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GEOLOGY OF THE CERROS DEL RIO VOLCANIC FIELD, SANTA FE, SANDOVAL, AND LOS ALAMOS COUNTIES, NEW MEXICO

by

Jayne Christine Aubele

B.S., Cleveland State University, 1972

THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Geology

in the Graduate School of
The University of New Mexico
Albuquerque, New Mexico

May, 1978

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ABSTRACT OF THESIS

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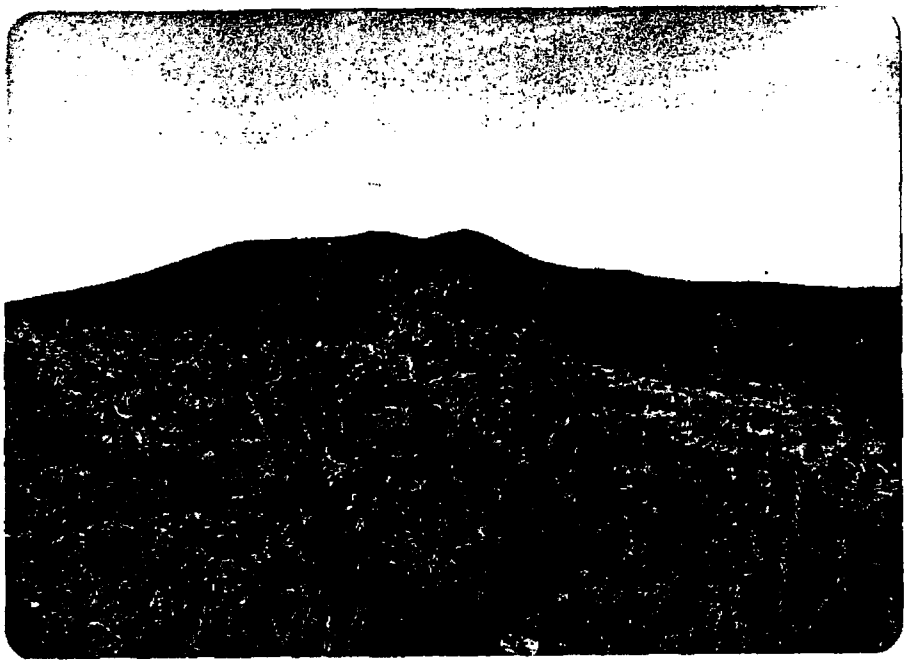

Frontispiece. "The Cerros del Rio lava flows deserve closer study than they have received. Intensive study of the Cerros del Rio conceivably could provide important new interpretations of the geologic history of the Santa Fe area. It is hoped that some investigators of the future will give the Cerros special attention." (Galusha and Blick, 1971).

Montoso Peak viewed to the southwest and Cholla in bloom.

ABSTRACT

The Cerros del Rio volcanic field is located about 10 km west of Santa Fe, New Mexico and southeast of the Jemez Mountains volcanic complex. The field lies on the Jemez-La Bajada constriction which separates the Española and the Albuquerque-Belen basins of the Rio Grande rift. At this point the rift is laterally offset 30 km. Approximately 180 sq km were mapped for this study. The northwestern map boundary parallels White Rock Canyon, a 300 m gorge which has been cut by the Rio Grande within the past 1 m.y. About 60 vents were discovered in the area, and the field was active about 2.6 m.y. ago.

White Rock Canyon has been modified largely by toreva block slumping and landslide deposits, which have resulted in repetition of the stratigraphy. Where it is visible, the stratigraphic section within the canyon consists of intercalated hawaiite flows and phreatomagmatic deposits with a few discontinuous conglomerate gravel lenses. The phreatomagmatic deposits vary in thickness from meter to tens of meters and are composed predominantly of accidental sand, silt and chert with additional ash, lapilli and basalt fragments. Bomb sags, cauliflower bombs and crossbeds formed by base surge, are common. The source for these deposits must have been a series of maar craters which paralleled the present White Rock Canyon. The predominant phreatomagmatic activity in this area implies that there was a

through-going drainage system parallel to the present Rio Grande at the time of eruption of the Cerros del Rio volcanic field.

The Tertiary Tesuque Formation (Pojoaque Member) is unconformably overlain by basaltic and phreatic ash of the Cerros del Rio at the eastern margin of the volcanic field. The ash deposits were partially eroded and reworked during and after deposition. Although the Ancha Formation was originally described from this area, it is the conclusion of this study that the Ancha, as a separate formation, does not exist within the map boundaries.

Activity, within the Cerros del Rio, began with extensive hawaiite flows in the north and south. Cinder cones and phreatomagmatic eruptions occurred simultaneously, especially in the vicinity of White Rock Canyon. This activity was followed by the eruption of andesite flow-domes and less voluminous flows of hawaiite emanating from a zone of vents trending NW-SE across the center of the area. After the andesite eruptions had ceased, hawaiite eruptions continued along this zone, and cinder cone formation represented the final stage of activity of the field.

In the vicinity of the present White Rock Canyon, the Cerros del Rio hawaiite was unconformably overlain by the Tshirege Member of the Bandelier Tuff about 1.1 m.y. ago. Airfall pumice, from the eruption of the Valles Caldera, must have initially covered the Cerros del Rio, and has been re-deposited in small surface deposits in protected hollows and valleys

throughout the area. The pumice also contributed to the development of Holocene soil which covers much of the volcanic field.

The rocks of the Cerros del Rio have been classified on the basis of petrography, major element chemistry and normative mineralogy. The chemical classification of Irvine and Baragar (1971) has been followed for rock nomenclature.

The hawaiite is generally gray and fine grained with visible olivine phenocrysts. SiO_2 varies from 47 to 49 percent. Total alkalies are about 6 percent. It is nepheline and olivine normative.

Two basaltic andesite flows exist in the area. The rock is black and fine grained, with few visible phenocrysts of olivine and clinopyroxene. SiO_2 content is 56 percent. Total alkalies are about 6 percent and it is quartz and hypersthene normative.

The andesite is dark gray to black with abundant andesine and some hornblende phenocrysts. SiO_2 content is 59 to 61 percent and the rock is quartz and hypersthene normative.

On plots of the major oxides and the AMF diagram, the hawaiite and andesite form two distinct groups. The basaltic andesite plots with the andesite. There is no apparent petrogenetic relationship between the two groups, and the hawaiite and andesite are assumed to be derived from separate sources.

Rounded, embayed and partially resorbed phenocrysts of andesine and quartz are characteristic of all but the last

three erupted rocks of the Cerros del Rio volcanic field. An origin by crustal contamination is favored for these phenocrysts, since they occur in both the hawaiite and andesite, and since small inclusions of metamorphosed sandstone have been found in early hawaiite flows.

The majority of the vents in the area are marked by cinder-and-spatter cone formation. Hawaiite flows show a zoned vertical section, with less than 1 m of vesicular rock at the top grading into a massive interior. The andesite forms sprawling masses, 60 m thick, which resemble dissected mesas. The rock is thinly foliated in the interior of the flow-dome and becomes increasingly glassy and massive toward the top. Intrusions in the area include several plugs, dikes trending to the northeast, and one sill exposed in White Rock Canyon.

A well exposed maar crater discovered on the edge of White Rock Canyon has been informally named Montoso maar. This maar has been dissected to a depth of 200 m by intermittent stream action, which has exposed its internal stratigraphy and a well-defined ring-fracture zone. The phreatomagmatic deposits consist of well-bedded sand, silt, basaltic ash and fragments interbedded with lenses of inflow breccia deposited as mudslides. Intermittent subsidence of the maar deposits occurred during and after eruption of the crater.

The Cerros del Rio flows appear to follow two distinct gradients which may relate to the regional gradients toward the Espanola and Santa Domingo basins. The divide for these

gradients appears to be the NW-trending zone of vents from which hawaiite was dominantly extruded. This alignment may reflect an extensional fracture zone between the two basins which served as a conduit for alkali magma from deep sources.

The Cerros del Rio petrologic assemblage, hawaiite-basaltic andesite-andesite, does not resemble the dominant alkalic-peralkaline volcanism of the east African or Ethiopian rifts. The absence of tholeiite in the Cerros del Rio may be due to its position on the postulated extensional fracture zone; however, the petrology of the volcanic field resembles other basin and range volcanic fields of the western United States far more than typical rift volcanism.

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