

Crystal structure of the solid solution (Sr_{1.65}Pb_{0.35})Al₆O₁₁

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The title compound, di(strontium/lead) hexaaluminate, is a member of the solid solution series (Sr_{2-x}Pb_x)Al₆O₁₁. It contains two statistically occupied M²⁺ (M = Sr, Pb) sites [both with site symmetries ..m; Sr:Pb occupancy ratios = 0.756 (2):0.244 (2) and 0.8968 (19):0.1032 (19)] that are located in the voids of an aluminate framework. The M²⁺ sites are surrounded by six and seven O atoms, respectively, if a cut-off M–O distance of 3 Å is chosen, resulting in considerably distorted MO_x polyhedra. The aluminate framework consists of three AlO₆ octahedra (two with point-group symmetries ..2/m and one with ..2) sharing edges to form partially filled layers extending parallel to (100) and located at x = 0, 0.5. Adjacent AlO₆ layers are linked by a network made up from two crystallographically different AlO₄ tetrahedra by sharing corners.

Keywords: crystal structure; solid solution; aluminate framework.

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1. Related literature

The title compound was obtained during experiments to prepare the strontium analogue of the lead calcium aluminate PbCa₂Al₈O₁₅ (Artner & Weil, 2012). For another member of the isotypic solid solution series (Sr_{2-x}Pb_x)Al₆O₁₁ with a different Sr:Pb ratio, see: Plötz & Müller-Buschbaum (1982).

2. Experimental

2.1. Crystal data

(Sr _{1.65} Pb _{0.35})Al ₆ O ₁₁	V = 903.03 (3) Å ³
M _r = 555.27	Z = 4
Orthorhombic, Pnmm	Mo Kα radiation
a = 22.0299 (4) Å	μ = 16.94 mm ⁻¹
b = 4.8802 (1) Å	T = 296 K
c = 8.3995 (2) Å	0.12 × 0.05 × 0.05 mm

2.2. Data collection

Bruker SMART CCD diffractometer	10434 measured reflections
Absorption correction: multi-scan (SADABS; Bruker, 2008)	2509 independent reflections
T _{min} = 0.236, T _{max} = 0.485	2190 reflections with I > 2σ(I)
	R _{int} = 0.042

2.3. Refinement

R[F ² > 2σ(F ²)] = 0.027	101 parameters
wR(F ²) = 0.061	Δρ _{max} = 1.12 e Å ⁻³
S = 1.05	Δρ _{min} = -1.51 e Å ⁻³
2509 reflections	

Data collection: SMART (Bruker, 2008); cell refinement: SAINT (Bruker, 2008); data reduction: SAINT; program(s) used to solve structure: SHELXS97 (Sheldrick, 2008); program(s) used to refine structure: SHELXL97 (Sheldrick, 2008); molecular graphics: ATOMS for Windows (Dowty, 2006); software used to prepare material for publication: publCIF (Westrip, 2010).

Acknowledgements

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Supporting information for this paper is available from the IUCr electronic archives (Reference: HB0009).

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supporting information

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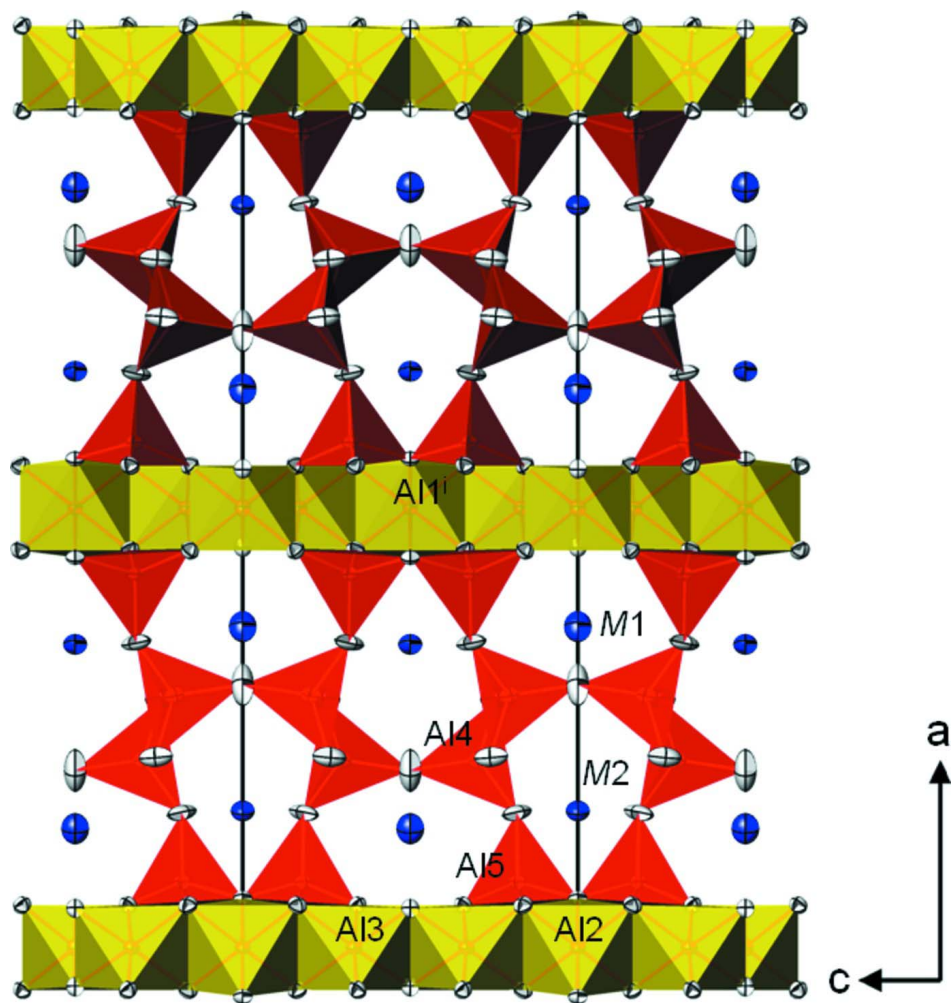
Matthias Weil

S1. Experimental

A mixture of 2PbCO₃Pb(OH)₂, SrCO₃ and Al(OH)₃ (molar ratio 1:6:24) was heated in a platinum crucible over a period of 24 h to 1233 K, kept at this temperature for 10 h and cooled over a period of 24 h to room temperature. A few colourless platy crystals of the title compound grew on top of a brick-red microcrystalline matrix that was not further analysed.

S2. Refinement

Atom labels and starting parameters for refinement were taken from the isotypic compound (Sr_{1.33}Pb_{0.67})Al₆O₁₁ (Plötz & Müller-Buschbaum, 1982). The two M^{2+} sites are statistically occupied by Pb and Sr. For each site, full occupancy was considered and the occupancy factors refined independently. The highest and lowest remaining electron densities are located 0.64 Å and 0.72 Å, respectively, from the site (Sr1/Pb1).

**Figure 1**

The crystal structure of $(\text{Sr}_{1.65}\text{Pb}_{0.35})\text{Al}_6\text{O}_{11}$ in a projection along $[010]$. AlO_6 octahedra are yellow, AlO_4 octahedra are red. Displacement ellipsoids are drawn at the 97% probability level. Bonds to the statistically occupied M^{2+} sites ($M = \text{Sr}, \text{Pb}$) were omitted for clarity. [Symmetry code: $i) x + 1/2, y, z.$]

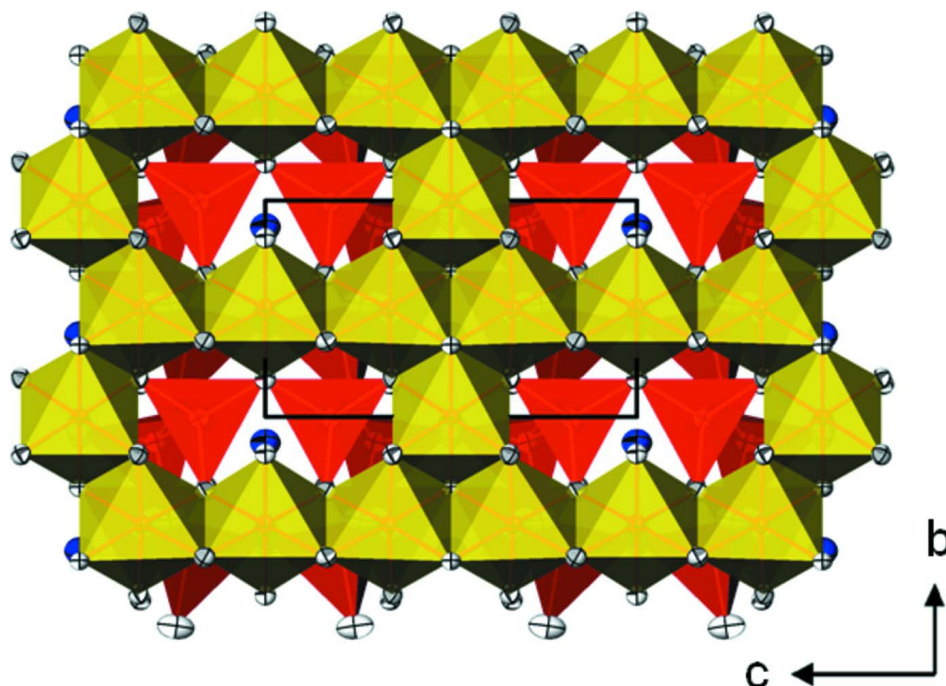


Figure 2

The crystal structure of $(\text{Sr}_{1.65}\text{Pb}_{0.35})\text{Al}_6\text{O}_{11}$ in a projection along $[100]$ showing one layer of edge-sharing AlO_6 octahedra and the connecting layer of corner-sharing AlO_4 tetrahedra as well as one layer of M^{2+} sites ($M = \text{Sr}, \text{Pb}$). Colour code and displacement ellipsoids are as in Fig. 1.

Di(strontium/lead) hexaaluminate

Crystal data

$(\text{Sr}_{1.65}\text{Pb}_{0.35})\text{Al}_6\text{O}_{11}$

$M_r = 555.27$

Orthorhombic, $Pnmm$

Hall symbol: $-P\ 2\ 2n$

$a = 22.0299\ (4)\ \text{\AA}$

$b = 4.8802\ (1)\ \text{\AA}$

$c = 8.3995\ (2)\ \text{\AA}$

$V = 903.03\ (3)\ \text{\AA}^3$

$Z = 4$

$F(000) = 1030$

$D_x = 4.084\ \text{Mg m}^{-3}$

Mo $K\alpha$ radiation, $\lambda = 0.71073\ \text{\AA}$

Cell parameters from 3598 reflections

$\theta = 3.7\text{--}32.5^\circ$

$\mu = 16.94\ \text{mm}^{-1}$

$T = 296\ \text{K}$

Plate, colourless

$0.12 \times 0.05 \times 0.05\ \text{mm}$

Data collection

Bruker SMART CCD

diffractometer

Radiation source: fine-focus sealed tube

Graphite monochromator

ω scans

Absorption correction: multi-scan

(*SADABS*; Bruker, 2008)

$T_{\min} = 0.236$, $T_{\max} = 0.485$

10434 measured reflections

2509 independent reflections

2190 reflections with $I > 2\sigma(I)$

$R_{\text{int}} = 0.042$

$\theta_{\max} = 37.5^\circ$, $\theta_{\min} = 3.7^\circ$

$h = -30 \rightarrow 37$

$k = -6 \rightarrow 8$

$l = -14 \rightarrow 9$

Refinement

Refinement on F^2
 Least-squares matrix: full
 $R[F^2 > 2\sigma(F^2)] = 0.027$
 $wR(F^2) = 0.061$
 $S = 1.05$
 2509 reflections
 101 parameters
 0 restraints

Primary atom site location: isomorphous
 structure methods
 $w = 1/[\sigma^2(F_o^2) + (0.0244P)^2 + 0.7036P]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\max} = 0.001$
 $\Delta\rho_{\max} = 1.12 \text{ e } \text{\AA}^{-3}$
 $\Delta\rho_{\min} = -1.51 \text{ e } \text{\AA}^{-3}$
 Extinction correction: *SHELXL97* (Sheldrick,
 2008), $F_c^* = kF_c[1 + 0.001x F_c^2 \lambda^3 / \sin(2\theta)]^{-1/4}$
 Extinction coefficient: 0.0022 (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 (\AA^2)

	x	y	z	$U_{\text{iso}}^*/U_{\text{eq}}$	Occ. (<1)
Pb1	0.364795 (11)	0.12254 (4)	0.0000	0.01369 (7)	0.756 (2)
Pb2	0.155369 (11)	0.54620 (5)	0.0000	0.01112 (8)	0.8968 (19)
Sr1	0.364795 (11)	0.12254 (4)	0.0000	0.01369 (7)	0.244 (2)
Sr2	0.155369 (11)	0.54620 (5)	0.0000	0.01112 (8)	0.1032 (19)
Al1	0.0000	0.0000	0.5000	0.00496 (19)	
Al2	0.0000	0.5000	0.0000	0.00509 (19)	
Al3	0.0000	0.5000	0.66773 (9)	0.00472 (14)	
Al4	0.21348 (3)	0.11886 (11)	0.29528 (7)	0.00638 (12)	
Al5	0.07460 (3)	0.00878 (11)	0.17903 (6)	0.00472 (11)	
O1	0.05605 (9)	0.8271 (4)	0.0000	0.0055 (3)	
O2	0.29866 (14)	0.5677 (5)	0.0000	0.0197 (5)	
O3	0.45181 (6)	0.3230 (3)	0.84219 (15)	0.0060 (2)	
O4	0.34669 (7)	0.4960 (3)	0.31766 (19)	0.0118 (3)	
O5	0.45552 (9)	0.8297 (4)	0.0000	0.0055 (3)	
O6	0.95192 (6)	0.6515 (3)	0.83661 (15)	0.0062 (2)	
O7	0.28328 (7)	0.9728 (3)	0.24121 (19)	0.0117 (3)	

Atomic displacement parameters (\AA^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Pb1	0.01691 (12)	0.01109 (9)	0.01306 (9)	0.00260 (7)	0.000	0.000
Pb2	0.00748 (12)	0.01603 (12)	0.00985 (10)	0.00238 (8)	0.000	0.000
Sr1	0.01691 (12)	0.01109 (9)	0.01306 (9)	0.00260 (7)	0.000	0.000
Sr2	0.00748 (12)	0.01603 (12)	0.00985 (10)	0.00238 (8)	0.000	0.000
Al1	0.0059 (5)	0.0041 (4)	0.0049 (4)	-0.0004 (4)	0.000	0.000

A12	0.0039 (5)	0.0070 (4)	0.0044 (4)	0.0012 (4)	0.000	0.000
A13	0.0043 (3)	0.0048 (3)	0.0050 (3)	0.0001 (2)	0.000	0.000
A14	0.0049 (3)	0.0067 (2)	0.0075 (2)	-0.00021 (18)	-0.00054 (18)	0.00025 (16)
A15	0.0035 (2)	0.0052 (2)	0.0054 (2)	-0.00008 (18)	0.00009 (17)	0.00014 (16)
O1	0.0041 (8)	0.0060 (7)	0.0063 (7)	-0.0011 (6)	0.000	0.000
O2	0.0319 (15)	0.0187 (10)	0.0086 (8)	0.0063 (10)	0.000	0.000
O3	0.0058 (6)	0.0064 (5)	0.0058 (5)	0.0007 (4)	-0.0006 (4)	0.0001 (4)
O4	0.0046 (6)	0.0151 (6)	0.0157 (6)	-0.0009 (5)	-0.0023 (5)	0.0065 (5)
O5	0.0065 (8)	0.0045 (7)	0.0055 (6)	-0.0002 (6)	0.000	0.000
O6	0.0058 (6)	0.0063 (5)	0.0065 (5)	0.0013 (4)	-0.0007 (4)	0.0000 (4)
O7	0.0067 (6)	0.0087 (6)	0.0196 (7)	0.0000 (5)	-0.0011 (5)	-0.0016 (5)

Geometric parameters (Å, °)

Pb1—O5 ⁱ	2.4569 (19)	A11—O3 ^{vii}	1.9055 (13)
Pb1—O3 ⁱⁱ	2.5275 (13)	A11—O3 ^{xv}	1.9055 (13)
Pb1—O3 ⁱⁱⁱ	2.5275 (13)	A12—O6 ^{xi}	1.8847 (13)
Pb1—O2	2.616 (3)	A12—O6 ^{xvi}	1.8847 (13)
Pb1—O7 ^{iv}	2.8042 (16)	A12—O6 ^{xvii}	1.8847 (13)
Pb1—O7 ⁱ	2.8042 (16)	A12—O6 ^x	1.8847 (13)
Pb1—O2 ⁱ	3.075 (3)	A12—O1	2.0181 (19)
Pb1—O4	3.2558 (17)	A12—O1 ^{xviii}	2.0181 (19)
Pb1—O4 ^v	3.2558 (17)	A13—O3 ^{xv}	1.9021 (13)
Pb2—O1	2.582 (2)	A13—O3 ^{xix}	1.9021 (13)
Pb2—O7 ^{vi}	2.5846 (16)	A13—O5 ^{xx}	1.9067 (14)
Pb2—O7 ^{vii}	2.5846 (16)	A13—O5 ^{vi}	1.9067 (14)
Pb2—O4 ^{viii}	2.6771 (15)	A13—O6 ^{xxi}	1.9186 (14)
Pb2—O4 ^{ix}	2.6771 (15)	A13—O6 ^{xxii}	1.9186 (14)
Pb2—O6 ^x	2.8983 (14)	A14—O4 ^{vi}	1.7368 (16)
Pb2—O6 ^{xi}	2.8983 (14)	A14—O7 ⁱ	1.7548 (17)
Pb2—O4 ^{vii}	3.0914 (17)	A14—O7 ^{vi}	1.7556 (16)
Pb2—O4 ^{vi}	3.0914 (17)	A14—O2 ^{vi}	1.7581 (8)
Pb2—O2	3.158 (3)	A15—O4 ^{vi}	1.7352 (16)
A11—O5 ^{xii}	1.8841 (18)	A15—O3 ^{vii}	1.7433 (14)
A11—O5 ^{vi}	1.8841 (18)	A15—O6 ^{xi}	1.7627 (14)
A11—O3 ^{xiii}	1.9055 (13)	A15—O1 ⁱ	1.7929 (11)
A11—O3 ^{xiv}	1.9055 (13)		
O5 ⁱ —Pb1—O3 ⁱⁱ	66.93 (5)	O6 ^{xvii} —A12—O6 ^x	180.0
O5 ⁱ —Pb1—O3 ⁱⁱⁱ	66.93 (5)	O6 ^{xi} —A12—O1	88.08 (5)
O3 ⁱⁱ —Pb1—O3 ⁱⁱⁱ	63.26 (6)	O6 ^{xvi} —A12—O1	91.92 (5)
O5 ⁱ —Pb1—O2	159.41 (8)	O6 ^{xvii} —A12—O1	91.92 (5)
O3 ⁱⁱ —Pb1—O2	95.80 (6)	O6 ^x —A12—O1	88.08 (5)
O3 ⁱⁱⁱ —Pb1—O2	95.80 (6)	O6 ^{xi} —A12—O1 ^{xviii}	91.92 (5)
O5 ⁱ —Pb1—O7 ^{iv}	111.67 (4)	O6 ^{xvi} —A12—O1 ^{xviii}	88.08 (5)
O3 ⁱⁱ —Pb1—O7 ^{iv}	164.89 (4)	O6 ^{xvii} —A12—O1 ^{xviii}	88.08 (5)
O3 ⁱⁱⁱ —Pb1—O7 ^{iv}	101.98 (4)	O6 ^x —A12—O1 ^{xviii}	91.92 (5)
O2—Pb1—O7 ^{iv}	81.94 (5)	O1—A12—O1 ^{xviii}	180.0

O5 ⁱ —Pb1—O7 ⁱ	111.67 (4)	O3 ^{xv} —Al3—O3 ^{xix}	174.98 (9)
O3 ⁱⁱ —Pb1—O7 ⁱ	101.98 (4)	O3 ^{xv} —Al3—O5 ^{xx}	92.40 (7)
O3 ⁱⁱⁱ —Pb1—O7 ⁱ	164.89 (4)	O3 ^{xix} —Al3—O5 ^{xx}	83.88 (7)
O2—Pb1—O7 ⁱ	81.94 (5)	O3 ^{xv} —Al3—O5 ^{vi}	83.88 (7)
O7 ^{iv} —Pb1—O7 ⁱ	92.52 (6)	O3 ^{xix} —Al3—O5 ^{vi}	92.40 (7)
O5 ⁱ —Pb1—O2 ⁱ	82.72 (7)	O5 ^{xx} —Al3—O5 ^{vi}	84.72 (9)
O3 ⁱⁱ —Pb1—O2 ⁱ	134.44 (5)	O3 ^{xv} —Al3—O6 ^{xxi}	91.22 (6)
O3 ⁱⁱⁱ —Pb1—O2 ⁱ	134.44 (5)	O3 ^{xix} —Al3—O6 ^{xxi}	92.49 (6)
O2—Pb1—O2 ⁱ	117.87 (11)	O5 ^{xx} —Al3—O6 ^{xxi}	176.38 (7)
O7 ^{iv} —Pb1—O2 ⁱ	57.79 (4)	O5 ^{vi} —Al3—O6 ^{xxi}	95.43 (6)
O7 ⁱ —Pb1—O2 ⁱ	57.79 (4)	O3 ^{xv} —Al3—O6 ^{xxii}	92.49 (6)
O5 ⁱ —Pb1—O4	115.16 (3)	O3 ^{xix} —Al3—O6 ^{xxii}	91.22 (6)
O3 ⁱⁱ —Pb1—O4	56.39 (4)	O5 ^{xx} —Al3—O6 ^{xxii}	95.43 (6)
O3 ⁱⁱⁱ —Pb1—O4	107.82 (4)	O5 ^{vi} —Al3—O6 ^{xxii}	176.38 (7)
O2—Pb1—O4	57.78 (3)	O6 ^{xxi} —Al3—O6 ^{xxii}	84.65 (9)
O7 ^{iv} —Pb1—O4	131.27 (4)	O4 ^{vi} —Al4—O7 ⁱ	112.79 (8)
O7 ⁱ —Pb1—O4	58.36 (4)	O4 ^{vi} —Al4—O7 ^{vi}	105.98 (8)
O2 ⁱ —Pb1—O4	115.78 (3)	O7 ⁱ —Al4—O7 ^{vi}	108.60 (6)
O5 ⁱ —Pb1—O4 ^v	115.16 (3)	O4 ^{vi} —Al4—O2 ^{vi}	111.66 (11)
O3 ⁱⁱ —Pb1—O4 ^v	107.82 (4)	O7 ⁱ —Al4—O2 ^{vi}	109.19 (12)
O3 ⁱⁱⁱ —Pb1—O4 ^v	56.39 (4)	O7 ^{vi} —Al4—O2 ^{vi}	108.46 (10)
O2—Pb1—O4 ^v	57.78 (3)	O4 ^{vi} —Al5—O3 ^{vii}	107.59 (8)
O7 ^{iv} —Pb1—O4 ^v	58.36 (4)	O4 ^{vi} —Al5—O6 ^{xi}	111.47 (7)
O7 ⁱ —Pb1—O4 ^v	131.27 (4)	O3 ^{vii} —Al5—O6 ^{xi}	115.93 (7)
O2 ⁱ —Pb1—O4 ^v	115.78 (3)	O4 ^{vi} —Al5—O1 ⁱ	102.91 (8)
O4—Pb1—O4 ^v	110.07 (5)	O3 ^{vii} —Al5—O1 ⁱ	109.03 (7)
O1—Pb2—O7 ^{vi}	121.11 (4)	O6 ^{xi} —Al5—O1 ⁱ	109.09 (7)
O1—Pb2—O7 ^{vii}	121.11 (4)	Al5 ^{xxiii} —O1—Al5 ^{xxiv}	114.01 (10)
O7 ^{vi} —Pb2—O7 ^{vii}	114.50 (7)	Al5 ^{xxiii} —O1—Al2	122.05 (6)
O1—Pb2—O4 ^{viii}	63.27 (5)	Al5 ^{xxiv} —O1—Al2	122.05 (6)
O7 ^{vi} —Pb2—O4 ^{viii}	68.99 (5)	Al5 ^{xxiii} —O1—Pb2	93.98 (7)
O7 ^{vii} —Pb2—O4 ^{viii}	127.14 (5)	Al5 ^{xxiv} —O1—Pb2	93.98 (7)
O1—Pb2—O4 ^{ix}	63.27 (4)	Al2—O1—Pb2	95.65 (7)
O7 ^{vi} —Pb2—O4 ^{ix}	127.14 (5)	Al4 ^{ix} —O2—Al4 ^{viii}	155.98 (17)
O7 ^{vii} —Pb2—O4 ^{ix}	68.99 (5)	Al4 ^{ix} —O2—Pb1	101.69 (8)
O4 ^{viii} —Pb2—O4 ^{ix}	69.79 (7)	Al4 ^{viii} —O2—Pb1	101.69 (8)
O1—Pb2—O6 ^x	59.05 (4)	Al4 ^{ix} —O2—Pb1 ^{xxiii}	86.97 (9)
O7 ^{vi} —Pb2—O6 ^x	141.12 (4)	Al4 ^{viii} —O2—Pb1 ^{xxiii}	86.97 (9)
O7 ^{vii} —Pb2—O6 ^x	88.97 (4)	Pb1—O2—Pb1 ^{xxiii}	117.87 (11)
O4 ^{viii} —Pb2—O6 ^x	122.01 (4)	Al4 ^{ix} —O2—Pb2	81.53 (10)
O4 ^{ix} —Pb2—O6 ^x	89.33 (4)	Al4 ^{viii} —O2—Pb2	81.53 (10)
O1—Pb2—O6 ^{xi}	59.05 (4)	Pb1—O2—Pb2	121.94 (10)
O7 ^{vi} —Pb2—O6 ^{xi}	88.97 (4)	Pb1 ^{xxiii} —O2—Pb2	120.19 (8)
O7 ^{vii} —Pb2—O6 ^{xi}	141.12 (4)	Al5 ^{xxv} —O3—Al3 ^{xiv}	125.65 (8)
O4 ^{viii} —Pb2—O6 ^{xi}	89.33 (4)	Al5 ^{xxv} —O3—Al1 ^{xix}	119.80 (7)
O4 ^{ix} —Pb2—O6 ^{xi}	122.01 (4)	Al3 ^{xiv} —O3—Al1 ^{xix}	95.46 (6)
O6 ^x —Pb2—O6 ^{xi}	56.52 (5)	Al5 ^{xxv} —O3—Pb1 ^{xxvi}	111.13 (7)
O1—Pb2—O4 ^{vii}	116.66 (5)	Al3 ^{xiv} —O3—Pb1 ^{xxvi}	97.22 (5)

O7 ^{vi} —Pb2—O4 ^{vii}	107.69 (4)	Al1 ^{xix} —O3—Pb1 ^{xxvi}	103.48 (5)
O7 ^{vii} —Pb2—O4 ^{vii}	58.03 (4)	Al5 ^{xxv} —O3—Sr1 ^{xxvi}	111.13 (7)
O4 ^{viii} —Pb2—O4 ^{vii}	174.49 (4)	Al3 ^{xiv} —O3—Sr1 ^{xxvi}	97.22 (5)
O4 ^{ix} —Pb2—O4 ^{vii}	115.37 (5)	Al1 ^{xix} —O3—Sr1 ^{xxvi}	103.48 (5)
O6 ^x —Pb2—O4 ^{vii}	57.61 (4)	Al5 ^{viii} —O4—Al4 ^{viii}	139.38 (10)
O6 ^{xi} —Pb2—O4 ^{vii}	86.18 (4)	Al5 ^{viii} —O4—Pb2 ^{vi}	92.13 (6)
O1—Pb2—O4 ^{vi}	116.66 (5)	Al4 ^{viii} —O4—Pb2 ^{vi}	125.63 (8)
O7 ^{vi} —Pb2—O4 ^{vi}	58.03 (4)	Al5 ^{viii} —O4—Sr2 ^{vi}	92.13 (6)
O7 ^{vii} —Pb2—O4 ^{vi}	107.69 (4)	Al4 ^{viii} —O4—Sr2 ^{vi}	125.63 (8)
O4 ^{viii} —Pb2—O4 ^{vi}	115.37 (5)	Al5 ^{viii} —O4—Pb2 ^{viii}	88.60 (6)
O4 ^{ix} —Pb2—O4 ^{vi}	174.49 (4)	Al4 ^{viii} —O4—Pb2 ^{viii}	87.68 (6)
O6 ^x —Pb2—O4 ^{vi}	86.18 (4)	Pb2 ^{vi} —O4—Pb2 ^{viii}	115.37 (5)
O6 ^{xi} —Pb2—O4 ^{vi}	57.61 (4)	Sr2 ^{vi} —O4—Pb2 ^{viii}	115.37 (5)
O4 ^{vii} —Pb2—O4 ^{vi}	59.39 (5)	Al5 ^{viii} —O4—Pb1	84.88 (6)
O1—Pb2—O2	146.03 (6)	Al4 ^{viii} —O4—Pb1	80.74 (6)
O7 ^{vi} —Pb2—O2	58.80 (4)	Pb2 ^{vi} —O4—Pb1	90.68 (5)
O7 ^{vii} —Pb2—O2	58.80 (4)	Sr2 ^{vi} —O4—Pb1	90.68 (5)
O4 ^{viii} —Pb2—O2	89.41 (5)	Pb2 ^{viii} —O4—Pb1	153.38 (5)
O4 ^{ix} —Pb2—O2	89.41 (5)	Al1 ^{viii} —O5—Al3 ^{xxvii}	96.02 (7)
O6 ^x —Pb2—O2	145.70 (4)	Al1 ^{viii} —O5—Al3 ^{viii}	96.02 (7)
O6 ^{xi} —Pb2—O2	145.70 (4)	Al3 ^{xxvii} —O5—Al3 ^{viii}	95.28 (9)
O4 ^{vii} —Pb2—O2	92.50 (5)	Al1 ^{viii} —O5—Sr1 ^{xxiii}	156.90 (10)
O4 ^{vi} —Pb2—O2	92.50 (5)	Al3 ^{xxvii} —O5—Sr1 ^{xxiii}	99.48 (6)
O5 ^{xii} —Al1—O5 ^{vi}	180.0	Al3 ^{viii} —O5—Sr1 ^{xxiii}	99.48 (6)
O5 ^{xii} —Al1—O3 ^{xiii}	95.60 (6)	Al1 ^{viii} —O5—Pb1 ^{xxiii}	156.90 (10)
O5 ^{vi} —Al1—O3 ^{xiii}	84.40 (6)	Al3 ^{xxvii} —O5—Pb1 ^{xxiii}	99.48 (6)
O5 ^{xii} —Al1—O3 ^{xiv}	84.40 (6)	Al3 ^{viii} —O5—Pb1 ^{xxiii}	99.48 (6)
O5 ^{vi} —Al1—O3 ^{xiv}	95.60 (6)	Al5 ^{xi} —O6—Al2 ^{xxviii}	127.55 (7)
O3 ^{xiii} —Al1—O3 ^{xiv}	180.0	Al5 ^{xi} —O6—Al3 ^{xxix}	119.36 (7)
O5 ^{xii} —Al1—O3 ^{vii}	84.40 (6)	Al2 ^{xxviii} —O6—Al3 ^{xxix}	94.41 (6)
O5 ^{vi} —Al1—O3 ^{vii}	95.60 (6)	Al5 ^{xi} —O6—Pb2 ^{xi}	94.48 (6)
O3 ^{xiii} —Al1—O3 ^{vii}	91.84 (8)	Al2 ^{xxviii} —O6—Pb2 ^{xi}	89.02 (5)
O3 ^{xiv} —Al1—O3 ^{vii}	88.16 (8)	Al3 ^{xxix} —O6—Pb2 ^{xi}	132.22 (6)
O5 ^{xii} —Al1—O3 ^{xv}	95.60 (6)	Al4 ^{xxiii} —O7—Al4 ^{viii}	118.72 (9)
O5 ^{vi} —Al1—O3 ^{xv}	84.40 (6)	Al4 ^{xxiii} —O7—Pb2 ^{viii}	100.62 (7)
O3 ^{xiii} —Al1—O3 ^{xv}	88.16 (8)	Al4 ^{viii} —O7—Pb2 ^{viii}	105.19 (7)
O3 ^{xiv} —Al1—O3 ^{xv}	91.84 (8)	Al4 ^{xxiii} —O7—Sr2 ^{viii}	100.62 (7)
O3 ^{vii} —Al1—O3 ^{xv}	180.0	Al4 ^{viii} —O7—Sr2 ^{viii}	105.19 (7)
O6 ^{xi} —Al2—O6 ^{xvi}	180.0	Al4 ^{xxiii} —O7—Pb1 ^{xxiii}	129.96 (8)
O6 ^{xi} —Al2—O6 ^{xvii}	86.54 (8)	Al4 ^{viii} —O7—Pb1 ^{xxiii}	95.99 (7)
O6 ^{xvi} —Al2—O6 ^{xvii}	93.46 (8)	Pb2 ^{viii} —O7—Pb1 ^{xxiii}	103.69 (5)
O6 ^{xi} —Al2—O6 ^x	93.46 (8)	Sr2 ^{viii} —O7—Pb1 ^{xxiii}	103.69 (5)
O6 ^{xvi} —Al2—O6 ^x	86.54 (8)		

Symmetry codes: (i) $x, y-1, z$; (ii) $x, y, -z+1$; (iii) $x, y, z-1$; (iv) $x, y-1, -z$; (v) $x, y, -z$; (vi) $-x+1/2, y-1/2, -z+1/2$; (vii) $-x+1/2, y-1/2, z-1/2$; (viii) $-x+1/2, y+1/2, -z+1/2$; (ix) $-x+1/2, y+1/2, z-1/2$; (x) $-x+1, -y+1, z-1$; (xi) $-x+1, -y+1, -z+1$; (xii) $x-1/2, -y+1/2, z-1/2$; (xiii) $x-1/2, -y+1/2, z+1/2$; (xiv) $-x+1/2, y-1/2, -z+3/2$; (xv) $x-1/2, -y+1/2, -z+3/2$; (xvi) $x-1, y, z-1$; (xvii) $x-1, y, -z+1$; (xviii) $-x, -y+1, -z$; (xix) $-x+1/2, y+1/2, -z+3/2$; (xx) $x-1/2, -y+3/2, z+1/2$; (xxi) $-x+1, -y+1, z$; (xxii) $x-1, y, z$; (xxiii) $x, y+1, z$; (xxiv) $x, y+1, -z$; (xxv) $-x+1/2, y+1/2, z+1/2$; (xxvi) $x, y, z+1$; (xxvii) $x+1/2, -y+3/2, z-1/2$; (xxviii) $x+1, y, z+1$; (xxix) $x+1, y, z$.