Fossil Forests of Ocú, Panama

Abstract. *Silicified woods, the remains of mid-Tertiary tropical forests, are abundant in the vicinity of Ocú, Panama. Initial identifications reveal plant taxa not previously recorded as fossil woods. The plants identified can be found today in moist forests of tropical America, but not in the savanna-like vegetation now growing at the fossil site.*

There have been few researches on Tertiary plant fossils of tropical America because of the scarcity of well-preserved remains, and because major centers of botanical research are located in temperate regions. The principal paleobotanical investigator of this area was E. W. Berry, whose floras of middle America, the Caribbean islands, and northern South America are mostly based on impressions of leaves. We have begun a detailed study of a Panamanian fossil flora represented entirely by silicified woods. Our preliminary results may be of interest to botanists and paleontologists because of the widely recognized importance of the isthmian region as a Cenozoic migration route.

The fossils occur in and around the town of Ocú, Herrera Province, in the north-central part of the Azuero Peninsula, a major physiographic feature on the Pacific side of the isthmus. Present vegetation at the collecting sites is savanna-like, comprising mostly grasslands with widely spaced trees and shrubs. The most conspicuous woody plants are *Curatella americana, Byrsonima crassifolia, Xylopia aromatica,* pipers, a clusia, and other shrubs usually associated with degraded soils. Grasses and sedges cover most of the land in a sparse layer. Patches of true forest occur occasionally in areas unavailable for agriculture and inaccessible to cattle.

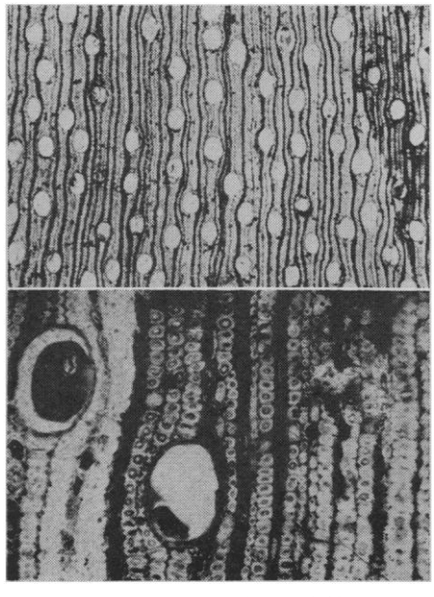

Fig. 1. Transverse section, silicified wood of *Vantanea* (Humiriaceae) from Ocú illustrating preservation of anatomical details (upper, about ×25; lower, about ×100).

Ocú lies in a region mapped by Terry (*1*) as "Oligocene with interbedded or intruded igneous rocks." The fossil woods lie on the surface, associated with volcanic tuffs. As yet, none has been found *in situ,* and it is still uncertain whether these remains are slightly older or somewhat younger than the nearby marine Oligocene sediments. In the absence of more adequate stratigraphic control, we refer to these fossils as "mid-Tertiary."

The fossils, known locally as *chumicos,* are strewn about in pastures and piled up in gullies in such abundance that the townspeople of Ocú use them as decorative building stones. Pieces are angular and range in size from small hand specimens to stumps a foot or more in diameter.

The best-preserved of the Ocú woods show excellent cellular detail in thin section. We have identified genera in Humiriaceae (*Vantanea*), Flacourtiaceae (*Tetrathylacium*), and Hernandiaceae (*Hernandia.*) These are apparently the first records of Tertiary woods from these families. The presence of these genera as fossils indicates that a pronounced floristic and vegetational change has occurred in the Ocú region since the mid-Tertiary. But in other portions of the isthmus, and in nearby North and South America, these same genera still form parts of the extant forest flora. This condition contrasts strongly with the situation among the mammals, where families which existed on the isthmus during the Tertiary Period are no longer present there (for example, Rhinocerotidae), and other families are extinct (for example, Hypertragulidae).

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Reference

1. R. A. Terry, *Calif. Acad. Sci. Occasional Papers No. 23* (1956).

5 April 1963

Radiogenic Strontium-87 as an Index of Geologic Processes

Abstract. *The abundance of radiogenic Sr^{87} relative to Sr^{86} at the time of crystallization has been determined for 45 rocks. The total range in the ratio Sr^{87}/Sr^{86} is less than 2 percent. Ratios for recent lavas range from 0.702 to 0.711. Oceanic basalts are closely grouped at 0.703, whereas ratios for continental volcanic rocks spread from 0.702 to 0.711. Among the volcanic rocks, ranging from basalt to rhyolite, no correlation was found between original ratio and rock type. Older mafic and felsic rocks that include both plutonic and extrusive types also cover this same range in original Sr^{87}/Sr^{86} ratios; however, there is a definite trend with geologic time. Precambrian rocks give values as low as 0.700. The data indicate that Sr^{87}/Sr^{86} of the weathering crust has changed 1.1 percent in 3000 million years, while the ratio in the mantle has changed no more than 0.5 percent.*

This report follows the general discussions previously outlined by Gast (*1*) and by Hurley *et al.* (*2*) on radiogenic strontium in the earth's crust. (See their reports for development of theory and review of previous work.)

In this study, analyses of 86 samples make possible the determination of initial Sr^{87}/Sr^{86} ratios of 45 rock units. Two important points come to light that differ with the results of Hurley *et al.* The absolute values of the Sr^{87}/Sr^{86} ratios are considerably lower, and significant variations of initial ratios with geologic time are outlined.

The isotope dilution analyses were done on a 6-inch, Nier-type mass spectrometer utilizing single-filament surface ionization. Unspiked strontium isotopic compositions were determined with four different mass spectrometers. These include the 6-inch and three different mass spectrometers of 12-inch radius-of-curvature, 68° deflection with 60° sector magnet, using both single-filament surface ionization and triple-filament ionization.

Figure 1 illustrates the data obtained for one sample of reagent strontium with the four instruments. There is a wide range in values, particularly between the two modes of ionization; however, the best fit line through the points follows the theoretical first-order pattern of isotopic fractionation within the mass spectrometers. If the ratio Sr^{86}/Sr^{88} is assumed not to vary in na-