Alteration of volcanic ash forms calcium-chloride brines

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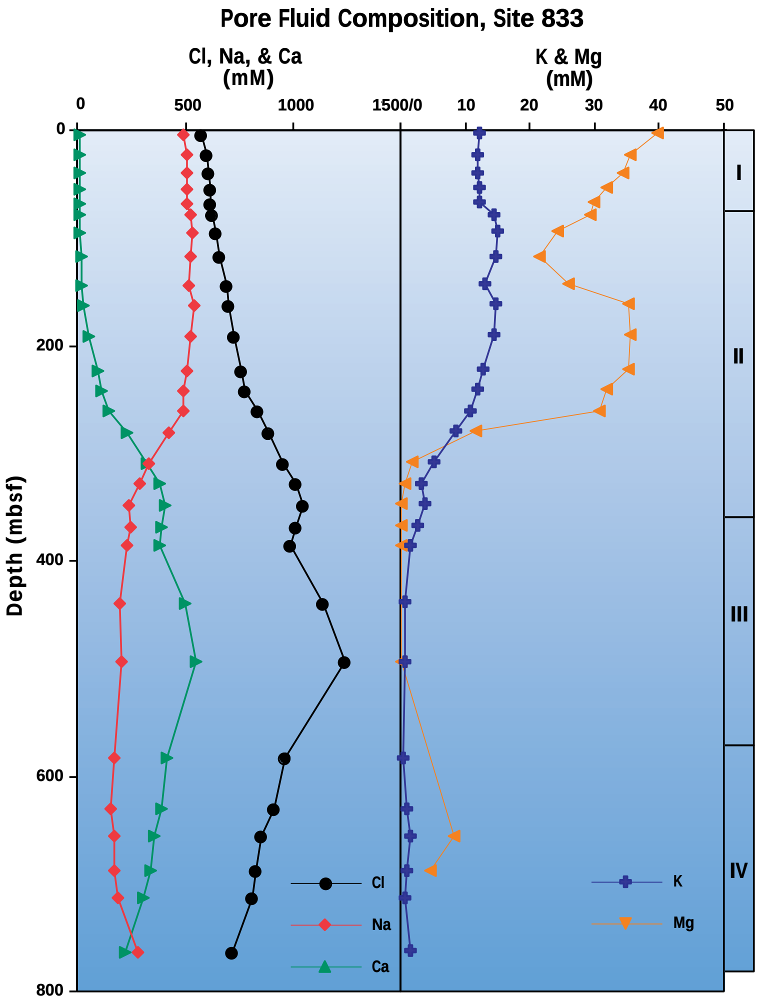

Large amounts of mass can be transferred between seawater and oceanic crust by fluid flow, particularly at active margins. The extent of these fluxes depends largely on the composition of the fluids, which is controlled by diagenetic reactions. Diagenetic reactions are important at the Izu-Bonin and New Hebrides convergent margins where recent drilling (ODP Legs 126 and 134) shows that alteration of volcanic ash forms calcium chloride brines from pore fluids that were initially identical to seawater [*Egeberg et al.,* 1990; *Egeberg,* 1992; *Martin,* 1994, *Martin et al.,* 1995]. These changes occurred in as little as 1 to 3 m.y., at temperatures as low as 25°C, and result from hydration reactions that form a suite of diagenetic minerals including smectite (a sink for Mg); analcite, clinoptilolite, and phillipsite (sinks for Na and K); and gypsum, heulandite, stilbite, and wairakite. The hydration reactions remove a sufficient amount of water from the pore fluids to increase concentrations of conservative elements such as Cl to more than twice the seawater value. These reactions also highly alter concentrations of reactive elements: Ca concentrations approach 10 times seawater value, K and Mg are almost completely removed from the pore fluid, and Na concentrations are approximately half of the seawater value (see figure). Large changes in the major element composition resulting from ash alteration have now been identified at two convergent margins, and future drilling will be important to identify the extent of this process at other convergent margins and in other tectonic settings. Nonetheless, these results indicate this process is an important control of pore fluid composition, and thus will influence mass fluxes when altered pore fluids vent from seafloor sediments.

References

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