



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

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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.

Fifty-three samples of volcanoclastic sandstone analysis were collected for petrographic analysis. Clast counts were completed in order to determine conglomerate compositions. Conglomerate and sandstone composition provide information 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 distinct 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 footwall 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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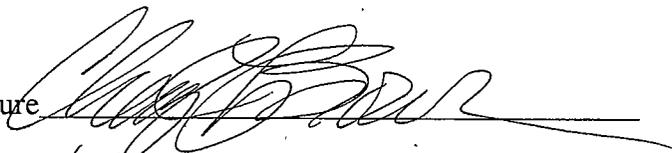
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Date

3/1/93

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TABLE OF CONTENTS

	Page
INTRODUCTION	1
Sedimentary Models of Extensional Basins.....	4
Structural Models of Extensional Basins	6
Integration of Sedimentologic and Structural Models.....	8
Objectives of Study	10
GEOLOGIC SETTING	13
HORSE CAMP FORMATION.....	19
METHODS.....	26
Field Methods.....	26
Laboratory Methods.....	29
SEDIMENTOLOGY.....	30
Lithofacies.....	30
Clast-Supported, Ungraded Conglomerate (Gcu).....	30
Description	30
Interpretation.....	35
Clast-Supported, Normally Graded Conglomerate(Gcn).....	37
Description	37
Interpretation.....	37
Clast-Supported, Inversely Graded Conglomerate (Gci).....	40
Description	40
Interpretation.....	41
Matrix-Supported, Ungraded Conglomerate (Gmu).....	45
Description	45
Interpretation.....	46
Matrix-Supported, Normally Graded Conglomerate (Gmn).....	47
Description	47
Interpretation.....	47
Matrix-Supported, Inversely Graded Conglomerate (Gmi).....	48
Description	48
Interpretation.....	49
Lateral Gradations in Massive Conglomerate Lithofacies.....	49
Horizontally Stratified Conglomerate (Gh).....	51
Description	51
Interpretation.....	51
Trough Cross-stratified Conglomerate (Gt).....	53
Description	53
Interpretation.....	53
Massive, Ungraded Sandstone (Sm).....	54

Description	54
Interpretation.....	55
Normally Graded Sandstone (Sn).....	55
Description	55
Interpretation.....	57
Inversely Graded Sandstone (Si).....	57
Description	57
Interpretation.....	57
Horizontal and Low-Angle Stratified Sandstone (Sh/Sl)	58
Description	58
Interpretation.....	60
Ripple Cross-Stratified Sandstone (Sr).....	60
Description	60
Interpretation.....	61
Trough Cross-Stratified Sandstone (St)	61
Description	61
Interpretation.....	62
Laminated Mudrock (Fl).....	62
Description	62
Interpretation.....	63
Lithofacies Assemblages and Depositional Environments.....	65
Proximal Alluvial Fan Deposits.....	65
Facies Assemblages.....	65
Interpretation.....	69
Medial Alluvial Fan Deposits	70
Facies Assemblages.....	70
Interpretation.....	72
Distal Alluvial Fan Deposits.....	72
Facies Assemblages.....	72
Interpretation.....	73
Sandflat Deposits.....	75
Facies Assemblages.....	75
Interpretation.....	75
Lacustrine Deposits	77
Facies Assemblages.....	77
Interpretation.....	77
Summary of Depositional Environments	78
 MEGABRECCIAS.....	 79
Introduction	79
Definition and Interpretation of Megabreccia Lithofacies.....	82
Deformed Substrate (DS).....	84
Description	84
Interpretation.....	89
Mixed Zone (MZ)	89
Description	89
Interpretation.....	91
Clastic Dikes (CD)	91
Description	91
Interpretation.....	93
Breccia Sheet.....	93

Disrupted Zone (DZ).....	95
Description.....	95
Interpretation.....	95
Comminuted Slip Surfaces (CSS).....	96
Description.....	96
Interpretation.....	96
Matrix Poor Zone (MPZ).....	98
Description.....	98
Interpretation.....	102
Boulder Cap (BC).....	102
Description.....	102
Interpretation.....	103
Longitudinal Trends.....	103
Proximal Stratigraphy.....	103
Medial Stratigraphy.....	105
Distal Stratigraphy.....	105
Emplacement of Megabreccias.....	106
PALEOCURRENTS AND PALEOSLOPE.....	108
PETROGRAPHY.....	111
Conglomerate.....	111
Composition.....	111
Oligocene Volcanic Rocks.....	112
Paleozoic Rocks.....	113
Composition Modes.....	114
Sandstone.....	115
Texture.....	115
Framework Grain Composition.....	117
Monocrystalline Quartz (Qm).....	118
Polycrystalline Quartz (Qp).....	118
Feldspar (F).....	118
Lithic Fragments (L).....	119
Sandstone Composition Modes.....	119
PROVENANCE.....	125
TECTONIC IMPLICATIONS.....	128
Early Tectonic History of the Horse Camp Basin.....	128
Influence of Transverse Structures on Member 1 Deposition.....	131
Rolling Hinge Model.....	134
REFERENCES CITED.....	136
APPENDIX.....	152
1. Clast count data summarizing the eight different types of clasts recognized in Member 1 of the Horse Camp Formation.....	153
2. Tabulation of the relative percentages of the eight different types of clasts in Member 1.....	154

3. Point count data summarizing the amount of each type of framework grain recognized in the sandstones from the northern portion of Member 1	155
4. Tabulation of the relative percentages of the framework grains identified in sandstones from the northern portion of Member 1	156

LIST OF TABLES

Table	Page
1. Lithofacies abbreviations, descriptions, and interpretations	31
2. Clast count data summarizing the eight different types of clasts recognized in Member 1 of the Horse Camp Formation.....	153
3. Tabulation of the relative percentages of the eight different types of clasts of Member 1.....	154
4. Point count data summarizing the amount each type of framework grain recognized in the sandstones of the northern portion of Member 1.....	155
5. Tabulation of the relative percentages of the framework grains that were identified from sandstones in the northern portion of Member 1.....	156

LIST OF FIGURES

Figure	Page
1. Location of Horse Camp basin study area relative to pertinent geographical features in the region	2
2. Generalized geologic map of the Horse Camp basin and surrounding area.....	3
3. Stratigraphy of Paleozoic and Cenozoic rocks in the vicinity of the northern Grant, Horse and southern White Pine Ranges and Horse Camp basin	17
4. Generalized stratigraphic column for the Horse Camp Formation	20
5. Geologic map of Member 1 of the Horse Camp Formation showing the location of measured section A through I	21
6. View toward north from near top of Section A showing the basal contact of Member 1 with underlying Window Butte Formation	22
7. Angular contact between Member 1 on the left and Member 2 on the right along Big Wash	23
8. Well developed shadow structure on downflow side of cobble clast	28
9. Matrix-supported, ungraded, pebble to cobble conglomerate (Gmu) with overlying clast-supported, ungraded, cobble to boulder conglomerate (Gcu)	33
10. Interbedded, laterally continuous conglomerate and sandstone units.....	34
11. Interbedded sandstone and conglomerate units deposited in a distal alluvial fan environment	36
12. Lithofacies transition within a massive conglomerate	38
13. Interbedded conglomerate and sandstone units deposited in a medial alluvial fan setting.....	39
14. Interbedded conglomerate and sandstone units deposited in a proximal alluvial fan setting.....	42
15. Interbedded conglomerate units deposited in a medial alluvial fan setting	43

16. Interbedded sandstone and conglomerate deposited in a medial alluvial fan setting	44
17. Interbedded sandstone and conglomerate deposited in a medial alluvial fan setting	50
18. Tilted interbedded horizontally stratified sandstone (Sh) and conglomerate (Gh)	52
19. Interbedded sandstone and mudstone deposited on a sandflat	56
20. Shallow scour (35 cm deep) filled with low-angle stratified sandstone (Sl) and horizontally bedded granule to pebble conglomerate (Gh), trough cross-stratified sandstone (St), and horizontally stratified sandstone (Sh) and granule, pebble conglomerate (Gh).....	59
21. Bioturbated silicified laminated mudstone (Fl).....	64
22. Schematic block diagram showing the characteristic distribution of proximal, medial, and distal alluvial fan and sandflat environments and lithofacies assemblages off of the footwall block.....	66
23. Proximal alluvial fan depositional sequence.....	67
24. Detailed lithofacies profiles showing representative proximal alluvial fan lithofacies assemblages	68
25. Detailed lithofacies profiles showing representative medial alluvial fan lithofacies assemblages	71
26. Detailed lithofacies profiles showing representative distal alluvial fan lithofacies assemblages	74
27. Detailed lithofacies profiles showing representative sandflat lithofacies assemblages	76
28. Panorama looking east of the two stratigraphically lower slide blocks composed of Railroad Valley Rhyolite and Windous Butte Formation.....	80
29. View northward from Section B towards Sections C and F.....	81
30. Schmatic block diagram showing the longitudinal changes within a megabreccia block.....	83
31. Effects of scouring at the base of a megabreccia	85
32. Deformation of substrata.....	86

33. Intense folding of mudstone layer	87
34. View to the south from Section F of outcrop of stratigraphically highest megabreccia.....	88
35. Mixed zone at the base of megabreccia block.....	90
36. Clastic dike extending into the megabreccia block	92
37. Disrupted zone with the contorted clastic dikes	94
38. Comminuted shear surfaces dipping to the right	97
39. Jigsaw breccia composed of pebble to cobble sized clasts that have undergone minimal rotation in a sandy matrix.....	99
40. Cliff of crackle breccia composed of very angular cobble to boulder sized clasts that have not undergone rotation and are separated by a layer of very thin sandy matrix.....	100
41. A cliff of massive nonbrecciated Railroad Valley rhyolite within the megabreccia block.....	101
42. Equal area stereographic projections showing: a) Measured trend and plunge of south vergent fold axes in deformed substrate at the base of the stratigraphically highest megabreccia in Member 1	110
43. Graphs showing the stratigraphic variation in relative percentage of conglomerate clast lithologies for measured sections of Member 1 of the Horse Camp Formation	116
44. QmFLt ternary diagram showing the provenance of Member 1 sandstones.	120
45. QtFL ternary diagram illustrating the provenance of Member 1 sandstones	121
46. QpLvLs ternary diagram showing arc orogen provenance of Member 1 sandstones.....	122
47. Graphs showing the vertical changes in sandstone composition for selected measured sections of Member 1 of the Horse Camp Formation.....	124
48. Schematic block diagram showing distribution of alluvial fan assemblages and location of the western source for the volcanic petrofacies	129
49. Schematic block diagram depicting the paleogeography and paleotectonic setting of the mixed petrofacies.....	132

LIST OF PLATES

1. Location and description of the nine measured stratigraphic sections of Member 1 of the Horse Camp Formation.
2. General distribution of alluvial fan, sandflat and lacustrine facies assemblages of Member 1 of the Horse Camp Formation. See legend on Plate 2 for symbols.

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

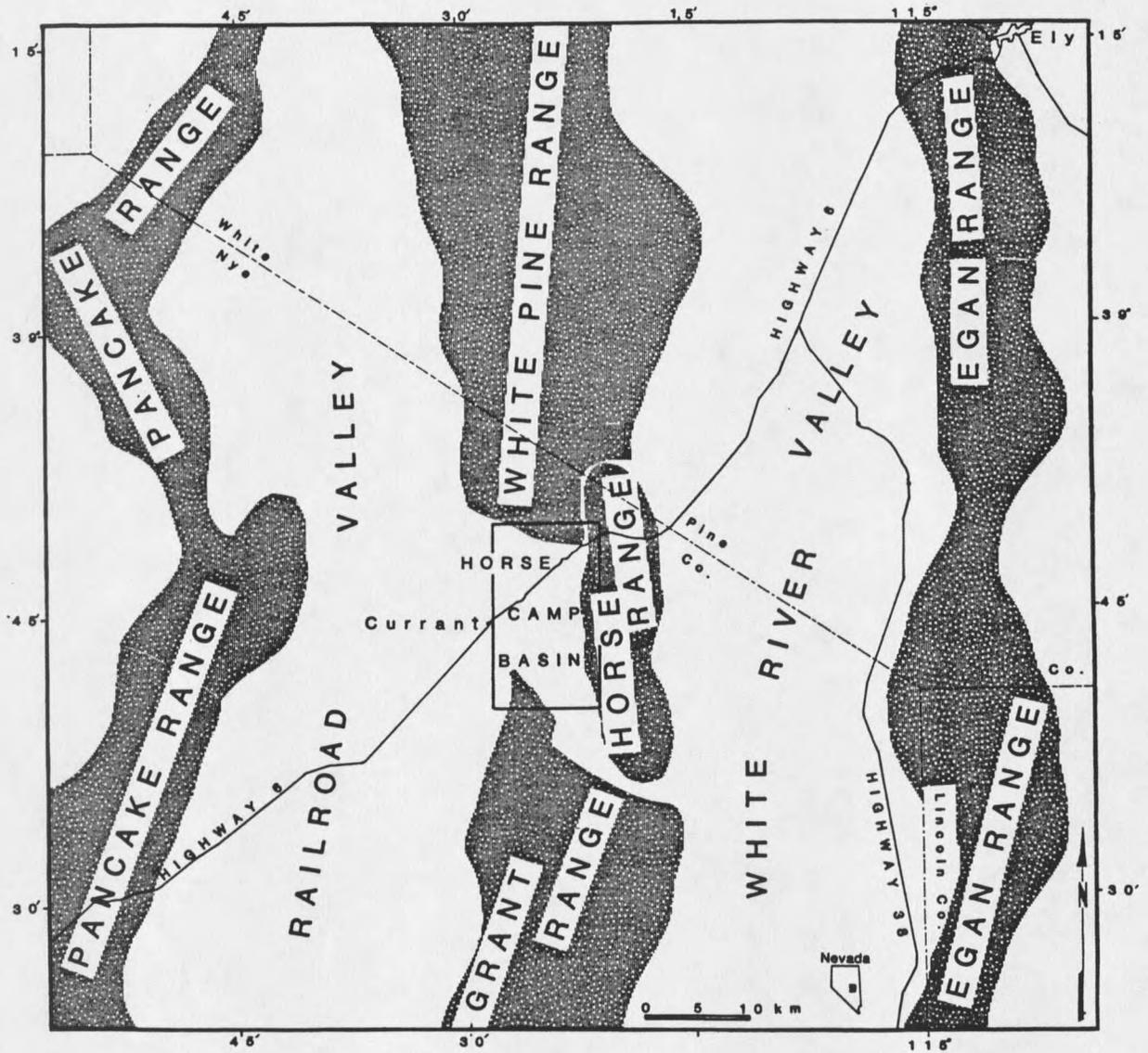


Figure 1. Location of Horse Camp basin study area relative to pertinent geographical features in the region. Stippled areas are mountain ranges. Outlined area is shown in more detail in Figure 2

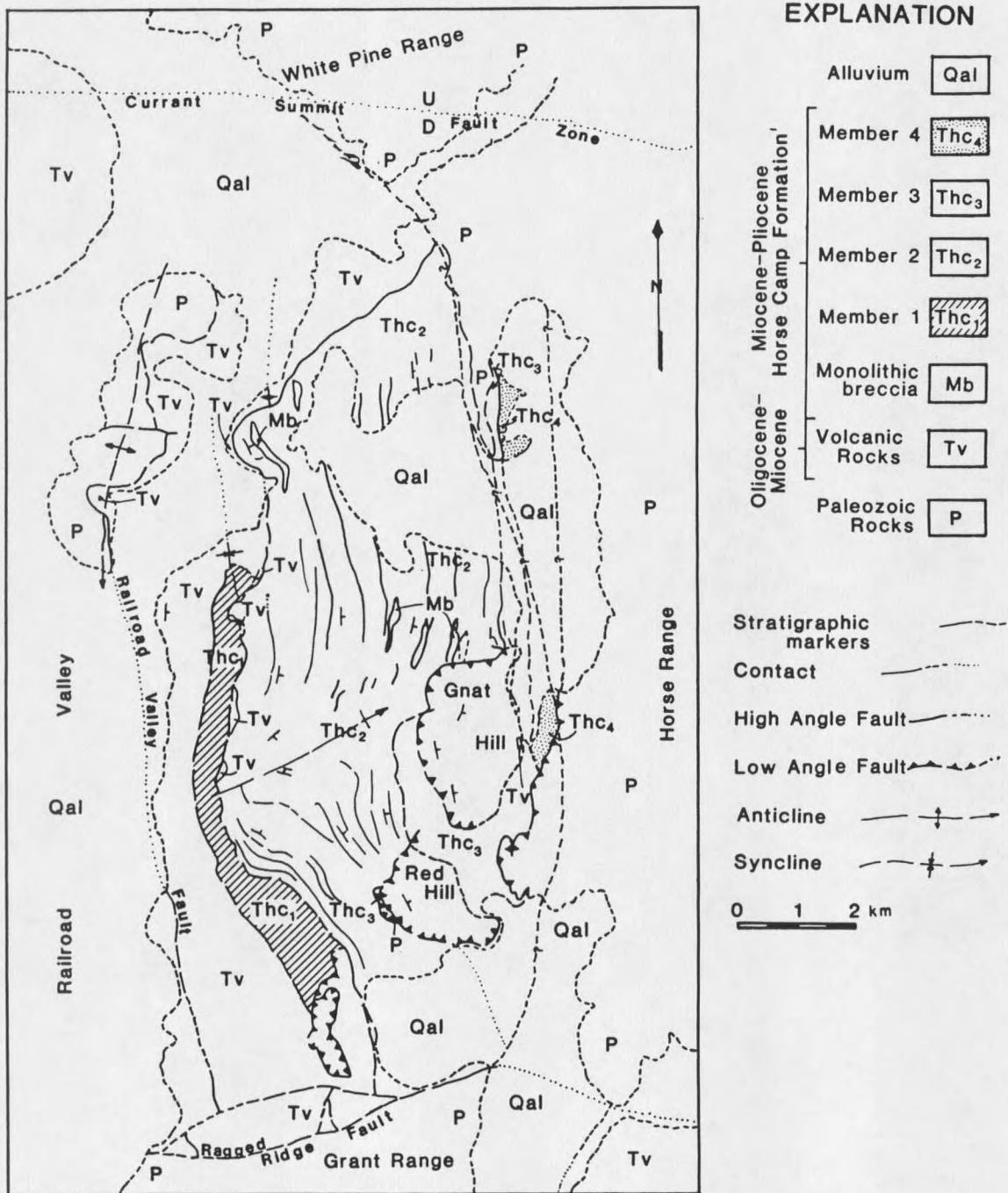


Figure 2. Generalized geologic map of the Horse Camp basin and surrounding area. Modified from Moores (1968).

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

