SPACE WEATHERING RATE REDETERMINATION USING IANNINI ASTEROID FAMILY SPECTRA.

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Introduction: The color mismatch between ordinary chondrite meteorites and their presumed source population, the inner main belt S-class asteroids, is a long-standing mystery. Using dynamical dating methods for asteroid families along with photometric and spectroscopic colors leads to a model which resolves the mystery by making the color a simple function of time. The new data points in this analysis result in a rate of change that agrees with lab measurements.

Sample: We obtained moderate S/N (~85) spectra at a realized resolution of R~100 for 11 Iannini family members, until recently the youngest known family at under 5 million years of age [1] The spectra were acquired using the Echellette Spectrograph and Imager in its low-resolution prism mode on the Keck II telescope. The family members belong to the S-complex of asteroids with perhaps some K class members.

Results: The Iannini family member's average spectral slope, defined as the slope of the best-fit line constrained to pivot about 1 at 550 nm, is (0.30±0.04)/μm, matching the (0.26±0.03)/μm reported by [2] using SDSS [3] color photometry. Using our spectra for this family as well as new observations of Karin family members [4] and new classifications of some older families we revised the space weathering rate of S-complex asteroids originally determined by [2]. Following [2] we parameterize the space weathering rate of the principal component color of the spectrum PC_1, which is correlated with the spectral slope, as $PC_1(t) = PC_1(0) + \Delta PC_1[1 - \exp(-t/\tau)^{\alpha}]$, where $PC_1(0)$ is the initial color, ΔPC_1 is the color change at infinite time, τ is the characteristic time and α is a generalizing term. Our revised rate suggests that the characteristic time scale for space weathering is $\tau = 570\pm220$ My and that new S-complex clusters will have an initial color of $PC_1(0) = 0.31\pm0.04$. The revised time scale agrees well (within error bar) with lab measurements [5] and our measurements support the use of space weathering as a dating method. Assuming all the spectra should be identical, since members derived from the same parent body are presumably covered with similar regolith, we combined them into a high-S/N composite family spectrum which is within the S-complex. Several of the spectra show a feature at 550 nm that may be diagnostic of young S-class surfaces.

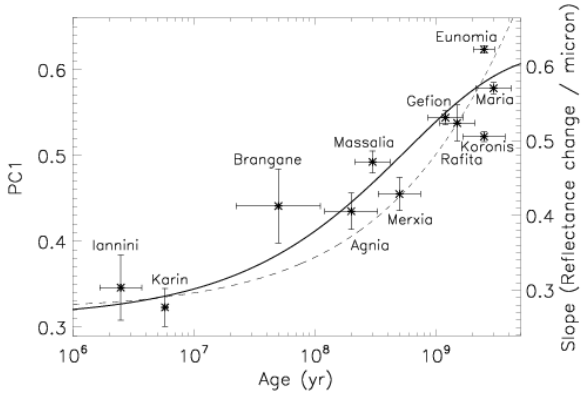

Figure 1 First principal color component PC1 vs age for the S-complex asteroid families as first shown by Nesvorný et al. [6] with the following modifications: our new Iannini PC1 value, a new Karin PC1 derived from Vernazza et al. [4] and the removal of the Eos family now considered to be K class. PC1 errors are the standard error on the mean for the family. The new fit (solid) to the space weathering function for our data is shown along with the fit (dashed) originally reported by Nesvorný et al. [6].

References: [1] Nesvorný, D. et al. (2003) ApJ 591, 486-497. 720-771. [2] Jedicke, R. et al. (2004) Nature, 429, 275-277. [3] Ivezic, Ž. et al. (2002) Proc. SPIE, 4836, pp. 98-103. [4] Vernazza, P. et al., (2006) A\&A 460, 945-951. [5] Sasaki et al. (2001) Nature, 410, 555-557. [6] Nesvorný, D. et al. (2005) Icarus 173, 132-152.