Alvin Video Mosaicking

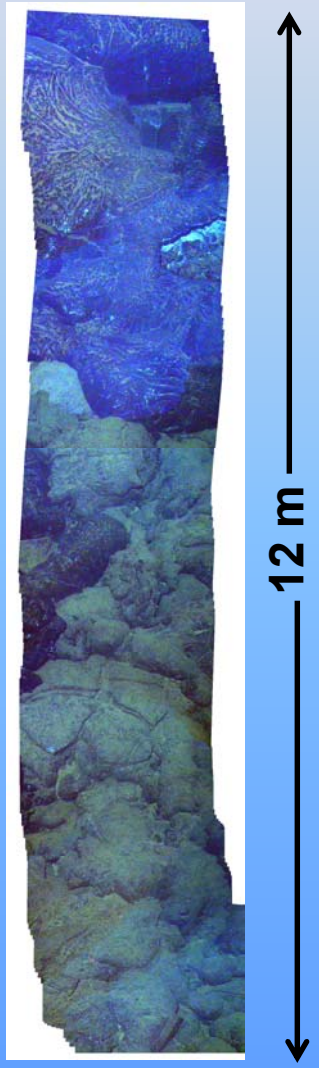
DESSC Meeting
May 31, 2007

WHOI Co-PI's

Stace Beaulieu and Tim Shank (Biology)
S. Adam Soule (Geology)

UNH Co-PI's:

Yuri Rzhanov and Larry Mayer
(Center for Coastal and Ocean Mapping)



Lava contact (EPR, Nov. 2006)

- *Objectives*

"The Generation of Georeferenced Video Mosaics in Support of Submersible and ROV Operations"

NSF-OCE
0452528,
0451983

Main objective:

Software to create image mosaics from video and navigation data collected during Alvin dives

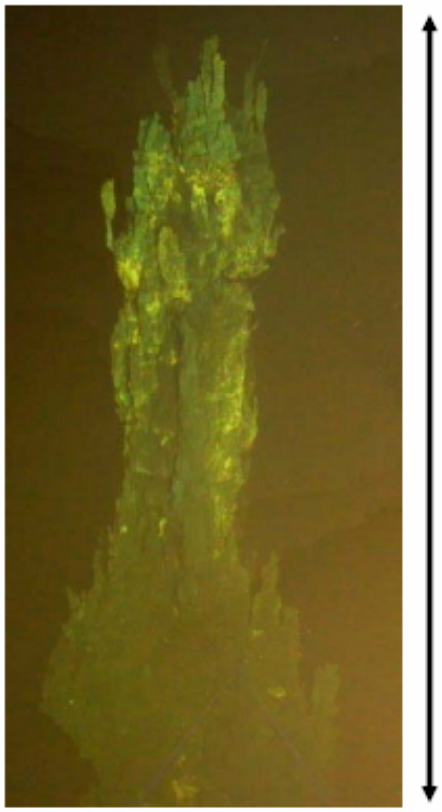
How do we get from these…

+

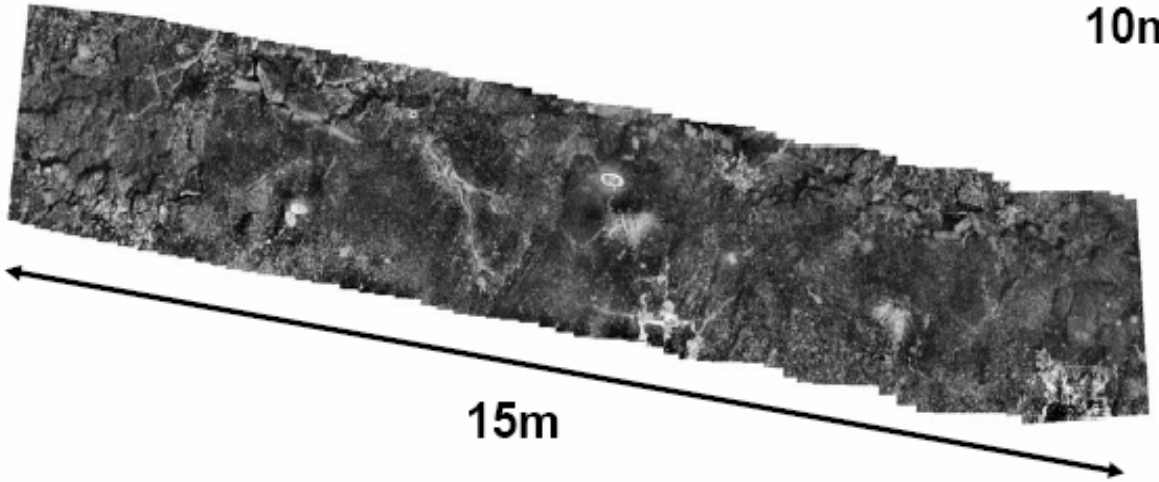
navigation data

…to these??

Panorama of vent discovered on Alvin Dive 4271 (EPR, Nov. 2006)



Transect at Rosebud on Alvin Dive 4117 (May 2005)



Why video mosaic?

- Dive planning and reports during the cruise
- Science (during or post-cruise)

  Geology:

  Identification of features on larger scale than single images;

  Visual confirmation of features in side-scan sonar or bathymetric maps.

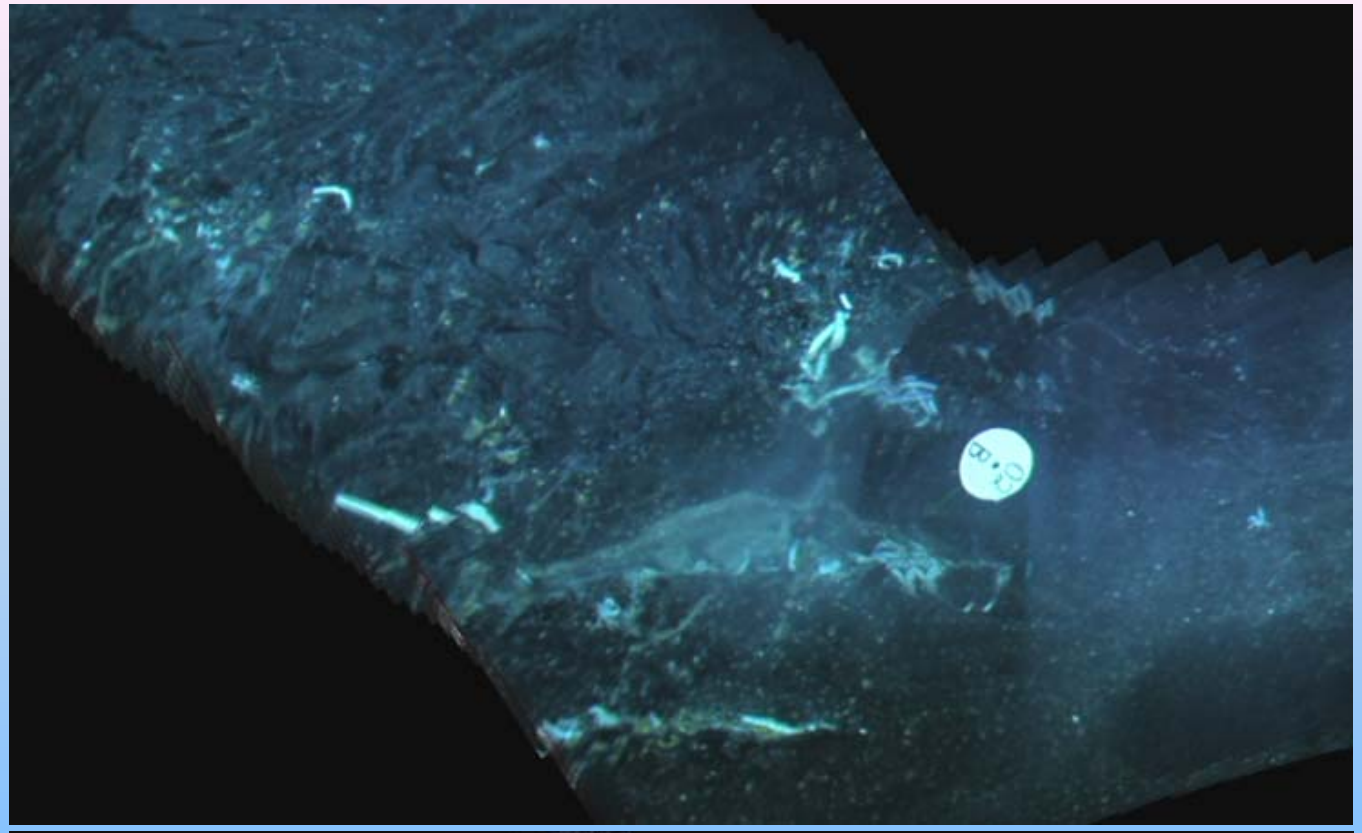
  Biology:

  Habitat mapping and density of benthic fauna.

Capability already exists for IFREMER vehicles…
first paper published earlier this year…

Rosebud Marker B

Transect mosaic 2002

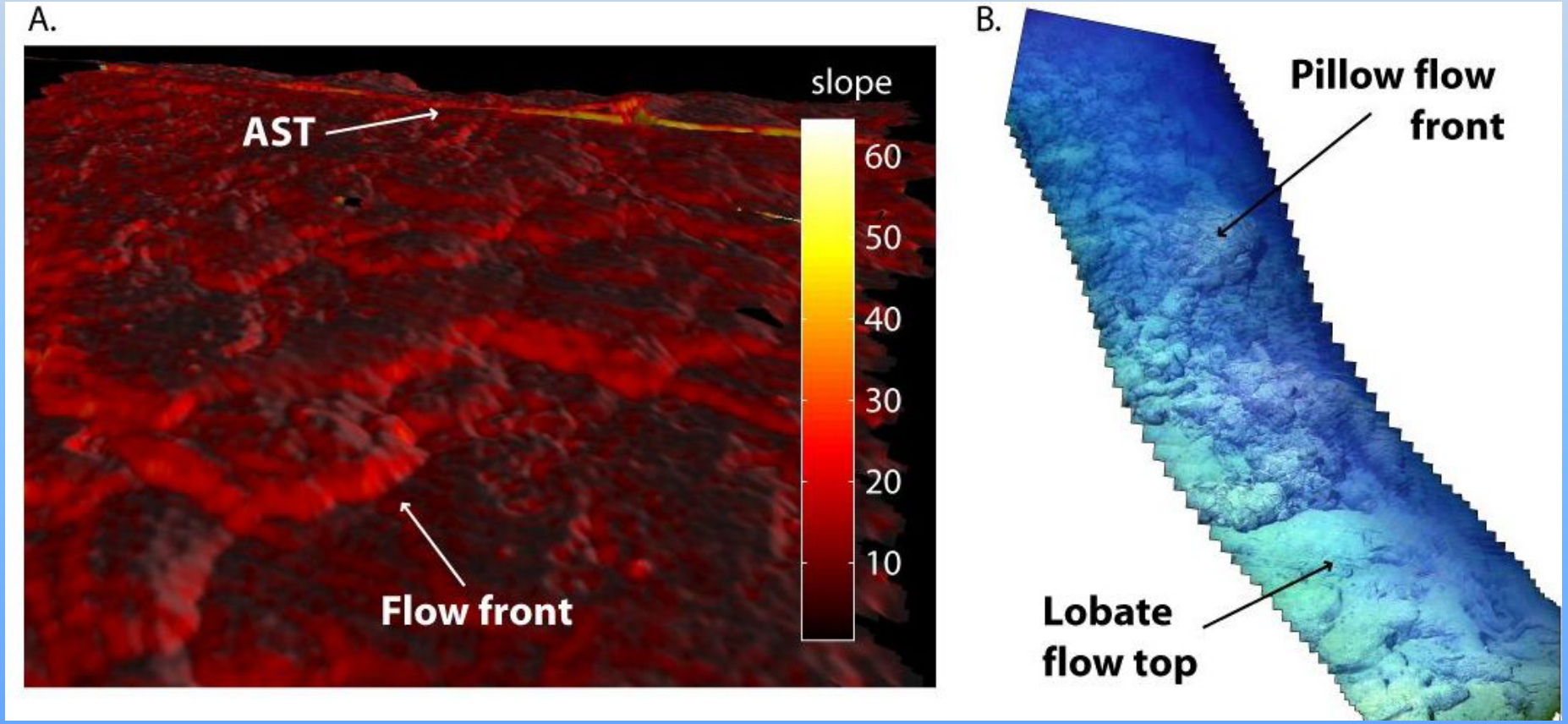


Panorama mosaic 2005

Example geological interpretation

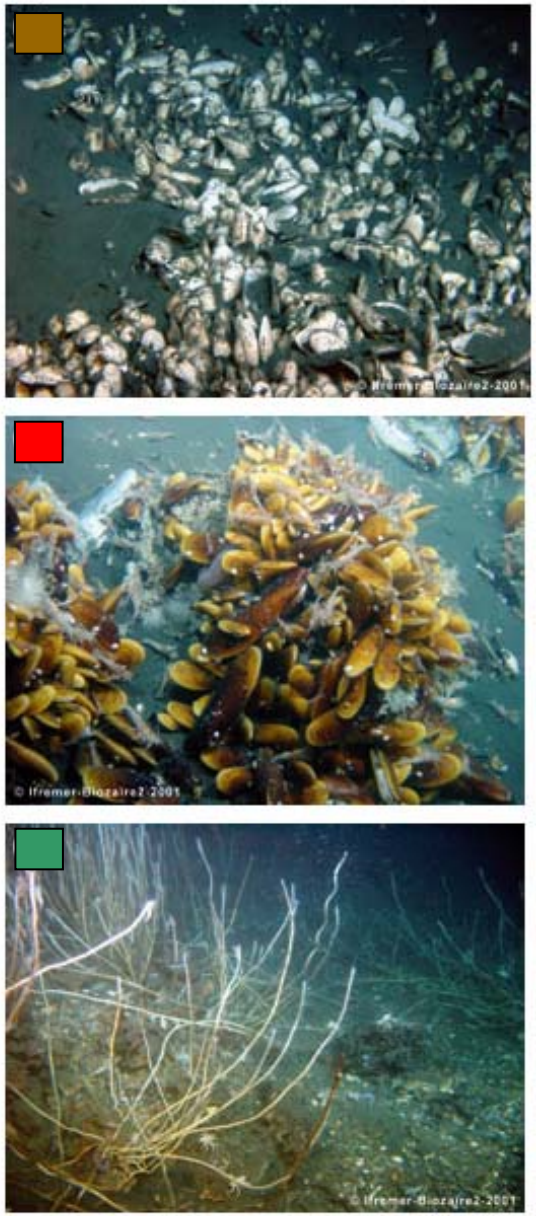
Plot of slope draped over bathymetry on ridge flank at EPR

Visual confirmation of lava contact



Slide from Adam Soule, Yuri Rzhanov

Habitat map of a cold seep,
using IFREMER's ROV Victor 6000
and proprietary video mosaicking software



Olu-LeRoy et al. (2007)

Alvin Video Mosaicking Software Suite

- Manual processing *

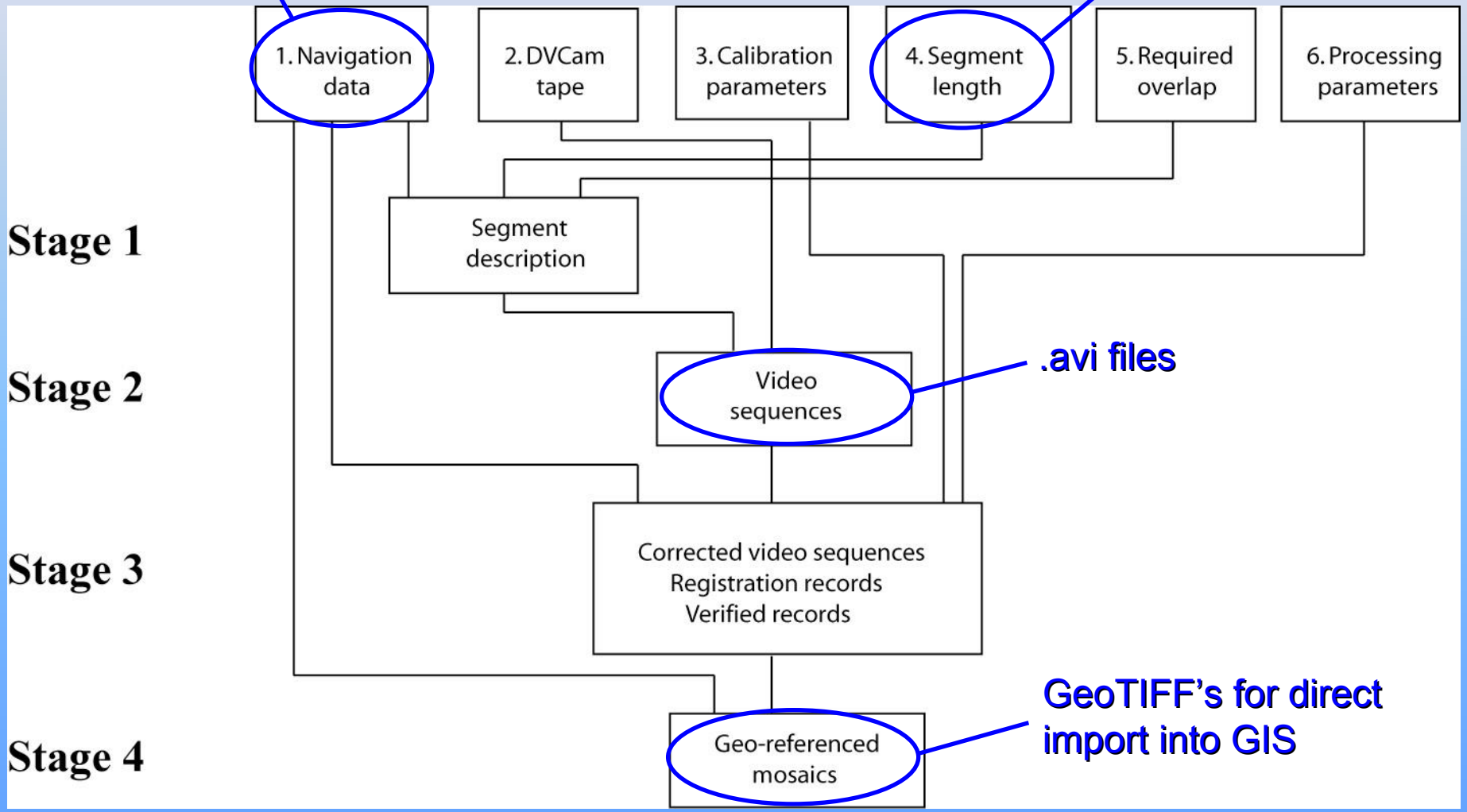
  Useful for transect mosaics when you have limited or no navigation data, or when you want to quickly make a mosaic for a targeted video segment;

  Required for panorama mosaics.

- Automated processing

  Produces transect mosaics for entire dive track, using video frames extracted from DVCAM tapes based on vehicle navigation and altitude data.

Automated Processing



Rzhanov et al. (2006)

Transect at Rosebud on Alvin Dive 4117 (May 2005)

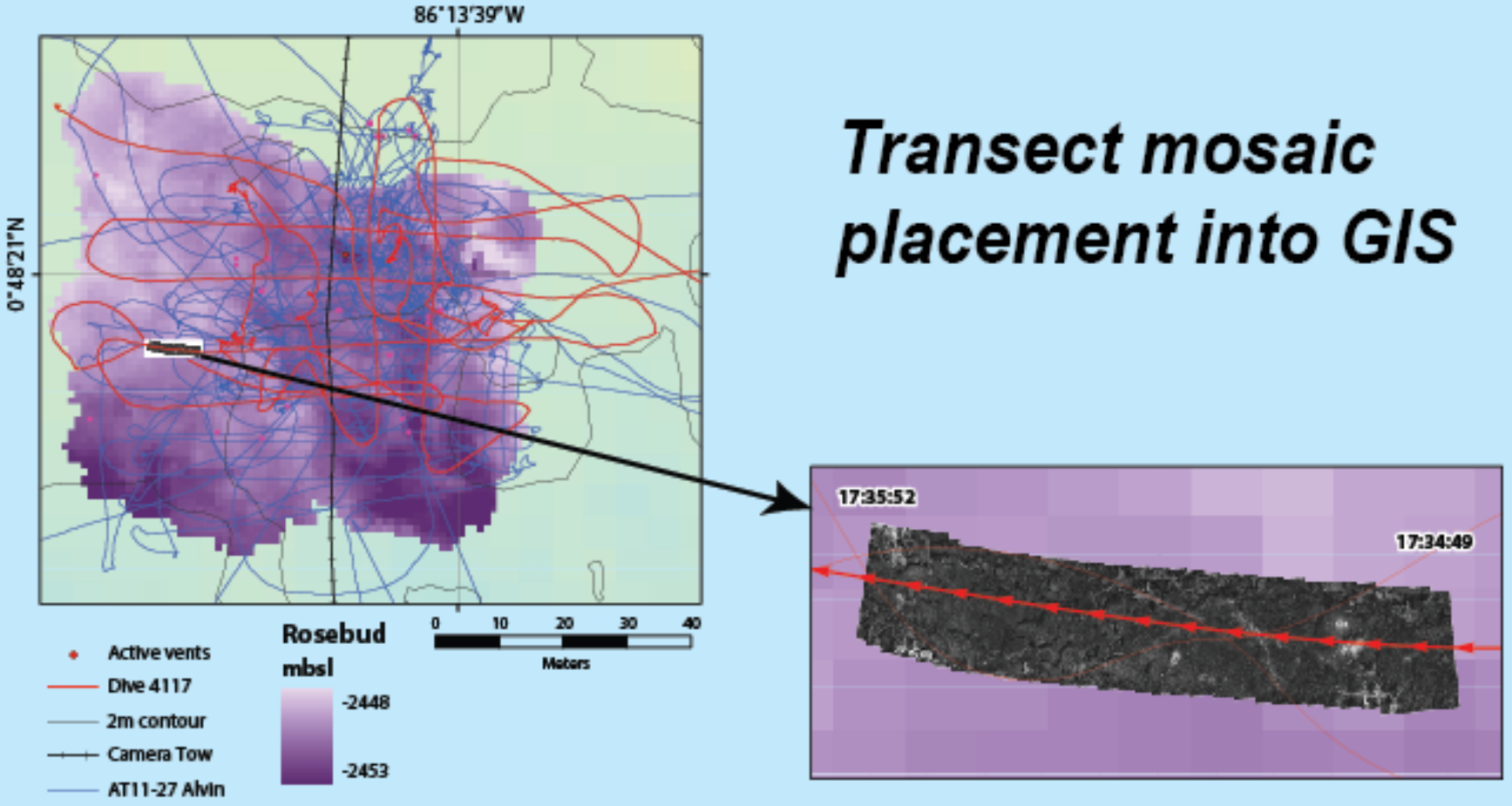


Figure by Adam Soule

Alvin Video Mosaicking Software Suite

Tested during 3 Alvin cruises:

EPR, Feb. 2004	Selected video segments (~1-min ea.)
Galapagos Rift, May 2005	1-hr “mow-the-lawn” survey to compare with still camera mosaic
EPR, Oct./Nov. 2006	Automated mosaicking performed during cruise for 7 of 15 dives; 42 - 98% (median 68%) of the mosaics were good (did not require manual post-processing) *.

** “Bad” mosaics generally due to switching cameras, altitude, or turbidity.*

Notes for data management from field trial (EPR, Oct./Nov. 2006)

Average no. mosaics per dive = 150
(~2250m total transit per dive)

Am't of data storage necessary per dive = 30 - 40 GB *
* (including .avi files; order of magnitude less if store only .tif files)

Video mosaicking Alvin Dive 4273 (EPR, Oct./Nov. 2006)

9-min of dive track along lava contact (total length 147m)

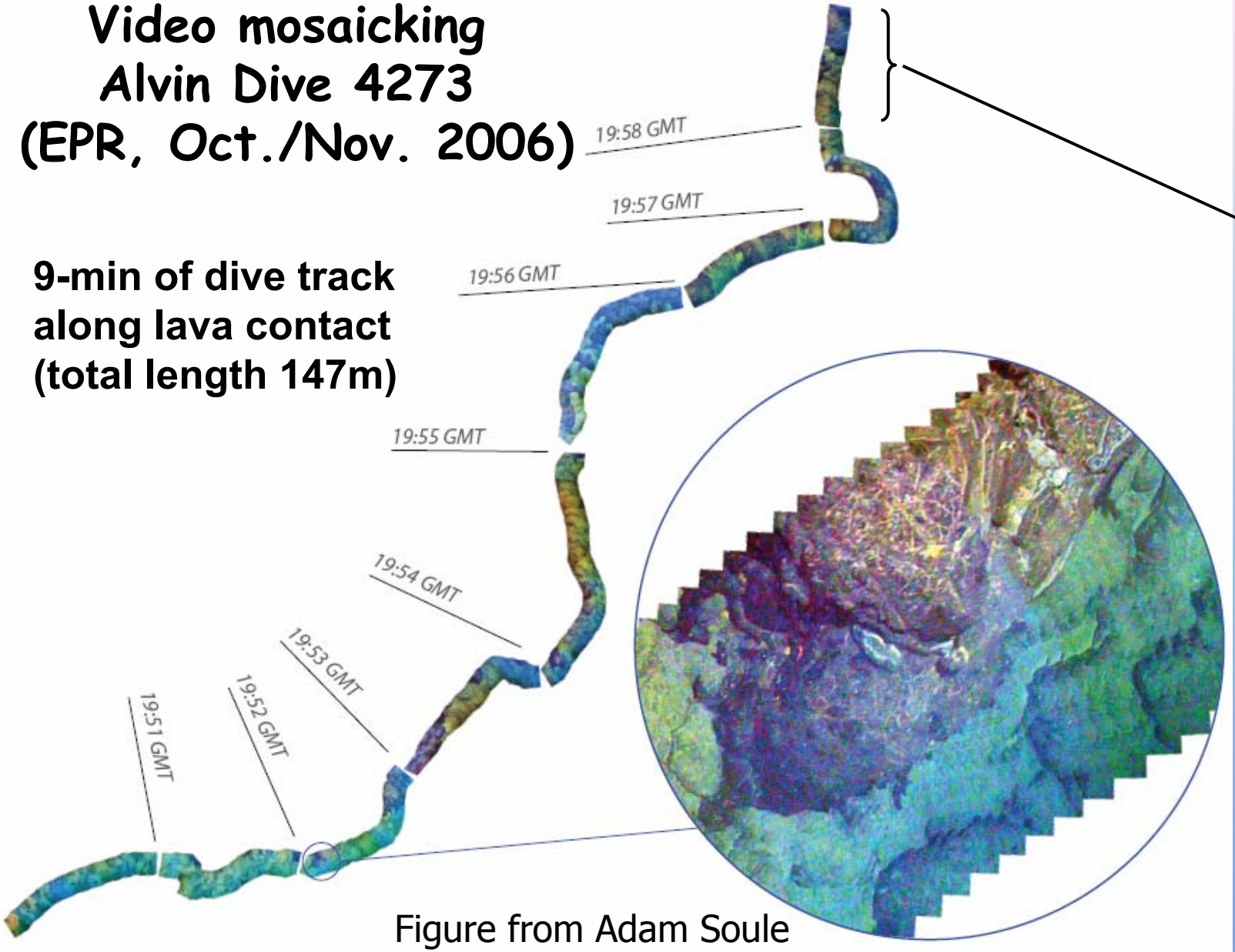


Figure from Adam Soule

For the best quality video mosaics…

Lights!

starboard lighting.

Camera!

starboard arm 3-chip:

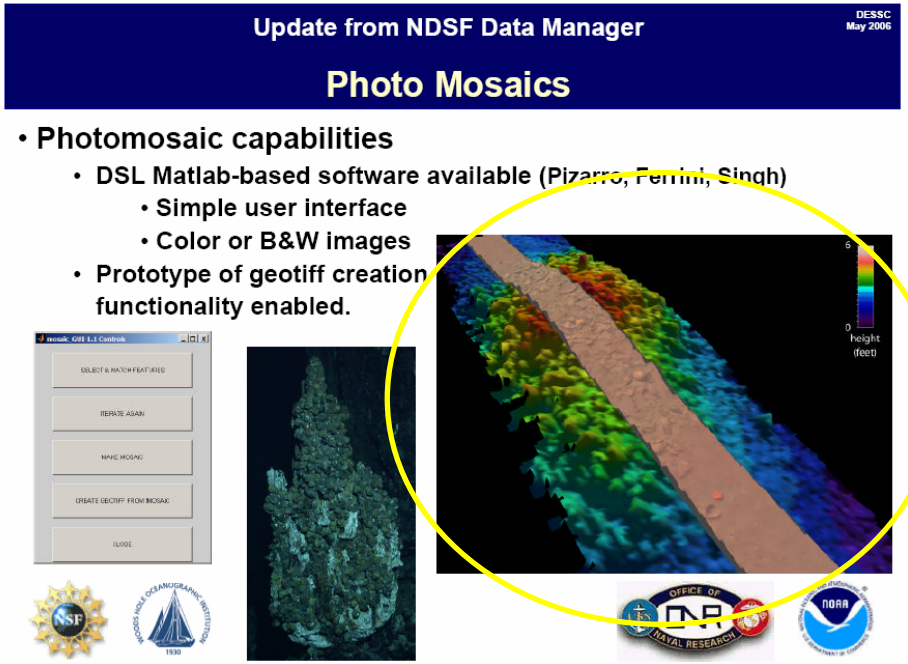
- as normal to seafloor as possible,
- zoomed all the way out,
- port observer recording the video transect,
- (optional) turn off overlay.

Altitude!

vehicle or Doppler altimeter; approx. 2-3m above bottom.

How does the new software differ from other available mosaicking software?

Slide from last year's DESSC meeting



Video mosaicking software	DSL photo mosaic software
Uses video sequences from DVCAM tapes, plus navigation data	Uses still images from user-supplied camera
Produces strip transects (single swath)	Produces 2-D mosaics (multiple swaths)
Runs via executable files (command prompt or GUI)	Runs via Matlab

- *Comparison to proprietary software*

Online description of ROV Victor 6000 promotes use of video mosaicking embedded in bathymetric swath

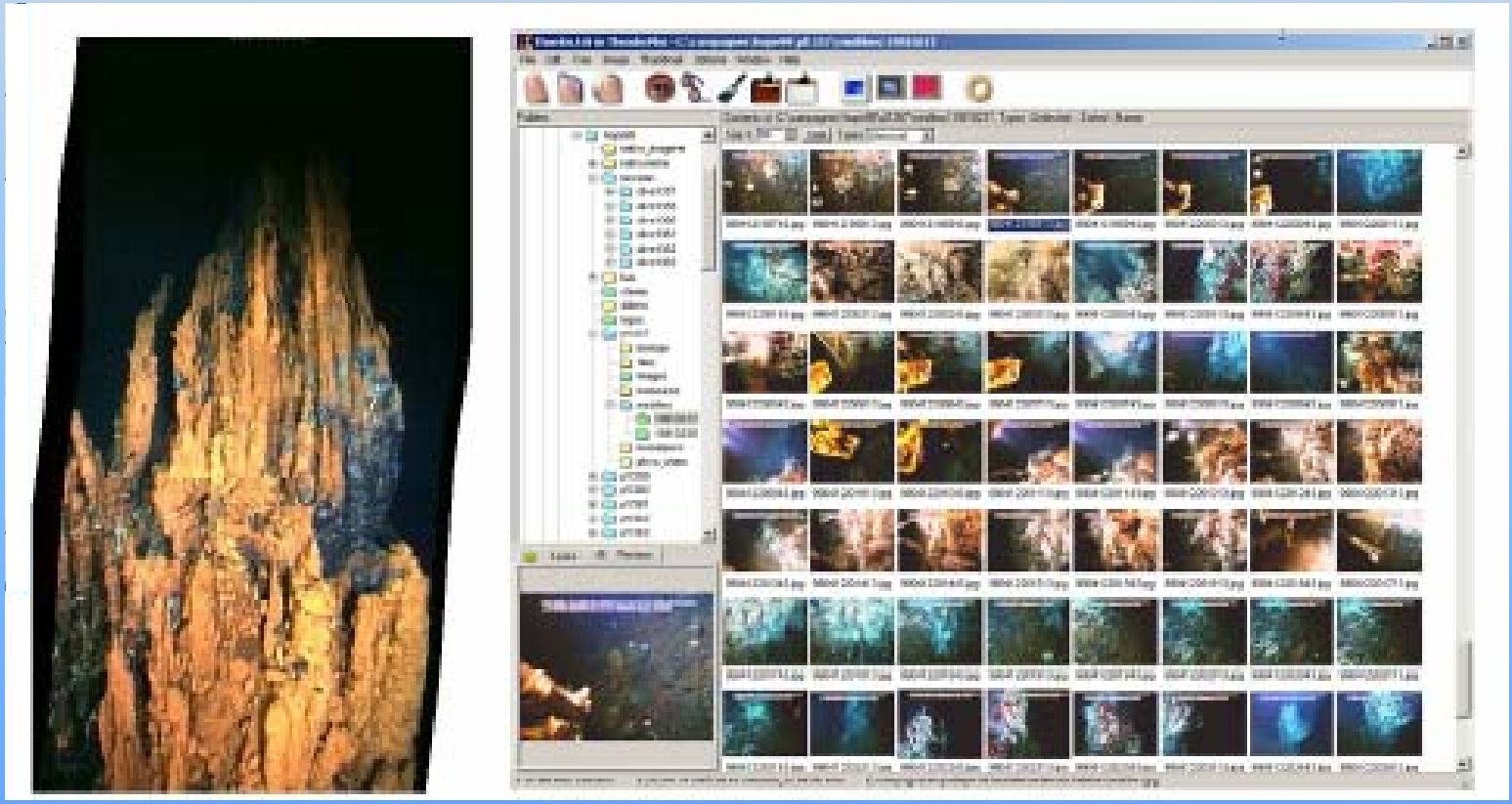
http://www.ifremer.fr/flotte/equipements_sc/logiciels_embarques/caraibes/journeesutilisateurs/Brest_2004/Presentation/CARAIBES%202004%20MMR.pdf

Together, Alvin Video Mosaicking Software and Alvin Framegrabber provide similar capability to proprietary software

Outputs of ADELIE software

Video mosaic

Proof sheet



http://www.ifremer.fr/fleet/systemes_sm/adelie/fiche-adelie151-uk.pdf

Quote from IFREMER Sept. 2006:
"… the cost of an ADELIE license is 6000 euros (about $7600)."

ADELIE users

- Research laboratories
  - Institut de Physique du Globe - Laboratoire de Gravimétrie et Géodynamique - Paris - France
  - Université de Bretagne Occidentale - Laboratoire de Géologie - Brest - France
  - Centre National de la Recherche Scientifique - UMR Géosciences Azur - Villefranche/mer et Sofia Antipolis - France
  - Station biologique de Roscoff - Roscoof - France
  - Alfred Wegener Institut - Bremerhaven - Germany
  - University of Bremen - Bremen - Germany
  - IFM-GEOMAR Leibniz Institute of marine science - Kiel - Germany
  - University of Erlangen-Nümberg - Erlangen - Germany
  - Unitersity of Amsterdam - Faculty of Earth Sciences Geomarine Centre - Amsterdam - Netherland
  - University of Lisbon - Geology department - Lisbon - Portugal
  - Museu Municipal do Funchal (Historia Natural) Madère - Portugal
  - University of The Azores - Portugal
  - Martin Ryan Marine Science Institute - Ireland
  - Institut of Zoology, University of SALZBURG - Austria
  - National Oceanography Centre - Southampton - United Kingdom
  - Ifremer - Départements Géosciences Marines, Etudes des Ecosystèmes Profonds, Sciences et Technologies Halieutiques, Laboratoires Environnement Ressources, - Brest, Sète, Nantes et Boulogne/mer - France
- Ships
  - L'Atalante - Ifremer - France
  - Pourquoi pas? - Ifremer - France

ROV Quest

http://www.ifremer.fr/fleet/systemes_sm/adelie/utilisateurs.htm
(accessed May 2007)

Alvin Video Mosaicking Timeline

Technical challenges
(e.g. extracting frames from DVCAM tapes)

⇨

Field trials on Alvin cruises
(manual processing 2004-2005, automated processing 2006)

⇨

Delivering software at sea and online

Where we are now

⇨ - We are recruiting scientists to try the software.

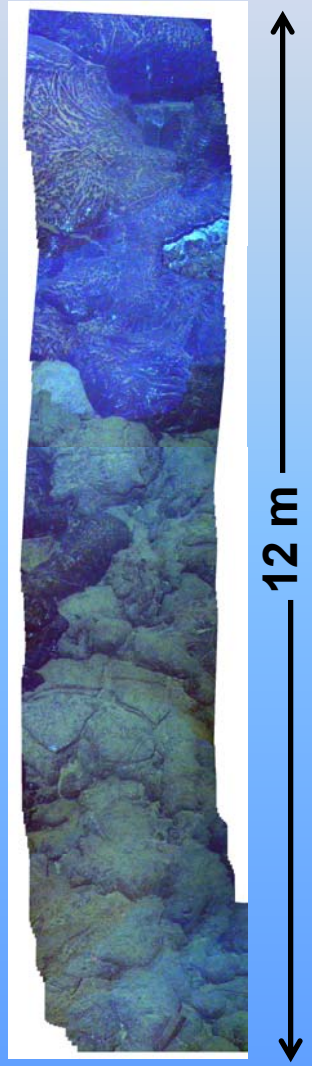
- We would like to identify an online “home” for the software.

- By 2008, we expect to publish the User Manual as a WHOI Technical Report.

Testimonials from science users of the software

"I thought it would be this huge time commitment, but it only took a few minutes to set up, and then it ran itself."
- Carly Strasser (WHOI graduate student)

"I thought it was easy to use. I like that you can start it going and then go do something else, and you don't have to babysit it."
- Kate Buckman (WHOI graduate student)



Future application to video from ROV Jason II

Technical challenge:
Extraction of video frames from DVD's

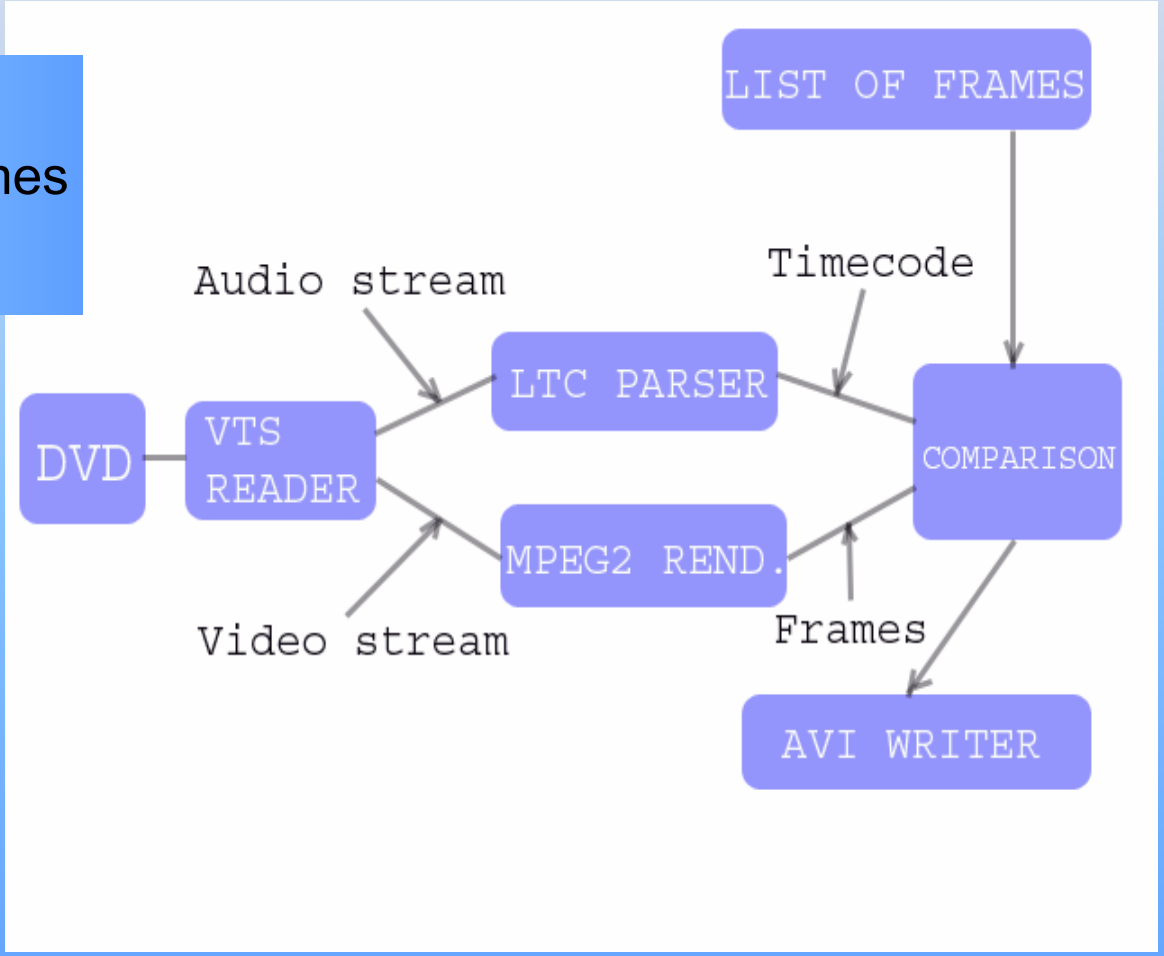
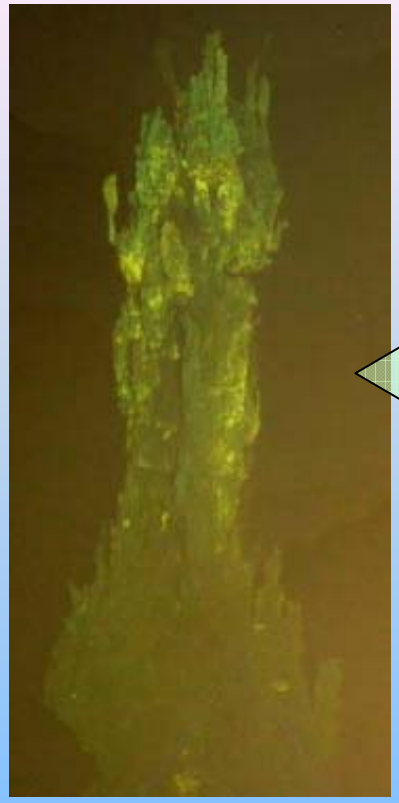
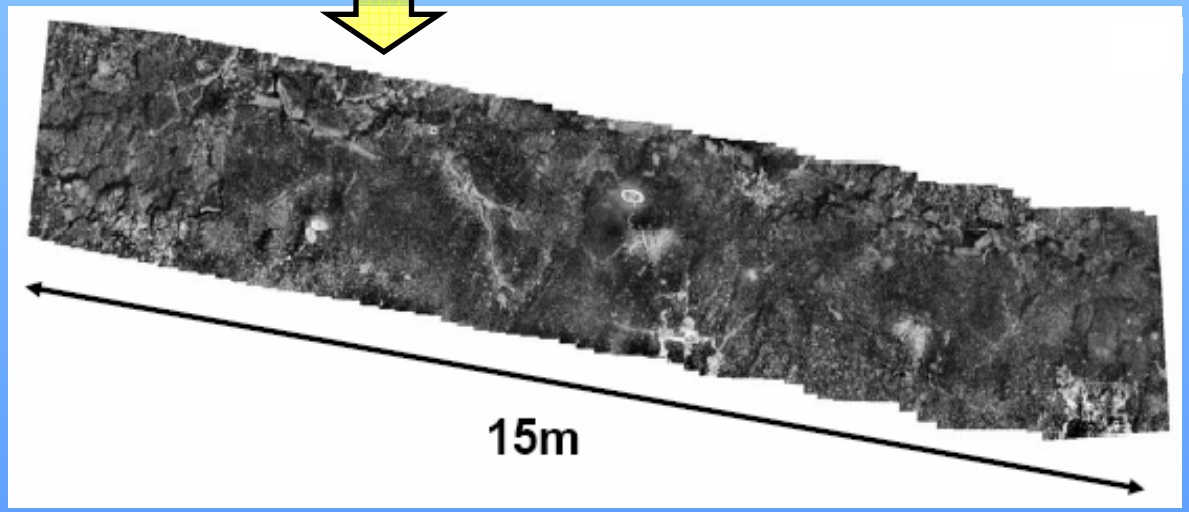


Figure from Yuri Rzhanov





Questions?
Contact stace@whoi.edu