The Uvas Basaltic Andesite: a Large-Volume Volcanic Field Erupted During the Initiation of the Southern Rio Grande Rift

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The Uvas Volcanic Field (UVF) is a large-volume dominantly mafic volcanic field representing the earliest (~27 Ma) significant mafic magmatism in the southern Rio Grande rift (RGR). It consists of lava flows, dikes, and domes with compositions ranging from basalt to trachyandesite. In this study, we will use \(^{40}\text{Ar}/^{39}\text{Ar}\) dating, isotope (Nd and Pb) and whole-rock geochemistry, and geothermometry (olivine-liquid) to evaluate magma sources during the early stages of crustal extension in the southern RGR.

We collected 32 samples over a broad area of the UVF, including the Sierra De Las Uvas Mtns, Goodsite Mtns., and Southern Caballo Mtns. Alteration is ubiquitous; to ensure accurate results, 10 of the least altered samples were subjected to ultrasonic leaching, crystal picking, and magnetic separation.

Thin-sections from 16 samples show an assemblage mainly consisting of microlitic plagioclase, magnetite, and clinopyroxene, and medium-grained olivine and pyroxene phenocrysts. The samples show extensive alteration, with widespread secondary replacement of olivine and pyroxene, extensive clay development within plagioclase, and calcite-filled amygdules.

Whole-rock geochemistry of 10 samples reveals a sub-alkaline character for the UVF with variations in \(\text{SiO}_2\) (50–58 wt.%), \(\text{Na}_2\text{O}\) (2.9–3.8 wt.%), and \(\text{K}_2\text{O}\) (0.5–2.4 wt.%). Magma evolution was influenced by olivine and pyroxene fractionation, resulting in lower MgO, FeO, and CaO concentrations with increasing \(\text{SiO}_2\).

Eight out of the ten samples generally show a depletion of high field-strength elements and an abundance of large-ion lithophile elements. The enrichment in mobile elements like Sr, Ba, and Pb, along with non-mobile elements such as Rb, despite being basaltic in composition, suggests significant crustal assimilation.

Most UVF samples resemble basalts that come from modified sub-continental lithospheric mantle melting, similar to the Mogollon-Datil Volcanic field connected to the Cenozoic ignimbrite flare-up (~37–23 million years ago). Two samples from a location 30 km away (Southern Caballo Mtns.) from the main central domal uplift have an Ocean Island Basalt (OIB)-like composition, suggesting a different magma source. The origin of these samples, whether from a less-contaminated magma or a later pulse from a deeper source related to rapid extension in the Rio Grande rift beginning around 27 million years ago, remains uncertain. More radiogenic isotope analysis and precise dating will help clarify this.

We will assess whether UVF’s composition corresponds to the onset of rifting. By merging geochemical data with accurate \(^{40}\text{Ar}/^{39}\text{Ar}\) dating, we aim to determine whether radiogenic isotope and geochemical signatures suggest a more primitive magma, as expected during widespread stretching in the eruptive period. Identifying a clear geochemical change from lithospheric mantle melting through conductive heating to asthenospheric melting through decompression melting would offer strong evidence for the onset of rifting around ~27 Ma. Our research will help improve existing models of magma generation during the early stages of the Rio Grande rift.

Keywords:
Rio Grande rift, Geochemistry, Early continental extension, Isotope Geochemistry, Geothermometry, \(\text{Ar}/\text{Ar}\) dating


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