Microbial Communities in Deep Seafloor Environments

This is an optional lab exercise that contains a lot of written explanation as an introduction. I recommend this exercise be done after plate tectonics and marine sediment.

Materials:
Guide students towards the following maps (they have used them in prior labs):

- Lithospheric plate map (United States Geological Survey. 2006)
- Global Distribution of Hydrothermal Vent Fields (NOAA PMEL)
- Seafloor sediment map in their textbook
- Location of seafloor sediment cores

Equipment:
Student reference material, either textbook or laptop computers
Instructor computer/projection system

Questions:

1. After reading the material at the beginning of this activity, study the maps and determine the locations of the greatest potential for microbial communities in the world’s oceans. Write a paragraph that explains your reasoning for each map.
   - Continental shelves – site of cold seep locations;
   - Vents – site of hydrothermal gas activity
2. Discuss two seafloor settings where chemosynthetic bacteria live.
   - Continental shelves – site of cold seep locations;
   - Vents – site of hydrothermal gas activity
3. What is a resource common to both of the settings you discussed in question 2 that supports the microbial life?
   - Both settings have a source of inorganic energy that the microbes need to conduct chemosynthesis.
4. Describe in detail where microbial communities are situated relative to plate boundaries.
   - Some microbial communities are located on divergent plate boundaries, where seafloor spreading processes supply gasses that are a source of energy for chemosynthesizing microbes.
   - Microbial communities are not associated with transform boundaries because there is no source.
   - {Convergent boundaries where subduction occurs may have communities associated with folded seafloor sediment in the trenches – students may not know this from the reading.}
5. Do you think oceanic hot spots could also support chemosynthetic microbial communities? Why or why not?
   - Yes. Hot spots are volcanic in origin and there would be a source of hydrothermal fluids and gasses necessary for chemosynthesis.
6. What type of sediment is more likely to support cold seep microbial communities?
Sediment containing high quantities of organic material that produces methane gas as it decomposes. A necessity is the source of gas for chemosynthesizers, and decomposing biogenic material is a requirement in the formation of gas.

7. What characterizes the location of all of the gas hydrate deposits on the map?
   The gas hydrates resources are all located on continental shelves. This is partially an artifact of where reserves have been identified and confirmed. Deep seafloor areas are less explored and it is less costly to work in shallow environments.

8. Explain why it is important to study oceanic microbial biocommunities.
   1) The microbial communities contain species of microbes, some newly identified, that can be used in developing new medicines/drugs.
   2) The formation of the methane hydrates in the process of microbial decomposition in the cold-seep environments create a natural resource (gas).

9. What are some challenges to studying microbial biocommunities in the deep ocean environments?
   Difficult and costly sampling conditions mean there less exploration of the deep ocean (versus the continental shelves).
Materials:

World Map of Volcanoes, Earthquakes and Lithospheric Plates. (USGS, 2006)
Materials:
Global Distribution of Hydrothermal Vent Fields (NOAA PMEL)

or
Global Compilation of Confirmed and Inferred Vent Sites (Pacific Marine Env. Lab)
Materials:

Map of the locations of gas hydrate deposits. (USGS, 2013)
Materials:

Distribution of different types of marine sediment (similar to student’s textbook graphic)
Materials:

Total Sediment Thickness of the World’s Oceans & Marginal Seas
(http://www.ngdc.noaa.gov/mgg/sedthick/sedthick.html)
Materials:

Location of seafloor cores from drilling expeditions. Dots show core locations.
(from NOAA Paleoclimatology Program/Department of Commerce, accessed at UCAR Office of Education and Outreach, 2010)
References

Student Preparation Information – (Read/viewed Prior to Activity)

NOAA Ocean Explorer. Lesson 5 – Chemosynthesis and Hydrothermal Vent Life (video).
http://oceanexplorer.noaa.gov/edu/learning/5_chemosynthesis/chemosynthesis.html#slide

Ocean Leadership. CORK Animation (You Tube Video). 12 November 2010.
http://www.youtube.com/watch?v=stqhtl-N7eg

http://oceanexplorer.noaa.gov/explorations/02fire/background/vent_chem/ventchem.html


For the written explanation at the beginning of the activity

1 National Oceanic and Atmospheric Administration (NOAA). Learning Ocean Science through Ocean Exploration; Section 4: Ocean Geologic Features.
www.oceanexplorer.noaa.gov

http://oceanexplorer.noaa.gov/explorations/02fire/background/vent_chem/ventchem.html


Materials:


Map of known and inferred locations of gas hydrate occurrence:


Location of seafloor cores from drilling expeditions: