

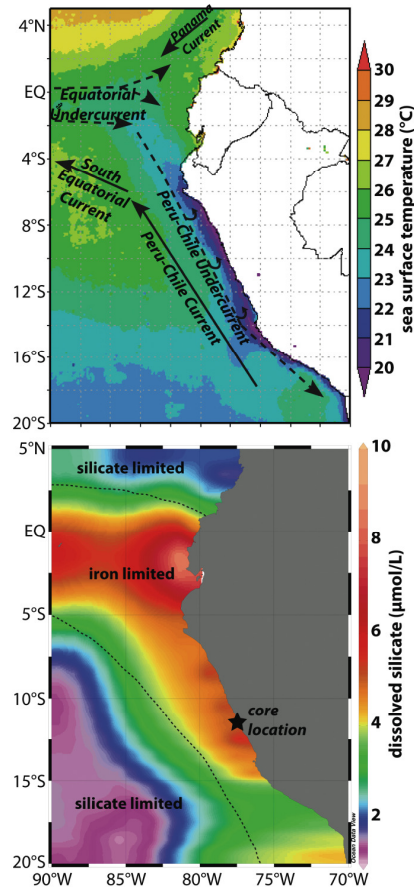
Nutrient utilisation along the Peruvian shelf during the past 20,000 years

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 Duration: january 2008- december 2011

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In coastal upwelling regions such as off Peru productivity is extremely high due to upwelling of subsurface waters from ca. 100 m water depth, which are very rich in nutrients (Fig. 1). Diatoms are the most abundant phytoplankton group. They take up dissolved silicate from the seawater to built their shells of biogenic silicate (opal).

Fig. 1. top: colours denote temperature in the surface water, the cooler waters near the coast indicate the upwelling, solid and dashed arrows indicate the main surface and subsurface currents, respectively. Bottom: concentrations of dissolved silicate in the surface water.



Results:

During the past 20,000 years productivity has changed pronouncedly off Peru (Fig. 2). It was extremely low during the last ice age before 18,000 years ago, and high between 8,000-10,000 years ago and during the past 2,000 years. This has been related to upwelling strength and the overall nutrient content in the water.

However, the content of diatoms in the sediment alone does not give enough information, because it can be biased, e.g. by dissolution. The ratio of stable silicon isotopes in these shells ($\delta^{30}\text{Si}$) provide information on how much dissolved silicate was available when the diatoms were growing, and how much they used (high values = high utilisation). Off Peru, this is mostly driven by the content of iron in the water, which is the most important micronutrient.

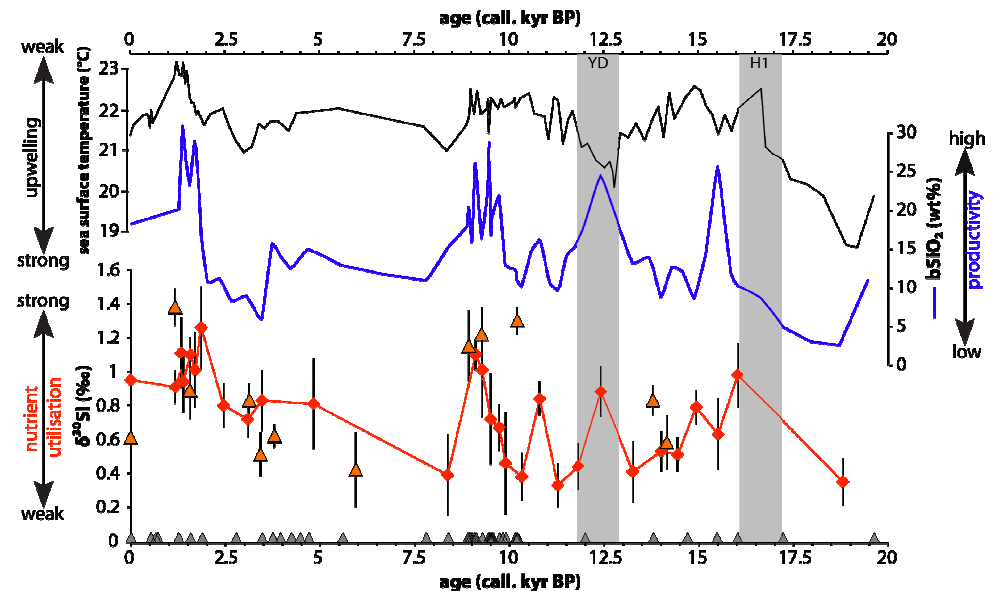


Fig. 2 changes in surface water temperatures (from Rein et al., 2005), diatom productivity, and nutrient utilisation during the past 20,000 years off Peru