Contrasting old and young volcanism at Aitutaki, Cook Inlands: Evidence for a distinct Rarotonga hotspot?

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The Cook-Austral volcanic lineament is proposed to be the product of three overlapping hotspots tracks: Macdonald, Arago, and Rarotonga hotspots. However, the entire Rarotonga hotspot track consists of just two islands with young, overlapping periods of volcanism—at Rarotonga Island (1.157 to 1.697 Ma), and the younger series of volcanism at Aitutaki Island (1.382 to 1.941 Ma)—making it difficult to evaluate a hotspot origin for the young volcanism on these islands. Here we present new geochemical data from Atiu and Aitutaki islands, located in the Cook Islands. Volcanism at Atiu (~7 Ma) is associated with the Arago hotspot. Aitutaki island exhibits two stages of volcanism: 1) a "younger volcanic series" (1.382 to 1.941 Ma) associated with the putative Rarotonga hotspot, and 2) an "older volcanic series" (9.53 Ma) tentatively linked with the Arago hotspot based on its age, but an association with the Arago hotspot has never been tested using radiogenic isotopes. New geochemical data on the older Aitutaki volcanic series confirms that the older series of volcanism on Aitutaki has clear geochemical affinities to Atiu lavas, confirming its relationship with the Arago hotspot. Aitutaki's younger volcanic series, constructed on a carbonate platform of a near-atoll, is geochemically-distinct from the older Aitutaki series. The younger volcanic series exhibits EM1 geochemical signatures similar to EM1 signatures of Samoa rejuvenated lavas, as well as geochemical affinities to EM1 lavas from Rarotonga island. If, like Samoan EM1 rejuvenated lavas, the young series EM1-type Aitutaki lavas are simply a rejuvenated cap on the shield stage of an older volcano, then it is also possible that the nearby (~260 km) EM1 Rarotonga island lavas also represent a subaerial rejuvenated stage that caps a deeper, older submarine volcanic stage related to a different hotspot. Submarine samples of the deep submarine flanks of Rarotonga Island are needed to test this hypothesis, which posits a non-plume origin for subaerial lavas at Rarotonga.

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