



# Full wwPDB X-ray Structure Validation Report ⓘ

May 29, 2020 – 05:45 am BST

PDB ID : 4PUT  
Title : Crystal structure of the Arabidopsis thaliana TOP2 oligopeptidase  
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Deposited on : 2014-03-13  
Resolution : 3.00 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](mailto: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.

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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	:	2.11
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)	:	2.11

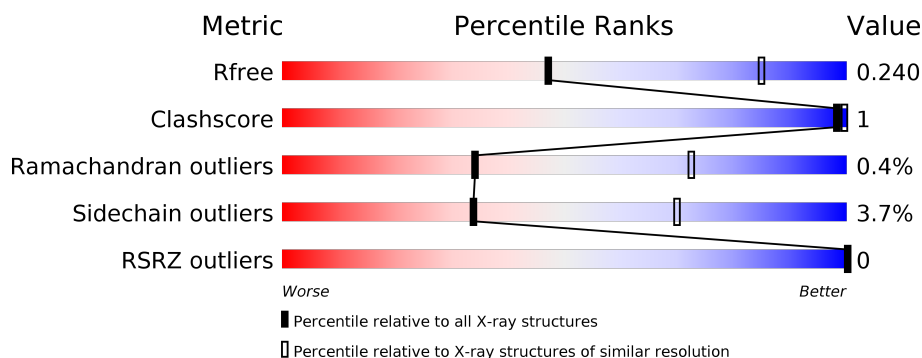
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.00 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	2092 (3.00-3.00)
Clashscore	141614	2416 (3.00-3.00)
Ramachandran outliers	138981	2333 (3.00-3.00)
Sidechain outliers	138945	2336 (3.00-3.00)
RSRZ outliers	127900	1990 (3.00-3.00)

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  $\geq 3$ , 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	721	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 10993 atoms, of which 5474 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 Cytosolic oligopeptidase A.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	692	Total	C	H	N	O	S	0	0	0
			10991	3519	5474	941	1040	17			

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	EXPRESSION TAG	UNP Q949P2
A	-18	GLY	-	EXPRESSION TAG	UNP Q949P2
A	-17	SER	-	EXPRESSION TAG	UNP Q949P2
A	-16	SER	-	EXPRESSION TAG	UNP Q949P2
A	-15	HIS	-	EXPRESSION TAG	UNP Q949P2
A	-14	HIS	-	EXPRESSION TAG	UNP Q949P2
A	-13	HIS	-	EXPRESSION TAG	UNP Q949P2
A	-12	HIS	-	EXPRESSION TAG	UNP Q949P2
A	-11	HIS	-	EXPRESSION TAG	UNP Q949P2
A	-10	HIS	-	EXPRESSION TAG	UNP Q949P2
A	-9	SER	-	EXPRESSION TAG	UNP Q949P2
A	-8	SER	-	EXPRESSION TAG	UNP Q949P2
A	-7	GLY	-	EXPRESSION TAG	UNP Q949P2
A	-6	LEU	-	EXPRESSION TAG	UNP Q949P2
A	-5	VAL	-	EXPRESSION TAG	UNP Q949P2
A	-4	PRO	-	EXPRESSION TAG	UNP Q949P2
A	-3	ARG	-	EXPRESSION TAG	UNP Q949P2
A	-2	GLY	-	EXPRESSION TAG	UNP Q949P2
A	-1	SER	-	EXPRESSION TAG	UNP Q949P2
A	0	HIS	-	EXPRESSION TAG	UNP Q949P2

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

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

- Molecule 3 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

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

**i**

- Molecule 1: Cytosolic oligopeptidase A

91%



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 63 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	168.74Å 168.74Å 175.59Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	48.09 – 3.00 48.09 – 3.00	Depositor EDS
% Data completeness (in resolution range)	94.0 (48.09-3.00) 93.9 (48.09-3.00)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.59 (at 3.01Å)	Xtriage
Refinement program	PRIMEX	Depositor
R, $R_{free}$	0.207 , 0.247 0.203 , 0.240	Depositor DCC
$R_{free}$ test set	1457 reflections (4.92%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	53.2	Xtriage
Anisotropy	0.230	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 33.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	10993	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.52% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, 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	0/5645	0.93	1/7645 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	A	222	PRO	N-CA-CB	8.99	114.08	103.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	221	GLY	Peptide

### 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	5517	5474	5469	7	0
2	A	1	0	0	0	0
3	A	1	0	0	0	0
All	All	5519	5474	5469	7	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 (7) 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:567:LYS:O	1:A:571:VAL:HG23	1.94	0.68
1:A:593:ARG:HH11	1:A:593:ARG:HG3	1.69	0.57
1:A:571:VAL:HG21	1:A:609:PHE:HZ	1.69	0.57
1:A:671:LYS:HG2	1:A:676:VAL:HG22	1.90	0.53
1:A:593:ARG:CG	1:A:593:ARG:HH11	2.27	0.47
1:A:326:PHE:HZ	1:A:353:SER:HG	1.66	0.44
1:A:324:LYS:HG2	1:A:336:ASP:H	1.84	0.42

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	690/721 (96%)	669 (97%)	18 (3%)	3 (0%)	34 72

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	222	PRO
1	A	556	PHE
1	A	214	GLU



### 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	591/614 (96%)	569 (96%)	22 (4%)	34 70

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	55	TRP
1	A	99	LYS
1	A	173	SER
1	A	193	ILE
1	A	219	ASP
1	A	247	GLU
1	A	262	ASP
1	A	268	ASP
1	A	275	LEU
1	A	288	GLU
1	A	321	GLU
1	A	328	LYS
1	A	349	ARG
1	A	370	LYS
1	A	373	ASP
1	A	434	MET
1	A	476	ARG
1	A	484	GLU
1	A	501	VAL
1	A	593	ARG
1	A	606	GLU
1	A	661	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	78	HIS
1	A	96	GLN
1	A	446	GLN

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Mol	Chain	Res	Type
1	A	517	GLN
1	A	658	GLN

### 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 2 ligands modelled in this entry, 2 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 [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

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<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	692/721 (95%)	-0.21	0 100 100	13, 45, 73, 91	0

There are no RSRZ outliers to report.

### 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 carbohydrates 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<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
2	ZN	A	801	1/1	0.97	0.22	30,30,30,30	0
3	CL	A	802	1/1	0.97	0.22	46,46,46,46	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.