



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 12:02 AM UTC

PDB ID : 2E2T / pdb_00002e2t
Title : Substrate Schiff-base analogue of copper amine oxidase from *Arthrobacter globiformis* formed with phenylhydrazine
Authors : Murakawa, T.; Okajima, T.; Taki, M.; Yamamoto, Y.; Kuroda, S.; Hayashi, H.; Tanizawa, K.
Deposited on : 2006-11-17
Resolution : 2.05 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

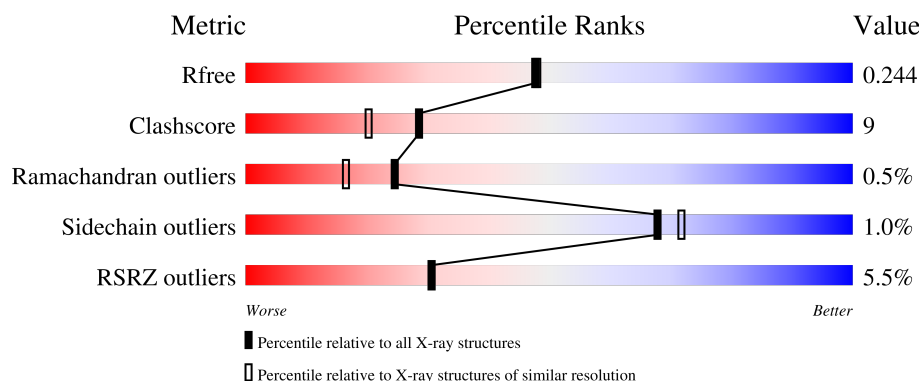
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.05 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	2260 (2.04-2.04)
Clashscore	190562	2333 (2.04-2.04)
Ramachandran outliers	187476	2318 (2.04-2.04)
Sidechain outliers	187428	2318 (2.04-2.04)
RSRZ outliers	180081	2260 (2.04-2.04)

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	638	5% 78% 18% ..

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5194 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 Phenylethylamine oxidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	620	Total	C	N	O	S	0	0	0
			4875	3080	857	929	9			

- Molecule 2 is COPPER (II) ION (CCD ID: CU) (formula: Cu).

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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	318	Total	O	0	0
			318	318		

4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	157.64Å 63.08Å 91.86Å 90.00° 112.16° 90.00°	Depositor
Resolution (Å)	26.50 – 2.05 26.50 – 2.05	Depositor EDS
% Data completeness (in resolution range)	(Not available) (26.50-2.05) 99.9 (26.50-2.05)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.41 (at 1.73Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.205 , 0.243 0.206 , 0.244	Depositor DCC
R_{free} test set	4418 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	28.7	Xtriage
Anisotropy	0.755	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 46.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	5194	wwPDB-VP
Average B, all atoms (Å ²)	45.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.02% 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: CU, YPZ

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	0.37	0/4975	0.91	14/6774 (0.2%)

There are no bond length outliers.

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	602	MET	N-CA-C	6.85	118.70	110.07
1	A	592	HIS	N-CA-C	6.67	119.79	107.99
1	A	34	GLY	CA-C-N	6.57	126.51	119.28
1	A	34	GLY	C-N-CA	6.57	126.51	119.28
1	A	582	ILE	N-CA-C	6.23	118.71	108.99
1	A	277	ILE	N-CA-C	-6.05	97.68	106.88
1	A	359	TRP	N-CA-C	5.99	117.81	111.28
1	A	455	VAL	N-CA-C	-5.96	101.33	109.55
1	A	300	GLY	N-CA-C	5.59	119.25	112.49
1	A	310	SER	N-CA-C	-5.38	99.74	108.41
1	A	605	ASP	N-CA-C	-5.37	101.12	109.72
1	A	446	PHE	N-CA-C	5.24	119.52	113.18
1	A	408	THR	N-CA-C	5.16	117.73	110.14
1	A	374	SER	N-CA-C	5.01	116.42	108.96

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	4875	0	4691	84	0
2	A	1	0	0	0	0
3	A	318	0	0	3	0
All	All	5194	0	4691	84	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 9.

All (84) 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:280:MET:HE3	1:A:298:ASP:HB2	1.66	0.75
1:A:22:GLU:O	1:A:26:ILE:HG12	1.91	0.71
1:A:66:ASP:OD1	1:A:68:SER:HB3	1.96	0.65
1:A:170:HIS:HD2	1:A:198:PRO:O	1.80	0.65
1:A:42:LEU:C	1:A:42:LEU:HD23	2.23	0.63
1:A:422:LEU:HD11	1:A:428:ALA:HB2	1.79	0.62
1:A:602:MET:HE1	3:A:1188:HOH:O	1.99	0.62
1:A:257:LEU:HB3	1:A:260:ILE:HD11	1.82	0.62
1:A:496:ILE:HD11	1:A:513:LYS:HE2	1.81	0.62
1:A:599:TRP:CD2	1:A:600:PRO:HA	2.34	0.62
1:A:324:LEU:HB2	1:A:342:ILE:HB	1.81	0.62
1:A:137:LEU:N	1:A:137:LEU:HD23	2.15	0.61
1:A:505:ARG:HD3	1:A:618:ASP:HB3	1.82	0.61
1:A:137:LEU:HD23	1:A:137:LEU:H	1.66	0.61
1:A:297:PHE:HB2	1:A:301:GLU:HG3	1.83	0.60
1:A:78:SER:HB2	1:A:85:ILE:HD11	1.82	0.60
1:A:72:PRO:HG2	1:A:90:LEU:HB2	1.83	0.60
1:A:154:ARG:HD2	1:A:293:TRP:CE3	2.36	0.60
1:A:261:ALA:HB1	1:A:268:LEU:HD22	1.84	0.58
1:A:443:ILE:H	1:A:448:ASN:HD21	1.51	0.58
1:A:347:GLU:OE1	1:A:370:ARG:HD3	2.04	0.57
1:A:450:VAL:HG22	1:A:497:ILE:CD1	2.36	0.56
1:A:138:SER:HA	3:A:1304:HOH:O	2.07	0.55
1:A:252:ARG:O	1:A:299:THR:HG23	2.08	0.54
1:A:232:VAL:HG22	1:A:238:ILE:CD1	2.37	0.54
1:A:137:LEU:HD23	1:A:154:ARG:O	2.08	0.53
1:A:104:GLU:O	1:A:107:VAL:HG22	2.09	0.53
1:A:280:MET:HE3	1:A:298:ASP:CB	2.39	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:39:ILE:HD12	1:A:39:ILE:N	2.24	0.52
1:A:163:PRO:HG2	1:A:164:GLU:OE2	2.10	0.52
1:A:370:ARG:O	1:A:370:ARG:HG2	2.11	0.51
1:A:317:CYS:HB3	1:A:321:ILE:HG12	1.93	0.50
1:A:277:ILE:HD11	1:A:398:PHE:CE1	2.47	0.50
1:A:188:ARG:NH1	1:A:190:ILE:HD11	2.27	0.49
1:A:188:ARG:HH21	1:A:188:ARG:HG2	1.78	0.49
1:A:142:PHE:CZ	1:A:293:TRP:HA	2.48	0.49
1:A:338:ILE:HD12	1:A:338:ILE:N	2.27	0.49
1:A:147:GLU:CG	1:A:152:ILE:HD12	2.43	0.49
1:A:483:ALA:HB1	1:A:543:VAL:HB	1.95	0.48
1:A:550:GLU:HG2	1:A:570:TYR:CE1	2.47	0.48
1:A:293:TRP:CD1	1:A:293:TRP:H	2.32	0.48
1:A:147:GLU:HG2	1:A:152:ILE:HD12	1.96	0.48
1:A:230:PHE:HB3	1:A:240:TRP:CD1	2.49	0.48
1:A:22:GLU:HG2	1:A:79:VAL:HG13	1.96	0.47
1:A:465:GLU:H	1:A:465:GLU:CD	2.23	0.47
1:A:147:GLU:CB	1:A:152:ILE:HD12	2.45	0.47
1:A:277:ILE:HD12	1:A:388:TRP:HZ2	1.80	0.47
1:A:309:ASN:HD22	1:A:376:PHE:HB3	1.78	0.47
1:A:479:ARG:O	1:A:482:GLU:HG2	2.15	0.47
1:A:296:TYR:HE2	1:A:382:YPZ:HH	1.54	0.46
1:A:602:MET:HA	1:A:603:PRO:HD3	1.81	0.46
1:A:10:SER:HA	1:A:11:PRO:HD3	1.82	0.46
1:A:105:PHE:HD1	1:A:136:PRO:HB2	1.81	0.46
1:A:277:ILE:HD12	1:A:277:ILE:N	2.31	0.46
1:A:358:LEU:C	1:A:358:LEU:HD13	2.41	0.46
1:A:321:ILE:N	1:A:321:ILE:HD12	2.31	0.45
1:A:513:LYS:O	1:A:611:LEU:HA	2.16	0.45
1:A:66:ASP:CG	1:A:70:ALA:HB3	2.43	0.44
1:A:450:VAL:HG22	1:A:497:ILE:HD13	2.00	0.44
1:A:472:ARG:NH1	3:A:1185:HOH:O	2.49	0.44
1:A:147:GLU:HB3	1:A:152:ILE:HD12	1.99	0.43
1:A:183:SER:OG	1:A:185:GLU:HG2	2.18	0.43
1:A:241:GLU:O	1:A:242:LYS:HB2	2.18	0.43
1:A:450:VAL:HG22	1:A:497:ILE:HD12	2.00	0.43
1:A:252:ARG:HG3	1:A:299:THR:O	2.19	0.43
1:A:479:ARG:HB3	1:A:574:ASP:OD2	2.19	0.43
1:A:231:THR:OG1	1:A:239:GLU:HB2	2.18	0.43
1:A:420:SER:OG	1:A:430:PHE:HE1	2.01	0.43
1:A:561:HIS:CE1	1:A:563:GLY:H	2.37	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:154:ARG:HG2	1:A:154:ARG:HH11	1.84	0.43
1:A:375:PHE:CE1	1:A:386:PHE:HB2	2.53	0.43
1:A:56:GLU:N	1:A:56:GLU:OE2	2.52	0.42
1:A:12:PHE:CE1	1:A:47:PRO:HD2	2.54	0.42
1:A:328:ILE:CD1	1:A:338:ILE:HD11	2.50	0.42
1:A:496:ILE:HD12	1:A:496:ILE:N	2.35	0.42
1:A:261:ALA:CB	1:A:268:LEU:HD22	2.50	0.41
1:A:550:GLU:HG2	1:A:570:TYR:CD1	2.54	0.41
1:A:206:ASP:CG	1:A:208:GLU:HG2	2.46	0.41
1:A:303:LEU:O	1:A:306:GLN:HG2	2.20	0.41
1:A:406:VAL:HG21	1:A:422:LEU:HD11	2.02	0.41
1:A:148:ARG:HD2	1:A:148:ARG:C	2.45	0.41
1:A:297:PHE:CD2	1:A:558:VAL:HG11	2.57	0.40
1:A:224:GLN:HA	1:A:225:PRO:HD2	1.88	0.40
1:A:137:LEU:N	1:A:137:LEU:CD2	2.82	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	A	617/638 (97%)	584 (95%)	30 (5%)	3 (0%)	24 16

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	54	GLU
1	A	55	ALA
1	A	565	ALA

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	513/529 (97%)	508 (99%)	5 (1%)	68 72

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

Mol	Chain	Res	Type
1	A	77	VAL
1	A	137	LEU
1	A	268	LEU
1	A	370	ARG
1	A	376	PHE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	81	ASN
1	A	170	HIS
1	A	306	GLN
1	A	309	ASN
1	A	340	ASN
1	A	418	ASN
1	A	448	ASN
1	A	507	ASN
1	A	515	HIS
1	A	518	ASN
1	A	519	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](#)

1 non-standard protein/DNA/RNA residue 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	$\# Z > 2$
1	YPZ	A	382	1	21,22,23	2.50	9 (42%)	19,29,31	2.13	3 (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
1	YPZ	A	382	1	-	5/10/27/29	0/2/2/2

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	382	YPZ	CE2-NX2	6.64	1.42	1.31
1	A	382	YPZ	CG-CD1	3.70	1.54	1.49
1	A	382	YPZ	C1'-NX1	3.69	1.47	1.40
1	A	382	YPZ	CE1-CD1	2.93	1.52	1.44
1	A	382	YPZ	C6'-C1'	2.89	1.44	1.39
1	A	382	YPZ	C2'-C1'	2.62	1.43	1.39
1	A	382	YPZ	C3'-C2'	2.30	1.42	1.38
1	A	382	YPZ	CE1-CZ	2.27	1.40	1.36
1	A	382	YPZ	C4'-C5'	2.05	1.42	1.38

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	382	YPZ	CE2-NX2-NX1	7.49	133.96	118.88
1	A	382	YPZ	CD2-CE2-CZ	3.04	120.89	117.44
1	A	382	YPZ	OH-CZ-CE1	-2.14	115.71	121.60

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	382	YPZ	N-CA-CB-CG
1	A	382	YPZ	C2'-C1'-NX1-NX2
1	A	382	YPZ	C6'-C1'-NX1-NX2
1	A	382	YPZ	C1'-NX1-NX2-CE2
1	A	382	YPZ	C-CA-CB-CG

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	382	YPZ	1	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 1 ligands modelled in this entry, 1 is 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	619/638 (97%)	0.34	34 (5%) 30 30	31, 43, 64, 94	0

All (34) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	296	TYR	7.0
1	A	565	ALA	5.4
1	A	628	ASN	4.9
1	A	564	GLY	4.8
1	A	148	ARG	4.8
1	A	9	ALA	4.3
1	A	145	ALA	3.8
1	A	298	ASP	3.7
1	A	51	ALA	3.7
1	A	562	SER	3.2
1	A	144	TYR	3.1
1	A	299	THR	3.0
1	A	558	VAL	3.0
1	A	563	GLY	3.0
1	A	146	GLU	2.7
1	A	55	ALA	2.7
1	A	137	LEU	2.6
1	A	56	GLU	2.6
1	A	293	TRP	2.6
1	A	141	VAL	2.4
1	A	338	ILE	2.4
1	A	53	SER	2.4
1	A	302	TYR	2.3
1	A	559	ASN	2.3
1	A	68	SER	2.2
1	A	290	ILE	2.2
1	A	54	GLU	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	142	PHE	2.1
1	A	297	PHE	2.1
1	A	561	HIS	2.1
1	A	315	CYS	2.1
1	A	627	ALA	2.1
1	A	339	ARG	2.0
1	A	152	ILE	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, 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
1	YPZ	A	382	21/22	0.88	0.16	37,54,75,76	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, 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	CU	A	1001	1/1	0.99	0.03	40,40,40,40	0

6.5 Other polymers [i](#)

There are no such residues in this entry.