PLANETARY CHRONOLOGY
Importance for the Outer Solar System

Report to OPAG, Tucson, November 7-8, 2006

OSS CHRONOLOGY NOT WELL CONSTRAINED

Ages of Large Young Icy Satellites (Europa, Titan, Triton)

Timing of Ganymede's Differentiation & Jovian Satellite Dynamical Reconfiguration

Timimg & Duration of Resurfacing Events on Enceladus

Timing of Planetary Ring Formation

Workshop on Surface Ages & Histories: Issues in Planetary Chronology

Houston May 21-23, 2006

Result: Formation of ad hoc Committee on Planetary Chronology

P Schenk, N Barlow, B Bierhaus

D Bogard, W. Bottke, W Hartmann, H Levison, A McEwen, W McKinnon, F Nimmo, C Quantin, K Tanaka, E Turtle, and growing . . .

Result: Preparation of a White Paper-style report on "Planetary Chronology 2007: Status and Issues" for peer-reviewed journal

Result: Preparation of Set of Recommendations for improving understanding of surface ages & chronologies in Solar System

Recommendations for Improving Understanding of Surface Ages & Chronologies in Solar System

3 Major Chronology Themes

Radiometric Dating of Samples
Cratering Counting
Solar System Dynamics

Recommendations for Improving Understanding of Surface Ages & Chronologies in Solar System

- RADIOMETRIC DATING OF SAMPLES -

Objective A1: **Firmly anchor Lunar Time Scale, both currently & at the LHB**

Recommendation A1: **We recommend that new samples be acquired from lunar surface, with priority to Copernicus and pre-Imbrium basin (e.g., Nectaris, SP-Aiken)**

Objective A2: **Firmly establish Impact-derived Chronologies on another body**

Recommendation A2: **We recommend that geologically samples be acquired from the surface of another celestial body beyond the Earth-Moon system (i.e., Mars)**

Note that OSS sampling not included. Should it be?

Sampling not yet feasible for large solid bodies in OSS. Studies of alternative approaches?

Recommendations for Improving Understanding of Surface Ages & Chronologies in Solar System

- CRATER COUNTING (1) -

Objective B1: Achieve transparency in crater count statistics & age estimates

Recommendation B1: We recommend that all crater statistics and support data (e.g., marked maps showing crater locations) be published on-line in a consistent style and level of detail

Objective B2: Understand the consistency and reliability of crater statistics (especially the SFD) as an age dating tool

Recommendation B2a: We recommend studies to evaluate the degree of human variability in crater measurement

Recommendation B2b: . . . that in select locales that craters be counted by two or more independent groups

Recommendation B2c: . . . automating the crater counting process as completely as is practical

Crater counting is main dating tool in OSS

Recommendations for Improving Understanding of Surface Ages & Chronologies in Solar System

- CRATER COUNTING (2) -

Objective B3: Understand contribution of secondary craters to production function

Recommendation B3a: We recommend that numerical modeling and geologic mapping to evaluate SFD & mass-velocity relationships for secondary craters

Recommendation B3b: We recommend Monte Carlo simulations of terrains to investigate the effects of secondary crater formation on local terrains

Objective B4: Understand the Lunar Production Function

Recommendation B4: We recommend numerical modeling and geologic mapping to evaluate the SFD and mass-velocity relationships

Secondary craters important on Europa and other young surfaces

Modeling and understanding of fate of planetocentric debris

Recommendations for Improving Understanding of Surface Ages & Chronologies in Solar System

- DYNAMICAL MODELING -

Modeling of Giant Planet/Small Body dynamics by Bottke, Levison, et al. suggests LHB Dynamical Link in both Inner & Outer Solar Systems!

- perhaps the biggest catharsis of the Workshop

Objective C1: Understand the orbits and size distributions of impactor populations throughout the solar system as a function of time and location

Recommendation C1a: We recommend continued study of solar system dynamics, especially small-body dynamics

Recommendation C1b: We recommend continue study on the collisional evolution of asteroidal and cometary bodies over time

Planetary Chronology 2007: Status, Issues, and Recommendations

Emerging Concensus that synergy of Radiometric Dating, Crater Counting, and Dynamics is Key

Dynamical modeling may finally link cratering records in ISS and OSS!

Report to Peer Journal (MAPS, JGR) in preparation

Recom's not set in stone; Contributions from Community Welcome!
Establishing SS Chronology should be a NASA priority

Similar Chronology Summary Briefings to be presented at MEPAG, VEXAG, etc.

What Should OPAG do?