W O R L D W I D E
wwPDB
PROTEIN DATA BANK

Full wwPDB X-ray Structure Validation Report ⓘ

Feb 23, 2026 – 01:49 pm GMT

PDB ID	:	9RJU / pdb_00009rju
Title	:	W-formate dehydrogenase from Nitratidesulfovibrio vulgaris (Desulfovibrio vulgaris) - anaerobic soaked with 50 bar CO2 for 1 min
Authors	:	Vilela-Alves, G.; Manuel, R.R.; Carpentier, P.; Pereira, I.C.; Romao, M.J.; Mota, C.
Deposited on	:	2025-06-12
Resolution	:	2.07 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:

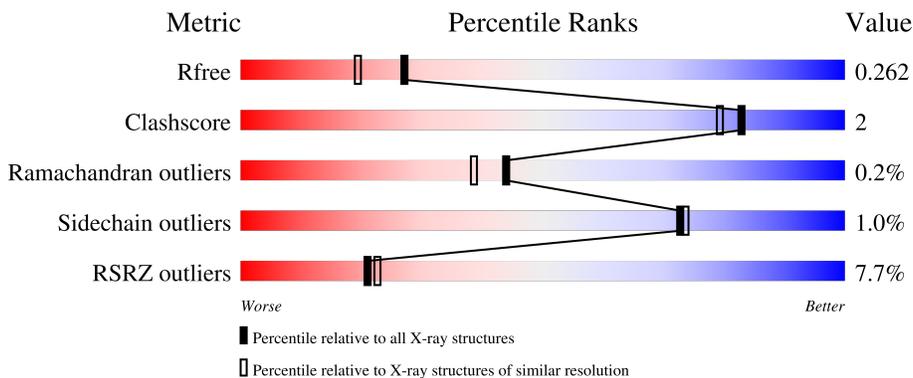|		
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.48.1

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 2.07 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	Percentile Ranks	Value
Rfree		0.262
Clashscore		2
Ramachandran outliers		0.2%
Sidechain outliers		1.0%
RSRZ outliers		7.7%

Worse .... *Better*

▌ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	164625	3436 (2.08-2.04)
Clashscore	180529	3661 (2.08-2.04)
Ramachandran outliers	177936	3649 (2.08-2.04)
Sidechain outliers	177891	3649 (2.08-2.04)
RSRZ outliers	164620	3436 (2.08-2.04)

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 <=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	1013	8% / 89% / 6% ·
2	B	215	5% / 94% / 6%

2 Entry composition ⓘ

There are 9 unique types of molecules in this entry. The entry contains 9590 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 Formate dehydrogenase, alpha subunit, selenocysteine-contai ning.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	968	7579	4830	1322	1385	41	1	0	0	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1006	TRP	-	expression tag	UNP Q72EJ1
A	1007	SER	-	expression tag	UNP Q72EJ1
A	1008	HIS	-	expression tag	UNP Q72EJ1
A	1009	PRO	-	expression tag	UNP Q72EJ1
A	1010	GLN	-	expression tag	UNP Q72EJ1
A	1011	PHE	-	expression tag	UNP Q72EJ1
A	1012	GLU	-	expression tag	UNP Q72EJ1
A	1013	LYS	-	expression tag	UNP Q72EJ1

- Molecule 2 is a protein called Formate dehydrogenase, beta subunit, putative.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	214	1664	1041	291	316	16	0	0	0

- Molecule 3 is 2-AMINO-5,6-DIMERCAPTO-7-METHYL-3,7,8A,9-TETRAHYDRO-8-OXA -1,3,9,10-TETRAAZA-ANTHRACEN-4-ONE GUANOSINE DINUCLEOTIDE (CCD ID: MGD) (formula: $C_{20}H_{26}N_{10}O_{13}P_2S_2$) (labeled as "Ligand of Interest" by depositor).
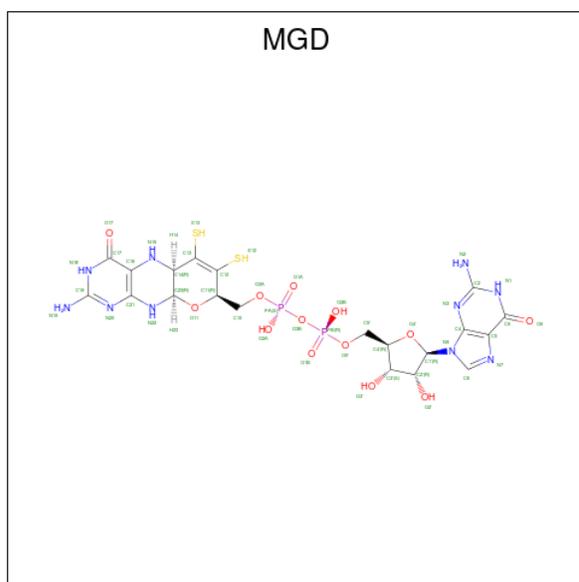
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	S	0	0
			47	20	10	13	2	2		
3	A	1	Total	C	N	O	P	S	0	0
			47	20	10	13	2	2		

- Molecule 4 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe_4S_4) (labeled as "Ligand of Interest" by depositor).
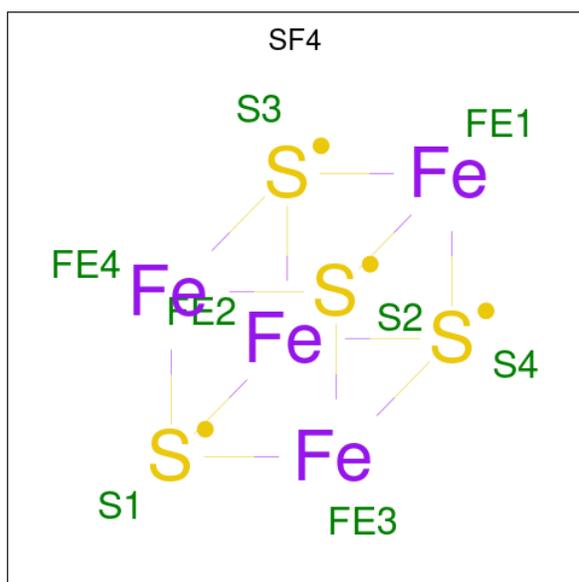
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	Fe	S	0	0
			8	4	4		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	B	1	Total 8	Fe 4	S 4	0	0
4	B	1	Total 8	Fe 4	S 4	0	0
4	B	1	Total 8	Fe 4	S 4	0	0

- Molecule 5 is TUNGSTEN ION (CCD ID: W) (formula: W) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total 1	W 1	0	0

- Molecule 6 is HYDROSULFURIC ACID (CCD ID: H2S) (formula: H_2S) (labeled as "Ligand of Interest" by depositor).
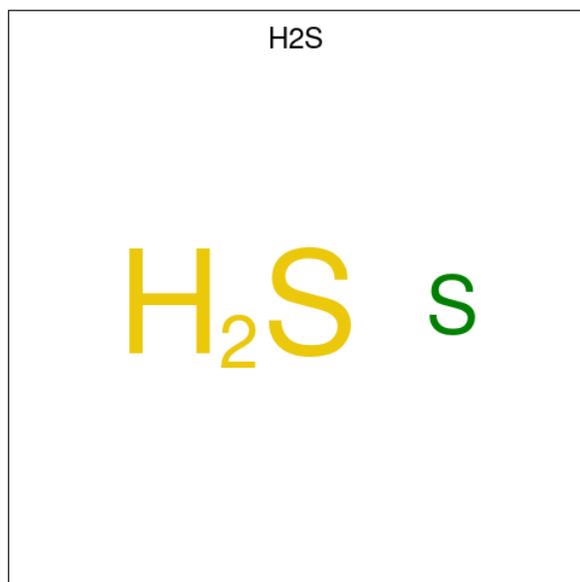
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total 1	S 1	0	0

- Molecule 7 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).

GOL
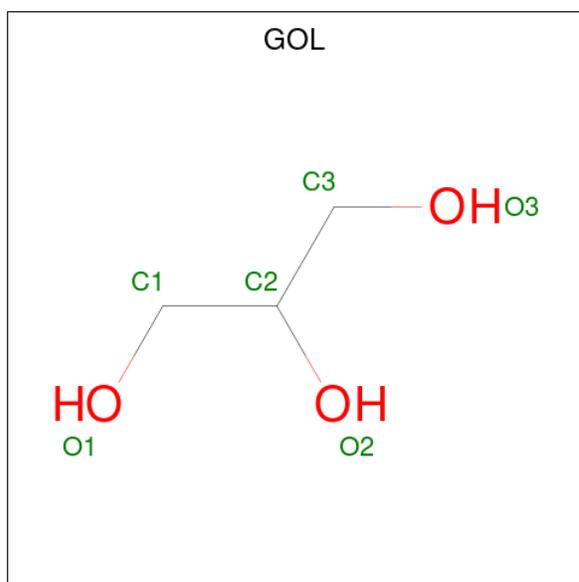
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total 6	C 3	O 3	0	0
7	A	1	Total 6	C 3	O 3	0	0
7	A	1	Total 6	C 3	O 3	0	0
7	B	1	Total 6	C 3	O 3	0	0

- Molecule 8 is CARBON DIOXIDE (CCD ID: CO2) (formula: CO_2) (labeled as "Ligand of Interest" by depositor).

CO2
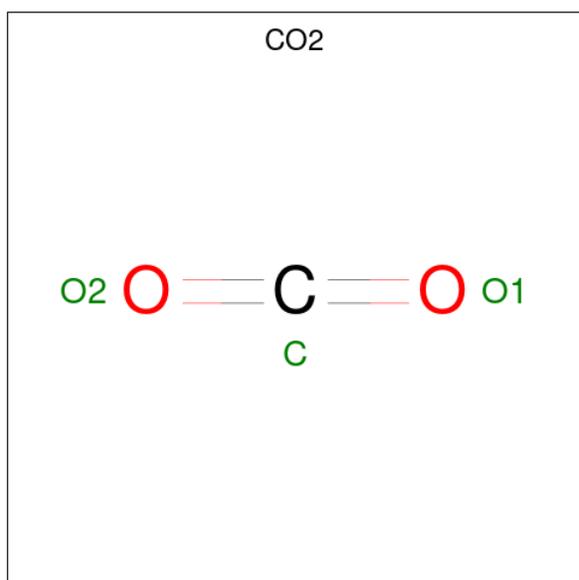
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	A	1	Total 3	C 1	O 2	0	0
8	B	1	Total 3	C 1	O 2	0	0
8	B	1	Total 3	C 1	O 2	0	0
8	B	1	Total 3	C 1	O 2	0	0
8	B	1	Total 3	C 1	O 2	0	0
8	B	1	Total 3	C 1	O 2	0	0

- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	116	Total 116	O 116	0	0
9	B	25	Total 25	O 25	0	0

3 Residue-property plots ⓘ

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: Formate dehydrogenase, alpha subunit, selenocysteine-containing

Chain A:
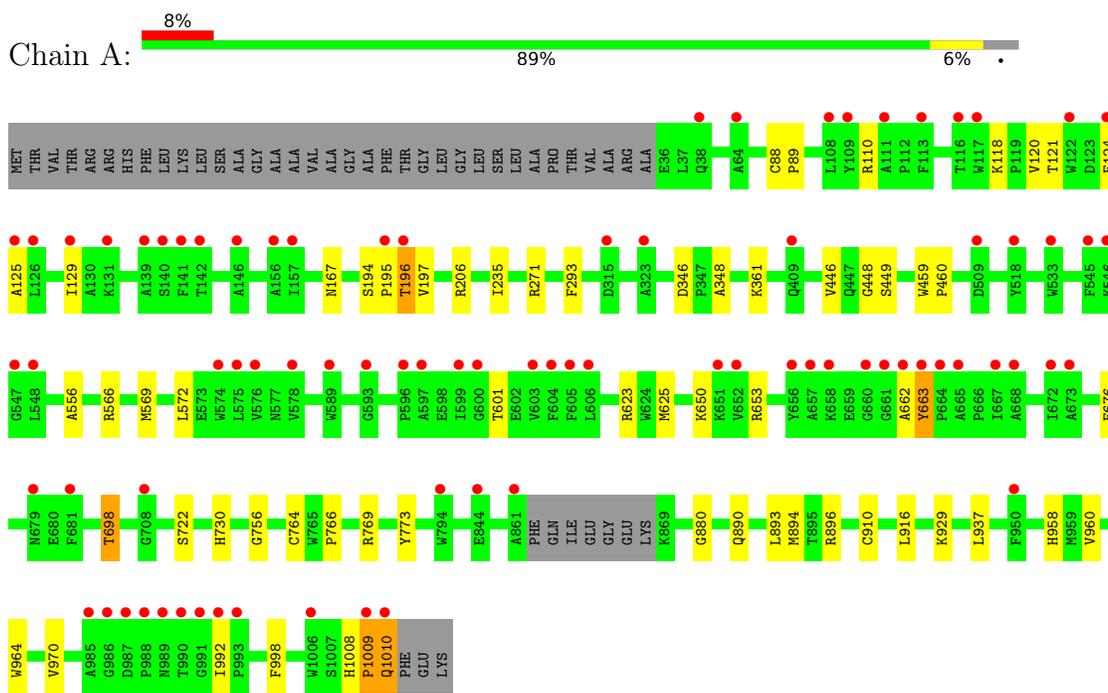
• Molecule 2: Formate dehydrogenase, beta subunit, putative

Chain B:
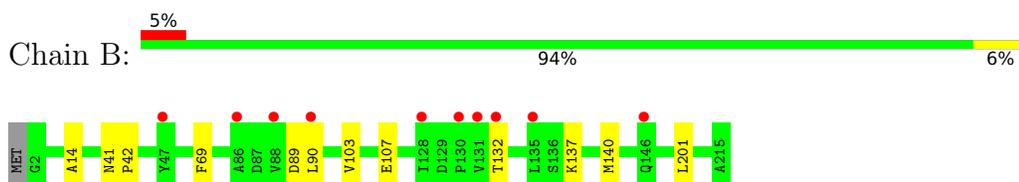
4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	65.03Å 128.72Å 149.86Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	59.65 – 2.07 59.65 – 2.07	Depositor EDS
% Data completeness (in resolution range)	73.7 (59.65-2.07) 73.4 (59.65-2.07)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.50 (at 2.07Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.211 , 0.255 0.218 , 0.262	Depositor DCC
R_{free} test set	2831 reflections (3.64%)	wwPDB-VP
Wilson B-factor (Å^2)	35.2	Xtriage
Anisotropy	0.056	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , 18.6	EDS
L-test for twinning[2]	$< |L| > = 0.51, < L^2 > = 0.35$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	9590	wwPDB-VP
Average B, all atoms (Å^2)	44.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.19% of the height of the origin peak. No significant pseudotranslation is detected.*

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

5 Model quality ⓘ

5.1 Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, CO2, SEC, SF4, W, H2S, MGD

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	0.99	0/7783	1.37	2/10560 (0.0%)
2	B	0.99	0/1699	1.39	0/2302
All	All	0.99	0/9482	1.37	2/12862 (0.0%)

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	A	293	PHE	CA-C-N	5.03	126.98	120.44
1	A	293	PHE	C-N-CA	5.03	126.98	120.44

There are no chirality outliers.

There are no planarity outliers.

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	7579	0	7403	35	0
2	B	1664	0	1633	7	0
3	A	94	0	44	2	0
4	A	8	0	0	0	0
4	B	24	0	0	0	0
5	A	1	0	0	0	0
6	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
7	A	18	0	24	2	0
7	B	6	0	8	0	0
8	A	39	0	0	0	0
8	B	15	0	0	0	0
9	A	116	0	0	0	0
9	B	25	0	0	0	0
All	All	9590	0	9112	42	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 2.

All (42) 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:120:VAL:HG11	1:A:124:PHE:CD1	2.31	0.65
1:A:1009:PRO:O	1:A:1010:GLN:HB2	1.98	0.61
1:A:118:LYS:O	1:A:120:VAL:HG23	2.05	0.56
2:B:41:ASN:HA	2:B:42:PRO:C	2.30	0.55
1:A:698:THR:HG21	1:A:722:SER:CB	2.38	0.54
1:A:698:THR:HG21	1:A:722:SER:HB3	1.90	0.54
1:A:894:MET:SD	3:A:1102:MGD:H2'	2.50	0.52
1:A:88:CYS:HB2	1:A:89:PRO:HD2	1.91	0.51
2:B:140:MET:O	2:B:140:MET:HG2	2.11	0.51
1:A:125:ALA:O	1:A:129:ILE:HG12	2.12	0.50
1:A:569:MET:HA	1:A:572:LEU:HD23	1.94	0.49
1:A:937:LEU:C	1:A:937:LEU:HD12	2.38	0.48
1:A:650:LYS:NZ	1:A:676:GLU:OE2	2.27	0.47
2:B:103:VAL:O	2:B:137:LYS:NZ	2.46	0.47
1:A:167:ASN:OD1	1:A:448:GLY:HA3	2.16	0.46
1:A:110:ARG:NH1	1:A:601:THR:O	2.48	0.46
1:A:910:CYS:SG	1:A:960:VAL:HG13	2.56	0.46
1:A:446:VAL:HA	1:A:449:SER:OG	2.15	0.46
1:A:756:GLY:HA3	7:A:1109:GOL:H11	1.98	0.46
2:B:107:GLU:OE1	2:B:107:GLU:N	2.44	0.46
1:A:756:GLY:HA3	7:A:1109:GOL:C1	2.46	0.45
1:A:1008:HIS:O	1:A:1009:PRO:C	2.59	0.45
1:A:662:ALA:O	1:A:663:TYR:C	2.60	0.45
2:B:14:ALA:HB2	2:B:69:PHE:CG	2.52	0.45
1:A:194:SER:N	1:A:195:PRO:CD	2.81	0.44
2:B:201:LEU:C	2:B:201:LEU:HD23	2.43	0.44
1:A:346:ASP:OD1	1:A:348:ALA:HB3	2.18	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:880:GLY:N	1:A:998:PHE:O	2.48	0.43
1:A:893:LEU:HD13	3:A:1102:MGD:O3'	2.17	0.43
1:A:896:ARG:HD2	1:A:970:VAL:O	2.19	0.43
1:A:623:ARG:O	1:A:764:CYS:HA	2.18	0.43
1:A:196:THR:HG22	1:A:197:VAL:N	2.34	0.43
1:A:459:TRP:HB3	1:A:460:PRO:HD2	2.01	0.42
1:A:566:ARG:HA	1:A:569:MET:HE3	2.00	0.42
1:A:556:ALA:HB2	1:A:569:MET:HE1	2.02	0.41
1:A:206:ARG:HB2	1:A:773:TYR:OH	2.20	0.41
1:A:890:GLN:HA	1:A:964:TRP:CH2	2.55	0.41
1:A:195:PRO:HG3	1:A:992:ILE:CD1	2.50	0.41
2:B:89:ASP:O	2:B:90:LEU:HD22	2.21	0.41
1:A:625:MET:HE3	1:A:730:HIS:CE1	2.56	0.40
1:A:766:PRO:HG2	1:A:769:ARG:HD2	2.04	0.40
1:A:916:LEU:HD22	1:A:958:HIS:HB3	2.04	0.40

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	963/1013 (95%)	927 (96%)	34 (4%)	2 (0%)	44	38
2	B	212/215 (99%)	207 (98%)	5 (2%)	0	100	100
All	All	1175/1228 (96%)	1134 (96%)	39 (3%)	2 (0%)	44	38

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	663	TYR
1	A	1009	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	787/819 (96%)	778 (99%)	9 (1%)	70	70
2	B	185/186 (100%)	184 (100%)	1 (0%)	86	88
All	All	972/1005 (97%)	962 (99%)	10 (1%)	73	73

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	121	THR
1	A	196	THR
1	A	235	ILE
1	A	271	ARG
1	A	361	LYS
1	A	653	ARG
1	A	698	THR
1	A	929	LYS
1	A	1010	GLN
2	B	132	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	106	GLN
1	A	678	HIS
2	B	24	GLN
2	B	147	ASN
2	B	163	ASN
2	B	212	HIS

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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 30 ligands modelled in this entry, 1 is monoatomic and 1 is modelled with single atom - leaving 28 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	$\#|Z| > 2$
3	MGD	A	1102	5	41,52,52	0.84	2 (4%)	40,81,81	1.02	3 (7%)
4	SF4	A	1103	1	0,12,12	-	-	-		
8	CO2	A	1107	-	2,2,2	0.21	0	1,1,1	0.73	0
8	CO2	B	305	-	2,2,2	0.18	0	1,1,1	0.75	0
8	CO2	A	1119	-	2,2,2	0.29	0	1,1,1	0.74	0
7	GOL	B	304	-	5,5,5	0.15	0	5,5,5	0.41	0
8	CO2	B	308	-	2,2,2	0.34	0	1,1,1	0.68	0
8	CO2	A	1112	-	2,2,2	0.23	0	1,1,1	0.75	0
8	CO2	A	1110	-	2,2,2	0.32	0	1,1,1	0.77	0
7	GOL	A	1109	-	5,5,5	0.12	0	5,5,5	0.32	0
8	CO2	B	306	-	2,2,2	0.20	0	1,1,1	0.73	0
8	CO2	B	309	-	2,2,2	0.33	0	1,1,1	0.68	0
4	SF4	B	302	2	0,12,12	-	-	-		
4	SF4	B	303	2	0,12,12	-	-	-		
3	MGD	A	1101	5	41,52,52	0.78	2 (4%)	40,81,81	1.12	5 (12%)
7	GOL	A	1106	-	5,5,5	0.11	0	5,5,5	0.33	0
8	CO2	A	1118	-	2,2,2	0.34	0	1,1,1	0.74	0
8	CO2	A	1115	-	2,2,2	0.26	0	1,1,1	0.78	0
8	CO2	B	307	-	2,2,2	0.21	0	1,1,1	0.75	0
8	CO2	A	1120	-	2,2,2	0.18	0	1,1,1	0.78	0
8	CO2	A	1116	-	2,2,2	0.34	0	1,1,1	0.70	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\lvert Z \rvert > 2$	Counts	RMSZ	$\#\lvert Z \rvert > 2$
8	CO2	A	1121	-	2,2,2	0.19	0	1,1,1	0.76	0
8	CO2	A	1111	-	2,2,2	0.07	0	1,1,1	0.77	0
8	CO2	A	1117	-	2,2,2	0.25	0	1,1,1	0.82	0
7	GOL	A	1108	-	5,5,5	0.11	0	5,5,5	0.36	0
8	CO2	A	1114	-	2,2,2	0.22	0	1,1,1	0.73	0
4	SF4	B	301	2	0,12,12	-	-	-		
8	CO2	A	1113	-	2,2,2	0.28	0	1,1,1	0.74	0

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
3	MGD	A	1102	5	-	4/18/66/66	0/6/6/6
4	SF4	A	1103	1	-	-	0/6/5/5
7	GOL	A	1108	-	-	2/4/4/4	-
7	GOL	A	1109	-	-	2/4/4/4	-
7	GOL	B	304	-	-	4/4/4/4	-
4	SF4	B	302	2	-	-	0/6/5/5
4	SF4	B	301	2	-	-	0/6/5/5
4	SF4	B	303	2	-	-	0/6/5/5
3	MGD	A	1101	5	-	1/18/66/66	0/6/6/6
7	GOL	A	1106	-	-	0/4/4/4	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	1101	MGD	C5-C6	-2.58	1.42	1.47
3	A	1102	MGD	C5-C6	-2.49	1.42	1.47
3	A	1101	MGD	C8-N7	-2.10	1.31	1.35
3	A	1102	MGD	C8-N7	-2.06	1.31	1.35

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	1101	MGD	C19-N20-C21	2.96	118.77	113.43
3	A	1102	MGD	C19-N20-C21	2.88	118.63	113.43
3	A	1101	MGD	O4'-C1'-C2'	-2.43	103.37	106.93
3	A	1102	MGD	O4'-C1'-C2'	-2.43	103.38	106.93
3	A	1102	MGD	O6-C6-C5	2.17	128.62	124.37

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	1101	MGD	O11-C23-N22	2.16	110.79	108.57
3	A	1101	MGD	O6-C6-C5	2.09	128.44	124.37
3	A	1101	MGD	PA-O3B-PB	2.05	139.86	132.83

There are no chirality outliers.

All (13) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	1102	MGD	C4'-C5'-O5'-PB
7	A	1109	GOL	O1-C1-C2-O2
7	A	1109	GOL	O1-C1-C2-C3
7	B	304	GOL	O1-C1-C2-C3
3	A	1102	MGD	O4'-C4'-C5'-O5'
7	A	1108	GOL	C1-C2-C3-O3
7	B	304	GOL	C1-C2-C3-O3
7	B	304	GOL	O2-C2-C3-O3
7	B	304	GOL	O1-C1-C2-O2
3	A	1102	MGD	C3'-C4'-C5'-O5'
3	A	1101	MGD	PA-O3B-PB-O5'
7	A	1108	GOL	O2-C2-C3-O3
3	A	1102	MGD	PA-O3B-PB-O2B

There are no ring outliers.

2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	1102	MGD	2	0
7	A	1109	GOL	2	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

Ligand MGD A 1102

Bond lengths

Bond angles

Torsions

Rings

Ligand SF4 A 1103

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1107

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 B 305

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1119

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 B 308

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1112

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1110

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 B 306

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 B 309

Bond lengths

Bond angles

Torsions

Rings

Ligand SF4 B 302

Bond lengths

Bond angles

Torsions

Rings

Ligand SF4 B 303

Bond lengths

Bond angles

Torsions

Rings

Ligand MGD A 1101

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1118

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1115

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 B 307

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1120

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1116

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1121

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1111

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1117

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1114

Bond lengths

Bond angles

Torsions

Rings

Ligand SF4 B 301

Bond lengths

Bond angles

Torsions

Rings

Ligand CO2 A 1113	
Bond lengths	Bond angles
Torsions	Rings

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(Å²)	Q<0.9
1	A	967/1013 (95%)	0.58	81 (8%)	18	20	21, 42, 70, 121	0
2	B	214/215 (99%)	0.51	10 (4%)	37	39	25, 44, 75, 84	0
All	All	1181/1228 (96%)	0.57	91 (7%)	21	22	21, 42, 71, 121	0

All (91) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1006	TRP	5.2
1	A	988	PRO	4.8
1	A	597	ALA	4.7
1	A	660	GLY	4.4
1	A	661	GLY	4.3
1	A	985	ALA	3.8
1	A	992	ILE	3.8
1	A	993	PRO	3.6
1	A	196	THR	3.6
1	A	950	PHE	3.6
1	A	987	ASP	3.2
2	B	90	LEU	3.2
1	A	593	GLY	3.2
1	A	673	ALA	3.2
1	A	1009	PRO	3.1
1	A	574	TRP	3.1
1	A	109	TYR	3.0
1	A	990	THR	3.0
1	A	125	ALA	3.0
1	A	652	VAL	2.9
1	A	672	ILE	2.9
1	A	545	PHE	2.9
1	A	605	PHE	2.9
1	A	146	ALA	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	989	ASN	2.9
1	A	142	THR	2.8
1	A	195	PRO	2.7
2	B	131	VAL	2.7
1	A	665	ALA	2.7
1	A	122	TRP	2.7
1	A	708	GLY	2.6
1	A	156	ALA	2.6
2	B	132	THR	2.6
1	A	664	PRO	2.6
1	A	599	ILE	2.6
1	A	126	LEU	2.6
1	A	547	GLY	2.5
1	A	651	LYS	2.5
1	A	509	ASP	2.5
1	A	575	LEU	2.5
1	A	578	VAL	2.5
1	A	1010	GLN	2.4
1	A	518	TYR	2.4
1	A	124	PHE	2.4
1	A	117	TRP	2.4
1	A	986	GLY	2.4
1	A	108	LEU	2.4
2	B	130	PRO	2.4
1	A	113	PHE	2.4
1	A	991	GLY	2.4
2	B	146	GLN	2.4
1	A	604	PHE	2.3
1	A	576	VAL	2.3
1	A	589	TRP	2.3
1	A	157	ILE	2.3
2	B	88	VAL	2.3
1	A	667	ILE	2.3
1	A	596	PRO	2.2
1	A	844	GLU	2.2
1	A	131	LYS	2.2
1	A	658	LYS	2.2
1	A	111	ALA	2.2
1	A	323	ALA	2.2
1	A	662	ALA	2.2
1	A	129	ILE	2.2
1	A	548	LEU	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	656	TYR	2.2
1	A	861	ALA	2.2
2	B	86	ALA	2.2
1	A	315	ASP	2.2
1	A	603	VAL	2.2
1	A	679	ASN	2.2
1	A	38	GLN	2.2
1	A	606	LEU	2.1
1	A	681	PHE	2.1
2	B	128	ILE	2.1
1	A	116	THR	2.1
1	A	140	SER	2.1
1	A	64	ALA	2.1
1	A	668	ALA	2.1
1	A	663	TYR	2.1
1	A	141	PHE	2.1
1	A	657	ALA	2.1
1	A	409	GLN	2.1
1	A	794	TRP	2.1
2	B	135	LEU	2.1
1	A	139	ALA	2.0
1	A	600	GLY	2.0
1	A	546	LYS	2.0
2	B	47	TYR	2.0
1	A	533	TRP	2.0

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 oligosaccharides 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. 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
7	GOL	A	1108	6/6	0.70	0.25	51,58,63,64	0
7	GOL	B	304	6/6	0.74	0.22	34,58,60,66	0
8	CO2	A	1116	3/3	0.78	0.19	47,47,48,56	0
7	GOL	A	1109	6/6	0.79	0.18	44,50,60,64	0
8	CO2	A	1111	3/3	0.80	0.13	48,48,53,53	0
8	CO2	A	1117	3/3	0.80	0.19	64,64,66,73	0
8	CO2	A	1110	3/3	0.82	0.20	37,37,47,51	0
8	CO2	A	1119	3/3	0.82	0.18	46,46,59,63	0
8	CO2	B	309	3/3	0.84	0.15	39,39,45,55	0
8	CO2	B	306	3/3	0.85	0.14	41,41,49,55	0
8	CO2	A	1118	3/3	0.85	0.18	43,43,45,56	0
8	CO2	A	1113	3/3	0.86	0.20	45,45,54,56	0
8	CO2	B	308	3/3	0.86	0.20	42,42,42,54	0
8	CO2	A	1115	3/3	0.86	0.19	41,41,51,52	0
8	CO2	A	1121	3/3	0.87	0.23	49,49,49,53	0
8	CO2	B	307	3/3	0.87	0.16	48,48,57,60	0
8	CO2	A	1120	3/3	0.88	0.13	55,55,60,65	0
8	CO2	A	1107	3/3	0.90	0.13	50,50,59,61	0
8	CO2	A	1112	3/3	0.90	0.16	47,47,64,65	0
8	CO2	A	1114	3/3	0.91	0.10	45,45,47,50	0
8	CO2	B	305	3/3	0.94	0.10	28,28,36,44	0
7	GOL	A	1106	6/6	0.95	0.09	36,40,41,49	0
6	H2S	A	1105	1/1	0.95	0.07	33,33,33,33	0
3	MGD	A	1102	47/47	0.96	0.07	28,34,45,49	0
3	MGD	A	1101	47/47	0.97	0.07	24,28,31,32	0
4	SF4	B	303	8/8	0.98	0.04	37,40,42,44	0
4	SF4	B	302	8/8	0.98	0.04	40,45,49,52	0
4	SF4	B	301	8/8	0.99	0.03	27,28,29,30	0
4	SF4	A	1103	8/8	0.99	0.03	23,25,26,29	0
5	W	A	1104	1/1	1.00	0.01	31,31,31,31	0

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.
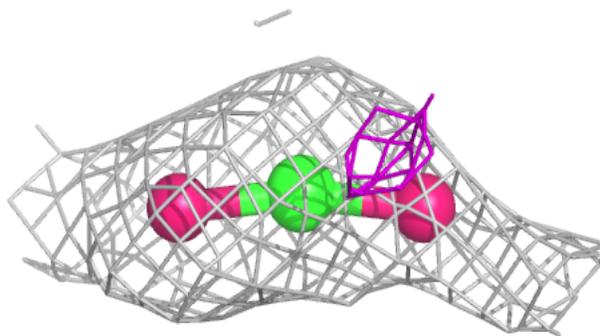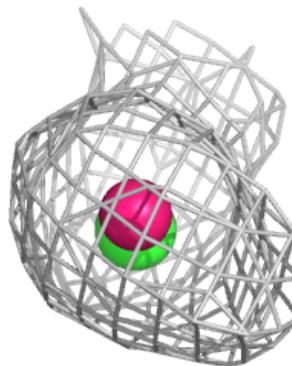
Electron density around CO2 A 1116:

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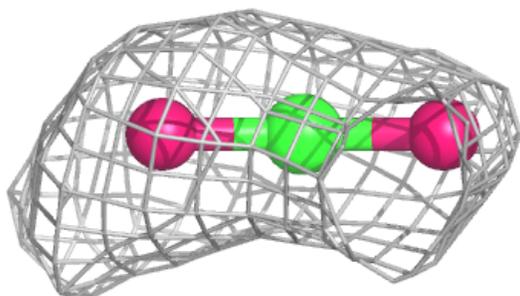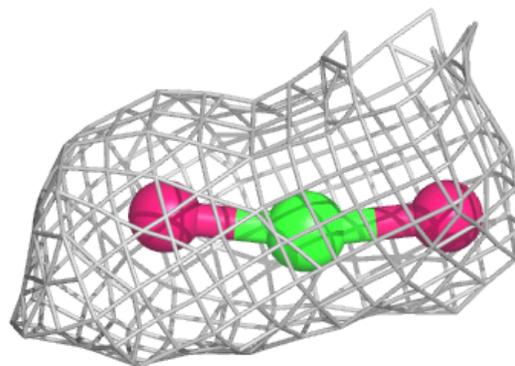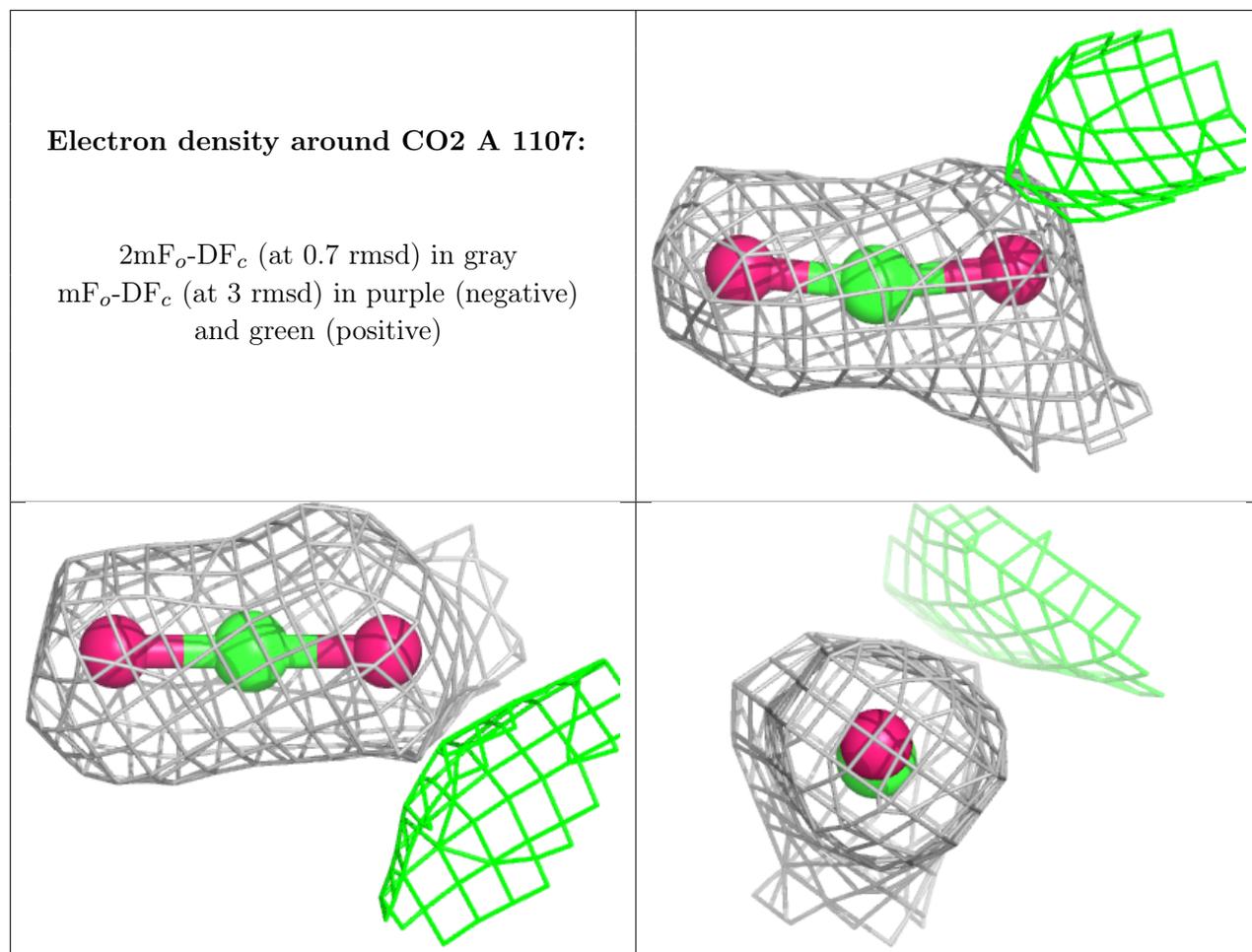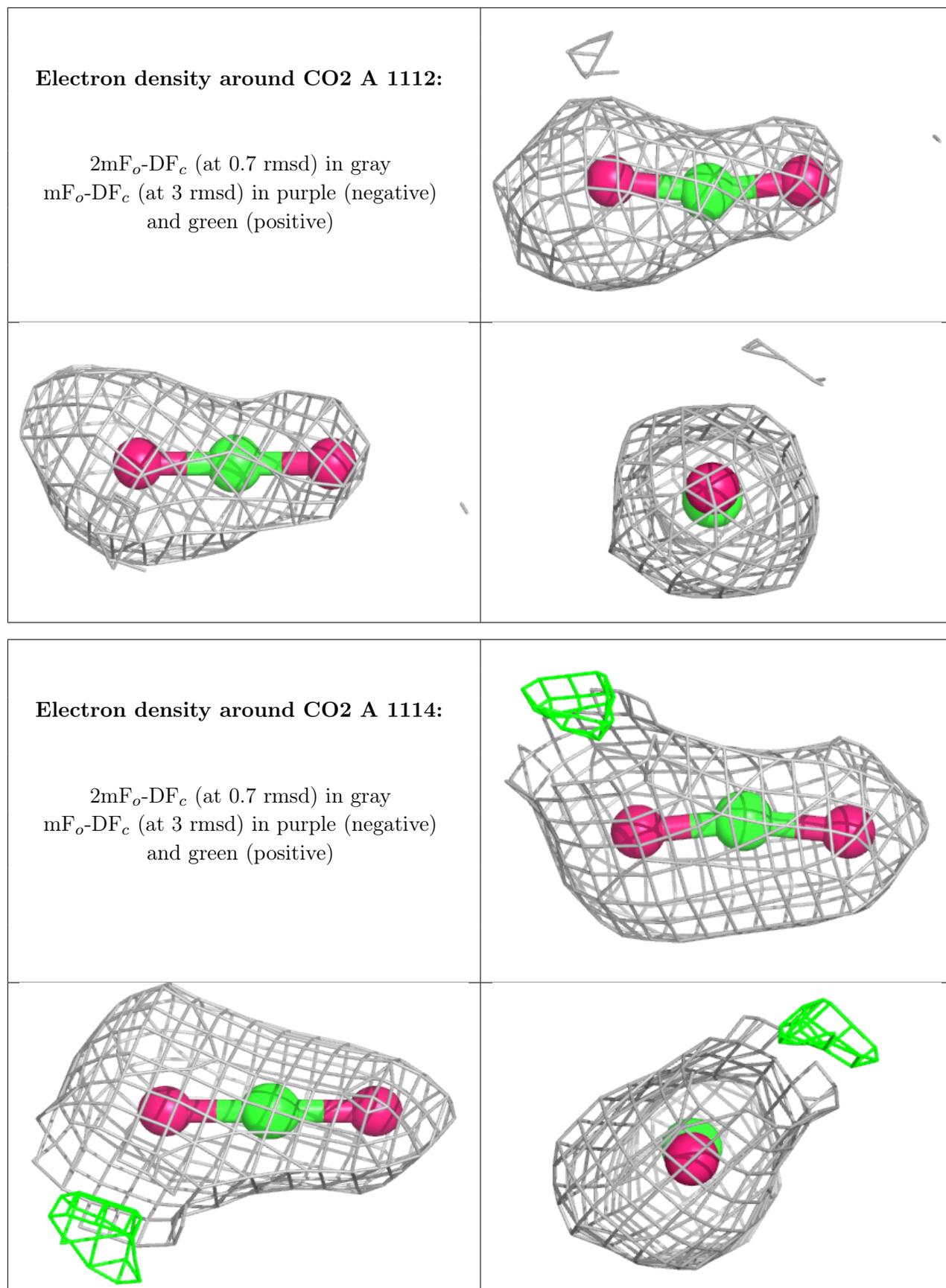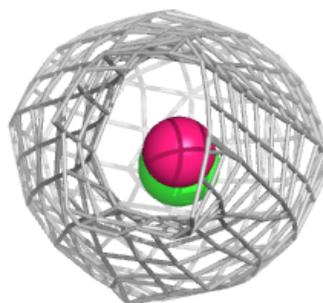mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around CO2 A 1111:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
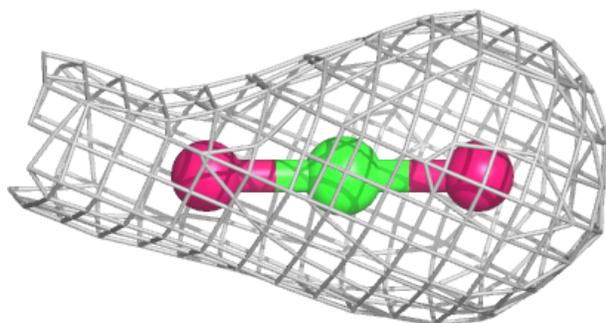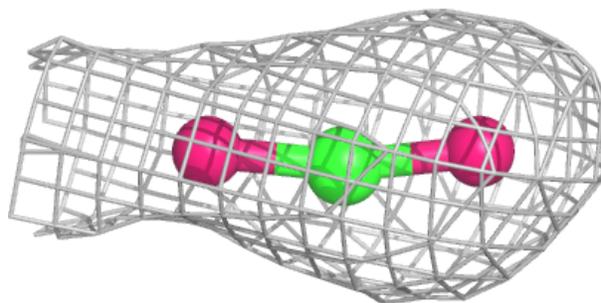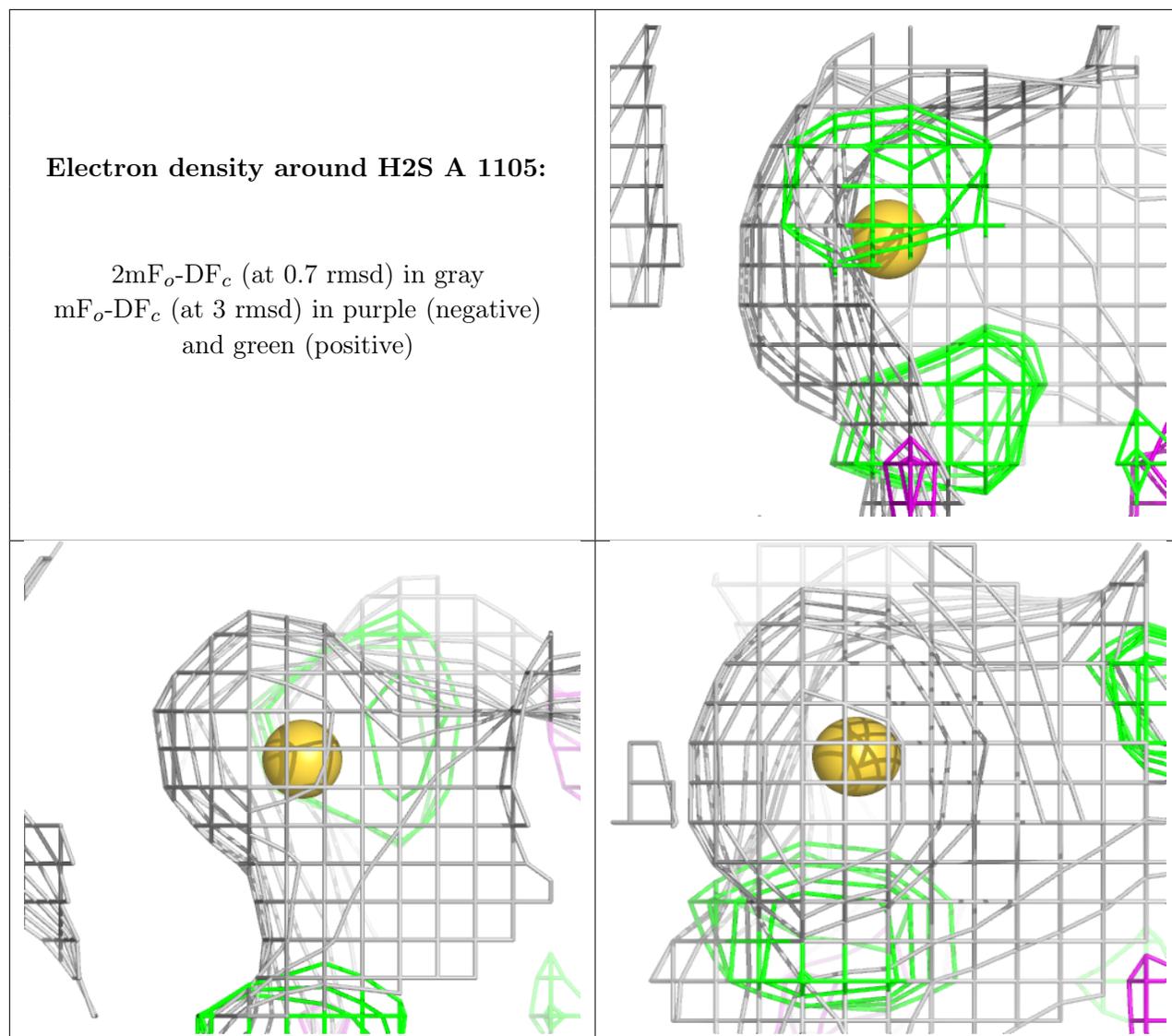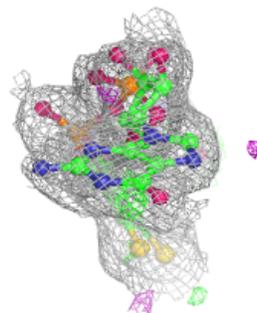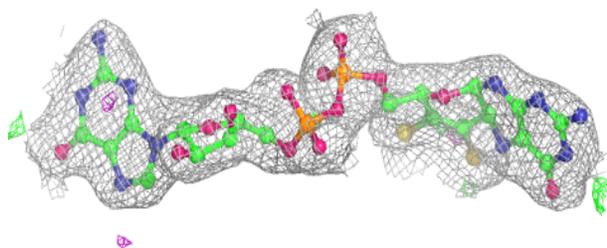mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
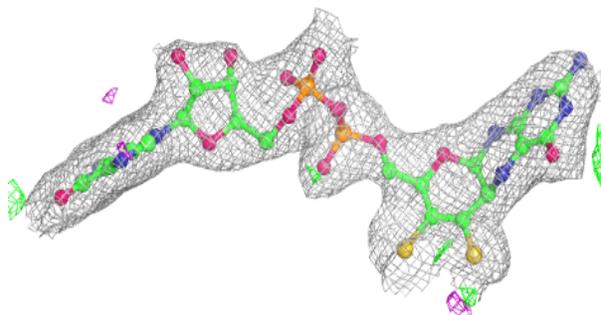
Electron density around CO2 A 1117:

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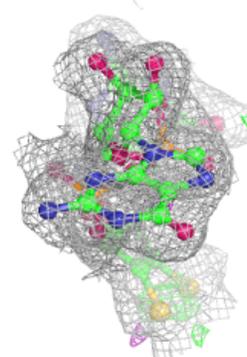and green (positive)

Electron density around CO2 A 1110:

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

Electron density around CO2 A 1119:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
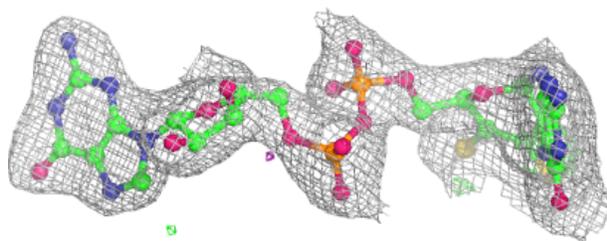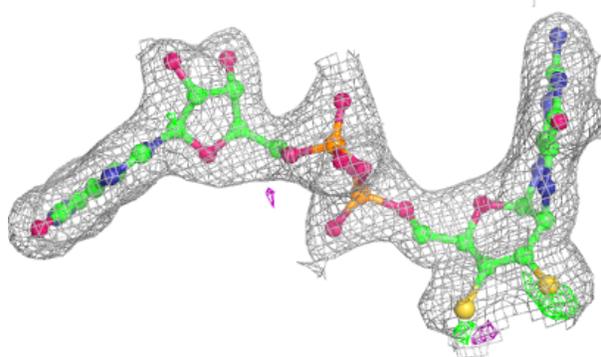and green (positive)
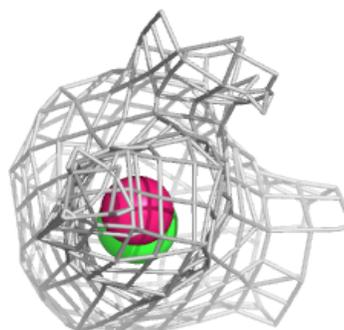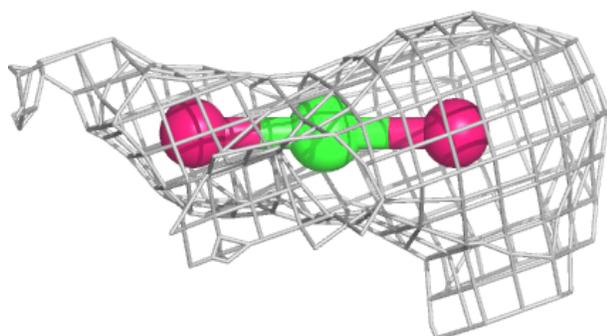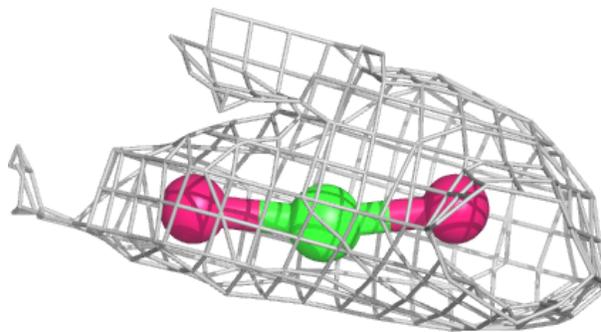
Electron density around CO2 B 309:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
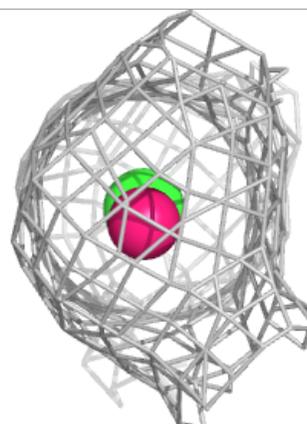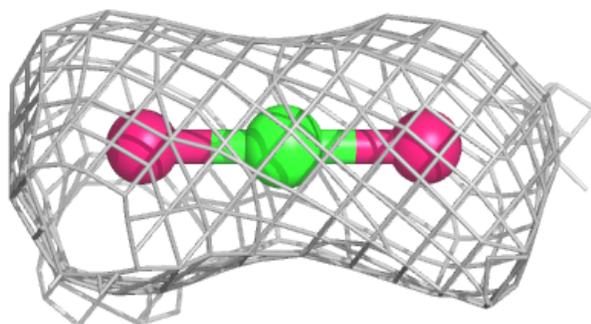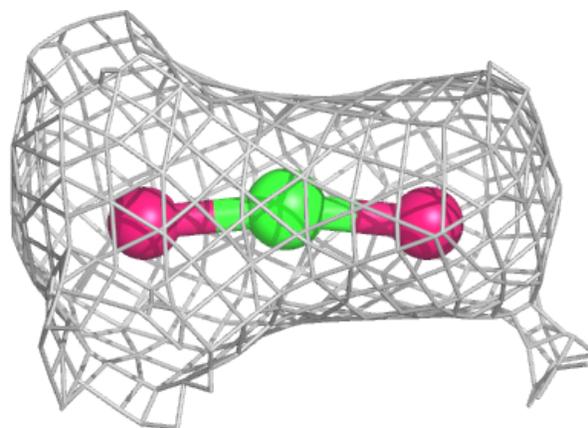
Electron density around CO2 B 306:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
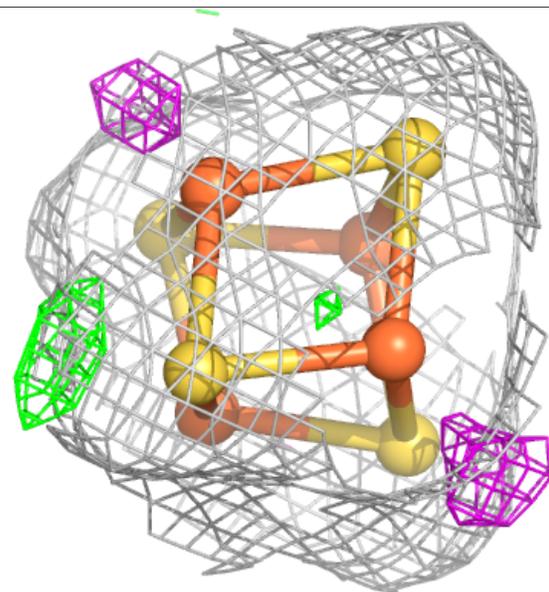and green (positive)
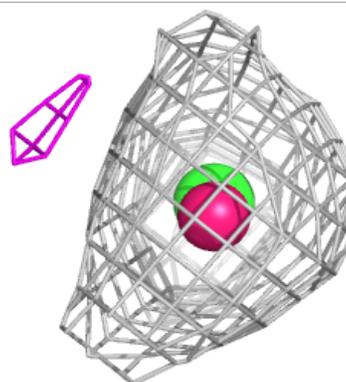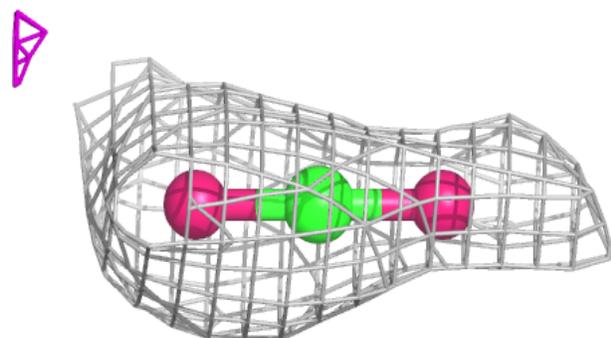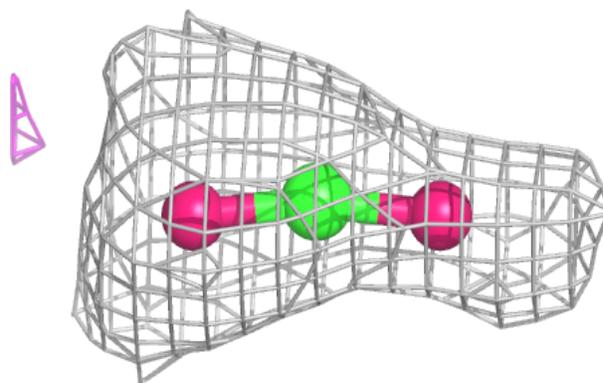
Electron density around CO2 A 1118:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
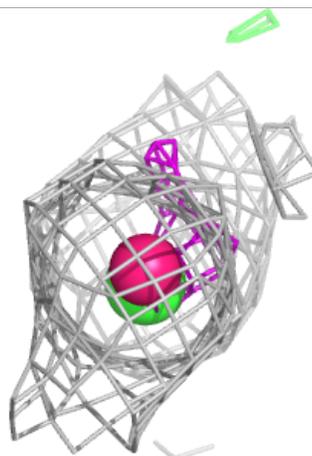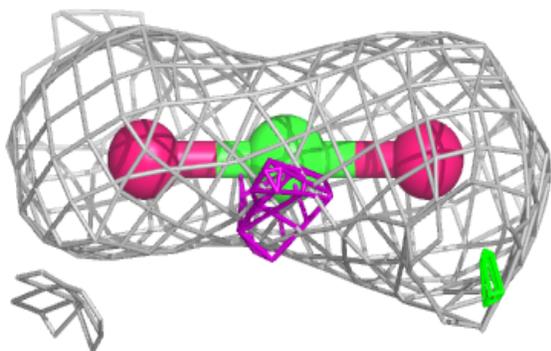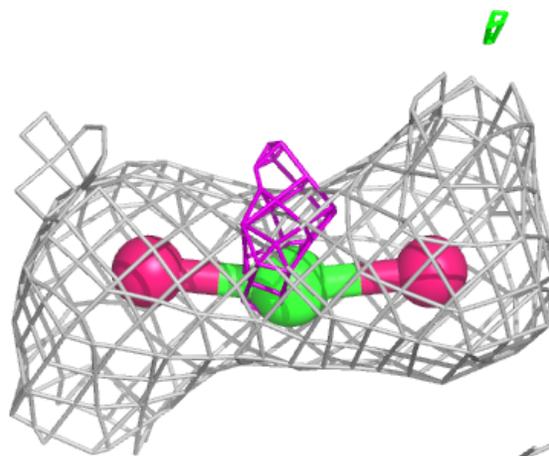
Electron density around CO2 A 1113:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
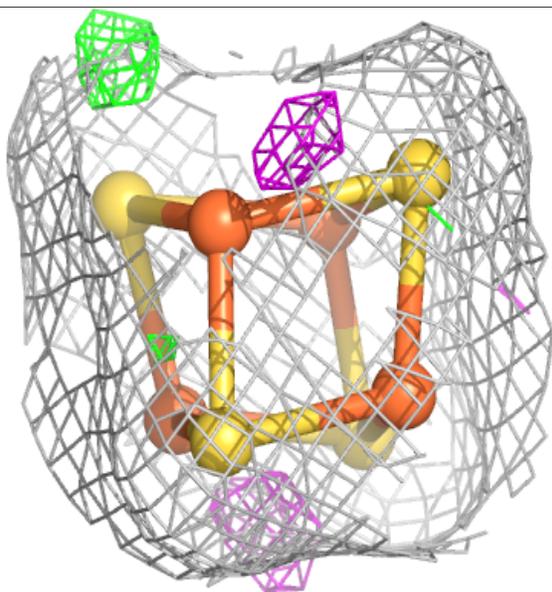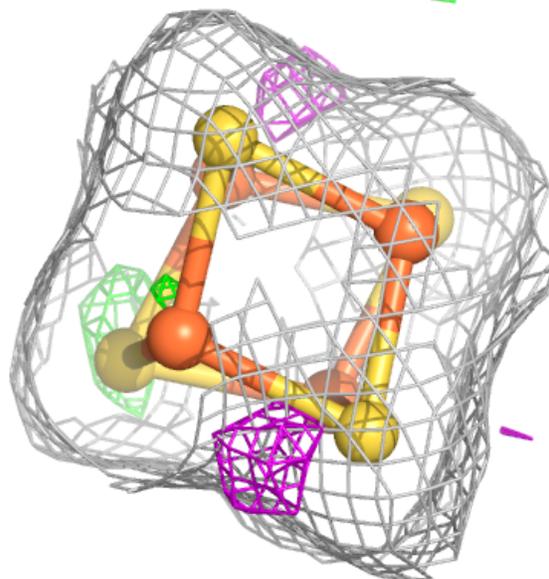and green (positive)
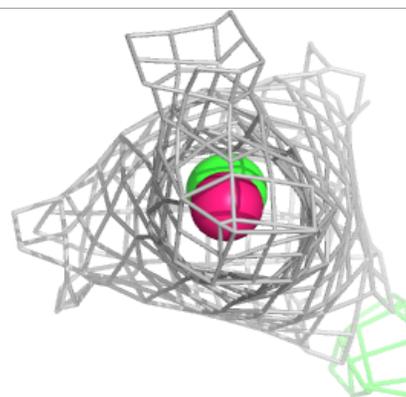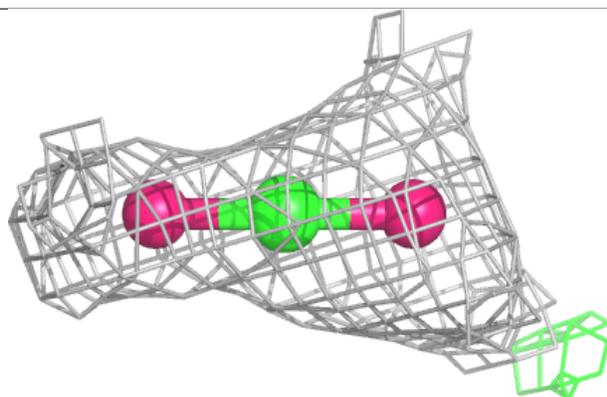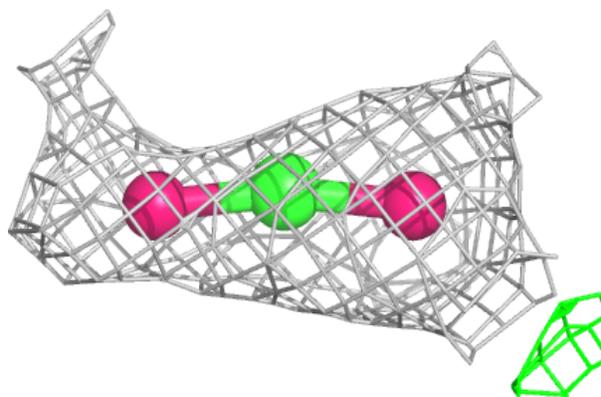
Electron density around CO2 B 308:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
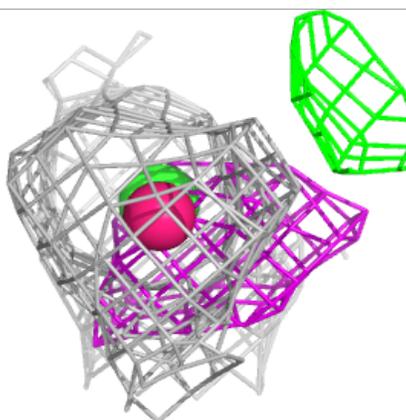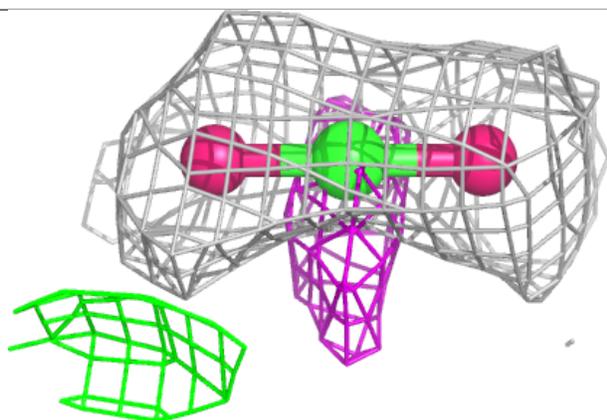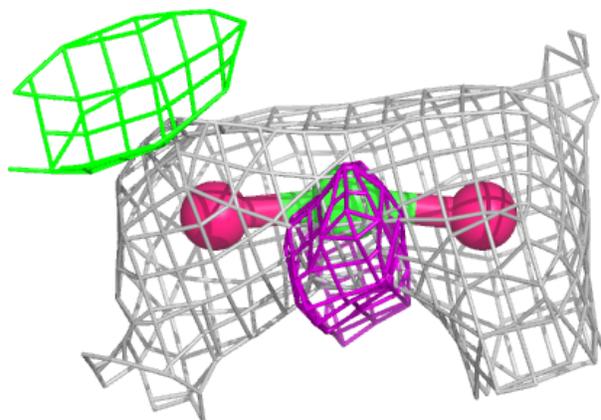
Electron density around CO2 A 1115:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)
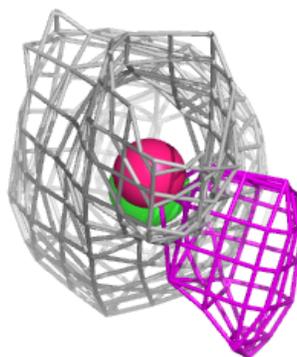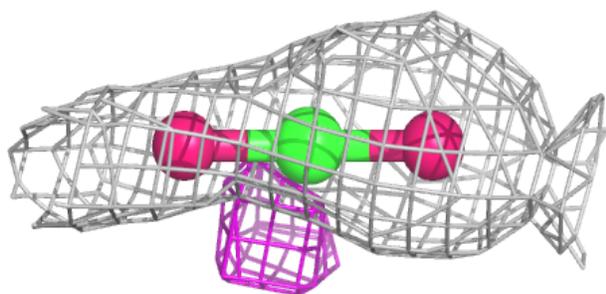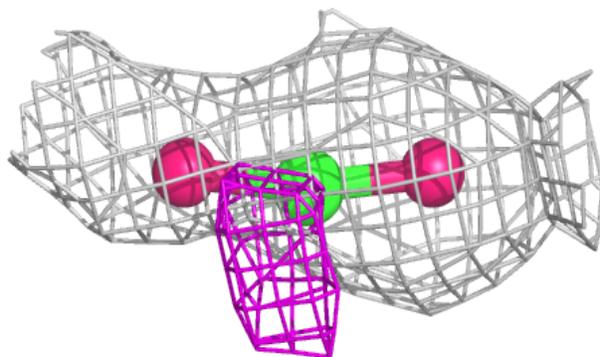
Electron density around CO2 A 1121:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)
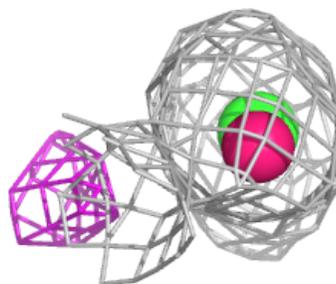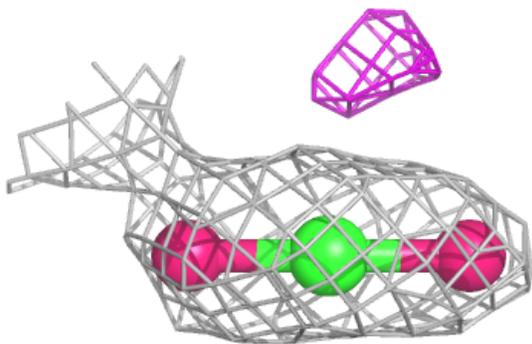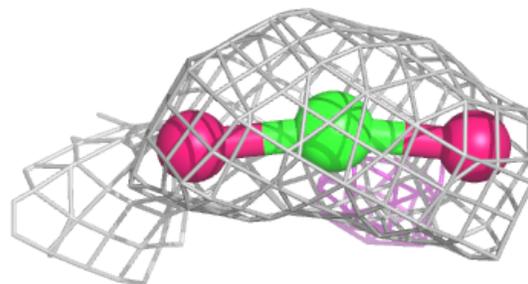
Electron density around CO2 B 307:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
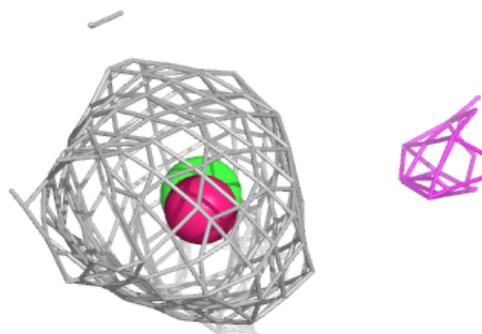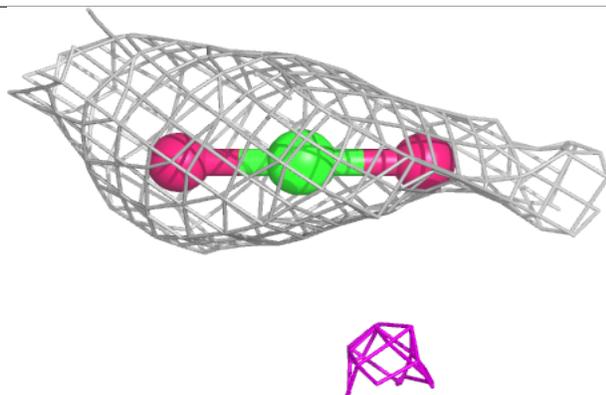
Electron density around CO2 A 1120:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
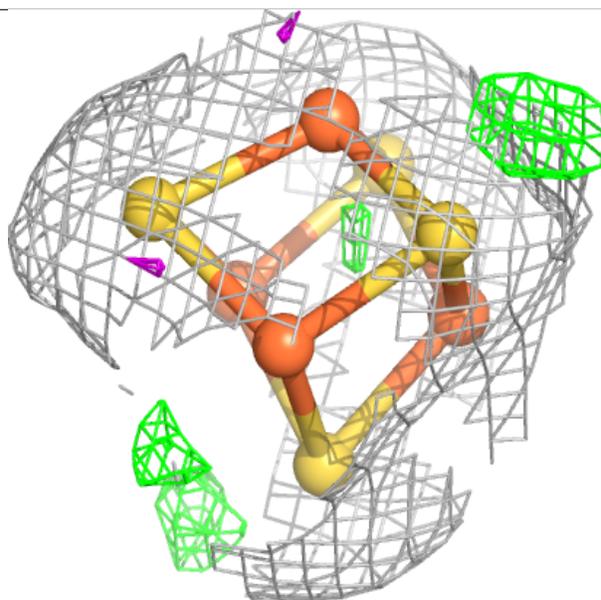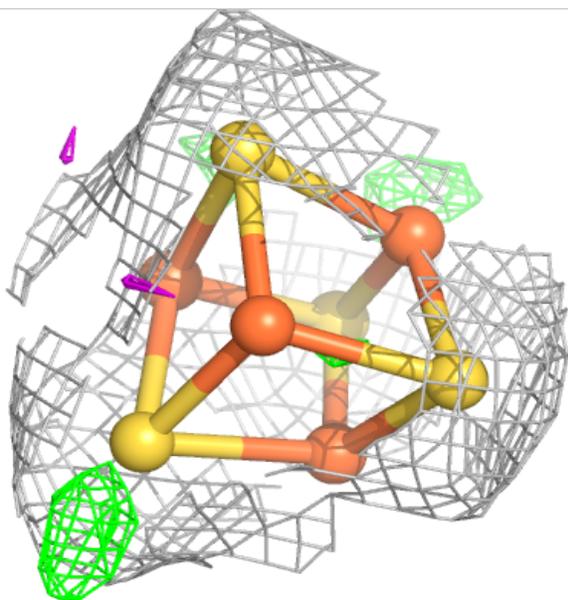mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
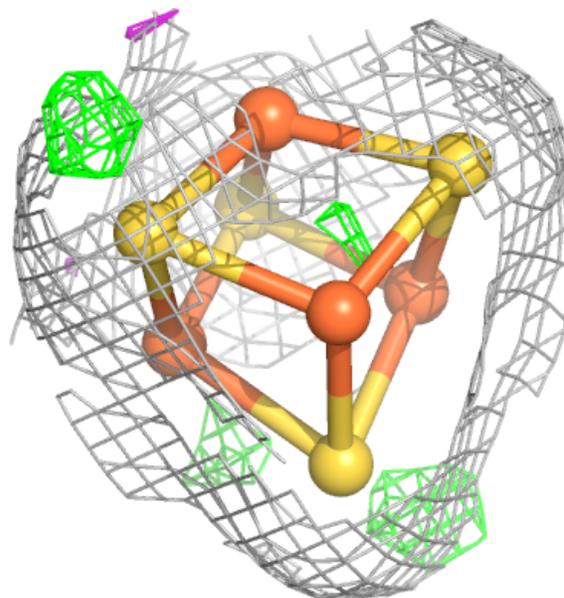
Electron density around CO2 A 1107:

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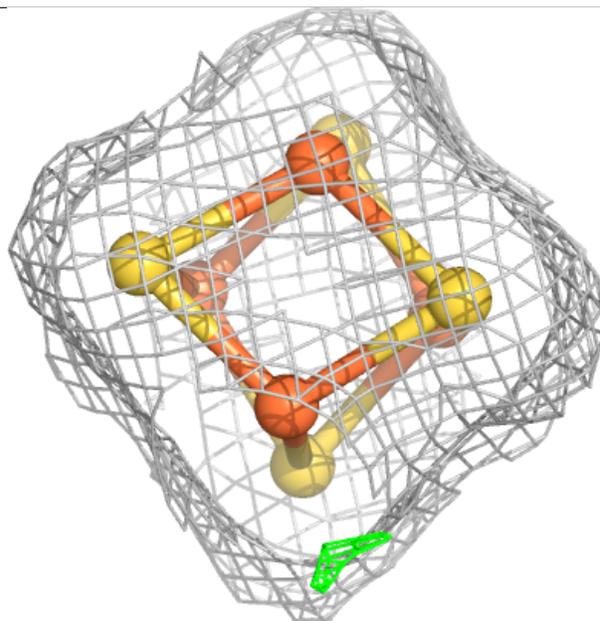and green (positive)

Electron density around CO2 A 1112:

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

Electron density around CO2 A 1114:

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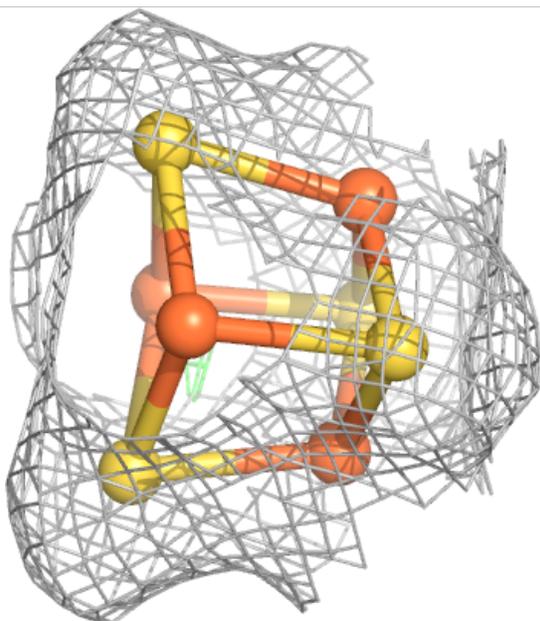and green (positive)

Electron density around CO2 B 305:

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

Electron density around H2S A 1105:

2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative)
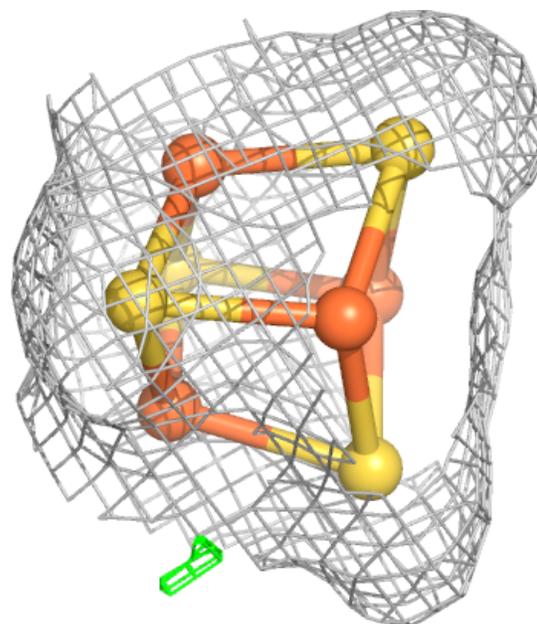and green (positive)

Electron density around MGD A 1102:

2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
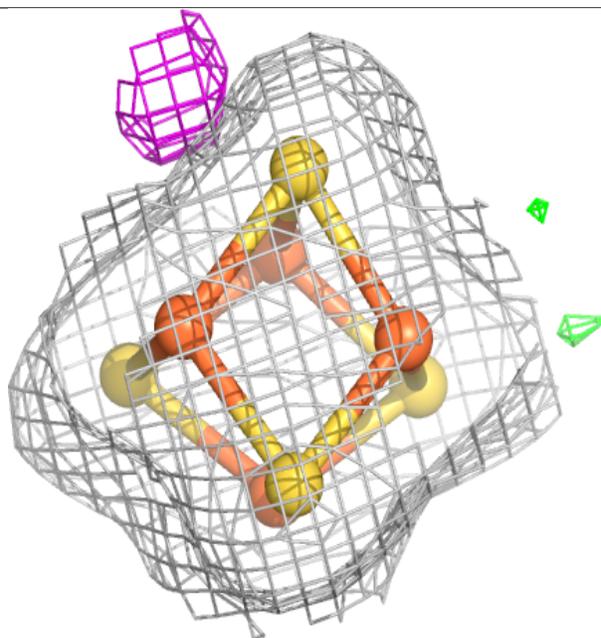mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around MGD A 1101:

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 SF4 B 303:

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

Electron density around SF4 B 302:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
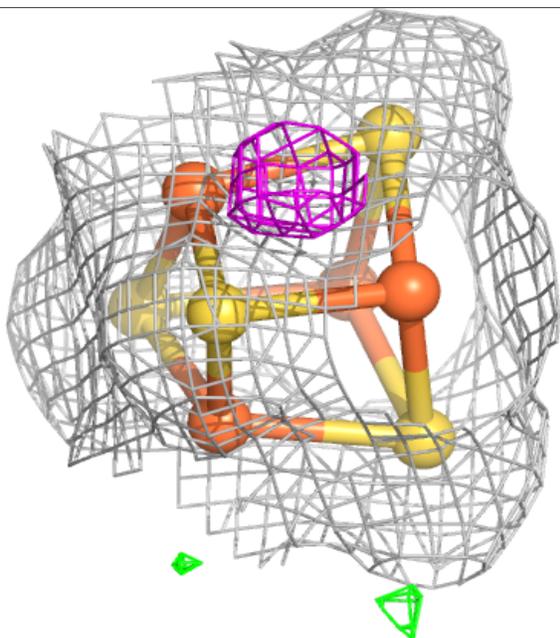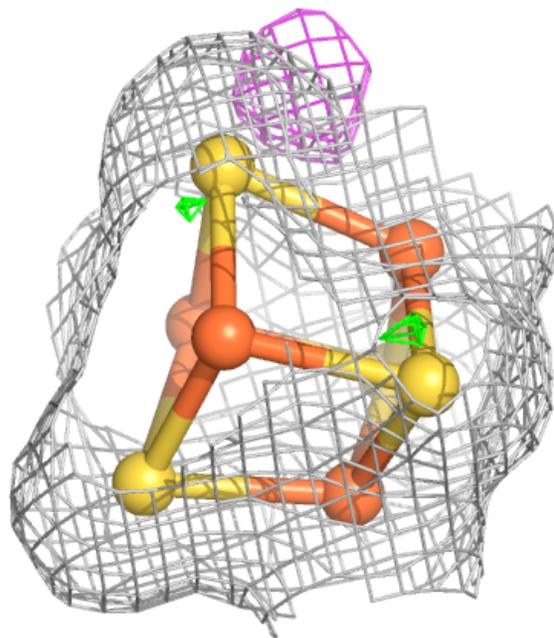and green (positive)
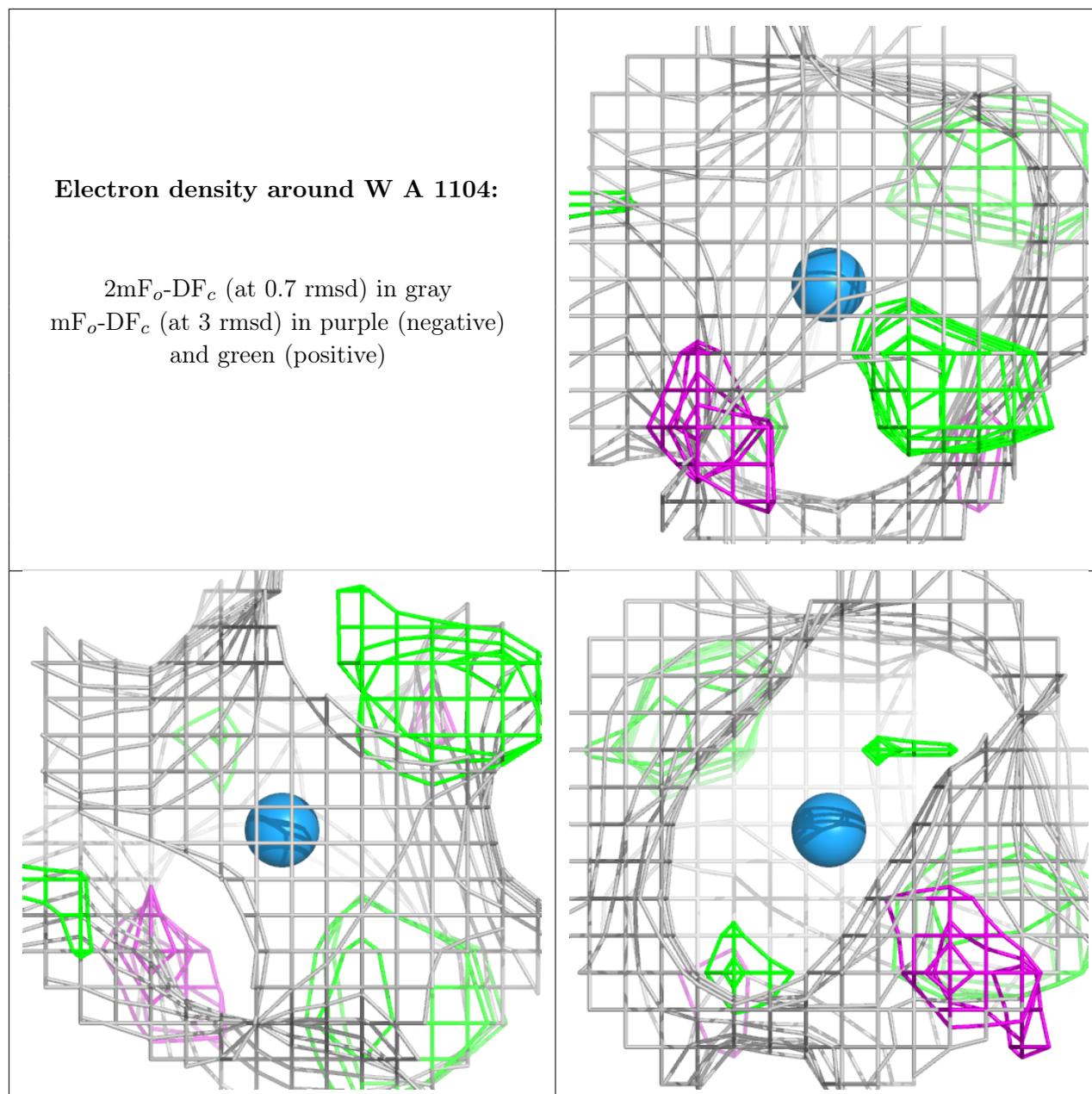
Electron density around SF4 B 301:

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

Electron density around SF4 A 1103:

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

Electron density around W A 1104:

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

6.5　Other polymers ⓘ

There are no such residues in this entry.