wwPDB X-ray Structure Validation Summary Report (i)

Jul 4, 2016 – 10:47 PM EDT

PDB ID	:	5CF2
Title	:	Crystal Structure of the I80Y/L114V/I116V mutant of LEH
Authors	:	Wu, L.; Sun, Z.T.; Reetz, M.T.; Zhou, J.H.
Deposited on	:	2015-07-08
Resolution	:	3.00 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 (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

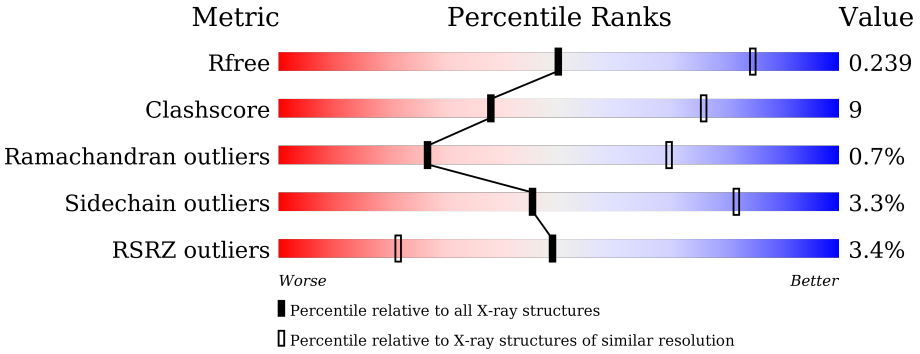
MolProbity	:	4.02b-467
Mogul	:	unknown
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20027790
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20027790

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 3.00 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}	91344	1578 (3.00-3.00)
Clashscore	102246	1912 (3.00-3.00)
Ramachandran outliers	100387	1853 (3.00-3.00)
Sidechain outliers	100360	1856 (3.00-3.00)
RSRZ outliers	91569	1592 (3.00-3.00)

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 <=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	155	5% 75% 16% • 6%
1	B	155	.% 61% 33% • 5%
1	C	155	6% 77% 15% • 6%
1	D	155	.% 77% 14% • 5%

2 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 4570 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 Limonene-1,2-epoxide hydrolase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	145	1135	722	183	226	4	0	0	0
			Total	C	N	O	S			
1	B	147	1150	731	186	229	4	0	0	0
			Total	C	N	O	S			
1	C	145	1135	722	183	226	4	0	0	0
			Total	C	N	O	S			
1	D	147	1150	731	186	229	4	0	0	0

There are 40 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-5	MET	-	expression tag	UNP Q9ZAG3
A	-4	HIS	-	expression tag	UNP Q9ZAG3
A	-3	HIS	-	expression tag	UNP Q9ZAG3
A	-2	HIS	-	expression tag	UNP Q9ZAG3
A	-1	HIS	-	expression tag	UNP Q9ZAG3
A	0	HIS	-	expression tag	UNP Q9ZAG3
A	1	HIS	-	expression tag	UNP Q9ZAG3
A	80	TYR	ILE	engineered mutation	UNP Q9ZAG3
A	114	VAL	LEU	engineered mutation	UNP Q9ZAG3
A	116	VAL	ILE	engineered mutation	UNP Q9ZAG3
B	-5	MET	-	expression tag	UNP Q9ZAG3
B	-4	HIS	-	expression tag	UNP Q9ZAG3
B	-3	HIS	-	expression tag	UNP Q9ZAG3
B	-2	HIS	-	expression tag	UNP Q9ZAG3
B	-1	HIS	-	expression tag	UNP Q9ZAG3
B	0	HIS	-	expression tag	UNP Q9ZAG3
B	1	HIS	-	expression tag	UNP Q9ZAG3
B	80	TYR	ILE	engineered mutation	UNP Q9ZAG3
B	114	VAL	LEU	engineered mutation	UNP Q9ZAG3
B	116	VAL	ILE	engineered mutation	UNP Q9ZAG3
C	-5	MET	-	expression tag	UNP Q9ZAG3

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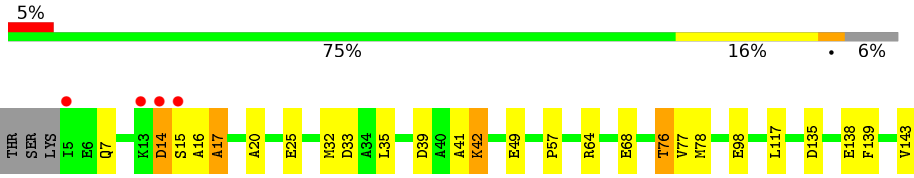
Chain	Residue	Modelled	Actual	Comment	Reference
C	-4	HIS	-	expression tag	UNP Q9ZAG3
C	-3	HIS	-	expression tag	UNP Q9ZAG3
C	-2	HIS	-	expression tag	UNP Q9ZAG3
C	-1	HIS	-	expression tag	UNP Q9ZAG3
C	0	HIS	-	expression tag	UNP Q9ZAG3
C	1	HIS	-	expression tag	UNP Q9ZAG3
C	80	TYR	ILE	engineered mutation	UNP Q9ZAG3
C	114	VAL	LEU	engineered mutation	UNP Q9ZAG3
C	116	VAL	ILE	engineered mutation	UNP Q9ZAG3
D	-5	MET	-	expression tag	UNP Q9ZAG3
D	-4	HIS	-	expression tag	UNP Q9ZAG3
D	-3	HIS	-	expression tag	UNP Q9ZAG3
D	-2	HIS	-	expression tag	UNP Q9ZAG3
D	-1	HIS	-	expression tag	UNP Q9ZAG3
D	0	HIS	-	expression tag	UNP Q9ZAG3
D	1	HIS	-	expression tag	UNP Q9ZAG3
D	80	TYR	ILE	engineered mutation	UNP Q9ZAG3
D	114	VAL	LEU	engineered mutation	UNP Q9ZAG3
D	116	VAL	ILE	engineered mutation	UNP Q9ZAG3

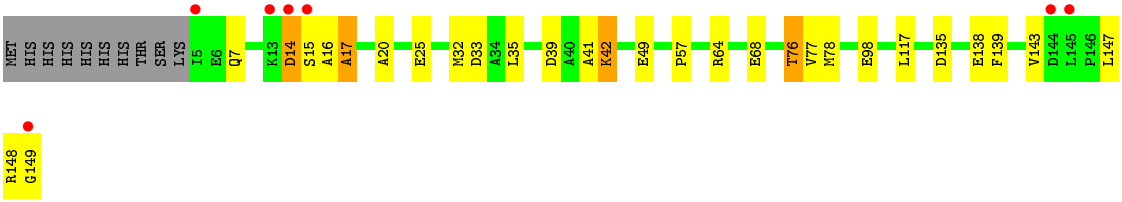
3 Residue-property plots (i)

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

- Molecule 1: Limonene-1,2-epoxide hydrolase

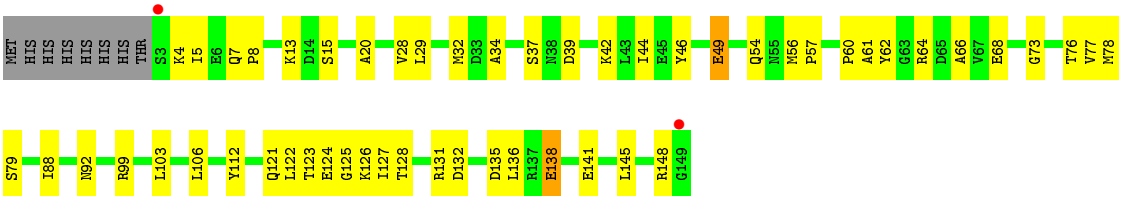
Chain A:





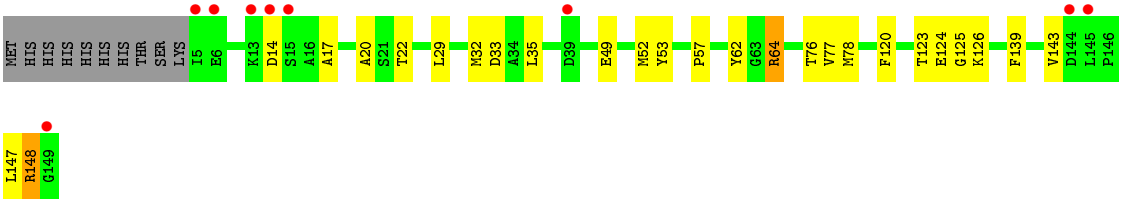
- Molecule 1: Limonene-1,2-epoxide hydrolase

Chain B:



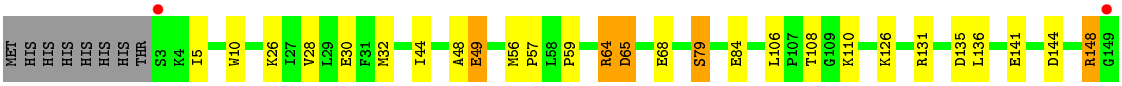
- Molecule 1: Limonene-1,2-epoxide hydrolase

Chain C:



- Molecule 1: Limonene-1,2-epoxide hydrolase

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 3	Depositor
Cell constants a, b, c, α, β, γ	103.65Å 103.65Å 73.26Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	36.63 – 3.00 44.88 – 3.00	Depositor EDS
% Data completeness (in resolution range)	99.5 (36.63-3.00) 99.8 (44.88-3.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.69 (at 3.01Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.9_1692)	Depositor
R, R_{free}	0.186 , 0.241 0.187 , 0.239	Depositor DCC
R_{free} test set	857 reflections (4.88%)	DCC
Wilson B-factor (Å^2)	56.9	Xtriage
Anisotropy	0.706	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.39 , 36.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.467 for -h,-k,l 0.047 for h,-h-k,-l 0.048 for -k,-h,-l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	4570	wwPDB-VP
Average B, all atoms (Å^2)	58.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.78% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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	0.49	0/1160	0.64	0/1576
1	B	0.48	0/1175	0.63	0/1595
1	C	0.51	0/1160	0.63	0/1576
1	D	0.48	0/1175	0.64	0/1595
All	All	0.49	0/4670	0.64	0/6342

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	D	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	D	64	ARG	Peptide

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	1135	0	1093	19	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	1150	0	1111	36	0
1	C	1135	0	1093	19	0
1	D	1150	0	1111	18	0
All	All	4570	0	4408	83	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 9.

The worst 5 of 83 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:49:GLU:HA	1:B:64:ARG:HG3	1.53	0.90
1:D:49:GLU:HA	1:D:64:ARG:HG3	1.57	0.86
1:B:121:GLN:OE1	1:B:128:THR:HB	1.80	0.81
1:C:78:MET:HE1	1:C:147:LEU:HD11	1.72	0.72
1:D:26:LYS:O	1:D:30:GLU:HG3	1.89	0.72

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	143/155 (92%)	133 (93%)	8 (6%)	2 (1%)	14 51
1	B	145/155 (94%)	138 (95%)	7 (5%)	0	100 100
1	C	143/155 (92%)	135 (94%)	8 (6%)	0	100 100
1	D	145/155 (94%)	136 (94%)	7 (5%)	2 (1%)	14 51
All	All	576/620 (93%)	542 (94%)	30 (5%)	4 (1%)	26 70

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	65	ASP
1	A	14	ASP
1	A	17	ALA
1	D	148	ARG

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	120/130 (92%)	114 (95%)	6 (5%)	30	70
1	B	122/130 (94%)	119 (98%)	3 (2%)	55	86
1	C	120/130 (92%)	116 (97%)	4 (3%)	45	82
1	D	122/130 (94%)	119 (98%)	3 (2%)	55	86
All	All	484/520 (93%)	468 (97%)	16 (3%)	45	82

5 of 16 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	138	GLU
1	B	148	ARG
1	C	148	ARG
1	B	49	GLU
1	D	49	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	121	GLN
1	B	92	ASN
1	C	92	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)

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 (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	145/155 (93%)	0.46	7 (4%)	34	14	38, 57, 83, 115	0
1	B	147/155 (94%)	0.31	2 (1%)	78	51	42, 56, 72, 107	0
1	C	145/155 (93%)	0.47	9 (6%)	24	9	39, 58, 80, 114	0
1	D	147/155 (94%)	0.35	2 (1%)	78	51	41, 56, 73, 115	0
All	All	584/620 (94%)	0.40	20 (3%)	49	21	38, 57, 79, 115	0

The worst 5 of 20 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	3	SER	6.1
1	C	149	GLY	5.1
1	C	15	SER	4.9
1	A	15	SER	4.0
1	D	3	SER	3.5

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)

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.