wwPDB X-ray Structure Validation Summary Report (i)

Jan 31, 2016 – 08:29 PM GMT

PDB ID	:	1KHU
Title	:	Smad1 crystal structure reveals the details of BMP signaling pathway
Authors	:	Qin, B.Y.; Lin, K.
Deposited on	:	2001-12-01
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
http://wwpdb.org/validation/2016/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

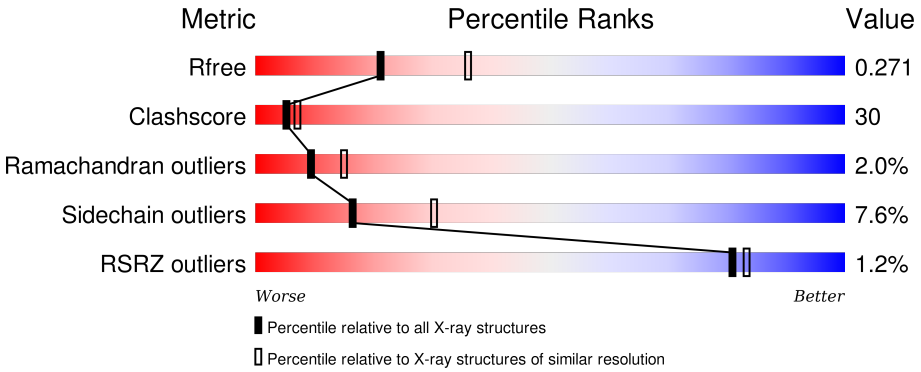
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026688
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	trunk26865

1 Overall quality at a glance (i)

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}	91344	3553 (2.50-2.50)
Clashscore	102246	4242 (2.50-2.50)
Ramachandran outliers	100387	4156 (2.50-2.50)
Sidechain outliers	100360	4158 (2.50-2.50)
RSRZ outliers	91569	3562 (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 >=3, 2, 1 and 0 types of geometric quality criteria. 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 <=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	218	2% 50% 36% 5% 9%
1	B	218	% 45% 39% 6% 10%
1	C	218	% 50% 35% 6% 10%
1	D	218	48% 32% • 16%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 6772 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 SMAD1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	198	Total	C	N	O	S	0	0	0
			1575	993	280	291	11			
1	B	197	Total	C	N	O	S	0	0	0
			1568	988	279	290	11			
1	C	197	Total	C	N	O	S	0	0	0
			1568	988	279	290	11			
1	D	184	Total	C	N	O	S	0	0	0
			1475	932	262	271	10			

- Molecule 2 is water.

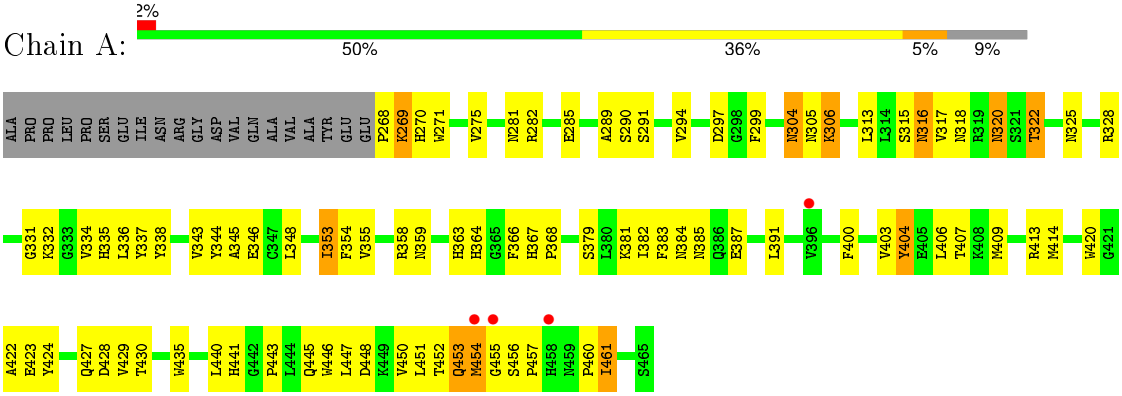
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	148	Total	O	0	0
			148	148		
2	B	135	Total	O	0	0
			135	135		
2	C	150	Total	O	0	0
			150	150		
2	D	153	Total	O	0	0
			153	153		

3 Residue-property plots (i)

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.

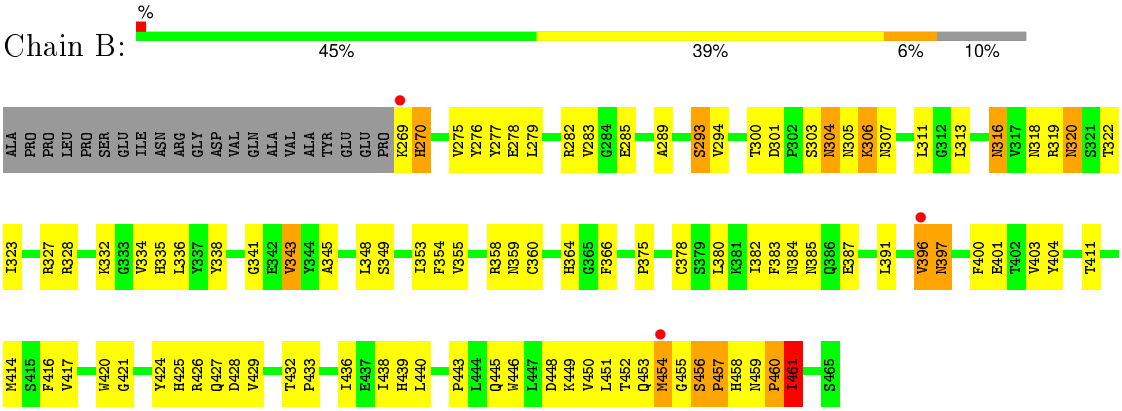
- Molecule 1: SMAD1

Chain A:



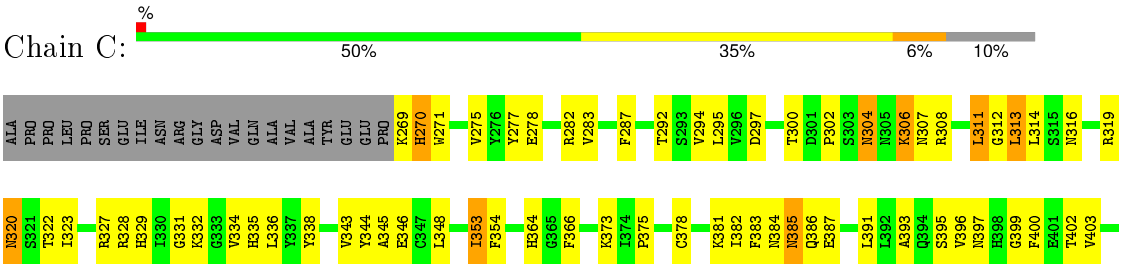
- Molecule 1: SMAD1

Chain B:



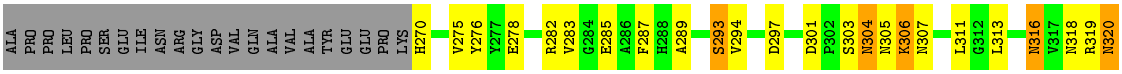
- Molecule 1: SMAD1

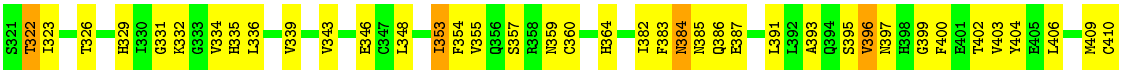
Chain C:

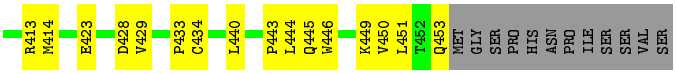


- Molecule 1: SMAD1

Chain D:







4 Data and refinement statistics (i)

Property	Value	Source
Space group	H 3	Depositor
Cell constants a, b, c, α, β, γ	138.13Å 138.13Å 199.34Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	38.00 – 2.50 38.29 – 2.50	Depositor EDS
% Data completeness (in resolution range)	93.8 (38.00-2.50) 93.6 (38.29-2.50)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.19 (at 2.51Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.239 , 0.274 0.240 , 0.271	Depositor DCC
R_{free} test set	2297 reflections (5.00%)	DCC
Wilson B-factor (Å^2)	40.1	Xtriage
Anisotropy	0.184	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 29.8	EDS
Estimated twinning fraction	0.329 for h,-h-k,-l	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.39$, $< L^2 > = 0.21$	Xtriage
Outliers	0 of 47619 reflections	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	6772	wwPDB-VP
Average B, all atoms (Å^2)	45.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.31% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

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	0.41	0/1619	0.66	0/2197
1	B	0.41	0/1611	0.65	1/2186 (0.0%)
1	C	0.40	0/1611	0.66	1/2186 (0.0%)
1	D	0.45	0/1515	0.68	0/2057
All	All	0.42	0/6356	0.67	2/8626 (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	C	0	1

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	300	THR	N-CA-C	5.43	125.67	111.00
1	C	300	THR	N-CA-C	5.04	124.62	111.00

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	277	TYR	Sidechain

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	1575	0	1509	100	0
1	B	1568	0	1501	104	0
1	C	1568	0	1501	98	0
1	D	1475	0	1409	82	0
2	A	148	0	0	15	0
2	B	135	0	0	10	0
2	C	150	0	0	23	0
2	D	153	0	0	18	0
All	All	6772	0	5920	367	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 30.

The worst 5 of 367 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:C:384:ASN:ND2	1:C:387:GLU:HG3	1.76	1.00
1:A:359:ASN:HD22	1:A:383:PHE:HA	1.30	0.93
1:B:396:VAL:HG13	1:B:397:ASN:H	1.34	0.92
1:A:328:ARG:HG2	1:B:404:TYR:HE1	1.34	0.90
1:D:282:ARG:HH21	1:D:282:ARG:HG2	1.39	0.88

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	196/218 (90%)	176 (90%)	19 (10%)	1 (0%)	34 55
1	B	195/218 (89%)	174 (89%)	13 (7%)	8 (4%)	3 4

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	C	195/218 (89%)	177 (91%)	13 (7%)	5 (3%)	7 10
1	D	182/218 (84%)	169 (93%)	12 (7%)	1 (0%)	34 55
All	All	768/872 (88%)	696 (91%)	57 (7%)	15 (2%)	9 15

5 of 15 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	396	VAL
1	B	456	SER
1	B	461	ILE
1	D	396	VAL
1	B	460	PRO

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	178/194 (92%)	164 (92%)	14 (8%)	15 28
1	B	177/194 (91%)	165 (93%)	12 (7%)	20 36
1	C	177/194 (91%)	163 (92%)	14 (8%)	15 28
1	D	165/194 (85%)	152 (92%)	13 (8%)	15 28
All	All	697/776 (90%)	644 (92%)	53 (8%)	16 30

5 of 53 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	391	LEU
1	C	311	LEU
1	D	353	ILE
1	B	428	ASP
1	C	270	HIS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 44 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	359	ASN
1	B	394	GLN
1	D	359	ASN
1	B	361	ASN
1	B	384	ASN

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 carbohydrates in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

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^{th} 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	198/218 (90%)	-0.12	4 (2%)	68	72	21, 42, 82, 97	0
1	B	197/218 (90%)	-0.11	3 (1%)	76	79	21, 41, 81, 89	0
1	C	197/218 (90%)	-0.17	2 (1%)	84	86	25, 41, 75, 100	0
1	D	184/218 (84%)	-0.07	0	100	100	18, 37, 67, 91	0
All	All	776/872 (88%)	-0.12	9 (1%)	81	83	18, 40, 79, 100	0

The worst 5 of 9 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	456	SER	4.6
1	B	269	LYS	3.0
1	A	396	VAL	3.0
1	C	457	PRO	2.9
1	A	454	MET	2.8

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

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.