2015-10-05 Barkley Canyon Workshop Notes

Date

05 Oct 2015

Attendees

- Pauline Chauvet
- Neus Campanya I Llovet
- Annie Mercier
- Marjolaine Matabos
- Gwyn Lintern
- Kim Juniper
- Pere Puig
- Fabio de Leo
- Steve Mihaly
- Jarrett Little
- Jacopo Aguzzi
- Garry Rogers
- John Dower
- Karina Ramos Musalem
- Mairi Best
- Tom Gallagher
- Martin Scherwath
- Martin Heesemann
- Maia Hoeberechts
- Dwight Owens
- Laurenz Thomsen (remote)
- Renald Belley (remote)
- John Pohlman (remote)
- Damianos Chatzievangelou (remote)

File	Modified
PDF File Barkley_Ops_Update.pdf	05-Oct-15 by Dwight Owens
PDF File Laurenz_Thomsen_Barkley_Workshop2015LTs.pdf	08-Oct-15 by Dwight Owens
Microsoft Powerpoint Presentation Barkley workshop_Belley et al_Barkley results summary.pptx	14-Oct-15 by Martin Scherwath
Microsoft Word 97 Document Puig_abstract.doc	14-Oct-15 by Martin Scherwath
PDF File Kanes_Barkley.pdf Ambient Acoustics in the Barkley Canyon Region, by Kristen Kanes	06-Nov-15 by Dwight Owens
PDF File Jacopo_Aguzzi_Oct_2015_presentation.pdf Networks of coordinated video-observatories as step forward in ecosystem monitoring	12-Nov-15 by Dwight Owens
PDF File Belley_et_al_Barkley_results_summary.pdf Key environmental drivers of benthic flux variation and ecosystem functioning in Salish Sea and northeast Pacific Sediments	12-Nov-15 by Dwight Owens
PDF File Ramos_ONCBarkley2015pres_compressed.pdf Physical Oceanography of Submarine Canyons: Research at UBC	12-Nov-15 by Dwight Owens
PDF File Mercier_ONC_Workshop.pdf Mixing chronobiology, phenology and evolutionary biology in the study of deep-sea organisms: a look at patterns and drivers of life cycles and species interactions	12-Nov-15 by Dwight Owens
PDF File Matabos_et_al_BCworkshop.pdf High-frequency study of benthic megafauna community dynamics in Barkley Canyon	12-Nov-15 by Dwight Owens
PDF File Neus_BC_Workshop_pres.pdf The Role of Food Supply in Structuring Barkley Canyon Benthic Fauna	12-Nov-15 by Dwight Owens
PDF File Scherwath_Lintern_Sonars_Vents_2015.pdf	01-Dec-15 by Martin Scherwath

Download All

Discussion items

Item	Notes

Workshop Overview
Richard Dewey
	• Goals for the workshop:
	  ◦ Proposal for next 5-year of funding coming up – planning horizon through 2022
	  ◦ Review state of infrastructure and present plans & committments
	  ◦ Review of research and observations
	  ◦ Assemble pieces of new science program
	  ◦ Integrate plans into a cohesive vision
	• Barkley Canyon Map

History of NEPTUNE and Barkley Canyon
 	
(Kim Juniper)
	• 3 planning workshops (Victoria & Halifax) for Barkley Canyon in 2004 following approval of funding (no major refresh in science planning for Barkley Canyon since 2004)
	  ◦ 3-5 May: finalize node locations, preliminary definition of themes/experiments 130 attendees
	  ◦ 25-27 September: Science use scenarios research themes/experiments; technical requirements
	  ◦ 22-23 November: coordination of proposals and observing systems: funding proposal deadline for Jan 2005
	• January 2005: $13M granted for instrumentation; original $37M proposals reviewed by an international review panel
	• Proposals:
	  ◦ Benthic processes
	  ◦ regional seisimic
	  ◦ ocean/climate
	  ◦ hydrates
	• Node provides power/connectivity to 2 platforms on upper slope; 4 in canyon
	• Challenges:
	  ◦ VPS
	  ◦ Trawling flipped platform
	  ◦ Node damaged in Jan 2015
	• Instrumentation
	  ◦ Broadband seismometer
	  ◦ Tsunami sensors
	  ◦ Cameras (main tool for ecological studies)
	  ▪ crab migrations
	  ▪ bioturbation
	  ▪ cameras on Wally
	  ▪ how to deal with volume of video data?
	  • computer vision
	  • crowd sourcing / citizen science
	  • Nested approach: algrorithms -> crowd -> experts
	• Question: Why Barkley chosen?
	  ◦ Multiple interests: hydrates; actively eroding submarine canyon; shelf edge nearby with separated shelf area; axis of canyon observations
	  ◦ Pods 3 and 4 originally wanted to be deeper - away from influences of hydrates - but insufficient funding
	• Question: Is this a "terminated canyon"
	  ◦ No it zigs and zags all the way to the abyssal plain
	• Question: why has multibeam bathymetry not been completed?
	  ◦ It has, and high-res map will be shown later during the workshop **ACTION**
	• A lot of fish out there because this is a dynamically/scientifically very interesting - but this productivity is also a main attractor for trawlers
	• We are on charts, AIS, instrument locations are even on ship's insurance company's

Update on status and plans for infrastructure
 	
(Jarrett Little)
	• Jarrett Little - Mechanical Engineer provides quick update on infrastructure at Barkley Canyon
	• PDF Version of Jarrett's Presentation
	  ◦ Status
	  ▪ Node, Trawler Resistant Frame (TRF), and Cable Termination Assembly (CTA) recovered and at ONC's Marine Technology Facility (MTC)
	  ▪ Hydrates science cable repaired
	  ▪ Upper slope cable needs to be repaired
	  ▪ both CTAs (incl. spare) now damaged, both ODIs removed
	  ▪ Pods 1-4 recovered
	  ▪ VPS not recovered
	  ▪ Wally recovered - to be shipped to Germany
	  ◦ January 2015 inspection and Spring 2015 node repair expedition
	  ▪ node tipped out and spun from TRF (**IMAGE**)
	  ▪ original node recovered, CTA recovered
	  ▪ hydrates cable repaired
	  ▪ spare node deployed
	  ▪ spliced spare CTA
	  ▪ HV connector shorted and everything was damaged
	  ▪ TRF frame flipped by cable ship
	  ▪ ODI is investigating the cause of the short to sea water – should have answer by end of year
	  ◦ Current redeployment plan
	  ▪ 2-ship operation to redeploy node and TRF together as one package (hard-wired package)
	  ▪ Node will be secured within TRF – strapped in so it does not get pulled out next time
	  ▪ TRF to be rebuilt and completely refurbished
	  ◦ Instrument platform maintenance
	  ▪ pods 1-4 recovered
	  ▪ wally recovered, crated and to be shipped to Germany
	  ▪ Wallyland sonars recovered, to be rebuilt
	  ▪ all instruments removed, will be cleaned, refurbished, recalibrated
	  ◦ Redeployment in July 2016
	  ▪ R/V Sikuliaq
	  ▪ Pods 3 and 4 to be combined
	  ▪ Pod 4 to be used as a spare junction box
	  ▪ full platform maintenance to be completed fall/winter 2015/16
	  ▪ some redesigns or instrument mounts, including camera tripods
	  ▪ Question: same instruments in same pods or changes?
	  • That's why we're having this workshop, to discuss changes
	  ▪ Oct 2015-Mar 2016
	  • refurbishments
	  • cleaning prop for deployment
	  ▪ May-Jun 2016 node repair, possible VPS recovery
	  ▪ Jul 2016 Sikuliaq expedition, with full redeployment and repowering; VPS will be recovered if not recovered in May-Jun 2016
	  ◦ Question: are cables very taut? is there enough slack to take a hit?
	  ▪ spur cable was not damaged, but cable between CTA and node was damaged
	  ▪ cable can take a lot of pull, but oilies (70 m short instrument cable) cannot
	  ▪ trawl-resistant frame surrounded by non-trawl-resistant cables that can be easily damaged by trawling
	  ◦ Question: could node be repositioned to a deeper location?
	  ▪ would require new cable lays for branches to upper slope and into the canyon

Framework for experiments and long-term observations (Kim Juniper)	**Long-term use of observatory infrastructure** • In 2004 - did not think long-term in terms of lifetimes of experiments • also did not think ahead to some sort of community decision-making process for re-thinking instrumentation and experiment changes • limited budget for instrument maintenance and repair • no budget for expansion or adding new instrumentation • observations at new locations would require new funding or redeployment of existing assets **long-term vs. short-term** • need to identify key locations and observations for ling time series (over the lifetime of the observatory) • consider concept of finite lifetime observations and experimental use of observatory infrastructure ◦ consensus required in order for existing platforms re-used, reconfigured, repositioned (if cabling is available) **But we have been doing some ad-hoc modifications of environment e.g. – quite different from passive long-term observation work** • enrichment experiment • INDEEP recruitment modules added • whale bone colonization experiment **Future experimental manipulations require community discussions and decision making** • whalefall experiment - being done near Azores rather than in Barkley Hydrates, but raised opportunity for community to discuss such changes and consequences • deep-water forensic experiments (pigs) **Might we be interested in moving Pod 3 to a place like Coral cliffs near Barkley Hydrates?** • corals are not that big, but broadly disbursed • slope is pretty steep **Question: what ship and ROV will be used?** • Dorado for May • Sikuliaq - Jason in July
Presentations on research accomplishments to date (Laurenz Thomsen Jacopo Aguzzi)	**Laurenz Thomsen** PDF version of Laurenz's Presentation

- collaborations w/Jacobs
- Publications:
  - 2 so far : 1 on methodology; 1 on ocean circulation
- Damianos time series of all data from Wally since October 2010: for papers upcoming
  - averaged and prepared for statistical analysis
  - 1st paper on Winter Chlorophyll production: showing link between surface waters with deep waters; need satellite data
  - 2nd paper on methane fluxes, pockmark mounds
    - collaboration with GEOMAR (Tom K) showing uplifts/slumps of mounds over time; laser 3D camera system
  - hydrate mound variations in faunal community over time – clam abundance using video mosaics
  - bacterial mat coverage changes over time - linked to flow velocity "horizontal export production" into surrounding benthic communities
  - observations of megafauna - snails; 100 snail towers
  - benthic community structure evolution
  - megafaunal interactions around a small mound visited repeatedly over time
  - seasonal variation in duel activity rhythms of epibenthic fauna in Barkley Canyon gas hydrates
  - international online course part of ROBEX program **HQP!** already on the web
  - International Summer School on Robotics - volcano island near Sicily, surface like moon, observations of seabed around the island
- would be very interested in deploying crawler to coral reef
- Comment: Tom Kwasnitschka re-evalutating changes to hydrate mounds;
  - Laurenz: some specialists doing the video analysis and statistical analysis
- Comment: Wally has been a very exciting project that demonstrated the interactive capabilities that cabled observatories can give you – points out ideas of other places for Wallys, also flying Wallys - especially for whale fall observations.
  - Jacob will talk about ROBEX program, with further modifications to Wally. Can be fully autonomous by next year. Airbus is also very interested and suggested Airbus flight simulators. Use wings with currents to allow Wally to fly up and down – Airbus willing to help fund this.
- Comment: (Maia) information about the course very exciting and important for us in terms of metrics. – please provide this information to ONC
- Laurenz: great to have a cable connected to a robot, allows control and evaluation. Great place for testing planetary robots tethered to junction boxes.

Jacopo Aguzzi

PDF version of Jacopo's Presentation

- Many collaborations (shown on slide)
- Studies behaviours which occur in temporal rhythms based on geophysical cycles, resulting in biases in stock and biodiversity assessments
- Example: Norway Lobsters hide in tunnels based on activity cycles
- Major objective: scale perceived communities compositions down to species behaviour and its environmental control
- Trawled catches 1-2 hours over 4 days at different depths - identifying catch ability periods
  - light intensity is a poorly considered parameter in field studies
  - poor known: knowledge of benthic migrations in response to light intensity variations, e.g. red shrimps can't be spotted with ROV, but could be studied by a network of cameras
  - by coordinating camera observations, can infer animal movements
- previously studied in Sagami Bay, Japan, using automated image capture
  - working with animal profiles, can use automatized methods to produce time series of visual observations -> deriving time series and periodicity information
    - swimming animals more affected by currents
- Saanich Inlet: time-lapse studies, applying automated processes
  - use of citizen science input into algorithm tuning
- Studies of sablefishes in Barkley Canyon
  - tides related to movements; fish use currents to displace themselves
  - created a model of movements between pod 4 and axis
- Present: Damianos/Laurenz: using crawler for spacial and seasonal monitoring; Carol Doya seasonal sampling
  - Crawler great platform for long-term observations
  - observations of animal behaviours in Wally video - not much has been published on behaviours of macro fauna
- Future: 3 scenarios:
  1. use cable video observatory networks for fishery-independent assessment and activity rhythms monitoring
  2. sampling coordination into spatio-temporally structured imaging and multi parametric surveys
     a. example in Barkley Canyon (map with red mark-ups) Image surveys activating acoustic cameras in different locations at the same time; study temporal evolution according to seasonal cycles;
        i. use monochromatic blue-light emitters to attract deep-sea macro fauna
        ii. low-light cameras to capture bioluminescence (benthopelagic coupling as factor controlling benthic rhythms) (use photomultipliers)
        iii. automatic image analysis
  3. Study using Folger Pinnacle data - multi-annual time series to disentangle effects of duel and seasonal rhythms on sampling
     a. produce exhaustive species lists
     b. for species of interest, produce monthly averages, using multivariate statistical methods, can pick up which element in the environment corresponds to variations in fish movements/
  4. Automatic image content recognition and classification
  5. Bio-luminescence event recognition and labelling
  6. They wish to instrument an OBSEA platform following ONC model and use borrowed crawler
  7. SAITO experiment on influence of currents - whale fall 71-day time lapse.
     a. species lists and time series of observations
  8. traditional trawl-based sampling has built-in bias. Can use cable observatories, but spacial bias
  9. ONC could be a referent/consultant for development of EMSO (11 nodes, 4 test sites)
  10. propose committee mixing of Canadian-European science
  11. Question: can videos/image collections be published as datasets?
      a. yes, we hope to publish datasets
      b. Jacopo: ONC should publish interesting event observations such as elephant seal/hagfish; crab migration
      c. Jacopo: we should develop and publish knowledge map in a single
  12. Question: what type of camera technology is there to not disturb darkness?
      a. protocols for minimizing light by taking only images
      b. acoustic cameras deliver very precise images (previously ONC had ARES acoustic camera, which can resolve very fine detail, but it flooded during deployment. Before repairing it, ONC need a science case)
      c. comment: when lights come on, there are big disturbances in currents
      d. comment: we had low-light cameras, but not so good for observing small things; currently we have 2-hr/day light budget (5 min/2 hours)

Presentations on research accomplishments to date

(Steve Mihaly
Annie Mercier
Mairi Best
Fabio de Leo
Neus Campanya I Llovet
Ronald Belley
Marjolaine Matabos
Pauline Chauvet
Garry Rogers
Jakob Schwender)

Steve Mihaly: Water Column Science at Barkley Canyon

- used VPS, hydrophones, ADCPs, ecosounders, BPSs, could also use gliders, Pressure Inverted EchoSounders, wave gliders
- upper slope: predominantly used for water column studies, not so much in canyon, but long-range 55 kHz ADCP planned for canyon
- not many changes since inception, did add microcats and oxygen sensors
- Water Column Science output
  - background to all the benthic studies
  - background to benthic ecology theses (3 completed, 3 in process)
  - bottom pressure recorders (Abdolal 2015, Thomson et al. 2014, Thomson et al 2011)
- Science output in preparation
  - Falkor cruise 2013: ADCPs
  - VPS data
    - highly disciplinary study – lofty goal, great potential
    - list of instruments
    - Barkley timeline
      - initially deployed Sept 2009 - did not come out of cage, pulled in may 2010
      - redeployed sept 2010, pulled again
      - upper slope trawl outage
      - redelopyed in 2012 – 300 casts over a full year
      - redeployed in 2014 - worked very well - 5 months of really good data total of 700 casts
      - regular schedule: 5 profiles/day
  - map of vertical profiles in the NE pacific
    - shallow ones in Puget Sound
    - Oregon coast and Station Papa: 5 more coming online this year
      - the one at Station Papa failed within a week
  - (data from first deployment in 2013 - temperatures, salinity, oxygen, chlorophyll)
- Future Plans:
  - interesting data comparison of pCO2 vs Oxygen
  - tidal ellipses and along/across shore currents through the water column
  - echo sounder data from period when VPS was at bottom
- Comment:
  - water column group not well represented at workshop
  - maybe VPS is performing at par compared with other systems
  - Discussion: should it be repaired and redeployed? Switch to a different technology for water column time series?
  - We spent $1M on the system already, deployment costs are not so great
  - Problems with VPS creating electric noise, picked up by the seismometers
    - could be filtered out of the data?

Annie Mercier (Memorial University)

PDF version of Annie's Presentation

- mixing chronobiology, phenology and evolutionary biology in the study of deep-sea organisms: a look at patterns and drivers of life cycles and species interactions
- main focus on reproductive strategies and life-history theories, also feeding behaviours, symbiosis, prey-preditor relationships
- benthic organisms and environmental factors at various scales
- breakthroughs:
  - lunar rhythms in reproduction of deep-water taxa
  - demonstration of seasonal functional relationship between fish larvae and deep-sea corals
- Methodologies:
  - field sampling, experimental trials, microscopic/cellular analyses
  - study of live deep-sea animals; trawl catches
  - live "realistic" lab experiments – try to mimic conditions in the deep for live animals in lab aquaria
- Would be great to make parallels with studies conducted in situ focusing on:
  - feeding, gamete production; gamete release; symbiotic associations; trophic interactions
  - how do environmental factors
- Deep-sea corals:
  - gamete development and breeding periodicity in octocorals
  - breeding periodicity and seasonal growth in scleractinians
    - discovered seasonal and depth patterns
  - lunar cycles for release of gametes or larvae still not understood
  - reproductive strategy comparisons
  - species interactions – red fish larvae trapped within sea pen polyps – toward designation of sea pens as deep-sea fish habitat
  - life history strategies – sea star reproduction whenever seawater temperature crosses 4 degree threshold; dual strategies of brooding/release
- deep-sea pycnogonids and annelids
- studies of live specimens under pressure
- studies of responses to climate change
- Trophic interactions
- a lot of student interest in:
  - deep-sea
  - live animals in lab
  - east coast/west coast comparisons
  - linking life stages with environmental factors.
- Funding/collaboration with DFO, CCG, ROPOS

Mairi Best

Deep sea shell taphonomy: how does biogenic carbonate enter the lithosphere on various time scales?

- Taphonomy: study of the grave
  - fossil record, calcium carbonate
  - uses bivalve shells
- what can dead shells tell us?
  - read the record of past life on earth
  - learn how carbon enters the lithosphere
  - skeletal death assemblages of an area reflects life assemblages
  - studies in 25 sites in 8 regions
  - skeletal material above, at, below sediment/water interface
  - various taphonometric variable gathered
  - multivariate statistical analyses
- VENUS: crabs and pile perch can eat shells within one year (Saanich Inlet within one year)
- Deep sea shell taphonomy
  - hydrate deposit formation and evolution
  - could shell material leave record of distribution?
  - focused vs. dispersed food/energy sources
  - high densities around focused sources
  - physical concentrating mechanisms
  - remineralization rates
- experiment at Barkley hydrates
  - looking for correlations with currents, bioturbation, pore water chemistry
  - oxidation of organic carbon in marine sediments
  - observations of macro biota lots of grazers, not so many shell munchers
- studies of shell weight loss across all experiments globally
- what are initial behaviours after deployment of fresh material is put out?
  - difficult to capture
- also deployed pine to see what happens to cellulose
  - big influence of macro biota
- processes are rapid and nonlinear
- 5% shell loss in 1st year
- 25% wood loss in 1 year, 75% in 3 years
- Future plans:
  - retrieval/analysis of 2011 and 2012 experiments
  - collaboration with other experiments
  - future deployments would be welcomed

Fabio de Leo

New research communities (INDEEP, INCISE)

- INDEEP International network for scientific investigation of deep-sea ecosystems
  - lot researchers interested in deep-sea ecosystems
  - working groups on
    - taxonomy/biodiversity
    - biogeography
    - connectivity
    - ecosystem function
- INCISE International network for submarine canyon investigation and scientific exchange
  - new community
  - interested in all processes related to canyons
- ONC-INDEEP workshop in April 2014
  - proposed whale fall experiment - Barkley Canyon Pod 3
  - whale bone experiment - 8 months of data collected and being analyzed
  - expansion of deep-sea connectivity larval colonization experiment
  - world freezer survey of microbial sediments
  - tanner crab feeding ecology
- INDEEP larval colonization frames
  - in collaboration with SERPENT and Transocean
- Sediment microbial diversity - mapping genetic diversity on worldwide scale''
- Sediment metanotroph bacteria and tanner crab feeding ecology
- Whalefall project
  - almost a go this summer, but not funded because of Barkley node outage
  - still trying to obtain funding for this experiment
  - macro ecology component
  - microbial/biogeochemistry questions
- inter-annual variability in overwintering copepod abundance at the benthic-boundary layer: implications for crab export from the euphoric zone to the deep-sea.
  - image analysis of stills from video clips - producing time series
- 3rd international INCISE symposium in Victoria 25-27 July 2016

Renald Belley

PDF version of Renald's Presentation

- recycling of organic matter uses O2, benthic flux of O2 can be measured to
- study sites in Salish Sea and NE Pacific
- sediment cores collected - onboard incubations, measurement of O2 nutrient fluxes, o2 micro-profiles, prokaryote and sediment characteristics
- deep barkley fluxes significantly smaller than upper slope and folger
- some significant differences in fluxes w/ deep Barkley sites
- influences of cold water and low dissolve oxygen (bottom water characteristics)
- difference with deep sites due to sediment grain size, porosity
- environmental variable explain 52% of benthic flux variation
- bottom water temperature was most important driver of benthic flux variation
- future: looking for postdoc for 2016
    - food supply utilization by benthic community – possible manipulative experiment using setup in front of camera, then collect samples via ROV

Neus Campanya I Llovet

PDF version of Neus' Presentation

PhD: role of food supply in structuring barkley canyon benthic fauna

- focus on the quality of the food, rather than the quantity. May play larger role in species composition.
- Quality: degree to which quantity and composition of accessible food fulfill consumer nutritional needs
- Barkley Canyon food quality
    - collected by ROV pumps and push cores
    - higher lipids at 400m - due to phosphor lipids
    - 800m max indicative of zooplankton migration
    - much lower lipids at 2000m
    - much higher hydrocarbons in sediment lipids at Barkley Canyon
- Barkley Hydrates
    - to what degree do in fauna depend on hydrocarbon food source?
    - push cores taken, analyzed for organic matter, porosity, grain size
    - 20m from outcrop, can see influence of hydrocarbons
- Food enrichment experiment
    - determine influence of food pulses
    - experiment deployed – frames with release – recovered after 8 months, looking for changes
- food quality very heterogeneous in Barkley; methane energy source ; quality of food sources can shorten food processing times

Marjolaine Matabos

PDF version of Marjolaine's Presentation

High-frequencye study of benthic megafauna community dynamics in Barkley Canyon

- camera sweeps every 2 hours for 5 minutes; organism counts and densities
- water mass change during 10 days of study period
- storm at surface with wave propagation to deep levels
- sablefish linked to sediment resuspension analysis
- 11 day oscillations; diurnal/semi-diurnal variations
- Influences
    - changes in community structure related to changes in water properties
    - 11-day oscillation in fauna and environment - linked to bottom currents
    - important role of tides in organism activities
    - storm can affect communities town to 900 m ?

Pauline Chauvet

Characterization of factors controlling the biodiversity of the macrofaunal community dynamics associated to the Barkley Canyon

- Why is Barkely the place to be?
  - California current; oxygen minimum zone; canyon as conduit of sediment
- variation of environmental factors in time – high gradient of variations in small space
- materials & methods
  - adcp, sediment trap; ctd, fluorometer, oxygen, video camera
    - video analysis; used grids
    - adcp current velocities
    - sediment trap time series or sediment flux
- fine scale 15-25 day variation explain 1-6%
- 1-3 month scale explain 1-6%
- 2-5 months explain 10-18% of variations.
- seasonal cycles
  - changes in water mass, current velocity, changes in species dominance, reproduction
- sporadic arrival of food
- Grooved Tanner Crabs
  - may-aug not many crabs
  - big arrival of small crabs in November
  - another arrival of larger crabs later
- Thesis aims: use environmental factors to study recruitment/dynamic of population and biotic interaction

Garry Rogers

Big strength of NEPTUNE is diversity and multidisciplinary studies

- only reason for Barkley is because it's the closed junction box to where he really wants to be (down on flat seafloor at toe of accretionary prism)
- instrumentation
  - broadband seismometer
  - accelerometer
  - pressure gauge
  - current meter
  - hydrophone
  - backup battery
- the shallower you get, the more noisy – Barkley Canyon too noisy to do this
- OZB site on land much better than NCBC for picking local earthquakes - numbers could be higher if there were no data diversions
- SeaJade also had much higher detections compared to NCBC location
- They would love to have a line down to the toe of the prism, very important to study strain there as well (geodetics, tilt)

Presentations on research accomplishments to date

(Karina Ramos Musalem
Pere Puig
Kristen Kanes
Martin Scherwath)

Karina Ramos Musalem

PDF version of Karina's Presentation

- methods:
  - physical models and numerical models, in collaboration with observationalists
  - submarine canyons: upwelling, cross-shelf break exchange, including nutrient flux onto the shelf (when geostrophic balance is broken)
    - upwelling quantification using upwelling depth and upwelling flux
    - mixing and stirring
  - collected vertical data during Falkor expedition
  - sensitivity studies in idealized canyon
  - long-term goal of group is to quantify enhanced flux of traces onto the continental shelf due to small topography such as submarine canyons (interactions among Barkley, Nitinat and JdF canyons.
- Comment: canyon axis spot is much deeper than what they are modelling, however our mooring is well positioned for this. gliders may also be useful
- Comment: what about downwelling?
  - 3 months of upwelling, 2 shoulder seasons, ~6 months of downwelling

Jakob Schwendner (robotics specialist from DFKI Robotics Innovation Center)

- Future technology developments for Wally
  - DFKI has 5 locations in Germany
  - public-private partnership
  - stakeholders
    - Jacobs University
    - ROBEX - large alliance studying robotics in extreme environments
    - iSeaMC - ROBEX spin-off
    - GTR - DFKI spin-off
    - DFKI
    - Scientists
  - Wally, Tramper, Viator
    - Tramper, long-term transects
    - Viator: GEOMAR has a lander with docking technology
  - PTU camera on Wally (for BBC whale fall proposal)
  - upgrades to Wally
    - embedded PC
    - improved pan-tilt unit
    - autonomy
      - following paths
    - 3D reconstruction of seafloor
    - manipulator arm, based on pan-tilt, 4 degrees of freedom with a gripper, tele-operated
  - Requirements?
    - experiment recover - send to surface
    - coring
  - test vehicle using omnidirectional camera (useful for science values)
    - ascot wheels
  - 2016 options
    - pan-tilt
    - hyperspectral camera
    - improved autonomy and localization
  - 2017 manipulator arm
  - 2018
    - large area coverage with docking
    - autonomous science experiments

Pere Puig

Deep-sea trawling and sediment dynamics

- Palamos submarine canyon
  - 7 moorings installed in 2001
  - lot of sediment from trawling on shelf
  - added mooring at 900m with download looking adcp and turbidity meter
  - many regular spikes: M,T,W,TH,F, not Sat/Sun
  - two spikes every day as fishing fleet begins trawling, and when they return to port
  - 5000 tons exported from top of canyon down to canyon axis
  - in 1970s, increase from .53 cm/y to .71 cm/yr (industrial trawling began in mid 70s) in canyon axis
  - between 2002-2011, 2.4 cm/yr
- Besos submarine canyon
  - yo-yo ctd profiler (off Barcelona)
  - anomalous turbid surge - coincides with passage of a trawler. turbidity from 400m up to the surface.
- deep-sea trawling activities generate period resuspension events
- trawl-induced sediment fluxes likely modify benthic environment

Kristen Kanes

PDF version of Kristen's Presentation

Ambient acoustics in the Barkley Canyon region

- 5 locations with hydrophones
- many different types of marine mammals recorded – many types only at Barkley, including the 2 rarest communities of Killer whales
- also seismic events, our acoustic instruments
- data mining challenges
  - difficult to search through acoustic data
  - annotating acoustic data by hand
  - search hydrophone data viewer
  - most spectrogram settings cannot visualize all signals
  - quantity problem: 17 hydrophones collecting continuously – too much for Kristen to monitor manually
  - are classifiers the solution?
    - imperfect accuracy
    - novel signals missed
    - good for detecting likely events
- JASCO working on a classifier; collaboration with Kristen
  - SpectroPlotter tool
    - can see humpbacks and fin whales, even blue whales, which are not visible in ONC spectrograms
    - humpbacks there year-round!
    - 77% of all files had marine mammal vocalizations – most had multiple species
- Other work being done
  - patterns of marine mammal vocalizations in relation to environmental variations
  - collaboration with baum (Francis?) Juanes lab on fish behaviour
  - collaboration with Herve Glotin on humpback whale stock definition
  - other classifiers being built
  - Orca call catalog additions (John Ford)
  - sperm whale habitat usage by Elizabeth Ferguson
- suggested improvements
  - implement classifiers
  - improve data mining functions
  - improve hydrophone viewer to support different signal types
  - minimize mechanical/active acoustic interference
- Question: how about non-marine mammal sounds?
  - Yes, fish sounds – Francis Juanes; hope to deploy acoustic camera together with a hydrophone
  - But how about biological non-invertebrates?
    - collaborators welcome
- Question: problem to have hydrophone co-located with camera?
  - not really a problem

Martin Scherwath and Gwyn Lintern

PDF version of Scherwath's and Lintern's Presentation

Scherwath: Sonar systems:

- rotary sonar and video imagery at pod 2 - pits and flatfish and sea urchins; calculated average time for bioturbation of seabed
- mid-canyon multi beam in mid-canyon
  - detects fish well – good tracking in sidescan mode and study influence of lights on environment
- 2 sonars in Wallyland – for tracking Wally's location, and also looking at changes to hydrate mounds over time
- sonars useful for bioturbation, but what else could they be use for?
- wanted to use sonars to track oil/gas bubbles, but have not found them yet

Gwyn Lintern: Shelf seepage and faults:

- gas seeps on continental shelf:
  - what's the plumbing of the faults?
  - looking vertically, can see a failure within bedrock above a gas seep – could that lead to a seabed collapse and resulting large tsunami?
- also monitoring turbidity currents at Fraser mouth – Barkley would be an ideal pace to monitor these

The ONC Barkley Canyon Working Group (Fabio de Leo Martin Heesemann)	(skipped) Effort to put more structure behind theme/site/system oriented groups of users. Places where you could obtain: - summaries - documents - opportunity to share and discuss

Summary (Richard Dewey)	We covered a lot today, but tomorrow's agenda is equally ambitious: • we will use breakouts and small groups to involve everyone in participating Today's key points: • Interest in maintaining experimental sites over long terms rather than moving experimental sites around? • we have fixed and mobile systems • Many discussions about benthic biorhythms and biodiversity – using spacial/temporal capabilities to study very diverse multiple sites in one area • Canyon dynamics, clearly related to high variability and biological • Need to be attentive to noisy/active/passive sensors to reduce contamination

Action items

- [ ] Steve F Mihaly Provide high-res bathymetry map of Barkley Canyon
- [ ] Dwight Owens Attach presentations to this page.