Course Review

ICHNOLOGY (TRACE FOSSILS) COURSE

Brunei Shell Petroleum, Seria (29th September – 1st October 2003)
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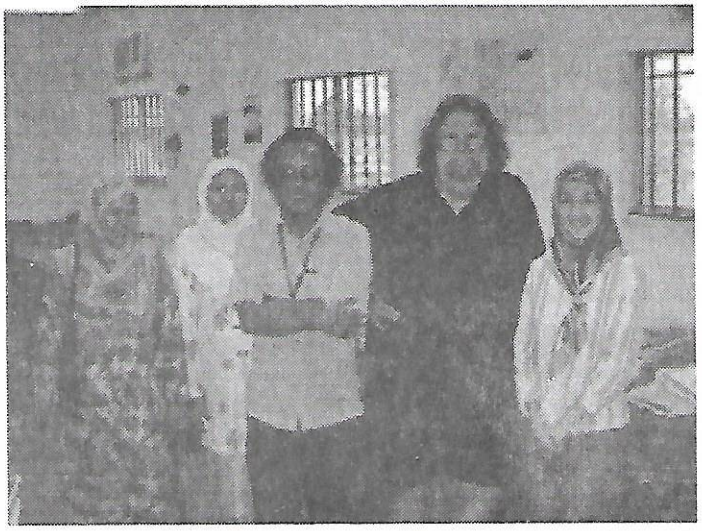
I, for one, was not a huge fan of the big and mouthful Latin names that are strongly associated with Ichnology or better known as the study of "Trace Fossils". Someone/some event may have yet to prove me otherwise. It may have been a narrow-minded approach in viewing this branch of Sedimentology but this may have come out of ignorance, rather than bliss. Hence when the opportunity arose in-house to attend a basic course on this subject, I nevertheless took it, with the objectives of learning more and possibly altering my perception of Ichnology.

A number of us from the Brunei Shell Petroleum (BSP) geoscientist community had this opportunity to attend the 3-days course conducted by the legendary George Pemberton. The course was aimed at providing a basic introduction to Ichnology, a subject rarely delved in depth by most geoscientists in BSP. It was helda at the local Learning and Development Center in Seria from the 29th September to 1st October 2003. What were gained from this course had been a tremendous learning and even an enlightening experience - both in its application and impact on ways of working. Having George as the course lecturer was in itself a refreshing change from the typical corporate lectures we normally attend.

The first 2 days were allocated for in-class lectures whereas the third day was spent in the BSP core shed for a more hands-on approach.

Day 1 started off with the introduction to the subject and its basic principles. It was quite comprehensive with explanations on the different biogenic sedimentary structures (bioturbation, bioerosion, biostratification and biodepositional structures) and general ichnological principles. Further classifications of the trace fossils based on their taxonomy, ethology (behaviour) and phylogenetic *(Phylogenetics is a method for determining the evolutionary relationships of organisms)* were also discussed. This provided a good overall view on how the trace fossils are grouped and classified. The relationship between the organisms and the sediments as well as the environments they dwell in was possibly the most relevant topic to bring away from the day's lectures. It was explained by the intricate relationship between various factors such as the depths of water, the proximity/distal to shoreline and hence sediment supply, amount and type of food available and method of sediment deposition. It represented the dynamic processes (e.g. burrow systems response to fluctuations in sediment rates and erosion). A short but interesting topic that was brought up was cryptic bioturbation. It is somewhat a relatively new idea in the Ichnology world. These meiofauna (size ranges between 0.01 – 1mm) are small enough to fit in between the sediment pore spaces. They homogenize the sediments and may enhance the reservoir properties especially in estuarine channel sediments. Proponents of the cryptic bioturbation believe that the so-called massive sandstone is an exemplary product of this form of bioturbation.

Day 2 concentrated more on the different assemblages of trace fossils and how they are related and can be used for indicators of depositional environments as well as its applications in the "Sequence Stratigraphy" context. The environments covered range from brackish water to the deep marine. A number of global examples and illustrations were used to enhance the understanding of how trace fossils are applied successfully in the oil and gas industry. It helped in further emphasizing how important this particular branch of Sedimentology can be in determining the sediment fairways. The day's lectures were also meant to provide more visual examples of the trace fossils associated with their environment. Each participant had been provided with individual copies of the Ichnology Atlas from the Ichnology Research Group (IRG) at the University of Alberta. This proved to be a very helpful guide in identifying the numerous trace fossils in the cores viewed later on Day 3. One very important topic covered in the lecture was effects of bioturbation on reservoir properties. Often, the negative effects of bioturbation have always been widely discussed. However, the lectures provided a lot of the industry "success stories" on how bioturbation can actually improve reservoir properties.



Bruneian geologists and George Pemberton (in black) during Ichnology (Trace Fossils) course in Brunei Shell Petroleum's core shed. Author is on the most right.

Day 3 was well spent on viewing and interpreting the "reality" - cores! A number of cores from various assets in BSP were laid out for this section of the course. Recent evaluation has suggested that the environment and overall structural style is different between the East Area (e.g. Champion) and West Area (e.g. Ampa) of Brunei Darussalam *(Darman, 2003)*. It was interesting to observe the trace fossils identified in cores from Champion (CW-11) and Ampa (SWA-173) reaffirmed this interpretation. It was interpreted that the trace fossil assemblages such as Arenicolites and Asterosoma that dominate the CW-11 core represent low energy shoreface environment, possibly with a tidal influence. On the other hand, the SWA-173 core is dominated by trace fossils such as the robust Ophiomorpha. This may be indicative of higher energy shoreface and more open environment. The core from Ampa was interpreted to be shoreface setting with amalgamated storm beds.

Overall, the format of the course was very lively with a number of interesting ideas presented and discussed. The presentations were clear and concise. It was apparent that the lecturer was very passionate about the subject and his enthusiasm definitely rubbed off on the participants. The course applicability to the nature of work among the geoscientists in BSP is without doubt. It provided a different take on looking into the trace fossils (an eye-opener). In a business like ours where time

is essentially money, a lot of shortcuts are taken to save costs and achieve a "fit-for-purpose" understanding of the reservoirs. The course instilled the importance of back to basics i.e. back to the rocks to understand the reservoirs more and therefore improve our understanding of the subsurface. At times, challenging the paradigms and established dogmas can turn the tide over for the better. This is a course that is highly recommended to all. The juniors or the experienced amongst the geoscientist community will gain from the tremendous learning. It definitely changed my view of trace fossils for the better. I now will try to decipher the code left by the organisms when I see one.

References:

Darman, H. & Damit, A. R, 2003, Structural Control on Sediment Distribution in Offshore Brunei Darussalam, South China Sea, IPA 29th annual convention proceedings.

Suggested Reading Materials:

AAPG Paper (Maori shales), SEPM (Sedimentary records, Charlotte Schreiber), AAPG 1998 (Use of trace fossils in recognizing bounding surfaces, George Pemberton), Sequence Stratigraphy (Blackwelder, 1090), IRG

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ICHNOLOGICAL APPLICATIONS TO GENETIC STRATIGRAPHY

The applications of ichnology to genetic stratigraphy are mainly two-fold. The most obvious use is in the demarcation of erosional discontinuities (Fig. 5). The second use is subtler, and is concerned with the palaeoenvironmental implications of the trace fossil suites, both with respect to the softground and the substrate-controlled assemblages.

Regressive Surfaces of Erosion (RSE) and Sequence Boundaries (SB)

Although subaerial exposure and/or erosion during relative sea level lowstand may produce widespread development of dewatered, firm or cemented substrates (corresponding to regressive surfaces of erosion and sequence boundaries) most are unlikely to become colonized by substrate-controlled trace fossil suites unless the surfaces are subsequently exposed to marine or marginal marine conditions prior to burial.

In most cases, deposition of significant thicknesses of nonmarine strata generally precludes development of these omission suites on the RSE or SB themselves. There are a number of scenarios, however, where such discontinuities may be preferentially colonized by tracemakers of substrate-controlled assemblages. Such settings include RSE developed beneath forced regressive shorefaces, SB underlying lowstand shorefaces, SB comprising submarine canyon margins, and SB lying at the estuarine mouths of incised valleys, prior to transgressive infill. All of these settings are conducive to colonization of the discontinuity, because the surfaces were excavated subaqueously in a marine or marginal marine environment.