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Potassium ditin(IV) tris[phosphate(V)], $KSn_2(PO_4)_3$

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Key indicators: single-crystal X-ray study; T = 296 K; mean σ(Sn–O) = 0.008 Å; R factor = 0.053; wR factor = 0.137; data-to-parameter ratio = 10.3.

The title compound, $KSn_2(PO_4)_3$, belongs to the NASICON-type family of phosphates with the space group $R\overline{3}$. Its structure is constructed by very regular [with P—O distances ranging from 1.513 (6) to 1.522 (6) Å] PO_4 tetrahedra and SnO_6 octahedra on the 3. axis, which are linked by O atoms, forming an $[Sn_2(PO_4)_3]$ framework. The K atoms occupy the $\overline{3}$. axis sites and are located in the voids of this arrangement. The crystal studied was a merohedral twin with twin law (010 100 $00\overline{1}$) and a component ratio of 0.580 (7):0.420 (7).

Related literature

For related NASICON-type compounds, see: Alamo & Rodrigo (1992); Boilot *et al.* (1987); Boujelben *et al.* (2007); Zatovskii *et al.* (2006); Zhao *et al.* (2011).

Experimental

Crystal data

$KSn_2(PO_4)_3$
M_r = 561.39
Trigonal, $R\overline{3}$
a = 8.3381 (1) Å
c = 23.5508 (3) Å
V = 1417.98 (3) $Å^3$
Z = 6
Mo $K\alpha$ radiation
μ = 6.30 mm^{-1}
T = 296 K
0.20 × 0.05 × 0.05 mm

Data collection

Bruker SMART 1K CCD diffractometer
Absorption correction: multi-scan (*SADABS*; Bruker, 1997) T_{min} = 0.366, T_{max} = 0.744
2168 measured reflections
597 independent reflections
591 reflections with $I > 2\sigma(I)$
R_{int} = 0.098

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.053
$wR(F^2)$ = 0.137
S = 1.24
597 reflections
58 parameters
$\Delta\rho_{max}$ = 2.23 e $Å^{-3}$
$\Delta\rho_{min}$ = −2.99 e $Å^{-3}$

Data collection: *SMART* (Bruker, 1997); cell refinement: *SMART*; data reduction: *SAINT* (Bruker, 1997); program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *DIAMOND* (Brandenburg, 2004); software used to prepare material for publication: *SHELXTL* (Sheldrick, 2008).

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: FI2111).

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supplementary materials

Acta Cryst. (2011). E**67**, i51 [**doi:10.1107/S1600536811035604**]

Potassium ditin(IV) tris[phosphate(V)], $KSn_2(PO_4)_3$

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Comment

In the past, the family of $AM_2(PO_4)_3$ (A = alkali metals; M = Ti, Zr, Ge, Sn) compounds with the NASICON-type ($Na_3Zr_2Si_2PO_{12}$: Boilot, *et al.*, 1987) structure have been extensively investigated for their intriguing properities, such as the ionic conductivity properities which may due to the complex and subtle interactions between NASICON framework and mobile ions. The NASICON-type structure with a flexible three-dimensional framework of PO_4 tetrahedra sharing comers with MO_6 octahedra, is amenable to a wide variety of chemical substitutions at the various crystallographic positions, thus yielding a large number of closely related compounds, such as $NaFeNb(PO_4)_3$ (Zatovskii, *et al.*, 2006) and $K_2Ca_2(SO_4)_3$ (Boujelben, *et al.*, 2007). In order to inrich this family of compounds, we synthesis the compound $KSn_2(PO_4)_3$ by the high-temperature reaction and determine the crystal structure from single-crystal X-ray diffraction analysis.$KSn_2(PO_4)_3$ is isostructure with Na (Alamo & Rodrigo, 1992) and Rb (Zhao *et al.*, 2011) analog crystals which crystallizes in the trigonal space group *R*-3.

A projection of the crystal structure of $KSn_2(PO_4)_3$ is given in Fig. 2. It is characterized by the presence of PO_4 tetrahedra and SnO_6 octahedra, linked by sharing corner O atoms, to establish a three-dimentional $[Sn_2(PO_4)_3]$ framework. Furthermore, this framwork delimits two types of channels in which the K atoms are located to compensate the negative charges. The PO_4 tetrahedra are quite regular, with the P–O distance ranging from 1.513 (6) to 1.522 (6) Å, while the SnO_6 octahedra is quite regular too, with the Sn–O distance ranging from 2.003 (6) to 2.045 (6) Å.

Experimental

Compound $KSn_2(PO_4)_3$ has been prepared by a high-temperature method in air. A powder mixture of K_2CO_3, SnO_2 and $NH_4H_2PO_4$ in the molar ratio of K: Sn: P = 15: 1: 15 was first ground in an agate mortar and then transferred to a platinum crucible. The sample was gradually heated in air at 1173 K for 24 h. After that, the intermediate product was slowly cooled to 773 K at the rate of 2 K h^{-1}, and finally quenched to room temperature. The obtained crystals were colorless with a prismatic shape.

Refinement

The $KSn_2(PO4)_3$ crystal studies was twinned by merohedry. For refinement the twin law (0 1 0 1 0 0 0 0 1) was used; the twin component ratio refined to 0.580 (7): 0.420 (7). The highest peak in the difference electron density map equals to 2.23 e/$Å^3$ at the distance of 0.05 Å from Sn1 site while the deepest hole equals to -2.99 e/$Å^3$ at the distance of 0.99 Å from Sn2 site.

Figures

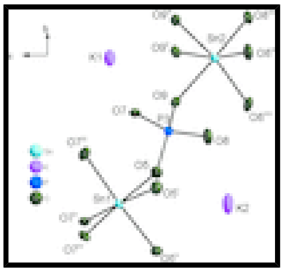

Fig. 1. The expanded asymmetric unit of $KSn_2(PO_4)_3$ showing the coordination environments of the P and Sn atoms. The displacement ellipsoids are drawn at the 50% probability level. [Symmetry codes: (i) *-x + y*, *-x*, *z*; (ii) *-y*, *x-y*, *z*; (iii) *y* - 1/3, *-x + y* - 2/3, *-z* + 1/3; (v) *-x* - 1/3, *-y* + 1/3, *-z* + 1/3; (vi) *-x*, *-y* + 1, *-z*; (vii) *x-y* + 1, *x* + 1, *-z*; (viii) *y*, *-x + y*, *-z*; (*x*) *-y* + 1, *x-y* + 1, *z*.]

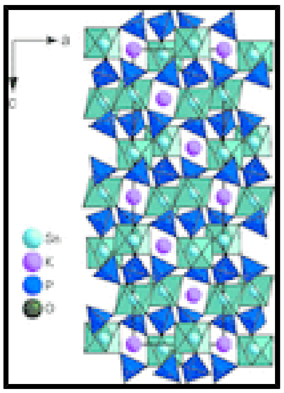

Fig. 2. View of the crystal structure of $KSn_2(PO_4)_3$ along [010]. PO_4 and SnO_6 units are given in the polyhedral representation.

Potassium ditin(IV) tris[phosphate(V)]

Crystal data

$KSn_2(PO_4)_3$	D_x = 3.945 Mg m^{-3}
M_r = 561.39	Mo $K\alpha$ radiation, λ = 0.71073 Å
Trigonal, $R\overline{3}$	Cell parameters from 256 reflections
Hall symbol: -R 3	θ = 2.6–23.6°
a = 8.3381 (1) Å	μ = 6.30 mm^{-1}
c = 23.5508 (3) Å	T = 296 K
V = 1417.98 (3) Å^3	Prism, colourless
Z = 6	0.20 × 0.05 × 0.05 mm
F(000) = 1560	

Data collection

Bruker SMART 1K CCD diffractometer	597 independent reflections
Radiation source: fine-focus sealed tube	591 reflections with $I > 2\sigma(I)$
graphite	R_{int} = 0.098
\ scans	θ_{max} = 25.7°, θ_{min} = 3.0°
Absorption correction: multi-scan (*SADABS*; Bruker, 1997)	$h = -10 \rightarrow 10$
T_{min} = 0.366, T_{max} = 0.744	$k = -10 \rightarrow 10$
2168 measured reflections	$l = -17 \rightarrow 28$

Refinement

Refinement on F^2	Primary atom site location: structure-invariant direct methods
Least-squares matrix: full	Secondary atom site location: difference Fourier map
$R[F^2 > 2\sigma(F^2)] = 0.053$	$w = 1/[\sigma^2(F_o^2) + (0.0764P)^2 + 11.5796P]$ where $P = (F_o^2 + 2F_c^2)/3$
$wR(F^2) = 0.137$	$(\Delta/\sigma)_{max} < 0.001$
$S = 1.24$	$\Delta\rho_{max} = 2.23$ e Å^{-3}
597 reflections	$\Delta\rho_{min} = -2.99$ e Å^{-3}
58 parameters	Extinction correction: *SHELXL97* (Sheldrick, 2008), $Fc^*=kFc[1+0.001xFc^2\lambda^3/\sin(2\theta)]^{-1/4}$
0 restraints	Extinction coefficient: 0.0063 (7)

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}
Sn1	0.0000	0.0000	0.15357 (4)	0.0107 (5)
Sn2	0.3333	0.6667	0.01858 (4)	0.0103 (5)
K1	0.3333	0.6667	0.1667	0.0273 (12)
K2	0.0000	0.0000	0.0000	0.0378 (14)
P3	−0.0441 (3)	0.3326 (4)	0.08384 (9)	0.0117 (6)
O5	−0.0732 (11)	0.1435 (9)	0.1006 (2)	0.0174 (15)
O7	−0.1043 (9)	0.4149 (9)	0.1310 (2)	0.0154 (14)
O8	−0.1477 (9)	0.3069 (10)	0.0284 (3)	0.0208 (15)
O9	0.1599 (8)	0.4650 (8)	0.0738 (2)	0.0140 (15)

Atomic displacement parameters (Å^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Sn1	0.0111 (6)	0.0111 (6)	0.0099 (6)	0.0056 (3)	0.000	0.000
Sn2	0.0108 (5)	0.0108 (5)	0.0093 (6)	0.0054 (3)	0.000	0.000
K1	0.0332 (17)	0.0332 (17)	0.015 (2)	0.0166 (9)	0.000	0.000
K2	0.050 (2)	0.050 (2)	0.014 (2)	0.0248 (11)	0.000	0.000
P3	0.0115 (12)	0.0118 (11)	0.0109 (11)	0.0052 (9)	0.0006 (9)	0.0003 (9)

O5	0.024 (4)	0.018 (4)	0.017 (3)	0.015 (3)	0.001 (3)	0.001 (2)
O7	0.023 (3)	0.009 (3)	0.016 (3)	0.009 (3)	0.006 (3)	0.000 (3)
O8	0.020 (4)	0.032 (4)	0.011 (3)	0.013 (3)	−0.003 (3)	0.002 (3)
O9	0.016 (3)	0.014 (3)	0.012 (3)	0.006 (3)	0.000 (2)	−0.003 (2)

Geometric parameters (Å, °)

Sn1—O5^{i}	2.023 (6)	K1—O7^{iv}	3.282 (7)
Sn1—O5^{ii}	2.023 (6)	K1—O7^{xii}	3.282 (7)
Sn1—O5	2.023 (6)	K1—O7^{xi}	3.282 (7)
Sn1—O7^{iii}	2.032 (6)	K1—O7^{x}	3.282 (7)
Sn1—O7^{iv}	2.033 (6)	K2—O5	2.853 (6)
Sn1—O7^{v}	2.033 (6)	K2—O5^{xiii}	2.854 (6)
Sn1—K2	3.6167 (9)	K2—O5^{i}	2.854 (6)
Sn2—O8^{vi}	2.003 (6)	K2—O5^{viii}	2.854 (6)
Sn2—O8^{vii}	2.003 (6)	K2—O5^{ii}	2.854 (6)
Sn2—O8^{viii}	2.003 (6)	K2—O5^{xiv}	2.854 (6)
Sn2—O9^{ix}	2.045 (6)	K2—O8^{xiii}	3.416 (7)
Sn2—O9	2.045 (6)	K2—O8^{i}	3.416 (7)
Sn2—O9^{x}	2.045 (6)	K2—O8^{viii}	3.416 (7)
Sn2—K1	3.4876 (9)	K2—O8^{ii}	3.416 (7)
K1—O9^{xi}	2.696 (6)	K2—O8^{xiv}	3.416 (7)
K1—O9^{xii}	2.696 (6)	K2—O8	3.416 (7)
K1—O9^{iv}	2.696 (6)	P3—O9	1.513 (6)
K1—O9^{ix}	2.696 (6)	P3—O7	1.516 (6)
K1—O9	2.696 (6)	P3—O8	1.520 (6)
K1—O9^{x}	2.696 (6)	P3—O5	1.522 (6)
K1—O7^{ix}	3.282 (7)	O7—Sn1^{v}	2.033 (6)
K1—O7	3.282 (7)	O8—Sn2^{vi}	2.003 (6)
O5^{i}—Sn1—O5^{ii}	85.9 (2)	O9—K1—O7^{x}	76.59 (17)
O5^{i}—Sn1—O5	85.9 (2)	O9^{x}—K1—O7^{x}	46.76 (15)
O5^{ii}—Sn1—O5	85.9 (2)	O7^{ix}—K1—O7^{x}	113.67 (8)
O5^{i}—Sn1—O7^{iii}	90.7 (2)	O7—K1—O7^{x}	113.67 (8)
O5^{ii}—Sn1—O7^{iii}	92.1 (2)	O7^{iv}—K1—O7^{x}	66.33 (8)
O5—Sn1—O7^{iii}	176.2 (2)	O7^{xii}—K1—O7^{x}	66.33 (8)
O5^{i}—Sn1—O7^{iv}	92.1 (2)	O7^{xi}—K1—O7^{x}	180.00 (14)
O5^{ii}—Sn1—O7^{iv}	176.2 (2)	O5—K2—O5^{xiii}	122.2 (2)
O5—Sn1—O7^{iv}	90.7 (2)	O5—K2—O5^{i}	57.8 (2)
O7^{iii}—Sn1—O7^{iv}	91.2 (2)	O5^{xiii}—K2—O5^{i}	180.0 (6)
O5^{i}—Sn1—O7^{v}	176.2 (2)	O5—K2—O5^{viii}	122.2 (2)
O5^{ii}—Sn1—O7^{v}	90.7 (2)	O5^{xiii}—K2—O5^{viii}	57.8 (2)
O5—Sn1—O7^{v}	92.1 (2)	O5^{i}—K2—O5^{viii}	122.2 (2)

O7^{iii}—Sn1—O7^{v}	91.2 (2)	O5—K2—O5^{ii}	57.8 (2)
O7^{iv}—Sn1—O7^{v}	91.2 (2)	O5^{xiii}—K2—O5^{ii}	122.2 (2)
O5^{i}—Sn1—K2	51.89 (17)	O5^{i}—K2—O5^{ii}	57.8 (2)
O5^{ii}—Sn1—K2	51.89 (17)	O5^{viii}—K2—O5^{ii}	180.0 (3)
O5—Sn1—K2	51.89 (17)	O5—K2—O5^{xiv}	180.000 (1)
O7^{iii}—Sn1—K2	124.44 (17)	O5^{xiii}—K2—O5^{xiv}	57.8 (2)
O7^{iv}—Sn1—K2	124.43 (17)	O5^{i}—K2—O5^{xiv}	122.2 (2)
O7^{v}—Sn1—K2	124.43 (17)	O5^{viii}—K2—O5^{xiv}	57.8 (2)
O8^{vi}—Sn2—O8^{vii}	92.4 (2)	O5^{ii}—K2—O5^{xiv}	122.2 (2)
O8^{vi}—Sn2—O8^{viii}	92.4 (2)	O5—K2—O8^{xiii}	83.25 (18)
O8^{vii}—Sn2—O8^{viii}	92.4 (2)	O5^{xiii}—K2—O8^{xiii}	44.79 (16)
O8^{vi}—Sn2—O9^{ix}	84.6 (3)	O5^{i}—K2—O8^{xiii}	135.21 (16)
O8^{vii}—Sn2—O9^{ix}	100.0 (3)	O5^{viii}—K2—O8^{xiii}	95.98 (17)
O8^{viii}—Sn2—O9^{ix}	167.3 (3)	O5^{ii}—K2—O8^{xiii}	84.02 (17)
O8^{vi}—Sn2—O9	100.0 (3)	O5^{xiv}—K2—O8^{xiii}	96.75 (18)
O8^{vii}—Sn2—O9	167.3 (3)	O5—K2—O8^{i}	96.75 (18)
O8^{viii}—Sn2—O9	84.6 (3)	O5^{xiii}—K2—O8^{i}	135.21 (16)
O9^{ix}—Sn2—O9	83.8 (2)	O5^{i}—K2—O8^{i}	44.79 (16)
O8^{vi}—Sn2—O9^{x}	167.3 (3)	O5^{viii}—K2—O8^{i}	84.02 (17)
O8^{vii}—Sn2—O9^{x}	84.6 (3)	O5^{ii}—K2—O8^{i}	95.98 (17)
O8^{viii}—Sn2—O9^{x}	100.0 (3)	O5^{xiv}—K2—O8^{i}	83.25 (18)
O9^{ix}—Sn2—O9^{x}	83.8 (2)	O8^{xiii}—K2—O8^{i}	180.0 (3)
O9—Sn2—O9^{x}	83.8 (2)	O5—K2—O8^{viii}	84.02 (17)
O8^{vi}—Sn2—K1	123.56 (18)	O5^{xiii}—K2—O8^{viii}	96.75 (18)
O8^{vii}—Sn2—K1	123.56 (18)	O5^{i}—K2—O8^{viii}	83.25 (18)
O8^{viii}—Sn2—K1	123.56 (18)	O5^{viii}—K2—O8^{viii}	44.79 (16)
O9^{ix}—Sn2—K1	50.48 (17)	O5^{ii}—K2—O8^{viii}	135.21 (16)
O9—Sn2—K1	50.48 (17)	O5^{xiv}—K2—O8^{viii}	95.98 (17)
O9^{x}—Sn2—K1	50.48 (17)	O8^{xiii}—K2—O8^{viii}	116.25 (7)
O9^{xi}—K1—O9^{xii}	60.9 (2)	O8^{i}—K2—O8^{viii}	63.75 (7)
O9^{xi}—K1—O9^{iv}	60.9 (2)	O5—K2—O8^{ii}	95.98 (17)
O9^{xii}—K1—O9^{iv}	60.9 (2)	O5^{xiii}—K2—O8^{ii}	83.25 (18)
O9^{xi}—K1—O9^{ix}	119.1 (2)	O5^{i}—K2—O8^{ii}	96.75 (18)
O9^{xii}—K1—O9^{ix}	119.1 (2)	O5^{viii}—K2—O8^{ii}	135.21 (16)
O9^{iv}—K1—O9^{ix}	179.999 (1)	O5^{ii}—K2—O8^{ii}	44.79 (16)
O9^{xi}—K1—O9	119.1 (2)	O5^{xiv}—K2—O8^{ii}	84.02 (17)
O9^{xii}—K1—O9	179.999 (1)	O8^{xiii}—K2—O8^{ii}	63.75 (7)
O9^{iv}—K1—O9	119.1 (2)	O8^{i}—K2—O8^{ii}	116.25 (7)
O9^{ix}—K1—O9	60.9 (2)	O8^{viii}—K2—O8^{ii}	180.0 (3)
O9^{xi}—K1—O9^{x}	179.999 (1)	O5—K2—O8^{xiv}	135.21 (16)
O9^{xii}—K1—O9^{x}	119.1 (2)	O5^{xiii}—K2—O8^{xiv}	95.98 (17)

O9^{iv}—K1—O9^{x}	119.1 (2)	O5^{i}—K2—O8^{xiv}	84.02 (17)
O9^{ix}—K1—O9^{x}	60.9 (2)	O5^{viii}—K2—O8^{xiv}	96.75 (18)
O9—K1—O9^{x}	60.9 (2)	O5^{ii}—K2—O8^{xiv}	83.25 (18)
O9^{xi}—K1—O7^{ix}	103.41 (17)	O5^{xiv}—K2—O8^{xiv}	44.79 (16)
O9^{xii}—K1—O7^{ix}	72.93 (16)	O8^{xiii}—K2—O8^{xiv}	116.25 (7)
O9^{iv}—K1—O7^{ix}	133.24 (16)	O8^{i}—K2—O8^{xiv}	63.75 (7)
O9^{ix}—K1—O7^{ix}	46.76 (16)	O8^{viii}—K2—O8^{xiv}	116.25 (7)
O9—K1—O7^{ix}	107.07 (16)	O8^{ii}—K2—O8^{xiv}	63.75 (7)
O9^{x}—K1—O7^{ix}	76.59 (17)	O5—K2—O8	44.79 (16)
O9^{xi}—K1—O7	72.93 (16)	O5^{xiii}—K2—O8	84.02 (17)
O9^{xii}—K1—O7	133.23 (16)	O5^{i}—K2—O8	95.98 (17)
O9^{iv}—K1—O7	103.41 (17)	O5^{viii}—K2—O8	83.25 (18)
O9^{ix}—K1—O7	76.59 (17)	O5^{ii}—K2—O8	96.75 (18)
O9—K1—O7	46.76 (16)	O5^{xiv}—K2—O8	135.21 (16)
O9^{x}—K1—O7	107.07 (16)	O8^{xiii}—K2—O8	63.75 (7)
O7^{ix}—K1—O7	113.68 (8)	O8^{i}—K2—O8	116.25 (7)
O9^{xi}—K1—O7^{iv}	76.59 (17)	O8^{viii}—K2—O8	63.75 (7)
O9^{xii}—K1—O7^{iv}	107.07 (16)	O8^{ii}—K2—O8	116.25 (7)
O9^{iv}—K1—O7^{iv}	46.76 (16)	O8^{xiv}—K2—O8	180.0
O9^{ix}—K1—O7^{iv}	133.24 (16)	O9—P3—O7	106.8 (4)
O9—K1—O7^{iv}	72.93 (16)	O9—P3—O8	108.8 (4)
O9^{x}—K1—O7^{iv}	103.41 (17)	O7—P3—O8	113.5 (4)
O7^{ix}—K1—O7^{iv}	180.0	O9—P3—O5	109.6 (4)
O7—K1—O7^{iv}	66.32 (8)	O7—P3—O5	111.2 (3)
O9^{xi}—K1—O7^{xii}	107.07 (16)	O8—P3—O5	106.9 (4)
O9^{xii}—K1—O7^{xii}	46.76 (16)	O9—P3—K1	44.3 (2)
O9^{iv}—K1—O7^{xii}	76.59 (17)	O7—P3—K1	67.0 (3)
O9^{ix}—K1—O7^{xii}	103.41 (17)	O8—P3—K1	142.9 (3)
O9—K1—O7^{xii}	133.24 (16)	O5—P3—K1	106.8 (3)
O9^{x}—K1—O7^{xii}	72.93 (16)	O9—P3—K2	88.0 (2)
O7^{ix}—K1—O7^{xii}	66.32 (8)	O7—P3—K2	160.5 (3)
O7—K1—O7^{xii}	180.0	O8—P3—K2	71.8 (3)
O7^{iv}—K1—O7^{xii}	113.68 (8)	O5—P3—K2	50.5 (2)
O9^{xi}—K1—O7^{xi}	46.76 (16)	K1—P3—K2	121.08 (7)
O9^{xii}—K1—O7^{xi}	76.59 (17)	P3—O5—Sn1	146.4 (4)
O9^{iv}—K1—O7^{xi}	107.07 (16)	P3—O5—K2	105.3 (3)
O9^{ix}—K1—O7^{xi}	72.93 (16)	Sn1—O5—K2	94.2 (2)
O9—K1—O7^{xi}	103.41 (17)	P3—O7—Sn1^{v}	136.9 (4)
O9^{x}—K1—O7^{xi}	133.24 (16)	P3—O7—K1	87.9 (3)
O7^{ix}—K1—O7^{xi}	66.33 (8)	Sn1^{v}—O7—K1	128.9 (2)
O7—K1—O7^{xi}	66.33 (8)	P3—O8—Sn2^{vi}	151.1 (4)

O7^{iv}—K1—O7^{xi}	113.67 (8)	P3—O8—K2	83.2 (3)
O7^{xii}—K1—O7^{xi}	113.67 (8)	Sn2^{vi}—O8—K2	124.2 (3)
O9^{xi}—K1—O7^{x}	133.24 (16)	P3—O9—Sn2	140.7 (4)
O9^{xii}—K1—O7^{x}	103.41 (17)	P3—O9—K1	112.7 (3)
O9^{iv}—K1—O7^{x}	72.93 (16)	Sn2—O9—K1	93.7 (2)
O9^{ix}—K1—O7^{x}	107.07 (16)		

Symmetry codes: (i) −*x*+*y*, −*x*, *z*; (ii) −*y*, *x*−*y*, *z*; (iii) *y*−1/3, −*x*+*y*−2/3, −*z*+1/3; (iv) *x*−*y*+2/3, *x*+1/3, −*z*+1/3; (v) −*x*−1/3, −*y*+1/3, −*z*+1/3; (vi) −*x*, −*y*+1, −*z*; (vii) *x*−*y*+1, *x*+1, −*z*; (viii) *y*, −*x*+*y*, −*z*; (ix) −*x*+*y*, −*x*+1, *z*; (x) −*y*+1, *x*−*y*+1, *z*; (xi) *y*−1/3, −*x*+*y*+1/3, −*z*+1/3; (xii) −*x*+2/3, −*y*+4/3, −*z*+1/3; (xiii) *x*−*y*, *x*, −*z*; (xiv) −*x*, −*y*, −*z*.

Fig. 1

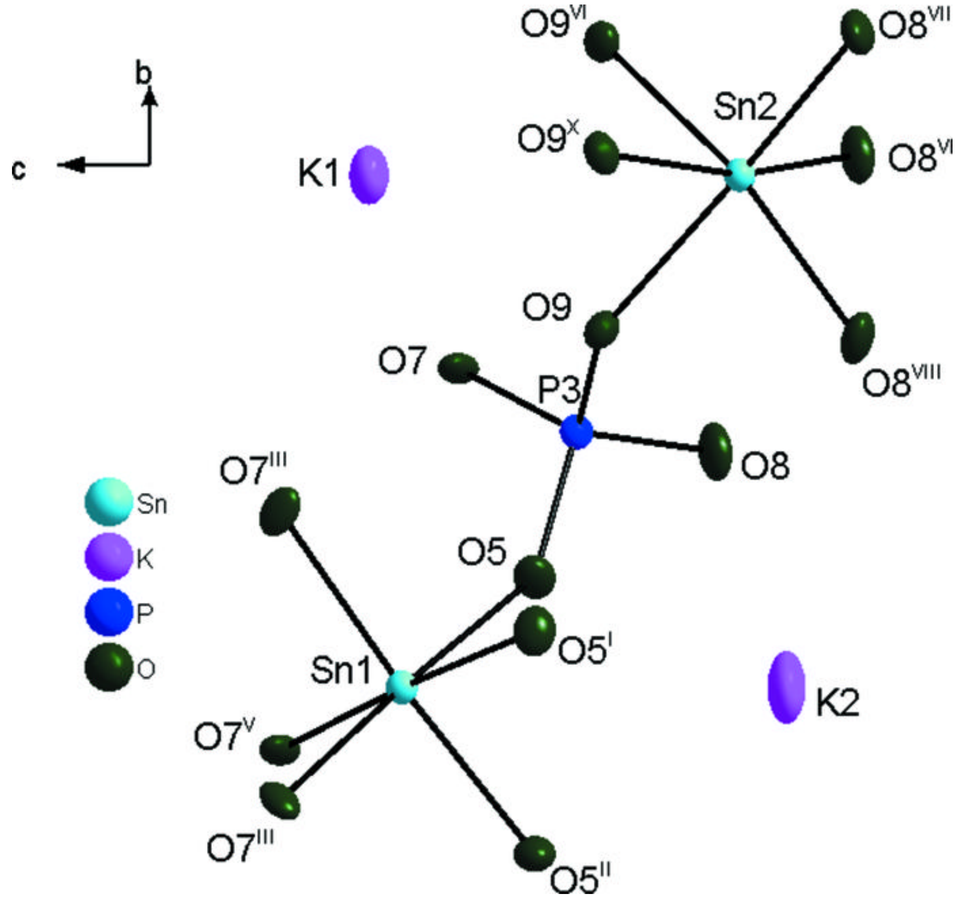
b
c
K1
O9VI
O8VII
Sn2
O9X
O8VI
O9
O7
P3
O8VIII
O8
O7III
Sn
K
P
O
O5
O5I
Sn1
K2
O7V
O7III
O5II

Fig. 2