

**Geochemical Evolution of the Izu-Bonin-Mariana (IBM) Arc System:
Evidence from Volcanic Ashes Recovered by DSDP Leg 60 and ODP
Leg 125, Western Pacific**

by

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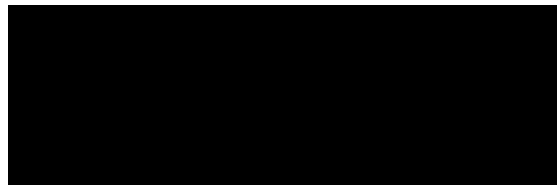
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STATEMENT

The assistance and guidance to the author by various people are detailed in the acknowledgments. Except where otherwise indicated, all results presented in this thesis are the author's own, as are all conclusions drawn from the data.

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

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ABSTRACT

This thesis includes three research topics: geochemical evolution of the Izu-Bonin-Mariana (IBM) arc system- evidence from volcanic ashes, petrogenesis of lower crustal xenoliths from the San Francisco volcanic field, and provenance of northwest Pacific, Plio-Pleistocene dropstones. The IBM ashes are emphasised with the other two topics addressed in Appendices.

A systematic geochemical study of a major representative set of volcanic ash samples recovered from DSDP Leg 60 Sites 458 and 459B and ODP Leg 125 Sites 782A, 784A, and 786A drilled in the IBM forearc is presented. A series of analytical techniques have been used to obtain major and /or trace element abundances plus selected Sr-Nd isotopic ratios on individual glass shards and mineral crystal fragments, pure bulk glass separates, pure bulk homogeneous and heterogeneous ashes, and sediment-containing bulk ashes. Notable results are 1) absence of a consistent and monotonic increase in alkalinity from older to younger deposits; 2) a change in comparative fertility of mantle wedge sources in the Izu-Bonin arc from relatively fertile to refractory subsequent to backarc (Shikoku Basin) formation; 3) the absence of such an effect in the Marianas where more extensive backarc basin spreading has occurred; 4) the appearance of alkaline compositions in the Marianas either related to arc renaissance subsequent to initial stages of backarc rifting, or through the tapping of a long-lived wedge heterogeneity centred at present in the vicinity of IwoJima near the junction of the IBM systems; 5) the absence of any evidence of crustal growth in IBM arc systems on the basis of consistency of major element characteristics believed to be a function of crustal thickness; 6) indications of significant compositional controls on the nature of arc volcanism exerted by a lithospheric filter effect; the Marianas (comparatively fertile filter) compared with the Izu-Bonin arc (comparatively refractory lithospheric filter); 7) the presence of high Ba/Rb (20 ± 4) of arc volcanic rocks relative to the mantle value (11 ± 3), possibly indicating sediment incorporation in island arc magmas; 8) the presence of uniform $^{87}\text{Sr}/^{86}\text{Sr}$ ratios from 0.7032 to 0.7040, flat HREE at 10 to 30 times chondritic abundance patterns, and consistent geochemical relationships among IBM arc and backarc volcanic rocks and N-MORB, indicating a common N-MORB-type mantle source beneath the Philippine Sea Plate, and no systematic temporal and spatial geochemical changes during the development of the Philippine Sea Plate.

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