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SANTA BARBARA • SANTA CRUZ

DEPARTMENT OF GEOLOGY

DAVIS, CALIFORNIA 95616

November 14, 1981

Dear Bob,

This is my proposal as it presently stands. I have talked to Elizabeth Miller about this project, and she is very excited about it. Apparently she has had no success in getting any students interested in this project. Could you please read this over and make any suggestions that you think would help this proposal. This is not the "official" proposal-- I still have to clean up the map and the typing job.

If you have any suggestions, please drop me a line or call and leave a message with the department and I will call back. Again, I would like to thank you for the map you sent me and for the helpful discussions on the phone. I will be visiting Dr. Miller sometime soon, and hopefully I will get a chance to drop by your office and meet with you personally-- I will let you know in advance.

Yours truly,

A handwritten signature in blue ink that reads "Kenn".

Kenneth Ehman

GRANT PROPOSAL

for the study of

THE STRUCTURE AND STRATIGRAPHY OF THE BULL RUN SEQUENCE, ELKO COUNTY, NEVADA

by

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presented to

ARCO Exploration Company

November 1981

ATTENTION

R. K. Hose
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THE STRUCTURE AND STRATIGRAPHY OF THE BULL RUN SEQUENCE, ELKO COUNTY, NEVADA

Introduction

Paleozoic rocks exposed in the Bull Run 15 minute quadrangle in Elko County, Nevada (see figure 1) reflect the complex paleogeographic and tectonic history of the western margin of the North American continent. In this area two Paleozoic allochthons are thrust over a lower Paleozoic miogeoclinal sequence. Here, the miogeoclinal sequence is considered by Stewart (1980) to be "transitional" between the carbonate and quartzite province (eastern facies) of the miogeocline and the siliceous and volcanic province (western facies) of the Roberts Mountains allochthon. Decker (1962) mapped this metamorphosed sequence as a simple Precambrian and/or Cambrian through Devonian succession. Preliminary work conducted during the summer of 1981 suggests that the structure and stratigraphy of this sequence is much more complicated than originally thought. ~~It is my intention~~ ^{I propose} to study the structure and stratigraphy of this "transitional" miogeoclinal sequence in the Bull Run and adjacent quadrangles. Not only will this result in expanded knowledge of the present day geology, but *also* it will provide new insights into the poorly understood Paleozoic tectonic evolution of western North America.

Regional Tectonics

Two Paleozoic orogenic trends, the Antler and the Sonoma orogenic belts, extend through the Bull Run quadrangle. The Antler orogenic belt is a band of tectonically deformed lower to middle Paleozoic rocks which extends north-northeastward through central Nevada northward into central Idaho and southward into the Mojave Desert region of California (Nilsen and Stewart, 1980). This orogeny is believed to be a Devonian-Carboniferous deformational event which thrust deep water, siliceous and volcanic eugeosynclinal rocks eastward over coeval shallow water carbonate rocks in Nevada (Roberts and others, 1958; Burchfiel and Davis, 1972, 1975; Dickinson, 1977). These displaced terranes, commonly known as the Roberts Mountains allochthon, reflect a minimum of 125 km of crustal shortening (Stewart, 1980). An emergent belt developed during the Antler orogeny. Clastic sediments were shed eastward from the orogenic highland from Early Mississippian through Early Pennsylvanian time into the Antler foreland basin (Poole, 1974). This clastic wedge, found in eastern Nevada,

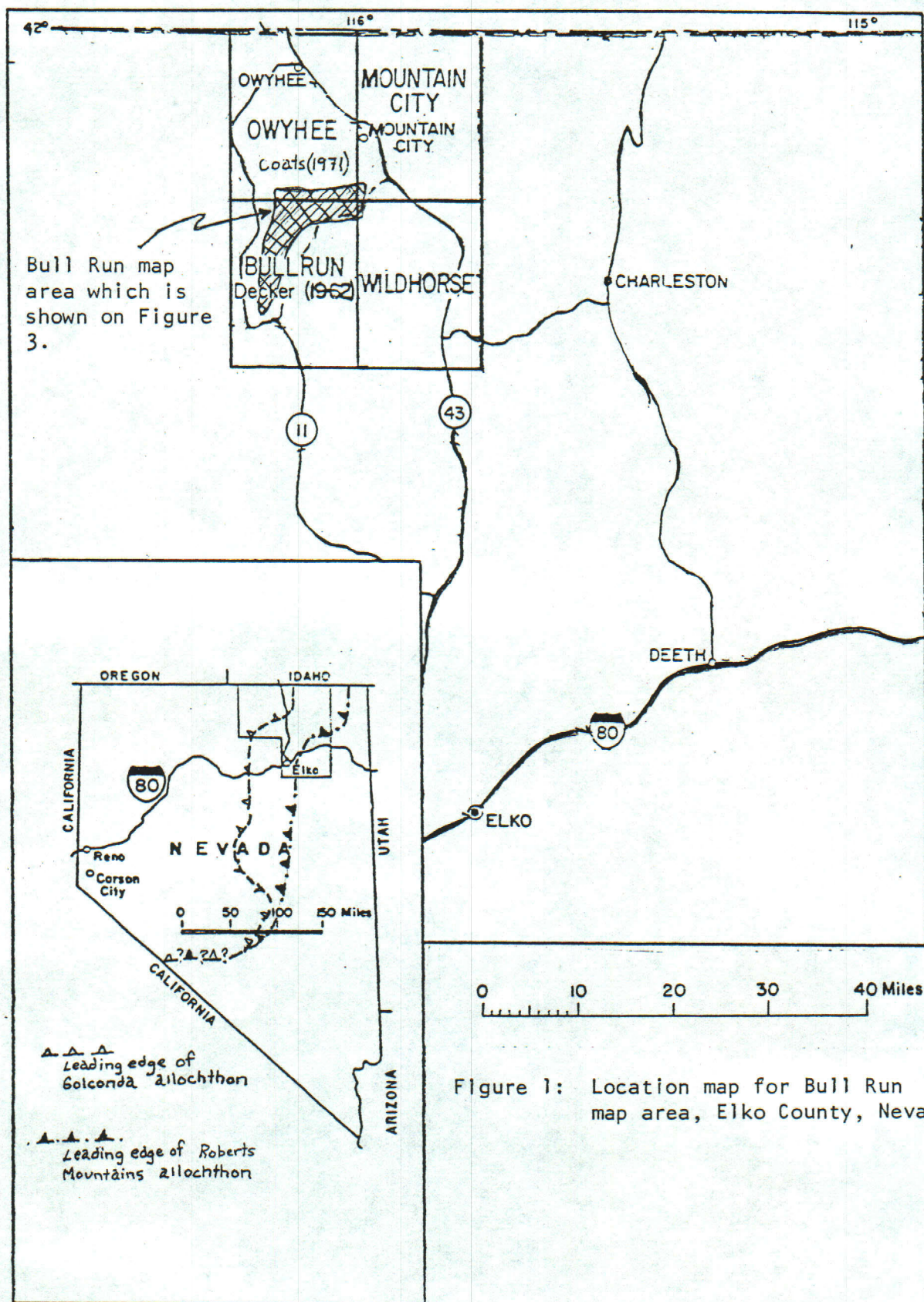


Figure 1: Location map for Bull Run map area, Elko County, Nevada.

provides the best evidence for the existence of a tectonic event during the middle Paleozoic.

Regionally, the Sonoma orogenic belt parallels, overlaps, and generally lies to the west of the Antler orogenic belt. The Sonoma orogenic belt consists of tectonically deformed upper Paleozoic rocks of the Golconda allochthon. The Sonoma orogeny is believed to be a Permo-Triassic deformational event which was very similar to the earlier Antler orogeny. Deformed assemblages of oceanic rocks such as the Havallah sequence (Mississippian-Permian) and the correlative Schoonover sequence were emplaced on partly coeval shallow marine and nonmarine rocks of the Antler sequence (Silberling and Roberts, 1962; Silberling, 1975; Stewart, 1980; Miller and others, ¹⁹⁸¹~~in press~~).

Recent work by Ketner and Smith (in press) in the Piñon Range of northeastern Nevada has cast doubt upon the temporal relationship between the Roberts Mountains thrust and the Antler orogeny. The Roberts Mountains thrust, which for over 20 years has been believed to be the "culmination" of the Antler orogeny, is now thought to post date the middle Paleozoic. The thrust was originally dated as Latest Devonian-Earliest Mississippian by the presence of an "overlap assemblage" which overlies both the allochthon and autochthon in the Piñon Range (Smith and Ketner, 1968, 1975, 1977). Ketner and Smith (¹⁹⁸¹~~in press~~) have reinterpreted this relationship and now believe the overlap assemblage is cut by the Roberts Mountains thrust. These authors suggest that the thrust is a post-Paleozoic structure. If this ^{suggestion} is true, then the Antler and Sonoma orogenies, as previously understood, should be reevaluated. The Bull Run area provides an excellent opportunity to study the nature, timing, and extent of the poorly understood and hotly debated Antler and Sonoma orogenies.

Geology of the Bull Run sequence

Decker (1962) mapped an uninterrupted stratigraphic sequence from the Precambrian and/or Cambrian (?) Prospect Mountain Quartzite through the Devonian (?) Van Duzer Limestone in the Bull Run quadrangle in northern Nevada (see figure 2). This metamorphosed stratigraphic sequence (~~which will be herein informally~~ ^{called} ~~informally referred to as~~ the Bull Run sequence) extends from the central Bull Run quadrangle to the southern part of the Owyhee 15' quadrangle mapped by Coats (1971) (see figure 3).

Stewart (1980) considers the Bull Run sequence to be autochthonous in relation to several thrust sheets exposed in the area. The Ordovician Valmy

Formation is thrust on top of the Van Duzer Limestone along the eastern part of the boundary between the Owyhee and Bull Run quadrangles. Decker (1962) named this fault the Trail Creek thrust, but Coats (1971) has considered this fault to be the Roberts Mountains thrust. Presently, Coats (personal communication, 1981) does not believe this fault is the Roberts Mountains thrust, although the thrust sheet, which consists of the Valmy Formation, may be part of the Roberts Mountains allochthon.

The Schoonover sequence (Mississippian-Permian) is thrust over the Bull Run sequence in the northeastern part of the Bull Run quadrangle (Fagan, 1962; Decker, 1962) (see figure 3). Churkin and Kay (1967) reported that the Schoonover is in depositional contact with the underlying Valmy equivalent rocks in the Northern Independence Mountains. Recent work by Elizabeth Miller and others (1981) in this same area has shown that the basal contact of the Schoonover is a thrust fault. Miller believes that the Schoonover is thrust on top of Late Mississippian nonmarine to shallow marine rocks which lie unconformably on deformed Ordovician strata of the Roberts Mountains allochthon. Radiolaria extracted from the cherts of the Schoonover sequence by Miller and others (1981) suggest that, at least in part, the Schoonover is stratigraphically equivalent to the Havallah sequence (Mississippian-Permian), and thus may be part of the Golconda allochthon.

The Problems

The lower Paleozoic rocks of the Bull Run sequence have been classified as a "transitional" assemblage in respect to the miogeocline which existed off the western margin of the continent at this time (Stewart, 1980). The Bull Run sequence is not a miogeoclinal carbonate-quartzite assemblage as found in lower Paleozoic sections exposed in eastern Nevada, nor is it an of deep water siliceous and volcanic rocks as found in the Roberts Mountains allochthon. The existence of a "transitional" assemblage is important in developing the popular paleogeographic model of a lower Paleozoic miogeocline off the continental margin with a eugeosyncline present some unknown distance west of the continent (Roberts and others, 1958).

Reconnaissance geology carried out by Jeffery Mount, Eldridge Moores, and me during the summer of 1981 of the Bull Run sequence has revealed some potential inconsistencies with ~~the map of~~ Decker's (1962) ^{map}. The structure of the Bull Run sequence appears to us to be much more complicated than originally believed by

Decker. Whether the Bull Run sequence exists as a continuous "transitional" stratigraphic section is a question worth further investigation.

Only two of the seven formations of the Bull Run sequence defined by Decker (1962) have been dated. The Edgemont Formation was dated as Lower Cambrian from a single trilobite ("Olenellus" species) collected from float. The Porter Peak Limestone was dated as Upper Cambrian to Lower Ordovician from several macrofossils collected from the lower portion of the formation. The other formations of the sequence, the Prospect Mountain Quartzite, the Aura Formation, the Chellis Formation, the Storff Formation, and the Van Duzer Limestone, were tentatively assigned ages by Decker "on the basis of regional correlation". The method of regional correlation is neither discussed nor described by Decker (1962). With the exception of the Prospect Mountain Quartzite, these undated formations have not been correlated to any formations exposed in lower Paleozoic sections in Nevada.

Hope and Coats (1976) mapped the Bull Run sequence somewhat differently than Decker (1962). They interpreted the Aura-Chellis contact of Decker (1962) as a thrust fault. Hope and Coats (1976) show the Chellis, Storff, and Van Duzer Formations as a thrust plate containing rocks of Mississippian to Permian (?) age, ~~The method of dating these rocks is not discussed by the authors,~~ although they gave no evidence for the age determinations.

Proposed Research

I propose a stratigraphic-structural study of the Bull Run sequence which would include remapping portions of the Bull Run, Owyhee, Mountain City, and Wildhorse 15' quadrangles (see figures 1 and 3). The stratigraphic units of this sequence will be described in detail, dated ^{if possible}, and redefined if necessary. Description of units will include petrographic and geochemical analysis of selected samples of the formations in the Bull Run sequence. The structural relationships within the sequence and between the Bull Run sequence and the overlying thrust sheets will be investigated.

The proposed study will attempt to answer the following questions:

- 1) Does the Bull Run sequence exist as an uninterrupted lower to middle (or upper?) Paleozoic stratigraphic succession?
- 2) Is the Bull Run sequence autochthonous or was the sequence (or parts of the sequence) thrust into position? If the sequence is (or contains) an allochthonous

sheet(s), when and from where was it transported into its present position?

3) How does the Bull Run sequence compare with other lower Paleozoic sections of the western United States, particularly so called "transitional" assemblages found exposed in other mountain ranges in Nevada? Does the sequence add to or detract from popular paleogeographic models of a lower Paleozoic miogeocline which was disrupted by Paleozoic orogenic events?

Funds are requested for support of one Ph.D. student for 2 1/2 years of work under the following program of research:

Mapping: 2 summer field seasons

The proposed mapping area covers 55-60 square miles of rugged terrain with topographic relief on the order of 3500 feet. A four wheel drive vehicle would be essential to carry out this study. Mapping would concentrate on defining the stratigraphy, dating the units, and understanding two aspects of the structure of the Bull Run sequence: 1) the structure within the sequence 2) the regional structural relationships between the Bull Run sequence and the overlying thrust sheets which contain both the Ordovician Valmy Formation (Roberts Mountains allochthon) and the Mississippian-Permian Schoonover sequence (Golconda allochthon).

Laboratory: 2 1/2 academic years

1) Petrographic analysis of selected samples from the Bull Run sequence will be done to help determine the following: a) composition of the rocks b) diagenetic/metamorphic history of the rocks c) possible location and type of source terranes for the various formations within the sequence d) processing of microfossils for dating rocks by outside personnel.

2) Electron micro-probe, XRF, and XRD analysis of selected samples from the Bull Run sequence to help determine bulk composition of rocks and the diagenetic/metamorphic history of the rocks.

Professors Eldridge M. Moores and Jeffrey F. Mount have agreed to direct my program of research at the University of California at Davis. Field work will begin during the summer of 1982.

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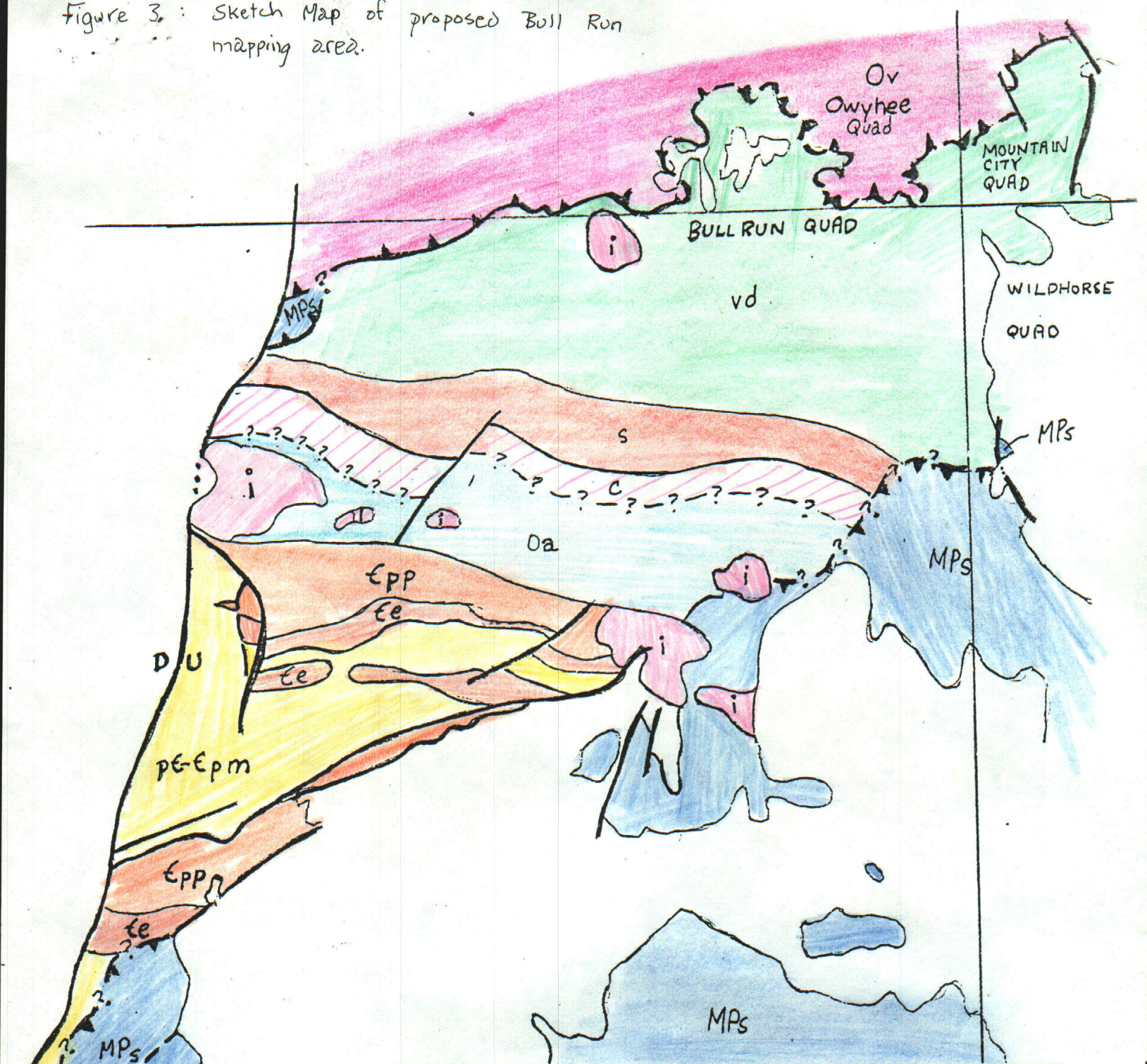
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Figure 3: Sketch Map of proposed Bull Run mapping area.



EXPLANATION:

WHITE AREAS: indicate Tertiary and younger rocks which cover older units.

INTRUSIVE

Contact; dashed where inferred

Contact; nature unknown

Fault; dashed where inferred

Low ANGLE THRUST

dashed where inferred; question marks indicate questionable existence. Sawteeth on upper plate.

ALLOCHTHONOUS ROCKS		AUTOCHTHONOUS ROCKS				
MISSISSIPPIAN - PERMIAN	{		SCHOONOVER SEQUENCE	AGE UNKNOWN		VAN DUZER LIMESTONE
			SCHOONOVER SEQUENCE			STORFF FORMATION
			SCHOONOVER SEQUENCE			CHELLIS FORMATION
ORDOVICIAN	{		VALMY FORMATION	ORDOVICIAN		AURA FORMATION
			PORTER PEAK LIMESTONE			EDGEMONT FORMATION
			PROSPECT MOUNTAIN QUARTZITE			PROSPECT MOUNTAIN QUARTZITE
			PROSPECT MOUNTAIN QUARTZITE			PROSPECT MOUNTAIN QUARTZITE
MESOZOIC(?)	{		INTRUSIVE	CAMBRIAN		EDGEMONT FORMATION
			EDGEMONT FORMATION			EDGEMONT FORMATION
PRECAMBRIAN	{		PROSPECT MOUNTAIN QUARTZITE	PRECAMBRIAN		PROSPECT MOUNTAIN QUARTZITE
			PROSPECT MOUNTAIN QUARTZITE			PROSPECT MOUNTAIN QUARTZITE

map revised from
 Hope & Coats (1976)
 Coats (1971)
 Decker (1962)
 Miller & others (1981)

SCALE 1:100,000

