



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 25, 2026 – 10:13 AM EDT

PDB ID : 2QVZ / pdb_00002qvz
Title : 4-Chlorobenzoyl-CoA Ligase/Synthetase, I303A mutation, bound to 3-Chlorobenzoate
Authors : Wu, R.; Reger, A.S.; Cao, J.; Gulick, A.M.; Dunaway-Mariano, D.
Deposited on : 2007-08-09
Resolution : 2.50 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

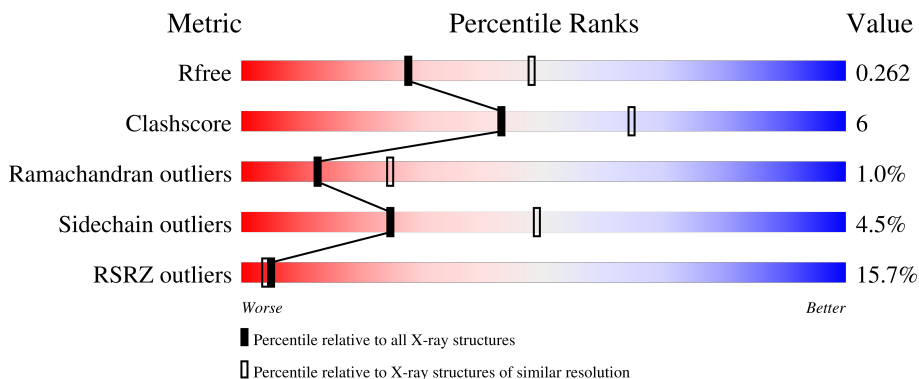
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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}	180053	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

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 $\leq 5\%$. 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	X	504	15% 84% 13% ..

2 Entry composition [i](#)

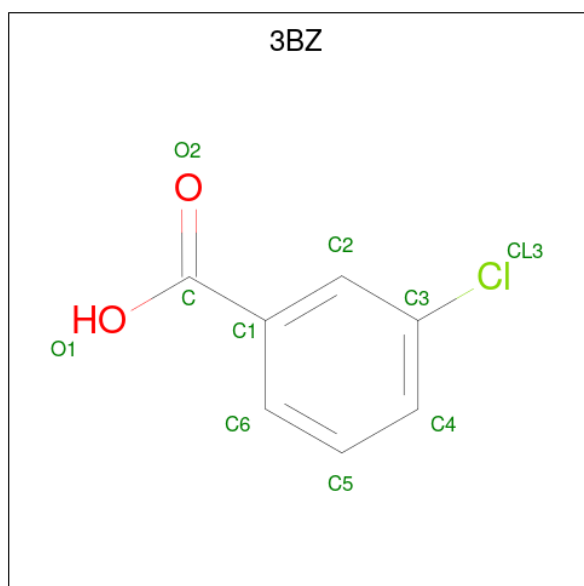
There are 3 unique types of molecules in this entry. The entry contains 3870 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 4-Chlorobenzoate CoA Ligase/Synthetase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	X	498	Total	C	N	O	S	0	0	0
			3723	2354	666	690	13			

- Molecule 2 is 3-chlorobenzoate (CCD ID: 3BZ) (formula: $C_7H_5ClO_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	X	1	Total	C	Cl	O	0	0
			10	7	1	2		

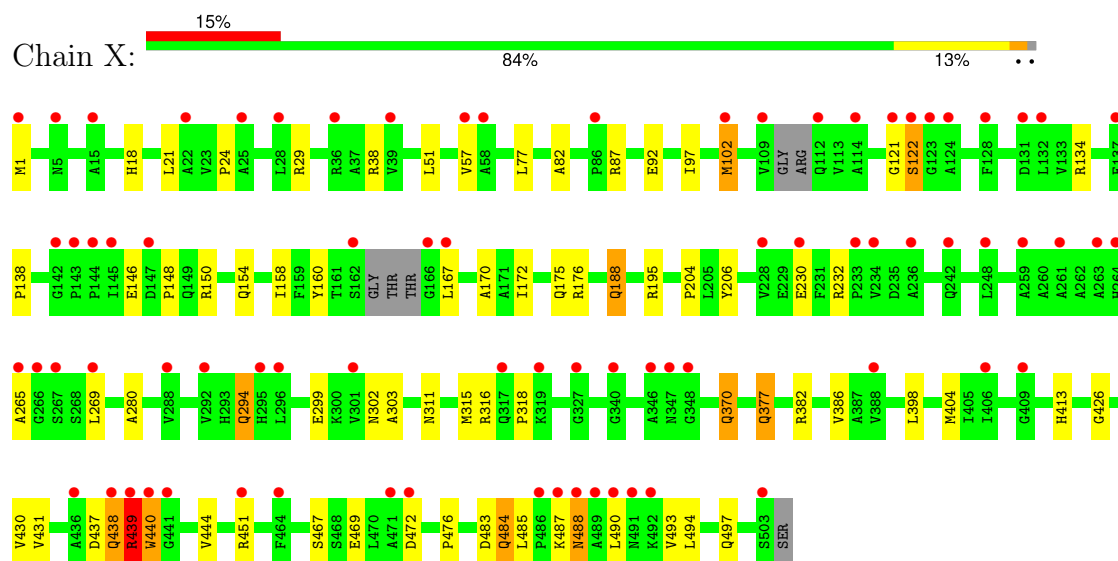
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	X	137	Total	O	0	0
			137	137		

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: 4-Chlorobenzoate CoA Ligase/Synthetase



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	127.85Å 127.85Å 71.35Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.00 – 2.50 30.00 – 2.50	Depositor EDS
% Data completeness (in resolution range)	99.3 (30.00-2.50) 99.3 (30.00-2.50)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.12 (at 2.45Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, R_{free}	0.193 , 0.266 0.193 , 0.262	Depositor DCC
R_{free} test set	1234 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å ²)	56.4	Xtriage
Anisotropy	0.032	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 59.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.023 for -h,-k,l	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	3870	wwPDB-VP
Average B, all atoms (Å ²)	61.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.72% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: 3BZ

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	X	0.78	0/3791	0.97	3/5165 (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	X	0	1

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	X	439	ARG	N-CA-C	-13.29	82.49	110.80
1	X	438	GLN	CA-C-N	6.01	133.02	121.54
1	X	438	GLN	C-N-CA	6.01	133.02	121.54

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	X	439	ARG	Peptide

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	X	3723	0	3722	46	0
2	X	10	0	4	0	0
3	X	137	0	0	2	0
All	All	3870	0	3726	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 6.

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:X:1:MET:HE3	1:X:176:ARG:HA	1.68	0.76
1:X:1:MET:HE1	1:X:175:GLN:C	2.11	0.76
1:X:426:GLY:H	1:X:451:ARG:HH21	1.40	0.69
1:X:188:GLN:HE21	1:X:311:ASN:HD22	1.42	0.68
1:X:438:GLN:HA	1:X:440:TRP:HA	1.76	0.68
1:X:487:LYS:O	1:X:488:ASN:O	2.14	0.65
1:X:431:VAL:HG23	1:X:485:LEU:HD13	1.79	0.64
1:X:265:ALA:HB1	1:X:269:LEU:HD12	1.80	0.64
1:X:426:GLY:H	1:X:451:ARG:NH2	1.98	0.62
1:X:294:GLN:HE21	1:X:294:GLN:HA	1.67	0.58
1:X:439:ARG:O	1:X:440:TRP:HB2	2.02	0.58
1:X:1:MET:CE	1:X:176:ARG:HA	2.37	0.55
1:X:188:GLN:HE21	1:X:311:ASN:ND2	2.06	0.52
1:X:431:VAL:HG21	1:X:493:VAL:HG21	1.92	0.51
1:X:299:GLU:OE2	1:X:316:ARG:HD2	2.11	0.51
1:X:386:VAL:HG12	1:X:398:LEU:HD12	1.95	0.48
1:X:315:MET:HE1	3:X:586:HOH:O	2.12	0.48
1:X:82:ALA:HA	1:X:158:ILE:HB	1.95	0.48
1:X:431:VAL:CG2	1:X:485:LEU:HD13	2.42	0.48
1:X:302:ASN:HB2	1:X:318:PRO:HG3	1.98	0.46
1:X:488:ASN:OD1	1:X:490:LEU:O	2.33	0.46
1:X:51:LEU:HD21	1:X:57:VAL:HG21	1.98	0.45
1:X:150:ARG:HA	1:X:154:GLN:HE22	1.80	0.45
1:X:488:ASN:HB3	1:X:494:LEU:HD21	1.98	0.44
1:X:18:HIS:CE1	1:X:195:ARG:HB3	2.53	0.44
1:X:92:GLU:HG2	1:X:167:LEU:HD21	1.99	0.44
1:X:404:MET:HE3	1:X:413:HIS:CE1	2.53	0.44
1:X:121:GLY:O	1:X:122:SER:C	2.60	0.44
1:X:426:GLY:N	1:X:451:ARG:HH21	2.13	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:X:280:ALA:HA	1:X:303:ALA:O	2.17	0.44
1:X:377:GLN:NE2	1:X:382:ARG:HH11	2.16	0.44
1:X:160:TYR:CE2	1:X:170:ALA:HB2	2.54	0.43
1:X:431:VAL:HG23	1:X:485:LEU:CD1	2.47	0.43
1:X:483:ASP:OD1	1:X:484:GLN:OE1	2.36	0.43
1:X:24:PRO:HD2	3:X:570:HOH:O	2.17	0.43
1:X:1:MET:HE3	1:X:1:MET:HB2	1.79	0.42
1:X:38:ARG:HG2	1:X:138:PRO:HD3	2.00	0.42
1:X:370:GLN:NE2	1:X:370:GLN:H	2.17	0.42
1:X:77:LEU:O	1:X:148:PRO:HG3	2.20	0.42
1:X:204:PRO:HB2	1:X:206:TYR:CE1	2.55	0.42
1:X:386:VAL:HG11	1:X:404:MET:HE3	2.03	0.41
1:X:444:VAL:HG12	1:X:476:PRO:HA	2.02	0.41
1:X:97:ILE:HA	1:X:102:MET:HE2	2.02	0.41
1:X:158:ILE:CD1	1:X:172:ILE:HG12	2.51	0.41
1:X:430:VAL:O	1:X:430:VAL:HG13	2.21	0.41
1:X:158:ILE:HD12	1:X:172:ILE:HG12	2.02	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	X	492/504 (98%)	463 (94%)	24 (5%)	5 (1%)	12 24

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	X	439	ARG
1	X	488	ASN
1	X	440	TRP
1	X	472	ASP

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Mol	Chain	Res	Type
1	X	437	ASP

5.3.2 Protein sidechains ⓘ

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	X	378/399 (95%)	361 (96%)	17 (4%)	24	49

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	X	21	LEU
1	X	29	ARG
1	X	87	ARG
1	X	102	MET
1	X	122	SER
1	X	134	ARG
1	X	146	GLU
1	X	188	GLN
1	X	230	GLU
1	X	232	ARG
1	X	294	GLN
1	X	370	GLN
1	X	377	GLN
1	X	467	SER
1	X	469	GLU
1	X	484	GLN
1	X	497	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	X	18	HIS
1	X	119	GLN
1	X	154	GLN

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Mol	Chain	Res	Type
1	X	175	GLN
1	X	238	GLN
1	X	241	GLN
1	X	294	GLN
1	X	295	HIS
1	X	311	ASN
1	X	367	ASN
1	X	377	GLN
1	X	497	GLN
1	X	501	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](#)

1 ligand is 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	$\# Z > 2$
2	3BZ	X	505	-	10,10,10	1.10	1 (10%)	13,13,13	0.94	2 (15%)

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
2	3BZ	X	505	-	-	0/4/4/4	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	X	505	3BZ	C3-CL3	2.01	1.79	1.74

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	X	505	3BZ	O1-C-C1	2.28	120.69	114.84
2	X	505	3BZ	O2-C-C1	-2.00	116.21	121.46

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	X	498/504 (98%)	1.21	78 (15%) 5 4	43, 60, 82, 100	0

All (78) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	X	489	ALA	5.2
1	X	234	VAL	4.9
1	X	409	GLY	4.4
1	X	143	PRO	4.1
1	X	142	GLY	4.1
1	X	124	ALA	3.9
1	X	265	ALA	3.8
1	X	144	PRO	3.7
1	X	440	TRP	3.5
1	X	5	ASN	3.5
1	X	436	ALA	3.5
1	X	264	HIS	3.5
1	X	488	ASN	3.4
1	X	491	ASN	3.4
1	X	22	ALA	3.3
1	X	162	SER	3.3
1	X	267	SER	3.3
1	X	464	PHE	3.2
1	X	109	VAL	3.2
1	X	123	GLY	3.2
1	X	259	ALA	3.1
1	X	492	LYS	3.1
1	X	441	GLY	3.1
1	X	486	PRO	3.0
1	X	25	ALA	3.0
1	X	348	GLY	3.0
1	X	490	LEU	2.9

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Mol	Chain	Res	Type	RSRZ
1	X	288	VAL	2.9
1	X	128	PHE	2.9
1	X	132	LEU	2.8
1	X	57	VAL	2.8
1	X	236	ALA	2.8
1	X	36	ARG	2.8
1	X	438	GLN	2.8
1	X	114	ALA	2.7
1	X	451	ARG	2.7
1	X	346	ALA	2.7
1	X	147	ASP	2.6
1	X	406	ILE	2.6
1	X	503	SER	2.6
1	X	1	MET	2.6
1	X	261	ALA	2.6
1	X	242	GLN	2.6
1	X	112	GLN	2.5
1	X	28	LEU	2.5
1	X	102	MET	2.5
1	X	269	LEU	2.5
1	X	347	ASN	2.5
1	X	166	GLY	2.4
1	X	266	GLY	2.4
1	X	487	LYS	2.4
1	X	292	VAL	2.4
1	X	317	GLN	2.4
1	X	296	LEU	2.3
1	X	301	VAL	2.3
1	X	263	ALA	2.3
1	X	122	SER	2.3
1	X	230	GLU	2.3
1	X	327	GLY	2.2
1	X	228	VAL	2.2
1	X	472	ASP	2.2
1	X	86	PRO	2.2
1	X	471	ALA	2.2
1	X	137	GLU	2.2
1	X	167	LEU	2.2
1	X	58	ALA	2.1
1	X	121	GLY	2.1
1	X	131	ASP	2.1
1	X	248	LEU	2.1

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Mol	Chain	Res	Type	RSRZ
1	X	319	LYS	2.1
1	X	439	ARG	2.1
1	X	39	VAL	2.0
1	X	15	ALA	2.0
1	X	340	GLY	2.0
1	X	145	ILE	2.0
1	X	233	PRO	2.0
1	X	295	HIS	2.0
1	X	388	VAL	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($\text{\AA}^2$)	Q<0.9
2	3BZ	X	505	10/10	0.95	0.12	46,51,53,57	0

6.5 Other polymers [i](#)

There are no such residues in this entry.