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Controls on the silicic acid distribution in the ocean

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Understanding the sediment opal record requires understanding what controls opal production and export, which in turn requires that we understand the water column distribution of silicic acid. The outstanding characteristic of the silicic acid distribution relative to nutrients is its low concentration in the main thermocline and enrichment in the deep ocean. This has traditionally been explained as resulting from a combination of the vertical trapping/global conveyor belt circulation mechanism in which opal exported from the surface dissolves in the deep ocean and becomes trapped in the deep waters of the thermohaline circulation; and the silica pump hypothesis in which even if there is a high input of silicic acid to the surface, the preferential surface recycling of nutrients will lead to a rapid preferential depletion of the silicic acid. We have proposed instead that silicic acid is rich in the deep sea and poor in the thermocline primarily because it is stripped out preferentially into deep waters in the Subantarctic Zone where Subantarctic Mode Water (SAMW) formation provides the main return conduit for deep nutrients and silicic acid into the main thermocline . We emphasize the importance of the low Si:N in these waters supplying the main thermocline as determining and limiting diatom production. The SAMW regulates the return of silicic acid as well as nitrate and phosphate from the deep ocean, thereby determining low latitude productivity not just of diatoms, but also of other phytoplankton.