10th Annual Meeting Abstracts and Program

Morphological and Chemical Variations within the Alga *Gloeocapsamorpha prisca*: Evidence for Separate Species.

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Based on morphological and chemical variations, it is suggested that the alga *Gloeocapsamorpha prisca* from core samples in the Llanvirnian Joins Formation (Crane Co., Texas) and outcrop material from the Caradocian Bromide Formation are two distinct species and not variants due to life stage or evolutionary change. While both sets were obtained from sediments that were deposited within low latitude regions on shallow marine shelves, the lithology of the Joins is that of a well-indurated black shale and the Bromide is a micritic carbonate. The occurrence of the alga in both samples was disseminated, although some bands or laminae can be observed. The primary objective of this study is to document the occurrence of end-member morphotypes of *G. prisca* and to characterize these samples chemically to establish evidence for separate species.

Microscopic and SEM examination of disseminated alga from the Joins show them to be composed of distinct spheres with no visible structure that would suggest a colonial habit. In contrast, algae from the Bromide occur in membranous sacs within a mucous envelope that may be folded or wrinkled, and is often drawn-out into irregular lobes containing the compound colonial bodies. Thus, either the Joins alga is a separate generic type from the Bromide encased colonial forms, or it represents a growth stage within the *G. prisca* complex. If the Joins and Bromide alga are the same species, differing only in their life cycle, the vertical sequences would be expected to contain multiple morphotypes. Since this is not observed in either of the formations, it is concluded that the Joins and Bromide alga probably represent separate species of the problematic alga.

Chemical characterization of the rock extracts provide additional evidence for separate species. The gas chromatogram from the Joins (Figure 1) displays the classic Ordovician signature with an odd-carbon preference in the C11-C19 n-alkane range, minor acyclic isoprenoids, and a low abundance of $C20^+$ alkanes. In contrast, the Bromide extract (Figure 2) contains some of the Ordovician signature but is markedly different in that the n-alkane envelope has an abrupt break after C17, a lesser break after C19, moderate concentration of acyclic isoprenoids, and $C20^+$ n-alkanes with a distinct odd-carbon preference (especially nC23-nC31). Analysis of these extracts by gas chromatography-mass spectrometry reveals that the Joins extract contains a peculiar distribution of n-alkylcyclohexanes (odd-carbon preference between C17 to C23) and methyl-n-alkylcyclohexanes (maximized at C20). Neither of these features are observed in the Bromide extracts. Within the traditional biomarker suites, both extract sets contain steranes in relatively low abundance (sterane/hopane ratios << 1.0) with the

carbon number distribution of C29 greater than C27, and pentacyclic terpanes that are dominant over the tricyclic terpanes. It is also observed that the Joins extract appear to contain the C30 steranes, whereas these compounds are absent in the Bromide extracts. Maturity estimates by biomarker-based isomerization reactions, Rock Eval pyrolysis, and blue light fluorescence suggest that the Bromide is immature and that the Joins is in the middle of the oil window.

Documentation of the morphological and chemical variations within these samples provides an important advancement in the knowledge of the alga referred to as *G. prisca*. Instead of explaining the variation of these samples with different growth stages or evolutionary changes, geologic evidence is presented to attribute the variations to different species. Thus, this research has provided a systematic interpretation of an important element within numerous Ordovician-age petroleum systems.

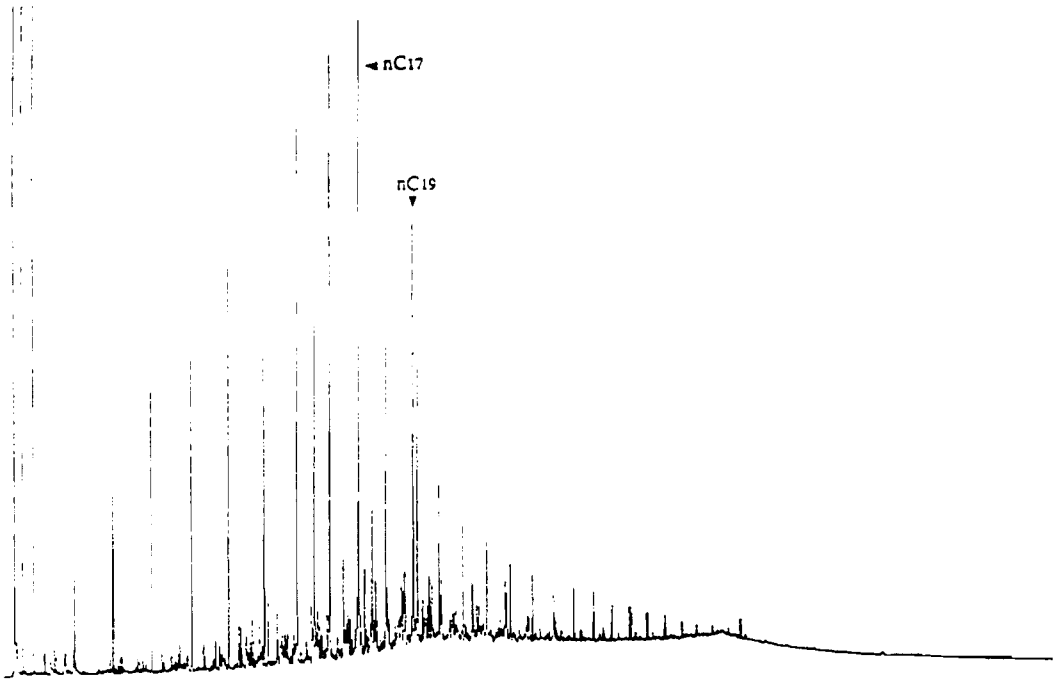

Figure 1. GC-FID of extract from Joins alga.

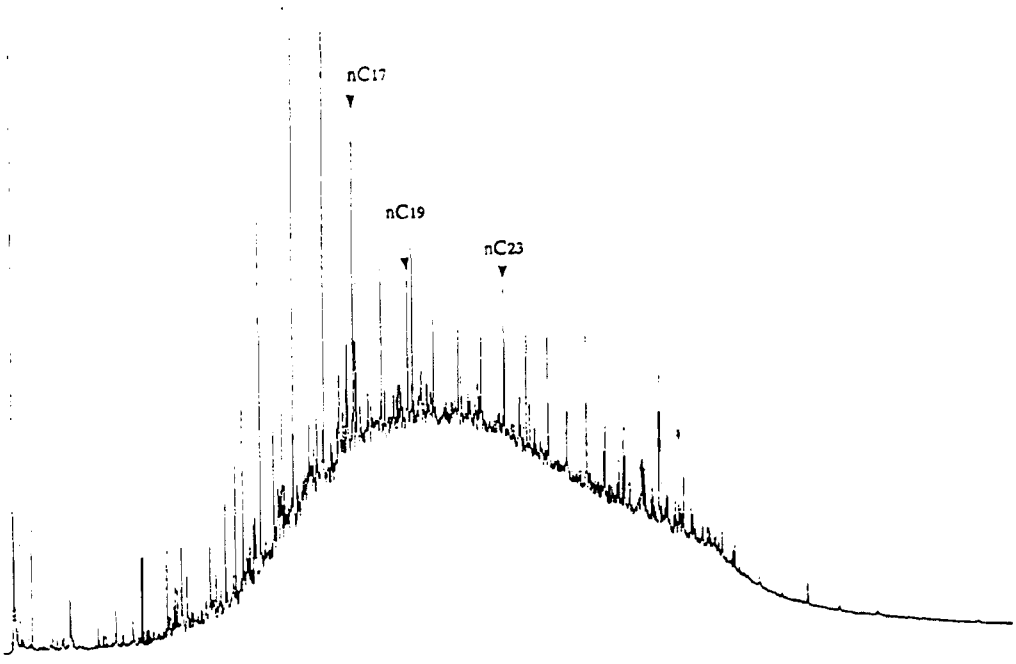

Figure 2. GC-FID of extract from Bromide alga.