SPHERULITIC PEDOGENIC CARBONATE NODULES FROM THE LOWER TUSCALOOSA: A TOOL TO BE USED IN PALEOGEOCHEMICAL EXPLORATION FOR HYDROCARBONS?

Lester Williams[1] and Brian E. Lock[2]

Geochemical exploration for hydrocarbons consists primarily of sampling soils and surface sediments for anomalous concentrations of a variety of materials resulting from vertical migration of hydrocarbon-contaminated subsurface waters. In addition to traces of light hydrocarbons, the anomalous materials include gases such as radon and other contaminants from oil, as well as substances concentrated by the physico-chemical properties of the vertically migrating waters. Iron concentrations are high because of the highly reduced condition of these waters; calcium, magnesium and bicarbonate ions because of the acidity of the waters.

Many authors have commented on the association of spherulitic aggregates of siderite (spherosiderite) in fossil soils and sedimentary facies such as levees and overbank splays in fluvial settings (Burley et al., 1985). The process by which iron is concentrated in these environments has been debated; in the oxidized state, which is normal in the surface continental environment, iron has a very low solubility. Authors such as Pickard and Felbeck (1976) have suggested that iron may have been derived by erosion from areas of lateritic weathering and transported as coatings on clay minerals or complexed with organic polymers. Seasonal flooding may then have carried the iron into overbank areas.

Recent papers by Ana Gunatilaka (1989 and earlier) may be relevant to this issue. He has reported and illustrated abundant dolomite spherulites in surface profiles of outcropping sediments of a variety of ages and mineral compositions from Kuwait, all from areas of surface hydrocarbon seeps or over known subsurface accumulations. Many of the spherulites are nucleated around hydrocarbon droplets, and the significance of the distribution is clear. Gunatilaka hypothesises that the dolomite spherulites are precipitated by the action of bacteria "feeding" on hydrocarbons, an idea supported by the work of Lalou (1957) which demonstrated that spherulites are common products of bacterial carbonate precipitation.

We suggest that the formation of some, at least, of the spherosiderites may also be related to vertically migrating oilfield fluids. Iron, calcium and magnesium may all be supplied by these waters, while the bacterial action apparently required for spherulitic morphologies to form in the pedologic setting may result from the availability of hydrocarbons in the same rising waters.

The presence of spherulitic siderite (and dolomite) in certain sedimentary rocks may have some exploration significance. In some cases (although not necessarily in all), the spherulites may represent contemporaneous geochemical anomalies. Additionally, since they are a component of soil profiles, they indicate a former exposure surface. If the host sediment is identified as marine or some other inappropriate depositional facies, the presence of spherulites would suggest an overlying unconformity within a few tens of feet.

Spherosiderites are relatively common in the Lower Tuscaloosa non-marine strata, and examples are illustrated from the Hammon Oil and Refining Co. #1 Steptoe Heirs wildcat well, Amite County, Mississippi (Figure 1).

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[1] S. & M.E. Westinghouse, 4000 Dekalb Technology Parkway, Suite 250, Atlanta, GA 30340

[2] Geology Department, University of Southwestern Louisiana, Box 44530, Lafayette, LA 70504

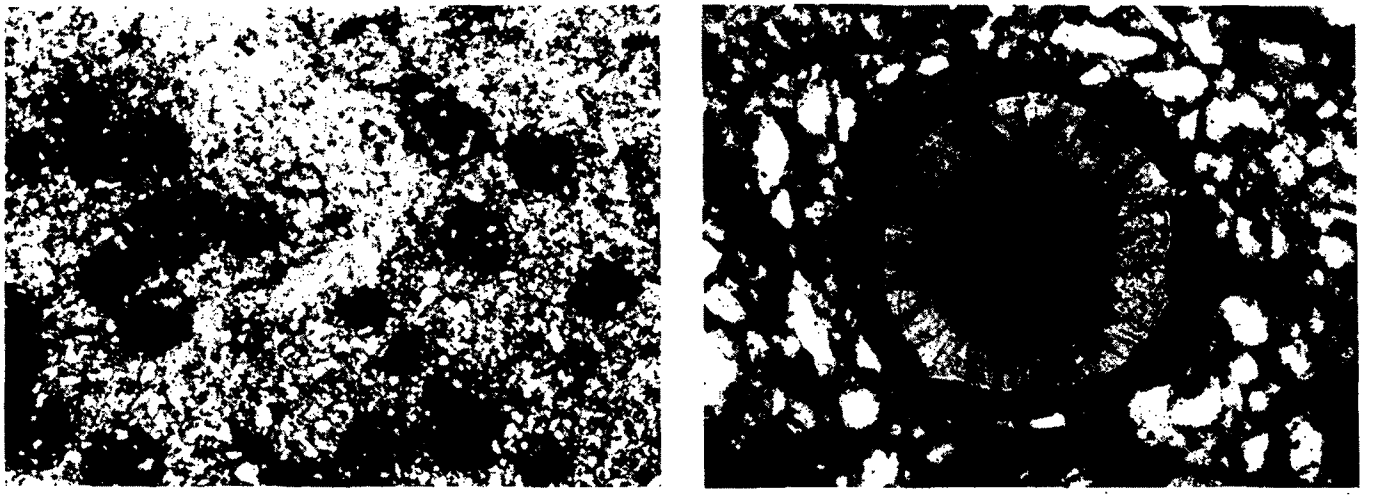

Figure 1. Photomicrographs of spherosiderites from the Hammon Oil and Refining Co. #1 Steptoe Heirs wildcat well, Amite County, Mississippi. A — width of photograph represents 4.5 millimeters, B — width represents 1.25 millimeters.