DISTINGUISHING ANHYDROUS CARBONATES USING SPECTRAL CENTROID AND ASYMMETRY NEAR 2.5 AND 4 MICRONS. Adrian J. Brown¹, Sara J. King², and Janice L. Bishop³, ¹Plancius Research (Severna Park, MD), ²SETI Institute (Mountain View, CA).

Summary: Anhydrous carbonates are abundant minerals on Earth and are also present on Mars [1], Ceres [2], and Bennu [3]. Remote detection of these minerals is often accomplished using the bands near 2.3, 2.5, and 4 µm. This study focuses on characterizing the shapes of these bands to facilitate carbonate detection on planetary surfaces, and is part of a larger project characterizing the spectral properties of anhydrous carbonates and nitrates [4]. Our results show that combining the centroid with the width or the centroid with an asymmetry parameter provides substantially improved discrimination of anhydrous carbonates than using the band center alone.

Methods: Reflectance spectra of a large collection of anhydrous carbonates are under investigation to understand the relationships between VNIR, mid-IR, and Raman spectroscopy and the composition and structure of these minerals [4]. For the analyses here, a continuum was removed and the bands were fitted in energy space, based on previous studies [5] from the carbonate spectra across the ranges 2.20-2.645 and 3.175-4.247 µm of selected spectra in order to facilitate comparison of the band centers (Fig. 1). We then performed Asymmetric Gaussian modeling [6] of these bands in order to characterize the band shape. A

![Fig. 1](https://example.com/fig1.png)

**Fig. 1** Selected continuum-removed carbonate spectra illustrating variations in band center and shape for the absorptions near 2.3, 2.5, 3.5 and 4 µm.

![Fig. 2](https://example.com/fig2.png)

**Fig. 2** Example plots showing the absorption features for the band near 2.3 µm in reflectance spectra (blue) of A) calcite and B) aragonite. An asymmetric Gaussian model of the spectrum (red) was used to create a fit of the asymmetry shape of the band.
comparison of the continuum-removed spectra and the Asymmetric Gaussian modeled spectra are shown for calcite and aragonite in Fig. 2. The band depth, half width at half height, and an asymmetry factor were computed for a collection of ~50 anhydrous carbonate spectra from our larger study [4].

Results: Comparisons of the centroid with the width and asymmetry parameters reveal separate clusters of data for many types of carbonates in our study. Clear patterns are observed that distinguish these minerals by combining width or asymmetry parameters together with the band center.