



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 24, 2024 – 08:01 AM EST

PDB ID : 5CAC  
Title : REFINED STRUCTURE OF HUMAN CARBONIC ANHYDRASE II AT 2.0  
ANGSTROMS RESOLUTION  
Authors : Lindahl, M.; Habash, D.; Harrop, S.; Helliwell, D.R.; Liljas, A.  
Deposited on : 1991-09-05  
Resolution : 2.20 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](mailto: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>.

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

MolProbity : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtrriage (Phenix) : **NOT EXECUTED**  
EDS : **NOT EXECUTED**  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.36

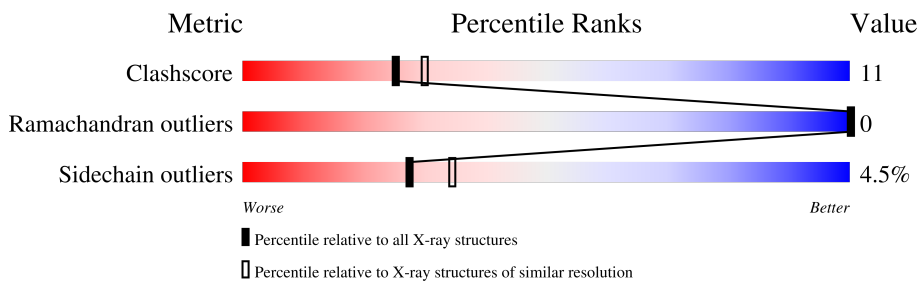
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.20 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	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)

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  $\geq 3$ , 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  $\leq 5\%$ .

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	259	64% 27% 7% .

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 2196 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.

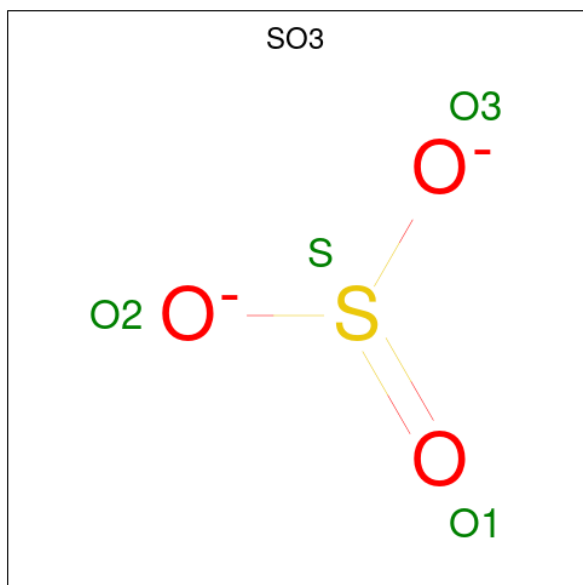
- Molecule 1 is a protein called CARBONIC ANHYDRASE FORM C.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	256	2039	1309	350	378	2	0	0	0

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Zn		
2	A	1	1	1	0	0

- Molecule 3 is SULFITE ION (three-letter code: SO3) (formula: O<sub>3</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	S		
3	A	1	4	3	1	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	152	Total 152	O 152	0	0

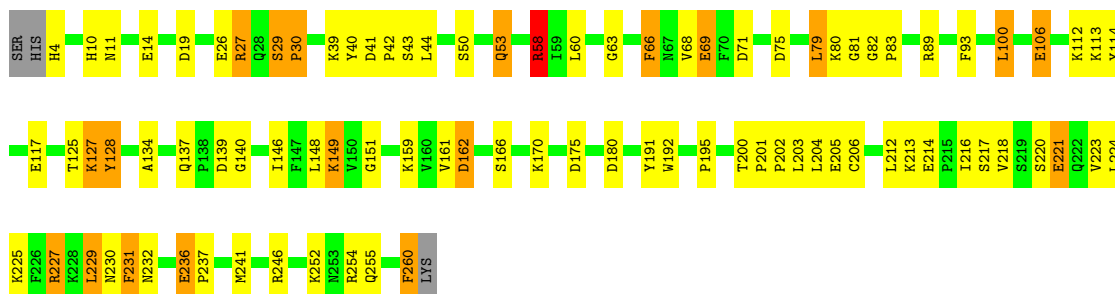
### 3 Residue-property plots [i](#)

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. 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. 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: CARBONIC ANHYDRASE FORM C

Chain A:  64% 27% 7%



## 4 Data and refinement statistics

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

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	42.70Å 41.70Å 73.00Å 90.00° 104.60° 90.00°	Depositor
Resolution (Å)	(Not available) – 2.20	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-2.20)	Depositor
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, $R_{free}$	0.189 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	2196	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	13.0	wwPDB-VP

## 5 Model quality i

### 5.1 Standard geometry i

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, SO3

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	1.62	9/2099 (0.4%)	1.90	45/2848 (1.6%)

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	236	GLU	CD-OE1	-10.09	1.14	1.25
1	A	69	GLU	CD-OE1	-7.31	1.17	1.25
1	A	50	SER	CB-OG	-6.81	1.33	1.42
1	A	227	ARG	CZ-NH2	5.98	1.40	1.33
1	A	106	GLU	CB-CG	5.72	1.63	1.52
1	A	260	PHE	C-O	5.71	1.34	1.23
1	A	29	SER	CB-OG	-5.66	1.34	1.42
1	A	254	ARG	NE-CZ	-5.06	1.26	1.33
1	A	81	GLY	N-CA	5.05	1.53	1.46

All (45) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	58	ARG	NE-CZ-NH1	16.24	128.42	120.30
1	A	89	ARG	NE-CZ-NH2	-12.78	113.91	120.30
1	A	58	ARG	NE-CZ-NH2	-12.41	114.10	120.30
1	A	58	ARG	CD-NE-CZ	11.56	139.78	123.60
1	A	175	ASP	CB-CG-OD1	11.41	128.57	118.30
1	A	227	ARG	NE-CZ-NH1	9.99	125.30	120.30
1	A	175	ASP	CB-CG-OD2	-8.98	110.22	118.30
1	A	75	ASP	CB-CG-OD1	8.98	126.38	118.30
1	A	100	LEU	CA-CB-CG	8.29	134.36	115.30
1	A	221	GLU	CA-CB-CG	8.26	131.58	113.40
1	A	180	ASP	CB-CG-OD1	7.58	125.12	118.30
1	A	19	ASP	CB-CG-OD2	-7.53	111.53	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	26	GLU	CG-CD-OE1	7.45	133.20	118.30
1	A	229	LEU	CA-CB-CG	6.95	131.28	115.30
1	A	71	ASP	CB-CG-OD1	6.88	124.49	118.30
1	A	113	LYS	CD-CE-NZ	6.56	126.80	111.70
1	A	93	PHE	N-CA-CB	6.32	121.98	110.60
1	A	149	LYS	N-CA-CB	6.28	121.91	110.60
1	A	27	ARG	NE-CZ-NH2	6.03	123.31	120.30
1	A	27	ARG	NE-CZ-NH1	5.95	123.28	120.30
1	A	128	TYR	CB-CG-CD1	-5.92	117.45	121.00
1	A	128	TYR	CB-CG-CD2	5.92	124.55	121.00
1	A	53	GLN	CA-CB-CG	-5.90	100.43	113.40
1	A	214	GLU	OE1-CD-OE2	-5.88	116.24	123.30
1	A	66	PHE	CB-CG-CD1	-5.72	116.80	120.80
1	A	162	ASP	CB-CG-OD1	5.69	123.42	118.30
1	A	89	ARG	NE-CZ-NH1	5.67	123.14	120.30
1	A	19	ASP	CB-CG-OD1	5.63	123.37	118.30
1	A	221	GLU	CB-CG-CD	5.55	129.19	114.20
1	A	79	LEU	CA-CB-CG	5.48	127.91	115.30
1	A	27	ARG	NH1-CZ-NH2	-5.45	113.41	119.40
1	A	4	HIS	CA-CB-CG	5.42	122.82	113.60
1	A	14	GLU	CB-CG-CD	5.38	128.73	114.20
1	A	236	GLU	CG-CD-OE1	5.33	128.97	118.30
1	A	10	HIS	CB-CA-C	5.29	120.98	110.40
1	A	68	VAL	N-CA-CB	5.29	123.14	111.50
1	A	151	GLY	CA-C-N	-5.24	105.67	117.20
1	A	166	SER	N-CA-CB	-5.21	102.69	110.50
1	A	192	TRP	N-CA-CB	5.20	119.97	110.60
1	A	113	LYS	CA-CB-CG	5.15	124.73	113.40
1	A	231	PHE	CB-CG-CD2	-5.08	117.25	120.80
1	A	246	ARG	CB-CA-C	-5.06	100.27	110.40
1	A	151	GLY	N-CA-C	-5.05	100.47	113.10
1	A	139	ASP	CB-CG-OD1	5.04	122.83	118.30
1	A	117	GLU	OE1-CD-OE2	5.01	129.31	123.30

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	2039	0	1988	43	0
2	A	1	0	0	0	0
3	A	4	0	0	0	0
4	A	152	0	0	6	0
All	All	2196	0	1988	43	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 11.

All (43) 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:A:125:THR:C	1:A:127:LYS:N	2.22	0.92
1:A:58:ARG:HD2	1:A:69:GLU:OE1	1.74	0.87
1:A:213:LYS:HD3	1:A:260:PHE:CZ	2.11	0.86
1:A:40:TYR:HE2	1:A:42:PRO:HB3	1.55	0.72
1:A:40:TYR:CE2	1:A:42:PRO:HB3	2.29	0.68
1:A:231:PHE:CE1	1:A:241:MET:HG3	2.31	0.65
1:A:44:LEU:HD11	1:A:83:PRO:HB3	1.78	0.64
1:A:162:ASP:OD2	4:A:531:HOH:O	2.15	0.64
1:A:125:THR:C	1:A:127:LYS:CA	2.67	0.62
1:A:41:ASP:OD1	1:A:43:SER:OG	2.16	0.62
1:A:112:LYS:HE3	1:A:114:TYR:CZ	2.36	0.60
1:A:82:GLY:HA2	1:A:191:TYR:OH	2.01	0.60
1:A:134:ALA:O	1:A:140:GLY:HA3	2.05	0.56
1:A:128:TYR:CE1	1:A:137:GLN:HG3	2.42	0.55
1:A:41:ASP:CG	1:A:43:SER:HG	2.10	0.54
1:A:236:GLU:HB3	1:A:237:PRO:HD2	1.90	0.54
1:A:27:ARG:HG3	1:A:205:GLU:HB3	1.89	0.53
1:A:230:ASN:HB3	1:A:232:ASN:OD1	2.09	0.53
1:A:30:PRO:HG3	1:A:106:GLU:HB3	1.92	0.51
1:A:231:PHE:CD1	1:A:241:MET:HG3	2.45	0.51
1:A:201:PRO:HA	1:A:203:LEU:HG	1.95	0.49
1:A:223:VAL:HG11	1:A:227:ARG:NH2	2.28	0.49
1:A:220:SER:O	1:A:224:LEU:HG	2.13	0.48
1:A:58:ARG:HD2	1:A:69:GLU:CD	2.33	0.47
1:A:149:LYS:O	1:A:217:SER:HA	2.15	0.47
1:A:146:ILE:HG12	1:A:212:LEU:HD12	1.98	0.45
1:A:60:LEU:O	1:A:66:PHE:HA	2.17	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:159:LYS:CE	4:A:577:HOH:O	2.64	0.45
1:A:206:CYS:HB3	4:A:522:HOH:O	2.17	0.44
1:A:58:ARG:CD	1:A:69:GLU:OE1	2.56	0.43
1:A:80:LYS:NZ	4:A:471:HOH:O	2.52	0.43
1:A:202:PRO:HG2	1:A:204:LEU:HG	1.98	0.43
1:A:218:VAL:CG2	1:A:223:VAL:HG23	2.48	0.43
1:A:63:GLY:HA3	1:A:170:LYS:NZ	2.34	0.42
1:A:252:LYS:NZ	4:A:523:HOH:O	2.52	0.42
1:A:128:TYR:CD1	1:A:137:GLN:HG3	2.55	0.41
1:A:223:VAL:CG1	1:A:227:ARG:NH2	2.83	0.41
1:A:11:ASN:OD1	1:A:11:ASN:N	2.53	0.41
1:A:200:THR:HB	1:A:201:PRO:HD2	2.03	0.41
1:A:148:LEU:HA	1:A:216:ILE:O	2.20	0.41
1:A:161:VAL:HG13	1:A:225:LYS:HD2	2.03	0.40
1:A:29:SER:HB3	1:A:30:PRO:HA	2.04	0.40
1:A:195:PRO:HG3	4:A:450:HOH:O	2.21	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	252/259 (97%)	240 (95%)	12 (5%)	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	221/224 (99%)	211 (96%)	10 (4%)	27 34

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	30	PRO
1	A	39	LYS
1	A	53	GLN
1	A	58	ARG
1	A	79	LEU
1	A	100	LEU
1	A	127	LYS
1	A	221	GLU
1	A	229	LEU
1	A	255	GLN

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

Mol	Chain	Res	Type
1	A	53	GLN
1	A	136	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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 for Mogul analysis.

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	SO3	A	431	2	1,3,3	2.67	1 (100%)	0,3,3	-	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	431	SO3	O1-S	2.67	1.55	1.44

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	A	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	A	125:THR	C	127:LYS	N	2.22

## 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.