New screening tool for sediment gas thermogenicity

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The natural presence in near-surface marine sediments of elevated levels of C_{2+} alkane gases has historically served as an indicator of migrating thermally-sourced gas, as conventional wisdom holds that ethane, propane, the butanes, and the pentanes are not locally generated and sustained at more than a few ppmV interstitial concentration levels near the seabed. We are now finding this premise to be false, as each of these gases seems to be produced locally in near-surface marine sediments. We have developed a new screening tool that attempts to better account for the complexities what we have found in piston-cored marine sediments in terms of light hydrocarbon gas generation, diffusion, consumption, migration, diagenetic alteration, and mixing.

We have first considered the compositions of well gases taken as representative of true thermogenic gases. We observe that this group of well gases follows a trend line corresponding to the sum of ethane+propane being about *3 times* the sum of the butanes+pentanes. We have then considered the tens of thousands of interstitial gas compositions that we have accumulated from piston coring in deepwater basins world-wide. When these data are plotted on our screening tool, ubiquitous background interstitial gas is clearly distinguished from anomalous microbial gas, and these are distinguished from from samples with trace fractions of thermogenic seepage in the seabed core samples.

We have also recently developed the robust ability to measure carbon isotope ratios of individual light hydrocarbons at concentrations lower than 1 ppmV in sediments, by cryogenically trapping and concentrating the entire volume of interstitial gas from 200 mL of sediment. This technique has opened the opportunity for direct measurement of stable carbon isotopes of microbially/diagenetically generated ethene, ethane, propene, and propane that we find below the sulfate reducing zone in marine sediments. We are finding the $\delta^{13}C$ values of such ethane to be lighter than –60 $^{o}/_{oo}$ whereas the associated propanes are lighter than -30 $^{o}/_{oo}$. We can use such stable isotope data from individual components of interstitial gas to confirm the interpretations indicated by the new screening tool as to the thermogenicity of the samples.