MAP I-2291-A

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MAPS SHOWING DISTRIBUTION, COMPOSITION, AND AGE OF EARLY AND MIDDLE CENOZOIC VOLCANIC CENTERS IN ARIZONA, NEW MEXICO, AND WEST TEXAS

By Robert G. Luedke

MISCELLANEOUS INVESTIGATIONS SERIES
Published by the U.S. Geological Survey, 1993

LUEDKE— DISTRIBUTION, COMPOSITION, & AGE OF EARLY & MIDDLE CENOZOIC VOLCANIC CENTERS, ARIZ., N.M., & W. TEXAS 1:1,000,000 MAP I-2291-A

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TO ACCOMPANY MAP I-2291-A

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DISCUSSION

This map is the first of a series showing the distribution, composition, and age of early and middle Cenozoic volcanic centers in the western conterminous United States. Designed primarily as a data base of igneous systems, the data shown provide the basic information necessary for such derivative studies as the development of geologic concepts to identify and assess igneous-related mineral deposits and(or) mineralized systems in a major geologic environment known to promote and host such deposits. In addition, this map series shows the temporal and spatial relationships of the early and middle Cenozoic igneous rocks and their geochemical and age associations, at a single common scale, within the many different igneous centers in the western states; it also can be useful as a base for studies of volcanology and volcanotectonics, and for studies of the general geology of volcanic rocks.

In this map series the early and middle Cenozoic time frame extends from about 58 Ma to 16 Ma, the time cutoff for an earlier published map series designed as a guide for the evaluation of igneous-related geothermal resources (for the comparable Arizona and New Mexico region, see Luedke and Smith, 1978). Within this early and middle Cenozoic time frame, the ages of the volcanic rocks are arbitrarily divided into three time increments: 58–37 Ma, 37–24 Ma, and 24–16 Ma. The ages of 58, 37, and 24 Ma, respectively, represent the approximate Paleocene-Eocene, Eocene-Oligocene, and Oligocene-Miocene boundaries (Berggren and others, 1985). Most volcanic rock units included and shown on the map generally fit well within the selected time frames. However, locally a few rock units, although indicated radiometrically to be plus or minus about 1 Ma particularly at the 24 Ma boundary, were included with the dominant age unit of the region in order to maintain petrologic, and indirectly tectonic, continuity.

This early and middle Cenozoic time frame principally includes rocks related to volcanotectonic activity that occurred during this time span. Some so-called Laramide volcanic events, however, started in Late Cretaceous and Paleocene time, continued into Eocene time or served as precursors to similar volcanic events later in the Cenozoic. Following a quiescence of volcanic activity in late Eocene time, volcanism and associated intrusions again commenced in the Oligocene and continued on a major scale into the Miocene, to the onset of late Cenozoic volcanism and associated extensional tectonism characteristic of the Basin and Range Province (Lipman and others, 1972) but also reflected in bordering regions. Because of the great amount of new and innovative geological, geochemical, geophysical, and geochronological data released during the last decade or two, reanalysis of both Laramide and post-Laramide volcanotectonic events is justified. Keith and Wilt (1986) have done such a synthesis of Laramide events principally for Arizona and environs, dividing the Laramide orogeny into (1) both an early and late initial phase (Late Cretaceous), (2) a medial phase (Paleocene), and (3) a culminant phase (Eocene). It is not the intent of this map to include the known or probable earlier Laramide volcanic areas, but to show some continuity, a few volcanic areas are outlined that bear some relationship to known magmatic or tectonic belts within the Rocky Mountain Cordillera. The Carrizo Mountains in northeasternmost Arizona, an igneous center in need of further study, constitutes the southwest end of the Colorado mineral belt (Mutschler and others, 1987) and is outlined on this map.

The volcanic rocks, including contemporaneous plutonic rocks, have been classified using a non-genetic system into five major types based primarily upon their known or inferred silica content:

1. Feldspathoidal basalts including basanite, tephrite, and other rare alkalic rocks	Less than 46 percent SiO_2
2. Basalt, including trachybasalt, hawaiite,etc.	46 – 54 percent SiO_2
3. Andesite, including trachyandesite, etc.	54 – 62 percent SiO_2
4. Dacite, including rhyodacite, quartz latite, trachyte, etc.	62 – 70 percent SiO_2
5. Rhyolite, etc.	More than 70 percent SiO_2

This rock classification permits a systematic application of the rock types throughout the map area and, as used, emphasizes the dominant rock type, recognizing that in any specific region several rock types may be intermixed. It is the same rock classification used in the map series on late Cenozoic volcanic rocks (Luedke and Smith, 1978), thereby permitting easy comparison.

Radiometric age data are referenced to the first or original source where possible. All older potassium-argon ages have been recalculated using the decay constants and isotopic abundances adopted by the International Union of Geological Sciences Commission on Geochronology August 24, 1976 (Dalrymple, 1979). Most ages shown were determined by potassium-argon and fission-track methods; a few ages determined by argon-argon and rubidium-strontium methods are included. Multiple ages at a given locality are shown when cartographically possible; some areas, such as the Clifton, Silver City, and Emory Peak 1° by 2° quadrangles (fig. 1) have many more ages than can be shown, so that an arbitrary selection was necessarily made.

References for geologic and age information are cited and indicated in figure 2. Wherever possible, original sources were consulted even though already included in or superceded by a general map compilation. Several references, because of their important but general and broad nature, are cited separately and are not numbered chronologically.

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