wwPDB X-ray Structure Validation Summary Report (i)

Nov 17, 2024 – 09:22 AM EST

PDB ID	:	4N8G
Title	:	Crystal structure of a TRAP periplasmic solute binding protein from Chromohalobacter salexigens DSM 3043 (Csal_0660), Target EFI-501075, with bound D-alanine-D-alanine
Authors	:	Vetting, M.W.; Al Obaidi, N.F.; Morisco, L.L.; Wasserman, S.R.; Sojitra, S.; Stead, M.; Attonito, J.D.; Scott Glenn, A.; Chowdhury, S.; Evans, B.; Hillerich, B.; Love, J.; Seidel, R.D.; Imker, H.J.; Gerlt, J.A.; Almo, S.C.; Enzyme Function Initiative (EFI)
Deposited on	:	2013-10-17
Resolution	:	1.50 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 (1)) were used in the production of this report:

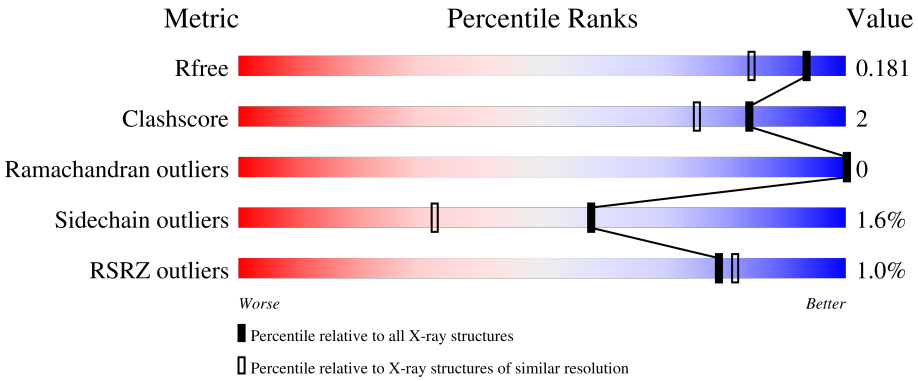
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)

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 1.50 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}	164625	3717 (1.50-1.50)
Clashscore	180529	4048 (1.50-1.50)
Ramachandran outliers	177936	3970 (1.50-1.50)
Sidechain outliers	177891	3967 (1.50-1.50)
RSRZ outliers	164620	3718 (1.50-1.50)

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	352	% 88% 5% 8%
1	B	352	% 86% 5% 9%
1	C	352	85% • 10%

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Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.39

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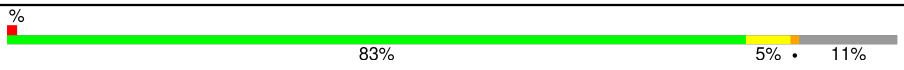
Mol	Chain	Length	Quality of chain
1	D	352	

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 21284 atoms, of which 9632 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 TRAP dicarboxylate transporter, DctP subunit.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	325	Total	C	H	N	O	Se	0	5	0
			5080	1651	2462	417	541	9			
1	B	321	Total	C	H	N	O	Se	0	2	0
			4966	1611	2410	410	526	9			
1	C	316	Total	C	H	N	O	Se	0	3	0
			4925	1598	2392	405	521	9			
1	D	312	Total	C	H	N	O	Se	0	6	0
			4877	1582	2368	402	516	9			

There are 28 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	346	ALA	-	expression tag	UNP Q1QZT7
A	347	GLU	-	expression tag	UNP Q1QZT7
A	348	ASN	-	expression tag	UNP Q1QZT7
A	349	LEU	-	expression tag	UNP Q1QZT7
A	350	TYR	-	expression tag	UNP Q1QZT7
A	351	PHE	-	expression tag	UNP Q1QZT7
A	352	GLN	-	expression tag	UNP Q1QZT7
B	346	ALA	-	expression tag	UNP Q1QZT7
B	347	GLU	-	expression tag	UNP Q1QZT7
B	348	ASN	-	expression tag	UNP Q1QZT7
B	349	LEU	-	expression tag	UNP Q1QZT7
B	350	TYR	-	expression tag	UNP Q1QZT7
B	351	PHE	-	expression tag	UNP Q1QZT7
B	352	GLN	-	expression tag	UNP Q1QZT7
C	346	ALA	-	expression tag	UNP Q1QZT7
C	347	GLU	-	expression tag	UNP Q1QZT7
C	348	ASN	-	expression tag	UNP Q1QZT7
C	349	LEU	-	expression tag	UNP Q1QZT7
C	350	TYR	-	expression tag	UNP Q1QZT7
C	351	PHE	-	expression tag	UNP Q1QZT7
C	352	GLN	-	expression tag	UNP Q1QZT7

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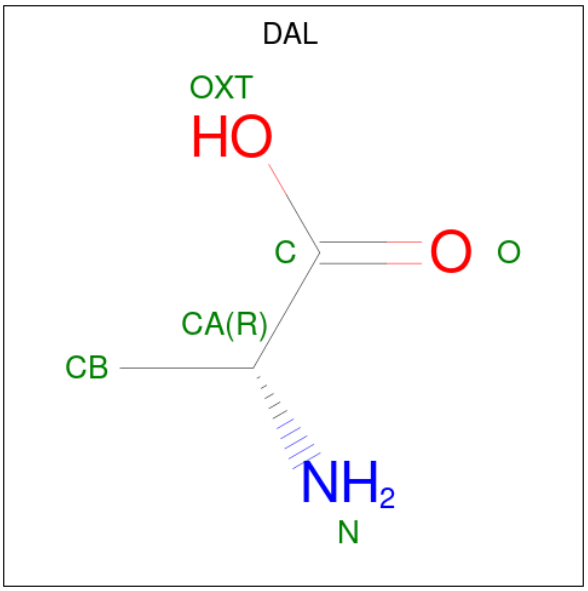
Chain	Residue	Modelled	Actual	Comment	Reference
D	346	ALA	-	expression tag	UNP Q1QZT7
D	347	GLU	-	expression tag	UNP Q1QZT7
D	348	ASN	-	expression tag	UNP Q1QZT7
D	349	LEU	-	expression tag	UNP Q1QZT7
D	350	TYR	-	expression tag	UNP Q1QZT7
D	351	PHE	-	expression tag	UNP Q1QZT7
D	352	GLN	-	expression tag	UNP Q1QZT7

- Molecule 2 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Cl 1 1	0	0
2	B	1	Total Cl 1 1	0	0
2	C	1	Total Cl 1 1	0	0
2	D	1	Total Cl 1 1	0	0

- Molecule 3 is D-ALANINE (three-letter code: DAL) (formula: $C_3H_7NO_2$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C N O 5 3 1 1	0	0

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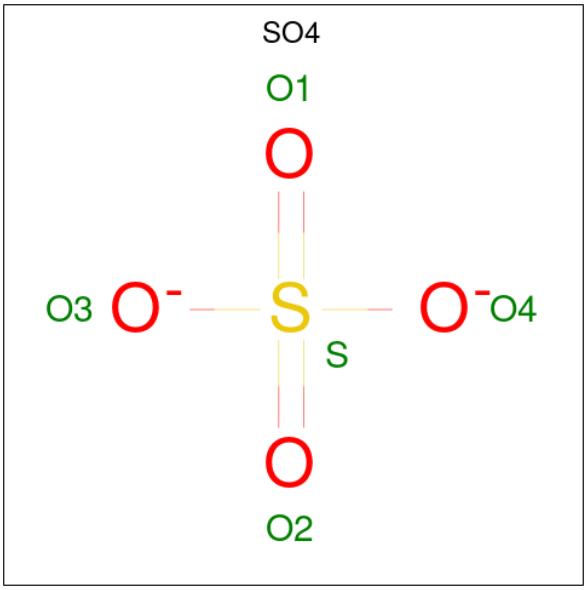
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C N O 6 3 1 2	0	0
3	B	1	Total C N O 5 3 1 1	0	0
3	B	1	Total C N O 6 3 1 2	0	0
3	C	1	Total C N O 5 3 1 1	0	0
3	C	1	Total C N O 6 3 1 2	0	0
3	D	1	Total C N O 5 3 1 1	0	0
3	D	1	Total C N O 6 3 1 2	0	0

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



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

- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	376	Total O 377 377	0	1

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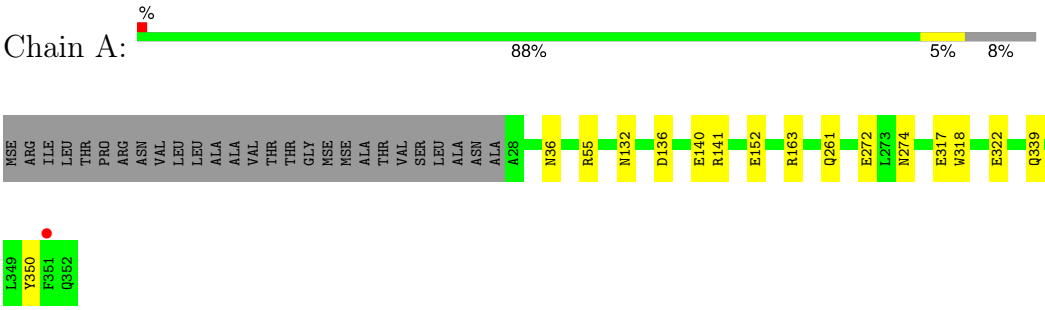
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	B	335	Total O 335 335	0	0
5	C	315	Total O 315 315	0	0
5	D	356	Total O 356 356	0	0

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.

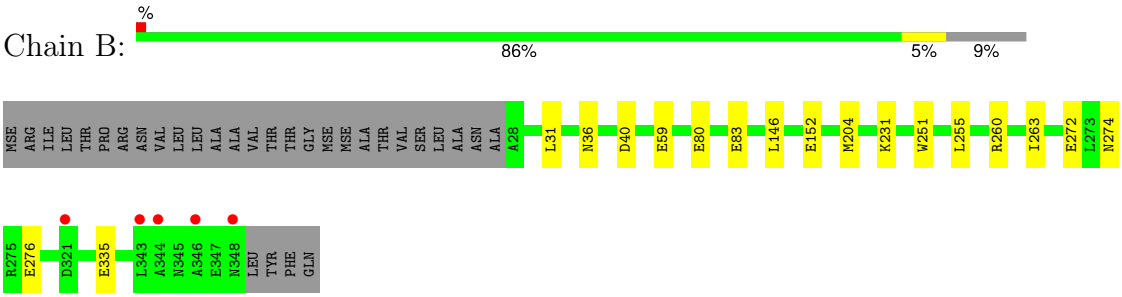
• Molecule 1: TRAP dicarboxylate transporter, DctP subunit

Chain A:



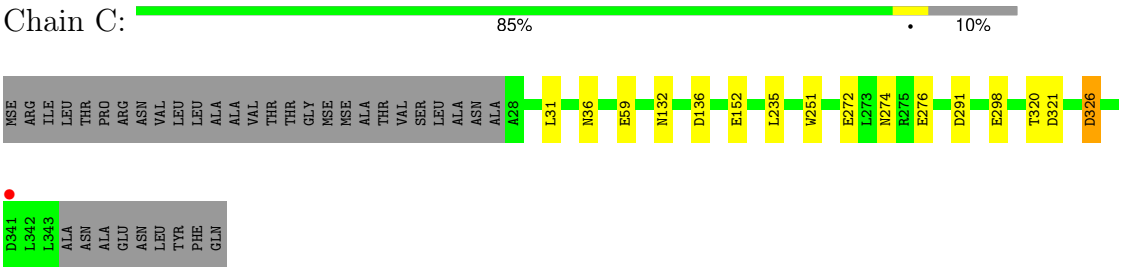
• Molecule 1: TRAP dicarboxylate transporter, DctP subunit

Chain B:



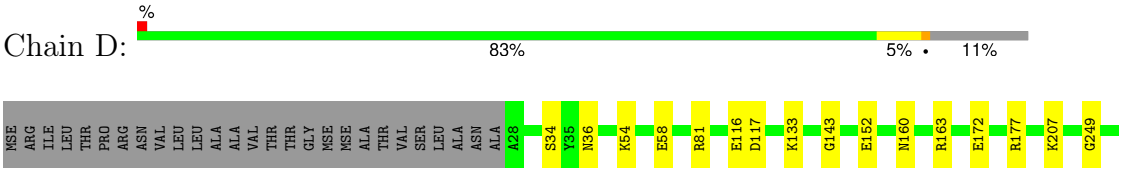
• Molecule 1: TRAP dicarboxylate transporter, DctP subunit

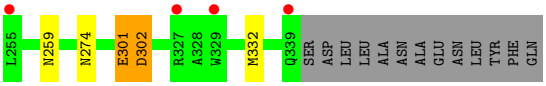
Chain C:



• Molecule 1: TRAP dicarboxylate transporter, DctP subunit

Chain D:




L255
N259
N274
E301
D302
R327
A328
W329
M332
Q339
SER
ASP
LEU
LEU
ALA
ASN
ALA
GLU
ASN
LEU
TYR
PHE
GLN

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	65.54Å 67.96Å 276.01Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.87 – 1.50 30.87 – 1.50	Depositor EDS
% Data completeness (in resolution range)	98.9 (30.87-1.50) 99.4 (30.87-1.50)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	0.09	Depositor
$< I/\sigma(I) >$ [1]	3.42 (at 1.50Å)	Xtriage
Refinement program	PHENIX 1.8.1_1168	Depositor
R, R_{free}	0.159 , 0.181 0.159 , 0.181	Depositor DCC
R_{free} test set	9870 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å^2)	14.8	Xtriage
Anisotropy	0.260	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.40 , 37.3	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.016 for k,h,-l	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	21284	wwPDB-VP
Average B, all atoms (Å^2)	19.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.28% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: DAL, 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	0.46	0/2678	0.62	1/3622 (0.0%)
1	B	0.47	0/2611	0.61	0/3531
1	C	0.47	0/2587	0.62	0/3499
1	D	0.49	0/2578	0.63	1/3488 (0.0%)
All	All	0.47	0/10454	0.62	2/14140 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	D	302	ASP	CB-CG-OD1	7.15	124.74	118.30
1	A	163	ARG	NE-CZ-NH2	5.52	123.06	120.30

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	2618	2462	2447	15	0
1	B	2556	2410	2394	12	0
1	C	2533	2392	2375	10	1
1	D	2509	2368	2342	10	0
2	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
3	A	11	0	10	0	0
3	B	11	0	10	0	0
3	C	11	0	10	0	0
3	D	11	0	10	0	0
4	A	5	0	0	0	0
5	A	377	0	0	5	0
5	B	335	0	0	7	2
5	C	315	0	0	1	1
5	D	356	0	0	2	0
All	All	11652	9632	9598	43	2

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 2.

The worst 5 of 43 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:132:ASN:ND2	1:C:132[B]:ASN:OD1	1.88	1.06
1:A:322[A]:GLU:OE1	5:A:706:HOH:O	1.88	0.91
1:A:272:GLU:OE1	5:A:753:HOH:O	2.02	0.78
1:C:31:LEU:HD11	1:C:251:TRP:CZ2	2.21	0.75
1:A:140:GLU:OE1	5:A:708:HOH:O	2.07	0.72

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:59:GLU:OE2	5:B:813:HOH:O[1_545]	2.00	0.20
5:B:722:HOH:O	5:C:726:HOH:O[1_565]	2.07	0.13

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	328/352 (93%)	322 (98%)	6 (2%)	0	100	100
1	B	321/352 (91%)	314 (98%)	7 (2%)	0	100	100
1	C	317/352 (90%)	312 (98%)	5 (2%)	0	100	100
1	D	316/352 (90%)	311 (98%)	5 (2%)	0	100	100
All	All	1282/1408 (91%)	1259 (98%)	23 (2%)	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	280/285 (98%)	277 (99%)	3 (1%)	70	48
1	B	273/285 (96%)	269 (98%)	4 (2%)	60	35
1	C	272/285 (95%)	268 (98%)	4 (2%)	60	35
1	D	271/285 (95%)	265 (98%)	6 (2%)	47	18
All	All	1096/1140 (96%)	1079 (98%)	17 (2%)	58	32

5 of 17 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	274	ASN
1	D	302	ASP
1	C	36	ASN
1	C	152	GLU
1	C	274	ASN

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

Mol	Chain	Res	Type
1	A	261	GLN

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 oligosaccharides in this entry.

5.6 Ligand geometry (i)

Of 13 ligands modelled in this entry, 4 are monoatomic - leaving 9 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	DAL	D	403	3	5,5,5	1.07	0	6,6,6	0.82	0
3	DAL	A	402	3	3,4,5	0.71	0	2,4,6	0.80	0
3	DAL	B	403	3	5,5,5	1.16	0	6,6,6	1.23	1 (16%)
3	DAL	D	402	3	3,4,5	0.65	0	2,4,6	0.45	0
4	SO4	A	404	-	4,4,4	0.29	0	6,6,6	0.21	0
3	DAL	C	403	3	5,5,5	1.06	0	6,6,6	1.26	0
3	DAL	B	402	3	3,4,5	0.69	0	2,4,6	0.96	0
3	DAL	C	402	3	3,4,5	0.60	0	2,4,6	0.74	0
3	DAL	A	403	3	5,5,5	1.20	0	6,6,6	0.80	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	DAL	D	403	3	-	0/4/4/4	-
3	DAL	A	402	3	-	0/1/2/4	-
3	DAL	B	403	3	-	0/4/4/4	-
3	DAL	D	402	3	-	0/1/2/4	-
3	DAL	C	403	3	-	1/4/4/4	-
3	DAL	B	402	3	-	0/1/2/4	-
3	DAL	C	402	3	-	0/1/2/4	-
3	DAL	A	403	3	-	0/4/4/4	-

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	B	403	DAL	OXT-C-CA	2.01	120.70	113.79

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	C	403	DAL	OXT-C-CA-CB

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^{th} 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	316/352 (89%)	-0.48	2 (0%)	85	88	10, 16, 29, 37	3 (0%)
1	B	312/352 (88%)	-0.31	5 (1%)	70	73	6, 18, 32, 66	1 (0%)
1	C	307/352 (87%)	-0.38	1 (0%)	90	92	10, 17, 32, 45	2 (0%)
1	D	303/352 (86%)	-0.40	4 (1%)	74	77	7, 17, 30, 48	3 (0%)
All	All	1238/1408 (87%)	-0.39	12 (0%)	79	82	6, 17, 31, 66	9 (0%)

The worst 5 of 12 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	348	ASN	3.4
1	C	341	ASP	3.2
1	D	255	LEU	2.8
1	B	346	ALA	2.7
1	B	321	ASP	2.6

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 monosaccharides 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. The B-factors column lists the minimum, median, 95^{th} 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
4	SO4	A	404	5/5	0.82	0.12	38,39,40,40	0
3	DAL	B	403	6/6	0.97	0.06	9,11,12,12	0
3	DAL	D	403	6/6	0.97	0.05	10,10,11,12	0
3	DAL	B	402	5/6	0.97	0.06	9,9,11,11	0
3	DAL	C	402	5/6	0.98	0.04	9,10,11,12	0
3	DAL	C	403	6/6	0.98	0.04	9,10,11,12	0
3	DAL	D	402	5/6	0.98	0.04	9,9,10,11	0
3	DAL	A	402	5/6	0.98	0.05	10,10,11,13	0
3	DAL	A	403	6/6	0.98	0.04	8,11,12,12	0
2	CL	B	401	1/1	0.99	0.03	12,12,12,12	0
2	CL	C	401	1/1	0.99	0.03	13,13,13,13	0
2	CL	D	401	1/1	0.99	0.02	13,13,13,13	0
2	CL	A	401	1/1	1.00	0.02	11,11,11,11	0

6.5 Other polymers (i)

There are no such residues in this entry.