96%)	5 (4%)	0	100	100
All	All	273/289 (94%)	264 (97%)	8 (3%)	1 (0%)	43	61

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	53	SER

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	119/119 (100%)	116 (98%)	3 (2%)	60	80
2	B	112/120 (93%)	110 (98%)	2 (2%)	71	88
All	All	231/239 (97%)	226 (98%)	5 (2%)	64	83

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	16	LYS
1	A	93	ARG
1	A	135	LEU
2	B	68	LEU
2	B	96	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	98	ASN
1	A	103	ASN
2	B	41	HIS
2	B	69	HIS
2	B	144	GLN

5.3.3 RNA ⓘ

There are no RNA chains in this entry.

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

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

5.6 Ligand geometry ⓘ

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
3	HEM	A	200	1,4	49,50,50	4.49	23 (46%)	46,82,82	1.85	12 (26%)
3	HEM	B	400	2	49,50,50	3.75	23 (46%)	46,82,82	1.87	19 (41%)

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
3	HEM	A	200	1,4	-	0/14/114/114	0/0/8/8
3	HEM	B	400	2	-	0/14/114/114	0/0/8/8

All (46) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	200	HEM	C3D-C4D	18.42	1.49	1.44
3	A	200	HEM	C2B-C1B	15.78	1.48	1.44
3	B	400	HEM	C2D-C1D	14.12	1.48	1.44
3	B	400	HEM	C3D-C4D	12.39	1.47	1.44
3	A	200	HEM	C2D-C1D	8.60	1.46	1.44
3	B	400	HEM	C2B-C1B	7.44	1.46	1.44
3	A	200	HEM	C4A-C3A	6.89	1.48	1.40
3	A	200	HEM	CBD-CGD	-5.00	1.37	1.50
3	A	200	HEM	C3C-CAC	4.82	1.55	1.40
3	B	400	HEM	CBC-CAC	4.81	1.56	1.28
3	B	400	HEM	CHA-C4D	4.74	1.42	1.35
3	A	200	HEM	CBB-CAB	4.74	1.56	1.28
3	B	400	HEM	C3C-CAC	4.54	1.54	1.40
3	A	200	HEM	C3B-C2B	-4.48	1.35	1.43
3	B	400	HEM	C4A-C3A	4.37	1.45	1.40
3	A	200	HEM	CHA-C4D	4.31	1.42	1.35
3	B	400	HEM	C3B-C4B	4.15	1.49	1.44
3	A	200	HEM	C3B-CAB	4.04	1.53	1.40
3	B	400	HEM	C3B-CAB	4.03	1.53	1.40
3	A	200	HEM	CBC-CAC	3.94	1.51	1.28
3	B	400	HEM	CBB-CAB	3.90	1.51	1.28
3	A	200	HEM	FE-NA	3.88	2.09	1.92
3	A	200	HEM	CAD-CBD	3.83	1.63	1.52
3	B	400	HEM	CMB-C2B	3.71	1.59	1.47
3	B	400	HEM	C3D-C2D	-3.57	1.37	1.43
3	B	400	HEM	O1A-CGA	3.34	1.34	1.22
3	B	400	HEM	CAD-CBD	3.31	1.61	1.52

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	200	HEM	CHD-C4C	3.27	1.42	1.36
3	A	200	HEM	CBA-CGA	-3.23	1.42	1.50
3	B	400	HEM	C3B-C2B	-3.23	1.38	1.43
3	B	400	HEM	C3C-C2C	-3.08	1.38	1.43
3	A	200	HEM	O1A-CGA	3.08	1.33	1.22
3	B	400	HEM	CHD-C4C	3.05	1.41	1.36
3	B	400	HEM	CBA-CGA	-3.00	1.42	1.50
3	B	400	HEM	FE-NA	2.95	2.05	1.92
3	A	200	HEM	C3C-C2C	-2.85	1.38	1.43
3	A	200	HEM	C3D-C2D	-2.74	1.39	1.43
3	A	200	HEM	CHB-C1B	2.73	1.39	1.35
3	B	400	HEM	CBD-CGD	-2.66	1.43	1.50
3	A	200	HEM	CHC-C1C	2.55	1.40	1.36
3	A	200	HEM	C3B-C4B	2.50	1.47	1.44
3	A	200	HEM	C1A-NA	2.33	1.41	1.36
3	A	200	HEM	CMC-C2C	2.24	1.54	1.47
3	B	400	HEM	CMC-C2C	2.17	1.54	1.47
3	B	400	HEM	O1D-CGD	2.09	1.29	1.22
3	B	400	HEM	CMD-C2D	2.06	1.53	1.47

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	200	HEM	CHC-C4B-NB	-5.25	120.22	124.58
3	A	200	HEM	CHD-C1D-ND	-4.61	120.75	124.58
3	B	400	HEM	CHC-C4B-NB	-4.06	121.21	124.58
3	A	200	HEM	CBD-CAD-C3D	-4.02	105.59	114.37
3	B	400	HEM	C3B-C4B-NB	-3.76	111.31	114.00
3	A	200	HEM	C1B-NB-C4B	-3.46	101.62	105.16
3	B	400	HEM	C1A-CHA-C4D	3.05	131.49	127.47
3	B	400	HEM	CHD-C4C-NC	-3.02	122.10	124.73
3	B	400	HEM	CHC-C1C-NC	-2.84	122.27	124.73
3	B	400	HEM	C3A-C4A-NA	2.79	111.51	109.41
3	A	200	HEM	O1A-CGA-CBA	-2.74	113.60	123.03
3	B	400	HEM	O2D-CGD-O1D	-2.68	116.47	123.30
3	B	400	HEM	C1B-NB-C4B	-2.58	102.52	105.16
3	A	200	HEM	CHC-C1C-NC	-2.56	122.51	124.73
3	A	200	HEM	C4A-NA-C1A	-2.54	103.41	106.76
3	A	200	HEM	O2A-CGA-CBA	2.44	122.84	114.22
3	B	400	HEM	CAD-CBD-CGD	2.40	120.97	113.48
3	B	400	HEM	CHA-C1A-NA	-2.37	120.61	124.58
3	B	400	HEM	O2D-CGD-CBD	2.33	122.47	114.22

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	200	HEM	CMA-C3A-C4A	-2.32	125.06	128.62
3	A	200	HEM	CHD-C4C-NC	-2.28	122.75	124.73
3	A	200	HEM	C2A-C1A-NA	2.26	112.88	109.73
3	B	400	HEM	CMA-C3A-C2A	2.21	129.11	124.94
3	B	400	HEM	CMD-C2D-C3D	2.20	130.60	125.60
3	B	400	HEM	CHD-C1D-ND	-2.20	122.76	124.58
3	B	400	HEM	C4A-C3A-C2A	-2.19	105.47	107.00
3	B	400	HEM	O2A-CGA-CBA	2.18	121.94	114.22
3	B	400	HEM	CMA-C3A-C4A	-2.10	125.40	128.62
3	B	400	HEM	CBA-CAA-C2A	-2.09	109.00	112.69
3	B	400	HEM	CAD-C3D-C2D	2.08	131.87	127.25
3	A	200	HEM	C4D-ND-C1D	-2.00	103.11	105.16

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues

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 will therefore be empty.

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

EDS was not executed - this section will therefore be empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section will therefore be empty.

6.4 Ligands ⓘ

EDS was not executed - this section will therefore be empty.

6.5 Other polymers ⓘ

EDS was not executed - this section will therefore be empty.