

Completion Report

Johnson, Paul

Period: 2/1/2012 - 1/31/2013

Project: R/NP-6 - *Glass Sponge Reef Habitat in the Pacific Northwest*

:: STUDENTS SUPPORTED

Hearn, Casey, ckh3@u.washington.edu, University of Washington, Oceanography, status:cont, field of study:Oceanography, advisor:H.P. Johnson, degree type:BS, degree date:2012-06-01, degree completed this period:Yes

Student Project Title:

Small Scale Ridge Structure and Orientation as a Control on Sediment Distribution.

Involvement with Sea Grant This Period: *none*

Post-Graduation Plans: *none*

Homola, Kira, khomola@u.washington.edu, University of Washington, Oceanography, status:cont, *no field of study*, advisor:H.P. Johnson, degree type:BS, degree date:2012-06-01, degree completed this period:Yes

Student Project Title:

Small Scale Ridge Structure and Orientation as a Control on Sediment Distribution.

Involvement with Sea Grant This Period: *none*

Post-Graduation Plans: *none*

Salmi, Marie, maries3@uw.edu, University of Washington, Oceanography, status:cont, field of study:Society for Integrative and Comparative Biology, advisor:H.P. Johnson, degree type:MS, *no degree date*, degree completed this period:No

Student Project Title:

Behavior of methane seep bubbles over a pockmark on the Cascadia Continental Margin

Involvement with Sea Grant This Period: *none*

Post-Graduation Plans: *none*

Wheeler, Ashley, anw5@u.washington.edu, University of Washington, Oceanography, status:cont, *no field of study*, advisor:H.P. Johnson, degree type:BS, degree date:2012-06-01, degree completed this period:Yes

Student Project Title:

Comparing heat flow measurements from thermal blankets and heat flow probes in Middle Valley, Juan de Fuca Ridge

Involvement with Sea Grant This Period: *none*

Post-Graduation Plans: *none*

:: CONFERENCES / PRESENTATIONS

No Conferences / Presentations Reported This Period

:: ADDITIONAL METRICS

| | |
|--|---|
| K-12 Students Reached: | Acres of degraded ecosystems restored as a result of Sea Grant activities: |
| Curricula Developed: | Resource Managers who use Ecosystem-Based Approaches to Management: |
| Volunteer Hours: | HACCP - Number of people with new certifications: |
| Cumulative Clean Marina Program - certifications: | |

:: PATENTS AND ECONOMIC BENEFITS

No Benefits Reported This Period

:: TOOLS, TECH, AND INFORMATION SERVICES

| Description | Developed | Used | Names of Managers | Number of Managers |
|--|--|------|-------------------|--------------------|
| Swath bathymetry datasets and habitat maps for Gray Canyon region, WA R/NP-6 | Actual 0 (2/1/2012 - 1/31/2013) : | 1 | | 3 |
| | Anticipated 0 (2/1/2013 - 1/31/2014) : | 0 | | |

:: HAZARD RESILIENCE IN COASTAL COMMUNITIES

No Communities Reported This Period

:: ADDITIONAL MEASURES

| | |
|---|---|
| <u>Safe and sustainable seafood</u> | |
| Number of stakeholders modifying practices | Number of fishers using new techniques |
| Actual (2/1/2012 - 1/31/2013) : | Actual (2/1/2012 - 1/31/2013) : |
| Anticipated (2/1/2013 - 1/31/2014) : | Anticipated (2/1/2013 - 1/31/2014) : |
| <u>Sustainable Coastal Development</u> | |
| Actual (2/1/2012 - 1/31/2013) : | <u>Coastal Ecosystems</u> |
| Anticipated (2/1/2013 - 1/31/2014) : | Actual (2/1/2012 - 1/31/2013) : |
| | Anticipated (2/1/2013 - 1/31/2014) : |

:: PARTNERS

No Partners Reported This Period

:: IMPACTS AND ACCOMPLISHMENTS

Title: Washington Sea Grant-funded research cruises reveal ancient sponge reefs that offer unique offshore habitat and compelling sites for large-scale geological research

Type: impact

Relevance, Response, Results:

Relevance: In 1987, reefs of glass sponges – organisms long thought to be extinct – were discovered off the coast of British Columbia. Because similar conditions exist on the continental shelf by Grays Canyon, scientists hypothesized that similar colonies might be found off the Washington coast.

Response: Beginning in 2007, Washington Sea Grant (WSG) supported three research cruises to this geologically and biologically important area.

Results: The cruises located, mapped and sampled extensive areas of both live and relict glass sponge reefs at the continental margin. In the same vicinity, they discovered “pockmarks,” methane bubble plumes venting from small mud volcanoes, and other geological features. These areas also turned out to be biological hotspots, supporting massive swarms of krill, along with predator fish and orca whales. Their discovery raises questions about possible links between high marine productivity and methane bubble plumes that have yet to be fully investigated. WSG’s investment in the initial research leveraged over \$10 million in National Science Foundation funding for three ship-based geological projects: the Cascadia Ocean Bottom Seismic Initiative Pool (OBSIP) to examine seismic hazards in the Cascadia subduction zone; a 2012 study to image the subduction zone and hydrate deposits on the margin; and a study to assess the thermal structure of the “locked zone” of the Cascadia megathrust.

Recap:

Recap: Washington Sea Grant-supported research cruises resulted in the discovery of glass sponge reefs, methane bubble streams, and dense swarms of krill in Grays Canyon, and spurred large-scale geological research investment in the area.

Comments:

Primary Focus Area – LME (HCE)

State Goal: Strengthen ecosystem approaches to management of living marine resources through improved understanding of marine biodiversity, marine and coastal ecosystem function, climate change and other sources of variability (HCE, Science).

Related Partners:

Columbia River Crab Fishermen's Association

National Oceanic and Atmospheric Administration (US DOC, NOAA)

Quinault Indian Nation

University of Washington, School of Oceanography, College of the Environment (UW)

:: PUBLICATIONS

Title: The thermal environment of Cascadia Basin.

Type: Reprints from Peer-Reviewed Journals, Books, Proceedings and Other Documents Publication Year: 2012

Uploaded File: [ggge2147.pdf](#), 3056 kb

URL: *none*

Abstract:

Located adjacent to the NE Pacific convergent boundary, Cascadia Basin has a global impact well beyond its small geographic size. Composed of young oceanic crust formed at the Juan de Fuca Ridge, igneous rocks underlying the basin are partially insulated from cooling of their initial heat of formation by a thick layer of pelagic and turbidite sediments derived from the adjacent North American margin. The igneous seafloor is eventually consumed at the Cascadia subduction zone, where interactions between the approaching oceanic crust and the North American continental margin are partially controlled by the thermal environment. Within Cascadia Basin, basement topographic relief varies dramatically, and sediments have a wide range of thickness and physical properties. This variation produces regional differences in heat flow and basement temperatures for seafloor even of similar age. Previous studies proposed a north-south thermal gradient within Cascadia Basin, with high geothermal flux and crustal temperatures measured in the heavily sedimented northern portion near Vancouver Island and lower than average heat flux and basement temperatures predicted for the central and southern portions of the basin. If confirmed, this prediction has implications for processes associated with the Cascadia subduction zone, including the location of the "locked zone" of the megathrust fault. Although existing archival geophysical data in the central and southern basin are sparse, nonuniformly distributed, and derived from a wide range of historical sources, a substantial N-S geothermal gradient appears to be confirmed by our present compilation of combined water column and heat flow measurements.

Citation:

Johnson, H. P., S. L. Hautala, and T. A. Bjorklund. 2012. The thermal environment of Cascadia Basin. *Geochemistry Geophysics Geosystems* 13(7):Q07003. DOI: 10.1029/2011GC003922.

Copyright Restrictions + Other Notes:
Reported in AR2012

Journal Title: *Geochemistry Geophysics Geosystems*

:: OTHER DOCUMENTS

No Documents Reported This Period

:: LEVERAGED FUNDS

No Leveraged Funds Reported This Period

WASHINGTON SEA GRANT COMPLETION REPORT

for the period 2/1/2007 – 4/30/2012

WSG Project Number: **R/NP-6**
Project Title: Glass Sponge Reef Habitat in the Pacific Northwest

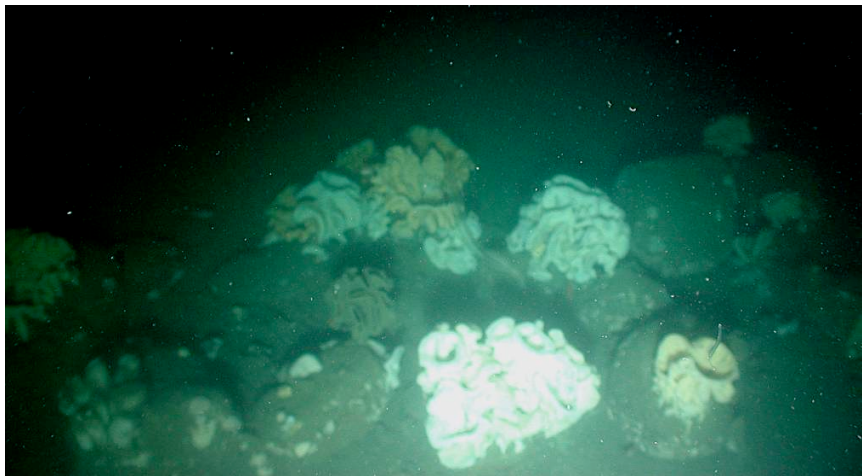
Principal Investigator(s) and Affiliation:
Paul Johnson University of Washington, School of Oceanography

The goal of this multi-year program was to characterize the spatial extent and viability of the sponge reefs near Grays Canyon, as the first step in defining the components of a sustainable seafloor habitat on the Washington margin. The initial cruise supported by this program in 2007 was to test the hypothesis that glass sponge reefs were present on the Washington margin off Grays Harbor, similar to those reefs that had been observed on the Canadian/British Columbian margin. This cruise was successful and mapped (using side-scan sonar) and sampled extensive areas of both live and relict glass sponge reefs at the edge of the continental margin.

Further discoveries in 2008 and 2009 on cruises supported by this program surprisingly showed extensive active methane (CH_4) bubble plumes and dissolved-phase fluid venting from a wide range of surface geological environments on the Washington continental margin. Seabed features associated with the CH_4 emissions include venting from small mud volcanoes with near-sub-surface gas pockets, active carbonate-lined pockmarks in the mid-shelf mud deposit with and without shallow gas reservoirs, and from folded Miocene and Pliocene sedimentary outcrops of the underlying accreted margin. Rising from ~160 m deep through the mid-shelf mud deposit sediments, these CH_4 seep bubbles are easily observed at the sea surface on the Washington margin. ROV dives showed that these methane bubbles plumes were associated with massive swarms of krill and other euphausiids, which were in turn intensely grazed by a wide variety of commercial fish. The spatial correlation between the krill and abundant, visible bacterial floc observed by ROV suggests a possible trophic link between the high euphausiid abundances and CH_4 seepage. Although krill have never been reported to use methane-derived carbon as a food source, krill are reported to feed on bacterial floc in the photic zone, and so may be able to take advantage of the bacterial food source deeper in the water column. In turn, krill are important prey for large marine predators including salmon, dogfish, rockfishes, Pacific hake, tuna, seabirds, and whales. Hence, seafloor CH_4 could be an important carbon source to the pelagic ecosystem, especially during fall and winter when photic-zone production is low. If confirmed by additional studies, the newly-discovered links between glass sponge reefs as nurseries, methane bubble plumes as non-seasonal sources of carbon and euphausiid swarms could transform conventional ideas of high marine productivity of this area of the continental shelf.



Glass Sponges on Washington margin.



The Washington Sea Grant–supported research and cruises also resulted in the Grays Harbor area of the Washington margin and shelf being designated a ‘GeoPRISM focus area’ for the National Science Foundation. As a result of this designation, an array of OBSIP Ocean Bottom Seismometers (for seismic hazard studies) was placed off Grays Harbor in 2011 and were recovered in the summer of 2012. As part of this integrated geophysical study, a Multi-Channel Seismic survey by the R/V Langseth was also complete in the Grays Harbor corridor (H. P. Johnson as Co-PI; see Holbrook et al, 2012). As a direct result of these focused studies, a 30-day cruise to measure heat flow within the Grays Harbor corridor of the Washington margin is funded by NSF for August, 2013 (H.P. Johnson, PI).