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

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I–2631 (Sheet 2 of 5)
Pamphlet accompanies map

EXPLANATION

This correlation chart is unconventional in that it gives unit ages by geographic area and lithologic type; the stratigraphic relations among individual map units are summarized in the description of volcanic units and figure 6. This chart can be used as an index to the vertical placement of units in figure 6. The five units (**QTaf**, **Qalg**, **Qcgj**, **Qlh**$_{1-5}$ and **Qlc**$_{1-4}$) that cross geographic areas are shown only in their respective areas; see figure 6 for unit correlations between areas. Volcanic units are grouped by geographic areas; within each area, they are further separated into mafic units (for example, type a) to the left and felsic units (for example, type I) to the right. Pyroclastic units, if present, are shown in the last column. Vertical placement of map units reflects age as determined from field relations, from K-Ar dating (table 3), and from polarity-chronostratigraphic data (Condit, 1984, 1991) derived from magnetic data (table 4), as interpreted within the context of the polarity-chronologic sequence of Mankinen and Dalrymple (1979). Flows have been placed in geochronologic divisions (Quaternary, Quaternary and Tertiary, or Tertiary) as defined by the North American Commission on Stratigraphic Nomenclature (1983); unit designations (Q, QT, or T) follow these conventions. The Pleistocene-Pliocene boundary is placed at 1.8 Ma (Bishop and others, 1978, p. 150); other authors have placed the boundary at 1.67 Ma (Aguirre and Pasini, 1985) and at 1.6 Ma (see Hansen, 1991, p. 59). Because most map units are of Quaternary age, they have been further subdivided into five polarity-chronologic age groups that are shown by color in the age-group columns and on sheets 2, 3, and 4; age-group divisions are based on magnetopolarity reversals. Color of box indicates rock type as shown on lithologic map.

Qwe$_4$ — **Map unit**—Box placed in center of time period during which unit was emplaced. Arrows point to correct column for unit in cases of overlap.

Map unit for which there is magnetopolarity information—See figure 6 for explanation of apparent discrepancies between magnetro-polarity of unit and position in polarity-chronologic sequence

Thq$_3$ — **Negative magnetopolarity**

Qlh$_{5y}$ — **Positive magnetopolarity**

Qlh$_5$ — **Transitional magnetopolarity**

Qaq$_{3.1}$ — **Map units having similar median age**

Qddg$_{4.1}$ Qddg$_4$ — **Map units whose probable times of emplacement overlap**—Placement of more than two units within box indicates probable overlap of adjacent samples

Mean age (whole-rock K-Ar) and limits of precision within one-sigma standard deviation—Dashed where stratigraphic and (or) magnetopolarity data prohibit assignment; gray where sample obtained from unit outside of map area. Mean at center of bar; asterisk place at favored time of emplacement

SURFICIAL DEPOSITS

Holocene — Qal — QTt

Pleistocene — QTc — QTl — QTg — QTa

SEDIMENTARY ROCKS

Unconformity

Oligocene — Tg

Unconformity

CRETACEOUS — Upper Cretaceous — Ku

Unconformity

TRIASSIC — Upper Triassic — Tru

Unconformity

Middle and Lower Triassic — Trm

Unconformity

PERMIAN — Lower Permian — Pk — Pc

AGE GROUP (sheet 1)

5 — 0.97 — 4 — 1.67 — 3 — 1.87 — 2 — 2.14 — 1

BASALTIC FLOWS AND PYROCLASTIC DEPOSITS

ANTELOPE MOUNTAIN AREA · BLUE RIDGE MOUNTAIN AREA · CERRO HUECO AREA · DEAD HORSE DRAW AREA · ECKS MOUNTAIN AREA · GREENS PEAK AREA · HAYSTACK MOUNTAIN AREA

CHANGE IN POSITION ON SCALE

CHANGE IN POSITION AND SCALE

BRUNHES NORMAL POLARITY CHRON

JARAMILLO NORMAL POLARITY SUBCHRON

MATUYAMA REVERSED POLARITY CHRON

REUNION NORMAL POLARITY SUBCHRON

AGE GROUP (sheet 1)

BASALTIC FLOWS AND PYROCLASTIC DEPOSITS — Concluded

IRIS SPRING AREA · JUAN GARCIA AREA · KNOLLS AREA · LAKE MOUNTAIN AREA · MORGAN MOUNTAIN AREA · North Fork White River Area · Ortega Sink Area · Pole Knoll Area · Richville Area · Show Low Creek Area · Udall Range Area · Vernon Area · White Lakes Basin Area

CHANGE IN POSITION AND SCALE

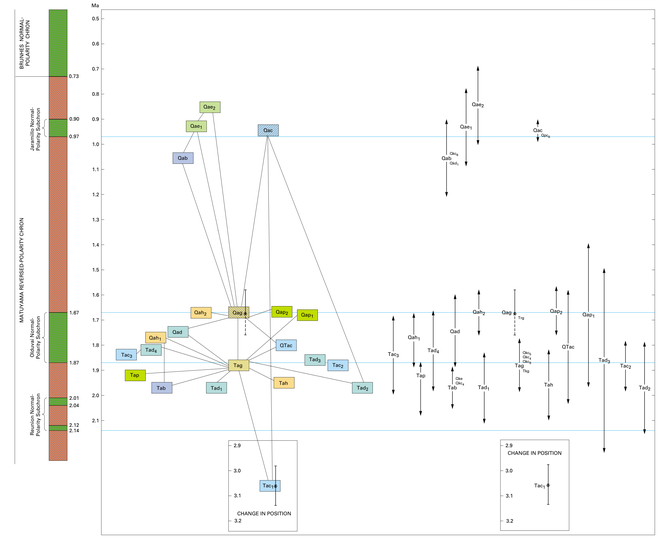
BRUNHES NORMAL POLARITY CHRON

JARAMILLO NORMAL POLARITY SUBCHRON

MATUYAMA REVERSED POLARITY CHRON

REUNION NORMAL POLARITY SUBCHRON

Figure 6. Stratigraphic relations and age constraints of volcanic flow units by geographic area (fig. 4, sheet 1). Volcanic units are placed in a chronologic framework by combining basalt stratigraphy with K-Ar ages (table 3, pamphlet) and magnetopolarity of units (table 4, pamphlet) as interpreted within polarity-chronologic sequence of Mankinen and Dalrymple (1979). Parts of the figure display all information except the geomorphology used to place these units chronologically. (See table 5, Description of Volcanic Units, column entitled Characteristics in pamphlet). Also shown are age limits for each unit, which have been estimated by combining the above information with observations on flow and cindercone morphology. Where a unit's age cannot be reasonably constrained by stratigraphic relations with overlying or underlying units that have K-Ar ages or magnetopolarity data, age limits reflect larger intervals. Following conventions applic. (1) Polarity-chronologic sequence (Mankinen and Dalrymple, 1979) between the present and 2.14 Ma is shown on left of each part of figure. Magnetopolarity of the Earth's field for this time period can be found on this scale. Ideally, a lava flow should preserve polarity at the time of eruption, and it can thus be placed in time period of corresponding polarity (see convention 6). (2) Boxes representing map units are placed in this chronologic framework on left side of each part of figure. Vertical lines showing the probably range in time when a unit may have been emplaced are shown on right. Most unit labels are placed in center of this range. Dashed lines indicate an interval when deposition is not permitted by any combination of K-Ar, stratigraphic, or magnetopolarity data. (For example, in area **M**, unit **Qme** has reverse-polarity, with upper and lower age limits that include periods of normal polarity). (3) Field-defined stratigraphic relations are shown by lines connecting boxes; box of underlying unit is at lower end of line. (See also table 5, pamphlet, Description of Volcanic Units.) (4) Where relative ages are known for units in adjacent geographic areas, these relations are shown by unit symbols to the right of the appropriate unit's vertical interval-of-emplacement line (see convention 2) as follows: symbols of overlying units are placed above symbol of appropriate unit; symbols of underlying units are placed below. Only exception is that of units **QTaf**, which occurs in or adjacent to all geographic subdivisions west of long 109°45′ (see convention 7). (5) Units whose ages have been determined by K-Ar methods are indicated by asterisks. (6) Line patterns within boxes indicate magnetopolarities of units where shown. Diagonal lines sloping up to the right indicate normal polarity; lines sloping down to the right, negative polarity. Vertical lines indicate transitional polarity. Some apparent mismatches between magnetopolarity of a unit and its position in polarity-chronologic sequence are due to insufficient data to assign unit to a single continuous polarity-chronologic unit that matches its polarity. Further complications to placement of units within Mankinen and Dalrymple's polarity-chronologic scheme (1979) may result from an as-yet-unrecognized normal subchron suggested by Tauxe and others (1983) and Burbank and Khan Tahirkheli (1985) and supported by work in this field by Castro and others (1983) on unit **Qrd** and possible unit **Qalg**, which have K-Ar ages of 1.47±0.06 Ma and 1.53±0.21 Ma, respectively. Because this event is not yet recognized, correlations are based on the polarity-chronologic sequence of Mankinen and Dalrymple (1979). If this event were included in correlations diagram, range in time of a unit's emplacement would be fixed more precisely. (7) Composite unit **QTaf** is composed of at least two flow sheets, whose ages are separated by the Olduvai Normal-Polarity Subchron. Field relations, the K-Ar age of unit **Qbbg**, and magnetopolarity data support this interpretation. (All 16 magnetopolarity sites on unit have reversed polarity.) In addition, where the two sheets can be distinguished, a 10-cm-thick soil zone commonly separates them. Field relations have also been made area lead to the interpretation that top flow sheet is present only in southwestern part of Springerville field (Show Low Creek and Blue Ridge Mountain areas); hence, only older (pre-Olduvai) age of unit is shown for correlations purposes on all parts of the figure except that for the Show Low Creek area (part **Q**).



A. Antelope Mountain area

B. Blue Ridge Mountain area

LITHOLOGIC, AGE-GROUP, MAGNETOPOLARITY, AND GEOCHEMICAL MAPS OF THE SPRINGERVILLE VOLCANIC FIELD, EAST-CENTRAL ARIZONA

By
Christopher D. Condit, Larry S. Crumpler, and Jayne C. Aubele

1999