



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 7, 2026 – 12:32 AM UTC

PDB ID : 6F6K / pdb_00006f6k
Title : R2-like ligand-binding oxidase V72L mutant with anaerobically reconstituted Mn/Fe cofactor
Authors : Griesse, J.J.; Hogbom, M.
Deposited on : 2017-12-05
Resolution : 1.98 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

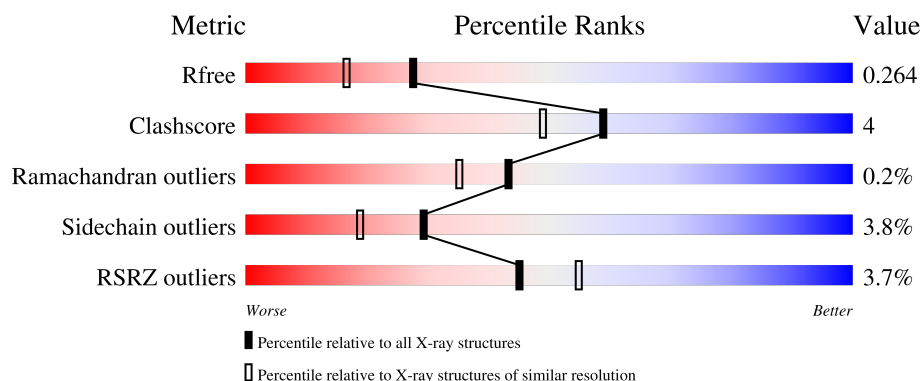
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.98 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	1506 (1.98-1.98)
Clashscore	190562	1534 (1.98-1.98)
Ramachandran outliers	187476	1518 (1.98-1.98)
Sidechain outliers	187428	1518 (1.98-1.98)
RSRZ outliers	180081	1506 (1.98-1.98)

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	316	 3% 75% 11% 14%
1	B	316	 4% 77% 9% 14%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 9170 atoms, of which 4446 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 Ribonucleotide reductase small subunit.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	272	Total	C	H	N	O	S	0	2	0
			4452	1456	2193	379	414	10			
1	B	273	Total	C	H	N	O	S	0	2	0
			4477	1462	2207	383	415	10			

There are 30 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-13	MET	-	initiating methionine	UNP Q5KW80
A	-12	ALA	-	expression tag	UNP Q5KW80
A	-11	HIS	-	expression tag	UNP Q5KW80
A	-10	HIS	-	expression tag	UNP Q5KW80
A	-9	HIS	-	expression tag	UNP Q5KW80
A	-8	HIS	-	expression tag	UNP Q5KW80
A	-7	HIS	-	expression tag	UNP Q5KW80
A	-6	HIS	-	expression tag	UNP Q5KW80
A	-5	VAL	-	expression tag	UNP Q5KW80
A	-4	ASP	-	expression tag	UNP Q5KW80
A	-3	ASP	-	expression tag	UNP Q5KW80
A	-2	ASP	-	expression tag	UNP Q5KW80
A	-1	ASP	-	expression tag	UNP Q5KW80
A	0	LYS	-	expression tag	UNP Q5KW80
A	72	LEU	VAL	engineered mutation	UNP Q5KW80
B	-13	MET	-	initiating methionine	UNP Q5KW80
B	-12	ALA	-	expression tag	UNP Q5KW80
B	-11	HIS	-	expression tag	UNP Q5KW80
B	-10	HIS	-	expression tag	UNP Q5KW80
B	-9	HIS	-	expression tag	UNP Q5KW80
B	-8	HIS	-	expression tag	UNP Q5KW80
B	-7	HIS	-	expression tag	UNP Q5KW80
B	-6	HIS	-	expression tag	UNP Q5KW80
B	-5	VAL	-	expression tag	UNP Q5KW80
B	-4	ASP	-	expression tag	UNP Q5KW80

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-3	ASP	-	expression tag	UNP Q5KW80
B	-2	ASP	-	expression tag	UNP Q5KW80
B	-1	ASP	-	expression tag	UNP Q5KW80
B	0	LYS	-	expression tag	UNP Q5KW80
B	72	LEU	VAL	engineered mutation	UNP Q5KW80

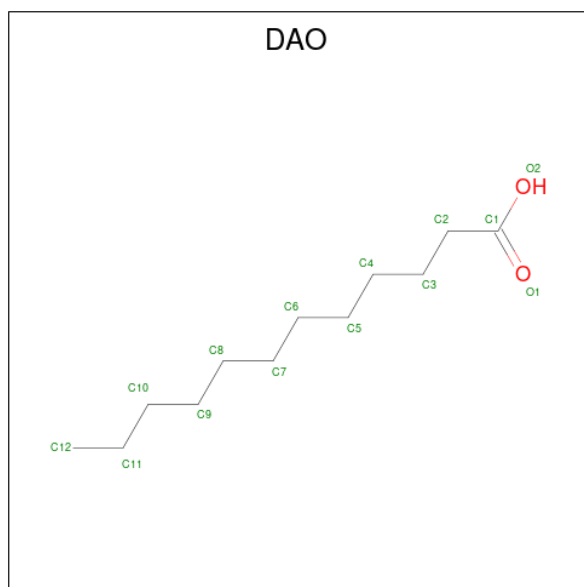
- Molecule 2 is MANGANESE (II) ION (CCD ID: MN) (formula: Mn).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Mn 1 1	0	0
2	B	1	Total Mn 1 1	0	0

- Molecule 3 is FE (II) ION (CCD ID: FE2) (formula: Fe).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	2	Total Fe 2 2	0	0
3	B	2	Total Fe 2 2	0	0

- Molecule 4 is LAURIC ACID (CCD ID: DAO) (formula: C₁₂H₂₄O₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	H	O	0	0
			37	12	23	2		
4	B	1	Total	C	H	O	0	0
			37	12	23	2		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	81	Total	O	0	0
			81	81		
5	B	80	Total	O	0	0
			80	80		

4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	160.61Å 55.66Å 70.08Å 90.00° 114.16° 90.00°	Depositor
Resolution (Å)	43.57 – 1.98 43.57 – 1.98	Depositor EDS
% Data completeness (in resolution range)	95.7 (43.57-1.98) 95.8 (43.57-1.98)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.10 (at 1.98Å)	Xtriage
Refinement program	PHENIX (1.10.1_2155: ???)	Depositor
R, R_{free}	0.198 , 0.263 0.199 , 0.264	Depositor DCC
R_{free} test set	1890 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å ²)	34.7	Xtriage
Anisotropy	0.268	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.42 , 42.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.016 for -h-2*k,l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	9170	wwPDB-VP
Average B, all atoms (Å ²)	43.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 10.06% 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: FE2, MN, DAO

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	0.56	0/2322	0.67	0/3136
1	B	0.58	0/2333	0.71	0/3150
All	All	0.57	0/4655	0.69	0/6286

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

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	2259	2193	2196	27	0
1	B	2270	2207	2209	16	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	14	23	23	0	0
4	B	14	23	23	0	0
5	A	81	0	0	2	0
5	B	80	0	0	1	0
All	All	4724	4446	4451	40	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 4.

All (40) 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:65:PHE:CE1	1:B:175:TYR:CE1	2.88	0.61
1:A:156:ILE:HD11	1:A:216:ILE:CG2	2.33	0.59
1:A:67:ALA:HB2	1:B:10:VAL:HG21	1.85	0.59
1:A:95:LEU:O	1:A:99[A]:MET:HG3	2.05	0.57
1:B:76:ILE:CG2	1:B:99[A]:MET:HG2	2.34	0.56
1:A:183:LYS:HG3	1:A:192:LEU:HD13	1.88	0.56
1:B:76:ILE:HG21	1:B:99[A]:MET:HG2	1.89	0.55
1:A:76:ILE:CG2	1:A:99[A]:MET:HG2	2.39	0.53
1:B:203:GLY:O	1:B:206:ILE:HG22	2.09	0.53
1:A:156:ILE:HD11	1:A:216:ILE:HG22	1.92	0.52
1:B:161:VAL:HG22	1:B:234:LEU:HD11	1.92	0.51
1:B:95:LEU:O	1:B:99[A]:MET:HG3	2.11	0.51
1:A:161:VAL:HG22	1:A:234:LEU:HD11	1.95	0.49
1:A:179:ARG:O	1:A:183:LYS:HB2	2.12	0.49
1:B:179:ARG:O	1:B:180:GLN:C	2.55	0.48
1:B:102:GLU:O	1:B:106:VAL:HG23	2.14	0.47
1:A:76:ILE:HG21	1:A:99[A]:MET:HG2	1.97	0.47
1:A:77:LEU:HD21	1:A:99[B]:MET:SD	2.55	0.47
1:A:76:ILE:O	1:A:76:ILE:HG13	2.15	0.45
1:A:157:ARG:HG2	5:A:570:HOH:O	2.17	0.45
1:A:133:ARG:HG2	1:A:237:HIS:CE1	2.51	0.45
1:A:278:LEU:HD23	1:A:279:ARG:NH1	2.32	0.44
1:A:275:GLN:O	1:A:279:ARG:HG2	2.17	0.44
1:A:156:ILE:HD11	1:A:216:ILE:HG21	2.00	0.44
1:A:59:LEU:N	1:A:60:PRO:CD	2.81	0.44
1:A:242:VAL:O	1:A:246:THR:HG23	2.18	0.43
1:A:96:THR:HA	1:A:99[A]:MET:HE2	2.01	0.43
1:B:156:ILE:CD1	1:B:223:TYR:HB3	2.48	0.43
1:A:26:LYS:HE2	5:A:561:HOH:O	2.18	0.42
1:A:99[A]:MET:HE3	1:B:99[A]:MET:HE3	2.00	0.42
1:A:123:LEU:HB2	1:B:10:VAL:HG13	2.01	0.42
1:B:65:PHE:O	1:B:69:GLU:HG2	2.20	0.42
1:A:81:HIS:NE2	1:A:85:ARG:NH1	2.68	0.42
1:A:151:SER:O	1:A:152:PRO:C	2.63	0.41
1:B:133:ARG:CZ	1:B:237:HIS:HE2	2.33	0.41
1:B:278:LEU:CD2	1:B:279:ARG:NH1	2.84	0.41
1:A:96:THR:HA	1:A:99[A]:MET:CE	2.52	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:156:ILE:CD1	1:A:216:ILE:HG21	2.51	0.40
1:A:157:ARG:O	1:A:161:VAL:HG23	2.21	0.40
1:B:192:LEU:HD12	5:B:555:HOH:O	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	270/316 (85%)	259 (96%)	10 (4%)	1 (0%)	30	20
1	B	271/316 (86%)	265 (98%)	6 (2%)	0	100	100
All	All	541/632 (86%)	524 (97%)	16 (3%)	1 (0%)	43	35

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	12	ALA

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	237/273 (87%)	229 (97%)	8 (3%)	32	22
1	B	238/273 (87%)	228 (96%)	10 (4%)	26	15

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
All	All	475/546 (87%)	457 (96%)	18 (4%)	29	19

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

Mol	Chain	Res	Type
1	A	5	ASP
1	A	32	LYS
1	A	72	LEU
1	A	106	VAL
1	A	183	LYS
1	A	199	ASN
1	A	278	LEU
1	A	286	THR
1	B	56	ILE
1	B	66	SER
1	B	72	LEU
1	B	144	ASN
1	B	156	ILE
1	B	199	ASN
1	B	221	GLU
1	B	267	LEU
1	B	284	SER
1	B	286	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	44	GLN
1	A	113	GLN
1	A	144	ASN
1	A	275	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 [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 8 ligands modelled in this entry, 6 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	$\# Z > 2$
4	DAO	A	404	-	13,13,13	0.74	1 (7%)	13,13,13	0.86	0
4	DAO	B	404	-	13,13,13	0.71	0	13,13,13	1.21	1 (7%)

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
4	DAO	A	404	-	-	4/11/11/11	-
4	DAO	B	404	-	-	5/11/11/11	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	404	DAO	O1-C1	2.03	1.28	1.22

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	404	DAO	O2-C1-O1	-2.56	116.76	123.33

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	B	404	DAO	C6-C7-C8-C9
4	B	404	DAO	C4-C5-C6-C7
4	B	404	DAO	C11-C10-C9-C8
4	A	404	DAO	C3-C4-C5-C6
4	A	404	DAO	C9-C10-C11-C12
4	A	404	DAO	O1-C1-C2-C3
4	A	404	DAO	O2-C1-C2-C3
4	B	404	DAO	O2-C1-C2-C3
4	B	404	DAO	O1-C1-C2-C3

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	272/316 (86%)	0.28	8 (2%) 53 63	17, 39, 67, 81	2 (0%)
1	B	273/316 (86%)	0.46	12 (4%) 39 49	18, 40, 71, 85	2 (0%)
All	All	545/632 (86%)	0.37	20 (3%) 45 55	17, 40, 70, 85	4 (0%)

All (20) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	175	TYR	4.4
1	B	267	LEU	3.9
1	B	265	TYR	3.5
1	A	286	THR	3.5
1	B	263	ILE	3.3
1	B	56	ILE	3.0
1	B	286	THR	2.9
1	A	270	HIS	2.7
1	B	52	SER	2.4
1	A	273	ILE	2.3
1	B	219	GLU	2.3
1	B	178	PHE	2.3
1	A	278	LEU	2.2
1	A	265	TYR	2.2
1	A	263	ILE	2.2
1	B	3	HIS	2.2
1	A	3	HIS	2.1
1	B	278	LEU	2.1
1	A	175	TYR	2.1
1	B	184	LYS	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
4	DAO	A	404	14/14	0.83	0.15	33,48,61,61	0
4	DAO	B	404	14/14	0.83	0.15	33,54,61,67	0
3	FE2	A	403	1/1	0.94	0.07	65,65,65,65	0
3	FE2	B	403	1/1	0.96	0.05	61,61,61,61	0
3	FE2	B	402	1/1	0.99	0.03	30,30,30,30	0
3	FE2	A	402	1/1	1.00	0.03	25,25,25,25	0
2	MN	A	401	1/1	1.00	0.02	27,27,27,27	0
2	MN	B	401	1/1	1.00	0.02	28,28,28,28	0

6.5 Other polymers [i](#)

There are no such residues in this entry.