Structural geology and history of the Buck Mountain fault and adjacent intra-range faults, Teton Range, Wyoming
by Daniel Joseph Smith

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Earth Sciences
Montana State University

Abstract:
The Teton Range in northwestern Wyoming lies on the western margin of Laramide basement-involved deformation in the Rocky Mountain foreland. The study area is located in the central Teton Range and includes the high peaks of the range (the Cathedral Group) and several basement-involved deformation zones. The purpose of this study is to: 1) determine the geometry, kinematics and age of the Buck Mountain, Stewart and Static faults in the central Teton Range, and 2) to characterize post-Archean basement deformation in the Teton Range by examining mesoscopic and microscopic fabrics and alteration mineralogies in the study area.

The north-striking Buck Mountain and northeast-striking Stewart faults exhibit brittle deformation including closespaced, unstable fractures and cataclasites. Slickenlines and drag folds indicate reverse dip-slip on the Buck Mountain fault. Both faults are interpreted to be Laramide on the basis of their basement-involved, contractional nature and brittle deformation.

Static fault strikes northeast, dips steeply southeast and can be divided into two segments: 1) a southwest segment characterized by mylonitic rocks and exhibiting oriented chlorite, relict hornblende crystals, and rotated quartzo-feldspathic porphyroblasts (interpreted to be a Proterozoic phyllonite zone); and 2) a northeast segment that was reactivated by the Buck Mountain fault and exhibits brecciation and cataclasites.

The Laramide Buck Mountain and Stewart fault zones are overprinted by the greenschist-facies assemblage chlorite + sericite + epidote + calcite. These minerals exhibit post-kinematic textures. Palinspastic restoration across the Buck Mountain fault indicates that temperatures in the fault zone during the Laramide orogeny were about 9O°-100°C and pressure around 1 kilobar. It is suggested that late-stage, convective thermal fluids supplied the fault zone with the necessary heat and fluid to produce greenschist-facies assemblages while retaining the brittle nature of the zones.

Structural measurements indicate existence of an Archean discontinuity (the Static Peak discontinuity) where north-striking Archean foliation to the north changes strike to northeast south of Static Peak. Phanerozoic structures are concordant with Proterozoic ductile deformation zones and Archean fabrics indicating that Precambrian basement fabrics controlled the orientations of Phanerozoic structures.

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APPROVAL

of a thesis submitted by

Daniel Joseph Smith

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Signature Daniel J. Smith

Date 1/3/91

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Tiger! Tiger! burning bright
In the forests of the night,
What immortal hand or eye
Could frame thy fearful symmetry?
William Blake

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ABSTRACT

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INTRODUCTION

Purpose of Investigation

The term "Laramide deformation" refers to predominantly compressional, crystalline basement-involved deformation that occurred in the Rocky Mountain foreland province of the western United States during Late Cretaceous to early Tertiary time (Love and Reed, 1971). Many diverse interpretations of structural styles and deformation-enhanced metamorphism representing Laramide deformation have been suggested. These interpretations include purely brittle deformation of a homogeneous basement (e.g., Mitra and Frost, 1981; Matthews, 1986; Mitra, 1990), folding and/or reactivation of preexisting basement fabrics, and greenschist-grade metamorphism associated with Laramide structures (e.g. Wagner, 1957; Hoppin, 1970; Schmidt and Garihan, 1983; Woodward, 1986; Miller, 1987), and brittle to ductile transition in Laramide deformation zones (e.g. Mitra, 1978; Mitra, 1984). Mitra and Frost (1981) have suggested that there are three generations of basement deformation zones in the Wind River Range corresponding to development in the: 1) early Precambrian; 2) late Precambrian; and 3) Laramide. Their work can be used as a

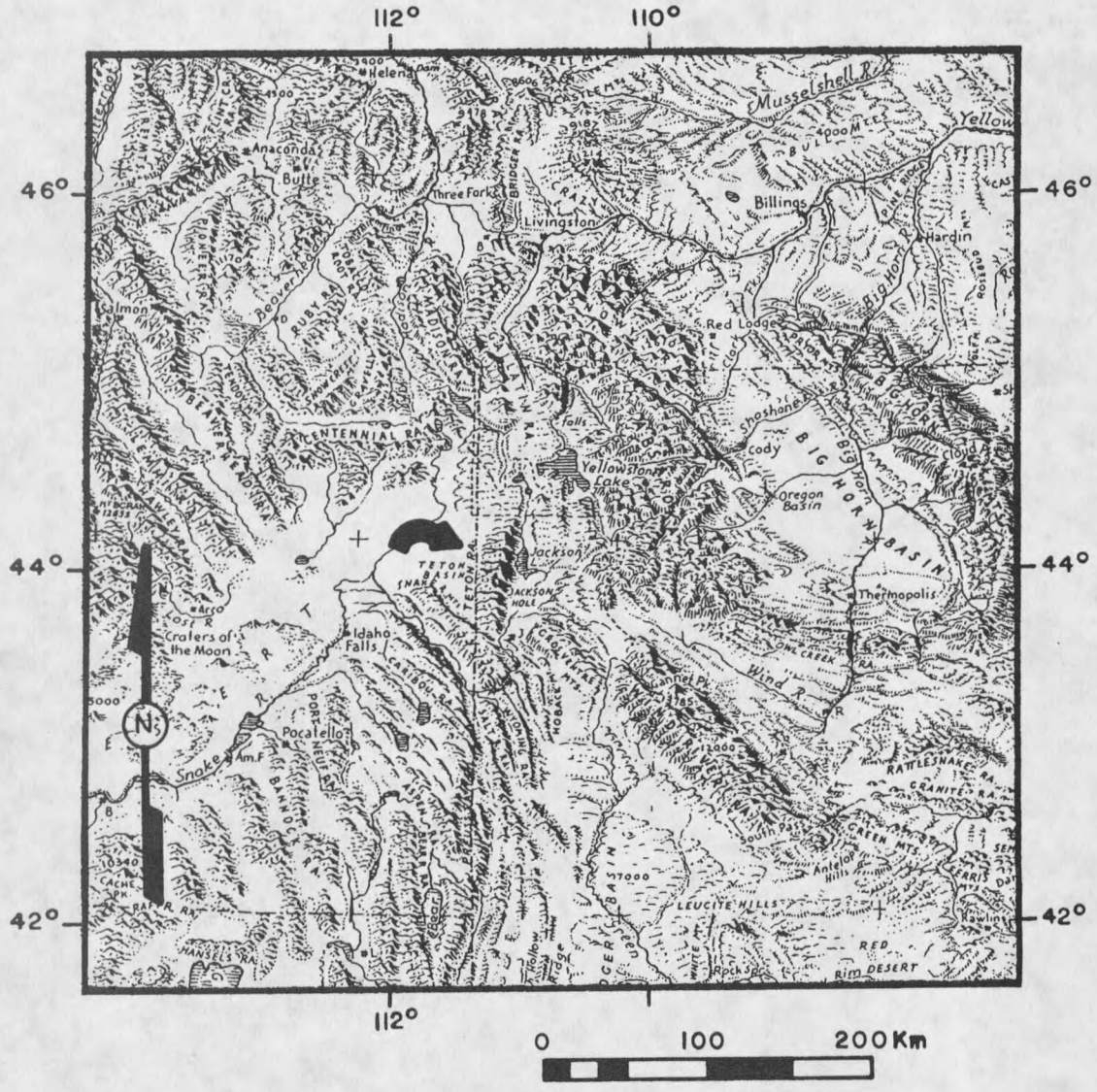

Figure 1 - The Teton Range south of Yellowstone National Park in northwestern Wyoming. From Raisz (1956).

base from which to compare basement deformation in other regions of the Rocky Mountain foreland.

The Teton Range (Figure 1) lies on the western-most margin of Laramide (basement-involved) deformation in the Wyoming foreland. The highest peaks in the Teton Range, the Cathedral Group, are clustered in the central part of the

range. They are bounded on the west and south by the Buck Mountain reverse fault (Love, 1968), on the southeast by the Static and Stewart faults (Bradley, 1956), and on the east by the Teton normal fault (Figure 2).

It has been assumed that the Buck Mountain fault in the central Teton Range is a Late Cretaceous to Early Eocene, Laramide-style reverse fault on which the high peaks of the Teton Range were uplifted (Love, 1968; Love and Reed, 1971; Love and others, 1973). In addition, Bradley (1956) mapped the Static and Stewart faults in the central Teton Range as high-angle Precambrian reverse faults that were reactivated during the Laramide orogeny. However, no definitive evidence has been presented to support these contentions. Furthermore, the mechanical response of Archean "basement" rocks and metamorphism occurring as a result of the Laramide orogeny have not been well documented in this area.

The purpose of this study is to: 1) characterize the geometry, kinematics, and ages of the Buck Mountain, Static, and Stewart faults, and determine their structural relationship; and 2) further the understanding of Laramide basement deformation by comparing the criteria presented by Mitra and Frost (1981) for differentiating early Precambrian, late Precambrian, and Laramide deformation zones in the Wind River Range with characteristics of deformation in the study area.