



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 06:01 PM UTC

PDB ID : 1PDZ / pdb_00001pdz
Title : X-RAY STRUCTURE AND CATALYTIC MECHANISM OF LOBSTER ENOLASE
Authors : Janin, J.; Duquerroy, S.; Camus, C.; Le Bras, G.
Deposited on : 1995-06-05
Resolution : 2.20 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)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

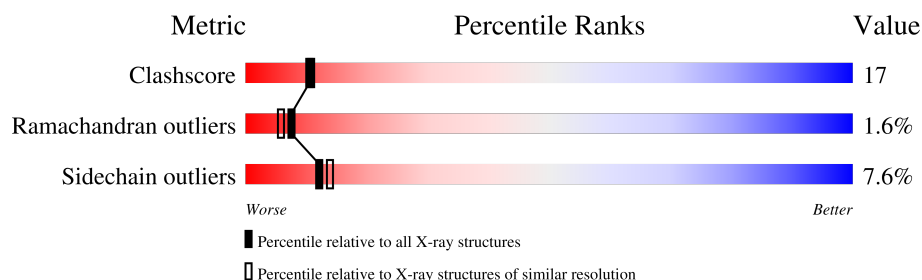
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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))
Clashscore	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	434	

2 Entry composition [i](#)

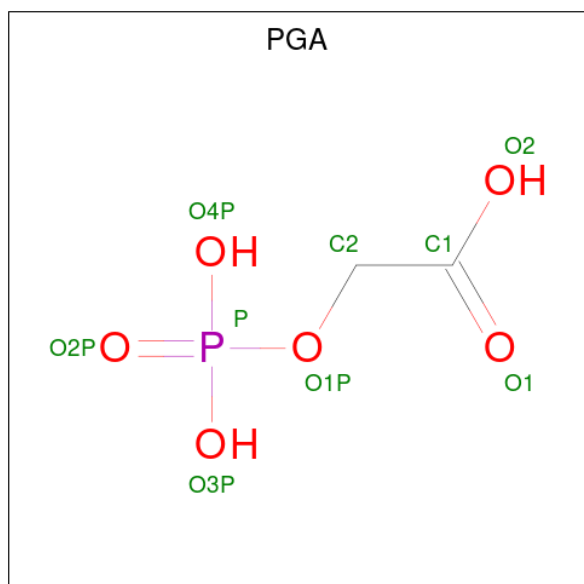
There are 4 unique types of molecules in this entry. The entry contains 3436 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 ENOLASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	434	3302	2075	564	643	20	0	0	0

- Molecule 2 is 2-PHOSPHOGLYCOLIC ACID (CCD ID: PGA) (formula: $C_2H_5O_6P$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	O	P		
2	A	1	9	2	6	1	0	0

- Molecule 3 is MANGANESE (II) ION (CCD ID: MN) (formula: Mn).

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

- Molecule 4 is water.

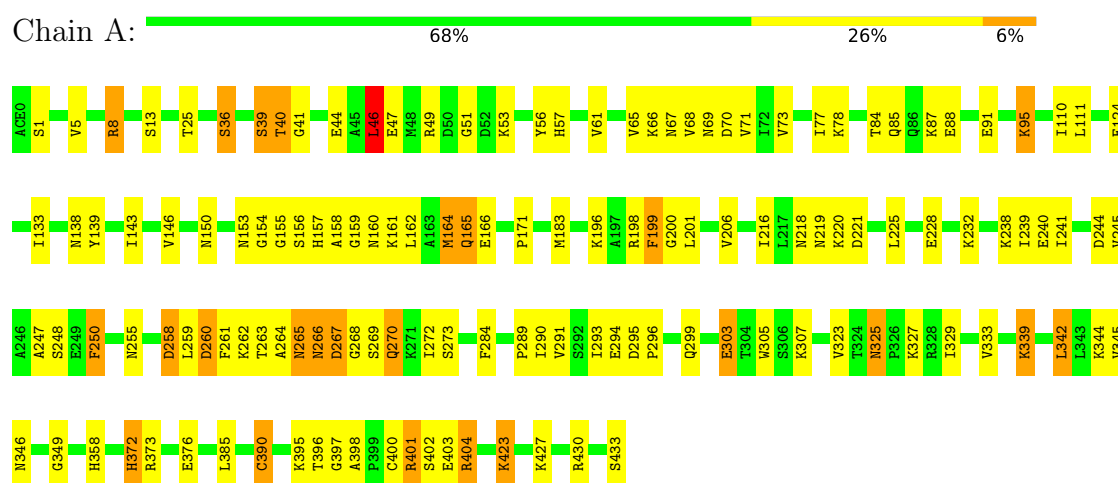
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	124	Total 124	O 124	0	0

3 Residue-property plots

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. 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. 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.

Note EDS was not executed.

• Molecule 1: ENOLASE



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	110.80 Å 110.80 Å 73.40 Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	8.00 – 2.20	Depositor
% Data completeness (in resolution range)	(Not available) (8.00-2.20)	Depositor
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.215 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3436	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: PGA, MN, ACE

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	0.64	0/3354	1.09	17/4525 (0.4%)

There are no bond length outliers.

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	165	GLN	N-CA-C	10.21	122.00	111.07
1	A	260	ASP	N-CA-C	-7.69	103.48	112.86
1	A	69	ASN	N-CA-C	7.49	119.08	111.07
1	A	349	GLY	N-CA-C	6.58	123.48	114.92
1	A	25	THR	N-CA-C	-6.47	99.73	108.86
1	A	402	SER	N-CA-C	6.15	120.05	112.54
1	A	95	LYS	N-CA-C	-6.10	104.54	111.07
1	A	238	LYS	N-CA-C	-6.04	106.51	114.31
1	A	146	VAL	N-CA-C	-5.71	101.31	108.05
1	A	342	LEU	N-CA-C	-5.62	100.03	108.96
1	A	206	VAL	N-CA-C	5.57	117.83	109.20
1	A	345	VAL	N-CA-C	5.56	116.96	110.62
1	A	46	LEU	N-CA-C	5.55	117.75	109.25
1	A	325	ASN	CA-C-N	5.48	125.30	119.28
1	A	325	ASN	C-N-CA	5.48	125.30	119.28
1	A	110	ILE	N-CA-C	5.29	115.50	110.42
1	A	430	ARG	N-CA-C	5.05	116.79	111.28

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	3302	0	3299	112	0
2	A	9	0	2	0	0
3	A	1	0	0	0	0
4	A	124	0	0	10	0
All	All	3436	0	3301	112	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 17.

All (112) 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:263:THR:HB	1:A:266:ASN:HB2	1.24	1.13
1:A:250:PHE:HB3	1:A:259:LEU:HB2	1.33	1.07
1:A:5:VAL:HB	1:A:73:VAL:HG22	1.57	0.86
1:A:263:THR:CB	1:A:266:ASN:HB2	2.13	0.74
1:A:250:PHE:CB	1:A:259:LEU:HB2	2.17	0.73
1:A:196:LYS:HE3	1:A:201:LEU:HD13	1.71	0.72
1:A:68:VAL:O	1:A:73:VAL:HG23	1.92	0.70
1:A:171:PRO:HB3	1:A:183:MET:HE2	1.75	0.68
1:A:40:THR:HA	1:A:46:LEU:HD13	1.75	0.68
1:A:218:ASN:HD22	1:A:220:LYS:HB3	1.60	0.67
1:A:150:ASN:O	1:A:398:ALA:HB2	1.97	0.64
1:A:269:SER:C	1:A:270:GLN:HG2	2.23	0.63
1:A:244:ASP:HA	1:A:294:GLU:HB3	1.81	0.63
1:A:161:LYS:HE2	1:A:263:THR:OG1	1.99	0.62
1:A:228:GLU:O	1:A:232:LYS:HG2	1.99	0.62
1:A:143:ILE:HG13	1:A:423:LYS:HB2	1.80	0.62
1:A:339:LYS:HE2	4:A:463:HOH:O	1.98	0.62
1:A:53:LYS:H	1:A:53:LYS:HD2	1.65	0.61
1:A:40:THR:HA	1:A:46:LEU:CD1	2.31	0.60
1:A:41:GLY:H	1:A:46:LEU:HD21	1.67	0.59
1:A:73:VAL:O	1:A:77:ILE:HG12	2.03	0.58
1:A:218:ASN:O	1:A:221:ASP:HB2	2.04	0.58
1:A:255:ASN:O	1:A:273:SER:HA	2.03	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:240:GLU:CD	1:A:291:VAL:HG11	2.30	0.57
1:A:164:MET:HG3	1:A:245:VAL:HG13	1.87	0.57
1:A:36:SER:HB2	1:A:373:ARG:HB3	1.86	0.57
1:A:400:CYS:O	1:A:401:ARG:HB2	2.04	0.56
1:A:293:ILE:HG22	1:A:296:PRO:HG3	1.86	0.56
1:A:139:TYR:OH	1:A:358:HIS:HE1	1.89	0.56
1:A:165:GLN:HG3	4:A:536:HOH:O	2.06	0.55
1:A:250:PHE:HB3	1:A:259:LEU:CB	2.22	0.55
1:A:329:ILE:O	1:A:333:VAL:HG23	2.07	0.55
1:A:260:ASP:HB3	1:A:263:THR:O	2.07	0.55
1:A:265:ASN:HA	1:A:267:ASP:OD2	2.08	0.54
1:A:258:ASP:O	1:A:259:LEU:HB3	2.08	0.54
1:A:373:ARG:O	1:A:404:ARG:NH2	2.41	0.53
1:A:303:GLU:O	1:A:307:LYS:HG3	2.08	0.53
1:A:241:ILE:HD12	1:A:289:PRO:HD2	1.91	0.53
1:A:396:THR:O	1:A:404:ARG:HG3	2.09	0.53
1:A:403:GLU:HG2	1:A:404:ARG:HD2	1.91	0.53
1:A:36:SER:HB3	4:A:569:HOH:O	2.08	0.52
1:A:260:ASP:HB3	1:A:266:ASN:HB3	1.92	0.52
1:A:325:ASN:OD1	1:A:327:LYS:HE3	2.10	0.52
1:A:164:MET:HE2	1:A:245:VAL:HG13	1.92	0.52
1:A:56:TYR:O	1:A:57:HIS:HB2	2.10	0.51
1:A:156:SER:O	1:A:157:HIS:HB2	2.11	0.51
1:A:390:CYS:SG	1:A:433:SER:CB	2.98	0.51
1:A:156:SER:C	1:A:158:ALA:H	2.18	0.51
1:A:73:VAL:HG11	4:A:504:HOH:O	2.10	0.51
1:A:344:LYS:NZ	4:A:546:HOH:O	2.44	0.50
1:A:390:CYS:HG	1:A:433:SER:CB	2.20	0.49
1:A:196:LYS:HG3	1:A:201:LEU:HA	1.93	0.49
1:A:259:LEU:C	1:A:261:PHE:N	2.70	0.49
1:A:219:ASN:HD21	1:A:261:PHE:HE2	1.61	0.49
1:A:154:GLY:O	1:A:156:SER:N	2.46	0.48
1:A:342:LEU:HD23	1:A:344:LYS:HE3	1.95	0.48
1:A:159:GLY:HA2	1:A:262:LYS:HZ2	1.79	0.48
1:A:67:ASN:O	1:A:71:VAL:HB	2.14	0.48
1:A:111:LEU:HD22	1:A:346:ASN:HA	1.95	0.47
1:A:323:VAL:HG12	1:A:323:VAL:O	2.14	0.47
1:A:342:LEU:CD2	1:A:344:LYS:HE3	2.45	0.47
1:A:260:ASP:HB3	1:A:266:ASN:CB	2.45	0.47
1:A:325:ASN:O	1:A:329:ILE:HG13	2.14	0.47
1:A:397:GLY:HA3	1:A:404:ARG:CG	2.45	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:245:VAL:HG12	1:A:250:PHE:HZ	1.80	0.47
1:A:87:LYS:O	1:A:91:GLU:HB2	2.14	0.46
1:A:91:GLU:O	1:A:95:LYS:HG3	2.14	0.46
1:A:5:VAL:CB	1:A:73:VAL:HG22	2.36	0.46
1:A:272:ILE:O	1:A:272:ILE:HG13	2.15	0.46
1:A:260:ASP:CB	1:A:266:ASN:HB3	2.45	0.46
1:A:261:PHE:CD1	1:A:270:GLN:OE1	2.69	0.46
1:A:44:GLU:HB3	1:A:323:VAL:CG1	2.47	0.45
1:A:165:GLN:HB3	4:A:566:HOH:O	2.15	0.45
1:A:199:PHE:CD1	1:A:199:PHE:N	2.84	0.45
1:A:150:ASN:ND2	1:A:166:GLU:HG2	2.32	0.45
1:A:372:HIS:CG	1:A:396:THR:HA	2.51	0.45
1:A:295:ASP:HA	1:A:305:TRP:CH2	2.52	0.45
1:A:247:ALA:HA	1:A:250:PHE:CZ	2.52	0.45
1:A:124:GLU:HG2	4:A:453:HOH:O	2.17	0.45
1:A:139:TYR:OH	1:A:358:HIS:CE1	2.68	0.44
1:A:8:ARG:HH11	1:A:8:ARG:HB3	1.82	0.44
1:A:339:LYS:NZ	1:A:339:LYS:HB3	2.33	0.44
1:A:376:GLU:HB2	1:A:403:GLU:HG3	2.00	0.44
1:A:395:LYS:NZ	4:A:441:HOH:O	2.51	0.44
1:A:39:SER:HA	1:A:47:GLU:HG2	1.99	0.44
1:A:260:ASP:CB	1:A:263:THR:O	2.66	0.43
1:A:268:GLY:C	1:A:270:GLN:H	2.26	0.43
1:A:247:ALA:HA	1:A:250:PHE:CE1	2.53	0.43
1:A:13:SER:HB2	1:A:403:GLU:OE2	2.18	0.43
1:A:150:ASN:HD21	1:A:166:GLU:HG2	1.83	0.43
1:A:284:PHE:HB3	1:A:290:ILE:HD12	2.01	0.42
1:A:39:SER:HB3	1:A:49:ARG:CG	2.49	0.42
1:A:164:MET:HB2	1:A:219:ASN:OD1	2.19	0.42
1:A:263:THR:O	1:A:265:ASN:N	2.52	0.42
1:A:166:GLU:HG3	4:A:566:HOH:O	2.19	0.42
1:A:156:SER:O	1:A:157:HIS:CB	2.68	0.42
1:A:183:MET:HE3	1:A:239:ILE:HG13	2.01	0.42
1:A:397:GLY:HA3	1:A:404:ARG:HG3	2.02	0.42
1:A:78:LYS:HA	1:A:78:LYS:HD3	1.87	0.42
1:A:85:GLN:HB3	1:A:88:GLU:HB2	2.02	0.42
1:A:240:GLU:OE1	1:A:291:VAL:HG11	2.19	0.42
1:A:198:ARG:HB3	1:A:199:PHE:CE1	2.55	0.41
1:A:265:ASN:C	1:A:267:ASP:H	2.29	0.41
1:A:41:GLY:N	1:A:46:LEU:HD21	2.33	0.41
1:A:196:LYS:O	1:A:200:GLY:N	2.51	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:61:VAL:O	1:A:65:VAL:HG23	2.21	0.41
1:A:133:ILE:HD13	1:A:385:LEU:HA	2.01	0.41
1:A:153:ASN:ND2	4:A:513:HOH:O	2.54	0.41
1:A:260:ASP:CA	1:A:266:ASN:HB3	2.51	0.41
1:A:295:ASP:HA	1:A:305:TRP:CZ2	2.57	0.40
1:A:423:LYS:N	1:A:423:LYS:HD3	2.36	0.40
1:A:51:GLY:O	1:A:53:LYS:HD2	2.21	0.40

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	432/434 (100%)	396 (92%)	29 (7%)	7 (2%)	7 6

All (7) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	36	SER
1	A	155	GLY
1	A	162	LEU
1	A	258	ASP
1	A	264	ALA
1	A	299	GLN
1	A	401	ARG

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	355/355 (100%)	328 (92%)	27 (8%)	12	14

All (27) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	SER
1	A	8	ARG
1	A	39	SER
1	A	40	THR
1	A	46	LEU
1	A	66	LYS
1	A	70	ASP
1	A	84	THR
1	A	138	ASN
1	A	160	ASN
1	A	164	MET
1	A	199	PHE
1	A	216	ILE
1	A	225	LEU
1	A	248	SER
1	A	250	PHE
1	A	265	ASN
1	A	266	ASN
1	A	267	ASP
1	A	270	GLN
1	A	303	GLU
1	A	339	LYS
1	A	372	HIS
1	A	390	CYS
1	A	404	ARG
1	A	423	LYS
1	A	427	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	135	ASN
1	A	157	HIS
1	A	218	ASN

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Mol	Chain	Res	Type
1	A	219	ASN
1	A	253	GLN
1	A	358	HIS

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 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 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	$\# Z > 2$
2	PGA	A	439	-	8,8,8	1.46	1 (12%)	10,11,11	1.20	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
2	PGA	A	439	-	-	1/6/6/6	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	439	PGA	O1P-C2	-2.78	1.40	1.43

There are no bond angle outliers.

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	439	PGA	O1-C1-C2-O1P

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 ⓘ

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

6.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

6.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.