

## **Possible new Ca-REE-Bi phosphate minerals from a tungsten-rich calcsilicate skarn, Sierra Nevada Mountains, California**

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### **ABSTRACT**

Scanning electron microscope and electron microprobe analyses of 3 to 15  $\mu\text{m}$  diameter grains present within a garnet-quartz granofels from a tungsten skarn reveal the possible existence of at least two new rare earth element (REE)-bearing phosphate phases:  $\text{Ca}(\text{Ce}, \text{La}, \text{Bi}, \text{Nd})_2[(\text{P}, \text{As})\text{O}_4]_2(\text{OH})_2$  and  $\text{Ca}(\text{La}, \text{Ce}, \text{Nd}, \text{Pr}, \text{Bi})_2[(\text{P}, \text{As})\text{O}_4]_2(\text{OH})_2$ . The analyzed REEs constitute up to 50 wt% of the phases; bismuth oxide contents range from 4.1 to 16.1 wt%. Structural data has proved impossible to obtain from these tiny grains, presumably due to radiation damage by thorium decay. These potentially new phosphate minerals are present within alteration assemblages of REE-rich epidote crystals, as well as along grain boundaries and cracks cross-cutting the quartz-garnet host rock. Association with the zeolite brewsterite-Ba suggests that these hydroxyl phosphates formed during water-rich, low-temperature, retrograde mineralization in the skarn environment.

**Keywords:** Phosphate mineral, rare earth element, bismuth, Sierra Nevada, tungsten, skarn