

Asphalt volcanoes revisited: Seafloor observations at natural hydrocarbon seeps in the southern Gulf of Mexico

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Asphalt volcanoes were surveyed and sampled with a remotely operated vehicle in the Bay of Campeche, southern Gulf of Mexico. The outflow of very heavy oil created fascinating landscapes at sites with seafloor depths between 1230 and 3150 m, where lobate asphalt flows covered tens of meters of the seabed. Seafloor observations revealed a chemosynthetic community thriving on the asphalts, with bacterial mats and vestimentiferan tubeworms growing on recent flows. Emission of liquid oil and gas bubbles were an additional component of hydrocarbon seepage. Sites with oil seepage featured oil-laden sediments and a diverse chemosynthetic community, which was heavily exposed to oil emissions. The gas emissions produce gas hydrate deposits at shallow seafloor depth, forming meter-sized mounds in soft sediments or filling the space between fragmented asphalts. Bathymodiolin mussels tended to cluster around active gas vents and the iceworm, *Hesiocaeca methanicola*, occurred on outcropping hydrates. We also found lush colonies of vestimentiferans growing on the hydrate deposits, with their posterior tubes infiltrating a 5 to 10 cm thick reaction zone composed of authigenic carbonates and microbial mats directly above the hydrates. Gas bubble emissions and liquid oil seepage were found to occur independent of asphalt deposits or through old, fragmented asphalts, hence presently active hydrocarbon seepage overprints older asphalt deposits. Compared to seafloor-covering asphalts known from other continental margins, those in our study appear to be relatively younger. Campeche Knolls is habitat for a productive heterotrophic community dominated by a few seep-endemic taxa, including crustaceans, alvinocaridid shrimp, *Munidopsis* sp, and the holothuroid *Chirodota* sp.