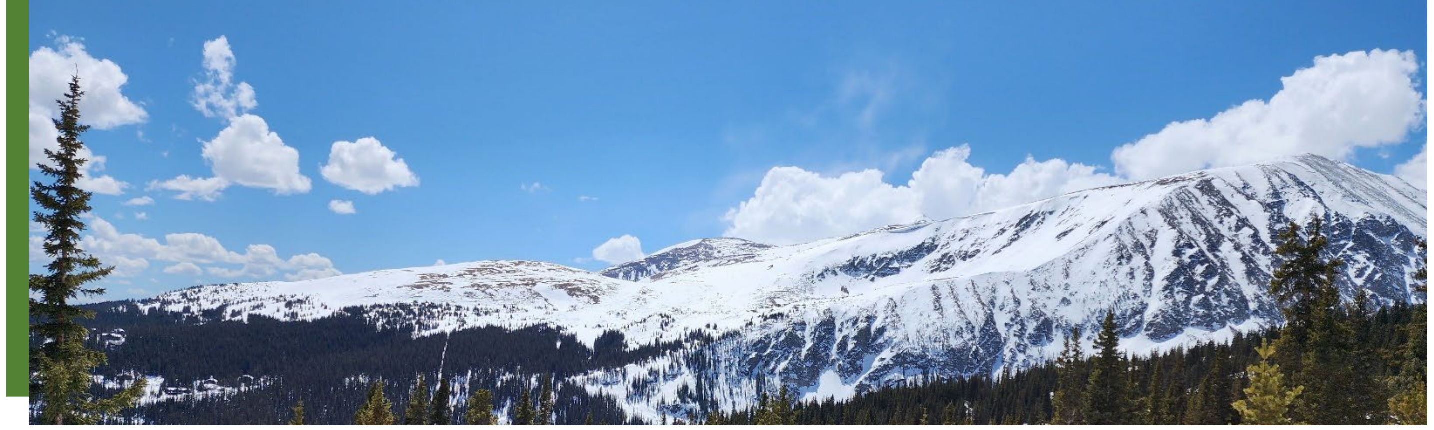
Geoscientists as Environmental Stewards

A Pragmatic Philosophy



BY MICHAEL P. DOLAN

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This blog is being written on April Fool's Day. Instead of playing a prank, I'll share a joke. Being an American Irish dad, the only jokes that I know are corny American Irish dad jokes. So here it is:

> Paddy Murphy died last night. Mrs. Murphy went to the local newspaper to take out an obituary. She walked into the newspaper office and announced that Paddy Murphy died. The man behind the desk was stricken and asked, "That's terrible Mrs. Murphy, did he have any last words?"
>
> "Yes, he said 'For heaven's sake, Mary, put down the gun.'"

That one gets me every time. I will be chuckling for the foreseeable future. As DIG approaches the start of its third decade in business, we are very serious about our contributions to the energy industry. We also had a lot of fun. We are serious about our core principles but there is room to celebrate our own, and our colleagues' successes. We are proud to be in the position to have such a positive impact on our people, our industry, and our environment.

My chosen profession as a geoscientist allows for a diversified understanding of the subsurface processes that are vital to human existence. Responsible stewardship of these processes is often the responsibility of geoscientists and engineers that ply their trade in mining and resource development.

I will not speak for my colleagues, but I want to reflect on my own choice. I *chose* to be a geoscientist. I chose to be a geoscientist in the energy mining industry. When you choose to do this work, you have an idea of how you will conduct yourself as a scientist, as a person.

As a scientist you conduct yourself, and your work, at a very high standard or you are not provided with the opportunities that will fulfill your ideal. As a person, or in my case as a father, you conduct yourself as a responsible steward for every geoscience project that you work on. One cannot commit to studying and knowing the earth's processes encompassed by geology and geochemistry without having an innate passion for the earth itself. Nobody loves the earth like a geoscientist. Who better upholds the ideals of environmental stewardship than those who study with passion all the earth's processes?

While passion is a huge part of the geoscience profession, pragmatism becomes a reality that must be recognized by every energy geoscientist. Believe it or not, I was a philosophy student at one point in my life. I took Symbolic Logic which taught me a few worthwhile lessons. I can apply them to being a pragmatic geoscientist. Consider this syllogism:

1. The global population is growing, fast.
2. Global populations need energy.
3. Energy use is growing, fast.

I know this is a very simple series of logical statements (I might have a few arguments coming my way from philosophers), but this logical series encompasses all that we need to talk about. One might ask, "What kind of energy does the global population need?" As an American, I am constrained by my energy infrastructure. This is true for anyone in the world. What kind of energy can be delivered to me safely and reliably? Electricity, yes; natural gas, yes; gasoline for my car, yes; solar energy, maybe, wind energy, maybe, and this list goes on and on. I might be willing to pay more if I want low-carbon energy, but not all people in my community or on our planet can afford this luxury. Consideration of economics for the region can provide limiting factors for the type of energy used in an area. I get it, this is oversimplified. But I still have a job to do. What can I do to support the responsible use of the basket of energies that my fellow Americans are provided to use? As a geoscientist, as it turns out, I can do a whole bunch of things.

We can get very political, or we can do the hard work to transition responsibly to lower carbon sources of energy. I choose to do the hard work to support the efforts to transition our energy sources.

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What does DIG do to support all energy development? DIG believes that the hard work is done in the subsurface. We want to support the efforts to keep greenhouse gases where they belong. That is, behind the infrastructure built to deliver, store, or utilize any source of energy, or better yet, in the subsurface. An incredible amount of investment is now being injected into our economy to develop low-carbon energy, move that energy from place to place, and reduce the amount of greenhouse gases from entering our atmosphere where it becomes a cause for pollution and climate alteration.

DIG is proud to be involved in many phases of these projects, primarily developing scientifically sound ways to monitor these extremely complex systems. Here are few examples:

Surface Casing Pressure in Hydrocarbon Production

Surface casing pressure (or, Bradenhead Pressure) describes the undesirable buildup of pressure on any of the annuli in an oil and gas well. That is, the space between the production casing that the outer most casing string.

When this occurs, many oil and gas well operators must determine the source of the pressure. This helps all the stakeholders prevent impacts on the near surface and can help prevent impacts of near surface aquifers or natural gas impacts on the atmosphere.

Natural Gas Storage

DIG Labs has long been involved with every sector of oil and gas monitoring, verification, and assessment (MVA) of upstream, midstream, and downstream infrastructure.

The reasons for storing and capturing natural gas are varied and all extremely important. Underground natural gas storage facilities (UNGSFs) play an important role in current energy supply, distribution systems and in keeping consumer energy costs consistent and predictable. DIG works with many pipeline operators to help solve gas storage issues.

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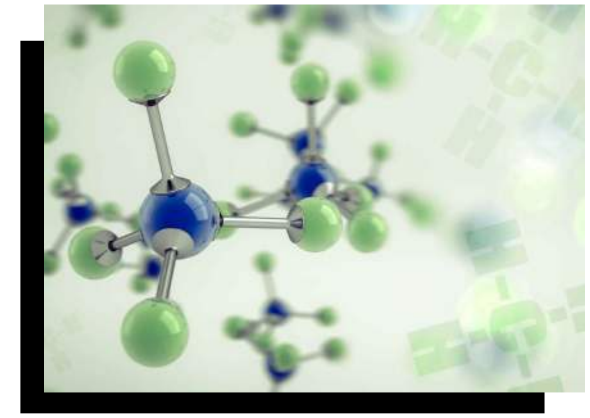

Monitor, Verify & Assess – Natural Gas Stable Isotope Analysis

The most robust and detailed characterization of hydrocarbon gas molecules available is accomplished using stable isotope analysis. Hydrocarbon gas composition analysis is combined with stable isotope analyses to characterize the genetics of the gas. The naturally occurring hydrogen and carbon isotopic tracers of C1 - C5 hydrocarbon gas molecules are remarkably useful because the relative abundance of 12C and 13C or 2H (deuterium) and 1H (protium) in a gas depends on the various processes involved in the generation and subsequent migration or alteration of the hydrocarbon gases.

Natural gas isotopes allow DIG scientists to differentiate biogenic and thermogenic gas. Hydrocarbon gases are generated naturally, occurring in the earth’s subsurface by two main processes: “biogenic” and “thermogenic”. Biogenic (also termed “bacterial” or “microbial”) gas is generated in shallow subsurface sediments and aquifers by microbes capable of metabolizing organic molecules to methane.

Because microbes can synthesize methane, very few soils or waters are completely devoid of hydrocarbons. Thermogenic gas is generated by thermal decomposition of organic matter in deeply buried sedimentary rocks (aka, source rocks). During the main stage of thermogenesis, methane is generated along with significant quantities of wetter hydrocarbons: ethane, propane, butane, pentane, and higher molecular weight compounds. In later stages of thermal maturation, dry gas consisting mostly of methane is generated. Gas with greater than 5 % ethane and higher molecular weight (C2+) hydrocarbons is a positive indication of a thermogenic origin. Gas with less than 5 % C2+ may have either a biogenic or late-stage thermogenic origin. Stable isotopes help to resolve this ambiguity while providing a more robust geochemical fingerprint.

Conclusion

Our natural gas, oil and water laboratory provides our clientele with setting geochemical baselines, wellbore integrity mitigation, carbon capture baseline geochemistry and monitoring. Fundamentally, we are assisting our clientele and providing the tools that allow them to be good stewards of the environment.

We continue to expand our geochemical knowledge in all phases of fluid production. Preventing impacts of oil, gas, and water to areas outside the area of operations is the goal of the responsible environmental steward. DIG's knowledge of these systems and the exacting standards of all our clientele assures that not only is everyone aware of the potential impacts to the environment, but it also remains absolutely the most important reason that geoscientists and engineers share such great responsibility to the communities in which we do our work. ■