



# Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 08:42 pm BST

PDB ID : 3HLK  
Title : Crystal structure of human mitochondrial acyl-CoA thioesterase (ACOT2)  
Authors : Mandel, C.R.; Tweel, B.; Tong, L.  
Deposited on : 2009-05-27  
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](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.

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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)  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.11

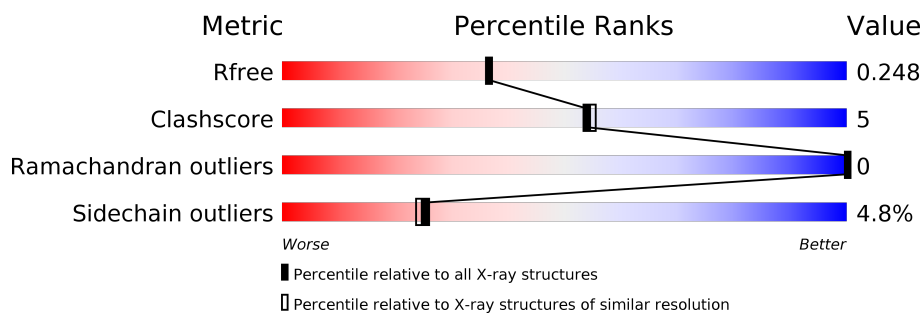
# 1 Overall quality at a glance

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))
$R_{free}$	130704	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (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  $\geq 3$ , 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  $\leq 5\%$ .

Mol	Chain	Length	Quality of chain
1	A	446	 78% 11% • 9%
1	B	446	 79% 11% • 8%

## 2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 6829 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 Acyl-coenzyme A thioesterase 2, mitochondrial.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	408	3183	2038	564	566	7	8	0	0	0
1	B	411	3205	2053	567	570	7	8	0	0	0

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	484	LEU	-	EXPRESSION TAG	UNP P49753
A	485	GLU	-	EXPRESSION TAG	UNP P49753
A	486	HIS	-	EXPRESSION TAG	UNP P49753
A	487	HIS	-	EXPRESSION TAG	UNP P49753
A	488	HIS	-	EXPRESSION TAG	UNP P49753
A	489	HIS	-	EXPRESSION TAG	UNP P49753
A	490	HIS	-	EXPRESSION TAG	UNP P49753
A	491	HIS	-	EXPRESSION TAG	UNP P49753
B	484	LEU	-	EXPRESSION TAG	UNP P49753
B	485	GLU	-	EXPRESSION TAG	UNP P49753
B	486	HIS	-	EXPRESSION TAG	UNP P49753
B	487	HIS	-	EXPRESSION TAG	UNP P49753
B	488	HIS	-	EXPRESSION TAG	UNP P49753
B	489	HIS	-	EXPRESSION TAG	UNP P49753
B	490	HIS	-	EXPRESSION TAG	UNP P49753
B	491	HIS	-	EXPRESSION TAG	UNP P49753


- Molecule 2 is water.

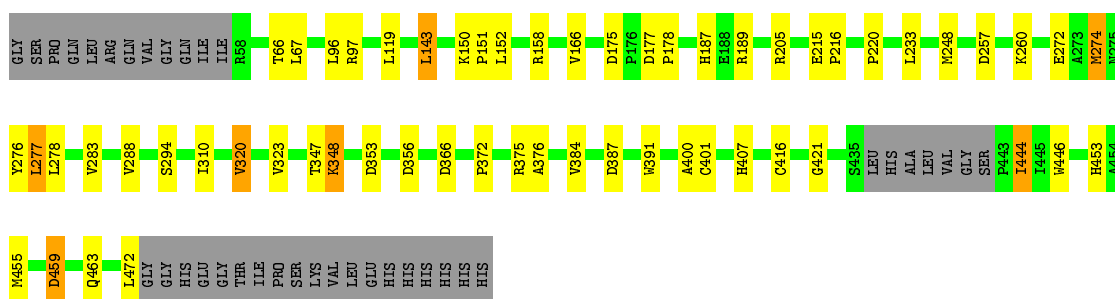
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	224	Total	O	0	0
			224	224		
2	B	217	Total	O	0	0
			217	217		

### 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. 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.

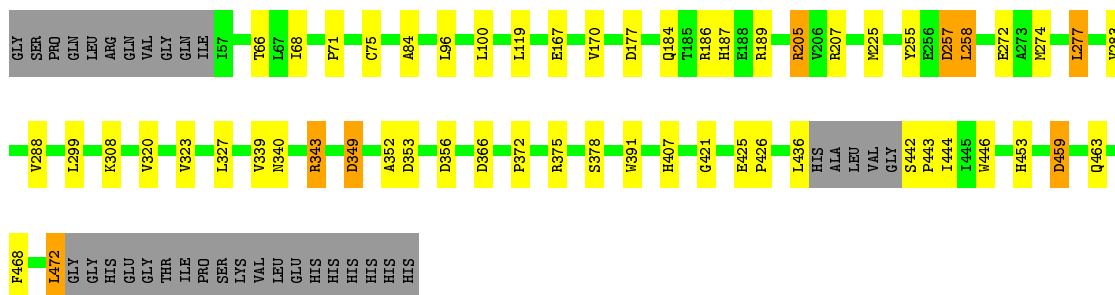
- Molecule 1: Acyl-coenzyme A thioesterase 2, mitochondrial

Chain A: 



- Molecule 1: Acyl-coenzyme A thioesterase 2, mitochondrial

Chain B: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	124.56Å 124.56Å 131.95Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.00 – 2.10 29.18 – 2.10	Depositor EDS
% Data completeness (in resolution range)	94.6 (30.00-2.10) 97.4 (29.18-2.10)	Depositor EDS
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.33 (at 2.10Å)	Xtrriage
Refinement program	REFMAC 5.2.0003	Depositor
R, $R_{free}$	0.194 , 0.236 0.252 , 0.248	Depositor DCC
$R_{free}$ test set	9957 reflections (7.48%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	30.5	Xtrriage
Anisotropy	0.274	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 46.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.022 for -h,-k,l	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	6829	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	34.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.87% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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 [i](#)

### 5.1 Standard geometry [i](#)

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	0.53	0/3259	0.73	8/4411 (0.2%)
1	B	0.52	0/3281	0.74	8/4442 (0.2%)
All	All	0.53	0/6540	0.73	16/8853 (0.2%)

There are no bond length outliers.

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	356	ASP	CB-CG-OD2	6.83	124.45	118.30
1	A	353	ASP	CB-CG-OD2	6.71	124.34	118.30
1	B	100	LEU	CA-CB-CG	6.47	130.18	115.30
1	B	353	ASP	CB-CG-OD2	6.45	124.11	118.30
1	B	366	ASP	CB-CG-OD2	6.15	123.84	118.30
1	B	459	ASP	CB-CG-OD2	6.01	123.70	118.30
1	A	175	ASP	CB-CG-OD2	5.75	123.48	118.30
1	B	356	ASP	CB-CG-OD2	5.75	123.47	118.30
1	B	349	ASP	CB-CG-OD2	5.70	123.43	118.30
1	A	459	ASP	CB-CG-OD2	5.58	123.32	118.30
1	A	177	ASP	CB-CG-OD2	5.28	123.05	118.30
1	B	257	ASP	CB-CG-OD2	5.20	122.98	118.30
1	A	366	ASP	CB-CG-OD2	5.20	122.98	118.30
1	A	387	ASP	CB-CG-OD2	5.19	122.97	118.30
1	B	177	ASP	CB-CG-OD2	5.16	122.94	118.30
1	A	257	ASP	CB-CG-OD2	5.15	122.94	118.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

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	3183	0	3191	35	0
1	B	3205	0	3217	37	0
2	A	224	0	0	8	0
2	B	217	0	0	3	0
All	All	6829	0	6408	68	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 5.

All (68) 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:407:HIS:HE1	1:B:407:HIS:HE1	1.14	0.95
1:A:416:CYS:SG	2:A:686:HOH:O	2.24	0.94
1:A:416:CYS:HB3	2:A:686:HOH:O	1.73	0.88
1:A:416:CYS:CB	2:A:686:HOH:O	2.21	0.87
1:B:274:MSE:HE1	1:B:308:LYS:O	1.76	0.85
1:A:407:HIS:HE1	1:B:407:HIS:CE1	1.94	0.85
1:A:187:HIS:HE1	1:A:189:ARG:HH11	1.24	0.83
1:B:421:GLY:H	1:B:453:HIS:HD2	1.30	0.80
1:A:421:GLY:H	1:A:453:HIS:HD2	1.33	0.76
1:A:407:HIS:CE1	1:B:407:HIS:HE1	2.00	0.76
1:B:343:ARG:HH11	1:B:343:ARG:HB2	1.52	0.75
1:B:205:ARG:CB	1:B:205:ARG:HH11	2.00	0.74
1:A:277:LEU:HD22	1:A:283:VAL:HG21	1.70	0.73
1:B:340:ASN:HB3	1:B:343:ARG:NH1	2.03	0.73
1:B:421:GLY:H	1:B:453:HIS:CD2	2.08	0.72
1:B:187:HIS:HE1	1:B:189:ARG:HH11	1.38	0.70
1:A:376:ALA:O	2:A:685:HOH:O	2.11	0.67
1:B:186:ARG:HH11	1:B:186:ARG:HG3	1.60	0.67
1:B:352:ALA:HB3	1:B:444:ILE:HG22	1.80	0.64
1:B:277:LEU:HD22	1:B:283:VAL:HG21	1.81	0.62
1:B:75:CYS:HB2	2:B:675:HOH:O	2.00	0.61
1:B:343:ARG:HH11	1:B:343:ARG:CB	2.14	0.61
1:A:187:HIS:CE1	1:A:189:ARG:HH11	2.13	0.60
1:A:205:ARG:HD3	1:A:272:GLU:OE1	2.00	0.60
1:B:205:ARG:HB2	1:B:205:ARG:HH11	1.64	0.60
1:A:143:LEU:HD21	1:A:166:VAL:HG21	1.84	0.58
1:B:468:PHE:O	1:B:472:LEU:HB2	2.03	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:205:ARG:NH1	1:B:272:GLU:OE1	2.37	0.57
1:A:278:LEU:HD13	1:A:288:VAL:HG13	1.88	0.56
1:B:343:ARG:CG	1:B:343:ARG:HH11	2.19	0.56
1:A:421:GLY:H	1:A:453:HIS:CD2	2.18	0.56
1:A:248:MSE:HE3	1:A:277:LEU:HG	1.87	0.55
1:B:187:HIS:HD2	2:B:535:HOH:O	1.89	0.54
1:B:187:HIS:CE1	1:B:189:ARG:HH11	2.22	0.53
1:A:274:MSE:HE1	1:A:310:ILE:HD11	1.91	0.52
1:B:442:SER:N	1:B:443:PRO:HD2	2.25	0.52
1:B:207:ARG:HD2	1:B:257:ASP:OD1	2.09	0.52
1:A:407:HIS:CE1	1:B:407:HIS:CE1	2.84	0.51
1:A:158:ARG:NE	1:A:233:LEU:HD22	2.26	0.51
1:A:248:MSE:HE1	1:A:276:TYR:CD2	2.47	0.50
1:B:340:ASN:HB3	1:B:343:ARG:HH12	1.74	0.49
1:A:248:MSE:HE1	1:A:276:TYR:HD2	1.77	0.48
1:B:96:LEU:HD22	1:B:170:VAL:HG22	1.96	0.48
1:B:459:ASP:O	1:B:463:GLN:HG2	2.15	0.47
1:A:97:ARG:HH12	1:A:178:PRO:HG3	1.80	0.47
1:A:459:ASP:O	1:A:463:GLN:HG2	2.15	0.46
1:B:68:ILE:CG2	1:B:84:ALA:HB3	2.46	0.46
1:B:255:TYR:O	1:B:258:LEU:HB2	2.16	0.46
1:B:372:PRO:HB2	1:B:375:ARG:HD3	1.98	0.46
1:A:215:GLU:HB3	1:A:216:PRO:HA	1.98	0.45
1:B:225:MSE:HE1	1:B:299:LEU:HD13	1.97	0.45
1:A:178:PRO:HA	2:A:690:HOH:O	2.15	0.44
1:A:220:PRO:HB3	1:A:472:LEU:HB3	2.00	0.44
1:A:320:VAL:CG1	1:A:400:ALA:HB2	2.48	0.44
1:A:401:CYS:HB2	2:A:672:HOH:O	2.18	0.43
1:B:339:VAL:HG12	1:B:340:ASN:N	2.34	0.43
1:B:425:GLU:HB3	1:B:426:PRO:HD2	2.00	0.43
1:B:444:ILE:HD11	1:B:446:TRP:CH2	2.53	0.43
1:A:472:LEU:HG	2:A:689:HOH:O	2.19	0.42
1:A:444:ILE:HD11	1:A:446:TRP:CZ3	2.54	0.42
1:A:347:THR:HA	1:A:348:LYS:HA	1.84	0.42
1:B:186:ARG:HH11	1:B:186:ARG:CG	2.31	0.42
1:A:151:PRO:O	1:A:152:LEU:HB2	2.20	0.42
1:A:150:LYS:HA	1:A:151:PRO:HD2	1.92	0.41
1:B:205:ARG:HH12	1:B:272:GLU:CD	2.23	0.41
1:B:71:PRO:HG2	2:B:675:HOH:O	2.20	0.41
1:A:372:PRO:HB2	1:A:375:ARG:HD3	2.03	0.40
1:A:455:MSE:SE	2:A:691:HOH:O	2.90	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	404/446 (91%)	394 (98%)	10 (2%)	0	100	100
1	B	407/446 (91%)	393 (97%)	14 (3%)	0	100	100
All	All	811/892 (91%)	787 (97%)	24 (3%)	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	332/355 (94%)	317 (96%)	15 (4%)	27	27
1	B	335/355 (94%)	318 (95%)	17 (5%)	24	22
All	All	667/710 (94%)	635 (95%)	32 (5%)	25	24

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	66	THR
1	A	67	LEU
1	A	96	LEU
1	A	119	LEU
1	A	143	LEU

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>
1	A	260	LYS
1	A	274	MSE
1	A	277	LEU
1	A	294	SER
1	A	320	VAL
1	A	323	VAL
1	A	348	LYS
1	A	384	VAL
1	A	391	TRP
1	A	444	ILE
1	B	66	THR
1	B	119	LEU
1	B	167	GLU
1	B	184	GLN
1	B	205	ARG
1	B	258	LEU
1	B	277	LEU
1	B	288	VAL
1	B	320	VAL
1	B	323	VAL
1	B	327	LEU
1	B	343	ARG
1	B	349	ASP
1	B	378	SER
1	B	391	TRP
1	B	436	LEU
1	B	472	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>
1	A	187	HIS
1	A	407	HIS
1	A	453	HIS
1	A	469	HIS
1	B	184	GLN
1	B	187	HIS
1	B	407	HIS
1	B	453	HIS
1	B	463	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](#)

There are no ligands in this entry.

### 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

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.3 Carbohydrates

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.4 Ligands

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.5 Other polymers

Unable to reproduce the depositors R factor - this section is therefore empty.