wwPDB X-ray Structure Validation Summary Report (i)

Feb 19, 2016 – 10:00 PM GMT

PDB ID	:	5C9F
Title	:	Crystal structure of a retropepsin-like aspartic protease from Rickettsia conorii
Authors	:	Li, M.; Gustchina, A.; Cruz, R.; Simoes, M.; Curto, P.; Martinez, J.; Faro, C.; Simoes, I.; Wlodawer, A.
Deposited on	:	2015-06-26
Resolution	:	2.00 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:

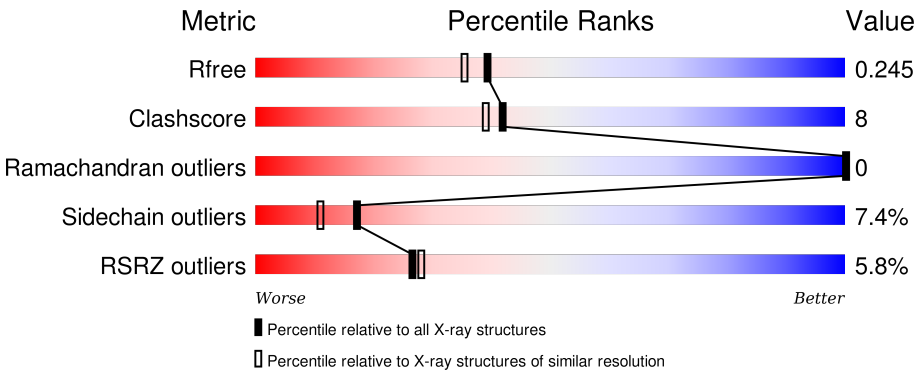
MolProbity	:	4.02b-467
Mogul	:	unknown
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026982
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20026982

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 2.00 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	6249 (2.00-2.00)
Clashscore	102246	7340 (2.00-2.00)
Ramachandran outliers	100387	7248 (2.00-2.00)
Sidechain outliers	100360	7247 (2.00-2.00)
RSRZ outliers	91569	6262 (2.00-2.00)

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	139	4% 81% 12% • 5%
1	B	139	7% 74% 12% • 11%
1	C	139	7% 78% 13% • 5%
1	D	139	3% 76% 14% • 9%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 4308 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 ApRick protease.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	132	1039	671	175	190	3	0	0	0
			Total	C	N	O	S			
1	B	124	989	644	166	176	3	0	2	0
			Total	C	N	O	S			
1	C	132	1039	671	175	190	3	0	0	0
			Total	C	N	O	S			
1	D	126	1013	657	170	183	3	0	3	0

There are 48 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	104	MET	-	initiating methionine	UNP Q92FY8
A	232	ALA	-	expression tag	UNP Q92FY8
A	233	ALA	-	expression tag	UNP Q92FY8
A	234	ALA	-	expression tag	UNP Q92FY8
A	235	LEU	-	expression tag	UNP Q92FY8
A	236	GLU	-	expression tag	UNP Q92FY8
A	237	HIS	-	expression tag	UNP Q92FY8
A	238	HIS	-	expression tag	UNP Q92FY8
A	239	HIS	-	expression tag	UNP Q92FY8
A	240	HIS	-	expression tag	UNP Q92FY8
A	241	HIS	-	expression tag	UNP Q92FY8
A	242	HIS	-	expression tag	UNP Q92FY8
B	104	MET	-	initiating methionine	UNP Q92FY8
B	232	ALA	-	expression tag	UNP Q92FY8
B	233	ALA	-	expression tag	UNP Q92FY8
B	234	ALA	-	expression tag	UNP Q92FY8
B	235	LEU	-	expression tag	UNP Q92FY8
B	236	GLU	-	expression tag	UNP Q92FY8
B	237	HIS	-	expression tag	UNP Q92FY8
B	238	HIS	-	expression tag	UNP Q92FY8
B	239	HIS	-	expression tag	UNP Q92FY8

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Chain	Residue	Modelled	Actual	Comment	Reference
B	240	HIS	-	expression tag	UNP Q92FY8
B	241	HIS	-	expression tag	UNP Q92FY8
B	242	HIS	-	expression tag	UNP Q92FY8
C	104	MET	-	initiating methionine	UNP Q92FY8
C	232	ALA	-	expression tag	UNP Q92FY8
C	233	ALA	-	expression tag	UNP Q92FY8
C	234	ALA	-	expression tag	UNP Q92FY8
C	235	LEU	-	expression tag	UNP Q92FY8
C	236	GLU	-	expression tag	UNP Q92FY8
C	237	HIS	-	expression tag	UNP Q92FY8
C	238	HIS	-	expression tag	UNP Q92FY8
C	239	HIS	-	expression tag	UNP Q92FY8
C	240	HIS	-	expression tag	UNP Q92FY8
C	241	HIS	-	expression tag	UNP Q92FY8
C	242	HIS	-	expression tag	UNP Q92FY8
D	104	MET	-	initiating methionine	UNP Q92FY8
D	232	ALA	-	expression tag	UNP Q92FY8
D	233	ALA	-	expression tag	UNP Q92FY8
D	234	ALA	-	expression tag	UNP Q92FY8
D	235	LEU	-	expression tag	UNP Q92FY8
D	236	GLU	-	expression tag	UNP Q92FY8
D	237	HIS	-	expression tag	UNP Q92FY8
D	238	HIS	-	expression tag	UNP Q92FY8
D	239	HIS	-	expression tag	UNP Q92FY8
D	240	HIS	-	expression tag	UNP Q92FY8
D	241	HIS	-	expression tag	UNP Q92FY8
D	242	HIS	-	expression tag	UNP Q92FY8

- Molecule 2 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Cl		
2	B	1	1	1	0	0
2	A	4	4	4	0	0
2	D	4	4	4	0	0
2	C	3	3	3	0	0

- Molecule 3 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Na		
3	B	1	1	1	0	0
			Total	Na		
3	D	2	2	2	0	0

- Molecule 4 is water.

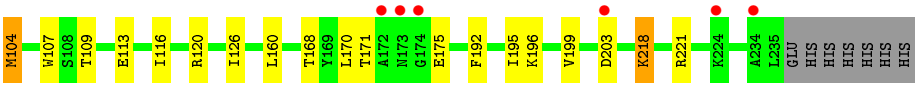
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	A	66	66	66	0	0
			Total	O		
4	B	51	51	51	0	0
			Total	O		
4	C	45	45	45	0	0
			Total	O		
4	D	51	51	51	0	0

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.

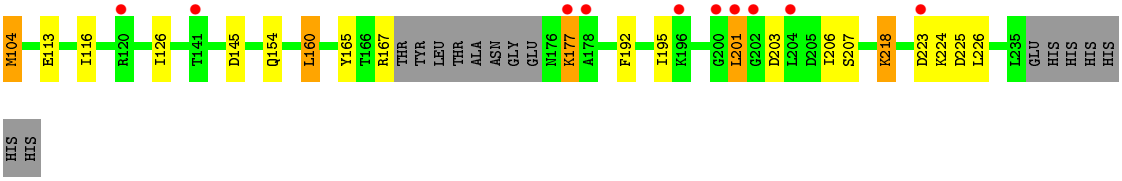
- Molecule 1: ApRick protease

Chain A:



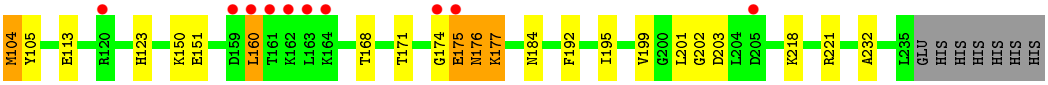
- Molecule 1: ApRick protease

Chain B:



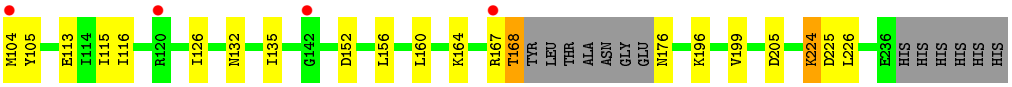
- Molecule 1: ApRick protease

Chain C:



- Molecule 1: ApRick protease

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	50.10Å 94.15Å 118.64Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	40.00 – 2.00 46.15 – 2.00	Depositor EDS
% Data completeness (in resolution range)	94.9 (40.00-2.00) 94.9 (46.15-2.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.06	Depositor
$< I/\sigma(I) >$ [1]	2.43 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.7.0032	Depositor
R, R_{free}	0.199 , 0.255 0.211 , 0.245	Depositor DCC
R_{free} test set	1831 reflections (5.25%)	DCC
Wilson B-factor (Å^2)	39.3	Xtriage
Anisotropy	0.201	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 51.9	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.33$	Xtriage
Outliers	1 of 36682 reflections (0.003%)	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	4308	wwPDB-VP
Average B, all atoms (Å^2)	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.46% 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 (i)

5.1 Standard geometry (i)

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

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	0.80	0/1055	0.90	2/1419 (0.1%)
1	B	0.70	0/1009	0.89	2/1354 (0.1%)
1	C	0.76	0/1055	0.87	0/1419
1	D	0.77	0/1033	0.89	2/1387 (0.1%)
All	All	0.76	0/4152	0.89	6/5579 (0.1%)

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	D	167	ARG	NE-CZ-NH1	8.22	124.41	120.30
1	A	203	ASP	CB-CG-OD1	6.58	124.22	118.30
1	D	167	ARG	NE-CZ-NH2	-5.82	117.39	120.30
1	B	203	ASP	CB-CG-OD1	-5.68	113.19	118.30
1	B	203	ASP	CB-CG-OD2	5.58	123.32	118.30

There are no chirality outliers.

There are no planarity outliers.

5.2 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 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	1039	0	1073	15	0
1	B	989	0	1040	35	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	1039	0	1073	14	0
1	D	1013	0	1058	16	0
2	A	4	0	0	0	0
2	B	1	0	0	0	0
2	C	3	0	0	0	0
2	D	4	0	0	0	0
3	B	1	0	0	0	0
3	D	2	0	0	0	0
4	A	66	0	0	5	1
4	B	51	0	0	2	0
4	C	45	0	0	4	0
4	D	51	0	0	7	1
All	All	4308	0	4244	70	1

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 8.

The worst 5 of 70 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:A:221:ARG:HD3	1:D:105:TYR:CE1	1.93	1.03
1:B:165:TYR:CD2	1:B:201:LEU:HD22	1.94	1.03
1:B:177:LYS:O	1:B:201:LEU:HD21	1.64	0.97
1:B:201:LEU:N	1:B:201:LEU:HD23	1.78	0.96
1:C:104:MET:HE2	4:D:401:HOH:O	1.84	0.78

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	Interatomic distance (Å)	Clash overlap (Å)
4:A:422:HOH:O	4:D:441:HOH:O[2_654]	1.95	0.25

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	130/139 (94%)	124 (95%)	6 (5%)	0	100	100
1	B	122/139 (88%)	115 (94%)	7 (6%)	0	100	100
1	C	130/139 (94%)	124 (95%)	6 (5%)	0	100	100
1	D	125/139 (90%)	118 (94%)	7 (6%)	0	100	100
All	All	507/556 (91%)	481 (95%)	26 (5%)	0	100	100

There are no Ramachandran outliers to report.

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	110/117 (94%)	104 (94%)	6 (6%)	27	21
1	B	106/117 (91%)	99 (93%)	7 (7%)	21	14
1	C	110/117 (94%)	98 (89%)	12 (11%)	8	4
1	D	109/117 (93%)	101 (93%)	8 (7%)	17	11
All	All	435/468 (93%)	402 (92%)	33 (8%)	17	10

5 of 33 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	113	GLU
1	C	175	GLU
1	D	199	VAL
1	C	151	GLU
1	C	160	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	230	ASN
1	C	127	ASN
1	C	176	ASN
1	D	127	ASN
1	D	176	ASN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates (i)

There are no carbohydrates in this entry.

5.6 Ligand geometry (i)

Of 15 ligands modelled in this entry, 15 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

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 (i)

6.1 Protein, DNA and RNA chains (i)

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	132/139 (94%)	0.15	6 (4%)	37	38	26, 40, 75, 115	0
1	B	124/139 (89%)	0.49	10 (8%)	15	15	28, 52, 90, 126	0
1	C	132/139 (94%)	0.46	10 (7%)	17	18	27, 50, 82, 127	0
1	D	126/139 (90%)	0.26	4 (3%)	51	52	24, 43, 83, 124	0
All	All	514/556 (92%)	0.34	30 (5%)	26	28	24, 46, 86, 127	0

The worst 5 of 30 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	175	GLU	5.2
1	A	203	ASP	4.9
1	A	172	ALA	4.7
1	B	200	GLY	4.3
1	C	163	LEU	4.3

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 carbohydrates 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. 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	RSCC	RSR	LLDF	B-factors(Å^2)	Q<0.9
2	CL	C	302	1/1	0.98	0.17	1.96	46,46,46,46	0
2	CL	A	302	1/1	0.98	0.13	1.12	47,47,47,47	0
3	NA	D	306	1/1	0.89	0.12	-0.45	46,46,46,46	0
2	CL	D	303	1/1	0.99	0.11	-0.55	34,34,34,34	0
2	CL	D	301	1/1	0.95	0.12	-0.64	59,59,59,59	0
3	NA	B	302	1/1	0.77	0.15	-0.70	54,54,54,54	0
2	CL	B	301	1/1	0.93	0.10	-0.82	51,51,51,51	0
2	CL	D	304	1/1	0.98	0.10	-1.10	36,36,36,36	0
2	CL	C	301	1/1	0.99	0.12	-1.97	42,42,42,42	0
2	CL	A	304	1/1	0.79	0.27	-	75,75,75,75	0
2	CL	A	303	1/1	0.96	0.13	-	53,53,53,53	0
2	CL	C	303	1/1	0.99	0.07	-	47,47,47,47	0
2	CL	A	301	1/1	0.94	0.09	-	40,40,40,40	0
2	CL	D	302	1/1	0.93	0.12	-	53,53,53,53	0
3	NA	D	305	1/1	0.87	0.26	-	69,69,69,69	0

6.5 Other polymers (i)

There are no such residues in this entry.