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COLOR OF RECENT SEDIMENTS IN TROPICAL MEXICO: A CONTRIBUTION TO THE ORIGIN OF RED BEDS

Abstract: The color of Recent fluvial sediments in tropical Mexico supports the hypothesis that the hematite pigment in ancient red beds forms *in situ* after deposition and is not derived from erosion of red tropical (lateritic) soils, as is commonly claimed. Although red soils do occur in the region's hot humid source areas, the Recent alluvium that is transported and deposited by rivers is grayish brown because the red detritus is masked by more abundant nonred material. Red coloration occurs only in soils resulting from prolonged weathering on well-drained upland surfaces of Pleistocene age or older.

Introduction

For nearly 20 years geologic literature dealing with ancient red beds has been dominated by the hypothesis that the hematite pigment is derived from erosion of red tropical (lateritic) soils and that most red beds are therefore indicators of warm moist source areas. The widespread acceptance of this hypothesis is directly attributable to the influence of P. D. Krynine (1950) who reported examples of Recent red sediment colored by lateritic detritus on the coastal piedmont of Tabasco in southern Mexico. His descriptions have been accepted unquestioningly as proof of this origin of red beds.

The purpose of this note is to testify that, contrary to Krynine's claims, Recent sediments in Tabasco are not red and that at present there is no documented evidence from Recent sediments anywhere that supports the hypothesis that red beds are colored by hematite derived from lateritic soils.

Recent Sediments in Tabasco

That examples of Recent red sediment exist on the coastal piedmont of Tabasco in southern Mexico was reported by Krynine (1950, p. 153) as follows:

"Sedimentation on a tropical piedmont, as observed on the Tabasco savanna, proceeds along the following lines. During the rainy season the stronger floods bring in the coarser fresh material from the denuded canyon walls of the forested mountains. Several floods per year are of the type of super-floods mentioned by von Engeln (1936). They produce marked erosion and sedimentation, directly observable. Weaker floods transport, sort, and deposit the red mud derived from the red soils washed down the slopes from the mountain interfluves. These sediments form alternating beds of coarser, pale-colored arkosic sands and finer-grained reddish or maroon siltstones and shales."

Krynine's conviction that rivers in Tabasco transport and deposit red mud is not supported by the color either of the rivers or of the Recent sediments. In a study of this tropical region, including localities described by Krynine (1935; 1950), the author examined the Mezcalapa River, cited by Krynine (1950, Pl. XXVIII, p. 233) to document his point. Samples were collected along the entire length of the Mezcalapa drainage, from the Mexico-Guatemala border to the Gulf of Mexico (Fig. 1). In addition, all other major rivers in the region were cursorily examined. Contrary to Krynine's claim, throughout the region both the suspended load in the rivers and the sediments on the flood plains are not red but grayish brown. Compared with the Munsell Soil Color Chart, the color of the sediments ranges from 10YR 3/2 (very dark grayish brown) to 10YR 5/2 (grayish brown), the most common color being 10YR 4/2 (dark grayish brown). No Recent red alluvium was seen anywhere.

Red pigment in sediments in Tabasco occurs only in soils and forms only *in situ* as a result of prolonged weathering. The red soils, which are highly altered, form only in well-drained upland areas on surfaces that are of Pleistocene age or older (Psuty, 1965, fig. 2).

The lack of red color in the rivers and Recent sediments in southern Mexico is due to the scarcity of red detritus in the highland source areas despite the high annual averages of temperature

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(75°–80° F) and rainfall (36–200 inches). Most soils are yellow or brown, without any red pigment. In those limited areas of well-developed red soils, only the top few feet of soil are red; the thick remainder is yellow or brown. With erosion, the small amount of red detritus is quickly masked by the much greater amount of nonred detritus. Masking is so rapid that freshly exposed roadcuts and borrow pits show yellow or brown detritus just below the outcrop. Nonred detritus is so abundant that even the small tributaries draining areas of well-developed red soils are not red. Moreover, the mountainous relief of much of the source area is too steep for soil formation; the bedrock is either exposed at the surface or underlies only a foot or two of black sod. These areas yield no red detritus whatever.

Conclusions

To prove that Recent red sediments are colored by detritus eroded from red tropical soils and are possible counterparts of ancient red beds, three conditions are essential: (1) sediments must be carried by rivers that, at least periodically, transport predominantly red laterite-derived detritus, particularly in the suspended load; (2) on the active flood-plain the sediments, particularly the muds and silts, must be red; and (3) the detrital red pigment must be preserved in older sediments that have been

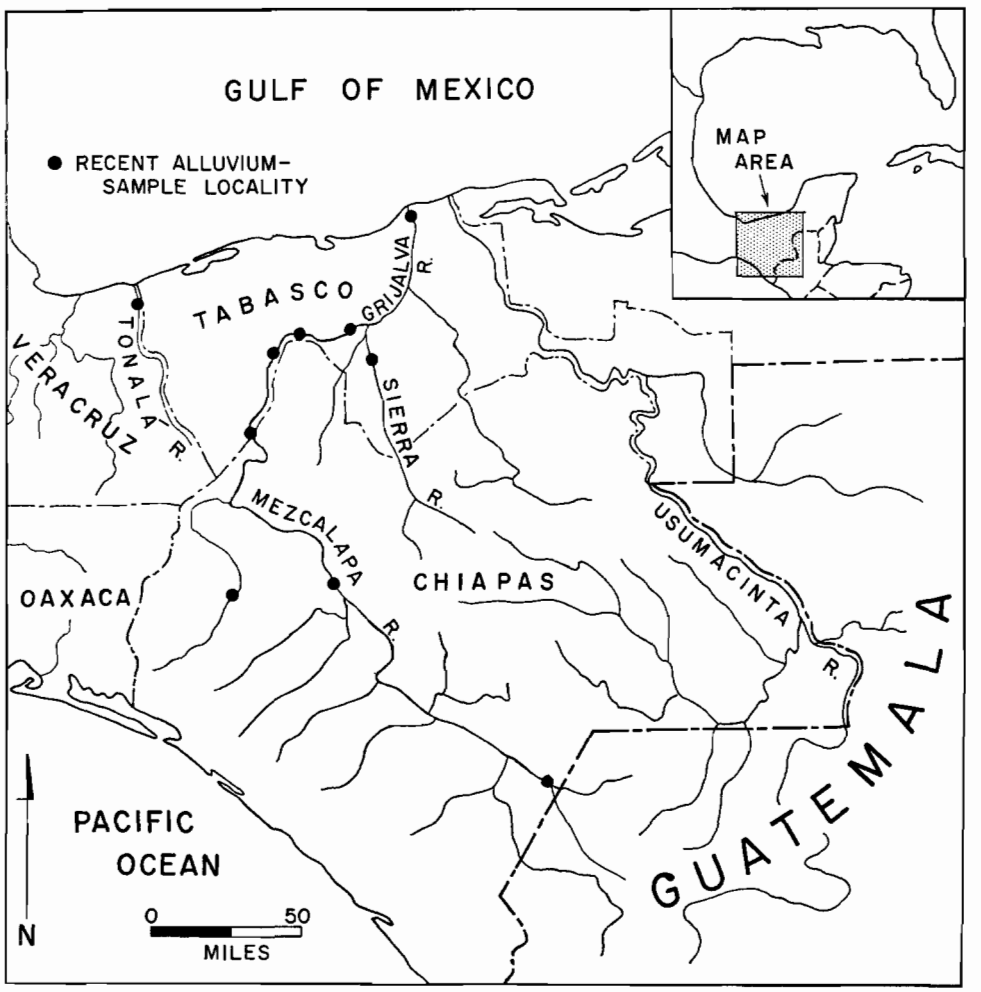

Figure 1. Index map of southern Mexico

buried below the water table. If the hypothesis advocated by Krynine is valid, modern examples of Recent red sediments that fulfill the three conditions should be common in tropical regions. None, however, has been documented.

Apparently detrital red sediments rarely, if ever, accumulate in moist tropical regions. The author examined all regions in Mexico that annually receive more than 40 inches of rainfall (Tamayo, 1962, map facing p. 152). Whereas most of these regions contain red soils in the source areas, nowhere are the rivers and the Recent flood-plain deposits red. That similar conditions occur in other tropical regions has been stressed by Van Houten (1964, p. 653). Therefore in most ancient red beds the hematite pigment is probably not derived from red tropical soils, but seems instead to reflect special interstitial chemical conditions favoring *in situ* formation and preservation of hematite within the depositional basin. The possible nature of such conditions has recently been discussed in another paper by the author (Walker, 1967, p. 361–363).

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