wwPDB X-ray Structure Validation Summary Report (i)

Sep 12, 2016 – 02:05 PM EDT

PDB ID	:	5KJA
Title	:	Synechocystis apocarotenoid oxygenase (ACO) mutant - Trp149Ala
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Deposited on	:	2016-06-18
Resolution	:	2.80 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at *validation@mail.wwpdb.org*
A user guide is available at
http://wwpdb.org/validation/2016/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

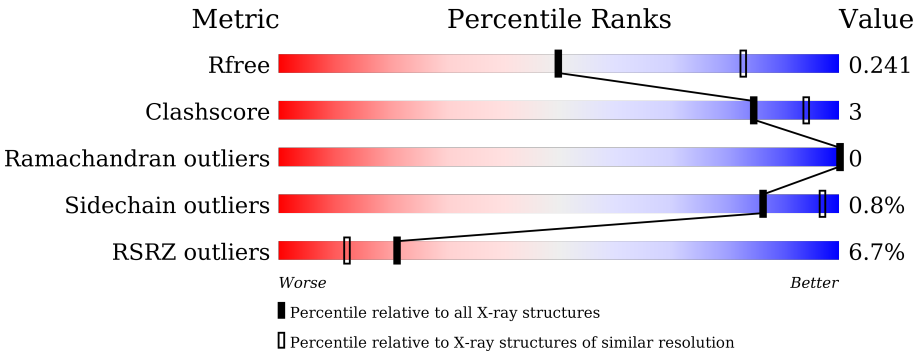
MolProbity	:	4.02b-467
Mogul	:	unknown
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20027939
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20027939

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 2.80 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}	91344	2393 (2.80-2.80)
Clashscore	102246	2827 (2.80-2.80)
Ramachandran outliers	100387	2782 (2.80-2.80)
Sidechain outliers	100360	2784 (2.80-2.80)
RSRZ outliers	91569	2404 (2.80-2.80)

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 on the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria. 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	490	91% 7% •
1	B	490	91% 7% •
1	C	490	90% 8% •
1	D	490	90% 7% •
1	E	490	32% 91% 7% •

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 18975 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 Apocarotenoid-15,15'-oxygenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	482	Total	C	N	O	S	0	0	0
			3778	2420	652	696	10			
1	B	479	Total	C	N	O	S	0	0	0
			3759	2409	649	691	10			
1	C	479	Total	C	N	O	S	0	0	0
			3759	2409	649	691	10			
1	D	479	Total	C	N	O	S	0	0	0
			3759	2409	649	691	10			
1	E	479	Total	C	N	O	S	0	0	0
			3759	2409	649	691	10			

There are 5 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	149	ALA	TRP	engineered mutation	UNP P74334
B	149	ALA	TRP	engineered mutation	UNP P74334
C	149	ALA	TRP	engineered mutation	UNP P74334
D	149	ALA	TRP	engineered mutation	UNP P74334
E	149	ALA	TRP	engineered mutation	UNP P74334

- Molecule 2 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Cl	0	0
			1	1		
2	A	1	Total	Cl	0	0
			1	1		

- Molecule 3 is FE (II) ION (three-letter code: FE2) (formula: Fe).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	1	Total Fe 1 1	0	0
3	A	1	Total Fe 1 1	0	0
3	D	1	Total Fe 1 1	0	0
3	C	1	Total Fe 1 1	0	0
3	E	1	Total Fe 1 1	0	0

- Molecule 4 is water.

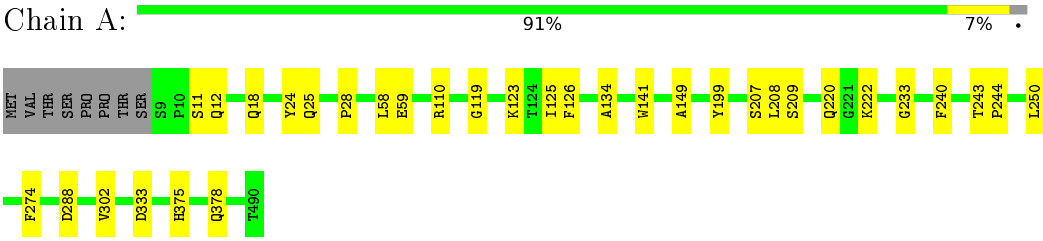
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	49	Total O 49 49	0	0
4	B	39	Total O 39 39	0	0
4	C	39	Total O 39 39	0	0
4	D	26	Total O 26 26	0	0
4	E	1	Total O 1 1	0	0

3 Residue-property plots (i)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

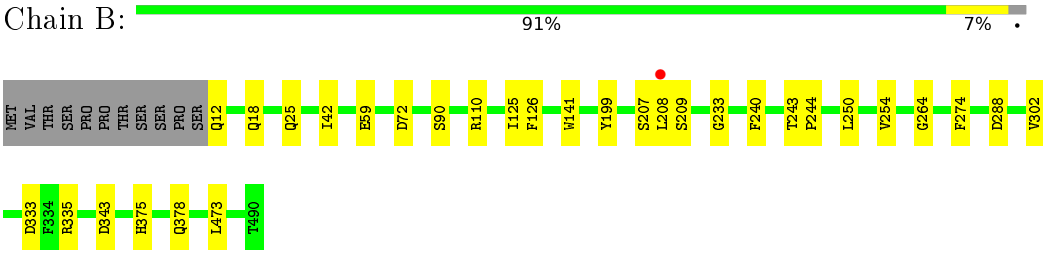
- Molecule 1: Apocarotenoid-15,15'-oxygenase

Chain A:



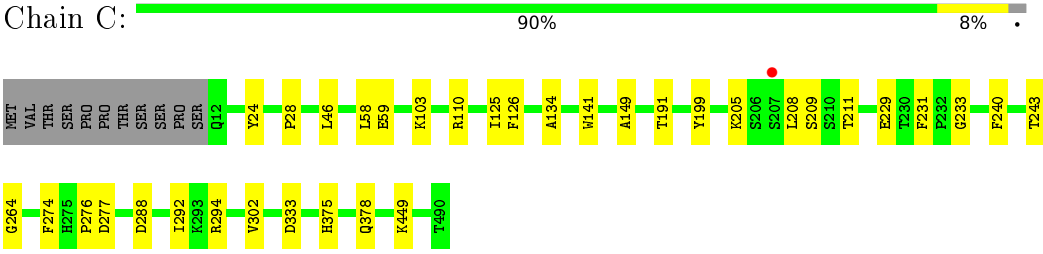
- Molecule 1: Apocarotenoid-15,15'-oxygenase

Chain B:



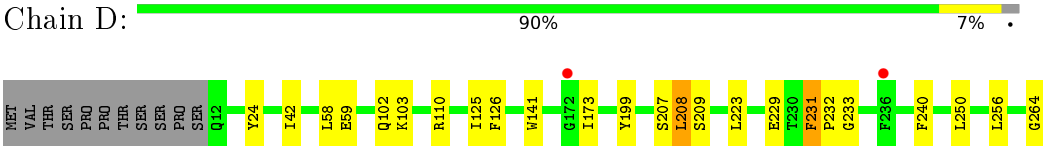
- Molecule 1: Apocarotenoid-15,15'-oxygenase

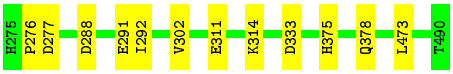
Chain C:



- Molecule 1: Apocarotenoid-15,15'-oxygenase

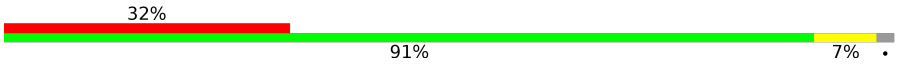
Chain D:

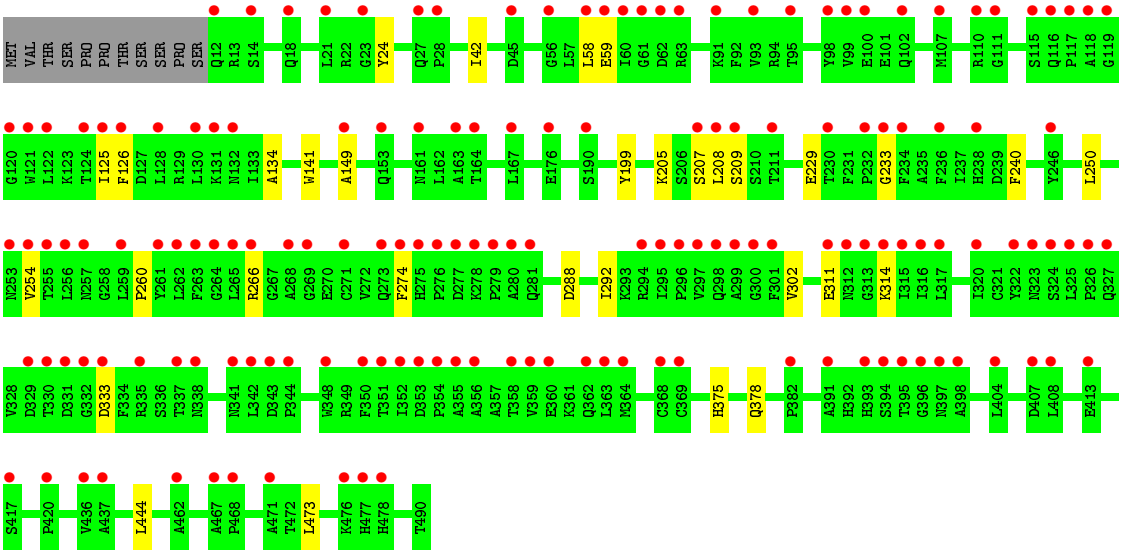




• Molecule 1: Apocarotenoid-15,15'-oxygenase

Chain E:





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	118.14Å 125.26Å 203.57Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.62 – 2.80 47.31 – 2.80	Depositor EDS
% Data completeness (in resolution range)	100.0 (48.62-2.80) 100.0 (47.31-2.80)	Depositor EDS
R_{merge}	0.19	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.34 (at 2.81Å)	Xtriage
Refinement program	REFMAC 5.8.0049	Depositor
R, R_{free}	0.198 , 0.239 0.203 , 0.241	Depositor DCC
R_{free} test set	3595 reflections (5.03%)	DCC
Wilson B-factor (Å^2)	64.7	Xtriage
Anisotropy	0.040	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.29 , 43.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.45$, $< L^2 > = 0.28$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	18975	wwPDB-VP
Average B, all atoms (Å^2)	75.0	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: FE2, CL

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	0.63	0/3890	0.72	2/5297 (0.0%)
1	B	0.61	0/3870	0.71	2/5269 (0.0%)
1	C	0.60	0/3870	0.71	2/5269 (0.0%)
1	D	0.59	0/3870	0.71	2/5269 (0.0%)
1	E	0.45	0/3870	0.66	3/5269 (0.1%)
All	All	0.58	0/19370	0.70	11/26373 (0.0%)

There are no bond length outliers.

The worst 5 of 11 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	288	ASP	CB-CG-OD1	6.93	124.53	118.30
1	D	288	ASP	CB-CG-OD2	6.77	124.39	118.30
1	E	288	ASP	CB-CG-OD1	6.46	124.11	118.30
1	B	288	ASP	CB-CG-OD1	6.33	124.00	118.30
1	E	444	LEU	CB-CG-CD1	6.29	121.70	111.00

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	3778	0	3671	20	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	3759	0	3654	21	0
1	C	3759	0	3654	30	1
1	D	3759	0	3654	28	0
1	E	3759	0	3654	15	1
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
3	E	1	0	0	0	0
4	A	49	0	0	0	0
4	B	39	0	0	3	0
4	C	39	0	0	3	0
4	D	26	0	0	1	0
4	E	1	0	0	0	0
All	All	18975	0	18287	109	1

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 3.

The worst 5 of 109 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:D:291:GLU:HA	4:D:624:HOH:O	1.65	0.97
1:C:229:GLU:HG3	1:C:292:ILE:HD11	1.65	0.79
1:A:119:GLY:HA3	1:A:123:LYS:HG3	1.64	0.78
1:D:229:GLU:HG3	1:D:292:ILE:HD11	1.68	0.75
1:E:254:VAL:HG22	1:E:274:PHE:CD1	2.30	0.67

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:209:SER:OG	1:E:205:LYS:NZ[2_545]	2.11	0.09

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	480/490 (98%)	466 (97%)	14 (3%)	0	100	100
1	B	477/490 (97%)	463 (97%)	14 (3%)	0	100	100
1	C	477/490 (97%)	462 (97%)	15 (3%)	0	100	100
1	D	477/490 (97%)	463 (97%)	14 (3%)	0	100	100
1	E	477/490 (97%)	463 (97%)	14 (3%)	0	100	100
All	All	2388/2450 (98%)	2317 (97%)	71 (3%)	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	401/409 (98%)	396 (99%)	5 (1%)	78	95
1	B	398/409 (97%)	395 (99%)	3 (1%)	86	97
1	C	398/409 (97%)	396 (100%)	2 (0%)	92	98
1	D	398/409 (97%)	394 (99%)	4 (1%)	82	96
1	E	398/409 (97%)	396 (100%)	2 (0%)	92	98
All	All	1993/2045 (98%)	1977 (99%)	16 (1%)	86	97

5 of 16 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	240	PHE
1	C	59	GLU
1	D	231	PHE
1	B	59	GLU
1	D	240	PHE

Some 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

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

5.5 Carbohydrates

There are no carbohydrates in this entry.

5.6 Ligand geometry

Of 7 ligands modelled in this entry, 7 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

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, 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	482/490 (98%)	-0.42	0 100 100	31, 55, 94, 144	0
1	B	479/490 (97%)	-0.33	1 (0%) 95 94	34, 56, 94, 132	0
1	C	479/490 (97%)	-0.35	1 (0%) 95 94	34, 57, 97, 177	0
1	D	479/490 (97%)	-0.29	2 (0%) 93 90	36, 63, 107, 168	0
1	E	479/490 (97%)	1.48	156 (32%) 1 0	81, 130, 185, 240	0
All	All	2398/2450 (97%)	0.02	160 (6%) 21 12	31, 63, 152, 240	0

The worst 5 of 160 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	263	PHE	8.6
1	E	124	THR	7.5
1	E	256	LEU	6.9
1	E	118	ALA	6.7
1	E	125	ILE	6.6

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 carbohydrates 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. LLDF column lists the quality of electron

density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å^2)	Q<0.9
2	CL	A	501	1/1	0.96	0.14	-0.51	61,61,61,61	0
3	FE2	C	501	1/1	0.95	0.15	-0.88	91,91,91,91	0
3	FE2	E	501	1/1	0.81	0.14	-0.91	152,152,152,152	0
3	FE2	D	501	1/1	0.95	0.12	-1.69	96,96,96,96	0
3	FE2	B	502	1/1	0.86	0.11	-1.84	97,97,97,97	0
3	FE2	A	502	1/1	0.89	0.10	-2.05	96,96,96,96	0
2	CL	B	501	1/1	0.96	0.10	-3.14	56,56,56,56	0

6.5 Other polymers (i)

There are no such residues in this entry.