GEOLOGIC MAP OF SADDLE MOUNTAIN, MARICOPA COUNTY, ARIZONA

by

Michael H. Ort[1] and Steve Skotnicki

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Northern Arizona University Department of Geology
P. O. Box 4099 Flagstaff, AZ 86011

Arizona Geological Survey
416 W. Congress, Suite #100, Tucson, Arizona 85701

Includes map, scale 1:24,000, and 11 page text.

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INTRODUCTION

The area described in this study includes Saddle Mountain and surrounding bedrock outcrops, and is within Maricopa County near the town of Tonopah. The study area encompasses all of the U.S. Geological Survey Saddle Mountain quadrangle (1:24,000 scale) and the southernmost part of the Burnt Mountain quadrangle (1:24,000 scale; Fig. 1). Sources of map data are shown in figure 2, rock-unit correlations and relative ages are depicted in figure 3, and map symbols are given in Table 1. Bedrock in this area consists of low hills composed of Proterozoic metamorphic rocks and a steep-sided mountain and scattered hills of mid-Tertiary mafic to intermediate volcanic rocks (Plate 1; Fig. 4). Access to the area is gained by unimproved roads from the Salome Highway and Courthouse Road on the north side of Saddle Mountain.

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PREVIOUS INVESTIGATIONS

Previous geologic studies of the area are limited to reconnaissance studies incorporated into State geologic maps by Wilson and others (1969) and Reynolds (1988). Recent mapping of adjacent areas include studies by Capps and others (1985) and Gray and others (1987) of the Big Horn Mountains to the north, by Scott (1991) and Gilbert and Skotnicki (1993) of the central Gila Bend Mountains to the south, and by Lane (1986), Miller and others (1989), Gilbert and others (1992), and Spencer and others (1992) of the western Gila Bend Mountains and eastern Eagletail Mountains to the west. Quaternary deposits have been mapped at 1:100,000 scale by Demsey (1990).

GEOLOGIC SETTING

The study area is within the Basin and Range physiographic and tectonic province which, in west-central Arizona, underwent moderate to severe Tertiary extension and magmatism (Spencer and Reynolds, 1989). The study area is regionally within an area of northwest-trending normal faults and fault blocks.

In western Arizona pre-Tertiary rocks consist of granitoid and greenschist- to amphibolite-grade crystalline rocks of probable Proterozoic age, and sparse, greenschist- to amphibolite(?)-grade metamorphosed Paleozoic and Mesozoic sedimentary and volcanic rocks. Voluminous magmatism and normal faulting occurred in the early Miocene and were followed by middle Miocene basaltic magmatism (Spencer and Reynolds, 1989).

The Saddle Mountain area is dominated by mid-Tertiary volcanic rocks and underlying Proterozoic crystalline rocks. There are few faults within the study area, and none appear to have experienced significant slip.

VOLCANIC HISTORY

Basaltic or basaltic andesite lava flows and cinders were the first Cenozoic erupted products in the Saddle Mountain area (Fig. 4). In some localities, the cinders are very abundant, with few flows, and probably represent vents (cinder cones). The study area was a basaltic field, and the flows probably had local sources and did not flow in from distant vents. Ash-flow and fallout tuffs of intermediate composition are present within the basaltic sequence, especially in the top few hundred meters. The fallout tuffs are dominantly pumice fall and crystal fall, with minor fine ash beds. These tuffs commonly change character over distances of 100's of meters, either in grain size or changing from ash flow to fallout deposits or vice versa. This suggests that they are pyroclastic deposits of local small- to moderate-sized eruptions.

Lava flows of the same composition as the tuffs (biotite-hornblende andesite and/or dacite) are also present within the basalt sequence (Fig. 4). These lavas represent the proximal deposits of the same eruptions that produced the tuffs. Biotite-hornblende andesite lavas and tuffs are progressively more abundant upsection. Vents are present in several localities where lava domes are surrounded by monolithologic breccias. Hornblende-pyroxene andesite lavas are the youngest rocks at Saddle Mountain. They cover the basalt and biotite-hornblende andesite sequence with a mixture of lava flows and breccias. The major vent for the hornblende-pyroxene andesite appears to have been just west of the Saddle Mountain summit, with Saddle Mountain itself consisting of the lava flows and associated breccias.

One remarkable aspect of the Saddle Mountain rocks is the great thicknesses of monolithologic breccias (Plate 1; Fig. 4). These breccias are associated with lavas of the same composition that occur as lobate flows within and surrounded by the breccias. The breccias were probably produced by complex interactions of flows and flow breccias. The clast-supported breccias are generally weakly bedded, and probably represent flow breccias. The matrix-supported breccias contain both vitrophyric and moderately vesicular blocks and are interpreted as, at least in part, block-and-ash flow deposits. Auto-brecciation and small avalanches from the moving lava flow may also have produced these deposits. Their great thickness, however, needs explanation. Evidence of a loss of stratification within the clast-supported breccia in one locality, near the saddle 1596' northwest of Saddle Mountain, suggests that at least some of the breccias were "bulldozed" and thickened by the lava flows. Bulldozing of flow breccias and block-and-ash flow deposits by the lava flows and subsequent intrusion into the breccias by the lava can explain the outcrop pattern. Similar features are described in a Quaternary lava flow by Huppert and others (1982).

STRUCTURE

Foliation in Proterozoic metamorphic rocks of the Saddle Mountain area strikes northerly and dips steeply to the west or east. Cenozoic volcanic rocks dip 10° to 25° to the west or southwest. Rare Tertiary faults have N-S or E-W trends. A conglomerate near the base of the volcanic section contains clasts of basalt and a granodiorite of probable mid-Tertiary age, implying the granodiorite was exhumed within a few million years of emplacement.

DESCRIPTION OF ROCK UNITS

Qs **Surficial deposits (Quaternary)**--Unconsolidated alluvium and colluvium, talus, sand and gravel in modern washes, and unconsolidated to poorly consolidated gravel, sandy gravel, and sand, locally with silt or boulders, that typically forms flat, locally incised surfaces up to 5 meters above modern drainages. Also includes moderately steep slopes mantled by boulders and underlain by weathered and disaggregated rock rubble.

Tpax **Matrix-supported monolithologic breccia derived from pyroxene-hornblende andesite (Tertiary)**--Massive, matrix-supported monolithologic breccia composed exclusively of clasts derived from pyroxene-hornblende andesite (map unit Tpa). Poorly sorted angular blocks are up to 60 cm in diameter and range from dense vitrophyre through devitrified to ~30% vesicular andesite. Matrix is ash and lapilli. Breccia beds reach 300 m in thickness and commonly form convolute lensoid shapes in outcrop. Rocks of this unit are intimately associated with andesite lava flows of map unit Tpa.

Tpac **Clast-supported monolithologic breccia derived from pyroxene-hornblende andesite (Tertiary)**--Blocks up to 40 cm diameter of vitrophyre and devitrified lava in a matrix of ash and lapilli. Rocks of this unit are associated with map units Tpa and Tpax.

Tpa **Pyroxene-hornblende andesite (Tertiary)**--Forms thick flows and domes, commonly intricately interfingered with map unit Tpax and, in the southwestern part of Saddle Mountain, with map unit Tpac. Flows are generally dense, and most are devitrified, although several glassy, nearly vitrophyric flows are present. Some rocks are flow banded. Contains 1-5% clinopyroxene, 0-1% orthopyroxene (at least some is xenocrystic), <1-3% hornblende (commonly with resorbed cores), 5-15% zoned plagioclase (commonly resorbed cores or rims), <1% opaques, <1% biotite, and accessory titanite. Matrix is composed of plagioclase microlites and glass.

Tbax **Matrix-supported monolithologic breccia derived from biotite-hornblende andesite (Tertiary)**--Poorly sorted, angular blocks up to 60 cm in diameter typically composed of dense and devitrified andesite, with minor vitrophyre blocks and <30% vesicular blocks. Matrix is ash and lapilli. Breccia beds reach 30-40 m in thickness and form lensoid shapes in outcrop. Rocks of this unit are intimately associated with lava flows of map unit Tba.

Tbac **Clast-supported monolithologic breccia derived from biotite-hornblende andesite (Tertiary)**--Commonly crudely bedded in beds up to 10 m thick. Clasts of vitrophyre and devitrified biotite hornblende andesite in a matrix of ash and lapilli. Rocks of this map unit are typically associated with map units Tba and Tbax.

Tbap **Porphyritic biotite-hornblende andesite (Tertiary)**--Crystal-rich, coarsely porphyritic biotite-hornblende andesite containing plagioclase crystals up to 7 mm diameter. Rocks of this unit are similar to map unit Tba except for coarse plagioclase.

Tba **Biotite-hornblende andesite (Tertiary)**--Forms thick flows and domes, commonly with flow breccia at base. Some flows are glassy and nearly vitrophyric, whereas most are devitrified. Flows are dense, generally with less than 5% vesicles. Flow banding and foliation are common. Lava is commonly found intricately interlayered with map units Tbax and Tbac. Rock contains 2-5% biotite, 1-5% hornblende, 7-10% plagioclase, <1% augite, and <1% opaque minerals. Matrix is composed of plagioclase microlites, tiny biotite crystals, and glass. Titanite and apatite are accessory minerals. In some samples, augite forms cores of hornblende crystals.

Tbm **Interbedded tuff, breccia, and basalt flows (Tertiary)**--Tuff consists of moderately well-sorted biotite-hornblende andesite fragments (some pumiceous) and crystals and occurs as laminated beds 1 to 10 cm thick. Tuff probably represents fallout or surge deposits. Breccia consists of basalt and biotite-hornblende andesite clasts, commonly as planar beds 1 to 10 m thick and locally crossbedded. Clasts are sub-angular, up to 7 cm diameter (average 2-3 cm). Matrix is basalt or biotite-hornblende andesite grains; in some cases exclusively one or the other. Matrix grains are sub-rounded. Interpreted as fluvial sedimentary rocks. Basalt is same as map unit Tb.

Tt **Bedded and massive tuffs (Tertiary)**--Bedded tuffs, interpreted as fallout, consist of clast-supported, moderately well-sorted ash and lapilli fragments that commonly form laminated to thin bedded layers up to 2 m thick. Clasts up to 3 cm diameter consist of pumiceous biotite-hornblende andesite. Ash is devitrified, hydrated, and chalky. Pumice clasts are also devitrified and chalky. Massive tuffs, interpreted as ash flows, consist of poorly sorted, non-welded ash and lapilli tuffs that form beds up to 10 m thick. Beds vary significantly in thickness over 500 m lateral distances. Angular pumice clasts of biotite-hornblende andesite are up to 10 cm in diameter. Angular basaltic fragments are common, but make up $<1\%$ of the rock, and fragments of Proterozoic metavolcanic rocks (map unit Xm) are rare. The matrix is devitrified ash, with 0.5-2 mm diameter crystals of biotite, plagioclase and hornblende. Bedded tuffs are interpreted as fallout, surge, and reworked tuffs, whereas massive tuffs are thought to be small-volume pyroclastic flow deposits.

Tb **Olivine-clinopyroxene basalt and clinopyroxene basaltic andesites (Tertiary)**--Basalt typically contains $<1\%$ olivine and clinopyroxene phenocrysts with seriate-porphyritic plagioclase microlites and glass in matrix. Basaltic andesite contains 7 to 30% plagioclase with resorbed cores, <1-2% clinopyroxene, 0-1% hornblende, and plagioclase-quartz, plagioclase-hornblende, and plagioclase-spinel-orthopyroxene-clinopyroxene-Fe-Ti-oxide clots up to 1 cm in diameter. Rocks of this unit commonly form interbedded lava flows and cinders. In some localities, cinders are very abundant, with few flows. Flows commonly have flow breccias at their bases and tops. Phenocrysts and glass are commonly altered, hydrated, and/or replaced with calcite.

Tgc **Matrix-supported conglomerate of granite and basalt fragments (Tertiary)**--Consists of sub-angular basalt clasts up to 10 cm diameter (2 cm average) and sub-rounded to rounded granite clasts up to 70 cm (20 cm average) in a basalt granule matrix.

Tg **Biotite-hornblende granodiorite (Tertiary?)**--Consists of 40% plagioclase, 30% quartz, 25% K-feldspar, 2-3% biotite and 2-3% hornblende (commonly altered to clinopyroxene). Exposed only in southeastern sector of map area where it forms low rounded outcrops. A possibly correlative granodiorite, the Columbus Wash Granodiorite in the Gila Bend Mountains, has been dated at 22.9 Ma (Gilbert and others, 1992).

Xb **Banded iron formation (Proterozoic X)**

Xm **Slaty metavolcanic rocks (Proterozoic X)**--Green, fine-grained metavolcanic rocks with slaty cleavage that contains K-feldspar and amphibole phenocrysts. Protolith was probably andesite. Map unit contains lenses of banded iron formation and quartz veins and crops out north of Salome Highway and as an isolated hill in the southeastern part of the map area.

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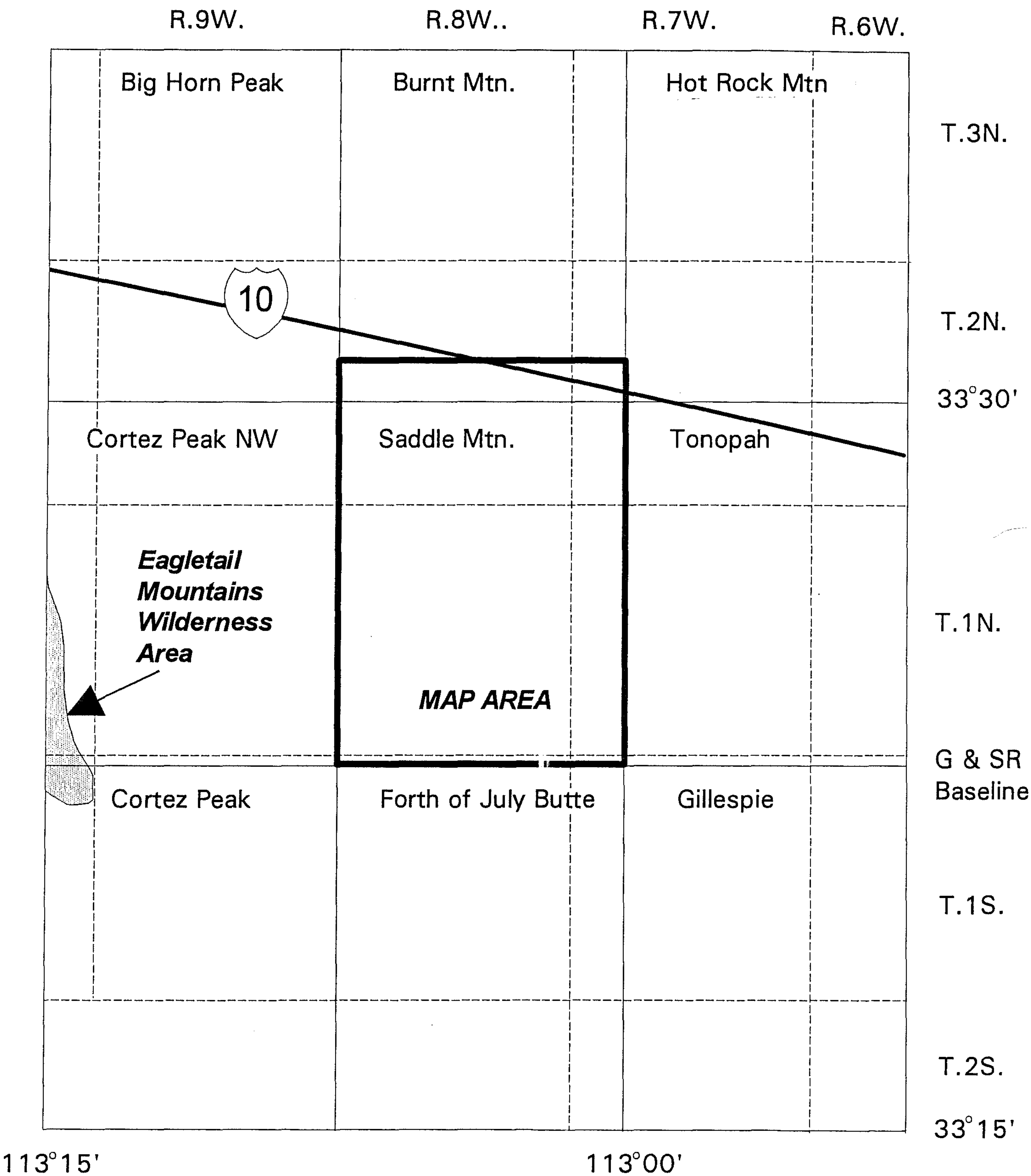


Fig. 1. Location of study area.

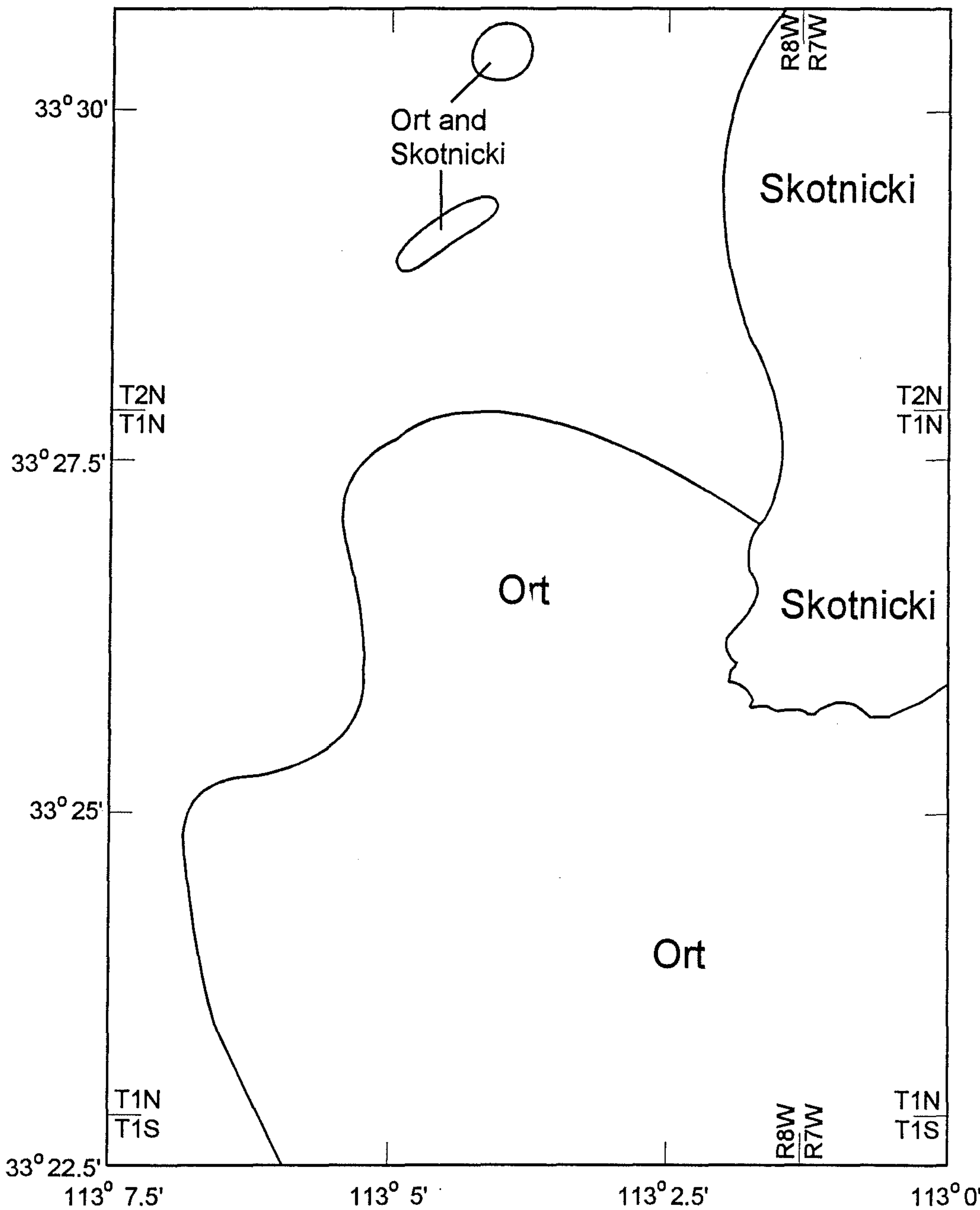


Fig. 2. Source of map data.

FILE: LOCMAP2.DRW

Figure 3. Correlation of Map Units

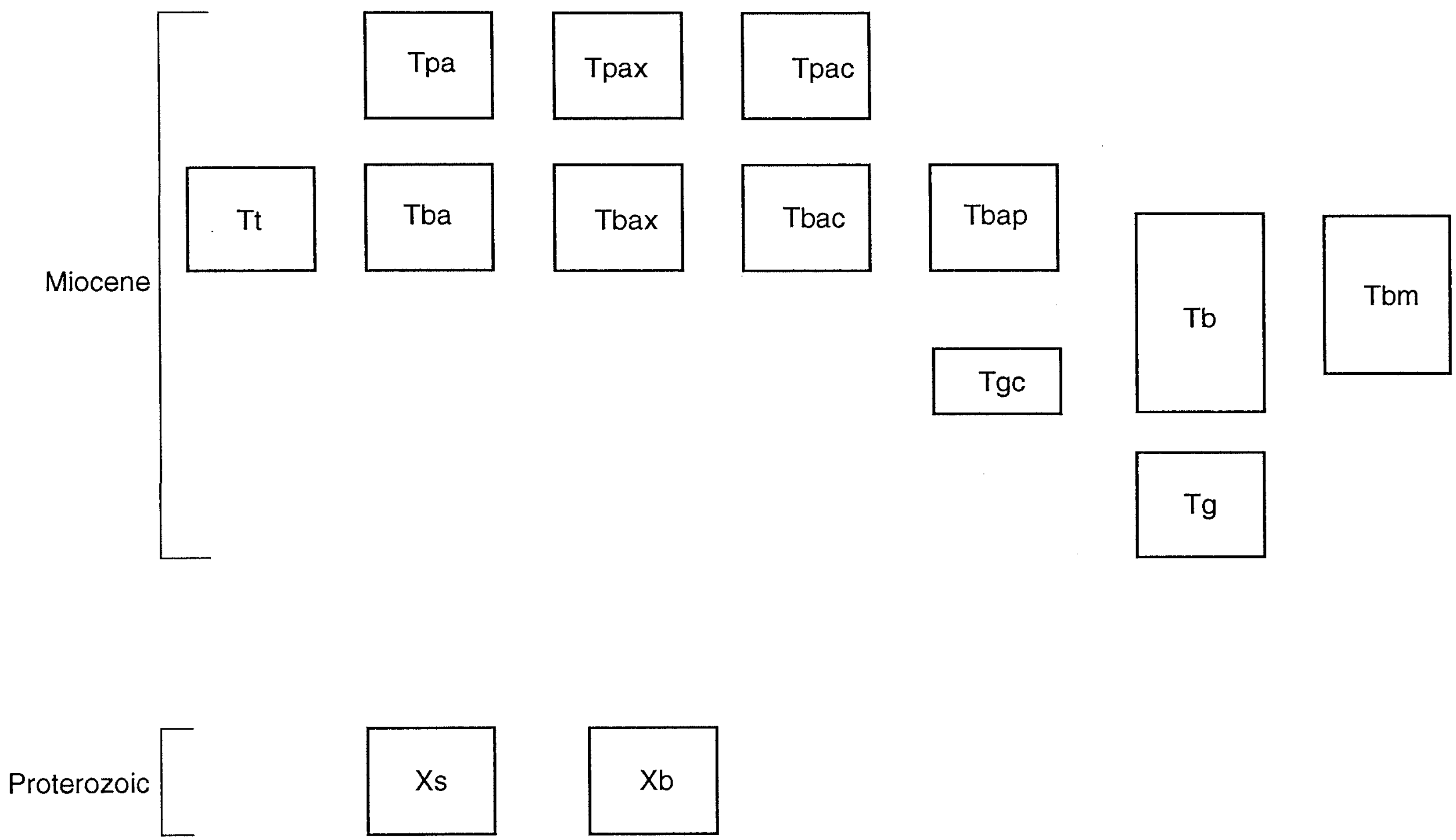


Figure 4. Cartoon diagram of generalized stratigraphy of Saddle Mountain

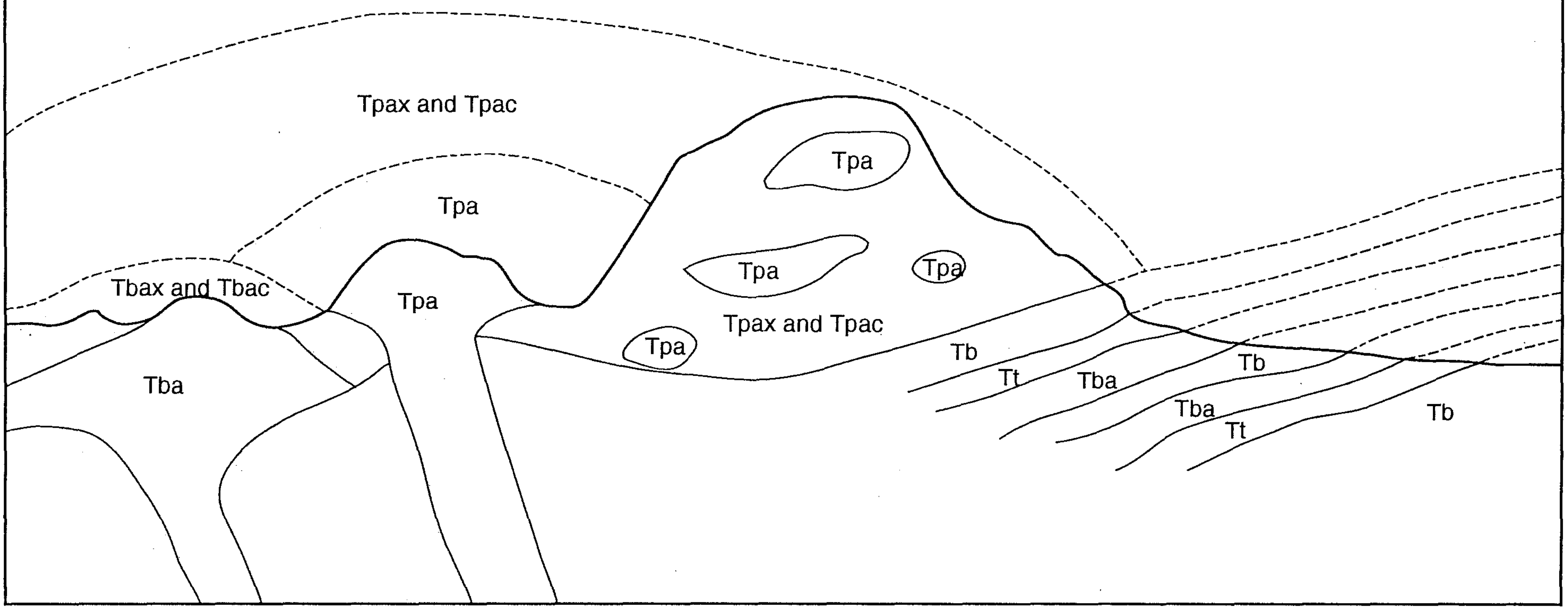
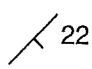
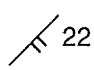
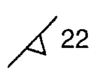
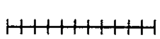


Table 1

Map Symbols

	Contact, dashed where approximate
	Fault, dashed where approximate
	Strike and dip of bedding
	Strike and dip of lava flow foliation
	Strike and dip of cleavage
	Strike and dip of vertical cleavage
	Mafic to intermediate dike