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Department of Earth Science

Earth Science Colloquium

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Sediment Assimilation or Sediment Subduction in the Southern Lesser Antilles?

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Convergent margin magmatism appears to have been the principal mechanism for creation of new continental crust at least since the Archean. Subduction in these settings also returns oceanic crust to the mantle, which is the principal mechanism by which regions of the mantle are enriched in incompatible elements. For these reasons, subduction-related volcanism is important in understanding Earth's evolution.

Armstrong and Cooper (1971) pointed out the similarity between Pb isotopic compositions of lavas from the Lesser Antilles Arc and marine sediments and argued that continent-derived sediments are also subducted into the mantle. A number of subsequent more detailed studies, beginning with White and Dupré (1986), have produced additional evidence supporting Armstrong's inference. Other studies, however, beginning with Davidson (1985) and Thirlwall and Graham (1984), have argued that the sedimentary signature in the Southern Lesser Antilles volcanics is acquired through assimilation of sediment in the arc crust.

In this presentation, I'll compare two islands of the Southern Lesser Antilles: St. Lucia and Grenada. In St. Lucia, volcanic activity over the last 1 to 3 million years has consisted of an andesite through rhyolite sequence erupted from the Soufriere Volcanic Complex (SVC) on the southwestern side of the island. There is compelling evidence that magmas erupted in the SVC have assimilated sediment within the arc crust. Earlier basaltic through andesitic activity on St. Lucia show no evidence of assimilation. In Grenada, magmatism has produced primarily alkali basalts, which belong to two distinct series: the predominant M-series and the less common C-series. I'll show that what had previously been inferred as sediment assimilation is instead simply assimilation of M-series magmas or crystallization products by C-series magmas.

The answer is thus both sediment assimilation and sediment subduction occur. However, sediment assimilation appears to be restricted to the two easternmost islands of Martinique and St. Lucia. The remaining islands, Guadeloupe, St. Vincent, and Grenada lack evidence of assimilation. The reason for this difference remains unclear but is likely related to the complex evolution of this subduction zone.