Full wwPDB X-ray Structure Validation Report (i)

Dec 17, 2023 – 11:27 pm GMT

PDB ID	:	4C1G
Title	:	Crystal structure of the metallo-beta-lactamase IMP-1 with D-captopril
Authors	:	Zollman, D.; Brem, J.; McDonough, M.A.; van Berkel, S.S.; Schofield, C.J.
Deposited on	:	2013-08-12
Resolution	:	1.71 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:

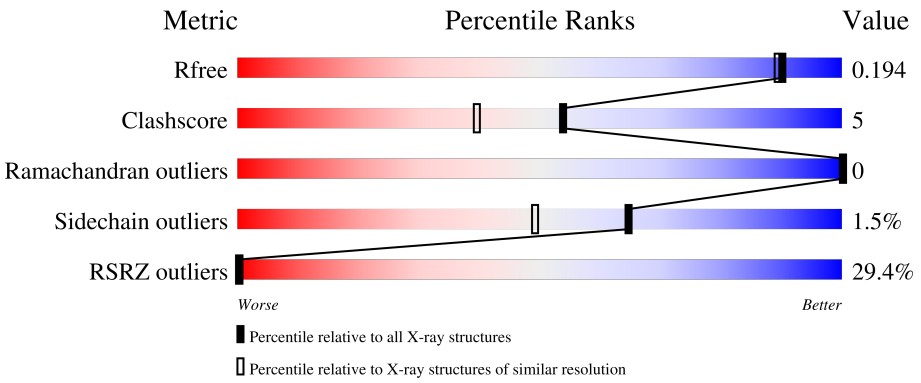
MolProbity	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 1.71 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	5722 (1.74-1.70)
Clashscore	141614	6152 (1.74-1.70)
Ramachandran outliers	138981	6051 (1.74-1.70)
Sidechain outliers	138945	6051 (1.74-1.70)
RSRZ outliers	127900	5629 (1.74-1.70)

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	228	2%, 89%, 7%, •
1	B	228	54%, 81%, 14%, 5%

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 3522 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.

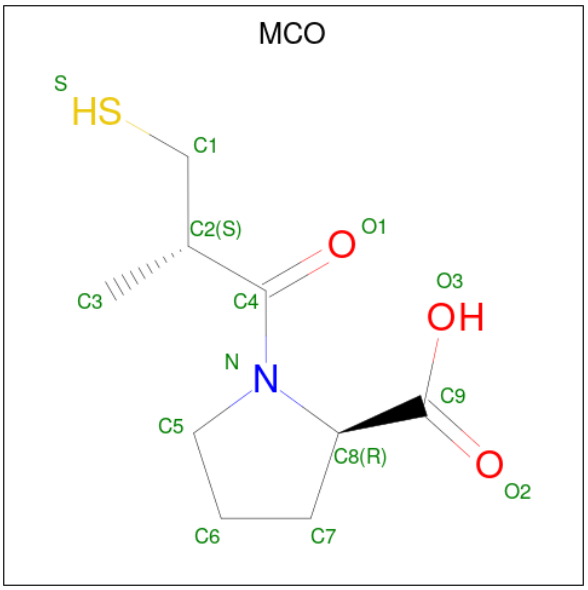
- Molecule 1 is a protein called BETA-LACTAMASE IMP-1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	219	1726	1118	281	326	1	0	4	0
1	B	217	1553	1006	254	292	1	0	0	0

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

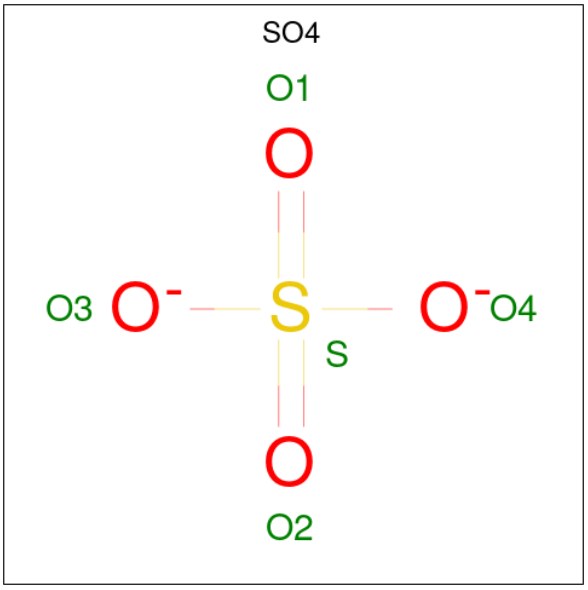
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Zn		
2	A	2	2	2	0	0
2	B	2	2	2	0	0

- Molecule 3 is 1-(3-MERCAPTO-2-METHYL-PROPIONYL)-PYRROLIDINE-2-CARBOXYLIC ACID (three-letter code: MCO) (formula: $C_9H_{15}NO_3S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
3	A	1	14	9	1	3	1	0	0

- Molecule 4 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



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

- Molecule 5 is water.

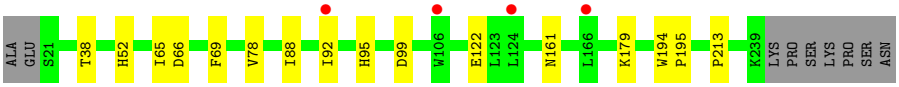
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	A	201	201	201	0	0
			Total	O		
5	B	14	14	14	0	0

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.

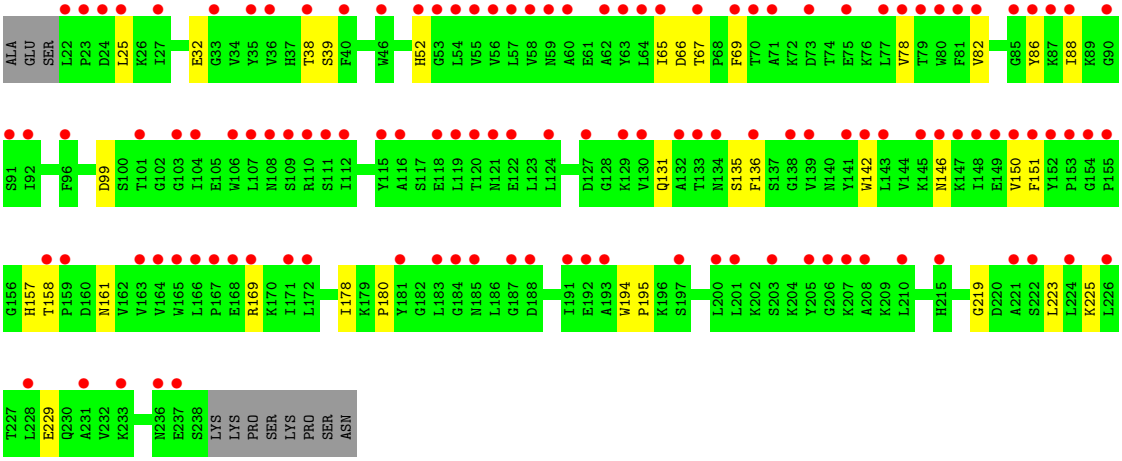
• Molecule 1: BETA-LACTAMASE IMP-1

Chain A:



• Molecule 1: BETA-LACTAMASE IMP-1

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	50.22Å 54.57Å 194.59Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	52.54 – 1.71 52.54 – 1.71	Depositor EDS
% Data completeness (in resolution range)	99.9 (52.54-1.71) 96.5 (52.54-1.71)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.08 (at 1.71Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, R_{free}	0.145 , 0.176 0.170 , 0.194	Depositor DCC
R_{free} test set	2015 reflections (3.45%)	wwPDB-VP
Wilson B-factor (Å^2)	21.1	Xtriage
Anisotropy	0.457	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 56.2	EDS
L-test for twinning[2]	$< \|L\| > = 0.45$, $< L^2 > = 0.28$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	3522	wwPDB-VP
Average B, all atoms (Å^2)	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.58% 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: MCO, SO4, 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	0.97	0/1773	0.82	0/2409
1	B	0.60	0/1597	0.62	0/2197
All	All	0.82	0/3370	0.73	0/4606

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 (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	1726	0	1708	11	0
1	B	1553	0	1380	22	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
3	A	14	0	13	5	0
4	A	10	0	0	0	0
5	A	201	0	0	3	0
5	B	14	0	0	1	0
All	All	3522	0	3101	34	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 5.

All (34) 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:142:TRP:HZ3	1:B:146:ASN:HA	1.53	0.73
1:B:65:ILE:O	1:B:66:ASP:HB2	1.95	0.66
1:A:179:LYS:NZ	3:A:305:MCO:O3	2.30	0.65
1:A:179:LYS:NZ	3:A:305:MCO:C9	2.61	0.64
1:A:179:LYS:NZ	3:A:305:MCO:O2	2.30	0.64
1:A:179:LYS:HZ1	3:A:305:MCO:C9	2.10	0.64
1:B:25:LEU:HG	1:B:38:THR:O	1.98	0.63
1:B:25:LEU:HD12	1:B:39:SER:HB3	1.82	0.60
1:B:219:GLY:HA3	1:B:223:LEU:HD11	1.84	0.59
1:A:65:ILE:O	1:A:66:ASP:HB2	2.03	0.58
1:B:142:TRP:CZ3	1:B:146:ASN:HA	2.35	0.58
1:B:131:GLN:NE2	5:B:2009:HOH:O	2.41	0.54
1:A:38:THR:OG1	1:A:52:HIS:HD2	1.91	0.53
1:B:142:TRP:HZ3	1:B:146:ASN:CA	2.20	0.53
1:A:122:GLU:HG3	5:A:2118:HOH:O	2.08	0.53
5:A:2024:HOH:O	1:B:52:HIS:HE1	1.93	0.52
1:A:69:PHE:CE2	1:A:99:ASP:HB3	2.45	0.52
1:B:32:GLU:O	1:B:169:ARG:NE	2.43	0.51
1:B:142:TRP:CZ3	1:B:146:ASN:N	2.79	0.50
1:B:82:VAL:HA	1:B:86:TYR:O	2.12	0.49
1:B:69:PHE:CE1	1:B:99:ASP:HB3	2.49	0.48
1:B:178:ILE:HG22	1:B:180:PRO:HD3	1.96	0.47
1:B:157:HIS:CD2	1:B:158:THR:HG23	2.51	0.46
1:B:150:VAL:HG12	1:B:151:PHE:N	2.31	0.45
1:A:78:VAL:HG13	1:A:88:ILE:HG13	1.98	0.45
1:B:78:VAL:HG22	1:B:88:ILE:HG13	1.99	0.44
3:A:305:MCO:O3	3:A:305:MCO:C6	2.64	0.44
1:A:213:PRO:HD2	5:A:2035:HOH:O	2.19	0.43
1:B:225:LYS:O	1:B:229:GLU:HG3	2.19	0.42
1:B:194:TRP:N	1:B:195:PRO:HD2	2.35	0.41
1:A:194:TRP:HB3	1:A:195:PRO:HD3	2.01	0.41
1:B:142:TRP:CZ3	1:B:146:ASN:CA	3.01	0.41
1:B:219:GLY:CA	1:B:223:LEU:HD11	2.50	0.41
1:B:135:SER:OG	1:B:136:PHE:N	2.53	0.40

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	221/228 (97%)	217 (98%)	4 (2%)	0	100	100
1	B	215/228 (94%)	205 (95%)	10 (5%)	0	100	100
All	All	436/456 (96%)	422 (97%)	14 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	187/196 (95%)	184 (98%)	3 (2%)	62	47
1	B	143/196 (73%)	141 (99%)	2 (1%)	67	52
All	All	330/392 (84%)	325 (98%)	5 (2%)	65	49

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	92	ILE
1	A	95	HIS
1	A	161	ASN
1	B	67	THR
1	B	161	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	52	HIS
1	A	131	GLN
1	B	52	HIS

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 7 ligands modelled in this entry, 4 are monoatomic - leaving 3 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	$\#\|Z\| > 2$
3	MCO	A	305	2	14,14,14	2.29	6 (42%)	18,19,19	1.53	4 (22%)
4	SO4	A	310	-	4,4,4	0.23	0	6,6,6	1.24	0
4	SO4	A	311	-	4,4,4	0.99	0	6,6,6	0.91	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
3	MCO	A	305	2	-	4/14/24/24	0/1/1/1

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	305	MCO	C4-N	4.86	1.45	1.34
3	A	305	MCO	C8-C9	-4.14	1.45	1.52
3	A	305	MCO	C1-C2	-2.74	1.50	1.53
3	A	305	MCO	C8-N	-2.18	1.42	1.47
3	A	305	MCO	C2-C4	-2.08	1.49	1.52
3	A	305	MCO	O3-C9	-2.08	1.23	1.30

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	305	MCO	C7-C8-C9	-3.03	106.38	111.36
3	A	305	MCO	C2-C1-S	-2.70	110.45	114.05
3	A	305	MCO	C9-C8-N	-2.47	107.26	112.26
3	A	305	MCO	C5-N-C8	-2.44	108.13	112.00

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	305	MCO	C7-C8-C9-O2
3	A	305	MCO	N-C8-C9-O2
3	A	305	MCO	C7-C8-C9-O3
3	A	305	MCO	N-C8-C9-O3

There are no ring outliers.

1 monomer is involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	305	MCO	5	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	219/228 (96%)	0.77	4 (1%)	68	72	14, 22, 40, 67	0
1	B	217/228 (95%)	2.65	124 (57%)	0	0	58, 77, 97, 118	0
All	All	436/456 (95%)	1.71	128 (29%)	0	0	14, 59, 93, 118	0

All (128) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	200	LEU	9.4
1	B	80	TRP	8.9
1	B	82	VAL	7.9
1	B	141	TYR	7.3
1	B	142	TRP	6.9
1	B	62	ALA	6.9
1	B	60	ALA	6.8
1	B	112	ILE	6.6
1	B	63	TYR	6.5
1	B	166	LEU	6.4
1	B	147	LYS	6.4
1	B	106	TRP	6.2
1	B	154	GLY	6.1
1	B	87	LYS	6.0
1	B	24	ASP	5.9
1	B	64	LEU	5.9
1	B	139	VAL	5.7
1	B	205	TYR	5.4
1	B	86	TYR	5.2
1	B	191	ILE	5.2
1	B	136	PHE	5.1
1	B	152	TYR	5.1
1	B	168	GLU	5.1
1	B	115	TYR	5.1

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Mol	Chain	Res	Type	RSRZ
1	B	148	ILE	5.1
1	B	35	TYR	5.1
1	B	138	GLY	5.0
1	B	92	ILE	4.9
1	B	27	ILE	4.8
1	B	224	LEU	4.8
1	B	57	LEU	4.8
1	B	208	ALA	4.7
1	B	165	TRP	4.6
1	B	127	ASP	4.6
1	B	104	ILE	4.6
1	B	111	SER	4.5
1	B	88	ILE	4.5
1	B	193	ALA	4.5
1	B	171	ILE	4.4
1	B	70	THR	4.3
1	B	69	PHE	4.3
1	B	58	VAL	4.2
1	B	81	PHE	4.2
1	B	143	LEU	4.1
1	B	146	ASN	4.1
1	B	53	GLY	4.1
1	B	150	VAL	4.1
1	B	163	VAL	4.1
1	B	231	ALA	4.1
1	B	91	SER	4.0
1	B	145	LYS	3.9
1	B	167	PRO	3.9
1	B	22	LEU	3.9
1	B	25	LEU	3.9
1	B	78	VAL	3.8
1	B	79	THR	3.8
1	B	110	ARG	3.8
1	B	233	LYS	3.8
1	B	118	GLU	3.8
1	B	133	THR	3.8
1	A	92	ILE	3.7
1	B	132	ALA	3.7
1	B	172	LEU	3.7
1	B	164	VAL	3.7
1	B	130	VAL	3.6
1	B	121	ASN	3.6

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Mol	Chain	Res	Type	RSRZ
1	B	153	PRO	3.5
1	B	55	VAL	3.5
1	B	96	PHE	3.5
1	B	40	PHE	3.5
1	B	221	ALA	3.4
1	B	46	TRP	3.4
1	B	151	PHE	3.4
1	B	77	LEU	3.4
1	B	71	ALA	3.2
1	B	33	GLY	3.2
1	B	75	GLU	3.2
1	B	122	GLU	3.2
1	B	85	GLY	3.2
1	B	215	HIS	3.2
1	B	120	THR	3.1
1	B	210	LEU	3.0
1	B	103	GLY	3.0
1	B	107	LEU	3.0
1	B	23	PRO	3.0
1	B	67	THR	2.9
1	B	206	GLY	2.9
1	B	129	LYS	2.9
1	B	101	THR	2.8
1	B	65	ILE	2.8
1	B	90	GLY	2.7
1	B	188	ASP	2.7
1	B	124	LEU	2.7
1	B	38	THR	2.7
1	B	108	ASN	2.7
1	B	158	THR	2.7
1	B	237	GLU	2.6
1	B	197	SER	2.6
1	B	185	ASN	2.6
1	B	183	LEU	2.6
1	B	119	LEU	2.6
1	B	169	ARG	2.5
1	B	236	ASN	2.5
1	B	73	ASP	2.4
1	B	149	GLU	2.4
1	B	109	SER	2.3
1	B	159	PRO	2.3
1	B	228	LEU	2.3

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Mol	Chain	Res	Type	RSRZ
1	B	56	VAL	2.3
1	B	201	LEU	2.3
1	A	124	LEU	2.2
1	B	134	ASN	2.2
1	B	203	SER	2.2
1	B	59	ASN	2.2
1	B	207	LYS	2.2
1	B	54	LEU	2.2
1	A	106	TRP	2.2
1	B	116	ALA	2.2
1	B	52	HIS	2.1
1	B	226	LEU	2.1
1	B	181	TYR	2.1
1	B	187	GLY	2.1
1	B	184	GLY	2.1
1	B	36	VAL	2.1
1	B	192	GLU	2.1
1	A	166	LEU	2.1
1	B	155	PRO	2.0
1	B	222	SER	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 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
3	MCO	A	305	14/14	0.68	0.28	24,31,35,40	0
4	SO4	A	310	5/5	0.90	0.13	59,60,64,65	0
4	SO4	A	311	5/5	0.92	0.11	19,32,34,35	5

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	ZN	B	301	1/1	0.98	0.06	61,61,61,61	0
2	ZN	A	301	1/1	0.99	0.15	18,18,18,18	0
2	ZN	B	300	1/1	0.99	0.06	63,63,63,63	0
2	ZN	A	300	1/1	1.00	0.16	19,19,19,19	0

6.5 Other polymers (i)

There are no such residues in this entry.