Ash-flow tuffs of northeast Mogollon-Datil volcanic field

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Geographic names

U.S. Board on Geographic Names

Barela Mesa—mesa, 8 km (5 mi) long, highest elevation 2,658 m (8,720 ft.); bound by Burro Mesa to the north, Horseshoe Mesa and Little Mesa to the east, and Horse Mesa and Little Fishers Peak Mesa to the west; 16.9 km (10.5 mi) northeast of Raton, New Mexico; named for Senator Casimiro Barela, a prominent Spanish-American resident of Trinidad, Colorado, in the 1890's; Colfax County, New Mexico and Las Animas County, Colorado; T. 35 S., R. 62 W., Sixth Principal Meridian and T. 32 N., R. 61 W., NMPM; 36°59′59″ N., 104°18′48″ W.; *not:* Barilla Mesa, Raton Mesa.

Bear Wallow Ridge—ridge, 4.8 km (3 mi) long, in Sangre de Cristo Mountains, highest elevation 2,965 m (9,727 ft), 7.2 km (4.5 mi) southeast of Ranchos de Taos; Taos County, New Mexico; 36°19′15″ N., 105°32′40″ W. (northwest end), 36°17′05″ N., 105°30′35″ W. (southeast end).

Beclabito—populated place, on the north side of Beclabito Wash 31 km (19 mi) northwest of Shiprock; a Navajo Indian name reportedly meaning "water underneath"; San Juan County, New Mexico; T. 30 N., R. 21 W., NMPM; 36°50′30″ N., 109°01′10″ W.; 1937 decision revised; *not:* Beclabato, Beklabito, Biclabito, Biltabito (BGN 1915), Bitlabito (BGN 1937).

Beclabito Spring—spring, in Beclabito 31 km (19 mi) northwest of Shiprock; a Navajo Indian name reportedly meaning "water underneath"; San Juan County, New Mexico; T. 30 N., R. 21 W., NMPM; 36°50′28″ N., 109°01′05″ W.; 1937 deci-

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Ash-flow tuffs of northeast Mogollon–Datil volcanic field

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Volcanoes and lava flows are a common sight throughout New Mexico. Most of the youngest rock types are basaltic lava flows and associated cinder cones, volcanic rocks that are relatively poor in SiO_2 (45–55%). Young, high-silica rocks (rhyolites) are scarce in New Mexico except in the Jemez Mountains, northwest of Santa Fe. However, within the older Mogollon–Datil volcanic field (Oligocene and early Miocene) that covers most of southwest New Mexico, rhyolitic rocks make up an appreciable percentage of volcanic materials. These rhyolites occur both as lava flows and domes and as pyroclastic deposits. Pyroclastic rocks dominate volumetrically and are also the most important for stratigraphic purposes. Ash-flow tuffs or ignimbrites (a New Zealand term for ash-flow tuffs) are by far the most voluminous and important pyroclastic rocks. Ignimbrites are the clastic deposits left behind by hot gas-and-particle slurries of volcanic origin. These move as ground-hugging, gravity-controlled pyroclastic flows (nuées ardentes) that are often very fluidal and travel long distances (many tens of km) from their source. Pyroclastic flows conserve heat very well, and their deposits are commonly so hot (>500–600°C) that the soft glassy particles weld together to form dense, solid rocks. These rock units are usually recognizable even after structural disruption and provide superb marker horizons (time lines) for reconstructing events within volcanic fields.

If ignimbrites are to be used as marker horizons, it is imperative that individual genetic units are separated and that ignimbrites are distinguished from rhyolite lavas with similar characteristics. Textural and mineralogical characteristics that are useful in distinguishing one ignimbrite from another are: color; proportions of ash, pumice, rock fragments, and phenocrysts; and the degree of welding and induration of the unit. Many of these textural characteristics vary laterally and vertically within the same unit and must be applied with caution. In the Socorro–Magdalena area, the amount and relative percentages of the various phenocrysts have proven to be the single most important correlation tool. Ignimbrites are often petrographically and chemically zoned in vertical sections; however, at least in this area, lateral zonation has not been observed in the many tens of kilometers of exposure. The same general sequence of units and zoning within units is observed from the Joyita Hills to Datil, a distance of approximately 100 km. For detailed descriptions of these units, the reader is referred to New Mexico Bureau of Mines and Mineral Resources Stratigraphic Chart 1 (Osburn and Chapin, 1983a) and to a summary article by the same authors (Osburn and Chapin, 1983b).

Because ignimbrites were originally fragmental, they usually can be distinguished from similar lava flows by the presence of pumice, lithic fragments, and broken crystal fragments in hand samples, and by the presence of glass shards (if preserved) in thin sections. Many papers in the geologic literature have treated these features in more detail; two of the best, *Ash-flow tuffs—their origin, geologic relations, and identifications* (Ross and Smith, 1961) and *Zones and zonal variations in welded ash-flow tuffs* (Smith, 1960) have been recently reprinted as New Mexico Geological Society Special Publication 9.

Figures 1–8 below are representative photomicrographs of each of the eight major regional ignimbrites found in the Socorro–Magdalena area. These photomicrographs are presented in ascending stratigraphic order (oldest to youngest). They were photographed at the same scale (for ease in comparing textures and phenocryst percentages) and with crossed polarizers rotated a few degrees from orthogonal to reduce contrast for photography. These side-by-side comparisons illustrate that, although many of these units are grossly similar and can be confused on cursory examination, differences do exist. All of these units have been defined in areas where thick sequences expose several units in unambiguous stratigraphic successions. The best areas for the units below Hells Mesa Tuff are in the western Gallinas Mountains and Datil Mountains (Harrison, 1980; Coffin, 1981; and Lopez and Bornhorst, 1979). Excellent exposures of the younger units are found in the Joyita Hills (Spradlin, 1976).

A variety of petrographic, vitroclastic, devitrification, and vapor-phase alteration textures are visible in these photomicrographs; these textures are discussed where pertinent. Obviously, many of the units can be easily distinguished from each other; however, some units are very similar and great care must be taken in identification. Rock House Canyon Tuff, La Jencia Tuff, and Vicks Peak Tuff (phenocryst-poor units) have mineralogies similar enough to be confusing; upper Lemitar Tuff and Hells Mesa Tuff (phenocryst-rich units) are nearly indistinguishable. Identification is especially difficult when dealing with isolated outcrops or less welded, distal deposits. A sequence containing several units is the best tool where identification is uncertain.

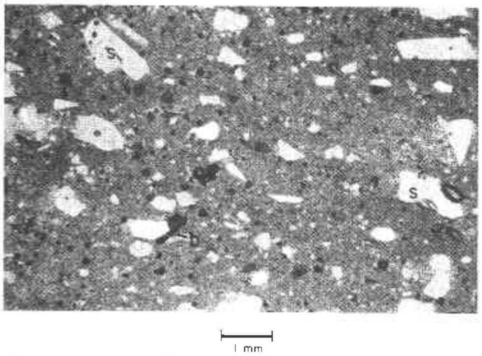
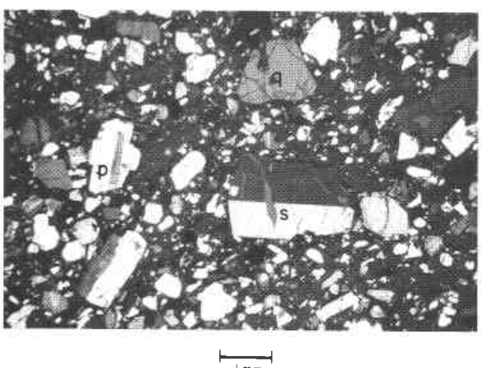


FIGURE 1—Datil Well Tuff (sample NJ–1–2, Jornada del Muerto) is a moderately phenocryst rich unit containing abundant feldspar (10–15%) and minor biotite (**b**) and opaque oxides. The mineralogy is distinctive in thin section because all of the feldspar is sanidine (**s**) (largely untwinned). This unit contains appreciable pumice and therefore is readily recognizable as an ignimbrite; however, normally, as in this section, the groundmass is devitrified into a finely crystalline mosaic showing little, if any, vitroclastic texture. The small dark circles are bubbles in thin-section epoxy.



FIGURES 4a, b—Hells Mesa Tuff (4a, sample IL–19–A; 4b, sample 80–1–3; both from Joyita Hills) is a very phenocryst rich, petrographically (and chemically) zoned ash-flow sheet.

Figure 4a depicts the lower zone of the tuff that contains subequal plagioclase (**p**) and sanidine (**s**), abundant biotite and minor quartz (**q**), opaque oxides, and hornblende. In this specimen, a glassy vitrophyre, well-preserved shards may be seen in the small dark-gray areas between phenocrysts.

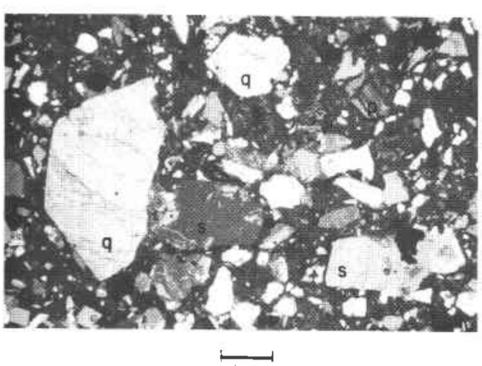


Figure 4b illustrates a higher zone of Hells Mesa Tuff. This interval is even more phenocryst rich and contains proportionally more quartz (**q**) and sanidine (**s**), less plagioclase (**p**) and biotite, and only traces of hornblende. The groundmass of this unit is strongly devitrified and shows only cloudy ghosts of shards. Pumice is often sparse in the Hells Mesa Tuff, and formerly it was commonly mistaken for a rhyolite lava or sill.

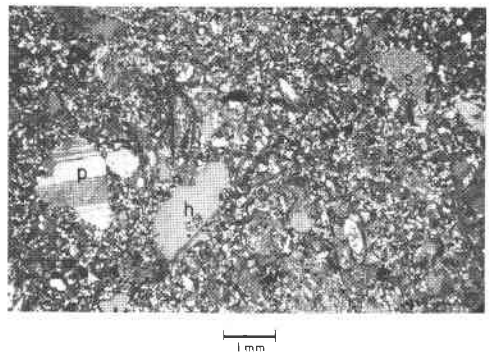


FIGURE 2—Rock House Canyon Tuff (sample NJ–1–3, Jornada del Muerto) is a phenocryst-poor tuff containing a few percent sanidine (**s**) and lesser plagioclase (**p**) with minor biotite, opaque oxides, and quartz. The unit usually contains abundant pumice, and in this specimen the groundmass exhibits a well-preserved vitroclastic texture even though it is partially devitrified. Lack of distortion in the glass shards (small dark-gray curved shapes) indicates an unwelded to poorly welded zone. (Shards are remnants of glass bubbles formed during vesiculation as pressure was released during eruption.) Well-preserved shard textures are commonly, but not universally, present in Rock House Canyon Tuff. This unit can be distinguished microscopically from the similar La Jencia and Vicks Peak Tuffs by the presence of more abundant plagioclase or by stratigraphic position. The large light-gray patch (**h**) in left center is a hole in the thin section.

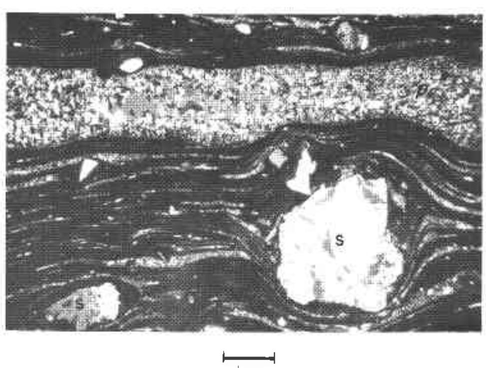


FIGURE 5—La Jencia Tuff (sample 3–1–790, southeast Magdalena Mountains) is a phenocryst-poor ignimbrite containing a few percent sanidine (**s**), minor quartz (none visible), traces of biotite, and at the upper stratigraphic levels, green clinopyroxene. This sample shows the characteristic extremely flattened pumice, which, in three dimensions, is both flattened and elongated. The elongation, within the plane of flattening, is thought to be caused by flowage of the unusually hot pumice during deposition (Chapin and Lowell, 1979). The groundmass of this sample is glassy to cryptocrystalline, and the pumice (***p***) is extensively recrystallized to quartz and potassium feldspar, probably by vapor-phase alteration during welding and cooling of the unit. La Jencia Tuff contains little pumice and fewer phenocrysts in the lower parts of the unit. Pseudobrookite(?) and other uncommon vapor-phase minerals are present sometimes in pumice and lithophysae (gas bubbles).

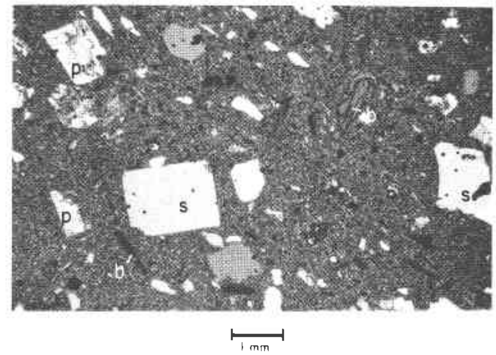
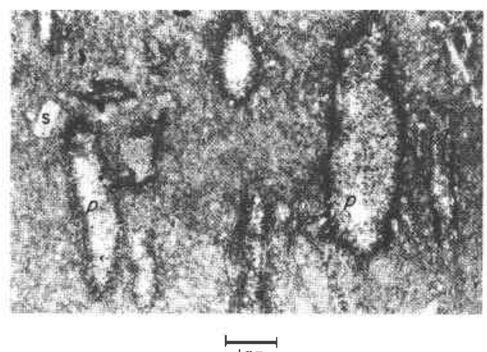


FIGURE 3—Blue Canyon Tuff (sample LJ–H, Datil Mountains) is moderately phenocryst rich and largely similar to the Datil Well Tuff. Petrographically, Blue Canyon Tuff contains plagioclase (**p**) as well as sanidine (**s**) and abundant (approximately 3%) biotite (**b**). In addition, the phenocrysts are larger and blockier in hand sample. Devitrified groundmass gives a hint of the vitroclastic nature of the unit.



FIGURES 6a, b—Vicks Peak Tuff (samples M–24–83, Bear Mountains; and Talp–213, Gallinas Mountains) is quite similar to La Jencia Tuff because it is phenocryst poor and contains a few percent sanidine (**s**), minor quartz, and traces of plagioclase. Vicks Peak Tuff contains less biotite, no known pyroxene, and is characteristically zoned from a very phenocryst poor base to a slightly less phenocryst-poor upper part.

Figure 6a, from the lower parts of the unit, illustrates the very phenocryst poor nature of this interval. Pumice (***p***) is usually present but probably accentuated in this example by the mild propylitic alteration that has affected this outcrop. The groundmass is totally recrystallized and little, if any, vitroclastic texture remains.

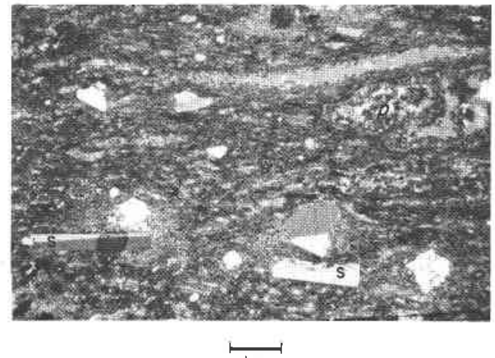
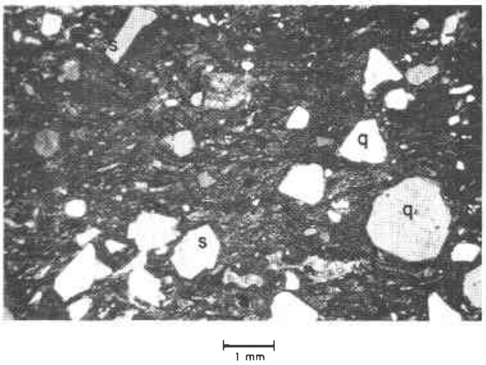


Figure 6b illustrates the upper intervals of Vicks Peak Tuff that contain more phenocrysts (same phases) and abundant large pumice (***p***). Vitroclastic texture is moderately well preserved in the groundmass of this specimen, but the pumice is characteristically recrystallized and, in some cases (top center), it is hollow in the center. ☞



FIGURES 7a, b, c—Lemitar Tuff (samples TS–5, TS–23, DB–10B, all from south and southeast Magdalena Mountains) is a strongly and complexly zoned unit. The Lemitar Tuff is a moderately crystal rich rhyolite at the base (7a) that grades normally upward into a quartz-poor quartz latite (7b), which in turn grades upward into a very phenocryst rich rhyolite (7c).

Figure 7a, from the lower rhyolite interval, contains approximately 12–15 percent phenocrysts consisting of sanidine (**s**), quartz (**q**), minor plagioclase, biotite and opaques, and traces of zircon and sphene. The groundmass in this sample is partly glassy and contains well-preserved shard structures. This lower interval grades upward over a few ft into a phenocryst-rich quartz latite (Fig. 7b).

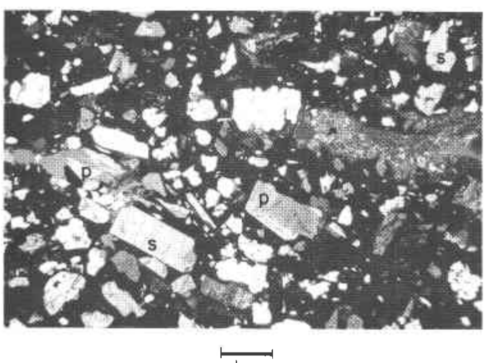


Figure 7b contains abundant sanidine (**s**), plagioclase (**p**), biotite and minor quartz, opaques and pyroxene. This middle zone grades upward over several tens of hundreds of ft into a very phenocryst rich rhyolite (Fig. 7c).

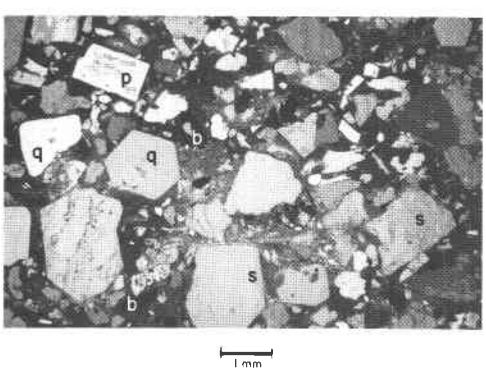
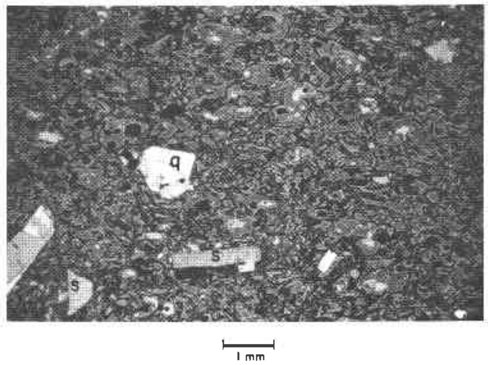


Figure 7c contains abundant quartz (**q**), sanidine (**s**), plagioclase (**p**), and biotite (**b**). Very little groundmass is visible between the phenocrysts in figures 7b and 7c, but large pumice fragments in outcrop attest to the pyroclastic origin.



FIGURES 8a, b—South Canyon Tuff (samples JA–SC–1, Joyita Hills; 8–11–8, southeast Magdalena Mountains) is texturally zoned from phenocryst poor below to moderately phenocryst rich above; mineralogies are similar in both zones.

Figure 8a illustrates a glassy vitrophyre from the base of the lower zone. Small gray, irregularly curved shapes are undeformed glass shards. Note slight compaction around phenocrysts. Subequal amounts of sanidine (**s**) and quartz (**q**) make up the phenocrysts.

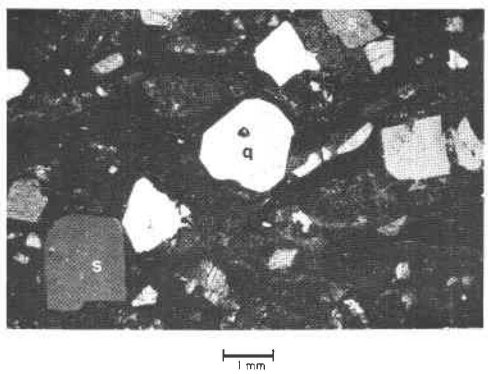


Figure 8b, from the upper interval of this unit, contains more abundant and larger phenocrysts of sanidine (**s**) and quartz (**q**) with minor biotite, but little preserved vitroclastic texture.

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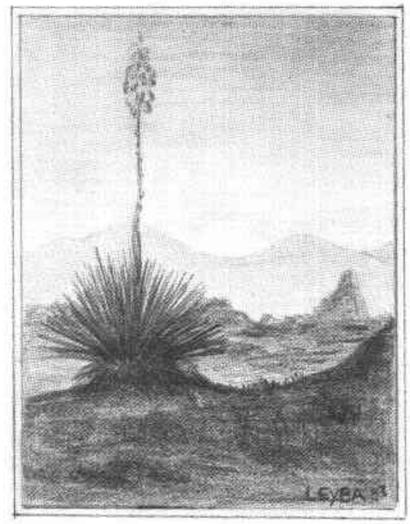

Sunset Ridge fluorite deposit

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