Full wwPDB X-ray Structure Validation Report (i)

Jun 19, 2024 – 08:18 AM EDT

PDB ID	:	4BRM
Title	:	Sulfur SAD phasing of the Legionella pneumophila NTPDase1 - crystal form III (closed) in complex with sulfate
Authors	:	Zebisch, M.; Schaefer, P.; Lauble, P.; Straeter, N.
Deposited on	:	2013-06-04
Resolution	:	2.02 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 (i) 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 (i)) were used in the production of this report:

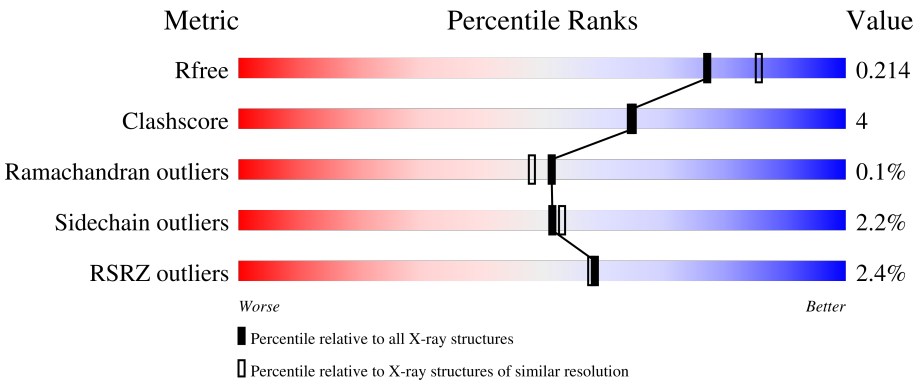
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	2.37.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.37.1

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.02 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	10434 (2.04-2.00)
Clashscore	141614	11643 (2.04-2.00)
Ramachandran outliers	138981	11493 (2.04-2.00)
Sidechain outliers	138945	11492 (2.04-2.00)
RSRZ outliers	127900	10220 (2.04-2.00)

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 <=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	368	2% 88% 10% •
1	B	368	3% 88% 9% •

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 6148 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.

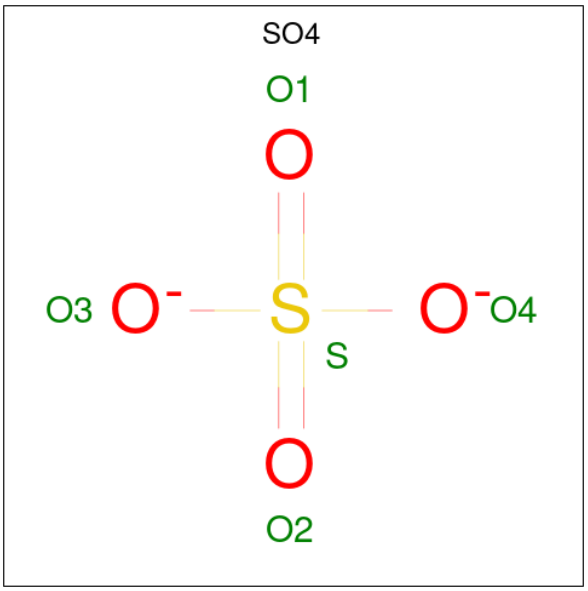
- Molecule 1 is a protein called ECTONUCLEOSIDE TRIPHOSPHATE DIPHOSPHOHYDROLASE I.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	359	2893	1843	476	559	15	0	5	0
1	B	356	2881	1832	476	559	14	0	7	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	34	MET	-	expression tag	UNP Q5ZUA2
A	137	ASP	GLU	conflict	UNP Q5ZUA2
A	149	VAL	ALA	conflict	UNP Q5ZUA2
A	394	LEU	-	expression tag	UNP Q5ZUA2
A	395	GLU	-	expression tag	UNP Q5ZUA2
A	396	HIS	-	expression tag	UNP Q5ZUA2
A	397	HIS	-	expression tag	UNP Q5ZUA2
A	398	HIS	-	expression tag	UNP Q5ZUA2
A	399	HIS	-	expression tag	UNP Q5ZUA2
A	400	HIS	-	expression tag	UNP Q5ZUA2
A	401	HIS	-	expression tag	UNP Q5ZUA2
B	34	MET	-	expression tag	UNP Q5ZUA2
B	137	ASP	GLU	conflict	UNP Q5ZUA2
B	149	VAL	ALA	conflict	UNP Q5ZUA2
B	394	LEU	-	expression tag	UNP Q5ZUA2
B	395	GLU	-	expression tag	UNP Q5ZUA2
B	396	HIS	-	expression tag	UNP Q5ZUA2
B	397	HIS	-	expression tag	UNP Q5ZUA2
B	398	HIS	-	expression tag	UNP Q5ZUA2
B	399	HIS	-	expression tag	UNP Q5ZUA2
B	400	HIS	-	expression tag	UNP Q5ZUA2
B	401	HIS	-	expression tag	UNP Q5ZUA2

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



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

- Molecule 3 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Cl 1 1	0	0
3	B	1	Total Cl 1 1	0	0

- Molecule 4 is water.

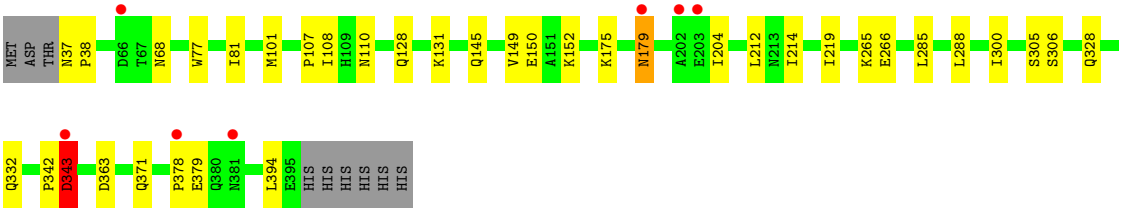
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	202	Total O 204 204	0	2
4	B	148	Total O 148 148	0	0

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.

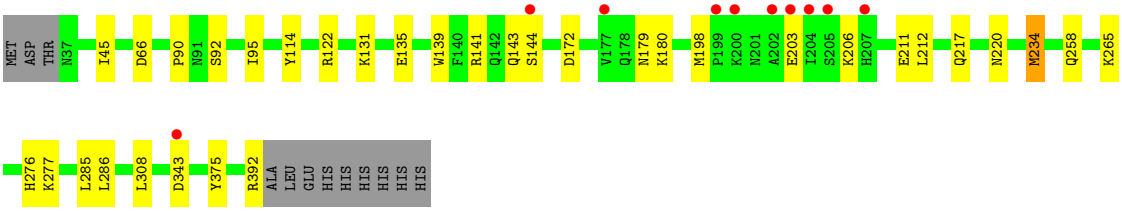
• Molecule 1: ECTONUCLEOSIDE TRIPHOSPHATE DIPHOSPHOHYDROLASE I

Chain A:



• Molecule 1: ECTONUCLEOSIDE TRIPHOSPHATE DIPHOSPHOHYDROLASE I

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	79.97Å 84.31Å 102.11Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	32.53 – 2.02 32.51 – 2.02	Depositor EDS
% Data completeness (in resolution range)	94.3 (32.53-2.02) 94.4 (32.51-2.02)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	6.20 (at 2.01Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.161 , 0.216 0.160 , 0.214	Depositor DCC
R_{free} test set	2191 reflections (5.05%)	wwPDB-VP
Wilson B-factor (Å^2)	22.2	Xtriage
Anisotropy	0.205	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.37 , 46.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	6148	wwPDB-VP
Average B, all atoms (Å^2)	24.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.66% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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)

Bond lengths and bond angles in the following residue types are not validated in this section: SO4, CL

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	0.92	1/2985 (0.0%)	0.92	2/4070 (0.0%)
1	B	0.92	1/2977 (0.0%)	0.95	4/4058 (0.1%)
All	All	0.92	2/5962 (0.0%)	0.93	6/8128 (0.1%)

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	B	0	2

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	266	GLU	CD-OE1	6.60	1.32	1.25
1	B	375	TYR	CG-CD1	5.43	1.46	1.39

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	122	ARG	NE-CZ-NH1	13.57	127.09	120.30
1	B	122	ARG	NE-CZ-NH2	-10.54	115.03	120.30
1	B	234	MET	CG-SD-CE	-8.16	87.14	100.20
1	B	141	ARG	NE-CZ-NH1	5.73	123.17	120.30
1	A	288	LEU	CA-CB-CG	5.34	127.59	115.30
1	A	266	GLU	CG-CD-OE1	5.30	128.90	118.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	144	SER	Peptide
1	B	343	ASP	Peptide

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	2893	0	2766	28	0
1	B	2881	0	2753	17	0
2	A	10	0	0	0	0
2	B	10	0	0	1	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	204	0	0	1	0
4	B	148	0	0	2	0
All	All	6148	0	5519	46	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 (46) 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:A:179:ASN:H	1:A:179:ASN:ND2	1.57	0.96
1:B:211:GLU:HG3	1:B:220:ASN:ND2	1.83	0.93
1:A:179:ASN:HD22	1:A:179:ASN:N	1.69	0.91
1:A:179:ASN:H	1:A:179:ASN:HD22	0.85	0.84
1:B:258:GLN:HG3	4:B:2043:HOH:O	1.84	0.77
1:A:305:SER:OG	1:A:378:PRO:HG3	1.84	0.77
1:B:90:PRO:O	1:B:131:LYS:HE2	1.88	0.73
1:A:179:ASN:ND2	1:A:179:ASN:N	2.31	0.72
1:B:198:MET:HE1	1:B:285:LEU:HD22	1.72	0.71
1:A:175:LYS:HE3	4:A:2092:HOH:O	1.90	0.70
1:B:211:GLU:HG3	1:B:220:ASN:HD21	1.57	0.68
2:B:1395:SO4:O4	4:B:2099:HOH:O	2.13	0.67
1:B:198:MET:CE	1:B:285:LEU:HD22	2.24	0.66
1:A:128:GLN:OE1	1:A:131:LYS:HE3	1.97	0.65

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:212[A]:LEU:CD1	1:A:214:ILE:HG22	2.28	0.64
1:A:212[A]:LEU:HD11	1:A:219:ILE:HD12	1.83	0.60
1:A:149:VAL:HG12	1:A:150:GLU:HG2	1.84	0.59
1:B:92:SER:HB3	1:B:135:GLU:OE1	2.04	0.58
1:A:328:GLN:O	1:A:332:GLN:HG3	2.08	0.54
1:A:204:ILE:HD11	1:A:285:LEU:HD21	1.90	0.52
1:A:77:TRP:CD2	1:A:107:PRO:HD3	2.46	0.51
1:B:114:TYR:CZ	1:B:392[A]:ARG:HD2	2.45	0.51
1:A:152:LYS:HD3	1:A:394:LEU:CD1	2.41	0.50
1:A:110:ASN:OD1	1:A:145:GLN:HA	2.12	0.49
1:A:81:ILE:HG21	1:A:101:MET:HG2	1.94	0.48
1:B:90:PRO:HA	1:B:95:ILE:HD11	1.95	0.48
1:B:139:TRP:CZ3	1:B:143:GLN:HG3	2.48	0.48
1:A:204:ILE:CD1	1:A:285:LEU:HD21	2.45	0.47
1:A:212[A]:LEU:CD1	1:A:214:ILE:CG2	2.93	0.46
1:B:179:ASN:OD1	1:B:180:LYS:HG2	2.17	0.45
1:A:107:PRO:HG2	1:A:108:ILE:HG12	1.98	0.44
1:A:212[A]:LEU:HD11	1:A:214:ILE:HG22	1.99	0.44
1:A:265:LYS:HD3	1:A:363:ASP:OD2	2.18	0.43
1:B:276:HIS:O	1:B:277:LYS:HB2	2.19	0.43
1:B:139:TRP:O	1:B:143:GLN:HG2	2.18	0.43
1:B:198:MET:HE2	1:B:285:LEU:HD22	2.01	0.43
1:A:379:GLU:CD	1:A:379:GLU:H	2.21	0.43
1:B:308:LEU:N	1:B:308:LEU:HD22	2.34	0.42
1:A:342:PRO:O	1:A:343:ASP:C	2.58	0.42
1:A:37:ASN:HA	1:A:38:PRO:HD2	1.94	0.42
1:A:265:LYS:HE3	1:A:265:LYS:HB3	1.78	0.42
1:B:203:GLU:O	1:B:203:GLU:HG2	2.20	0.41
1:B:286:LEU:HD23	1:B:286:LEU:HA	1.90	0.41
1:A:212[A]:LEU:HD13	1:A:214:ILE:CG2	2.50	0.41

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

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	362/368 (98%)	349 (96%)	12 (3%)	1 (0%)	41	36
1	B	360/368 (98%)	344 (96%)	16 (4%)	0	100	100
All	All	722/736 (98%)	693 (96%)	28 (4%)	1 (0%)	51	48

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	343	ASP

5.3.2 Protein sidechains (i)

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	324/328 (99%)	318 (98%)	6 (2%)	57	59
1	B	324/328 (99%)	316 (98%)	8 (2%)	47	48
All	All	648/656 (99%)	634 (98%)	14 (2%)	52	53

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	68	ASN
1	A	179	ASN
1	A	300	ILE
1	A	306	SER
1	A	343	ASP
1	A	371	GLN
1	B	45	ILE
1	B	66	ASP
1	B	172	ASP
1	B	206	LYS
1	B	212	LEU
1	B	217	GLN

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Mol	Chain	Res	Type
1	B	234	MET
1	B	265	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	179	ASN
1	A	331	HIS
1	A	371	GLN
1	B	220	ASN
1	B	310	HIS
1	B	318	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 6 ligands modelled in this entry, 2 are monoatomic - leaving 4 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	SO4	B	1395	-	4,4,4	0.55	0	6,6,6	0.75	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	SO4	A	1397	-	4,4,4	0.28	0	6,6,6	0.44	0
2	SO4	A	1396	-	4,4,4	0.52	0	6,6,6	1.07	0
2	SO4	B	1394	-	4,4,4	0.84	0	6,6,6	0.67	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.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	1395	SO4	1	0

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	359/368 (97%)	-0.09	7 (1%)	66	66	11, 21, 41, 56	0
1	B	356/368 (96%)	-0.13	10 (2%)	53	52	10, 21, 47, 61	0
All	All	715/736 (97%)	-0.11	17 (2%)	59	58	10, 21, 44, 61	0

All (17) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	207	HIS	4.3
1	B	202	ALA	4.1
1	A	343	ASP	3.6
1	B	343	ASP	3.6
1	A	381	ASN	2.7
1	B	205	SER	2.6
1	B	204	ILE	2.6
1	A	202	ALA	2.5
1	A	179	ASN	2.5
1	B	144	SER	2.4
1	B	177	VAL	2.3
1	B	203	GLU	2.2
1	B	199	PRO	2.2
1	B	200	LYS	2.2
1	A	203	GLU	2.2
1	A	66	ASP	2.1
1	A	378	PRO	2.1

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 monosaccharides 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, 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	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	SO4	B	1395	5/5	0.91	0.33	19,21,25,25	5
3	CL	B	1393	1/1	0.95	0.16	24,24,24,24	1
2	SO4	A	1396	5/5	0.96	0.11	27,28,32,32	0
2	SO4	A	1397	5/5	0.99	0.10	19,20,23,28	0
3	CL	A	1398	1/1	0.99	0.05	27,27,27,27	0
2	SO4	B	1394	5/5	0.99	0.09	13,15,16,16	0

6.5 Other polymers (i)

There are no such residues in this entry.