

SOUTH-CENTRAL COLORADO REJECTED AS PROVENANCE FOR LOWER EOCENE SANDSTONES, TEXAS COASTAL PLAIN

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INTRODUCTION

It has long been the assumption of many geologists that the Tertiary sands of the Texas Coastal Plain were derived from the western interior as a result of Laramide Uplift. This assumption may hold for much of the Tertiary section of the Texas Gulf Coast. The mineralogy of these sands is consistent with a plutonic source rock, as would be found in the southern Rocky Mountains. However, the Carrizo Formation and Newby Member of the Reklaw Formation (lower Claiborne) contain significant amounts of high-rank, pelitic metamorphic minerals, which could not have been derived from the Rocky Mountains. There must have been another source area which was active during the lower to middle Eocene.

MINERALOGIC COMPARISON OF THE TWO AREAS

The southern Rocky Mountains are now primarily granitic and gneissic, with few pelitic metamorphic rocks. The mineralogy at the time of uplift was probably very similar; if not, any differences would be recorded in Tertiary sandstones at the foothills of this mountain range. I studied the Huerfano and Cuchara formations, which occur at the eastern foothills of the Rockies, and are time-equivalent to the lower Claiborne Group in Texas (lower to middle Eocene).

The average composition of the samples studied from Colorado is 47 percent quartz, 27 percent feldspar (primarily plagioclase and microcline), 22 percent granite and gneiss fragments, a trace of shale and slate fragments, and a trace of non-framework grains. This mineralogic suite indicates a silicic plutonic source. Minor provenance types include a low-grade, pelitic metamorphic source, and a sedimentary source.

The only non-opaque heavy minerals occurring in significant amounts are epidote (45 percent of the non-opaque heavy minerals) and garnet (32 percent). Others include apatite, zircon, and hornblende, with rutile and siderite present in minor amounts. There were no kyanite or staurolite grains among those counted. This suite of heavy minerals indicate igneous and quartzo-feldspathic or basic metamorphic source rocks. The mineralogy of the Rocky Mountains in the Eocene was, therefore, similar to what we see today.

The Carrizo Formation and Newby Member of the Reklaw Formation crop out in a linear belt along the entire Gulf Coast of Texas and extend eastward to Florida. The average Carrizo or Newby sand in Bastrop County consists of 76 percent quartz, 9 percent metamorphic rock fragments, 8 percent feldspar, and less than 5 percent each of other constituents (Todd and Folk, 1957). Three major provenances are indicated by the bulk

mineralogy - a plutonic source, a high-rank metamorphic source, and a low-rank metamorphic source.

The most abundant heavy minerals in the lower Claiborne are zircon, tourmaline, rutile, kyanite, staurolite and minor amounts of garnet (data of others, summarized in Boggs, 1978). Significant amounts of kyanite and staurolite are unique to the sediments of the Claiborne Group. In Bastrop County, kyanite accounts for 21 percent and staurolite for 15 percent of all non-opaque heavy minerals (Todd and Folk, 1957). Two source types are indicated by this heavy mineral assemblage - a volcanic source, and a high-rank, pelitic metamorphic source.

The primary difference between the mineralogy of the two areas, in terms of provenance studies, is in the ratio of feldspar to rock fragments. In the average Colorado sandstones studied, this ratio is 49:2, whereas in the average Carrizo or Newby sandstone, the ratio is 8:9. The source area for the Carrizo Formation and Newby Member was richer in metasediments, whereas the source area for the Cuchara and Huerfano formations was much richer in granites and gneisses.

Four heavy minerals reported in the Tertiary sands of Texas which are particularly suitable for correlation and provenance studies are kyanite, staurolite, epidote-zoisite, and garnet. I looked at the ratio of kyanite and staurolite to garnet and epidote throughout the Tertiary in central Texas (Fig. 1). It is obvious that there was a source of sediments in the Claiborne Group (supplying high-rank, metamorphic heavy minerals) that was not active in the rest of the Tertiary.

POSSIBLE SOURCE AREAS

Possible primary source areas of the metamorphic minerals of the basal Claiborne Group in Texas include the southern Rocky Mountains region of northern New Mexico, the Llano Uplift, the Appalachian Mountains, and the Ouachita Uplift.

There are characteristics of the lower Claiborne which impose certain requirements on the source area. First, the high-rank metamorphic minerals are most common toward the Mississippi River and decrease in abundance toward south Texas (Cogen, 1940). This implies a source area to the north or east. Second, cross-bedding analyses by Ridley (1955) indicate an ultimate northerly or westerly source. Third, the kyanite and staurolite grains are large (up to 0.25 mm), angular, and exhibit well-defined cleavage. The source, therefore, must have been fairly close. And obviously, the source must have been exposed and uplifted at the time (no Cretaceous cover).

There are difficulties with each of the source areas which has been proposed. In terms of depositional considerations, the Ouachita Mountains are the best choice; however, selecting the Ouachitas as a provenance necessitates proposing an area of higher metamorphism than has previously been described.

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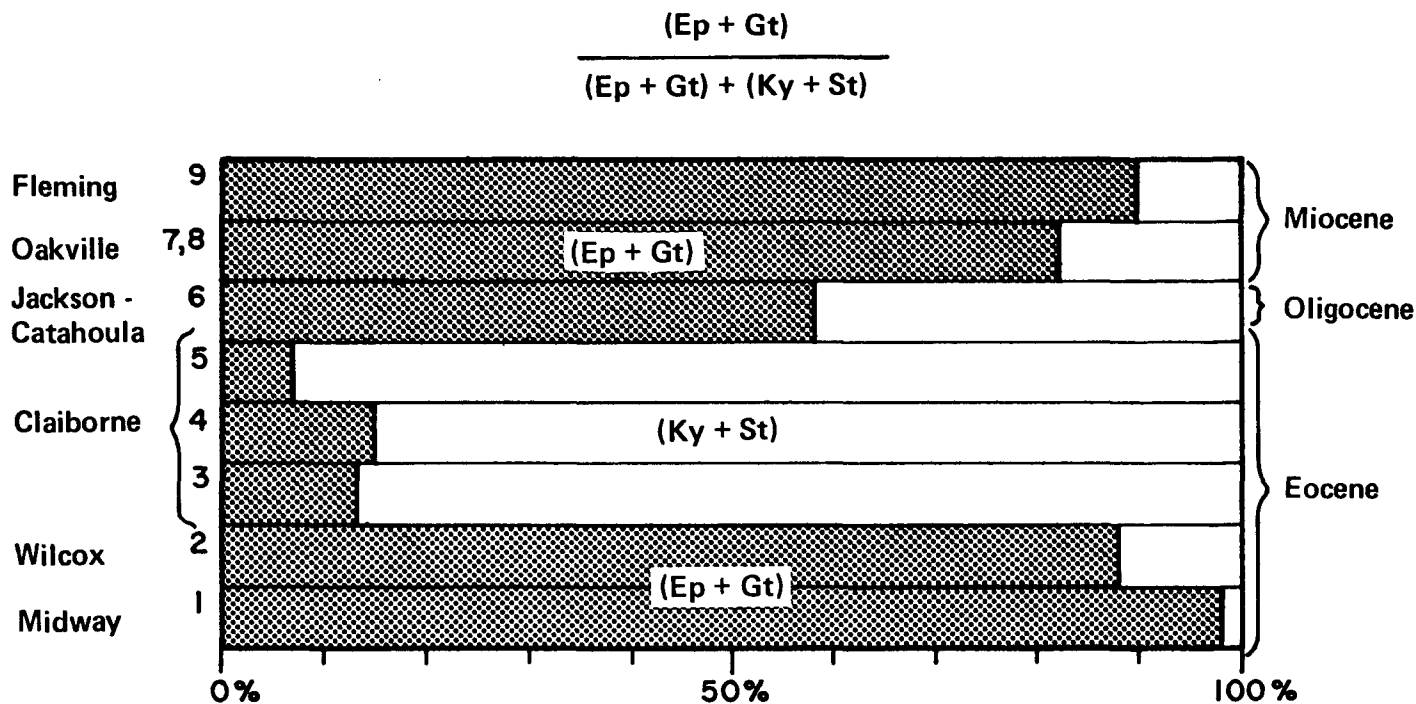


Figure 1. Percentages of epidote and garnet to epidote and garnet plus kyanite and staurolite in part of the Tertiary of the Texas Coastal Plain. The decreases in the Claiborne Group is presumably due to influx from a new, kyanite- and staurolite-rich source area. (From data of others, summarized in Boggs, 1978).

REFERENCES CITED

Boggs, A. S., 1978, Petrology of lower Eocene sandstones in south-central Colorado compared to their time equivalents in Texas: Univ. Texas Master's Thesis, 167 p.

Cogen, W. M., 1940, Heavy-mineral zones of Louisiana and Texas Gulf Coast sediments: Am. Assoc. Petroleum Geologists Bull., v. 24, p. 2069-2101.

Ridley, W. C., 1955, Geology of the northwest corner of the Smithville Quadrangle, Bastrop County, Texas: Univ. Texas Master's Thesis.

Todd, T. W. and Folk, R. L., 1957, Basal Claiborne of Texas, record of Appalachian tectonism during Eocene: Am. Assoc. Petroleum Geologists Bull., v. 41, p. 2545-2566.