Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 08:37 AM UTC

PDB ID	:	9QXQ / pdb_00009qxq
Title	:	native structure of full-length pesticidal protein Cry1Ca18 at pH9, from crystals formed in vivo
Authors	:	Best, H.L.; Williamson, L.J.; Rizkallah, P.J.; Oberthur, D.; Crickmore, N.; Berry, C.
Deposited on	:	2025-04-16
Resolution	:	1.65 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 ⓘ 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 ⓘ) were used in the production of this report:

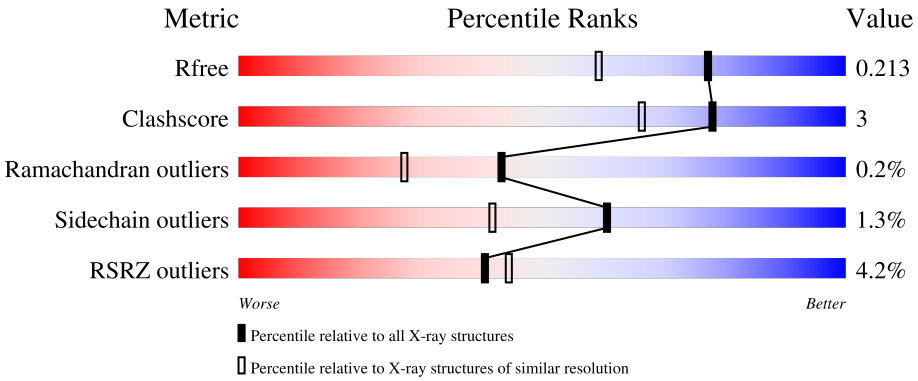
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

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 1.65 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}	180053	2563 (1.66-1.66)
Clashscore	190562	2662 (1.66-1.66)
Ramachandran outliers	187476	2621 (1.66-1.66)
Sidechain outliers	187428	2621 (1.66-1.66)
RSRZ outliers	180081	2564 (1.66-1.66)

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	1189	4% 82% 7% • 11%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 9526 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 Crystaline entomocidal protoxin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	1061	Total	C	N	O	S	0	33	0
			8808	5563	1544	1680	21			

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	183	LEU	VAL	conflict	UNP Q9L877
A	592	GLN	ARG	conflict	UNP Q9L877
A	1185	LEU	VAL	conflict	UNP Q9L877

- Molecule 2 is CALCIUM ION (CCD ID: CA) (formula: Ca) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Ca	0	0
			1	1		

- Molecule 3 is ZINC ION (CCD ID: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Zn	0	0
			1	1		

- Molecule 4 is water.

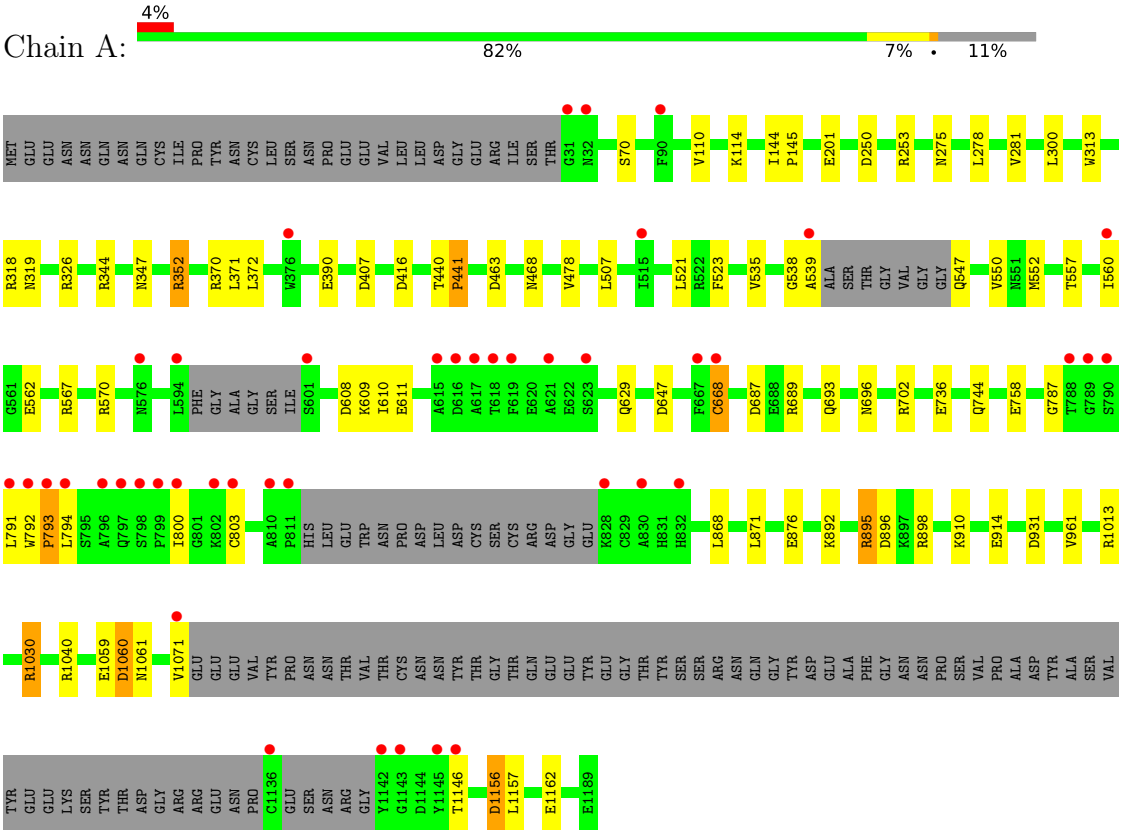
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	716	Total	O	0	0
			716	716		

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: Crystaline entomocidal protoxin

Chain A:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α, β, γ	88.80Å 88.80Å 267.82Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	26.91 – 1.65 26.91 – 1.65	Depositor EDS
% Data completeness (in resolution range)	99.4 (26.91-1.65) 99.4 (26.91-1.65)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.69 (at 1.65Å)	Xtriage
Refinement program	REFMAC 5.8.0425	Depositor
R, R_{free}	0.178 , 0.206 0.186 , 0.213	Depositor DCC
R_{free} test set	6387 reflections (4.94%)	wwPDB-VP
Wilson B-factor (Å^2)	17.8	Xtriage
Anisotropy	0.007	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 40.0	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	9526	wwPDB-VP
Average B, all atoms (Å^2)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.87% 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: CSO, ZN, CA

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	0.68	1/8981 (0.0%)	1.07	16/12190 (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	A	0	5

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1060	ASP	CG-OD1	7.69	1.40	1.25

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	1060	ASP	CB-CA-C	-8.35	106.94	116.54
1	A	562	GLU	CB-CA-C	8.01	124.19	109.46
1	A	1156	ASP	CA-CB-CG	7.39	119.99	112.60
1	A	687	ASP	CA-CB-CG	6.74	119.34	112.60
1	A	407	ASP	CA-CB-CG	6.63	119.23	112.60
1	A	931	ASP	CA-CB-CG	6.45	119.05	112.60
1	A	507	LEU	N-CA-CB	-6.41	99.66	111.13
1	A	552	MET	CB-CA-C	-6.39	100.43	110.02
1	A	689	ARG	CG-CD-NE	-6.03	98.74	112.00
1	A	416	ASP	CA-CB-CG	5.93	118.53	112.60
1	A	352	ARG	CA-CB-CG	-5.86	102.38	114.10
1	A	736	GLU	N-CA-CB	-5.81	101.27	110.22

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	647	ASP	CA-CB-CG	5.44	118.04	112.60
1	A	250	ASP	CA-CB-CG	5.30	117.90	112.60
1	A	326	ARG	CG-CD-NE	-5.22	100.52	112.00
1	A	463	ASP	CA-CB-CG	5.09	117.69	112.60

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	318[A]	ARG	Sidechain
1	A	352	ARG	Sidechain
1	A	567[A]	ARG	Sidechain
1	A	702	ARG	Sidechain
1	A	895[A]	ARG	Sidechain

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	8808	0	8540	48	0
2	A	1	0	0	0	0
3	A	1	0	0	0	0
4	A	716	0	0	13	1
All	All	9526	0	8540	48	1

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 3.

All (48) 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:1060:ASP:CG	1:A:1061:ASN:H	1.56	1.06
1:A:1060:ASP:CG	1:A:1061:ASN:N	2.13	0.96
1:A:390:GLU:OE2	4:A:1301:HOH:O	1.91	0.87
1:A:693[A]:GLN:H	1:A:744:GLN:HE22	1.25	0.83

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:693[B]:GLN:H	1:A:744:GLN:HE22	1.29	0.77
1:A:758:GLU:OE1	4:A:1302:HOH:O	2.01	0.77
1:A:1030:ARG:HB2	1:A:1030:ARG:HH11	1.56	0.70
1:A:629:GLN:NE2	4:A:1305:HOH:O	2.25	0.69
1:A:275:ASN:ND2	1:A:278:LEU:HD12	2.12	0.65
1:A:791:LEU:C	1:A:793:PRO:HD2	2.24	0.62
1:A:668:CYS:SG	4:A:1700:HOH:O	2.47	0.61
1:A:792:TRP:N	1:A:793:PRO:CD	2.64	0.61
1:A:1059[A]:GLU:HA	1:A:1059[A]:GLU:OE2	2.01	0.60
1:A:696:ASN:OD1	4:A:1303:HOH:O	2.17	0.60
1:A:319:ASN:OD1	1:A:370:ARG:HD2	2.02	0.58
1:A:609[A]:LYS:NZ	4:A:1310:HOH:O	2.37	0.58
1:A:892:LYS:NZ	1:A:896:ASP:OD2	2.37	0.56
1:A:1162[B]:GLU:O	1:A:1162[B]:GLU:HG2	2.06	0.55
1:A:538:GLY:O	1:A:539:ALA:HB2	2.07	0.55
1:A:300:LEU:HD11	1:A:478:VAL:HG23	1.89	0.53
1:A:347:ASN:HB3	4:A:1929:HOH:O	2.08	0.52
1:A:876:GLU:OE1	4:A:1302:HOH:O	2.18	0.51
1:A:201:GLU:OE2	4:A:1304:HOH:O	2.20	0.50
1:A:253[B]:ARG:NH1	4:A:1326:HOH:O	2.45	0.50
1:A:1040[A]:ARG:HG2	1:A:1156:ASP:HB3	1.93	0.49
1:A:110:VAL:HG12	1:A:114:LYS:HE2	1.93	0.49
1:A:371:LEU:C	1:A:372:LEU:HD12	2.37	0.49
1:A:608:ASP:CG	1:A:609[B]:LYS:HG3	2.38	0.48
1:A:910:LYS:NZ	1:A:914:GLU:OE2	2.45	0.47
1:A:144:ILE:N	1:A:145:PRO:CD	2.78	0.46
1:A:803:CYS:N	4:A:1327:HOH:O	2.46	0.46
1:A:1030:ARG:HB2	1:A:1030:ARG:NH1	2.29	0.46
1:A:787:GLY:CA	4:A:1328:HOH:O	2.64	0.46
1:A:898:ARG:CZ	1:A:961:VAL:HG11	2.47	0.45
1:A:1157:LEU:HD12	1:A:1157:LEU:C	2.41	0.45
1:A:440:THR:HA	1:A:441:PRO:HA	1.89	0.43
1:A:535:VAL:HB	1:A:550:VAL:HB	2.01	0.43
1:A:792:TRP:N	1:A:793:PRO:HD2	2.31	0.43
1:A:523:PHE:CD1	1:A:610:ILE:HG22	2.54	0.43
1:A:868:LEU:HD12	1:A:868:LEU:C	2.43	0.43
1:A:868:LEU:HD13	1:A:871:LEU:HD21	2.00	0.43
1:A:468:ASN:O	1:A:611:GLU:HA	2.19	0.43
1:A:895[B]:ARG:NH1	1:A:895[B]:ARG:HG2	2.35	0.42
1:A:557:THR:HG22	1:A:570:ARG:HD2	2.02	0.42
1:A:344[A]:ARG:HH11	1:A:344[A]:ARG:HD3	1.66	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:538:GLY:O	1:A:539:ALA:CB	2.69	0.41
1:A:347:ASN:ND2	4:A:1318:HOH:O	2.42	0.41
1:A:313:TRP:CD1	1:A:313:TRP:C	2.98	0.40

All (1) 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)
4:A:1739:HOH:O	4:A:1776:HOH:O[5_445]	2.09	0.11

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	1080/1189 (91%)	1056 (98%)	22 (2%)	2 (0%)	43 27

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	793	PRO
1	A	441	PRO

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	963/1041 (92%)	950 (99%)	13 (1%)	61 42

All (13) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	70	SER
1	A	281	VAL
1	A	521	LEU
1	A	547	GLN
1	A	560	ILE
1	A	668	CYS
1	A	794	LEU
1	A	800	ILE
1	A	1013[A]	ARG
1	A	1013[B]	ARG
1	A	1030	ARG
1	A	1071	VAL
1	A	1146	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (14) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	211	ASN
1	A	306	ASN
1	A	348	GLN
1	A	374	GLN
1	A	592	GLN
1	A	629	GLN
1	A	703	GLN
1	A	744	GLN
1	A	797	GLN
1	A	807	ASN
1	A	848	ASN
1	A	929	GLN
1	A	1061	ASN
1	A	1069	ASN

5.3.3 RNA

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains (i)

3 non-standard protein/DNA/RNA residues 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	$\#\|Z\| > 2$
1	CSO	A	997	1	3,6,7	0.76	0	1,6,8	0.62	0
1	CSO	A	844[B]	1	3,6,7	0.60	0	1,6,8	1.09	0
1	CSO	A	844[A]	1	3,6,7	0.92	0	1,6,8	0.65	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
1	CSO	A	997	1	-	0/1/5/7	-
1	CSO	A	844[B]	1	-	0/1/5/7	-
1	CSO	A	844[A]	1	-	1/1/5/7	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	844[A]	CSO	N-CA-CB-SG

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates (i)

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

Of 2 ligands modelled in this entry, 2 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^{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	1059/1189 (89%)	-0.07	44 (4%) 40 44	7, 21, 50, 169	32 (3%)

All (44) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	792	TRP	7.9
1	A	791	LEU	7.2
1	A	615	ALA	6.9
1	A	793	PRO	5.1
1	A	794	LEU	5.0
1	A	617	ALA	4.7
1	A	796	ALA	4.7
1	A	1142	TYR	4.6
1	A	1071	VAL	4.5
1	A	619	PHE	4.4
1	A	601	SER	4.3
1	A	790	SER	4.2
1	A	789	GLY	4.1
1	A	788	THR	4.0
1	A	539	ALA	3.7
1	A	832	HIS	3.5
1	A	1136	CYS	3.5
1	A	618	THR	3.3
1	A	811	PRO	3.1
1	A	800	ILE	3.1
1	A	90	PHE	3.1
1	A	799	PRO	3.0
1	A	668	CYS	2.9
1	A	667	PHE	2.9
1	A	376	TRP	2.9
1	A	594	LEU	2.8
1	A	830	ALA	2.8

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Mol	Chain	Res	Type	RSRZ
1	A	616	ASP	2.8
1	A	1146	THR	2.6
1	A	31	GLY	2.6
1	A	802	LYS	2.6
1	A	560	ILE	2.6
1	A	621	ALA	2.6
1	A	1145	TYR	2.6
1	A	576	ASN	2.4
1	A	515	ILE	2.4
1	A	810	ALA	2.2
1	A	32	ASN	2.2
1	A	623	SER	2.2
1	A	798	SER	2.2
1	A	797	GLN	2.1
1	A	1143	GLY	2.0
1	A	803	CYS	2.0
1	A	828	LYS	2.0

6.2 Non-standard residues in protein, DNA, RNA chains (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^{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
1	CSO	A	844[A]	7/8	0.91	0.08	19,20,25,25	7
1	CSO	A	844[B]	7/8	0.91	0.08	19,20,23,23	7
1	CSO	A	997	7/8	0.93	0.08	20,22,28,29	0

6.3 Carbohydrates (i)

There are no oligosaccharides in this entry.

6.4 Ligands (i)

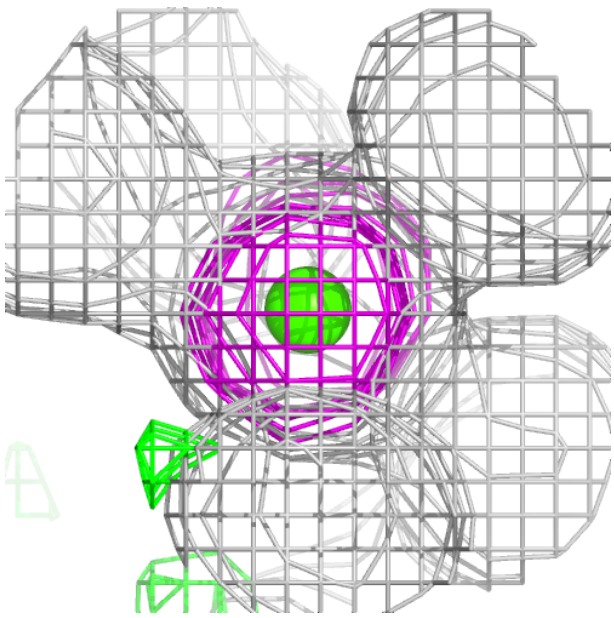
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

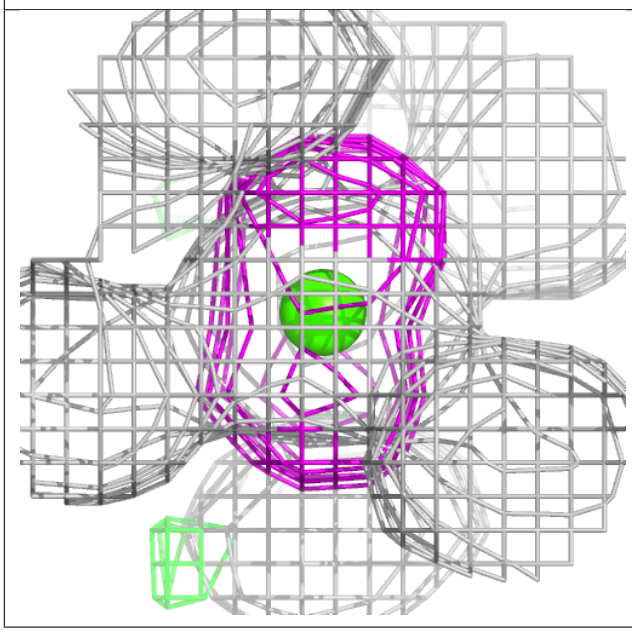
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	CA	A	1201	1/1	0.98	0.13	21,21,21,21	0
3	ZN	A	1202	1/1	0.98	0.03	18,18,18,18	0

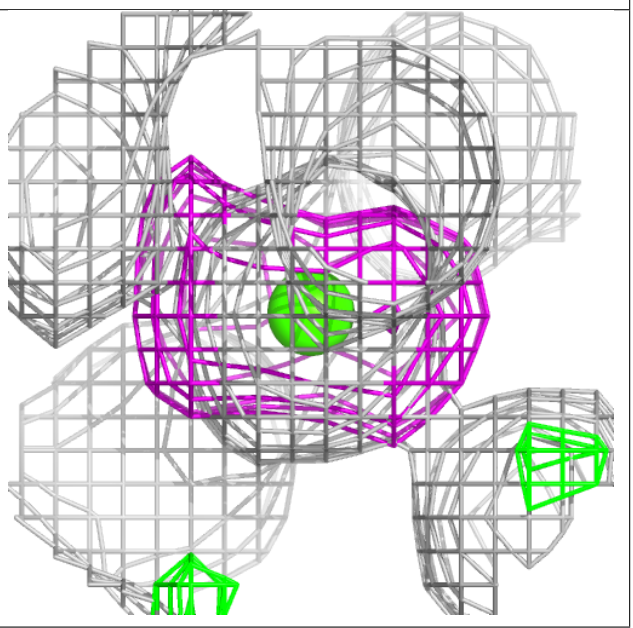
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around CA A 1201:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

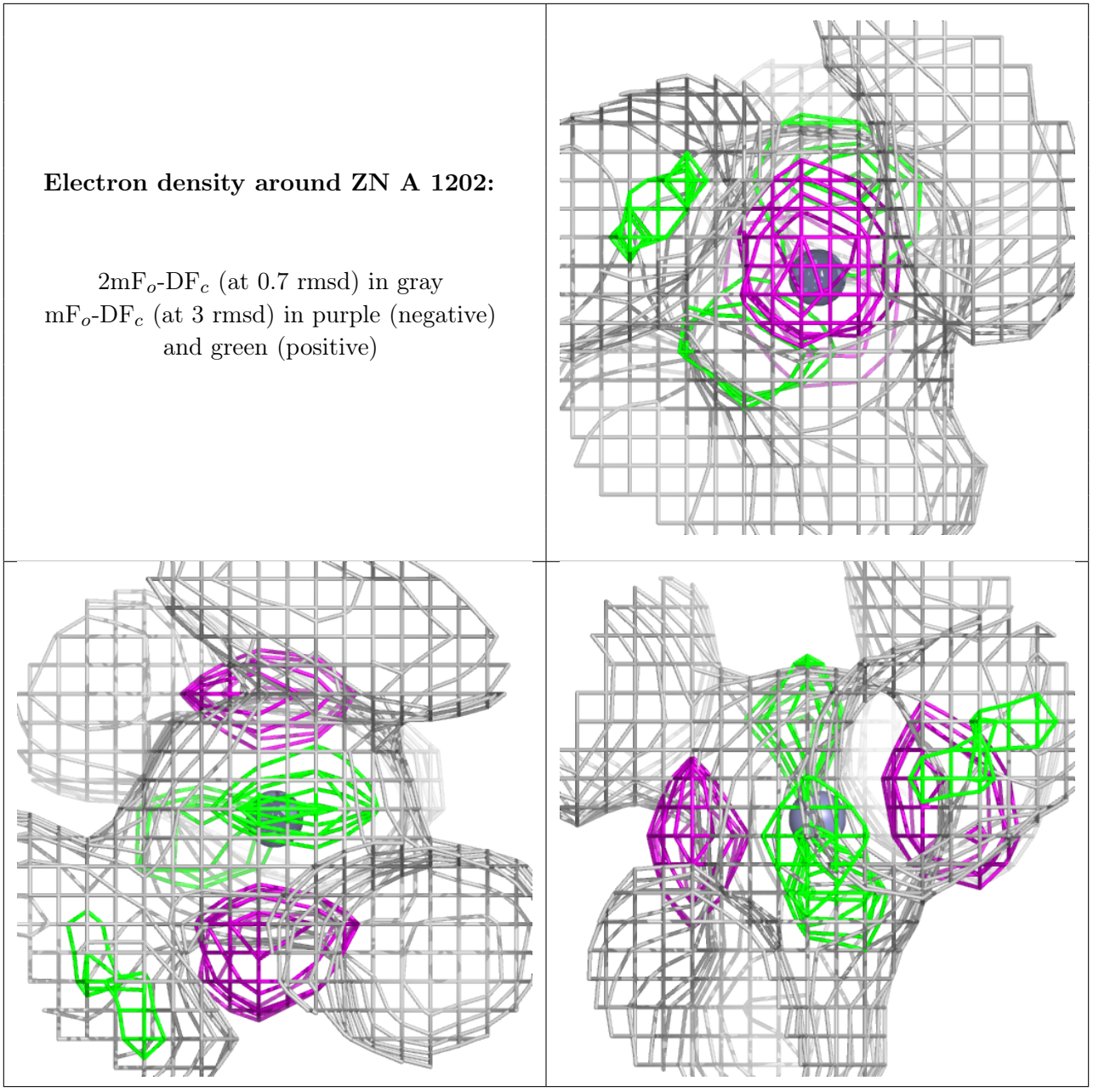






Electron density around ZN A 1202:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)



6.5 Other polymers

There are no such residues in this entry.