



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 05:45 PM UTC

PDB ID : 2WL8 / pdb_00002wl8
Title : X-ray crystal structure of Pex19p
Authors : Schueller, N.; Holton, S.J.; Stanley, W.A.; Song, Y.H.; Konarev, P.; Roessle, M.; Erdmann, R.; Schliebs, W.; Wilmanns, M.
Deposited on : 2009-06-22
Resolution : 2.05 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

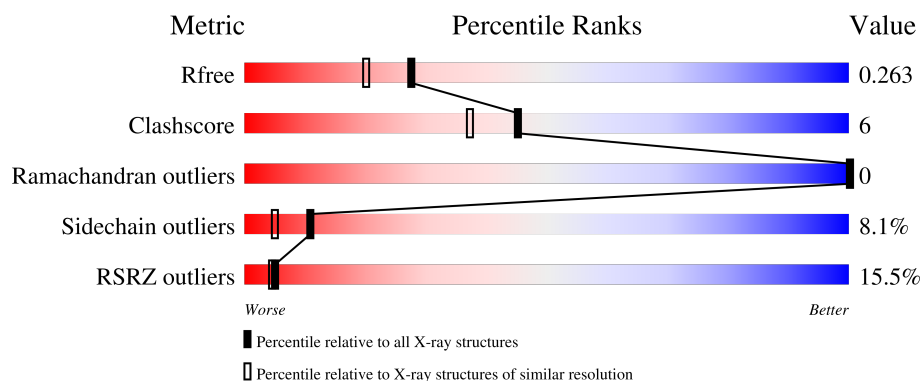
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.05 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	2260 (2.04-2.04)
Clashscore	190562	2333 (2.04-2.04)
Ramachandran outliers	187476	2318 (2.04-2.04)
Sidechain outliers	187428	2318 (2.04-2.04)
RSRZ outliers	180081	2260 (2.04-2.04)

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	126	10% 67% 20% 13%
1	B	126	12% 68% 10% 17%
1	C	126	6% 67% 15% 13%
1	D	126	25% 70% 16% 13%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3715 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 PEROXISOMAL BIOGENESIS FACTOR 19.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	110	Total	C	N	O	S	0	0	0
			897	570	143	176	8			
1	B	104	Total	C	N	O	S	0	0	0
			850	539	136	167	8			
1	C	109	Total	C	N	O	S	0	0	0
			889	564	142	175	8			
1	D	109	Total	C	N	O	S	0	0	0
			889	564	142	175	8			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	158	GLY	-	expression tag	UNP P40855
A	159	ALA	-	expression tag	UNP P40855
A	160	MET	-	expression tag	UNP P40855
B	158	GLY	-	expression tag	UNP P40855
B	159	ALA	-	expression tag	UNP P40855
B	160	MET	-	expression tag	UNP P40855
C	158	GLY	-	expression tag	UNP P40855
C	159	ALA	-	expression tag	UNP P40855
C	160	MET	-	expression tag	UNP P40855
D	158	GLY	-	expression tag	UNP P40855
D	159	ALA	-	expression tag	UNP P40855
D	160	MET	-	expression tag	UNP P40855

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	50	Total	O	0	0
			50	50		
2	B	75	Total	O	0	0
			75	75		

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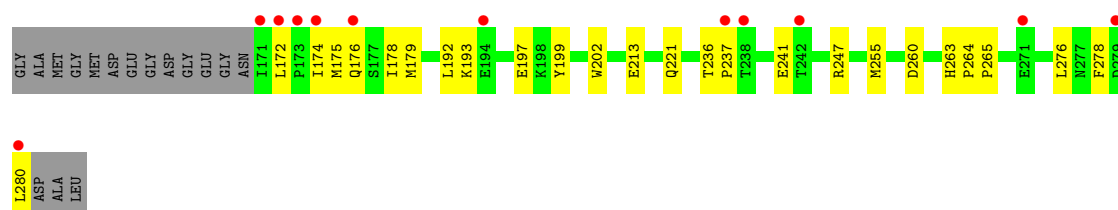
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	C	50	Total	O	0	0
			50	50		
2	D	15	Total	O	0	0
			15	15		

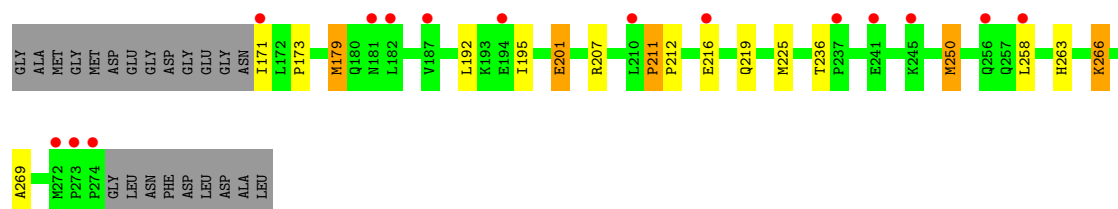
3 Residue-property plots [i](#)

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.

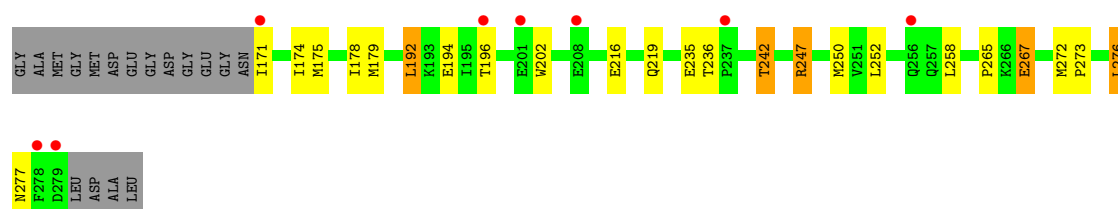
• Molecule 1: PEROXISOMAL BIOGENESIS FACTOR 19



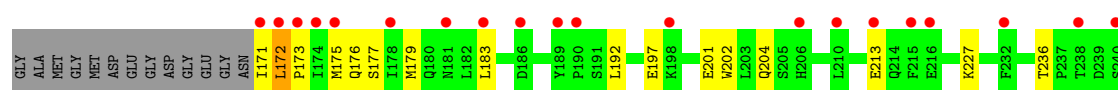
• Molecule 1: PEROXISOMAL BIOGENESIS FACTOR 19

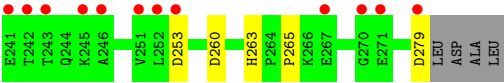


• Molecule 1: PEROXISOMAL BIOGENESIS FACTOR 19



• Molecule 1: PEROXISOMAL BIOGENESIS FACTOR 19





4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	67.15Å 91.12Å 122.29Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.45 – 2.05 49.45 – 2.05	Depositor EDS
% Data completeness (in resolution range)	99.1 (49.45-2.05) 99.1 (49.45-2.05)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.30 (at 2.05Å)	Xtriage
Refinement program	REFMAC 5.5.0088	Depositor
R, R_{free}	0.199 , 0.239 0.231 , 0.263	Depositor DCC
R_{free} test set	2400 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	37.3	Xtriage
Anisotropy	0.352	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 48.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	3715	wwPDB-VP
Average B, all atoms (Å ²)	42.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.73% 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	0.86	0/918	0.94	0/1242
1	B	0.96	1/870 (0.1%)	1.03	2/1177 (0.2%)
1	C	0.87	0/910	1.04	2/1231 (0.2%)
1	D	0.70	0/910	0.99	0/1231
All	All	0.85	1/3608 (0.0%)	1.00	4/4881 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	173	PRO	N-CD	7.14	1.57	1.47

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	174	ILE	N-CA-C	5.36	116.09	110.62
1	C	247	ARG	NE-CZ-NH2	-5.33	114.41	119.20
1	B	211	PRO	CA-C-N	5.11	124.28	118.97
1	B	211	PRO	C-N-CA	5.11	124.28	118.97

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	897	0	878	14	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	850	0	834	11	1
1	C	889	0	867	18	1
1	D	889	0	867	7	0
2	A	50	0	0	0	0
2	B	75	0	0	1	0
2	C	50	0	0	2	0
2	D	15	0	0	0	0
All	All	3715	0	3446	41	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 6.

All (41) 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:266:LYS:HG2	1:C:194:GLU:HB3	1.65	0.76
1:D:179:MET:HE3	1:D:183:LEU:HD11	1.72	0.71
1:B:269:ALA:HB3	1:C:194:GLU:HG3	1.75	0.69
1:C:192:LEU:O	1:C:196:THR:HG23	1.94	0.68
1:A:179:MET:HE1	1:C:178:ILE:HD12	1.75	0.68
1:D:263:HIS:HB3	1:D:279:ASP:HA	1.78	0.66
1:B:192:LEU:CD1	1:B:225:MET:HE3	2.29	0.63
1:C:242:THR:HG22	2:C:2032:HOH:O	2.00	0.62
1:A:179:MET:HE1	1:C:178:ILE:CD1	2.30	0.61
1:B:263:HIS:HE1	2:C:2041:HOH:O	1.83	0.60
1:A:193:LYS:O	1:A:197:GLU:HG3	2.02	0.60
1:B:192:LEU:HD12	1:B:225:MET:HE3	1.85	0.59
1:C:272:MET:H	1:C:277:ASN:HD21	1.51	0.58
1:A:179:MET:HG3	1:C:175:MET:HG2	1.88	0.55
1:C:202:TRP:NE1	1:C:267:GLU:HG2	2.21	0.55
1:C:202:TRP:CZ2	1:C:265:PRO:HB3	2.43	0.53
1:C:202:TRP:HE1	1:C:267:GLU:HG2	1.73	0.53
1:A:221:GLN:HE22	1:A:264:PRO:HA	1.74	0.53
1:D:171:ILE:HG13	1:D:173:PRO:HD2	1.92	0.51
1:A:178:ILE:HD12	1:C:179:MET:HE1	1.93	0.50
1:B:216:GLU:HA	1:B:219:GLN:HE21	1.76	0.50
1:C:235:GLU:HG3	1:C:247:ARG:HD3	1.93	0.49
1:A:255:MET:HE2	1:A:276:LEU:HD22	1.94	0.49
1:A:175:MET:HE2	1:C:175:MET:HB3	1.95	0.48
1:B:195:ILE:HG22	1:B:225:MET:HE1	1.95	0.47
1:B:192:LEU:HD12	1:B:225:MET:CE	2.43	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:216:GLU:HA	1:C:219:GLN:HE21	1.80	0.47
1:A:263:HIS:HD2	1:A:264:PRO:O	1.98	0.46
1:B:179:MET:HE3	1:B:179:MET:HB3	1.76	0.46
1:D:202:TRP:CZ2	1:D:265:PRO:HB3	2.51	0.45
1:B:201:GLU:HG3	2:B:2019:HOH:O	2.17	0.45
1:A:260:ASP:OD2	1:D:260:ASP:OD2	2.36	0.44
1:C:273:PRO:O	1:C:276:LEU:HB2	2.18	0.44
1:D:172:LEU:HA	1:D:175:MET:HE3	2.00	0.43
1:C:267:GLU:H	1:C:267:GLU:CD	2.28	0.42
1:A:199:TYR:OH	1:A:221:GLN:NE2	2.53	0.42
1:A:263:HIS:HA	1:A:278:PHE:O	2.19	0.42
1:B:211:PRO:HA	1:B:212:PRO:HD3	1.75	0.42
1:A:202:TRP:CZ2	1:A:265:PRO:HB3	2.56	0.41
1:A:236:THR:HB	1:A:237:PRO:HD2	2.02	0.40
1:C:171:ILE:O	1:D:227:LYS:HE3	2.20	0.40

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:B:250:MET:CE	1:C:250:MET:CE[3_646]	1.98	0.22

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	108/126 (86%)	107 (99%)	1 (1%)	0	100	100
1	B	102/126 (81%)	102 (100%)	0	0	100	100
1	C	107/126 (85%)	106 (99%)	1 (1%)	0	100	100
1	D	107/126 (85%)	107 (100%)	0	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	424/504 (84%)	422 (100%)	2 (0%)	0	100	100

There are no Ramachandran outliers to report.

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	104/113 (92%)	96 (92%)	8 (8%)	12	6
1	B	99/113 (88%)	91 (92%)	8 (8%)	11	5
1	C	103/113 (91%)	96 (93%)	7 (7%)	14	8
1	D	103/113 (91%)	93 (90%)	10 (10%)	8	3
All	All	409/452 (90%)	376 (92%)	33 (8%)	11	5

All (33) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	172	LEU
1	A	174	ILE
1	A	176	GLN
1	A	192	LEU
1	A	213	GLU
1	A	241	GLU
1	A	247	ARG
1	A	280	LEU
1	B	171	ILE
1	B	179	MET
1	B	201	GLU
1	B	207	ARG
1	B	236	THR
1	B	250	MET
1	B	258	LEU
1	B	266	LYS
1	C	192	LEU

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Mol	Chain	Res	Type
1	C	236	THR
1	C	242	THR
1	C	252	LEU
1	C	258	LEU
1	C	267	GLU
1	C	276	LEU
1	D	172	LEU
1	D	176	GLN
1	D	177	SER
1	D	192	LEU
1	D	197	GLU
1	D	201	GLU
1	D	204	GLN
1	D	213	GLU
1	D	236	THR
1	D	253	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (20) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	181	ASN
1	A	204	GLN
1	A	214	GLN
1	A	221	GLN
1	A	231	GLN
1	A	263	HIS
1	B	214	GLN
1	B	219	GLN
1	B	263	HIS
1	C	204	GLN
1	C	206	HIS
1	C	219	GLN
1	C	263	HIS
1	C	277	ASN
1	D	176	GLN
1	D	206	HIS
1	D	214	GLN
1	D	221	GLN
1	D	222	HIS
1	D	259	GLN

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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, 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	110/126 (87%)	0.85	12 (10%) 10 10	36, 41, 50, 60	0
1	B	104/126 (82%)	1.16	15 (14%) 6 5	33, 41, 50, 63	0
1	C	109/126 (86%)	0.92	8 (7%) 21 21	33, 41, 51, 58	0
1	D	109/126 (86%)	1.66	32 (29%) 1 0	35, 42, 52, 55	0
All	All	432/504 (85%)	1.15	67 (15%) 5 4	33, 42, 51, 63	0

All (67) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	171	ILE	6.4
1	C	171	ILE	5.8
1	A	280	LEU	5.6
1	D	173	PRO	4.4
1	C	256	GLN	4.3
1	A	238	THR	4.0
1	D	242	THR	3.9
1	B	241	GLU	3.8
1	D	238	THR	3.7
1	B	274	PRO	3.6
1	A	279	ASP	3.6
1	B	245	LYS	3.4
1	A	171	ILE	3.3
1	D	174	ILE	3.3
1	B	171	ILE	3.2
1	D	246	ALA	3.2
1	C	237	PRO	3.2
1	D	172	LEU	3.1
1	B	272	MET	3.1
1	A	172	LEU	3.0
1	D	270	GLY	3.0

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Mol	Chain	Res	Type	RSRZ
1	C	279	ASP	3.0
1	C	201	GLU	2.9
1	A	174	ILE	2.8
1	D	213	GLU	2.8
1	A	242	THR	2.8
1	B	273	PRO	2.8
1	D	190	PRO	2.7
1	C	278	PHE	2.7
1	D	189	TYR	2.6
1	D	243	THR	2.6
1	D	183	LEU	2.6
1	D	198	LYS	2.5
1	B	181	ASN	2.5
1	D	253	ASP	2.5
1	D	279	ASP	2.5
1	D	216	GLU	2.4
1	B	210	LEU	2.4
1	C	196	THR	2.4
1	D	206	HIS	2.4
1	D	186	ASP	2.3
1	D	245	LYS	2.3
1	C	208	GLU	2.3
1	D	241	GLU	2.3
1	B	182	LEU	2.3
1	D	210	LEU	2.3
1	A	173	PRO	2.2
1	A	237	PRO	2.2
1	D	181	ASN	2.2
1	A	271	GLU	2.2
1	D	175	MET	2.2
1	D	267	GLU	2.2
1	D	252	LEU	2.2
1	B	216	GLU	2.1
1	D	178	ILE	2.1
1	B	187	VAL	2.1
1	D	240	SER	2.1
1	B	237	PRO	2.1
1	D	251	VAL	2.1
1	B	194	GLU	2.1
1	D	215	PHE	2.1
1	D	232	PHE	2.1
1	A	194	GLU	2.0

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Mol	Chain	Res	Type	RSRZ
1	D	271	GLU	2.0
1	A	176	GLN	2.0
1	B	256	GLN	2.0
1	B	258	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.