Hornblende andesites/dacites in an oceanic arc setting at Narcondam volcano, Andaman Sea, S.E. Asia

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Narcondam volcano is located in the north central Andaman Sea and is part of the volcanic arc system that stretches from Sumatra to Burma (Myanmar). Narcondam volcano and its southern active (last eruption in 1995) neighbor, Barren Island volcano, define an intraoceanic magmatic arc situated in a ~300-400 km wide, 1000-3000 m deep rift basin with active sea-floor spreading in its eastern part. Narcondam volcano forms a small island, ~3.5 km across and 710 m high, that rises isolated from its immediate ~17 km wide base at 1000 m beneath the sea, but nearby ocean floor is as deep as ~ 2000 m. Estimated submarine and subaerial volumes are 95 km^3 and 4 km^3, respectively. Last activity is likely Holocene but subaerial lavas have been dated as old as 550 and 700 Ka suggesting no significant edifice displacement due to rifting or change in magma sources for at least this period. The top of the eastward dipping Indian plate is thought to lie at ~90 km below the magmatic arc.

Subaerial lavas are calc-alkaline andesites and dacites with typical volcanic arc chemical signatures and are isotopically distinctly more radiogenic than basaltic/andesitic lavas of the 140 km distant Barren island volcano (e.g., $^{87/86}Sr$ >0.70515 vs. <0.70405; $^{206/204}Pb$ >18.56 vs. <18.31). Mineral assemblages of Narcondam silicic andesites and dacites are dominated by phenocrysts of plagioclase followed by hornblende (multiple populations, ranging from euhedral with reaction rim to completely replaced), oxide minerals, and opx, but also phenocrysts of quartz, biotite and mineral clots with cpx and/or olivine. Zircon inclusions have been found in hornblende.

Chemical data and mineral assemblages, especially hornblende, suggest that Andaman sea floor below Narcondam is underlain by continental type crust either of the rifted Burma plate or by older arc root material.

Hf-Nd-Pb isotope variations of subducting sediments

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In order to understand the processes involved in subduction zones, it is important constrain the geochemical charicteristics of sediments being actively subducted today. In this study, we report Pb isotopic data for more than 50 samples from 6 DSDP sites (Table 1) to complement our existing Hf and Nd data from these samples in order to examine their coupled Hf-Nd-Pb isotopic relationships. In terms of Pb isotopic composition, these sediments lie along a narrow, positively correlated array in $^{207}Pb/^{204}Pb$ vs. $^{206}Pb/^{204}Pb$ that ranges from unradiogenic compositions, coincident with Pacific MORB, represented by the Philippine and Ryuku sites, to highly radiogenic compositions, represented by the Nicobar and Astoria fan sites. The Pb isotopic ratios for these radiogenic sediments lie along two parallel and highly linear Pb isotopic trends.

Table 1. Pb and Hf isotopic ratios of DSDP sediments.

Ref.Site	location	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	ε_{Hf}
174	Astoria Fan	18.92-19.34	15.65-15.72	-20.02-0.74
211	Nicobar	18.83-19.32	15.69-15.81	-19.06-5.13
291	Philippines	18.36-18.85	15.57-15.65	8.17-10.04
294/295	Ryuku	18.41-18.67	15.54-15.65	-2.62-12.66
495	Cent Am	18.74-18.80	15.61-15.63	9.94-11.35
881(ODP)	Kamchatka	18.62-18.70	15.61-15.63	N/A

Taken together, all the sediments we analyzed plot along broad, negatively correlated Hf-Pb and Nd-Pb, and positively correlated Hf-Nd, isotopic arrays. The two notable exceptions to this are the compositions of the metal rich pelagic clays from the Philippine and Ryuku sites. In terms of Hf and Nd, these sediments have highly anomalous compositions that plot distinctly above the terrestrial Hf-Nd isotopic array. However, in terms of Hf and Pb, these samples lie well within our Hf-Pb array with no obvious deviation. In terms of Nd and Pb, in contrast, these compositions plot on the unradiogenic Nd side of the Nd-Pb array. This is shown most visibly in terms of $^{206}Pb/^{204}Pb$ but also for $^{207}Pb/^{204}Pb$. These relationships further indicate that the anomalous Hf-Nd compositions of pelagic sediments are not controlled by radiogenic Hf but rather by the unradiogenic Nd isotopic compositions of these REE rich sediments.