



# Full wwPDB X-ray Structure Validation Report ⓘ

May 29, 2020 – 05:57 am BST

PDB ID : 4RUE  
Title : Human K2P4.1 (TRAAK) potassium channel, G124I mutant  
Authors : Lolicato, M.; Minor, D.L.Jr.  
Deposited on : 2014-11-19  
Resolution : 3.30 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](mailto: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.

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

MolProbity : 4.02b-467  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.11

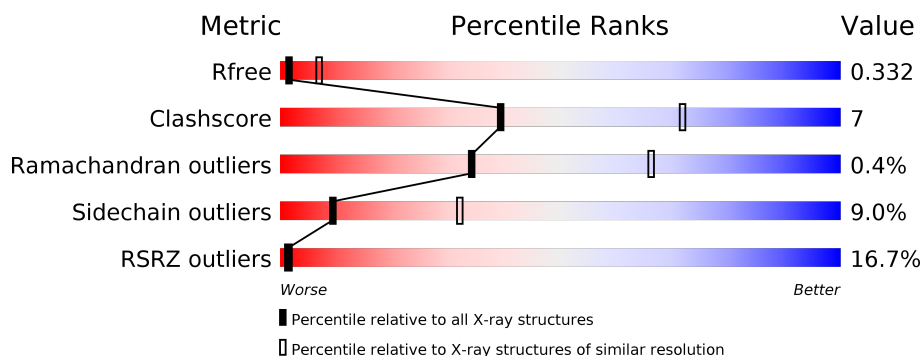
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.30 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))
$R_{free}$	130704	1149 (3.34-3.26)
Clashscore	141614	1205 (3.34-3.26)
Ramachandran outliers	138981	1183 (3.34-3.26)
Sidechain outliers	138945	1182 (3.34-3.26)
RSRZ outliers	127900	1115 (3.34-3.26)

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  $\geq 3$ , 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	309	
1	B	309	

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3893 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 Potassium channel subfamily K member 4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	251	Total	C	N	O	S	0	0	0
			1926	1274	311	335	6			
1	B	252	Total	C	N	O	S	0	0	0
			1961	1297	319	339	6			

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	104	GLN	ASN	ENGINEERED MUTATION	UNP Q9NYG8
A	108	GLN	ASN	ENGINEERED MUTATION	UNP Q9NYG8
A	124	ILE	GLY	ENGINEERED MUTATION	UNP Q9NYG8
A	301	SER	-	EXPRESSION TAG	UNP Q9NYG8
A	302	ASN	-	EXPRESSION TAG	UNP Q9NYG8
A	303	SER	-	EXPRESSION TAG	UNP Q9NYG8
A	304	LEU	-	EXPRESSION TAG	UNP Q9NYG8
A	305	GLU	-	EXPRESSION TAG	UNP Q9NYG8
A	306	VAL	-	EXPRESSION TAG	UNP Q9NYG8
A	307	LEU	-	EXPRESSION TAG	UNP Q9NYG8
A	308	PHE	-	EXPRESSION TAG	UNP Q9NYG8
A	309	GLN	-	EXPRESSION TAG	UNP Q9NYG8
B	104	GLN	ASN	ENGINEERED MUTATION	UNP Q9NYG8
B	108	GLN	ASN	ENGINEERED MUTATION	UNP Q9NYG8
B	124	ILE	GLY	ENGINEERED MUTATION	UNP Q9NYG8
B	301	SER	-	EXPRESSION TAG	UNP Q9NYG8
B	302	ASN	-	EXPRESSION TAG	UNP Q9NYG8
B	303	SER	-	EXPRESSION TAG	UNP Q9NYG8
B	304	LEU	-	EXPRESSION TAG	UNP Q9NYG8
B	305	GLU	-	EXPRESSION TAG	UNP Q9NYG8
B	306	VAL	-	EXPRESSION TAG	UNP Q9NYG8
B	307	LEU	-	EXPRESSION TAG	UNP Q9NYG8
B	308	PHE	-	EXPRESSION TAG	UNP Q9NYG8
B	309	GLN	-	EXPRESSION TAG	UNP Q9NYG8

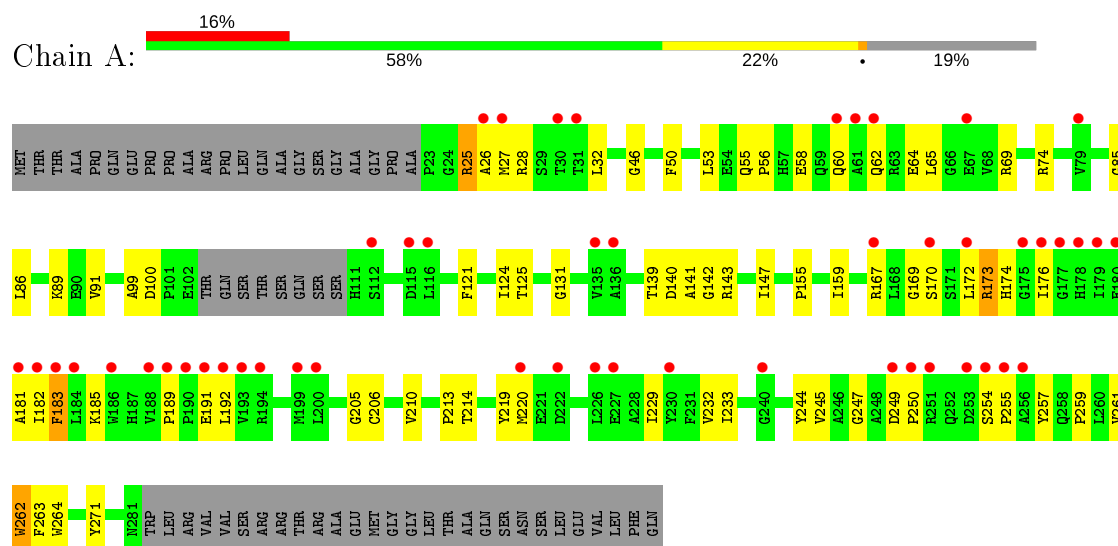
- Molecule 2 is POTASSIUM ION (three-letter code: K) (formula: K).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	K	0	0
			1	1		
2	A	5	Total	K	0	0
			5	5		

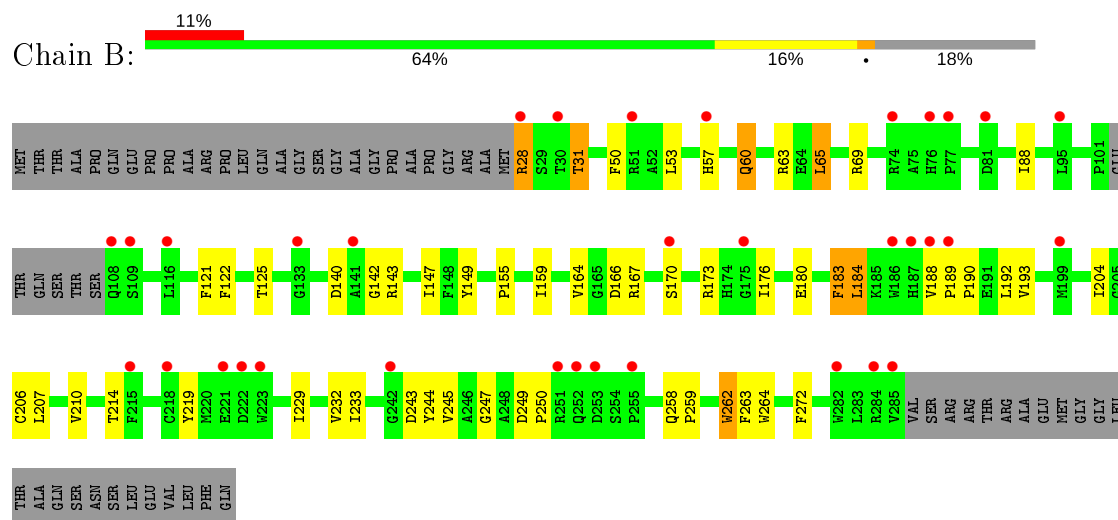
### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of 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: Potassium channel subfamily K member 4



- Molecule 1: Potassium channel subfamily K member 4



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	87.49 Å 118.70 Å 128.70 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	14.99 – 3.30 14.99 – 3.30	Depositor EDS
% Data completeness (in resolution range)	95.3 (14.99-3.30) 95.3 (14.99-3.30)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.08 (at 3.33 Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.4_1496)	Depositor
R, $R_{free}$	0.291 , 0.323 0.307 , 0.332	Depositor DCC
$R_{free}$ test set	1026 reflections (5.25%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	134.8	Xtriage
Anisotropy	0.355	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.23 , 225.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.40$ , $\langle L^2 \rangle = 0.23$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	3893	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	291.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.36% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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

### 5.1 Standard geometry

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

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	0.23	0/1975	0.39	0/2693
1	B	0.21	0/2012	0.37	0/2744
All	All	0.22	0/3987	0.38	0/5437

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 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	1926	0	1934	38	0
1	B	1961	0	1981	30	0
2	A	5	0	0	0	0
2	B	1	0	0	0	0
All	All	3893	0	3915	58	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 7.

All (58) 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:170:SER:HA	1:B:173:ARG:HG2	1.72	0.71
1:A:189:PRO:HG2	1:A:192:LEU:HB2	1.77	0.67
1:A:169:GLY:HA2	1:A:172:LEU:HD12	1.78	0.64
1:B:184:LEU:HD21	1:B:190:PRO:HG3	1.81	0.62
1:A:182:ILE:H	1:A:185:LYS:HE3	1.65	0.61
1:A:25:ARG:O	1:A:25:ARG:NH1	2.33	0.59
1:A:170:SER:O	1:A:174:HIS:ND1	2.36	0.59
1:A:205:GLY:HA3	1:A:271:TYR:CZ	2.39	0.58
1:A:147:ILE:HG23	1:B:233:ILE:HG12	1.86	0.57
1:A:53:LEU:HD13	1:B:142:GLY:HA2	1.86	0.57
1:A:245:VAL:HG12	1:A:247:GLY:H	1.69	0.56
1:A:32:LEU:HD22	1:B:167:ARG:HG2	1.88	0.56
1:A:259:PRO:HA	1:A:262:TRP:NE1	2.21	0.56
1:B:189:PRO:HG2	1:B:192:LEU:HD12	1.88	0.55
1:A:99:ALA:HB1	1:B:65:LEU:HD13	1.89	0.55
1:B:259:PRO:HA	1:B:262:TRP:NE1	2.23	0.53
1:B:184:LEU:HG	1:B:193:VAL:HG21	1.92	0.52
1:B:245:VAL:HG12	1:B:247:GLY:H	1.75	0.51
1:A:26:ALA:O	1:A:28:ARG:N	2.44	0.50
1:B:247:GLY:O	1:B:258:GLN:NE2	2.42	0.49
1:B:164:VAL:HA	1:B:167:ARG:HB3	1.95	0.48
1:A:214:THR:HG21	1:A:229:ILE:HG12	1.96	0.48
1:A:173:ARG:O	1:A:176:ILE:HG12	2.15	0.47
1:B:243:ASP:OD1	1:B:244:TYR:N	2.48	0.47
1:B:28:ARG:HG3	1:B:31:THR:HB	1.98	0.46
1:B:180:GLU:HA	1:B:183:PHE:HB3	1.98	0.45
1:A:143:ARG:NH1	1:B:244:TYR:OH	2.49	0.45
1:A:142:GLY:HA2	1:B:53:LEU:HD13	1.99	0.45
1:A:28:ARG:CB	1:A:32:LEU:HB2	2.46	0.45
1:A:206:CYS:O	1:A:210:VAL:HB	2.17	0.44
1:A:139:THR:HG22	1:A:141:ALA:H	1.83	0.44
1:A:233:ILE:HG12	1:B:147:ILE:HG23	1.99	0.44
1:A:254:SER:HA	1:A:255:PRO:HD3	1.85	0.43
1:B:188:VAL:HA	1:B:189:PRO:HD3	1.87	0.43
1:B:214:THR:HG21	1:B:229:ILE:HG12	2.00	0.43
1:A:232:VAL:HG13	1:A:264:TRP:HZ2	1.83	0.43
1:A:124:ILE:HD13	1:A:262:TRP:HB3	2.01	0.43
1:A:181:ALA:O	1:A:183:PHE:N	2.45	0.42
1:A:155:PRO:O	1:A:159:ILE:HG12	2.19	0.42
1:B:204:ILE:HA	1:B:207:LEU:HB3	2.01	0.42
1:A:91:VAL:HG21	1:B:88:ILE:HG23	2.02	0.42
1:A:244:TYR:OH	1:B:143:ARG:NH1	2.51	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:249:ASP:HA	1:A:250:PRO:HD3	1.80	0.42
1:B:155:PRO:O	1:B:159:ILE:HG12	2.19	0.42
1:B:60:GLN:OE1	1:B:63:ARG:NH2	2.53	0.42
1:A:257:TYR:O	1:A:261:VAL:HG23	2.20	0.42
1:A:125:THR:HB	1:A:131:GLY:HA2	2.02	0.42
1:A:213:PRO:HG3	1:A:264:TRP:HE1	1.85	0.42
1:A:46:GLY:HA3	1:B:149:TYR:CZ	2.54	0.41
1:A:55:GLN:N	1:A:56:PRO:HD2	2.35	0.41
1:A:172:LEU:O	1:A:176:ILE:HG23	2.20	0.41
1:A:26:ALA:C	1:A:28:ARG:H	2.23	0.41
1:A:69:ARG:HH21	1:A:85:GLY:HA2	1.84	0.41
1:B:122:PHE:O	1:B:125:THR:OG1	2.36	0.41
1:B:232:VAL:HG13	1:B:264:TRP:HZ2	1.86	0.41
1:A:65:LEU:O	1:A:69:ARG:HB2	2.20	0.41
1:B:249:ASP:HA	1:B:250:PRO:HD3	1.76	0.40
1:B:206:CYS:O	1:B:210:VAL:HB	2.20	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	247/309 (80%)	223 (90%)	22 (9%)	2 (1%)	19	51
1	B	248/309 (80%)	232 (94%)	16 (6%)	0	100	100
All	All	495/618 (80%)	455 (92%)	38 (8%)	2 (0%)	34	66

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	62	GLN
1	A	27	MET

### 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	197/249 (79%)	178 (90%)	19 (10%)	8	29
1	B	205/249 (82%)	188 (92%)	17 (8%)	11	36
All	All	402/498 (81%)	366 (91%)	36 (9%)	9	32

All (36) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	25	ARG
1	A	50	PHE
1	A	58	GLU
1	A	60	GLN
1	A	64	GLU
1	A	74	ARG
1	A	86	LEU
1	A	89	LYS
1	A	100	ASP
1	A	121	PHE
1	A	140	ASP
1	A	167	ARG
1	A	173	ARG
1	A	183	PHE
1	A	191	GLU
1	A	219	TYR
1	A	220	MET
1	A	262	TRP
1	A	263	PHE
1	B	28	ARG
1	B	31	THR
1	B	50	PHE
1	B	57	HIS
1	B	60	GLN
1	B	65	LEU
1	B	69	ARG
1	B	121	PHE

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Mol	Chain	Res	Type
1	B	140	ASP
1	B	166	ASP
1	B	176	ILE
1	B	183	PHE
1	B	184	LEU
1	B	219	TYR
1	B	262	TRP
1	B	263	PHE
1	B	272	PHE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

Of 6 ligands modelled in this entry, 6 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 [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 ⓘ

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	251/309 (81%)	0.90	50 (19%)	1 1	228, 287, 408, 424	0
1	B	252/309 (81%)	0.70	34 (13%)	3 3	207, 279, 346, 409	0
All	All	503/618 (81%)	0.80	84 (16%)	1 1	207, 283, 390, 424	0

All (84) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	180	GLU	11.1
1	B	252	GLN	10.1
1	B	253	ASP	9.9
1	B	188	VAL	8.5
1	A	179	ILE	8.3
1	A	256	ALA	6.5
1	B	116	LEU	6.4
1	A	178	HIS	6.4
1	A	192	LEU	5.9
1	A	253	ASP	5.7
1	A	249	ASP	5.5
1	B	222	ASP	5.4
1	A	193	VAL	5.2
1	A	255	PRO	5.0
1	B	221	GLU	4.8
1	B	109	SER	4.8
1	B	189	PRO	4.7
1	A	190	PRO	4.5
1	A	250	PRO	4.4
1	A	177	GLY	4.3
1	A	183	PHE	4.3
1	B	175	GLY	4.2
1	A	191	GLU	4.1
1	B	133	GLY	4.1

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Mol	Chain	Res	Type	RSRZ
1	B	223	TRP	4.1
1	B	81	ASP	4.0
1	A	200	LEU	3.8
1	A	189	PRO	3.8
1	A	60	GLN	3.8
1	B	251	ARG	3.7
1	B	285	VAL	3.7
1	A	186	TRP	3.6
1	A	230	TYR	3.5
1	B	57	HIS	3.4
1	A	116	LEU	3.3
1	B	242	GLY	3.2
1	B	215	PHE	3.2
1	A	176	ILE	3.2
1	A	170	SER	3.1
1	A	26	ALA	3.1
1	B	30	THR	3.1
1	A	172	LEU	3.1
1	A	175	GLY	3.1
1	A	251	ARG	3.0
1	A	136	ALA	3.0
1	B	186	TRP	2.9
1	A	115	ASP	2.8
1	A	184	LEU	2.8
1	A	182	ILE	2.8
1	B	284	ARG	2.7
1	A	61	ALA	2.6
1	B	108	GLN	2.6
1	B	218	CYS	2.6
1	A	240	GLY	2.6
1	B	170	SER	2.6
1	B	51	ARG	2.5
1	A	30	THR	2.5
1	A	135	VAL	2.5
1	A	220	MET	2.4
1	A	222	ASP	2.4
1	A	27	MET	2.4
1	A	62	GLN	2.3
1	A	254	SER	2.3
1	A	227	GLU	2.3
1	A	188	VAL	2.3
1	A	112	SER	2.3

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Mol	Chain	Res	Type	RSRZ
1	B	187	HIS	2.3
1	B	95	LEU	2.2
1	B	76	HIS	2.2
1	A	181	ALA	2.2
1	B	282	TRP	2.2
1	B	141	ALA	2.2
1	A	194	ARG	2.2
1	B	28	ARG	2.2
1	B	255	PRO	2.1
1	A	31	THR	2.1
1	A	167	ARG	2.1
1	A	199	MET	2.1
1	B	77	PRO	2.1
1	A	67	GLU	2.0
1	A	226	LEU	2.0
1	B	74	ARG	2.0
1	A	79	VAL	2.0
1	B	199	MET	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. The B-factors column lists the minimum, median, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
2	K	A	401	1/1	0.30	0.28	262,262,262,262	0
2	K	A	403	1/1	0.31	0.18	245,245,245,245	0
2	K	B	401	1/1	0.37	0.27	274,274,274,274	0
2	K	A	404	1/1	0.77	0.38	323,323,323,323	0
2	K	A	402	1/1	0.77	0.10	260,260,260,260	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	K	A	405	1/1	0.79	0.30	254,254,254,254	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.