Full wwPDB X-ray Structure Validation Report ⓘ

Jun 27, 2024 – 06:08 PM EDT

PDB ID	:	8TD9
Title	:	Structure of PYCR1 complexed with NADH and L-pipecolic acid
Authors	:	Tanner, J.J.; Meeks, K.R.
Deposited on	:	2023-07-02
Resolution	:	1.75 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	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.37.1
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.37.1

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 1.75 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.
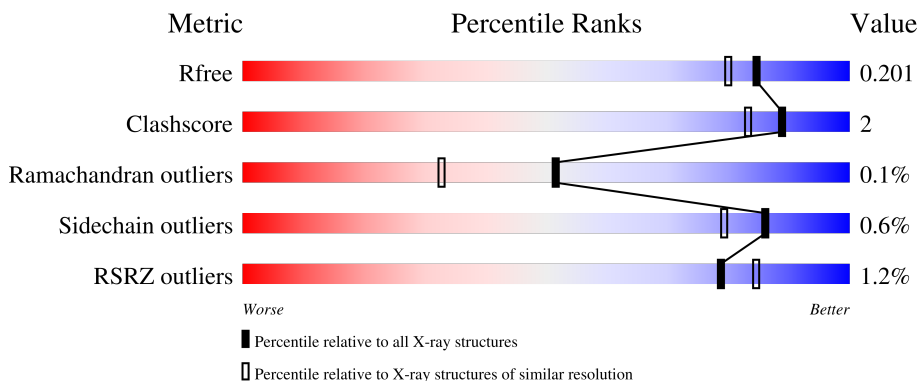
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	2340 (1.76-1.76)
Clashscore	141614	2466 (1.76-1.76)
Ramachandran outliers	138981	2437 (1.76-1.76)
Sidechain outliers	138945	2437 (1.76-1.76)
RSRZ outliers	127900	2298 (1.76-1.76)

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	316	85% • 12%
1	B	316	83% 5% 12%
1	C	316	81% 6% 13%
1	D	316	85% • 11%
1	E	316	84% • 12%

2 Entry composition ⓘ

There are 5 unique types of molecules in this entry. The entry contains 11016 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 Pyrroline-5-carboxylate reductase 1, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	279	Total	C	N	O	S	0	1	0
			2003	1261	353	375	14			
1	B	278	Total	C	N	O	S	0	1	0
			2001	1260	352	376	13			
1	C	276	Total	C	N	O	S	0	1	0
			1978	1244	347	373	14			
1	D	281	Total	C	N	O	S	0	2	0
			2020	1273	356	377	14			
1	E	277	Total	C	N	O	S	0	2	0
			1977	1246	346	371	14			

There are 110 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-21	MET	-	initiating methionine	UNP P32322
A	-20	HIS	-	expression tag	UNP P32322
A	-19	HIS	-	expression tag	UNP P32322
A	-18	HIS	-	expression tag	UNP P32322
A	-17	HIS	-	expression tag	UNP P32322
A	-16	HIS	-	expression tag	UNP P32322
A	-15	HIS	-	expression tag	UNP P32322
A	-14	SER	-	expression tag	UNP P32322
A	-13	SER	-	expression tag	UNP P32322
A	-12	GLY	-	expression tag	UNP P32322
A	-11	VAL	-	expression tag	UNP P32322
A	-10	ASP	-	expression tag	UNP P32322
A	-9	LEU	-	expression tag	UNP P32322
A	-8	GLY	-	expression tag	UNP P32322
A	-7	THR	-	expression tag	UNP P32322
A	-6	GLU	-	expression tag	UNP P32322
A	-5	ASN	-	expression tag	UNP P32322
A	-4	LEU	-	expression tag	UNP P32322
A	-3	TYR	-	expression tag	UNP P32322

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Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	PHE	-	expression tag	UNP P32322
A	-1	GLN	-	expression tag	UNP P32322
A	0	SER	-	expression tag	UNP P32322
B	-21	MET	-	initiating methionine	UNP P32322
B	-20	HIS	-	expression tag	UNP P32322
B	-19	HIS	-	expression tag	UNP P32322
B	-18	HIS	-	expression tag	UNP P32322
B	-17	HIS	-	expression tag	UNP P32322
B	-16	HIS	-	expression tag	UNP P32322
B	-15	HIS	-	expression tag	UNP P32322
B	-14	SER	-	expression tag	UNP P32322
B	-13	SER	-	expression tag	UNP P32322
B	-12	GLY	-	expression tag	UNP P32322
B	-11	VAL	-	expression tag	UNP P32322
B	-10	ASP	-	expression tag	UNP P32322
B	-9	LEU	-	expression tag	UNP P32322
B	-8	GLY	-	expression tag	UNP P32322
B	-7	THR	-	expression tag	UNP P32322
B	-6	GLU	-	expression tag	UNP P32322
B	-5	ASN	-	expression tag	UNP P32322
B	-4	LEU	-	expression tag	UNP P32322
B	-3	TYR	-	expression tag	UNP P32322
B	-2	PHE	-	expression tag	UNP P32322
B	-1	GLN	-	expression tag	UNP P32322
B	0	SER	-	expression tag	UNP P32322
C	-21	MET	-	initiating methionine	UNP P32322
C	-20	HIS	-	expression tag	UNP P32322
C	-19	HIS	-	expression tag	UNP P32322
C	-18	HIS	-	expression tag	UNP P32322
C	-17	HIS	-	expression tag	UNP P32322
C	-16	HIS	-	expression tag	UNP P32322
C	-15	HIS	-	expression tag	UNP P32322
C	-14	SER	-	expression tag	UNP P32322
C	-13	SER	-	expression tag	UNP P32322
C	-12	GLY	-	expression tag	UNP P32322
C	-11	VAL	-	expression tag	UNP P32322
C	-10	ASP	-	expression tag	UNP P32322
C	-9	LEU	-	expression tag	UNP P32322
C	-8	GLY	-	expression tag	UNP P32322
C	-7	THR	-	expression tag	UNP P32322
C	-6	GLU	-	expression tag	UNP P32322
C	-5	ASN	-	expression tag	UNP P32322

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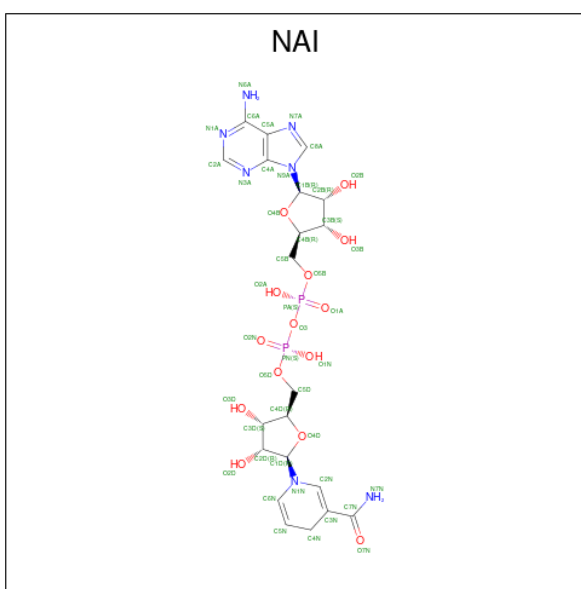
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Chain	Residue	Modelled	Actual	Comment	Reference
C	-4	LEU	-	expression tag	UNP P32322
C	-3	TYR	-	expression tag	UNP P32322
C	-2	PHE	-	expression tag	UNP P32322
C	-1	GLN	-	expression tag	UNP P32322
C	0	SER	-	expression tag	UNP P32322
D	-21	MET	-	initiating methionine	UNP P32322
D	-20	HIS	-	expression tag	UNP P32322
D	-19	HIS	-	expression tag	UNP P32322
D	-18	HIS	-	expression tag	UNP P32322
D	-17	HIS	-	expression tag	UNP P32322
D	-16	HIS	-	expression tag	UNP P32322
D	-15	HIS	-	expression tag	UNP P32322
D	-14	SER	-	expression tag	UNP P32322
D	-13	SER	-	expression tag	UNP P32322
D	-12	GLY	-	expression tag	UNP P32322
D	-11	VAL	-	expression tag	UNP P32322
D	-10	ASP	-	expression tag	UNP P32322
D	-9	LEU	-	expression tag	UNP P32322
D	-8	GLY	-	expression tag	UNP P32322
D	-7	THR	-	expression tag	UNP P32322
D	-6	GLU	-	expression tag	UNP P32322
D	-5	ASN	-	expression tag	UNP P32322
D	-4	LEU	-	expression tag	UNP P32322
D	-3	TYR	-	expression tag	UNP P32322
D	-2	PHE	-	expression tag	UNP P32322
D	-1	GLN	-	expression tag	UNP P32322
D	0	SER	-	expression tag	UNP P32322
E	-21	MET	-	initiating methionine	UNP P32322
E	-20	HIS	-	expression tag	UNP P32322
E	-19	HIS	-	expression tag	UNP P32322
E	-18	HIS	-	expression tag	UNP P32322
E	-17	HIS	-	expression tag	UNP P32322
E	-16	HIS	-	expression tag	UNP P32322
E	-15	HIS	-	expression tag	UNP P32322
E	-14	SER	-	expression tag	UNP P32322
E	-13	SER	-	expression tag	UNP P32322
E	-12	GLY	-	expression tag	UNP P32322
E	-11	VAL	-	expression tag	UNP P32322
E	-10	ASP	-	expression tag	UNP P32322
E	-9	LEU	-	expression tag	UNP P32322
E	-8	GLY	-	expression tag	UNP P32322
E	-7	THR	-	expression tag	UNP P32322

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Chain	Residue	Modelled	Actual	Comment	Reference
E	-6	GLU	-	expression tag	UNP P32322
E	-5	ASN	-	expression tag	UNP P32322
E	-4	LEU	-	expression tag	UNP P32322
E	-3	TYR	-	expression tag	UNP P32322
E	-2	PHE	-	expression tag	UNP P32322
E	-1	GLN	-	expression tag	UNP P32322
E	0	SER	-	expression tag	UNP P32322

- Molecule 2 is 1,4-DIHYDRONICOTINAMIDE ADENINE DINUCLEOTIDE (three-letter code: NAI) (formula: $C_{21}H_{29}N_7O_{14}P_2$) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	B	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	C	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	D	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	E	1	Total	C	N	O	P	0	0
			44	21	7	14	2		

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O_4S).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total 5	O 4	S 1	0	0
3	B	1	Total 5	O 4	S 1	0	0
3	C	1	Total 5	O 4	S 1	0	0
3	D	1	Total 5	O 4	S 1	0	0
3	D	1	Total 5	O 4	S 1	0	0

- Molecule 4 is (2S)-piperidine-2-carboxylic acid (three-letter code: YCP) (formula: $C_6H_{11}NO_2$) (labeled as "Ligand of Interest" by depositor).
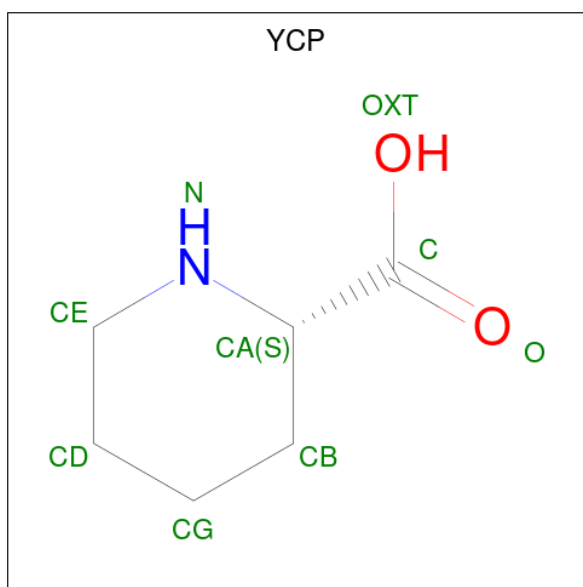
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total 9	C 6	N 1	O 2	0	0
4	B	1	Total 9	C 6	N 1	O 2	0	0
4	C	1	Total 9	C 6	N 1	O 2	0	0
4	D	1	Total 9	C 6	N 1	O 2	0	0
4	E	1	Total 9	C 6	N 1	O 2	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	189	Total 189	O 189	0	0
5	B	157	Total 157	O 157	0	0
5	C	130	Total 130	O 130	0	0
5	D	127	Total 127	O 127	0	0
5	E	144	Total 144	O 144	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 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: Pyrroline-5-carboxylate reductase 1, mitochondrial
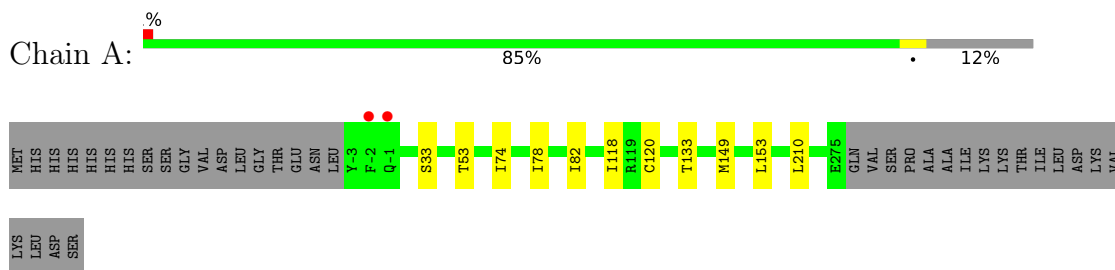
Chain A:

• Molecule 1: Pyrroline-5-carboxylate reductase 1, mitochondrial

Chain B:
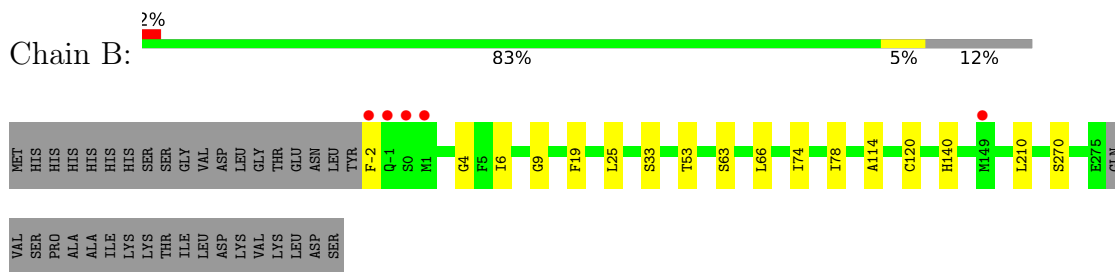
• Molecule 1: Pyrroline-5-carboxylate reductase 1, mitochondrial
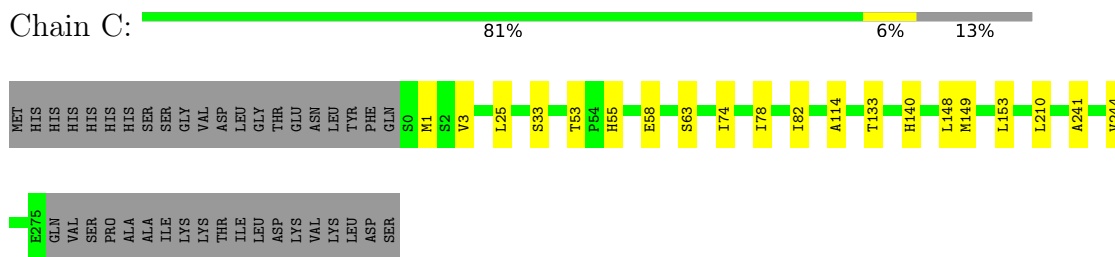
Chain C:

• Molecule 1: Pyrroline-5-carboxylate reductase 1, mitochondrial
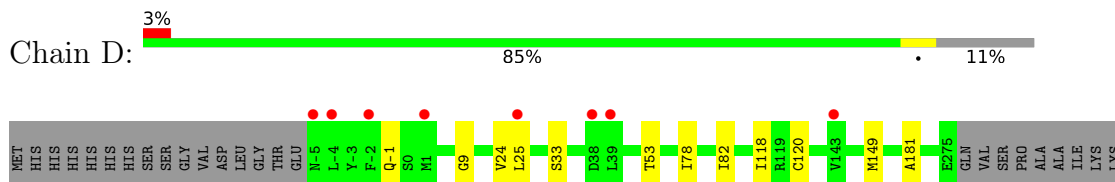
Chain D:

THR ILE LEU ASP LYS VAL LYS LEU ASP SER

• Molecule 1: Pyrroline-5-carboxylate reductase 1, mitochondrial

%

Chain E:

84%   •   12%

MET HIS HIS HIS HIS HIS SER SER GLY VAL ASP LEU GLY THR GLU ASN LEU TYR PHE Q-1 V3 L25 D38 V42 L52 I74 I78 I82 A114 H140 L185 L210 Q222 E275 GLN VAL SER PRO ALA ALA ILE LYS LYS THR ILE

LEU ASP LYS VAL LYS LEU ASP SER

4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	112.19Å　180.03Å　87.71Å 90.00°　　106.88°　　90.00°	Depositor
Resolution (Å)	90.02　–　1.75 90.02　–　1.75	Depositor EDS
% Data completeness (in resolution range)	94.1 (90.02-1.75) 97.8 (90.02-1.75)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.42 (at 1.75Å)	Xtriage
Refinement program	PHENIX 1.20.1_4887	Depositor
R, R_{free}	0.182　,　0.207 0.175　,　0.201	Depositor DCC
R_{free} test set	8137 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å^2)	30.8	Xtriage
Anisotropy	0.266	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 45.4	EDS
L-test for twinning[2]	$< |L| > = 0.49, < L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	11016	wwPDB-VP
Average B, all atoms (Å^2)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.58% of the height of the origin peak. No significant pseudotranslation is detected.*

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[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: YCP, NAI, SO4

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	0.36	0/2036	0.58	0/2764
1	B	0.34	0/2035	0.55	0/2762
1	C	0.34	0/2011	0.55	0/2732
1	D	0.33	0/2058	0.55	0/2796
1	E	0.35	0/2013	0.56	0/2735
All	All	0.34	0/10153	0.56	0/13789

There are no bond length outliers.

There are no bond angle outliers.

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	2003	0	2012	6	0
1	B	2001	0	2009	9	0
1	C	1978	0	1978	12	0
1	D	2020	0	2014	6	0
1	E	1977	0	1975	7	0
2	A	44	0	27	0	0
2	B	44	0	27	1	0
2	C	44	0	27	0	0

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W O R L D W I D E
wwPDB
PROTEIN DATA BANK

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	D	44	0	27	1	0
2	E	44	0	27	0	0
3	A	5	0	0	0	0
3	B	5	0	0	0	0
3	C	5	0	0	0	0
3	D	10	0	0	0	0
4	A	9	0	10	0	0
4	B	9	0	10	0	0
4	C	9	0	10	0	0
4	D	9	0	10	0	0
4	E	9	0	10	0	0
5	A	189	0	0	0	0
5	B	157	0	0	0	0
5	C	130	0	0	0	0
5	D	127	0	0	0	0
5	E	144	0	0	1	0
All	All	11016	0	10173	38	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 (38) 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:133:THR:HG21	1:A:153:LEU:HD13	1.80	0.64
1:A:210:LEU:HD11	1:B:210:LEU:HD13	1.90	0.54
1:E:74:ILE:HG22	1:E:78:ILE:HG12	1.89	0.53
1:E:222:GLN:NE2	5:E:501:HOH:O	2.26	0.53
1:D:78:ILE:O	1:D:82:ILE:HG13	2.10	0.51
1:E:3:VAL:HG21	1:E:25:LEU:HD11	1.96	0.48
1:E:78:ILE:O	1:E:82:ILE:HG13	2.14	0.47
1:A:118:ILE:HD12	1:A:149[B]:MET:HG2	1.96	0.47
1:C:114:ALA:HA	1:C:140:HIS:CD2	2.50	0.47
1:D:118:ILE:HD12	1:D:149[A]:MET:HG3	1.96	0.47
1:D:9:GLY:HA3	2:D:401:NAI:O5B	2.15	0.46
1:C:78:ILE:O	1:C:82:ILE:HG13	2.15	0.46
1:C:149[B]:MET:HG3	1:C:153:LEU:HD12	1.97	0.46
1:C:114:ALA:HA	1:C:140:HIS:CG	2.52	0.45
1:C:3:VAL:HG21	1:C:25:LEU:HD21	1.98	0.45
1:A:78:ILE:O	1:A:82:ILE:HG13	2.15	0.45
1:B:114:ALA:HA	1:B:140:HIS:CD2	2.51	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:9:GLY:HA3	2:B:401:NAI:O5B	2.17	0.45
1:C:55:HIS:HB2	1:C:58:GLU:HG3	1.97	0.45
1:C:210:LEU:HD22	1:D:181:ALA:HB2	1.99	0.45
1:C:74:ILE:HG22	1:C:78:ILE:HG12	2.00	0.44
1:A:33:SER:HA	1:A:53:THR:O	2.17	0.44
1:B:33:SER:HA	1:B:53:THR:O	2.18	0.44
1:C:33:SER:HA	1:C:53:THR:O	2.18	0.44
1:C:241:ALA:O	1:C:244:VAL:HG22	2.18	0.44
1:B:74:ILE:HG22	1:B:78:ILE:HG12	1.99	0.43
1:A:74:ILE:HG22	1:A:78:ILE:HG12	2.01	0.43
1:E:185:LEU:HD21	1:E:210:LEU:HD22	2.00	0.43
1:B:6:ILE:HG13	1:B:66:LEU:HD11	2.01	0.42
1:B:4:GLY:HA3	1:B:63:SER:OG	2.20	0.42
1:D:33:SER:HA	1:D:53:THR:O	2.20	0.42
1:B:19:PHE:HB3	1:B:25:LEU:HD12	2.02	0.41
1:C:1:MET:CE	1:C:148:LEU:HD11	2.50	0.41
1:C:133:THR:HG21	1:C:153:LEU:HD13	2.03	0.41
1:E:42:VAL:HG13	1:E:52:LEU:HD22	2.03	0.41
1:E:114:ALA:HA	1:E:140:HIS:CD2	2.56	0.41
1:B:114:ALA:HA	1:B:140:HIS:CG	2.56	0.40
1:D:24:VAL:HG23	1:D:25:LEU:HD23	2.03	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	278/316 (88%)	274 (99%)	4 (1%)	0	100	100
1	B	277/316 (88%)	274 (99%)	3 (1%)	0	100	100
1	C	275/316 (87%)	270 (98%)	5 (2%)	0	100	100
1	D	281/316 (89%)	276 (98%)	4 (1%)	1 (0%)	34	17

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	E	277/316 (88%)	272 (98%)	5 (2%)	0	100	100
All	All	1388/1580 (88%)	1366 (98%)	21 (2%)	1 (0%)	51	33

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	-1	GLN

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	A	203/251 (81%)	202 (100%)	1 (0%)	88	83
1	B	204/251 (81%)	201 (98%)	3 (2%)	65	49
1	C	201/251 (80%)	200 (100%)	1 (0%)	88	83
1	D	204/251 (81%)	203 (100%)	1 (0%)	88	83
1	E	199/251 (79%)	199 (100%)	0	100	100
All	All	1011/1255 (81%)	1005 (99%)	6 (1%)	86	79

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	120	CYS
1	B	-2	PHE
1	B	120	CYS
1	B	270	SER
1	C	63	SER
1	D	120	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	140	HIS
1	C	140	HIS
1	E	140	HIS

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 monosaccharides in this entry.

5.6 Ligand geometry ⓘ

15 ligands 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	$\#|Z| > 2$
4	YCP	A	403	-	9,9,9	1.09	0	8,11,11	1.65	2 (25%)
3	SO4	D	403	-	4,4,4	0.15	0	6,6,6	0.12	0
2	NAI	E	401	-	42,48,48	1.24	3 (7%)	47,73,73	1.54	9 (19%)
2	NAI	A	401	-	42,48,48	1.31	5 (11%)	47,73,73	1.46	8 (17%)
4	YCP	D	404	-	9,9,9	1.15	0	8,11,11	1.94	2 (25%)
2	NAI	B	401	-	42,48,48	1.35	4 (9%)	47,73,73	1.48	8 (17%)
4	YCP	C	403	-	9,9,9	1.14	0	8,11,11	1.73	2 (25%)
3	SO4	B	402	-	4,4,4	0.21	0	6,6,6	0.13	0
2	NAI	C	401	-	42,48,48	1.24	4 (9%)	47,73,73	1.66	11 (23%)
3	SO4	A	402	-	4,4,4	0.11	0	6,6,6	0.10	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	#|Z| > 2	Counts	RMSZ	#|Z| > 2
2	NAI	D	401	-	42,48,48	1.32	6 (14%)	47,73,73	1.57	11 (23%)
4	YCP	B	403	-	9,9,9	1.34	2 (22%)	8,11,11	1.87	2 (25%)
4	YCP	E	402	-	9,9,9	1.13	1 (11%)	8,11,11	1.76	2 (25%)
3	SO4	C	402	-	4,4,4	0.16	0	6,6,6	0.25	0
3	SO4	D	402	-	4,4,4	0.18	0	6,6,6	0.11	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	NAI	E	401	-	-	3/25/72/72	0/5/5/5
2	NAI	A	401	-	-	4/25/72/72	0/5/5/5
4	YCP	D	404	-	-	0/4/12/12	0/1/1/1
2	NAI	B	401	-	-	3/25/72/72	0/5/5/5
4	YCP	C	403	-	-	2/4/12/12	0/1/1/1
2	NAI	C	401	-	-	4/25/72/72	0/5/5/5
2	NAI	D	401	-	-	4/25/72/72	0/5/5/5
4	YCP	B	403	-	-	0/4/12/12	0/1/1/1
4	YCP	A	403	-	-	0/4/12/12	0/1/1/1
4	YCP	E	402	-	-	0/4/12/12	0/1/1/1

All (25) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	401	NAI	PN-O5D	3.60	1.73	1.59
2	C	401	NAI	PA-O5B	3.57	1.73	1.59
2	D	401	NAI	PA-O5B	3.41	1.73	1.59
2	A	401	NAI	PA-O5B	3.27	1.72	1.59
2	B	401	NAI	PA-O5B	3.19	1.72	1.59
2	E	401	NAI	PA-O5B	3.19	1.72	1.59
2	B	401	NAI	C4A-N3A	3.06	1.39	1.35
2	A	401	NAI	PN-O5D	2.96	1.71	1.59
2	C	401	NAI	PN-O5D	2.93	1.71	1.59
2	E	401	NAI	PN-O5D	2.85	1.70	1.59
2	D	401	NAI	PN-O5D	2.69	1.70	1.59
2	C	401	NAI	C2A-N3A	2.43	1.36	1.32
2	D	401	NAI	C2A-N3A	2.33	1.35	1.32
2	A	401	NAI	C4A-N3A	2.30	1.38	1.35

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	401	NAI	C7N-N7N	2.29	1.39	1.33
2	A	401	NAI	C2A-N3A	2.28	1.35	1.32
2	D	401	NAI	C3D-C4D	2.24	1.58	1.53
4	E	402	YCP	CA-C	2.22	1.58	1.52
4	B	403	YCP	CA-N	2.20	1.53	1.47
2	D	401	NAI	C7N-N7N	2.12	1.39	1.33
2	B	401	NAI	O2D-C2D	-2.12	1.38	1.43
2	A	401	NAI	O5D-C5D	-2.09	1.36	1.44
4	B	403	YCP	CA-C	2.07	1.58	1.52
2	E	401	NAI	C7N-N7N	2.05	1.38	1.33
2	D	401	NAI	C2A-N1A	2.04	1.37	1.33

All (57) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	401	NAI	PN-O3-PA	-5.30	114.64	132.83
2	D	401	NAI	PN-O3-PA	-5.04	115.52	132.83
2	B	401	NAI	PN-O3-PA	-4.64	116.90	132.83
2	E	401	NAI	PN-O3-PA	-4.41	117.69	132.83
2	A	401	NAI	PN-O3-PA	-4.16	118.54	132.83
2	E	401	NAI	O4B-C1B-C2B	-3.78	101.40	106.93
4	E	402	YCP	CD-CG-CB	3.38	118.30	111.42
2	C	401	NAI	O4B-C1B-C2B	-3.34	102.05	106.93
4	C	403	YCP	C-CA-N	3.32	113.93	108.97
4	D	404	YCP	CD-CG-CB	3.32	118.18	111.42
4	D	404	YCP	C-CA-N	3.20	113.75	108.97
2	C	401	NAI	O2A-PA-O1A	3.04	127.28	112.24
4	B	403	YCP	CD-CG-CB	3.01	117.55	111.42
2	D	401	NAI	O2A-PA-O1A	2.94	126.75	112.24
2	E	401	NAI	O2A-PA-O1A	2.93	126.71	112.24
4	A	403	YCP	C-CA-N	2.92	113.34	108.97
4	E	402	YCP	C-CA-N	2.92	113.34	108.97
4	B	403	YCP	C-CA-N	2.92	113.33	108.97
2	B	401	NAI	C1B-N9A-C4A	-2.88	121.58	126.64
2	B	401	NAI	O2A-PA-O1A	2.88	126.48	112.24
4	A	403	YCP	CD-CG-CB	2.85	117.22	111.42
4	C	403	YCP	CD-CG-CB	2.82	117.16	111.42
2	A	401	NAI	C3B-C2B-C1B	-2.74	96.86	100.98
2	A	401	NAI	O2A-PA-O1A	2.73	125.75	112.24
2	C	401	NAI	O1N-PN-O2N	2.71	125.66	112.24
2	D	401	NAI	O4B-C1B-C2B	-2.71	102.97	106.93
2	D	401	NAI	C1B-N9A-C4A	-2.68	121.94	126.64

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	401	NAI	O4B-C1B-C2B	-2.64	103.06	106.93
2	D	401	NAI	O1N-PN-O2N	2.64	125.28	112.24
2	A	401	NAI	O4B-C1B-C2B	-2.61	103.12	106.93
2	A	401	NAI	C1B-N9A-C4A	-2.52	122.22	126.64
2	A	401	NAI	O1N-PN-O2N	2.47	124.46	112.24
2	E	401	NAI	C1B-N9A-C4A	-2.42	122.39	126.64
2	B	401	NAI	O1N-PN-O2N	2.40	124.10	112.24
2	E	401	NAI	O1N-PN-O2N	2.37	123.96	112.24
2	A	401	NAI	C3N-C2N-N1N	-2.36	119.73	123.10
2	C	401	NAI	C3B-C2B-C1B	-2.35	97.43	100.98
2	C	401	NAI	C5B-C4B-C3B	-2.34	106.42	115.18
2	D	401	NAI	O5B-PA-O1A	-2.27	100.19	109.07
2	D	401	NAI	C3N-C2N-N1N	-2.26	119.87	123.10
2	D	401	NAI	C5B-C4B-C3B	-2.25	106.75	115.18
2	D	401	NAI	PA-O5B-C5B	-2.22	108.66	121.68
2	E	401	NAI	C5B-C4B-C3B	-2.21	106.88	115.18
2	E	401	NAI	C3N-C2N-N1N	-2.20	119.96	123.10
2	B	401	NAI	C3B-C2B-C1B	-2.19	97.68	100.98
2	D	401	NAI	O5D-PN-O2N	-2.16	100.62	109.07
2	C	401	NAI	C4A-C5A-N7A	2.15	111.64	109.40
2	C	401	NAI	O7N-C7N-N7N	-2.14	117.88	122.88
2	C	401	NAI	O5B-PA-O1A	-2.14	100.72	109.07
2	E	401	NAI	O7N-C7N-N7N	-2.13	117.89	122.88
2	B	401	NAI	O5D-PN-O2N	-2.11	100.83	109.07
2	D	401	NAI	O7N-C7N-N7N	-2.11	117.95	122.88
2	B	401	NAI	PA-O5B-C5B	-2.09	109.40	121.68
2	A	401	NAI	O5B-C5B-C4B	-2.04	101.97	108.99
2	C	401	NAI	O5D-PN-O2N	-2.03	101.12	109.07
2	E	401	NAI	PA-O5B-C5B	-2.03	109.79	121.68
2	C	401	NAI	PA-O5B-C5B	-2.02	109.86	121.68

There are no chirality outliers.

All (20) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	401	NAI	O4D-C1D-N1N-C6N
2	E	401	NAI	O4D-C1D-N1N-C6N
2	A	401	NAI	O4D-C1D-N1N-C6N
2	C	401	NAI	O4D-C1D-N1N-C6N
2	D	401	NAI	O4D-C1D-N1N-C6N
2	A	401	NAI	O4B-C4B-C5B-O5B
2	A	401	NAI	C2D-C1D-N1N-C6N

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Mol	Chain	Res	Type	Atoms
2	A	401	NAI	PN-O3-PA-O2A
2	C	401	NAI	PN-O3-PA-O2A
2	D	401	NAI	O4B-C4B-C5B-O5B
4	C	403	YCP	OXT-C-CA-N
2	D	401	NAI	O4D-C4D-C5D-O5D
2	B	401	NAI	O4B-C4B-C5B-O5B
2	E	401	NAI	O4B-C4B-C5B-O5B
2	B	401	NAI	PN-O3-PA-O2A
2	D	401	NAI	PN-O3-PA-O2A
2	E	401	NAI	PN-O3-PA-O2A
2	C	401	NAI	O4B-C4B-C5B-O5B
4	C	403	YCP	O-C-CA-N
2	C	401	NAI	C2D-C1D-N1N-C6N

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	401	NAI	1	0
2	D	401	NAI	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

Ligand YCP A 403

Bond lengths

Bond angles

Torsions

Rings

Ligand NAI E 401

Bond lengths

Bond angles

Torsions

Rings

Ligand NAI A 401

Bond lengths

Bond angles

Torsions

Rings

Ligand YCP D 404

Bond lengths

Bond angles

Torsions

Rings

Ligand NAI B 401

Bond lengths

Bond angles

Torsions

Rings

Ligand YCP C 403

Bond lengths

Bond angles

Torsions

Rings

Ligand NAI C 401

Bond lengths

Bond angles

Torsions

Rings

Ligand NAI D 401

Bond lengths

Bond angles

Torsions

Rings

Ligand YCP B 403

Bond lengths

Bond angles

Torsions

Rings

Ligand YCP E 402

Bond lengths

Bond angles

Torsions

Rings

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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	279/316 (88%)	-0.34	2 (0%)	87	92	21, 29, 47, 73	0
1	B	278/316 (87%)	-0.26	5 (1%)	68	76	22, 32, 57, 85	0
1	C	276/316 (87%)	-0.26	0	100	100	23, 35, 58, 75	0
1	D	281/316 (88%)	-0.09	8 (2%)	53	58	24, 38, 66, 94	0
1	E	277/316 (87%)	-0.24	2 (0%)	87	92	22, 33, 58, 89	0
All	All	1391/1580 (88%)	-0.24	17 (1%)	79	84	21, 33, 59, 94	0

All (17) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	-2	PHE	4.9
1	D	25	LEU	4.2
1	A	-1	GLN	4.1
1	D	-2	PHE	3.9
1	D	-4	LEU	3.7
1	B	-1	GLN	3.2
1	D	38	ASP	3.0
1	D	143	VAL	2.6
1	B	0	SER	2.3
1	B	1	MET	2.1
1	A	-2	PHE	2.1
1	D	39	LEU	2.1
1	B	149	MET	2.1
1	D	1	MET	2.1
1	E	38	ASP	2.0
1	E	210	LEU	2.0
1	D	-5	ASN	2.0

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

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

6.3 Carbohydrates ⓘ

There are no monosaccharides in this entry.

6.4 Ligands ⓘ

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(Å^2)	Q<0.9
4	YCP	C	403	9/9	0.91	0.09	27,30,36,36	0
3	SO4	D	402	5/5	0.92	0.11	41,44,46,50	5
3	SO4	B	402	5/5	0.93	0.08	40,43,46,48	5
3	SO4	C	402	5/5	0.93	0.16	50,52,62,64	0
4	YCP	D	404	9/9	0.93	0.09	25,28,33,35	0
3	SO4	A	402	5/5	0.94	0.09	40,44,44,47	5
4	YCP	B	403	9/9	0.94	0.07	26,26,32,34	0
4	YCP	A	403	9/9	0.95	0.08	25,26,32,33	0
4	YCP	E	402	9/9	0.95	0.07	27,30,32,33	0
3	SO4	D	403	5/5	0.96	0.08	48,51,55,56	5
2	NAI	C	401	44/44	0.96	0.07	29,34,41,42	0
2	NAI	D	401	44/44	0.97	0.07	30,36,43,46	0
2	NAI	E	401	44/44	0.97	0.07	28,32,38,41	0
2	NAI	B	401	44/44	0.97	0.07	26,31,35,39	0
2	NAI	A	401	44/44	0.97	0.07	24,28,32,33	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.
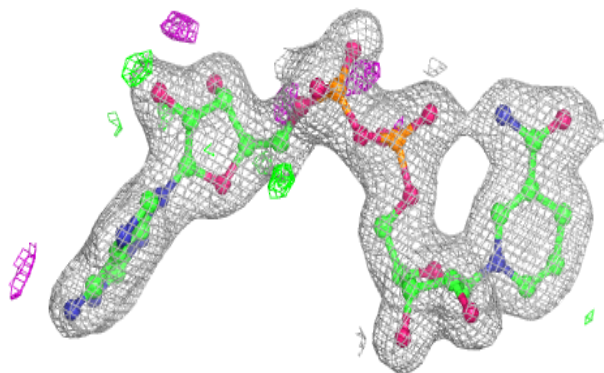
Electron density around YCP C 403:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
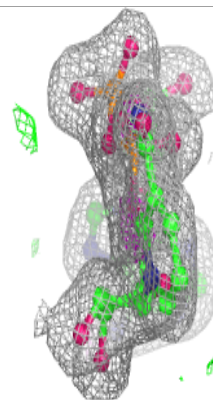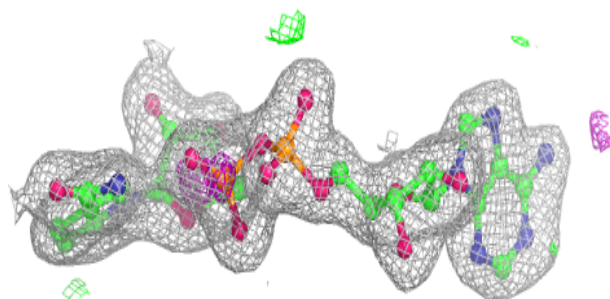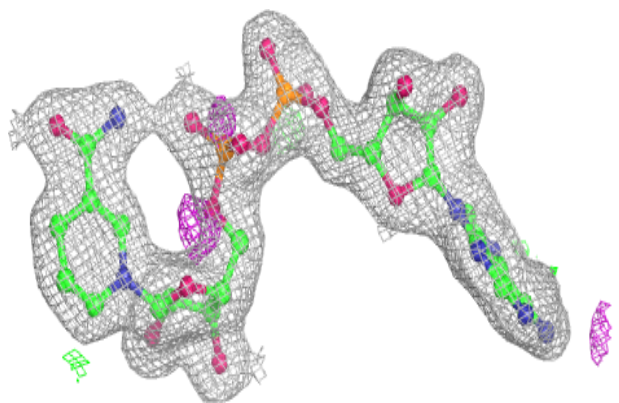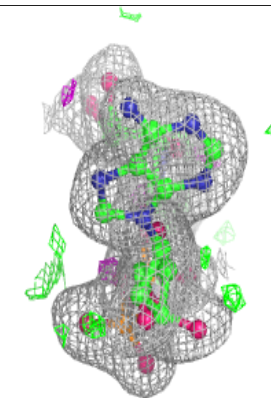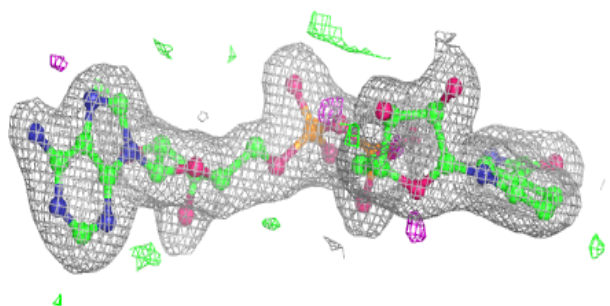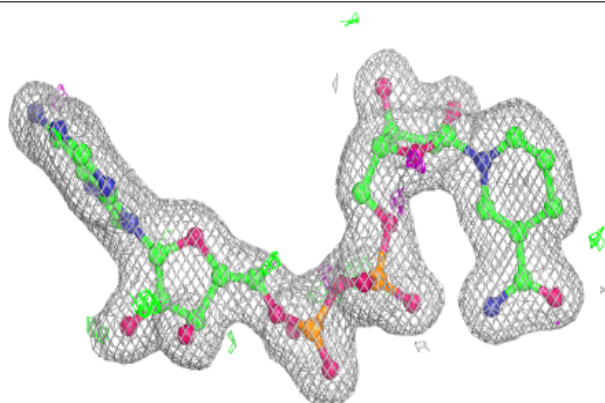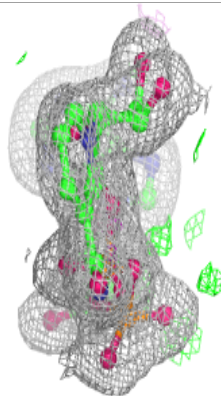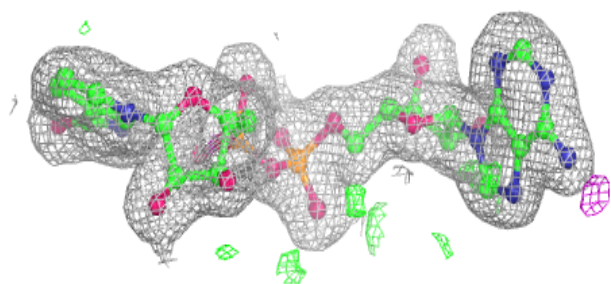mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
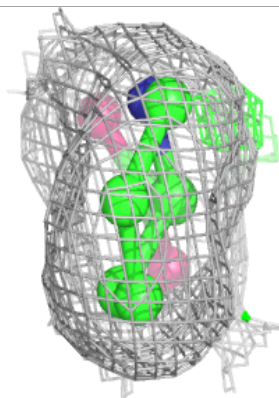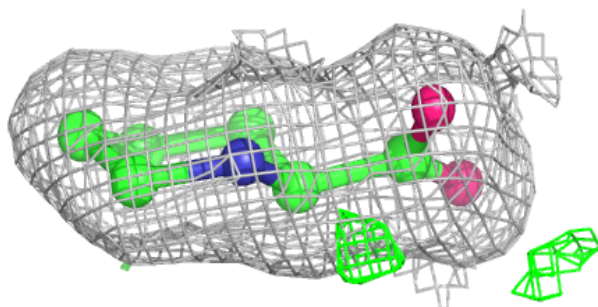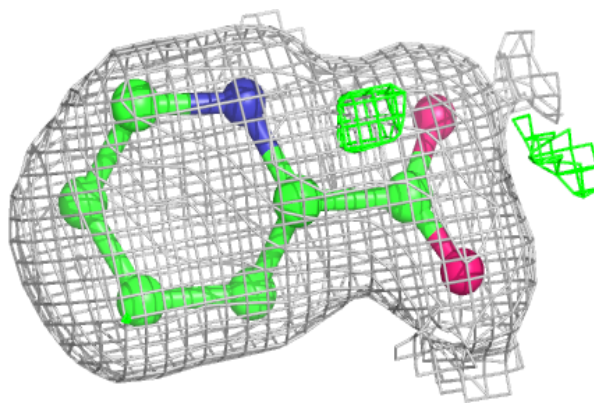
Electron density around YCP D 404:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
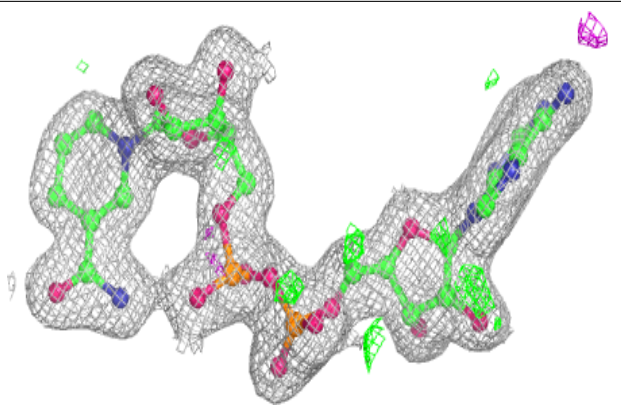
Electron density around YCP B 403:

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

Electron density around YCP A 403:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
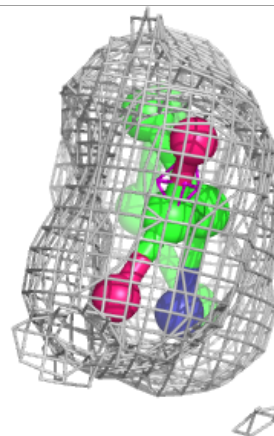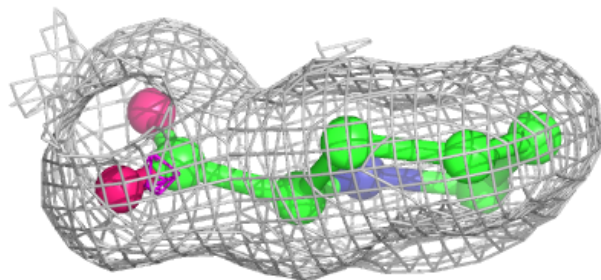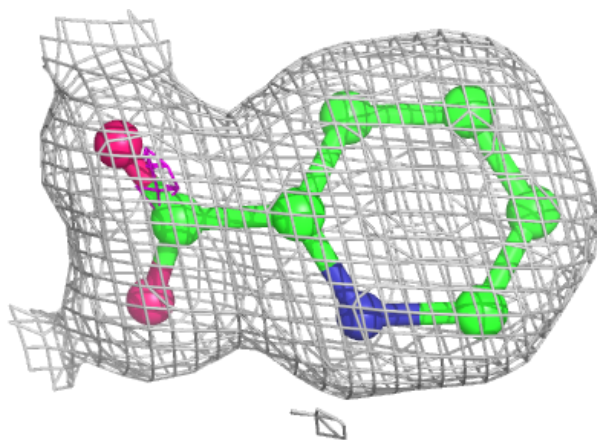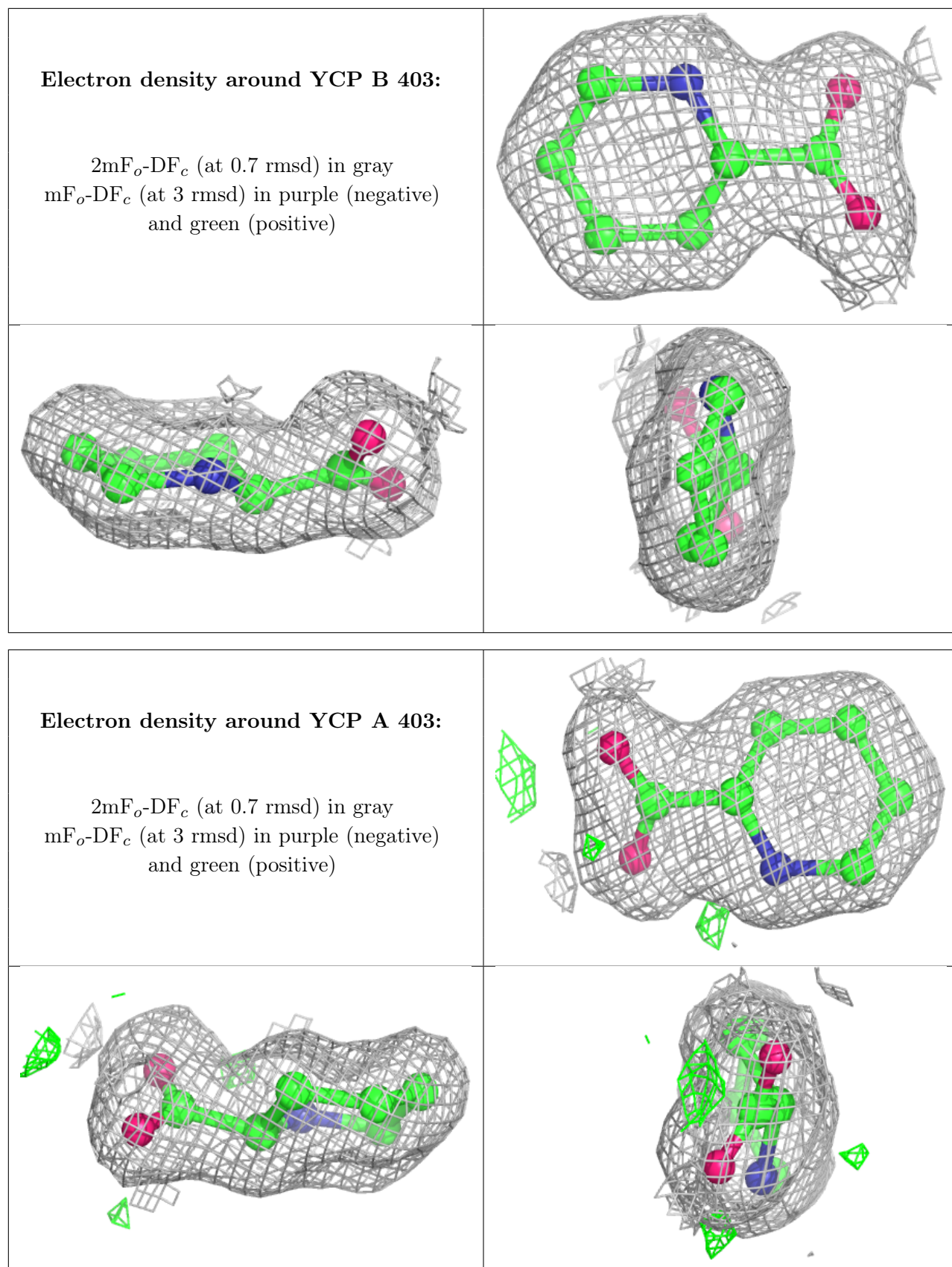
Electron density around YCP E 402:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
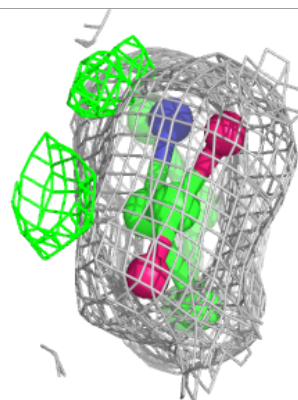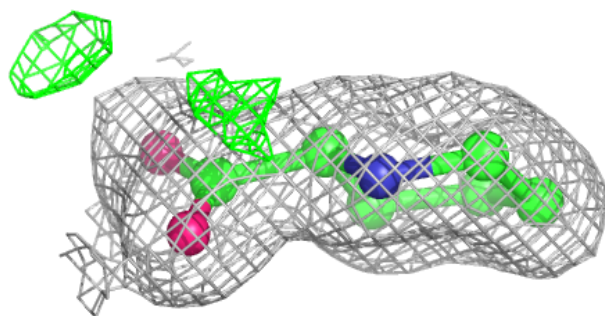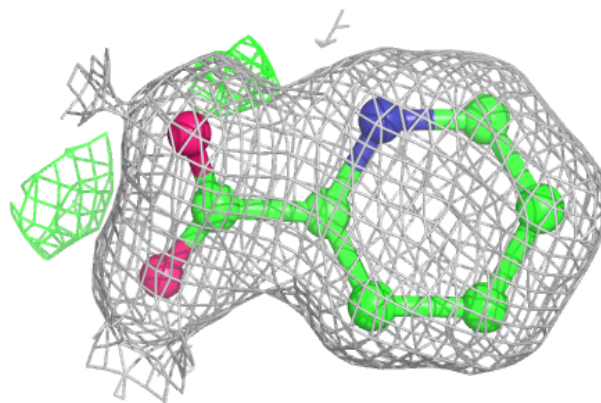
Electron density around NAI C 401:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
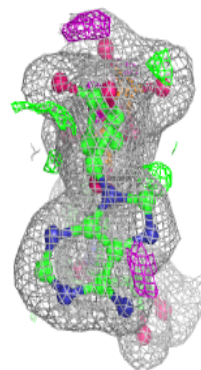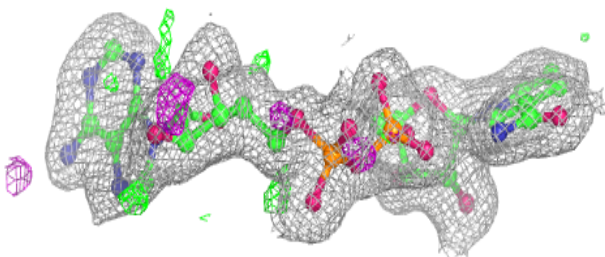
Electron density around NAI D 401:

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

Electron density around NAI E 401:

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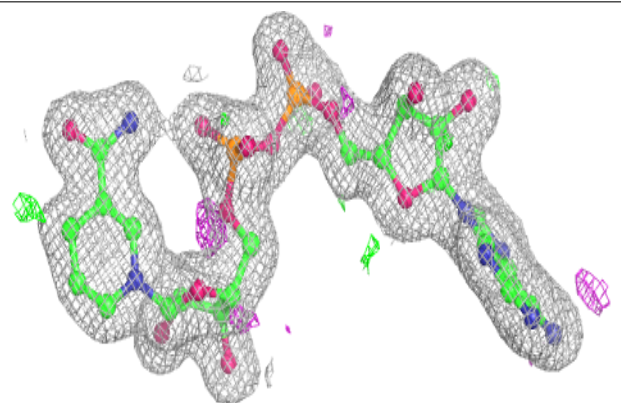mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around NAI B 401:

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

Electron density around NAI A 401:

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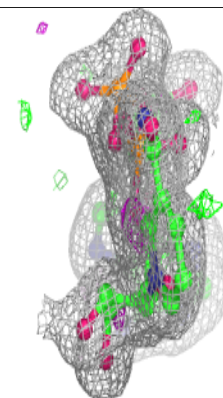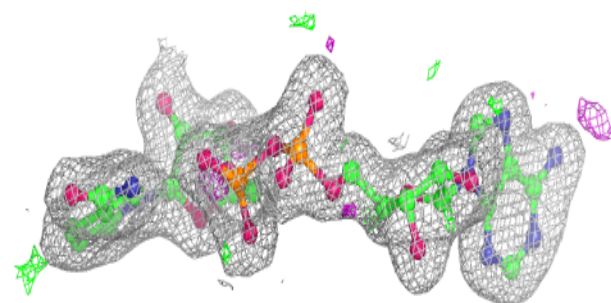
6.5 Other polymers (i)

There are no such residues in this entry.