

Laboratory synthesis, spectroscopic characteristics, and thermal behavior of phoxite

**WENXI CHEN^{1,†}, XIAOHUI FU^{1,2,*}, ZHONGCHEN WU^{1,2}, JIANG ZHANG^{1,2}, GUOBIN JIN¹,
LINGXI ZHANG¹, AND WANG LIU¹**

¹School of Space Science and Technology, Institute of Space Sciences, Shandong University, Weihai, Shandong, 264209, China

²Shandong Key Laboratory of Space Environment and Exploration Technology, Institute of Space Sciences,
Shandong University, Weihai, China

ABSTRACT

Phoxite, $(\text{NH}_4)_2\text{Mg}_2(\text{C}_2\text{O}_4)(\text{HPO}_4)_2 \cdot 4\text{H}_2\text{O}$, was initially discovered in 1977 and then confirmed in 2018. It is the first mineral known to contain both phosphate and oxalate groups. Phoxite has only been found so far, in the Petrogale Cave, Western Australia, and Rowley mine, Arizona, U.S.A. In this work, we synthesized phoxite using oxammite and newberyite as precursors under different relative humidity conditions. Then, a systematic spectral characterization of this mineral was performed using Raman spectroscopy, mid-infrared (MIR) spectroscopy, and visible-near infrared (VNIR) spectroscopy. The obtained spectra are compared with those of other oxalates, hydrated sulfates, and carbonates to determine the diagnostic spectral characteristics of phoxite. In addition, the thermal behavior of phoxite during pyrolysis was investigated using evolved gas analysis (EGA), thermogravimetry (TG), and differential scanning calorimetry (DSC). Our results indicate that phoxite may be a potential biomarker on Earth and an indicator of a warm and humid environment. The results may also serve as the spectral database for the identification of phoxite within the habitable environment on Earth and even other planets.

Keywords: Oxalate minerals, phoxite, spectroscopy, biomarker