



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 11:19 AM UTC

PDB ID : 3CQR / pdb_00003cqr
Title : Crystal Structure of the Lipocalin domain of Violaxanthin de-epoxidase (VDE) at pH5
Authors : Arnoux, P.; Morosinotto, T.; Pignol, D.
Deposited on : 2008-04-03
Resolution : 2.00 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

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

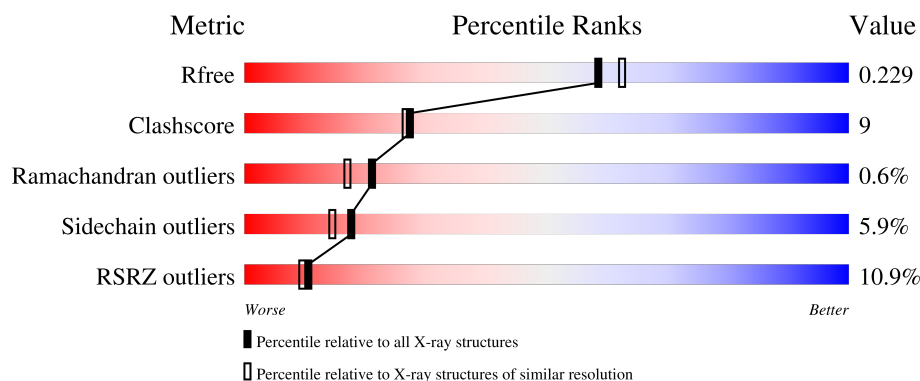
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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}	180053	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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 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	185	10% 74% 14% • • 8%
1	B	185	10% 79% 10% • • 8%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2979 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 Violaxanthin de-epoxidase, chloroplast.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	171	Total	C	N	O	S	0	1	0
			1402	896	235	269	2			
1	B	170	Total	C	N	O	S	0	2	0
			1396	895	232	267	2			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	77	MET	-	initiating methionine	UNP Q39249
A	254	ARG	-	expression tag	UNP Q39249
A	255	SER	-	expression tag	UNP Q39249
A	256	HIS	-	expression tag	UNP Q39249
A	257	HIS	-	expression tag	UNP Q39249
A	258	HIS	-	expression tag	UNP Q39249
A	259	HIS	-	expression tag	UNP Q39249
A	260	HIS	-	expression tag	UNP Q39249
A	261	HIS	-	expression tag	UNP Q39249
B	77	MET	-	initiating methionine	UNP Q39249
B	254	ARG	-	expression tag	UNP Q39249
B	255	SER	-	expression tag	UNP Q39249
B	256	HIS	-	expression tag	UNP Q39249
B	257	HIS	-	expression tag	UNP Q39249
B	258	HIS	-	expression tag	UNP Q39249
B	259	HIS	-	expression tag	UNP Q39249
B	260	HIS	-	expression tag	UNP Q39249
B	261	HIS	-	expression tag	UNP Q39249

- Molecule 2 is GADOLINIUM ATOM (CCD ID: GD) (formula: Gd).

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

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	2	Total	Gd	0	0
			2	2		

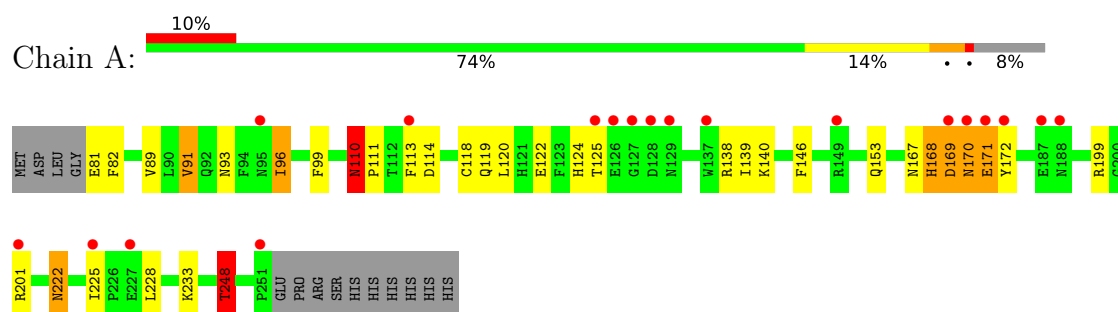
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	88	Total	O	0	0
			88	88		
3	B	90	Total	O	0	0
			90	90		

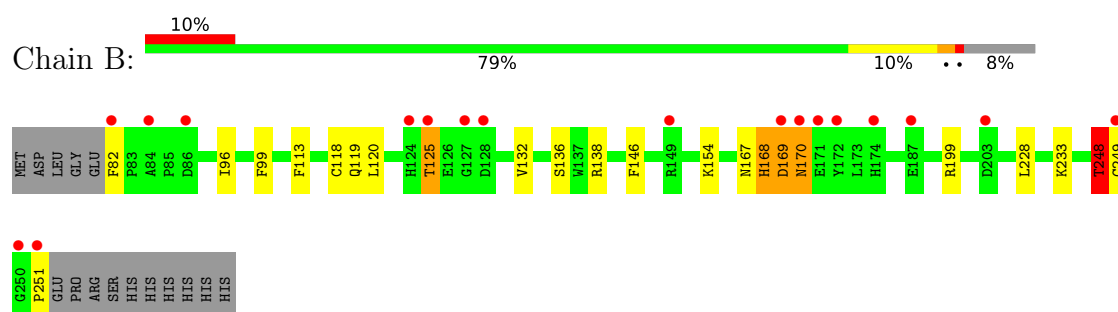
3 Residue-property plots [i](#)

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: Violaxanthin de-epoxidase, chloroplast



- Molecule 1: Violaxanthin de-epoxidase, chloroplast



4 Data and refinement statistics

Property	Value	Source
Space group	I 41 2 2	Depositor
Cell constants a, b, c, α , β , γ	122.30Å 122.30Å 158.34Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.20 – 2.00 29.20 – 2.00	Depositor EDS
% Data completeness (in resolution range)	98.3 (29.20-2.00) 98.1 (29.20-2.00)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.82 (at 2.00Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.208 , 0.234 0.209 , 0.229	Depositor DCC
R_{free} test set	1996 reflections (4.92%)	wwPDB-VP
Wilson B-factor (Å ²)	28.0	Xtriage
Anisotropy	0.060	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 39.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	2979	wwPDB-VP
Average B, all atoms (Å ²)	29.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.11% 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: GD

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	1.01	0/1445	1.06	7/1967 (0.4%)
1	B	1.09	0/1439	1.02	3/1961 (0.2%)
All	All	1.05	0/2884	1.04	10/3928 (0.3%)

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
1	B	0	2
All	All	0	3

There are no bond length outliers.

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	170	ASN	N-CA-C	8.79	123.73	112.92
1	A	110	ASN	CA-C-N	7.72	128.19	119.92
1	A	110	ASN	C-N-CA	7.72	128.19	119.92
1	B	170	ASN	N-CA-C	7.53	122.19	112.92
1	A	248	THR	N-CA-CB	-6.02	100.59	110.40
1	A	248	THR	OG1-CB-CG2	5.79	120.87	109.30
1	B	248	THR	N-CA-CB	-5.56	101.16	110.39
1	A	169	ASP	N-CA-C	5.43	122.37	110.80
1	B	169	ASP	N-CA-C	5.11	121.67	110.80
1	A	110	ASN	N-CA-C	5.05	120.08	108.81

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	168	HIS	Peptide
1	B	168	HIS	Peptide
1	B	249	CYS	Peptide

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	1402	0	1304	36	0
1	B	1396	0	1302	21	0
2	A	1	0	0	0	0
2	B	2	0	0	0	0
3	A	88	0	0	8	2
3	B	90	0	0	1	2
All	All	2979	0	2606	49	2

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 (49) 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:81:GLU:HB3	3:A:465:HOH:O	1.21	1.29
1:B:82:PHE:O	1:B:199:ARG:HD2	1.54	1.07
1:A:138[B]:ARG:NH2	1:A:140:LYS:HD2	1.70	1.05
3:A:404:HOH:O	1:B:251:PRO:HA	1.71	0.90
1:B:136:SER:OG	1:B:138:ARG:NH2	2.11	0.84
1:A:138[A]:ARG:HG2	1:B:113:PHE:HB2	1.60	0.82
1:A:82:PHE:O	1:A:199:ARG:HD2	1.81	0.80
1:A:138[B]:ARG:NH2	1:A:140:LYS:CD	2.48	0.76
1:B:82:PHE:O	1:B:199:ARG:CD	2.37	0.70
1:A:119:GLN:H	1:A:248:THR:CG2	2.05	0.69
1:A:201:ARG:HD2	3:A:403:HOH:O	1.90	0.69
1:B:119:GLN:H	1:B:248:THR:CG2	2.07	0.68
1:A:153:GLN:HE21	1:A:167:ASN:ND2	1.95	0.64

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:138[B]:ARG:HG3	1:B:113:PHE:HB2	1.80	0.64
1:A:119:GLN:H	1:A:248:THR:HG23	1.62	0.63
1:B:167:ASN:HD21	1:B:170:ASN:HD21	1.48	0.60
1:A:138[B]:ARG:HH22	1:A:140:LYS:HD2	1.63	0.60
1:B:119:GLN:H	1:B:248:THR:HG23	1.70	0.55
1:A:113:PHE:HB2	1:B:138:ARG:HG2	1.91	0.51
1:A:96:ILE:HG13	3:A:413:HOH:O	2.11	0.51
1:A:81:GLU:CD	3:A:465:HOH:O	2.55	0.50
1:B:132[B]:VAL:HG12	1:B:154:LYS:HG2	1.94	0.49
1:A:138[B]:ARG:HH21	1:A:140:LYS:CG	2.26	0.48
1:A:167:ASN:ND2	1:A:170:ASN:HD21	2.11	0.48
1:A:114:ASP:HA	1:B:138:ARG:NH1	2.27	0.48
1:A:124:HIS:HD2	3:A:404:HOH:O	1.96	0.48
1:B:118:CYS:HA	1:B:248:THR:HG23	1.95	0.48
1:A:138[B]:ARG:HG2	1:A:139:ILE:N	2.27	0.48
1:A:118:CYS:HA	1:A:248:THR:HG23	1.95	0.47
1:A:120:LEU:HD22	1:B:120:LEU:HD22	1.95	0.47
1:A:171:GLU:HB3	1:A:172:TYR:H	1.54	0.47
1:A:81:GLU:CB	3:A:465:HOH:O	2.08	0.46
1:B:119:GLN:HB2	1:B:248:THR:HG21	1.98	0.46
1:A:138[B]:ARG:NH2	1:A:140:LYS:CG	2.78	0.46
1:A:138[B]:ARG:HH21	1:A:140:LYS:CD	2.26	0.45
1:A:113:PHE:HB3	1:B:146:PHE:CD2	2.53	0.44
1:A:138[A]:ARG:HE	1:A:138[A]:ARG:HB2	1.75	0.44
1:B:167:ASN:HD21	1:B:170:ASN:ND2	2.15	0.44
1:A:138[B]:ARG:NH2	1:B:113:PHE:CZ	2.86	0.44
1:A:146:PHE:CD2	1:B:113:PHE:HB3	2.53	0.44
1:A:110:ASN:HA	1:A:111:PRO:HD2	1.51	0.43
1:A:222:ASN:HA	1:A:225:ILE:HD12	2.02	0.42
1:B:168:HIS:O	1:B:170:ASN:N	2.50	0.42
1:A:91:VAL:HG13	1:A:93:ASN:O	2.20	0.42
1:A:222:ASN:HB2	3:A:428:HOH:O	2.20	0.41
1:A:168:HIS:O	1:A:170:ASN:N	2.53	0.41
1:A:119:GLN:HG2	1:A:248:THR:HG21	2.02	0.41
1:A:119:GLN:CG	1:A:248:THR:HG21	2.52	0.40
1:B:125:THR:HG21	3:B:513:HOH:O	2.21	0.40

All (2) 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)
3:A:434:HOH:O	3:B:485:HOH:O[5_555]	2.15	0.05
3:A:489:HOH:O	3:B:462:HOH:O[5_555]	2.19	0.01

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	170/185 (92%)	165 (97%)	4 (2%)	1 (1%)	21	17
1	B	170/185 (92%)	167 (98%)	2 (1%)	1 (1%)	21	17
All	All	340/370 (92%)	332 (98%)	6 (2%)	2 (1%)	21	17

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	169	ASP
1	B	169	ASP

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	153/165 (93%)	141 (92%)	12 (8%)	11	8
1	B	153/165 (93%)	147 (96%)	6 (4%)	28	28
All	All	306/330 (93%)	288 (94%)	18 (6%)	18	14

All (18) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	89	VAL
1	A	91	VAL
1	A	96	ILE
1	A	99	PHE
1	A	110	ASN
1	A	122	GLU
1	A	125	THR
1	A	171	GLU
1	A	222	ASN
1	A	228	LEU
1	A	233	LYS
1	A	248	THR
1	B	96	ILE
1	B	99	PHE
1	B	125	THR
1	B	228	LEU
1	B	233	LYS
1	B	248	THR

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	110	ASN
1	A	134	ASN
1	A	167	ASN
1	B	153	GLN
1	B	167	ASN
1	B	202	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 oligosaccharides in this entry.

5.6 Ligand geometry

Of 3 ligands modelled in this entry, 3 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

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	171/185 (92%)	0.62	19 (11%) 10 9	13, 29, 47, 55	1 (0%)
1	B	170/185 (91%)	0.53	18 (10%) 11 10	10, 26, 42, 54	2 (1%)
All	All	341/370 (92%)	0.58	37 (10%) 10 9	10, 27, 43, 55	3 (0%)

All (37) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	251	PRO	6.6
1	B	250	GLY	5.6
1	A	172	TYR	5.2
1	A	188	ASN	4.6
1	B	172	TYR	4.3
1	B	128	ASP	3.9
1	B	127	GLY	3.7
1	B	124	HIS	3.7
1	B	203	ASP	3.6
1	B	169	ASP	3.2
1	A	201	ARG	3.1
1	B	84	ALA	3.0
1	A	127	GLY	3.0
1	A	129	ASN	2.9
1	A	169	ASP	2.9
1	A	170	ASN	2.8
1	A	187	GLU	2.7
1	B	149	ARG	2.7
1	A	171	GLU	2.7
1	A	128	ASP	2.7
1	A	227	GLU	2.4
1	A	126	GLU	2.4
1	B	174	HIS	2.4
1	B	86	ASP	2.3

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Mol	Chain	Res	Type	RSRZ
1	B	249	CYS	2.3
1	A	95	ASN	2.3
1	A	113	PHE	2.2
1	A	251	PRO	2.2
1	B	171	GLU	2.2
1	A	149	ARG	2.2
1	B	170	ASN	2.2
1	B	187	GLU	2.2
1	A	125	THR	2.2
1	B	82	PHE	2.2
1	B	125	THR	2.2
1	A	137	TRP	2.1
1	A	225	ILE	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	GD	B	403	1/1	0.89	0.18	32,32,32,32	1
2	GD	B	402	1/1	0.99	0.03	24,24,24,24	1
2	GD	A	401	1/1	0.99	0.03	24,24,24,24	1

6.5 Other polymers [i](#)

There are no such residues in this entry.