Briefing on
The Consortium for Risk Evaluation with Stakeholder Participation (CRESP II)

Amchitka Report

August 1, 2005

www.cresp.org

Amchitka
and
Alaska

David Barnes
UAF


GLADIATOR


OCEAN EXPLORER


A1
Alaska
Alaska Airlines

Amchitka Independent Assessment
A Press and Public Briefing on the CRESP Report
August 1, Anchorage, Alaska

Consortium for Risk Evaluation with Stakeholder Participation II (CRESP II)

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Rutgers
Lead, Biological

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Vanderbilt
Lead, Geophysical

I
R
M

Amchitka

Goals of the Assessment Plan, the Expedition and the Analysis

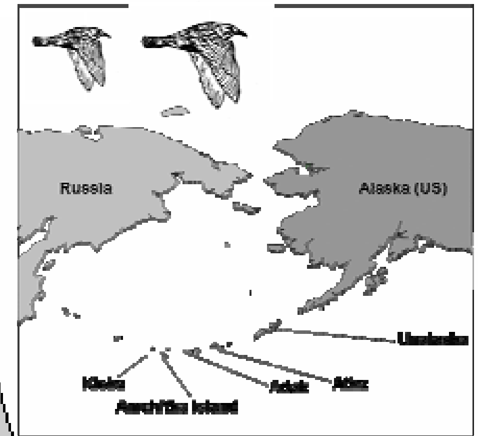
To determine:

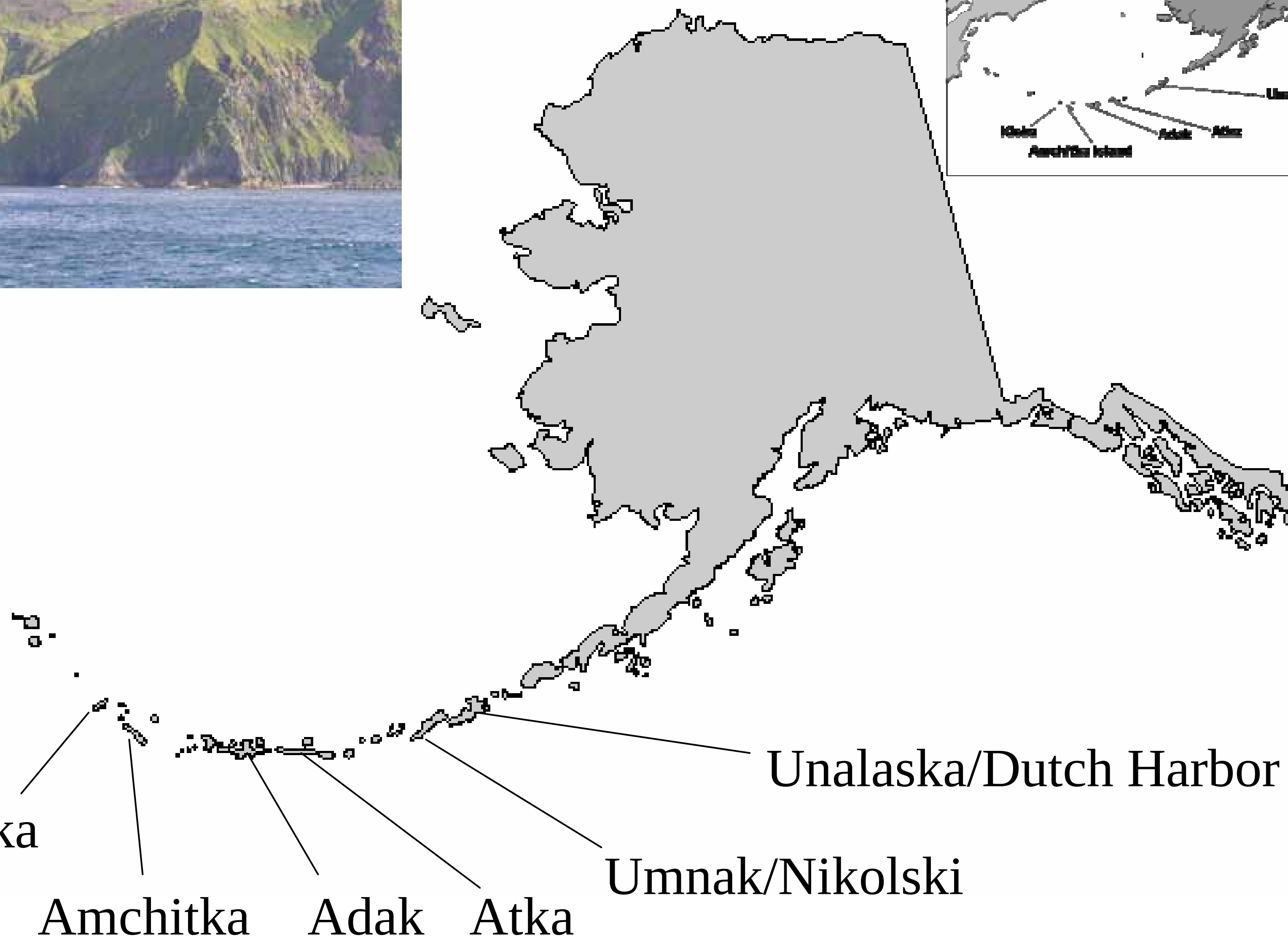
1. whether there is any current threat to human health and environment from radionuclide release into the Island's sea waters from nuclear tests shots at Amchitka; and

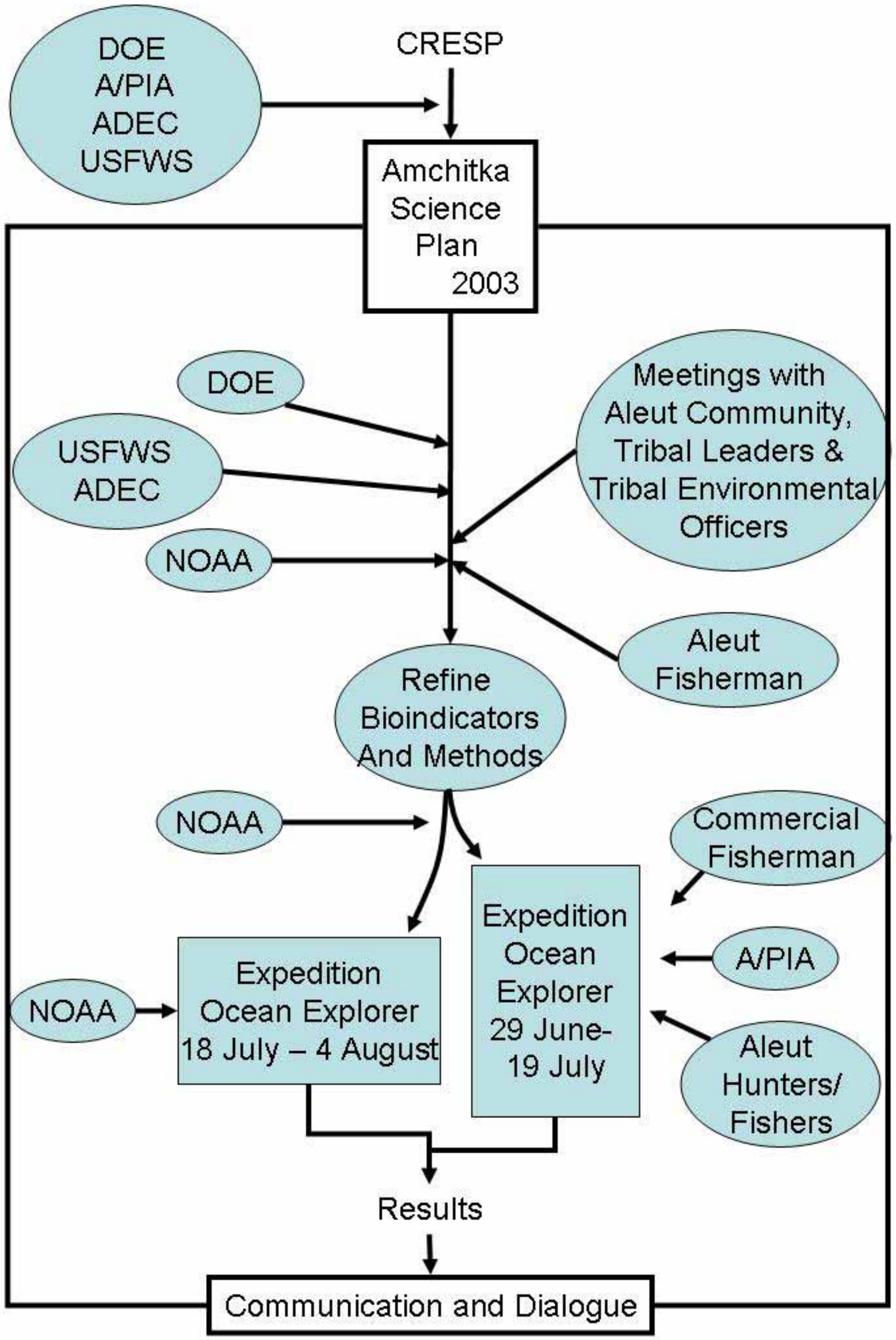
2. a baseline of biological and physical data that should aid in the reduction of model uncertainty and development of a long-term stewardship plan

The 6/02 Letter of Intent has been the lodestar for CRESP efforts and its understanding of its role in the Amchitka process

Alaska


Russia
Alaska (US)


Unalaska/Dutch Harbor
Kiska
Umnak/Nikolski
Amchitka
Adak
Atka



Atka

Nikolski

Bering Sea
Amchitka Island
Kiska Island (Reference Site)
Pacific Ocean
Transects
MT sites
CTD Transects
Diver Transects
LOCATIONS
C Cannikin
Constantine Harbor
L Longshot
M Milrow
CRESPII Amchitka Project
0 3.5 7 14 Miles
Projection: World Robinson

CRESP and Amchitka

Remembering What Got Us to this Briefing

Two Timelines:

Process leading to the Approval of a Science Plan and its Financing

This Report

Initiation of the Effort: ADEC, the Governor of Alaska and the Secretary of DOE – 2000

CRESP and UAF Research Efforts and the 2/02 Fairbanks Workshop

State of Alaska and DOE Letter of Intent – 6/02

CRESP Drafts of Science Plan and Meetings to Review Plans

Substantive Approvals/Go-Ahead + Stakeholder Explanation

Financial/Institutional Wherewithal to Implement

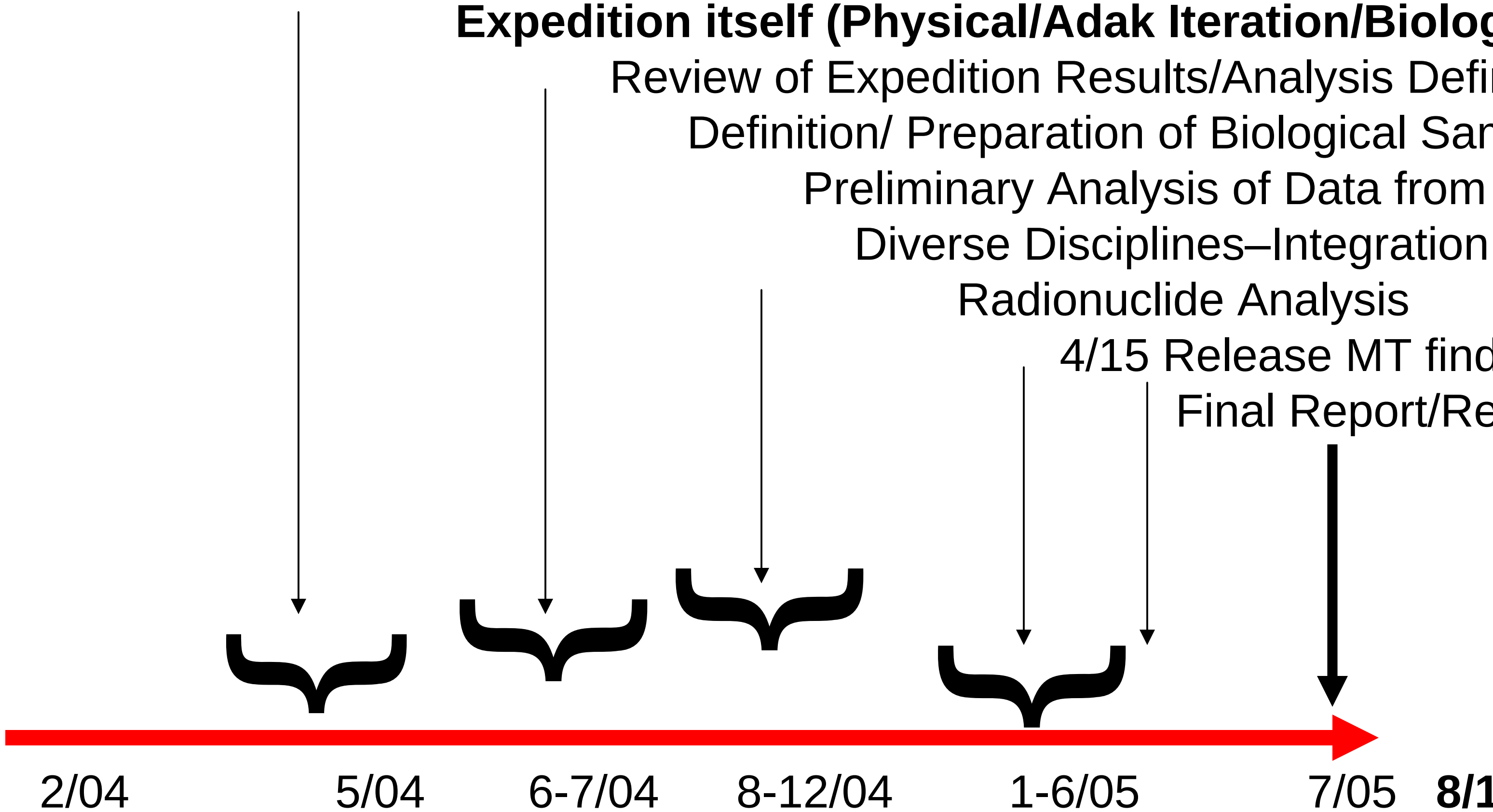
Actual Initiation of Expedition Plan

6/00 2/02 6/02 5-7/03 2/2004

CRESP and Amchitka

Process Since Approval and Go-Ahead to Report

Initiation of University Agreements and Identification of Expedition
Leadership/Ship and Equipment
Specific Planning and Development of HASP/Implementation Plan
Definition of Sampling Goals and Analytic Techniques
Expedition itself (Physical/Adak Iteration/Biological)
Review of Expedition Results/Analysis Definition
Definition/ Preparation of Biological Samples
Preliminary Analysis of Data from
Diverse Disciplines–Integration
Radionuclide Analysis
4/15 Release MT findings
Final Report/Review



Health and Safety Hazards

Stormy Weather and Rough Seas

SHIP
Obstructions
Falls
Cranes

LAB
Cuts
Spines

UNDERWATER
Getting Lost (Drift)
Decompression
Equipment Failure
Entanglement
Spears
Spines
Military Debris
Ordinance

SKIFF
Engine
Trouble,
Flooding

LAND
Getting Lost
Uneven Terrain
Hidden Objects
Vehicles
Firearms
Rock Climbing
Military Debris
Ordinance
Rommel
Stakes

INTERTIDAL
Slips
Military Debris
Ordinance
Sharp rocks & Organisms

Remaining Agenda of the Briefing

40 minutes

Joanna Burger – Biology Summary
David Kosson – Geophysical Summary
David Kosson – Geophysical Findings
Joanna Burger – Biological Findings
Arthur Upton – Review Committee

Questions

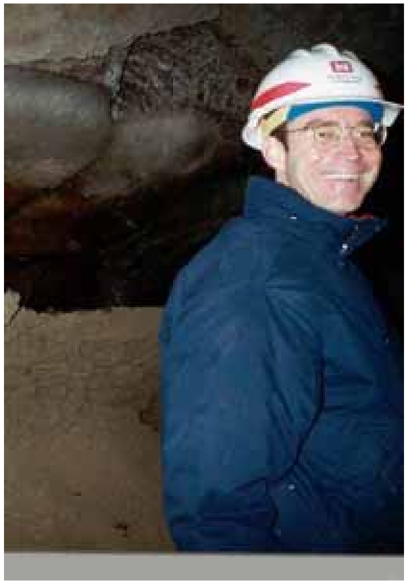
More Specific Questions

8:30 AM August 2 – Here in these rooms

GEOPHYSICAL PROJECTS

David Kosson

Mark Johnson



David Barnes

Martyn Unsworth

Summary and Results from CRESP Geophysical Investigations and Groundwater Modeling

<u>Presenter:</u>

David S. Kosson – leader for CRESP's Amchitka geophysical and radiological analysis studies

Professor and Chair of Civil and Environmental Engineering, Vanderbilt University

<u>Task Leaders:</u>

Mark Johnson – Oceanographic geophysical studies
Professor, University of Alaska, Fairbanks

Martyn Unsworth – Magnetotelluric studies
Professor, University of Alberta

David Barnes – Groundwater modeling
Associate Professor, University of Alaska, Fairbanks

Geophysical Investigations I – Oceanographic Investigations of Bathymetry, Discharge of Freshwater through the Ocean Floor and Sediment Distribution

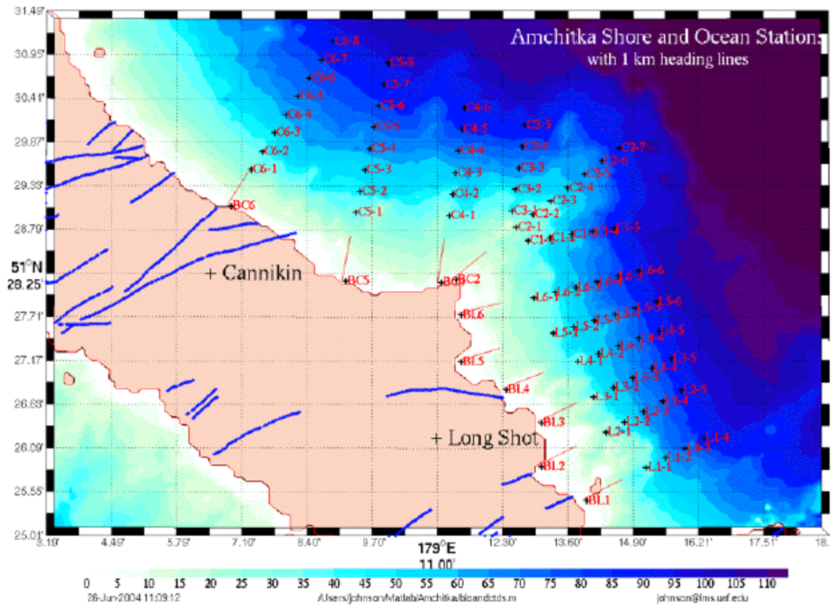
Who: Mark Johnson, University of Alaska, Fairbanks, Alaska
Colin Stewart, U.S. Naval Undersea Warfare Center, Keyport, WA

Key questions:

- *Is there evidence of freshwater discharge through the ocean floor in the areas that were previously identified as most likely to have discharge of freshwater originating from the test shots?*
- *Is there evidence of sediment accumulation on the ocean floor off-shore from the test shots?*

Why:

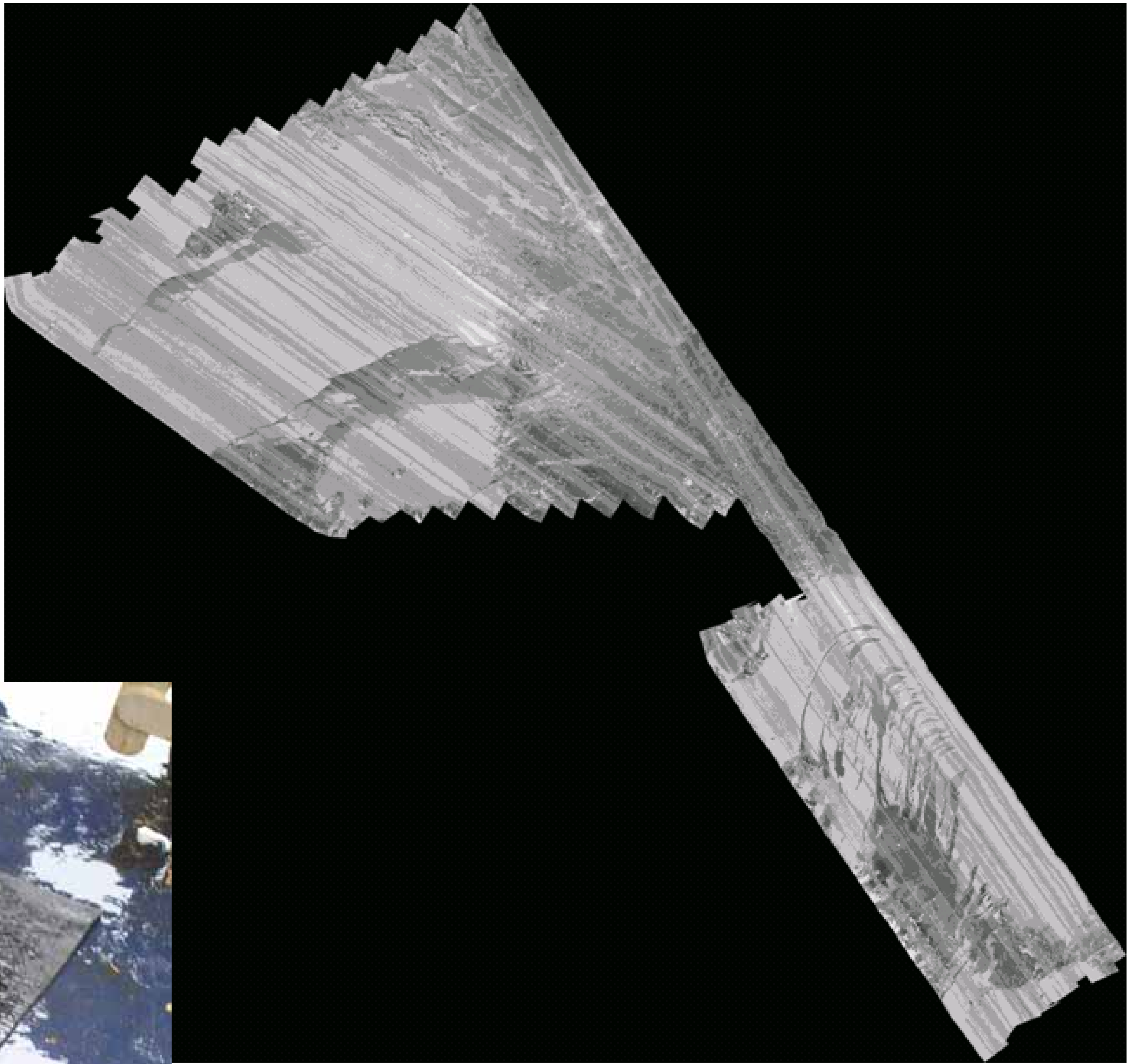
- Localized freshwater discharge through the ocean floor may indicate preferential flow paths for more rapid transport of radionuclides to the marine environment.
- Ocean floor sediments support marine biota and may accumulate and concentrate certain radionuclides.



CTD (salinity) monitoring locations

Side scan sonar transects

Side scan
sonar mosaic
(darker areas
indicate sediment
deposits)



Summary of Results

- There is no evidence for consistent, large-volume, or broad scale freshwater outflow in the bottom waters of the study region from 20 m to 100 m offshore from the Cannikin and Long Shot test sites.
  - Measurements at 6 locations indicated slight anomalies that may be the result of either freshwater discharge or measurement interferences that cannot be distinguished.
- Significant regions of the ocean floor in the study area off Cannikin and Long Shot test sites have sediment accumulations.
  - This is contrary to earlier assumptions that the ocean floor in these areas was devoid of sediment accumulations because of energetic ocean currents.

Significance

- No preferential, or potentially more rapid, pathways were identified for radionuclide transport from the nuclear test locations to the marine environment based on salinity measurements.
- Sediment accumulations are present at locations where they can accumulate radionuclides potentially transported through groundwater and support marine biota.

Geophysical Investigations II - Magnetotelluric measurements for determining the subsurface salinity and porosity structure

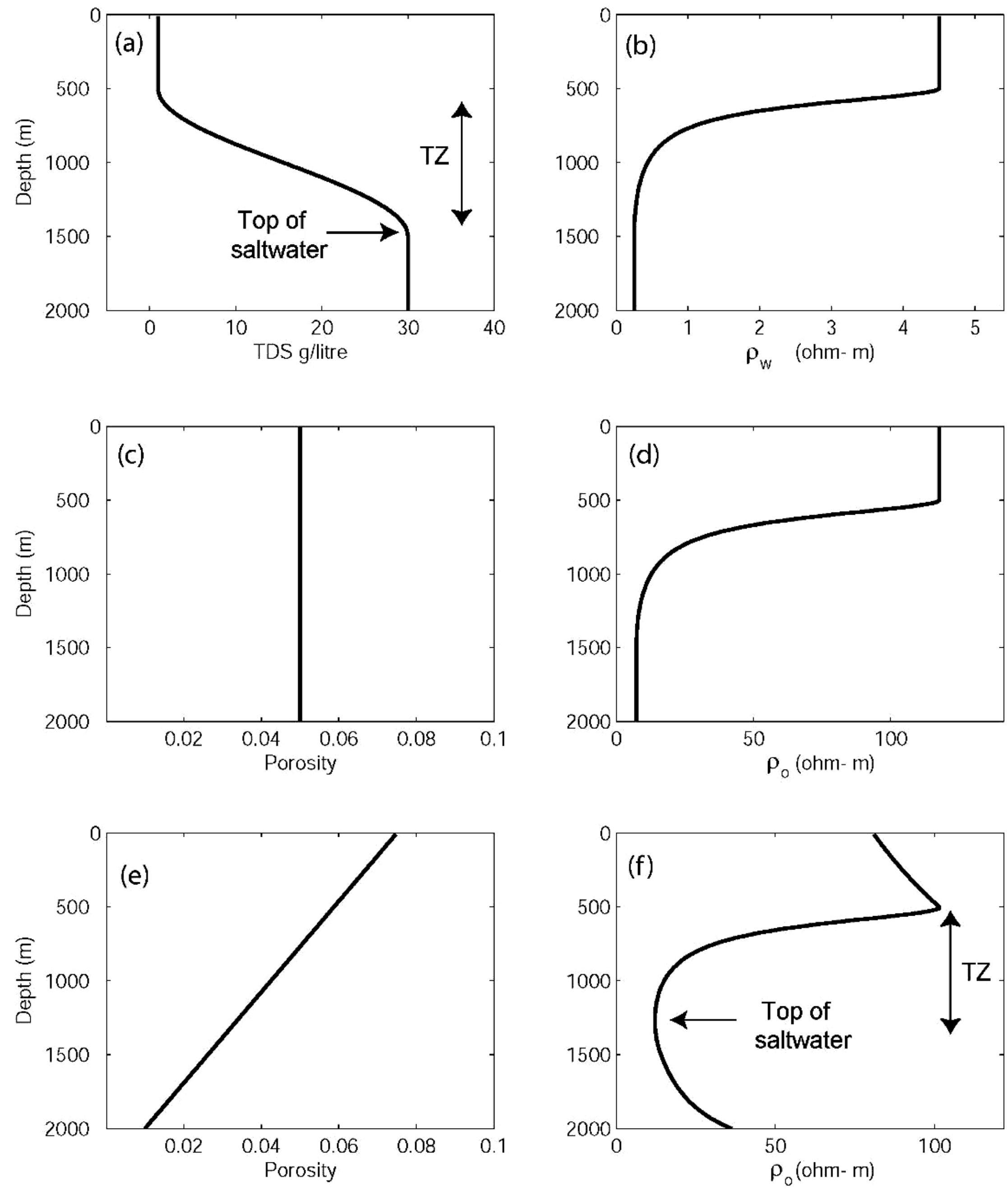
Who: Martyn Unsworth, Wolfgang Soyer and Volkan Tuncer
Department of Physics & Institute for Geophysical Research
University of Alberta

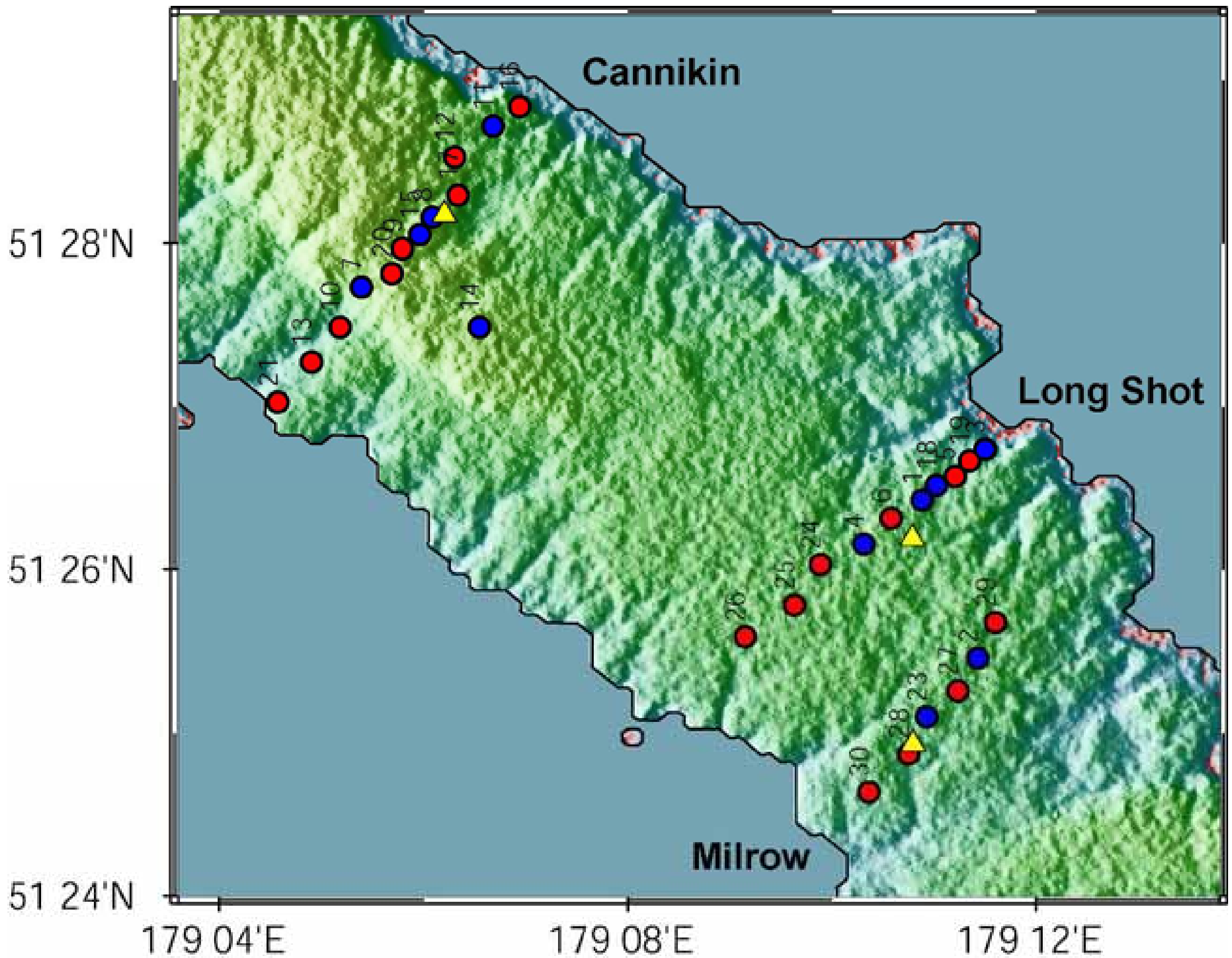
Key questions:

- *What is the depth of the fresh-salt water interface at each test shot?*
- *Can subsurface features associated with the underground nuclear testing be imaged with MT?*
- *Can faults be detected through their effects on groundwater flow?*

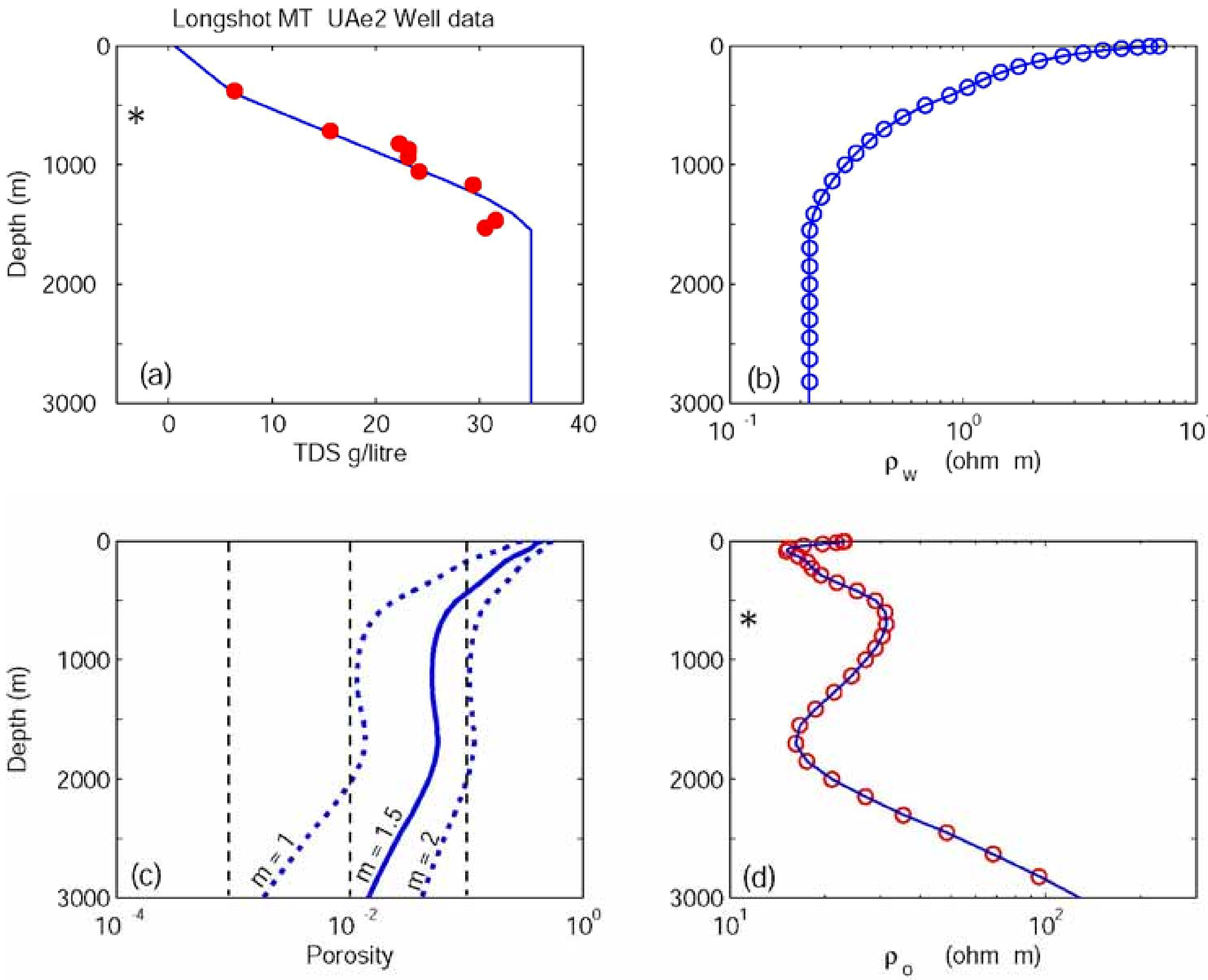
Why:

These factors have a major effect on the path and timeframes for radionuclide transport from the nuclear test locations through groundwater to the marine environment.

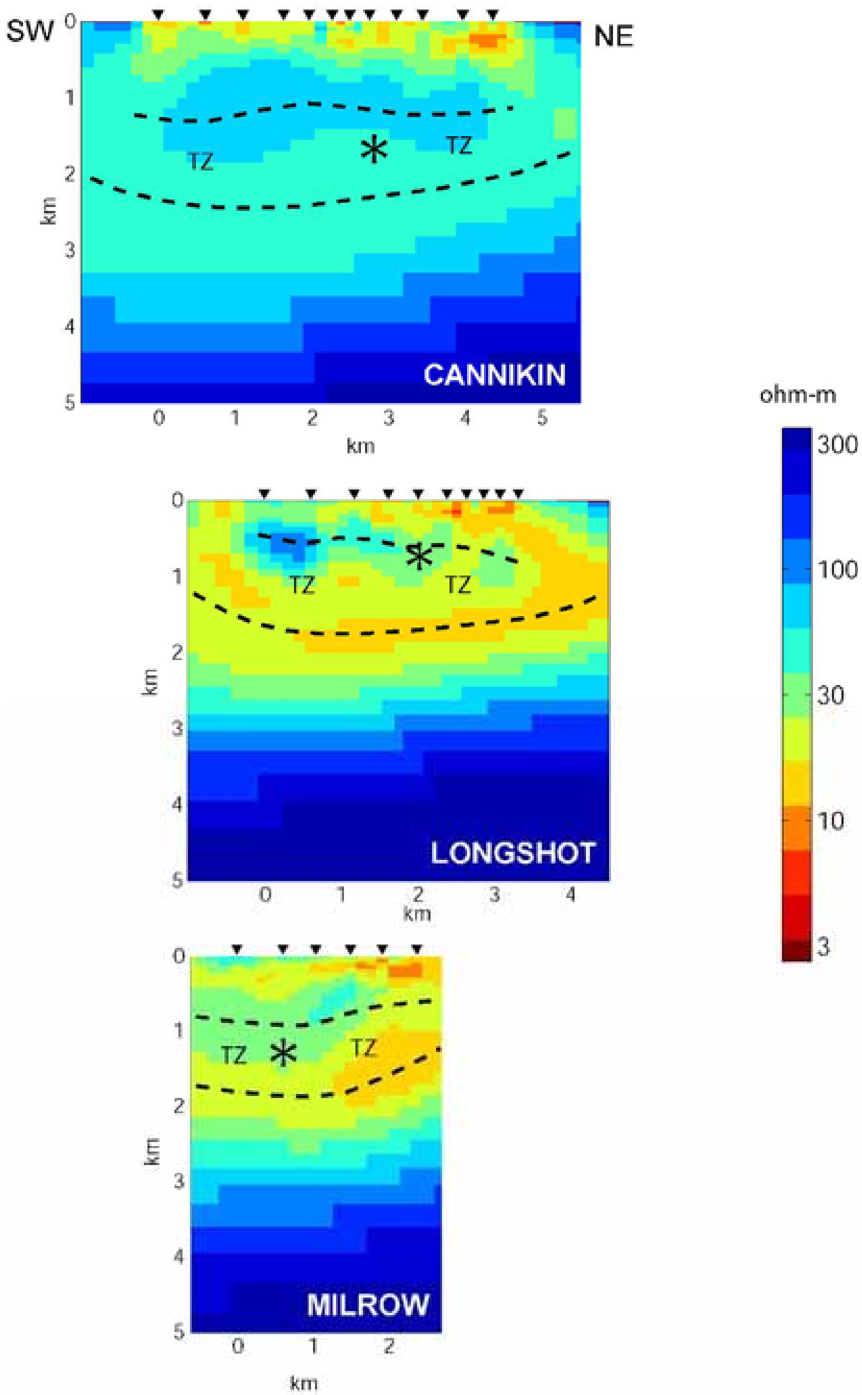

(a)
Depth (m)
TDS g/litre
TZ
Top of
saltwater
(b)
ρ_w (ohm- m)
(c)
Porosity
(d)
ρ_o (ohm- m)
(e)
Porosity
(f)
ρ_o (ohm- m)
TZ
Top of
saltwater



Cannikin
Long Shot
Milrow
51 28'N
51 26'N
51 24'N
179 04'E
179 08'E
179 12'E



Longshot MT UAe2 Well data
Depth (m)
TDS g/litre
(a)
(b)
ρ_w (ohm m)
(c)
Porosity
m = 1
m = 1.5
m = 2
(d)
ρ_o (ohm m)


SW
NE
CANNIKIN
LONGSHOT
MILROW
TZ
km
0
1
2
3
4
5
ohm-m
300
100
30
10
3

Summary of Results

	Shot depth (m)	*Salinity at shot (g/liter)*[1]	*Top of TZ (m)*	*Top of TZ Possible range (m)*	*Base of TZ (m)*	*Base of TZ Possible range (m)*
Milrow	1200	20	900	800-1100	1700	1500-2100
Long Shot	700	10	600	500-1000	1700	1500-2000
Cannikin	1700	5	900	800-1000	2500	2000-2700

1. Saliniity is measured by chloride concentration which is usually < 0.7 g/liter (parts per thousand) in fresh water and 19.3 g/liter in pure salt water or by total solute (35 g/liter or ppt) in saltwater.

Significance

- The nuclear test locations are in the fresh to salt water transition zone, implying very long travel times for radionuclides to reach the marine environment.
- Prior studies assumed a sharp fresh to salt water interface at ca. 1,120 m depth
- Greater subsurface pore volume of water (porosity) than previously modeled implies longer groundwater travel times.
- No preferential groundwater flow pathways were detected that would provide for more rapid radionuclide transport to the marine environment.

Groundwater Modeling in the Vicinity of the Long Shot Nuclear Test

Who: Anna Forsstrom and David Barnes
Dept. of Civil and Environmental Engineering
University of Alaska, Fairbanks, Alaska

Key questions:

- *What is the impact of the new MT data and case assumptions on the estimated locations for discharge of groundwater originating from near the Long Shot test site?*
- *What is the impact of the new MT data and case assumptions on the estimated time for groundwater to travel from near the Long Shot test site to the point of discharge through the ocean floor?*

Why:

Answers to these questions help form our understanding of health risks and monitoring needs.

Comparison of scenarios modeled in this study.

	Scenarios 1 and 2 **(R_{min} and R_{max})**	**Scenarios 3 through 6** **(K_{Banjo}, $K_{Abovesill}$, K^{min}_{LS} and K^{max}_{LS})**	**Scenarios 7 and 8** **(R^{min}_{sill} and R^{max}_{sill})**
Primary Assumptions and Approach	**Whole island modeled as homogeneous.** 2-D based on MT results, fixed recharge, **varied hydraulic conductivity** to match MT prediction of transition zone.	**Whole island modeled as homogeneous.** 2-D based on MT results, fixed hydraulic conductivity, **varied recharge** to match MT prediction of transition zone.	**Whole island modeled as heterogeneous considering the andesite sills.** 2-D based on MT results, fixed recharge, varied hydraulic conductivity to match MT prediction of transition zone.
Recharge, R (m/day)	9.1×10^{-5} and 3.1×10^{-4}	1.9×10^{-6} to 1.4×10^{-4}	9.07×10^{-5} and 3.13×10^{-4}
Hydraulic conductivity, K (m/s)	2.3×10^{-7} and 7.9×10^{-7}	4.7×10^{-9} to 3.5×10^{-7}	Rock matrix: 1.9×10^{-7} and 7.4×10^{-7} Sill: 1.9×10^{-5} and 7.4×10^{-5}

Summary of results from previous studies and this study for the *Long Shot* test shot at Amchitka.

Scenario	Fenske (1972)	Wheatcraft (1995)	DRI (Hassan et al. 2002)	This study (homogeneous)	This study (andesite sills)
Distance to off-shore edge of freshwater discharge (m)	Not reported[a]	335[b]	580 to 1380[c]	20	30
Distance to off-shore edge of transition zone (m)	Not reported[a]	400[b]	1,380 to 3,280[c]	1,360	1,350 to 1,500
Location of freshwater/saltwater transition zone, depth (m)	1,120[a]	1,200[b]	1,120	680 to 1,560	740 to 1,560
Travel time for groundwater from working point of *Long Shot* to the Bering Sea (years)	Not reported[a]	880	10 to >2,200[d]	1,400 to 4,700	400 to 1,400

Notes:
a) The 1,120 m is for the top of the freshwater/saltwater transition zone. Distance to off-shore edge of freshwater discharge, distance to off-shore edge of transition zone, and travel times were not reported for *Long Shot*.
b) Wheatcraft calibrated the freshwater distance to 1,200 m measured from the water table to the middle of the transition zone (at the center of the island). The distance to off-shore edge of freshwater discharge and the distance to off-shore edge of transition zone were not stated by Wheatcraft; the values were read off of one of the figures and are thus estimated distances.
c) The location of the left and right edge of the plume from the cavity of *Long Shot* were reported but not the freshwater/saltwater transition zone. Location of the left edge of the mass plume was between 580 and 1,380 m from the shore-line. The right edge of the mass plume was approximately between 1,380 and 3,280 m from the shore-line.
d) DRI used a fracture porosity of undisturbed rocks of 5.0×10^{-4} which is lower than what was reported by Unsworth et al. (2005). The lower value of porosity will decrease the ground-water travel time (Hassan et al. (2002))

Summary of Results

- Groundwater travel times from the Long Shot test shot to discharge through the ocean floor into the marine environment will take very long times.
  - Estimates of travel times range from 1,400 to 4,700 years assuming a homogeneous subsurface for likely scenarios, and from 400 to 1,400 years assuming the influence of an andesite sill layer.
  - Contaminant transport travel times will be longer than groundwater travel times because of contaminant retardation processes (e.g., adsorption and diffusion).
- Including the presence of subsurface heterogeneity (i.e., andesite sills), actual topography, and the knowledge gained from the MT studies can have a significant impact on the estimated travel times and discharge locations for contaminants from the test shots to the marine environment.

Significance

Additional groundwater modeling that includes new geophysical data and subsurface heterogeneity will improve understanding risk and monitoring needs.

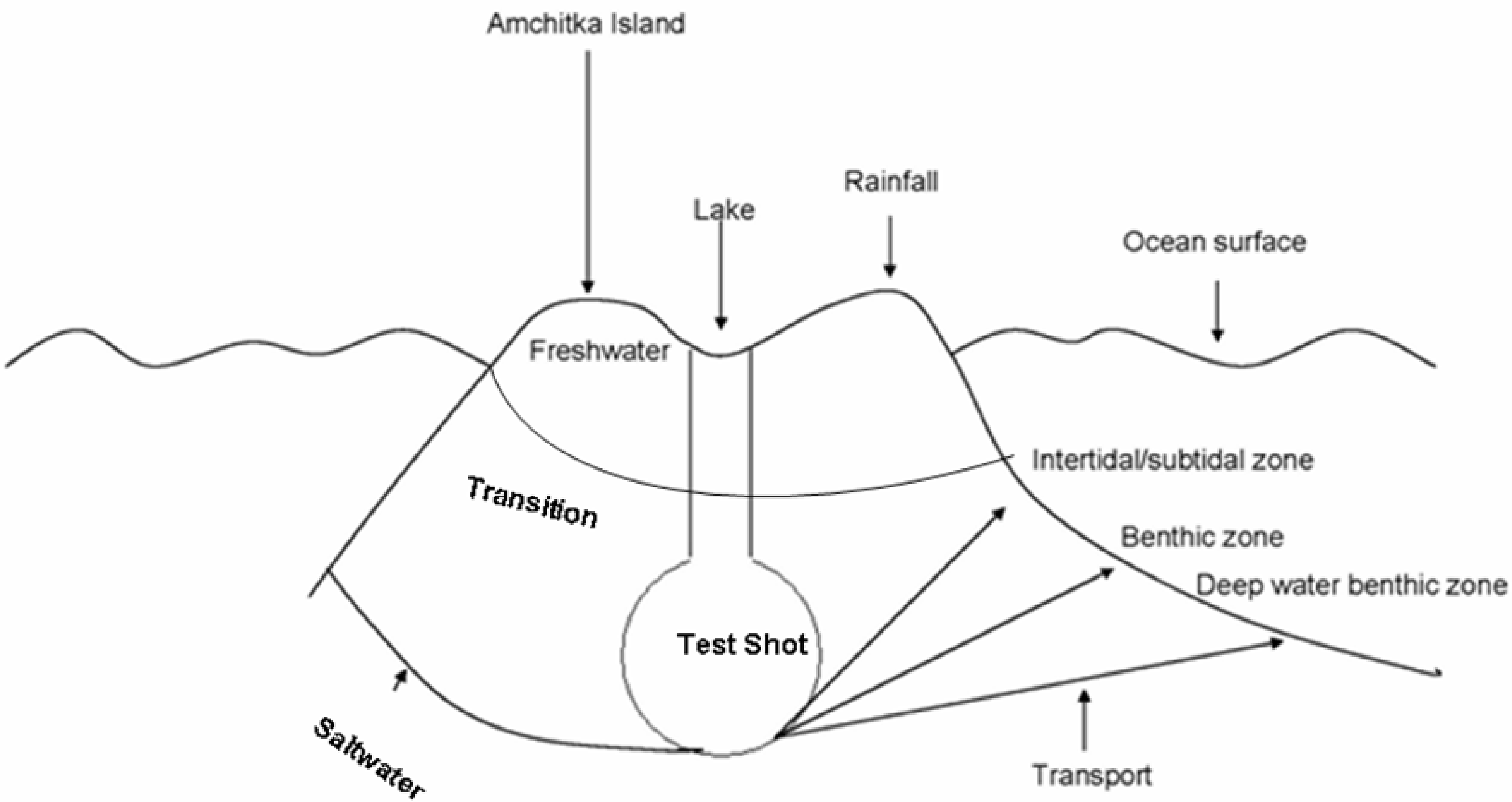


Figure 3.3 Schematic of Amchitka showing possible transport to the sea in relation to which the CRESP sampling program was developed

THE BIOLOGICAL EXPEDITION

28 June – 21 July 2004 (Ocean Explorer)
18 July – 8 August (Gladiator)

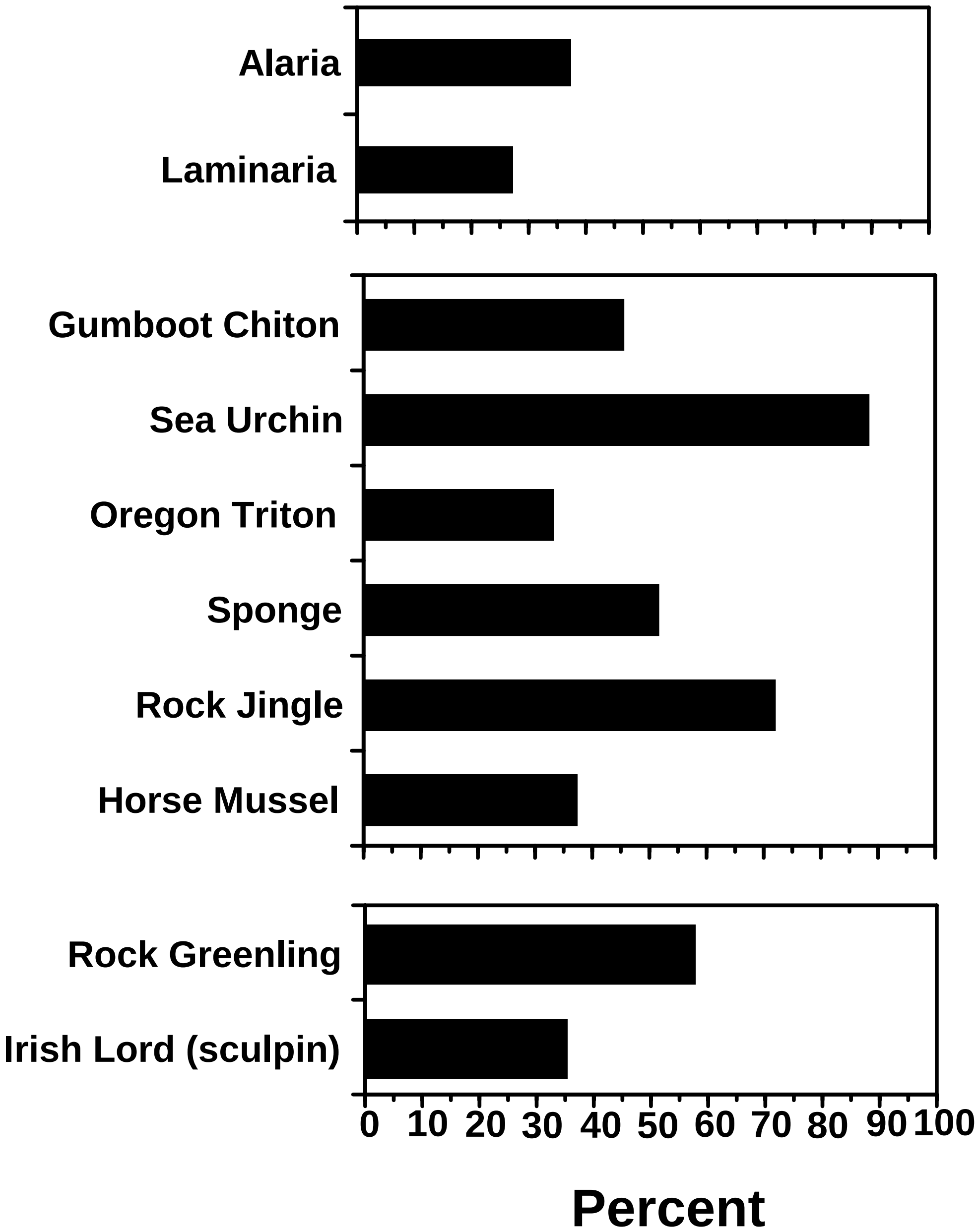
Team Leaders

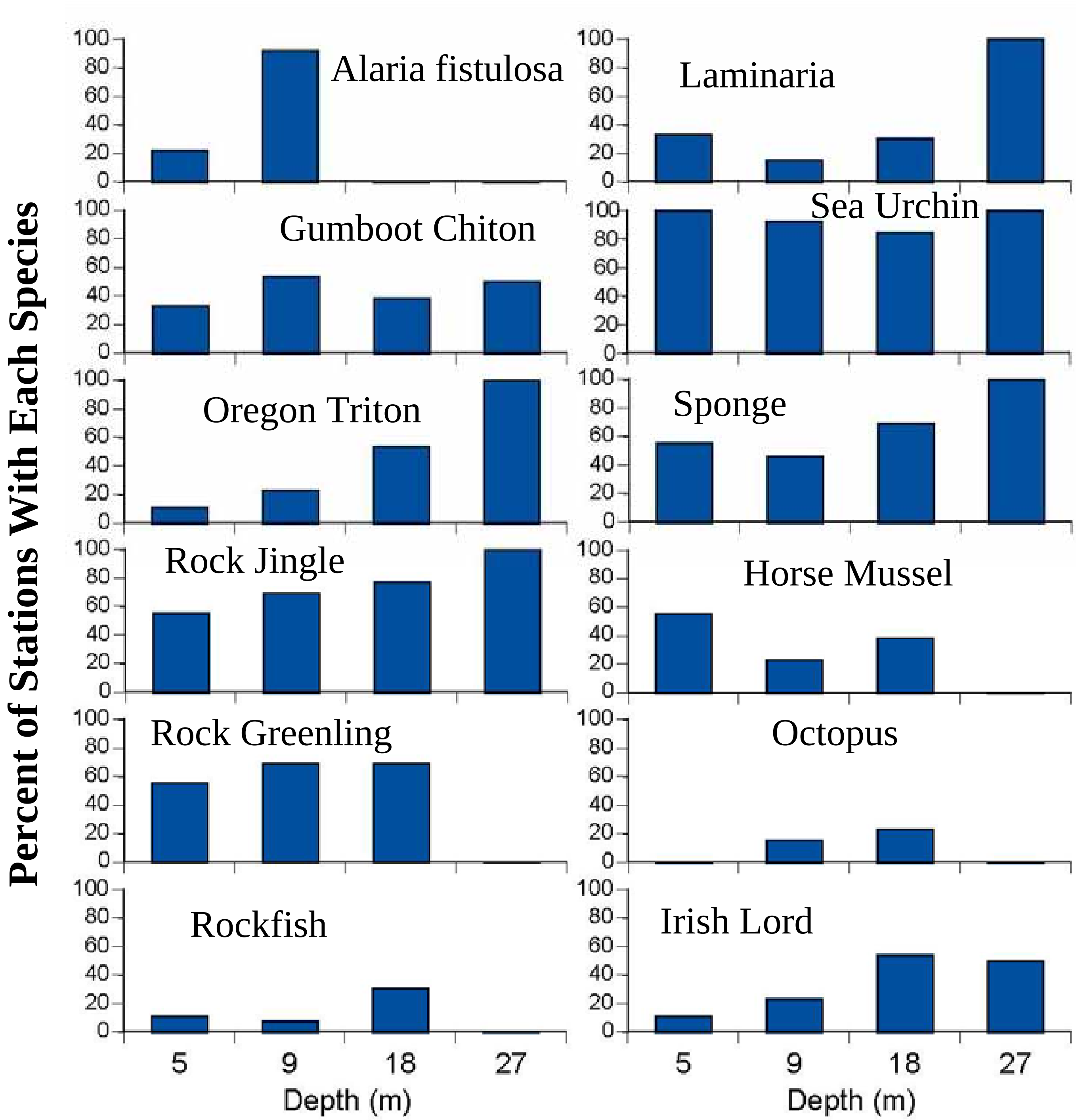
Joanna Burger
Michael Gochfeld
Stephen Jewett
Robert Patrick

SUCCESSFUL SAMPLE COLLECTION:

38 Coolers
2481 Pounds
(+10 NOAA Coolers)

Percent of Benthic Transects With Each Species Collected





Rougheye Rockfish

RADIONUCLIDES IN MARINE BIOTA

- •Overall Levels
- •Differences among Species
- •Differences between Amchitka and Kiska
- •Differences among the Test Shots
- •Compare CRESP Amchitka levels to :
    - •1970's from Amchitka
    - •Other Regions
    - •Effects Levels
    - •Standards and Guidelines

FROM COLLECTION TO PREPARATION

IMPORTANCE OF RADIONUCLIDES

- Are the foods safe?
- Is the biota of Amchitka contaminated with radionuclides?
- Are levels high enough to pose harm to biota including humans?
- What species are appropriate for biomonitoring?

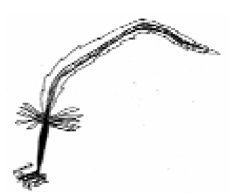
ATKA

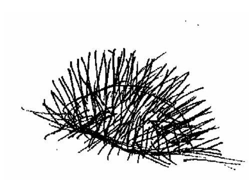
DUTCH HARBOR

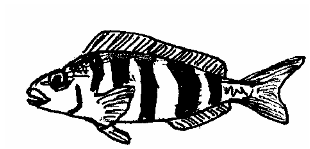
NUMBER OF RADIONUCLIDE ANALYSES

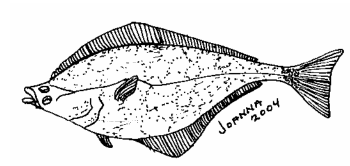
	Primary Producers	Grazers/ Filter Feeders	Predators	Top - Level Predators	Total
Cs - 137[a]	10/12	11/8	17/136	31/17	69/173
I - 129	12	9	45	5	71
Co - 60	12	8	136	17	173
Eu - 152	12	8	136	17	173
Sr - 90	12	11	57	5	85
Alpha Analysis (U, Pu, Am)	48	3	22	18	91
Tc 99	12	7	35	6	60

[a] 1000g/100g

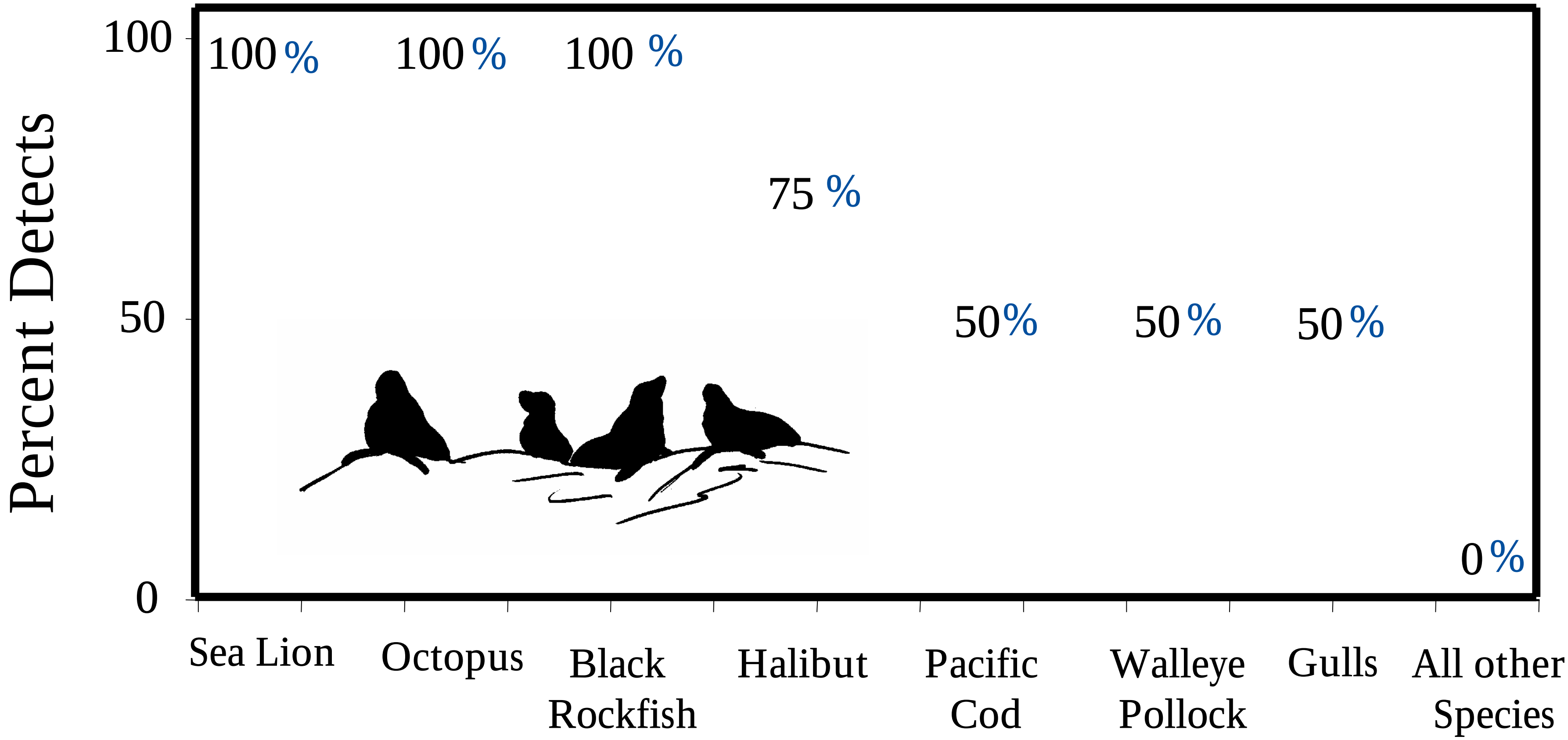








CESIUM – 137 (1000 gram SAMPLES)



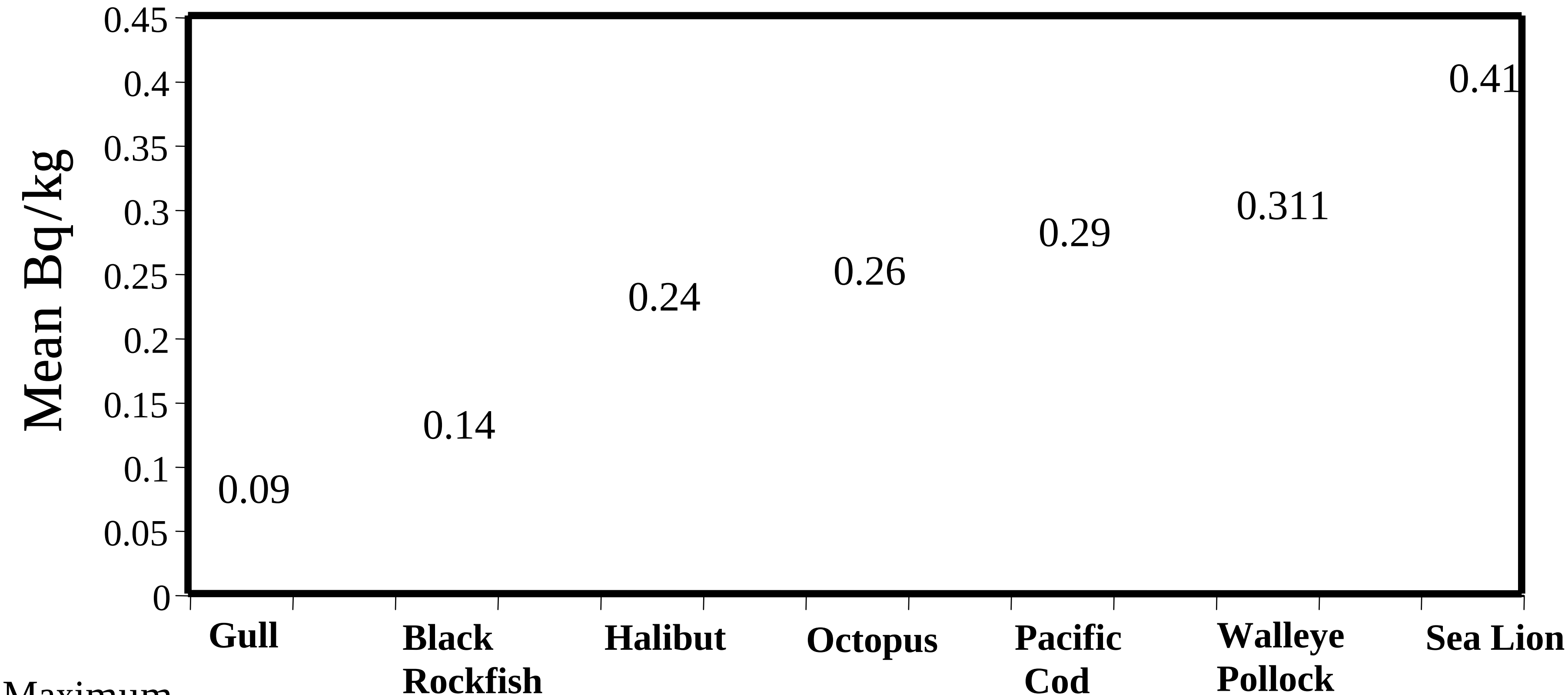
	Sea Lion	Octopus	Black Rockfish	Halibut	Pacific Cod	Walleye Pollock	Gulls	All other Species
No. Analyses	2	4	3	4	14	2	2	38
No. Individuals	1	4	31	14	71	10	18	1303

KELP: SPECIES DIFFERENCES

Isotope **(Bq/kg)**	*Alaria fistulosa* **(N=10)**	*Alaria nana* **(N=12)**	*Fucus* **(N=14)**	Chi square (p value)
Pu-239,240	0.067 ± 0.094	0.029 ± 0.016	0.031 ± 0.017	0.002 (0.99)
U-234	0.48 ± 0.26	0.77 ± 0.31	3.12 ± 1.087	22.5 (<0.0001)
U-235	0.028 ± 0.003	0.039 ± 0.024	0.15 ± 0.052	21.7 (<0.0001)
U-238	0.53 ± 0.29	0.68 ± 0.30	2.74 ± 0.95	21.7 (<0.0001)



Cesium – 137



Maximum Age (yrs)	35	50	55	5	25	28	30

PERCENT DETECTS FOR ALL ANALYSES

	Percent Above MDA		
	Amchitka	Kiska	x^2 (p)
Cs-137	13	9	0.0002 (NS)
Am-241	9	14	0.51 (NS)
Pu -238	5	0	2.03 (NS)
Pu-239, 240	15	2	5.94 (0.02)
U-234	82	78	0.22 (NS)
U-235	31	28	0.10 (NS)
U-236	4	3	0.05 (NS)
U-238	84	83	0.01 (NS)

NS = Not Significant

Cesium – 137
For
Black Rockfish, Halibut, Pacific Cod, Walleye Pollock

	Amchitka	Kiska	
Number of Composites	15	8	
Number of Detects (%)	7(47%)	7(87%)	P < 0.056
Mean ± SD (all)	0.24± 0.14	0.28 ± 0.13	P = 0.22
Mean ± SD (Detects Only)	0.30 ± 0.18	0.30 ± 0.14	P = 0.84

Walleye Pollock

PLUTONIUM – 239, 240: FOR ALGAE

	Amchitka	Kiska	
Mean MDA	0.039 ± 0.04	0.018 ± 0.008	NS
Number of Analyses	31	17	4.32 (<0.04)
Number of Detects	11	1	
Percent of Detects	32%	5%	

PLUTONIUM – 239, 240: FOR ALGAE

	Number of Analyses	Number Detects (%)	Mean Above MDA ± SD
Milrow	9	6 (66%)	0.037 ± 0.007
Long Shot	11	2 (18%)	0.051 ± 0.032
Cannikin	5	3 (60%)	0.033 ± 0.0008
Kiska	11	1 (9%)	0.037 ± 0.008
X^2 (p)		10.0 (0.018)	3.87 (p = 0.27)

TEMPORAL PATTERNS IN Cs - 137 (Bg/kg) atAmchitka

	1967 - 68 [a]	1965 - 1975 [b]	CRESP 2004
Walleye Pollock	0.96	----	0.32
Pacific Cod	1.14	----	0.2
Halibut	1.24	0.58	0.14
Rock Greenling	0.93	0.52	<MDA [c]
Dolly Varden	not done	7.2 (2.4)[d]	0.7
Fucus	0.66		<MDA

a. Isakson & Seymour (1968)

b. Seymour & Nelson (1977)

c. MDA = 0.29

d. Average with and without The post Long Shot & post Cannikin high values.

Cs - 137 (Bq/kg)

	Mussels	Cod
Baltic Sea	---	8.86
Irish Sea	2.4	6.44
North Sea	0.1	0.38
Norwegian Sea	0.16	0.32
Barents Sea	---	0.29
North Atlantic	0.03	0.28
Arctic	---	0.20
Channel	---	0.20
Japan	0.01	
Hong Kong	<0.02	
Amchitka/Kiska	**<MDA**	0.20

MAXIMUM LEVELS BY TROPHIC LEVEL
Related to Human Health Guidelines

		Cs-137	Am-261	Pu-239, 240	U-234	U-235	U-236	U-238
Codex Levels (Bq/kg)		1,000	1	1	a	1	---	a
Primary Producers:	Fucus	ND	0.035	0.059	5.1	0.254	0.044	4.47
Grazer:	Rock Jingle	ND	0.031	0.034	0.513	0.020	0.011	0.447
Lower Predator:	Ocean Perch	ND	ND	ND	0.655	ND	ND	0.654
Higher Predator:	Black Rockfish	0.189	0.029	ND	2.18	0.116	ND	1.83
Top - Level [b]:	Pacific Cod	0.6	0.015	ND	0.20	ND	ND	0.225
	Walleye Pollack	0.46	0.02	0.02	0.857	0.053	ND	0.779
Natural or Anthropogenic		A	A	A	N	N	A	N

a. should be the same as for U-235
b. Sea Lion: Cs-137 level was 0.55 Bq/kg ww
c. ND=all values below detection level

MAIN CONCLUSIONS

- Human foods are well below published health guidance levels
- There is a wide range of biota in the intertidal and benthic habitats around Amchitka that could be at risk from radionuclide seepage
- There are complex food webs that allow the potential for bioaccumulation and biomagnification up the food chain

CONCLUSIONS –CONTINUED

• Our data do NOT suggest that radionuclides in biota collected near Amchitka are attributable to the test shots

•A combination of sedentary and mobile species at different trophic levels should be used for bioindicators

• Use of NOAA trawls (for Fish) and U.S. Fish & Wildlife (for kelp) Vessels

•Additional analyses of existing samples is suggested

CONCLUSIONS - CONTINUED

- Substantial localized discharge of freshwater through the ocean floor was not indicated by CRESP ocean floor salinity measurements. Thus, no freshwater flow through geological faults was found.
- There was substantial sediment accumulation on the ocean floor near *Cannikin* and *Long Shot.*
- All 3 test shots were within the transition zone between fresh and salt groundwater, and greater subsurface pore volume was present than previously assumed.

AMCHITKA INDEPENDENT ASSESSMENT SCIENCE PLAN

Biological and Geophysical Aspects of Potential Radionuclide Exposure in the Amchitka Marine

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