# Compositional Characterization of the Polana-Eulalia Complex with JWST

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Determining the distribution of water throughout the main asteroid belt can inform us about the formation and evolution of the early Solar System. A powerful method for probing water abundance involves the observation and characterization of carbon-rich (C-complex) asteroids in the "3-μm region," which contains the fundamental OH stretching mode associated with hydrated or hydroxylated minerals (Rivkin et al. 2002). Carbonaceous chondrites, the meteorite analogs for C-complex primitive asteroids, generally exhibit the OH-strech from Fe- or Mg-rich phyllosilicates, which affect the band shape and center differently (Johnson & Fanale 1973; Takir et al. 2013). The range in band parameters, in turn, aligns with the degree of aqueous alteration (Takir et al. 2013). Though ground-based observations of the 3-μm region are obstructed by Earth's atmospheric water features, the James Webb Space Telescope (JWST) provides unmatched access to this crucial wavelength range. Additionally, JWST can access features longward of the 3-μm region that could be associated with water-ice, organics, carbonates, or ammoniated phyllosilicates (Campins et al. 2010a; Rivkin & Emery 2010; Clark et al. 2009; Rivkin et al. 2022). Thus, JWST observations of C-complex asteroids in this region allow for insight into the formation and evolution of these bodies and the Solar System at large.

The Polana-Eulalia Complex (PEC) is a low-inclination, carbon-rich (C-complex) asteroid population residing in the inner Main Belt (IMB) among numerous other families (Walsh et al. 2013). As shown in Figure 1, the PEC is composed of two dynamically overlapping families centered around (142) Polana and (495) Eulalia, the largest members of each one. The nearby $\nu_6$ secular resonance has likely caused some small PEC members to drift into near-Earth space. Notable examples of this dynamical evolution scenario include near-Earth asteroids Bennu and Ryugu, the targets of *OSIRIS-REx* and *Hayabusa2* sample-return spacecraft missions, which are probabilistically traced back to the PEC region (Campins et al., 2010b, 2013; Bottke et al., 2015). Ground-based observational campaigns focused on near-ultraviolet (NUV; 0.35 – 0.46 μm), visible (VIS; 0.46 – 0.9 μm), and near-infrared (NIR; 0.9 – 2.2 μm) wavelengths found that members from both PEC families display featureless spectra (Tatsumi et al. 2022; de León et al. 2016, Pinilla-Alonso et al. 2016). Though PEC asteroids lack 0.7-μm features associated with Fe-bearing phyllosilicates, the presence of the fundamental OH-stretch from Mg-rich phyllosilicates in the 3-μm region cannot be ruled out (Rivkin et al. 2002; Takir et al. 2013). Spectral characterization in this wavelength region is particularly

relevant to understanding the distribution of water throughout the Solar System as well as to disentangling the specific family of origin for Bennu and Ryugu.

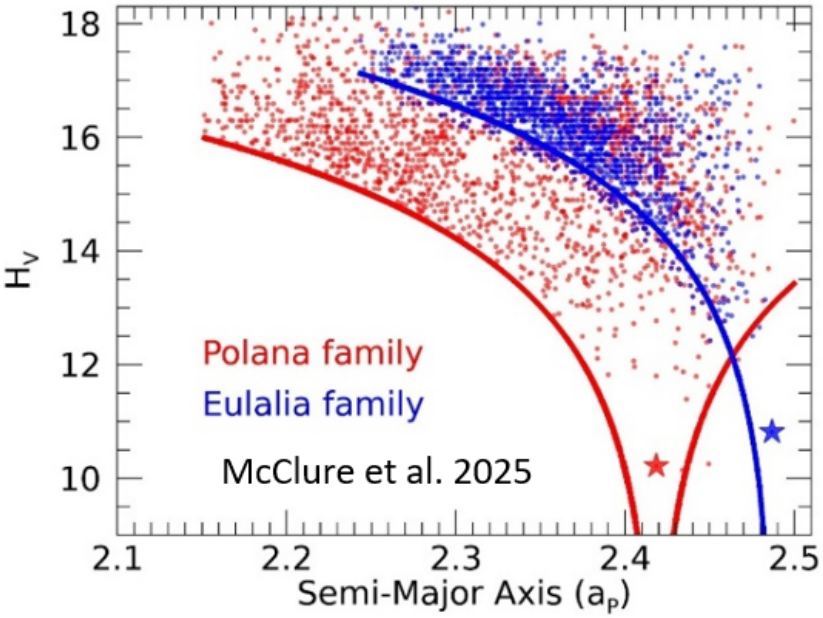


**Figure 1**: *The Yarkovsky Drift of the two families of the PEC, with asteroids Polana (red star) and Eulalia (blue star) at their relatively centralized orbital positions (Vokrouhlický et al. 2006; Walsh et al. 2013).*

In this work, we present a portion of JWST Cycle 3 spectra from Program #6384, led by Driss Takir. Entitled the "Spectral Analysis of Main Belt Asteroids in the 3-μm Region" (SAMBA3), this JWST program uses the NIRSpec instrument and has acquired spectra from (495) Eulalia and two ~10-km-sized Polana family asteroids: (6712) Hornstein & (2441) Hibbs. Upon calibrating the SAMBA3 spectra, we inspected/calculated spectral parameters for the observed features within and longward of the 3-μm region, including band shape and minimum. In addition to connecting the SAMBA3 spectra with VIS-NIR spectra of these objects, we compare PEC spectra to other relevant spectra, such as the spectrum of Bennu (remote & return-sample), of Ryugu (remote & return), and of (142) Polana (from Cycle 2 – Program #3760, PI A. Arredondo). We also contextualize the PEC spectra with the larger sample from this program, which also observed (84) Klio, (302) Clarissa, and (163) Erigone, largest members of the other carbon-rich, primitive-like families in the IMB. Additionally, we link these PEC asteroid spectra to specific carbonaceous chondrite meteorite types.

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