



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 05:41 AM UTC

PDB ID : 2P2O / pdb_00002p2o
Title : Crystal structure of maltose transacetylase from *Geobacillus kaustophilus* P2(1) crystal form
Authors : Liu, Z.J.; Li, Y.; Chen, L.; Zhu, J.; Rose, J.P.; Ebihara, A.; Yokoyama, S.; Wang, B.C.; Southeast Collaboratory for Structural Genomics (SECSG); RIKEN Structural Genomics/Proteomics Initiative (RSGI)
Deposited on : 2007-03-07
Resolution : 1.74 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

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>.

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

MolProbity : 4-5-2 with Phenix2.0
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

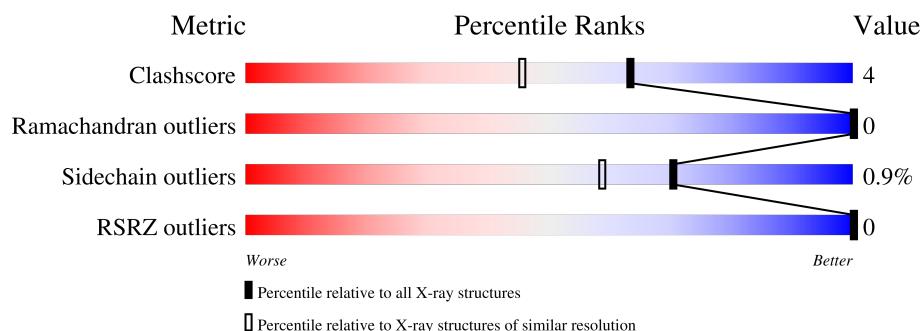
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.74 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	190562	1207 (1.74-1.74)
Ramachandran outliers	187476	1200 (1.74-1.74)
Sidechain outliers	187428	1200 (1.74-1.74)
RSRZ outliers	180081	1188 (1.74-1.74)

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 $\leq 5\%$. 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	185	88% 12% .
1	B	185	90% 9% .
1	C	185	90% 9% .
1	D	185	93% 6% .
1	E	185	92% 7% ..
1	F	185	92% 7% ..

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 9806 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 Maltose transacetylase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	184	Total	C	N	O	S	0	0	0
			1443	919	256	263	5			
1	B	184	Total	C	N	O	S	0	0	0
			1443	919	256	263	5			
1	C	184	Total	C	N	O	S	0	0	0
			1438	915	255	263	5			
1	D	183	Total	C	N	O	S	0	0	0
			1434	913	254	262	5			
1	E	184	Total	C	N	O	S	0	0	0
			1443	919	256	263	5			
1	F	184	Total	C	N	O	S	0	0	0
			1438	915	255	263	5			

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	211	Total	O	0	0
			211	211		
2	B	198	Total	O	0	0
			198	198		
2	C	168	Total	O	0	0
			168	168		
2	D	194	Total	O	0	0
			194	194		
2	E	207	Total	O	0	0
			207	207		
2	F	189	Total	O	0	0
			189	189		

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 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.

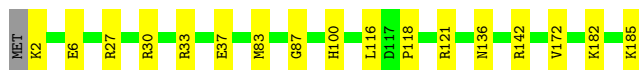
- Molecule 1: Maltose transacetylase

Chain A: 



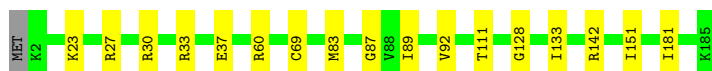
- Molecule 1: Maltose transacetylase

Chain B: 

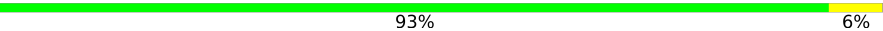


- Molecule 1: Maltose transacetylase

Chain C: 



- Molecule 1: Maltose transacetylase

Chain D: 



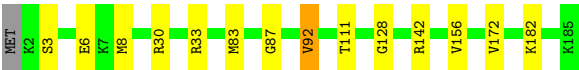
- Molecule 1: Maltose transacetylase

Chain E: 



- Molecule 1: Maltose transacetylase

Chain F: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	66.47Å 122.46Å 72.54Å 90.00° 97.88° 90.00°	Depositor
Resolution (Å)	20.00 – 1.74 20.00 – 1.74	Depositor EDS
% Data completeness (in resolution range)	100.0 (20.00-1.74) 88.5 (20.00-1.74)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.05	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.04 (at 1.74Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.184 , 0.237 0.182 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	15.7	Xtriage
Anisotropy	0.288	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 45.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	9806	wwPDB-VP
Average B, all atoms (Å ²)	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.58% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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	0.99	1/1476 (0.1%)	0.92	0/2000
1	B	0.90	1/1476 (0.1%)	0.90	2/2000 (0.1%)
1	C	0.89	1/1471 (0.1%)	0.96	0/1994
1	D	0.99	1/1467 (0.1%)	0.94	2/1989 (0.1%)
1	E	0.92	0/1476	0.88	0/2000
1	F	0.89	0/1471	0.91	0/1994
All	All	0.93	4/8837 (0.0%)	0.92	4/11977 (0.0%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	181	ILE	CA-CB	6.54	1.61	1.55
1	A	179	LYS	C-O	-6.12	1.16	1.23
1	B	100	HIS	ND1-CE1	5.48	1.38	1.32
1	D	12	HIS	ND1-CE1	5.29	1.37	1.32

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	100	HIS	CB-CG-CD2	-6.64	122.57	131.20
1	D	12	HIS	CB-CG-CD2	-6.11	123.25	131.20
1	B	100	HIS	CB-CG-ND1	5.68	131.22	122.70
1	D	12	HIS	CB-CG-ND1	5.31	130.66	122.70

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	1443	0	1433	20	0
1	B	1443	0	1433	16	0
1	C	1438	0	1421	9	0
1	D	1434	0	1420	6	0
1	E	1443	0	1433	15	0
1	F	1438	0	1421	12	0
2	A	211	0	0	8	0
2	B	198	0	0	3	0
2	C	168	0	0	2	0
2	D	194	0	0	3	0
2	E	207	0	0	3	0
2	F	189	0	0	2	0
All	All	9806	0	8561	69	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 4.

All (69) 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:142:ARG:NH2	1:C:142:ARG:O	1.78	1.17
1:B:136:ASN:HB3	2:C:247:HOH:O	1.80	0.81
1:E:142:ARG:NH2	1:F:142:ARG:O	2.11	0.78
1:F:30:ARG:HG3	1:F:33:ARG:NH2	2.00	0.77
1:E:60:ARG:HD3	2:E:351:HOH:O	1.88	0.74
1:B:30:ARG:HG3	1:B:33:ARG:NH2	2.04	0.72
1:A:27:ARG:HD2	2:A:294:HOH:O	1.88	0.72
1:A:185:LYS:HB2	1:B:118:PRO:HD2	1.76	0.68
2:A:205:HOH:O	1:B:121:ARG:HD2	1.92	0.68
1:A:37:GLU:HG3	2:A:304:HOH:O	1.94	0.68
1:B:142:ARG:HH22	1:C:142:ARG:C	1.99	0.67
1:B:116:LEU:O	1:B:121:ARG:NH2	2.29	0.65
1:C:30:ARG:HG3	1:C:33:ARG:NH2	2.12	0.64
1:B:2:LYS:HA	1:B:6:GLU:OE1	1.97	0.64
1:E:142:ARG:NH2	1:F:142:ARG:HE	1.96	0.63
1:F:3:SER:OG	1:F:6:GLU:HG3	2.01	0.61
1:A:121:ARG:HD2	2:A:238:HOH:O	2.03	0.59
1:D:52:GLU:OE2	2:D:378:HOH:O	2.17	0.58
2:D:225:HOH:O	1:E:121:ARG:HD2	2.03	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:121:ARG:NH2	2:E:391:HOH:O	2.18	0.56
1:A:181:ILE:O	1:A:182:LYS:HB3	2.06	0.56
1:E:116:LEU:O	1:E:121:ARG:NH2	2.39	0.55
1:C:37:GLU:HG3	2:C:312:HOH:O	2.06	0.55
1:C:83:MET:HE2	1:C:87:GLY:HA3	1.89	0.54
1:D:30:ARG:HG3	1:D:33:ARG:NH2	2.24	0.53
1:A:185:LYS:HG2	1:A:185:LYS:O	2.09	0.53
1:B:2:LYS:N	2:B:344:HOH:O	2.43	0.52
1:A:142:ARG:NH2	1:B:142:ARG:O	2.36	0.50
1:F:83:MET:HE2	1:F:87:GLY:HA3	1.92	0.50
1:A:27:ARG:CD	2:A:294:HOH:O	2.51	0.49
1:A:116:LEU:O	1:A:121:ARG:NH2	2.46	0.49
1:A:52:GLU:OE2	2:A:395:HOH:O	2.20	0.48
1:A:133:ILE:HD13	1:A:139:ILE:HD11	1.96	0.48
1:D:172:VAL:HB	1:D:182:LYS:HG3	1.95	0.48
1:E:8:MET:HG3	1:E:92:VAL:HG13	1.96	0.48
1:D:121:ARG:HD2	2:F:277:HOH:O	2.13	0.48
1:A:27:ARG:NE	2:A:294:HOH:O	2.46	0.48
1:B:83:MET:HE2	1:B:87:GLY:HA3	1.95	0.48
1:A:40:GLU:CD	1:A:40:GLU:H	2.22	0.48
1:E:108:HIS:HB3	1:E:110:TYR:CE1	2.50	0.47
1:F:156:VAL:HB	1:F:172:VAL:HG22	1.97	0.47
1:F:111:THR:O	1:F:128:GLY:HA2	2.14	0.47
1:C:111:THR:O	1:C:128:GLY:HA2	2.15	0.46
1:E:115:PRO:O	1:E:121:ARG:HB2	2.15	0.46
1:B:37:GLU:HG3	2:B:382:HOH:O	2.15	0.46
1:C:23:LYS:HE3	1:C:27:ARG:HH21	1.82	0.45
1:D:60:ARG:HD2	2:D:242:HOH:O	2.16	0.45
1:F:8:MET:HG3	1:F:92:VAL:HG13	1.97	0.45
1:A:170:ASN:OD1	1:A:185:LYS:HD3	2.18	0.43
1:C:133:ILE:HG12	1:C:151:ILE:HD12	2.00	0.43
1:E:142:ARG:HH22	1:F:142:ARG:C	2.15	0.43
1:F:33:ARG:HD2	2:F:366:HOH:O	2.19	0.43
1:A:108:HIS:HB3	1:A:110:TYR:CE1	2.55	0.42
1:A:30:ARG:HG3	1:A:33:ARG:NH2	2.34	0.42
1:A:154:ASN:HD22	1:A:170:ASN:HD21	1.67	0.42
1:A:170:ASN:OD1	1:A:185:LYS:HB3	2.19	0.42
1:D:133:ILE:HG12	1:D:151:ILE:HD12	2.01	0.41
1:A:39:LEU:HB2	1:A:42:GLU:HG3	2.01	0.41
2:A:205:HOH:O	1:B:121:ARG:CD	2.62	0.41
1:E:30:ARG:NH1	2:E:286:HOH:O	2.53	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:39:LEU:HB2	1:E:42:GLU:HG3	2.03	0.41
1:F:30:ARG:HG3	1:F:33:ARG:HH21	1.82	0.41
1:B:27:ARG:HD3	2:B:280:HOH:O	2.19	0.41
1:E:23:LYS:HB3	1:E:23:LYS:HE2	1.74	0.41
1:E:142:ARG:HH21	1:F:142:ARG:HE	1.64	0.41
1:A:185:LYS:HB2	1:B:118:PRO:CD	2.47	0.40
1:B:172:VAL:HB	1:B:182:LYS:HB3	2.03	0.40
1:E:185:LYS:HE2	1:E:185:LYS:HB3	1.78	0.40
1:C:69:CYS:HA	1:C:89:ILE:O	2.21	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	182/185 (98%)	179 (98%)	3 (2%)	0	100	100
1	B	182/185 (98%)	180 (99%)	2 (1%)	0	100	100
1	C	182/185 (98%)	181 (100%)	1 (0%)	0	100	100
1	D	181/185 (98%)	178 (98%)	3 (2%)	0	100	100
1	E	182/185 (98%)	181 (100%)	1 (0%)	0	100	100
1	F	182/185 (98%)	179 (98%)	3 (2%)	0	100	100
All	All	1091/1110 (98%)	1078 (99%)	13 (1%)	0	100	100

There are no Ramachandran outliers to report.

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	153/154 (99%)	152 (99%)	1 (1%)	76	67
1	B	153/154 (99%)	152 (99%)	1 (1%)	76	67
1	C	152/154 (99%)	150 (99%)	2 (1%)	61	43
1	D	152/154 (99%)	151 (99%)	1 (1%)	76	67
1	E	153/154 (99%)	152 (99%)	1 (1%)	76	67
1	F	152/154 (99%)	150 (99%)	2 (1%)	61	43
All	All	915/924 (99%)	907 (99%)	8 (1%)	70	59

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	19	LEU
1	B	185	LYS
1	C	60	ARG
1	C	92	VAL
1	D	19	LEU
1	E	185	LYS
1	F	92	VAL
1	F	182	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	122	ASN
1	A	136	ASN
1	A	154	ASN
1	B	122	ASN
1	B	136	ASN
1	C	66	ASN
1	C	119	HIS
1	C	122	ASN
1	C	136	ASN
1	E	122	ASN
1	E	136	ASN
1	F	122	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 oligosaccharides 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	184/185 (99%)	-0.33	0 100 100	11, 17, 25, 31	0
1	B	184/185 (99%)	-0.21	0 100 100	11, 19, 27, 39	0
1	C	184/185 (99%)	-0.15	0 100 100	12, 20, 28, 36	0
1	D	183/185 (98%)	-0.29	0 100 100	12, 17, 27, 34	0
1	E	184/185 (99%)	-0.25	0 100 100	12, 18, 28, 38	0
1	F	184/185 (99%)	-0.08	0 100 100	14, 21, 29, 39	0
All	All	1103/1110 (99%)	-0.22	0 100 100	11, 19, 28, 39	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 oligosaccharides 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.