INTRODUCTION

In 1985, Compagnie Generale de Geophysique (CGG) acquired 300 mi (483 km) of regional, nonexclusive Vibroseis seismic data in the Rough Creek graben area of western Kentucky and southern Illinois. Data consist of four dip lines and a 100 mi (161 km) strike line (Figure 15-1). Field acquisition, processing, and display parameters for the data are presented in Table 15-1. Energy penetration was good and "seismic-basement" reflections were observed locally down to two-way travel times of approximately 3.0 seconds.

Sonic logs and formation tops from two deep wells in Webster County, Kentucky (Table 15-2), were integrated into the study. Depth-to-time conversion functions were generated for each well, and a two-way time representation of the wells was prepared. Major seismic events were identified by correlating formation tops in the wells to seismic data.

The major seismic reflections were then traced around the seismic grid. The nature of the grid did not allow us to "tie loops"; "jump" correlations were, therefore, commonly made across faults. Such correlations were based primarily on reflection character and stratigraphic thickness. Interpretation was relatively straightforward for shallow data within the Moorman syncline, but correlations across the northern and southern boundary faults of the Rough Creek graben and in the deeper section are more tentative.

Two-way time and isochron values were read from the seismic data and then converted to depth and thickness respectively, using interval velocities derived from well data.

The data, studied and integrated into a consistent geologic picture, added considerable new insight into the structural history of the western Kentucky-southern Illinois area.

NORTHERN BOUNDARY OF ROUGH CREEK GRABEN AND ROUGH CREEK FAULT ZONE

The Rough Creek fault zone is a zone of deformation that has been mapped at the surface. Figure 15-2 shows a segment of seismic line that crosses the Rough Creek graben (at depth) and the Rough Creek fault zone (surface). Seismic data lead to several geologic interpretations:

1. The bounding fault of the ancient Rough Creek graben is normal and listric, dipping towards the south. It penetrates inferred "basement."

2. Pre-Knox sediments are much thicker south of the bounding fault than north of the fault. Within the graben, Pre-Knox rift-fill sediments thicken towards the north, indicating that the rift was asymmetrical, with subsidence taking place more rapidly in the north than in the south.

3. At inferred basement level, maximum present-day throw across the graben-bounding fault in this area is at least 8000 ft (2.4 km), down to the south.

4. A fault zone extends upwards from the graben-bounding fault to the outcrop of the Rough Creek fault zone. Throw across the northernmost fault in this zone is variable—1300 ft (396 m) at base