



Full wwPDB X-ray Structure Validation Report ⓘ

Nov 7, 2014 – 07:14 PM EST

PDB ID : 2AC2
Title : Crystal structure of the Tyr13Phe mutant variant of Bacillus subtilis Ferrochelatase with Zn(2+) bound at the active site
Authors : Shipovskov, S.; Karlberg, T.; Fodje, M.; Hansson, M.D.; Ferreira, G.C.; Hansson, M.; Reimann, C.T.; Al-Karadaghi, S.
Deposited on : 2005-07-18
Resolution : 2.50 Å(reported)

This is a full wwPDB validation 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/ValidationPDFNotes.html>

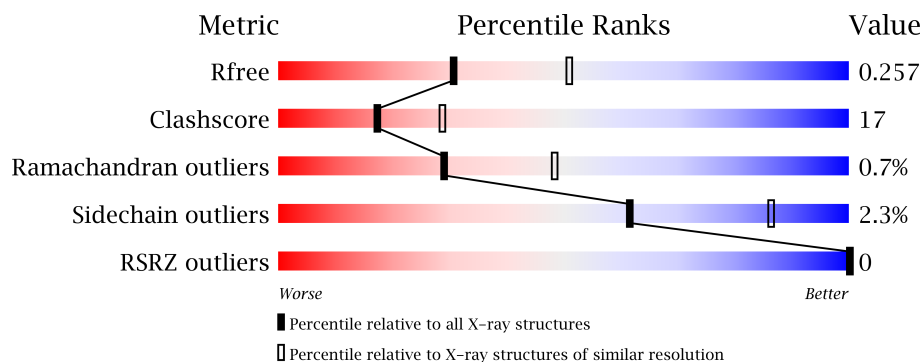
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.16 November 2013
Xtriage (Phenix) : dev-1439
EDS : trunk24195
Percentile statistics : 23426
Refmac : 5.8.0049
CCP4 : 6.1.3
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : trunk24195

1 Overall quality at a glance

The reported resolution of this entry is 2.50 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}	77520	3163 (2.50-2.50)
Clashscore	88313	3845 (2.50-2.50)
Ramachandran outliers	86584	3762 (2.50-2.50)
C α geometry	86677	3767 (2.50-2.50)
Sidechain outliers	86556	3764 (2.50-2.50)
RSRZ outliers	77580	3164 (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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	309	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2523 atoms, of which 0 are hydrogen and 0 are deuterium.

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 Ferrochelatase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	309	Total	C	N	O	S	0	0	0
			2485	1585	407	485	8			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	13	PHE	TYR	ENGINEERED	UNP P32396

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

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

- Molecule 3 is water.

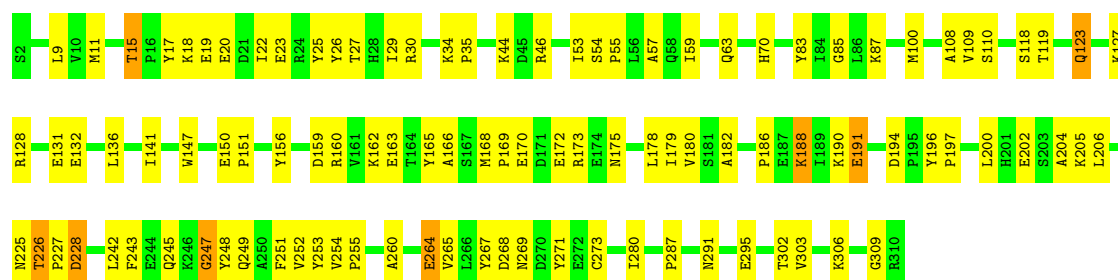
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	37	Total	O	0	0
			37	37		

3 Residue-property plots

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: Ferrochelatase

Chain A: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	48.17Å 49.70Å 117.97Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.50 9.95 – 2.50	Depositor EDS
% Data completeness (in resolution range)	95.3 (20.00-2.50) 88.7 (9.95-2.50)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	0.10	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.73 (at 2.50Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.210 , 0.257 0.221 , 0.257	Depositor DCC
R_{free} test set	484 reflections (5.00%)	DCC
Wilson B-factor (Å ²)	26.8	Xtriage
Anisotropy	0.490	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.42 , 21.5	EDS
Estimated twinning fraction	0.109 for k,h,-l	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.36$, $\langle L^2 \rangle = 0.18$	Xtriage
Outliers	0 of 17098 reflections	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	2523	wwPDB-VP
Average B, all atoms (Å ²)	23.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.47% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: ZN

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	0.41	0/2547	0.61	0/3453

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2485	0	2402	85	0
2	A	1	0	0	0	0
3	A	37	0	0	4	0
All	All	2523	0	2402	85	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 17.

All (85) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:175:ASN:HD22	1:A:249:GLN:HG3	1.05	1.17

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:175:ASN:ND2	1:A:249:GLN:HG3	1.86	0.90
1:A:165:TYR:HA	1:A:168:MET:HE3	1.59	0.83
1:A:226:THR:HG22	1:A:227:PRO:HD2	1.59	0.82
1:A:54:SER:OG	1:A:55:PRO:HD3	1.83	0.78
1:A:17:TYR:HA	3:A:504:HOH:O	1.85	0.75
1:A:243:PHE:CE2	1:A:280:ILE:HB	2.24	0.71
1:A:196:TYR:HB3	1:A:197:PRO:HD3	1.71	0.70
1:A:264:GLU:O	1:A:268:ASP:HB2	1.92	0.69
1:A:127:LYS:O	1:A:131:GLU:HG3	1.92	0.69
1:A:15:THR:HG22	1:A:57:ALA:HB2	1.72	0.69
1:A:265:VAL:HA	1:A:269:ASN:HD22	1.61	0.66
1:A:23:GLU:CD	1:A:34:LYS:HE3	2.16	0.65
1:A:87:LYS:HE3	1:A:128:ARG:NH1	2.11	0.65
1:A:46:ARG:HD3	1:A:267:TYR:CE2	2.32	0.64
1:A:243:PHE:CG	1:A:280:ILE:HD12	2.32	0.63
1:A:15:THR:HG21	1:A:57:ALA:N	2.15	0.61
1:A:22:ILE:HD11	1:A:53:ILE:HD11	1.82	0.60
1:A:269:ASN:O	1:A:273:CYS:HB2	2.02	0.59
1:A:228:ASP:N	1:A:228:ASP:OD1	2.35	0.56
1:A:243:PHE:CD2	1:A:280:ILE:HB	2.42	0.55
1:A:18:LYS:HE2	1:A:20:GLU:HB2	1.89	0.55
1:A:156:TYR:HA	1:A:295:GLU:OE2	2.07	0.53
1:A:159:ASP:O	1:A:163:GLU:HG3	2.07	0.53
1:A:19:GLU:CD	1:A:44:LYS:HD3	2.29	0.53
1:A:180:VAL:HG21	1:A:204:ALA:HA	1.90	0.53
1:A:175:ASN:HD22	1:A:249:GLN:CG	1.98	0.53
1:A:132:GLU:OE1	1:A:132:GLU:HA	2.09	0.52
1:A:15:THR:CG2	1:A:57:ALA:HB2	2.38	0.52
1:A:243:PHE:CD1	1:A:247:GLY:HA2	2.44	0.52
1:A:83:TYR:CD1	1:A:100:MET:HG2	2.45	0.52
1:A:309:GLY:HA2	3:A:505:HOH:O	2.10	0.51
1:A:248:TYR:HB2	1:A:251:PHE:CE1	2.45	0.51
1:A:267:TYR:O	1:A:271:TYR:HB3	2.11	0.51
1:A:59:ILE:HG21	1:A:260:ALA:HB1	1.93	0.51
1:A:108:ALA:O	1:A:141:ILE:HA	2.12	0.50
1:A:178:LEU:HD12	1:A:252:VAL:O	2.11	0.50
1:A:226:THR:CG2	1:A:227:PRO:HD2	2.38	0.50
1:A:30:ARG:HD3	1:A:35:PRO:HG3	1.94	0.50
1:A:160:ARG:HB3	1:A:287:PRO:HB3	1.93	0.49
1:A:11:MET:HA	1:A:85:GLY:O	2.12	0.49
1:A:169:PRO:O	1:A:170:GLU:C	2.51	0.49
1:A:302:THR:CG2	1:A:306:LYS:HE3	2.43	0.49

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:182:ALA:HB2	1:A:200:LEU:HD13	1.96	0.48
1:A:63:GLN:HG2	1:A:291:ASN:O	2.14	0.48
1:A:165:TYR:O	1:A:173:ARG:NH1	2.45	0.48
1:A:87:LYS:HE3	1:A:128:ARG:HH11	1.74	0.47
1:A:190:LYS:HG3	1:A:191:GLU:N	2.27	0.47
1:A:243:PHE:O	1:A:247:GLY:N	2.48	0.47
1:A:169:PRO:O	1:A:172:GLU:N	2.48	0.46
1:A:202:GLU:O	1:A:206:LEU:HG	2.15	0.46
1:A:254:VAL:O	1:A:254:VAL:HG12	2.14	0.46
1:A:26:TYR:O	1:A:30:ARG:N	2.31	0.46
1:A:83:TYR:CG	1:A:100:MET:HG2	2.51	0.46
1:A:109:VAL:O	1:A:109:VAL:HG13	2.16	0.46
1:A:87:LYS:CE	1:A:128:ARG:NH1	2.79	0.46
1:A:265:VAL:O	1:A:269:ASN:HB2	2.17	0.45
1:A:118:SER:HA	1:A:194:ASP:OD1	2.16	0.45
1:A:264:GLU:HG2	1:A:264:GLU:H	1.62	0.45
1:A:25:TYR:O	1:A:29:ILE:HG13	2.17	0.45
1:A:150:GLU:OE2	1:A:151:PRO:HD2	2.17	0.45
1:A:26:TYR:O	1:A:27:THR:C	2.55	0.44
1:A:30:ARG:CD	1:A:35:PRO:HG3	2.48	0.44
1:A:132:GLU:O	1:A:136:LEU:HG	2.18	0.44
1:A:70:HIS:HD2	3:A:527:HOH:O	2.01	0.43
1:A:15:THR:HG21	1:A:57:ALA:CA	2.48	0.43
1:A:205:LYS:C	1:A:205:LYS:HD3	2.39	0.43
1:A:26:TYR:O	1:A:29:ILE:N	2.52	0.43
1:A:19:GLU:OE2	1:A:44:LYS:HD3	2.19	0.43
1:A:186:PRO:CB	1:A:188:LYS:HE2	2.49	0.42
1:A:150:GLU:CD	1:A:151:PRO:HD2	2.39	0.42
1:A:188:LYS:C	1:A:190:LYS:N	2.73	0.42
1:A:179:ILE:HD11	1:A:251:PHE:HD2	1.84	0.42
1:A:242:LEU:HA	1:A:245:GLN:HG2	2.01	0.42
1:A:147:TRP:HB2	1:A:303:VAL:HG21	2.02	0.42
1:A:253:TYR:O	1:A:255:PRO:HD3	2.20	0.42
1:A:9:LEU:HB3	1:A:110:SER:HB3	2.02	0.41
1:A:191:GLU:HG2	3:A:509:HOH:O	2.20	0.41
1:A:59:ILE:HD13	1:A:291:ASN:OD1	2.20	0.41
1:A:225:ASN:HD22	1:A:226:THR:N	2.19	0.41
1:A:23:GLU:OE1	1:A:34:LYS:HE3	2.20	0.41
1:A:179:ILE:CD1	1:A:251:PHE:HD2	2.34	0.41
1:A:46:ARG:HD3	1:A:267:TYR:CD2	2.55	0.40
1:A:119:THR:HA	1:A:123:GLN:HB2	2.03	0.40
1:A:162:LYS:O	1:A:166:ALA:HB2	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	307/309 (99%)	288 (94%)	17 (6%)	2 (1%)	29 48

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	188	LYS
1	A	247	GLY

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	266/266 (100%)	260 (98%)	6 (2%)	61 86

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	15	THR
1	A	123	GLN
1	A	191	GLU
1	A	226	THR
1	A	228	ASP
1	A	264	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such

sidechains are listed below:

Mol	Chain	Res	Type
1	A	62	GLN
1	A	69	GLN
1	A	70	HIS
1	A	88	HIS
1	A	123	GLN
1	A	175	ASN
1	A	221	GLN
1	A	225	ASN
1	A	249	GLN
1	A	269	ASN

5.3.3 RNA ⓘ

There are no RNA chains 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 carbohydrates in this entry.

5.6 Ligand geometry ⓘ

Of 1 ligands modelled in this entry, 1 is 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.

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

6.1 Protein, DNA and RNA chains

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	309/309 (100%)	-0.13	0 100 100	10, 21, 37, 48	0

There are no RSRZ outliers to report.

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates

There are no carbohydrates in this entry.

6.4 Ligands

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	RSR	LLDF	B-factors(Å ²)	Q<0.9
2	ZN	A	500	1/1	0.09	-3.01	52,52,52,52	0

6.5 Other polymers

There are no such residues in this entry.