

ABSTRAK

Zona subduksi daerah penelitian tersebar pada tiga busur kepulauan: Busur Halmahera, Busur Sangihe, dan Busur Filipina Timur yang melibatkan komponen subduksi berbeda tetapi masih memiliki relasi yang menyebabkan adanya perbedaan dan kesamaan karakteristik geokimia batuan vulkanik antar busur kepulauan. Walau demikian, tidak banyak dilakukan karakterisasi selain menggunakan diagram geokimia tradisional. Sehingga, selain pengolahan diagram geokimia, dilakukan analisis komputasi geosains: *principal component analysis*, *k-means clustering*, dan *gaussian mixture model* yang diharapkan mampu mengkarakterisasi data sehingga diketahui relasi ketiga busur kepulauan.

Penelitian menggunakan data unsur mayor dan unsur jejak yang telah dikompilasi GeoROC. Tiap sampel divisualisasi pada diagram geokimia. Secara terpisah, data dinormalisasi dan ditransformasi *principal component analysis*, kemudian diklasifikasi *k-means clustering* dan *gaussian mixture model*.

Hasil penelitian menunjukkan bahwa batuan vulkanik dari Busur Sangihe dan Busur Halmahera memiliki kesamaan karakteristik, di mana karakteristik ini dapat dibedakan terhadap Busur Filipina Timur. Kluster data Busur Filipina Timur memiliki nilai rasio unsur *fluid mobile*, Sr/Y dan Rb/Yb, dan rasio unsur *melt mobile*, La/Yb, Nb/Er, Nb/Y, La/Eu dan Nb/Zr, yang lebih tinggi dibandingkan Busur Sangihe dan Busur Halmahera. Busur Sangihe dapat terbagi menjadi dua bagian: Busur Sangihe Utara dan Busur Sangihe Selatan, di mana Busur Sangihe Utara memiliki nilai rasio Ba/Nb dan Sr/Y yang lebih tinggi dan Th/Ce dan Rb/Sr yang lebih rendah dibandingkan Busur Sangihe Selatan. Sedangkan karakteristik Busur Halmahera berada pada kluster yang sama dengan Busur Sangihe Selatan jika dibandingkan dengan Busur Sangihe Utara.

Kata Kunci: Busur Kepulauan, Subduksi, Batuan Vulkanik, Geokimia, Analisis Komputasi Geosains

ABSTRACT

The research area encompasses three island arcs: Halmahera, Sangihe, and East Philippine, each characterized by distinct subduction components but interconnected. This results in varying and shared geochemical traits in volcanic rocks across these arcs. However, apart from traditional geochemical diagrams, limited characterization has been conducted. Based on this, besides utilizing geochemical diagrams, computational geoscience techniques were employed, including principal component analysis, k-means clustering, and Gaussian mixture model, aiming to characterize the data and elucidate the relationship between these island arcs.

The research employed major and trace element data compiled from GeoROC. Each sample was plotted on geochemical diagrams. Separately, data underwent normalization and transformation using principal component analysis, followed by cluster analysis.

The research results indicate that volcanic rocks from the Sangihe Arc and the Halmahera Arc have similar characteristics, which can be distinguished from the Eastern Philippine Arc. The data cluster of the Eastern Philippine Arc exhibits higher values for the ratios of mobile fluid elements, Sr/Y and Rb/Yb, and the ratios of mobile melt elements, La/Yb, Nb/Er, Nb/Y, La/Eu, and Nb/Zr, compared to the Sangihe Arc and the Halmahera Arc. The Sangihe Arc can be divided into two parts: the Northern Sangihe Arc and the Southern Sangihe Arc, where the Northern Sangihe Arc has higher values for the Ba/Nb and Sr/Y ratios and lower values for Th/Ce and Rb/Sr compared to the Southern Sangihe Arc. Meanwhile, the characteristics of the Halmahera Arc fall within the same cluster as the Southern Sangihe Arc when compared to the Northern Sangihe Arc.

Keyword: Island Arc, Subduction, Volcanic Rocks, Geochemistry, Computational Geosciences analysis