Time scales for the progress of space weathering on D-type and very red asteroids

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The surface layers of airless bodies such as asteroids in the Solar System are known to be affected by space weathering process. Experiments simulating space weathering are essential methods for studying the effects and factors of space weathering, but the defect is that the time spent to reproduce space weathering is billions of times shorter than it actually is. An impactor collided with T-type asteroid 596 Scheila in December 2010, freshening its surface layer. Since this year is over a decade after that impact event, it is an opportunity to see how the surface layer has been altered by space weathering. We (Hasegawa et al. 2022, ApJL, 939, L9) therefore performed visible spectrophotometric and near-infrared spectroscopic observations of 596 Scheila. The obtained spectrum of 596 Scheila is consistent with those observed during the 2010 impact event within the observational error range. This indicates that the surface color of dark asteroids is not changed by space weathering in about 10 years. This study is the first to confirm the presence or absence of color changes due to space weathering on the surfaces of actual asteroids in the solar system. Considering that fresh layers are regularly created on asteroids surfaces by collisional events, we suggest a genetic link between D/T-type and dark (low albedo) X-complex asteroids and very red objects such as 269 Justitia, 732 Tjilaki (and 203 Pompeja). New observations show that 203 Pompeja has a X-type-like surface, with some local surface areas exhibiting a very red spectrum. We also suggest that the near-infrared spectral mismatch between 3200 Phaethon and 155140 2005 UD is due to the different epochs of the refreshment to the surface of each asteroid.

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