



The Genealogy of OSIRIS-REx

*Asteroid Sample
Return Mission*

**New Frontiers-3
Proposal Due July 31, 2009**

**Principal Investigator
Michael Drake (UA)**

**Deputy PI
Dante Lauretta (UA)**



Principal Investigator-led mission opportunities in NASA Planetary Science

- Discovery

- Medium-class, cost-capped mission (\$425M in Discovery 12)
- Many successful missions (Pathfinder, NEAR-Shoemaker, Lunar Prospector, Genesis, Genesis, Stardust, Deep Impact, Kepler, Dawn, MESSENGER), one failure (CONTOUR), (CONTOUR), and one in development (GRAIL).
- Next opportunity – D13, proposals due ~early 2010

- Scout

- Medium-class, cost-capped mission (\$475M in Scout 2)
- One successful mission (Phoenix) and one in development (MAVEN)
- Next opportunity – Scout 3?

- New Frontiers

- Large-class, cost-capped mission (\$650M in NF3 + launch vehicle)
- One in flight (New Horizons) and one in development (Juno)
- Next opportunity – NF3, proposals due July 31, 2009



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May 17, 2009

- Independent body that provides oversight and guidance for for NASA science activities
- Produced the *New Frontiers in the Solar System* document in in 2003
- Described Asteroid Rover/Sample Return mission concept
 - Recommended returning to 433 Eros to build on the NEAR mission



The first attempts at a NASA Asteroid Sample Sample Return Mission – Hera

- University of Arkansas – Lockheed Martin – JPL team proposed mission concept
- Submitted to Discovery 10
(+ Discovery 9?)
- Never selected for Phase A Concept Study
- In preparation for Discovery 11, JPL and Lockheed Martin parted ways





OSIRIS is born

- Discovery 11 mission opportunity in 2004
- Hera team resubmits
- Lockheed Martin and UA team together and submit first OSIRIS proposal
- No spacecraft mission selected
- Moon Mineralogy Mapper instrument selected as Mission of Opportunity on Chandrayaan mission
- OSIRIS team is debriefed and decides to regroup for Discovery 12





Discovery 12 – Step 1

- Immediately after Discovery 11 debrief, OSIRIS team develops a schedule schedule for responding to the Discovery 12 opportunity.
- Goddard Space Flight Center is brought in to perform Mission Management Management
 - Lack of NASA center considered a weakness
 - JPL continuing to move forward with Hera team
- OSIRIS submits D12 Step-1 proposal in 2006
- Hera team also resubmits a Step-1 proposal
- Three teams are selected for Phase A Concept Studies
 - GRAIL – Lunar gravity field mapper
 - Vesper – Venus atmospheric science orbiter
 - OSIRIS – Asteroid Sample Return



Discovery 12 – Phase A

- Each team awarded \$1.2M for an 8-month Concept Study
 - Refine mission profile
 - Develop implementation plan
 - Determine mission cost and cost risk posture
 - Produce 200+ page document (plus four movies, project schedule, etc.)
- NASA TMCO panel evaluates Concept Study Report and performs a site site visit with each team
 - One week in advance, team receives ~80 questions from TMCO panel
 - Team prepares written and oral responses to TMCO questions
 - 10-hour presentation period in front of 50-member TMCO panel
 - Extensive question-and-answer sessions
 - Tiger teams work solutions to extended questions
- Ultimately, NASA selects GRAIL mission
- OSIRIS scores well for science, engineering, and mission design but is judged too expensive for Discovery-class mission (\$425M cost cap)



NOSSE Report – March, 2008

- NRC establishes a committee to provide guidance to NASA on NASA on list of eligible missions for the next New Frontiers Frontiers mission (NF3).
- A total of eight mission concepts are recommended
 - South-Pole Aitken Basin Sample Return
 - Asteroid Rover/Sample Return
 - Comet Surface Sample Return
 - Trojan/Centaur Flyby
 - Venus In Situ Explorer
 - Ganymede Observer
 - Io Observer
 - Network Science



NF3 Asteroid Rover/Sample Return requirements

- Driven in large part by the OSIRIS mission concept, the NRC suggests that that carbonaceous asteroids are the most promising targets for asteroid asteroid sample return. The emphasis on sample return from Eros is dropped dropped
 - Map the surface texture, spectral properties (e.g., color, albedo) and geochemistry of the the surface of an asteroid at sufficient spatial resolution to resolve geological features (e.g., (e.g., craters, fractures, lithologic units) necessary to decipher the geologic history of the the asteroid and provide context for returned samples;
 - Document the regolith at the sampling site in situ with emphasis on, e.g., lateral and vertical vertical textural, mineralogical, and geochemical heterogeneity at scales down to the submillimeter; and
 - Return a sample to Earth an amount sufficient for molecular (or organic) and mineralogical mineralogical analyses, including documentation of possible sources of contamination contamination throughout the collection, return, and curation phases of the mission.



OSIRIS REx is evolution of our Discovery concept concept into a New Frontiers-class mission

- **Origins**

- provide pristine sample to reveal the origin of organics that led to life on Earth (and Mars?) (and Mars?)

- **Spectral Interpretation**

- provide ground truth for ground-based and space based spectral observations of a B-type NEO

- **Resource Identification**

- identify B-type NEO resources that we might use in human exploration

- **Security**

- quantify the Yarkovsky Effect, thus providing a tool to aid in securing the Earth from from future asteroid impacts

- **Regolith Explorer**

- Explore the regolith at scales down to sub-millimeter



OSIRIS REx intends to win the NF3 competition

- **The team is experienced**
 - Heritage team with many Discovery and Scout mission accomplishments
- **The team is dedicated**
 - Five years of continuous mission-concept development
- **The team is relentless**
 - We have never stopped working on this mission concept concept
- **The team is the best**
 - Only team that has returned samples from an extraterrestrial extraterrestrial body



Stay Tuned

- NF3 Phase A selections
expected in the Fall of 2009
2009