



wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 5, 2026 – 02:26 AM UTC

PDB ID : 9SD1 / pdb_00009sd1
Title : The R62Q clinical variant of human bisphosphoglycerate mutase (hBPGM).
Authors : Gavira, J.A.; Martinez-Rodriguez, S.
Deposited on : 2025-08-12
Resolution : 2.50 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

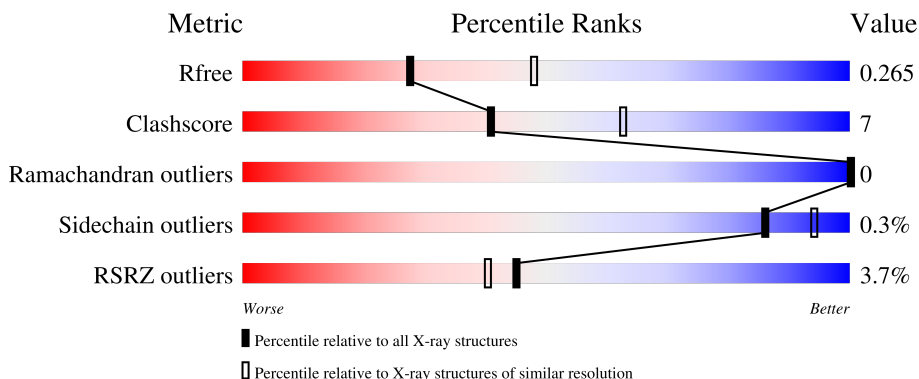
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

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	267	<div> <div>3%</div> <div>78%</div> <div>14%</div> <div>8%</div> </div>
1	B	267	<div> <div>2%</div> <div>76%</div> <div>16%</div> <div>7%</div> </div>
1	C	267	<div> <div>4%</div> <div>79%</div> <div>14%</div> <div>7%</div> </div>
1	D	267	<div> <div>4%</div> <div>70%</div> <div>19%</div> <div>11%</div> </div>

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 8515 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 Bisphosphoglycerate mutase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	246	Total	C	N	O	S	0	10	0
			2085	1320	370	388	7			
1	B	248	Total	C	N	O	S	0	5	0
			2059	1305	364	384	6			
1	C	248	Total	C	N	O	S	0	11	0
			2099	1332	375	385	7			
1	D	237	Total	C	N	O	S	0	11	0
			2015	1277	358	373	7			

There are 36 discrepancies between the modelled and reference sequences:

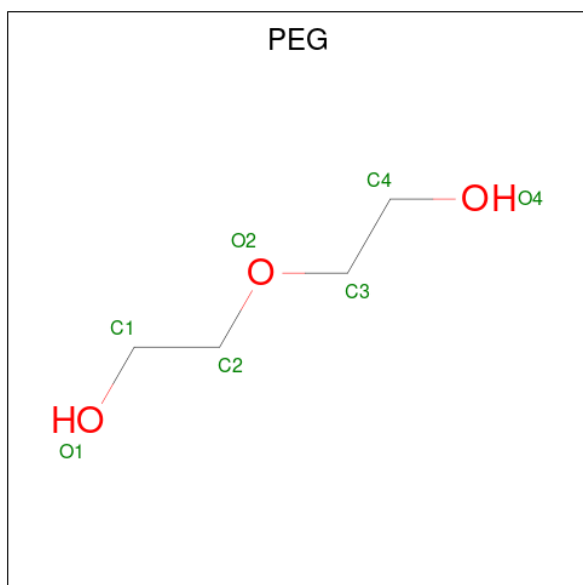
Chain	Residue	Modelled	Actual	Comment	Reference
A	62	GLN	ARG	variant	UNP P07738
A	260	LEU	-	expression tag	UNP P07738
A	261	GLU	-	expression tag	UNP P07738
A	262	HIS	-	expression tag	UNP P07738
A	263	HIS	-	expression tag	UNP P07738
A	264	HIS	-	expression tag	UNP P07738
A	265	HIS	-	expression tag	UNP P07738
A	266	HIS	-	expression tag	UNP P07738
A	267	HIS	-	expression tag	UNP P07738
B	62	GLN	ARG	variant	UNP P07738
B	260	LEU	-	expression tag	UNP P07738
B	261	GLU	-	expression tag	UNP P07738
B	262	HIS	-	expression tag	UNP P07738
B	263	HIS	-	expression tag	UNP P07738
B	264	HIS	-	expression tag	UNP P07738
B	265	HIS	-	expression tag	UNP P07738
B	266	HIS	-	expression tag	UNP P07738
B	267	HIS	-	expression tag	UNP P07738
C	62	GLN	ARG	variant	UNP P07738
C	260	LEU	-	expression tag	UNP P07738
C	261	GLU	-	expression tag	UNP P07738

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
C	262	HIS	-	expression tag	UNP P07738
C	263	HIS	-	expression tag	UNP P07738
C	264	HIS	-	expression tag	UNP P07738
C	265	HIS	-	expression tag	UNP P07738
C	266	HIS	-	expression tag	UNP P07738
C	267	HIS	-	expression tag	UNP P07738
D	62	GLN	ARG	variant	UNP P07738
D	260	LEU	-	expression tag	UNP P07738
D	261	GLU	-	expression tag	UNP P07738
D	262	HIS	-	expression tag	UNP P07738
D	263	HIS	-	expression tag	UNP P07738
D	264	HIS	-	expression tag	UNP P07738
D	265	HIS	-	expression tag	UNP P07738
D	266	HIS	-	expression tag	UNP P07738
D	267	HIS	-	expression tag	UNP P07738

- Molecule 2 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			7	4	3		

- Molecule 3 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	C	1	Total	C	O	0	0
			4	2	2		

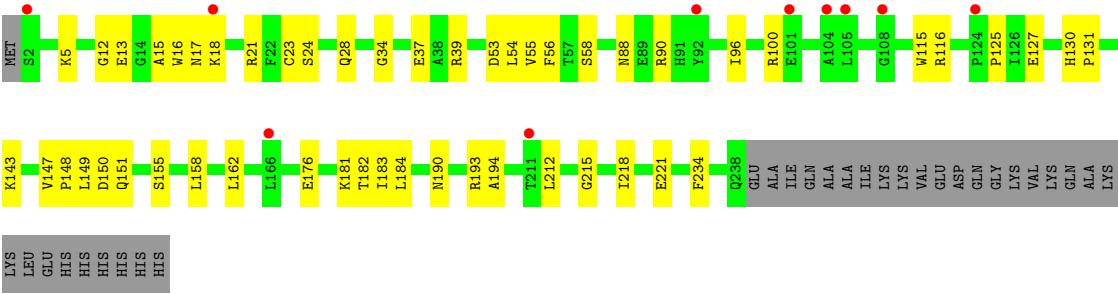
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	78	Total	O	0	0
			78	78		
4	B	76	Total	O	0	0
			76	76		
4	C	51	Total	O	0	0
			51	51		
4	D	41	Total	O	0	0
			41	41		

i

- Molecule 1: Bisphosphoglycerate mutase





LYS
LEU
GLU
HIS
HIS
HIS
HIS
HIS
HIS

4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	37.55Å 47.24Å 143.04Å 86.86° 84.12° 83.17°	Depositor
Resolution (Å)	71.08 – 2.50 71.08 – 2.50	Depositor EDS
% Data completeness (in resolution range)	93.3 (71.08-2.50) 93.3 (71.08-2.50)	Depositor EDS
R_{merge}	0.19	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.43 (at 2.51Å)	Xtriage
Refinement program	PHENIX (1.21.2_5419: ???)	Depositor
R, R_{free}	0.208 , 0.264 0.207 , 0.265	Depositor DCC
R_{free} test set	1557 reflections (4.64%)	wwPDB-VP
Wilson B-factor (Å ²)	27.4	Xtriage
Anisotropy	0.405	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 55.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.013 for -h,-k,-h+l	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	8515	wwPDB-VP
Average B, all atoms (Å ²)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.95% 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: EDO, PEG

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	0.09	0/2149	0.28	0/2908
1	B	0.12	0/2117	0.31	0/2868
1	C	0.10	0/2172	0.28	0/2938
1	D	0.14	0/2088	0.33	0/2827
All	All	0.11	0/8526	0.30	0/11541

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	2085	0	2068	29	0
1	B	2059	0	2041	24	0
1	C	2099	0	2107	23	1
1	D	2015	0	2002	34	1
2	A	7	0	10	0	0
3	C	4	0	6	1	0
4	A	78	0	0	1	0
4	B	76	0	0	1	0
4	C	51	0	0	0	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	D	41	0	0	0	0
All	All	8515	0	8234	108	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 7.

The worst 5 of 108 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:D:16:TRP:H	1:D:28:GLN:HE22	1.09	1.00
1:D:100:ARG:HD3	1:D:116:ARG:HH11	1.48	0.76
1:A:3:LYS:HD3	1:A:223:ASP:HA	1.70	0.73
1:B:207:ILE:HD12	1:B:210:ILE:HG13	1.77	0.66
1:A:179:ARG:HH21	1:A:181:LYS:HZ1	1.42	0.65

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:C:146:ASP:O	1:D:39:ARG:NH2[1_655]	2.17	0.03

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	254/267 (95%)	246 (97%)	8 (3%)	0	100	100
1	B	251/267 (94%)	245 (98%)	6 (2%)	0	100	100
1	C	257/267 (96%)	249 (97%)	8 (3%)	0	100	100
1	D	246/267 (92%)	238 (97%)	8 (3%)	0	100	100
All	All	1008/1068 (94%)	978 (97%)	30 (3%)	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	229/238 (96%)	229 (100%)	0	100	100
1	B	226/238 (95%)	225 (100%)	1 (0%)	84	93
1	C	232/238 (98%)	228 (98%)	4 (2%)	53	78
1	D	224/238 (94%)	224 (100%)	0	100	100
All	All	911/952 (96%)	906 (100%)	5 (0%)	86	92

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	3	LYS
1	C	101[A]	GLU
1	C	101[B]	GLU
1	C	138[A]	ASN
1	C	138[B]	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 16 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	233	GLN
1	D	198	HIS
1	C	170	ASN
1	D	190	ASN
1	C	151	GLN

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 ⓘ

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	$\# Z > 2$
2	PEG	A	301	-	6,6,6	0.26	0	5,5,5	0.24	0
3	EDO	C	301	-	3,3,3	0.24	0	2,2,2	0.35	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	PEG	A	301	-	-	3/4/4/4	-
3	EDO	C	301	-	-	0/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	301	PEG	O1-C1-C2-O2
2	A	301	PEG	C4-C3-O2-C2

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms
2	A	301	PEG	C1-C2-O2-C3

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	301	EDO	1	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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	246/267 (92%)	0.32	9 (3%) 45 40	12, 32, 70, 88	10 (4%)
1	B	248/267 (92%)	0.32	5 (2%) 65 61	17, 33, 60, 76	5 (2%)
1	C	248/267 (92%)	0.45	12 (4%) 35 31	15, 35, 73, 87	11 (4%)
1	D	237/267 (88%)	0.52	10 (4%) 40 36	18, 40, 66, 78	11 (4%)
All	All	979/1068 (91%)	0.40	36 (3%) 45 40	12, 35, 68, 88	37 (3%)

The worst 5 of 36 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	18[A]	LYS	3.8
1	C	103	MET	3.8
1	D	211	THR	3.5
1	A	239[A]	GLU	3.2
1	A	14	GLY	3.2

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(\AA^2)	Q<0.9
2	PEG	A	301	7/7	0.84	0.15	52,60,68,70	0
3	EDO	C	301	4/4	0.87	0.15	39,49,54,55	0

6.5 Other polymers [i](#)

There are no such residues in this entry.