



Full wwPDB X-ray Structure Validation Report

Mar 1, 2014 – 03:30 AM GMT

PDB ID : 2NX1
Title : Structural and mechanistic changes along an engineered path from metallo to non-metallo KDO8P synthase
Authors : Kona, F.; Xu, X.; Martin, P.; Kuzmic, P.; Gatti, D.L.
Deposited on : 2006-11-16
Resolution : 1.80 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>

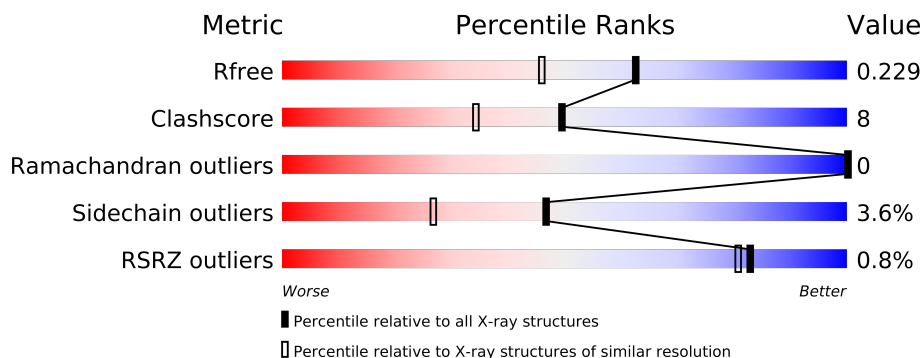
The following versions of software and data (see [references](#)) were used in the production of this report:

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 1.80 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	3513 (1.80-1.80)
Clashscore	79885	4461 (1.80-1.80)
Ramachandran outliers	78287	4404 (1.80-1.80)
Sidechain outliers	78261	4403 (1.80-1.80)
RSRZ outliers	66119	3515 (1.80-1.80)

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	267	
1	B	267	

2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 4738 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.

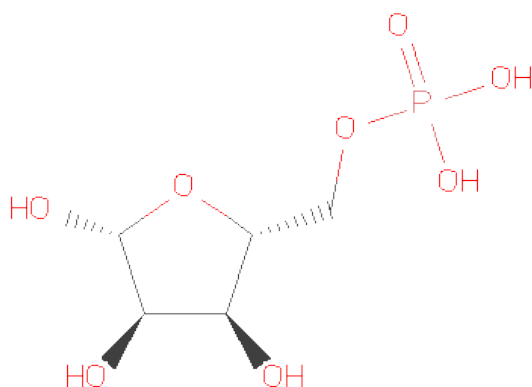
- Molecule 1 is a protein called 2-dehydro-3-deoxyphosphooctonatealdolase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	263	Total	C	N	O	S	0	0	0
			2067	1332	346	384	5			
1	B	262	Total	C	N	O	S	0	0	0
			2058	1327	345	381	5			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1011	ASN	CYS	ENGINEERED	UNP O66496
B	2011	ASN	CYS	ENGINEERED	UNP O66496

- Molecule 2 is 5-O-PHOSPHONO-BETA-D-RIBOFURANOSE (three-letter code: RP5) (formula: C₅H₁₁O₈P).



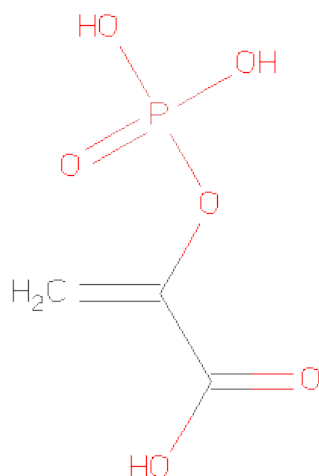
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	O	P	0	0
			14	5	8	1		

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	B	1	Total	C	O	P	0	0
			14	5	8	1		

- Molecule 3 is PHOSPHOENOLPYRUVATE (three-letter code: PEP) (formula: $C_3H_5O_6P$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	O	P	0	0
			10	3	6	1		
3	B	1	Total	C	O	P	0	0
			10	3	6	1		

- Molecule 4 is water.

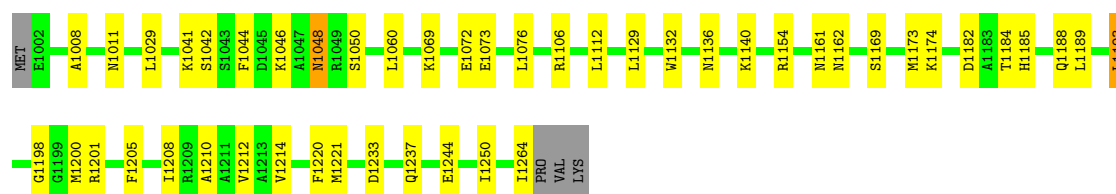
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	298	Total	O	0	0
			298	298		
4	B	267	Total	O	0	0
			267	267		

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.

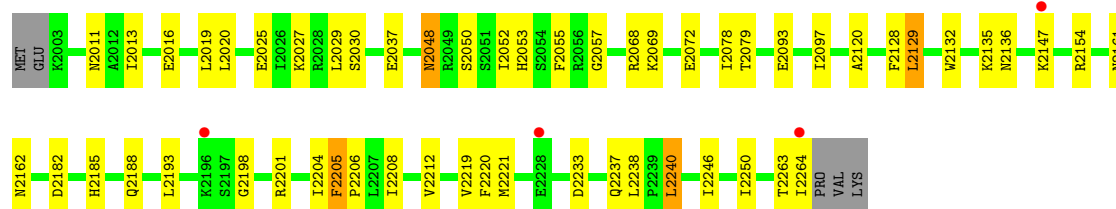
- Molecule 1: 2-dehydro-3-deoxyphosphooctonatealdolase

Chain A: 



- Molecule 1: 2-dehydro-3-deoxyphosphooctonatealdolase

Chain B: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	84.77Å 84.77Å 160.58Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	36.71 – 1.80 36.70 – 1.74	Depositor EDS
% Data completeness (in resolution range)	88.8 (36.71-1.80) 82.1 (36.70-1.74)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	0.11	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.35 (at 1.74Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.200 , 0.230 0.199 , 0.229	Depositor DCC
R_{free} test set	5434 reflections (9.76%)	DCC
Wilson B-factor (Å ²)	25.3	Xtriage
Anisotropy	0.333	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 40.5	EDS
Estimated twinning fraction	0.012 for -h,-k,l	Xtriage
L-test for twinning	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Outliers	4 of 56843 reflections (0.007%)	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	4738	wwPDB-VP
Average B, all atoms (Å ²)	29.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.73% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: RP5, PEP

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	0.37	1/2108 (0.0%)	0.58	0/2843
1	B	0.33	0/2099	0.57	0/2831
All	All	0.35	1/4207 (0.0%)	0.57	0/5674

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1072	GLU	CD-OE2	7.11	1.33	1.25

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	2067	0	2102	33	0
1	B	2058	0	2096	38	0
2	A	14	0	9	0	0
2	B	14	0	9	0	0
3	A	10	0	2	0	0
3	B	10	0	2	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	298	0	0	4	0
4	B	267	0	0	3	0
All	All	4738	0	4220	64	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 8.

All (64) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:B:2208:ILE:HD11	1:B:2219:VAL:HG11	1.48	0.94
1:A:1161:ASN:HD21	1:B:2132:TRP:HE1	1.09	0.91
1:A:1132:TRP:HE1	1:B:2161:ASN:HD21	1.19	0.91
1:B:2025:GLU:HG2	1:B:2240:LEU:HD22	1.66	0.77
1:A:1174:LYS:HG3	1:A:1264:ILE:HG12	1.68	0.73
1:A:1185:HIS:O	1:A:1188:GLN:HG2	1.88	0.73
1:B:2011:ASN:H	1:B:2237:GLN:NE2	1.85	0.73
1:B:2238:LEU:HD21	1:B:2246:ILE:HD12	1.76	0.68
1:B:2205:PHE:O	1:B:2208:ILE:HG22	1.95	0.66
1:A:1205:PHE:O	1:A:1208:ILE:HG22	1.96	0.66
1:B:2037:GLU:HG3	4:B:3412:HOH:O	1.96	0.65
1:A:1011:ASN:HD21	1:A:1046:LYS:HE2	1.62	0.64
1:B:2185:HIS:O	1:B:2188:GLN:HG2	1.99	0.62
1:B:2048:ASN:HD22	1:B:2048:ASN:H	1.48	0.62
1:B:2011:ASN:H	1:B:2237:GLN:HE22	1.48	0.60
1:A:1048:ASN:HD22	1:A:1048:ASN:H	1.49	0.59
1:B:2193:LEU:HD23	1:B:2198:GLY:CA	2.34	0.57
1:B:2135:LYS:HE3	4:B:3501:HOH:O	2.05	0.56
1:B:2205:PHE:HB3	1:B:2206:PRO:HD3	1.88	0.55
1:A:1041:LYS:HD3	1:A:1042:SER:N	2.23	0.54
1:A:1212:VAL:HG11	1:A:1250:ILE:HB	1.90	0.54
1:B:2263:THR:O	1:B:2264:ILE:HG22	2.09	0.52
1:A:1044:PHE:CZ	1:A:1060:LEU:HD23	2.46	0.51
1:A:1193:LEU:HD22	1:A:1198:GLY:HA2	1.93	0.50
1:A:1136:ASN:HB3	1:B:2050:SER:O	2.12	0.50
1:B:2016:GLU:O	1:B:2020:LEU:HG	2.12	0.50
1:A:1041:LYS:C	1:A:1041:LYS:HD3	2.33	0.49
1:B:2068:ARG:O	1:B:2072:GLU:HG3	2.13	0.49
1:B:2147:LYS:NZ	1:B:2147:LYS:HB3	2.28	0.49
1:A:1188:GLN:NE2	4:A:3003:HOH:O	2.46	0.48
1:A:1201:ARG:HG2	4:A:3358:HOH:O	2.13	0.48
1:A:1069:LYS:HE3	1:A:1073:GLU:OE1	2.13	0.48
1:A:1011:ASN:HD21	1:A:1046:LYS:CE	2.26	0.47

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:B:2013:ILE:HG23	1:B:2019:LEU:HD11	1.96	0.47
1:A:1182:ASP:HA	1:A:1220:PHE:HB3	1.95	0.47
1:A:1233:ASP:O	1:A:1237:GLN:HG3	2.15	0.47
1:A:1184:THR:HB	4:A:3145:HOH:O	2.16	0.46
1:A:1161:ASN:ND2	1:B:2132:TRP:HE1	1.93	0.45
1:A:1048:ASN:HD22	1:A:1048:ASN:N	2.10	0.45
1:B:2020:LEU:HD21	1:B:2069:LYS:HG3	1.99	0.45
1:A:1169:SER:O	1:A:1173:MET:HG3	2.17	0.45
1:A:1050:SER:O	1:B:2136:ASN:HB3	2.17	0.44
1:B:2212:VAL:HG11	1:B:2250:ILE:HB	2.00	0.44
1:A:1008:ALA:HA	1:A:1221:MET:O	2.18	0.44
1:B:2048:ASN:HD22	1:B:2048:ASN:N	2.10	0.43
1:A:1193:LEU:HD22	1:A:1198:GLY:CA	2.48	0.43
1:B:2027:LYS:O	1:B:2030:SER:HB3	2.18	0.43
4:A:3173:HOH:O	1:B:2053:HIS:HE1	2.01	0.43
1:B:2182:ASP:HA	1:B:2220:PHE:HB3	2.00	0.43
1:B:2093:GLU:HG3	4:B:3282:HOH:O	2.18	0.42
1:A:1189:LEU:HD21	1:A:1200:MET:HE1	2.01	0.42
1:B:2078:ILE:HG22	1:B:2079:THR:N	2.35	0.42
1:A:1210:ALA:O	1:A:1214:VAL:HG23	2.19	0.41
1:B:2263:THR:O	1:B:2264:ILE:CG2	2.69	0.41
1:A:1189:LEU:HD21	1:A:1200:MET:CE	2.51	0.41
1:B:2097:ILE:HG12	1:B:2120:ALA:HB3	2.02	0.41
1:A:1140:LYS:HG2	1:B:2052:ILE:HB	2.01	0.41
1:B:2055:PHE:CZ	1:B:2057:GLY:HA2	2.55	0.41
1:A:1132:TRP:HE1	1:B:2161:ASN:ND2	2.00	0.41
1:B:2128:PHE:CE1	1:B:2129:LEU:HD13	2.56	0.41
1:A:1060:LEU:HD13	1:A:1060:LEU:C	2.41	0.41
1:A:1029:LEU:HD21	1:A:1244:GLU:HB2	2.03	0.41
1:B:2219:VAL:HG12	1:B:2221:MET:HG3	2.03	0.40
1:B:2201:ARG:HG3	1:B:2204:ILE:HD12	2.02	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	261/267 (98%)	257 (98%)	4 (2%)	0	100	100
1	B	260/267 (97%)	254 (98%)	6 (2%)	0	100	100
All	All	521/534 (98%)	511 (98%)	10 (2%)	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	220/224 (98%)	212 (96%)	8 (4%)	47	27
1	B	219/224 (98%)	211 (96%)	8 (4%)	45	26
All	All	439/448 (98%)	423 (96%)	16 (4%)	47	27

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1048	ASN
1	A	1076	LEU
1	A	1106	ARG
1	A	1112	LEU
1	A	1129	LEU
1	A	1154	ARG
1	A	1162	ASN
1	A	1193	LEU
1	B	2029	LEU
1	B	2048	ASN
1	B	2129	LEU
1	B	2154	ARG
1	B	2162	ASN
1	B	2205	PHE
1	B	2233	ASP
1	B	2240	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (16) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1011	ASN
1	A	1048	ASN
1	A	1058	HIS
1	A	1136	ASN
1	A	1161	ASN
1	A	1162	ASN
1	A	1188	GLN
1	B	2011	ASN
1	B	2048	ASN
1	B	2053	HIS
1	B	2083	HIS
1	B	2099	GLN
1	B	2122	ASN
1	B	2161	ASN
1	B	2162	ASN
1	B	2237	GLN

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 ⓘ

4 ligands are modelled in this entry.

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
3	PEP	A	1268	-	9,9,9	2.17	2 (22%)	13,13,13	2.33	4 (30%)
2	RP5	A	1269	-	14,14,14	2.83	3 (21%)	21,21,21	2.06	7 (33%)
3	PEP	B	2268	-	9,9,9	2.26	2 (22%)	13,13,13	2.67	6 (46%)
2	RP5	B	2269	-	14,14,14	2.92	4 (28%)	21,21,21	1.04	1 (4%)

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
3	PEP	A	1268	-	-	0/9/9/9	0/0/0/0
2	RP5	A	1269	-	-	0/6/22/22	0/1/1/1
3	PEP	B	2268	-	-	0/9/9/9	0/0/0/0
2	RP5	B	2269	-	-	0/6/22/22	0/1/1/1

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1269	RP5	C1'-C2'	9.39	1.60	1.52
2	B	2269	RP5	C1'-C2'	8.83	1.59	1.52
3	B	2268	PEP	C2-C1	4.97	1.54	1.49
3	A	1268	PEP	C2-C1	4.82	1.54	1.49
2	B	2269	RP5	O1'-C1'	4.03	1.47	1.42
3	A	1268	PEP	O2'-C1	-3.33	1.19	1.30
3	B	2268	PEP	O2'-C1	-3.30	1.19	1.30
2	B	2269	RP5	C3'-C4'	3.23	1.61	1.53
2	B	2269	RP5	C5'-C4'	2.50	1.59	1.51
2	A	1269	RP5	P'-O5'	-2.21	1.52	1.60
2	A	1269	RP5	C5'-C4'	2.18	1.58	1.51

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	2268	PEP	O1-C1-C2	-5.26	113.68	121.81
3	B	2268	PEP	P-O2-C2	5.08	135.08	123.31
3	A	1268	PEP	O2'-C1-C2	5.02	122.67	113.90
3	A	1268	PEP	P-O2-C2	4.76	134.34	123.31
2	A	1269	RP5	O5'-P'-O1X	4.45	119.74	106.71
2	A	1269	RP5	O5'-C5'-C4'	-4.43	92.68	108.94
3	B	2268	PEP	O2'-C1-C2	3.58	120.16	113.90

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	2268	PEP	O3P-P-O1P	3.36	121.44	110.44
2	A	1269	RP5	O1'-C4'-C3'	3.05	111.35	105.17
3	A	1268	PEP	O2'-C1-O1	-2.95	116.64	123.62
3	A	1268	PEP	O3P-P-O1P	2.80	119.59	110.44
2	B	2269	RP5	O1'-C1'-C2'	2.66	107.27	104.72
3	B	2268	PEP	O2P-P-O1P	-2.33	102.82	110.44
2	A	1269	RP5	O1-C1'-O1'	-2.19	108.30	111.28
2	A	1269	RP5	O1'-C4'-C5'	2.17	117.11	109.36
3	B	2268	PEP	O3P-P-O2P	2.16	116.02	107.61
2	A	1269	RP5	C5'-C4'-C3'	-2.05	107.02	115.21
2	A	1269	RP5	O3X-P'-O5'	-2.04	101.01	106.65

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	263/267 (98%)	-0.48	0 100 100	17, 25, 39, 53	0
1	B	262/267 (98%)	-0.26	4 (1%) 70 66	19, 27, 44, 55	0
All	All	525/534 (98%)	-0.37	4 (0%) 83 81	17, 26, 43, 55	0

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	2264	ILE	2.7
1	B	2228	GLU	2.5
1	B	2196	LYS	2.4
1	B	2147	LYS	2.3

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(\AA^2)	Q<0.9
2	RP5	A	1269	14/14	0.07	-0.39	22,29,31,32	0
2	RP5	B	2269	14/14	0.07	-0.62	27,31,34,37	0
3	PEP	B	2268	10/10	0.08	-0.99	18,24,27,27	0
3	PEP	A	1268	10/10	0.06	-1.52	17,19,21,23	0

6.5 Other polymers

There are no such residues in this entry.