Probing giant lava bursts from the mantle: The Ontong Java Plateau

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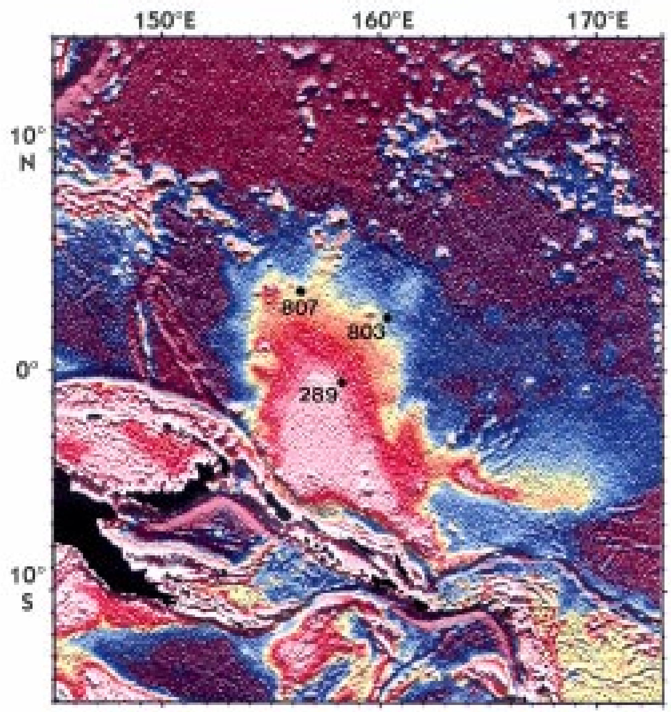
Preliminary evidence suggests that many oceanic plateaus may represent enormous volumes of magma emplaced rapidly on the seafloor. If so, emplacement of the larger plateaus may have had significant environmental effects. Because large plateaus are likely to resist subduction, they also may be an important means of continental growth (e.g., [*Cloos,* 1993]). Many workers now attribute the largest plateaus, like the Alaska-size Ontong Java Plateau (OJP) in the Pacific (see figure), to massive melting within the heads of new "plumes" that have welled up into shallow levels of the mantle; plume heads are theorized to consist of voluminous amounts of hot mantle originating at much greater depths, perhaps near the boundary between the mantle and the metal core (e.g., [*Richards et al.,* 1991] and [*Coffin and Eldholm,* 1993]. Most oceanic plateaus appear to have formed in the Cretaceous period (before 65 Myr ago), suggesting that convection in the mantle during the Cretaceous may have differed in important respects from that during the last several tens of millions of years.



The Ontong Java Plateau and locations of drill sites reaching basement.

Unfortunately, plateau basement crusts are very poorly sampled and thus their ages and compositions remain poorly known. Because they are buried by thick sediment blankets (often > 1 km thick), drilling is the on*ly* way to sample basement systematically over large areas of a plateau. Reconnaissance basement drilling on the OJP during ODP Leg 130 penetrated 149 m of basalts at Site 807 and 26 m at Site 803 (see figure); earlier DSDP drilling at Site 289 penetrated 9 m of a single lava flow. In addition, the OJP is unique among Pacific plateaus in that several fragments of its upper crust are exposed on land in the Solomon Islands. Consistent with plume models, recent geochemical data for available basement basalts indicate an origin by high degrees of melting in plume-type mantle; also compatible with some plume-head models, the mantle source region contained material of two different compositions that appear not to have intermixed appreciably (e.g., [*Tejada et al.,* 1996]). The most surprising finding — and one of the most important — is that two distinct basement ages are evident: one group of lavas is ~122 Myr old, whereas a second group is ~90 Myr old (e.g., [*Tejada et al.,* 1996]). Because plume-head models predict that a plateau is emplaced in a single episode of short duration, this discrepancy has forced a reevaluation of such models; for example, one possibility (based on theory and laboratory experiments) is that under some circumstances two plume heads may form within one plume at different times [*Bercovici and Mahoney*, 1994]. However, because of the very sparse sampling of OJP basement, the relative magnitudes of the 122 Myr and 90 Myr events cannot yet be determined; indeed, the possibility that basement lavas of other ages exist on the OJP cannot be discounted. Further understanding (and no doubt surprises) awaits future, systematic basement drilling.

References:
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