Comparing felsic and mafic volcanics along Central America with implications for interaction with continental crust

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The subduction of the Cocos plate beneath the Caribbean plate has formed the Central American Volcanic Arc (CAVA) extending from Guatemala through central Costa Rica. We have analyzed all Pliocene through Holocene felsic tephras along the volcanic front, which we compare with mafic tephras and lavas in terms of major and trace element as well as Sr-Nd-Pb-Hf isotope compositions. Thus we extend previous geochemical studies that have largely focused on mafic rocks while attempting to constrain mantle-source conditions. In contrast, our mafic-felsic comparison aims to identify crustal influences on evolving magmas along the CAVA.

Along the southern CAVA, incompatible-element and isotope ratios of mafic and felsic rocks co-vary in a fashion expected from simple fractional crystallization of mantle-derived melts. However, felsic compositions along the northern CAVA, from central El Salvador through Guatemala, deviate from the associated mafic compositions particularly for radiogenic and some HFS elements in a way that suggests interaction with Mesozoic continental crust. Our observations have two implications:

(1) The onset of the geochemical deviation places the transition from mafic to continental crust between San Vincente volcano and Ilopango caldera in central El Salvador.

(2) The reason that crustal contamination has affected the cooler felsic rather than the hotter mafic magmas argues against partial melting of crustal rocks but rather favors hydrothermal interaction of magma reservoirs with host rocks such that contamination of felsic magmas benefits from their longer residence times allowing for longer-lasting interaction of hot fluids with both the resident magma and the host rocks.

210Pb and 137Cs in margin sediments of the Arctic Ocean: controls on boundary scavenging

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Abstract

Scavenging and burial of particle-reactive elements along continental margins play important roles in the oceanic biogeochemical cycling of many elements and may be particularly important in the Arctic Ocean, where the shelves are disproportionally large and there are extreme contrasts in productivity, particle supply and sedimentation between the margins and interior ocean. Water-column distributions of radioisotopes have provided insight into scavenging processes in the interior Arctic Ocean but the importance of, and controls on, scavenging in margin areas, which are not dominated by vertical processes, remain poorly understood. In this study, we report new measurements of the naturally-occurring radioisotope 210Pb and the artificial radioisotope 137Cs in 25 sediment cores that were collected broadly along the North American Arctic margin, from the North Bering Sea eastward to Baffin Bay/Davis Strait. We apply sediment profiles and inventories of 210Pb and 137Cs to the dual objectives of (1) determining and validating the sediment accumulation rates in the cores; and (2) assessing the intensity of scavenging and burial of particle-reactive elements along the North American Arctic margin. Outside the North Bering and Chukchi Sea shelves, most sediments contain an actively mixed surface layer and a subsurface layer in which sediment mixing appears to be negligible relative to sediment accumulation. Variation in sediment accumulation rates among the cores explains much of the variation in sediment inventories of 137Cs but little of the variation in the sediment inventories of 210Pb, which everywhere meet or exceed the total supply of 210Pb to the ocean by atmospheric deposition and 226Ra decay. Although the data imply enhanced scavenging all along the North American arctic margin, relative to the interior Arctic Ocean, there are also pronounced regional differences in the accumulation of 210Pb. Geographic disparities in the distributions of 210Pb and 137Cs in margin sediments are examined with regard to regional variations in sea ice cover, degree of terrestrial influence, productivity and strength of lateral exchanges with the interior ocean.