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Kessler, L. G., II

1972, pp. 165-167. https://doi.org/10.56577/FFC-23.165

in:

East-Central New Mexico, Kelley, V. C.; Trauger, F. D.; [eds.], New Mexico Geological Society 23 rd Annual Fall Field Conference Guidebook, 236 p. https://doi.org/10.56577/FFC-23

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CHANNEL GEOMETRY, DEVELOPMENT, AND VARIATION, SOUTH CANADIAN RIVER, EASTERN NEW MEXICO AND WEST TEXAS

by

L. G. KESSLER, II
Canada–Cities Service, Ltd.
Calgary, Alberta

INTRODUCTION

The Canadian-South Canadian River system in eastern New Mexico and West Texas has developed a complex variety of channel patterns. The river flows in a shallow, narrow valley with its source just northwest of Raton, New Mexico in Las Animas County, Colorado. The river turns from southwestward to south near Raton and flows nearly due south to Conchas Reservoir in San Miguel County. Here it turns due east into West Texas and Oklahoma (Fig. 1).

From its source to central Oldham County, Texas, the Canadian-South Canadian River is a highly sinuous, coarse-grained meander belt channel system with point bars developed on meander bends. Across this area, the river width does not exceed 250 yards. In central Oldham County and to the east, the South Canadian River valley straightens and maintains a braided channel pattern through west Texas and Oklahoma. Throughout this area, the river widens greatly commonly reaching widths of nearly 2 miles. The dominant floodplain features observed east of Oldham County include longitudinal and transverse bars as described by Kessler and Cooper (1970) and Kessler (1971, 1972). These floodplain changes will be

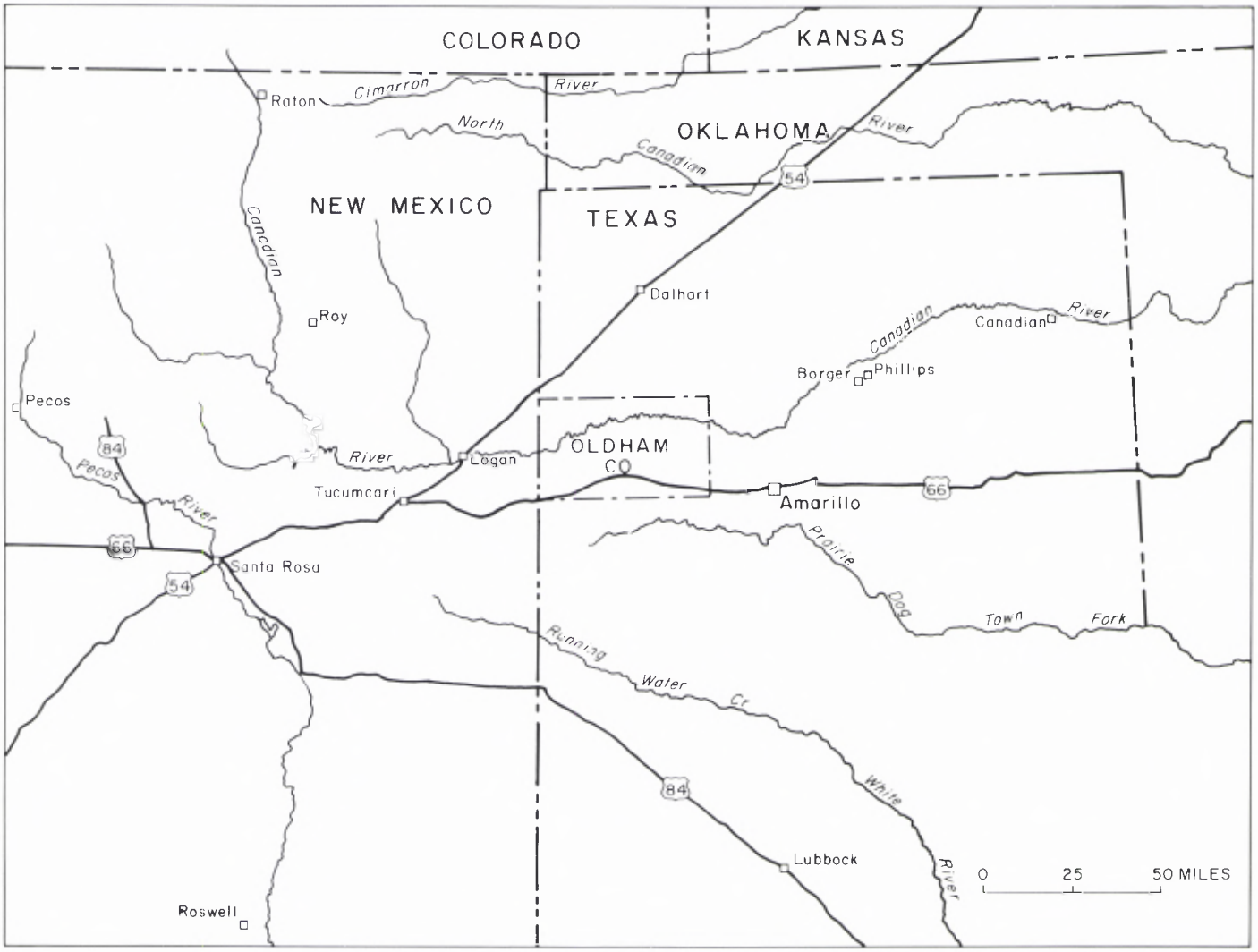

Figure 1. Location of study area.

discussed in terms of channel gradient and average daily discharge.

The Canadian and Pecos Rivers in eastern New Mexico may have a related geomorphic history. The apparent alignment of the two rivers (Fig. 1) raises interesting questions about their development during Pleistocene time.

CHANNEL GEOMETRY AND FLOODPLAIN VARIATION

The Canadian River has a meandering channel system in eastern New Mexico and West Texas. The Canadian River near Roy, New Mexico (Fig. 2A) has developed low point bars and transports a highly graveliferous load. Topographic maps and field observations show that the Canadian River in eastern New Mexico is very sinuous and meandering. Using Brice's (1964) sinuosity index (Sinuosity Index = length of active channel) to show the degree of meandering in a stream, this part of the Canadian system has a sinuosity index of 1.72. This is compared to a sinuosity index of 1.18 east of Oldham County, Texas. Brice (1964) states that a sinuosity index of 1.00 is a perfectly straight channel, and that 1.50 is the maximum index for a braided channel. Figure 2B shows the braided pattern in the South Canadian River in its lower sinuosity reaches in the eastern Texas Panhandle.

Channel gradient also varies greatly between eastern New Mexico and West Texas. In New Mexico, the gradient varies from 56.4 feet per mile in the mountains to the northwest to 18.0 feet per mile on the plains and in the canyons from Raton to Conchas Reservoir. The gradient of the river across the Texas Panhandle varies from 7.2 feet per mile in western Oldham County to 5.5 feet per mile in the eastern Texas Panhandle. Thus, an increase in braiding appears to occur with a decrease in gradient.

Schumm (1972) points out that an increase in sinuosity usually occurs with an increase in valley slope and channel gradient. Thus, it appears that the meandering and highly sinuous part of the river is mostly related to higher channel gradient in eastern New Mexico. Lower channel gradient, excess sediment supply, and highly variable discharge contribute to a straighter and braided channel in the South Canadian River in the Texas Panhandle.

The floodplain pattern of the Canadian River is highly sinuous (Fig. 2A). The continual growth and eradication of

Figure 2A. Active channel of the Canadian River near Roy, New Mexico (river floodplain is 200 feet wide).

Figure 2B. Braided active channel of the South Canadian River, eastern Texas Panhandle (bar in foreground is 25 feet wide).

numerous graveliferous point bars shows that the river is constantly downcutting and removing most of its earlier floodplain deposits. Conversely, the South Canadian River east of Oldham County, Texas has preserved a moderately complete record of earlier active channel deposits. Despite some modification of these deposits in catastrophic floods, at least 8 channel sequences of varying ages have been recognized on aerial photographs and in the field. These sequences represent the aggradational results of major catastrophic flood events (average daily discharge greater than 10,000 cubic feet per second). Kessler and Cooper (1970) and Kessler (1971) report that such flooding has occurred only 0.85 percent of the time from 1938 to 1970. Flood events of similar magnitude and time distribution in eastern New Mexico have resulted in a net erosional and degradational effect rather than an aggradational effect.

Figure 3 shows distribution of preserved channel sequences in a reach of the South Canadian River in the eastern Texas Panhandle. Sequences are numbered from 1 (the active channel) to 8 (the oldest and heaviest vegetated channel sequence).

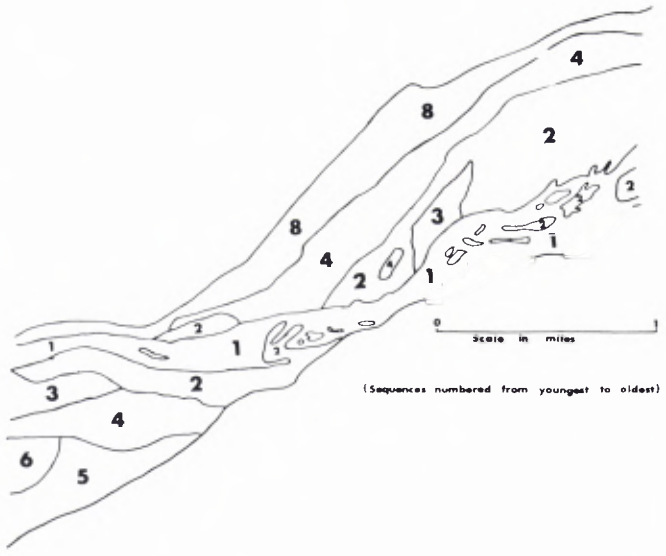

Figure 3. Channel Sequences 1-8 Reach 22 Hemphill County Texas

PECOS–CANADIAN RIVER ALIGNMENT

No geomorphic discussion of the Canadian River would be complete without speculation on an unusual map relationship between the Canadian and Pecos Rivers. As shown in Figure 1, the upper parts of the main valleys of the two rivers are aligned indicating a possible common north-south control for their valleys. Two possible reasons for this alignment can be advanced. The first is a response to a north-south structural lineament paralleling the Rio Grande trough. Although the author has seen no evidence for such a feature, some workers such as Dr. Jan Kutina of UNESCO favor this idea. The second reason requires a modification in existing geomorphic ideas concerning the Pleistocene history of eastern New Mexico. It was proposed, in Thornbury (1954), that the Pecos River cut headward from southwest Texas into New Mexico in middle-late Pleistocene time pirating all eastward-flowing streams from the mountains except the Canadian. The alignment of the Canadian and Pecos Rivers suggests that though the Pecos pirated eastward-flowing streams in southern New Mexico, it was in turn pirated by the Canadian. The sudden right-angled bend in the Canadian near Conchas Reservoir may be evidence for this. Preliminary analysis of aerial photographs indicates the presence of possible channel deposits in the 45-mile interval between the Pecos and the Canadian. Future field work will be a test of this hypothesis.

SUMMARY AND CONCLUSIONS

The Canadian-South Canadian River system in eastern New Mexico and West Texas changes from a coarse-grained meander belt to a braided channel pattern on moving from west to east. This change is largely the result of a major decrease in gradient eastward into the Texas High Plains. Greater variation in average daily channel discharge and an increase in sediment supply are also important factors in this change. The braided part of the South Canadian River in West Texas has developed a series of preserved channel sequences representing major catastrophic flood events. Records of similar floods in eastern New Mexico are not preserved due to the gross degradational character of the river in this area.

The Canadian and Pecos Rivers in their upper reaches are closely aligned in the north-south direction in eastern New Mexico. This alignment may indicate that the Canadian pirated the Pecos River in middle-late Pleistocene time. Earlier work, now disputed by this author, indicated that the Canadian channel in New Mexico had existed since early Pleistocene and was not related to the Pecos.

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