Winston Field Trip Handout February 19, 2021

Virginia T. McLemore

STOP 1: Monticello diatomite deposit (exit 89)

A diatomatite deposit is found near Monticello Point in Cañada Alamosa, where the canyon enters the Rio Grande (Fig. 1; New Mexico Mines Database Id. No. NMSI1743, latitude 33.309053°, longitude 107.212049°). Diatoms (class *Bacillariophyta*) are a type of silica-based algae and are unicellar organisms, colonies, or filaments found in marine, freshwater, and brackish streams, lakes, and oceans. When diatoms die, their siliceous skeletons sink to the bottom of the lake or sea and form a chalky, siliceous mud that becomes diatomite or diatomaceous earth, a soft, fine-grained sedimentary deposit. Commercial diatomite deposits in the United States are found in marine sedimentary rocks that accumulated near the continental margins, lacustrine lakes or marshes, and modern lakes, marshes, and bogs. The unique physical properties of diatomite are derived from the size, shape, and structure of individual diatom skeletons and the packing characteristics of the skeletons. Diatoms range in diameter from 10 μm to more than 500 μm and generally have a spiny structure with intricately pitted surfaces. Diatoms are very porous, light weight, chemically inert, do not conduct heat, do not burn, are abrasive, have low density, and are composed of silica. Thus, diatomite or diatomaceous earth is used as a 1) filter to make syrups, drinks (including alcoholic beverages), medicines, solvents and chemicals, 2) additive in cement and other compounds 3) absorbent for industrial spills and pet litter, 4) filler in paint, paper, ceramics and detergents, 5) high-temperature insulation (fire doors, sound insulation), 6) whitener in paint, 7) mild abrasive, 8) measuring optical image quality, and 9) various pharmaceutical and biomedical uses. Very pure diatomite is used 1) in animal feed, 2) for use as a wormer in livestock, 3) for protecting grain and seeds from insects, and 4) as insecticides. Diatomite was once used in manufacturing dynamite. The Monticello Point diatomite formed within the Monticello Point maar, a volcanic crater created by a phreatomagmatic eruption formed when rising basaltic magma contacted groundwater. A basalt flow at the nearby Mitchell Point was dated as 2.9±0.3 Ma; a similar age is likely for the Monticello Point maar. Formation of the Monticello Point diatomite deposit can be summarized as (Lucas and Kietzke, 1994):

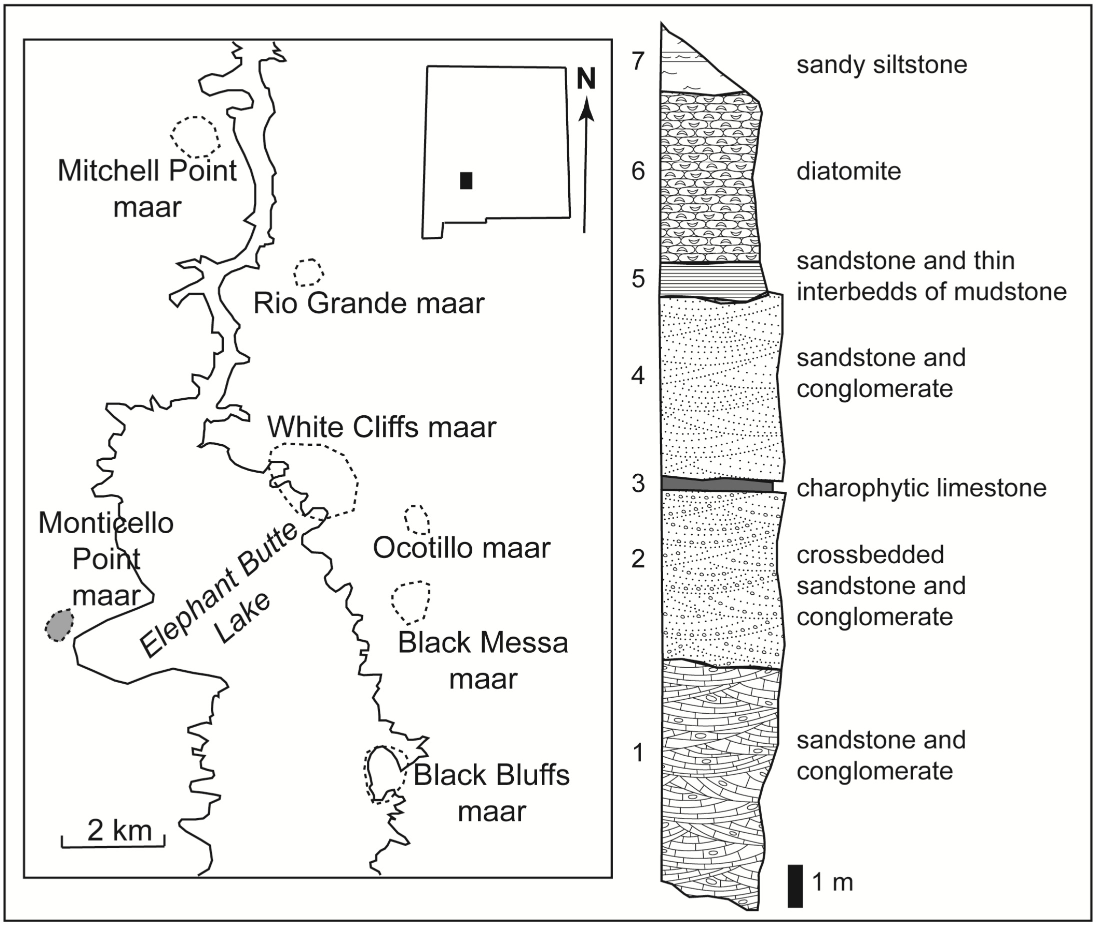
1) Explosive formation of the maar basin by rising magma contacting groundwater
2) Erosion of the maar forming a stable sedimentary basin
3) Formation of the saline, diatom-rich lake
4) Evaporation of the lake and burial of the diatomite by younger sedimentary rocks.

Aubele, J.C., Crumpler, I.S., Loeber, K.N., and Kudo, A.M., 1976, Maare and tuff rings in New Mexico: New Mexico Geological Society, Special Publication 6, p. 109-114.

Bachman, G.O. and Mehnert, H.H., 1978, New K-Ar dates and the late Pliocene to Holocene geomorphic history of the central Rio Grande region, New Mexico: Geological Society of America, Bulletin, v. 89, p. 283-292.

Lucas, S.G. and Kietzke, K.K., 1994, Pliocene microfossils from the Monticello Point maar, Sierra County, New Mexico: New Mexico Geology, v. 16, no. 3, p. 41-48.

McLemore, V.T., Solomon K. A. Owusu, S.K.A., and Morris, R., 2012, Monticello Point diatomite deposit, Sierra County, New Mexico: New Mexico Geological Society, Guidebook 63, p. 72-73.



Location and measured stratigraphic column of the Monticello Point diatomite deposit, Sierra County (from Lucas and Kietzke, 1994). Location of maars in the vicinity from Warren (1978).

STOP 2: St. Cloud zeolite mine, south of Winston HOST: Joseph McEnaney, President

A zeolite is a crystalline hydrated aluminosilicate whose framework structure encloses cavities (or pores) occupied by cations and water molecules, both of which have considerable freedom of movement, permitting ion exchange and reversible dehydration. This definition places it in the class of materials known as "molecular sieves." The pores in dehydrated zeolite are 6 Å in size, while those of a typical silica gel average about 50 Å, and activated carbon averages 105 Å. Open cavities contain cations (Ca, K, Na, Ba). Cations balance negative charge of framework. Ions are easily exchanged, move freely through framework. Remain stable after losing water from structure. All commercially useful zeolites owe their value to one or more of three properties: adsorption, ion exchange, and catalysis. Selectively adsorb ammonia, hydrogen sulfide, carbon monoxide, carbon dioxide, sulfur dioxide, water vapor, oxygen, nitrogen, formaldehyde, and others. Public toilets, horse stables, chicken houses, and feed lots, pet litter trays release ammonia fumes. Adding zeolites can minimize odors. Tertiary volcanic rocks near Winston in Sierra County comprise the Winston clinoptilolite deposit; ash–flow tuffs and related tuffaceous breccias; predominantly clinoptilolite–heulandite. St. Cloud Mining Company currently mines, processes, and markets Winston deposit zeolites.

Source=http://www.stcloudmining.com

White, J.L., Chavez, Jr., W.X., and Barker, J.M., 1996, Economic geology of the St. Cloud Company (Cuchillo Negro) clinoptilolite deposit, Sierra, County, New Mexico; *in* Austin, G.S., Hoffman, G.K., Barker, J.M., Zidek, J., and Gilson, N., eds., Proceedings of the 31st Forum on the Geology of Industrial Minerals—The Borderland Forum: New Mexico Bureau of Mines and Mineral Resources, Bulletin 154, p. 113-120.

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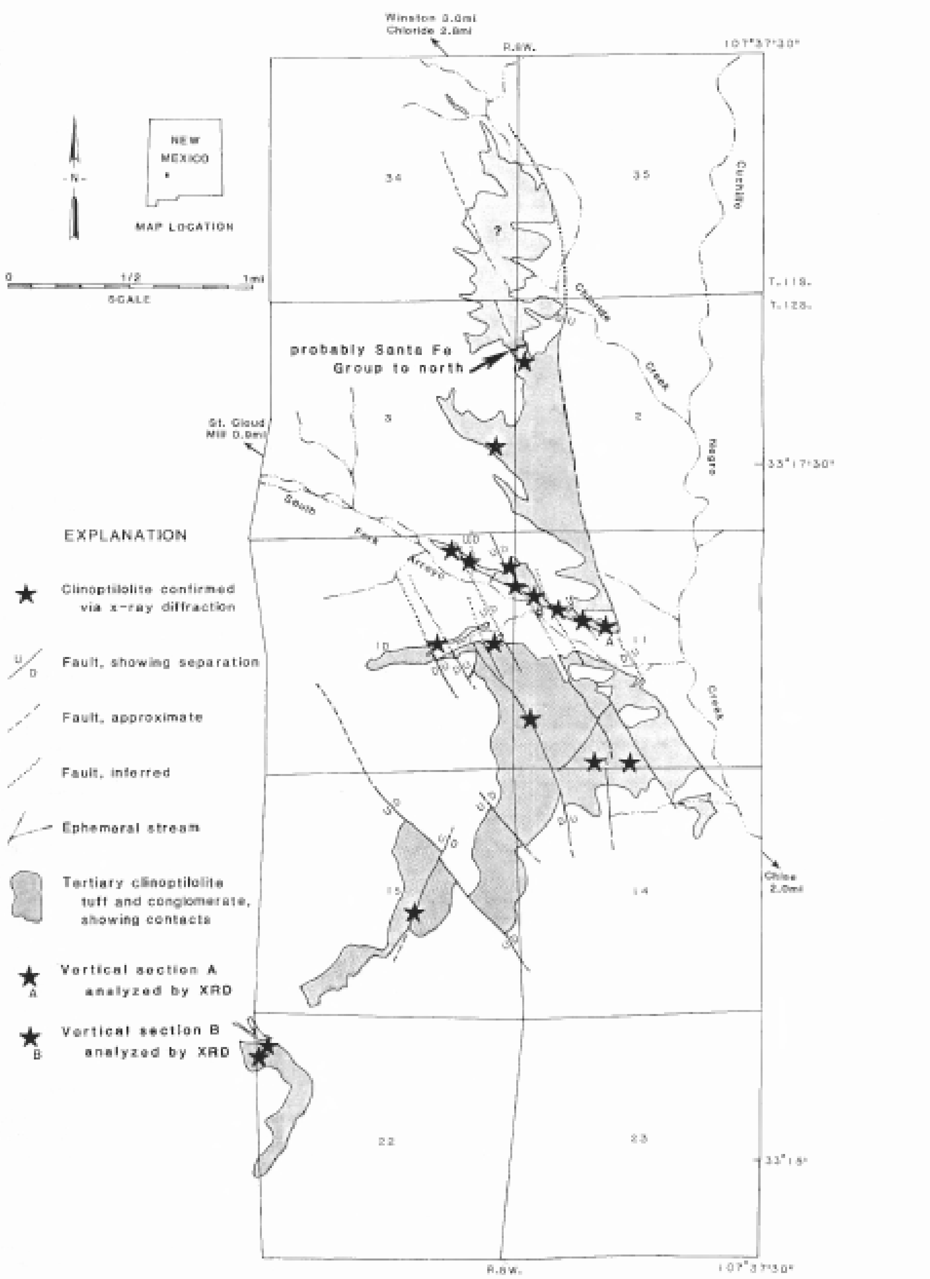
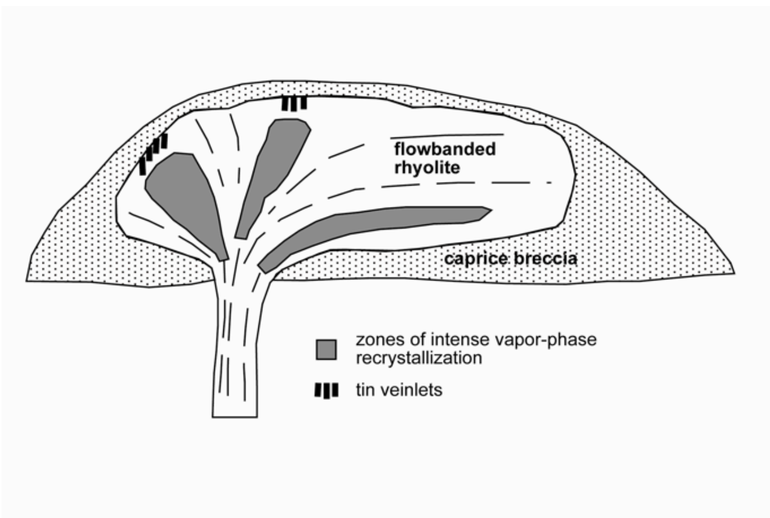


FIGURE 1—Outcrop pattern (shaded) of tuff of Little Mineral Creek in southern end of Winston Graben. Starred sample localities contain clinoptilolite confirmed by XRD. Two vertical sections (A, B) of tuff were analyzed by XRD to investigate vertical trends in mineralogy (modified from Maxwell & Heyl 1976 and Bowie et al. in press).

STOP 3: Kline Mountain kaolinite deposit, Taylor Creek district
Large deposits consisting of a mixture of highly crystalline kaolinite and cristobalite occur in hydrothermally altered tuffs and other volcanic rocks along the continental divide about 14 mi west of Winston, Sierra County (Kline, NMSI0881). Portions of this deposit consist of rather uniform light colored clay, but much of it contains appreciable vein quartz or other forms of silica and only partially altered volcanic rock. A few short tons of clay from this deposit were used experimentally in making ceramic tile, and were explored in some detail, including evaluations for use as paper coater. However, the presence of considerable amounts of cristobalite and tridymite make these deposits unsuitable for this use at this time (Isik et al., 1994).

Isik, I., Clark, K.F., and Austin, G.S., 1994, Geology and alteration of the Kline Mountain Kaolin deposit, Sierra County, New Mexico: New Mexico Geological Society, Guidebook 45, p. 311-314.



Schematic cross section of flow-banded Taylor Creek dome and associated rhyolite-hosted tin deposits (modified from Eggleston and Norman, 1986).

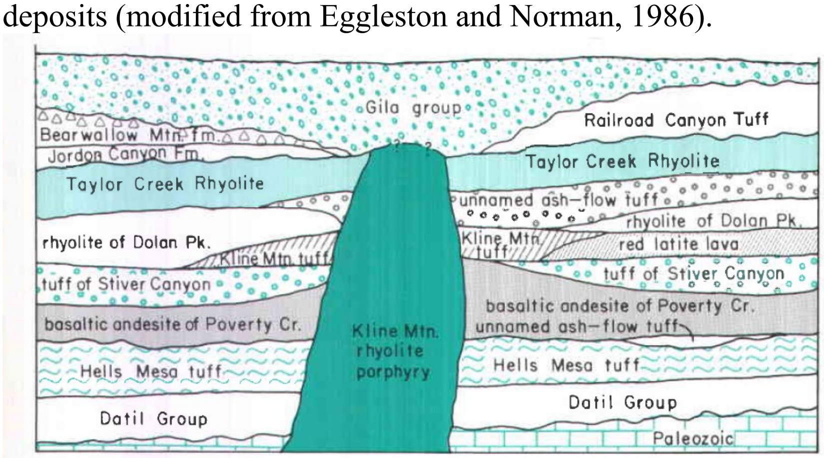


FIGURE 2—SCHEMATIC STRATIGRAPHIC SECTION SHOWING STRATIGRAPHY AND GEOLOGIC RELATIONSHIPS IN TAYLOR CREEK REGION.

Eggleston and Norman, 1983,
https://geoinfo.nmt.edu/publications/periodicals/nmg/5/n1/nmg_v5_n1_p1.pdf

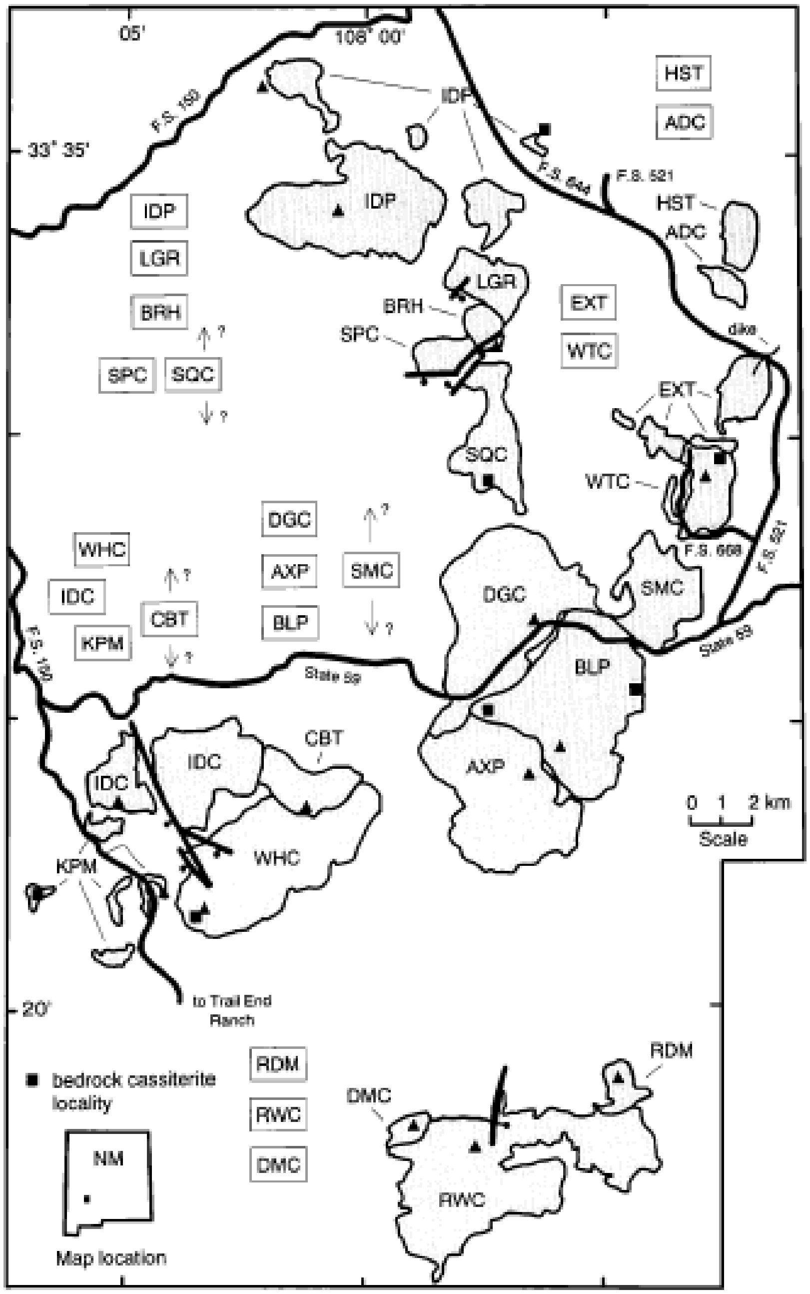


FIG. 1. Geologic map of the Taylor Creek Rhyolite lava domes and flows, after Duffield et al. (1987). Each map unit (e.g., RWC) represents an eruptive unit. Solid triangles indicate sample localities; triangle just outside unit IDP marks sample locality for pumice of initial pyroclastic phase that was followed by emplacement of IDP lava dome. Filled squares represent bedrock cassiterite localities. Bold curves labeled with route numbers are local roads. Relative ages of overlapping units shown by stratigraphic boxes; relative ages of nonoverlapping units unknown. F.S. = unpaved forest service road.

Webster and Duffield, 1994

STOP 4: Taylor Creek tin deposits

Rhyolite-hosted tin deposits consist of discontinuous veins and veinlets in rhyolite domes and volcanic centers. Tin mineralization forms from the vapor phase portion of the rhyolite magma and crystallizes within the fractured and brecciated outer parts of flow-dome complexes and are hosted by high-silica (>75% SiO_2), peraluminous rhyolites and/or pyroclastic deposits. Hematitic and argillic alteration is commonly associated with the tin deposits. Four types of tin deposits are found in and around the altered rhyolite domes and tuffs in the Taylor Creek district, Sierra and Catron Counties, including

1) miarolitic cavities within rhyolite
2) thin veins and veinlets cutting rhyolite
3) disseminations in rhyolite
4) placer deposits in streams and alluvial deposits adjacent to rhyolite domes and flows.

The deposits are typically small in size, comprising less than several hundred thousand short tons, and low grade (<2% Sn) (Cox and Singer, 1986). Cassiterite is the predominant ore mineral. The age of the Taylor Creek Rhyolite is about 28 Ma.