



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 14, 2023 – 07:57 PM EDT

PDB ID : 7T8Q
Title : CRYSTAL STRUCTURE OF T151G CAO1
Authors : Daruwalla, A.; Kiser, P.D.
Deposited on : 2021-12-16
Resolution : 2.15 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

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

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity : 4.02b-467
Xtriage (Phenix) : 1.13
EDS : 2.36
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

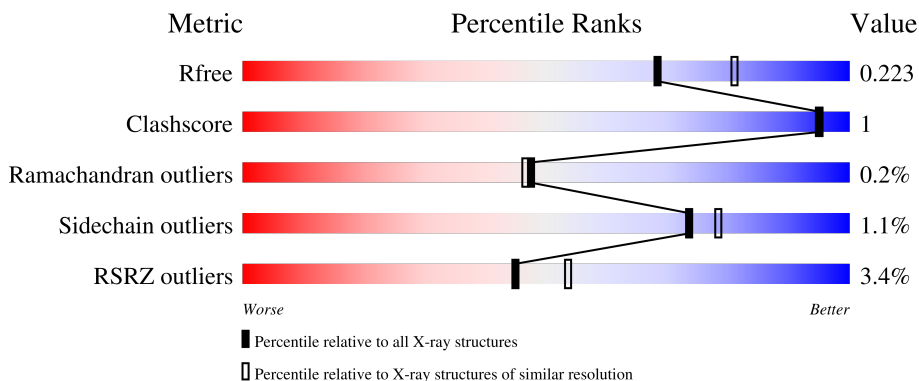
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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}	130704	1479 (2.16-2.16)
Clashscore	141614	1585 (2.16-2.16)
Ramachandran outliers	138981	1560 (2.16-2.16)
Sidechain outliers	138945	1559 (2.16-2.16)
RSRZ outliers	127900	1456 (2.16-2.16)

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 of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. 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 $\leq 5\%$. 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	526	 3% 92% 6%
1	B	526	 4% 90% 6%
1	C	526	 3% 92% 5%
1	D	526	 2% 91% 6%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 17178 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 Carotenoid oxygenase 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	497	3974	2550	675	729	20	0	0	0
1	B	497	3978	2553	677	728	20	0	1	0
1	C	500	4003	2567	679	737	20	0	0	0
1	D	497	3974	2549	675	730	20	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	151	GLY	THR	engineered mutation	UNP Q7S860
B	151	GLY	THR	engineered mutation	UNP Q7S860
C	151	GLY	THR	engineered mutation	UNP Q7S860
D	151	GLY	THR	engineered mutation	UNP Q7S860

- Molecule 2 is FE (II) ION (three-letter code: FE2) (formula: Fe) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Fe 1 1	0	0
2	B	1	Total Fe 1 1	0	0
2	C	1	Total Fe 1 1	0	0
2	D	1	Total Fe 1 1	0	0

- Molecule 3 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

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

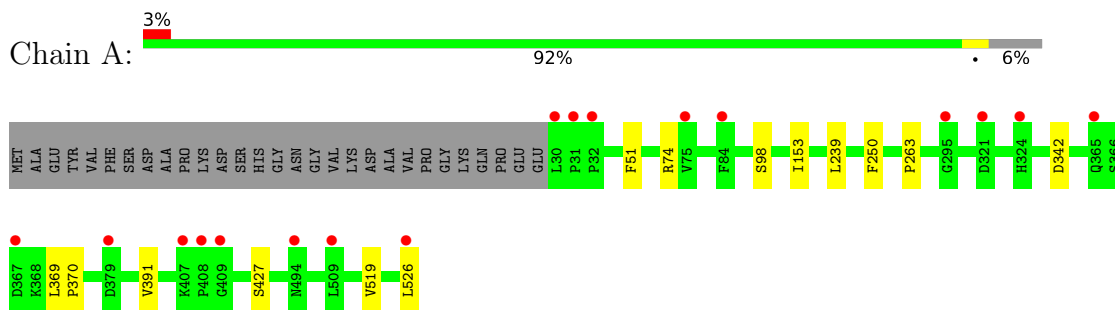
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	290	Total O 290 290	0	0
4	B	305	Total O 305 305	0	0
4	C	309	Total O 309 309	0	0
4	D	331	Total O 331 331	0	0

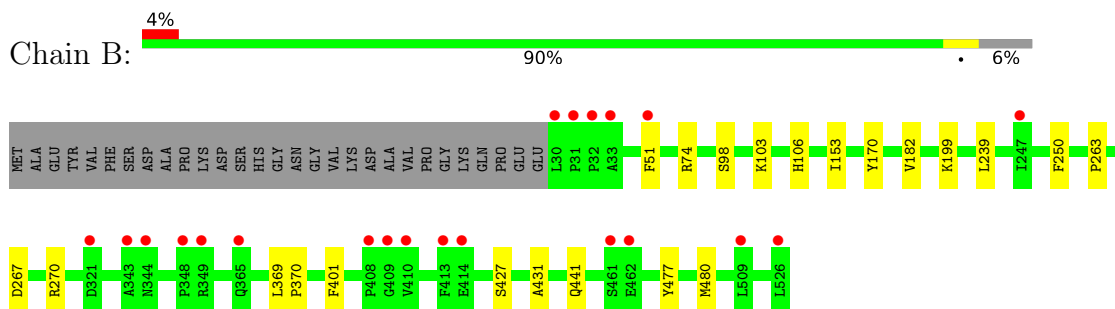
3 Residue-property plots [i](#)

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

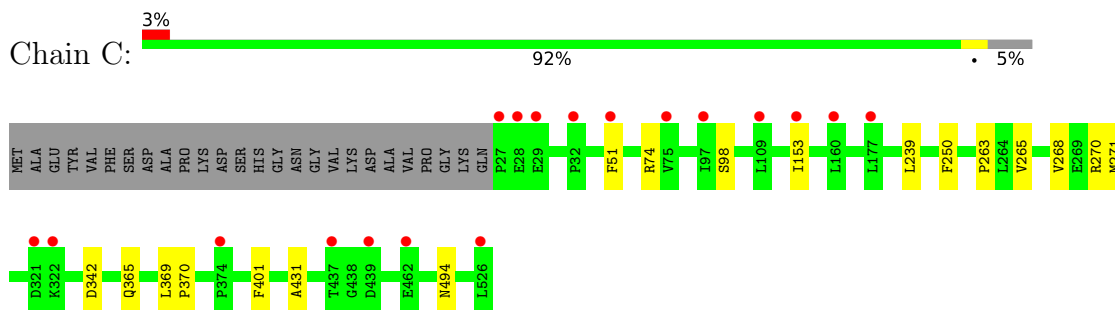
- Molecule 1: Carotenoid oxygenase 1



- Molecule 1: Carotenoid oxygenase 1

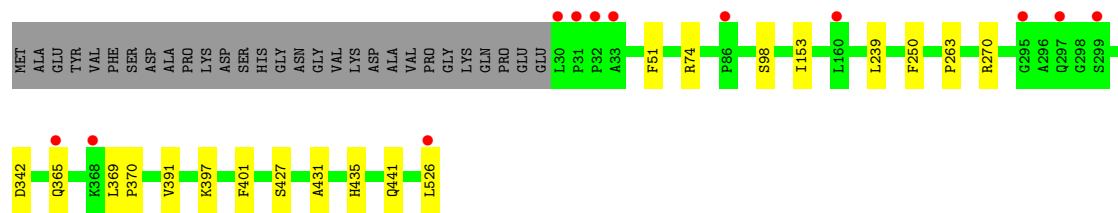


- Molecule 1: Carotenoid oxygenase 1



- Molecule 1: Carotenoid oxygenase 1





4 Data and refinement statistics i

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	100.63Å 100.63Å 447.66Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	49.09 – 2.15 49.09 – 2.15	Depositor EDS
% Data completeness (in resolution range)	99.0 (49.09-2.15) 99.0 (49.09-2.15)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.21 (at 2.16Å)	Xtrriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.190 , 0.211 0.201 , 0.223	Depositor DCC
R_{free} test set	6063 reflections (4.26%)	wwPDB-VP
Wilson B-factor (Å ²)	43.8	Xtrriage
Anisotropy	0.139	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 33.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	0.013 for -h,-k,l	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	17178	wwPDB-VP
Average B, all atoms (Å ²)	48.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.61% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 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: FE2, 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	0.61	0/4098	0.72	0/5569
1	B	0.61	0/4106	0.71	0/5581
1	C	0.61	0/4128	0.72	0/5609
1	D	0.61	0/4098	0.71	0/5570
All	All	0.61	0/16430	0.71	0/22329

There are no bond length outliers.

There are no bond angle outliers.

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	3974	0	3797	5	0
1	B	3978	0	3797	11	0
1	C	4003	0	3823	11	0
1	D	3974	0	3792	9	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
3	A	3	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	2	0	0	0	0
3	C	2	0	0	0	0
3	D	3	0	0	0	0
4	A	290	0	0	0	0
4	B	305	0	0	3	0
4	C	309	0	0	3	0
4	D	331	0	0	2	0
All	All	17178	0	15209	36	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 1.

All (36) 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:B:103:LYS:O	1:B:106[B]:HIS:CD2	2.47	0.67
1:B:477:TYR:HA	1:B:480:MET:HE2	1.83	0.60
1:B:477:TYR:HA	1:B:480:MET:CE	2.34	0.57
1:B:199:LYS:HE3	4:B:880:HOH:O	2.04	0.57
1:C:268:VAL:HA	1:C:271:MET:CE	2.37	0.54
1:C:270:ARG:NH2	4:C:704:HOH:O	2.43	0.51
1:D:441:GLN:NE2	4:D:702:HOH:O	2.45	0.49
1:B:74:ARG:HG2	1:B:98:SER:HB2	1.96	0.48
1:B:170:TYR:CZ	1:B:182:VAL:HG22	2.49	0.47
1:A:74:ARG:HG2	1:A:98:SER:HB2	1.97	0.47
1:C:268:VAL:HA	1:C:271:MET:HE2	1.97	0.47
1:A:391:VAL:CG1	1:A:526:LEU:HD12	2.45	0.47
1:D:365:GLN:HA	1:D:365:GLN:OE1	2.15	0.46
1:D:391:VAL:CG1	1:D:526:LEU:HD12	2.45	0.46
1:C:74:ARG:HG2	1:C:98:SER:HB2	1.97	0.46
1:C:365:GLN:OE1	1:C:365:GLN:HA	2.16	0.46
1:D:74:ARG:HG2	1:D:98:SER:HB2	1.97	0.46
1:B:369:LEU:HB2	1:B:370:PRO:HD3	1.96	0.46
1:C:369:LEU:HB2	1:C:370:PRO:HD3	1.98	0.45
1:C:494:ASN:HB2	4:C:934:HOH:O	2.17	0.44
1:A:369:LEU:HB2	1:A:370:PRO:HD3	1.99	0.44
1:D:369:LEU:HB2	1:D:370:PRO:HD3	1.99	0.44
1:C:268:VAL:HA	1:C:271:MET:HE3	1.99	0.43
1:B:441:GLN:NE2	4:B:715:HOH:O	2.51	0.43
1:C:153:ILE:O	1:C:153:ILE:HG23	2.19	0.42
1:B:267:ASP:HB3	1:B:270:ARG:NH1	2.35	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:153:ILE:O	1:B:153:ILE:HG23	2.20	0.42
1:D:401:PHE:CE1	1:D:431:ALA:HB3	2.55	0.41
1:A:153:ILE:HG23	1:A:153:ILE:O	2.19	0.41
1:D:153:ILE:HG23	1:D:153:ILE:O	2.20	0.41
1:B:401:PHE:CE2	1:B:431:ALA:HB3	2.56	0.41
1:C:401:PHE:CE2	1:C:431:ALA:HB3	2.56	0.41
1:A:519:VAL:HG11	4:B:1004:HOH:O	2.21	0.41
1:C:265:VAL:HB	4:C:823:HOH:O	2.20	0.40
1:D:397:LYS:HA	1:D:435:HIS:HB2	2.04	0.40
1:D:270:ARG:NH2	4:D:726:HOH:O	2.54	0.40

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	495/526 (94%)	485 (98%)	9 (2%)	1 (0%)	47	46
1	B	496/526 (94%)	489 (99%)	6 (1%)	1 (0%)	47	46
1	C	498/526 (95%)	487 (98%)	10 (2%)	1 (0%)	47	46
1	D	495/526 (94%)	487 (98%)	7 (1%)	1 (0%)	47	46
All	All	1984/2104 (94%)	1948 (98%)	32 (2%)	4 (0%)	47	46

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	263	PRO
1	C	263	PRO
1	D	263	PRO
1	A	263	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	420/444 (95%)	415 (99%)	5 (1%)	71	76
1	B	420/444 (95%)	416 (99%)	4 (1%)	76	81
1	C	424/444 (96%)	420 (99%)	4 (1%)	78	83
1	D	420/444 (95%)	415 (99%)	5 (1%)	71	76
All	All	1684/1776 (95%)	1666 (99%)	18 (1%)	73	78

All (18) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	51	PHE
1	A	239	LEU
1	A	250	PHE
1	A	342	ASP
1	A	427	SER
1	B	51	PHE
1	B	239	LEU
1	B	250	PHE
1	B	427	SER
1	C	51	PHE
1	C	239	LEU
1	C	250	PHE
1	C	342	ASP
1	D	51	PHE
1	D	239	LEU
1	D	250	PHE
1	D	342	ASP
1	D	427	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 14 ligands modelled in this entry, 14 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

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	497/526 (94%)	0.19	17 (3%) 45 53	34, 48, 69, 90	0
1	B	497/526 (94%)	0.29	21 (4%) 36 45	34, 45, 72, 107	0
1	C	500/526 (95%)	0.25	18 (3%) 42 51	34, 47, 66, 108	0
1	D	497/526 (94%)	0.08	12 (2%) 59 67	33, 44, 62, 81	0
All	All	1991/2104 (94%)	0.20	68 (3%) 45 53	33, 46, 68, 108	0

All (68) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	409	GLY	4.7
1	D	32	PRO	4.6
1	A	30	LEU	4.6
1	C	27	PRO	4.2
1	C	29	GLU	4.2
1	B	526	LEU	4.0
1	B	30	LEU	3.9
1	A	32	PRO	3.8
1	B	32	PRO	3.7
1	B	343	ALA	3.7
1	D	365	GLN	3.7
1	C	526	LEU	3.6
1	D	30	LEU	3.6
1	B	349	ARG	3.4
1	C	322	LYS	3.4
1	A	324	HIS	3.4
1	B	31	PRO	3.4
1	B	408	PRO	3.3
1	C	437	THR	3.2
1	C	177	LEU	3.1
1	D	526	LEU	3.0

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Mol	Chain	Res	Type	RSRZ
1	C	462	GLU	3.0
1	C	439	ASP	3.0
1	C	321	ASP	2.9
1	C	28	GLU	2.8
1	C	32	PRO	2.8
1	B	321	ASP	2.8
1	A	367	ASP	2.7
1	B	414	GLU	2.7
1	C	97	ILE	2.7
1	D	297	GLN	2.7
1	C	153	ILE	2.7
1	A	31	PRO	2.6
1	A	494	ASN	2.6
1	A	321	ASP	2.5
1	B	348	PRO	2.5
1	B	344	ASN	2.5
1	D	33	ALA	2.5
1	B	413	PHE	2.5
1	C	109	LEU	2.5
1	B	365	GLN	2.4
1	B	462	GLU	2.4
1	D	31	PRO	2.4
1	D	368	LYS	2.4
1	A	365	GLN	2.4
1	C	374	PRO	2.3
1	D	295	GLY	2.3
1	A	509	LEU	2.3
1	C	51	PHE	2.3
1	B	410	VAL	2.2
1	D	86	PRO	2.2
1	B	247	ILE	2.2
1	A	379	ASP	2.2
1	A	84	PHE	2.2
1	C	75	VAL	2.2
1	C	160	LEU	2.2
1	B	409	GLY	2.2
1	B	461	SER	2.2
1	A	408	PRO	2.1
1	B	51	PHE	2.1
1	A	407	LYS	2.1
1	A	295	GLY	2.1
1	A	526	LEU	2.0

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Mol	Chain	Res	Type	RSRZ
1	D	299	SER	2.0
1	B	33	ALA	2.0
1	A	75	VAL	2.0
1	B	509	LEU	2.0
1	D	160	LEU	2.0

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 monosaccharides in this entry.

6.4 Ligands [i](#)

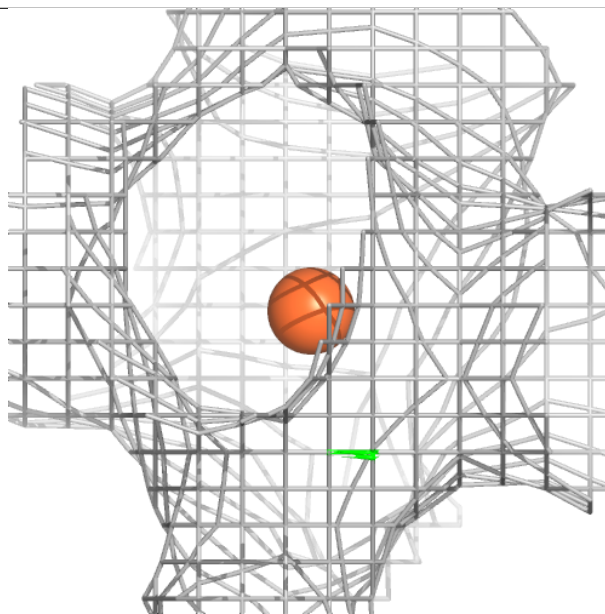
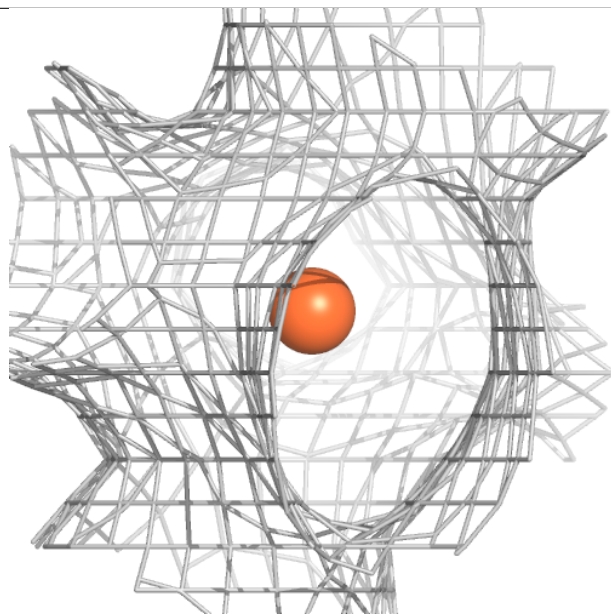
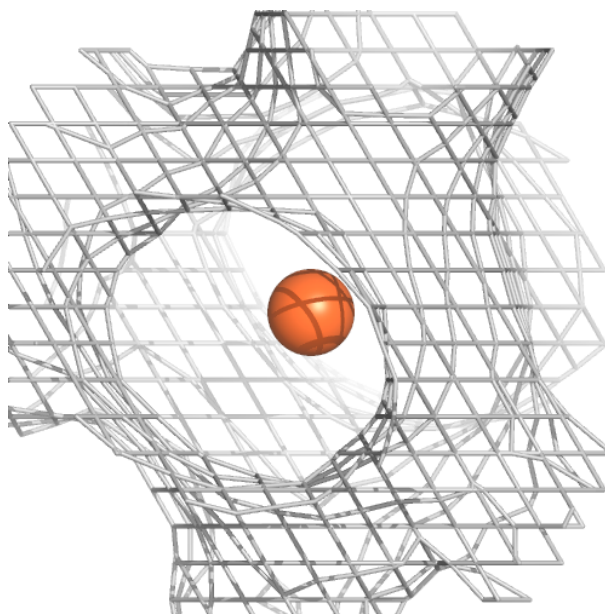
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	CL	A	603	1/1	0.88	0.19	70,70,70,70	0
3	CL	D	603	1/1	0.89	0.41	86,86,86,86	0
3	CL	A	604	1/1	0.97	0.12	60,60,60,60	0
3	CL	B	603	1/1	0.97	0.09	61,61,61,61	0
3	CL	C	603	1/1	0.97	0.09	59,59,59,59	0
3	CL	A	602	1/1	0.97	0.09	54,54,54,54	0
3	CL	B	602	1/1	0.98	0.10	56,56,56,56	0
3	CL	D	602	1/1	0.98	0.10	48,48,48,48	0
3	CL	C	602	1/1	0.98	0.07	55,55,55,55	0
3	CL	D	604	1/1	0.98	0.05	54,54,54,54	0
2	FE2	B	601	1/1	0.99	0.17	43,43,43,43	1
2	FE2	C	601	1/1	0.99	0.13	42,42,42,42	1
2	FE2	A	601	1/1	1.00	0.16	43,43,43,43	1
2	FE2	D	601	1/1	1.00	0.11	38,38,38,38	1

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

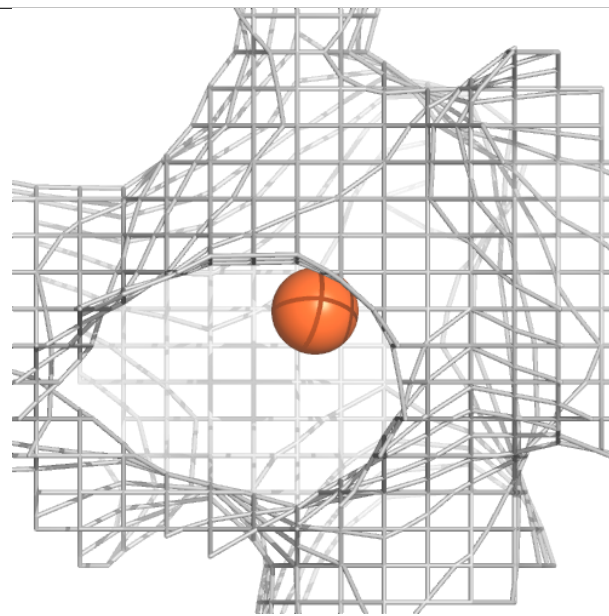
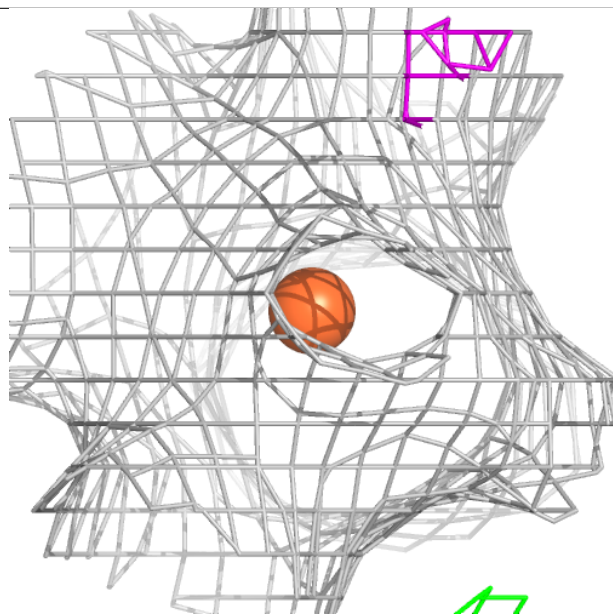
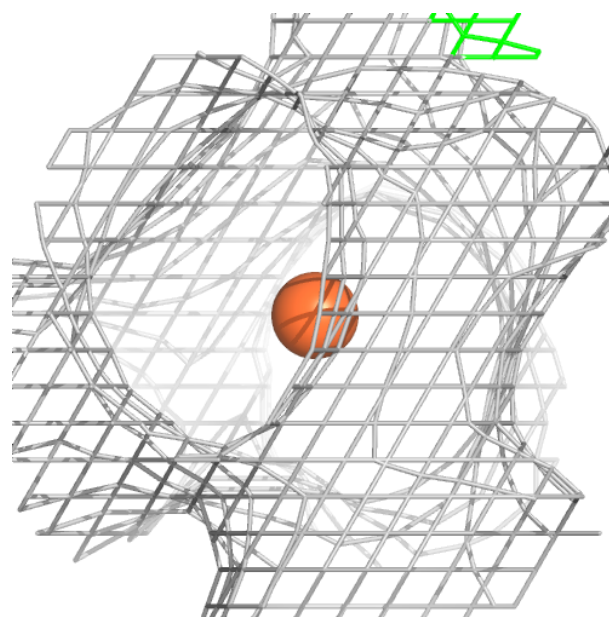
Electron density around FE2 B 601:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



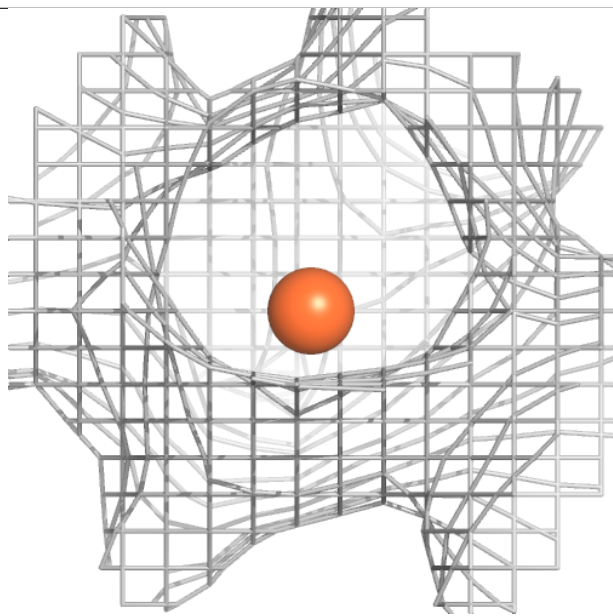
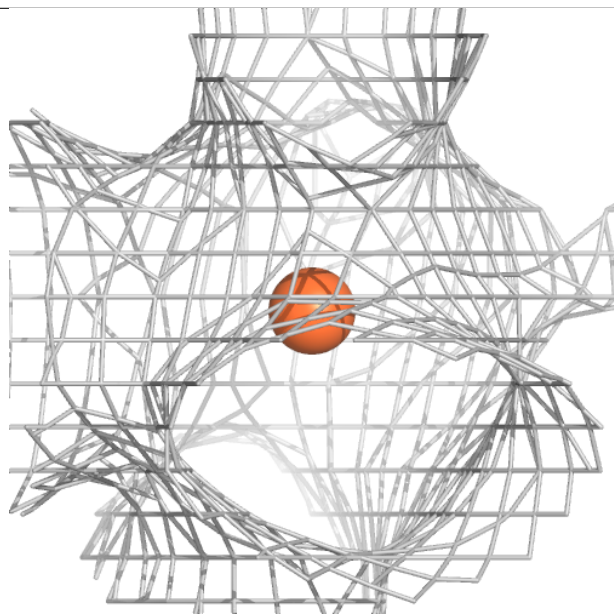
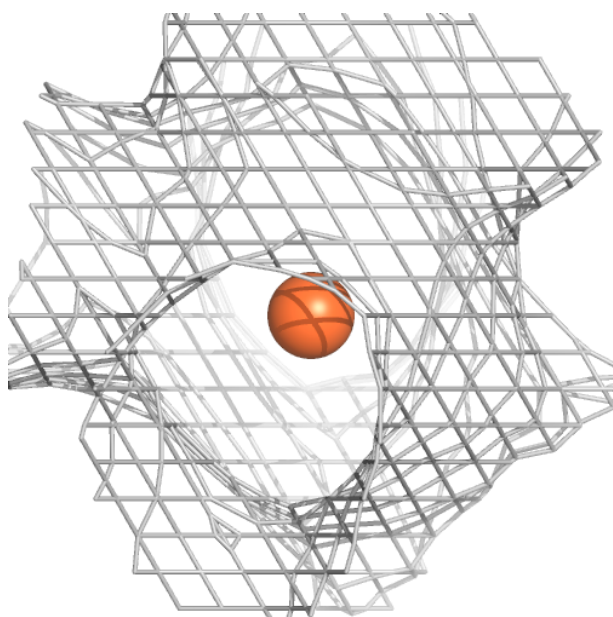
Electron density around FE2 C 601:

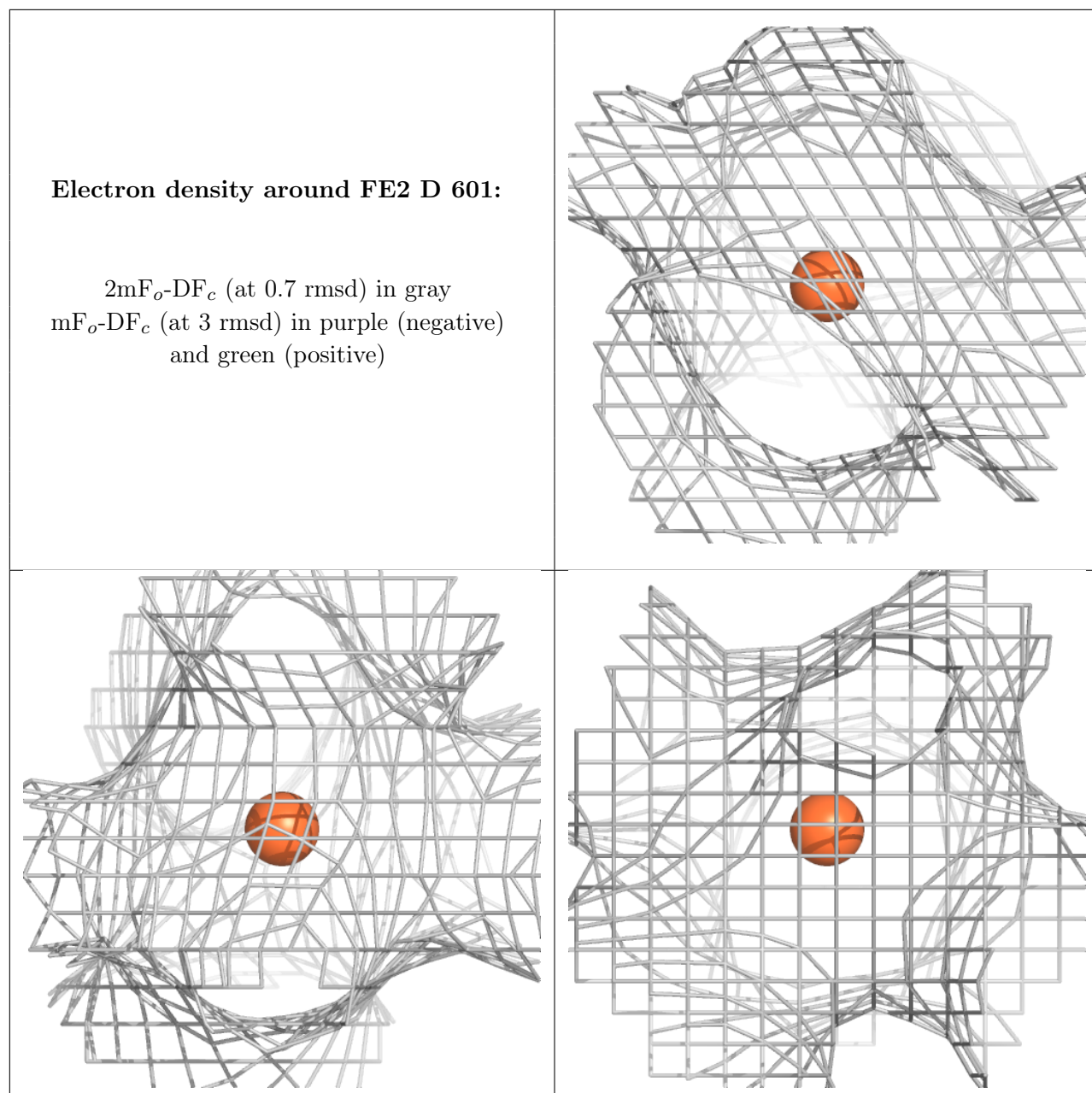
$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around FE2 A 601:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)





6.5 Other polymers [i](#)

There are no such residues in this entry.