



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 07:34 PM GMT

PDB ID : 4P9O  
Title : Complex of Voltage-gated ion channel in a the presence of channel blocking compound  
Authors : Naylor, C.E.; Bagneris, C.; Wallace, B.A.  
Deposited on : 2014-04-04  
Resolution : 2.89 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](mailto:validation@mail.wwpdb.org)  
A user guide is available at  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

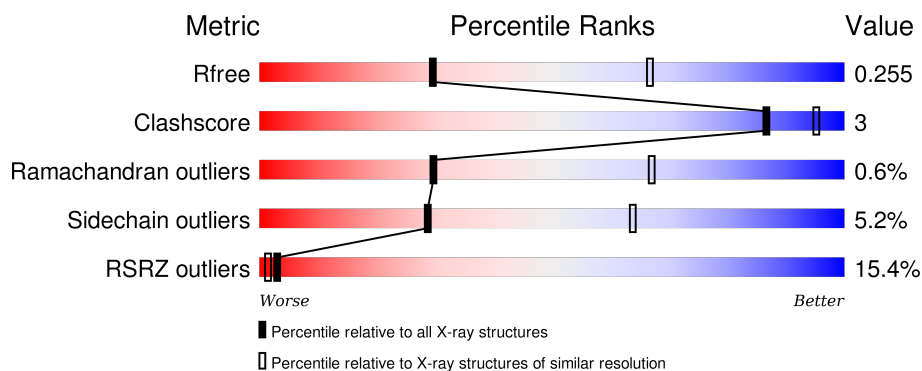
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.89 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))
$R_{free}$	91344	1451 (2.90-2.90)
Clashscore	102246	1668 (2.90-2.90)
Ramachandran outliers	100387	1630 (2.90-2.90)
Sidechain outliers	100360	1632 (2.90-2.90)
RSRZ outliers	91569	1456 (2.90-2.90)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	149	<div> <div>10%</div> <div>53%</div> <div>9%</div> <div>38%</div> </div>
1	B	149	<div> <div>9%</div> <div>55%</div> <div>5%</div> <div>40%</div> </div>
1	C	149	<div> <div>9%</div> <div>52%</div> <div>9%</div> <div>39%</div> </div>
1	D	149	<div> <div>10%</div> <div>52%</div> <div>8%</div> <div>39%</div> </div>

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 crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	2CV	A	300	-	-	-	X
2	2CV	B	302	-	-	-	X
3	BR	B	301	-	-	-	X
3	BR	B	304	-	-	-	X
3	BR	D	301	-	-	-	X
3	BR	D	303	-	-	-	X

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 3232 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.

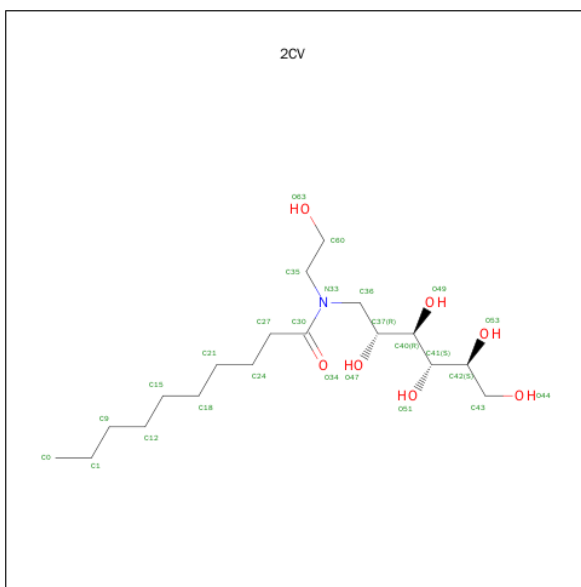
- Molecule 1 is a protein called Ion transport protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	92	Total	C	N	O	S	0	0	0
			718	488	106	119	5			
1	B	90	Total	C	N	O	S	0	0	0
			711	483	104	119	5			
1	C	91	Total	C	N	O	S	0	0	0
			715	485	105	120	5			
1	D	91	Total	C	N	O	S	0	0	0
			712	482	105	120	5			

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	126	GLY	-	expression tag	UNP A0L5S6
A	127	SER	-	expression tag	UNP A0L5S6
A	128	HIS	-	expression tag	UNP A0L5S6
A	129	MET	-	expression tag	UNP A0L5S6
B	126	GLY	-	expression tag	UNP A0L5S6
B	127	SER	-	expression tag	UNP A0L5S6
B	128	HIS	-	expression tag	UNP A0L5S6
B	129	MET	-	expression tag	UNP A0L5S6
C	126	GLY	-	expression tag	UNP A0L5S6
C	127	SER	-	expression tag	UNP A0L5S6
C	128	HIS	-	expression tag	UNP A0L5S6
C	129	MET	-	expression tag	UNP A0L5S6
D	126	GLY	-	expression tag	UNP A0L5S6
D	127	SER	-	expression tag	UNP A0L5S6
D	128	HIS	-	expression tag	UNP A0L5S6
D	129	MET	-	expression tag	UNP A0L5S6

- Molecule 2 is HEGA-10 (three-letter code: 2CV) (formula: C<sub>18</sub>H<sub>37</sub>NO<sub>7</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			26	18	1	7		
2	A	1	Total	C	N	O	0	0
			13	11	1	1		
2	B	1	Total	C	N	O	0	0
			26	18	1	7		
2	B	1	Total	C	N	O	0	0
			16	13	1	2		
2	C	1	Total	C	N	O	0	0
			18	13	1	4		
2	D	1	Total	C	N	O	0	0
			20	15	1	4		

- Molecule 3 is BROMIDE ION (three-letter code: BR) (formula: Br).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	2	Total	Br	0	0
			2	2		
3	D	2	Total	Br	0	0
			2	2		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	62	Total	O	0	0
			62	62		

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	50	Total	O	0	0
			50	50		
4	C	76	Total	O	0	0
			76	76		
4	D	65	Total	O	0	0
			65	65		



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	80.42Å 328.37Å 80.39Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	32.91 – 2.89 45.24 – 2.89	Depositor EDS
% Data completeness (in resolution range)	98.8 (32.91-2.89) 98.9 (45.24-2.89)	Depositor EDS
$R_{merge}$	0.19	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.54 (at 2.91Å)	Xtriage
Refinement program	BUSTER 2.10.0	Depositor
R, $R_{free}$	0.214 , 0.251 0.218 , 0.255	Depositor DCC
$R_{free}$ test set	1263 reflections (5.52%)	DCC
Wilson B-factor (Å <sup>2</sup> )	37.6	Xtriage
Anisotropy	1.428	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 92.2	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 24136 reflections	Xtriage
$F_o, F_c$ correlation	0.91	EDS
Total number of atoms	3232	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	61.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 27.44 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 2.1980e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 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: 2CV, BR

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	0.51	0/740	0.67	0/1015
1	B	0.53	0/733	0.66	0/1005
1	C	0.51	0/737	0.65	0/1010
1	D	0.51	0/734	0.67	0/1006
All	All	0.52	0/2944	0.66	0/4036

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	718	0	726	4	0
1	B	711	0	721	2	0
1	C	715	0	724	5	0
1	D	712	0	715	5	0
2	A	39	0	56	0	0
2	B	42	0	61	0	0
2	C	18	0	22	0	0
2	D	20	0	29	0	0
3	B	2	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	D	2	0	0	0	0
4	A	62	0	0	0	0
4	B	50	0	0	0	0
4	C	76	0	0	0	0
4	D	65	0	0	1	0
All	All	3232	0	3054	16	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.

All (16) 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:157:PHE:CZ	1:B:188:VAL:HA	2.32	0.64
1:D:148:MET:HG2	4:D:438:HOH:O	2.04	0.58
1:C:189:MET:HA	1:C:192:HIS:O	2.07	0.54
1:D:189:MET:HA	1:D:192:HIS:O	2.09	0.53
1:A:157:PHE:CZ	1:A:188:VAL:HA	2.47	0.49
1:A:196:TRP:HB2	1:A:200:ILE:HD12	1.96	0.47
1:C:215:ILE:HA	1:C:218:ILE:HD12	1.96	0.47
1:A:179:SER:HB3	1:A:183:GLY:HA3	1.96	0.47
1:B:179:SER:HB3	1:B:183:GLY:HA3	1.96	0.47
1:C:200:ILE:O	1:C:204:MET:HG3	2.15	0.47
1:A:175:MET:SD	1:A:210:VAL:HG21	2.57	0.45
1:D:215:ILE:HA	1:D:218:ILE:HD12	1.99	0.43
1:D:157:PHE:CZ	1:D:188:VAL:HA	2.53	0.43
1:D:206:THR:C	1:D:208:PHE:H	2.22	0.42
1:C:206:THR:C	1:C:208:PHE:H	2.23	0.42
1:C:184:ILE:O	1:C:187:PRO:HD2	2.21	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	90/149 (60%)	83 (92%)	6 (7%)	1 (1%)	17	51
1	B	88/149 (59%)	82 (93%)	5 (6%)	1 (1%)	17	51
1	C	89/149 (60%)	82 (92%)	7 (8%)	0	100	100
1	D	89/149 (60%)	81 (91%)	8 (9%)	0	100	100
All	All	356/596 (60%)	328 (92%)	26 (7%)	2 (1%)	30	67

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	208	PHE
1	B	208	PHE

### 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	77/129 (60%)	73 (95%)	4 (5%)	29	64
1	B	78/129 (60%)	75 (96%)	3 (4%)	40	76
1	C	78/129 (60%)	74 (95%)	4 (5%)	29	65
1	D	77/129 (60%)	72 (94%)	5 (6%)	21	52
All	All	310/516 (60%)	294 (95%)	16 (5%)	29	64

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	163	ASP
1	A	178	GLU
1	A	212	ASN
1	A	217	ILE
1	B	163	ASP
1	B	190	ASN

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Mol	Chain	Res	Type
1	B	217	ILE
1	C	137	LEU
1	C	142	PHE
1	C	148	MET
1	C	211	LEU
1	D	137	LEU
1	D	142	PHE
1	D	148	MET
1	D	156	THR
1	D	211	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	192	HIS

### 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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

Of 10 ligands modelled in this entry, 4 are monoatomic - leaving 6 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	2CV	A	300	-	25,25,25	0.21	0	29,30,30	1.09	1 (3%)
2	2CV	A	301	-	12,12,25	0.30	0	12,12,30	0.26	0
2	2CV	B	302	-	25,25,25	0.29	0	29,30,30	1.27	1 (3%)
2	2CV	B	303	-	15,15,25	0.33	0	15,16,30	0.61	0
2	2CV	C	300	-	17,17,25	0.23	0	17,19,30	0.58	0
2	2CV	D	302	-	19,19,25	0.21	0	19,21,30	0.52	0

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	2CV	A	300	-	-	0/34/34/34	0/0/0/0
2	2CV	A	301	-	-	1/11/11/34	0/0/0/0
2	2CV	B	302	-	-	0/34/34/34	0/0/0/0
2	2CV	B	303	-	-	0/16/16/34	0/0/0/0
2	2CV	C	300	-	-	0/20/20/34	0/0/0/0
2	2CV	D	302	-	-	0/22/22/34	0/0/0/0

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	300	2CV	C35-N33-C36	5.13	120.43	115.45
2	B	302	2CV	C35-N33-C36	5.77	121.05	115.45

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	301	2CV	C27-C30-N33-C36

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	92/149 (61%)	0.61	15 (16%) 2 1	28, 45, 145, 207	0
1	B	90/149 (60%)	0.51	13 (14%) 3 2	27, 44, 141, 194	0
1	C	91/149 (61%)	0.43	13 (14%) 4 2	32, 44, 134, 191	0
1	D	91/149 (61%)	0.44	15 (16%) 2 1	30, 43, 134, 184	0
All	All	364/596 (61%)	0.50	56 (15%) 3 1	27, 44, 139, 207	0

All (56) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	219	VAL	8.2
1	B	219	VAL	8.1
1	A	222	MET	8.1
1	C	220	ASP	8.0
1	A	221	ALA	7.6
1	D	218	ILE	7.0
1	C	218	ILE	6.1
1	C	219	VAL	6.0
1	D	213	LEU	6.0
1	C	213	LEU	5.9
1	B	220	ASP	5.6
1	B	134	VAL	5.3
1	D	220	ASP	5.2
1	D	214	PHE	5.1
1	A	213	LEU	5.1
1	A	134	VAL	5.0
1	D	219	VAL	4.9
1	C	131	VAL	4.8
1	B	218	ILE	4.7
1	D	131	VAL	4.6
1	D	217	ILE	4.4

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Mol	Chain	Res	Type	RSRZ
1	C	214	PHE	4.3
1	A	220	ASP	4.3
1	B	133	SER	4.1
1	C	217	ILE	4.1
1	A	133	SER	4.0
1	B	213	LEU	3.7
1	D	132	GLY	3.4
1	C	210	VAL	3.3
1	A	217	ILE	3.3
1	C	132	GLY	3.2
1	B	131	VAL	3.2
1	A	212	ASN	3.2
1	B	216	GLY	3.0
1	D	210	VAL	3.0
1	D	212	ASN	2.9
1	A	218	ILE	2.9
1	B	214	PHE	2.6
1	A	131	VAL	2.6
1	C	135	ALA	2.5
1	A	214	PHE	2.5
1	B	212	ASN	2.5
1	C	212	ASN	2.4
1	C	215	ILE	2.4
1	A	137	LEU	2.4
1	D	133	SER	2.3
1	A	132	GLY	2.3
1	B	132	GLY	2.3
1	D	209	THR	2.2
1	C	133	SER	2.1
1	B	137	LEU	2.1
1	A	216	GLY	2.1
1	D	134	VAL	2.1
1	D	216	GLY	2.1
1	B	217	ILE	2.1
1	D	130	GLY	2.0

## 6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.



### 6.3 Carbohydrates [i](#)

There are no carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95<sup>th</sup> 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	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
2	2CV	B	302	26/26	0.84	0.30	4.17	56,75,100,101	0
3	BR	B	304	1/1	0.91	0.52	3.29	38,38,38,38	1
2	2CV	A	300	26/26	0.86	0.29	3.10	56,73,105,108	0
3	BR	B	301	1/1	0.91	0.47	2.72	39,39,39,39	1
3	BR	D	303	1/1	0.78	0.61	2.41	37,37,37,37	1
2	2CV	C	300	18/26	0.88	0.25	1.76	53,71,78,80	0
3	BR	D	301	1/1	0.83	0.56	1.71	34,34,34,34	1
2	2CV	D	302	20/26	0.90	0.22	1.67	42,59,70,74	0
2	2CV	B	303	16/26	0.88	0.25	0.78	71,82,92,93	0
2	2CV	A	301	13/26	0.89	0.20	0.37	67,72,76,79	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.