Visible-Wavelength Spectroscopy of Subkilometer-Sized Near-Earth Asteroids with a Low Delta-*v*

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The research on near-Earth asteroids (hereafter NEAs) has entered a new phase thanks to sample-return space explorations together with state-of-the-art large ground-based telescopes. NEAs with a low delta-v, which is defined in terms of the criterion for accessibility, are known as potential candidates for exploration including flybys, rendezvous, sample return, and human missions. However, only a small percent of known NEAs have been observed in the effort to acquire physical characteristics, because most such asteroids have short windows of observable opportunity.

In our work [1], to investigate the spectroscopic properties of the unclassified asteroids, we performed visible spectroscopic observations during two years from 2011 at the Subaru (FOCAS: [2]), GEMINI-North (GMOS: [3]), GEMINI-South (GMOS) and Okayama 188 cm (KOOLS: [4]). Ten NEAs among these asteroids share features of both the sub-kilometer-size with $18.8 \leq H < 21.7$ and the low delta-v of less than 7 km/sec. All observations were in the long-slit mode with the wide slit (2–6″ wide slit), and the low resolution grating (or grsim). The reflectance spectrum of an asteroid was obtained from the raw asteroid spectrum by dividing it by the spectrum of a standard solar analog star. The final spectrum of each asteroid was summed up and re-binned to match a resolution based on the instrument settings. Figures 1 shows the asteroid spectra from FOCAS. All spectra provide wavelength coverage from roughly 0.5 to 0.9 μm.

A total of 13 asteroids were classified by comparing a best fit between our data and the visible parts of the mean Bus-DeMeo spectra [5]. We find that eleven asteroids are classified as S-complex[1)] and one asteroid as V-type. Most S-complex asteroids (eight out of eleven, ~70 %) have spectra similar to subgroups of Q or Sq-type, suggesting that these objects are less matured against space weathering.

In [1], we show their spectra and discuss dominance of S-complex asteroids based on the previous research. It is clear that S-complex asteroids make up the majority of low delta-v asteroids. We further found that the fractions of S/C-complexes[2)] are less dependent on delta-v. Although we examined the fractions based on the absolute magnitude H to study the observational bias, we concluded that the dominance of S-complex asteroids is not sampling bias based on either delta-v or absolute magnitude H criteria.

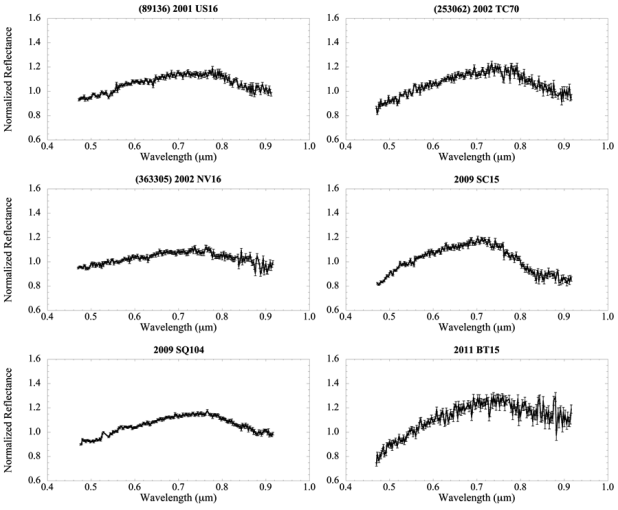

Figure 1: Visible spectra of six NEAs obtained with FOCAS at the Subaru telescope. All spectra are normalized to 0.55 μm. Their error bars are evaluated in terms of Poisson errors including the gain and readout noise and the uncertainty depending on the airmass mismatch.

1) S-type or the associated types of Q, O, A, Sr, Sq-type
2) C-type or the associated types of B, F, G type

References

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