ABSTRACT: A computerized data bank of over 1200 published major element analyses has been created, listing volcanic rocks from the Rio Grande rift and its flanks in New Mexico, Colorado and Texas. In this preliminary study, the data for each of the major volcanic fields, summarized on histograms and binary and triangular plots, are compared to establish a relation between petrochemistry and tectonic position with respect to the rift, and to determine temporal changes in volcanicity.

No consistent systematic chemical variations across the rift were found, except locally. The only observed chemical change along the rift axis is the southward increase in TiO\(_2\)-index of rift basalts. Three volcanic districts (Mt. Taylor-Mesa Chivato, Sierra Blanca and Trans-Pecos Texas) differ significantly from the others, in higher total alkali (especially Na\(_2\)O), total iron oxide, and TiO\(_2\) and lower SiO\(_2\). These differences do not appear to be related to the Rio Grande rift. The strongly alkalic composition of the Mt. Taylor-Mesa Chivato field (Pliocene-Pleistocene) may arise from its location on the Jemez lineament, which may penetrate to greater depths in the mantle. The considerably older (Oligocene) Sierra Blanca and Trans-Pecos Texas districts, on the other hand, form the eastern-most of a series of parallel magmatic belts in northern Mexico and Texas, which may have been associated with a broad, eastward-dipping subduction zone during the middle Tertiary.

The absence of a distinct petrochemical “signature” for the Rio Grande rift lavas implies that the physico-chemical environment of melting has remained the same throughout the region. Although the Rio Grande rift is a well-defined geophysical entity, it belongs to a broader zone of crustal extension in the Basin and Range province. The rift has been localized in part by structural “inheritance”, and in part by its position as the eastern boundary between the Colorado Plateau and Southern Rockies.

Transverse structures, such as the Jemez lineament, have also played an important role in localizing contemporaneous volcanism of highly variable and differentiated compositions, often strongly alkalic.

INTRODUCTION

The Rio Grande rift (Fig. 1) has been recognized as a major structural feature extending from central Colorado, through New Mexico and into Trans-Pecos Texas (Chapin and Seager, 1975; Woodward et al., 1978; Tweto, 1979). Recent geophysical studies show that the Rio Grande valley is characterized by anomalously high heat flow (Reiter et al., 1978, 1979), positive gravity anomalies (Ramberg et al., 1978; Cordell, 1978), and decreased crustal thickness (Bridwell, 1976; Cook et al., 1979; Keller et al., 1979; Olsen et al., 1979). The high geotherms and anomalous seismic reflections suggest that shallow magma bodies may be present locally, as near Socorro (Olsen et al., 1979; Reilinger et al., 1979, 1980; Rinehart et al., 1979). Evidence for current geologic activity includes seismicity, recent faulting and vertical movements (Reilinger et al., 1979; Reilinger and York, 1979). Considered together, these features strongly suggest that the Rio Grande rift represents a zone of crustal thinning, partial melting of the lower lithosphere and intrusion of basaltic magma.

Because crustal thinning, caused by extension, has progressed further in the rift than on its flanks, the rift volcanics might be expected to differ petrologically and geochemically from contemporaneous volcanics outside the rift. Data from experimental petrology suggest that the composition of basaltic magmas depends on the depth of magma separation, the degree of partial melting and their volatile content (Green and Ringwood, 1969). Incipient melting of the mantle during the early stages of continental rifting can generate highly alkaline mafic magmas at depths of 80-120 km (Green, 1971), especially in the presence of volatiles, particularly CO\(_2\) (Bailey, 1974).