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Asteroid age distributions determined by space weathering and collisional evolution models

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We provide evidence of consistency between the dynamical evolution of main belt asteroids and their color evolution due to space weathering. The dynamical age of an asteroid's surface \citep{bib.bot05a,bib.nes05} is the time since its last catastrophic disruption event which is a function of the object's diameter. The age of an S-complex asteroid's surface may also be determined from its color using a space weathering model \citep[e.g.][]{bib.wil10,bib.jed04,bib.wil08,bib.mar06}. We used a sample of 95 S-complex asteroids from SMASS and obtained their absolute magnitudes and u,g,r,i,z filter magnitudes from SDSS. The absolute magnitudes yield a size-derived age distribution. The u,g,r,i,z filter magnitudes lead to the principal component color which yields a color-derived age distribution by inverting our color-age relationship, an enhanced version of the `dual τ' space weathering model of \citet{bib.wil10}.

We fit the size-age distribution to the enhanced dual τ model and found characteristic weathering and gardening times of $\tau_w = 2050 \pm 80$ Myr and $\tau_g = 4400^{+700}_{-500}$ Myr respectively. The fit also suggests an initial principal component color of -0.05 ± 0.01 for fresh asteroid surface with a maximum possible change of the probable color due to weathering of $\Delta PC = 1.34 \pm 0.04$. Our predicted color of fresh asteroid surface matches the color of fresh ordinary chondritic surface of $PC_1 = 0.17 \pm 0.39$.

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