Our Ocean Backyard

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2021 – Sober Optimism about Energy and Climate

If I were to ask ten of you how oil forms, my guess is that I would probably get 8 or 10 different answers. In April 2008, twelve and a half years ago now, I wrote my first Ocean Backyard column with a title of “Oil Formation in the Sea”, which was about how oil forms. And it has happened in our ocean backyard, but requires a special set of conditions.

Oil doesn’t form from dinosaurs, whales or seaweed, but from phytoplankton, or microscopic plants like diatoms and their relatives. In order to produce the billions of gallons of hydrocarbons preserved in sedimentary rocks we need a lot of these little creatures, gigatons of these that die and settle to the seafloor over millions of years where they accumulate in bottom sediments. We see blooms of these plankton from time to time in our coastal waters, some of these are red, yellow or brown. This happens along the Central Coast in the late spring and often into summer and fall when wind moves the surface waters offshore, and cooler, nutrient-rich bottom water rises to the surface in a process known as upwelling. The plankton respond by growing like crazy, similar to fertilizing your garden.

The first requirement for oil formation is that the trillions of these microscopic organisms blooming in the surface waters need to sink to the seafloor and be covered with sediment or stagnant bottom water in order remove them from oxygen before they can decompose. So burial, followed by subsidence beneath additional layers of sediment creates a seafloor pressure cooker, where higher temperatures and pressures slowly cook the preserved organic matter into oil and gas. We also need a permeable rock like a sandstone for these hydrocarbons to accumulate in, and then an impermeable material like shale in order to trap or keep the oil and gas from seeping from the permeable rock into the ocean.

These unique conditions and processes have occurred at many different locations throughout the world’s ocean over the past 600 million years or so. Due to tectonic activity, folding and faulting, uplift and subsidence, many of these oil-bearing sedimentary rocks are now found beneath continents, but we are also still recovering oil from deep beneath the seafloor, in fact in water over 5,000 feet deep in the Gulf of Mexico and over 13,000 feet into the seafloor. Drilling and recovering oil from 18,000 feet below sea level presents serious challenges, however, as the BP Horizon blow out in 2010 made clear, with nearly 5 million barrels of crude oil entering the Gulf.

Petroleum is a nonrenewable resource, however, because if takes millions of years to form, so what we have now is all we will ever have. In the U.S. today, 37% of our energy is provided by oil and 32% by natural gas. We use 20 million barrels of oil every day, and 9 million barrels of that is imported. And burning oil, gas and coal, which combined provide 81% of all U.S. energy and 84% of global energy, all produce carbon dioxide, which is a greenhouse gas that is continuing to warm the planet with all of the effects that we are experiencing virtually daily: rising temperatures, longer and more frequent droughts and forest fires; rising sea levels and increased coastal flooding and shoreline erosion from melting ice and retreating glaciers. And all carbon dioxide molecules trap heat – they don’t have any political affiliations.

The single most important step that California, the U.S. and the planet can take is to move as fast as possible with a transition from our reliance on fossil fuels to renewables, with solar and wind in the lead at this point. And as we have now just entered 2021, there are some good signs and reasons for optimism – sober optimism. The U.S. will rejoin the Paris Climate Accord and work with the rest of the world to reduce carbon emissions. Coal is on the way out in the U.S. where power companies announced more than a dozen plants were retired this year. As utilities are shutting down coal plants they are opting for renewables rather than natural gas, as solar and wind power are increasingly competitive economically with natural gas. Of the planned additions to new electrical generation in 2020, wind made up 44%, solar 32%, and natural gas 22%. These are all positive signs.

The European Union pledged to cut emissions 55% by 2030, and China in September reported that they will achieve carbon neutrality by 2060. In September, California became the first state to announce a ban on internal combustion powered vehicles by 2035. This was following commitments by France, Canada, the UK and at least a dozen other countries to phase out internal combustion vehicles over the next twenty years. Our survival will depend on continuing this trend.