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Stratigraphic Relations and Lithologic Variations in the Jemez Volcanic Field, New Mexico

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Over 100 radiometric dates and recent detailed geologic mapping allow some refinements of the stratigraphic relations of major units and generalization of temporal lithologic variations in the Jemez volcanic field. Volcanism had begun in the area by about 16.5 Ma with episodic eruptions of alkaline basalts. By 13 Ma, alkaline volcanism had been replaced with eruptions of more voluminous olivine tholeiite. High-silica rhyolite, derived from melts of lower crust, also was erupting by about 13 Ma. Basalt and high-silica rhyolite continued to be erupted until about 7 and 6 Ma, respectively, but effusions of dominantly andesitic differentiates of basalt that began as early as about 12 Ma volumetrically overshadowed all other eruptive products between 10 and 7 Ma. From 7 to 3 Ma the dominant erupted lithology was dacite, which appears to have been generated by mixing of magmas whose compositions are approximated by earlier andesites and high-silica rhyolites. Less than 4–3 Ma volcanism was dominated by eruption of rhyolitic tuffs. Field relations, geochemistry, and dates specifically indicate the following with regards to stratigraphic relations: (1) distinctions among basalt of Chamisa Mesa, Paliza Canyon Formation basalts, and Lobato Basalt for other than geographic reasons are artificial; basaltic volcanism was continuous in volcanic field from >13 to 7 Ma. (2) Canovas Canyon and Bearhead rhyolites form a continuum of high-silica rhyolite volcanism from >13 to 6 Ma. (3) hypabyssal and volcanic rocks of the Cochiti mining district probably represent the exhumed interior of a Keres Group volcano(s). (4) temporal overlaps exist among the major stratigraphic groups which may imply some genetic relations, and (5) the Tewa Group formation Cerro Rubio Quartz Latite may more appropriately be considered part of the Tschicoma Formation of the Polvadera Group. Preliminary analysis of hydrothermal alteration in the context of the volcanic stratigraphy suggests at least three distinct hydrothermal events have occurred in the volcanic field's history.

INTRODUCTION

With increasing scientific interest focused on the Jemez volcanic field because of the Continental Scientific Drilling Program, numerous detailed geological, geochemical, and petrologic studies (for example, this special section) of various aspects of the Jemez Mountains have been done since the pioneering work of the U.S. Geological Survey [e.g., *Iddings*, 1890; *Ross*, 1931, 1938; *Doell and Dalrymple*, 1966; *Smith and Bailey*, 1966, 1968; *Smith et al.*, 1970]. As commonly occurs when more detailed information becomes available, revisions of or substitutes for earlier geologic models are necessary. The purpose of this paper is to present stratigraphic relations, based on new field and radiometric data, together with generalized temporal lithologic variations which have important implications for the development of the Jemez volcanic field and probably the Bandelier Tuff magmatic system(s).

Bailey et al. [1969] and *Smith et al.* [1970] developed a formalized stratigraphy for the volcanic and volcaniclastic rocks of the Jemez volcanic field. They divided the volcanic field into the three stratigraphic groups from oldest to youngest, Keres, Polvadera, and Tewa. A compilation of available dates (Table 1) and field relations indicate temporal overlap among all groups (Figure 1), but the three stratigraphic groups retain much of their petrological significance, as implied by *Bailey et al.* [1969].

Stratigraphic relations within a complex volcanic field such as the Jemez Mountains are not as straightforward as in most sedimentary sequences. Too commonly, genetic relations for the volcanic rocks overshadow purely stratigraphic considerations. Hence instead of attempting to redefine the stratigraphy of the Jemez volcanic field, in this paper we point out stratigraphic and lithologic relations of major units so as to provide a skeletal framework from which further refinements may be made. Although the formal stratigraphy was based on excellent field geology and some radiometric dates for the pre-Tewa Group rocks, the cyclic, bimodal nature of volcanism it implies is misleading (see below). However, it is our intention that this paper complement *Bailey et al.* [1969], not replace it.

Figure 1 is a summary of the refined stratigraphic relations that are discussed in this paper. The reader will find comparison of Figure 1 to Figure 2 of *Bailey et al.* [1969] instructive. Figure 2 shows the distribution of the major stratigraphic groups in the Jemez Mountains, and Figure 3 together with Table 2 provide an index of geographic localities mentioned in the text.

Lithologic nomenclature for rocks of the Jemez volcanic field is problematic and has been discussed in detail elsewhere [*Gardner*, 1985]. Both chemical and modal classification

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