VQ6. Earth Surface, Snow/Ice and Shallow Water Benthic Composition

What is the land surface soil/rock, snow/ice and shallow water benthic compositions?
VQ6. Earth Surface, Snow/Ice, and Shallow Water Benthic Composition – Sub Questions

- What is the distribution of the primary minerals and mineral groups on the exposed terrestrial surface?
- What is the bottom composition (sand, rock, mud, coral, algae, SAV, etc) of the shallow water regions of the Earth?
- What fundamentally new concepts for mineral and hydrocarbon research will arise from uniform and detailed global geochemistry of the exposed rock/soil surface?
- What changes in bottom substrate occur in shallow coastal and inland aquatic environments?
- What impact do desert dust and black carbon have on critical water resources through the acceleration of snow and glacier melt?
- What is the impact of climate change on the reflectivity of snow and ice in the Earth’s polar regions?
- How can measurements of rock and soil composition be used to understand and mitigate hazards?
What is the distribution of the primary minerals and mineral groups on the exposed terrestrial surface?

- **Science Issue**
  - The composition and distribution of the exposed rock and soil substrate of the terrestrial surface is not accurately known globally. Surface rock and soil composition is closely linked to an understanding of resources, hazards and is a major critical element of the Earth system.

- **Tools**
  - Contiguous spectral measurement from 400 to 2500 nm at 10 nm spatial sampling at 60 m with high signal-to-noise ratio and with excellent spectral and IFOV uniformity.

- **Approach**
  - Measure the exposed surface rock and soil compositions globally.
  - Measure the available rock forming and alteration minerals and subtle changes in composition via spectral absorption position and shape.
  - Derive fractional abundance through spectral mixture analysis and related approaches.


Above left and right: Spectroscopically derived maps of minerals in the 400 to 1500 nm and 1500 to 2500 nm spectral regions.
What is the surface composition (sand, rock, mud, coral, algae, SAV, etc) of the shallow water regions of the Earth?

- **Science Issue**
  - The composition, distribution and seasonal variability of the materials in the observable shallow water coastal regions are poorly understood globally. The habits and resources of the coastal zone is closely tied to the composition and structure of the substrate.

- **Tools**
  - Seasonal measurement of the contiguous spectral signature from 400 to 800 nm at 10 nm spatial sampling at 60 m with high signal-to-noise ratio and with excellent spectral and IFOV uniformity.

- **Approach**
  - Measure the optically available spectral signature of the coastal zone globally through several seasons
  - Use spectral signature based algorithms and forward inversion approach to measure and extend our understanding of the composition, distribution and seasonal variability of these critical regions of the Earth.
  - Accurate atmospheric characterization and correction is a critical enable requirement.

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**Left:** In situ spectral measurements of benthic materials. **Above:** Example spectral discrimination of algae and coral.

**Above left:** Imaging spectrometer measurements of Kaneoe Bay, Hawaii. **Right:** Shallow water bottom composition derived from spectral measurements.
How can measurements of rock and soil composition be used to understand and mitigate hazards?

• Science Issue
  – In some environmental setting both natural and human placed geological materials can cause a hazard to human health. Two examples are: (1) acid water drainage sulfate bearing mine waste and natural sulfate mineral occurrence. (2) distribution and disturbance of asbestos bearing rocks.

• Tools
  – Contiguous spectral measurement from 400 to 2500 nm at 10 nm spatial sampling at 60 m with high signal-to-noise ratio and with excellent spectral and IFOV uniformity.

• Approach
  – Measure the exposed surface rock and soil composition globally.
  – Measure the molecular and scattering signatures of the hazard related minerals.
  – Derive fractional abundance through spectral mixture analysis and related approaches.
  – Use imaging spectroscopy derived maps of the hazards for mitigation and control.