$V_{1.42}In_{1.83}Mo_{15}Se_{19}$

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The structure of the title compound, vanadium indium pentadecamolybdenum nonadecaselenide, $V_{1.42}In_{1.83}Mo_{15}$-Se_{19}, is isotypic with $In_{2.9}Mo_{15}Se_{19}$ [Grüttner *et al.* (1979). *Acta Cryst.* B**35**, 285–292]. It is characterized by two cluster units $Mo_6Se_8^iSe_6^a$ and $Mo_9Se_{11}^iSe_6^a$ (where i represents inner and a apical atoms) that are present in a 1:1 ratio. The cluster units are centered at Wyckoff positions 2*b* and 2*c* and have point-group symmetry $\bar{3}$ and $\bar{6}$, respectively. The clusters are interconnected through additional Mo—Se bonds. In the title compound, the V^{3+} cations replace the trivalent indium atoms present in $In_{2.9}Mo_{15}Se_{19}$, and a deficiency is observed on the monovalent indium site. One Mo, one Se and the V atom are situated on mirror planes, and two other Se atoms and the In atom are situated on threefold rotation axes.

Related literature

For previous reports on the crystal structure of $In_{\sim 3}Mo_{15}Se_{19}$ compounds, see: Grüttner *et al.* (1979). For physical properties of this type of compound, see: Seeber *et al.* (1979). The crystal structures of the substituted compounds $Ho_{0.76}In_{1.68}Mo_{15}Se_{19}$ and $In_{0.87}K_2Mo_{15}Se_{19}$ were reported by Salloum *et al.* (2006; 2007). For details of the *i*- and *a*-type ligand notation, see: Schäfer & von Schnering (1964).

Experimental

Crystal data

$V_{1.42}In_{1.83}Mo_{15}Se_{19}$	$Z = 2$
$M_r = 3221.80$	Mo $K\alpha$ radiation
Hexagonal, $P6_3/m$	$\mu = 29.21$ mm^{-1}
$a = 9.7361$ (1) Å	$T = 293$ K
$c = 19.3090$ (4) Å	$0.09 \times 0.07 \times 0.05$ mm
$V = 1585.11$ (4) Å^3	

Data collection

Nonius KappaCCD diffractometer	27560 measured reflections
Absorption correction: analytical	2390 independent reflections
(de Meulenaar & Tompa, 1965)	1634 reflections with $I > 2\sigma(I)$
$T_{min} = 0.161$, $T_{max} = 0.329$	$R_{int} = 0.093$

Refinement

$R[F^2 > 2\sigma(F^2)] = 0.037$	67 parameters
$wR(F^2) = 0.087$	$\Delta\rho_{max} = 3.22$ e Å^{-3}
$S = 1.08$	$\Delta\rho_{min} = -2.57$ e Å^{-3}
2390 reflections	

Table 1
Selected bond lengths (Å).

Mo2—Se5	2.5259 (8)	Mo3—Se2	2.5631 (6)
Mo2—Se2	2.5974 (6)	Mo3—Se2^{vii}	2.5631 (6)
Mo2—Se2^i	2.6290 (6)	Mo3—Se3	2.5965 (9)
Mo2—Mo2^i	2.6474 (7)	Mo3—Se3^i	2.6095 (9)
Mo2—Se1^{ii}	2.6504 (6)	Mo3—Mo3^{viii}	2.7056 (10)
Mo2—Se3^i	2.6966 (6)	Mo3—Mo2^{ix}	2.7136 (5)
Mo2—Mo3^i	2.7136 (5)	In1—Se5	3.0759 (15)
Mo2—Mo3	2.7557 (5)	In1—Se2^x	3.1221 (5)
Mo1—Se1^{iii}	2.5467 (7)	In1—Se1^x	3.4904 (7)
Mo1—Se4	2.5481 (8)	V1—Se4	2.510 (2)
Mo1—Se1	2.5717 (6)	V1—Se3^{iv}	2.730 (3)
Mo1—Se1^{iv}	2.6111 (6)	V1—Se2^v	2.7981 (18)
Mo1—Se2	2.6378 (7)	V1—Se3^v	2.831 (3)
Mo1—Mo1^v	2.6992 (7)	V1—Mo3^v	2.865 (3)
Mo1—Mo1^{vi}	2.7223 (8)		

Symmetry codes: (i) $-y+1, x-y, z$; (ii) $-x+y+1, -x, z$; (iii) $x-y, x, -z+1$; (iv) $-y, x-y, z$; (v) $-x+y, -x, z$; (vi) $y, -x+y, -z+1$; (vii) $x, y, -z+\frac{3}{2}$; (viii) $-x+y+1, -x+1, z$; (ix) $-x+y+1, -x+1, -z+\frac{3}{2}$; (x) $-x+1, -y, -z+1$.

Data collection: *COLLECT* (Nonius, 1998); cell refinement: *COLLECT*; data reduction: *EVALCCD* (Duisenberg *et al.*, 2003); program(s) used to solve structure: *SIR97* (Altomare *et al.*, 1999); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *DIAMOND* (Bergerhoff, 1996); software used to prepare material for publication: *SHELXL97*.

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supporting information

V$_{1.42}$In$_{1.83}$Mo$_{15}$Se$_{19}$

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S1. Comment

From the point of view of crystal chemistry and physical properties, the reduced molybdenum selenides In$_{\sim3}$Mo$_{15}$Se$_{19}$ (Grüttner *et al.*, 1979) constitute an interesting family of compounds. Indeed, their crystal structure contains an equal mixture of Mo$_6$ and Mo$_9$ cluster units and the In atoms occupy two crystallographically different positions depending on their formal oxidation state of +1 or +3. Recently, we have shown that the In^{3+} cation can be replaced by other trivalent cations such as Ho^{3+} (Salloum *et al.*, 2006) and the In$^+$ cation by K$^+$ (Salloum *et al.*, 2007). Interest in these Mo cluster compounds also lies in their physical properties, because they become superconductors with high critical magnetic fields at about 4 K (Seeber *et al.*, 1979). We present here the crystal structure of V$_{1.42}$In$_{1.83}$Mo$_{15}$Se$_{19}$ in which a 3*d* element replaces the trivalent indium atom.

The Mo—Se framework of the title compound consists of the cluster units Mo$_6$Se$^i_8$Se$^a_6$ and Mo$_9$Se$^i_{11}$Se$^a_6$ in a 1:1 ratio (for details of the *i*- and *a*-type ligand notation, see: Schäfer & von Schnering (1964)). Both cluster units are interconnected through additional Mo—Se bonds (Figs. 1 and 2). The first unit can be described as an Mo$_6$ octahedron surrounded by eight face-capping inner Se^i and six apical Se^a ligands. The Mo$_9$ cluster is surrounded by 11 Se^i atoms capping one or two faces of the bioctahedron and six Se^a ligands above the apical Mo atoms. The Mo$_6$Se$^i_8$Se$^a_6$ and Mo$_9$Se$^i_{11}$Se$^a_6$ units are centered at Wyckoff positions 2*b* and 2*c* and have point-group symmetry $\bar{3}$ and $\bar{6}$, respectively. The Mo—Mo distances within the Mo$_6$ cluster are 2.6992 (7) Å for the distances of the Mo triangles formed by the Mo1 atoms related through the threefold axis, and 2.7223 (8) Å for the distances between these triangles. The Mo—Mo distances within the Mo$_9$ clusters are 2.6474 (7) and 2.7056 (10) Å in the triangles formed by the atoms Mo2 and Mo3, respectively, and 2.7136 (5) and 2.7557 (5) Å for those between the Mo2$_3$ and Mo3$_3$ triangles. The Se atoms bridge either one (Se1, Se2, Se4 and Se5) or two (Se3) triangular faces of the Mo clusters. Moreover, atoms Se1 and Se2 are linked to an Mo atom of a neighboring cluster. The Mo—Se bond lengths range from 2.5467 (7) to 2.6378 (7) Å within the Mo$_6$Se$^i_8$Se$^a_6$ unit, and from 2.5259 (8) to 2.6966 (6) Å within the Mo$_9$Se$^i_{11}$Se$^a_6$ unit. Each Mo$_9$Se$^i_{11}$Se$^a_6$ cluster is interconnected by six Mo$_6$Se$^i_8$Se$^a_6$ units (and vice versa) via Mo2—Se1 bonds (and Mo1—Se2 bonds, respectively), forming the three-dimensional Mo—Se framework, the connectivity formula of which is Mo$_9$Se$^i_5$Se^i-*a*$_{6/2}$Se-*ai*$_{6/2}$, Mo$_6$Se$^i_2$Se^i-*a*$_{6/2}$Se^a-*i*$_{6/2}$. It results from this arrangement that the shortest intercluster Mo1—Mo2 distance is 3.4216 (6) Å, indicating only weak metal—metal interaction. The In$^+$ cations are surrounded by seven Se atoms forming a distorted tricapped tetrahedron, as is the case in In$_{2.9}$Mo$_{15}$Se$_{19}$. The Se5 and Se2 atoms forming the tetrahedron are at 3.0759 (15) and 3.1221 (5) Å from the In atom, and the capping Se1 atoms are at 3.4904 (7) Å. The V^{3+} cations, as the In^{3+} cations in the In$_3$Mo$_{15}$Se$_{19}$ compounds, occupy partially at 47.4 (6)% a triangular group of distorted octahedral cavities, which are formed by two Mo$_6$Se$^i_8$Se$^a_6$ and three Mo$_9$Se$^i_{11}$Se$^a_6$ units, around the threefold rotation axis. The V—Se distances are in the 2.510 (2) - 2.831 (3) Å range.

S2. Experimental

Single crystals of $V_{1.42}In_{1.83}Mo_{15}Se_{19}$ were prepared from a mixture of V_2Se_3, $MoSe_2$, InSe and Mo with a nominal composition $V_{1.5}In_2Mo_{15}Se_{19}$. Before use, Mo powder was reduced under H_2 flowing gas at 1273 K during ten hours in order to eliminate any trace of oxygen. The binaries V_2Se_3, $MoSe_2$, InSe were obtained by heating stoichioetric mixtures of the elements in sealed evacuated silica tubes during about 2 days. All handlings of materials were done in an argon-filled glove box. The initial mixture (*ca*. 5 g) was cold pressed and loaded into a molybdenum crucible, which was sealed under a low argon pressure using an arc welding system. The charge was heated at the rate of 300 K/h up to 1773 K, the temperature which was held for 48 hours, then cooled at 100 K/h down to 1373 K and finally furnace cooled.

S3. Refinement

The highest peak and the deepest hole are located 1.56 Å and 0.66 Å from Mo3, respectively. Refinement of the occupancy factors of the V and In atoms led to the final composition $V_{1.42 (2)}In_{1.832 (8)}Mo_{15}Se_{19}$.
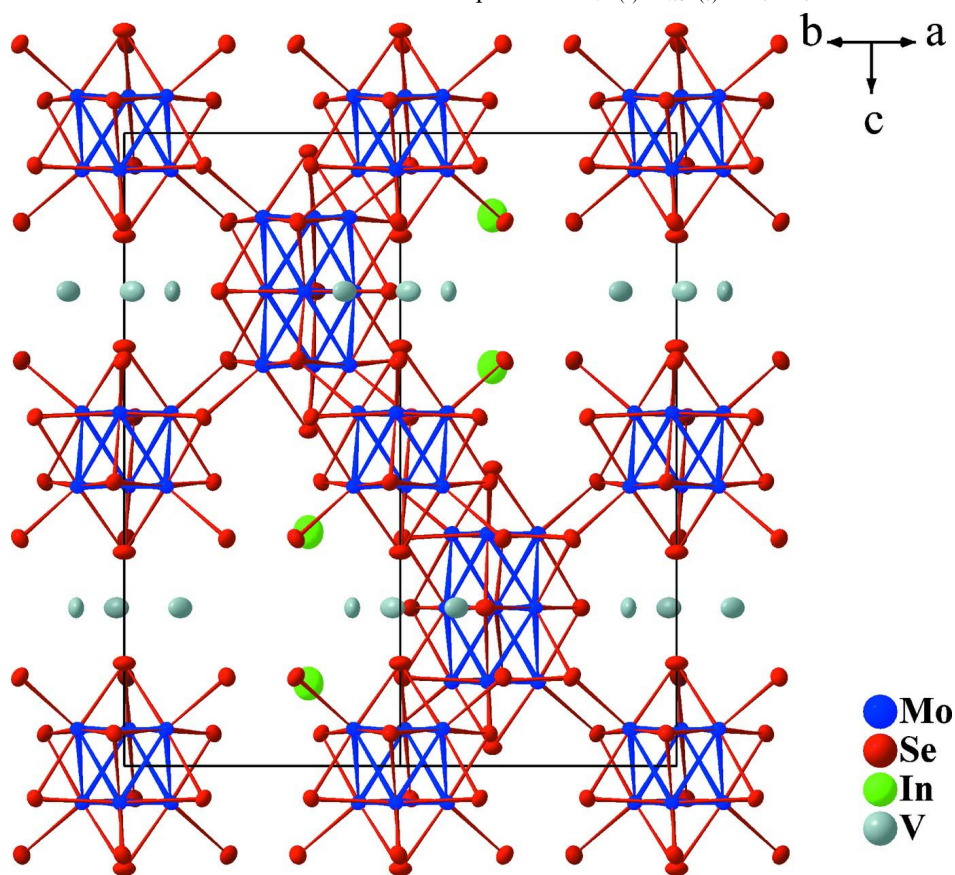

Figure 1

View of $V_{1.42}In_{1.83}Mo_{15}Se_{19}$ along [110]. Displacement ellipsoids are drawn at the 97% probability level.
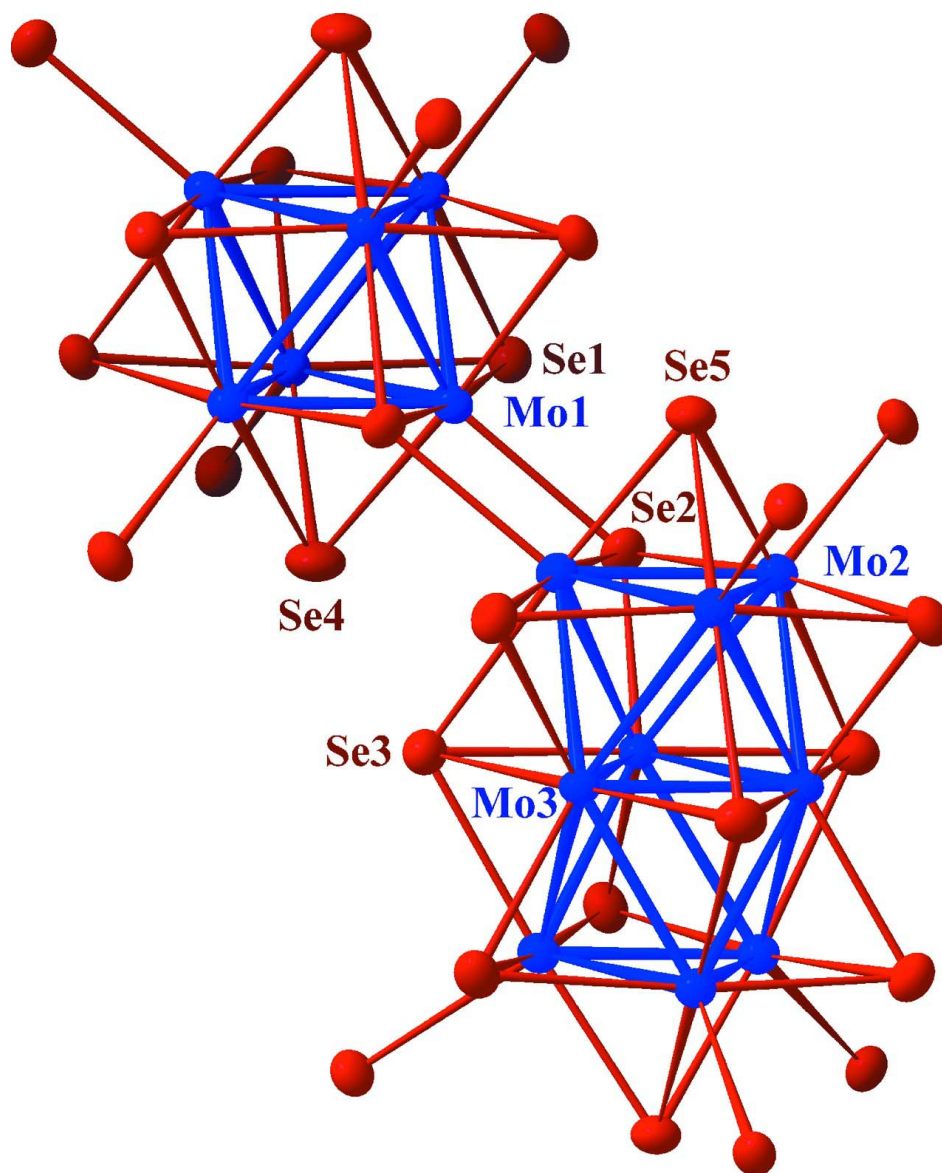
Figure 2

Plot showing the atom-numbering scheme and the interunit linkage of the $Mo_9Se_{11}Se_6$ and $Mo_6Se_8Se_6$ cluster units. Displacement ellipsoids are drawn at the 97% probability level.

vanadium indium pentadecamolybdenum nonadecaselenide

Crystal data

$V_{1.42}In_{1.83}Mo_{15}Se_{19}$	$D_x = 6.750$ Mg m^{-3}
$M_r = 3221.80$	Mo $K\alpha$ radiation, $\lambda = 0.71069$ Å
Hexagonal, $P6_3/m$	Cell parameters from 26495 reflections
Hall symbol: -P 6c	$\theta = 2.6–35.0°$
$a = 9.7361$ (1) Å	$\mu = 29.21$ mm^{-1}
$c = 19.3090$ (4) Å	$T = 293$ K
$V = 1585.11$ (4) Å^3	Irregular block, black
$Z = 2$	$0.09 \times 0.07 \times 0.05$ mm
$F(000) = 2797$	

Data collection

Nonius KappaCCD diffractometer	27560 measured reflections
Radiation source: fine-focus sealed tube	2390 independent reflections
Graphite monochromator	1634 reflections with $I > 2\sigma(I)$
φ scans ($\kappa = 0$) + additional ω scans	$R_{int} = 0.093$
Absorption correction: analytical (de Meulenaar & Tompa, 1965)	$\theta_{max} = 35.0°$, $\theta_{min} = 2.6°$
$T_{min} = 0.161$, $T_{max} = 0.329$	$h = -15 \rightarrow 15$
	$k = -15 \rightarrow 12$
	$l = -30 \rightarrow 31$

Refinement

Refinement on F^2	Secondary atom site location: difference Fourier map
Least-squares matrix: full	
$R[F^2 > 2\sigma(F^2)] = 0.037$	$w = 1/[\sigma^2(F_o^2) + (0.0413P)^2 + 0.9587P]$ where $P = (F_o^2 + 2F_c^2)/3$
$wR(F^2) = 0.087$	
$S = 1.08$	$(\Delta/\sigma)_{max} = 0.001$
2390 reflections	$\Delta\rho_{max} = 3.22$ e Å^{-3}
67 parameters	$\Delta\rho_{min} = -2.57$ e Å^{-3}
0 restraints	Extinction correction: *SHELXL97* (Sheldrick, 2008), Fc*=kFc[1+0.001xFc$^2\lambda^3$/sin(2θ)]$^{-1/4}$
Primary atom site location: structure-invariant direct methods	Extinction coefficient: 0.00025 (5)

Special details

Geometry. All esds (except the esd in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell esds are taken into account individually in the estimation of esds in distances, angles and torsion angles; correlations between esds in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell esds is used for estimating esds 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 > 2sigma(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}	Occ. (<1)
Mo1	0.16776 (5)	0.01669 (5)	0.55780 (2)	0.00914 (10)	
Mo2	0.68407 (5)	0.18577 (5)	0.63317 (2)	0.00965 (10)	
Mo3	0.51292 (7)	0.16694 (7)	0.7500	0.00868 (11)	
Se1	0.03647 (6)	−0.28702 (6)	0.55134 (3)	0.01070 (11)	
Se2	0.37798 (6)	0.00665 (6)	0.64065 (3)	0.01233 (12)	
Se3	0.34594 (8)	0.30753 (9)	0.7500	0.01280 (15)	
Se4	0.0000	0.0000	0.66221 (5)	0.01643 (19)	
Se5	0.6667	0.3333	0.52902 (5)	0.01225 (17)	
In1	0.6667	0.3333	0.36972 (6)	0.0374 (4)	0.916 (4)
V1	−0.2026 (4)	−0.1744 (3)	0.7500	0.0177 (9)	0.474 (6)

Atomic displacement parameters (Å^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Mo1	0.00996 (18)	0.00853 (18)	0.0089 (2)	0.00456 (15)	0.00070 (14)	−0.00012 (14)
Mo2	0.00995 (18)	0.00993 (18)	0.0089 (2)	0.00488 (15)	0.00013 (14)	−0.00037 (14)

Mo3	0.0096 (2)	0.0099 (3)	0.0071 (3)	0.0053 (2)	0.000	0.000
Se1	0.0110 (2)	0.0097 (2)	0.0116 (2)	0.00543 (19)	0.00107 (17)	0.00229 (17)
Se2	0.0115 (2)	0.0119 (2)	0.0138 (3)	0.00598 (18)	−0.00305 (18)	−0.00208 (18)
Se3	0.0121 (3)	0.0158 (3)	0.0117 (3)	0.0079 (3)	0.000	0.000
Se4	0.0203 (3)	0.0203 (3)	0.0086 (4)	0.01016 (14)	0.000	0.000
Se5	0.0142 (2)	0.0142 (2)	0.0083 (4)	0.00712 (12)	0.000	0.000
In1	0.0345 (4)	0.0345 (4)	0.0431 (7)	0.0172 (2)	0.000	0.000
V1	0.0216 (16)	0.0095 (13)	0.0165 (16)	0.0038 (11)	0.000	0.000

Geometric parameters (Å, º)

Mo2—Se5	2.5259 (8)	Mo3—Mo3ii	2.7056 (10)
Mo2—Se2	2.5974 (6)	Mo3—Mo3i	2.7056 (10)
Mo2—Se2i	2.6290 (6)	Mo3—Mo2ix	2.7136 (5)
Mo2—Mo2i	2.6474 (7)	Mo3—Mo2ii	2.7136 (5)
Mo2—Mo2ii	2.6474 (7)	Mo3—Mo2viii	2.7557 (5)
Mo2—Se1iii	2.6504 (6)	In1—Se5	3.0759 (15)
Mo2—Se3i	2.6966 (6)	In1—Se2x	3.1221 (5)
Mo2—Mo3i	2.7136 (5)	In1—Se2xi	3.1221 (5)
Mo2—Mo3	2.7557 (5)	In1—Se2iv	3.1221 (5)
Mo1—Se1iv	2.5467 (7)	In1—Se1x	3.4904 (7)
Mo1—Se4	2.5481 (8)	In1—Se1xi	3.4904 (7)
Mo1—Se1	2.5717 (6)	In1—Se1iv	3.4904 (7)
Mo1—Se1v	2.6111 (6)	In1—Se3vii	4.2444 (9)
Mo1—Se2	2.6378 (7)	In1—Se3xii	4.2444 (9)
Mo1—Mo1vi	2.6992 (7)	In1—Se3xiii	4.2444 (9)
Mo1—Mo1v	2.6992 (7)	V1—Se4	2.510 (2)
Mo1—Mo1vii	2.7223 (8)	V1—Se4viii	2.510 (2)
Mo1—Mo1iv	2.7223 (8)	V1—Se3v	2.730 (3)
Mo3—Se2	2.5631 (6)	V1—Se2vi	2.7981 (18)
Mo3—Se2viii	2.5631 (6)	V1—Se2xiv	2.7981 (18)
Mo3—Se3	2.5965 (9)	V1—Se3vi	2.831 (3)
Mo3—Se3i	2.6095 (9)	V1—Mo3vi	2.865 (3)
Se5—Mo2—Se2	92.603 (17)	Se2viii—Mo3—Mo3i	117.84 (2)
Se5—Mo2—Se2i	91.858 (17)	Se3—Mo3—Mo3i	118.92 (3)
Se2—Mo2—Se2i	173.59 (3)	Se3i—Mo3—Mo3i	58.45 (3)
Se5—Mo2—Mo2i	58.396 (13)	Mo3ii—Mo3—Mo3i	60.0
Se2—Mo2—Mo2i	120.06 (2)	Se2—Mo3—Mo2ix	149.88 (3)
Se2i—Mo2—Mo2i	58.978 (19)	Se2viii—Mo3—Mo2ix	59.685 (15)
Se5—Mo2—Mo2ii	58.396 (13)	Se3—Mo3—Mo2ix	60.991 (14)
Se2—Mo2—Mo2ii	60.16 (2)	Se3i—Mo3—Mo2ix	118.165 (16)
Se2i—Mo2—Mo2ii	118.878 (19)	Mo3ii—Mo3—Mo2ix	61.129 (16)
Mo2i—Mo2—Mo2ii	60.0	Mo3i—Mo3—Mo2ix	89.824 (14)
Se5—Mo2—Se1iii	90.42 (2)	Se2—Mo3—Mo2ii	59.685 (15)
Se2—Mo2—Se1iii	86.03 (2)	Se2viii—Mo3—Mo2ii	149.88 (3)
Se2i—Mo2—Se1iii	98.54 (2)	Se3—Mo3—Mo2ii	60.991 (14)
Mo2i—Mo2—Se1iii	137.757 (18)	Se3i—Mo3—Mo2ii	118.165 (16)

Mo2ii—Mo2—Se1iii	129.74 (2)	Mo3ii—Mo3—Mo2ii	61.129 (16)
Se5—Mo2—Se3i	175.68 (2)	Mo3i—Mo3—Mo2ii	89.824 (14)
Se2—Mo2—Se3i	85.76 (2)	Mo2ix—Mo3—Mo2ii	112.47 (3)
Se2i—Mo2—Se3i	89.46 (2)	Se2—Mo3—Mo2viii	145.46 (3)
Mo2i—Mo2—Se3i	119.150 (18)	Se2viii—Mo3—Mo2viii	58.328 (15)
Mo2ii—Mo2—Se3i	117.432 (18)	Se3—Mo3—Mo2viii	118.823 (15)
Se1iii—Mo2—Se3i	93.45 (2)	Se3i—Mo3—Mo2viii	60.271 (14)
Se5—Mo2—Mo3i	120.23 (2)	Mo3ii—Mo3—Mo2viii	88.941 (14)
Se2—Mo2—Mo3i	116.35 (2)	Mo3i—Mo3—Mo2viii	59.578 (16)
Se2i—Mo2—Mo3i	57.311 (17)	Mo2ix—Mo3—Mo2viii	57.893 (17)
Mo2i—Mo2—Mo3i	61.851 (15)	Mo2ii—Mo3—Mo2viii	146.06 (3)
Mo2ii—Mo2—Mo3i	91.063 (14)	Se2—Mo3—Mo2	58.328 (15)
Se1iii—Mo2—Mo3i	138.90 (2)	Se2viii—Mo3—Mo2	145.46 (3)
Se3i—Mo2—Mo3i	57.36 (2)	Se3—Mo3—Mo2	118.823 (15)
Se5—Mo2—Mo3	118.64 (2)	Se3i—Mo3—Mo2	60.271 (14)
Se2—Mo2—Mo3	57.123 (17)	Mo3ii—Mo3—Mo2	88.941 (14)
Se2i—Mo2—Mo3	116.58 (2)	Mo3i—Mo3—Mo2	59.578 (16)
Mo2i—Mo2—Mo3	90.142 (14)	Mo2ix—Mo3—Mo2	146.06 (3)
Mo2ii—Mo2—Mo3	60.255 (15)	Mo2ii—Mo3—Mo2	57.893 (17)
Se1iii—Mo2—Mo3	131.66 (2)	Mo2viii—Mo3—Mo2	109.90 (3)
Se3i—Mo2—Mo3	57.177 (19)	Mo1vii—Se1—Mo1	64.26 (2)
Mo3i—Mo2—Mo3	59.29 (2)	Mo1vii—Se1—Mo1vi	63.70 (2)
Se1iv—Mo1—Se4	176.34 (2)	Mo1—Se1—Mo1vi	62.77 (2)
Se1iv—Mo1—Se1	88.948 (17)	Mo1vii—Se1—Mo2xv	131.23 (2)
Se4—Mo1—Se1	91.765 (17)	Mo1—Se1—Mo2xv	128.19 (2)
Se1iv—Mo1—Se1v	88.084 (17)	Mo1vi—Se1—Mo2xv	81.114 (19)
Se4—Mo1—Se1v	90.859 (17)	Mo3—Se2—Mo2	64.549 (18)
Se1—Mo1—Se1v	173.79 (3)	Mo3—Se2—Mo2ii	63.004 (18)
Se1iv—Mo1—Se2	93.50 (2)	Mo2—Se2—Mo2ii	60.86 (2)
Se4—Mo1—Se2	90.13 (2)	Mo3—Se2—Mo1	130.39 (2)
Se1—Mo1—Se2	86.306 (19)	Mo2—Se2—Mo1	126.33 (2)
Se1v—Mo1—Se2	99.32 (2)	Mo2ii—Se2—Mo1	81.018 (19)
Se1iv—Mo1—Mo1vi	119.568 (17)	Mo3—Se3—Mo3ii	62.62 (3)
Se4—Mo1—Mo1vi	58.018 (12)	Mo3—Se3—Mo2ix	61.649 (16)
Se1—Mo1—Mo1vi	59.33 (2)	Mo3ii—Se3—Mo2ix	62.551 (16)
Se1v—Mo1—Mo1vi	117.827 (19)	Mo3—Se3—Mo2ii	61.649 (16)
Se2—Mo1—Mo1vi	129.11 (2)	Mo3ii—Se3—Mo2ii	62.551 (16)
Se1iv—Mo1—Mo1v	118.595 (17)	Mo2ix—Se3—Mo2ii	113.56 (3)
Se4—Mo1—Mo1v	58.018 (12)	Mo1vi—Se4—Mo1	63.96 (2)
Se1—Mo1—Mo1v	119.25 (2)	Mo1vi—Se4—Mo1v	63.96 (2)
Se1v—Mo1—Mo1v	57.903 (19)	Mo1—Se4—Mo1v	63.96 (2)
Se2—Mo1—Mo1v	137.270 (18)	Mo2i—Se5—Mo2	63.21 (3)
Mo1vi—Mo1—Mo1v	60.0	Mo2i—Se5—Mo2ii	63.21 (3)
Se1iv—Mo1—Mo1vii	59.30 (2)	Mo2—Se5—Mo2ii	63.21 (3)
Se4—Mo1—Mo1vii	118.273 (15)	Mo2i—Se5—In1	142.763 (16)
Se1—Mo1—Mo1vii	57.423 (15)	Mo2—Se5—In1	142.763 (16)
Se1v—Mo1—Mo1vii	116.42 (2)	Mo2ii—Se5—In1	142.763 (16)
Se2—Mo1—Mo1vii	132.182 (19)	Se4viii—V1—Se4	84.98 (9)

Mo1^{vi}—Mo1—Mo1^{vii}	60.281 (10)	Se4^{viii}—V1—Se3^{v}	87.27 (7)
Mo1^{v}—Mo1—Mo1^{vii}	90.0	Se4—V1—Se3^{v}	87.27 (7)
Se1^{iv}—Mo1—Mo1^{iv}	58.31 (2)	Se4^{viii}—V1—Se2^{vi}	166.76 (13)
Se4—Mo1—Mo1^{iv}	118.273 (15)	Se4—V1—Se2^{vi}	87.36 (2)
Se1—Mo1—Mo1^{iv}	116.86 (2)	Se3^{v}—V1—Se2^{vi}	103.16 (8)
Se1^{v}—Mo1—Mo1^{iv}	56.998 (14)	Se4^{viii}—V1—Se2^{xiv}	87.36 (2)
Se2—Mo1—Mo1^{iv}	140.74 (2)	Se4—V1—Se2^{xiv}	166.76 (13)
Mo1^{vi}—Mo1—Mo1^{iv}	90.0	Se3^{v}—V1—Se2^{xiv}	103.16 (8)
Mo1^{v}—Mo1—Mo1^{iv}	60.281 (10)	Se2^{vi}—V1—Se2^{xiv}	97.98 (8)
Mo1^{vii}—Mo1—Mo1^{iv}	59.44 (2)	Se4^{viii}—V1—Se3^{vi}	85.09 (8)
Se2—Mo3—Se2^{viii}	110.93 (3)	Se4—V1—Se3^{vi}	85.09 (8)
Se2—Mo3—Se3	93.18 (2)	Se3^{v}—V1—Se3^{vi}	169.63 (12)
Se2^{viii}—Mo3—Se3	93.18 (2)	Se2^{vi}—V1—Se3^{vi}	83.50 (6)
Se2—Mo3—Se3^{i}	88.30 (2)	Se2^{xiv}—V1—Se3^{vi}	83.50 (6)
Se2^{viii}—Mo3—Se3^{i}	88.30 (2)	Se4^{viii}—V1—Mo3^{vi}	122.97 (8)
Se3—Mo3—Se3^{i}	177.38 (3)	Se4—V1—Mo3^{vi}	122.97 (8)
Se2—Mo3—Mo3^{ii}	120.789 (19)	Se3^{v}—V1—Mo3^{vi}	136.14 (12)
Se2^{viii}—Mo3—Mo3^{ii}	120.789 (19)	Se2^{vi}—V1—Mo3^{vi}	53.80 (4)
Se3—Mo3—Mo3^{ii}	58.92 (3)	Se2^{xiv}—V1—Mo3^{vi}	53.80 (4)
Se3^{i}—Mo3—Mo3^{ii}	118.45 (3)	Se3^{vi}—V1—Mo3^{vi}	54.23 (5)
Se2—Mo3—Mo3^{i}	117.84 (2)		

Symmetry codes: (i) $-y+1$, $x-y$, z; (ii) $-x+y+1$, $-x+1$, z; (iii) $-x+y+1$, $-x$, z; (iv) $x-y$, x, $-z+1$; (v) $-y$, $x-y$, z; (vi) $-x+y$, $-x$, z; (vii) y, $-x+y$, $-z+1$; (viii) x, y, $-z+3/2$; (ix) $-x+y+1$, $-x+1$, $-z+3/2$; (x) $-x+1$, $-y$, $-z+1$; (xi) $y+1$, $-x+y+1$, $-z+1$; (xii) $x-y+1$, x, $-z+1$; (xiii) $-x+1$, $-y+1$, $-z+1$; (xiv) $-x+y$, $-x$, $-z+3/2$; (xv) $-y$, $x-y-1$, z.