Full wwPDB X-ray Structure Validation Report ⓘ

Sep 24, 2023 – 11:38 AM EDT

PDB ID	:	5U8Y
Title	:	Crystal structure of Co-CAO1
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Deposited on	:	2016-12-15
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:

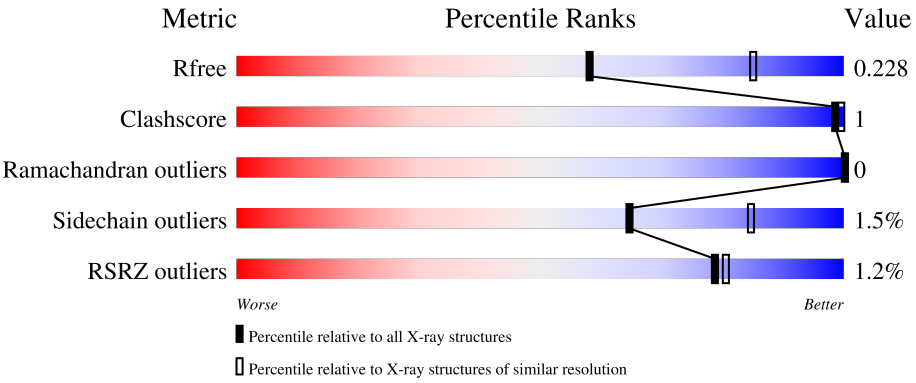
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

1 Overall quality at a glance (i)

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}	130704	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)
RSRZ outliers	127900	4559 (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 <=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	526	93% · 6%
1	B	526	2% 91% · 6%
1	C	526	91% · 5%
1	D	526	92% · 6%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 16839 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 Carotenoid oxygenase 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	497	Total 3981	C 2554	N 676	O 731	S 20	0	0	0
1	B	497	Total 3992	C 2563	N 677	O 732	S 20	0	1	0
1	C	498	Total 3990	C 2559	N 677	O 734	S 20	0	0	0
1	D	497	Total 3988	C 2559	N 677	O 732	S 20	0	1	0

- Molecule 2 is COBALT (II) ION (three-letter code: CO) (formula: Co).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total 1	Co 1	0	0
2	B	1	Total 1	Co 1	0	0
2	C	1	Total 1	Co 1	0	0
2	D	1	Total 1	Co 1	0	0

- Molecule 3 is water.

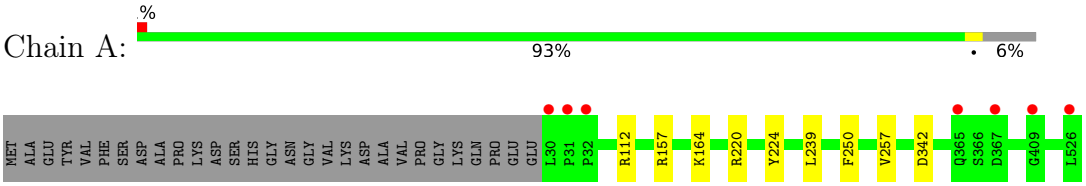
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	200	Total 200	O 200	0	0
3	B	221	Total 221	O 221	0	0
3	C	231	Total 231	O 231	0	0
3	D	232	Total 232	O 232	0	0

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.

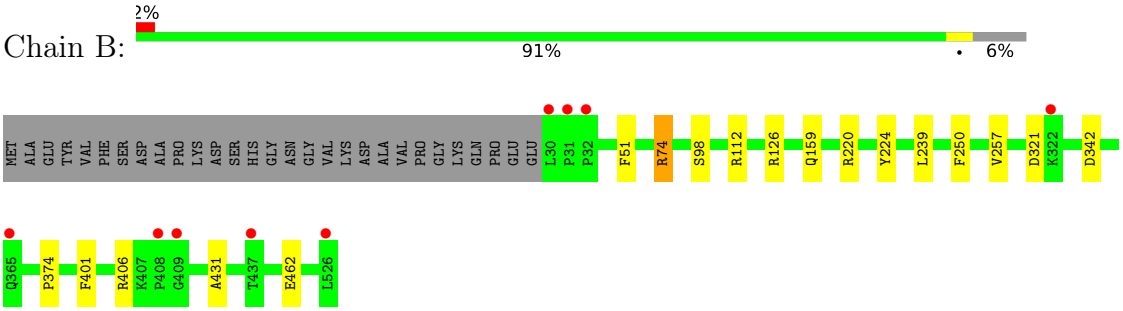
• Molecule 1: Carotenoid oxygenase 1

Chain A:



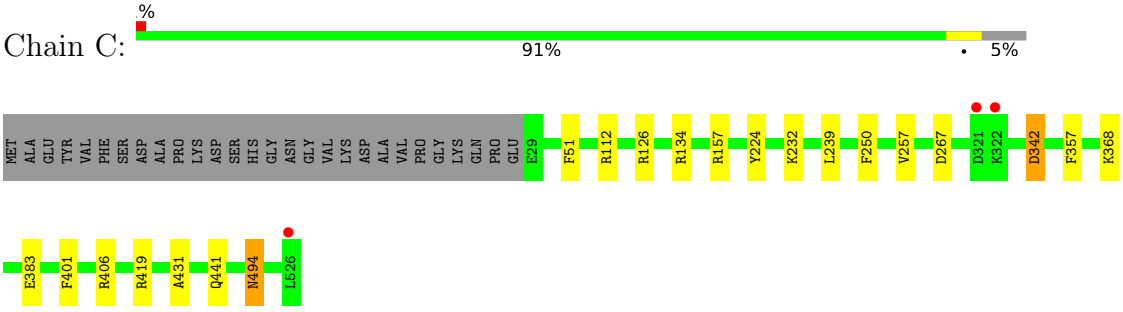
• Molecule 1: Carotenoid oxygenase 1

Chain B:



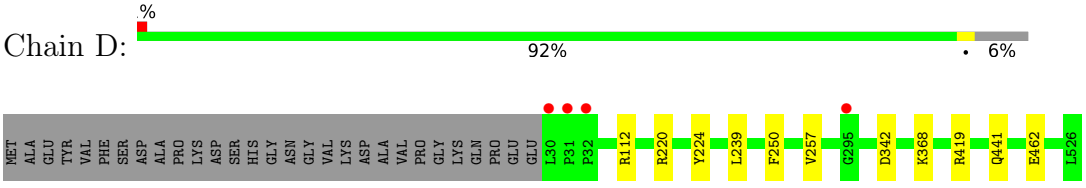
• Molecule 1: Carotenoid oxygenase 1

Chain C:



• Molecule 1: Carotenoid oxygenase 1

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α, β, γ	100.44Å 100.44Å 447.98Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	49.00 – 2.50 49.00 – 2.50	Depositor EDS
% Data completeness (in resolution range)	99.5 (49.00-2.50) 99.5 (49.00-2.50)	Depositor EDS
R_{merge}	0.28	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.24 (at 2.51Å)	Xtriage
Refinement program	REFMAC 5.8.0155	Depositor
R, R_{free}	0.185 , 0.223 0.191 , 0.228	Depositor DCC
R_{free} test set	4453 reflections (4.84%)	wwPDB-VP
Wilson B-factor (Å^2)	35.7	Xtriage
Anisotropy	0.128	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 41.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	0.032 for -h,-k,l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	16839	wwPDB-VP
Average B, all atoms (Å^2)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.50% of the height of the origin peak. No significant pseudotranslation is detected.*

[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: CO

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	0.58	0/4105	0.79	2/5579 (0.0%)
1	B	0.59	0/4117	0.79	4/5595 (0.1%)
1	C	0.60	1/4114 (0.0%)	0.80	5/5591 (0.1%)
1	D	0.58	0/4112	0.78	1/5589 (0.0%)
All	All	0.59	1/16448 (0.0%)	0.79	12/22354 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	494	ASN	CB-CG	5.94	1.64	1.51

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	74	ARG	NE-CZ-NH2	7.52	124.06	120.30
1	B	220	ARG	NE-CZ-NH1	7.29	123.94	120.30
1	D	220	ARG	NE-CZ-NH2	6.65	123.62	120.30
1	C	134	ARG	NE-CZ-NH2	-6.59	117.00	120.30
1	A	220	ARG	NE-CZ-NH2	-6.21	117.20	120.30
1	A	157	ARG	NE-CZ-NH2	-5.59	117.51	120.30
1	C	267	ASP	CB-CG-OD1	5.44	123.19	118.30
1	C	126	ARG	NE-CZ-NH1	5.24	122.92	120.30
1	B	74	ARG	NE-CZ-NH1	-5.19	117.71	120.30
1	C	157	ARG	NE-CZ-NH2	-5.09	117.75	120.30
1	C	342	ASP	CB-CG-OD1	5.09	122.88	118.30
1	B	126	ARG	NE-CZ-NH2	5.08	122.84	120.30

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts (i)

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	3981	0	3807	2	0
1	B	3992	0	3815	7	0
1	C	3990	0	3813	7	0
1	D	3988	0	3815	3	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
3	A	200	0	0	1	0
3	B	221	0	0	2	0
3	C	231	0	0	3	0
3	D	232	0	0	2	0
All	All	16839	0	15250	17	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 1.

All (17) 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:C:494:ASN:HB2	3:C:856:HOH:O	1.80	0.81
1:B:51[B]:PHE:CE1	1:C:51:PHE:HD2	2.01	0.77
1:B:51[B]:PHE:CE1	1:C:51:PHE:CD2	2.84	0.65
1:D:441:GLN:NE2	3:D:701:HOH:O	2.27	0.64
1:C:419:ARG:HD2	3:C:724:HOH:O	2.05	0.57
1:D:419:ARG:HD2	3:D:744:HOH:O	2.10	0.52
1:A:164:LYS:HE2	3:A:766:HOH:O	2.10	0.51
1:C:441:GLN:NE2	3:C:708:HOH:O	2.43	0.50
1:B:159:GLN:HG3	3:B:709:HOH:O	2.13	0.49
1:B:224:TYR:CE1	1:B:257:VAL:HG11	2.54	0.43
1:D:224:TYR:CE1	1:D:257:VAL:HG11	2.54	0.43
1:A:224:TYR:CE1	1:A:257:VAL:HG11	2.54	0.42
1:C:224:TYR:CE1	1:C:257:VAL:HG11	2.55	0.42
1:B:74:ARG:HG2	1:B:98:SER:HB2	2.02	0.42
1:B:401:PHE:CE1	1:B:431:ALA:HB3	2.56	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:374:PRO:HA	3:B:824:HOH:O	2.19	0.41
1:C:401:PHE:CE1	1:C:431:ALA:HB3	2.55	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	495/526 (94%)	484 (98%)	11 (2%)	0	100	100
1	B	496/526 (94%)	486 (98%)	10 (2%)	0	100	100
1	C	496/526 (94%)	485 (98%)	11 (2%)	0	100	100
1	D	496/526 (94%)	485 (98%)	11 (2%)	0	100	100
All	All	1983/2104 (94%)	1940 (98%)	43 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	422/445 (95%)	418 (99%)	4 (1%)	78	92
1	B	423/445 (95%)	416 (98%)	7 (2%)	60	82
1	C	423/445 (95%)	414 (98%)	9 (2%)	53	78

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	D	423/445 (95%)	417 (99%)	6 (1%)	67 86
All	All	1691/1780 (95%)	1665 (98%)	26 (2%)	65 85

All (26) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	112	ARG
1	A	239	LEU
1	A	250	PHE
1	A	342	ASP
1	B	112	ARG
1	B	239	LEU
1	B	250	PHE
1	B	321	ASP
1	B	342	ASP
1	B	406	ARG
1	B	462	GLU
1	C	112	ARG
1	C	232	LYS
1	C	239	LEU
1	C	250	PHE
1	C	342	ASP
1	C	357	PHE
1	C	368	LYS
1	C	383	GLU
1	C	406	ARG
1	D	112	ARG
1	D	239	LEU
1	D	250	PHE
1	D	342	ASP
1	D	368	LYS
1	D	462	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA

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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 4 ligands modelled in this entry, 4 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, 95^{th} 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	497/526 (94%)	-0.34	7 (1%)	75 77	24, 40, 65, 95	0
1	B	497/526 (94%)	-0.32	9 (1%)	68 71	23, 35, 61, 91	0
1	C	498/526 (94%)	-0.31	3 (0%)	89 90	22, 37, 59, 88	0
1	D	497/526 (94%)	-0.44	4 (0%)	86 87	21, 34, 56, 75	0
All	All	1989/2104 (94%)	-0.35	23 (1%)	79 80	21, 36, 61, 95	0

All (23) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	30	LEU	3.4
1	D	32	PRO	3.2
1	A	32	PRO	2.8
1	A	365	GLN	2.7
1	D	30	LEU	2.7
1	B	409	GLY	2.6
1	B	322	LYS	2.6
1	B	30	LEU	2.6
1	A	409	GLY	2.5
1	B	365	GLN	2.5
1	B	408	PRO	2.4
1	C	321	ASP	2.3
1	A	526	LEU	2.3
1	C	322	LYS	2.2
1	D	295	GLY	2.2
1	B	31	PRO	2.2
1	C	526	LEU	2.1
1	B	32	PRO	2.1
1	D	31	PRO	2.1
1	B	526	LEU	2.1
1	B	437	THR	2.0

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Mol	Chain	Res	Type	RSRZ
1	A	367	ASP	2.0
1	A	31	PRO	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 monosaccharides 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, 95^{th} 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
2	CO	A	601	1/1	0.99	0.17	33,33,33,33	0
2	CO	C	601	1/1	0.99	0.12	30,30,30,30	0
2	CO	D	601	1/1	0.99	0.12	31,31,31,31	0
2	CO	B	601	1/1	1.00	0.14	28,28,28,28	0

6.5 Other polymers (i)

There are no such residues in this entry.