Acta Crystallographica Section E
**Structure Reports Online**
ISSN 1600-5368

# 12-Chloro-6-cyclohexyl-5,6,7,12-tetrahydrodibenzo[*c*,*f*][1,5]azastibocine

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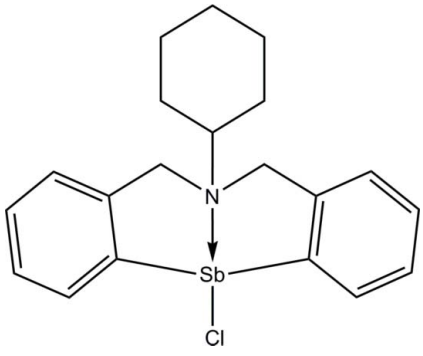
Received 25 May 2011; accepted 3 June 2011

Key indicators: single-crystal X-ray study; $T$ = 293 K; mean $\sigma$(C–C) = 0.006 Å; $R$ factor = 0.032; $wR$ factor = 0.092; data-to-parameter ratio = 17.4.

In the title organometallic complex, $[Sb(C_{20}H_{23}N)Cl]$, the central antimony-containing part of the complex exhibits a pseudo-trigonal-bipyramidal geometry, where two C atoms and a lone electron pair of the Sb atom exist at the equatorial positions, while the N and Cl atoms are located at the apical positions, and a transannular interaction exists between the Sb and N atoms on 1,5-azastibocine. Intermolecular C—H···Cl hydrogen bonds are also observed.

## Related literature

For general background, see: Yin *et al.* (2008); Chovancová *et al.* (2009); Opris *et al.* (2009); Svoboda *et al.* (2010); Tan & Zhang (2011). For related structures, see: Kakusawa *et al.* (2006); Xia *et al.* (2010).




## Experimental

### Crystal data

$[Sb(C_{20}H_{23}N)Cl]$
$M_r$ = 434.59
Monoclinic, $P2_1/c$
$a$ = 10.0771 (7) Å
$b$ = 16.2881 (12) Å
$c$ = 12.2040 (9) Å
$\beta$ = 111.812 (1)°
$V$ = 1859.7 (2) Å$^3$
$Z$ = 4
Mo $K\alpha$ radiation
$\mu$ = 1.63 mm$^{-1}$
$T$ = 293 K
0.37 × 0.35 × 0.21 mm

### Data collection

Bruker SMART CCD area-detector diffractometer
Absorption correction: multi-scan (*SADABS*; Sheldrick, 1999)
$T_{min}$ = 0.653, $T_{max}$ = 1.000
10058 measured reflections
3644 independent reflections
3107 reflections with $I > 2\sigma(I)$
$R_{int}$ = 0.047

### Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.032
$wR(F^2)$ = 0.092
$S$ = 1.05
3644 reflections
209 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 0.78 e Å$^{-3}$
$\Delta\rho_{min}$ = −0.55 e Å$^{-3}$

**Table 1**
Hydrogen-bond geometry (Å, °).

| $D$—H···$A$ | $D$—H | H···$A$ | $D$···$A$ | $D$—H···$A$ |
|---|---|---|---|---|
| C7—H7$A$···Cl1$^{i}$ | 0.97 | 2.80 | 3.695 (4) | 154 |

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

Data collection: *SMART* (Bruker, 1997); cell refinement: *SAINT* (Bruker, 1997); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *SHELXTL* (Sheldrick, 2008); software used to prepare material for publication: *SHELXL97*.

The authors thank the NSFC for financial support (grant No. 21003040).

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: VM2099).

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# supporting information

*Acta Cryst.* (2011). E**67**, m917 [doi:10.1107/S1600536811021477]

## 12-Chloro-6-cyclohexyl-5,6,7,12-tetrahydrodibenzo[*c*,*f*][1,5]azastibocine

**Weiguo Yi and Nianyuan Tan**

### S1. Comment

The chemistry of hypervalent compounds bearing heavier pnictogens (in particular Sb, Bi) has been studied intensively in recent years (Yin *et al.*, 2008; Chovancová *et al.*, 2009; Svoboda *et al.*, 2010; Tan & Zhang, 2011). Intramolecular interactions between antimony and $sp^3$-nitrogen atoms have been widely reported (Kakusawa *et al.*, 2006; Opris *et al.*, 2009; Xia *et al.*, 2010). Here, we reported the crystal structure of the title organometallic complex (Fig. 1). The central antimony-containing part of the complex shows a distorted pseudo trigonal-bipyramidal structure. The C1, C8 atoms along with a lone electron pair of the Sb atom exist at the equatorial positions while the N1 and Cl1 atoms are located at the apical positions. The Sb–C1 and Sb–C8 distance is 2.144 (4) Å and 2.134 (3) Å, respectively. The C1–Sb–C8 angle is 98.17 (12)°, while the N1–Sb–Cl1 angle is 162.92 (7)° (rather than 180°). The Sb–N1 distance (2.397 (3) Å) is shorter than the sum of the van der Waals radii of nitrogen and antimony atoms (3.74 Å) (Kakusawa *et al.*, 2006), indicating that coordination exists between the two atoms. The complex also displays intermolecular hydrogen-bonding interaction between the $CH_2$ groups and chlorine atom Cl1 (Table 1).

### S2. Experimental

*N*,*N*-bis(2-bromobenzyl)cyclohexanamine (2.186 g, 5.0 mmol) was allowed to react with n-BuLi (2.5 *M*, 4.0 ml, 10 mmol) at -50 $^o$C, and the resulting solution was added to a mixture of $SbCl_3$ (1.141 g, 5.0 mmol) in $Et_2O$ (80 ml) at -78 $^o$C. The obtained mixture was gradually warmed to room temperature and stirred for 12 h. Then the solvent was removed under vacuum and the residue was extracted with toluene, and the insoluble material was removed by filtration. The organic layer was washed with de-ionized $H_2O$ and dried over anhydrous $Na_2SO_4$. After the solvent was removed under reduced pressure, the residue was recrystallized from $CH_2Cl_2$/hexane to obtain the title compound in the form of colorless crystals.

### S3. Refinement

All H atoms were positioned geometrically and refined using a riding model, with C—H = 0.93 Å for aryl, 0.98 Å for methine and 0.97 Å for methylene H atoms, respectively. $U_{iso}$(H)= 1.2$U_{eq}$(C) for all H atoms.

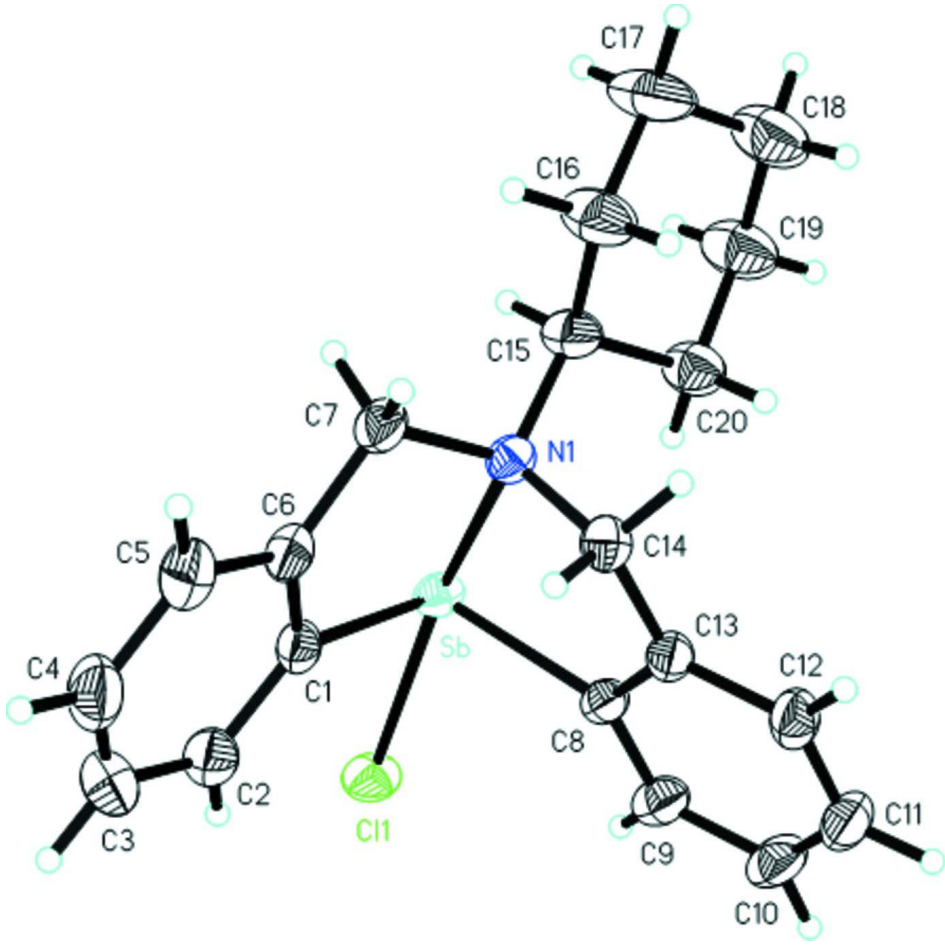


**Figure 1**

The molecular structure of the title compound with atomic numbering scheme. Displacement ellipsoids are drawn at the 30% probability level.

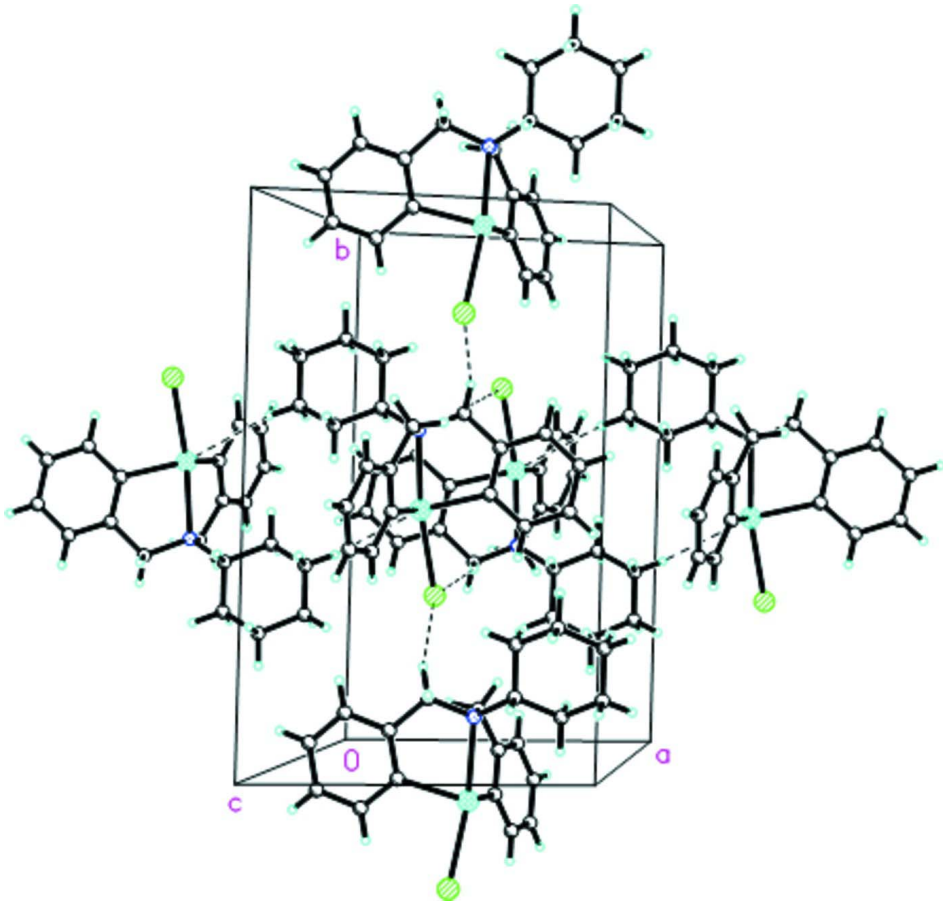


**Figure 2**

A packing diagram of the title compound viewed down the *a* axis.

**12-Chloro-6-cyclohexyl-5,6,7,12- tetrahydrodibenzo[c,f][1,5]azastibocine**

*Crystal data*

[Sb($C_{20}H_{23}N$)Cl]
$M_r$ = 434.59
Monoclinic, $P2_1/c$
Hall symbol: -P 2ybc
$a$ = 10.0771 (7) Å
$b$ = 16.2881 (12) Å
$c$ = 12.2040 (9) Å
$\beta$ = 111.812 (1)°
$V$ = 1859.7 (2) Å$^3$
$Z$ = 4

$F(000)$ = 872
$D_x$ = 1.552 Mg m$^{-3}$
Melting point: 527.15 K
Mo $K\alpha$ radiation, $\lambda$ = 0.71073 Å
Cell parameters from 5285 reflections
$\theta$ = 4.4–55.7°
$\mu$ = 1.63 mm$^{-1}$
$T$ = 293 K
Prismatic, colorless
0.37 × 0.35 × 0.21 mm

*Data collection*

Bruker SMART CCD area-detector diffractometer
Radiation source: fine-focus sealed tube
Graphite monochromator
Detector resolution: 10.00 pixels mm$^{-1}$
$\varphi$ and $\omega$ scans

Absorption correction: multi-scan (*SADABS*; Sheldrick, 1999)
$T_{min}$ = 0.653, $T_{max}$ = 1.000
10058 measured reflections
3644 independent reflections
3107 reflections with $I > 2\sigma(I)$
$R_{int}$ = 0.047

$\theta_{max}$ = 26.0°, $\theta_{min}$ = 2.2°
$h$ = −12→7
$k$ = −20→19
$l$ = −15→14

*Refinement*

Refinement on $F^2$
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)]$ = 0.032
$wR(F^2)$ = 0.092
$S$ = 1.05
3644 reflections
209 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
$w = 1/[\sigma^2(F_o^2) + (0.0544P)^2 + 0.1065P]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.020
$\Delta\rho_{max}$ = 0.78 e Å$^{-3}$
$\Delta\rho_{min}$ = −0.55 e Å$^{-3}$
Extinction correction: *SHELXL97* (Sheldrick, 2008), $Fc^*=kFc[1+0.001xFc^2\lambda^3/\sin(2\theta)]^{-1/4}$
Extinction coefficient: 0.0030 (4)

*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 (Å$^2$)*

| | $x$ | $y$ | $z$ | $U_{iso}$*/$U_{eq}$ |
|---|---|---|---|---|
| Sb | 0.38578 (2) | 1.037779 (13) | 0.117005 (18) | 0.04278 (12) |
| Cl1 | 0.43763 (12) | 1.19188 (5) | 0.12783 (8) | 0.0597 (3) |
| N1 | 0.3869 (3) | 0.89526 (15) | 0.1662 (2) | 0.0400 (6) |
| C1 | 0.6082 (4) | 1.0063 (2) | 0.1912 (3) | 0.0459 (8) |
| C2 | 0.7215 (5) | 1.0616 (3) | 0.2281 (4) | 0.0615 (10) |
| H2 | 0.7033 | 1.1177 | 0.2246 | 0.074* |
| C3 | 0.8613 (5) | 1.0335 (3) | 0.2700 (5) | 0.0772 (14) |
| H3 | 0.9367 | 1.0707 | 0.2947 | 0.093* |
| C4 | 0.8882 (5) | 0.9511 (3) | 0.2750 (5) | 0.0734 (13) |
| H4 | 0.9822 | 0.9324 | 0.3034 | 0.088* |
| C5 | 0.7772 (4) | 0.8953 (3) | 0.2383 (4) | 0.0647 (11) |
| H5 | 0.7968 | 0.8393 | 0.2424 | 0.078* |
| C6 | 0.6365 (4) | 0.9224 (2) | 0.1953 (3) | 0.0475 (8) |
| C7 | 0.5159 (4) | 0.8623 (2) | 0.1497 (3) | 0.0505 (9) |
| H7A | 0.4943 | 0.8521 | 0.0666 | 0.061* |
| H7B | 0.5436 | 0.8107 | 0.1917 | 0.061* |
| C8 | 0.3459 (3) | 1.04120 (18) | 0.2769 (3) | 0.0405 (7) |
| C9 | 0.3038 (4) | 1.1103 (2) | 0.3214 (3) | 0.0544 (9) |
| H9 | 0.2980 | 1.1605 | 0.2836 | 0.065* |
| C10 | 0.2703 (4) | 1.1057 (3) | 0.4213 (4) | 0.0662 (11) |
| H10 | 0.2449 | 1.1530 | 0.4515 | 0.079* |

| | | | | |
|---|---|---|---|---|
| C11 | 0.2746 (4) | 1.0317 (3) | 0.4757 (4) | 0.0641 (11) |
| H11 | 0.2484 | 1.0286 | 0.5410 | 0.077* |
| C12 | 0.3175 (4) | 0.9621 (2) | 0.4344 (3) | 0.0530 (10) |
| H12 | 0.3233 | 0.9124 | 0.4733 | 0.064* |
| C13 | 0.3522 (3) | 0.96613 (19) | 0.3339 (3) | 0.0413 (7) |
| C14 | 0.4045 (4) | 0.89040 (19) | 0.2921 (3) | 0.0445 (7) |
| H14A | 0.5048 | 0.8823 | 0.3398 | 0.053* |
| H14B | 0.3523 | 0.8431 | 0.3033 | 0.053* |
| C15 | 0.2520 (4) | 0.8556 (2) | 0.0804 (3) | 0.0546 (9) |
| H15 | 0.2451 | 0.8713 | 0.0009 | 0.066* |
| C16 | 0.2535 (5) | 0.7640 (2) | 0.0841 (5) | 0.0772 (13) |
| H16A | 0.2598 | 0.7455 | 0.1615 | 0.093* |
| H16B | 0.3362 | 0.7435 | 0.0702 | 0.093* |
| C17 | 0.1141 (5) | 0.7300 (3) | −0.0122 (5) | 0.1008 (18) |
| H17A | 0.1129 | 0.7441 | −0.0898 | 0.121* |
| H17B | 0.1127 | 0.6706 | −0.0065 | 0.121* |
| C18 | −0.0157 (5) | 0.7648 (3) | 0.0023 (5) | 0.0968 (17) |
| H18A | −0.1006 | 0.7448 | −0.0607 | 0.116* |
| H18B | −0.0193 | 0.7461 | 0.0767 | 0.116* |
| C19 | −0.0150 (5) | 0.8545 (3) | 0.0004 (5) | 0.0885 (15) |
| H19A | −0.0989 | 0.8749 | 0.0125 | 0.106* |
| H19B | −0.0197 | 0.8731 | −0.0765 | 0.106* |
| C20 | 0.1202 (4) | 0.8898 (2) | 0.0964 (4) | 0.0636 (10) |
| H20A | 0.1197 | 0.9492 | 0.0907 | 0.076* |
| H20B | 0.1217 | 0.8751 | 0.1739 | 0.076* |

*Atomic displacement parameters (Å²)*

| | $U^{11}$ | $U^{22}$ | $U^{33}$ | $U^{12}$ | $U^{13}$ | $U^{23}$ |
|---|---|---|---|---|---|---|
| Sb | 0.05674 (19) | 0.03541 (16) | 0.03702 (16) | 0.00115 (9) | 0.01840 (11) | −0.00007 (8) |
| Cl1 | 0.0872 (7) | 0.0321 (4) | 0.0647 (6) | −0.0061 (4) | 0.0338 (5) | −0.0033 (4) |
| N1 | 0.0432 (15) | 0.0373 (14) | 0.0405 (14) | 0.0032 (11) | 0.0168 (11) | −0.0007 (11) |
| C1 | 0.051 (2) | 0.0490 (19) | 0.0467 (19) | −0.0022 (16) | 0.0285 (16) | −0.0007 (15) |
| C2 | 0.067 (3) | 0.059 (2) | 0.067 (3) | −0.007 (2) | 0.035 (2) | −0.007 (2) |
| C3 | 0.057 (3) | 0.096 (4) | 0.084 (3) | −0.022 (2) | 0.032 (2) | −0.017 (3) |
| C4 | 0.051 (2) | 0.095 (4) | 0.081 (3) | 0.005 (2) | 0.034 (2) | −0.002 (3) |
| C5 | 0.058 (2) | 0.075 (3) | 0.069 (3) | 0.009 (2) | 0.033 (2) | 0.001 (2) |
| C6 | 0.053 (2) | 0.050 (2) | 0.048 (2) | 0.0037 (16) | 0.0287 (16) | 0.0017 (15) |
| C7 | 0.061 (2) | 0.0412 (18) | 0.059 (2) | 0.0029 (16) | 0.0332 (18) | −0.0030 (16) |
| C8 | 0.0390 (17) | 0.0445 (18) | 0.0372 (17) | 0.0020 (13) | 0.0134 (13) | −0.0059 (13) |
| C9 | 0.053 (2) | 0.058 (2) | 0.050 (2) | 0.0065 (17) | 0.0155 (16) | −0.0105 (16) |
| C10 | 0.056 (2) | 0.084 (3) | 0.061 (3) | 0.010 (2) | 0.0237 (19) | −0.026 (2) |
| C11 | 0.056 (2) | 0.094 (3) | 0.049 (2) | −0.003 (2) | 0.0279 (19) | −0.015 (2) |
| C12 | 0.044 (2) | 0.076 (3) | 0.040 (2) | −0.0035 (16) | 0.0162 (16) | 0.0037 (16) |
| C13 | 0.0347 (17) | 0.052 (2) | 0.0355 (17) | −0.0007 (13) | 0.0118 (13) | −0.0021 (13) |
| C14 | 0.0472 (18) | 0.0436 (18) | 0.0433 (18) | 0.0026 (14) | 0.0177 (14) | 0.0068 (14) |
| C15 | 0.057 (2) | 0.0428 (19) | 0.059 (2) | −0.0008 (16) | 0.0163 (18) | −0.0080 (16) |
| C16 | 0.069 (3) | 0.048 (2) | 0.105 (4) | −0.0050 (19) | 0.020 (2) | −0.012 (2) |

| | | | | | | |
|---|---|---|---|---|---|---|
| C17 | 0.085 (4) | 0.065 (3) | 0.131 (5) | −0.017 (3) | 0.016 (3) | −0.041 (3) |
| C18 | 0.066 (3) | 0.080 (3) | 0.128 (5) | −0.020 (3) | 0.018 (3) | −0.021 (3) |
| C19 | 0.062 (3) | 0.076 (3) | 0.106 (4) | −0.004 (2) | 0.007 (3) | −0.016 (3) |
| C20 | 0.051 (2) | 0.057 (2) | 0.075 (3) | −0.0014 (18) | 0.0144 (19) | −0.0096 (19) |

*Geometric parameters (Å, º)*

| | | | |
|---|---|---|---|
| Sb—C8 | 2.134 (3) | C10—H10 | 0.9300 |
| Sb—C1 | 2.144 (4) | C11—C12 | 1.374 (5) |
| Sb—N1 | 2.397 (3) | C11—H11 | 0.9300 |
| Sb—Cl1 | 2.5573 (9) | C12—C13 | 1.396 (5) |
| N1—C14 | 1.481 (4) | C12—H12 | 0.9300 |
| N1—C7 | 1.487 (4) | C13—C14 | 1.503 (4) |
| N1—C15 | 1.518 (4) | C14—H14A | 0.9700 |
| C1—C2 | 1.391 (5) | C14—H14B | 0.9700 |
| C1—C6 | 1.393 (5) | C15—C16 | 1.493 (5) |
| C2—C3 | 1.385 (6) | C15—C20 | 1.518 (5) |
| C2—H2 | 0.9300 | C15—H15 | 0.9800 |
| C3—C4 | 1.367 (6) | C16—C17 | 1.560 (6) |
| C3—H3 | 0.9300 | C16—H16A | 0.9700 |
| C4—C5 | 1.381 (6) | C16—H16B | 0.9700 |
| C4—H4 | 0.9300 | C17—C18 | 1.495 (7) |
| C5—C6 | 1.389 (5) | C17—H17A | 0.9700 |
| C5—H5 | 0.9300 | C17—H17B | 0.9700 |
| C6—C7 | 1.497 (5) | C18—C19 | 1.462 (6) |
| C7—H7A | 0.9700 | C18—H18A | 0.9700 |
| C7—H7B | 0.9700 | C18—H18B | 0.9700 |
| C8—C9 | 1.383 (4) | C19—C20 | 1.541 (6) |
| C8—C13 | 1.397 (4) | C19—H19A | 0.9700 |
| C9—C10 | 1.382 (6) | C19—H19B | 0.9700 |
| C9—H9 | 0.9300 | C20—H20A | 0.9700 |
| C10—C11 | 1.369 (6) | C20—H20B | 0.9700 |
| | | | |
| C8—Sb—C1 | 98.17 (12) | C11—C12—C13 | 119.9 (4) |
| C8—Sb—N1 | 77.37 (10) | C11—C12—H12 | 120.0 |
| C1—Sb—N1 | 75.86 (11) | C13—C12—H12 | 120.0 |
| C8—Sb—Cl1 | 91.80 (8) | C8—C13—C12 | 119.9 (3) |
| C1—Sb—Cl1 | 92.95 (10) | C8—C13—C14 | 120.4 (3) |
| N1—Sb—Cl1 | 162.92 (7) | C12—C13—C14 | 119.6 (3) |
| C14—N1—C7 | 110.3 (3) | N1—C14—C13 | 112.7 (3) |
| C14—N1—C15 | 115.1 (3) | N1—C14—H14A | 109.0 |
| C7—N1—C15 | 110.9 (3) | C13—C14—H14A | 109.0 |
| C14—N1—Sb | 107.40 (18) | N1—C14—H14B | 109.0 |
| C7—N1—Sb | 103.79 (19) | C13—C14—H14B | 109.0 |
| C15—N1—Sb | 108.64 (19) | H14A—C14—H14B | 107.8 |
| C2—C1—C6 | 119.4 (4) | C16—C15—C20 | 111.2 (3) |
| C2—C1—Sb | 125.8 (3) | C16—C15—N1 | 114.1 (3) |
| C6—C1—Sb | 114.7 (2) | C20—C15—N1 | 110.9 (3) |

| | | | |
|---|---|---|---|
| C3—C2—C1 | 120.4 (4) | C16—C15—H15 | 106.7 |
| C3—C2—H2 | 119.8 | C20—C15—H15 | 106.7 |
| C1—C2—H2 | 119.8 | N1—C15—H15 | 106.7 |
| C4—C3—C2 | 119.9 (4) | C15—C16—C17 | 109.6 (4) |
| C4—C3—H3 | 120.0 | C15—C16—H16A | 109.7 |
| C2—C3—H3 | 120.0 | C17—C16—H16A | 109.7 |
| C3—C4—C5 | 120.6 (4) | C15—C16—H16B | 109.7 |
| C3—C4—H4 | 119.7 | C17—C16—H16B | 109.7 |
| C5—C4—H4 | 119.7 | H16A—C16—H16B | 108.2 |
| C4—C5—C6 | 120.2 (4) | C18—C17—C16 | 111.0 (4) |
| C4—C5—H5 | 119.9 | C18—C17—H17A | 109.4 |
| C6—C5—H5 | 119.9 | C16—C17—H17A | 109.4 |
| C5—C6—C1 | 119.5 (3) | C18—C17—H17B | 109.4 |
| C5—C6—C7 | 120.4 (3) | C16—C17—H17B | 109.4 |
| C1—C6—C7 | 120.0 (3) | H17A—C17—H17B | 108.0 |
| N1—C7—C6 | 110.1 (3) | C19—C18—C17 | 111.5 (4) |
| N1—C7—H7A | 109.6 | C19—C18—H18A | 109.3 |
| C6—C7—H7A | 109.6 | C17—C18—H18A | 109.3 |
| N1—C7—H7B | 109.6 | C19—C18—H18B | 109.3 |
| C6—C7—H7B | 109.6 | C17—C18—H18B | 109.3 |
| H7A—C7—H7B | 108.2 | H18A—C18—H18B | 108.0 |
| C9—C8—C13 | 118.7 (3) | C18—C19—C20 | 111.6 (4) |
| C9—C8—Sb | 124.7 (3) | C18—C19—H19A | 109.3 |
| C13—C8—Sb | 116.3 (2) | C20—C19—H19A | 109.3 |
| C10—C9—C8 | 120.9 (4) | C18—C19—H19B | 109.3 |
| C10—C9—H9 | 119.5 | C20—C19—H19B | 109.3 |
| C8—C9—H9 | 119.5 | H19A—C19—H19B | 108.0 |
| C11—C10—C9 | 120.0 (4) | C15—C20—C19 | 109.5 (4) |
| C11—C10—H10 | 120.0 | C15—C20—H20A | 109.8 |
| C9—C10—H10 | 120.0 | C19—C20—H20A | 109.8 |
| C10—C11—C12 | 120.4 (4) | C15—C20—H20B | 109.8 |
| C10—C11—H11 | 119.8 | C19—C20—H20B | 109.8 |
| C12—C11—H11 | 119.8 | H20A—C20—H20B | 108.2 |

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| C8—Sb—N1—C14 | −17.0 (2) | C1—Sb—C8—C13 | −68.2 (3) |
| C1—Sb—N1—C14 | 84.9 (2) | N1—Sb—C8—C13 | 5.3 (2) |
| Cl1—Sb—N1—C14 | 34.7 (4) | Cl1—Sb—C8—C13 | −161.4 (2) |
| C8—Sb—N1—C7 | −133.8 (2) | C13—C8—C9—C10 | 0.8 (5) |
| C1—Sb—N1—C7 | −31.9 (2) | Sb—C8—C9—C10 | 175.3 (3) |
| Cl1—Sb—N1—C7 | −82.1 (3) | C8—C9—C10—C11 | −1.9 (6) |
| C8—Sb—N1—C15 | 108.1 (2) | C9—C10—C11—C12 | 2.6 (6) |
| C1—Sb—N1—C15 | −150.0 (2) | C10—C11—C12—C13 | −2.2 (6) |
| Cl1—Sb—N1—C15 | 159.8 (2) | C9—C8—C13—C12 | −0.5 (5) |
| C8—Sb—C1—C2 | −91.1 (3) | Sb—C8—C13—C12 | −175.4 (3) |
| N1—Sb—C1—C2 | −165.8 (3) | C9—C8—C13—C14 | −176.9 (3) |
| Cl1—Sb—C1—C2 | 1.2 (3) | Sb—C8—C13—C14 | 8.2 (4) |
| C8—Sb—C1—C6 | 92.5 (2) | C11—C12—C13—C8 | 1.2 (5) |
| N1—Sb—C1—C6 | 17.8 (2) | C11—C12—C13—C14 | 177.6 (3) |

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| Cl1—Sb—C1—C6 | −175.2 (2) | C7—N1—C14—C13 | 137.9 (3) |
| C6—C1—C2—C3 | −0.9 (6) | C15—N1—C14—C13 | −95.7 (3) |
| Sb—C1—C2—C3 | −177.2 (3) | Sb—N1—C14—C13 | 25.4 (3) |
| C1—C2—C3—C4 | 0.1 (7) | C8—C13—C14—N1 | −24.4 (4) |
| C2—C3—C4—C5 | 0.2 (8) | C12—C13—C14—N1 | 159.2 (3) |
| C3—C4—C5—C6 | 0.3 (7) | C14—N1—C15—C16 | −72.1 (4) |
| C4—C5—C6—C1 | −1.0 (6) | C7—N1—C15—C16 | 54.0 (4) |
| C4—C5—C6—C7 | 176.9 (4) | Sb—N1—C15—C16 | 167.5 (3) |
| C2—C1—C6—C5 | 1.3 (5) | C14—N1—C15—C20 | 54.4 (4) |
| Sb—C1—C6—C5 | 178.0 (3) | C7—N1—C15—C20 | −179.5 (3) |
| C2—C1—C6—C7 | −176.6 (3) | Sb—N1—C15—C20 | −66.0 (3) |
| Sb—C1—C6—C7 | 0.0 (4) | C20—C15—C16—C17 | 56.9 (5) |
| C14—N1—C7—C6 | −74.4 (3) | N1—C15—C16—C17 | −176.8 (4) |
| C15—N1—C7—C6 | 156.9 (3) | C15—C16—C17—C18 | −55.8 (6) |
| Sb—N1—C7—C6 | 40.4 (3) | C16—C17—C18—C19 | 56.2 (7) |
| C5—C6—C7—N1 | 151.3 (3) | C17—C18—C19—C20 | −57.1 (7) |
| C1—C6—C7—N1 | −30.7 (4) | C16—C15—C20—C19 | −57.3 (5) |
| C1—Sb—C8—C9 | 117.3 (3) | N1—C15—C20—C19 | 174.6 (3) |
| N1—Sb—C8—C9 | −169.3 (3) | C18—C19—C20—C15 | 57.0 (6) |
| Cl1—Sb—C8—C9 | 24.0 (3) | | |

*Hydrogen-bond geometry (Å, º)*

| *D*—H···*A* | *D*—H | H···*A* | *D*···*A* | *D*—H···*A* |
|---|---|---|---|---|
| C7—H7*A*···Cl1$^{i}$ | 0.97 | 2.80 | 3.695 (4) | 154 |

Symmetry code: (i) −*x*+1, −*y*+2, −*z*.