wwPDB X-ray Structure Validation Summary Report (i)

Apr 28, 2024 – 11:39 pm BST

PDB ID	:	5A2O
Title	:	Crystal structure of the nitrate transporter NRT1.1 from Arabidopsis thaliana in complex with nitrate.
Authors	:	Parker, J.L.; Newstead, S.
Deposited on	:	2015-05-20
Resolution	:	3.71 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
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) 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 (i)) were used in the production of this report:

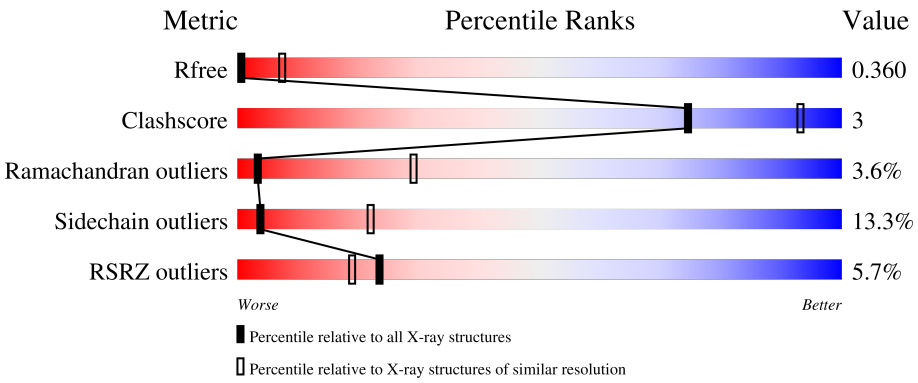
MolProbity	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

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 3.71 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	1089 (3.90-3.54)
Clashscore	141614	1012 (3.88-3.56)
Ramachandran outliers	138981	1114 (3.90-3.54)
Sidechain outliers	138945	1110 (3.90-3.54)
RSRZ outliers	127900	1020 (3.90-3.54)

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	590	3% 64% 14% • 20%
1	B	590	6% 63% 15% • 20%

2 Entry composition (i)

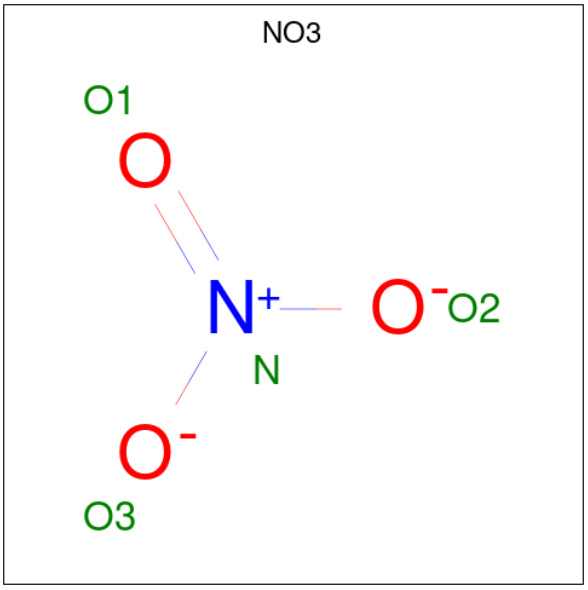
There are 2 unique types of molecules in this entry. The entry contains 13874 atoms, of which 6558 are hydrogens and 0 are deuteriums.

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 NITRATE TRANSPORTER 1.1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	470	6933	2408	3279	599	629	18	0	0	0
1	B	470	6933	2408	3279	599	629	18	0	0	0

- Molecule 2 is NITRATE ION (three-letter code: NO3) (formula: NO_3).



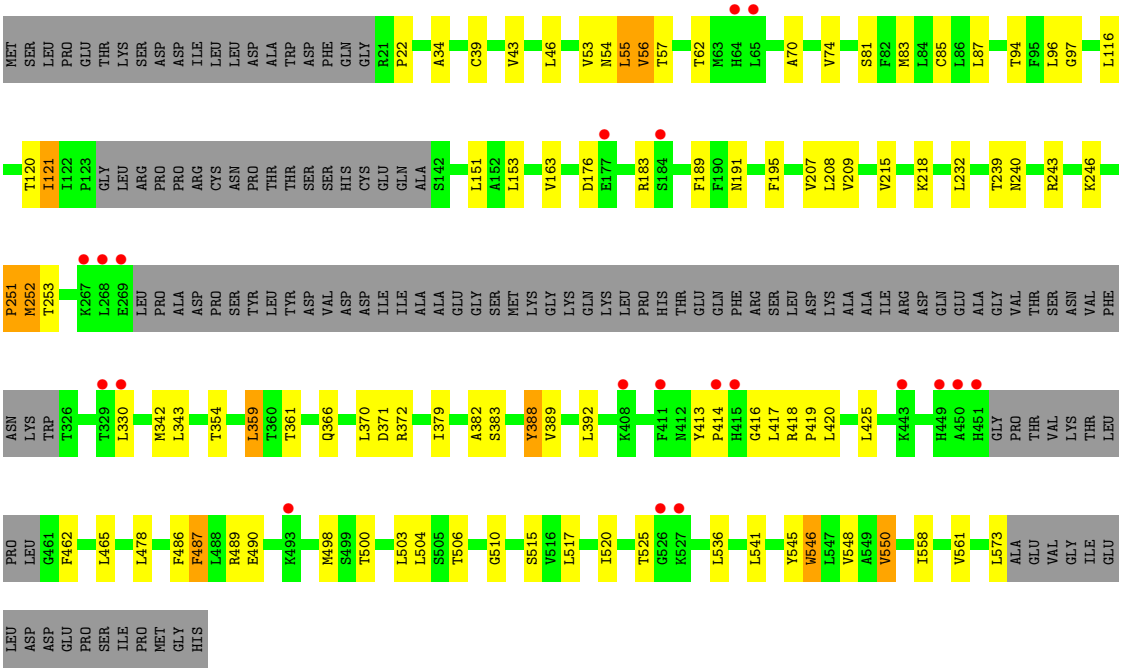
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	N	O		
2	A	1	4	1	3	0	0
2	B	1	4	1	3	0	0

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.

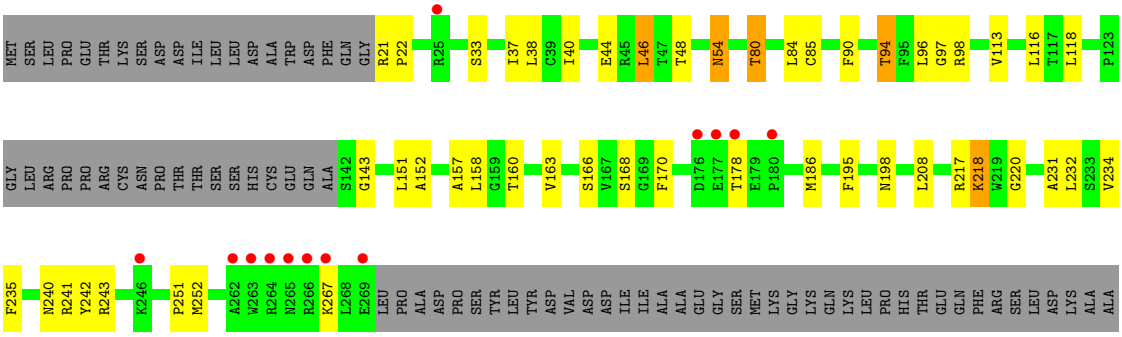
• Molecule 1: NITRATE TRANSPORTER 1.1

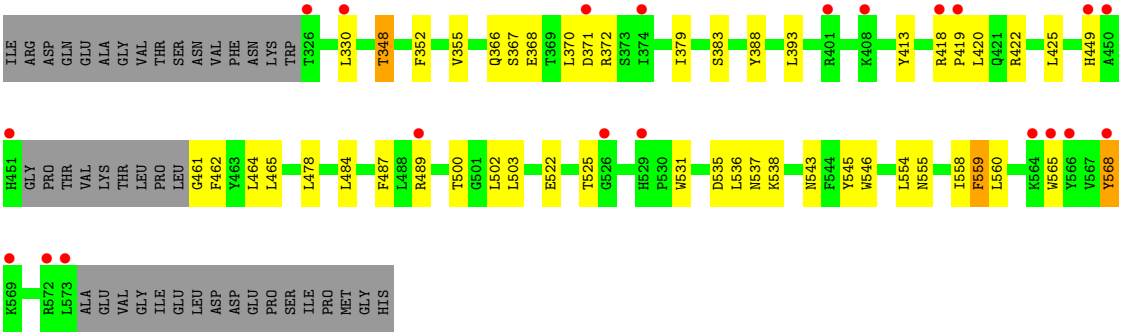
Chain A:



• Molecule 1: NITRATE TRANSPORTER 1.1

Chain B:




ILE
ARG
ASP
GLN
GLU
ALA
GLY
VAL
THR
SER
ASN
VAL
PHE
ASN
LYS
TRP
T326
L330
T348
F352
V355
Q366
S367
E368
T369
L370
D371
R372
S373
I374
I379
S383
Y388
L393
R401
K408
Y413
R418
P419
L420
Q421
R422
L425
H449
A450
H451
GLY
PRO
THR
VAL
LYS
THR
LEU
PRO
LEU
G461
F462
Y463
L464
L465
L478
L484
F487
L488
R489
T500
G501
L502
L503
E522
T525
G526
H529
P530
W531
D535
L536
N537
K538
N543
F544
Y545
W546
L554
N555
I558
F559
L560
K564
W565
Y566
V567
Y568
K569
R572
L573
ALA
GLU
VAL
GLY
ILE
GLU
LEU
ASP
ASP
GLU
PRO
SER
ILE
PRO
MET
GLY
HIS

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	121.83Å 123.59Å 153.62Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	27.74 – 3.71 27.60 – 3.71	Depositor EDS
% Data completeness (in resolution range)	87.7 (27.74-3.71) 87.9 (27.60-3.71)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.15 (at 3.74Å)	Xtriage
Refinement program	BUSTER 2.10.0	Depositor
R, R_{free}	0.287 , 0.328 0.316 , 0.360	Depositor DCC
R_{free} test set	1121 reflections (5.09%)	wwPDB-VP
Wilson B-factor (Å^2)	105.7	Xtriage
Anisotropy	0.028	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , 134.9	EDS
L-test for twinning[2]	$< \|L\| > = 0.44$, $< L^2 > = 0.26$	Xtriage
Estimated twinning fraction	0.039 for k,h,-l	Xtriage
F_o,F_c correlation	0.82	EDS
Total number of atoms	13874	wwPDB-VP
Average B, all atoms (Å^2)	106.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.61% 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 (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: NO3

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	0.50	0/3734	0.66	0/5067
1	B	0.51	0/3734	0.67	0/5067
All	All	0.50	0/7468	0.66	0/10134

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 (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	3654	3279	3786	21	0
1	B	3654	3279	3786	27	0
2	A	4	0	0	0	0
2	B	4	0	0	0	0
All	All	7316	6558	7572	48	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 3.

The worst 5 of 48 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:B:80:THR:HG23	1:B:84:LEU:HD23	1.66	0.77
1:A:56:VAL:HG22	1:A:74:VAL:HG21	1.69	0.73
1:B:80:THR:HG22	1:B:157:ALA:HB1	1.81	0.63
1:A:354:THR:HG22	1:A:510:GLY:O	2.00	0.61
1:A:388:TYR:CZ	1:A:392:LEU:HD11	2.36	0.61

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	462/590 (78%)	405 (88%)	39 (8%)	18 (4%)	3 27
1	B	462/590 (78%)	400 (87%)	47 (10%)	15 (3%)	4 31
All	All	924/1180 (78%)	805 (87%)	86 (9%)	33 (4%)	3 29

5 of 33 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	22	PRO
1	A	240	ASN
1	A	252	MET
1	A	413	TYR
1	A	414	PRO

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	386/489 (79%)	332 (86%)	54 (14%)	3 20
1	B	386/489 (79%)	337 (87%)	49 (13%)	4 23
All	All	772/978 (79%)	669 (87%)	103 (13%)	4 22

5 of 103 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	44	GLU
1	B	186	MET
1	B	536	LEU
1	B	48	THR
1	B	116	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	212	GLN
1	A	240	ASN
1	A	555	ASN
1	B	72	ASN

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 monosaccharides in this entry.

5.6 Ligand geometry (i)

2 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	$\#\|Z\| > 2$
2	NO3	B	1574	-	1,3,3	0.17	0	0,3,3	-	-
2	NO3	A	1574	-	1,3,3	0.42	0	0,3,3	-	-

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 (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, 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	470/590 (79%)	-0.05	20 (4%)	35	29	5, 91, 271, 300	0
1	B	470/590 (79%)	0.09	34 (7%)	15	12	3, 86, 234, 299	0
All	All	940/1180 (79%)	0.02	54 (5%)	23	19	3, 88, 245, 300	0

The worst 5 of 54 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	330	LEU	5.9
1	B	569	LYS	5.7
1	B	371	ASP	5.5
1	B	573	LEU	5.0
1	B	568	TYR	4.9

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, 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
2	NO3	A	1574	4/4	0.81	0.67	64,68,68,70	0
2	NO3	B	1574	4/4	0.81	0.55	64,68,68,70	0

6.5 Other polymers (i)

There are no such residues in this entry.