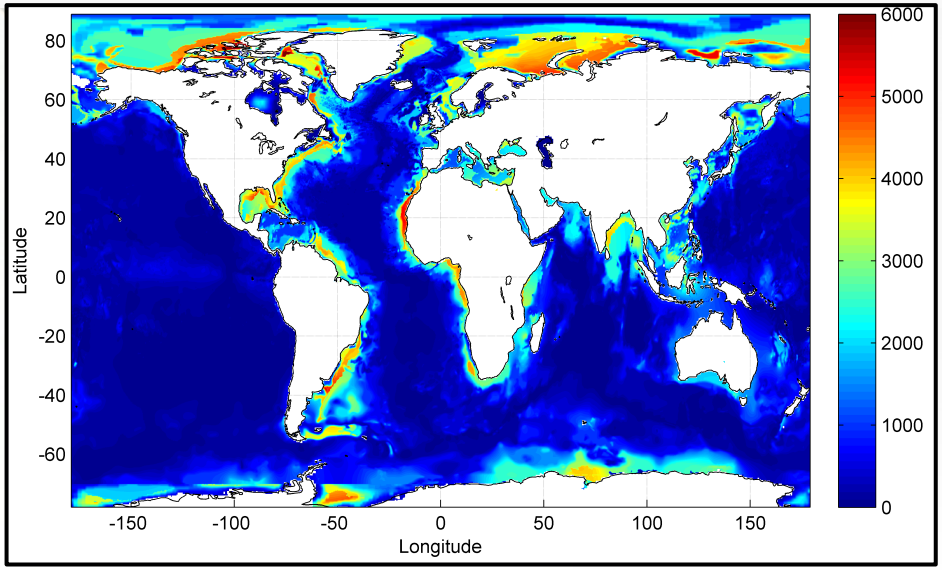
Thermal Habitability of the Earth's Seafloor

BACKGROUND: Approximately 70% of the Earth's surface is covered by ocean—on average, under 3,700 m of water. At the seafloor is a blanket of unconsolidated sediment consisting of continental detritus; particulate organic matter; silica- and carbonate-rich, biologically produced hard materials; and void spaces filled with saline fluids of wide-ranging chemistries. Globally, there are about 3×10^8 km^3 of ocean sediment saturated with 8×10^7 km^3 of porewater that is inhabited by an estimated 3×10^{29} microbial cells.

Sediment thickness for T < 80 °C (m)



THE RESEARCH: Several global data sets (sediment thickness, bathymetry, heat flow, bottom water temperatures) were combined with modeling efforts to calculate the 3-D distribution of temperature in marine sediments. Temperature influences the thermodynamic tendency of reactions to happen, the kinetics of these reactions, the diffusion of chemical species and the physical properties (e.g., density, viscosity) of water that dictate the direction and speed of fluid flow.

TAKE-HOME: **The temperature in about 25% of global sediment is less than 20°C, conditions most preferred by cold-loving psychrophiles. However, about 75% of global sediment is less than 80°C, a temperature range suitable for extensive biological activity, including that of mesophiles and thermophiles.** Although some archaea and bacteria grow in the laboratory at temperatures higher than 100°C, even to as high as about 120°C, biotic processes in natural environments appear to be nearly inconsequential above about 80°C.

Amend and LaRowe (2016), *Microbe*, **11**, 427-432. LaRowe et al. (2017), *Geology*, **45**, 275-278.