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Publisher *Taylor & Francis*

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## Phosphorus, Sulfur, and Silicon and the Related Elements

Publication details, including instructions for authors and subscription information:

<http://www.informaworld.com/smpp/title~content=t713618290>

## Phosphates with Two Kinds of Condensed Anions

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**To cite this Article** Averbuch-pouchot, M. T. and Durif, A.(1987) 'Phosphates with Two Kinds of Condensed Anions', *Phosphorus, Sulfur, and Silicon and the Related Elements*, 30: 3, 657

**To link to this Article:** DOI: 10.1080/03086648708079151

**URL:** <http://dx.doi.org/10.1080/03086648708079151>

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## Phosphates with Two Kinds of Condensed Anions

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Up to now a dozen of inorganic condensed phosphates containing two anions with different degrees of condensation have been reported.

We describe two additional examples of such rare compounds :  $\text{Pb}_2\text{Cs}_3(\text{P}_4\text{O}_{12})(\text{PO}_3)_3$  and  $\text{CaNb}_2\text{O}(\text{P}_2\text{O}_7)(\text{P}_4\text{O}_{13})$ .

### **A - $\text{Pb}_2\text{Cs}_3(\text{P}_4\text{O}_{12})(\text{PO}_3)_3$**

This salt has been characterized during a systematic investigation of the  $\text{P}_2\text{O}_5\text{--PbO--Cs}_2\text{O}$  system. This is the first evidence for the existence of tetramétaphosphates.

Crystal data : triclinic,  $\bar{P}1$  with

$$\begin{array}{lll} a = 6.808(5) & b = 7.875(6) & c = 22.12(1) \text{ \AA} \\ \alpha = 86.23(1) & \beta = 96.96(1) & \gamma = 113.98(1)^\circ \\ V = 1075.4 \text{ \AA}^3 & Z = 2. & \end{array}$$

Structure refined with  $R = 0.048$  for 3350 independent reflexions. Centrosymmetrical  $\text{P}_4\text{O}_{12}$  ring anions alternate with  $(\text{PO}_3)_\alpha$  chains.

### **B - $\text{CaNb}_2\text{O}(\text{P}_2\text{O}_7)(\text{P}_4\text{O}_{13})$**

Characterized during investigations in the system  $\text{P}_2\text{O}_5\text{--Nb}_2\text{O}_5\text{--CaO}$  this salt is the first example for the coexistence of  $\text{P}_2\text{O}_7$  and  $\text{P}_4\text{O}_{13}$  groups in a condensed phosphate.

Crystal data : monoclinic,  $\text{C2/m}$  with

$$\begin{array}{lll} a = 13.264(8) & b = 10.574(5) & c = 12.393(5) \text{ \AA} \\ \beta = 96.09(5)^\circ & V = 1728.8 \text{ \AA}^3 & Z = 4. \end{array}$$

Structure refined with  $R = 0.049$  for 1204 independent reflexions. The  $\text{P}_4\text{O}_{13}$  groups have a twofold symmetry, while the  $\text{P}_2\text{O}_7$  groups have a mirror one.