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New evidence for the Kerguelen plume activity during East Gondwana rifting to breakup

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Extensive volcanism accompanied the Late Jurassic through Early Cretaceous rifting between Australia-Antarctica and Greater India, which culminated in the breakup of the supercontinent Gondwana and opening of the Indian Ocean. Seafloor spreading started at 136 Ma and was established at 132-133 Ma on the Perth Abyssal Plain, adjacent to the central part of the southwestern Australian continental rifted margin, and at 126-124 Ma to the west of the Naturaliste Plateau, on the southwestern part of the margin. Similar ages of volcanic rocks, from the 137-132 Ma Bunbury Basalts in southwest Australia to the 130-129 Ma basalts along the margins of the Naturaliste Plateau and ~124 Ma basalts on the Wallaby Plateau offshore, suggest that a widespread volcanism occurred contemporaneously with these events. New ages of 127-121 Ma for the Southern Kerguelen Plateau basalts indicate that Kerguelen plume has been active earlier than previously thought. Thus, many workers attribute the breakup to the presence of the Kerguelen plume.

A volcanic sequence recovered during the International Ocean Discovery Program (IODP) Expedition 369 at Site U1513 on the Naturaliste Plateau may have recorded the evolving tectono-magmatic events at the focal point of the East Gondwana continental breakup and are the best materials for investigating the role of the Kerguelen plume. The best ages obtained from dolerite dikes that likely fed the flows based on geochemical similarity are 134 Ma and 123 Ma, which encompass the period from rifting to breakup. Trace elements obtained from the least altered samples from each flow package vary from light rare earth element (LREE) enriched transitional basalt to LREE-depleted tholeiitic basalt compositions toward the top of the section. This is coupled with a change from isotopically more enriched to depleted compositions toward the upper flows, suggesting evolving magma source. These results possibly indicate thinning lithosphere from rifting to breakup and increasing input from asthenospheric mantle source. Isotope data that are distinct from those of the Indian Ocean ridge basalts, coupled with large degree melting and high mantle potential temperature previously determined for some primitive flows, suggest involvement of the Kerguelen plume.