Geophysical Research Abstracts
Vol. 13, EGU2011-12864, 2011
EGU General Assembly 2011
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Geochemistry of volcanic rocks from the Woodlark Basin

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The Woodlark Basin east of Papua New Guinea represents one of the few places on Earth where a spreading axis propagates into continental crust. This special tectonic setting allows insights into the evolution of magma composition as continental extension and break-up changes to the formation of ocean crust. We report here geochemical results on samples collected in 2009 from the four segments closest to the continental breakup, from segment 1 which abuts the detachment fault responsible for continental extension on Moresby Seamount in the West, to segment 4, representing mature oceanic crust in the East.

A total of 208 glass samples have been analyzed for their major (EMPA) and trace element (LA-ICPMS) compositions. The data show strong E-W variations. Samples ranging from tholeiitic basalt and basaltic andesite to andesite and rhyolite are found on Segment 1. They have generally high alkali values and a wide range of trace element contents and ratios. Segments 2 to 4 magmas in contrast only comprise tholeiitic basalt with lower alkali contents and a more restricted range of trace element chemistry. The geochemical differences between the segments cannot be attributed to differentiation processes alone, and different sources are required. High Ba/La, (La/Sm)N, Rb/Sr, and Th/La on Segment 1 suggest a derivation from an enriched mantle source, while low Nd/Pb and Nb/U suggest that some of the enrichment may also reflect the influence of continental crust during magma genesis. Whether this continental signature is present in the form of recycled material in the mantle or as rafted continental blocks in the axial region is at present unclear.

In contrast to rocks from segment 1, trace element compositions of volcanic glasses from segments 2 to 4 show a stronger MORB signature, presumably reflecting more mature spreading in this part of the basin. The influence of continental material appears to be minimal, suggesting that uncontaminated asthenosphere quickly flows into the rift and/or that continental blocks are not retained in the axial region for long time periods following the rifting-spreading transition.