Reconnaissance Methods for Regional Inventory of Seep Chemosynthetic Communities

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RV GYRE
RV METEOR 67-2

MMS

TDI Brooks

The Island University

Texas A&M-Corpus Christi

Co-Investigators

- Participants of RV GYRE & RV ATLANTIS cruises
- Bill Shedd, Jesse Hunt, Ron Lai – MMS
- Harry Roberts, Bob Carney – LSU
- Jim Brooks, Bernie Bernard – TDI
- Chuck Fisher. Eric Cordes – PSU / Harvard
- Samantha Joye – UGA
- Beate Zimmer – TAMUCC

Students

- Maggie Dalthorp
- Oscar Garcia
- Adriana Leiva

Supporting Programs

Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico:

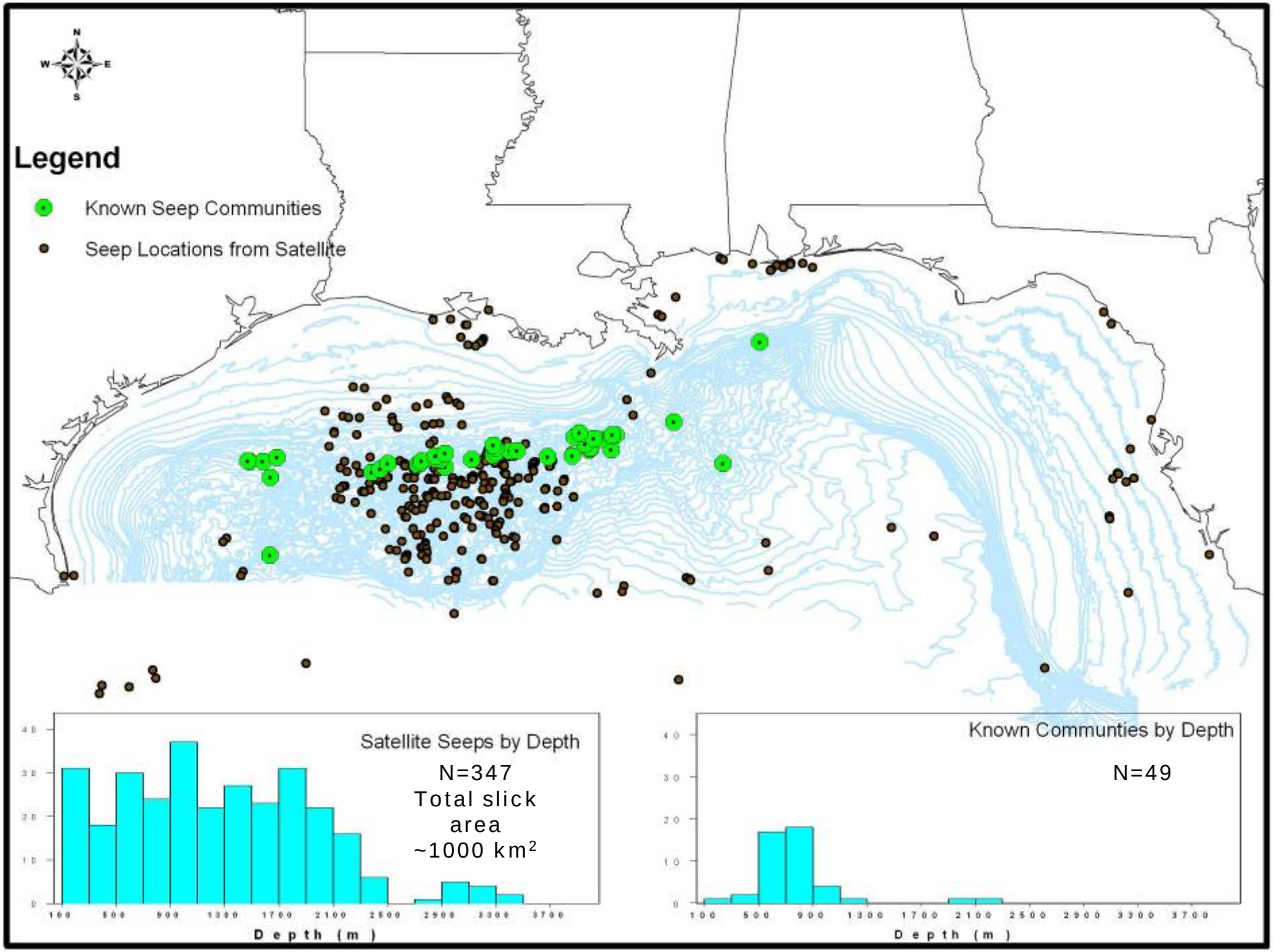
Minerals Management Service
NOAA Ocean Exploration

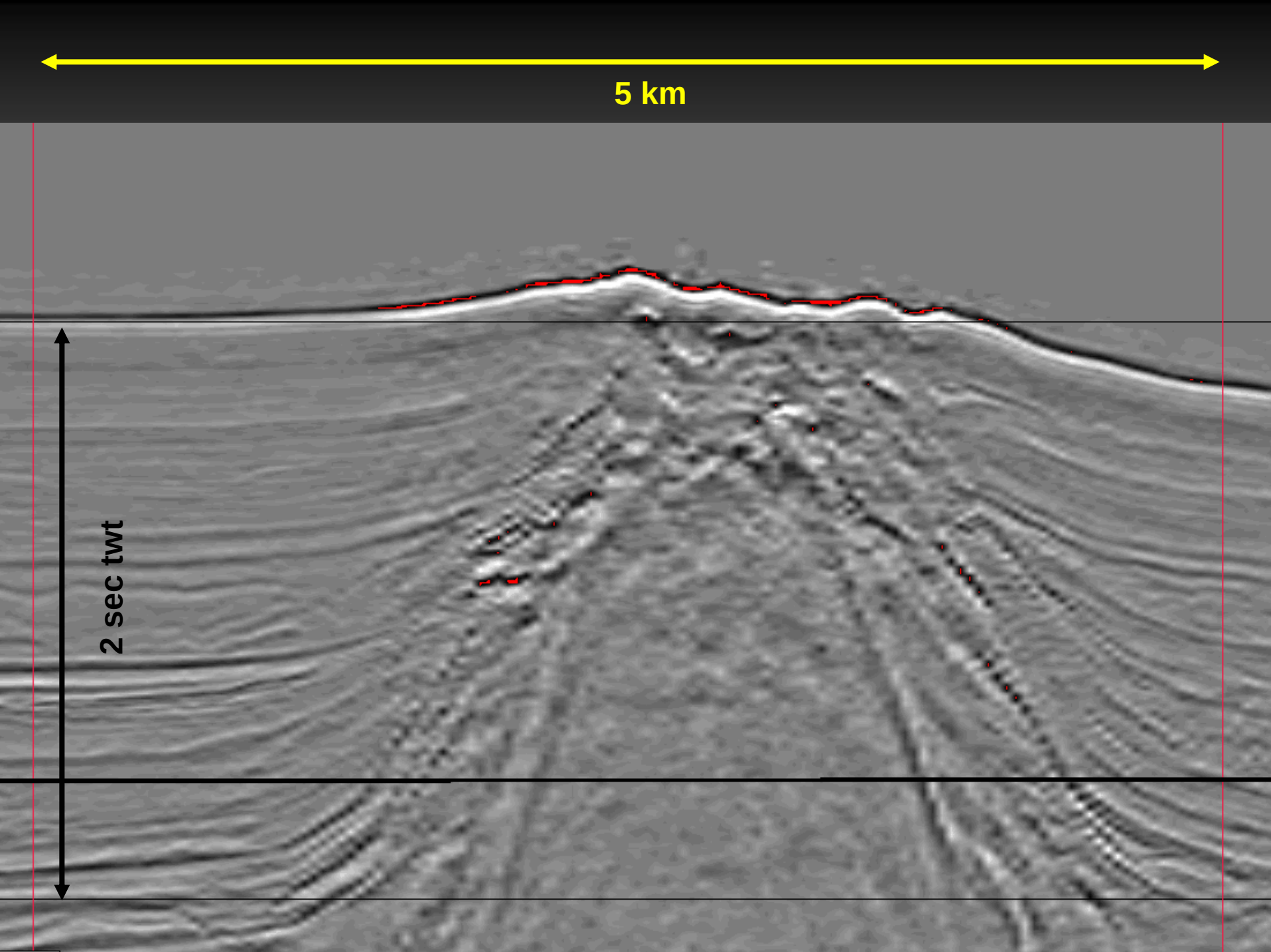
SAR Detection of Persistent Oil Slicks and Associated Deep-Sea Chemosynthetic Communities in the Gulf of Mexico Offshore:

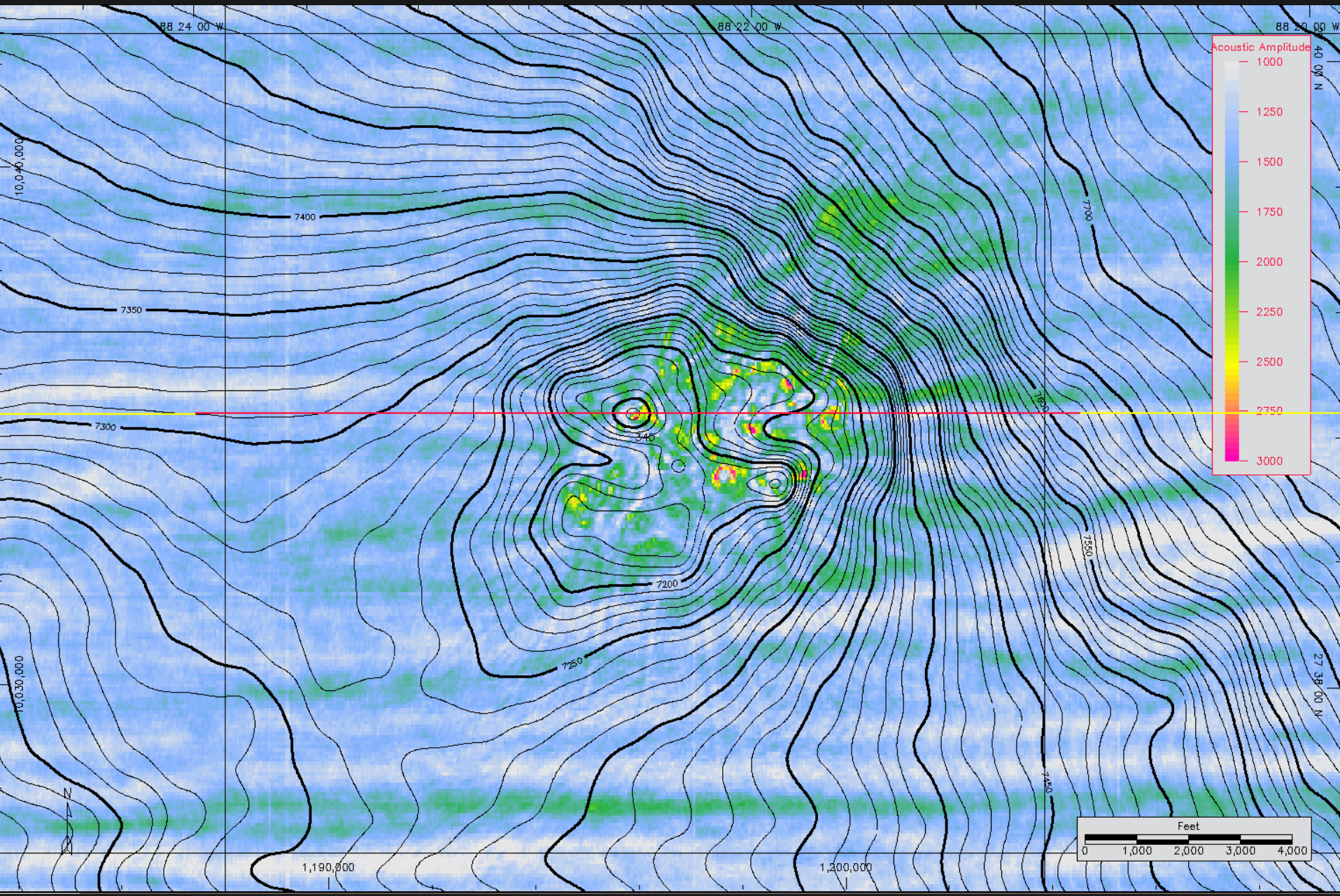
Alaska Satellite Facility, NASA

Outline

- Describe the planning and execution of reconnaissance cruise
- Compare reconnaissance results with photographic survey of sampling sites visited by ALVIN
- Discuss parallel satellite reconnaissance of outer slope oil seeps.
- Describe analytical approach for satellite data
- Highlight future efforts

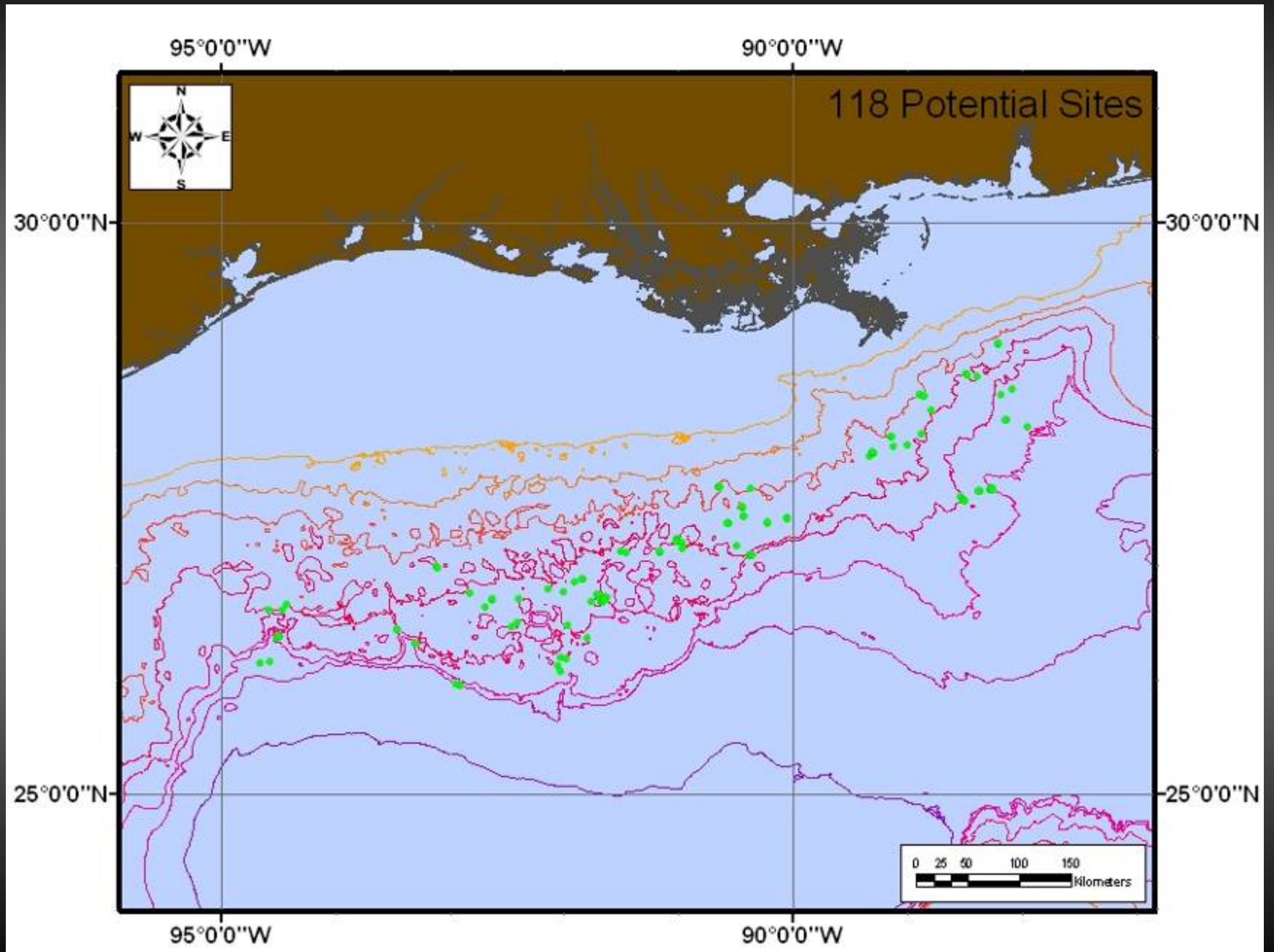

N
W
E
S
Legend
Known Seep Communities
Seep Locations from Satellite
Satellite Seeps by Depth
N=347
Total slick area ~1000 km²
0
10
20
30
40
100
500
900
1300
1700
2100
2500
2900
3300
3700
Depth (m)
Known Communties by Depth
N=49
0
10
20
30
40
100
500
900
1300
1700
2100
2500
2900
3300
3700
Depth (m)

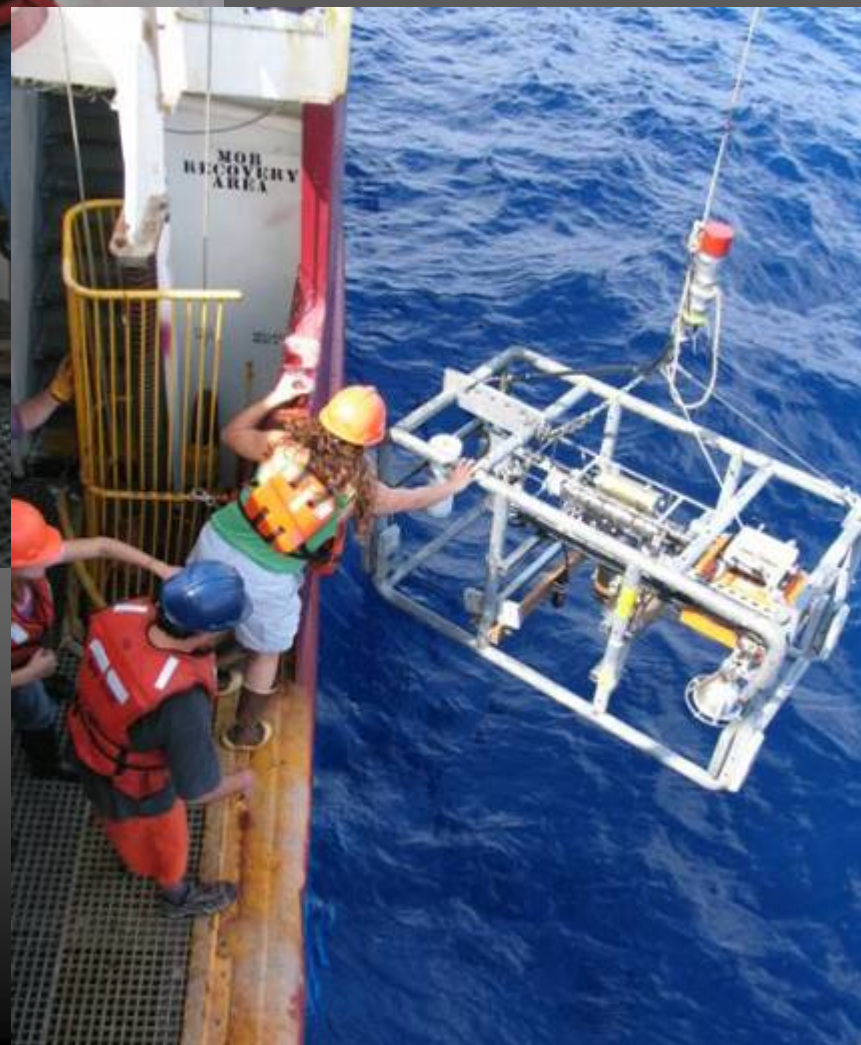

5 km
2 sec twt



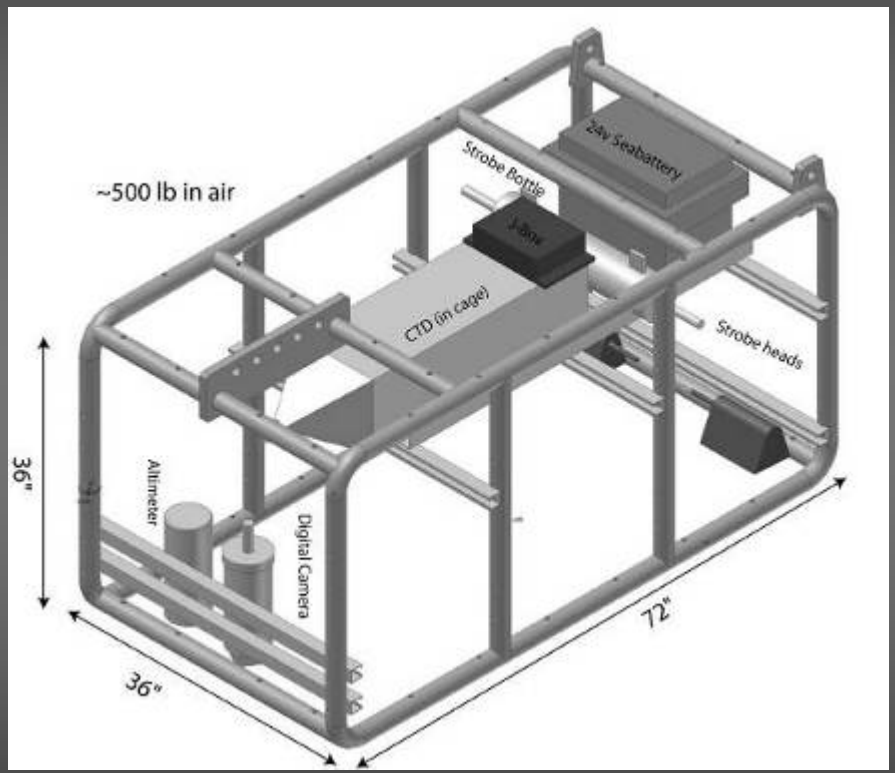
88 24 00 W
88 22 00 W
88 20 00 W
40 00 N
27 38 00 N
10,040,000
10,030,000
1,190,000
1,200,000
7400
7350
7300
7200
7250
7700
7600
7550
7450
345
Acoustic Amplitude
1000
1250
1500
1750
2000
2250
2500
2750
3000
Feet
0
1,000
2,000
3,000
4,000
N

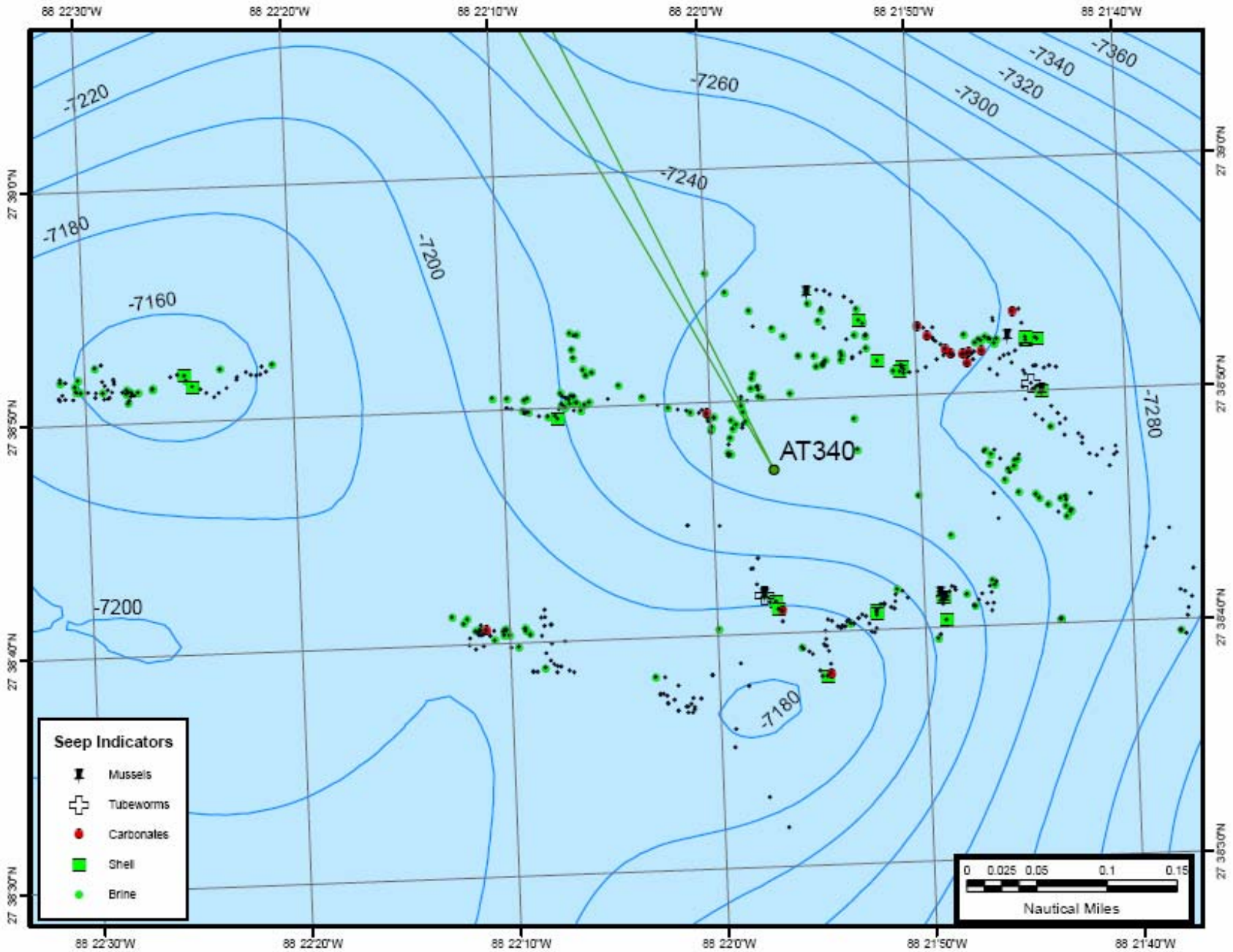
POTENTIAL SITE SELECTION February ‘06



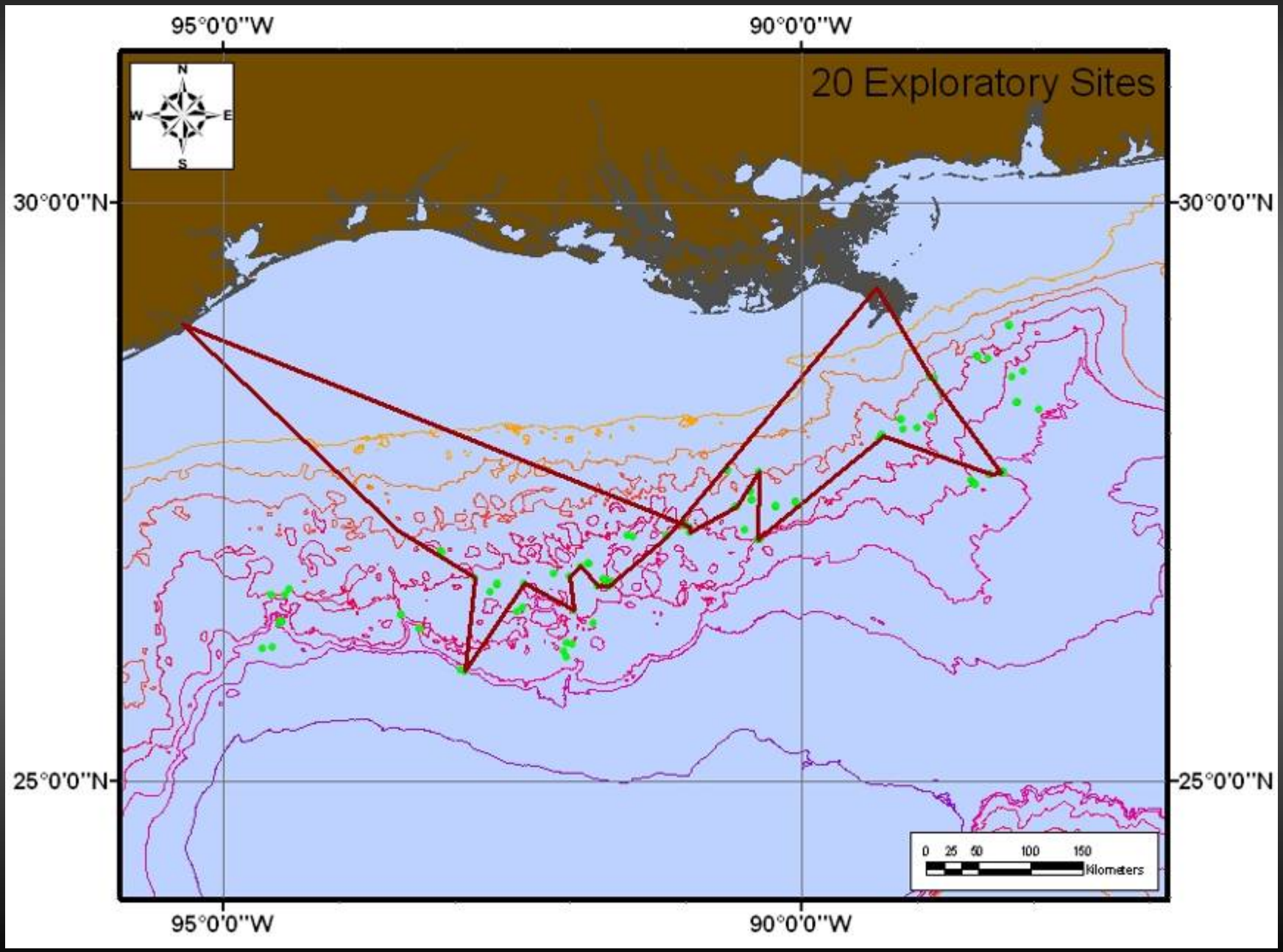

MOB
RECOVERY
AREA

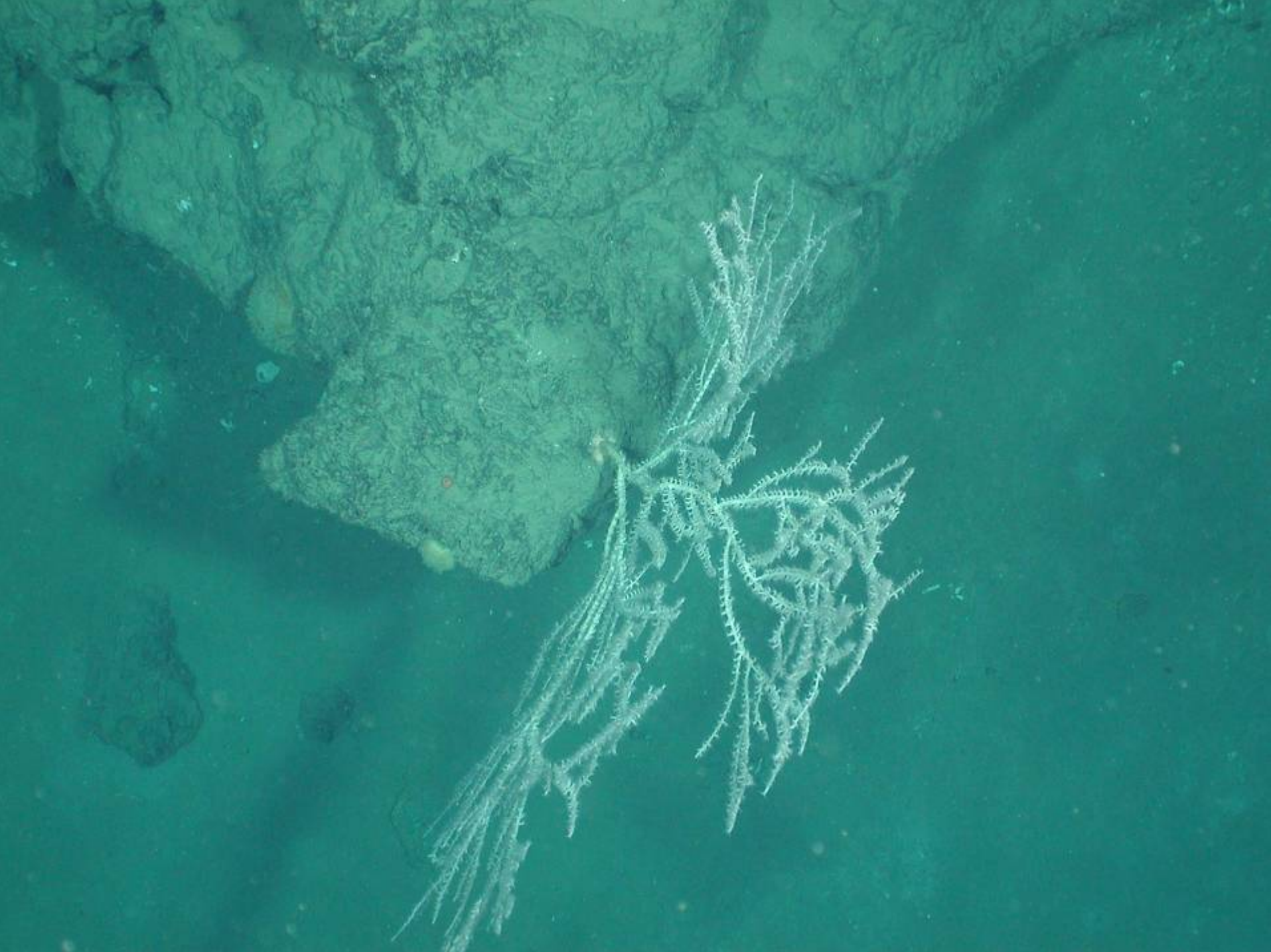
Drift camera for RV GYRE cruise




88 22'30"W
88 22'20"W
88 22'10"W
88 22'0"W
88 21'50"W
88 21'40"W
27 39'0"N
27 38'50"N
27 38'40"N
27 38'30"N
-7220
-7260
-7340
-7360
-7320
-7300
-7240
-7180
-7200
-7160
-7280
AT340
Seep Indicators
Mussels
Tubeworms
Carbonates
Shell
Brine
0 0.025 0.05 0.1 0.15
Nautical Miles

GYRE Reconn CRUISE: 14–28 MARCH ‘06

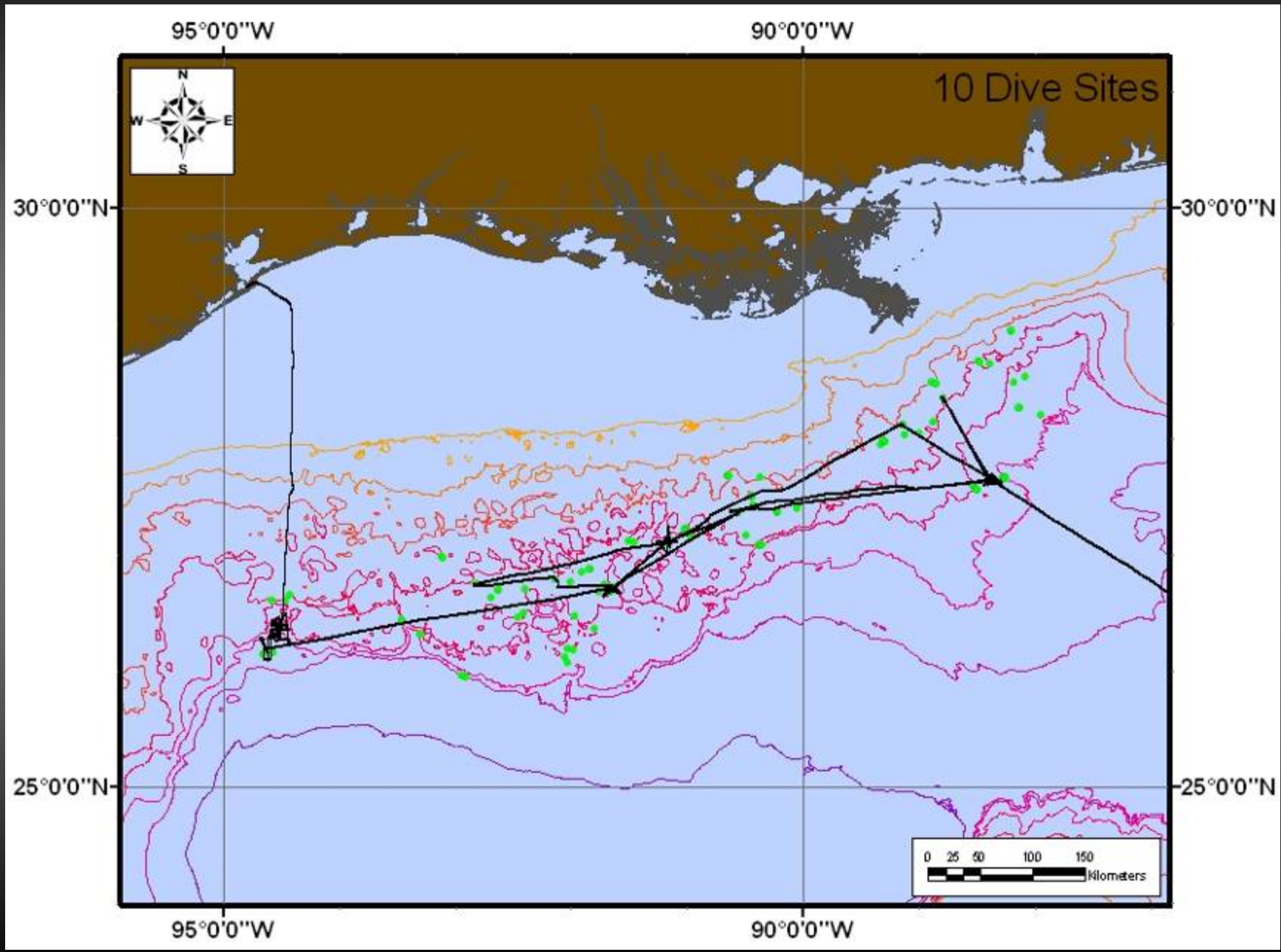


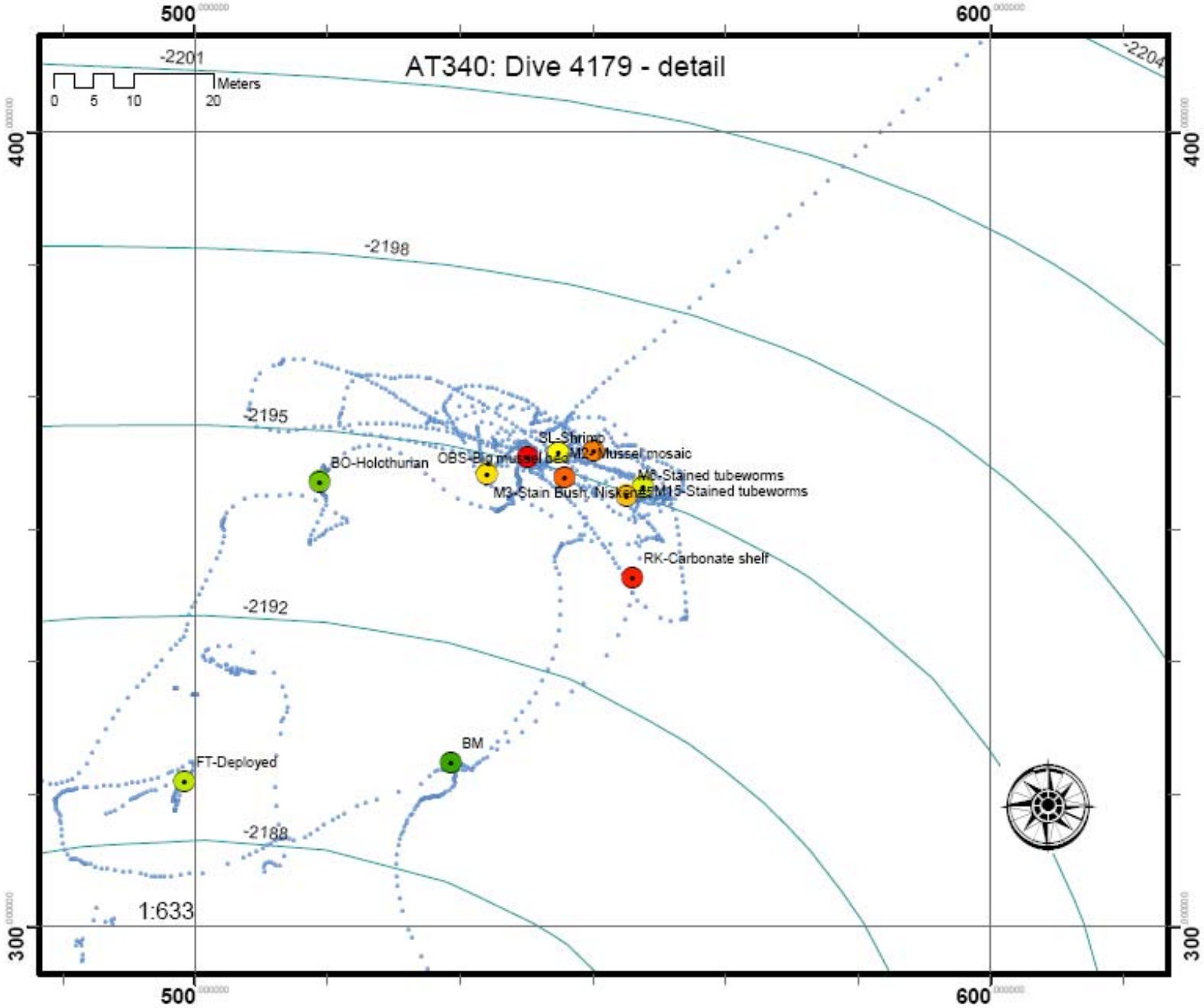


Summary of Reconnaissance Results

RV ATLANTIS Cruise with ALVIN

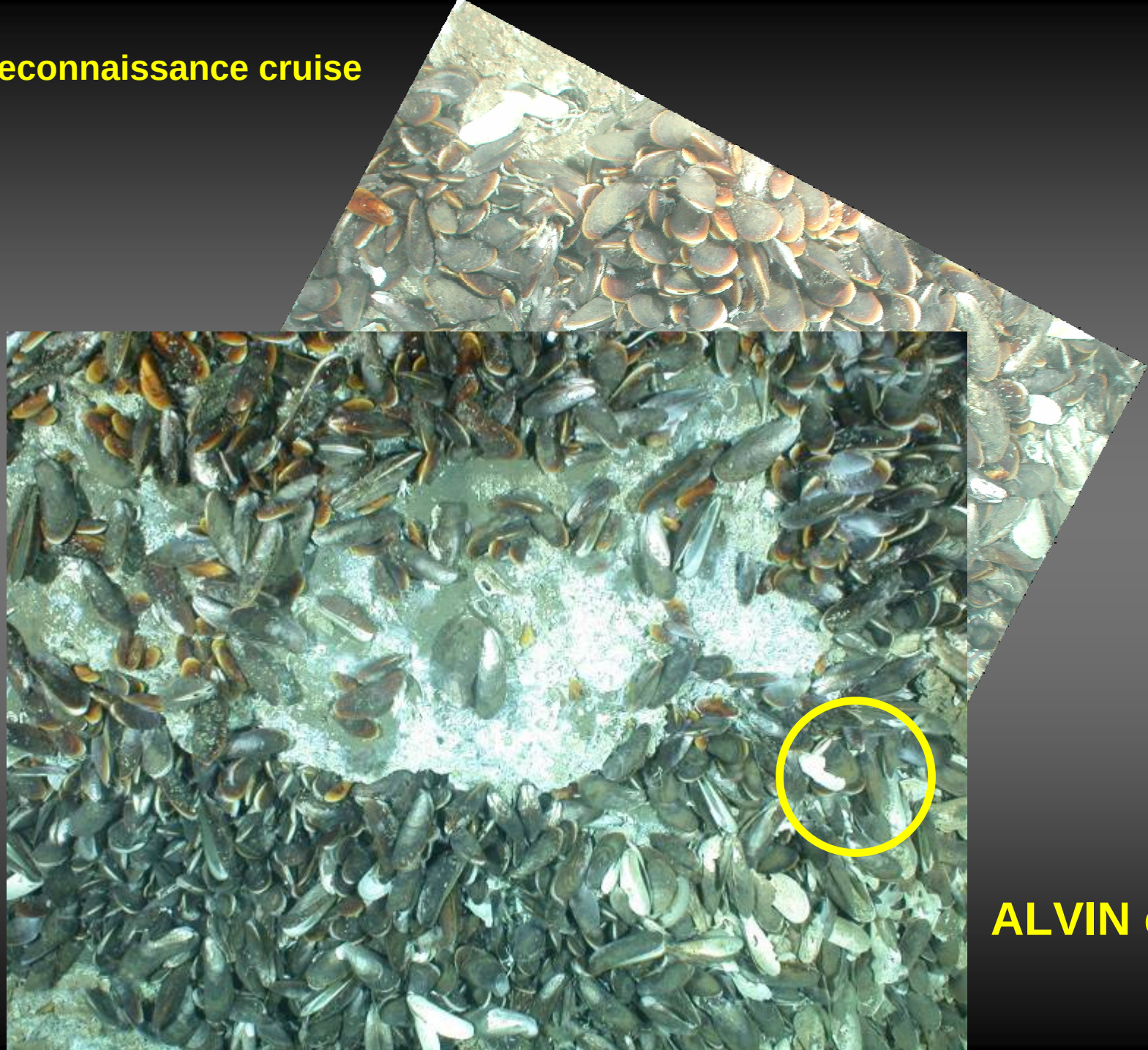
ATLANTIS/ALVIN CRUISE: 7 MAY–3 JUNE ‘06



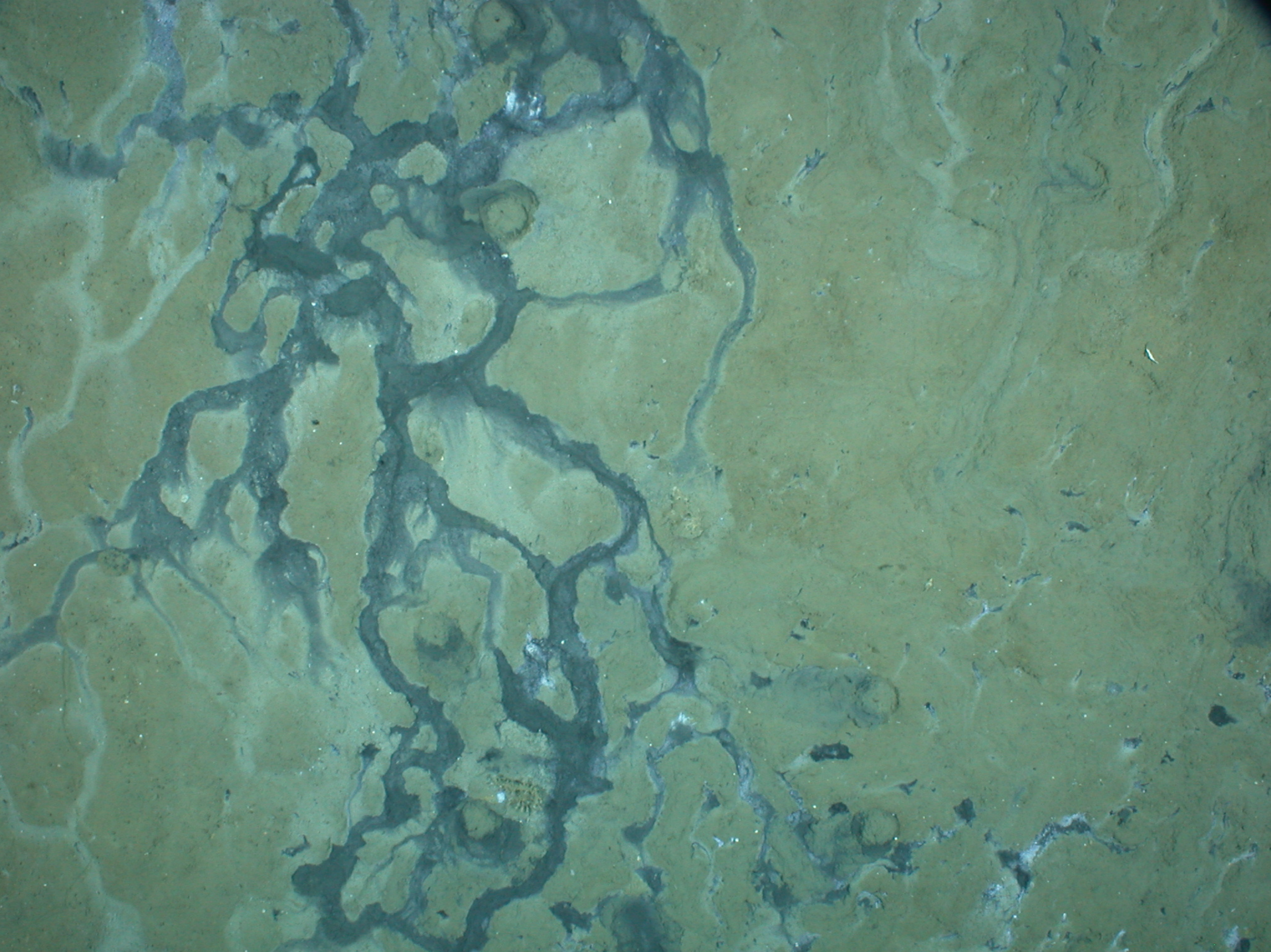

AT340: Dive 4179 - detail
500
600
400
300
-2201
-2204
-2198
-2195
-2192
-2188
Meters
0 5 10 20
SL-Shrimp
M2-Mussel mosaic
BO-Holothurian
OBS-Big mussel bed
M3-Stain Bush, Niskin
M8-Stained tubeworms
M15-Stained tubeworms
RK-Carbonate shelf
BM
FT-Deployed
1:633

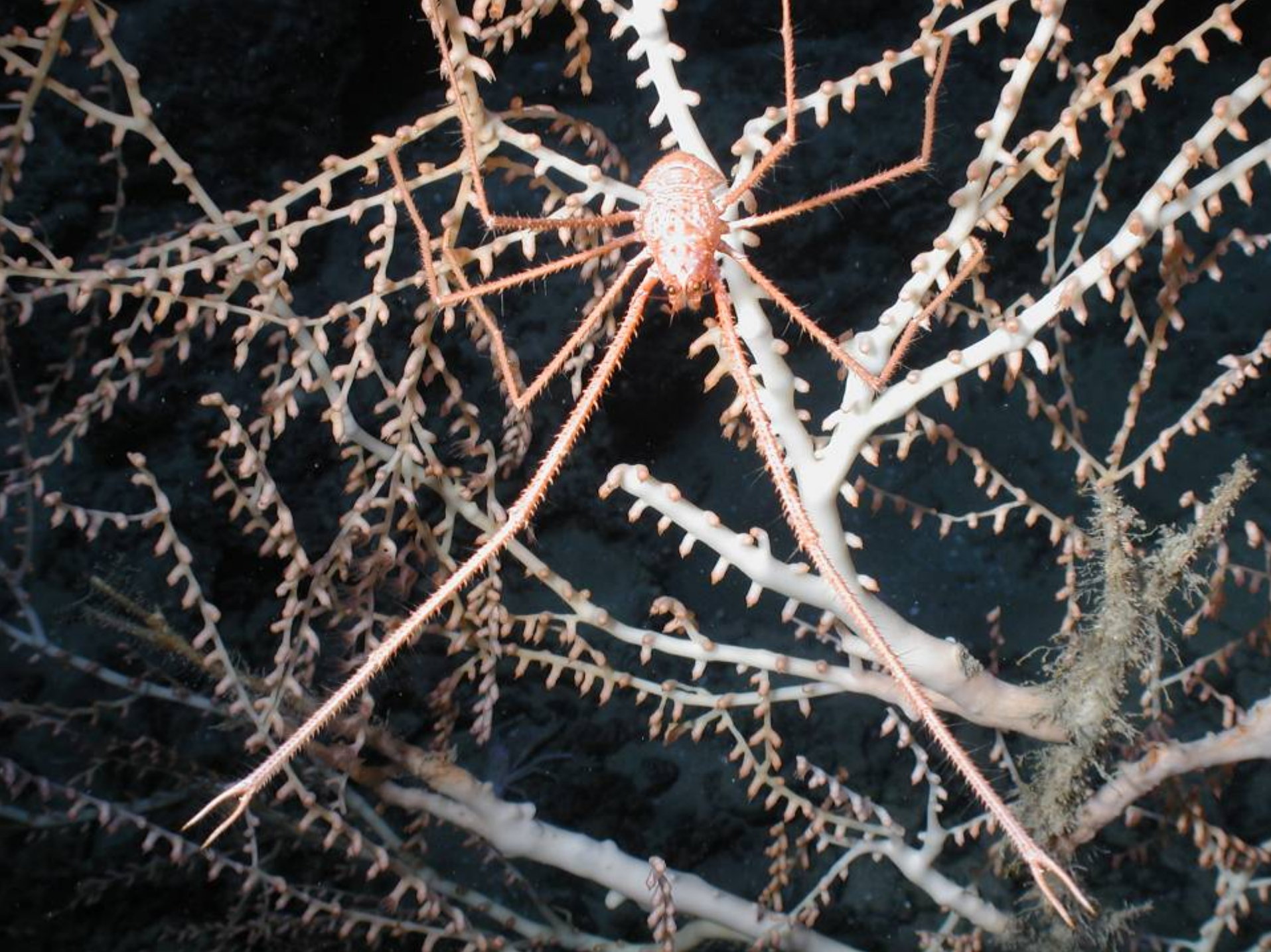
Reconnaissance cruise

Reconnaissance cruise



ALVIN cruise

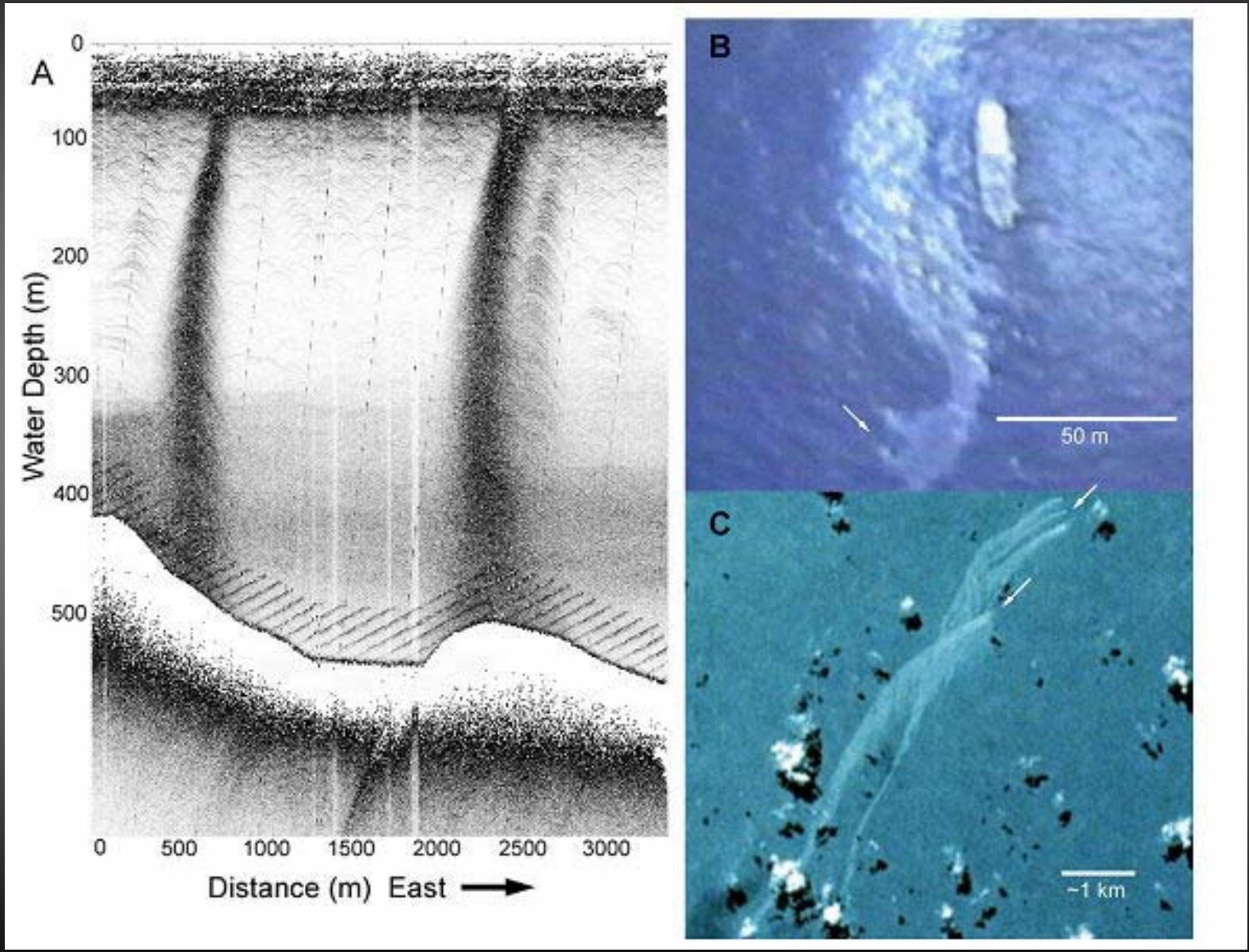




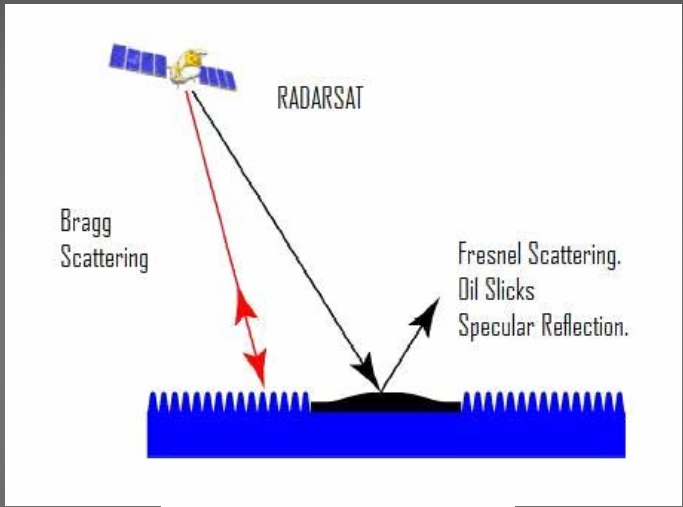
Cruise	GYRE	ATLANTIS	
Dive Site	Photos	Dives	Photos
AC601		2	640
AC645		2	1008
AC818		2	2250
AT340	502	5	3433
AT342	516		
GC296	766		
GC600	694	2	1540
GC767	269		
GC812	225		
GC817	515		
GC852	1054	6	3734
GC868	236		
KC129	271		
KC216	802		
KC243	356	1	207
KC333	331		
KC514	579		
MC462	622		
MC640	976	1	932
MC981	825		
WR268	523		
WR269	467	2	743
TOTALS	**10529**	**23**	**14487**

25016

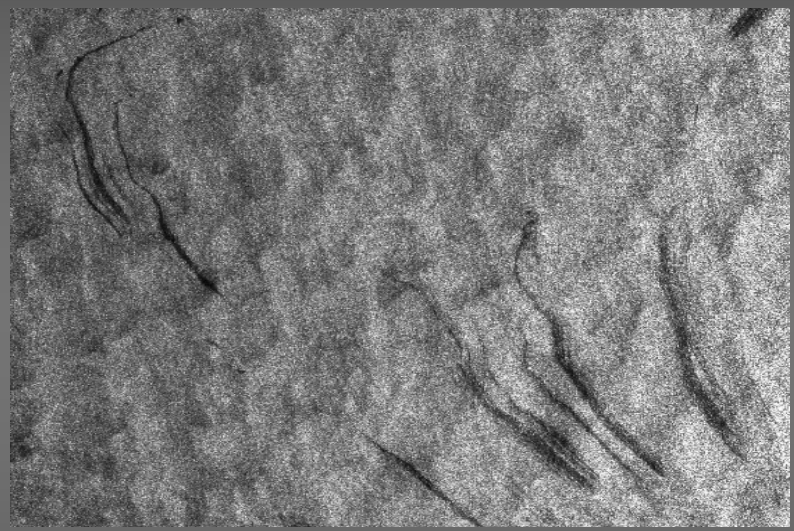
Water Column and Surface



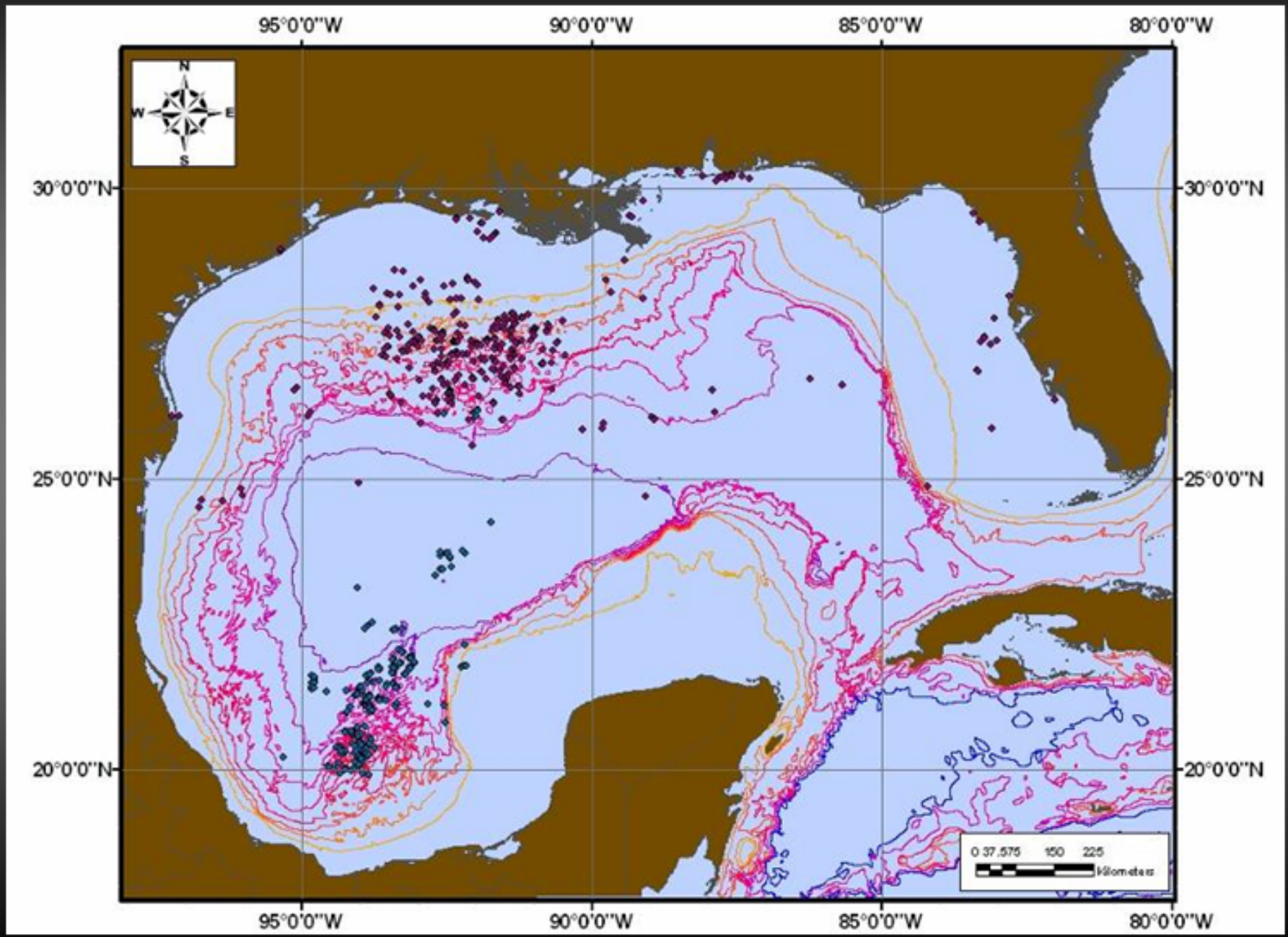
Surfactant Layers (Slicks) Generate Strong Contrast with SAR Backscatter

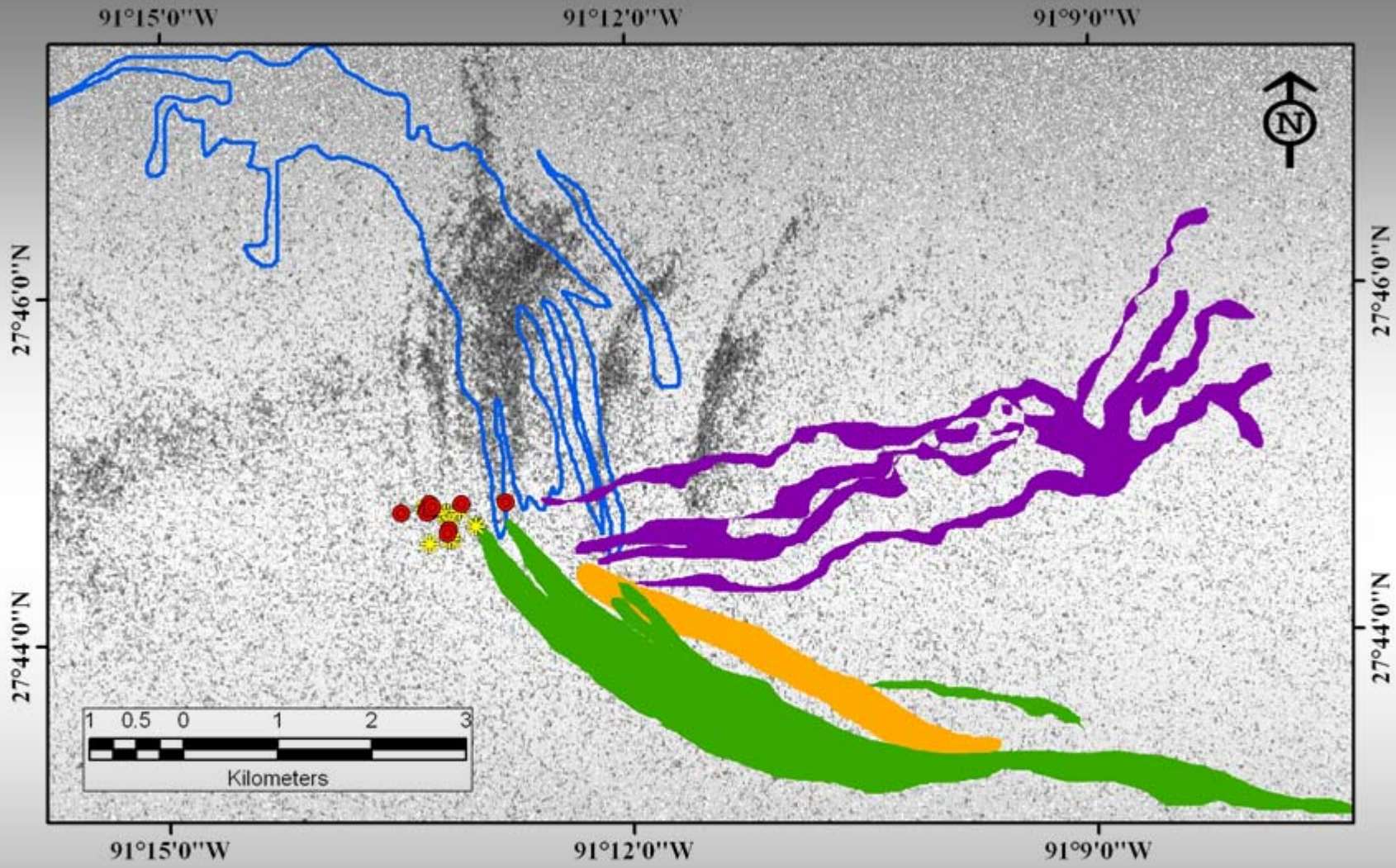


Fortuny (2003)

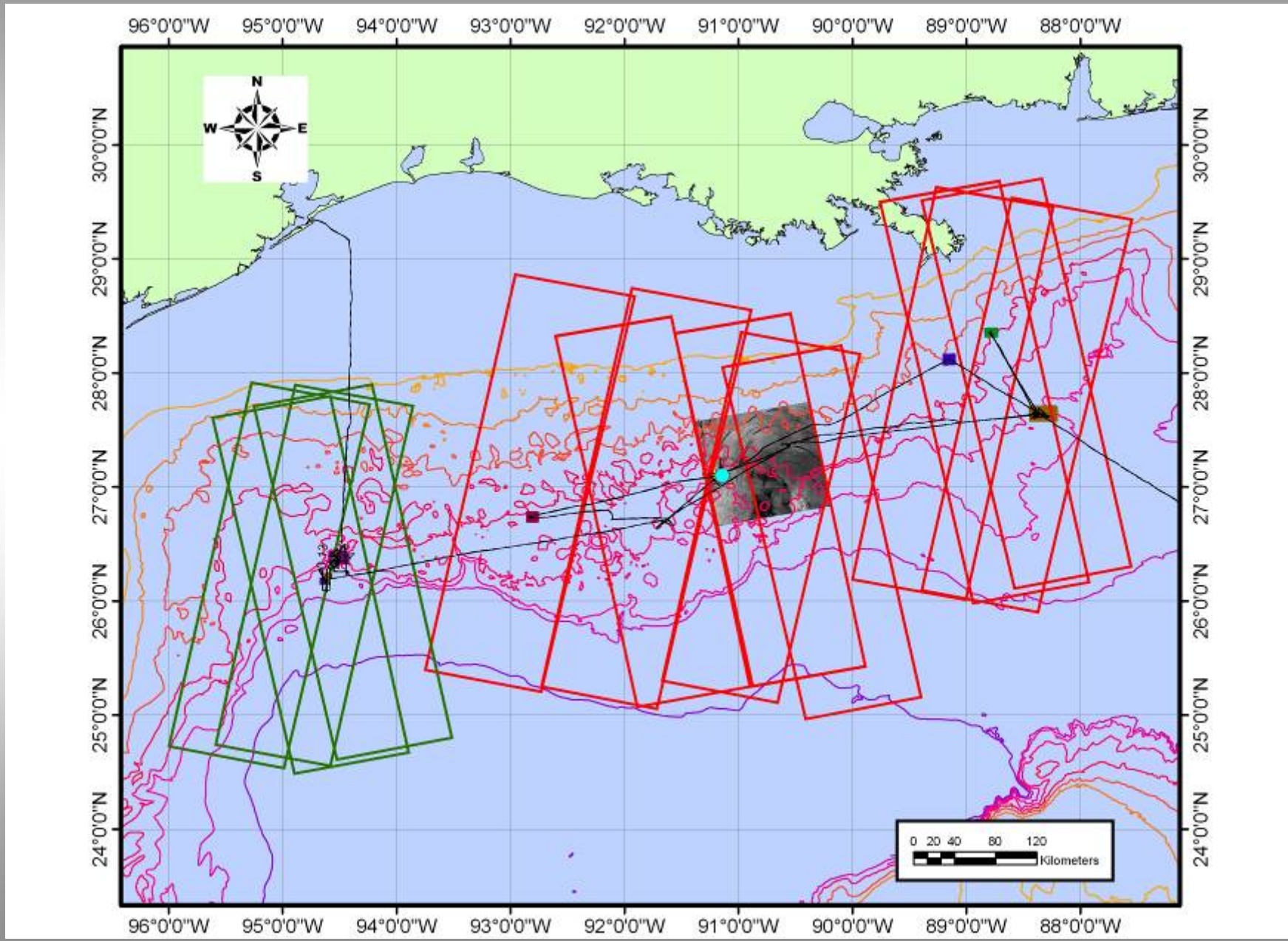


Historic Seep Sites Detected in Satellite Imagery

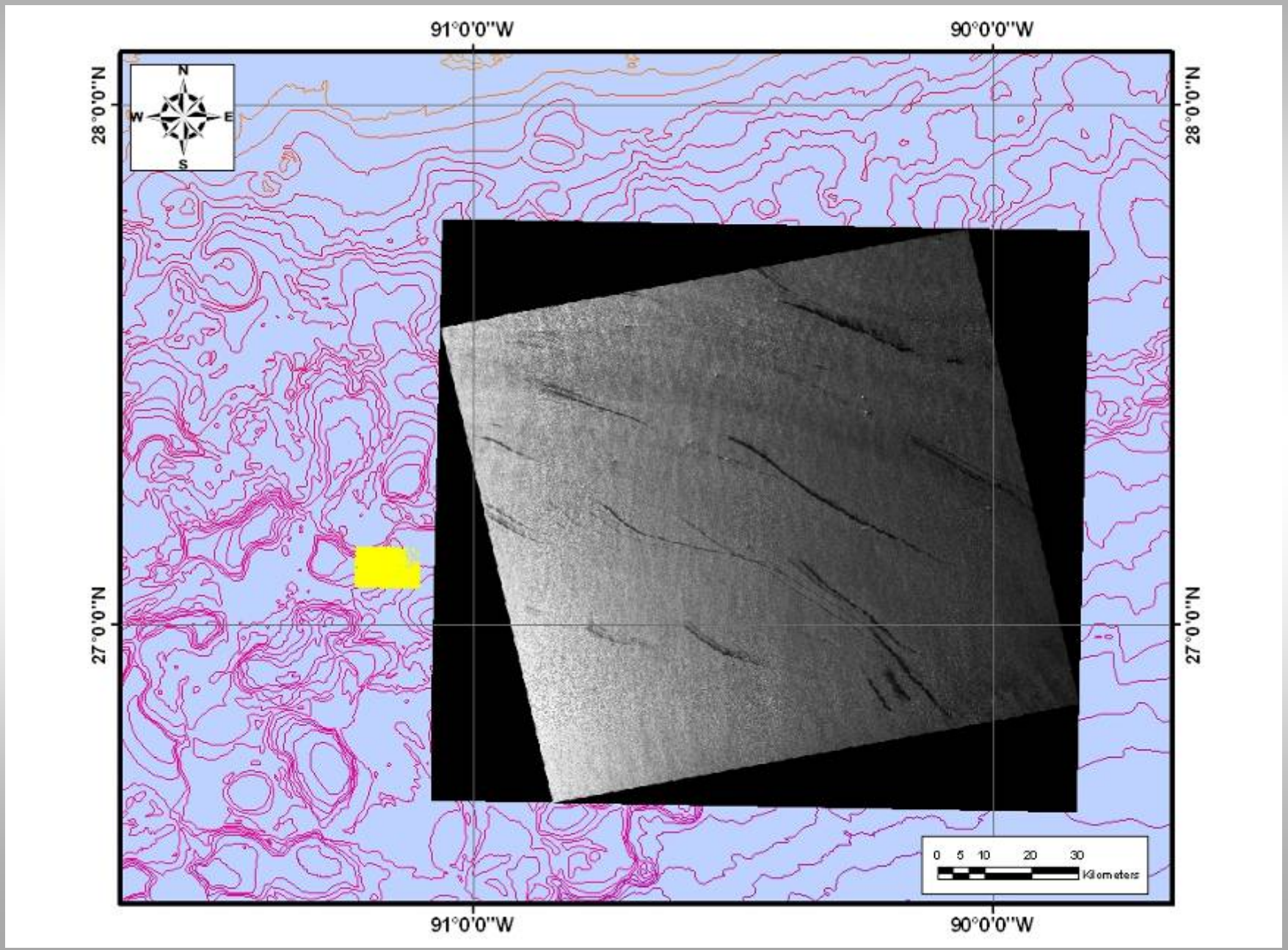



91°15'0"W
91°12'0"W
91°9'0"W
27°46'0"N
27°44'0"N
N
1 0.5 0 1 2 3
Kilometers
Plumes 2001
Plumes 2002
July 12, 2001
July 19, 2001
July 22, 2001
July 16, 2001

RV ATLANTIS Track and RADARSAT Swaths: May 2006

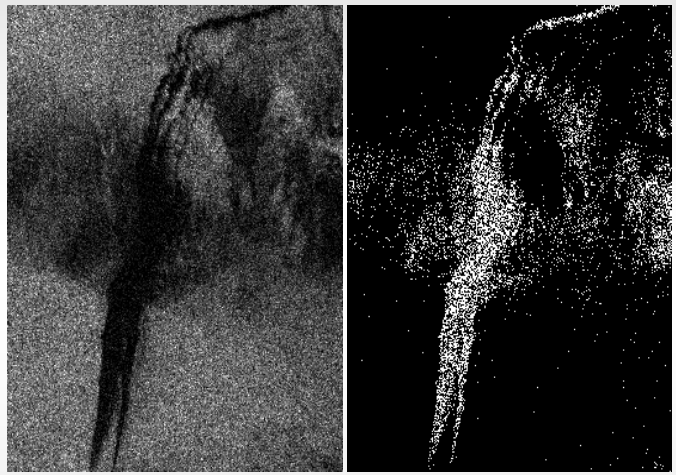


12 May 2006 – SAR

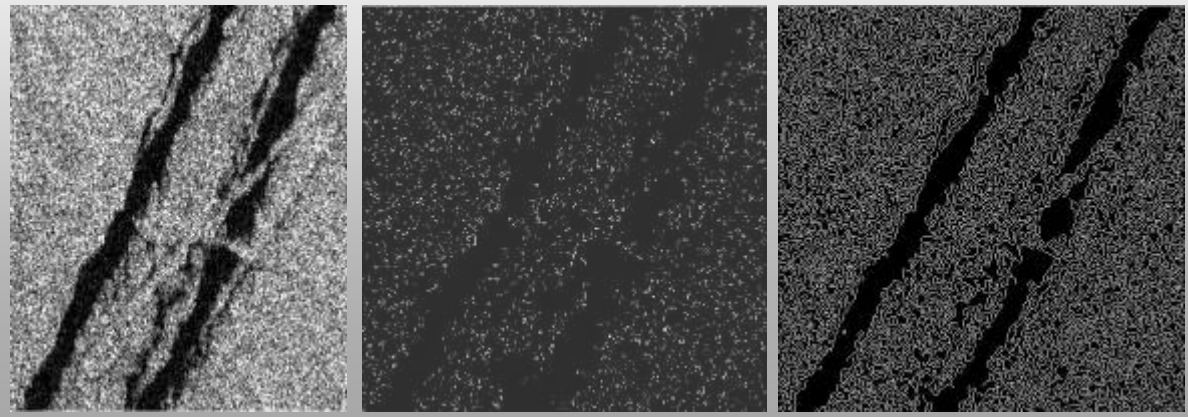


Standard Methods of Object Detection Do Not Work Well with SAR Oil Slicks

Threshold does not eliminate rain shadow.



Edge detection cannot cope with significant contrast differences within a scene.

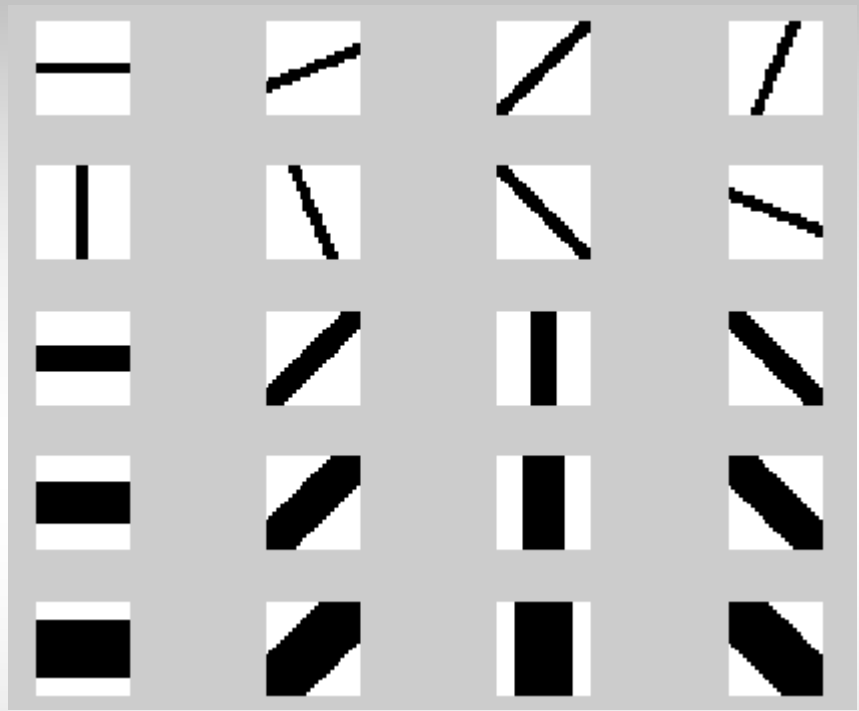


Texture Analysis with Textons

- Texture recognition is part of developing technique of artificial vision.

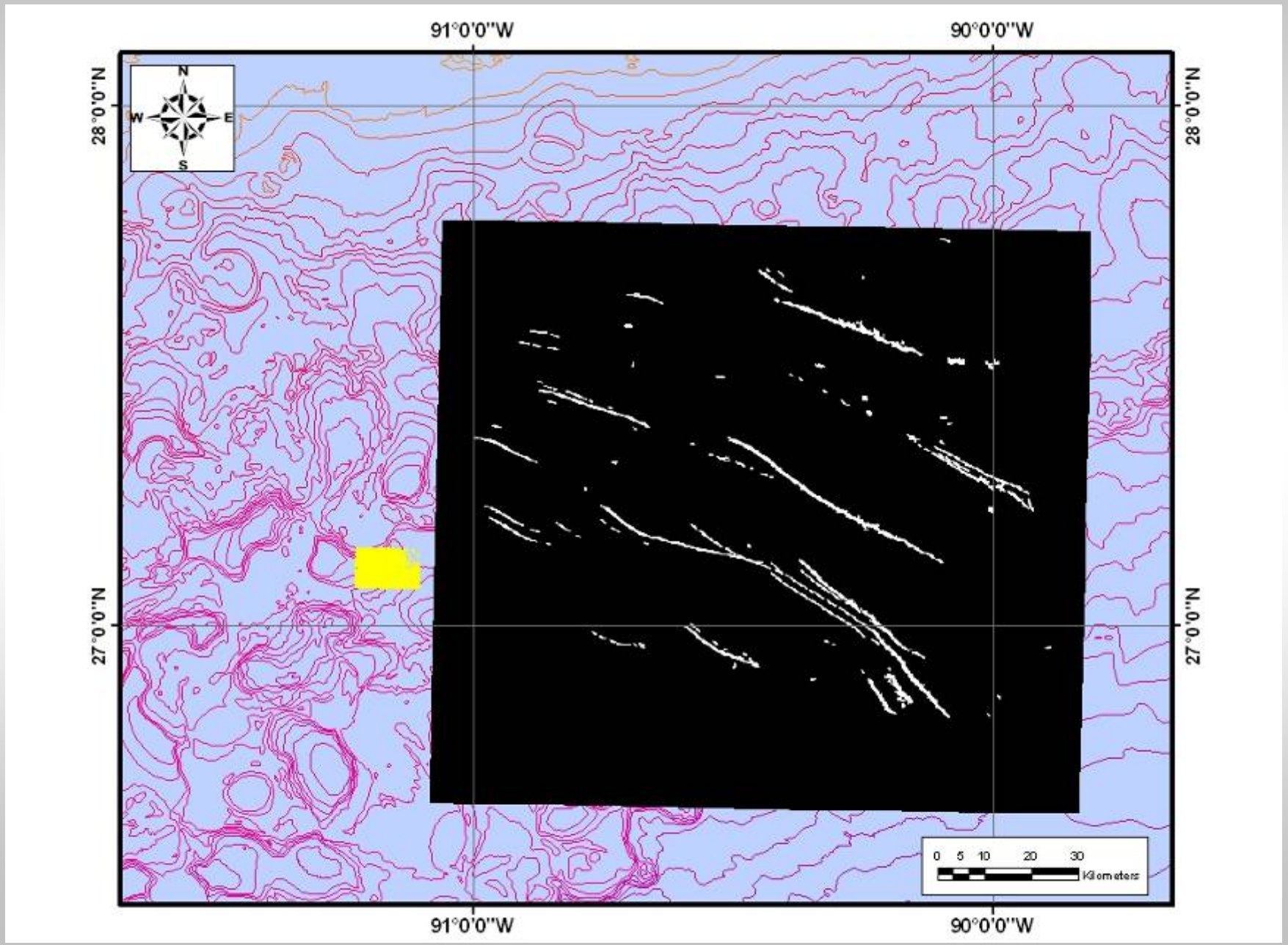
  (T.Leung and J. Malik. 2001. Representing and recognizing the visual appearance of materials using three-dimensional textons. International Journal of Computer Vision 43(1):29–44.)

- An image is exposed to a number of filters and the reaction of a pixels' neighborhood to each filter is stored in a vector.
- Vectors are then grouped by K-means clustering into different response groups called textons.
- New images are classified by assigning each pixel to the texton closest to this response.
- Textons work best with uniform contras.

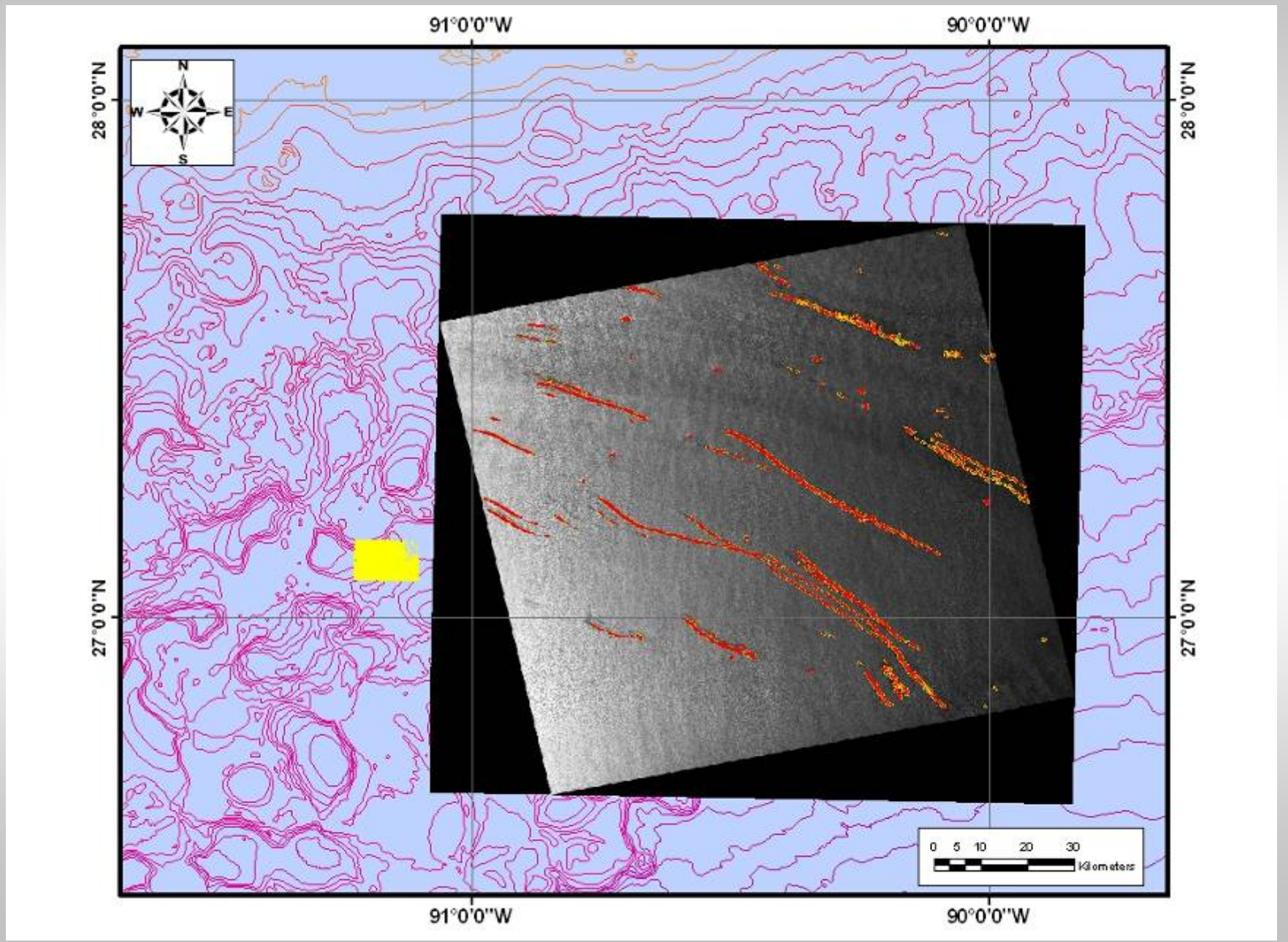


- We use a combination of eroding and dilating to determine the background of the image negative and subtract it from the image.

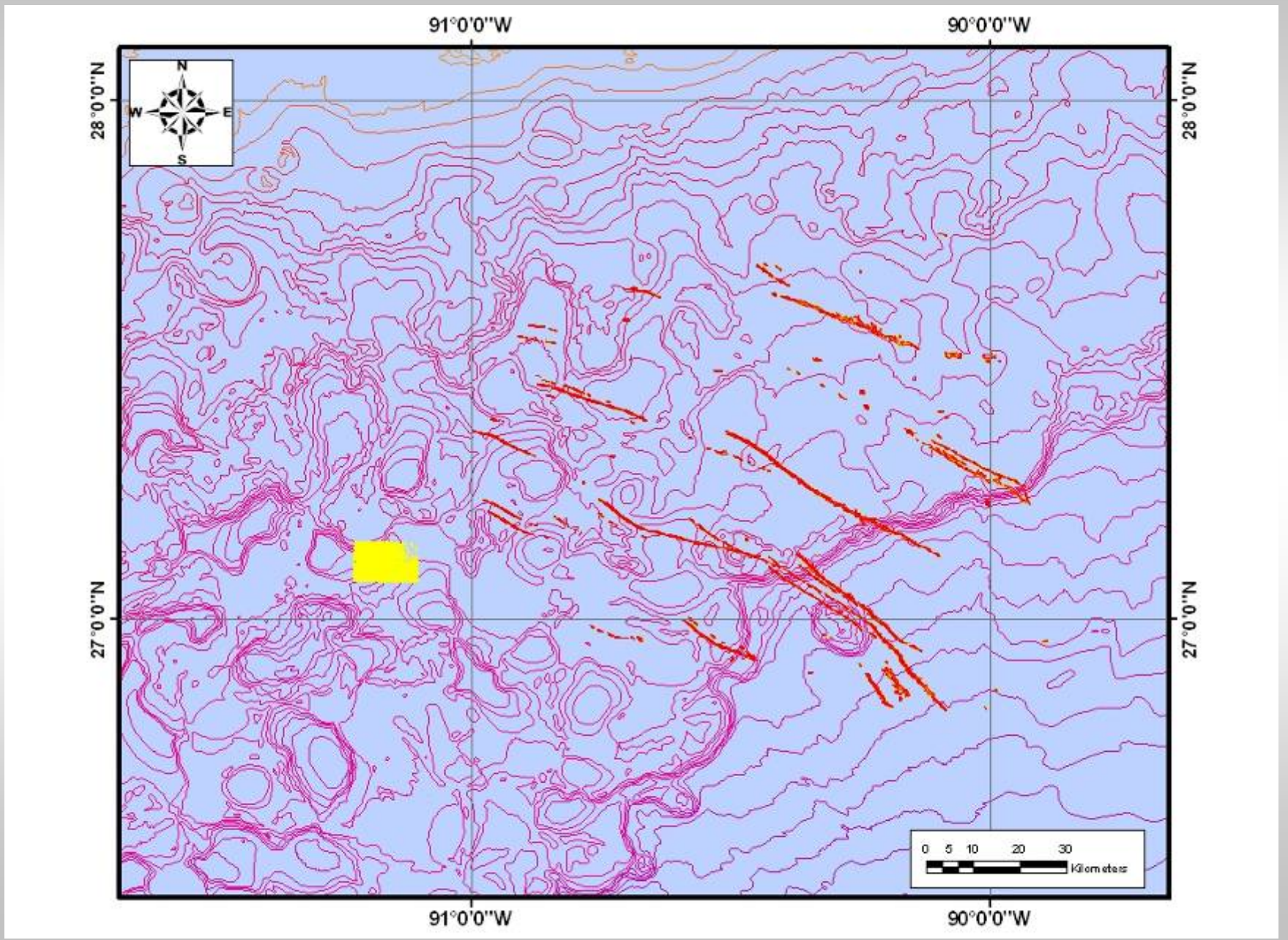
12 May 2006 – Texton Filter



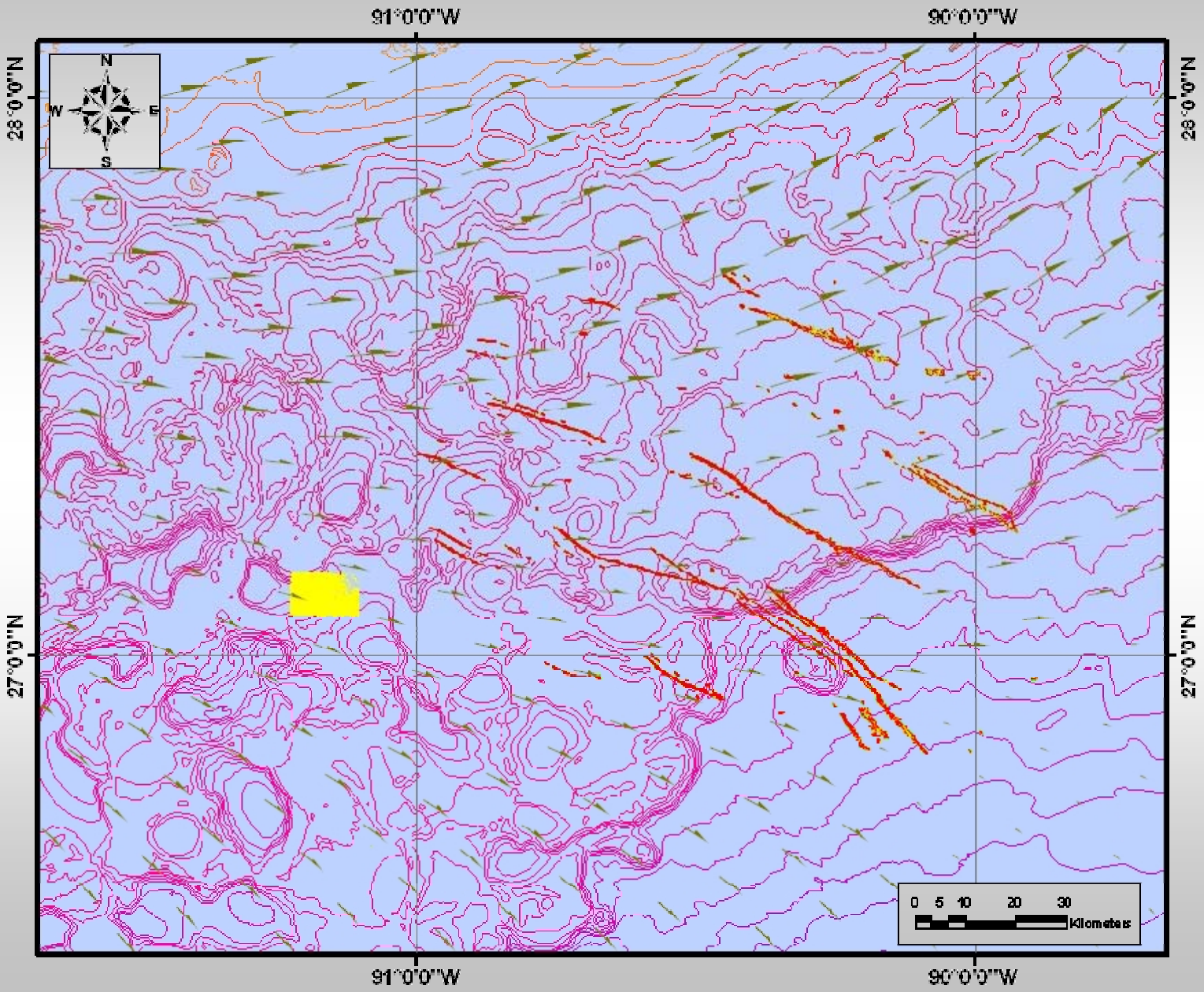
12 May 2006 – Raw and Filtered Slicks



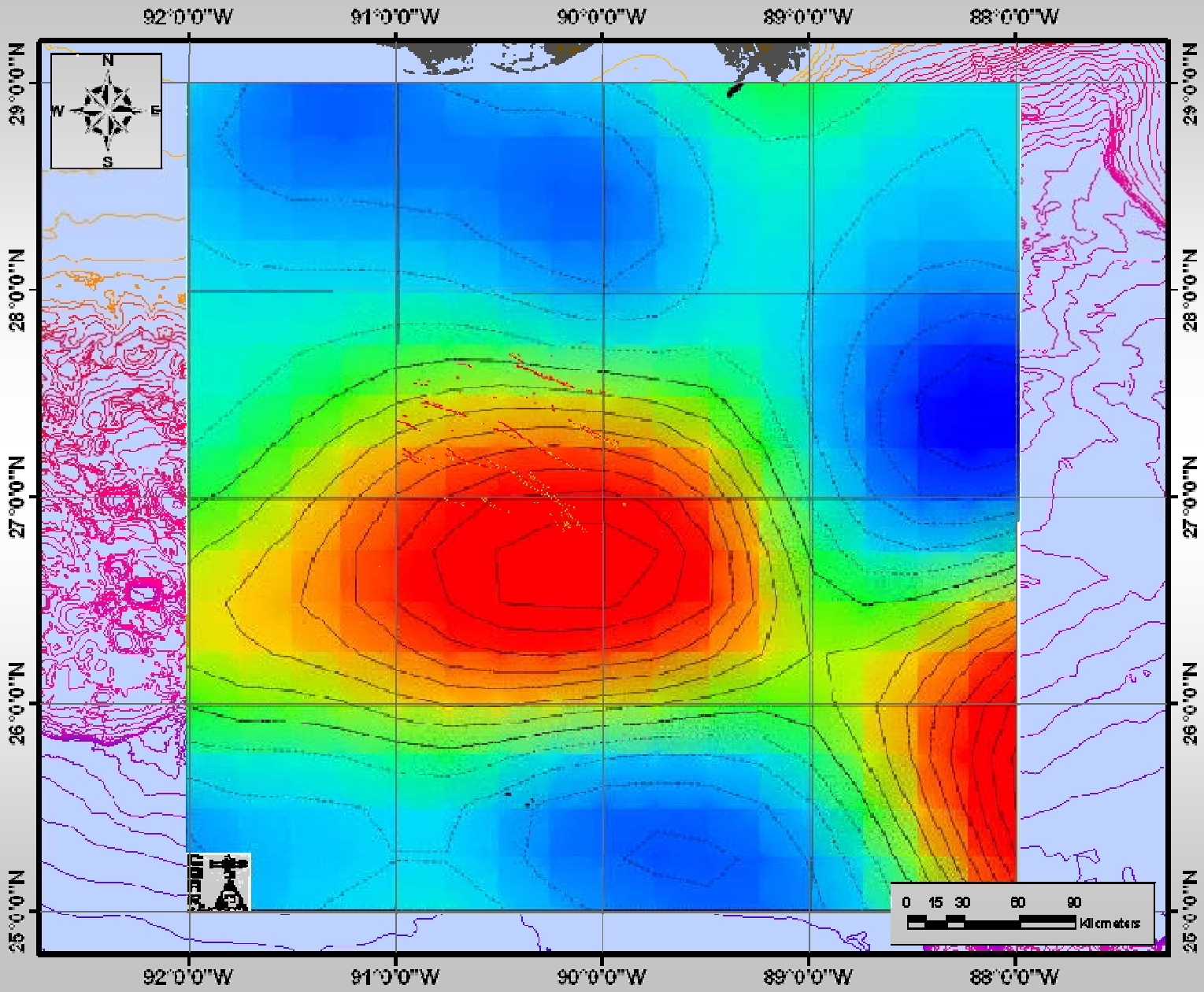
12 May 2006 – Automated Slick Outlines



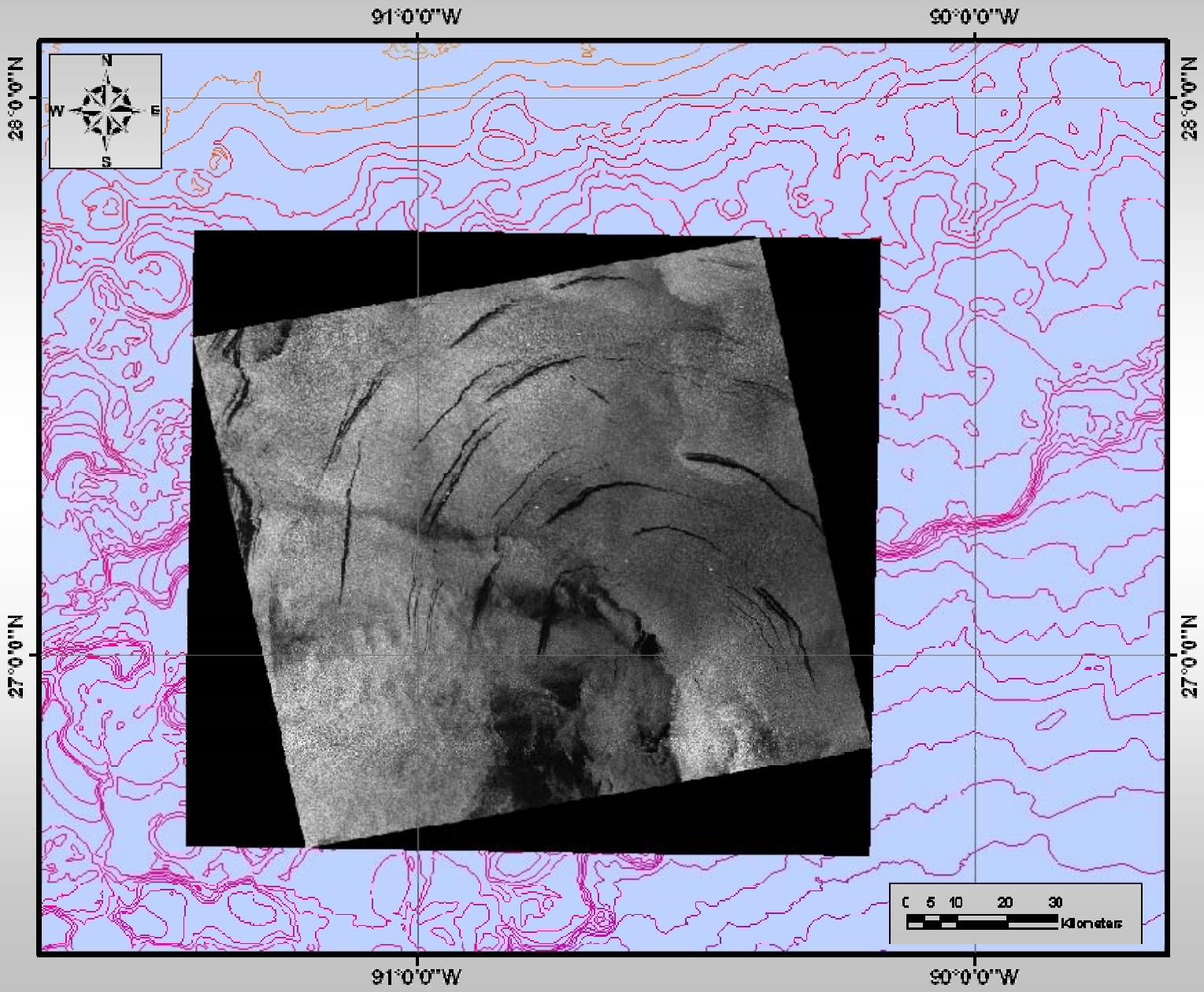
12 May 2006 – Slick and Wind Field



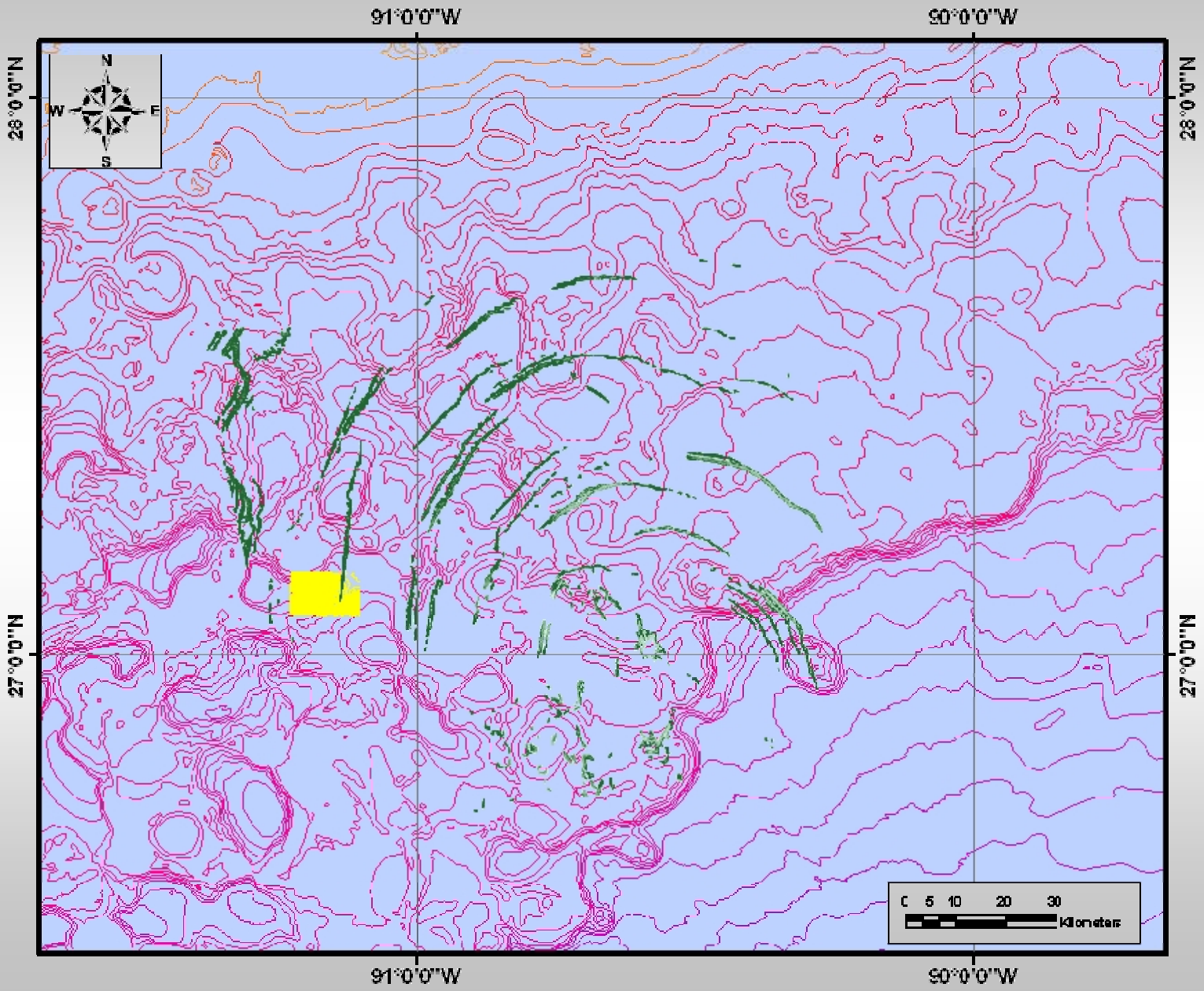
12 May 2006 – Warm-Core Eddy



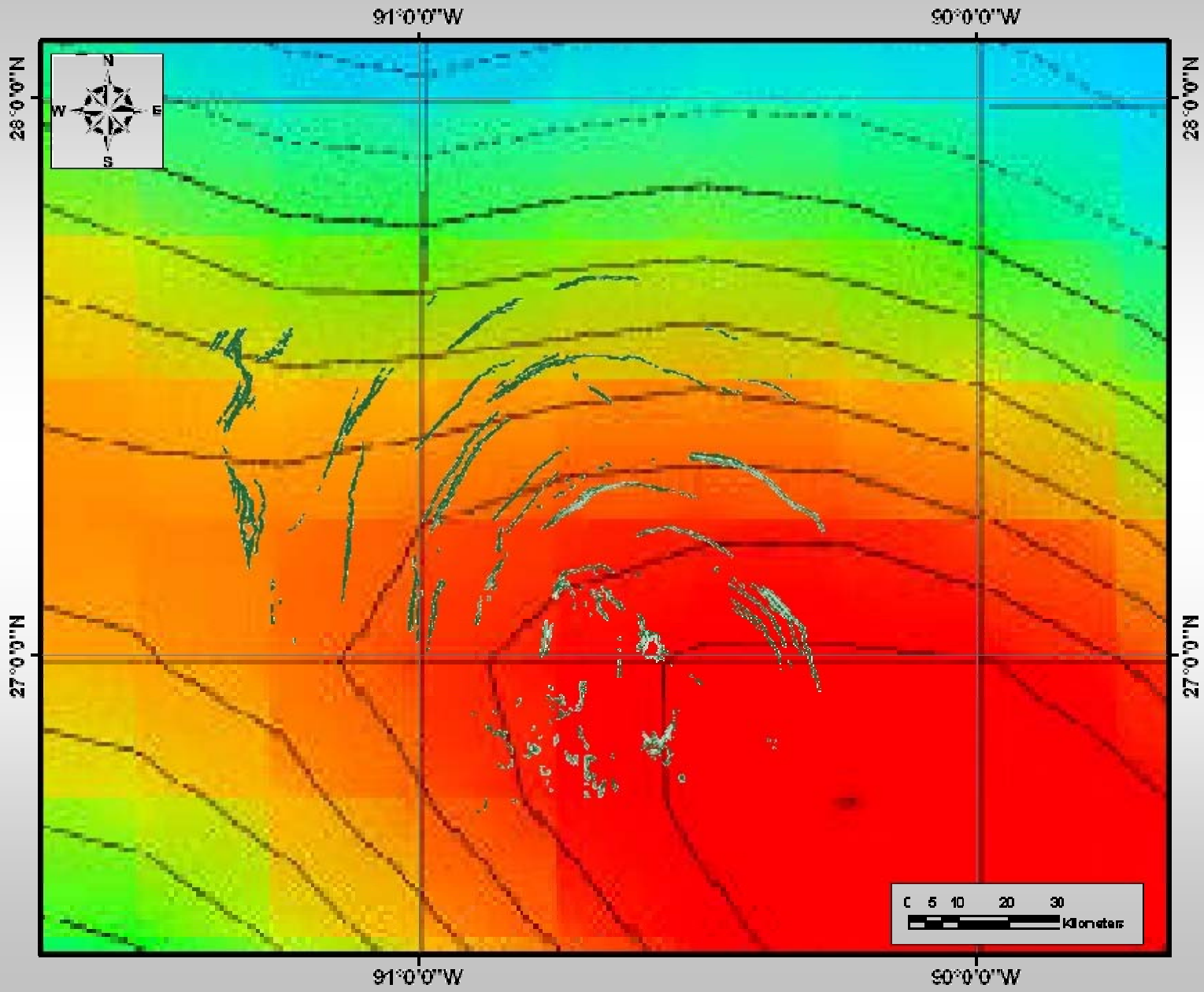
23 May 2006 – SAR



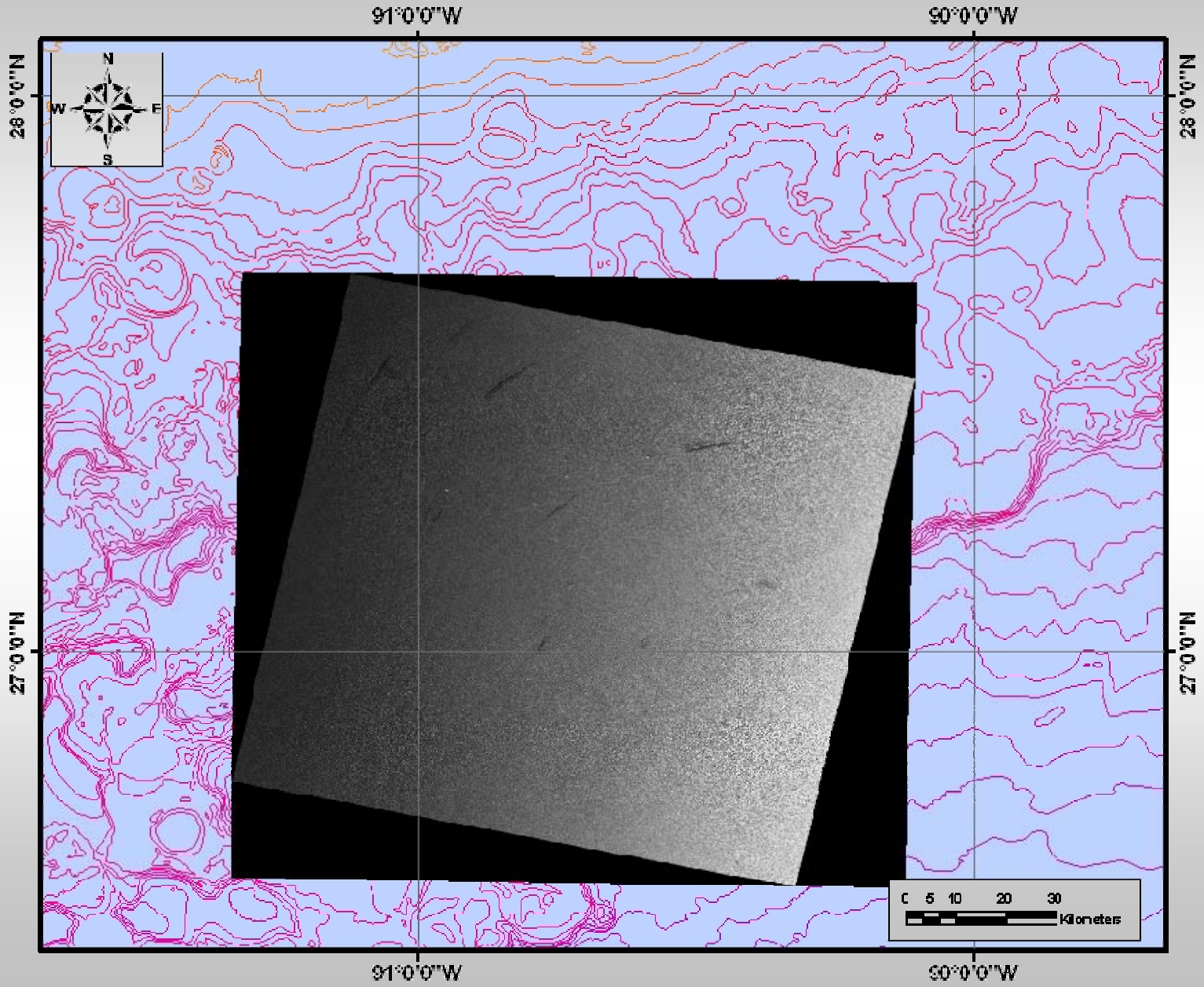
23 May 2006 – Automated Slicks



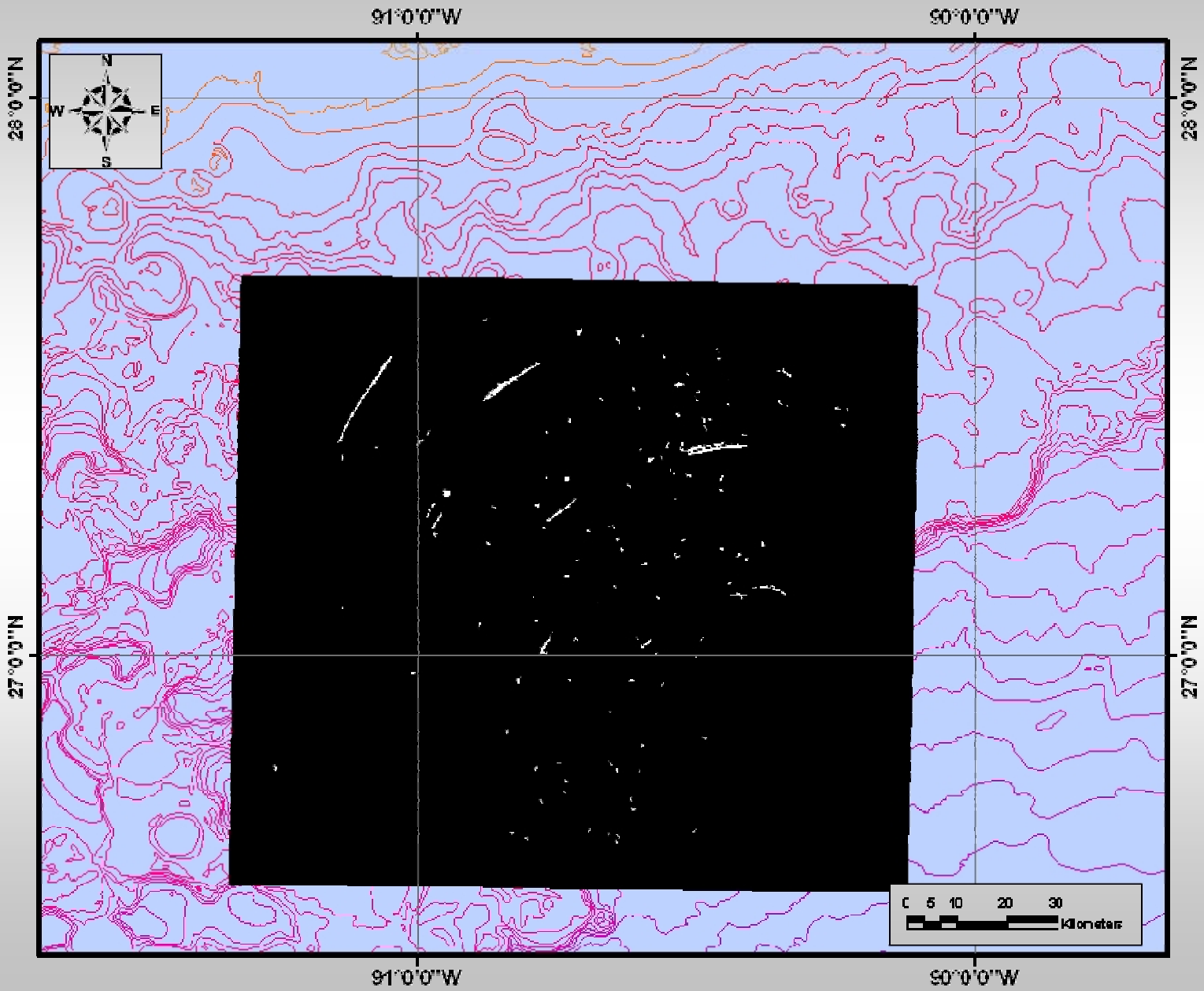
23 May 2006 – Slicks and Eddy



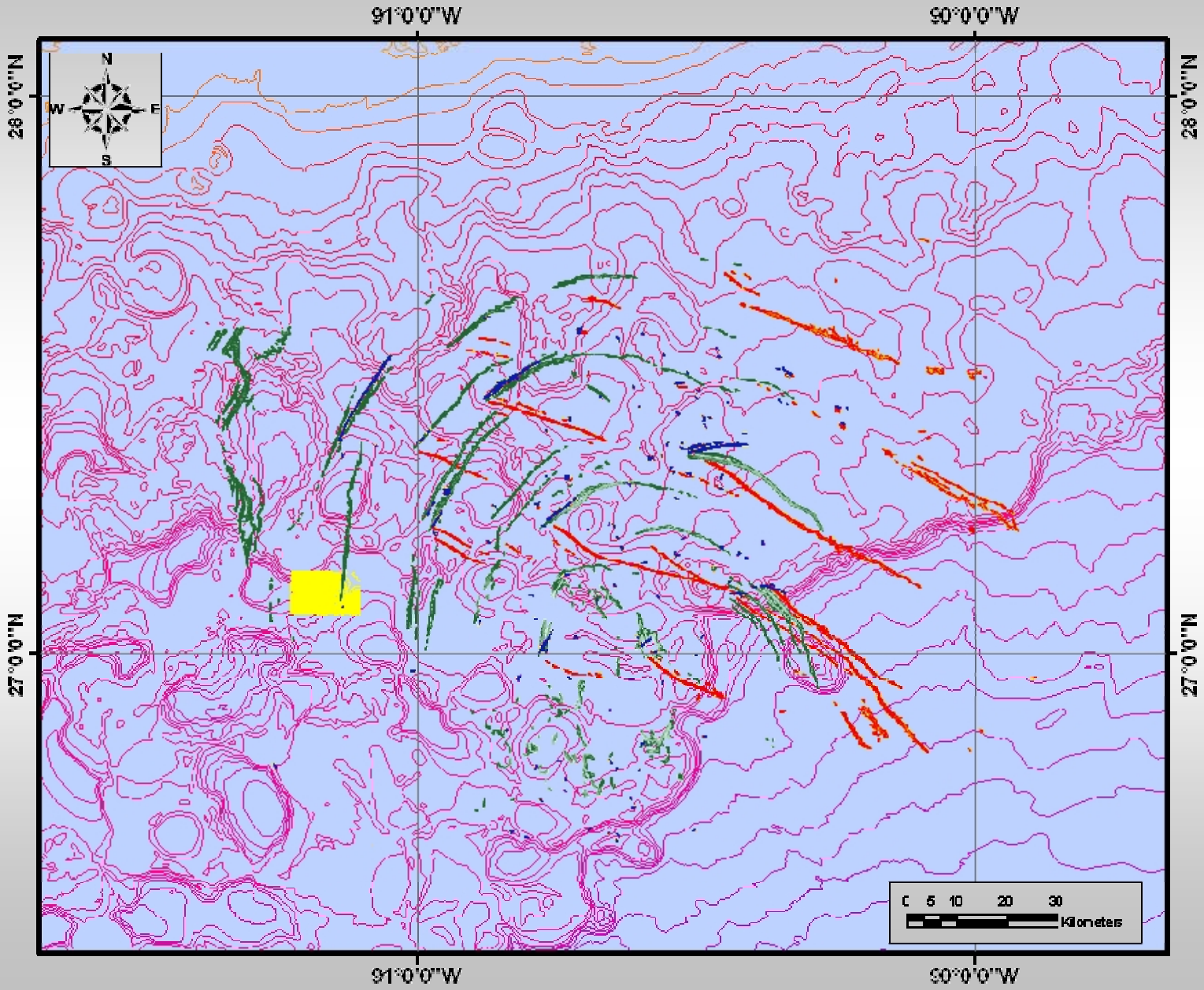
27 May 2006 – SAR



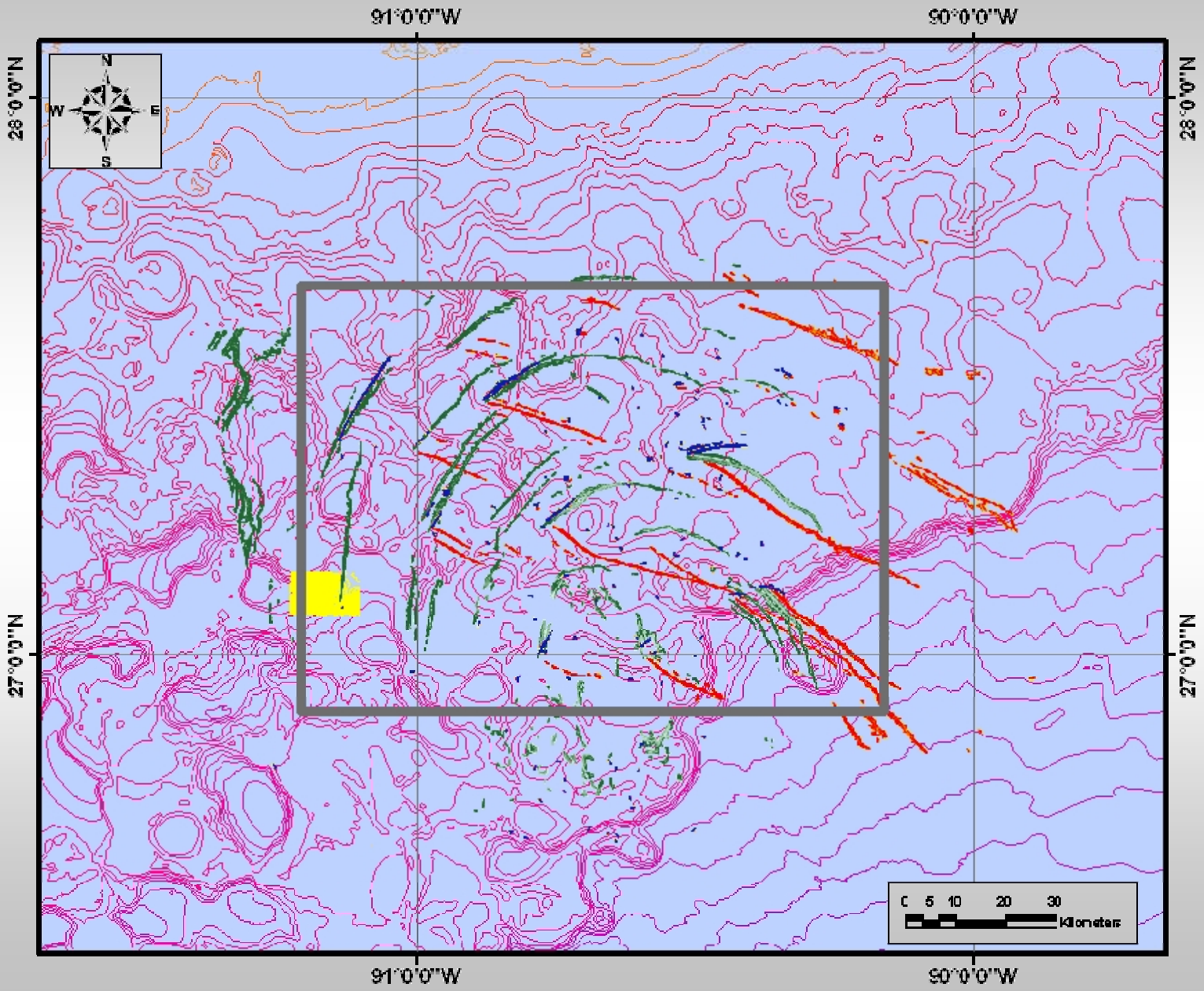
27 May 2006 – Filter with Low Threshold



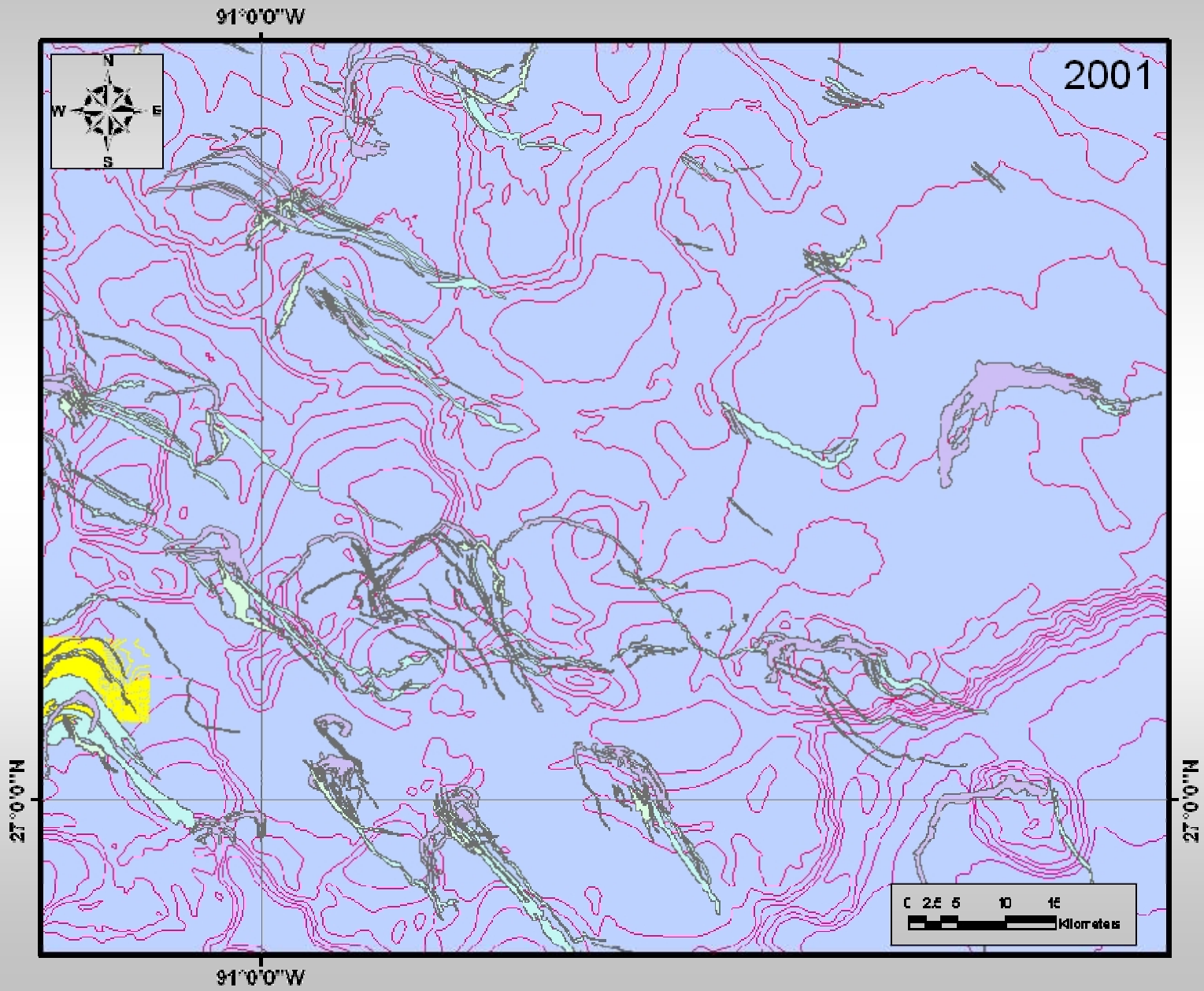
12, 23, & 27 May – Slick Overlay



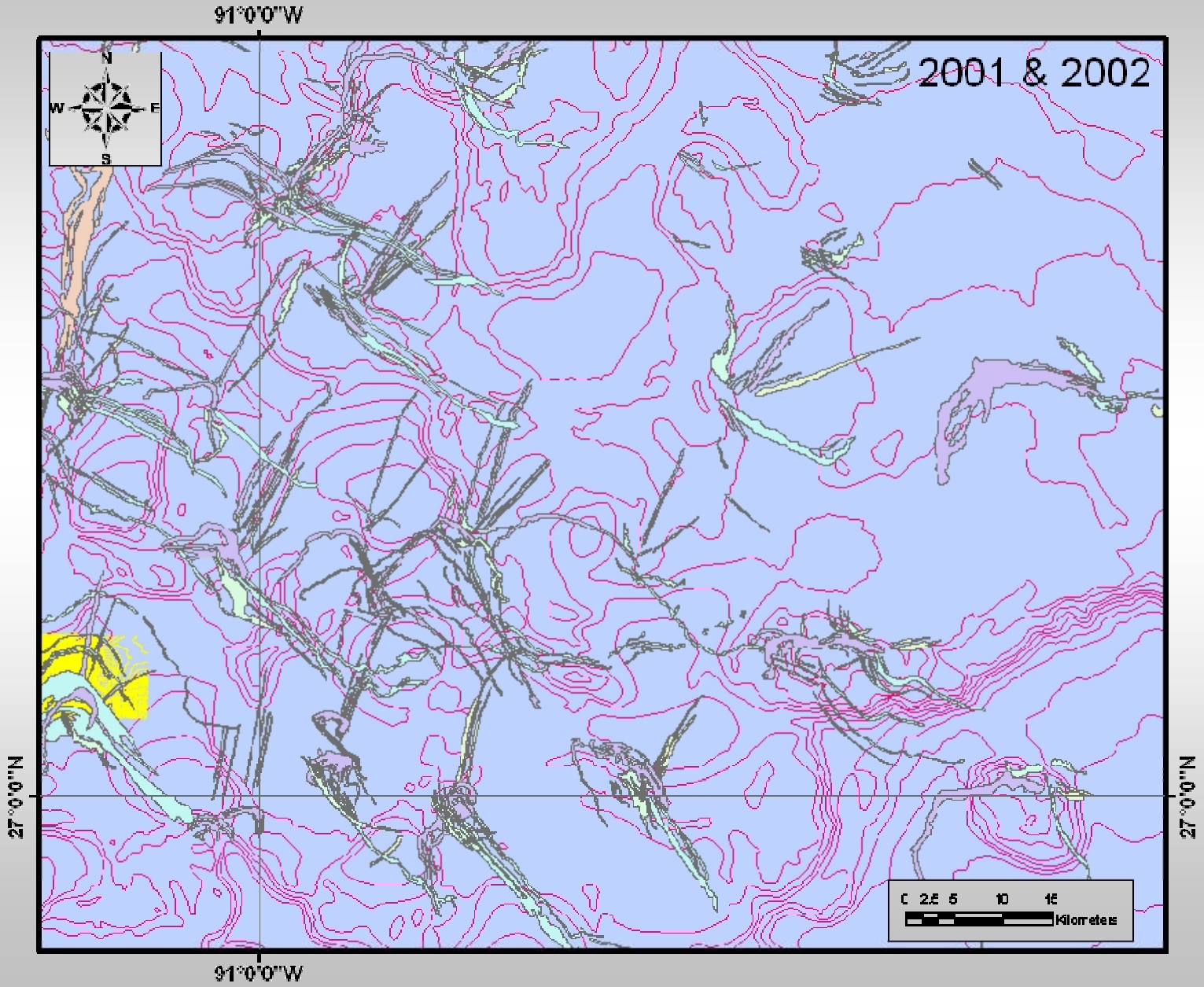
Central Gulf Detail



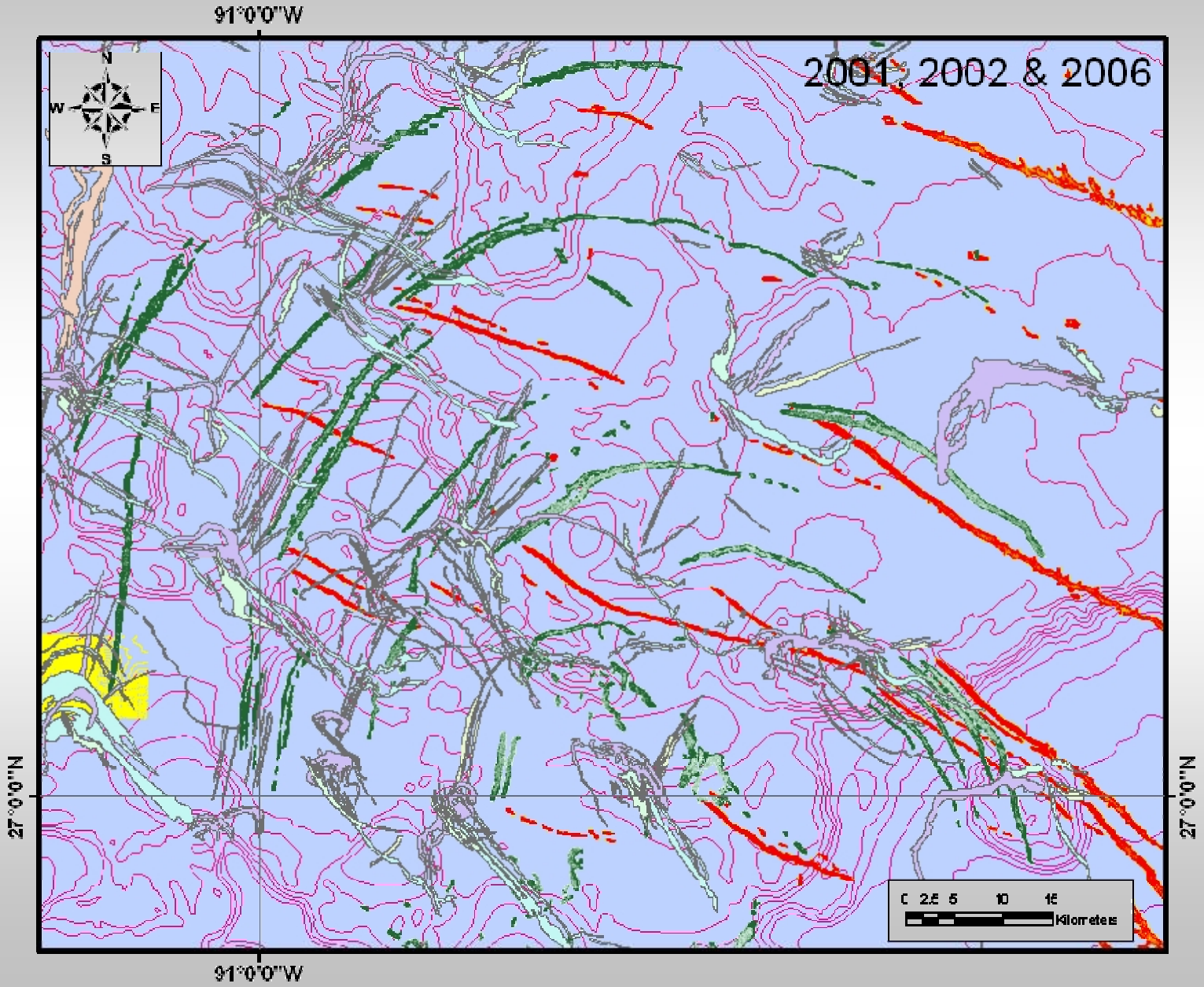
Historic Seepage June 2001

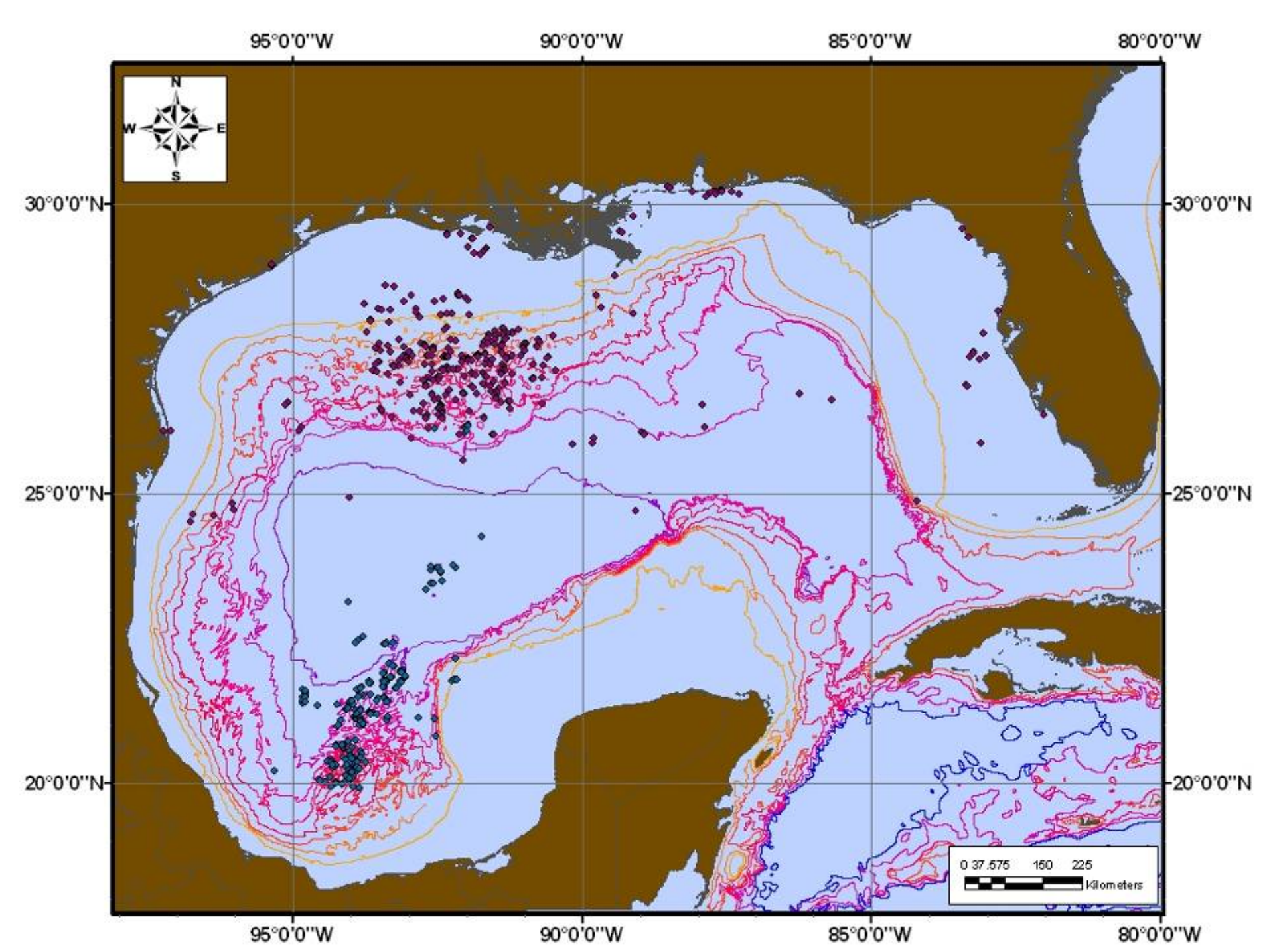
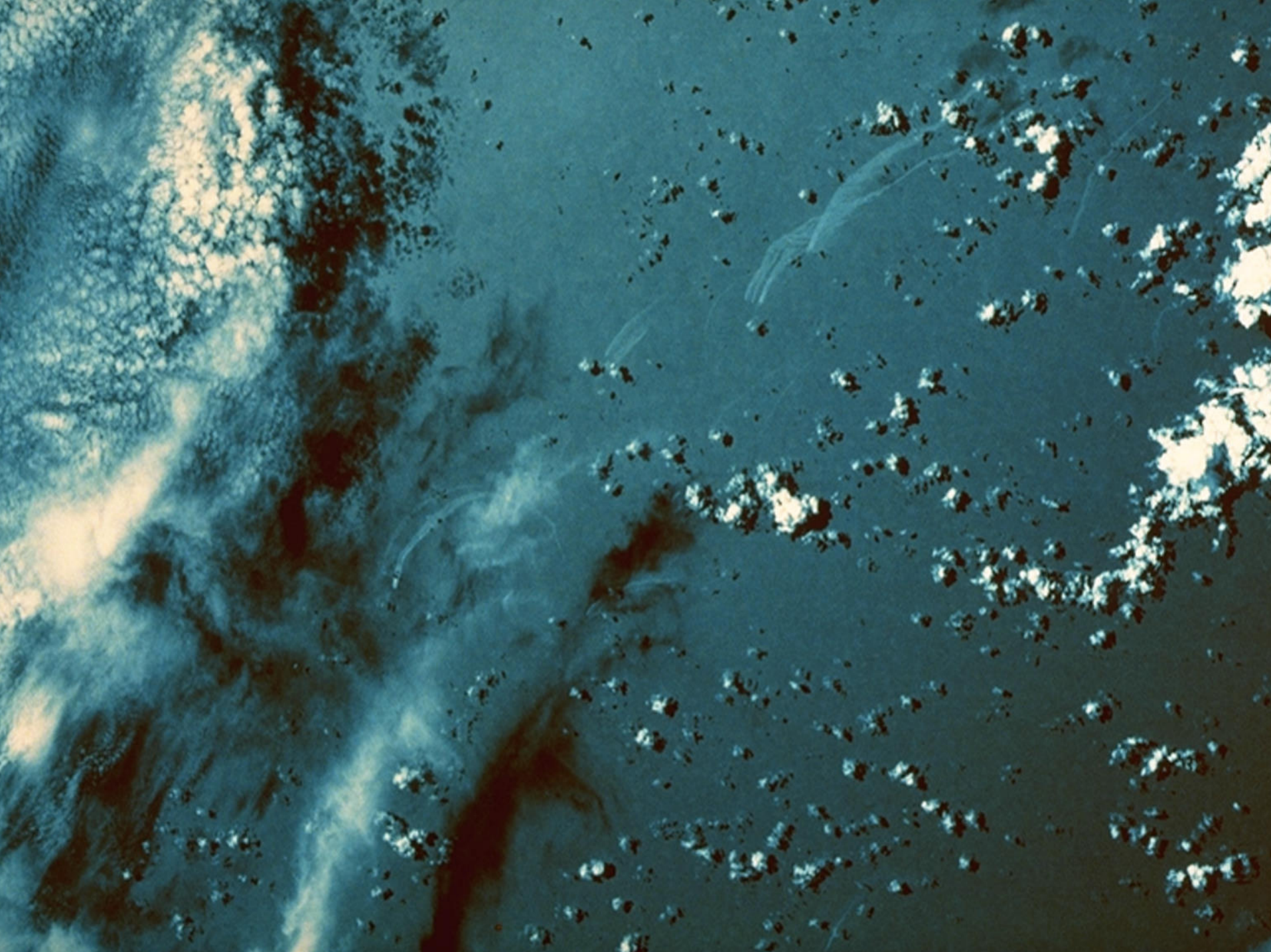


Historical Slicks – 2001 & 2002



Historical Slicks and 2006 Data




95°0'0"W
90°0'0"W
85°0'0"W
80°0'0"W
30°0'0"N
25°0'0"N
20°0'0"N
N
W
E
S
0 37.575 150 225
Kilometers