GEOLOGIC MAP OF THE LYNNDAL 30- BY 60-MINUTE QUADRANGLE, WEST-CENTRAL UTAH

By Earl H. Pampeyan

INTRODUCTION

The Lynndyl 30- by 60-minute 1:100,000-scale quadrangle is located in west-central Utah at the eastern edge of the Great Basin (fig. 1). The Sevier River, which drains part of the western Colorado Plateaus province, flows through the southeast corner of the quadrangle and terminates at Sevier Lake. The rocks and sediments exposed in the quadrangle represent a fairly complete sequence ranging in age from Middle Proterozoic to Holocene excluding most of the Mesozoic, which is present to the east in the Colorado Plateaus. The presence of major ore deposits in the East Tintic Mountains stimulated geologic interest in this region, and early stratigraphic work was concentrated around the Tintic ore deposits. Tower and Smith (1899), Crane (1917), and Lindgren and Loughlin (1919) established the basic geologic framework that stood for many years. Subsequent updating of the stratigraphy by Morris and Lovering (1961; 1979), Morris (1978), and Christie-Blick (1982) and the regional structure by Morris (1983) and Christie-Blick (1983) is shown on this map.

Geologic data for the bedrock areas of the Lynndyl 30- by 60-minute quadrangle were compiled from a variety of published and unpublished sources, many of which were used by Morris (1978) in his compilation of the Delta 2° quadrangle (see index to geologic mapping, fig. 2). The intervening areas of surficial deposits were mapped by the author largely in a reconnaissance fashion between 1981 and 1983, with the exception of an area east of Lynndyl that was mapped in great detail by Varnes and Van Horn (1984). The physical properties of bedrock and surficial units were not determined for this map, but some soils engineering data are available in public documents, for example, Utah State Department of Highways (1971), Stott (1977), and numerous private site investigations reports prepared for the Intermountain Power Agency and the U.S. Air Force, pertaining to the Intermountain Power Project site and the M-X Missile siting scheme, respectively. The ground-water hydrology and its relation to surficial deposits in a large part of the map area has been described by Holmes (1984).

The quality of geologic source materials used in this map is shown in the reliability diagram (fig. 3), mainly to indicate the state of geologic knowledge in the quadrangle and where future geologic studies might best be directed. The rocks have not changed in historic time but interpretations based on them have, and ongoing improvements in access, mapping and laboratory techniques, and topographic base maps will benefit future interpretations.

Map units selected for use on this map correspond as nearly as possible to a division of geologic periods into epochs. The map-unit boundaries, in most cases, match epoch boundaries, but where a formation boundary straddles a time boundary the formation is arbitrarily included in one or the other adjacent unit, and owing to map scale and thickness of map units, the map pattern is not noticeably different than if the formation had been included in the other adjacent map unit. An attempt at consistency in usage is made, but differences in mapping style and interpretation in the source materials inadvertantly may cause some misidentifications or misassignments. In some cases the map units consist of a single formally recognized formation and in other cases two or more formations.

The igneous rocks are separated into intrusive and extrusive units, and--where not formally named--are informally named to indicate their distribution throughout the quadrangle; the correlations are approximate and based on the available physical evidence and sparse radiometric dates. The igneous units in the Keg, Simpson, and Desert Mountains and in the area around Sage Valley need to be studied in detail before more meaningful relations can be established throughout the quadrangle.

GEOLOGIC SETTING

The geologic setting of the region including the Lynndyl quadrangle is controlled by the regional structure, and the reader is referred to papers by Morris (1983) and Christie-Blick (1983) for a comprehensive description of the regional structure. Paleozoic rocks herein are separated into three "facies" determined by their position relative to two major thrust faults, the Tintic Valley and Sheeprock thrusts (fig. 4). The Tintic Valley thrust is exposed in the east half of the Gilson Mountains and south end of the East Tintic Mountains, and its position under Tintic Valley is dictated by significant facies changes in Cambrian to Devonian rocks between the East and West Tintic ranges. The Sheeprock thrust is exposed in the West Tintic and Sheeprock Mountains and its presence under the Sand Hills, Black Mountains, and Jericho Ridge is indicated by lithologic differences in Lower and Middle Cambrian rocks and proximity of Pennsylvanian rocks. The Canyon Range thrust is considered to be part of the Sheeprock thrust displaced along the Leamington transcurrent fault (Morris, 1983). (The Canyon Range thrust fault and the Canyon Range

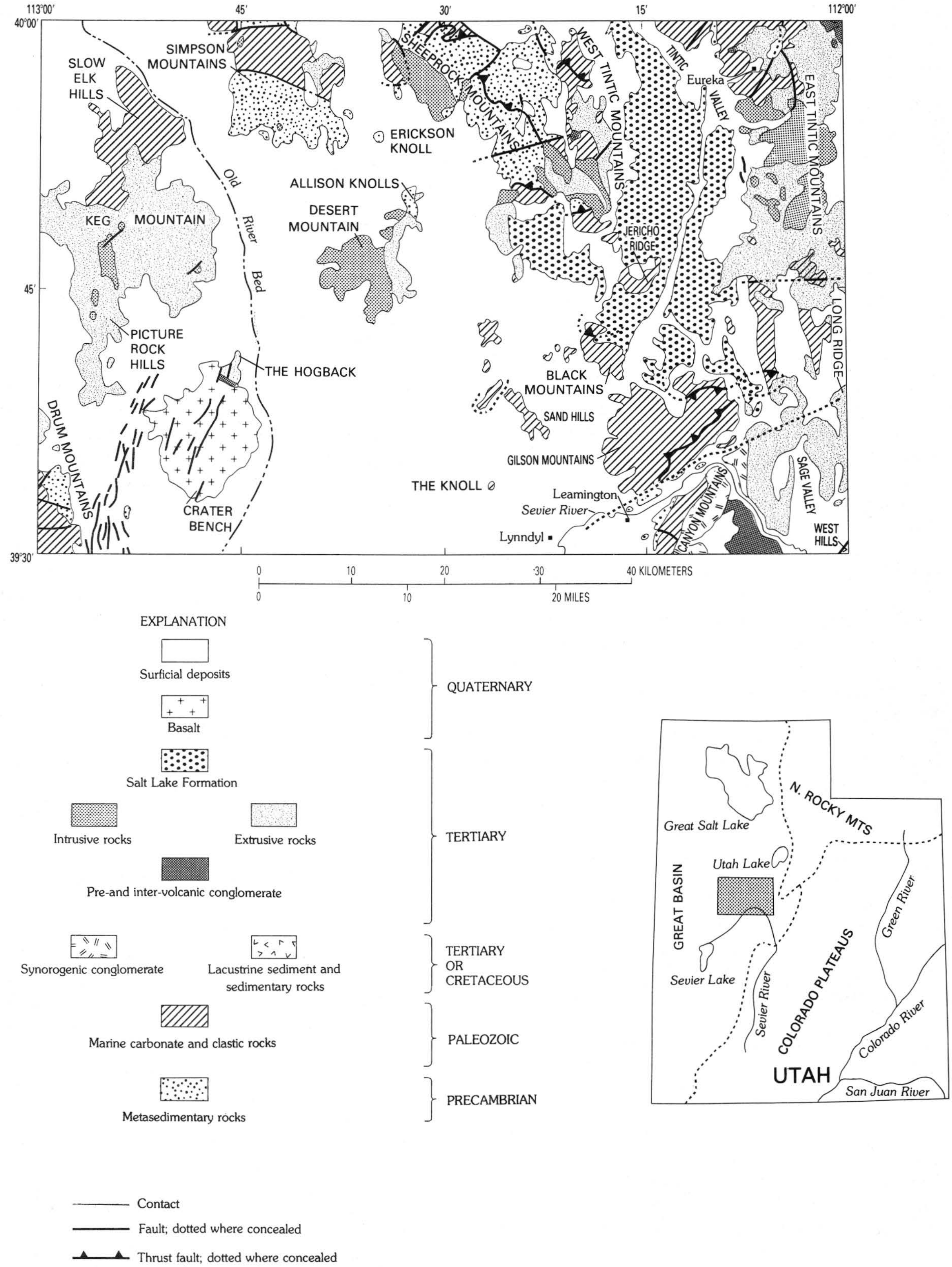
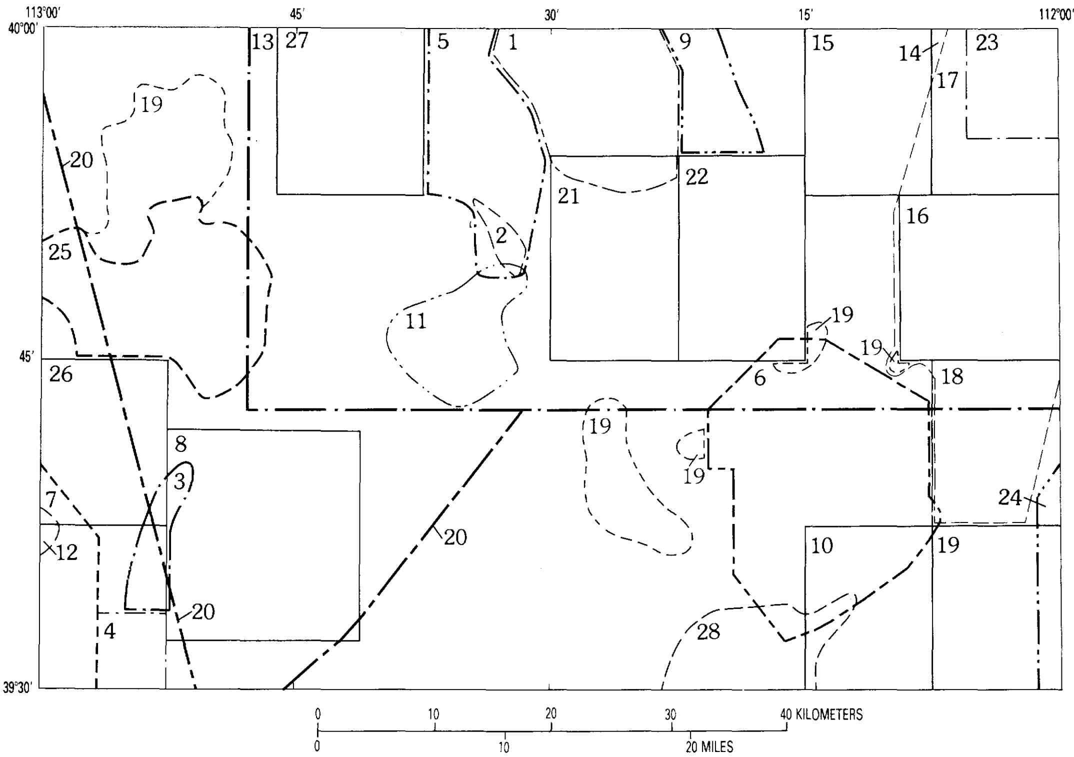


Figure 1.—Generalized geologic map of the Lynndyl 30- by 60-minute quadrangle, and index map of Utah showing location of quadrangle (shaded) and other pertinent features.



1. Blick (1979) and Christie-Blick (1982; 1983)
2. Blick (1979)
3. Faults from Bucknam and Anderson (1979a) and R.C. Bucknam, unpubl. data, 1982, with additions
4. Faults from Bucknam and Anderson (1979a) and Crone (1983), with additions
5. Cohenour (1959), modified by Morris (1978), with additions
6. Costain (1960) and Morris (1978)
7. Dommer (1980), with additions and modifications
8. Galyardt and Rush (1981), with additions and modifications
9. Groff (1959), modified by Morris (1978), with additions
10. Higgins (1982)
11. Kattelman (1968) and Rees and others (1973), modified by Morris (1978)
12. Lindsey (1979)
13. Mabey and Morris (1967) and Morris (1977)
14. Morris (1964a)
15. Morris (1964b)
16. Morris (1975)
17. Morris (1975)
18. Morris (1977)
19. Morris (1978), with additions and modifications
20. Regional structural features from Morris (1983) and H.T Morris, oral commun., 1984
21. Morris and Kopf (1970a), with modifications
22. Morris and Kopf (1970b; 1967), with modifications
23. Morris and Lovering (1979)
24. Muessig (1951a)
25. Shawe (1972) and Lindsey and others (1975), modified by Morris (1978), with additions
26. Staub (1975), modified by Morris (1978), with additions
27. Thomas (1958), modified by Morris (1978; unpubl. data, 1985)
28. Varnes and Van Horn (1984; unpubl. data, 1981)

Figure 2.—Index to geologic mapping, Lynndyl 30- by 60-minute quadrangle, Utah. (Bedrock and locally surficial geology compiled or adapted from these sources.)

Formation of Stolle (1978) have their type areas in the Canyon Mountains, a physiographic unit known in the geologic literature as the Canyon Range.) The Frisco-Wah Wah thrust is not exposed in the Lynndyl quadrangle but its presence is required to explain lithologic differences between lower Paleozoic rocks of the western part of the quadrangle and those just beyond the west edge. The Precambrian to Middle Cambrian rocks of the part of the Drum Mountains in the Lynndyl quadrangle, however, are the same as and included with those of the Sheeprock plate.

The Proterozoic section, most complete in the Sheeprock Mountains where it is more than 6,500 m thick (Christie-Blick, 1982), consists of metasedimentary rocks that include a thick section of tillite. Overlying the Proterozoic rocks along the east edge of the quadrangle is a Paleozoic sedimentary section that exceeds 10,000 m, more than half of which is Pennsylvanian and Permian Oquirrh Formation (Morris, 1964a, 1964b, 1977) (fig. 5). Westward across the quadrangle, upper Paleozoic rocks are not exposed, but lower Paleozoic rocks are represented by about 4,200 m of Cambrian and Ordovician beds (Dommer, 1980), almost twice the thickness of equivalent rocks at the east edge of the quadrangle. The westward increase in thickness of Paleozoic rocks toward the axis of the Cordilleran geosyncline is emphasized by foreshortening across several major thrust faults. Unconformably above the Paleozoic rocks in the southeast corner of the quadrangle is as much as 1,000 m of coarse conglomerate (Higgins, 1982) resulting from thrusting in

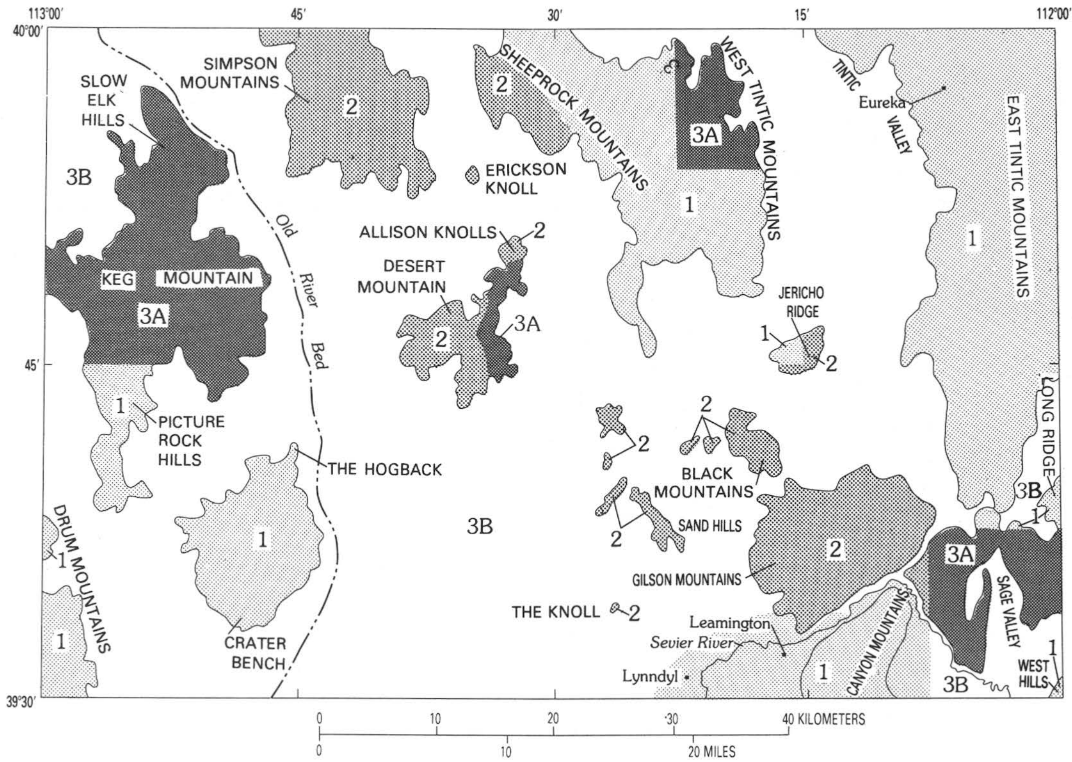


Figure 3.—Geologic data used in this map were compiled from a variety of sources ranging from detailed to rapid reconnaissance field studies plotted on good, large-scale (1:24,000) to poor, small-scale (1:250,000) topographic maps and aerial photographs. This diagram is an assessment of the overall quality of the geologic materials as they pertain to this 1:100,000-scale geologic map.

EXPLANATION

- 1 — Few additions or modifications needed
- 2 — Some additions or modifications needed
- 3A — Many additions or modifications needed
- 3B — Many additions and modifications needed in areas of surificial deposits

Late Cretaceous or early Tertiary time. This conglomerate is succeeded by--and in places equivalent to--finer fluviatile conglomerates and lacustrine limestones, the latter being widely exposed east of the quadrangle. Other local deposits of fluviatile conglomerate are present under and interlayered with a succession of Eocene to Miocene extrusive rocks widespread in the quadrangle; intrusive rocks closely related to the extrusive rocks are present in much of the area and in places cut the major faults. This period of igneous activity was followed by regional deposition of a thick sequence of fine-grained lacustrine deposits with volcanic ash interbeds–the Miocene and Pliocene Salt Lake Formation. In Pleistocene time local eruptions of basaltic lava and ash in and south of the quadrangle occurred during the accumulation of Lake Bonneville deposits. Although the major tectonic events preceeded late Cenozoic time, late Pleistocene or Holocene faulting is manifested by a swarm of faults that cut Lake Bonneville deposits in the southwest corner of the area (Bucknam and Anderson, 1979b; Crone, 1983).

In general, igneous rocks of the east half of the quadrangle--and those west of the quadrangle--have been studied in greater detail than those in the west half, mainly because of their relations to ore deposits. Both intrusive and extrusive rocks are predominantly of intermediate composition and consist of monzonite and quartz monzonite stocks and latite and quartz latite flows and tuffs, with some acidic and basic rocks present locally.

Lacustrine deposits of the Salt Lake Formation crop out in the eastern half of the Lynndyl quadrangle above the Bonneville shoreline, from about 1,567m up to about 1,920 m. Below the Bonneville shoreline, which ranges from an elevation of about 1,559 m to 1,593 m across the map area, the Salt Lake deposits either are covered, eroded, or reworked and indistinguishable from fine-grained Lake Bonneville deposits. An isolated exposure of Salt Lake deposits is present at the south edge of Crater Bench in a quarry opened in 1982 to supply ballast for the spur railroad between Lynndyl and the Intermountain Power Project site. There, reddish-brown to pink, fine clastic sediments are unconformably overlain by the Basalt of Crater Bench. These beds, lithologically identical to the Salt Lake deposits north of the Gilson Mountains, appear to be a remnant of the Salt Lake Formation protected from erosion in Lake Bonneville by the basalt cap. Crater Bench is surrounded by wave-worked basalt scree and is capped with patches of fossilferous fine-grained deposits of Lake Bonneville. Three sections of Lake Bonneville

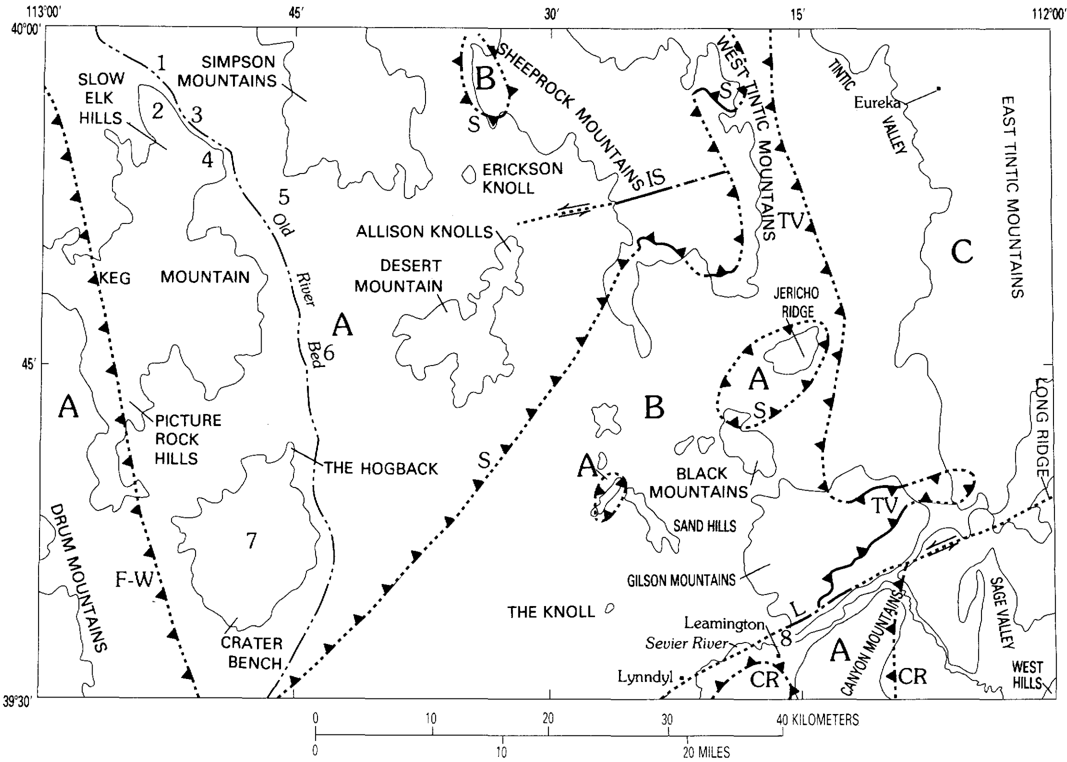


Figure 4. Generalized map showing structural framework of the Lynndyl quadrangle as determined from distribution of pre-Mesozoic sedimentary rocks, after Morris (1983). F-W, Frisco-Wah Wah thrust; IS, Indian Spring transcurrent fault; S, Sheeprock thrust; TV, Tintic Valley thrust; L, Leamington transcurrent fault; CR, Canyon Range (= Sheeprock) thrust. Faults are dotted where inferred; sawteeth are on upper plate of thrust faults; arrows indicate relative movement. The Sheeprock, Tintic Valley, and Leamington faults form the boundaries of three Paleozoic lithologic facies, A, B, and C (see correlation of map units). Also shown are localities of geomorphic features described by Gilbert (1890): 1, Lower River Bed section (p. 189-191); 2, Reservoir Butte (p. 148-149, pls. VII, XXIV, XXV, XXXI); 3, Upper River Bed section (p. 194-196, pl. XXXII); 4, Cup Butte (p. 55, 138, pls. VI, XXIII, XXXI); 5, The Snowplow (p. 138, 147-148, pls. VII, XIX, XXIII, XXXI); 6, Old River Bed (p. 181-184, pl. XXXXI); 7, Fumarole Butte (p. 332-335, pl. XXXI); 8, Leamington section (p. 192-193).

deposits, originally used by Gilbert (1890) to derive his theory of lake-level oscillations, lie within the Lynndyl quadrangle; the Upper and Lower River Bed and Leamington localities (fig. 4). Modern studies by Varnes and Van Horn (1961) and Currey and others (1983) have reinterpreted the history of Lake Bonneville on the basis of these same stratigraphic sections. The quadrangle also contains lacustrine geomorphic features described by Gilbert (1890), for example, Reservoir Butte (Table Mountain on modern maps), Cup Butte, The Snowplow, and the Old River Bed (fig. 4).

Metallic mineral resources of the quadrangle consist chiefly of gold, silver, lead, and zinc with lesser amounts of copper, manganese, and tungsten, and traces of beryllium, thorium, samarian, and uranium. Major base- and precious-metal ore bodies in the East Tintic Mountains have been worked since the early 1870's (Billingsley and Crane, 1933); smaller deposits in the West Tintic, Sheeprock, and Simpson Mountains and at Desert Mountain also have been productive. The base- and precious-metal deposits occur as narrow veins in igneous rocks and as replacement veins and bodies in carbonate rocks, and are thought to represent the culmination of Tertiary igneous activity. Thorium-and samarium-bearing minerals are found in pegmatite dikes cutting granite, and beryl is disseminated in the same granite in the Sheeprock Mountains (Cohenour, 1959). The uranium appears to be localized in fluorite, which occurs in some base-metal veins. For detailed information on the history of mining and the stratigraphic and structural controls and mineralogy of these ore deposits the reader is referred to papers by Lindgren and Loughlin (1919), Butler and others (1920), Billingsley and Crane (1933), Stringham (1942), Cohenour (1959), and Morris (1968). The world's largest beryllium deposits are in the Thomas Range, about 15 km west of the quadrangle, and this range also contains well-known deposits of topaz (Staatz and Carr, 1964.

Nonmetallic resources of the quadrangle are halloysite clay, high-purity limestone, high-silica quartzite, and construction materials. The major United States source of catalytic grade halloysite is just south of Eureka where it occurs in pipelike bodies in lower Paleozoic limestone near the monzonite porphyry contact. Summary statements on the metallic and nonmetallic commodities of this area are found in a report on the mineral resources of Utah (U.S. Geological Survey, 1964).

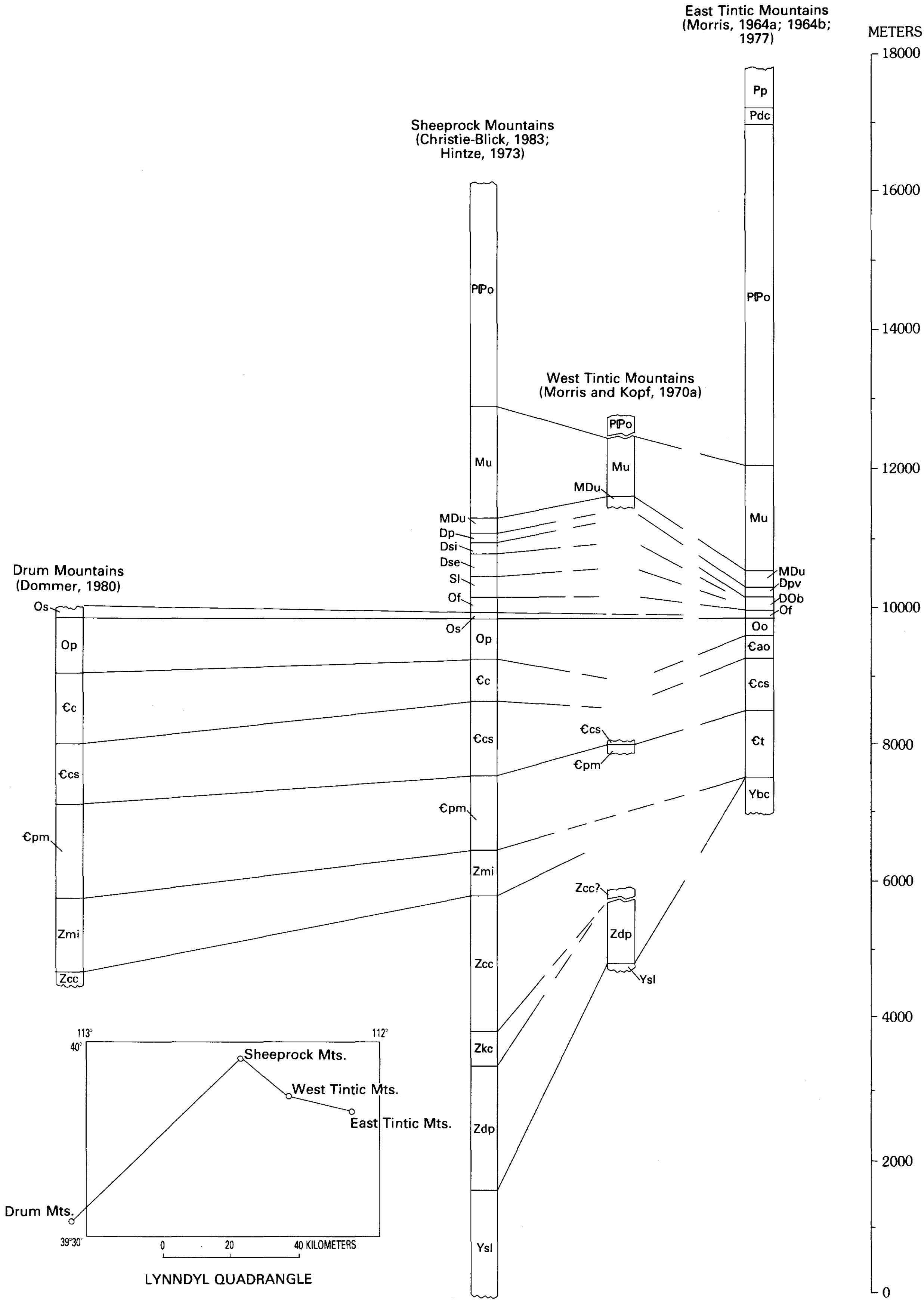


Figure 5. Stratigraphic sections across the Lynndyl 30- by 60-minute quadrangle, Utah. See description of map units for explanation of letter symbols.

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