Full wwPDB NMR Structure Validation Report (i)

Apr 27, 2016 – 02:13 AM BST

PDB ID	:	2M13
Title	:	The ZZ domain of cytoplasmic polyadenylation element binding protein 1 (CPEB1)
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Deposited on	:	2012-11-14

This is a Full wwPDB NMR Structure Validation 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/NMRValidationReportHelp
with specific help available everywhere you see the (i) symbol.

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

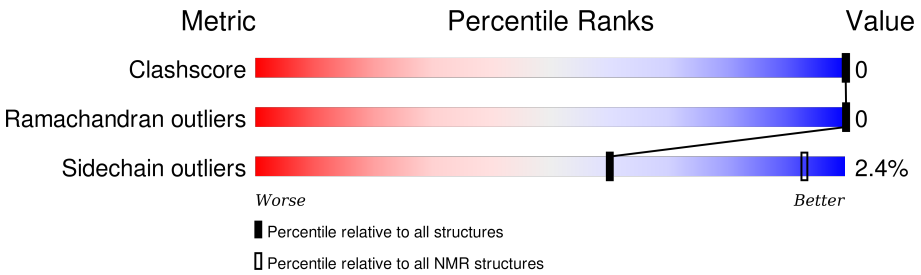
Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Mogul	:	unknown
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	rb-20027457
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20027457

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
SOLUTION NMR

The overall completeness of chemical shifts assignment is 89%.

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)	NMR archive (#Entries)
Clashscore	114402	11133
Ramachandran outliers	111179	9975
Sidechain outliers	111093	9958

The table below summarises the geometric issues observed across the polymeric chains and their fit to the experimental data. The red, orange, yellow and green segments indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria. A cyan segment indicates the fraction of residues that are not part of the well-defined cores, and 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%

Mol	Chain	Length	Quality of chain
1	A	65	63% 37%

2 Ensemble composition and analysis (i)

This entry contains 20 models. Model 13 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *lowest energy*.

The following residues are included in the computation of the global validation metrics.

Well-defined (core) protein residues			
Well-defined core	**Residue range (total)**	**Backbone RMSD (Å)**	**Medoid model**
1	A:515-A:555 (41)	0.23	13

Ill-defined regions of proteins are excluded from the global statistics.

Ligands and non-protein polymers are included in the analysis.

The models can be grouped into 4 clusters and 3 single-model clusters were found.

Cluster number	Models
1	3, 5, 6, 8, 13, 14, 15, 16
2	2, 4, 10, 11, 12
3	9, 18
4	17, 19
Single-model clusters	1; 7; 20

3 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 1040 atoms, of which 497 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Cytoplasmic polyadenylation element-binding protein 1.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	65	1038	337	497	103	93	8	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	502	GLY	-	EXPRESSION TAG	UNP Q9BZB8
A	503	PRO	-	EXPRESSION TAG	UNP Q9BZB8

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	
			Total	Zn
2	A	2	2	2

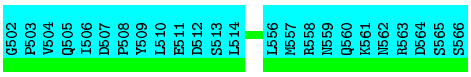
4 Residue-property plots (i)

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA and DNA chains in the entry. The first graphic is the same as shown in the summary in section 1 of this report. The second graphic shows the sequence where residues are colour-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. Stretches of 2 or more consecutive residues without any outliers are shown as green connectors. Residues which are classified as ill-defined in the NMR ensemble, are shown in cyan with an underline colour-coded according to the previous scheme. Residues which were present in the experimental sample, but not modelled in the final structure are shown in grey.

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A:



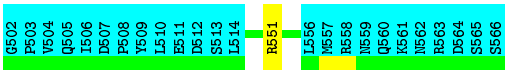
4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

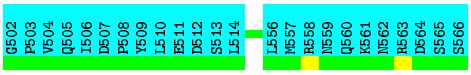
Chain A:



4.2.2 Score per residue for model 2

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A:



4.2.3 Score per residue for model 3

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R538 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.4 Score per residue for model 4

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R528 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.5 Score per residue for model 5

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R551 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.6 Score per residue for model 6

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R528 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.7 Score per residue for model 7

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R544 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.8 Score per residue for model 8

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R538 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.9 Score per residue for model 9

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 S519 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.10 Score per residue for model 10

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 60% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R544 R551 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.11 Score per residue for model 11

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R528 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.12 Score per residue for model 12

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 58% 5% 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 Y535 R538 R544 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.13 Score per residue for model 13 (medoid)

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 60% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R544 R551 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.14 Score per residue for model 14

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R551 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.15 Score per residue for model 15

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 R528 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.16 Score per residue for model 16

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 Q530 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.17 Score per residue for model 17

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%

G502 P503 V504 Q505 I506 D507 P508 Y509 L510 E511 D512 S513 L514 K534 L556 M557 R558 N559 Q560 K561 N562 R563 D564 S565 S566

4.2.18 Score per residue for model 18

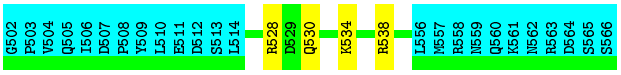
- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 60% • 37%

4.2.19 Score per residue for model 19

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

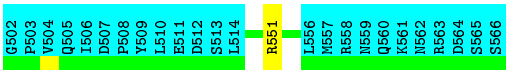
Chain A: 57% 6% 37%



4.2.20 Score per residue for model 20

- Molecule 1: Cytoplasmic polyadenylation element-binding protein 1

Chain A: 62% • 37%



5 Refinement protocol and experimental data overview (i)

The models were refined using the following method: *molecular dynamics, torsion angle dynamics.*

Of the 50 calculated structures, 20 were deposited, based on the following criterion: *structures with the lowest energy.*

The following table shows the software used for structure solution, optimisation and refinement.

Software name	Classification	Version
AMBER	refinement	10
CYANA	refinement	1.0.5

The following table shows chemical shift validation statistics as aggregates over all chemical shift files. Detailed validation can be found in section 7 of this report.

Chemical shift file(s)	2m13_cs.str
Number of chemical shift lists	1
Total number of shifts	789
Number of shifts mapped to atoms	789
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	89%

No validations of the models with respect to experimental NMR restraints is performed at this time.

6 Model quality (i)

6.1 Standard geometry (i)

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

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 (average) 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	0.80±0.00	0±0/365 (0.0±0.0%)	0.87±0.03	1±1/493 (0.1±0.1%)
All	All	0.80	0/7300 (0.0%)	0.87	10/9860 (0.1%)

There are no bond-length outliers.

All unique angle outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})	Models	
								Worst	Total
1	A	551	ARG	NE-CZ-NH1	6.00	123.30	120.30	5	6
1	A	535	TYR	CB-CG-CD2	-5.55	117.67	121.00	12	1
1	A	551	ARG	NE-CZ-NH2	-5.46	117.57	120.30	5	1
1	A	538	ARG	NE-CZ-NH1	5.24	122.92	120.30	3	2

There are no chirality outliers.

There are no planarity outliers.

6.2 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 each 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 averaged over the ensemble.

Mol	Chain	Non-H	H(model)	H(added)	Clashes
All	All	7000	6140	6140	-

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 -.

There are no clashes.

6.3 Torsion angles (i)

6.3.1 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 PDB entries followed by that with respect to all NMR entries. 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	41/65 (63%)	39±0 (96±1%)	2±0 (4±1%)	0±0 (0±0%)	100	100
All	All	820/1300 (63%)	786 (96%)	34 (4%)	0 (0%)	100	100

There are no Ramachandran outliers.

6.3.2 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 PDB entries followed by that with respect to all NMR entries. 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	39/62 (63%)	38±1 (98±2%)	1±1 (2±2%)	60	93
All	All	780/1240 (63%)	761 (98%)	19 (2%)	60	93

All 6 unique residues with a non-rotameric sidechain are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	528	ARG	6
1	A	544	ARG	4
1	A	534	LYS	3
1	A	538	ARG	3
1	A	530	GLN	2
1	A	519	SER	1

6.3.3 RNA (i)

There are no RNA molecules in this entry.

6.4 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

6.5 Carbohydrates (i)

There are no carbohydrates in this entry.

6.6 Ligand geometry (i)

Of 2 ligands modelled in this entry, 2 are monoatomic - leaving 0 for Mogul analysis.

6.7 Other polymers (i)

There are no such molecules in this entry.

6.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

7 Chemical shift validation (i)

The completeness of assignment taking into account all chemical shift lists is 89% for the well-defined parts and 89% for the entire structure.

7.1 Chemical shift list 1

File name: 2m13_cs.str

Chemical shift list name: *assigned_chem_shift_list_1*

7.1.1 Bookkeeping (i)

The following table shows the results of parsing the chemical shift list and reports the number of nuclei with statistically unusual chemical shifts.

Total number of shifts	789
Number of shifts mapped to atoms	789
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	2

7.1.2 Chemical shift referencing (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	65	-0.53 ± 0.19	Should be applied
$^{13}C_{\beta}$	62	0.10 ± 0.33	None needed (< 0.5 ppm)
$^{13}C'$	56	-0.15 ± 0.28	None needed (< 0.5 ppm)
^{15}N	58	-0.59 ± 1.05	None needed (imprecise)

7.1.3 Completeness of resonance assignments (i)

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 89%, i.e. 488 atoms were assigned a chemical shift out of a possible 551. 0 out of 2 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	196/199 (98%)	79/79 (100%)	79/82 (96%)	38/38 (100%)
Sidechain	204/244 (84%)	132/152 (87%)	70/77 (91%)	2/15 (13%)

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	Total	^{1}H	^{13}C	^{15}N
Aromatic	88/108 (81%)	46/56 (82%)	30/40 (75%)	12/12 (100%)
Overall	488/551 (89%)	257/287 (90%)	179/199 (90%)	52/65 (80%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 89%, i.e. 759 atoms were assigned a chemical shift out of a possible 857. 0 out of 6 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	302/315 (96%)	123/125 (98%)	121/130 (93%)	58/60 (97%)
Sidechain	363/426 (85%)	230/260 (88%)	127/140 (91%)	6/26 (23%)
Aromatic	94/116 (81%)	50/60 (83%)	32/44 (73%)	12/12 (100%)
Overall	759/857 (89%)	403/445 (91%)	280/314 (89%)	76/98 (78%)

7.1.4 Statistically unusual chemical shifts (i)

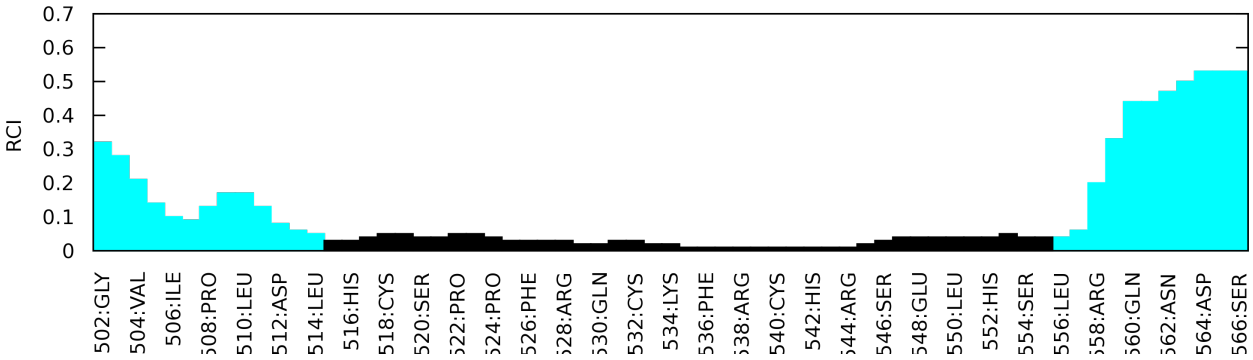
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

Mol	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	544	ARG	HG3	0.07	3.00 – 0.10	-5.1
1	A	555	PRO	HB3	0.19	3.81 – 0.21	-5.1

7.1.5 Random Coil Index (RCI) plots (i)

The image below reports *random coil index* values for the protein chains in the structure. The height of each bar gives a probability of a given residue to be disordered, as predicted from the available chemical shifts and the amino acid sequence. A value above 0.2 is an indication of significant predicted disorder. The colour of the bar shows whether the residue is in the well-defined core (black) or in the ill-defined residue ranges (cyan), as described in section 2 on ensemble composition.

Random coil index (RCI) for chain A:


RCI
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
502:GLY
504:VAL
506:ILE
508:PRO
510:LEU
512:ASP
514:LEU
516:HIS
518:CYS
520:SER
522:PRO
524:PRO
526:PHE
528:ARG
530:GLN
532:CYS
534:LYS
536:PHE
538:ARG
540:CYS
542:HIS
544:ARG
546:SER
548:GLU
550:LEU
552:HIS
554:SER
556:LEU
558:ARG
560:GLN
562:ASN
564:ASP
566:SER