Patterns of Melt Migration at the East Pacific Rise

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Introduction
Previously we discovered that along the East Pacific Rise (EPR) between 6°N and 18°N the ridge discontinuities coincide with changes in the chemical characteristics of the ridge basalts. The EPR is migrating to the northeast at a rate of approximately 5 cm/year. The end of the ridge segment that is at the western end of a ridge discontinuity is called the leading end of the segment while the end of the ridge segment on the other side of the discontinuity is called the trailing end. Along the EPR the ridge depth at the leading end of segments is systematically shallower and the crust is systematically thicker than the trailing end of ridge segments [1]. This indicates that more melt is delivered at the leading edge than at the trailing edge. These features has led to the hypothesis that low-degree melts generated off-axis at the trailing end of a segment can cross the plane of the discontinuity and collect at the leading end of next segment instead of migrating against the main mantle flow and accumulate at the trailing end of a segment.

Results and Discussion
The difference in the chemistry between the different ridge segments can now be used to determine whether indeed can cross ridge discontinuities. We have concentrated on the Siqueiros Fracture Zone as this transform zone show intra-transform volcanism. The accompanying figure illustrates that the intra transform zone has a larger range in isotopic composition that either of the two ridge segments and that the basalts from the two ridge segments have different isotopic composition. A difference in isotopic composition is also observed in Sr-Hf and Pb isotope space. Furthermore, basalts from the leading end of the ridge segments show higher Ce/Yb values indicating the existence of low-degree melts. However, these low-degree melts have a different isotopic composition than the basalts from the trailing segment indicating that the low-degree melts from the leading edge are not sourced from across the transform fault plane. The large range in isotopic composition and the variable Ce/Yb ratio of the intra-transform basalts indicates that they are sourced from a smaller volume of heterogeneous mantle then the ridge basalts. The lack of correlation between geographic location and isotopic composition indicates the intra-transform basalts are sourced from both sides of the transform plane.

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References