



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 09:13 PM UTC

PDB ID : 9H99 / pdb_00009h99
Title : Native structure of the full-length pesticidal protein Cry1Ca18 at pH7, from crystals formed in vivo
Authors : Best, H.L.; Williamson, L.J.; Rizkallah, P.J.; Galchenkova, M.; Oberthur, D.; Crickmore, N.; Berry, C.
Deposited on : 2024-10-30
Resolution : 1.80 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
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

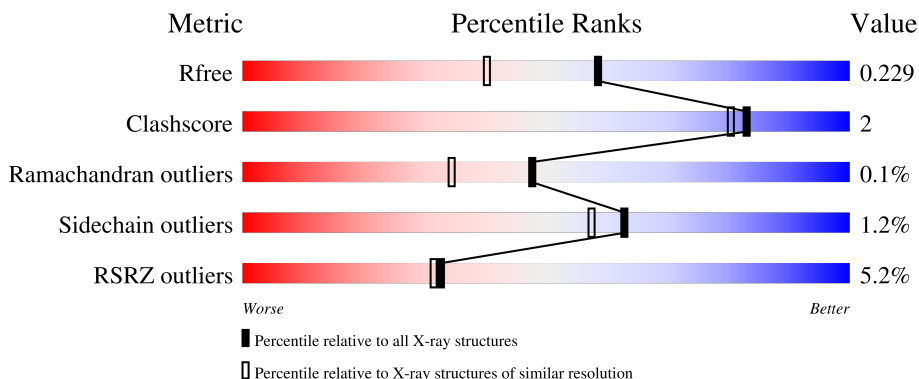
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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	7662 (1.80-1.80)
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

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 $\leq 5\%$. 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	1189	<div> <div>5%</div> <div> <div></div> <div>82%</div> <div>6%</div> <div>11%</div> </div> </div>

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 9318 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 Crystalline entomocidal protoxin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	1057	Total	C	N	O	S	0	2	0
			8507	5395	1478	1615	19			

- Molecule 2 is ZINC ION (CCD ID: ZN) (formula: Zn).

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

- Molecule 3 is CALCIUM ION (CCD ID: CA) (formula: Ca).

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

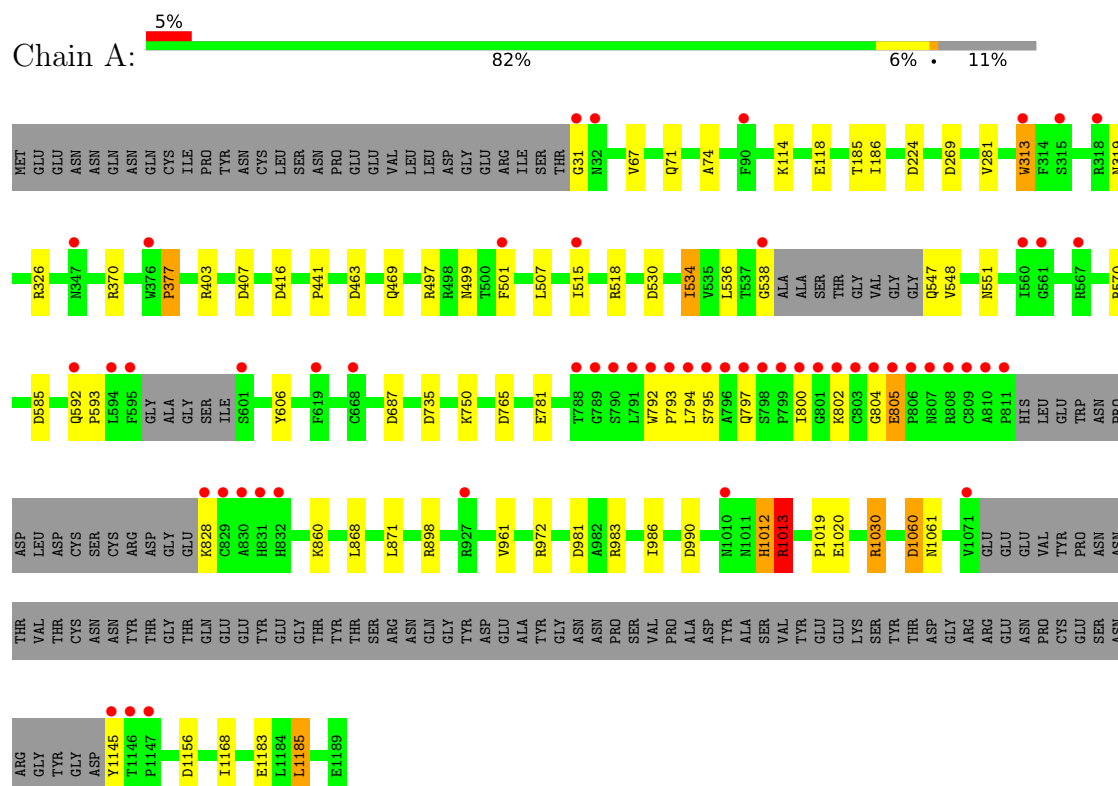
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	809	Total	O	0	0
			809	809		

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: Crystalline entomocidal protoxin



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	88.16Å 88.16Å 266.43Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	36.19 – 1.80 36.19 – 1.80	Depositor EDS
% Data completeness (in resolution range)	100.0 (36.19-1.80) 100.0 (36.19-1.80)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.75 (at 1.81Å)	Xtriage
Refinement program	REFMAC 5.8.0425	Depositor
R, R_{free}	0.182 , 0.222 0.189 , 0.229	Depositor DCC
R_{free} test set	4841 reflections (4.93%)	wwPDB-VP
Wilson B-factor (Å ²)	13.3	Xtriage
Anisotropy	0.612	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 37.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	9318	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 2.69% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 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	0.67	2/8704 (0.0%)	1.09	25/11831 (0.2%)

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	3

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1060	ASP	CG-OD1	5.69	1.36	1.25
1	A	972	ARG	NE-CZ	5.15	1.38	1.33

All (25) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1012	HIS	CB-CG-CD2	-9.92	118.30	131.20
1	A	1012	HIS	CB-CG-ND1	8.82	135.92	122.70
1	A	860	LYS	CB-CA-C	-7.55	97.42	110.17
1	A	463	ASP	CB-CA-C	7.38	118.26	109.85
1	A	1020	GLU	CG-CD-OE1	6.86	134.17	118.40
1	A	1020	GLU	CG-CD-OE2	-6.68	103.03	118.40
1	A	269	ASP	CA-CB-CG	6.56	119.16	112.60
1	A	530	ASP	CA-CB-CG	6.49	119.09	112.60
1	A	407	ASP	CA-CB-CG	6.33	118.93	112.60
1	A	1156	ASP	CA-CB-CG	6.31	118.91	112.60
1	A	403	ARG	N-CA-CB	-6.09	101.03	110.29

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	185	THR	CA-CB-OG1	-5.94	100.69	109.60
1	A	507	LEU	N-CA-CB	-5.77	100.80	111.13
1	A	765	ASP	CA-CB-CG	5.72	118.32	112.60
1	A	735	ASP	CA-CB-CG	5.71	118.31	112.60
1	A	1013	ARG	CD-NE-CZ	-5.69	116.44	124.40
1	A	990	ASP	CA-CB-CG	5.64	118.24	112.60
1	A	416	ASP	CA-CB-CG	5.63	118.23	112.60
1	A	463	ASP	CA-CB-CG	5.62	118.22	112.60
1	A	377	PRO	N-CA-CB	-5.55	96.50	102.60
1	A	687	ASP	CA-CB-CG	5.30	117.91	112.60
1	A	1013	ARG	N-CA-CB	-5.19	101.80	110.83
1	A	585	ASP	CA-CB-CG	5.11	117.71	112.60
1	A	1013	ARG	NE-CZ-NH2	5.07	123.76	119.20
1	A	224	ASP	CA-CB-CG	5.03	117.63	112.60

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	1013	ARG	Sidechain
1	A	326	ARG	Sidechain
1	A	983	ARG	Sidechain

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	8507	0	8286	41	0
2	A	1	0	0	0	0
3	A	1	0	0	0	0
4	A	809	0	0	14	0
All	All	9318	0	8286	41	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 2.

All (41) 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	1.08
1:A:469:GLN:CD	4:A:1303:HOH:O	1.97	1.05
1:A:1013:ARG:NH1	4:A:1301:HOH:O	1.88	0.98
1:A:1060:ASP:CG	1:A:1061:ASN:N	2.12	0.96
1:A:781:GLU:OE1	4:A:1302:HOH:O	1.93	0.85
1:A:469:GLN:NE2	4:A:1303:HOH:O	2.16	0.76
1:A:31:GLY:HA3	1:A:74:ALA:HB1	1.72	0.69
1:A:1030:ARG:HB2	1:A:1030:ARG:HH11	1.58	0.68
1:A:501:PHE:HB3	4:A:1329:HOH:O	1.98	0.63
1:A:802:LYS:O	1:A:805:GLU:HG2	1.99	0.63
1:A:548:VAL:HG21	1:A:794:LEU:HG	1.82	0.62
1:A:518:ARG:NH2	4:A:1310:HOH:O	2.31	0.61
1:A:499:ASN:O	4:A:1304:HOH:O	2.16	0.59
1:A:750:LYS:HE2	4:A:1854:HOH:O	2.02	0.59
1:A:986:ILE:HD11	1:A:1168:ILE:HD13	1.85	0.57
1:A:795:SER:HB3	1:A:797:GLN:O	2.04	0.57
1:A:828:LYS:N	4:A:1314:HOH:O	2.37	0.57
1:A:570:ARG:NH2	4:A:1315:HOH:O	2.37	0.56
1:A:781:GLU:CD	4:A:1302:HOH:O	2.42	0.55
1:A:981:ASP:HB2	4:A:1782:HOH:O	2.07	0.55
1:A:898:ARG:NH2	1:A:961:VAL:HG11	2.21	0.54
1:A:986:ILE:CD1	1:A:1168:ILE:HD13	2.38	0.54
1:A:497:ARG:HD3	1:A:606:TYR:CE2	2.44	0.53
1:A:1060:ASP:OD2	1:A:1061:ASN:N	2.28	0.53
1:A:538:GLY:O	4:A:1305:HOH:O	2.19	0.52
1:A:67:VAL:HG13	1:A:71:GLN:HB2	1.90	0.52
1:A:1030:ARG:HH11	1:A:1030:ARG:CB	2.22	0.51
1:A:800:ILE:HG23	1:A:804:GLY:HA2	1.93	0.50
1:A:792:TRP:O	1:A:793:PRO:C	2.55	0.49
1:A:1183:GLU:OE1	1:A:1185:LEU:HD21	2.13	0.48
1:A:534:ILE:HD11	1:A:551:ASN:ND2	2.28	0.47
1:A:1012:HIS:HD2	4:A:2038:HOH:O	1.97	0.47
1:A:114:LYS:O	1:A:118:GLU:HG3	2.16	0.45
1:A:802:LYS:O	1:A:805:GLU:CG	2.65	0.45
1:A:868:LEU:HD13	1:A:871:LEU:HD21	1.98	0.44
1:A:868:LEU:HD12	1:A:868:LEU:C	2.43	0.44
1:A:592:GLN:HB3	1:A:593:PRO:HD2	2.00	0.42
1:A:319:ASN:ND2	1:A:370:ARG:HD3	2.35	0.42
1:A:313:TRP:CD1	1:A:313:TRP:C	2.98	0.42
1:A:536:LEU:HA	1:A:547:GLN:O	2.20	0.41
1:A:548:VAL:HG21	1:A:794:LEU:CG	2.47	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	1049/1189 (88%)	1024 (98%)	24 (2%)	1 (0%)	48	34

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
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	933/1043 (90%)	922 (99%)	11 (1%)	63	57

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	186	ILE
1	A	281	VAL
1	A	313	TRP
1	A	377	PRO
1	A	515	ILE
1	A	534	ILE
1	A	805	GLU
1	A	1019	PRO
1	A	1030	ARG
1	A	1145	TYR

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Mol	Chain	Res	Type
1	A	1185	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (17) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	78	GLN
1	A	162	GLN
1	A	248	ASN
1	A	319	ASN
1	A	348	GLN
1	A	436	GLN
1	A	469	GLN
1	A	510	ASN
1	A	547	GLN
1	A	629	GLN
1	A	703	GLN
1	A	797	GLN
1	A	992	ASN
1	A	1009	GLN
1	A	1011	ASN
1	A	1012	HIS
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 ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

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, 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	1057/1189 (88%)	0.17	55 (5%) 33 31	7, 16, 36, 115	2 (0%)

All (55) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	829	CYS	8.6
1	A	809	CYS	8.1
1	A	794	LEU	8.0
1	A	792	TRP	7.9
1	A	831	HIS	7.8
1	A	830	ALA	7.4
1	A	1145	TYR	6.9
1	A	789	GLY	6.6
1	A	807	ASN	5.9
1	A	808	ARG	5.6
1	A	803	CYS	5.6
1	A	592	GLN	5.5
1	A	791	LEU	5.3
1	A	793	PRO	5.3
1	A	806	PRO	5.1
1	A	811	PRO	5.1
1	A	828	LYS	5.0
1	A	810	ALA	4.8
1	A	800	ILE	4.7
1	A	595	PHE	4.6
1	A	790	SER	4.6
1	A	804	GLY	4.3
1	A	796	ALA	4.2
1	A	832	HIS	4.1
1	A	1071	VAL	4.1
1	A	799	PRO	4.1
1	A	795	SER	4.1

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Mol	Chain	Res	Type	RSRZ
1	A	32	ASN	4.0
1	A	802	LYS	3.9
1	A	805	GLU	3.9
1	A	31	GLY	3.8
1	A	788	THR	3.7
1	A	601	SER	3.6
1	A	1147	PRO	3.6
1	A	318	ARG	3.6
1	A	801	GLY	3.5
1	A	561	GLY	3.4
1	A	797	GLN	3.4
1	A	798	SER	3.3
1	A	90	PHE	3.3
1	A	376	TRP	3.2
1	A	668	CYS	3.1
1	A	1146	THR	3.1
1	A	594	LEU	3.0
1	A	501	PHE	2.7
1	A	347	ASN	2.7
1	A	560	ILE	2.5
1	A	927	ARG	2.5
1	A	313	TRP	2.5
1	A	538	GLY	2.4
1	A	567	ARG	2.4
1	A	1010	ASN	2.3
1	A	315	SER	2.2
1	A	515	ILE	2.1
1	A	619	PHE	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 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, 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(\AA^2)	Q<0.9
2	ZN	A	1201	1/1	0.99	0.03	13,13,13,13	0
3	CA	A	1202	1/1	0.99	0.04	7,7,7,7	0

6.5 Other polymers [i](#)

There are no such residues in this entry.