The crystal structures of natural barium beryllophosphates

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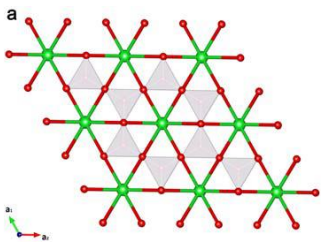
Introduction

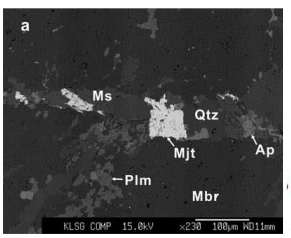
- Only 30 beryllophosphate minerals are known in Nature.
- Formed by reaction between beryl and P-bearing hydrothermal solutions.
- Different polymerization degrees of the BeO_4-PO_4 tetrahedra.
- Crystal structures similar to those of aluminosilicates and borosilicates: chain structures (fransoletite), sheet structures (herderite), framework structures (hurlbutite), zeolite structures (pahasapaite).
- Three new Ba beryllophopshtaes were recently found: minjiangite, wilancookite, and limousinite. Their crystal structures are described here.

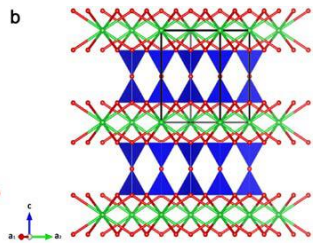
Minjiangite



$BaBe_2P_2O_8$

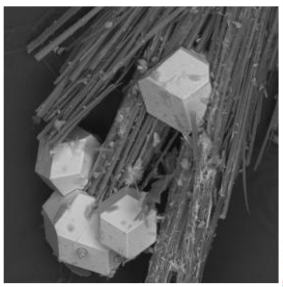
*P*6/*mmm*
a = 5.029(1) Å
c = 7.466(1) Å

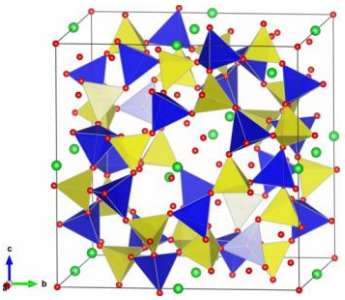




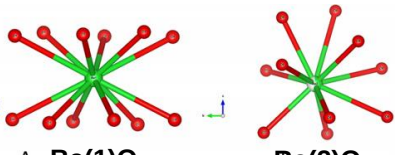
Wilancookite

$(Ba,K,Na)_8(Ba,Li,[])_6Be_{24}P_{24}O_{96}.32H_2O$



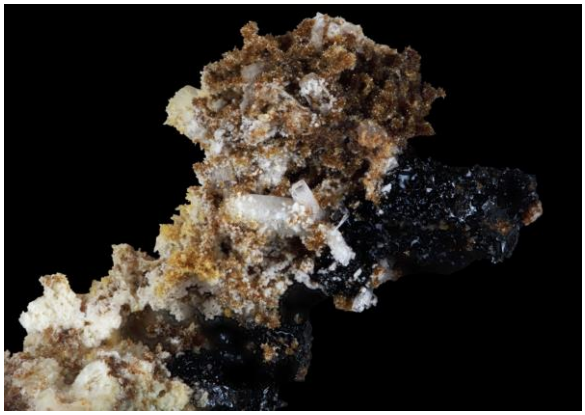


*I*23
a = 13.5398(2) Å



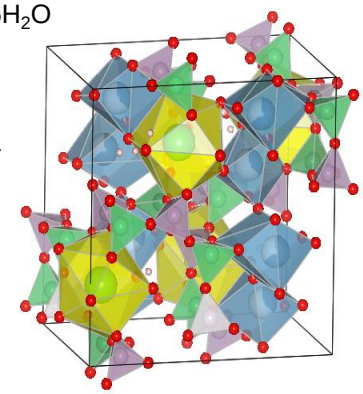
A **$Ba(1)O_{12}$** B **$Ba(2)O_{10}$**

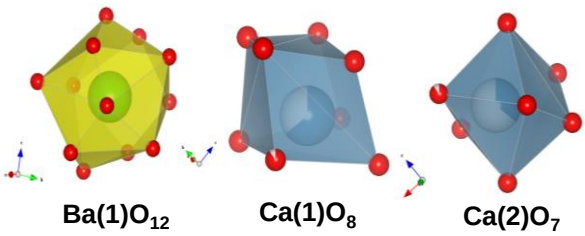
Limousinite



$BaCaBe_4P_4O_{16}.6H_2O$

*P*2$_1$/*c*
a = 9.4958(4) Å
b = 13.6758(4) Å
c = 13.4696(4) Å
β = 90.938(3)°





$Ba(1)O_{12}$ **$Ca(1)O_8$** **$Ca(2)O_7$**

Conclusions

- The three new Ba beryllophosphates show completely different crystal structures.
- Minjiangite = sheet structure, wilancookite = zeolite-RHO structure, limousinite = zeolite phillipsite structure.
- Pahasapaite, wilancookite and limousinite are the three known zeolite phosphates.
- Limousinite is the first zeolite phosphate with a framework identical to those of natural zeolite silicates.
- Necessity to revise the classification of phosphate minerals.

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