



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 05:45 PM UTC

PDB ID : 2W6Q / pdb_00002w6q
Title : Crystal structure of Biotin carboxylase from E. coli in complex with the triazine-2,4-diamine fragment
Authors : Mochalkin, I.; Miller, J.R.
Deposited on : 2008-12-18
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
Mogul	:	2022.3.0, CSD as543be (2022)
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

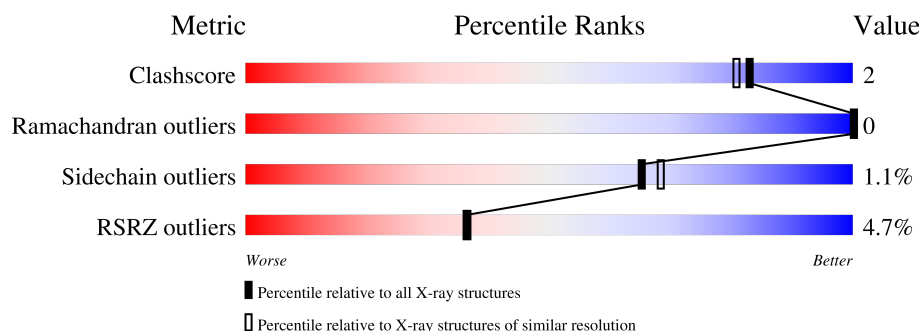
1 Overall quality at a glance

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))
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	449	95% 5%
1	B	449	8% 92% 7%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	CL	B	1447	-	-	X	-

2 Entry composition [i](#)

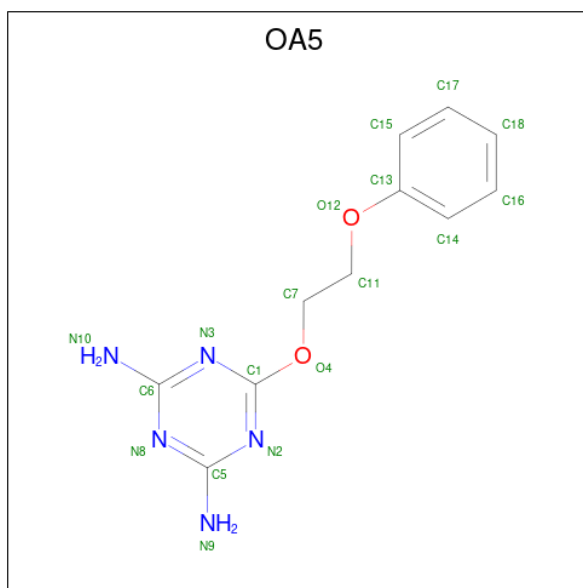
There are 4 unique types of molecules in this entry. The entry contains 7633 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 BIOTIN CARBOXYLASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	447	Total	C	N	O	S	0	5	1
			3449	2173	616	638	22			
1	B	446	Total	C	N	O	S	0	6	1
			3447	2168	618	639	22			

- Molecule 2 is 6-(2-phenoxyethoxy)-1,3,5-triazine-2,4-diamine (CCD ID: OA5) (formula: $C_{11}H_{13}N_5O_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			18	11	5	2		
2	B	1	Total	C	N	O	0	0
			18	11	5	2		

- Molecule 3 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

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

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	400	Total 400	O 400	0	0
4	B	299	Total 299	O 299	0	0

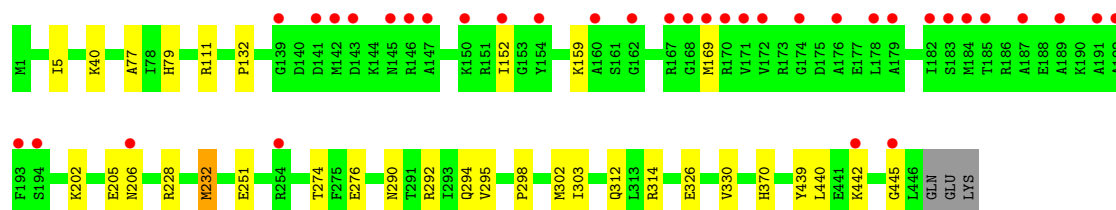
3 Residue-property plots [i](#)

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: BIOTIN CARBOXYLASE



• Molecule 1: BIOTIN CARBOXYLASE



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	84.00Å 105.57Å 122.05Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	16.00 – 2.05 16.00 – 2.05	Depositor EDS
% Data completeness (in resolution range)	96.9 (16.00-2.05) 92.1 (16.00-2.05)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.47 (at 2.05Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, R_{free}	0.184 , 0.224 (Not available) , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	23.8	Xtriage
Anisotropy	0.094	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 41.0	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	0.95	EDS
Total number of atoms	7633	wwPDB-VP
Average B, all atoms (Å ²)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.16% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: OA5, 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	0.55	1/3537 (0.0%)	0.77	0/4772
1	B	0.55	1/3540 (0.0%)	0.77	0/4777
All	All	0.55	2/7077 (0.0%)	0.77	0/9549

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	446	LEU	C-N	-6.89	1.23	1.33
1	B	445	GLY	C-N	-6.66	1.24	1.33

There are no bond angle outliers.

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	3449	0	3485	11	0
1	B	3447	0	3473	22	0
2	A	18	0	13	0	0
2	B	18	0	13	0	0
3	A	1	0	0	0	0
3	B	1	0	0	2	0
4	A	400	0	0	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	B	299	0	0	1	0
All	All	7633	0	6984	33	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 2.

All (33) 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:232:MET:HE2	1:B:440:LEU:HB2	1.36	1.03
1:B:232:MET:HE3	1:B:232:MET:HA	1.72	0.70
1:B:232:MET:HE2	1:B:440:LEU:CB	2.19	0.69
1:B:292:ARG:NH1	3:B:1447:CL:CL	2.67	0.65
1:A:113:MET:HE3	1:A:267:ILE:HD13	1.81	0.62
1:B:152:ILE:CG2	1:B:202:LYS:HB2	2.30	0.61
1:A:79:HIS:HD1	1:A:81:GLY:H	1.47	0.61
1:B:152:ILE:HG21	1:B:202:LYS:HB2	1.83	0.59
1:B:79:HIS:HE2	1:B:312:GLN:NE2	2.04	0.55
1:A:105:PRO:HG2	1:A:291:THR:HB	1.90	0.53
1:A:298:PRO:O	1:A:302:MET:HG2	2.09	0.53
1:B:298:PRO:O	1:B:302:MET:HG2	2.10	0.51
1:A:113:MET:CE	1:A:267:ILE:HD13	2.41	0.51
1:A:1:MET:HE2	1:A:26:ILE:HD11	1.93	0.51
1:B:40:LYS:HE3	1:B:370:HIS:HA	1.94	0.50
1:B:295:VAL:HG23	3:B:1447:CL:CL	2.49	0.49
1:B:5:ILE:HG22	1:B:77:ALA:HB3	1.95	0.49
1:A:340:ASN:HD22	1:A:384:MET:HA	1.79	0.48
1:A:5:ILE:HG22	1:A:77:ALA:HB3	1.98	0.46
1:B:314:ARG:NH2	4:B:2188:HOH:O	2.41	0.45
1:B:132:PRO:HB2	1:B:152:ILE:HG23	1.97	0.45
1:B:228:ARG:HH21	1:B:294:GLN:NE2	2.15	0.45
1:B:290:ASN:ND2	1:B:294:GLN:OE1	2.50	0.44
1:A:1:MET:HE3	1:A:2:LEU:H	1.83	0.43
1:B:276:GLU:CD	1:B:290:ASN:HD21	2.25	0.43
1:B:274:THR:HG21	1:B:294:GLN:HE22	1.83	0.43
1:B:232:MET:HE1	1:B:439:TYR:HD2	1.84	0.42
1:B:274:THR:HG21	1:B:294:GLN:NE2	2.35	0.42
1:B:205:GLU:O	1:B:206:ASN:ND2	2.53	0.41
1:A:212:ILE:HD13	1:A:227:GLU:HB3	2.03	0.41
1:B:303:ILE:HD12	1:B:330:VAL:HG13	2.03	0.41
1:B:159:LYS:HG2	1:B:169:MET:HG2	2.02	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:442[B]:LYS:HD2	4:A:2399:HOH:O	2.20	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	450/449 (100%)	441 (98%)	9 (2%)	0	100	100
1	B	450/449 (100%)	442 (98%)	8 (2%)	0	100	100
All	All	900/898 (100%)	883 (98%)	17 (2%)	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	363/361 (101%)	360 (99%)	3 (1%)	73	77
1	B	363/361 (101%)	358 (99%)	5 (1%)	59	60
All	All	726/722 (101%)	718 (99%)	8 (1%)	65	68

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	106	LYS
1	A	237	GLN
1	A	323	ILE
1	B	111	ARG
1	B	232	MET
1	B	251	GLU
1	B	326	GLU
1	B	442	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (16) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	312	GLN
1	A	329	HIS
1	A	340	ASN
1	A	404	ASN
1	A	438	HIS
1	B	195	ASN
1	B	206	ASN
1	B	233	GLN
1	B	236	HIS
1	B	290	ASN
1	B	294	GLN
1	B	312	GLN
1	B	319	GLN
1	B	340	ASN
1	B	404	ASN
1	B	432	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

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 for Mogul analysis.

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	OA5	B	1446	-	19,19,19	1.06	1 (5%)	22,24,24	2.01	6 (27%)
2	OA5	A	1447	-	19,19,19	0.87	1 (5%)	22,24,24	2.01	6 (27%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	OA5	B	1446	-	-	3/7/7/7	0/2/2/2
2	OA5	A	1447	-	-	2/7/7/7	0/2/2/2

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1446	OA5	O4-C1	3.11	1.37	1.34
2	A	1447	OA5	O4-C1	2.38	1.36	1.34

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	1446	OA5	N3-C1-N2	-4.37	119.70	127.65
2	A	1447	OA5	N3-C1-N2	-4.06	120.27	127.65
2	A	1447	OA5	N3-C6-N8	-3.96	119.42	125.48
2	B	1446	OA5	N2-C5-N8	-3.65	119.89	125.48
2	B	1446	OA5	N3-C6-N8	-3.59	119.98	125.48
2	B	1446	OA5	C7-O4-C1	3.38	122.74	117.80
2	A	1447	OA5	C7-O4-C1	3.31	122.64	117.80
2	A	1447	OA5	C5-N8-C6	3.27	120.08	114.76
2	A	1447	OA5	N2-C5-N8	-3.27	120.47	125.48

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	1446	OA5	C5-N8-C6	3.22	120.00	114.76
2	A	1447	OA5	N10-C6-N8	2.88	121.54	117.22
2	B	1446	OA5	N9-C5-N8	2.14	120.43	117.22

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	1447	OA5	O12-C11-C7-O4
2	B	1446	OA5	O12-C11-C7-O4
2	B	1446	OA5	C15-C13-O12-C11
2	B	1446	OA5	C14-C13-O12-C11
2	A	1447	OA5	C7-C11-O12-C13

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

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	447/449 (99%)	-0.26	6 (1%) 75 76	16, 23, 32, 44	5 (1%)
1	B	446/449 (99%)	0.00	36 (8%) 18 18	12, 21, 75, 81	6 (1%)
All	All	893/898 (99%)	-0.13	42 (4%) 36 36	12, 23, 65, 81	11 (1%)

All (42) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	447	GLN	5.3
1	B	168	GLY	4.9
1	B	146	ARG	4.0
1	B	172	VAL	3.5
1	B	182	ILE	3.5
1	B	179	ALA	3.5
1	B	189	ALA	3.3
1	B	187	ALA	3.3
1	B	178	LEU	3.1
1	B	174	GLY	2.9
1	B	171	VAL	2.8
1	B	160	ALA	2.7
1	B	154	TYR	2.7
1	B	152	ILE	2.6
1	B	147	ALA	2.6
1	B	193	PHE	2.6
1	A	445	GLY	2.6
1	B	183	SER	2.6
1	B	176	ALA	2.5
1	B	184	MET	2.5
1	B	162	GLY	2.5
1	B	194	SER	2.5
1	B	192	ALA	2.5
1	B	206	ASN	2.5

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Mol	Chain	Res	Type	RSRZ
1	B	141	ASP	2.4
1	A	97	ARG	2.3
1	B	167	ARG	2.3
1	A	96	GLU	2.3
1	B	142	MET	2.3
1	B	254	ARG	2.3
1	B	185	THR	2.2
1	B	445	GLY	2.2
1	B	143	ASP	2.2
1	B	145	ASN	2.2
1	B	169	MET	2.2
1	A	326	GLU	2.1
1	B	442	LYS	2.1
1	B	191	ALA	2.1
1	A	446	LEU	2.0
1	B	170	ARG	2.0
1	B	150	LYS	2.0
1	B	139	GLY	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](#)

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($\text{\AA}^2$)	Q<0.9
2	OA5	B	1446	18/18	0.82	0.11	44,46,52,52	0
2	OA5	A	1447	18/18	0.86	0.12	26,29,42,42	0
3	CL	A	1448	1/1	0.98	0.05	25,25,25,25	0
3	CL	B	1447	1/1	0.98	0.12	34,34,34,34	0

6.5 Other polymers [i](#)

There are no such residues in this entry.