WORLDWIDE wwPDB PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 22, 2023 – 05:22 PM EDT

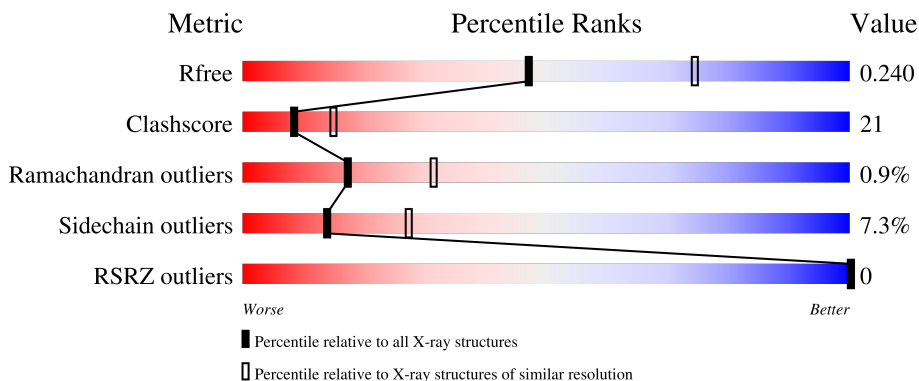|		
PDB ID	:	3D5T
Title	:	Crystal structure of malate dehydrogenase from Burkholderia pseudomallei
Authors	:	Seattle Structural Genomics Center for Infectious Disease (SSGCID)
Deposited on	:	2008-05-16
Resolution	:	2.51 Å(reported)

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 2.51 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	Percentile Ranks	Value
Rfree		0.240
Clashscore		21
Ramachandran outliers		0.9%
Sidechain outliers		7.3%
RSRZ outliers		0

Worse   *Better*

▮ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)
RSRZ outliers	127900	4559 (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 of the lower bar indicate the fraction of residues that contain outliers for >=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 <=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	331	62% 28% 7% · ·
1	B	331	70% 24% · ·
1	C	331	68% 24% 5% · ·
1	D	331	72% 23% · ·

2 Entity composition ⓘ

There are 4 unique types of molecules in this entry. The entry contains 10008 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 Malate dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	321	Total	C	N	O	S	0	0	0
			2376	1504	413	450	9			
1	B	321	Total	C	N	O	S	0	0	0
			2395	1515	417	454	9			
1	C	323	Total	C	N	O	S	0	0	0
			2418	1531	422	456	9			
1	D	321	Total	C	N	O	S	0	0	0
			2390	1514	412	455	9			

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-3	GLY	-	expression tag	UNP Q3JKE9
A	-2	PRO	-	expression tag	UNP Q3JKE9
A	-1	GLY	-	expression tag	UNP Q3JKE9
A	0	SER	-	expression tag	UNP Q3JKE9
B	-3	GLY	-	expression tag	UNP Q3JKE9
B	-2	PRO	-	expression tag	UNP Q3JKE9
B	-1	GLY	-	expression tag	UNP Q3JKE9
B	0	SER	-	expression tag	UNP Q3JKE9
C	-3	GLY	-	expression tag	UNP Q3JKE9
C	-2	PRO	-	expression tag	UNP Q3JKE9
C	-1	GLY	-	expression tag	UNP Q3JKE9
C	0	SER	-	expression tag	UNP Q3JKE9
D	-3	GLY	-	expression tag	UNP Q3JKE9
D	-2	PRO	-	expression tag	UNP Q3JKE9
D	-1	GLY	-	expression tag	UNP Q3JKE9
D	0	SER	-	expression tag	UNP Q3JKE9

- Molecule 2 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total 1	Na 1	0	0

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	1	Total 1	Mg 1	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	78	Total 78	O 78	0	0
4	B	131	Total 131	O 131	0	0
4	C	84	Total 84	O 84	0	0
4	D	134	Total 134	O 134	0	0

3 Residue-property plots ⓘ

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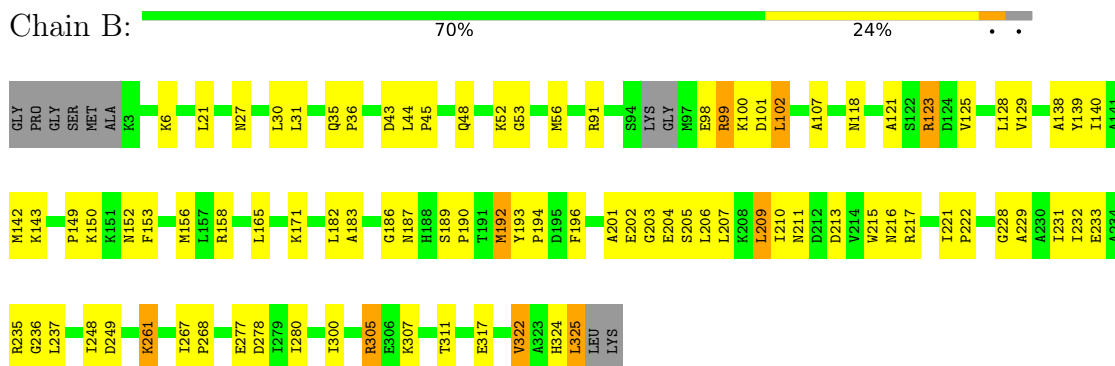 outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 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.
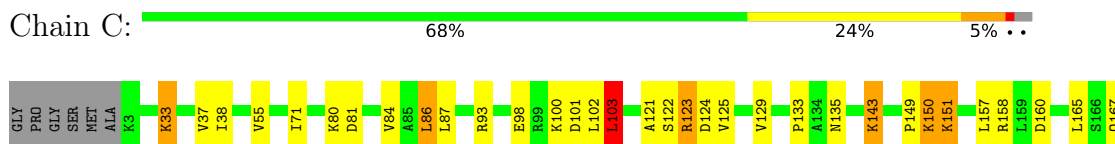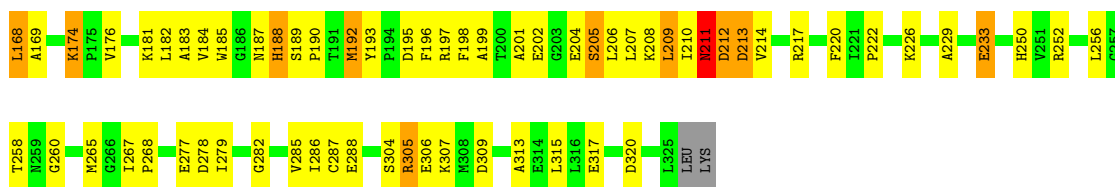
- Molecule 1: Malate dehydrogenase
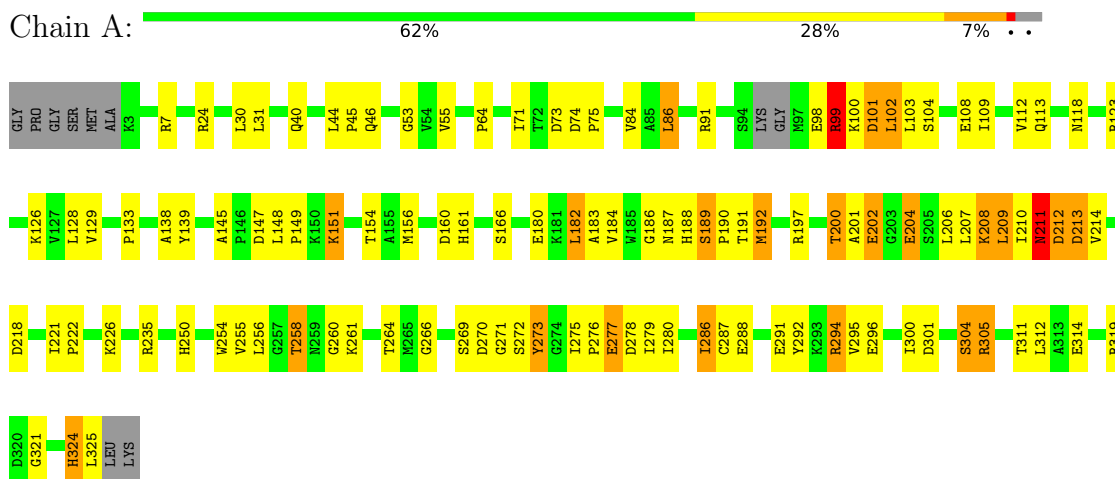
- Molecule 1: Malate dehydrogenase

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L168 A169 K174 P175 V176 K181 L182 A183 V184 W185 G186 N187 H188 S189 P190 T191 M192 Y193 P194 D195 F196 R197 F198 A199 T200 A201 E202 G203 E204 S205 L206 L207 K208 L209 I210 N211 D212 D213 V214 R217 F220 I221 P222 K226 A229 E233 H250 V251 R252 L256 G257

T258 N259 G260 M265 G266 I267 P268 E277 D278 I279 G282 V285 I286 C287 E288 S304 R305 E306 K307 M308 D309 A313 E314 L315 L316 E317 D320 L325 LEU LYS

• Molecule 1: Malate dehydrogenase

Chain D:

72%   23%   • •

GLY PRO GLY SER MET ALA K3 P4 R7 V10 T11 I17 G32 K33 D34 Q40 L41 L42 D43 Q48 V51 K52 G53 V54 V55 M56 A78 F79 K80 D81 L86 L87 R91 S94 LYS GLY M97 E98 R99 K100 D101 L102 L103 N118 A121 S122 R123

D124 V125 L128 V129 T136 N137 A138 Y139 I140 A145 M156 L157 A164 I179 E180 K181 L182 A183 V184 W185 G186 N187 H188 S189 P190 T191 M192 Y193 P194 D195 F196 A199 E204 S205 L206 L207 K208 L209 I210 N211 D212 D213 V214 W215 D218 T219 A240 H250

T258 W262 S272 E277 D278 I279 G282 V283 P284 V285 I286 C287 E299 L316 V322 A323 H324 L325 LEU LYS

4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	59.39Å 79.61Å 288.87Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.62 – 2.51 47.60 – 2.51	Depositor EDS
% Data completeness (in resolution range)	89.1 (47.62-2.51) 89.1 (47.60-2.51)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.98 (at 2.51Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.178 , 0.241 0.178 , 0.240	Depositor DCC
R_{free} test set	2181 reflections (5.09%)	wwPDB-VP
Wilson B-factor (Å^2)	34.0	Xtriage
Anisotropy	0.262	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 47.9	EDS
L-test for twinning[2]	$< |L| > = 0.46, < L^2 > = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	10008	wwPDB-VP
Average B, all atoms (Å^2)	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 33.81 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 7.5381e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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[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 ⓘ

5.1 Standard geometry ⓘ

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

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	0.83	0/2417	0.88	0/3290
1	B	0.88	1/2436 (0.0%)	0.91	0/3312
1	C	0.94	1/2459 (0.0%)	0.90	2/3337 (0.1%)
1	D	0.91	1/2431 (0.0%)	0.90	2/3305 (0.1%)
All	All	0.89	3/9743 (0.0%)	0.90	4/13244 (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	C	0	1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	233	GLU	CG-CD	6.77	1.62	1.51
1	B	322	VAL	CB-CG1	-5.14	1.42	1.52
1	D	299	GLU	CG-CD	5.10	1.59	1.51

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	C	320	ASP	CB-CG-OD1	6.73	124.35	118.30
1	C	103	LEU	CA-CB-CG	5.47	127.88	115.30
1	D	195	ASP	CB-CG-OD1	5.25	123.03	118.30
1	D	195	ASP	CB-CG-OD2	-5.11	113.70	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	288	GLU	Peptide

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	2376	0	2369	144	0
1	B	2395	0	2401	90	0
1	C	2418	0	2447	94	0
1	D	2390	0	2397	74	0
2	B	1	0	0	0	0
3	B	1	0	0	0	0
4	A	78	0	0	6	0
4	B	131	0	0	4	0
4	C	84	0	0	3	0
4	D	134	0	0	7	0
All	All	10008	0	9614	400	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 21.

The worst 5 of 400 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:260:GLY:CA	1:A:286:ILE:HD11	1.29	1.62
1:A:260:GLY:HA2	1:A:286:ILE:CD1	1.36	1.50
1:B:192:MET:CE	1:B:194:PRO:HD3	1.47	1.40
1:B:324:HIS:CD2	1:B:325:LEU:HD21	1.65	1.32
1:A:182:LEU:HD13	1:A:183:ALA:N	1.42	1.30

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	317/331 (96%)	285 (90%)	26 (8%)	6 (2%)	8	13
1	B	317/331 (96%)	304 (96%)	13 (4%)	0	100	100
1	C	319/331 (96%)	295 (92%)	20 (6%)	4 (1%)	12	21
1	D	317/331 (96%)	302 (95%)	14 (4%)	1 (0%)	41	61
All	All	1270/1324 (96%)	1186 (93%)	73 (6%)	11 (1%)	17	31

5 of 11 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	99	ARG
1	A	208	LYS
1	A	212	ASP
1	C	150	LYS
1	C	188	HIS

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	242/258 (94%)	218 (90%)	24 (10%)	8	15
1	B	246/258 (95%)	232 (94%)	14 (6%)	20	39
1	C	249/258 (96%)	230 (92%)	19 (8%)	13	25
1	D	246/258 (95%)	231 (94%)	15 (6%)	18	36
All	All	983/1032 (95%)	911 (93%)	72 (7%)	14	27

5 of 72 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	80	LYS
1	D	284	PRO
1	D	91	ARG
1	D	208	LYS
1	B	91	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 11 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	188	HIS
1	D	113	GLN
1	D	324	HIS
1	D	250	HIS
1	B	250	HIS

5.3.3 RNA ⓘ

There are no RNA molecules 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 monosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 2 ligands modelled in this entry, 2 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

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 ⓘ

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 (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	321/331 (96%)	-0.26	0	100	100	17, 39, 61, 75	0
1	B	321/331 (96%)	-0.54	0	100	100	15, 25, 46, 66	0
1	C	323/331 (97%)	-0.35	0	100	100	15, 33, 54, 64	0
1	D	321/331 (96%)	-0.49	0	100	100	16, 26, 46, 62	0
All	All	1286/1324 (97%)	-0.41	0	100	100	15, 30, 54, 75	0

There are no RSRZ outliers to report.

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 monosaccharides 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. 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	B-factors(Å^2)	Q<0.9
3	MG	B	401	1/1	0.97	0.08	67,67,67,67	0
2	NA	B	402	1/1	0.99	0.05	42,42,42,42	0

6.5 Other polymers ⓘ

There are no such residues in this entry.