



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 20, 2026 – 10:09 AM UTC

PDB ID : 7RBP / pdb_00007rbp
Title : Medicago truncatula D-1-piperidine-2-carboxylic acid reductase
Authors : Torrens-spence, M.P.; Weng, J.K.
Deposited on : 2021-07-06
Resolution : 2.10 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	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

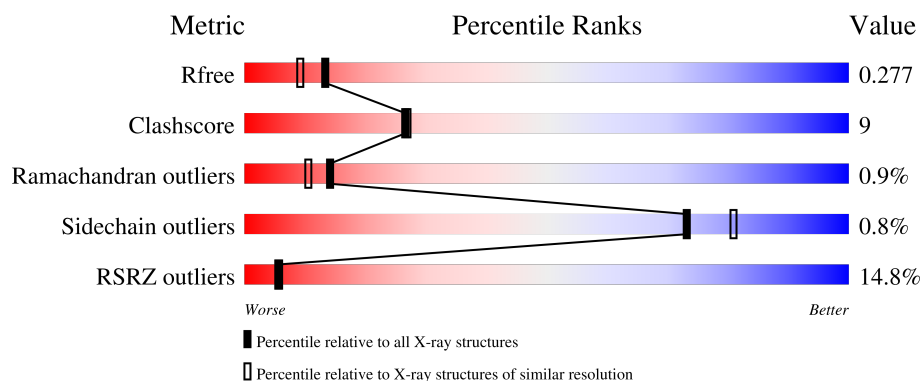
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.10 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}	180053	6658 (2.10-2.10)
Clashscore	190562	7164 (2.10-2.10)
Ramachandran outliers	187476	7099 (2.10-2.10)
Sidechain outliers	187428	7100 (2.10-2.10)
RSRZ outliers	180081	6662 (2.10-2.10)

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 $\leq 5\%$. 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	336	7% 82% 14% ..
1	B	336	19% 60% 19% 21%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4601 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 Ornithine cyclodeaminase/mu-crystallin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	329	Total	C	N	O	S	0	0	0
			2509	1587	423	490	9			
1	B	265	Total	C	N	O	S	0	0	0
			2020	1276	343	393	8			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	169	LYS	ARG	conflict	UNP B7FJU0
A	181	ILE	LYS	conflict	UNP B7FJU0
A	182	ASN	THR	conflict	UNP B7FJU0
B	169	LYS	ARG	conflict	UNP B7FJU0
B	181	ILE	LYS	conflict	UNP B7FJU0
B	182	ASN	THR	conflict	UNP B7FJU0

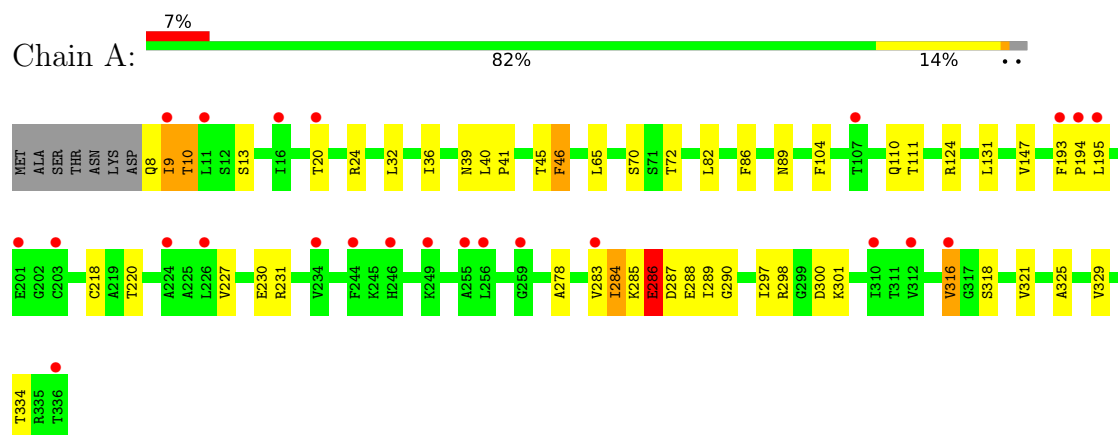
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	58	Total	O	0	0
			58	58		
2	B	14	Total	O	0	0
			14	14		

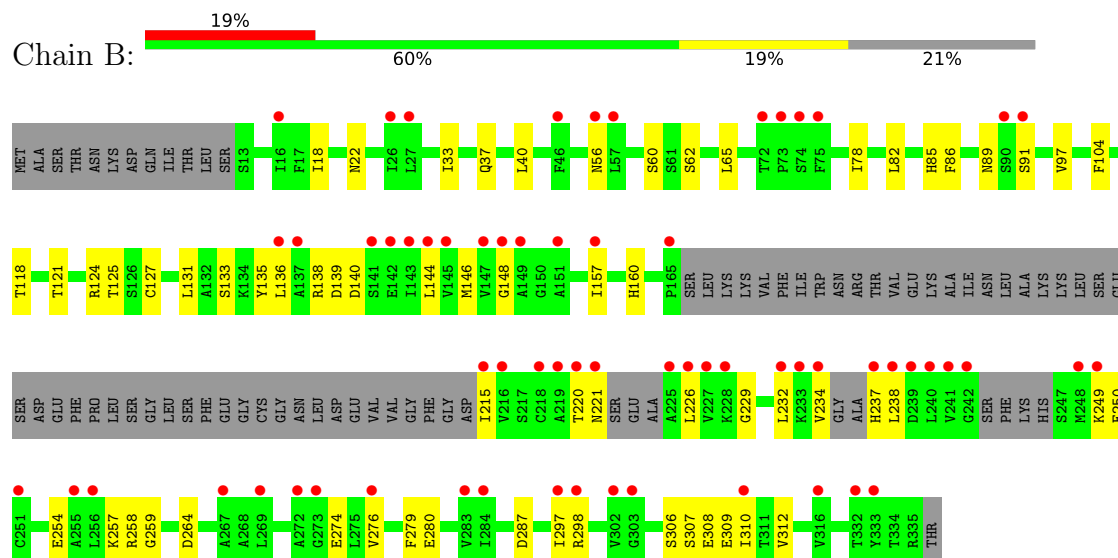
3 Residue-property plots [i](#)

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: Ornithine cyclodeaminase/mu-crystallin



- Molecule 1: Ornithine cyclodeaminase/mu-crystallin



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	80.14Å 83.67Å 113.81Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	67.41 – 2.10 67.41 – 2.10	Depositor EDS
% Data completeness (in resolution range)	98.8 (67.41-2.10) 98.8 (67.41-2.10)	Depositor EDS
R_{merge}	0.01	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.26 (at 2.10Å)	Xtriage
Refinement program	PHENIX 1.17.1_3660	Depositor
R, R_{free}	0.252 , 0.272 0.257 , 0.277	Depositor DCC
R_{free} test set	2010 reflections (4.46%)	wwPDB-VP
Wilson B-factor (Å ²)	55.7	Xtriage
Anisotropy	0.123	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 57.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.021 for k,h,-l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4601	wwPDB-VP
Average B, all atoms (Å ²)	85.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.49% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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](#)

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	0/2554	0.61	5/3459 (0.1%)
1	B	0.21	0/2052	0.45	0/2777
All	All	0.40	0/4606	0.54	5/6236 (0.1%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	285	LYS	N-CA-C	6.99	121.07	111.71
1	A	286	GLU	N-CA-C	6.05	123.68	110.80
1	A	316	VAL	N-CA-C	-5.84	97.20	109.34
1	A	316	VAL	CB-CA-C	5.45	120.22	111.29
1	A	46	PHE	N-CA-C	5.28	119.81	112.90

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	2509	0	2520	36	0
1	B	2020	0	2032	50	0
2	A	58	0	0	0	0
2	B	14	0	0	0	0
All	All	4601	0	4552	84	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 9.

All (84) 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:215:ILE:HG22	1:B:237:HIS:HB3	1.40	0.97
1:A:9:ILE:HD12	1:A:10:THR:HG23	1.63	0.79
1:B:298:ARG:C	1:B:298:ARG:HD3	2.06	0.78
1:A:290:GLY:O	1:A:301:LYS:HE3	1.83	0.78
1:B:258:ARG:HB3	1:B:310:ILE:HG12	1.65	0.78
1:B:254:GLU:HB2	1:B:257:LYS:HB2	1.66	0.75
1:B:258:ARG:HB2	1:B:310:ILE:HG21	1.72	0.71
1:A:284:ILE:HG22	1:A:288:GLU:OE2	1.91	0.71
1:A:40:LEU:N	1:A:41:PRO:HD2	2.08	0.69
1:B:306:SER:OG	1:B:307:SER:N	2.22	0.68
1:A:46:PHE:HE1	1:B:287:ASP:HB3	1.59	0.68
1:B:238:LEU:HB3	1:B:312:VAL:HG12	1.76	0.66
1:B:144:LEU:HD23	1:B:215:ILE:HG13	1.78	0.66
1:B:259:GLY:HA3	1:B:310:ILE:HB	1.78	0.65
1:A:46:PHE:CE2	1:A:72:THR:HG21	2.31	0.64
1:A:286:GLU:HA	1:A:289:ILE:HD13	1.79	0.64
1:B:56:ASN:OD1	1:B:62:SER:HB3	1.99	0.62
1:A:193:PHE:CD2	1:A:194:PRO:HD3	2.35	0.61
1:B:276:VAL:O	1:B:280:GLU:HG2	2.00	0.61
1:A:13:SER:HA	1:A:110:GLN:HE22	1.65	0.61
1:A:13:SER:C	1:A:110:GLN:NE2	2.59	0.60
1:A:13:SER:HA	1:A:110:GLN:NE2	2.17	0.60
1:B:131:LEU:HD21	1:B:297:ILE:HD11	1.83	0.59
1:B:56:ASN:HA	1:B:62:SER:HA	1.84	0.58
1:A:65:LEU:HD22	1:A:82:LEU:HD22	1.85	0.58
1:A:104:PHE:CE2	1:A:111:THR:HG22	2.38	0.58
1:A:46:PHE:CD2	1:A:72:THR:HG21	2.39	0.57
1:B:306:SER:HB3	1:B:309:GLU:HG3	1.85	0.57
1:A:46:PHE:CE1	1:B:287:ASP:HB3	2.39	0.57
1:B:238:LEU:O	1:B:312:VAL:HA	2.05	0.57
1:B:276:VAL:HA	1:B:279:PHE:CD2	2.41	0.55
1:B:62:SER:OG	1:B:85:HIS:HB2	2.05	0.55
1:B:121:THR:O	1:B:125:THR:HG23	2.06	0.55
1:B:65:LEU:HD22	1:B:82:LEU:HD22	1.87	0.55
1:B:226:LEU:HD13	1:B:249:LYS:HB2	1.88	0.54
1:A:40:LEU:N	1:A:41:PRO:CD	2.70	0.54
1:B:306:SER:HG	1:B:307:SER:H	1.53	0.54

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:309:GLU:HG2	1:B:310:ILE:H	1.72	0.54
1:B:33:ILE:HG13	1:B:127:CYS:HB3	1.89	0.53
1:B:135:TYR:CZ	1:B:297:ILE:HA	2.43	0.53
1:A:32:LEU:O	1:A:36:ILE:HG12	2.09	0.53
1:B:298:ARG:HD3	1:B:298:ARG:O	2.08	0.53
1:B:18:ILE:HG23	1:B:22:ASN:HB3	1.91	0.53
1:B:86:PHE:O	1:B:89:ASN:HB2	2.08	0.52
1:B:229:GLY:HA2	1:B:232:LEU:HD12	1.91	0.52
1:A:20:THR:O	1:A:24:ARG:HG3	2.10	0.52
1:B:148:GLY:HA3	1:B:220:THR:HB	1.91	0.52
1:A:325:ALA:O	1:A:329:VAL:HG23	2.11	0.51
1:A:318:SER:OG	1:A:321:VAL:HG23	2.10	0.50
1:B:146:MET:HE3	1:B:157:ILE:HG13	1.94	0.50
1:A:45:THR:HG22	1:A:46:PHE:CD1	2.46	0.50
1:B:124:ARG:HH11	1:B:125:THR:HG22	1.76	0.49
1:A:9:ILE:HG13	1:A:334:THR:O	2.13	0.49
1:B:146:MET:CE	1:B:157:ILE:HG13	2.43	0.49
1:A:8:GLN:HG2	1:A:9:ILE:HG23	1.95	0.48
1:B:60:SER:O	1:B:60:SER:OG	2.29	0.48
1:B:144:LEU:CD2	1:B:215:ILE:HG13	2.44	0.48
1:B:78:ILE:HB	1:B:104:PHE:HB2	1.97	0.47
1:B:234:VAL:HB	1:B:308:GLU:HB3	1.97	0.47
1:B:250:GLU:HB2	1:B:274:GLU:OE2	2.15	0.47
1:A:124:ARG:HG3	1:A:321:VAL:HG12	1.96	0.47
1:A:13:SER:CA	1:A:110:GLN:HE22	2.30	0.45
1:A:40:LEU:HD23	1:A:297:ILE:HD12	1.99	0.45
1:B:306:SER:HB3	1:B:309:GLU:HB2	1.97	0.45
1:B:91:SER:O	1:B:91:SER:OG	2.28	0.45
1:A:131:LEU:HD21	1:A:297:ILE:HD11	1.99	0.44
1:B:37:GLN:HB2	1:B:131:LEU:HD13	1.98	0.44
1:B:221:ASN:ND2	1:B:250:GLU:HG3	2.31	0.44
1:A:298:ARG:HG3	1:A:300:ASP:OD2	2.18	0.44
1:A:230:GLU:OE2	1:A:231:ARG:HG2	2.17	0.44
1:A:278:ALA:HB1	1:A:284:ILE:HG13	1.98	0.44
1:B:97:VAL:O	1:B:118:THR:HG21	2.18	0.44
1:B:40:LEU:HD23	1:B:297:ILE:HD12	2.00	0.44
1:A:86:PHE:O	1:A:89:ASN:HB2	2.18	0.43
1:A:13:SER:CA	1:A:110:GLN:NE2	2.79	0.43
1:A:39:ASN:C	1:A:41:PRO:HD2	2.42	0.43
1:A:218:CYS:SG	1:A:227:VAL:HG21	2.58	0.43
1:A:147:VAL:HG12	1:A:220:THR:HG21	2.01	0.42

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:194:PRO:O	1:A:195:LEU:HD23	2.21	0.41
1:B:264:ASP:N	1:B:264:ASP:OD1	2.53	0.41
1:B:133:SER:HG	1:B:160:HIS:CE1	2.39	0.40
1:B:136:LEU:HD23	1:B:136:LEU:HA	1.80	0.40
1:B:138:ARG:O	1:B:140:ASP:N	2.55	0.40
1:B:298:ARG:C	1:B:298:ARG:CD	2.87	0.40

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	327/336 (97%)	313 (96%)	10 (3%)	4 (1%)	10	7
1	B	255/336 (76%)	240 (94%)	14 (6%)	1 (0%)	30	28
All	All	582/672 (87%)	553 (95%)	24 (4%)	5 (1%)	14	10

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	10	THR
1	A	316	VAL
1	B	139	ASP
1	A	286	GLU
1	A	9	ILE

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	282/288 (98%)	278 (99%)	4 (1%)	59	67
1	B	228/288 (79%)	228 (100%)	0	100	100
All	All	510/576 (88%)	506 (99%)	4 (1%)	73	81

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	70	SER
1	A	283	VAL
1	A	284	ILE
1	A	287	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	30	GLN
1	A	39	ASN
1	A	110	GLN
1	B	35	HIS
1	B	54	HIS
1	B	155	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 oligosaccharides in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

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	329/336 (97%)	0.75	24 (7%)	21 22	49, 70, 118, 167	0
1	B	265/336 (78%)	1.38	64 (24%)	2 2	56, 96, 144, 174	0
All	All	594/672 (88%)	1.03	88 (14%)	5 6	49, 81, 139, 174	0

All (88) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	75	PHE	5.3
1	B	143	ILE	4.7
1	B	215	ILE	4.7
1	A	9	ILE	4.4
1	B	256	LEU	4.1
1	B	225	ALA	4.1
1	B	26	ILE	4.0
1	B	302	VAL	3.9
1	A	193	PHE	3.8
1	B	310	ILE	3.7
1	B	255	ALA	3.7
1	B	227	VAL	3.7
1	A	194	PRO	3.6
1	B	149	ALA	3.6
1	B	144	LEU	3.6
1	B	218	CYS	3.6
1	B	56	ASN	3.5
1	A	316	VAL	3.5
1	B	216	VAL	3.4
1	B	251	CYS	3.3
1	B	157	ILE	3.3
1	B	242	GLY	3.2
1	B	284	ILE	3.1
1	B	232	LEU	3.1

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	B	72	THR	3.1
1	A	244	PHE	3.1
1	B	249	LYS	3.0
1	B	297	ILE	3.0
1	B	145	VAL	2.9
1	B	241	VAL	2.9
1	B	333	TYR	2.9
1	A	195	LEU	2.9
1	B	226	LEU	2.8
1	B	272	ALA	2.8
1	A	11	LEU	2.8
1	B	57	LEU	2.8
1	B	137	ALA	2.8
1	B	240	LEU	2.8
1	A	226	LEU	2.8
1	A	310	ILE	2.8
1	B	219	ALA	2.7
1	B	303	GLY	2.7
1	A	16	ILE	2.7
1	B	74	SER	2.7
1	A	20	THR	2.6
1	B	332	THR	2.6
1	B	141	SER	2.6
1	A	336	THR	2.6
1	B	237	HIS	2.6
1	B	298	ARG	2.6
1	A	256	LEU	2.6
1	B	151	ALA	2.5
1	A	283	VAL	2.5
1	B	234	VAL	2.5
1	A	246	HIS	2.5
1	A	249	LYS	2.5
1	B	16	ILE	2.5
1	B	165	PRO	2.5
1	B	90	SER	2.4
1	B	91	SER	2.4
1	B	46	PHE	2.4
1	B	148	GLY	2.4
1	B	221	ASN	2.4
1	A	234	VAL	2.4
1	B	136	LEU	2.4
1	B	238	LEU	2.4

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	B	233	LYS	2.4
1	B	239	ASP	2.3
1	B	220	THR	2.3
1	B	147	VAL	2.2
1	B	228	LYS	2.2
1	B	248	MET	2.2
1	A	201	GLU	2.2
1	A	255	ALA	2.2
1	B	142	GLU	2.2
1	A	107	THR	2.2
1	B	276	VAL	2.1
1	B	283	VAL	2.1
1	A	203	CYS	2.1
1	A	312	VAL	2.1
1	B	267	ALA	2.1
1	B	27	LEU	2.1
1	B	273	GLY	2.1
1	B	73	PRO	2.1
1	A	259	GLY	2.1
1	B	316	VAL	2.1
1	A	224	ALA	2.1
1	B	269	LEU	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 oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.