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The University of Texas at El Paso, 1987

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STRUCTURAL GEOLOGY AND GEOPHYSICS OF THE PIPELINE COMPLEX NORTHERN FRANKLIN MOUNTAINS EL PASO, TEXAS

by

SANDS HARDIN FIGUERS B.A.,B.S.

DISSERTATION

Presented to the Faculty of the Graduate School of

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NORTHERN FRANKLIN MOUNTAINS

EL PASO, TEXAS

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This Dissertation is

Dedicated to

Dr. E. M. P. Lovejoy

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ABSTRACT

The Pipeline Complex is a low set of hill along the eastern side of the Franklin Mountains, El Paso, Texas. Their origin has been attributed to either a recent landslide independent of range uplift (Lovejoy, 1976a-e); or, rotation of early high-angle Eastern Boundary Fault Zone (EBFZ) faults to low angle by subsequent range uplift (Seager, 1981).

Mapping of the Complex identified three east dipping fault bound plates with simple internal structures. The plates are stacked upon each other, with each plate being younger and cutting the underlying plate. The youngest (uppermost) plate cuts off the eastern end of the main boundary fault. The main boundary fault is a north-south trending (25-35° E dip) scissors fault with displacements ranging from zero at the north to 10000 feet (3050 m) in the south. The internal structures can be accounted for by differential internal movement of the plates as a result of the main boundary fault scissor motion. A magnetic survey demonstrated that little magnetic material, presumably Precambrian, was incorporated into the Pipeline Complex. As part of the survey, magnetic susceptibility measurements were made on samples of units in the Franklins.

The important point is that beds in the Pipeline Complex dip 20-25° W while the same units dip 50-60° W in the main ridge of the Franklins just to the west. This relationship as well as the internal structures is difficult to explain with either previous theory. The Pipeline Complex probably initially developed as a long term toppling

failure into the 'bench' identified on seismic line 6-B. The failure was associated with, but not structurally related to, EBFZ development.

Talwani-type models of a gravity profile across the Franklin Mountains (20 miles [36 km] long, 1000 stations) suggests the existence of a near surface, high density dike (3.00 gm/cm^3) just west of the main ridge of the Franklins. Various EBFZ orientations were modeled. In all orientations the upper part of the EBFZ (0-5000 feet [0-1500 m]) could only be modeled with an east dip greater than 45° because of constraints from surface geology. At greater depths the EBFZ could be modeled as a normal, step, or reverse fault. Modeling also suggested that the Western Boundary Fault Zone (WBFZ) was located west of the Anthony synclinorium. A magnetic profile along the same line exhibited a large (250 gamma) monoclinal anomaly which did not match the gravity profile. The EBFZ did not seem to have a magnetic anomaly.

An east-west seismic line (line 6-B) across the northern Franklin Mountains was interpreted. The EBFZ was evident and was interpreted to be a high angle, east dipping normal fault (to a depth of 1.8-2.0 seconds). The EBFZ did not appear to be listric. Between the EBFZ and the outcropping ridge of the northern Franklins is a structurally complex bench with an estimated depth of 2000 feet (600 m). Neither the WBFZ or the Franklin Mountain Dike were visible. Seismic lines in the Mesilla Bolson (lines 6, 7, and 10) showed that basin fill has a uniform thickness of 2500 feet (760 m).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES