



# wwPDB X-ray Structure Validation Summary Report i

Feb 27, 2014 – 07:59 PM GMT

PDB ID : 2A9C  
Title : Crystal structure of R138Q mutant of recombinant chicken sulfite oxidase with the bound product, sulfate, at the active site  
Authors : Karakas, E.; Wilson, H.L.; Graf, T.N.; Xiang, S.; Jaramillo-Busquets, S.; Rajagopalan, K.V.; Kisker, C.  
Deposited on : 2005-07-11  
Resolution : 2.50 Å(reported)

This is a wwPDB validation summary 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/ValidationPDFNotes.html>

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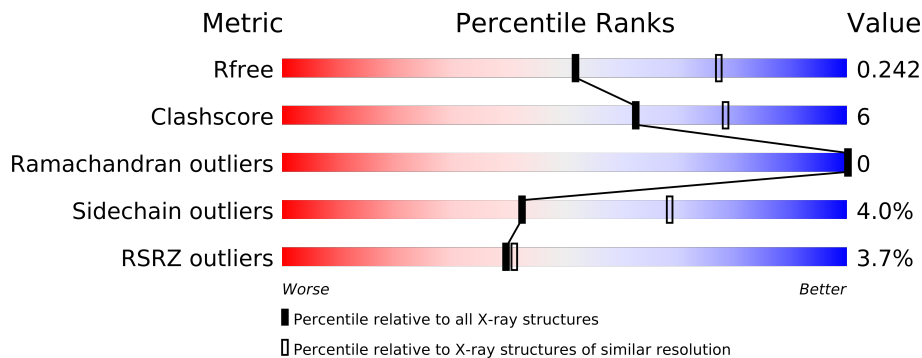
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.15 2013  
Xtriage (Phenix) : **FAILED**  
EDS : stable22639  
Percentile statistics : 21963  
Refmac : 5.8.0049  
CCP4 : 6.3.0 (Settle)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)  
Validation Pipeline (wwPDB-VP) : stable22683

# 1 Overall quality at a glance

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))
$R_{free}$	66092	2784 (2.50-2.50)
Clashscore	79885	3562 (2.50-2.50)
Ramachandran outliers	78287	3480 (2.50-2.50)
Sidechain outliers	78261	3482 (2.50-2.50)
RSRZ outliers	66119	2785 (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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	372	
1	B	372	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
5	GOL	B	9505	-	X

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 6142 atoms, of which 0 are hydrogen and 0 are deuterium.

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 Sulfite Oxidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	359	Total	C	N	O	S	0	0	0
			2772	1756	502	507	7			
1	B	359	Total	C	N	O	S	0	0	0
			2772	1756	502	507	7			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	138	GLN	ARG	ENGINEERED	UNP P07850
B	138	GLN	ARG	ENGINEERED	UNP P07850

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



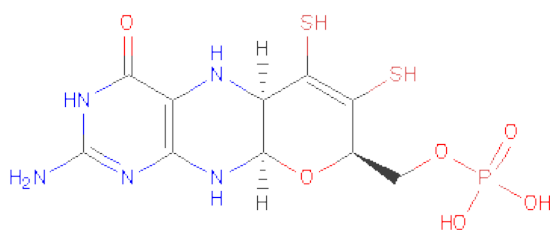
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		

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

- Molecule 3 is PHOSPHONIC ACIDMONO-(2-AMINO-5,6-DIMERCAPTO-4-OXO-3,7,8A, 9,10,10A-HEXAHYDRO-4H-8-OXA-1,3,9,10-TETRAAZA-ANTHRACEN-7-YLMETHYL) ESTER (three-letter code: MTE) (formula: C<sub>10</sub>H<sub>14</sub>N<sub>5</sub>O<sub>6</sub>PS<sub>2</sub>).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	S	0	0
			24	10	5	6	1	2		
3	B	1	Total	C	N	O	P	S	0	0
			24	10	5	6	1	2		

- Molecule 4 is MOLYBDENUM ATOM (three-letter code: MO) (formula: Mo).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Mo	0	0
			1	1		
4	A	1	Total	Mo	0	0
			1	1		

- Molecule 5 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
5	B	1	Total	C	O	0	0
			6	3	3		

- Molecule 6 is water.

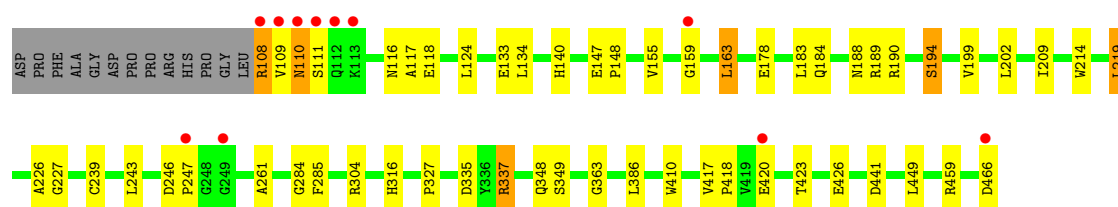
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	278	Total	O	0	0
			278	278		
6	B	254	Total	O	0	0
			254	254		

### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

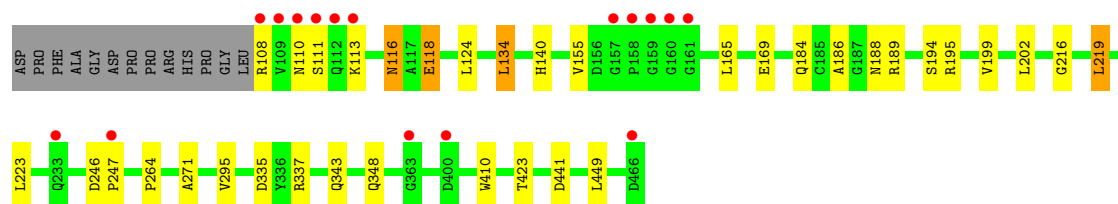
#### • Molecule 1: Sulfite Oxidase

Chain A: 



#### • Molecule 1: Sulfite Oxidase

Chain B: 



## 4 Data and refinement statistics

Xtriage (Phenix) failed to run properly - this section will therefore be incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	53.91Å 122.57Å 55.18Å 90.00° 94.97° 90.00°	Depositor
Resolution (Å)	30.00 – 2.50 28.65 – 2.51	Depositor EDS
% Data completeness (in resolution range)	97.2 (30.00-2.50) 97.2 (28.65-2.51)	Depositor EDS
$R_{merge}$	0.16	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	REFMAC 5.2	Depositor
R, $R_{free}$	0.156 , 0.237 0.165 , 0.242	Depositor DCC
$R_{free}$ test set	1215 reflections (5.37%)	DCC
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 27.7	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	6142	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	22.0	wwPDB-VP

## 5 Model quality

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, MO, SO4, MTE

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	0.73	1/2854 (0.0%)	0.84	1/3904 (0.0%)
1	B	0.77	0/2854	0.87	1/3904 (0.0%)
All	All	0.75	1/5708 (0.0%)	0.86	2/7808 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	239	CYS	CB-SG	-5.15	1.73	1.81

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	134	LEU	CA-CB-CG	5.54	128.04	115.30
1	A	337	ARG	NE-CZ-NH1	5.02	122.81	120.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2772	0	2714	37	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	2772	0	2714	22	0
2	A	5	0	0	0	0
2	B	5	0	0	1	0
3	A	24	0	10	1	0
3	B	24	0	10	1	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
5	B	6	0	8	0	0
6	A	278	0	0	6	1
6	B	254	0	0	6	1
All	All	6142	0	5456	60	1

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 6.

The worst 5 of 60 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:B:116:ASN:HD22	1:B:202:LEU:HD13	1.25	0.98
1:A:227:GLY:O	6:A:7709:HOH:O	1.96	0.82
1:A:316:HIS:ND1	6:A:7634:HOH:O	2.16	0.78
1:B:116:ASN:ND2	1:B:202:LEU:HD13	2.00	0.75
1:A:189:ARG:HH11	1:A:348:GLN:HE22	1.37	0.72

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	Distance(Å)	Clash(Å)
6:A:7538:HOH:O	6:B:9704:HOH:O[1_554]	2.19	0.01

## 5.3 Torsion angles

### 5.3.1 Protein backbone ⓘ

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	357/372 (96%)	345 (97%)	12 (3%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	357/372 (96%)	348 (98%)	9 (2%)	0	100	100
All	All	714/744 (96%)	693 (97%)	21 (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	291/301 (97%)	278 (96%)	13 (4%)	38	63
1	B	291/301 (97%)	281 (97%)	10 (3%)	49	75
All	All	582/602 (97%)	559 (96%)	23 (4%)	42	68

5 of 23 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	441	ASP
1	A	466	ASP
1	B	441	ASP
1	A	449	LEU
1	B	116	ASN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 12 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	465	GLN
1	B	177	HIS
1	B	343	GLN
1	A	348	GLN
1	B	319	GLN

### 5.3.3 RNA ⓘ

There are no RNA chains 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 carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 7 ligands modelled in this entry, 2 are monoatomic - leaving 5 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$
3	MTE	A	1501	4	26,26,26	2.21	6 (23%)	34,40,40	2.24	14 (41%)
2	SO4	A	7503	-	4,4,4	0.42	0	6,6,6	0.45	0
3	MTE	B	4501	4	26,26,26	2.29	5 (19%)	34,40,40	1.91	9 (26%)
2	SO4	B	8503	-	4,4,4	0.31	0	6,6,6	0.62	0
5	GOL	B	9505	-	5,5,5	0.28	0	5,5,5	0.66	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	MTE	A	1501	4	-	0/6/34/34	0/0/3/3
2	SO4	A	7503	-	-	0/0/0/0	0/0/0/0
3	MTE	B	4501	4	-	0/6/34/34	0/0/3/3
2	SO4	B	8503	-	-	0/0/0/0	0/0/0/0
5	GOL	B	9505	-	-	0/4/4/4	0/0/0/0

The worst 5 of 11 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	4501	MTE	C6-C1'	-7.43	1.40	1.50
3	B	4501	MTE	C6-N5	-5.64	1.37	1.45
3	A	1501	MTE	C6-N5	-5.64	1.37	1.45
3	A	1501	MTE	C6-C1'	-5.61	1.42	1.50
3	B	4501	MTE	C4'-C3'	-4.56	1.45	1.52

The worst 5 of 23 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1501	MTE	C1'-C6-N5	6.00	123.02	111.70
3	B	4501	MTE	C1'-C6-N5	6.00	123.01	111.70
3	A	1501	MTE	C7-C6-N5	4.40	114.03	108.44
3	A	1501	MTE	C7-O3'-C3'	3.53	118.93	112.03
3	A	1501	MTE	C9-C10-N8	3.50	123.11	119.12

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

## 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	359/372 (96%)	-0.24	11 (3%) 47 48	11, 19, 37, 66	0
1	B	359/372 (96%)	-0.12	16 (4%) 32 33	11, 19, 37, 65	0
All	All	718/744 (96%)	-0.18	27 (3%) 39 40	11, 19, 37, 66	0

The worst 5 of 27 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	111	SER	6.4
1	B	109	VAL	5.8
1	A	112	GLN	5.3
1	B	113	LYS	4.9
1	B	160	GLY	4.9

### 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 ⓘ

There are no carbohydrates in this entry.

### 6.4 Ligands ⓘ

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	RSR	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
5	GOL	B	9505	6/6	0.36	5.41	49,49,49,49	0
3	MTE	B	4501	24/24	0.14	-0.25	12,14,16,17	0
3	MTE	A	1501	24/24	0.12	-0.40	12,13,13,14	0
2	SO4	B	8503	5/5	0.10	-0.65	38,38,39,39	0
2	SO4	A	7503	5/5	0.09	-0.80	36,36,36,37	0
4	MO	B	5501	1/1	0.09	-1.66	17,17,17,17	0
4	MO	A	2501	1/1	0.07	-2.75	14,14,14,14	0

## 6.5 Other polymers ⓘ

There are no such residues in this entry.