The Lawson Creek Formation of Middle Proterozoic Age in East-Central Idaho

GEOLOGICAL SURVEY BULLETIN 1482-E

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By S. W. HOBBS

CONTRIBUTIONS TO STRATIGRAPHY

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A description of a new post-Swauger Middle Proterozoic formation in east-central Idaho

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CONTENTS

ILLUSTRATIONS

TABLE

CONTRIBUTIONS TO STRATIGRAPHY

THE LAWSON CREEK FORMATION OF MIDDLE PROTEROZOIC AGE IN EAST-CENTRAL IDAHO

By S. W. HOBBS

ABSTRACT

The Swauger Formation, the youngest middle Proterozoic or Proterozoic Y unit heretofor identified in east-central Idaho, is overlain at four localities in the northernmost part of the Lost River Range and adjacent Salmon River Mountains by a heterogeneous sequence of strata that constitutes a new stratigraphic unit of post-Swauger age. This unit is herein named the Lawson Creek Formation from an exposure of more than 1,200 m (meters) of strata that overlie the Swauger Formation in a westerly dipping homocline near Lawson Creek in the northeast part of the Lost River Range. These exposures are designated the type locality and consist of predominantly medium-reddish-purple to dark-purplish-gray and maroon quartzite, impure quartzite, siltstone, and argillite that are predominantly thin bedded but that contain local thick beds of light purple quartzite very similar to that of the Swauger. The top of the unit is covered by Challis Volcanics and the total thickness is unknown.

The Lawson Creek Formation appears at places to be gradational from the Swauger, and although it does have local structural discontinuities at or near the basal contact, distinctive lithologic aspects and structural relations identify it as a separate stratigraphic unit overlying the Swauger Formation.

INTRODUCTION

The Precambrian rocks of east-central Idaho are extensively exposed in the Lemhi Range and Beaverhead ranges and the Salmon River mountains where they were recognized and partially delineated during early reconnaissance studies in the region—notably those of Umbleby (1913, p. 30–32; 1917, p. 23). They were further described and subdivided by the subsequently more detailed work of Ross (1925, p. 5–8; 1947, p. 1096–1102; 1961, p. 195–201). It was not, however, until the detailed work of Ruppel in the Lemhi Range (1968, 1975a) that the Precambrian units were carefully delineated, their structural relations deciphered, and their relations to the Paleozoic section described.

A revised sequence of middle Proterozoic strata has been defined in the Lemhi Range by Ruppel's work. The lowest unit exposed in east-central Idaho, and presumably the oldest, has been correlated with

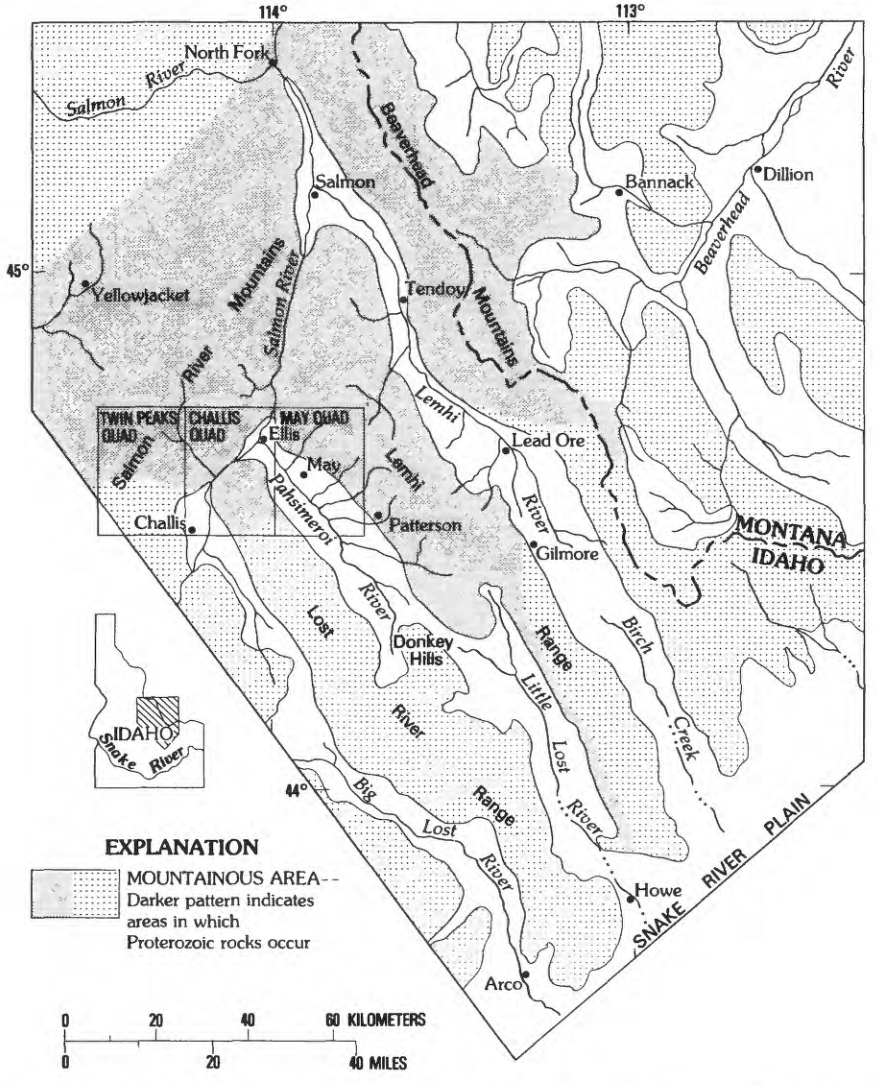


FIGURE 1.—Index map of east-central Idaho and southwestern Montana, showing general distribution of Proterozoic rocks. Modified from Ruppel (1975).

the Yellowjacket Formation as defined by Ross (1934, p. 16). The base of the Yellowjacket has not been found, and the upper contact wherever seen in east-central Idaho is the Medicine Lodge thrust system (Ruppel, 1978). Above the thrust system in the Lemhi Range, the remainder of the middle Proterozoic strata comprises the Lemhi Group that includes five formations, the Inyo Creek, West Fork, Big Creek, Apple Creek, and Gunsight Formations, and at the top the

Swauger Formation whose upper contact is everywhere a thrust fault. These units total more than 12,000 m of generally fine-grained quartzite, siltstone, and argillite, and nowhere in the Lemhi Range have any younger rocks assignable to the middle Proterozoic been identified. Locally, as much as 300 m of the Wilbert Formation unconformably overlies the middle Proterozoic units and in places is overlain by the Lower Ordovician Summerhouse Formation (Ruppel and others, 1975). Although the Wilbert Formation has been tentatively assigned a late or Proterozoic Z age, part of it may be Cambrian.

Figure 1 shows the geography of east-central Idaho and southwest Montana and the general distribution of Proterozoic strata.

LOCATION AND REGIONAL RELATIONS

In the northern part of the Lost River Range and adjacent parts of the Salmon River Mountains, isolated exposures of several middle Proterozoic formations that are identifiable with those described in the Lemhi Range project through the widespread Challis Volcanics that blanket most of the area (fig. 2). Most notable of these are the three major outcrop areas of the Swauger Formation, which have similar stratigraphic succession, generally parallel structure, and comparable thickness (approximately 3,000 m). These Swauger exposures (A, B, B′, B″, and C, fig. 2) almost certainly represent a threefold structural repetition of most, if not all, of the complete Swauger stratigraphic section.

LAWSON CREEK FORMATION

DEFINITION AND GENERAL CHARACTER

At four localities in two structurally separated tectonic blocks in the northern part of the Lost River Range (McIntyre and Hobbs, 1978), the Swauger Formation is overlain with apparent conformity by a sequence of rocks that are sufficiently distinctive to be considered a new formation. These different rocks are herein named the Lawson Creek Formation, a new formation in the Proterozoic sequence of east-central Idaho. The largest of the Lawson Creek Formation exposures in the Lost River Range extends nearly 4 km (kilometers) southeast along the east foot of the Lost River Range from the place in the southwestern corner of the May quadrangle where Lawson Creek flows into the broad Pahsimeroi Valley. These exposures, mostly in sections 4 and 9, T. 14 N., R. 21 E., are designated the type locality.

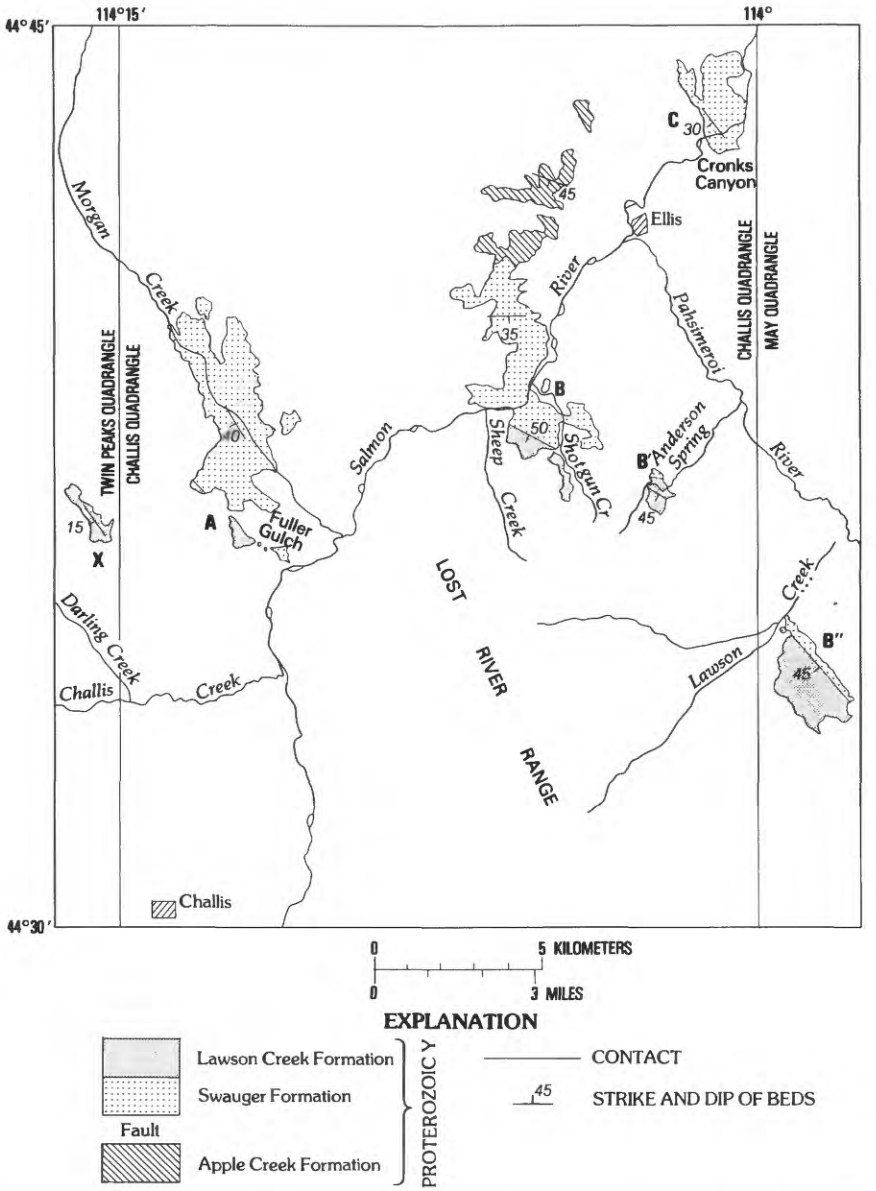


FIGURE 2.—Distribution of Lawson Creek and Swauger Formations, east-central Idaho. Geology by S. W. Hobbs. Letters indicate localities described in text.

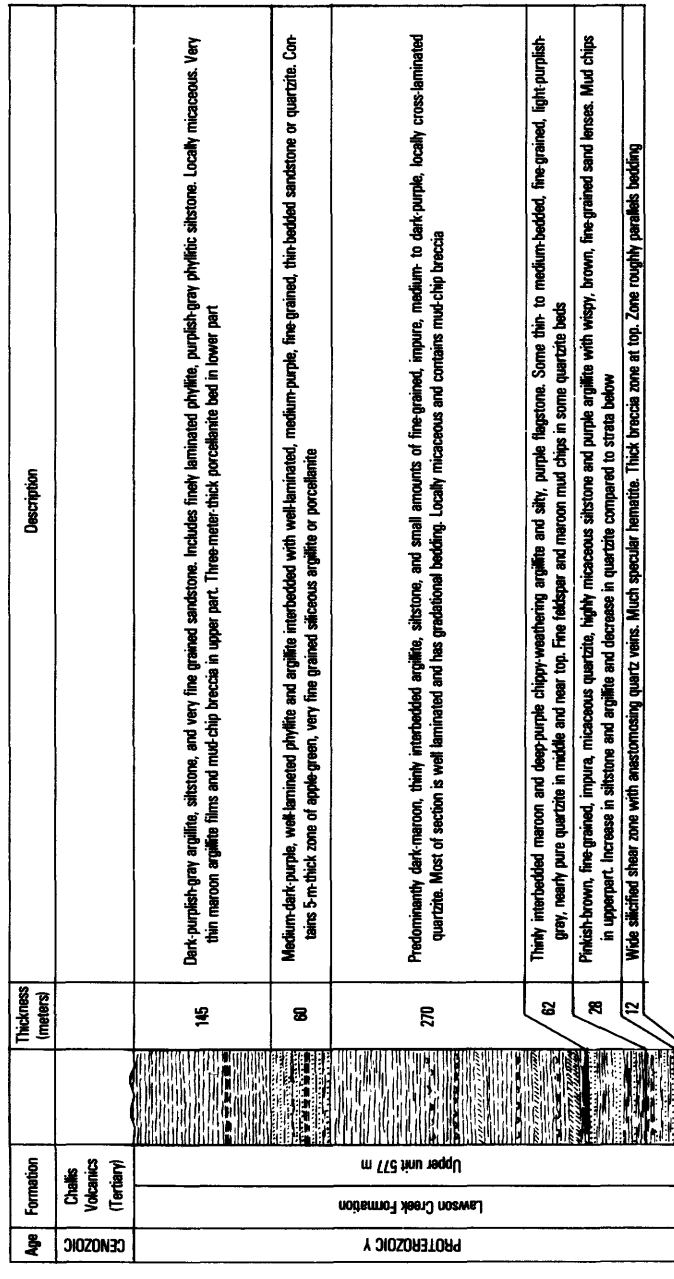
The Swauger Formation, on which the Lawson Creek Formation rests, is basically similar to that described in the Lemhi Range (Ruppel, 1975, p. 12–14). It is composed of distinctive pale-purple, light-pink, or pale-purple-red, vitreous quartzite that is generally quite pure. Beds range from 0.15 to 1.8 m thick and many are prominently

cross laminated. Partings or thin beds of greenish-gray to nearly black siltite or argillite separate the quartzite beds at places, but these are distinctly subordinate. Some bedding planes are ripple marked. Quartz grains that make up from 80 to 97 percent of the quartzite beds are 0.1–0.75 mm (millimeter), mostly about 0.5 mm, in diameter and are generally well sorted in any one layer. Many grains show optically oriented overgrowths of quartz, and some boundaries are sutured or form a mosaic pattern. Strain shadows are always present and in some places developed a pseudoparallel twinning in the quartz grains. Scattered grains of quartzite are usually present but form only a few percent at most, and grains of intermixed, fine-grained quartz and sericite are probably pseudomorphic after feldspar, which never exceeds a few percent. Well-rounded grains of zircon and tourmaline together with a very sparse matrix of fine-grained quartz, sericite, and hematite dust make up the remaining 2 or 3 percent of the rock.

In contrast to the Swauger, the Lawson Creek Formation is thinner bedded, more heterogeneous in composition, generally finer grained, and more vividly colored. As herein defined, the Lawson Creek Formation is a sequence of medium-reddish-purple to dark-purplish-gray and maroon quartzite, impure quartzite, siltstone, and argillite that is predominantly thin bedded but that contains local thick beds of lighter purple quartzite and zones of intermixed medium to thick bedded quartzite, siltstone, and thinly bedded silty argillite. The quartzite beds within it are generally less pure than those in the Swauger and are locally highly feldspathic; the entire section shows an abundance of mud chip breccia, ripple marks, and micaceous partings.

LITHOLOGY AND CONTACTS

Figure 3 is a generalized stratigraphic section of the Lawson Creek Formation as exposed in the hills south of Lawson Creek (locality B", fig. 2) where approximately 1,300 m have been measured in a nearly uninterrupted section from the contact with the Swauger to the uppermost exposure where it is covered by Challis Volcanics. Although the basal contact is covered by surficial debris and the strata adjacent to the contact are sheared and silicified, the general structural and lithologic compatability both here and at the other localities indicate a strictly conformable and generally gradational change from the Swauger into the Lawson Creek Formation. Two other places in the measured section—a covered interval about 660 m above the base and a silicified breccia zone at 720 m above the base—may represent minor faults but the beds are not significantly offset.


Age
Formation
Thickness (meters)
Description
CENOZOIC
Chalks Volcanics (Tertiary)
PROTEROZOIC Y
Lawson Creek Formation
Upper unit 577 m
145
Dark-purplish-gray argillite, siltstone, and very fine grained sandstone. Includes finely laminated phyllite, purplish-gray phyllitic siltstone. Locally micaceous. Very thin maroon argillite films and mud-chip breccia in upper part. Three-meter-thick porcellanite bed in lower part
60
Medium-dark-purple, well-laminated phyllite and argillite interbedded with well-laminated, medium-purple, fine-grained, thin-bedded sandstone or quartzite. Contains 5-m-thick zone of apple-green, very fine grained siliceous argillite or porcellanite
270
Predominantly dark-maroon, thinly interbedded argillite, siltstone, and small amounts of fine-grained, impure, medium- to dark-purple, locally cross-laminated quartzite. Most of section is well laminated and has gradational bedding. Locally micaceous and contains mud-chip breccia
62
Thinly interbedded maroon and deep-purple chippy-weathering argillite and silty, purple flagstone. Some thin- to medium-bedded, fine-grained, light-purplish-gray, nearly pure quartzite in middle and near top. Fine feldspar and maroon mud chips in some quartzite beds
28
Pinkish-brown, fine-grained, impure, micaceous quartzite, highly micaceous siltstone and purple argillite with wispy, brown, fine-grained sand lenses. Mud chips in upperpart. Increase in siltstone and argillite and decrease in quartzite compared to strata below
12
Wide silicified shear zone with anastomosing quartz veins. Much specular hematite. Thick breccia zone at top. Zone roughly parallels bedding

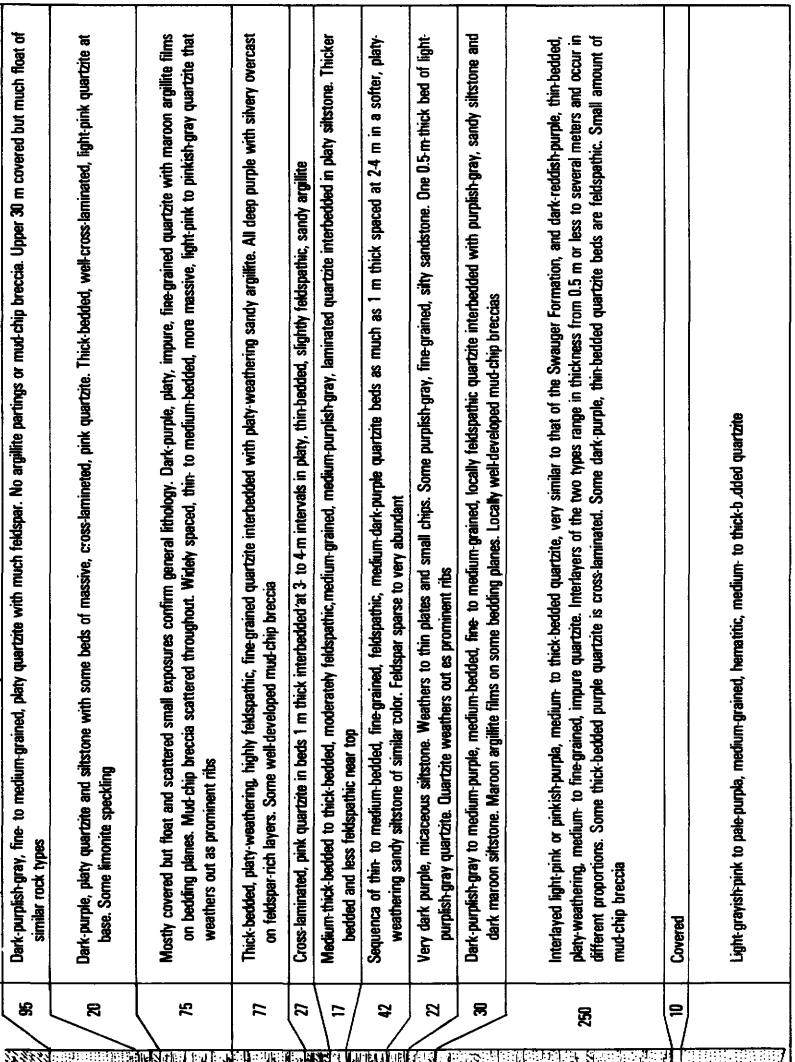


FIGURE 3.—Incomplete columnar section and description of the Lawson Creek Formation.

The Lawson Creek Formation can be divided into three informal units, as shown in figure 3. These are (1) a basal transitional zone from the Swauger Formation about 250 m thick; (2) a middle interbedded quartzite and silty argillite unit 453 m thick, and (3) an upper thin-bedded and laminated argillite unit that is at least 577 m thick. The transitional zone is predominantly quartzite that is similar in many ways to the Swauger but generally is thinner bedded, dark reddish purple, less pure, and less well indurated. Thin interbeds of silty quartzite and siltstone become more abundant toward the top. Although the member is predominantly dark colored and generally thinner bedded, thick beds of pure, light-pink quartzite identical to those in the Swauger Formation are scattered through the section. The middle unit of interbedded quartzite and silty argillite, although not uniform throughout, is in general a sequence of thin-bedded dark-purple and purplish-gray, silty argillite and fine-grained, platy-weathering, sandy siltstone layers, interbedded with medium- to thick-bedded and somewhat more resistant medium-reddish purple to light-pink impure to pure quartzite. In places the middle unit includes widely spaced thick beds of cross-laminated, light-pinkish-purple quartzite that are identical to the predominant lithology of the Swauger Formation. The quartzites and the silty and argillitic layers are interbedded in different proportions and at different spacings. In some places medium to thick interbeds are even spaced; elsewhere quartzite ribs 0.5 to 1 m thick are separated by several meters of thin bedded silty argillite. Many of the fine-grained, platy, impure quartzite beds are highly felspathic and have maroon argillite films on the bedding planes, micacous partings, and mud-chip breccias that have been formed by the disruption of the maroon argillite. The upper unit of thin-bedded and laminated argillite is composed of thin-bedded, dark-purplish-gray siltstone, argillite and very fine grained dark-purplish sandstone or quartzite with a few widely spaced cross-laminated, medium-thick beds of medium-grained quartzite. In general, the upper exposed part of the upper member becomes more argillaceous and contains much dark-purplish-gray well-laminated phyllite. Several beds, 1–3 m thick, of a light-gray-green, siliceous mudstone or porcellanite occur in the upper 200 m of the member. Mud-chip breccia and micaceous partings are abundant, and ripple marks and thin, cross-laminated, impure sandstone beds are present but are not common.

THE LAWSON CREEK FORMATION AT OTHER LOCALITIES

The type locality at Lawson Creek is the southernmost and most complete of a string of three exposures of the formation along the east side of the Lost River Range (fig. 2). All of these exposures are

parts of a single west-dipping homocline of Swauger Formation overlain by Lawson Creek Formation. At Anderson Spring, about 5 km northwest of Lawson Creek, the same basal contact relations and lithologies that have been described for the type locality are repeated, but only the lower 400 m of the Lawson Creek Formation is exposed. Farther to the northwest, between Shep and Shotgun Creeks, the contact of the Lawson Creek Formation with the underlying Swauger is fully exposed and undisturbed, but the transition zone is either missing or much compressed. At this locality, thick-bedded Swauger quartzite is conformably overlain in sharp contact with a sequence more than 400 m thick of alternating layers 1 to 2 m thick of quartzite and siltstone. The quartzite is medium gray to purplish gray, partly mottled or speckled, thick to medium bedded, and somewhat impure. The siltstone is dark purplish gray, thin bedded, platy weathering and laminated and contains some irregular stringers of brown, sandy siltstone. Siltstone and argillite layers increase upward in the section and quartzite beds decrease. The rocks include sparse mud-chip breccias and locally have well-developed ripple marks and mud cracks, and cross lamination in the thick beds of quartzite.

At locality A (fig. 2) south of Morgan Creek, the Lawson Creek Formation appears to rest upon the thick section of Swauger strata that is well exposed on both sides of Morgan Creek. The formation and the basal contact are in sections 16 and 21, T. 15 N., R. 19 E., in the west-central part of the Challis 15-minute quadrangle (McIntyre and Hobbs, 1978) where they are crossed by the old access road to upper Morgan Creek. Here less than 100 m of strata are exposed between the contact with the Swauger Formation and the cover of Challis Volcanics, and the prevalence of thin beds of mixed lithologies, dark-red-purple color, and impure quartzite show that these rocks are the lower part of the transition zone of the Lawson Creek Formation. A zone of steep dips, near-vertical fractures, and quartz veining along the contact with the Swauger Formation indicates some structural adjustment at or near the contact but probably no significant movement. However, about 3 km southeast along the contact in Fuller Gulch, the strata both above and below the contact are strongly disturbed, probably as a result of thrusting from the southwest.

At locality X (fig. 2), north of Darling Creek which is in the Twin Peaks quadrangle and less than 2 km from the western border of the Challis quadrangle, several hundred meters of strata that probably are part of the Lawson Creek Formation are exposed in a 2-km-long northwest-trending window eroded through the covering Challis Volcanics. The correlation with the Lawson Creek is uncertain, however, because this thin and isolated sequence of rocks is structurally complex, and the presumably underlying Swauger Formation is not exposed.

GEOLOGIC HISTORY OF THE AREA AND PROBLEMS OF CORRELATION

The limited known distribution of the Lawson Creek Formation is a result of the complex geologic history of east-central Idaho, which is slowly being unraveled through the efforts of many workers. A report by Ruppel (1978) on the Medicine Lodge thrust system, east-central Idaho and southwest Montana, summarized the state of knowledge on this area. Great thicknesses of Precambrian rocks were eroded in late Precambrian and early Paleozoic time, and almost all of the rocks of the region are cut by great flat thrusts and are allochthonous. The Paleozoic rocks of the region overlie the Precambrian rocks with strong angular unconformity, and in places the Middle Ordovician Kinnikinic Quartzite was deposited on the Gunsight Formation. In these places, all of the Swauger Formation as well as the Lawson Creek and Wilbert Formations are missing as a result of late Precambrian and early Paleozoic deformation and erosion.

Thrust faults related to the Antler and Sevier orogenies transported almost all of the rocks of the region many kilometers east of their original depositional basins and interleaved them in a complex of imbricate thrust plates. And steep faults of Cenozoic age further complicate the understanding of stratigraphic relations.

The Lawson Creek Formation includes the only known rocks conformable above the Swauger that have survived the tectonic events and erosional destruction. As far as I know, these rocks are preserved only in the small area in and around the north end of the Lost River Range. The formation is a distinctive sequence of rocks, however, and is unlike any of the Precambrian rocks lower in the section. These different and lithologically varied rocks indicate a major change in depositional conditions, from the long-continued stability that the thick, homogeneous Swauger rocks suggest, to a more varied and unstable depositional environment. Recognition of the Lawson Creek as a new formation, above the Swauger Formation, therefore adds significant new information on the post-Swauger Precambrian depositional history of this region.

As pointed out by Ruppel (1975, p. 18), any definitive correlation of the middle Proterozoic strata in east central Idaho with the better known Belt Supergroup units of comparable age in west central Montana is premature. In a tentative correlation table (table 1), Ruppel suggested that the Swauger Formation could most logically be equated to some part of the Missoula Group. If so, the Lawson Creek Formation as a stratigraphically conformable extension of this part of the section is also a logical correlative part of the upper Missoula group.

TABLE 1.—*Tentative regional correlation of Proterozoic rocks in Idaho and western Montana (modified from Ruppel, 1975).*

East-central Idaho			Western Montana-northern Idaho	
Belt miogeosyncline			Belt Basin	
Proterozoic Y sedimentary rocks		Lawson Creek Formation	Proterozoic Y Belt Supergroup	Missoula Group
		Swauger Formation		
	Lemhi Group	Gunsight Formation		Helena and Wallace Formations
		Apple Creek Formation		
		Big Creek Formation		Ravalli Group
		West Fork Formation		
		Inyo Creek Formation		
		Yellowjacket Formation		Prichard Formation

Paleomagnetic sampling by Donald P. Elston and Stephen L. Bressler has been carried out in strata of the lower Swauger Formation exposed near Patterson in the Lemhi Range, the middle(?) Swauger exposed along the Salmon River near May, the uppermost Swauger exposed at Lawson Creek, and the lower Lawson Creek Formation exposed at Anderson Spring. Elston and Bressler (oral commun., 1979) reported that preliminary paleomagnetic directions have both normal and reversed polarities that are statistically identical to directions reported for the Missoula Group of the Belt Supergroup (Elston and Bressler, 1979). Because only normal polarity directions

have been found for Belt strata underlying the Missoula Group, the mixed polarity in the Swauger as well as the paleomagnetic directions indicate a correlation with the Missoula Group. On the basis of polarity zonation and directions, the upper Swauger Quartzite and Lawson Creek Formation appear to correlate best with the upper Mount Shields Formation, Bonner Quartzite and lower McNamara Formation. In addition, certain stratigraphic details of the Lawson Creek more closely match those found in the Mount Shields and McNamara Formations than those of any earlier units, and they suggest a more proximate or possibly interconnected depositional environment during this latest middle Proterozoic time span.

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