



wwPDB X-ray Structure Validation Summary Report i

Feb 26, 2014 – 04:19 PM GMT

PDB ID : 2VQQ
Title : STRUCTURE OF HDAC4 CATALYTIC DOMAIN (A DOUBLE CYSTEINE-TO-ALANINE MUTANT) BOUND TO A TRIFLUORO METHYLKETONEINHBITOR
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Deposited on : 2008-03-18
Resolution : 1.90 Å(reported)

This is a wwPDB validation summary report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

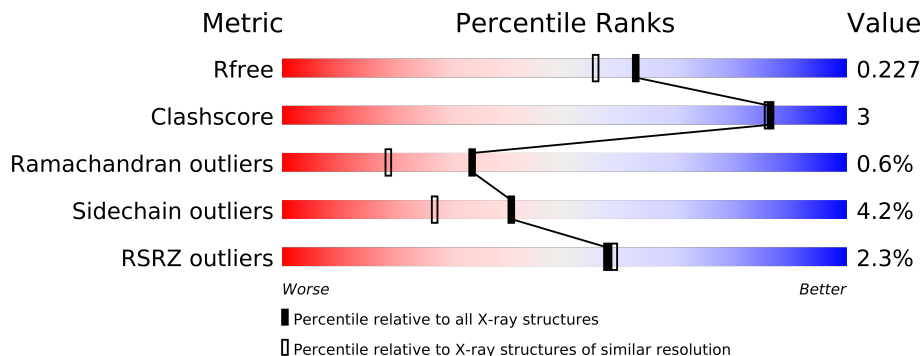
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.15 2013
Xtriage (Phenix)	:	dev-1323
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 1.90 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	3684 (1.90-1.90)
Clashscore	79885	4465 (1.90-1.90)
Ramachandran outliers	78287	4413 (1.90-1.90)
Sidechain outliers	78261	4414 (1.90-1.90)
RSRZ outliers	66119	3686 (1.90-1.90)

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 ≥ 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	413	
1	B	413	

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

Mol	Type	Chain	Res	Geometry	Electron density
3	K	A	1408	-	X
3	K	B	1407	-	X
5	ZN	A	1411	-	X
5	ZN	B	1410	-	X

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 6218 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.

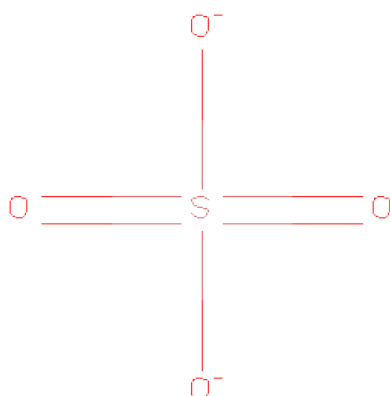
- Molecule 1 is a protein called HISTONE DEACETYLASE 4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	361	Total	C	N	O	S	0	12	0
			2783	1764	478	524	17			
1	B	357	Total	C	N	O	S	0	10	0
			2747	1738	474	518	17			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	25	ALA	CYS	ENGINEERED MUTATION	UNP P56524
A	56	ALA	CYS	ENGINEERED MUTATION	UNP P56524
B	25	ALA	CYS	ENGINEERED MUTATION	UNP P56524
B	56	ALA	CYS	ENGINEERED MUTATION	UNP P56524

- Molecule 2 is SULFATE ION (three-letter code: SO₄) (formula: O₄S).

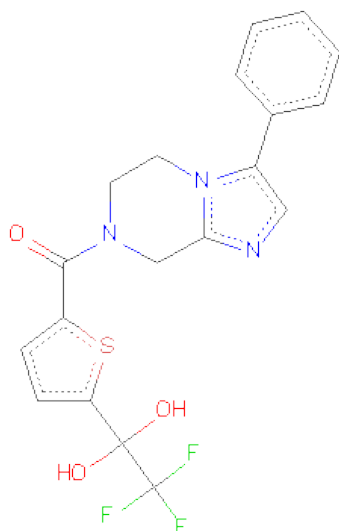


Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0

- Molecule 3 is POTASSIUM ION (three-letter code: K) (formula: K).

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

- Molecule 4 is 2,2,2-TRIFLUORO-1-{5-[(3-PHENYL-5,6-DIHYDROIMIDAZO[1,2-A]PYRAZIN-7(8H)-YL)CARBONYL]THIOPHEN-2-YL}ETHANE-1,1-DIOL (three-letter code: TFG) (formula: C₁₉H₁₆F₃N₃O₃S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C F N O S 29 19 3 3 3 1	0	0
4	B	1	Total C F N O S 29 19 3 3 3 1	0	0

- Molecule 5 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	B	1	Total 1	Zn 1	0	0
5	A	1	Total 1	Zn 1	0	0

- Molecule 6 is water.

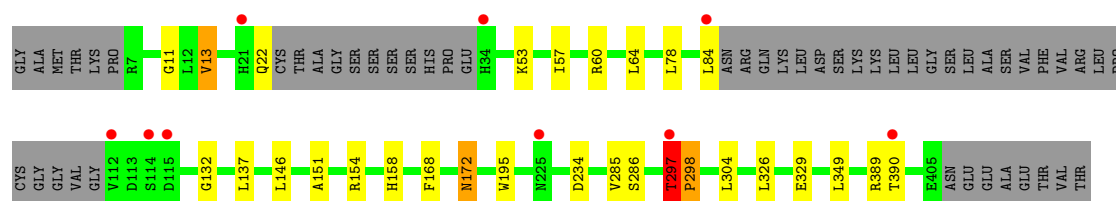
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	270	Total 270	O 270	0	0
6	B	339	Total 339	O 339	0	0

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.

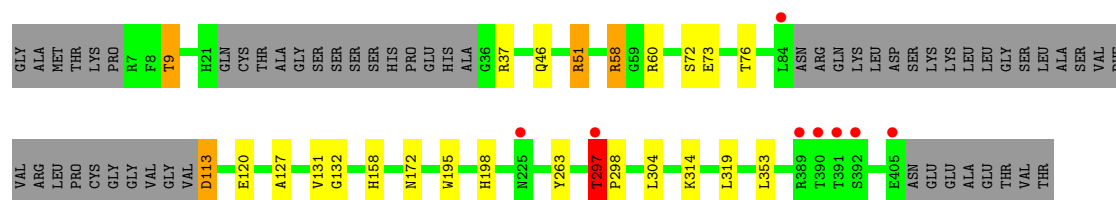
• Molecule 1: HISTONE DEACETYLASE 4

Chain A: 



• Molecule 1: HISTONE DEACETYLASE 4

Chain B: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	85.61Å 70.67Å 88.20Å 90.00° 108.08° 90.00°	Depositor
Resolution (Å)	60.00 – 1.90 36.80 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.9 (60.00-1.90) 99.9 (36.80-1.80)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.88 (at 1.81Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.194 , 0.221 0.205 , 0.227	Depositor DCC
R_{free} test set	4640 reflections (5.27%)	DCC
Wilson B-factor (Å ²)	21.2	Xtriage
Anisotropy	0.161	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 35.3	EDS
Estimated twinning fraction	0.137 for l,-k,h	Xtriage
L-test for twinning	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	5 of 92723 reflections (0.005%)	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	6218	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.70% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, K, TFG, 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	0.43	0/2878	0.57	1/3906 (0.0%)
1	B	0.43	0/2835	0.57	2/3845 (0.1%)
All	All	0.43	0/5713	0.57	3/7751 (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 (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	297	THR	N-CA-C	5.82	126.71	111.00
1	B	37	ARG	NE-CZ-NH1	5.37	122.99	120.30
1	B	297	THR	N-CA-C	5.23	125.13	111.00

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	389	ARG	Peptide

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	2783	0	2756	11	0
1	B	2747	0	2713	13	0
2	A	10	0	0	0	0
2	B	5	0	0	0	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	29	0	14	3	0
4	B	29	0	14	4	0
5	A	1	0	0	0	0
5	B	1	0	0	0	0
6	A	270	0	0	0	0
6	B	339	0	0	3	0
All	All	6218	0	5497	29	0

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 3.

The worst 5 of 29 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:53[A]:LYS:HG3	1:A:349:LEU:HD22	1.81	0.62
1:B:73[B]:GLU:CD	1:B:73[B]:GLU:H	2.06	0.58
1:A:297:THR:HG22	1:A:298:PRO:HD3	1.85	0.58
1:B:58:ARG:HD2	6:B:2124:HOH:O	2.04	0.56
1:A:13:VAL:HG13	1:A:57:ILE:CG1	2.37	0.55

There are no symmetry-related clashes.

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	367/413 (89%)	358 (98%)	7 (2%)	2 (0%)	38	23
1	B	361/413 (87%)	350 (97%)	9 (2%)	2 (1%)	33	19
All	All	728/826 (88%)	708 (97%)	16 (2%)	4 (0%)	33	23

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	297	THR
1	B	297	THR
1	A	298	PRO
1	B	298	PRO

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	299/333 (90%)	283 (95%)	16 (5%)	31	17
1	B	294/333 (88%)	282 (96%)	12 (4%)	41	28
All	All	593/666 (89%)	565 (95%)	28 (5%)	40	22

5 of 28 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	297	THR
1	A	390	THR
1	B	314[A]	LYS
1	A	304[A]	LEU
1	A	304[B]	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 15 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	148	ASN

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Mol	Chain	Res	Type
1	B	172	ASN
1	B	362	GLN
1	A	368	ASN
1	B	303	ASN

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 11 ligands modelled in this entry, 6 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	$\# Z > 2$
2	SO4	A	1406	-	4,4,4	0.27	0	6,6,6	0.19	0
2	SO4	A	1407	-	4,4,4	0.16	0	6,6,6	0.24	0
4	TFG	A	1410	5	32,32,32	2.30	7 (21%)	45,49,49	2.66	13 (28%)
2	SO4	B	1406	-	4,4,4	0.30	0	6,6,6	0.34	0
4	TFG	B	1409	5	32,32,32	2.32	7 (21%)	45,49,49	2.62	13 (28%)

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	SO4	A	1406	-	-	0/0/0/0	0/0/0/0
2	SO4	A	1407	-	-	0/0/0/0	0/0/0/0
4	TFG	A	1410	5	-	0/20/36/36	0/2/4/4
2	SO4	B	1406	-	-	0/0/0/0	0/0/0/0
4	TFG	B	1409	5	-	0/20/36/36	0/2/4/4

The worst 5 of 14 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	1410	TFG	O3-C5	7.79	1.48	1.40
4	B	1409	TFG	C4-S1	-7.10	1.65	1.72
4	B	1409	TFG	O3-C5	7.05	1.48	1.40
4	A	1410	TFG	C4-S1	-6.51	1.66	1.72
4	B	1409	TFG	C11-N2	4.38	1.42	1.36

The worst 5 of 26 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	1410	TFG	N3-C11-N2	-10.09	106.31	111.67
4	B	1409	TFG	N3-C11-N2	-9.79	106.47	111.67
4	A	1410	TFG	F1-C6-C5	-7.93	104.41	111.69
4	B	1409	TFG	F1-C6-C5	-7.81	104.52	111.69
4	B	1409	TFG	C4-C7-N1	5.29	128.79	119.74

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, 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	361/413 (87%)	-0.28	9 (2%) 54 56	11, 19, 34, 43	0
1	B	357/413 (86%)	-0.31	8 (2%) 59 60	11, 19, 33, 43	0
All	All	718/826 (86%)	-0.29	17 (2%) 57 57	11, 19, 34, 43	0

The worst 5 of 17 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	391	THR	5.2
1	A	84	LEU	4.3
1	B	297	THR	4.1
1	B	84	LEU	4.0
1	B	392	SER	3.5

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, 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	RSR	LLDF	B-factors(\AA^2)	Q<0.9
5	ZN	A	1411	1/1	0.10	10.05	13,13,13,13	0
5	ZN	B	1410	1/1	0.10	4.55	14,14,14,14	0
3	K	B	1407	1/1	0.10	3.52	32,32,32,32	0
3	K	A	1408	1/1	0.11	3.01	31,31,31,31	0
4	TFG	A	1410	29/29	0.09	0.23	16,18,19,20	0
3	K	B	1408	1/1	0.07	-0.24	36,36,36,36	0
4	TFG	B	1409	29/29	0.08	-0.36	15,17,19,21	0
2	SO4	B	1406	5/5	0.06	-0.82	17,19,19,19	0
2	SO4	A	1407	5/5	0.08	-0.95	29,30,32,32	0
2	SO4	A	1406	5/5	0.07	-1.16	17,18,19,20	0
3	K	A	1409	1/1	0.06	-1.31	39,39,39,39	0

6.5 Other polymers ⓘ

There are no such residues in this entry.