Deep-sea sediments and stratigraphy on the Juan de Fuca ridge

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Deep-sea sediment types

Biogenic: CaCO$_3$, opal (amorphous biosilica), C$_{org}$

Lithogenic: Hemipelagic rain, dust, ice-rafted debris, clay

Authigenic: Precipitates from seawater, porewater, vents

Volcanogenic: From subaerial and submarine eruptions

Cosmogenic: Extraterrestrial
10 Multi-cores
9 Gravity cores
9 Big Berthas
2 Big Bertha-RC
13 Rock cores
9 Piston cores

Basemap courtesy of Boulahanis, Gibson and Carbotte
Examples of JdF ridge sediments
(All sediment types are present in VOICE cores)
Ocean depth and seawater chemistry, through the varying concentration of dissolved carbonate ion \([\text{CO}_3^{2-}]\), combine to control the preservation and thus the deposition of \(\text{CaCO}_3\) on the seafloor.

The deep North Pacific is generally among the most corrosive deep-sea environments in the modern ocean.
A contour map of calcium carbonate percentages in Pacific surface sediments. The bathymetry is after Menard [1964].
Seafloor CaCO3 content
(smallest symbols <1%, largest symbols > ~20%)
Seafloor CaCO$_3$ content near Juan de Fuca ridge
Pre-cruise CaCO$_3$ content data from existing JdF cores (suggests substantial burial in the past)
New CaCO$_3$ content data from SeaVOICE core (suggests substantial burial during each glaciation)

Luis et al., unpub.
Sea-surface indicators: Foraminifera and IRD

High density intervals in JdF cores have polar forams and IRD

N. pachyderma, sinistral, polar foram.

Iceberg-rafted debris (IRD)
Oxygen isotopes provide a global stratigraphy to compare events. Climate cycles identified as marine isotope stages (MIS). The even # MIS are glacial intervals, odd MIS are interglacial intervals.
Benthic (bottom-dwelling) foraminifera genus *Uvigerina* selected for $\delta^{18}O$ analyses
5pc: piston core with long section on oldest crust

Basemap courtesy of Boulahanis, Gibson and Carbotte
Benthic foraminifera $\delta^{18}O$

High density intervals have high (glacial) $\delta^{18}O$
9pc: highest accumulation rate, longest section

Basemap courtesy of Boulahanis, Gibson and Carbotte
Benthic foraminifera $\delta^{18}O$

High density intervals have high (glacial) $\delta^{18}O$ - sed. rate varies
Summary

SeaVOICE cores have identifiable glacial cycles.

High density intervals represent glaciations.

$\text{CaCO}_3$ is present nearly throughout, varies widely.

Accumulation rates range from $\sim 1\text{cm/ka}$ to $\sim 3\text{cm/ka}$.

Many sediment sections extending to $\sim 300\text{ ka}$.

Several sediment sections extend to $\sim 500-800\text{ ka}$.