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SEDIMENTARY STRUCTURES IN A CORE TAKEN ON SIGNAL MOUNTAIN, TENNESSEE (CUMBERLAND PLATEAU), WERE USED TO INTERPRET THE DEPOSITIONAL ENVIRONMENT OF THE PENNSYLVANIAN SEWANEE SANDSTONE, SIGNAL POINT SHALE, AND WARREN POINT SANDSTONE

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ABSTRACT—A rock core from Signal Mountain, Tennessee, showed that sedimentary structure sequences in the Pennsylvanian Raccoon Mountain Formation, Warren Point Sandstone, Signal Point Shale, and Sewanee Sandstone reflect tectonic activity (mountain building) in an ancient (Late Paleozoic) mountainous source area situated east of present day Signal Mountain. Raccoon Mountain swampy deposits overlie Mississippian (Pennington and Bangor formations) tidal-flat sequences. Renewed tectonic activity in the eastern source area increased gradients markedly and sent braided streams (Warren Point) spreading westward over swampy deposits (Raccoon Mountain). Toward the end of Warren Point deposition, gradients decreased as the eastern mountain masses wore down and rates of sedimentation slowed. In this immediate region, low-gradient deposits (swamps and meandering streams) of the Signal Point reflect little tectonic activity in the eastern mountainous sediment source area. Then, renewed tectonic activity in the east took place as suggested by Sewanee (braided streams) scour-filling activity which reflect increased gradients. Thus, the sedimentary record in the core from Signal Mountain reflects the cyclic nature of mountain building in the eastern source area, with great activity in Warren Point and Sewanee deposits and little activity in Raccoon Mountain and Signal Point deposits.

A core of approximately 122 m in length was spudded-in inside the boundary of the town of Signal Mountain, Tennessee, adjacent to Signal Mountain Boulevard, and was drilled in conjunction with an environmental remediation project. From the top down, the core included the lower part of the Pennsylvanian Sewanee Sandstone and the entire thickness of the Signal Point Shale and Warren Point Sandstone as well as the upper meter of the Raccoon Mountain Formation.

Work by Cant and Walker (1976) and Prothero (1990) facilitated interpretation of sedimentary structures in the core as representative of braided and meandering stream environments of deposition. Wilson et al. (1956) provided stratigraphic information on the Cumberland Plateau. The purpose of the present paper is to present sedimentational evidence of late Paleozoic tectonism in southeastern North America.

DESCRIPTION AND INTERPRETATION OF THE CORE FROM SIGNAL MOUNTAIN

The core from Signal Mountain penetrated 122.5 m of Pennsylvanian rock. In a stratigraphic sense, it was spudded-in somewhere in the middle to lower part of the Sewanee Sandstone. The formational contact (at 25.6 m downhole) of the Sewanee with the underlying Signal Point Shale is transitional (no erosion surface present) as is the contact (at 41.8 m downhole) of the Signal Point with the Warren Point Sandstone. The Warren Point contact (at 119.5 m downhole) with the underlying Raccoon Mountain Formation may be unconformable (gap in the record with a scour structure over a coal seam).

It is important to realize that a core is merely a small diameter (3.8 cm), tube-like sample of various combinations of sedimentary structures stacked one on top of another in some type of architectural sequence. With this in mind, we can recognize a core sample of a trough crossbed by its low-angle crossbedded appearance. Also, we can recognize scour structures by lag gravel deposits of pebbles of quartz, shale, and siderite at the base. A core through a scour may show massive bedding, low-angle crossbeds (troughs), or it may contain high-angle crossbeds with planar tabular layers (in-channel bars). All these scour-and-fill structures show a "fining upward" sequence. A typical fining-upward sequence might begin with a scour structure that shows lag gravel with massive bedding, overlain by trough crossbeds or in-channel bars, which, in turn, are overlain by thin-bedded, rippled sandstone, overlain by rippled shale with ripple troughs filled with fine-grained sand (shale with sand lenses).

Sewanee Sandstone—The core of the Sewanee contains 3.1 m of soil at the top. From 3.1 to 22.9 m downhole, there are seven fining-upward scour sequences (Fig. 1; an isosceles triangle is the symbol for a fining-upward sequence). These scour sequences were likely formed in a series of shifting channels in a braided stream complex with a relatively steep gradient. The bottom 3.1 m of the Sewanee core consist of a thin-bedded, rippled sandstone which formed in shallow water with low energy such as on a floodplain.

Signal Point Shale—Core samples of the Signal Point extend from 25.6 to 41.8 m downhole and are made up largely of shale with sand lenses and thin-bedded, rippled sandstone. In the basal part of this core (39.9-41.8 m), a burrowed siltstone-sandstone-claystone unit may represent a potential coal-forming horizon that just never materialized (Fig. 1). Thus, the Signal Point may have been deposited in a widespread slough (a low place) with a localized lensoid shape that initially contained

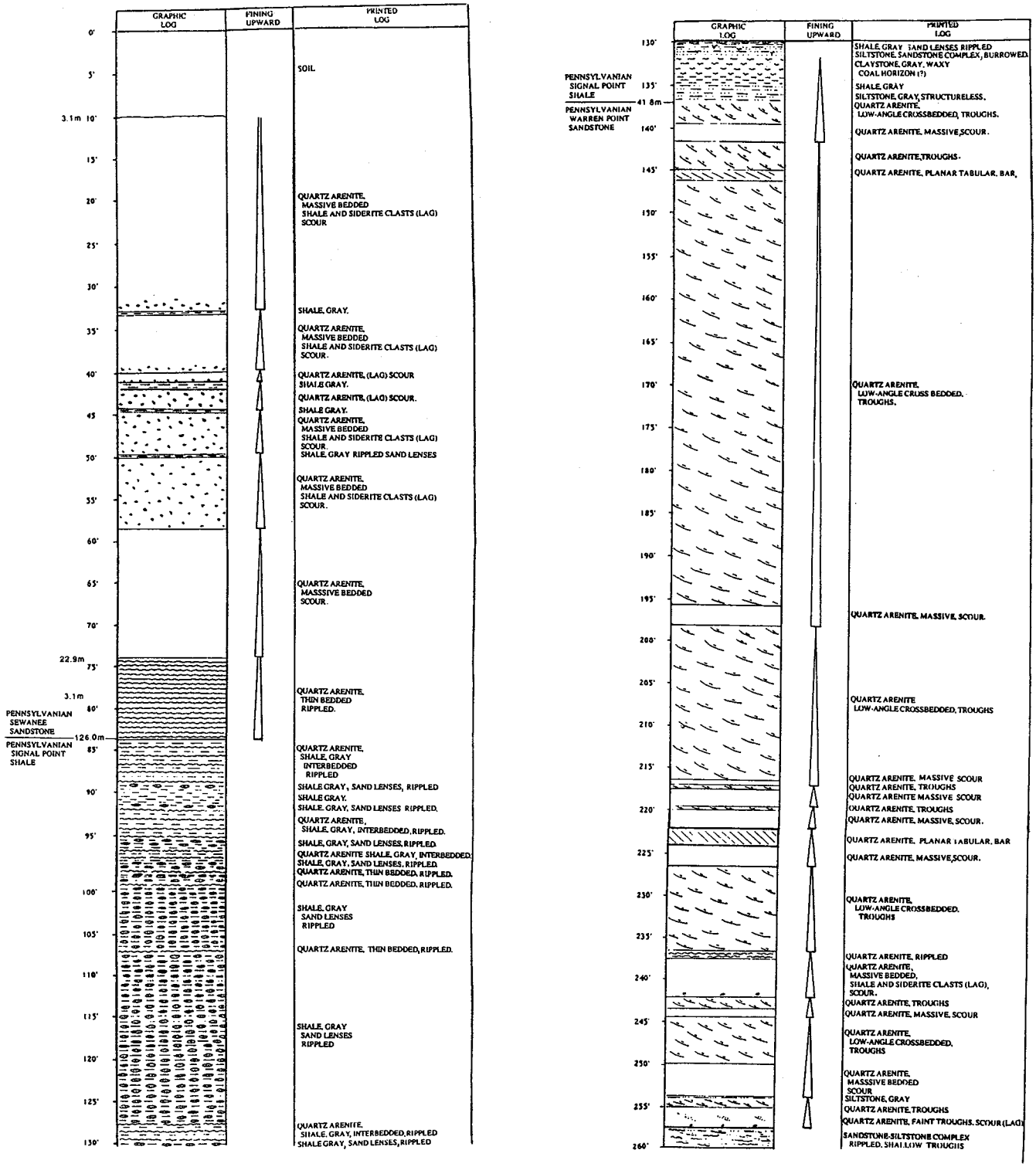

FIG. 1. Sedimentary structures in a core of Pennsylvanian rocks, Signal Mountain, Tennessee.

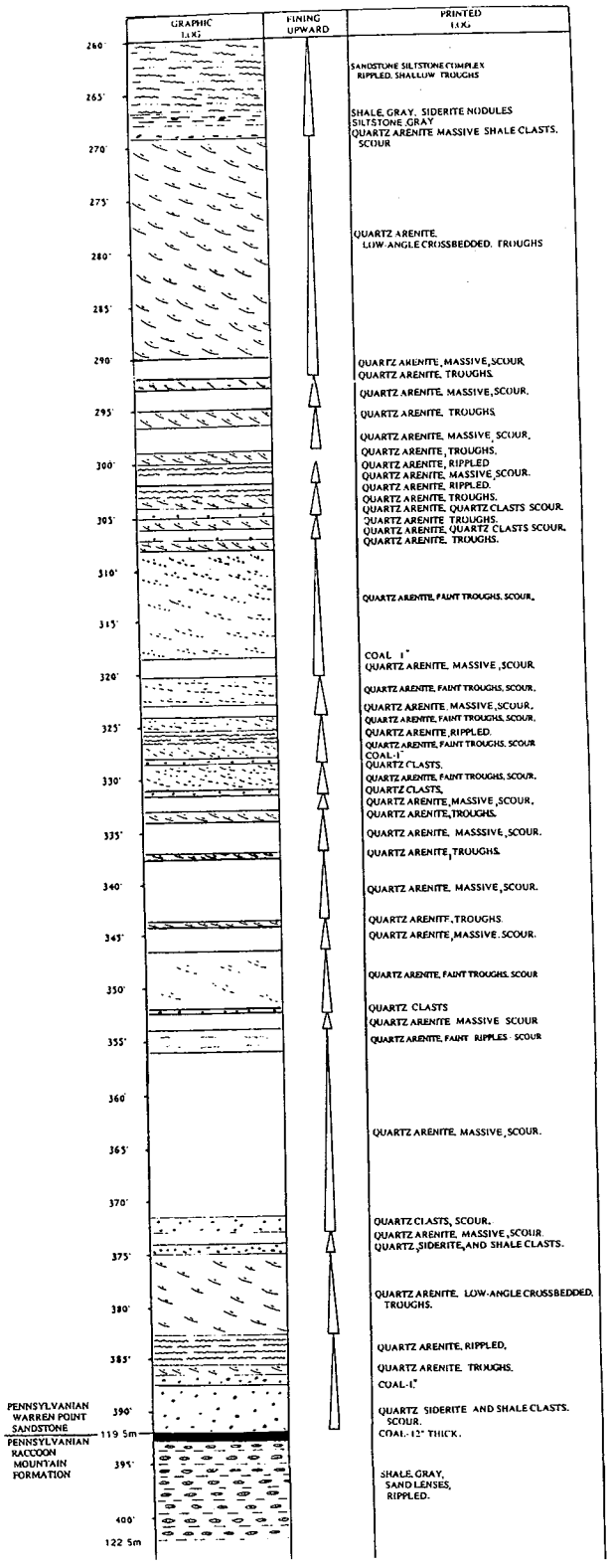

FIG. 1. Continued.

a swampy area (coal?). This slough then represents a time of low-gradient deposition in a huge, regionally distributed, braided-stream mass.

Warren Point Sandstone—The sedimentary structure sequence in the Warren Point extends downward from 41.8 to 119.5 m in this core from Signal Mountain. The typical fining-upward unit in the Warren Point is composed of a basal scour with quartz clasts (lag) that is infilled with massive sandstone or troughs or rarely with in-channel bars, all of which may be capped by thin-bedded, rippled sandstone. In some instances, the complete scour cycle of infilling is not present because the upper part has been removed by renewed (younger) scouring activity. Thirty-two fining-upward scour sequences are present in this Warren Point core. Further, in the upper part of this core (41.8-66.1 m), there are thick scour fillings of trough crossbeds (Fig. 1). The numerous scour fillings in this Warren Point core are thought to reflect rapidly shifting channel (scour) deposits in a braided stream complex associated with a relatively steep gradient in the initial Warren Point depositional phase. The thick deposits of trough crossbeds in scour infillings suggest a lessening of regional gradient in the latter stages of Warren Point deposition.

Raccoon Mountain Formation—Only the uppermost 3.1 m (119.5-122.5 m) of the Raccoon Mountain are represented in this core from Signal Mountain by a coal seam and shale with sand lenses (Fig. 1). This rock record may be interpreted as having accumulated in an ancient swamp.

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