Bioturbation, Oil Spills and Geology

David T. Dockery III, RPG

A KATC.com news item (January 29, 2019) with James Savage of the University of Louisiana at Lafayette (ULL) featured the heading, "Clams don't mess around after oil spill, UL researchers find." The report found that, following simulated oil spills in aquarium environments, those environments with the deep burrowing razor clam *Tagelus plebelus* (Figure 1) had 25% less oil that those without the clam. Dr. Paul Klerks of ULL summed up the findings: "That could mean clams are absorbing oily residue, or they might be burying it. Either way, they're acting as frontline custodians combatting environmental crises." Burrows of clams, shrimp, and other burrowing organisms collectively contribute to bioturbation of seafloor sediments, a process that aerates and reworks bottom sediments. Researchers noted that the clams' burrowing activity could work in tandem with oil-consuming bacteria in the oil reduction.

Figure 1. The stout razor clam *Tagelus plebelus* found in shallow coastal waters of the Western Atlantic from Cape Cod to Florida, to Texas, and the West Indies and Brazil. Photograph by Dr. Darryl Felder, University of Louisiana at Lafayette.

A paper by Genovese and others (2014) in *Frontiers in Microbiology* (April 14, 2014, 5: 162) entitled "Effective bioremediation strategy of rapid *in situ* cleanup of anoxic marine sediments in mesocosm oil spill simulation" noted that oil consumption by aerobic bacteria created reduced oxygen conditions in the sediment with subsequent recession of biodegradation rates. To increase biodegradation of the oil, a "Modular Slurry System (MSS)" successfully re-aerated the sediment by pumping air into the sediment through a battery of needles. The conclusion was that "petroleum-contaminated anaerobic marine sediments could efficiently be cleaned through an *in situ* oxygenation which stimulates their self-cleaning potential due to reawakening of allochtonous aerobic OMHCB [obligate marine hydrocarbonoclastic bacteria]." In natural marine environments, burrowing organisms are the "MSS" that aerate sediment, reawaken aerobic bacteria, and increase oil biodegradation rates.

It is difficult to trench the seafloor to inventory how well burrowing organisms are reworking bottom sediments. However, proxy examples occur in the ancient bioturbated seafloors of Mississippi's geologic column. Bioturbation in some formations has the sediment so stirred up that individual burrows are obscure. Figure 2 shows the deep burrowing fossil clam *Panopea* in life position in its burrow in the Early Oligocene Glendon Limestone. Figure 3 shows burrows of callinasid shrimp in the Middle Eocene Meridian Sand at Philadelphia, Mississippi. Figure 4 shows burrows characteristic of the Middle Eocene Tallahatta Formation at Grenada, Mississippi. Figure 5 shows ironstone-filled burrow in the Creola Member of the upper Cockfield Formation on Techeva Creek in Yazoo County. Figure 6 shows veins of tar in the Yazoo Clay from a seafloor oil seep some 34 million years ago. These examples show that burrowing marine organisms have long handled oil from natural oil seeps in the Gulf of Mexico.

Figure 2. The deep burrowing clam *Panopea* in life position in the Glendon Limestone from Rankin County.

Figure 3. *Ophiomorpha*, trace fossils of callianassid shrimp burrows, in the Meridian Sand in a road cut on Highway 16 west of Philadelphia, Mississippi. Picture was taken on September 4, 2003.

Figure 4. Burrows in the Tallahatta Formation behind the EXXON station on the south side of Highway 8 just east of I-20 at Grenada, Mississippi. Picture was taken in August of 1975.

Figure 5. James Starnes at an outcrop of the Creola Member in the banks of Techeva Creek at Sharper Bridge in Yazoo County. White shells and brown burrows can be seen weathering out on the slope. Picture was taken on August 24, 2004.

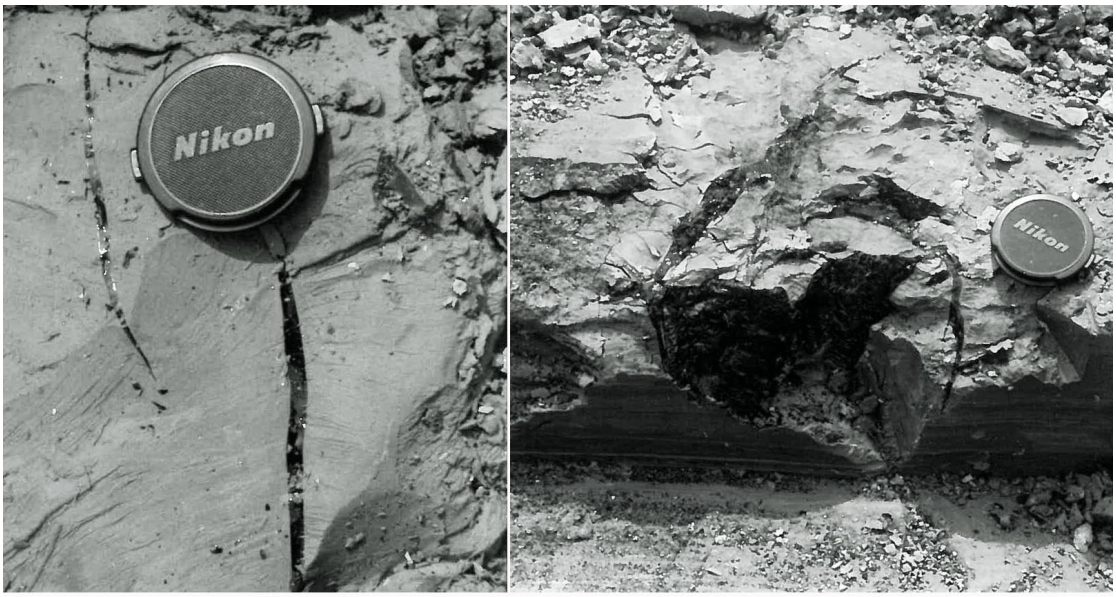

Figure 6. Veins of tar in the Yazoo Clay at the Miss Lite Clay pit in Cynthia, Mississippi, associated with an ancient oil seep on the seafloor.