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Near-infrared spectral variability of the newly active asteroid (6478) Gault

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1. Introduction

Sporadic activity was recently reported on the ∼6-km size inner main-belt asteroid (6478) Gault. Several million kilograms of dust ejected at escape velocity formed a comet-like tail first identified in images collected by the Hawai'i ATLAS survey between late December 2018 and early January 2019 [1]. Several additional emissions were subsequently observed [2,3,4], and two or three different tails were identified on higher angular resolution images [5,6,7,8], seemingly ruling out a single collision as the origin of Gault's activity. On the other hand, signatures of a rotation period of ∼2 h [9], close to the rotational break up, indicate activity may be triggered by rapid spin up due to solar heating (the YORP effect).

2. Observations

Spectroscopic observations of Gault were conducted on two different nights with the 3-meter NASA Infrared Telescope Facility (IRTF) located on Mauna Kea, Hawaii. We used the SpeX NIR spectrograph combined with a 0.8×15 arcsec slit in the low-resolution prism mode to measure the spectra over the 0.7–2.5 micron wavelength range. Series of spectral images with 120 s exposure time were recorded in an AB beam pattern to allow efficient removal of the sky background by subtracting pairs of AB images. Three solar analog stars were observed throughout each night for data reduction purposes.

3. Results

On one of our two nights of observation, Gault exhibited a near-infrared spectrum similar to that of S-type asteroids, with a red spectral gradient and two broad mafic mineral absorption bands located near 1 and 2 micron. This result confirms Gault likely originated from the (25) Phocaea collisional family of S-type asteroids, as suggested by its orbit [10]. On the second night, however, Gault's spectrum turned out to be bluer than solar (i.e., with negative spectral slope), while still showing the two S-type-like absorption bands. Careful examination of our dataset and the associated calibration files indicate this blue spectral slope is not an artefact from an instrumental or data reduction problem. We will discuss here possible origins for the spectral variability of Gault.

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