Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33713

Role of subduction in the active rifting of the Guaymas Basin: Insights from Petrography and Geochemical studies

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The Guaymas Basin (GB) is a relatively young marginal rift basin in the Gulf of California, which began spreading ~6Myr ago [2]. The high rate of sedimentation, comprising both marine and terrigenous origins, impedes conventional crustal accretion, thereby facilitating the emplacement of magma as mafic sills within the thick sedimentary deposits [1]. These mafic sills were successfully retrieved during the International Ocean Discovery Programme (IODP), Expedition-385. In this study, we conducted petrographical and geochemical analyses of these mafic sills recovered during the expedition to understand the mantle processes and characterize the nature and source of the magma involved in the evolution of this actively growing basin. Major and trace elements data suggest that these mafic sills are tholeiites, exhibiting a range from normal to enriched Mid Oceanic Ridge Basalt (MORB) characteristics. However, notable positive anomalies of fluid-mobile elements (e.g. Pb, Ba, U) and depletion of fluid-immobile elements (e.g. Nb, Th) resemble those of an Island Arc Basalt. The substantial variation in the Mg# value (~47-73 mol%) indicates the evolved nature of magma. The variation in elemental ratios such as K_2O/TiO_2, Nb/U, Ba/Th, Ba/Nb, Rb/Nb, suggests a strong subduction influence. The high Ba/Zr ratios suggest the possible influence of dehydrated subducted oceanic crust. This could explain the inevitable influence of the Farallon oceanic plate subduction in the rifting of the Guaymas basin, suggesting that the magma was generated by low-pressure partial melting of shallow, depleted mantle that had been metasomatized by subsequent addition of recycled subducted components, producing the observed elemental anomalies.

References:

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