Early tectono-sedimentary history of a Neogene extensional basin in east-central Nevada
by Cheryl Lynn Brown

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

Abstract:
The Neogene Horse Camp Formation of east-central Nevada is a thick, well-exposed extensional basin-fill sequence composed of conglomerate, sandstone, mudrock, and limestone. The lowest member of this formation, Member 1, was examined to develop a tectono-sedimentary model for the initial phases of an extensional basin evolution. Nine stratigraphic sections were measured. Sixteen lithofacies and five lithofacies assemblages were described. Spatial and temporal distribution of these lithofacies assemblages provide the basis for determining the paleogeography and depositional environments that characterized the area while Member 1 was being deposited.

Fifty-three samples of volcaniclasdc sandstone analysis were collected for petrographic analysis. Clast counts were completed in order to determine conglomerate compositions. Conglomerate and sandstone compostion provide infomation about the provenance of Member 1. The paleogeography of the area was determined by calculating the paleoflow and paleoslope directions from measured trough axes in sandstone and folds at the base of megabreccias.

Member 1 is composed of two distict petrofacies which record a temporal change in sediment source areas. The lower portion is composed of sediment deposited on the medial to distal portions of a large radius alluvial fan derived from a western source terrain composed of volcanic rocks. The upper portion is composed of sediment deposited on large alluvial fans shed from a hangingwall block to the north and small alluvial fans deposited off of a football block to the south. Both source terrains were composed of Oligocene volcanic rocks and Paleozoic sedimentary rocks. Mudrock was deposited in a lacustrine setting between these alluvial fans.

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APPROVAL

of a thesis submitted by

Cheryl Lynn Brown

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.

March 9, 1993
Date

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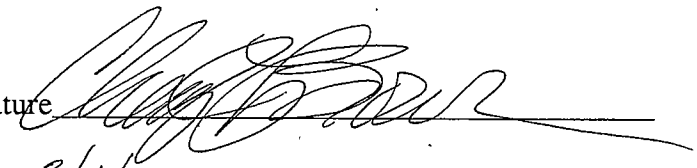
Signature 

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ABSTRACT

The Neogene Horse Camp Formation of east-central Nevada is a thick, well-exposed extensional basin-fill sequence composed of conglomerate, sandstone, mudrock, and limestone. The lowest member of this formation, Member 1, was examined to develop a tectono-sedimentary model for the initial phases of an extensional basin evolution. Nine stratigraphic sections were measured. Sixteen lithofacies and five lithofacies assemblages were described. Spatial and temporal distribution of these lithofacies assemblages provide the basis for determining the paleogeography and depositional environments that characterized the area while Member 1 was being deposited.

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INTRODUCTION

Patterns of sedimentation in extensional basins are fundamentally related to local normal fault geometry and kinematics. The spatial and temporal geometry of the basin and its surrounding orogen must be analyzed in order to understand the evolution of extensional basins. This study represents the initial phase of an ongoing research project of James G. Schmitt and others focused on the tectono-sedimentary development of the Neogene Horse Camp basin of east-central Nevada and its surrounding extensional orogen: the northern Grant, Horse, and southern White Pine Ranges (Figures 1 and 2). This area was selected for study because of the presence of an unusually thick (3000 meter), well-exposed, Neogene basin-fill sequence of conglomerate, sandstone, mudrock, and limestone called the Horse Camp Formation. Seismic data reveal that many Oligocene to Recent basin-fill sequences in the northern Basin and Range province reach thicknesses of 2000-3000 meters beneath modern valleys (Effimoff and Pinezich, 1981, 1986; Anderson and others, 1983; Gans and others, 1989). However, continuing late Cenozoic extension and basin subsidence cause exposures of basin-fill to be relatively uncommon. Therefore, field-based studies of extensional basin-fill sedimentology and stratigraphy are inhibited and the tectono-sedimentary history of extensional orogenic systems is obscured. From this perspective, the Neogene Horse Camp Formation provides an unusual opportunity to examine the development of a synextensional basin.

A detailed analysis of the sedimentology and stratigraphy of the basal member (Member 1) is described and related to local structures in order to develop a tectono-sedimentary model for the initial phases of development of the Horse Camp depositional

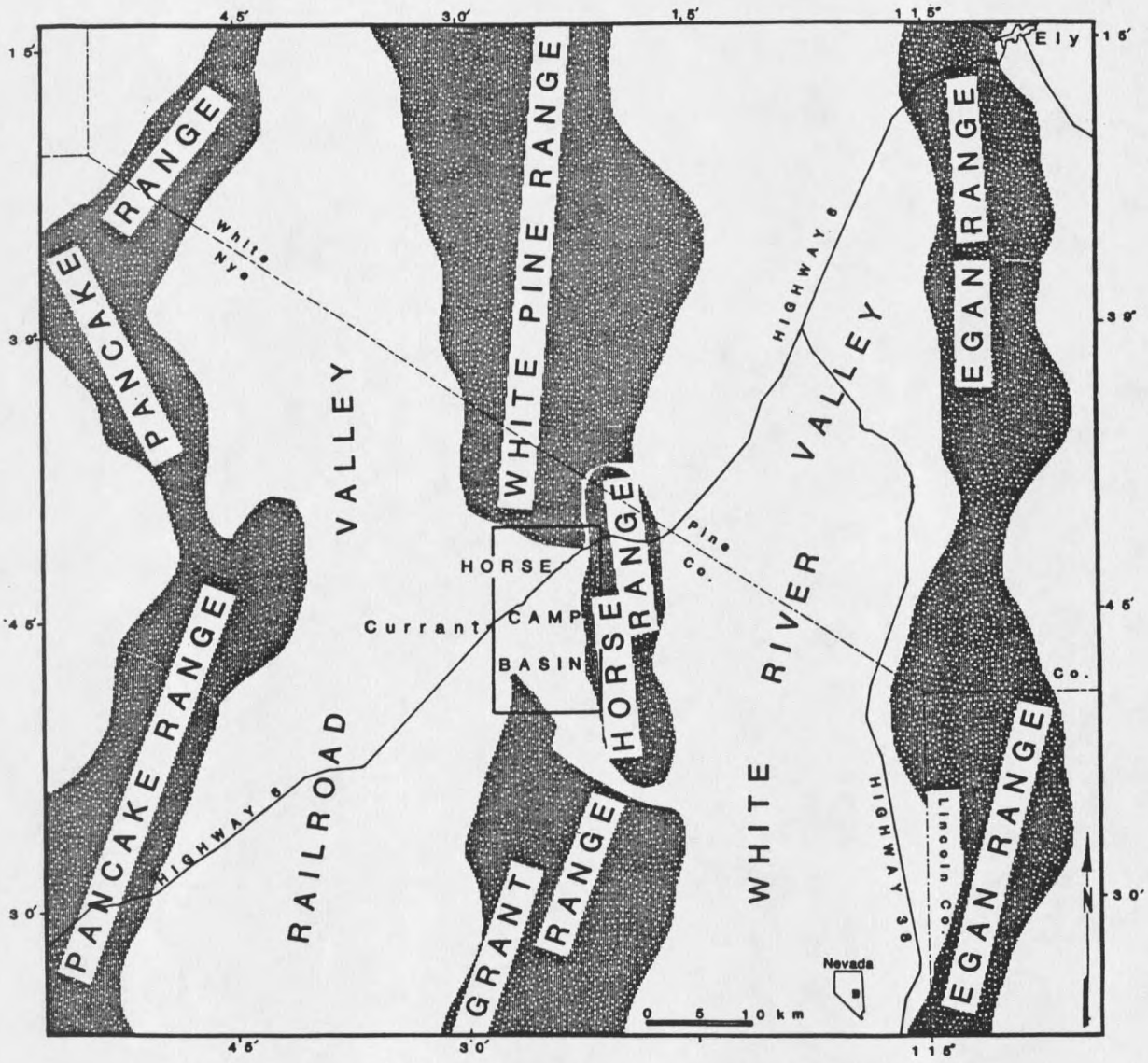

Figure 1. Location of Horse Camp basin study area relative to pertinent geographical features in the region. Stippled areas are mountain ranges. Outlined area is shown in more detail in Figure 2

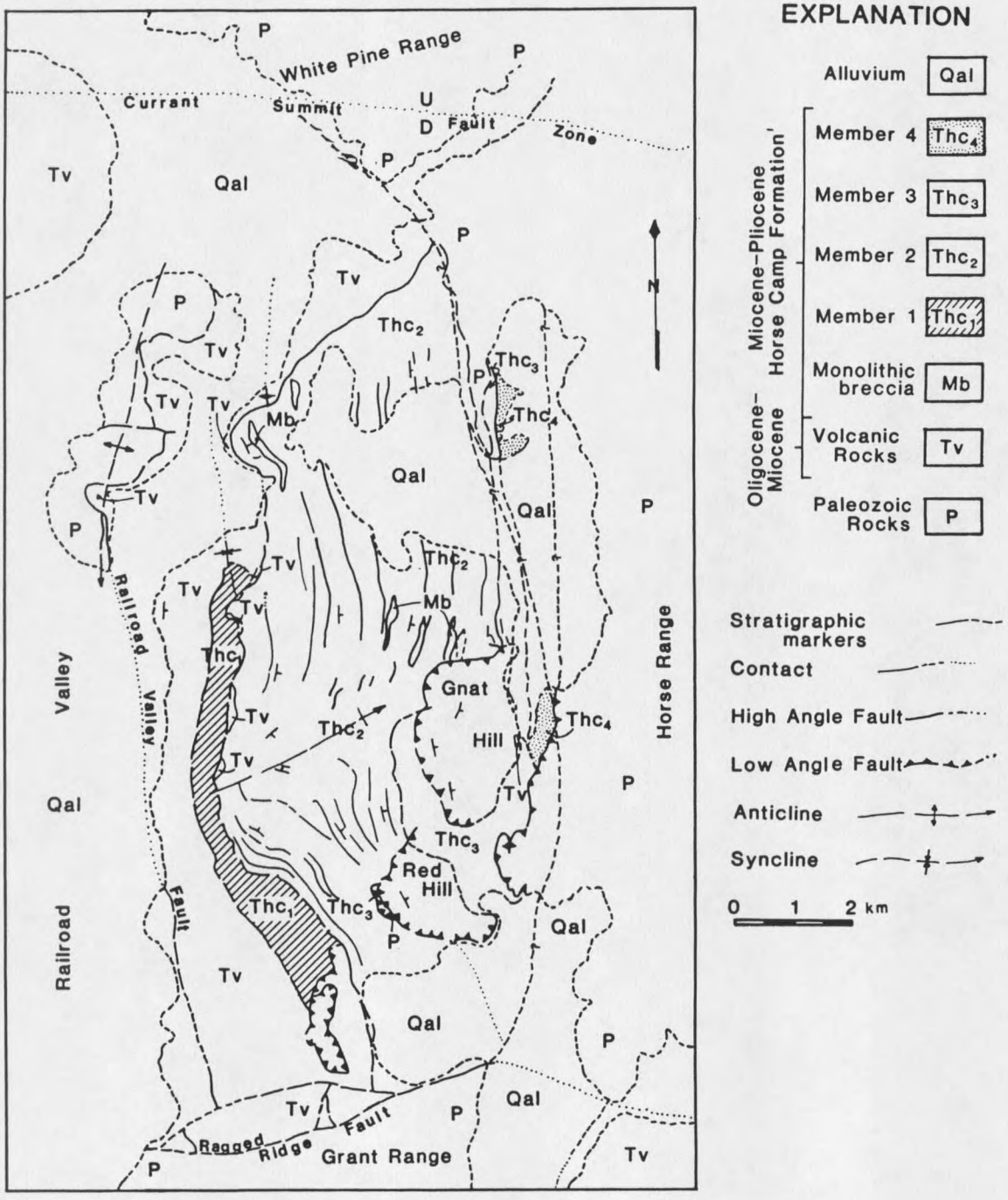

Figure 2. Generalized geologic map of the Horse Camp basin and surrounding area. Modified from Moores (1968).

basin(s). The results of this research are compared to various sedimentary and structural models of extensional basins which are described below.

Sedimentary Models of Extensional Basins

Integration of sedimentology and structural geology have advanced our understanding of relations between development of extensional sedimentary basins and mechanics and style of continental lithospheric extension (e.g. Sclater and Celerier, 1987; Schlische and Olsen, 1990). Numerous models describing the development of extensional sedimentary basins have been developed in the last 15 years. The earliest models describe these basins as relatively simple grabens bounded by high-angle normal faults (Stewart, 1978; Illies, 1981). Because of the structural symmetry of this type of basin, sediment dispersal patterns are also symmetrical with coarser sediment deposited nearest to the adjacent highlands and finer sediment near the center of the basin (Reading, 1982). However, detailed analyses of sedimentology and stratigraphy of actual extensional basins indicate that these types of models are over simplified (Bally and Snelson, 1980).

Advancements in structural geology and geophysics have led to the identification of half grabens that develop in response to block rotation on listric normal faults which sole at depth into low-angle detachments or crustal shear zones (e.g. Wernicke and Burchfiel, 1982; Jackson and others, 1982; Jackson and McKenzie, 1983; Gibbs, 1984; and Rosendahl and others, 1986). Gibbs (1984) has identified several structural complexities of listric normal fault systems including hanging wall folds, transfer structures which act as accommodation zones between areas which have undergone different amounts of extension, and intrabasinal antithetic and synthetic normal faulting. The asymmetry of basins bounded by listric normal faults within continental rift systems is not consistently