



Full wwPDB X-ray Structure Validation Report

Feb 28, 2014 – 11:14 AM GMT

PDB ID : 4KM4
Title : E. coli alkaline phosphatase mutant S102G/R166S in complex with inorganic phosphate
Authors : Andrews, L.D.; Fenn, T.D.; Herschlag, D.
Deposited on : 2013-05-08
Resolution : 2.80 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>

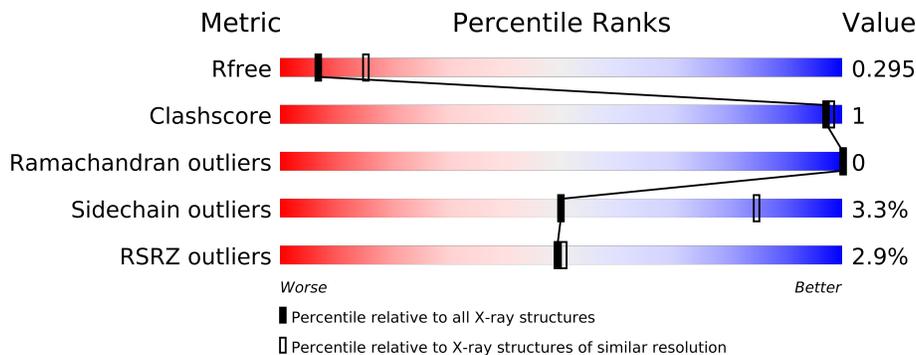
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.15 2013
Xtriage (Phenix) : dev-1323
EDS : stable22639
Percentile statistics : 21963
Refmac : 5.8.0049
CCP4 : 6.3.0 (Settle)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : stable22683

1 Overall quality at a glance

The reported resolution of this entry is 2.80 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}	66092	1799 (2.80-2.80)
Clashscore	79885	2295 (2.80-2.80)
Ramachandran outliers	78287	2252 (2.80-2.80)
Sidechain outliers	78261	2254 (2.80-2.80)
RSRZ outliers	66119	1802 (2.80-2.80)

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	445	
1	B	445	

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 12972 atoms, of which 6426 are hydrogens 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.

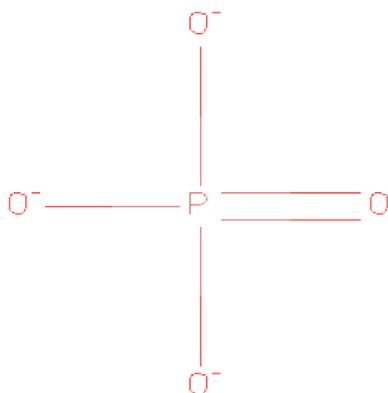
- Molecule 1 is a protein called Alkaline phosphatase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
1	A	445	6478	2018	3213	573	662	12	0	0	0
1	B	445	6478	2018	3213	573	662	12	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	102	GLY	SER	ENGINEERED MUTATION	UNP P00634
A	166	SER	ARG	ENGINEERED MUTATION	UNP P00634
B	102	GLY	SER	ENGINEERED MUTATION	UNP P00634
B	166	SER	ARG	ENGINEERED MUTATION	UNP P00634

- Molecule 2 is PHOSPHATE ION (three-letter code: PO4) (formula: O₄P).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	P	0	0
			5	4	1		
2	B	1	Total	O	P	0	0
			5	4	1		

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

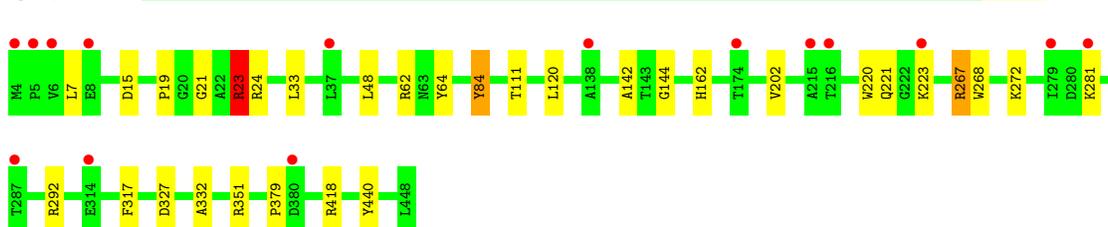
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	3	Total	Zn	0	0
			3	3		
3	A	3	Total	Zn	0	0
			3	3		

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.

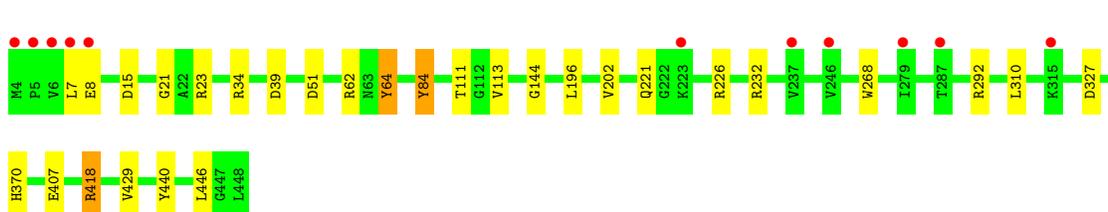
- Molecule 1: Alkaline phosphatase

Chain A:



- Molecule 1: Alkaline phosphatase

Chain B:



4 Data and refinement statistics

Property	Value	Source
Space group	P 63 2 2	Depositor
Cell constants a, b, c, α , β , γ	160.94Å 160.94Å 139.55Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 2.80 42.04 – 2.80	Depositor EDS
% Data completeness (in resolution range)	(Not available) (50.00-2.80) 99.3 (42.04-2.80)	Depositor EDS
R_{merge}	0.34	Depositor
R_{sym}	0.41	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.57 (at 2.81Å)	Xtrriage
Refinement program	FFX	Depositor
R, R_{free}	0.232 , 0.296 0.239 , 0.295	Depositor DCC
R_{free} test set	1335 reflections (5.31%)	DCC
Wilson B-factor (Å ²)	35.9	Xtrriage
Anisotropy	0.653	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , -10.0	EDS
Estimated twinning fraction	No twinning to report.	Xtrriage
L-test for twinning	$\langle L \rangle = 0.53$, $\langle L^2 \rangle = 0.36$	Xtrriage
Outliers	1 of 26488 reflections (0.004%)	Xtrriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	12972	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.82% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality i

5.1 Standard geometry i

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, PO4

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	0.80	0/3319	1.07	16/4506 (0.4%)
1	B	0.81	0/3319	1.07	15/4506 (0.3%)
All	All	0.81	0/6638	1.07	31/9012 (0.3%)

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	A	0	2
1	B	0	3
All	All	0	5

There are no bond length outliers.

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	B	62	ARG	NE-CZ-NH1	11.48	126.04	120.30
1	B	62	ARG	NE-CZ-NH2	-9.23	115.68	120.30
1	A	84	TYR	CB-CG-CD1	8.52	126.11	121.00
1	B	84	TYR	CB-CG-CD1	8.49	126.10	121.00
1	A	62	ARG	NE-CZ-NH1	8.41	124.50	120.30
1	B	232	ARG	NE-CZ-NH1	8.14	124.37	120.30
1	A	84	TYR	CB-CG-CD2	-8.08	116.15	121.00
1	B	292	ARG	NE-CZ-NH1	7.58	124.09	120.30
1	B	84	TYR	CB-CG-CD2	-7.51	116.50	121.00
1	B	292	ARG	NE-CZ-NH2	-7.47	116.56	120.30
1	A	292	ARG	NE-CZ-NH2	-7.43	116.58	120.30
1	B	418	ARG	NE-CZ-NH1	7.38	123.99	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	62	ARG	NE-CZ-NH2	-7.35	116.62	120.30
1	B	34	ARG	NE-CZ-NH1	7.34	123.97	120.30
1	A	292	ARG	NE-CZ-NH1	7.11	123.86	120.30
1	B	84	TYR	CA-CB-CG	6.90	126.50	113.40
1	A	418	ARG	NE-CZ-NH1	6.66	123.63	120.30
1	A	84	TYR	CA-CB-CG	6.62	125.99	113.40
1	A	267	ARG	NE-CZ-NH1	6.57	123.59	120.30
1	B	418	ARG	NE-CZ-NH2	-6.54	117.03	120.30
1	A	351	ARG	NE-CZ-NH1	5.97	123.28	120.30
1	B	226	ARG	NE-CZ-NH1	5.93	123.27	120.30
1	A	23	ARG	NE-CZ-NH2	-5.75	117.42	120.30
1	A	418	ARG	NE-CZ-NH2	-5.53	117.53	120.30
1	B	268	TRP	CG-CD2-CE3	-5.35	129.08	133.90
1	A	267	ARG	NE-CZ-NH2	-5.35	117.63	120.30
1	A	24	ARG	NE-CZ-NH1	5.24	122.92	120.30
1	B	51	ASP	CB-CG-OD2	5.22	123.00	118.30
1	A	268	TRP	CG-CD2-CE3	-5.18	129.24	133.90
1	A	351	ARG	NE-CZ-NH2	-5.12	117.74	120.30
1	B	64	TYR	CB-CG-CD2	-5.05	117.97	121.00

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	23	ARG	Sidechain
1	A	64	TYR	Sidechain
1	B	370	HIS	Sidechain
1	B	418	ARG	Sidechain
1	B	64	TYR	Sidechain

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	3265	3213	0	8	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	3265	3213	0	5	0
2	A	5	0	0	0	0
2	B	5	0	0	0	0
3	A	3	0	0	0	0
3	B	3	0	0	0	0
All	All	6546	6426	0	11	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 1.

All (11) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:B:144:GLY:HA2	1:B:202:VAL:O	2.09	0.52
1:A:144:GLY:HA2	1:A:202:VAL:O	2.14	0.47
1:B:15:ASP:O	1:B:21:GLY:HA3	2.17	0.45
1:A:440:TYR:CD2	1:B:23:ARG:HD2	2.53	0.43
1:A:272:LYS:HE3	1:A:332:ALA:O	2.19	0.43
1:A:120:LEU:O	1:A:162:HIS:HA	2.19	0.42
1:A:15:ASP:O	1:A:21:GLY:HA3	2.20	0.41
1:A:23:ARG:HD2	1:B:440:TYR:CD2	2.56	0.41
1:A:142:ALA:O	1:A:317:PHE:HA	2.21	0.41
1:B:111:THR:OG1	1:B:113:VAL:HG13	2.21	0.40
1:A:220:TRP:O	1:A:223:LYS: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	443/445 (100%)	430 (97%)	13 (3%)	0	100	100
1	B	443/445 (100%)	428 (97%)	15 (3%)	0	100	100
All	All	886/890 (100%)	858 (97%)	28 (3%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains ❶

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	335/335 (100%)	324 (97%)	11 (3%)	50	85
1	B	335/335 (100%)	324 (97%)	11 (3%)	50	85
All	All	670/670 (100%)	648 (97%)	22 (3%)	50	85

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	7	LEU
1	A	19	PRO
1	A	33	LEU
1	A	48	LEU
1	A	84	TYR
1	A	111	THR
1	A	221	GLN
1	A	267	ARG
1	A	281	LYS
1	A	327	ASP
1	A	379	PRO
1	B	7	LEU
1	B	8	GLU
1	B	39	ASP
1	B	84	TYR
1	B	196	LEU
1	B	221	GLN
1	B	310	LEU
1	B	327	ASP
1	B	407	GLU
1	B	429	VAL
1	B	446	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	338	GLN

5.3.3 RNA [i](#)

There are no RNA chains 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](#)

Of 8 ligands modelled in this entry, 6 are monoatomic - leaving 2 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	PO4	A	501	3	4,4,4	0.67	0	6,6,6	0.33	0
2	PO4	B	501	3	4,4,4	0.64	0	6,6,6	0.34	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	PO4	A	501	3	-	0/0/0/0	0/0/0/0
2	PO4	B	501	3	-	0/0/0/0	0/0/0/0

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	445/445 (100%)	0.29	15 (3%) 43 44	5, 19, 37, 64	0
1	B	445/445 (100%)	0.22	11 (2%) 54 55	5, 20, 36, 66	0
All	All	890/890 (100%)	0.25	26 (2%) 49 50	5, 20, 36, 66	0

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	216	THR	4.3
1	B	5	PRO	3.7
1	B	8	GLU	3.2
1	A	5	PRO	3.1
1	B	279	ILE	3.1
1	B	7	LEU	3.0
1	A	8	GLU	3.0
1	A	6	VAL	2.8
1	A	37	LEU	2.6
1	B	237	VAL	2.6
1	A	223	LYS	2.6
1	B	6	VAL	2.4
1	B	246	VAL	2.4
1	A	314	GLU	2.4
1	A	4	MET	2.4
1	A	174	THR	2.4
1	B	223	LYS	2.3
1	A	281	LYS	2.2
1	A	138	ALA	2.2
1	A	287	THR	2.2
1	B	287	THR	2.2
1	B	4	MET	2.1
1	A	215	ALA	2.1
1	B	315	LYS	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	279	ILE	2.1
1	A	380	ASP	2.0

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](#)

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	PO4	B	501	5/5	0.14	-0.70	21,22,22,26	0
3	ZN	A	504	1/1	0.14	-1.20	21,21,21,21	0
2	PO4	A	501	5/5	0.14	-1.54	4,6,15,17	0
3	ZN	B	503	1/1	0.11	-1.54	15,15,15,15	0
3	ZN	A	502	1/1	0.14	-1.61	13,13,13,13	0
3	ZN	B	502	1/1	0.09	-2.42	10,10,10,10	0
3	ZN	B	504	1/1	0.06	-3.00	13,13,13,13	0
3	ZN	A	503	1/1	0.08	-4.85	14,14,14,14	0

6.5 Other polymers [i](#)

There are no such residues in this entry.