



# Full wwPDB X-ray Structure Validation Report ⓘ

Jun 17, 2024 – 10:51 PM EDT

PDB ID : 3BQL  
Title : Structure of a chondroitin sulphate binding DBL3X domain from a var2csa encoded PfEMP1 protein  
Authors : Higgins, M.K.  
Deposited on : 2007-12-20  
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](mailto: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>.

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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 : 2022.3.0, CSD as543be (2022)  
Xtriage (Phenix) : 1.20.1  
EDS : 2.37.1  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.37.1

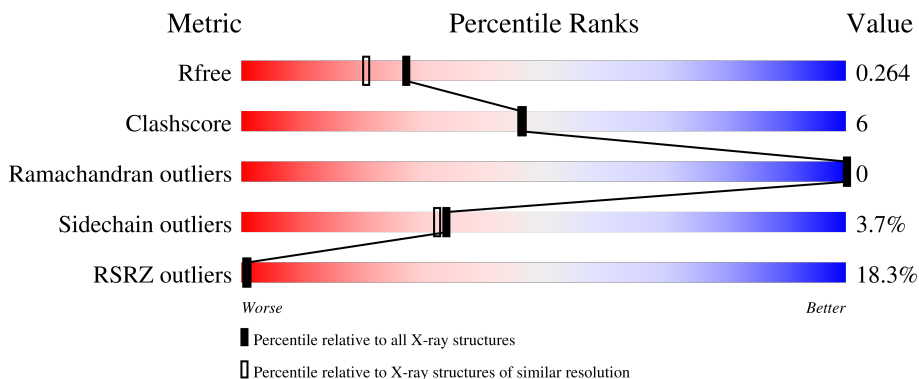
# 1 Overall quality at a glance

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))
$R_{free}$	130704	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (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  $\geq 3$ , 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	360	

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
2	SO4	A	1	-	-	-	X

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3003 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 Erythrocyte membrane protein 1.

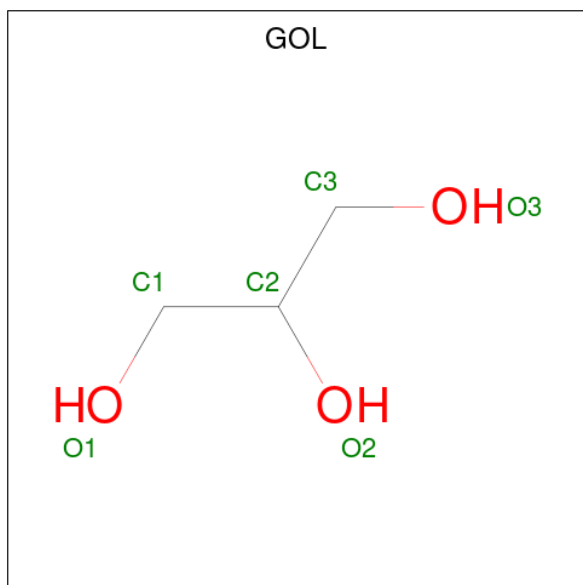
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	338	2732	1713	471	530	18	0	0	0

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	S		
2	A	1	5	4	1	0	0

- Molecule 3 is GLYCEROL (three-letter code: GOL) (formula: C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O 6 3 3	0	0

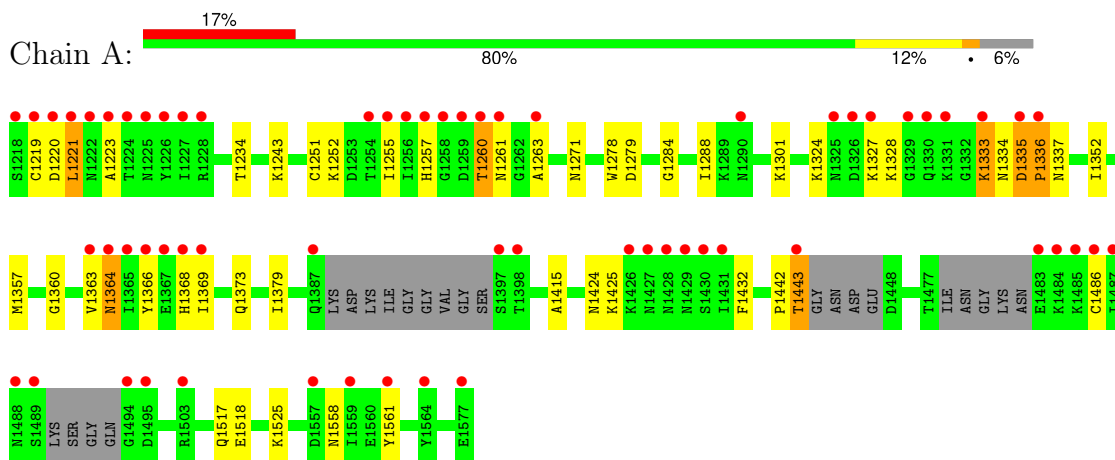
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	260	Total O 260 260	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: Erythrocyte membrane protein 1



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	41.58Å 86.99Å 92.66Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.32 – 2.00 63.42 – 2.00	Depositor EDS
% Data completeness (in resolution range)	100.0 (46.32-2.00) 100.0 (63.42-2.00)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	0.08	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.30 (at 2.00Å)	Xtrriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.222 , 0.271 0.220 , 0.264	Depositor DCC
$R_{free}$ test set	1202 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	27.3	Xtrriage
Anisotropy	0.471	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 59.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	3003	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	33.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.68% of the height of the origin peak. No significant pseudotranslation is detected.*

<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, 0.333 respectively for untwinned datasets, and 0.375, 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: GOL, SO4

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	0.54	0/2785	0.57	1/3733 (0.0%)

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

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	A	1336	PRO	N-CA-C	-6.31	95.68	112.10

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	1335	ASP	Peptide

### 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	2732	0	2649	34	0
2	A	5	0	0	0	0
3	A	6	0	8	2	0
4	A	260	0	0	1	0
All	All	3003	0	2657	34	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 6.

All (34) 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:1424:ASN:HD21	1:A:1432:PHE:H	1.09	0.94
1:A:1278:TRP:CH2	1:A:1368:HIS:HB2	2.11	0.86
1:A:1234:THR:H	1:A:1271:ASN:HD21	1.35	0.72
1:A:1335:ASP:OD1	1:A:1335:ASP:C	2.31	0.68
1:A:1255:ILE:HD11	1:A:1263:ALA:HB3	1.76	0.65
1:A:1357:MET:HA	1:A:1373:GLN:HE21	1.62	0.65
1:A:1352:ILE:HD12	3:A:2:GOL:H31	1.78	0.64
1:A:1366:TYR:HB2	1:A:1369:ILE:HB	1.85	0.58
1:A:1234:THR:H	1:A:1271:ASN:ND2	2.03	0.57
1:A:1336:PRO:CD	1:A:1337:ASN:H	2.16	0.57
1:A:1278:TRP:CZ2	1:A:1368:HIS:HB2	2.40	0.55
1:A:1424:ASN:ND2	1:A:1432:PHE:H	1.93	0.55
1:A:1301:LYS:HG3	1:A:1415:ALA:HB2	1.91	0.53
1:A:1220:ASP:HB2	1:A:1223:ALA:HB3	1.89	0.53
1:A:1352:ILE:CD1	3:A:2:GOL:H31	2.40	0.52
1:A:1360:GLY:HA2	1:A:1373:GLN:CD	2.31	0.51
1:A:1255:ILE:HD11	1:A:1263:ALA:CB	2.41	0.51
1:A:1333:LYS:HD2	1:A:1334:ASN:N	2.28	0.49
1:A:1279:ASP:O	1:A:1284:GLY:HA2	2.14	0.48
1:A:1221:LEU:O	1:A:1425:LYS:HE2	2.13	0.48
1:A:1558:ASN:HB2	1:A:1561:TYR:CD2	2.49	0.47
1:A:1336:PRO:HD2	1:A:1337:ASN:H	1.80	0.47
1:A:1252:LYS:HB2	1:A:1255:ILE:HG12	1.97	0.46
1:A:1324:LYS:HE3	4:A:1682:HOH:O	2.16	0.45
1:A:1364:ASN:H	1:A:1364:ASN:HD22	1.63	0.45
1:A:1357:MET:O	1:A:1373:GLN:HG2	2.17	0.44
1:A:1442:PRO:CB	1:A:1443:THR:HB	2.47	0.44
1:A:1517:GLN:HG3	1:A:1518:GLU:N	2.32	0.44
1:A:1336:PRO:CD	1:A:1337:ASN:N	2.77	0.43
1:A:1251:CYS:HA	1:A:1263:ALA:O	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:1288:ILE:O	1:A:1379:ILE:HD11	2.19	0.42
1:A:1360:GLY:HA2	1:A:1373:GLN:NE2	2.34	0.42
1:A:1260:THR:HG23	1:A:1525:LYS:NZ	2.35	0.41
1:A:1257:HIS:CD2	1:A:1363:VAL:HG23	2.56	0.41

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	328/360 (91%)	318 (97%)	10 (3%)	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	300/316 (95%)	289 (96%)	11 (4%)	34 32

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1219	CYS
1	A	1221	LEU

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Mol	Chain	Res	Type
1	A	1243	LYS
1	A	1260	THR
1	A	1261	ASN
1	A	1327	LYS
1	A	1328	LYS
1	A	1333	LYS
1	A	1364	ASN
1	A	1443	THR
1	A	1486	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1225	ASN
1	A	1271	ASN
1	A	1305	HIS
1	A	1356	ASN
1	A	1364	ASN
1	A	1373	GLN
1	A	1424	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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

2 ligands are modelled in this entry.

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
3	GOL	A	2	-	5,5,5	0.36	0	5,5,5	0.30	0
2	SO4	A	1	-	4,4,4	0.24	0	6,6,6	0.11	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
3	GOL	A	2	-	-	2/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	2	GOL	O1-C1-C2-C3
3	A	2	GOL	O1-C1-C2-O2

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	2	GOL	2	0

## 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, 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	338/360 (93%)	0.94	62 (18%) <b>1</b> <b>1</b>	10, 30, 57, 78	0

All (62) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1224	THR	10.8
1	A	1494	GLY	10.8
1	A	1223	ALA	9.3
1	A	1487	ILE	8.5
1	A	1218	SER	7.9
1	A	1258	GLY	7.1
1	A	1222	ASN	6.9
1	A	1430	SER	6.1
1	A	1488	ASN	6.0
1	A	1485	LYS	5.9
1	A	1255	ILE	5.5
1	A	1561	TYR	5.4
1	A	1495	ASP	5.3
1	A	1577	GLU	5.2
1	A	1221	LEU	5.0
1	A	1226	TYR	4.8
1	A	1329	GLY	4.8
1	A	1254	THR	4.5
1	A	1363	VAL	4.4
1	A	1443	THR	4.4
1	A	1484	LYS	4.3
1	A	1486	CYS	4.3
1	A	1219	CYS	4.3
1	A	1220	ASP	4.3
1	A	1256	ILE	4.1
1	A	1364	ASN	4.1
1	A	1257	HIS	4.0

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Mol	Chain	Res	Type	RSRZ
1	A	1397	SER	3.9
1	A	1365	ILE	3.7
1	A	1557	ASP	3.7
1	A	1489	SER	3.7
1	A	1429	ASN	3.7
1	A	1325	ASN	3.5
1	A	1225	ASN	3.4
1	A	1366	TYR	3.4
1	A	1367	GLU	3.3
1	A	1426	LYS	3.2
1	A	1333	LYS	3.2
1	A	1564	TYR	3.1
1	A	1263	ALA	3.0
1	A	1260	THR	2.9
1	A	1261	ASN	2.8
1	A	1559	ILE	2.8
1	A	1330	GLN	2.8
1	A	1259	ASP	2.7
1	A	1228	ARG	2.6
1	A	1503	ARG	2.6
1	A	1431	ILE	2.6
1	A	1428	ASN	2.6
1	A	1483	GLU	2.5
1	A	1387	GLN	2.5
1	A	1327	LYS	2.5
1	A	1335	ASP	2.4
1	A	1368	HIS	2.3
1	A	1290	ASN	2.2
1	A	1398	THR	2.2
1	A	1227	ILE	2.1
1	A	1326	ASP	2.1
1	A	1331	LYS	2.1
1	A	1427	ASN	2.1
1	A	1369	ILE	2.1
1	A	1336	PRO	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 monosaccharides 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, 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	B-factors(Å <sup>2</sup> )	Q<0.9
2	SO4	A	1	5/5	0.76	0.50	126,126,126,126	0
3	GOL	A	2	6/6	0.78	0.33	41,43,43,44	0

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

There are no such residues in this entry.