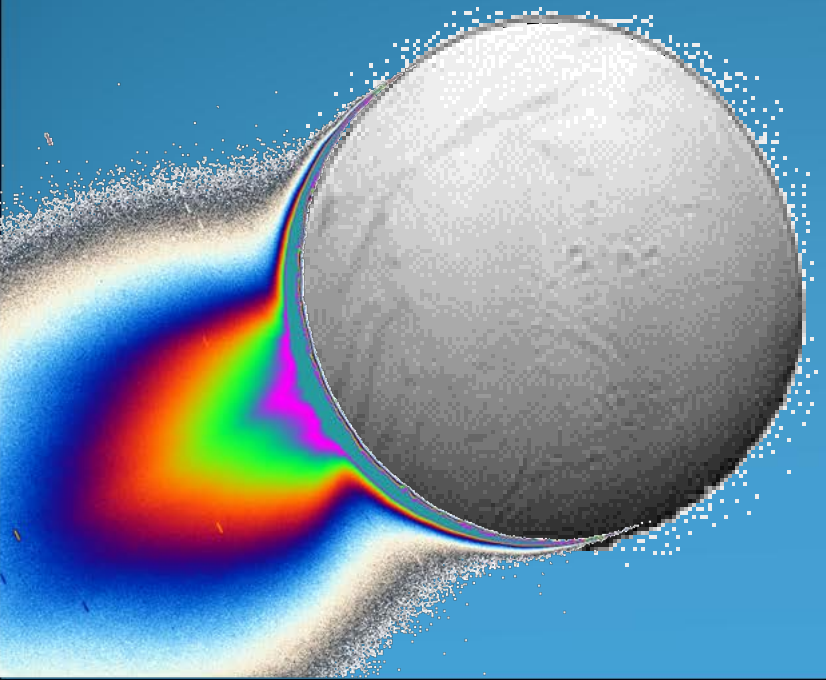
Low-cost Sample Return from an Icy World: Enceladus

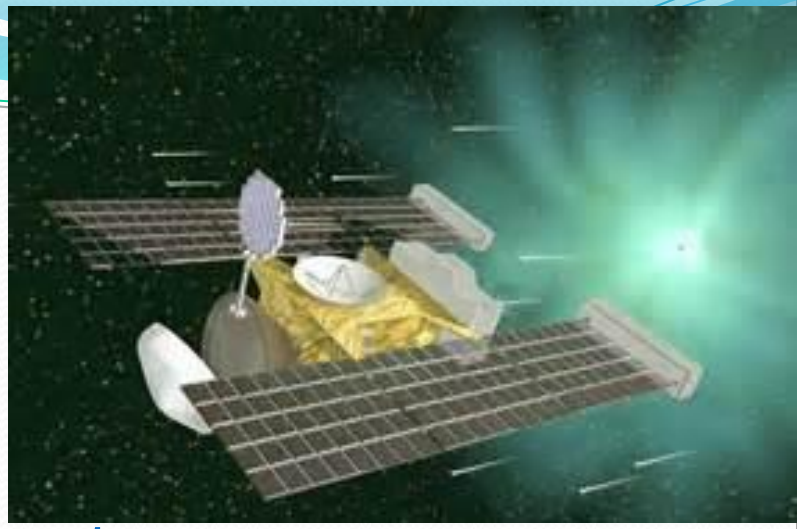


Tsou, Anbar, Atwegg, Baross, Brownlee, Dissly, Glavin, Glein, Kanik, McKay, Porco, Sekine, Takai, Takano, Williams & Yano

Feb 20, 2015

NASA Ames 1:30 pm

STARDUST Payload

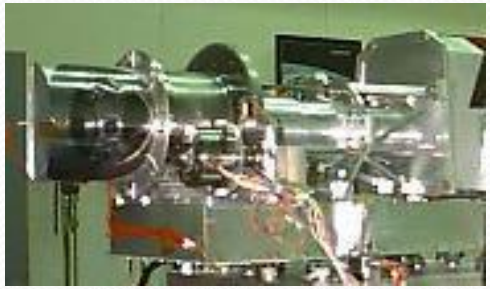


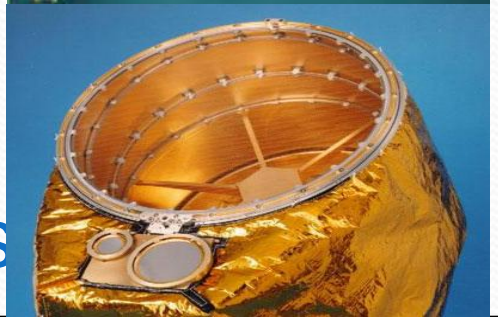
Sample Instrument

- Sample Capture Instrument

In Situ Instruments

- Voyager Wide Angel Camera
- Mass Spectrometer
- Dust Flux Monitor
- Dust Shield Microphone
- Spacecraft Attitude Control Sys





2 OBSERVATIONS

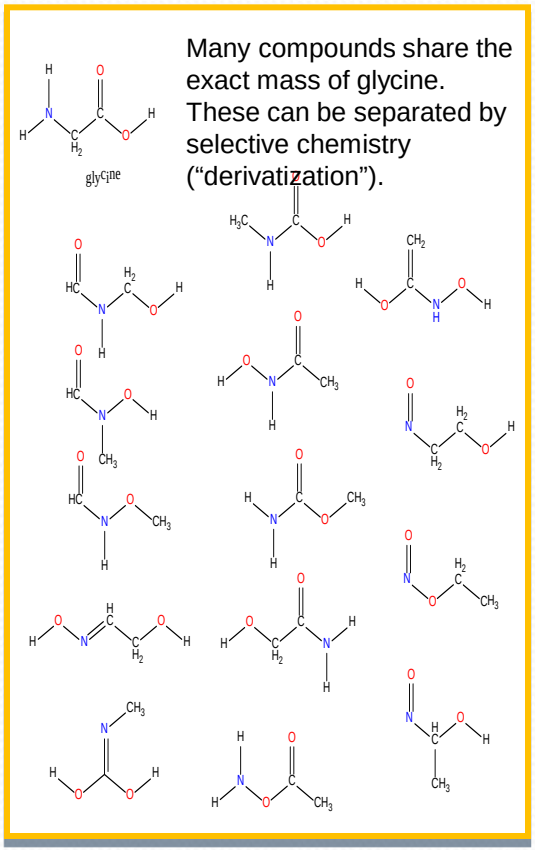
- Returning Samples is Essential to Finding & Confirming Life
- A Proven Plume allows a low-cost flyby sample return

2 REQUESTS

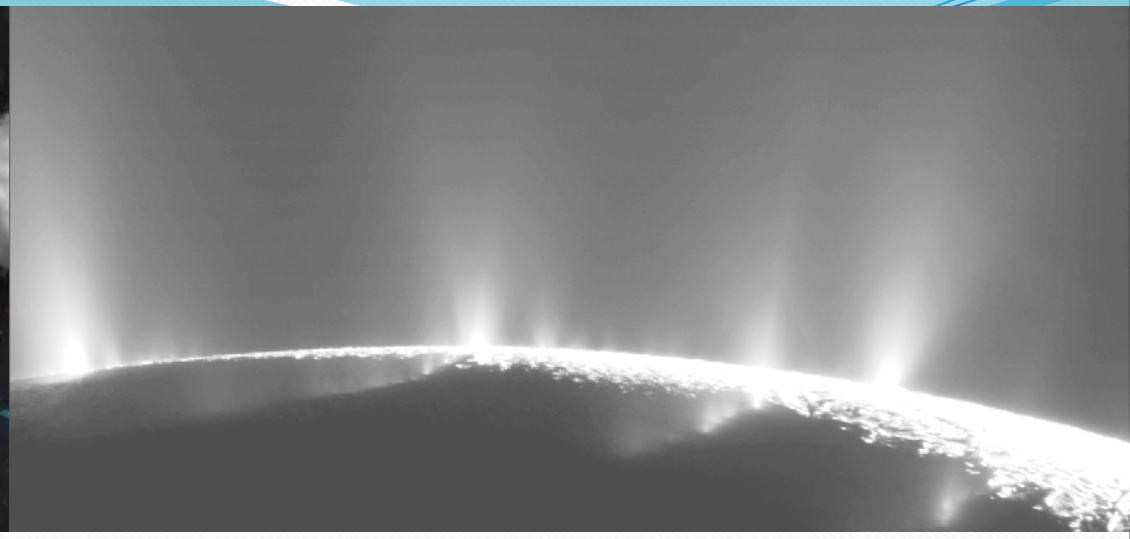
- How to add Enceladus Sample Return to the Decadal List
- Formulate a NASA group to work with JAXA/ISAS' Working Group on PP/design issues

Returning Samples - Essential to Finding & Confirming Life

- Stardust found glycine (m/z 75), confirming it being cometary took 3 yrs
- Advance Proton Source, Mega SIMS – too big to fly
- Terrestrial instruments > decade advanced than flight instruments
- Consensus of analysts and labs
- Modification of analysis procedures
- Experimentation on samples
- Available to new instruments, new analysts







A Plume allows low-cost flyby sample return

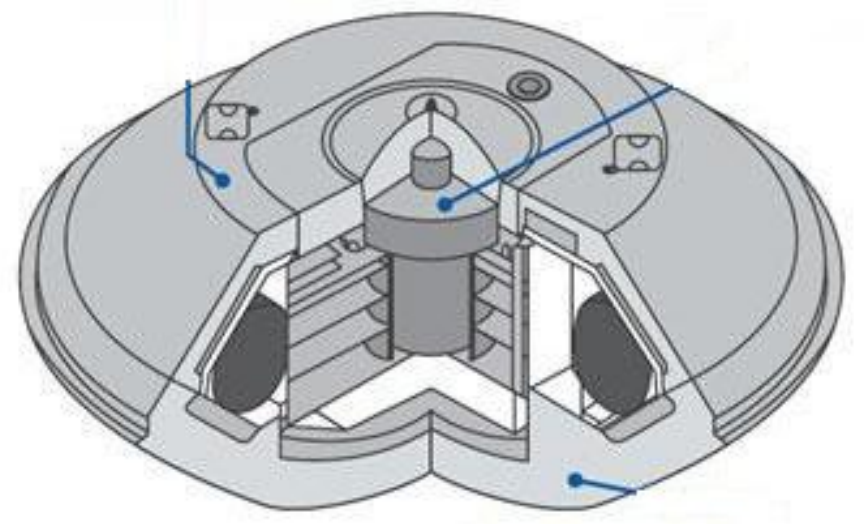
- Fresh samples
- Locating samples unnecessary
- No landing required
- Proven flyby sample return technology: Stardust and Hayabusa I

Include in the Decadal List

- LIFE should be a focused Discovery Mission like Stardust
- Without a RPS, LIFE needs a New Frontiers
- Enceladus Sample Return is not in the Current Decadal

Establish a NASA/Japan Study

- JAXA/ISAS
  - Working Group formed in 2013
  - Planetary Protection Issues
- JAMSTEC
  - Sample capturing
  - Sample handling, BSL4



Enceladus Flyby Sample Return Needs New Trajectory

- Previous studies by direct Enceladus flyby
  - Long mission duration, > 18 years
  - High encounter speeds, > 10 km/s
  - Cost > $1B
- New Trajectory – Saturn Orbit Insertion
  - Pump down to Enceladus via Titan
  - Shorter mission duration, 13.5 years
  - Low Encounter speeds 4 to 2 km/s
  - Multiple flybys

Needs cost reduction

Foreign Contributions

- NASA – Senior Partner
  - Project Management
  - Mission Operations
  - Spacecraft
  - Launch Vehicle
- Japan
  - Integrated Sample Subsystem
  - Operations Support
- Switzerland
  - Mass Spectrometer
- Other Contributions

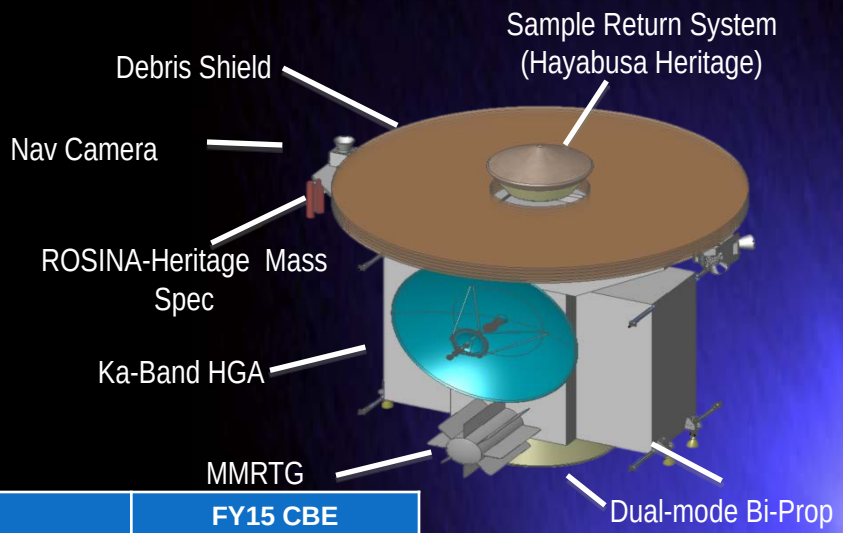
Case : LIFE-Enceladus Sample Return
via 2014 Discovery

- Team 

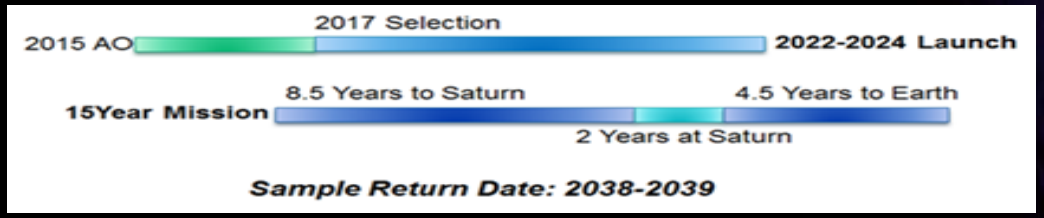
- JPL - Project Management
- Ball Aerospace - Spacecraft
- JAXA/ISAS - sample capsule subsystem
- JPL with JAXA/ISAS - operations
- JAMSTEC - Sample Processing, BSL4 facility
- In Situ (MS) and Samplings (plume, E ring)
- 2 GFE ASRGs for electrical power source

LIFE Fact Sheet

Parameter	Value	Margin
Dry Mass	667 kg	17%
Wet Mass	1682 kg	36%
Power (EOL)	220 W	62-34%
Falcon 9 V1.1	2290 kg	36%
Ka Band 75W	42 kb/s	3.9 dB



Major Component	FY15 CBE
LIFE NASA Cost	$513M
Contributions	
Integrated Sampling Subsystem (JAXA/ISAS) Sample De-integration Facility (JAMSTEC) Flight Operations Support (JAXA/ISAS)	$100M $50M $50M
Mass Spectrometer (UoBern)	$30M
Total	**$743M**

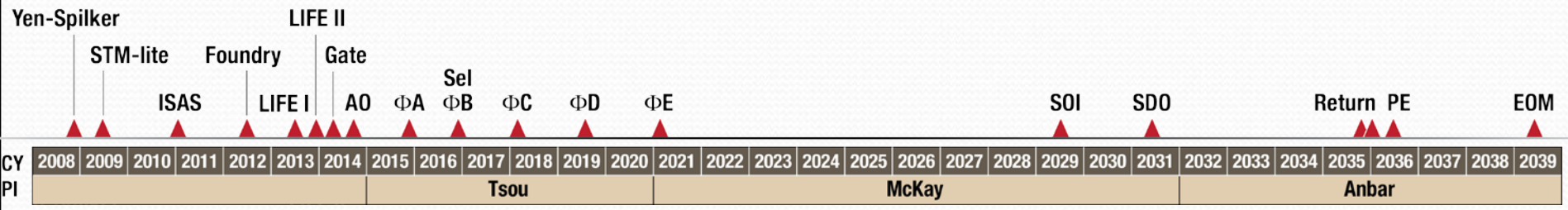


LIFE Findings

- Trajectory Innovation for low cost flyby Enceladus
- Sample Return Technology - NASA JAXA
- Mutual beneficial joint LIFE effort with Japan
- Can Fit a Discovery with Contributions/GFEs

Challenges

- Multigenerational Mission Duration – Phased PI



- Cost realism – International Cooperation
- Backward PP Requirements – Hayabusa II

- Integrated Sample Handling/Return Subsystem
- Sample Earth Contamination Protection
- RPS Availability