JPL SUBGLACIAL TECHNOLOGY DEVELOPMENTS IN ROBOTICS
AND INSTRUMENTATION SUPPORTING A EUROPA OCEAN
EXPLORATION MISSION

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F Carsey, 2000
The Europa Chaos Region Provided Key Motivation for Earth Scientists to Look at Europa
Sea Ice Cakes

F Carsey, 2000
Antarctic Ice Shelf SAR Image
From Galileo Data
Astonishing Results
Integrated Data Set Points to Ocean a Few Km’s Beneath Surface
Chemical Data of Surface Has 100 km Variability

Thus, No “Easy” Mission Answers Key Questions
Surface Study Requires Long Traverse In Hostile Conditions
Ocean Exploration Requires Deep Subsurface Mobility

Our Decision: Focus on the Ocean and Adjacent Ice

Crucial Technology Issues:

- Planetary Protection—Modest Progress
- Subsurface Mobility/Instrumentation—2 Projects
- Surface-Based Survey—One Concept in Development
- Communication—Scant Progress
- Scientific & Operational Autonomy—Scant Progress

F Carsey, 2000
ICE

WEIGHT RATIO (g/kg)

TEMPERATURE (°C)

BRINE

ICE

SALTS

F Carsey, 2000
Ice Grains, 0.5 mm to 10 cm diameter, are bounded on triple junctions by brine/hydrated salt inclusions
ICE AS A THEME FOR SCIENCE AND TECHNOLOGY

Ice Has Properties That Make It Highly Interesting In Studies on Earth, Mars, Europa, Callisto, Titan...

In-Situ and Basal Processes Are Particularly Relevant--
    Higher Temperatures Than Surface Ice
    Access to Minerals And/or LH2O
    Protection From Harmful Radiation, Chemistry

Exploration of Basal Regime Requires Technology Development: Access, Pressure, Communications, etc

This Development Has Elements Common to Other Science and Engineering

Planetary Preparation Can Be Partnered With Useful Science and Development

F Carsey, 2000
Baseline Design
Ice Camera Probe
Caltech-JPL West Antarctic Basal Ice Study
Hydrothermal Vent (Deep Water) Probe
Figure 1 Inflatable Rover Engineering Model
Rover wheels are 1.5 m diameter. The proposed vehicle would probably have smaller wheels for stability in winds. JPL staff shown for scale; all scenes are in California where the trafficability of the rover was examined.

THE INFLATABLE ROVER DRIVES ON ALL TERRAINS

F Carsey, 2000
Snowcat breaking show bridge, TAE (Fuchs and Hillary, 1958).
International Trans Antarctic Scientific Expedition (ITASE) planned traverses, starting in 1999-2000 field season