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Bis(benzoato-κ^2O,O')(2,9-dimethyl-1,10-phenanthroline-κ^2N,N')cobalt(II)

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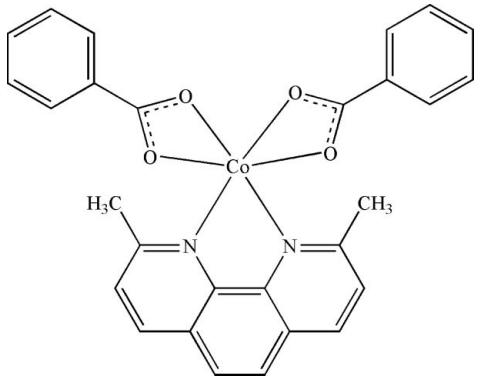
Key indicators: single-crystal X-ray study; T = 293 K; mean σ(C–C) = 0.004 Å; disorder in main residue; R factor = 0.041; wR factor = 0.111; data-to-parameter ratio = 12.5.

In the title compound, $[Co(C_7H_5O_2)_2(C_{14}H_{12}N_2)]$, the Co^{II} ion is located on a twofold rotation axis and is chelated by a 2,9-dimethyl-1,10-phenanthroline (dmphen) ligand and two benzoate anions in a distorted octahedral geometry. The crystal packing is stabilized by π–π interactions between parallel dmphen ligands of neighbouring molecules, with a face-to-face distance of 3.411 (2) Å.

Related literature

For background information on cobalt coordination chemistry, see: Wang *et al.* (1996); Wall *et al.* (1999); Naing *et al.* (1995). For related structures, see: Wu *et al.* (2003); Su *et al.* (2005); Ding *et al.* (2006); Ren *et al.* (2007); Zhong *et al.* (2006); Li *et al.* (2007).



Experimental

Crystal data

$[Co(C_7H_5O_2)_2(C_{14}H_{12}N_2)]$
M_r = 509.41
Monoclinic, $C2/c$
a = 17.632 (3) Å
b = 14.410 (2) Å
c = 9.5282 (15) Å
β = 90.796 (2)°
V = 2420.6 (7) Å^3
Z = 4
Mo $K\alpha$ radiation
μ = 0.75 mm^{-1}
T = 293 (2) K
0.30 × 0.22 × 0.22 mm

Data collection

Bruker SMART CCD area-detector diffractometer
Absorption correction: multi-scan (*SADABS*; Sheldrick, 2004)
T_{min} = 0.805, T_{max} = 0.856
8882 measured reflections
2253 independent reflections
1840 reflections with $I > 2\sigma(I)$
R_{int} = 0.026

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.041
$wR(F^2)$ = 0.111
S = 1.06
2253 reflections
180 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 0.48 e Å^{-3}
$\Delta\rho_{min}$ = −0.37 e Å^{-3}

Table 1
Selected bond lengths (Å).

Co1—N1	2.114 (2)	Co1—O2	2.154 (2)
Co1—O1	2.159 (2)		

Data collection: *SMART* (Bruker, 2004); cell refinement: *SAINT* (Bruker, 2004); data reduction: *SAINT*; program(s) used to solve structure: *SHELXTL* (Bruker, 2001); program(s) used to refine structure: *SHELXTL*; molecular graphics: *SHELXTL*; software used to prepare material for publication: *SHELXTL*.

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Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: XU2376).

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supporting information

Acta Cryst. (2008). E**64**, m327 [doi:10.1107/S1600536807068080]

Bis(benzoato-κ^2O,O')(2,9-dimethyl-1,10-phenanthroline-κ^2N,N')cobalt(II)

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S1. Comment

Metal-phenanthroline complexes and their detivatives have attracted much attention because of their peculiar features during recent decades (Wang *et al.*, 1996; Wall *et al.*, 1999; Naing *et al.*, 1995). A number of Co(II) complexes have been synthesized and structures determined (Wu *et al.*, 2003; Su *et al.*, 2005; Ding *et al.*, 2006; Ren *et al.*, 2007; Zhong *et al.*, 2006; Li *et al.*, 2007). The title complex, (I), was recently prepared and its crystal structure is reported here.

Each Co^{II} ion is located on a twofold rotation axis and six-coordinated by two N atoms from a dmphen ligand and four carbonyl O atoms from two benzoate ligands (Fig. 1) with a distorted octahedral geometry (Table 1).

In the crystal structure, molecules are linked into a one dimensional network by π-π interactions between the dmphen ring systems (Fig. 2). These intermolecular interaction occur between the parallel rings within offset face-to-face packing. The face-to-face distance of neighboring parallel rings is 3.411 (2) Å.

S2. Experimental

Sodium benzoate (0.1455 g, 1 mmol) and $Co(NO_3)_2{\cdot}6H_2O$ (0.1456 g, 0.5 mmol) were dissolved in distilled water (15 ml). This solution was added to a solution of 2,9-dimethyl-1,10-phenanthroline hemihydrate ($C_{14}H_{12}N_2{\cdot}0.5H_2O$, 0.1090 g, 0.5 mmol) in ethanol (10 ml). The mixture was refluxed for 4 h. After cooling to room temperature the mixture was filtered. Brown single crystals were obtained by slow evaporation at room temperature after 1 d.

S3. Refinement

The benzene ring of benzoate ligand is disordered over two positions, site occupancy factors were refined and converged to 0.452 (14) and 0.548 (14), respectively. H atoms were placed in calculated positions and refined in riding model approximation, with C—H = 0.93 Å and U_{iso}(H) = 1.2U_{eq}(C) for aromatic, and 0.96 Å, U_{iso}(H) = 1.5U_{eq}(C) for methyl.

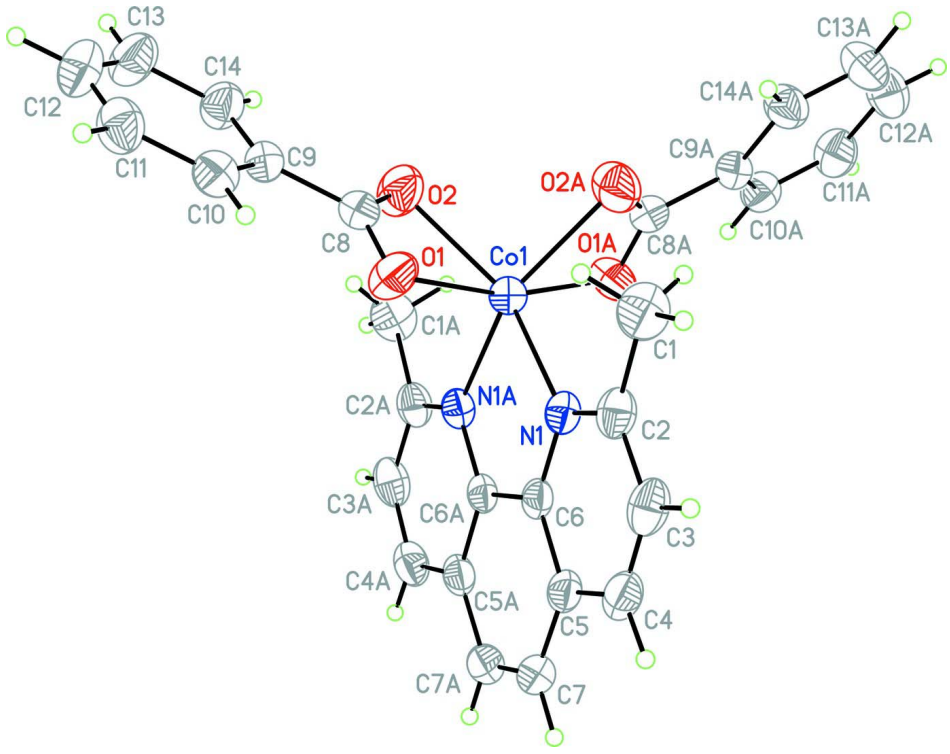

Figure 1

The molecular structure of the title complex with 30% probability displacement ellipsoids, one disordered component has been omitted for clarity. Symmetry code: (A) -*x* + 1, *y*, -*z* + 3/2.

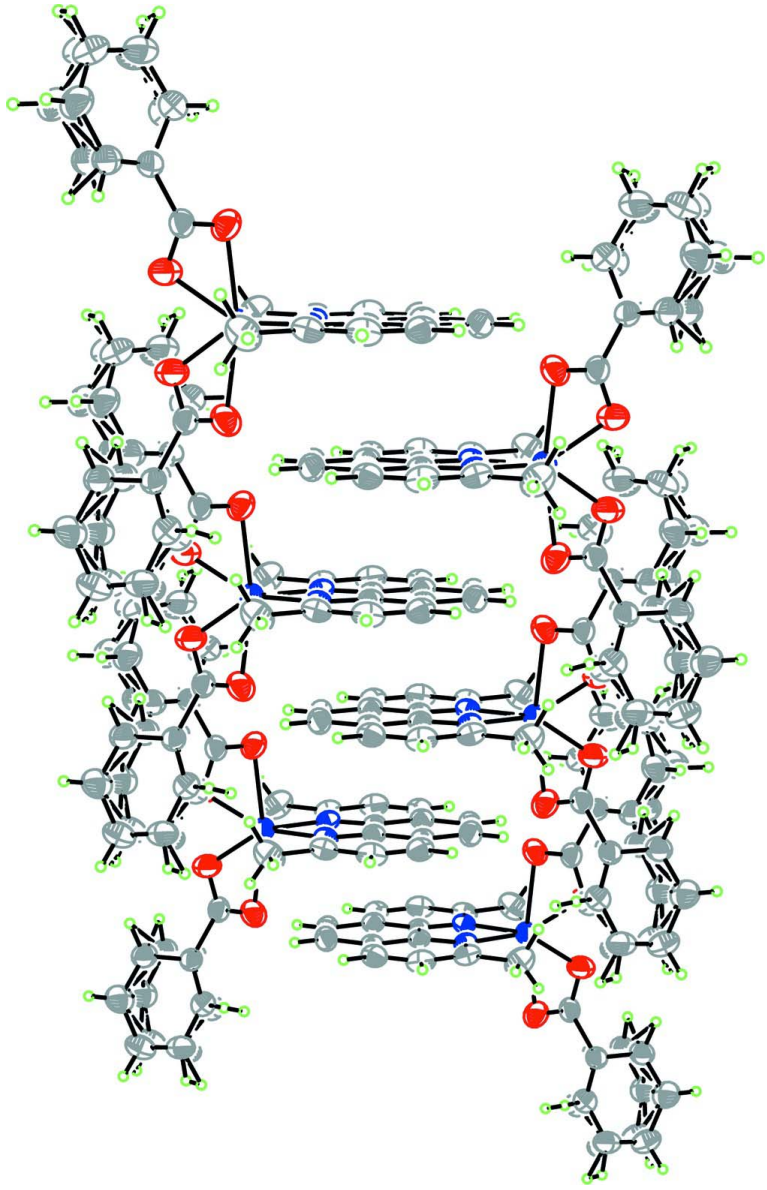

Figure 2

The π-π interaction between the dmphen rings of neighboring molecules in the crystal structure.

Bis(benzoato-κ^2O,O')(2,9-dimethyl-1,10-phenanthroline-κ^2N,N')cobalt(II)

Crystal data

$[Co(C_7H_5O_2)_2(C_{14}H_{12}N_2)]$
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Monoclinic, $C2/c$
Hall symbol: -C 2yc
$a = 17.632$ (3) Å
$b = 14.410$ (2) Å
$c = 9.5282$ (15) Å
$\beta = 90.796$ (2)°
$V = 2420.6$ (7) Å^3
$Z = 4$
$F(000) = 1052$
$D_x = 1.398$ Mg m^{-3}
Mo $K\alpha$ radiation, $\lambda = 0.71073$ Å
Cell parameters from 2433 reflections
$\theta = 2.3$–22.5°
$\mu = 0.75$ mm^{-1}
$T = 293$ K
Block, brown
0.30 × 0.22 × 0.22 mm

Data collection

Bruker SMART CCD area-detector diffractometer
Radiation source: fine-focus sealed tube
Graphite monochromator
φ and ω scans
Absorption correction: multi-scan (*SADABS*; Sheldrick, 2004)
T_{min} = 0.805, T_{max} = 0.856
8882 measured reflections
2253 independent reflections
1840 reflections with $I > 2\sigma(I)$
R_{int} = 0.026
θ_{max} = 25.5°, θ_{min} = 2.3°
h = −21→21
k = −17→17
l = −11→11

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)]$ = 0.041
$wR(F^2)$ = 0.111
S = 1.06
2253 reflections
180 parameters
0 restraints
Primary atom site location: structure-invariant direct methods
Secondary atom site location: difference Fourier map
Hydrogen site location: inferred from neighbouring sites
H-atom parameters constrained
$w = 1/[\sigma^2(F_o^2) + (0.0507P)^2 + 2.0726P]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max} < 0.001$
$\Delta\rho_{max}$ = 0.49 e Å^{-3}
$\Delta\rho_{min}$ = −0.37 e Å^{-3}

Special details

Geometry. All e.s.d.'s (except the e.s.d. in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell e.s.d.'s are taken into account individually in the estimation of e.s.d.'s in distances, angles and torsion angles; correlations between e.s.d.'s in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell e.s.d.'s is used for estimating e.s.d.'s involving l.s. planes.

Refinement. Refinement of F^2 against ALL reflections. The weighted R-factor wR and goodness of fit S are based on F^2, conventional R-factors R are based on F, with F set to zero for negative F^2. The threshold expression of $F^2 > \sigma(F^2)$ is used only for calculating R-factors(gt) *etc*. and is not relevant to the choice of reflections for refinement. R-factors based on F^2 are statistically about twice as large as those based on F, and R- factors based on ALL data will be even larger.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å²)

	x	*y*	*z*	U_{iso}*/U_{eq}	Occ. (<1)
Co1	0.5000	0.76395 (3)	0.7500	0.0542 (2)	
C1	0.63842 (19)	0.7820 (2)	0.9976 (4)	0.0839 (10)	
H1A	0.5975	0.7472	1.0373	0.126*	
H1B	0.6776	0.7906	1.0673	0.126*	
H1C	0.6585	0.7488	0.9191	0.126*	
C2	0.60968 (14)	0.8746 (2)	0.9496 (3)	0.0593 (7)	
C3	0.63991 (16)	0.9577 (2)	1.0038 (3)	0.0678 (8)	
H3	0.6782	0.9552	1.0719	0.081*	
C4	0.61443 (17)	1.0410 (2)	0.9589 (3)	0.0651 (8)	
H4	0.6345	1.0953	0.9966	0.078*	
C5	0.55731 (15)	1.04513 (18)	0.8547 (3)	0.0560 (6)	
C6	0.52910 (13)	0.96006 (17)	0.8040 (2)	0.0471 (6)	
C7	0.52756 (18)	1.1299 (2)	0.8001 (3)	0.0693 (8)	
H7	0.5463	1.1861	0.8338	0.083*	
C8	0.57021 (17)	0.68233 (18)	0.5604 (3)	0.0602 (7)	
C9	0.6070 (2)	0.6373 (2)	0.4415 (3)	0.054 (4)	0.452 (14)

C10	0.68276 (16)	0.6552 (3)	0.4177 (4)	0.066 (3)	0.452 (14)
H10	0.7095	0.6954	0.4766	0.079*	0.452 (14)
C11	0.71880 (15)	0.6135 (3)	0.3065 (4)	0.078 (6)	0.452 (14)
H11	0.7698	0.6255	0.2905	0.094*	0.452 (14)
C12	0.6791 (3)	0.5537 (4)	0.2190 (5)	0.096 (4)	0.452 (14)
H12	0.7034	0.5256	0.1441	0.115*	0.452 (14)
C13	0.6034 (3)	0.5358 (6)	0.2427 (7)	0.111 (4)	0.452 (14)
H13	0.5767	0.4956	0.1838	0.133*	0.452 (14)
C14	0.5674 (3)	0.5776 (6)	0.3540 (6)	0.084 (3)	0.452 (14)
H14	0.5164	0.5655	0.3700	0.100*	0.452 (14)
C9′	0.6177 (2)	0.63122 (19)	0.4495 (3)	0.056 (3)	0.548 (14)
C10′	0.68099 (17)	0.6701 (2)	0.3936 (5)	0.064 (3)	0.548 (14)
H10′	0.6970	0.7284	0.4236	0.077*	0.548 (14)
C11′	0.72124 (15)	0.6236 (2)	0.2934 (4)	0.083 (5)	0.548 (14)
H11′	0.7643	0.6505	0.2553	0.100*	0.548 (14)
C12′	0.6981 (3)	0.5377 (2)	0.2495 (5)	0.084 (3)	0.548 (14)
H12′	0.7257	0.5059	0.1823	0.101*	0.548 (14)
C13′	0.6347 (5)	0.4987 (3)	0.3043 (9)	0.090 (3)	0.548 (14)
H13′	0.6185	0.4407	0.2734	0.108*	0.548 (14)
C14′	0.5949 (4)	0.5449 (3)	0.4048 (7)	0.072 (2)	0.548 (14)
H14′	0.5521	0.5177	0.4431	0.087*	0.548 (14)
N1	0.55395 (11)	0.87653 (14)	0.8526 (2)	0.0496 (5)	
O1	0.60107 (14)	0.74637 (15)	0.6274 (3)	0.0847 (5)	
O2	0.50361 (13)	0.65984 (16)	0.5879 (2)	0.0847 (5)	

Atomic displacement parameters (Å²)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Co1	0.0625 (3)	0.0494 (3)	0.0509 (3)	0.000	0.0041 (2)	0.000
C1	0.076 (2)	0.098 (3)	0.077 (2)	0.0292 (18)	−0.0178 (17)	0.0002 (18)
C2	0.0486 (14)	0.0791 (19)	0.0502 (15)	0.0093 (13)	0.0026 (11)	−0.0044 (13)
C3	0.0521 (16)	0.098 (2)	0.0530 (16)	−0.0035 (15)	−0.0033 (12)	−0.0160 (15)
C4	0.0679 (18)	0.075 (2)	0.0522 (16)	−0.0159 (15)	0.0081 (13)	−0.0161 (14)
C5	0.0638 (16)	0.0613 (16)	0.0433 (13)	−0.0074 (12)	0.0138 (12)	−0.0070 (11)
C6	0.0506 (14)	0.0547 (14)	0.0363 (12)	0.0007 (11)	0.0101 (10)	−0.0017 (10)
C7	0.099 (2)	0.0540 (16)	0.0549 (17)	−0.0078 (14)	0.0167 (14)	−0.0058 (12)
C8	0.0749 (18)	0.0479 (15)	0.0579 (16)	−0.0033 (13)	0.0010 (14)	0.0031 (12)
C9	0.059 (5)	0.049 (7)	0.055 (7)	0.002 (5)	0.015 (5)	0.007 (5)
C10	0.066 (8)	0.075 (6)	0.056 (5)	−0.008 (5)	−0.008 (5)	−0.001 (4)
C11	0.051 (9)	0.105 (12)	0.079 (10)	0.001 (8)	0.001 (7)	0.006 (10)
C12	0.096 (7)	0.120 (9)	0.072 (6)	0.012 (6)	0.010 (5)	−0.035 (5)
C13	0.103 (7)	0.129 (9)	0.103 (7)	−0.024 (7)	0.017 (6)	−0.059 (7)
C14	0.074 (5)	0.089 (6)	0.088 (6)	−0.014 (5)	0.013 (5)	−0.034 (5)
C9′	0.062 (5)	0.058 (6)	0.047 (6)	−0.003 (4)	−0.004 (4)	−0.006 (4)
C10′	0.062 (6)	0.059 (4)	0.073 (4)	0.000 (4)	0.004 (4)	0.009 (4)
C11′	0.071 (9)	0.099 (9)	0.080 (9)	0.007 (7)	0.028 (7)	0.012 (8)
C12′	0.076 (4)	0.110 (6)	0.067 (4)	0.015 (5)	0.016 (4)	−0.010 (5)
C13′	0.097 (6)	0.086 (5)	0.086 (5)	−0.018 (4)	0.010 (4)	−0.039 (4)

C14′	0.068 (4)	0.073 (4)	0.077 (4)	−0.020 (3)	0.016 (4)	−0.014 (3)
N1	0.0488 (12)	0.0589 (13)	0.0412 (11)	0.0050 (9)	0.0029 (9)	−0.0033 (9)
O1	0.0876 (11)	0.0800 (11)	0.0870 (11)	−0.0088 (8)	0.0221 (9)	−0.0209 (8)
O2	0.0876 (11)	0.0800 (11)	0.0870 (11)	−0.0088 (8)	0.0221 (9)	−0.0209 (8)

Geometric parameters (Å, º)

Co1—N1	2.114 (2)	C8—C9	1.465 (4)
Co1—N1^{i}	2.114 (2)	C8—C9′	1.544 (4)
Co1—O1	2.159 (2)	C9—C10	1.3816 (16)
Co1—O1^{i}	2.159 (2)	C9—C14	1.3816 (16)
Co1—O2^{i}	2.154 (2)	C10—C11	1.3815 (16)
Co1—O2	2.154 (2)	C10—H10	0.9300
Co1—C8^{i}	2.498 (3)	C11—C12	1.3816 (16)
C1—C2	1.497 (4)	C11—H11	0.9300
C1—H1A	0.9600	C12—C13	1.3816 (16)
C1—H1B	0.9600	C12—H12	0.9300
C1—H1C	0.9600	C13—C14	1.3816 (16)
C2—N1	1.339 (3)	C13—H13	0.9300
C2—C3	1.406 (4)	C14—H14	0.9300
C3—C4	1.349 (4)	C9′—C10′	1.3643 (16)
C3—H3	0.9300	C9′—C14′	1.3726 (16)
C4—C5	1.406 (4)	C10′—C11′	1.3726 (16)
C4—H4	0.9300	C10′—H10′	0.9300
C5—C6	1.406 (3)	C11′—C12′	1.3660 (16)
C5—C7	1.425 (4)	C11′—H11′	0.9300
C6—N1	1.360 (3)	C12′—C13′	1.3619 (15)
C6—C6^{i}	1.444 (5)	C12′—H12′	0.9300
C7—C7^{i}	1.353 (6)	C13′—C14′	1.3685 (16)
C7—H7	0.9300	C13′—H13′	0.9300
C8—O1	1.243 (3)	C14′—H14′	0.9300
C8—O2	1.249 (3)		
N1—Co1—N1^{i}	79.73 (11)	O1—C8—C9	122.0 (3)
N1—Co1—O2^{i}	102.73 (9)	O2—C8—C9	118.4 (3)
N1^{i}—Co1—O2^{i}	148.05 (8)	O1—C8—C9′	117.9 (3)
N1—Co1—O2	148.05 (8)	O2—C8—C9′	122.7 (3)
N1^{i}—Co1—O2	102.73 (9)	C10—C9—C14	120.0
O2^{i}—Co1—O2	91.74 (13)	C10—C9—C8	118.9 (2)
N1—Co1—O1	88.33 (8)	C14—C9—C8	121.1 (2)
N1^{i}—Co1—O1	102.08 (9)	C11—C10—C9	120.0
O2^{i}—Co1—O1	109.81 (9)	C11—C10—H10	120.0
O2—Co1—O1	59.85 (8)	C9—C10—H10	120.0
N1—Co1—O1^{i}	102.08 (9)	C10—C11—C12	120.0
N1^{i}—Co1—O1^{i}	88.33 (8)	C10—C11—H11	120.0
O2^{i}—Co1—O1^{i}	59.85 (8)	C12—C11—H11	120.0
O2—Co1—O1^{i}	109.81 (9)	C11—C12—C13	120.0
O1—Co1—O1^{i}	166.53 (12)	C11—C12—H12	120.0

N1—Co1—C8^{i}	104.54 (8)	C13—C12—H12	120.0
N1^{i}—Co1—C8^{i}	118.14 (8)	C12—C13—C14	120.0
O2^{i}—Co1—C8^{i}	30.01 (8)	C12—C13—H13	120.0
O2—Co1—C8^{i}	102.14 (9)	C14—C13—H13	120.0
O1—Co1—C8^{i}	139.20 (10)	C9—C14—C13	120.0
O1^{i}—Co1—C8^{i}	29.84 (8)	C9—C14—H14	120.0
C2—C1—H1A	109.5	C13—C14—H14	120.0
C2—C1—H1B	109.5	C10′—C9′—C14′	119.2
H1A—C1—H1B	109.5	C10′—C9′—C8	121.72 (19)
C2—C1—H1C	109.5	C14′—C9′—C8	119.06 (19)
H1A—C1—H1C	109.5	C9′—C10′—C11′	120.3
H1B—C1—H1C	109.5	C9′—C10′—H10′	119.8
N1—C2—C3	120.4 (3)	C11′—C10′—H10′	119.8
N1—C2—C1	118.1 (3)	C12′—C11′—C10′	120.0
C3—C2—C1	121.4 (3)	C12′—C11′—H11′	120.0
C4—C3—C2	121.2 (3)	C10′—C11′—H11′	120.0
C4—C3—H3	119.4	C13′—C12′—C11′	120.0
C2—C3—H3	119.4	C13′—C12′—H12′	120.0
C3—C4—C5	119.6 (3)	C11′—C12′—H12′	120.0
C3—C4—H4	120.2	C12′—C13′—C14′	119.9
C5—C4—H4	120.2	C12′—C13′—H13′	120.0
C4—C5—C6	116.9 (3)	C14′—C13′—H13′	120.0
C4—C5—C7	123.4 (3)	C13′—C14′—C9′	120.5
C6—C5—C7	119.7 (2)	C13′—C14′—H14′	119.8
N1—C6—C5	123.0 (2)	C9′—C14′—H14′	119.8
N1—C6—C6^{i}	117.74 (13)	C2—N1—C6	118.9 (2)
C5—C6—C6^{i}	119.30 (15)	C2—N1—Co1	128.61 (18)
C7^{i}—C7—C5	120.99 (16)	C6—N1—Co1	112.39 (15)
C7^{i}—C7—H7	119.5	C8—O1—Co1	90.36 (19)
C5—C7—H7	119.5	C8—O2—Co1	90.41 (17)
O1—C8—O2	119.4 (3)		

N1—C2—C3—C4	−0.8 (4)	C3—C2—N1—C6	2.3 (4)
C1—C2—C3—C4	179.2 (3)	C1—C2—N1—C6	−177.6 (2)
C2—C3—C4—C5	−0.8 (4)	C3—C2—N1—Co1	178.41 (18)
C3—C4—C5—C6	0.8 (4)	C1—C2—N1—Co1	−1.5 (4)
C3—C4—C5—C7	−179.4 (3)	C5—C6—N1—C2	−2.4 (3)
C4—C5—C6—N1	0.9 (4)	C6^{i}—C6—N1—C2	177.8 (2)
C7—C5—C6—N1	−179.0 (2)	C5—C6—N1—Co1	−179.10 (18)
C4—C5—C6—C6^{i}	−179.4 (2)	C6^{i}—C6—N1—Co1	1.2 (3)
C7—C5—C6—C6^{i}	0.8 (4)	N1^{i}—Co1—N1—C2	−176.7 (3)
C4—C5—C7—C7^{i}	−179.9 (3)	O2^{i}—Co1—N1—C2	35.9 (2)
C6—C5—C7—C7^{i}	0.0 (5)	O2—Co1—N1—C2	−79.0 (3)
O1—C8—C9—C10	11.2 (5)	O1—Co1—N1—C2	−74.1 (2)
O2—C8—C9—C10	−174.2 (4)	O1^{i}—Co1—N1—C2	97.3 (2)
C9′—C8—C9—C10	−49.13 (12)	C8^{i}—Co1—N1—C2	66.7 (2)
O1—C8—C9—C14	−169.0 (5)	N1^{i}—Co1—N1—C6	−0.41 (11)
O2—C8—C9—C14	5.7 (5)	O2^{i}—Co1—N1—C6	−147.88 (16)

C9′—C8—C9—C14	130.70 (19)	O2—Co1—N1—C6	97.2 (2)
C14—C9—C10—C11	0.0	O1—Co1—N1—C6	102.19 (17)
C8—C9—C10—C11	179.8 (3)	O1^{i}—Co1—N1—C6	−86.45 (17)
C9—C10—C11—C12	0.0	C8^{i}—Co1—N1—C6	−117.03 (16)
C10—C11—C12—C13	0.0	O2—C8—O1—Co1	0.7 (3)
C11—C12—C13—C14	0.0	C9—C8—O1—Co1	175.3 (3)
C10—C9—C14—C13	0.0	C9′—C8—O1—Co1	−177.0 (2)
C8—C9—C14—C13	−179.8 (3)	N1—Co1—O1—C8	−177.35 (18)
C12—C13—C14—C9	0.0	N1^{i}—Co1—O1—C8	−98.22 (18)
O1—C8—C9′—C10′	−20.3 (5)	O2^{i}—Co1—O1—C8	79.71 (19)
O2—C8—C9′—C10′	162.1 (4)	O2—Co1—O1—C8	−0.39 (17)
C9—C8—C9′—C10′	103.27 (16)	O1^{i}—Co1—O1—C8	41.69 (17)
O1—C8—C9′—C14′	160.6 (4)	C8^{i}—Co1—O1—C8	72.1 (3)
O2—C8—C9′—C14′	−17.0 (5)	O1—C8—O2—Co1	−0.7 (3)
C9—C8—C9′—C14′	−75.85 (18)	C9—C8—O2—Co1	−175.5 (3)
C14′—C9′—C10′—C11′	0.3	C9′—C8—O2—Co1	176.9 (3)
C8—C9′—C10′—C11′	−178.9 (3)	N1—Co1—O2—C8	6.1 (3)
C9′—C10′—C11′—C12′	−0.3	N1^{i}—Co1—O2—C8	97.09 (18)
C10′—C11′—C12′—C13′	0.6	O2^{i}—Co1—O2—C8	−111.61 (19)
C11′—C12′—C13′—C14′	−1.0	O1—Co1—O2—C8	0.38 (17)
C12′—C13′—C14′—C9′	1.0	O1^{i}—Co1—O2—C8	−170.06 (17)
C10′—C9′—C14′—C13′	−0.6	C8^{i}—Co1—O2—C8	−140.01 (16)
C8—C9′—C14′—C13′	178.5 (3)		

Symmetry code: (i) $-x+1, y, -z+3/2$.